MUSEUM OF NEW MEXICO

OFFICE OF ARCHAEOLOGICAL STUDIES

STUDYING THE TAOS FRONTIER: THE POT CREEK DATA RECOVERY PROJECT

VOLUME 1: EXCAVATION

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ADMINISTRATIVE SUMMARY

Between September and December 1989, the Office of Archaeological Studies (OAS), Museum of New Mexico, conducted data recovery investigations at six sites along NM 518, Taos County, New Mexico. The work was conducted prior to the reconstruction of the road. The sites are located in the narrow valley of the Rio Grande del Rancho, 11 to 14 km (6.8 to 8.7 mi) south of Taos on lands administered by the Camino Real District of Carson National Forest. Jeffrey L. Boyer and James L. Moore acted as project directors. David A. Phillips, Jr., former director of OAS, and Timothy D. Maxwell, acting director, served as principal investigators.

The sites included two prehistoric pithouse sites (LA 2742 and LA 70577), a site that once included a pithouse (LA 3570), two prehistoric farming areas represented by artifact scatters (LA 71189 and LA 71190), and a multicomponent artifact scatter (LA 70576). The three pithouse sites dated to the Valdez phase (A.D. 1100-1225) of the Rio Grande Developmental period. The prehistoric farm sites dated to the Pot Creek phase (A.D. 1225-1270) of the Rio Grande Coalition period. The sixth site had a prehistoric Valdez-phase component and a historic late nineteenth-century component.

Excavation and analysis of cultural material from the pithouse sites showed they were similar to other sites in the southern Taos district. Comparison with other excavated Valdez-phase sites in the district demonstrated that these sites were characteristic of a "community" of Valdez-phase sites in the southern part of the district that was significantly different from a contemporaneous "community" in the northern district. Chronometric data show that the Valdez phase began with Anasazi population movement into the Taos area about A.D. 1100. During the Valdez phase, communication and interaction was focused between these communities and with Anasazi and non-Puebloan peoples to the east and northeast. This focus shifted to the central Rio Grande Valley at the beginning of the Pot Creek phase. The Pot Creek-phase sites were fields used by occupants of nearby small pueblos. Microbotanical remains show that corn was a primary crop. In addition, one of the sites includes a prehistoric irrigation canal probably constructed by the residents of nearby Pot Creek Pueblo. Archaeomagnetic analysis of canal sediments suggests that the canal was built in the A.D. 1300s, probably coinciding with a late immigration to the site and attendant pressure on local resources. This represents the first documented use of irrigation technology by prehistoric Anasazi in the region. Initially thought to represent an Apachean site, LA 70576 proved too late to have been occupied by Apaches and was probably a temporary camp occupied by travelers along the road from Taos to Picuris.

Previous researchers in the Taos district have debated whether the region was a frontier or simply a unique Anasazi enclave. Comparison of excavated sites with archaeological expectations of frontiers derived from cultural geography shows that the

district was an Anasazi sociocultural frontier. A frontier perspective is useful in explaining long-noted differences between the Taos district and Anasazi developments in the central Rio Grande Valley to the south.

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Many people have been instrumental in bringing the Pot Creek project to a semblance of order and finality. The field crew--Laurie Evans, Joan Gaunt, Vern Lujan, Anthony Martínez, Sibel Melik, Linda Mick-O'Hara, Augusta Otte, Amelia Schafer, and my codirector, Jim Moore--performed at peak efficiency under conditions ranging from hot sun to driving rain to snow and frozen ground. Further, they put up with my idiosyncracies with precious little complaint. Sam Sweesy volunteered his time and sense of humor during the last days of the project while still recovering from heart bypass surgery. The lab crew--Joan, Vern, Anthony, Sibel, Linda, Jim, Daisy Levine, Marcy Snow, Susan Moga, Rani Alexander, Mollie Toll, and Laurel Wallace, as well as Glenna Dean at the Castetter Laboratory, University of New Mexico--conducted various analyses while listening with at least feigned interest to my often scattered ideas on frontiers and how they should look in the archaeological record. Daisy was kind enough to point out that the ceramic data supported my expectations in the research design, contrary to my verbal interpretations. Rick Morris of the Office of Contract Archeology, University of New Mexico spent several hours discussing horseshoes and then volunteered to inspect the horseshoes from LA 70576.

The OAS production crew worked diligently to create a respectable report. Tom Ireland edited the sometimes formidable prose, while Rob Turner and Ann Noble created the numerous figures with alacrity and imagination. Nancy Warren photographed the artifacts and other cultural materials and produced the photographs of site features. Dr. Keith Jameson, DDS, produced the dental radiographs of the the burial from LA 2742.

I have benefited much from long discussions with Jim Moore on what we were and were not learning from our research and how it might or might not apply to frontiers. I have also taken numerous opportunities to bend the ears of Sally and Weber Greiser of Historical Research Associates in Missoula, Montana. The Greisers' research on aboriginal irrigation in the Taos Valley has provided this project with a valuable regional perspective on prehistoric settlement and economy.

As usual, I owe more to my family than I can say. Ginger has listened to my never-ending worries about the time, the budget, and the analytical results with more grace than I am worthy of. She and Pat Keenan brought pizza to the site for a birthday party for me and Anthony. And, at a critical time in my life, when my father died in the middle of the field season, she made sure that I didn't need to worry about what the crew was doing. Meg and Miles put up with my working weekends and evenings and being too busy, distracted, or tired to do whatever it was they needed.

My parents have always been supportive of my work, and this project was no exception. When my father, Jack Boyer, died in November 1989, he took with him more information on the history of the Taos Valley than I will ever acquire. My efforts on the Pot Creek project are gratefully dedicated to his memory.

Jeff Boyer

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THE PROJECT AND THE PROJECT AREA

INTRODUCTION

During the spring of 1989, archaeologists with the Office of Archaeological Studies, Museum of New Mexico, conducted a survey of the right-of-way of NM 518 in Taos County, New Mexico (Fig. 1). The survey, conducted at the request of William L. Taylor of the New Mexico State Highway and Transportation Department (NMSHTD), involved 10.4 km (6.5 mi) of highway right-of-way and adjacent land in the valley of the Rio Grande del Rancho. Ten km (6.25 mi) is in Carson National Forest. The remaining small parcel is right-of-way acquired from private sources at the mouth of the river canyon near the south side of the village of Talpa. In addition to the right-of-way, the survey included 4.8 ha (12 acres) of Carson National Forest land intended for an interpretive center parking lot near Southern Methodist University's Fort Burgwin Research Center and the many sites surrounding Pot Creek Pueblo.

Eight archaeological sites were found, and six previously recorded sites were relocated. Thirteen of these sites were prehistoric, including six pithouse or probable pithouse sites; two small pueblos; and five sherd and lithic artifact scatters, three with possible agricultural features. The fourteenth site was an artifact scatter containing historic micaceous sherds. All or portions of ten sites were found within the highway right-of-way, and four sites were in the parking lot survey area.

Seven sites, two in the parking lot area and five in the right-of-way, were within proposed construction zones. The parking lot sites, LA 71189 and LA 71190, showed no evidence of subsurface remains. Surface remains at LA 70577 indicated a pithouse. Test excavations demonstrated that subsurface remains were not present within the construction zone at LA 51673, but were present at LA 2742, LA 3570, and LA 70576 (Boyer 1989a:16-36). These three sites, along with the probable pithouse site and the two parking lot sites, were recommended for data recovery.

A data recovery plan was prepared (Boyer 1989a:40-63), and between September and December 1989, archaeologists conducted data recovery investigations at the six sites. The sites included two prehistoric pithouse sites (LA 2742 and LA 70577), a site that once included a pithouse (LA 3570), two prehistoric farming areas represented by artifact scatters (LA 71189 and 71190), and the historic site (LA 70576).

Jeffrey L. Boyer and James L. Moore acted as project directors. Boyer directed excavations at LA 3570, LA 70577, and LA 71189, and Moore directed excavations at LA 2742, LA 70576, and LA 71190. David A. Phillips, Jr., former director of OAS, and Timothy D. Maxwell, acting director, served as principal investigators. The field crew consisted of Laurie Evans, Joan Gaunt, Vernon Lujan, Anthony Martinez, Sibel Melik, Linda Mick-O'Hara, Augusta Otte, and Amelia Schafer. Sam Sweesy volunteered his time and sense of humor during the last days at LA 2742. In the laboratory, Vernon

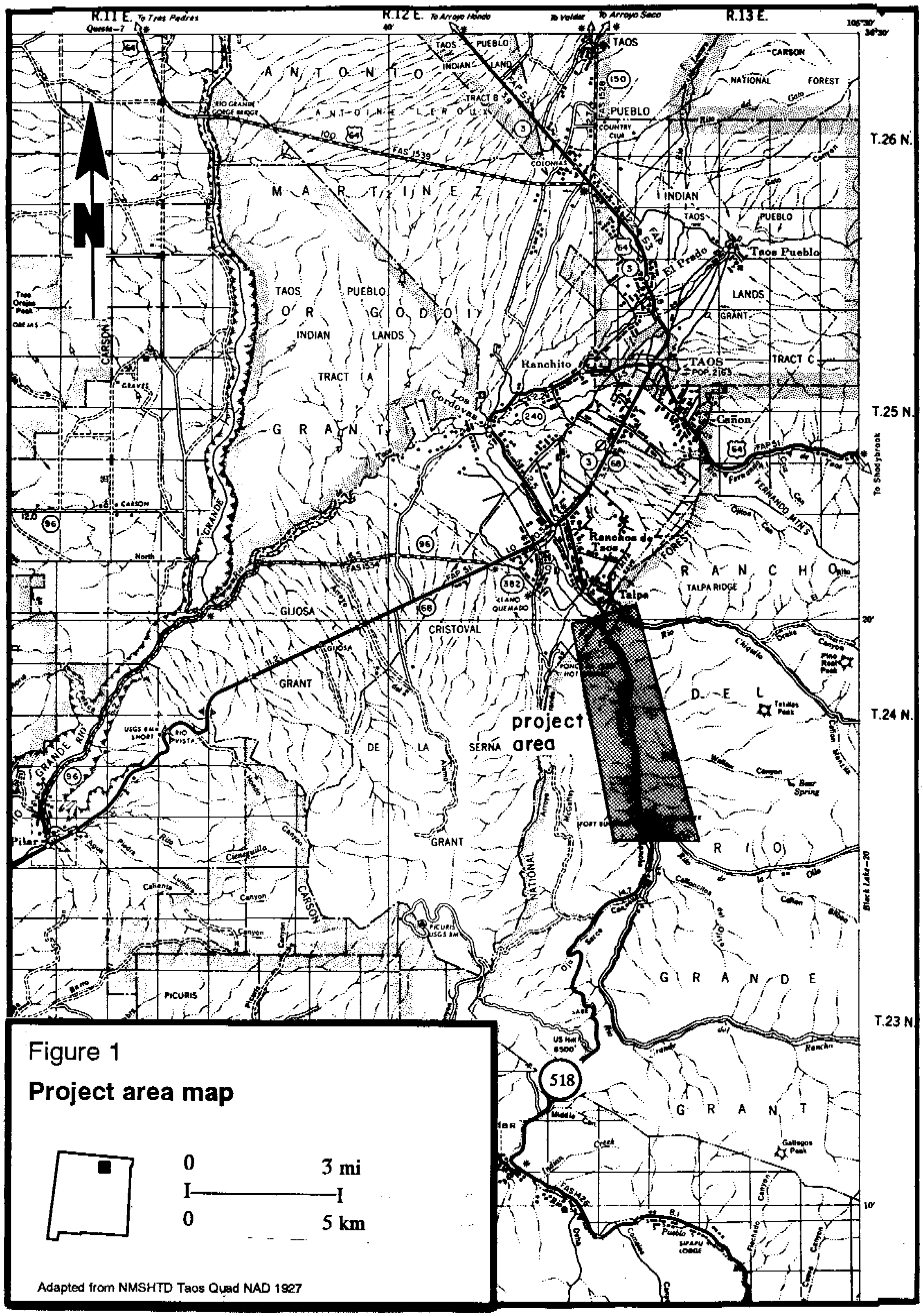


Figure 1

Project area map

Lujan, Sibel Melik, and Marcy Snow assisted Daisy Levine in analyzing the ceramic artifacts, Susan Moga and Rani Alexander assisted Linda Mick-O'Hara in analyzing the faunal remains, Linda Mick-O'Hara analyzed the human remains, Joan Gaunt analyzed the adobe material, Vernon Lujan analyzed the ground stone artifacts, Mollie Toll and Laurel Wallace analyzed the macrobotanical remains, Jeffrey Boyer analyzed the Euroamerican artifacts, and James Moore analyzed the chipped stone artifacts. Rick Morris of the University of New Mexico's Office of Contract Archeology inspected and interpreted the horseshoes from LA 70576. Glenna Dean of the University of New Mexico's Castetter Laboratory for Ethnobotanical Studies analyzed the microbotanical remains. David Hill located clay sources near the project area and conducted comparative petrographic analysis of the clays and sherds from the sites.

The sites are located in the narrow valley of the Rio Grande del Rancho, 11 to 14 km (6.8 to 8.7 mi) south of the center of the town of Taos on lands administered by the Camino Real District of Carson National Forest. All six sites are on Carson National Forest land, and excavation was authorized by Carson National Forest Special Use Permit No. 70-03-02-04-2107-01-441. See Appendix 1 for legal and UTM locations of the sites.

Field Methods

Each site was mapped using a transit and stadia or tape. Surface artifacts were collected in 4 by 4 m grid units established from a primary datum. At LA 71190, some isolated artifacts at the north end of the site were piece-plotted. At LA 2742, LA 3570, and LA 70576, the grid network incorporated existing 1 by 1 m test pits. Existing road cuts at LA 2742 and LA 3570 were treated as discrete collection units.

Excavation units and strategies varied with each site. In general, excavations were based on 1 by 1 m grid units and proceeded in 10 cm levels until natural or cultural strata could be defined. Thereafter, excavations followed the strata. A grid-level form was used to record information on provenience, soil matrix, artifacts collected, and the comments of the excavator for each level or stratum within an excavation unit. Several 1 by 1 m grid units were excavated by levels or strata in the pithouses at LA 2742 and LA 70577 to establish stratigraphic control and ascertain the location and condition of structural features such as walls and floors. Then the pithouses were divided into quadrants, and the remaining fill was excavated by quadrants. At LA 71189, excavation units included 1 by 1 m, 1 by 2 m, and 2 by 2 m units, the latter used only for surface stripping. Features identified during survey and testing were partially or completely excavated, as were features identified during data recovery. Feature forms were used to record information on provenience, the feature and its construction, the soil matrix, relationships with other features, and artifacts collected from the feature. At LA 70577, extensive augering was used to search for and define subsurface features. Auger holes were placed at corners of the 4 by 4 m grid network and in the vicinity of features and possible features at 2 m intervals within the network. At each hole, the excavator recorded the nature of the soil, the depth of the hole and why excavation stopped at that point, and artifacts collected. Augering was also used at LA 71190 to search for subsurface deposits and features and to collect micro- and macrobotanical samples. Auger holes were located at the corners of the 4 by 4 m grid network. A backhoe was used to excavate two trenches across the possible canal at LA 71190. The trench walls were prepared using hand tools prior to drawing profiles and collecting archaeomagnetic samples. A backhoe was also used to excavate a trench and examine the possible pit feature discovered during testing at LA 3570.

At each site, excavated material from cultural strata was screened through 1/4 inch hardware cloth, and all artifacts were collected. Chronometric samples, including archaeomagnetic, radiocarbon, and dendrochronological samples, were collected, as were micro- and macrobotanical samples. Adobe samples and natural soil samples were collected from the pithouses.

Analytical Methods

Pollen and Phytolith Samples

Pollen studies can be used to examine the prehistoric environment, search for evidence of cultigens, and examine features for specialized use or treatment. Phytolith studies can be used as an adjunct to this research. Certain cultural features and potential prehistoric fields were sampled for pollen spectra during this study, but only potential agricultural fields were sampled for phytoliths. Sampling specifics are presented in individual site descriptions. Analytic methods are summarized from Dean's report (1991a:2-12), which presents a more detailed discussion.

Pollen-extraction procedures were designed for arid Southwest sediments by the University of New Mexico's Castetter Laboratory for Ethnobotanical Studies. Samples consisted of 25 g of sediment screened through a tea strainer. The samples were "spiked" with three tablets of compressed *Lycopodium* (clubmoss) spores. The batch used to spike the sediments contained 12,100 grains per tablet. Concentrated hydrochloric acid was added to remove carbonates. After removing the dissolved carbonates and acid, fine sediments (including pollen) were separated from heavier sediments using a process similar to bulk soil flotation. The fine sediments were concentrated and rinsed using repeated centrifugation and distilled water washes and then mixed with hydrofluoric acid to remove smaller silicates. Charcoal and small organic particles were removed using a trisodium phosphate bath and repeated centrifugations with distilled water, followed by acetolysis. The lighter pollen fraction was then concentrated by heavy density separation using zinc chloride and centrifugation. Sample residues were rinsed with methanol and stained with safranin O. They were then rinsed with butanol and transferred to vials, where they were mixed with 1000 CKS silicon oil for storage.

Samples were examined under a microscope at magnifications of 200x and 400x, using two procedures. Samples for which a 200 pollen grain count was specified were examined at a magnification of 400x until the requisite number of grains were counted. The uncounted portion was then examined at 200x to search for pollen from cultigens, cholla, prickly pear cactus, and rare types. Other samples, in particular those from farming features, were scanned for cultigen pollen using intensive systematic microscopy, a procedure specifically developed for this study.

As cultigen pollens are usually numerically rare, finding them requires an approach different from that of the standard 200 grain count. Dean (1991a:9) determined that with a sample size of 25 g and a total spike count of 36,300, between 594 and 1,005 spike grains must be counted before a rare pollen present in a concentration of two grains per gram of soil can be expected to show up in a sample. This was determined using the following equation:

$$PU = \frac{FP}{SC} \times \frac{SA}{WT}$$

where PU is the number of pollen grains per unit sample, FP is the number of fossil pollen counted, SC is the number of spike grains counted, SA is the number of spike grains added, and WT is the weight (or volume) of the sample. Similarly, to find a rare pollen type present in concentrations of one grain per gram of soil, it would be necessary to count between 1,006 and 3,200 spike grains.

Taking budgetary and time constraints into account, we decided that pollen scans would be aimed at finding rare types present in concentrations of at least two grains per gram of soil. A minimum count of 750 spike grains was agreed upon, representing the approximate center of the range. In practice, counts ended only when entire slides were examined to compensate for the uneven distribution of rare pollens on slides. Thus, spike counts ranged between 750 and 1,675, and only one count ended at 750 spike grains. Total pollen concentrations for samples were estimated by tabulating the number of pollen and spike grains seen in two transects of each slide at 200x. The remainder of the slide was then scanned for rare pollens. Pollen samples from active corn, cotton, and squash fields were examined to provide a data base for comparison with samples from suspected prehistoric fields. Pollen spectra from the active fields are shown in Table 1.

Dean (1991a:11) also used experimental methods to extract phytoliths from sediment samples taken from the suspected field at LA 71190. A soil texture kit and 2 percent solution of sodium pyrophosphate were used to separate the sand, silt, and clay

Table 1. Control pollen counts from modern agricultural fields

Taxon	Cornfield 1		Cornfield 2		Cornfield 3		Squash Garden		Cotton Field	
	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]
Pinaceae	16	310	11	333	7	678	4	415	1	6
Pinus	47	910	58	1,755	10	968	72	7,467	11	65
Picea	3	58	2	61	1	97	4	415	-	0
Juniperus	22	426	20	605	31	3,001	8	830	5	29
Juniperus/ Populus	-	0	-	0	6	581	-	0	-	0
Quercus	1	19	-	0	1	97	3	311	2	12
Ulmus	2	39	2	61	-	0	36	3,734	-	0
Juglans	-	0	-	0	1	97	-	0	-	0
Elaegnus	1	19	-	0	-	0	1	104	-	0
Cheno-am	51	987	81[3]	2,450	2,07[3]	20,038	55	5,704	161[3]	946
Ephedra	1	19	-	0	1	97	2	207	1	6
Gramineae	9	174	3	91	2	194	5	519	5	29
Zea	26[2]	406	9[2]	520	+	111	+	23[4]	-	0
Low-spine composite	27[3]	523	16	484	68	6,582	8	830	1	6
Artemisia	-	0	-	0	2	194	1	104	1	6
High-spine composite	8	155	13	393	3	290	3	311	3	18
Cichoreae	2	39	2[3]	61	-	0	0-	0	-	0
Eriogonum	1	19	-	0	-	0	-	0	-	0
Yucca	-	0	-	0	-	0	1	104	-	0
Cucurbita	-	0	-	0	-	0	+	23	-	0
Gossypium	-	0	-	0	-	0	+	23[4]	3[2]	14
Solanaceae	-	0	-	0	-	0	-	0	1	6
Cactaceae	1	19	-	0	-	0	-	0	-	0
Cruciferae	-	0	-	0	-	0	1	104	-	0
Unknown	2	39	1	30	1	97	32	3,319	1	6
Unidentified	13/9%	252	19/8%	575	9/3%	871	38/14%	3,941	6/3%	35
Total	233	4,413	237	7,419	350	33,993	274	28,488	202	1,184
Spike	75	-	48	-	15	-	14	-	247	-

[1] Pollen concentration expressed as estimated number of pollen grains per gram of sample.
[2] Number of grains seen during 200 grain count; final pollen concentration computed using total number of pollen type:spike grains on slide to compensate for uneven distribution of pollen type on slide.
[3] One or more clumps of three or more grains seen during count.
[4] *Gossypium* pollen carried by bees from nearby garden to *Cucurbita* flowers in squash garden, and *Zea* pollen similarly deposited by wind in the squash garden.
+ One or more grains seen during scan after count completed.

fractions. Silt fractions were retained and examined at a magnification of 400x. Though numerous phytoliths were present, no cultigen phytoliths were seen during limited microscopy.

Chipped Stone Artifacts

Chipped stone artifacts were recovered from all of the excavated sites. Each artifact was studied under a binocular microscope to aid in defining morphology and material type, examine platforms, and determine if it was used as a tool. The level of magnification varied between 15x and 80x. Higher magnification was used for wear pattern analysis. Utilized and modified edge angles were measured with a goniometer; other dimensions were measured with a sliding caliper. Analytic results were entered into a computerized data base using SPSS/PC+ Data Entry. Data summaries are included in individual site reports and discussed in Chipped Stone Artifact Analysis.

OAS's (1990a) standardized methodology was used to analyze material selection, reduction technology, tool use, and site formation processes. These topics provide information on ties to other regions, mobility, site function, and the reliability of specific attributes. While material selection studies cannot reveal *how* materials were obtained, they can usually provide some indication of *where* they were obtained. In particular, by examining the type of cortex present on artifacts it is possible to determine if the material was obtained at the source or from secondary gravel deposits. This is important in studying links between regions and should provide information concerning ties between frontier and core areas. By studying the reduction strategy employed on a site it is possible to assess the level of residential mobility. A population residing in pithouses and living on the frontier should demonstrate a higher degree of residential mobility than a population fully adapted to a region (see Research Design). Tool types can be used to help determine the function of a site, particularly with artifact scatters lacking features. Tools can also be used to help assess the range of activities that occurred at a site. Finally, the condition of an assemblage can be used to assess the reliability of certain attributes. This entails analysis of artifact breakage and edge damage patterns, which can provide information on the source of damage. Thus, as the percentage of artifacts broken after removal and the incidence of edges damaged by noncultural means (erosion or trampling) increase, the reliability of artifact size, flake portions, and evidence of use decreases.

Table 2 lists the attributes examined during this study and indicates which relate to each class of chipped stone artifact. Four classes were recognized: flakes, angular debris, cores, and formal tools. Flakes were debitage exhibiting definable dorsal and ventral surfaces, a bulb of force, and a platform. Angular debris were debitage on which no ventral or dorsal surfaces could be defined, but which exhibited negative scarring. Cores were pieces of lithic material exhibiting no positive bulb of percussion and having three or more negative scars originating from one or more surfaces. Formal tools were artifacts intentionally altered to produce specific shapes or edge angles. Alterations took the form of unifacial or bifacial retouching, and artifacts were considered intentionally shaped when retouch scars extended across two-thirds or more of a surface.

Table 2. Correlation of chipped stone attributes and categories

Attribute	Flakes	Angular Debris	Cores	Formal Tools
Material type	x	x	x	x
Material quality	x	x	x	x
Artifact morphology	x	x	x	x
Artifact function	x	x	x	x
Cortex	x	x	x	x
Cortex type	x	x	x	x
Portion	x	x	x	x
Platform type	x			
Platform lipping	x			
Dorsal scarring	x			
Distal termination type	x			
Thermal alteration	x	x	x	x
Wear patterns	x	x	x	
Modified edge angles	x	x	x	x
Dimensions	x	x	x	x

Attributes recorded for all artifacts include material type and quality, artifact morphology and function, amount of surface covered by cortex, portion, evidence of thermal alteration, edge damage, and dimensions. Material type was coded by gross category unless specific sources could be identified. Texture was measured subjectively to examine flakability. Most materials were divided into fine, medium, and coarse categories, depending on grain size, and such measures were applied within material types but not across them. Obsidian was classified as glassy by definition, and this category was applied to no other material.

Two attributes were used to provide information about artifact form and function: morphology, which categorized artifacts by general form; and function, which categorized tools by inferred use. Cortex was recorded by percent in increments of 10, and cortex type was defined when possible. All artifacts were coded as whole or fragmentary; when fragmentary, the portion was recorded if it could be determined. Two types of alteration were noted: thermal and edge damage. When present, the type and location of thermal alteration were recorded. This information was used to determine if thermal treatment was purposeful or incidental. Edge damage, both cultural and noncultural, was recorded when present. Edge angles were measured on all artifacts demonstrating cultural edge damage and on the edges of all formal tools. Edges lacking evidence of cultural damage were not measured.

The dimensions of each artifact were measured. On angular debris and cores, length was defined as the artifact's largest measurement, width was the longest dimension perpendicular to the length, and thickness was the smallest measurement perpendicular to both width and length. On flakes and formal tools, length was the distance between the platform (or proximal end) and termination (or distal end), width was the maximum distance between the edges paralleling the length, and thickness was the distance between dorsal and ventral surfaces.

Four attributes were examined only on flakes: platform type, platform lipping, dorsal scarring, and distal termination. Platform type was an indicator of reduction technology and stage. Any modifications on platforms were noted, as were missing and collapsed platforms. Platform lipping usually indicates soft hammer reduction (Crabtree 1972) and is often an indication of the later reduction stages. Analysis of dorsal scarring entailed noting whether scars originating from the distal end of a flake were present (opposing scars are often evidence of removal from a biface). The type of distal termination was noted to help determine if it was a successful removal or ended prematurely, and to provide data on manufacturing versus post-removal breakage.

A polythetic set of variables was used to determine if flakes had been removed from a core or a biface. A polythetic framework is one in which fulfilling a majority of propositions is both necessary and sufficient for inclusion in a class (Beckner 1959). The polythetic set contains an array of conditions of which only a set percentage in any combination need be fulfilled. This array of conditions models an idealized biface flake and includes information on platform morphology, flake shape, and earlier removals. The polythetic set used here was adapted from Acklen et al. (1983). In keeping with that model, when a flake meets 70 percent of the listed conditions it is classified as a removal from a biface. This percentage is high enough to isolate flakes produced during the later stages of biface production from those removed from cores, and at the same time low enough to permit flakes removed from a biface, but which do not fulfill the entire set of conditions, to be properly identified. While not all flakes removed from bifaces can be identified by the polythetic set, those that are may be considered definite evidence of biface reduction. Flakes that meet less than 70 percent of the conditions are considered to have been struck from cores. The polythetic set provides a flexible means of categorizing flakes and helps account for some of the variation seen in flakes removed during experiments.

Polythetic set for distinguishing biface flakes from core flakes

Whole flakes:

1. Platform
    a. has more than one facet
    b. is modified (retouched and/or abraded)
2. Platform is lipped.
3. Platform angle is less than 45 degrees.
4. Dorsal scar orientation is:
    a. parallel
    b. multidirectional
    c. opposing
5. Dorsal topography is regular.
6. Edge outline is even.
7. Flake is less than 5 mm thick.
8. Flake has a relatively even thickness from proximal to distal end.
9. Bulb of percussion is weak (diffuse).
10. There is a pronounced ventral curvature.

Broken flakes or flakes with collapsed platforms:

1. Dorsal scar orientation is:
    a. parallel
    b. multidirectional
    c. opposing
2. Dorsal topography is regular.
3. Edge outline is even.
4. Flake is less than 5 mm thick.
5. Flake has a relatively even thickness from proximal to distal end.
6. Bulb of percussion is weak.
7. There is a pronounced ventral curvature.

Artifact is a biface flake when:

1. If whole it fulfills seven of ten attributes.
2. If broken or platform is collapsed it fulfills five of seven attributes.

Distinguishing between biface and core flakes in an assemblage is an important step in defining basic reduction technology. A predominance of biface flakes in an assemblage, particularly those removed from large bifaces serving as cores, suggests a high degree of mobility (Kelly 1988). Conversely, a predominance of core flakes in an assemblage containing only a few small biface flakes suggests limited formal tool manufacture by a sedentary population. Both conclusions can have important implications when applied to a frontier model.

Ground Stone Artifacts

Ground stone artifacts were recovered from four of the six excavated sites. OAS's standardized methodology (1990b) was used to analyze material selection, manufacturing technology, and use. Artifacts were examined macroscopically, and dimensions were measured with a sliding caliper or metal tape. Analytic results, entered into a computerized data base using SPSS/PC+ Data Entry, are discussed in the individual site descriptions.

Besides providing information on activities occurring at a site, this analysis measures assemblage costs and values. When these measures are compared, it is possible to look at differences between artifacts entering and leaving a site, length and type of occupation, and processes of site abandonment. For example, in an orderly site abandonment, ground stone tools with an intrinsic value that outweighs the difficulty of transport will be removed. In a hasty or unplanned abandonment, ground stone tools that retain value and are easily transported may be left behind. A long-term sedentary occupation should leave behind an array of broken and exhausted ground stone tools demonstrating a wide range of production inputs. A fieldhouse or farmstead, on the other hand, should contain few whole ground stone tools, and those that remain should retain little if any value.

Attributes recorded for all ground stone artifacts included material type, material texture and quality, function, portion, preform morphology, production input, plan view outline form, ground surface texture and sharpening, shaping, number of uses, wear patterns, evidence of heating, presence of residues, and dimensions. The only specialized attributes recorded in this analysis were mano cross-section form and ground surface cross-section.

By examining functions, it is possible to define the range of activities in which ground stone tools were used. Because these tools are usually large and durable, they may undergo a number of different uses during their lifetime, even after being broken. Several attributes were designed to provide information on the life history of ground stone tools: dimensions, evidence of heating, portion, ground surface sharpening, wear patterns, alterations, and the presence of adhesions. These measures can help identify post-manufacturing changes in artifact shape and function, and describe the value of an assemblage by identifying the degree of wear or use. Such attributes as material type, material texture and quality, production input, preform morphology, plan view outline form, and ground stone texture provide information on assemblage cost. In combination they provide data on raw material choice and cost and the cost of producing various tools. Mano cross-section form and ground surface cross-section are specialized measures aimed at describing aspects of form for manos and metates; as these tools wear they undergo regular changes in morphology that can be used as relative measures of age.

Ceramic Artifacts

Both a rough sort and a detailed analysis of the ceramic artifacts were conducted. The rough sort was intended to provide a count for each site and an idea of what types would be encountered during analysis. During the rough sort, sherds were classified by ware, vessel form, and frequency. General ware categories included decorated, micaceous utility ware, nonmicaceous utility ware, corrugated/banded, and incised/punctated. Temper was examined with a binocular microscope when necessary to distinguish micaceous from nonmicaceous plain ware. The detailed analysis was designed according to rough sort results, which aided in decisions on sampling and the level of detail in type distinctions.

The detailed analysis was geared toward questions of frontier development. This involved distinguishing locally made types from imported wares and examining type diversity. As proposed in Research Design: Studying the Taos Frontier, a frontier population might be making their own pottery and producing only a few types for all functions.

Because of assemblage sizes, all sherds from each site were examined. Wares were separated into specific types, taking into account the various local and nonlocal variations of white wares, the many variations of Taos Gray (based on surface treatment), and micaceous utility wares. There has been some confusion in distinguishing Taos Black-on-white from Kwahe'e Black-on-white: the former is thought to be a local variant of the latter, which is a widespread northern Rio Grande type. In the literature, the only consistent criterion for distinguishing between these types is the presence or absence of exterior slip on bowls, but since this attribute is applicable only to bowls, it is not valid for differentiating between the types. Therefore, we established a temporary type, Taos/Kwahe'e Black-on-white. All mineral-painted jar sherds with a Taos or Kwahe'e Black-on-white design and bowl sherds with an eroded exterior slip and this design were included in this type. Only bowl sherds with noneroded exterior surfaces could be confidently distinguished as Taos or Kwahe'e Black-on-white according to the type descriptions. Consequently, thin section and petrographic analysis was conducted to aid in distinguishing local versus nonlocal manufacture. Since the results indicated that all three were really one locally made type, they have been combined in the site summaries as Taos Black-on-white.

Carbon-painted black-on-white sherds with tuff temper and a fine paste were coded as Santa Fe Black-on-white. A possible local variety of Santa Fe Black-on-white with coarse sand temper was coded as Santa Fe Black-on-white: local. Indeterminate white wares were those lacking any design.

Taos Gray was recorded as plain, incised, punctate, and corrugated. Design styles of the surface treatment such as linear, herringbone, fingernail, and combinations thereof were monitored.

Sherds were assigned to vessel form categories, including jar, bowl, ladle, canteen, handle, pipes, and indeterminate vessel form. Taos Gray and Micaceous utility ware vessels are generally jars, but unless we had rim sherds or sherds large enough to accurately discern vessel form, sherds from these types were categorized as indeterminate.

Temper was examined with a binocular microscope and recorded for all sherds. Magnification ranged from 10 to 45x. Many codes were descriptive rather than geological, as in "crushed dark crystalline rock." The white ware pastes were fine and homogeneous, and the nonplastic inclusions were so minuscule that identification could not be accurately made until the petrographic analysis was complete. We expected to see temper differences in locally and nonlocally made types. Sherd and tuff temper would indicate Kwahe'e Black-on-white from the central Rio Grande, while more sand and quartz in the temper would indicate local manufacture. Using temper as an attribute could thus aid in defining a core area and provide information as to how much pottery the frontier population was producing.

Various attributes relating to physical properties, such as surface treatment, were monitored for white wares. Slip was recorded for location on the vessel (interior, exterior, interior and exterior), color, and quality (thin, thick, streaky, crackled).

Detailed design elements and styles were recorded for white ware sherds. Codes were mainly variations on hatchure and solid styles.

Thickness was recorded in millimeters for all sherds using sliding calipers. Rim diameter, when possible, was recorded in centimeters.

Other attributes recorded for both white wares and utility wares included handle type (vertical, horizontal, lug), rim form, paste color, and paste texture. These criteria, combined with those discussed above, help present well-rounded definitions of ceramic types.

Any intentional or unintentional alterations were coded. These included burned exterior, interior smudging, worked sherds, mend holes, fire clouds, carbon streaks, and basket impressing.

Faunal Remains

All of the bone recovered during the project was returned to OAS for processing. The bone was cleaned by brushing and rehoused in plastic bags before actual identification was undertaken. All bone was identified using the osteological comparative collections housed at the Museum of New Mexico, Office of Archaeological Studies, along with the more extensive collection at the Museum of Southwest Biology, University of New Mexico, Albuquerque. Olsen (1964, 1968, 1979), Gilbert (1980), and Gilbert et al. (1981) were used in preliminary identifications to narrow the number of comparative specimens checked per bone by the analyst.

All bone was identified as specifically as possible. Faunal remains were identified at least to class. Mammal bone was divided into small, medium, and large forms. By definition, small mammals were the size of a jackrabbit or smaller, medium mammals were larger than a jackrabbit and as large as a sheep, and large mammals were antelope-sized and larger. A large number of specimens in any faunal assemblage can be identified only to this level due to the fragmenting of elements during human processing and consumption and postdepositional activities. Most of this segment of the assemblage was also separated into long bone or plate or blade fragments, and measurements established the degree of fragmentation.

The remaining bone was identified as specifically as possible to order, family, genus, and species. The element, portion, side, and general age category were also evaluated and recorded. In addition to these traditional identification variables, all bone was evaluated for environmental and animal alteration, burning, cut or impact marks, and any tool-production modification. Bone lengths were recorded for all rib segments and long bone sections to address questions of carcass reduction, cooking, and consumption. The data collected from this project for several of these categories are insufficient for any synthesis at this time, but with more data from the area a good comparative data base may be established.

Data were recorded using OAS faunal analysis forms and entered into an SPSS/PC+ database for statistical analyses. The results are discussed in the individual site descriptions and summarized in Overview of the Faunal Remains, where this faunal assemblage is compared to others from the area.

Architectural Adobe

Using techniques developed at the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), in Rome, adobe brick and plaster samples from LA 2742 and LA 70577 were subjected to a series of analyses to define the character of the adobe used at the sites and its relation to natural on-site soil. Because adobe is made of soil, these analyses are borrowed from soil science. Each sample's Munsell soil color was recorded. Tests performed on the samples included particle size analyses by sieving and sedimentation, Attenburg tests to define liquid and plastic limits of the material, and analyses of soluble salts. Methods and standards for conducting these tests are detailed by Teutonico (1988). The tests were conducted at the Architectural Preservation Laboratory at the Laboratory of Anthropology in Santa Fe. Test results are discussed in the individual site descriptions.

Euroamerican Artifacts

The few Euroamerican artifacts from LA 70576 were analyzed using an early version of the OAS standardized historic artifact analysis format (OAS 1991), which focuses on artifact function and is designed to monitor function regardless of material of manufacture. The function of each artifact is described in a hierarchical framework comprised of functional categories, types, and specific functions. For this project, analysis emphasized function and chronological data.

NATURAL ENVIRONMENT

Jeffrey L. Boyer

Regional Geomorphology

The Taos region lies within the Southern Rocky Mountain physiographic province. Four major landforms in the region are relevant to this project: the Taos Plateau, the Taos Range, the Tres Ritos Hills, and the Picuris Range.

The Taos Plateau is a broad region bounded on the west by the San Juan Uplift (the San Juan and Tusas Mountains) and on the east by the Sangre de Cristo Mountains. It was formed by block-faulting along the Rio Grande Rift that produced a wide trough (the Rio Grande Depression). Accumulation of volcanic and sedimentary materials in the trough resulted in the Santa Fe formation, consisting of a variety of quartzites, sandstones, volcanic rocks, cherts, and clays from the nearby mountains. Much of the area is capped by volcanic rock, primarily basaltic flows, which are a major and obvious feature of the region (Heffern n.d.). In New Mexico, the plateau is known as the Taos Valley; in Colorado, it is called the San Luís Valley. The rolling terrain of the plateau is bisected by the Rio Grande, which has cut a gorge up to 198 m (650 ft) deep through the accumulated material of the plateau floor. To the west of the gorge, the plateau is dotted by volcanoes. To the east, it is characterized by alluvial fans and terraces from the Sangre de Cristo Mountains, although volcanic features such as Ute Mountain, Guadalupe Mountain, the Questa caldera, Cerro Negro, and their associated basalt flows are present where the features have not been covered by alluvial material.

The Sangre de Cristo Mountains are the southernmost extension of the southern Rocky Mountains. Three ranges have been defined along the east and south sides of the Taos Plateau: the Taos Range, the Tres Ritos Hills, and the Picuris Range, or Prong. The Taos Range ranges in elevation from about 2,133 m (7,000 ft) near Taos to 3,997 m (13,120 ft) at Wheeler Peak and is made up largely of Precambrian granites, schists, and quartzites. Vulcanism during the Tertiary period also produced intrusive deposits of andesite, rhyolite, granite, and quartz throughout the range (Schilling 1960:18). Subsequent to this vulcanism, a period of extensive erosion resulted in the formation of large alluvial fans extending onto the Taos Plateau along the mountain margins.

The Tres Ritos Hills are a low-lying segment of the Sangre de Cristo Mountains south of the Taos Range. The range is bounded on the north by Rio Pueblo de Taos and on the south by Rio Pueblo de Picuris. The Tres Ritos Hills have generally lower elevations than the Taos Range, up to around 3,047-3,351 m (10,000 to 11,000 ft). They are composed of interbedded sandstones, limestones, and shales overlying the

Paleozoic rocks (Schilling 1960:16-17). The Tres Ritos Hills are a region of perennial streams, including, in the area of this project, Rio Grande del Rancho and its tributaries, Rito de la Olla (Pot Creek) and Rio Chiquito.

The Picuris Range, or Prong, is an isolated spur of the Sangre de Cristo Mountains consisting of metamorphic and igneous rocks similar to those of the Taos Range. Micaceous schist is a common component of the metamorphic complex (Schilling 1960:16). The range is a complex series of ridges and deep canyons radiating around Picuris Peak, whose elevation is 3,295 m (10,810 ft). It juts westward, forming the southwest corner of the Taos Plateau, and is separated from the adjacent Tres Ritos Hills by a fault that formed the Rio Grande del Ranchos Valley. All drainages of the Picuris Range are intermittent, including Arroyo Miranda, a tributary of Rio Grande del Rancho that parallels the latter for several miles before joining it near the village of Llano Quemado.

Rio Grande del Rancho flows from the mountains near Talpa and has cut a canyon through a wide alluvial fan. Benches on either side of the canyon, which is 9-15 m (30-50 ft) deep, are the locations of three Hispanic villages: Talpa, Llano Quemado, and Ranchos de Taos.

Several features--the Santa Fe formation, the volcanos and basalt flows, and the sedimentary formations of the Tres Ritos Hills--are culturally important because they have provided raw lithic materials for the region's prehistoric and historic inhabitants. Of specific importance are sandstone, chert, rhyolite, and quartzite from the Santa Fe formation gravels, chert from the limestone beds in the Tres Ritos Hills, and basalt and obsidian from the volcanic features (see Newman 1983 for preliminary evaluation of local and exotic lithic material use). Soil accumulation along drainages has provided an important source of clay for pottery manufacture and building materials. However, little study has been focused on clay sources (see Appendix 3).

Reconstructing the Past Climate

Most descriptions of the climate of the Taos Valley and the surrounding region rely on modern data obtained from weather stations that have recorded a variety of climatic information for various lengths of time (see Gabin and Lesperance 1977). Since most archaeology in the region has been in the form of small surveys, descriptions from modern data provide adequate descriptions of survey areas. The use of modern climatic data to characterize the prehistoric landscape has not been addressed, however, and most researchers have implicitly followed Herold's (1968:17) contention that "in general, precipitation and temperature in the area seem to have approximated that recorded in the last fifty years."

The primary reason for relying on modern data is that paleoenvironmental studies have not been carried out in the Taos Valley. Consequently, it remains difficult to accurately reconstruct the paleoclimate of the region. Quinn (1980:81-94) attempts to correlate palynological and glacial evidence from other parts of the Southwest with events in the Taos Valley. Citing Martin (1963), Quinn (1980:85) suggests that vegetation zones reached their present positions about 1,200 years ago and have remained relatively stable since that time, with no significant changes until historic and modern "environmental manipulation." She observes that Martin's data indicates that, of his four study areas throughout the Southwest, pollen variability was lowest in the San Juan Mountains of southern Colorado, the study area closest to the Taos Valley. This suggests only that the southern Rocky Mountains have seen relatively less change than other areas. After reviewing pollen and alluvial deposit reconstructions from the Colorado Plateau, the Basin and Range province, and the Rio Grande Valley, Quinn (1980:93-94) summarizes:

> Some areas on the Colorado Plateau, southern Arizona, and New Mexico experienced more extreme environmental fluctuations. Other areas, such as the Southern Rocky Mountain Province, which includes the San Juan and Sangre de Cristo Mountains, seem to have undergone very few changes.
>
> Considering the present and past environmental data for the Southwest and the Taos region, there has probably been a series of climatic changes since about A.D. 900 in the Southern Rocky Mountain Province. The intensity of these fluctuations may not have been great, compared to changes in other areas of the Southwest.

Citing research on alluvial chronologies, glaciation, and dendroclimatology, Greiser et al. (1990b) point to a significant climatic shift around A.D. 1000 or 1050. Specifically, these data suggest that for several centuries before the shift, panregional conditions throughout the West were relatively wetter and perhaps cooler. Glacial studies and alluvial chronologies point to a shift to drier, warmer conditions around 1000. This shift provoked the slow retreat of glaciers in the mountains (Greiser et al. 1990b:105-107). This is an important point since Greiser et al. (1990b:110) argue, "Initially, residual glacial ice and snow fields in the high mountains would have acted as reservoirs, storing moisture in the form of snow accumulated in the winter and slowly releasing it throughout the summer months. Thus, even though precipitation was decreasing, the mountain drainages were carrying a reliable flow of meltwater all summer long." They then point to a period of relative drought in the early A.D. 1200s, particularly in the 1250s, followed by a wetter period between A.D. 1295 and 1335. By attempting to correlate climatic dates and events from other areas with events in the Taos Valley, Quinn and Greiser et al. extend these chronologies to the Taos area, implying that climatic patterns recorded at Tesuque, Santa Fe, the San Juan Mountains, Oklahoma, and elsewhere are also applicable to the Taos area. This is an argument that can only be tested against local paleoclimatic data, of which there are very little.

Loose (1974:41) summarizes palynological data from two pithouse sites near the village of Valdez, 13 to 16 km (8 to 10 mi) north of Taos, by observing that pollen samples from LA 9201 "seemed to indicate that precipitation values for the site area during the period of occupancy were significantly lower than they are today." An examination of her summary pollen data (Loose 1974:42) shows that in the three control samples taken from the area of LA 9201, arboreal pollen accounts for 57 to 73.5 percent, and the remainder was from grasses, shrubs, and annual plants. This is consistent with the modern situation in that the site is located in a piñon-juniper forest overlooking the narrow Rio Hondo floodplain. In contrast, pollen from pithouse floor features show a reversal of modern conditions: only 24 to 36 percent was arboreal pollen, and 64 to 76 percent came from nonarboreal plants. Pollen from LA 9200, 5.3 km (3.3 mi) north of LA 9201 near the mountain foothills, was 51 to 73 percent nonarboreal and 32 to 49 percent arboreal. It is important to note that, of the five prehistoric samples, only one had a 200 grain count, the same size as the control samples. That sample is from LA 9201, Feature 3. The samples from LA 9201, Feature 2; and LA 9200, Feature 7 (cist) and Feature 5, had 100 grain counts. The fifth sample, from LA 9200, Feature 7, had only a 50 grain count. Loose (1974:42) states that James Schoenwetter, who conducted the pollen analysis, reported to her that the fifth sample was perhaps not large enough for valid comparison and that the three samples with 100 grain counts may not have been large enough for comparison. However, the pollen counts from those samples are consistent with the sample from LA 9201, Feature 3, suggesting that the pattern is accurate. It is apparently this pattern that leads Loose to postulate that a significant shift in the natural environment took place between the occupation of the sites and the mid-1960s, when the sites were excavated.

No chronometric dates were obtained for LA 9200 or LA 9201. By comparing the pollen profiles from the sites with pollen sequences from the San Juan Basin, Schoenwetter suggested that the sites dated between A.D. 850 and 950 (Loose 1974:41). Although this is consistent with Loose's acceptance of Ellis and Brody's (1964) A.D. 900 date for the beginning of the Valdez phase and with the reported presence of Red Mesa Black-on-white sherds at the sites, there is little evidence of Anasazi habitation of the Taos Valley before A.D. 1050 (Crown 1990:66) or 1100. Further, recent pollen studies have shown that pollen concentrations in a sample are more informative than percentages or counts (see Introduction). While palynologists did not calculate concentration values at the time that LA 9200 and LA 9201 were being studied, the lack of concentration data renders the pollen information inconclusive. Since it seems unlikely that LA 9200 and LA 9201 date to the A.D. 800s and 900s, and since the significance of the pollen data is ambiguous, another explanation may be needed for the reversal of the arboreal/nonarboreal pollen ratio from the prehistoric samples to the control samples. We will address this issue in the following discussion.

In 1981, the School of American Research published a reconstruction of the past climate of the Santa Fe area based on dendroclimatology (Rose et al. 1981). The reconstruction process involved converting the widths of tree rings, principally piñon, to measures of seasonal and annual precipitation. Rose et al. (1981:101-103) were able to construct a table listing annual precipitation for each year from 985 to 1970. After calculating the mean of the annual figures, they were able to determine how far each year departed from the mean in terms of standard deviations from the mean. However, because their interest was in climatic events that could have had an archaeologically recognizable effect on human behavior, they suggested, "In order to comprehend possible relationships between the dendroclimatic reconstructions and the behavior of people at Arroyo Hondo, paleoclimatic variations of somewhat longer duration than one year were examined" (Rose et al. 1981:91). They then converted annual figures to figures for decades, assuming that climatic events lasting most of or more than 10 years are more likely to have had archaeologically identifiable results. Their method was to combine annual figures to produce figures for decades that overlap at five-year intervals: for example, A.D. 990-1000, A.D. 995-1005, A.D. 1000-1010, and so on. In effect, this produces departure values for each five-year period in the chronology. The standard deviations for each period were plotted against the mean, and a graph showed the progression of precipitation about the mean through time (Fig. 2a).

Not all decadal events will be behaviorally significant, however. Rose et al. (1982:92) and Dean and Robinson (1977:7) stated,

> Variation that exceeds two standard deviations in either direction from the mean is considered to be significant in the sense that such departures are of sufficient rarity and magnitude to have had potential adaptive consequences for plant, animal, and human populations. Thus, we emphasize those values that lie outside the range of 95 percent of the variability about the mean.

To define the components of the precipitation-tree growth relationship, Rose et al. tested the effects of various periods of precipitation and mean temperatures on annual precipitation values and ring widths. Two variables were significantly correlated and could be reconstructed: spring precipitation (March through June) and annual precipitation (August through July). By comparing reconstructions of spring and annual precipitation, they concluded that "most of the variability in annual precipitation can be attributed to variability in spring precipitation" (Rose et al. 1981:93). Figure 2a shows their spring and annual reconstructions for the Santa Fe area.

Dean and Robinson (1977) provided a series of maps showing trends in precipitation by decade for much of the Southwest. Their data were obtained from a "network" of 25 "stations" representing archaeological and modern dendrochronologies from A.D. 680 to 1970. The maps show figures at or near the "stations" that represent standard deviations from the mean of the chronology for that station for each decade. One station is called the "Rio Grande, North" station. Although it is not otherwise identified, its longitude/latitude coordinates place it near Rio Grande del Rancho in southern Taos Valley. The data were apparently obtained from dendrochronologies in and near the Taos Valley and may, therefore, be used to examine past climate in the valley.

Dean and Robinson's data are not as fine-grained as those of Rose et al. since each figure is a decadal departure value, and the decades cannot be overlapped. However, if graphed in the way that Rose et al. graphed their data, the decadal figures provide a basic reconstruction of Taos Valley precipitation. Rose et al. plotted each departure value at the midpoint of its 10-year period. By plotting Dean and Robinson's decadal values at the midpoint of each decade, we arrive at the reconstruction shown in Figure 2b. This is a reasonable procedure since the decadal departure values were probably not characteristic of every year of any decade. Rather, the values probably characterized some years, while those near the beginning and end of a decade probably represented transitions from the previous decade and to the next. Therefore, the graph in Figure 2b shows climatic progression through time better than a histogram-like graph with departure values for full decades. When, in the following discussion, we use the term "significant" to refer to decades that were wetter or drier than normal, we use Rose et al.'s criteria for years whose decadal departure values approach or exceed two standard deviations above or below the mean. Decadal departures over one standard deviation may have been noticeable but do not meet the criteria for "significant" climatic variations.

The first three decades, A.D. 680 through 710, were perhaps years when precipitation oscillations were, to use Rose et al.'s (1981:94) terms, of high frequency and high amplitude. There was a significant dry period in the first decade of the 700s. We cannot be sure whether these years were the end of an earlier precipitation pattern or a short, highly variable interlude in a longer pattern. About A.D. 710, precipitation shifted to a pattern of high-frequency, low-amplitude oscillations, with about nine oscillations per century. Each oscillation spanned about one decade. No oscillation exceeds a single standard deviation above or below the mean, and over half have departure values less than one-half standard deviation. The pattern lasted until about A.D. 850 and resulted in a period of low variability in climatic fluctuation.

From A.D. 850 to about A.D. 980, the pattern shifted to moderate-frequency, moderate-amplitude oscillations. There were six to seven oscillations per century, and oscillations typically spanned one and a half to two decades. This was a time of increased variability in climatic fluctuation. Still, there were no prolonged periods of higher or lower than normal precipitation, and half of the oscillations peak at or under one standard deviation above or below the mean. The period began with significantly wetter years between A.D. 850 and 860. There were no peaks at or over two standard deviations below the mean, although departure values for the A.D. 900s, 950s, and 970s were at or over one and a half standard deviations below the mean. These years may have been noticeably drier than normal.

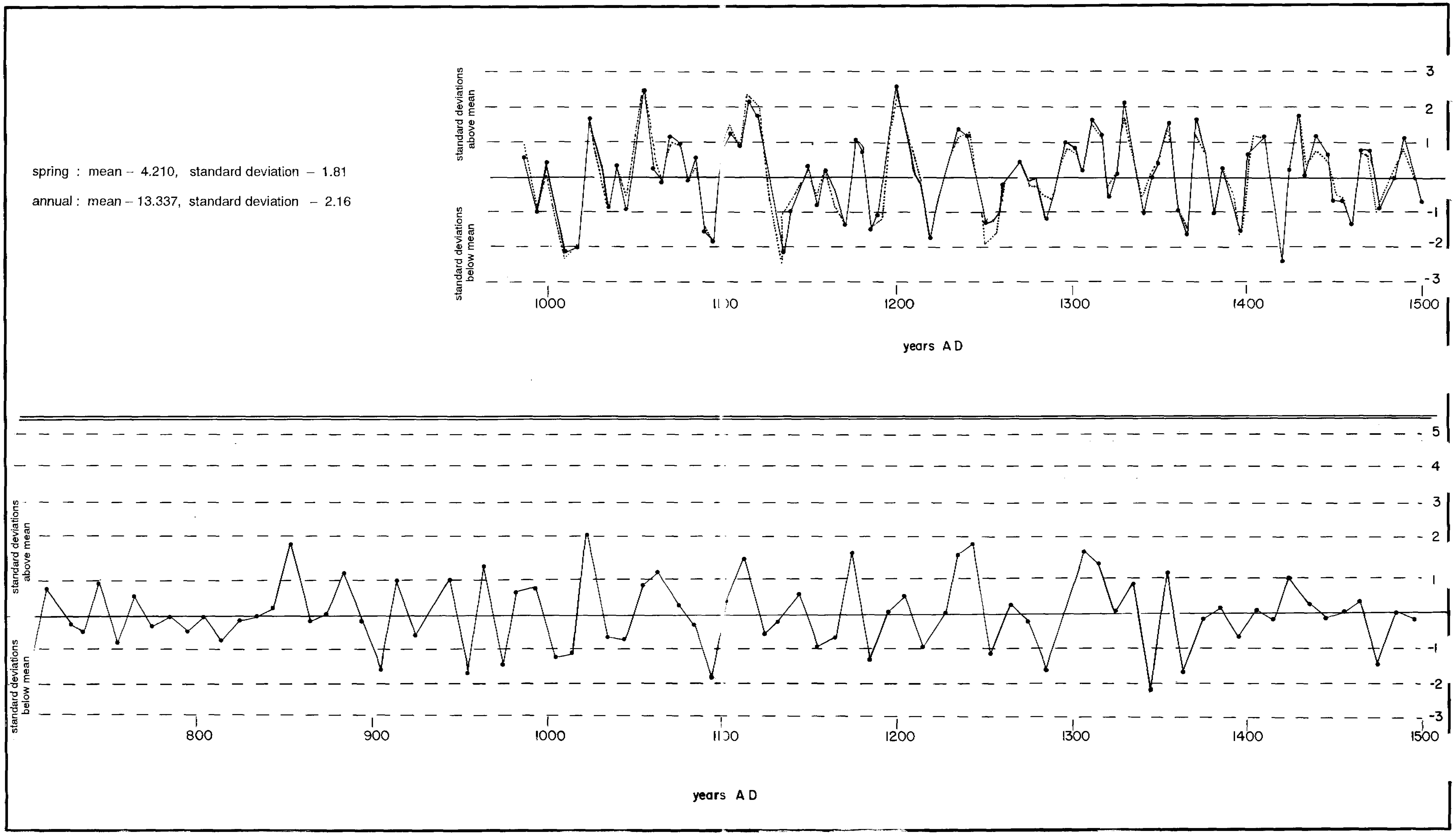
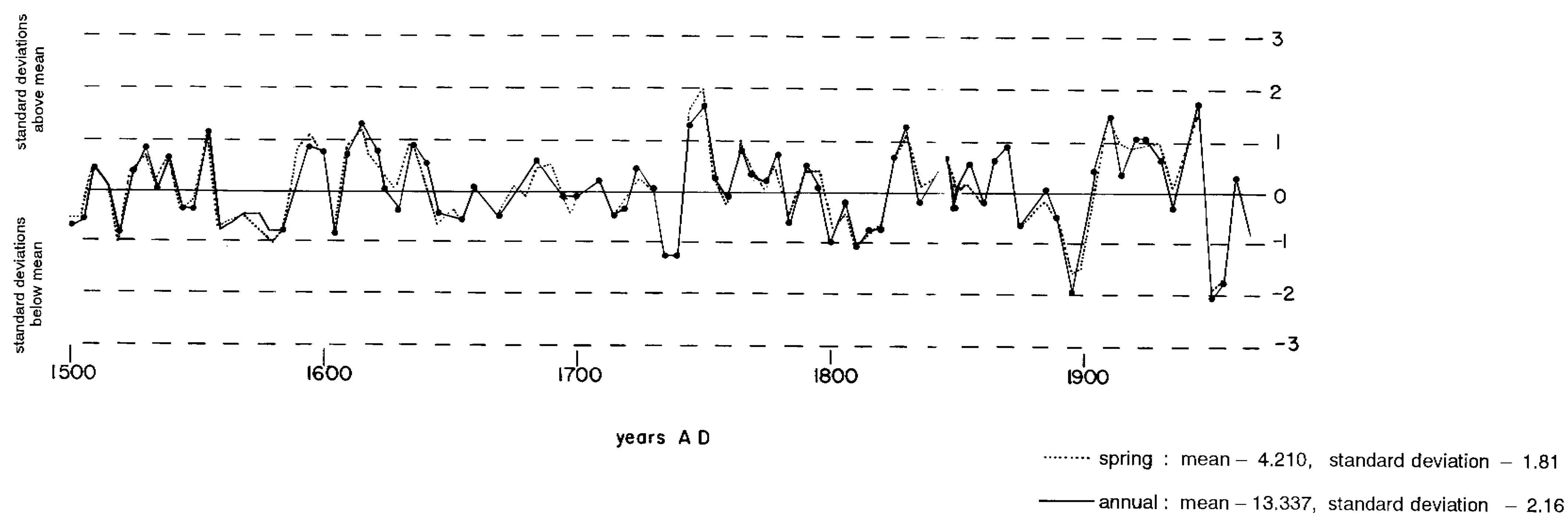


Figure 2. (a) Dendroclimatic reconstructions of spring and annual precipitation in the Santa Fe area, A.D. 985 to 1970. from Rose et al. (1981). (b) Dendroclimatic reconstruction of precipitation by decade, A.D. 680 to 1970, Rio Grande North Station, Taos area, from Dean and Robinson (1977). Values before A.D. 1100 are interpolated.



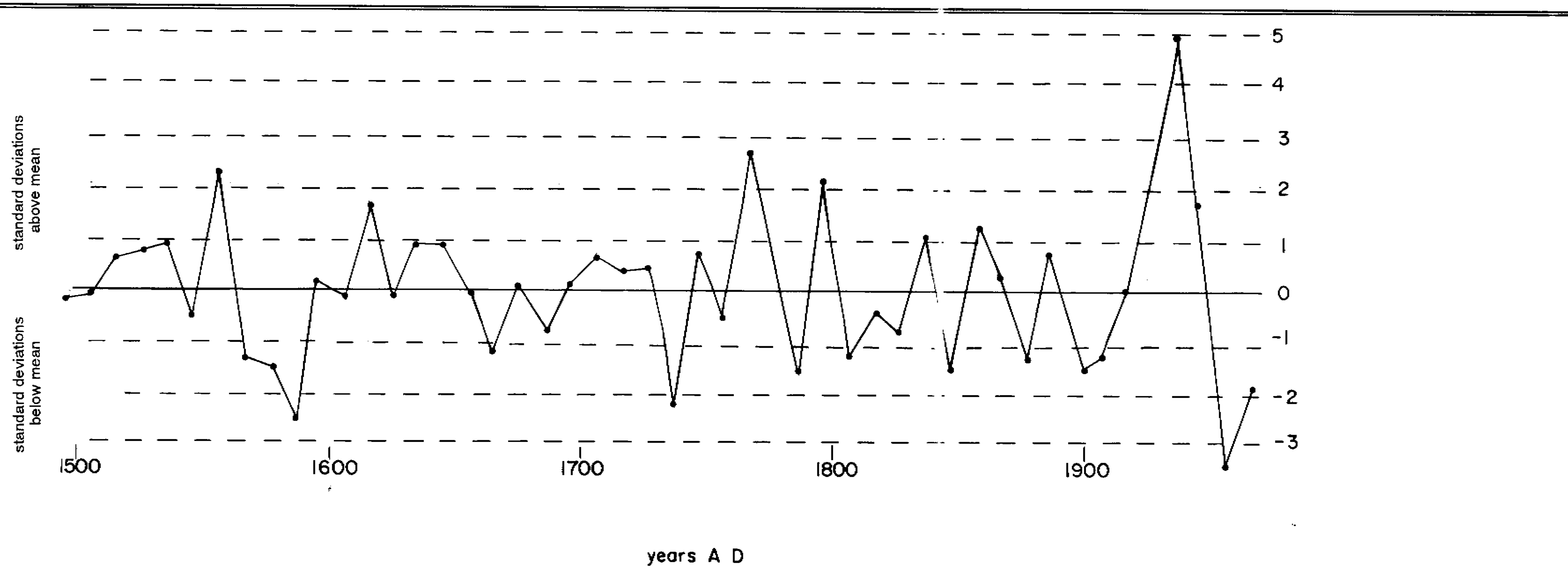


Figure 2 (cont.).

Greiser et al. observe that A.D. 850 recurs in many regional alluvial chronologies as documenting "fluvial responses to widespread climatic variation." They conclude that "in total, these data document a trend of relatively moist conditions beginning ca. A.D. 1 and persisting until ca. A.D. 1050" (Greiser et al. 1990b:107-108). Although the dendroclimatic reconstruction does show increased climatic variation beginning about 850, it does not support the conclusion of moister conditions. Only one significantly wetter decade, the A.D. 850s, is seen in the reconstruction, while the A.D. 680s and 960s may have been noticeably wetter than normal. Still, these are three decades over the course of three centuries, and they show no pattern of increased precipitation.

Conversely, Loose (1974:41) suggests that, based on the Valdez area pollen samples, the years between A.D. 850 and 950 were drier than modern conditions. Although conditions may have been noticeably drier in the A.D. 910s and 950s, there was a significantly wetter decade in the 850s, and the intervening years tended to be at or slightly above normal, but perhaps not noticeably. This lends support for our contention that a nonclimatic factor must account for the arboreal/nonarboreal pollen ratios from Loose's sites. We suggest that the factor is cultural, in that the occupants of the sites removed the surrounding tree cover for construction and fuel, an activity that would have altered the local pollen rain. It is important to note that most of the nonarboreal pollen recovered came from disturbed-ground plants. At least some are also culturally useful plants, particularly the chenopods and grasses, which were subsistence plants. In either case, the data suggest that the pollen is not the result of naturally changing vegetative zones or plant communities.

After about A.D. 980, the pattern shifted again to low-frequency, high-amplitude oscillations, with four to six oscillations per century. Oscillations typically spanned two to three decades. This pattern, which lasted until about A.D. 1370, resulted in a period of high climatic variability. However, that variability was a long-term phenomenon, with highs and lows lasting longer than in previous periods. Within the 390-year period, two trends are apparent. During the first 200 years, there were two significantly wet decades separated by 140 years (the A.D. 1020s and 1160s) and one significantly dry decade (the A.D. 1090s) that came halfway between the wet decades. In the last 190 years, there were two significant wet periods spanning two decades each: A.D. 1230 to 1250 and A.D. 1300 to 1320. These two periods were 70 years apart and separated by two decades that may have been noticeably if not significantly drier than normal, the A.D. 1250s and 1280s. After the second high peak, the area saw two decades, the A.D. 1340s and 1360s, with significantly less precipitation than normal.

The research cited by Greiser et al. (1990b:105-108) suggests that a climatic shift took place at about A.D. 1000. Glaciation studies indicate that a short period of glaciation beginning about A.D. 600 ended around A.D. 1000. Since glacial retreat is normally associated with warmer and/or drier conditions, the researchers see a significant climatic shift at about A.D. 1000. This is supported by data from Oklahoma alluvial chronologies that show a shift from relatively moist to relatively dry conditions. This shift may have been widespread over most of the southern plains and the Southwest (Greiser et al. 1990b:107). While the local dendroclimatic reconstruction does not indicate a simple shift from wetter to drier conditions, it does show a significant shift to increased long-term climatic variability at about A.D. 1000. How this shift correlated with regional shifts and the possible end of a short glacial period is not known and must await studies of local alluvial chronologies. We point, however, to Quinn's (1980:93-94) cautionary note: "Considering the present and past environmental data for the Southwest and the Taos region, there has probably been a series of climatic changes since about A.D. 900 in the Southern Rocky Mountain Province. The intensity of these fluctuations may not have been great, compared to changes in other areas of the Southwest."

Rose et al. (1981:94, 100) also observe a climatic shift in the Santa Fe area. Their description of the period from 990 to 1430 A.D. is one of high-frequency, high-amplitude oscillations (Fig. 2a). They do not characterize the period as relatively dry. Rather, it is clear that, although there were several significantly dry years, there were also several very wet years, and the period was characterized by high variability.

Greiser et al. (1990b:110) describe the years between A.D. 1100 and 1250 by saying, "Although there were short-term fluctuations in moisture during this period, generally, this was a time marked by aridity and resultant erosion." They cite Miller and Wendorf (1958), whose alluvial chronology from Tesuque shows erosional disconformities suggesting drought between A.D. 1200 and 1250. Holbrook and Mackey (1976) also point to dry conditions around A.D. 1200 in the Gallina area. In the Santa Fe area, Rose et al. (1981:94-98, 100) observe that A.D. 1250 to 1255 was drier than the "Great Drought" of the late 1200s. Their reconstruction also shows dry years in the A.D. 1220s. The Taos reconstruction does not support this description. Figure 2b shows that in the Taos area, the A.D. 1220s and 1250s may have been noticeably dry but were not significantly so. Further, these decades were separated by one of the longest wet periods in the entire chronology. In fact, there were no significant dry decades between A.D. 1100 and 1250, while there were three significantly wet periods. Most variation was within one standard deviation of normal precipitation. Thus, we cannot characterize the A.D. 1100-1250 period as relatively arid, and whether it was marked by erosion remains to be studied.

Rose et al. (1981:94-98, 100) observe that the "Great Drought" of A.D. 1276-1299 was minimally evident in spring precipitation in the Santa Fe area but was more noticeable in annual precipitation, with a low from A.D. 1285 to 1290. The difference "seems to indicate that nonspring precipitation was depressed more than spring precipitation during the Great Drought period in the upper Rio Grande Valley" (Rose et al. 1981:100). Figure 2b shows that in the Taos area, the "Great Drought" was experienced as a noticeable and perhaps significant low in precipitation in the A.D. 1280s. If there was an important dry period in the Taos Valley, it was not in the first half of the A.D. 1200s but rather between A.D. 1250 and 1300, when precipitation was generally below the mean, and two decades, the A.D. 1250s and 1280s, were much drier than normal.

In the Santa Fe area, the dry years of the late A.D. 1200s were followed by increased precipitation between A.D. 1295 and 1335. According to Rose et al. (1981:100), this corresponded to a "major, post-Great Drought high" that occurred over most of the northern Southwest. This post-drought high is also evident in the Taos reconstruction (Fig. 2b) as a time of above-normal precipitation between A.D. 1300 and 1340. In the Santa Fe area, the post-drought high was followed by a return to the earlier oscillation pattern lasting until A.D. 1430, when the pattern shifted to low-frequency, low-amplitude oscillations (Fig. 2a). These conditions are not mirrored in the Taos area. Instead, the post-drought high was followed by two significant dry decades in the A.D. 1340s and 1360s.

From A.D. 710 to 1370, we see a general long-term trend in precipitation oscillations of decreasing frequency and increasing amplitude. That is, through time, oscillations were fewer and lasted longer, while there were more significant wet and dry decades. All of this translates into increased variability through time, but that variability became a longer-term phenomenon after the late A.D. 900s and particularly after about 1200. By the end of this long-term trend around A.D. 1370, the Pot Creek-upper Rio Grande del Rancho Valley had been abandoned by its Anasazi occupants. Of our six sites, only one dates after A.D. 1370. Therefore, while we are concerned with regional developments in the Taos Valley after that time, our primary focus is on the pre-A.D. 1370 occupation and, therefore, on the pre-A.D. 1370 climate.

From A.D. 1370 to about 1550, the beginning of the historic period in the Taos Valley, the precipitation pattern was one of moderate-frequency, low-amplitude oscillations. There were five to seven oscillations per century, and oscillations typically spanned one to two decades. One exception was the years between A.D. 1460 and 1490, a three-decade period of slightly increased moisture. During the 180 years of this pattern, only one decade, the A.D. 1470s, had a departure value over one standard deviation.

From A.D. 1550 to 1620, the pattern shifted again to moderate-frequency, high-amplitude oscillations. This 70-year period was a time of high variability with two significant wet decades, the 1550s and 1610s, separated by a major drought from about 1560 to 1590 or 1600. The years of the Spanish entradas were very dry in the Taos Valley. About 1620, the climate returned to its A.D. 1370-1550 pattern and remained in that pattern until about 1730. This suggests that the 360 years from 1370 to 1730 were a long period of low to moderate variability in precipitation interrupted by a short interlude of dramatic oscillations that included two significant highs and a major drought. The pattern was interrupted again between 1730 and 1810 by another shift to moderate-frequency, high-amplitude oscillations resulting in significantly dry years in the 1730s and 1780s and significantly wet years in the 1760s and 1790s. From 1810 to 1930, oscillation frequency increased while amplitude decreased to moderate limits, with five peaks over one standard deviation (four below and one above the mean), but none approaching two standard deviations. Finally, after 1930, the pattern again shifted to high-frequency, very high-amplitude oscillations, including the wettest and driest decades in the entire chronology. In general, the years after A.D. 1370 were characterized by periods of moderate variability punctuated by periods of high variability. There appears to have been shortened periodicity during these years. The first moderate period, 1370 to 1550, spanned about 180 years. The succeeding high period spanned 70 years and was followed by another moderate period of 90 years, a high period of 80 years, a third moderate period of 80 years, and a return to high variability. With the exception of the first 180-year moderate period, climatic shifts appear to have come at 70- to 90-year intervals throughout the historic period.

Modern Climate

Precipitation

Gabin and Lesperance (1977:390) show that Taos, the nearest weather station to the Pot Creek project area, has a mean annual precipitation of 316.5 mm (12.5 in) (Table 3). This agrees with weather station data summarized by Cordell (1979a) and Maker et al. (1974), who show Taos's mean annual precipitation as 310 mm (12.2 in) and 320 mm (12.6 in), respectively. Monthly precipitation ranges from a minimum of 16.5 mm (0.6 in) in December to 46.2 mm (1.8 in) in August. Rainfall between April and September accounts for 62 percent of annual precipitation (195.6 mm; 7.7 in). Of that amount, just under two-thirds (119.4 mm; 4.7 in) comes during the last half of the growing season, while the rest comes in April, May, and June (76.2 mm; 3.0 in).

At 2,124 m (6,970 ft) elevation, the Taos weather station is about 70 to 130 m (230 to 430 ft) lower than the Pot Creek project area. The next nearest weather station is at the Camino Real Ranger Station (formerly the Peñasco Ranger Station) in Peñasco, some 16 km (10 miles) south of the project area. The elevation of the ranger station is 2,414 m (7,920 ft), or 160 to 220 m (520 to 720 ft) higher than the project area. The average of the two weather station elevations is 2,269 m (7,445 ft), 13.7 to 68.6 m (45 to 225 ft) higher than our sites. Averaging the precipitations of the two stations may provide an approximate if slightly high figure for precipitation in the project area. However, it may not be too high, because the project area is in the mountains, but both weather stations are in valley settings.

Table 3 shows that averaging the mean annual precipitation of the Taos and Peñasco stations yields a figure of 354.4 mm (13.6 in), with a mean minimum of 19.0 mm (0.7 in) in December and a mean maximum of 53.6 mm (2.1 in) in August. To check the accuracy of this figure, we averaged the mean precipitation figures for all Taos County weather stations between 2,124 m (6,970 ft), the elevation of Taos, and 2,286

Table 3. Summary of regional climatological data

Weather Station	Elevation	Mean Precipitation			Mean Temperature			Mean Potential Evapotranspiration (PE)			Mean Annual Precipitation Deficit	Percent of PE Provided by Mean Precipitation
		Min.	Max.	Ann.	Min.	Max.	Ann.	Min.	Max.	Ann.		
Taos[1]	2,124 m 6,970 ft	16.5 mm .6 in	46.2 mm 1.8 in	316.5 mm 12.5 in	-3.9 C 25.0 F	20.0 C 68.1 F	8.5 C 47.3 F	8.4 mm .3 in	165.3 mm 6.5 in	804.1 mm 31.6 in	518.9 mm 20.4 in	39.3
Peñasco[2]	2,414 m 7,920 ft	21.6 mm .8 in	61.2 mm 2.4 in	374.4 mm 14.7 in	-4.9 C 23.2 F	17.2 C 63.0 F	5.8 C 42.5 F	7.6 mm .3 in	134.6 mm 5.3 in	612.1 mm 24.1 in	273.7 mm 9.4 in	61.0
Average Taos and Peñasco	2,269 m 7,445 ft	19.0 mm .7 in	53.6 mm 2.1 in	345.4 mm 13.6 in	-4.4 C 24.1 F	18.6 C 65.5 F	7.1 C 44.9 F	8.0 mm .3 in	149.9 mm 5.9 in	708.1 mm 27.8 in	362.7 mm 14.2 in	48.9
Average all Taos County stations[3] 2,124-2,286 m 6,970-7,500 ft	2,176 m 7,140 ft	11.4 mm .4 in	58.4 mm 2.3 in	340.4 mm 13.4 in	-4.4 C 24.1 F	18.6 C 65.5 F	7.1 C 44.9 F	8.0 mm .3 in	149.9 mm 5.9 in	708.1 mm 27.8 in	367.7 mm 14.4 in	48.2

[1] All data from Gabin and Lesperance (1977).

[2] Elevation and mean precipitation from Gabin and Lesperance (1977). Mean temperature calculated from Carson National Forest elevation-temperature regression formulas. Mean PE calculated from formula in Gabin and Lesperance (1977).

[3] Elevation and mean precipitation from Gabin and Lesperance (1977). Mean temperature and PE are Taos-Peñasco averages, since mean temperatures are not provided for other stations by Gabin and Lesperance (1977) and were not calculated for this project.

Table 4. Mean monthly temperatures at each site

Site	LA 3570	LA 2742	LA 70576	LA 70577	LA 71189	LA 71190	Mean
Elevation	2185 m 7210 ft	2194 m 7240 ft	2200 m 7260 ft	2212 m 7300 ft	2242 m 7400 ft	2242 m 7400 ft	2213 m 7302 ft
Temperature							
January	-4.0 C 24.7 F	-4.1 C 24.6 F	-4.1 C 24.6 F	-4.2 C 24.5 F	-4.3 C 24.3 F	-4.3 C 24.3 F	-4.2 C 24.5 F
February	-1.3 C 29.6 F	-1.4 C 29.5 F	-1.4 C 29.4 F	-1.5 C 29.3 F	-1.6 C 29.0 F	-1.6 C 29.0 F	-1.5 C 29.3 F
March	-.1 C 31.9 F	-.1 C 31.8 F	-.2 C 31.7 F	-.2 C 31.6 F	-.4 C 31.2 F	-.4 C 31.2 F	-.2 C 31.6 F
April	4.6 C 40.4 F	4.6 C 40.3 F	4.5 C 40.2 F	4.5 C 40.1 F	4.3 C 39.7 F	4.3 C 39.7 F	4.5 C 40.1 F
May	12.4 C 54.4 F	12.4 C 54.3 F	12.3 C 54.2 F	12.2 C 54.0 F	11.9 C 53.5 F	11.9 C 53.5 F	12.8 C 55.0 F
June	14.7 C 58.5 F	14.6 C 58.4 F	14.6 C 58.3 F	14.5 C 58.2 F	14.3 C 57.8 F	14.3 C 57.8 F	14.5 C 58.2 F
July	18.7 C 65.8 F	18.7 C 65.7 F	18.6 C 65.6 F	18.6 C 65.5 F	18.4 C 65.1 F	18.4 C 65.1 F	18.6 C 65.5 F
August	18.7 C 65.7 F	18.6 C 65.6 F	18.6 C 65.5 F	18.5 C 65.4 F	18.3 C 65.0 F	18.3 C 65.0 F	18.5 C 65.4 F
September	13.2 C 55.7 F	13.1 C 55.6 F	13.0 C 55.5 F	13.0 C 55.4 F	12.8 C 55.0 F	12.8 C 55.0 F	13.0 C 55.4 F
October	8.3 C 46.9 F	8.2 C 46.8 F	8.2 C 46.7 F	8.1 C 46.6 F	7.9 C 46.3 F	7.9 C 46.3 F	8.1 C 46.6 F
November	2.2 C 35.9 F	2.1 C 35.8 F	2.1 C 35.8 F	2.0 C 35.7 F	1.9 C 35.5 F	1.9 C 35.5 F	2.0 C 35.7 F
December	-2.0 C 28.4 F	-2.0 C 28.4 F	-2.0 C 28.3 F	-2.0 C 28.3 F	-2.1 C 28.2 F	-2.1 C 28.2 F	-2.0 C 28.3 F
Annual	7.1 C 44.8 F	7.0 C 44.7 F	7.0 C 44.6 F	6.9 C 44.5 F	6.8 C 44.2 F	6.8 C 44.2 F	6.9 C 44.5 F

m (7,500 ft), 30 m (100 ft) higher than our highest site. Table 3 shows that the average elevation of these stations is 2,176 m (7,140 ft), 21 m (70 ft) lower than our lowest site. The mean minimum is 11.4 mm (0.4 in), slightly lower than the Taos-Peñasco average, while the mean maximum is 58.4 mm (2.3 in), which is within the Taos-Peñasco range. The annual mean is 340.4 mm (13.4 in), nearly identical to the Taos-Peñasco average. Therefore, we feel secure in suggesting that the Pot Creek project area receives a mean minimum of 11.5 to 19.0 mm (0.4 to 0.7 in) in December, a mean maximum of 53.0 to 58.0 mm (2.0 to 2.3 in) in August, and an annual mean of 340 to 345 mm (13.4 to 13.6 in).

This figure is quite near the low end of the mean annual precipitation range given by Edwards et al. (1987) for the Terrestrial Ecosystem Survey (TES) units within which our sites are located. They show the mean annual precipitation in units 119, 145, and 159 as 350 to 450 mm (13.8 to 17.8 in). Since our sites are located in the lowest parts of the units, which typically extend far up the mountain slopes above the project area, we would expect precipitation in the project area to fall at the low end of their range. Cordell (1979a:89) shows that recorded variability in annual precipitation is considerable. Between 1893 and 1960, departures of 76 mm (3 in) or more below the mean were not uncommon, although departures never reached 101 mm (4 in) below the mean.

Temperature

Gabin and Lesperance (1977) report that the mean temperature at Taos ranges from a monthly minimum of -3.9 degrees C (25.0 degrees F) in January to a monthly maximum of 20.0 degrees C (68.1 degrees F) in July, with an annual mean of 8.5 degrees C (47.3 degrees F) (Table 3). Although they do not provide temperature data for Peñasco, we have calculated mean monthly temperatures using elevation-temperature regression formulas computed by Carson National Forest (personal communication). Using the formulas, we arrive at a mean minimum for Peñasco of -4.9 degrees C (23.2 degrees F) in January, a mean maximum of 17.2 degrees C (63.0 degrees F) in July, and an annual mean of 5.8 degrees C (42.5 degrees F). Using these figures to average with Gabin and Lesperance's temperatures for Taos, the mean minimum for the two stations is -4.4 degrees C (24.1 degrees F), the mean maximum is 18.6 degrees C (65.5 degrees F), and the annual mean is 7.1 degrees C (44.9 degrees F).

Using the same elevation-temperature regression formulas, we calculated mean monthly and annual temperatures for each site and for the project area (average of all sites). Table 4 shows that the mean minimum temperature for all sites is -4.2 degrees C (24.5 degrees F) in January, the mean maximum is 18.6 degrees C (65.5 degrees F) in July, and the annual mean is 6.9 degrees C (44.5 degrees F).

Potential Evapotranspiration

Gabin and Lesperance (1977:6) calculate potential evapotranspiration (PE) using a method that "predicts the consumptive use of water by irrigated crops--this includes water used in transpiration and building of plant tissue, the water evaporated from adjacent soil, and the precipitation that is intercepted by the plant." As such, PE is an effective measure of the water needs of crop plants relative to available moisture. When compared with precipitation, PE provides a means of determining how much of crop water needs is provided by available precipitation and whether supplemental water is necessary.

Table 5 shows that mean PE in Taos ranges from a minimum of 8.4 mm (0.3 in) in January to a maximum of 165.3 mm (6.5 in) in July. The mean annual PE for Taos is 804.1 mm (31.6 in). Comparing this figure with mean annual precipitation, 316.5 mm (12.5 in), reveals a mean annual precipitation deficit of 518.9 mm (20.4 in). In other words, mean annual precipitation provides only 39.3 percent of PE water needs in Taos. Conditions are better in Peñasco, where a higher elevation and lower temperatures result in a lower PE rate. Higher precipitation means that in Peñasco, the annual precipitation deficit is lower, and annual precipitation provides 61 percent of PE water needs. Averaging the Taos and Peñasco figures to obtain temperature and PE rates for the lower mountain area between the towns reveals a mean annual PE of 708.1 mm (27.8 in) and indicates that mean annual precipitation provides only about 49 percent of PE water needs for the area.

To check the accuracy of this figure, we calculated mean monthly and annual PE for each site and for the project area (average of all sites). Table 5 shows that mean minimum PE is 8.1 mm (0.3 in) in January for all sites, mean maximum PE ranges from 145.8 to 149.6 mm (5.7 to 5.8 in) in July, and mean annual PE ranges from 674.7 to 695.8 mm (26.4 to 27.3 in). Assuming mean annual precipitation is 345.4 mm (13.6 in), mean annual precipitation deficit at the sites ranges from 329.3 to 350.4 mm (12.8 to 13.7 in). In other words, mean annual precipitation provides 49.6 to 51.2 percent of PE needs at the sites. Taking an average of all sites to provide figures for the project area, mean minimum PE is 8.1 mm (0.3 in) in January, mean maximum PE is 147.8 mm (5.8 in) in July, and mean annual PE is 685.7 mm (27.1 in). Mean annual precipitation deficit is 340.3 mm (13.5 in), and mean annual precipitation provides 50.4 percent of PE needs for the project area. These figures are in substantial agreement with the Taos-Peñasco averages and demonstrate that annual precipitation is generally insufficient to provide for the PE needs of crop plants. Consequently, dry farming is normally unacceptable as an agricultural strategy, and farm/garden areas require supplemental water to produce crops.

Table 5. Mean potential evapotranspiration (PE) for each site

LA Number	Mean Potential Evapotranspiration (mm/in)													Mean Annual Precipitation Deficit	Percent of PE Provided by Annual Precipitation
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual		
3570	8.1 .3	11.2 .4	17.3 .7	33.5 1.3	89.6 3.5	113.3 4.4	149.6 5.9	133.8 5.3	74.2 2.9	41.1 1.6	14.7 .6	9.4 .4	695.8 27.3	350.4 13.7	49.6
2742	8.1 .3	11.2 .4	17.3 .7	33.5 1.3	89.1 3.5	112.0 4.4	148.8 5.8	133.3 5.2	73.6 2.9	40.9 1.6	14.7 .6	9.4 .4	691.9 27.1	346.7 13.5	49.9
70576	8.1 .3	11.2 .4	17.3 .7	33.0 1.3	88.6 3.5	111.5 4.4	148.3 5.8	132.8 5.2	73.4 2.9	40.6 1.6	14.7 .6	9.4 .4	688.9 27.1	343.5 13.5	50.1
70577	8.1 .3	11.2 .4	17.3 .7	32.7 1.3	87.9 3.5	111.0 4.4	147.8 5.8	132.3 5.2	73.1 2.9	40.4 1.6	14.5 .6	9.4 .4	685.7 27.1	340.3 13.5	50.4
71189	8.1 .3	10.9 .4	17.0 .7	32.0 1.2	85.8 3.4	109.2 4.3	145.8 5.7	130.5 5.1	71.9 2.8	39.6 1.5	14.5 .6	9.4 .4	674.7 26.4	329.3 12.8	51.2
71190	8.1 .3	10.9 .4	17.0 .7	32.0 1.2	85.8 3.4	109.2 4.3	145.8 5.7	130.5 5.1	71.9 2.8	39.6 1.5	14.5 .6	9.4 .4	674.7 26.4	329.3 12.8	51.2
Average all sites	8.1 .3	11.2 .4	17.3 .7	32.7 1.3	87.9 3.5	111.0 4.4	147.8 5.8	132.3 5.2	73.1 2.9	40.4 1.6	14.5 .6	9.4 .4	685.7 27.1	340.3 13.5	50.4

Length of Growing Season

The annual growing season is usually described in terms of the number of frost-free days, that is, days between the last occurrence of 0 degrees C (32 degrees F) in the spring and the first occurrence in the fall. Tuan et al. (1973:79) state:

> The frost-free season is a very liberal measure of the period available for plant growth. Growth does not normally happen below 40°-42° F, and the season with temperatures above this level is, of course, shorter than the frost-free season.
>
> There is a further complication, in that the temperatures upon which the frost-free season is based are normally measured six feet above the ground in a standard meteorological instrument shelter. Frost occurs closer to the ground, where many crops grow, later in spring and earlier in fall, than at the six foot level.

Thus, the actual growing season, conditioned by temperatures higher than freezing and by proximity to the ground surface, will often be shorter than the length of the frost-free season. Further, temperatures fall an average of 0.1 degree C (3 degrees F) for each 305 m (1,000 ft) increase in elevation, so that the frost-free season shortens with increased elevation.

Tuan et al. (1973:87) show that Taos, the nearest weather station, has an average 140 frost-free days annually. The average last date of killing frost in the spring is May 10. However, recorded dates of last killing frost range from April 18 to June 23, a span of 66 days (Tuan et al. 1973:88, 95). The average first date of killing frost in the fall is about October 1, but recorded dates range from September 9 to October 29, a span of 50 days (Tuan et al. 1973:89, 95). The close of the frost-free season is slightly more reliable than the opening, indicating that length of growing season is more strongly conditioned by spring weather than fall weather. These dates agree with those of Maker et al. (1974:7), who list Taos as having an average 140-day frost-free season, with average dates of last and first killing frost on May 17 and October 4. The midpoint of the season is between July 19 and 25, during the July-August rainy season. Cordell (1979a:71) shows Taos with 145 frost-free days, but with considerable variability about the mean. However, her data, which span the years from 1893 to 1930, never show a negative departure from the mean of more than 25 days. Using her mean figure, the frost-free season was never shorter than 120 days.

Because the Pot Creek project area is 70 to 130 m (230 to 430 ft) higher than Taos, we would expect its frost-free season to be shorter. This is confirmed by Edwards et al. (1987), who state that the frost-free season in the vicinity of LA 71189 and LA 71190, the highest sites, averages 120 days, and 130 days at the other sites. Hacker and Carleton (1982) state that the soil survey unit that includes LA 71189 and LA 71190 has 110 to 135 frost-free days (midpoint, 122.5 days), while the unit that includes the other sites has 120 to 140 frost-free days (midpoint, 130 days). Interestingly, TES unit 84, which follows the floodplains of Rito de la Olla, Rio Grande del Rancho, and Bear Wallow canyon, has an average of only 80 frost-free days (Edwards et al. 1987:72). No explanation for this phenomenon is given, but it is probably the result of cold-air drainage and "the tendency of cold, dry, dense air to collect in the hollows" (Tuan et al. 1973:79). Tuan et al. (1973:79) include sheltered valleys as one of the topographic situations that "introduces departures from the average conditions of a region." With regard to short frost-free seasons, Tuan et al. (1973:80) state, "A more significant feature is this: the shorter the average length of the frost-free season, the greater the variation in length from year to year. This makes agriculture at higher elevations a very hazardous enterprise."

One obvious conclusion to be drawn is that the floodplains of the rivers, which are the best locations of agricultural activities in the project area because of precipitation deficits and the need for supplemental water, have the shortest and most variable growing seasons. Conversely, the alluvial fans above the floodplains, where the growing season is longer and less variable, are less suitable agricultural locations because of the water deficit.

Soils

Hacker and Carleton's (1982) soil survey identified two soil associations in the project area. The two southern sites, LA 71189 and LA 71190, are within one association, and the remaining four sites are within the other association. Edwards et al. (1987) recognize four TES units in the area. The sites are in three units. Since TES units are defined by the interaction of soil, climate, and vegetation, they are not identical to the soil associations. However, descriptions of soils in the TES units are similar to the soil associations, and they provide complementary information.

LA 2742 and LA 3570 are within TES unit 159. Soils in the unit are described as very gravelly, sandy loams whose residual parent material is derived from conglomerate and sandstone. Rock fragments comprise 40 to 70 percent of the A horizon and 5 to 65 percent of lower horizons. Bedrock occurs below 50 cm (20 in). The soils are found on hillsides with 15 to 80 percent slopes. Mean annual soil temperature is 9 degrees C (48.2 degrees F). Mean summer soil temperature is not available (Edwards et al. 1987:132). Hacker and Carleton (1982:18) identify the soils as part of the Devisadero-Rock outcrop complex and describe them as moderately deep, gravelly loams over gravelly clay formed in colluvium and residuum of sandstone and shale. Runoff is medium, and the erosion hazard is moderate to high. "The moderate to high erosion hazard, the rock outcrops, and the steep slopes severely limit the use of this map unit" (Hacker and Carleton 1982:18). Further, they note that the slope and shallow depth to bedrock place "severe restrictions" on buildings with basements or other subterranean excavations (Hacker and Carleton 1982:150).

Hacker and Carleton (1982) show LA 70577 in the Devisadero-Rock outcrop complex. Edwards et al. (1987:116) show the site in TES unit 145, whose soils are described as fine, deep, mixed loams derived from parent material of various sources, principally mixed alluvium and eolian sands. They occur on nearly flat, elevated plains. Rock fragments make up 0 to 30 percent of the A and B horizons, and bedrock is deeper than 50 cm (20 in). Mean annual soil temperature is 9 degrees C (48.2 degrees F). Mean summer soil temperature is not available.

LA 70576 is located at the boundary of TES units 145 and 84. Soils in unit 84, which is in the river floodplain, are deep, poorly to moderately well-drained loams formed in mixed alluvium on valley plains. Rock fragments comprise 0 to 25 percent of the A horizon. Bedrock is found well below 50 cm (20 in). Mean annual soil temperature is 4 degrees C (39.2 degrees F), less than half that of the other soil units in the area, and mean summer soil temperature is 8 degrees C (46.4 degrees F). Hacker and Carleton (1982:16-17) show LA 70576 at the boundary of the Devisadero-Rock outcrop complex and Cumulic Haplaquoll associations. The latter, which follows the floodplain in this area, is described as deep, stratified, gravelly, sandy loams and clay loams formed in mixed alluvium. Runoff and erosion hazard are slight. The seasonal water table rises to within 50 cm (20 in) of the surface.

Hacker and Carleton (1982:16) include LA 71189 and LA 71190 in the Cumulic Haplaquoll association. However, that description better fits the floodplain than the alluvial fan on which the sites are located, a conclusion confirmed by their description of the vegetation in this soil unit. Edwards et al. (1987:84) place the sites in TES unit 119, whose soils are identical to those in unit 145. Maker et al. (1974:30) specify that the soils in these units are the only soils in the area suitable for irrigation. They "require clearing and land leveling for irrigation. In addition, these irrigable lands are widely distributed and occur in relatively small and irregularly shaped tracts. These factors undoubtedly will place severe restrictions on the use of these lands for irrigation." No description of their erosion potential is available.

Soil descriptions support our concerns regarding length of growing season in that the floodplains, where supplemental water is immediately available, have much lower annual and summer soil temperatures than the adjacent alluvial fans. These data suggest that floodplain agriculture was not likely to yield consistently viable crops.

Vegetation

Vegetation in TES unit 159 around LA 2742 and LA 3570 is a forest community of piñon (20 percent) and juniper (15 to 20 percent) with an understory of big sagebrush (6 percent) and grasses such as blue and sideoats grama (4 to 6 percent) and New Mexico feathergrass (6 percent). TES unit 145, near LA 70577, supports a similar community of piñon (20 percent) and juniper (15 to 20 percent). Big sagebrush covers the wide plain east of the site and overall comprises 20 percent of the unit vegetation. Blue grama (15 percent) makes up most of the remaining understory. In TES unit 119, near LA 71189 and LA 71190, piñon dominates the forest community (40 percent), followed by big sagebrush (15 percent), juniper (5 to 10 percent), and blue grama (5 percent). Finally, TES unit 84 in the river floodplains is dominated by a riparian community of Kentucky bluegrass (30 percent), sedges (20 percent), and dense stands of willow. Blue spruce, Douglas fir, narrowleaf cottonwood, and thinleaf alder are common, particularly along Rito de la Olla and the upper portion of Rio Grande del Rancho, and can comprise over half of the vegetation in the unit (Edwards et al. 1987:73, 85, 117, 133).

CULTURAL ENVIRONMENT

Jeffrey L. Boyer

Because no preceramic sites were investigated during the Pot Creek project, the following culture history of the area focuses on the Puebloan (Anasazi) and Historic periods. The reader is referred to Cordell (1979a), Stuart and Gauthier (1981), and Young and Lawrence (1988) for more detailed regional syntheses.

Previous Research

Archaeological research in the Rio Grande del Rancho area has a long history. Bandelier (Lange and Riley 1966) noted the presence of several ruins in the Ranchos de Taos area, including the pueblo at Llano Quemado that was partly excavated in 1920 by J. A. Jeançon (LA 1892). Jeançon (1929:6) was the first to describe the large pueblo at Pot Creek, which he called "one of the largest adobe-walled remains the writer has seen in the Southwest." In contrast, the Llano ruin, which Jeançon chose to study, was apparently a much smaller pueblo, what would later be called a unit-type pueblo, common during the Pot Creek phase (Jeançon 1929:27-28). However, since only part of the site was excavated, its actual size remains unknown.

In 1956, Blumenschein (1956:55-56) reported that the Taos Archaeological Association had carried out excavation at Pot Creek Pueblo in 1953. She reported evidence of two occupations based on stratigraphic relations between structures and the presence of both Taos/Kwahe'e and Santa Fe Black-on-white pottery.

Also in 1956, the Museum of New Mexico carried out salvage excavations at two sites along Rio Grande del Rancho, LA 3569 and LA 3570 (Peckham and Reed 1963:2-4, 10). LA 3569 was a four-room jacal structure with possible associated pits. Based on pottery frequencies, it apparently dated to the Valdez phase. LA 3570 was a circular pithouse from the same phase (Peckham and Reed 1963:4-6, 10). The site was relocated by Boyer (1989a), and additional investigations were conducted as part of this project. The results are discussed below.

In 1968, Herold reported on a 1960 survey of the Rio Grande del Rancho canyon in which he located 110 archaeological sites. He classified these sites according to types of structures present and dated pottery groups ranging from A.D. 1000 to 1875 (Herold 1968). In the same volume, Luebben (1968) reported on the 1960 excavations at TA-32, a pithouse site approximately 0.75 mile (1.2 km) north of Fort Burgwin on the second terrace east of the river.

Also in 1968, the results of Wetherington's excavations at Pot Creek Pueblo were published (Wetherington 1968). This seminal volume not only describes the pueblo, its features, and artifacts, but also defines Puebloan occupational phases in the Taos Valley--a sequence still used today--and attempts to relate what was then known of Taos archaeology to the rest of the upper Rio Grande.

In 1969 and 1975, Vickery reported on excavations at TA-26, a small pueblo near Pot Creek (Vickery 1969; Ottaway 1975). In 1976, Green reported on excavations at Valdez-phase sites near Pot Creek and Ranchos de Taos (Green 1976). In the same year, Morenon et al. (1976) discussed a noncollection survey and the utility of predictive models in the Tres Ritos Hills. These issues were again addressed by Morenon and Quinn (1977) after further survey.

Research in the 1980s by the staff and students of Fort Burgwin Research Center has led to new information on the region, including lithic procurement (Newman 1983), plant use (Baker 1983), painted ceramics (Proctor-Weiss 1983), agriculture (Woosley 1983), and settlement (Woosley 1986; Kriebel 1983), as well as a preliminary synthesis (Woosley 1980a, 1986). Unfortunately, most of this material is in the form of individual papers, and a unified collection and synthesis of the material awaits further work. Crown (1987, 1990, 1991; Crown and Kohler 1990) has begun to summarize data from the Fort Burgwin excavations.

In 1985, Kit Carson Memorial Foundation conducted a survey of the highway right-of-way from Ranchos de Taos to Fort Burgwin for a seismic mapping project (Boyer 1985b). The survey recorded four sites, one of which, LA 51673, was tested during the survey and testing phase of this project (Boyer 1989a). The others were avoided.

Finally, in 1985, Boyer searched the files of the Fort Burgwin Research Center for site locations in the area. The region, including the Ranchos de Taos-Talpa-Llano Quemado area, has been intensively surveyed by the staff and students of the center. However, site files and maps for the Rio Grande de Ranchos Valley have been removed from the center, and only sites on Fort Burgwin property and those located by Herold (1968) are on currently accessible maps.

Puebloan Period (ca. A.D. 1100-1600)

Most discussions of the Puebloan period in the Taos region stress the scarcity of Basketmaker and early Puebloan sites (Wetherington 1968; Cordell 1979a, 1984). Remains from Basketmaker and early Puebloan periods (Basketmaker II and III and Pueblo I in the Pecos classification; late Preceramic and early Developmental in Wendorf and Reed's [1955] classification) are identified by isolated projectile points on sites with later components (e.g., Rudecoff 1982; Boyer 1984). While Woosley (1980a, 1986) discusses the Developmental period in Taos prehistory, no sites have been chronometrically dated to the first half of the period (A.D. 600-900). Rudecoff (1982:55) states that "evidence of Basketmaker II occupation . . . is indicated at six of the seven testing project sites" along the Taos-Black Lake transmission line corridor. She also states,

> Assuming the projectile point identifications and temporal assignments are correct, the Taos-Black Lake testing program sites were primarily the scene of Basketmaker II occupation. Only Basketmaker II occupations are evidenced at the Moreno Valley sites and the Taos Plateau site. Later Anasazi occupation appears to be restricted to the Taos Canyon sites, although Basketmaker occupation is also evidenced at these locations. (Rudecoff 1982:47)

That is, of the six sites, Basketmaker II projectile points were the only temporally diagnostic artifacts at three, while the other three included later (post-A.D. 900) Anasazi points, and two had both prehistoric and historic sherds. Rudecoff interprets this to show multiple components but does not consider the possibility of artifact curation or reuse. Except for the projectile points, there is no direct evidence of Basketmaker components, and none of the sites revealed evidence of component superimposition. No structural remains were discovered. Rudecoff (1982:4) asserts that her sites refute the notion that the area was not occupied by Anasazi before the Valdez-phase (A.D. 1100 to about 1225) pithouse sites. In fact, her sites show that, if they were occupied by Basketmaker Anasazi, the occupants pursued a mobile, hunting-gathering lifestyle that, except for their projectile points, would be difficult to distinguish from that of Archaic hunter-gatherers. However, the presence of "Basketmaker" projectile points is not adequate to prove that Basketmaker Anasazi as identified near Albuquerque, the Four Corners region, and the Cimarron area inhabited the Taos Valley. It also does not support an indigenous cultural development from Archaic hunter-gatherers through Basketmaker into Puebloan Anasazi (Rudecoff 1982:55), nor does it explain a 250- to 300-year hiatus between the end of the Basketmaker II period and the beginning of the Puebloan Anasazi occupation.

The earliest Puebloan period securely identified in the Taos area is called the Valdez phase. This phase is commonly dated to A.D. 1000-1200 by the presence of Taos/Kwahe'e Black-on-white, which has been dendrochronologically cross-dated to A.D. 900-1200 (Wetherington 1968; Green 1976). However, because only three Valdez-phase sites have yielded tree-ring or archaeomagnetic dates before A.D. 1100 (Crown 1990), and radiocarbon dates do not consistently agree with tree-ring and archaeomagnetic dates (this report), the phase probably dates between A.D. 1100 and about 1225. Sites from this phase commonly consist of deep pithouses with associated surface work areas and/or surface rooms of jacal or adobe construction (Green 1976; Cordell 1979a:36; Woosley 1980a:8). The largest pithouse "village," LA 9201, consists of only five scattered pithouses near the Rio Hondo (Loose 1974). Most sites contain one or two pithouses. In the southern Taos area, pithouses tend to be round (Luebben 1968; Green 1976; Woosley 1980a), while those in the Arroyo Seco-Arroyo Hondo area, to the north, are usually square or rectangular (Blumenschein 1956, 1958, 1963; Wolfman et al. 1965; Loose 1974). Greiser et al. (1990b:25-26, 48-49) suggest a possible correlation between this pattern and Taos Pueblo traditions that tell of different groups of people inhabiting the northern and southern parts of the valley prior to aggregation that resulted in the formation of Taos Pueblo. Associated ceramic types include a plain, incised, or neck-banded gray or brown ware known as Taos Gray and a mineral-painted type known locally as Taos Black-on-white. Distinctions between this type and the contemporaneous and more widespread Kwahe'e Black-on-white are minimal and perhaps meaningless (Lent 1991). We have chosen to call the mineral-painted type Taos (see Ceramic Analysis). A detailed examination of Valdez-phase dating, architecture, and site structure is presented in Occupying the Taos Frontier: The Valdez Phase and Valdez-Phase Sites.

The Pot Creek phase is usually dated to A.D. 1200-1250 by the presence of Santa Fe Black-on-white sherds and vessels. Crown (1990) suggests dates between A.D. 1225 and 1260 or 1270 based on tree-ring dates from Pot Creek Pueblo. This phase was apparently characterized by population aggregation in numerous small "unit pueblos." Examples have been recorded in the Taos, Arroyo Seco-Arroyo Hondo, Arroyo Miranda, Ranchos de Taos-Llano Quemado-Talpa, and Pot Creek-Rio Grande del Rancho areas, although only two such sites, LA 1892 and TA-26, have been excavated (Jeançon 1929; Vickery 1969; Ottaway 1975). In this phase, kivas are first present at some sites (Vickery 1969; Wetherington 1968), although Crown (1990) suggests that kivas may have been present at some Valdez-phase sites. Taos/Kwahe'e Black-on-white remained a part of the ceramic assemblage, while incised and neck-banded Taos Gray was largely replaced by a corrugated variety.

The Talpa phase is usually dated to A.D. 1250-1350 by the presence of Talpa Black-on-white, apparently a local coarse sand-tempered variety of Santa Fe Black-on-white. Crown (1990) suggests beginning dates of A.D. 1260 or 1270 for the phase. During this phase, population aggregation continued, apparently at the expense of the earlier small pueblos. The phase is known only from excavations at Pot Creek Pueblo, a large pueblo first occupied in the Pot Creek phase that grew to perhaps 300 ground-floor rooms during the Talpa phase. Crown (1991:310) describes the growth of Pot Creek Pueblo as growth

> by accretion, with no clear ground plan except for the existence of spatially separate room blocks of contiguous adobe rooms surrounding an open plaza area. Each room block developed into a series of structures 1-3 rooms deep, generally enclosing a central courtyard, with an opening to the east and/or south. Up to the 1300s, the isolated mounds surrounded a large outdoor activity area with an opening to the south and east. The eastern entry effectively was blocked by the construction of unit 4 in the

first decades of the 1300s, creating an essentially enclosed plaza area surrounded by room blocks.

The trend of population aggregation and site growth may have set the stage for the establishment of the large pueblos at Cornfield Taos and Old Picuris. The end of the phase is established by the abandonment of Pot Creek Pueblo, which Wetherington (1968) assumes to have occurred before A.D. 1350 because neither Biscuit nor glaze-painted ceramics are present at the site. Based on tree-ring data, Crown (1990:71; 1991:305) places the end dates at the site near the 1320s, although she states, "Given the use life [of rooms] of 19 years and an absence of any cutting dates at the site past A.D. 1319, it is unlikely that Pot Creek Pueblo was occupied beyond 1340" (Crown 1991:305).

The final phase in the prehistoric Puebloan period is unnamed but roughly corresponds to Dick's (1965) Vadito phase, dated from A.D. 1375 to 1500 from excavations at Old Picuris. These years are similar to those given by Ellis and Brody (1964) for the occupation of Cornfield Taos. Several other sites in the Taos area apparently date to this phase on the basis of polychrome and glazed ceramics. Like those of the preceding phase, the sites are generally large, although some smaller sites are known. A site near Llano Quemado (LA 1892) may be ancestral to one kiva group at Taos Pueblo, while the very large El Pueblito site (LA 12741) in Arroyo Hondo is considered ancestral by another kiva, as is Pot Creek Pueblo. Cornfield Taos is evidently directly ancestral to Taos Pueblo. On the basis of ceramics, Ellis and Brody (1964) contend that Cornfield Taos was first occupied about A.D. 1300 or 1350 and abandoned about A.D. 1450, when Taos Pueblo was occupied. Greiser et al. (1990b:51-53) disagree. Citing Taos oral tradition and descriptions of the village as first seen by the Spaniards, particularly the Castañeda chronicle of the Coronado expedition (Winship 1990:137), they side with Bandelier (1890), Miller (1898), Harrington (1906), and Hodge (1912) in suggesting that Cornfield Taos was occupied until the time of the entradas in the late 1500s. They do not suggest a date when the Indians moved from Cornfield to Taos and admit that "unless more data could be collected from Cornfield Taos and the modern pueblo, the issue of residency at the time of contact will remain unsolved" (Greiser et al. 1990b:53). Taos Pueblo is, of course, still occupied (Boyer 1986b; Greiser et al. 1990b).

Historic Period (A.D. 1500-present)

The presence of historic Plains Indian groups in the Taos area is recorded in early historic Spanish documents and the archaeological record. Spielmann's (1983) research indicates that economic interactions between Plains and Pueblo Indians were relatively minor before the late A.D. 1400s but increased considerably after that time. Archaeologically, this is reflected in a relative scarcity of materials indicating Puebloan use of Plains resources at Pot Creek Pueblo (Wetherington 1968:63-65; Girard 1986:11). Chemical analyses of bison bones from the site may demonstrate that they were not obtained from the plains east of the mountains and may have come from the Taos Valley (John Speth, personal communication). Certainly, by the time of Spanish contact in 1540, the Indians of Taos Pueblo had established relations with Apaches, Kiowas, Utes, and other groups, facilitated by annual trade fairs at the pueblo. Girard (1986:11) notes that "Apachean groups from the Plains (Querechos, Vaqueros) regularly visited Taos Pueblo at the time of initial Spanish contact and there is some indication that some Apachean groups (Quinia Apaches, Apaches del Acho may have resided permanently in the Taos area during the seventeenth century."

In the 1620s, a band of "Apaches de Quinia," apparently led by a man named Quinia, had *rancherías* near Taos and to the west (Girard 1988:14). Gunnerson and Gunnerson (1988:3) identify the Quinia Apaches as ancestors of the Jicarillas. Knowledge of the relationships between the Apaches and the Taos is not detailed, but by 1640, the Taos were comfortable enough with their neighbors to move to the El Cuartelejo Apache settlements in western Kansas. They returned in 1662, and J. Gunnerson (1974:90; cited by Girard [1988]) suggests that the 22 years spent in Kansas provided influences that resulted in the semisedentary lifestyle of the eastern Apaches, reported after that time.

Although Pueblo-Apache relations apparently suffered from the Hispanic presence in New Mexico in the late 1600s, El Cuartelejo was again visited by Puebloans, this time from Picuris, in 1696. In an aborted attempt to secure their return, Governor de Vargas observed Apaches living on Rio Colorado (Red River), north of Taos, probably in the vicinity of the modern village of Questa (Gunnerson and Gunnerson 1988:4). When Juan de Ulibarrí set out for Kansas in 1706 to bring back the Picuris, he encountered Apaches living on the eastern side of the mountains in semisedentary communities and farming maize, beans, and pumpkins. These and other eastern Apaches were the victims of Ute and Comanche raids, a trend that continued for several decades (Girard 1988:15-16). Finally, "Comanche attacks drove the Jicarilla Apaches westward from the Cimarron area in the Sangre de Cristo Mountains in the 1720's. Some Jicarillas settled in the mountain valleys between Taos and Picuris" (Girard 1988:11). This resettlement was encouraged by Fray Mirabel, Franciscan missionary to Taos Pueblo, who was also given permission to serve the Apaches. Gunnerson and Gunnerson (1988:6) contend that the focus of resettlement was the Las Trampas area, now known as Ranchos de Taos, where a mission was established for the Apaches in 1727 or 1733. However, Girard (1988:18) notes that the actual location of this mission, which has sometimes been identified with the church of San Francisco de Asís in Ranchos de Taos, is not clearly revealed in the documents. The mission may have been on Rio Colorado, north of Taos, where Apaches had been living for some time (Hackett 1937:403). Bishop Tamarón, in the report of his 1760 *visitación* to the churches in New Spain, observed "encampments of peaceful infidel Apache Indians" near the mouth of Arroyo Miranda, south of Rio de las Trampas (Rio Grande del Rancho) (Adams 1954:215-217). They were gathered there to avail themselves of Spanish protection from the Comanches. Girard (1988:19-20) considers it important that Fray Domínguez's 1776 report described Spanish settlement in the Las Trampas Valley but did not mention the presence of Apaches. On the other hand, the Taos Indians continued to maintain a hold on the valley. In 1715, the Taos were consulted about the Cristobal de la Serna grant and stated that they were farming in the valley but would harvest their crops and not farm there again (Martinez 1968:5). In 1760, Bishop Tamerón noted the ranch of a wealthy Taos Indian in the valley near the Apache settlements, and in the 1780s, the villagers of San Francisco de las Trampas were allowed to farm the wide floodplain by its rightful owners, the Taos Indians (Girard 1988:20). Wroth (1979:16) notes that oral tradition in Ranchos de Taos ascribes community origin to Taos Indians who returned to the pueblo or joined the Hispanic community. Plains Indian influence, probably Apache, is also noted.

In 1799, the Jicarilla Apaches were specializing in agriculture and tanning hides in the valleys between Taos and Picuris (Girard 1988:21-22). The Apaches may have largely left the open Taos Valley for more hidden locations in the Tres Ritos Hills. In part, this may have been due to the 1787 peace treaty between the Spaniards and the Comanches, which deprived the Jicarillas of their former ally against the Comanches.

By the American occupation in 1846, the Jicarillas had established a homeland range in and along the eastern slopes of the Sangre de Cristos from San Miguel on the Pecos to Taos (Gunnerson and Gunnerson 1988:7-8). In 1852, after quelling the 1847 insurrection, which began in Taos, American troops quartered in Taos moved to a new post, Cantonment Burgwin. The cantonment was on the wagon road from Picuris to Taos at the junction of Rito de la Olla and Rio Grande del Rancho. Its primary function was to keep the road, which led to Santa Fe and Fort Union, open and free from Indian attack and to act as a deterrent to Indian hostilities in the valley (Murphy 1973). Its location, then, reflects Apache settlement in the mountains south of Taos. In spite of many skirmishes and a major battle with soldiers in 1854, Jicarilla Apaches remained in the Taos area until at least 1880, when a reservation was established west of Tierra Amarilla (Gunnerson and Gunnerson 1988:9).

Girard (1988) describes investigations at 17 sites thought to represent the Jicarilla occupation of the Rio Grande del Rancho drainage. The sites are clustered in five "areas" from the mouths of the Rio Chiquito and Rio Grande del Rancho canyons to the mouth of the Rito de la Olla canyon. They are characteristically identified by micaceous pottery made by the Apaches, but ground and chipped stone artifacts and Euroamerican items are usually present as well. The results of Girard's investigations (personal communication), intended to clarify the nature of the Apachean occupation of the region, have been inconclusive. Micaceous vessels were also made at Picuris and Taos pueblos (and still are) and perhaps by Hispanic villagers. Further, they were widely traded and used by each of these groups. Therefore, their presence on a site indicates only a historic occupation, and it remains difficult to identify a site as Apachean. The problem is compounded by the fact that, of the 17 sites, only two had definable features. One site had a small, shallow roasting pit, while the other contained remains of a pole and brush shelter and a sandstone chimney over a hearth. Girard (1988:131) suggests that several structures were present or planned at the site, but it was occupied for only a short time. Although archaeomagnetic and tree-ring dates indicate that the site was used in the 1860s, when Jicarilla Apaches occupied the region, Girard (1988:131) is not able on the basis of the artifacts, structural remains, or site structure to definitely identify the site as Apachean. If a site with this kind of data potential cannot be positively identified as Apachean, it is not surprising that micaceous sherd scatters are difficult to categorize by cultural origin. This issue is discussed in more detail in the description of LA 70576.

Cordell (1979a:121-129) suggests four important research questions for the historic period: the development of Hispanic settlement, the use of the region for subsistence and commercial pastoralism, the introduction and development of logging and logging railroads, and late nineteenth- and early twentieth-century mining activities. Mining was apparently not a significant activity in the Tres Ritos Hills (Schilling 1960), although several small coal mines in the Rio Fernando and Rio Pueblo de Picuris canyons supplied coal for blacksmiths and home fuel into the 1900s (Boyer 1989b, 1991a).

First seen by the Spaniards in 1540, the pueblo of Taos became the location of a Franciscan mission in the early 1600s, and a community of Spanish settlers began to grow in the valley. The settlers first lived just outside the pueblo walls for security but soon moved out into the valley (Jenkins 1966). Small agricultural villages grew up along many river valleys in northern New Mexico, and missions were established at most pueblos. The increasing presence of Spanish culture in northern New Mexico produced dramatic changes in the region's cultural and economic fabric (Cordell 1979a:103; Cordell 1979b:150-151). The Spaniards brought to the area a different religion, social organization, and economy, including domestic animals and new plant foods. Their arrival would also create drastic changes in the lives of the native inhabitants.

Although Bunting (1964:3) stated that "all through the Colonial and Mexican periods, settlers were grouped closely in villages," other historians are adamant in denying the historical importance of the plaza community, insisting that the normal pattern of Hispanic settlement was one of dispersion. Snow (1979:46) points out that this pattern began at the first settlement at San Gabriel: "Except for Santa Fe . . . the 17th century rural landscape lacked villages; community organization existed, if at all, only in a very limited fashion" (see also Simmons 1969).

Snow contends (1979:47) that after the Spanish reconquest of the 1690s,

> the major thrust of 18th century settlement was toward the limits of effective military and administrative control and toward unoccupied agricultural lands, primarily in the narrow tributaries of the Rio Grande and the Chama River.
>
> Ranchos proliferated as individuals applied for and received

minuscule *mercedes* for themselves, their relatives and friends in more and more marginal locations along such tributaries.

Simmons (1969) cites two reasons for this situation: a decrease in the Indian population, resulting in a reduced labor force, and an increase in Hispanic immigration, resulting in population growth.

However, by the last half of the eighteenth century, the largely rural population increasingly left their isolated ranches and congregated in small fortified plazas (Simmons 1969). The impetus for this significant settlement change was a period of intense hostility on the part of mobile Indian groups such as Apaches, Navajos, Utes, and particularly Comanches. In 1772, Governor Mendinueta recommended to the viceroy that the scattered settlers be made to form plaza communities. Four years later, Antonio de Bonilla described the New Mexican settlements as scattered and unable to defend themselves. Finally, in 1778, a council held in Chihuahua recommended swift action to unify the New Mexican population. As a result, Comandante Teodoro de Croix ordered Governor de Anza to "regularize" settlements by making the populace live in compact units. Although Simmons (1969) contends that by 1780, considerable progress had been made toward that end, in 1782, Father Morfí complained that the settlers still preferred dispersed settlement, a preference that he blamed on their moral depravity (Simmons 1977). Nonetheless, by 1830, Josiah Gregg found that the New Mexicans commonly lived in fortified houses or villages resembling Moorish castles, "whether from motive of pride or fear of savages" (Gregg 1954:144). Thus, Snow (1979:50) argues: "Rural Hispano villages in New Mexico are a product, for the most part, of the last quarter of the 18th century and of the 19th century. If we examine destructive pressures since 1848, we are looking at village or community structures which, in most cases, were less than 75 years in existence prior to that date--a space of only two generations or so."

A dispersed settlement pattern is characteristic of the furthest reaches of frontier expansion. Casagrande et al. (1964:311-315) discuss characteristic features of colonization settlement in what they call a "colonization gradient." This gradient consists of five kinds of settlement that have both temporal and spatial aspects. The differences between these types and levels of settlement have to do with the strength of their direct ties to the core area from which colonization emanates and their levels of internal integration. Casagrande et al. (1964:314) state, "There are many zones within an area of colonization characterized by the presence of scattered houses. This feature we have termed *dispersed settlement*. Although formally these individual households may be included in a larger corporate entity such as a municipality, they are but loosely integrated within it."

Taking a synchronic view, these levels of settlement on the frontier may characterize communities at a particular point in time. Thus, we can compare Casagrande's lower levels of settlement with Snow's (1979:46) statement that "the 17th century rural landscape lacked villages; community organization existed, if at all, only in a very limited fashion," a situation he believes continued into the late 1700s. Taking both of these into account, we can conclude that Spanish colonial settlement in north-central New Mexico reflected the far reaches of frontier expansion. As Casagrande et al. (1964:314-315) state, "As one proceeds away from the metropolitan area toward the frontier, settlements diverge more and more from those of the settled area." This is seen in the 1779 Miera y Pacheco map of the Interior Province of New Mexico (Adams and Chávez 1956:2-4), in which the Alcaldía de la Villa de Santa Cruz de la Cañada consisted of the *villa*, several *pueblos de los indios cristianos*, and numerous small communities characterized by *poblaciones dispersas de los españoles*. In the Alcaldía de Taos, Miera y Pacheco noted only the location of Taos Pueblo and a community of dispersed *españoles* along Rio de las Trampas, now known as Rio Grande del Rancho. In northern Spanish colonial New Mexico, then, we can postulate that Santa Fe, as territorial capital, was a frontier town; Santa Cruz de la Cañada served was a nucleated settlement; the mission communities were seminucleated settlements; and until the late 1700s, there were many dispersed settlements such as that on Rio de las Trampas. This situation changed in the late 1700s and early 1800s as seminucleated settlements began to grow in the province in response to the change to a plaza-centered settlement pattern.

These patterns can be seen in the Rio de las Trampas/Rio Grande del Rancho valley, where Wroth (1979) has documented settlement on the Durán y Chávez and Cristobal de la Serna grant, stretching from the Taos Pueblo league to the Picuris Range. The Durán y Chávez grant was given to Don Fernando Durán y Chávez before the Pueblo Revolt in 1680. Durán y Chávez survived the revolt but did not reoccupy the grant and, in 1715, the grant was reassigned to Cristobal de la Serna (Martinez 1968:3-5). Serna may never have actually lived on the grant, and in 1724 his heirs sold it to Diego Romero, known locally as El Coyote (Wroth 1979:16). Romero apparently lived on Rio Fernando at the northern end of the grant, and his son, Francisco Xavier, El Talache (the pickaxe) homesteaded Rio de las Trampas. How his presence affected the Jicarilla Apaches living in the area is not known. Wroth (1979:16) notes that by 1765 a community known as San Francisco de la Trampas was established on Rio de las Trampas. However, the settlement pattern was one of scattered ranches spread along waterways close to arable lands. When Bishop Tamarón crossed Rio de las Trampas in 1760, he noted the presence of several acequias, apparently watering the lands of these ranches. Following the Comanche raid on the Villalpando hacienda in 1760 and other attacks, including a 1770 Comanche raid on a plaza, perhaps in the El Prado area, the settlers temporarily abandoned their homes and lands, and by 1776, all Hispanic settlers in the Taos Valley were living at Taos Pueblo (Adams 1954; Adams and Chávez 1956; Jenkins 1966). However, Fray Domínguez noted that the settlers were building a plaza "in the *cañada* where their farms are," probably referring to Rio de las Trampas (Adams and Chávez 1956:113). The plaza may have been completed around 1779 (Wroth 1979:17-18), although it is not present on the Miera y Pacheco map.

The case of San Francisco de las Trampas points out the temporal aspect of the colonization gradient. As Casagrande et al. (1964:314) point out,

> These several types of settlements may be seen as graded stages in a developmental process by which the area of colonization may achieve a higher level of socio-cultural integration. . . . The stages in this process, as we have labeled them, are then: dispersed settlement, semi-nucleated settlement, nucleated settlement, frontier town, and possibly eventually, entrepot. But while these are recognizable stages in a general developmental process, not every individual settlement goes through all of them.

At San Francisco de las Trampas, the community changed from a scatter of ranchos along Rio de las Trampas before the severe Comanche raids of the 1760s and 1770s to a plaza-centered community in the 1780s and later. This community was the origin and center of settlement in the Talpa, Llano Quemado, and Cordillera area. Even today, however, the structure of this community, now know as Ranchos de Taos, is informal and centers around the church, the school, the acequias, and the community's involvement in regional political issues. Thus, the community never moved past the level of a seminucleated settlement.

Wroth (1979:18) contends that this was the beginning of the small plazas in the Taos Valley. He argues that Hispanic population growth and the decreased Comanche threat after de Anza's 1786 treaty with Cuerno Verde encouraged a return to a dispersed settlement pattern. Unlike the former pattern, however, nineteenth-century dispersed settlement was plaza-centered. Farms and ranches were scattered around small plazas that gave the settlers a community focus and identity. Thus, while the 1779 Miera y Pacheco map shows Hispanic settlement focused at Taos Pueblo and along Rio de las Trampas, in the course of only 17 years, settlement shifted to plaza-centered communities: a 1796 census of the valley lists six plazas with a combined population of 779.

There is no record of formal settlement in the Talpa area before the early 1800s. The community is not listed in the 1796 census. However, its location at the mouth of Rio Chiquito, an important tributary of Rio Grande de Ranchos and the source of several acequias, suggests that the area should have seen early settlement as population outgrew the confines of the plaza at San Francisco de las Trampas. According to Baxter (1990:100-120), settlement and irrigation agriculture in the Serna grant has a complex history. It is clear, however, that settlers were present on the eastern side of the grant in the Talpa area after about 1795. Water and land requests and disputes suggest that until the 1820s, settlement in the Rio Chiquito area consisted of scattered farms and ranches.

In 1823, Manuel Lucero, a wealthy landowner and perhaps son of Bernardo Lucero, who was given a large tract of land crossing Rio de las Trampas and Rio Chiquito in 1795, donated a plot of land to 20 settlers. They were to build a plaza on the land, which was 105 *varas* on a side and situated "between the public road ('*camino* *real'*) and the Rio Chiquito" (Wroth 1979:24; Baxter 1990:106). This is the location of the now largely abandoned Talpa plaza. By 1827, the settlers of the plaza and "its respective ranches" numbered "a little more than 30 heads of families" (Wroth 1979:24). That same year, Don Bernardo Lujan petitioned Don Antonio José Martínez, the parish priest in Taos, asking that the community be allowed to recognize as its patroness Nuestra Señora de San Juan de los Lagos. In the petition, Lujan identified himself as a "citizen of the department of Rio Chiquito, Barrio of San Francisco de las Trampas" (Wroth 1979:76). The chapel was built the following year. Wroth (1979:24) states that the chapel was built in the center of the plaza. However, this contradicts information from local residents, who said the plaza was north of the chapel. This situation would not be unusual since the plaza predated the chapel: an obvious example is Nuestra Señora de Guadalupe in Taos.

Although identified with Nuestra Señora de San Juan, the community continued to be called Rio Chiquito well into the 1900s. The name Talpa, officially bestowed on the post office in 1904 (Dike 1958-59), came from a family chapel dedicated to Nuestra Señora de Talpa, named for the famous shrine in Talpa, Jalisco, Mexico (Wroth 1979:26-27, 45).

The Pot Creek project area is located within the Rancho del Rio Grande grant, which was given to 11 petitioners, mostly descendants of Diego Romero, in 1795 (Martinez 1968:6-7). The grant, which consists almost entirely of mountains and narrow river valleys, was apparently intended to protect the sources of irrigation water from Rio Grande del Rancho and Rio Chiquito from being usurped by settlers (Bowden 1969:985-986). It was primarily used for grazing, hunting, and wood cutting by the residents of the adjacent Serna grant (Bowden 1969:986). There is no record of Hispanic settlement on the Rancho del Rio Grande grant. Wroth (1979:26) suggests that this was because water resources within the grant were considered inadequate for cultivation. Perhaps more important, the grant was never intended for settlement, but to protect the interests of the downstream residents. A third and probably equally important reason may have been that the grant lands were occupied by Jicarilla Apaches.

In 1827, Nicolas Sandoval, angered because a grant request for lands north of Taos was denied, registered a parcel of farmland on "vacant public land having no owner in the part and place of the Rio Grande" (Wroth 1979:25; Bowden 1969:987). Bowden (1969:987) does not identify the location of this tract but suggests that it was near the confluence of Rio Chiquito and Rio Grande del Rancho. This seems unlikely because the community of Rio Chiquito (Talpa) already included a plaza and surrounding ranches (Wroth 1979:24). Wroth (1979:25) identifies the tract as the junction of Rito de la Olla and Rio Grande del Rancho, the location of Pot Creek Pueblo and, later, of Cantonment Burgwin. Whether Sandoval did not know of the 1795 grant or assumed it was invalid because it was never settled is not known. The latter seems more likely, since by the time Sandoval and 10 other petitioners officially requested the land in the form of a grant in 1837, he was living in Rio Chiquito. He must have at least known of if not participated in grazing, hunting, and wood cutting on the grant. He must also have known the true origin of the grant since he assured Governor Pérez in the grant petition,

> We are not asking for even the smallest portion of the waters for irrigation of our fields, we satisfying ourselves with a few springs of water found at the top of the mountain, and which not running to any collection of water are only absorbed in the mountain. We obligate ourselves by force of our labor to take these waters out of insalubrity and put them in use for the irrigation of our lands. (Wroth 1979:75)

A committee appointed by the *ayuntamiento* of Taos recommended that the request be denied on three grounds. First, the land in question was already in use as pasturage by the 300 families of the Serna grant. Further, the small springs referred to in the petition were judged too small to supply adequate irrigation water, and the petitioners would be forced to appropriate water from the rivers that was already fully assigned to the landowners below. Finally, the committee pointed out that the land in question had already been granted in 1795 and that a new grant would be illegal. Sandoval's request was denied, ending the only official attempt to settle on the Rancho del Rio Grande grant (Bowden 1969:988-989; Wroth 1979:26).

Archaeological remains apparently associated with pastoral activities have been recorded on the "floor" of the Taos plateau, in the mountains west of the valley between Tres Piedras and Tierra Amarilla, and in the Tres Ritos Hills. On the plateau floor, sheep camps tend to be scatters of artifacts, primarily steel food and tobacco cans, occasionally with small clearings in the brush or rock structures that may have been pens (Boyer 1983; 1984; 1985a; 1988). Since the herders used wagons or tents, habitation structures are not known. Warm-weather camps in the mountains are marked by the presence of carved aspen trees near large meadows. The carvings usually consist of Hispanic names, place names, and dates in the warm months (May through September) of the 1900s through the 1930s. Reoccurrence of names with dates indicates the continued use of areas, and the distribution of names indicates a degree of territoriality in pastoral land use (Boyer 1987). During the early 1900s, the Bond-McCarthy Company secured grazing rights on the Rancho del Rio Grande grant and set up allotments for its *partidarios*, shepherds who worked for the company for a share of the lamp crop. Jack Boyer (personal communication) states that in the 1920s and 1930s, the company hired a bear hunter named McMullen to kill grizzly bears that harassed the *partidarios* and keep down the black bear population. McMullen's home was a cabin at the mouth of Rito de la Olla, where the townsite of Pot Creek would later be, but he apparently had other cabins in the surrounding mountains.

"Anglos" (that is, non-Hispanic or non-Indian people of European descent) began moving into the area in the early 1800s, and Taos became a central location for a group of independent mountain men and trappers known as the Taos Trappers (Weber 1968). Because of the trappers, Taos was also an important center for merchants and traders and an important port for Santa Fe Trail merchandise.

One important Anglo site from this period in the Rio Grande del Rancho Valley is St. Vrain's Mill--a mill, distillery, and trading post owned by the firm of Roland and Workman in the 1830s. Before leaving for California, Roland and Workman were major competitors of Simeon Turley in the production of wheat flour and wheat whiskey ("Taos Lightning"). The mill was used by Ceran St. Vrain, a partner of the Bent brothers, from 1849 to 1864, when the structure burned and St. Vrain built his famous mill at Mora. Archaeological evidence suggests that the mill was rebuilt after 1864 and used until about 1903, when it was again abandoned (Newman et al. n.d.).

Another significant site in the valley is Cantonment Burgwin. Established in 1852 by Col. E. V. Sumner, the post was named for Capt. John H. Burgwin, who was killed at Taos Pueblo in the 1847 revolt. The location of Cantonment Burgwin, near the confluence of the Rito de la Olla and Rio Grande del Rancho, was chosen by Sumner for several reasons. First, it was on the Picuris-Taos wagon road, the main road connecting Santa Fe, the territorial capital, and Fort Union, the regional military center, with Taos and Colorado (Wheeler 1881:Atlas Sheet No. 69D). An 1853 map of the post shows the road on the west side of the post between the buildings and Rio Grande del Rancho (Murphy 1973:23). Second, it was only 8 km (5 mi) to the nearest saloon, in Ranchos de Taos (Murphy 1973:7). Third, the area was well-watered, and pasture was abundant. Constructed of vertical logs, the main compound enclosed two *plazuelas* separated by a row of rooms and connected by a single passageway. Outbuildings housed the hospital (Woosley 1980b), the officers' quarters, the guard house, and the laundresses' rooms (Murphy 1973:9).

Although the soldiers of Cantonment Burgwin were involved in several minor campaigns against hostile Utes and Apaches (Murphy 1973:10, 12-13), their most noteworthy battle took place in March 1854 at a place called Cieneguilla. Murphy (1973) incorrectly places the battle site along Cieneguilla Creek, in the Moreno Valley, east of the post. The battlefield was actually in Cieneguilla Canyon, on the west side of the Picuris Mountains, near present-day Pilar (Jack K. Boyer research files; Jack Boyer n.d.; Frazer 1980). There, 60 soldiers rode into an Apache *ranchería*. In the ensuing battle, 22 soldiers were killed and 23 wounded, and 45 horses were lost. The Apaches moved west to the mountains near Ojo Caliente. A campaign to punish the Indians was unsuccessful (Jack Boyer n.d.; Frazer 1980; Murphy 1973), as were others that followed. The remaining years at Cantonment Burgwin were characterized by drunkenness, dissension, and desertion. Costs of maintaining the post climbed with every year, and in 1856, only four years after its establishment, the post was in sore need of repair. By 1859, the buildings were considered too dangerous for occupation, and Cantonment Burgwin was officially closed in 1860. Wheeler (1881:326) referred to the post as "Old Camp Burgwin."

Directly across NM 518 from Fort Burgwin, as the site is now known, is the site of Pot Creek. Now on property owned by Southern Methodist University, the small town is completely abandoned, but it was once a thriving community of houses and sawmills. The community grew as a result of commercial logging in the nearby mountains encouraged by Ralph Rounds, a Kansas lumberman who acquired the Rancho del Rio Grande grant from the Santa Barbara Tie and Pole Company. This subsidiary of the Santa Fe Railroad had moved onto the grant from the Peñasco-Tres Ritos area, where it was cutting trees for railroad ties (Gjevre 1984:44-46). In the 1950s, Rounds traded most of the grant to Carson National Forest, except for a small parcel including Pot Creek Pueblo and Cantonment Burgwin, which was given to Southern Methodist University.

RESEARCH DESIGN: STUDYING THE TAOS FRONTIER

Jeffrey L. Boyer

This chapter is revised from the Pot Creek data recovery plan (Boyer 1989a). The reader can refer to the plan for arguments linking the research design to the specific sites.

Previous Models of Land Use in the Taos Area

Three major arguments or "models" of prehistoric land use have been used to characterize the Anasazi occupation of the Taos area. They all arise from individual acceptance or rejection of the concept of the area being on the Anasazi "margin" or "periphery." This concept is usually attributed to Wendorf and Reed (1955), although they do not actually propose it. This section will briefly discuss the models and their proponents.

Peckham, Reed, and Herald: Development on the Late Anasazi Periphery

Peckham and Reed (1963) and Herold (1968) wholeheartedly accept the "periphery" concept. In 1956, Peckham and Reed excavated three sites in the Ranchos de Taos-Rio Grande del Rancho area. Two were pithouses, and one was a jacal structure, all apparently dating to the Valdez phase. One, LA 3570, was investigated during this project and is described below. In their summary of the work, Peckham and Reed describe the Taos Anasazi as having a "provincial character" with a "less than metropolitan flavor." This may, they suggest, be the result of geographical barriers isolating the Taos area from the Anasazi mainstream. But, "it is equally possible that the slow development of the Taos area may be attributed to the fact that it lies 'at the end of the line' " (Peckham and Reed 1963:24).

Herold conducted an extensive survey of the parallel Rio Grande del Rancho and Arroyo Miranda drainages, the first systematic investigation of site distribution in the region. The survey recorded ceramic types, structures, stone tools, and some associated features at 110 sites. From the association of ceramic types, structures, and site locations, Herold proposes a cultural sequence for the area that employs "pottery groups." These groups and their attendant sites make up what would later be called "phases" that are essentially identical to those proposed by Wetherington (1968) (Herold 1968:26-33).

Herold (1968:18) describes Puebloan development in the Taos area as "characterized to an outstanding degree by *lateness* and *peripheral nature*. Although much Pueblo settlement centers in the upper Rio Grande today, during most of its prehistory, this area was on the *fringe* of the Pueblo world" (my emphasis). Later, he states that the Taos Anasazi were a "late peripheral branch of the Rio Grande Anasazi" (Herold 1968:39).

This peripheral condition was responsible, Herold (1968:39-40) maintains, for two "obvious" characteristics of Puebloan life in the area: individualism and conservatism. Both are visible primarily in the use, throughout the sequence, of isolated pithouses and pithouse villages and in the local production of both mineral- and carbon-painted pottery. Thus, the continued presence of pithouses represents both an "individualistic way of life," apparently in contrast to community-focused life in the pueblos, and conservative holdovers from an earlier era. The same is held to be true for the presence of local mineral-painted pottery throughout the sequence and for production of a "local variety" of Santa Fe Black-on-white.

Wetherington: Isolated Development of a Cultural Enclave

As discussed above, Wetherington's excavations at Pot Creek Pueblo, combined with the results of other excavations and Herold's survey, resulted in the development of the local phase sequence still in use today. Although Wetherington (1968) appears to accept the basic concept of the Anasazi periphery, he takes a stand midway between Peckham, Reed, and Herold's unquestioning acceptance and later ideas rejecting the concept. Specifically, Wetherington argues that the Taos area should be viewed as a "district," an area of "archaeologically distinct cultural developments" (Wetherington 1968:73). He goes on to say,

> Throughout most of its prehistoric development, the Northern Rio Grande Region appears to have been an effective cultural-ecological isolate. Within this geographically and culturally defined region, there developed local enclaves of culture which in turn became isolated.
>
> The Taos District is perhaps the most notable of these. This locally distinct cultural manifestation appears to have had its own evolution while participating in a generalized Rio Grande pattern. (Wetherington 1968:94)

This local evolution is visible in several areas (Wetherington 1968:97-99), including the local manufacture of ceramics related to but distinctive from those to the south, a temporal lag in shifting from subsurface to surface construction, the presence of certain architectural features, and contact with Plains tribes. Thus, Wetherington's argument can be contrasted with that of Peckham, Reed, and Herold, who see Taos's peripheral location as resulting in "backwater" Anasazi, having some trappings of their more "cosmopolitan" (Herold's term) southern relatives, but without their sophistication. Wetherington, on the other hand, sees geographical barriers creating an Anasazi enclave that responded to its isolation by pursuing its own distinctive cultural development.

Quinn and Woosley: A Continuum of Development within the Local Sequence

In 1973, Quinn conducted an intensive survey of the Arroyo Miranda drainage. Her thesis (Quinn 1980) describes her work and its results. In it, she criticizes "accepted views" of the Taos Anasazi that rely on the "periphery" concept for not considering human-environmental interactions and focusing on research that only supports preconceptions (Quinn 1980:136-137). She contends that her research shows that the local Anasazi practiced a "dynamic, balanced economy" using both natural and agricultural resources and that settlement actually reflects this balance. She writes: "The prehistoric record in the Taos Valley indicates that while it bears similarities to other Anasazi regions, it is also significantly different and therefore should be considered as a region unto itself rather than an example of peripheral development of the Rio Grande Anasazi (Quinn 1980:148).

From 1978 to 1983, Woosley directed the archaeology program at the Fort Burgwin Research Center. Her program involved excavations at selected sites and a large-scale intensive survey of the Rio Grande del Rancho drainage, adjacent hills and valleys, and a large area surrounding Talpa, Ranchos de Taos, Llano Quemado, and Los Cordovas. A detailed synthesis of the data gathered during these projects has not been forthcoming; Woosley has discussed preliminary results in articles and papers. The exception to this is a small booklet (Woosley 1980a) in which she outlines her perspective on Taos archaeology. In a section on the Rio Grande Anasazi, she makes an impassioned argument against the concept of the Anasazi periphery. She observes that the abilities of the Taos Anasazi in architecture and construction and in ceramic manufacture show that they were as capable and advanced as their southern neighbors (Woosley 1980a:19-21). She concludes: "In summary, we are not dealing with a culturally retarded group of people living on the margin of the mainstream of Anasazi development. Rather, we observe a people who successfully adapted to their own set of circumstances, a local situation distinct from that faced by other Anasazi groups (Woosley 1980a:21). Elsewhere, she states: "Changing settlement distribution, increasing complexity in site organization, as well as alterations in material culture assemblages such as ceramics can all be easily interpreted in terms of a Taos District continuum of gradual cultural development within the local Anasazi sequence" (Woosley 1986:161).

Thus, Woosley concurs with Wetherington that the Taos Anasazi pursued their own cultural development. However, she completely rejects the notions of isolation and periphery, preferring instead to view the local Anasazi as another group of Anasazi adapting to its own situation, as did all the other "variants" in the northern Southwest.

All of these arguments attempt to explain the characteristics of Taos archaeology. Each model has different preconceptions, assumptions, and interpretations of what are in essence the same data. The question, then, remains whether the Taos area was a frontier and whether the local archaeology represents the development of adaptation to the frontier. What is lacking thus far is a consideration of the nature of frontiers and frontier adaptations and a consistent evaluation of archaeological remains in that light.

Frontiers

Before the question of the Anasazi frontier can be adequately addressed, it is necessary to describe the characteristics and processual conditions of frontiers. Frontiers can be described both as geographical locations and as processes. Lewis (1977:153) defines a frontier as an area where the "outer edge of an expanding society adapts to conditions of attenuated contact with the homeland and the physical conditions of a new environment." This compliments the definition of Casagrande et al. (1964:282), which sees the colonization of a frontier as a "creative process" because the colonists must learn to adapt to new ecological, social, and economic arrangements.

Kristof (1959:269-270) describes a frontier as "an area which was part of a whole, specifically that part which was ahead of the hinterland." Thus, "the frontier was not the end ('tail') but rather the beginning ('forehead') of the expanding society." Kristof then contrasts frontiers with boundaries. "Boundary" is "a term appropriate to the present-day concept of the state" (Kristof 1959:270). Frontiers, he argues, are "outer-oriented," their focus of attention pointing toward outlying areas. Further, as "zone(s) of transition from the sphere (ecumene) of one way of life to another," they provide "an excellent opportunity for mutual interpenetration and sway" because neither the colonists nor the natives are likely to be fully assimilated to their respective sociocultural milieus. The actual degree of "interpenetration" depends on the degree of sociocultural similarity between colonist and native and the attractiveness of one way of life to the practitioners of the other (Kristof 1959:273). Conversely, boundaries are "inner-oriented," representing well-established political limits, "the outer line of effective control exercised by the central government." Boundaries are separating factors, impeding integration. Further, a boundary "does not exist in nature or by itself. It owes its existence to man." Boundaries are, therefore, anthropocentrically defined (Kristof 1959:272-273, 275, 277).

Kristof's distinction between frontiers and boundaries is echoed by Juteson and Hampson (1985), who distinguish between open and closed systems. An open system has semipermeable boundaries that are "zones of low interaction" between the system under study and an adjacent system. In contrast, closed systems have impermeable boundaries, delineating "zones of no interaction" (Juteson and Hampson 1985:16-17). They do not use the term "boundary" in the Kristofian sense, but rather to indicate the edge of systemic expansion. Consequently, they argue, boundary definition is problem-related and may be specified by density of population, economic interaction, or another variables, and that "such definitions need not coincide" (Juteson and Hampson 1985:17). They maintain that cultural systems are open systems, but that normative cultural descriptions have treated them as closed, obscuring the interaction that occurs in frontiers and is often a harbinger of social change (Juteson and Hampson 1985:17-19; Green and Perlman 1985:9-10).

Frontiers have a variety of geographical and processual conditions and characteristics, although Kristof (1959:273) argues that "it is difficult to pinpoint essential features of the frontier which are universally valid." This is perhaps due to the variety of social systems that may be involved in frontier colonization. For instance, Lewis (1973:96) first insisted that at least a chiefdom level of society is necessary to organize penetration and successful settlement on a frontier. Later, he maintains that "the intrusive society must possess a level of sociocultural integration equivalent to that of a stratified society or state as defined by Fried." (Lewis 1977:162). On the other hand, Kristof's distinction between frontiers and boundaries implies that any expanding society will have a frontier area while actual boundaries are characteristics of states. Further, the series of papers edited by Green and Perlman (1985) includes studies of frontier expansion by hunter-gatherers, pastoralists, and subsistence farmers, as well as by complex societies. The dichotomy may be resolved by noting that Lewis is concerned with formally *organized* colonization, an issue not raised by Kristof or Green and Perlman (see also Wells 1973:7).

This diversity notwithstanding, certain characteristics stand out from various studies of frontiers. It should be noted that these studies have concentrated on complex societies, often at a state level. The degree to which their results are applicable to less complex societies is not clear. The basic characteristics of frontiers are: (1) spatial and temporal settlement impermanence as the frontier expands (Lewis 1977:153, 155; Casagrande et al. 1964:283; Gilpin 1982:558-559); (2) characteristic settlement patterns that Casagrande et al. (1964:311-314) term "colonization gradients," Wells (1973:9-10) refers to as "geographic zones" of habitation, and Lewis (1977:153, 155) observes are replicated as the frontier expands; and (3) a sudden loss of sociocultural complexity on the part of the colonists (Doolittle 1973:32; Lewis 1973:94; Lewis 1977:155; Gilpin 1982:558) resulting from relative isolation and attenuation of trade and communication with the parent society.

Given this loss of complexity, Lewis (1977:163) argues that the colonists must still maintain a level of sociocultural complexity that is higher than that of the natives. Casagrande et al. (1964:283) contend that the colonists must be technologically "superior" to the natives and have a power advantage over them, though not necessarily a larger population, if the frontier is to become established and survive. In other words, the colonists must be able to adapt successfully to the economic exploitation of their new environment within their sociocultural parameters. In that light, Lewis (1977:163) also observes that the new environment must meet two conditions. It must be amenable to subsistence and perhaps commercial exploitation by the colonists, and it must not contain natural barriers that would preclude access to all parts of the potential frontier. Presumably, the actual frontier would be restricted by such barriers, at least temporarily.

