MUSEUM OF NEW MEXICO

OFFICE OF ARCHAEOLOGICAL STUDIES

ARCHAEOLOGICAL EXCAVATION AT LA 59497, ALONG STATE ROAD 264, MCKINLEY COUNTY, NEW MEXICO

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ADMINISTRATIVE SUMMARY

Between May 1987 and May 1988, the Office of Archaeological Studies, Museum of New Mexico, excavated a portion of LA 59497 and LA 55647 and conducted an ethnohistorical study on LA 55647, the Wildcat Springs Trading Post site, for the New Mexico State Highway and Transportation Department. Portions of the sites were within the right-of-way for a proposed widening project of State Road 264 in McKinley County. This report describes the excavations at LA 59497. LA 55647 is described in a separate report (Post and York 1992).

LA 59497 is a late Pueblo II masonry pueblo with an extensive midden deposit that extends into the highway right-of-way. The excavated portion of the midden yielded a large amount of discarded prehistoric artifacts, two extramural features, two formal human burials, and the scattered and mixed remains of four other individuals. Specialized artifact and sample analyses provided detailed information with which to interpret the artifacts and human remains in light of research questions proposed in the data recovery plan.

Submitted in fulfillment of Joint Powers Agreement FO0490 between the Office of Archaeological Studies, Museum of New Mexico, and the New Mexico State Highway and Transportation Department.

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CONTENTS

Figures

Tables

INTRODUCTION

Between August 1986 and May 1987, New Mexico State Highway and Transportation Department (NMSHTD) archaeologists identified four sites and one isolated occurrence within the right-of-way of State Road 264 in McKinley County, New Mexico. The NMSHTD proposed to widen State Road 264 to four lanes within the existing right-of-way (Fig. 1). Two sites, LA 59497 and LA 55647 (the Wildcat Springs Trading Post), were recommended for data recovery. This report presents the results of the excavations at the prehistoric site, LA 59497. The results of excavations and ethnohistoric research at LA 55647 are presented in a separate report (Post and York 1992).

The data recovery plan and subsequent archaeological and ethnohistorical data recovery efforts were proposed and performed by the Office of Archaeological Studies (OAS, formerly the Research Section, Laboratory of Anthropology), Museum of New Mexico. The principal investigator was Dr. David A. Phillips, Jr. The project director was Stephen S. Post. Field assistants included Sara Ann Noble and Charles A. Hannaford of OAS. Local labor was provided by three members of the Navajo Nation hired through the Tsa-ya-toh Chapter House.

LA 59497 is on Navajo Tribal Fee Title land, administered by the Navajo Nation. Site location data are in Appendix 8 (removed from copies for general circulation).

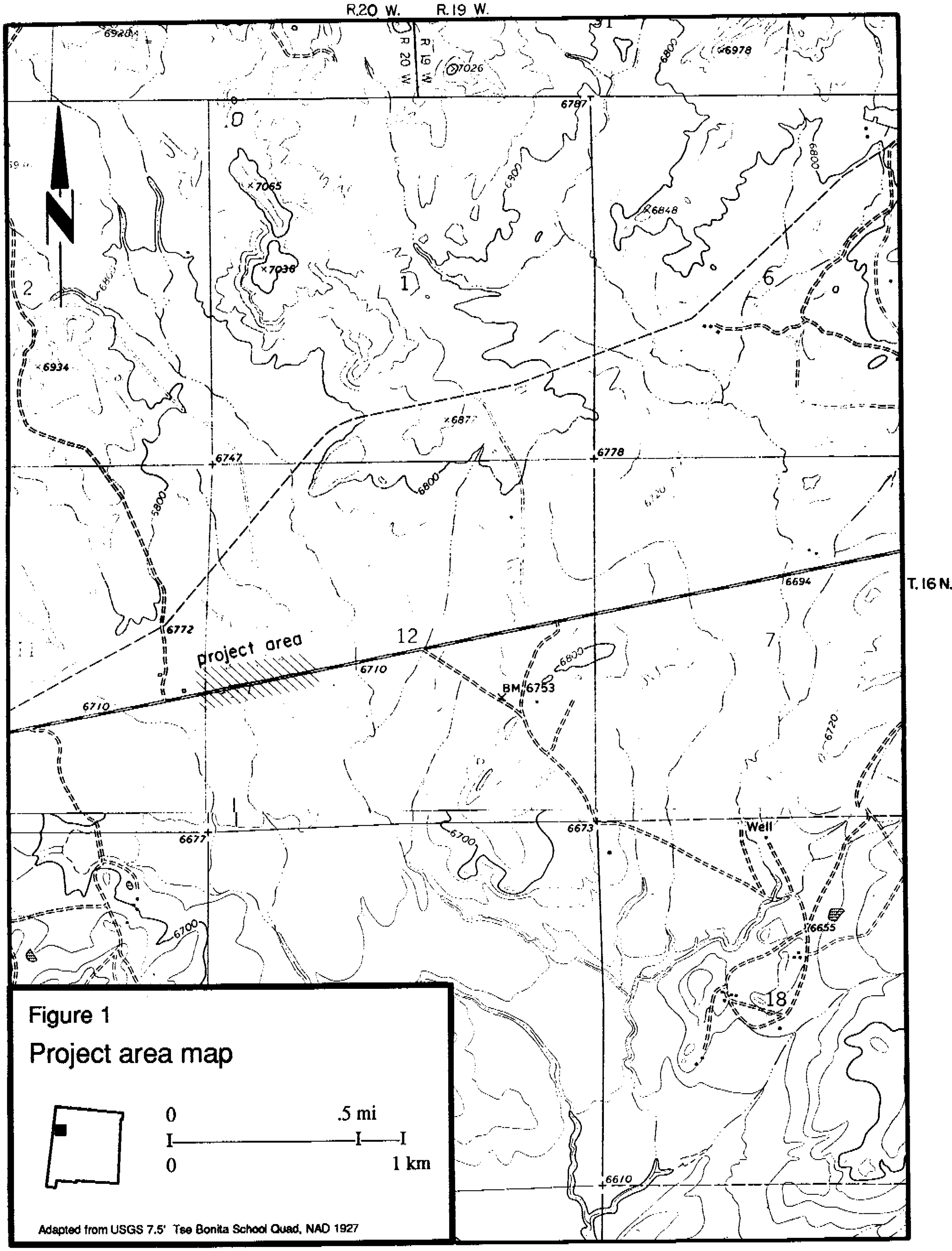

Figure 1
Project area map

ENVIRONMENT

Physiography

The road-widening project area is on the southern Colorado Plateau. The southwestern corner of the project area extends into the San Juan Basin (Fig. 2), the eastern portion of the project is located in the Gallup Sag or Gallup Syncline, and the western end of the project is located on the eastern side of the Fort Defiance uplift, which forms the western boundary of the San Juan Basin. The local geographic province is called the Manuelito Plateau and is characterized as a "series of flat-topped hills outlined by the 7000' contour" (Gregory 1916:27). The plateau lies between the Rio Puerco of the West (to the south) and the Chuska Mountains (to the north). Elevations range from 2,652 m (8,700 ft) in the Chuska Mountains to below 1,823 m (6,000 ft) in the valley bottoms (Hewett 1982:28).

LA 59497 is centrally located within the region. It is bordered on the east by an arroyo that flows out of the north from an area of broad, open valleys, and low broken mesas. Elevations in the immediate area range from 2,012 to 2,173 m (6,600 to 6,800 ft). The site is in a natural bowl that would drain a large area. It is well within the environmental zone that McKinley Mine investigators considered optimal for farming (Nelson and Cordell 1982).

Geology and Ground Water

The Gallup Sag is composed primarily of yellow and brown sandstones interbedded with blue and iron-gray shales. All of the formations contain varying amounts of coal. The principal rock formations are Dakota Sandstone, Mancos Shale, and the Mesaverde Group, in ascending order. Quaternary materials consist of unconsolidated sediments formed by alluvial, terrace, landslide, and eolian deposits (Cooley et al. 1969:17)

No perennial streams exist in the project area. The project area is drained by three main washes--Burned Death (east), Tse Bonita (central), and Sand Wash (west)--and the Defiance Draw. Waterflow and resulting soil movement depend on seasonal runoff from snow melt and rain showers. The soils are fine-grained sands and dark clays deposited by slow moving streams and ponds.

During human prehistory three major episodes of alluviation (followed by arroyo cutting) occurred. The first episode of alluviation occurred from 9000 to 5500 B.C. and is evidenced by soils that indicate a very wet climate with considerably more forest land. These contain *Bison occidentalis* bones and Folsom point types. This was followed by an Altithermal Interval from 4000 to 2500 B.C., a period of weathering, arroyo cutting, channel filling, and soil formation. The second episode occurred between 2000 B.C. and A.D. 1., characterized by floodplain aggradation and channel filling with as much as 50-100 ft of deposition possible. The third period of deposition occurred from A.D. 1200-1800 on the Colorado Plateau. The heavy arroyo cutting found in modern floodplains may be partly due to overgrazing and a trend towards heavy summer showers, but other factors may be involved (Hewett 1982:38-39).

