Limited Excavations at LA 83772,

a Multicomponent Site along NM 90, White Signal, Grant County, New Mexico

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LIMITED EXCAVATIONS AT LA 83772, A MULTICOMPONENT SITE ALONG NM 90, WHITE SIGNAL, GRANT COUNTY, NEW MEXICO

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ADMINISTRATIVE SUMMARY

The Office of Archaeological Studies (OAS), Museum of New Mexico, conducted limited excavations at LA 83772 along SR 90 near White Signal, Grant County, New Mexico, in the fall of 1992. The work was requested by the New Mexico State Highway and Transportation Department . The work was authorized by Archaeological Excavation Permit SE-82 and Annual Human Burial Excavation Permit ABE-056, issued by the New Mexico Cultural Properties Review Committee to the Museum of New Mexico.

LA 83772 is a multicomponent Mogollon site on the north terrace of Walnut Canyon, a major stream that issues from the southeastern side of the Big Burro Mountains. At least two components are present at the site, dating to the Early Pithouse period and the Mimbres phase. Most of the OAS excavations took place within the existing highway right-of-way east of NM 90. Minor work was conducted in the existing highway cut immediately west of NM 90.

Excavations uncovered the remains of a pithouse dating to the Early Pithouse period, two human burials of uncertain time period, and small numbers of artifacts.

C. Dean Wilson undertook clay-sourcing and sherd-refiring studies to determine whether the painted and utility pottery types were made at the site and thus whether the inhabitants of LA 83772 were extensions of populations from the Gila or Mimbres River Valleys or whether they were a separate population. The pottery studies indicate that all pottery probably was made in the White Signal area, lending credence to the separate-population hypothesis.

Richard G. Holloway, using pollen spectra, assessed the degree of rodent disturbance (bioturbation) on the excavated deposits. It was noted during the excavations that numerous, highly visible rodent burrows, both active (open) and inactive (backfilled by the rodents), were present. Since rodent disturbance is rarely so clearly demonstrated in archaeological deposits, we had the perfect opportunity to provide a cross-check on laboratory techniques designed to assess degree of disturbance. Holloway's study not only confirmed the severity of disturbance but also elucidated the relative degree of disturbance in different areas of the site.

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NMSHTD Project No. F-012-1(11).
MNM Project No. 41.510.
Cultural Properties Review Committee Excavation Permit No. SE-69, as amended.

The Superintendent

ACKNOWLEDGMENTS

I was assisted in the field by Peter Bullock and Natasha Williamson of the OAS staff. Locally hired labor included Hector Guerra, Patrick Villegas, and, for a short time, Timothy "Jake" Bennett. Jeanne Jones provided night security, and Michael Charles Jones served as "sidewalk superintendent" when not engaged in his ranching chores.

We are particularly indebted to the late Mr. Robert Abercrombie of White Signal for permission to visit and collect artifacts from the Mimbres component of LA 83772 that is on his land (outside the highway right-of-way) and to Brandon Jones for lending his projectile point collection from the site for study.

In the laboratory in Santa Fe, Desiree Downing and Annie Rooney (volunteer) washed the artifacts, and Eden Chipman water-separated the soil samples. Susan Moga identified the faunal materials, and Nancy Akins critiqued the fauna section. Nancy Hunter Warren did her usual fine job of shooting the artifacts and developing and printing the photographs. In the office, Pat McCollum, Delinda Andermann, and Teresa Romero kept the operation running smoothly in spite of various bureaucratic snafus. Rob Turner and Tom Ireland performed the tedious services of drafting, editing, and report production. How they managed to keep their sanity and sense of humor during all of it never ceased to amaze me. And finally, though not insignificantly, I want to thank Steven Lekson and Lynne Sebastian for permitting me to use an early draft of the newest overview on the prehistory and history of southwestern New Mexico.

CONTENTS

Figures

INTRODUCTION

The Office of Archaeological Studies (OAS), Museum of New Mexico, completed excavations at LA 83772 along NM 90 between Silver City and Lordsburg, New Mexico (Fig. 1 and Appendix 1). The team, led by Regge N. Wiseman, who was assisted by Peter Y. Bullock and Natasha Williamson, spent 90 person-days excavating 63 sq m of the site within the proposed highway project area. Most of the work took place east of NM 90, but a few hours were expended on the roadcut to the west. The remains of one possible pit structure, two human interments, and extramural refuse were uncovered. The work was accomplished from October 5 through November 2, 1992.

Two features designated for investigation in the data recovery plan (Wiseman 1991) were not excavated. The bottom remnant of a burned-rock-filled pit was found to consist of a few rock fragments lacking charcoal or other cultural fill among or below them, indicating the rest of the feature had been removed in during previous construction. The second feature, a hearth on the undisturbed surface north of the burned-rock-filled pit, is just outside the proposed highway project area and will be protected by fencing during the highway work.

LA 83772 is a multicomponent Mimbres-Mogollon site on the north bank of Walnut Creek at White Signal, New Mexico (Fig. 2). The portion of the site excavated during the project reported here was too small to confirm the cultural sequence it represents. Thus, the original description of the site still stands: both the Pithouse and Mimbres periods are present, but we still are not certain if both the Early and the Late Pithouse periods are represented.

The site lies within and west of the existing highway right-of-way. A US West Communications trench immediately east of the east right-of-way fence revealed no surface or subsurface cultural remains. Overall, the site is 130 m north-south by 75 m east-west, or 9,750 sq m.

The Mimbres component consists of two *cimiento* pueblos (groups of rooms with cobble foundations and walls of perishable materials) just west of the existing highway right-of-way. The larger, southern pueblo has an estimated six to ten rooms, all of which have been intensively dug over the past few decades (Fig. 3). The smaller, northern pueblo has two rooms that have been disturbed slightly by diggers.

The Pithouse period remains are documented by the OAS excavations described here and by one of the individuals who dug in and beneath the south pueblo. Current data suggest that Pithouse period pithouses and associated refuse underlie the south pueblo of the Mimbres component and extend as far east as the east fence of the highway right-of-way (Fig. 4).

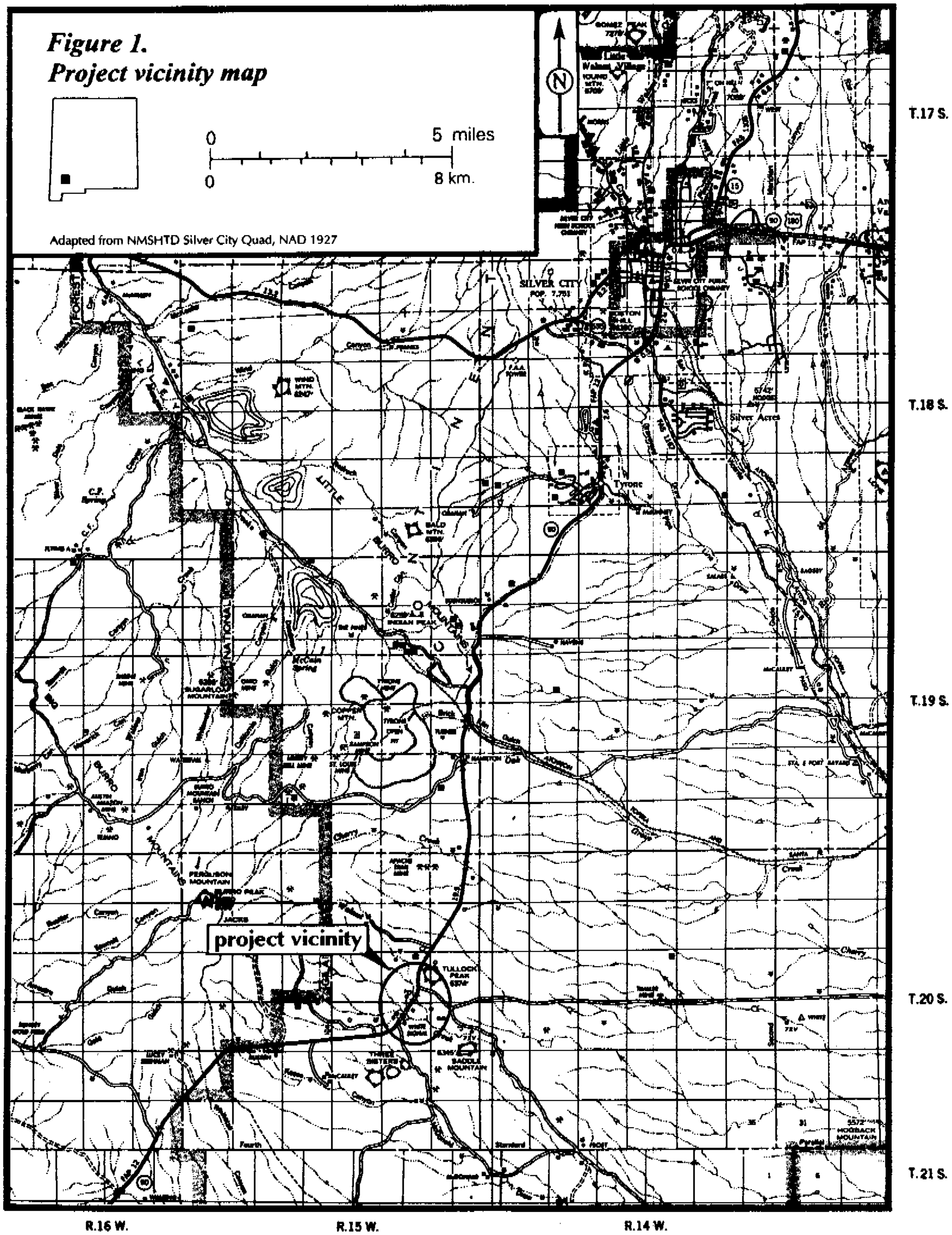
Figure 1.
Project vicinity map
0
5 miles
0
8 km.
Adapted from NMSHTD Silver City Quad, NAD 1927
N
SILVER CITY
Silver Acres
project vicinity
T.17 S.
T.18 S.
T.19 S.
T.20 S.
T.21 S.
R.16 W.
R.15 W.
R.14 W.

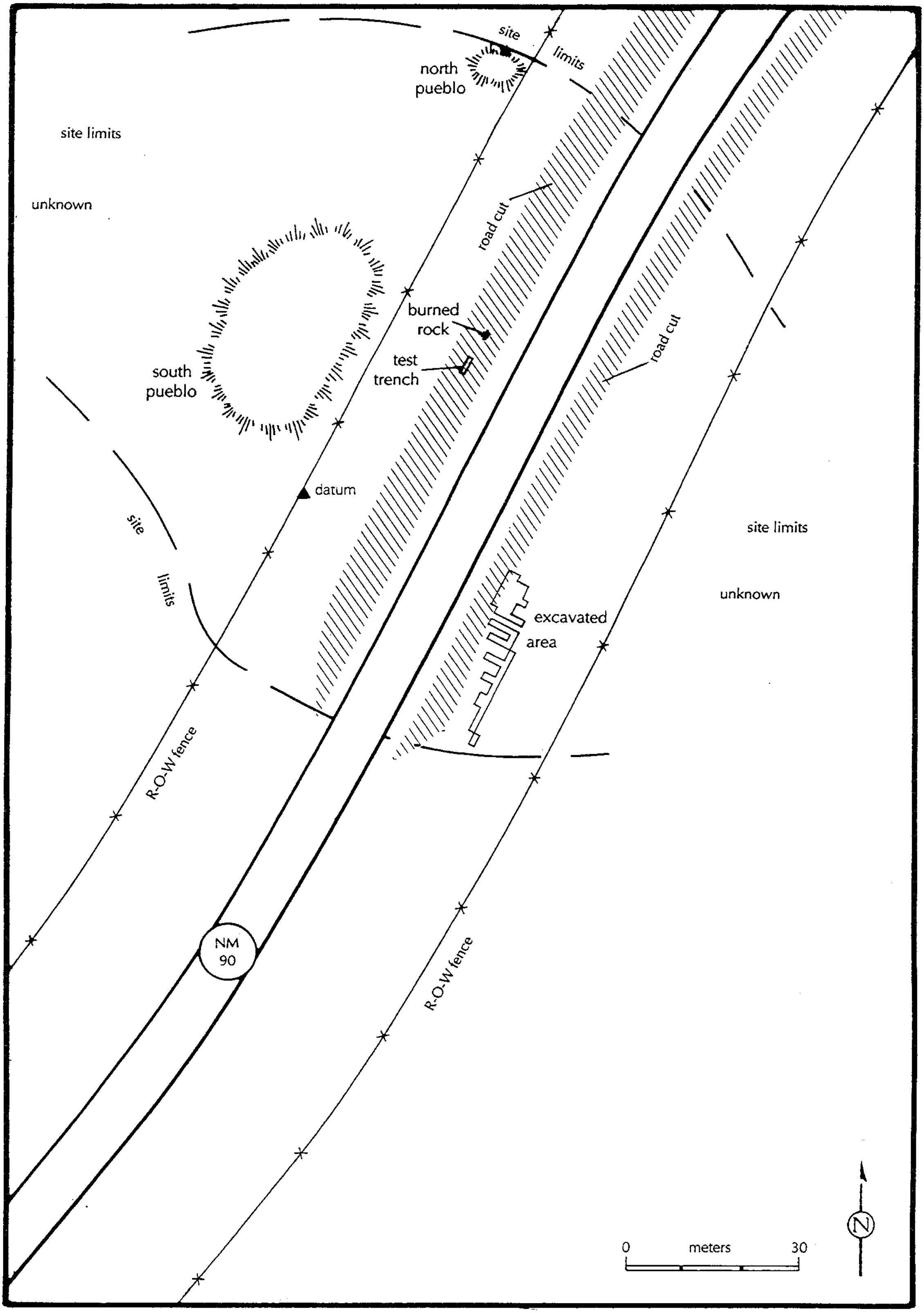

Figure 2. LA 83772 site map.

Figure 3. Mimbres component, west of highway (private land), looking southeast.

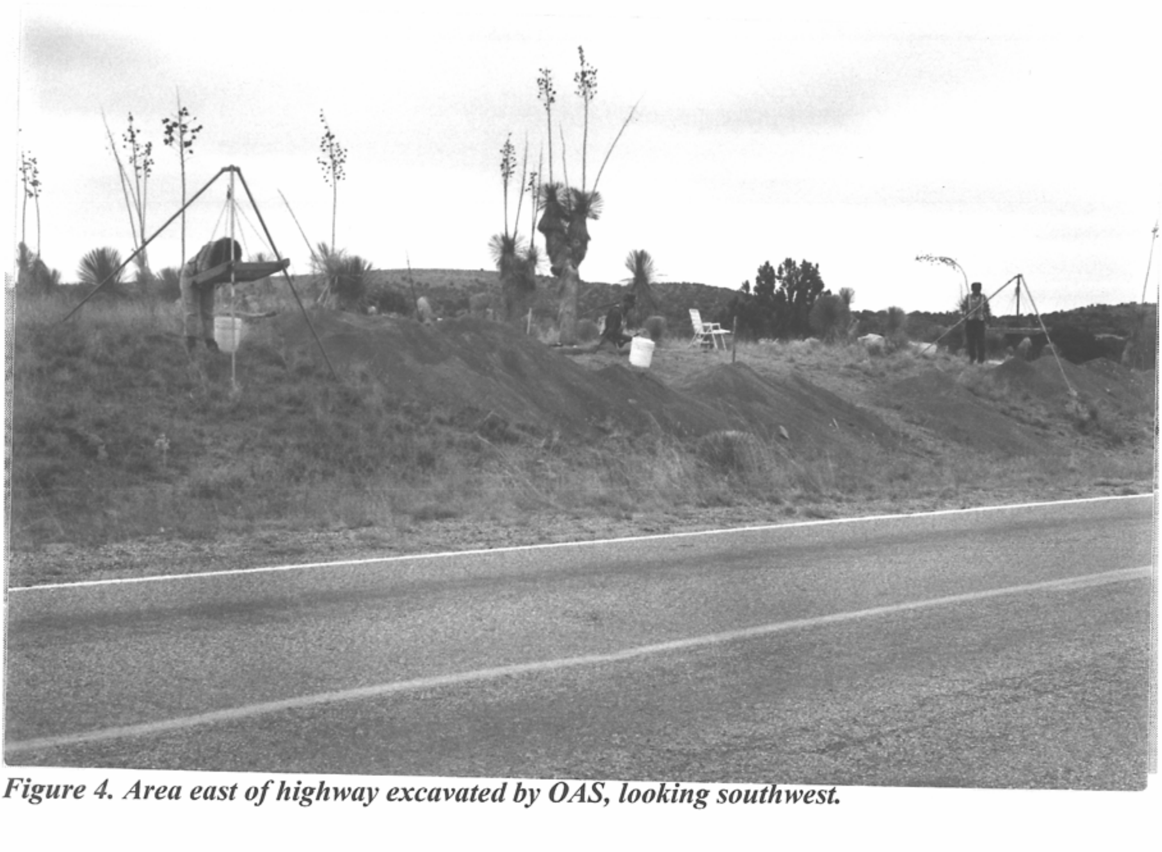

Figure 4. Area east of highway excavated by OAS, looking southwest.

NATURAL SETTING

The project area is on the east terrace above Walnut Creek in White Signal, New Mexico. Walnut Creek is a major tributary of Cow Springs Draw, an intermittent, southeast-trending drainage that empties into the Deming Plain southwest of Deming, New Mexico. White Signal is in the eastern foothills of the Big Burro Mountains. Elevations range from 1,830 m at the sites, to 2,440 m at the top of the Big Burro Mountains (7.5 km northwest), to 1,370 m where Cow Springs Draw enters the Deming Plain 50 km southeast of White Signal.

Winters in the project area are mild (January mean of 3.3 degrees C), and summers are warm (July mean of 23.3 degrees C) (Gabin and Lesperance 1977). The frost-free period is long, averaging 200 days (Tuan et al. 1973). The normal annual precipitation of 356 mm is slightly summer dominant (U.S. Department of Commerce 1967).

The surface geology of the area includes Precambrian rocks (undivided), various igneous intrusives (laccoliths, dikes, and sills) of Late Cretaceous to Miocene (?) age, and the Gila Conglomerate (Quaternary) (Dane and Bachman 1965). White Signal began as a mining settlement in the White Signal District, where gold, silver, and other minerals were mined in the late 1800s (Northrup 1959).

The project sites lie within the juniper-piñon woodland not far from the pine–Douglas fir forest (Kuchler 1964). The association is dominated by one-seed juniper and piñon pine. Walnut Creek supports a riparian community dominated by cottonwood and walnut trees. Plants noted on the archaeological sites include grama grass, oak, prickly pear, yucca, squawbush, and a single alligator juniper.

Numerous species of animals useful to humans were common in the area in prehistoric times, including deer, pronghorn, mountain lion, bear, peccary (javelina), jackrabbit, cottontail, squirrels, and a variety of woodrats, rats, and mice (Findley and others 1975).

CULTURAL SETTING

The project area lies within the Mimbres-Mogollon culture area. Since several archaeological overviews have been written about this part of New Mexico, the reader is referred to them for more details of the prehistory and history of the area (Haury 1936b; Wheat 1955; Danson 1957; Bullard 1962; LeBlanc and Whalen 1980; Stuart and Gauthier 1981; Fitting et al. 1982; and Wilson 1985).

People have been attracted to the wealth of natural resources of the Silver City region for at least the last 12,000 years. The earliest people, called Paleo-Indians, followed a hunting and gathering lifeway that relied to some extent on now extinct forms of elephants and buffalo.

The retreat of the glaciers about 8,000 years ago brought an end to the Pleistocene and resulted in a general climatic warming. In adjusting to the increasing aridity and the disappearance of the large Pleistocene animals, the Native Americans turned to smaller animal forms such as deer and rabbits and began incorporating a larger share of plant foods in their diet. Several stages have been identified in what is called the Archaic Cochise culture. At some point late in the Archaic period, maize horticulture and the building of semipermanent houses were introduced. The stage was set for the Mogollon period.

The Mogollon period or culture, starting some time in the first few centuries A.D., is characterized by the formation of villages. The first villages were usually small and located on high terrain well back from rivers and streams. Pithouses were the primary habitation structure, production and use of pottery began, and the economy was based on hunting and gathering supplemented by horticulture of maize, beans, and squash. However, there seems to have been little change in the form and function of most tool categories. Through time, village size and dependence on cultivated plants increased, and village locations shifted closer and closer to drainage courses.

Shifts in various aspects of the cultural configuration of the early Mogollon have been denoted by a series of period and phase names as follows: Early Pithouse period, including the Pinelawn (A.D. 250 to 550?) and Georgetown (A.D. 550 to 650?) phases; and the Late Pithouse period, composed of the San Francisco (A.D. 650 to 850?) and Three Circle (A.D. 850 to 975 or 1000) phases. Some scholars believe that sufficient evidence exists to designate a fifth phase, the Mangus, the last phase of the Late Pithouse period (cf. Lekson 1989:F-48-56).

The final phase in the Mogollon sequence of southwestern New Mexico is called Mimbres (A.D. 975 to 1150?). While many aspects of this phase are continuations of previous trends, three changes have caught the imagination of archaeologists and lay people alike. These are: (1) the shift to above-ground dwellings (jacal and cobble pueblo-style rooms); (2) the formation of very large villages; and (3) the production of exquisitely painted pottery. The abandonment of the Mimbres villages and the disappearance of the Mogollon culture are the subject of much debate.

The Animas or Black Mountain phase (A.D. 1150 or 1175 to 1375 or 1400?) followed the Mogollon. These sites are denoted by small to large adobe-walled pueblos, distinctive polychrome pottery, and an agricultural economy. Many archaeologists believe that the Animas peoples were directly connected with, and perhaps colonies of, the Casas Grandes culture area in northern Mexico (McCluney 1962:40). Other archaeologists believe that Animas sites are merely a continuation of the Mimbres-Mogollon occupation with a change in the pottery suite (Lekson 1989).

The Salado or Cliff phase (A.D. 1300? to 1450?) occupation may have overlapped the Animas phase settlements in time. These sites are denoted by another series of distinctive polychrome pottery types, small to large adobe-walled pueblo villages, an agricultural economy, and a propensity for cremation of the dead. The geographic center of the Salado stretches from the Gila River west well into Arizona.

Although the end dates of the Animas and Salado occupations are not well established, prehistoric occupation of southwestern New Mexico appears to have terminated by A.D. 1400 or 1450. Human use of the region between then and A.D. 1500 has not been documented.

By A. D. 1500 or shortly thereafter, Apachean groups entered southwestern New Mexico, where they hunted and gathered for about 300 years. Spanish settlement in northern Mexico, New Mexico, and Arizona brought the two groups in contact starting in the late seventeenth and early eighteenth centuries. Relations between the Apaches and the Spaniards ranged from friendly to hostile. In the eighteenth century, numerous Spanish punitive expeditions penetrated southwestern New Mexico in pursuit of Apache raiders. Problems between the two groups increased with the discovery of the Santa Rita copper ore in the early nineteenth century. Spanish attempts to settle the area to mine the copper intensified Apache hatred because the Europeans settled in the heart of Apache country.

Anglo-American acquisition of Texas, New Mexico, Arizona, and California in the mid-nineteenth century brought these peoples into contact, and ultimately into conflict, with the Apaches. The lure of mineral wealth, grasslands for ranching, and good farmland brought a flood of settlers following the American Civil War. By the late 1880s, the Apaches were defeated and placed on reservations, leaving the Anglo-Americans in peaceful possession of southwestern New Mexico.

QUESTIONS POSED IN THE DATA RECOVERY PLAN

The following discussions and questions, presented in Wiseman (1991), are included here in their entirety.

Background

Two areas of LA 83772 require further treatment. We are not certain about the age of either area. The structure exposed in the existing face of the west highway cut could belong to the Pithouse period, or, given that it is immediately east of the south pueblo, it may be a ceremonial structure of the Mimbres phase. This pattern is common in the Anasazi Culture in the Four Corners region, but it has only recently been proposed for the Mimbres-Mogollon (pers. comm., S. Lekson, 1991).

The features located at the south end of the site and east of the highway may belong to the Early Pithouse period. If so, they represent some of the earliest pottery period remains known in the Mimbres-Mogollon region. Because of these uncertainties, this data recovery plan discusses problems and approaches for both the Early Pithouse period and the Mimbres phase. Lekson's draft overview (1989), the most recent statement on the prehistory of southwestern New Mexico, is the primary document followed here.

Early Pithouse Period

We know less about the Early Pithouse period than any other prehistoric pottery period in southwestern New Mexico (Lekson 1989:F-38ff). For one thing, Early Pithouse period remains are difficult to recognize because archaeologists have tended to concentrate on the large, late, multicomponent, Mimbres phase sites in the Mimbres Valley. Later occupants of sites tended to dispose of trash in low places, such as the depressions of earlier structures. This misleads archaeologists into believing that such structures are later because of the late pottery assemblages. Second, some archaeologists, in discussing settlement patterns, categorically state that Early Pithouse period sites are found on high mesas set back from streams and not on terrace edges overlooking arable land. Thus, Early Pithouse period sites are not sought, or found, on terraces. Third, Early Pithouse sites can be difficult to recognize, especially when surface depressions, signifying the presence of pithouses, are absent. By appearing to be simple sherd scatters, such sites are easily mistaken for limited-activity rather than habitation sites.

We know that Early Pithouse habitation sites have pithouses of variable sizes, shapes, and interior features (such as the numbers and placement of storage pits, roof-support postholes, and hearths), but we do not know if significant patterns are present for the reasons enumerated above. We know that subsistence remains included cultigens, wild animals, and wild plants, and that the relative contributions of each resource to the diet shifted through time. However, we do not know how important each component (collected versus cultivated) was to the overall diet at any given time, nor specifically when and why the shifts in emphasis took place.

One of Lekson's (1989) more provocative ideas is that the Mimbres-Mogollon people of the Early and Late Pithouse periods had a seasonal subsistence round, even though they built pithouses in the Mimbres country. He believes the seasonal round involved large territories, and that the

Mogollons, like the later Apaches, spent the summer and fall in the Mimbres area and went south well into Mexico for the winter. In Mexico, they subsisted on wild plants and hunted animals into the spring. They would move back north to southwestern New Mexico in time for planting.

However, when the Casas Grandes Culture and its attendant high population density arose, the Mexican region was denied to the Mogollons. Then, hypothesizes Lekson, storable cultigens grown by means of ditch irrigation in the Mimbres country became the dominant food source, permitting or causing the Mogollons to reside year round in southwestern New Mexico. This series of events set the stage for the development of the Mimbres phase, with its pueblo-style buildings, irrigation agriculture, and exquisite pottery.

The key to solving these problems of the Early Pithouse period and investigating the first part of Lekson's hypothesis is the accurate identification of sites; sampling, excavation, and collection of the floral and faunal materials; obtaining good dates; and looking for evidence of seasonal occupation. Single-component sites and multicomponent sites in which the early components lie away from the later components are the best for these investigations.

Mimbres Phase

Our current understanding of the Mimbres Phase comes mainly from the excavation of several large sites along the Mimbres River and its tributaries. Minor investigations have also taken place at Mimbres sites in the Rio Grande and Gila River Valleys. With few exceptions, the investigated sites are multicomponent, usually having remains that both predate and postdate the Mimbres phase. This presents a number of problems, a primary example being that, until lately, archaeologists believed that sites of 50 or more rooms are the typical Mimbres village. Yet, surveys (Lekson 1989) have shown that small sites (10 to 20 rooms) are far more common and therefore more typical of Mimbres phase village sizes. Additionally, since the Mimbres people frequently built their sites along small drainages, our understanding of their culture is incomplete until we study these sites.