A final characteristic of frontiers is a situation of prolonged contact, albeit attenuated, between the colonists and the parent society (Lewis 1977:154). Casagrande et al. (1964:282) maintain that colonization is a "selective process" in terms of demographics and particularly features of the parent society to be maintained on the frontier. They state that successful colonization must include communication with the parent society and a continuity of tradition from it. Colonization may be viewed as "a conscious effort to reconstitute a familiar way of life in an alien land" (Casagrande et al. 1964:283). Wells (1973:8) states that "several types of communication are involved in all frontier systems. The most important, however, are economic, political, religious, and prestige communication." Wells also contends that types of communication are more important than channels or routes. Lewis (1977:163) states that contact with the parent society usually involves a type of exchange that he calls "vertical specialization," in which raw materials move from the frontier and manufactured goods and services move to the frontier. Doolittle (1973:33) cautions, however, that a distinction must be made between "colonial" and "pioneer" societies on the frontier. The former are almost completely dependent on the mother culture for economic and technological support, while the latter are largely self-sufficient. The actual differences between the two are relative, and he argues that they are a function of rapidity in communication and transportation. Doolittle's two types of frontier societies mirror Steffen's (1980) distinction between "cosmopolitan" and "insular" frontiers. Cosmopolitan frontiers are associated with what Steffen calls "modal" change in sociocultural structure and practice, "an altered overt manifestation of practice or belief whose conceptual foundation remained the same" (Steffen 1980:xi). In contrast, insular frontiers are associated with "fundamental" change that "involved the replacement or significant alteration of the very assumption upon which given practices were based" (Steffen 1980:xi):

> I am suggesting that there is a direct relation between the degree of insularity and the level of change experienced on any given frontier. Insularity, in turn, can be determined by analyzing the nature and number of interacting links between a given frontier and its parent culture. If the interacting links were few in number or nonexistent, the frontier was insulated to a significant degree from its parent culture, a condition that increased the importance of the indigenous environment as a causative factor for change. Therefore, frontiers with inherent environments that called for change and with few interacting links were more likely to experience fundamental change. And, of course, the reverse was true for those frontiers that possessed many interacting links with their parent cultures. (Steffen 1980:xi)

It is important, in this regard, to recall Kristof's (1959:273) observation that frontiers are integrating factors, zones of transition and sociocultural assimilation. Thus, economic and social interaction are found both between the frontier and the parent society and between the frontier and the natives.

The Archaeology of the Frontier

The research conducted during this data recovery project focused on evaluating the Taos area as a sociocultural frontier. Clearly, the number and nature of the sites examined during data recovery does not allow a full or intensive examination of the wide range of archaeological implications that could be derived from a frontier perspective. Still, it is anticipated that the sites will yield data of significant value in assessing the appropriateness of viewing the region as a frontier.

To relate the sites to a frontier perspective, it is necessary to postulate certain expectable conditions if the region was indeed a sociocultural frontier. The following discussion provides a series of archaeological expectations and data requirements based on the characteristics of frontiers discussed above.

Spatial and Temporal Impermanence

Expectations. Spatial and temporal impermanence carries with it two concepts: mobility and rapid change.

Regarding mobility, *it is expected that* (1) The number of "early" sites, those representing the initial years of colonization, should be higher than the number of later sites when the frontier becomes established. This is due to attempts by the colonists to find their places in a new environment. (2) Depending on how well the new environment can support their "traditional" economic pursuits, one can expect seasonal mobility between sites. (3) The "early" sites may have relatively short occupations. Those that do not may be placed near resources that would support long-term occupation.

Regarding rapid change, *it is expected that* (1) There will be relatively rapid changes in settlement sequences until the frontier becomes established. For instance, the time periods in the Wendorf and Reed classification range from 125 to 600 years, with an average of about 337.5 years. One would expect the length of phases in a frontier sequence to be much shorter if the changes reflected in the sequence came much faster. (2) In addition, one might expect the phases to get longer as the frontier becomes established, in response to closer ties with a more "stable" central area. If this does not happen, it may reflect continued instability on the frontier.

Data Requirements. The most pressing problem in Taos archaeology continues to be chronology. The accurate temporal placement of sites in the region is obviously necessary for examining the origins and subsequent development of the region's various occupations. But the use of chronometric techniques has not been consistent. Areal chronology continues to rely on the Wendorf and Reed classification and Wetherington's phase sequence. By concentrating on normative trait descriptions, these chronologies group sites together in broad temporal categories (a classic use of "closed system" modeling) but do not allow realistic discussions of site feature contemporaneity or relative association. Further, these chronologies continue to rely primarily on ceramic and architectural cross-dating and are difficult to alter in the face of new chronometric evidence. Nonetheless, they continue to be used despite these problems: witness Woosley's (1980a, 1986) discussions of the Developmental period in the Taos area, even though chronometric dating suggests that most if not all Valdez-phase sites date to the last one-sixth of the period.

Similarly, the subsequent Puebloan developments in the region are conceptualized using cross-dated phases that may obscure social and economic patterns within and between phases. At issue are why sites like Pot Creek Pueblo rose to such prominence during the Pot Creek phase, while other pueblos remained comparatively small; and why the very large El Pueblito site (LA 12741) has a ceramic assemblage dominated by Taos/Kwahe'e Black-on-white. Similar patterns are seen in the Talpa phase, when Pot Creek Pueblo reached its climax, and in the later Classic period. Without accurate chronometric data for site occupation and abandonment, it is not possible to determine whether these patterns represent contemporaneous colonization gradients or cycles of population aggregation and disintegration (sequential colonization gradients).

Finally, it should be noted that the archaeological phase sequence in common use is focused on the Puebloan occupation of the region. Wetherington (1968) was not convinced that the region was occupied at all before the Valdez phase. He essentially ignored developments beyond the end of the Talpa phase except to note that Pot Creek Pueblo was apparently ancestral to both Picuris and Taos Pueblos. Researchers attempting to deal with this have adopted Dick's (1965) Picuris-area Vadito phase to identify the years between the abandonment of Pot Creek Pueblo and the possible first occupation of Taos Pueblo (ca. A.D. 1325 and A.D. 1350-1450?), although that period has been only minimally investigated (Ellis and Brody 1964) and remains essentially unknown, and although there is little evidence that the events in the Picuris and Taos regions were identical or similar enough to warrant this adoption.

At issue here is the question of the applicability of Puebloan sequences for studying non-Puebloan residents of the region. Boyer (1986a:7) has contended:

> It is clear that archaeologists have assumed that adaptive strategies characterized by the development of increasingly complex social conditions which are manifested archaeologically by larger and larger sites

and more diverse artifactual assemblages indicating extensive exchange relationships were the normal and perhaps the only strategies at work and were characteristic of the human occupation of the region during their respective time periods.

But research has clearly shown the presence of nonsedentary, possibly nonagricultural residents in the region before (Renaud 1942, 1946; Hume 1973, 1974a and 1974b; Boyer 1984), during (Boyer 1986a), and after (Girard 1986, 1987a, 1987b, 1988) the prehistoric Puebloan occupation. Included here are sites possibly produced by historic Apachean groups. Accurate assessment of these non-Puebloan residents of the area is not possible within a chronology focused on Puebloan developments, since these sites will not fit into Puebloan phases. Chronometric dating of these sites is necessary to establish the timing of nonsedentary occupations of the region relative to themselves and to Puebloan and other groups and to discern patterns of land and resource use, social organization, and economy through time and across space. In the case of Apachean sites, these data are needed to evaluate the possible development of an Apachean frontier as Apache groups were forced to move into new areas, including the Taos region, in the eighteenth century.

Clearly, accurate chronometric dating of sites of all kinds is important for evaluating the Taos frontier. Accurate dating will require collecting materials for a variety of chronometric techniques, including archaeomagnetism, radiocarbon studies, dendrochronology, and obsidian hydration.

Some aspects of settlement could not be realistically investigated at the study sites. For instance, accurate definition of frontier "colonization gradients" (Casagrande et al. 1964:311-314) requires accurate chronometric dates and a knowledge of regional site distributions. The latter requires the results of intensive and extensive regional survey, such as that directed by Woosley in the Taos area. However, the results of Woosley's survey have not been forthcoming, and no other project to date has the same data potential. Thus, a systematic and realistic knowledge of regional site distributions is not presently attainable.

Still, at least two aspects of settlement can be used to identify characteristics of the sites and so to study their possible roles in frontier settlement: site function and seasonality. Site function can be inferred from site structure and activities performed on the site. Site structure can be determined by the kinds of features present on a site and the relationships between those features. Crown (1987:9) discusses the results of two studies of room function at Pot Creek Pueblo. One of these (Holschlag 1975) attempted to define household composition through architectural units and o evaluate changing household composition through time. But Crown (1987:10) notes, "Aspects of the internal organization of sites, including room function, have not been assessed for sites earlier than Pot Creek Pueblo." Particularly, Crown (1987:10) asserts that "the spatial and functional relationships between multiple pithouses at a single site and between these structures and outdoor activity areas have not been evaluated." It also may be said that the internal organizations of sites contemporaneous with or later than Pot Creek Pueblo have not been studied. Site structure can be addressed by studying (1) the spatial configuration of the site, including site location and the relationships between features; (2) types of features present and evidence of remodeling and superimposition of features; and (3) dates of construction, use, and abandonment of features.

On-site activities are defined through studies of site features and artifacts, particularly of patterns in relationships between artifacts and features and within the assemblages. Gilman's (1987) research suggests that both pithouses and pueblos are used primarily for non-growing season habitation, in the Southwest, the cold winter months. If she is right, then study of these types of sites should reveal features and artifact assemblages reflecting a range of habitation activities, including food storage, processing, cooking, and consumption and craft production, such as pottery or weaving. Conversely, agricultural sites would be expected to show a narrower range of activities, with a focus on agricultural activities and less evidence of long-term use. So, storage and the use of stored foods should be only minimally represented, if at all, and artifacts may show expedient use of lithic and ceramic materials as well as gatherable food resources.

Gilman (1987) discusses seasonality at length. Her research suggests that pithouse dwellers are at least biseasonally mobile and that the pithouse, far from being a semipermanent dwelling, as often assumed, is a cold-weather habitation structure. Thus, during the warm growing season months, the pithouse dwellers move out of the structure and occupy other sites near specific resource areas. Apparently, these sites are not likely to be pithouses. Still, Gilman (1987:552-553) notes that the pithouse site itself may be occupied during warm months if it is near a resource that the occupants would exploit. In that case, activities move from within the pithouse during cold weather to exterior surface activity areas in at least some warm months. Included in the latter should be surface structures that could serve as shelters and storage locations. Gilman states (1987:560) that her research "suggests that architecture, in the forms of pit structures and, to a lesser degree, pueblos, is more directly indicative of seasonality than are some traditional measures," such as pollen, macrobotanical, and faunal studies.

While the pithouse sites should show evidence of cold-weather habitation, if Gilman is correct, the possible agricultural sites should show evidence of warm-weather use. "The biseasonal settlement pattern [of pueblo dwellers], then, should take the form of sites near agricultural fields and more permanent sites in other locations" (Gilman 1987:555). Structural remains may be present and more substantial than at similar sites associated with pithouses, but less substantial than a pueblo. If structural remains are not present, then the site may not have been associated with a pueblo, may have been too close to a pueblo to warrant a structure, may have been quickly abandoned as an unsuitable location, or may not in fact have been a field site.

Finally, seasonality is not an issue that has been addressed at Apachean sites.

Little is known of Apachean adaptation in the areas of mobility and subsistence after the Apache were forced off the plains and into the mountains and river valleys. Given some seasonal movement in response to resource availability, it may also be assumed that relations between features and artifacts at sites such as LA 70576 may provide information useful in determining when the site was occupied and for how long.

Presence of a "Colonization Gradient"

Expectations. As the frontier becomes established, one would expect to see the development of a characteristic settlement pattern resembling that observed by Casagrande et al. As discussed above, this pattern may be one of those characteristics derived from complex, state-level societies. Whether such a pattern will exist in less complex frontiers is not clear and is one focus of this research. The pattern defined by Casagrande et al. (1964:311-314) includes these basic types of settlements: (1) entrepot: a community in the core area that is the connecting link between the core area and the frontier; (2) frontier town: a supply center and social, economic, political, and religious focus for surrounding portions of the frontier; (3) nucleated settlement: a politically and socially organized cluster of households linked to the frontier town; (4) seminucleated settlement: a group of households characterized by a lack of integration; (5) dispersed settlement: an area of scattered homesteads.

These settlements may be viewed both synchronically and diachronically.

In a synchronic view, *one would expect that* (1) At any time, there should be a diversity of site types across a region representing the various levels of the colonization gradient. But
(2) In the early stages of colonization, this diversity may not be easily evident, and settlement may be characterized by the "lower" or less-aggregated types of settlement.

In a diachronic view, *one would expect that* (1) The development of a regional gradient through time should be visible by studying site distributions through time. (2) A diachronic view also may be taken of a particular site, since it is expected that some sites will change through time from "lower" to "higher" levels in the gradient, perhaps reaching the level of a frontier town.

Further, *it is expected that*, as a site moves to successively "higher" levels in the gradient, it becomes more closely tied to regional exchange and communication systems. This should be reflected in increasing diversity within the site, especially in architecture and material goods, including ceramics, lithic materials, and exotic items. The site also should show the effects of population aggregation, including growth in site size, changing social relations within the community, and changing subsistence needs. The latter may be visible in the presence of agricultural features, including field sites and water/soil control features.

Data Requirements. To assess adequately the synchronic view of settlement, one needs a knowledge of regional site distributions and accurate chronometric dates to evaluate association and contemporaneity. The same is true to assess the first expectation of a diachronic view.

To assess the second expectation of a diachronic view, one needs (1) a knowledge of site structure through time: the number, diversity, association, and condition of features within a site, and (2) accurate chronometric dates of site features. This is necessary to establish contemporaneity, remodeling episodes and dates of use and abandonment of the features.

These data will allow an evaluation of the level to which a site may have risen within the gradient. Besides these, information on artifactual diversity is necessary to address on-site activities.

Clearly, the sites in this project will not allow either a synchronic or diachronic view of regional colonization gradients. The sites are too few in number, too localized geographically, and too different in nature to support intensive regional study. But they may be useful in studying the second approach to a diachronic view, that involved in understanding changes in individual sites. In this way, they may provide information that, when combined with information from other sites in the region, will be useful in compiling the regional database necessary for determining whether colonization gradients were present and, therefore, whether the area was a frontier.

Sudden Loss of Sociocultural Complexity

Expectations. The conditions of isolation and attenuated contact with the core area result in a loss of sociocultural complexity on the part of the colonists. This should take the form of reversion to sociocultural traits that are simpler to use and maintain and probably came from earlier periods in the group's sociocultural development.

Specifically, *it is expected that* (1) if a parent society usually lives in aggregated communities, the colonists will initially revert to dispersed settlement as they attempt to adapt to the new environment. (2) This should be accompanied by reversion to earlier or simpler architectural forms, especially those amenable to use in dispersed settlement. For instance, Gilman (1987:545) discusses the case of the Iraqw of northern Tanzania who live in above-ground, jacal-like structures, unless colonizing a new area. In that situation, they live in pit structures. (3) Further, there should be an adaptation of simpler economic/subsistence patterns in accordance with dispersed settlement and new ecological arrangements. (4) There should be, initially at least, a relatively great decrease in diversity of material goods, coupled with increased use of local materials. For instance, ceramics should show a low diversity of types with few types being used for all vessel forms. Similarly, lithic artifacts should show few material types to make a wide range of tools. (5) As the frontier is being established, there should be considerable interaction with the natives and other nearby groups. Initially, this interaction should be informal, perhaps involving mostly foodstuffs and access to local materials.

Data Requirements. Evaluation of these expectations will require (1) accurate chronometric dating of sites and features; (2) site structural analyses to define sites, and (3) artifactual analyses focused on assemblage diversity and the use of diverse materials through time. This will include analyses of subsistence-related items (pollen, macrobotanical samples, fauna) to assess the relative importance of gathered versus agricultural products. The relative frequencies of these products through time will point to the actual viability of the economic base of the parent society on the frontier.

Continued Contact with Parent Society

Expectations. Prolonged contact with the parent society is a necessity if the frontier is to survive as a viable part of the expanding society. *It is expected that* evidence should be found of both (1) a continuation of life styles from the parent society; and (2) selection of sociocultural features.

Specifically, *it is expected that* the nature of contact with the parent society should be reflected in (1) evidence that "early" sites represent isolation and cultural attenuation, as discussed above. (2) Through time, as the frontier becomes established and communication and exchange lines become operational, the sites should reflect closer ties to the communication and exchange systems, and a greater diversity of material goods. For instance, ceramics may show more types and a stronger correlation between types and vessel forms than at earlier sites. Lithic artifacts may show the use of more material types and a stronger correlation between material types and tool types. Also, there may be evidence of more formalized relations with natives and others, especially at "higher" level sites in the gradient. At "lower" levels, such interaction may remain relatively informal. For instance, it seems possible that the presence of significant amounts of exotic faunal materials, such as bison, may signal the initiation of more formalized relationships with Plains groups. It would be interesting to compare Spielmann's (1983) contention that trade with Plains tribes was infrequent until the late 1400s, with significant amounts of trade wares and exotic goods at Classic-period sites. (3) It is expected that evidence should be found of "vertical specialization," of raw materials leaving the frontier and manufactured goods and services coming into the frontier. (4) Finally, it is expected that attempts to maintain sociocultural continuity on the frontier will result in the greatest continuity in areas such as architectural tradition, styles in material goods, though not necessarily in raw materials, and ceremonial life. The least continuity is expected in areas such as subsistence and social organization, which would need to be more malleable under conditions of adaptation.

Data Requirements. Data needed to assess levels of contact with a parent society include accurate chronometric dating site structural analyses, and artifactual analyses. Regarding vertical specialization, it will be necessary to define what types of materials, raw and manufactured, are passing between the frontier and the core area. For raw materials, this may be possible through study of reported sites in the core area to identify those items that probably or possibly came from frontier areas. On the other side, goods from the core area should include decorated ceramics, exotic lithic materials, either raw or as tool preforms, and other exotic items such as shell or turquoise. Analyses of subsistence-related items and samples should provide important data on the economic viability of the frontier. This would include the presence of exotic faunal materials, especially in significant amounts.

VALDEZ-PHASE SITES

LA 2742
(AR-03-02-05-51?)

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LA 2742 was on a terrace flanking the east edge of the Rio Grande del Rancho Valley at an elevation of 2,194 m. The site covered an area of 3,124 sq m and was first recorded by Peckham, probably in the 1950s. Though a pithouse was noted and a sample of pottery collected, no map or detailed description from this visit exist. Haecker (1985) relocated the site in 1985. Finding only two sherds, he concluded that it had been destroyed by erosion and erection of a transmission line pole. During a subsequent survey, Boyer (1989a) noted a sherd and lithic artifact scatter. He also found that the *Carson National Forest Cultural Resources Atlas* cross-referenced LA 2742 with forest site AR-03-02-05-57. The atlas location for the site is 335 m north of NM 518, but close examination revealed no cultural properties in that area (Boyer 1985b, 1989a). A later atlas notation suggested that LA 2742 might actually be AR-03-02-05-51, a pithouse site whose location is closer to LA 2742. Thus, forest site AR-03-02-05-57 was mislocated or does not exist.

Boyer (1989a) described LA 2742 as a scatter of pottery and lithic artifacts atop a terrace overlooking Rio Grande del Rancho. No obvious pithouse depression was noted, but artifacts were eroding into the roadcut in two places: near a transmission line pole on top of the terrace, and at the base of the terrace on the north edge of the scatter. Because of the site's history and ambiguous nature, it was tested to identify the context of cultural remains found during survey.

Test pits were excavated in areas where artifacts were eroding into the road cut. The first test pit was placed atop the terrace near the transmission line pole. Artifacts were eroding from a zone 50 cm below the surface in this area, suggesting the presence of a buried feature. Cultural materials found to a depth of 1.3 m suggested that this was the location of the pithouse initially recorded at the site. The second test pit examined an area 15.5 m north of the first, where artifacts were eroding into the roadcut near the base of the terrace. Between 40 and 50 cm of cultural deposits were found, and this area was thought to represent a midden. As testing indicated that both a structure and refuse area existed within project limits at LA 2742, data recovery was initiated.

During excavation, LA 2742 was found to contain a pithouse and shallow midden in addition to a surface scatter of pottery and lithic artifacts (Fig. 3). Chronometric samples indicate that the structure was occupied in the A.D. 1100s and early 1200s, consistent with dates derived from pottery analysis. Though our initial impression was that less than half of the pithouse remained, during excavation we found that the structure

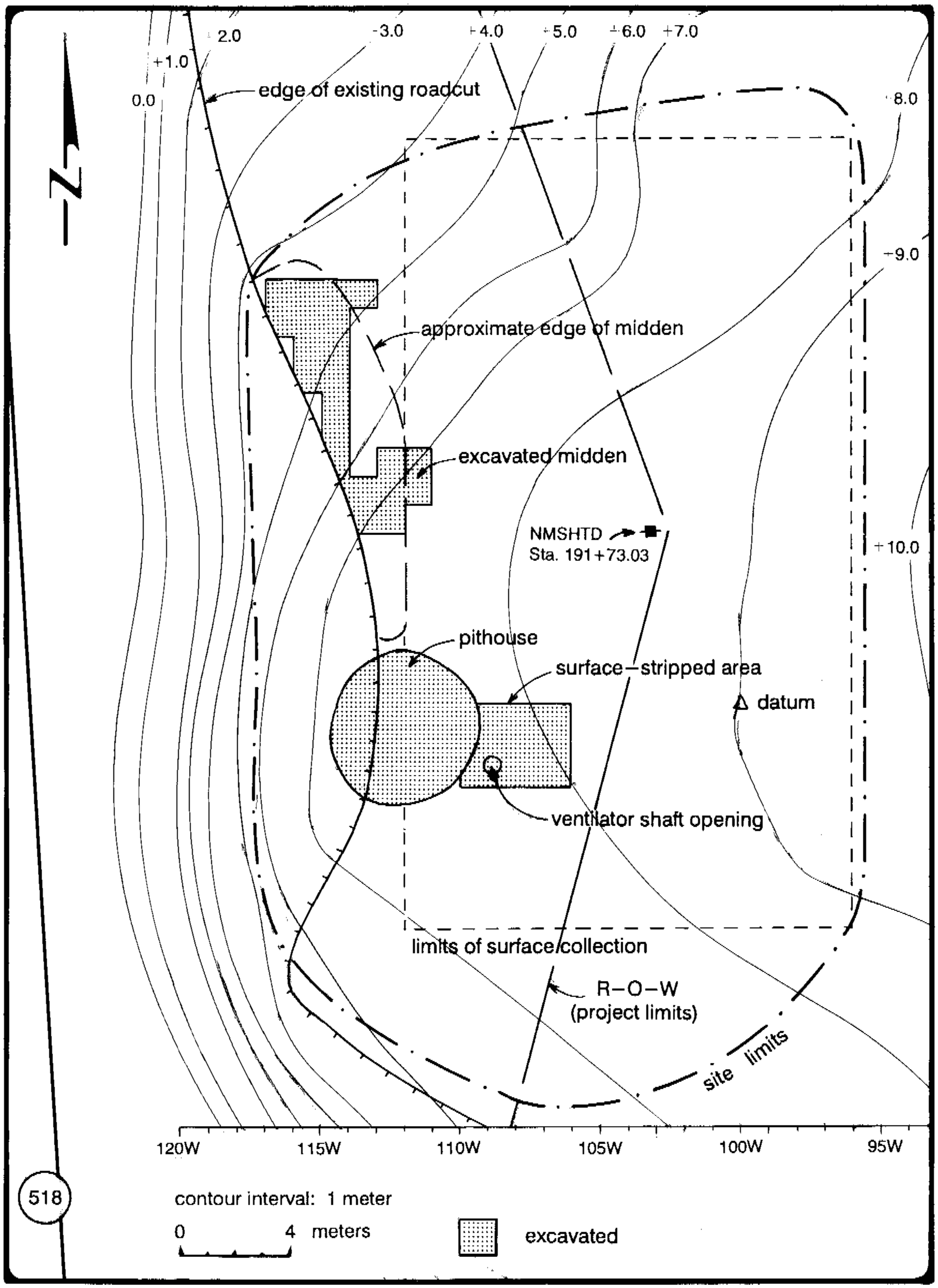

Figure 3. LA 2742, site map.

was nearly intact. Despite the transmission line pole in its approximate center, strata in the pithouse were relatively undisturbed. Because previous construction had removed the end of the terrace, it was impossible to determine whether there had been other structures or surface features west of the pithouse. A shallow midden was the only other feature found. It extended down the terrace slope on the north side of the structure and was truncated on the west by the road cut.

Excavation Methods

Surface artifacts were collected in 4 by 4 m units except where they had eroded into the road cut. Artifacts were collected in two units along that exposure, one corresponding to the pithouse and the second to the midden. The test pit on top of the terrace was reopened, designated grid 99N/113W, and excavated to the floor of the structure. Trenching continued west through grids 99N/114W and 99N/115W until the wall of the structure was encountered.

After trenching from the approximate center of the structure to its west wall, stratigraphic profiles were drawn, and the structure was determined to have been filled by natural processes. With the exception of building materials, artifacts in the fill were washed in from adjacent areas, out of their original context. Therefore, the fill was not screened during subsequent excavation unless it was removed from features. Artifacts were collected when seen, but no effort was made to control for their locations.

Following completion of the test trench, the pithouse was divided into quadrants along the 99N and 112W lines (Fig. 4). Each quadrant was excavated separately, and profiles of quadrant walls were drawn to provide east-to-west and north-to-south stratigraphic cross-sections (Fig. 5). Charcoal and wood were collected for chronometric dating. Each quadrant's fill was removed as a single unit to within 5 to 10 cm above the pithouse floor. After excavating all of the quadrants to this depth, the last 5 to 10 cm of noncultural deposits were removed as a unit. This helped protect the floor and associated features during excavation.

Twenty-one whole or partial grids were excavated in the midden to examine its contents and recover materials discarded during occupation of the pithouse. Between 60 and 70 percent of the midden was excavated; soil removed from this area was screened, and all visible artifacts were collected. Soil samples for pollen and flotation analysis were taken. Initial excavation was in 10 cm levels, but when deposits were found to be homogenous, grids were dug as single units.

A 4 by 3 m area on the east side of the pithouse was surface stripped to locate the exterior opening of the ventilator shaft, and to determine whether other features were present. As elsewhere on the site, initial excavation was in 10 cm levels. When it was determined that only one soil stratum was present, grids were excavated as single units.

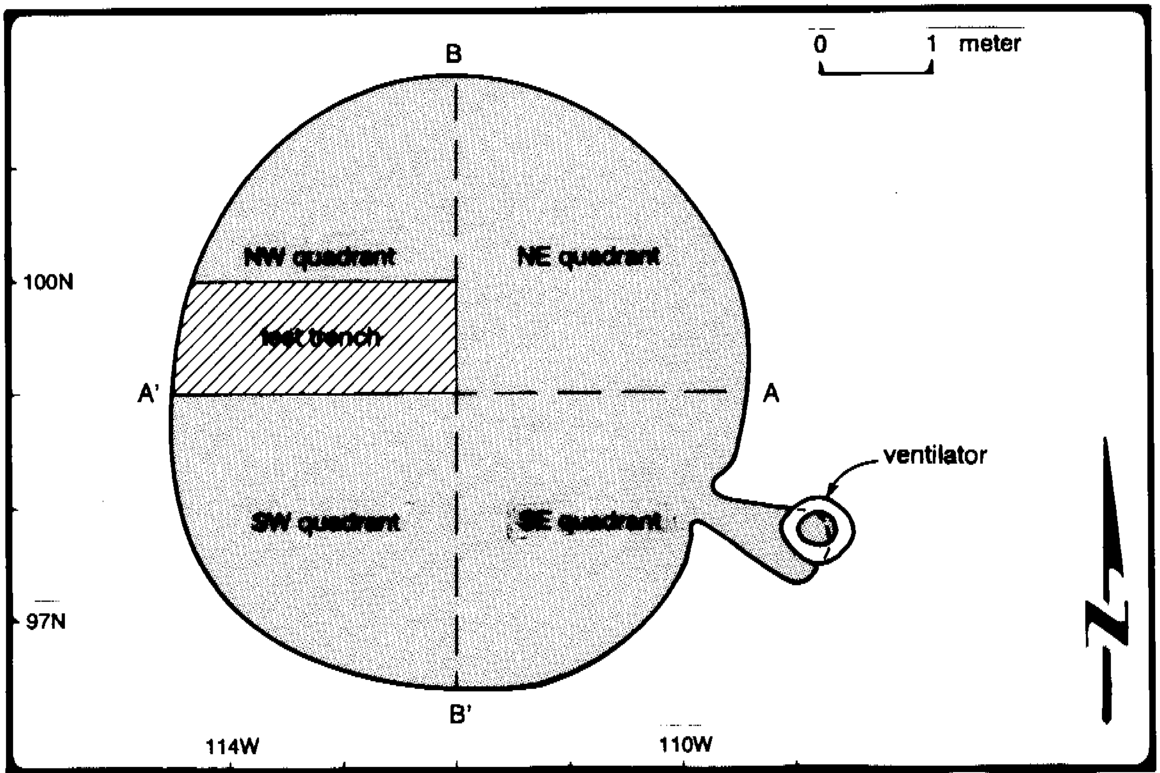

Figure 4. LA 2742, plan of pithouse showing quadrant and test trench locations.

Structure 1 (Pithouse)

The pithouse was on the flat terrace top at the edge of the existing roadcut. The west edge of the structure was exposed in the roadcut, but the lower 1.25 m of wall and fill were intact on that side. Roughly circular, the pithouse measured 5.0 m along its east-west axis and 5.4 m along its north-south axis. At its deepest point the floor was 2.6 m below the modern ground surface. There was no evidence of use for refuse disposal after abandonment. The structure contained 17 features and had been remodeled several times (Figs. 6 and 7).

Stratigraphy

Excluding deposits removed from features, 11 strata were defined. All deposits above the pithouse floor were noncultural. Although artifacts occurred in all strata, they were washed in from nearby extramural deposits. Thus, we made no attempt to recover cultural materials by stratum. The stratigraphic sequence is described from surface to floor, and the history of deposition is summarized.

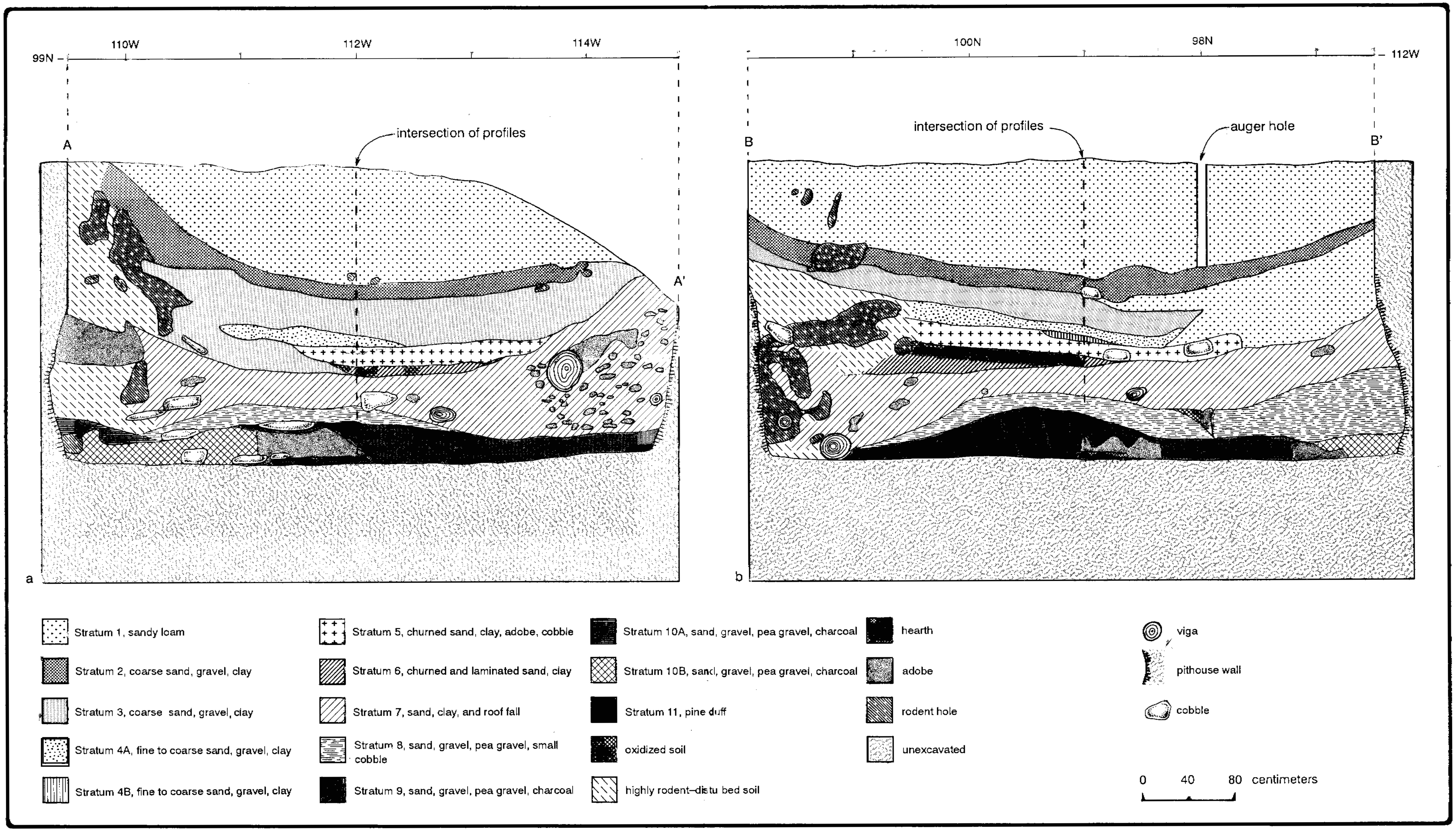

Figure 5. LA 2742, (a) east-to-west and (b) north-to-south profiles of pithouse fill.

Figure 6. LA 2742, excavated pithouse, looking south.

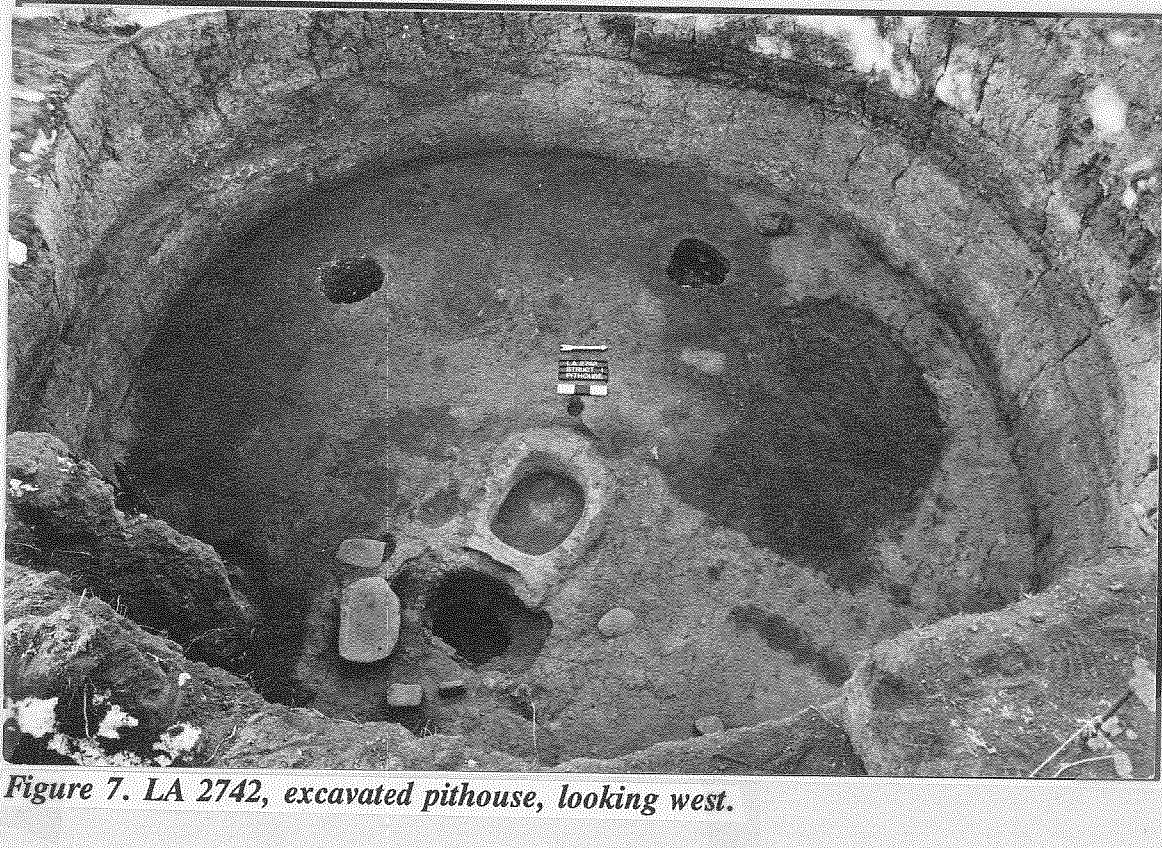

Figure 7. LA 2742, excavated pithouse, looking west.

Stratum 1 was a 44 to 96 cm thick layer of brown sandy loam containing a moderate amount of gravel and a few chunks of adobe. Sands were poorly sorted and coarse to very coarse with subrounded particles. Charcoal flecks occurred throughout Stratum 1, particularly in the lower 30 cm. Considerable bioturbation was noted.

Stratum 2 was a 16 to 40 cm thick series of light brownish gray laminated sands, pea gravels, and gravels interbedded with clay. Sands were poorly sorted and coarse to very coarse with subrounded particles. Flecks of charcoal occurred throughout the unit and bioturbation was common. A 3 cm thick gray ash lens containing a moderate amount of charcoal was found at the base of the stratum.

Stratum 3 was a 10 to 70 cm thick mix of light brownish gray sands, pea gravels, and gravels. Sands were unsorted and rounded to subrounded with coarse to very coarse particles. Fragments of charcoal occurred throughout the unit, and bioturbation was common. This stratum disappeared in the south half of the structure, where it graded into a unit identical to Stratum 1.

Stratum 4 was an 8 to 18 cm thick mix of light brownish gray sands, pea gravels, gravels, and small cobbles. Most of the materials were unsorted, but laminations occurred in places. Sand particles were rounded to subrounded and fine to coarse textured. Flecks of charcoal occurred throughout the unit. This stratum occurred only in the center of the pithouse; it pinched out and disappeared near the walls.

Stratum 5 was a 10 to 16 cm thick series of pale brown laminated sands and clays in the center of the structure that graded into mixed sands, clays, and chunks of adobe near the walls. Small cobbles occurred throughout. Sands were poorly sorted and subrounded and fine to coarse textured. A 5 cm thick gray ash lens containing some charcoal occurred at the top of the stratum, particularly in the south parts of 99N/112W and 99N/113W. Soil was oxidized under the ash lens in places, indicating that it burned in place. This unit occurred only in the center of the pithouse; it pinched out and disappeared near the walls.

Stratum 6 was an 8 to 26 cm thick series of pale brown, fine to coarse subrounded sands interbedded with clays. Upper deposits were laminated and partly sorted in the center of the structure. They became mixed near the walls, where adobe chunks also occurred. Lower deposits were a mix of fine to coarse sands, clays, pebbles, and adobe chunks. Fragments of charcoal were noted throughout, and the upper 4 cm of 99N/112-113W was burned. The oxidized zone was reddish brown and covered by a 3 cm thick grayish brown ash lens.

Stratum 7 was 24 to 136 cm thick and contained grayish brown fine to coarse sands interbedded with clays, adobe chunks, and burned timbers. This layer, a mixture of collapsed roof and water-deposited sediments, was excavated as a single unit because individual components could not be separated. The roof was still burning at the time of collapse, as evidenced by the oxidized sediments found beneath most timbers.

Stratum 8 was a 2 to 23 cm thick mix of grayish brown sands, pea gravels, gravels, and small cobbles. Sands were poorly sorted, rounded to subrounded, and fine to coarse textured. Charcoal flecks occurred throughout the unit, but in smaller amounts than in higher strata. Stratum 8 was thickest in the center of the structure and pinched out near the walls.

Stratum 9 was a 10 to 44 cm thick series of yellowish brown sands interbedded with clays. Pea gravels, gravels, and charcoal fragments occurred throughout. Sands were unsorted and fine to coarse textured. This stratum was directly above the floor in the west and north parts of the structure.

Stratum 10 was a 10 to 35 cm thick layer of colluvium, very similar to Stratum 9, except it contained more gravels. The main difference between these units was their source. Stratum 9 washed in through the entrance hole, while Stratum 10 washed in through the ventilator shaft (Stratum 10a) and a break in the southwest wall (Stratum 10b). This unit was directly above the floor in the east part of the structure.

Stratum 11 was a 1 to 3 cm thick layer of black organic material. It appeared to be deteriorated pine duff and occurred mostly above the floor along the walls.

Features

Two floors containing 17 features were found. Four features were exclusively associated with the lower floor (Features 14 through 18), and three were exclusively associated with the upper floor (Features 8, 9, and 12). The 10 remaining features were associated with both floors, and some were remodeled at least once. Three groups of features were defined: the hearth/ash pit/ventilator complex (Features 2, 3, 4, and 13), the postholes (Features 1, 7, 8, 9, 10, and 11), and the remaining floor features (Features 5, 6, 12, 14, 15, 16, and 17).

Hearth-Ash Pit-Ventilator Complex

Feature 2 consisted of the vertical ventilator shaft, horizontal chamber, and opening along the southeast wall of the pithouse. The shaft and chamber were dug separately, resulting in a slight offset. The shaft was 1.75 m long and slanted slightly south, having been started to the north of the chamber (Fig. 8a). The chamber belled outward to meet the shaft (Fig. 8b) and measured 1.14 m deep, 55 cm high, and up to 60 cm wide. The chamber interior was plastered with adobe; no evidence of horizontal supports remained. The collared shaft opening was 40 cm in diameter (Fig. 9). The chamber opening was 40 cm wide by 53 cm high and was sealed by a metate (Fig 10).

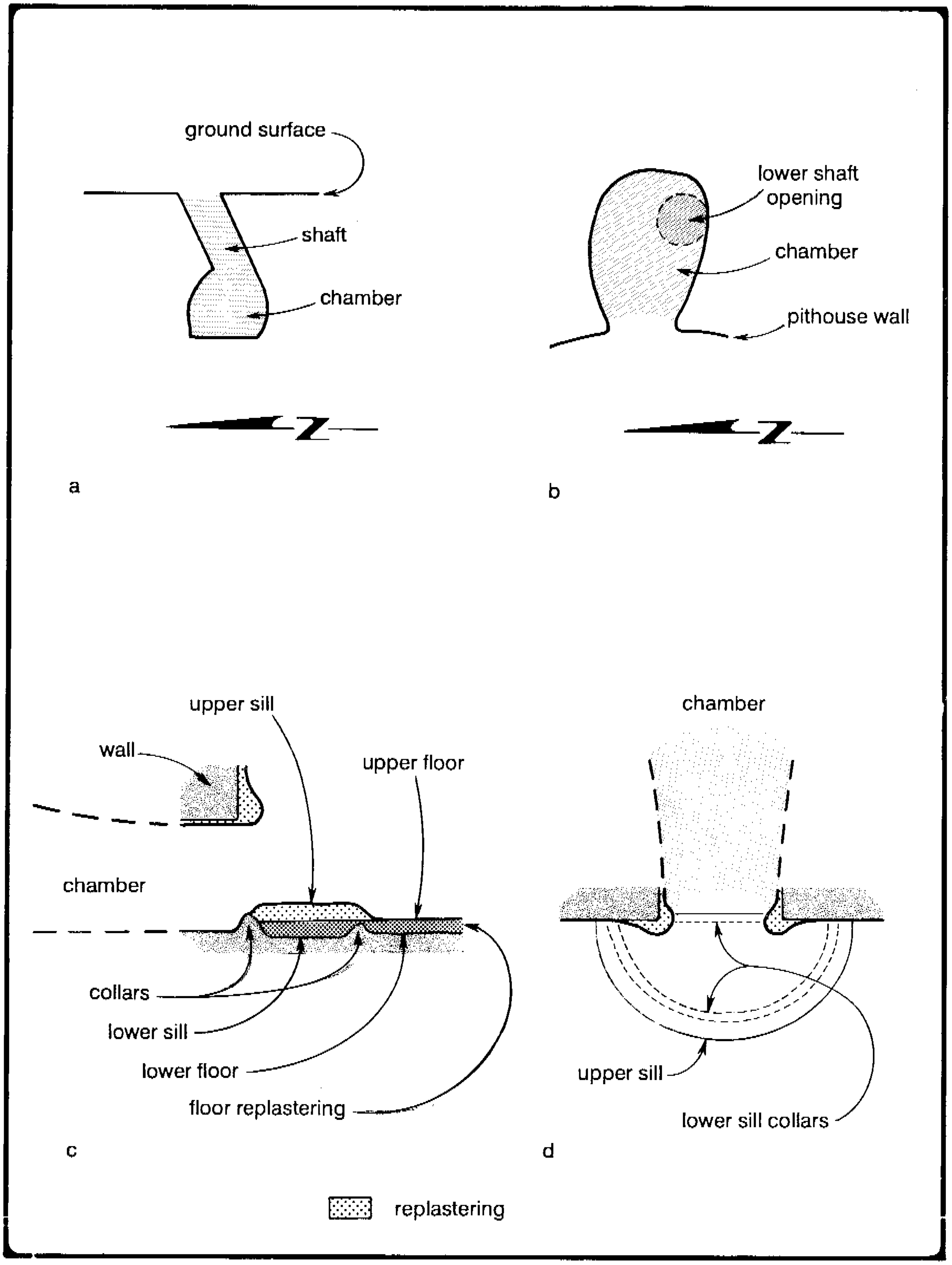

Figure 8. LA 2742, sketch plans of ventilator shaft construction (not to scale): (a) vertical cross section of ventilator shaft and chamber; (b) horizontal cross section of ventilator chamber; (c) cross section of ventilator chamber opening; (d) plan view of ventilator chamber opening.

Figure 9. LA 2742, surface opening of ventilator shaft, showing adobe collar.

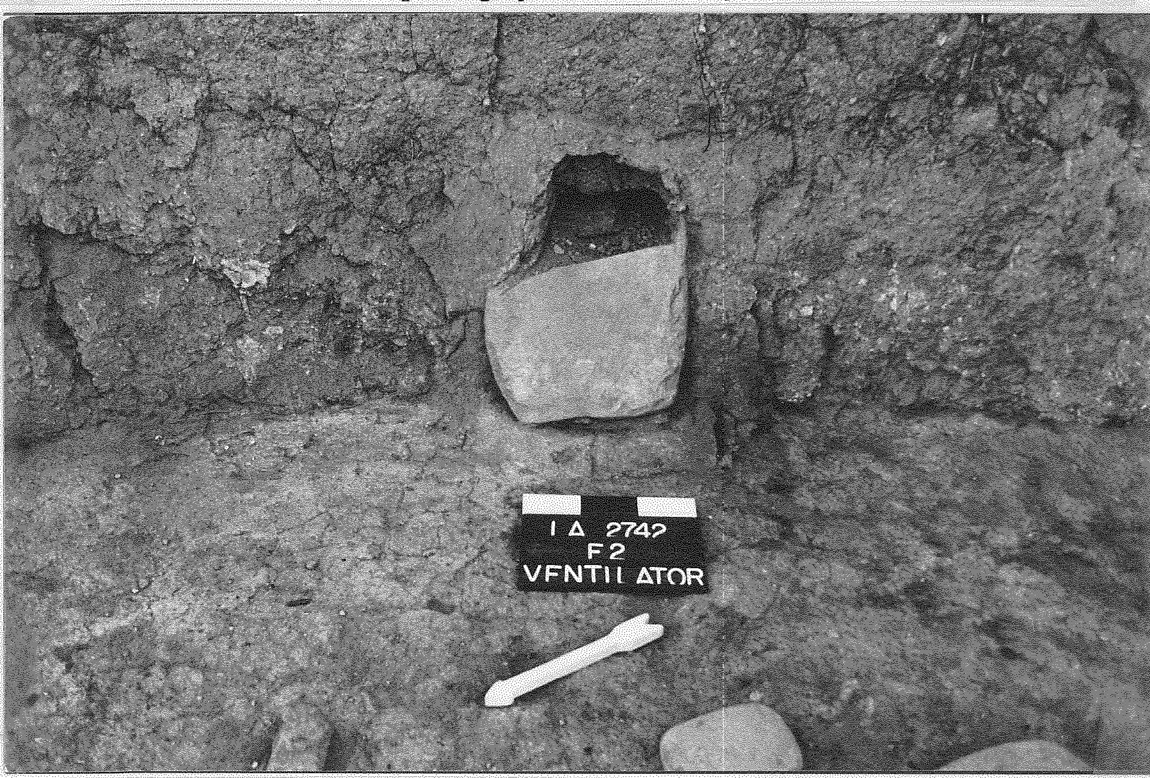

Figure 10. LA 2742, interior opening of ventilator chamber, sealed by metate.

Figure 11. LA 2742, original ventilator chamber opening, showing the inner collar (L), damper sill (S), and lower floor (F1).

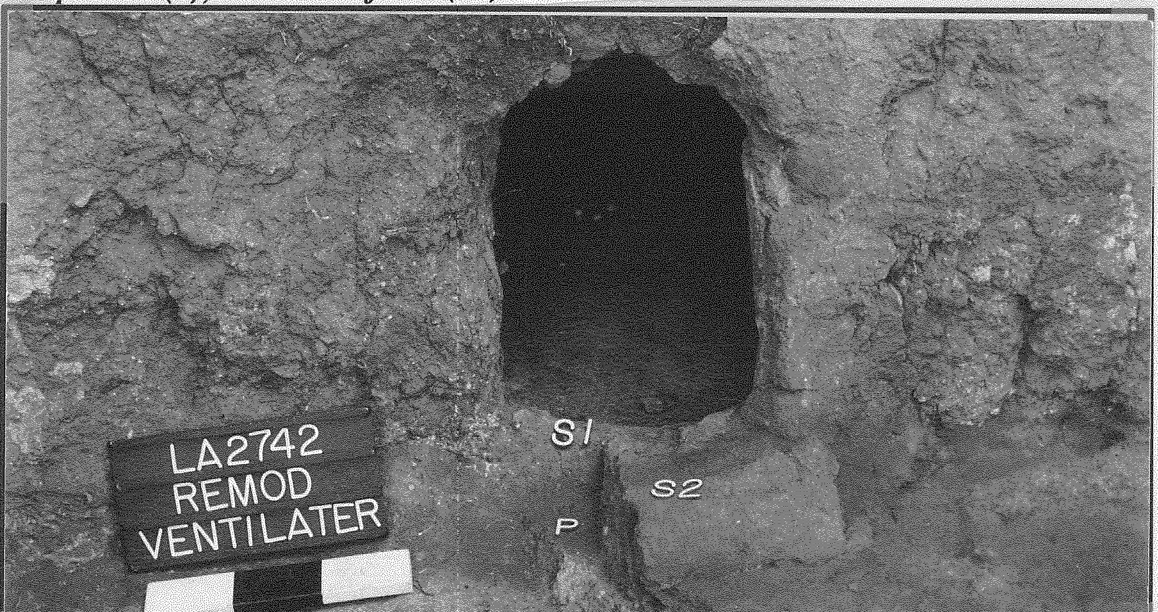

Figure 12. LA 2742, remodeled ventilator chamber opening, showing the inner collar of the lower damper sill (S1), upper damper sill (S2), lower floor (F1), upper floor (F2), and a patch (P).

Two building episodes were visible in the damper sill at the chamber opening (Figs. 11 and 12). The original sill was part of the lower floor and measured 20 by 60 cm. It included a 3 to 4 cm high adobe collar across the chamber opening, and a 2 to 3 cm high adobe collar formed its outer edge (see Fig. 8c). A slight depression between the collars may have held a damper slab used to cover the opening. Part of the depressed area became damaged or worn and was patched with an adobe whose yellow brown color contrasted with the gray floor.

The second floor was poured across the lower damper sill and outer collar, extending to the inner collar. A second damper sill was then built above the first, extending 26 cm out across the upper floor. This damper sill was 66 cm wide and 5 cm high. A 2 to 3 cm thick adobe collar was added to the sides and top of the chamber opening (see Fig. 8d). At the time of abandonment, a trough metate was placed across the chamber opening and sealed in place with adobe mortar. The metate eventually broke, and the upper quarter was deposited inside the structure.

Feature 3 was a hearth near the center of the structure, associated with a deflector and ash pit (Fig. 13a). Three building episodes were visible (Figs. 13b and 14). The original hearth and first remodeling articulated with the lower floor, while a second remodeling corresponded to the upper floor. The original hearth was 32 cm deep. It measured 95 by 81 cm at the top, sloping down to 62 cm in diameter at the bottom. The collar was 15 cm wide and 2 to 3 cm higher than the lower floor, and the interior surface of the feature was plastered with adobe.

The hearth was remodeled before the upper floor was poured, reducing its size (Fig. 15). A layer of adobe was added to the interior of the feature, squaring its sides. The plaster ranged from 16 to 22 cm thick at floor level and was 5 cm thick at the base of the firepit. This hearth was 14 cm deep and measured 58 by 54 cm. The collar was narrow (5 to 6 cm) and extended only 2 to 3 cm above the floor.

A second remodeling occurred when the upper floor was poured. A 20 cm wide collar extending 6 cm above the new floor was molded over the others, and the sides and possibly the floor of the feature were replastered with a 1 to 2 cm thick layer of adobe. This hearth was 20 cm deep and measured 53 by 50 cm. While the earlier hearths were cleaned out before they were remodeled, the last hearth was filled with a compact ash containing a few pieces of charcoal and artifacts.

Feature 4 was an ash pit in the southeast quadrant of structure, associated with a hearth and deflector (see Fig. 13). Two building episodes were visible (Figs. 16 and 17). The original shallow (about 16 cm deep) ash pit articulated with the lower floor and measured 94 by 80 cm. Its actual depth could not be determined because most of the feature was removed during remodeling. There may have been a channel for scooping ash out of the hearth on the west side of the feature near the deflector, but most traces of it were destroyed during remodeling. Except around the edge of the feature, most of

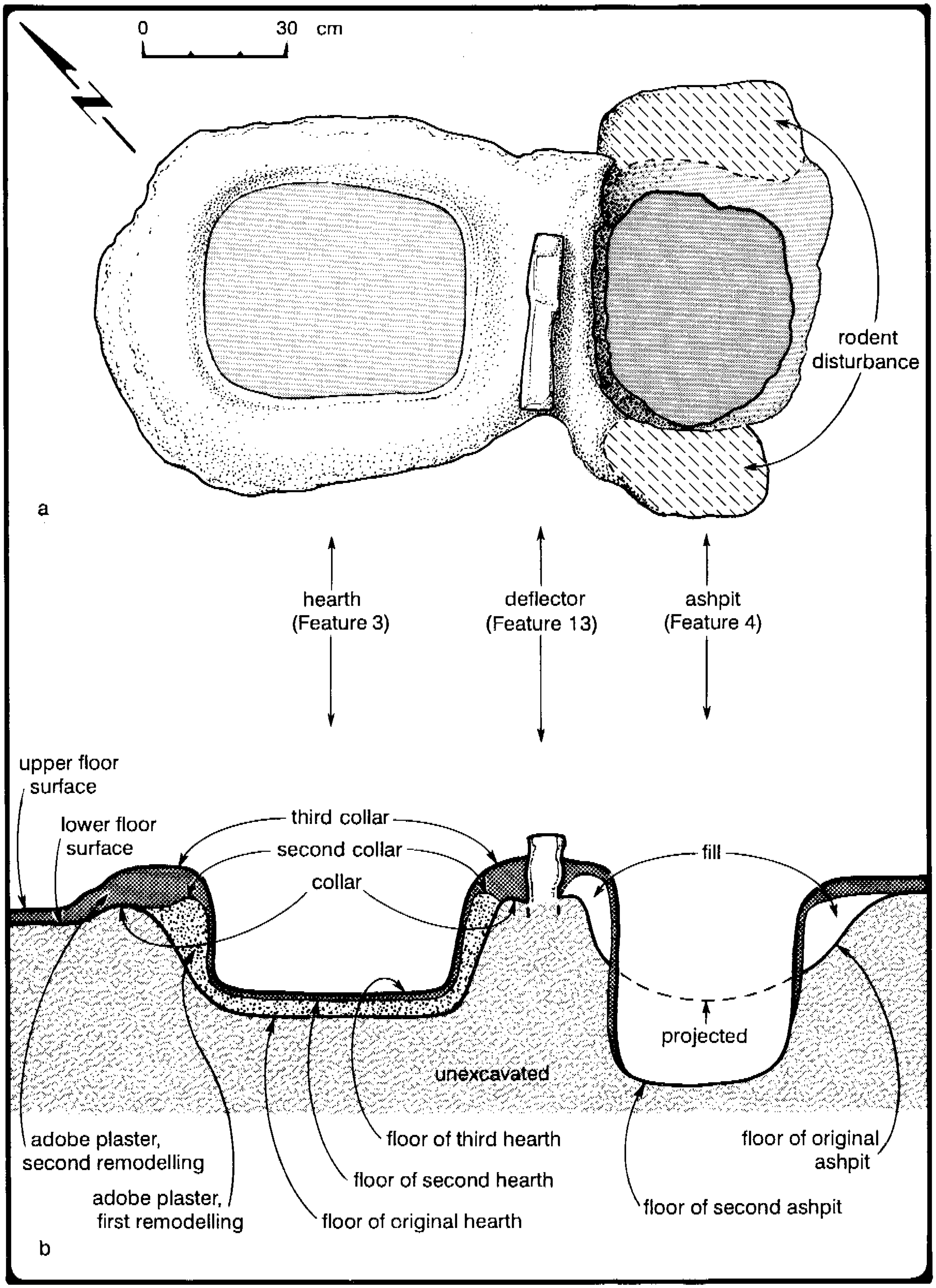

Figure 13. LA 2742, (a) plan view of hearth-ash pit complex (Features 3, 4, and 13); (b) cross section of hearth-ash pit complex (not to scale).

Figure 14. LA 2742, hearth construction details: lower floor (F1), upper floor (F2), original collar and hearth floor (1), collar from first remodeling (2), collar and hearth floor from second remodeling (3).

Figure 15. LA 2742, first remodeling of hearth.

Figure 16. LA 2742, ash pit.

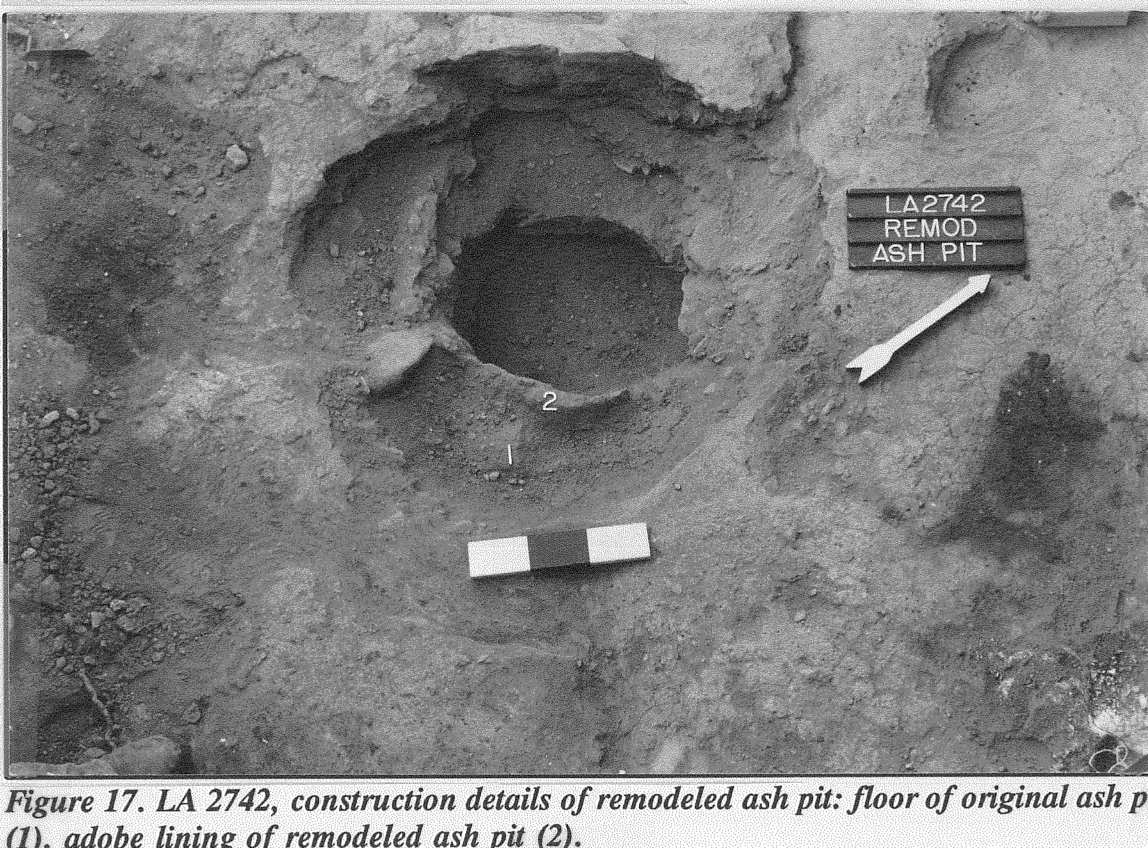

Figure 17. LA 2742, construction details of remodeled ash pit: floor of original ash pit (1), adobe lining of remodeled ash pit (2).

the ashy fill associated with the original ash pit was also removed. The remaining fill was left in place and plastered over when the edge of the new ash pit was built.

The ash pit was rebuilt when the upper floor was poured, probably when the hearth was remodeled for the second time. The new feature was smaller and deeper than the original ash pit and was dug through it. This ash pit was 43 cm deep and measured 45 by 38 cm. There may have been a low collar around its mouth, but this is uncertain because most of that area was destroyed by rodent burrows. The sides of the new ash pit were plastered with a thin layer of adobe, but the floor was left unplastered. Feature 4 was filled with ash, charcoal, and artifacts mixed with soil and gravel introduced by rodent activity.

Feature 13 was a deflector in the southeast quadrant, comprised of a slab of unidentified igneous rock measuring 36 by 7 cm. The slab was set vertically between the hearth and ash pit and projected 4 cm above the latest hearth (see Figs. 13-15). The deflector was not removed, so we could not determine how deeply into the floor it extended, but removal of adobe added during remodeling showed that it originally projected at least 10 cm above the first floor.

The Postholes

Feature 1 was a posthole in the southeast quadrant and contained an upright juniper post (Fig. 18; also see Fig. 7). It measured 45 by 42 cm at the top and 23 cm in diameter at the bottom, and it was 75 cm deep. This feature was one of the original postholes and was used throughout the occupation of the structure. The remaining section of post, 2.47 m long, was charred at the top. It ranged from 12 to 15 cm thick, but it had deteriorated, and only the core remained. Four rocks set between the west wall of the hole and the post braced it in an upright position (Fig. 19). The lower 35 cm of fill was a sterile yellow brown sandy loam. The upper 40 cm was a fine gray sandy loam containing charcoal, a few artifacts, gravels, and cobbles.

Feature 7 was a posthole in the northeast quadrant measuring 44 by 37 cm in diameter by 48 cm deep. This was also one of the original postholes, and it continued to be used until the structure was abandoned. It was filled with sterile sands and gravels similar to those underlying the structure.

Feature 8 was a posthole in the northwest quadrant measuring 44 by 41 cm in diameter by 36 cm deep. This feature was a secondary posthole built during a remodeling episode to replace Feature 11. Its sides belled slightly outward near the bottom, and it was filled with a gravelly loam containing a few artifacts. No evidence of the post remained, suggesting that it was removed after abandonment. Many cobbles were found at the bottom of this feature, but it was unclear whether they were placed there to function as a base for the post or were deposited naturally.

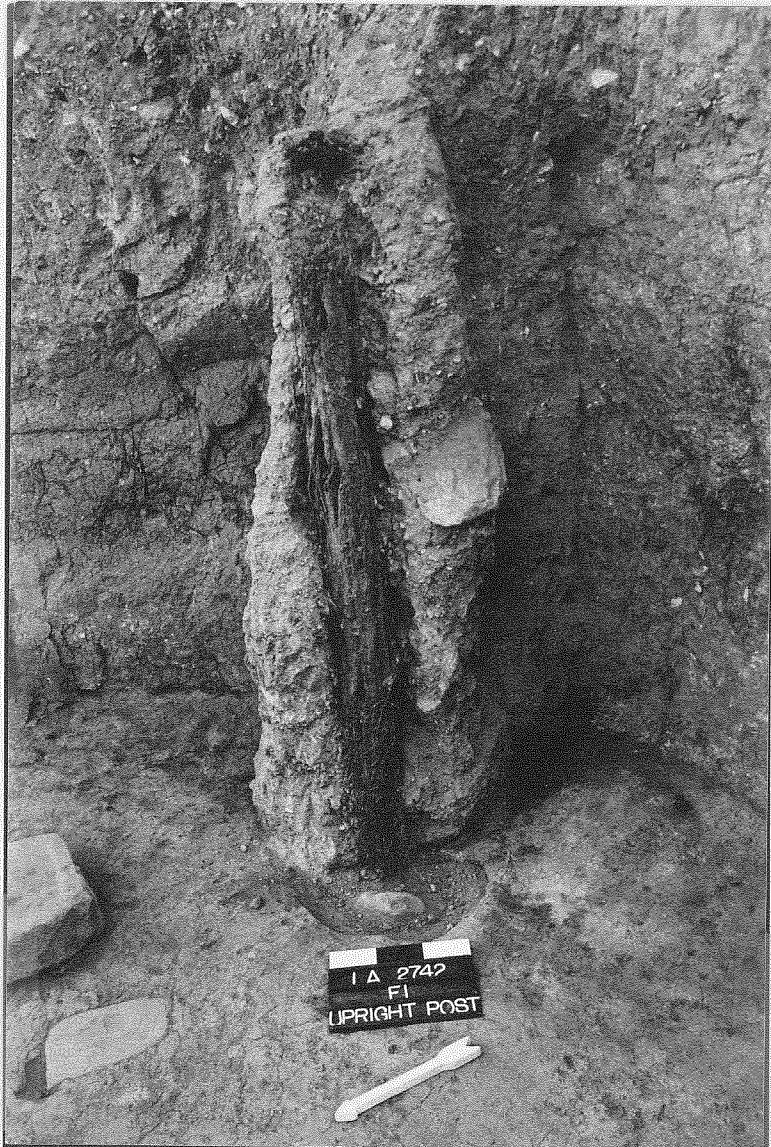

Figure 18. LA 2742, Feature 1, showing upright juniper post.

Feature 9 was a posthole in the southwest quadrant measuring 42 by 41 cm in diameter by 46 cm deep. It was a secondary posthole built during a remodeling episode to replace Feature 10. The upper fill was a gravelly sandy loam containing a few artifacts grading into a gravelly fine sand and silt near the bottom. No evidence of the post remained, and it was probably removed after abandonment.

Feature 10 was a posthole in the southwest quadrant measuring 107 by 105 cm at the top, 17 cm in diameter at the bottom, and 99 cm deep. This was one of four original postholes. The post broke while being removed during remodeling, leaving a 36 cm long stub (Fig. 20). The bottom of the stub was charred, suggesting that fire was

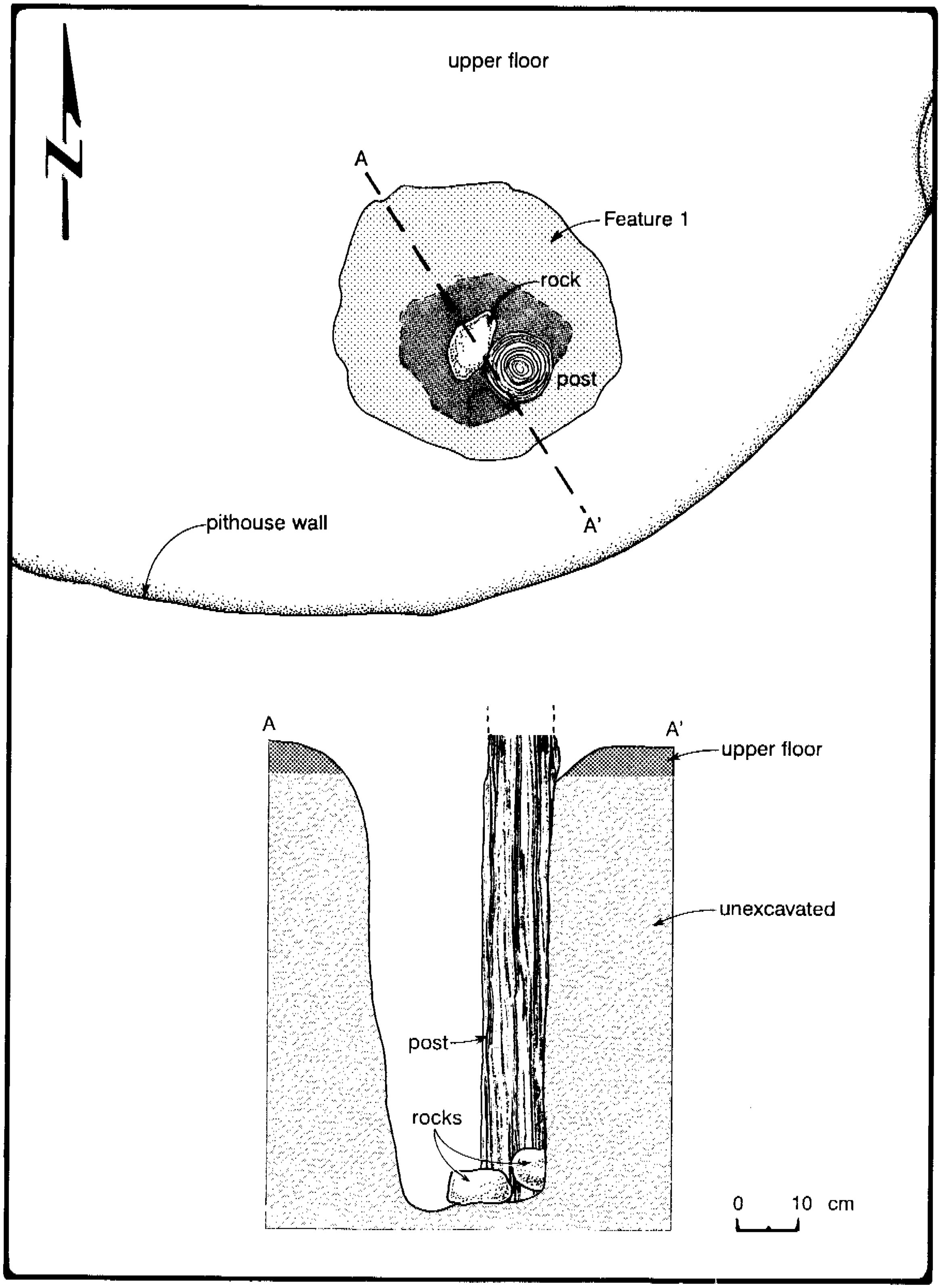

Figure 19. LA 2742, plan and cross section of Feature 1.

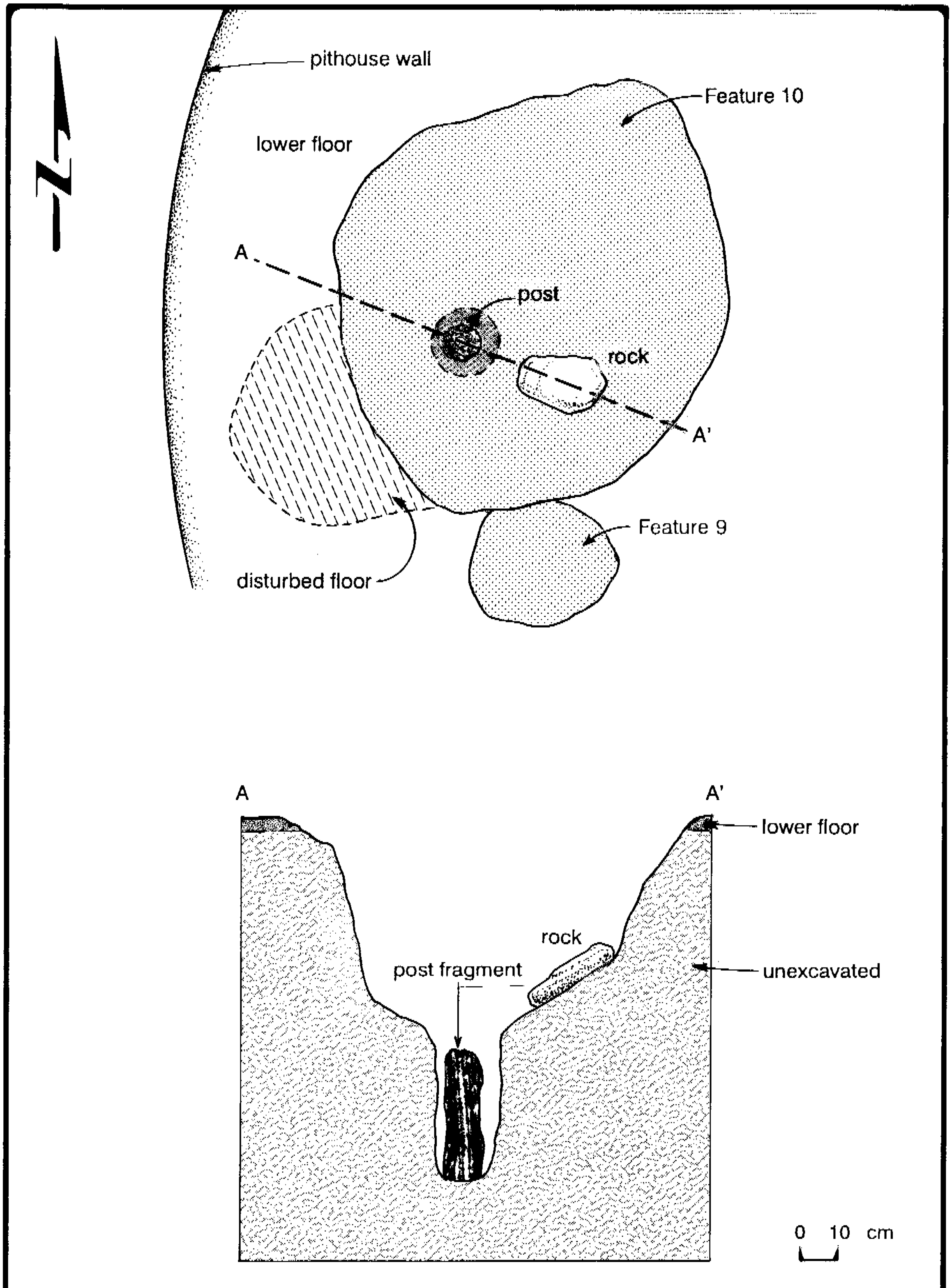

Figure 20. LA 2742, plan and cross section of Feature 10.

used to fell the tree from which it was made. The feature was filled with a loosely compacted gravelly sandy loam containing charcoal and artifacts. A sandstone slab found in the pit may have helped brace the post. The narrow section of pit containing the post fragment was the original posthole, while the broad upper section was dug during remodeling.

Feature 11 was a posthole in the northwest quadrant measuring 160 by 76 cm in diameter by 86 cm deep. This was one of four original postholes. The post was removed during remodeling (Fig. 21). It was filled with laminated sands and clays containing wood chips, charcoal, and a few artifacts. The narrow lower section of pit represents the original posthole, while the broad upper section was excavated during remodeling.

Other Floor Features

Feature 5 was a quartzite cobble anvil embedded in the floor on the north side of the hearth-ash pit complex. It measured 24 by 19 cm by 9.4 cm thick. The cobble was set into the lower floor, and its upper surface was used as an anvil. That surface was left exposed when the upper floor was poured.

Feature 6 was a quartzitic sandstone metate/anvil embedded in the floor on the south side of the hearth-ash pit complex. It measured 26.5 by 17.5 by 5.9 cm thick. Both surfaces were used, and its edges were shaped by pecking. The exposed surface was a shallow basin metate or mortar that was also used as an anvil. As this surface was partly exfoliated, the amount of anvil wear was difficult to ascertain. The lower surface first served as a slab metate, then was reused as an anvil. Feature 6 was set into the lower floor. Either there was no upper floor in this area, or it was less than 1 cm thick and indistinguishable from the lower floor.

Feature 12 was a possible sipapu in the northwest quadrant measuring 10 cm in diameter by 7 cm deep. It articulated with the upper floor only.

Features 14 through 17 were shallow postholes or sockets in the lower floor (Fig. 22). Feature 14 was in the northeast quadrant and measured 18 by 17 cm in diameter by 10 cm deep (Fig. 22a). It was loosely filled with fine yellow brown sand. Feature 15 was in the northeast quadrant and measured 18 by 15.5 cm in diameter by 7 cm deep (Fig. 22b). It was also loosely filled with fine yellow brown sand. Feature 16 was in the northwest quadrant and measured 18 by 15 cm in diameter by 19 cm deep (Fig. 22c). This hole was plugged with adobe and loosely filled with pale gray ashy soil containing small chunks of adobe and two artifacts. Feature 17 was in the northwest quadrant and measured 14 by 13 cm in diameter by 4 cm deep (Fig. 22d). It was filled with sand and gravel resembling the natural substrate.

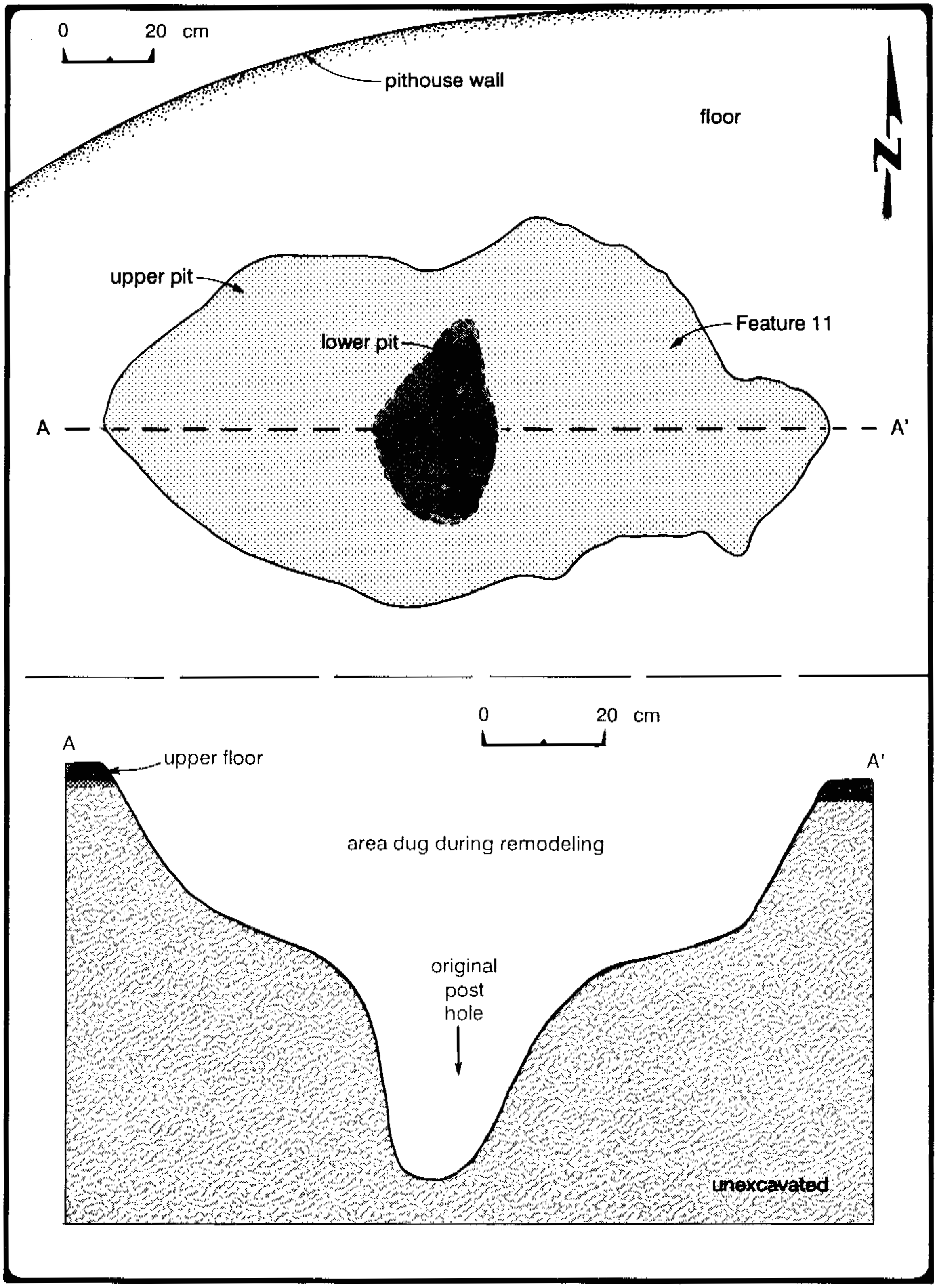

Figure 21. LA 2742, plan and cross section of Feature 11.

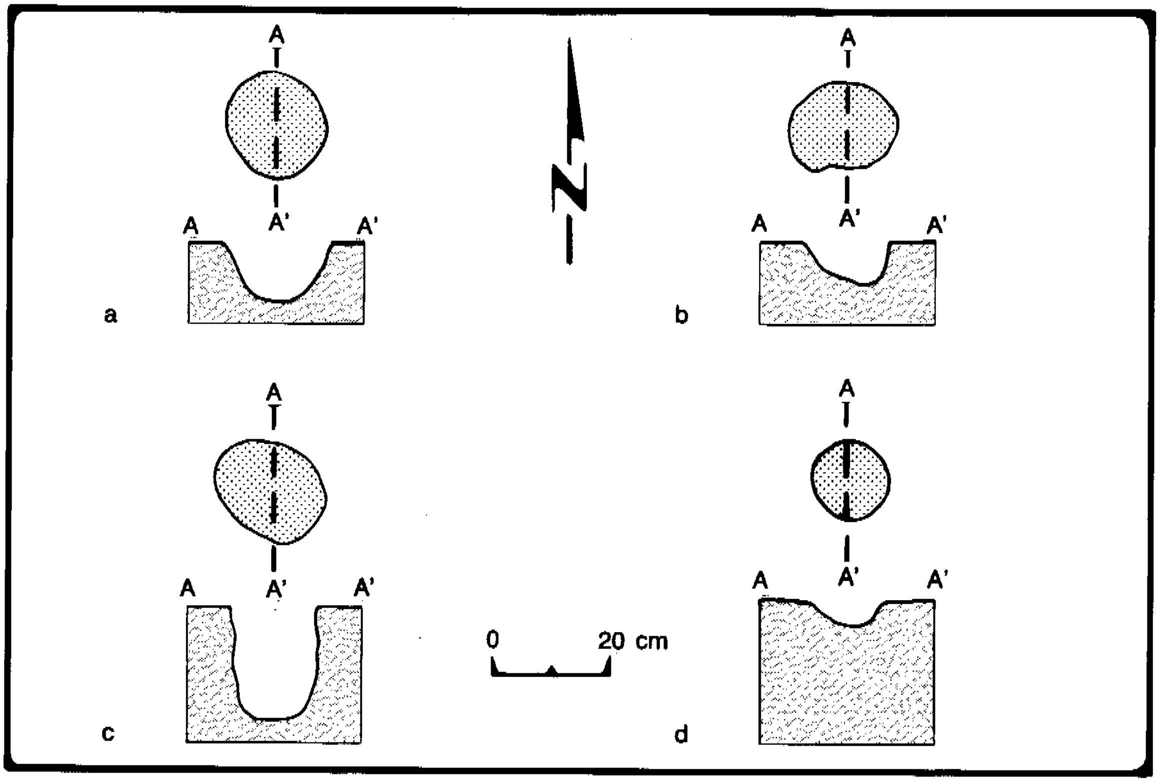

Figure 22. LA 2742, plans and cross sections of Features 14 through 17: (a) Feature 14; (b) Feature 15; (c) Feature 16; (d) Feature 17.

Midden

A midden began 1 to 2 m north of the pithouse and extended 14 m down the north slope of the terrace (Fig. 23). As the western side of this feature was removed by the roadcut, its width could not be determined. The remaining portion was 1 to 3.5 m wide. The midden was shallow, ranging from 21 to 66 cm deep and averaging 46 cm deep. Sixteen whole and five partial grids were excavated, comprising 60 percent of the remaining deposits.

Stratigraphy

Two strata were defined, a thin upper unit and a thicker lower unit. The break between them was very subtle and difficult to follow. Both contained cultural materials, and the difference between them was related to soil development rather than deposition. Thus, these strata were excavated as a single unit in most grids. North-to-south, east-to-west, and south wall profiles are illustrated in Figures 24a through 24c.

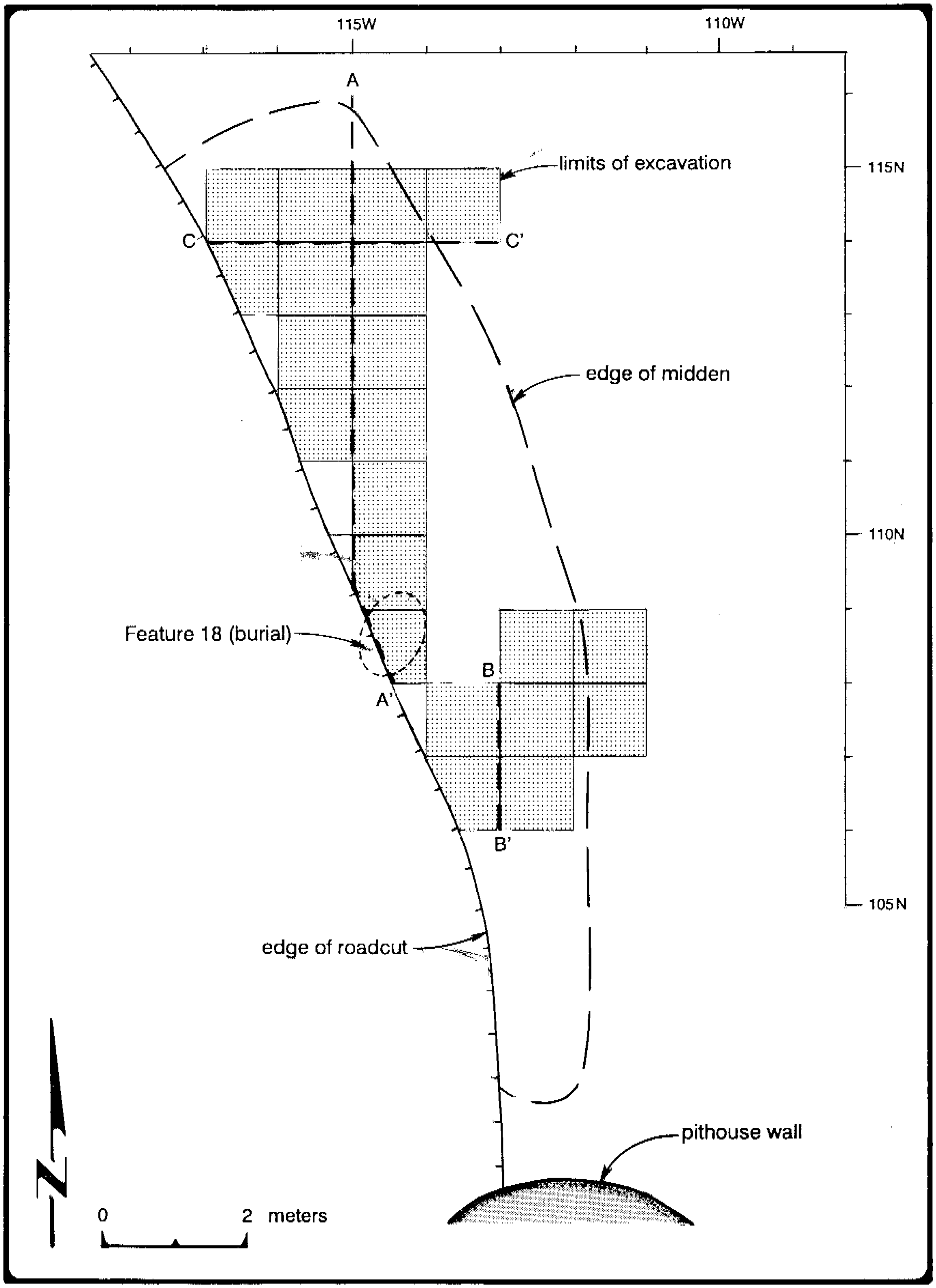

Figure 23. LA 2742, plan view of midden.

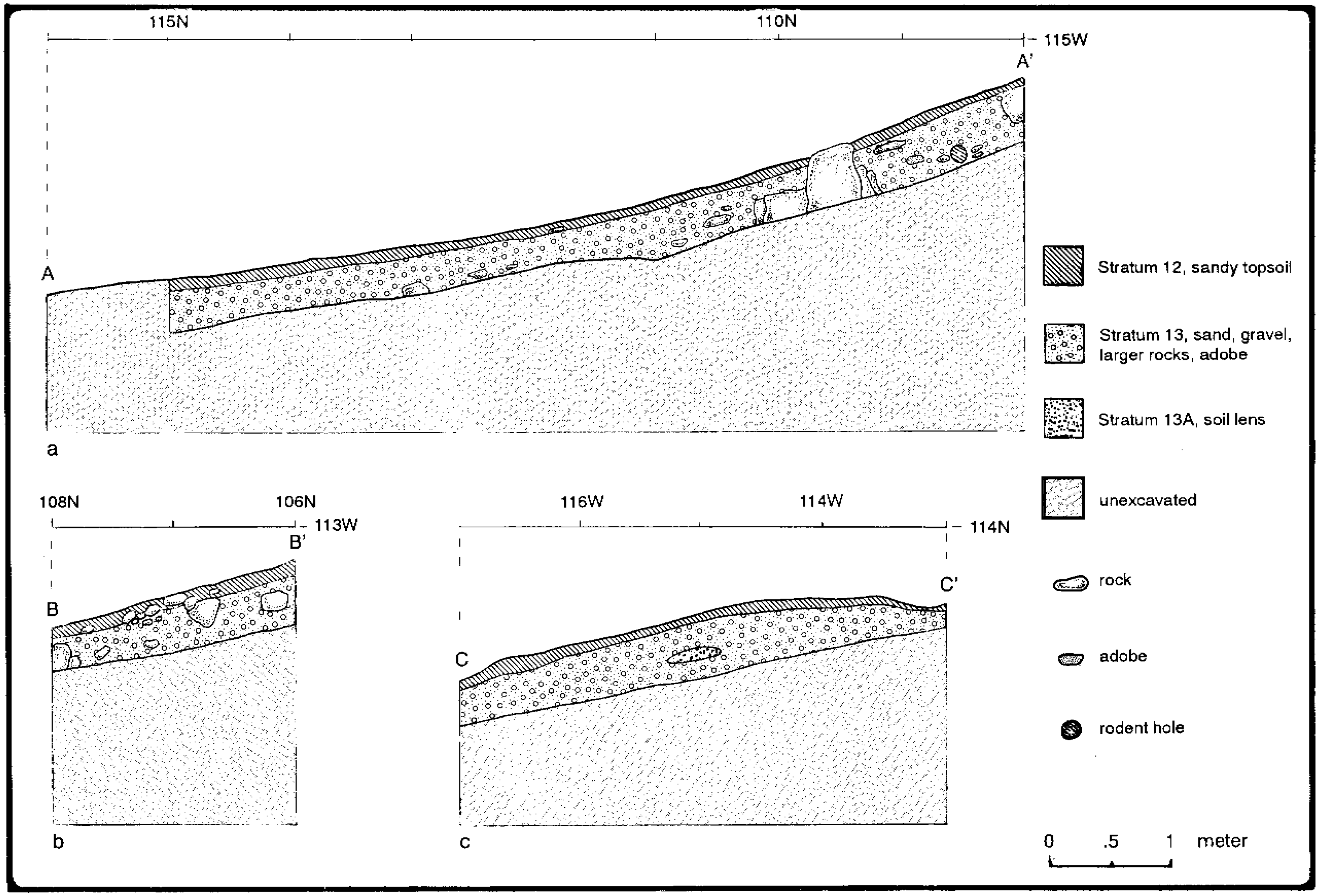

Figure 24. LA 2742, midden profiles: (a) north to south; (b) east to west; south wall at 114N/113117W.

Stratum 12 was a layer of brown sandy loam that averaged 10 cm thick and contained numerous artifacts and charcoal fragments. It had a high organic content, probably because pine duff was mixed into the soil by bioturbation. This unit contained numerous pebbles and gravels and appeared to be a developing A horizon.

Stratum 13 was a layer of dark brown sandy loam that ranged from 11 to 56 cm thick and contained numerous bedrock fragments, pebbles, and gravels. Cultural materials were common and included pottery, bone, chipped and ground stone, and charcoal. The unit was highly bioturbated, and numerous tree roots were encountered during excavation. A lens (Stratum 13a) of sterile fill was noted (Fig. 24c). It was a 10 cm thick layer of yellowish brown sandy loam containing a few rock inclusions.

Features

Feature 18. The only feature found in the midden was a human burial that was flexed with its head pointing downslope to the northeast. The head faced down, the right arm was flexed at the elbow and drawn up next to the head, and the left arm was straight and followed the line of the trunk. Both legs, flexed at the knee and hip, were drawn up next to the trunk. Feet and hands were missing and were probably scattered by rodents.

The burial was placed in a shallow pit excavated through midden deposits into the sterile substrate. Though pottery and lithic artifacts were present, they were incidental, and there was no evidence of associated grave goods. Numerous cobbles and angular bedrock fragments above the grave suggested it was covered by a layer of rock. This made it impossible to determine the exact dimensions of the pit. More detailed descriptions of the burial are included in the discussions of pollen analysis and the analysis of human remains.

Surface-Stripped Area

A 4 by 3 m area on the east side of the pithouse was surface- stripped to search for the upper opening of the ventilator shaft and determine whether a rock alignment was a cultural or natural feature (Fig. 25). The ventilator opening was thought to be in Grid 99N/108W, the first unit excavated in this area. The upper 15 to 20 cm of fill was a loose brown sandy loam that contained few artifacts. Below this was a 16 to 26 cm thick layer of dark brown sandy loam containing numerous artifacts and charcoal flecks. Sterile soil was encountered at a depth of 46 cm. No evidence of the ventilator opening was found, and excavation was extended to 98N/108W.

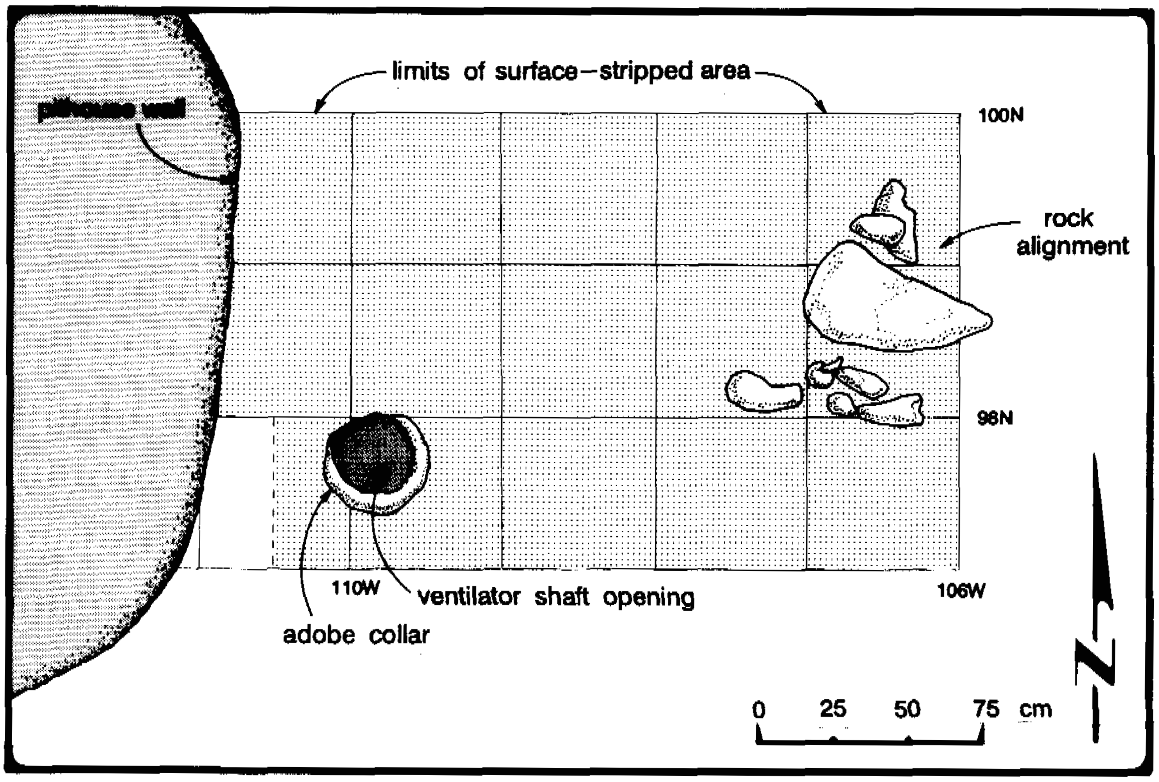

Figure 25. LA 2742, plan of surface-stripped area, east of pithouse.

Grid 98N/108W was dug in natural levels, and excavation ended when sterile soil was encountered. Fill was consistent with that found in 98N/108W. No evidence of the ventilator was found, but excavation showed that cultural materials were concentrated in a stratum resting on sterile soil. Artifacts were rare above that layer, and had probably been carried upward by bioturbation. For this reason, subsequent grids were excavated as single units.

A disturbed area at the bottom of 99N/108W was thought to be either a rodent burrow or the edge of the ventilator opening. Because the southeast corner of this grid was disturbed, the next grid to the west (98N/109W) was excavated, demonstrating that the disturbed area was a rodent burrow. This suggested that the ventilator opening was either closer to the structure or offset from the chamber. Following the first possibility, grids 99N/109W and 98-99N/110W were excavated. That area contained no features, and grids 97N/109-110W were opened up, revealing the edge of the ventilator opening in the south half of 97N/110W. The north half of 97N/111W was excavated to expose the rest of the feature. The opening articulated with the top of the sterile substrate. A low adobe collar was molded around the opening on top of the sterile soil, showing that it was the original ground surface.

Following discovery of the ventilator shaft opening, four grids were excavated to examine the surface rock alignment. They included 97N/108W and 97-99N/107W. All contained the same fill found elsewhere in this area. Excavation showed the rock alignment to be natural. Because the ventilator shaft opening had been located and no evidence of other extramural features was found, excavation in this area was ended.

Pithouse Construction

Trenching under the floor and through part of a wall provided information on building techniques. When combined with information from the features and floor, a detailed discussion of construction and remodeling is possible. Four building episodes were defined: initial construction, first remodeling of hearth, second remodeling of floor and associated features, and third remodeling to repair structural defects.

Construction began by excavating a pit slightly larger in diameter and depth than the finished structure. The pit was cylindrical, and its walls curved down into the floor. At least four courses of puddled adobe were visible in the pithouse wall (Fig. 26). Inner wall surfaces were smooth, while outer surfaces were rough and uneven. This indicates that adobe was applied directly to the pit wall. The lowest course was thickest at 65 cm. In ascending order, the other courses measured 43 cm, 47 cm, and 42 cm thick. Courses shrank and cracked as they dried, and the walls gave the appearance of large, roughly rectangular adobe blocks. Each course was 8 to 10 cm wide, and gaps between courses were filled with adobe and smoothed to form a regular surface. The base course extended below the floor, and its outer surface curved inward, reflecting the shape of the original pit (Figs. 27-29). The wall was originally covered with a thin layer of plaster that was badly preserved and found only in patches. The plaster surface was gray, probably a result of sooting, and contrasted with the pale brown natural adobe color.

The lower floor abutted the wall, showing that it was poured after the wall was in place (Figs. 27 and 29). This floor was constructed in several steps. First, a 5 cm thick layer of light brownish gray coarse sand, pea gravel, and gravel was spread across the floor of the pit to level it. A 2 cm thick layer of coarse brown adobe was poured over those materials, forming the base of the floor. This was topped with a 1 cm thick layer of pale brown fine clay or adobe plaster, which formed the floor surface.

Several features were associated with the lower floor (Fig. 30a). Roof support posts were set in four holes spaced evenly around the structure (Features 1, 7, 10, and 11). Four other holes or sockets in the north half of the structure did not seem to be part of the roof support system (Features 14-17). Features 14 and 15, nearly identical in size and depth, contained a fine yellow brown sand. This suggests that they were filled at the same time and may have been related. Feature 16 was similar in diameter to Features 14 and 15 but was deeper, filled with a different material, and capped with an adobe plug. Feature 17, the smallest and shallowest of the four, was filled with sand and gravel.

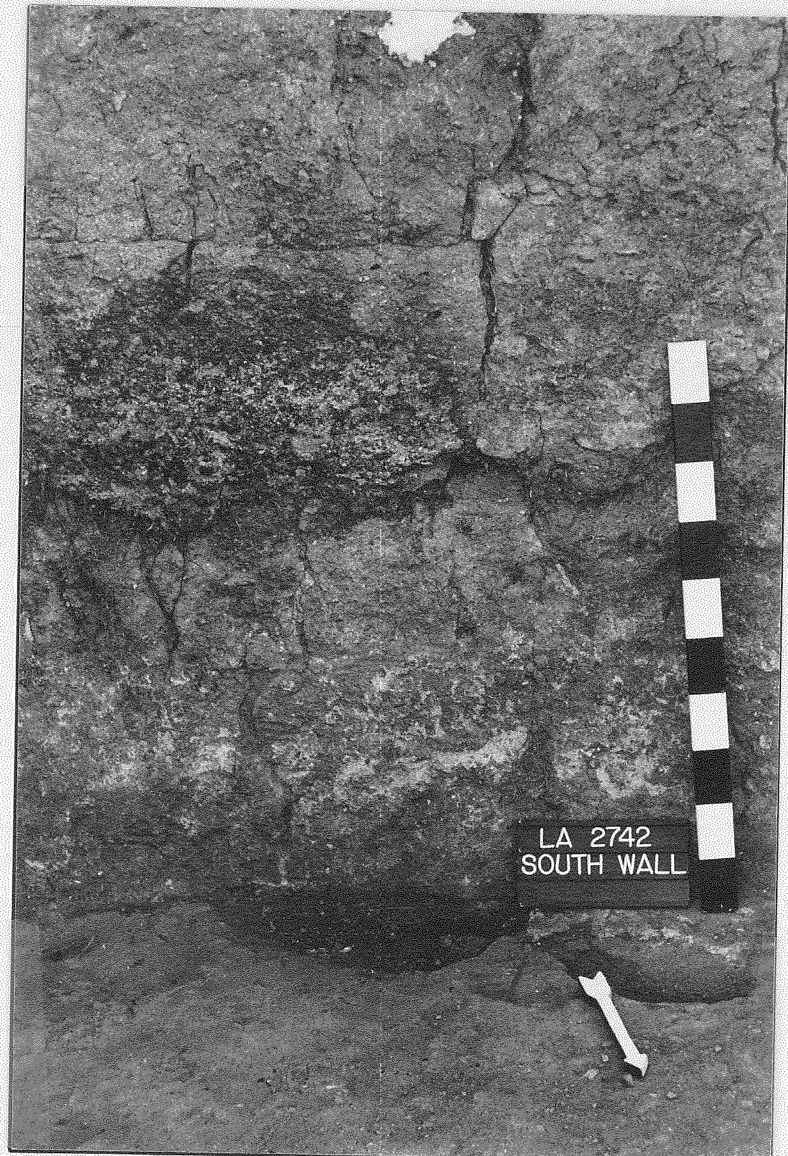

Figure 26. LA 2742, south wall, showing adobe courses.

The similarity in size and fill of Features 14 and 15 suggest that they were paired and may have been sockets for a loom. Features 16 and 17 did not appear to be related to one another or to Features 14 and 15. It is possible that they represent different sipapu locations. Feature 16 would have been the earlier location and was perhaps sealed when Feature 17 was built. A second, but less likely, possibility is that all four were part of the same feature, perhaps a dividing screen or platform.

Features 5 and 6 were rocks set into the lower floor on either side of the hearth/ash pit complex. Feature 5 was an anvil, while Feature 6 was a basin metate reused as an anvil. As both sides of Feature 6 evidenced similar wear patterns, it apparently was used for a long time before being set into the floor.

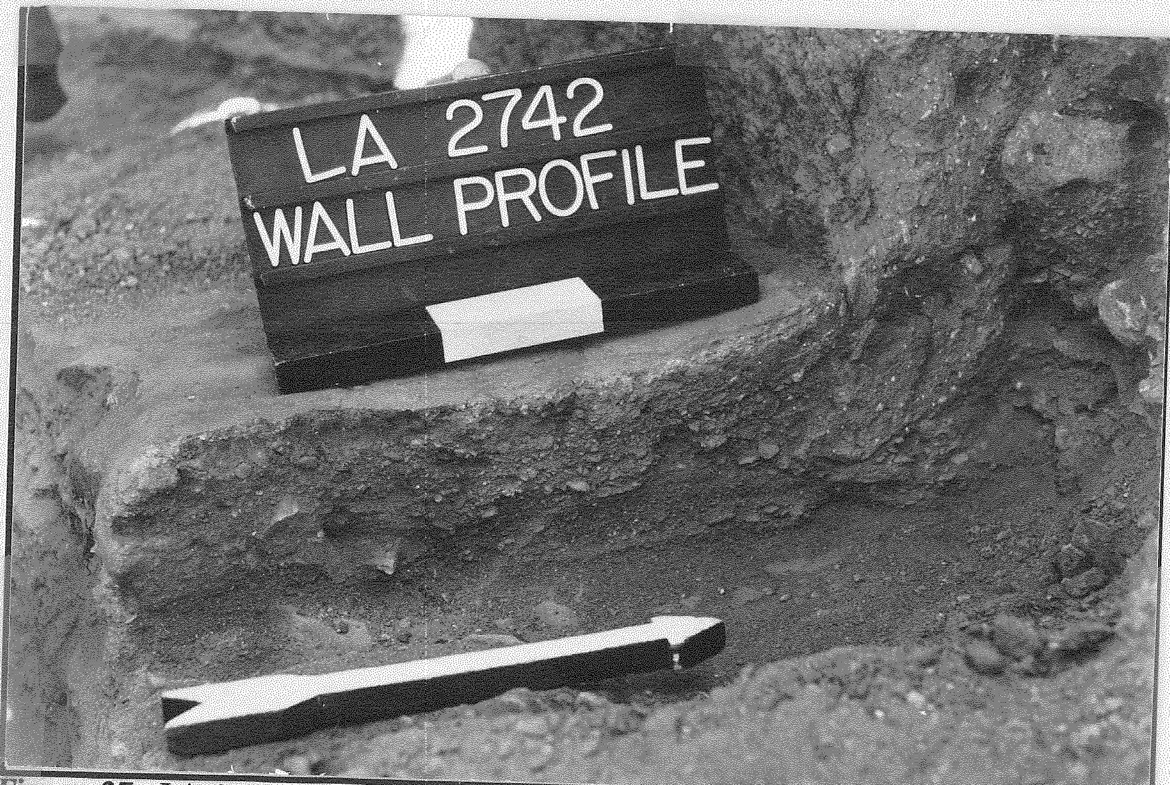

Figure 27. LA 2742, detail of wall and floor construction. Note the curved outer surface at the base of the wall.

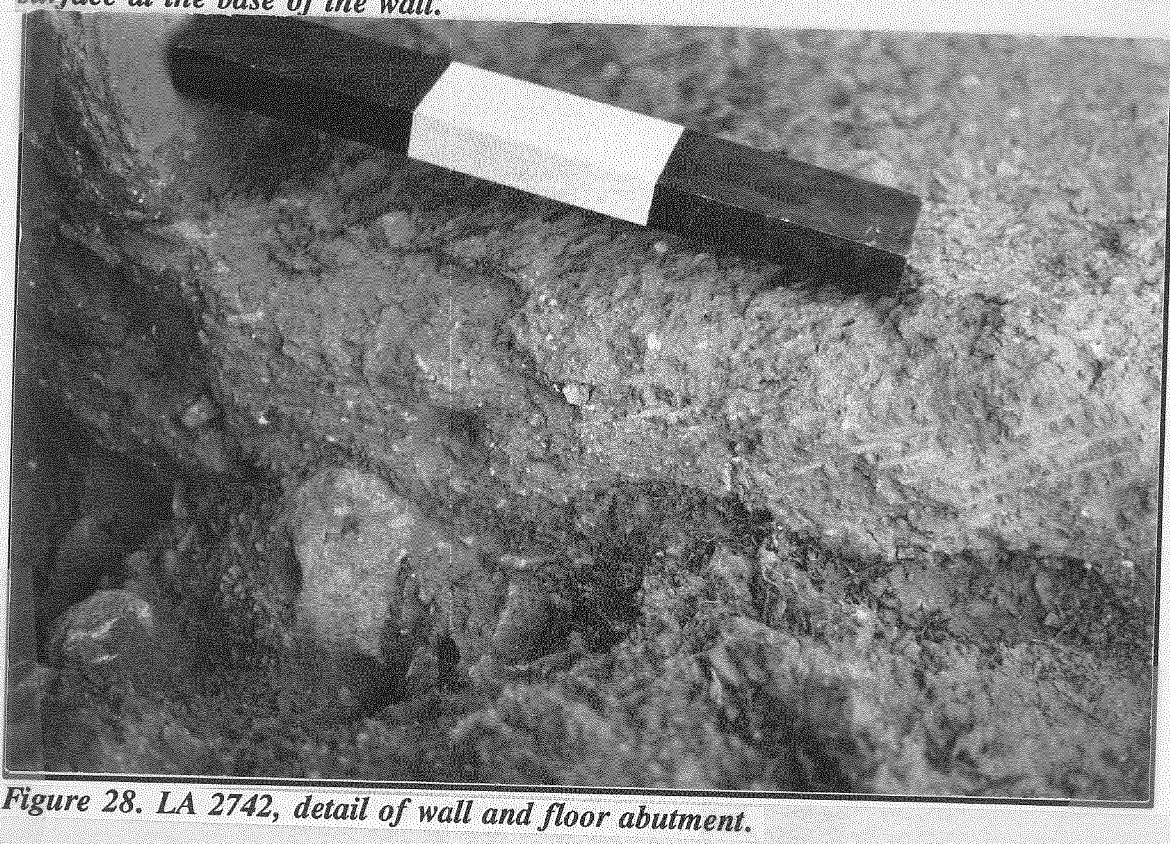

Figure 28. LA 2742, detail of wall and floor abutment.

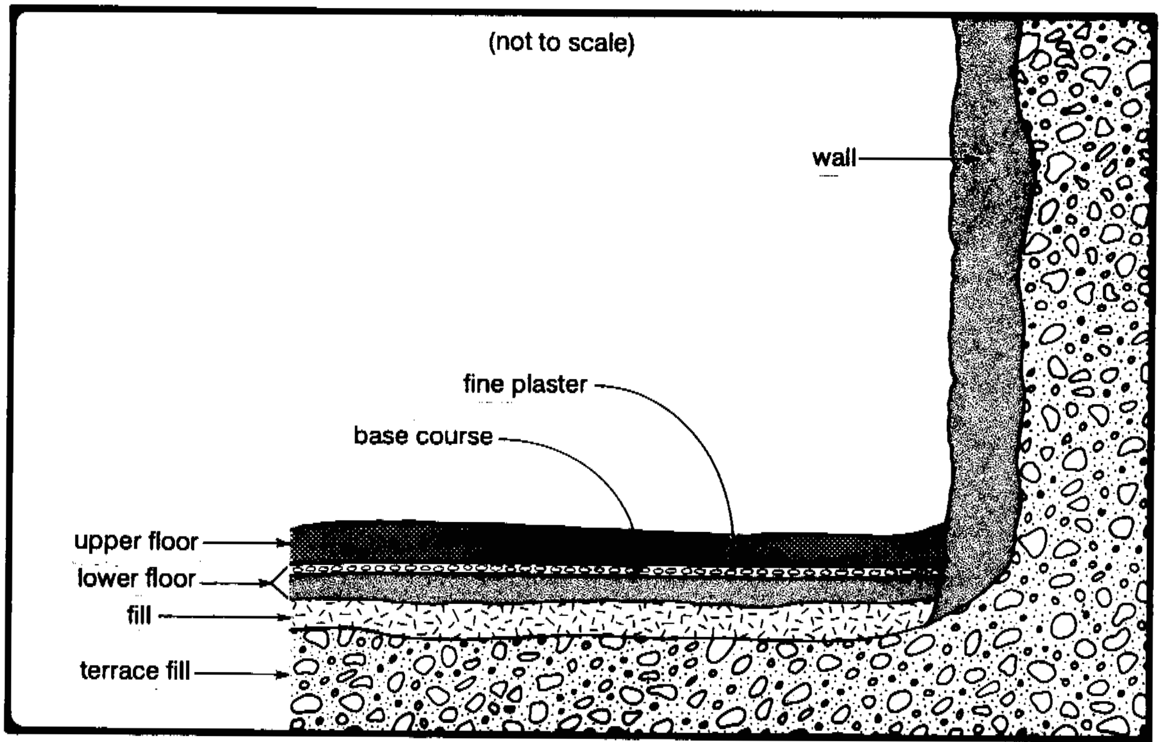

Figure 29. LA 2742, profile of wall and floor abutment, showing details of construction.

Only the hearth seems to have been altered during the first remodeling. While other changes may have been made at that time, no evidence of them was found. Remodeling consisted of applying a layer of adobe to the hearth interior, decreasing its circumference and depth. The remodeled hearth was considerably smaller than the original and had vertical rather than sloping walls, with a new collar only a few centimeters high and wide.

The lower floor surface became worn and deteriorated with use, and its condition may have contributed to the decision to undertake a major remodeling. There does not seem to have been an occupational hiatus before this remodeling occurred. The upper floor rested directly upon the lower floor, and there were no intervening deposits. Many changes were made to the interior of the structure during this remodeling episode. A new floor was installed, though no evidence of it was found in the southeast quadrant. A new floor may not have been needed in that area if the original was still usable. However, it is more likely that the new floor was contiguous across the structure and was obscured by rodent activity or some other sort of disturbance in that area.

Figure 30b shows the features associated with the upper floor. Interestingly, though the upper floor was not screened during excavation, several ornaments were recovered from its matrix, suggesting that they were intentionally placed in it, perhaps as offerings. They included a ground and polished fragment of large mammal hornsheath, two marine shell pendants, and two marine shell ornaments.

Coinciding with construction of the new floor, major changes were made to the hearth, ash pit, and ventilator chamber opening. The hearth retained the size and shape of its first remodeling, but a new, much taller and thicker collar was added. In addition, its interior basin was relined with a thin layer of adobe. The new ash pit was much deeper and had a smaller diameter than the original. It may have had a low collar, but this was difficult to ascertain because of rodent disturbance. Unlike the original ash pit, the sides of the new version were lined with adobe, though the bottom was apparently left unplastered. Since the upper floor covered the original damper sill at the ventilator chamber opening, a new sill nearly the height of the original inner collar was added.

The anvil (Feature 5) set into the lower floor north of the hearth/ash pit complex was left exposed when the new floor was added, though it was now flush with the floor surface rather than projecting above it. It is likely that the basin metate reused as an anvil (Feature 6) set in the lower floor south of the hearth/ash pit complex was treated in the same fashion, though the condition of the floor in that area made this impossible to ascertain. Finally, a possible sipapu (Feature 12) was added on an axis with the hearth/ash pit complex and ventilator chamber opening.

Only cosmetic changes were made to the structure during the first and second remodelings. The third, and final, remodeling involved modification of the interior support system in which both original support posts on the west side of the pithouse (Features 10 and 11) were replaced and removed. One possible scenario is that new postholes (Features 8 and 9) were dug south of each feature, and new supports were set in them before the originals were removed. Since the new posts were out of alignment with the roof beams, it is possible that a beam was set across the new posts to help support the roof before the old posts were removed. To withdraw the original posts, the roof had to be supported or removed. There would have been no reason to reposition the posts if the roof was removed; it would have been easier and more sound structurally to set new posts in the same positions as the old. Thus, the roof seems to have been left in place while the support system was altered. The old posts were removed by excavating a hole through the upper floor around each of them. They were probably removed because they were rotten. A stub at the bottom of Feature 10 represented the base of an original post that broke during removal, supporting the idea that the post was rotten at the time of removal.

When a plan of the remodeled roof was drawn, a problem became apparent (Fig. 30c). This reconstruction would have been structurally unsound, since a beam placed across the tops of the posts set in Features 8 and 9 (Beam A) would have supported only the southwest corner of the roof, and the northwest corner would have collapsed. This suggested three possibilities: (1) there was a third support post for which no evidence was found; (2) two new beams rather than one were put in to support the roof; (3) this reconstruction is faulty.

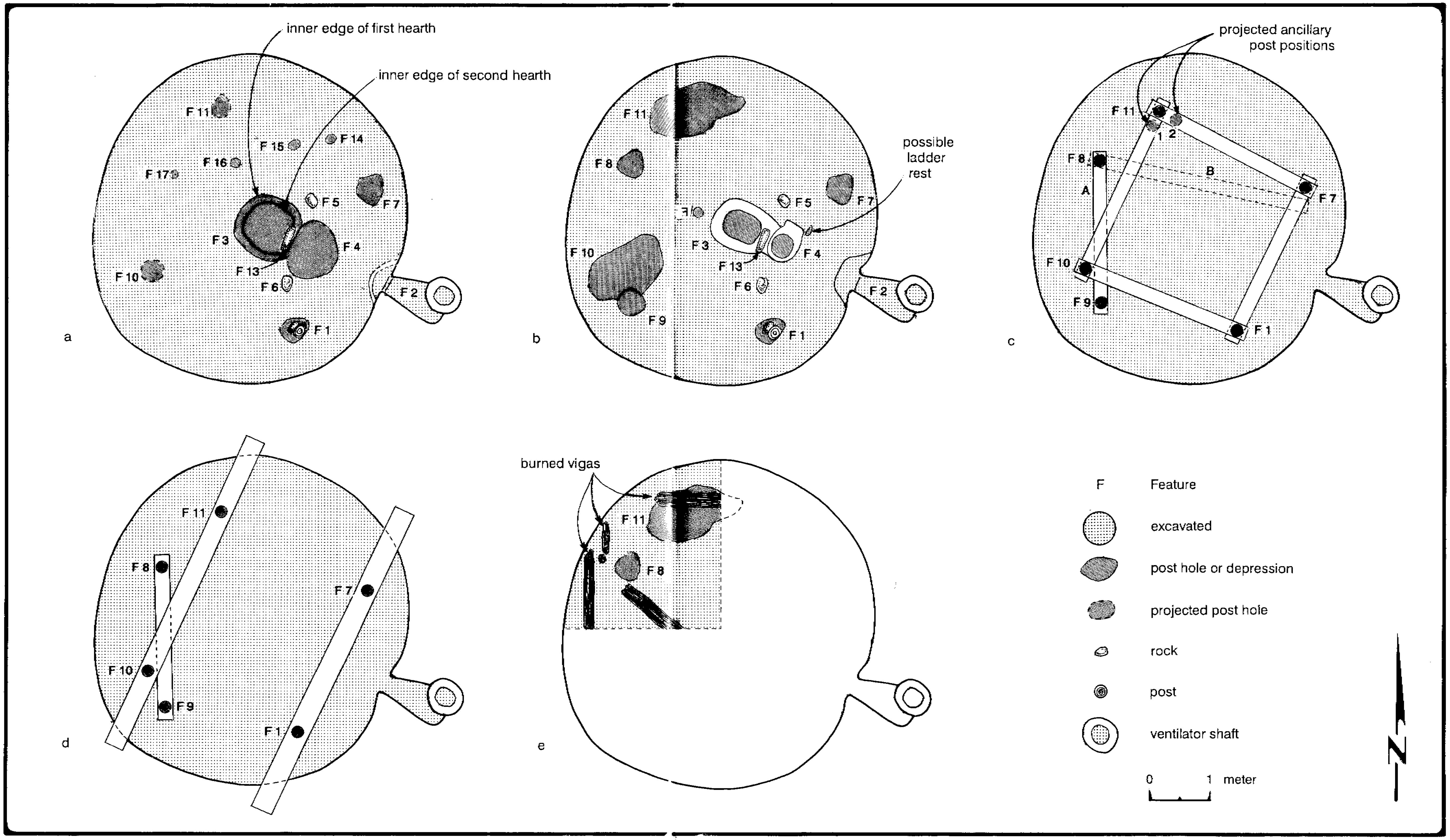

Figure 30. LA 2742: (a) lower floor features; (b) upper floor features; (c) reconstruction of post and beam locations, and details of last remodeling; (d) reconstruction of roof, based on reroofed kiva at TA-26; (e) plan view of northwest quadrant of pithouse, showing locations of burned vigas in relation to postholes (Features 8 and 11).

An additional support post may have been placed next to the original in the area disturbed during its removal. If the north-south beams were the main roof supports, the ancillary post would have been in position 1, as illustrated in Figure 30c. If the east-west beams were the main supports, it would have been in position 2. A second possibility is that there were two beams (A and B), especially if the east-west beams were the main roof supports.

These scenarios depend on supposition rather than fact. It is more likely that the roof was originally supported by a system similar to that used in reroofing a kiva at site TA-26 near Pot Creek Pueblo. That reconstruction is based on techniques still used at Picuris Pueblo (R. Mermejo, personal communication). The main load-bearing beams were probably longer than the structure, and their ends were set in trenches outside the pithouse. Thus, the upright posts provided supplemental support inside the structure but did not bear the entire weight of the roof. This reconstruction is illustrated in Figure 30d. One supplemental support was probably sufficient if the interior supports did not bear the entire weight of the roof.

Post-Abandonment History of the Structure

An orderly abandonment of the pithouse is likely, possibly with the intention of returning at a later date. Several lines of evidence support this conclusion:

(1) The structure was cleaned out before it was abandoned. The only artifacts in contact with the floor were a metate, a mano, a polishing stone, and a possible cobble tool. While other artifacts were found near the floor, none was in direct association, and they were probably washed in at a later time.

(2) The pithouse was sealed at the time of abandonment. A trough metate was placed across the ventilator chamber opening and may have been mortared in place. Shaped slabs and a layer of melted adobe were found directly above the hearth during excavation. Their haphazard arrangement indicated they were not purposefully set in place. Because pithouse entrances also served as smoke holes, they were normally located above the hearth. The location and arrangement of the adobe and slabs in the fill above the hearth suggest they were used to seal the entrance and fell into the pithouse as it deteriorated.

(3) A layer of duff (Stratum 11) was directly above the floor in places, especially along the west wall. This organic material may have been used for bedding or a similar purpose. As it occurs under strata deposited when the structure began deteriorating, it must have been on the floor when the pithouse was sealed.

The pithouse was never reoccupied, probably because of rapid decay after abandonment. The upper 1.5 m of wall was badly deteriorated. Deterioration on the west side of the structure was probably caused by construction in the 1950s. However, wall damage on the east side was older. The wall above and south of the ventilator was partially collapsed and leaned inward at such an extreme angle that it had to be removed during excavation. A layer of water-deposited sediments was directly above the floor in the southeast quadrant below this section of wall, sloping down toward the center of the structure. This was Stratum 10b, which seemed to have washed in through the collapsed wall segment. Because these sediments abutted the adobe and shaped slabs found above the hearth, the structure had probably been abandoned for some time before the wall collapsed. Stratum 10b also abutted the metate sealing the ventilator opening, holding it in place. Pressure from sediments in the ventilator chamber eventually broke the metate. Its upper quarter was pushed into the structure, and sediments spilled out of the ventilator opening to form Stratum 10a.

Following these events, Strata 8 and 9 washed in through the entrance hatch. We know they came in through the entrance because both were mounded in the center of the room and lay above Strata 10a and 10b as well as the adobe and slabs that covered the hearth. Stratum 8 may have also washed in through the break in the southeast wall because it was thickest along the wall of that quadrant.

The structure next appears to have burned, and usable roof materials were salvaged. The burning seems to have occurred first because parts of at least five burned vigas and a post were left behind when other materials were removed. The viga sections were in Stratum 7, a jumbled layer of roof materials mixed with water-deposited sediments. Most of the viga sections were near the top of the unit, and the soil around them was oxidized. This suggests that much of Stratum 7 was deposited before the roof collapsed and that part of the roof was burning when it fell since soil was only oxidized around the vigas rather than throughout the stratum, as would be expected had the entire roof burned. The fire was probably not intense because there was no layer of charcoal and ash. None of the viga sections was completely carbonized.

It is likely that unburned roof materials were salvaged soon after the structure burned. Three posts (Features 7, 8, and 9) seem to have simply been pulled out of the structure because there was no evidence of digging around them. The southeast post (Feature 1) was left behind because it was burned. As illustrated in Figure 30e, an undisturbed burned viga was found above Feature 11. This indicates that the post associated with that feature was removed before the structure collapsed. Had it been removed after the collapse, the viga would have been disturbed during excavation.

The pithouse filled naturally after being salvaged. Six levels of colluvial fill were defined (Strata 1 through 6). Evidence of at least three fires was visible in these levels. A 3 cm thick ash lens was at the base of Stratum 2, a 5 cm thick ash lens was at the top of Stratum 5 (in places overlying oxidized soil), and the upper part of Stratum 6 was oxidized to a depth of 4 cm and covered with a 3 cm thick ash lens. These lenses are probably indications of forest fires, especially those in Strata 5 and 6, where soil oxidation indicates intense heat. Variations in colluvial strata may also be related to fires, resulting in intensified erosion after each burn. This may have caused the textural variations that allowed strata to be differentiated. Eventually the pithouse was completely filled and indistinguishable from the natural terrace surface.

Dating the Site

Four types of chronometric samples from LA 2742 were submitted for dating, including one tree-ring, four archaeomagnetic, seven radiocarbon, and three obsidian hydration samples. The dates acquired through these analyses vary widely, and both radiocarbon and obsidian hydration analyses yielded wide ranges of dates, many apparently too early.

One tree-ring sample was submitted to the University of Arizona Laboratory of Tree-Ring Research. The sample (TNM-23) was a burned piece of ponderosa pine recovered from pithouse fill, probably a viga fragment from the roof of the structure. The interior date was A.D. 1018p (pith ring present), and the exterior date was A.D. 1122vv. There is no way of estimating how far the last ring is from bark and thus no way to determine exactly how long after A.D. 1122 the viga was cut, but it shows that the structure was built after that date.

Four archaeomagnetic samples were analyzed by Daniel Wolfman of the Office of Archaeological Studies. They included samples from a burned zone in Stratum 6, the original hearth, and both remodeled hearths. Results are shown in Table 6. Because of its high α_{95} value, no date could be assigned to the sample from Stratum 6, which represented a postoccupational burn. All three samples from the hearth had low α_{95} values and were assigned dates centering around A.D. 1200. There was no statistically significant difference between these samples (Daniel Wolfman, personal communication), and they provide a date range of A.D. 1195 to 1220. This is consistent with the tree-ring date and shows that the structure was occupied in the late A.D. 1100s or early A.D. 1200s.

Radiocarbon samples from a variety of proveniences within the site are listed in Table 7. None of the radiocarbon dates corresponds with those provided by the archaeomagnetic and tree-ring analyses. Both of the corn cob samples yielded dates that are much too early, as are those from the support posts. The latter can probably be dismissed as "old wood," since they come from the cores of juniper logs. It is also possible that the early date for the hearth sample has a similar source. In all, only the midden and ash pit samples come close to corresponding with the other dates, and then only at the second standard deviation. There is a 95 percent chance that the midden sample dates between A.D. 890 and 1170, and the ash pit sample between A.D. 900 and 1250 (calibrated dates). Clearly, when compared with other dating methods, the radiocarbon analysis leaves much to be desired. The results could indicate a date 200 years or more earlier than the actual time of occupation.

Table 6. LA 2742, archaeomagnetic analysis

Sample No.	Location	Lat.	Long.	α_{95}	δp	δm	N	Demag.	Date (A.D.)
PC510	Stratum 6	81.9	185.4	6.0	6.5	8.8	8/8	NRM	-
PC537	original hearth	77.6	199.1	1.4	1.7	2.2	8/8	50	1170-1230
PC663	hearth-first remodeling	78.1	185.8	1.5	1.7	2.2	8/7	200	1170-1230
PC609	hearth-second remodeling	78.4	195.9	2.5	2.9	3.8	8/8	NRM	1175-1245
-	average of hearth samples	78.1	193.9	1.0	1.2	1.6	24/23	-	1195-1220

Table 7. LA 2742, radiocarbon analysis (ranges are at one standard deviation)

Sample No.	Type and Provenience	Uncorrected Date, A.D.	C-13 Adjusted Date and Range, A.D.	Calibrated Date(s) and Range(s), A.D.
Beta-46595	charcoal from midden (107N/113W)	1000±70	940±70 (870-1010)	1015 (974-1039)
Beta-46596	corn cob from pithouse fill	880±120	650±120 (530-770)	681 (640-880)
Beta-46597	corn cob from pithouse fill	1100±130	900±130 (770-1030)	991 (880-1050, 1091-1119, 1143-1153)
Beta-46599	charcoal from ash pit (Feature 4)	1030±80	990±80 (910-1070)	1030 (999-1166)
Beta-46600	support post fragment (Feature 10)	860±60	810±60 (750-879)	891 (810-849, 851-975)
Beta-46601	support post fragment (Feature 1)	730±70	690±70 (620-760)	725, 735, 766 (669-860)
Beta-47036	charcoal from upper hearth (Feature 3)	790±60	780±60 (720-840)	883 (780-953)

Three pieces of debitage were submitted for obsidian hydration analysis (Table 8). Dates were calculated using ground temperature and humidity data from both Sagebrush Pueblo and Pot Creek Pueblo (Ridings 1991). The correspondence of dates derived using this method to those provided by other chronometric techniques depends on which ground temperature and humidity figures are used. Using the Sagebrush Pueblo data, the early end of the range for sample 91-520 corresponds to the archaeomagnetic dates. Unfortunately, most of this range seems too late. Both of the other samples dated far too early when compared with other chronometric data. The Pot Creek Pueblo temperature and humidity figures seem to yield more accurate results. While one sample (91-520) seems to date a century too late, the others correspond more closely to the dates suggested by other chronometric data. Because LA 2742 is on the same side of the valley as Pot Creek Pueblo and the opposite side from Sagebrush Pueblo, the ground temperature and humidity regime would be expected to more closely resemble the former. That the use of those figures provide dates more closely approximating those provided by other chronometric techniques lends support to that conclusion.

Table 8. LA 2742, obsidian hydration analysis

Sample	Source	EHT (°C)	Rate	Rim Width	SD	Date (A.D.)	SD	Date Range
91-519[1]	Polvadera	10.8	100%	2.42	0.07	952	±83	869-1035
91-519[2]		12.6				1148	±68	1080-1216
91-520[1]	Polvadera	12.2	96%	2.13	0.07	1256	±66	1190-1322
91-520[2]		13.6				1329	±25	1304-1354
91-521[1]	Polvadera	12.2	96%	2.51	0.07	987	±78	909-1065
91-521[2]		13.6				1132	±67	1065-1199

[1] Temperature and relative humidity data from Sagebrush Pueblo (Ridings 1991).
[2] Temperature and relative humidity data from Pot Creek Pueblo (Ridings 1991).

Pollen Analysis

Four pollen samples were analyzed at the University of New Mexico's Castetter Laboratory for Ethnobotanical Studies (CLES). They included two from Feature 18 (burial) and two from midden fill (Dean 1991a:14-16). One of the burial samples (CLES-90224) was from material adhering to the back of the skull, and the other was from the abdominal cavity (CLES-90225). Midden samples were from grids 107N/114W (CLES-90211) and 106N/114W (CLES-90223). Results are presented in Table 9. It is surprising that neither midden sample contained corn (*Zea*), prickly pear (*Platyopuntia*), cholla (*Cylindropuntia*), or chicory/dandelion (*Cichorieae*) pollen, since they are common

Table 9. LA 2742, pollen analysis

Taxon	Midden Samples				Burial Samples			
	CLES-90211		CLES-90223		CLES-90224 (beneath skull)		CLES-90225 (abdominal cavity)	
	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]
Pinaceae	18	1,452	54	784	27	852	22	710
Pinus	30	2,420	65	944	72	2,273	80	2,581
Picea	1	81	-	0	-	0	1	32
Abies	-	0	-	0	-	0	-	0
Juniperus	15	1,210	2	29	3	95	7	226
Juniperus/Populus	-	0	-	0	-	0	-	0
Alnus	-	0	-	0	-	0	-	0
Quercus	-	0	-	0	-	0	-	0
Cheno-am	96[2]	7,744	54[2]	784	41[2]	1,294	44[2]	1,420
Ephedra	1	81	1	15	3	95	-	0
Gramineae	-	0	5	73	-	0	1	32
Zea	-	0	-	0	[4]	19	56[2]	1,807
Low-spine composite	10	807	9	131	4[2]	126	5	161
Artemisia	-	0	1	15	-	0	1	32
High-spine composite	-	0	1	15	7	221	1	32
Cichorieae	-	0	-	0	5	158	11	355
Opuntia	-	0	-	0	-	0	-	0
Cylindropuntia	-	0	-	0	2	63	1+[3]	28
Platyopuntia	-	0	-	0	1	32	7	226
Unknown	0	0	1	15	0	0	0	0
Unidentifiable	48 (22%)	3,872	24 (11%)	348	32[2] (16%)	1,010	19[2] (8%)	613
Total pollen	218	17,667	217	3,153	201	6,238	256	8,255
Spike	18		100		46		45	

[1] Pollen concentration expressed as estimated number of pollen grains per gram of sample.
[2] One or more clumps of three or more grains seen during count.
[3] One or more grains seen during scan of slide after count completed.
[] Number of grains seen during 200 grain count; final pollen concentration computed using total number of pollen type:spike grains on slide to compensate for uneven distribution of pollen type on slide.

in both burial samples. Dean (1991a:15) notes that half the corn pollen grains from the abdominal cavity were torn or identified from isolated pores, indicating that they had been ground. The presence of prickly pear, chicory/dandelion, and cholla pollen in both samples suggests that they were intentionally placed in the grave, perhaps as burial offerings. Corn pollen in the sample from the back of the skull probably also represents material intentionally placed in the grave, while that in the sample from the abdominal cavity may be from cornmeal sprinkled over the body at the time of burial, or part of a last meal, or both. While cholla and prickly pear pollen could be derived from dried buds, it is likely that the *Cichorieae* pollen came from fresh flowers (G. Dean, personal communication). The high percentage of pine pollen in the burial samples suggests that the grave was covered with pine boughs before it was sealed with stone slabs (Dean 1991a:15). Thus, it is likely that the burial occurred sometime during the spring or summer months.

Pollen in the midden samples represents the natural pollen rain as well as vegetal matter discarded during occupation of the pithouse. The latter process may account for sample CLES-90211, where the percentages of pine and cheno-am pollens are very high, as is the overall pollen content (Dean 1991a:15). Arboreal pine and juniper pollen make up relatively large percentages of both midden samples (29 and 56 percent), as do cheno/ams (44 and 25 percent). A surface control sample from LA 71190 contained 76 percent arboreal pine and juniper pollen and only 6 percent cheno-ams. While distance and large amounts of unidentifiable pollens in the midden samples render tentative any conclusions, these differences may indicate a less wooded, more open and disturbed environment at the time the midden was being used. Conversely, they could also indicate that cheno-ams were an important food source, particularly at the time of flowering. This is analogous to the situation observed at Loose's (1974) north area sites, and lends support to our contention that the differences between Loose's prehistoric and modern control samples reflect prehistoric land use patterns, including forest clearing and its consequences.

Human Remains

The remains of an adult female 45 to 50 years of age and 154.4 cm (5 ft 1 in) in height were recovered during the excavation of the midden area north of the pit structure at LA 2742 (Fig. 31). The individual was lying in a prone, flexed position with her lower torso slumped to the right side from postdepositional pressure. The top of the cranium was toward the northeast, and her body extended to the southwest. Her right arm extended above her cranium and was bent at the elbow, so the elements of the hand, when present, would have been under the cranium. The left arm was extended along the left side of the body. Both legs were flexed to the chest, with the left leg above the right, and the innominate and sacrum overlying these limbs. The torso was nearly straight and followed the slope of the midden and original ground surface. The burial

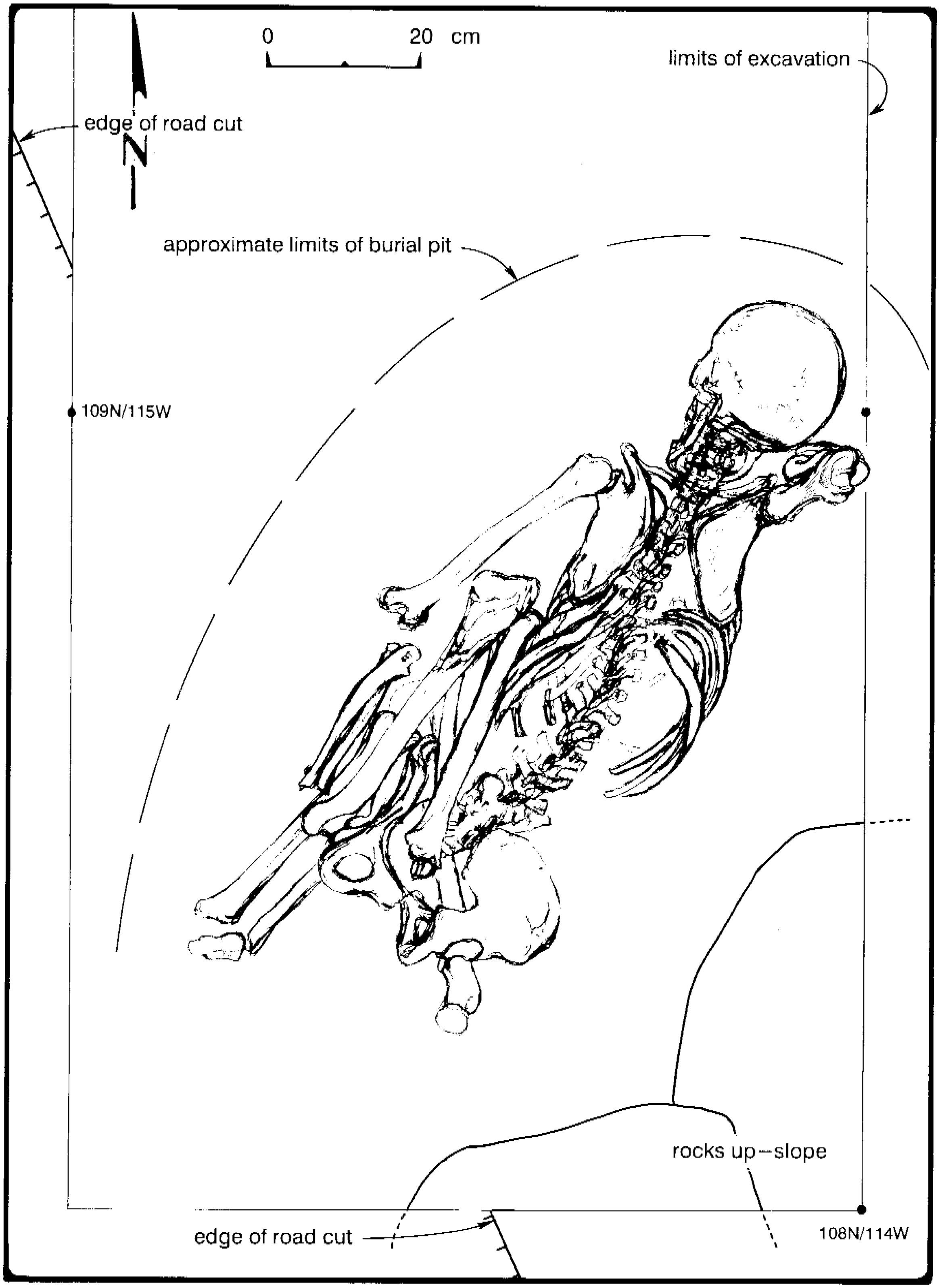

Figure 31. LA 2742, plan of burial (Feature 18).

pit (Feature 18), if present, was quite ephemeral and shallow. It was heavily disturbed by rodent burrowing in the area. In addition, a shallow pit could have been excavated into this midden area and not be readily apparent because it was filled with similar matrix. There were numerous cobbles over and around the burial, suggesting that it was covered by cobbles as part of interment.

This individual was generally well preserved, though some erosion was present on the long bones of the left side. The remains were fairly complete. Four cervical vertebrae and most of the hands and feet were missing. Rodent activity apparently displaced the cervical vertebrae and the elements of the right hand. The other missing elements may have been displaced by the same processes. Since bones of the foot and hand are small and often missing or displaced in burial context, the agent of disturbance can only be assumed in this case.

Cranial Remains

The cranium is complete, though excavation trauma to the left temporal resulted in several displaced fragments that were subsequently refitted. All cranial sutures are fused, and there is some obliteration of the sagittal suture. The parietals exhibit slight bossing.

The most interesting aspects of the cranium are the individual's small palate and dental anomalies. The marked dental anomalies and pathologies are the result of inherited traits and pathological tooth loss. The congenital lack of a tooth or teeth (agenesis) is an inherited trait, though nondevelopment of a permanent tooth bud may have nutritional implications as well. In order to determine true agenesis from noneruption, radiographs were done of the articulated cranium and mandible, and the palate (Figs. 32 and 33). Figure 32, a panoramic radiograph of the articulated cranium and mandible, shows no unerupted teeth in either the maxilla or mandible. This is consistent with a lack of any bulging in the maxillary or mandibular cortical tissue in these areas. The radiograph does show the right first premolar erupting through the maxillary tissue near the nasal (also see Fig. 37). Identification of this tooth as a first premolar was made from the partially visible occlusal surface (Fig. 34) and an individual radiograph done of this partially exposed tooth (Fig. 35).

The maxilla exhibits several interesting anomalies. The overall dimensions of the palate are small (see inventory, Appendix 2; Fig. 36). The third molars appear to have been lost antemortem, but only the posterior aspect of the sockets are resorbed. The first and second maxillary molars are hyper-erupted due to the early loss of their mandibular counterparts. The right first molar has a large caries on the mesial/occlusal aspect that extends into the dentine layer.

The right second premolar shows heavy wear with dentine exposure, and the left

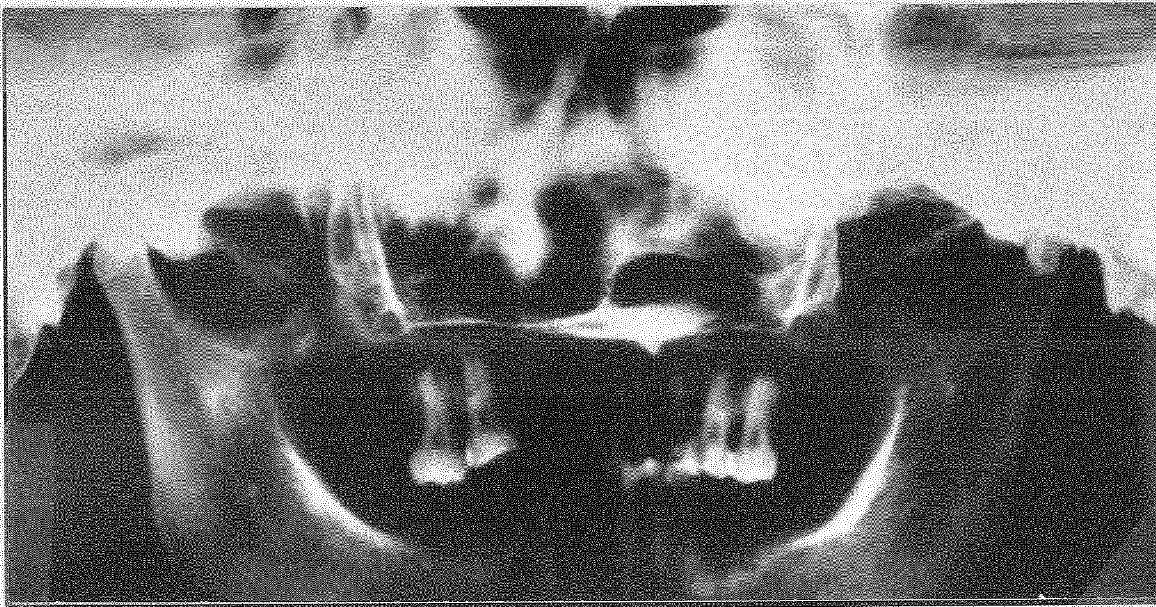

Figure 32. LA 2742, radiograph of articulated cranium and mandible.

Figure 33. LA 2742, radiograph of palate.

Figure 34. LA 2742, photograph of right maxilla.

Figure 35. LA 2742, radiograph of maxillary first premolar.