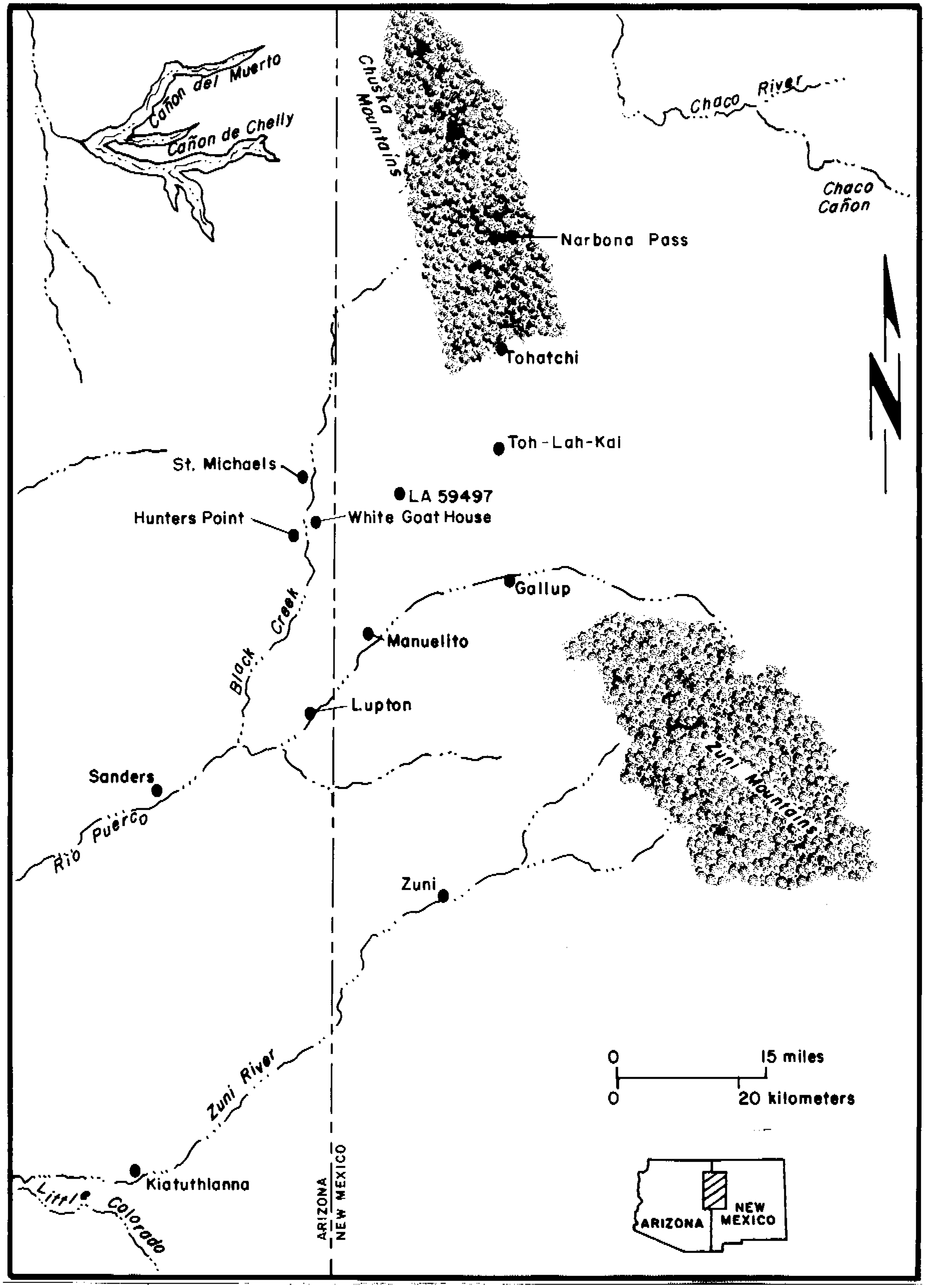

Figure 2. Project area region, LA 59497, and regionally important Pueblo II-III sites (adapted from Fehr et al. 1982).

Prehistoric water availability would have been restricted to seeps, springs, and ephemeral stream flow. The McKinley Mine alluvium and substrata are low water-bearing sources (Hewett 1982:46). Replenishment of the sources would occur with heavy upland snows. Severe depletion of the water resources would occur during consecutive years of low precipitation, and this depletion of the surface water would have had a profound effect on the success of prehistoric agriculture (Hewett 1982:40).

Climate

The local climate is characterized as semi-arid to arid with low humidity, infrequent, summer-dominated precipitation, moderate to strong winds, and a wide diurnal temperature variation.

The average annual rainfall for the McKinley Mine area is 32 cm (12.61 inches); 50 percent occurs in the summer months. In the Gamerco area, the average annual rainfall over the last 50 years is 250 mm (9.7 inches). There is almost an 80 mm (3 inches) discrepancy in rainfall for the two areas (Knight 1982a:49-51). This is in part due to more upland area and generally higher elevations on the McKinley Mine Lease, which leads to greater rainfall.

Prehistorically, there was an increase in precipitation early in the A.D. 1000s, with the trend peaking by A.D. 1100. This was caused by a 65-mile northerly shift of the jet stream, allowing warmer moisture-bearing air masses to move farther north. This pattern was reversed between A.D. 1100 and 1200, with the moist air pushed out by northern air masses, causing frequent drought (Knight 1982a:51).

Temperatures average 51 degrees F during the year with an average 32 degree difference between the night and day. The last frost occurs during the second week of May, and the first killing frost occurs during the third or fourth week in September. The average estimated growing season is 140 days, with a range of 90 to 150 days depending on the elevation (Knight 1982a:51).

Flora and Fauna

The following information is taken from Knight (1982b). The area surrounding LA 59497 supports three plant communities: piñon-juniper, sagebrush, and greasewood-saltbush. The piñon-juniper community covers the mesa tops, ridges, slopes, and occasionally flat lowlands. The sagebrush community covers the gentle slopes above the valley floors, and often mixes with the piñon-juniper and greasewood-saltbush communities. The greasewood-saltbush occurs in the low-lying alkali flats.

The piñon-juniper community supports mule deer, cottontail rabbit, jackrabbit, coyote, bobcat, and assorted small rodents, including squirrels, mice, and rats. The sagebrush and grassland communities support similar populations with the addition of prairie dog. The greasewood-saltbush community supports smaller mammals, including mice, rats, and gophers, and their predators, coyote and badger. Most of the mammals could have been found in the vicinity of prehistoric fieldhouses and residential sites within the McKinley Mine area.

PREHISTORIC BACKGROUND

Prehistory

The prehistoric background of the project area can be synthesized from a collection of survey, excavation, and research reports resulting from archaeological research at the McKinley and Gamerco mines, along the Rio Puerco of the West, and in Manuelito Canyon (Nelson and Cordell 1982; Kauffman 1985; Scheick 1983; Gumerman and Olson 1968; Weaver 1978) (Fig. 3). The reader is referred to these reports for the prehistoric background that does not apply to the Pueblo II-Pueblo III period. Table 1 lists all of the Anasazi components recorded in the four USGS quadrangles surrounding LA 59497 as of 1988.

Table 1. Frequencies of Components in Four Quads: Tse Bonita School, Twin Lakes, Samson Lake, and Gallup West

Period	No. of sites	Percent
Basketmaker II-III, A.D. 1-700	1	0.5
Basketmaker III, A.D. 500-700	8	4.0
Basketmaker III-Pueblo I, A.D. 500-900	7	3.5
Pueblo I, A.D. 700-900	7	3.5
Pueblo I-Pueblo II, A.D. 700-1100	6	3.0
Pueblo I-Pueblo III, A.D. 700-1300	9	4.5
Pueblo II, A.D. 900-1100	48	24.1
Pueblo II-Pueblo III, A.D. 900-1300	48	24.1
Pueblo III, A.D. 1100-1300	65	32.7
Total	199	99.9

Pueblo II

Locally, the Pueblo II period (A.D. 900-1100 in the Pecos Classification) has been divided into two phases, Red Mesa and Wingate (Gladwin 1945). These two phase designations were adopted by Weaver (1978) and Gumerman and Olson (1968) for their study areas. The Red Mesa phase is dated from A.D. 900 to A.D. 975 or 1000. Sites have low numbers of linear, contiguous surface rooms; deep, four-posted pithouses with masonry entryways; and kivas with masonry-faced benches. Red

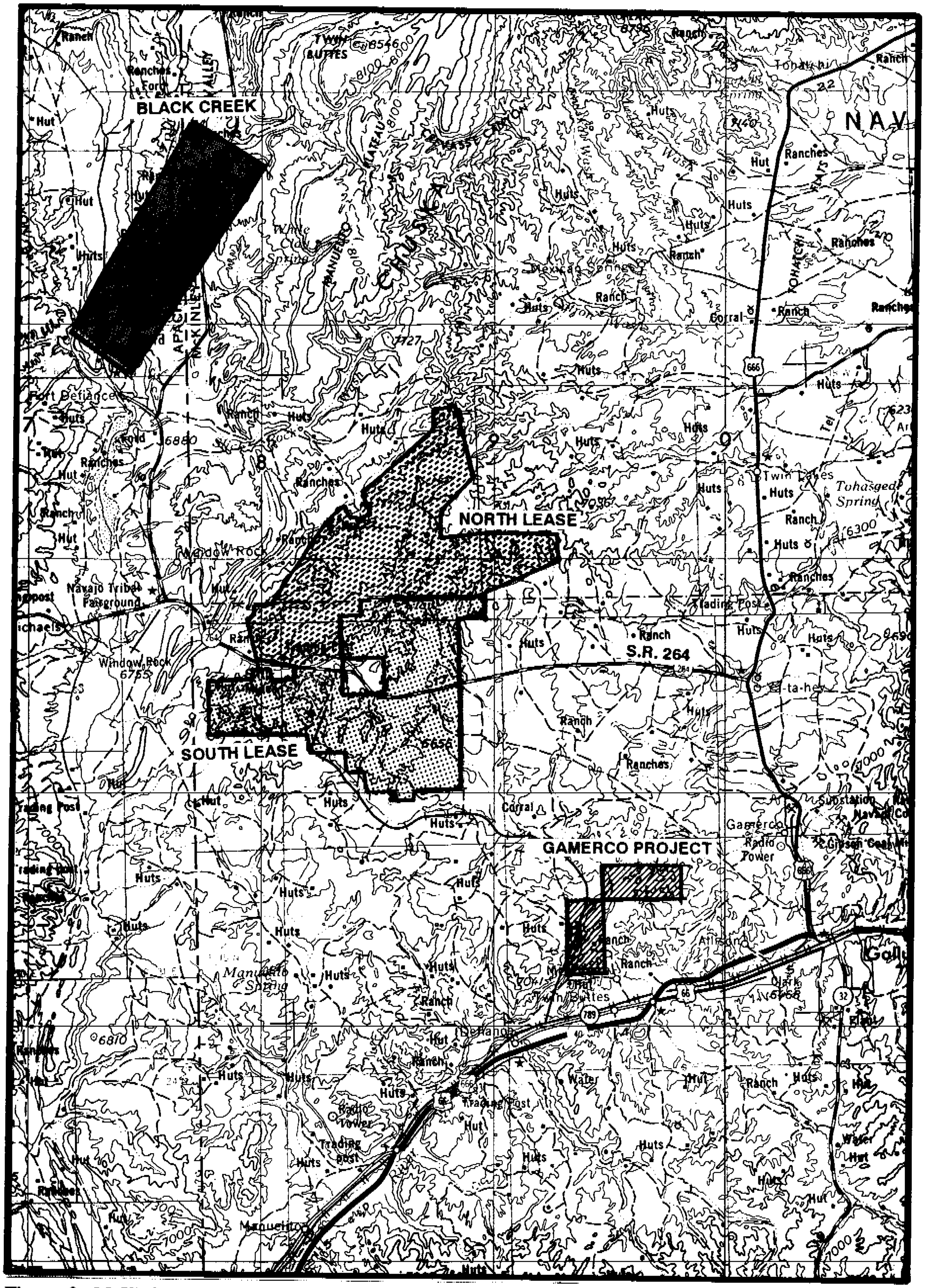

Figure 3. McKinley and Gamerco Mine leases and Black Creek.

Mesa Black-on-white is the primary white ware, with small amounts of Puerco Black-on-white present in late Red Mesa phase sites. Utility wares change from neckbanded to neck indented pottery, exuberant corrugated pottery, and eventually to overall indented corrugated pottery late in the phase.

The Wingate phase is marked by the appearance of Puerco and Wingate Black-on-red ceramics, and L- or U-shaped masonry pueblos of 10 rooms or less with one or more masonry-faced kivas. Puerco and Gallup Black-on-white ceramics and low frequencies of Red Mesa Black-on-white also are present. The Wingate phase is dated between A.D. 975 and 1050 by Gumerman and Olson (1968:120) and Weaver (1978:37).

The time span for the White Mountain Redware types is open for debate and varies depending on the area of investigation. Lang (1982:93) dates its occurrence in the eastern Red Mesa Valley after A.D. 1050 and correlates White Mountain Redwares in part with the growth of the Chaco system. He extends the Wingate phase to the early 1100s. The widely used tree-ring dates synthesized by Breternitz (1966:89, 102) place the production of Puerco and Wingate Black-on-red after A.D. 1030.