The study of small Mimbres sites on minor drainages is important on several analytical levels. On the regional level, Lekson (1989:E-20) asserts that the Mimbres built villages on the smaller drainages late in the Mimbres phase to relieve population pressures in the more central areas. It should be mentioned in this context that certain cultural developments did not occur at the same time in both the large drainages and the small drainages.

On the individual settlement level, one aspect of small Mimbres sites is a combination roomblock and "pit structure." The small pueblos have long been recognized, but the interpretation of square pit structures as possible ceremonial structures or "kivas" is relatively new (pers. comm., S. Lekson, 1991). This situation is due mainly to the nature of large, multicomponent Mimbres sites, where structures of different components are usually interspersed, even superimposed on one another. Lacking sufficient temporal control, contemporaneity of structures is difficult or impossible to establish. However, small sites like the Dinwiddie site (LA 6783; Hammack et al. 1966) and possibly LA 83772 are simpler in internal layout and allow easier recognition of contemporary structures. Thus, they can provide the opportunity to investigate remains that belong to discrete occupations.

The shift of habitations to the small drainages has implications for the subsistence base. Most scholars agree that hunting and gathering, supplemented by gardening, provided the mainstay of the Pithouse period diet. Although authorities do not agree as to when the shift to heavier reliance on cultigens took place, all seem to agree that it had occurred by the beginning of the Mimbres phase. Lekson (1989:F-90) further believes that ditch irrigation was an integral part of Mimbres agriculture. Did those Mimbres people who moved to small drainages change their agricultural practices or shift back to a greater reliance on wild plant and animal foods? As discussed above for the Pithouse period, we are talking about differences of degree rather than of kind. To get the answers, we must attempt to make accurate determinations of relative importance of hunted and gathered foods versus agricultural products to the Mimbres diet.

M. Nelson (1984) has provided one of the more novel attempts to assess the question of relative importance of wild versus domestic foods through her analysis of chipped lithic debris for the Mimbres Foundation. She monitored material types, cortex, flake size, edge angles, retouch, and frequency of biface thinning flakes. These attributes, and her assumptions about how they permit differentiation of plant-related from animal-related activities, are provocative and merit testing on new data.

Data Recovery Questions and Data Requirements

We were not certain at the time we wrote the data recovery plan which of the Mimbres-Mogollon phases are represented in the two areas of LA 83772 to be treated. Therefore, we outlined and discussed questions and data requirements pertinent to those cultural periods most likely represented: Early Pithouse period and Mimbres phase. It should be understood that these questions could be addressed only if remains of the appropriate time periods were recovered. For instance, if the pit structure exposed in the west roadcut dates to the Pithouse period, we will be unable to address the questions posed for the Mimbres phase.

Early Pithouse Period

(1) What are the structures, other features, and artifactual remains of an Early Pithouse period site?

Few sherds dating later than the Early Pithouse period were recovered from east of the highway at LA 83772, so it is likely that the buried features at the south end of the east side of the site belong to the Early Pithouse period. The situation approximates the expectations for a single-component site, rendering the opportunity to look at this early time period in a more or less pure context. This is especially important because LA 83772 is on a terrace, a circumstance that contrasts with the current view that early sites occur only on high elevations set back from drainages.

Data collection will include the thorough documentation of all features and artifactual remains associated with an Early Pithouse period site. Structures, extramural pits, hearths, and associated remains within the proposed highway improvement areas will be located, excavated, recorded, and photographed. Artifacts, datable materials (C-14 samples, tree-ring specimens, etc.), sediment samples (for recovery of floral materials), and other cultural and natural items and data will be collected and analyzed to confirm the proper cultural and temporal placement of the remains and to document the activities carried on in this area of the site.

(2) What foods were eaten by the Early Pithouse period people? Were wild plant and animal foods eaten, and if so, what species? Were domesticated plants eaten? What proportions of wild to

domesticated species were consumed? What proportions of plant to animal foods were eaten?

The data collection will include the systematic collection of faunal remains, floral remains, sediment samples, and artifacts from the excavations. Microremains (including pollen) will be extracted from sediment samples. The floral and faunal analyses will focus on species identification, the relative proportions of species, and the documentation of residues obtained from the surfaces of artifacts, especially the grinding stones. We will also look at the ratios of artifact classes (grinding stones to hunting paraphernalia, for instance).

For a variety of reasons, dietary mixes cannot be derived from simple, direct comparison of ratios of plant species or of animal species or of artifact classes. Instead, we will have to make *qualitative* estimates based on the data at hand, comparison with samples reported in the literature, taphonomic considerations, and experience of the specialists. If human remains are recovered and the requisite consultations permit such studies, isotope (C12/C13, N14/N15, and Sr) and pathology studies will be conducted to determine the subsistence mix and general health of the population.

(3) Do the Early Pithouse period habitation sites reflect seasonal occupations?

This question relates directly to the idea that Early Pithouse period subsistence was based primarily on hunting and gathering supplemented by limited agriculture. We will seek evidence of seasonal occupation among the subsistence data (both plant and animal remains). While it is sometimes possible to find evidence of occupation during a specific season (like the presence of fetal, newborn, or juvenile animals), it is usually difficult or impossible to show that the other seasons were not also represented.

In cultural remains from the Early Pithouse period, we should find warm-weather indicators (wild and domestic plants indicative of the growing and harvesting seasons) and a clear absence of winter and early spring indicators (such as animals killed during these periods). Such evidence would support Lekson's (1989) postulation of occupation during the summer and fall months and open the possibility that the people lived elsewhere during the cold season. Lekson postulates that the people moved south into northern Mexico, where they could take advantage of perennial food species such as cacti, agave, and sotol during the cold months.

We sometimes get evidence that is tangential to but may inform upon seasonality question as discussed here. One example is the finding of several superimposed floors in the same room, where each floor was riddled by rodent activity. The rodent burrows were then plugged with rocks and chunks of adobe before the next floor was laid and new hearths were constructed (Wiseman 1980:135-137). Another possibility is pottery. Although early Mexican (pre-polychrome) pottery types such as those described by DiPeso et al. (1974) have not yet been recovered in early Mogollon sites in southwestern New Mexico (cf. Anyon and LeBlanc 1984), we must be aware of the possibility. Their presence would demonstrate contacts between the two regions and strengthen the connection proposed by Lekson. Thus, we will seek any and all lines of evidence that will provide perspective on the nature of the LA 83772 occupations. By combining several lines of evidence, we gain confidence in our interpretations.

Mimbres Phase

(1) Is the pit structure exposed in the west face of the highway cut a ceremonial structure? How does it compare with structures believed to be ceremonial structures at the Dinwiddie site

(LA 6783; Hammack, et al. 1966).

Kivas or ceremonial structures in Anasazi sites have long been identified on the basis of placement in the village, shape, and distinctive floor and wall features (but see Lekson 1988 and Wilshusen 1989 for recent divergent opinions on this matter). Such easily identified structures are generally lacking in the Mogollon area except for the category of large or great kivas. In his review and discussion, Smith (1952) finds this problem is common to most southwestern cultures. He concludes that ceremonial structures may be defined on the basis of any, some, or all criteria including placement with respect to other structures at the site, size, shape, and interior features.

In effect, the definition of a ceremonial structure is largely judgmental. We intend to follow Smith's wisdom in assessing the structure at LA 83772. Since we will not be excavating Mimbres surface rooms on this project, we will have to glean comparative data from published sources to render an opinion on the matter.

Data collection will include architectural details, floor contact artifacts, and sediment samples from the floor features and floor contact situations. The sediment samples will provide pollen and other plant remains that, if of a ceremonial or healing nature, can be indicative of these uses, especially if found in quantity. Architectural plans, artifacts, and possibly pollen samples from the Dinwiddie site are available for study at the Museum of New Mexico.

(2) What foods were eaten by the Mimbres people? What species of wild plants, domesticated plants, and animals were eaten? What proportions of wild to domesticated species were consumed? What proportions of plant to animal foods were eaten?

The data requirements include the systematic collection of faunal remains, floral remains, sediment samples, and artifacts from the excavations. Microremains (including pollen) will be extracted from the sediment samples. Analysis of these materials will focus on species identification, the relative proportions of species, and the documentation of residues obtained from the surfaces of artifacts (especially from grinding stones). If corn remains are found in quantity, specialists will examine the growth characteristics (size, degree of homogeneity, etc.) to assess whether the plants were irrigated. We will also look at the ratios of certain artifact classes (grinding stones to hunting paraphernalia, for instance) as rough indices to the relative importance of these activities. If human remains are recovered and if consultations permit, isotope ($C12/C13$, $N14/N15$, Sr) and pathology studies will be undertaken to estimate the subsistence mix and general health of the population.

(3) Did the people of LA 83772 come from, or in some way belong to, the populations of the large river systems (the Gila, for instance)?

Data requirements include samples of pottery and lithic materials. Other materials and items found in the excavations will be evaluated for their potential applicability to the question. Clay collection trips will be made to the site area and to the Mimbres and the Gila valleys to obtain comparative materials. Pottery temper and designs will be compared to samples from other areas, especially the Gila and Mimbres river systems to establish the degree of similarity. Where possible, lithic materials from White Signal will be related to source areas. Collections housed at the Museum of New Mexico, the existing literature, and information gained from consultations with replicative potters like Paul and Laurel Thornberg will be used in this comparative study.

(4) How old are the remains at LA 83772?

Data requirements include recovery of datable materials such as tree-ring specimens, radiocarbon samples, and archaeomagnetic samples. Since cultural and social developments in the Mimbres region did not occur simultaneously across the region (Lekson 1989), it is necessary to obtain good dates to investigate why, where, and when the changes took place. Examples of nonsynchronous cultural developments include: (1) the shift from pithouses to pueblos as the main habitation form; (2) the manufacture dates of all painted pottery types, to establish which are sequential and which are contemporary; and (3) population shifts from one valley to another and back at different points in time.

(5) Was the occupation at LA 83772 seasonal, and if so, what season(s)?

Archaeological data that can provide information on seasonality include remains of fetal, newborn, and young mammals animals; the annular rings of fish scales and freshwater mollusc shells; migratory waterfowl; flowering parts of plants; and certain annual plant species that have woody (lignified) parts. Although these indicators are occasionally found in sites, interpretation of seasonality is usually ambiguous for a variety of reasons, including the fact that seasonal data are not sufficiently discrete. Again, careful weighing of the evidence is a necessary aspect of the process. The trick is to find sites that produce seasonal data restricted to one or two discrete seasons. These situations are rare (Toll 1983).

Although we do not anticipate finding restricted seasonal data at LA 873772, we will monitor for it. If seasonal data are found, we will compare and contrast them with the expectations implied by Lekson (1989), as follows: For the Mimbres phase, we will need to find evidence of the winter and spring seasons to demonstrate occupation during cold weather. Winter and especially spring indicators include fetal and new-born animals of species that normally bear young in the winter and spring months and plants that have been documented as being spring foods of ethnographic groups. Winter/spring indicators will support an interpretation of year round occupation in the region and lend confidence to Lekson's model, assuming, of course, that summer/fall indicators such as agricultural products and late maturing plant species are also present.

The location and extent of the excavations were conditioned by the highway project needs. Most of the work took place in a triangular sector within the right-of-way and immediately east of the existing blacktop. This sector was 30 m north-south by 8 m east-west (Figs. 5 and 6). West of the blacktop, excavations were restricted to the existing highway cut, where several possible features were exposed.

Figure 5. Excavations in progress east of highway, looking south southeast.

Excavations were conducted in 1 by 1 m squares and 20 cm levels. Most work was accomplished with small picks and shovels, but trowels were frequently used to investigate possible cultural features and straighten the sides and bottoms of the excavations. All fill was screened through quarter-inch wire mesh.

The human interments were exposed using trowels, dental picks, and brushes. All fill surrounding the burials was screened through eighth-inch wire mesh.

The floor fill (3 to 5 cm of fill resting on the floor) of the possible pit structure was excavated by trowel. All fill was screened through quarter-inch mesh.

Three four-sample columns of flotation samples and a pollen sample were taken from selected points in the excavation. The work was documented using standard Museum of New Mexico forms and 35 mm photography.

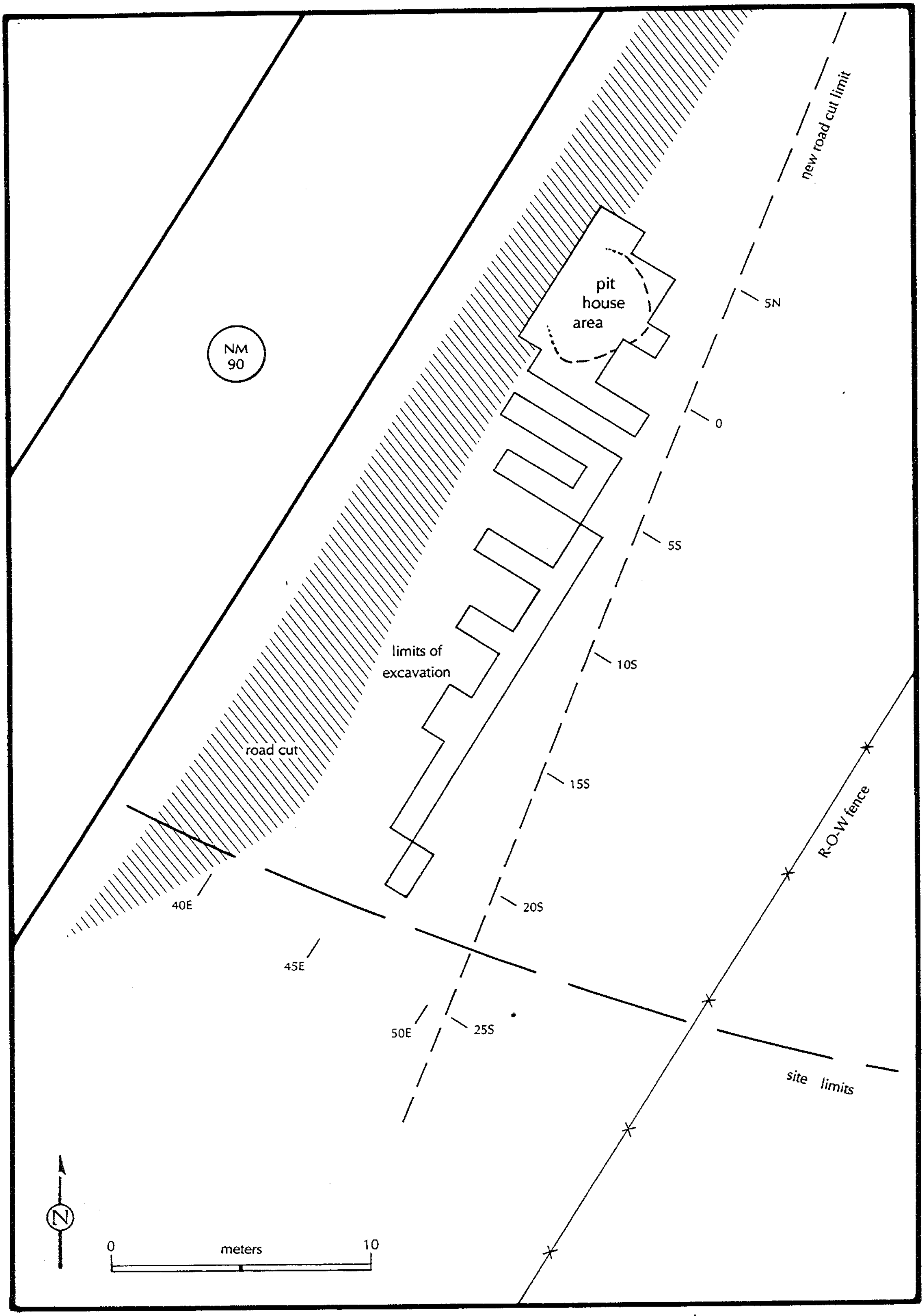

Figure 6. Plan of excavations east of the highway.

Severe rodent disturbance was noticed early in the excavations (Fig. 7). The destruction to stratigraphy, cultural features, and interments was the worst ever observed by team members. While a pit structure was found east of the highway, so little remained that we could not describe or measure its shape, floor, walls, and internal features.

Figure 7. Profile along Line 45E between 16S and 20S, showing severity of rodent disturbance. Looking southwest.

With the exception of a rock concentration and a few small pockets of darker, less-disturbed fill, the cultural fill was a homogeneous, fine-grained, medium-gray soil. Numerous rodent burrows, many still open and others backfilled by the rodents themselves, were evident everywhere. The underlying, lighter-colored, culturally sterile soil was also penetrated by rodents. The demarcation between the cultural and natural layers was basically destroyed at the level of the original contact, resulting in a highly convoluted, difficult-to-follow line of demarcation perhaps as much as 25 to 50 cm lower than had originally been the case (Fig. 8). This undoubtedly resulted in complete destruction of some cultural features and made the identification of others difficult.

Thirty-four rocks were roughly grouped along the west side of the main excavation in squares 0N/40E, 1N/40E, 2N/40E, and 3N/40E (Fig. 9). At this location, next to the original highway cut and just above floor level of the pithouse, the rodent burrowing was so severe that we could not work out the relationship of the rock cluster to the pithouse or to the original ground surface. The rocks appeared to have been redeposited from some other part of the site, probably as a single event. The smallest rocks were fist-sized, and the largest was 50 cm long and 25 cm wide. Six metate fragments, one mano fragment, and a core were present in the concentration. All other

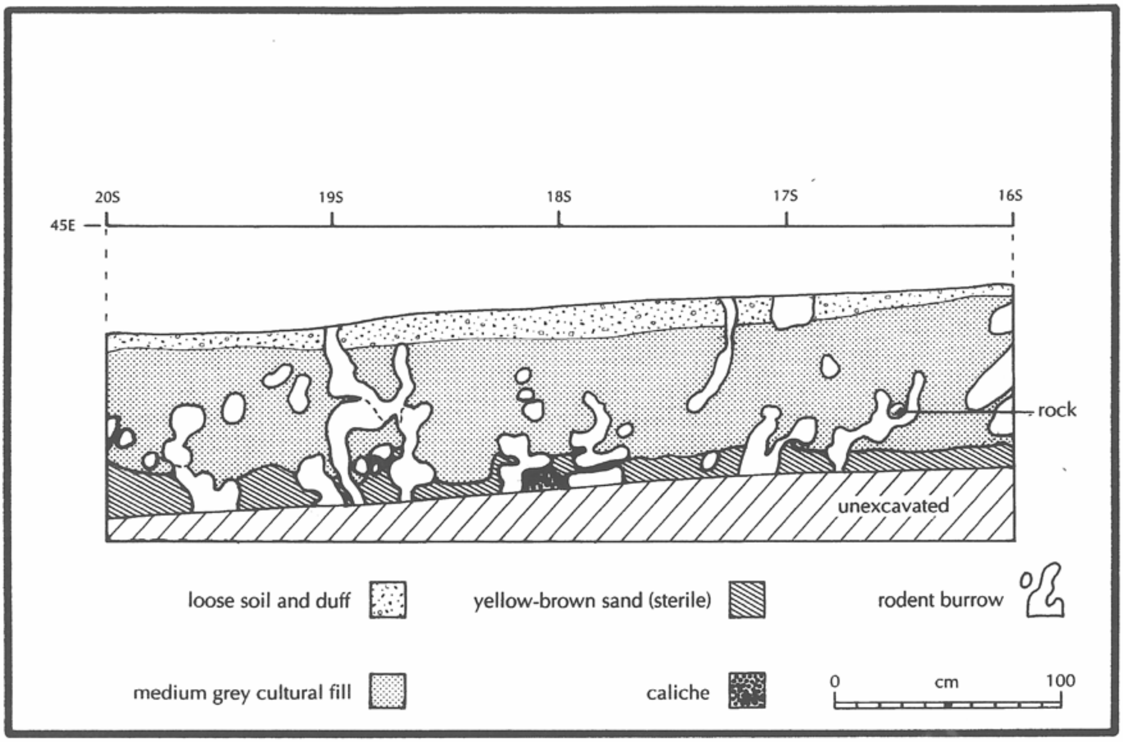

Figure 8. Profile drawing along Line 45E between 16S and 20S.

Figure 9. Rock concentration in lower pithouse fill (east of highway), looking southwest.

rocks were unmodified except for the fact that they were all burned. Interestingly, none of the artifacts was burned.

Architecture

At the end of the testing and evaluation phase (Wiseman 1991), we had good evidence for the existence of at least two pit structures within the highway project boundaries. One was exposed in the west highway cut. The other, east of NM 90, was indicated by a series of auger tests that produced cultural items from 0.5 to 1 m below the surface.

Possible Structure West of Highway

The possible structure in the west highway cut took the form of a dark, well-defined lens of cultural fill. The lens varied in intensity and covered an area 5 m north-south by 2 m east-west. The excavation of three adjacent 1 m squares in this lens showed that it had no depth and no indications of walls or floors. Rather than a structure or other cultural feature, it appears to have been a smear of cultural fill made by heavy equipment, presumably at the time the cut was made for the highway.

Structure East of Highway

East of the highway, excavations uncovered the vague outline of a pit structure that was mostly obliterated by rodent burrowing down to just above floor level (Fig. 10). Other indications of a structure were a greatly increased artifact count between 60 and 80 cm deep, the remains of a hearth at the bottom, and patches of floor.

Although we are unable to provide many details of construction and interior features, the structure appeared to be rectangular with well-rounded corners. The remnant of a hearth was on the floor in the southeast quadrant of the room. The structure was approximately 5 m north-south by 4.5 m east-west. The hearth remnant, crescent-shaped and burned a reddish color, was topped by a 2-3 mm layer of compact white ash. Its original shape could not be determined. Patches of floor were denoted by smooth, flat-lying sterile soil coated with a 1 mm layer of blackened material resembling soot and grime from human treading. Most of the walls and floor were destroyed by rodent burrowing, which penetrated at least 50 cm below the floor level in places. Floor depth below the modern surface was 80 to 83 cm. The western part of the structure was removed when the existing highway cut was made.

Human Interments

Burial 1 (Feature 2)

This very fragmentary burial was exposed in the west highway cut. Many of the bone fragments were washed downhill from the grave location, and some fragments had been displaced as much as 6 m.

The jumbled nature of the few bones remaining in the grave fill suggests that the grave was dug out when the highway cut was made and the bones thrown back into the grave. Bone preservation was extremely poor. A single discoidal bead was recovered from the grave fill near a piece of cranium. No grave pit could be discerned at the time of excavation.

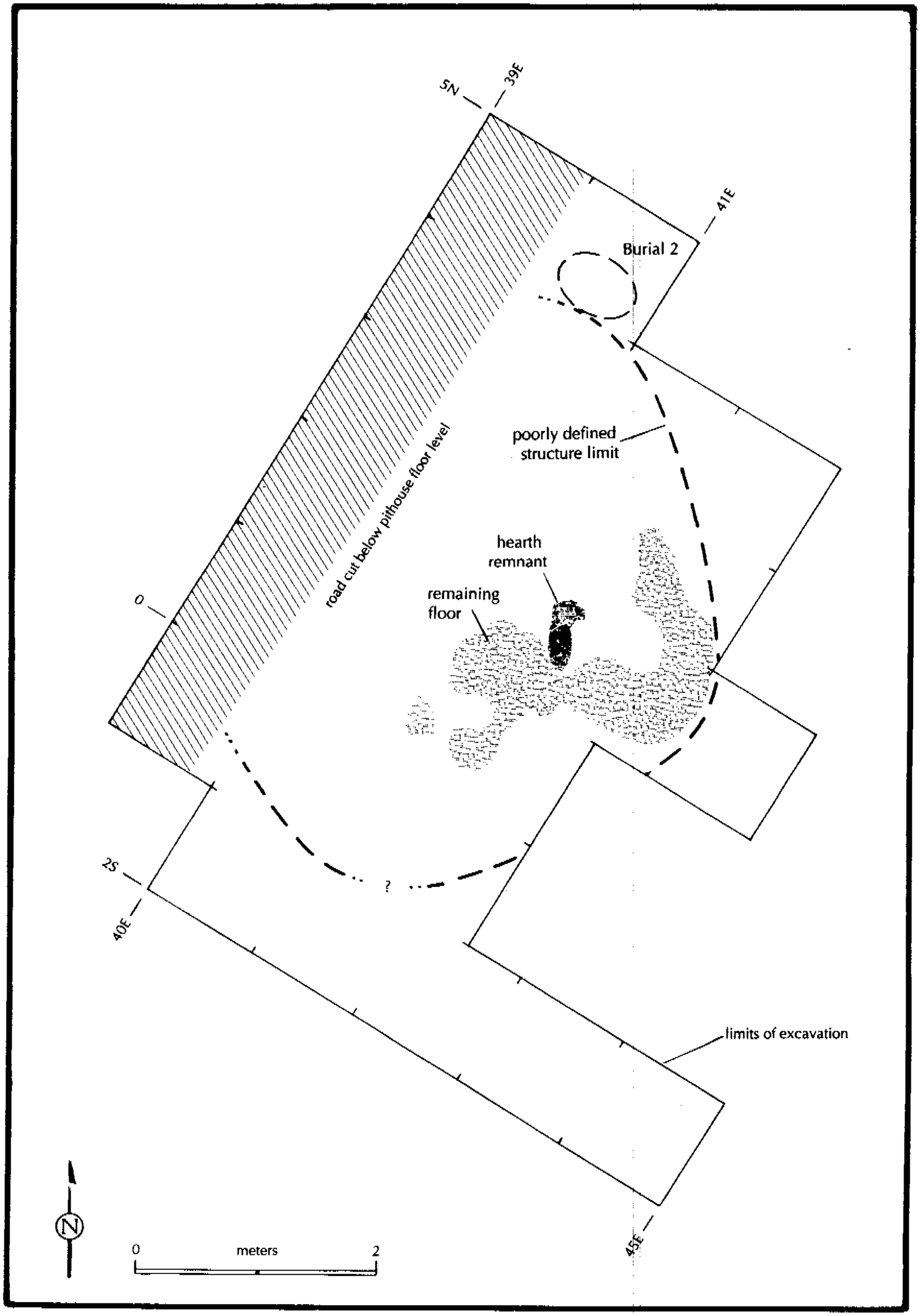

Figure 10. Pithouse remains east of the highway.

Burial 2 (Feature 3)

Burial 2, at a depth of 60 to 80 cm below modern ground surface, was east of the highway and just north of the possible pit structure. Although the grave fill was greatly disturbed by rodents, and most of the small bones were missing, many of the large bones were still in their original positions (Fig. 11).