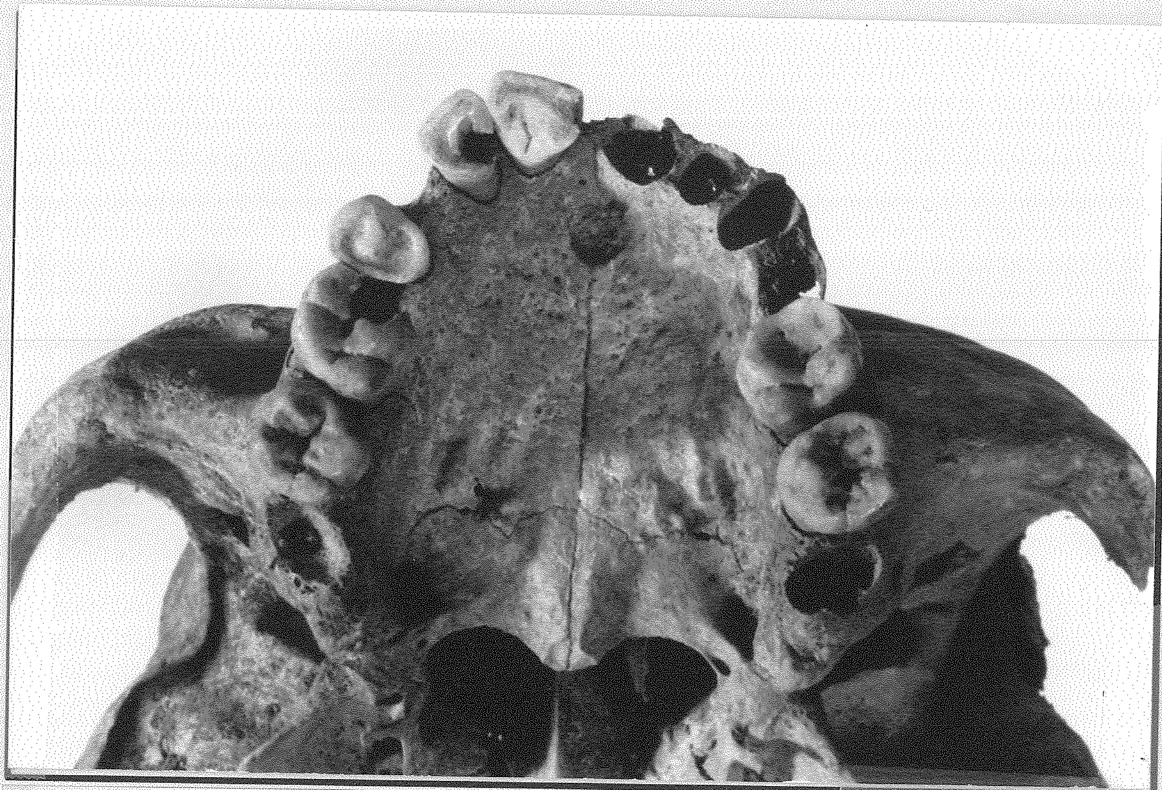

Figure 36. LA 2742, photograph of palate.

Figure 37. LA 2742, photograph of full maxilla.

Figure 38. LA 2742, photograph of mandible.

Figure 39. LA 2742, photograph of left distal femur.

second premolar is missing. The loss of the left second premolar appears to have been antemortem because the socket is ephemeral due to resorption in the area. There is agenesis of the left first premolar with a small space, but no socket occurring at that location in the dental arch. The right first premolar has no space in the dental arch but has partially erupted through the maxillary table near the nasal opening (Fig. 37). There is agenesis of both maxillary canines, a rare phenomenon in prehistoric Anasazi populations, though it has been recorded.

The left lateral and central incisors were lost postmortem, and the right lateral and central incisors are present and exhibit extensive wear. Both are worn into the dentine at a labiolingual angle that suggests that these teeth were used both for cutting and grinding. The right lateral incisor has a caries on the mesiolingual aspect of the neck. The lateral incisors of this individual occluded with the mandibular canines. This resulted in heavy wear to the lateral aspects of the canines. There is also wear on the buccal surface of the lower canines.

The mandible of this individual also exhibits interesting variations. The dimensions of the mandible reflect its small size (see inventory, Appendix 2). It is wide at the condyles but tapers to a distinctly pointed chin (Fig. 38). All of the molars were lost early in this individual's life, as is apparent from the complete resorption of tissue in that area and the hyper-eruption of the maxillary molars. Though the molars are absent, there is some question whether there was space available for the eruption of all three molars. The thinning of the posterior horizontal ramus may suggest agenesis of the third molars, the most common pattern of tooth absence among the Native American populations in the Southwest (White 1990). Given the other congenital absences in this individual, the absence of lower third molars fits a pronounced variation from normal eruption patterns.

The left first and second premolars are missing postmortem. The right first and second premolars exhibit moderate occlusal wear. The left canine is also missing, but the right canine exhibits moderate to heavy wear on the buccal and occlusal surfaces that produced a reduction of the occlusal surface. When the mandible and cranium were refitted, this canine occluded with the maxillary lateral incisor, which is the reason for this distinctive wear pattern.

Both mandibular lateral incisors were congenitally missing (agenesis), resulting in the occlusion described for the one mandibular canine represented. Lack of mandibular lateral incisors has been noted in individuals from the Chaco area (Akins 1986:148) and is another common agenesis noted by White (1990). Both lower central incisors are missing postmortem, but the sockets are present in this almost V-shaped anterior mandible. The distinctly protruding chin is a result of the size of the mandible, the lack of lateral incisors, and the sex of the individual.

The numerous dental anomalies made determination of age from the dentition difficult. Both agenesis of several teeth and early tooth loss produced aberrant occlusal patterns and wear. Further, the diet of the southwestern individuals whose dental wear patterns are used in aging the dentition of skeletal remains was primarily agricultural (Bass 1987:287). Wear on this individual's anterior teeth suggests that her diet was not primarily agricultural.

Postcranial Remains

The postcranial remains of this individual exhibit some interesting disease processes. Osteoarthritis is apparent on several postcranial elements, but the seventh and eighth thoracic vertebrae are the most severely affected. There is evidence of neoplastic lesions in five elements that may have resulted in the death of this individual (Fig. 39). Metastasis is evident, but with only skeletal remains, soft tissue involvement is uncertain. The occurrence of lesions at epiphyseal boundaries of the humerus, ulna, femur, and sacrum, along with small lesions in the right innominate, indicates that this was probably a metastatic carcinoma (White 1990:349; Ortner and Putschar 1985:265). The pattern of lesions most closely follows that described by Ortner and Putschar (1985:264-265) for multiple myeloma, but this condition is rarely found in archaeological remains. The lesions accelerated erosion of these elements so that most measurements of lesion size are close approximations (see inventory, Appendix 2).

Discussion

This single interment of an adult female from an occupation midden area is informative on several fronts. The interment practice is similar to that observed at other Valdez-phase sites. At least one other burial from a site near LA 2742 (a female from LA 3643; Peckham and Reed 1963) does not express the anomalies noted in this individual, making this individual's dental patterns even more intriguing. Finally, the implications that dental anomalies might have for nutritional stress tracking family groups are worth pursuing. More studies on burials from the Valdez phase and later phases in the area could provide critical information on both population migration and population diet.

The interment is similar to the cairn-covered midden burials described by Reed from LA 3643 (Peckham and Reed 1963) and Steen (1976) at LA 14868. Green (1976) states that a number of methods of interment were used during the Valdez phase, but she also notes the occurrence of cairn burials (e.g., TA-18). Dean's (1991a:15) pollen analysis for LA 2742 suggests that pine boughs were used to close the burial before the cobbles were added.

The pollen analysis adds other information on the details of the interment of this individual (Dean 1991a:15). Two samples were taken from the burial, one from the back of the skull and one from the abdominal area, and two samples were taken from the general midden area. The differences between the burial and general samples provide evidence of the last meal and burial activities. A significant number of torn corn pollen grains along with cholla and prickly pear cactus pollen may be indicative of this individual's last meal. The number of cactus pollens is higher in the burial samples, and Dean suggests they were introduced as a food item in the form of unopened flowers and fruits. Since corn pollens are not normally torn even after passing through an individual's digestive tract, these torn corn pollen grains were most likely the result of food preparation by grinding. The concentration of torn corn pollens from the abdominal area of the burial suggests that corn meal was part of the last meal consumed by this individual, though corn meal may also have been sprinkled over the burial before the grave was closed.

The burial position was the result of interment and postdepositional slumping of the body. We also know that rodents have disturbed some of the burial context by churning through the surrounding matrix. These postdepositional processes may have mixed pollens from the abdomen with other areas above and around the burial. Thus, the cactus and corn pollens could have been part of the last meal or from burial offerings made during interment. When compared to the general midden samples, the high frequency of chicory/dandelion pollen within the burial samples also suggests that these yellow to purplish flowers were intentionally placed in the grave before it was closed. The use of these blooms also indicates that the individual died during the late spring, when these flowers are available in the area.

As discussed above, apart from interment practices, this individual expressed a number of interesting anomalies and pathologies. The small palate and mandible noted in this individual was also noted in several of the burials described by Green (1976:61) and the burial described by Reed (Peckham and Reed 1963). The agenesis of maxillary canines, one maxillary premolar, and the mandibular lateral incisors raise questions about dietary stress as well as inheritance. We know from White (1990) and Bass (1987) that agenesis of the third molars and occasional agenesis of the lateral incisors is known from prehistoric Southwestern burials. Agenesis of canines and asymmetrical absence of a left premolar are extremely uncommon occurrences. There is some question as to the origin of such phenomena. Though the absence of the canines may indeed be an additional hereditary expression, the premolar absence may well be the result of early (perhaps in utero) nutritional stress during the period of permanent tooth bud development (Dean and Beynon 1991; Schwartz and Langdon 1991). At this point, either suggestion could be equally valid.

This burial had a pattern of bone lesions that would suggest a multiple myeloma as the likely the cause of death, though any soft tissue involvement can never be ascertained. The individual's age was near the life expectancy for that period, and other complicating factors may have played a part in her death.

Conclusions

This individual has provided evidence on hereditary expression of dental traits, disease, and burial practices during the Valdez phase. This burial expressed a pattern of dental agenesis that extends beyond those more common to this area. Third molar and lateral incisor agenesis fit a pattern previously observed. The absence of upper canines and a left first premolar is much less common and could be useful in tracking inheritance to later populations in the area or periods of extreme food stress.

The cancer noted in this individual may be a hemopoietic form that has been infrequently documented in prehistoric remains. However, a more intensive study of the human remains from the Valdez phase and later phases is required before any pattern can be established. This individual has provided evidence of anomalies and disease that has piqued our interest but provides only one case to date.

Pollen analysis, along with excavation evidence, provide information on the interment practices used for the individual. The suggestion that corn meal was sprinkled over the burial, along with the presence of flowers, indicates that some interment ritual was followed. The pine bough that would have been placed over the body also provides evidence of a more formal interment than the midden area and displaced cobbles might have initially suggested.

Chipped Stone Artifacts

A total of 486 chipped stone artifacts were recovered from LA 2742 (Table 10). Local materials, making up 88 percent of the assemblage, include cherts, undifferentiated igneous rocks, basalt, limestone, quartzite, rhyolite, micaceous schist, and quartz. Nonlocal materials, 12 percent of the assemblage, include Pedernal chert, obsidian, and quartzitic sandstone. Obsidian was imported from the Jemez Mountains, mostly from the Polvadera Peak source. Pedernal chert outcrops near Abiquiu and is found in gravel deposits along the Rio Chama and the Rio Grande south of Española. The source for quartzitic sandstone is unknown, but it may also come from the Chama Valley (Newman 1983).

Reduction debris (debitage and cores) comprises 99 percent of the assemblage. Only nine formal tools were found. They include a chert uniface fragment, a fragment of a Pedernal chert uniface, a basalt chopper, part of a Pedernal chert Pueblo side-notched point that broke during manufacture, a complete obsidian Pueblo side-notched point, a complete basalt En Medio point, the blade of a hafted Polvadera obsidian drill, an unfinished chert biface that snapped at a flaw during manufacture, and a chert biface that was abandoned during manufacture because it was too thick.

Table 10. LA 2742, chipped stone artifact morphology by material type

Material	Artifact Morphology							
	Core Flakes	Biface Flakes	Angular Debris	Cores	Cobble Tools	Unifaces	Bifaces	Totals
Chert	177	0	92	13	0	1	2	285
Pedernal chert	37	0	10	1	0	1	1	50
Obsidian undifferentiated	2	0	0	0	0	0	1	3
Polvadera obsidian	3	0	0	0	0	0	1	4
Igneous undifferentiated	37	0	5	1	0	0	0	43
Basalt	42	2	3	0	1	0	1	49
Rhyolite	2	0	0	0	0	0	0	2
Limestone	27	0	1	2	0	0	0	30
Quartzite	13	0	0	0	0	0	0	13
Quartzitic sandstone	1	0	0	0	0	0	0	1
Micaceous schist	0	0	1	0	0	0	0	1
Quartz	4	0	1	0	0	0	0	5
Totals	345	2	113	17	1	2	6	486

Ground Stone Artifacts

Forty-five ground stone artifacts were recovered. The distribution of functional type by material is listed in Table 11. Sandstone predominates, and, in combination with quartzitic sandstone, comprises over 60 percent of the assemblage. Tools associated with food processing (manos, metates, pestles) make up over 60 percent of the assemblage. Both one- and two-hand manos were found. Metates are represented by basin, trough, and slab forms, the latter predominating. One pestle was found, but mortars are lacking.

Other activities are also suggested by this assemblage. Two types of polishing stones were identified, one used on pottery, the other on plaster. The presence of palettes suggests that pigment was ground to make paint, and a lapidary stone may be evidence of jewelry-making. Hammerstones were used for flintknapping or other activities that involved pounding. At least three tools were multipurpose: two metates were reused as anvils, and a third was reused as a palette.

Two pieces of ground stone, Features 5 and 6, were set into the pithouse floor. Artifacts not assigned a specific function include shaped slabs and unidentified fragments. Several of the former were found above the hearth in pithouse fill and probably represent

Table 11. LA 2742, ground stone artifact function by material type

Function	Material Type									
	Igneous undiff.	Basalt	Vesicular Basalt	Sedimentary undiff.	Sandstone	Siltstone	Quartzite	Quartzitic sandstone	Mica	Totals
Indeterminate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.2
Polishing stone	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	2 4.4
Shaped slab	0 0.0	0 0.0	0 0.0	3 37.5	3 37.5	0 0.0	0 0.0	1 12.5	1 12.5	8 17.8
Anvil	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	1 2.2
Palette	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
Lapidary stone	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.2
Hammerstone	0 0.0	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	2 4.4
Mano indeterminate	1 50.0	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
One-hand mano	2 25.0	0 0.0	0 0.0	0 0.0	4 50.0	0 0.0	0 0.0	2 25.0	0 0.0	8 17.8
Two-hand mano	1 25.0	0 0.0	0 0.0	0 0.0	2 50.0	0 0.0	0 0.0	1 25.0	0 0.0	4 8.9
Basin metate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.2
Trough metate	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	2 4.4
Slab metate	0 0.0	1 10.0	0 0.0	0 0.0	5 50.0	0 0.0	0 0.0	4 40.0	0 0.0	10 22.2
Pestle	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.2
Totals/ Percent	5 11.1	1 2.2	1 2.2	4 8.9	18 40.0	2 4.4	3 6.7	10 22.2	1 2.2	45 100.0

Table 12. LA 2742, ground stone artifact function by preform morphology

Function	Preform Morphology								
	Indeterminate	Rounded cobble	Core	Chunky or angular	Flattened cobble	Thick slab	Thin slab	Very thin slab	Totals
Indeterminate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.2
Polishing stone	0 0.0	1 50.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	2 4.4
Shaped slab	2 25.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 50.0	2 25.0	8 17.8
Anvil	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.2
Palette	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 50.0	2 4.4
Lapidary stone	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.2
Hammerstone	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
Mano indet.	0 0.0	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	2 4.4
One-hand mano	1 12.5	1 12.5	0 0.0	1 12.5	3 37.5	0 0.0	0 0.0	2 25.0	8 17.8
Two-hand mano	0 0.0	0 0.0	0 0.0	0 0.0	3 75.0	0 0.0	0 0.0	1 25.0	4 8.9
Basin metate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.2
Trough metate	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
Slab metate	5 50.0	0 0.0	0 0.0	0 0.0	0 0.0	1 10.0	1 10.0	3 30.0	10 22.2
Pestle	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.2
Totals/ Percent	12 26.7	3 6.7	1 2.2	2 4.4	9 20.0	1 2.2	6 13.3	11 24.4	45 100.0

Table 13. LA 2742, ground stone artifact function by labor invested in production

Function	Labor Investment				
	None (natural form)	Slightly modified	Mostly modified	Fully shaped	Totals
Indeterminate	0 0.0	1 100.0	0 0.0	0 0.0	1 2.2
Polishing stone	1 50.0	1 50.0	0 0.0	0 0.0	2 4.4
Shaped slab	0 0.0	4 50.0	2 25.0	2 25.0	8 17.8
Anvil	1 100.0	0 0.0	0 0.0	0 0.0	1 2.2
Palette	0 0.0	0 0.0	1 50.0	1 50.0	2 4.4
Lapidary stone	0 0.0	1 100.0	0 0.0	0 0.0	1 2.2
Hammerstone	1 50.0	1 50.0	0 0.0	0 0.0	2 4.4
Mano indet.	0 0.0	0 0.0	2 100.0	0 0.0	2 4.4
One-hand mano	0 0.0	5 62.5	2 25.0	1 12.5	8 17.8
Two-hand mano	0 0.0	0 0.0	4 100.0	0 0.0	4 2.2
Basin metate	0 0.0	0 0.0	1 100.0	0 0.0	1 2.2
Trough metate	0 0.0	0 0.0	0 0.0	2 100.0	2 4.4
Slab metate	0 0.0	1 10.0	4 40.0	5 50.0	10 22.2
Pestle	0 0.0	0 0.0	0 0.0	1 100.0	1 2.2
Totals/ Percent	3 6.7	14 31.1	16 35.6	12 26.7	45 100.0

Table 14. LA 2742, ground stone artifact function by portion

Function	Portion						
	Indeterminate	Whole	End fragment	Edge fragment	Corner	Only corner(s) missing	Totals
Indeterminate	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.2
Polishing stone	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	2 4.4
Shaped slab	1 12.5	1 12.5	3 37.5	0 0.0	2 25.0	1 12.5	8 17.8
Anvil	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.2
Palette	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	1 50.0	2 4.4
Lapidary stone	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.2
Hammerstone	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
Mano indet.	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	2 4.4
One-hand mano	0 0.0	7 87.5	0 0.0	0 0.0	0 0.0	1 12.5	8 17.8
Two-hand mano	0 0.0	3 75.0	1 25.0	0 0.0	0 0.0	0 0.0	4 8.9
Basin metate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.2
Trough metate	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 4.4
Slab metate	0 0.0	6 60.0	0 0.0	2 20.0	1 10.0	1 10.0	10 22.2
Pestle	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.2
Totals/ Percent	2 4.4	23 51.1	7 15.6	2 4.4	6 13.3	5 11.1	45 100.0

materials used to seal the entrance after abandonment. A shallow trough metate was used to seal the ventilator opening, and a second was found on the pithouse floor.

Table 12 illustrates ground stone function by preform morphology. About 40 percent of the assemblage was manufactured from very thin to thick slabs. Another 12 percent was fashioned from round or flat cobbles. Only three artifacts were made from cores or irregular chunks of material. Preform morphology could not be determined for more than a quarter of the assemblage. Table 13 shows the amount of labor invested in producing each functional category. Only a few artifacts are unshaped, including a polishing stone, an anvil, and a hammerstone. Roughly a third of the assemblage was slightly modified, while nearly two-thirds was mostly modified or fully shaped. Both palettes, the pestle, and most of the metates fit into the latter category. About 60 percent of the manos were mostly modified to fully shaped, and the rest were at least partially modified. Thus, grinding tools had the most labor invested in their manufacture, while tools used for pounding and rubbing had the least.

Table 14 shows ground stone function by portion. Slightly more than half of the ground stone artifacts are whole. About half the metates and 71 percent of the manos are whole. Other complete artifacts include an anvil, a polishing stone, a shaped slab, and two hammerstones. Table 15 shows portion by production labor investment. All unshaped artifacts are whole. While 58 percent of the lightly modified and 63 percent of the mostly modified tools are broken, only 33 percent of the fully shaped artifacts are broken. Except for the latter, the percentage of whole artifacts decreases with the amount of labor invested in production. Whole artifacts found on the pithouse floor include a trough metate, two one-hand manos, and the trough metate used to seal the ventilator opening. Even with these artifacts removed from consideration, half of the fully shaped ground stone artifacts were discarded while whole. While a basin metate set into the floor is missing a corner, it was reused as an anvil and, thus, is whole if only secondary use is considered. Two unshaped artifacts, a hammerstone and anvil, were also found on the floor. These seven complete artifacts seem to have been left behind as site furniture.

It is possible that other whole tools also fall into the category of site furniture. As discussed earlier, the pithouse was sealed when it was abandoned, perhaps with the intention of reoccupying it at a later date. Some of the other complete ground stone tools may have also been intentionally left behind rather than discarded. Indeed, 11 of the other 17 whole ground stone tools were recovered from pithouse fill. These artifacts may have been cached on the roof or the nearby ground surface and deposited with the fill after the structure collapsed.

Table 15. LA 2742, ground stone portions by labor invested in production

Portion	Labor Investment				
	None (natural) form	Lightly modified	Mostly modified	Fully shaped	Totals
Indeterminate	0 0.0	2 100.0	0 0.0	0 0.0	2 4.4
Whole	3 13.0	6 26.1	6 26.1	8 34.8	23 51.1
End fragment	0 0.0	3 42.9	3 42.9	1 14.3	7 15.6
Edge fragment	0 0.0	0 0.0	2 100.0	0 0.0	2 4.4
Corner	0 0.0	1 16.7	3 50.0	2 33.3	6 13.3
Only corner(s) missing	0 0.0	2 40.0	2 40.0	1 20.0	5 11.1
Total/ Percent	3 6.7	14 31.1	16 35.6	12 26.7	45 100.0

Ceramic Artifacts

The ceramic assemblage from LA 2742 is summarized here (for a detailed discussion see Ceramic Analysis. The assemblage consists mainly of locally made prehistoric types. A minimal number of intrusive types, including Wiyo Black-on-white, Santa Fe Black-on-white, and Red Mesa Black-on-white are also found in the assemblage. The total number of sherds collected and analyzed is 2,856. Of these, 83.3 percent are plain wares, and 16.7 percent are white wares, a ratio of 5:1. Within the plain wares, 98.6 percent are jar sherds. Within the white wares, 63.5 percent are bowl sherds, 27.7 percent are jar sherds, and 7.9 percent are of an indeterminate form (Table 16).

More than half of the assemblage (55.1 percent) was from the pithouse, and 30.1 percent was from the midden. Other proveniences from which ceramics were collected were surface stripping, surface collection, and test pits.

The ceramic assemblage at LA 2742 is characteristic of the Valdez phase. The white wares are dominated by Taos/Kwahe'e Black-on-white, though there is a minimal amount (0.1 percent) of later intrusive white wares from the northern Rio Grande (Santa Fe Black-on-white and Wiyo Black-on-white). Most of the plain wares (68.7 percent) are Taos Gray plain or incised/linear (10.2 percent). Corrugated and other textured varieties of Taos Gray, which are more common in the subsequent Pot Creek phase, were found in very low frequencies (Table 17).

Table 16. LA 2742, summary of ceramic ware vessel forms

Plain Ware Vessel Forms	Percent
Jar	98.6
Bowl	0.5
Indeterminate	0.7
Canteen	less than 0.0
Pipe	less than 0.0
Cloud blower	less than 0.0
White Ware Vessel Forms	
Jar	27.7
Bowl	63.5
Indeterminate	7.9
Ladle	0.6
Canteen	0.2

Faunal Remains

The pithouse and shallow midden area produced all of the 260 bone fragments recovered from LA 2742. The majority of the bone (87.7 percent) was removed from the pithouse fill that apparently washed in from a trash area around the structure. Only 32 bone fragments, 12.3 percent of the sample, were recovered from the excavation of approximately 60 percent of the midden area. This difference is most likely due to preservation. Bones in the shallow midden area would have been exposed to environmental factors (e.g., leaching and root action) to a much greater extent than those in the deep, stratified fill of the pithouse; therefore, more intact bone would be expected in the latter context. Since division of the bone from these two areas would be impractical given these conditions, the bone from them will only be compared for environmental alterations. Taxon identified, element distributions, butchering, and other taphonomic considerations will be presented for the assemblage as a whole.

Table 18 presents the frequency and percentage of taxonomic identifications. The assemblage is dominated by small mammal species that may or may not be intrusive (see

Table 17. LA 2742, ceramic type by vessel form, frequencies and percentages

Type	Indeterm.	Jar	Bowl	Ladle	Canteen	Pipe	Total
Unknown	1 .0	2 .1	3 .1				6 .2
Taos Black-on-white	7 .2	66 2.3	229 8.0	2 .1	1 .0		305 10.3
Santa Fe Black-on-white		3 .1	3 .1				6 .2
Santa Fe Black-on-white, local		2 .1					2 .1
Wiyo Black-on-white		1 .0					1 .0
Indeterminate mineral white ware	1 .0	5 .2	7 .2				13 .5
Indeterminate carbon white ware			7 .2				7 .2
Indeterminate white ware	29 1.0	57 2.0	59 2.1	1 .0			146 5.1
Taos Gray Plain	13 .5	1,934 67.7	13 .5		1 .0	2 0.1	1,963 68.7
Taos Gray Incised, linear		291 10.2					291 10.2
Taos Gray Incised, herringbone		33 1.2					33 1.2
Taos Gray Incised, linear		14 .5					14 .5
Taos Gray Incised, other		13 .5					13 .5
Taos Gray Corrugated, indented		2 .1					2 .1
Taos Gray Corrugated, simple		3 .1					3 .1
Taos Gray, neck-banded		15 .5					15 .5
Taos Gray Punctate, linear		5 .2					5 .2
Taos Gray Punctate, herringbone		25 .9					25 .9
Taos Gray Punctate, other		5 .2					5 .2
Red Mesa Black-on-white			1 .0				1 .0
Taos Gray Punctate, linear and herringbone		1 .0					1 .0
Total/ Percent	51 1.8	2,477 86.7	322 11.3	3 .1	2 .1	1 .0	2,857 100.0

Table 18. LA 2742, faunal taxa

Taxon	Frequency	Percent
Small mammal	12	4.6
Medium mammal	1	0.4
Large mammal	44	16.9
Rodentia	19	7.3
Eutamias quadrivittatus (Colorado chipmunk)	1	0.4
Cynomys gunnisonni (Gunnison's prairie dog)	7	2.7
Tamiasciurus hudsonicus (red squirrel)	3	1.2
Thomomys bottae (Botta's pocket gopher)	7	2.7
Dipodomys ordii (Ord's kangaroo rat)	52	20.0
Neotoma sp. (woodrats)	5	1.9
Neotoma mexicana (Mexican woodrat)	5	1.9
Microtus sp. (voles)	21	8.1
Sylvilagus auduboni (desert cottontail)	18	6.9
Lepus californicus (black-tailed jackrabbit)	7	2.7
Canis sp. (dog, coyote, wolf)	3	1.2
Artiodactyla	3	1.2
Odocoileus sp. (deer)	22	8.5
Aves (bird)	3	1.2
Meleagris gallopavo (turkey)	13	5.0
Ophidia (snake)	1	0.4
Bufonidae (true toads)	13	5.0
Total	260	100.2

Overview of the Faunal Remains). A brief discussion of each taxon will provide information about occurrence in the area, the possible mode of introduction to site context, and their economic importance.

Bone fragments not identifiable beyond the class level were categorized as small mammals, medium mammals, large mammals, and birds by thickness of cortical tissue and the presence and morphology of cancellous tissue. Sixty bones, or 23.1 percent of the sample, fall into this category. This is a low percentage compared to other prehistoric assemblages, which range around 60 percent unidentifiable. This decreased percentage of unidentifiable bone may be the result of the multitude of smaller species occurring in the deposits. Since smaller mammal bone is often less fragmented and retains its identifiable characteristics when split, less bone would then fall into this category as the frequency of small mammal bone increased. The remaining 200 bone fragments, 76.9 percent of the sample, could be identified to three orders, one family, four genera, and nine species.

Small Mammals

Colorado Chipmunk (*Eutamias quadrivittatus*)

The Colorado chipmunk is the most common *Eutamias* form in the ponderosa forest but is also common in mixed coniferous forest and woodland. It is also common in scattered piñon-juniper woodlands, especially if rock outcrops are present (Findley et al. 1975:108).

One anterior cranium could be assigned to this species. This element was tanned by heating or roasting and appears to have been crushed. Though this species occurs in the immediate site area, and burrowing was noted throughout the site, the roasted appearance and crushing would suggest that the Colorado chipmunk was an economic species at the site. Thomas's (1971) criteria for distinguishing a species as part of a cultural or noncultural assemblage state that intrusive species would be represented by a more complete individual. The presence of a partial cranium supports the use of this animal as an economic species.

Gunnison's Prairie Dog (*Cynomys gunnisoni*)

Gunnison's prairie dog occurs in low valleys but is common in montane forest meadows up to 3,050 m (10,000 ft) (Findley et al. 1975:133). They are not abundant today but have been a fairly common species in the past.

Seven elements could be assigned to this species. They include a cervical vertebra, a rib, two innominate fragments, a humerus, a femur, and a tibia. Four of these elements exhibited carnivore gnawing, and four specimens were lightly weathered from exposure on the surface. Five of the elements were recovered from the same stratum and unit. This suggests that this species may have been intrusive in site context and may represent a burrow death or an individual killed and consumed by canids and redeposited into structural fill.

Red Squirrel (*Tamiasciurus hudsonicus*)

The range of the red squirrel and Albert's tassel-eared squirrel overlap, and their morphology is similar, but the tassel-eared squirrel tends to be larger. Both may occur in ponderosa forest, but the red squirrel predominates in lower forests and woodlands. There is a clinal variation in the size of the red squirrel from south to north in the state: the northern populations are smaller (Findley et al. 1975:138-140).

Three partial mandibles with dentition were assigned to this species. A partial left and right mandible were recovered from Feature 8 in the northwest quad of the pit structure and may actually be from the same individual. The third mandible was recovered from pithouse fill and was probably washed in from nearby. All the mandibles exhibit slight weathering and discoloration, perhaps from boiling.

Botta's Pocket Gopher (*Thomomys bottae*)

Botta's pocket gopher is one of the most widespread species in the state. It inhabits almost every environment where suitable soils are available. There is a large size variation in New Mexico that may be related to soil depth. Smaller species inhabit rocky soils (Findley et al. 1975:144).

Seven elements were identified as Botta's pocket gopher. Five of these (cranium, mandible, innominate, radius, and ulna) were recovered from the fill in the southwest quad of the pithouse and may represent the burrow death of one individual. Another partial innominate was recovered from the ventilator fill, and a cranial fragment was recovered from the upper levels of the pithouse fill. The occurrence of single elements suggests that some individuals were part of the diet of the site occupants. This is supported by the analysis of other Anasazi faunal assemblages (Mick-O'Hara 1993, 1987a). The fact that a number of elements were recovered together indicates only that at least one individual of this species was intrusive.

Ord's Kangaroo Rat (*Dipodomys ordii*)

Ord's kangaroo rat is common and widespread within the state of New Mexico. It is found in suitable habitat below mid-woodland (Findley et al. 1975:174).

This species is represented by 52 elements in the LA 2742 faunal assemblage. Most were recovered from pit structure fill, though an almost whole animal was recovered from Feature 8 in the northwest quadrant of the pithouse. There are at least five individuals represented by recovered femora, but enough cranial and postcranial remains were recovered to suggest that some individuals might be burrow deaths. Figure 40 shows the distribution of kangaroo rat and vole elements at the site. Though kangaroo rat is represented by a number of anatomical segments, both that species and the voles have increased numbers in at least one element. This suggests that these specimens were cultural introductions, probably part of the household stew.

Woodrat and Mexican Woodrat (*Neotoma mexicana*)

There are five species of woodrat in the state, three of which occur in the Pot Creek area (Findley et al. 1975:232-251). Five partial elements could only be identified to the family level because of their overlapping ranges.

Mexican woodrats are a montane species reaching their greatest numbers in mixed coniferous forests and occurring in more mesic areas in lower woodlands (Findley et al. 1975:247). Five elements could be assigned to this species. These include a cranial fragment, two humerii, a sacrum, and a femur. Four of these elements were isolated from Feature 8 in the northwest quadrant of the pithouse. Feature 8 also contained several other species of rodent, perhaps indicating the cultural use of these small mammals.

Voles (*Microtus*)

Five species of voles of the genus *Microtus* occur in New Mexico (Findley et al. 1975:254). These species are extremely hard to distinguish, and no attempt was made to separate them in this assemblage. Twenty-one small mammal elements could be identified as voles. Nineteen were cranial elements, and of those, 12 were mandibles representing at least eight individuals. With several other small mammals, 12 elements were recovered from Feature 8, and all but two of these were cranial (see Fig. 40 for element distribution). This indicates that this species, along with several others found in Feature 8, were economic in nature and at one time were part of the diet of the former occupants.

Desert Cottontail (*Sylvilagus auduboni*)

The desert cottontail occurs in piñon-juniper woodland throughout the state (Findley et al. 1975:83). Cottontail was an important economic species for prehistoric Puebloan groups, and annual rabbit hunts still take place at many pueblos.

Eighteen elements were identified as desert cottontail. A single tooth was the only cranial element recovered. All others were axillary skeleton or long bones. This included five femora and four innominate fragments that represent at least four different individuals. Desert cottontail remains were isolated from the structural fill; Feature 2 (ventilator shaft fill); and Features 8 and 10, both postholes, although Feature 8 appears

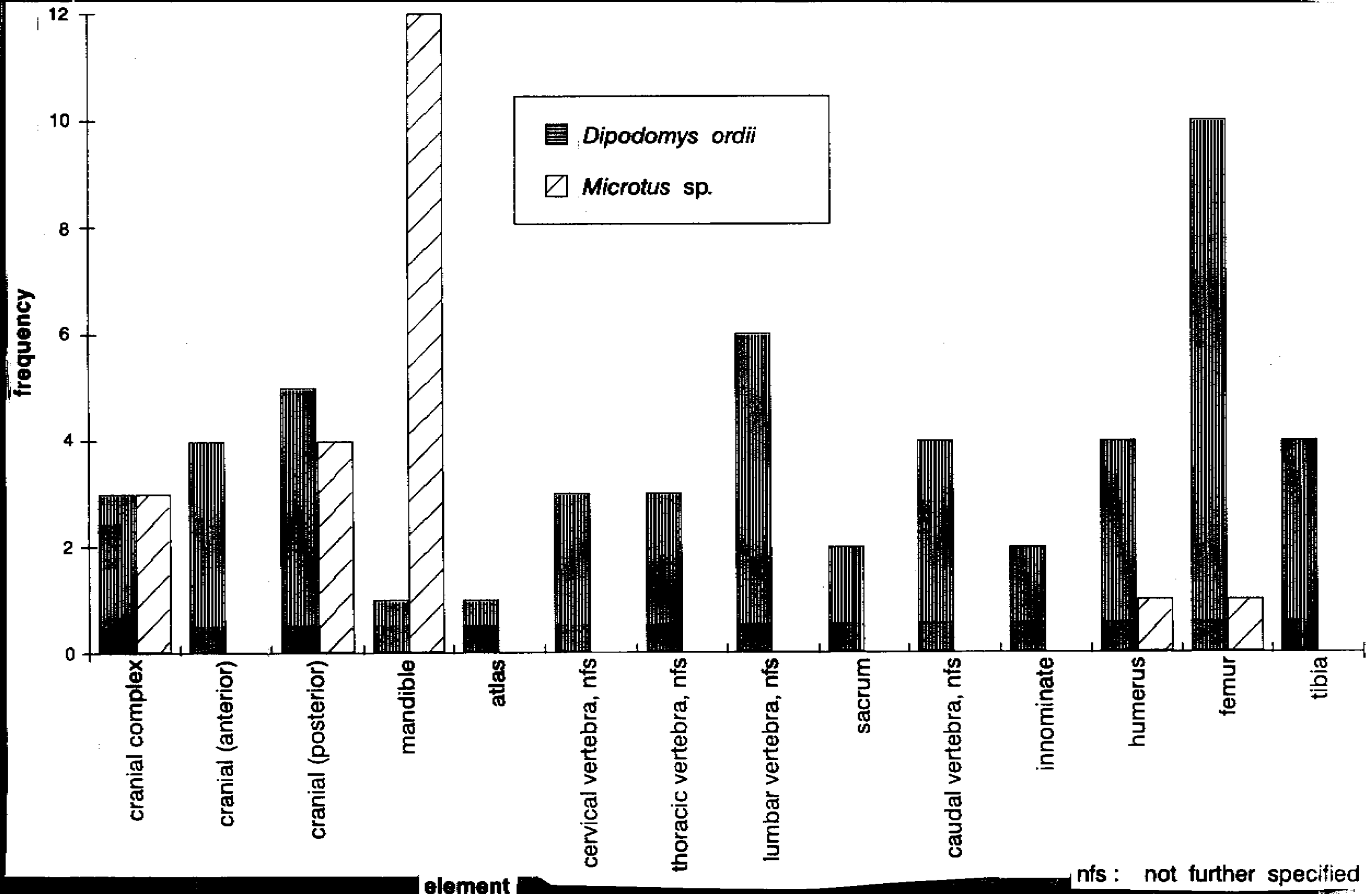

Figure 40. LA 2742, elemental distribution of two rodent species.

to have had another use prior to its use as a posthole, perhaps a storage cyst subsequently filled with trash.

Black-tailed Jackrabbit (*Lepus californicus*)

The black-tailed jackrabbit is frequently observed in grasslands and deserts throughout the state but occurs in almost all areas below the ponderosa forest (Findley et al. 1975:93).

Only seven elements identifiable as black-tailed jackrabbit were recovered from LA 2742. All were recovered from the fill of the pithouse, and they represent at least two individuals. The elements were scattered within the fill and probably washed in from a midden area nearby. Several elements are carnivore gnawed, suggesting that some of these remains may have been brought to the area by dogs or scavenged by dogs from midden areas.

Other Species

Canis sp. (Dog, Coyote, Wolf)

Three thoracic vertebrae could be assigned to this genus. These vertebrae were recovered from the fill of the ventilator shaft (Feature 2). They may be the remains of a Puebloan dog or a coyote that wandered into the area, but apparently the elements recovered were brought into the ventilator by rodent burrowing in the ventilator.

Artiodactyla

An antler fragment and two rib fragments could be positively assigned to the order Artiodactyla, but they are probably the remains of deer (*Odocoileus* sp.). Twenty-two other large mammal elements could be identified to the genus *Odocoileus* and represent the deer utilized by the occupants of LA 2742. Figure 41 presents the distribution of deer elements. This elemental distribution is interesting because 72.7 percent of the bone are elements of low meat value or low meat utility (Binford 1978). This would indicate that most elements recovered were discarded units that washed into the pithouse fill. Discard of these low meat utility units is supported by the presence of two burned elements in Feature 4, the ash pit.

Turkey (*Meleagris gallopavo*)

Wild turkeys are the largest and the swiftest of foot of all American game birds. Turkeys were once abundant in all suitable habitats within the state (Ligon 1961:101). Thirteen elements could be assigned to this species from the recovered faunal assemblage. Nine of these were left and right wing elements from the same individual

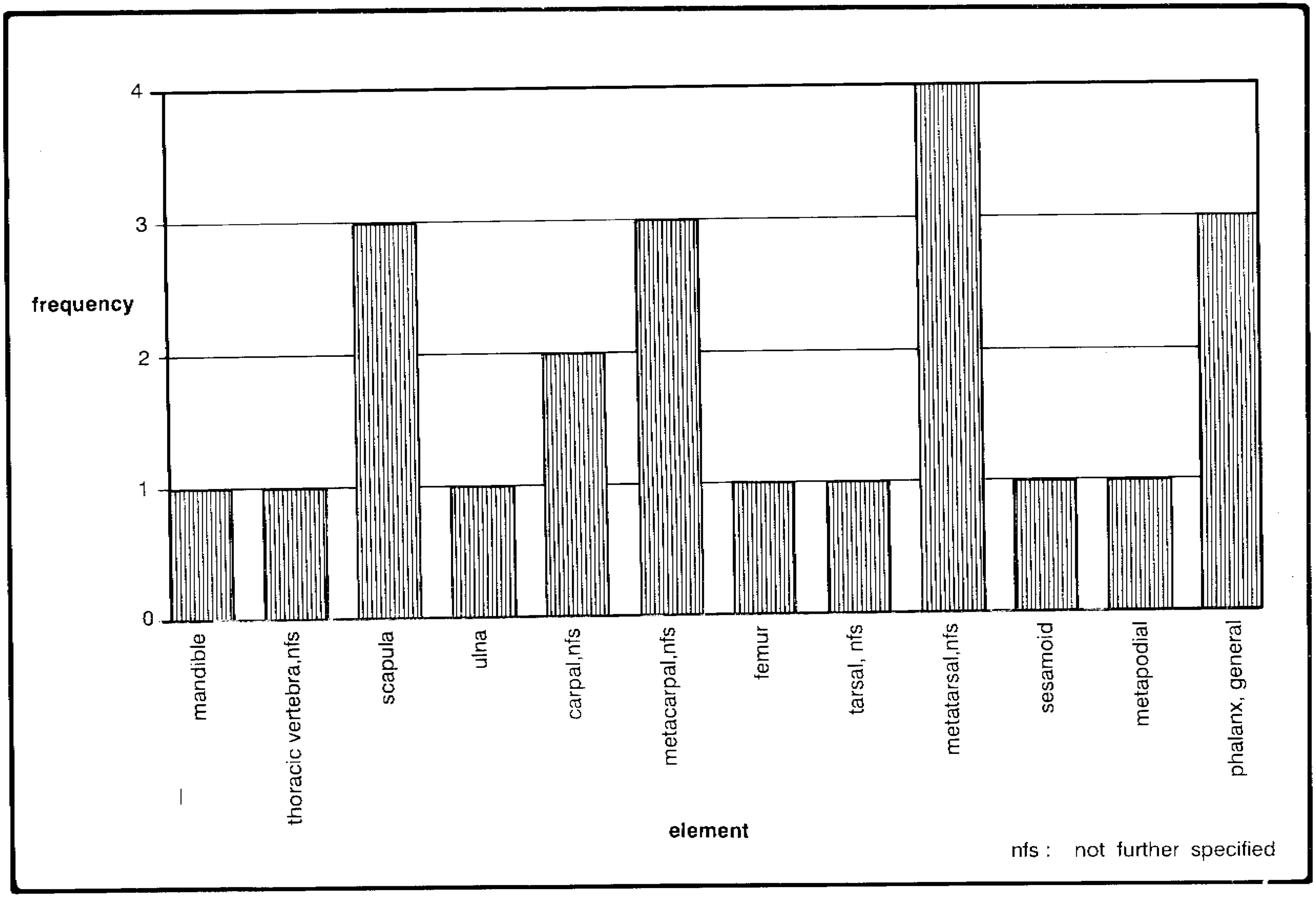

Figure 41. LA 2742, elements identified as deer.

recovered from one stratum of pithouse fill, and three elements were burned black and found in the pithouse hearth (Feature 3). Their occurrence points to the use of this species but does not indicate the extent of that use. The occurrence of both wings from one individual is interesting, but the recovery of these elements from the structural fill makes the interpretation of their presence difficult.

Snakes (Ophidia) and True Toads (Bufonidae)

One snake vertebra was isolated from Feature 8. Its occurrence with other small mammal remains suggests that this taxon was occasionally included as part of the menu. One almost complete toad was recovered from the pithouse fill. Its presence suggests that filling of the structure was gradual, and there were periods when the fill was wet enough to attract that taxon.

Discussion

The majority of the faunal assemblage from LA 2742 came from the pithouse. The difference between the faunal remains retrieved from the structural fill and those from features, especially Feature 8, is interesting. The fill contains all the taxa contained in Table 18. Some species, such as the toad and the prairie dog, are clearly intrusive. Other species identified from the pithouse fill appear to have been part of the overall diet of the former occupants, washed in from a nearby midden. Remains isolated from feature fill include burned turkey and cottontail elements from the hearth, burned deer elements from the ash pit, and four species of small rodents and cottontail elements from a secondary posthole (Feature 8). Feature 8 was bell-shaped, and the bottom was lined with cobbles. One or two rodent species burrowing into soft feature fill could be expected, but this feature contained four rodent species, cottontail, and snake remains. The element distribution among the rodents also suggests that they were economic species. Perhaps these species were garbage from the cooking pot tossed into this feature prior to its use as a posthole. If so, the faunal remains may be evidence of feature remodeling and reuse during a period of structural remodeling at the site.

Flotation Analysis

The principal site elements at LA 2742, a pithouse and midden, were both sampled in some detail. Within the pithouse, sample locations included material overlying the floor (FS 160, 173, 326), the large central hearth (FS 361, 362), and the adjoining ash pit (FS 371, 372, 373). Corn debris was found throughout (Tables 19 and 20). Otherwise, the hearth was actually the *least* productive provenience, with no additional species found. The ash pit added several species of unburned weedy annuals, including some with likely economic associations (goosefoot, winged pigweed, tobacco).

Table 19. LA 2742, Pithouse 1, flotation scan results

Taxa	Trash above floor FS 160	Floor duff 99N/115W FS 173	NW quad Floor FS 326	Feature 3 Hearth FS 361	Feature 3 Hearth FS 362	Feature 4 Ash pit FS 371	Feature 4 Ash pit FS 372	Feature 4 Ash pit FS 373
Chenopodium goosefoot	+*	+	+ + + *?			+	+	+
Cycloloma winged pigweed							+	
Portulaca purslane	+ +							
Nicotiana tobacco			+			+		+ +
Physalis groundcherry		+						
Euphorbia spurge								+
Atriplex canescens saltbush	+*							
Juniperus juniper		+*						
Echinocereus hedgehog cactus		+						
Opuntia pricklypear		+	+ + + *?					
Yucca yucca		+	+*					
Zea mays corn	c*	c*	c*		k*, c*	k*, c*	c*	k*, c*
Total taxa/ Burned taxa	4 3	7 2	5 4	0 0	1 1	3 1	2 1	4 1

+ 1-10 seeds; + + 11-25 seeds; + + + > 25 seeds
* some or all items burned
k = kernel; c = cupule; tw = twig; ne = needle; nu = nutshell; co = male cone

Table 20. LA 2742, flotation full-sort results

Taxa	Pit Structure 1					Midden
	Hearth FS 160	99N/115W Duff FS 173	NW quad FS 326	Feature 4 Ash pit FS 371	Feature 4 Ash pit FS 373	111N/116W FS 195
Probable economics, weedy annuals						
Chenopodium (goosefoot)	19/32*					
Amaranthus (pigweed)	3/5*					
Nicotiana (tobacco)	1/1	2/3.1		2/4.3		
Probable economics, perennials						
Juniperus (juniper)	tw*	1/0.8*				
Atriplex canescens (fourwing saltbush)	2/2*					
Cultivars						
Zea mays (corn)	c+*	c+*	c+*	c++*	c++* 1/0.6*	
Unidentifiable	7/13*					
Total probable economic species: Total taxa/ Burned taxa/ Total seeds	 7 6 32/53	 3 2 3/3.9	 1 1 0	 2 1 2/4.3	 1 1 1/0.6	 0 0 0
Uncertain role						
Chenopodium (goosefoot)		35/58.5	13/208.0	1/2.1		4/12.3
Amaranthus (pigweed)		2/3.1	1/16.0			
Portulaca (purslane)	161/308	9/13.8				
Physalis (groundcherry)		2/2.3				
Pinus edulis (piñon)						ne+++
Echinocereus (hedgehog cactus)		4/6.2				
Opuntia (pricklypear)		27/26.2	37/44.8		1/0.6	
Yucca (yucca)		1/0.8				
Unidentifiable						1/0.8
Total uncertains: Total taxa/ Total seeds	 1 161/308	 7 80/110.9	 3 51/268.8	 1 1/2.1	 1 1/0.6	 3 23/26.9
Probable contaminant: *Euphorbia* (spurge)	 1/2	 0	 0	 0	 1/3.1	 0

a/b: Number before slash is actual number of seeds recovered; number after slash is adjusted number of seeds per liter of soil sample (taking into account any subsampling or soil sample size other than the standard one liter).
* = some or all items burned; c = cupule; k = kernel; ne = needle; tw = twig
+ 1-10 seeds; ++ 11-25 seeds; +++ > 25 seeds

The pithouse floor produced the greatest abundance and diversity of probable economic plant materials, including cacti and succulents, saltbush, and annuals.

Flotation samples were taken from throughout the excavated midden (13 samples from 11 grids). Although two strata were discerned in some grids, excavators suspected that all midden layers were quite mixed and that upper levels exhibited higher organic content because of juniper and piñon duff from the surface. Horizontal distribution of materials was expected to be of interest, but plant remains were of relatively uniform content throughout the midden. A variety of unburned juniper and piñon parts were found in many of the samples and were more common near the pit structure, as opposed to further down the hill (Table 21). Unburned goosefoot, pigweed, purslane, and groundcherry seeds, present in various grids, are additional possible recent intrusives. Carbonized corncob fragments and kernels, found in small quantities in six of the samples, are the only certain cultural plant materials in the midden area. All four pollen samples analyzed from LA 2742 derived from the midden. The two samples from the burial both contained corn. This may reflect a direct association of corn pollen with the burial, while the charred corn debris in various midden grids was probably household trash.

Compared with its slightly earlier counterpart (LA 70577), LA 2742 is distinctive for the more widespread occurrence of various conifer parts, including piñon needles and nutshell, and juniper twig fragments, seeds, and male cones (the pollen-bearing organs). Many of these occurrences were unburned remains in the midden. The only carbonized conifer remains were juniper seeds and twigs from central locations within the pithouse. Corn remains were roughly similar in distribution (13 out of 20 samples, or 65 percent, as opposed to 8 of 11, or 73 percent, at LA 70577) but slightly more abundant and in better shape. The only corncob fragments large enough to be measured (three cobs with a complete cross-section) were found at LA 2742 (Table 21). These three carbonized specimens varied considerably, from a very small, eroded 8-row cob to larger 12- and 14-row cobs, one with most of its glumes still present. Unburned seeds of weedy annuals included several taxa also at LA 70577 (*Chenopodium*, *Amaranthus*, *Portulaca*, *Euphorbia*, *Cycloloma*, *Physalis*, and *Nicotiana*). A number of possible economic species showed up only at LA 2742: *Oryzopsis* (ricegrass), *Atriplex* (four-wing saltbush), *Yucca*, and *Echinocereus* (hedgehog cactus).

Charred wood specimens from LA 2742 were less diverse than those at LA 70577, lacking Douglas fir and oak (Table 22). Juniper accounted for 24 percent of the assemblage by number of pieces but 88 percent by weight because of one very large specimen, which alone constituted 74 percent of total weight. Ponderosa pine was the other principal component (59 percent by number and 12 by weight). Piñon was negligible at this site.

Table 21. LA 2742, midden, flotation scan results

Taxa	106N/ 114W FS 263	107N/ 113W FS 221	107N/ 114W FS 246	109N/ 115W FS 194	110N/ 115W FS 181	111N/ 116W FS 195	112N/ 116W FS 185	113N/ 115W FS 154	113N/ 115W FS 155	114N/ 115W FS 118	114N/ 117W FS 87	117N 113W FS 107
Chenopodium goosefoot	+				+	+ *?	+					
Amaranthus pigweed										+		
Physalis groundcherry						+				+	+	
Juniperus juniper	tw	tw, co	+, tw	tw, co	+, tw, co	tw, co	co				co	
Pinus edulis pinyon	ne	ne	ne	ne	ne	ne, nu	ne	ne	ne			ne
Zea mays corn				k*, c*	c*	k*		c*	c*		c*	
Total taxa/ Burned taxa	3 0	2 0	2 0	3 1	4 1	5 1	3 0	2 1	2 1	2 0	3 1	1 0

+ 1-10 seeds; ++ 11-25 seeds; +++ > 25 seeds
* some or all items burned
k = kernel, c = cupule, tw = twig, ne = needle, nu = nutshell, co = male cone

Table 22. LA 2742, species composition of charcoal submitted for C-14 dating

	Pithouse 1								Midden	Total Percent
Taxa	99.45N/ 113.5W FS 156	NW quad FS 199	NW quad Stratum 5 FS 210	Feature 3 Hearth FS 359	Feature 4 Ash pit FS 363	Feature 4 Ash pit FS 384	Feature 10 Beam FS 415	Feature 1 Post FS ?	107N/ 113W FS 223	(number/ weight)
Juniperus juniper	1 410.0 g		6 3.8 g	2 0.89	1 2.39 g		1 51.3 g[1]	1 17.0 g		24 88
Pinus edulis piñon				1 0.4 g						2 <1
Pinus ponderosa ponderosa		2 36.6 g	4 1.8 g	10 3.9 g	4 3.9 g	5 7.0 g			4 10.4 g	59 12
Undetermined conifer				7 2.8 g						14 <1
Total pieces/ Total weight (g)	1 410.0 g	2 36.6 g	10 5.6 g	20 7.9 g	5 6.29 g	5 7.0 g	1 51.3 g	1 17.0 g	4 10.4 g	100 100

Adobe Building Materials

Three natural soil samples and five adobe samples from LA 2742 were collected and analyzed. Table 23 lists the samples by provenience and type. Table 24 summarizes the analytical results.

Munsell Color

A variety of circumstances can affect sample color, and it is not always a reliable estimator of sample similarity. However, M. Boyer's (1992) work at the Vigil-Torres site (LA 77861) shows that color can indicate similarities born out by other tests. On the basis of color, the eight samples from LA 2742 can be combined into two groups of samples and two additional, ungrouped samples. The first group, consisting of samples C1, C2, 3, and 4, was brown (10YR5/3). The second, samples 1 and 2, was pale brown (10YR6/3). Sample C3 was light brownish gray (10YR6/2), and sample 5 was brown (7.5 YR5/4), but redder than the samples in the first group.

Table 23. LA 2742, adobe sample numbers, proveniences, and types

Sample No.	Provenience	Type
C1	Roadcut, 3 m below modern ground surface	natural soil
C2	Roadcut, 2 m below modern ground surface	natural soil
C3	Roadcut, 1 m below modern ground surface	natural soil
1	Pithouse, upper floor	adobe floor
2	Pithouse, lower floor	adobe floor
3	Pithouse, north wall	adobe wall
4	Pithouse fill, SE quad	adobe (roof fall?)
5	Pithouse, upper hearth collar	adobe

Particle Size Distribution

Figure 42 shows significant differences between the particle size distribution of the control samples and that of the adobe samples. There is also considerable similarity within the adobe samples. Two groups can be defined based on particle size distribution. The first consists of soil samples C1 and C2. Both samples have as their dominant component coarse sand, at 54 and 64 percent, and both are less than 5 percent clay. Sands make up about 80 percent of the samples, to about 20 percent silt/clay.

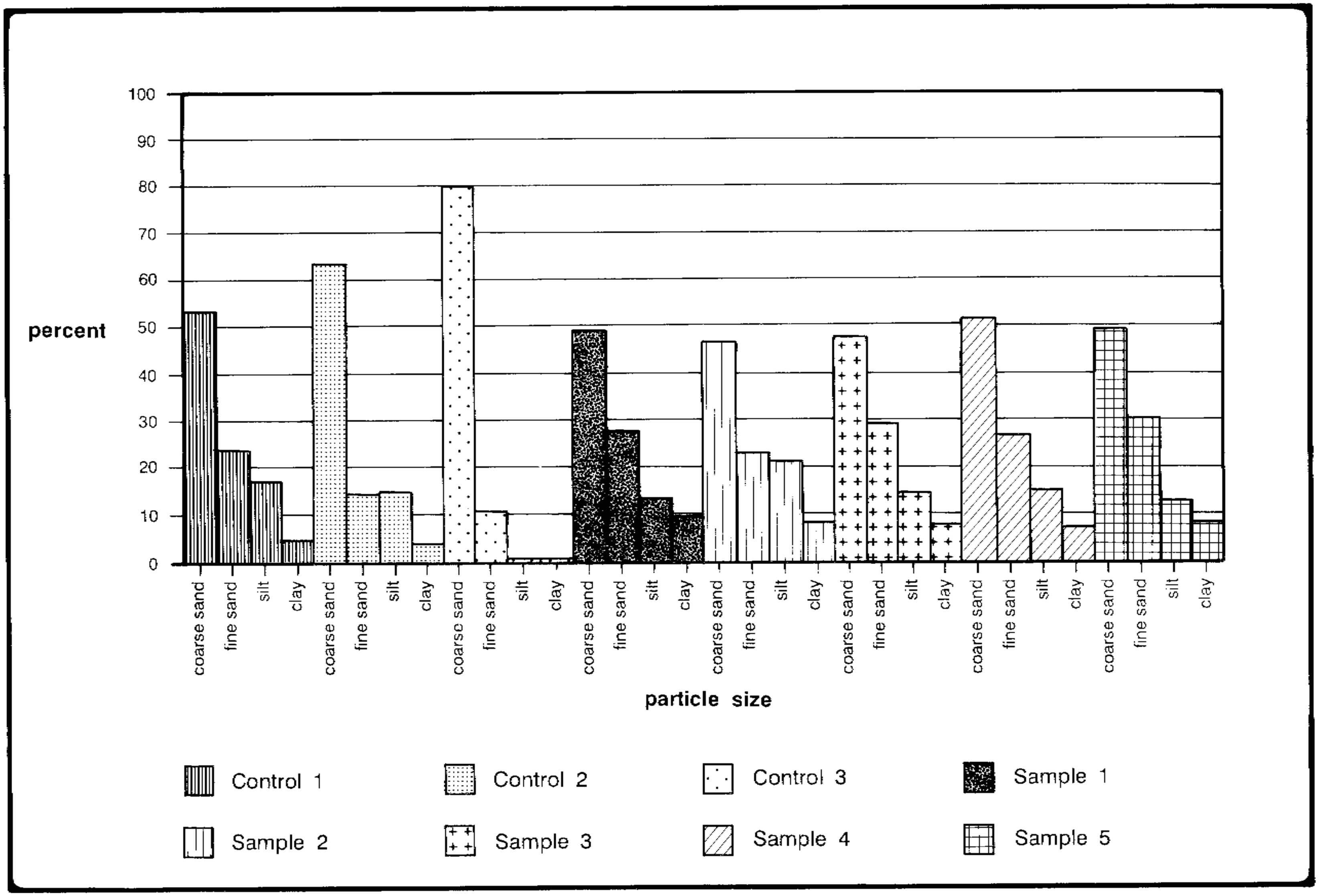

Figure 42. LA 2742, adobe and natural soil particle size distribution.

The second group consists of adobe samples 1, 3, and 5. This group is most evident in the coarse sand-fine sand-silt/clay ratio: 1.8/2.1/1.4. Although all five adobe samples show similar decreases in particle frequency from coarse sand to clay, these three samples are most similar in their rates of decrease.

Three samples stand by themselves in distribution of particle sizes. Sample C3 is clearly different in having the highest percentage of large particles and almost no silt or clay. Sample 2, while similar to the other adobe samples, has the lowest percentage of sand and the highest of silt. Its particle size ratio is 2.0/1.1/2.6, clearly different than the samples in the second group. Finally, Sample 4, with a particle size ratio of 1.9/1.8/2.1, is also different from the other adobe samples, although its percentages of sand and silt/clay are in the middle of the range of the adobe group.

Plasticity

Figure 43 shows that three groups can be defined using plasticity data. The first group, Samples C1 and C3, are virtually or wholly nonplastic. That is, they will not hold together in their natural states. The second group, Samples 1 and 5, have similar liquid and plastic limits, as do Samples 2 and 3 in the third group. Samples C2 and 4 are by themselves.

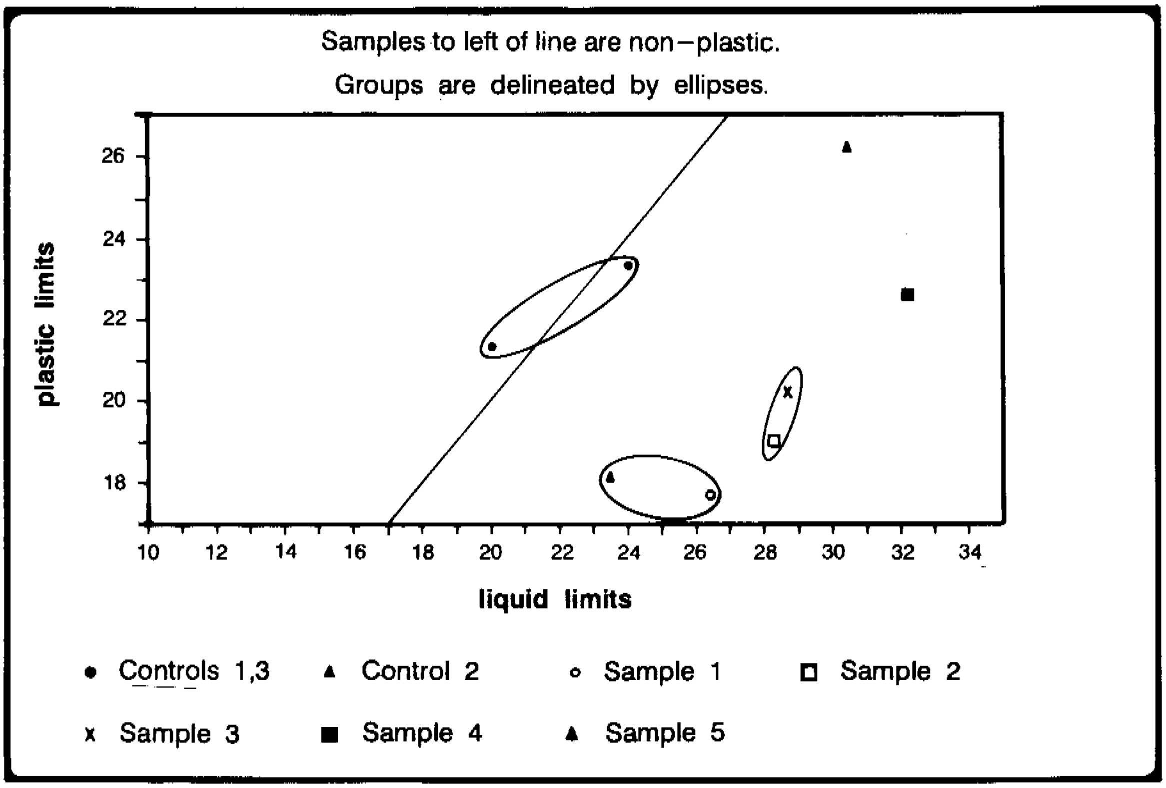

Figure 43. LA 2742, adobe and natural soil plasticity.

Soluble Salts

Again, three groups can be defined (Table 24). The first consists of the three control samples, which are high in carbonates but lacking in other salts. The second group, Samples 1 and 5, are also high in carbonates, while sulfates are present, chlorides are notable, and nitrites are absent. The third group, Samples 2 and 3, resembles the second, but sulfates are notable and chlorides are strong/dominant. Finally, Sample 4 is high in carbonates, and sulfates and chlorides are only perceptibly present.

Interpreting the Results

Analyses show that the adobe samples from LA 2742 can be combined into three groups, each consisting of two samples. Two other samples do not fall within groups, although they share similarities with the groups.

Group A consists of natural soil samples C1 and C2, obtained from 3 and 2 m below the modern ground surface, respectively. Both samples are brown (10YR5/3). Both are high in carbonates, but lacking in other salts. This is expectable since the surrounding mountains are composed of interbedded shale, sandstone, and limestone, and the soils are derived from these rocks. The presence of limestone accounts for the high carbonates in all samples, adobe and natural soil. The samples in Group A have an average 79.5 percent sand to 20.5 percent silt/clay and are virtually or completely nonplastic, since clay makes up less than 5 percent of each.

Group B consists of adobe samples 1 and 5, taken from the upper pithouse floor and the upper (latest) hearth collar. The samples have very different colors, pale brown (10YR6/3) and brown (7.5YR5/4), probably due to burning of Sample 5. In both samples, sulfates are present, chlorides are notable, carbonates are strong/dominant, and nitrites are absent. There are two primary sources for sulfates. One is calcium sulfate in the soil. Calcium carbonate is present because of the limestone, so we might expect calcium sulfate, as well. However, were this the source, sulfate should have been present in the natural soil samples (M. Boyer 1992), which it is not. The second source is air polluted by burning hydrocarbons. Since the samples come from the interior wall and the hearth of the enclosed structure, smoke from the fire may be the source of the sulfates. This is consistent with Glennie's (1983:123-126) observation that smoke was difficult to control in his experimental pithouse. Chlorides are often found in mortars and plasters and are probably the result of fine material added to otherwise coarse adobe. In this case, it is apparent that the adobe contains much more fine sand, silt, and clay than does the natural soil. Chlorides may be the result of adding these materials. Finally, the absence of nitrites indicates that the pithouse was not affected by groundwater. In surface adobe structures, nitrites are often present from rising damp in the walls, particularly if the wall has no foundation or footing. This was apparently not a problem in the pithouse at LA 2742, perhaps because the structure was located on top

Table 24. LA 2742, adobe analysis

Sample	Munsell	Particle Size in Percent						Plasticity			Soluble Salts			
		course sand	fine sand	silt	clay	all sand	silt/ clay	liquid limit	plastic limit	plasticity index	sulfates	chlorides	nitrates	carbonates
C1	10YR5/3	53.8	23.9	17.6	4.6	7.8	22.2	20.0	21.3	-1.3	-	-	-	+++
C2	10YR5/3	63.6	14.5	15.1	4.1	81.1	19.1	30.5	26.2	4.3	-	-	-	+++
C3	10YR6/2	80.2	11.1			91.2	8.8	24.0	23.3	.7	-	-	-	+++
1	10YR6/3	49.3	27.7	13.4	9.6	76.9	23.0	26.4	17.7	8.7	+	++	-	+++
2	10YR6/3	46.9	23.1	21.4	8.3	70.1	29.8	28.3	19.0	9.3	++	+++	-	+++
3	10YR5/3	47.9	29.4	14.7	7.9	77.3	22.6	28.7	20.2	8.5	++	+++	-	+++
4	10YR5/3	51.5	26.5	14.9	7.0	78.0	21.9	32.2	22.6	9.6	±	±	-	+++
5	7.5YR5/4	49.1	30.1	12.7	8.0	79.2	20.7	23.5	18.1	5.4	+	++	-	+++

- = absent; ± = perceptible; + = present; ++ = notable; +++ = strong/dominant of a very narrow ridge. The landform may have facilitated water drainage away from the pithouse.

The samples average 78.1 percent sand to 21.9 percent silt/clay. These figures are not significantly different from those of Group A. The major difference is in the amount of clay, which makes up 8.6 to 9 percent of the samples, twice that of Group A, increasing the plasticity of the samples. Although their plasticity indices are not close, their liquid and plastic limits are the lowest of the adobe sample. Figures 44 and 45 show that their silt/clay and sand profiles are almost identical, although they do diverge in the large silt particles.

Group C consists of adobe samples 2 and 3, collected from the lower floor and the pithouse wall. The floor was pale brown (10YR6/3), and the wall was brown (10YR5/3). In both samples, sulfates are notable, chlorides and carbonates are strong/dominant, and nitrites are absent. If the sulfates are the result of smoke from the fire, the difference between the samples in Group B and the wall sample in Group C is probably due to the wall being continually exposed to smoke throughout the life of the structure. The strong presence of sulfates in the lower floor may suggest that it was used longer than the upper floor, that is, that the upper floor was poured relatively late in the life of the structure.

The samples average 73.7 percent sand to 26.2 percent silt/clay. Although their sand and silt/clay percentages are farther apart than those in Group A, Figure 44 shows that their silt/clay profiles are almost identical and are clearly different from the other samples. Their sand profiles (Fig. 45) diverge with increasing grain size, and Sample 3 has a higher frequency of larger sand particles. This is perhaps due to the difference between a wall, which can be relatively coarse, and a floor, which should be finer and smoother. Their liquid and plastic limits are the closest of the groups.

Other Samples

Besides these three groups, two samples stand on their own, different from each other and from the groups. Natural sample C3, taken from 1 m below the modern ground surface, has its own color, light brownish gray (10YR6/2), its own plasticity figures (Fig. 43), and its own particle size distribution (Figs. 42 and 45). Only in soluble salts does it resemble any other samples. Adobe sample 4, collected from the fill of the pithouse and possibly representing roof material, shares its color with the natural samples in Group A and the adobe samples in Group C. Its particle size distribution, although similar to the other adobe (Fig. 42), is unique, particularly in the actual distribution of clay and small silt particles (Fig. 44).

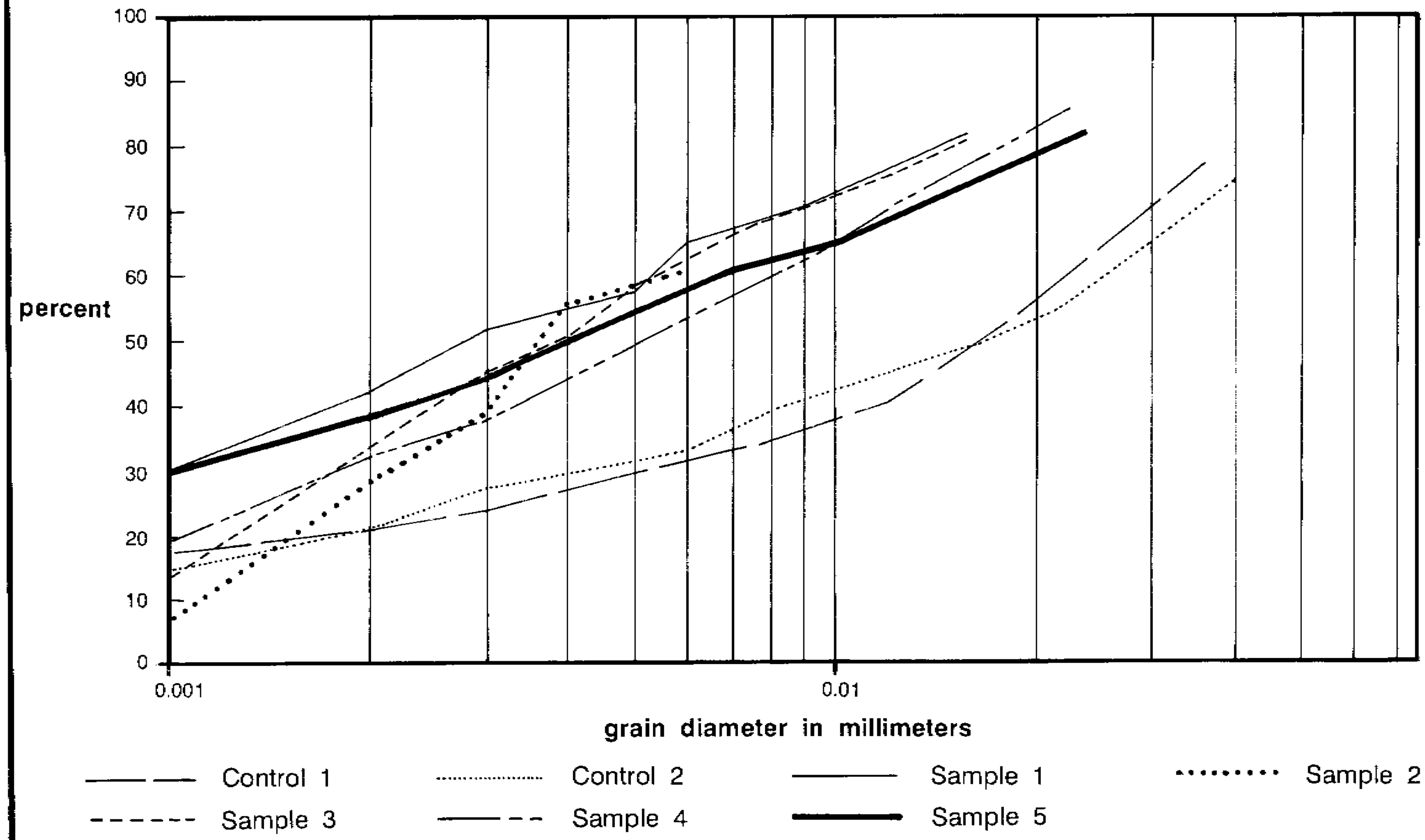

Figure 44. LA 2742, adobe and natural soil silt/clay profiles.

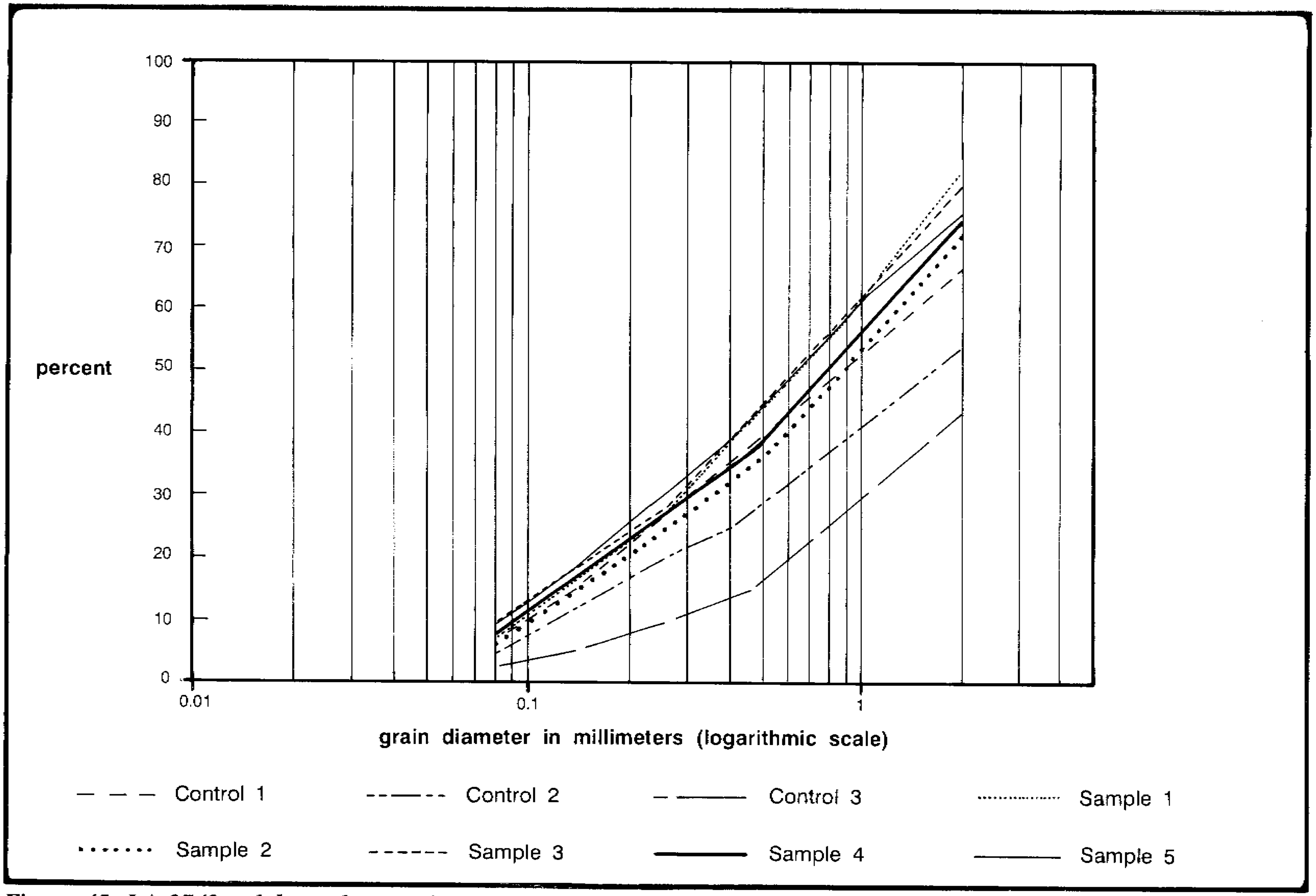

Figure 45. LA 2742, adobe and natural soil sand profiles.

Discussion

The adobe from LA 2742 was made from on-site soil. The sand profiles (Fig. 45) show that the actual distribution of sand particles in the adobe samples most closely match that of natural sample C1. Samples C2 and C3 are similar in the fine sand particles but diverge dramatically as particle size increases. This situation is mirrored in Figure 42, in which sample C1 more closely resembles the adobe samples than do C2 and C3. Sample C1 came from 3 m below the modern ground surface, suggesting that the adobe at LA 2742, while having important internal variation, was probably made from soil from the deepest part of the original pithouse hole. This is expectable, given that excavation of the original hole would have left the deepest soil on top of the resulting dirt and rock mound (reverse stratigraphy). The adobe was made by adding fine material to the natural soil. This is apparent in that the clay content of the adobe samples is 1.5 to 2 times higher than the natural soil samples. Except in Sample 2, the silt content is slightly lower in the adobe than in the natural soil. Similarly, fine sand is higher in the adobe than in the natural soil, while coarse sand is slightly lower. Together, the changes in particle size do not dramatically change the sand-silt/clay ratios from the natural soil to the adobe. Again, Sample 2 is the exception. However, the increased presence of clay, which acts as a binder for the adobe, is responsible for significantly increasing the plasticity of the adobe over the natural soil. Thus, the inhabitants of LA 2742 obtained clay, and perhaps fine sand, to add to the natural soil from the pithouse hole to make acceptable adobe. The source(s) of these materials is presently unknown, but they may have come from the margins of the Rio Grande del Rancho floodplain or a nearby tributary arroyo.

Archaeological excavation of the pithouse revealed evidence of remodeling of the structure. Adobe analysis supports this evidence. Two of the three groups of samples are adobe from what are interpreted as construction and remodeling episodes. Group C consists of samples from the lower floor and the wall, both from the initial construction of the structure. Group B consists of samples from the upper floor and the upper or last hearth collar, both from a later remodeling episode. The evidence from soluble salts suggests that some time passed between construction and remodeling and that the last remodeling episode may have occurred late in the life of the structure.

LA 3570
(AR-03-02-05-58?)

Jeffrey L. Boyer, James L. Moore, Daisy F. Levine, and Linda Mick-O'Hara

LA 3570 was located at an elevation of 2,185 m on a low terrace on the east side of Rio Grande del Rancho. The site was on the south side of an unnamed drainage across from LA 2742. Recorded by Peckham in 1956, it was partially excavated as a salvage project during the reconstruction and paving of NM 518 (then NM 3). A photo of the site adorns the cover of the final report (Peckham and Reed 1963). The *Carson National Forest Cultural Resources Atlas* identifies LA 3570 as site AR-03-02-05-58, placing it in the highway right-of-way about 410 m north of LA 3570. As previously noted, no site could be located in that area (Boyer 1985b, 1989a), and it appears that site AR-03-02-05-58 was mislocated. No map or detailed description exists from Peckham's work at the site. The site record contains only photographs and a plan view map of a pithouse excavated in the road (Peckham and Reed 1963:4-6).

When relocated during the survey for this project, the site consisted of a sherd and lithic artifact scatter on the low terrace (Fig. 46). No concentrations of cultural material were observed. A single 1 m by 1 m test pit was excavated near the edge of the road cut in an area of darkened soil. The pit was excavated to 1.5 m below surface. A single artifact-bearing stratum was defined that yielded one to 10 lithic artifacts per 10 cm level. Because testing suggested the presence of subsurface deposits, and because a pithouse was once present at the site, we thought that the deep, artifact-bearing stratum might represent fill in a second pithouse. For these reasons, data recovery was initiated.

Excavation revealed that the artifact-bearing deposit was fill in a natural feature, probably an arroyo. A shallow hearth or roasting pit was discovered. A concentration of historic artifacts, an abandoned road or trail, and a possible mining prospect hole were recorded, and much of the prehistoric artifact scatter was collected.

Excavation Methods

Surface artifacts were collected in 4 m by 4 m units except where they occurred in the roadcut. The roadcut was collected as a single unit 35 m long by 15 m wide (525 sq m). Surface collection included the area within project limits and a large area outside the project limits where artifacts were collected to provide access for a backhoe. The collected area above the roadcut included 22 whole or partial 4 m by 4 m units, totaling 323 sq m.

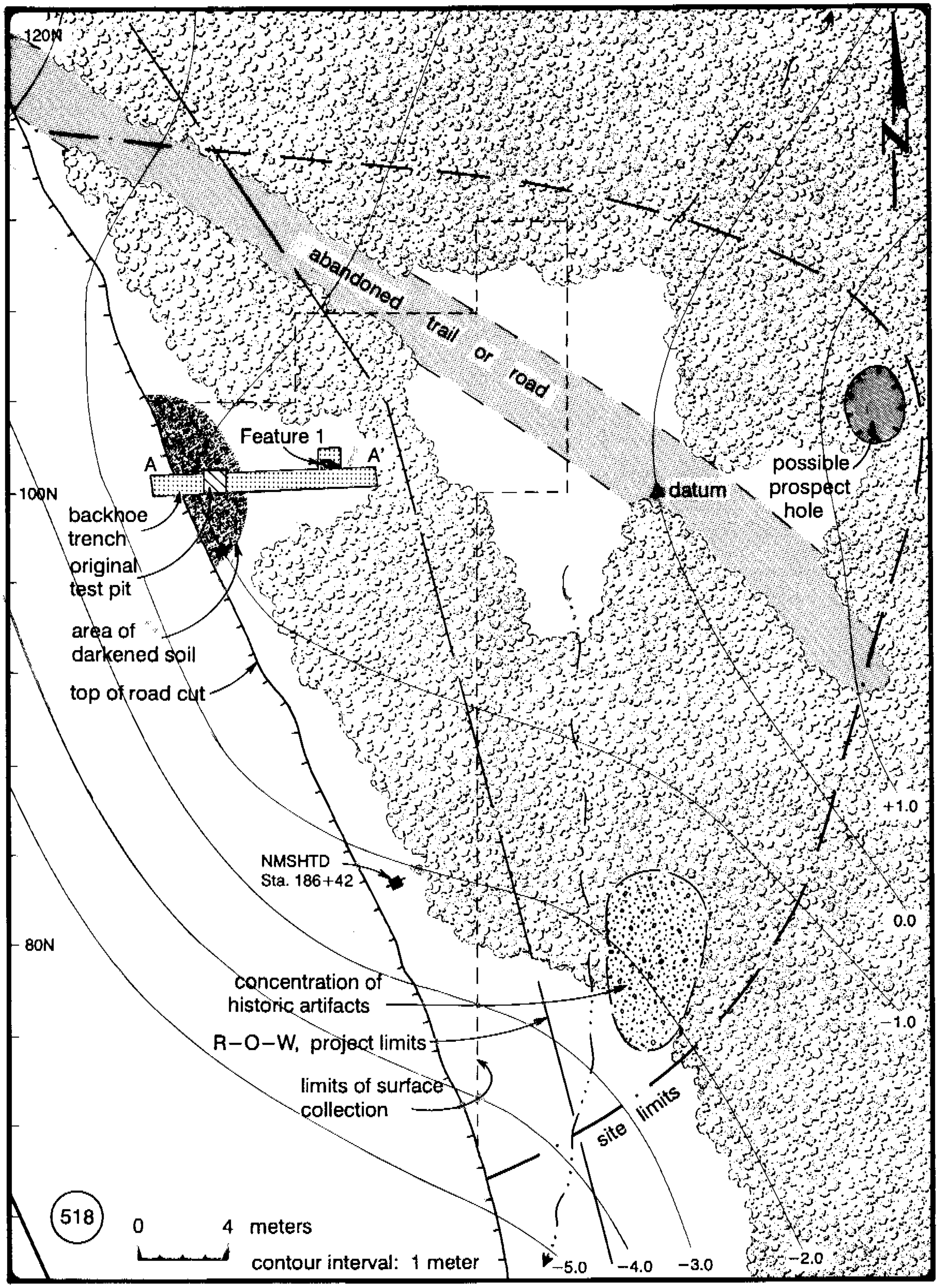

Figure 46. LA 3570, site map.

LA 3570 was examined after excavations at LA 70577 were complete and during excavation at LA 2742. Based on the results of excavations at LA 70577 and LA 2742, we suspected that the artifact-bearing stratum at LA 3570 was a natural phenomenon since culturally sterile gravels below the artifact-bearing stratum were reached without discovering cultural features (Boyer 1989a). To clarify the situation quickly, we used a backhoe to trench the area (Fig. 47). The backhoe trench was approximately 1 m wide and 10.3 m long, running east from the road cut. It incorporated the original 1 m by 1 m test pit, and was excavated to depths ranging from 1.75 m below surface at its east end to 2.3 m in the vicinity of the original test pit. The trench profile was drawn showing the location of the original test pit and the hearth/roasting pit feature.

The hearth/roasting pit was discovered during excavation of the backhoe trench. The remains of the feature were examined by excavating a single 1 m by 1 m unit that included the feature. That unit, 102N/115W, was excavated in 10 cm levels to the base of the feature. Two samples of the ashy fill of the feature were collected to recover macrobotanical remains, particularly charcoal for radiocarbon dating. Obsidian samples were submitted for hydration dating.

Peckham's Pithouse

Peckham and Reed (1963:4-5) provide the following description of the discovery of a pithouse at LA 3570:

> This site was first noted by the presence of a few potsherds along the edge of the existing graded roadway, State Highway 3, which had been cut through a narrow point of land projecting into the valley of the Rio Grande de Ranchos. The old road cut was about fifty feet wide and had removed what other surface indications might have been present. At one point in the roadway traces of fire-reddened soil were almost completely hidden by gravel shifted and compacted by normal traffic and periodic grading of the road. Trowelling exposed a charcoal-stained mass of soil which filled the interior of a subterranean structure whose upper walls had been removed by previous construction of the road. Clearing this area revealed a well-preserved pithouse whose floor was only a foot or less below the surface of the road.

The pithouse was located near the center of the road (Fig. 48). It was roughly circular and measured 4.6 m along its north-south axis and 4.1 m along its east-west axis (Fig. 49). Fifteen features were recorded. The structure had apparently undergone at least one remodeling episode.

Figure 47. LA 3570, backhoe trench.

Figure 48. LA 3570, Peckham's pithouse.

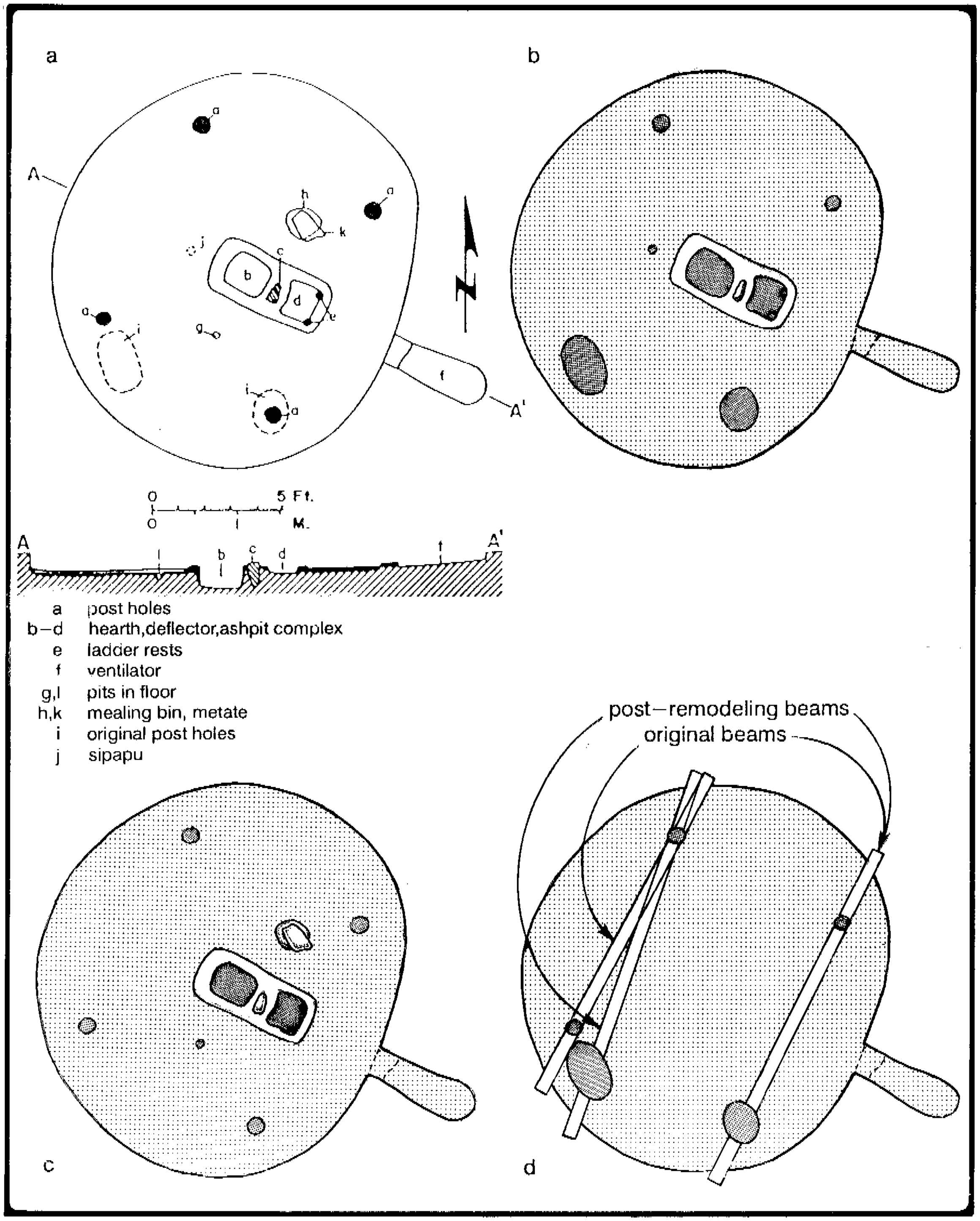

Figure 49. LA 3570: (a) plan view and profile of pithouse, from Peckham and Reed (1963:4); (b) lower floor features; (c) upper floor features (Peckham and Reed [1963] provide no evidence for remodeling of these features); (d) reconstructed locations of vigas (primary roof beams) before and after remodeling of pithouse.

Stratigraphy

Because most of the structure had been removed before excavation, there is no evidence of the stratigraphy of the pithouse fill. Peckham and Reed (1963:6) were only able to observe that "the entire upper floor of the pit house was covered with a dense mass of charred pine, pinyon, and cottonwood, indicating that the room had been destroyed by fire."

Features

Two floors containing 15 features were found. Three were associated with only the lower floor. The remaining 12 were associated with the upper floor or both floors and demonstrate remodeling of the structure.

Hearth/Ash Pit/Ventilator. Peckham and Reed (1963:5) state that the most "prominent" feature in the structure was a "composite hearth, deflector, ash pit, and ladder rest, enclosed by a raised clay rim" (Fig. 49a). The composite feature was 1.5 m long and 0.7 m wide. The rim was 7 to 15 cm thick. The hearth was rectangular and measured 40 cm by 50 cm. It was separated from the ash pit by a deflector consisting of a single rock laid on edge between the features. The deflector is described as "a rudimentary sort, unlike the well-defined screens found in San Juan Anasazi pit houses and kivas" (Peckham and Reed 1963:6). The ash pit was almost square, about 40 cm on a side, with a concave side facing the deflector. The ladder rests were two small, round holes at the southeast and northeast corners of the ash pit. Whether the complex was remodeled is not known.

The bottom of the ventilator chamber and opening extended to the southeast of the structure. The chamber was about 1.25 m long by 40 cm wide and belled slightly at the back, where the vertical shaft would have entered it. There was a low adobe sill at the mouth of the chamber. Unlike those at LA 2742 and LA 70577, this sill was placed within rather than outside the mouth. Peckham and Reed (1963:6) speculate that the sill "may have served to keep water from coming in through the ventilator opening." Whether it was modified during the remodeling is not known.

Floor. Peckham and Reed (1963:5) state that "the floor had been plastered with 0.1 foot of sterile clay resting on an earlier floor, which was devoid of cultural debris."

Postholes. Five postholes were present. Two along the south side of the structure were associated with the first floor (Fig. 49b). The southwestern hole was oblong and measured 0.6 by 0.4 m. Its depth was not recorded. It was covered by the second or upper floor. The southeastern hole was 0.4 m in diameter and "enclosed a roof support" (Peckham and Reed 1963:6). That is, it was covered by the upper floor, and another posthole associated with the upper floor was placed within it (Figs. 49b and 49c). The latter hole is one of the four remaining postholes placed in a quadrilateral arrangement in the upper floor. According to the plan view (Fig. 49a), they were all roughly circular and 20 to 25 cm in diameter. No depths were recorded.

Other Floor Features. Other features found on the floors included a shallow pit on the north side of the ash pit containing a small metate and two small holes assumed to be sipapus. One, associated with the first or lower floor (Fig. 49b), was northwest of the hearth in line with the hearth/ash pit complex and the ventilator opening. It was covered by the upper floor. The second, associated with the upper floor, was south of the hearth (Fig. 49c).

Construction Details

Because of the structure's condition at the time of excavation, we cannot specify many of the construction details. We can presume that the basic construction sequence followed that of LA 2742. Although Peckham and Reed (1963:5) observed no plaster on the wall remnants, the walls were probably plastered with adobe. The well-preserved walls at LA 2742 and LA 70577 had only remnants of plaster adhering to them at the time of excavation. The two large holes in the lower floor on the south side of the structure were probably postholes. Their large size indicates that their posts were dug out and removed during a remodeling episode. Figure 49d suggests one possible reason for this activity. The figure is a possible reconstruction of the locations of vigas, the primary roof beams, supported by the upright posts. The minimum span across the pit from northeast to southwest is 3.9 to 4.1 m (wall to wall), while the minimum northwest-southeast span to 3.4 to 3.6 m, a difference of 0.5 m. Assuming that it would be easier to procure shorter beams and sounder, structurally, for those beams to span the shortest lengths, the beams should have run northwest to southeast. However, the kiva reconstruction at site TA-26 shows that a viga needs to run perpendicular to the orientation of the ladder through the entrance/smoke hole to best support the weight of people using the ladder. Therefore, the reconstruction in Figure 49d shows the vigas running northeast-southwest. It also shows that the roof would not have been evenly supported by the vigas and the four upright posts. Rather, the west side would have had less support than the rest of the roof margin. If there were an activity area or surface structure at the site, it would likely have been just west of the pithouse. This would have resulted in increased traffic on the west side of the pithouse roof and exacerbated the problem of structural weakness in the roof. There may have been a weak spot on the west side of the roof that eventually needed to be fixed and resupported, resulting in the posthole pattern associated with the upper floor.

The large holes left after removing the upright posts were filled with culturally sterile soil and replaced by the two southern postholes associated with the upper floor. One of these, the southeastern, was dug into an earlier hole. Posts were placed in these new holes, and a new floor was poured that covered the earlier holes. It also covered the small sipapu hole east of the hearth. Apparently this remodeling did not require replacing the two northern posts. Whether the hearth/ash pit complex was remodeled at that time is not known, but a second small hole was dug south of the hearth, perhaps replacing the original sipapu. A metate was set in the floor in a shallow bin north of the ash pit. Peckham and Reed recorded no evidence that suggests remodeling of the ventilator.

Post-Abandonment History of the Structure

Photos of the structure appear to show that the only artifacts found on the floor were the metate set in the upper floor and two other stones that may be metates or metate fragments. If this is so, then the structure was probably abandoned in an orderly fashion. The fact that the upper floor rested conformably on the lower suggests that the remodeling was undertaken during occupation, probably as a matter of structural maintenance. Consequently, it seems clear that the structure was not reoccupied after abandonment.

Peckham and Reed's (1963:6) observation that the floor was covered with a "dense mass" of burned wood suggests that the structure was burned following abandonment. It seems likely that usable wood was first salvaged since Peckham and Reed do not mention the presence of burned posts in the holes or burned viga fragments. The burned material may have been the latillas and bush making up the roof.

Backhoe Trench

As discussed above, a backhoe was used to trench the area of the site explored during the testing phase. A profile of the north wall of the trench shows that the original test pit, renumbered 101N/120W, was excavated into a large, natural depression in the terrace (Fig. 50). Seven natural strata were defined.

Stratigraphy

Stratum 1 was the topsoil layer, consisting of 3.5 to 16.5 cm of dark brown, loose, sandy, loam.

Stratum 2 was the fill of the large depression. It was a very dark brown, compact, sandy loam containing gravel, rocks, and scattered charcoal and artifacts. The test pit was excavated near the deepest part of the depression. There was no internal stratigraphy or lensing in Stratum 2 (see Fig. 49b; see also Boyer 1989a:19-21). This precludes the possibility that the deposit was cultural in origin. Instead, it appears to have been naturally redeposited cultural debris mixed with rocks and loamy soil. The stratum was 1.5 m thick at its deepest part, tapering away to the east and west.

Stratum 3 was the fill of the hearth/roasting pit discovered during excavation by the backhoe. It consisted of a 6.5 cm thick lens of black, loose, sandy, ashy loam with tiny flecks of charcoal. The hearth was excavated through Stratum 2, and Stratum 3 rested conformably on Stratum 4.

Stratum 4 was a layer of brown to dark brown, hard-packed, sandy, clayey loam. The stratum was of variable thickness, ranging from 20 cm at the east end of the trench to 1.1 m at the west end. It was present on the east and west sides of the trench and could be seen tapering down toward the middle of the trench, where it disappeared. On the west side, Stratum 4 rested conformably on Stratum 7. On the east side, it rested on Strata 5 and 6, filling a small depression in Stratum 6.

Stratum 5 was a layer of gray, compact, sandy loam with gravel inclusions. It was found only at the east end of the trench between Strata 4 and 6. Stratum 5 was 50 to 75 cm thick.

Stratum 6 was a relatively thin (13.5 to 56.5 cm), very compact layer of brown, sandy clay loam with small gravel inclusions. It was found in the eastern half of the trench beneath Strata 4 and 5 but was not found west of the large depression filled by Stratum 2. This fact and the presence of a smaller depression near the east end of the trench filled by Strata 4 and 5 suggest that Stratum 6 was cut, perhaps by erosional activity, and replaced by subsequent deposition of Strata 4 and 5.

Stratum 7, the deepest recognized in the profile, was a light gray-brown layer of alluvium containing large cobbles and gravels. This stratum was encountered at the bottom of the original test pit (Boyer 1989a:19). It lay beneath all the other strata and was consistently 63 to 87 cm thick except at the east end. Like Stratum 6, there was a shallow depression near the east end suggesting an area of erosion.

Discussion

The trench profile shows that the tested part of LA 3570 contained no deposits of cultural origin. It was, instead, an area of natural erosion and redeposition. The profile suggests the presence of two arroyos. The earliest, near the east end of the profile, cut into Strata 6 and 7. It was filled by Stratum 5, which was later cut and partially replaced by Stratum 4. Stratum 6 was also cut near the west end of the trench. It was replaced there by Stratum 4, which was then cut, producing the large depression subsequently filled by Stratum 2. The shape of the cuts and their orientation in the profile indicate that they were arroyos draining to the south from the top of the terrace. The site map (Fig. 46) shows a similar arroyo draining to the south outside the project

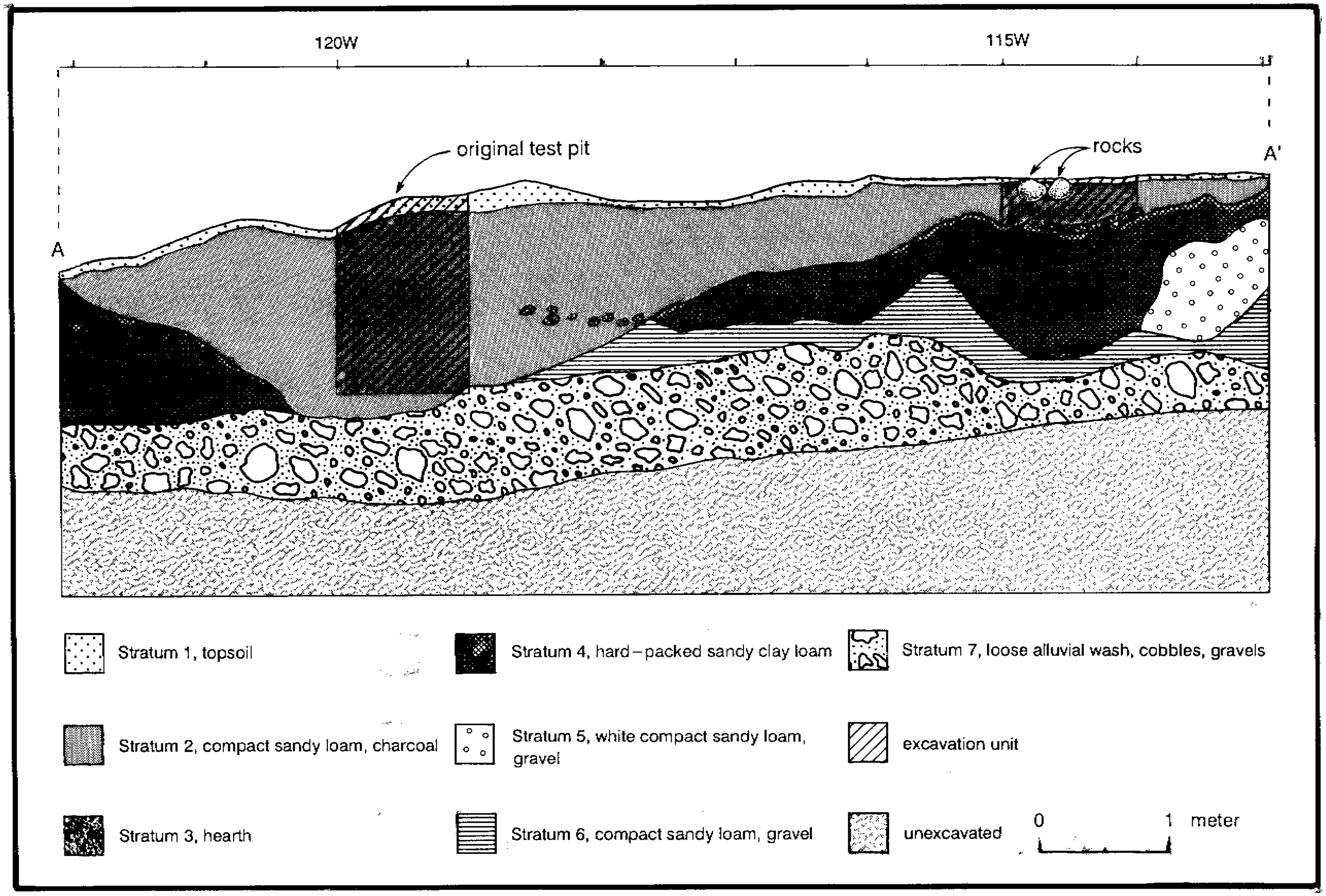

Figure 50. LA 3570, profile of backhoe trench.

limits. Had the terrace not been modified by road construction, the arroyos seen in the profile might have been more evident. However, it seems clear that they were completely filled.

Features within the Project Limits

Excavation of the backhoe trench revealed a shallow, burned pit near the east end of the trench. The soil above this feature, Stratum 2, contained lithic artifacts and bits of charcoal. The feature was largely covered by Stratum 2 and rested on top of Stratum 4, into which it had been slightly excavated. This suggests that deposition of Stratum 2 had begun at the time that the feature was in use.

The pit was probably roughly rectangular (Figs. 51 and 52), although its southern end was removed by the backhoe. The remaining portion was 40 cm wide by 40 to 80 cm long and 5 to 6 cm deep. It was oriented in a southeast-northwest direction. The feature contained many fire-cracked rock fragments and appeared to have been lined with rock. The sides were baked very hard and may have been clay-lined, although the baking may have produced the surface thought to be clay. Fill consisted of loose, ashy soil with many rock fragments. The pit appeared to have been so completely burned that no large pieces of charcoal were left. In fact, two flotation samples of the fill failed to yield enough charcoal for even extended count radiocarbon dating.

The function of this feature is not known. The shallow size suggests a hearth rather than a roasting pit. However, the abundance of fire-cracked rock and the evidence of very high temperatures point to the latter, despite the lack of depth normally associated with such features.

Features outside the Project Limits

Possible Prospect Hole

At the eastern end of the site near the junction of the hillslope and the terrace is a large depression that resembles a historic mining prospect hole. The depression is oblong, 2.5 m by 3.5 m, and 0.5 to 0.75 m deep. A tailings pile is present on the downhill western and northern sides. No artifacts are associated with the feature, and its actual function is unknown. There are no known records of historic mining or prospecting in the vicinity (Schilling 1960).

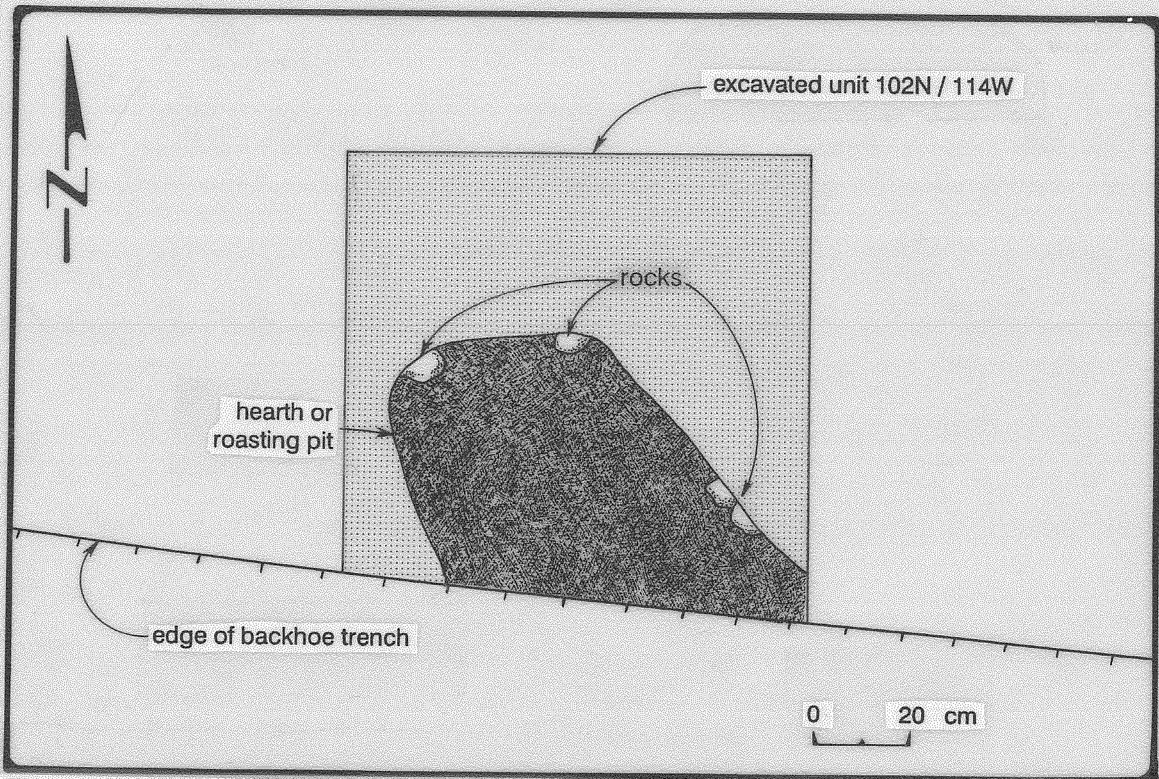

Figure 51. LA 3570, plan view of hearth/roasting pit.

Figure 52. LA 3570, hearth/roasting pit.

Abandoned Road or Trail

An abandoned road or trail traverses the site from northwest to southeast. It is about 3 m wide and appears to have connected the old road near the valley bottom with another paralleling the river along the hillslope above the site. The road has not been used for many years, judging from the amount of plant growth and rock debris within it, and there is no evidence of the time of its use. Part of the road is within the project limits.

Historic Artifact Concentration

A concentration of late historic artifacts was recorded on the south side of the site. The concentration covers about 34 sq m (4.5 m by 7.5 m) and consists of about 75 cans, two or more broken plates and bowls, and several broken bottles. No artifacts were collected since the concentration is outside the project limits, and only a preliminary field analysis was conducted. The concentration probably represents a single dumping episode.

Glass Artifacts

Fragments of a blue glass bottle with flat, paneled sides were found. The bottle base has a maker's mark used by the Maryland Glass Co. from 1916 to the present (Toulouse 1971:339-341). The bottle probably contained milk of magnesia. Portions of a clear glass milk bottle were also present. The bottle was a one quart size and had a silk-screened label that read "Slades...vir...Santa Fe, New Mexico." The dairy has not been identified, but the labeling technique was used after about 1930. One amethyst glass bowl fragment and several other clear glass fragments were observed.

Cans

Of the 75 or more cans, about half are condensed milk in post-1931 sizes (Fontana et al. 1962:75). None has soldered side seams. Several one-quart oil cans; one large baking powder can, brand unknown; and a rectangular meat can were found. The rest are sanitary food cans, mostly no. 2 or larger. None had modern ribbing around the body of the can.

Ceramic Artifacts

The ceramic plate and bowl sherds are the type of white ware known as "hotel china." Two maker's marks were recorded: TEA Rose and Harvest.

Dating the Site

Three Polvadera obsidian artifacts from the site were submitted for hydration dating, yielding four dates (Stevenson 1991). The results are listed in Table 25. Overlap of the two late dates is between A.D. 1079 and 1163, during the Valdez phase. This is consistent with ceramic dates for the site. The earlier date may suggest reuse of an older artifact.

Table 25. LA 3570, obsidian hydration analysis

Sample	Source	EHT (°C)	Rate	Rim Width (um)	Standard Deviation	Date (A.D.)	Standard Deviation	Date Range (A.D.)
91-473	Polvadera	12.7	7.39	2.16	0.08	1326	±63	1263-1389
91-474	Polvadera	15.9	8.72	2.79	0.05	1098	±65	1033-1163
91-475	Polvadera	15.9	8.72	3.25	0.07	780	±76	704-856
91-475	Polvadera	15.9	8.72	2.72	0.07	1143	±64	1079-1207

The third obsidian flake came from Level 3 (20-30 cm below surface), immediately above the hearth feature. It yielded a date of A.D. 1263 to 1389, during the Pot Creek or Talpa phases. This is the only evidence of an A.D. 1200s or 1300s use of the site. Its provenience in Stratum 2 above the hearth feature may indicate that the hearth was contemporaneous with the Valdez-phase pithouse occupation of the site. This is the only evidence of the age of that feature.

The Euroamerican artifacts in the concentration are from the twentieth century. With the exception of the amethyst bowl fragment and the Maryland Glass Co. bottle, both of which could date to the first two decades of the 1900s, the artifacts date after about 1930. The absence of modern items suggests that the artifacts do not date after 1960.

Chipped Stone Artifacts

A total of 186 chipped stone artifacts were recovered from LA 3570 (Table 26). Local materials made up 80 percent of the total and included cherts, basalt, undifferentiated igneous rocks, chertic rhyolite, limestone, and quartzite. Exotic materials comprised 20 percent of the assemblage and included Pedernal chert and obsidian. Obsidian was imported from the Polvadera Peak and other Jemez Mountain sources. Pedernal chert outcrops near Abiquiu and is found in gravel deposits along the Rio Chama and the Rio Grande south of Española.

Table 26. LA 3570, chipped stone morphology by material type

Material Type	Artifact Morphology					
	Angular debris	Core flakes	Biface flakes	Cores	Bifaces	Totals
Chert	37	73	1	6	0	117
Pedernal chert	3	5	0	1	1	10
Obsidian	2	11	2	0	0	15
Polvadera obsidian	4	7	1	0	1	13
Igneous undiff.	1	2	0	0	0	3
Basalt	1	16	2	0	2	21
Rhyolite	0	1	0	0	0	1
Limestone	0	3	0	0	0	3
Quartzite	0	2	0	0	1	3
Total/ Percent	48 25.8	120 64.5	6 3.2	7 3.7	5 2.7	186 100.0

Reduction debris (debitage and cores) dominated the lithic artifact assemblage, comprising 97 percent of the total. Only five formal tools were recovered; all were undifferentiated bifaces. Two bifaces were basalt, and one each were made from Pedernal chert, Polvadera Peak obsidian, and quartzite. Two of these materials (basalt and Polvadera Peak obsidian) were also represented by biface flakes, and biface flakes from two materials (chert and obsidian from other Jemez sources) lacked bifaces. Thus, it would appear that only part of the formal tool assemblage was represented by artifacts recovered during investigations at LA 3570.

Ground Stone Artifacts

A mano and a slab metate were recovered from LA 3570. Both were quartzitic sandstone. The metate was made from a very thin slab and the mano from an indeterminate preform type. Both artifacts were fragmentary, and neither demonstrated secondary use. There seemed to have been little labor expended in shaping the metate. No complementary information was available for the mano fragment.

Ceramic Artifacts

Only nine sherds were recovered from LA 3570 during this project. All came from surface collection. However, Peckham and Reed (1963) collected and analyzed 416 sherds. Our minimal analysis (Table 27) is consistent with the results of Peckham's assemblage (Table 28). The sherds from Peckham's excavation represent a Valdez-phase assemblage. The gray wares are mainly plain or incised, and all of the white ware is Taos Black-on-white. There is no Santa Fe Black-on-white or indented corrugated.

Table 27. LA 3570, ceramic types by vessel form

Type	Indeterminate	Jar	Bowl	Total	Percent
Unknown		1		1	11.1
Taos Black-on-white	1	1		2	22.2
Indeterminate white ware		1	1	2	22.2
Peñasco Micaceous		2		2	22.2
Vadito Micaceous		1		1	11.1
Taos Gray Plain	1			1	11.1
Total/ Percent	2 22.2	6 66.7	1 11.1	9	100.0

Table 28. LA 3570, ceramic types and frequencies (from Peckham and Reed 1963)

Type	Frequency	Percent
Taos Gray Plain	286	68.7
Taos Gray, neck-banded	9	2.2
Taos Gray Incised	42	10.1
Taos Black-on-white	63	15.1
Unidentified white ware	16	3.9
Total	416	100.0

Faunal Remains

Only fourteen pieces of bone were recovered during excavation of units one and three at LA 3570. This bone could be identified only as small, medium, or large mammal, and four pieces were identified to two small mammal species (Table 29). Identification of two rodent species was possible because a maxillary region with intact dentition (Mexican woodrat) and a diagnostic cranial segment (Ord's kangaroo rat) were recovered. In addition, a femur and single innominate could be assigned to Ord's kangaroo rat. These species both occur in the area and may be the remains of burrow deaths intrusive to the site or part of the dietary component. Using Thomas's criteria (1971) for cultural versus noncultural bone, which relate to the completeness of the specimen present, this bone could have been a result of cultural events at the site.

Table 29. LA 3570, faunal taxa

Taxon	Frequency	Percent
Small mammal	1	7.1
Medium mammal	7	50.0
Large mammal	2	14.3
Dipodomys ordii (Ord's kangaroo rat)	3	21.4
Neotoma mexicana (Mexican woodrat)	1	7.1
Total	14	99.9

The ten bone fragments that could only be identified as small, medium, and large mammal were one indeterminate fragment, eight long bone fragments, and one rib fragment. Four long bone fragments exhibited evidence of having been split by impact fractures, and the one medium mammal rib displayed a snap break. One long bone fragment from a medium mammal was burned black and was obviously from a secondary disposal context.

The paucity of remains from LA 3570 prevents any suggestions about a reliance on any one body-size category or a particular species. This small sample reflects access to all size-grades of mammals and impact reduction of bone during processing.

LA 70577
(AR-03-02-05-50?)

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Linda Mick-O'Hara, and Mollie S. Toll

LA 70577 was located on a terrace on the north side of Bear Wallow Canyon, east of the Rio Grande del Rancho floodplain (Fig. 53). The terrace top is at an elevation of 2,212 m (7,257 ft), and the site covered about 4,200 sq m. It was recorded during the survey for this project (Boyer 1989a). Boyer (1989a:23) described the site as a large scatter of pottery and lithic artifacts with a shallow depression (6 m in diameter and 0.25 m deep) and a rock mound. Test excavations were not conducted.

Data recovery at LA 70577 revealed a pithouse, a rock alignment probably representing the footing of a jacal or brush windbreak for a surface activity area, a rock mound, and the surface scatter of artifacts (Fig. 54). Chronometric samples suggest an occupation in the A.D. 1100s, consistent with dates from ceramic analysis.

Data recovery was initiated at LA 70577 because most of the site's surface artifact scatter was within the construction zone. The pithouse was outside the construction zone, but it was included in data recovery for two reasons. First, collection of most of the artifact scatter without excavation of the structure would have separated the artifacts from their context. Second, although the pithouse was outside the construction zone, it would have been very close to the roadcut after construction and could have been affected by erosion.

Excavation Methods

Surface artifacts were collected in 4 by 4 m units. An auger was used to test for buried features prior to excavation. Initially, auger holes were excavated at the intersections of the 4 by 4 m grid and were concentrated around the pithouse depression, a small clearing 6 to 15 m south of the depression, and another shallow depression in the southeast part of the site. Augering in the second depression was increased to 2 m intervals but revealed no subsurface remains. The depression was a natural feature. The same results were obtained in the clearing. In both cases, the depth of the auger holes when stopped by rocks ranged from 10 to 48 cm. In contrast, auger holes along the periphery of the pithouse depression ranged in depth from 50 to 86 cm. Although only one of the holes yielded an artifact, these depths indicated that the subsurface soil had been disturbed in the area of the shallow depression. During excavation of the pithouse, surface artifacts were collected from an 8 by 16 m area north of the pithouse needed for backdirt piles. Augering at 2 and 4 m intervals yielded several subsurface artifacts but no evidence of actual subsurface deposits or features. Near the end of the excavations, several auger holes were excavated east and southeast of the pithouse to search for other buried features or deposits. None was found.

Excavations in the pithouse began in 1 by 1 m units placed near the center of the shallow depression. Two grids were partially excavated in 10 cm levels, one through Level 16 and the other through Level 11. The south wall of the pithouse was discovered in Unit 109N/102W (Fig. 54), and strata comprising the structure fill were also defined in that unit. The remaining portions of both units were excavated by strata to the floor. Eleven other 1 by 1 m units were excavated by strata. Three units near and along the south wall were excavated to the floor. When rain threatened the floor, it was covered with dirt, and excavation in the other eight units stopped 10 to 15 cm above the floor to protect it and its associated features. Soil from these units was screened, and all artifacts were collected. Charcoal was collected for radiocarbon dating. In this way, over half of the pithouse fill was removed, enabling us to draw a profile along the 112N line (Fig. 55). The profile confirmed that the fill consisted of only three strata and that the pithouse had filled by natural colluvial processes. Consequently, the remaining fill was divided in half along the 102.5W line, and each half was removed as a single unit. The fill was not screened, but artifacts were collected when seen. When both halves had been excavated to 10 to 15 cm above the floor, the remaining fill above the floor across the structure was excavated as a single unit. Artifacts found on the floor were left in place, their locations were mapped, and they were collected as individual specimens. Floor features were mapped and excavated, their fill was screened, and artifacts were collected. Archaeomagnetic samples were taken from the hearth, and charcoal samples were collected from the hearth and the ash pit. Flotation samples were collected from the floor-wall junction, a thin layer of organic material on the floor, an ash concentration on the floor against the south wall, and the hearth and ash pit. Pollen samples were collected from the thin organic layer on the floor and from beneath a large metate found on the floor near the ventilator opening.

Four 1 by 1 m units were excavated in the clearing south of the pithouse because we thought the high surface artifact density might indicate an activity surface. Each unit was excavated in 10 cm levels. Only one level was excavated in one unit, and the other three were excavated through Level 3. All soil was screened, and artifacts were collected. No activity surface or other feature was found.

Immediately east of the pithouse, a line of rocks was visible at the modern ground surface. Two 1 by 1 m units were excavated in 10 cm levels, one through two levels and the other through three, to investigate and define the feature. The soil was screened, and artifacts were collected. When it was determined that only the topsoil needed to be removed to expose the rock alignment, Stratum 1 was stripped in 1 by 1 m units. The soil was not screened, but artifacts were collected when seen.

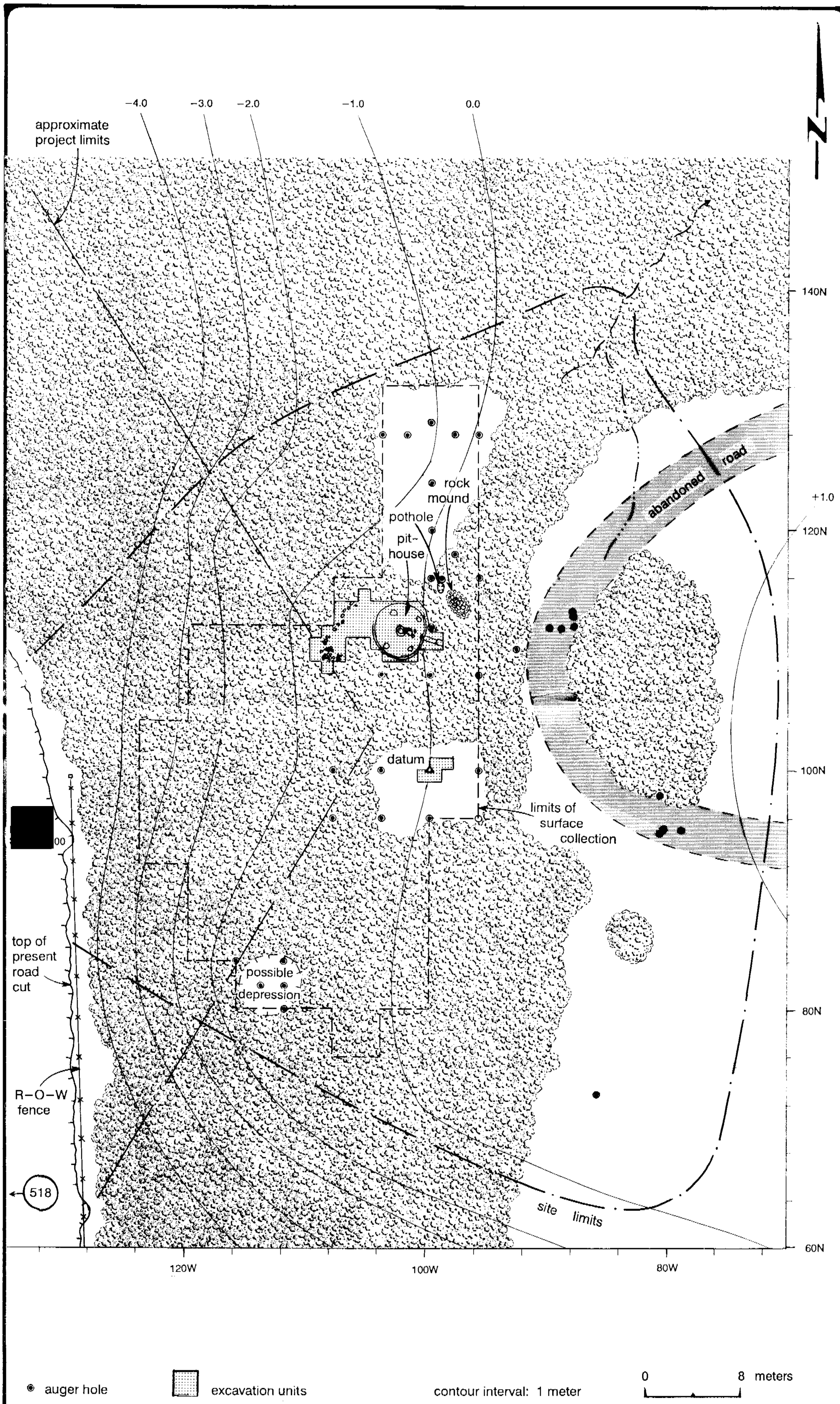

Figure 53. LA 70577, site map.

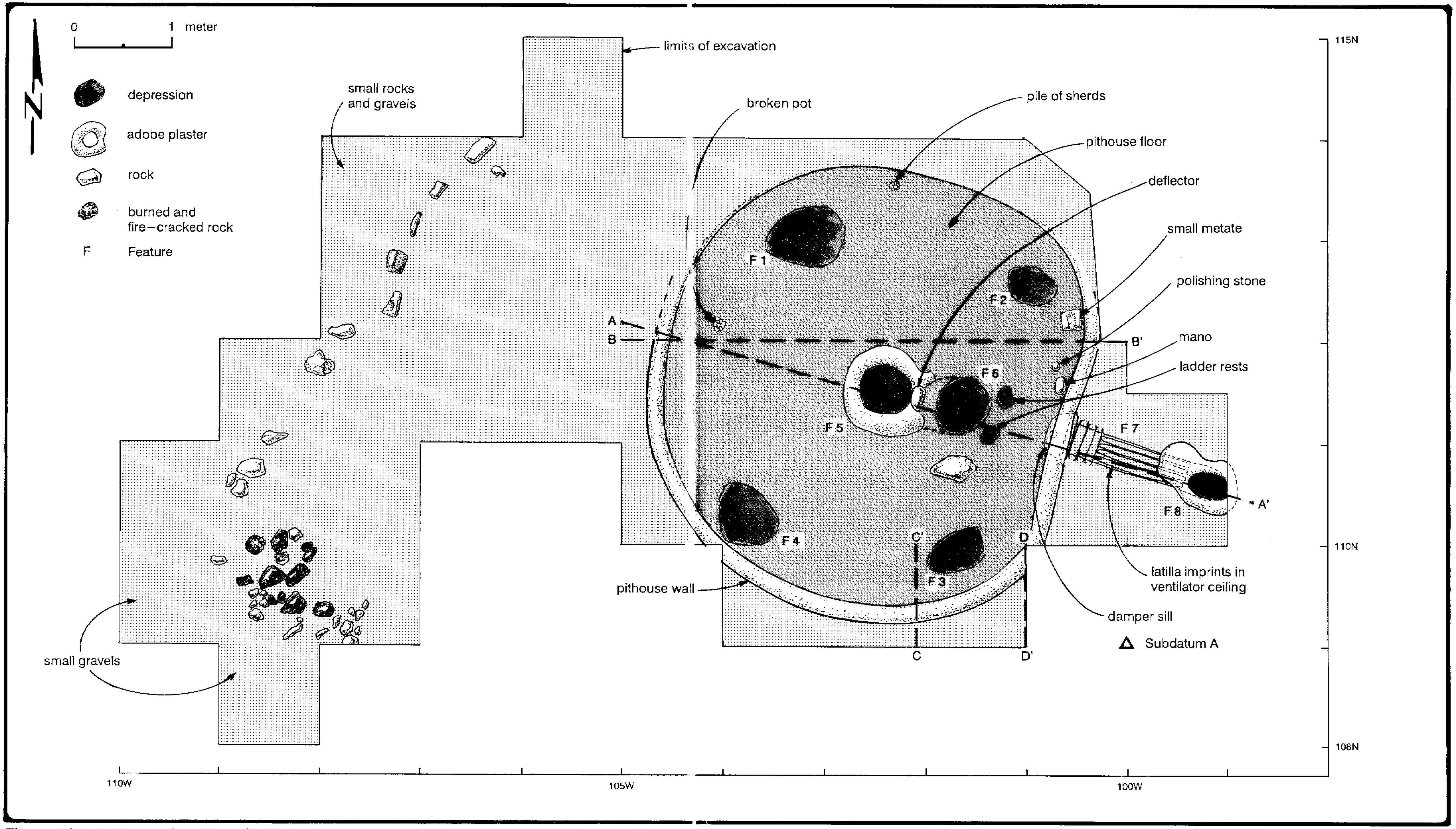

Figure 54. LA 70577, plan view of pithouse and surface feature (see Figs. 55 and 57 for profiles).

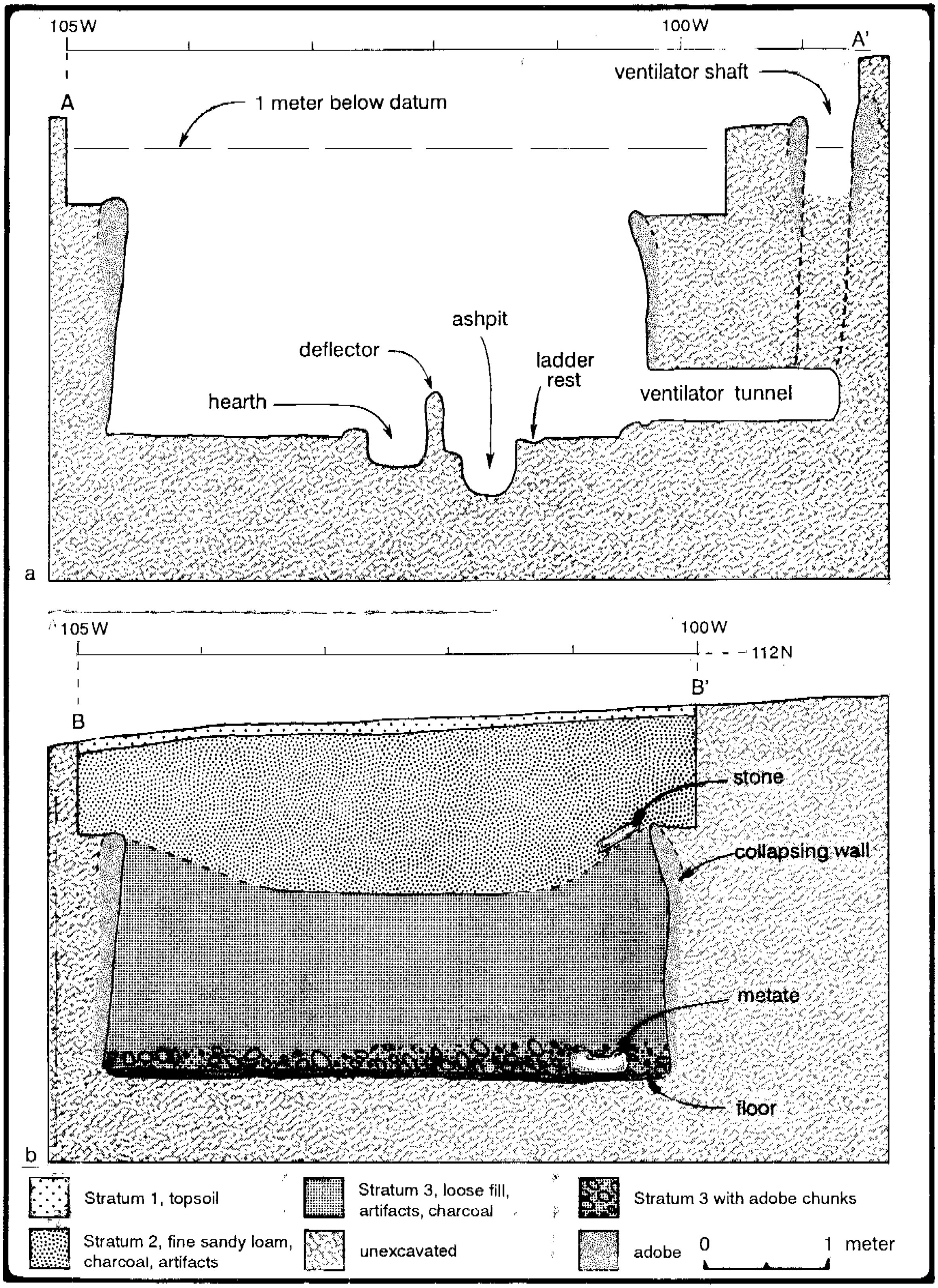

Figure 55. LA 70577, profile: (a) pithouse; (b) pithouse fill.

Structure 1 (Pithouse)

The pithouse was on the top of the terrace, 30 m east of the existing roadcut. About 7 m west of the structure, the terrace began to slope toward the road. The pithouse was roughly circular but slightly flattened on the east side around the ventilator opening. It measured 4.5 m along its north-south axis by 4.0 m along its east-west axis (Fig. 54), and the floor was 2.8 to 2.9 m below the modern ground surface (Figs. 55 and 56). Three fill strata were defined. There was no evidence of remodeling of the structure or its features, and the structure was not used for refuse disposal after abandonment.

Figure 56. LA 70577, view of excavated pithouse, looking east.

Stratigraphy

Not including the fill of individual features, the fill of the pithouse consisted of three strata (Figs. 55b and 57). Each was the result of natural processes, primarily colluvial and eolian, that filled the pithouse with soil, rocks, and artifacts from nearby deposits, probably mostly from the east. Two natural strata occurring outside the pithouse walls were also defined. The stratigraphic sequence is described from surface to floor.

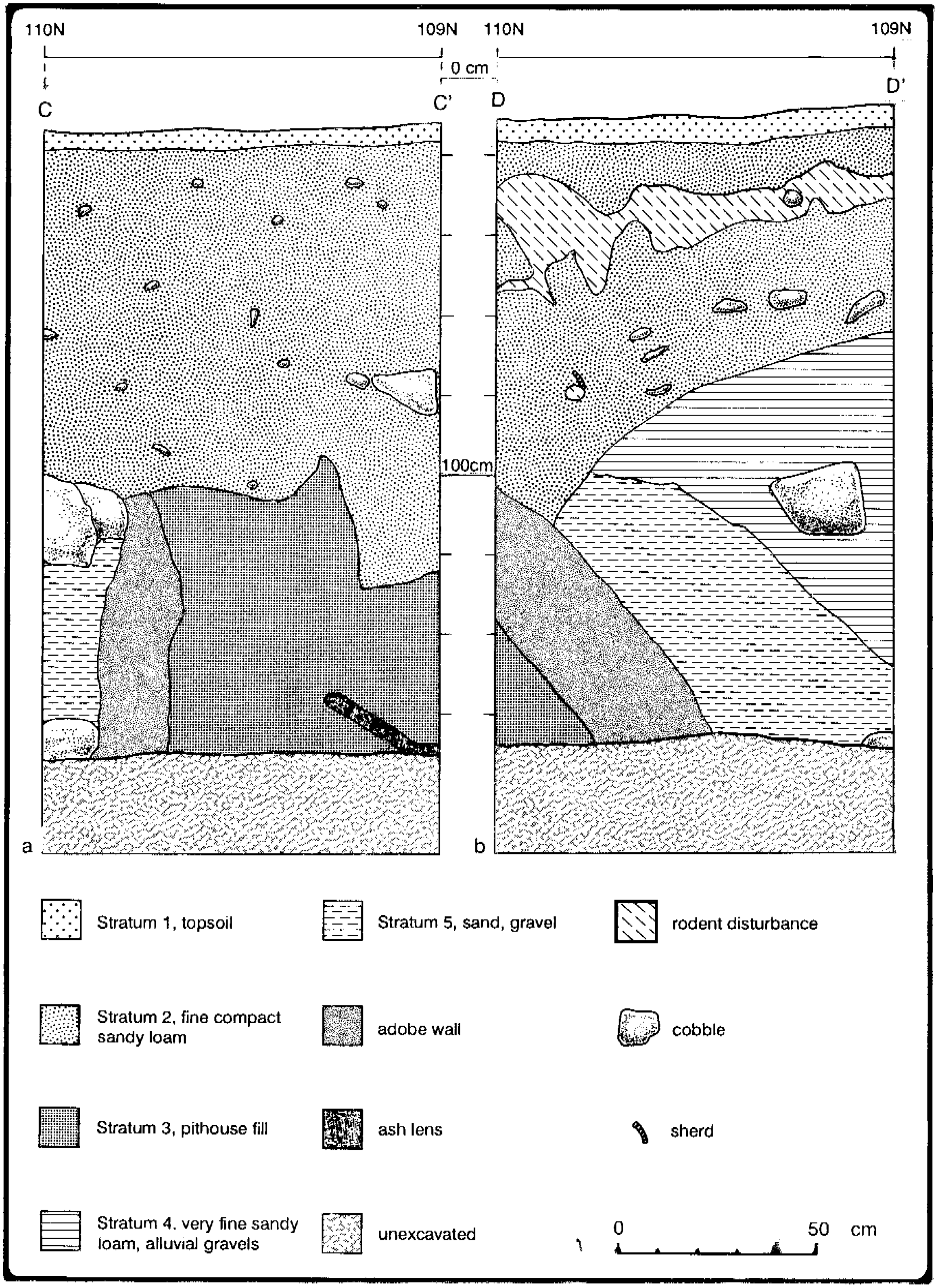

Figure 57. LA 70577, profiles of pithouse fill, Grid 109N/102W: (a) west wall; (b) east wall.

Figures 57a and 57b, profiles of the west and east walls of the upper 1.6 m of Grid 109N/102W, show both the fill strata and the natural strata outside the wall.

Stratum 1 was a very fine, brown, sandy loam topsoil, 4 to 8 cm thick, loose, and containing small flecks of charcoal.

Stratum 2 was a fine, dark gray-brown, compact, sandy loam containing caliche and a moderate amount of rocks and large gravels, mostly 10 to 20 cm in diameter. Charcoal and artifacts occurred consistently throughout the stratum, which was significantly affected by root growth and rodent disturbance. The stratum ranged from about 70 cm thick above the west wall of the pithouse to 1.35 m thick in the center of the structure. A 6 to 11 cm thick lens of chunks of red clay, possibly burned adobe, was observed between 70 and 80 cm below surface in grids near the southeast wall. This lens was first thought to represent collapsed, burned roof fall. Its location, however, was actually above the top of the wall in the fill, indicating that its presence was not the result of abandonment processes but rather of natural, post-abandonment filling of the depression.

Stratum 3 was a loose, mixed, dark yellow-brown, sandy loam comprising the fill of the actual pithouse. It began at the top of the walls and generally sloped down to the center, creating a shallow depression that was filled by Stratum 2. In depth, it ranged from 1.9 to 2 m at the pithouse walls to 1.4 m in the center of the structure. Artifacts and charcoal were more numerous than in Stratum 2. The stratum contained rocks, large gravels, and caliche. An ash lens was encountered 45 to 60 cm below the top of the wall. It was only noted in two 1 by 1 m units near the east wall of the pithouse and one along the south wall (Fig. 57a). The lens was described as a 10 to 20 cm thick lens of gray-brown soil containing ash, chunks of charcoal, rotten wood, and red, possibly burned clay or adobe sloping to the west and north. One description mentions a group of large cobbles found just above the lens. The lens was initially thought to represent burned roof fall and was designated Stratum 6. Further excavation, however, revealed its location within the natural fill comprising Stratum 3 and showed that its north and west trending slope followed the upper contour of Stratum 3. While observable in unit profiles, the lens was patchy and often difficult or impossible to define when encountered from above. It was naturally deposited during the filling of the pithouse by Stratum 3 and was present only in the southeast quadrant of the pithouse fill, as evidenced by its absence in Figure 57a. Eventually, its designation as a stratum was dropped. The lens may well represent natural deposition of cultural items, perhaps including roofing material. It may also have been the result of a natural phenomenon such as a forest fire. In front of the mouth of the ventilator was a small deposit of alluvial sands deposited by washing down the ventilator after abandonment. At the bottom of Stratum 3, the fill contained numerous large and small chunks of adobe. This material may have been roof fall deposited during salvaging of the roof and its support system. Since the matrix around the adobe chunks was not distinguishable from Stratum 3, and no stratum break was definable, the material was not given a stratum number.

Stratum 4 was seen in the west wall of grid 109N/102W (Fig. 57a) and the area of the ventilator shaft opening. The stratum was a very pale brown soil consisting of mixed, compact, sandy loam, loose gravels, and large rocks apparently representing natural on-site soil. In the profile, its depth ranged from 3 to 85 cm, but these figures are probably not characteristic of the stratum away from the area of structural disturbance. Figure 57a shows that it sloped down to the north near the pithouse wall and that it was covered by Stratum 2. This slope was probably due to excavation of the original pit.

Stratum 5 was a vertical layer of yellow-brown, loose, sands and gravel occurring on the outside of the pithouse wall. Figure 57a shows that it was perhaps capped at the top of the wall by large cobbles, although we cannot be sure that this point represents the actual top of the wall. Figure 57b shows that Stratum 4 was found beyond or "outside" Stratum 5 and that as the wall began to slump from exterior pressure near the ventilator, Stratum 5 slumped with it. In that profile, its thickness ranged from 17 to 45 cm. We do not know whether it followed the wall to its bottom or whether its thickness varied more than that seen in the profile. Stratum 5 apparently represents natural soil excavated from the original pit and used to fill between the adobe wall of the structure and the original pit wall. As such, we can expect that it was thicker near the top and may not have been present near the outside bottom of the adobe wall.

Features

A single floor with seven associated features was found. No evidence of remodeling was encountered. Two groups of features were defined: the postholes (Features 1 through 4) and the hearth-ash pit-ventilator complex (Features 5, 6, and 7). The top of the ventilator shaft was designated Feature 8.

The Postholes

Feature 1 was a posthole in the northwest quadrant of the structure, oblong in shape, 70 by 47 cm at floor level, and narrowing toward the bottom (no measurements). It was 40 cm deep. Several cobbles were present in the east wall. The fill consisted of sands and gravels resembling Stratum 3 and contained lithic artifacts. No evidence of the post was found, and the size of the hole indicates that the post was intentionally removed.

Feature 2 was a posthole in the northeast quadrant, oblong in shape, 45 by 40 cm at floor level, and 31 cm deep. The fill resembled Stratum 3 and contained sherds. No evidence of the post was found, and the size of the hole indicates that the post was intentionally removed.

Feature 3 was a posthole in the southeast quadrant, oblong, flattened on the east side, 47 by 43 cm at floor level, and narrowing toward the bottom (no measurements). It was 40 cm deep. The fill was considerably darker than that of the other three postholes and contained more charcoal and more artifacts, mostly sherds. Cobbles were present along the southwest side. No evidence of the post was found, and the size of the hole indicates that the post was intentionally removed.

Feature 4 was a posthole in the southwest quadrant, semitriangular with rounded corners, 56 by 55 cm at floor level, and narrowing toward the bottom (no measurements). It was 41 cm deep. The fill resembled Stratum 3 and contained bone fragments and lithic artifacts. No evidence of the post was found, and the size of the hole indicates that the post was intentionally removed.

Hearth-Ash Pit-Ventilator Complex

Feature 5 was a circular, adobe-lined, and adobe-collared hearth near the center of the floor of the pithouse (Fig. 58). The inside measurements of the hearth at floor level were 51 by 47 cm, while exterior measurements, including the collar, were 87 by 80 cm. The collar was 17 to 27 cm thick. The bottom of the hearth was about 25 cm below the floor. The collar was 5 cm high above the floor, for a total hearth depth of 30 cm. The hearth was filled to the top of the collar with very hard, compact ash containing charcoal and artifacts.

On the east side of the hearth, an unshaped rock measuring 23 by 35 by 11.5 cm thick was set on edge on top of the collar as a deflector. It projected 37.5 cm above the floor. The rock was not plastered into place, suggesting that it could be removed, perhaps to facilitate moving ash from the hearth to the ash pit immediately east of the deflector. North of the deflector, the hearth collar flared slightly. This flare and a similar bulge in the collar south of the deflector created short wings extending toward the ash pit.

Feature 6 was a circular, partly adobe-lined ash pit on the east side of the structure between the hearth and the ventilator opening (Fig. 58). The ash pit measured 51 cm in diameter and was 49 cm deep below the floor. Only part of the east side was adobe-lined when excavated, although the entire hole was probably lined at one time. The pithouse floor was not present between the hearth and the ash pit, perhaps as a result of moving ash from the former to the latter.

Feature 7 was the ventilator opening and "damper sill" at the base of the east wall of the structure (Fig. 59). The ventilator opening was a rectangular hole 30 to 31 cm wide by 45 cm high, beginning 10 to 11 cm above the floor. Its top was the top of the first course of adobe in the wall, demonstrating that the opening was made by not completing the first course of the wall. The horizontal ventilator chamber was 1.55 to 1.6 m long and ran east-southeast of the structure at nearly a right angle to the flattened east wall. In the adobe roof of the chamber, *latilla* (small pole) imprints showed that three *latillas* had been placed perpendicular to the length of the chamber. Those three took up 25 to 28 cm of the chamber roof from the opening. Four imprints showed the locations of longer *latillas* running parallel to the length of the chamber, reaching to the front of the vertical shaft. No *latillas* remained.

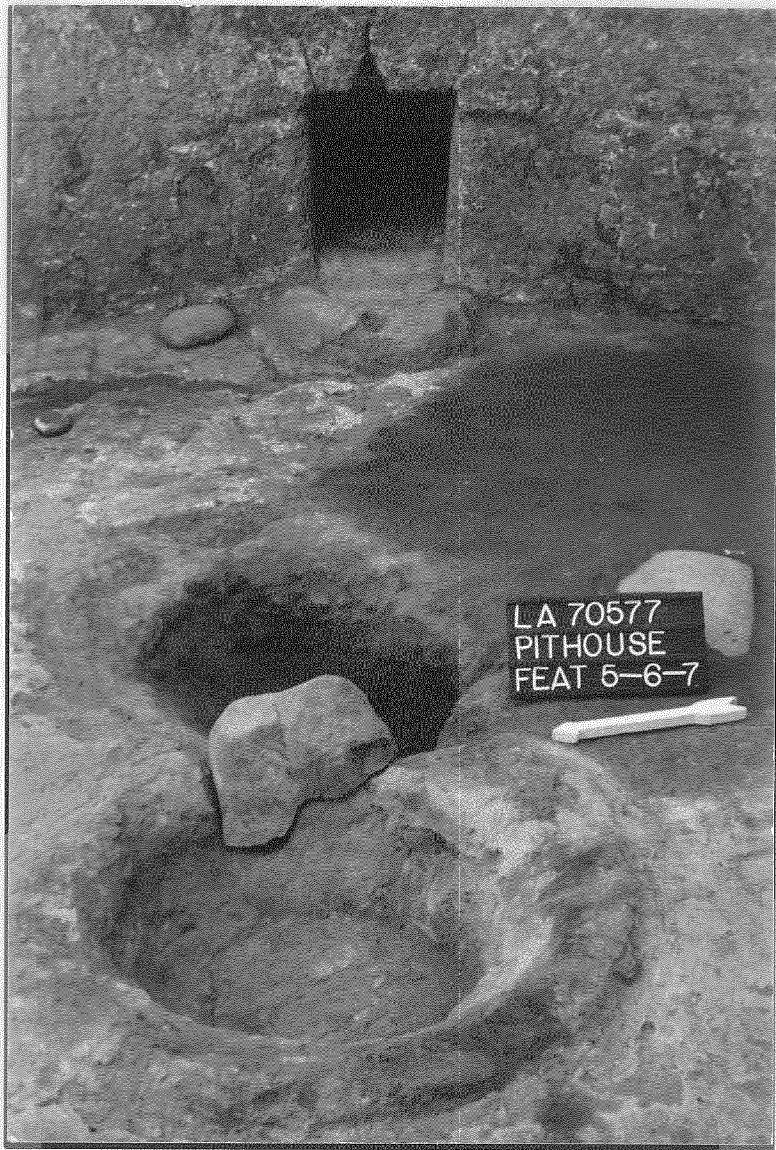

Figure 58. LA 70577, hearth, deflector, ash pit, and ventilator (Features 5, 6, and 7).