The other development that is important to this area is the development of the Chaco interaction sphere. This occurred between A.D. 1020 and 1120 during the Classic Bonito phase. This period is earmarked by repeated construction at the large-house sites in Chaco Canyon and a proliferation of Chacoan outliers in the San Juan Basin and its peripheries. Several Chacoan outliers are present in the vicinity of the project area suggesting probable interaction between local and Chacoan populations (Cordell 1982:128) (Fig. 2).

Archaeological research within the McKinley Mine South and North leases was in part directed toward understanding the role of the McKinley Mine areas in the Chaco system (Allen and Nelson 1982; Kauffman 1985). Association with Chaco social and economic organization would be evidenced by the occurrence of Chaco-like ceramics; the presence of larger kivas at larger sites, implying the development of hierarchies; architectural styles of kivas and house units built in a similar fashion to Chaco Canyon sites or outliers; and the presence of goods that could only be obtained by long-distance trade.

Kauffman (1985) and Acklen (1982) conclude that the McKinley Mine Lease area was inhabited by populations that interacted with Chacoan outlier populations, as suggested by the presence of Chaco and McElmo Black-on-white pottery and by ceramics from the Chuska Valley. Acklen (1982:595) suggests that the Chaco network was integral in administering the movement of people to resources rather than resources to people to buffer against the effects of drought. Kauffman (1985:422) suggests that "The settlement pattern, subsistence data, and architectural data of the McKinley Mine are best explained as indicative of a low-level, egalitarian, subsistence oriented, socioeconomic structure with a Chacoan-affiliated ceremonial overlay." Cordell (1982) characterizes the McKinley Mine area as a "loosely integrated reserve area" into which overflow populations were moved. Chaco-related social activities may have been organized through the Toh-la-kai outlier, 12.9 km (8 miles) from the McKinley Mine area, or other more distant outliers that ring the McKinley Mine area. The subsistence data from both lease areas indicate continuous cultivation of corn from PI to early PIII, but more significant is the evidence for heavy reliance on wild plants, which represented as much as 90 percent of the pollen recovered from PII sites in the North Lease. There also appears to be a dichotomy in site type frequencies between the North and South Lease. The South Lease has more lowlands and permanent habitation sites associated with possible agricultural areas. The North Lease has fewer permanent habitations, more seasonal residences, and more limited activity sites that may have been located to exploit seasonal resources available at higher elevation (Kauffman 1985:26). This pattern suggests that local residents were exploiting an extensive resource base by using both upland and lowland areas.

There is no evidence for intensified agricultural production during PII times. The lack of evidence of intensification that might have yielded a surplus suggests that the local economy could not support immigrant populations or participate in a trade network that circulated agricultural products. The variety of sites in the lease areas further suggests that populations were mobile and needed access to a large area to survive.

Scheick (1983) believes that the data from the McKinley Mine and Gamerco areas indicate slow, in situ population growth. When precipitation patterns were favorable, the area may have been used seasonally for wild seed gathering and some cultivation (Scheick 1983). Greater site density may not have resulted from increased population size but from the exploitation of limited resources in a broad geographical area by a few families. Scheick feels that there is no evidence to support the hypothesis for centrally organized population movement into the Gamerco area because she sees no evidence of the complex social organization that would be necessary to administer such a system (1983:631). Also, the limited resources offered by the area could only support a small population.

The ARMS (Archeological Records Management System) files list 111 components that could date between A.D. 900 and 1100 in the four quadrangles surrounding and including the McKinley Mine area (see Table 1). This is a significant increase over the previous two periods. The greater number of sites reflects both population growth and a greater diversity of site types. The greater diversity of site types may reflect the exploitation of a wider variety of geographical and environmental areas for subsistence. Former peripheral areas may have become economically more attractive because of the favorable climatic patterns of the eleventh century. The large number of recorded Pueblo II sites may also be due to a survey bias towards areas that were occupied by Pueblo II populations.

Pueblo III

Pueblo III refers roughly to the period between A.D. 1100 and 1300. It includes both the Houck (A.D. 1050-1250) and Kintiel (A.D. 1250-1325) phases (Gumerman and Olson 1968:122-124; Weaver 1978:38-39). The Houck phase is characterized by masonry structures of 20 to 25 rooms, keyhole-shaped kivas, and pottery including Puerco Black-on-white, White Mountain Redware, and plain and indented corrugated gray wares. Along the Rio Puerco of the West, White Mountain Redware polychromes are particularly diagnostic of this period (Gumerman and Olson 1968:122).

The Kintiel phase (A.D. 1250-1325) is characterized by population aggregation into fewer large sites with satellite communities, interior kivas, great kivas, and large dance plazas. The site types are best represented in Manuelito Canyon. The primary ceramic types are Klagetoh Black-on-white and Klagetoh Polychrome.

Ceramic complexes from the McKinley Mine and Gamerco area sites (Acklen 1982; Lang 1983a) exhibit different affiliations for this period, also known as the late Bonito phase (A.D. 1120-1220). The Gamerco area complex is described as having a distinct southern San Juan or Chaco Basin affiliation. Lang (1983a) believes that almost all of the Puerco and McElmo Black-on-white pottery was brought into the Gamerco area. This supports Scheick's contention that Pueblo III populations were not full-time residents but seasonally moved into the Gamerco area. Interestingly enough, Lang's analysis suggests the population comes from the north, and not from Manuelito Canyon and the Zuni uplands, which were becoming major population centers late in the 1100s and early 1200s. The primary indicator of northern ceramic sources is McElmo Black-on-white, a carbon-painted ware. This type replaces mineral-painted Gallup and Puerco Black-on-white pottery by the early 1200s (Lang 1983:391).

The ceramics from the South Lease of the McKinley Mine indicate that the local ceramic tradition continues into Pueblo III times. There is much less McElmo Black-on-white in the McKinley Mine assemblages than found in the Gamerco assemblages. There is evidence for local ceramic production, but no evidence for imports or population movement into the area from the north. Acklen (1982:596) considers use of the area by Manuelito Canyon populations a possibility. This would seem plausible, given the ceramic similarity between the two areas. Cibola ceramic traditions continued in Manuelito Canyon until the early 1200s (Weaver 1978:38). It would appear from the data that there were two different groups inhabiting the vicinity of the project area during Pueblo III times.

The data from the Gamerco and South Lease areas indicate similar settlement and subsistence patterns (Nelson and Cordell 1982; Scheick 1983). The sites in both areas are primarily limited activity sites and seasonal residences. Scheick (1983) and Nelson and Cordell (1982) suggest that the residents, in response to variability in precipitation patterns, seasonally used the Gamerco and McKinley Mine areas, resulting in shorter occupations. Small-scale population aggregation, as reflected by small numbers of large habitation sites in the McKinley Mine area, suggests intensification of farming and increased dependence on agriculture products. The smaller, less substantial sites reflect a subsistence focus on seasonally available resources. The contemporaneity of these different sites cannot be firmly established. It is probable that they represent different settlement and subsistence strategies in response to climatic shifts and changing availability of wild resources.

The North Lease shows a greater number of habitation sites during PIII times compared to the South Lease. These sites are at higher elevations than the PII sites and appear to be an attempt to diversify field placement to offset an unpredictable climate or to diversify the subsistence strategy in general (Kauffman and Hill 1985:427). The investigators recognize that the habitation sites may have only been occupied for two or three years at a time, as permitted by the climatic conditions (Kauffman and Hill 1985:428).

Abandonment of the McKinley and Gamerco Mine areas occurred between A.D. 1200 and 1300. The causes of abandonment are unknown. Scheick (1983) believes that the period of rainfall variability and drought between A.D. 1140 and 1220 severely hampered agricultural efforts and narrowed an already limited subsistence base for Gamerco populations. The South Lease abandonment is perplexing because the excavation data show little evidence of subsistence stress. The South Lease residents may have had access to a wider range of wild food resources, which would have offset the drop in agricultural productivity caused by low rainfall. The abandonment of the South Lease may have been due to shifts in centers of social organization (Chaco to Manuelito Canyon) (Nelson and Cordell 1982:893).

A similar settlement pattern is evident in the North Lease with the location of habitation sites in more diversified environmental settings. The McKinley Mine North excavations did not provide insight into the abandonment of the area. Excavation of a rock shelter that may have been occupied into the early A.D. 1300s suggests that limited use of the area continued after the major abandonment in the early or mid A.D. 1200s.

DATA RECOVERY RESEARCH ORIENTATION AND GOALS

This section provides the orientation and goals or expectations for the research that guided the data recovery effort. It is primarily derived from the data recovery plan by Post (1987:42-44).

The data from other excavated sites and archaeological surveys indicate certain trends in the settlement and subsistence patterns for the McKinley Mine leases from A.D. 1050 to 1200. The settlement pattern shows an increased number and diversity of sites dating after A.D. 1050. This is interpreted as a reflection of the influx of nonlocal populations and a diversification of subsistence strategies (Allen and Nelson 1982; Kauffman 1985).

Subsistence patterns were reflected in this functional diversity in site types. Based on proximity to arable land and low slope gradients, some site locations are thought to represent a focus on agriculture. The exploitation of a broad spectrum of wild foods, based on proximity to the environmental transition zones that yield the greatest plant and animal diversity, is postulated for nonagricultural sites.

Nelson and Cordell (1982) conclude that the occupants of the larger habitation sites, like LA 59497, occupied between A.D. 1150 and 1250, were practicing a strategy of agricultural intensification possibly in response to increased population. The largest sites were located closest to the most arable lands and had the most evidence for an agriculturally focused subsistence strategy. The increased population was hypothesized to place greater stress on existing subsistence strategies. Indices of stress included an increased diversity of faunal remains at residential sites, a decrease in the numbers of large fauna, and an increase in anatomical portions that have marginal nutritional value. The hypothesis of subsistence stress was conditionally rejected because the indices showed a low correlation for residential sites. Large faunal remains increased through time, diversity remained steady or decreased, and there was little change in the relative frequencies of low nutritional value anatomical portions. Agricultural intensification was therefore not a response to stress.

All investigators feel that the small local population was increased by the population overflow from demographically stressed adjacent areas (Cordell 1982; Kauffman 1985). In an attempt to explain the population influx, an association with the social and economic organization tacitly represented by the Chacoan outliers of the area is hypothesized. This suggests that people and/or goods were transported through the Chaco system, relieving demographic and subsistence stress. A low level of organized response at the regional level was inferred from the excavation data. Most investigators conclude that the local population was probably socioculturally affiliated with the groups occupying adjacent areas.

Regional social interaction is evidenced by the presence of Chuska, White Mountain, and Chacoan pottery (Acklen 1982; Hill 1985). These types indicate that the local populations maintained contact and probably shared information with regional populations through the exchange of ceramics. The Chacoan system may have influenced the social and economic development of the area until its collapse. With the collapse, the social and economic system that local residents participated in may have changed, and new alliances had to be developed or alliances of secondary importance reinforced. Investigators speculate that new alliances were formed with the groups in the Manuelito Canyon and White Mountain areas. These areas show increased population aggregation soon after the collapse of the Chacoan system.