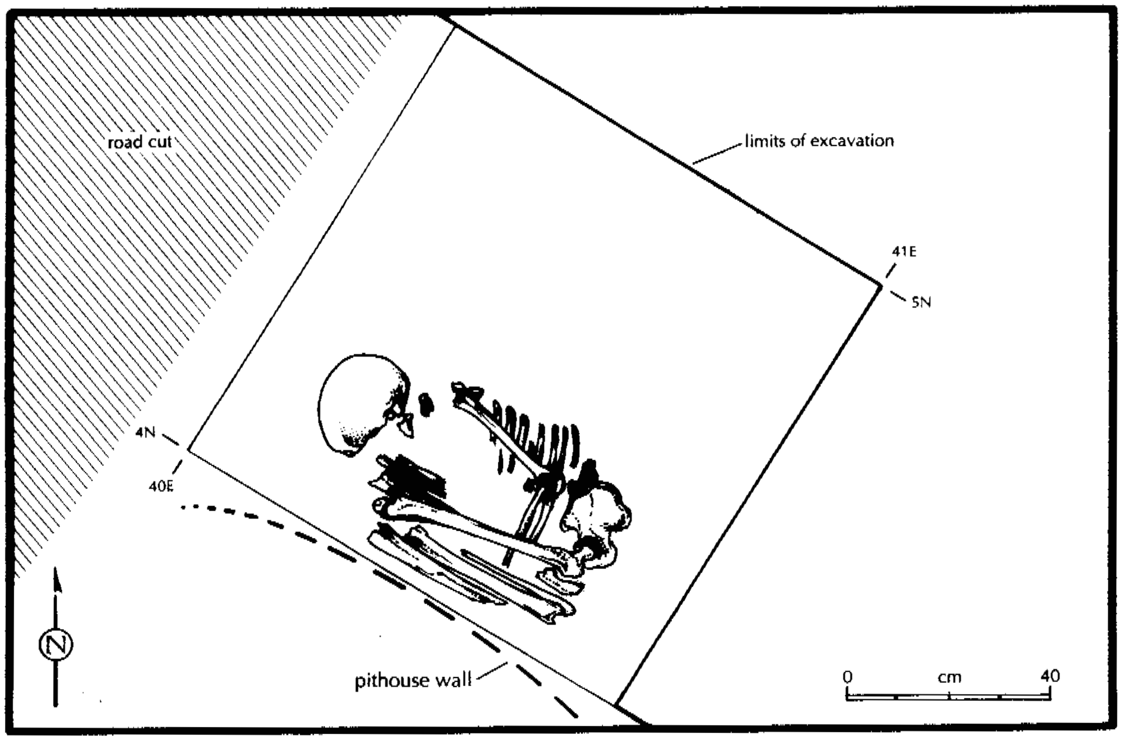

Figure 11. Burial 2 (Feature 3).

The body lay horizontally on its right side with the head to the northwest (facing southwest) and the feet to the southeast. The legs were tightly drawn up to the chest. The one arm still in place was folded. The humerus was parallel to and against the side. The forearm bent at the elbow at approximately 90 degrees and placed between the legs and the torso. No grave goods were present at the time of excavation, and no grave pit could be discerned.

During the analysis of the skeletal material (Akins, this report), elements of a third individual were found in excavation lots from the vicinity of Burial 2. The bones evidently had been moved around by rodents, and the point of interment was not found during the excavations.

MATERIAL CULTURE

Although we catalogued over 300 artifact lots, most contain five items or less. Potsherds are the most common, followed by lithic debitage, animal bones, and formal artifacts. Formal artifacts, which were surprisingly rare, include complete and fragmentary manos, metate fragments, a discoidal bead, and a single projectile point.

Projectile Points, Preforms, and Bifaces

Although a number of projectile points were collected from the surface of LA 83772 over the past several decades, only one projectile point (Fig. 12n) and one preform (Fig. 12q) were recovered by OAS.

The projectile point, from 3S/42E, is made of red and dark gray chalcedonic chert. It measures 36 by 21 by 4 mm and weighs 2.3 g, and the minimum stem width is 9 mm. The tip of the blade and the tips of the tangs are missing. A complete preform of coarse gray chert measures 35 by 22 by 6 mm and weights 3.7 mm.

To infer more information about the site, several projectile points, preforms, and bifaces from a private collection are also described here (Appendix 2). All of these items are from private land in the western part of LA 83772. It should be noted that because some of the digging on the private land was as deep as 2 m in places, some of the artifacts may date from the Pithouse or even Archaic periods.

The distinction between arrow points and dart points in the private collection is ambiguous, and several specimens could fit into either category. In one of the more recent attempts to deal with this problem, Katz and Katz (1985:83) determined that projectile points in the Brantley locality of southeastern New Mexico can be assigned to cultural/temporal periods on the basis of neck width. The neck is the minimum width of the stem between notches. The categories are: Late Archaic dart points, 15 mm and wider; Transitional or Terminal Archaic dart points (diminutive examples of earlier forms, for the most part), 9 to 14 mm; and Late Prehistoric arrow points, 8 mm or less. Although we have no way of knowing at this time whether these categories accurately reflect the situation in southwestern New Mexico, we are using them here for descriptive purposes.

Dart Points

Two side-notched points (Figs. 12s and 12t) represent Late Archaic or earlier sizes. They are made of chert and rhyolite.

Transitional Points

Perhaps because of the larger sample size (N=10), this group contains the most variation in size and shape. Lengths range from 21 to 48 mm. Two are stemmed (Figs. 12a and 12b), one is basally notched (Fig. 12e), five are corner-notched (Figs. 12j through 12n), and two are side-notched (Figs. 12c and 12d). The point in Figure 12d has a reworked blade, making it the smallest point in the collection. Chert is the dominant material (N=8), and two are silicified siltstone. The point shown in Figure 12n came from Level 1 of 3S/42E.

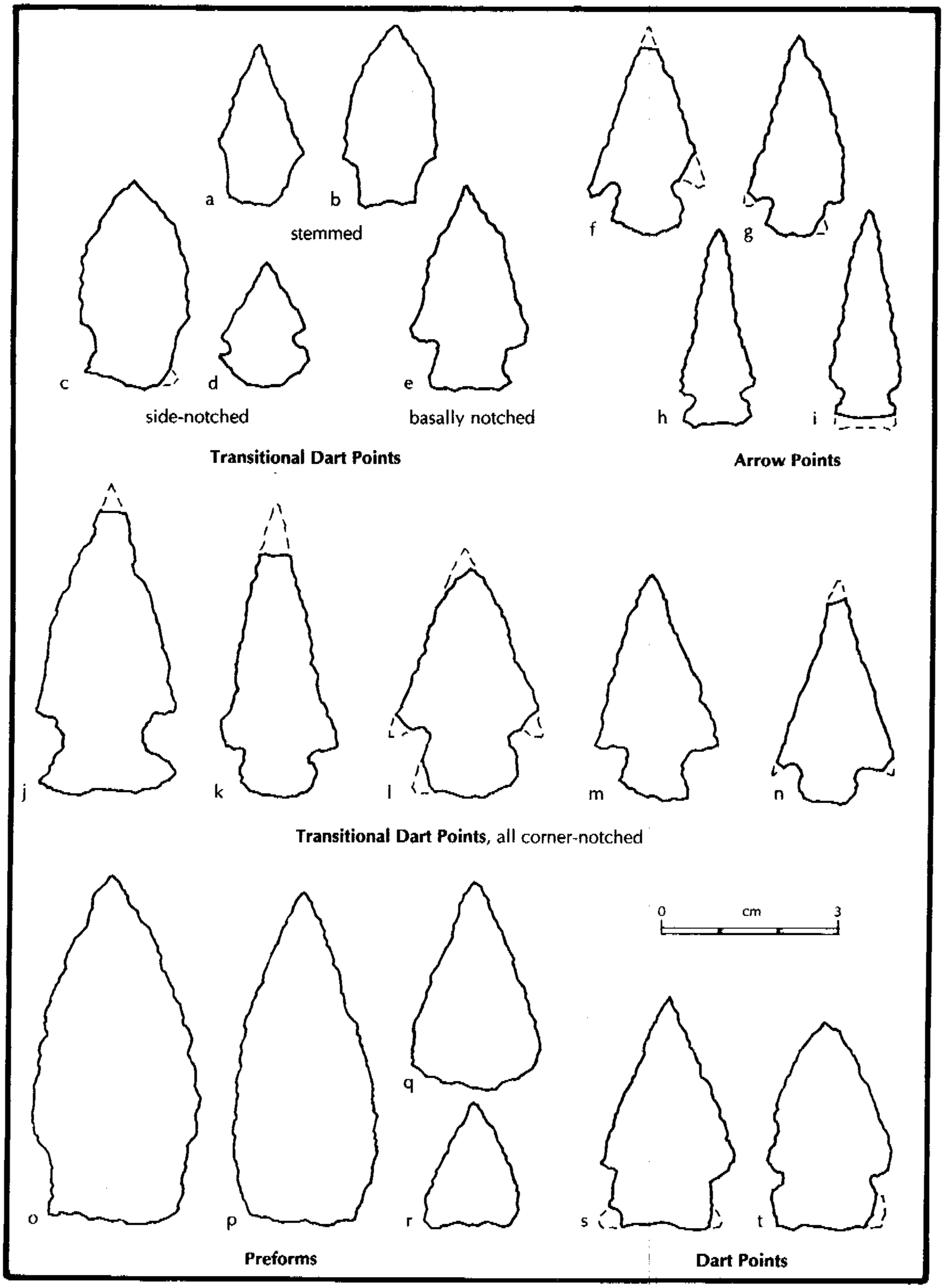

Figure 12. Projectile points and preforms.

Arrow Points

Two corner-notched points (Figs. 12f and 12g) and two side-notched points (Figs. 12h and 12i) have stem widths of 8 mm or less. They are made of chert (N=3) and chalcedony (N=1).

Preforms and Bifaces

Four bifaces (Figs. 12o through 12r) are projectile point preforms or artifacts that functioned in some other capacity such as knives. These triangular and elongate triangular items vary greatly in size and range from 21 to 60 mm long, 16 to 29 mm wide, and 5 to 12 mm thick, and weigh 1.7 to 18.6 g. The bifaces are made of chert (N=2); siliceous, fine-grained sandstone (N=1); and rhyolite (N=1). The artifact shown in Figure 12q came from the surface of 0N/45E in the highway right-of-way.

Ground Stone Artifacts

Thirty-one items of ground stone were collected from the site. Three are from the surface within the highway right-of-way, 20 are from the OAS excavations, and 7 were collected from private land (surface of south pueblo) with the permission of the landowners.

Manos

The 15 manos are classified as one-hand, two-hand, and indeterminate (Table 1 [all tables are in Appendix 6]). The three basic material types used in their manufacture were granite, sandstone, and rhyolite (Table 2). All were made from stream cobbles or rounded chunks of colluvial rock.

All but one of the eight oval, one-hand manos have a single, well-used grinding surfaces that are flat to moderately convex along both the longitudinal and transverse axes (Fig. 13). The one exception has two parallel grinding surfaces. Shaping other than the grinding surface varies from none to moderate. There are two complete or nearly complete specimens: #163, 146 by 122 by 61 mm, 1,574 g (one grinding surface; white granite); and #218, 159 by 117 by 42 mm, 1,198 g (one grinding surface; partially indurated medium gray sandstone).

The two two-hand manos are also made on cobbles and have single, flat to slightly convex grinding surfaces. One fragment is elongate and is little modified, except for the grinding surface. The other, complete, large, and oval, is edge-ground to shape, measures 179 by 160 by 80 mm, and weighs 3,300 g.

Five fragmentary manos have single, flat grinding surfaces.

Pestle

A small cobble with well-developed grinding surfaces on both ends evidently was used as a pestle. Made of a hematite and magnetite gabbro (?), the artifact measures 119 by 93 by 75 mm and weighs 1,339 g. The grinding surface on the larger end is roughly triangular, measures 75 by 75 mm, and has two facets of about equal size. The grinding surface on the smaller end is round and measures 36 by 33 mm. The purpose of this single-facet surface may have been nothing more than to facilitate holding and to cushion the hand during use.

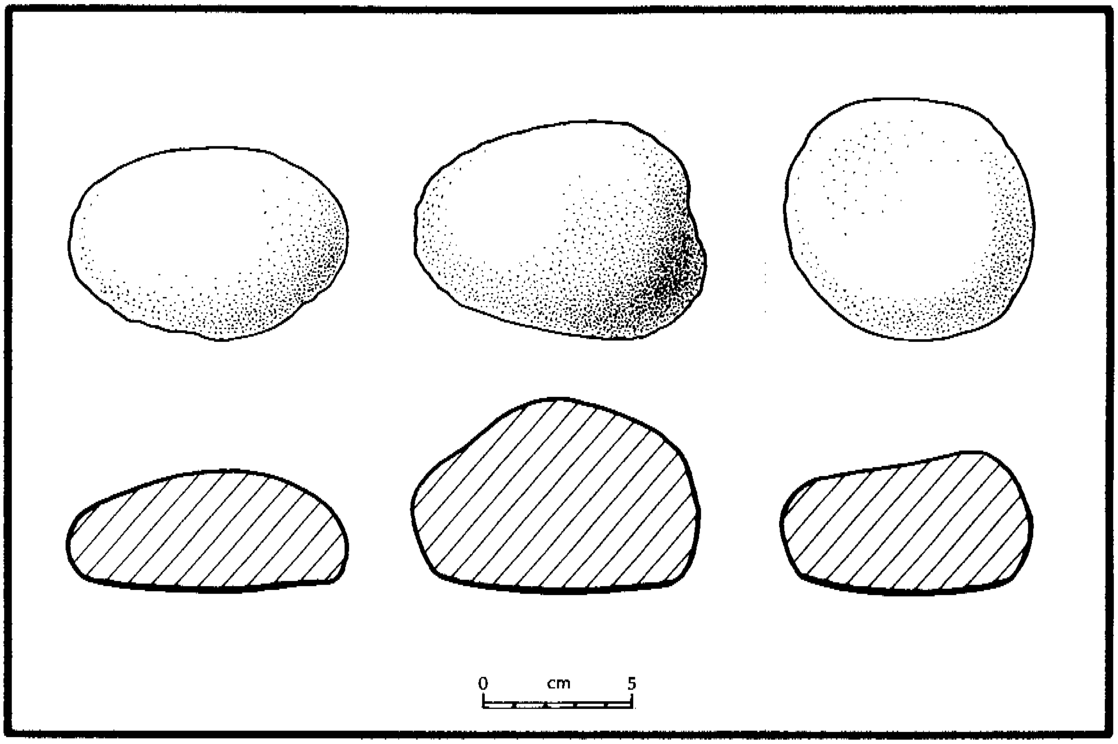

Figure 13. One-hand manos.

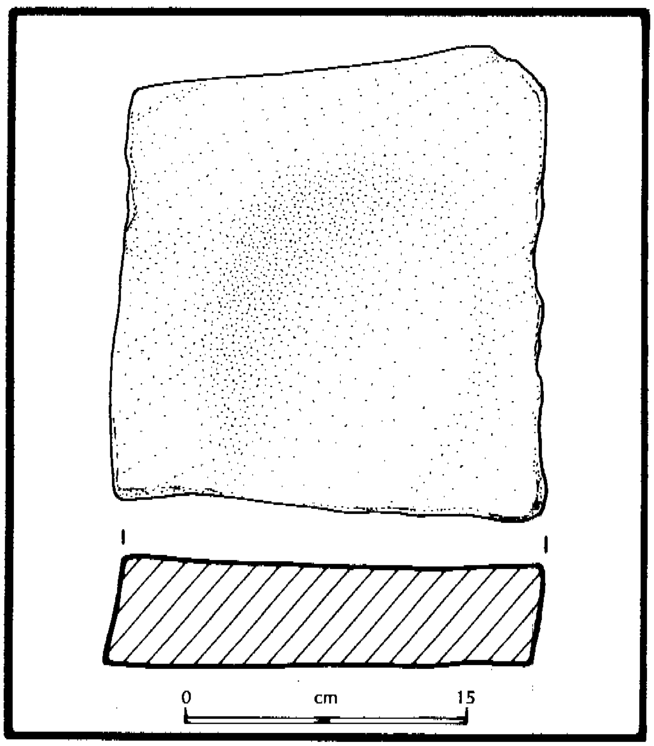

Figure 14. New basin metate.

Metates

Ten metates, one complete and nine fragmentary, represent basin and trough classes (Table 3). Several different basic materials were used: granite, sandstone, vesicular basalt, and one or more unidentified rocks (Table 4). Although the edges of several metates evidence shaping by either chipping or grinding, the shape of the artifact is dominated by the original small boulder or slab from which it was made.

Basin metates include new examples (Fig. 14) as well as examples with shallow and deep basins. The differences probably signify little more than the length of use-life prior to breakage and/or discard. All but one of the metates have single grinding basins. The exception has two grinding basins, one on each face or side of the rock. The only complete basin metate is made of white, fine-grained sandstone and measures 16.6 by 15.4 by 3.3 to 4.2 cm. The slightly used grinding area is oval and measures 12.4 by 9.0 cm.

The two trough metate fragments differ from the basin metates in that they possess grinding surfaces with sharply upturned sides. The basalt specimen is the only artifact recovered from the site made of this material. While several of the metate fragments from the site are wholly or partly burned to shades of yellow, red, or gray, the red color on the trough metate fragment is actually alternately banded with white, suggesting that the coloration is natural.

Grinding Stones/Slabs

One small slab and one small boulder each have grinding areas on one side (Tables 3 and 4). In both cases, the use-wear is small in area (125 to 130 mm long and 92 to 110 mm wide) and oval in outline. The degree of attrition on the surfaces of the rocks is slight, suggesting limited use for purposes other than grinding foodstuffs. No materials or colors adhere to either of the stones.

Miscellaneous Ground Stone Fragments

Two small fragments of sandstone could not be confidently assigned to one of the above classes of ground stone. Both have grinding wear on one side and an edge shaped by limited grinding. They were found in 115N/45E, L. 3 (40-60 cm); and 55N/43E, L. 2 (20-40 cm).

Miscellaneous Artifacts and Materials

Hammerstones

Six rocks display one or more battered points and ridges from use as hammers. They range in length from 74 to 105 mm, in width from 64 to 84 mm, in thickness from 37 to 73 mm, and in weight from 202 to 642 g. Materials include gray igneous chert (N=4), gray-green hornblendite (?) (N=1), and an unidentified aphanitic white igneous stone (N=1). The hammerstones were found in 0S/43E (L. 4, 60-80 cm), 2N/42E (L. 4, 60-80 cm), 9S/46E (L. 2, 20-40 cm), 9S/46E (L. 2, 20-40 cm), 4N/40E (L. 3, 40-60 cm), and 5N/41E (L. 2, 20-40 cm).

Flake Tools

In spite of the tremendous effort put into use-wear studies over the past 20 years, the results have largely been inconclusive, and much of it is contradictory. The situation is exacerbated by postoccupational edge damage from natural sources, and, conversely, by the degree to which hardness and graininess of rocks influence manifestation of use-wear. For instance, Richard Gould (1969) watched a group of Australian Aborigine hunters skin and butcher a kangaroo with a single quartzite flake. Subsequent examination of the discarded flake failed to find use-wear on the edges. Because of these and other problems, our analysis of the White Signal assemblage was very conservative in ascribing damage to use-wear. We also take the simplistic interpretive position that, in general, unifacial wear mostly reflects scraping use, and bifacial wear mostly indicates cutting use.

Twenty-one flakes possess one or more edges with use-wear in the form of microflake scars, grinding facets, or polish (Table 5). No flakes display intentional retouch. The analysis monitored the type of use-wear, the configuration of the used edges, whether the wear was unifacial or bifacial, the angle of the wear to the ventral surface, and the length of use-wear. Only the more important observations are reported here.

Sixteen flakes have only one edge with use-wear, four have two edges, and one has three edges. Of the total of 26 used edges, 18 have unifacial flake scars, five have bifacial flake scars, one has a grinding facet that is perpendicular to the ventral surface, and one is rounded and has the high sheen of use-polish. Only one notch, measuring 9 mm across and 2 mm deep, was noted. The lengths of the use-wear are summarized in Table 5. And finally, for reasons mentioned above, it comes as no surprise that use-wear was found primarily on the finer-quality materials such as cherts and chalcedonies (57.1 percent). Fine and medium rhyolites account for 38.1 percent, and indeterminate igneous for 4.8 percent.

Jewelry

Two jewelry items, a bead and a pendant, were recovered from the fill surrounding Burial 1 and from general excavation (3N/41E, L. 4), respectively.

The bead is discoidal, 7 mm in diameter, 3.5 mm thick, and is made of an aphanitic white stone with microscopic red speckles and fewer but larger black splotches. The more-or-less centralized hole is 3 mm in diameter.

The pendant was originally subrectangular and measures 32 mm long by 25 mm wide by 2 mm thick (Fig. 15). The material is dark gray shale.

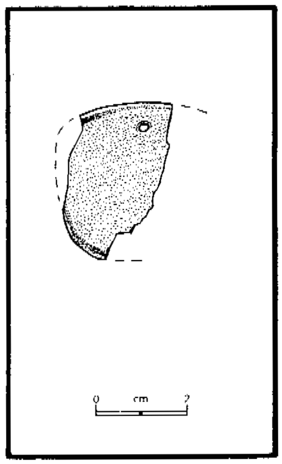

Figure 15. Pendant.

Pigment

Two small chunks of hematite clay (?) evidently were used for coloring objects or perhaps humans. Both contain occasional microscopic minerals in the form of crystals, most appearing to be feldspar.

The larger one is cone-shaped. The bottom was faceted by grinding during the removal of material for use. The grinding facet measures 42 by 33 mm, the cone is 33 mm high, and the piece weighs 36.7 g.

The second piece is much smaller, measuring 19 by 13 by 8 mm and weighing 1.8 g. This piece is of higher quality than the larger one in that it is brighter red in color, softer to the touch, and smears more readily when rubbed.

Pottery

A total of 513 sherds was recovered during the excavations at LA 83772. Of these, 498 came from east of the highway and 15 from west of the highway (Table 6). Previously recognized and described pottery types include Alma Plain, Mimbres Corrugated, San Francisco Red, and Mimbres Black-on-white. Three other categories of sherds are represented: a corrugated pottery that may be a variant of Mimbres Corrugated, a tool-impressed red ware, and two sherds of possible Apachean manufacture.

In the sections that follow, the study of distributions omits the west side collection because of small sample size. Paste characteristics of all types and categories were studied by Dean Wilson and David Hill. Their results are presented in the chapters that follow.

Alma Plain

The majority of Alma sherds (62 percent) have smoothed, unpolished surfaces. The surfaces of a few undulate somewhat, while on others the surfaces are quite rough. The latter sherds almost certainly qualify as Alma Rough, for the surfaces have remnant scrape marks and other evidence of manufacture that were not obliterated by the smoothing process. Surface polishing, either streaky or thorough, occurs on only 20 percent of the Alma sherds. This variety is referred to here as "regular" Alma. The surfaces of 19 percent of the Alma sherds are too eroded to assign to the smoothed or polished categories. Surface colors for Alma as a whole average a light to medium brown to grayish-brown but range from shades of buff to terra cotta to dark grayish-brown and black.

Rim sherds and definitive vessel-form sherds are uncommon, but most of those noted are from seed jars, a globular, neckless, closed form. Two other forms were also noted--bowl and nonspecific jar--but in every case the sherds are too small to permit description of the entire vessel.

Generally speaking, polished (regular) Alma sherds have relatively fine temper, though not invariably so, and smoothed sherds have coarse temper. Several examples of the latter are strongly reminiscent of El Paso Brown with its coarse white temper grains, black paste, and reddish surfaces.

Intentional smudging was noted on a number of sherds, though the overall incidence in the Alma Plain from the site is quite low (N=13, or 3 percent). Intentional smudging is denoted by a solid black, carbonaceous, interior surface and a paste with a well-defined zone of carbon black next to that surface. Sherds that are black on both surfaces and throughout the paste are not counted as smudged, though they could be. Interestingly, eight of the smudged sherds are smooth Alma, five are eroded Alma, and none are of the polished variety. Of the eleven smudged sherds from east of the highway, nine came from Levels 2 and 3 (20-40 and 40-60 cm), and one each came from Levels 1 and 4. Proveniences include 1N/40E, 1N/41E, 5S/43E, 5S/44E, 8S/45E, and 49N/16E for the smooth Alma, and 3N/43E, 3S/42E, 11S/45E, and 12S/46E for the eroded Alma.

Mimbres Black-on-White

All sherds of this type are small (half-dollar size or smaller), making identification of design style difficult or impossible. The styles and their more familiar cognates have been defined by Anyon and LeBlanc (1984): Style 1 (Bold Face Black-on-white), Style 2 (Transitional Black-on-white), and Style 3 (Classic Black-on-white).

Of the seven sherds from LA 83772, three are Style 3 (3N/43E, L. 2; 2N/44E, L. 1; 5S/43E, L. 1), one is Style 2 or 3 (3S/41E, L. 1), and three either lack paint (4N/43E, L. 2; 1S/43E, L. 4) or the appropriate design elements (6S/46E, L.2) by which to make typological assignments.

Mimbres Corrugated

All indented corrugated sherds in the assemblage are assumed to belong to this type. Tempers vary mineralogically, but the surface treatment embodies little overall variation, being generally sloppy in execution. Indentations are generally subtle or even inconspicuous. Coils vary in width and are partially obscured or obliterated by smoothing. In some cases, the sherds are polished over the coils and indentations.

San Francisco Red

Two sherds, one from 2N/42E, L. 5, and the other from 0N/41E, L. 1, have red slips. All others are unslipped, but the degree of redness is so strong that they are readily distinguished from what we presume to be accidentally red-fired Alma Plain. The interior surface of the sherd from 5S/42E, L. 2 is smudged.

Ribbed Brown

Several sherds of what appears to be a single, very distinctive vessel were recovered from several squares. The "ribs" are nothing more than horizontal, unflattened coils that are barely conjoined on the inner surface and left unmodified on the exterior. During the analysis, we believed that these sherds were Three Circle Neck Corrugated, but now it is believed that they are a variant of Mimbres Corrugated, or at least date from that period rather than the Early or Late Pithouse period.

Tool-Impressed

Two sherds, probably of local manufacture, have punctuations made by a stick or similar tool. The unslipped surfaces are reddish or terra cotta in color caused by oxidation during firing. Both sherds are reminiscent of Cloverdale Corrugated.

Possible Apache Pottery

One sherd from 10S/46E, L. 1, and possibly a second sherd from 4S/45E, L. 4 (60-80 cm), are reminiscent of Apache pottery. Both sherds are 1 cm in greatest dimension, making description and assessment difficult.

The first sherd has the strongest resemblance to Apache pottery. It is thin (4 - 4.5 mm), hard, and dense-feeling, with black surfaces and paste. The temper is quartz-rich igneous (?) rock. The bumpy nature of the exterior surface is similar to random indenting, rendering an effect unlike any of the Mogollon Corrugated sherds.

The second sherd is basically like the first except that it is thicker (5-5.5 mm), has a thin brown core to the paste, and feels less dense (more like the Mogollon sherds). The bumpy surface is just like the first sherd and definitely unlike the Mogollon sherds.

Distribution of the Varieties of Alma Plain

The preponderance of the Alma Rough relative to regular Alma suggests that an early component existed east of the highway. Because of the large sample size, and in spite of the bioturbation problems discussed earlier, we thought that a study of the horizontal distributions of the three varieties might assist in establishing, or give cause for rejection of, this hypothesis. In the exercises that follow, we do not intend to imply that the regular and eroded varieties are one in the same, for they probably are not. They are grouped here because their horizontal distributions are similar to each other and differ from the rough variety.

The results of the horizontal distribution (Fig. 16), while not definitive, show some slight patterning. As might be expected, sherds of all three categories (rough, regular, and eroded) are found throughout the site. However, Alma Rough differs somewhat from the regular and the eroded Almas in that it was concentrated in the center of the pit structure (Fig. 16d).

To examine the vertical distribution of the three varieties within the limits of the structure, we chose two lines of squares through the greatest concentration of Alma Rough: 1N/41E, 1N/42E, 1N/43E, and 2N/41E, 2N/42E, 2N/43E, 2N/44E (Fig. 17). Alma Rough sherds are fairly evenly scattered vertically throughout the 1N squares. Although they tend to cluster more in the 2N squares, concentrations both high and low, plus low concentrations throughout Levels 1-3, suggest the concentrations are not significant. The vertical distributions of regular Alma and eroded Alma combined are also generalized throughout with the single exception of 2N/43E, Level 4. However, nine of the ten sherds in this concentration belong to the same vessel, as demonstrated by refitting. We conclude that the vertical distribution data do not provide useful clues about temporal differences between the Alma Rough and the regular variety of Alma. Nor can we be certain whether this lack of separation indicates contemporaneity of the varieties or is the result of bioturbation.