The "damper sill" was 10 to 11 cm high and extended 26 cm from the ventilator opening (Fig. 59). It was 47 cm wide at the wall and narrowed to 38 cm wide with rounded corners. A shallow channel 47 cm long, 7 to 8 cm wide, and 5 cm deep ran across the sill at the mouth of the ventilator. In the approximate center of the sill, there was a shallow, circular depression about 8 cm in diameter. The actual function of these two small features is not known, but the channel may have once held a flat, vertical slab like that found at LA 2742, and the depression may have held one end of a stick that kept the slab in place in front of the ventilator. At TA-47, Green found a slab placed in front of the ventilator of a subterranean structure that was probably a pithouse, although she called it a kiva. The damper sill had a channel in front of the ventilator opening, but the slab was resting on the floor immediately in front of the sill, leaning against the wall (Green 1976:28-29).

Remaining Floor Features (not numbered)

Between the ash pit and the ventilator opening were two shallow, oblong depressions presumed to be ladder rests. The northern depression was 23 by 19 cm, and the southern one was 23 by 15 cm. Both were 4 to 5 cm deep.

Immediately south of the ash pit, a flat rock was embedded in the floor. The rock measured 46 by 31 cm. It was not removed from the floor, and no thickness was measured. Because it was not removed, its surfaces were not analyzed for wear patterns. It may have had a function similar to that of a rock embedded in the floor of LA 2742 (Feature 6), a combination metate and anvil.

Ventilator Shaft

Feature 8. The top of the vertical ventilator shaft was located southeast of the pithouse wall. The actual opening was an oblong hole 50 by 30 cm. An adobe collar around the opening, varying from 10 to 15 cm thick, indicated that the shaft was at least partially lined. The opening was generally directly over the rear of the horizontal chamber, offset slightly to the southeast, so that the shaft sloped minimally to the northwest (Fig. 54). Excavation northwest of the actual opening revealed a thick, amorphous deposit of adobe alongside the shaft. This probably represented adobe used to fill a trench between the shaft and the pithouse wall. The shaft was not completely excavated.

Rock Alignment

Surface stripping west of the pithouse revealed a line of rocks running in a northeast-southwest direction 2.5 m west of the pithouse. Several rocks, especially near the north end of the line, were set on edge (Fig. 60). At its southern end, the line turned

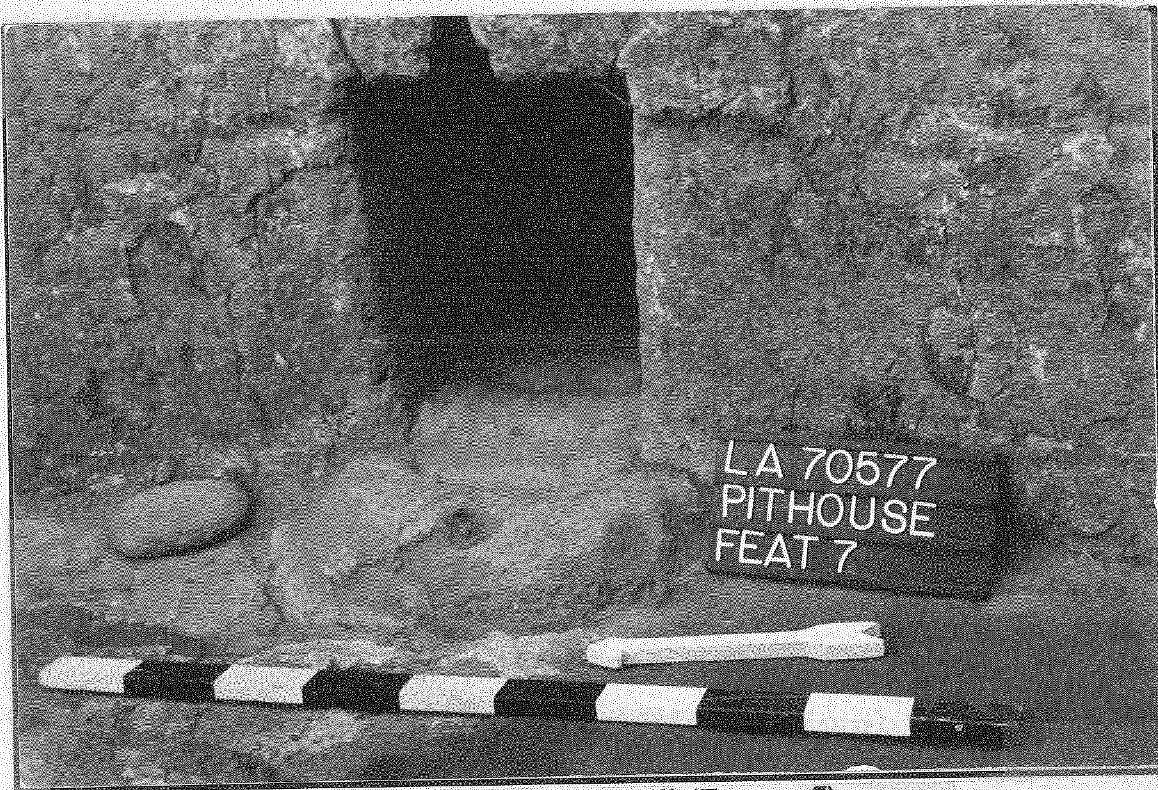

Figure 59. LA 70577, ventilator and damper sill (Feature 7).


Figure 60. LA 70577, upright rocks at north end of alignment.

sharply to the southeast. Within this corner was a small pile of rocks, including twelve fire-cracked rocks, suggesting a hearth. The main alignment was 5.07 m long, and the south side was 1.73 m long. No postholes were encountered.

The feature probably represented the remains of a *jacal* or brush windbreak, though the lack of postholes indicates that it may not have had a substantial wall. The rocks in the alignment were relatively evenly spaced, with a minimum distance between rocks of 15.4 cm, a maximum of 65.4 cm, and an average of 31.6 cm. The rocks in the northern half of the alignment were more evenly and closely spaced, ranging from 19.2 to 34.6 cm, with an average of 23.7 cm. The soil on the east side of the alignment was a loose loam containing scattered artifacts and small gravels. On the west side, the soil was a thin loam with fewer artifacts and a much higher gravel content. Although we could not be sure that the ground surface beneath the topsoil was actually an activity surface, it was harder than the topsoil, and, in two 1 m by 1 m units excavated below Level 1, was culturally sterile. Further, the rocks were set on or slightly embedded in this soil. Together, this information suggests an activity area between the rock alignment and the pithouse and shows that there has been very little soil accumulation on this side of the pithouse. A similar structure was excavated at TA-32 (Luebben 1968).

Rock Mound

During survey, a low rock mound was recorded just northeast of the pithouse depression. The mound was 4 m long, 2 to 2.5 m wide, and 0.5 m high. A hole 1 by 1.5 m had been dug about 0.25 m into the northwest end of the mound, perhaps the result of pothunting. During data recovery, several auger tests were attempted in the top and sides of the mound but failed to reach depths of more than 10 cm. However, it should be noted that Peckham and Reed (1963) excavated a human burial from a rock mound at LA 3643, a pithouse site near Ranchos de Taos; Steen (1976) excavated several human burials from a rock mounds at LA 14868, a Valdez-phase surface site near Taos; and the burial at LA 2742 may have been covered with stones. Consequently, the possibility that the mound at LA 70577 represents a burial cairn cannot be discounted. One bit of evidence in support of this is the human mandible fragment found in the pithouse fill. It must have washed into the fill, probably from the east, the direction of the rock mound. Because the mound was well outside the project limits, because auger testing indicated that it was only a rock mound, and because it might have been a burial location, we did not investigate the mound beyond the auger tests. Since the site is being preserved by Carson National Forest, care should be taken to ensure it is not disturbed, in the event that a human burial is present.

Construction Details

Construction of the pithouse began by digging a hole larger and perhaps deeper than the completed structure. Figure 57b shows that the sides of this hole sloped in and down slightly, although the hole was roughly cylindrical. A trench was excavated to the east-southeast for the ventilator. The width of the trench is not known. Green (1976) found that pithouse ventilator trenches varied in width from the actual width of the feature to several meters. The walls consisted of thick courses of puddled adobe. Four courses totaling 1.7 m in height were present on the east side near the ventilator (Fig. 61), and five courses totaling 2.25 m in height were present on the north side (Fig. 62). The walls were 20 to 25 cm thick. In ascending order, the courses were 42 to 47 cm, 44 to 45 cm, 35 to 40 cm, and 37 cm high. Each course was made of adobe stiff enough to hold its vertical shape but soft enough to settle down over the rounded top of the course below it so that the bottom of each course except the lowest was concave. As they dried, the courses shrank and cracked at relatively regular intervals of 30 to 35 cm (see Fig. 61), giving the appearance of large rectangular to almost square adobe blocks set upright in the wall. The gaps between these "blocks" were filled with plaster when the walls were finished. Figure 57b shows that the space between the vertical walls and the steeply sloping sides of the original hole was filled with Stratum 4, a loose, mixed, sandy, gravelly loam. The interior of the walls was covered with a thick layer of adobe plaster that was then finished with a thin coat of fine plaster. Figure 61 shows adobe plaster on the third course near the top of the meter stick, while the fine plaster is seen on the lowest course. The thick adobe plaster was present only in patches, and only small fragments of the fine plaster remained. Figure 63 shows the thick plaster, which was up to 1 cm thick. Figure 64 shows the fine plaster on the bottom course. In this figure, the plaster is very light and resembles *tierra blanca*, a fine plaster made of micaceous clay and commonly found in historic structures in the Taos area. Whether this represents intentional coloring of the bottom course is not known since only small fragments were found. Green (1976) excavated three pithouses whose bottom wall courses were apparently decorated. At TA-10, the pithouse walls were black, but the bottom course and part of the second course were painted white with a narrow band of yellow at the junction of the two courses (Green 1976:14). At TA-18, the bottom wall course in Pithouse B was plastered and painted with a black band, while in Pithouse C the bottom course was plastered white with a black band (Green 1976:15, 18). Whether this phenomenon represents decoration of only the bottom wall course or is due to deterioration of the plaster above the bottom course is not known.

The plaster was not grayer or darker than the adobe in the wall, suggesting that it was not discolored by smoke. However, the floor was slightly grayer than the wall, indicating discoloration from use. The wall was plastered after the floor was poured, since the plaster extended down from the wall onto the floor (Fig. 65). Whether the floor abutted the wall as at LA 2742 is not known since the floor was not trenched near the wall. The floor was exposed in the postholes, where it was seen as a 1 to 2 cm thick layer of adobe.

Figure 61. LA 70577, adobe wall courses, east side.

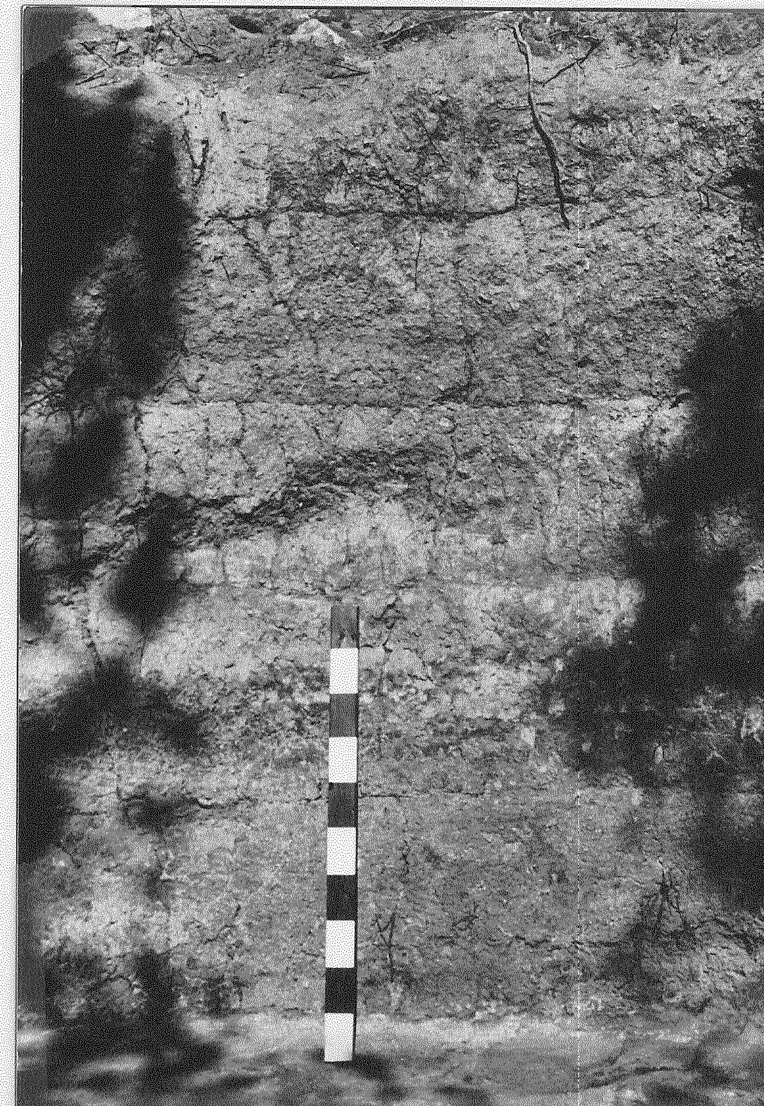

Figure 62. LA 70577, adobe wall courses, north side.

Figure 63. LA 70577, adobe wall with plaster, east side.

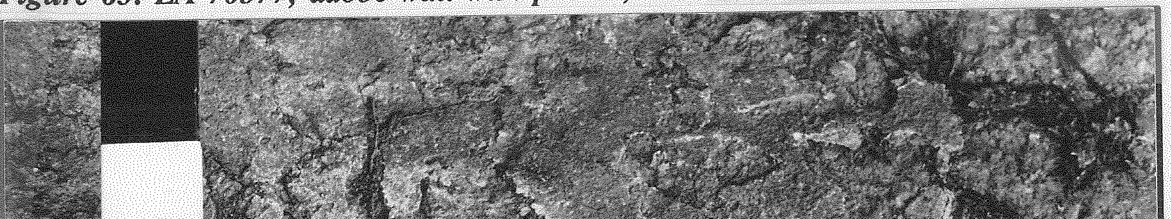

Figure 64. LA 70577, adobe wall with finish plaster, east side.

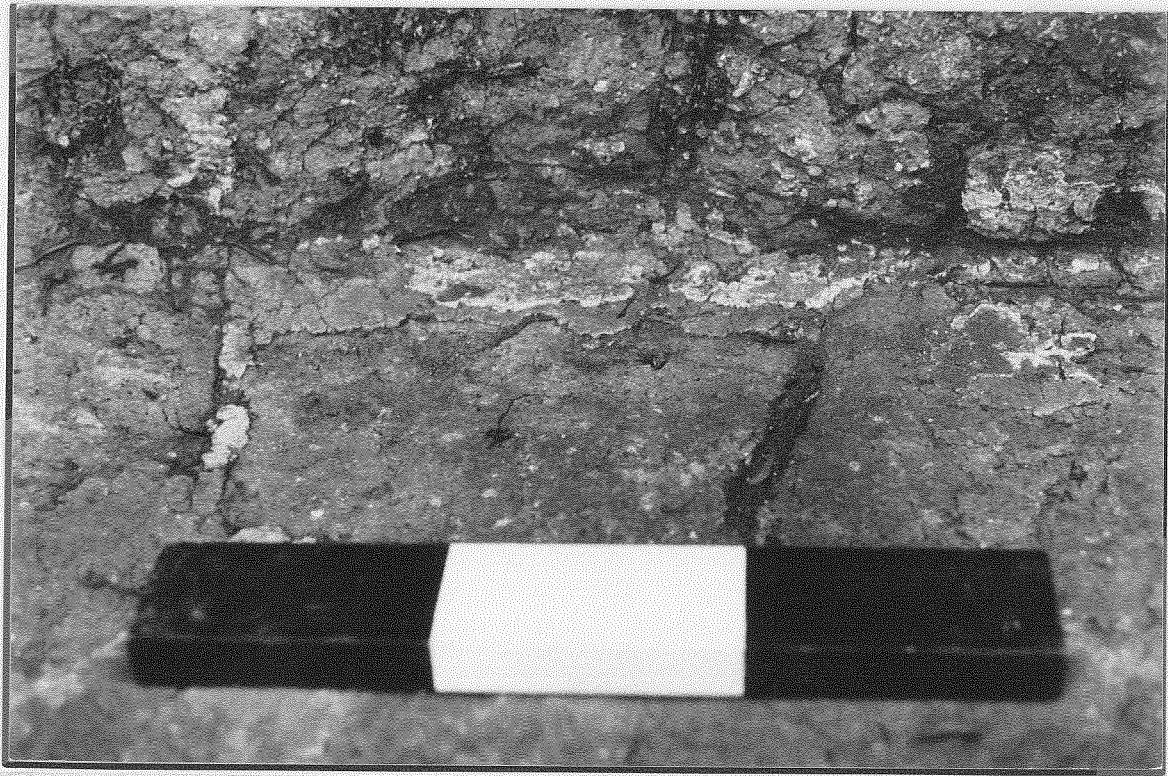

Figure 65. LA 70577, adobe plaster extending onto floor.

Figure 66. LA 70577, ground stone artifacts on the floor.

Four upright posts were set in holes in each quadrant of the floor. These uprights supported the *vigas* or primary roof beams, which probably ran north-south. The minimum spans, wall to wall, in this direction were 6.2 and 6.25 m, 0.45 to 1 m longer than the minimum east-west spans. However, east-west spans between the *vigas* would have been about 1 m shorter, reducing the weight and stress on the secondary roof beams. Also, assuming the ladder protruded out of the smoke/entrance hole to the west, based on the location of the ladder rests, the weight of the ladder and anyone using it would have been born by the western *viga*.

The floor features were associated with the single floor. There is no evidence of remodeling or additions to the features, including the rock in the floor on the south side of the ash pit, which was set in place before the adobe floor was poured.

The large sizes of the four postholes and the absence of post stubs show that the upright posts were intentionally removed from the structure. This event accompanied removal of the roof, as evidenced by the total absence of roof beams or fragments thereof in the structural fill. Small, burned juniper stick fragments may have been *latilla* remnants, but we could not determine that with any certainty. This points to intentional salvaging of the roof and its support system at or after abandonment.

Post-Abandonment History of the Structure

The pithouse was abandoned in an orderly fashion. Artifacts found on the floor included a small, broken Taos Gray pot near the west wall, a small pile of Taos Gray sherds near the north wall, a small metate, a mano, and a polishing stone--all near the east wall (Fig. 66, which shows the mano on the metate)--and a very large trough metate, also near the east wall (Fig. 67). The metate was in place when Figure 55 was drawn but was stolen before the plan view was drawn.

A thin layer of organic material resembling decayed pine duff was found on the floor. The artifacts were found in and on this layer. Pollen analysis suggests that the layer was the remains of pine boughs, perhaps used for bedding. The large holes dug to remove the upright posts were dug through this duff layer, showing that it was in place before the posts were removed. Directly above the duff and covering the large postholes was a deposit of large and small adobe chunks, probably roof material that fell in during removal of the roof. This indicates that little or no time elapsed between abandonment and salvaging the roof.

The structure fill above the duff layer consisted of naturally deposited soil containing artifacts and other cultural material. This fill formed the matrix around the adobe chunks, showing that colluvial filling of the structure began after they were deposited, further supporting the interpretation that the roof was salvaged at or very shortly after abandonment. This interpretation is also supported by the fact that the structure fill did not include a complex array of strata such as that encountered at LA 2742. Directly in front of the ventilator opening was a small deposit of alluvially deposited sand that had washed in through the ventilator. Otherwise, the fill was largely homogenous, with only lenses of other material.

Figure 67. LA 70577, very large trough metate on floor.

The thick layer of Stratum 2 seen in Figures 55, 57a, and 57b contrasts distinctly with the thin soil deposit in the area of the rock alignment. There, the presence of the alignment at the base of the thin topsoil layer shows very little soil accumulation over the centuries. One possible explanation is that dirt and rocks removed from the original hole were placed in piles to the east of the structure in the area of the rock mound. Assuming that the original hole was about 5 m in diameter, not including the ventilator trench, and 3 m deep, allowing for some filling before the floor was poured, as at LA 2742, it would have yielded about 59 cu m of dirt and rocks. The circumference of the structure was about 14.2 m, and the walls were about 2.25 m high (as seen on the north side) and 20 to 25 cm thick. Making the adobe for the walls and floor would have required about 6.5 cu m of dirt. If the roof was 5 m across and the dirt on it was 30 cm thick, some 4.7 cu m of dirt was needed for the roof. Adding for adobe for the hearth and ventilator and plaster for the walls, a liberal estimate of 14 cu m of dirt was needed for the structure, leaving about 45 cu m piled outside the structure. Even assuming use, over the life of the site, of an additional 5 cu m for needs such as mud for the windbreak, pottery manufacture, and other activities, a 40 cu m pile of dirt and rock would be left. Although the shape of the pile is obviously not known, it could, for instance, have been an imposing feature 5 m long, 4 m wide, and 2 m high. Natural erosion of this pile, whatever its size, would have moved dirt and rocks back into the hole left after the roof was removed, if the pile was on the east (uphill) side of the structure. The hole itself would have prevented soil movement into the area of the rock alignment, leaving soil accumulation in that area to depend largely on eolian deposition and decay of duff from the piñon and juniper trees. If this scenario is correct, it may account for the stratigraphic differences from one side of the pithouse to the other and for the presence of the rock mound.

Dating the Site

One archaeomagnetic, five radiocarbon, and seven obsidian samples were submitted for chronometric analysis. As at LA 2742, the results vary widely, and several radiocarbon dates appear too early. However, the anomalies are not as great as at LA 2742.

The archaeomagnetic sample, PC 509, was taken from the hearth of the pithouse and was analyzed by Daniel Wolfman of OAS. The sample yielded a date of A.D. 1125-1190, placing the site in the Valdez phase (Table 30). This is a broad range spanning much of the A.D. 1100s.

Table 30. LA 70577, archaeomagnetic analysis

Sample No.	Provenience	Lat.	Long.	α_{95}	δp	δm	N	Demag.	Date (A.D.)
PC-509	hearth	73.7	189.3	1.2	1.4	1.9	9/8	400	1125-1190

Radiocarbon samples came from various proveniences, as listed in Table 31. The five dates adjusted for C-13 range from A.D. 880 to 1150 (one standard deviation), with the period of greatest overlap of dates between A.D. 990 and 1070. Only two dates overlap with the archaeomagnetic date. If two standard deviation ranges are used, the five samples range between A.D. 780 and 1230. This 450 year period is far too long to shed any light on the occupation of LA 70577 except to place it sometime before the mid-A.D. 1200s. When the samples are calibrated, they yield nine dates between A.D. 1027 and 1166 with a single standard deviation range between A.D. 980 and 1245. The period of greatest date overlap is A.D. 1040 to 1170. The calibrated date ranges all overlap with the archaeomagnetic date. They fall into two groups. The earlier group has four dates between A.D. 1027 and 1078. The later group, with five dates between A. D. 1125 and 1166, falls into the overlap period with the archaeomagnetic date.

Table 31. LA 70577, radiocarbon analysis (ranges are at one standard deviation)

Sample No.	Type and Provenience	Uncorrected Date (A.D.)	C-13 Adjusted Date and Range (A.D.)	Calibrated Date(s) and Range(s) (A.D.)
Beta-46602	burned wood and charcoal from pithouse floor near ventilator	1050±60	1010±60 (950-1070)	1039 (1018-1166)
Beta-46603	charcoal from posthole (Feature 3)	830±80	1070±80 (990-1150)	1166 (1030-1245)
Beta-46604	charcoal from hearth (Feature 5)	1050±100	980±100 (880-1080)	1027 (980-1170)
Beta-46605	charcoal from ash pit (Feature 6)	1100±70	1060±70 (990-1130)	1163 (1030-1225)
Beta-46606	charcoal from ash pit (Feature 6)	1080±70	1040±70 (970-1110)	1058, 1078, 1125, 1136, 1156 (1024-1217)

Seven obsidian samples were submitted for hydration analysis. The results are listed in Table 32. The seven samples fall tightly into two groups of dates. The actual dates, however, vary according to whether they are calculated using ground temperature and humidity figures from Sagebrush Pueblo or Pot Creek Pueblo (Ridings 1991). Using the Sagebrush Pueblo figures, one group of four samples dates between A.D. 447 and 703, and the second group of three samples dates between A.D. 1049 and 1224. Using the Pot Creek Pueblo temperature and humidity figures, the first group of samples dates between A.D. 742 and 948, and the second dates between A.D. 1225 and 1366.

Table 32. LA 70577, obsidian hydration analysis

Sample	Source	EHT (°C)	Rate	Rim Width (um)	Standard Deviation	Date (A.D.)	Standard Deviation	Date Range (A.D.)
91-522[1]	Polvadera	10.8	100%	2.81	0.05	605	±98	507-703
91-522[2]		12.6				869	±79	790-948
91-523[1]	Polvadera	10.8	100%	2.87	0.07	547	±100	447-647
91-523[2]		12.6				822	±80	742-902
91-524[1]	Polvadera	10.8	100%	2.20	0.05	1126	±77	1049-1203
91-524[2]		12.6				1287	±62	1225-1349
91-525[1]	Polvadera	10.8	100%	2.18	0.05	1140	±76	1064-1216
91-525[2]		12.6				1299	±61	1238-1360
91-526[1]	Polvadera	10.8	100%	2.81	0.05	605	±98	507-703
91-526[2]		12.6				869	±79	790-948
91-527[1]	Polvadera	10.8	100%	2.17	0.07	1148	±76	1072-1224
91-527[2]		12.6				1305	±61	1244-1366
91-528[1]	Polvadera	10.8	100%	2.83	0.04	586	±98	488-684
91-528[2]		12.6				853	±79	774-932

[1] Temperature and relative humidity data for Sagebrush Pueblo from Ridings (1991).
[2] Temperature and relative humidity data for Pot Creek Pueblo from Ridings (1991).

Comparison with the archaeomagnetic date shows that the hydration dates based on the Sagebrush Pueblo figures appear to be most accurate. The second group of dates, with a period of greatest date overlap between A.D. 1072 and 1203, closely approximate the archaeomagnetic date, although with a longer range. They also overlap with all five calibrated radiocarbon dates. In contrast, neither group of samples matches the archaeomagnetic or calibrated radiocarbon dates if hydration dates are calculated using the Pot Creek Pueblo temperature and humidity figures. One group is too early and the other too late.

Taking the archaeomagnetic, calibrated radiocarbon, and obsidian hydration data together, we can state that LA 70577 was occupied in the mid-A.D. 1100s. The greatest overlap of dates from all sources is between A.D. 1120 and 1170.

Pollen Analysis

Two pollen samples were analyzed by the University of New Mexico's Castetter Laboratory for Ethnobotanical Studies (CLES). Both were from the pithouse floor, one from beneath a large trough metate and the second from a layer of organic material resembling decayed pine duff found on the floor. Results are presented in Table 33. Although both samples showed signs of extensive grain degradation, neither showed evidence of grinding (Dean 1991a:16). However, Table 33 shows that both samples contained large estimated numbers of pine family pollen grains. Dean (1991a:16) concludes, "Pine needles are the logical source of the pine family pollen grains, having been brought into the pitstructure for use as a floor covering, perhaps under matting."

Human Remains

During excavation of the pithouse a partial human mandible was recovered from the fill. This was an anterior fragment with part of the left alveolar ridge of a child three years ± six months of age. Only the left first and second deciduous molars are present in the jaw. These two teeth exhibit slight wear on the occlusal surface in the form of rounding and polish on the cusps. The second primary molar has two small caries, one mesial and one posterior, on the occlusal surface. Erosion of the inferior mandibular cortical tissue is moderate to heavy and has exposed portions of the developing permanent incisor crowns. The development of these permanent teeth appears normal for this age.

This fragmentary element was the only human bone isolated from LA 70577. It had washed into the structural fill from a midden or activity area on the original ground surface. Visible permanent incisors appear to have developed normally, but the caries on the second primary molar show that overall dental health was somewhat jeopardized, perhaps from weaning onto a high-carbohydrate diet.

Lithic Artifacts

A total of 1,199 chipped stone artifacts were recovered from LA 70577 (Tables 34 and 35). Local materials make up 74 percent of the assemblage, including cherts, basalt, limestone, siltstone, quartzite, undifferentiated igneous rocks, massive quartz, chertic rhyolite, micaceous schist, and concretions. Exotic materials comprise 26 percent of the assemblage, including Pedernal chert, obsidian, and quartzitic sandstone. Obsidian was imported from the Jemez Mountains, mostly from the Polvadera Peak source. Pedernal chert outcrops near Abiquiu and is found in gravel deposits along the Rio

Chama and the Rio Grande, south of Española. The source of quartzitic sandstone is unknown, but it may also come from the Chama Valley (Newman 1983).

Reduction debris (debitage and cores) dominate the assemblage, comprising 98 percent of the total (Table 35). Nearly half the debitage removed during formal tool use or manufacture is from exotic materials, including fifteen biface flakes and a notching flake. All resharpening flakes are basalt and appear to be from only one or two tools. Twenty-nine formal tools were identified (Table 34), including a chopper, three drills, two end scrapers, thirteen bifaces, and ten projectile points. The latter include one En Medio point, six Pueblo side-notched points, one Pueblo point with three side notches, one large side-notched point, and one unidentified small side-notched point. Most of the formal tools were made from exotic materials. Three drills, five bifaces, and four projectile points are Pedernal chert, and two bifaces and two projectile points are obsidian.

Ground Stone Artifacts

Thirty-seven ground stone artifacts were recovered. The distribution of functional type by material is shown in Table 36. Quartzitic sandstone dominates the assemblage and with sandstone comprises over 83 percent. Tools associated with food processing (manos, metates, cylindrical tools) make up over 67 percent of the assemblage. Both one- and two-hand manos were found. Metates are represented by basin, trough, and slab forms, the latter predominating.

Other activities are also suggested by this assemblage. Two types of polishing stones were identified: one used on pottery, and the other on plaster. Hammerstones were used for flintknapping or other activities that involved pounding. Mauls were also used for pounding, though probably not for flintknapping. The function of the single cylindrical tool could not be determined, but it was probably used for grinding.

Table 37 shows function by preform morphology. Few tools have an identifiable preform morphology. Of those that do, 21.6 percent were manufactured from cobbles, and 2.7 percent were made from very thin slabs. Both flattened and round cobbles were used; the former were most common. Table 38 shows the amount of labor invested in producing each functional category. Both hammerstones and two polishing stones were unshaped. Slightly more than 10 percent of the assemblage was slightly modified, and around 70 percent was mostly or fully modified. One polishing stone and 4 manos fall into the former category; the latter contains 2 shaped slabs, 1 polishing stone, 13 manos, 4 metates, 1 artifact of undetermined function, and 1 cylindrical tool. In general, tools used for grinding had the most labor expended in their manufacture, while those used for pounding or rubbing had the least.

Table 33. LA 70577, pollen analysis

Taxon	CLES-90210		CLES-90212	
	No.	Conc.[1]	No.	Conc.[1]
Pinaceae	12	581	21	2,346
Pinus	31	1,500	31	3,462
Picea	2	97	1	112
Abies	-	0	-	0
Juniperus	7	339	6	670
Juniperus/ Populus	-	0	-	0
Alnus	-	0	1	112
Quercus	-	0	-	0
Cheno-am	1,05[2]	5,082	78	8,712
Ephedra	1	48	1	112
Gramineae	2	97	5	558
Zea	-	0	[1]	147
Low-spine composite	13	629	9	1,005
Artemisia	-	0	3	335
High-spine composite	8	387	4	447
Cichorieae	-	0	-	0
Cleome	-	0	1	112
Opuntia	-	0	-	0
Cylindropuntia	-	0	-	0
Platyopuntia	-	0	-	0
Unknown	2	97	-	0
Unidentifiable	39 (84%)	1,888	53 (25%)	5,920
Total pollen	222	10,745	215	24,050
Spike[3]		30/112		13/79

1 Pollen concentrations expressed as estimated numbers of pollen grains/gram of sample.
2 One or more clumps of three or more grains seen during count.
3 Number seen during 200 grain count/total number of spike grains on slide.
[] Number of grains seen during 200 grain count; final pollen concentration computed using total number of pollen type:spike grains on slide to compensate for uneven distribution of pollen type on slide.

Table 34. LA 70577, chipped stone artifact morphology by material type, formal tools

Material Type	Artifact Morphology					
	Choppers	Drills	Scrapers	Bifaces	Projectile points	Totals
Chert	0	0	1	4	3	568
Pedernal chert	0	3	0	5	4	118
Obsidian	0	0	0	1	0	44
Polvadera obsidian	0	0	0	1	2	144
Igneous undiff.	0	0	0	0	0	23
Basalt	0	0	0	2	1	242
Rhyolite	0	0	1	0	0	4
Limestone	0	0	0	0	0	19
Siltstone	0	0	0	0	0	1
Quartzite	1	0	0	0	0	25
Quartzitic sandstone	0	0	0	0	0	5
Schist	0	0	0	0	0	2
Massive quartz	0	0	0	0	0	3
Concretion	0	0	0	0	0	1
Totals/ Percent	1 0.1	3 0.3	2 0.2	13 1.1	10 0.8	1,199

Table 35. LA 70577, chipped stone artifact morphology by material type, debitage

Material Type	Artifact Morphology								
	Indet.	Cores	Angular debris	Potlids	Core flakes	Biface flakes	Resharpening flakes	Notching flakes	Bipolar flakes
Chert	0	15	194	1	345	3	1	0	1
Pedernal chert	0	0	26	0	79	2	0	0	0
Obsidian	0	0	2	0	36	5	0	0	0
Polvadera obsidian	0	0	22	0	110	8	0	1	0
Igneous undiff.	0	0	3	0	20	0	0	0	0
Basalt	0	2	22	0	202	8	5	0	0
Rhyolite	0	0	1	0	2	0	0	0	0
Limestone	0	0	1	0	18	0	0	0	0
Siltstone	0	0	0	0	1	0	0	0	0
Quartzite	0	1	5	0	18	0	0	0	0
Quartzitic sandstone	0	0	0	0	5	0	0	0	0
Schist	2	0	0	0	0	0	0	0	0
Massive quartz	0	0	1	0	2	0	0	0	0
Concretion	1	0	0	0	0	0	0	0	0
Total Percent	3 0.3	18 1.6	277 23.1	1 0.1	838 69.9	26 2.2	6 0.5	1 0.1	1 0.1

Table 36. LA 70577, ground stone artifact function by material type, frequencies and row percentages

Function	Material Type								
	Igneous undiff.	Basalt	Vesicular basalt	Sandstone	Siltstone	Quartzite	Quartzitic sandstone	Schist	Totals
Indeterminate	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Polishing stone	1 25.0	0 0.0	1 25.0	0 0.0	0 0.0	0 0.0	2 50.0	0 0.0	4 10.8
Shaped slab	0 0.0	0 0.0	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	2 5.4
Hammerstone	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 50.0	1 50.0	0 0.0	2 5.4
Mano unident.	0 0.0	1 20.0	0 0.0	3 60.0	0 0.0	0 0.0	1 20.0	0 0.0	5 13.5
One-hand mano	0 0.0	0 0.0	0 0.0	4 33.3	0 0.0	0 0.0	7 58.3	1 8.3	12 32.4
Two-hand mano	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	1 50.0	0 0.0	2 5.4
Metate unident.	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Basin metate	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.7
Trough metate	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Slab metate	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	0 0.0	0 0.0	0 0.0	3 8.1
Maul-grooved	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	2 5.4
Cylindrical tool	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.7
Totals/ Percent	1 2.7	1 2.7	1 2.7	15 40.5	1 2.7	1 2.7	16 43.2	1 2.7	37 100.0

Table 37. LA 70577, ground stone artifact function by preform morphology, frequencies and row percentages

Function	Preform Morphology				
	Indeterminate	Rounded cobble	Flattened cobble	Very thin slab	Totals
Indeterminate	1 100.0	0 0.0	0 0.0	0 0.0	1 2.7
Polishing stone	2 50.0	1 25.0	1 25.0	0 0.0	4 10.8
Shaped slab	2 100.0	0 0.0	0 0.0	0 0.0	2 5.4
Hammerstone	0 0.0	1 50.0	1 50.0	0 0.0	2 5.4
Mano indet.	5 100.0	0 0.0	0 0.0	0 0.0	5 13.5
One-hand mano	10 83.3	0 0.0	1 8.3	1 8.3	12 32.4
Two-hand mano	2 100.0	0 0.0	0 0.0	0 0.0	2 5.4
Metate indet.	1 100.0	0 0.0	0 0.0	0 0.0	1 2.7
Basin metate	0 0.0	0 0.0	1 100.0	0 0.0	1 2.7
Trough metate	1 100.0	0 0.0	0 0.0	0 0.0	1 2.7
Slab metate	3 100.0	0 0.0	0 0.0	0 0.0	3 8.1
Maul-grooved	0 0.0	1 50.0	1 50.0	0 0.0	2 5.4
Cylindrical tool	1 100.0	0 0.0	0 0.0	0 0.0	1 2.7
Totals/ Percent	28 75.7	3 8.1	5 13.5	1 2.7	37 100.0

Table 38. LA 70577, ground stone artifact function by labor invested in production, frequencies and row percentages

Function	Labor Invested in Production					
	Indeterminate	None	Slightly modified	Mostly modified	Fully shaped	Totals
Indeterminate	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.7
Polishing stone	0 0.0	2 50.0	1 25.0	0 0.0	1 25.0	4 10.8
Shaped slab	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2 5.4
Hammerstone	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	2 5.4
Mano indet.	2 40.0	0 0.0	0 0.0	2 40.0	1 20.0	5 13.5
One-hand mano	0 0.0	0 0.0	0 0.0	2 16.7	10 83.3	12 32.4
Two-hand mano	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2 5.4
Metate indet.	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Basin metate	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	1 2.7
Trough metate	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.7
Slab metate	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 8.1
Maul-grooved	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	2 5.4
Cylindrical tool	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.7
Totals Percent	3 8.1	4 10.8	4 10.8	5 13.5	21 56.8	37 100.0

Table 39. LA 70577, ground stone artifact function by portion, frequencies and row percentages

Function	Portion								
	Indet. fragment	Whole	End fragment	Edge fragment	Internal fragment	Corner	Corner missing	Long. split fragment	Totals
Indeterminate	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Polishing stone	0 0.0	3 75.0	0 0.0	1 25.0	0 0.0	0 0.0	0 0.0	0 0.0	4 10.8
Shaped slab	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 5.4
Hammerstone	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 5.4
Mano indet.	0 0.0	0 0.0	1 20.0	1 20.0	0 0.0	3 60.0	0 0.0	0 0.0	5 13.5
One-hand mano	0 0.0	7 58.3	2 16.7	0 0.0	0 0.0	1 8.3	1 8.3	1 8.3	12 32.4
Two-hand mano	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 5.4
Metate indet.	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.7
Basin metate	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Trough metate	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Slab metate	0 0.0	1 33.3	1 33.3	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	3 8.1
Maul-grooved	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 5.4
Cylindrical tool	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Totals/ Percent	1 2.7	17 45.9	7 18.9	5 13.5	1 2.7	4 10.8	1 2.7	1 2.7	37 100.0

Table 39 shows ground stone function by portion. Whole artifacts comprise less than half the assemblage. Only a third of the metates are whole; other complete artifacts include 3 polishing stones, 2 hammerstones, 7 manos, 2 mauls, and 1 cylindrical tool. Table 40 shows artifact portion by labor invested in production. Only 1 of the unshaped artifacts and none of the lightly shaped artifacts is broken. Sixty percent of the mostly modified and 62 percent of the fully shaped artifacts are broken. With one exception, the percentage of whole artifacts decreases with the amount of labor expended in production. Three ground stone artifacts were found on the pithouse floor, including a large trough metate, a small metate, and a mano. The trough metate was whole, but it is not included in any of the tables because it was removed by vandals during excavation.

Table 40. LA 70577, ground stone portion by labor invested in production, frequencies and row percentages

Function	Labor Invested in Production					
	Indeterminate	None	Slightly modified	Mostly modified	Fully shaped	Totals
Indeterminate	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.7
Whole	0 0.0	3 17.6	4 23.5	2 11.8	8 47.1	17 45.9
End fragment	0 0.0	0 0.0	0 0.0	1 14.3	6 85.7	7 18.9
Edge fragment	1 20.0	1 20.0	0 0.0	0 0.0	3 60.0	5 13.5
Internal fragment	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.7
Corner	1 25.0	0 0.0	0 0.0	1 25.0	2 50.0	4 10.8
Corner missing	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.7
Long. split fragment	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 2.7
Totals/ Percent	3 8.1	4 10.8	4 10.8	5 13.5	21 56.8	37 100.0

With the exception of the missing trough metate, it is likely that few of the whole artifacts were intentionally left behind as site furniture. Only one whole artifact, a maul, was found during surface stripping. All other whole tools were recovered from pithouse fill. Most of these tools were probably abandoned or discarded and later washed into the pithouse. Seven complete artifacts are pounding or rubbing tools, only one of which is fully shaped. In that case, it is likely that the shaping resulted from use rather than intentional modification. Thus, these are tools upon which little effort was spent in production. A basin metate is the only other complete tool that exhibits little manufacturing effort. Complete tools evidencing the expenditure of considerable effort in shaping include seven one-hand manos, a slab metate, and a cylindrical tool. Only two of the one-hand manos were mostly shaped; the rest were fully shaped. None of these is a heavy tool, and if they were considered useful at the time of abandonment, they would have been transported elsewhere. Thus, it is likely that they represent discarded or abandoned items rather than site furniture.

Ceramic Artifacts

The ceramic assemblage consists mainly of locally made prehistoric types. A few locally made historic micaceous wares were also found. A minimal number of possible intrusive types, including Santa Fe Black-on-white (see Ceramic Analysis for a discussion of locally made Santa Fe Black-on-white), are in the assemblage. The total number of sherds collected and analyzed is 2,295. Of these, 75.1 percent are plain wares, and 24.3 percent are white wares (0.6 percent are "other"). Within the plain wares, 98.4 percent are jar sherds. Within the white wares, 56.5 percent are bowl sherds, and 39.0 percent are jar sherds (Table 41).

Table 41. LA 70577, summary of ceramic ware vessel forms

Plain ware vessel forms	Percent
Jar	98.4
Bowl	0.3
Indeterminate	1.3
White ware vessel forms	
Jar	39.0
Bowl	56.5
Ladle	0.4
Indeterminate	4.1

Most of the assemblage was from the pithouse (67.0 percent). The other sizable sample (24.7 percent) was from surface collection. Additional proveniences from which ceramics were collected included surface stripping around the rock alignment, excavation around a possible activity area, and auger testing. Within this sample, jar sherds outnumbered bowl sherds 6 to 1.

The ceramic assemblage at LA 70577 is characteristic of the Valdez phase. The white wares were dominated by Taos Black-on-white, and the gray wares were mostly Taos Plain, with a few incised. Santa Fe Black-on-white and Corrugated wares, both indicators of the subsequent Pot Creek phase, were found in small numbers (Table 42).

Faunal Remains

The pit structure and activity area at LA 70577 produced a faunal assemblage of 425 bone fragments. Of that total, 167 (39.3 percent) are only identifiable to the class level, with mammal bone divided between small, medium, and large body forms. The remaining 258 elements could be identified to three orders, two families, three genera, and thirteen species (Table 43). The majority of this bone was recovered from the pithouse fill and appears to have washed in from the rock mound and midden area east of the structure. Since the pithouse was never remodeled, and the support posts were salvaged at or shortly after the time of abandonment, structural fill was probably a mixture of the trash and soils on the original ground surface. The numerous rodent and small mammal species isolated from the pithouse fill suggest that smaller animals made an important contribution to the diet of the former occupants. A brief review of the taxa identified and their distribution will form the basis of this dietary inference.

It is apparent from Table 43 that numerous small rodent species were recovered from the site, some in substantial numbers. Ground squirrel, prairie dog, pocket gopher, New World rats, vole, and other elements assigned to the order Rodentia can all be grouped together as small rodents, which dominate the faunal assemblage (186 bones, 43.8 percent of the sample). All of these taxa inhabit the site area and are frequent burrowers in suitable soils in the region (Findley et al. 1975). Archaeological sites provide deep, disturbed soil deposits for such burrowing, and burrowing was evident within the fill of the pithouse at this site. The remains, however, suggest more than just intrusive burrowing.

The element distributions for the two most frequently identified rodents, Gunnison's prairie dog (*Cynomys gunnisoni*) and Botta's pocket gopher (*Thomomys bottae*) are presented in Figure 68. The occurrence of cranial and most postcranial elements of prairie dog suggests that some of these remains could be accounted for by intrusive individuals, especially when paired long bones occur (i.e., ulna, femur) (Thomas 1971). However, besides these probably intrusive individuals, there are elements from multiple individuals isolated from pockets of bone that include several other species. This bone appears to have been introduced through a combination of cultural and natural mechanisms (Schiffer 1987). The pocket gopher remains in the

Table 42. LA 70577, ceramic type by vessel form, frequencies and row percentages

Type	Indeterminate	Jar	Bowl	Ladle	Total
Unknown	2 .1	1 .0	3 .1		6 .3
Taos Black-on-white	3 .1	70 3.1	206 9.0	1 .0	280 12.2
Santa Fe Black-on-white	1 .0	5 .2	13 .5	1 .0	20 .9
Santa Fe Black-on-white, local			3 .1		3 .1
Indeterminate mineral white ware		7 .3	9 .4		16 .7
Indeterminate carbon white ware		2 .1	3 .1		5 .2
Indeterminate white ware	16 .7	137 6.0	82 3.6		235 10.2
Peñasco Micaceous		2 .1			2 .1
Vadito Micaceous		2 .1			2 .1
Indeterminate micaceous		2 .1			2 .1
Taos Gray Plain	20 .8	1545 67.3	5 .2		1570 68.4
Taos Gray Incised, linear		114 5.0			114 5.0
Taos Gray Incised, herringbone		3 .1			3 .1
Taos Gray Incised, linear and herringbone		11 .5			11 .5
Taos Gray Incised, fingernail		3 .1			3 .1
Taos Gray Corrugated, simple		2 .1			2 .1
Taos Gray Punctate, linear		3 .1			3 .1
Taos Gray Punctate, herringbone		13 .6			13 .6
Taos Gray Punctate, other		1 .0			1 .0
Taos Gray Punctate, linear and herringbone		4 .2			4 .2
Total/ Percent	42 1.8	1,927 83.7	324 14.1	2 .1	2,295 100.0

Table 43. LA 70577, faunal taxa

Taxon	Frequency	Percent
Small mammal	80	18.8
Medium mammal	13	3.1
Large mammal	58	13.6
Rodentia	11	2.6
Ammospermophilus leucurus (white-tailed antelope squirrel)	1	0.2
Spermophilus sp. (ground squirrels)	12	2.4
Spermophilus variegatus (rock squirrel)	2	0.5
Cynomys gunnisoni (Gunnison's prairie dog)	54	12.7
Thomomys bottae (Botta's pocket gopher)	41	9.6
Dipodomys ordii (Ord's kangaroo rat)	6	1.4
Dipodomys spectabilis (banner-tailed kangaroo rat)	17	4.0
Peromyscus leucopus (white-footed mouse)	16	3.8
Onychomys leucogaster (northern grasshopper mouse)	2	0.5
Sigmodon hispidus (Hispid's cotton rat)	4	0.9
Neotoma albigula (white-throated woodrat)	3	0.7
Neotoma mexicana (Mexican woodrat)	2	0.5
Microtus montanus (Montane voles)	15	3.5
Sylvilagus auduboni (desert cottontail)	9	2.1
Canis sp. (dog, coyote, wolf)	1	0.2
Artiodactyla	3	0.7
Odocoileus sp. (deer)	10	2.4
Aves (bird)	16	3.8
Tetraonidae (grouse and ptarmigan)	1	0.2
Meleagris gallopavo (turkey)	36	8.5
Ophidia (snake)	10	2.4
Bufonidae (true toads)	2	0.5
Total	425	100.0

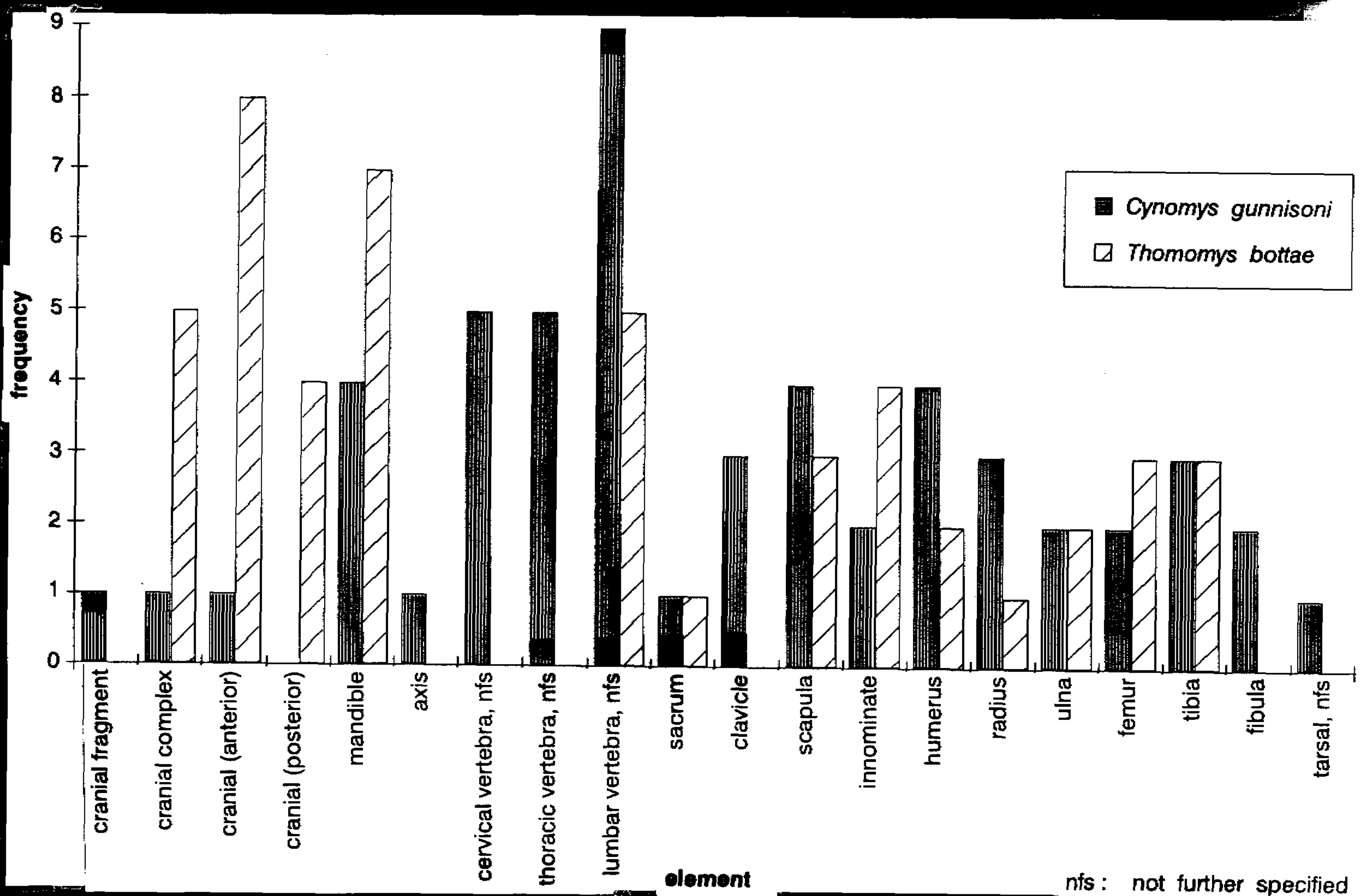

Figure 68. LA 70577, elemental distribution of* Cynomys *and* Thomomys *remains.

structural fill have a somewhat more arbitrary element distribution, but both cranial and numerous postcranial remains are represented. Again, paired long bones such as the humerus and ulna along with cranial and axial remains retrieved from the same layer in the same unit indicate at least one intrusive individual. But other remains assigned to this species may have been refuse from processing and consumption. The occurrence of numerous cranial elements along with mandibles that far outnumber the postcranial bone would support the economic use of this species (Thomas 1971).

One stratigraphic subunit consisting of a sandy matrix washed in through the ventilator contained remains of ground squirrel, prairie dog, pocket gopher, two kinds of kangaroo rats, two species of mice, vole, snake, and turkey. Their occurrence in one pocket suggests that they were washed in from a concentration of bone somewhere around the top of the ventilator shaft. The tanned appearance of some bones and the numerous species present suggest this concentration was the refuse from one or perhaps several dumps from the household stew pot. The remains of four other rodent species are illustrated in Figure 69. Their element distributions are biased toward cranial fragments, and only a few postcranials are represented. Thomas (1971) has separated cultural versus noncultural bone by the completeness of skeletal elements present. If most elements are represented, the species is considered intrusive. On that basis, the four species diagrammed in Figure 69 would have been introduced through the economic or cultural use of each species.

Desert Cottontail (Sylvilagus auduboni)

Desert cottontail occurs in piñon-juniper woodlands throughout the state (Findley et al. 1975:83). Nine elements were identified to this species from the LA 70577 faunal assemblage. Elements were isolated from the ash pit, a posthole, and the fill of the pithouse. Cottontails were an important economic species for the prehistoric Puebloan groups. In this sample, however, the use of smaller rodents outweighs the use of this species.

Canis *sp. (Dog, Coyote, Wolf)*

Only one first phalange could be identified to the genus *Canis*. From the few bones also isolated from LA 2742 and carnivore gnawing on bone, we know that Puebloan dogs or coyotes scavenged the sites' trash areas and occasionally became part of the faunal assemblage. Though dogs were sometimes an economic species, their remains suggest they were not at this site or at LA 2742.

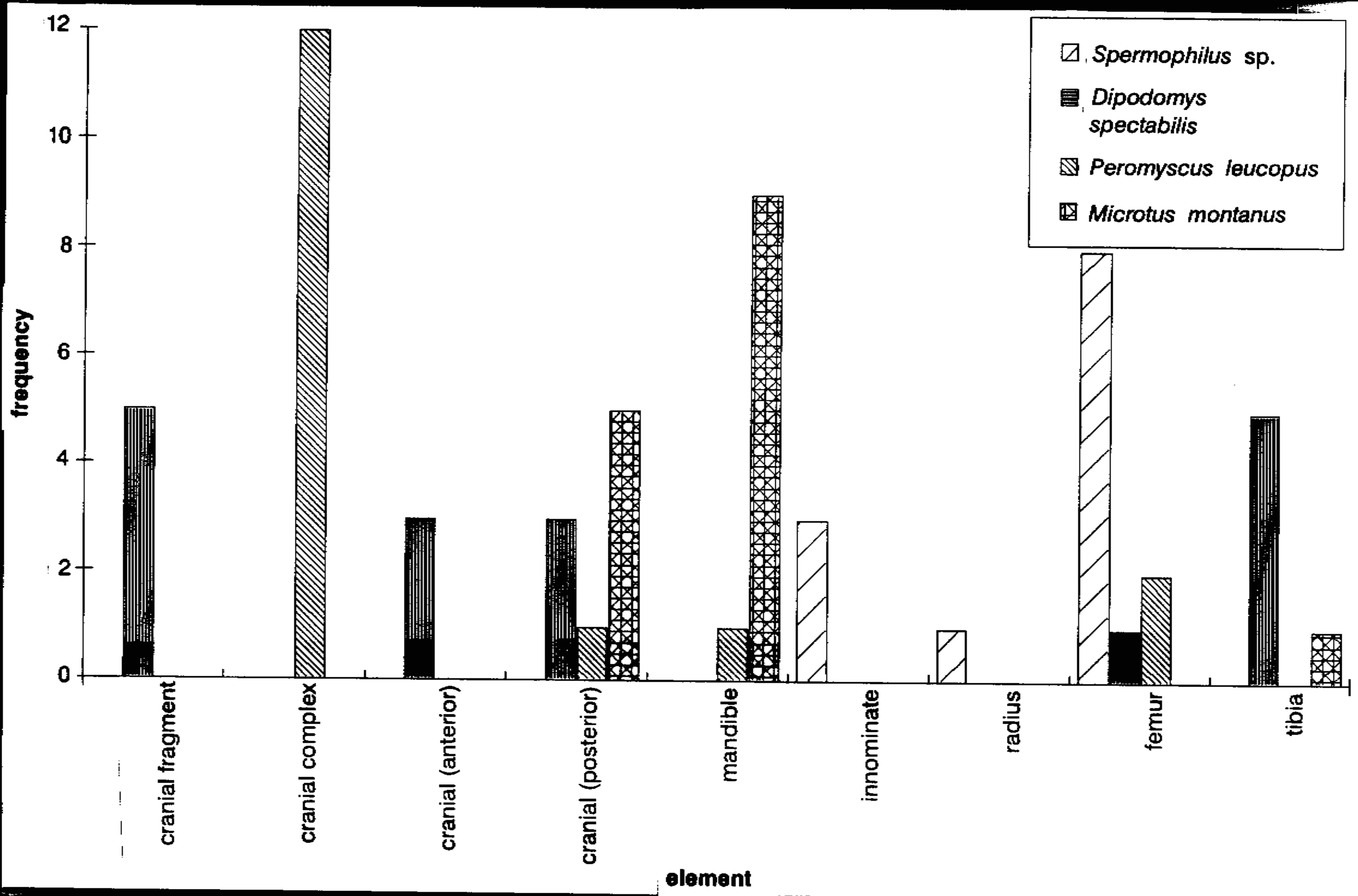

Figure 69. LA 70577, elemental distribution of four rodents.

Artiodactyla

Fragments of antler, vertebra, and a scapula could be positively identified to the order Artiodactyla, but they are most likely the remains of deer (*Odocoileus* sp.) utilized by the site occupants. Ten elements scattered in the pithouse fill, one posthole, and the ash pit could be identified as deer. The element from the posthole, a bone awl (see Bone Tool Analysis), was perhaps placed there for storage at some point during occupation of the structure. Other elements appear to have been discarded into trash outside the pithouse and washed in after the structure was abandoned.

Grouse and Ptarmigan (Tetraonidae)

One coracoid could be assigned to the family Tetraonidae but not to a species. Members of this family are chickenlike and well camouflaged in their environment (Ligon 1961:85). They are excellent game birds and occur frequently in prehistoric faunal assemblages. Though only represented by one element, these birds could have been included in the diet.

Turkey (Meleagris gallopavo)

The largest and swiftest of foot of the American game birds, the New Mexican turkey is the progenitor of the domestic variety (Ligon 1961:101). It appears to have become a significant economic species for Puebloan groups as primary economic species (e.g., deer) decreased in the environment (Mick-O'Hara 1987b). Thirty-six elements could be assigned to this species. The majority (25 elements) were from pithouse fill that washed in through the ventilator shaft and may have come from the same trash area as the rodent bone discussed above.

Snakes (Ophidia) and True Toads (Bufonidae)

Ten snake vertebrae were isolated from pithouse fill that washed in through the ventilator. They may have been associated with other dietary trash from the original ground surface. Two elements could be identified as toad and were also recovered from alluvial fill in front of the ventilator shaft.

Discussion

It appears that the highest concentration of faunal remains recovered from this site comes from Stratum 3, especially from an alluvial deposit located in front of the ventilator. Much of the pithouse fill appears to be colluvial deposits from trash areas near the structure. Refuse from cooking activities and concentrations of small animal bone were probably close enough to the ventilator shaft to be washed into the structure through that opening.

The dominance of small mammal species in this assemblage and their elemental distribution suggests that they were an important part of the diet of former occupants of this site. The small amount of deer bone suggests that this resource was not readily available during the occupation of LA 70577. Rather, the high frequency of turkey and small mammals remains indicate that secondary resources were important sources of calories for the inhabitants of this pithouse.

Flotation Analysis

Sampled proveniences at LA 70577 were confined to the pithouse, situated just within the piñon/juniper treeline. Most samples from the site contained unburned weed seeds (*Chenopodium* and *Portulaca* in four samples, *Euphorbia* in three, and *Physalis* in one) that can be considered probable intrusives (Table 44). Small quantities of charred corn cupules were also widespread. The eight samples exhibiting this combination of floral remains include samples from the floor (FS 400, 402, 407, and 409), the hearth (Feature 5; FS 426, 427, and 432), and an ash concentration against the south wall (FS 485).

The ash pit (Feature 6; FS 440, 442, and 443) stands out in several ways (Table 45). Charred corn remains, including kernels, were more abundant here, and wild tobacco (*Nicotiana*) is present in all three samples. Burned juniper (twigs and a seed) and winged pigweed (seed) are both present in FS 442, and goosefoot (seed) in FS 443. The unburned, fragmentary prickly pear seed in FS 443 may easily be rodent-introduced. The ash pit samples exhibit basic continuity in fill characteristics, with several recurring elements. Likely economic species are more frequent in FS 442, while more probable intrusives occur in FS 443.

A 2 cm layer of pine duff (partially decomposed pine needles) lay on the pithouse floor. It is interpreted as intentional fill, possibly for padding under sleeping mats. Pine pollen was abundant in the pithouse (two samples, with concentrations of Pinaceae grains >2000/g and >6000/g, respectively; Dean 1991a:16), but larger remains such as needles, cone scales, or bark scales were not recovered in any of the 11 flotation samples, nor as macrobotanical remains.

Charred wood from all proveniences at LA 70577 was principally coniferous (82 percent by weight), with occasional oak (in Stratum 3 and the ash pit; Table 46). Juniper, growing in the immediate site environs, was the predominant wood type (46 percent by weight). By comparison, piñon provided a tiny percentage. Two higher-

Table 44. LA 70577, flotation scan samples

Taxa	Central Floor FS 400	Central Floor FS 402	Floor Fill FS 407	Floor Fill FS 409	Feature 5 Hearth FS 426	Feature 5 Hearth FS 427	Feature 5 Hearth FS 432	Feature 6 Ash pit FS 440	Feature 6 Ash pit FS 442	Feature 6 Ash pit FS 443	Ash conc. FS 485
Chenopodium goosefoot			+	+						+	+
Cycloloma winged pigweed									+*		
Portulaca purslane		+		+				+	+		
Euphorbia spurge	+								+	+	
Nicotiana tobacco							+	+	+	+	
Physalis groundcherry					+						
Juniperus juniper									s+ tw+*		
Opuntia pricklypear										+	
Zea mays corn	c+*	c+*	c+*	c+*				k+* c+*	k+* c+*	c+*	c+*
Total taxa	2	2	2	2	1	0	1	3	6	5	2
Burned taxa	1	1	1	1	0	0	0	1	3	1	1

+ 1-10 seeds; ++ 11-25 seeds; +++ > 25 seeds
* some or all items burned
k = kernel; c = cupule; tw = twig; ne = needle; nu = nutshell; co = male cone

Table 45. LA 70577, Feature 6, ash pit, flotation full-sort results

Taxa	FS 440	FS 442	FS 443
Weedy annuals			
Chenopodium goosefoot			10/45.5*
Cycloloma winged pigweed		1/0.5*	
Nicotiana tobacco	5/8.7	3/34.0	6/27.3
Perennials: *Juniperus* (juniper)		1/0.5* tw*	
Cultivars: *Zea mays* (corn)	1/0.7* c*	1/0.5* c*	c*
Total probable economic species: Total taxa/ Total burned taxa/ Total seeds	 2 1 6/9.4	 4 3 5/13.0	 2 1 16/72.8
Taxa with uncertain role: *Portulaca* (purslane)	1/0.7	1/0.5	5/22.7
Probable contaminants: *Euphorbia* (spurge)		1/5.0	7/31.8
Papaveraceae Poppy family			1/4.5
Opuntia pricklypear			1/0.5
Total contaminants: Total taxa/ Total seeds	 0 0	 1 1/5.0	 3 9/36.8

a/b: Number before slash is actual number of seeds recovered; number after slash is adjusted number of seeds per liter of soil sample (taking into account any subsampling or soil sample size other than the standard 1 l).
* = some or all items burned; c = cupule; tw = twig

Table 46. LA 70577, species composition of charcoal submitted for C-14 dating

Taxa	110-111N/102W Stratum 4 Ash Lens FS 218/236	111N/104W Stratum 3 FS 265/306	109N/102W Stratum 3 FS 267	111N/101W Stratum 3 FS 357	Feature 3 FS 428	Feature 5 Hearth FS 433	Feature 6 Ash pit FS 439	Feature 6 Ash pit FS 441	Percent (number/ weight)
Conifers									
Juniperus juniper	2 0.2 g	3 2.2 g	6 2.4 g	1 27.0 g	10 4.0 g	5 4.7 g	6 5.1 g	3 1.8 g	46 28
Pinus edulis piñon	2 0.1 g		2 0.8 g		1 0.4 g	1 0.5 g	1 0.6 g		2 6
Pinus ponderosa ponderosa	20 5.0 g	10 4.0 g	2 0.5 g		5 2.9 g			2 1.7 g	14 30
Pseudotsuga Douglas-fir			1 0.1 g		2 0.7 g			2 1.6 g	2 4
Undetermined conifer	3 2.2 g	3 0.4 g	8 2.8 g		2 0.6 g	4 2.8 g	6 5.3 g	4 4.7 g	18 23
Total conifer	27 7.5 g	16 6.6 g	19 6.6 g	1 27.0 g	20 8.6 g	10 8.0 g	13 11.0 g	11 9.8 g	82 91
Quercus oak			1 0.3 g					9 16.0 g	16 8
Undetermined nonconifer							1 2.7 g		2 1
Total pieces Total weight	27 7.5 g	16 6.6 g	20 6.9 g	1 27.0 g	20 8.6 g	10 8.0 g	14 13.7 g	20 25.8 g	100 100

elevation taxa, ponderosa pine and Douglas fir, accounted for a significant proportion (20 percent) of the assemblage.

Adobe Analysis

Three natural soil samples and four adobe samples were collected and analyzed. Table 47 lists the samples by provenience and type. Table 48 summarizes the results.

Table 47. LA 70577, adobe samples, proveniences, and types

Sample No.	Provenience	Type
C4	Roadcut, 1 m below modern ground surface	natural soil
C5	Roadcut, 2 m below modern ground surface	natural soil
C6	Roadcut, 3 m below modern ground surface	natural soil
6	Pithouse wall	adobe wall
7	Pithouse floor	adobe floor
8	Pithouse hearth	adobe
9	Pithouse wall	adobe plaster

Munsell Color

The seven samples can be combined into two groups of colors. The first group, consisting of Samples C4, C5, C6 and 7, was brown (10YR5/3). The second group, Samples 6, 8, and 9, was pale brown (10YR6/3). With the exception of Sample 7, these groupings reflect differences between the natural soil and the adobe.

Particle Size Distribution

The major differences in particle size distribution are also between the natural soil and the adobe. The natural soil samples differ considerably, particularly in their sand content, but are similar in their silt and clay content (Figs. 70, 71, and 72). While there is variation between the adobe samples, it is generally less than that between the adobe and the natural soil. For instance, there is almost no difference in the clay content of the adobe samples, five to six times that of the natural soil. The greatest diversity is in silt, while the samples cluster together in fine and coarse sand. Sample 6 has a higher percentage of fine sand than the others, and Sample 7 is higher in coarse sand.

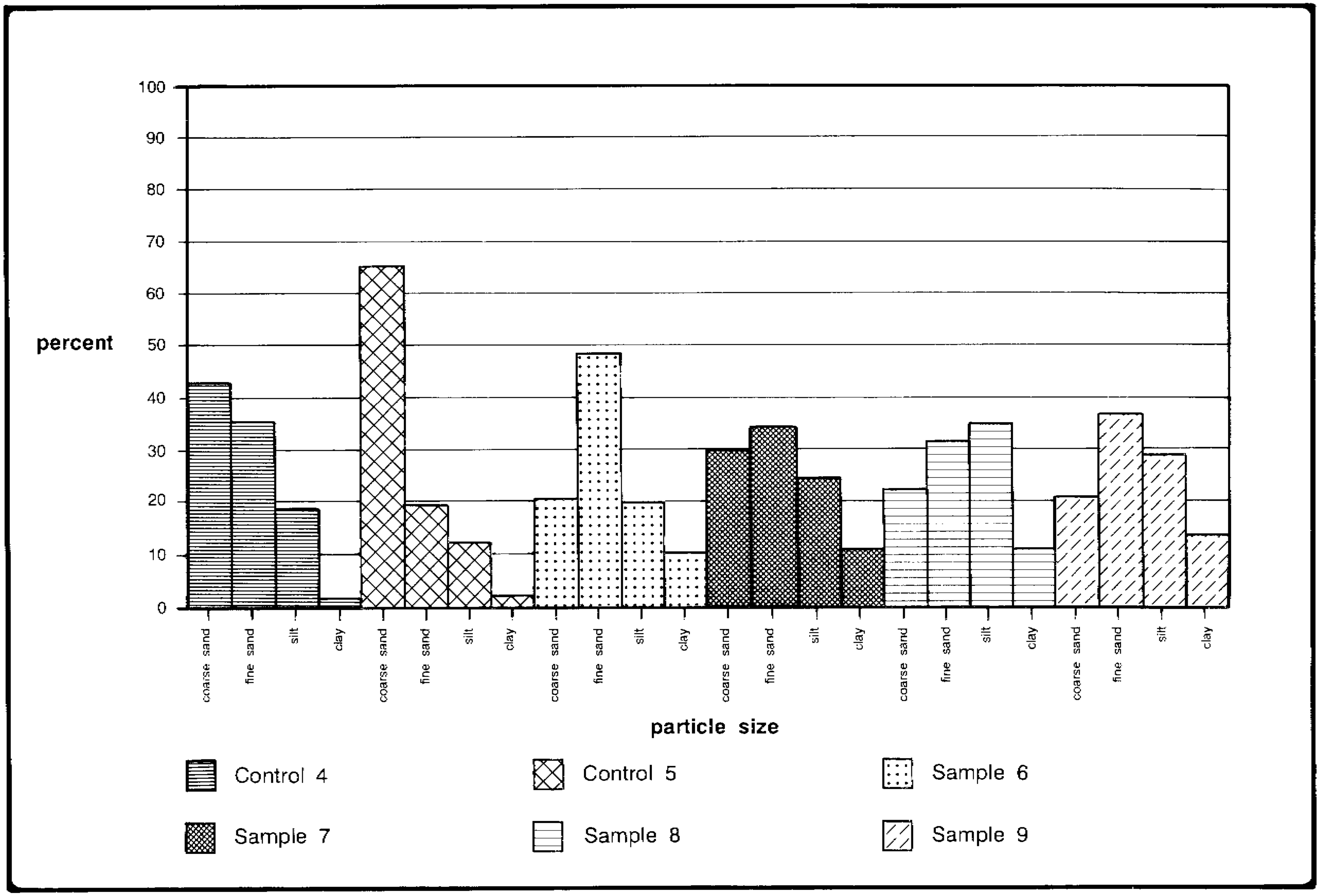

Figure 70. LA 70577, adobe and natural soil particle size distribution.

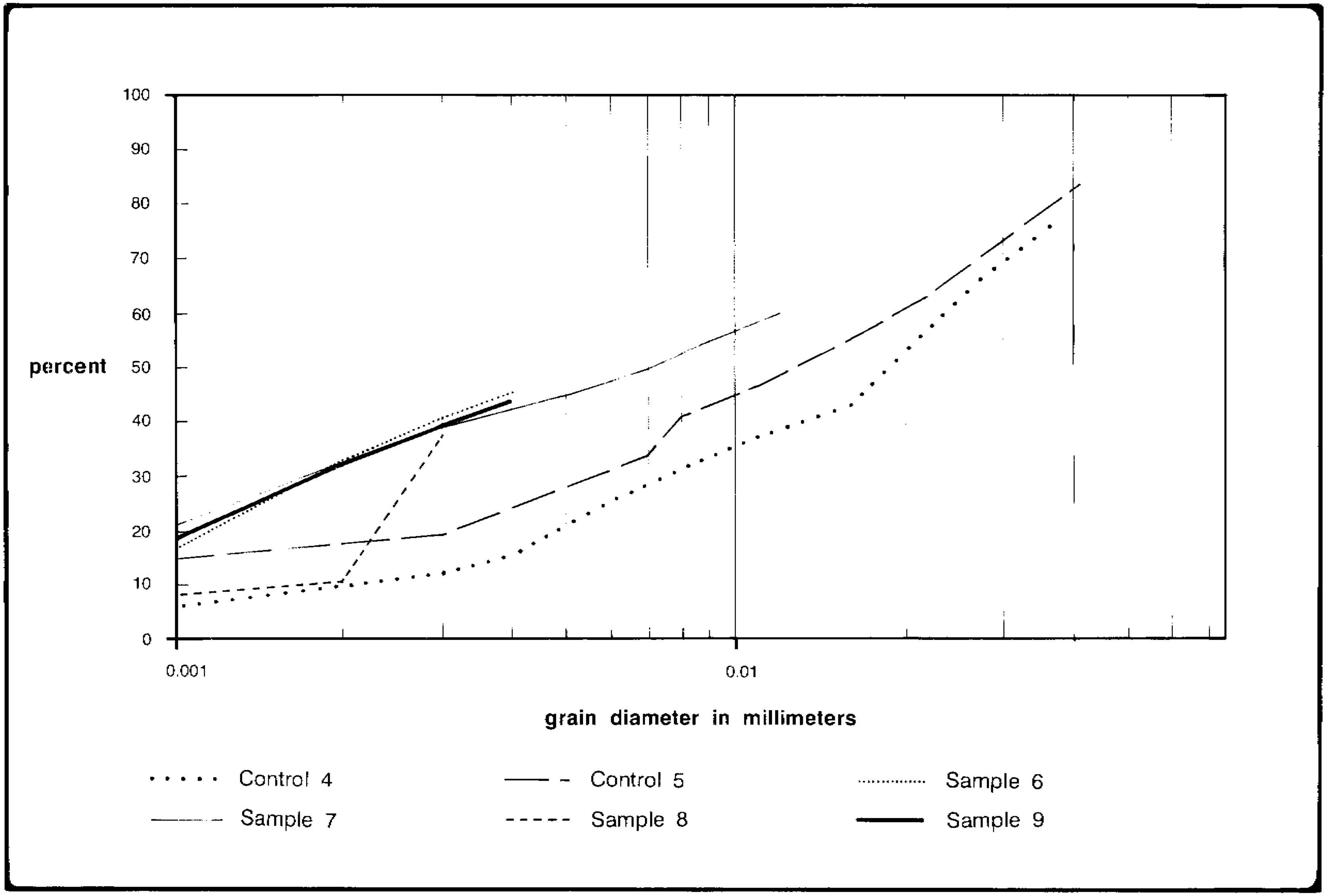

Figure 71. LA 70577, adobe and natural soil silt/clay profiles.

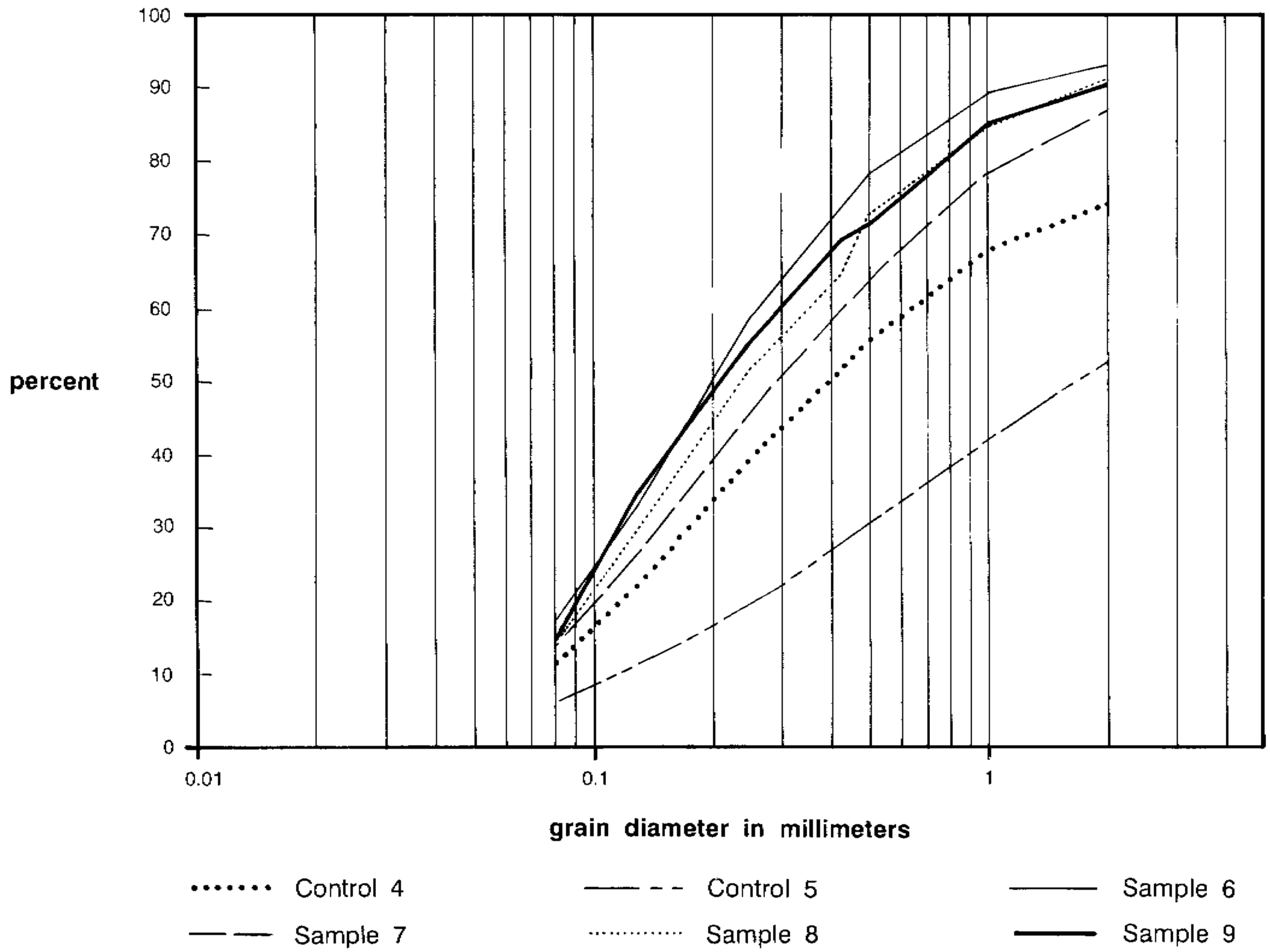

Figure 72. LA 70577, adobe and natural soil sand profiles.

Figure 71 shows that three adobe samples, 6, 7 and 9, have virtually identical profiles. Sample 8 is lower in the smallest clay particles measured, resembling the control samples, but quickly climbs to join the other adobe samples in silt particle distribution. In the sand profiles (Fig. 72), there is more variation, but significant similarities exist at the upper and lower ends of the particle size distribution.

Plasticity

Differences between the natural soil and adobe samples and the similarities within the two groups account for the variation seen in plasticity (Fig. 73). The natural soil samples are virtually or completely nonplastic, and the adobe samples are almost identical in liquid limits and plastic limits, and, therefore, in their plasticity indices.

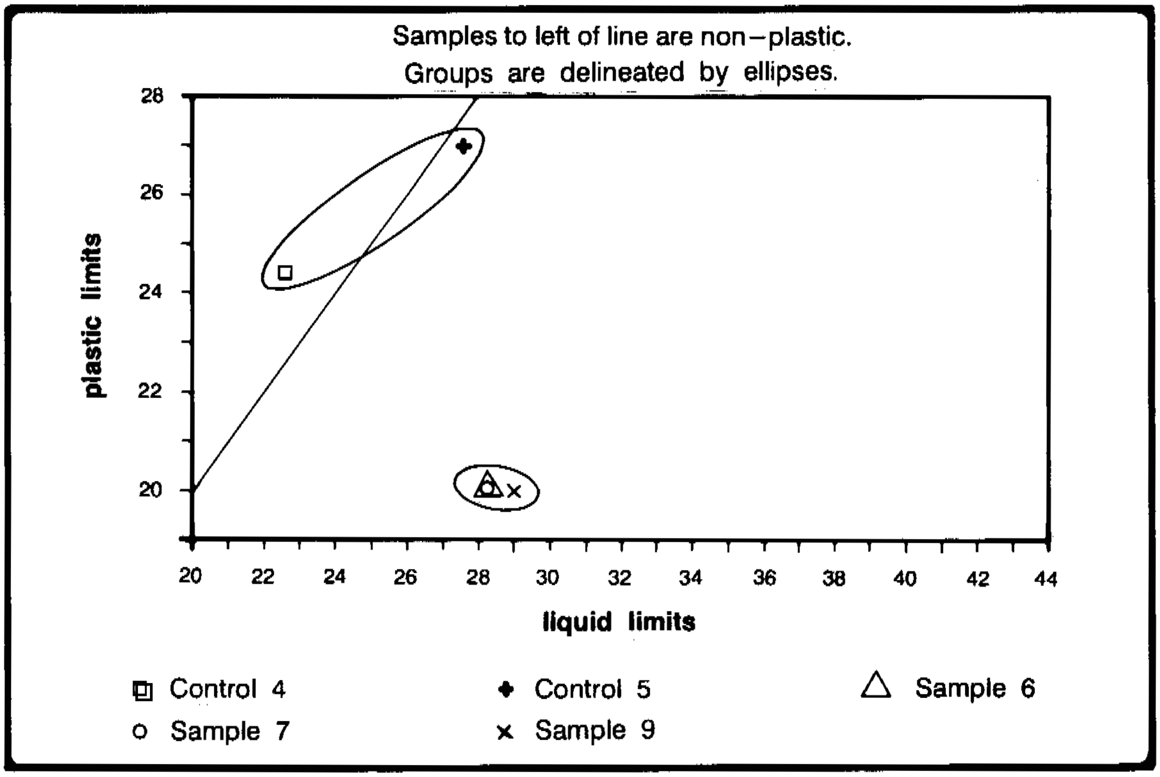

Figure 73. LA 70577, adobe and natural soil plasticity.

Soluble Salts

Again, the differences are between the natural soil and adobe samples. The natural soil samples are high in carbonates and lacking in other salts. The adobe samples, on the other hand, show the presence of sulfates, chlorides, and nitrites in addition to the strong presence of carbonates. As noted at LA 2742, the strong presence of carbonates is likely due to the presence of calcium carbonate in the soil derived from limestone in the surrounding mountains. Since the natural samples do not contain sulfates, calcium sulfate in the soil is not a likely source of sulfates in the adobe. Therefore, as at LA 2742, sulfates in the adobe may be the product of smoke in the pithouse from the fire in the hearth. Since the pithouse showed no sign of remodeling, all the adobe in the structure was subject to the same factors causing the sulfates. It is clear from Table 48 and Figures 70, 71, and 72 that the adobe has higher percentages of fine material than the natural soil. The addition of fine material such as silt and clay probably accounts for the presence of chlorides in the adobe. Finally, the presence of nitrites may indicate that the pithouse at LA 70577, unlike the pithouse at LA 2742, was subject to the effects of groundwater. Although nitrites were observed to be present, there was no sign of efflorescence of salt on the pithouse wall during excavation, and groundwater and rising damp may not have been a significant problem at the site.

Discussion

The adobe from LA 70577 was probably made from on-site soil. The silt/clay and sand profiles (Figs. 71 and 72) show that in smaller particle sizes in each profile, the adobe matches the natural soil. Unlike at LA 2742, however, it is not possible to state that the adobe more closely resembles one natural soil sample than another. The silt/clay profiles suggest a closer relationship to sample C5 (Fig. 71), and the sand profiles suggest affinity to C4 (Fig. 72). The adobe was made by adding fine material to natural soil. This involved clay and silt and perhaps also fine sand. The effect was to decrease the relative content of coarse sand. The source(s) of the finer material is not known but may have been the nearby Rio Grande del Rancho floodplain or a tributary arroyo. Adding finer soil, especially clay, dramatically increased the plasticity of the adobe.

Archaeological excavations revealed no evidence of remodeling at the pithouse, a conclusion supported by the adobe data. Although there is variation within the adobe samples, it is minor compared to differences in the natural soil. This shows that different adobe manufacturing episodes, correlated with construction and remodeling episodes, did not occur.

Although chronometric dates for LA 70577 point only to occupation in the mid-A.D. 1100s, the adobe data may indicate a short occupation period. Two lines of evidence support this: the lack of remodeling evidence and the consistently minor presence of sulfates in the adobe. If qualitative analysis of salts can suggest occupational longevity, then we can postulate that the pithouse at LA 70577 had a shorter use-life than chronometric dates indicate, and perhaps a shorter use-life than LA 2742 or LA 3570.

Table 48. LA 70577, adobe analysis

Sample	Munsell Color	Particle Size in Percent						Plasticity			Soluble Salts			
		coarse sand	fine sand	silt	clay	all sand	silt/ clay	liquid limit	plastic limit	plasticity index	sulfates	chlorides	nitrites	carbonates
C4	10YR5/3	43.2	35.6	19.3	1.9	78.8	21.2	22.6	24.4	-1.8	-	-	-	+++
C5	10YR5/3	65.6	19.7	12.5	2.2	85.3	14.7	27.6	27.0	.6	-	-	-	+++
C6	10YR5/3	not analyzed									-	-	-	+++
6	10YR6/3	20.8	48.5	20.2	10.5	69.3	30.7	28.3	20.1	8.2	+	+	±?	+++
7	10YR5/3	30.0	34.4	24.6	11.0	64.4	35.6	28.3	20.1	8.2	+	+	+	+++
8	10YR6/3	22.4	31.5	34.9	11.0	53.9	45.9				+	+	+	+++
9	10YR6/3	21.1	36.6	29.0	13.6	57.7	42.6	29.0	20.0	9.0	+	+	+	+++

- = absent; ± = perceptible; + = present; ++ = notable; +++ = strong/dominant

POT CREEK-PHASE SITES

LA 71189
(AR-03-02-05-192)

James L. Moore and Daisy F. Levine

LA 71189 was located on an alluvial fan near the confluence of Rito de la Olla and Rio Grande del Rancho, directly east of the canal at LA 71190. The site was at an elevation of 2,256 m (7,402 ft) and covered 1,134 sq m (see Appendix 1). It was initially recorded as a scatter of sherds and lithic artifacts, and two distinct concentrations of cultural materials were defined. No structures or features were noted, and the site was thought to represent a seasonally occupied fieldhouse (Boyer 1989a:31, 57-58). Because of its proximity to Pot Creek Pueblo and sites with farming features, LA 71189 was tentatively assigned a farming function (Boyer 1989a:57). Much of the surface was obscured by vegetation and pine duff, suggesting that the distribution of artifacts and lack of structures and features were the result of poor visibility rather than the lack of cultural activities.

No testing was conducted at this site because it seemed intact and was thought to have good potential for containing subsurface remains. Data recovery was initiated because the site was located in the proposed interpretive center parking lot area. It focused on gathering information concerning frontier settlement and subsistence. It was felt that LA 71189 might "provide a perspective on settlement permanence and seasonal mobility, the development of a settlement gradient and concomitant subsistence strategies, and levels of sociocultural complexity" (Boyer 1989a:57-58).

Four potential features were defined as data recovery began: a cobble-bordered contour terrace, an L-shaped cobble alignment, a rock pile, and one of the artifact concentrations noted during survey. A light scatter of artifacts covering the area containing the three structural features was the second artifact concentration defined during survey, but it was not designated as a separate feature. Data recovery focused on defining the nature and purpose of the features and determining site function.

Excavation Methods

Because artifacts were lightly scattered across most of the site, the surface was collected in 4 by 4 m grids. A 448 sq m area was collected in this manner. Forty-three lithic artifacts and 153 sherds were recovered, a density of 0.43 artifacts per sq m. The highest artifact density was in a small clearing in the southeast part of the site (Feature 4). Though no surface evidence of a structure was visible in that area, we felt that the artifact concentration might represent the remains of an ephemeral field shelter. With this in mind, an 8 sq m area was surface stripped to search for structural remains. A 4 sq m area was also surface stripped around the L-shaped cobble alignment (Feature 2) to determine its function.

Two 1 by 1 m grids were excavated into the cobble bordered contour terrace (Feature 1), and three were excavated into the rock pile (Feature 3) to examine fill, recover data on construction techniques and use, and determine whether the features had been correctly identified. Excavation continued until the bottom of the feature or sterile preoccupational deposits were encountered.

Features

Feature 1: Cobble-Bordered Contour Terrace

From the surface, Feature 1 appeared to be a wide cobble-bordered contour terrace 6.5 m long by up to 2 m wide (Fig. 74). A 2 by 1 m trench was excavated to determine whether it was correctly identified as a farming device, examine construction techniques, and recover sediments for pollen and phytolith analysis. The trench included Grids 94N/101-102W and was excavated to a maximum depth of 30 cm below surface. One grid (94N/102W) was placed on top of the terrace wall to expose its surface, and the other (94N/101W) was placed on the upslope side of the wall to examine the fill that had built up behind it.

Two soil strata were defined. The surface soil (Stratum 1), a loose light yellowish brown sandy loam containing a large percentage of organic material (primarily pine duff), was 6 to 8 cm thick. Beneath this was a layer of colluvially deposited pale brown sandy clay loam (Stratum 2) representing natural soil buildup behind the terrace wall. While Stratum 2 contained some gravels and occasional small to medium-sized cobbles (5-20 cm diameter), the terrace wall was clearly demarcated as a heavy concentration of cobbles and angular rock fragments. Excavation ended 10 cm below the base of the wall.

Following exposure of the terrace wall surface, a section in the north half of 94N/102W was removed to examine construction details. The terrace wall was 20 cm high and built by laying down a noncontiguous line of medium-sized cobbles (10 to 20 cm in diameter) and filling the spaces around and between them with fist-sized cobbles. Although the width of the terrace wall (up to 2 m) might indicate that it was once much higher and collapsed after abandonment, this is unlikely. Rather, it is probable that the wall was intentionally constructed as it was found. The rocks were probably provided by field clearing but were too small to use in building a masonry wall.

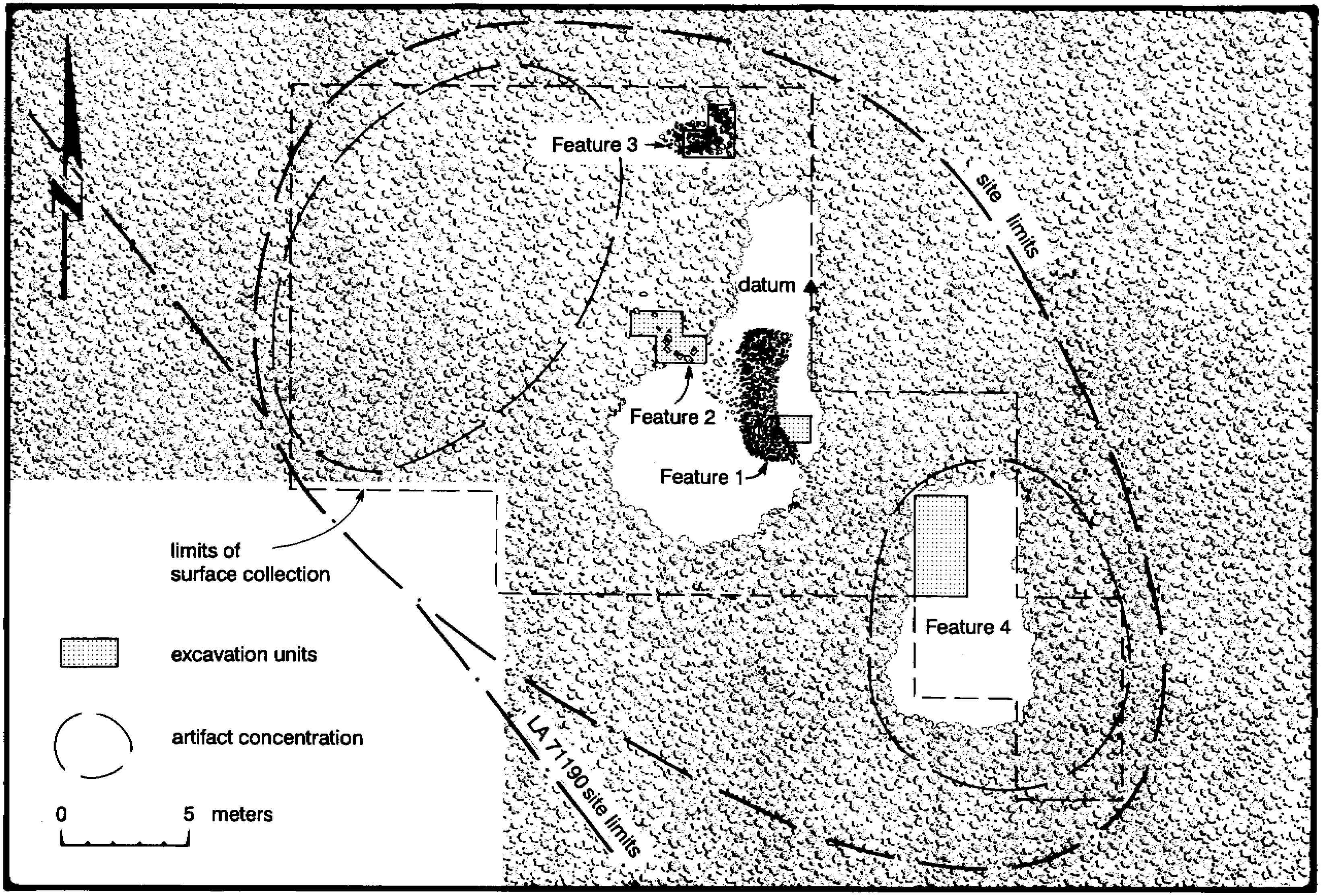

Figure 74. LA 71189, site map.

Feature 2: Rock Alignment

Feature 2 was an L-shaped alignment of seven or more medium-sized cobbles (20 to 30 cm diameter) (Fig. 74). Four 1 by 1 m grids were surface stripped to more accurately define the alignment and determine its nature. Thus, the upper 5 to 8 cm of soil was removed from Grids 97N/105-106W and 98N/106-107W. These grids were positioned to investigate the rock alignment and several other cobbles in possible association.

Surface stripping revealed a single noncontiguous course of seven cobbles set in a crescent measuring 0.75 by 1.3. Five other cobbles southeast of the alignment were in questionable association, and their placement may have been natural. The surface soil (Stratum 1), a loose light yellowish brown sandy loam containing a large percentage of organic material (primarily pine duff), was 5 to 8 cm thick. There were no signs of an activity surface or hearth. Only a few artifacts (five sherds and one lithic artifact) were recovered from this area.

Feature 3: Rock Pile

From the surface, Feature 3 was a pile of cobbles measuring 1.5 by 2 m (Fig. 74). It was similar in appearance to other rock piles scattered across the surface of the alluvial fan around Pot Creek Pueblo and is thought to have resulted from field clearing. Three 1 by 1 m grids were excavated to investigate the nature and structure of this feature. They included Grids 105N/104-105W and 106N/104W, and excavation continued to depths of 20 to 28 cm. One grid was placed on top of the rock pile, and the other two were adjacent to the feature. Numerous cobbles were encountered during excavation of the latter two grids, showing that the feature was larger than originally thought.

Two soil strata were defined. The surface soil (Stratum 1), a loose light yellowish brown sandy loam containing a large percentage of organic material (primarily pine duff), was 6 to 8 cm thick. Beneath this was a pale brown sandy clay loam (Stratum 2) with a compact pale brown clay loam filling the interstices between larger cobbles. Numerous cobbles and gravels occurred in both strata and comprised most of the exposed matrix.

The feature had no formal structure and was larger than originally defined, having been partially covered by colluvium. One sherd was recovered from the upper 10 cm of fill and a second from 10 to 20 cm below surface. No sediment samples were obtained because the feature was thought to be natural at the time of excavation.

Feature 4: Artifact Concentration

As discussed above, the highest artifact density was in a small clearing in the southeast part of the site (Fig. 74). Two 2 by 2 m grids were surface stripped to determine whether the remains of an ephemeral structure were present in that area. The upper 4 to 5 cm of soil was removed and consisted of a light yellowish brown sandy clay loam containing a large amount of organic matter (primarily pine duff). Numerous small to medium cobbles (5 to 20 cm diameter) were found, but there was no pattern to their distribution, and they did not represent structural remains. A fire-cracked ground stone fragment was the only artifact recovered below the surface. Excavation ended when the pale brown sandy loamy clay preoccupational substrate was encountered.

Dating the Site

Two pieces of debitage were submitted for obsidian hydration dating (Stevenson 1991). Results are presented in Table 49. Neither date is consistent with that of the associated ceramic assemblage. While their presence in A.D. 1200s sheet trash might indicate that they were obtained elsewhere and transported to the site, it is also possible that they represent earlier use of the area by Archaic hunter-gatherers.

Table 49. LA 71189, obsidian hydration analysis

Sample No.	Source	EHT (°C)	Rate	Rim Width	S.D.	Date	S.D.	Date Range
91-471	Cerro del Medio	17.5	8.11	3.64	.07	A.D. 357	91	A.D. 266-448
91-472	Cerro del Medio	17.5	8.11	5.28	.07	1446 B.C.	132	1578-1314 B.C.

Pollen and Phytolith Analyses

Four sediment samples were examined for pollen or phytoliths from cultigens. Pollen samples were obtained from sediments behind the contour terrace, one from the top of Stratum 2 (CLES-90283) and the other from the bottom of Stratum 2 at a depth of 30 cm (CLES-90222). Both were scanned for cultigens using methods developed by Dean (1991a) and described in the Introduction. Phytolith samples were obtained from similar locations, one from under rocks on the surface of the terrace (CLES-91701) and the other from beneath the terrace wall (CLES-91702). Both samples were scanned for cultigen phytoliths, but none was found, perhaps because of sample locations. The sample obtained below surface rocks may have contained sediments deposited after the feature was abandoned, and the sample from beneath the terrace wall probably contained sediments deposited before or shortly after it was built. Thus, they may bracket the period of agricultural use.

Results of the pollen analysis are presented in Table 50. While no cultigen pollen was found in the sample obtained from the top of Stratum 2, the sample taken near the bottom of Stratum 2 contained a relatively high concentration of corn (*Zea*) pollen. This is consistent with results obtained during studies of modern cornfields (Table 1; Dean 1991a:17), indicating that this feature was probably used for growing corn.

Table 50. LA 71189, pollen scans

Taxon	CLES-90283 (below topsoil)		CLES-90222 (30 cm below surface)	
	No.	Conc.[1]	No.	Conc.[1]
Zea	-	0	5	7
Total pollen[2]	1,045	2,023	524	710
Total spike	750	-	1,071	-

[1] Pollen concentration expressed as estimated number of pollen grains per gram of sample.
[2] Eight slides completely examined for CLES-90283 and two for CLES-90222; numbers reflect the sum of grains estimated to have been examined for all samples (no.) and the estimated pollen concentration (conc.).

Chipped Stone Artifacts

A total of 43 chipped stone artifacts was recovered (Table 51). Local materials comprise 95 percent of the assemblage, including cherts, basalt, undifferentiated igneous rocks, chertic rhyolite, limestone, and siltstone. Obsidian from the Jemez Mountains, the only exotic material recovered, makes up 5 percent of the assemblage. The entire assemblage is comprised of reduction debris (debitage and cores). The only evidence of formal tools is a single undifferentiated igneous biface flake.

Ground Stone Artifacts

A two-hand mano and two unidentified mano fragments were recovered (Table 52). Two were made from quartzitic sandstone, and the third was sandstone. The preform morphology of the two-hand mano could not be determined. The others were

Table 51. LA 71189, chipped stone artifact morphology by material type

Material	Artifact Morphology				
	Core flakes	Biface flakes	Angular debris	Cores	Total
Chert	22	0	6	1	29
Obsidian undiff.	2	0	0	0	2
Igneous undiff.	5	1	0	0	6
Basalt	3	0	0	0	3
Rhyolite	1	0	0	0	1
Limestone	1	0	0	0	1
Siltstone	0	0	0	1	1
Totals	34	1	6	2	43

Table 52. LA 71189, ground stone artifacts by material type

Artifact Type	Material Type		
	Sandstone	Quartzitic sandstone	Totals
Mano	1 50.0	1 50.0	2 66.7
Two-hand mano	0 0.0	1 100.0	1 33.3
Totals/ Percent	1 33.3	2 66.7	3 100.0

made from cobbles, one flattened and the other rounded. All three artifacts are fragmentary, and none demonstrates secondary use. While the two-hand mano was fully shaped, the others were used in their natural form, and no labor was expended in shaping them.

Ceramic Artifacts

The ceramic assemblage from LA 71189 consisted of 208 prehistoric sherds, mostly of local manufacture. Table 53 presents types by vessel form. Most of the ceramics were recovered during surface collection (79.3 percent). The other 20.7 percent were from surface stripping.

Table 53. LA 71189, ceramic type by vessel form, frequency and percentages

Type	Indeterminate	Jar	Bowl	Total
Taos Black-on-white		3 1.4	17 8.2	20 9.6
Santa Fe Black-on-white	1 .5		4 1.9	5 2.4
Santa Fe Black-on-white, local		1 .5	2 1.0	3 1.4
Indeterminate mineral white ware			5 2.4	5 2.4
Indeterminate white ware	1 .5	18 8.7	15 7.2	34 16.3
Taos Gray Plain		95 45.7		95 45.7
Taos Gray Incised, linear		2 1.0		2 1.0
Taos Gray Corrugated, simple		18 8.7		18 8.7
Taos Gray Corrugated, indented		18 8.7		18 8.7
Taos Gray Corrugated, smeared indented		8 3.8		8 3.8
Total/ Percent	2 1.0	163 78.4	43 20.7	208 100.0

The jar-to-bowl ratio is 3.8:1. Jar sherds, almost all plain wares, account for 78.4 percent of the assemblage. Santa Fe Black-on-white may be the only intrusive white ware (see Ceramic Analysis). Three sherds of "local Santa Fe Black-on-white" were also found.

LA 71189 has a higher percentage of corrugated sherds than any of the other sites. Simple, indented, and smeared corrugated sherds comprise 21.2 percent of the assemblage. Taos Gray Corrugated is rare or absent in the Valdez phase but present in all subsequent phases. Taos Gray Incised, predominant in the Valdez phase, is minimal (1.0 percent). Santa Fe Black-on-white (3.8 percent) occurs almost as frequently as Taos Black-on-white (9.6 percent). Based on these factors, LA 71189 may date early in the Pot Creek phase.

Discussion

Because of the ephemeral nature of most features at this site, it is difficult to conclusively define their functions. Only the cobble-bordered contour terrace (Feature 2) had a demonstrable function. The location of this feature on a gentle slope, the presence of colluvial buildup behind the wall, and the rather high concentration of corn pollen from its fill argue persuasively for an erosion control device that also functioned as a small farming plot. The other features at this site are more problematic.

Feature 1 was a concentration of artifacts first thought to represent an ephemeral field structure. However, because no structural remains were found in this area during data recovery, this is unlikely. While this feature might represent a camp associated with farming activities, no evidence of hearths or other signs of limited occupation (with the possible exception of the burned ground stone fragment) was found. It is likely that Feature 1 represents a surface refuse scatter.

The rock pile (Feature 3) was initially considered a natural deposit of cobbles and gravel, perhaps representing an old stream bed. However, upon reflection, we have determined that it was related to local farming activities. The presence of a sherd in its fill at a depth of 10 to 20 cm below surface may be partial confirmation of this, though transport by rodent or insect burrowing cannot be ruled out. Examination of other parts of the large alluvial fan showed that similar rock piles are common. Areas around those features are usually devoid of surface cobbles and, in places, they are patterned, occurring in lines or as corners of probable farm plots. Large rock piles associated with apparent farming sites are also common in other parts of the Taos district (Greiser and Greiser 1989; Jeançon 1929; Steen 1976). While a noncultural origin cannot be completely ruled out, it is likely that Feature 3 represents an area where cobbles were discarded during field clearing and cultivation.

The function of the L- or crescent-shaped alignment (Feature 2) is likewise problematic. Its location near two farming features suggests that it may have had a related use. For instance, it could have been used to direct excess runoff from the terrace toward a farm plot, or it may have been a small soil-retention device. Unfortunately, the cobbles in the alignment are not contiguous, and both of these functions require an unbroken alignment. The rocks may have been used to hold brush in place if Feature 2 was a small diversion or soil-retention wall. However, no evidence of such a function remains.

A second possibility is that the stones of Feature 2 formed the base of an field structure similar to the Hopi "kishoni," or uncovered shade, as illustrated by Mindeleff (1891:218). This type of structure simply provided shelter from the sun, and should contain no formal floor or hearth. The presence of an ephemeral shelter would also account for the concentration of cultural debris in Feature 4 and, to a lesser extent, around the other features. There was an overall density of 0.43 artifacts per square meter at LA 71189. With duff- or tree-covered grids factored out, it increases to 0.55 artifacts per square meter. While this density is low when compared to that of nearby pueblo and pithouse sites, it is much higher than that of the field at LA 71190. The latter is characterized by a diffuse scatter of cultural materials with no discernable concentrations and no associated features other than a canal. The comparatively heavy concentration of artifacts at LA 71189 argues for an origin other than materials lost or discarded while tending crops. On the other hand, the absence of structural remains and the low density and small range of artifact types when compared to nearby residential sites suggests that it was a limited occupation locale. While the presence of an ephemeral field shelter at this location is likely, it remains uncertain whether Feature 2 fulfilled that function.

The location of LA 71189 just above the canal and cornfield at LA 71190 may be significant. Features like the contour terrace may have been built to protect the canal from erosion or sediments originating upslope. The large rock pile may represent materials removed from the field and discarded beyond its limits. The presence of a possible field structure may also be related to farming at LA 71190, since the most likely location for a shelter is at the edge of a field. The designation of LA 71189 as a distinct site is an archaeological construct and should not be construed as a reflection of how it functioned prehistorically. These features do not represent isolated plots. Rather, they were part of an integrated farming system that included most of the alluvial fan at Pot Creek. In this context, LA 71189 provides important clues about the local farming system. The presence of a contour terrace indicates that soil erosion was an important concern and that farmers were attempting to arrest the process. However, by clearing rock from fields and concentrating it in piles outside zones of cultivation they actively contributed to erosion. Finally, though the village of Pot Creek was only a few minutes' walk away, ephemeral structures may have been built at the edge of fields to provide shelter for farmers or for temporary residence at certain times to discourage wild animals from consuming crops.

LA 71190
(AR-03-02-05-193)

James L. Moore and Daisy F. Levine

LA 71190 was located on the alluvial fan near the confluence of Rito de la Olla and Rio Grande del Rancho. The site was at an elevation of 2,249 m (7,379 ft) and covered 7,000 sq m within the project boundaries (Fig. 75). It was initially recorded as a dispersed scatter of sherds and lithic artifacts associated with a probable canal (Boyer 1989a:31). A long linear feature next to the canal was thought to be an abandoned road or a second canal. Artifact density was low, and no structures or features other than the probable canal and canal/road were found. These features defined the east edge of the scatter, while the existing highway right-of-way defined the west boundary. The north edge of the site ended where the canal met the existing highway right-of-way, and the south edge was artificially defined as the boundary between Carson National Forest and property owned by Southern Methodist University's Fort Burgwin Research Center. Our investigations were confined to Carson National Forest because the property owned by Fort Burgwin was outside the project boundaries.

The area is heavily forested by piñon, juniper, and occasional ponderosa pine. The ground surface was consequently obscured in places by a thick layer of pine duff. Trees were sparse at the edge of the right-of-way, where vegetation was dominated by rabbitbrush and grasses. The scattered distribution of artifacts, the presence of one or more possible canals, and the site's location very near Pot Creek Pueblo suggested that it was an agricultural field.

No testing was conducted at LA 71190 because there was little evidence of subsurface deposits. However, the presence of two possible canals suggested that important remains were present. Data recovery was aimed at gathering information about the role of agriculture in prehistoric Anasazi subsistence strategies in the Taos district: "The presence of possible agricultural features suggests that the site may provide a perspective on subsistence strategies concomitant with the development of a settlement gradient and on levels of sociocultural complexity. In addition, it may provide evidence of seasonal mobility" (Boyer 1989a:58). Data recovery focused on defining the nature and function of the diffuse sherd and lithic artifact scatter defined during survey and determining whether the possible canals were cultural or natural features.

Excavation Methods

Because the distribution of surface artifacts was very diffuse, collection was in 4 by 4 m grids. The only exception was the north end of the site, beyond the possible canals, where a scatter of ceramic and chipped stone artifacts was collected by point provenience. The surface of many grids was covered by pine duff, and no artifacts were visible (Fig. 76).

Of the features defined as possible canals during survey, one (Ditch 5) proved to be an eroded road. This was confirmed by a long-time resident of the area, who said that the road once led to the logging community of Pot Creek, which was associated with sawmills built along Rito de la Olla. According to the informant the road was built next to a "gully," presumably the feature called Ditch 4 during survey. Thus, Ditch 5 was eliminated from consideration as a prehistoric feature, and investigations concentrated on Ditch 4.

Two types of subsurface investigations were conducted at this site. Trenches were excavated by backhoe at two locations along Ditch 4 within the project area. This allowed us to define the shape of the channel in cross-section and obtain sediment samples. Pollen samples were taken at 10 cm intervals to the base of the channel and were expected to show that the area was deforested at the time the feature was abandoned. Investigations in southeast Arizona suggest that it may be possible to date sediments at the bottom of prehistoric canals archaeomagnetically (Eighmy and Klein 1990; Eighmy and Howard 1991). With this in mind, archaeomagnetic samples were obtained from the channel bottom in both trenches.

Rather than excavating trenches in the diffuse artifact scatter, 25 auger holes were dug along two grid lines to define the depth of cultural deposits and determine whether subsurface features were present. The auger holes were dug at 8 m intervals from north to south, 14 along the 84W grid line, and 11 along the 112W line. This strategy covered most of the site's length, allowing us to determine whether more intensive excavation was needed and collect subsurface sediment samples for pollen and phytolith analysis.

Features

Feature 1: Agricultural Field

A diffuse ceramic and chipped stone artifact scatter covered most of the site, and because of its association with the nearby canal, this area was thought to be a prehistoric agricultural field. No features or structures were found other than the probable canal. All visible surface artifacts were collected, and auger tests were conducted to examine subsurface stratigraphy and determine whether buried cultural features were present (Fig. 75). Because augering revealed no evidence of subsurface cultural deposits or features, more intensive investigations were felt to be unnecessary. Augering data are presented in Table 54.

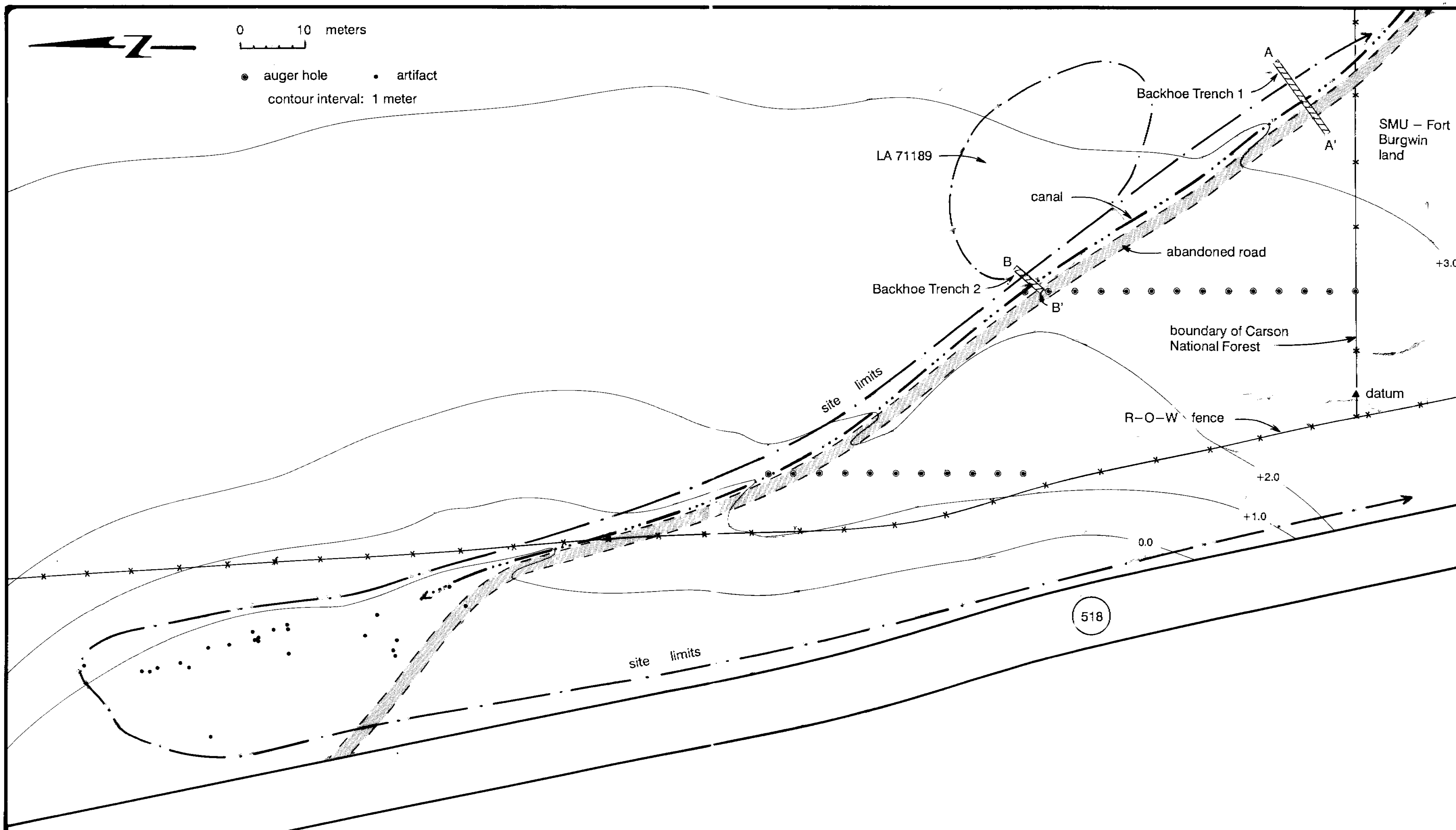

Figure 75. LA 71190, site map.

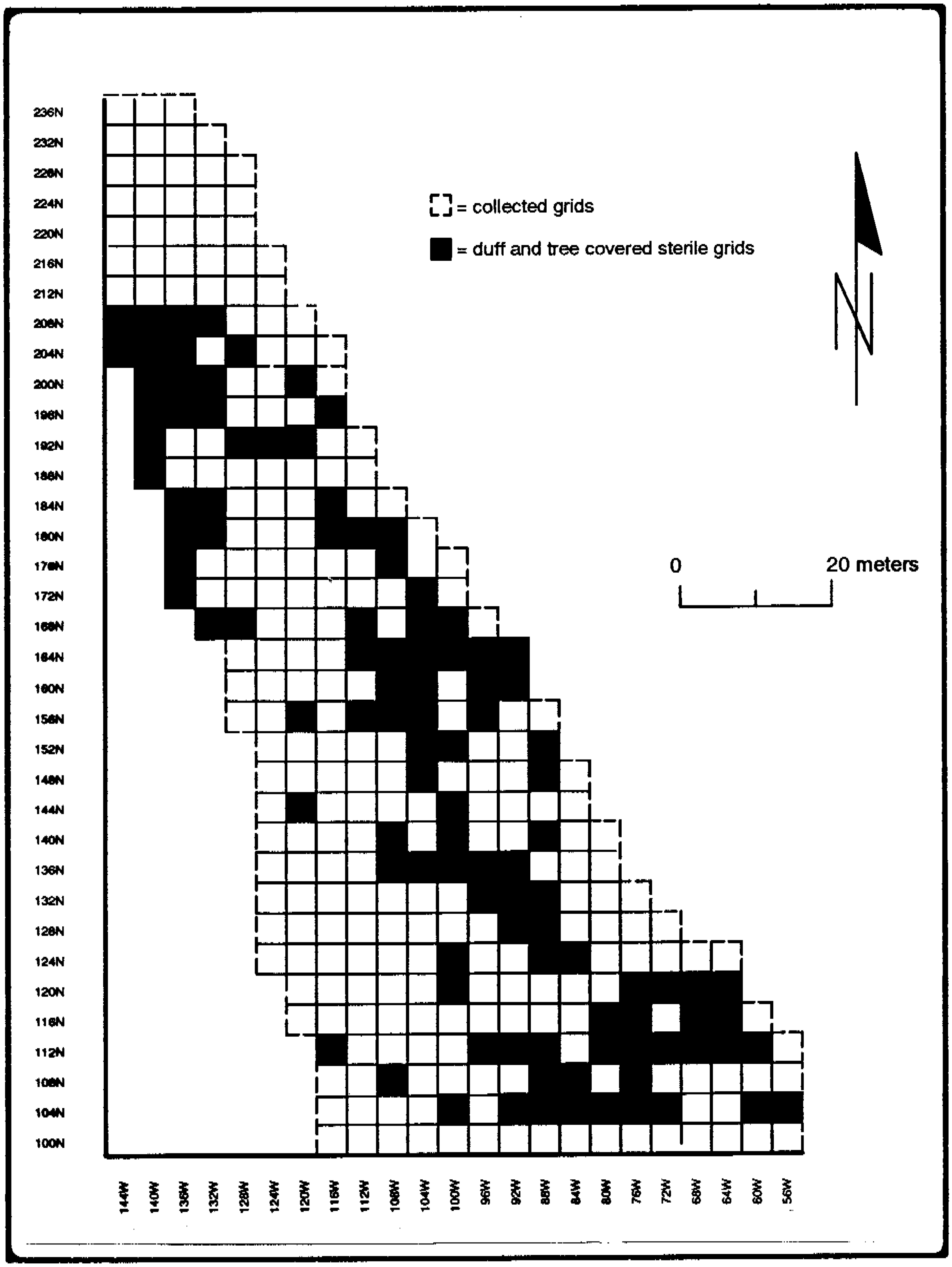

Figure 76. LA 71190, collected grids.

Table 54. LA 71190, auger hole information for the prehistoric field

Auger Holes along the 84W Line

Location	Depth	Sample Depth	Moisture Depth	Cultural Materials
100N/84W	.80 m	.3 m	-	none
104N/84W	1.05 m	.15-.20 m	.40 m	none
108N/84W	1.00 m	.15-.20 m	.25 m	none
112N/84W	1.05 m	.15-.20 m	.27 m	none
116N/84W	.90 m	.15-.20 m	.40 m	none
120N/84W	1.00 m	.15-.20 m	.25 m	none
124N/84W	1.17 m	.15-.20 m	.20 m	none
128N/84W	1.00 m	.15-.20 m	.25 m	none
132N/84W	1.03 m	.20-.25 m	.27 m	none
136N/84W	1.00 m	.15-.20 m	.45 m	none
140N/84W	1.00 m	.15-.20 m	.27 m	none
144N/84W	1.01 m	.15-.20 m	.27 m	none
148N/84W	1.10 m	.15-.20 m	.45 m	none
152N/84W	1.00 m	.15-.25 m	.20 m	none

Auger Holes along the 112W Line

Location	Depth	Sample Depth	Moisture Depth	Cultural Materials
152N/112W	1.02 m	.15-.25 m	-	none
156N/112W	1.00 m	.15-.25 m	-	none
160N/112W	1.03 m	.15-.25 m	.40 m	none
164N/112W	1.01 m	.15-.25 m	.53 m	none
168N/112W	.85 m	.20-.25 m	.34 m	none
172N/112W	.85 m	.15-.25 m	.35 m	none
176N/112W	1.00 m	.20-.25 m	.35 m	none
180N/112W	1.00 m	.20-.25 m	.35 m	none
184N/112W	1.05 m	.20-.25 m	.40 m	none
188N/112W	1.05 m	.20-.25 m	.45 m	none
192N/112W	1.10 m	.15-.20 m	.40 m	none

Table 55. LA 71190, pollen and phytolith analyses

Location	Pollen Sample	Phytolith Sample
108N/84W	corn pollen	-
112N/84W	-	no domesticates
116N/84W	no domesticates	-
120N/84W	-	no domesticates
124N/84W	corn pollen	-
128N/84W	-	no domesticates
132N/84W	corn pollen	-
136N/84W	no domesticates	-
144N/84W	no domesticates	-
148N/84W	-	no domesticates
152N/84W	corn pollen	-
152N/112W	-	no domesticates
156N/112W	corn pollen	-
160N/112W	-	no domesticates
164N/112W	corn pollen	-
168N/112W	-	no domesticates
172N/112W	no domesticates	-
176N/112W	-	no domesticates
180N/112W	no domesticates	-
188N/112W	corn pollen	-

Auger tests ranged from 0.8 to 1.17 m deep and averaged 1 m. Except for minor variations in strata thickness, depth of moisture penetration, and depth at which caliche was encountered, soils were consistent across the site. The surface layer was a sandy clay loam 5 to 15 cm thick. It was underlain by a loamy clay or sandy loamy clay containing occasional gravels and extending to the bottom of all auger tests. Flecks of caliche occurred in this stratum at an average depth of 0.63 m. Augering was completed after two weeks of periodic rains. Rainfall was generally slow and steady, and upper soils were saturated to an average depth of 0.34 m.

Where the forest cover was cleared, the site was covered by rabbitbrush and grasses. Rabbitbrush is used by the Hopis as an indicator of potential cornfield locations because corn and rabbitbrush have similar moisture and nutrient requirements (Bradfield 1971). This suggests that the alluvial fan was suitable for growing corn. As noted earlier, the presence of a diffuse artifact scatter next to a probable canal and a large pueblo suggested that LA 71190 was a field. To test this idea, sediment samples from auger tests were examined for evidence of cultigens. Though no domesticate phytoliths were found, corn pollen was recovered from seven samples (Table 55), indicating that this part of LA 71190 was indeed a corn field.

Feature 2: Probable Canal

The probable canal (labeled Ditch 4 during survey) was traced as far as it was visible, and that segment was 0.6 km long (Fig. 77). The abandoned road, deepened and widened by erosion, followed the feature for most of its length and obliterated it in places. The canal was visible as a low swale, often no more than 10 to 20 cm deep. Soil seemed to be bermed along the downslope side of the canal, but erosion made this impossible to verify along most of its length. All evidence of the canal was eroded away beyond the 236N grid line, and there were no signs of its north end. The south end of the canal turned east up Rito de la Olla before disappearing into an area disturbed by the abandoned logging camp.

Several attributes suggested that Feature 2 was a canal rather than a natural erosional channel. Perhaps most convincing was that it runs roughly perpendicular to the natural drainage pattern, paralleling topographic contours rather than flowing across them. The probable canal runs across the fan rather than directly downslope. Further, where natural drainages twist and curve across the landscape, the probable canal was linear, lacking the curves and sudden turns exhibited by active gullies. A geomorphologist confirmed that this feature was not natural. The presence of a field on the downslope side suggests that Feature 2 was used to convey water to crops and was built and used during the prehistoric occupation of the area. As discussed in Prehistoric Agriculture in the Taos District, many prehistoric erosion-control devices were built upslope from the probable canal, but none was found on its downslope side. Most of these devices probably helped protect it and the field from gullying.

A backhoe was used to dig two trenches across the probable canal (Fig 75). Profiles of both trenches were drawn, and sediment samples were obtained for pollen and archaeomagnetic analyses to help confirm the nature and age of the feature. While these studies do not positively confirm that Feature 2 was a canal, they strongly support the physical evidence that it is cultural in origin and not a natural drainage.

Trench 1

Trench 1, at the south end of the investigated part of the site, was dug across the probable canal and the abandoned road. Six soil strata were defined in this trench (Fig.

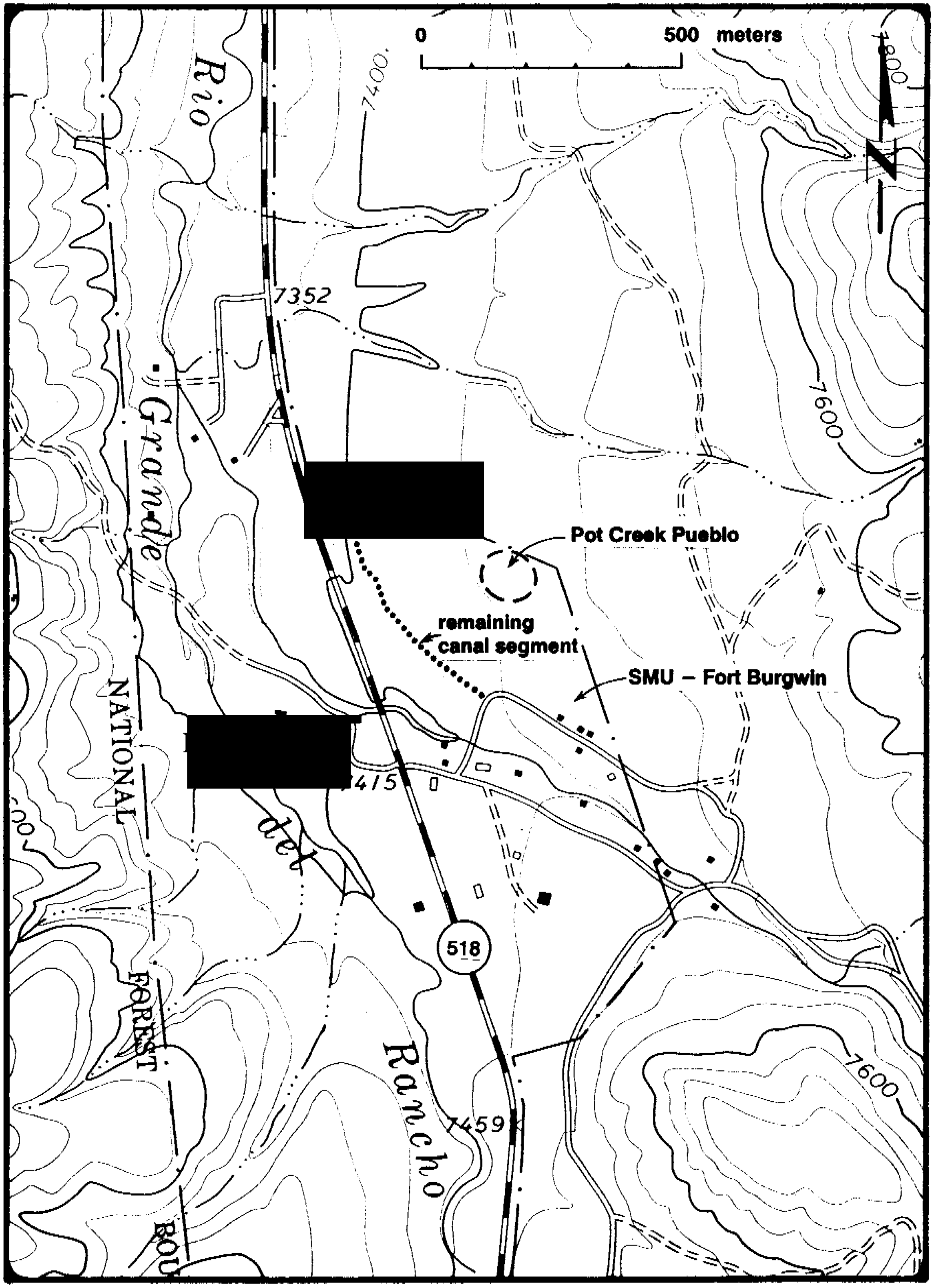

Figure 77. LA 71190, remaining segment of possible canal.

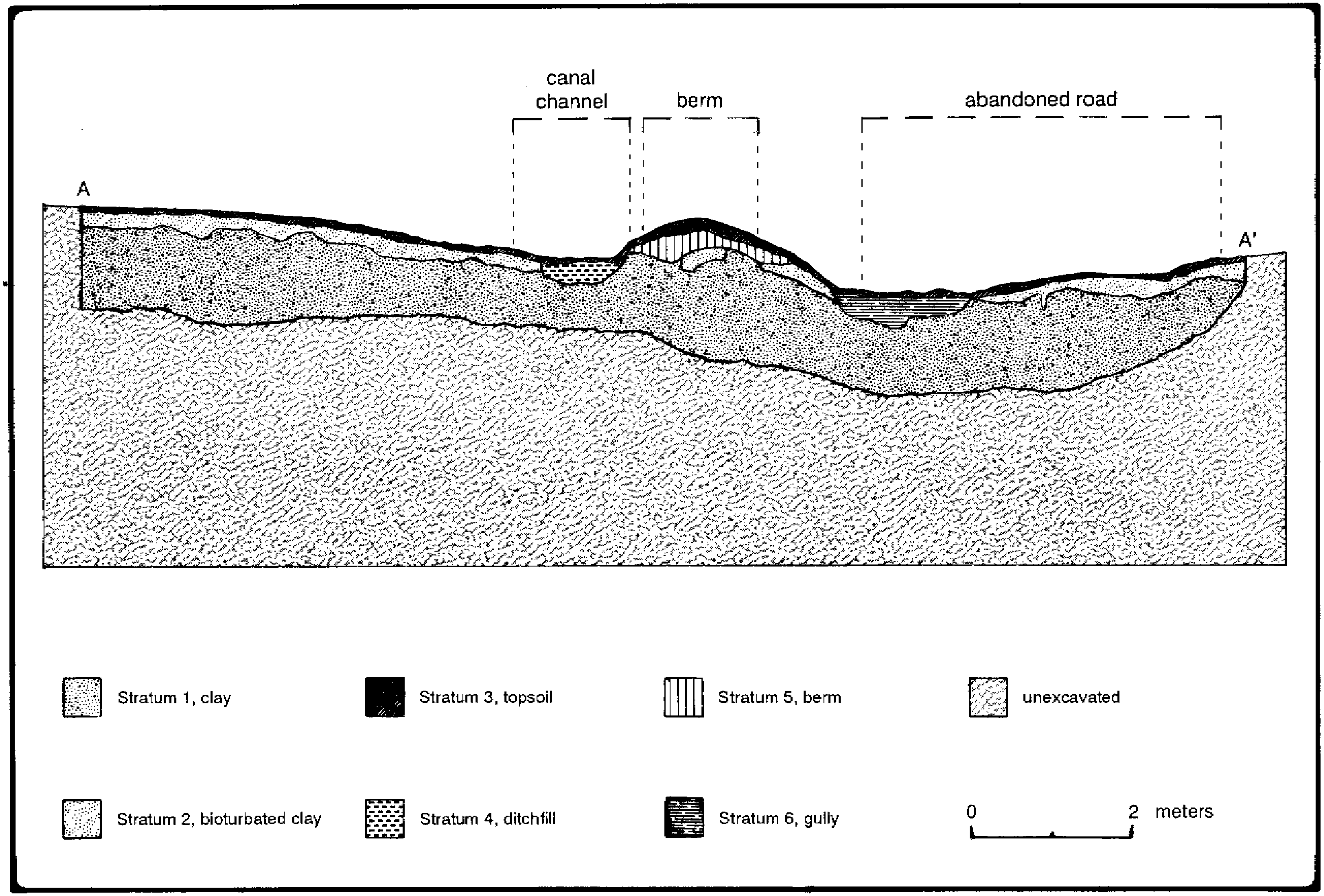

Figure 78. LA 71190, profile of Trench 1.

78). Stratum 1, the deepest unit, was a layer of pale brown sandy clay or sandy loamy clay containing a few gravel lenses. Gravels were rounded to angular, and caliche flecks were noted through most of the unit. This stratum probably corresponds to the sandy clay encountered at the base of the nearby auger holes.

The upper 15 to 30 cm of Stratum 1, heavily bioturbated, was separated from that unit and described as Stratum 2. It had the same basic characteristics as Stratum 1 but was yellow brown and contained numerous roots. The amount of visible bioturbation suggested that this zone was better aerated and contained more organic matter than Stratum 1. Stratum 3 was a thin (5 cm) pale brown sandy clay or sandy clay loam containing a high percentage of organic matter. This unit formed the local soil surface and was obscured by pine duff in many places.

Stratum 4, the channel fill, consisted of a dark grayish brown laminated sandy clay containing a few pea gravels. Sands were subangular to rounded and contained many roots. Stratum 5 was a layer of dark brown sandy clay and clay on the west side of the channel. This unit resembled the bioturbated zone (Stratum 2) in that it contained a high percentage of organic matter and was well aerated. The location of this unit on the downslope side of the channel suggested that it was a berm formed of materials removed from the channel. Stratum 6 was a dark brown sandy soil containing a few gravels and small cobbles. Sand particles were subangular, and texture ranged from fine to medium. A few laminated clays were also noted. This unit fills a shallow gully cut into the abandoned roadbed.

Trench 2

Trench 2 was dug between the 148W and 154W grid lines. As the relationship between the probable canal and abandoned road had already been examined in Trench 1, excavation in this trench was confined to the probable canal channel. Four soil strata were defined (Fig. 79). Strata 1 through 3 were essentially as in Trench 1, except for their color. In Trench 2, Stratum 2 was brown, and Stratum 3 was dark brown.

As in Trench 1, Stratum 4 represented channel fill deposits. It was brown in this trench, and the lower 2 to 3 cm contained fine- to coarse-textured, subangular to rounded, laminated sands with a few pea gravels. The rest of the unit was a sandy clay loam that exhibited some laminations and contained a few gravels.

Dating the Site

Archaeomagnetic samples were obtained from both canal trenches and analyzed by Daniel Wolfman of OAS. In addition to these samples, five pieces of debitage were submitted for obsidian hydration dating (Stevenson 1991).

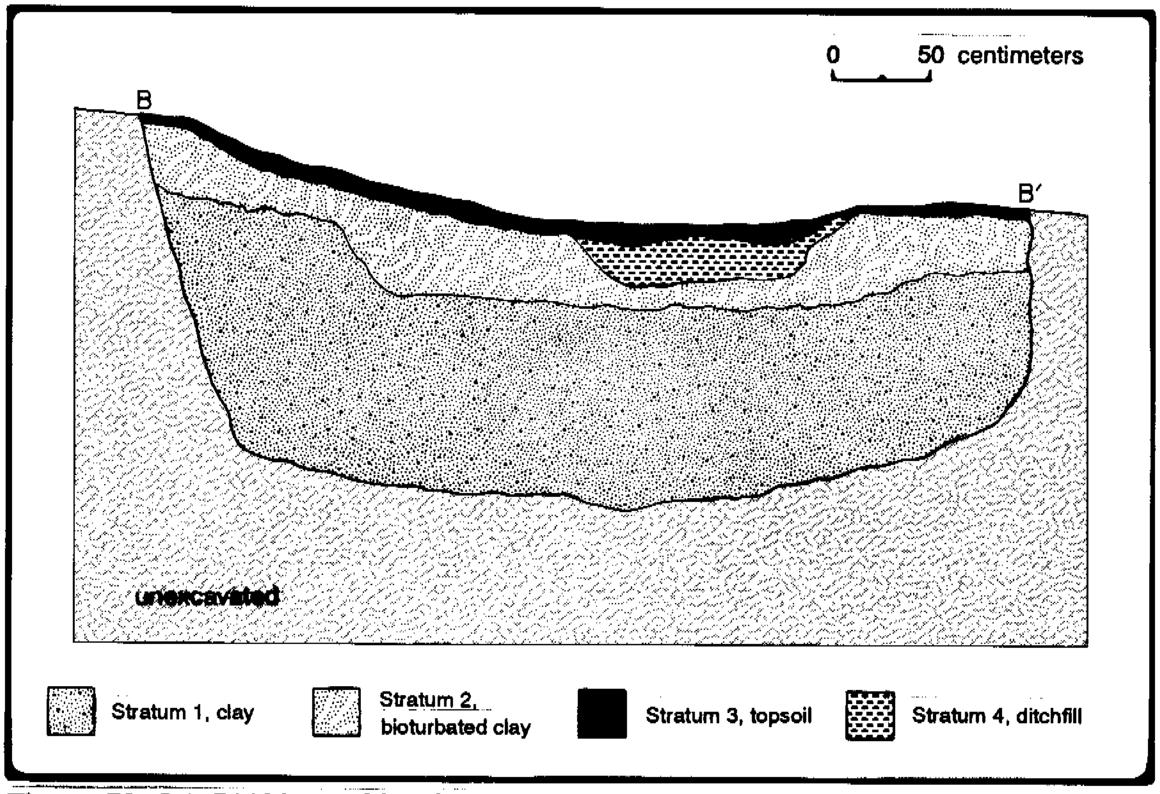

Figure 79. LA 71190, profile of Trench 2.

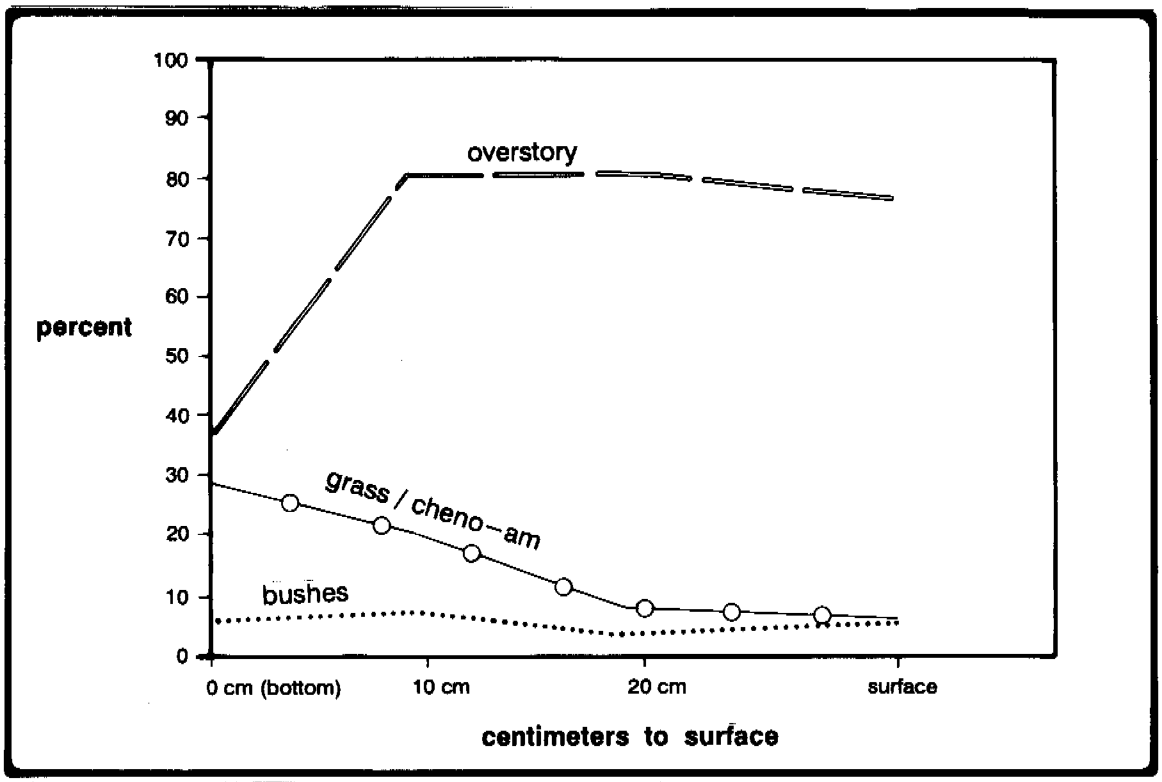

Figure 80. LA 71190, pollen profiles from Trench 2 and surface samples.

The results of archaeomagnetic analysis are presented in Table 56. Wolfman (personal communication) cautions that sediments settling through moving water rarely yield useful archaeomagnetic results and that even sediments deposited in quiet waters do not produce results as accurate as those routinely obtained from baked clays. Nevertheless, low alpha-95 values for both samples suggest that the dates are acceptable. The sample from Trench 1 has a 95 percent oval of confidence that includes one section of the southwestern archaeomagnetic curve near A.D. 1050 and a second at ca. A.D. 1365. The 95 percent oval of confidence for the Trench 2 sample includes nearly all of the curve from 1851 to 1975 (Wolfman, personal communication).

Table 56. LA 71190, archaeomagnetic samples from the probable canal

Sample No.	Location	Lat.	Long.	α_{95}	δp	δm	N	Demag.	Date (A.D.)
PC536	Trench 1	79.6°	221.9°	2.0	2.5	3.2	8/8	150	1050-1365
PC564	Trench 2	76.9°	316.3°	2.8	3.2	4.2	8/8	50	1851-1975

Table 57. LA 71190, obsidian hydration analysis

Sample	Source	EHT (°C)	Rate	Rim Width (um)	S.D.	Date (A.D.)	S.D.	Date Range (A.D.)
91-479	Polvadera	17.5 17.5	10.53 10.53	3.32 2.77	.07 .05	944 1262	63 53	881-1007 1209-1315
91-480	Polvadera	17.5	10.53	2.81	.05	1241	54	1187-1295
91-481	Polvadera	17.5	10.53	2.86	.07	1214	55	1159-1269
91-482	Polvadera	17.5	10.53	2.74	.06	1278	53	1225-1331
91-483	Polvadera	17.5	10.53	2.37	.07	1458	46	1412-1504

Table 57 illustrates the results of the obsidian hydration analysis. All five samples were recovered from the surface and were from Polvadera Peak. One rim width was measured on four samples, and two rim widths were measured on one. Four of the six dates are in the A.D. 1200s. When the first standard deviation range is considered, the samples could date between the mid to late 1200s and the early 1300s. The second measurement for sample 91-479 suggests that it was salvaged from earlier deposits and reused at LA 71190. The date derived from Sample 91-483 postdates the abandonment of Pot Creek Pueblo by about a hundred years. At least two processes may account for this date. Trampling could have fractured the edge and exposed a new surface to hydration long after the artifact was discarded, or the date could reflect a later use of the area by Puebloans or early Athabaskans.

Combining these data suggests that both the canal and field are prehistoric. While archaeomagnetic dates from the canal may not reflect the actual time of use, they do indicate the last time when sediments at the bottom of the channel were saturated to the point that magnetic ions were free to rotate. In one case the date is historic, but in the other, an A.D. 1300s date is indicated. Thus, it seems likely that this feature was in place and abandoned by the middle 1300s. Obsidian hydration dates suggest that the field was in use before that date, most likely in the mid to late 1200s. This is consistent with dates provided by analysis of the ceramic assemblage and suggests that the canal-field complex was used during the Pot Creek- or Talpa-phase occupation of the fan.

Pollen and Phytolith Analyses

A total of 18 pollen and 8 phytolith samples were examined. Nine of the pollen samples were fully analyzed, and 9 were scanned for cultigens (Dean 1991a:17-18). Pollen scans were completed using the methods described in the Introduction and Dean (1991a). All scanned samples were from auger tests, as were 3 of the fully analyzed samples. The latter were also scanned to provide data comparable to those obtained from other auger tests, and those data are used in this discussion. The remaining full analysis samples were from the probable canal. One was a control from the modern surface, 2 were from Trench 1, and 3 were from Trench 2. All 8 phytolith samples were from auger tests in the suspected field area. These analyses had two goals: demonstrating the cultural nature of the probable canal, and determining what was grown in the suspected field.