Given the problems discussed above, the data recovery effort for LA 59497 is primarily focused on the changes in subsistence strategies and the changes in the social and economic interaction of local populations brought on by the collapse of the Chacoan system. The goals and expectations of the data recovery effort were as follows:

1. A change in the subsistence strategy occurred with the aggregation of populations into larger residential sites. There will be little direct evidence for change in the subsistence strategy. No water control devices have been located in the McKinley Mine or Gamerco areas during survey and excavation. A resurvey of the area surrounding LA 59497 should be conducted to identify any water control features or confirm their absence.

Excavation of stratified midden deposits and features may yield faunal remains. The remains will be analyzed for anatomical portion, age, condition, and frequency to determine if there is any change though depositional time. These results will be compared with the McKinley Mine and Gamerco results to look for significant differences between roughly contemporaneous occupations.

Stratified midden deposits and features may yield ethnobotanical remains and pollen samples. These samples may provide information about the variety of plant foods that were consumed and the changes in diet that occurred throughout the occupation. From the McKinley Mine data we would expect an increase in corn pollen through time and a decrease or stabilization of the gathered plant pollens. From the presence of cultivated plant pollen we can only infer farming. From intensive farming and consumption, large amounts of pollen might be expected. Modern pollen samples will help to determine if the prehistoric deposits are contaminated. Pollen analysis often reveals information about the prehistoric environment and possibly analysis will confirm if the environmental conditions were favorable for increased agricultural production.

The presence of grinding implements indicates processing cultivated or gathered plants. An increase in the grinding area on metates has been shown to correlate with increased use of metates for corn processing (Lancaster 1983). For instance, slab metates would be most common on sites where large amounts of corn are processed for consumption or storage. Trough or basin metates might be common on sites processing a large amount of gathered seeds or nuts.

2. Changes in social and economic interaction between local population and regional groups should be apparent in the ceramic assemblage. It is hypothesized that the ceramic assemblage should exhibit changes in the frequencies of intrusive ceramics (Chacoan, White Mountain, Black Creek, or Rio Puerco of the West, Chuskan, etc.) that would correspond to the collapse of the Chacoan system as an organizational mechanism.

The ceramic assemblage will be analyzed to produce data that will identify local pottery. This may be accomplished through petrographic analysis of decorated and utility wares in conjunction with a detailed study of the regional surface geology. Detailed information about the surface geology should be available because of the extensive energy-related developments in the area. If the local pottery can be identified, then it should be possible to identify intrusive pottery on the basis of paste, surface finish, and design attributes. The proportions of intrusive ceramic types through time should provide information about the regional social and economic organization.

Nonlocal lithic materials may provide information about the social and economic organization. Certain materials like Jemez obsidian, Pedernal chert, and San Andres limestone, have fairly specific source areas. If these materials are present, then they may confirm or supplement the data obtained from the petrographic study of the pottery.

DESCRIPTION OF LA 59497

LA 59497 is on the slope of a low rise overlooking an unnamed tributary of the Ft. Defiance Draw. It is a prehistoric pueblo house mound and an associated midden (Fig. 4). The house mound and most of the midden are north and outside of the right-of-way. The distinct portion of the house mound is 14 m in diameter and 1 m high in the center. Sandstone rubble extends 7 m to the south and wall alignments are visible in a road cut to the west of the house mound.

The rubble mound includes large tabular sandstone slabs, blocks, and small sandstone chinking. The large amount of chinking suggests that it was used extensively in wall construction. The southern portion of the house mound is divided by a 2-m-wide bulldozer cut. The east portion of the mound has been removed by the excavation of a large stock pond. The midden covers a 300-sq-m area in which the surface artifact density is about 100 artifacts per square meter. A more diffuse scatter covers the remainder of the site area.

The area of the site within the right-of-way consists of a small portion of the midden and a light scatter of artifacts in disturbed areas. Figure 4 shows the location of the bulldozer cuts and where soil was redeposited. Surface artifacts in the right-of-way numbered between 100 and 200, with most showing up at the edge of bulldozer cuts and disturbed areas.

Excavation Methods

The first goal of the excavation was to collect surface artifacts within the right-of-way. This was accomplished by setting up a 1-by-1-m grid system across the right-of-way. A site datum was established as 100N/100E with an elevation of 5.00 m. The grid number was assigned to its northeast corner. Each grid unit was examined for artifacts, which were bagged by grid. A total of 1,596 sq m was inspected and collected.

Following the surface collection, Grids 99N/135E and 99N/143E were excavated in 10-cm levels, exposing the site stratigraphy. After Stratum 4 (the cultural stratum) was identified in Grid 99N/135E, eight grids along the 99N line to 143E were excavated to determine the eastern extent of the cultural stratum. The cultural deposit ended at Grid 99N/136E. The remaining grids did not yield artifacts from undisturbed strata. In some places the fill was disturbed to the bedrock, as evidenced by modern refuse in contact with the bedrock. Six additional units placed in the eastern portion of the right-of-way did not yield well-defined cultural strata. They were excavated in 10- and 20-cm levels until sterile soil was reached.

At this point, excavation was concentrated in the site area containing Stratum 4. Stratum 4 was defined along the 99N grid line from 134 to 138E, the grids from 96N to 99N and 134E to 138E, and 97N to 98N and 131E to 133E. It was exposed by removing the upper disturbed and noncultural fill to the top of Stratum 4 in one level.

Following the removal of the overburden, Stratum 4 was excavated in two levels of 5 to 7 cm each. Stratum 4 depth tended to be shallowest to the west and south, and deepest toward the fence

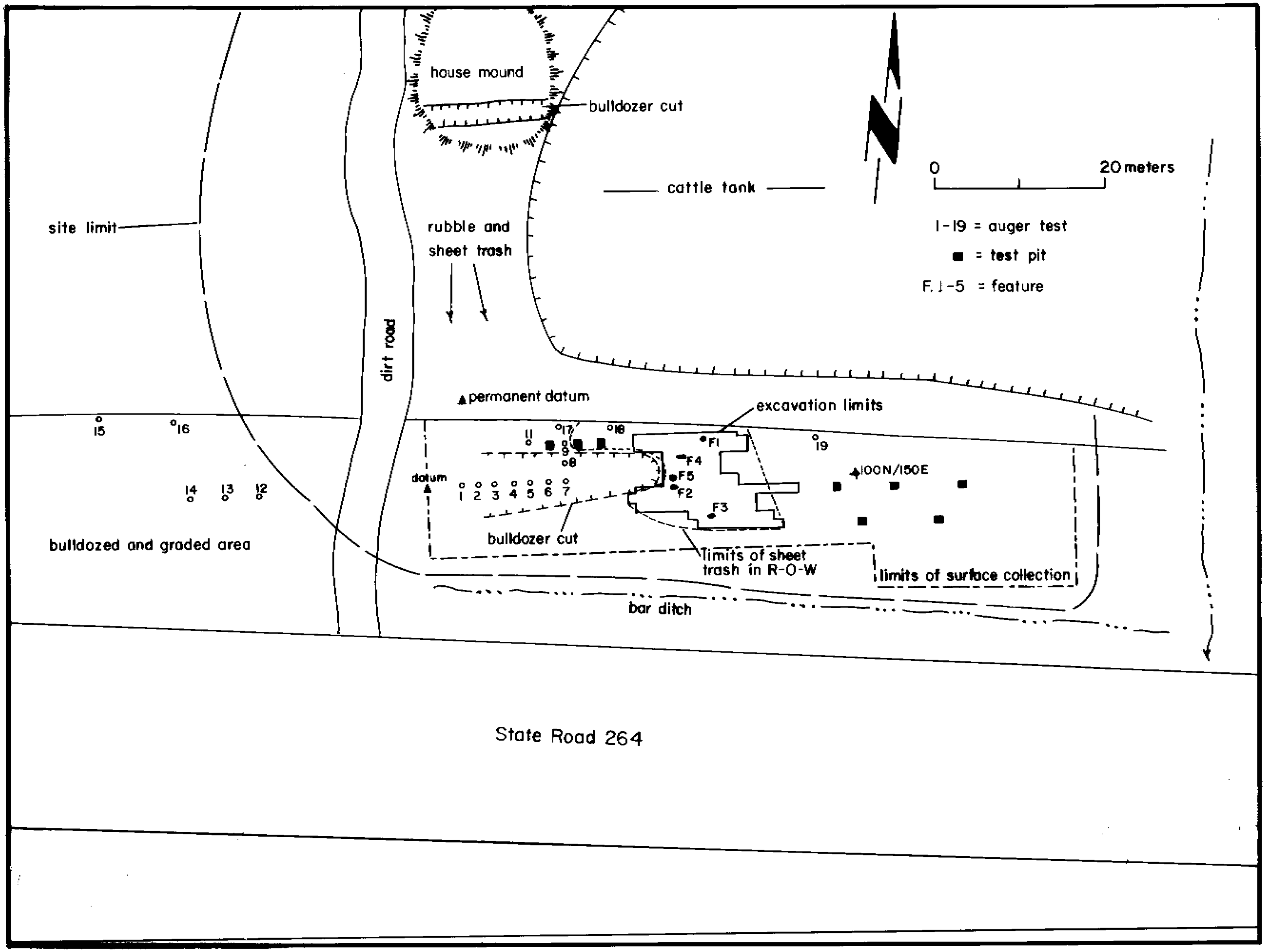

Figure 4. Site map, LA 59497.

line, where modern soil removal was minimal. Stratum 4 had no natural or cultural stratigraphic breaks, so it was excavated in arbitrary levels.

Wherever Stratum 4 was encountered, it was completely excavated until sterile soil (Stratum 5 or 7) was reached. All of Stratum 4 was sifted through ¼-inch screen mesh. Artifacts were collected in paper bags that were labeled with vertical and horizontal provenience information.

Five prehistoric cultural features were exposed in Stratum 4. As each feature was encountered, an area covering 4 sq m around it was cleared. Once the horizontal extent of the feature was defined, it was excavated in two halves. The first half was used to identify natural or cultural levels. If stratified deposits were absent, the feature was excavated in 5 cm levels. Samples were taken from contexts that appeared likely to yield the most data on feature function and age. The features were drawn and profiled, sample locations were located on the plan views and profiles, and the features were photographed and described on field journal forms.

Each human burial was excavated as a unit. The remains were exposed to reveal method of interment, condition of remains, post-depositional forces that affected the condition of the remains, and burial goods and their spatial relationships to the human remains. The remains were drawn, profiled, and described.

Feature and site fill were described on field journal forms and grid forms. The grid forms included excavated depths in centimeters below surface and below datum, information about soil color and texture, artifact types and density, presence of sandstone slabs and other discarded material. Soil colors were described using Munsell color notation.

After complete excavation of Stratum 4 to sterile levels, the excavation area was mapped with a transit and stadia rod, including the limits of the excavation, location of exploratory units, auger holes, and cultural features. After mapping, the deepest and potentially most dangerous portions of the excavation were backfilled.