Paste Analysis of LA 83772 Pottery

C. Dean Wilson

Prehistoric pottery produced in much of southwestern New Mexico exhibits similar ranges of paste and stylistic characteristics resulting in assignment to types of the Mimbres tradition (Haury 1936a). While variation in ceramic pastes associated with different occupations of the Mimbres have long been noted (Bradfield 1929), very little is known concerning variation of contemporaneous pottery from different areas of this region. Such information may be important in the investigations of patterns of production and exchange between different areas of the Mimbres region. Since White Signal (LA 83722) is some distance from the better known sites of the Mimbres branch (LeBlanc 1983; Lekson 1989), comparisons of characteristics of ceramics from this site to those from other areas of the Mimbres region along the Mimbres and Upper Gila

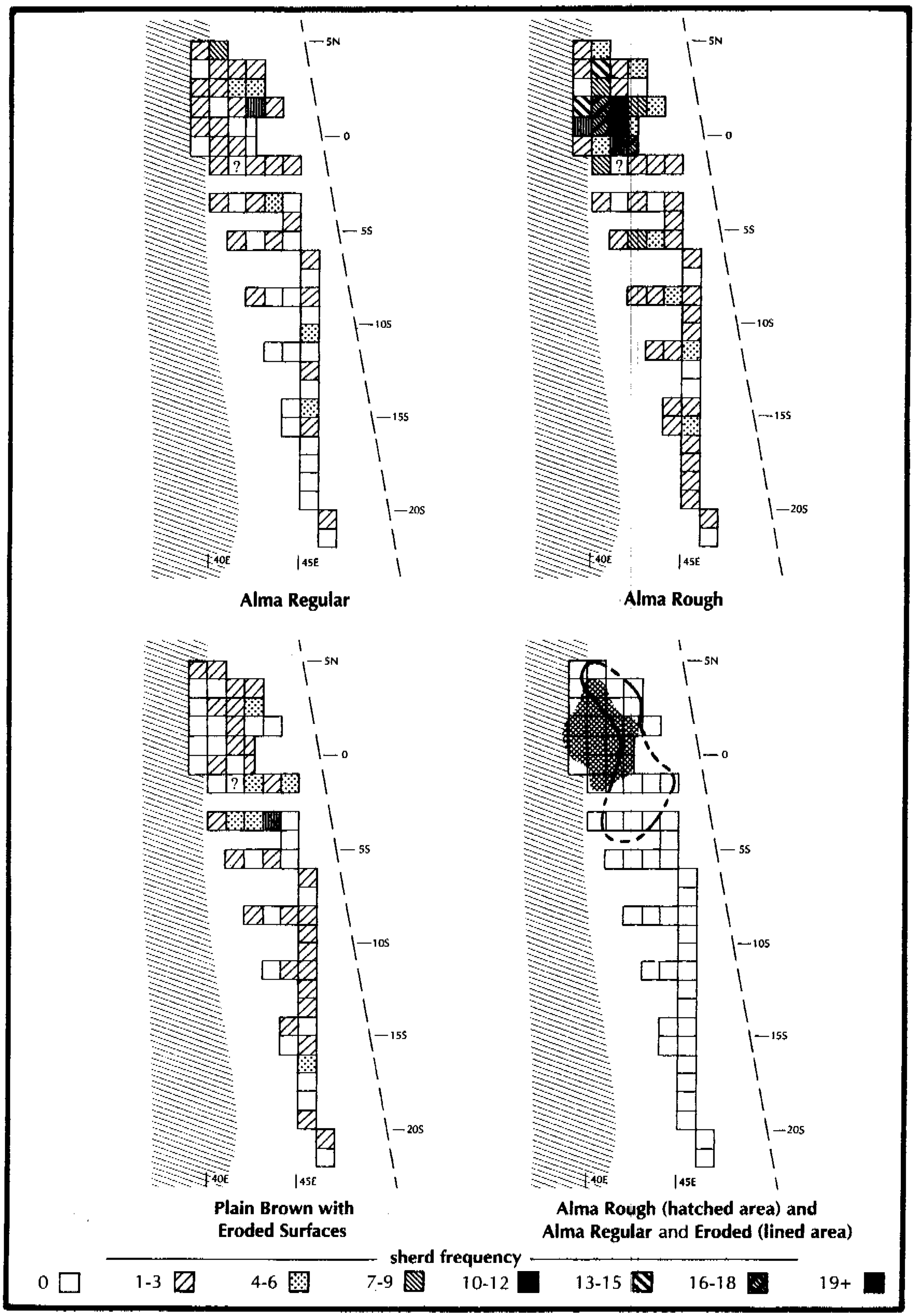

Figure 16. Comparative horizontal distributions of Alma Plain varieties east of the highway.

drainages may be used to examine areal variation. Thus, this section presents information concerning a preliminary comparison of sherds from the Early Pithouse and Classic Mimbres components at White Signal and contemporaneous occupations from other areas of the Mimbres region.

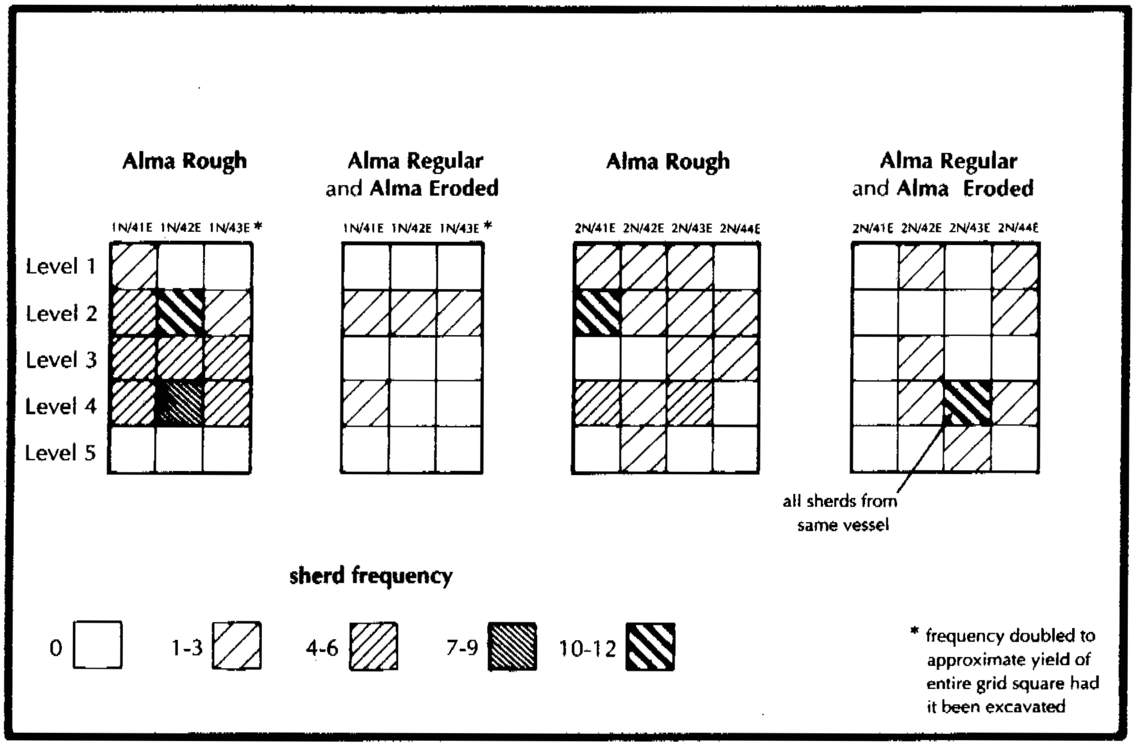

Figure 17. Vertical distributions of Alma Plain varieties in selected squares within the pithouse east of the highway.

The first step in such an investigation is to determine if paste clay or slip sources available and used in different areas of this region can be readily differentiated. Therefore, potential paste and slip clays sources near White Signal as well as scattered sources along the Mimbres and Upper Gila areas were collected and described. In addition, data providing for comparison of paste characteristics of sherds from White Signal and other sites in the Mimbres region were recorded. This involved the additional characterization of small samples of sherds from sites along the Mimbres and Upper Gila drainages presently stored in the Mera Collection at Laboratory of Anthropology of the Museum of New Mexico, including LA 1746 and LA 1679, near the Mimbres River, and LA 2104, north of Cliff. Because ceramic type distributions indicate the presence of two distinct occupations, including an Early Pithouse and Classic Mimbres component at the White Signal site, an attempt was made to select at least one other site containing ceramic types indicative of both and early and late occupation. Information concerning distributions associated with earlier Plain Brown Ware and later Mimbres Corrugated and White Ware types are considered separately. Following the analysis of these sherds, samples of sherds exhibiting typical tempering material were submitted to David Hill (reported in this volume) for petrographic analysis to further determine the composition and potential similarities of ceramics clay sources from different areas of this region. The possibility of areal specialization of various wares was also examined by comparing the characteristics and distribution of ceramic pastes in contemporaneous Mimbres utility and decorated ware types.

Clay Collection and Characterization

In order to determine the potential effect of differences in clay geology on paste characteristics, potential paste clay and slip sources were collected from the vicinity of White Signal (13 sources) and from sources in the Mimbres and Upper Gila areas (10 sources) (Appendix 3). Information recorded for clays collected included the evaluation of working qualities, recording of natural and refired color, and description of inclusions. Refiring analysis allows for the common comparison of clay sources and ceramic pastes by eliminating effects from the original firing of a vessel by firing sherd clips and clay samples in similar oxidation conditions to a temperature of 950 C. These samples may be compared based on the influence of mineral (particularly iron oxides) from similar sources on clay, paste, or slip color. Two self-tempered clay samples, made into tiles and fired, were submitted for petrographic analysis.

Comparison of different source samples indicate similar origins and characteristics of available clay sources for all the areas from which clay samples were collected. This similarity reflects the extensive distribution of similar volcanic outcrops and volcaniclastic sandstones, and the general lack of shale-bearing sedimentary formations (Chapin and Elston 1978). Clay sources that could have been used in the manufacture of ceramic vessels appear to be limited to pedogenic clays weathered from local volcanic deposits. These clays are gray to brown in color and high in iron content. Most fired to red colors in standard oxidation conditions. One sample from a source near White Signal fired to a lighter pink. Because these clay sources are weathered from local volcanic or volcanic-derived sources, they consistently contain nonplastic inclusions primarily derived from nearby volcanic outcrops, so it was not necessary to add temper. These inclusions consisted of angular fragments dominated by angular to subangular light-colored lustrous grains. In addition, smaller dark grains, apparently derived from basalt, dull light-colored tuff fragments, and small sand fragments from volcanic-derived sandstones, were sometimes present. The inclusions noted in these clay samples were similar in appearance to nonplastics present in Mimbres Brown Ware and White Ware types, indicating the use of self-tempered clays, similar to those used in other areas of the Mogollon country (Wilson 1992).

Two self tempered clays were submitted for petrographic analysis. A sample from the lighter firing clay near White Signal contained abundant sub-angular fragments of highly altered rhyolitic tuff and basalt (Hill this volume). In other cases quartz fragments are smaller and more variable. A sample from the Mimbres Valley, fired to a redder color and contained abundant hematite spots, and large basalt fragments.

The remaining material sources collected represent soft white material weathering directly from tuff sources. Similar deposits are found throughout the Mogollon Highlands, and no differences in the characteristics of sources from different areas were noted during the present study. Attempts to form weathered tuff into ceramics were unsuccessful, although in some cases passable white slip could be made from these sources. With better processing, it is likely most weathered tuff sources could be applied as slips. Unlike the pedogenic paste clays, slips made from these deposits often fired to a white to buff color when exposed to an oxidation atmosphere, and are similar in appearance to Mimbres White Ware slips. Many of the sources applied as slips did tend to flake or wear off, although it is possible stronger slips may be produced using more high weathered deposits and increased grinding and processing. Slips noted for Mimbres white wares are also fairly soft and easily eroded indicating prehistoric potters encountered the same problems.

Characterization of Ceramic Pastes

Examination of ceramic pastes through a binocular microscope of sherds from all sites examined indicate that Mimbres Brown Ware and White Ware types contain inclusions very similar to those noted in samples of pedogenic clay sources collected, and indicates the use of self tempered clays. Inclusions noted in most sherds are similar, although a preliminary analysis did indicate some variability in the characteristics of nonplastic particles. This variability was used to define three categories during analysis of ceramic pastes, and include the following. Angular Lithic and Sand refers to pastes inclusions dominated by light to dark shiny angular lithic fragments, sometimes occurring with lower frequencies of sand or sandstone fragments. Tuff Dominated refers to pastes dominated by dull white to buff colored tuff or pumice fragments. Sand Dominated refers to pastes dominated by sand or sandstone particles apparently derived from local volcanic derived sandstone formations (Gila Conglomerate) along with tuff or angular rock.

The analysis of 806 sherds from White Signal indicates the overwhelming dominance of angular lithic fragments similar in characteristics. The relative frequency of this category is equally high for Plain Utility wares (88.8 percent), Corrugated Utility (89,1 percent), and red wares (76.9 percent) from this site. This category was noted in a minority (22,9 percent) of the Mimbres White Ware sherds from White Signal. The majority (65.7 percent) of the white wares contain tuff dominated inclusions, while a significant frequency (11.4 percent) contain sand dominated inclusions.

Although samples sizes are much smaller similar trends were noted for collections from other areas of the Mimbres region, although the frequency of brown wares dominated by tuff inclusions was slightly higher. A similar dominance in white wares containing tuff dominated was noted for LA 1746 but not for LA 1679.

Clips were taken from selected samples of clips from these sites and fired to the same standardized conditions described for clays. The majority of the Plain Brown Ware sherds, associated with the earlier components, and Corrugated Brown Ware sherds, associated with the later components of White Signal fired to similar red colors similar in color to majority of local clay sources. Pastes of Mimbres Black-on-white sherds from White Signal tended to fire to lighter Pinkish or Yellow-Red colors similar to the range noted for a single clay sources collected from just south of the White Signal Site. Slips of Mimbres Black-on-white sherds fired to buff or white colors, distinct from those noted in ceramic pastes and local pastes clay, but similar to color of some of the slips made from ash sources collected.

The majority of pastes of the Early Plain Brown Ware, Mimbres Corrugated, and Mimbres Black-on-white sherds from the other sites examined fired to red colors similar in color to the majority of pedogenic clay sources collected from these areas. A small proportion of the Mimbres Black-on-white sherds from these sites fired to yellow-red or pink colors noted for the majority of Mimbres Black-on-white sherds from White Signal. Mimbres Black-on-white sherds exhibiting the range of paste colors noted consistently contain similar white or buff firing pastes, matching several of the ash sources collected. Pastes from sherds from these sites assigned to Anasazi-style white ware types, such as Reserve Black-on-white or Tularosa Black-on-white, consistently fired to buff colors, not encountered in any workable clay sources so far collected from the Mimbres country or other areas of the Mogollon Highlands.

Conclusions

Limited examinations of ceramics pastes and locally occurring clay sources in vicinity of White Signal and other areas of the Mimbres region indicate the use of similar pastes. This similarity reflects the use of self tempered pedogenic clays with high iron content derived from the extensive volcanic deposits covering much of Southwest New Mexico. A comparison of inclusions and paste colors associated with early Plain Brown ware and Mimbres Corrugated types indicate the use of similar resources for the production of utility ware types during earlier and later occupations of this region. Significant differences were noted in the associated inclusions and paste colors in contemporaneous Mimbres utility ware type and Mimbres Black-on-white sherds from White Signal, and lesser differences were noted for samples from sites in other areas of this region. While it was initially tempting to interpret such differences as reflecting areal patterns in the production of Mimbres utility versus decorated types, comparisons of distributions of ceramic pastes and clay sources indicate that both could have been produced locally at White Signal, and thus differences in clay selection may be reflected.

Petrographic analysis of clay inclusions and ceramics also indicate these differences in pastes may reflect the use of two distinct locally available pedogenic clay sources by potters at White Signal (Hill this volume). Utility brown ware types may have been manufactured with clays derived from extensive granite outcrops associated with the Big Burro Mountains and located in the vicinity of White Signal. Unfortunately, given the wide distribution of similar outcrops, it is difficult to distinguish utility ware types produced at White Signal from other areas of the Mimbres region. While Mimbres White Ware vessels may have also been produced using locally available pedogenic clays, petrographic analysis indicates these may have been derived from pastes weathered from altered volcaniclastic rock, predominately composed of rhyolitic tuff. As distinct slips were consistently applied over Mimbres white wares, it is difficult to determine why lighter colored clays were selected for the production of decorated ceramics, although it may reflect qualities of the associated nonplastic inclusions favorable for the production of painted white ware vessels. The use of different types of pedogenic sources in some areas but not others may also explain why distinct pastes are associated with different Mimbres wares in some areas of the Mimbres and not others. Much more research and descriptions are needed before the nature and cause of such variation is adequately understood. This very rudimentary examination of distribution and relationships of clay sources and ceramic pastes provides a starting point from which more detailed and systematic investigations may precede.

Petrographic Analysis of Selected Ceramics from LA 83772 and Other Sites in the Mimbres Area of Southwestern New Mexico

David V. Hill

A total of nine sherds representing both plain and decorated ceramics from the White Signal site were submitted for petrographic analysis. For comparative purposes, four sherds each from LA 1746, on the Mimbres River near the Three Circle site; LA 1679, also in the Mimbres drainage area; and LA 2104, north of Cliff, New Mexico, were also examined. Two samples of fired clay obtained from outcrops, one from near White Signal and the other from the Mimbres drainage were analyzed.

The sherds were prepared commercially for thin-sectioning. Analysis was conducted in two stages. First of all, each of the thin sections were examined, and paste and temper were described. The size of the inclusions found in the paste of the sherds was described in terms of the Wentworth Scale. The petrographic samples were then reexamined to compare sherds with similar compositions to one another to see if they could have been derived from the same or similar sources.

LA 1746

1746-5 (1), Mimbres Corrugated. The paste of this sherd is dark brown and contains silt-sized subangular quartz and feldspar grains along with black opaque spots and small books of brown biotite.

The major component in the matrix of this sherd is rock fragments that appear to have been derived from a granite. Rock fragments range from coarse to very coarse. These rock fragments consist of quartz, orthoclase, plagioclase (bytownite), microcline, and sparse biotite. The quartz occasionally displays undulose extinction and is also sometimes contained poikilitically within the feldspars. The feldspars range in appearance from fresh to considerably altered to sericite and clay minerals. Fresh and altered feldspars are observed as isolated mineral grains and in some rock fragments.

1746-5 (2), Alma Plain. The paste of this sherd is a light brown and contains sparse brown biotite books, some of which are altered to hematite, and a few ferro-manganese inclusions. Also contained in the paste are volcaniclastic rocks and isolated mineral grains that were derived from the rock fragments. These rock fragments range from fine to medium-grained. The most common rock is basalt. The basalt fragments are trachytic in texture. The plagioclase, classifiable as an andesine, is often kaolinized. Also contained in the basalt grains are ferro-manganese cubes that are often altered to hematite, along with some augite and olivine.

The other common rock type observed in the sherd is a highly altered rhyolitic tuff. Some of the tuff grains display axiolitic texture or compaction and contain sanidine porphyritically. Isolated grains of volcanic quartz, sanidine, hornblende, augite, and brown biotite are present in the paste as well.

1746-5 (3), Alma Plain. The paste is a mottled gray brown, resulting from incomplete oxidation of the clay. The paste contains abundant silt-sized highly altered feldspars. The major component in the paste are medium to very coarse volcaniclastic rocks. The predominant rock type is a highly altered rhyolitic tuff. A few of the tuff grains contain sanidine porphyritically. Some of the tuff fragments are welded. A few tuff fragments contain secondary chalcedony.

Also present are fragments of a trachytic basalt. The plagioclase is classifiable as an andesine. Sparse ferro-manganese cubes are also present in the basalt grains. Isolated medium-sized grains of sanidine, plagioclase, and quartz are also found in the paste.

1746-7, Mimbres Black-on-white. The paste of this sherd is a dark gray that contains very abundant fragments of rhyolite porphyry. Sanidine is the major porphyritic mineral; however, some grains contain volcanic quartz. These rock fragments range from silt-sized to medium-grained. Isolated grains of sanidine, quartz, and sparse brown biotite are also present in the paste. The continuous size of the grains combined with their gray color, similar to that of the paste, suggests that rhyolitic tuff was a natural constituent of the ceramic clay rather than an added material.

LA 1679

1679-5 (1), Mimbres Corrugated. The paste of this sherd is a dark brown and contains sparse opaque black concretions and contains rock fragments that appear to have been derived from a granite. This sherd has an overall composition quite similar to 1746-1 (1), another sherd of Mimbres Corrugated, and both could have come from the same source.

1679-5 (2), Mimbres Corrugated. The paste of this sherd is a golden brown and contains moderate amounts of angular silt-sized feldspar, quartz grains, and brown biotite. The other major inclusion in the paste is fragments of very fine to fine gray rhyolitic tuff. Some of these tuff fragments contain sanidine porphyritically. Brown biotite that is often altered to hematite. Sanidine is also present as isolated grains.

1679-5 (3), Mimbres Black-on-white. The paste of this sherd is brown with abundant silt-sized subangular quartz and feldspar grains and occasional books of brown biotite. The paste also contains fine- to medium-grained fragments of rhyolitic tuff. Most of the tuff fragments display spherulitic texture. Several fragments also contain secondary chalcedony and/or brown biotite altered to hematite. Sanidine is contained porphyritically within several of the tuff grains as well. a few isolated rombs of plagioclase (andesine) are also present.

1679-5 (5), Mimbres Black-on-white. The paste and inclusions in this sherd are quite similar to that of 1679-5 (3) in terms of the types and sizes of inclusions present and may have been derived from the same source. However, the paste of this sherd is much grayer than the previous specimen.

LA 2104

2104-1, Mimbres Black-on-white. The paste of this sherd is brown. There are abundant inclusions of mixed volcanic rocks ranging from silt-sized to medium-grained. The continuous distribution of particle sizes and the similarity in composition suggests that these inclusions are a natural constituent of the ceramic paste rather than an added element. Only examination of clay beds in the vicinity of the site can confirm this assumption. The volcanic assemblage consists primarily of kaolinized rhyolitic tuffs. Some of these tuffs contain sanidine porphyritically. A few tuff fragments also display axiolitic texture. Also present are sparse basalt grains. These basalt fragments contain ferro-manganese cubes that are altered to hematite. Isolated mineral grains of quartz, plagioclase (andesine), brown biotite, and sanidine are present in the paste as well.

2104-3, Mimbres Corrugated. The paste of this sherd is a bright reddish brown and contains abundant silt-sized hematitic spots, presumably the result of the alteration of biotite. Within this matrix are medium- to coarse-grained highly weathered volcanic rock fragments. Rock types include basalt, rhyolite, and possibly latite. Identification of feldspars is difficult because alteration has clouded most of those in the rock fragments and found as isolated grains in the paste. Sparse hematite and brown biotite are also present in the rock fragments.

LA 83722

83722-12-1, Mimbres Black-on-white. The paste of this sherd is light gray. Contained within the paste are rhyolitic tuff fragments that range from silt-sized to medium-grained. The similarity in composition, degree of weathering, and continuous size grading of the inclusions suggest that they are a natural constituent of the ceramic clay. These tuff particles are somewhat variable in texture, and some contain sanidine porphyritically. Other particles display spherulitic or axiolitic textures. Volcanic quartz, sanidine, and brown biotite are also present in the paste as isolated mineral grains.

83722-0-1, Mimbres Black-on-white. The paste and inclusions are similar to those of 83722-12-1 in terms of the types and composition of the inclusions, suggesting that they could have been derived from the same clay source. However, the paste in this sample has a brownish color.

83722-0-16, Mimbres Corrugated. The paste of this specimen is brown, containing abundant brown biotite that is often altered to hematite. The paste contains abundant granitic rock fragments that range from coarse to very coarse. The quartz present often displays undulose extinction. The plagioclase tends to be altered to sericite and brown biotite, as does the orthoclase. These minerals are present as isolated grains along with augite and brown hornblende. The latter two minerals are present only in trace amounts.

83722-128-1, Alma Rough. With the exception of having a slightly lighter-colored paste, this sample is virtually identical to 83722-0-16 in terms of the texture of the paste and types of inclusions.

83722-56-1, Alma Rough. The paste of this sherd is an opaque black. The inclusions are of the same composition as the two previous specimens; however, the size of the rock fragments ranges from coarse to very coarse.

83722-159-2, Coiled Brown. The paste and inclusions found in this sherd are virtually identical to those of 83722-128-1.

83722-311-01, Alma Rough. The paste and inclusions in this sherd match that of the other brown ware samples examined in this collection.

83722-315-4, Mimbres Corrugated. The paste and inclusions in this sherd match that of the other brown ware samples examined in this collection.

Refired Clay Samples

Near White Signal. The clay matrix of this sample is a light grayish brown. This clay body contains abundant subangular fragments of highly altered rhyolitic tuff and basalt. These fragments range in size from fine- to medium-grained. Most of the tuff fragments are opaque, and a few contain books of brown biotite that has weathered to hematite. A few of the tuff fragments contain sanidine porphyritically. Axiolitic texture is present in some of the fragments. A few isolated grains of sanidine, quartz, and chalcedony are also present in the clay.

From the Mimbres Valley. The clay is light brown and contains abundant hematitic spots, probably resulting from the weathering of biotite. Larger inclusions are present in the form of medium to coarse highly weathered basalt grains. The ferro-manganese cubes within the basalt fragments are partially weathered to hematite. Occasional weathered fragments of rhyolitic tuff are also found. Isolated mineral grains consist exclusively of kaolinized feldspars.

Discussion

The ceramic sample from White Signal shows that at least two different sources of clay and temper were used to make the ceramics. The brown wares were all made using a brown firing paste that contained coarse to very coarse grained granitic rock. Granite outcrops extensively in the Big Burro Mountains and in the vicinity of White Signal would have been readily available to prehistoric potters (Hewitt 1959). Given the proximity of a granitic source to LA 83772, it is likely that the brown ware ceramics recovered from the site were produced there or nearby.

Due to the limited occurrence of granite in the Mimbres Valley and southwestern New Mexico, it has been suggested that Mogollon brown ware vessels could have been widely exchanged (Rugge 1976). While granite-tempered ceramics could have been produced at LA 83772, they may not have been at other places they may have been recovered, such as the two sherds of Mimbres Corrugated from LA 1746 and LA 1679.

White wares were made with a lighter firing paste that contained highly altered volcaniclastic rock fragments, predominately rhyolitic tuff. Complex interbedded and/or brecciated rhyolitic flows and intrusives of Tertiary age (Hewitt 1959) and in beds of the Gila Conglomerate contain tuffs in southwestern New Mexico. Clay deposits are often associated with these (Hermon et al. 1965). Tuffs are also found redeposited in alluvial deposits in valley fill. It is from this latter source that the two clay samples examined were derived.

The presence of altered tuffs and basalts within the clay sample and the paste of the sherds from LA 83722 suggests that alluvial clays containing tuffs could have been used to produce Mimbres white wares recovered from the site. Weathered tuffs and other extrusive volcanic rock fragments were observed in the clay sample from the Mimbres Valley as well. Weathered volcaniclastic rocks like those observed in the clay sample from the Mimbres area were found in the Mimbres white wares and some brown wares recovered from sites in the Mimbres Valley. The complex nature of the history of volcanic activity in southwestern New Mexico combined with the use of redeposited materials for forming vessels might preclude the assignment of a particular vessel to a single outcrop source through petrographic means alone (Elston 1976; Elston et al. 1976). Only through a long-term program of analysis of Mimbres white wares from sites in southwestern New Mexico can regional variation in ceramic production be examined.