There were two reasons for using pollen analysis to help investigate the nature of the probable canal. First, it was thought likely that pollen from cultigens would be found at the bottom of the channel if it filled soon after abandonment. Second, the scale of prehistoric erosion control efforts around Pot Creek Pueblo (see Prehistoric Agriculture in the Taos District for a discussion) suggests heavy deforestation at the time of occupation. Thus, evidence of reforestation should be visible in the pollen record. Table 58 presents pollen counts for samples taken from canal profiles and the surface. No cultigen pollen was found during the 200 grain counts, but at least one corn pollen grain was seen during a scan of the sample taken 20 cm above the bottom of the channel in Trench 2. It is difficult to draw conclusions from these limited data, but they suggest two possible explanations. First, it is possible that sediments washed into the channel from fields located upslope (as at LA 71189) and sampling error is responsible for the presence of corn pollen in only one sample. Second, the lower sediments could represent silt dropped by irrigation water early in the growing season, and corn pollen may have

Table 58. LA 71190, pollen content of sediment samples taken from canal trenches

Taxon	Control		Trench 1				Trench 2					
			10 cm above bottom[3]		Bottom[3]		20 cm above bottom		10 cm above bottom[3]		Bottom[3]	
	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]	No.	Conc.[1]
Pinaceae	32	422	2	58	-	0	27	2,178	6	96	3	44
Pinus	159	20,988	4	116	2	28	86	6,937	1	16	5	73
Picea	1	132	-	0	-	0	2	161	-	0	-	0
Abies	-	0	-	0	-	0	-	0	-	0	-	0
Juniperus	88	11,616	3	87	-	0	50	4,033	10	160	8	116
Juniperus/ Populus	-	0	1	29	-	0	1	,81	-	0	1	15
Alnus	-	0	-	0	-	0	-	0	1	16	-	0
Quercus	5	660	-	0	-	0	-	0	1	16	2	29
Cheno-am	22	2,904	49	1,423	18	249	17	1,371	15	239	10	145
Ephedra	1	132	-	0	-	0	-	0	-	0	-	0
Graminae	2	264	2	58	4[1]	55	-	0	3	48	4	58
Zea	-	0	-	0	-	0	+	3	-	0	-	0
Low-spine composite	16	2,112	4	116	4	55	3	242	12	191	2	29
Artemisia	4	528	-	0	1	14	1	81	1	16	-	0
High-spine composite	3	396	4	116	2	28	2	161	1	16	1	15
Cichoreae	-	0	-	0	1	14	-	0	-	0	-	0
Cleome	-	0	-	0	-	0	-	0	-	0	-	0
Opuntia	-	0	-	0	1	14	-	0	-	0	-	0
Unknown	1	132	0	0	1[2]	14	0	0	-	0	0	0
Unident.	34[2]	4,488	23	668	20	277	15	1,210	35	558	12	174
Total	368	48,774	92	2,671	54	748	204	16,458	86	1,372	48	698
Spike	11		50		105		18		91		100	

[1] Pollen concentration expressed as estimated number of pollen grains per gram of sample.
[2] One or more clumps of three or more grains seen during count.
[3] Poorly preserved slide, preservation determined from examination of at least 5 percent of slide.

been subsequently deposited on top of them by wind action. If the latter is true, much of the canal fill may have been deposited before abandonment. Unfortunately, it is not possible to evaluate the accuracy of either explanation, and it is equally likely that neither was responsible for the presence of corn pollen in this sample.

A superficial examination suggests that evidence of reforestation is visible in these data. Fig. 80 graphs pollen percentages for samples from Trench 2 and the surface. Overstory plants include pine (Pinaceae, *Pinus*), spruce (*Picea*), juniper (*Juniperus*), juniper/cottonwood (*Juniperus/Populus*), fir (*Abies*), oak (*Quercus*), and alder (*Alnus*). Understory plants were separated into two categories: grass and cheno-ams (Graminae, *Chenopodium*, *Amaranthus*), and bushes and composites (*Artemisia*, *Ephedra*, *Opuntia*, lo-spine and hi-spine composites). Pollen percentages from bushes and composites remain fairly stable through the profile and are not considered further. On the other hand, overstory pollen percentages increase rapidly as grass/cheno-am pollen percentages drop. This suggests that trees became more common and grasses and cheno-ams became less abundant after the canal fell into disuse, providing some support for the idea that the area was deforested at the time of abandonment. Unfortunately, these tendencies may be illusory, as unidentified pollen comprises large percentages of most of the subsurface samples. While reforestation *appears* to be demonstrated by the pollen data from Trench 2, the high percentages of pollen deteriorated beyond identification render this conclusion speculative.

Conversely, analysis of sediment samples from the field provide definite evidence of cultivation. Though there have been many attempts to recover domestic pollen from farming features, results have usually been unsatisfactory. On the rare occasions when domestic pollen was found, it was present in such small quantities that interpretation was difficult. An experimental scanning method was used in this analysis to help find a way to provide more usable information. Comparable efforts at farming sites west of Abiquiu produced excellent results (Dean 1991b; Moore 1990), and similar success was anticipated at LA 71190.

As shown in Table 59, corn (*Zea*) pollen was found in 7 of 12 samples. The presence of corn pollen in numerous samples taken from 15 to 25 cm below the surface demonstrates that this area was a cornfield, even though the pollen concentrations are lower than those of the control samples from modern fields (Table 1). The reason for this scarcity is unknown, but is probably related to a number of processes. Limited data provided by studies of active fields show that corn pollen can occur in high concentrations, but it can also be quite rare. Poor preservation was displayed in four of five canal samples and one of three auger samples submitted for 200 grain counts, suggesting that much of the pollen contained by these soils may have deteriorated. It is also impossible to tell where the soil surface was during the Anasazi occupation. The alluvial fan was probably being eroded at that time, and most of the surface contemporary with the Anasazi occupation may have been washed away. Under these conditions, the samples may reflect a mixture of pollen rain at the time of soil deposition and later pollen moved downward by bioturbation rather than pollen deposited on the surface of the cornfield. Thus, a combination of factors--scarcity, poor preservation, erosion, and bioturbation--may be responsible for these small concentrations.

Table 59. LA 71190, scans for cultigen pollen

Grid	Depth	Pollen Type	No. Grains	Conc.[2]	Total No.	Total Conc.
108N/84W	20-25 cm	*Zea*	3	5	5,607	8,615
116N/84W	15-20 cm	-	0	0	10,311	18,169
124N/84W[1]	15-20 cm	*Zea*	1	4	228	5,808
132N/84W	20-25 cm	*Zea*	1	3	4,060	13,248
136N/84W	15-20 cm	-	0	0	11,333	20,416
144N/84W	15-25 cm	-	0	0	30,086	54,170
152N/84W	15-25 cm	*Zea*	2	3	1,963	2,923
156N/112W[1]	15-25 cm	*Zea*	+	2	180	4,752
164N/112W[1]	15-25 cm	*Zea*	+	2	287	1,642
172N/112W	15-25 cm	-	0	0	11,880	16,061
180N/112W	20-25 cm	-	0	0	2,330	2,641
188N/112W	20-25 cm	*Zea*	1	5	850	4,346

[1] 200 grain count completed, then slide scanned for cultigens.
[2] Pollen concentration expressed as estimated number of pollen grains/gram of sample.
+ One or more grains seen during scan following 200 grain count.

Chipped Stone Artifacts

A total of 211 chipped stone artifacts were recovered from LA 71190 (Table 60). Local materials make up 82 percent of the assemblage, including cherts, basalt, other undifferentiated igneous rocks, limestone, siltstone, quartzite, and rhyolite. Exotic materials comprise 17 percent of the assemblage, including Pedernal chert, obsidian, and quartzitic sandstone. An unidentified material whose source could not be determined was represented by a single core flake. Obsidian was imported from the Jemez Mountains, mostly from Polvadera Peak (66.7 percent). Pedernal chert outcrops near Abiquiu and is found in gravel deposits along the Rio Chama and the Rio Grande south of Española. The source for quartzitic sandstone is unknown, but it may be from the Chama Valley as well (Newman 1983).

Table 60. LA 71190, chipped stone artifact morphology by material type

Material	Artifact Morphology					
	Core flakes	Biface flakes	Angular debris	Cores	Bifaces	Totals
Chert	89	5	37	3	0	134
Pedernal chert	2	0	1	0	0	3
Obsidian	8	0	1	0	2	11
Polvadera obsidian	18	1	3	0	0	22
Basalt	15	1	0	0	3	19
Rhyolite	1	0	0	0	0	1
Igneous undiff.	4	0	1	0	0	5
Limestone	1	0	0	0	0	1
Siltstone	3	0	0	0	0	3
Quartzite	8	0	0	0	0	8
Quartzitic sandstone	2	0	0	0	0	2
Unknown	1	0	0	0	0	1
Totals	152	7	43	3	5	210

Reduction debris (debitage and cores) dominate the chipped stone assemblage, comprising 97 percent of the total. Among the debitage are a flake from a hammerstone and a potlid. The hammerstone flake suggests that hard hammers were used for core reduction, though none was found. While the potlid might suggest that materials were altered by heat to facilitate reduction, in this case it is more likely the result of a forest or brush fire.

Only five formal tools were recovered, including four generalized bifaces and one large side-notched dart point. While the formal tools were manufactured from obsidian and basalt, most of the biface flakes were removed from chert and Polvadera obsidian tools. Only one basalt biface flake was recovered. This shows that more bifaces were used at the site than is reflected in the formal tool count. Informal tool use is suggested by the presence of a single retouched rhyolite core flake.

Ceramic Artifacts

Only 142 sherds from LA 71190 were collected and analyzed. These were mostly from surface collecting the site in 4 by 4 m grids, and a few were collected by point proveniencing. Table 61 presents ceramic types by vessel form.

Table 61. LA 71190, ceramic type by vessel form, frequencies and percentages

Type	Indeterminate	Jar	Bowl	Total
Taos Black-on-white		4 2.8	16 11.3	20 14.1
Santa Fe Black-on-white		1 .7	1 .7	2 1.4
Santa Fe Black-on-white, local			3 2.1	3 2.1
Indeterminate mineral white ware		4 2.8	1 .7	5 3.5
Indeterminate white ware	1 .7	20 14.1	25 17.6	46 32.4
Taos Gray Plain		46 32.4	2 1.4	48 33.8
Taos Gray Incised, linear		7 4.9		7 4.9
Taos Gray Corrugated, simple		2 1.4		2 1.4
Taos Gray Corrugated, indented		5 3.5		5 3.5
Taos Gray Corrugated, smeared indented		4 2.8		4 2.8
Total Percent	1 .7	93 65.5	48 33.8	142 100.0

The jar-to-bowl ratio at LA 71190 is 2:1. Jar sherds account for 65.5 percent of the assemblage, 68.8 percent of which are plain wares. There is a notable difference in the number of plain wares compared to the number of white wares, which affects the relatively low jar percentage. At every other site, plain wares outnumber white wares in ratios ranging from 2.4:1 (LA 71189) to 5:1 (LA 2742). At LA 71190, white wares outnumber plain wares. The assemblage consists of 46.5 percent plain wares and 53.5

percent white wares, a ratio of 0.9:1. This indicates that water jars were more common than cooking vessels, significant because the phenomenon occurs only at this agricultural site.

The assemblage at LA 71190 is representative of the Pot Creek phase. This is characterized by the low number of Taos Gray Incised sherds (4.9 percent) compared to the relatively high frequency of Taos Gray Corrugated sherds (7.7 percent); and the frequency of Santa Fe Black-on-white (3.5 percent) compared to the Valdez-phase sites (less than 1.0 percent).

Discussion

LA 71190 contained a probable canal and a sherd and chipped stone artifact scatter. The artifact scatter was diffuse and lacked definable concentrations. Augering found no subsurface cultural deposits or features. The distribution of surface artifacts is illustrated in Figure 81. Figures 82 and 83 show chipped stone and ceramic artifact distributions. A total of 351 grids were collected, and 333 artifacts were recovered. Of 219 sterile grids, 108 were covered by a thick layer of pine duff that concealed the ground surface. Overall, 3,888 sq m were collected, a density of 0.06 artifacts per square meter. When duff-covered grids are eliminated, artifact density is still only 0.09 per square meter. The highest densities were in the west part of the site within and next to the existing highway right-of-way and in the south part of the site along the property fenceline and a path leading to Pot Creek Pueblo. Much of the vegetation had been removed from these areas, they were more prone to erosion than other parts of the scatter, and they contained less pine duff. Thus, the higher artifact densities in those zones is more a result of increased surface visibility than the distribution of prehistoric activities.

The association of a canal with the field remains tentative, although several lines of evidence support this possibility. As noted earlier, this feature runs perpendicular to the natural drainage pattern, paralleling the topographic contours. It lacked the curves and sudden turns of active gullies, and a geomorphological inspection concluded that it was not a natural feature. In both trenches, the channel had a shallow trough-shaped cross-section that was too narrow to have been a road. While soil seemed bermed along the west edge of the channel in Trench 1, this feature was lacking in Trench 2. One of the archaeomagnetic dates was modern, the other was prehistoric, and both had acceptably low alpha-95 values.

Analysis of sediments from auger tests demonstrate that corn was grown here. The lack of structures, features, and subsurface cultural deposits suggest that LA 71190 was a limited activity locale. Few formal or informal tools were found in the chipped stone assemblage. The lack of informal tools was no surprise because the assemblage

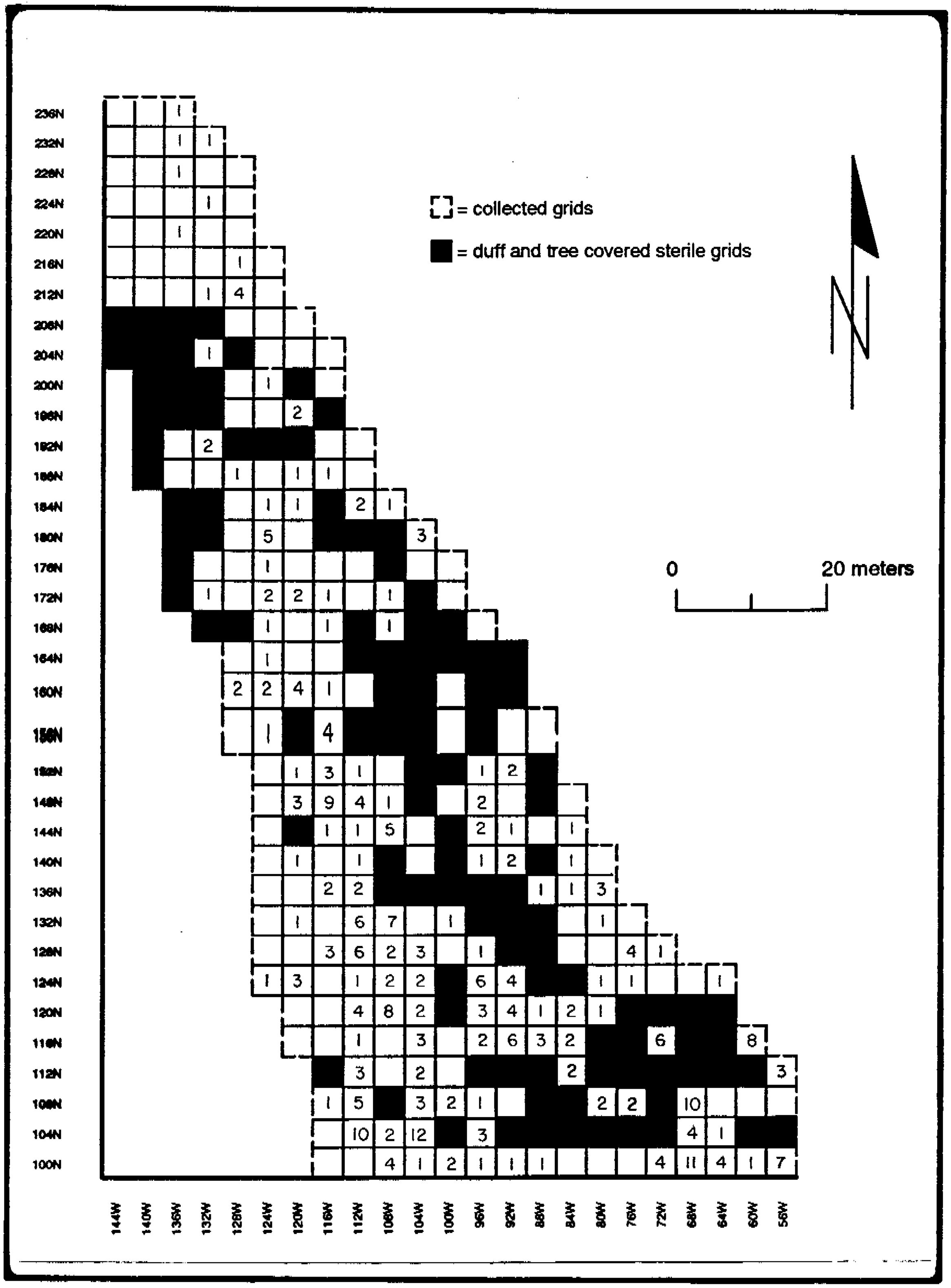

Figure 81. LA 71190, distribution of surface-collected artifacts.

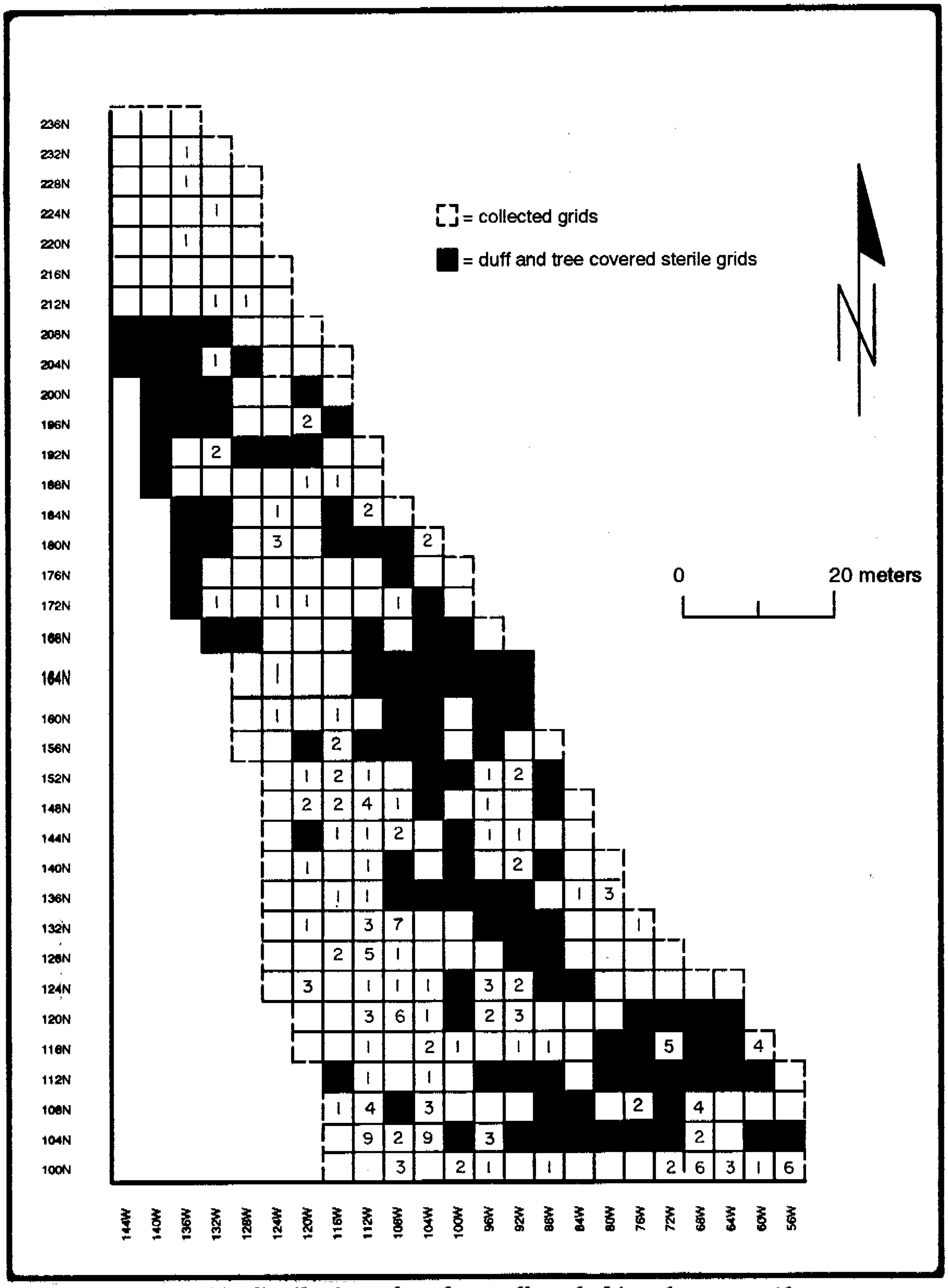

Figure 82. LA 71190, distribution of surface-collected chipped stone artifacts.

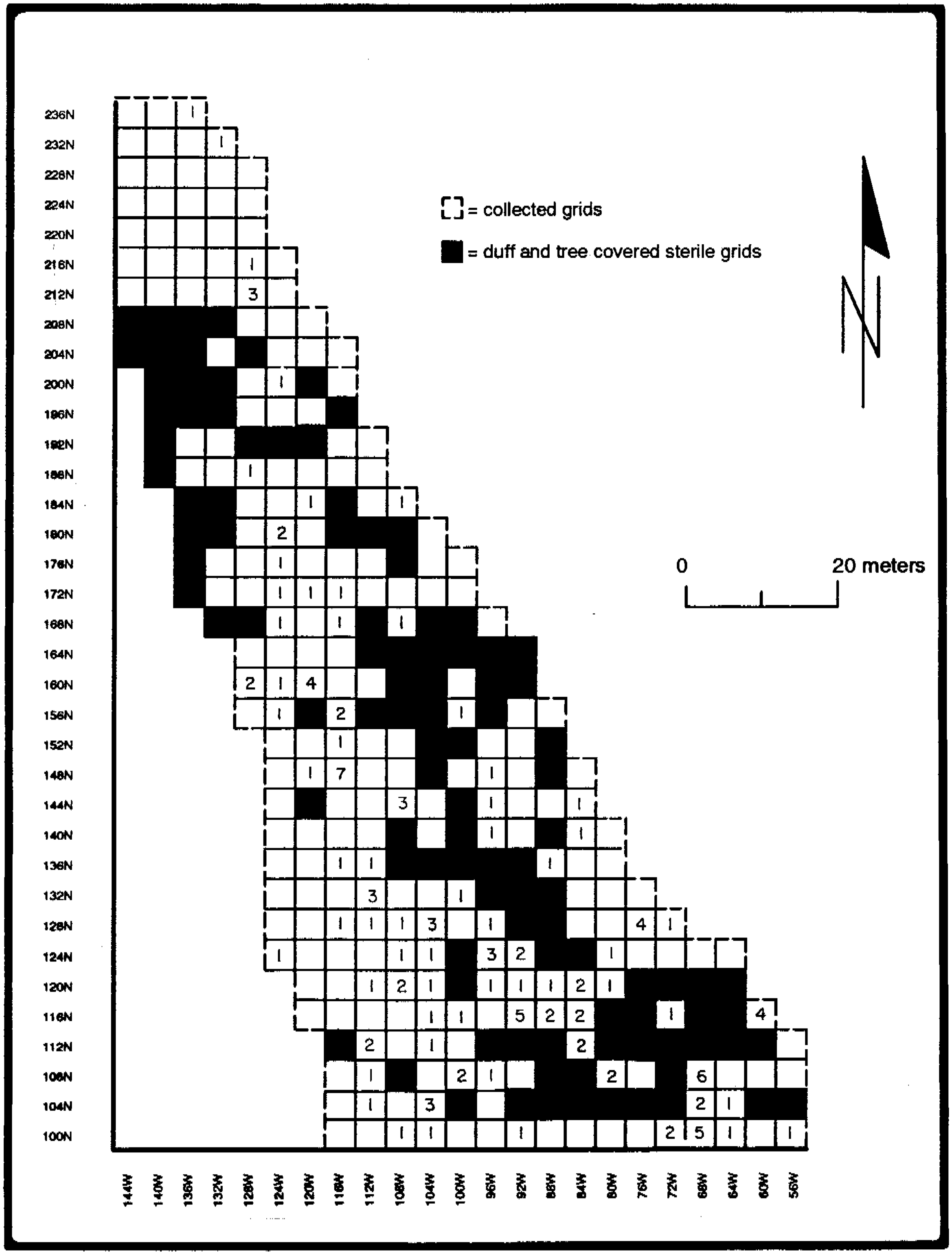

Figure 83. LA 71190, distribution of surface-collected ceramic artifacts.

was surficial, and only artifacts exhibiting extreme evidence of use were assigned to this category. Of the five formal tools recovered, four were large unspecialized bifaces, and the fifth was a side-notched dart point. Similar points were dated to the Middle and Late Archaic at Abiquiu Reservoir, occurring as early as 2300 B.C. and lasting until ca. 200 B.C. (Earls et al. 1989:347). Large unspecialized bifaces are usually associated with a mobile lifestyle, and their presence in an Anasazi field near a major residential site is suspicious. These tools may be evidence of an earlier component, and much of the chipped stone artifact assemblage might also be related to that occupation.

HISTORIC SITE:
LA 70576
(AR-03-02-05-188)

Jeffrey L. Boyer, James L. Moore, Daisy F. Levine, and Linda Mick-O'Hara

LA 70576, recorded during the survey for this project, was described as a small scatter of historic micaceous sherds in an area of about 12 sq m. The site was located at an elevation of 2,200 m (7,218 ft) on the eastern edge of the Rio Grande del Rancho floodplain (Fig. 84). It was at the base of the first terrace above the river.

Testing at LA 70576 revealed that artifacts were restricted to the surface and the topsoil layer, and that the site had little subsurface data potential. However, testing also showed that numerous artifacts were present in the topsoil, warranting data recovery.

Upon returning to the site, we found that it was larger than originally recorded and included additional features. An abandoned road leads from the floodplain up an arroyo at the north end of the site. A concentration of lithic artifacts was found along that road near the mouth of the arroyo but outside the project limits. An isolated hearth was found on a low bench overlooking the site, also outside the project limits. Only the artifact scatter originally recorded was within the project limits, and it was the only part of the site investigated during data recovery.

Excavation Methods

The original test pit, renumbered 100N/100E, had only been excavated to 20 cm below surface because the second level, 10 to 20 cm, was culturally sterile. The first level yielded 12 lithic and ceramic artifacts. Augering in the vicinity of the test pit revealed no subsurface deposits or evidence of buried features. Consequently, excavations at LA 70576 were limited to surface stripping the topsoil, about 10 cm in depth, in 1 m by 1 m units. Surface artifacts were not collected in larger units, as they were at other sites, but at the start of work in each 1 m by 1 m unit. Additional isolated artifacts within the project limits were piece-plotted and collected.

Bits of charcoal scattered in the fill were collected for radiocarbon dating, and obsidian samples were submitted for hydration dating. Results are discussed below.

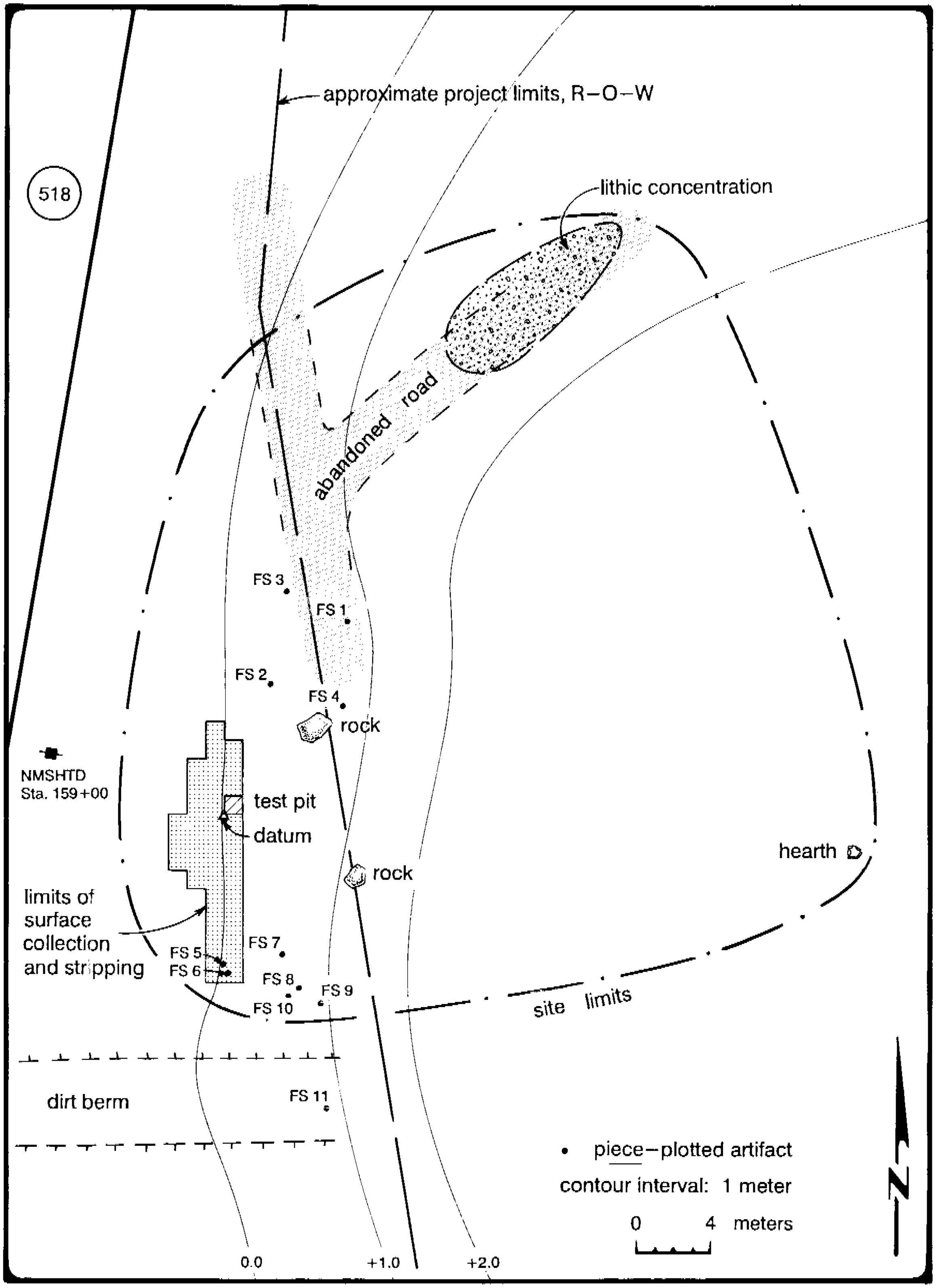

Figure 84. LA 70576, site map.

Features within the Project Limits

Artifact Scatter

Figure 84 shows that an area covering 37 sq m was excavated. This was the area of highest artifact density in the topsoil. Artifact density dropped off at the north and south ends and east and west sides of this area. No cultural features were discovered during excavation.

Stratigraphy

Testing revealed the presence of three strata at the site. Only the upper two were encountered during excavation.

Stratum 1 was the topsoil layer containing the majority of artifacts recovered from the site. This layer was stripped during excavation. The stratum was 5 to 14 cm thick and consisted of a light brown, sandy loam with 10 to 20 percent pebble inclusions. It contained artifacts and flecks of charcoal, but excavation notes consistently record that both artifacts and charcoal were usually found at the bottom of Stratum 1 in its contact zone with Stratum 2. This fact and the very uneven, sometimes undulating surface of Stratum 2 suggest that Stratum 1 was disturbed prior to excavation and was subject to some form of redeposition. Boyer (1989a:21) notes that the artifact scatter may have been redeposited by a drainage at the base of the terrace that once ran north into the arroyo. It has since been redirected under the highway by a dirt berm constructed just south of the scatter. The size and density of the scatter probably precludes complete redeposition but does not preclude disturbance and partial redeposition. Evidence that the scatter was also disturbed by construction is found in the presence of one artifact, a flake, on top of the berm (Fig. 84). Figure 84 also shows that the old road through the valley probably ran through the artifact scatter, although there was no evidence of rutting in the excavations. Taken together, these observations indicate that Stratum 1 has been disturbed by both natural and cultural processes. This disturbance may have affected the integrity of the scatter but probably did not dramatically alter its composition.

Stratum 2 was a thick layer of hard, granular, gray-brown clay-loam. Auger holes excavated during testing indicate that Stratum 2 is 0.65 to 1 m thick. The stratum is culturally sterile.

Stratum 3 was encountered only in the auger holes during the testing phase. It is a sandy, rocky soil of unknown thickness.

Features outside the Project Limits

Lithic Artifact Concentration

A concentration of lithic artifacts was recorded along the abandoned road leading up the arroyo on the north side of the site (Fig. 84). The concentration, located at the base of the terrace hillslope, was about 9 m long by 3 m wide. We were not able to conduct field analyses and consequently have no estimates of artifact density or morphology. Field observations indicate that most of the artifacts were obsidian.

Abandoned Roads

Near the north end of the site was the junction of two abandoned roads. One appeared to follow the river valley and may have been the dirt road replaced by NM 518. The other led up the arroyo to the top of the terrace overlooking LA 70576. The remnants of both roads were about 2.5 m wide. Neither has been traveled in some time, and there was no indication of their age.

Isolated Hearth

An isolated hearth was discovered on a low ridge that is a finger of the terrace overlooking LA 70576. The hearth was roughly circular, 50 to 55 cm in diameter, and rock-lined. No artifacts or other cultural material were associated with the hearth, and its age is unknown. However, the lack of visible charcoal suggests that it is not recent.

Dating the Site

Artifact Dates

Six Euroamerican artifacts were recovered from the site. Four are datable. A white ware sherd was made after about 1820. Two horseshoes were made after 1880, probably between about 1890 and 1930. A horseshoe nail was made after 1880. These artifacts show that the historic component probably dates to the last quarter of the nineteenth century or the first quarter of the twentieth century.

Chronometric Dates

Collection of bits of charcoal from the excavation area failed to yield a sample large enough for extended count radiocarbon dating. Further, the consistent presence of charcoal throughout the excavation area, usually at the contact zone between Strata 1 and 2, suggests that the charcoal was not the result of cultural activity but more likely a natural phenomenon. A forest or brush fire is an obvious possibility.

Three obsidian flakes, two from Polvadera Peak and one from Cerro del Medio, were submitted for hydration dating (Stevenson 1991). The results are shown in Table 62. The overlap of the dates is A.D. 1124 to 1194, during the Valdez phase. Interestingly, the overlap date is almost exactly the same as the archaeomagnetic date from the hearth at LA 70577, on the terrace overlooking LA 70576 (A.D. 1125-1190). This does not demonstrate that the obsidian artifacts at LA 70576 came from or were associated with LA 70577, but the dates are from the Valdez phase. The third date, in the A.D. 1300s, is the only evidence of a Talpa-phase use of the site area.

Table 62. LA 70576, obsidian hydration analysis

Sample	Source	EHT (°C)	Rate	Rim Width (um)	Standard Deviation	Date (A.D.)	Standard Deviation	Date Range (A.D.)
91-476	Polvadera	15.9	8.72	2.74	0.08	1130	±64	1066-1194
91-477	Polvadera	15.9	8.72	2.31	0.05	1379	±54	1325-1433
91-478	Cerro del Medio	15.9	6.7	2.31	0.05	1195	±71	1124-1266

Chipped Stone Artifacts

A total of 43 chipped stone artifacts were recovered from LA 70576 (Table 63). Local materials make up 79 percent of the total, including cherts, basalt, limestone, undifferentiated igneous rocks, and quartzite. Exotic materials comprise 21 percent of the assemblage, including Pedernal chert, quartzitic sandstone, and obsidian. Obsidian was imported from the Jemez Mountains, and one specimen was from the Polvadera Peak source. Pedernal chert outcrops near Abiquiu and is found in gravel deposits along the Rio Chama and the Rio Grande, south of Española. The source of quartzitic sandstone is unknown, but it may be from the Chama Valley as well (Newman 1983).

Reduction debris (debitage and cores) dominate the chipped stone artifact assemblage, comprising 95 percent of the total. Only two formal tools, a drill and an end scraper, were identified. No biface flakes were found, and it was not possible to determine if the formal tools were manufactured elsewhere and carried to the site, or if debitage from on-site biface production was too small for recovery.

Table 63. LA 70576, chipped stone artifact morphology by material type

Material Type	Artifact Morphology				
	Angular debris	Core flakes	Unifaces	Bifaces	Totals
Chert	10	14	1	0	25
Pedernal chert	1	4	0	0	5
Obsidian	0	2	0	0	2
Polvadera obsidian	0	1	0	0	1
Igneous undiff.	0	1	0	0	1
Basalt	0	3	0	1	4
Limestone	0	3	0	0	3
Quartzite	1	0	0	0	1
Quartzitic sandstone	0	1	0	0	1
Total/ Percent	12 27.9	29 67.4	1 2.3	1 2.3	43 100.0

Ceramic Artifacts

Ceramics recovered at LA 70576 during data recovery were all from surface stripping the upper 10 cm of the site. No sherds were found below this level.

Only 54 sherds were collected. Most of the assemblage is micaceous ware. These sherds have a micaceous paste, rather than just a micaceous slip. They may be Peñasco Micaceous, a historic Puebloan type, or Cimarron Micaceous, an Apache type. The 46 micaceous sherds may represent only two or three vessels. The rest of the assemblage is composed of prehistoric types of local manufacture. Table 64 presents ceramic types by vessel form.

The prehistoric component consists of only eight sherds (14.8 percent of the assemblage), mostly Taos Gray plain. All except one sherd of Taos Gray plain came from the testing phase excavation.

The prehistoric assemblage at LA 70576, though minimal, seems to be consistent with dates obtained from obsidian hydration dating, most of which fall in the Valdez phase. This is based only on the presence of Taos Incised and the lack of any corrugated wares. There is some doubt as to whether the historic component, represented by 46 micaceous sherds, is Puebloan or Apachean (see Ceramic Analysis). Peñasco Micaceous dates from 1600 to the present (Dick 1965); Cimarron Micaceous (Apache) dates from 1750 to 1900 (Gunnerson 1969).

Table 64. LA 70576, ceramic type by vessel form, frequencies and percentages

Type	Indeterminate	Jar	Bowl	Total
Indeterminate white ware			1 1.9	1 1.9
Taos Gray Plain		5 9.5		5 9.3
Taos Gray Incised, linear		2 3.7		2 3.7
Micaceous ware: Peñasco/Cimarron	14 25.9	32 59.3		46 85.2
Total/ Percent	14 25.9	39 72.2	1 1.9	54 100.0

Faunal Remains

Excavation of this artifact scatter produced a total of five pieces of animal bone (Table 65). This assemblage includes a fragment from the femur of a medium-sized mammal, a plate fragment from a large mammal, a partial cottontail ulna, the axis (second cervical vertebra) of a deer, and a rib fragment from a turkey-sized bird. All specimens except for the medium mammal femur fragment appear to have been exposed to heat through cooking or discard in an ash pile that contained embers hot enough to discolor the bone.

The small amount of bone recovered precludes any inference about selection of species or elements. It does give us an idea of some of the species that were utilized by the site's occupants and that they were hunting and taking both mammals and birds to augment their diet. Whether the bone was associated with the prehistoric or historic component is not known.

Table 65. LA 70576, faunal taxa

Taxon	Frequency	Percent
Medium mammal	1	20.0
Large mammal	1	20.0
Sylvilagus auduboni (desert cottontail)	1	20.0
Odocoileus spp. (deer)	1	20.0
Aves	1	20.0
Total	5	100.0

Euroamerican Artifacts

Six Euroamerican artifacts were collected from LA 70576, including two horseshoes and a horseshoe nail. The shoes, both machine-made, are from two different horses, apparent from their very different sizes (Fig. 85). They were examined by Rick Morris of the University of New Mexico's Office of Contract Archeology. The following information is summarized from his letter report (Morris 1992).

The larger shoe is a right hind shoe, 17.8 cm (7 in) long from toe to heel and 14 cm (5.5 in) wide from quarter to quarter. It was designed for a horse weighing 680 to 907 kg (1,500 to 2,000 lb). The horse was involved in daily work as part of a freight wagon, stagecoach, or farm plow team. It was probably not used as a saddle horse. Calks, present on both heels, were intended to increase traction. The calks were made by turning up the heel ends of the unfinished shoe, an option available to the farrier because the shoes were made long in the heel by the manufacturer. In addition, the right heel has a small trailer. The trailer, a slight flaring out of the heel, was intended to change the balance of the foot by adding leveraged weight that caused a change in the hoof's path from step to step. Use of a trailer made the shoe "a form of corrective shoe designed to remedy some perceived problem in the horse's gait" (Morris 1992). No toe calk is present, and would not be expected on a hind shoe unless traction was a serious concern. Construction of the calks and trailer on a large shoe shows that the shoe was finished and set by a capable farrier, requiring a blacksmith's forge and anvil.

The left branch and heel calk are so worn that the fullering is largely obliterated, and the shoe is very worn just right of the toe. The condition of the shoe suggests it was at the end of its wear cycle. Nails are present in three of the five holes in each branch. The shoe is bent at the toe. The position of the nails and the bending suggest that the shoe was lost during use rather than removed by a farrier. This may have happened when the horse stepped on its own foot or hung the shoe on a rock.

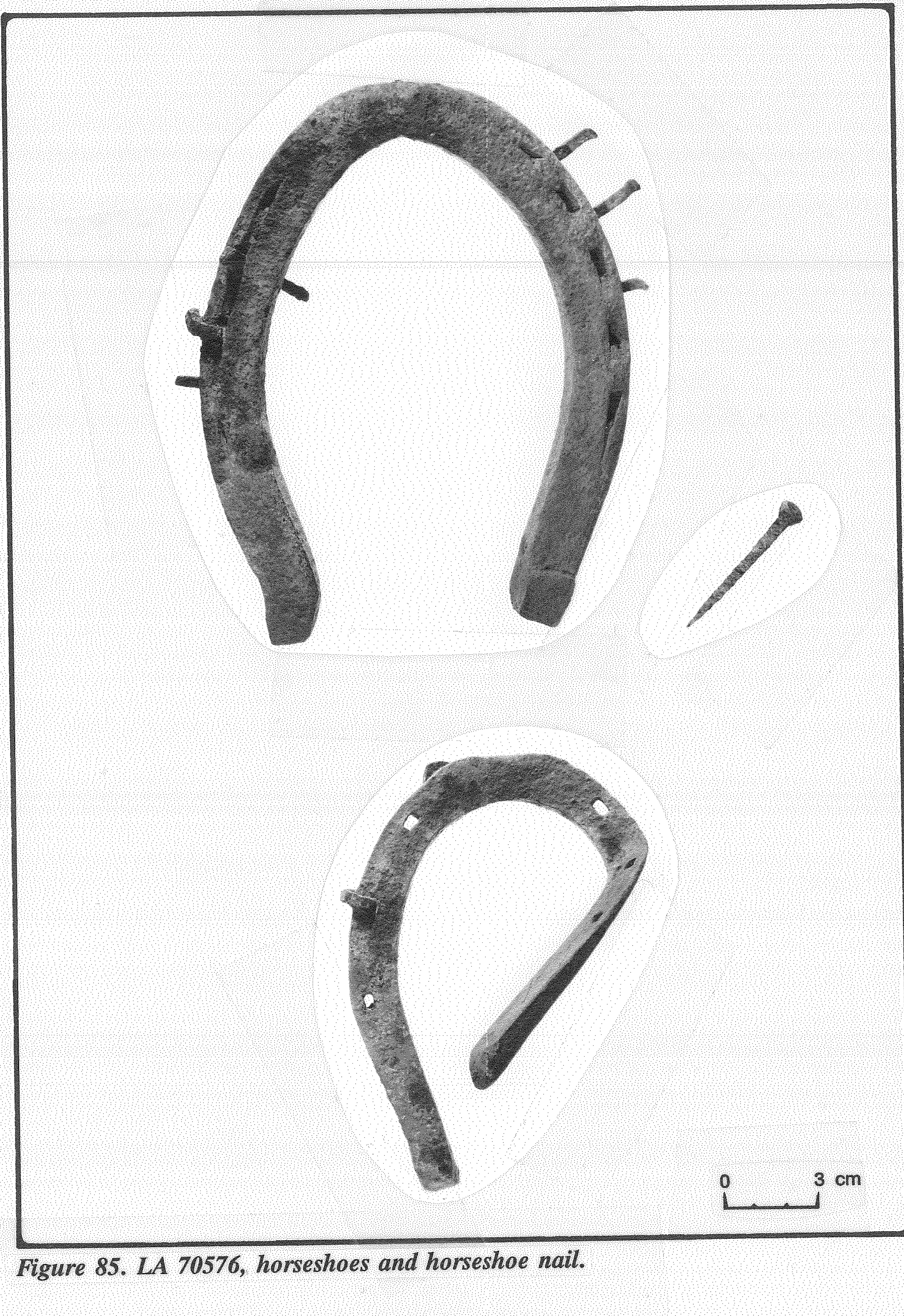

Figure 85. LA 70576, horseshoes and horseshoe nail.

Although no identifiable maker's mark is present, the shoe is stylistically similar to Phoenix or Juniata brand horseshoes, made in Illinois and Pennsylvania from about 1890 through the 1930s. The nails, also machine-made, are stylistically similar to Northwestern or Star brand nails, made from the 1880s through the 1920s.

The second shoe is also a right hind shoe. It is much smaller than the other shoe, measuring 14 cm (5.5 in) long from toe to heel and 9.8 cm (3 7/8 in) wide from quarter to quarter. The shoe was worn by a horse weighing less than 1,200 pounds (544 kg). The horse was not involved in heavy work, but was more likely used to pull a buggy or buckboard wagon in the mountains. Calks are present on both heels and at the toe. The heel calks were made by turning up the heel ends, while the toe calk is a piece of iron welded to the shoe. This required the services of a farrier with a blacksmith's forge and anvil.

The right heel calk is almost worn completely away. The left heel calk is also very worn but is clearly visible. The toe calk is almost worn away on the right side, and the shoe is very worn just right of the toe. The fullering is obliterated on the right branch but is almost intact on the left. The shoe was well past the end of its wear cycle when discarded. Each branch has three nail holes, and one clinched nail is present on the left side. In addition, the nail holes are very worn. This suggests that the horse wore the shoe in its worn-out condition for a long time or that the shoe was removed and reset several times. The shoe is severely bent at the toe, which, along with the clinched nail, suggests it was lost during use.

Although no maker's mark is present, the shoe is stylistically similar to Phoenix or Juniate shoes, made from the late 1880s through the 1930s.

The horseshoe nail is 5.1 cm (2 in) long and machine-made. It has never been used. No maker's mark can be defined, but the shape and style of the nail head suggest it was made by the Capwell Horseshoe Nail Company after 1881. It is the size used for a shoe like the smaller of the two collected at the site.

A small, undecorated white ware sherd was collected on the ridge between the hearth and the excavation area. It was a body sherd of a vessel of unknown shape or function.

Finally, two very small pieces of brown glass were collected from the excavation area. While they could be road trash, it is surprising that more of the same kind were not found. Both are very "sick," indicating that they may be relatively old, but it is not possible to tell their age because no other diagnostic traits are present. They may be from a vessel belonging to the historic occupation of the site.

Discussion

LA 70576 was an enigmatic site. As discussed above, there is evidence that it may have been at least partially redeposited. However, the degree of concentration of the artifact scatter suggests that any redeposition did not dramatically alter the site. The lithic assemblage is not significantly different from those of the prehistoric sites investigated during this project. The native ceramic assemblage contains prehistoric and historic types, and the prehistoric types indicate a Valdez-phase occupation. Chronometric dates from obsidian artifacts also point to the Valdez phase. The evidence for a historic occupation comes from the micaceous sherds and the Euroamerican artifacts. Dates for the micaceous sherds span several hundred years, making them less than useful for dating the historic component. The Euroamerican artifacts dated to the late nineteenth or early twentieth centuries.

The site may have been occupied twice, once during the early Anasazi occupation of the area and again in the nineteenth or early twentieth century. This would account for both components as seen in the artifact assemblage and the chronometric dates. If so, the prehistoric component probably represents an activity area associated with LA 70577, although we cannot specify what activities took place there. Obvious suggestions include farming in the river floodplain or the collection of fine soil material for adobe or pottery manufacture.

Alternatively, LA 70577 may have been occupied historically, and the prehistoric artifacts may appear on the site through cultural or natural processes. Since LA 70577 is located on the terrace above LA 70576, it is possible that the prehistoric artifacts actually came from LA 70577. This would also account for their presence. Whether they came by a natural process such as erosion or by collecting by the historic occupants is not known.

That it may have been the latter is indicated by the dearth of prehistoric artifacts in the area between the two sites. During excavation of the two sites, which took place simultaneously, there was considerable foot traffic by crew members between the sites. This traffic resulted in the identification of the hearth on the ridge at LA 70576 and the discovery of the white ware sherd between the hearth and the excavation area. Otherwise, artifacts were not observed in the area between the sites, although they would almost certainly have been present had prehistoric artifacts from LA 70577 washed down the terrace slope to LA 70576. Further, most surface artifacts observed washing downslope at LA 70577 were west to southwest of the pithouse. LA 70576 was northwest of LA 70577, making natural erosion an unlikely process for depositing the prehistoric artifacts at LA 70576. In addition, because the prehistoric component (including the lithic artifacts) was about as large as the historic component, it seems likely that it represents a separate earlier occupation.

At Girard's (1988) micaceous sherd scatter sites, prehistoric artifacts were often present but did not make up a major part of the artifact assemblages. Because micaceous sherd scatters are often assigned to Apaches, we initially assumed the site was an Apache camp. It remains, then, to determine whether such could have been the case.

Apachean Sites in the Taos Area

Two kinds of archaeological remains found in and around the Taos Valley have often been attributed by archaeologists to the Jicarilla Apaches. The first consists of peeled or scarred ponderosa pine trees that occur singly or in groups. These trees are characterized by one or more large, manmade scars on their lower trucks. A brief review of records of such trees in Carson National Forest's *Cultural Resources Atlas* shows that the scars normally range between 0.9 and 1.5 m tall, and 10 to 30 cm wide, beginning 30 to 70 cm above the ground. Swetnam (1984) compares the manmade scars with those made by fire, lightning strike, and other natural processes. Interpretation of these trees usually relies on research by Swetnam (1984), who describes numerous occurrences in several western states and discusses ethnographic evidence for their production. He reports that the purpose of scarring the trees was to expose its inner bark, which is edible, and the Jicarilla Apache were known to have used the inner bark for food (Swetnam 1984:179). Because they are usually found singly or in small groups, very few scarred ponderosa pines have been recorded as sites. In 1988, only eight scarred ponderosa pine sites had been recorded in Carson National Forest, although many were known (Young and Lawrence 1988; Swetnam 1984). Seven of these sites were in the Warm Springs Timber Sale are on the west side of Picuris Mountain (Lawrence 1986). Most scarred trees are recorded as isolated occurrences. In the 488 ha (1,200 acre) Warm Springs Timber Sale area, 220 scarred trees were recorded as isolated occurrences. After that number was recorded, actual isolated occurrence records were not kept for each tree. Other scarred trees were only photographed, and their locations plotted on the USGS quadrangle map. Over 500 trees were recorded in this way in the survey area (Lawrence 1986:3). Although scarred trees are common in the Tusas Mountains west of the Taos Valley (Swetnam 1984; Bob Lawrence, personal communication), the Warm Springs group represents the largest known concentration of scarred trees in the region (Swetnam, personal communication). Further, the known limits of the concentration are defined not necessarily by their actual distribution but by the boundaries of the timber sale cutting units. It is clear from Lawrence's (1986:Fig. 4) report that hundreds more such trees are probably to be found between and around the timber sale cutting units. Besides this vast collection, scarred ponderosa pines have been recorded in several parts of the adjacent Tres Ritos Hills (see, for instance, Keenan 1986, 1987; Kreibel 1988, 1990; Boyer 1991c). Most of these areas are east and south of the Picuris Mountains in parts of the Tres Ritos Hills more remote from the Taos and Picuris valleys.

Scarred ponderosa pines are potentially amenable to tree-ring dating. The process of scarring usually seems to have involved only exposing and removing the inner bark, often leaving the last growth ring intact. As the tree continues to grow, a collar forms around the scar as rings and bark are added around the scar. Assuming the last growth ring was left intact, which was probably not a major concern for Indians, it can be used to date the year of scarring. Additionally, if the last ring is intact, the season of scarring can be estimated according to the relative presence of earlywood and latewood cells on each side of the ring (Swetnam 1990).

Table 66 lists 29 dates from 26 scarred trees in the Picuris Mountains, many from the Warm Springs Timber Sale area (Swetnam 1990). The dates span 98 years between 1784 and 1882. Within this span, four groups of dates are apparent (Fig. 86). Three are in the 1800s, between 1825 and 1865. As discussed earlier, the Jicarillas may have largely retreated into the mountains in the early nineteenth century because the 1787 treaty between the Spaniards and the Comanches threatened the Jicarilla's relationship with the Spaniards. It also encouraged expansion of Hispanic settlement into areas previously occupied by Jicarillas. Therefore, the clusters of dates in the 1800s may represent the time of more intense occupation of the mountainous areas by local Jicarilla bands. The last dates, around 1880, may correspond to the establishment of the Jicarilla Apache reservation west of Tierra Amarilla in 1880, after which the Apaches were compelled to leave the Taos area.

Of the four groups of dates, the three earliest correspond to periods when our dendroclimatological reconstruction shows lower than normal precipitation patterns. As noted earlier, a shift to moderate-frequency, high-amplitude precipitation oscillations in the 1730s brought on a significantly drier period in the 1780s that was relieved by wet years in the 1790s. The first group of dates includes two at 1784 and two at 1792. After about 1810, precipitation oscillations increased in frequency but decreased in amplitude. Although not dramatically drier than normal, the years between 1805 and 1830 were somewhat drier, with the length of time perhaps making up for the less dramatic decrease in precipitation. The second group of dates includes two at 1812, one at 1826-27, three at 1829, two at 1830, and one at 1833. In our reconstruction, the 1840s were a decade of notably less precipitation than normal. Swetnam (personal communication) states that this is not the case, but that several years in the 1840s were very dry even though the decade was generally wetter than normal. The third group of dates includes one at 1841, one at 1842-43, another at 1843, and one at 1845. These years are identified by Swetnam (personal communication) as years of lower than normal precipitation. The apparent correlations between decreased precipitation and increased use of ponderosa pine inner bark may suggest that during drier periods, the Jicarillas' agricultural practices did not produce surpluses sufficient to feed people through the winters, and they were forced to gather wild resources for food.

This interpretation is supported by data on the seasons during which trees were scarred. Table 67 lists the scarring seasons. This table and Figure 87 compare scars made by intentional bark peeling with those made by natural fires. About half of the fire scars could not be assigned to a season. Of the remaining fire scars, the largest number were formed in July. Most of these were probably formed during early rainy season fires started by lightning. Almost as many could only be assigned to the earlywood period, from May through July. Since none was formed in May and June, it is likely that the three formed in the earlywood period were also formed in July, increasing the number of summer fire scars to 30 percent. The remaining scars were formed in the fall and winter.

In contrast, the manmade scars show a pattern of inner bark use during the cold, non-growing season months. Over half of the peeled scars were made in the latewood-dormant and dormant periods, between August-September and April, followed by almost 20 percent in May. In other words, over 70 percent of the scars were formed between the fall harvest and spring planting times. Swetnam's (1984) review of ethnographic inner bark use indicates that most of this use occurred in the late spring, when other food supplies were scarce after the winter. At this time of the year, the sap begins to rise in the tree, and the inner bark is thicker and juicier than normal. It also contains more nutrients (Swetnam, personal communication). Although it may not always have been the case that inner bark was an emergency food item, Swetnam (1984:180) points out that "for some native peoples, during some periods, it may have been true that annual use and emergency use of inner bark were the same thing, because food was very scarce every year during certain seasons." About 19 percent were scarred in July and early August, with the remaining 10 percent scarred in other summer and fall months. Together with the peeling dates, these data support the interpretation that the Jicarilla Apaches used ponderosa pine inner bark more intensively in cold months during periods when annual precipitation was lower than normal.

The fourth group of scarred tree dates includes three at 1857, two at 1859, one at 1860-61, and one at 1863. Unlike the earlier groups, these dates do not correspond with drier than normal years. Rather, the 1850s and 1860s were years of slightly or notably above normal precipitation. Interestingly, and perhaps significantly, the fourth group of dates also corresponds to the occupation of Cantonment Burgwin, built in 1852 and abandoned in 1860. It was during this period, in March 1854, that the most important battle between U.S. soldiers and the Jicarillas took place at the head of Aguas Calientes canyon, in the Warm Springs Timber Sale area. The presence of soldiers at Cantonment Burgwin appears to have encouraged the Apaches to move higher into the remote mountains, removing themselves from the lower valleys. If so, then even in wetter years, the Apaches may not have had agricultural surpluses adequate to carry them through the winters and may have had to turn to ponderosa pine inner bark.

The second type of purportedly Jicarilla Apachean archaeological remains are sites containing micaceous sherds. Lawrence (1986) observed micaceous sherds associated with some but not all scarred trees. More often, however, micaceous sherds are found on artifact scatter sites such as LA 70576. As Woosley and Olinger (1990:351) point

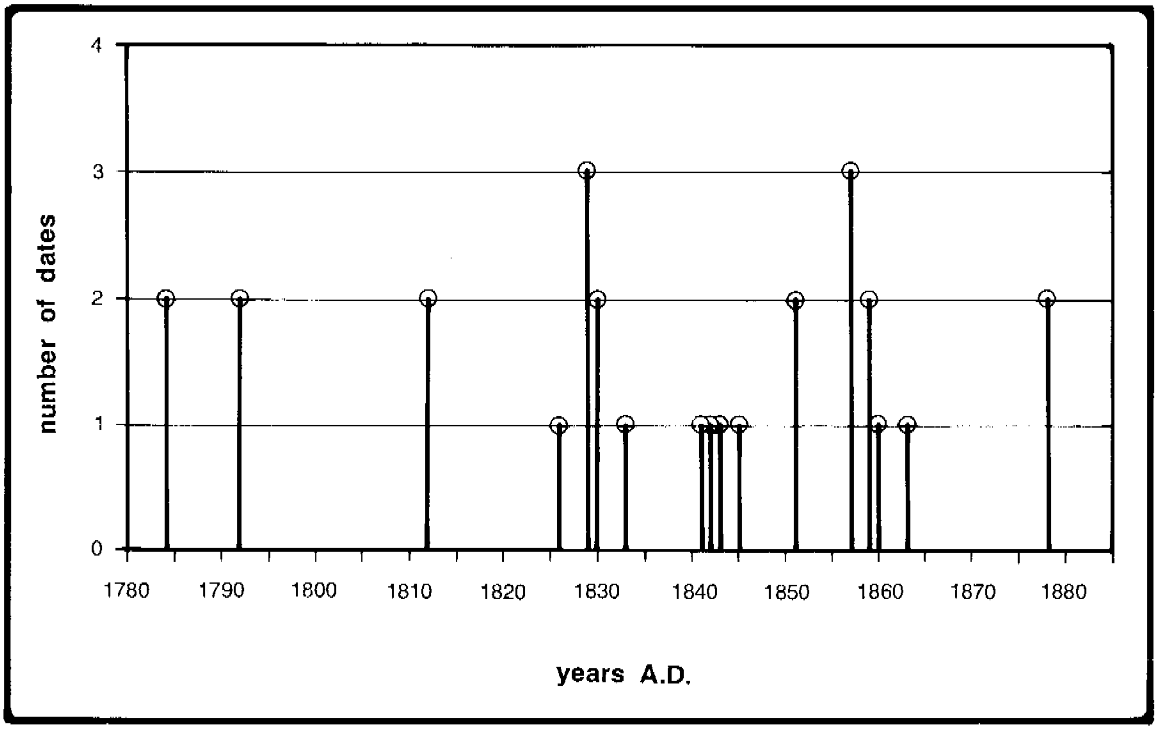

Figure 86. Peeling dates of scarred ponderosa pine trees, Picuris Mountains, Carson National Forest.

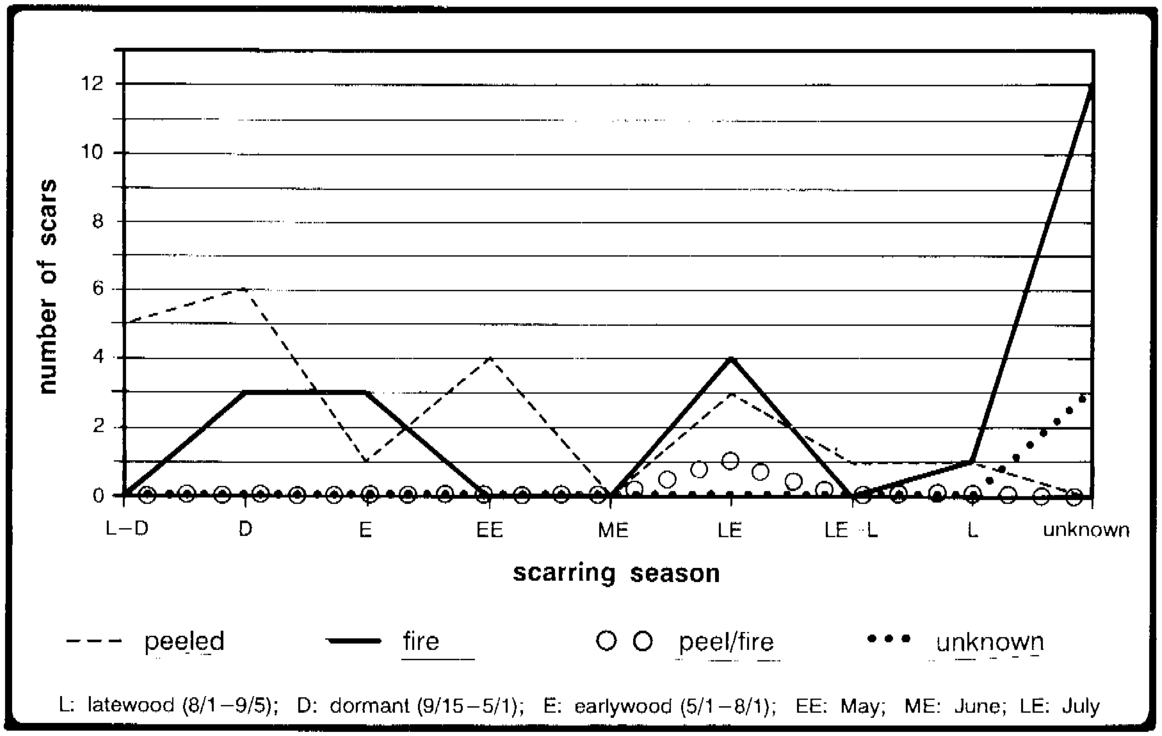

Figure 87. Scarring season by scar type for ponderosa pine trees, Picuris Mountains, Carson National Forest.

Table 66. Peeling dates of scarred ponderosa pine trees in the Picuris Mountains, Carson National Forest

Sample No.	Dates (A.D.)		
	Inner ring	Outer ring	Peeling
PIC 1	1661	-	1784
PIC 4	1696	-	1784
NNM4-2 231B	1677 (pith)	1987	1792
NNM4-3 231B	1735	1987	1792
NNM4-1 231B	1730	1987	1812
NNM4-2 231B	1677 (pith)	1987	1812
NNM1-2 17B	1722	1987	1826V[1]
NNM5-1	1682 (pith)	1987	1829
NNM5-2 221A	1671 (pith)	1987	1829
NNM8-1 221F	1717	1987	1829
NNM8-2 221F	1665 (pith)	1987	1830
NNM4-1 231B	1730	1987	1830
NNNM10	1778 (pith)	1988	1833
NNM7-1 215A	1787 (pith)	1987	1841
NNM3-1 217 89A	1809	1987	1842V[1]
NNM3-2 89A	1778 (pith)	1987	1843
NNM3-2 89A	1778 (pith)	1987	1845
NNM9 18	1789 (pith)	1986	1851
NNM9 18	1789 (pith)	1986	1851
NNM6-1	1811	1987	1857
NNM6-2 231A	1790	1987	1857
NNM1-1 17B	1694 (pith)	1987	1857
PIC 2	1697	-	1859
PIC 3	1700	-	1859
NNM7-2 215A	1793 (pith)	1987	1860V[1]
MAS 1	1788	-	1863
MAS 2	1817	-	1878
MAS 3	1822	-	1878
NNM2 22E	1791 (pith)	1987	1882V[1]

Dates are from Swetnam (1990). Some sample numbers have multiple dates.
[1]V: Variable year. In cases of growth suppression at the scar site, it may not be possible to date the scar to a specific year. The scar is assigned to the earliest possible year of formation. The "V" indicates that the scar may have occurred in the following year.

Table 67. Scarring season by scar type for ponderosa pine trees from the Picuris Mountains, Carson National Forest.

Season (approx. dates)	Type of Scar				
	Peeled	Fire	Peel/Fire	Unknown	Total
Latewood-dormant (8/1-5/1)	5 100.0 23.8	0	0	0	5 100.0 10.4
Dormant (9/15-5/1)	6 66.7 28.6	3 33.3 13.0	0	0	9 100.0 18.8
Earlywood (5/1-8/1)	1 25.0 4.8	3 75.0 13.0	0	0	4 100.0 8.3
Early earlywood (May)	4 100.0 19.0	0	0	0	4 100.0 8.3
Mid earlywood (June)	0	0	0	0	0
Late earlywood (July)	3 37.5 14.3	4 50.0 17.4	1 12.5 100.0	0	8 100.0 16.7
Late earlywood-latewood (7/15-8/15)	1 100.0 4.8	0	0	0	1 100.0 2.1
Latewood (8/1-9/15)	1 50.0 4.8	1 50.0 4.8	0	0	2 100.0 4.2
Unknown	0	12 80.0 52.2	0	3 20.0 100.0	15 100.0 31.3
Total	21 43.8 100.1	23 47.9 99.9	1 2.1 100.0	3 6.3 100.0	48 100.1 100.1

Data are from Swetnam (1990). Numbers in each cell are actual count, percent of row, percent of column.

out, "In the Taos Valley, micaceous pottery is often linked with Tiwan potters, though its presence in historic archaeological sites is used to identify them as Apache." This apparent dichotomy has provoked research into the nature of micaceous pottery sites in the area (Girard 1987a, 1987b, 1988) and the pottery itself (Olinger and Woosley 1989; Woosley and Olinger 1990). Girard's work at possible Apachean sites has been discussed in an interim report (Girard 1988) and was summarized in Cultural Environment. He has told Boyer (personal communication) that although his analyses remain incomplete, he considers it difficult and perhaps impossible to clearly define sites consisting of scatters of micaceous sherds as Apachean on the basis of site structure or artifactual assemblage. In large measure, this is due to the issue pointed out by Woosley and Olinger: although micaceous pottery on sites is often ascribed to Apaches, micaceous wares were made by Apaches, Tiwan Pueblos, and, perhaps, Hispanics. Further, micaceous vessels are known to have been made by Apacheans for trade. There is, therefore, an issue of ethnicity both of potter and user, and it is the latter whose activities most likely left sherds on a site, unless the site can be demonstrated to have been a production locale.

Bart Olinger and Anne Woosley have studied micaceous pottery from a variety of archaeological contexts to clarify this issue. Using x-ray fluorescence (XRF), they examined sherds from about 100 artifact scatter sites in the Taos Valley, from Refuse Mound III at Taos Pueblo (Ellis and Brody 1964), and from the Glasscock site, a reportedly Apachean site on the east side of the Sangre de Cristos (Gunnerson 1969). Their results (Woosley and Olinger 1990:365-366), discussed in detail in Ceramic Analysis, indicate to them that most micaceous vessels were made by

> a semisedentary people ranging throughout a region, exploiting numerous micaceous clay sources and making pots as needed for domestic use and trade. This situation is in contrast to a single chemical cluster characteristic of a settled people mining clays from limited source locations through time, as is the case, for example, for the historic plain brown utility ware produced by Taos Pueblo.

Further, their data (Woosley and Olinger 1990:367) suggest that "certain clay sources were more frequently exploited than others and, possibly, also the commitment to micaceous pottery production at Jicarilla settlements."

Consequently, Woosley and Olinger (1990:367) argue that

> Taos Pueblo was not a major micaceous pottery-producing center in the sense that it was responsible for the preponderance of the northern Rio Grande micaceous wares. Rather, the random, weak, multiple clusters describing micaceous ceramics from the refuse mound suggest that, though Taos Pueblo made some, the Pueblo probably traded for most of it.

This trade began, they suspect, in the early to mid 1700s.

Having characterized the micaceous sherd assemblages, they present an argument for why many or most micaceous sherd scatter sites in the valley are probably of Apachean origin. This argument has three components:

> 1. Most of the sites found thus far are along the northern foothills of the Picuris Mountains, including the Rio Grande del Rancho Valley (Woosley and Olinger 190:354-355). This is the area where Jicarilla settlements are described in eighteenth-century Spanish documents (Adams 1953, 1954; Cutter 1975). Woosley and Olinger (1990:359) describe five major concentrations of sites, four of which are along the northern and northeastern foothills of the Picuris Mountains.
>
> 2. There is a dearth of historic Taos Pueblo pottery found at these sites, although historic Tewa wares are sometimes present. Chipped stone artifacts are present, as are occasional metal items, but ground stone is absent (Woosley and Olinger 1990: 356, 364, 366; but see Girard 1988). The point seems to be that if the sites were of Taos Pueblo origin, other kinds of historic Taos pottery would be present. However, they neglect to note that at some undetermined time, micaceous pottery superseded historic Taos Brown. Further, Taos people made no painted wares historically, relying instead on trade with the Tewa Pueblos.
>
> 3. Features, when present at all, usually consist of rock rings or piles, often associated with Apachean sites (Woosley and Olinger 1990:356, 366).

Their interpretation, then, is that many of the micaceous sherd scatters are eighteenth-century Jicarilla Apache sites. The fact that Fray Domínguez's 1776 report (Adams and Chávez 1956) does not mention Apaches in the same area but does mention Hispanic settlers suggests to Girard (1988) that expansion of Hispanic settlement had begun to push the Apaches into the mountains between Taos and Picuris. This may be supported by the dates of scarred trees in the Picuriś Mountains, which could show increased settlement of mountain areas in the late eighteenth and nineteenth centuries. However, Woosley and Olinger (1990:367) point out,

> Great caution must be exercised when using the presence of micaceous pottery as a diagnostic indicator of either Jicarilla Apache or Tiwa potter ethnicity. Micaceous pottery was produced by both and probably traded between them and to Spanish settlers.
>
> The problem of distinguishing between use and production of material remains occurring in sites will potentially blur the ethnic affiliation of some sites, especially small, specialized activity localities. Ultimately, it may be possible to identify the ethnicity of the potter who produced a particular vessel by chemical analysis, but not who used it.

Is LA 70576 an Apache Site?

Clearly, LA 70576 has a historic component represented by micaceous sherds. While Woosley and Olinger's argument for interpreting micaceous sherd scatter sites as Apachean in origin is reasoned, their caveat concerning producer versus user ethnicity is pertinent. Although we did not perform XRF studies of the micaceous sherds from LA 70576, their results show that we could expect such studies to be inconclusive. Further, there is a time factor to be considered. Woosley and Olinger's argument rests largely on the documented presence of Jicarilla Apaches in the northern foothills of the Picuris Mountains in the early to mid 1700s. Late eighteenth- and nineteenth-century documents show expanding Hispanic settlement in the same area, and Girard (1988) has suggested that it was during this period that the Jicarillas began spending more time in remote mountainous regions. This may be supported by Swetnam's (1990) tree-ring data.

Based on this information and the site's location in the lower canyon, we might expect LA 70576 to be Apachean if the site dated to the eighteenth century. By the nineteenth century, the Apaches were apparently settled mostly in isolated mountain areas. Swetnam's (1990) tree-ring dates suggest that during the 1850s, when Cantonment Burgwin was in use, the Jicarillas may have retreated farther into remote parts of the surrounding mountains. Although documents show that Apaches visited the fort under both formal and surreptitious circumstances during the 1850s (Brooks and Reeve 1947; Murphy 1973), we would not expect a mid-nineteenth-century Jicarilla campsite so close to the fort (2.8 km, 1.7 mi). Particularly, the Jicarillas are not likely to have camped along the floodplain near the well-traveled road to Taos, unless the campsite postdated the abandonment of the fort in 1860.

While the Euroamerican artifacts recovered from LA 70576 do not comprise an assemblage capable of yielding accurate dates for the historic component, they do suggest that the component dates to the late nineteenth or early twentieth century. Given these considerations, if the historic component at LA 70576 were Apachean in origin, it would probably date after 1880, when their reservation was established in its present location west of Chama. Although Swetnam's (1990) tree-ring dates show that some Apaches were apparently still present in the mountains after 1880, it seems unlikely that a Jicarilla camp would be located in such a visible and accessible position. Consequently, we cannot assign LA 70576 to Jicarilla Apaches. However, since micaceous sherds were also made by Taos and Picuris Pueblo Indians and, perhaps, by Hispanics, the site may be of Puebloan or Hispanic origin. Further, given the potter versus user issue, it may also have been an Anglo site. Until more such sites are studied, we cannot know what the presence of these kinds of artifacts tells us about ethnicity of the user and about access to a variety of native and Euroamerican goods.

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STUDYING THE TAOS FRONTIER:
THE POT CREEK DATA RECOVERY PROJECT

VOLUME 2: DISCUSSION AND INTERPRETATION

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THE TAOS FRONTIER: DISCUSSION AND INTERPRETATIONS

CHIPPED STONE ARTIFACT ANALYSIS

James L. Moore

Two basic strategies of chipped stone reduction have been defined in the Southwest. Curated strategies entailed the manufacture of bifaces that served both as unspecialized tools and cores, while expedient strategies were based on the removal of flakes from cores for use as informal tools. Technology was at least partly related to lifestyle. Curated strategies were associated with a high degree of residential mobility, while expedient strategies were associated with sedentism. In theory, bifacial reduction strategies were similar to the blade technologies of Mesoamerica and western Europe in that they focused on efficient reduction with little waste. Curated strategies allow flintknappers to produce the maximum length of usable flake edge per core. By maximizing the return from cores, they were able to reduce the amount of raw material required for production of informal tools. This helped lower the amount of weight that had to be transported from camp to camp. Material waste and transport costs were not important considerations in expedient strategies. Flakes were simply struck from cores when needed.

The chipped stone analysis focused on defining the reduction strategies used at the excavated sites. Other topics of interest included raw material selection and procurement, and tool manufacture and use. Questions concerning residential mobility, where the local Anasazi farmers came from, ties with other regions, and variation in the reduction strategies used by farmers at villages versus limited occupation sites can be addressed using these data.

One line of thought suggests that a mobile hunter-gatherer lifestyle prevailed locally until ca. A.D. 1000 to 1100. Some researchers think that the hunter-gatherers settled down at that time, beginning to farm and build pithouses (Rudecoff 1982; Woosley 1986). Others suggest that farmers migrated to the Taos region after A.D. 1000, augmenting or displacing local hunter-gatherers (see Cultural Environment). The first premise entails rapid change from a mobile to a sedentary lifestyle, while the second involves the movement of a sedentary population from one region to another. An examination of chipped stone reduction technology should allow us to determine which proposition best explains the sudden appearance of sedentary farmers in this region. If the former is true, a transition from a hunter-gatherer to a farming adaptation should be visible in the remains left by the early pithouse dwellers, who should have initially retained a high degree of residential mobility and associated technologies. Thus, the continued use of a curated reduction strategy would be expected, especially during the early years of pithouse occupancy. However, if the early pithouse dwellers were immigrants with a long history of relative residential stability, an expedient reduction strategy would be expected from the outset.

A closely related question involves links between the Taos area and other regions, particularly if the local farming population moved in from elsewhere. According to the model of frontier settlement presented in the Research Design, frontier populations maintain social and economic ties with the core area. This link should be visible in the material culture of the frontier population. Within the chipped stone assemblage, these ties might be represented by relatively high frequencies of materials from the core area, particularly during the early years of settlement. While this relationship should continue as the frontier population becomes established, it will taper off as people become less dependent on the core area.

A third question returns to the problem of curated versus expedient reduction strategies. Did sedentary populations expediently reduce lithic materials at all times, or was a curated strategy used while they were away from the village? Little technological variation should be visible between assemblages from residential and limited occupation sites in the former case. There should be significant variation in the latter, with debitage from large unspecialized bifaces predominating at camps and expediently produced debitage from unprepared cores at primary residential sites.

To address these questions, it is necessary to examine material selection, reduction technology, and tool use for each site. While such a small sample of assemblages cannot be expected to produce definitive results, it should provide an idea of the direction in which future research might proceed.

Comparative data are provided in this chapter. Site-specific data are included in the site descriptions.

Material Selection

Table 68 presents material selection data. Chert is the most common material at all six sites, and with the exception of LA 70577, comprises over half of each assemblage. Basalt is the second most common material. With the addition of undifferentiated igneous rocks, these materials comprise about 20 percent of the LA 2742, LA 70577, and LA 71189 assemblages and over 11 percent of the LA 3570, LA 70576, and LA 71190 assemblages. Pedernal chert and obsidian (from the Polvadera and other Jemez sources) are common, averaging 8.8 and 11.9 percent of each site assemblage, respectively. Other materials were comparatively rare, averaging less than 3 percent each.

In general, materials are cryptocrystalline, isotropic, and elastic--qualities that are ideally suited for the production of chipped stone tools (Crabtree 1972). Materials that lack these qualities and are unsuitable for reduction included micaceous schist and concretions. While these materials are foreign to the sites from which they were recovered, there is no evidence that they were used to produce chipped stone tools, and they will not be considered in this discussion.

Material Source: Local versus Exotic

An examination of material sources is critical to a discussion of curated versus expedient technologies and to a consideration of frontier ties to the core area. Tools are produced in anticipation of need in curated strategies, while in expedient strategies, tools are manufactured according to immediate need. In essence, these strategies constitute the opposite ends of a behavioral continuum (Bamforth 1990). While Kelly (1988) associates curated strategies with mobility, Bamforth (1986) argues that they are more closely related to the availability of desirable materials.

Preliminary studies near San Ildefonso (Moore n.d.b) suggest that both positions are correct. Archaic assemblages in that study displayed a differential reduction of local and exotic materials. While local materials were mostly reduced in an expedient manner, exotic materials were primarily reduced as bifaces. However, most of the exotic materials and evidence of biface manufacture were found in Archaic components. Anasazi assemblages contained few exotics and little evidence of biface production. It was concluded that Archaic populations reduced exotic materials efficiently because they were desirable and in limited supply. Local materials were expediently reduced because they were easily obtained and plentiful, and conservation was unnecessary. Only when moving toward exotic material sources were local materials bifacially reduced. Large unspecialized bifaces were made in anticipation of future need and to replace exhausted or broken curated tools rather than for immediate use.

Local materials are types that are easily accessed from a specific site location. Exotic materials are more difficult to obtain and often must be transported long distances. Most materials used in the Pot Creek area have been summarized by Newman (1983). Local materials include Mississippian cherts from the Terrero formation, Precambrian quartzites from the Ortega formation, Pennsylvanian limestones and siltstones, Servilleta formation basalts, Taos plateau rhyodacites (glassy andesite or vitrophyre), Picuris/Taos range rhyolite tuffs, and obsidian from No Agua Mountain. Other undifferentiated igneous rocks are available from volcanic formations throughout the region. Exotic materials include chalcedonies and jaspers from the Las Vegas and Ocate areas, Pedernal chert from the Rio Chama Valley, Jemez obsidians, Grants Ridge obsidian from the Mount Taylor area, Washington Pass chert from the Chuska Mountains, siliceous sandstones from the Chama Valley and Ocate Mesa areas, and Zuni Mountain/Hosta Butte "leopard" chert.

Local materials used for producing chipped stone artifacts at the excavated sites include cherts, undifferentiated igneous rocks, basalt, limestone, siltstone, chertic rhyolite, quartzite, and massive quartz. Exotic materials include Pedernal chert and

Table 68. Chipped stone material type selection by site, frequencies and column percentages

Material	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
Chert	285 58.6	117 62.9	25 58.1	619 46.8	6 67.4	135 64.0	1,187 52.5
Pedernal chert	50 10.3	10 5.4	5 11.6	133 10.1	0 0.0	3 1.4	201 8.6
Obsidian	3 0.6	15 8.1	2 4.7	47 3.6	2 4.7	11 5.2	80 3.5
Polvadera obsidian	4 0.8	13 7.0	1 2.3	152 11.5	0 0.0	22 10.4	192 8.5
Igneous undiff.	43 8.9	3 1.6	1 2.3	26 2.0	6 14.0	5 2.4	84 3.8
Basalt	49 10.1	21 11.3	4 9.3	280 21.2	3 7.0	19 9.0	376 15.5
Rhyolite	2 0.4	1 0.5	0 0.0	4 0.3	1 2.3	1 0.5	9 0.4
Limestone	30 6.2	3 1.6	3 7.0	22 1.7	1 2.3	1 0.5	60 2.6
Siltstone	0 0.0	0 0.0	0 0.0	1 0.1	1 2.3	3 1.4	5 0.2
Quartzite	13 2.7	3 1.6	1 2.3	27 2.0	0 0.0	8 3.8	52 2.3
Quartzitic sandstone	1 0.2	0 0.0	1 2.3	5 0.4	0 0.0	2 0.9	9 0.4
Schist	1 0.2	0 0.0	0 0.0	2 0.2	0 0.0	0 0.0	3 0.1
Concretion	0 0.0	0 0.0	0 0.0	1 0.1	0 0.0	0 0.0	1 0.05
Massive quartz	0 0.0	0 0.0	0 0.0	4 0.3	0 0.0	0 0.0	4 0.1
Unknown	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.5	1 0.05
Totals	481	186	43	1,323	20	211	2,264

obsidian from the Polvadera Peak, Cerro del Medio, and other Jemez sources. The source of the quartzitic sandstone is currently unknown, but is considered exotic and may represent the siliceous sandstone described by Newman (1983). Table 69 presents percentages of local and nonlocal materials. High percentages of nonlocal materials occur in all assemblages except that of LA 71189.

Table 69. Percentage of local versus nonlocal lithic materials by site

Site No.	Local Materials	Nonlocal Materials
LA 2742	88.0	12.0
LA 3570	79.6	20.4
LA 70576	79.1	20.9
LA 70577	74.5	25.5
LA 71189	95.3	4.7
LA 71190	81.9	18.1
Average	83.0	17.0

While each of these materials outcrops in one or more locations, they were not necessarily obtained at those sources. Rocks can be transported away from outcrops by water and deposited in gravel terraces, often a great distance from the outcrop. Not only are materials like Pedernal chert and Jemez obsidian available in outcrops, they are also common in terraces flanking streams that drain the regions in which they outcrop and along the rivers into which those streams flow. Both are common in the Rio Grande Valley near Albuquerque and occur at least as far south as Las Cruces.

This distribution complicates discussions of material source. The type of cortex on artifacts gives a more accurate indication of their source. Waterworn cortex indicates that a material was obtained from stream deposits away from the location in which it outcrops, while nonwaterworn cortex implies procurement at or near an outcrop.

Table 70 provides data on cortex type by site. Overall, there is an even split between materials procured at or near outcrops and from gravel deposits. Materials obtained at or near outcrops dominate the LA 2742 and LA 71189 assemblages, while materials from gravel beds dominate the LA 3570, LA 70576, and LA 70577 assemblages. Sources were relatively evenly split at LA 71190.

Table 70. Cortex type by site, frequencies and row percentages

Site Number	Cortex Type			
	Waterworn	Nonwaterworn	Indeterminate	Totals
LA 2742	56 32.6	114 66.3	2 1.2	172 31.3
LA 3570	33 66.0	17 34.0	0 0.0	50 9.1
LA 70576	5 71.4	1 14.3	1 14.3	7 1.3
LA 70577	138 58.5	98 41.5	0 0.0	236 43.0
LA 71189	3 33.3	6 66.7	0 0.0	9 1.6
LA 71190	21 51.2	19 46.3	1 2.4	41 7.5
Totals	256 49.7	255 49.5	4 0.8	515

Table 71 illustrates frequencies and percentages of cortex type for each material type. While there is a rather even split between nonwaterworn (53 percent) and waterworn (47 percent) cortex on local materials, cortex on exotic materials is mostly waterworn (80 percent). Thus, local materials were procured from outcrops and stream terraces in nearly equal amounts, while exotic materials were mostly obtained from gravel deposits.

Cortex type data are broken down by site in Table 72. The low frequency of cortical nonlocal materials at LA 2742 suggests that the apparent bias toward exotics obtained from gravel deposits might be due to sample error. However, there is a strong bias toward procurement of local materials at or near outcrops. In contrast, local material procurement at LA 70577 was only slightly biased toward those available in gravel beds, while most exotic materials came from stream deposits. Most of the exotics at LA 3570 and LA 71190 were obtained from gravel deposits, but again, small sample size rather than selection bias may be responsible for these figures. Local materials were mostly obtained from stream deposits at LA 3570, while their procurement was balanced at LA 71190. No cortical exotic materials were found at LA 70576 or LA 71189. The tendency toward procurement of local material from stream deposits at LA 70576 and at or near outcrops at LA 71189 may again be due to small sample size.

Overall, while there were a few differences between sites, local material procurement was almost evenly split between outcrops and stream deposits. In contrast, there seems to have been a tendency toward procurement of nonlocal materials in stream deposits. As discussed above, while it is possible to determine where materials with nonwaterworn cortex were obtained, the same is not true of those with waterworn cortex. Though gravel deposits along the Rio Chama contain waterworn Pedernal chert nodules and streams below the Polvadera source contain waterworn obsidian nodules, it is impossible to determine whether artifacts with waterworn cortex were obtained from these areas or from many miles away along the Rio Grande. Thus, while the presence of some exotic materials with nonwaterworn cortex suggests contact between the Pot Creek area sites and the Rio Chama Valley and Jemez Mountain regions, all that can be said about most of the exotics is that they were obtained downstream from their outcrops.

Table 71. Cortex type by material type, frequencies and row percentages

Material Type	Cortex Type			
	Waterworn	Nonwaterworn	Indeterminate	Totals
Chert	153 51.2	143 47.8	3 1.0	299 55.1
Pedernal chert	12 85.7	2 14.3	0 0.0	14 2.6
Obsidian	8 57.1	6 42.9	0 0.0	14 2.6
Polvadera obsidian	30 90.9	3 9.1	0 0.0	33 6.8
Igneous undiff.	10 27.0	26 70.3	1 2.7	37 6.8
Basalt	32 38.1	52 61.9	0 0.0	84 15.5
Limestone	0 0.0	25 100.0	0 0.0	25 4.6
Siltstone	1 50.0	1 50.0	0 0.0	2 0.4
Quartzite	26 92.9	2 7.1	0 0.0	28 5.2
Quartzitic sandstone	2 40.0	3 60.0	0 0.0	5 0.9
Massive quartz	1 50.0	1 50.0	0 0.0	2 0.4
Total/ Percent	275 50.6	264 48.6	4 0.7	543 100.0

Table 72. Type of cortex on local and nonlocal materials by site, frequencies and column percentages

Site No.	Cortex Type	Material Source	
		Local	Nonlocal
LA 2742	waterworn	50 30.8	6 85.7
	nonwaterworn	112 69.2	1 14.3
LA 3570	waterworn	25 59.5	8 100.0
	nonwaterworn	17 40.5	0 0.0
LA 70576	waterworn	5 83.6	0 0.0
	nonwaterworn	1 16.4	0 0.0
LA 70577	waterworn	124 56.2	33 76.7
	nonwaterworn	97 43.9	10 23.3
LA 71189	waterworn	3 33.3	0 0.0
	nonwaterworn	6 66.7	0 0.0
LA 71190	waterworn	16 50.0	5 62.5
	nonwaterworn	16 50.0	3 37.5

Material Texture

Different materials are suited to different tasks (Chapman 1977). For example, while obsidian is eminently suited to production of cutting tools because it is easily flaked and possesses extremely sharp edges, it is too fragile to be used for heavy-duty chopping. Conversely, while basalt and quartzite have duller edges and are less efficient as cutting tools, they are well suited to heavy use like chopping because they are dense and resist shattering. The suitability of materials for specific tasks also varies according to texture. Fine-grained materials have sharper edges than coarse materials and are more amenable to the manufacture of formal tools because they are easily and predictably flaked. For example, fine-grained basalt produces nearly as good a cutting edge as obsidian or chert, while coarse-grained basalt may only be suitable for chopping or battering.

Table 73 illustrates material quality by material type. It should be noted that obsidian is glassy by definition, and no other materials are assigned to that category. Overall, glassy and fine-grained materials make up 88.5 percent of the total assemblage. Medium-grained materials comprise around 10 percent, while just over 1 percent of the assemblage is coarse-grained. Except for a few pieces of chert, the coarse materials are igneous or metamorphic rocks. Most medium-grained materials are also igneous or metamorphic, but some sedimentary rocks also fall into this category.

Table 74 shows material quality by material type for each site. LA 2742 has the lowest combined percentage of glassy and fine-grained materials and the highest overall percentage of medium-grained materials. LA 70577 and LA 71189 have the highest combined percentages of glassy and fine-grained materials. However, even with these differences, the assemblages are quite similar, and selection for textures amenable to efficient production of formal tools and cutting edges predominated. While medium- and coarse-grained materials were used, they occur in significantly smaller numbers.

Material quality for formal tools and tool-making debris are illustrated by site in Table 75. Tool-making debris includes biface, resharpening, and notching flakes. Formal tools include all whole and fragmentary unifaces, bifaces, and cobble tools. Other than two choppers at LA 70577 (medium basalt and coarse quartzite), formal tools were made from glassy and fine-grained materials. This suggests that most were produced for use in cutting or scraping activities rather than chopping or battering. Glassy materials comprise 25.9 percent of the formal tool and tool debitage assemblage, while 72.2 percent are fine-grained materials. This suggests that the latter were preferred for tool manufacture, although it should be remembered that fine-grained materials comprise 76.6 percent of the overall assemblage, while only 11.9 percent are glassy materials (Table 73). Over 10 percent of the glassy artifacts are tools or tool making debris, but only 4.5 percent of the fine-grained artifacts fall into these categories. Thus, while fine-grained materials were used for more tool manufacture overall, glassy materials seem to have been preferred for tool production when available.

Table 73. Material quality by material type, frequencies and row percentages

Material Type	Material Quality				
	Glassy	Fine	Medium	Coarse	Totals
Chert	0 0.0	1,063 87.9	139 11.5	8 0.7	1,210 52.9
Pedernal chert	0 0.0	201 100.0	0 0.0	0 0.0	201 8.8
Obsidian	80 100.0	0 0.0	0 0.0	0 0.0	80 3.5
Polvadera obsidian	192 100.0	0 0.0	0 0.0	0 0.0	192 8.4
Igneous undiff.	0 0.0	53 63.1	30 35.7	1 1.2	84 3.7
Basalt	0 0.0	342 91.0	34 9.0	0 0.0	376 16.4
Rhyolite	0 0.0	8 88.9	1 11.1	0 0.0	9 0.4
Limestone	0 0.0	54 90.0	6 10.0	0 0.0	60 2.6
Siltstone	0 0.0	3 60.0	2 40.0	0 0.0	5 0.2
Quartzite	0 0.0	21 40.4	22 42.3	9 17.3	52 2.3
Quartzitic sandstone	0 0.0	6 66.7	2 22.2	1 11.1	9 0.4
Massive quartz	0 0.0	1 11.1	1 11.1	7 77.8	9 0.4
Totals/ Percent	272 11.9	1,752 76.6	237 10.4	26 1.1	2,287

Table 74. Material quality by material type for each site, frequencies and row percentages

Material Type	LA 2742				LA 3570				LA 70756			
	g	f	m	c	g	f	m	c	g	f	m	c
Chert	0 0.0	240 84.2	44 15.4	1 0.4	0 0.0	92 78.6	24 20.5	1 0.9	0 0.0	20 80.0	5 20.0	0 0.0
Pedernal chert	0 0.0	50 100.0	0 0.0	0 0.0	0 0.0	10 100.0	0 0.0	0 0.0	0 0.0	5 100.0	0 0.0	0 0.0
Obsidian	3 100.0	0 0.0	0 0.0	0 0.0	15 100.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0
Polvadera obsidian	4 100.0	0 0.0	0 0.0	0 0.0	13 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0
Igneous undiff.	0 0.0	24 55.8	18 41.9	1 2.3	0 0.0	3 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0
Basalt	0 0.0	33 67.3	16 32.7	0 0.0	0 0.0	19 90.5	2 9.5	0 0.0	0 0.0	4 100.0	0 0.0	0 0.0
Rhyolite	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Limestone	0 0.0	24 80.0	6 20.0	0 0.0	0 0.0	3 100.0	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	0 0.0
Quartzite	0 0.0	6 46.2	6 46.2	1 7.7	0 0.0	2 66.7	0 0.0	1 33.3	0 0.0	0 0.0	1 100.0	0 0.0
Quartzitic sandstone	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0
Massive quartz	0 0.0	0 0.0	1 20.0	4 80.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Totals	7 1.4	379 78.1	92 19.0	7 1.4	28 15.1	130 69.7	26 14.0	2 1.1	3 7.0	32 76.7	7 16.3	1 2.3

g = glassy; f = fine-grained; m = medium-grained; c = coarse-grained

Table 74 (cont.)

Material Type	LA 70577				LA 71189				LA 71190			
	g	f	m	c	g	f	m	c	g	f	m	c
Chert	0 0.0	564 91.1	51 8.2	4 0.7	0 0.0	28 96.6	1 3.4	0 0.0	0 0.0	119 88.2	14 10.3	2 1.5
Pedernal chert	0 0.0	133 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	0 0.0
Obsidian	47 100.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	11 100.0	0 0.0	0 0.0	0 0.0
Polvadera obsidian	152 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	22 100.0	0 0.0	0 0.0	0 0.0
Igneous undiff.	0 0.0	16 61.5	10 38.5	0 0.0	0 100.0	5 83.8	1 16.7	0 0.0	0 0.0	5 100.0	0 0.0	0 0.0
Basalt	0 0.0	268 95.7	12 4.3	0 0.0	0 0.0	2 66.7	1 33.3	0 0.0	0 0.0	16 84.2	3 15.8	0 0.0
Rhyolite	0 0.0	4 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Limestone	0 0.0	22 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Siltstone	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 33.3	2 66.7	0 0.0
Quartzite	0 0.0	9 33.3	13 48.1	5 18.5	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 50.0	2 25.0	2 25.0
Quartzitic sandstone	0 0.0	5 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0
Massive quartz	0 0.0	1 25.0	0 0.0	3 75.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Unknown	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Totals	199 15.1	1,023 77.5	86 6.5	12 0.9	2 4.6	38 88.4	3 7.0	0 0.0	33 15.6	151 71.6	23 10.9	4 1.97

g = glassy; f = fine-grained; m = medium-grained; c = coarse-grained

Table 75. Formal tools and tool-making debris by material quality for each site, frequencies and row percentages

Site	Artifact Type	Material Quality				
		Glassy	Fine	Medium	Coarse	Total
LA 2742	tool making debris	0 0.0	2 100.0	0 0.0	0 0.0	2 18.2
	formal tools	2 22.2	7 77.8	0 0.0	0 0.0	9 81.8
LA 3570	tool making debris	3 50.0	3 50.0	0 0.0	0 0.0	6 54.5
	formal tools	1 20.0	4 80.0	0 0.0	0 0.0	5 45.5
LA 70576	formal tools	0 0.0	2 100.0	0 0.0	0 0.0	2 100.0
LA 70577	tool making debris	14 37.8	23 62.2	0 0.0	0 0.0	37 52.1
	formal tools	5 14.7	27 79.4	1 2.9	1 2.9	34 47.9
LA 71189	tool making debris	0 0.0	1 100.0	0 0.0	0 0.0	1 100.0
LA 71190	tool making debris	1 14.3	6 85.7	0 0.0	0 0.0	7 58.3
	formal tools	2 40.0	3 60.0	0 0.0	0 0.0	5 41.7

Reduction Strategies

Several attributes contribute information on reduction technology. Among them are debitage ratios, platform shape and modification, flake breakage patterns, amount of dorsal cortex, and types and conditions of formal tools. Debitage is an important indicator of reduction technology because it is rarely curated and often constitutes the only remaining evidence of reduction on sites where formal tools and cores were removed after reduction. However, debitage ratios should not be used exclusively because postreduction processes may have altered their original patterning.

Sullivan and Rozen (1985) have produced a model for defining reduction trajectories based on the presence of a single interior (ventral) surface, a point of applied force (platform), and condition of artifact margins. These attributes were used to produce a hierarchical key that assigns debitage to a range of classes, including complete and broken flakes, flake fragments, and debris. They conclude that "shaped stone tool manufacture produces comparatively high and invariable proportions of flake fragments and broken flakes, while core reduction results in relatively high and variable proportions of complete flakes and debris" (Sullivan and Rozen 1985:773).

While Sullivan and Rozen's (1985) study has interesting implications, it makes assumptions that may be inaccurate and fails to take other variables into account except in passing. Prentiss and Romanski (1989) suggest that the assumption that trampling would not have a major effect on assemblages deposited in soft sand is wrong. Experiments showed that the number of complete flakes in both biface and core reduction assemblages were significantly reduced by trampling (Prentiss and Romanski 1989:94-95). A second assumption concerning flake breakage during manufacture is also questionable. While Sullivan and Rozen (1985) assume that tool manufacture will produce larger numbers of broken flakes than core reduction, Ensor and Roemer (1989:177) note that this is unsubstantiated. Observations made by this author while flintknapping indicate that flake breakage occurs during both processes. While, in general, there may be more breakage during biface production, the pattern varies according to the type of material being worked. For instance, obsidian produces larger numbers of broken flakes during both core and biface reduction than do either chert or basalt.

While Sullivan and Rozen (1985:759) note that cortex and platform information can be used to test their model, they weaken their model by ignoring both of these classes of data. Though its use has never been standardized, the amount, location, and type of cortex can be an important indicator of reduction stage. Sullivan and Rozen (1989:170) are correct in noting that cortex on flake fragments provides inaccurate data because it is impossible to determine how much was on the missing portion. However, they fail to discuss how examination of cortex can be applied to the unbroken flake assemblage. Similarly, platforms can be important indicators of reduction technology and provide data that is critical to any assessment of an assemblage, yet this information is also left out of their model.

Though Sullivan and Rozen (1985) have made a laudable attempt at developing a nontypological approach to studies of reduction technology, their model is flawed because it makes unsupported assumptions and ignores critical variables. The approach followed in this study is more complicated because the lithic reduction process is itself quite complex. Our approach is typological because it is possible to classify certain types of debitage by shape and other characteristics.

Dorsal Cortex

While cortex has been discussed in the context of material source, its relation to reduction stage remains to be considered. This section is only concerned with dorsal cortex; cortex on platforms will be included in the discussion of flake platforms. Cortex is the weathered outer rind on nodules which has been chemically altered by exposure to the elements and rarely possesses a suitable surface for reduction or use. Further, the outer sections of nodules that have been transported by water often contain microcracks and fissures created by cobbles striking against one another, producing a zone with unpredictable flaking characteristics. Thus, because cortex flakes differently from nodule interiors and is usually unsuitable for use or further reduction, cortical surfaces are typically removed and discarded. In general, flakes have progressively less dorsal cortex as reduction proceeds. Thus, cortex can be used to examine reduction stages in an assemblage: the early stages are characterized by high percentages of flakes with lots of dorsal cortex, while the opposite suggests later reduction stages.

Reduction can be divided into two stages: core reduction and tool manufacture. Flakes are removed for use or further modification during core reduction. *Primary* core reduction includes initial core platform preparation and removal of the cortical surface. *Secondary* core reduction is the removal of flakes from nodule or core interiors. During reduction, this difference is rarely as obvious as these definitions make it seem. Both processes often occur simultaneously, and rarely is all cortex removed before secondary reduction begins. In this analysis, primary core flakes are those with 50 percent or more of their dorsal surfaces covered by cortex, and secondary core flakes are those with less than 50 percent dorsal cortex. These distinctions can provide information on the condition of cores reduced at a site. For example, a lack of primary flakes suggests that initial reduction occurred elsewhere, while the presence of few secondary flakes may indicate that cores were carried off for further reduction. Tool manufacture refers to the purposeful modification of debitage into a specialized form. As discussed in the Introduction, flakes produced during tool manufacture (biface flakes) were defined using a polythetic set of variables that includes platform attributes as well as flake form characteristics. Primary core flakes represent the early stages of reduction, while secondary core flakes and biface flakes represent the later stages.

Table 76 shows dorsal cortex percentages for each site. Each assemblage is dominated by debitage lacking dorsal cortex. Overall, these percentages suggest that the later reduction stages dominated at all sites. However, by combining flakes (intentional removals) and angular debris (shatter) we may be obscuring the pattern. Only flakes are included in Table 77. Except for LA 71189 (where the variation is probably due to small sample size), there are no significant differences between sites. This supports the conclusion that the later stages of reduction dominated at all sites. Table 78 separates flakes removed from cores, bifaces, and tools. The latter category is comprised of flakes removed from hammerstones and resharpened tools. Little cortex occurs on biface and tool flakes, and, as they were minor components of the assemblages, their removal causes no great change in the overall distribution of cortex percentages. This indicates that the assemblages were dominated by the later stages of core reduction rather than tool manufacture.

Table 76. Percentage of dorsal cortex on debitage by site, frequencies and column percentages

Percent of Dorsal Cortex	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
0	323 70.0	133 76.4	34 82.9	1,051 83.3	33 80.5	173 85.2	1,747 80.1
10	11 2.4	13 7.5	1 2.4	38 3.0	0 0.0	5 2.5	68 3.1
20	17 3.7	6 3.4	2 4.9	36 2.9	2 4.9	4 2.0	67 3.1
30	28 6.1	6 3.4	1 2.4	35 2.8	2 4.9	11 5.4	83 3.8
40	17 3.7	7 4.0	1 2.4	28 2.2	1 2.4	2 1.0	56 2.6
50	4 0.9	1 0.6	1 2.4	10 0.8	0 0.0	2 1.0	18 0.8
60	16 3.5	3 1.7	0 0.0	18 1.4	0 0.0	2 1.0	39 1.8
70	12 2.6	1 0.6	0 0.0	9 0.7	2 4.9	0 0.0	24 1.1
80	3 0.7	3 1.7	0 0.0	6 0.5	0 0.0	1 0.5	13 0.6
90	8 1.7	0 0.0	1 2.4	8 0.6	0 0.0	0 0.0	17 0.8
100	20 4.4	1 0.6	0 0.0	23 1.8	1 2.4	3 1.5	48 2.2
Totals/ Percent	459 21.1	174 8.0	41 1.9	1,262 57.9	41 1.9	203 9.3	2,180

Table 77. Percentage of dorsal cortex on flakes by site, column percentages only

Percent of Dorsal Cortex	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
0	70.6	74.6	82.8	84.5	85.7	83.6	80.7
10	2.3	7.1	3.4	2.8	0.0	3.1	3.0
20	4.0	4.8	3.4	2.8	5.7	1.9	3.2
30	6.1	3.2	0.0	2.5	2.9	5.0	3.5
40	2.9	4.8	3.4	1.9	2.9	1.3	2.3
50	0.9	0.0	3.4	0.4	0.0	1.3	0.6
60	4.0	2.4	0.0	1.4	0.0	1.3	1.9
70	2.0	0.8	0.0	0.8	2.9	0.0	1.0
80	0.6	1.6	0.0	0.3	0.0	0.6	0.5
90	2.0	0.0	3.4	0.8	0.0	0.0	1.0
100	4.6	0.8	0.0	1.7	0.0	1.9	2.2

Table 79 illustrates flake percentages from the primary and secondary stages of core reduction. While relatively little initial core reduction appears to have occurred at most of the sites, it seems to have been rather important at LA 2742. Only one primary flake was found at LA 71189, suggesting that initial core reduction may not have even occurred there. Primary core reduction seems to have occurred at the four remaining sites. However, it appears that many of the cores brought to those locations may have been partially reduced elsewhere. Conversely, cores may have been reduced further at sites other than LA 2742, producing more flakes per core, and thus, a smaller percentage of primary flakes.

With the exception of rare materials (less than 10 examples overall), exotic materials have the lowest percentages of primary core flakes, as would be expected (Table 80). The quartzite, limestone, and undifferentiated igneous categories all contain the highest percentages of primary flakes (over 15 percent each). Though there were high percentages of these three materials at LA 2742, they were also present in substantial amounts at other sites. While LA 2742 had the largest combined percentage of these materials (17.6), LA 71189 had only a slightly smaller combined percentage (16.3) as well as the lowest percentage of primary flakes. Thus, behavior rather than material selection was probably responsible for this variation.

To summarize, the presence of only small numbers of biface and tool flakes in these assemblages suggests that formal tool manufacture and refurbishing were of little relative importance in chipped stone reduction activities. Primary core reduction appears to have been important only at LA 2742. Secondary core reduction dominated the remaining assemblages, though some primary core reduction seems to have occurred at those locations as well, with the possible exception of LA 71189. While material selection may be weakly linked to these differences, behavioral variation is a more likely explanation. This will be considered in more detail with other data.

Flake Platforms

Platforms are remnants of the core or tool edge that were struck to remove flakes. Various types of platforms can be distinguished, providing information about the condition of the artifact from which a flake was removed and reduction technology. Cortical platforms are usually evidence of early-stage core reduction, particularly when dorsal cortex is also present. Single facet platforms can occur at any time during reduction but are most often associated with flakes removed from cores. Multifacet platforms are indications of multiple previous removals along an edge. They occur on both core and biface flakes and suggest that the parent artifact was subjected to a considerable amount of earlier reduction.

Platforms were often modified to expedite flake removal. Two types of modification were used: retouch and abrasion. While abrasion occurs on all types of platforms, retouch is considered a distinct platform type in this analysis. Thus, abrasion can occur on cortical, single facet, and multifacet platforms, but retouch can not. Both modifications result from rubbing an abrader across an edge. Movement perpendicular to the edge removes microflakes and retouches the platform. Movement parallel to the edge produces abrasion. These processes increase the platform angle, strengthening it and reducing the risk of shattering. Stronger platforms also allow longer flakes to be removed from a core or tool. While modified platforms are often an indication of tool production, they also occur on cores. Thus, by itself this attribute is not an accurate indication of tool manufacture.

In many instances, flake platforms could not be defined. The most common reason was breakage, when the proximal portion including the platform was absent. When possible, flakes broken by trampling or natural processes were distinguished from those broken during removal. Distal or medial fragments with snap fractures at their proximal ends could have fragmented during or after removal. Applying conservative standards, this pattern was considered evidence of postremoval breakage. When a step or hinge fracture occurred at the proximal end of distal or medial fragments, the flake was classified as broken during manufacture. When combined with other attributes, this distinction provides information about assemblage condition and is discussed in more detail later.

Table 78. Percentage of dorsal cortex by flake type for each site, column percentages only

Core Flakes							
Percent of Dorsal Cortex	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
0	70.4	74.2	82.8	83.9	85.3	82.8	80.2
10	2.3	6.7	3.4	2.9	0.0	3.3	3.1
20	4.1	5.0	3.4	2.9	5.9	2.0	3.3
30	6.1	3.3	0.0	2.6	2.9	5.3	3.6
40	2.9	5.0	3.4	2.0	2.9	1.3	2.4
50	0.9	0.0	3.4	0.4	0.0	1.3	0.6
60	4.1	2.5	0.0	1.4	0.0	1.3	2.0
70	2.0	0.8	0.0	0.9	2.9	0.0	1.1
80	0.6	1.7	0.0	0.3	0.0	0.7	0.5
90	2.0	0.0	3.4	0.9	0.0	0.0	1.0
100	4.6	0.8	0.0	1.7	0.0	2.0	2.3
Biface Flakes							
Percent of Dorsal Cortex	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
0	100.0	83.3	0.0	100.0	100.0	100.0	97.8
10	0.0	16.7	0.0	0.0	0.0	0.0	2.2
Tool Flakes							
Percent of Dorsal Cortex	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
0	0.0	0.0	0.0	100.0	0.0	100.0	100.0

Table 79. Core reduction stages for each site, frequencies and row percentages

Site No.	Core Reduction Stage		
	Primary	Secondary	Totals
LA 2742	49 14.2	296 85.8	345 21.6
LA 3570	7 5.8	113 94.2	120 7.5
LA 70576	2 6.9	27 93.1	29 1.8
LA 70577	52 5.7	866 94.3	918 57.5
LA 71189	1 2.9	33 97.1	34 2.1
LA 71190	8 5.3	143 94.7	151 9.5
Totals/ Percent	119 7.5	1,478 92.5	1,597

Two other processes can obscure platforms during reduction. An unmodified or poorly prepared platform will sometimes be crushed when force is applied. While the point of impact is still visible on a crushed platform, its original configuration is impossible to determine. Platforms can also collapse when force is applied. Collapsed platforms detach separately from flakes, leaving a scar on the dorsal or ventral surface. A small portion of the platform may be preserved on one or both sides of the scar. While those remnants are usually too small to allow definition of the original platform configuration, they show where impact occurred and indicate that, while the platform is missing, flake dimensions are complete. Platforms are also obscured by use or damage from natural processes; these were simply recorded as obscured.

Table 81 illustrates percentages of platform types by site. Cortical platforms were most common at LA 2742, and none were found at LA 70576. Small percentages occurred at the remaining sites, ranging from slightly less than 6 to nearly 7 percent. Only one cortical platform is abraded, suggesting that little platform modification occurred during initial core reduction. Overall, single facet platforms (including abraded) are the most common type, comprising 20 percent or more of each assemblage except for LA 71189. Overall, few single facet platforms are abraded, and none occurred at LA 2742 or LA 71189. Multifacet platforms (including abraded) comprise 17 to 18 percent of three assemblages (LA 3750, LA 70577, and LA 71190), over 22 percent of two (LA 2747 and LA 71189), and less than 11 percent of one (LA 70576). Abrasion occurs on more multifacet platforms overall, but no multifacet platforms were

Table 80. Core flake types for each material type, all sites combined; frequencies and row percentages

Material	Core Flake Type		
	Primary	Secondary	Totals
Unknown	0 0.0	1 100.0	1 0.1
Chert	59 7.8	695 92.2	754 47.2
Pedernal chert	2 1.5	133 98.5	135 8.5
Obsidian	1 1.6	62 98.4	63 3.9
Polvadera obsidian	6 4.1	141 95.9	147 9.2
Igneous undiff.	11 15.7	59 84.3	70 4.4
Basalt	19 6.2	286 93.8	305 19.1
Rhyolite	0 0.0	7 100.0	7 0.4
Limestone	11 20.0	44 80.0	55 3.4
Siltstone	0 0.0	4 100.0	4 0.3
Quartzite	10 25.0	30 75.0	40 2.5
Quartzitic sandstone	0 0.0	9 100.0	9 0.6
Massive quartz	0 0.0	7 100.0	7 0.4
Totals/ Percent	119 7.5	1,478 92.5	1,597

Table 81. Platform type by site, column percentages and row totals

Platform Type	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
Cortical	13.3	6.3	0.0	6.0	5.7	6.9	124 7.5
Cortical and abraded	0.0	0.0	0.0	0.1	0.0	0.0	1 0.1
Single facet	23.6	22.2	20.7	25.0	14.3	18.9	389 23.6
Single facet and abraded	0.0	1.6	3.4	2.1	0.0	1.9	26 1.6
Multifacet	25.9	12.7	10.3	13.0	20.0	12.6	260 15.8
Multifacet and abraded	0.0	5.6	0.0	4.8	2.9	2.5	60 3.6
Retouched	0.3	0.8	0.0	0.9	0.0	1.3	13 0.8
Retouched and abraded	0.3	0.8	0.0	1.7	5.7	1.9	23 1.4
Abraded	0.6	0.8	0.0	1.8	0.0	2.5	24 1.5
Collapsed	15.9	10.3	10.3	15.3	11.4	15.1	245 14.9
Crushed	0.9	4.0	6.9	2.4	2.9	0.6	35 2.1
Absent (snap)	7.2	14.3	17.2	6.7	17.1	10.1	134 8.1
Absent (broken in manufacture)	11.8	20.6	27.6	19.8	20.0	25.8	312 18.9
Obscured	0.3	0.0	3.4	0.1	0.0	0.0	3 0.2
Totals/ Percent	347 21.0	126 7.6	29 1.8	953 57.8	35 2.1	159 9.6	1,649

modified at either LA 2742 or LA 70576. Retouched platforms, both with and without abrasion, are the least common type. No retouched platforms were found at LA 70576; elsewhere they ranged from a low of 0.6 percent at LA 2742 to a high of 5.7 percent at LA 71189. Surprisingly, the highest percentages occurred at the farming sites. Simple abraded platforms are present in several assemblages; this category was used when grinding was visible, but other platform attributes could not be defined.

Platforms are missing or obscured on large numbers of flakes, ranging from 36.1 percent at LA 2742 to 65.4 percent at LA 70576. When obscured platforms are discounted, platforms are missing on 35 to 37 percent of the flakes from LA 3570, LA 71189, and LA 71190. Lower percentages of missing platforms were noted at LA 2742 (19 percent) and LA 70577 (26.5 percent), and higher percentages at LA 70576 (44.8 percent). While flake breakage can be more frequent during tool manufacture than core reduction because of relative flake thickness (Sullivan and Rozen 1985), this attribute alone is not an accurate indicator of tool manufacture. However, we can tentatively suggest that core reduction was most frequent at LA 2742 and LA 70577, and tool production was most common at LA 70576.

Most platforms in the assemblage are unmodified. When missing and obscured platforms are removed from the assemblage, 84 percent of the platforms are unmodified, and only 16 percent were abraded or retouched to facilitate removal. Table 82 shows frequencies and percentages of modified and unmodified platforms for each site. The lowest percentages of modified platforms were at LA 2742 and LA 70576. This may be due to sample error at LA 70576 because of the small number of platforms recorded, but such is not the case at LA 2742. With LA 70576 removed from consideration, LA 2742 contained the smallest percentage of modified platforms, suggesting that little tool manufacture occurred there compared to the other sites.

Table 82. Modified and unmodified platforms by site, frequencies and column percentages

Platform Type	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
Unmodified	218 98.2	52 81.3	9 90.0	419 79.1	14 82.4	61 79.2	773 84.0
Modified	4 1.8	12 18.8	1 10.0	111 20.9	3 17.6	16 20.8	147 16.0
Totals	222	64	10	530	17	77	920

Reduction Stages

A few attributes were used to provide preliminary indications of reduction stages. Dorsal cortex percentages suggested that early-stage core reduction was more common at LA 2742 than at the other sites. The LA 2742 assemblage also contains the fewest modified and missing platforms. These characteristics support the conclusion that early-stage core reduction was more prevalent there than at the other sites. High percentages of modified platforms suggest that tool manufacture was most important at LA 70577 and LA 71190.

Debitage ratios and flake breakage patterns can also be used as reduction stage indicators. Low flake to angular debris ratios suggest core reduction while the opposite suggests tool manufacture. Flake removal during tool production is usually accomplished by soft hammer percussion or pressure flaking. These techniques are more controlled than hard hammer percussion and produce less angular debris. Hard hammer percussion is usually used in core reduction and results in comparatively large amounts of angular debris. Though reduction techniques are more controlled during tool manufacture, flake breakage increases because debitage gets thinner as the reduction sequence proceeds. Much of this breakage is by secondary compression, in which outward bending during removal causes flakes to snap (Sollberger 1986). Certain characteristics of the distal ends of proximal fragments and the proximal ends of distal fragments can be used to determine whether breakage occurred during or after flake removal. These traits have already been discussed for distal fragments. Characteristics diagnostic of manufacturing breakage on proximal fragments include "pieces à languette" (Sollberger 1986:102), negative hinge scars, positive hinges curving up into small negative step fractures on the ventral surface, and step fractures on the dorsal rather than ventral surface (Fig. 88).

Table 83 shows chipped stone assemblage characteristics for each site. LA 70576 has the lowest flake to angular debris ratio, while LA 71189 has the highest. However, in no case is the flake to angular debris ratio high enough to suggest tool manufacture. Analysis of chipped stone assemblages from sites near San Ildefonso where tool manufacture was an important activity produced flake to angular debris ratios of 7:1 or more (Moore n.d.b). This is much higher than the flake to angular debris ratio for these sites (with the possible exception of LA 71189) and supports the conclusion that tool manufacture was not an important activity. Core reduction appears to dominate these assemblages.

Except for LA 2742, at least 46 percent of each flake assemblage is broken. If breakage occurred during manufacture, this would suggest that early-stage core reduction dominated at LA 2742, while later stage core reduction and perhaps tool manufacture prevailed at the other sites. However, if breakage occurred after removal, this pattern is essentially meaningless. An examination of flake breakage patterns can help clarify this problem.

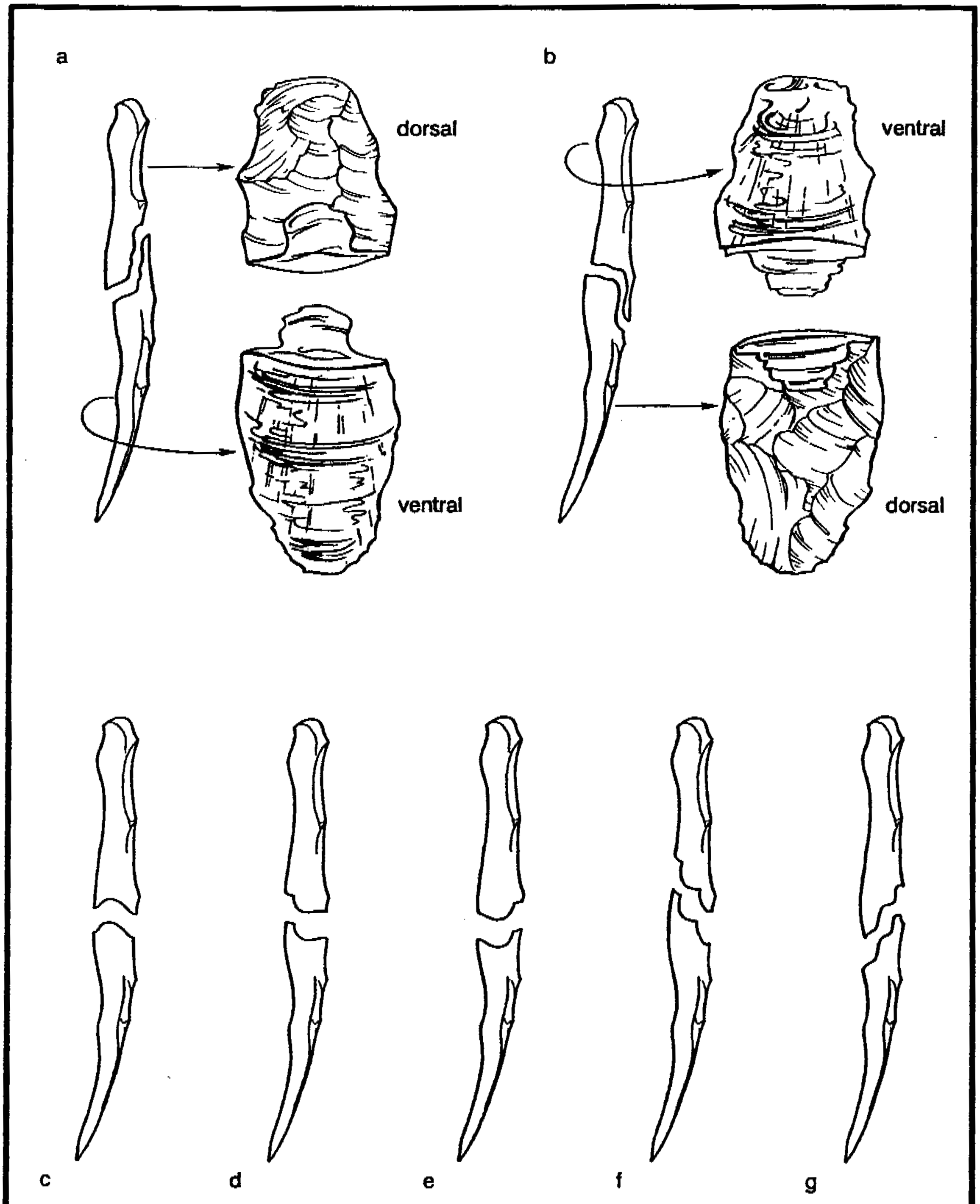


Figure 88. Manufacturing breakage patterns on flakes: (a-b) **pieces à languette,** *adapted from Sollberger (1986:102); (c) negative proximal hinge, positive distal hinge; (d) positive proximal hinge with small step off ventral surface, negative distal hinge; (e) positive proximal hinge, negative distal hinge; (f) proximal step, distal step off distal surface; (g) reverse proximal step, distal step off ventral surface. Note that proximal fragments of (e) and (f) resemble natural core terminations and would usually be defined as such.*

Table 83. Chipped stone assemblage characteristics for each site

Assemblage Characteristics	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190
Flake:angular debris ratio	3.10	2.63	2.42	3.12	5.83	3.70
Percentage broken flakes	28.0	46.8	62.1	49.0	62.9	47.2
No. proximal fragments	28	14	3	116	8	16
No. distal fragments	65	34	10	191	9	48

Table 84. Breakage patterns on proximal and distal flake fragments for each site, percentages for each site

Flake Portions	Breakage Pattern	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190
Proximal	snapped	25.0	57.1	66.7	54.9	87.5	75.0
	broken in manufacture	75.0	42.9	33.3	45.1	12.5	25.0
Distal	snapped	38.5	41.2	30.0	24.3	44.4	26.1
	broken in manufacture	61.5	58.8	70.0	75.7	55.6	73.9

Table 85. Flake types by site, frequencies and column percentages

Flake Type	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
Core flakes	345 99.4	120 95.2	29 100.0	918 96.1	34 97.1	151 95.0	1597 96.7
Biface flakes	2 0.6	6 4.8	0 0.0	30 3.1	1 2.9	7 4.4	46 2.8
Tool flakes	0 0.0	0 0.0	0 0.0	7 0.7	0 0.0	1 0.6	8 0.5
Totals/ Percent	347 21.0	126 7.6	29 1.8	955 57.8	35 2.1	159 9.6	1,651

In an assemblage, equivalent numbers of distal and proximal fragments suggests postreduction breakage by trampling or other natural processes. If distal fragments significantly outnumber proximal fragments, however, much of the breakage probably occurred during reduction. This situation arises because our analytic scheme identifies whole flakes as artifacts having striking platforms and natural terminations. While some breaks attributable to secondary compression can be identified on proximal fragments, other types are indistinguishable from natural terminations on whole flakes (Fig. 88). Thus, many artifacts classified as whole flakes with hinge or step terminations may actually have been the proximal ends of broken flakes. The number of proximal and distal flake fragments from each site are shown in Table 83. With the exception of LA 71189, distal fragments far outnumber proximal fragments. While there is a 2:1 or 3:1 ratio of distal to proximal fragments in most of the other assemblages, that ratio is about 1.7:1 for LA 70577. None of these ratios is particularly high, and they suggest that both manufacturing and postreduction breakage occurred.

Proximal and distal fragment breaks are shown in Table 84, which does not include fragments with breaks obscured by natural or cultural processes. Large percentages of manufacturing breaks occur on both types of fragment at LA 2742, suggesting that most breakage occurred during flake removal at that site. Still, many proximal and distal portions exhibit snap fractures, indicating that natural postremoval processes could have caused much of the breakage. Manufacturing and postremoval impact each seem to have been responsible for about half of the breaks at LA 3570. The rather high percentage of snap fractures is no surprise because this site was largely surficial. Two-thirds of the proximal fragments at LA 70576 were snapped, while 70 percent of the distal fragments were broken during manufacture. This pattern is probably the result of sample error, however, becasue only three proximal fragments were recovered.

Slightly less than half of the proximal fragments and three-quarters of the distal fragments at LA 70577 were broken during manufacture. This is an interesting pattern that is difficult to interpret. While the proximal fragments suggest that manufacturing and postremoval impact were responsible for roughly equal amounts of breakage, the distal fragments suggest that most breaks occurred during removal. When these portions are combined, 35 percent have snap fractures, and 65 percent broke during manufacture. Thus, as at LA 2742, it is likely that most breakage occurred during reduction, but much of the assemblage was also broken after removal. A similar pattern is visible at LA 71189 and LA 71190. Proximal fragments were predominantly broken after removal at these sites. The percentage of distal fragments broken during manufacture is slightly higher than those broken after removal at LA 71189 and much higher at LA 71190. When these portions are combined, 65 percent display snap breaks at LA 71189, suggesting that postremoval impact was responsible for most breakage. The pattern at LA 71190 is the reverse, with 61 percent of the fragments having broken during manufacture.

This analysis suggests that the proportion of whole to broken flakes in an assemblage may not provide an accurate assessment of reduction stage. Both manufacturing and postremoval impact were responsible for breakage at each site. While manufacturing breakage dominated at several sites, postremoval impact could have been responsible for 30 percent or more of the breaks. Thus, while this type of analysis can provide an indication of assemblage integrity, its applicability to reduction stage is questionable. It also sheds doubt on Sullivan and Rozen's (1985) nontypological debitage analysis, which assumes that most flake breakage occurred during manufacture.

Flakes removed during tool manufacture were categorized separately from those struck from cores using the polythetic set discussed in the Introduction. The polythetic set is an idealized model of flakes removed during tool production. Unfortunately, it is often impossible to distinguish flakes struck early in tool manufacture from those removed late in the secondary stage of core reduction. Thus, some flakes removed early in the tool manufacturing process may be included in the core flake category. In addition, it is impossible to reliably assign many flake fragments to a specific stage when few of the necessary attributes are present on the remaining portion. Therefore, flake fragments that cannot be assigned to tool manufacture are classified as core flakes by default. While not every flake removed during tool production can be identified by the polythetic set, those that are can be considered definite evidence of tool manufacture, providing a relative measure of core versus tool reduction at a site.

Three types of flakes were identified. *Core flakes* fulfill less than 70 percent of the conditions in the polythetic set, and include fragments that are too small for accurate assignment to a specific type. *Biface flakes* (manufacturing flakes) fulfill 70 percent or more of the conditions in the polythetic set and were presumably removed during tool manufacture. *Tool flakes* are specimens removed from the edges of utilized tools. Included in this category are resharpening and hammerstone flakes. The former are evidence of tool refurbishing, while the latter represent inadvertent spalling during use.

Table 85 illustrates flake types for each site and shows that core flakes dominate each assemblage. While biface flakes occurred at all sites except LA 70576, they comprise only minor parts of each assemblage. Tool flakes were found at only two sites, comprising less than one percent of those assemblages. Further, nearly all of the tool flakes recovered at LA 70577 are from a single artifact. Even considering the possibility of assignment errors, these percentages suggest that formal tool production and refurbishing was of limited importance at these sites.

Core reduction dominated the reduction sequence at these sites, though limited tool manufacture is evidenced at all but LA 70576. At the beginning of this section it was noted that dorsal cortex and platform data suggest that core reduction was more prevalent at LA 2742 than at any other site. This conclusion must be now be amended, because only limited tool manufacture occurred at any of the sites. Thus, while core reduction dominated in each assemblage, it appears that more early-stage core reduction occurred at LA 2742 than elsewhere. Core type and core flake modification data might shed more light on this question.

Table 86 illustrates core types for each site. Cores were categorized by the direction of removals and number of platforms. Flakes were removed from one surface on unidirectional cores and from two surfaces on bidirectional cores; both categories had only one striking platform. Multidirectional cores had flakes removed from more than one surface and exhibited multiple platforms. Most cores are multidirectional, suggesting that they were reduced as far as possible before being discarded. Thus, unidirectional and bidirectional cores should be larger than multidirectional cores.

Table 86. Core type by site, frequencies and column percentages

Core Type	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Total
Unidirectional	1 5.9	1 14.3	0 0.0	5 20.8	0 0.0	0 0.0	7 13.2
Bidirectional	1 5.9	0 0.0	0 0.0	2 8.3	0 0.0	0 0.0	3 5.7
Multidirectional	15 88.2	6 85.7	0 0.0	17 70.8	2 100.0	3 100.0	43 81.1
Totals	17	7	0	24	2	3	53

Table 87 was constructed using core length as a measure of size. In general, multidirectional cores are slightly smaller than the other types, averaging 53.9 mm long, while unidirectional cores have a mean length of 54.6 mm, and bidirectional cores average 66.0 mm. However, this variation is probably not significant because the two latter categories constitute less than 20 percent of the core assemblage. Over 75 percent of the cores are local chert, and 90 percent of the chert cores are multidirectional (Table 88). Other materials are represented by only 1 to 3 examples each.

As noted above, the differences in average core length are probably not significant. Since core length may not be a good measure of the number of platforms and surfaces from which flakes were struck, other possibilities must be explored. Table 89 illustrates the distribution of core lengths for each material type. With two exceptions (quartzite and undifferentiated igneous), all nonchert cores are between 51 and 100 mm long. Chert cores (both local and Pedernal varieties) are rather evenly split between lengths of 1 to 50 mm and 51 to 100 mm (55 percent and 45 percent, respectively). This suggests that core size may have been related to material type. Among the materials represented in the core assemblage, cherts are the most amenable to reduction and possess the sharpest edges. Thus, the fact that chert cores dominate this assemblage and were reduced to a smaller size than other materials is not surprising.

Table 87. Core length by type, frequencies and row percentages

Core Length	Core Type			
	Unidirectional	Bidirectional	Multidirectional	Totals
1-50 mm	4 57.1	1 33.3	20 46.5	25 47.2
51-100 mm	2 28.6	2 66.7	22 51.2	26 49.1
101-150 mm	1 14.3	0 0.0	1 2.3	2 3.8
Totals/ Percentages	7 13.2	3 5.7	43 81.1	53

Table 88. Core variety by material type, frequencies and row percentages

Material Type	Core Variety			
	Unidirectional	Bidirectional	Multidirectional	Totals
Chert	2 5.0	2 5.0	36 90.0	40 75.5
Pedernal chert	1 50.0	0 0.0	1 50.0	2 3.8
Igneous undiff.	1 33.3	0 0.0	2 66.7	3 5.7
Basalt	1 33.3	1 33.3	1 33.3	3 5.7
Limestone	1 33.3	0 0.0	2 66.7	3 5.7
Siltstone	0 0.0	0 0.0	1 100.0	1 1.9
Quartzite	1 100.0	0 0.0	0 0.0	1 1.9
Totals Percent	7 13.2	3 5.7	43 81.1	53

Table 89. Core length by material type, frequencies and row percentages

Material Type	Core Length			
	1-50 mm	51-100 mm	101-150 mm	Totals
Chert	21 52.5	19 47.5	0 0.0	40 75.5
Pedernal chert	2 100.0	0 0.0	0 0.0	2 3.8
Igneous undiff.	1 33.3	2 66.7	0 0.0	3 5.7
Basalt	0 0.0	2 66.7	1 33.3	3 5.7
Limestone	0 0.0	2 66.7	1 33.3	3 5.7
Siltstone	0 0.0	1 100.0	0 0.0	1 1.9
Quartzite	1 100.0	0 0.0	0 0.0	1 1.9
Totals/ Percent	25 47.2	26 49.1	2 3.8	53

Table 90. Core information for sites with four or more cores, frequencies and column percentages

Core Lengths	LA 2742		LA 3570		LA 70577	
	All cores	Chert cores	All cores	Chert cores	All cores	Chert cores
1-50 mm	7 41.2	7 50.0	4 57.1	4 57.1	10 41.7	8 47.1
51-100 mm	9 52.9	7 50.0	3 42.9	3 42.9	13 54.2	9 52.9
101-150 mm	1 5.9	0 0.0	0 0.0	0 0.0	1 4.2	0 0.0
Totals	17	14	7	7	24	17

Cores, particularly those made from chert, should be larger at LA 2742 if early-stage reduction was more prevalent there than elsewhere. Table 90 shows data for assemblages containing four or more cores. Overall, cores from LA 2742 are a bit larger than those from LA 3570, but the size distribution is almost identical to that of LA 70577. This relationship also pertains to chert cores. Core length averages 56.8 mm at LA 2742, 47.4 mm at LA 3570, and 57.8 mm at LA 70577. Thus, core length data do not support the conclusion that early-stage reduction was more prevalent at LA 2742 than elsewhere.

Though platform modification is more likely to occur during tool manufacture, core platforms can also be modified to increase control over flake length and shape and to prevent platform shattering. This is more likely to occur during the later stages of core reduction, when continued flake removal has created steeply angled platforms that may shatter when struck. Table 91 shows modified and unmodified core flake frequencies and percentages for each site. With the exception of LA 2742, 10 percent or more of core flake platforms were modified at each site. The highest percentages occurred at LA 70577 and LA 71190, while the lowest were at LA 70576 and LA 71189. Even allowing for some early-stage manufacturing flakes being assigned to the core flake category, significantly fewer core platforms were modified at LA 2742. These data support the contention that more early-stage core reduction occurred at LA 2742 than at the other sites. This suggests that core length was not an appropriate measure of reduction stage.

Table 91. Modified and unmodified core flake platforms by site, frequencies and column percentages

Platform Type	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190	Totals
Unmodified	218 99.1	52 85.2	9 90.0	415 81.4	14 87.5	59 81.9	767 86.3
Modified	2 0.9	9 14.8	1 10.0	95 18.6	2 12.5	13 18.1	122 13.7
Totals	220	61	10	510	16	72	889

Tool Use

Formal and informal tools were recovered from five of six sites; only LA 71189 lacked tools. Formal tools are debitage whose shape was significantly altered to produce a certain shape or edge angle. Flaking patterns are unifacial or bifacial, and artifacts are classified as early-, middle-, and late-stage tools based on the extent of flaking and edge condition. Early-stage tools have an irregular outline and widely and variably spaced scars that often do not extend completely across surfaces. Middle-stage tools have a semiregular outline and closely or semiregularly spaced scars that sometimes extend completely across surfaces. Late-stage tools have a regular outline and closely or regularly spaced scars that usually extend completely across surfaces. While these categories may reflect manufacturing stages, this is not always true. For example, flaking is often confined to margins on late prehistoric projectile points, suggesting the early or middle stages of the manufacturing process, even though the points are finished tools. Thus, tools cannot be judged as finished or unfinished on the basis of morphology alone.

Informal tools are pieces of debitage that were used without modification, or with modification limited to marginal retouch. Very conservative standards were applied when defining edge damage as evidence of use. This was necessary because trampling and erosional movement can cause damage that might be mistaken for cultural use. Only when scar patterns were consistent along an edge and the edge margin was regular (no extreme scoops or projections) were artifacts categorized as informal tools.

Informal Tools

Informal tools are listed by general wear patterns for each site in Table 92. The largest numbers of informal tools were found at LA 2742 and LA 70577, which was not unexpected because those sites contained the largest chipped stone assemblages. Only 9 pieces of angular debris were used as informal tools, compared to 80 core flakes and no biface flakes. The only tool flakes exhibiting wear are 5 resharpening flakes from LA 70577 and a hammerstone flake from LA 71190. These artifacts are evidence of formal rather than informal tool use. Discounting them, 8.2 flakes were used for every piece of angular debris. This ratio is considerably higher than the overall flake to angular debris ratio of 3.14, suggesting that flakes were intentionally selected over angular debris for use as informal tools.

Five basic wear patterns were found: utilization, retouch, battering, rotary, and rounding. Utilized edges exhibit unidirectional or bidirectional attrition scars that are less than 2 mm long. Retouched edges exhibit unidirectional or bidirectional scars more than 2 mm long. Rotary wear occurs on projections and combines edge attrition and rounding on opposing edges. Battered edges are crushed and abraded from contact with hard materials. Rounding is an extreme form of abrasion that is sometimes accompanied by polish.

Unidirectional utilization is the most common wear pattern, occurring on 32 artifacts. Only 9 artifacts were bidirectionally utilized. Marginal retouch is less common: 6 artifacts were unidirectionally retouched, and 7 were bidirectionally retouched. Rounding occurs alone on 4 artifacts and in combination with unidirectional utilization on 12, bidirectional utilization on 4, and unidirectional retouch on 3. Four tools were unidirectionally retouched and utilized, 4 were battered, 1 was bidirectionally retouched and battered, and 1 was bidirectionally retouched and utilized. Rotary wear occurs on only one piece of debitage.

Table 92. Informal tools by general wear patterns for all sites, frequencies and row percentages

Debitage Type	Wear Pattern	LA 2742	LA 3570	LA 70576	LA 70577	LA 71190	Total
Angular debris	utilized	1 33.3	0 0.0	0 0.0	2 66.7	0 0.0	3
	retouched	2 66.7	0 0.0	0 0.0	1 33.3	0 0.0	3
	rounded	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	3
Tool flakes	battering	0 0.0	0 0.0	0 0.0	2 66.7	1 33.3	3
	rounded	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	3
Core flakes	battering	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2
	utilized	11 29.0	1 2.6	0 0.0	25 65.8	1 2.6	38
	retouched	6 35.3	0 0.0	0 0.0	11 64.7	0 0.0	17
	rotary	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1
	rounded	6 37.3	0 0.0	1 5.9	10 58.9	0 0.0	17

As noted in the discussion of material type and quality, glassy and fine materials are best suited for cutting tasks, and coarser materials are better for heavy-duty chopping or pounding. Table 93 shows material type by artifact morphology for all informal tools. Most were made from materials that produce sharp edges when fractured, such as cherts and obsidians. Only two were made from medium-grained materials. This suggests that most informal tools were used for cutting or scraping.

The distribution of wear patterns by artifact morphology is shown in Table 94. Though considerably more flakes than angular debris were used as informal tools, there does not seem to be any great difference in the types of wear that occur on them. Thus, flakes and angular debris seem to have been suited to the same range of tasks. Only two types of wear occur on resharpening flakes: battering and rounding. These artifacts

Table 93. Material type by artifact morphology for informal tools, frequencies and row percentages

Site No.	Artifact Type	Material Type							
		Chert	Pedernal Chert	Obsidian	Polvadera Obsidian	Basalt	Limestone	Quartzitic Sandstone	Rhyolite
LA 2742	angular debris	1 33.3	2 66.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
	core flake	13 52.0	5 20.0	0 0.0	0 0.0	4 16.0	3 12.0	0 0.0	0 0.0
LA 3570	core flake	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
LA 70576	core flake	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0
LA 70577	angular debris	2 33.3	3 50.0	0 0.0	1 16.7	0 0.0	0 0.0	0 0.0	0 0.0
	core flake	17 36.2	17 36.2	2 4.3	6 12.8	4 8.5	0 0.0	1 2.1	0 0.0
	resharpening flake	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0	0 0.0	0 0.0	0 0.0
LA 71190	core flake	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0

Table 94. Wear patterns on informal tools by artifact morphology, frequencies and row percentages

Wear Pattern	Informal Tool Types			
	Angular debris	Core flake	Resharpening flake	Totals
Unidirectional utilization	3 9.1	29 90.6	0 0.0	32 36.0
Bidirectional utilization	0 0.0	9 100.0	0 0.0	9 10.1
Unidirectional retouch	0 0.0	7 100.0	0 0.0	7 7.9
Bidirectional retouch	1 14.3	6 75.0	0 0.0	7 7.9
Rounding	0 0.0	1 25.0	3 75.0	4 4.5
Unidirectional utilization and rounding	1 8.3	11 91.7	0 0.0	12 13.5
Bidirectional utilization and rounding	1 25.0	3 75.0	0 0.0	4 4.5
Unidirectional retouch and rounding	1 33.3	2 66.7	0 0.0	3 3.4
Rotary	0 0.0	1 100.0	0 0.0	1 0.0
Battering	0 0.0	2 50.0	2 50.0	4 5.6
Unidirectional retouch and utilization	2 50.0	2 50.0	0 0.0	4 4.5
Bidirectional retouch and battering	0 0.0	1 100.0	0 0.0	1 1.1
Bidirectional retouch and utilization	0 0.0	1 100.0	0 0.0	1 1.1
Totals/ Percent	9 10.1	75 83.2	5 5.6	89

Table 95. Wear patterns grouped by edge angles, frequencies and row percentages

Wear Pattern	Edge Angle		
	1-40 degrees	41-100 degrees	Totals
Unidirectional utilization	12 36.4	21 63.6	33 39.3
Bidirectional utilization	5 55.6	4 44.4	9 10.7
Unidirectional retouch	1 14.3	6 85.7	7 8.3
Bidirectional retouch	1 16.7	5 83.3	6 7.1
Rounding	0 0.0	1 100.0	1 1.2
Unidirectional utilization and rounding	2 16.7	10 83.3	12 14.3
Bidirectional utilization and rounding	1 25.0	3 75.0	4 4.8
Unidirectional retouch and rounding	0 0.0	3 100.0	3 3.6
Battering	0 0.0	2 100.0	2 2.4
Rotary	0 0.0	1 100.0	1 1.2
Unidirectional retouch and utilization	0 0.0	4 100.0	4 4.8
Bidirectional retouch and battering	0 0.0	1 100.0	1 1.2
Bidirectional retouch and utilization	1 100.0	0 0.0	1 1.2
Totals	23 27.7	61 72.3	84

comprise 75 percent of the rounded and 50 percent of the battered edges, figures that are high enough to suggest that most activities producing these wear patterns used formal tools. No biface flakes were utilized or retouched, suggesting that bifaces were not used as cores to provide flakes for use as informal tools.

The types of scars occurring along a utilized edge can vary with the way a tool was used and the material it was used on. Experiments by Vaughan (1985:20) showed that use in a longitudinal direction (cutting) caused mostly bidirectional edge scarring (65 percent), though a significant number of specimens were scarred on only one surface (17 percent). Transverse use (scraping or whittling) produced bidirectional scarring in 46 percent of his experiments, and unidirectional scarring in 54 percent. Thus, it is difficult to assign a specific function to any of these patterns. Similarly, rounding occurred when flakes were used in both longitudinal and transverse directions (Vaughan 1985:26). While retouch may represent an attempt to resharpen an edge dulled by use, this is unlikely in most cases. It is likely that most informal tools were discarded when they became dull, and a new flake was selected as a replacement. Striking a new flake from a core requires less effort than retouching a dulled edge. Most of what were identified as marginal retouch scars are probably long scars resulting from use.

Material hardness, both that of the object being processed and the tool, can also be important factors in scarring. Vaughan's (1985:22) experiments showed that consistent scarring along the utilized portion of an edge was almost always the result of contact with a hard material. However, nearly half of the edges used on hard materials and 80 percent of those used on medium-hard materials (such as fresh or soaked wood or soaked antler) were not consistently scarred. These conclusions are similar to those reached by Schutt (1980). In her experiments, consistent edge scarring also occurred only when hard materials were contacted. Scarring will also vary with the type of material being used as a tool. Fragile materials like obsidian scar more easily than tough materials like chert and basalt. Further, scars are easier to define on glassy and fine-grained materials than on medium- or coarse-grained materials.

Though numerous wear patterns were identified, it is difficult to assign most to specific functions. The only exception to this is rotary wear, which is evidence that the tool was used for drilling. The presence of obvious signs of wear suggests that the other tools were used to cut and scrape hard or medium-hard materials such as wood, bone, or antler. As the suitability of edges for certain tasks is partly determined by their sharpness, wear patterns are grouped by edge angles in Table 95. Most edges used in Schutt's (1980) experiments that measured over 40 degrees were found to be poorly suited for cutting. Thus, we assume that edge angles smaller than 40 degrees were best for longitudinal use (cutting), while those larger than 40 degrees were better for transverse use (scraping). Most informal tools have edge angles greater than 40 degrees. Only a quarter of the assemblage has edges measuring less than 40 degrees. Some wear patterns occurred only on the steeper edges, including rounding, unidirectional retouch and rounding, unidirectional retouch and utilization, battering, bidirectional retouch and utilization, and bidirectional retouch and battering. The last three categories suggest use against hard materials, perhaps a stone anvil.

Using the experimental criteria cited above, it is likely that most of the informal tools were used to scrape or cut relatively hard materials. Unfortunately, since processing of soft materials rarely creates visible scarring and even use on medium hard and hard materials will not always result in consistent scarring, it is likely that only a small portion of the informal tool assemblage was identified by this analysis. Thus, while we can conclude that informal tool use occurred at most of our sites, it is impossible to determine how many pieces of debitage were actually used as tools.

The highest percentages of informal tools per debitage assemblage were at LA 2742 (6.1 percent) and LA 70577 (4.1 percent), both residential sites. While a pithouse was once present at LA 3570, the remaining artifact scatter contained only one informal tool (0.6 percent of the debitage assemblage), suggesting that the collected portion of this site represents reduction debris rather than a processing area. While only one informal tool was found at LA 70576, it comprised 2.4 percent of the assemblage. No informal tools were identified at LA 71189, and only two (1.0 percent) were found at LA 71190.

Formal Tools

Formal tools were rare, as shown by Table 96. Overall, they comprise only 2.4 percent of the total assemblage, ranging from none at LA 71189 to 4.7 percent at LA 70576. Bifaces are the most common category, comprising 87.3 percent of the tool assemblage. Cobble tools and unifaces are rare. The former occurred at only two sites, while the latter were found at three.

Table 97 shows tool morphology at each site. One cobble tool is bidirectionally flaked, and the other is unidirectionally flaked, forming sharp edges on both. Two unifaces could not be assigned to a morphological stage. Of the three remaining unifaces, two are early-stage, and one is late-stage. The bifaces are rather evenly split between the three morphological stages. The largest number, 18 (38.3 percent), are late-stage, while 16 (34.0 percent) are early-stage, and 13 (27.7 percent) are middle-stage. Most of the bifaces are from two sites: LA 2742 (7) and LA 70577 (29). In both cases, early- and middle-stage bifaces outnumber late-stage bifaces by wide margins, suggesting that manufacture occurred at both sites. Late-stage bifaces were in the majority at LA 3570, which suggests that they were used rather than manufactured in the investigated part of that site. Though middle-stage bifaces dominated at LA 71190, the lack of early-stage bifaces suggests that, like LA 3570, they were used rather than manufactured there.

Information on tool breakage patterns was collected during analysis. Nine formal tools were recovered from LA 2742: seven bifaces, one uniface, and one cobble tool.