Artifacts, unprocessed samples, and all field notes, drawings, and maps are stored at the State Archaeological Repository and the Archeological Records Management System files in Santa Fe. The human remains were reburied according to Navajo Nation regulations (Mick-O'Hara and Post 1991).

Stratigraphy

Excavation defined nine natural and cultural strata. They were assigned numbers that were used in the excavation notes and site and feature drawings. The numbers are consecutive but do not necessarily describe the relative order of the strata. Strata locations are shown in Figure 5.

Stratum 1 was a yellowish brown (10YR 5/4), light to medium compacted sand containing sandstone spalls and gravel, bottle glass, and other modern artifacts, and occasional prehistoric potsherds. The types of historic artifacts present indicated that Stratum 1 was redeposited across the right-of-way after 1960. At its thickest (in Grid 99N/151E) it was 30 cm deep. In Grids 99N/140E and 99N/142E, Stratum 1 was on top of sandstone bedrock. West of the 128E grid line, Stratum 1 was absent, having been removed by a blade and redeposited on top of the site to the east. Along the

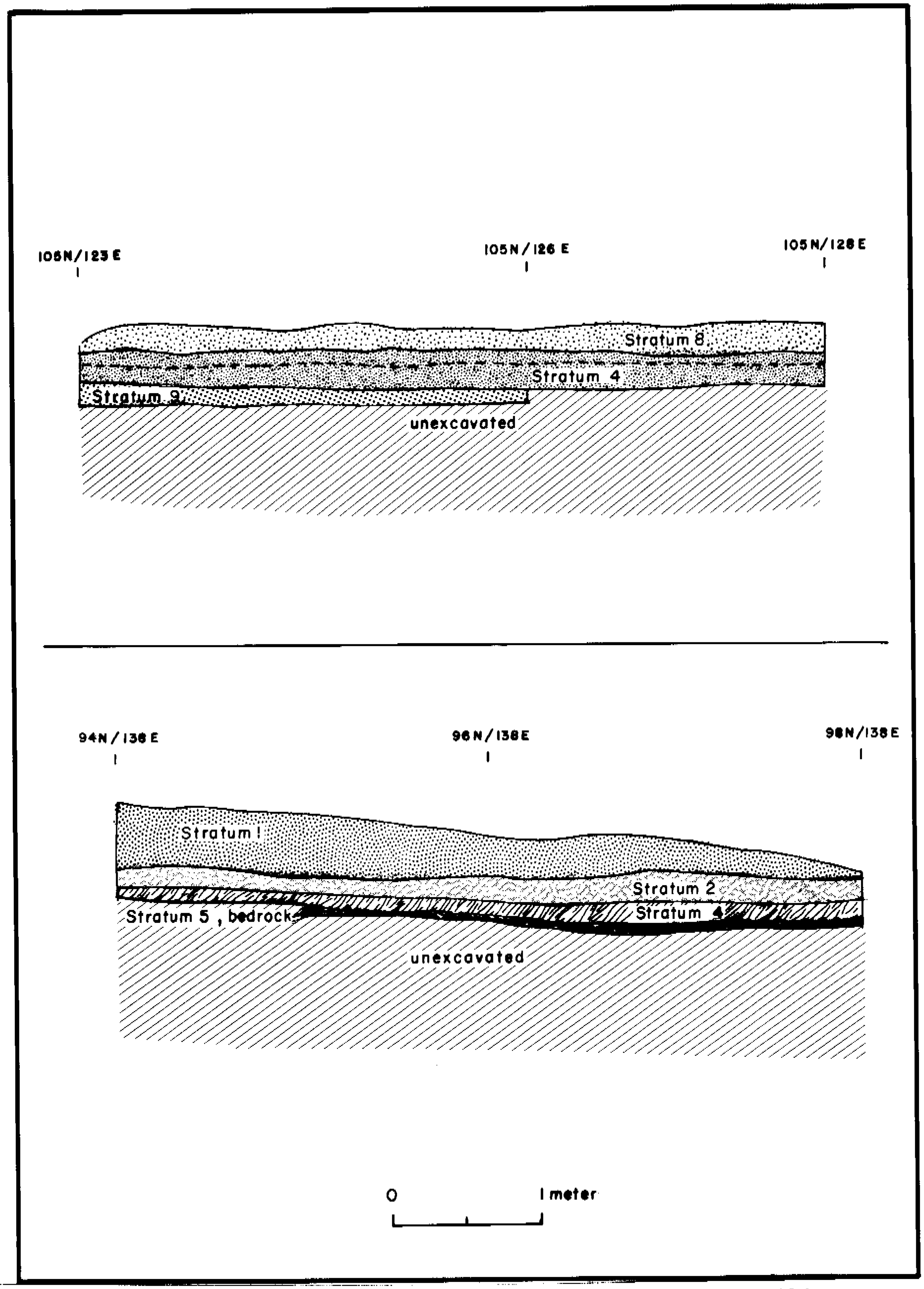

Figure 5. (a) North profile of grids 105N/123-128E; (b) east profile of grids 94-98N/138E.

fence, Strata 1 and 4 were mixed by fence construction and utility cable trenching. Additional Stratum 1 soil was redeposited on the site by old bar-ditch excavations along the north edge of State Road 264.

Stratum 2 was a compact yellowish brown (10YR 5/4) clayey sand with large grains of rounded quartz and feldspar in a matrix of very fine silt. The soil was moderately plastic when wet. Origin of this soil type was not known. It contained sandstone gravel and spalls, occasional flecks of charcoal, and modern artifacts. The top of Stratum 2 was the modern ground surface prior to 1960. It was usually separated from Stratum 1 by a lens of decomposed grass. Stratum 1 and 2 usually co-occurred across the site. Stratum 2 ranged from absent to 15-cm thick and was usually 8- to 15-cm thick.

Stratum 3 was only identified in Grid 99N/143E, although it may have been present in unexcavated areas. It was a lens of compact brown clayey sand (10YR 5/3) that contained decomposing sandstone, modern artifacts, and sherds. Styrofoam was found at the bottom of the stratum in contact with the bedrock. Maximum thickness was 57 cm. It is possible that the bedrock was exposed prior to 1960 and then was covered with redeposited fill.

Stratum 4 contained the prehistoric sheet trash deposit. It was loose, very dark grayish brown (10YR 3/3) sand containing charcoal flecks, chunks and staining, burned and unburned slabs, potsherds, lithic artifacts, burned bone, and features excavated into and through the stratum. It ranged between 8- and 20-cm thick. It was excavated in two levels, usually of equal proportions. These levels were arbitrary divisions because no natural breaks were observed. Stratum 4 was directly below Strata 1 and 2, depending on which was present. Stratum 4 was at the surface in the western portion of the excavation. Although Stratum 4 was present throughout the excavation area, cultural materials were concentrated between 96N and the right-of-way fence, and 126E and 135E (an area of about 90 sq m). East of 135E, artifact density was low and the dark staining was more diffuse. In the upper levels of Stratum 4, sherds were often lying flat suggesting that they were in situ. The lower levels of the stratum contained increasingly larger sherds, another indication of the integrity of the deposit. The bedrock that was in contact with the bottom of Stratum 4 was charcoal stained.

Stratum 5 was a brown (10YR 5/3) compacted sandy clay grading into clay at contact with the bedrock, containing crumbling bedrock and no cultural material. It ranged from 5- to 12-cm thick. Stratum 5 mostly co-occurred with Stratum 4, but lacked concentrated cultural material. For most of the concentrated sheet trash area, Stratum 5 was excavated as part of Stratum 4, Level 2.

Stratum 6 was a 3-cm-thick layer of silt sitting on top of the bedrock in Grids 99N/148E, 99N/155E, and 99N/163E. It was brown(10YR 5/3), compacted, and similar to Stratum 5 except that it was not present in the central excavation area. This layer was not found in Grids 99N/138, 143, or 148 where the disturbed soils continued downwards to bedrock.

Stratum 7 was found at the west end of the excavation area. It was brown silt and coarse-sized sand (10YR 6/4) with very low frequencies of artifacts and scattered small charcoal flecks. Rodent burrows were present and may have contributed to the presence of the artifacts and charcoal. Stratum 7 was present where Stratum 5 and bedrock were absent. The depth of Stratum 7 was unknown, but it was the beginning of sterile soil based on the decrease in cultural materials.

Stratum 8 was dark grayish brown (10YR 4/2) heavily compacted, plastic clay, ranging from 30- to 40-cm thick. It was encountered along the fence line in Grids 105N/115E, 105N/119E, 105N/121E. In the upper part of the deposit, charcoal and artifacts were present. This stratum appeared to be a disturbed layer in Stratum 4.

Stratum 9 was defined in the auger holes as fine, loose, pale yellow-brown (10YR 6/4) sand, with increasing amounts of caliche corresponding to depth. This stratum was on top of bedrock in the west portions of the right-of-way. It extended to at least 150 cm below the modern ground surface.

Feature Descriptions

Feature 1 was an oval-shaped, shallow depression found in Grid 104N/131E (Fig. 6). It was excavated through Stratum 5 with a bottom of decomposing sandstone. The feature was at the bottom of Stratum 4, Level 2. The feature fill was dark brown to black, loose sand with sandstone spalls. It was located 5.30 below datum and measured 41 cm east-west by 24 cm north-south by 3-5 cm deep. No artifacts were associated or recovered from the fill. All of the feature fill was collected for flotation and pollen studies.

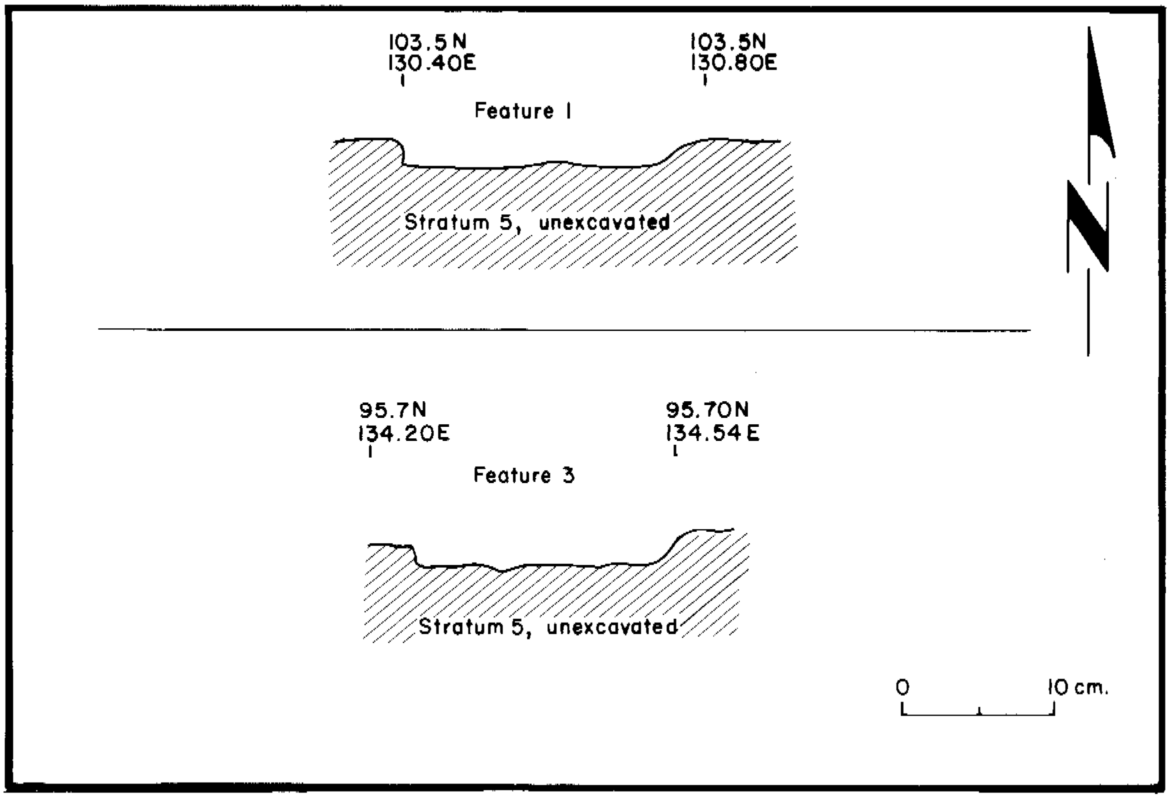

Figure 6. Profiles of Features 1 and 3.