The different rock types observed during this analysis in the paste of Mimbres brown wares and white wares has been observed in ceramic assemblages in the Mimbres Valley where petrographic studies have been conducted (Hill 1993; Rugge 1976, 1977). The presence of granites in the samples of brown ware from LA 1679 and LA 1746 occurring in the same assemblages with rhyolitic tuffs bears evidence of this. The differences in temper type and particle size between functional classes of southwestern ceramics has been widely documented (Mills 1984) and seems to hold true for Mimbres white wares and brown wares as well.

Pottery Summary

The pottery recovered in the limited excavations at LA 83772 represents types common to the Early Pithouse and Classic periods in Mimbres-Mogollon prehistory. Previously recognized and described types include Alma Rough, Alma Plain ("regular" Alma), San Francisco Red, Mimbres Corrugated, Mimbres Black-on-white Style I (Bold Face or Mangus Black-on-white), and Mimbres

Black-on-white Style III (Mimbres Classic Black-on-white). Low-frequency minor variants include ribbed brown (a rare Mimbres Corrugated variant?) and tool-impressed Alma.

Wilson's clay sourcing and refiring experiments, and comparative work with selected sites in the Mimbres and Gila River Valleys, indicate that the LA 83772 sherds probably were made in the vicinity of White Signal, not in the Mimbres or Gila Valleys.

Hill's petrographic study was not helpful in determining the manufacture locale of the LA 83772 pottery. The surface geologies of the Mimbres River and White Signal regions, as expressed in the mineral inclusions in the study collections, are too similar to permit reliable distinctions at the level of mineral petrography. Judging by the Dane and Bachman surface-geology map (1965), this is probably also true of the Gila River Valley (Cliff to Redrock sector). The surface geology there is essentially the same as in the White Signal and lower-elevation Mimbres River areas. In a personal communication, Hill suggested that a geochemical study will probably be necessary for determining manufacture locales. However, geochemistry, given the geologic conditions of southwestern New Mexico, may not provide all of the answers we are seeking.

Chipped Stone Manufacture Debris

The data recovery plan (Wiseman 1991) calls for chipped stone debris analysis following the procedures and goals pursued by Margaret Nelson (1984). Through chipped stone analysis, she investigated changes in subsistence emphasis among the various periods of the Mimbres-Mogollon in the Mimbres Valley. Our work at LA 83772 documented the presence of two different cultural components within the area excavated, ostensibly presenting an excellent opportunity for using Nelson's approach and providing for comparative treatment. However, it was clearly obvious during the excavations, and verified in subsequent analyses, that the deposits at LA 83772 had suffered extreme bioturbation, making assignment of the artifacts to one or the other cultural periods hopeless. We are therefore reduced to describing and discussing the chipped lithic debris as a single sample.

Raw Materials

The chipped stone raw materials from LA 83772 are highly varied in texture and color. Sixty-three sorting categories in nine material groups were recognized during the analysis. Virtually all are of igneous origin, suggesting availability in the Big Burro and/or other nearby mountain ranges. Obsidian is the only demonstrably nonlocal material.

Most of the materials are either rhyolite or closely related rocks. Because of the range of textures and the need to monitor texture for comparison with M. Nelson's study of Galaz Ruin lithic artifacts, grain sizes approximating the categories normally used for sedimentary rocks were used for descriptive purposes. The rationale for this unorthodox approach stems from the need to characterize the smoothness or roughness of rock texture as it relates to knapping and the fabrication of tools. Thus, the analysis includes categories of "siltitic" or medium rhyolite and "quartzitic" or coarse rhyolite, which are rendered as "medium" and "coarse" rhyolites, respectively, in discussions below. The other analytical categories include rhyolitic chert, chert, chalcedonic chert, chalcedony, indeterminate igneous, and other. It is important to remember that color variations frequently occur in two or more texture categories. The texture categories are described in Appendix 3.

The medium or siltitic rhyolites are the most common materials in the debitage and embody the most variation in color and texture (Table 7). The only other material that constitutes more than 10 percent of the assemblage is chert. Obsidian is represented by only two pieces, a tiny fragment of a biface and a biface thinning flake. In terms of Nelson's texture categories, coarse-textured materials (all rhyolites and indeterminate igneous) comprise at least 70.4 percent, and fine-textured materials (cherts and chalcedonies) comprise at least 23.0 percent.

Heat Treatment

The heating or baking of lithic materials to make them more amenable to knapping is a well-known facet of prehistoric technology. For the most part, especially when considering materials of sedimentary origin, criteria are fairly well established for determining that heat treatment was or was not used. Metamorphic and igneous rocks are more problematic, however, in that extremes of heat were involved in their geologic genesis. Accordingly, we are unable to make unequivocal statements that the technique was used on the White Signal materials.

For lack of better alternatives, we employed some of the same heat-treatment criteria established for sedimentary rocks. We noted the presence of color changes on exterior surfaces as well as within the materials themselves. Difference in luster was also used but to a much lesser degree since few rocks showed such differences, even when color changes were present. In most instances, we used the less certain terms of "possibly" and "probably," but in four cases, items were certainly heat treated (Table 8).

Cores and Tested Cobbles

Eighteen complete cores, two core fragments, and nine attempted cores (tested cobbles) were recovered from the surface and excavations. These 29 items constitute 4.1 percent of the lithic debitage.

Only one core was well developed, meaning that it had been so thoroughly used that the whole cobble was modified. Most cores were used on only one or two faces, leaving much of the cobble unmodified. The dimensions of the cores reflect the cultural aspects of the cores and only indirectly the dimensions of the cobbles themselves. The dimensions were derived as follows. *Core length* is the distance from the platform to the distal end, equal to the maximum possible length of a flake removed from the core. *Core width* is the distance across the face (parallel to the platform) from which flakes were removed. *Core thickness* is the distance from the face from which flakes were being removed to the opposite side of the core. In the cases of cores with more than one platform, the dimensions refer to the best-developed platform and flake-removal face. Because the overall sample size of cores is small, the descriptive statistics were calculated for all complete cores, regardless of material type.

The size and weight ranges of cores are considerable and a result more of the range in size of the original cobbles than of degree of use (Table 9). No clearly "exhausted" cores are present in the assemblage. This can be seen in the fact that the cores, as a group, are simple in form. Single-platform cores are the most numerous, and more complex forms (three or more platforms) are uncommon. Most of the major material groups are represented, and medium rhyolites are the most numerous (Table 10). Fully half of the cores may have been heat-treated.

Flakes

Including flake-tools, complete and fragmentary flakes from the surface and excavations total 638, or 89.4 percent of the lithic debitage. Flake types are core-decortication, core-reduction, platform-edge rejuvenation, biface-reduction (or thinning), biface-notching, and indeterminate, of which core-reduction flakes are the most numerous (Table 11).

All 63 material sorting categories and 9 material groups are represented in the flakes. Since the majority of flakes represent only a few sorting categories, Table 12 summarizes the flakes by material group rather than the individual categories. The medium rhyolites clearly dominate the material groups. The cherts are a distant second.

Core-reduction flakes constitute the singly largest class of flakes. The analyses that follow pertain to the complete core-reduction flakes (N=188) as a group, regardless of material type.

Core-reduction flakes vary greatly in length, width, thickness, and weight (Table 13), although overall, they are generally small. In spite of this variability, a correlation matrix (Pearson's r) suggests a fair amount of standardization in flake dimensions and indicates reasonable success in obtaining flakes of predictable shape (Table 14). It is interesting to note in this regard that the strongest correlations involve width, thickness, and weight, suggesting that flake length was the least well-controlled and perhaps the least important variable.

Regarding cortex, the core-reduction flakes, when combined with data from complete decortication flakes, display the normal range of dorsal-surface coverage in assemblages where the full range of core reduction took place at one location (Table 15). That is, the majority of flakes lack cortex, and each category up to and including full coverage (100 percent dorsal cortex) has progressively fewer examples. The estimation of dorsal cortex does not include the striking platform.

Striking platforms provide information on the skill, methodicalness, and sophistication of the knapper. Skill, methodicalness, and sophistication result in more efficient use of the material and greater success in obtaining tools with the desired characteristics. *Cortical*, *single-flake-scar*, and *multiple-flake-scar* platforms are the simplest and allow for the least control over flake detachment. *Pseudo-dihedral* platforms, while probably at least partly opportunistic, are platforms whereon the flake-detaching blow was aimed at the tiny ridge created by two flake scars or a flake scar and cortex. These ridges provide a restricted aiming point, thereby helping the knapper control flake size and shape. The same is true of *pointed* platforms, a more pronounced ridge that may or may not have been produced intentionally. The *faceted* platform is perhaps the most sophisticated type in the LA 83772 assemblage. This platform was carefully prepared by removing a series of small, parallel flakes from the platform edge to produce a slightly domed platform surface. The dome restricts the amount of surface area contacted by the hammer or billet, thereby centering the force of the blow and providing more control on flake size and shape. The range and proportions of platform types in a flake assemblage, then, provide a rough index of the inventory of knapping skills and give insight into the requirements for the chipped stone artifact inventory.

The majority of striking platforms on LA 83772 core-reduction flakes are simple (Table 16), indicating more concern with expediency than with control. Single-flake-scar platforms are the most common, followed by cortical and multiple-flake-scar types. Examples of pseudo-dihedral platforms, pointed, and faceted are present, indicating a familiarity with the more sophisticated procedures, but the purposes of the knappers were generally satisfied with the simpler techniques.

Flake termination type, as evidenced by the distal edges of flakes, provides a rough index of core-reduction and flake-production success. *Feathered edges* are highly desirable because they provide for continued use of the core and facilitate the manufacture of tools through further working of the individual flakes. *Modified-feathered* (or axial) terminations occur when a thick flake carries away a section of the opposite side of the core, resulting in a steep-angled edge that is difficult or impossible to work. In most cases, these flakes are probably intentional and were meant to help reconfigure the core. *Hinged and stepped terminations* are unintentional and very disruptive to further use of the cores and flakes. Thus, high percentages of modified-feathered and hinged/stepped flake terminations indicate lower flake-detachment success and greater waste of material.

In the LA 83772 assemblage, less than two-thirds of the core-reduction flakes have feathered distal terminations (Table 17). Nearly a quarter of the flakes are hinged or stepped, and nearly 14 percent have modified-feathered terminations. Thus, the flake-detachment failure rate and the loss of material through the need to reconfigure cores at LA 83772 was rather high.

Angular Debris

Forty-six fragments of rock resulted from unplanned, irregular fractures during flake removal. Although an attempt was made to exclude them, a few flake fragments may be included in this category.

The size and weight ranges of angular debris are rather large (Table 18), as might be expected, and all major material groups are represented. Comparatively few (N=12, or 26.1 percent) display evidence of possible heat treatment (Table 19). Angular debris constitutes 6.6 percent of the lithic debitage.

Summary

The chipped stone industry at LA 83772 focused on the production of flakes for use as informal flake tools and for making formalized tools. The materials included a wide variety of locally available igneous rocks, the most popular being rhyolites of medium texture and cherts. Materials from outside the site region are limited to two small pieces of obsidian that may have come from the Mule Creek regional source (see discussion in Appendix 4).

The primary knapping technique employed was expedient, though more sophisticated techniques were known and used on occasion. A fair degree of success was achieved in producing flakes of standardized proportions, but the flake-removal failure rate--as gauged by flake terminations, minimal development of cores, and a high number of tested cobbles--was relatively high. In this regard, toughness of the materials was probably a major factor.

POLLEN AND FLOTATION ANALYSIS OF THREE EXCAVATION UNITS AT LA 83772: AN ANALYSIS OF SEDIMENT MIXING

Richard G. Holloway

Thirteen soil samples for pollen analysis and twelve flotation samples were submitted to the Castetter Laboratory for Ethnobotanical Studies (CLES) at the University of New Mexico.

Methods and Materials

Palynological Methods

Chemical extractions of pollen samples were conducted using a procedure designed for arid southwestern sediments. This methodology, as detailed below, specifically avoids use of such reagents as nitric acid, bleach, and potassium hydroxide, which are destructive to pollen grains (Holloway 1981; Bryant and Holloway 1983).

Initially, 25 ml of soil were subsampled, and prior to chemical extraction, three tablets of concentrated *Lycopodium* spores (batch #710961, Dept. Quat. Geol., Lund, Sweden) were added to each subsample for a total of 41,733 marker grains each. This was done to permit the later calculation of pollen concentration values and, secondly, to serve as a marker against accidental destruction of the pollen assemblage by laboratory methods. Each sample was also weighed and the weight recorded prior to chemical extraction. The samples were initially treated with 35 percent HCl overnight to remove carbonates and to release the *Lycopodium* spores from their matrix. An overnight treatment is preferable so that the chemical can completely remove the carbonates. After neutralizing the acid with distilled water, the samples were allowed to settle for a period of at least three hours before the supernatant liquid was removed. Additional distilled water was added, and the mixture swirled and allowed to settle for five seconds. The suspended fine fraction was decanted from the original mixture through 195μ mesh screen into a second beaker. This procedure, repeated at least three times, differentially removed lighter materials, including pollen grains, from the heavier fractions. The fine material was concentrated by centrifugation at 2,000 RPM.

This fine fraction was treated with cold 49 percent HF overnight to remove silicates. After neutralizing the acid with distilled water, trisodium phosphate (Na_3PO_4, 2.5 percent) was added to each sample. This material was repeatedly washed out by rinsing with distilled water, followed by centrifugation at 2,000 RPM. This procedure removed fine charcoal and other associated organic matter, and the procedure was continued until the supernatant liquid was neutral after centrifugation. The residues were washed with glacial acetic acid to remove any remaining water in preparation for acetolysis.

Acetolysis solution (acetic anhydride and concentrated sulfuric acid in 9:1 ratio) was added to each sample, following Erdtman (1960). The tubes were heated in a boiling water bath for five minutes and allowed to cool down an additional five minutes before centrifugation and removal of the acetolysis solution. The samples were washed with glacial acetic acid to remove all traces of the acetolysis solution prior to multiple washes with hot distilled water. Centrifugation at 2,000 RPM for 90 seconds dramatically reduced the size of the sample and from periodic examination of the residue did not remove fossil palynomorphs.

The residues were treated with a heavy-density separation using zinc chloride (SG 1.99-2.00) to remove other, small, inorganic particles. The lighter, organic portion was removed by pipette, diluted with distilled water (10:1), and concentrated with distilled water. The residue was repeatedly washed with distilled water and centrifugation until the supernatant liquid was clear. The material was rinsed in methanol stained with safranin O suspended in a methanol solution. Three rinses with methanol effectively destained the samples, which were transferred to 2 dram vials with tertiary butyl alcohol (TBA). Subsequent washes (90 second centrifugation) with TBA effectively reduced the residue size of large samples by removing fine charcoal and organic materials. The samples were mixed with a small quantity of 1,000 centistoke (cks) silicon oil and allowed to stand overnight for evaporation of the TBA. The storage vials were capped and are in permanent storage at CLES. The unused portion of the sediment samples was returned to the Museum of New Mexico for curation.

A drop of the polliniferous residue was mounted on a microscope slide for examination under 18 X 18 mm cover slips, which were sealed with fingernail polish. The slide was examined using 250X or 400X magnification under an aus-Jena Laboval 4 compound microscope. A minimum count of 200 grains/sample was attempted for each sample, as suggested by Barkley (1934). After obtaining 200+ grain counts, the remainder of the slide was examined for the presence of cultigen pollen types such as *Zea mays, Cucurbita,* or members of the families Malvaceae, Cactaceae, or Nyctaginaceae.

Pollen concentration values were computed for each sample using the following formula:

$$PC = \frac{K * \Sigma_{H_T}}{\Sigma_{R} * S}$$

Where: PC = pollen concentration
K = *Lycopodium* spores added
Σ_p = fossil pollen counted
Σ_L = *Lycopodium* spores counted
S = sediment weight (grams)

Statistically, the concentration values provide a more reliable estimate of pollen abundance, since a minimum number of marker grains was counted rather than relying upon variable numbers of fossil grains. This is particularly evident in the treatment of rare types. Using pollen frequencies, rare grains are usually present in frequencies of 1 percent or less. Using concentration values, numbers of grains per unit weight can be directly compared from different proveniences. Thus, a more accurate interpretation can be made.

Pollen grains were identified to the lowest taxonomic level whenever possible. The majority of these identifications conformed to existing levels of taxonomy, but with a few exceptions. For example, the category cheno-am is an artificial, pollen-morphological category that includes pollen of the Chenopodiaceae (goosefoot) family and the genus *Amaranthus* (pigweed; Martin 1963), which are indistinguishable from each other. All members are wind pollinated (anemophilous) and produce very large quantities of pollen. In many sediment samples from the American Southwest, this taxon often predominates the assemblage.

Pollen of the Asteraceae (Composite) family were divided into four groups. The high spine and low spine groups were identified on the basis of microscopic spine length of the grains. High spine Asteraceae was defined as those grains with spines greater or equal to 2.5μ long, while the low spine group contained spines less than 2.5μ long (Bryant 1969; Martin 1963). *Artemisia* is identifiable to the genus level due to its unique morphology of a double tectum in the mesocopial (between furrows) region of the pollen grain. Pollen grains of Liguliflorae are also distinct in shape having a fenestrate type pollen grain. Grains of this type are restricted to the tribe Cichoreae, which includes such genera as *Taraxacum* (dandelion) and *Lactuca* (lettuce).

Pollen of the Poaceae (grass) family are generally indistinguishable below the family level, the single exception being pollen of *Zea mays*. All members of the family contain a single pore, are spherical, and have simple wall architecture. Identification of noncorn pollen is dependent on the presence of the single pore. Only grains or grain fragments containing this pore were tabulated as Poaceae.

Flotation Methods

The physical flotation was conducted by personnel of MNM, and only the light fraction was sent for analysis. The initial volume of material was measured and recorded. The material for flotation was placed in a plastic bucket filled with tap water. The heavier fraction was stirred and the light material removed using a wire strainer covered with organza cloth. This procedure was repeated a minimum of three (3) times or until no additional light fraction was released. When all the light organic fraction had been collected, the organza cloth containing the light fraction was tied and labeled and set in a drying rack to air dry.

After drying completely, the light fraction was passed through a geologic screen series consisting of #5, #10, #18, and #35 screens. The contents of each of these screens were placed in individual coin envelopes, and all size fractions from a single sample were placed within a plastic zip-loc bag and transported to CLES. The volume of each size fraction was recorded and the material examined using a stereoscopic zoom microscope (8X-40X magnification).

Identifications were based on comparisons with modern reference specimens housed in CLES and the Biology Department herbarium at UNM.

Results

Pollen Samples

The results of the pollen analysis are contained in Tables 20 and 21. Table 20 presents the raw pollen counts, and Table 21 provides the pollen concentration values for each sample.

Unit 0N/44E. The uppermost level (0-20 cm) contained the highest pollen concentration values of any level (1776 grains/g). The assemblage was dominated by *Pinus* (474 grains/g) and secondarily by cheno-am, high spine Asteraceae, and Poaceae pollen. The remaining three samples (20-40 cm, 40-60 cm, and 60-80 cm) from this unit all contained pollen concentration values below 1,000 grains/g. *Pinus* pollen was low (<60 grains/g) with traces of *Juniperus, Picea,* and *Quercus* pollen. These assemblages were dominated by cheno-am and Poaceae pollen, and all three contained low but consistent numbers of *Artemisia* pollen.

Unit 9S/44E. The upper two levels (0-20 cm and 20-40 cm) from this unit contained pollen concentration values in excess of 478 grains/g. *Pinus* pollen was low but peaked in the 20-40 cm level, and *Quercus* pollen was present in three of the four levels. The assemblages were dominated by cheno-am and Poaceae pollen with the consistent presence of low spine Asteraceae and *Artemisia* pollen. *Artemisia* was much higher in the 0-20 cm level than in the other levels from this unit. The lowest unit (60-80 cm) contained a trace of Platyopuntia type pollen.

Unit 18S/47E. This unit was somewhat variable in concentration values. None of the samples contained pollen concentration values in excess of 1000 grains/g. The assemblages were dominated by cheno-am, Poaceae, and high spine Asteraceae pollen. Low spine Asteraceae and *Artemisia* pollen was consistently present in low amounts. *Ephedra* pollen was present in three of the four samples.

Unit 2N/43E. Only a sample from the 80-85 cm level was submitted from this unit. The pollen concentration value was fairly low (725 grains/g). The assemblage was dominated by cheno-am and both high and low spine Asteraceae. *Pinus* pollen (127 grains/g) was slightly higher than in many of the other levels.

Flotation Samples

The volume recovery of the flotation data is presented in Table 22. With the exception of FS 346 (0-20 cm, 9S/44E) the light fraction consisted of only 1 percent or less of the original sample volume. FS 346 consisted of over 2 percent of the original volume. The results of the flotation analysis are presented in Table 23.

0S/44E. The majority of the samples contained uncharred plant debris. Three of the four samples contained small quantities of *Mollugo verticilata* (Indian chickweed) seeds. A small quantity of uncharred *Chenopodium* seeds were also recovered from the 20-40 cm level.

9S/44E. The upper two levels (0-20 and 20-40 cm) contained *Mollugo verticillata* seeds. The lower two samples contained primarily inorganic sand or silt-sized particles.

18S/47E. The upper sample (0-20 cm) contained only uncharred plant debris and a small quantity of charcoal fragments too small to identify. *Mollugo verticillata* seeds were present in the 20-40 and 60-80 cm levels. A small quantity of uncharred *Chenopodium* and Caryophyllaceae seeds were also recovered.

Discussion

One of the primary goals of this study was to determine the extent, if any, of the degree of mixing which had occurred between adjacent sampling intervals within any column. To this end, 0.95 confidence limits were calculated for the total pollen concentration values. The confidence limits were calculated by the formula:

$$\hat{u}(0.95\,limit) = \frac{\hat{u} + [(1.96)^{1/2}/(2n)] \pm (1.96)\sqrt{[\hat{u}(1+\hat{u})/n] + [(1.96)^{1/2}/(4n^{1/2})]}}{1 + [(1.96)^{1/2}/n]}$$

This formula is based on Maher (1981). The confidence limits provide a measure for a range of values from which the true proportion of the concentration values can be determined. Figure 18 illustrates the confidence limits of these concentration values by level for each of the excavation.

Further, Maher (1981) illustrates the practicality of using the null hypothesis. For any two samples for which the 0.95 confidence intervals have been calculated, the null hypothesis provides a vehicle for deciding if the pollen concentration values are too different to have come from the same population. In this case, the degree of mixing between adjacent samples can be inferred if the null hypothesis is accepted. The formulas used to test the null hypothesis are provided in Table 24. The calculations for this procedure were made using a computer program written in Basic and developed by Louis Maher (1981). Tables 25a and 25b provide the comparison data for these calculations.

Based on these calculations we can see a trend in the degree of mixing on a north-south axis from this site. The more northerly unit (0S/44E) shows the least amount of mixing, whereas the southern unit reveals almost a complete mixing of the four levels. Using Maher's (1981) criteria, the null hypothesis would be accepted if $(\log C_2 - \log C_1)_{min} \leq 0$ (Fig. 18). All samples recovered from unit 18S/47E *could* have been drawn from the same population. This indicates that quite a bit of sediment mixing may have occurred.

The data from unit 9S/44E shows that the null hypothesis would be accepted for each pair of adjacent samples. This suggests that differences between adjacent samples are slight. However, the 0-20 cm level is significantly different from the 40-60 and the 60-80 cm levels. Thus, the degree of mixing appears less than in the more southerly unit.

In unit 0S/44E, the majority of comparisons are positive, thus indicating rejection of the null hypothesis. The comparison between the 40-60 and 60-80 cm levels indicates they were drawn from the same population as is the comparison between the 20-40 and 60-80 cm levels. The upper level (0-20 cm) is significantly different from any of the other levels from this unit. This is not unexpected given the good degree of preservation from the surface level. Thus, this unit reveals the least amount of mixing observable from the study.

Figure 19 shows the variation in pollen concentration values among selected taxa by each excavation unit. The clustering of concentration values is much tighter in the 18S/47E unit than in either of the two more northerly units. This diagram supports the numerical analysis of the degree of mixing.

The flotation recovery was fairly weak overall. The majority of the material recovered consisted of uncharred plant debris and inorganic particles. Thus, quantification of the recovered material was not warranted. The only notable seed recovered was *Mollugo verticillata.* This species is a member of the Molluginaceae family (Cronquist, 1981) and is commonly represented by the common carpetweed. Hedrick (1972) notes the use of a different species of *Mollugo* as a common potherb from India, and it is likely that our species was used in a similar way. Lewis and Elvin-Lewis (1977) also report that extracts of this plant were used to control itching. However, from their description, it is unlikely that the seeds would have been preserved due to this process. Only traces of uncharred *Chenopodium* seeds and uncharred Caryophyllaceae (cf. *Silene*) seeds were recovered. Since they were uncharred, it is likely they were accidentally introduced. The distribution of the *Mollugo verticillata* seeds also suggests some degree of mixing occurred within these samples. They are a common component of the flotation material. However, there was not

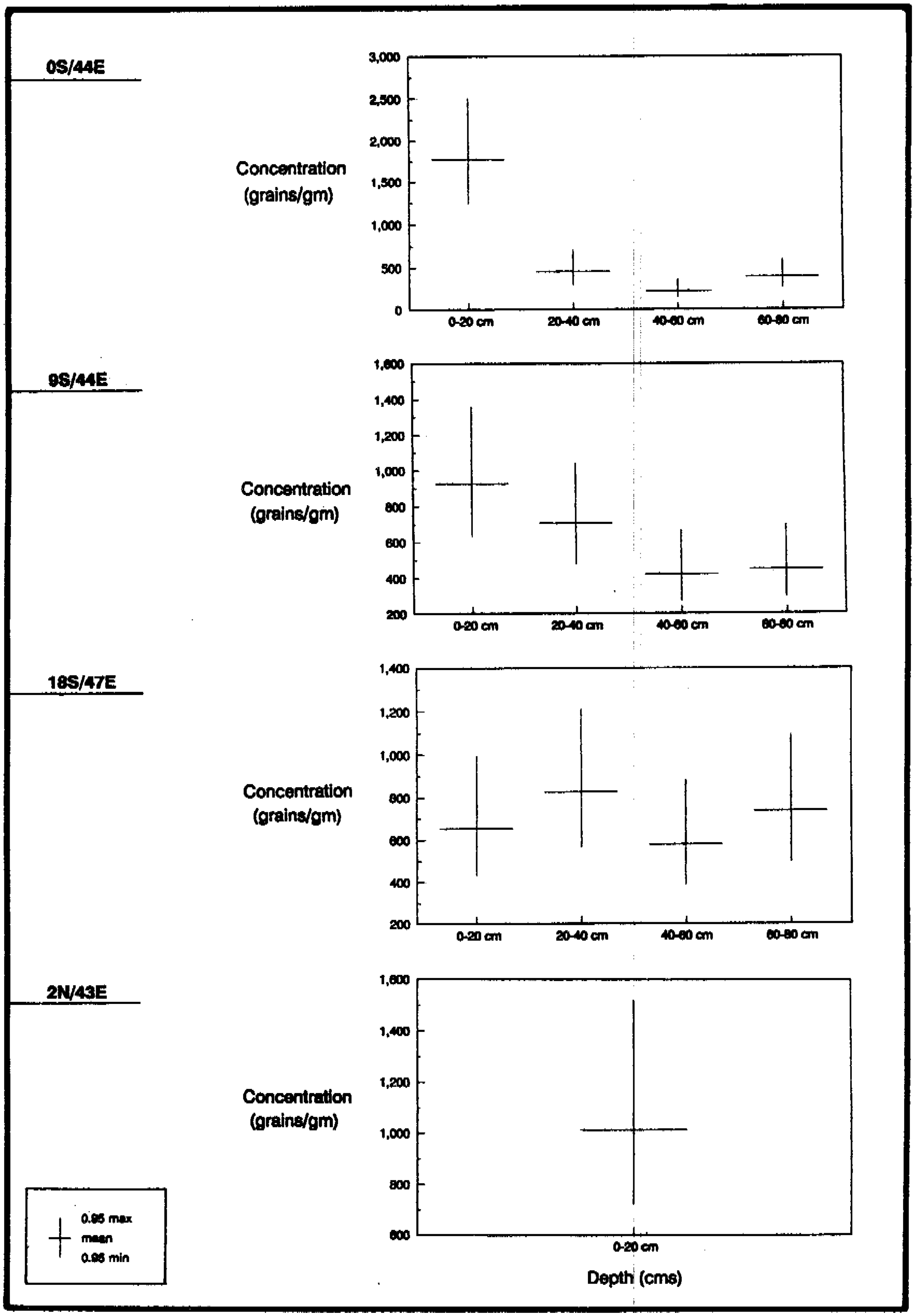

Figure 18. 0.95 Confidence limits for total concentration.