Table 96. Site assemblage summaries, frequencies and row percentages

Site	Debitage	Cores	Cobble Tools	Unifaces	Bifaces	Total Tools
LA 2742	459 94.6	17 3.5	1 0.2	1 0.2	7 1.4	9 1.9
LA 3570	174 93.5	7 3.8	0 0.0	0 0.0	5 2.7	5 2.7
LA 70576	41 95.3	0 0.0	0 0.0	1 2.3	1 2.3	2 4.7
LA 70577	1,262 95.6	24 1.8	1 0.1	3 0.2	30 2.3	34 2.6
LA 71189	41 95.3	2 4.7	0 0.0	0 0.0	0 0.0	0 0.0
LA 71190	203 96.2	3 1.4	0 0.0	0 0.0	5 2.4	5 2.4
Totals/ Percent	2,180 95.3	53 2.3	2 0.1	5 0.2	48 2.1	55 2.4

Table 97. General tool morphology by site, frequencies and column percentages

Artifact Morphology	LA 2742	LA 3570	LA 70576	LA 70577	LA 71190	Total
Cobble tool	1 11.1	0 0.0	0 0.0	1 2.9	0 0.0	2 3.6
Uniface, undiff.	0 0.0	0 0.0	0 0.0	2 5.9	0 0.0	2 3.6
Uniface-early stage	1 11.1	0 0.0	1 50.0	0 0.0	0 0.0	2 3.6
Uniface-late stage	0 0.0	0 0.0	0 0.0	1 2.9	0 0.0	1 1.8
Biface-early stage	4 44.4	1 20.0	0 0.0	11 32.4	0 0.0	16 29.1
Biface-middle stage	2 22.2	1 20.0	0 0.0	6 17.6	4 80.0	13 23.6
Biface-late stage	1 11.1	3 60.0	1 50.0	12 35.3	1 20.0	18 32.7
Totals/ Percent	9 16.4	5 9.1	2 3.6	33 61.8	5 9.1	54

The cobble tool and two bifaces were whole; all other specimens were broken. One of the complete tools was a biface abandoned during early production because it was too thick. Three biface fragments exhibited lateral snaps, evidence of manufacturing breakage (Johnson 1979). One was a Pueblo side-notched projectile point that snapped during notching, the others were early- and middle-stage bifaces. A uniface also appeared to have fractured during manufacture. The two remaining bifaces, a drill and a Basketmaker II projectile point, exhibit snap fractures, which can occur during manufacture or use, or from postmanufacture impact.

Five bifaces were found at LA 3570, of which only one (middle-stage) was complete. Three late-stage biface fragments exhibited lateral snaps, while the break on the fourth (middle-stage) was of an indeterminate nature. Only two formal tools were recovered at LA 70576, an early-stage scraper and a late-stage T-shaped drill; both were whole. No formal tools were found at LA 71189, and only five were found at LA 71190--all fragmentary. They include four middle-stage bifaces, two with lateral snaps, one with a perverse fracture, and one with a reverse fracture. Like lateral snaps, perverse and reverse fractures are indicative of manufacturing breakage (Johnson 1979). The fifth tool is a large side-notched projectile point (late-stage) with the tip snapped off.

The largest number of formal tools were found at LA 70577. Thirteen of 34 specimens are whole, including four Pueblo side-notched points (three middle, one late-stage), a three-notched Pueblo point (late-stage), six bifaces (four early-, one middle-, one late-stage), a chopper, and a scraper. At least two complete early-stage bifaces seem to have been abandoned during manufacture because of flaws or mistakes. One was discarded because an edge was gouged during flaking and the second is complete but fractured at a flaw. Four projectile points (1 early-, three late-stage) exhibit snap fractures, as did six biface fragments (three early-, three late-stage). This is also the case with a scraper (early-stage), a T-shaped drill (late-stage), and a chopper fragment. A Pueblo side-notched point (late-stage) has a possible impact fracture at its tip, and a Basketmaker II point (late-stage) was impact fractured at its tip and has a haft snap at its base. Both of these types of break are indicative of fracture during use. The remaining tools were broken during manufacture. Three bifaces (two middle-, one late-stage) have lateral snaps, and a biface (early-stage) and a drill (early-stage) were heat fractured. The last tool is a Basketmaker II point reworked into a hafted scraper. Though complete as a scraper, it was made from a broken point scavenged from an earlier site.

Earlier we suggested that bifaces were manufactured at LA 2742 and LA 70577, while they were only used and discarded at LA 3570 and LA 71190. Breakage pattern data do not support all these preliminary conclusions. Tool manufacture occurred at LA 2742 and LA 70577 because tools broken during manufacture were recovered from both sites. Some 66.7 percent of the broken tools at LA 2742 and 29.4 percent at LA 70577 fall into this category. In addition, one whole biface from LA 2742 and two from LA 70577 were abandoned during manufacture because of mistakes or material failure. However, most tool breakage at LA 70577 occurred after manufacture. At least two tools, a Pueblo side-notched point and a Basketmaker II point, were broken during use. Ten other fragmentary tools exhibit snap fractures that probably occurred during use or after loss or discard. Thus, while the presence of early- and middle-stage tools suggests that manufacturing occurred at both locales, use of that single attribute provides an incomplete picture. This becomes even more evident when the other sites are reexamined.

Where artifact morphology suggested that tool use rather than manufacture occurred at LA 3570 and LA 71190, analysis of breakage patterns suggests the opposite. Three of four biface fragments at LA 3570 and four of five at LA 71190 were broken during manufacture. Only one whole biface was found at LA 3570, and none was recovered from LA 71190. Thus, most bifaces from these sites were broken and discarded during manufacture, indicating that tool production occurred at these locales. In contrast, only two tools were recovered from LA 70576, and both were complete, suggesting that this site was a tool use rather than tool manufacturing locale.

Tool functions are tabulated by morphology in Table 98. Not surprisingly, cobble tools seem to have been used as choppers. Most unifaces were used as scrapers, though one was used as a chopper, and the function of another could not be determined. Bifaces were used as drills (4), projectile points (16), and generalized cutting tools (at least 6). The latter category only includes whole undifferentiated bifaces that were not discarded during manufacture. No specific function could be ascribed to fragmentary bifaces.

Table 98. Tool morphology by function, frequencies and row percentages

Artifact Morphology	Artifact Function						
	Chopper	Drill	End scraper	Uniface	Biface	Projectile point	Totals
Cobble tool	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 3.6
Uniface, undiff.	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	2 3.6
Uniface-early stage	0 0.0	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	2 3.6
Uniface-late stage	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 1.8
Biface-early stage	0 0.0	2 12.5	0 0.0	0 0.0	12 75.0	2 12.5	16 29.1
Biface-middle stage	0 0.0	0 0.0	0 0.0	1 7.7	8 61.5	4 25.0	13 23.6
Biface-late stage	0 0.0	2 11.5	0 0.0	0 0.0	7 38.9	10 62.5	19 34.6
Totals Percent	3 5.5	4 7.3	3 5.5	2 3.6	27 49.1	16 29.1	49

Thirteen projectile points were assigned to temporal categories. Three were Basketmaker II dart points, and 11 were Pueblo side-notched arrow points, one with an additional notch on one side. Two large side-notched dart points and a small side-notched arrow point could not be typed. The former probably date to the late Archaic period, and the latter may be part of a Pueblo side-notched point. While points that potentially date to the Late Archaic period were found on three sites (LA 2742, LA 70577, and LA 71190), there were no indications of earlier, underlying occupations. At least one Basketmaker II point from LA 70577 (the reworked specimen) was undoubtedly acquired at another site.

Both cobble tools and unifaces were used as choppers. While cobble tools had no other function in this assemblage, unifaces were also used as scrapers. Choppers were probably used to chop and shred vegetal materials like bark, wood, or yucca leaves. Scrapers are generally considered to be hide processing tools, but they may have been used to carve wood as well; the tough, steep edges on these tools are suited to either purpose. Hafted scrapers are still used to process cow hides by the Gurage of Ethiopia (Gallagher 1977) and for working wood by the Ngatjara of Australia (Gould et al. 1971).

Bifacial tools included drills, generalized bifaces, and projectile points (Fig. 89). Drills are perforators and were identified as much by the presence of rotary wear as by shape. Generalized bifaces may have been all-purpose tools. They do not seem to have functioned as cores as did those produced during the Archaic period. These tools were probably used for cutting, chopping, whittling, and scraping: essentially any task for which a sharp, durable edge was needed. Projectile points were primarily used for hunting. This is especially true of the two specimens with impact fractured tips. While some of the larger points could also have been used as knives, that function was probably secondary. One Basketmaker II point from LA 70577 did not function as a projectile point in this context, having been reworked into a scraper.

Table 99 tabulates artifact functions for each site. Though formal tools comprise minor parts of each assemblage, they are evidence of some of the activities that occurred at those locations. However, it is likely that most usable formal tools were carried off when the sites were abandoned, and only small parts of the formal tool assemblages were recovered. Generalized bifaces are the most common tools, occurring at four of five sites containing formal tools. Projectile points and drills are also well represented, occurring in three assemblages each. Scrapers and generalized unifaces were found at two sites each.

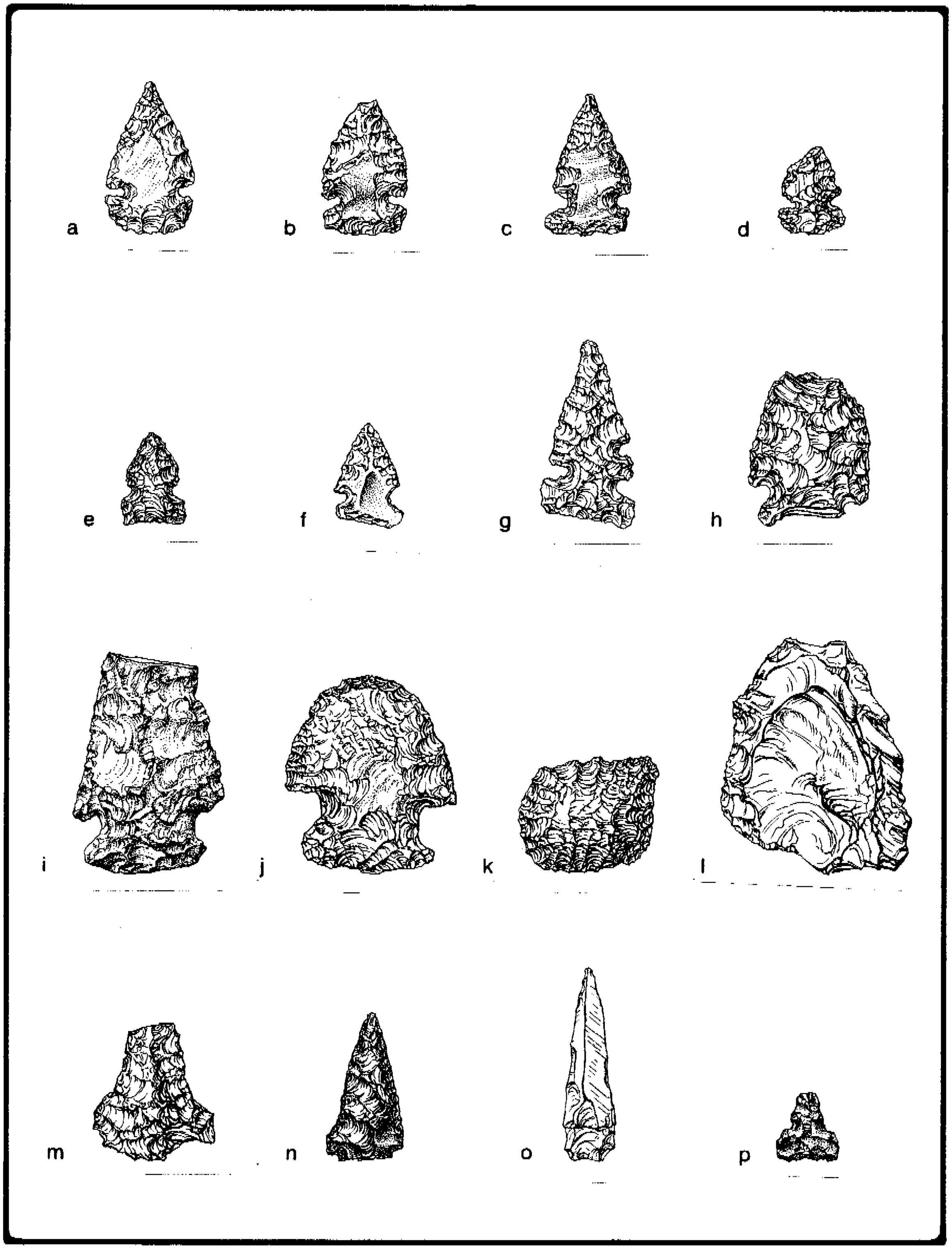


Figure 89. Formal tools from the Pot Creek sites: (a-f) Pueblo side-notched points; (g) Pueblo side-notched point with three notches; (h, i) Basketmaker II points; (j) Basketmaker II biface, reworked, used as scraper; (k, l) bifaces; (m-p) drills.

Table 99. Artifact function by site

Artifact Function	LA 2742	LA 3570	LA 70576	LA 70577	LA 71190	Total
Chopper	1 11.1	0 0.0	0 0.0	1 3.6	0 0.0	2 4.1
Drill	1 11.1	0 0.0	1 50.0	2 7.1	0 0.0	4 8.2
Scraper	0 0.0	0 0.0	1 50.0	2 7.1	0 0.0	3 6.1
Uniface	2 22.2	0 0.0	0 0.0	0 0.0	0 0.0	2 4.1
Biface	2 22.2	5 100.0	0 0.0	13 46.4	4 80.0	24 49.0
Large projectile point	1 11.1	0 0.0	0 0.0	2 7.2	1 20.0	4 8.2
Small projectile point	2 22.2	0 0.0	0 0.0	8 28.6	0 0.0	10 20.3
Total/ Percent	9 18.4	5 10.2	2 4.1	28 57.1	5 10.2	49 100.0

Summary

Six assemblages of varying size and temporal affiliation were examined during this analysis. Three are from Valdez-phase pithouse sites (LA 2742, LA 3570, LA 70577), two are from Pot Creek-phase farming sites (LA 71189, LA 71190), and one was from a historic camp with a possible prehistoric component (LA 70576). As discussed in other chapters, complete lithic assemblages were available from only the three latter sites. Different recovery strategies were implemented at LA 2742 and LA 70577. All visible artifacts on the surface of both sites were collected, and the pithouse fill was sampled. However, as both structures were filled with sediments deposited by natural processes, much of the fill at both was removed without screening. Artifacts were collected when visible, but no attempt at systematic sampling was made. In both cases the entire assemblage was combined into a single analytic unit because artifacts in pithouse fill originated in adjacent surface or midden deposits, washing into the structures over a period of years. Only a partial sample is available from LA 3570 because much of that site was removed during earlier highway construction, and the only known pithouse was previously excavated (Peckham and Reed 1963).

Analysis of the LA 2742 assemblage shows that an expedient core-flake reduction strategy was used. Limited tool manufacture occurred as evidenced by two biface flakes, three bifaces broken during manufacture, and a biface discarded during manufacture.

However, tool manufacture appears to have focused on the production of specialized tools rather than bifaces that could serve as both general purpose tools and cores. LA 2742 had the highest percentage of primary core flakes and cortical flakes, and the smallest percentage of modified platforms. This suggests that there was more initial core reduction here than at any of the other sites. Except for LA 71189, it also had the lowest percentage of nonlocal materials and showed a bias toward local materials procured at or near an outcrop. Both informal and formal tool use was documented, and the highest percentage of informal tools occurred here (6.1 percent).

An expedient core-flake reduction strategy was used at LA 3570, but some tool manufacture also occurred as evidenced by six biface flakes and four bifaces broken during manufacture. However, core reduction debris dominates the assemblage, and biface manufacture appears to have been aimed at producing generalized cutting tools rather than bifaces that could function as both cores and tools. This assemblage contains the second highest percentage of cortical flakes, but the percentage of primary flakes and modified platforms was similar to that of most of the other sites. While there was a bias toward the use of local materials for reduction, over 20 percent of the assemblage is from nonlocal sources. Local material procurement was slightly biased toward secondary gravel deposits, with only about 40 percent obtained at or near outcrops. None of the exotic materials seems to have been procured at or near outcrops. Both informal and formal tools were found, though the amount of informal tool use was small. The only whole tool was a middle-stage biface that may never have been finished. Peckham and Reed's (1963) report on the excavation of the associated pithouse adds little to this discussion, documenting the presence of only two informal and no formal tools.

The chipped stone assemblage from LA 70576 was one of the smallest recovered, containing only 43 artifacts. Again, an expedient core-flake reduction strategy was used. There is no evidence of biface manufacture, and the entire assemblage seems to consist of core reduction debris. While the percentage of primary flakes is similar to that of most of the other sites, the percentage of modified platforms is the second lowest observed. Material procurement was biased toward local materials obtained in secondary gravel deposits, though slightly more than 20 percent of the assemblage are nonlocal materials. Both formal and informal tool use occurred, but evidence for both is limited.

An expedient reduction strategy was also used at LA 70577. Biface manufacture also occurred, as evidenced by 37 biface flakes and four formal tools broken during manufacture. In addition, at least two complete bifaces were discarded during manufacture because of mistakes or material failure. Biface manufacture appears to have focused on production of specialized tools rather than bifaces that could function as both general purpose tools and cores. The percentage of both primary flakes and modified platforms was consistent with most of the other sites. Though local materials dominated, LA 70577 had the highest percentage of exotics. Local material procurement was almost evenly split between secondary gravel deposits and at or near outcrops. Most exotics came from secondary gravel deposits. Both formal and informal tool use occurred.

Only 20 chipped stone artifacts were recovered from LA 71189. Again, evidence suggests that an expedient core-flake reduction strategy was used. Tool manufacture may have occurred, but evidence of this is limited to a single biface flake. While this assemblage contains the lowest percentage of primary flakes, the percentage of modified platforms is consistent with that of most of the other sites. Local materials, particularly those obtained at or near outcrops, dominate the assemblage, and only two pieces of nonlocal material were recovered. No formal or informal tools were found.

LA 71190 resembles the other sites in evidence of an expedient core-flake reduction strategy, though the presence of seven biface flakes and two bifaces broken during manufacture suggests that tool manufacture also occurred. This site had the smallest percentage of cortical flakes (14.8), but the percentage of primary flakes was consistent with that of most of the other sites, as was the percentage of modified platforms. Local materials dominate the assemblage, and there was an even split between procurement in secondary gravel deposits and at or near outcrops. Nonlocal materials were mostly obtained from secondary gravel deposits, though the small sample size makes this conclusion tentative. Both formal and informal tool use occurred, though the assemblage contains the smallest percentage of informal tools.

These sites can be separated into residential and open-air locales. LA 3570 is considered a residential site because of the pithouse that was originally associated with the surface scatter investigated by this project. At this level of analysis, it is impossible to determine whether LA 70576 was a camp or part of the nearby residential site at LA 70577. The remaining open-air sites were farming locales, but an ephemeral shelter is thought to have existed at LA 71189. Thus, it was probably also used as a temporary residence. LA 71190, on the other hand, was a cornfield-canal complex, where no evidence of shelters was found. Further analysis should be able to isolate differences between these types of sites, particularly in terms of material selection, reduction technology, and tool manufacture and use, and should help in determining the function of LA 70576.

Table 100 lists selected variables for each site. Two main differences between sites can be defined: reduction technology and tool manufacture and use. A simple expedient core-flake reduction strategy was employed to produce most of the debitage at each site. This is supported by flake to angular debris ratios, which are low for all sites. However, percentages of primary flakes, cortical flakes, and modified platforms indicate that more early-stage core reduction occurred at LA 2742 than elsewhere. Local materials dominate each assemblage, and mostly glassy and fine-grained materials were selected for reduction. Formal tools were manufactured at all sites except LA 70576. Large biface flakes are rare or do not occur, and none of the generalized bifaces is large, suggesting that they were only used as cutting tools and not as cores. LA 70576 contained the highest percentage of formal tools, but this may be attributable to sample error because its small assemblage actually contains only two tools. The five remaining sites contained similar percentages of formal tools, ranging from 1.9 percent at LA 2742 to 2.7 percent at LA 3570. Informal tool use was highest at the residential sites with pithouses (LA 2742 and LA 70577), while the third residential site (LA 3570) had one of the lowest percentages. Because this site was previously investigated, however, this figure may be the result of sample error. Overall, the lowest percentages of informal tool use were at the farming sites.

Table 100. Comparison of various attributes of each assemblage (with the exception of the flake/angular debris ratio, all values expressed are percentages)

Variable	LA 2742	LA 3570	LA 70576	LA 70577	LA 71189	LA 71190
Exotic materials	12.0	20.4	20.9	25.5	4.7	18.1
Glassy and fine-grained materials	79.5	74.8	83.7	92.6	93.0	87.2
Biface flakes	0.4	3.5	0.0	2.9	2.4	3.5
Noncortical flakes	70.6	74.6	82.8	84.5	85.7	83.6
Primary flakes	12.2	5.8	6.9	5.7	2.9	5.3
Modified platforms	1.8	18.8	10.0	20.9	17.6	20.8
Flake/angular debris ratio	3.10	2.63	2.42	3.12	5.83	3.70
Informal tools	6.1	0.6	2.4	4.5	0.0	0.5
Formal tools	1.9	2.7	4.7	2.6	0.0	2.4

While there were technological differences between sites, they were not related to any significant variation in reduction strategy. More informal tool use seems to have occurred at the two residential sites with pithouses, but in general, the assemblages are quite similar. There are small variations between assemblages, but none seems different enough to suggest occupancy by another cultural group. Thus, while LA 70576 was originally classified as a historic Apache campsite on the basis of the ceramic assemblage, there is no evidence from the lithic assemblage to support this contention.

Conclusions

Three questions that might be addressed by analysis of the chipped stone assemblages were presented at the outset of this discussion. Two were related to reduction strategy, and the third to contact with other regions:

1. Does the lithic reduction strategy employed at these sites suggest

occupancy by groups with a long tradition of sedentism, or were they occupied by peoples who had recently adopted agriculture?

2. What do the exotic lithic materials in these assemblages tell us about frontier links with the core area?

3. Were different reduction strategies employed at camps than at residences?

The earliest of the dated sites investigated, LA 70577, seems to have been occupied during the second and third quarters of the A.D. 1100s. This is 25 to 75 years after the proposed initial occupation of the Taos region by farmers (Prehistoric Agriculture in the Taos District). The source of this population is a problem. Did they migrate into the area, or were they descended from the hunter-gatherers who had occupied the region before ca. A.D. 1000? Much of this analysis was aimed at addressing this issue. Where mobile Southwestern hunter-gatherers usually employed a bifacial reduction strategy (Kelly 1988), sedentary farmers generally used an expedient core-flake strategy. As hunter-gatherers began to add horticulture and seasonal sedentism to their subsistence system, there should have been a transition to an expedient reduction strategy. However, it is unlikely that this transition was instantaneous, particularly if the population maintained a fair degree of mobility.

Information from populations residing further to the west provide some comparative data. Though there is some evidence that corn was grown in the northern Southwest before the Basketmaker II period (Irwin-Williams 1973), it was during that phase that horticulture and seasonal sedentism became important parts of the subsistence system. Thus, the Basketmaker II period (and possibly the earlier Armijo phase) was transitional between a fully mobile hunter-gatherer adaptation and a sedentary farming adaptation. In general, data from many studies suggest that the reduction strategy employed by Basketmaker II peoples was based on the production of curated bifaces.

Data from the CGP survey in northwestern New Mexico (Reher 1977) indicates that Basketmaker II and earlier Archaic occupants of that area were more reliant on facially flaked tools than were the later Anasazi. Chapman's (1977) analysis of these assemblages suggested that the Anasazi employed a more expedient reduction strategy than was evident at Archaic sites. An analysis of Archaic (including Basketmaker II) lithic assemblages at Cochiti Reservoir showed that a bifacial reduction strategy was employed. Late Archaic (Armijo and Basketmaker II) assemblages near Abiquiu Dam also evidenced a reliance on biface reduction (Hicks 1986). While biface manufacture continued during the Anasazi occupation, it was secondary to the expedient reduction of flakes from cores (Hicks 1986). Analysis of chipped stone assemblages from several sites near San Ildefonso suggested that a bifacial reduction strategy was employed during the Basketmaker II period, while an expedient core-flake strategy was used by the Anasazi in that area (Moore n.d.b). Excavations at a nearby Basketmaker II residential site confirmed this observation. Lent (1991) excavated a Basketmaker II pit structure dating between 540 ± 70 B.C. and A.D. 110 ± 70, finding a high reliance on biface reduction.

Several analyses in the San Juan Basin echo these trends. Laumbach (1980) noted that nearly all bifaces recovered during investigations on Block II of the NIIP were found on Archaic and Basketmaker II sites, including all large bifaces. Analysis of chipped stone assemblages on the Navajo Mine lease showed that Archaic and Basketmaker II sites were characterized by a predominance of biface reduction, while an expedient core-flake reduction trajectory was indicated at Anasazi sites (Hogan et al. 1983; Kerley and Hogan 1983). In particular, two Basketmaker sites (LA 19374A and LA 19374D) closely fit the pattern observed at earlier Archaic sites.

Further afield, Rozen (1981) also noted that Archaic (including Basketmaker II) reduction in western Arizona was characterized by an emphasis on biface manufacture. He assumes that the switch to an expedient core-flake reduction strategy had begun by the Basketmaker III phase, but this conclusion was based on mixed Basketmaker II-III assemblages. Irwin-Williams (1973) noted that Basketmaker III (Trujillo phase) assemblages in the Arroyo Cuervo District were very similar to those of the preceding En Medio, or Basketmaker II phase. Unfortunately, not enough data is presented to determine whether the transition to an expedient reduction strategy occurred at that time. Finally, early farmers in the Dolores area of southwestern Colorado employed an expedient core-flake reduction strategy (Hruby 1988). Kane (1986) indicates that they were mobile horticulturalists who moved into the area near the end of the Basketmaker III period (Tres Bobos subphase, A.D. 600 to 700).

From these limited data, it appears that as Archaic hunter-gatherers began to adopt seasonal sedentism along with limited corn horticulture, they initially remained reliant on a bifacial reduction strategy. The transition to an expedient strategy probably occurred as populations became increasingly sedentary and less reliant on seasonal movement, but it certainly did not happen as soon as domesticated plants and seasonal sedentism were added to the subsistence system.

If the population of the Taos area represents indigenous hunter-gatherers that began to settle down and become sedentary farmers ca. A.D. 1000-1050, a similar transition would be expected, and an instantaneous and radical change in reduction strategy should not have occurred. Thus, a continuing reliance on the production and use of curated bifaces would be expected, particularly during the early years of the farming occupation. Our data suggest that this is not the case. There is no startling technological difference between the earliest site (LA 70577) and the latest sites (LA 71189 and LA 71190). Instead, the assemblages suggest a population with a long-established lithic technology based on the expedient reduction of cores, with biface manufacture aimed at the production of tools with specific functions.

This suggests that these people were sedentary farmers before the Taos area was settled. In turn, this suggests that they moved into this area from elsewhere. It is interesting that all of the identified exotic materials have sources in the central Rio Grande region, from the Rio Chama Valley south. While some exotics were procured at or near outcrops, most were obtained from secondary gravel deposits. Whether these materials were picked up by locals while traveling south or were carried into the region by visitors is impossible to determine and irrelevant to this discussion. The presence of these materials in relatively high percentages (in most cases) suggests close ties with populations further south. There also does not seem to be a decay of these ties over time in the available sample of sites. With the exception of LA 71189, the site containing the lowest percentage of exotics, LA 2742, falls into the middle of the occupational sequence. LA 70577 contained the highest percentage of exotics (25.5) and is the earliest site in the sample. Exotics comprise 18.1 percent of the LA 71190 assemblage, which seems to be the latest site. This is a smaller percentage than that of LA 70577, but it is higher than that of LA 2742. If LA 70576 was part of LA 70577 and LA 3570 was occupied at about the same time as LA 2742, it could be argued that there was a slightly greater use of exotic materials in the early sites than in the later ones. While this might be interpreted as an attenuation of contacts with the core area over time, the relatively high percentage of exotics at LA 71190 suggests that these ties actually remained close. This pattern may be a result of small sample size and a lack of good dates rather than cultural processes.

The same reduction technology seems to have been used at camp sites and residential sites. Unfortunately, assemblage mixing and the lack of discrete camp sites located a long distance from residential sites make this conclusion tentative. While the nonstructural sites reflect activities occurring away from main residences, this pattern could be illusory. LA 70576 was probably part of LA 70577 and thus an extension of a residential site. While both LA 71189 and LA 71190 were farming sites separated from the main residence, both are very near Pot Creek Pueblo and several smaller villages. It would have been easy to transport most, if not all, of the materials found at those locations from the village, obscuring any assemblage differences that might occur at distant camps.

This discussion has generated more questions than it has answered. It appears that the reduction strategy employed at these sites was well established before they were occupied. In turn, this suggests that the population was adapted to sedentary farming before they moved into the area. Unfortunately, this conclusion is based on assumptions, because the question of how rapid the transition from a bifacial to an expedient reduction strategy occurs remains unresolved. If the process was nearly instantaneous, our conclusions are negated. This does not seem to be the case in the examples cited, and a bifacial reduction strategy seems to have been used through the period of initial adjustment to increased dependence on farming. We can tentatively conclude that the chipped stone artifact analysis suggests the movement of an established farming population into this region rather than the adoption of sedentary farming by hunter-gatherers. However, this question can only be resolved with further research.

Similarly, if this was a frontier population, the types of exotic lithic materials found in the assemblages suggest close ties with the central Rio Grande. Unfortunately, because most of the exotics were obtained from secondary gravel deposits, this area can only be narrowed to the Rio Chama Valley southward. Finally, while we have tentatively concluded that the same reduction strategy was used by Anasazi farmers at residential and limited occupation sites, the close proximity of the limited occupation sites to residential sites significantly weakens this conjecture. A larger number of well-dated limited occupation sites located at a distance from villages is needed to fully test this idea, which, if true, may provide a means of distinguishing between nondiagnostic lithic scatters occupied by hunter-gatherers and farmers.

CERAMIC ANALYSIS

Daisy F. Levine

Ceramic analysis is an invaluable tool for addressing questions regarding the Anasazi frontier, as well as questions about local cultural development posed by previous researchers. Ceramics are particularly useful when considering the geographic origins of frontier settlers and the extent to which they were connected to the core area.

Several criteria proposed in the Research Design relate to ceramics. The assemblage from a frontier population should show a low diversity of types, with an increased use of local materials. This pattern should change through time as interaction with other groups increases. Thus, early sites (Valdez-phase) would reflect the isolation of a developing frontier group. Ties to the parent group would show in ceramic styles, and actual ceramic trade during this time would be minimal or nonexistent.

Other researchers (Peckham and Reed 1963; Wetherington 1968; Woosley 1980a) have discussed the Taos area in terms of independent development leading to local production of pottery. Specifically, this issue revolves around the relationship between Taos Black-on-white, a supposed locally made type, and Kwahe'e Black-on-white, from the central Rio Grande region to the south. At the beginning of this analysis, two suppositions were considered as possibilities. One was that Taos Black-on-white was indeed locally made, and Kwahe'e Black-on-white was a separate type confined to the area south of the Taos Valley. This would exclude trade as a means of explaining the presence of this Kwahe'e-like type (Taos Black-on-white and Kwahe'e Black-on-white are macroscopically identical in appearance). The other was that Taos Black-on-white was synonymous with Kwahe'e, and thus there was really only one type. Its presence in the Taos Valley would then indicate stronger ties to the parent Anasazi population. This issue will be discussed first because its resolution affects questions concerning the frontier.

Local or Intrusive Types: Kwahe'e Black-on-white, Taos Black-on-white, and Santa Fe Black-on-white

The problem of differentiating Taos Black-on-white from Kwahe'e Black-on-white has previously been discussed by Mera (1935), Peckham and Reed (1963), Wetherington (1968), Green (1976), and most recently by Lent (1991). These types are stylistically very similar but have been differentiated based on temper and slip. However, over time the definitions and criteria have become contradictory.

Mera (1935) first described Kwahe'e Black-on-white based on sherds from LA 116, the type site. He recognized the similarities between the two types, named Taos Black-on-white, and described it as a northern "mutation" of Kwahe'e Black-on-white (Mera 1935:6). Both of these types were seen as a derivation of Chaco 2 (Red Mesa Black-on-white). Taos Black-on-white, however, diverged in the quality of the slip, which remained thicker than that on Kwahe'e Black-on-white. This occurred only in the vicinity of Taos. The slip on Kwahe'e was more of a thin wash, in keeping with other white wares of that period, and bowls were only slipped in the interior. This was Mera's first criterion in distinguishing these two types.

Most white wares of the period were tempered with crushed potsherds, a practice Mera attributed to the Chaco area. Again, a divergence from tradition was seen in Taos Valley. Here, sherd temper was replaced by a "sandy substance sometimes containing coarse rounded particles" (Mera 1935:6).

Thus, Mera differentiated Taos and Kwahe'e Black-on-white based on the presence or absence of a good slip (as opposed to a wash) and sherd temper, though stylistically both were derived from Chaco 2. Peckham and Reed (1963) were the next to discuss Taos Black-on-white in detail, after excavating three Valdez-phase sites. They described the temper more explicitly than Mera, as "fine gray and black angular fragments (sherd?), angular quartz crystals, mica, calcite, and basalt (rare)" (Peckham and Reed 1963:11). Bowl interiors and exteriors had a streaky white slip (although Mera attributed this characteristic to Kwahe'e Black-on-white). Geometric rectilinear designs in the Dogozhi style were common. Their comparison to Kwahe'e Black-on-white reiterates Mera's definition, which specified that Kwahe'e had no slip on bowl exteriors. However, their temper description varies slightly in that sherd temper is a possible, though not consistently present tempering agent, along with sand or angular rock fragments. Like Smiley et al. (1953), they assign a date of A.D. 1150 to 1250 to Taos Black-on-white.

Wolfman et al. (1965) excavated a Valdez-phase pithouse in Arroyo Seco, north of Taos, and presented a detailed description of temper from 10 randomly selected Taos Black-on-white sherds. Minerals found included hornblende, magnetite, quartz, feldspar, muscovite, and biotite. Their suggestion that a certain portion of these minerals was probably inherent in the clay is interesting with respect to the conclusions from our own petrographic analysis, discussed later in this chapter. Dick found dark gray sherd temper, which itself was originally sand tempered, in 70 percent of the sherds. The other 30 percent had sand temper only. Based on temper analysis alone, most of these sherds would fit Mera's definition of Kwahe'e Black-on-white.

Wetherington (1968) presented one of the more detailed discussions of Taos and Kwahe'e Black-on-white. The temper he described from sherds from Pot Creek Pueblo is very similar to what Peckham found: crushed rock, fine angular quartz crystals, and occasional mica and sherd particles. Here again is a case of sherd temper in a type defined as having sand, not sherd, temper. Wetherington suggests the continued use of Taos Black-on-white as a type until more information is available.

Green (1976) proposed revising the names of the two types and considering them varieties of one type. Thus, there would be Kwahe'e Black-on-white, Tesuque variety (Mera's Kwahe'e Black-on-white), and Kwahe'e Black-on-white, Taos variety. Her criteria for distinguishing them are consistent with Mera (presence of slip on bowl exteriors and sand temper in Taos Black-on-white), with the addition of a third criterion: longevity. Taos variety persisted throughout the Valdez phase into the Pot Creek and Talpa phases, from about A.D. 950 to 1400 (Green's dates). Tesuque variety was not as long-lived (the dates in Smiley et al. 1953 are A.D. 1150 to 1250).

Other researchers who have dealt with this issue include Hawley (1936), who wrote that both varieties had sherd temper, and Glassow (1980:137), who could not see a clear distinction between the two types in the Cimarron area and classified them all as Taos Black-on-white. Vickery (1969:215) labelled all mineral-painted pottery at site TA-26 Taos Black-on-white based on its distribution in the Taos area and its recognition as a distinctive type by "the majority of authorities." Finally, Proctor-Weiss (1983) advocates the use of two separate types, based on paste color and texture, surface finish (slip), little or no sherd temper in Taos Black-on-white, and areal and temporal distribution.

Lent (1991) succinctly summarized the problems and contradictions and went to the source to resolve them. He examined Mera's type collections of Kwahe'e Black-on-white from LA 116 and Taos Black-on-white from LA 260. The results both add to the confusion and suggest a resolution. Lent found that only a very small percentage of those sherds labelled Kwahe'e Black-on-white had sherd temper; a few contained vitric tuff, and most were sand tempered. Most of the bowl forms were slipped on the interior only, but 16 percent were slipped on both sides. Examining the Taos Black-on-white collection proved only slightly less confusing. Roughly half of the sample was sand tempered; other tempering agents included crushed rock or sandstone, and vitric tuff. No sherd temper was observed, which is at least consistent with Mera's type description. However, one-third of the bowl sherds were slipped on the interior only, a trait Mera assigned to Kwahe'e Black-on-white. Lent concluded that because of the frequent mixing of these attributes in the Mera collections, the criteria may be unreliable, and the distinction between the two types may be unwarranted.

Similar typological problems occur in differentiating Santa Fe Black-on-white and a locally made (Taos Valley) version of Santa Fe. Santa Fe is the first carbon-painted ware in the Rio Grande region black-on-white. It marks the beginning of the Pot Creek phase in the Taos area and the Coalition period to the south (A.D. 1200).

Santa Fe Black-on-white was named by Mera (1935) and first described by Amsden (1931) as "Blue-gray type." The slip was thin, varied from slate blue to whitish, and was usually applied only to bowl interiors. A subtype had a whitish slip applied to bowl exteriors. Amsden described the temper in Santa Fe Black-on-white as coarse sand; Mera added volcanic tuff and crushed sherds to the definition. Mera characterized fine-grained pastes as the rule and coarse, sand-tempered examples as exceptions. He believed that this was a sign of the lack of standardization of the time, and that the tuff-tempered variety was the forerunner of a later, more standardized type that used this material exclusively (Mera 1935:14). Amsden described Santa Fe Black-on-white from Forked Lightening Ruin near Pecos; Mera named LA 742, in Tesuque Valley, as the type site.

The locally made variant in Taos Valley is described as having crushed sand temper with large inclusions, giving the paste a grainier appearance and a more crumbling fracture. Quartz particles are the most common inclusion, but sherd, tuff, and mica also occur (Wetherington 1968:55). Based on Mera and Amsden's observations, this description fits the original definition for Santa Fe Black-on-white well enough to not be considered a separate type. As is the case with Taos Black-on-white, differences may be the result of using local clay.

Proctor-Weiss (1983) believed the differences were great enough to warrant naming a new type, Pot Creek Black-on-white, as the local carbon-painted ware that succeeded Taos Black-on-white. She argued that the carbon-painted pottery is technologically, materially, and stylistically so similar to Taos Black-on-white and different enough from Santa Fe Black-on-white that it merits a separate type name to distinguish it from carbon-paint developments to the south. The similarities to Taos Black-on-white include the continued use of exterior slip on bowls, design elements, paste, and temper. Perhaps most important is that carbon-paint ware does not replace mineral paint ware in the Taos area, as it does to the south. Taos Black-on-white and the local carbon paint pottery coexist in the Taos area during the Pot Creek phase and, perhaps, the Talpa phase.

Taking into account the typological problems and their implications, our analysis was oriented toward discerning technological differences. As discussed in the Introduction, the category "Taos/Kwahe'e" was used for all mineral-painted jar sherds with a Taos or Kwahe'e design and bowl sherds with this design and an eroded exterior slip. Only bowl sherds with an exterior slip could confidently be called Taos Black-on-white, based on the type definition. The problem inherent in this system of classification is the lack of criteria for defining jar sherds. Mera's definition did not provide for jars, except to note that Kwahe'e has a wash and Taos has a "good" slip. But problems arise when dealing with jar sherds with a thin wash and sand temper, or a completely eroded slip. Temper alone, as previous analyses have shown, is a weak criterion.

Thin sections and petrographic analysis of a sample of our sherds were performed by David Hill (see Appendix 3). Our intention was to identify temper differences in Taos Black-on-white and Kwahe'e Black-on-white sherds that had been sorted by the presence or absence of exterior slip on bowls. Various attempts have been made to define Taos Black-on-white temper, but they are generally vague: sandy substance, fine gray and black angular fragments, various minerals, occasional crushed sherds, crushed rock, and angular quartz crystals. Our temper codes were similarly descriptive rather than specific. By identifying the "angular fragments" and "sandy substances," we hoped to define differences between the types, if they existed. Unexpectedly, the petrographic study demonstrated that all of the white ware sherds were made from local untempered clay. The fine black and gray inclusions thought to be crushed rock were decomposing and altered minerals in the clay, including biotite, orthoclase, and plagioclase. One clay source was located directly across the river from LA 70576 and LA 70577; another was approximately 5.9 km (3.7 mi) south of Ft. Burgwin at U.S. Hill. All samples analyzed were made from the local clay, including what we had called Kwahe'e based on slip.

Unfortunately, the sample of carbon-paint pottery from our assemblage is too small to resolve the controversy. The sample that we did submit for petrographic analysis indicated that it was made from the same local self-tempered clay as the Taos/Kwahe'e Black-on-white sherds. Extensive residual tuff deposits near Picuris may have been used, resulting in a paste similar to that of Santa Fe Black-on-white in the Santa Fe area (Dick 1990:6). Further study of carbon-paint types in both areas is needed to resolve the status of these two types.

These results support the supposition that Taos Black-on-white is a locally made type. This conclusion has inherent implications for the frontier model (discussed below). The sample from our assemblage indicates that in the Pot Creek area, white ware bowls were being made that sometimes were slipped only on the interior and sometimes were slipped on both sides. Both were made from the same local clay and were self-tempered. This suggests that in the Taos area, two similar ceramic types did not coexist, and that Taos Black-on-white is an appropriate designation for the self-tempered variety, regardless of how bowls are slipped. It also suggests that slip is not a viable criterion for distinguishing Taos Black-on-white and Kwahe'e Black-on-white. Similar analysis would need to be conducted on sherds from sites in the Kwahe'e geographic area, and optimally from the Mera type collections of both ceramic types, to definitively establish a distinction between Taos Black-on-white and Kwahe'e Black-on-white.

Ceramics and the Frontier

Boyer's frontier model (Research Design) suggests that links to the core area should be visible in the material culture of the frontier population, since this population maintained social and economic ties to the parent society. In terms of the ceramic assemblage, wares should reflect the styles from the core area in relatively high frequencies during the early years (Valdez-phase sites), while the frontier population was becoming established. Pottery should be of local manufacture, and a low diversity of ceramic types would be expected. Once the population was established, more types would be expected as exchange and communication links with other nearby groups, including the core area, were solidified. Thus, the ceramics could serve as indicators of social and economic processes in the region. Boyer's model is opposed to those presented by Herold (1968), Wetherington (1968), and Woosley (1980a), who favor the idea of independent cultural development, also resulting in local production of pottery.

Ceramics from the Valdez-phase sites, then, should show a high frequency of Kwahe'e-style Black-on-white, representing a link to the Rio Grande area to the south. The predominant decoration on Taos Black-on-white is Dogozhi style (hatchure between parallel framing lines). It is noteworthy that Dogozhi style predominates during late Pueblo II and early Pueblo III times throughout the Anasazi area. It is found under various names in the San Juan Basin, Mesa Verde area, Kayenta region, and the central Rio Grande. Gallup Black-on-white, Black Mesa Black-on-white, Cortez Black-on-white, and Kwahe'e Black-on-white all exhibit the hatchure design so common during this period. This is not to suggest the San Juan Basin as a core area; rather, it implies that the Anasazi were following the traditional decorative guidelines for late Pueblo II-early Pueblo III white wares.

A low diversity of ceramic types occurs in that only one decorated ware was found (locally made Taos Black-on-white), and most of the utility wares are either plain or incised (also locally made). The occurrence of locally made types encompassing regional design style suggests that a population arrived in the Taos area with an established ceramic technology, and their adaptation involved finding and using local clay and temper sources. This would free them from, rather than tie them to, the parent population.

Few data are available on the utility wares associated with Kwahe'e Black-on-white in the central Rio Grande, making it difficult to compare them with Taos Gray wares. Mera (1935:6) devoted two sentences to these utility wares, stating that indented corrugation began during this period and that incising on a smoothed surface was common. Later excavations at Kwahe'e-period sites, however, have not shown that incising was common; apparently, Mera was only referring to the Taos area. Styles that occur most frequently with Kwahe'e Black-on-white are plain or corrugated utility ware. This was observed by McNutt (1969) at the Tesuque By-pass site. Neck-banding was next in frequency after corrugation, and only a handful of incised and punctate sherds were found. At the KP site (Wiseman 1989:44-57), a late Developmental-period site in Santa Fe, no incised or punctate wares were found; again, indented corrugated and plain utility were the most frequent types. Kidder and Shepard (1936:300-306) describe many forms of surface treatment from the Forked Lightening Ruin, but incising is not mentioned. They associate corrugated styles with the Developmental period (A.D. 600-1200).

Thus, it appears that the surface treatment on Taos Gray wares was not an idea imported from southern neighbors. Corrugation was not common in the Taos Valley until the Pot Creek phase, and neck-banding was rare. A plain surface is most common, followed by linear or herringbone incising. The incised ware closely resembles Potsui'i Incised, a type that first appeared in the northern Rio Grande, primarily in the lower Chama valley, about A.D. 1450 (Harlow 1973). We will return to incised wares later in this chapter.

The absence of any trade wares implies the self-sufficient nature of the population, the degree of isolation in which they lived, or the probability that the area was not an important exchange center during the Valdez phase. Contact with the Rio Grande Anasazi to the south is indicated by the similarity in ceramic style, and the appearance of carbon-painted wares about A.D. 1200 in both areas; thus, contact was largely in terms of *ideas*, not material goods.

Lucius (1981:53-56) also developed a model of frontier interaction. He questioned the existing model of Archaic to Anasazi development and suggested that the Anasazi tradition may have resulted from the adaptation of Mogollon homesteaders to a frontier situation, thus offering an alternate view of Anasazi origins. His model was based on the presence of Mogollon-style pithouses and ceramics (brown wares) in the Four Corners area. He presented six propositions, several of which relate to expectations in the ceramic assemblage. Most pertinent are those dealing with isolation from the parent society. In this situation, he proposed that ceramic (and architectural) styles would develop independently of developments occurring in the Mogollon area. More data was needed to test this proposition, including a regional study and comparison of styles in both areas.

Wiseman and Olinger (1991) studied a problem similar to the Taos/Kwahe'e controversy in the central Rio Grande area. The issue concerned a type thought to be imported, but which the local population started making themselves. At the Pojoaque Grant site (LA 835), the presence of Red Mesa Black-on-white prompted questions regarding the degree to which painted pottery was imported into the Rio Grande region, and the time when the Rio Grande Anasazi began making their own painted wares. Mera (1935) indicated that some Red Mesa Black-on-white was imported, but subsequent researchers believed that some was also locally made (Stubbs 1954:45, Wetherington 1968:88). Defining the difference between local and nonlocal Red Mesa Black-on-white was critical in making these determinations.

Wiseman and Olinger (1991:209) summarize the history of painted pottery in the Rio Grande region as follows. Painted wares were imported from the west during the early Developmental period (ca. A.D. 600-800). During the middle Developmental period (ca. A.D. 800-1100), some was imported from the west, and some may have been locally made. Starting in the late Developmental period (A.D. 1100-1200), most painted pottery was locally made. Specifically, Kwahe'e Black-on-white was made in the central Rio Grande, and Taos Black-on-white was manufactured in the Taos Valley.

X-ray fluorescence was used to sort locally made sherds from Red Mesa Black-on-white, made to the west. The results indicated that although almost half the assemblage was Red Mesa Black-on-white, only 3 percent of this type was locally made. Though not a significant amount at first glance, it suggests that the Rio Grande Anasazi began making their own version of a western type as early as the late A.D. 800s. Significant local production of painted pottery did not begin until about A.D. 1100, the starting date for Kwahe'e Black-on-white. Wiseman and Olinger believe that the results of the ceramic study, combined with recent reassessment of the dating of LA 835, show that the Rio Grande Anasazi did not significantly lag behind the Chacoan Anasazi in ceramic technology and development, even though the import of Red Mesa Black-on-white may suggest otherwise.

It also seems that the Taos Valley Anasazi did not lag behind the rest of the northern Rio Grande Anasazi in ceramic development. Several factors may determine local development of pottery manufacture. One is the availability of resources. Arnold (1985:20-60) studied distances travelled by potters to various resources, in such diverse areas as Greece, Peru, Guatemala, Morocco, Pakistan, Bolivia, and the American Southwest. His model shows that most potters only travel within a 1 km radius for clay, with an average maximum range of up to 7 km. In the Rio Grande area, San Ildefonso potters historically went less than 1 km to a clay source; Santa Clara potters went from 6.1 to 6.9 km. Distance to temper sources also averages 1 km but ranges to 9 km. Distance to slip and paint was greater, averaging less than 10 km, though the range extended to 30 km. Fuel is also a consideration, though there is not much data available on these distances. Evidence from Peru, Guatemala, and Mexico indicates that fuels used were local materials (Arnold 1985:53).

The chance for origination and development of potterymaking decreases with distance to necessary resources. Once local resources are exhausted, resources must be imported from beyond the upper range of distance travelled, potters must move nearer to a new source of supply, or pottery is no longer made. The presence of resources alone, however, is not necessarily a sufficient impetus for a population to begin pottery manufacture.

The degree of sedentism, combined with climate, is another determining factor. If a sedentary society is located near good quality resources and lives in a favorable climate for at least part of the year, potterymaking could emerge as part of the cultural pattern (Arnold 1985:125). Warm temperatures, relatively low humidity, and high amounts of sunshine (including the winter months) are important factors in the drying and firing of pottery. Pottery can be made by nonsedentary or partially sedentary populations, but it plays a more dominant role in sedentary societies as cooking and storage containers.

Difficulty in transporting ceramic vessels does not necessarily account for lack of trade. Pottery can be safely transported without breakage using adaptations such as carrying slings, net bags, special shapes that are easily carried, or by cushioning with special packing material. Arnold (1985:110-111) cites examples of vessels being padded with grass, bark, pine needles, corn husks, and cloth, and carried in net bags or carrying frames. Pottery was thus carried as far as 250 km.

The Taos Valley frontier population settled in an area in which all the proposed criteria for local development of potterymaking were met. Identified clay sources were close to the sites, and one source was directly across the river from LA 70576 and LA 70577. Another, about 5.9 km (3.7 mi) to the south, falls within the 6.9 km upper range for distance travelled to clay sources. The population consisted of sedentary agriculturalists who lived in an ideal climate for making pottery. Sunshine is abundant, humidity is low, and temperatures are moderate, as in much of the Southwest. Because the population had knowledge of pottery manufacture and settled in a favorable area, it is not surprising that they would be making their own pottery rather than importing it.

White Wares

At all the sites except LA 71190, white wares were less common than plain wares. Plain ware to white ware ratios ranged from 2.4:1 at LA 71189 to 5:1 at LA 2742.

Table 101 presents these figures and the white ware percentages of each site assemblage. White wares comprise less than one-quarter of each assemblage, except at LA 71189 and LA 71190. Since both sites are agricultural locations, a high frequency of white wares may be an indicator of agricultural activity. Although bowl sherds outnumber jar sherds within the white wares at these two sites, the data suggest that painted vessels were being used to carry water to the fields. Small bowls may have been used as dippers to fill larger ollas.

Table 101. Plain ware to white ware ratios and white ware percentages

Site No.	Plain Ware to White Ware Ratio	White Ware: Percentage of Assemblage
LA 2742	5:1	16.7
LA 70576	4.4:1	18.5
LA 70577	3:1	24.4
LA 71189	2.4:1	29.8
LA 71190	0.9:1	53.5
LA 3570	4.3:1	19.0

The percentages of white wares at the three Valdez-phase sites, LA 2742, LA 70577, and LA 3570, differ significantly from Wetherington's (1968:48) findings at Pot Creek Pueblo. In the Valdez-phase assemblage, he found that white wares comprised 42.2 percent of the assemblage. The proportion of painted wares decreased through time to 30.7 percent in the Pot Creek phase and 18.2 percent in the Talpa phase. During the same time, culinary wares increased in proportion.

Ceramic Types

During analysis, white wares were divided into eight categories, five typological and three descriptive. The latter three were indeterminate mineral paint black-on-white, indeterminate carbon paint black-on-white, and indeterminate white ware. Indeterminate white ware were those sherds with no paint left or unpainted portions of decorated vessels, making identification of ceramic type impossible. Unfortunately, at most sites this was the predominant white ware. The exception is LA 2742, where Taos Black-on-white predominated (35.6 percent). Taos/Kwahe'e Black-on-white was used for decorated mineral-painted white wares when a distinction could not be made based on presence or absence of exterior slip, as discussed above. This category and Taos Black-on-white are next in frequency. The few sherds that could definitely be identified as Kwahe'e Black-on-white (no exterior slip on bowls) were recorded only from LA 2742 and LA 70577. They comprise less than 3 percent of the white ware assemblage at each site.

Table 102 presents percentages of Kwahe'e, Taos, and Taos/Kwahe'e Black-on-white, eliminating indeterminate sherds. None of the identifiable white wares comprises a significant amount of any site assemblage. Since there is so little of what has been called "Kwahe'e Black-on-white," we can assume that the indeterminate mineral white ware and Taos/Kwahe'e Black-on-white sherds are all Taos Black-on-white.

Table 103 shows this combined Taos Black-on-white group as a percentage of white ware and of total assemblages at each site. If the assumption is correct, the percentage of Taos Black-on-white in each site assemblage increases significantly, and this type, along with indeterminate white ware, dominates the white ware assemblages. These type classifications reflect those created during the analysis, which were based on the conventional definitions of Taos and Kwahe'e Black-on-white. However, based on the results of the petrographic analysis, the assumption is unnecessary, and all of these types from our assemblages can now be considered as one type, Taos Black-on-white.

Prior to the petrographic analysis, a statistical comparison was made between slip and temper to detect differences in what we were calling Taos and Kwahe'e Black-on-white. Mineral-painted bowl sherds were sorted by interior slip only, exterior slip only, interior and exterior slip, and unslipped (codes used during analysis). Temper codes for each slip category were then compared. Sherds that were slipped on the interior and

Table 102. Kwahe'e, Taos, and Taos/Kwahe'e Black-on-white, percentages of total white ware assemblage and total site assemblage

Site No.	Kwahe'e Black-on-white	Taos Black-on-white	Taos/Kwahe'e Black-on-white
LA 2742	2.9 0.5	35.6 6.0	25.0 4.2
LA 70576	--	--	--
LA 70577	1.1 0.3	24.5 6.0	24.5 6.0
LA 71189	-- --	14.9 4.8	14.9 4.8
LA 71190	-- --	14.5 7.7	11.8 6.3
LA 3570 (Peckham's)	-- --	78.5 14.9	1.3 0.2

Table 103. Combined Taos Black-on-white, percentages of white ware assemblage and total site assemblage

Site No.	"Taos Black-on-white"
LA 2742	63.3 10.6
LA 70576	--
LA 70577	51.9 12.6
LA 71189	37.3 12.0
LA 71190	33.0 17.6
LA 3570 (Peckham's)	79.7 19.0

exterior far outnumber any other category (68.3 percent of mineral-painted white wares at LA 2742, 66.5 percent at LA 70577). Temper frequencies are almost identical when comparing sherds with an interior slip only and those with an interior and exterior slip. Most sherds were coded either as "fine sand" or "crushed dark crystalline rock, quartz, and fine sand." From the subsequent petrographic analysis we know that these particles were natural inclusions in the clay rather than added tempering agents. This comparison corroborated the results of the petrographic analysis by showing that there is no temper difference between bowl sherds with an interior slip and those slipped on both surfaces.

Range of Taos and Kwahe'e Black-on-white

Areal distribution has been a consideration when defining these types. Most researchers have limited the range of Taos Black-on-white to the vicinity of Taos (Mera 1935:6; Herold and Luebben 1968:24; Wetherington 1968:53; McNutt 1969:84; Glassow 1980). Green (1976:35) and Lutes (1959:62) extended its distribution into southern Colorado, the Sangre de Cristo Mountains east and south of Pot Creek, and the Ponil Creek area near Cimarron. As Green points out, it is not clear whether this distribution is a result of trade or local manufacture, since the boundaries of Taos Black-on-white are not clear. Kwahe'e Black-on-white has a much broader range. Mera (1935) recorded Kwahe'e Black-on-white along the western tributaries of the Rio Grande from Albuquerque to Cuba, along the Rio Grande from Albuquerque to Española, on the Pecos River between Pecos and Santa Rosa, and in the Watrous and Springer areas. McNutt's (1969:84-85) distribution is similar, showing Kwahe'e Black-on-white in the Rio Grande Valley from Corrales north to a point slightly beyond the mouth of the Rio Chama (near Española), with extensions up the Jemez River, and east of the Rio Grande in small enclaves on the Cimarron, Mora, and Pecos Rivers.

Dates

The reported time range for Taos Black-on-white varies considerably. Table 104 lists dates presented by various researchers. Beginning dates given by Wetherington, Vickery, Green, and Proctor-Weiss appear to reflect each researcher's beginning date for the Valdez phase (reported Valdez-phase time range variability is discussed by Boyer in Occupying the Taos Frontier). Peckham and Reed's time range is based on tree-ring dates (Smiley et al. 1953). Wetherington and Vickery's extended ending date reflects the occurrence of Taos Black-on-white during the Talpa phase at Pot Creek Pueblo and at Picuris and Cornfield Taos. Because the excavation and collection at Taos was so limited, and the published information from Picuris is minimal, we are suggesting a date of A.D. 1100-1350, based on the coexistence of Taos Black-on-white and Santa Fe Black-on-white. Perhaps further work at Pot Creek- and Talpa-phase sites will clarify the time frame of Taos Black-on-white and shed some light on its co-occurrence with Santa Fe Black-on-white, a phenomenon that contrasts with the central Rio Grande, where carbon paint *replaced* mineral paint.

Table 104. Dates for Taos Black-on-white

Reference	Dates (A.D.)
Peckham and Reed (1963)	1150-1250
Wetherington (1968)	1000-1400
Vickery (1969)	1000-1400
Green (1976)	950-1325
Proctor-Weiss (1983)	1050-1250

Table 105. Carbon-painted pottery, percentages of white ware assemblages and of total site assemblages

Site No.	Santa Fe Black-on-white	Santa Fe "Local"	Indeterminate Carbon-painted
LA 2742	1.3 0.2	0.4 0.1	1.5 0.2
LA 70576	--	--	--
LA 70577	3.6 0.9	0.5 0.1	0.9 0.2
LA 71189	7.5 2.4	4.5 1.4	-- --
LA 71190	2.6 1.4	3.9 2.1	-- --
LA 3570	--	--	--

Table 106. Santa Fe Black-on-white, percentages of white ware assemblages and total site assemblages

Site No.	Santa Fe Black-on-white
LA 2742	10.3 0.5
LA 70576	--
LA 70577	5.0 1.2
LA 71189	11.9 3.8
LA 71190	6.6 3.5
LA 3570	--

Very few carbon-painted sherds were found. This is not surprising at the Valdez-phase sites because production of Santa Fe Black-on-white began about A.D. 1200. The frequency of Santa Fe Black-on-white increases during the Pot Creek phase. This is seen at LA 71189 and LA 71190 (Table 105). We will assume that Santa Fe Black-on-white, Santa Fe "local," and indeterminate carbon-painted white ware all represent Santa Fe Black-on-white, made from the same local clay as Taos Black-on-white (an assumption that cannot confidently be made because our sample size was so small). The frequency of combined Santa Fe Black-on-white sherds at each site is shown in Table 106.

Santa Fe Black-on-white dates from A.D. 1200 to 1350 and is considered a hallmark of the Pot Creek phase, as it is in Coalition-period sites to the south. It seems, then, that a more significant increase in carbon-painted pottery would be expected at the Pot Creek-phase sites. As seen in Table 106, there is an increase of only 2.6 percent in the total percentage of Santa Fe Black-on-white from LA 70577 to LA 71189 and LA 71190. However, Taos Black-on-white is still the predominant type at LA 71189 and LA 71190 (Table 107), suggesting that they date very early in the Pot Creek phase.

Table 107. Comparison of Taos Black-on-white and Santa Fe Black-on-white, percentages of white ware assemblages and total site assemblages

Site No.	Taos Black-on-white	Santa Fe Black-on-white
LA 2742	63.3 10.6	10.3 0.5
LA 70576	--	--
LA 70577	51.9 12.6	5.0 1.2
LA 71189	37.3 12.0	11.9 3.8
LA 71190	33.0 17.6	6.6 3.5
LA 3570 (Peckham's)	79.7 19.0	-- --

Design Style

The most common design recorded for Taos Black-on-white during analysis was Dogozhi style: framing lines filled in by hatching (Fig. 90). Next in frequency was Sosi style (solids and heavy lines), followed in decreasing order of frequency by a combination of hatching and solids, checkerboard style, and parallel lines (Fig. 91). Styles found in minimal amounts (less than 5 percent) include solid triangles, opposing

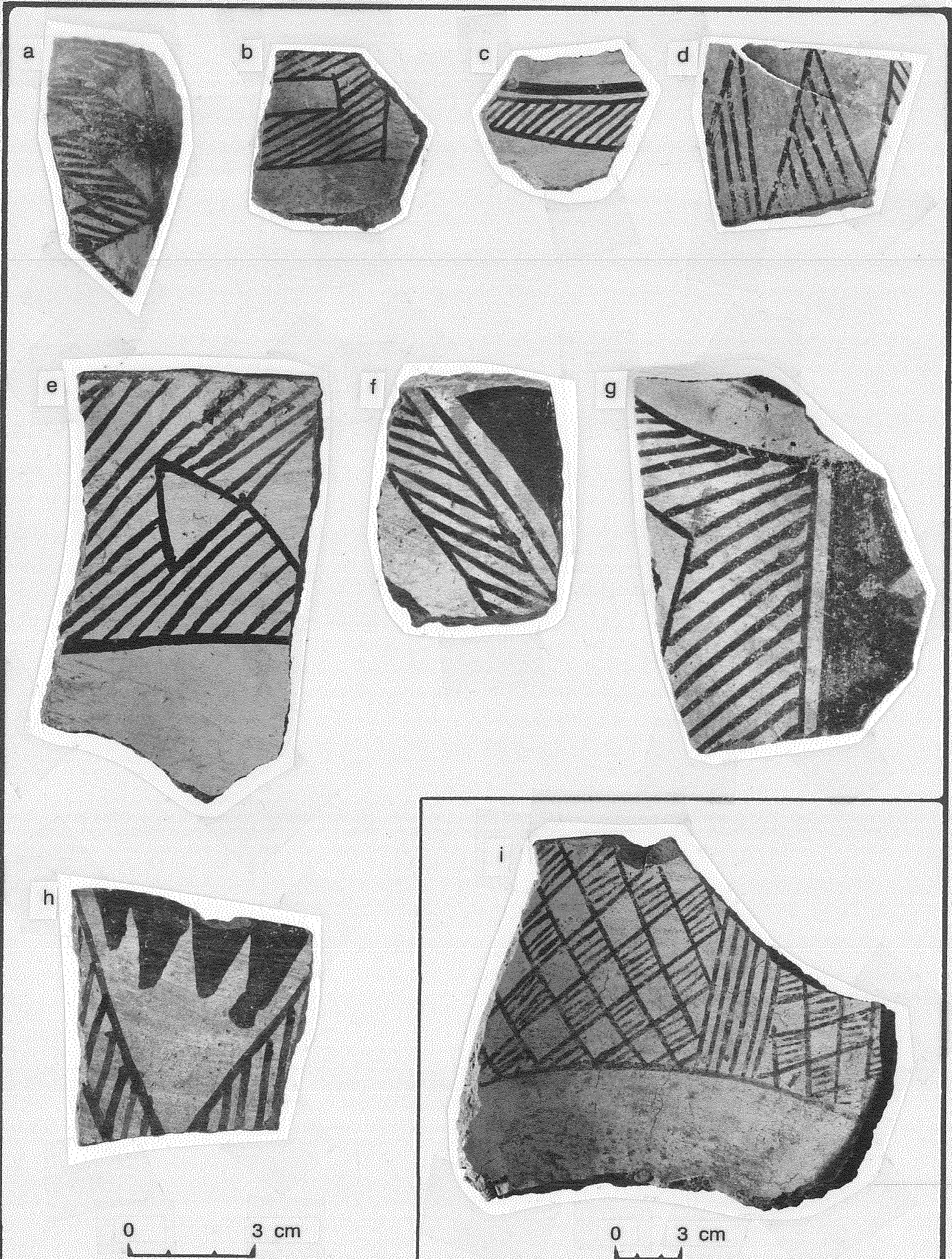


Figure 90. (a-i) Taos Black-on-white designs.

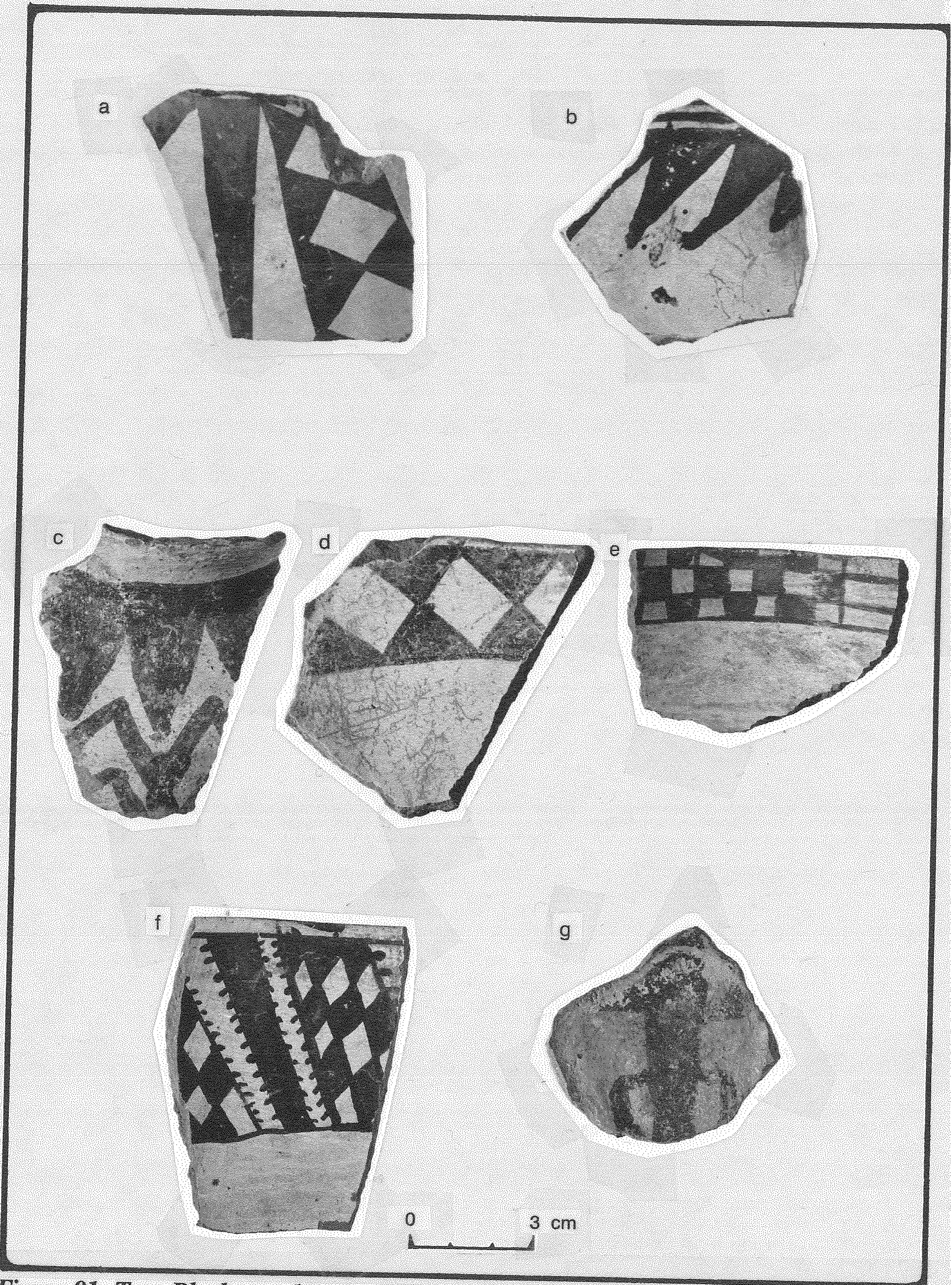


Figure 91. Taos Black-on-white designs (cont.): (a-c) solids and triangles; (d) opposing triangles; (e, f) checkerboard; (g) zoomorphic figure.

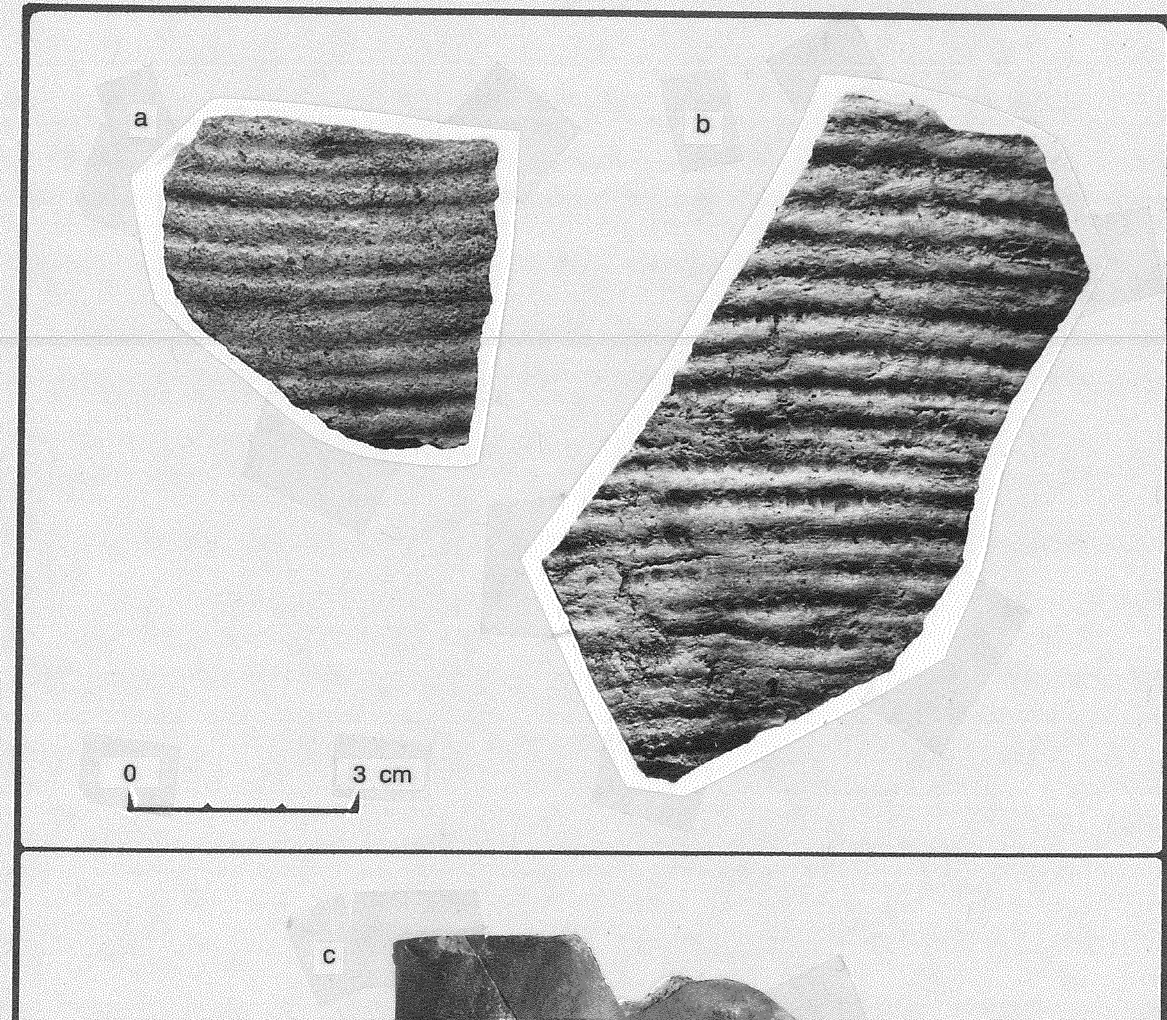


Figure 92. (a, b) Taos Black-on-white, basket-impressed exterior; (c) Taos Gray Incised jar.

triangles filled with hatching, opposing solid triangles, and triangles with bands. One sherd with an animal design, possibly a lizard (Fig. 91g), was found. Curvilinear designs were rare. Basket-impressing occurred occasionally (Fig. 92a). These styles are consistent with the assemblage from Pot Creek Pueblo (Wetherington 1968:52-53) and from Peckham and Reed's three sites (1963:11).

The Santa Fe Black-on-white sample is too small (44 sherds) to make an accurate style comparison, but it seems that design styles are similar to those on Taos Black-on-white. Elements recorded include parallel lines, combinations of hatching and solids, Dogozhi style, and triangles. No curvilinear designs were noted. Again, these results are consistent with the Pot Creek Pueblo assemblage (Wetherington 1968:54).

Vessel Forms

Most of the white ware sherds are from bowls. Table 108 presents vessel forms by sites. LA 3570 has been omitted because our sample is too small, and Peckham and Reed's study did not differentiate vessel forms. LA 70576 was omitted because there is only one white ware sherd in the assemblage.

Table 108. White ware vessel form, percentages by site

Site No.	Jar	Bowl	Ladle	Canteen	Indeterminate
LA 2742	27.7	63.5	0.6	0.2	7.7
LA 70577	39.0	56.5	0.4	--	3.6
LA 71189	32.8	64.2	--	--	3.0
LA 71190	38.2	60.5	--	--	1.3

White ware bowl forms average 61.2 percent of the total white ware assemblage, while jar sherds average 34.4 percent. Other vessel forms occur only in minimal amounts. This differs from Wetherington's (1968:53) analysis, where jars predominated within Taos Black-on-white. Peckham and Reed (1963:11) lists bowls, dippers, jars and pitchers as vessel forms for Taos Black-on-white, but it is not clear whether he is listing forms in order of frequency.

Relatively few rim sherds were found. Bowl rims far outnumber jar rims, but this is not unexpected since the rim of a bowl accounts for a greater proportion of a vessel than does a jar rim. Most white ware jar rims are straight and rounded or everted and rounded. A few have tapered lips, but the sample size (17) is too small to accurately characterize white ware jar rim forms. Most bowl rims are straight with rounded edges.

Next in frequency are straight with tapered lips and straight with squared lips. A few are inverted with either rounded, square, or tapered lips.

Utility Wares

Utility wares dominate the assemblages, except at LA 71190, discussed above. At LA 2742, utility wares comprise 83.0 percent of the assemblage, and 75.1 percent at LA 70577. All culinary ware sherds were considered Taos Gray and were subdivided into types based on Peckham and Reed's (1963:12-15) and Wetherington's (1968:58-60) descriptions. The four main categories are plain, incised, corrugated, and punctate. All are coarsely tempered with angular quartz and granitic gneiss. Almost all utility ware sherds represent jars (98.6 percent at LA 2742, 98.4 percent at LA 70577). Bowls, canteen, and pipe sherds were found in very low frequencies. Everted, tapered rims and straight, rounded rims are most common. Other rim forms noted include flared tapered, everted tapered, and straight tapered. The following descriptions are from Peckham and Reed (1963) and Wetherington (1968).

Taos Gray Plain

The surface of Taos Gray Plain is unpolished, often rough and pitted. Scraping sometimes left a brushed or scored appearance. The coils are often unobliterated, emphasized in neck-banding and corrugating. Basket-impressing occurred occasionally. Many Taos Plain sherds may represent lower portions of decorated utility vessels, since decoration generally occurs only on the necks and shoulders of culinary vessels. This skews the counts of utility ware types.

Most culinary sherds from our sites are Taos Gray Plain. This type accounted for 82.8 percent of the utility wares at LA 2742 and 91.1 percent at LA 70577 (Table 109).

Taos Gray Incised

Incised decoration was predominant in the Valdez phase, usually a linear or herringbone design. Linear design consists of parallel lines running horizontally around the neck and shoulder of the vessel, reminiscent of neck-banding (Figs. 92b, 93a-93e). The herringbone pattern generally consists of parallel, horizontal rows of nested chevrons, or herringbone elements (Figs. 93f-93h). Occasionally both linear and herringbone elements occur on the same vessel (Figs. 93i, 93j). An incised squiggle-line design is shown in Figure 94a. Vickery (1969:240) suggests the use of bone awls as incising tools. Fingernail incising occurs rarely. Table 110 is a breakdown of the

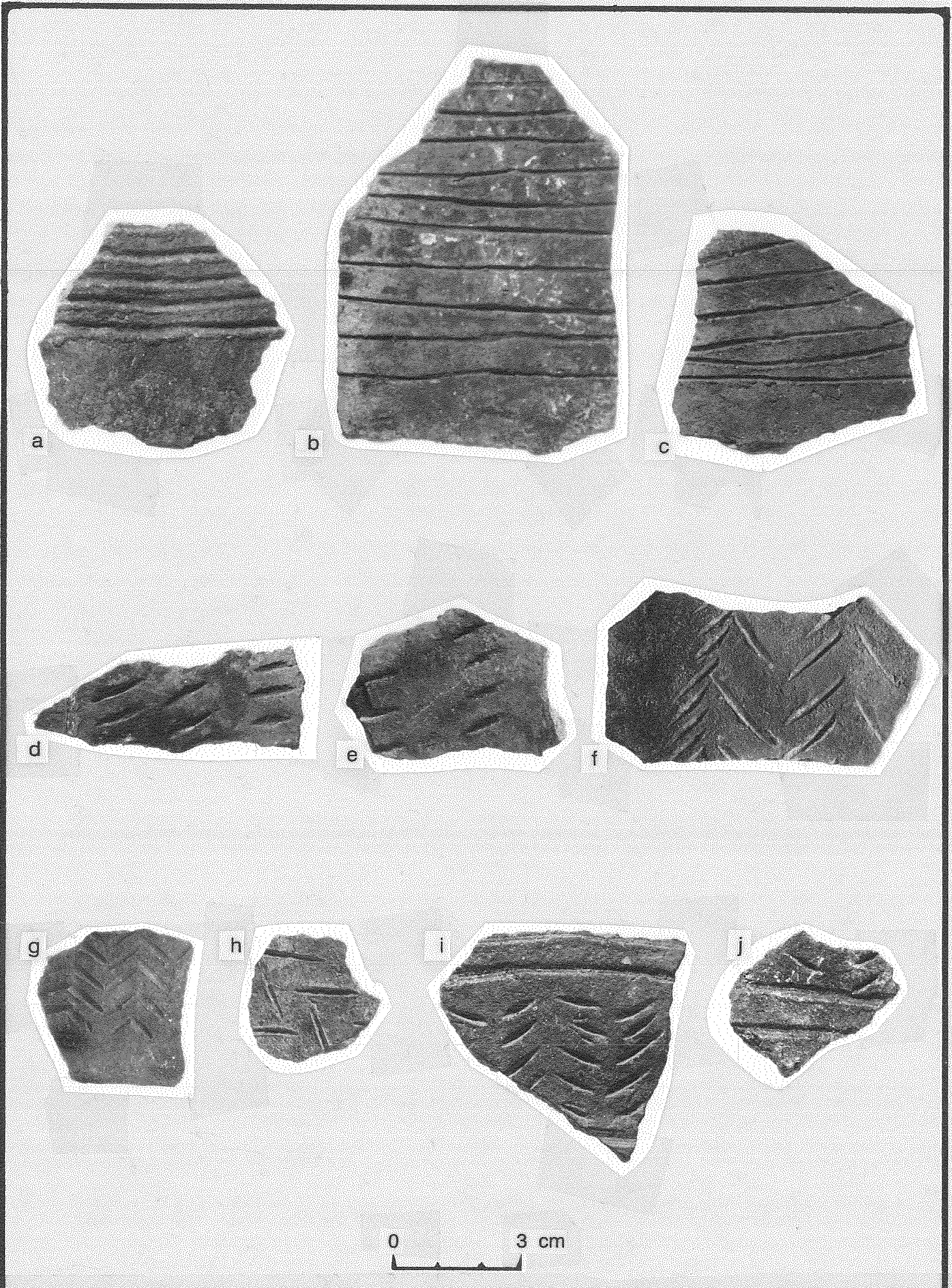


Figure 93. Taos Gray utility ware: (a-e) linear incising; (f-h) herringbone incising; (i, j) linear and herringbone incising.

various incised motifs. LA 70576 was omitted because of the small sample size. LA 3570 was omitted because our sample was too small, and Peckham and Reed did not distinguish incised styles.

Table 109. Utility wares types, percentages of utility ware assemblages and site assemblages

Site No.	Plain	Incised	Punctate	Corrugated	Neck-banded
LA 2742	82.8 68.7	14.8 11.4	1.5 1.3	0.2 0.2	0.6 0.5
LA 70576	70.6 9.3	23.5 3.7	5.9 --	-- --	-- --
LA 70577	91.1 68.4	7.6 5.7	1.3 0.9	0.1 0.1	-- --
LA 71189	67.4 45.7	1.4 1.0	-- --	31.3 21.2	-- --
LA 71190	72.7 33.8	10.6 4.9	-- --	16.7 7.7	-- --
LA 3570 (Peckham)	84.9 68.7	12.5 10.1	-- --	-- --	-- --

Table 110. Taos Gray Incised styles, percentages of Taos Gray ware assemblage

Site No.	Linear	Herringbone	Linear and Herringbone	Fingernail	Other
LA 2742	12.3	1.4	0.6	--	0.5
LA 70577	6.6	0.2	0.6	0.2	--
LA 71189	1.4	--	--	--	--
LA 71190	10.6	--	--	--	--

Taos Gray Punctate

Punctate designs are similar to incised designs; the method of decoration is the only difference. While incised designs were drawn with a sharp pointed object, a blunt object was pressed into the wet clay to make punctate patterns. Taos Gray Punctate occurs rarely (Figs. 94b, 94c).

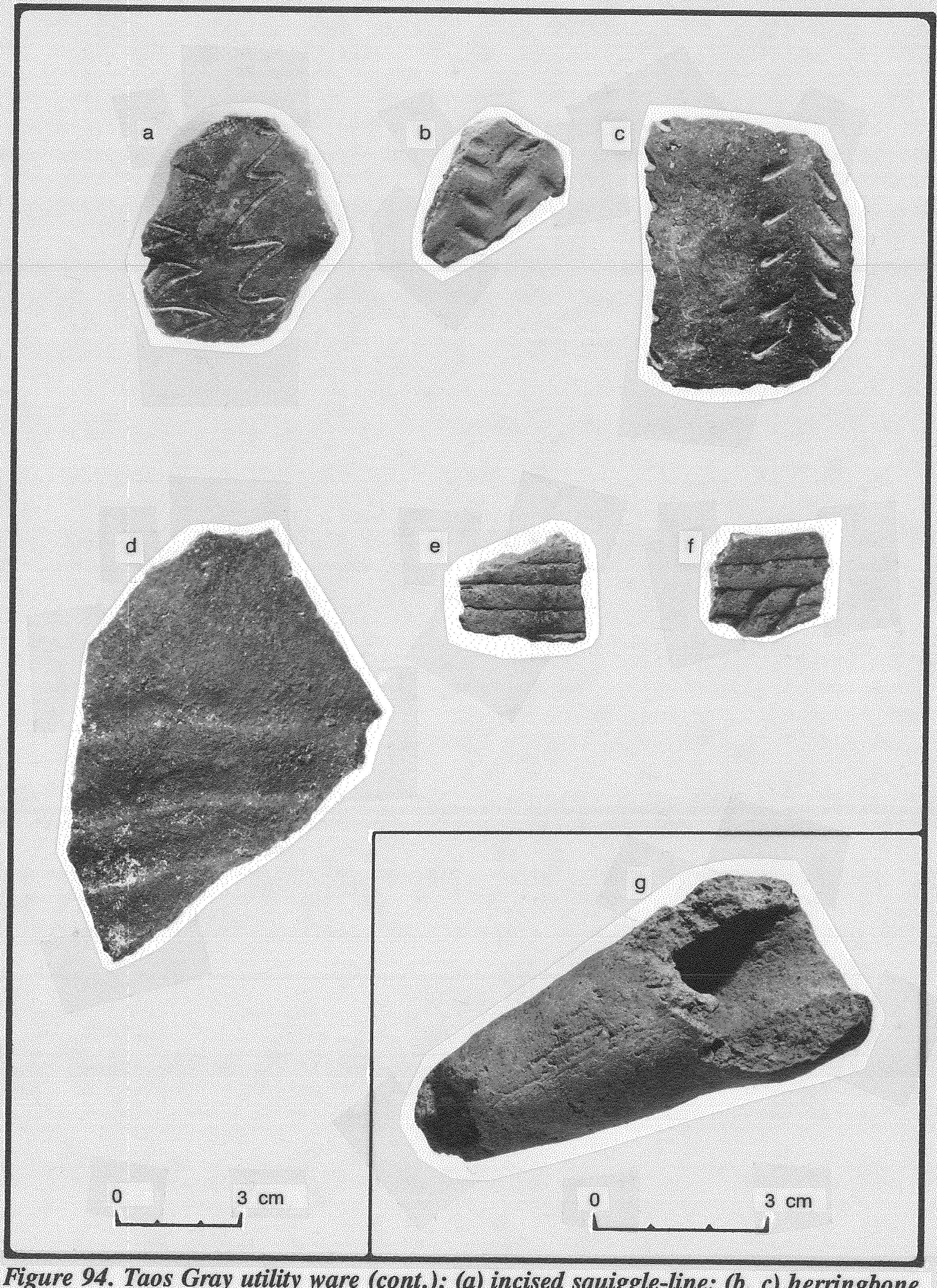


Figure 94. Taos Gray utility ware (cont.): (a) incised squiggle-line; (b, c) herringbone punctuate; (d) plain, with unobliterated coils; (e) simple corrugation; (f) indented corrugation; (g) Taos Gray Plain, cloud blower.

Taos Gray Corrugated

Taos Gray Corrugated is found in higher frequencies during the Pot Creek phase than the Valdez phase (see Table 109: Pot Creek-phase sites are LA 71189 and LA 71190). Both simple and indented corrugated occur (including smeared indented), but indented is the more frequent type (Figs. 94e, 94f). In both varieties, corrugation is confined to the neck and shoulder of vessels. Often the corrugation is smoothed, and sometimes it is slightly polished. Neck-banding is seen rarely, and probably only in the early part of the Valdez phase. Table 111 presents types within Taos Gray Corrugated.

Table 111. Subtypes of Taos Gray Corrugated, percentages of utility ware assemblage and total site assemblage

Site No.	Simple	Indented	Smeared Indented
LA 2742	-- 	0.1 0.1	0.1 0.1
LA 70577	0.1 0.1	-- --	-- --
LA 71189	12.8 8.7	12.8 8.7	5.7 3.8
LA 71190	3.0 1.4	7.6 3.5	6.1 2.8

Taos Gray Plain occurred throughout the Valdez, Pot Creek, and Talpa phases. Taos Gray Incised was predominant during the Valdez phase, though it continued into the Pot Creek phase, and until recently it has been thought to gradually decrease through the Talpa phase (Wetherington 1968:48). This has not been clearly demonstrated. Taos Gray Corrugated did not occur in significant amounts until the Pot Creek phase, when it was the dominant culinary ware associated with Santa Fe Black-on-white. Taos Gray Punctate never appeared in significant amounts, and its temporal range is not clear (Wetherington 1968:59).

Boyer (1991d:11) has suggested that Taos Gray Plain may have a longer time span than has traditionally been thought, perhaps lasting until as late as 1750. This assumption is based on Dick's (cited in Boyer 1991d:11) projected starting date of 1706 for micaceous utility wares in the area. There is no documented utility ware between the end of the Talpa phase, around A.D. 1350-1400, and 1706. Because Taos Gray Plain is found in ceramic assemblages that otherwise appear historic (Olinger and Woosley 1989; Woosley and Olinger 1990), Boyer proposed that this type may last into historic times, until it was replaced by micaceous wares.

Vickery (1969:255) questions "Tesuque Smeared Indented," the type name Green (1963:109) used for smeared indented sherds from Pot Creek Pueblo. Tesuque Smeared Indented, named by Mera (1935:14), is the culinary ware associated with Santa Fe Black-on-white in the central Rio Grande region (Coalition period). Regional distribution may be the only distinction between this type and Taos Gray, smeared indented corrugated, though a detailed study of the Tesuque variety is necessary to confirm this. If the Taos variety is a local version of Tesuque Smeared Indented, then the name "Taos Gray Smeared Indented" seems appropriate, in keeping with the rest of the Taos Gray series.

The incised wares are puzzling in that there is no clear antecedent for this style within the northern or central Rio Grande, and incised pottery was rare among the San Juan Anasazi. Potsui'i Incised, a major type in the lower Rio Chama Valley, was not made until almost 150 years later. Wendorf and Reed (1955:143) suggest that the appearance of incised pottery may reflect influence from Plains and Mississippian cultures to the east. Plains groups to the north and in the Texas Panhandle were making cordmarked culinary pottery, with only a hint of incising, usually on the lip or just below the rim (Kreiger 1946:44). But since rim incising is generally later, during the Antelope Creek focus (A.D. 1200-1450), and Plains pottery is formed by the paddle and anvil method rather than coiling, it is doubtful that these types influenced Taos area pottery.

Taos Gray Incised has been found in sites near Cimarron in northeastern New Mexico, at sites associated with the Ponil phase (A.D. 1100-1250) (Lutes 1959:62; Glassow 1980:74). The main site types during this time were caves and rock shelters. It has also been recorded in the Trinidad Lake area in southeastern Colorado. Wood and Bair (1980:185-189) describe a locally made Taos Gray Incised (synonymous with Sopris Plain), tempered with sand, sandstone, and siltstone, which is found with Taos Black-on-white. These types occurred during the Sopris phase (A.D. 1000-1225) of the Upper Purgatoire complex. Incised pottery comprised a significant portion of the assemblages from two excavated sites, while white ware percentages were very low. This pattern is very similar to that seen in the sites of the northern part of the Taos Valley, discussed by Boyer (Conclusions). At site 5LA1416 at Trinidad Lake, 9.5 percent of the assemblage was Taos Gray Incised, and 4.5 percent was white wares (including Taos Black-on-white, Red Mesa Black-on-white, and unidentified white wares). The north area sites near Taos had 15.6 percent Taos Gray Incised and 4.3 percent white ware. The south area, in which our sites were located, had 9.6 percent incised sherds and 25.7 percent white wares (see Conclusions). The other Trinidad Lake site, 5LA1211, had 40.3 percent Taos Gray Incised and 4.6 percent white wares. The striking similarities in incised and white ware proportions may suggest a northern influence in the settlement of the Taos Valley, at least in the Arroyo Hondo area. Perhaps the Trinidad area was an as yet undefined link to northern groups passing influence from north to south.

Micaceous Wares

The only site with a substantial micaceous ware assemblage is LA 70576 (85.2 percent). Three sherds were found at LA 70577, which is just upslope from LA 70576, and these sherds may have been carried there at a later time. Three micaceous sherds were also found at LA 3570. The assemblage from LA 70576 was coded as Peñasco/Cimarron because of the small size of the sherds, making identification difficult, and because of the difficulty in distinguishing Puebloan from Apachean micaceous wares. Peñasco Micaceous, a Puebloan type, has a micaceous paste and is still produced today at Picuris Pueblo. Dick (1990) has dated Peñasco Micaceous from A.D. 1650 to the present. Cimarron Micaceous is defined as 4-6 mm thick, with a laminated micaceous paste, dating from 1750 to 1900 (Gunnerson 1969). More recently, Dick (cited in Boyer 1991d:11) lumped the supposed Apache and Puebloan micaceous wares together as a single type with minor variations, based on the thin, laminar paste, dating from 1706 to 1850. He believes the modern Taos and Picuris wares are different.

Woosley and Olinger (1990:351-373) have discussed the risk in using micaceous pottery as an ethnic marker to distinguish the cultural affiliations of historic sites. During the historic period in the Taos Valley, the only ceramics produced were plain wares, particularly micaceous pottery. Similarities in Apachean and Pueblo micaceous wares make it difficult to differentiate the two types. To understand the source of the confusion, the following discussion of the history of interaction between the two groups is abstracted from Woosley and Olinger (1990:352-356).

Apaches were living in the Taos Valley and trading with Picuris and Taos Pueblos in the late sixteenth century, when their presence was documented by Spanish explorers. An alliance soon developed between the Pueblos and the Apaches, uniting them against the Spaniards. When Taos Pueblo revolted in 1640, the Pueblo residents fled with the Apaches to the Cuartelejo Plains region of eastern Colorado and western Kansas. Puebloan and Apachean interaction continued after the subsequent 1680 revolt.

During this time, cultural knowledge was shared as a result of the alliance between the two groups. Athapaskan potterymaking is thought to have developed early in this period because of prolonged contact between Pueblo and Plains groups.

In the eighteenth century, three ethnic groups occupied the Taos Valley: Tiwans, Jicarilla Apaches, and Spaniards. Relations changed between them when all three banded together against the Comanches. During the time of Comanche predations, the Apaches and the Spaniards sought shelter in the pueblo. This intensified the interaction between groups as a result of the exchange of goods and knowledge. The Spaniards eventually resettled in the valley, while the Apaches crossed the mountains and established semipermanent settlements to avoid the Comanches. A 1765 census reported Jicarilla settlements along Rio Grande del Rancho (then known as Rio de las Trampas). Relations between these three ethnic groups deteriorated as the Comanche threat lessened in the nineteenth century.

Given the extent of contact and acculturation between the Pueblos and Apaches, this was an ideal time for knowledge of pottery manufacture to be transferred. Woosley and Olinger (1989:2; Woosley and Olinger 1990:367) suggest that the Jicarillas may have started making micaceous pottery about 1700. Their X-ray fluorescence data indicate that there was not a well-established micaceous pottery tradition at Taos Pueblo at this time and that the Pueblos were getting their pottery from the Jicarillas. After learning pottery manufacture from their Puebloan neighbors, the Apaches may have refined the technique by using micaceous clay. The Taos Gray utility ware associated with the Tiwa pueblos was not highly micaceous. Woosley and Olinger (1990:365) suggest that "the use of micaceous clays, needing little alteration once collected, might appeal as a craft to an essentially mobile people." Thus, they may have learned the technique between 1600 and 1700, and the use of micaceous clay could have been an Apache innovation. The Pueblos may later have adapted the use of micaceous clay themselves because Taos and Picuris Pueblos are traditionally known as centers of micaceous pottery production. Puebloan potters call their micaceous clay "Apache clay," and Taos potters say that the Jicarillas taught them how to make micaceous pots (Gunnerson 1959:152). However, if this is the case, dates for Peñasco and Cimarron Micaceous need to be revised, reflecting an earlier date for Cimarron (Apache) than for Peñasco (Puebloan) Micaceous.

Woosley and Olinger used X-ray fluorescence to identify micaceous clay sources to determine ethnicity. Sherds from sites both in and out of the valley were examined. The result was that five different chemical clusters were identified, indicating the existence of multiple clay sources or production centers. As Woosley and Olinger (1990:366) state,

> These results may indicate a semisedentary people ranging throughout a region, exploiting numerous micaceous clay sources and making pots as needed for domestic use and trade. This situation is in contrast to a single chemical cluster characteristic of a settled people mining clays from limited source locations over time, as is the case, for example, for the historic brown utility ware produced by Taos Pueblo.

Taos Brown, as defined earlier by Olinger and Woosley (1989:1), is a catch-all category for several types of utility ware produced historically at Taos Pueblo. These types include a sand-tempered polished black, Taos Incised, lightly grooved utility, Taos Plain utility, nonmicaceous ribbed, smeared indented, and ridged. They describe the paste as less vitrified than that of Taos Gray (though the Taos Gray from our assemblage rarely had a vitrified paste). Taos Brown is usually smudged and thus appears darker than Taos Gray. Both types have sand temper, though the mica content is slightly higher in Taos Brown (but not enough to be considered a micaceous ware).

Though the ceramic assemblage alone may not determine the cultural affiliation of a site, a combination of ceramics, architecture, other associated artifacts, and site setting ultimately may (see LA 70576). At micaceous ware sites examined by Woosley and Olinger, Powhoge Polychrome (A.D. 1760-1850) was often found; San Juan or Nambe Polished Black was found less often. Lithic artifacts were abundant. Metal projectile points, hearths, and rock rings were sometimes associated. At this point, this group of attributes simply identifies a historic micaceous ware site; cultural affiliation is still unclear. Perhaps with further study of these types of sites we will be able to specify the ethnicity of the occupants.

Conclusions

The results of the analysis point to a developing frontier population, based on the propositions outlined in the Research Design. A low diversity of ceramic types is seen at all sites. Assemblages at all sites are dominated by Taos Black-on-white and Taos Gray Plain. Bowl forms predominate within Taos Black-on-white, while Taos Gray ware sherds are almost exclusively from jars. A slight increase in types is observed in the Pot Creek-phase sites (LA 71189 and LA 71190), where Taos Gray Corrugated and Santa Fe Black-on-white are seen more frequently. However, because these two sites are agricultural rather than habitation sites, they may not be accurate representations of a Pot Creek-phase assemblage. During this period at Pot Creek Pueblo, trade wares such as St. John's Polychrome and Wiyo Black-on-white are found, types not represented in our assemblage.

The issue of whether ceramics, particularly Taos Black-on-white, were locally made is important because it addresses questions of social and economic interactions of a developing frontier population. The analysis indicates that there are no non-locally made ceramics in either the Valdez-phase or Pot Creek-phase assemblages. Taos Black-on-white is a locally made version of Kwahe'e Black-on-white, based on the results of the petrographic study. Traditionally these types were separated based on presence or absence of an exterior slip on bowls, and presence or absence of sherd temper. Sorting bowl sherds by presence or absence of exterior slip and then examining temper confirmed that these variables are not reliable for defining two distinct ceramic types. Given this information, it is macroscopically impossible to distinguish Taos Black-on-white and Kwahe'e Black-on-white. Even with the aid of a binocular microscope, it would be difficult. Both have a very fine homogenous paste, and the nonplastic material, even in Kwahe'e sherds from the type collections, is so small that it is difficult to identify. Unless other distinguishing characteristics are identified in the future, petrographic analysis and identification of clay sources may be the only way to separate Taos Black-on-white from Kwahe'e Black-on-white and determine areas of manufacture.

Establishing Taos Black-on-white as a locally made type eliminates the supposition that pottery was supplied to the Taos Valley by neighbors to the south. The similarity to Kwahe'e Black-on-white and the quality of manufacture indicates that the immigrant population arrived in the Taos Valley with an already established ceramic technology. Knowledge of manufacturing techniques is further suggested by the fact that they found and used a local untempered clay, thereby eliminating the step of preparing and adding temper. Thus, it appears that the population was independent enough to produce pottery for their own needs. If the core area for the frontier was the central Rio Grande region, this is only partially reflected in ceramic styles. The white wares reflect this because Taos Black-on-white is a copy of Kwahe'e Black-on-white, and the small amount of Santa Fe Black-on-white from our assemblage also appears to be locally made. However, style alone is not sufficient to identify a core area. Dogozhi style (hatching), the most common decoration found on Taos Black-on-white, was a popular style throughout the Anasazi region, including the San Juan Basin, Mesa Verde area, and Kayenta region. But proximity to the central Rio Grande, similarity in paste between Taos Black-on-white and Kwahe'e Black-on-white, and the subsequent presence of Santa Fe Black-on-white seem to point to the central Rio Grande as the core area.

Styles in utility wares do not indicate the central Rio Grande. Incised wares were not common there, and corrugated pottery was in use with Kwahe'e Black-on-white (Valdez phase in the Taos District). However, corrugated wares were not in frequent use in the Taos area until the Pot Creek phase, associated with Santa Fe Black-on-white. As incised wares were not common anywhere in the Anasazi sphere, except perhaps south-central Colorado, their presence may suggest early contact with northern groups.

Analysis of ceramics in relation to frontier theory has both answered and posed new questions. Why did mineral-painted wares persist once carbon wares were introduced in the Taos Valley, when carbon paint *replaced* mineral paint in the central Rio Grande around A.D. 1200? What influence generated incised pottery? Why do trade wares not show up at the Pot Creek-phase agricultural sites (is our assemblage just too small)? Did Santa Fe Black-on-white from the central Rio Grande become an imported ware, or was all Santa Fe Black-on-white locally made? More study of Pot Creek- phase and Talpa-phase sites may answer some of these questions. Further study of other Valdez-phase sites in the Taos district within the framework of frontier development may eventually answer others.

OVERVIEW OF THE FAUNAL REMAINS

Linda Mick-O'Hara

Sites from the Pot Creek Project producing faunal remains were primarily Valdez phase. This was the first notable Anasazi occupation in the area. Therefore, occupants of Valdez-phase sites would have had a greater array of resources available to them than subsequent occupants of the Taos region. Faunal resource use should represent selection from the greater landscape along with a combination of production techniques brought into the region by this population. Analysis of faunal remains from these sites may shed light on part of this subsistence behavior. The small assemblage of 705 bone fragments recovered from all project sites can only begin to approach such questions and stimulate new questions to be explored.

The following synthesis of the bone recovered during the Pot Creek project will approach three issues: the taxa identified and segments of animals used, the context of recovery, and the taphonomic processes these remains have undergone. Comparisons will be made between the two pithouse sites, LA 2742 and LA 70577. These sites produced the most faunal remains and thus provided enough taxon and element identifications for at least a general comparison. Some of the small mammals identified will be used to discuss intrusive species versus those of economic importance.

Butchering and Consumption

Processing of animals for consumption and the discard of elements after consumption is of interest because of the information it can provide about the subsistence behavior of the prehistoric occupants of a site. While small mammals can be dismembered using only hands or left whole and thrown into a stew pot, reducing a large-sized mammal requires some planning and equipment. The use of stone tools to dismember carcasses and strip meat leaves butchering marks on the bone that can provide information about large mammal processing (Binford 1978, 1981). The effect of this processing on large mammal bone and the extent of bone fragmentation can provide information on the intensity of use of large mammals and, likely, the numbers of these animals being taken (Mick-O'Hara 1987b).

The paucity of large mammal remains in the faunal assemblages of LA 2742 and 70577 provides only limited evidence of carcass reduction and preparation, but some suggestions can be made based on their number and fragmentary condition. Only 69 bone fragments from LA2742 could be identified as large mammal, artiodactyl, or deer. Of that number, 57 fragments show evidence of reduction. Splitting is the most prevalent indicator of butchering. At LA 70577, 64 pieces of bone were identified as large mammal, artiodactyl, or deer, and only 21 fragments exhibit butchering, primarily in the form of splitting. Secondary cut marks are present from both sites, but in many cases the bone is so reduced through impact that cut marks and fleshing marks are obliterated.

Figure 95 presents the element distributions of remains identified as *Odocoileus* sp. from LA 2742 and LA 70577. At both sites, the mandibles isolated are those of mature individuals. At least three individuals are represented by metatarsals at LA 2742, while only one individual is represented by scattered remains at LA 70577. High meat utility elements are represented only by scapulae, innominate (ilium, acetabulum), humerus, and femur. Low meat utility elements dominate both samples in the form of lower limb bones, which carry small amounts of meat but are frequently reduced for bone grease and marrow (Binford 1978). Splitting of these elements indicates that they were processed for marrow and bone grease and that these animals were used as intensively as possible. This suggests that few of these animals were available or taken, a conclusion supported by the small number of deer bones. Low intensity of use is also reflected in the use of secondary species such as turkey and very small mammals in the diet, indicated by concentrations of small animal bone at both sites. Since many smaller mammal species burrow into fields, and turkeys tend to frequent gardens, these faunal assemblages may show an increase in garden hunting when scheduling conflicts prevent forays for larger game (Linares 1976; Hames and Vickers 1982).

Figure 96 shows the element distribution of turkey remains at LA 2742 and LA 70577. At LA 2742, where more deer remains were isolated, there are fewer and more concentrated occurrences of turkey remains, representing not more than two individuals. At LA 70577, at least four individuals are represented by femora and numerous postcranial remains isolated from the structural fill. This may indicate greater use of turkeys and correlates with fewer deer remains. These differences between sites are not great, but they suggest that more hunting was undertaken by the inhabitants of LA 2742 than by those of LA 70577 and that more secondary resources were used by the latter.

Context of Recovery (Cultural versus Intrusive Remains)

A limited amount of literature has dealt with the issue of small mammal remains as cultural or intrusive in archaeological context. The standard reference on this subject is Thomas's (1971) article, in which he identifies a small animal as intrusive if most of its skeletal remains are present within a deposit. If the remains are scattered within the deposits and represent only part of the overall skeletal anatomy, the animal is considered part of the cultural deposits and, by inference, economic in nature. The deposits encountered at LA 2742 and LA 70577 can be used to shed new light on this issue.

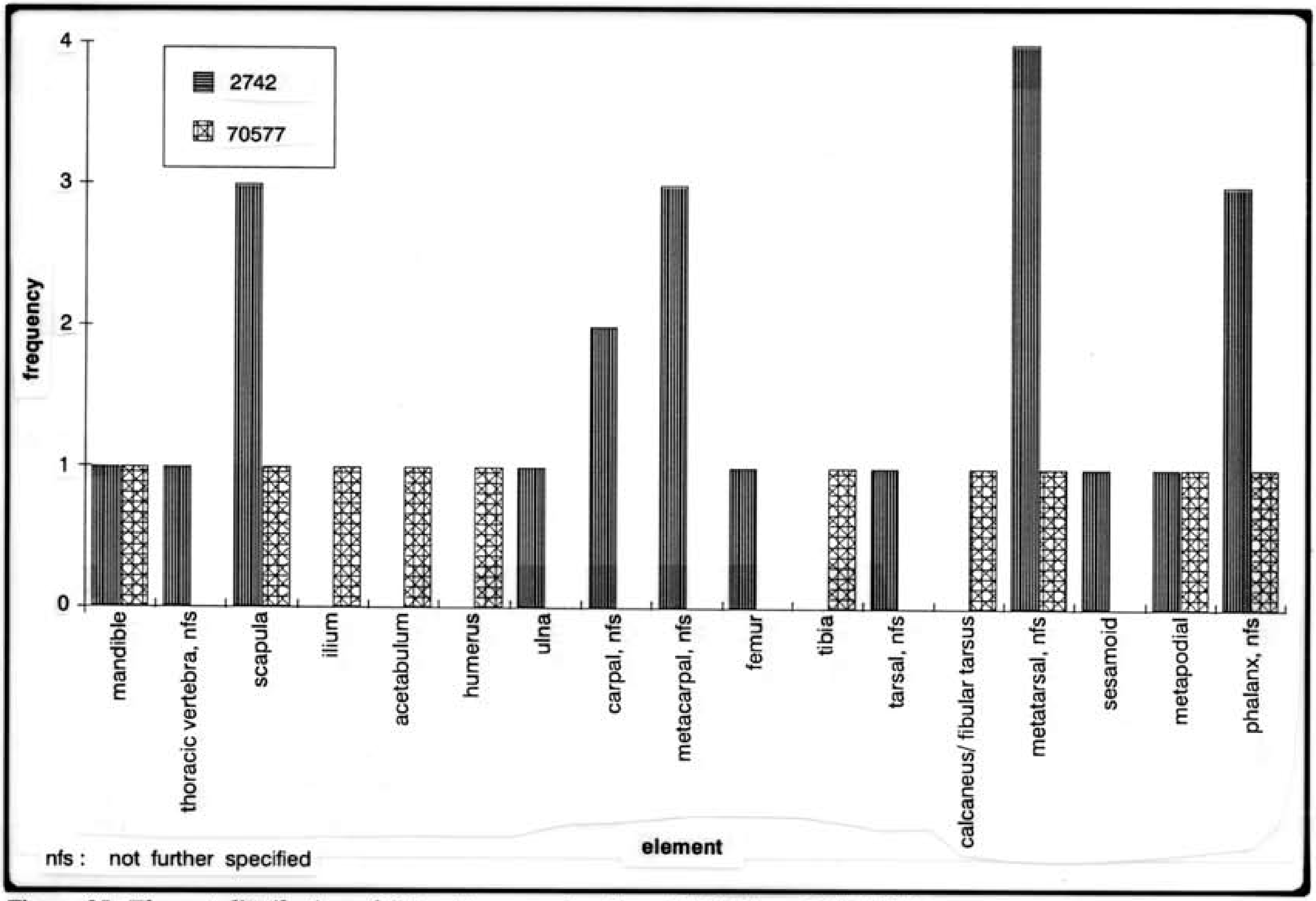


Figure 95. Element distribution of Odocoileus *remains from LA 2742 and LA 70577.*

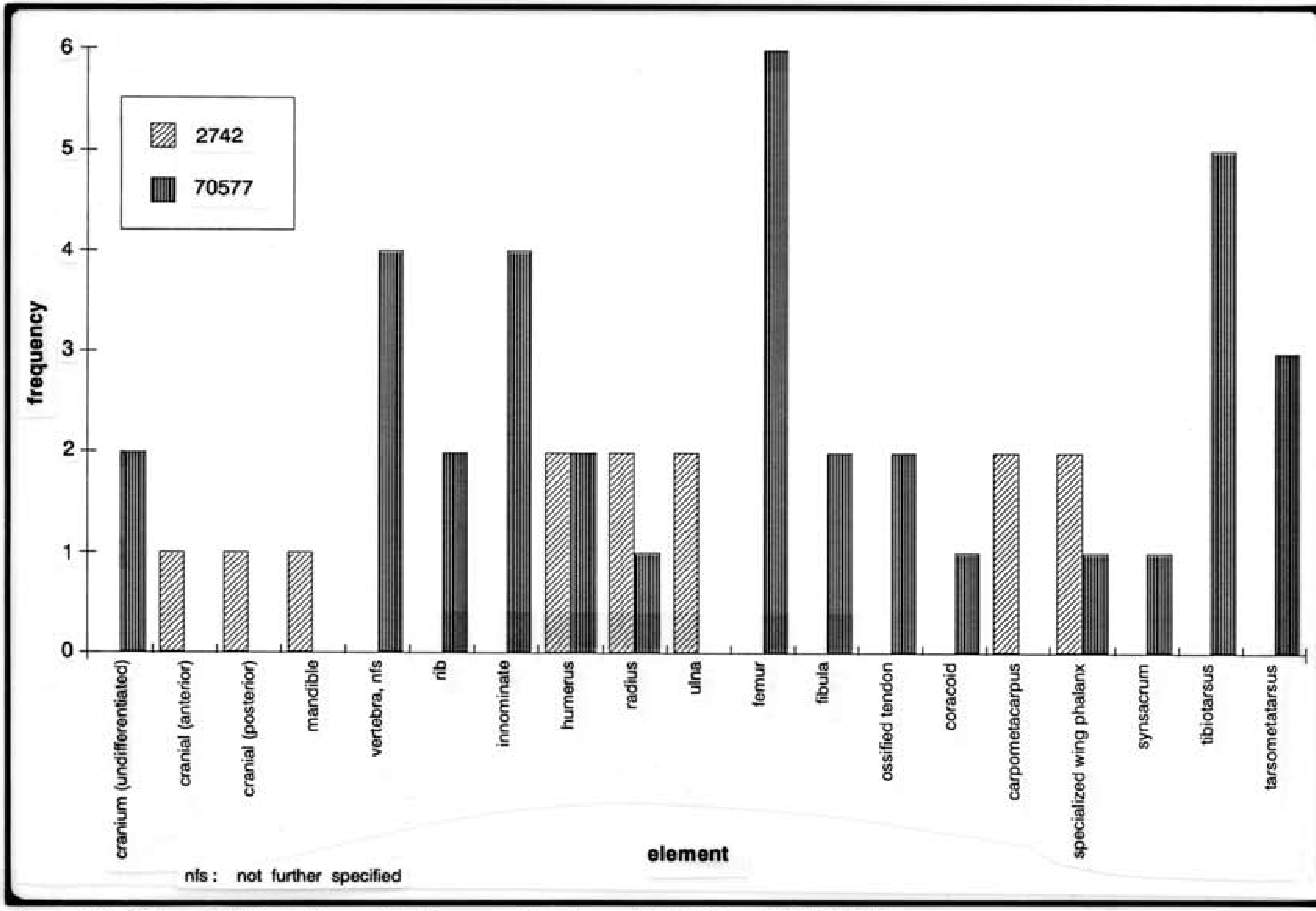


Figure 96. Element distribution of turkey remains from LA 2742 and LA 70577.

Small rodent remains are an important part of both site assemblages, and their element distributions and proveniences within those archaeological contexts make them even more interesting. The element distributions of kangaroo rat and vole at LA 2742 show that the vole is cultural (dietary) in introduction, but the kangaroo rat remains present a different picture. One or two kangaroo rats are represented by most skeletal elements. One individual died in a burrow. However, the other kangaroo rat remains were isolated from Feature 8 or were scattered in the structural fill with other rodent remains, suggesting that they represent part of the human dietary component.

Additional support for the combined cultural and intrusive nature of small animal remains at these sites comes from the numerous species isolated at LA 70577. At least one individual identified as prairie dog (and illustrated in the element distribution) was a burrow death. That, however, cannot explain the numerous other prairie dog remains concentrated with other small mammal species in front of the ventilator in the pithouse fill. These remains, along with those of pocket gopher, kangaroo rat, ground squirrel, mice, and vole, appear to have washed in from pot dumps near the top of the ventilator shaft. The identification of an intrusive individual of one species does not prove that other individuals were not used as part of the dietary component.

The use of a large number of small animal resources and turkey by the occupants of LA 2742 and LA 70577 has interesting implications. If Valdez-phase sites represent the first Anasazi occupation of the Pot Creek area, why were deer either not more readily available or not used? The few deer remains recovered suggest these animals were utilized as fully as possible and, thus, when taken were a preferred species. If hunting was reduced by agricultural scheduling conflicts, then the Valdez-phase occupants were much more involved in agricultural pursuits than their hunting and gathering predecessors. The economic nature of the small mammal remains support this view because these species are often taken in garden hunting (Linares 1976). These Valdez-phase sites suggest this population was very different from hunter and gatherers in the area. A migration of this population into the Pot Creek area may be the best explanation of this difference.

Taphonomy of the Faunal Assemblages

The general nature of the faunal remains and their context present an intriguing situation at both sites. The remains washed into the pithouse fill from nearby midden areas, so most bone is in at least a secondary context. This process is accented by the occurrence of a concentration of small animal bone in front of the ventilator at LA 70577, suggesting that these redeposited midden materials and the consequent filling of the pithouses was episodic to the extent that some materials remained in concentrations reflecting their primary deposal context. The redeposited faunal remains at both sites exhibit little weathering or erosion from exposure or water-borne sands. The bones must have been washed into the structures with a great deal of midden soil, which quickly reburied them. Bone recovered from Feature 8 at LA 2742 is the exception and probably represents intentional use of refuse to fill a pit prior to the feature's use as a posthole.

Modification by burning or carnivore gnawing occurred prior to deposition in the structural fill at both sites. Carnivores scavenged bone from midden deposits that subsequently became part of the pithouse fill. Outside of the few burned pieces of bone recovered from the hearths and ash pits, most remains were cooked and discarded without significant thermal alteration. Redeposited bone and bone recovered from features obviously reflect animal use by the former site occupants, but the biases in assemblage composition introduced by colluvial processes remain unknown.

Conclusion

The Valdez-phase sites investigated during the Pot Creek Project produced a small but intriguing faunal assemblage. The importance of small mammal species, the use of turkey, and the intensive use of deer remains suggest that the inhabitants of these sites were focusing on protein sources from field settings and unable, for whatever reasons, to participate in numerous hunting trips. The deer they did procure were processed as completely as possible, which suggests that this was a preferred resource but not a readily available one. Small mammals and turkeys are attracted to field settings and could be taken on an encounter basis while fields were being planted and tended. These small animals could be cooked in a stew pot, providing needed protein for the site occupants.

As discussed above, the site occupants were behaving quite differently from hunter and gatherers in the area. If the Valdez-phase occupation of this area was an outgrowth of earlier hunters and gatherers, their hunting practices should at least in part resemble those of their predecessors. The characteristics of these faunal assemblages suggest that this Anasazi population was fully agricultural. The sudden appearance of an agricultural population indicates that the Valdez-phase Anasazi may have been migrants into the Pot Creek area.

BONE TOOL ANALYSIS

Linda Mick-O'Hara

Excavations at LA 2742 and LA 70577 produced bone tools and shell ornaments. The bone tool assemblages from these sites are small and dominated by awls and awl fragments. They do, however, provide some insight into the use of curated bone and into various production activities that took place at the site.

Methods

Bone tool materials were initially analyzed with the other faunal materials recovered from the Pot Creek Project. These special production items were then separated from the other bone and analyzed a second time as tools. The shell ornaments were not analyzed with the dietary component of the faunal assemblages. Because all but one ornament appear to be made from marine shell, we can safely assume that they did not enter into the diet of the former occupants.

Bone tools and shell ornaments were identified using criteria developed for the Dolores Archaeological Project (Phagan and Hruby 1984) and the La Plata Archaeological Project; information on bone tools from Sandra Olsen's work at Grasshopper Pueblo (1979) and Kinishba Ruin (1980); and Mobley-Tanaka and Church's (1989) work from Yellowjacket. Kidder's (1932) bone tool classifications were also considered. All tools and ornaments were recorded, measured, and photographed.

LA 2742

LA 2742 produced six bone tools, one horn sheath ornament blank, and three shell pendants. Table 112 identifies as specifically as possible the bone and shell artifacts by species and element used in their production. Such a small assemblage of bone and shell artifacts precludes in-depth comparisons, but its occurrence does suggest some activities that took place at the site during and after occupation.

The bone tools from this site are the product of reduction of large mammal long bone. The two fine-point awls in Figures 97a and 97b were manufactured from deer metapodials. They conform to Kidder's (1932) Class B, in which the proximal end of the tool was split during processing, but further reduction of that end was apparently through use-wear alone. They are also similar to awls described by Green (1976:58) from other Valdez-phase sites.

Table 112. LA 2742, bone tools

Taxon	No.	Type	Element
Large mammal	1	gaming piece	long bone
	1	awl fragment	long bone
	1	tool indeterminate	long bone
	1	ornament blank	horn sheath
Artiodactyl	1	tine flaker	antler
Odocoileus sp.	1	fine-point awl	metatarsal
	1	fine point awl	metapodial
Invertebrate	3	shell pendant	marine shell bivalve
Total	10		

An antler tine flaker was also identified (Fig. 97c). This implement was beveled and broken at the tip and was probably discarded in a trash area. The tool is similar to several illustrated by Kidder (1932:280), but he indicates polish and use-wear on his beveled flakers. There is no apparent use-wear on the LA 2742 antler tine tip after the beveled break.

A flattened ovoid piece of large mammal bone most closely resembles a gaming piece, though no incising typical of that form is present (Fig. 97d). It could also have been a reworked awl fragment.

The other bone tools are an awl fragment and a tool fragment with a smoothed notch and a ground edge, probably part of a broken spatulate, but the full tool shape could not be determined from this fragment (Fig. 97e). The specimen was initially made from a complete element of large mammal long bone and was discarded after it was broken.

All the bone tools were recovered from pithouse fill. The fact that some of these tools appear to have been discarded supports the contention that the fill was at least partly composed of soils and trash washed in from a midden area or activity area nearby. Thus, the pithouse was a secondary context for these items. Nonetheless, artifacts in this postabandonment trash fill represent occupational activities at the site. The awls reflect clothing production or other work with skins or plant fibers, while the antler tine flaker was used in stone tool production, especially fine pressure flaking, at the site.

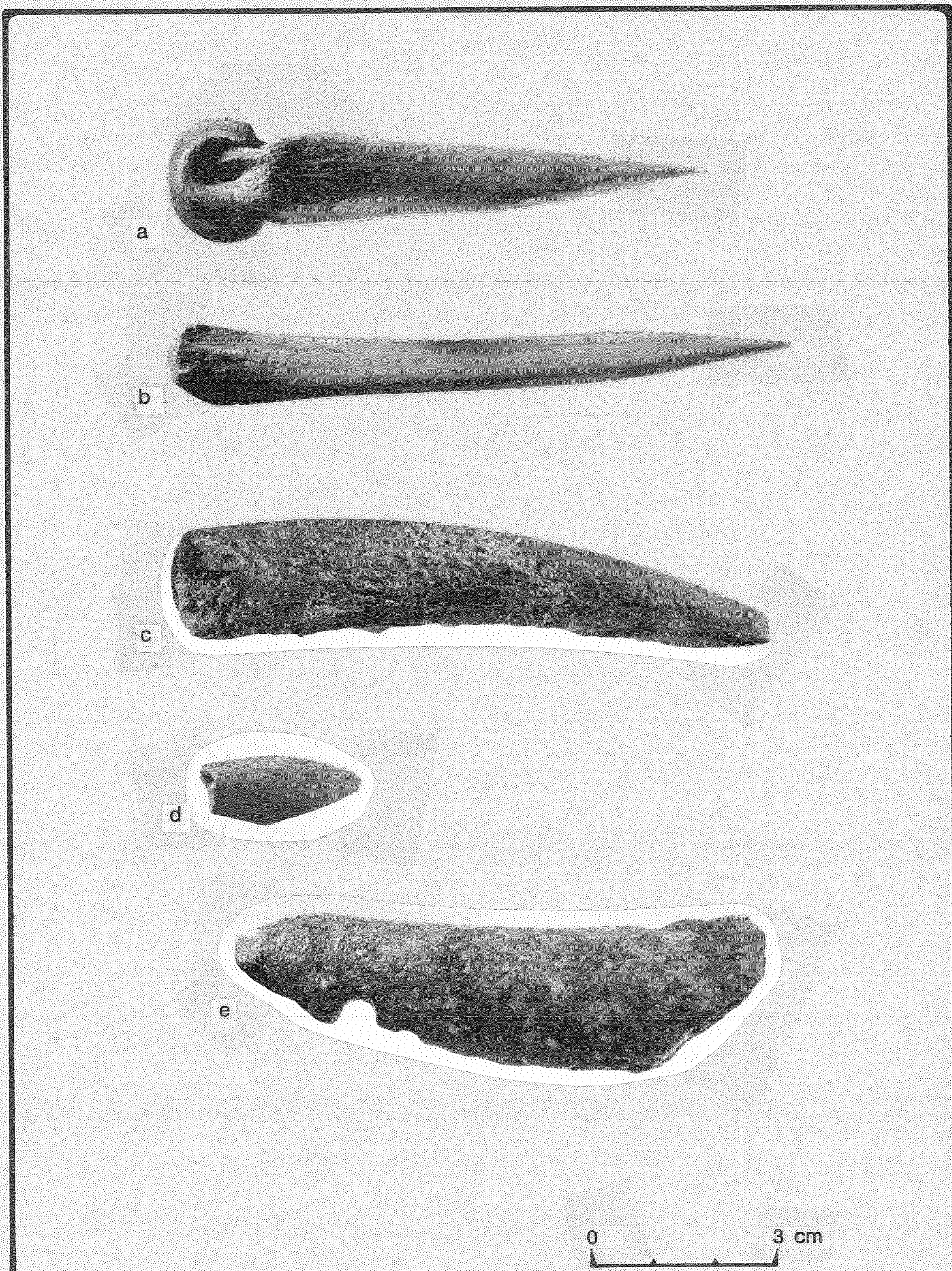


Figure 97. LA 2742, bone tools: (a) fine-point awl from distal end of deer metapodial; (b) fine-point awl from proximal end of deer metapodial; (c) antler tine flaker; (d) possible gaming piece; (e) possible spatulate.

Figure 98. LA 2742, bone and shell ornaments: (a) horn sheath pendant; (b) shell bead; (c) shell ornament; (d) shell pendant. LA 70577, bone artifacts: (e) coarse-point awl; (f) weathered coarse-point awl; (g) fine-point awl; (h) bone tube bead; (i) antler tine tool.

The other mammalian tissue used in ornament production was horn sheath. One ornament blank made of horn sheath was isolated from the midden north of the pithouse. It is rectilinear and shows a polished side with some striations (Fig. 98a). The other shell ornaments were all isolated from the pithouse floor and ventilator shaft. All appear to be made of some form of marine shell. Two are drilled beads, one triangular and one elongate (Figs. 98b and 98c). The third is rectilinear with two parallel grooves on one side and appears to have been a pendant (Fig. 98d). The three ornaments are made from a similar type of shell and may have come from a single imported specimen.

LA 70577

Of the bone and shell recovered during excavation at LA 70577, six pieces of worked bone and one shell ornament fragment were isolated from the pithouse fill. These items are summarized by species and element in Table 113. All the implements or tool fragments were made from small or large mammal bone. Only one awl could be assigned to a species and element.

Table 113. LA 70577, bone tools

Taxon	No.	Type	Element
Small mammal	1	polished waste	long bone
	1	bone tube bead	long bone
Large mammal	1	tool indeterminate	long bone
	2	coarse-point awl	long bone
Odocoileus sp.	1	fine-point awl	metapodial
Invertebrate	1	shell pendant fragment	marine shell bivalve
Total	7		

The two coarse-point awls identified were made from large mammal long bone, probably proximal metapodials (Figs. 98e and 98f). They conform to Kidder's (1932:209) Class C awls, in which the proximal end of the tool has been worked down from its original form, but some morphology remains. Both specimens are highly polished and extensively worked, and striations are still visible along the split surface. The single fine-point awl recovered from the pithouse fill was made from the split distal metapodial of a deer (Fig. 98g). It is comparable to Kidder's (1932:207) Class B, in which the element used for production has been split, but no further modification was made to the proximal or handle end of the subsequent tool. The point of this tool is round in cross section, and striations near the tip appear to have been produced through use. The implement may have been used to make basketry or for a similar task involving rotary motion that would create the wear evident on the functional end. Awls similar to these specimens were identified from other Valdez-phase sites in the area (Green 1976:58, 59).

One bone tube bead and a polished tool production waste specimen were also recovered from pithouse fill. These items were made from small mammal bone and appear to have been discarded and then washed in to the structural fill. The bone tube was cracked but does exhibit evidence of interior polish from having been strung (Fig. 98h).

Another bone tool recovered at LA 70577 was made from an antler tine (Fig. 98i). The tool was broken, but the remaining end was cut and rounded. Kidder (1932:283) has illustrated a similar tool form. The function of this implement is uncertain, but it may be part of a flaker used in stone tool production until it was broken and discarded. Alternatively, it may have been an antler awl such as those described by Green (1976:60) from other Valdez-phase occupations in the area.

The only item made of shell found at LA 70577 was a broken pendant, generally triangular, with no perforation or apparent incising. The shell appears to be of a marine type, similar to that recovered from LA 2742. This specimen was isolated from the structural fill but was obviously ornamental until it was broken and discarded.

Discussion

These small bone and shell tool assemblages provide some clues to activities during the occupation of LA 2742 and LA 70577. The tools are dominated by awls, which is true in most bone tool assemblages from habitation sites in the Southwest, including sites from the Valdez phase investigated by Green (1976). All items recovered are common to bone tool assemblages at habitation sites.

At both sites, imported bivalve shells and bone beads were used to make ornaments to adorn the occupants. Green (1976:59) suggests that objects of shell were rare during the Valdez phase. Their apparent rarity may suggest that such items were carefully curated and discarded only by accident. Bone awls were probably used in the production and repair of clothing and other household items. Antler flakers were used to produce lithic bifaces and projectile points, which were then used to supply the households with game and, coincidentally, more bone to be used in the production of tools and items of adornment.

OCCUPYING THE TAOS FRONTIER: THE VALDEZ PHASE AND VALDEZ-PHASE SITES

Jeffrey L. Boyer

Descriptions of the Valdez Phase

The earliest Anasazi occupation of the Taos Valley was first described by Herold (1968), based on the results of his 1960 survey of the Rio Grande del Rancho and Arroyo Miranda valleys. From 110 recorded sites, Herold defined three prehistoric "pottery groups" representing associations of pottery types with structural types and distributions. His Pottery Group 1 included 72 sites (65 percent of the total) (Herold 1968:27). The ceramic assemblage of this group, its most distinctive characteristic, included Taos Black-on-white, found at 99 percent of the Group 1 sites; Taos Gray Plain, found at 96 percent of the sites; and Taos Gray Incised, found at 78 percent of the sites. A variety of structural remains were recorded at Group 1 sites, including pithouse depressions, small pueblo mounds, and rock alignments. A fourth subgroup had no evidence of structures, but, assuming structures to be present if not evident, Herold assigned them to a category called "obliterated structures" (Herold 1968:33). In sum, Herold (1968:27) characterized Pottery Group 1 by stating, "The stage distinguished by Taos Black-on-White as the only painted pottery has the simplest composition, the longest duration, the greatest number of sites and the broadest distribution of all prehistoric pottery groups in the survey area."

Wetherington's (1968) seminal report on Pot Creek Pueblo was published in the same year. In addition to a decade of excavations at the site, Wetherington discusses the context of the large pueblo within the Anasazi occupation of the Taos Valley. He also compares Taos Valley archaeological developments with those of the Santa Fe and Albuquerque areas and the eastern plains, as known in the late 1960s. Wetherington's (1968) report is the first published use of the name "Valdez phase" to describe the earliest Anasazi occupation of the region. The name was taken from the village of Valdez in the Rio Hondo Valley north of Taos (Green 1963, 1976).

By the time Wetherington's report was published, several Valdez-phase sites had been excavated and, unlike Herold, Wetherington could incorporate survey and excavation data into a broader picture. According to Wetherington (1968:75), the Valdez-phase ceramic assemblage consists of Taos Black-on-white, some Kwahe'e Black-on-white, and plain, incised, and neck-banded Taos Gray. Architecturally, the sites consist of pithouses, often in groups of two to four, and small surface structures of coursed adobe begin to appear. He notes Peckham and Reed's (1963) excavation of an isolated *jacal* structure. He also notes that while many of the excavated pithouses were circular, rectangular ones were known, especially from Blumenschein's (1956, 1958,

1963) excavations near Rio Hondo and Arroyo Seco. Survey data indicated that three "areas of site concentration" could be defined in the northern, central, and southern parts of the region, and site locations ranged from about 2,130 m (7,000 ft) on the valley floor to narrow benches on ridges at close to 2,440 m (8,000 ft) (Wetherington 1968:77). These "areas of site concentration" appear to follow river drainages.

Wetherington (1968:79) assumes an evolutionary trend from pithouses early in the phase to a time "in the latter part of the Valdez phase [when] the people began to build small surface units of contiguous adobe-walled rooms. These, and the evidence from some *jacal* construction, suggest a growing tendency toward surface habitation, with the persistence of the pithouse essentially unchanged."

He is critical, however, of Green's (1963, 1976) designation of subterranean structures as "kivas" when found in association with surface structures. Referring to TA-47, where two small, superimposed surface pueblos were associated with two subterranean structures, he notes, "Contemporaneous with one or both occupations were two pithouses, or kivas" (Wetherington 1968:79). Of these structures, Green (1976:30) states,

> the two structures at Site TA-47 were called kivas rather than pit houses because of the presence of surface dwellings at the site and because of their location in relation to the pueblos. Without evidence to the contrary, it is assumed that the underground structures and the surface houses at Site TA-47 were contemporaneous; the contrast in architecture between the two underground rooms plus their architectural similarity to later religious structures strongly suggests that they were kivas.

Wetherington (1968:79) is unconvinced. He states, "Other than the size of the larger, which Green calls a kiva, there are no features which distinguish it from other pithouses in the area." He then asserts, "To attempt to see in surface construction alone the spontaneous evolution of the kiva for group ceremonial functions is both unnecessary and arbitrary" (Wetherington 1968:79). Arguing that growth in social size and complexity were probable causes of the formation of group ceremonial activities and facilities, he maintains that such conditions were not present in the Valdez phase and that, except for changes in subterranean structures that might suggest changing structural function, there was little actual evidence for such complexity in the succeeding Pot Creek phase. Rather, he contends that "ceremonial organization and social complexity slowly evolved with an increasing population" (Wetherington 1968:80). He does not note that the changes in subterranean structures possibly indicative of kiva use appear rather suddenly with the advent of the Pot Creek phase, as seen at Pot Creek Pueblo (Wetherington 1968:43-44) and TA-26 (Vickery 1969), belying his scenario of gradual structural evolution.

Taking this information together, Wetherington (1968:80) is able to draw conclusions regarding sociocultural conditions during the Valdez phase:

> Present evidence suggests that during most of the Valdez Phase social groupings consisted of several physically separated nuclear and extended family domiciles in several preferred areas in the district. It is logical to assume that these groups were mutually cooperative and friendly, since they all participated in the same subsistence pattern--growing maize and hunting. There is no evidence that they had either a common ceremonial complex or a common economic organization at this time.

Green's (1976) report on Valdez-phase sites describes the results of excavations at six sites in the Pot Creek, Talpa, and Llano Quemado areas, south of Taos. Excavated structures at five sites were pithouses; the sixth site, TA-47, consisted of two subterranean structures and two superimposed surface room blocks. Green does not describe provide a description of the Valdez phase; rather, she refers the reader to Wetherington's report. She does summarize the artifactual material from the sites and draws certain "condensed anthropological inferences" about the Valdez-phase Anasazi.

Like Herold and Wetherington, Green characterizes the phase's ceramic assemblage as including plain, incised, and neck-banded varieties of Taos Gray. She prefers to call the mineral-painted pottery Kwahe'e Black-on-white, Taos variety, rather than Taos Black-on-white, the name used by Mera (1935), Peckham and Reed (1963), Herold (1968), Wetherington (1968), and others, arguing that the differences between Kwahe'e and Taos Black-on-white are insufficient to distinguish them as types. The Valdez phase, she says, "begins with the local manufacture of ceramics in the Taos area and ends with the introduction of Santa Fe Black-on-white into the region" (Green 1976:63). Excavations demonstrate to her that both pithouses and surface pueblos were used during the phase and that "there is no reason to believe that pit houses and pueblos were not occupied contemporaneously" (Green 1976:64).

Ignoring the fact that earlier Basketmaker habitation sites have not been found in the Taos Valley and that the Taos Anasazi sequence begins later than its counterparts in other parts of the northern Southwest, Green (1976:64) argues,

> Without evidence to the contrary, it is presumed that the population of this region during the Tenth Century was descendant from earlier peoples there. There is no doubt that pottery manufacture was introduced from elsewhere--from the south, probably around Santa Fe--but whether or not the other items of material culture were part of the local tradition is still problematical.

Based on her excavation data and that of others as well as on survey data on the distribution of Valdez-phase sites, Green attempts to reconstruct various aspects of A.D. 900s Anasazi life in the Taos Valley. She states that the presence of maize pollen and charred maize cobs, kernels, and stalks shows that agriculture was an important economic activity, and, although other crops were probably grown and wild resources collected, maize was probably "the primary food source" (Green 1976:67). Nonetheless, the number of projectile points and other lithic tools as well as the number of bone tools demonstrates that hunting was a source of food and usable materials for tools. Interestingly, she found relatively few unworked bones in the trash deposits at her sites. Although she could find "no artifactual evidence of [wild plant] gathering as distinguished from farming" (Green 1976:67), several one-hand manos and two metates perhaps used with one-hand manos were recovered (Green 1976:45-47, 54-55). The presence of ceramic jars and ground stone artifacts outside of surface rooms and on top of collapsed pithouse roofs suggests that much food processing took place outside of the structures.

Animal domestication is evidenced by canine skeletons at two sites; both were found in pithouse ventilator shafts, which may suggest accidental death. Personal ornamentation is represented by a shell pendant, a shell bead, and four bone beads. The shell bead and pendant were found next to the right forearm of a human burial and may have been part of an arm band. The presence of hematite-stained paint palettes in "kiva 2" at TA-47 is the primary evidence of ritual activity. White, black, or yellow plaster on the first course of adobe at several pithouses may have had some religious significance, but Green (1976:88) observes that the so-called kivas at TA-47 were not similarly painted.

Green (1976:68-69) sees only limited evidence for contact and trade between the Taos Anasazi and other Anasazi populations. She points to obsidian tools and axes also found in the Santa Fe and Largo-Gallina areas. This interpretation is based on her assumption that the Valdez-phase inhabitants of the valley were descended from local hunter-gatherers who learned pottery manufacture and adobe architecture from Anasazi living to the south. Having accounted for these traits, she sees little else to indicate continued contact with people to the south. On the other hand, the considerable ceramic homogeneity suggests to Green that there was significant contact between pithouse villagers within the valley. Generally, evidence of intersite violence is lacking. However, three human burials were found on the floor of pithouse D, TA-18. Their positions, lying on top of each other and on features, covered by large stone including metates, and their crushed bones, suggest casual internment and perhaps violence. Also, a single human cranium was found on the floor of the smaller pithouse at TA-47.

The most recent description of the early Anasazi occupation of the Taos Valley comes from Woosley (1986), whose research purports to "suggest alternative interpretative models for prehistoric puebloan developments" in the region (Woosley 1986:145). Woosley does not use local phase names, preferring to discuss prehistoric settlement and demography in terms of Wendorf and Reed's (1955) classification. In this system, the Valdez phase falls into the Developmental period. Woosley (1986:148) states, "Early Developmental period sites consist of pit house clusters and are followed at a slightly later date by small surface pueblos of less than 10 rooms with or without a kiva." Her assignment of these sites to the early Development period, usually dated between A.D. 600 and 900, will be discussed later. At this point, it is important to remember Green's (1976) statement that there is no evidence to suggest that pithouses and surface structures were not occupied contemporaneously. Woosley (1986:148) goes on to describe Developmental-period sites near the village of Los Cordovas: "Thirty-seven of the 85 sites located in a 10 km^2 area consist of small, single-story room blocks, some with associated pit houses, and two with obvious kiva depressions surrounding surface rooms."

Since this information is derived from survey data, one must wonder how Woosley can distinguish between pithouse depressions and "obvious kiva depressions." Further, a site from this period (or any other) with kiva depressions surrounding a room block must certainly be considered an anomaly.

Looking back to Wetherington's (1968) cautions about assuming kiva function on the basis of association with surface rooms, Woosley provides no obvious assessment of the sociocultural situation that might have prompted the construction of communal ceremonial structures. She does, however, interpret the site density in a way that may show why community religious organization would be present when she says (Woosley 1986:149):

> The existence of a large number of contemporaneous, or at least partially temporally overlapping, sites suggests a local population of some size. Contemporaneity is determined on the basis of settlement type and associated artifacts, with ceramics considered the most sensitive temporal markers.

Thus, Woosley assumes that *all* Developmental-period sites were roughly or exactly contemporaneous. They must, then, have had fairly long use-lives, as reflected in her statement that the Cerrita site, consisting of a remodeled pithouse and a remodeled surface structure, was occupied for about 250 years (Woosley 1986:153). Several studies show, however, that pithouses had an expected use-life of 7 to 12 years before repair and structural remodeling became necessary, after which their use-lives might be extended to 20 to 30 years (Ahlstrom 1985; Schlanger 1985, 1986; Cameron 1990), or roughly one-tenth of the time postulated by Woosley for the Cerrita site. Cameron (1990:161-162) shows the effect of this difference on regional population estimates:

> Continuous occupation of a few families with a frequent change in structure could easily give the impression of a large contemporary population. One family changing structures every 10 years could, in only five decades, produce five pit structures. Fifty years is well within the temporal range of most ceramic types. The conclusion is that archaeological sites with many pit structures that show occupation over a long temporal span cannot be assumed to have had a large population over

> this period but instead may be the result of a small population occupying consecutively built structures.

The last sentence could well be rewritten to focus on regions with many pit structure sites. Cameron's (1990:162-163) revised figures for the Mimbres Valley, assuming pithouse life of 15 years instead of the 75 years assumed by Blake et al. (1986) decrease the regional population estimates by about 75 percent. This is an important issue since Woosley describes changing site density in the Taos region in terms of changing levels of population aggregation. She argues for a transitional phase between the Developmental and Coalition periods defined "by settlement aggregation, elaborations in architecture, and overlapping time-diagnostic ceramics" (Woosley 1986:148). Assuming site contemporaneity, she calculates site densities for seven "topographically circumscribed areas of the Taos district." The data from her table (Woosley 1986:150) are reproduced in Table 114, which also shows the actual number of sites in each area (calculated from her percentage figures) and the percent of increase or decrease in site numbers between periods. Note that the total number of sites in each row (column 11) does not equal the number of sites recorded in each area (column 3). The difference is apparently in those sites that could not be assigned to a period (nondiagnostic artifact scatters?).

Woosley observes an increase in the number of sites per square kilometer beginning with the Developmental period, but a decrease at the transition from late Developmental to Coalition periods. Relying on the assumption of site contemporaneity and the consequent large regional population, she states (Woosley 1986:150):

> The occurrence of fewer numbers of sites is not related to a concomitant reduction of total Taos District population, but is viewed as a shift from a more dispersed settlement system represented by many small villages to a greater aggregation of the population into fewer but larger pueblos.

She describes this process as "one of gradual local development" that is "not due to an influx of peoples from outside the district" (Woosley 1986:161). In fact, she insists that "changing settlement distribution, increased complexity in site organization, as well as alterations in material culture assemblages such as ceramics" can all be "easily interpreted in terms of a Taos District continuum of gradual cultural development within the local Anasazi sequence" (Woosley 1986:160).

However, Woosley's own data show that the changes are anything but gradual. Table 114 shows that between the early and late Developmental period, there is an average 446 percent increase in the number of sites, with local area increases ranging from 191 to 1,380 percent. These increases took place, according to Woosley, in about 350 years. Even more remarkable are the changes supposedly taking place in her 75- to 100-year-long transition period between the Developmental and Coalition periods. In that time, site frequencies decreased 85 percent, with local area decreases ranging from

Table 114. Changing site density in the southern Taos Valley (Woosley 1986:150), with additions by author (figures for each period are the number of recorded sites and the site density)

Taos District Subarea	Subarea in km²	Total Number of Sites	Archaic Period	Developmental Period	Percent increase or decrease to next period	Developmental to Coalition Transition Period	Percent increase or decrease to next period	Coalition Period	Total sites	Percent of recorded sites
Sage Flats West of Llano Quemado	12.6	27	7 sites .55/km²	4 sites .3/km²	100% decrease	0 sites	-	3 sites .23/km²	14	52
North Llano Quemado	10.0	85	0 sites	5 sites .5/km²	1380% increase	74 sites 7.4/km²	95.9% decrease	3 sites .3/km²	82	95
South Llano Quemado	9.4	117	2 sites .2/km²	11 sites 1.2/km²	509.1% increase	67 sites 7.1/km²	77.6% decrease	15 sites 1.6/km²	95	81
Rio Grande del Ranchos Valley	10.0	109	0 sites	9 sites .9/km²	433.3% increase	48 sites 4.8/km²	89.6% decrease	5 sites .5/km²	62	57
Talpa Ridge	1.5	15	0 sites	1 site .2/km²	500% increase	6 sites 4.0/km²	33.3% decrease	4 sites 2.6/km²	11	73
Northeast Talpa	12.5	64	0 sites	12 sites .95/km²	191.7% increase	35 sites 2.8/km²	85.7% decrease	5 sites .4/km²	52	81
Arroyo Seco-Rio Pueblo de Taos Junction	1.5	8	0 sites	1 site .5/km²	400% increase	5 sites 3.0/km²	80.0% decrease	1 site .5/km²	7	87
Total	57.5	425	9 sites .15/km²	43 sites .75/km²	446.5% increase	235 sites 4.1/km²	84.7% decrease	36 sites .62/km²	323	74

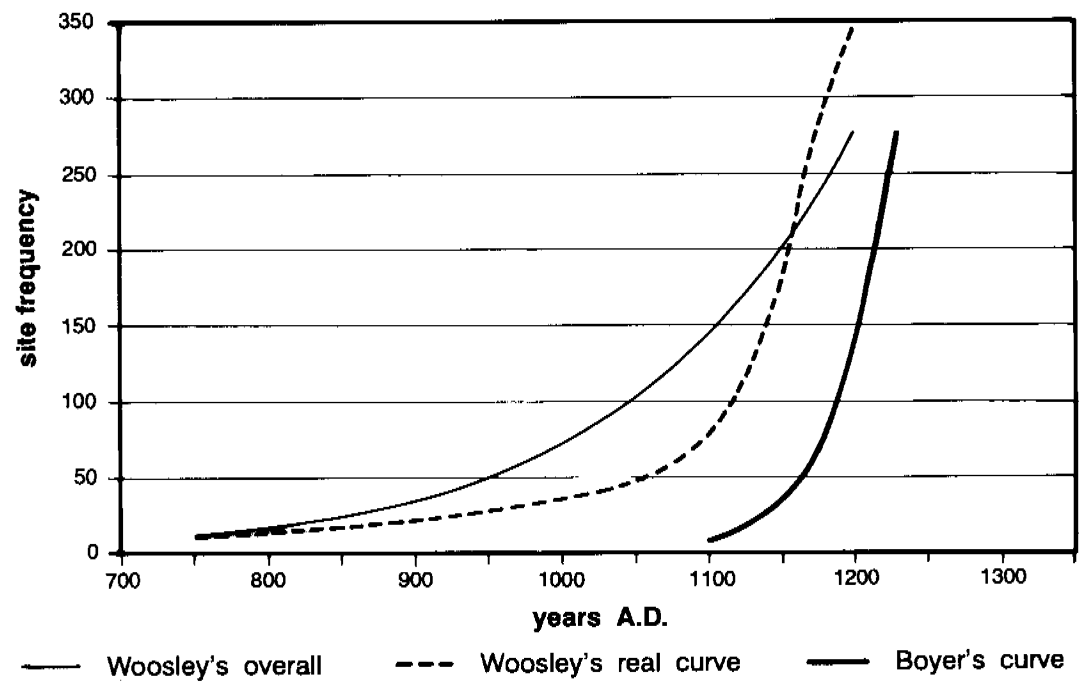
33 to 96 percent. Thus, in the course of 400 to 450 years, site frequencies climbed 446 percent and then plummeted 85 percent in the last 75 to 100 years. Woosley maintains that these trends reflect gradual local developments, including normal population growth followed by population aggregation. If she is right, one would expect *all* Coalition-period sites to be *very* large to accommodate the tremendous population from sites abandoned after the Developmental-Coalition transition period. In fact, only a few large sites are known.