Feature 2 was a human burial. It was a 23-year-old woman who was buried in a flexed position within the sheet trash deposit in Grids 99N/129 and 99N/130E (Appendix 3, Fig. A3.1). No formal burial pit was defined, but the bottom was in contact with the sandstone bedrock. The feature fill, a brown sand containing artifacts and charcoal flecks, was similar to Stratum 4. The base of the burial was 27 cm below the modern ground surface, but the original depth was probably deeper prior to blading. Excavation exposed the top of the skull within Stratum 4, Level 1. Pollen samples were collected from under the skull and within the pelvic area. For more detailed description see Human Remains and Appendix 3.

Feature 3 was a shallow semi-oval-shaped hearth that measured 50 cm east-west by 37 cm north-south and 4-5 cm deep (Fig. 6). It was in Grid 96N/135E. The hearth fill was slightly oxidized brown sand with charcoal flecks. Four small sandstone slabs lined the interior of the feature. Removal of the slabs revealed charcoal stained and slightly oxidized soil, indicating that the feature was slab lined and collapsed or that the slabs were used as pot supports within the hearth. The feature extended into Stratum 5, below the dense artifact concentration. No artifacts were found in the hearth. A pollen sample was collected from below the slabs and most of the hearth fill was collected as a flotation. No burned economic plant taxa were identified in the flotation (Toll, Appendix 5).

Feature 4 was the disarticulated and incomplete remains of four human skeletons (Appendix 3, Fig. A3.2). They were recovered from the surface and Stratum 4 within Grids 104N/128E and 104N/129E. This feature was in the bladed portion of the excavation area. No evidence of a burial pit could be found. A pollen sample was collected from under a sacrum that appeared to be in situ. For a more detailed description see Human Remains and Appendix 3.

Feature 5 was a nearly complete human skeleton interred in an oblong pit (Appendix 3, Fig. A3.3). It was located in Grids 100N/129E and 101N/129E. The pit was excavated into Strata 4 and 5 with sandstone bedrock at the bottom of the pit. The burial pit measured 80 cm north-south by 100 cm east-west and 18 cm deep. The skeleton was supine with flexed legs. The orientation was east-west. The hands appear to have been brought up to the face, although only one finger from the left hand was recovered. On the left side of the burial was a double cylinder jar with both Gallup and Puerco design styles, to the right of the skeleton was a large body sherd from a Puerco Black-on-white olla, and a Gallup Black-on-white canteen fragment was high in the pit fill. It is likely that the canteen was part of the grave assemblage. Flotation samples were collected from the soil within the double cylinder jar. Pollen samples were collected from under and within the double cylinder jar, from under the skull, and from under the Puerco Black-on-white olla fragment. For a more detailed description see Human Remains and Appendix 3.

HUMAN REMAINS FROM BURNED DEATH WASH

Linda Mick-O'Hara

Human remains were excavated from three proveniences at LA 59497. These remains include two articulated burials and a group of fragmented remains representing four other individuals. The fragmentary group of remains had been affected by earlier road-grading activities. All remains were discovered close to the current ground surface and had been disturbed to varying degrees by roots, rodents, and soil moisture. The following report summarizes the findings from the analysis of these remains. A full inventory of the human materials found at this site is included as Appendix 3.

All of the remains recovered were cleaned by dry brushing the specimens prior to analysis. Each element was inventoried separately and all possible measurements were taken following the guidelines set out by Bass (1987). Elements were analyzed for apparent anomalies and pathologies, and appropriate elements were used to estimate sex, age, and stature. Stature estimates were made using the formulas developed by Genoves (1967).

Feature 2

Feature 2 consisted of the remains of an adult female approximately 23 years of age. Stature estimates were done on both the left femur and left tibia (see Appendix 3). The left femur estimate places this individual at 5 ft 1 in (154.9 cm) and is the most accurate estimate of her height (Genoves 1967). An blow that perforated the skull in a triangular pattern at the parietal/lambdoidal/occipital juncture was perimortem in nature and was the probable cause of death (Appendix 3, Fig. A3.4b).

This female was found lying in a fully flexed position on her left side facing south. She was located in a midden area, but there was no apparent burial pit and no associated burial goods. Rodent activity is the probable cause of the displacement of some bones and the absence of others. Soil moisture had affected the left side of the burial so that some of these bones were eroded, fragmentary, or missing. The right foot was absent and probably had been removed by heavy equipment. This individual's spine had been twisted during burial or after deposition from ground pressure so that her pelvis was located under her sacrum.

The burial consisted of a cranium with part of the right parietal and occipital missing and the left maxilla eroded with teeth present; a mandible fractured near the midline with the left half heavily eroded; all cervical vertebrae; 11 thoracic vertebrae; 3 lumbar vertebrae; a complete sacrum; a sternal fragment; partial right and left scapulae; both clavicles; 12 right and 11 left ribs; a complete right and an eroded left humerus; fragmentary right and left radii; mostly complete but broken right and left ulnae; fragmentary right and nearly complete left innominate; eroded right and left femora; nearly complete right and left tibiae; partial right and complete left fibulae; complete right and left patellae; partial right hand with left hand represented by three metacarpals; and both right and left tarsals with no metatarsals or phalanges present.

There were no osteologically apparent pathologies and the only observable perimortem impact trauma was to the parietal area of the cranium.

Feature 5

Feature 5 consisted of the remains of an adult male approximately 22 years of age. Stature estimates from the left femur indicate a height of approximately 5 ft 4 in (162.6 cm). This individual had a small and overcrowded maxilla and mandible with several dental anomalies. Right maxillary 1st and 2d premolars were rotated and mandibular 3d molars were impacted. Central maxillary incisors, left central mandibular incisor, and right 1st premolar appeared to have been extracted near the time of death (Appendix 3, Fig. A3.4a). The removal of teeth in individuals at or near the time of death was noted by Turner and others (1970) during their analysis of the fragmentary remains from Awatobi, but extractions are rarely noted in the literature. No osteologically observable pathologies were present.

This individual was interred in a pit dug into bedrock within a midden area. The remains were discovered just below the present ground surface. He was lying on his back in a semi-flexed position with his knees flexed to the south, his head extended to the east, and his arms bent toward his head. This individual was buried with a canteen, a double cylinder jar, and the base of a large olla. There was much rodent activity in the area; his manubrium was located by his jaw, the rest of his sternum was isolated by his left humerus, and all of the bones from his hands that were found had been displaced. Preservation varied from good to poor, with root activity and erosion varying from bone to bone, but increasing toward the feet, where only a few bones remained intact.

The burial consisted of a cranium with the posterior parietals and most of the occipital missing; a complete mandible; all cervical vertebrae; all thoracic vertebrae, eroded; all lumbar vertebrae, heavily eroded; part of the 1st and 2nd sacral vertebrae; right and left scapulae, heavily eroded; right and left clavicles, complete; 10 right and 10 left ribs, broken and eroded; right and left humerii, broken and eroded; right and left radii, eroded; right and left ulnae, eroded; right and left innominate present but fragmentary and heavily eroded; right and left femora, complete with slight erosion; right and left tibiae, complete with slight erosion; right and left fibulae, complete; bones of the hand include right carpals, two metacarpals, and one phalange; and the bones of the feet include right and left tarsals, two left metatarsals, and two unsided phalanges.

Feature 4

Feature 4 consisted of the partial remains of four individuals. All remains were recovered from just below ground surface. The partial remains of these individuals were presumed, during excavation, to be a single partial burial that had been impacted by previous road work in the area. Analysis of these remains, however, confirmed that several individuals were represented. No formal burial pit was noted during excavation and some remains were recovered from areas around the main concentration.

The bones from this locality exhibit some evidence of perimortem impact as noted by Nickens (1975) and White (1989). These trauma marks will be noted while discussing each individual.

Individual 1 is an adult female approximately 39 to 44 years of age. This woman is the most intact of the individuals found in this cluster and may be a burial that was disturbed by heavy equipment, leaving predominantly axial and lower limb bones intact. Orientation of the remains would suggest that the individual was positioned on her back with her legs flexed to her chest and her head toward the east. Rodent activity repositioned some of this individual's remains and aided in mixing them with the remains of three other individuals.

The bones that were assigned to this burial were for the most part articulated or positioned near their anatomically correct locations. The elements that were present and could be included with this burial are the vertebral arches and centrum fragments of all 5 lumbar vertebrae; a sacrum with a partial 1st sacral vertebra, eroded with some arthritic deformation; 6 right and 6 left rib fragments, two which appear to have been split along an oblique plane; a left distal radius with canid bite marks and gnawing; right fragmentary innominate and left fairly complete innominate; right proximal femur; right partial patella; one 1st phalange from a hand; and approximately 75 indeterminate fragments.

Individual 2 is an adult female approximately 23 years of age. The remains of this individual were intermixed with the remains of Individual 1. Age and sex determination were made on the basis of a sacral fragment.

The elements that could be assigned to this individual include: two dorsal fragments from a lumbar vertebra; a fragmented 3d sacral vertebra; 7 rib fragments; and an unsided iliac crest that was partially fused. No impact fractures were noted in these remains.

Individual 3 is an adult male of indeterminate age. This individual is represented by cranial fragments. Sex was inferred from the size of the mastoid. The cranial fragments include a left mastoid; left zygomatic and anterior temporal; and eight left parietal and occipital fragments. Three fragments could be conjoined and all fragments display what appear to be impact fractures along thicker aspects of the bone table (Appendix 3, Fig. A3.4d). These impacts form straight lines sometimes lipping in or out and do not appear to be natural or due to post-depositional processes. Nickens (1975) noted a predominance of cranial trauma from Mancos Canyon and White's (1989) reanalysis supported this observation.