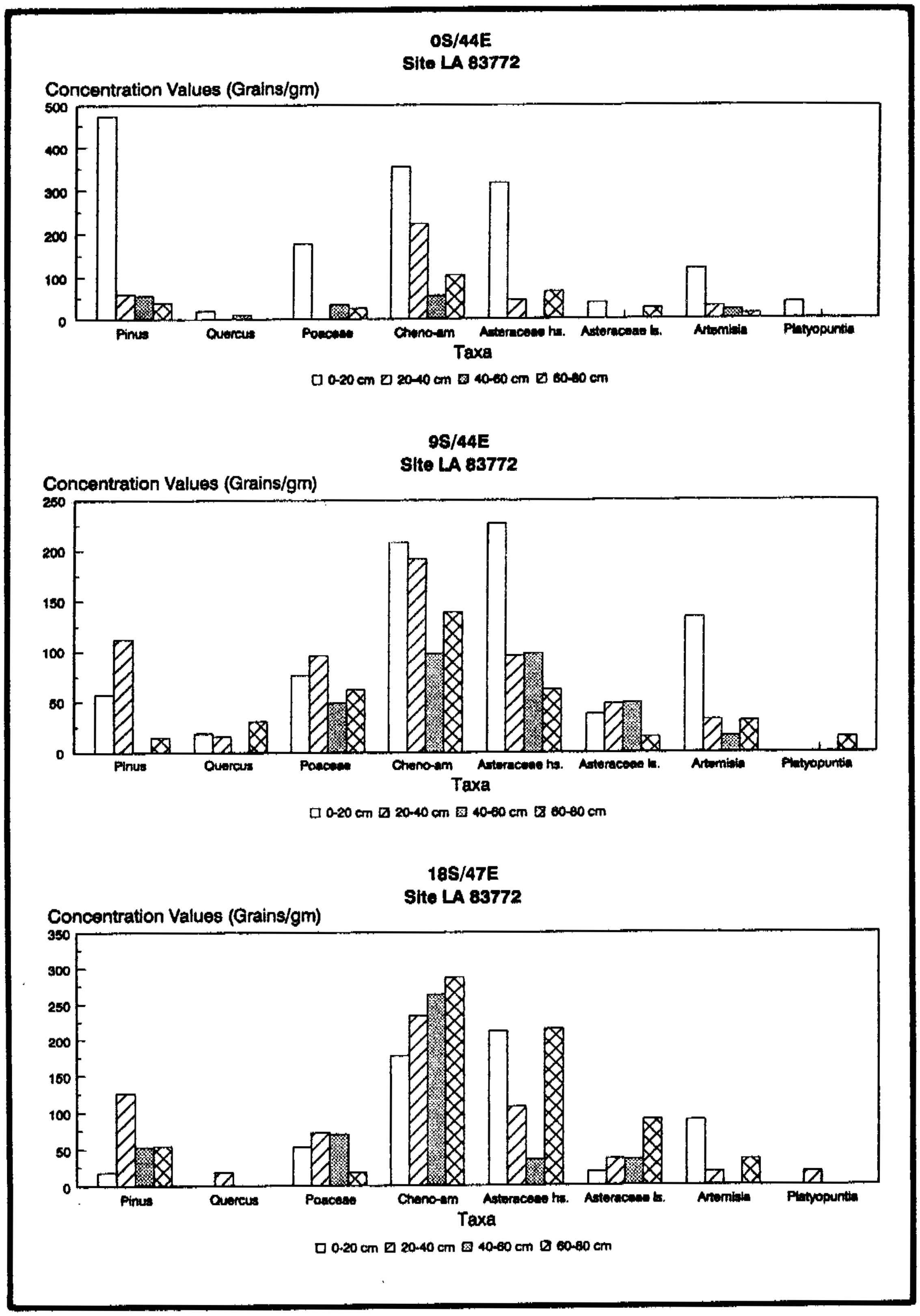

Figure 19. Comparison of pollen concentration values by excavation unit.

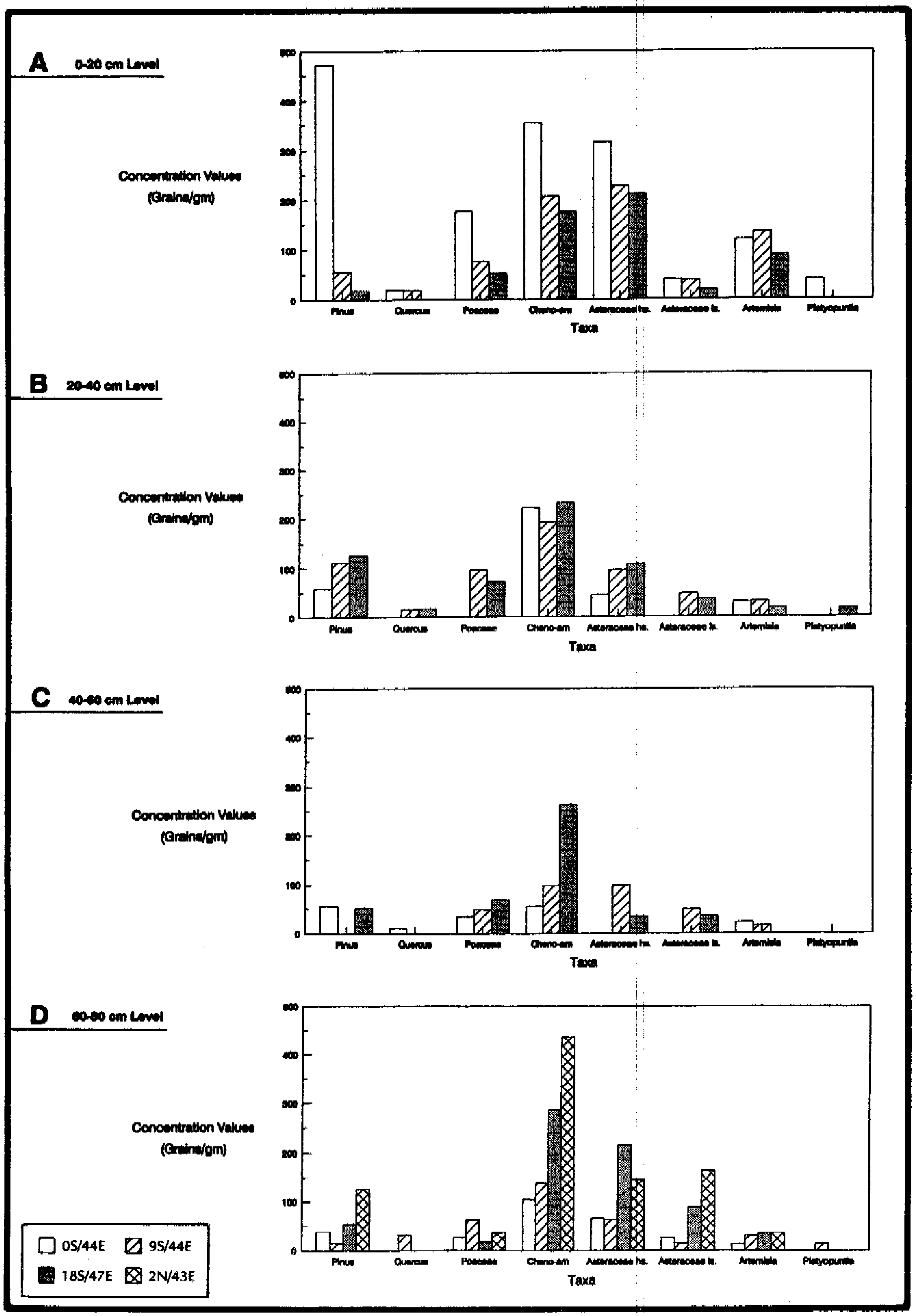

Figure 20. Comparison of pollen concentration values by level.

sufficient quantity to permit calculations of their distribution.

Finally, Figures 20a-20d compare the pollen concentration values of selected taxa by levels across excavation units. In general, the pollen concentration values in the 0-20 cm level are slightly elevated over the deeper levels. The taxa appear to be very close however, with the exception of the much higher overall concentration values recovered from 0S/44E. There is a close correspondence of the taxa throughout the study units. Cheno-am pollen tends to increase on a north-south axis, however, and both low spine and high spine Asteraceae tend to increase in the southerly units in the deeper levels. The distribution of the pollen concentration values does indicate that the three main study units are very similar, which is to be expected, given their proximity.

The presence of *Zea mays* pollen in the 60-80 cm level from unit 18S/47E is not unexpected given the age of both occupations. It could have come from the Early Pithouse period or the Mimbres phase, but its position in this, the most disturbed unit, does not allow assignment to one or the other. Since the presence of corn pollen was based on a single grain, I think the most we can say is that this taxon was present. The lack of corn macrofossils suggests that they were not preserved or that corn was not present in large quantities. At present, this remains unresolved.

Conclusions

Based on the analysis of the pollen and flotation data from this site there appears to be a trend (north-south) of increasing mixing of sediments. The statistical analysis of these data indicate that the 18S/47E unit is more homogeneous than either of the more northerly sites.

The presence of corn pollen was noted in unit 18S/47E. Only the presence of this taxon can be determined. No macrofossils of this taxon were recovered. This may reflect the small number of remains or the lack of adequate preservation. The ages of the two occupations are consistent with known ages of corn utilization. The small quantity of remains is surprising, however, and this aspect should be investigated. The only other evidence for food plants is derived from the presence of *Mollugo verticillata,* which was found in all three units. The presence of this taxon suggests reliance upon wild foods during both occupations.

FAUNAL REMAINS

Susan Moga identified the faunal remains using the system developed by Linda Mick-O'Hara for the Office of Archaeological Studies.

The 105 bones and fragments of animal bones were identified to the most specific taxonomic level possible (Table 26). Most are identifiable to only the level of genus (*Canis* and *Spermophilus*), order (Rodentia and Artiodactyla), or phylum (Mammalia and Aves). Mammalia fragments (N=70, or 68 percent), because of their large number, were further assigned to general size categories: small, medium, large, or indeterminate. Bones identifiable to species are, in order of frequency, jackrabbit, cottontail, ground squirrel, antelope, prairie dog, pocket gopher, cotton rat, and kangaroo rat.

Several aspects of the faunal assemblage warrant comment. The number of identified *burrowing* rodent species (N=5) is interesting in light of the bioturbation problems evident in the excavations. However, since none of the bones are relatively fresh, and no intact skeletons were recovered, we cannot demonstrate that any of the rodent bones are postoccupational intrusives. Nor can we demonstrate that the bones are cultural, because none are burned, have cut marks, or have other clear-cut evidence of cultural activity.

The ratio of large and medium mammal bone fragments to small mammal bones is four and one-half to one (45:10). Yet, in terms of bones identifiable to species, genus, and order, almost the opposite is true. The small mammals outnumber the medium and large ones by nearly four to one (26:7). Looking at taphonomic factors (Table 27), we see that the incidence of *clear-cut* human damage to mammal bones (burning and butchering) is low overall, involving only 12 percent of the total bones. Many more large and medium mammal bones are burned than small mammal bones, but overall, the percentage of burned large and medium mammal bones is much too low to account for all of the fragmentation. No cut marks were observed on any of the bones.

Two other types of taphonomic actions affect the condition of bones, but a variety of natural, as well as human, agencies may be the cause. Consumption by carnivores, rodents, and possibly humans (gnawing and passage through the digestive track) are fairly straightforward. In Table 27, all size groups closely approximate the total average of 8 percent, indicating that all categories of bone were about equally exposed in this regard.

Active and passive mechanical breakage (impacts and splitting) is the most common taphonomic factor observed in the mammal bones. Active breakage results from a myriad of natural, animal, plant, soil, and human processes, while passive breakage results from freeze/thaw and wetting/drying cycles. It is not surprising that, overall, half of the bones show some form of breakage not attributable to other sources. More importantly, twice as many large and medium mammal bones are broken (67 percent) as small mammal bones (33 percent). It should be noted that excavation damage was also monitored during the analysis but is not included among the tallies of observations here.

In summary, the fragmentation of bones recovered from LA 83772 appears to relate more to natural mechanisms than to cultural ones. One obvious source of this breakage is severe bioturbation, especially rodent burrowing, documented during excavation. If this assessment is accurate, the mammal bone size categories *from this site* cannot be readily interpreted from a cultural perspective. The presence of bones of several species of burrowing rodents lends additional weight to this argument.

If mammal bone size categories cannot be used as an index of human reliance on animals grouped by body size, we are left with the far fewer data available on animals identified to species, genus, or order. The situation is further complicated by the fact that at least two cultural components--Early Pithouse period and Mimbres phase--are represented in the assemblage, and the faunal materials belonging to each cannot be segregated for analysis. For this reason alone, we can say very little about the significance of the remains other than to note which species, genuses, and orders are present.

PHYSICAL ANTHROPOLOGY

Nancy J. Akins

Portions of at least three individuals were recovered from the excavations at LA 83772. These include an adult burial, scattered adult elements, and the remains of the burial of an 8 to 12 year old child.

Burial 1

Burial 1, the child, was in very poor condition. Exposed in the bank of the highway cut, the bones were previously excavated then thrown back into the hole.

Cranial parts include portions of both parietals, the right temporal, the sphenoid, the maxilla, and the mandible. All cranial parts were fragmentary. Six permanent teeth were found. Maxillary dentition consists of a left canine and a right second premolar, both with the roots almost completely formed. A left first premolar with the root almost completely formed, the completely formed crown of a right third premolar, and a left central incisor worn just to dentine represent the mandibular dentition. The final tooth is probably a premolar with most of the enamel missing. The stage of root development for the canine and premolars is consistent with that of a 12 year old child, plus or minus 30 months (Ubelaker 1978: Fig. 62).

No caries were observed on the teeth. The canine tooth has a single hypoplasia line on the upper third of the tooth. This portion of the canine develops during the fourth to sixth year of life (see Ubelaker 1978: Fig. 62). Hypoplasia lines are nonspecific indicators of metabolic and nutritional disruption. Rates of hypoplasia formation are generally high during the second and third years, when weaning occurs (Goodman et al. 1987:8, 17). A single line formed at a later age may suggest a incidence of nutritional or short-term metabolic disturbance for the child from LA 83772.

Postcranial parts consist of 18 unsided rib fragments, about a third of the shaft of a left femur, a fragment of a right patella, fragments of both tibiae and fibulae, two hand phalanges, and fragments of a tarsal, a metatarsal, and two first foot phalanges. In addition, there were over 150 unrecognizable long bone fragments and 20 flat bone fragments.

No measurements were possible on the fragmentary elements. Long bone size, when compared to aged skeletons from northwestern New Mexico, is consistent with individuals ranging from 7 to 10 years of age. The absence of anomalies or pathologies may be at least partially attributable to the condition and fragmentation of the elements.

Burial 2

The adult burial is more complete and in better condition. The bone is fragile and exhibits varying degrees of erosion. Root and rodent disturbance undoubtedly displaced many of the smaller elements and added to the breakage and disintegration of larger parts.

Cranial parts include portions of both parietals, both temporals, the occipital, the base, and the right mandibular condyle. No teeth were found with the burial, and the maxilla was completely missing or deteriorated. The trunk is represented by an almost complete atlas vertebra, a lumbar vertebra body, fragments of two thoracic or lumbar vertebrae bodies, the glenoid and acromion portions of the left scapula, parts of at least three left ribs, 26 unsided rib fragments, fragments of both ischia, and a partial left ilium.

The right arm is represented by a third of the radius shaft, half of the ulna shaft, one carpal (a scaphoid), and the fourth and fifth metacarpals. The left arm is represented by the distal end and partial shaft of the humerus, a complete left radius, and the proximal end and half of the shaft of the ulna.

The right leg is more fragmentary than the left. It consists of five shaft fragments from the femur and four from the tibia. The left leg is represented by the proximal and shaft portion and the distal end of the femur, a proximal fragment and the distal end and shaft of the tibia, much of the patella, and fragments of the calcaneus and talus. In addition to the recognizable parts, there were approximately 30 long bone shaft, 20 cancellous, and over 40 pieces of flat bone fragments.

Measurements were possible on several elements (Table 28).

Neither innominate was complete enough to determine the sex of the individual. The measurements are ambiguous. When compared with a population from Pecos Pueblo, the biepicylar width of the humerus is just within the female range (Bass 1987:154). The maximum diameter of the femur head falls just within the female range for the Terry collection (Bass 1987:220), within the male range for the OAS Lalata collection, and within the female range for the OAS LA 3333 collection. When the stature is estimated from the maximum length of the radius (using the formula for Mexican populations; Bass 1987:163), the estimate for this individual (159.5 $\pm$ 4.04 cm, or 5 ft and 3 inches) is closer to the male averages given by Stodder (1989:185) for a number of southwest populations. Females from 17 sites range from 148.0 to 162.0 cm, mean 153.0, SD 3.2; and males from 19 sites range from 154.9 to 169.3 cm, mean 162.7, SD 3.3. The age of the individual is also uncertain.

Evidence of degenerative arthritis is slight, suggesting a younger individual. Very slight marginal lipping was observed in the left hip, left ankle, and feet. Traumatically induced arthritis of the right elbow, consisting of small degenerative lesions on the distal humerus and proximal radius and ulna, is not indicative of age. The proximal ulna also has a moderate amount of marginal lipping, while the radius and humerus have only slight amounts. Given the overall lack of arthritic lipping and surface degeneration, trauma is the most likely cause of these particular lesions. Another instance of trauma is found in the left fibula shaft just above the distal end. It has a completely healed fracture with only a small callus of bone remaining.

The right parietal and the left ilium both have an interesting form of erosion. While this appears to be environmental deterioration of the outer bone table, it could also represent pathological destruction of the bone. Visually, the destruction on the parietal resembles porotic hyperostosis with no expansion of the diploe. Similar erosion occurs on the inner table, strongly suggesting an environmental origin. The innominate is missing the outer table in a 15 by 19 mm area with thin lacy margins.

Additional Human Bone

Several pieces of human bone were found in the vicinity of Burial 2, and some of these could easily have been transported by rodents. Elements include a part of a single rooted tooth, which is badly eroded with extreme wear and little remaining enamel; the shaft of metacarpal; two hand first phalanges, and a carpal. One of the hand phalanges and the metacarpal shaft are from an individual larger than Burial 2, indicating that at least one additional individual was interred in the area.

Conclusions

The sample of at least three individuals is much to small to draw conclusions on the population as a whole. The fragmentary nature of the burials and elements do not provide a lot of information on the health of the individuals.

DATING

Pottery

Few datable materials were recovered from the site. Pottery, in the form of Mimbres Black-on-white, demonstrates that one occupation, dating between A.D. 1000 to 1150, was present. A few sherds of this type and several more of Mimbres Corrugated were recovered from all depths of our excavations. Given the small sizes of sherds and the severe rodent disturbance throughout the excavations, we believe that the painted and corrugated pottery was introduced into the lower excavation units by rodent burrowing.

The very low percentage of late pottery types and dominance of Alma Plain suggested from the outset that the primary occupation in the eastern part of the site was earlier. This suggestion was strengthened by the observation that most of the Alma, unlike Alma from demonstrably later contexts (Late Pithouse period, for instance), has slightly rough to smoothed surfaces. Few sherds have streaky or overall polishing, but the treatment of even these sherds is decidedly less intense than that of later Alma. The pottery therefore seems to be early, an impression buttressed by the radiocarbon results.

We can look at the problem from another perspective--the vertical distribution of the various pottery types throughout the eastern part of the site (Tables 29 and 30). First of all, the sherds were concentrated in Level 2 (20-40 cm), with fewer in Level 3 (40-60 cm), and still fewer in Levels 1 (0-20 cm) and 4 (60-80 cm). Level 5 (80-83 cm and below floor level) yielded only a negligible number of sherds.

Mimbres Black-on-white and Mimbres Corrugated clustered in Levels 1 and 2, the stratigraphically correct position for late component sherds. We believe the few Mimbres Corrugated sherds recovered from Levels 3 and 4 got to these deeper levels through rodent burrowing.

The distribution of San Francisco Red, on the other hand, is different than expected. Although the type was made throughout most of the prehistoric period, it was more common in the Late Pithouse period. Breternitz's (1966) dates for San Francisco are A.D. 750-950, although these are not necessarily the beginning or ending dates for the type. Generally speaking, we would expect the San Francisco sherds to be concentrated in levels below those containing the two Mimbres types. As can be seen in the tables, this is not the case, for the majority of all three types are in the same levels.

The Ribbed Brown sherds are evenly scattered through the top three levels, with a single sherd recovered from Level 4. We believe that all of these sherds belong to a single vessel. If so, their distribution demonstrates a thorough mechanical mixing of the deposits.

We clearly have conflicting information. To what degree are these differences real? Are some correct and others not? Are the Mimbres Black-on-white and Mimbres Corrugated distributions reliable and those of the San Francisco Red and the Ribbed Brown not? Or, are all distributions and our beliefs about them real and indicative of vastly different degrees of disturbance or lack of disturbance on the microlevel?

Maps of the horizontal distribution of the Mimbres Black-on-white, Mimbres Corrugated, and San Francisco Red show that most sherds of all three types came from the northern half of the excavations east of the highway (Fig. 21). This is in general agreement with the fact that most pottery of all types came from the same part of the site. In all, 35 squares produced at least one of the three types, but only four produced both Mimbres and San Francisco sherds. Two of these squares produced what might be the expected norm, that is, the later Mimbres sherds were higher in the fill than the mostly early San Francisco sherds. The two examples fitting this expectation are 5S/43E, with a Mimbres Black-on-white sherd in Level 1 (0-20 cm) and a San Francisco Red sherd in Level 4 (60-80 cm), and 2N/43E, with two Mimbres Corrugated sherds in Level 1 (0-20 cm) and a San Francisco Red sherd in Level 5 (80-83 cm).

Less clear cut, but still "acceptable," are 1N/41E and 3S/43E. The former had a Mimbres Corrugated sherd in Level 2 (20-40 cm), and both a Mimbres Corrugated sherd and a San Francisco Red sherd in Level 3 (40-60 cm). The latter had both a Mimbres Corrugated sherd and a San Francisco Red sherd in Level 2 (20-40 cm).

4S/45E defies expectations in that Level 1 (0-20 cm) produced the San Francisco sherd, and Level 3 (40-60 cm) the Mimbres Corrugated sherd. But again, we are reminded that small numbers of San Francisco Red vessels evidently were made until the end of the Mimbres-Mogollon period, and we should therefore occasionally encounter these seeming discrepancies. After all, the White Signal sample is small, and a single sherd out of place, especially under conditions of bioturbation, should not be taken too seriously.

Radiocarbon

Three samples were submitted to Beta-Analytic for radiocarbon dating. All three came from the single juniper timber recovered from near the floor level in 1N/41E. The timber was 30 cm long with a minimum diameter of 7 to 8 cm. Although outer rings may have been missing, we believe that the number was small, perhaps no more than 5 to 10 rings. The timber was divided into three samples, two composed entirely of outer rings, and one composed only of inner rings. The inner-ring sample included heart wood, though we do not know what percentage. The timber was sampled in this manner was to provide a check on the results. Beta-Analytic was unaware that the samples were from the same timber until after the dates were in hand.

The results are interesting (Appendix 5). The two outer-ring samples, Beta-57895 and Beta-57896, are identical at 1770 B.P. (C13/C14 adjusted; uncalibrated), except for a slight difference in standard deviation. Both samples were given extra counting time to enhance precision. Surprisingly, the inner-ring sample yielded a more recent date, 1630 B.P. (C13/C14 adjusted; uncalibrated). This discrepancy remains even after calibration and cannot be readily explained. However, because all three dates overlap within two standard deviations, they are statistically the same and do not constitute a problem from the standpoint of usefulness.

The radiocarbon samples were calibrated individually and averaged in two different ways using the ATM10.14C file (Stuiver and Becker 1986) of the University of Washington's CALIB program (Table 31; Appendix 5).

The identical nature of the two outer-ring samples gives credence to the A.D. 245 date for the timber. However, one other reliability factor must be taken into account: the fact that the timber

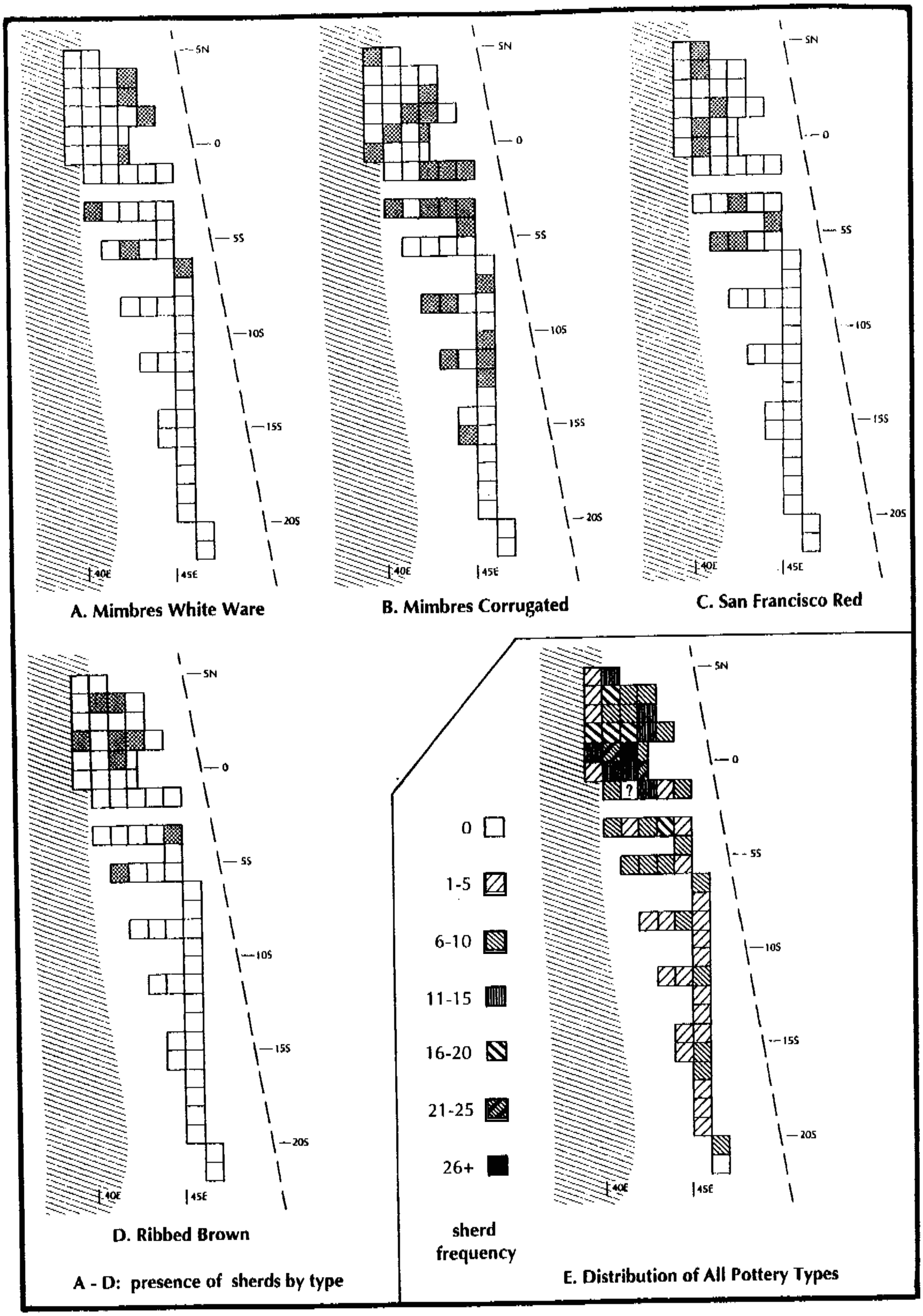

Figure 21. Comparative horizontal distributions of selected pottery types.