What seems more reasonable is that Woosley's site numbers reflect (1) misidentification of sites, (2) population immigration, and (3) high mobility within the local population prior to the Coalition period. In the first case, Woosley follows a traditional evolutionary scheme in suggesting the development of small pithouse villages, followed by larger communities including surface structures, and finally the beginnings of population aggregation. However, we have seen that her model can hardly account for the shifts in her own data, particularly assuming site contemporaneity. If Developmental-period (Valdez-phase) sites can consist of pithouses, clusters of pithouses, surface structures, and pithouses with surface structures (Blumenschein 1956, 1958, 1963; Peckham and Reed 1963; Herold 1968; Wetherington 1968; Loose 1974; Green 1976; and this project), then all or most of Woosley's Developmental and Developmental-Coalition transition-period sites fall into the Valdez phase. This serves to actually enlarge the relative increase (2,988.9 percent) in site numbers between the Archaic and Developmental periods (Valdez phase) and the relative decrease (87.1 percent) between the Developmental and Coalition periods (Valdez and Pot Creek phases). It exacerbates Woosley's problem of explaining such enormous site frequency increases through gradual population growth. It also creates problems for explaining site frequency decreases through aggregation, unless we eschew Woosley's assumption of site contemporaneity in favor of population mobility and relatively short site life, whether due to seasonal use (Gilman 1987) or short structural use-life (Cameron 1990), or both. This becomes even more critical when we see, as is discussed in the following section on dating, that the Developmental period, Valdez phase, was only about 125 years long, rather than the 400 to 450 years postulated by Woosley. With such a foreshortened time frame, Woosley's Anasazi would have had to spend more time procreating than farming and eating to produce the tremendous number of people and contemporaneous sites she sees at the Valdez-Pot Creek-phase transition.

We can calculate rates of annual growth in site frequency using Woosley's figures and the formula,

$$\text{growth rate} = \ln(N_t/N_o)/T,$$

where T is time, N_t is the final site frequency, and N_o is the original site frequency (Blake et al. 1986). Assuming 450 years from the end of the Archaic period to the beginning of the Coalition period, as Woosley does, we arrive at an annual growth rate of 0.72 percent. Site frequencies would double about every 100 years. However, if we break Woosley's figures down into Developmental and "Transition" periods, we get a growth rate during the Developmental period of 0.45 percent, or a doubling of site frequency about every 160 years. These are very low figures. In the "Transition" period, the growth rate jumps to 1.69 percent, or a doubling about every 42.6 years. Figure 99 shows Woosley's figures expressed as site frequency growth curves. It indicates slow growth before A.D. 1050, followed by rapid growth until about A.D. 1200.



Frequency growth curves based on data from Woosley (1986: 150).

Figure 99. Developmental-period projected site frequency growth curves

If, on the other hand, we assume that Woosley's Developmental- and "Transition"-period sites all belong in the Valdez phase and that, as discussed below, the Valdez phase began about A.D. 1100 and lasted about 125 years, we arrive at a different picture. The annual site frequency growth rate was 2.74 percent, meaning that site frequency doubled about every 26.3 years, a very high rate.

Figure 99 shows that my curve and Woosley's real curve are very similar between about A.D. 1050 and 1250. Differences between them are due to Woosley's insistence that some Developmental-period sites date as far back as A.D. 750 and on dating transitions about 100 years later than accepted years. The rapid increase in site frequency after A.D. 1050 on Woosley's curve mirrors our curve after A.D. 1100 and strongly suggests that site frequency does not reflect a "continuum of gradual cultural development" (Woosley 1986:160). Rather, the data indicate a sudden and rapid increase in the frequency of Valdez-phase sites after about A.D. 1050. As mentioned above, two reasons for this situation are population immigration and mobility. These issues are explored in more detail in the following sections of this chapter.

Dating the Valdez Phase

Ceramic Cross-Dating

Dating Valdez-phase sites has traditionally been accomplished by ceramic cross-dating of the mineral-painted ware known as Taos Black-on-white. Peckham and Reed (1963) follow Mera (1935) in relating Taos Black-on-white to Kwahe'e Black-on-white, thought to be descended from Red Mesa Black-on-white ("Chaco 2"; see Wetherington [1968:51-54, 75-77] for a lengthy discussion of the presumed lineage of Taos Black-on-white). The latter is dated between A.D. 850 and 1050-1125 and is present at early Developmental-period sites in the Rio Grande Valley (Wendorf and Reed 1955). In the late Developmental period, it is largely replaced by Kwahe'e Black-on-white, which is tree-ring dated between A.D. 1115 and about 1200 (Smiley et al. 1953; Breternitz 1966), although Breternitz lists tree-ring dates for Kwahe'e as early as A.D. 963. Mera (1935) dates Taos Black-on-white between A.D. 1150 and 1250; Peckham and Reed (1963) agree. Breternitz (1966) states that tree-ring dates are inadequate to change these dates, but the site he refers to is LA 1892 (Jeançon's Llano Pueblo), presumably a Pot Creek-phase pueblo where Taos Black-on-white was associated with Santa Fe Black-on-white. Smiley et al. (1953) give tree-ring dates for LA 1892 as probably A.D. 1207+ to 1239. Robinson and Cameron (1991) list A.D. 1239 as the earliest and latest cutting date for LA 1892. Thus, while the site may provide information relevant to the end date for Taos Black-on-white, it is not helpful when determining the beginning date.

Were we to follow Mera, who provides the earliest description of Taos Black-on-white, the Valdez phase, which is characterized by this type, would date between A.D. 1150 and 1250. Indeed, these are the dates used by Peckham and Reed (1963) and Wolfman et al. (1965). Wetherington (1968), on the other hand, pushes the beginning date for the Valdez phase back to A.D. 1000. His reasons are not clear but may have to do with Breternitz's earlier dates for Kwahe'e sites. This has become the accepted beginning date for the phase, used by Luebben (1968), perhaps by Schaafsma (1980), and others.

Three dissenters argue that the Valdez phase began before A.D. 1000. Loose (1974) argues that the presence of purportedly Red Mesa Black-on-white sherds at several Valdez-area pithouse sites shows that they were occupied much earlier. She suggests a date of A.D. 850 to 1050-1100, which she feels concurs with dates derived from comparative studies of pollen samples from LA 9200. Problems with the pollen dates are discussed in Natural Environment. Further, Cordell (1977) suggests that all supposed Red Mesa sherds from the Taos area be petrographically examined to determine their real identity. This calls into question their use in dating the occupation of the sites and the phase. Green (1976) dates the phase between A.D. 900-950 and 1200 on the basis of the presence of Kwahe'e Black-on-white, Taos variety, sherds. It is not clear why she chooses to push the dates back to the early A.D. 900s, unless she is using Breternitz's early dates for Kwahe'e sites.

Finally, Woosley (1986) prefers to date sites according to Wendorf and Reed's (1955) classification. Valdez-phase sites fall into the Developmental period, which she dates between A.D. 750 and 1100. These dates are not those used by Wendorf and Reed, who date the period between A.D. 600 and 1200. Why she deviates from their dates is not clear. Woosley (1980a, 1986) consistently discusses Anasazi sites from the early Developmental period, although she never states the bases for assigning sites to these years. Further, a review of her dates for this and other periods shows them to be 50 to 100 years earlier than those used by other researchers in the region. For instance, in arguing for a Developmental-Coalition transition period, she ignores the fact that a transitional period, the Pot Creek phase, was proposed by Herold (1968; "Pottery Group 2"), and its use by Wetherington (1968) has made it an accepted part of the local phase sequence. Because she argues for ending the Developmental period (Valdez phase) at A.D. 1100 instead of 1200, the date commonly used, her transition period is about 100 years earlier than the Pot Creek phase, although her description of it matches in some ways the Pot Creek phase descriptions.

We have seen that dating the Valdez phase has most commonly been tied to dating a mineral-painted ceramic ware known variously as Taos Black-on-white or Kwahe'e Black-on-white, Taos variety. With the exception of Woosley, who provides no justification for her dates, differences in dating the Valdez phase are primarily based on opinions about the relationship of Taos to Kwahe'e, the dates for Kwahe'e, and whether Taos/Kwahe'e is really the earliest painted ware in the valley. These differences will not be resolved without petrographic analysis of sherds representative of the various wares and, more importantly, without chronometric dates for Valdez-phase sites.

Chronometric Dates

Eleven sites in the Taos Valley have yielded chronometric dates from the years commonly thought to encompass the Valdez phase. Four sites have provided tree-ring dates, six have provided archaeomagnetic dates, two have provided obsidian hydration dates, and six have provided radiocarbon dates. The sites and their dates are summarized in Table 115. Their locations are shown in Figure 100. Figures 101 and 102 show the dates arranged by dating technique.

Table 115. Valdez-phase chronometric dates

Site	Date (A.D.)	Reference
Tree-Ring Dates		
TA-47 ("kiva")	1077 +vv	Crown 1990
Pot Creek Pueblo ("kiva 2")	1121 vv	Crown 1990
LA 2742	1122 vv	this project
TA-18	1142 vv	Crown 1990
TA-47 ("kiva")	1147 r	Crown 1990
Pot Creek Pueblo ("kiva 2")	1154 vv	Crown 1990
Archaeomagnetic Dates		
Cerrita ("early level")	1050-1150	Woosley 1986
LA 9205	1095-1145	Loose 1974
LA 70577	1125-1190	this project
TA-32	1170-1210	Cordell 1978
TA-34	1170-1210	Crown 1990
LA 2742	1195-1220	this project
Obsidian Hydration Dates[1]		
LA 2742	869-1035[2] 1080-1216[3]	this project
	909-1065[2] 1065-1199[3]	
	1190-1322[2] 1304-1354[3]	
LA 70577	447-647[2] 742-902[3]	this project
	488-684[2] 774-932[3]	
	507-703[2] 790-948[3]	
	507-703[2] 790-948[3]	
	1049-1203[2] 1225-1349[3]	
	1064-1216[2] 1238-1360[3]	
	1072-1224[2] 1244-1366[3]	
Radiocarbon Dates[4]		
LA 2742	530-770[5] 640-880[6]	this project
	620-760[5] 669-860[6]	
	720-840[5] 780-953[6]	

Table 115 (cont.)

Site	Date (A.D.)	Reference
	750-870[5] 810-849, 851-975[6]	
	770-1030[5] 880-1050, 1091-1119, 1143-1153[6]	
	870-1010[5] 974-1039[6]	
	910-1070[5] 999-1166[6]	
LA 70577	880-1080[5] 980-1170[6]	this project
	950-1070[5] 1018-1166[6]	
	970-1110[5] 1024-1217[6]	
	990-1130[5] 1030-1225[6]	
	990-1150[5] 1030-1245[6]	
TA-34	906-1018	Crown 1990
	1105-1215	Crown 1990
Sagebrush Pueblo	906-1020	Crown 1990
Cerrita (late levels)	1110-1270	Woosley 1986
	1220-1320	Woosley 1986
KC:TGP:1	1120-1280	Moore 1986

[1] Obsidian hydration dates were calculated using estimated hydration temperatures (EHTs) derived from temperature and humidity figures for sites near the project area, from Ridings (1991).
[2] Calculated using Sagebrush Pueblo EHTs (Ridings 1991).
[3] Calculated using Pot Creek Pueblo EHTs (Ridings 1991).
[4] 1 sigma ranges. Dates from TA-34, Sagebrush Pueblo, Cerrita, and KC:TGP:1 are assumed to be adjusted, 1-sigma ranges.
[5] Adjusted date.
[6] Calibrated date.

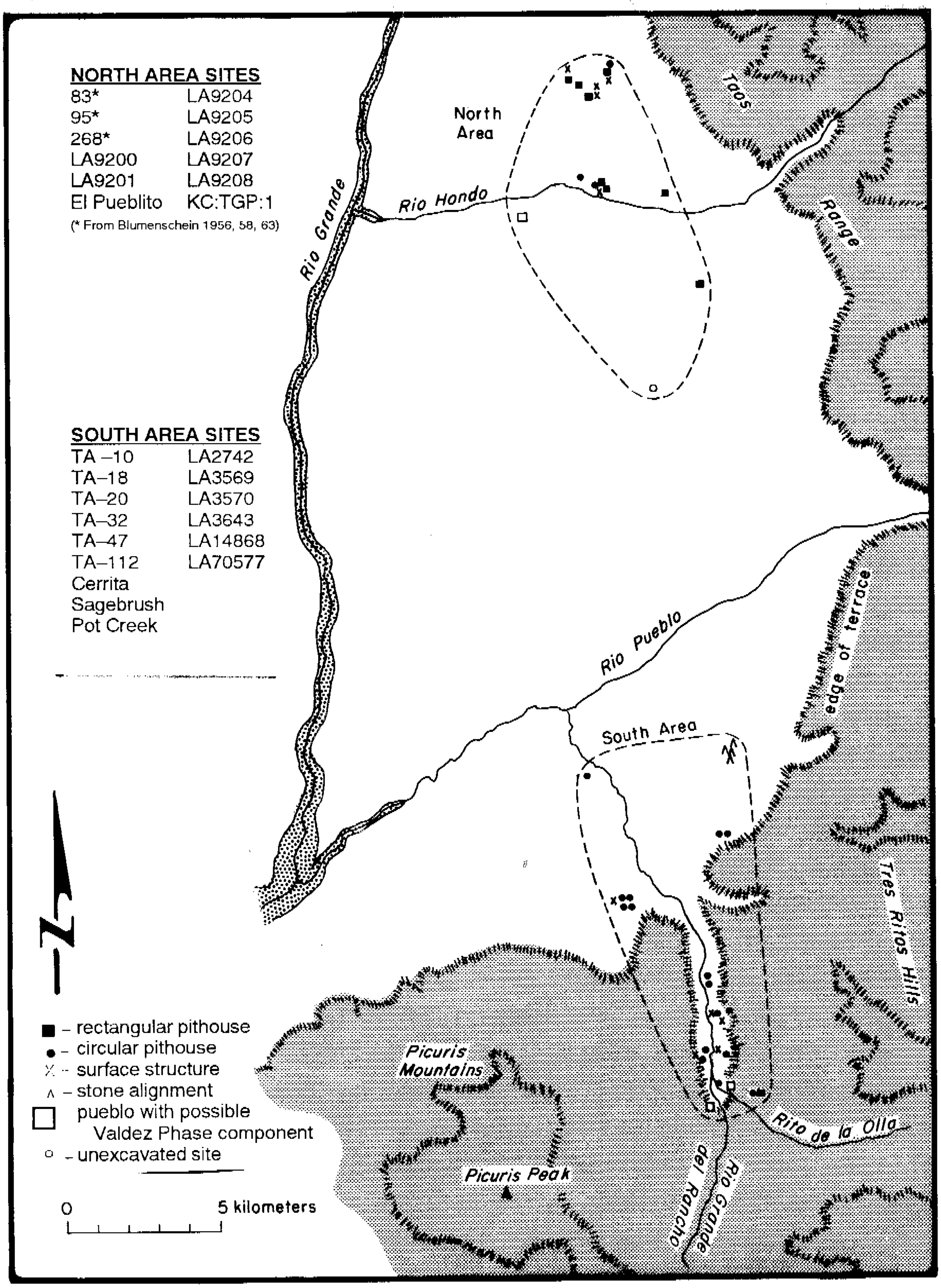


Figure 100. Taos Valley sites yielding Valdez-phase chronometric dates .

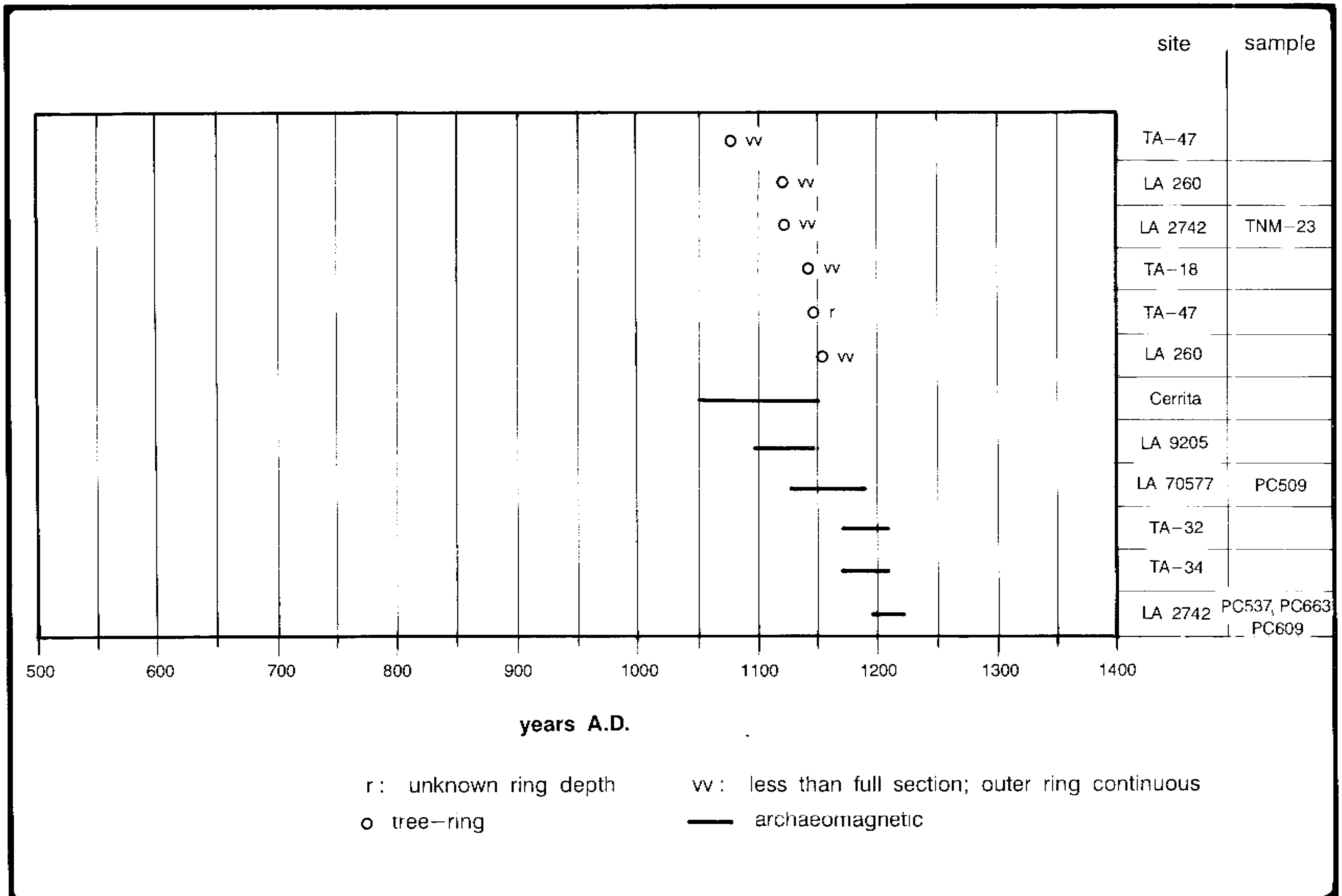


Figure 101. Valdez-phase tree-ring and archaeomagnetic dates.

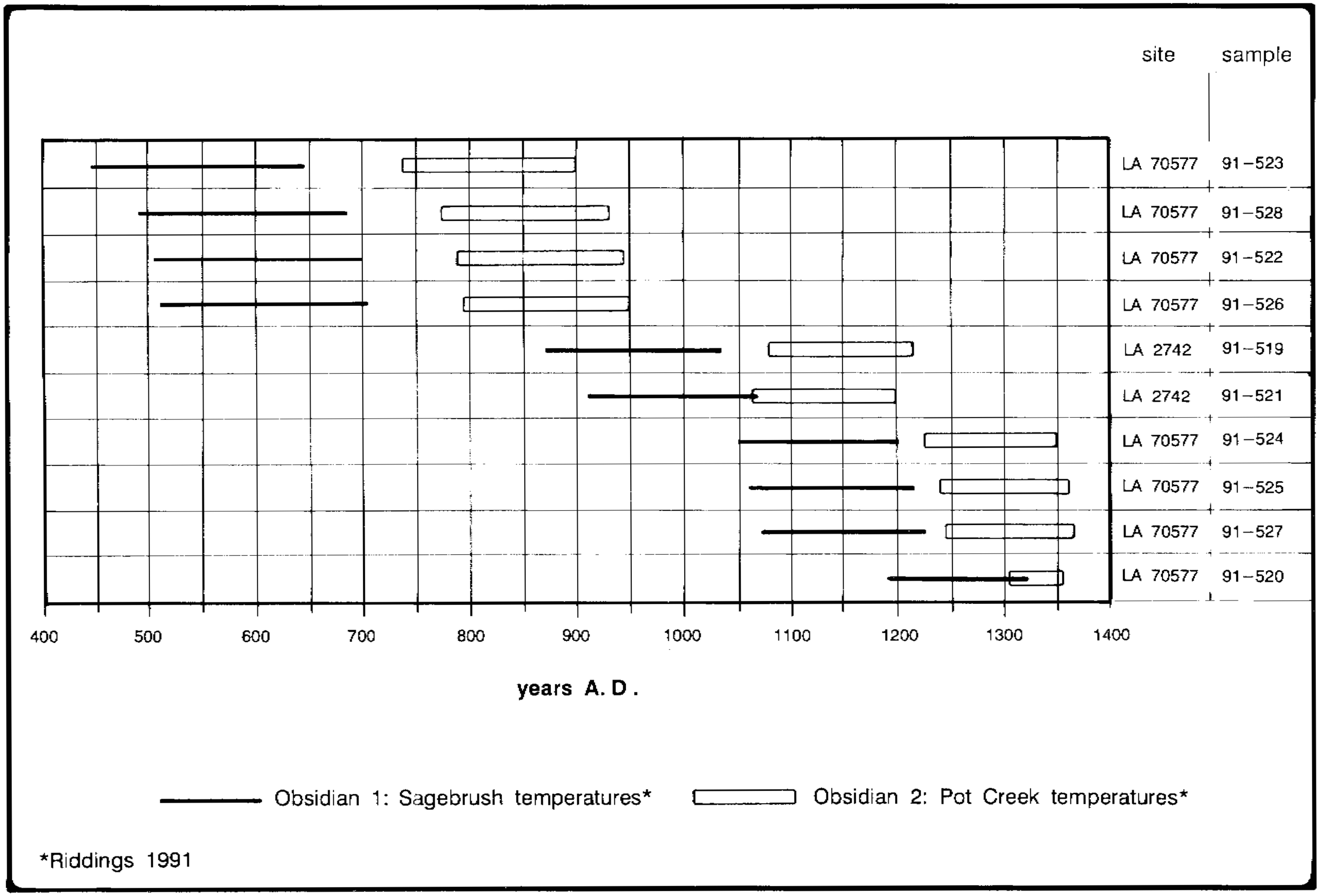


Figure 102. Valdez-phase obsidian hydration dates.

Six tree-ring dates were obtained from four sites, including three pithouses (TA-18, LA 2742, TA-47) and "kiva 2" at Pot Creek Pueblo. Crown (1990) includes "kiva 2" because it was beneath room block "unit 2." Wetherington (1968) includes it with the Pot Creek-phase occupation, but Crown (1990) is suspicious that the tree-ring date may indicate that it was an earlier structure. She does not dispute its description as a kiva but suggests that it may show that kivas were in use earlier than the Pot Creek phase. Five dates are "vv" or "+vv" dates, indicating that the last growth ring is missing, and estimates cannot be made of how far the last available ring is from the cutting date. Therefore, these dates are earlier than the actual cutting date by undetermined numbers of years, and the "+vv" date is the least reliable. The sixth date is an "r" date, meaning that the last growth ring is present around a portion of the specimen's circumference. This may be a cutting date. With the exception of the "+vv" date at A.D. 1077, the samples fall tightly between A.D. 1120 and 1160. A.D. 1077 is earlier than the actual cutting date, and the tree was likely cut near or after A.D. 1100.

Together, the available tree-ring dates, though an admittedly small sample, show construction of Valdez-phase structures after A.D. 1100 and, for the most part, after A.D. 1120. They suggest that the initial Anasazi occupation of the region took place about or slightly after A.D. 1100. Because only one of the tree-ring dates is a probable cutting date, the dates are not accurate enough to point out the end of Valdez-phase construction in the same way that Crown (1991) sees beginning and ending construction dates at Pot Creek Pueblo.

The use of A.D. 1100 as a beginning date for the Valdez phase is supported by six archaeomagnetic dates from six pithouse sites. The dates range between A.D. 1050 and 1220. They do not all overlap at any point. If we look for a period when at least two dates overlap, we find two: A.D. 1095-1150 and A.D. 1170-1220. The first corresponds substantially to the cluster of tree-ring dates, while the second corresponds to the years when the structures would have been occupied, since the tree-ring dates are earlier than the actual cutting dates. Even if we assume that 50 years of growth rings were missing from each of the "vv" tree-ring specimens, the cutting dates would all still fall within the range shown by the archaeomagnetic dates. This shows considerable support for Crown's (1990) contention that an ending date of A.D. 1210 to 1225 should be assigned to the Valdez phase. However, it does not support her use of A.D. 1050 as a beginning date; rather, it appears that, based on the tree-ring and archaeomagnetic dates, A.D. 1100 is a more accurate beginning date.

As a dating technique for the Valdez phase, obsidian hydration has only been used at the two pithouse sites excavated during this project. Nonetheless, the results are in substantial agreement with those obtained from tree-ring and archaeomagnetic samples. However, there are discrepancies depending on differences in ground temperature and humidity data. At LA 2742, use of Ridings's (1991) Pot Creek Pueblo ground temperature and humidity figures resulted in two obsidian hydration dates corresponding closely to tree-ring and archaeomagnetic dates, while her Sagebrush Pueblo temperature and humidity figures produced one date that could match the tree-ring and archaeomagnetic dates, and two that were over a century earlier. Since the location of LA 2742 more closely resembles that of Pot Creek Pueblo in terms of elevation and setting, these results are expectable.

On the other hand, at LA 70577, Ridings's Pot Creek Pueblo figures resulted in three dates that are much later than the archaeomagnetic date and four that are much earlier. However, when the dates are calculated using her Sagebrush Pueblo figures, the three late dates correspond very closely to the archaeomagnetic date, while the four early dates are even earlier. Since LA 70577 is located in a setting more resembling LA 2742 and Pot Creek Pueblo than Sagebrush Pueblo, which is on the opposite side of the river valley, we expected the dates derived from the Pot Creek Pueblo figures to be more accurate. If this is the case, however, then the archaeomagnetic date is too late, and LA 70577 is the earliest Valdez-phase site in the region, dating to the A.D. 800s; or it is too early, and LA 70577 dates to the late A.D. 1200s or early 1300s. Since there are no other dated Valdez-phase sites that would support either option, we must presume that the Sagebrush Pueblo figures produced the more accurate result in this case. However, this only serves to reiterate Ridings's (1991:84) point that "when a high degree of temporal resolution is required, both precise depth provenience for the artifacts and a measurement of the effective hydration temperature at several depths within the site are important," and that "since the factors that affect soil temperature fluctuations can vary over a relatively small space, using a cell EHT from a nearby site also has the potential for producing misleading results." While obsidian hydration analysis has produced results that appear to support dates obtained from tree-rings and archaeomagnetism, it is clear that additional study of variation in ground temperature and its effect on hydration dates is necessary to assess the utility of this dating technique for dating Valdez-phase sites.

The A.D. 1100 to 1225 range for the Valdez phase is supported by radiocarbon dates from three pithouse sites: TA-34, Cerrita, and KC:TGP:1. However, Figure 103 shows that radiocarbon dates from Valdez-phase sites are often considerably earlier than tree-ring and archaeomagnetic dates. Eighteen radiocarbon dates from seven sites range from A.D. 530 to 1320. Clearly, most of these dates are far earlier than the tree-ring and archaeomagnetic dates. Since the radiocarbon dates are expressed as ranges of dates, within which the samples may actually date, it may be helpful to determine the degree of overlap of dates, as with the archaeomagnetic dates. The results of this exercise are shown in Figure 104, which shows the percent of samples that could date to each decade between A.D. 500 and 1400. Both adjusted and calibrated dates are graphed in the figure. The adjusted dates show a significant peak in the number of dated samples at A.D. 900, with a peak between A.D. 990 and 1020, and a drop at A.D. 1070. That is, 50 percent or more of the samples could date between A.D. 990 and 1020, while less than one-third could date before A.D. 900 or after A.D. 1070.

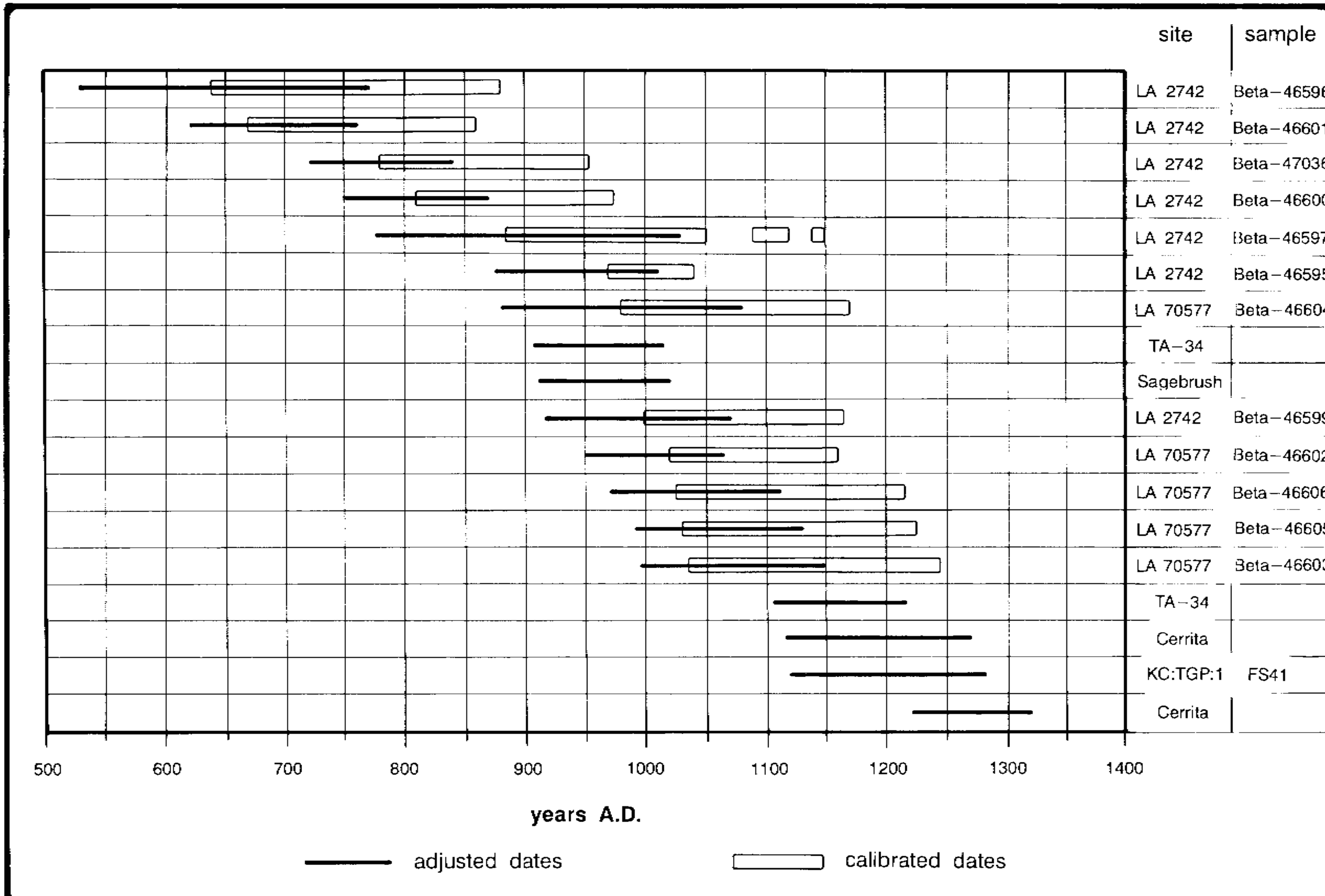


Figure 103. Valdez-phase radiocarbon dates.

The calibrated dates show a different picture, with two peaks, one between A.D. 1030 and 1050, and the second, longer one between A.D. 1090 and 1170. Over 50 percent of the samples with calibrated dates could date to one of these peaks, the second of which corresponds substantially to the Valdez-phase dates indicated by tree-ring and archaeomagnetic analyses. This is not to say, of course, that calibrated radiocarbon dates clearly support the A.D. 1100 to 1225 date range for the phase, since the samples could date anywhere in their ranges.

Further, there is the obvious question of the very early radiocarbon dates and the peaks between A.D. 990 and 1050. One problem that may make radiocarbon dates earlier than dates obtained by other techniques is the presence of calcium carbonate in the soil. Although samples are routinely checked for the presence of calcium carbonate, a higher than normal presence may mean that some calcium carbonate remains in the sample during the dating procedure. This could result in an early date. Of the 18 radiocarbon dates, 12 are from LA 2742 and LA 70577. They show the widest ranges of dates, and the seven dates from LA 2742 range between A.D. 530 and 1070, adjusted (A.D. 640 to 1166, calibrated), and the five dates from LA 70577 ranging between A.D. 880 and 1150, adjusted (A.D. 980 to 1245, calibrated). LA 2742 has the earliest dates of the six sites, and its radiocarbon dates never overlap its tree-ring or archaeomagnetic dates. The calibrated dates from LA 70577 overlap its archaeomagnetic date, but the adjusted dates are generally earlier. In the descriptions of both sites, we noted that the soil as deep as 3 m is very high in calcium carbonate, probably because of limestone beds in the mountains near both sites. This may explain the early radiocarbon dates from LA 2742 and LA 70577.

Conversely, radiocarbon dates from the Cerrita site and KC:TGP:1 fall within the range indicated by tree-ring and archaeomagnetic dates. The Cerrita site is on the west side of Rio Grande del Rancho, above river floodplain. Geologic differences between the Picuris Mountains, at the base of which the site is located, and the Tres Ritos Hills, across the narrow valley, suggest that soils formed from the two ranges will be different. Hacker and Carleton (1982) state that soils on the west side of the valley above the floodplain are derived from granite in the Picuris Mountains. We might expect, then, that radiocarbon dates from sites on the west side of the valley would be less affected by the presence of calcium carbonate than sites on the east side of the valley. Although this may explain the radiocarbon dates from the Cerrita site, a date of A.D. 906 to 1020 was obtained from Sagebrush Pueblo, on the west side of the valley near Fort Burgwin. This does not negate the proposed relationship between high calcium carbonate levels and early radiocarbon dates on the east side of the valley, but it suggests that the situation on the west side may not be as clear-cut. A radiocarbon date of A.D. 1120 to 1280 was obtained from KC:TGP:1, along the Arroyo Seco north of Taos. The alluvial soils making up the fan on which KC:TGP:1 is located are derived from the Taos Range rather than the Tres Ritos Hills. Although soil testing was not conducted at KC:TGP:1, the soils should have lower calcium carbonate levels than those derived from the Tres Ritos Hills. In that case, normal laboratory cleaning procedures should alleviate the problem of early dates from calcium carbonate. Obviously, without soil testing at other sites, a relationship between very high calcium carbonate levels and significantly early radiocarbon dates such as those from LA 2742 and LA 70577 cannot be conclusively established. The situation at those two sites, however, contrasted with dates from sites in different soil associations, suggests that testing for calcium carbonate levels should be a routine part of data recovery if radiocarbon dating is to be used.

With regard to the end of the Valdez phase, Figure 104 shows that less than half of the calibrated radiocarbon samples could date after A.D. 1170, less than 25 percent after A.D. 1220, and none after A.D. 1240. Considering that the radiocarbon dates are generally earlier than the tree-ring and archaeomagnetic dates, this shows significant support for using A.D. 1220 as an approximate end date for the phase.

Taken together, the chronometric dates suggest that the initial Anasazi occupation of the Taos Valley occurred about A.D. 1100. This occupation, the Valdez phase, lasted until the early 1200s, about A.D. 1225. These dates are indicated by both tree-ring and archaeomagnetic dates. The only evidence for extending the phase back to the mid-A.D. 1000s or before comes from radiocarbon dates from sites in the Rio Grande del Ranchos Valley, where very high calcium carbonate levels in the soil may affect the accuracy of the dates. Importantly, using calibrated rather than adjusted radiocarbon dates produces results more consistent with tree-ring and archaeomagnetic dates, including a peak in dated samples between A.D. 1090 and 1170, followed by rapid declines with no dated samples after A.D. 1240. Until additional dates are obtained that demonstrate otherwise, the best dates for the Valdez phase are A.D. 1100 to 1225. There is no apparent difference in dates between pithouses and surface structures. This is evident in that one of the earliest archaeomagnetic dates comes from LA 9205, a site consisting of surface rooms and activity areas but no pithouse. Early Anasazi architecture in the Taos Valley did not undergo an evolutionary development as seen in other parts of the Southwest. It appeared as a well-developed tradition having several styles of subterranean and surface structures.

Valdez-Phase Sites

Descriptions of the Valdez phase show that sites can consist of a variety of features, structural and nonstructural. This discussion will focus on site features and structure. Moore and Levine discuss lithic and ceramic artifacts, which make up most of the artifact assemblages.

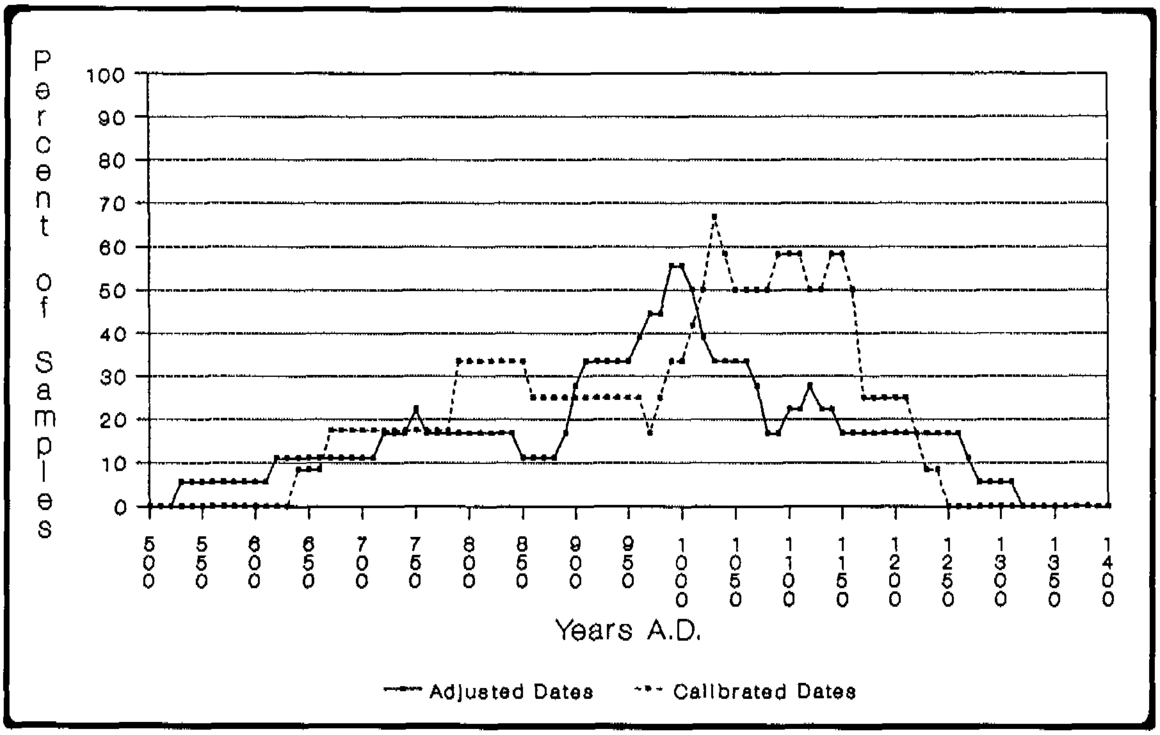


Figure 104. Percent of Valdez-phase radiocarbon samples that could date to each decade, A.D. 500-1400.

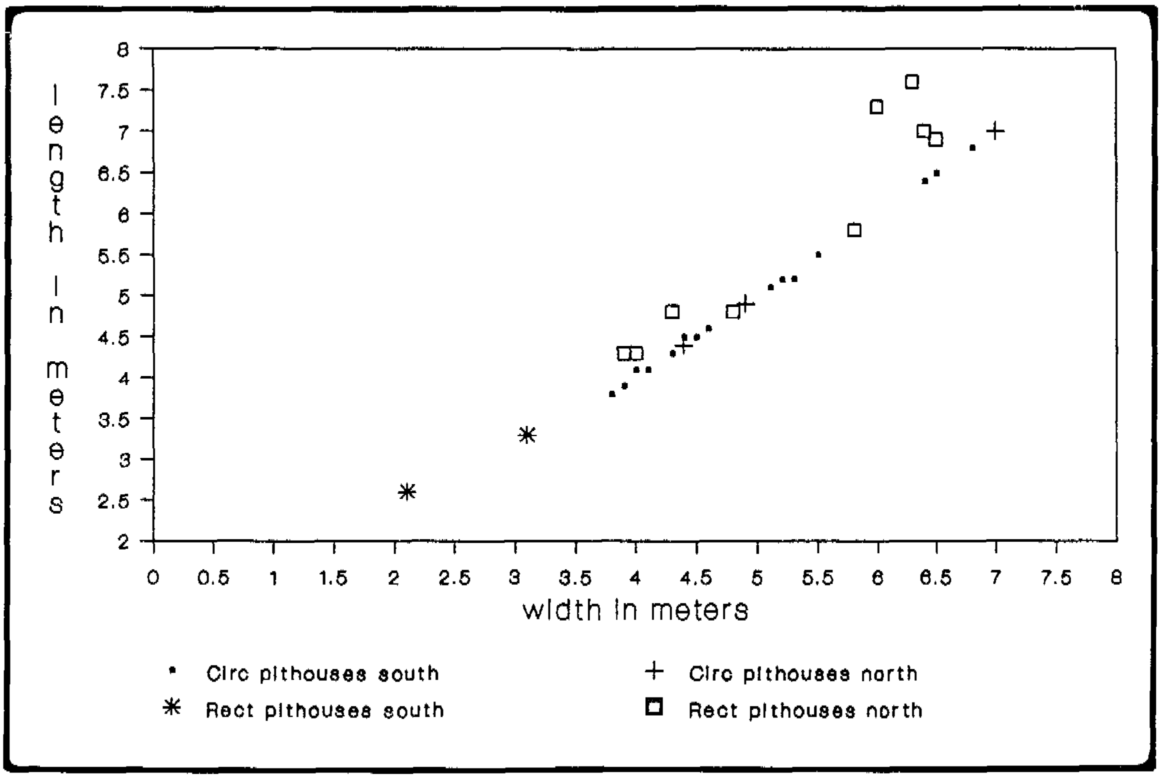


Figure 105. Valdez-phase pithouse size distribution.

Architecture

Pithouses

Over 30 pithouses have been excavated in the Taos region. Their locations range from upper Lobo Creek, north of Valdez and Rio Hondo, to the southern Rio Grande del Rancho Valley, near Pot Creek (Fig. 100). However, within this large region, excavated pithouse sites are actually found in two areas: the Arroyo Seco-Rio Hondo-Lobo Creek area, north of Taos, and the Ranchos de Taos-Rio Grande del Rancho area, south of Taos. In the northern area, 13 or 14 pithouses have been excavated at 10 sites. The uncertainty is the result of reexcavation by the University of New Mexico field school of two or three pithouses at LA 9201, first investigated by the Taos Archaeological Society (Blumenschein 1958, 1963; Loose 1974). While Loose's descriptions of the pithouses at LA 9201 include notations that they were previously trenched or excavated, she does not correlate her pithouse numbers with Blumenschein's original site numbers. Further, since Blumenschein's work was sometimes limited to trenching across pithouses without complete excavation, there are discrepancies between her and Loose's descriptions that make correlation difficult or impossible. Consequently, there is overlap in the data from the northern area that cannot be confidently resolved. This results in a data set of 16 pithouses. In the southern area, 18 pithouses have been excavated at 12 sites. Most are in the southern Rio Grande del Rancho Valley, but pithouses have also been excavated near Talpa, Llano Quemado, and Los Cordovas.

It is important to note that survey data show Valdez-phase sites between the northern and southern areas. Included are artifact scatters; sites with depressions, probably representing pithouses; and small mounds, probably representing pueblos.

Data from the 22 excavated sites with 34 pithouses show interesting patterns differentiating sites in the northern area from those in the southern area. These patterns have to do with construction methods, remodeling, abandonment, and architectural form and features. The following discussion summarizes data obtained from reports by Blumenschein (1956, 1958, 1963), Peckham and Reed (1963), Wolfman et al. (1965), Luebben (1968), Wetherington (1968), Loose (1974), Green (1976), Woosley (1980a, 1986), Wiseman (n.d.), and from this project.

Construction. Table 116 summarizes pithouse construction information from both areas, showing significant differences in construction techniques between the two areas. The most obvious is wall material. Over half of the north-area pithouses had natural soil walls, that is, plaster was applied directly to the natural soil into which the pithouse was excavated. Only about 19 percent had walls of coursed adobe. This contrasts with the southern area, where all pithouses whose wall material is noted had coursed adobe walls (88.9 percent), while none had natural soil walls. Over 12 percent of the north-area pithouses had vertical pole supports in some part of the walls, while only 5.5 percent of the south-area pithouse walls were helped to stand by vertical poles, usually around the

Table 116. Comparison of construction data from north-area and south-area pithouses (percent of pithouses)

Area	Wall Material[1]				Walls Plastered[2]			Floor Material[1]			No. of Post Holes[3]			
	A	S	P	ND	Y	N	ND	A	S	ND	2	4	8	ND
North	18.8	56.3	12.5	25.0	56.3	18.8	25.0	54.5	4.5	40.9	6.3	50.0	12.5	31.3
South	88.9	0	5.5	11.1	55.6	22.2	22.2	94.4	0	5.5	0	94.4	0	5.5

[1] A = adobe; S = natural soil; P = pole supported; ND = no data.
[2] Y = yes; N = no; ND = no data.
[3] ND = no data.

Table 117. Comparison of remodeling data from north- and south-area pithouses (percent of pithouses in each area)

Area	No. of Plaster Coats[1]				No. of Floors[1]				Features Associated with Separate Remodeling Episodes
	0	1	2	ND	1	2	3	ND	
North	18.8	12.5	0	68.8	56.3	25.0	6.3	12.5	22.2
South	22.2	50.0	0	27.8	72.2	16.7	0	11.1	11.1

[1] ND = no data.

ventilator opening. The use of adobe plaster was about the same in both areas. The difference in the use of adobe in the pithouses may also be seen in the floor materials, where all south-area pithouses whose floor material was recorded had adobe floors. In the northern area, 54.5 percent had adobe floors, and 4.5 percent had natural soil floors. These figures may not be representative, however, since floor material was not recorded for 41 percent of the north-area pithouses.

The other obvious difference between the two areas is in the number of postholes. In the southern area, all pithouses for which this information is available (94.4 percent) had four postholes arranged in a quadrilateral pattern. In the northern area, half of the pithouses had a four-hole quadrilateral pattern. Two pithouses had eight postholes, four pairs arranged in the same quadrilateral pattern as those with four holes. One pithouse, Blumenschein's (1956) site 95, had only two postholes, one near the wall northeast of the central hearth, and the other near the wall southwest of the hearth. While most of the north-area pithouses used a roof support system involving two primary horizontal roof beams, eight had two vertical posts supporting each beam, and two had four posts combined in two pairs for each beam. One pithouse had a single horizontal beam supported by two posts.

Remodeling. Table 117 summarizes the available information on remodeling. Most of the information from both areas has to do with cosmetic rather than structural remodeling: the number of plaster coats and the number of floors. None of the pithouses in either area had more than a single coat of adobe plaster, although the percentage of pithouses for which no data are available is significant, particularly in the northern area. We observed at both LA 2742 and LA 70577 the presence of a single coat of thick (1 to 2 cm) adobe plaster, over which a thin layer of fine plaster had been applied. We assume the fine plaster was a finish coat applied to the rough first coat rather than a separate episode of replastering. The presence of a fine finish plaster is not noted in any of the other reports, although Green (1976) mentions "painted" bands of decoration at three pithouses in the southern area (see description of LA 70577 for discussion of wall decoration at the pithouses).

The number of floors in each pithouse is different between the areas. In both cases, most pithouses had a single floor, but the number having multiple floors in the northern area is twice that of the southern area and includes one pithouse with a remnant of a third floor. The higher frequency of multiple floors in the northern area argues for more frequent remodeling. In one case, Blumenschein's (1956) unnumbered site, some time elapsed between remodeling episodes, and 0.7 m of fill separated the two floors. This seems more like reoccupation than remodeling.

The frequency of significant remodeling as evidenced by features that could be associated with each episode is twice as high in the northern area as in the southern. At two of the Lobo Creek sites, Loose (1974) describes remodeling that covered earlier features and included adding benches around the circumferences of the pithouses, the only recorded pithouse benches in the region. At LA 9201-03, construction of the bench involved covering two wall cists and supporting the ventilator opening. At LA 9204, a cist in the first floor was partially covered by the bench. Addition of the bench was accompanied by construction of a second ventilator slightly north of the original. Since the hearth and ash pit were in line with the later ventilator, at least the ash pit was moved from its original location.

No remodeling episodes of this magnitude are known from the southern area. However, it should be pointed out that these changes may be largely cosmetic. There is no evidence in Loose's report that the earlier ventilator at LA 9204 was dysfunctional or that the roof support system was altered. At LA 9201-03, construction of the bench embedded auxiliary roof support posts (this was one of the pithouses with eight posts), suggesting they were in place before the remodeling and that the roof support system was not altered. Whether other structural changes needed to lengthen the use-lives of the pithouses occurred during the remodeling episodes is not reported by Loose.

In fact, only the pithouses at LA 2742 and LA 3570 in the southern area show actual structural changes in the form of removing and replacing two roof support posts. Only these two sites show the kind of structural changes that would potentially lengthen pithouse use-life. This amounts to less than 6 percent of the excavated pithouses. If LA 9201-03 and LA 9204 are included on the assumption that such major cosmetic changes also included structural remodeling, then about 12 percent of the excavated pithouses show evidence of structural remodeling. The four sites are divided between the two areas and account for 12.5 and 11.1 percent of the pithouses in the northern and southern areas, respectively. This is important because information on pithouse use-lives, discussed above, suggests that structural remodeling was necessary if a pithouse was to be used for more than 7 to 12 years. The fact that almost 90 percent of the excavated pithouses show no evidence of structural remodeling supports an interpretation of short pithouse use-lives, short site occupations, and, therefore, high population mobility to account for the large number of Valdez-phase sites in the region.

Abandonment. Table 118 summarizes the information available on abandonment processes and postabandonment use of the excavated pithouses. None of the published reports presents abandonment information in much detail. We are left with evidence of burning, descriptions of pithouse fill when available, and the presence of human remains in the pithouse.

Evidence of pithouse burning consists of the presence of burned roof material in the fill or reddened or blackened walls. Table 118 shows that only a few sites in each area showed evidence of burning, amounting to about 31 percent (five sites) in the northern area and 22 percent (four sites) in the southern area. Two sites in the southern area and three in the northern area had burned roof material in the fill, suggesting that the roof burned and collapsed. The lack of burned roof material suggests that most pithouses were salvaged at or after abandonment, their roof support systems removed for

Table 118. Comparison of abandonment data from north- and south-area pithouses (percent of pithouses in each area)

Area	Evidence of Burning		Pithouse Fill				No. of Burials on Floor						No. of Burials in Fill					
	Burned roof material in fill	Other evidence	Nonstratified colluvial	Stratified colluvial	Collapsed structure	"Trash-filled"	0	1	2	3	4	No data	0	1	2	4	7	No data
North	18.8	12.5	6.3	0	12.5	12.5	6.3	12.5	0	0	0	81.3	6.3	18.8	6.3	0	6.3	62.5
South	11.1	11.1	22.2	38.9	33.3	5.5	61.1	11.1	5.5	5.5	5.5	11.1	55.5	37.5	11.1	5.5	0	11.1

use in another structure. This is supported, particularly in the southern area, by descriptions of pithouse fill. Over 60 percent of the pithouses were filled with eolian and, especially, colluvial deposits. About 22 percent contained essentially nonstratified fill such as that found at LA 70577, while almost 39 percent had well-stratified natural deposits containing sand, adobe, and lenses of charcoal. Interestingly, 33 percent of the south-area pithouse descriptions included references to collapsed structural remains, primarily roof material. Four of these also had well-stratified natural deposits, including LA 2742. Only two pithouse descriptions mention collapsed structural remains without well-stratified natural deposits, and only three mention well-stratified natural deposits without structural remains. In most cases, it is not clear whether collapsed structural remains include actual roof beams, but they seem most often to refer to lenses of adobe presumed to represent roof material.

The situation is not as clear in the northern area, primarily because there are almost no descriptions of pithouse fill from those sites. One had nonstratified colluvial fill, two had collapsed structural remains, and two were "trash-filled." Without more accurate descriptions, it is not possible to determine what these statements mean. This is particularly true for the "trash-filled" pithouses. Both are Blumenschein's (1956, 1958) sites, and she suggests that they were filled by the inhabitants of nearby pithouses, assuming the nearby pithouses were occupied later. However, she provides no descriptions of the fill, and there is no way to evaluate her interpretation. It is clear that both contained artifacts, but the depositional processes are unknown. One of the collapsed structure sites is LA 9206, which may also have burned (Wiseman n.d.). The description is clear in showing the collapse of the roof onto the floor, probably as it burned. Wiseman also suggests that the pithouse was intentionally abandoned and burned, based primarily on the paucity of artifacts found on the floor.

Since there are more pithouses with collapsed structural remains in the fill than with nonstratified colluvial fill (and none with well-stratified colluvial deposits), we may speculate that although north-area pithouses seem to have undergone more frequent remodeling episodes, when they were finally abandoned, they were less subject to salvaging and revisiting than their south-area counterparts. This is perhaps supported by information on human remains found in pithouses. Table 118 shows that, in the northern area, only 12.5 percent (two pithouses) of the pithouses had human burials on the floor. Each case was a single burial. The 81.3 percent with no data probably represent sites with no burials on the floor. Human burials in pithouse fill were more common, with three sites containing single burials, one with two burials, and one with seven individuals in the fill. Again, the 62.5 percent with no data probably represent pithouses with no burials in the fill. These figures contrast with those from the south- area pithouses, where human burials on the floor are twice as frequent, and those in the fill are 1.7 times as frequent. The floor burial figures show a much broader range in the number of individuals, with up to four present on one floor. There are about twice as many pithouses with single and double burials in the fill as in the northern area. Thus, only about 12 percent of north-area pithouses had burials on the floor, and about 31 percent had burials in the fill, compared to almost 28 percent of south-area pithouses with floor burials and 54 percent with fill burials.

Combined with data on pithouse fill, this suggests that south-area pithouses more often had their roof support systems salvaged and were used as burial locations while they filled by natural processes. On the whole, this suggests more revisiting of abandoned pithouses in the southern area than in the northern area. It may also point to different mortuary practices in the two areas, although we cannot securely differentiate mortuary practices from site abandonment processes with these data. In large part, this is due to the relative lack of investigation of site areas beyond the pithouses in both areas. Excavations carried out thus far show what is probably a realistic picture of burial practices within abandoned pithouses in both areas. Investigations of parts of sites outside pithouses and of nonpithouse sites have begun to show the range of extramural burial situations, including middens and cairns, but have not been consistently carried out so that the contexts and spatial distributions of these burial situations can be specified.

Architectural Form and Features. Tables 119 through 123 summarize information available on architectural form and features. The most obvious difference between north-area and south-area pithouses is pithouse shape (Table 119). The table shows that over 80 percent of north-area pithouses are rectangular or subrectangular, and over 80 percent of south-area pithouses are circular, usually with slightly flattened east sides. This dichotomy has been noted by other researchers (Wetherington 1968; Loose 1974; Green 1976), but only Greiser et al. (1990b) mention the distinct distribution of pithouse shapes in the two areas. While some circular pithouses are found in the northern area, and some rectangular pithouses in the southern area, excavation data show a clear distinction between the two areas.

Table 119. Comparison of architectural form from north- and south-area pithouses

Area	Pithouse Shape (percent of pithouses in each area)		Average Pithouse Size (meters)	Average Pithouse Depth (meters below modern ground surface)
	Circular	Rectangular		
North	18.8	81.3	Circular: 5.4 Rectangular: 5.4 x 5.7 Group 1: 4.3 x 4.4 Group 2: 6.3 x 6.8	2.4
South	83.3	11.1	Circular: 4.8 Rectangular: 2.6 x 2.9 Group 1: 4.2 (3.8-4.6) Group 2: 5.3 (5.1-5.5) Group 3: 6.6 (6.4-6.8)	2.7

Table 120. Comparison of architectural features from north- and south-area pithouses (dimensions and percent of pithouses)

Area	Hearth Shape[1]			Hearth Size (m)	Hearth Collar[2]			Deflector[2]				Ash Pit Shape[1]					Ash Pit Size (m)	Hearth/Ash Pit[3]			Ventilator Sill[2]			Vent Chamber Length (m)
	C	R	O		P	A	N	P	A	O	N	C	R	O	A	N		C	S	N	P	A	N	
North	68.8	6.3	12.5	Circ: .7 Rect: .7 x .8	87.5	0	12.5	12.5	12.5	0	75.0	31.3	0	6.3	18.8	43.8	.5	18.8	18.8	62.3	25.0	43.8	31.3	.9
South	61.1	16.6	16.6	Circ: .6 Rect: .4 x .5	77.7	16.7	5.5	77.7	5.5	5.5	11.1	50.0	16.7	16.7	0	16.7	Circ: .5 Rect: .4 x .6 Other: .3 x .4	27.7	61.1	11.1	72.0	22.2	11.1	1.3

[1] C = circular; R = rectangular; O = other; A = absent; N = no data.
[2] P = present; A = absent; O = other; N = no data.
[3] C = complex of features; S = separate features; N = no data.

North-area pithouses are generally larger than those in the southern area. Circular pithouses average an extra 0.6 m in diameter in the northern area, and rectangular pithouses average about twice the size of those in the southern area. Within the north-area rectangular pithouses, there are two size groups (Fig. 105). The smaller averages 4.3 by 4.6 m, while the larger averages 6.3 by 6.8 m. Similarly, among south-area circular pithouses, there are three size groups. The first, with the most examples, averages 4.2 m in diameter (3.8-4.6 m), the second averages 5.3 m in diameter (5.1-5.5 m), and the third averages 6.6 m in diameter (6.4-6.8 m). LA 3570 and LA 70577 are in the first group; LA 2742 is in the second. While north-area pithouses are larger, south-area pithouses are deeper by an average 0.3 m, although there is considerable overlap.

Differences between the two areas are also evident in the presence and characteristics of several internal features. Over 62 percent of north-area pithouses had either no ash pit or no data recorded about an ash pit (Table 120). This compares to 16.7 percent (three pithouses) of south-area pithouses with no data on ash pits. Otherwise, all south-area pithouses had ash pits, mostly circular or oval. The recorded north-area ash pits were also circular or oval. Perhaps because ash pits were not always present or recorded, north-area pithouses appear to have a paucity of hearth deflectors compared to south-area pithouses, where they are always present. While this could be because they simply weren't recorded, it is interesting that in almost every case, excavators noted the presence of large, flat stone slabs over or near the ventilator opening. These are presumed to be dampers used to regulate air flow into the pithouse. Since they were so often present, it seems unlikely that hearth deflectors would not be mentioned with the same consistency. In that light, it is also interesting that almost 44 percent of north-area pithouses lacked so-called "damper sills" at the mouth of the ventilators. These features are assumed to support the slab damper in a nearly vertical position over the ventilator opening and are present at over 70 percent of south-area pithouses, as are hearth deflectors. Slab dampers are often present, as well.

South-area ventilator chambers are an average 0.4 m longer than those in the northern area. Chamber lengths from both areas fall into two groups. The first ranges from 0.3 to 0.8 m, the second from 1.1 to 1.8 m. One south-area chamber was 2.1 m long.

Internal storage features are not common in either area (Table 121). However, subfloor cists, ceramic jars embedded in floors, and storage bins occur more frequently in south-area pithouses than in north-area pithouses. With regard to food preparation features (Table 122), the presence of mealing bins is limited to one site in both areas, while flat rocks embedded in floors on the north and south sides of hearths and ash pits occur more frequently in south-area pithouses. Analyses of these features at LA 2742 show that they served multiple functions as anvils and metates. Together, these data suggest a higher frequency of food storage and preparation activities within south-area pithouses than within north-area pithouses. This could be checked by examining the provenience and condition of ground stone artifacts from pithouse floors and fill, but such data are not available in most cases. Refer to the site descriptions of LA 2742 and LA 70577 for discussions of ground stone artifacts from those sites.

Table 121. Comparison of internal storage features from north- and south-area pithouses (percent of pithouses)

Area	Storage Cist(s) in Floor[1]			Ceramic Jar(s) in Floor[1]			Wall Cist[2]	Storage Bin[2]
	P	A	N	P	A	N		
North	6.3	6.3	87.5	12.5	0	87.5	12.5	0
South	16.6	72.2	11.1	16.6	72.2	5.5	5.5	5.5

[1] P = present; A = absent; O = other; N = no data.
[2] Percent of pithouses in each area with this feature.

Table 122. Comparison of internal food preparation features from north- and south-area pithouses (percent of pithouses)

Area	Flat Rock Embedded in Floor[1]			Mealing Bin[2]
	P	A	N	
North	6.3	6.3	87.5	6.3
South	22.2	66.6	11.1	5.5

[1] P = present; A = absent; O = other; N = no data.
[2] Percent of pithouses in each area with this feature.

Another test involves the association of pithouses with surface structures and "activity areas." These site features are discussed in more detail below. It is pertinent here to note that, while excavations have not always included portions of sites beyond the pithouses, those that have show an interesting pattern. Although Blumenschein (1958:110) states that no surface structures were found in her excavations, Loose's (1974) report shows a very different picture. Of her seven sites with nine excavated pithouses, only one, LA 9207, was not associated with a small pueblo. These pueblos were built of coursed adobe walls, usually on cobble footings, and had from one to four rooms (Table 123). Of the five excavated pueblos, two had two rooms with hearths, and two had one room with a hearth. Three had one room with storage features, and one had two rooms with storage features. The fifth, which had only one room with a hearth, also had manos and metates on the floor.

Table 123. Surface structures at north-area sites

Site	No. of Rooms	Wall Material	No. of Rooms with Hearths	No. of Rooms with Storage Features
LA 9200	3	adobe	2	1
LA 9201	1	adobe	1	0 (but manos and metates on floor)
LA 9204	4	adobe	1	2
LA 9205	3	adobe	-	2
LA 9206	3	adobe	2	1
LA 9208	2?	adobe	-	-

Table 124 shows that, in addition to the pueblos, at least four sites had six surface activity areas. All the areas had hearths, ranging from one to seven per area. One area had a single storage cist, and another had three ceramic jars associated with a metate. These data suggest that a considerable amount of activity, including food storage and preparation, took place outside the north-area pithouses, including within associated adobe pueblos and at outdoor activity areas.

Data on south-area surface structures and activity areas differ (Table 125). Only at site TA-47 were pithouses associated with adobe pueblos (Green 1976). The lower pueblo had three or four rooms, none of which had a hearth. One room had a jar in the floor and a jar in one wall that actually opened to the outside. The upper pueblo had five or six rooms, only one of which had a hearth. Two rooms had subfloor holes (not definite cists), and a third had two jars in its floor. These jars were originally buried in the ground north of the pueblo and were incorporated into a floor as the pueblo expanded. An outdoor activity area was suggested by the presence of two jars and a metate near the east wall of the lower pueblo. The other four sites for which data are available have *jacal* structures. Only LA 3569 (Peckham and Reed 1963) had more than one room. The small four-room structure had two rooms with hearths and storage cists. Structures at TA-32 (Luebben 1968), Cerrita (Woosley 1986), and LA 70577 (this project) were single-room *jacal* or brush structures. At LA 70577, a small pile of fire-cracked rock showed a possible hearth location, while TA-32 had a hearth pit. At Cerrita, Woosley found three hearth pits inside the *jacal* structure and two hearths near the pithouse. Outdoor storage features were not found at these sites or at LA 3569.

Table 124. Activity areas at north-area sites

Site	No. of Hearths	No. of Storage Features (cists and jars)	Metates Present
LA 9203	1	-	-
LA 9204 "utility area"	2	-	-
LA 9204 "adobe floor"	1	-	-
LA 9205	4	1	-
LA 9206 "work area"	7	-	-
LA 9206 "utility area"	3	3	yes

Table 125. Surface structures and activity areas at south-area sites

Site	No. of Rooms	Wall Material	No. of Rooms with Hearths	No. of Rooms with Storage Features (cists and jars)
TA-32	1	jacal	1	0
TA-47 lower pueblo	4	adobe	0	2 (1 opened to outside)
TA-47 upper pueblo	6	adobe	1	3?
TA-47 activity area	-	-	-	2 (also 1 metate)
Cerrita "roomblock"	1	jacal	1	0
Cerrita activity area	-	-	(2 present)	-
LA 3569	4	jacal	2	2
LA 70577	1	jacal?	1	0

Clearly, many activities, including food storage and preparation, took place outside the pithouses. This is evident from the relatively low number of preparation and storage features in the pithouses and the presence of such features outside the pithouses, as well as from the presence of ground stone artifacts in the pithouse fill at LA 2472 and

LA 70577. However, it is also clear that surface structures at excavated south-area sites were, with the exception of TA-47, considerably less substantial than those at north-area sites. While hearths are present, storage features are not consistently present. At TA-47, of the eight to ten rooms comprising the two pueblos, only one had a hearth, and four or five had storage features. Activity areas are not as clearly defined as at north-area sites. It is, of course, possible that these data represent excavational bias in terms of the extent of area examined at each site. However, the pattern of simple *jacal* structures and of lower frequencies of hearths and storage features in surface structures and outdoor activity areas supports the higher frequency of pithouse food storage and preparation features within south-area pithouses. Together, these data suggest differences in pithouse and surface activities between the two areas.

Surface Structures

The presence of surface structures at Valdez-phase sites was first noticed by Herold (1968), whose 1960 survey showed the association of surface and subterranean structures. Since then, surveys have recorded Valdez-phase surface structures in the southern valley (Woosley 1986), the central area near Taos (Boyer 1990c, 1991b), and the northern area (Nelson 1986). Eleven Valdez-phase surface structures have been excavated. Because these structures are usually associated with pithouses, their distribution can be divided into the northern and southern areas discussed under pithouse distribution. In the northern area, excavations at six sites revealed structures with a total of 16 surface rooms. At one site, an additional structure was uncovered, but no information about its size is available, and it is not considered here. In the southern area, excavations at five sites revealed 15 or 17 surface rooms. The difference is in the interpretation of two areas at the south ends of two linear structures that were, at the time of excavation, only partly enclosed by walls (Green 1976). In this discussion, these areas are considered as rooms since they had floors and at least two walls. Also considered as rooms are areas that may have been only partly enclosed or covered by *jacal* or brush shelters.

Data from the 11 excavated structures totaling 33 rooms show patterns differentiating the northern and southern areas. These patterns have to do with construction methods, remodeling, and architectural form and features. Abandonment is also discussed here, although data comparable to that available from the pithouses is generally lacking. This discussion summarizes information from Luebben (1968), Loose (1974), Green (1976), Woosley (1980a, 1986), and this project.

Construction. Table 126 summarizes construction information from both areas and shows differences in construction techniques between the two areas. The most obvious difference is in wall material. All excavated north-area surface structures were built of adobe. With the exception of one wall at LA 9204 built of adobe "turtlebacks" (hand-formed blocks), the north-area room walls were coursed adobe. In the southern area, 59 percent of the room walls were coursed adobe. This figure is misleading, however, because it represents two structures at one of the five south-area sites. While these two structures contribute 10 of the 17 south-area rooms (58.8 percent), they constitute only one-third of the excavated south-area structures. The remaining four south-area structures, with a total of seven rooms (41.2 percent), were built of *jacal* or brush. There are no excavated *jacal* structures in the northern area.

Wall footings also show construction differences. Most north-area room walls had a cobble footing upon which the adobe wall was built. In only two cases were walls built without a cobble footing, and one of those was a wall probably used to subdivide a room whose outer walls were cobble-based. In the southern area, three structures have a cobble footing. They are the *jacal* or brush structures at TA-32, LA 3569, and LA 70577, where upright cobbles supported the bases of the *jacal* or brush walls. At TA-47, the south-area site with adobe-walled structures, the walls were built in shallow footing trenches, but cobbles were not used as footings. The fact that surface structure walls consistently lack plaster may be a result of preservation rather than practice, since most pithouse walls in both areas were plastered.

Finally, there is a difference in floor material. More south-area rooms having natural soil floors, primarily a result of many south-area rooms being *jacal* or brush structures rather than formal adobe pueblo rooms. The "puddled caliche" floors at TA-47 were probably adobe.

Remodeling. Table 127 summarizes the available information on remodeling and shows that remodeling was both cosmetic and structural. There are more multiple floors in the south-area sample, but they are only from TA-47. The *jacal* structures do not show evidence of multiple floors. At LA 9200, in the northern area, one room had a central feature that was remodeled twice (Loose 1974). It was first a large storage cist with a central roof support post (see Wetherington [1968] and Ottaway [1975] for discussions of this type of feature; this appears to be its earliest appearance). The cist was filled and used as a hearth, which was subsequently remodeled but kept its function. It is not clear from the report whether remodeling the cist/hearth was included in one or more larger remodeling episodes.

The most striking examples of remodeling occur at LA 9204, in the northern area, and TA-47, in the southern area. At both sites, a small surface structure was razed and another built on top of the first. At LA 9204, excavators found that the four- (or more?) room surface structure was built on another structure, which was found beneath the two central rooms of the upper pueblo. The only construction detail known about the lower pueblo was that its walls, like most in the northern area, were cobble-based. The number and size of rooms and the presence of features are not known (Loose 1974:13). The pithouse at LA 9204 was significantly remodeled. Loose (1974:13) suspects that the lower pueblo was associated with the pithouse in its original form and the upper pueblo was associated with the remodeled pithouse.

Table 126. Comparison of construction data from north- and south-area surface structures (percent of rooms)

Area	Wall Material			Wall Footing				Walls Plastered			Floor Material			
	Coursed adobe	Adobe "turtle-backs"	Jacal	Cobble	Shallow trench	None	No data	Yes	No	No data	Adobe	Soil	Caliche	No data
North	93.8	6.3	0	75.2	0	12.5	12.5	0	6.3	93.8	43.8	6.3	0	50.0
South	58.8	0	41.2	17.6	58.8	-	23.6	0	5.9	94.1	29.4	23.5	47.1	0

Table 127. Comparison of remodeling data from north- and south-area surface structures (percent of rooms)

Area	No. of Plaster Coats		No. of Floors			Features Associated with Separate Remodeling Episodes
	0	No Data	1	2	No Data	
North	0	100.0	25.0	0	75.0	6.3
South	23.5	76.5	64.7	23.5	11.8	0

At TA-47 excavators also found an upper pueblo superimposed on the ruins of a lower one (Green 1976). The lower pueblo had been built in two stages, beginning with two rooms just west of a pithouse and followed with the addition of another room and a partly enclosed area or room on the south end of the room block. The first rooms may have been abandoned for a short time, because their multiple floors were separated by a thin layer of trash. The floors of the new rooms were at the level of the upper floors in the old rooms. This structure was abandoned and razed at the top of the first course of adobe. Its fill consisted of artifact-bearing soil that may have been naturally deposited but was probably leveled and used by the site occupants to fill between the walls, which were cut to the same level across the structure, creating a low mound (Green 1976:26-27). The upper pueblo was built on this mound, also in two stages. In the first, four rooms were built of coursed adobe with adobe floors. A short abandonment period is suggested by a thin layer of eolian sand separating the first adobe floors from later floors of "puddled caliche" (probably adobe). Apparently at the same time that the "caliche" floors were made, two rooms or a room and a partly enclosed area were built on the south end of the room block. Their floors were also "puddled caliche," as were the walls of one room (Green 1976:22-25). The upper pueblo rooms were considerably larger than those of the lower pueblo, averaging 2.3 by 5.8 m compared to the average 1.3 by 2.3 m rooms of the lower pueblo.

Like LA 9204, changes in the surface structures at TA-47 may have been related to changes in the pithouses. The smaller pithouse at TA-47, "kiva 1," was "trash filled" and contained several human burials. The larger "kiva 2" pithouse was probably filled by natural eolian and colluvial processes. Green (1976:27) suggests that the lower pueblo was associated with the smaller pithouse and that when the lower pueblo was razed, the smaller pithouse was abandoned, becoming a trash pit for the builders and occupants of the upper pueblo and the larger pithouse. She does not suggest that the occupants were different or that the second building episode represented a reoccupation of the site. The reasons for abandoning the earlier structures are not known.

Abandonment. Information relevant to abandonment processes at Valdez-phase surface structures is generally not available in the excavation reports. As just discussed, two reports describe replacement of adobe structures by other adobe structures. The processes of abandonment of the earlier structures are not known except that they were razed and that, in both cases, the later structures were built on the earlier ones. At TA-47, the fill of the earlier structure, although perhaps naturally deposited, was apparently used to fill the rooms and create a low mound on which the later pueblo was built.

The first rooms of the lower pueblo apparently went unused for a time as they were covered by a thin layer of trash, after which a second floor was constructed on top of the trash layer. Thus, the building was built and used, temporarily abandoned, reoccupied with additional rooms, abandoned, and razed. The upper pueblo underwent a similar process. Its first rooms were built on the low mound of the lower pueblo. They went temporarily unused before being reoccupied, as evidenced by a thin layer of eolian sand separating the first and second floors. When the rooms were refloored, new rooms were added, after which the structure was abandoned. The major difference between the two is that the intermediate disuse period at the lower pueblo was characterized by a layer of trash between floors, while the same period at the upper pueblo was characterized by eolian sand. Clearly, the site was occupied during the disuse period of the lower pueblo. Whether it was also occupied during the upper pueblo disuse period is not known, but the pueblo was apparently not in use, even for trash disposal.

Architectural Form and Features. Table 128 summarizes information on surface architectural form. Several differences between the areas are evident in the related characteristics. While most north-area structures are linear, most south-area structures are rectangular. This is a function of the number of rooms. Most north-area structures consist of multiple rooms, and most south-area structures are single rooms. Therefore, most north-area structures are linear room blocks, while single rectangular structures dominate the southern area.

The other obvious difference is in average room size. North-area rooms are bigger over all (average 8.3 sq m of floor area compared to average 5.7 sq m in the south-area adobe rooms, and 4.2 sq m in south-area *jacal* rooms) and wider over all than south-area rooms. Figure 106 shows that, in south-area rooms, width is limited regardless of length: adobe rooms range between 1.2 and 2.8 m wide, and *jacal* rooms range between 1.3 and 1.8 m wide. North-area rooms range from about 0.8 to 4.5 m wide. The trend lines for south-area rooms show that width increases only minimally as length increases. The trend line for the north-area rooms shows that width increases more directly with increased length. It is, however, conditioned by the figures for three rooms from the upper pueblo at LA 9204 (the three dots around 1.5 by 5 m). If those figures, which are clearly different from most of the north-area room size figures, are deleted, the trend line is revised as in Figure 107 to show a much more dramatic increase in width relative to length.

Since room width is conditioned by the length of *vigas*, it may be helpful to look at the actual distribution of room widths. There are three clusters of room widths. The first is between 1.2 and 1.8 m and includes all south-area *jacal* rooms, six south-area adobe rooms (60 percent), and six north-area rooms (42.9 percent). This group contains 60 percent of all surface structure rooms. The second group is between 2.2 and 2.8 m and consists of four south-area adobe rooms (40 percent) and three north-area rooms (21.4 percent), or 23.3 percent of all rooms. The third group is between 3.1 and 3.8 m and includes three north-area rooms (21.4 percent), or 10 percent of all rooms. If we include two rooms, one less than 1 m wide and one more than 4 m wide, we find that 86.7 percent of the rooms are less than 2.8 m wide, and 13.3 percent are greater than 3 m wide. The latter are found only in the northern area. Since most sites in both areas are found in mountain foothill settings, where access to tall trees such as ponderosa pine or fir would not be restricted, the presence of wide rooms in the northern area is

Table 128. Comparison of data on architectural form from north- and south-area surface structures (dimensions and percent of rooms)

Area	Structure Shape					No. of Rooms					Average Room Size (meters)		Direction from Associated Pithouse			
	"L"	"C"	Block	Rect.	Linear	1	2	3	4	6	Adobe	Jacal	West	North	South	No pithouse
North	16.7	16.7	16.7	16.7	33.3	16.7	16.7	50.0	16.7	0	2.3 x 3.6	-	50.0	16.7	16.7	16.7
South	20.0	20.0	20.0	60.0	20.0	50.0	0	0	33.3	16.7	1.8 x 4.1	1.5 x 4.1	66.6	16.7	0	16.7

Table 129. Comparison of architectural feature data from north- and south-area surface structures (dimensions and percent of rooms)

Area	Hearth[1]			Hearth Size (meters)	Storage Cist[1]			Storage Jar in Floor[1]			Manos, Metates on Floor[1]			Mealing Bin[2]	Ash Pit[2]	Postholes[2]	Door[2]
	P	A	N		P	A	N	P	A	N	P	A	N				
North	37.5	31.3	31.3	.6	31.3	50.0	18.8	25.0	56.3	18.8	0	18.8	81.2	0	6.3	12.5	6.3
South	35.3	64.7	0	.5	17.6	82.4	0	23.5	70.6	5.9	5.9	88.2	5.9	0	0	5.9	0

[1] P = present; A = absent; N = no data.
[2] Percent of pithouses in each area with this feature.

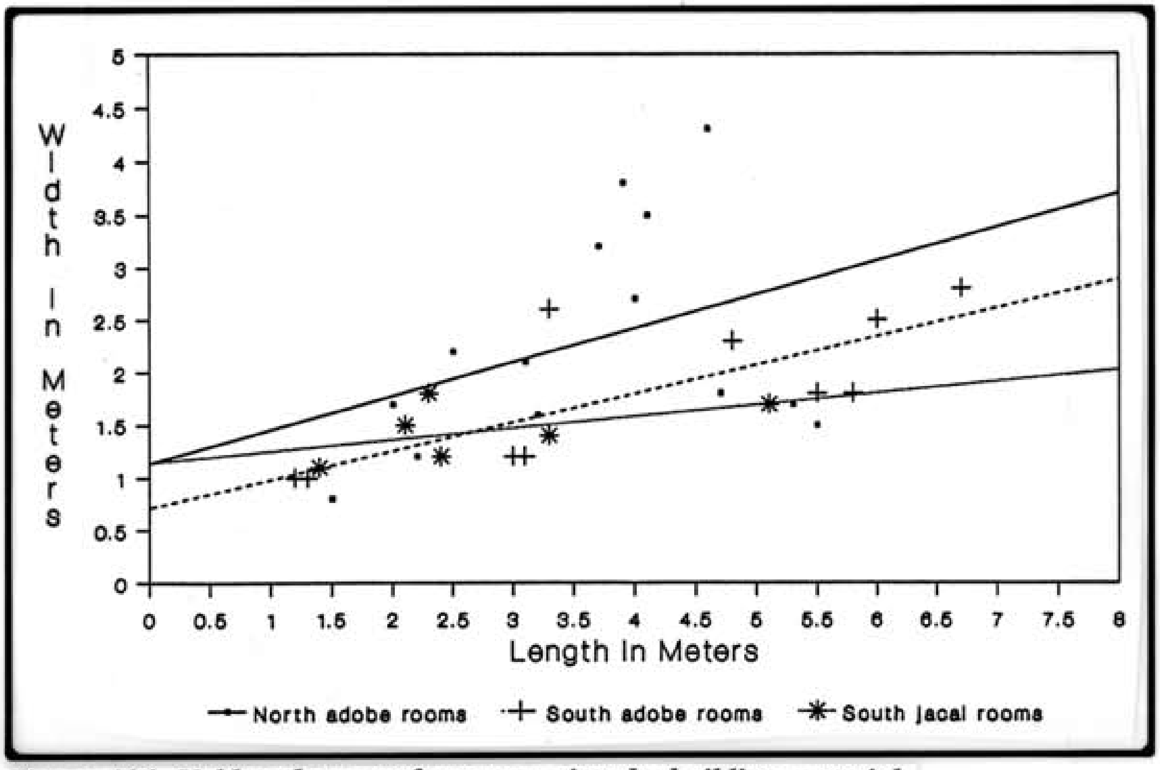


Figure 106. Valdez-phase surface room sizes by building material.

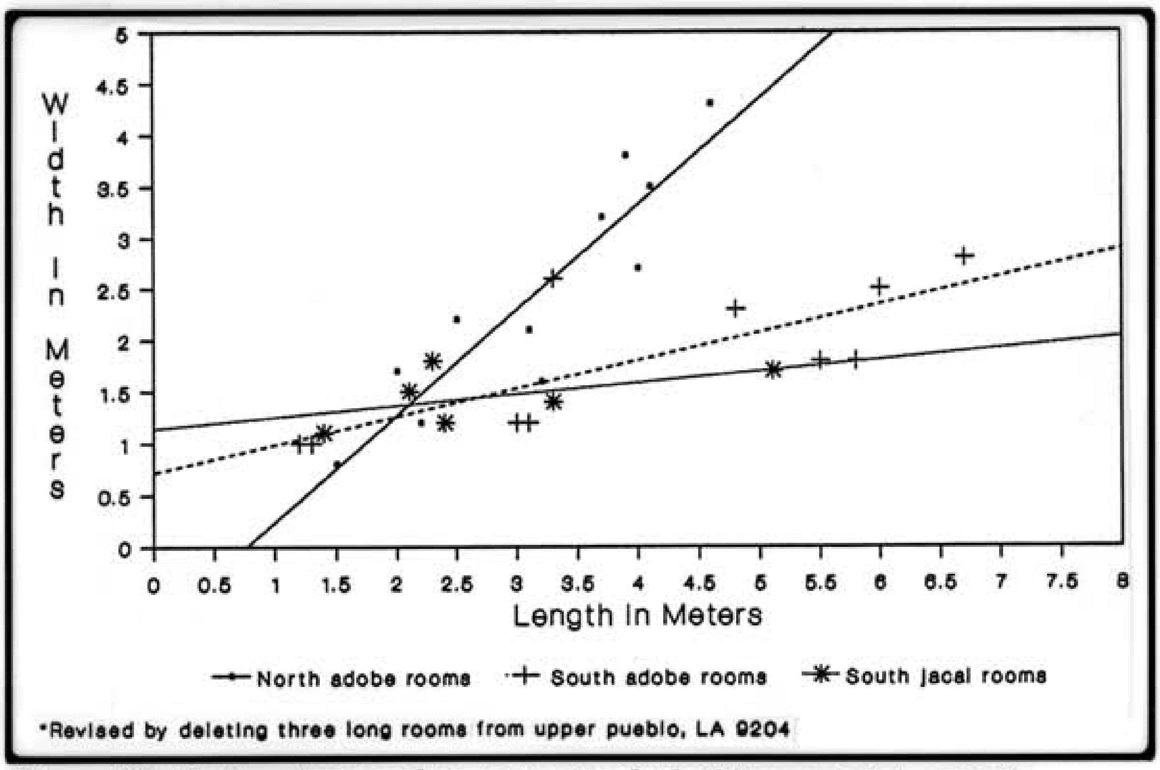


Figure 107. Valdez-phase surface room sizes by building material, revised.

probably not a function of availability of longer *vigas*. The differences in room widths between areas must represent differences in selection and use of materials.

Most surface structures in both areas were located on the west sides of their associated pithouses. One structure in both areas was located north of their pithouses. At LA 9402, in the northern area, the surface pueblos were located on the south sides of the pithouses. Thus, there is more variability in the placement of surface structures relative to associated pithouses in the northern area than in the southern area.

The only significant difference between the two areas in internal features of surface structures is the presence of storage features, particularly storage cists (Table 129). Although not common in either area, the frequency of storage cists is almost twice as high in the north-area sites as in the southern area. Storage jars in room floors were found at only two sites (one in each area): TA-47 and LA 9204.

Nonarchitectural Features

Activity Areas

Activity areas at Valdez-phase sites have usually been identified by the presence of hearths placed on what are assumed to be ground surfaces in use at the time of occupation. Although this may be the result of excavational bias in terms of amount of site area examined, activity areas seem to be more readily identifiable in the northern area than in the southern area. Examples of this are LA 9204 and LA 9206. At LA 9204, two hearths were found in a narrow strip between the surface structure and an "adobe floor." This strip, some 10 m wide and 25 m long, was identified as a "utility area" (Loose 1974:14-15). The "adobe floor" was a circular adobe surface 5.9 m in diameter rimmed by a low adobe wall about 0.2 m thick. Its function is unknown. At LA 9206, the "utility area" north of the pithouse consisted of three hearths and two "potrests" in a rectangular area of hard-packed earth. The area measured 3.5 by 3.2 m and was located at the northeast corner of the surface structure. The "work area" at the same site consisted of seven hearths just south of the pithouse in an area about 7.3 m long by 3.6 m wide. On the other hand, the four hearths at LA 9205 were scattered about the site. Two were on the east side of the structure, one was about 9 m west, and one was about 21 m north of the structure near a possible rock wall.

In the southern area, the activity area at TA-47 was defined between the structures and the pithouses by the presence of ceramic jars and a metate on the hard-packed ground surface (Green 1976). Hearths were not present. Also, two ceramic jars were set in the ground just north of the lower pueblo, suggesting an activity area north of the structure. During construction of the upper pueblo, these jars were left in place and incorporated in the floor of a room. At the Cerrita site (Woosley 1986), hearths were found near the south side of the pithouse. An activity area could not be defined at LA

70577 except for the area sheltered by the *jacal* or brush structure. This may also have been the case at TA-32 (Luebben 1968).

Agricultural Features

Woosley (1986) mentions stone terraces at the Cerrita site. The association of the terraces with the pithouse and *jacal* structure or the later, superimposed room block is not made clear. Steen (1976), on the other hand, discusses several stone alignments on the Rio Fernando alluvial fan, just south of Taos. LA 14868 consists of seven widely separated concentrations of artifacts associated with stone alignments. The ceramic assemblages at these concentrations consist of Taos/Kwahe'e Black-on-white and Taos Gray Plain, Incised, and Corrugated. The concentrations or "components" (Steen 1976) range from 25 to 60 m wide by 50 to 150 m long. Six contain stone alignments. Steen does not number them or provide maps or descriptions except to say that one is 15 m long with a 2 m long arm forming a right angle at one end. Test excavations in parts of several alignments showed them to have no depth and not to be natural features or associated with structures. Steen (1976:4, 7) identifies them as agricultural field borders. He states:

> The evidence indicates that in the period during which Taos Black on White was made the Taos Plain was dotted with small garden plots. These would have been places between drainage channels where the ground cover was removed and crops planted. Within the somewhat irregular clearings, low stone and earth dikes were built to retain precipitation within small garden plots. (Steen 1976:25)

The presence of Taos/Kwahe'e Black-on-white and Taos Gray Plain, Incised, and Corrugated sherds places these features in the Valdez phase and shows that the early Anasazi occupation in the region included an agricultural economy that involved use of soil and water control features. See Prehistoric Agriculture in the Taos District.

Discussion

Dating

We have seen that the earliest Anasazi sites in the Taos area appeared about A.D. 1100. This date is derived from tree-ring and archaeomagnetic dates from nine excavated Valdez-phase sites. While the tight clustering of dates is remarkable, the sites represent only 25.7 percent of the excavated sites from the phase. This points to one of the most pressing needs in understanding the initial Anasazi occupation of the region: accurate chronometric dating of sites.

This need is emphasized by reviewing radiocarbon dates from Valdez-phase sites. Of the six sites that have yielded radiocarbon dates, multiple dates were obtained from four sites (Table 115). Interestingly, the radiocarbon dates from these sites span time periods from two centuries (Cerrita) to five centuries (LA 2742). The time span lengthens to include older and older dates as the number of radiocarbon dates increases. At LA 2742 and LA 70577, the sites with the most radiocarbon dates and the longest time spans, the long time spans are from one sigma dates. If two sigma dates are used, the spans are considerably longer. Given that pithouses had use-lives of less than 15 to 30 years, and considering the absence of other structures that could have been used after the excavated pithouses at LA 2742 and LA 70577 were abandoned, it is inconceivable that four to five centuries of datable trash would occur at the sites. Further, most of the dated samples came from pithouse fill or features such as ash pits and hearths. Even if the hearths and ash pits were never cleaned out by the prehistoric inhabitants, they could not have held several centuries of burned trash.

There are clearly serious problems with using radiocarbon dates for the sites, since they do not substantially match the tree-ring and archaeomagnetic dates, and they provide date ranges that are 25 to 30 times the probable use-lives of the structures. The dating section of this chapter suggests that high carbonate levels in the soil may indicate that extreme carbonate contamination of the radiocarbon samples caused the early dates from LA 2742 and LA 70577. Discussions with the radiocarbon analyst (Darden Hood, personal communication) suggest that if carbonate contamination is the causative factor, it is more likely a result of the kind than the amount of carbonates: perhaps carbonate species more resistant to normal laboratory pretreatment procedures than calcium carbonate, the most common. This does not, of course, securely identify the source of the problem producing old dates. The dates could be the result of "old wood," although we tried to minimize this problem by having charcoal and wood samples identified by genus, and species when possible, and then selecting samples for dating that were less likely to be affected by the possible antiquity of the plant. Further, we would expect that "old wood" would be revealed simply as old dates, as at TA-34 (Table 115), rather than as a series of overlapping dates, as seen in Figure 103.

An additional problem in using radiocarbon dates is that their date ranges are often too long to accurately place sites within the short phases of the Taos region. The seven adjusted dates from LA 2742 have an average one sigma range of 185.7 years, while the five from LA 70577 average 152 years. If two sigma ranges are used to achieve 95 percent confidence in the date, the ranges average 371.4 years at LA 2742 and 304 years at LA 70577. The average range for the 18 dates listed in Table 115, assuming all to be adjusted one sigma dates, is 156.4 years, or 312.8 years for two sigma dates. These figures compare with an average two sigma range of 53.3 years for the six archaeomagnetic dates in Table 115. For sites belonging to a phase that we believe to be about 125 years long, dates with average one sigma ranges of 156 years may, at best, simply confirm a phase assignment, as at TA-34 (second date) or Cerrita (first date), but are unlikely to even place a site near one or the other end of the phase. Using two sigma dates may, at best, show only that the site belongs somewhere in the prehistoric Anasazi sequence, a conclusion that may be more simply and inexpensively drawn using empirical observations of architecture and artifact assemblages.

This is not to argue that radiocarbon dating should not be used at Valdez-phase sites. However, the problems encountered demonstrate that other chronometric techniques should be used for more accurate site dates and to evaluate radiocarbon dates. Even if tree-ring samples cannot be obtained, as at LA 70577, archaeomagnetic samples from hearths should be obtained. Further, the differences between adjusted and calibrated radiocarbon dates and the possible correspondence between the second peak in calibrated samples seen in Figure 104 and the tree-ring and archaeomagnetic dates suggest that all radiocarbon dates should be calibrated for increased accuracy.

Architecture and Site Structure

With the exception of LA 3569, Peckham and Reed's (1963) jacal structure; and LA 14868, Steen's (1976) agricultural site, excavated Valdez-phase sites consist of pithouses, usually in association with small surface structures. Not all excavated sites include both pithouses and surface structures. Still, the frequency with which they co-occur suggests that cases where they do not probably represent excavational bias rather than actual site structure.

Having said this, however, there are several major differences between sites in the northern and southern areas. The most obvious have to do with architecture. North-area pithouses are predominantly rectangular, and surface structures are small, coursed adobe pueblos. South-area pithouses are predominantly circular, and surface structures are small *jacal* shelters. These characteristics are present whether pithouses and surface structures occur together or separately. Additionally, while surface structures are usually found to the west of associated pithouses, there is more variability in this spatial relationship in the northern area than in the southern area. North-area surface structures are found to the north, south, and west of associated pithouses.

The two areas also differ in construction methods. North-area pithouses, unlike their surface structures, more often have walls of natural soil plastered with adobe. South-area pithouses have coursed adobe walls, also plastered with adobe. Perhaps as a consequence, north-area pithouses more often have sections of walls supported by vertical poles embedded in the walls. While most pithouses in both areas have a quadrilateral pattern of four vertical roof support posts, there is more variability in the northern area, including pithouses with two and eight posts. Besides differences in surface structure wall material, noted above, north-area surface structures often have cobble wall footings, while south-area adobe walls are set in shallow trenches.

Evidence of pithouse remodeling is limited in both areas and primarily points to cosmetic remodeling. Only 11 to 12 percent of pithouses in both areas show evidence of significant remodeling. This suggests that pithouses were more often abandoned than remodeled to a degree allowing longer use. Similarly, surface structures seem to have undergone cosmetic remodeling, as seen in multiple floors in adobe structures, but were abandoned, razed, and replaced rather than being structurally remodeled. This is true of adobe structures in both areas. *Jacal* structures in the southern area present no evidence of remodeling.

Information on structural abandonment processes, primarily from human burials on pithouse floors and in pithouse fill, but also including fill descriptions when recorded, suggests that south-area pithouse roof support systems were often, perhaps usually, salvaged at or after abandonment. After abandonment, south-area pithouses were apparently revisited more often than north-area pithouses, particularly for use as burial locations. South-area pithouses are over twice as likely to have burials on the floor and to have multiple floor burials and 1.7 times as likely to have burials in the fill as their north-area counterparts. Coupled with remodeling data that suggest high population mobility, this information may indicate that pithouse dwellers, particularly in the southern but also in the northern area, maintained ties to what might be conceived as ancestral sites or at least sites having some familial ties.

Finally, data on internal and external features, particularly food storage and preparation features, suggest differences in activity locations between the areas. North-area sites with more extramural and surface structure hearths and storage features may have seen food storage and preparation outside the pithouses. In contrast, south-area sites have more food storage and preparation features within pithouses.

Taken together, these data on Valdez-phase site architecture and structure suggest two different Anasazi populations, one in the northern Arroyo Seco-Rio Hondo area and the other in the southern Ranchos de Taos-Rio Grande del Rancho area. Chronometric dates indicate that both appeared in the region at roughly the same time, about A.D. 1100. These populations had significantly different architectural complexes involving architectural form, construction materials and techniques, and site structure. The location of activities involving food storage and preparation features differed between the populations, as did processes of site abandonment and postabandonment use of pithouses. Both populations were apparently highly mobile, judging from evidence on structural use and remodeling. By classifying all Taos/Kwahe'e Black-on-white sites as Valdez phase, archaeologists have masked this variability within the Taos region. Although architectural variability within the region has been noted in the past, the extent to which the northern and southern areas differ in architecture and site structure has been obscured by assigning sites to the Valdez phase. The effect has been to assume that variation within the phase is less or less significant than variation between phases. This review of architecture and site structure suggests that such is not the case.

PREHISTORIC AGRICULTURE IN THE TAOS DISTRICT

James L. Moore

The Taos area lacks evidence of occupation by farmers before about A.D. 1100, and it was on the Pueblo frontier until the nineteenth century. Isolation and conservatism are assumed to characterize the Pueblo occupation, beginning as early as the Valdez phase (Wetherington 1968:81). Its position at the edge of the Anasazi world has caused Taos to be considered a bit backward, lagging behind developments elsewhere (Cordell 1979a, 1989; Herold 1968; Peckham and Reed 1963). Two factors contributing to this view are the use of pithouses at a late date and historic conditions at Taos Pueblo. However, this developmental lag is probably perceptual rather than real. As discussed earlier in this report, rather than an anachronism resulting from conservatism or slow development, residence in pithouses was related to frontier settlement.

Historic conditions of isolation and conservatism at Taos Pueblo have been projected backward to become a fundamental characteristic of the area's occupation. However, as Cordell (1979b:146-147) points out, the suitability of modern Pueblos as analogies for their ancestors is questionable. Though modern pueblos have often remained culturally distinct, many of their beliefs and lifeways have been affected by their Euroamerican neighbors. Thus, historic patterns cannot be confidently projected backward into prehistory.

This is also true of agriculture. While the importance of farming to the Anasazi has long been recognized, agricultural features were virtually ignored until recently. With a few notable exceptions (e.g., Hayes 1964; Woodbury 1960), farming features were usually mentioned in passing when they were discussed at all. This began changing as archaeologists recognized the importance of small sites in prehistoric economies and realized that direct analogies could not be drawn between prehistoric and modern Pueblos. As more attention was paid to small sites, numerous farming features were recorded, many of which had no historic cognate. It is now recognized that prehistoric farming systems were varied and often quite different from the simplistic models based on earlier ethnographic studies.

If the Anasazi in the Taos region were isolated or overly conservative, there should have been considerable variation between farming techniques used there and in the central Rio Grande. The relatively sophisticated farming technology used in the latter area was either missing from the Taos district (suggesting conservatism) or adopted at a later time (suggesting isolation and cultural lag). However, if the isolation and conservatism are perceptual, developments in agricultural technology should mirror those in the central Rio Grande. Variation should be related to ecological rather than cultural factors.

Definitions of Agricultural Features

Because the archaeological literature abounds with terms for farming features, those used in this discussion are explicitly defined to prevent confusion. Two classes of farming systems are recognized: irrigation and dry-farming. Irrigation systems transport water from permanent sources through canals to fields. Lateral ditches, diversion walls, headgates, field borders, water spreaders, and retaining walls are features that can be associated with canals. Dry-farming relies on impermanent water sources, such as rainfall and runoff. Features can include terraces within gullies or on slopes, diversion walls, gridded plots, and ditches for distributing runoff.

Canals and *ditches* differ in the source of the water they transport. Canals carry water from permanent sources, and ditches carry water from impermanent sources. Thus, canals move water from perennial streams or reservoirs to farming areas, while ditches carry water from impermanent sources like canals, diversion systems, or temporary reservoirs to fields. Size makes no difference; a canal can be smaller than a ditch.

Check dams are linear alignments placed across erosional channels to trap soil and slow runoff velocity. Conservation-oriented *contour terraces* are linear alignments placed perpendicular to slopes to stabilize existing soil, trap eroded soil, and slow runoff velocity. While earth, stone, or both were used to build these features, usually only those constructed of stone are preserved. They are similar in construction and function, and both provide small farming plots by trapping soil. A second variety of contour terrace was filled by hand rather than erosion, and supplements rather than conserves farmland. These features, expensive to build and maintain, are rare in the Southwest.

Diversion walls fall into several categories. Those placed across gullies can redirect flow and conduct water into ditches or onto fields. Some diversion walls temporarily impound water for later use. Another variety occurs in combination with check dams or contour terraces and redirects excess runoff away from plots. Still another type helps to spread water across fields. These features are often impermanent and built to ensure equal delivery of water during a runoff episode.

Holding dams are built across channels to impound water. The main difference between holding dams and diversion walls is that the former impounds water on a permanent basis, while the latter redirects flow, though temporary impoundment sometimes occurs. The area holding water behind a dam is one type of *reservoir*. A second is an artificial excavation for storing water from runoff or diverted stream flow.

Grids are linear stone alignments subdivided into a series of cells. They usually occur on level surfaces or very gentle slopes and are sometimes gravel or cobble mulched. *Headgates* occur in several types of systems. They regulate water flow in canals and ditches. In contour terraces they occur as breaks allowing excess runoff to pass into lower parts of the system or exit without causing damage.

Agricultural Features in the Taos District

While regional overviews generally discuss the extensive and complex farming features in Chaco Canyon, the Rio Chama Valley, and at Mesa Verde, there is usually a dearth of similar information for the Taos district (Cordell 1979a, 1979b; Moore 1981; Stuart and Gauthier 1981). However, rather than being indicative of the level of cultural development, this lack is attributable to insufficient survey coverage and reporting. Information provided by recent studies and obscure or unpublished papers and reports show that a sophisticated and complex farming system was also used in the study area.

Bandelier (1892) was the first to mention farming features in the region. Though he never visited them, he noted "extensive vestiges of garden plots" near Ranchos de Taos (Bandelier 1892:32-33) and compared them to features in the Rio Chama and Ojo Caliente valleys, in central Arizona, and in the Sierra Madre of Sonora and Chihuahua. From these comparisons it is obvious that he was describing grids.

During his studies in the region, Jeançon (1929:3) noted numerous "tower sites" between San Fernandez de Taos and Taos Pueblo, as well as "long lines of broken ditches". The "towers" were rock piles less than 1 m high and 1 to 7 m in diameter. Greiser and Greiser (1989:3) conclude that these features are evidence of field clearing rather than the remains of structures. Similar rock piles occur along the Rio Lucero and are associated with extensive systems of contour terraces and cobble bordered grids. Many of the grid borders are piles of cobbles as much as 1 m wide and 30 to 40 cm high.

During a survey on the Taos plain, Steen (1976) found eroded grids or contour terraces and rock piles. Rocks were common on his sites but not in surrounding areas and often formed complete or obviously disarticulated alignments. While human burials were found under two rock piles, the other features are similar to those described by Jeançon (1929) and Greiser and Greiser (1989), suggesting that they were related to field clearing. While surveying an adjacent area, Boyer (1991b) located a series of three check dams.

Numerous and extensive farming features have also been recorded near Picuris Pueblo. First noted by H. P. Mera, the Peñasco Alto site (LA 926) contains an extensive collection of farming features covering literally hundreds of acres. It is situated on top of a flat ridge separating the Rio Pueblo and Rio Santa Barbara valleys, southeast of Picuris Pueblo. Mera (n.d.) drew a sketch plan of the west end of the site but furnished no description. Partial descriptions are provided by two later studies. In 1963, Woodbury (n.d.) examined features in three areas next to an airstrip near the center of the site. All three contained cobble-bordered grid systems in various stages of completion. Walls bordering the grids were constructed of local rock cleared from the internal grid surfaces. One system contained parallel alignments with occasional perpendicular walls, implying an incomplete grid pattern.

Peñasco Alto was also examined by Nemaric (1975) and Snow (1975). The site was estimated to cover 3.8 sq km and contained hundreds of cobble-bordered grids (Nemaric 1975:7). A few fieldhouses or small habitations were noted, mostly in areas overlooking Rio Santa Barbara or Rio Pueblo (Nemaric 1975:7). Diagnostic pottery included Taos Black-on-white, Kwahe'e Black-on-white, Santa Fe Black-on-white, Socorro Black-on-white, and Hopi area Black-on-orange. Snow (1975) noted that the grids were variably sized, averaging 3 by 2 m or smaller. Extensive contour terracing was also present, along with apparent diversion walls used to control runoff (Snow 1975).

Nemaric (1975) also found six smaller farming complexes east of Picuris Pueblo in the Rio Pueblo Valley. Vadito West (LA 12747) covered 1 ha and contained cobble-bordered grids and contour terraces. Kwahe'e Black-on-white sherds were associated with the farming features, and possible structures were noted in places. Peñasco Grande (LA 12748) is a probable field covering about 2 ha. Rock was cleared from this area, and it was bounded by a 200 m long stone wall. Kwahe'e and Taos Black-on-white sherds and historic Tewa and micaceous wares were scattered across the field, suggesting prehistoric as well as historic use. Dos Peñascos (LA 12749) contained grids and contour terraces as well as historic structures. The features covered 2 ha and were thought to be prehistoric, though they may have been reused more recently. Contour terraces and grids covered about 1 ha at the Grant Boundary site (LA 12570). Diagnostic cultural materials suggested prehistoric use. Contour terraces and grids were also found at the Vadito I and II sites (LA 12751 and LA 12752), covering 2 ha and 1 ha, respectively. Diagnostic sherds suggested that both dated to the Taos phase, the local equivalent of the Valdez phase. While no structures were found at Vadito I, four possible pithouses were noted at Vadito II.

During a timber sale survey, Gauthier et al. (1978) recorded several farming sites north and west of Picuris Pueblo. The largest, LA 16765, covered 80 ha. Contour terraces and cobble-bordered grids at this site were mostly single coursed. Grids averaged 5 by 3 m and were oriented perpendicular to the slope. Five cobble alignments were found at LA 16758, the remains of a grid system. Diagnostic artifacts suggested use between A.D. 1150 and 1750. Two cobble alignments representing the eroded remains of a grid were recorded at LA 16762, but no diagnostic artifacts were found.

While several surveys have been conducted along Rio Grande del Rancho, all suffer from inadequate coverage or reporting. Herold (1968) surveyed the valley from the Rito de la Olla to its confluence with the Rio Pueblo, recording 110 sites. Two contained "check dams," which, from his description, are more accurately identified as contour terraces. Possible cobble-bordered grids were noted at four other sites. While these sites seem to be located near valley bottom floodplains amenable to farming, Herold's (1968) study was biased toward this zone and ignored higher elevations away from permanent streams.

Kriebel (1983) found site concentrations along the Arroyo Miranda and Rito de la Olla, in both cases near their confluence with Rio Grande del Rancho. Of 283 sites, 25 contained contour terraces, 32 contained grids, and 6 contained check dams (Kriebel 1983:5). Woosley (1980c, 1983) documented numerous farming features around Pot Creek Pueblo and near Llano Quemado, including check dams, contour terraces, grids, retaining walls, and rock alignments. Farming features were noted in virtually every location containing potentially arable land (Woosley 1983). Unfortunately no numbers or more detailed descriptions are provided. While no direct evidence of canal irrigation was found, Woosley (1983) argues that it was probably used, citing local folklore and noting a correspondence between the locations of prehistoric fields and historic irrigated plots.

Most of the types of farming features found in the Taos district have prehistoric analogues elsewhere in the Pueblo region and seem to be relatively common and widely distributed across the district. Beyond Woosley's (1983) unsupported contention that canals were used prehistorically, however, few of these features have been documented in the northern Rio Grande. While some argue that canal irrigation was unimportant or absent before Spanish contact, enough evidence exists to suggest that it was actually an important component of the late prehistoric farming system.

Prehistoric Canal Irrigation

The use of canal irrigation in the northern Rio Grande before Spanish contact is poorly supported by archaeological data. Historic documents provide some information but are open to interpretation. Proving or disproving the existence of canals in this area before Spanish contact is difficult because it has been the focus of settlement since the fourteenth century, and continued use has obliterated most traces of the prehistoric farming system.

Wozniak (1987) argues against the existence of extensive canal irrigation before Spanish contact:

> All Puebloan groups in the Rio Grande Valley are assumed to have engaged in extensive irrigation agriculture before the time of the Coronado expedition (1540-1541); most studies even go so far as to assert that the

> Coronado expedition found the Puebloans engaged in such activity. Neither of these assertions is accurate, and neither is founded upon any scientific or documentary evidence. (Wozniak 1987:6)

> Consequently one must conclude, in the absence of any evidence to the contrary, that irrigation agriculture was either not practiced or practiced to an insignificant and inconsequential degree among the New Mexican Pueblos in the first half of the sixteenth century. (Wozniak 1987:13)

Wozniak equates irrigation with the extensive and almost exclusive use of canals drawing water from the Rio Grande for growing crops. Expedient water diversion and canals drawing from smaller streams and side flow of the Rio Grande are termed subirrigation and considered merely an elaboration of floodwater farming. While noting that there is evidence of some irrigation before Spanish contact, Wozniak feels that the continued and widespread use of dry-farming suggests limited rather than intensive use of irrigation:

> We can conclude that irrigation was practiced by some Puebloans in the late sixteenth century, but not all Puebloan groups can necessarily be assumed to have utilized irrigation systems. The Piros, the Acomas, the Zunis, one group of Keresans, and some Tewas can be demonstrated to have had irrigation agriculture, in specific circumstances. Floodwater and other forms of dryfarming, however, would appear to have been virtually the exclusive form of agriculture among most Puebloan groups and to have remained a major component of the subsistence technology even among those who utilized some form of irrigation. (Wozniak 1987:15)

His argument seems contradictory. While admitting that there is evidence for prehistoric canal irrigation in the Rio Grande Valley, it is effectively dismissed because canals are assumed to be minor components of the farming system or to have had sources other than the main Rio Grande channel. Neither of these assertions is demonstrated in the literature.

Documentary Evidence of Prehistoric Canal Irrigation

Documents associated with the Vásquez de Coronado expedition of 1540-41 provide the earliest descriptions of Pueblo farming. In a letter from Viceroy Mendoza to the king dated April 17, 1540, quoting an earlier letter from Vásquez de Coronado dated March 20, 1540, the Pueblos are said to "cultivate the land in the same way as in New Spain" (Hammond and Rey 1940:159). This passage is interesting because canal irrigation was common in New Spain, especially around Mexico City, where Vásquez de Coronado lived before being appointed governor of Nueva Galicia in 1538 (Bolton 1949). Unfortunately, it represents a summary of information gathered before Vásquez de Coronado's arrival at Cibola and is not a direct observation.

Better information is available from the three *entradas* that occurred between the Vásquez de Coronado expedition and 1598. Martín de Pedrosa produced a list of villages found by the Chamuscado-Rodríguez expedition of 1581-82 (Hammond and Rey 1966:115-120). Among them is a pueblo (Castilleja, probably San Felipe) north of Medina de la Torre (probably Kuaua) that irrigated its fields from a nearby stream (Hammond and Rey 1966:118). Luxán's account of the Espejo expedition of 1582-83 suggests that canals were used at Zuñi and Acoma, and Espejo's report indicates they were used by the Piros. Along what is probably Rio San José, near Acoma, Luxán observed "many irrigated cornfields with canals and dams, built as if by Spaniards" (Hammond and Rey 1966:182). Espejo also mentions these features: "These people have their fields two leagues distant from the pueblo, near a medium-sized river, and irrigate their farms by little streams of water diverted from a marsh near the river" (Hammond and Rey 1966:224). Near Zuñi, Luxán noted "a large marsh which enables the natives to irrigate some fields of corn. There are two canals with water" (Hammond and Rey 1966:186).

Espejo's description of Piro agriculture is one of the most detailed, though it is still rather sketchy:

> They have fields planted with corn, beans, calabashes, and tobacco [*piciente*] in abundance. These crops are seasonal, dependent on rainfall, or they are irrigated by means of good ditches. They are cultivated in Mexican fashion, and in each planted field the worker has a shelter, supported by four pillars, where food is carried to him at noon and he spends the siesta; for usually the workers stay in their fields from morning until night just as do the people of Castile. (Hammond and Rey 1966:220)

Further upriver among the Tiwa pueblos, Espejo noted that "the planted fields and the character of the land seemed to be the same" as in the Piro area (Hammond and Rey 1966:221). Since he had just described the use of canals by the Piro, this passage suggests that they were used by the southern Tiwas as well.

An anonymous chronicler noted the use of canals by the Tewa during the de Sosa expedition of 1590 to 1591: "All six of these settlements had canals for irrigation, which would be incredible to anyone who had not seen them with his own eyes" (Hammond and Rey 1966:282). The villages were not named, but Hammond and Rey (1966) believe they included Tesuque, Nambe, Pojoaque, Jacona, and Cuyamungue, which are all near Santa Fe. Another village (probably San Ildefonso) is described as lying "in an extensive valley, all under irrigation" (Hammond and Rey 1966:283).

Several documents related to Oñate's colony at San Gabriel also suggest that canals were used by the Pueblos before Spanish contact. During Valverde's investigation of conditions in New Mexico in 1601, several witnesses provided interesting information. Joseph Brondate gave a short description of Pueblo farming: "Some of their fields are irrigated by means of ditches, others depend on seasonal rain" (Hammond and Rey 1953:626). Marcelo de Espinosa provided virtually the same information: "Some fields are irrigated, others depend on seasonal rain" (Hammond and Rey 1953:634).

While this could simply mean that the Pueblos had picked up the idea of using canal irrigation from the Spanish colonists, other documents indicate that the Pueblos were initially unresponsive to Spanish teaching and had few examples to copy. Fray Francisco de Zamora testified: "They did not show as great an inclination toward our teaching as we should have liked in order to encourage us to redouble our efforts to teach them" (Hammond and Rey 1953:675). Fray Juan de Escalona noted in a letter to the viceroy dated October 1, 1601, that efforts to sow a community plot had failed and that the Pueblos had to provide all of the colony's food (Hammond and Rey 1953:692-693). It is unlikely that three short years of haphazard farming by the Spanish inspired the Pueblos to emulate their technology.

Archaeological Evidence of Canal Irrigation

Evidence of canal irrigation occurs across the Southwest, though it is limited in the Rio Grande Valley. Numerous studies of the Hohokam canal systems of southeastern Arizona have been conducted, such as those by Crown (1984), Haury (1976), and Masse (1976). Many canal systems in the Salt and Gila River valleys served multiple communities in a single time period, suggesting cooperative use (McAllister 1976). At least 584 km of canals were built in that area, and individual systems containing an average of 55 km of primary and secondary canals (McAllister 1976).

Irrigation systems failed to reach similar levels of complexity elsewhere in the Southwest. Mimbres canals were probably short and operated by individual villages (LeBlanc 1989:188). Herrington (1979) located several small Mimbres canals used to water floodplain fields in the middle part of the Rio de Arenas Valley. One system fed a series of bordered plots covering 25 ha (Herrington and Creel 1991). Kintigh feels that the late prehistoric Zuni made "substantial, if not almost exclusive, use of spring and riverine irrigation" (Kintigh 1985:114). This position is based on documentary evidence from the Espejo expedition and on settlement shifts to areas amenable to irrigation late in the prehistoric period. It is suggested that irrigation agriculture may have begun as early as A.D. 1275 to 1300 in the area (Kintigh 1985). Unfortunately, no evidence of these canals has been found.

A few canals and related features have been found in the Western Anasazi area. Fewkes (1904:30) noted the remains of prehistoric ditches near Homolovi 3, though recent surveys found no evidence of these features (Lange 1989). Three canal systems were identified by Plog (1970) along Hay Hollow Wash, the longest of which transported water for 8 km.

Canals also occur in the Sinagua area of Arizona. A channel that seemed to be part of an irrigation system was recorded by Breternitz (1960) at NA 2385 in the Verde Valley. Fewkes (1912) found a probable canal along Walnut Creek and notes that "irrigation ditches" were known from that area. During his studies in the Verde Valley, Mindeleff (1896) found several canals. Perhaps the best preserved examples in the region took water from Beaver Creek near Montezuma's Well (Schroeder 1948; Schroeder and Hastings 1958).

Several possible canals have been identified in the Eastern Anasazi area. Ellis (1970) defined two canals which took water from El Rito Creek near Sapawe and carried it as far as 4 km. Unfortunately, this system is poorly documented, and some feel it was built by Spaniards (Wozniak 1987:8). Similarly, though Ellis (1970) asserts that there are prehistoric canals at Nambe, they have not been accurately dated and may be historic. Bugé (n.d.) found a possible canal in the north part of the Ojo Caliente Valley but provides no details. Further northwest, Moorehead (1908:259-260) reported canals in the La Plata Valley, noting that some could be traced for miles. Prehistoric canals were distinguishable from historic canals because they were built in different locations: "The ancient farmer extended his ditches along the base of the mesa, not high up on its side as does the white ranchman of today" (Moorehead 1908:259). Recent research near Taos Pueblo has tentatively identified several canal systems (Greiser and Greiser 1989; Greiser et al. 1990a, 1990b). These systems are under investigation and appear to have taken water from tributaries of the Rio Grande.

Discussion

Descriptions of Pueblo farming technology provided by early Spanish expeditions are sketchy but contain several important implications. First, it is obvious that canal irrigation was widespread at the time of Spanish contact. Eyewitness accounts described canal systems in the Piro and Zuñi provinces, near Acoma, among the Keres, and at six or seven Tewa villages. Oñate's colonists had little effect on Pueblo farming techniques. Official depositions taken during investigations of the colony suggest that the settlers had little interest in farming. Though a few halfhearted attempts at cultivation were made, the bulk of their food came from the Pueblos, who continued to use their traditional farming methods, which included canal irrigation.

While small streams and marshes were used as water sources in the Zuñi, Acoma, Keres, and Tewa areas, this may not be true elsewhere. Wozniak cites Earls's (1985) study of the Piros, concluding that they used a "moderately elaborated form of floodwater farming rather than intensive irrigation agriculture" (Wozniak 1987:11). Unfortunately, there is no evidence for this position. No prehistoric Piro canals have been studied, and none of the early chronicles states that the Piro diverted water from side flows or marshes. It may be significant that when the source was a marsh or small stream, as at Acoma, Zuñi, and Castilleja, that fact *was* noted. The lack of this sort of reference could be used to suggest that the Piro were irrigating from the Rio Grande rather than tributary streams or marshes.

Documentary evidence shows that a variety of farming systems were used at the time of Spanish contact. Both dry-farming and irrigation were important, which is no surprise. The prehistoric Pueblos were astute farmers, familiar with the danger of relying too heavily on one type of field. Studies in the valleys of the Rio Chama and its tributaries (Bugé 1984; Moore n.d.a) suggest that it was a common practice to scatter fields across the landscape, planting at a variety of elevations and on different landforms to prevent a single disaster from destroying the entire crop. The absence of total dependence on irrigated fields is no indication of a lack of agricultural intensity. Rather, it is evidence of a buffering mechanism in which both dry-farmed and irrigated fields were used to prevent total economic disaster.

Archaeological evidence suggests that canals were relatively common in several areas. While the most extensive systems were built by the Hohokam, smaller systems were built in the Mimbres area, in eastern Arizona, and perhaps along tributaries of the Rio Grande and Rio Chama in northern New Mexico. Moorehead's (1908) description of canals along the La Plata River is one of the few reports of irrigation features in the Four Corners region and has not been substantiated by later studies. These features have probably been eradicated by modern farming.

While undisputed canals have been found in regions bordering the Eastern Anasazi area, the prehistoric affiliation of the few reported examples from the upper Rio Grande has been questioned. Yet descriptions of agriculture provided by sixteenth-century Spanish expeditions clearly show that canal irrigation was practiced by many Pueblo groups. Hard archaeological evidence of these features is lacking because this area has been the focus of Euroamerican farming and settlement since the sixteenth century. Prehistoric canals have been modified and reused or eradicated by historic farming. It is possible that prehistoric canals will never be found in much of the Rio Grande Valley because of this continued use. The few possible canals found along tributaries of the Rio Chama are easily disputed because the Spanish were building canals in that area by the mid-eighteenth century, most of which are poorly documented. Thus, when abandoned canals are found in that area it is difficult to determine who actually built them. In order to find evidence of prehistoric canal systems, the search must concentrate on areas lacking such a long and continuous history of agricultural use. River valleys with wide floodplains and dependable water are not good places to look, because they are as attractive to modern agriculturalists as they were to prehistoric farmers. Prehistoric canals will probably only be found in areas that are less attractive to modern farmers than to the Anasazi. The alluvial fan at the confluence of Rito de la Olla and Rio Grande del Rancho is such a location.

Agriculture at Pot Creek Pueblo

Recent studies show that farming features cover the alluvial fan on which Pot Creek Pueblo is situated. In addition to those described by Woosley (1980c, 1983), Boyer (1989a) identified possible canals or ditches and artifact scatters thought to represent fields or fieldhouses. Further examination suggests that some of these features are natural gullies; however, at least two may be manmade channels. LA 71190 contains one of these features and was investigated during this project. Adjacent to the probable canal is a large expanse of level ground covered by a diffuse artifact scatter. While farming features were absent from this area, pollen studies show that it was a cornfield, and it was probably watered by the canal, which runs along its eastern boundary.

A second farming site, located just east of LA 71190, was also investigated. LA 71189 contained a cobble contour terrace and a large rock pile. The rock pile was probably a result of field clearing, and pollen analysis showed that corn was grown on the terrace. LA 71187, northeast of LA 71190, contains two possible canals (Boyer 1989a). Closer examination suggested that one canal is actually a natural drainage. The other is similar to the canal at LA 71190 in that it runs perpendicular rather than parallel to the slope. A low berm was noted along the downslope side of this feature, and an eroded check dam may have spanned the channel at one time. A third possible canal was defined at LA 71188, but closer examination suggested that it is natural. A check dam was found north of the channel, and the gully may have rerouted itself as a result of this obstacle.

Survey by Carson National Forest on an adjacent parcel of land located numerous farming features upslope from LA 71190 (Kriebel 1989). Possible canals occurred at two sites--LA 84517 and LA 84519. While it is uncertain whether these channels are natural or artificial, one seems to have its source at a spring (Robert Kriebel, personal communication). A concentration of rocks along the channel at LA 84519 suggests that a check dam was built across it. A check dam also crosses the channel at LA 84517. In addition to farming features, LA 84517 contains an adobe pueblo mound and midden dating ca. A.D. 1100 to 1200. A broad cobble contour terrace and three or more rock piles were found at LA 84520. At least one pithouse depression was also noted, and diagnostic artifacts suggest occupation ca. A.D. 1100 to 1200. Two cobble alignments were found at LA 84521, representing contour terraces or an eroded grid system. Also present at this site is an adobe pueblo mound dating ca. A.D. 1200 to 1350. Similarly, LA 84522 and LA 84523 contain adobe pueblo mounds, cobble contour terraces, and rock piles dating ca. A.D. 1200 to 1350. Rock piles, possible check dams, a cobble contour terrace, and a probable cobble-bordered grid are all associated with an adobe pueblo mound at LA 84524. Rock piles and check dams occur adjacent to an adobe pueblo mound at LA 84525. Finally, disarticulated contour terraces and cobble-bordered grids were noted at LA 84526, and other concentrations of rock in that area may represent eroded farming features. These last three sites appear to date ca. A.D. 1100 to 1200.

While farming features were recorded with pithouses or adobe pueblo mounds during Kriebel's (1989) survey, they were not necessarily associated with the residential features. Examination of the gentle slope above LA 71190 suggests that farming features are extensively distributed across that area and that their location adjacent to structures may, in many cases, simply be fortuitous. Rock piles and disarticulated alignments are common and it is often impossible to distinguish those with a natural origin from manmade features. Woosley (1980c, 1983) found a similar distribution on an adjacent parcel, noting that farming features occupied virtually every location containing potentially arable land.

Irrigation and dry-farming features are common around Pot Creek Pueblo. While prehistoric dates for contour terraces, check dams, and grids are rarely questioned, similar dates for canals are usually treated with suspicion, as noted earlier. Thus, before proceeding further, it is necessary to present evidence for associating the canal at LA 71190 with the occupation of Pot Creek Pueblo. The function of the dry-farming features found in the area must also be discussed. When these topics have been addressed, it will be possible to develop a model of prehistoric farming in the region.

Dating the Canal at LA 71190

Sediments from the channel bottom in both trenches across the canal at LA 71190 were archaeomagnetically dated. While unbaked sediments are not ideally suited for this procedure, studies suggest they can be dated under the right circumstances. The precision with which mean sample directions are determined is expressed as the alpha-95 value, which is related to the magnetic dispersion of cube directions (Wolfman 1982:279). Alpha-95 values higher than 4 degrees are usually considered unacceptable (Wolfman 1982:284). Sediments deposited under nonturbulent conditions in the Chetro Ketl field at Chaco Canyon were archaeomagnetically dated at A.D. 1250 (Lyons 1976; Nichols 1975). Unfortunately, alpha-95 values for these samples were larger than 4 degrees, suggesting that this date is inaccurate.

Archaeomagnetic studies from southeast Arizona suggest it is possible to obtain usable results from canal sediments (Eighmy and Howard 1991), but there are problems with the procedure. While initial results were promising, most alpha-95 values were high (Eighmy and Klein 1990). Control studies from historic canals with known construction dates and use-lives showed that there was often a serious error in sample inclination, though declinations matched expected values fairly well (Eighmy and Howard 1991:92). Inclination error may have resulted in erroneously early dates in several of the prehistoric canals sampled (Eighmy and Howard 1991:99). While this phenomenon has been studied for many years, its cause is still unknown and has been attributed to both depositional and postdepositional processes (Verosub 1977a).

both depositional and postdepositional processes (Verosub 1977a).

In addition to inclination error, the source of remanent magnetism in sediments can also lead to incorrect dates. Wolfman (1984:381-382) defines three sources of remanent magnetism:

> The alignment of magnetic particles as they settle through water and come to rest on the basin floor is called *depositional detrital remanent magnetism* (DRM) whereas alignment due to rotation after deposition in the wet sediment is termed *postdepositional detrital remanent magnetism* (PDRM). . . . This latter effect is enhanced in many situations by bioturbation. . . . In addition to depositional and postdepositional detrital remanent magnetism, in some cases a significant portion of the remanence in sediments came about by several processes including oxidation, reduction, and hydration long after deposition.

Whatever the source, sediments have a demonstrated ability to retain a stable remanent magnetism, particularly when deposited under quiet conditions (Merrill and McElhinny 1983; Tarling 1971; Verosub 1977b). What must be remembered is that dates from sediments may not be related to the time of deposition. PDRM can be acquired if sediments are saturated to the point where particles become free to realign, causing them to date later than the time of deposition. Thus, there are three sources of error in archaeomagnetic dates from canal sediments: little confidence can be placed in samples with high alpha-95 values, inclination error can result in dates that are too early, and acquisition of remanent magnetism after deposition (PDRM) can make it difficult to be certain of the event being dated.

With this in mind, it is no surprise that one trench sample had a prehistoric date while the other was modern. The 95 percent oval of confidence for the Trench 1 sample includes a section of the archaeomagnetic curve near A.D. 1050, and a second at A.D. 1365. The oval of confidence for the Trench 2 sample includes nearly all of the curve from 1851 to 1975 (Daniel Wolfman, personal communication). Low alpha-95 values suggest that both dates are acceptable. In both cases, it is likely that the date refers to the last time sediments were saturated to the point that particles were able to align or realign with magnetic north. In Trench 1, the last saturation episode seems to have occurred in or before the fourteenth century, while in Trench 2 it happened much more recently. This is explained by the nature of the sediments. While the channel in Trench 1 was filled with a dense sandy clay that would have made it very difficult for sediments to become saturated, the channel in Trench 2 was filled with permeable sediments that seem to have allowed a more recent saturation.

The oval of confidence for the Trench 1 sample encounters the archaeomagnetic curve at a date soon after the abandonment of Pot Creek Pueblo. Two processes could be responsible for this: clay particles could have aligned after settling through standing water in the bottom of the channel; or channel bottom deposits became saturated at a later date, allowing particle realignment. The latter is more likely because canals are designed to move water rather than hold it, and it represents a process that could have occurred several times before sediments were buried deeply enough to prevent saturation. Thus, this feature was probably abandoned for some time before PDRM was acquired. Inclination error is also possible, suggesting that the date may be a bit early. However, it is doubtful that the error is as high as 500 years, which would be necessary to bring it into correspondence with the first Euroamerican occupation of the area. Thus, prehistoric construction, use, and abandonment of this feature are likely. The range spanned by the dates at which the oval of confidence approaches or encounters the archaeomagnetic curve also supports this conclusion. The early date (ca. A.D. 1050) is about 50 years before the beginning of the Valdez phase, while the later date (ca. A.D. 1365) is 25 to 40 years after abandonment of Pot Creek Pueblo. These dates span the Anasazi occupation of the study area.

While the early dates and association of the canal with a prehistoric cornfield suggest it was used by occupants of Pot Creek Pueblo or some other nearby village, the historic date and its location near Cantonment Burgwin can be used to argue for a nineteenth-century association. Though it is difficult to satisfactorily demonstrate the former, there is enough information available to test the latter.

Historic settlement did not reach the Pot Creek area until the American Territorial period (see Cultural Environment). Before the establishment of Cantonment Burgwin, the only historic-period residents of the area were Jicarilla Apaches, who lived in *rancherías* and practiced only limited farming. The Pot Creek area was specifically chosen for a military outpost because it was distant from any center of population (Murphy 1973:7). Cantonment Burgwin was built in 1850 at the confluence of Rito de la Olla and Rio Grande del Rancho, nearly 5 km from Talpa. Occupation continued until 1860, when the rapidly deteriorating post was abandoned (Murphy 1973).

An attempt to establish kitchen gardens and farms at military posts in New Mexico began in the early 1850s (Frazer 1963; 1983). Was there a kitchen garden or farm at Cantonment Burgwin, and if so, where were they located? If they were near LA 71190, the canal and cornfield could date from that period rather than the Anasazi occupation. Watercolor sketches of the post painted in 1857 help address this question. An overview from the southwest shows that while there were a few clearings east of the cantonment, no large areas were cleared for farming (Murphy 1973, facing p. 14). However, a field is visible in the foreground *west* of the post, between the buildings and the river. In a second sketch, showing the southwest corner of the palisade, the field is again visible between the cantonment and Rio Grande del Rancho (Murphy 1973, facing p. 15).

The diary of James A. Bennett, a dragoon stationed at Cantonment Burgwin on several occasions between 1850 and 1856, mentions no garden or farm (Brooks and military in the Southwest during the early American Territorial period, Frazer (1983:68) notes: "Because it was never intended to be permanent, Cantonment Burgwin did not participate in the farming program. Other than wood and native grass, cut and stacked by the men, the garrison had no part in providing its own supplies."

The farming program was never extended to Cantonment Burgwin. Supplies were purchased from local farmers or requisitioned at Fort Union. In contrast, post gardens were successful, and the garden at Cantonment Burgwin was west of the post near the river. Frazer's (1983:72) assertion that every post except Cantonment Burgwin had a garden is contradicted by Mansfield's report as well as Anderson's watercolor sketches.

A final argument concerns the route of the probable canal. Historic canals tend to follow the edge of terraces flanking stream valleys, and parallel the flood plain. The canal at LA 71190 runs across an alluvial fan, a route that does not fit the historic pattern seen in areas like the Rio Chama, Rio Grande, Rio Puerco of the East, and Vermejo Valleys. It does, however, fit the pattern defined for Native American canal irrigation in the Taos area by Greiser et al. (1990b).

There is no evidence to associate the canal or cornfield with Cantonment Burgwin. Sketches painted in 1857 show that LA 71190 was still forested at that time. The farming program was not extended to Cantonment Burgwin, and the kitchen garden was west of the post in the floodplain. The absence of historic farming in this area helps confirm the prehistoric date for the canal and cornfield. This is supported by one archaeomagnetic date and the route followed by the canal. The historic date is probably related to an episode of ground saturation that occurred long after the canal was abandoned.

The Function and Implications of Farming Features

Agricultural features can be divided into two categories. *Supplemental* features represent an attempt to augment existing supplies of land or water by artificial means. *Conservation* systems represent an attempt to protect or reclaim fields from erosion. In the Taos region, canals transporting water to fields from springs or streams are supplemental systems, while contour terraces, check dams, and grids are conservation systems.

Functions of Farming Features

The need for supplemental features is best explained by population dynamics. Farming communities were absent from the area until ca. A.D. 1100 (Woosley 1980, 1983; Boyer 1989a; this report). Population aggregation began ca. A.D. 1220 with movement into pueblos of 4 to 25 rooms, culminating after A.D. 1250 with construction of large villages containing several hundred rooms (Woosley 1980c, 1983; Crown and Kohler 1990). Initial aggregation in the Pot Creek area was probably stimulated by the availability of arable land on the alluvial fan at the confluence of Rito de la Olla and Rio Grande del Rancho. With continued population growth and eventual coalition into a large village, agricultural productivity had to be expanded. By augmenting water supply to fields, it is possible to increase production. While this can be accomplished in several ways, transport by canals is the most efficient. By employing canal irrigation to augment natural water supplies and increase crop yield, Pot Creek farmers were able to use arable land more efficiently.

Erosion-control features were also important components of the farming system. Water erosion causes gullying, removes topsoil, and results in the loss of moisture that could be used for farming. It also causes loss of organic carbon, directly affecting the availability of soil nutrients like nitrogen, and indirectly affecting fertility (Lowrance and Williams 1988:1445). Similarly, wind erosion removes topsoil, decreases the fertility and water holding capacity of soil, and reduces agricultural productivity by abrading plant materials (Finkel 1986). Like water erosion, it also removes organic material, causing soil structure to deteriorate and reducing water-holding capacity and nutrient availability (Lyles and Tatarko 1986). The erosion-control features used in this region prevented soil loss in different ways, and each provided a unique set of benefits.

Check dams were built across gullies to slow runoff and trap soil that would otherwise have been lost (Doolittle 1985; Finkel 1986; Hausenbuiller 1972; Herold 1965). By reducing the velocity of channel flow, they prevented further downcutting (Finkel 1986:104). Properly built dams retard the flow of water without stopping it completely; improperly built dams cause the erosion of depressions below them (Finkel 1986).

Contour terraces stabilize soil on slopes, trap sheetwashed soil, and slow runoff (Finkel 1986; Foster and Highfill 1983; Herold 1965; Highfill 1983; Schwab et al. 1981). They are important because they work in a way paralleled by no other conservation practice--they control sheet and rill erosion by breaking slopes into shorter lengths and allow gullies to heal by intercepting runoff and slowing its velocity (Finkel 1986; Foster and Highfill 1983; Highfill 1983). These features conserve water and soil and protect arable land at the base of slopes from gullying or inundation by sediments originating uphill (Doolittle 1985; Schmidt and Gerold 1988).

Rock piles are among the more puzzling features found at farming sites. They are widely distributed and apparently served a variety of functions. Studies near Tucson concluded that they served as mulches for agave cultivation (Fish 1987; Fish et al. n.d.; Fish et al. 1985; Fish et al. 1989). Similarly, Dart (1983) felt that rock piles in the Gila Valley were mulches for crops planted in and around the features. On the other hand, rock piles in the upper Rio Grande seem to represent materials cleared from fields before and during cultivation (Moore n.d.a). Analysis of sites at the edge of La Bajada Mesa suggests that rock piles were often connected by walls built from stockpiled materials or during further removal of cobbles during cultivation (Acklen et al. 1984; Moore 1984; Moore and Harlan 1984). This formed a series of adjoining cells, with systems expanding as grids were exhausted or more plots were needed. Unconnected peripheral rock piles suggest that the development of grid systems was dynamic, with expansion continuing as long as they were in use.

Removing stones from the soil surface reduces its roughness, lowering the rate of moisture infiltration and increasing runoff (Epstein et al. 1966; Evenari et al. 1982; Lamb and Chapman 1943; Lehrsch et al. 1988). It also increases soil loss through wind erosion (Hausenbuiller 1972; Tibke 1988). Thus, while surface stone removal eases cultivation, it also promotes runoff and erosion. This was not a major problem where rock removal was associated with harvesting water; where it was done to prepare fields, the consequences could be dire.

Cobble-bordered grids are common around Taos and provided two main benefits to Anasazi farmers. When walls were stacked relatively high (30-40 cm), they acted as heat reservoirs, storing energy during the day and releasing it at night. This resembles a technique used by the Hopis, who plant early corn in narrow gullies where nocturnal heat radiation protects plants from frost (Bradfield 1971; Hack 1942). Cobble borders also restored some of the surface roughness lost when fields were cleared. By eliminating runoff or significantly reducing its velocity, sheetwashing, gullying, and associated soil loss were prevented.

Cobble borders also helped reduce wind erosion. In structure and function they resemble the low earth ridges recommended for reducing wind-caused soil loss in modern farming (Armbrust et al. 1964; Hausenbuiller 1972; Schwab et al. 1981; Tibke 1988). Like earth ridges, cobble borders create an alternating ridged-depressed configuration. Depressed areas behind borders trap saltating soil particles by changing surface air flow patterns, preventing them from impacting and detaching other particles and causing them to be deposited (Finkel 1986; Schwab et al. 1981; Tibke 1988). The formation of closed grids eliminated the need to align features perpendicular to prevailing winds (Finkel 1986; Schwab et al. 1981). The typical small size of individual grids may or may not have been related to erosion-control efforts, but this characteristic helped decrease the risk of wind erosion. The amount of soil set in motion by wind is related to the distance particles can travel without encountering an obstacle (Hausenbuiller 1972:408; Lyles 1988). By limiting plot size, saltating soil particles were able to move only a short distance before being blocked.

Though cobble-bordered grids provided many benefits, there were also deficits associated with their use. Gridding helped retain runoff, but it also altered surface drainage patterns, preventing other sources from contributing moisture to plots. While cobble borders helped retain soil, they also prevented replenishment of nutrients by sediments washed in from elsewhere. This would have been particularly detrimental if entire plants were removed during or after the harvest.

Implications of Water and Soil Control

The construction of water- and soil-control features is one in a series of responses to stress on the food production system and was usually adopted only when less expensive options were unavailable or were unable to relieve the stress (Moore 1981). Less expensive options included switching to alternate food sources, increasing field size or farming more distant areas, moving to an unused part of the local region, and population redistribution through alliance networks. This sequence is neither linear nor exclusive. Rather than building water- and soil-control features, a group might choose to combine increased use of wild foods with farming more distant fields. Instead of relocating, they might adopt intensive farming methods or combine intensification with a more extensive system, building features near fieldhouses situated a distance from the main village. When all else failed, the final solution was moving to a new area. This type of migration was costly because it required construction of new homes, clearing and cultivation of new farmland, and establishment of new alliance and exchange networks.

The source of stress on food production systems is often difficult to define but can include climatic change, population growth, environmental deterioration, local catastrophe, or a combination of factors. The solution to the problem depends on social organization and the source of stress. Societies capable of fielding large cooperative groups might undertake large-scale projects, while those capable of mustering only small cooperative groups might proceed in a more piecemeal fashion. Thus, while several villages might cooperate on a massive hydraulic project in one area, in another the solution might be the responsibility of individual farmers.

A Model of Pueblo Farming at Pot Creek

Initial residence at Pot Creek was in pithouses built in the mid-A.D. 1100s, and population aggregation began with the construction of small pueblos in the A.D. 1230s (Crown 1990, 1991). The large village, which began forming by the late A.D. 1260s (Crown 1991; Crown and Kohler 1990), represents a further aggregation of local population, probably at the expense of the small pueblos (Boyer 1989a:7). The village grew accretionally by the addition of discrete room blocks around a central exterior activity area (Crown 1991:303). This suggests that residents of the small pueblos that formed the aggregated village remained distinct social groups within the larger community. Crown's (1991) site structure analysis suggests that village size was stable until A.D. 1300. This may indicate population stability as well, but, as she cautions, the use of room counts to estimate population assumes that household size remained constant. Because there was a 1.02 sq m increase in mean room size between A.D. 1270 and 1310, population stability should not be assumed (Crown 1991:307). A small amount of growth between A.D. 1300 and 1310 was followed by a flurry of building activity between A.D. 1310 and 1320, which produced a 31 percent increase in village size (Crown 1991:307). This growth spurt is interpreted as evidence for migration into the site (Crown 1991:307; Crown and Kohler 1990).

Settlement trends at Pot Creek are mirrored by developments around Taos, where Greiser et al. (1990b) link a shift to settlement in larger villages at the upper ends of alluvial fans to a decrease in summer stream flow. They relate this to a major drought, evidenced by dendroclimatic and alluvial sequences from other regions and the disappearance of glacial remnants in the mountains (Greiser et al. 1990b:111). They argue that villages moved upstream to secure dependable water supplies for farming. This may also account for the development of larger settlements; the number of locations with dependable water were limited and attracted farmers from the small dispersed villages.

Settlement shifts at Pot Creek can be linked to demography and the requirements of corn farming and the environment. Corn is an adaptable plant, differing from other cereals in its ability to adjust to local growing conditions (Montgomery 1919). Through natural selection corn can adapt to local moisture supply, temperature, and growing season (Martin and Leonard 1949:338). Thus, even if initially imported from a region better suited to its growth, corn can adapt to local conditions over a period of time. Even so, there are minimum requirements that must be met before a mature crop can be produced.

Critical climatic variables include sunlight, temperature, moisture availability and timing, and length of growing season. Corn requires abundant sunlight and produces poorly where it is restricted, for example, by cloudy conditions that prevail more than half the time (Montgomery 1919). Temperature affects both germination and growth. Corn requires a minimum mean temperature of 10 degrees C for germination and grows best when temperatures average between 20 and 22 degrees C in June, July, and August (Martin and Leonard 1949:336). In the modern corn belt, planting usually begins when temperatures average 12.7 degrees C, and most planting occurs when mean temperatures reach 16 degrees C (Wallace and Bressman 1937:93).

The amount of water available for germination, growth, and fruiting is also important and must exceed 152 mm during the growing season before a crop can be expected (Allessi and Power 1965:612). Dry farming in the corn belt is restricted to areas receiving 380 mm of precipitation or more, with at least 200 mm falling during the growing season (Martin and Leonard 1949:337). Irrigated strains of corn require more water. Irrigated corn near Bloomfield consumes 600 mm of water annually (Blaney and Hanson 1965:37). Timing is also critical. Corn uses both stored soil moisture and rainfall for germination, growth, and production (Holt et al. 1964; Robins and Domingo 1953; Russell and Danielson 1956). Experiments in South Dakota and Minnesota showed that the effect of soil moisture on corn growth is minimized by high precipitation levels during the last half of the growing season. However, the amount of soil moisture present at planting was critical when rainfall was below normal during that period (Holt et al. 1964:85). When winter and spring precipitation provide plenty of soil moisture, rainfall is less important during the first half of the growing season than it is during the period of critical growth in the last half of the season. However, most soil moisture will be used by midsummer when there is little rain during the first half of the season. If late summer rains fail, there will not be enough water for grain production.

Equally critical to crop production is the number of frost-free days available for vegetative growth and maturing. As noted above, corn can adjust to local conditions, including length of growing season. Some varieties grown in North Dakota matured in as few as 80 days, while varieties grown in the Gulf states took 200 days to mature (Montgomery 1919:59). Dent corns need at least 90 days to mature; some require less time, but most need between 110 and 130 days (Wilson 1948:285). Unseasonal frosts can damage a crop, whether they come at the beginning or end of the season. Corn seedlings can withstand light frosts until they are about 15 cm tall; after that, any frost will kill most plants (Martin and Leonard 1949:336). A typical frost kills the upper two or three leaves, but the plant soon recovers and sends new leaves up within a few days (Wallace and Bressman 1937:93). Even after a fairly severe frost corn can often send up a vigorous new growth from the roots (Wallace and Bressman 1937:93). Early fall frosts can end growth before a crop has matured and result in soft corn. Soft corn can be eaten but is not good for seed because it has low germination rates when planted in the cold moist soil that prevails in spring (Shaw and Thoms 1951b:541; Rush and Neal 1951:116).

Corn growth can be divided into several stages (Shaw and Thoms 1951a, 1951b) but for the purpose of this discussion is broken into two basic periods: vegetative growth and tasseling to maturity. The period of vegetative growth is quite variable and is closely related to temperature (Shaw and Thoms 1951a). As soil temperature increases between 10 and 30 degrees C, seedling growth rate also increases (Van Wijk et al. 1959). Experimental data show that silking can occur three days earlier for every mean air temperature increase of 1 degree F during the first 60 days of growth (Shaw and Thoms 1951a). Thus, warmer soils at planting result in faster germination, and warmer air temperatures speed early growth. Water is also important during this period, and early water stress (during the first 30 days) indirectly affects grain yield by reducing plant size ((Denmead and Shaw 1962:274). Soil moisture, especially in the upper 20 to 30 cm, can be critical during this period because late spring and early summer tend to be dry in the Southwest.

The later growth period includes the tasseling, silking, and maturation stages. Corn is pollinated at the beginning of this period, and the rest of the growth period is devoted to ear formation and growth. The length of time between silking and maturation is predictable and averages around 50 days (Shaw and Thoms 1951b:545). Moisture is critical during this period, particularly during tasseling and silking. Moisture depletion to the wilting point at this time can reduce yield up to 22 percent if it persists for one or two days, and if it lasts for six to eight days, yield can be reduced by up to 50 percent (Denmead and Shaw 1962:274).

To summarize, climatic factors are of critical importance to corn growth. Among them are sunlight, temperature, moisture availability and timing, and length of growing season. Since corn needs abundant sunlight, shady conditions that prevail in forested areas are not conducive to successful crop production. Temperature is critical during the vegetative growth period, and warmer soil and air temperatures stimulate both germination and early growth. While water is necessary at all stages of growth, it is especially critical at the tasseling stage, and a plentiful supply is needed between silking and maturation to produce an abundant crop. Finally, there must be enough time between the last killing frost in the spring and the first killing frost in the fall to allow full crop maturation. Unseasonal late frosts can damage or kill young plants, and early frosts can end plant growth before the crop has fully matured.

Timing was of ultimate importance in prehistoric corn agriculture. It is likely that planting was scheduled so that the period of critical growth between tasseling and maturation would coincide with the onset of the late summer monsoon season in July and August. Soil moisture was probably exhausted by then, and without the large amount of rain that normally falls in late summer there would be no crop. Planting also had to be scheduled late enough to avoid the last killing frost but early enough to allow the crop to mature before the first killing frost. Beyond this, soil and air temperatures had to be above 10 degrees C before germination and growth could be expected.

While a variety of topographic and environmental zones are amenable to corn agriculture around Pot Creek, there are benefits and deficits associated with each. Local floodplains are well-watered, and dependable sources of supplementary water are located nearby. Unfortunately, because of cold air drainage they have short growing seasons with frost-free periods lasting only 80 days (Edwards et al. 1987). The alluvial fan and adjacent uplands at Pot Creek have longer growing seasons, averaging 120 frost-free days (Edwards et al. 1987). Unfortunately, except in drainages, they lack enough available moisture to allow successful corn agriculture in most years. The interplay between these factors is critical to any understanding of local demography.