Individual 4 is probably an adult male. Sex was determined by the bluntness of the superior border of the occipital, but no age determination was possible. This individual may be part of Individual 3; individual separation appears to be warranted because of a distinct weathering pattern. The fragments assigned to this individual include a left superior orbital; 5 other cranial fragments that could not be refitted; and 2 long bone fragments. All of the bone was weathered white and flaking. The orbital fragment exhibits edges that appear to have been impacted across a thick tissue table (Appendix 3, Fig. A3.4c). Turner (1970, 1989) observed impact marks on the thicker aspects of the cranial fragments he analyzed.

Summary

The human remains from LA 59497 suggest evidence of violence and differential status that can only be speculated on from such a small amount of data. The two single interments are of prime age individuals. The female appears to have been killed by a blow to the back of the head. The male's cause of death is unknown. His dental anomalies and the extraction of some teeth near the time of his death might have something to do with his demise, but this is speculation at best. The fact that he was buried with funerary objects could indicate that he held a position of status within the community. Were the deaths of these individuals the result of an attack on an agricultural community or independent events related to the community, but unrelated to each other? Why was an apparently prime age male buried with grave goods while a female suffered an apparently violent death?

The group of fragmentary remains adds significantly to these questions. The partial burial of an older woman in the community associated, at least physically, with fragments from a younger female and two mature males, may partially be the result of post-depositional disturbance, but the articulation of the remains of the older female would suggest that the remains were in or near their original depositional location. Were they all deposited as a result of the same event or redeposited from other areas of the midden that were dug into during the occupation of the site? And what of the apparent cranial trauma noted on the male? How do these fragmentary burials relate to the two complete burials?

The answers to these questions are far from clear. The death of the female and the trauma noted on the cranial fragments suggest that some violent events took place at this site. The connection between these events is unknown as well as their connection with the male burial. The remains discovered at LA 59497 add to a body of data from the Four Corners area that suggests the Puebloan II and III periods were, at times, subject to episodes of random or organized violence.

C-14 samples were collected from two contexts. Beta Analytic made extended counts for both samples and calibrated both dates. Treatment procedures and data summaries are in Appendix 7.

The sample from Feature 3, in Grid 96N/135E, yielded a mid-date of A.D. 350 $\pm$ 70 years. Feature 3 was a hearth located at the bottom of Stratum 4, excavated into Stratum 5. The sample was dispersed small fragments of fuel wood. The presence of the feature below the sheet trash deposit suggests that the midden area was used for outdoor activities prior to being covered with the sheet trash. The C-14 date is very early given the ceramic dates for the excavation area.

The sample from Grid 104N/130E, upper level of Stratum 4, was a scatter sample from a charcoal concentration. It has a mid-date of A.D. 500 $\pm$ 90 years. Stratigraphically, it was above the other sample, but it is still a composite sample of small fuel wood chunks. This date is very early given the ceramic dates suggested from the overall assemblage.

Ceramic dating relies on the comparison of pottery types (Table 2) with assemblages that have been placed into temporal groups from other projects within the region. Hill (1985:145) assigned an A.D. 1050-1150 date to assemblages from the McKinley Mine North Lease that are similar to LA 59497. These assemblages were dominated by Puerco- and Gallup-style ceramics, and they mark the first appearance of Cibola carbon-painted white ware.

Table 2. Ceramic Type References and Dates

Type	Reference	Date and Source
White Mound Black-on-white	Gladwin 1945:50	A.D. 750-900, Breternitz 1966:102
Red Mesa Black-on-white	Gladwin 1945:56-67	Dominant A.D. 900-1030, Windes 1981
Gallup Black-on-white	Windes 1981:40-47	A.D. 1025-1150, Dominant A.D. 1050-1100, Windes 1981
Puerco Black-on-white	Olson and Wasley 1956:369-370	A.D. 1075-1150, Windes 1981
Chaco Black-on-white	Windes 1981:48-50	A.D. 1075-1150, Windes 1981:48
Reserve Black-on-white	Cibola White Ware Conference 1958	A.D. 1032-1090, best trade dates, Breternitz 1966:90
Deadmans Black-on-red	Blinman and Wilson 1989:31-32	A.D. 880-1100
Wingate Black-on-red	Carlson 1970:11-17	A.D. 1050-1200, Carlson 1970:17
Wingate Polychrome	Carlson 1970:17-28	A.D. 1125-1200, Carlson 1970:27

Lang (1983a) concluded that Gamerco assemblages containing small amounts of McElmo and Gallup Black-on-white, with a predominance of Puerco Black-on-white, date between A.D. 1120 and 1150. He maintains that later assemblages contain increased numbers of McElmo Black-on-white and St. Johns Black-on-red or Polychrome.

Popelish (in Fehr et al. 1982) observes that the typological composition of the Black Creek ceramic assemblages is similar to late Pueblo II-early Pueblo III assemblages described by Marshall et al. (1977), Olson and Wasley (1956), and Gumerman and Olson (1968). These assemblages were dominated by varying amounts of Gallup and Puerco Black-on-white, indented corrugated, small amounts of Red Mesa Black-on-white, and Puerco or Wingate Black-on-red. Date ranges for these assemblages are A.D. 1050 to 1150.

For comparison, in Chaco Canyon, Windes (1981) suggested that assemblages dominated by Gallup Black-on-white date between A.D. 1050 and 1100. Chaco-McElmo and Chaco Black-on-white are more common between A.D. 1120 and 1140 or towards the end of the Classic Bonito phase.

Based on a comparison with the above data, the assemblage from the excavation dates between A.D. 1050 and 1150. Ceramics that might suggest a later occupation are not present. White Mound Black-on-white, which can date as early as A.D. 900, is present in such low numbers that an early occupation is unlikely. More precise dating from the ceramics is not possible because collections from the surrounding area have not been calibrated with reliable independent dates.

The C-14 dates unfortunately are much earlier than the ceramic dates, despite their stratigraphic contemporaneity. The discrepancy between the C-14 dates and the ceramic dates is so great that the "old wood" problem alone cannot be the sole cause (Schiffer 1987:308). Perhaps the coal deposits in the sandstone outcrops to the west of the site may be responsible. Adding 600 years to the carbon dates places them in the ball park defined by the ceramic dating. Whether or not this 600-year discrepancy could be applied to samples from other areas with similar potential for contamination is unknown. The processing of carbon samples from independently dated contexts within coal-bearing regions may yield a pattern that can be used to correct the dates.

CERAMIC ANALYSIS

The ceramic analysis is divided into two parts. The first part deals with the descriptive aspects of the assemblage. The second part uses the descriptive information to address the research problems outlined in the data recovery plan (Post 1987).

The Descriptive Study

The descriptive study provides the informative framework for addressing the research questions. The descriptive study includes the analysis methods, typological and classificatory definitions, and a summary of the typological and functional characteristics of the assemblage. This bulk analysis provides summary data that can be compared with ceramic studies from the McKinley Mine Coal Lease excavations. A subsequent analysis of a sample of the assemblage provides more specific typological and technological data. These data were used to look at manufacture origins for the ceramics.

Analytical Methods

Sherds brought in from the field were washed, counted, and numbered. They were then typed according to existing descriptions. The bulk study attribute list is presented in Appendix 2.

The bulk study provided information on type, vessel form and portion, temper, and sooting for the whole assemblage (Appendix 2). Provenience information included grid, stratum, level, and feature. Sherds were assigned to a formal type based on surface treatment, design elements, pigment, and temper. Sherds not assignable to type were placed into generic classes so they could be included in broad assemblage summaries and comparisons. A binocular microscope was used to identify temper and pigment. Functional attributes included vessel portion, vessel form, and sooting. All attribute data were entered on computer coding forms. Computer coded data are on 3¼-inch disks in formats that can be read by DBASE II, III, or IV, Multiplan, Lotus 1-2-3, and Symphony. Data summaries were produced using SPSS/PC for the IBM PC/XT and PS/2.

Detailed Analysis Definitions and Discussion

The detailed ceramic analysis data are used to address the research problems outlined in the data recovery plan (Post 1987). Ceramic technological and typological data are used to suggest interaction between local prehistoric populations and between local and regional prehistoric populations. The list of attributes monitored in the detailed analysis is presented in Appendix 2. Sherds that were equal to or greater than 5 cm in size were included.

The primary indicators of ceramic manufacture origin are temper and pigment. These two attributes are recognized as the most spatially distinctive for most Southwestern pottery. Identification of surface treatments and paste attributes tend to be subjective. Surface treatment and paste attributes when objectively studied may provide information about changes in local technology. This information may be applied to broader areas where comparable data are available. The problem is finding comparable procedures and goals among analysts.

Temper

Temper identification has a long and productive history of isolating specific areas of production within broad ceramic traditions. Shepard's (1939) classic work with the ceramics of the La Plata River Valley in northwest New Mexico provided a means to identify intrusive ceramics from the La Plata River Valley in assemblages from other areas. Shepard's study also showed important differences in the temper of utility and nonutility or decorated pottery. This distinction was important because it led later investigators to study the relationship between temper and vessel function.

Studies in Chaco Canyon identified large numbers of trachyte-tempered sherds. The occurrence of trachyte-tempered pottery was used to suggest a strong economic and social connection between Chaco Canyon and Chuska Valley residents. Early temper studies were followed by efforts aimed at providing a more detailed understanding of the relationship between Chaco Canyon and outlying areas (Warren 1977; Toll et al. 1980; Toll and McKenna 1987). Warren (1977) identified potential temper sources for Chaco Canyon and other large Anasazi communities that led to a better understanding of the distribution of manufacturing areas for Cibola White and Gray Wares.

Ceramic studies for the McKinley Mine North (Hill 1985) and South (Acklen 1982) coal lease projects found little temper variability in the Cibola White and Gray Wares. Both studies tried to identify manufacture and exchange of ceramics at the local and regional levels. Local area referred to the McKinley Mine project area. Regional referred to the surrounding areas, including the Chuska Valley to the north, the Black Creek Valley to the west, and the Zuni highlands to the south. Both studies were hampered by an overwhelming predominance of crushed sherd with or without sand/sandstone in the white wares and crushed sand/sandstone in the gray ware. These two tempers made up over 90 percent of the sherds from both projects.

Acklen (1982) reported possible pottery manufacture tool kits and unfired clays at three of the residential sites, suggesting local origin for some of the South Lease pottery. Hill (1985) found unfired pottery on the floor of the kiva at NL 86 on the North Lease, also good evidence for local manufacture. A lack of comparison between the two studies left issues of local manufacture, use, and exchange unresolved.

Cibola White Ware tempers have been difficult to match with a specific geologic source. Rugge (1985:149) studied survey collections of white, gray, and brown wares from Pueblo II sites, near Fence Lake, New Mexico. Petrographic analysis of Cibola White Wares revealed subtle differences in proportions of sand grain sizes and paste texture that would be difficult to distinguish with a binocular microscope. Rugge stated that it was likely that a majority of the ceramics were locally produced. However, he also noted that temper from the Springerville Project (Rugge and Doyel 1980) was similar to the Fence Lake ceramics, suggesting the uniform distribution of clay and temper sources over a broad area (Rugge 1985:149).