DISCUSSION

In this section, we discuss the project findings with respect to the questions posed in the data recovery plan. Additionally, the nature of the deposits presented an opportunity to assess the effects of bioturbation on the site, leading to implications for other sites in general.

Data Recovery Questions

Early Pithouse Period

(1) What are the structures, other features, and artifactual remains of an Early Pithouse period site?

The excavations at White Signal uncovered the remains of one pithouse and an assemblage of artifacts from both intramural and extramural locations, all east of the highway, where they were semi-isolated from the Mimbres phase component. Although a few Mimbres component sherds and perhaps some lithic debitage and animal bone strayed east of the highway, it seems likely that most of the artifacts recovered there belong to the Early Pithouse period. With this in mind, the character of the Early Pithouse period, as manifested in our excavations, can be described as follows. The reader should also keep in mind that this part of the site has been heavily disturbed by rodent burrowing, a factor that has had a decidedly negative effect on the quality of the data.

We can say little about the pithouse other than the probability that one existed at the north end of our excavations. Rodent disturbance destroyed the outline, the walls, most of the floor, and most of the hearth. While we are confident that a structure is present, the details of construction are essentially lacking.

The artifact inventory is relatively sparse, perhaps because of the nature and length of the occupation in this part of the site. Pottery sherds and lithic debitage comprise the bulk of the remains. Formal artifacts are few in number and include complete and fragmentary manos, metate fragments, a pestle fragment, a projectile point, and two pieces of jewelry. One-hand manos (N=10) and basin metates (N=7) are the most abundant formal artifacts. Informal tools are dominated by uniface-edged flakes developed through use-wear. Not surprisingly, the most readily-identifiable flake tools are made of chert, a material that has a molecular structure more amenable to use-damage than most igneous materials other than obsidian.

The three dates obtained from our excavations are from a single juniper timber that came from near the floor of the excavated pithouse. Of all the possible permutations, we believe that the range of A.D. 132 to 417 best characterizes the dating window of the pithouse and equates with Anyon et al.'s (1981) Cumbre phase. This date range confirms that at least some Early Pithouse period habitation sites were at low elevation and in nondefensible settings as predicted by Lekson (1989). It contrasts sharply with what LeBlanc (1983) has stated to be the normal situation--villages on high, defendable knolls and bluffs.

(2) What foods were eaten by the Early Pithouse period people? What species and what proportions of wild plant and animal species and domestic plants were used?

The only food-plant taxa noted in the flotation and pollen samples are corn and *Mollugo* *verticillata*. No macroremains were noted in the samples or in the fill during excavation. This list is too small to say more than that domestic and wild plants were used. The single corn pollen grain came from the south end of the excavations east of the highway. The location near the edge of the terrace is sufficiently far (16 m) from the pithouse that we cannot assume an association between the corn and the Early Pithouse period.

Eight species of mammals are identifiable in the faunal assemblage. At least three--pronghorn, jackrabbit, and cottontail--are the result of human predation. The remaining five species are burrowing animals that may or may not be cultural. The majority of bones are referable only to body size. Large mammals comprise 26 percent (N=27), medium mammals 17 percent (N=18), small mammals 10 percent (N=10), and indeterminate mammals 14 percent (N=15) of the total assemblage (N=105). Unfortunately, we have no way of knowing for certain which elements belong to the Early Pithouse period and which to the Mimbres phase.

Human remains were recovered, but the condition of the skeletal material does not warrant isotope studies related to subsistence type and mix. Although observations of pathology are limited because of element representation (many bones missing from each burial) and condition, none of the individuals display unusual or severe health problems. A canine of Burial 1 (12 year old child) has a single hypoplastic line, indicating nutritional or metabolic disturbance between 4 and 6 years of age. Pathologies in Burial 2 (adult of indeterminate age and sex) are evidently trauma-induced and therefore not related to nutrition. These are: (1) marginal evidence of degenerative arthritis in the left hip and leg; (2) trauma in the form of lesions and a healed fracture in the left leg; and (3) trauma-induced indicators in the right arm. This individual also has possible evidence of porotic hyperostosis in the cranium, although environmental factors cannot be ruled out at this time.

In summary, the subsistence evidence recovered by our excavations at LA 83772 is minimal and too spotty to address the data recovery questions concerning subsistence mix. We can say that hunted/gathered plants and animals and corn are represented. However, lacking clear-cut temporal associations, we cannot confidently assign the remains to one or the other period.

(3) Do the Early Pithouse period remains reflect seasonal occupations?

The subsistence evidence recovered by our excavations at LA 83772 is minimal and too spotty to address the data recovery questions concerning seasonality. No seasonality information (young animals, ageable large mammal remains such as teeth, etc.) is present in the faunal data. Only one corn pollen grain and no macroremains of corn were recovered. Lacking clear-cut temporal associations, we cannot confidently assign the remains to one or the other period. Also, no architectural evidence that might be attributed to seasonal occupation (plugged rodent burrows in structure floors, closely-spaced refurbishing of floors indicative of short occupational hiatuses, etc.) was found in the one, poorly preserved structure.

Mimbres Phase

(1) Is the pit structure exposed in the west face of the highway cut a ceremonial structure?

The stain outlined in the west cutbank was not a structure or other prehistoric cultural feature.

(2) What foods were eaten by the Mimbres phase people?

Although some of the subsistence remains (animal bone, plant pollen, etc.) recovered during the excavations probably belong to the Mimbres phase occupation, we are unable to assign specific remains to that phase. Instead, it is likely, based on the relative representations of pottery in the excavations and the location of the main excavations east of the highway (the Mimbres structures are located west of the highway), that the majority of the subsistence remains belong to the Early Pithouse period.

(3) Did the people of LA 83772 come from, or in some way belong to, the populations of the large river systems (specifically, the Gila or the Mimbres)?

We anticipated that the lithic debitage, pottery, and perhaps the formal artifacts, especially the materials from which they were made, would provide the answer to this questions. Among the lithic debitage and the formal artifacts, only two small pieces of obsidian could be identified as intrusive from outside the White Signal region. The obsidians include a nondescript fragment of a bifacial artifact and a biface thinning flake. Both are too small to permit sourcing by the more commonly available methods (x-ray fluorescence, for instance). That leaves visual identification, with the assistance of written descriptions (Shackley 1988), as the only recourse currently available. This method, though far from definitive, suggests that the LA 83772 obsidians came from the Mule Creek source region, along the New Mexico-Arizona border, some 80 km northwest of White Signal.

A typological study of the pottery from LA 83772 revealed the absence of readily identifiable intrusives in the assemblage. A petrographic study shows that the aplastic inclusions of LA 83772 sherds reflect the local geology, a geology that is quite similar across vast stretches of southwestern New Mexico, including the nearest sectors of both the Mimbres and Gila drainages. The clay-sourcing and refiring study, however, demonstrates the likelihood that most, if not all, of the LA 83772 pottery (both utility and painted) was made locally.

In summary, both the lithic materials and the pottery data show few connections with regions outside of the White Signal area. While these data do not definitively illustrate that the LA 83772 people constituted a population local to the White Signal area that was at least semi-independent of the populations residing in the larger river valleys, they do make an important first step. Accordingly, it is also unlikely that the White Signal peoples engaged in a seasonal round that took them into northern Mexico during one part of the year, as Lekson has suggested.

(4) How old are the Mimbres phase remains at LA 83772?

No chronometric dates were obtained for the Mimbres phase component at LA 83772. Accordingly, we are unable to directly date this specific manifestation of the Mimbres and thereby refine our temporal knowledge of this hinterland location. We are also not in a position to assess some of the temporal incongruities listed in the data recovery plan (see introductory section of this report). To do this, we need primary dates specific to the site. Pottery provides general dating but relies on previously established dates in the more central Mimbres areas.

(5) Was the occupation at LA 83772 seasonal?

No seasonal information on the Mimbres phase was recovered by our excavations. We did not encounter identifiable Mimbres phase structures and deposits, nor could we confidently assign the faunal material we did recover to either occupation represented in our excavations.

Bioturbation Study

Prior to the excavations, we had not anticipated finding so much direct evidence of rodent burrowing in the site. All archaeologists encounter occasional open rodent burrows. More commonly, we find some evidence for this kind of disturbance in the form of backfilled burrows. But rarely does one encounter a site with deposits that are best characterized as Swiss cheese. This was the case in the sector we excavated at LA 83772, and it provided an excellent laboratory for demonstrating the effects this form of disturbance has on the deposits. It is one thing to have some direct evidence of bioturbation (most sites do), but quite another to have abundant visual evidence of mixing on a wide scale. The problem, then, was to come up with a reliable method for assessing degree of mixing in the more typical situation, in which some visual evidence is present, but the archaeologist suspects the problem is more serious than the visual evidence suggests.

R. Holloway (this volume) came up with a formula that uses pollen for assessing degree of mixing in deposits. His results are most gratifying. His data consisted of three series of samples taken in three columns, one each from the north, middle, and south sectors of the excavated area east of the highway. His results confirmed that all columns showed mixing. However, the *degree* of mixing varied. The south column shows the most mixing, the middle column less mixing, and the north column the least mixing. The south column was near the edge of the terrace in a south-facing situation, and the middle and north columns were successively farther away. It should be noted, though, that all columns were about equidistant (2-3 m) from the existing highway cut, which may be in part responsible for the generally high degree of rodent activity encountered in all of the excavations east of the highway.

SUMMARY AND CONCLUSIONS

Recent excavations at LA 83772 for the New Mexico State Highway and Transportation Department exposed an Early Pithouse period pithouse and two human burials of uncertain age. The structure demonstrates the existence of Early Pithouse period habitation sites in low, nondefensible settings. This contradicts one of the more prevalent views of early Mogollon prehistory (LeBlanc 1983) and now requires a reassessment of Early Pithouse period settlement, subsistence, and social patterns.

A study of potential pottery clay sources and sherd refiring studies indicate that local manufacture of both utility and painted potteries was possible and very likely. One of the key points to be addressed by this project was to establish whether the prehistoric White Signal occupation was a seasonal extension out of the more central, higher-populated Gila or Mimbres river valleys. The manufacturing locale of pottery might provide one key to this question, assuming that some or all of it would be brought from the home villages to seasonal locations. The finding that all of the White Signal pottery was probably made in the White Signal area supports the notion that the White Signal population was locally based. Unfortunately, we did not recover seasonal data that would allow us to assess the full nature of the White Signal occupation.

The finding that the LA 83772 deposits were demonstrably highly disturbed by rodent burrowing provided a unique, unanticipated opportunity to employ plant pollen to assess degree of disturbance using laboratory techniques. What makes LA 83772 especially important is that we were able to visually assess how seriously the deposits were disturbed and thereby provide another line of evidence by which to assess the results of the pollen study. Although evidence of bioturbation is often encountered in archaeological sites, the severity of it is often masked by the lack of all but a limited number of clearly defined markers. Clearly, a pollen study such as Holloway's (this volume) provides one avenue in assessing the severity of such disturbance in the absence of more direct evidence and which parts of a site are more disturbed than others.

The LA 83772 case is particularly helpful in this regard, for the excavation profiles amply demonstrate that both open (in-use) and closed (rodent-backfilled) burrows permeate the site. We believe this is the case because the site fill is a relatively coarse-grained, residually formed soil that apparently retains the shapes of rodent intrusions to a greater degree than finer-textured soils. The observations of the severity of rodent intrusion are buttressed by the pollen study, which was also able to assess the relative severity of disturbance from one part of the site to another.

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APPENDIX 2: BRANDON JONES COLLECTION OF CHIPPED STONE ARTIFACTS FROM PRIVATE LAND AT LA 83772

Figure No.	Type	Material	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	MSW (mm)	Remarks
12a	transitional dart	dark brownish gray siltstone	27	14	5	1.3	9	complete; may not be a finished artifact
12b	transitional dart	black and dark red-brown chert	30	17	6	3.4	10	complete
12c	transitional dart	coarse dark red and gray chert	35	19	5	4.3	14	corner of base missing
12d	transitional dart	white chalcedonic chert	21	15	5	1.4	12	reworked blade; complete
12e	arrowpoint	coarse black chert	32	18	5	2.3	8	tip and one tang missing
12f	arrowpoint	purple-gray chert	34	16	6	1.8	8	corner and part of tang missing
12g	arrowpoint	yellow, red, black, white dappled chert	33	12	4	1.3	8	complete
12h	arrowpoint	clear chalcedony with white clouds	36	13	4	1.5	8.5	waxy luster; base missing; side-notched
12i	transitional dart	speckled brown-gray igneous (?) siltstone (?)	48	24	8	7.9	14	reworked tip; lower 60% of blade edges ground; tip missing
12j	transitional dart	coarse white and red chert	42	21	7	4.6	11	tip missing
12k	transitional dart	light gray and brown chert	39	25	7	5.7	14	reworked tip; tangs and part of base missing
12l	transitional dart	[?]	39	22	9	4.7	11	complete
12n	transitional dart	light gray and red dappled rhyolitic chert	36	20	6	3.6	12	probably complete
12o	biface/ preform	purple-gray rhyolite	60	29	12	18.6	23	may not be a finished artifact (thinning problems); complete
12p	biface/ preform	medium gray-brown chert	57	54	10	12.9		thinning problems; complete
12r	preform	dark brown-red cherty sandstone	21	16	5	1.7		complete
12s	dart point	light gray chert with red banding	41	24	7	5.9	18	not alibates material; both corners of base missing
12t	dart point	purple-gray rhyolite	34	21	6	3.9	16	part of base missing

MSW = minimum stem width
Note: A "transitional dart" is a diminutive dart point that may represent the very end of the period of use of the atlatl, or an early arrowpoint form, or the continued use of the atlatl alongside the bow and arrow.

APPENDIX 3: SOURCES OF WHITE SIGNAL CLAY ANALYSIS
(color notations according to Munsell 1954)

Sample 1 is from a weathered colluvial deposit near turn of Gold Gulch road south of White Signal. Deposit is white to gray in color.
Form: Chunky; fair plasticity
Natural Color: Pale brown (10 YR 6/3)
Refired Color: Light reddish brown (2.5 YR 6/4)
Inclusions: Angular inclusions and sandstone

Sample 2 is clay on upper part of road south of White Signal.
Form: Chunky; very good plasticity
Natural Color: Reddish yellow (7.5 YR 7/8)
Refired Color: Pink (7.5 YR 8/4)
Inclusions: Small light to gray angular fragments

Sample 3 is a clay slightly below road-cut near Sample 2.
Form: Chunky; poor plasticity
Natural Color: Pinkish gray (7.5 YR 6/2)
Refired Color: Light red (2.5 YR 7/6)
Inclusions: Light angular fragments

Sample 4 is tuff on lower part of road-cut by C Bar road-cut.
Form: Chunky
Natural Color: White (2.5 Y 8/0)
Refired Color: Very pale brown (10 YR 8/4)
Inclusions: None

Sample 5 is a recent deposit on top of roadcut north of Lordsburg.
Form: Chunky; good plasticity
Natural Color: Brown (7.5 YR 5/2)
Refired Color: Red (2.5 YR 5/6)
Inclusions: Sand

Sample 6 is a clay along upper ditch exposure near White Signal.
Form: Chunky; fair plasticity
Natural Color: Brown (7.5 YR 5/4)
Refired Color: Pink (5 YR 7/4)
Inclusions: Angular, white, gray, and pinkish rock

Sample 7 is an alluvial clay along road cut by Tullock Peak near White Signal.
Form: Chunky; fair plasticity
Natural Color: Brown (7.5 YR 5/4)
Refired Color: Red (2.5 YR 5/6)
Inclusions: White angular fragments

Sample 8 is a tuff layer north of Tullock Peak near White Signal.
Form: Not plastic
Natural Color: White (2.5 Y 8/0)

Refired Color: Very pale brown (10 YR 8/4)
Inclusions: None

Sample 9 is north of White Signal and consists of white tuff clay behind roadcut.
Form: Very soft, easily-eroded chunks
Natural Color: White (2.5 Y 8/0)
Refired Color: White (2.5 Y 8/1)
Inclusions: Angular fragments

Sample 10 is from same location as the previous sample. It is a purple clay above white ash behind roadcut.
Form: Chunky; good plasticity
Natural Color: Red (10 R 5/6)
Refired Color: Red (10 R 5/6)
Inclusions: Almost none

Sample 11 is from the same location as the previous sample. It is a purple clay on top of roadcut near Sample 3.
Form: Chunky
Natural Color: Pink (5 YR 7/3)
Refired Color: Yellowish red (5 YR 5/6)
Inclusions: Angular white rock

Sample 12 is from the same location as the previous sample. It is a weathered white tuff associated with same roadcut as the previous sample.
Form: Very soft; chunky
Natural Color: White (2.5 Y 8/0)
Refired Color: White (2.5 Y 8/2)
Inclusions: None

Sample 13 is weathered white ash near Bayard.
Form: Powdery
Natural Color: White (2.5 Y 8/0)
Refired Color: Very pale brown (10 YR 8/4)
Inclusions: None

Sample 14 is weathered soil clay on upper deposits by roadcut near Bayard.
Form: Chunky; fair plasticity
Natural Color: Light brown (7.5 YR 6/4)
Refired Color: Red (2.5 YR 5/6)
Inclusions: Large, numerous, angular igneous fragments

Sample 15 is a multicolored clay on top of roadcut on road to the Gila Clff Dwellings.
Form: Chunky
Natural Color: Mottled: light reddish brown, light reddish brown, pinkish gray, and white (2.5 YR 6/4; 5 YR 6/4; 5 YR 7/2; and 10 YR 8/2)
Refired Color: 2.5 YR 5/6 (red)
Inclusions: Angular igneous fragments

Sample 16 is soil clay along Gila drainage.
Form: Chunky; good plasticity
Natural Color: Dark gray brown (10 YR 4/2)
Refired Color: Red (2.5 YR 5/6)
Inclusions: White angular rock

Sample 17 is on the west side of highway 15 north of Silver City.
Form: Chunky; fair plasticity
Natural Color: Yellowish red (5 YR 5/8)
Refired Color: Red (2.5 YR 4/6)
Inclusions: Very tiny sparse angular fragments

Sample 18 is on the west side of highway 15 directly under Sample 17.
Form: Chunky; very good plasticity
Natural Color: Brown with white speckles
Refired Color: 5 YR 4/4 (reddish brown)
Inclusions: None

Sample 19 is near is near quarry along NM 15. Consists of white volcanic ash deposit.
Form: Powdery
Natural Color: White (2.5 Y 8/0)
Refired Color: White (2.5 Y 8/0)
Inclusions: None

Sample 20 is due north of Kneeling Nun.
Form: Powdery
Natural Color: White (2.5 Y 8/0)
Refired Color: Very pale brown (10 YR 8/4)
Inclusions: None

Sample 21 is near Grant County airport and represents third layer of dark brown deposit.
Form: Soft, crumbly, chunky; good plasticity
Natural Color: Brown to dark brown (7.5 YR 4/2)
Refired Color: Red (2.5 YR 5/6)
Inclusions: None

Sample 22 is located along NM 180; topsoil.
Form: Soft, chunky; good plasticity
Natural Color: Brown to dark brown (7.5 YR 4/2)
Refired Color: 2.5 YR 5/6 (red)
Inclusions: None

APPENDIX 4: CHIPPED STONE RAW MATERIALS

Over 90 percent of the raw materials used for making flakes and chipped stone artifacts are igneous, mostly rhyolitic, in origin. As explained in the text, we introduce terms normally used to describe the texture of sedimentary rocks to characterize grain sizes of the rhyolites. The purpose is to look at the quality of the materials for knapping purposes in terms more familiar to archaeologists. The terms also serve to highlight the fact that some of the materials border on being fine-grained granites. The texture categories are described below.

The texture categories were further subdivided into colors and combinations of colors in case actual sources are discovered. Colors also hold clues as to whether the material was thermally altered (heat treated) to improve fracture characteristics. It should be noted that several color categories cross-cut two or more texture categories, thereby indicating that some material sources contain a range of materials of variable knapping quality. The material categories are listed below, along with their computer code numbers.

The distinctions in textural differences are based on observations of the materials under ten power magnification of hand specimens. The differences between categories are not that clear cut, for we are dealing with a continuum rather than discreet categories. The same is true within categories.

In general, the term *rhyolite* refers to a light-colored igneous rock with individual crystals scattered throughout a fine crystalline matrix (Chesterman and Lowe 1979:684-685). The matrix is aphanitic, meaning that the crystal constituents cannot be seen with the unaided eye. The individual crystals, on the other hand, may range greatly in size and number but are readily observed with the unaided eye. In some cases, a flake lacks individual crystals, but we can be reasonably certain that the material is rhyolitic because it shares other characteristics of rhyolites in the assemblage. The terms *siltitic* and *quartzitic*, though not normally used in the description of igneous rocks, are used here to refer to the texture of the crystalline matrix, not the individual crystals. Although not necessarily important to geologists on the level used here, grain size has important ramifications for knapping rock into tools and other items.

Rhyolite

Materials attributed to this category generally conform to the above description. Texturally, the category, as used here, includes all rhyolitic materials not assigned to one of the other rhyolite categories. The fractured surfaces of these materials are definitely rough to the touch.

Rhyolitic Chert

This category includes rhyolites in which the matrix is dull (not shiny or waxy) and the crystals in the matrix are too fine to see individual crystals under 10 power magnification. The individual crystals are generally sparse. The fractured surfaces of these materials are somewhat rough to the touch and grade between chert and siltitic rhyolite.

Chert

Most, if not all, of the cryptocrystalline siliceous materials referred to as *chert* conform to fairly standard field-expedient criteria for cherts used by geologists and mineralogist. The finest examples usually have a slight luster, but many do not. Fractured surfaces have a characteristic roughness or coarseness that does not usually occur on sedimentary cherts. Most, if not all, are probably igneous in origin.

Chalcedonic Chert

These materials conform to the description of chert given above, except that they are slightly translucent on thin edges.

Chalcedony

Most, if not all of these cryptocrystalline siliceous materials conform to fairly standard field-expedient criteria for chalcedonies used by geologists and mineralogist. That is, they are cryptocrystalline siliceous materials with partial to nearly total translucence. Most or all of the LA 83772 examples are probably of sedimentary (i.e., nonlocal) origin.

Medium or Siltitic Rhyolite

Under 10 power magnification, the matrix of these rhyolites is characterized by tiny crystals that are reminiscent of mudstone and siltstone hand specimens. The grain sizes, of course, are much smaller than the particles of either sedimentary rock. As mentioned in the descriptions above, the cherts and chalcedonies under 10 power magnification show no crystals in the matrix because they are so much smaller and can be viewed only under much higher magnification.

Coarse or Quartzitic Rhyolite

The use of the word *quartzitic* for these rhyolites is something of a misnomer beyond the fact that the rocks are clearly igneous in origin. *Quartzitic* is used here to denote the rough texture of fractured surfaces, especially when viewed at 10 power magnification. The roughness probably derives from the crystalline structure of the matrix, but the crystals of the matrix are not as obvious as those in the siltitic rhyolites, even under magnification. The roughness of the fractured surfaces, however, has greater topographic microrelief than the siltitic rhyolites but generally less than in the materials classified here as rhyolites.

Other

The only material in this category requiring comment is obsidian. The two pieces of obsidian, one a tiny fragment of a biface and the other a biface thinning flake, are from the same source. To the unaided eye, the glass is essentially clear black with parallel streaks of black ash. They most closely resemble one of the varieties from the Mule Creek regional source of west-central New

Mexico and east-central Arizona (Shackley 1988:761-762). The Mule Creek region is 70 km northwest of LA 83772.

Lithic Raw Material Types Recognized in the Analysis

Code Description
No.

Rhyolite (fine)
10 light and medium gray/mauve-gray with flow lines
11 medium reddish-gray (mauve)
12 coarse white
13 light yellow-brown (burned/heat-treated #12?)