Early farmers around Taos lived in pithouses. The study area contains many such structures, but the relatively large number may be illusory. Using ethnographic and archaeological data, Cameron (1991:161) concludes that Anasazi and Mogollon pithouses had shorter life spans than most traditional estimates suggest, averaging no more than 10 to 15 years. What seem to be villages might actually be a series of houses occupied by one or a few families over a long period: "Archaeological sites with many pit structures that show occupation over a long temporal span cannot be assumed to have had a large population over this period but instead may be the result of a small population occupying consecutively built structures" (Cameron 1991:162). A few families could build and occupy many pithouses in a century or more. Based on Cameron's estimates, 20 families could build between 260 and 400 pithouses over a 200 year period.

The early farming population was, therefore, small and residentially mobile. People were able to move locally as adjustments to precipitation patterns or resource depletion became necessary. Their fields were probably restricted to the prime soils on floodplains and along intermittent drainages. Secondary land resources were unsuitable for farming at this time because not enough rain fell during the critical months of July and August. This shortfall is illustrated in Figure 108, which compares current mean rainfall with the water requirements of corn. Irrigation figures are from San Juan Pueblo (Ford 1977), and dry-farming figures are from the Nebraska agricultural station (Montgomery 1919). While neither may be directly applicable to Taos, they provide a scale against which local conditions can be measured. The irrigated corn shown in Figure 108 was planted in May, and water needs peaked in July. Dry-farmed corn was planted at the beginning of June, and water needs also peaked in July. Serious deficits exist between rainfall and water needs in both cases, especially during the critical growth period in July and August. Average rainfall during the growing season is 156 mm, which is barely enough to mature a crop (Allessi and Power 1965:612). While soil moisture would add to the amount of available water, under modern conditions, the Pot Creek area is only marginally suited to corn farming.

Figure 109 models modern growing season conditions. While information on the length of the growing season is available for the area, dates for first and last killing frosts are lacking and must be estimated. The frost-free period at Taos averages 140 days. The average date for the last killing frost is May 10, and the first killing frost occurs around September 30 (Tuan et al. 1973). With a 120 day frost-free period at Pot Creek, the last killing frost probably occurs around May 20 and the first around September 20. Thus, planting probably began in mid to late May, and corn was mature by mid to late September. Mean temperature is between 10 and 12.8 degrees C by mid to late May, which is sufficient for germination and seedling growth. However, using the examples cited earlier, there are serious water deficits with both irrigated and dry-farmed varieties of corn, particularly during the critical period of growth in July when tasseling and silking would occur. At least 40 mm of supplemental water would be needed in July and 30 mm in August to mature a crop.

Figure 110 illustrates decadal precipitation patterns for the Taos region between A.D. 1000 and 1400 (Dean and Robinson 1977). Initial occupation followed a long period of moderate frequency and amplitude variation, which ended around A.D. 1000. The period between A.D. 1000 and 1335 was characterized by low-frequency, high-amplitude variation, after which the frequency of decadal variations returned to high frequency and amplitude. While the amplitude of variation around the mean remained high between A.D. 1000 and 1335, the frequency of variation was lower than before or after this period. Thus, this was a time when precipitation was more predictable and reliable over the short term. This may have given farmers the edge they needed to use

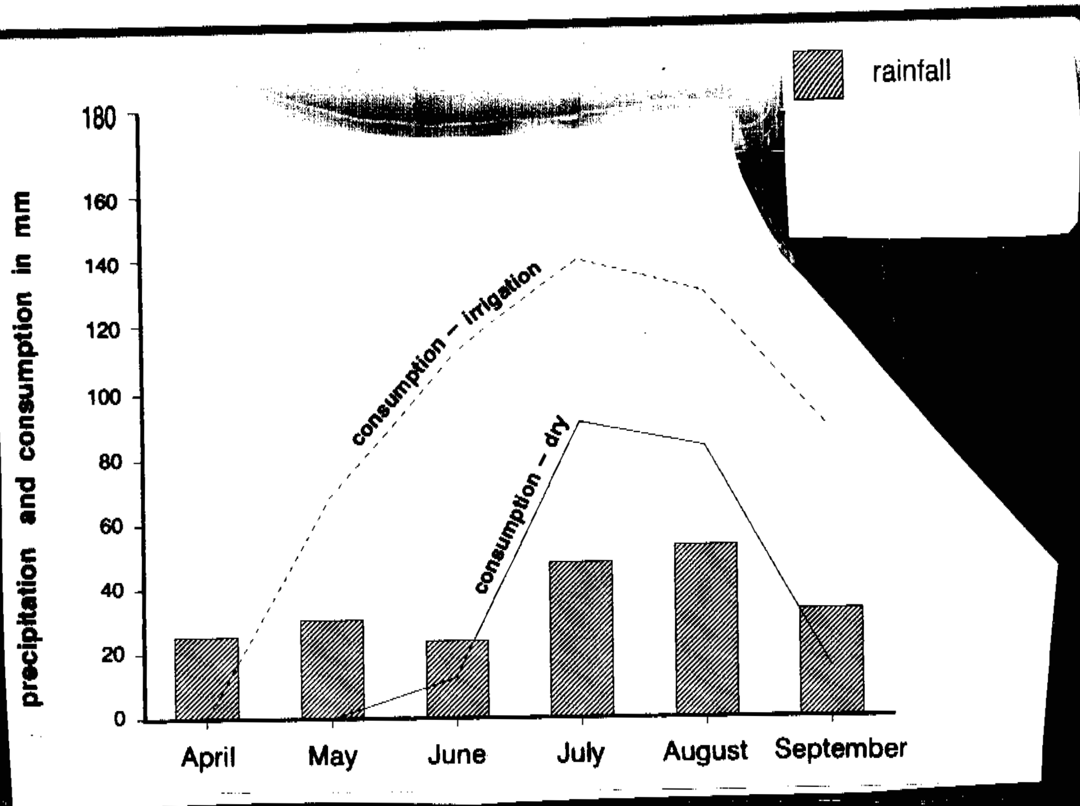


Figure 108. Water availability and requirements, corn-growing season.

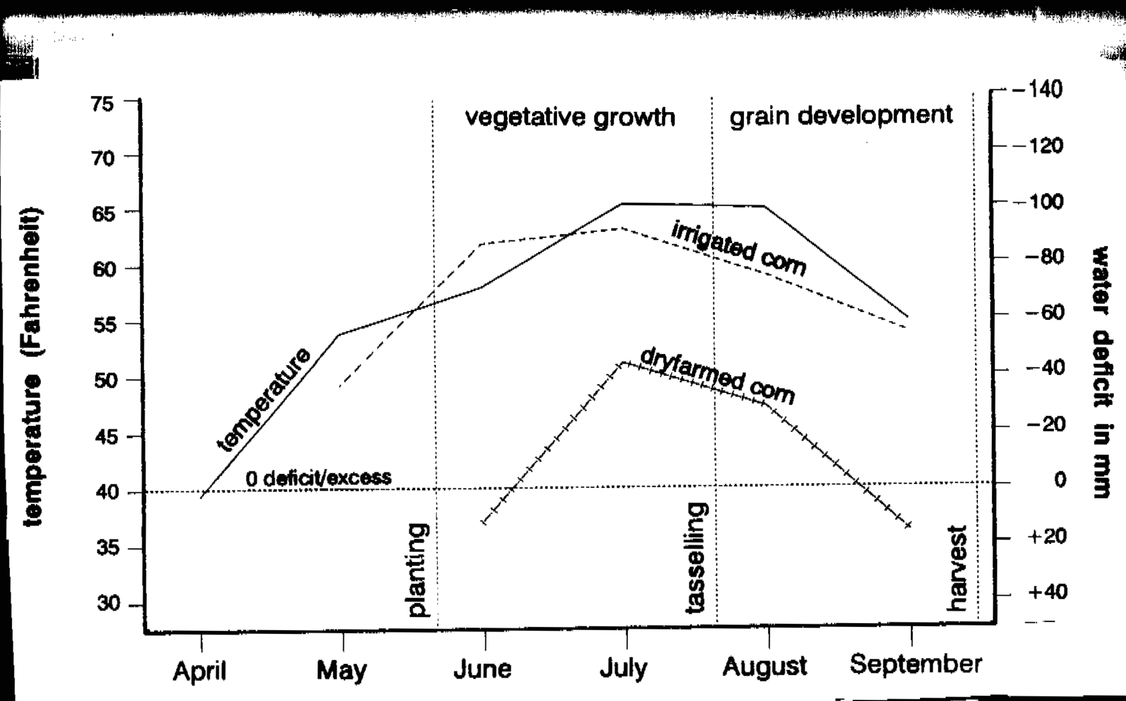


Figure 109. Estimated water deficit during corn season, using modern data.

the region. Occupation of the Pot Creek area began in the mid-A.D. 1100s (Crown 1990, 1991), perhaps coinciding with higher than average decadal precipitation in the A.D. 1110s and 1160s. Unfortunately, lacking a firm date for the initial occupation, this cannot be substantiated.

It is unlikely that the fan was farmed during this early period. Besides lacking sufficient water, it would have been heavily forested, and trees would have to be cleared to provide sunlight for crops. Removal of trees stimulates runoff (Evans and Patric 1983) and can reduce the amount of moisture available for crops. Thus, without supplemental water or higher than normal precipitation the fan would have been unsuited for corn growing during most years. Perhaps small plots were planted when heavy winter and spring precipitation provided higher than normal soil moisture, but these years were probably rare.

Farming settlements occupied a larger variety of areas in the Taos Valley before A.D. 1250 than after. This pattern has been linked to a drought coupled with reductions in stream flow resulting from disappearance of glacial remnants in the mountains (Greiser et al. 1990b). Our dendroclimatic reconstruction shows no drought or significantly dry decades between A.D. 1100 and 1250. The A.D. 1250s and 1280s were drier than normal, the latter corresponding to the panregional "Great Drought." However, these events followed initial aggregation of the Pot Creek population into small villages and could not have contributed to the nucleation process in the area. Instead, it is likely that population growth and climatic amelioration contributed to the founding of the small aggregated villages.

The first period of aggregation at Pot Creek occurred when average decadal precipitation was much higher than normal for a 20 year period (Fig. 110). This trend is mirrored in the Santa Fe area, where Rose et al. (1981:93) conclude that most of the variation was due to fluctuations in spring rainfall. Late summer rainfall was fairly stable and less variable than other components (Rose et al. 1981:105). If this reflects a widespread pattern rather than local variation, as is likely, the spring precipitation component at Pot Creek was probably similarly variable, and late summer precipitation was relatively stable.

Precipitation levels more than two standard deviations from normal are significant because they "are of sufficient rarity and magnitude to have had potential adaptive consequences for plant, animal, and human populations" (Rose et al. 1981:92). Precipitation was about 1.5 standard deviations above normal in the 1230s and two standard deviations above normal in the 1240s, and this 20 year period of above-average precipitation appears to have been significant to the human population.

While these figures cannot be converted to precipitation amounts for Taos, in the Santa Fe area one standard deviation equals about 55 mm of precipitation. Using an estimated 50 to 55 mm per standard deviation for Taos, the A.D. 1230s probably

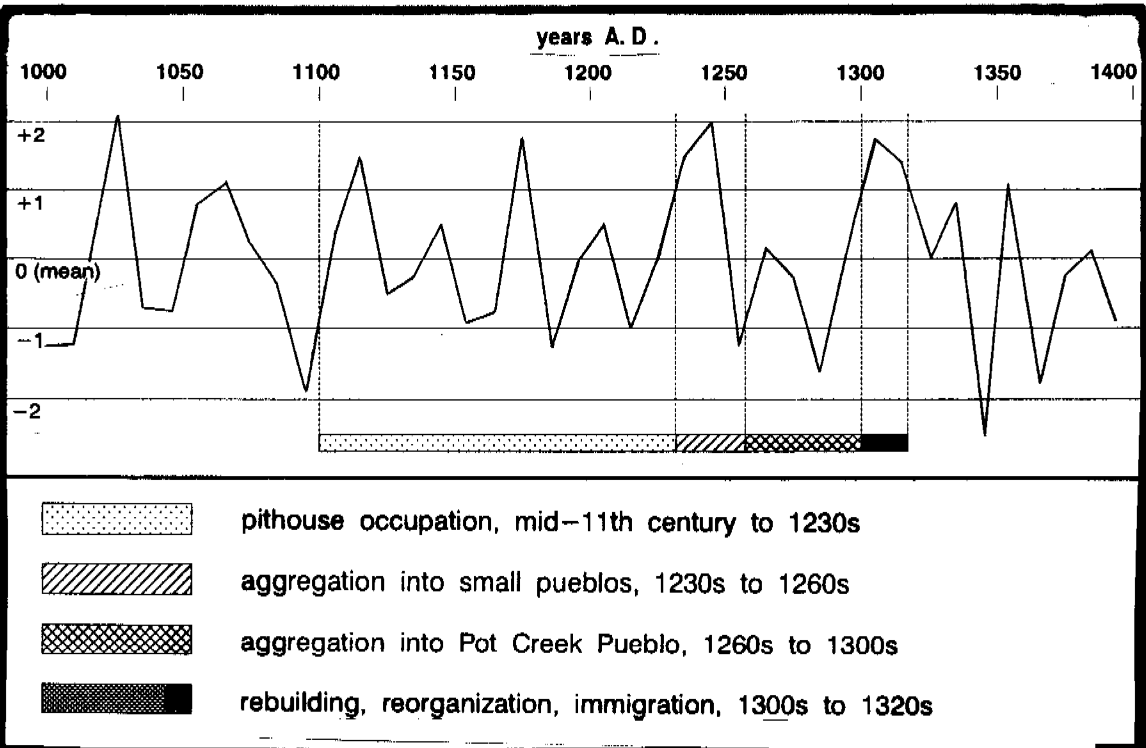


Figure 110. Prehistoric settlement changes in the Rio Grande del Rancho Valley.

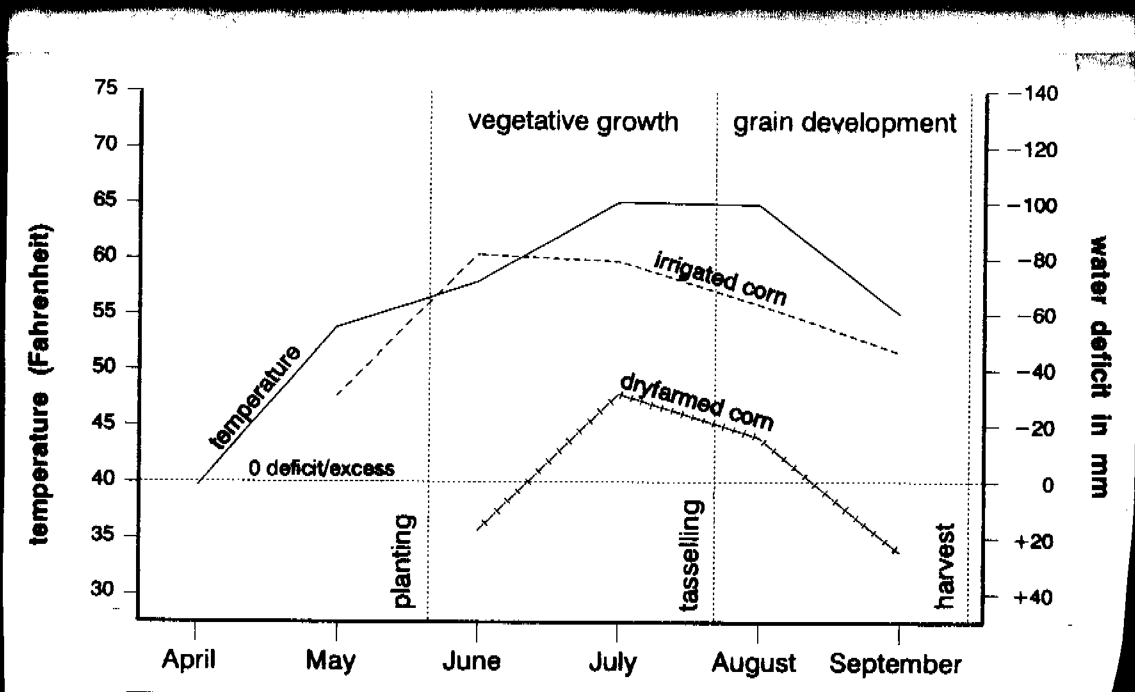


Figure 111. Estimated water deficit during corn season, A.D. 1230's and 1240's.

averaged 75 to 83 mm more annual precipitation than normal, and the A.D. 1240s as much as 100 to 110 mm more. Adding the lower figure (75 mm) to the modern average and estimating growing season rainfall based on percent of annual precipitation falling during each month yields the amounts in Figure 111. Moisture deficits approximate a 1.5 standard deviation increase in precipitation, based on an even rate of increase through the year. While the deficit for irrigated corn remains high, that for dry-farmed corn is quite a bit lower, totaling under 50 mm for the critical growth period. At 2 standard deviations, the deficit for this strain of corn is only 40 mm. However, as Rose et al. (1981) note, the late summer component seems to have been stable throughout the period they studied at Arroyo Hondo, and most variation was due to fluctuations in spring rainfall.

Thus, it is likely that increased precipitation was not spread evenly throughout the year, but was concentrated in the spring. This has important implications for farmers. Because spring rains are less intense than those of the monsoon season, and evaporation rates are not as high as those of late summer, more moisture would be allowed to percolate into the soil. Increased rainfall during the early growing season also means that less soil moisture will be used during that period of growth. Both of these factors mean increased soil moisture availability during the critical growth period. Whether variation in precipitation was spread evenly through the year or was mostly concentrated in the spring, soil moisture appears to have been the critical element.

A 1.5 to 2 standard deviation above the mean increase in precipitation at this time appears to have encouraged occupants of the Pot Creek area to begin farming secondary land resources. Where dry-farming on the fan was barely possible before this time, increased precipitation (particularly during spring) seems to have made its use economically feasible. The 70 mm deficit shown in Figure 109 is based on a yield of 50 bushels per acre (Montgomery 1919), which may be much higher than prehistoric production levels. During the Spanish period in Mexico, a crop of 16 bushels per acre was considered normal (Bray 1968:121). Lower productivity requires less water, so an average increase of less than 70 mm of rain and soil moisture may have been enough to make these resources attractive.

The switch to residence in small aggregated villages has important implications for the frontier model. Rather than high residential mobility as indicated by pithouse use before A.D. 1230, construction of larger and more permanent structures suggests that the population had adapted to the environment and was better able to remain in place. It also suggests that population size had significantly increased, necessitating the formation of larger settlements as the landscape began to fill. This response to population growth also fits the frontier model in that it replicates the residential pattern seen in the core area. Site locations suggest that farming on the fan was limited in extent. Villages occur across the fan, with some indication of a tendency to locate along major intermittent drainages. This suggests that floodplain and drainage soils remained the primary agricultural resource, while soils on the fan were of secondary importance. Had the fan been considered prime agricultural land, it is doubtful that it would have been used for residence.

The growth of the large village beginning in the A.D. 1260s coincides with the end of a two-decade-long precipitation high and the beginning of a 40 year period of mostly below average decadal precipitation. Lower precipitation meant reduced crop yields on the fan and probably along intermittent drainages. Reduced stream flow may have affected the yield of floodplain fields, but since both streams are permanent, this is unlikely. The options available for adapting to these changes were severely limited by the larger population. A return to the dispersed, highly mobile farming system that prevailed before the A.D. 1230s was out of the question--there were too many people, and climatic change had reduced the number of areas suitable for farming.

At Pot Creek, the population opted to further aggregate into a large village. While this process probably took some time and a few villages may have chosen not to join until much later, many selected to concentrate in one area. This significantly increased the amount of the alluvial fan available for farming. Herold (1968:36) estimates that 490 acres of potential farmland exist on the floodplain and first terrace of the upper Rio Grande del Rancho Valley. In contrast, there are 880 acres on the fan and second terrace (Herold 1968:36). By vacating most of the fan and devoting it to agriculture, Pueblo farmers were able to at least double the amount of land available for cultivation. While this area would have been less productive than well-watered soils on the floodplain and along drainages, the growing season was long enough to produce a mature crop. Thus, there were trade-offs: lowered production per acre for a mature crop. It is likely that many of the conservation-oriented water- and soil-control systems found on the fan were built during this period. To expand farming, it was necessary to clear vegetation and surface rocks from the fan. This would have stimulated erosion, as is discussed later.

The final period of building, in-migration, and social reorganization coincided with another period of above-average precipitation spanning two decades (Fig. 110). Increased rainfall would have boosted production, allowing more people to be supported. This would have permitted the village to grow and may have attracted outsiders. To support the large migrant population that seems to have moved in after A.D. 1310, there had to be untapped farming resources. Augmentation of water supplies in fields is a likely candidate, and canals were probably built at this time. The village was abandoned sometime after A.D. 1320, possibly because the increased population was too large to be supported by the limited farming resources of the valley, even with irrigation. Another possibility is that there was too little rainfall during the very dry decade of the 1340s (2+ standard deviations below normal) to grow enough food, even when augmented by irrigation. A second dry period followed in the 1360s, and an increase in the frequency of decadal precipitation variation occurred after A.D. 1370. When added to the high-amplitude fluctuations that prevailed throughout the occupation, this last event would have severely reduced rainfall predictability. In effect, the area returned to the condition that predominated before it was occupied, suggesting that it was no longer suitable for farming, even for a dispersed and mobile population. While it is not yet possible to determine whether this sequence of events led to abandonment, it is likely that it contributed to the decision to relocate outside the valley and the failure of subsequent farming populations to reoccupy the study area on a permanent basis.

Discussion of the Model and Its Implications

Erosion on the Alluvial Fan

If the model is correct, farming on the fan began on a limited basis between A.D. 1230 and 1250 and increased in extent and intensity after the 1260s. A combination of residential and farming use probably led to the initiation of erosion. Erosion is a complex process with many causes, including alteration of natural vegetation, weakening of soil structure, masking of soil and vegetation by sediments, increase in slope or hydraulic radius, and reduction of surface roughness (Cooke and Reeves 1976). While climatic change is often blamed for erosion, many cultural activities can also be responsible. Cutting trees for building, to clear fields, or for firewood can be one of the main causes. Runoff from a forested tract is dramatically increased by removing more than 20 percent of the tree cover, and soil erosion accelerates when regrowth is prevented, as would occur in a densely populated area (Evans and Patric 1983). Removing the understory by clearing fields, using shrubs as fuel, and harvesting wild plants also stimulates erosion. Experiments in the Negev (Tadmor and Shanan 1969) showed that runoff from shallow slopes triples when vegetation is removed. Clearing rocks from fields can also contribute to the process. Removing surface stones increases runoff and sheetwash (Epstein et al. 1966; Lamb and Chapman 1943), leading to the formation of rills and gullies. Even the increased level of traffic around a village can stimulate erosion. Soils like silt loams and silty clay loams form crusts during rainfall that are resistant to wind erosion (Finkel 1986). When the crusts are disturbed, erosion can begin.

Evidence from other regions shows that environmental deterioration often accompanied population growth. Anasazi use of wood for building and fuel may have caused a drastic reduction in piñon-juniper woodlands at Chaco Canyon after A.D. 700 (Betancourt and Van Devender 1981). Based on pollen studies, farming practices in the Mangas Valley appear to have led to environmental deterioration (Van Asdall et al. 1982). Botanical studies in the upper San Juan suggest that farming and fuel gathering substantially decreased local woodlands (Kohler and Matthews 1988; Martin and Byers 1965; Wyckoff 1977). These findings are corroborated by faunal and coprolite studies, which suggest that shrub and grasslands developed as the area was deforested (Minnis 1989; Stiger 1979).

Forest depletion is also demonstrated by historic documents. In a letter written to Viceroy Mendoza from Zuñi, Vásquez de Coronado noted that there were few trees suitable for use as fuel around the village, and that fuel was obtained "from a small clump of junipers four leagues distant" (Hammond and Rey 1940:172). He also complained about the lack of firewood in the Tiwa Province (Hammond and Rey 1940:190). Similar conditions prevailed at San Gabriel when Oñate established his colony there. A letter from Captain Velasco to the viceroy states: "To keep warm in the winter, we have to go four or five leagues for firewood, and none is to be obtained except for cottonwood trees along the river" (Hammond and Rey 1953:610). This was corroborated by Ginés de Herrera Horta's testimony during Valverde's investigation of conditions in New Mexico in 1601:

> Moreover, there is a scarcity of firewood, which has to be brought six or eight leagues to the camp in wagons and carts. The wood is mostly cottonwood from the river valleys, and it is so smoky that most of the women and children are in tears night and day, for they have nothing with which to provide light at night except these fires. (Hammond and Rey 1953:656)

While many accounts state that cottonwood groves were common around pueblos along the Rio Grande, cottonwood is a less than desirable fuel because it burns quickly and smokes. The lack of better fuels near these villages suggests that this resource was seriously depleted.

Woodland depletion is a serious consequence of occupation and was undoubtedly a major cause of erosion. While pollen profiles from the canal at LA 71190 were unable to demonstrate that the area was reforested after abandonment, the presence of a large cornfield next to the pueblo indicates that much of the area was at one time deforested. Removal of the overstory was necessary to ensure that corn received enough sunlight and would not have to compete with wild plants for soil moisture. Added to the use of wood for building and as fuels, it is likely that the fan was severely deforested by the end of the occupation.

A second cause of erosion was removal of stones during cultivation. Rock piles are common on the fan and represent materials removed and discarded next to fields during farming. By altering surface microrelief patterns, prehistoric farmers reduced its roughness. This would have led to increased runoff and the development of rills and gullies. Unless countered, this process would have destroyed much of the farmland on the fan. Traffic to and from the village and cultivation undoubtedly exacerbated the situation, continually breaking the erosion resistant crust that would have developed during heavy rains.

Social Structure and Farming

The structure of the early aggregated village suggests that farming was carried out by individuals or family groups, and the types of features found on the fan support this notion. While a few grids have been identified, farming features consist mainly of rock piles, check dams, and contour terraces (Kriebel 1989; Woosley 1980c, 1983). These features are associated with active erosion, are small scale, and were probably built and maintained by individual farmers. The location of many near pithouses is fortuitous. Contrary to Woosley's (1980c) conclusion that check dams were constructed to protect residences from erosion, they were probably built long after the structures were abandoned. Pithouse residents would have simply moved had erosion been a problem. The association of pithouses with check dams is more an indication of the later village's need for farmland, converting areas that had formerly been used for residence to farming.

A flurry of building at the village began with extensive remodeling and construction between A.D. 1300 and 1310. Between A.D. 1310 and 1320, a new unit that enclosed the plaza was built (Crown 1991:307). Construction also began on a large kiva at this time, but it may have never been completed (Crown 1991:310). This building phase has been linked to migration into the site (Crown 1991; Crown and Kohler 1990), and the new configuration and large kiva suggest that village organization changed. Rather than a collection of loosely linked and relatively independent units, the village now seems to have been cohesively organized as a single entity. Crown and Kohler (1990) conclude that these architectural changes reflect a need for greater integration and a reorganization of the decision-making process. Whether they were related to population growth or were introduced by immigrants is unimportant to this discussion. What is important is that they are evidence of village reorganization along lines allowing large-scale cooperative projects, like canal building and maintenance.

The prehistoric Pueblos used farming strategies that did not require managerial control over water use. As Ford (1977) demonstrated for the Rio Grande Pueblos, a central authority regulating water-use rights is not essential to an irrigation system, but a sizable cooperative group is needed. Water allotment is regulated by ritual and custom among the Pueblos rather than a central authority. This is similar to systems in the Swiss Alps, where control is based on an intricate system of water-sharing agreements and rights rather than centralized authority (Netting 1974). These systems are maintained by the cooperation of a large group of individuals rather than the efforts of one or more people with vested powers. Netting (1974:74) suggests that formalized rules and rights, rationalized distribution, and centralized control may develop when a water source is not locally controlled and rights are acquired and defended from other communities, or when construction and maintenance of the system require the joint efforts of several otherwise independent communities. Spooner (1974:48) agrees with this concept, separating small- from large-scale irrigation on the basis of whether they are operated by one or several villages. Large-scale systems require a degree of centralized organization that small-scale systems do not.

Irrigation systems at Pot Creek Pueblo were small-scale and undoubtedly served farmers from only that village. Construction and maintenance could easily have been accomplished without any centralized authority. However, it is questionable whether the loosely linked social structure of the early large village was capable of supporting this type of project. The canals are short and shallow and could have been built by one or a few family groups. However, unless those groups held more or less exclusive use-right to the land traversed by their canal, construction would have been complicated by violation of the use-rights of other uninvolved groups, resulting in dissention and conflict. Reorganization of the village into a more cohesive cooperative entity may have facilitated this process by vesting such managerial decisions in the village as a whole rather than in smaller units with traditional use-rights.

Thus, several lines of evidence suggest that farming at Pot Creek followed a trajectory of increasing complexity related to regional population and environmental trends. The area does not seem to have been amenable to use by local farmers until the A.D. 1100s. Predictable precipitation patterns appear to have allowed occupation of the area by a dispersed and residentially mobile farming population at that time. Notably higher than normal decadal precipitation in the A.D. 1230s and 1240s seems to have encouraged farmers to begin cultivating the alluvial fan on a limited basis. This use is related to settlement trends that suggest that the Pueblos had successfully adapted to the environment and that residence in small mobile groups was no longer appropriate. By the A.D. 1260s, a shift to below-normal decadal precipitation made it necessary for the local population to further aggregate into one large village, freeing potentially arable land on the fan for farming and possibly increasing the size of the cooperative labor pool. This was necessitated by the lower crop yield that would have occurred with less precipitation available for recharging soil moisture and growing season use. Once secondary land resources were in use they could not be abandoned when their productivity declined: the population was too large to be supported by floodplain and drainage soils alone. By expanding the farming base, the occupants of Pot Creek were temporarily able to avoid having to relocate. Most of the agricultural features on the fan probably date to this time and later. A second period of high decadal precipitation appears to have attracted immigrants to the site ca A.D. 1310 to 1320, and it is probable that the canals date to this period, reflecting a further level of intensification. By the end of the A.D. 1330s, continued use of the area for farming and residence had probably seriously depleted local woodlands. Judging by the number of rock piles, check dams, and contour terraces on the fan, erosion was a major problem. These difficulties, coupled with a large population and a serious dry period in the A.D. 1340s, appear to have been too much for the occupants of Pot Creek to adapt to, and the area was abandoned.

Conclusions

Several diverse topics have been discussed, but all are related to development of a model for farming in the Taos region. Though limited by a lack of survey coverage and reporting, an overview of farming features has been presented, demonstrating that water- and soil-control devices are common in the region and suggesting that their distribution is patterned. Historical and archaeological documentation were presented to show that canal irrigation was present in the Rio Grande Valley at the time of Spanish contact, and perhaps as much as two centuries earlier. This was partially corroborated by data suggesting a prehistoric date for the probable canal at LA 71190. Using these data, a model for farming in the Pot Creek area was developed. By extending this model to the Taos region in general and comparing it with trends in the central Rio Grande, it is possible to fulfill the goals stated at the outset of this chapter.

Pot Creek Pueblo was one of the early large villages in the region. Following its abandonment, it is likely that the population moved to Cornfield Taos or Picuris Pueblo, both of which seem to have been founded around or after A.D. 1300. While Pot Creek Pueblo is surrounded by features that stimulated or countered active erosion, a different situation seems to prevail at the later villages. Farming features around Picuris consist mainly of cobble-bordered grids, with some contour terraces and check dams (Gauthier et al. 1978; Mera n.d.; Nemeric 1975; Snow 1975; Woodbury n.d.). Similar features occur around Taos. Extensive systems of cobble-bordered grids, contour terraces, and rock piles exist along Rio Lucero. Gridding has also been found in the buffalo pasture adjacent to the village (Greiser et al. 1990b). Bandelier (1892) described extensive grids near Ranchos de Taos, though he never visited them. More recently, contour terraces and check dams have been recorded in that area (Boyer 1991b; Steen 1976). Grids act to prevent erosion from beginning rather than countering its effects. This is an important distinction, because if the dating of these sites is correct, it indicates a major change in farming technology. Rather than waiting for erosion to begin, farmers were attempting to stop the process at its source before it began. The presence of contour terracing and check dams near gridded fields suggests that they were unsuccessful in this endeavor or were attempting to control gullying and sheetwash outside fields.

The development of agricultural features in the Taos region mirrors developments elsewhere in the Anasazi area. Farming features in the area occupied by the eastern Anasazi before A.D. 1300 are aimed at countering active erosion. Grids are found only in areas occupied after A.D. 1300 (Moore 1990). Areas that were heavily peopled before A.D. 1300 were suffering from environmental deterioration and erosion linked to intense farming and residential use (Moore n.d.a). While the Great Drought of A.D. 1276-1299 was not the sole reason for the abandonment of the Four Corners region and San Juan Basin, it contributed by exacerbating an already bad situation. The drought meant a drop in agricultural productivity and probably led to the further reduction of vegetation. The former required intensification of the farming system, while the latter made it difficult to do so because it would have further stimulated the process of erosion. In short, lengthy and intense occupation had damaged local environments, and the Anasazi could not adapt to a severe drought under those conditions. The population relocated to areas like the Rio Grande and Rio Chama valleys and Galisteo Basin. Construction of farming features aimed at preventing erosion from beginning shows that they had learned from past mistakes. In areas occupied after A.D. 1300, care was taken to protect fields that were prone to gullying and sheet wash.

The timing of developments around Taos closely follows that of the central eastern Anasazi region. Erosion-control devices were used at an earlier date in areas like Mesa Verde and Chaco Canyon, but this is probably related to residential intensity rather than developmental lag. Where those other areas had been occupied by Pueblo farmers since at least A.D. 400, the Taos area was not similarly occupied for another 700 years. Once the Pot Creek area was occupied by farmers, it wasn't long before erosion control was needed. Grids were used to prevent the start of erosion by the early A.D. 1300s around Taos and Picuris, about the same time the technique was developed and spread through the central Rio Grande. The presence of a few grids around Pot Creek Pueblo suggests that they might have been used in that area at an even earlier date. These features resemble grid systems at the edge of La Bajada Mesa, and they probably functioned similarly. In addition to preventing water and wind erosion, many were built to act as heat reservoirs, protecting seedlings against late frosts and perhaps helping to stimulate early growth. If our assessment of the probable canal at LA 71190 is correct, canal irrigation was used at an early date in the Taos region. While similar features have not been conclusively documented in the central Rio Grande area, it is likely that they were also used there.

In terms of agricultural technology, the Taos region does not seem to have lagged behind developments in other parts of the eastern Anasazi region. While the building of erosion-control devices may have begun at a slightly later date there than elsewhere, this was related to occupational intensity rather than isolation. As large villages were formed, the need for erosion control soon followed. The late A.D. 1200s and early 1300s saw large-scale regional population movements accompanied by major changes in farming technology. Similar changes occurred in the Taos region at the same time, suggesting that it was closely tied to other regions. No evidence of cultural conservatism or isolation is present in the farming technology of the Taos region. Rather, the data suggest close ties with other regions and a willingness to accept new ideas and innovations.

CONCLUSIONS: THE TAOS DISTRICT AS A FRONTIER

Jeffrey L. Boyer

In the Research Design, we observed that the sites in the Pot Creek project were too few and too varied to resolve, in themselves, the issue of whether the Taos district was an Anasazi sociocultural frontier. Nonetheless, we contended that the sites could provide data pertinent to this issue, particularly if the sites were placed in regional contexts. In each site description, we have provided the data obtained from the sites, their features and structures, and their assemblages of cultural and natural material. In the succeeding chapters, we interpreted these data in light of their relevance to conditions in a frontier setting. We then attempted to place the three pithouse sites within the context of the Valdez-phase occupation of the district (Occupying the Taos Frontier) and the two agricultural sites within the context of the development of a regional agricultural economy (Prehistoric Agriculture in the Taos District). The sixth site, LA 70576, is enigmatic and is not discussed beyond the site description. In this chapter, we will review the data in light of the model of frontier colonization. The model presents conditions that characterize frontiers. This discussion will address each condition in turn, summarizing the relevant data and pointing to additional data needs and future research directions.

The Taos Frontier

"Sudden" Appearance of the Anasazi

In Occupying the Taos Frontier, we showed that the Anasazi occupation began "suddenly" about A. D. 1100. Obviously, this is a relative term because we do not know when the first pithouse was built in the Taos Valley. However, chronometric data show that the sites from the Valdez phase, the first identifiable as Anasazi, appear in the A.D. 1100s. There is no evidence to suggest a local Anasazi development from an earlier Basketmaker population.

This conclusion is supported by analysis of Valdez-phase site structure, which shows that Valdez-phase sites appear with a well-established architectural tradition that included a variety of structures, subsurface and surface. There is no evidence to suggest experimentation with architectural forms or any "evolutionary" development of forms. It is also supported by chipped stone artifact analysis, which shows no appreciable differences between the assemblages from the Valdez- and later Pot Creek-phase sites. All are characterized by expedient core reduction. This indicates that the Valdez-phase Anasazi already relied on a reduction strategy characteristic of people whose settlement patterns are relatively sedentary. The strategy is contrary to that of hunter-gatherers, who practiced a lithic reduction strategy focused on curated bifaces.

The conclusion is further supported by ceramic analysis, which shows that the Taos Valley Anasazi arrived with an established ceramic technology. Correlation of both painted and utility sherds with local clay sources shows that the Valdez-phase Anasazi sought out, located, and used appropriate clay sources (Appendix 3). Further, the earliest sites show painted designs consistent with those found in the middle Rio Grande Valley at the same time. Ceramic types older than Taos or Kwahe'e Black-on-white, such as Red Mesa Black-on-white, are found only infrequently in the district and never comprise a significant portion of any assemblage.

Finally, the notion of an immigrant population is supported by faunal analysis. Faunal assemblages from this project show an emphasis on small mammals and turkeys and intensive utilization of deer remains. This pattern is consistent with the actions of an agricultural population whose abilities to engage in hunting trips for big game were limited and who focused on procuring animal species found in and near their homes and farming areas.

Spatial and Temporal Impermanence

Spatial and temporal impermanence carry with them the concepts of settlement mobility and rapid settlement change. In the first case, we expect to see many more sites from the initial years of frontier settlement than from later years. We also expect to see evidence of short occupations at early sites relative to those of later sites and, perhaps, of seasonal mobility between sites.

Clearly, the limited number of sites investigated in this project cannot be used to assess changing site frequency through time. However, in Occupying the Taos Frontier, we summarized the results of Herold's (1968) and Woosley's (1986) surveys in the southern Taos Valley. They show a decrease of 85 percent in site numbers from the Valdez to the Pot Creek phase (Herold 1968), or an average 772 percent drop from the Developmental to the Coalition period (Woosley 1986). Variation in these figures is due to differences in the temporal sequences used by the two researchers and to variation between subareas of the southern valley (Woosley 1986:150). Nonetheless, the data show that on average in the southern valley there are 7.7 times as many Valdez-phase sites as Pot Creek- and Talpa-phase sites, and subarea figures range from 1.3 to 26.3 times more Valdez-phase sites. This certainly seems to support the expectation of changing site frequency through time, depending on the length of site occupation.

At the Valdez-phase sites, the issue of site occupation length is related to structural use-life. In Occupying the Taos Frontier, we summarized Cameron's (1990) study, showing that pithouses had normal use-lives of seven to 12 years. These figures could be extended to 20 to 30 years by repair and structural remodeling. A review of excavation reports shows that only two sites had major structural repairs (LA 2742 and LA 3570), while most others had only cosmetic repairs (additional plaster, etc.). LA 70577 had no evidence of even cosmetic repairs. This suggests that LA 70577 may have only been occupied for a few years, while the others may have been occupied for up to two or three decades. The floor and wall samples from LA 2742 contained significant amounts of sulfates, while sulfates are present in only minor amounts in the adobe from LA 70577. We suggested that smoke from the hearth may have been the cause of the sulfates, since Glennie's (1983) study showed that smoke was difficult to control in his experimental pithouse. If this were the case, it might suggest that LA 70577 had a much shorter use-life than LA 2742, based on the qualitative presence of sulfates in the structural surfaces exposed to smoke. This would support the structural remodeling evidence.

Comparable data from later phases are available from Pot Creek Pueblo and two small pueblos. Based on tree-ring construction data, Crown (1990, 1991; Crown and Kohler 1990) suggests that Pot Creek-phase pueblos were probably occupied up to about 35 years. The large Talpa-phase component at Pot Creek Pueblo was probably built beginning about A.D. 1270 and ending about 1320. Assuming a maximum 20 years of use-life after construction, as Crown does for the Pot Creek-phase sites, the Talpa-phase component would have been occupied for 50 to 70 years. If all these figures are correct, then we see that structural use-life roughly tripled from the Valdez phase to the Pot Creek phase and then roughly doubled again in the Talpa phase. Undoubtedly, considerable maintenance was required to achieve the use-life figures shown for the Talpa phase at Pot Creek Pueblo. This has important implications for understanding community social structure that are beyond the scope of this discussion.

Evidence of seasonal mobility is less obvious. To assess site seasonality, we need to know a site's function and whether it was used in a particular season. These issues are approached through analysis of site structure and on-site activities. The Valdez-phase sites investigated during this project provide no evidence of being only seasonally occupied. If Gilman's (1987) research is accurate, and the pithouse sites were primarily cold-season habitations, we should see features used for food storage and preparation and features representing a wide variety of activities (as opposed to a narrow range of activities at sites with more specific functions). In fact, food storage features are not present at either LA 2742 or LA 70577, unless the possible *jacal* structure at LA 70577 was a storage room. This situation is mirrored throughout the district. While internal storage features are more common in south-area pithouses, they are present in less than 17 percent of the south-area sites and less than 13 percent of the north-area sites. Additionally, It should be noted that none of these is a large feature, such as the substantial cists found in other parts of the northern Southwest. In contrast, north-area sites had more surface storage features, particularly features inside surface structure rooms. Still, the features were not large. These data may suggest that food storage was not consistently an important part of subsistence activities. In turn, they may suggest that the sites were not cold-season habitations. However, two factors argue against this conclusion. First, given the number of pithouses excavated in the district, it is unlikely that archaeologists would have inadvertently selected only warm-season sites unless all pithouse sites were warm-season habitations. Second, since utility ware sherds far outnumber painted sherds in the site assemblages, and since utility wares were overwhelmingly used for jars, it is possible that most storage features were actually ceramic jars rather than architectural features. Jars have been found embedded in floors or activity surfaces at some sites. That portable jars made up most of the storage features is, therefore, a strong possibility. If so, then we can assume that pithouse sites were probably used as cold-weather habitations.

However, faunal analysis shows an emphasis on small mammals and turkeys. Overview of the Faunal Remains suggests that these species were procured by "garden hunting," taking animals found in and around agricultural plots. The dominant presence of small mammals and turkeys in the faunal assemblages may indicate that the sites were occupied during the growing season, when scheduling conflicts would preclude hunting trips for big game. This is supported by the pollen data from the human burial at LA 2742, which shows that inhumation occurred in the late spring or summer, when dandelion is in bloom.

The evidence suggests, then, that LA 2742 and LA 70577 were occupied during both warm and cold seasons, or essentially year-round. Because of the similarities between these and other pithouse sites in the region, we can extend that conclusion to most Valdez-phase pithouse sites. Gilman (1987:552-553) recognizes this possibility where warm-season resources are located near the site. In that case, she argues, activity locations within the site will shift from inside the pithouse during the cold season to surface-activity areas and structures during the warm season. This would account for surface structures that are commonly associated with Valdez-phase pithouses. It would also account for hearths commonly found associated with surface structures and activity areas. We should note that one Valdez-phase site, LA 3569, may show seasonal occupation. The site consisted of a small, four-room *jacal* structure with no associated pithouse (Peckham and Reed 1963). Although small subfloor pits were present, the structure is an unlikely candidate for winter occupation. How many such sites are present in the district is not known, but LA 3569 does suggest intersite mobility. Still, most excavated Valdez-phase sites point to intrasite rather than intersite seasonal mobility.

The agricultural sites, on the other hand, are clearly seasonal sites because agriculture is a seasonal activity. LA 71190 had no evidence of habitation structures, suggesting that the farmers traveled to the site daily from a nearby habitation location. The nearest Pot Creek-phase site is TA-26, but Pot Creek Pueblo and other pueblo sites are also nearby, and it is not possible to definitively associate LA 71190 with any of them. Excavation at LA 71189 revealed what may have been the remains of an ephemeral temporary structure resembling a Hopi "kishoni." Such structures were intended to shade the farmer from the sun and were not seasonal habitations. Consequently, the two agricultural sites do not show seasonal residential mobility, although they are season-specific sites.

The second expectation of spatial and temporal impermanence is rapid change. Most clearly seen in settlement, such impermanence would also be evident in other material ways. The average length of the seven periods in the Pecos classification is 250 years. Because they believed the Pecos system did not adequately portray developments in the Rio Grande area, Wendorf and Reed (1955) formulated a regional classification with four Puebloan periods, ranging from 125 to 600 years long and averaging 337.5 years. The shortest is the Coalition period, the longest the Developmental period. Only three phases are accurately defined in the Taos district. They fit into two of Wendorf and Reed's periods and almost within a single period of the Pecos classification. They average 80 years long (range, 50 to 120 years) and total about 240 years. Thus, in 240 years, the Taos district Anasazi ran the sequential gamut of architectural and settlement variation from dispersed pithouses, probably occupied by small family units, to large, multistory pueblos representing aggregated communities. The same progression in the Santa Fe district took 450 to 550 years, and, if we include the late Basketmaker-Pueblo I sites, perhaps 750 years in the Albuquerque district (Cordell 1979a).

We can see, then, that in terms of changing site frequency through time, length of site occupation, and rapid change in settlement and architecture, Taos Valley Anasazi sites appear to conform to conditions of spatial and temporal impermanence on the frontier.

Presence of a "Colonization Gradient"

In the frontier model discussed in Research Design, we said that the characteristic frontier settlement pattern could be viewed both synchronically and diachronically, each with its own expectations of the archaeological record. Accurate assessment of the district as a frontier in terms of this condition requires extensive survey data. It is beyond the scope of this discussion to dully summarize existing survey data from the district. We can point out, however, that the Valdez-phase pattern of scattered pithouse sites reflects the expectation that early stages of colonization are characterized by "lower levels" or less aggregated settlement types. Obviously, one could say the same about Basketmaker-Pueblo I developments in other parts of the northern Southwest without reference to a frontier perspective. What sets the Taos case apart is the relatively sudden appearance of such sites in the district, showing that the Taos district was not the scene of Anasazi development from an Archaic-Basketmaker base. Consequently, the data suggest a settlement pattern of dispersed households that appeared rather than developed in the district.

Whether the expectation of a diversity of site types representing the various levels of the colonization gradient can be met in the Taos district is not yet clear. Most researchers see a progression of settlement types from scattered pithouses to small aggregated pueblos to large pueblos (see Cultural Environment). In this regard, however, it important to note Woosley's (1980a, 1986) contention that pithouses continued to be used throughout the prehistoric sequence as presently defined. This contention has yet to be supported by chronometric dates. Should it prove to be true, it would provide significant support for this expectation.

An important issue in this regard is the definition of social structure in regard to settlement, which is necessary for us to accurately assess settlement relative to the levels of the colonization gradient. The lowest level, characteristic of early frontier expansion, is "dispersed settlement," defined by Casagrande et al. (1964:314) as "zones within an area of colonization characterized by the presence of scattered houses." Concerning the organization of these zones, Casagrande et al. (1964:314) state, "Although formally these individual households may be included in a larger corporate entity such as a municipality, they are but loosely integrated within it." In other words, the scattered households may be considered parts of a community, although they show no evidence of formal community organization such as population aggregation or community facilities for religion or distribution of food or other goods.

In Occupying the Taos Frontier, we observed that significant differences in Valdez-phase architecture and site structure point to two different Anasazi populations in the district. One was in the southern Rio Grande del Rancho area, the other in the northern Rio Hondo area. Evidence on structural remodeling suggests that both populations consisted of very mobile households, inhabiting both pithouses and surface structures, often in association. An examination of artifactual assemblages from excavated sites belonging to the two populations supports the distinction between them and suggests that they were organized beyond the household level into two communities.

Tables 130 and 131 list ceramic types by frequency from excavated sites in the northern and southern communities. For this review, all black-on-white sherds are combined, relieving us from resolving the issue of Loose's (1974) supposed Red Mesa Black-on-white sherds at north-area sites. The category of black-on-white also includes white ware sherds otherwise unidentifiable because no decoration is present. The data from each community are presented in Figures 112 and 113. The figures show significant differences between the communities. North-community ceramic assemblages contain an average 4.3 percent white ware sherds, and individual figures range from 0 to 12.5 percent. South-community assemblages contain an average 27.2 percent white ware sherds, and individual figures range from 11.5 to 39.1 percent. An overlap of only 1 percent in the two ranges shows that the differences are real.

North-community assemblages contain an average 73.5 percent Taos Gray Plain sherds, compared to an average 60.2 percent at south-community sites. This difference is not made up by decorated utility sherds in the south-community assemblages, which contain an average 9.6 percent Taos Gray Incised, compared to 15.8 percent in north-community assemblages. Corrugated and neck-banded sherds, a classic hallmark of late Developmental-period sites in the middle Rio Grande Valley, make up an average 5.5 percent of north-community assemblages, but only 2.1 percent of south-community assemblages. Finally, other types make up about 1 percent of assemblages from both areas. Figure 114 shows the differences between north- and south-community averages. Clearly, varieties of Taos Gray make up most of the assemblages of both communities. In the northern sites, however, Taos Gray varieties comprise an average of over 95 percent of the assemblages, compared to less than 75 percent in the southern sites. We cannot compare vessel forms between the communities because Loose (1974), the principal source of north-community data, does not provide vessel form data. However, the data available show that the architectural and site structural differences between the two communities are accompanied by differences in use of ceramic types. If the north-community residents manufactured pottery from clay sources local to the community, as was the case in the southern community, we may be seeing differences indicative of ceramic specialization within the district. Specifically, we may be seeing evidence that the northern community concentrated on making varieties of Taos Gray, while the southern community made Taos Black-on-white. Obviously, this speculative statement needs to be tested by petrographic analysis of north-community sherds, both painted and Taos Gray.

Tables 132 and 133 list the number and type of chipped stone, ground stone, and bone tools from both communities, and the data are displayed in Figures 115 and 116. Figures for the south community include all sites excavated by Peckham and Reed (1963) and reported by Green (1976). For instance, Peckham and Reed (1963) found one projectile point at their three sites, while Green (1976) reports five points from her five sites. Figure 117 illustrates the differences in community averages of chipped stone, ground stone, and bone tools. North-community sites have yielded an average 32.6 projectile points, 18.8 scrapers, 10.7 knives, and 1.8 drills per site. This compares to south-community averages of 2.9 projectile points, 5.1 scrapers, 1.0 knife, and 0.9 drill per site. While excavation bias related to the amount of site excavated and differing excavation strategies may account for part of the differences, a review of the site figures in Tables 132 and 133 shows that most north-community sites really do have many more of these tools than the south-community sites.

Conversely, the tables also show that south-community sites have yielded more ground stone artifacts than their north-community counterparts. While the community averages are not a great deal different, the site figures show that north-community sites have yielded one to 25 manos or mano fragments and one to eight metates or metate fragments per site. Comparable figures for the southern community are 4.3 to 63 manos or mano fragments and 0.3 to 44 metates or metate fragments per site.

Together, the data on chipped stone and ground stone tools suggest economic differences between the two communities. The north-community figures may represent

Table 130. Valdez-phase ceramic types, north-community sites (percent of sherds)

Site	Ceramic Type				
	All Black-on-white	Taos Gray Plain	Taos Gray Incised	Taos Gray Corrugated or Neck-banded	Other
LA 9200	6.0	61.5	22.0	6.5	4.0
LA 9201-01	9.1	62.9	19.6	8.4	0
LA 9201-02	1	66.4	25.9	6.6	0
LA 9201-03/04	2.4	61.5	32.2	3.5	.4
LA 9203	8.7	78.7	8.3	2.2	2.1
LA 9204	0.2	88.6	8.9	1.5	1.0
LA 9205	0	85.4	10.8	3.8	0
LA 9206	2.4	80.1	9.0	3.0	5.6
LA 9207	1.8	68.0	16.6	13.1	0.4
LA 9208	2.7	78.6	11.4	7.1	0.1
"268"	12.5	76.2	6.5	4.7	0.1
Average	4.3	73.5	15.8	5.5	1.2

Table 131. Valdez-phase ceramic types, south-community sites (percent of sherds)

Site	Ceramic Type				
	All Black-on-white	Taos Gray Plain	Taos Gray Incised	Taos Gray Corrugated or Neck-banded	Other
TA-1	30.3	49.7	2.3	13.3	4.4
TA-10	37.5	57.3	3.2	1.7	0.3
TA-18	36.2	52.0	9.5	0	2.3
TA-20, Pithouse A	39.1	52.3	8.1	0	0.5
TA-20, Pithouse B	37.1	54.9	6.5	0.4	1.1
TA-32	36.8	43.9	16.4	0.7	2.3
TA-47, "Kiva 1"	22.2	67.6	8.6	1.5	0.1
TA-47, "Kiva 2"	22.1	63.7	12.7	1.5	0
TA-47, Lower Pueblo	11.5	71.0	10.7	6.1	0.7
TA-47, Upper Pueblo	13.9	74.9	9.3	1.9	0
LA 2742	17.0	68.7	12.4	0.7	1.2
LA 3569	32.3	55.1	12.6	0	0
LA 3570	19.0	68.7	10.1	2.2	0
LA 3643	28.0	54.7	15.6	0.9	0.9
LA 70577	24.7	68.4	5.7	0.1	1.1
Average	27.2	60.2	9.6	2.1	1.0

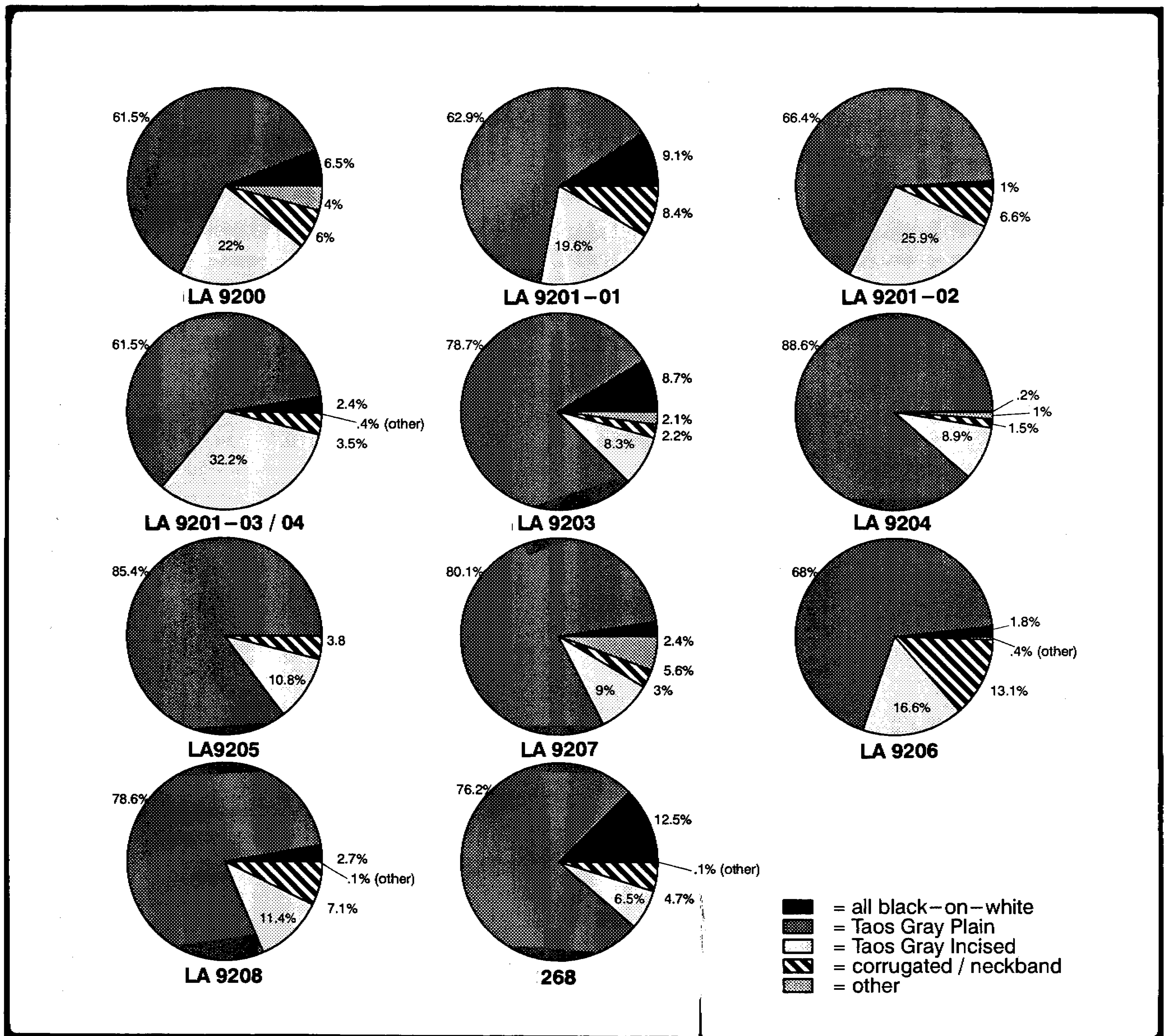


Figure 112. Valdez-phase ceramic types, north-area sites.

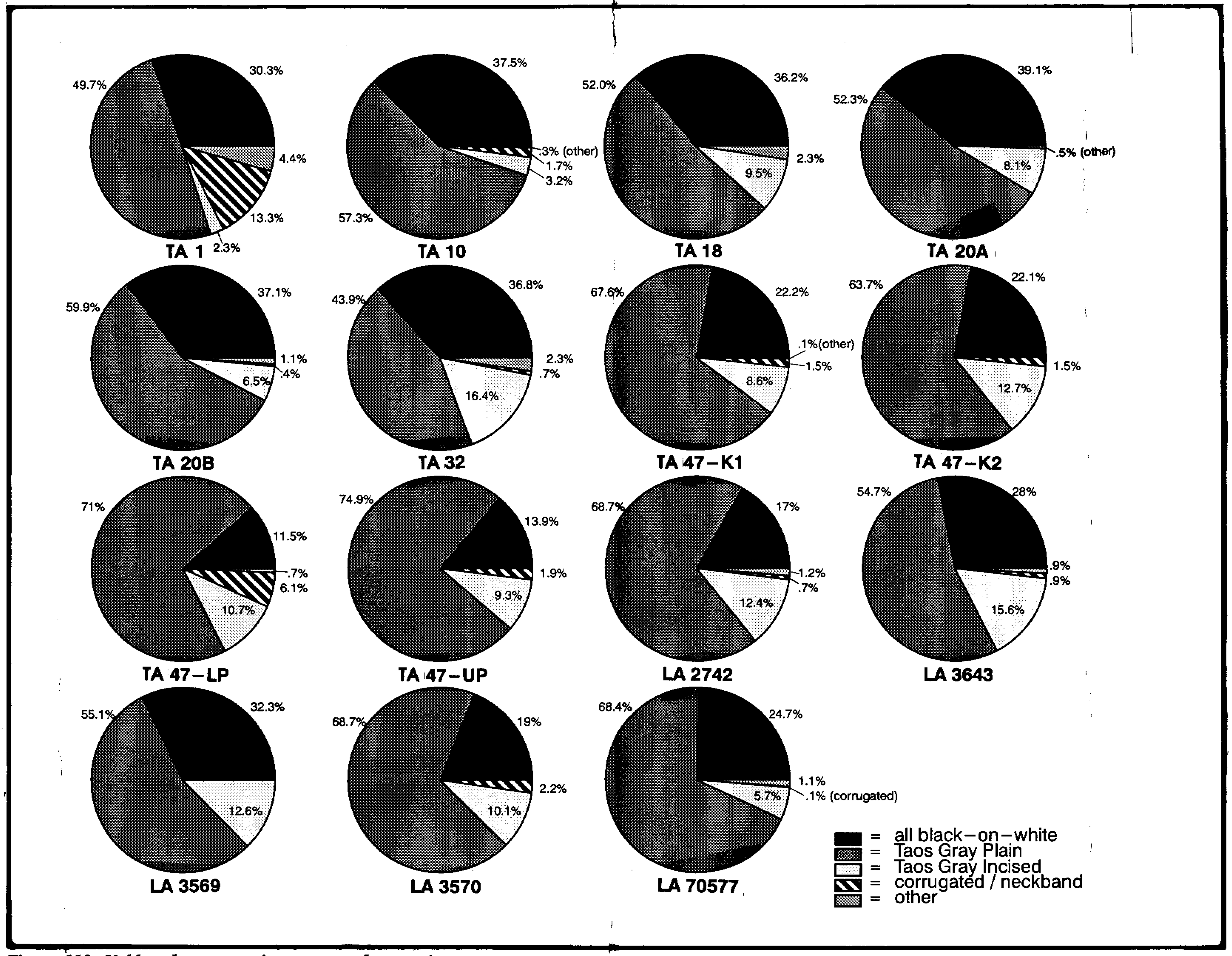


Figure 113. Valdez-phase ceramic types, south-area sites.

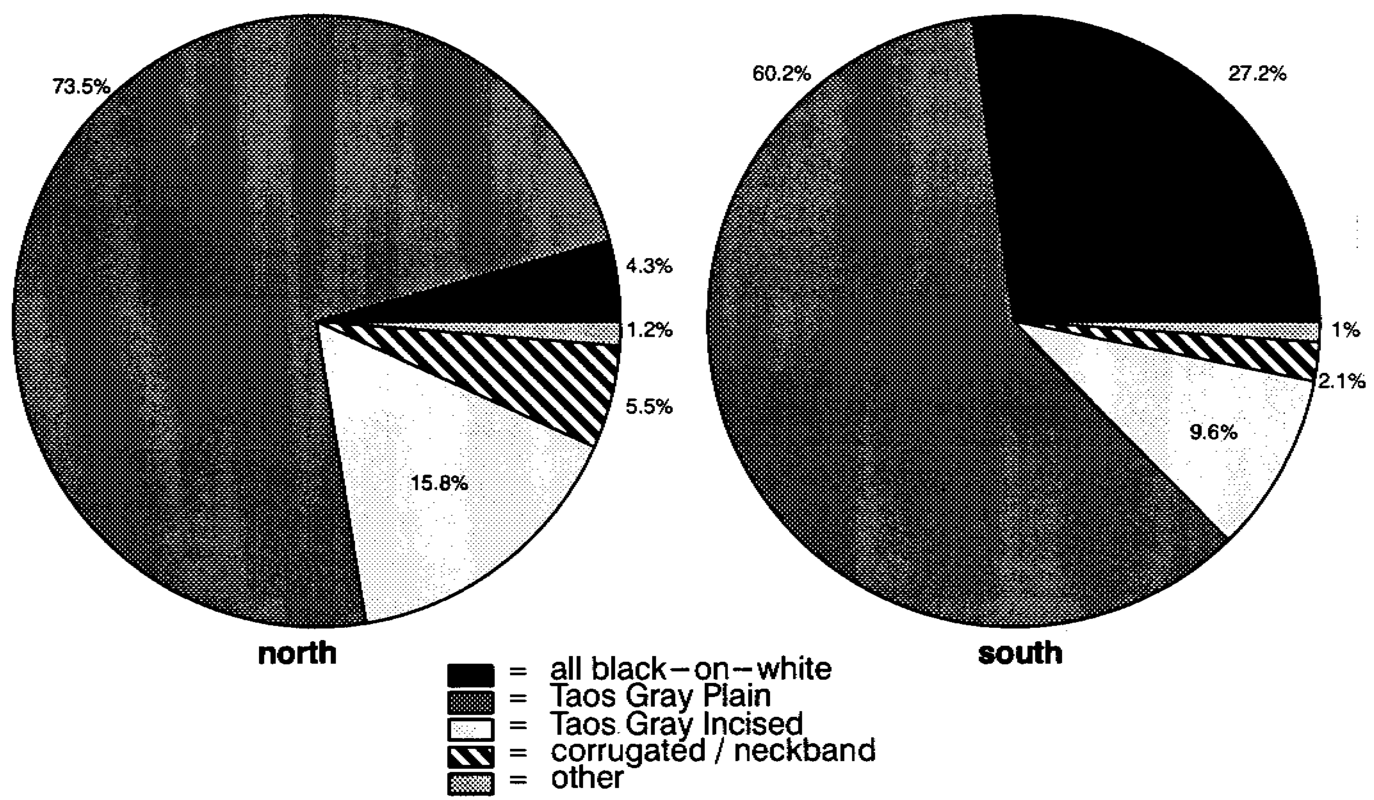


Figure 114. Valdez-phase ceramic types, north- and south-area averages.

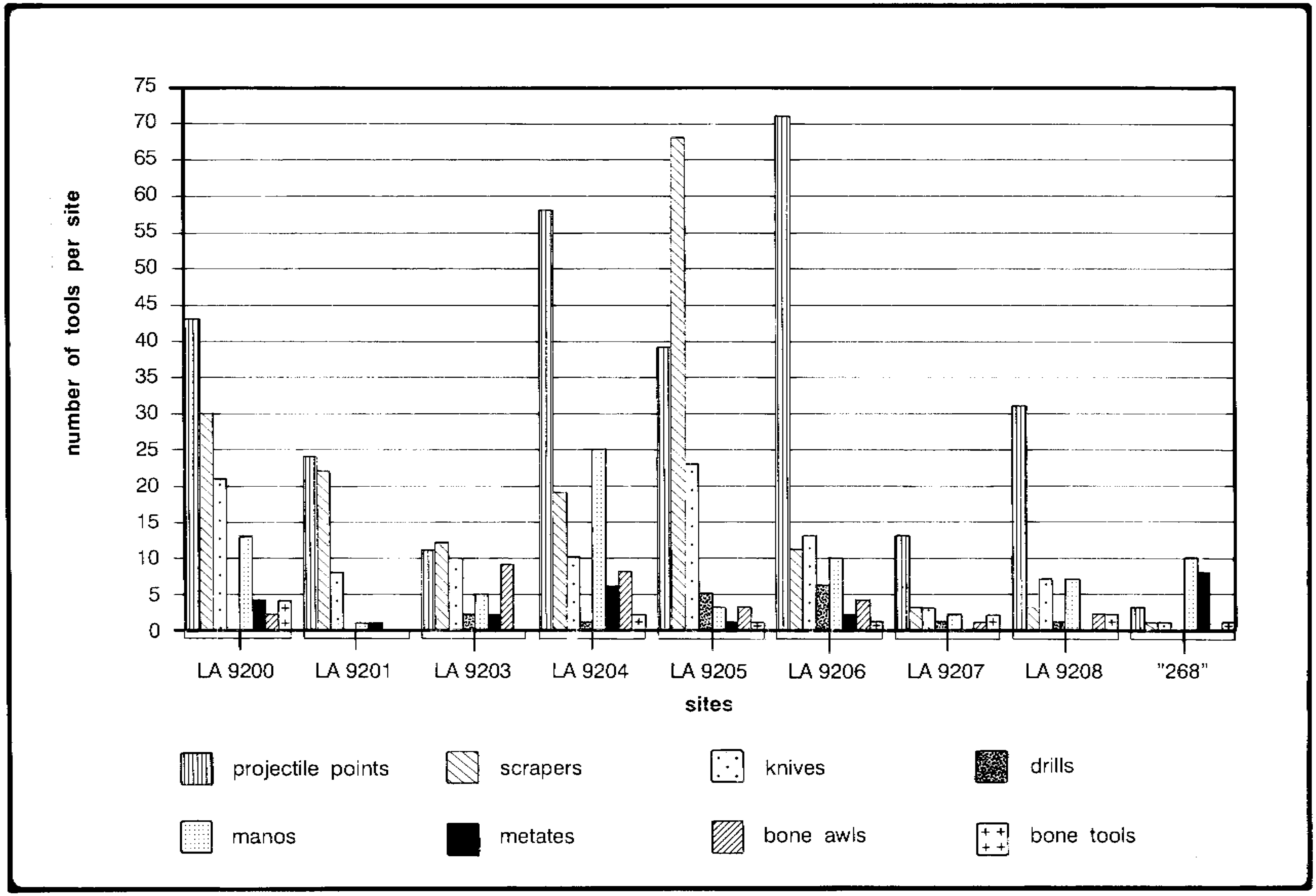


Figure 115. Valdez-phase stone and bone tools, north-area sites.

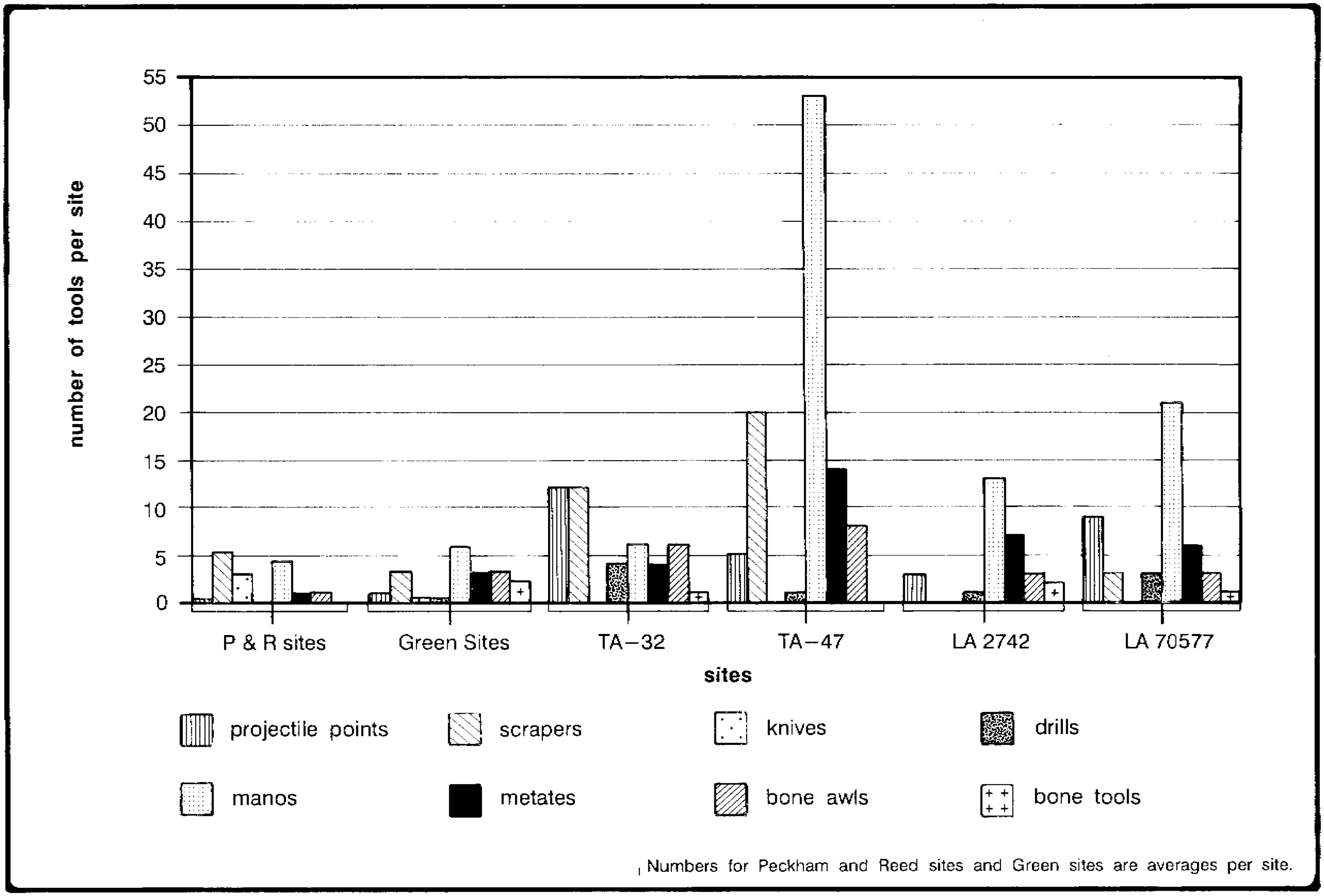


Figure 116. Valdez-phase stone and bone tools, south-area sites.

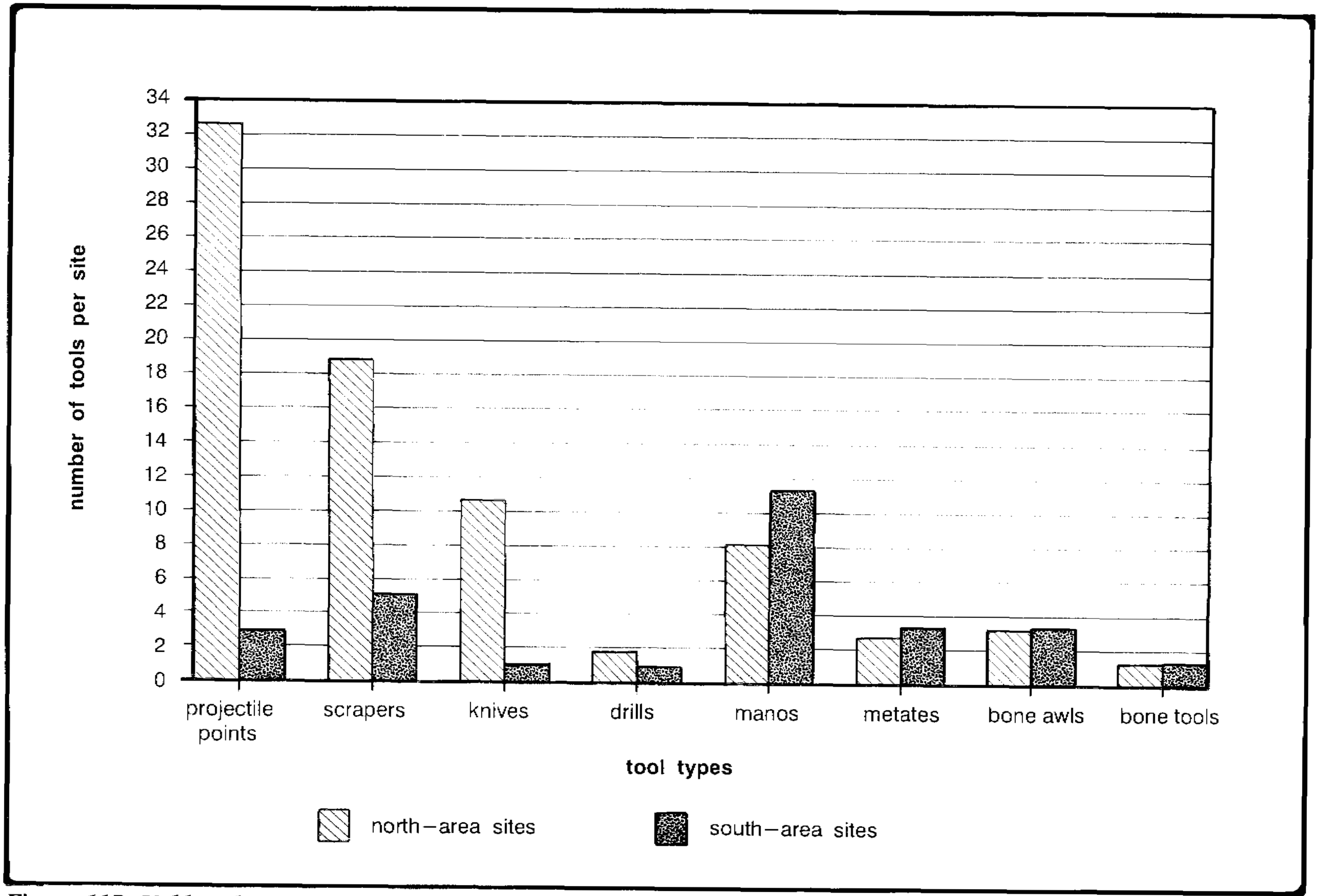


Figure 117. Valdez-phase stone and bone tools, north- and south-area averages.

Table 132. Valdez-phase stone and bone tools, north-community sites (number of tools)

Site	Chipped Stone Tools				Ground Stone Tools		Bone and Antler Tools	
	Projectile points	Scrapers	Knives	Drills	Manos	Metates	Awls	Other tools
LA 9200	43	30	21	0	13	4	2	4
LA 9201	24	22	8	0	1	1	0	0
LA 9203	11	12	10	2	5	2	9	0
LA 9204	58	19	10	1	25	6	8	2
LA 9205	39	68	23	5	3	1	3	1
LA 9206	71	11	13	6	10	2	4	1
LA 9207	13	3	3	1	2	0	1	2
LA 9208	31	3	7	1	7	0	2	2
"268"	3	1	1	0	10	8	0	1
Average	32.6	18.8	10.7	1.8	8.1	2.7	3.2	1.3

Table 133. Valdez-phase stone and bone tools, south community sites

Site	Chipped Stone Tools				Ground Stone Tools		Bone and Antler Tools	
	Projectile points	Scrapers	Knives	Drills	Manos	Metates	Awls	Other Tools
Peckham and Reed sites (n=3)	1	16	3	0	13	1	1	0
Green sites (n=5)	5	16	2	2	29	16	16	11
TA-32	12	10	0	4	63	44	6	1
TA-47	5	20	0	1	53	14	8	0
LA 2742	3	-	-	1	13	7	3	2
LA 70577	9	3	0	3	21	6	3	1
Average	2.9	5.1	1.0	.9	11.3	4.2	3.3	1.3

Numbers for TA-32, TA-47, LA 2742, and LA 70577 are actual number of tools. Numbers for Peckham and Reed's (1963) sites and Green's (1976) sites are from all sites.

an economy focused on collecting wild resources. Specifically, the figures suggest more hunting in the northern community than in the southern community, while south-community figures suggest more processing of agricultural plant foods. Interestingly, the figures for bone tools are almost identical for the two communities. We expected to see more bone tools from the northern community if its residents were in fact hunting more than south-community residents. But, Linda Mick-O'Hara (personal communication) has suggested that the potential differences in bone availability may have been ameliorated by more intensive use of large mammal products in the southern community, an explanation supported by her faunal analysis for this project.

Clearly, we cannot say that the data indicating significant economic differences demonstrate that the northern community engaged in more hunting and gathering than the southern community, which was primarily agricultural. Corn remains have been found at sites in both communities (Occupying the Taos Frontier), albeit in small quantities. Further, faunal analyses comparable to those performed for this project have not been conducted for north-community sites or most other south-community sites. Nonetheless, striking differences in the data from the communities may be supported by two interesting observations. First, the faunal assemblages from LA 2742 and LA 70577, while clearly showing deer hunting as an economic activity, indicate that much faunal procurement happened in association with activities near habitation and agricultural locations. Second Mick-O'Hara's analysis of faunal remains from LA 12741, a large, possibly Valdez-phase pueblo near Arroyo Hondo, shows a higher than expected frequency of large mammal and deer bones (Boyer and Mick-O'Hara 1991:30), suggesting that large mammal hunting was an important economic activity. Botanical samples from the site show that wild plant foods were also utilized. While the small size of the faunal sample and the conditions under which it and the botanical samples were collected (excavation of a single human burial) preclude relying on these data as representative of the economy of the site residents, they appear to be consistent with information from other north-community sites. Interestingly, the same small excavation area (1 by 2 m) yielded four projectile points and a point blank, more than expected from such a small area in such a large site. There is no indication that they represented burial items. A metate fragment and a two-hand mano were also recovered (Boyer and Mick-O'Hara 1991:28-29).

Taken together, data on the assemblages of ceramic artifacts and stone and bone tools strongly support the conclusion drawn from architecture and site structure in Occupying the Taos Frontier. During the Valdez phase, the district contained two distinct Anasazi communities.

There is a significant correlation between these data and oral migration stories from Taos Pueblo. Greiser et al. (1990b) have produced the most succinct summary of the various migration stories recorded at Taos. Although there are six kiva groups at Taos, their origins appear to have been in four separate groups of people who entered the area from different areas or at different times. One group was the Winter or Ice people, identified as hunters living north of Rio Hondo; another the Summer people, identified as farmers living near the hot springs near the confluence of Arroyo Miranda and Rio Grande del Rancho. These groups are identified as contemporaneous. Interestingly, the Winter people are also identified as Apache-speakers. Schroeder (Greiser et al. 1990b:45) speculates that the actual chronology of events is confused because Apaches should not have been a major factor in Taos Pueblo history until the 1600s. However, another possibility is that, over time, the Winter people became identified with Jicarilla Apaches because of similarities in their hunter/gatherer economies. Thus, the Winter people may not have actually been Apaches but their lifestyle so resembled that of the historic Apaches that they eventually became identified as Apaches. Because there is no other evidence supporting the presence of Apaches in the region in the A.D. 1100s, this scenario seems more likely and explains why the archaeological data appear to support the oral history of two contemporary communities with different economies.

Without further study, we cannot define the structure of these communities. Oral history tells of several "clans" among the Summer people, which Greiser et al. (1990b) speculate could account for the many sites in the southern area. Woosley (1986:149, 150) lists three to seven "subareas" of the southern area that appear to be defined by concentrations of sites. Obviously, we cannot securely correlate these "subareas" with the Summer people "clans." We do not know the structure or spatial distribution of the "clans," and we do not have accurate descriptions of the "subareas" or sites, nor accurate estimates of site contemporaneity based on chronometric dates, all of which are necessary before we can assess the structure of the southern community and its possible subunits. The same must be said of the northern community. At this point, we are limited to being able to define these two large communities, which seem to have maintained their separate identities at least through the Valdez phase. This is, however, an important contribution to understanding the archaeology of the district. Future research in the area between these communities will need to focus on defining their respective limits or "boundaries" and assessing interaction between them, for they eventually came together to form a single village at Taos Pueblo.

This discussion is necessary to address the question of whether the Valdez-phase occupants of the district were merely scattered households on the fringes of Anasazi settlement in the A.D. 1100s (Peckham and Reed 1963; Herold 1968) or comprised one or more communities at the lowest level of frontier settlement, the "dispersed settlement." Although we are currently unable to specify the internal structure of the two communities or the nature of interaction between them, we can say that they appear to have more internal cohesion that would be expected of scattered, unrelated households. Therefore, they appear to fit the description of "dispersed settlement" on the Anasazi frontier.

Because our Pot Creek-phase sites were farm sites rather than habitations, we cannot reconstruct from them the place of Pot Creek-phase sites in the colonization gradient. Such a reconstruction requires a detailed review of excavated Pot Creek-phase sites. However, the definition of Valdez-phase communities may have significant implications for studying population aggregation into pueblo communities in the Pot Creek phase. As discussed below, the use of pithouse architecture on scattered sites may reflect loss of sociocultural complexity on the frontier and selection of material items or traits representing earlier or simpler parts of a population's material repertoire. If this is so, then population aggregation on the frontier may represent perceived stability in frontier settlement and economy and the consequent formation of more formal communities at higher levels in the colonization gradient as the frontier became more firmly integrated with the core area. As Casagrande et al. (1964:314) note, "These several types of settlements may be seen as graded stages in a developmental process by which the area of colonization may achieve a higher level of socio-cultural integration." This process would explain why population aggregation in the district seems to be the response to a period of greater than normal precipitation between about A.D. 1230 and 1260.

We suggest, with little supporting evidence at this time, that Pot Creek-phase pueblos represent community formation at the level of the "nucleated settlement," defined as "a cluster of households which are organized politically at least to the extent of having some form of municipal government" (Casagrande et al. 1964:313). Religious facilities and facilities for redistribution of food and other goods may be present, but the community does not replace the frontier town as a supply center. There is a step between dispersed and nucleated settlements, the "semi-nucleated settlement," which is "characterized more by its lack of integration and community facilities than by their presence" (Casagrande et al. 1964:313). We cannot say whether such communities existed in the district, but the different "clans" of the Summer people are an intriguing possibility.

With respect to a diachronic view of the colonization gradient, we expect to see the development of the gradient through time in regional site distributions. We also expect to see that some sites will undergo a process of changing from one level in the gradient to another, becoming more integrated into regional lines of communication and exchange and showing the effects of population aggregation. None of the sites included in this project can be so characterized because none shows evidence of growth and change through time. However, the Pot Creek-phase sites are related to aggregated villages such as TA-26 and Pot Creek Pueblo, where this process may be seen. James L. Moore (this report) presents a model to explain the origin and context of sites such as LA 71189 and LA 71190 in the process of population aggregation and associated patterns of land use. This process may ultimately have to do with the establishment of formal communities on the frontier and the attendant necessary adaptations of agricultural strategies, both in terms of the natural environment and of intracommunity structure.

Sudden Loss of Sociocultural Complexity

If this model does characterize Taos Anasazi prehistory, we expect a variety of conditions having to do with the loss of sociocultural complexity and the selection of socio-cultural traits to be maintained on the frontier. We specified five expectations having to do with settlement pattern, architectural form(s), economic/subsistence patterns, diversity in material goods, and interaction with other people in and near the frontier zone. This is by no means a complete list. Other areas might include social structure and religious structure and activities. Accurate assessment of this condition requires that we attempt to identify the parent or core area from which the immigrant population was drawn. As it turns out, this task is easier stated than accomplished.

Discussions of Taos district archaeology have commonly linked the district with the middle Rio Grande Valley. A review of prehistoric architecture at about A.D. 1100 reveals an interesting situation. In their seminal description of Rio Grande Valley archaeology, Wendorf and Reed (1955) state that during the early Developmental period (A.D. 600 to 900), settlement and architecture were characterized by scattered pithouses. After A.D. 900, sites are characterized by pueblos ranging from 10-12 rooms to communities of over 100 rooms associated with kivas.

However, reported excavations point to a variety of structural types and settlement patterns. Cordell's (1979a) review shows that pithouses were common in the Santa Fe district after about A.D. 900. Usually, they were associated with surface structures. Examples include the Tesuque By-pass site (LA 3294; McNutt 1969) and the Tsogue site (LA 746; Allen 1972) near Tesuque; the Dead Horse site (LA 272; Honea 1971); the Red Snake Hill site (LA 6461; Bussey 1968a) and the North Bank site (LA 6462; Bussey 1968b) at Cochiti Reservoir; and the KP site (LA 46300; Wiseman 1989) in Santa Fe. A review of the research on these sites provides data on 25 subterranean structures in the Santa Fe district, which borders the Taos district on the south. Seventeen of the structures are identified as pithouses, six as "kivas," and two as "pit rooms." The "kivas" were always associated with surface structures, and this association apparently determined what they were called. However, their features are indistinguishable from those in structures identified as pithouses. "Pit rooms" were rectangular structures found only at LA 6462 (Bussey 1968b). Except for shape, their features are also within the pattern shown by pithouses.

Of the 25 structures, 22 (88 percent) were circular, and two (8 percent) were rectangular. The average diameter was 4.1 m, ranging from 3.1 to 6.4 m. The latter measurement is considerably larger than the norm. However, if it is excluded, the average diameter decreases only to 4.0 m. Depths ranged from 0.5 to 2.4 m and averaged 1.7 m. The former figure is abnormally low; the structure had a *jacal* superstructure (Bussey 1968b). Another pithouse, unfinished at the time of abandonment, was only 0.7 m deep (Bussey 1968b). If these two are excluded, depths ranged from 1.4 to 2.4 m and averaged 1.8 m. Eleven structures (44 percent) had walls of sterile soil covered with adobe plaster, and two (8 percent) had natural soil walls without plaster. Four (16 percent) had coursed adobe walls; three of these are identified as "kivas" (Bussey 1968b). One structure had walls of large cobbles set in adobe mortar (McNutt 1969). As noted, one was very shallow and had a *jacal* superstructure. Two unfinished pithouses at LA 6462 had no wall treatment, and no data are available for three structures.

The two unfinished pithouses had no ventilators (Bussey 1968b), and no data on ventilators are available for two other structures (Bussey 1968b; Wiseman 1989). Of the remaining 21 structures, all had ventilators oriented to the east. One (4 percent) was oriented northeast, three (12 percent) were oriented south-southeast (almost south), and 17 (80.9 percent) were oriented southeast. The number of postholes ranged from one to five, most often four (ten structures, 40 percent). However, a quadrilateral post pattern was defined or assumed at only six structures (Bussey 1968b; McNutt 1969; Honea 1971; Allen 1972). Postholes at the other structures were irregularly placed. Hearths were overwhelmingly circular and collared with adobe. This was found at 17 structures (68 percent). A collared oval hearth, a collared rectangular hearth, and a cobble-lined circular hearth were found at one site each. Ash pits were present at 14 structures (56 percent) and absent at nine (36 percent). No data are available for two structures. Deflectors were found at 12 structures (48 percent), while slab dampers were found at two structures at LA 3294 (McNutt 1969) and two at LA 272 (Honea 1971), comprising 16 percent of the sample. The most common deflector type was a *jacal* feature called "adobe post-core" (Bussey 1968a and 1968b). This is not representative, however, because Bussey's structures make up most of the sample discussed here. LA 746 had a large cobble set between the hearth and ash pit (Allen 1972). One or two ladder holes were found at 14 structures (56 percent). They were absent at nine (36 percent). A sipapu was present at 14 structures (56 percent) and absent at nine (36 percent).

Of the 25 pit structures, nine (36 percent) were apparently not associated with a surface structure. Fourteen (56 percent) were associated, and two (8 percent) may have been, although excavation did not establish association (Allen 1972; Wiseman 1989). The 14 pit structures were associated with seven surface structures. These surface structures ranged from two (?) to 19 rooms, with an average of 9.3 rooms per structure. The number of rooms with hearths ranged from one to six, with an average of 3.1 rooms. Rooms with hearths comprised about 38 percent of all rooms in a structure, and individual figures ranged from 16.7 to 57.1 percent. No data are available on wall construction at two structures (Bussey 1968b; Honea 1971). The others apparently had coursed adobe walls. At four structures, the walls had slab or cobble footings (Bussey 1968b; McNutt 1969; Honea 1971). The fifth had footings of adobe set in shallow trenches (Bussey 1968a). Wiseman (1989) believes these structures had *jacal* walls rather than coursed adobe because the vertical slab footings were rarely found with actual adobe walls (Regge Wiseman, personal communication).

Apparently, much larger sites are known from the period. LA 835, the Pojoaque Grant site, consisted of one to two dozen units comprised of pithouses and surface structures concentrated near a great kiva (Stubbs and Stallings 1953; Cordell 1979a; Wiseman 1989). Stubbs and Stallings assign a date of A.D. 950 to 1100. Wiseman (personal communication) feels that this date is appropriate for Pueblo B but that Pueblo A probably dates to the A.D. 800s, based on tree-ring dates from the structures. Other large pueblos such as Mocho (LA 191) and Arroyo Negro (LA 114) have been partially excavated but never reported.

The information presented in this review is consistent with that presented by Wetherington (1968:88-91) in his brief review of the Santa Fe district, except that we now have more data. Using phase names, Wetherington characterizes the Red Mesa phase (A.D. 900-1000) as having pithouse villages and small surface structures with slab-lined adobe and *jacal* walls. If Wiseman is correct, A.D. 900 is too late for the beginning of this phase, but then LA 835 is hardly characteristic of the phase description, at least in terms of site structure. The succeeding Tesuque phase (A.D. 1000-1200) saw a considerable increase in the number of rooms per surface structure, and LA 835 reached or exceeded 100 rooms (Wetherington 1968). Pit structures associated with these surface units are called "kivas" by the archaeologists (Bussey 1968b; McNutt 1969; Wetherington 1968), although, as we noted above, there is little physical evidence to suggest a change in function from habitation to religious. We observed that Wetherington criticizes Green for assuming pit structures were "kivas" simply by association with surface rooms. The transition seems to have been complete by about A.D. 1200. The introduction of Santa Fe Black-on-white corresponded to the presence of numerous aggregate villages, although there does not seem to have been a major architectural or settlement change associated with the new ceramic type. There was still considerable variability in site size (Cordell 1979a:56-57).

Comparing the Taos and Santa Fe districts may provide information useful in determining the core area of the Taos frontier immigrants. About A.D. 1100 in both areas, pithouses were common architectural forms. Most Santa Fe district pithouses were circular, averaging 4.0 to 4.1 m in diameter and 1.7 to 1.8 m deep. Ventilators were oriented to the southeast, and internal features consisted of a circular, collared hearth, usually accompanied by an ash pit between the hearth and the ventilator, a sipapu, one or more postholes, and a deflector or a slab damper. Comparison with Valdez-phase sites shows that this description closely matches that of south-community pithouses. These structures were circular with ventilators oriented to the southeast. Hearths were circular and collared. There were differences, however. Valdez-phase south-community pithouses averaged about 1 m larger in diameter and 1 m deeper than the Santa Fe district pit structures. The source of these differences, particularly depth, may relate to altitude and climate (Farwell 1981). South-community pithouses always had ash pits and almost always had a deflector set between the hearth and the ash pit. In the Santa Fe district sample, deflector placement was as variable as its presence. Sipapus were rarely present in south-community pithouses. Other differences are apparent. South-community pithouses almost always had a quadrilateral posthole pattern. This pattern is not consistently found in the Santa Fe district, although the more northern sites appear to have it. Further, south-community pithouses almost always had coursed adobe walls, with no recorded instances of plaster directly on natural soil walls. In the Santa Fe district sample, almost half the pithouses had plastered natural soil walls.

If we compare the Santa fe district sites with the Valdez-phase northern community, we also see similarities and differences. The most glaring difference is in pithouse shape. Most north-community pithouses are rectangular, but only two such structures are recorded in the Santa Fe district sample. Otherwise, there are striking similarities between the two groups of structures. Like the Santa Fe district pithouses, north-community pithouses had circular, collared hearths. Ash pits were absent in almost 20 percent of the recorded cases. Deflectors were not always present, either, but slab dampers were often observed, as they were at LA 746 and LA 3294, in the Tesuque area, and LA 272, at Cochiti Reservoir. Sipapus were not common in the north-community sites. Like the Santa Fe district structures, however, north-community pithouses more commonly had walls of plaster on natural soil. Further, there was much more variability in the number of postholes in north-community pithouses.

We can see, then, that the features and characteristics commonly associated with Santa Fe district pithouses just before and about A.D. 1100 are present in Valdez-phase pithouses. They are, however, differentially distributed between the north and south communities. Similarly, surface structures associated with sites in the two districts show similarities and differences. Excavators of Santa Fe district sites describe their surface structures as having coursed adobe walls, often with vertical slab or cobble footings. That description may not always be accurate, since the actual walls were not always present at the time of excavation. Wiseman (1989) describes surface structures of the period as having *jacal* walls. This distinction may be significant in light of the Taos data, since north-community surface structures are described as having coursed adobe walls (Wiseman disagrees; personal communication), while south-community structures, with the exception of TA-47, had *jacal* walls. Further, *jacal* structures are often characterized by rows of slabs or cobbles set on edge, while many north-community walls had footings of cobbles set in trenches. Thus, while descriptions are not necessarily clear, it seems that north-community surface structures more closely resemble those of the Santa Fe district. Again, the exception is TA-47.

A significant difference is seen, however, when the size of surface structures is compared. While Santa Fe district structures ranged from seven to 19 rooms, those in the Valdez northern community ranged from one to four. In fact, the upper pueblo at TA-47 in the southern community had the most rooms, six, so far recorded at a Valdez-phase site. In part, this difference may have to do with the idea that the number of pithouses associated with a surface structure reflects the size of site population. This, of course, assumes contemporaneity of pithouses at a site, an assumption that is often plainly untenable (Bussey 1968a; Green 1976). Nonetheless, lacking adequate information to assess structural contemporaneity at most Santa Fe district sites, we see that 14 pithouses were associated with seven surface structures, or two pithouses per surface structure. In some "units" at LA 6462 (Bussey 1968b), there were three pit structures near each surface structure. At the Valdez-phase sites, surface structures are commonly associated with only one pithouse. The exception is TA-47, but surface structural imposition and pithouse fill stratigraphy suggest that the two surface structures were each associated with only one pithouse. This indicates smaller site populations at Valdez-phase sites, perhaps reflected in the number of surface rooms needed for storage and extra-pithouse activities. We might suggest that the differences reflect different family sizes, perhaps primarily nuclear or small extended families at most Valdez-phase sites, versus larger extended families at Santa Fe district sites. The large Santa Fe district sites such as LA 114, LA 191, and LA 835 obviously represent significant multifamily aggregations.

The significance of variation in the characteristics of late Developmental-period sites in the Valdez-phase northern and southern communities cannot be accurately assessed at this time, primarily because more late Developmental-period sites have been excavated and reported in the Taos district than in neighboring regions. Thus, the detail with which we are beginning to view the Valdez phase, including the definition of two distinct communities, cannot be duplicated in other areas. For instance, the 25 pithouses reviewed from the Santa Fe district are from only six sites: three at Cochiti Reservoir, two near Tesuque, and one in Santa Fe. By comparison, in Occupying the Taos Frontier, we reviewed the data from 34 pithouses excavated at 22 Valdez-phase sites. We cannot at this time begin to describe the nature or distribution of variability in the Developmental period in the Santa Fe district. We suggest, however, that evidence exists of communities of pithouse-surface structure sites in that district. Bussey's (1968a and 1968b) data from Cochiti Reservoir show striking similarities between pithouses at LA 6461 and LA 6462 that are not found in the pithouses at LA 272, LA 746, LA 3492, or LA 46300.

However, given the difficulty in assessing variation between the Taos and Santa Fe districts at the time of initial Anasazi occupation of the Taos district, several points seem clear. While pithouses were common architectural forms in both districts, Santa Fe district sites had more rooms per surface structure and more pithouses per surface structure than their Taos district counterparts. Further, several large sites comprised of multiple room blocks and pithouses, such as LA 114, LA 191, and LA 835, are known. This suggests that, while the situation was not as clear-cut as Wendorf and Reed saw it in 1955, the processes of population aggregation were well under way in the late Developmental period in the Santa Fe district. Wiseman's revised dates for LA 835 indicate that this process may have begun by the A.D. 800s. Further, the presence of a great kiva at LA 835 suggests that changes were under way in regional social organization, as well. In the Taos district, Valdez-phase sites reflect scattered households that were apparently integrated at some level into large local communities. The nature of community integration is not known at this time, but it obviously involved shared architectural, ceramic, and economic characteristics.

An important site in this regard is the El Pueblito site, LA 12741, near Arroyo Hondo. This large site consists of three structural areas with up to nine room blocks, 14 small depressions (pithouses? kivas?), and two large depressions (kivas?) (Boyer and Mick-O'Hara 1991). Despite its size and complexity, the ceramic assemblage is dominated by Taos Black-on-white, suggesting a Valdez-phase occupation. This is perhaps substantiated by an adjusted radiocarbon date of A.D. 1120 $\pm$ 120 from the burial excavation (Sally Greiser and Weber Greiser, personal communication). However, the actual nature of the site is not known, and we cannot determine its possible function within the northern community at this time. Consequently, lacking data to indicate otherwise, we can suggest that the Valdez-phase pattern of scattered households represents reversion to and maintenance of dispersed settlement on the frontier. There was obvious continuity in architectural forms, apparently associated with smaller population units, perhaps nuclear or small extended families. Further, with the possible exception of LA 12741, there seems to be little evidence of aggregate communities such as those in the Santa Fe district. Therefore, when aggregation was producing both small and large villages in the central Rio Grande Valley, the Taos district Anasazi seem to have been living in communities of dispersed households. Aggregation into formal pueblo communities appears to have begun in the early A.D. 1200s, coincident with the appearance of Santa Fe Black-on-white in the Taos district. Judging from available data, this was 100 to 400 years after similar communities appeared in the Santa Fe district.

This appears to support our expectations of dispersed settlement and associated architectural forms on the frontier. It further suggests that the use of pithouses later in the regional cultural sequence that would be expected was not merely a matter of cultural lag (Peckham and Reed 1963; Herold 1968) or of strict environmental necessity (Stuart and Farwell 1983), but actually reflected the colonization of the Taos frontier. The length of time characterized by this pattern of dispersed pithouse settlement may, then, reflect the instability of the frontier and considerable population mobility within community areas. As discussed above, aggregation and the formation of formal pueblo communities may reflect perceived stability on the frontier.

Another expectation of the loss of sociocultural complexity has to do with adoption of economic/subsistence patterns consistent with settlement and new ecological arrangements. This point is impossible to assess at this time because the kinds of economic/subsistence analyses conducted for this project have not been conducted for other excavations in the Taos district, or, for that matter, in the Santa Fe district. Since our data show that a mixed economy based on foraging and agriculture cannot be compared with other sites from any phase in the district, we cannot discern patterns in economic/subsistence procurement or consumption across the district or through time.

The ceramic assemblages from this project uniformly show a low diversity of ceramic types. The Valdez-phase assemblages are dominated by Taos Black-on-white and Taos Gray Plain and Incised, while the Pot Creek-phase assemblages show a slight increase in diversity with the addition of Santa Fe Black-on-white and Taos Gray Corrugated. This situation is consistent with that described by Peckham and Reed (1963), Luebben (1968), Wetherington (1968), Loose (1974), and Green (1976). However, the ceramic analysis points out that the two agricultural sites may not be representative of Pot Creek-phase habitation sites. The Pot Creek-phase component at Pot Creek Pueblo included sherds of St. John's Polychrome and Wiyo Black-on-white. Comparison with late Developmental-period sites in the Santa Fe district shows much greater diversity in ceramic assemblages in that area. For instance, the painted sherds from LA 6461 could be assigned to 13 different types, and four make up about 80 percent of the painted assemblage: Kwahe'e, Borrego, Taos, and Gallina Black-on-white (Honea 1968). Similarly, the utility sherds could be assigned to four corrugated types. Kwahe'e, Borrego, Cholla, and Taos Black-on-white comprise 86 percent of the painted sherds from LA 6462, and the remainder were divided among 17 other types (Honea 1968). The utility sherds consisted of four corrugated types. The painted sherds from LA 46300 could be assigned to 10 types, dominated by Kwahe'e, Escavada, "Chaco II," Red Mesa, and Puerco Black-on-white (Wiseman 1989). The utility sherds could be assigned to 13 types dominated by corrugated and plain varieties. This range of diversity is present in the ceramic assemblages from LA 742 and LA 3294 (Allen 1973; McNutt 1969).

By comparison, the Taos district sites are clearly low in ceramic diversity, reflecting a loss in sociocultural complexity. On the other hand, we do not see equity in vessel forms between types, as suggested in the Research Design. Rather, this project shows that vessel forms were distinctly divided by type. Taos Gray and its varieties were used almost exclusively for jars, and Taos Black-on-white was used mostly for bowls. Comparable data are not available from other sites, particularly in the northern community. However, Boyer and Mick-O'Hara (1991) found no apparent distinction between utility and painted sherds from their limited excavation at LA 12741. The small sample size precludes accurate assessment, but the results may be consistent with data from north-community sites showing that north-community assemblages average about 4 percent white ware sherds. If white ware vessels made up such a small proportion of a site's assemblage, utility vessels should show more diversity in vessel form.

Chipped stone artifacts also show low diversity of materials. The number of lithic materials from each site ranges from seven at LA 71189 to 14 at LA 70577. However, only two or three material types make up most of the chipped stone assemblages. If we total the number of artifacts from materials comprising more than 10 percent of each assemblage, we see that two types make up 74.2 percent at LA 3570, 69.7 percent at LA 70576, 81.3 percent at LA 71189, and 74.4 percent at LA 71190. Three types make up 79 percent from LA 2742 and 81.1 percent from LA 70577. In each case, chert is the dominant material, comprising 48.9 to 67.4 percent of the assemblages. Much of the chert is from local sources, either limestone beds in the nearby mountains or gravels. LA 70577 has the highest percentage of nonlocal materials (25.5 percent). Together, these data support our expectation of low material diversity, reliance on local materials, and use of few materials for most purposes.

Finally, there is an issue of contact with native peoples in the frontier zone and with other nearby groups. Interaction with hunter/gatherers inhabiting the Taos district prior to the Anasazi occupation is difficult to discern at this time. Because we are only beginning to understand the nature of the Anasazi presence, including the presence of early communities and ties to the central Rio Grande, we cannot specify the kinds of data available or needed to illuminate interaction with previous residents of the valley.

On the other hand, ceramic data provide evidence of interaction with nearby regions. While architectural and settlement data support the conclusion that the middle Rio Grande Valley was the source of an immigrant population to the Taos Valley, the ceramic data are less conclusive. Given the low diversity of ceramic types in the Taos district, particularly in the early years, it is not surprising that local ceramic assemblages are dominated by Taos Black-on-white. What is surprising is that the utility ware assemblages contain very few corrugated sherds. Various corrugated wares dominate the late Developmental and Coalition period assemblages in the middle Rio Grande Valley. However, the dominant decoration technique of Taos Gray sherds in the Developmental period (Valdez phase) is incising, a technique virtually unknown in the middle Rio Grande Valley until the Classic period (post-A.D. 1300). Researchers have ascribed the technique to the eastern plains and postulated interaction between the Taos Anasazi and plains residents (Wendorf and Reed 1955:143). However, the technique appeared on the plains after about A.D. 1200, making this an unlikely scenario.

A review of the literature suggests that, while proving technical antecedents may be difficult, the presence of incised decoration may indicate directions of interaction from the Taos district. Several researchers (Glassow 1980; Wood and Bair 1980; Gunnerson 1987) have noted the presence of ceramic assemblages resembling those of the Valdez phase at sites along the eastern mountain margins from the Cimarron area north to Trinidad. Although Glassow (1980) argues for local Anasazi development from a Basketmaker base on the Park Plateau, and Wood and Bair (1980) contend that the Trinidad-area, Sopris-phase occupants were not Anasazi, neither study disputes significant interaction between the region and the Taos district.

Table 134 lists ceramic types by percentage from several Sopris-phase sites near Trinidad and Escritores/Ponil-phase sites near Cimarron (Wood and Bair 1980; Lutes 1959; York Canyon Archaeological Project 1984). As in Tables 130 and 131, all white ware sherds are combined as black-on-white, with no type distinctions. It should be noted that most recorded sherds are Taos Black-on-white, though some Kwahe'e sherds were found in the Cimarron area. The data are listed in a form comparable to that of Tables 130 and 131 for the Valdez-phase northern and southern communities. For comparison, Table 135 lists ceramic types by percentage from three late Developmental-period sites in the Santa Fe district. The average figures from each area are combined

Table 134. Sopris- and Escritores/Ponil-phase ceramic types (percent of sherds)

Site	Ceramic Types				
	All Black-on-white	Plain	Taos Gray Incised	Corrugated or Neck-banded	Other
Sopris-phase sites					
5LA1416	4.5	76.6[1]	9.5	0.6	8.8
5LA1211 (TC:C9:9)	9.2	85.7 (includes plain and incised)		1.0	4.1
5LA1211 (TC:C9:8) (1967 excavations)	1.0	73.2[1]	14.9	0	11.1
5LA1211 (TC:C9:8) 1976 excavations)	3.4	50.4[1]	17.7	0	28.4
5LA1211 (TC:C9:9B)	1.7	82.5[1]	0	3.3	12.5
Average	4.0	71.4[2]	10.7[2]	1.0	13.0
Escritores/Ponil-phase sites)					
KS-30 (Deer Fly)	0	92.3	0	7.7	0
KS-53	0	42.9	4.8	52.4	0
KS-100 (Red Bow)	0	80.2	8.4	5.4	5.9
Philmont Village	5.3	78.3	10.0[4]	2.9	3.5
Average	1.3	73.4[3]	5.8	17.1[5]	2.4

[1] Identified as Taos Gray/Sopris Plain because the two types are indistinguishable (Wood and Bair 1980:194).
[2] Calculated using estimated figures for 5LA1211 (TC:C9:9): Plain, 74.5 percent; Incised, 11.2 percent. Estimates determined using rations of Plain/Incised sherds from 5LA1416 and 5LA1211 (TC:C9:8, 1967 excavations).
[3] This figure is perhaps too low, based on the percent from KS-53. The ceramic assemblage from FS-53 consists of only 21 sherds (York Canyon Archaeological Project 1984:202). If that assemblage is discounted, the average figure for Plain sherds from the Escritores-phase sites is 83.6 percent.
[4] Includes incised and punctate design sherds (Lutes 1959:62). This means that the Taos Gray Incised figure is high and the "other" figure is low, but Lutes provides no way to resolve the difference.
[5] This figure is perhaps too high, based on the percent from KS-53. If the KS-53 assemblage is discounted, the average figure for corrugated/neck-banded sherds from the Escritores-phase sites is 5.3 percent.

with those from the Valdez phase (Tables 130 and 131) in Figure 118. If we compare the Valdez phase as a whole with the other areas, without separating the communities, we see that in terms of white wares, the Valdez phase most closely matches the Santa Fe district sites. That, however, is the end of the similarity. The Valdez-phase assemblage has much higher percentages of plain sherds and incised sherds and a much lower proportion of corrugated sherds. However, the Valdez-phase assemblage does not compare favorably with either the Sopris- or Escritores/Ponil-phase assemblages.

Table 135. Santa Fe District Developmental-period ceramic types (percent of sherds)

Site	Ceramic Types				
	All Black-on-white	Plain	Incised	Corrugated/ Neck-banded	Other
LA 46300 (KP)	13.4	31.5	0	49.1	6.0
LA 3294 (Tesuque Bypass, Area A)	17.5	37.7	0.4	42.5	1.9
LA 835, Pueblo B	6.9	50.2	1.0	36.3	5.6
Average	12.6	39.8	0.5	42.6	4.5

If we differentiate the northern and southern Valdez-phase communities, a different picture begins to emerge. In its low proportion of white ware sherds and high proportions of plain and incised sherds, the northern community most closely resembles the Sopris and Escritores/Ponil assemblages. There is considerable diversity between these areas in percentages of corrugated and other types. In fact, the Escritores/Ponil assemblage has the second largest percentage of corrugated sherds. If relative percentages of ceramic types are indicative of interregional interaction, then we suggest that the interaction often discussed between the Taos district and the eastern mountain margins actually involved the Valdez-phase northern community. This is not to say that the origins of incised pottery were either in the northern community or the mountain margins. In fact, neither can be demonstrated to be earlier than the other. The Escritores phase is supposed to date between A.D. 900 and 1000, based on the presence of sherds that Glassow (1980) identifies as Kana'a Gray but admits are indistinguishable from Taos Gray. The Sopris and Ponil phases are said to begin about 1000, based on ceramic cross-dating of Taos Black-on-white and Taos Gray from Pot Creek Pueblo (Wood and Bair 1980; Glassow 1980; Wetherington 1968). If these types actually date after A.D. 1100, as they appear to in the Taos district, then the dates for the Sopris and Escritores/Ponil phases are too early. Therefore, until data demonstrate otherwise, the incised sherds accompanying Taos Gray Plain and Taos Black-on-white seem to appear in both areas about the same time.

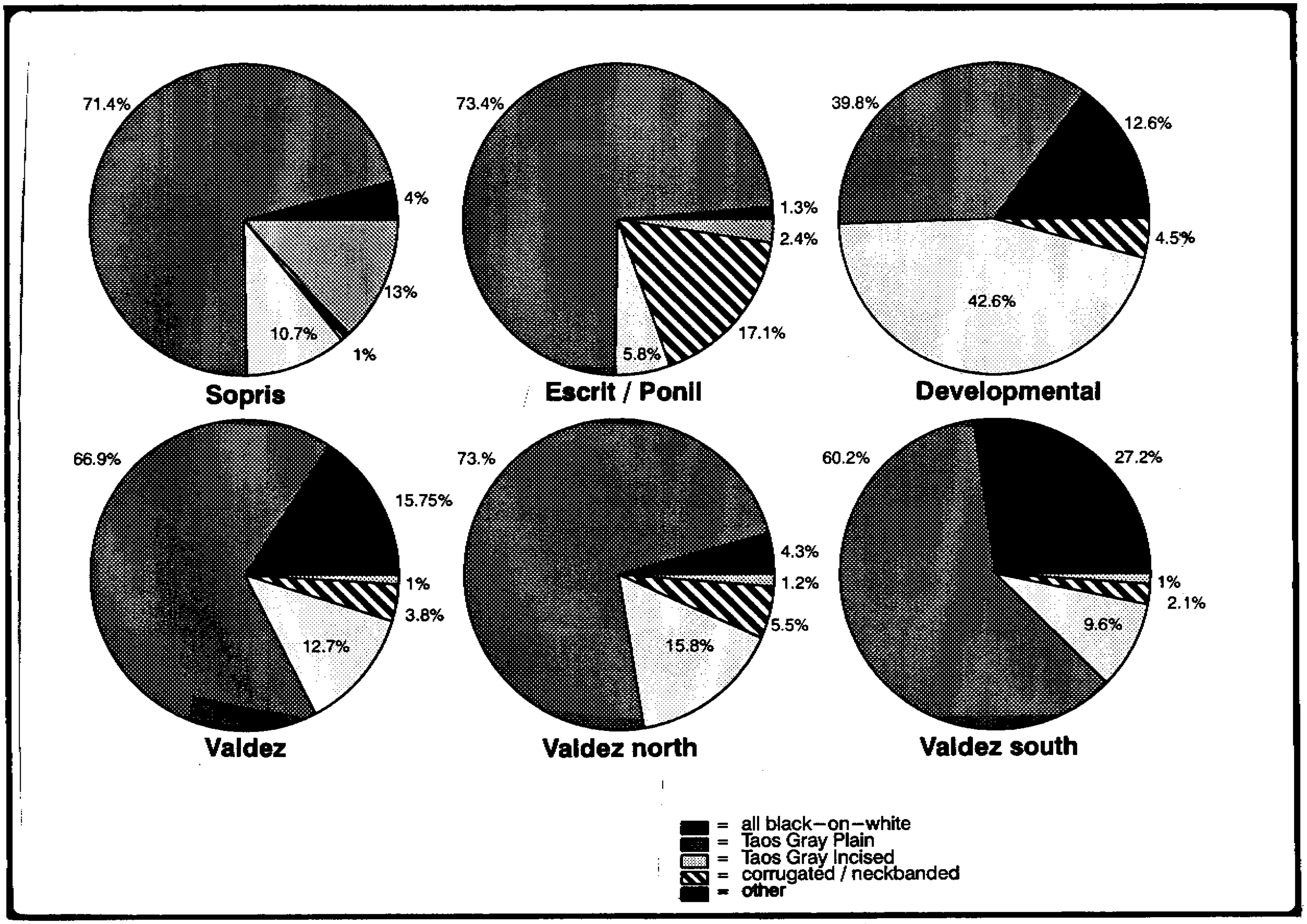


Figure 118. Sopris, Escritores/Ponil, Developmental, and Valdez-phase ceramic types.

It seems likely, then, that the Valdez-phase northern community interacted with peoples living along the eastern mountain margins. The high frequency of painted sherds in the south-community assemblage may argue for relationships to the south, but the rest of the assemblage suggests that most interaction was between the north and south communities. If, as discussed above, the differences between north- and south-community ceramic assemblages reflect specialization in ceramic manufacture, then we may be seeing that the Taos Anasazi were, at least in relation to factors influencing ceramic design styles and frequencies, relatively isolated from the middle Rio Grande Valley and that most interaction during the Valdez phase occurred between the two communities and with the eastern mountain margins.

Continued Contact with the Parent Society

The argument just forwarded supports the expectation that "early" frontier sites will show evidence of isolation and cultural attenuation with respect to the parent or core area. Architectural and settlement data (Occupying the Taos Frontier) show that the Taos district Anasazi used architectural forms in use in the middle Rio Grande before and contemporaneous with the occupation of the Taos Valley. However, settlement data suggest that the Taos district Anasazi initially followed a pattern of dispersed settlement involving smaller social units, consistent with the necessity of adapting to a frontier zone. This contrasts with the middle Rio Grande, where, judging from available evidence, contemporaneous settlements were generally at least twice as large and often much larger, in terms of site size. The dispersed Taos district units were apparently integrated into large, probably informal communities. Comparable communities have not been identified in the middle Rio Grande, primarily due to a relative scarcity of excavated and reported late Developmental-period sites.

Nonetheless, we can see that processes of population aggregation in the middle Rio Grande were creating formal communities occupying pueblos of varying sizes. The same pattern occurred in the Taos district at a later time, apparently beginning in the early A.D. 1200s. The processes by which the Valdez-phase communities formed small, aggregate Pot Creek-phase pueblo communities are not known at this time. We have argued, however, that they may reflect perceived stability on the frontier that encouraged formal communities, in keeping with community structure in the parent or core area.

There is an interesting correlation, not presently understood, between this settlement shift and the appearance of organic painted black-on-white pottery, Santa Fe Black-on-white, in the Taos district. This may suggest a reorientation of frontier community interaction. Above, we observed that ceramic assemblage data indicate that most interaction during the Valdez phase was between the two communities and with the eastern mountain margins. It is important to note that the late Sopris phase apparently ended about A.D. 1225 and that there is little or no evidence for interaction with the Taos district after that time (Wood and Bair 1980). In the Cimarron area, the Ponil phase ended about A.D. 1200 with the appearance of Santa Fe Black-on-white (Glassow 1980; Gunnerson 1987). It appears that interregional interaction from the Taos district swung from a northeast orientation to a southern orientation. This ended Rio Grande interaction with the Trinidad area. In the Cimarron area, Taos Black-on-white was occasionally present in the Cimarron phase (A.D. 1200-1300), but architecture consisted of surface masonry pueblos (Glassow 1980). This suggests that while some interaction continued between the Taos and Cimarron areas, both shifted focus to the south in the early A.D. 1200s century.

These patterns support the expectations that "early" frontier sites will reflect relative isolation and attenuated contact, but later sites will reflect closer ties to regional communication and exchange systems. In the Research Design, we quoted Wells (1973) in saying that the most important forms of communication between the core and frontier zones are economic, political, religious, and prestige. How these are represented by shifts in settlement, architecture, and ceramic style is not clear, since we are only beginning to view regional archaeology in this way. However, the implications for studying Pot Creek-phase sites in this light are significant. Further, these patterns also support our expectation that the frontier will show continuity in architectural tradition, styles of material goods (though not necessarily in raw material), and ceremonial life. This last area has not been investigated at Valdez-phase sites. However, we suggest that it is probably best examined at the level of communities rather than individual households, because structures generally identified as "kivas" occur with formal aggregated communities in the Pot Creek phase. In this light, Crown's (1990) contention that kivas were in use in the Valdez phase has important implications for community religious organization, suggesting that community ceremonial activities took place even when the community consisted of scattered households. This points to continuity in community religious life even under conditions of altered community structure.

Nonproject data suggest greater material diversity at later sites than at early sites, but as the ceramic analysis makes clear, our sample may not be representative of Pot Creek-phase sites. Certainly, it does not represent Talpa-phase sites. Quick perusal of reports from Pot Creek and Talpa components indicates that the expectations hold for ceramics, lithic materials, and other items, but an in-depth review is needed.

On the other hand, our project data provide no obvious evidence of "vertical specialization." It is not clear how that situation would be revealed in the archaeological record in the case of relatively loose regional social and economic integration. That is, this may be an expectation that holds at higher integrative levels, where the core area population maintains some degree of control over resource flow from and into the frontier zone. An example would be Spanish Colonial New Mexico, where governmental and economic forces in New Spain acted to control access by New Mexican colonists to manufactures goods such as metal items, cloth, and arms. The colonists transported raw materials such as sheep, wool, and piñon to the core area and received manufactured items in return. This was a case of officially endorsed and sponsored colonization, and the colonists were intended to remain in contact with and dependent upon the core area. There is no evidence at this time to suggest that such a colonization situation pertained to the Taos district Anasazi. Rather, they seem to have occupied an area previously uninhabited by Anasazi, although occupied by hunter/gatherers, through a process of settlement expansion. Therefore, we may expect that the core area contributed to the expanding population but maintained no great control over it and vertical specialization was not present, or not significantly so.

Conclusions

In this chapter, we have summarized the data gathered during the Pot Creek data recovery project in light of the frontier model presented in the Research Design for the project. In so doing, we have placed our data in larger regional contexts. Comparison of our data and that gathered by other projects in the Taos district with the conditions of a sociocultural frontier as described by historians and geographers indicates that the Taos district was an Anasazi frontier. This is seen in the relatively "sudden" appearance of Anasazi communities in the district and in evidence for spatial and temporal impermanence; the presence of settlement patterns resembling a colonization gradient; the loss of sociocultural complexity; and continued but changing contact with the core area, probably the middle Rio Grande Valley. We can now assess the accuracy of previous models of prehistoric occupation in the Taos district.

Given the conclusions of this project, we can see that the perspective taken by Peckham and Reed (1963) and Herold (1968) is to identify the Taos district Anasazi as a sort of hillbilly population, out of touch and behind the times. To the extent that trends affecting a core area population occur later on the frontier, this is realistic. However, a frontier population is involved in adapting to new environmental conditions, both natural and cultural. As we have seen, change on the frontier is related to perceived levels of stability and will occur at a rate that may be as rapid as or more rapid than in the core area but will happen later than a sequence defined from the core area. That trends may "take longer" to affect a frontier population is related to the population's level of stability and its ability to accommodate the trends with circumstances.

Recognition that a frontier population will follow its own time schedule leads Wetherington (1968:94) to describe the Taos district Anasazi as having their "own evolution while participating in a general Rio Grande pattern." However, Wetherington is not correct in assessing the district as a cultural enclave of "geographically challenged" people that became isolated. Rather, they were isolated from the first but became less so through time. In fact, the data appear to confirm that, through time, the Taos district Anasazi not only participated in "a general Rio Grande pattern," but became more firmly integrated into Rio Grande regional exchange and communication as the frontier population became established. It is not likely that the Taos Anasazi reacted to their isolation by pursuing a distinctive cultural development (Wetherington 1968); rather, that they pursued social and economic stability so that they could participate in regional cultural development. Future research into Pot Creek- and Talpa-phase and Classic-period developments will show how successful they were at reaching regional integration.

Finally, we can see that the perspective taken by Quinn (1980) and Woosley (1980a, 1986) is myopic. Their reactions to concepts of backwater Anasazi lead them to focus so closely on local developments that they lose sight of regional developments. Woosley (1986) has attempted to support this perspective by actually redefining the temporal parameters of the Anasazi sequence. As we have seen, her proposed changes are unsupported by chronometric data, and the settlement sequence she proposes is not supported by her own data. It is true that the Taos district Anasazi were not "a culturally retarded group of people" (Woosley 1980a:21), but it is clear that they did live on the margin of the Anasazi mainstream. Nonetheless, they were integrated with the middle Rio Grande core area, at first rather loosely, but more firmly with time. This is important, since it allows us to study the local developments that Quinn and Woosley are concerned with while relating them to regional trends. The frontier model provides a framework within which local developments and regional integration can be studied and related.

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APPENDIX 2: LA 2742, HUMAN REMAINS INVENTORY

Project No.: 41.442

Project Name: Pot Creek

Site No.: LA 2742

Field Specimen No.: 233

Provenience: 108N/115W; 2.61-2.96 m below datum

Feature: Burial 1

Inventoried: 9-12-91

Sex Estimation: Female

1. Brow ridge - Slight but present
2. Upper edge of orbital - Sharp
3. Posterior zygomatic - Slight extension/not beyond mastoid
4. Mastoid processes - Small
5. Occipital muscle ridges - Small not modeled
6. Chin - Pointed
7. Pelvis - Greater sciatic notch moderately wide
8. Pelvis - Ventral arc with subpubic concavity
9. Pelvis - Subpubic angle moderate to wide
10. Sacrum - Very flat
11. Vertical diameter of humerus head (rt.) - 37.6 mm
12. Vertical diameter of femur head (rt.) - 36.8 mm

Age Estimate: Approximately 45-50 years

1. Complete union of medial epiphyses in clavicles - 23+
2. Pubic symphysis remodeling - 32 to 52 (Gilbert and McKern 1973); 39 to 44 (Todd from Krogman 1962)
3. Sacrum - obliteration of inferior fissures - 31+
4. Slight obliteration of sagital suture and slight lateral bone resorption on cranium - 50+
5. Lacunae developing near humerus head - 41-50 years

Racial Estimate: Mongoloid/American Indian

1. Edge to edge bite/maxillary incisor slightly shoveled
2. Inferior zygomatic projection present

Craniometrics

Maximum cranial length: 175.5 mm
Maximum cranial breadth: 143.0 mm
Basion-bregma height: 125.5 mm
Minimum frontal breadth: 105.0 mm
Total facial height: 108.3 mm
Upper facial height: 65.8 mm
Nasal height: 43.2 mm
Nasal breadth: 23.4 mm
Bizygomatic breadth (facial width): 120.8 mm
Orbital height: left 31.5 mm; right 31.5 mm
Orbital width: left 36.0 mm; right 37.2 mm
Palatal length: 47.2 mm
Palatal breadth: 40.0 mm

Cranial Inventory

Cranium well preserved with approximately half of maxillary dentition present. Excavation impact from pick at left temporal. Nasals are missing and left 2/3 of frontal was fractured and displaced during excavation.

The cranium is complete, with the nasals and parts of the left zygomatic broken but present. All sutures are fused with some obliteration of the posterior sagital. There are segments of wormian bone along the right lamboidal suture and moderate muscle attachment along the occipital protuberance. Only slight evidence of cradle board deformation is present near the parietal occipital juncture displaced to the left side of the posterior cranium. There is slight bossing of the parietals above the temporal line. Seven teeth are present in the maxilla. There appears to be a congenital absence (agenesis) of both canines, as well as the lack of the left first premolar. The right first premolar has erupted through the maxilla near the nasal.

Table 137. LA 2742, burial, maxillary dentition

Tooth	Condition/Comments	Caries/Pits
Left: M3	absent with some tissue resorption/antemortem loss	
M2	present with only slight wear/Y5	
M1	moderate wear	
PM2	absent/socket ephemeral	
PM1	absent/agenesis?	
C	congenital absence (agenesis)/no socket	
I2	absent	
I1	absent	
Right: I1	worn into dentine at labial/lingual angle; only slight shoveling	
I2	worn into dentine at labial/lingual angle	carie on mesial/lingual aspect of neck
C	congenital absence (agenesis)/no socket	
PM1	tooth displaced/erupting through maxilla near nasal	
PM2	erupted with heavy wear/dentine exposed	
M1	moderate wear	large carie on mesial/occlusal aspect
M2	light wear/slight rotation distally	
M3	absent with tissue resorption/antemortem loss	

Mandible

Excellent preservation with some postmortem loss of dentition.

The mandible is wide at the condyles and tapers to a distinctly pointed chin. There was antemortem loss of all molars and the surrounding tissue is completely resorbed, thinning the mandible laterally. The lower jaw is quite thick with well defined muscular attachments. There is a congenital lack of lateral incisors.

Bicondylar width: 117.3 mm
Bigonial width: 98.0 mm
Symphysis height: 33.9 mm
Ascending ramus height: 60.1 mm

Table 138. LA 2742, burial, dentition

Tooth	Condition/Comments	Caries/Pits
Left: M3	absent/tissue resorbed	
M2	absent/tissue resorbed	
M1	absent/tissue resorbed	
PM2	absent	
PM1	absent	
C	absent	
I2	congenital absence/no socket	
I1	absent	
Right: I1	absent	
I2	congenital absence/no socket	
C	incisor morphology/displaced mesially	
PM1	moderate wear	
PM2	moderate wear	
M1	absent/tissue resorbed	
M2	absent/tissue resorbed	
M3	absent/tissue resorbed	

Hyoid

Absent.

Table 139. LA 2742, burial, vertebrae

Vertebra	Condition/Comments	Body	Processes
C1	absent		
C2	absent		
C3	present/separate from burial (108N/113W)	eroded	
C4	absent		
C5	absent		
C6	excellent condition complete		
C7	excellent condition complete		
T1	excellent condition complete		
T2	excellent condition complete		
T3	excellent condition complete		
T4	excellent condition complete		
T5	excellent condition complete		
T6	excellent condition complete		
T7	excellent condition complete	arthritic extension of caudal epiphysis/ right lateral aspect	
T8	excellent condition complete	arthritic extension of cranial epiphysis/ right lateral aspect	
T9	excellent condition complete		
T10	excellent condition complete		
T11	slight erosion of body complete		
T12	slight erosion of body complete		
L1	slight erosion of body complete		
L2	excellent condition complete		
L3	excellent condition complete		
L4	excellent condition complete		
L5	excellent condition complete		

Sacrum

The sacrum is completely fused with all fissures substantially obliterated. Spina bifida occulta is apparent in the dorsal aspects of the first and second sacral vertebrae. A small amount of arthritic bone deposition has occurred on the sacral wings. The element is flattened dorsal/ventrally. There is a lesion present between the first and second vertebral bodies, approximately 15 mm in diameter. When compared to the other postcranial lesions present, this appears to be a neoplasm of similar origin.

Sacral breadth: 106.2 mm
Sacral height: 103.9 mm
Sacral index: 102.21

Sternum

Manubrium and corpus sterni present, xyphoid process missing. A sternal foreman of moderate size is present in corpus sterni.

Scapula

Right fairly complete with coracoid broken off and missing. Postdepositional impact to distal/superior margin and spine. The element is fully fused.

Right scapula breadth: 96.4 mm
Right scapula length: 136.6 mm
Right glenoid cavity length: 31.2 mm

Left fairly complete with anterior acromion process and part of medial border missing. The element is fully fused.

Left scapula breadth: 96.8 mm
Left scapula length: 137.0 mm
Left glenoid cavity length: 31.8 mm
Scapular index: 70.66

Clavicle

Right complete, fully fused with arthritic spur on medial superior diaphysis.

Left complete, fully fused with a possible lesion and erosion at the lateral end.

Rib

Right. One through ten are complete, eleven is missing, and twelve has proximal end only present. They are all in good condition, though some fractured do to ground pressure.

Left. One through eleven are present and twelve is missing. Six of the ribs were fractured postdepositionally but could be refitted. They are in fair condition with some erosion of the distal/sternal ends.

Humerus

Right. The element is in excellent condition. Lacunae are developing near the proximal head.

Maximum length: 282.5 mm
Maximum diameter shaft: 20.5 mm
Minimum diameter shaft: 17.3 mm
Maximum diameter of head: 37.7 mm
Least circumference: 57.5 mm

Left. The element is in excellent condition. Lacunae are present near the epiphyseal line on the proximal head. A lesion approximately 9 mm in diameter is present at the proximal epiphyseal line on the medial aspect of this element. This lesion is similar to that on the sacrum and may be the result of a metastatic carcinoma or a rare occurrence of multiple myeloma.

Maximum length: 281.5 mm
Maximum diameter shaft: 20.5 mm
Minimum diameter shaft: 17.0 mm
Maximum diameter of head: 37.6 mm
Least circumference: 57.1 mm

Age estimate: Formation of lacunae - 41-50 years

Sex estimate: vertical diameter of the humeral head: female = < 43 mm, indeterminate = 44 to 46 mm, male = > 47 mm (Bass 1987:151).

Radius

Right. The element is in excellent condition, completely fused, exhibiting only slight erosion at the proximal end. Muscle attachments are only minimally defined.

Maximum length: 206.2 mm

Left. The element is in excellent condition, completely fused, with only slight erosion at the proximal end. Again, muscle attachments are only minimally defined.

Maximum length: 205.2 mm

Ulna

Right. The element is in excellent condition and completely fused.

Maximum length: 226.2 mm
Least circumference: 33.8 mm

Left. The element is completely fused and in excellent condition. A lesion approximately 8 mm in diameter is present at the proximal/medial epiphyseal junction.

Maximum length: 220.0 mm
Least circumference: 33.0 mm

Innominate

Right. The innominate is in good condition with the pubis broken during discovery but refitted prior to analysis. All epiphyses are fused and the pubic symphysis has a flat face with a complete rim. The anterior surface of the symphysis exhibits some arthritic remodeling. There is a lesion (sarcoma) on the superior aspect of the ilial-pubic border that is approximately 17 mm in diameter. There is another smaller lesion on the superior pubic symphysis (10.5 mm) and two more on the ischial tuberosity (both approximately 6.5 mm in diameter).

Maximum height: 191.5 mm
Maximum breadth: 142.2 mm

Left. The innominate is in excellent condition with only slight impact to the iliac crest and the inferior pubic arch. All epiphyses are fused, and the pubic symphysis is flat with a complete rim (39-44 years). The anterior surface of the symphysis exhibits arthritic remodelling.

Maximum height: 189.5 mm
Maximum breadth: 138.0 mm
Age estimate: 39-44 years

Femur

Right. The element is in excellent condition with only slight erosion at the distal end. Muscle attachments are fairly pronounced. Fusion is complete with lines obliterated.

Circumference, midshaft: 78.2 mm
Maximum length: 392.2 mm

Vertical diameter femur head: 38.3 mm
Anterior/posterior diameter: 27.8 mm
Mediolateral diameter: 20.8 mm
Bicondylar width: 69.1 mm

Left. The element is broken at distal midshaft with some erosion of the distal end. This erosion appears postdepositional subsequent to a large sarcomal lesion (approximately 40 mm by 20 mm) within the anterior/lateral aspect of the distal epiphysis and another possible lesion within the medial distal aspect. These lesions possibly accelerated the erosion of this element.

Circumference, midshaft: 77.0 mm
Maximum length: not possible
Vertical diameter femur head: 38.7 mm
Anterior/posterior diameter: 26.5 mm
Mediolateral diameter: 20.8 mm
Bicondylar width: 68.2 mm

Sex estimate: vertical diameter of the head: female = < 42.5 mm; indeterminate = 43.5 to 44.5 mm; male = > 45.5 mm (Bass 1987:219).

Stature estimate: Mongoloid male (Bass 1987:221): 2.15 x 39.22 cm + 72.57 ± 3.8 = 156.89 cm (-2.5 cm [Genoves 1967]) = 154.39 cm = 5 ft 0.7 in.

Tibia

Right. The element is complete, fully fused, and in excellent condition. There is slight erosion near the proximal end but no observable lesions.

Circumference at nutrient foramen: 84.2 mm
Maximum length: 323.5 mm
Anterior/posterior diameter: 30.0 mm
Mediolateral diameter: 22.4 mm

Left. The element is complete, fully fused, and in excellent condition. There are no observable lesions on this bone.

Circumference at nutrient foramen: 84.0 mm
Maximum length: 324.2 mm
Anterior/posterior diameter: 29.2 mm
Mediolateral diameter: 22.6 mm

Sex estimate: circumference at the nutrient foramen, Arikara Indians: male mean = 98.58 mm; female mean = 83.84 mm.

Stature estimate: Mongoloid male (Bass 1987:238): 2.39 x 32.42 + 81.45 ± 3.27 = 158.93 cm (-2.5 cm. [Genoves 1967]) = 156.43 cm = 5 ft 1.6 in.

Fibula

Right. The element is in excellent condition, completely fused, and not eroded.

Maximum length: 315.2 mm

Left. The element is in excellent condition, fully fused, and not eroded.

Maximum length: 314.5 mm

Patella

Not present.

Bones of the Hand

Carpals. Right navicular present, complete, and in excellent condition.

Metacarpal. Right fifth metatarsal present but separated from the body (FS 214, 108N/113W).

Bones of the Feet

Talus. Right and left present, complete, and not eroded.

Calcaneus. Right and left are present, complete, and not eroded.

Metatarsals. Right second present, complete, and not eroded.
Right fifth present and complete but separated from the body (FS 228, isolated above the burial in 108N/115W). Left fourth present and complete but separated from the burial by rodent activity (FS 228, isolated above the burial in 108N/115W).

Phalanges. One first phalange present, rodent gnawed and found with two metatarsals separated from burial (FS 228, 108N/115W). One second phalange present, complete, and not eroded.

APPENDIX 3: PETROGRAPHIC ANALYSIS OF CERAMICS FROM NEAR FORT BURGWIN, NEW MEXICO

David V. Hill

The petrographic study of ceramics from LA 2742 and LA 70577 focuses on not only the compositional variation observed in the sherds from the two sites, but also the relationship of the ceramic tempers and pastes to the geologic resources that would have been available to prehistoric potters. A sample of twenty-three sherds were first analyzed petrographically. Based on this analysis, two samples of rock and two clay samples were collected near the project sites for comparison with the ceramic sample.

Geologic Resources of the Fort Burgwin Area

The geological overview focuses primarily on the area around Fort Burgwin. As ethnographic studies have shown, traditional potters seldom travel more than two or three miles for obtaining ceramic clay and temper (Arnold 1985). Discussion will also be limited to exposed formations since most subsurface materials would have been inaccessible to prehistoric potters.

The earliest formations in the area are of Precambrian age. In the southern Sangre de Cristo Mountains, Precambrian formations consist of a series of metamorphic crystalline rocks. These rock were later intruded by pink or gray granite and granitic gneiss. Precambrian rocks in the Sangre de Cristo Mountains have been classified into two groups based on their composition. The first is the meta-quartzite group, which includes muscovite-hematite gneiss and granulite, mica quartzite, and sillimanite mica gneiss. The other group consists of quartz biotite schist and gneiss (Clark 1966). Precambrian rocks do not outcrop within several miles of the sites. However, there are abundant Precambrian cobbles in the nearby streams.

The most commonly exposed rocks in the Fort Burgwin area are of Pennsylvanian age. The Pennsylvanian age rocks consist of a complex series of alternating conglomerates, medium to coarse-grained feldspathic sandstone and arkose, shale, and limestone. These complex facies changes were the result of a rapid shifting of deltas associated with the subsidence of the Taos trough and rise of the ancestral Uncompahgre Plateau (Casey and Scott 1979; Lambert 1966). An extensive outcrop of Pennsylvanian rocks in found at U.S. Hill, approximately three miles north of Fort Burgwin.

Overlaying much of the Pennsylvanian rocks in this area is a series of Miocene to Pleistocene deposits known as the Santa Fe group (Clark 1966). A major unit within the

Santa Fe group in this area is the Picuris Tuff (Cabot 1938). The Picuris Tuff is a series of coarse crossbedded conglomerates made up of Tertiary volcanic rocks and Precambrian gneiss, metamorphic rocks and water-laid tuffs. Some of the rocks within the Picuris Tuff have been decomposed through weathering (Lambert 1966). Outcrops of the Picuris Tuff range from green to gray.

Methodology

The ceramic and raw material thin sections were prepared commercially. Analysis of the sherds was performed at the Department of Earth Sciences, New Mexico State University, Las Cruces, New Mexico. Initially, each of the slides was examined to identify any unusual minerals that might be present and to provide data that could be compared with the regional geological literature.

A second phase of analysis consisted of point counting a sample of 300 points for each thin section. The sampling interval was 0.35 mm. All of the inclusions thought to represent temper particles greater than 0.01 mm were measured along their X and Y axis.

Finally, the thin sections were compared with one another to see if their were any similarities in the paste and mineral suites between the sherds that might suggest a common origin. Additions to the narrative descriptions of the thin sections were made at this time.

Samples of clays and possible temper sources were collected in the vicinity of the project area sites after analysis of the ceramic sample. The rock samples were thin sectioned, and if they resembled any of the ceramic tempers they were point counted. Two clay samples were fired to 600 degrees C to examine color, thermal stability, and natural inclusions, and to enhance the samples stability for the thin-sectioning process. Samples of the two clays were also subjected to x-ray diffraction to identify the mineralogy of the smaller silt-sized grains present.

Results of the Ceramic Analysis

The pastes in all of the ceramics were surprising similar. The major difference observed during the analysis was between the gray ware and white ware. While all of the ceramics in the petrographic sample had a similar paste, only the gray wares contained an added tempering agent. The paste in the sherds varied in opacity, and some areas were more translucent than others. The paste in all of the ceramics observed is a uniform gray containing abundant isolated subangular grains of quartz, orthoclase, and rare plagioclase. Occasional small aggregates of quartz with undulose extinction were observed. Another characteristic inclusion in the paste were small black spots. These spots represent fragments of micaceous schist in which the biotite has been completely altered to clay minerals, leaving a black opaque matrix. Occasionally quartz grains with undulose extinction were observed still adhering to the black matrix. Occasional flakes of brown biotite and less altered schist fragments were also seen in the paste of the sherds. Samples FS 76-2 and FS 158-4 contained sparse isolated hornblende and a few small fragments of a fine-grained syenitic rock. The schistose and syenitic rock fragments are probably natural inclusions in the clay used in making the ceramics.

Two sherds, FS 253-46 and 253-52, have a reddish-brown paste. The color difference between these samples and the rest of the sherds probably results from oxidation of the paste due to a greater firing temperature than the other sherds. The inclusions in these two sherds resembles those found in the other ceramics. Sample 253-46 also contained a large rounded grain of a silty sandstone.

Samples FS 253-40, 121-6, 98-1, 110-1, 158-4, 253-26, 121-10, and 252-4 contain opaque yellowish-white siltstone or clay sub-rounded inclusions. These inclusions are probably natural inclusions in the clay used in making the ceramics. Sample 252-14 contains a rounded brownish inclusion that could represent a siltstone grain or possibly a ferric sesquioxide pellet. This latter feature is an accretional structure formed in poorly drained soils and back-swamp deposits as the result of leaching of iron and manganese from the soil environment (Brewer 1969).

The gray ware sherds are tempered using a quartz biotite schist. Brown biotite is abundantly present and strongly foliated. Minerals represented in the rock fragment are predominately quartz with minor amounts of orthoclase. Deformation of the mineral grains has made determination of optical characteristics difficult and often unreliable.

Field Reconnaissance

Two samples of clay and two rock samples were collected near the project area sites. Clay Sample 1 was collected at the Tierra Azul picnic area from modern stream deposits. These streams deposits were formed in part by the weathering of the Picuris Tuff, which outcrops across the highway from the picnic area. Clay Sample 2 was collected from the roadcut at U.S. Hill, approximately 3.7 miles from Fort Burgwin. This clay deposit was located within the Picuris Tuff. The two rock samples were collected from the bed of the Cañoncito del Ojito. Rock Sample 1 is a coarse-grained arkose. Rock Sample 2 is a granite.

Petrographic analysis of Clay Sample 1 after firing displayed a reddish-brown color with small flakes of brown biotite, most of which had been altered to hematite. The clay contains abundant fine-grained minerals and a few large enough to be analyzed petrographically. Inclusions of isolated quartz, orthoclase, and plagioclase grains were observed. Two rock fragments were present; one was syenitic in composition, the other a highly altered basalt.

Clay Sample 2 is a yellowish-white with abundant quartz microlites. The clay contains opaque sub-rounded areas, and the opacity of the whole sample is quite variable. Angular quartz grains make up most of the inclusions large enough for analysis. Occasional rock fragments from a granite or schist were observed.

X-ray diffraction of the mineral inclusions within the two clay samples was preformed at the Analytical Geochemistry Research Laboratory, Department of Earth Sciences, New Mexico State University. The predominate mineral in both samples was quartz. A small amount of calcite was observed in the sample from Tierra Azul.

Rock Sample 1 is an arkose; that is, it is a sedimentary rock containing at least 25 percent feldspar. Quartz is present, displaying both straight and undulose extinction. Orthoclase is the predominate feldspar. The orthoclase grains range from having a fresh appearance to severe sericitization. Occasional books of muscovite are present between mineral grains. Reddish-brown clay minerals fill most of the interstitial spaces between the sub-rounded mineral grains.

Rock Sample 2 is a porphyritic microcline granite. Orthoclase occasionally altered to sericite is contained poikilitically within some of the microcline. Some granophyric texture is also present in the sample. Deformation of the source outcrop has resulted in undulose extinction of the mineral grains. Books of brown biotite are present between many of the mineral grains.

Discussion

It is apparent from this analysis that the use of temper was confined to the Taos gray wares. All of the white ware sherds were made from untempered clay. While neither of the clay samples analyzed during the project contained the black altered schist fragments, both of the samples were as variable in opacity at the sherds and contained abundant fine mineral grains and occasional altered rock fragments. In the case of Clay Sample 1, the reddish brown color, hematitic "spots," and isolated plagioclase grains suggest that the Tierra Azul locality could have served as the source of the paste for FS 253-46 and 253-52. Other outcrops of the Picuris Tuff where clays are available are known from the area around Fort Burgwin (Herbert Dick, personal communication). These other outcrops could have provided the clays used in making the other ceramics.

The temper of the Taos gray ware sherds is apparently a granitic gneiss. Petrographic analysis of the two rock samples collected showed that these two samples did not match the composition of the tempering agent found in the gray ware sherds. Apparently more gneissic granites are available in the area, or gray wares at the project sites represent exchange items.

Petrographic Analysis Point Count Data

Table 140. White ware sherds

FS Number	Paste	Void	Comments
253-52	296	3	Quartz grain 0.06 x 0.04 mm in diameter
253-46	155	-	small sherd N=155
253-38	110	2	small sherd N=112
252-14	119	1	small sherd N=120
76-2	120	0	small sherd N=170
119-3	294	6	silty fragments up to 0.1 mm in diameter
247-2	299	1	silty fragments up to 0.1 mm in diameter
158-4	293	7	gneissic grains up to 1 mm in diameter
110-1	296	4	silty fragments up to 0.4 mm in diameter
98-1	292	8	silty fragments up to 0.1 mm in diameter
252-4	296	4	silty fragments up to 0.4 mm in diameter
253-25	293	7	
253-26	300	0	
253-40	300	0	
200-20	152	3	small sherd N=155
301-13	294	6	
121-10	295	5	isolated altered basalt grain

Table 141. Gray ware sherds

FS Number	Paste	Void	Rock Fragments	Average	Standard Deviation
116-2	264	4	32	0.124	.13
119-23	270	1	29	0.13	.134
305-11	265	6	29	0.096	.077
332-4	265	7	28	0.076	.104