Rhyolitic chert
20 gray-brown and light gray mottled (similar to #31)
21 dark purple
22 purple and gray
23 red and white
24 light gray
25 orange

Chert
27 mauve
28 medium gray/gray-brown with red (not gray and red mottled)
29 light gray
30 coarse white
31 purple and gray mottled (may or may not be chalcedonic)
32 creamy detrital (microscopic angular fragments of various colors)
33 medium gray-brown and white rhyolitic
34 light brown
35 yellow or orange
36 medium gray and brown detritus cemented with white crystalline silica
37 light and medium gray/mauve gray with flow lines
38 dark gray-brown with curvilinear flow structure and white crystalline streaks
39 dark brown-gray

Chalcedonic chert
40 white rhyolitic with white and orange inclusions
41 light gray
42 light brown/gray-brown
43 white semi-opaque
44 light gray/gray-brown with yellow and red inclusions

Chalcedony
50 clear with white inclusions
51 light gray with black and white specks
52 white (burned and crazed)

53 red and gray mottled
54 clear with profuse red inclusions
55 clear with light reddish-brown inclusions
56 white and light gray
57 orange

Siltitic rhyolite
58 fine dark brown-gray
59 light brown and light gray with flow lines
60 medium gray or brownish-gray
61 dark gray
62 dark and medium gray banded
63 light gray
64 purple and gray mottled
65 mauve
66 white and light gray
67 off-white
68 black
69 medium or dark gray-green rhyolitic and non-rhyolitic
70 red and yellow
71 zoned medium gray and blackish-red with dendrites
72 black and with dendrites (possibly *not* rhyolitic)
73 dark purple and orange
74 dark red detrital and rhyolitic
75 dark brown

Quartzitic rhyolite
76 red and gray mottled
77 light gray
78 medium gray with or without sparse black mafic grains
79 dark green-gray

Indeterminate igneous
80 white dike rock with dendrites
81 dark gray-green granitic with hornblende laths
82 off-white granitic
87 light-colored (leucocratic)
88 intermediate-colored (mesocratic)
89 dark-colored (melanocratic)

Other

90 massive quartz
91 obsidian, clear black with lamellar black ash streaks
92 black basalt
93 medium and dark gray to gray-brown silicified wood
99 unknown/undifferentiated

APPENDIX 5: RADIOCARBON DATA

Calibration file(s): ATM10.14C

Beta-57895
Radiocarbon Age BP 1770.0 ± 70.0+ Reference(s)
Calibrated age(s) cal AD 245 (Stuiver and Becker)
cal BP 1705
cal AD/BC (cal BP) age ranges obtained from intercepts (Method A):
one Sigma** cal AD 133- 204(1817-1746) 207- 265(1743-1685)
268- 342(1682-1608) 374- 377(1576-1573)
two Sigma** cal AD 70- 410(1880-1540)

Summary of above --
minimum of cal age ranges (cal ages) maximum of cal age ranges:
one sigma cal AD 133 (245) 377
cal BP 1817 (1705) 1573
two sigma cal AD 70 (245) 410
cal BP 1880 (1705) 1540

cal AD/BC age ranges (cal ages as above) from probability distribution (Method B):
% area enclosed cal AD (cal BP) age ranges relative area under probability distribution
68.3 (one sigma) cal AD 134- 161(1816-1789) .13
166- 202(1784-1748) .19
209- 263(1741-1687) .31
275- 341(1675-1609) .37
95.4 (two sigma) cal AD 79- 119(1871-1831) .05
126- 409(1824-1541) .95

Beta-57896
Radiocarbon Age BP 1770.0 ± 50.0+ Reference(s)
Calibrated age(s) cal AD 245 (Stuiver and Becker)
cal BP 1705
cal AD/BC (cal BP) age ranges obtained from intercepts (Method A):
one Sigma** cal AD 174- 198(1776-1752) 215- 262(1735-1688)
278- 337(1672-1613)
two Sigma** cal AD 130- 390(1820-1560)

Summary of above --
minimum of cal age ranges (cal ages) maximum of cal age ranges:
one sigma cal AD 174 (245) 337
cal BP 1776 (1705) 1613
two sigma cal AD 130 (245) 390
cal BP 1820 (1705) 1560

cal AD/BC age ranges (cal ages as above) from probability distribution (Method B):

% area enclosed cal AD (cal BP) age ranges relative area under probability distribution
68.3 (one sigma) cal AD 144- 147(1806-1803) .02
171- 199(1779-1751) .18
213- 262(1737-1688) .37
277- 338(1673-1612) .43
95.4 (two sigma) cal AD 128- 391(1822-1559) 1.00

Beta-57897
Radiocarbon Age BP 1630.0 ± 60.0 Reference(s)
Calibrated age(s) cal AD 414 (Stuiver and Becker)
cal BP 1536
cal AD/BC (cal BP) age ranges obtained from intercepts (Method A):
one Sigma** cal AD 344- 373(1606-1577) 378- 434(1572-1516)
453- 466(1497-1484) 502- 514(1448-1436)
515- 531(1435-1419)
two Sigma** cal AD 256- 304(1694-1646) 320- 560(1630-1390)

Summary of above --
minimum of cal age ranges (cal ages) maximum of cal age ranges:
one sigma cal AD 344 (414) 531
cal BP 1606 (1536) 1419
two sigma cal AD 256 (414) 560
cal BP 1694 (1536) 1390

cal AD/BC age ranges (cal ages as above) from probability distribution (Method B):
% area enclosed cal AD (cal BP) age ranges relative area under probability distribution
68.3 (one sigma) cal AD 264- 271(1686-1679) .04
341- 374(1609-1576) .20
376- 437(1574-1513) .44
448- 472(1502-1478) .13
497- 533(1453-1417) .20
95.4 (two sigma) cal AD 256- 306(1694-1644) .10
316- 560(1634-1390) .90

Weighted average: Outer-Ring Samples (Beta-57895 and Beta-57896)

Radiocarbon Age BP 1770.0 ± 40.7
Calibrated age(s) cal AD 245 (Stuiver and Becker)
cal BP 1705
cal AD/BC (cal BP) age ranges obtained from intercepts (Method A):
one Sigma** cal AD 178- 195(1772-1755) 223- 260(1727-1690)
280- 292(1670-1658) 297- 325(1653-1625)
two Sigma** cal AD 131- 357(1819-1593) 370- 382(1580-1568)

Summary of above --
minimum of cal age ranges (cal ages) maximum of cal age ranges:

one sigma cal AD 178 (245) 325
cal BP 1772 (1705) 1625
two sigma cal AD 131 (245) 382
cal BP 1819 (1705) 1568

cal AD/BC age ranges (cal ages as above) from probability distribution (Method B):
% area enclosed cal AD (cal BP) age ranges relative area under probability distribution
68.3 (one sigma) cal AD 174- 197(1776-1753) .16
215- 261(1735-1689) .39
278- 294(1672-1656) .12
296- 336(1654-1614) .33
95.4 (two sigma) cal AD 132- 357(1818-1593) .98
371- 379(1579-1571) .02

Weighted average: All Samples (Beta-57895, Beta-57896, and Beta-57897)

Radiocarbon Age BP 1725.9 ± 33.7
Calibrated age(s) cal AD 261, 280, 293 (Stuiver and Becker)
297, 335
cal BP 1689, 1670, 1657
1653, 1615
cal AD/BC (cal BP) age ranges obtained from intercepts (Method A):
one Sigma** cal AD 251- 356(1699-1594) 370- 381(1580-1569)
two Sigma** cal AD 182- 191(1768-1759) 227- 409(1723-1541)

Summary of above --
minimum of cal age ranges (cal ages) maximum of cal age ranges:
one sigma cal AD 251 (261, 280, 293, 297, 335) 381
cal BP 1699 (1689, 1670, 1657, 1653, 1615) 1569
two sigma cal AD 182 (261, 280, 293, 297, 335) 409
cal BP 1768 (1689, 1670, 1657, 1653, 1615) 1541

cal AD/BC age ranges (cal ages as above) from probability distribution (Method B):
% area enclosed cal AD (cal BP) age ranges relative area under probability distribution
68.3 (one sigma) cal AD 256- 313(1694-1637) .56
315- 352(1635-1598) .36
.01
372- 379(1578-1571) .07
95.4 (two sigma) cal AD 181- 192(1769-1758) .02
227- 409(1723-1541) .98

References for data sets (and intervals) used:
Stuiver, M. and Becker, B, 1986, Radiocarbon, 28, 863-910.

Comments:

+This standard deviation (error) may include a lab error multiplier.
IF SO SPECIFY!
** 1 sigma = square root of (sample std. dev.^{2}+ curve std. dev.^{2})
2 sigma = 2 x square root of (sample std. dev.^{2}+ curve std. dev.^{2})
0* represents a "negative" age BP
1955* denotes influence of bomb C-14

APPENDIX 6: TABLES

Table 1. Manos by class and provenience

	West of Highway (Pithouse and/or Mimbres)	East of Highway (probably Pithouse period)	Totals
One-hand	2	6	8
Two-hand	1	1	2
Indeterminate	2	3	5
Totals	5	10	15

Table 2. Manos by class and material type

	Granite		Sandstone		Rhyolite	Totals
	White	Red	White	Dirty		
One-hand	4			2	2	8
Two-hand	1		1			2
Size unknown	5					5
Totals	10	0	1	2	2	15

Table 3. Metates and grinding stones by class and provenience

Type	West of Highway (Pithouse and/ or Mimbres)	East of Highway (probably Pithouse period)	Totals
Basin metate	1	7	8
Trough metate	2		2
Grinding stone		2	2
Totals	3	9	12

Table 4. Metates and grinding stones by class and material

	Granite		Sandstone	Basalt	Other	Totals
	White	Red*				
Basin metate	4	1	1		2	8
Trough metate		1		1		2
Grinding stone	1		1			2
Totals	5	2	2	1	2	12

* Red color may be the result of burning.

Table 5. Summary of use-wear length of flake tools

Use-Wear	Mean Length (mm)	Range (mm)	Standard Deviation	Number	Percent
Unifacial edges	9.72	5 - 25	5.48	18	69.2
Bifacial edges	10.40	5 - 18	-	5	19.2
Use-ground edge	33.00	-	-	1	3.8
Use-polished edge	16.00	-	-	1	3.8
Notch (see text)	-	-	-	1	3.8
Totals				26	99.8

Table 6. Summary of pottery

	East of Highway		West of Highway		Totals	
	N	%	N	%	N	%
Alma Plain:						
Rough variety	274	55	7	47	281	55
Regular variety	83	17	6	40	89	17
Eroded	84	17	1	7	85	17
Mimbres Corrugated	27	5	1	7	28	5
Ribbed Brown *	10	2.0	-	-	10	1.9
San Francisco Red	9	1.8	-	-	9	1.8
Mimbres Black-on-white	7	1.5	-	-	7	1.4
Tool-impressed brown	2	>1	-	-	2	>1
Possible Apache	2	>1	-	-	2	>1
Totals	498	99+	15	101	513	99+

* Although initially recorded as Three Circle Neck Corrugated, these sherds may be a variant of Mimbres Corrugated. All sherds may belong to a single vessel.

Table 7. Lithic debitage types by material group

Material Group	Flakes	Cores	Angular Debris	Totals	Percent
Medium rhyolites	353	15	25	393	55.2
Cherts	92	4	3	99	13.9
Fine rhyolites	48	3	3	54	7.6
Rhyolitic cherts	23	2	2	27	3.8
Chalcedonies	22	1	0	23	3.2
Coarse rhyolites	18	0	1	19	2.7
Chalcedonic cherts	14	0	1	15	2.1
Indeterminate igneous	28	2	5	35	4.9
Other	39	2	6	47	6.6
Totals	637	29	46	712	100.0

Table 8. Lithic debitage types by heat treatment category

Heat Treatment	Flakes	Cores	Angular Debris	Totals	Percent
No	453	15	34	502	70.5
Possibly	165	8	10	183	25.7
Probably	16	6	1	23	3.2
Yes	3	0	1	4	0.6
Totals	637	29	46	712	100.0

Table 9. Measurements of complete cores

Attribute	Number	Mean	Range	SD
Length (mm)	18	47.78	22 - 61	13.90
Width (mm)	18	65.28	31 - 89	19.67
Thickness (mm)	18	50.72	14 - 81	19.47
Weight (g)	18	232.35	11.6 - 598.6	173.93

Table 10. Material of cores and tested cobbles

Core Type	Number	Material
Single platform	8	Medium rhyolite
	1	Chert
	1	Rhyolitic chert
Two adjacent platforms	4	Medium Rhyolite
	1	Chert
	1	Fine rhyolite
	1	Rhyolitic chert
	1	Chalcedony
Three platforms	1	Medium rhyolite
Bifacial	1	Fine rhyolite
Tested Cobble	2	Medium rhyolite
	2	Chert
	1	Fine rhyolite
	2	Indeterminate igneous
	2	Other
Column Totals:		
Single platform	10	Medium rhyolite 15
Two adjacent platforms	8	Chert 4
Three platforms	1	Fine rhyolite 3
Bifacial	1	Rhyolitic chert 2
Tested Cobbles	9	Chalcedony 1
		Indeterminate igneous 2
Total	29	Other 2
		Total 29

Table 11. Flake types, frequencies, and percentages

Flake Type	Frequency	Percent
Core-decortication	69	10.8
Core-reduction	465	73.0
Platform-edge rejuvenation	10	1.6
Biface reduction (thinning)	21	3.3
Biface-notching	2	0.3
Indeterminate	70	11.0
Totals	637	100.0

Table 12. Flakes by material group

Material Group	Number	Percent
Medium rhyolites	353	55.4
Cherts	92	14.4
Fine rhyolites	48	7.5
Rhyolitic cherts	23	3.6
Chalcedonies	22	3.5
Coarse rhyolites	18	2.8
Chalcedonic cherts	14	2.2
Indeterminate igneous	28	4.4
Other	39	6.1
Totals	637	100.0

Table 13. Measurements of complete core-reduction flakes

Dimension	No.	Mean	SD	Range
Length (mm)	188	23.15	10.72	5 - 62
Width (mm)	188	24.35	10.65	9 - 73
Thickness (mm)	188	6.91	3.81	1 - 24
Weight (g)	188	5.43	10.44	0.1 - 82.8

Table 14. Correlation matrix (Pearson's r) of complete core-reduction flakes

	Length	Width	Thickness	Weight
Length				
Width	.76860			
Thickness	.73799	.82145		
Weight	.75770	.84339	.81084	

Table 15. Cortex coverage on dorsal surfaces of whole core reduction (N=188) and decortication (N=31) flakes

Dorsal Cortex Category	Number	Percent
0 0%	141	64.4
1 1 - 25%	27	12.3
2 26 - 50%	23	10.5
3 51 - 75%	15	6.8
4 76 - 99%	4	1.8
5 100%	9	4.1
Totals	219	99.9

Table 16. Platform types of whole core-reduction flakes

Striking Platform Type	Number	Percent
Single-flake-scar	72	38.3
Cortical	42	22.3
Multiple-flake-scar	31	16.5
Pseudo-dihedral	18	6.8
Pointed	6	9.6
Faceted (Old World sense)	1	0.5
Shattered/crushed	16	8.5
Unknown	2	1.1
Totals	188	100.0

Table 17. Core-reduction flake distal terminations

Flake Termination Type	Number	Percent
Feathered	116	61.7
Modified-feathered	26	13.8
Hinged and/or stepped	44	23.4
Uncertain	2	1.1
Totals	188	100.0

Table 18. Measurements of angular debris

Attribute	Number	Mean	Range	SD
Length (mm)	46	30.30	14 - 48	10.94
Width (mm)	46	20.78	7 - 37	7.35
Thickness (mm)	46	9.87	3 - 23	4.17
Weight (g)	46	6.24	0.2 - 32.7	6.29

Table 19. Angular debris by material type

Material Group	Number	Percent
Medium rhyolite	25	54.3
Chert	3	6.5
Fine rhyolite	3	6.5
Rhyolitic chert	2	4.3
Chalcedony	0	0
Coarse rhyolite	1	2.2
Chalcedonic chert	1	2.2
Indeterminate igneous	5	10.9
Other	6	13.0
Totals	46	99.9

Table 20. Raw pollen counts

FS Number	South	East	Level	Depth (cm)	CLES #	*Pinus*	*Juniperus*	Picea	Quercus	Onagraceae	Poaceae	Cheno-am	High Spine Asteraceae
300	2N	43	5	80-	93214	7					2	24	8
342	0	44	1	0-20	93190	24	1	1	1		9	18	16
343	0	44	2	20-30	93191	4		1				15	3
344	0	44	3	40-60	93912	5			1		3	5	
345	0	44	4	60-80	93913	3					2	8	5
346	9	44	1	0-20	93200	3			1	1	4	11	12
347	9	44	2	20-40	93204	7			1		6	12	6
348	9	44	3	40-60	93212						3	6	6
349	9	44	4	60-80	93213	1			2		4	9	4
350	18	47	1	0-20	93203	1					3	10	12
351	18	47	2	20-40	93202	7			1	1	4	13	6
352	18	47	3	40-60	93205	3					4	15	2
353	18	47	4	60-80	93201	3					1	16	12

Table 20. Raw pollen counts (continued)

FS Number	South	East	Level	Depth (cm)	CLES #	Low Spine Asteraceae	Artemisia	Platyopuntia	*Ephedra*	Indeterminate	*Zea mays*	Marker
300	2N	43	5	80-	93214	9	2			4		57
342	0	44	1	0-20	93190	2	6	2		10		53
343	0	44	2	20-30	93191		2			6		68
344	0	44	3	40-60	93912		2			4		90
345	0	44	4	60-80	93913	2	1			9		76
346	9	44	1	0-20	93200	2	7			9		58
347	9	44	2	20-40	93204	3	2			6		62

348	9	44	3	40-60	93212	3	1			7		65
349	9	44	4	60-80	93213	1	2	1		5		62
350	18	47	1	0-20	93203	1	5		1	4		56
351	18	47	2	20-40	93202	2	1	1	1	9		67
352	18	47	3	40-60	93205	2				6	1	66
353	18	47	4	60-80	93201	5	2		1	1		61

Table 20. Raw pollen counts (continued)

FS Number	South	East	Level	Depth (cm)	CLES #	Pollen Sum	Weight	Concentration	Lower 0.95 C.L.	Upper 0.95 C.L.
300	2N	43	5	80-	93214	56	40.4	1015	725.426	1523.973
342	0	44	1	0-20	93190	90	39.9	1776	1261.687	2500.315
343	0	44	2	20-30	93191	31	41.3	461	300.722	705.666
344	0	44	3	40-60	93912	20	41.4	224	137.865	363.982
345	0	44	4	60-80	93913	30	42.4	389	254.415	593.334
346	9	44	1	0-20	93200	49	38.0	928	632.876	1360.222
347	9	44	2	20-40	93204	44	42.0	705	478.185	1039.886
348	9	44	3	40-60	93212	26	39.5	423	267.725	667.106
349	9	44	4	60-80	93213	29	43.6	448	287.538	697.115
350	18	47	1	0-20	93203	37	42.1	655	431.430	994.286
351	18	47	2	20-40	93202	46	34.7	826	566.229	1204.130
352	18	47	3	40-60	93205	33	36.0	580	380.959	881.893
353	18	47	4	60-80	93201	41	38.1	736	494.541	1096.011

Table 21. Pollen concentration values

FS Number	South	East	Level	Depth (cm)	CLES #	*Pinus*	*Juniperus*	Picea	Quercus	Onagraceae	Poaceae	Cheno-am	High Spine Asteraceae
300	2N	43	5	80-	93214	127	0	0	0	0	36	435	145
342	0	44	1	0-20	93190	474	20	20	20	0	178	355	316
343	0	44	2	20-30	93191	59	0	15	0	0	0	223	45
344	0	44	3	40-60	93912	56	0	0	11	0	34	56	0
345	0	44	4	60-80	93913	39	0	0	0	0	26	104	65
346	9	44	1	0-20	93200	57	0	0	19	0	76	208	227
347	9	44	2	20-40	93204	112	0	0	16	16	96	192	96
348	9	44	3	40-60	93212	0	0	0	0	0	49	98	98
349	9	44	4	60-80	93213	15	0	0	31	0	62	139	62
350	18	47	1	0-20	93203	18	0	0	0	0	53	177	212
351	18	47	2	20-40	93202	126	0	0	18	18	72	233	108
352	18	47	3	40-60	93205	53	0	0	0	0	70	263	35
353	18	47	4	60-80	93201	54	0	0	0	0	18	287	215

Table 21. Pollen concentration values (continued)

FS Number	South	East	Level	Depth (cm)	CLES #	Low Spine Asteraceae	Artemisia	Platyopuntia	*Ephedra*	Indeterminate	*Zea mays*
300	2N	43	5	80-	93214	163	36	0	0	72	0
342	0	44	1	0-20	93190	39	118	39	0	197	0
343	0	44	2	20-30	93191	0	30	0	0	89	0
344	0	44	3	40-60	93912	0	22	0	0	45	0
345	0	44	4	60-80	93913	26	13	0	0	117	0
346	9	44	1	0-20	93200	38	133	0	0	170	0
347	9	44	2	20-40	93204	48	32	0	0	96	0
348	9	44	3	40-60	93212	49	16	0	0	114	0
349	9	44	4	60-80	93213	15	31	15	0	77	0
350	18	47	1	0-20	93203	18	89	0	18	71	0
351	18	47	2	20-40	93202	36	18	18	18	162	0
352	18	47	3	40-60	93205	35	0	0	0	105	18
353	18	47	4	60-80	93201	90	16	0	18	18	0

Table 22. Flotation Recovery

FS #	South	East	Depth (cm)	Volume	4.0 mm	2.0 mm	1.0 mm	0.5 mm	Total	Percent
342	0	44	0-20	1.0	1	3	3	3	10	0.01
343	0	44	20-40	1.0	1	5	3	3	12	0.012
344	0	44	40-60	1.0	1	3	3	3	10	0.01
345	0	44	60-80	1.0	3	1	1	1	6	0.006
346	9	44	0-20	0.9	3	5	7	10	25	0.027
347	9	44	20-40	1.0	1	3	3	5	12	0.012
348	9	44	40-60	1.0	3	3	3	1	10	0.01
349	9	44	60-80	1.0	3	3	3	5	14	0.014
350	18	47	0-20	1.0	5	5	10	10	30	0.03
351	18	47	20-40	1.0	3	3	3	3	12	0.012
352	18	47	40-60	1.4	1	3	3	3	10	0.007
353	18	47	60-80	1.0	3	3	3	3	12	0.012

Table 23. Flotation Results

FS #	South	East	Depth (cm)	Identification
342	0	44	0-20	uc Plant debris, I, FP, inorganic, charred *Mollugo verticillata*
343	0	44	20-40	uc Plant debris, CF, inorganic, uc Chenopodium <5, charred *Mollugo verticillata*
344	0	44	40-60	uc Plant debris, CF, Inorganic,
345	0	44	60-80	uc Plant debris, CF, charred *Mollugo verticillata* <5
346	9	44	0-20	uc Plant debris, CF, charred *Mollugo verticillata* <10
347	9	44	20-40	uc Plant debris, I, CF, charred *Mollugo verticillata* <10
348	9	44	40-60	uc Plant debris, CF, inorganic
349	9	44	60-80	uc Plant debris, CF, inorganic- > 90% inorganic
350	18	47	0-20	uc Plant debris, CF,
351	18	47	20-40	uc Plant debris, inorganic, uc Chenopodium <5, charred *Mollugo verticillata* <5
352	18	47	40-60	uc Plant debris, onorganic, uc Caryophyllaceae <5, uc Chenopodium <1,
353	18	47	60-80	uc Plant debris, CF, charred *Mollugo verticillata* <5

Table 24. A test of the hypothesis that the microfossil concentration is the same in two different samples

Given: 1. Confidence limits for samples' microfossil concentration

2. If 0.95 confidence intervals are involved, $Z=1.96$

3. Let C_2 represent the confidence interval with the larger mean concentration estimate RM/V, and let C_1 represent the confidence limit with the smaller mean estimate. Define the upper and lower confidence limits of C_2, respectively as $(C_2)_{max}$ and $(C_2)_{min}$; define the upper and lower confidence limits of C_1, respectively, as $(C_1)_{max}$ and $(C_1)_{min}$.

$$\overline{\log C_2}=[\log(C_2)_{max}+\log(C_2)_{min}]/2$$

$$S\log C_2=[\log(C_2)_{max}-\log(C_2)_{min}]/(2Z)$$

$$\overline{\log C_1}=[\log(C_1)_{max}+\log(C_1)_{min}]/2$$

$$S\log C_1=[\log(C_1)_{max}-\log(C_1)_{min}]/(2Z)$$

Test: To test whether the null hypothesis can be accepted at $p \geq 0.05$, $Z = 1.960$

$$(\log C_2-\log C_1)_{min}=\overline{\log C_2}-\overline{\log C_1}-Z[(s\log C_2)^2+(s\log C_1)^2]^{1/2}$$

Accept null hypothesis if $(\log C_2 - \log C_1)_{min} \leq 0$.
Reject null hypothesis if $(\log C_2 - \log C_1)_{min} > 0$.

Table 25a. NulConc-L. J. Maher program data as p value, pairs of samples

	300	342	343	344	345	346	347	348	349	350	351	352	353
300		0.008553	0.1128	0.40613	0.1878	-0.1771	-0.05983	0.1403	0.1198	-0.03702	-0.1248	0.01531	-0.08153
342			0.3489	0.6424	0.4237	0.059088	0.1765	0.3757	0.3554	0.1988	0.1113	0.2515	0.1544
343				0.032926	-0.1876	0.055243	-0.06532	-0.2345	-0.2553	-0.1062	0.006502	-0.1606	-0.04959
344					-0.03985	0.3496	0.2291	-0.01333	0.01606	0.1888	0.3007	0.1345	0.2451
345						0.13	0.009436	-0.2345	-0.2048	-0.03151	0.08127	-0.08586	0.02515
346							-0.1177	0.08254	0.06198	-0.09501	-0.1831	-0.0423	0.1397
347								-0.03796	-0.05855	-0.2155	-0.1664	-0.1628	-0.2228
348									-0.2516	-0.07855	0.0337	-0.1328	-0.02211
349										-0.09929	-0.06629	-0.1536	-0.04276
350											-0.1437	-0.2038	-0.1999
351												-0.09102	-0.1883
352													-0.1471
353													

Table 25b. NulConc–L. J. Maher program data as p value, by excavation unit

0S/44E				
	342	343	344	345
342		0.3489	0.6424	0.4237
343			0.0329	-0.1876
344				-0.0398
345				
9S/44E				
	346	347	348	349
346		-0.1177	0.08254	0.06198
347			0.03796	-0.05855
348				-0.2516
349				
18S/47E				
	350	351	352	353
350		-0.1437	-0.2038	-0.1999
351			-0.09102	-0.1883
352				-0.1471
353				

Table 26. Summary of faunal remains by taxon and frequency

Scientific Name	Common Name	Number of Fragments
	mammal, indeterminate size	15
	small mammal	10
	medium mammal	18
	large mammal	27
Order Rodentia	rodents	2
Spermophilus sp.	ground squirrels	4
Spermophilus spilosoma	spotted ground squirrel	1
Cynomys ludovicianus	black-tailed prairie dog	2
Thomomys bottae	Botta's pocket gopher	2
Dipodomys spectabilis	banner-tailed kangaroo rat	1
Sigmodon hispidus	Hispid's cotton rat	1
Sylvilagus audubonii	desert cottontail	6
Lepus californicus	black-tailed jackrabbit	7
Canis sp.	dog, coyote, wolf	3
Order Artiodactyla	even-toed hoofed mammals	2
Antilocapra americana	pronghorn	2
Aves	birds	2
Total		105

Table 27. Summary of taphonomic observations on mammal bones (all taxonomic categories combined)

	Burned		Cut Marks		Gnawed/Digested		Impacted/Split	
	N	%	N	%	N	%	N	%
Large/medium mammals (N=52)	9	17	0	0	5	10	35	67
Small mammals (N=36)	1	3	0	0	2	6	12	33
Indeterminate mammals (N=15)	2	13	0	0	1	7	6	40
Totals (N=103)	12	12	0	0	8	8	53	51

Table 28. Burial 2 measurements

Element/Side	Measurement	mm
scapula/left	glenoid cavity length	34.9
humerus/left	epicondyle breadth	55.8
radius/left	maximum length	222.0
	sagittal diameter	10.6
	transverse diameter	12.8
ulna/left	dorsal ventral diameter	11.9
	transverse diameter	13.5
femur/left	maximum head diameter	42.2
	subtrochanter sagittal diameter	20.6
	subtrochanter transverse diameter	28.1
tibia/left	anterior/posterior at nutrient foramen	33.1
	medial/lateral at nutrient foramen	18.6
	circumference at nutrient foramen	83.8
fibula/left	maximum diameter midshaft	15.6

Table 29. Vertical frequency distribution of pottery by type, east of highway

Level	Brown	Mimbres Corrugated	Mimbres Black-on-white	San Francisco Red	Ribbed Brown *	Totals
Level 1	82	12	3	3	3	103
Level 2	152	9	4	3	3	171
Level 3	122	3	-	1	3	129
Level 4	82	3	-	1	1	87
Level 5	7	-	-	1	-	8
Total number	445	27	7	9	10	498

* Possibly all one vessel

Table 30. Vertical percentage distribution of pottery by type, east of highway

Level	Brown	Mimbres Corrugated	Mimbres Black-on-white	San Francisco Red	Ribbed Brown *	Totals
Level 1	18	46	43	33	30	21
Level 2	34	32	57	33	30	34
Level 3	27	11	-	11	30	26
Level 4	18	11	-	11	10	17
Level 5	2	-	-	11	-	2
Total %	99	100	100	99	100	100

* Possibly all one vessel

Table 31. Calibrated radiocarbon dates from a single timber

Sample No.	Portion of Timber	Calibrated Dates	
		Intercepts	Ranges (2 sigma)
Beta-57895	outer-ring Sample #1	A.D. 245	A.D. 70-410
Beta-57896	outer-ring Sample #2	A.D. 245	A.D. 130-390
Beta-57897	inner-ring sample	A.D. 414	A.D. 256-560
Average of 57895/57896	2 outer-ring samples	A.D. 245	A.D. 132-357 (98%) A.D. 371-379 (2%)
Average of all three	2 outer-ring samples and 1 inner-ring sample	A.D. 261 A.D. 280 A.D. 293 A.D. 297 A.D. 335	A.D. 182-409