Rugge's work demonstrates that Hill and Acklen were not alone in their inability to find significant variability in the white ware tempers. There has been more success with utility wares. Garrett (1984), Rugge (1985), and Rugge and Doyel (1980) all found that utility wares were tempered with materials that were more geologically distinctive than the white ware tempers. Perhaps because crushed rock tempers without sherd are more abundant in the clay body it is easier for analysts to see differences in the materials.

Although the prospects for identifying variability in sherd tempers were not bright, all sherds from LA 59497 were examined under a binocular microscope, and the major temper constituents were recorded. In addition, 61 sherds were selected randomly from LA 59497 and 39 sherds were selected subjectively from McKinley Mine South sites to undergo petrographic analysis to provide more fine-grained temper data (Garrett, this report).

Pigment

Pigment type is recognized throughout the Anasazi culture area as an important indicator of area of manufacture and of period of manufacture for some areas. Pigment type was observed for all sherds, but was not recorded as an independent variable. Instead, this observation is encoded in pottery type assignments, which incorporate pigment in their definition.

The Cibola White Wares are traditionally recognized as having mineral paint designs, with the exception of Chaco-McElmo Black-on-white, a carbon-painted type that occurred with mineral-painted white wares in the San Juan Basin between A.D. 1120 and 1150 (Windes 1981). Chuska Valley sherds have both mineral- and carbon-painted designs. Although unconfirmed by independent study, Peckham and Wilson (1964) suggest that mineral paint may be more common in the south Chuska Valley and carbon paint in the north Chuska Valley. There are also good temporal indications that carbon paint replaces mineral paint on Chuska ceramics after A.D. 1150 or so. Tusayan White Wares are typically decorated with carbon paint (Colton 1955). Mesa Verde White Wares began with a mix of carbon and mineral paint, change to a predominance of mineral paint until the late 1000s or early 1100s, and are almost exclusively carbon painted by the early 1200s (Breternitz et al. 1974). In the absence of other distinctive differences between sherds, differences in pigment may provide the best clue to region of manufacture.

Paste Characteristics

Temper grain size was monitored for white and gray wares. Hill (1985) suggests that different grain sizes may influence the degree of porosity, how well a vessel reacts to thermal shock, and resistance to breakage over the long term. Grain sizes were measured in millimeters, using a comparator. This measurement was taken on the most common grain size visible in the sherd cross-section.

Temper density may affect vessel tensile strength and porosity. If white and gray ware vessels have different functions, then they should have different temper densities. Temper density was recorded as the percentage of paste that was made up of temper. Percentages were calculated by superimposing a grid, using a comparator over the sherd edge, and counting how many grids out of the total contained temper. Although imprecise, this method should distinguish sparse and abundant distributions of temper.

Paste texture as defined by Bennett (1974:31) "refers to the appearance of the paste as determined by the clay particle (or 'chunk') size." Temper size or density does not determine paste texture. Fine texture describes a particle size that is too fine to have a chunky or blocky appearance (Bennett 1974:32). Coarse has many particles of 1 mm in diameter or slightly larger (Bennett 1974:32). Coarse texture should be visible with the unaided eye. Associated with the fine and coarse designations were soft and hard. These were subjective observations based on how easily a paste could be pulverized. Soft pastes could easily be pulverized with a metal probe. Hard pastes were very resistant to being pulverized. Vitreous pastes result when clay is fired at an extreme temperature or for a long duration.

Paste color refers to the color of the sherd interior. Colors were primarily shades of gray for white and gray wares, orange and red for red wares, and tan and brown for brown wares. The fired clay color depends on the iron and carbon content and firing temperature, atmosphere, and duration. A fully oxidized firing atmosphere will burn out all of the carbon, oxidize the iron, and result in clay body shades of buff, orange, or red. Paste color is used to monitor regularities in firing techniques. Multiple modes in paste color frequency may suggest a lack of control in firing or the use of different clays by different potters. Unimodal distributions may suggest a high level of control, fewer sources, or fewer manufacturers (Rye 1981).

Core refers to the presence of a carbon steak within the paste. Carbon streaks result when carbon is not completely burned out of the clay during firing. The carbon streak is a product of the amount of carbon in the clay source and the extent of oxidation during firing. This is intended to be a general measure of firing control and is difficult to relate to actual firing methods. The core distinctions are adapted from Toll (1988).

Decoration

Gray ware decorations were executed on vessel exteriors. The types of decoration were separated into two main groups, bands and corrugation. Bands were unindented coils, while corrugated categories include oblique, vertical, smeared, tooled, and zoned. These five categories were found in combinations of up to three. Oblique was defined as indentations that alternate by row, creating diagonal patterns. Vertical indentations are one above the other, so no overall pattern is formed. Zoned indented refers to areas of a whole vessel that alternate between indented and banded. For example, the zones may consist of three rows of indented followed by three rows of banded, followed by three rows of indented. Smeared indented refers to finger or tool indented coils that are smeared, so that the indentations are less pronounced. Tooling describes incision with a sharp implement over obliterated coils or bands, or in conjunction with indentations. Indentations were recorded as tooled or fingered. Fingering was identified by fingerprints in the indentations. Tooled was assigned in the absence of fingerprints or if a tool mark was discernible in the indentation. Direction of the indentation was recorded as left or right. When a sherd was held upright clockwise orientations were right and counter-clockwise orientations were left.

Rim fillet widths and the width of the three coils immediately below the rim fillet were measured in millimeters. Rim fillet widths may change through time (Toll and McKenna 1984). Although LA 59497 is not expected to display great time depth, this attribute was monitored to produce data that could be used by researchers in other areas.

Average coil width was measured if three or more coils remained attached to a rim sherd. Restricting measurement to rim sherds controls in part for the large amount of variability that could occur on a single vessel (Toll 1988). Coil widths can be cross-tabulated with coil decoration to see is certain coil widths occurred more commonly with specific coil decorations.

White ware surface treatments were recorded to provide needed baseline data that can be used to reevaluate typologies that were established 30 to 40 years ago. Even recent analyses have provided type descriptions without quantification of the attributes. Changes in surface treatments may or may not be temporally or functionally significant for Pueblo II period Cibola White Wares, and detailed recording of attributes will be necessary to evaluate the possibility.

The surface attributes are listed in Appendix 1. The results of the detailed analysis are presented in the form of type descriptions.

White ware designs were hierarchically classified. This division was fairly simple; the most common element was designated the primary element, and the second most common element as secondary. The primary and secondary elements were recorded by their respective filler. For instance, Gallup Black-on-white was recorded as having a primary element of narrow parallel lines and a primary filler of diagonal hatchure. Elaborations, such as ticks or barbs, were recorded for each element. If we could discern a design layout it was recorded as part of the element (rectilinear or curvilinear broad lines, for example). Finally, rim decoration was recorded if it was present.

Size and Function

Orifice diameters were measured for each rim sherd (regardless of ware) that was long enough to permit a reasonably accurate measurement (3 to 4 cm long). Rim sherds were matched to a template that had diameters ranging from 5 to 40 cm. Rim diameters can be related to vessel function. More restricted openings are expected for storage vessels. Ollas are expected to have the narrowest diameters in order to prevent spills and retard evaporation. Gray ware vessels with larger openings may be used for both storage and cooking. White ware bowls often have the greatest diameters allowing frequent access to their contents for short term storage during cooking or consumption. Many different vessel diameters would be expected to correspond with domestic activities. A more restricted range of orifice diameters is expected from special use sites or sites with shorter duration occupations, such as fieldhouses or gathering sites.

Type Descriptions

These type descriptions are based on the detailed analysis. The detailed analysis included all sherds with a dimension that was greater than 5 cm. A total of 402 or 16.3 percent of the bulk ceramic assemblage was studied. Identification was initially guided by existing type descriptions. The descriptions are divided into gray, white, and red wares. Ceramic type references and manufacture dates are presented in Table 2 (pg. 29).

Gray Ware

Pueblo II-III Corrugated

Vessel Form: Undifferentiated jar (183, 97.9%); small jar (1, .5%); large jar (2, 1.1%); ladle/tubular (1, .5%)

Vessel Portion: Rim (1, .5%); neck (1,.5%); body (172, 92.0%), base (13, 7.0%)

Temper: Sand (146, 78.1%); sandstone (9, 4.8%); sherd (2, 2.7%); sherd and sand (21, 11.2%); trachyte (1, .5%); sand and clay pellets (3, 1.6%); hematitic sandstone (2, 1.1%)

Temper Grain Size: Fine (6, 3.2%); medium (153; 81,8%); coarse (28, 15.0%)

Temper Density: Less than 5% (66, 35.3%); 5 to 10% (75, 40.1%); 11 to 20% (31, 16.6%); 21 to 30% (15, 8.0%)

Paste Texture: Fine grained, hard (87, 46.5%); coarse grained, hard (67, 35.8%); fine grained, friable (14, 7.5%); coarse grained, friable (16, 8.6%); miscellaneous, soft (3, 1.5%)

Paste Color: White (22, 11.8%); black (4, 2.1%), light gray (78, 41.7%); dark gray (16, 18.6%); tan (17, 9.1); brown (5, 2.7%); cream (45, 24.1%)

Carbon Streak: Absent (40, 21.4%), diffuse edges, wide (41, 21.9%); diffuse edges, narrow (15,8.0%); distinct edges, wide (65, 34.8%); distinct edges, narrow (13, 7.0%), half and half (13, 7.0%)

Surface Decoration: Undetermined (3, 1.6%); irregular bands (1, .5%); regular bands (4, 2.1%); clapboard (9, 4.8%); tooled bands (2, 1.1%); banded, smeared, tooled (1, .5%); oblique, finger, right (10, 5.3%); oblique finger, left (42, 22.5%); oblique tooled, right (11, 5.9%); oblique tooled, left (7, 3.7%); vertical finger, right (7, 3.7%); vertical finger, left (40, 21.4%); vertical tooled, right (2, 1.1%); vertical tooled, left (4, 2.1%); zoned, oblique finger, right (1, 0.5%); zoned, oblique finger left (8, 4.3%); zoned, oblique tooled, right (1, 0.5%); zoned, vertical finger, left (4, 2.1%); zoned, vertical tooled, left (3, 1.6%); smeared, right (2, 1.1%); smeared, left (2, 1.1 %); zoned, undetermined (3, 1.6%); plain (2, 1.1 %); smeared, undetermined (1, .5%); undetermined, finger (9, 4.8%); oblique and vertical finger, left (1, .5%); smeared and ridged, left (2, 1.1%); clapboard, vertical incised (1, .5%)

Sooting: Present (21, 11.2%); absent (186, 88.8%)

Comments: Pueblo II-III indented corrugated was assigned to all corrugated sherds that were not rim sherds. Straight to slightly everted rims are a Pueblo II trait, while everted rims are a Pueblo III trait. This type can be characterized as undifferentiated jar sherds, sand-tempered, with a medium grain size, 5 to 10 percent temper density, fine and coarse grained, hard paste of light gray or cream color; 28 different corrugated patterns, which are dominated by vertical and oblique, finger indented left. The 28 different styles suggest that there were few stylistic constraints, and potentially a large number of potters made the gray indented corrugated pottery.

Observations can be made about the success of the binocular and unaided eye determinations. Temper densities were mostly less than 5 to 20 percent, which is lower than the petrographically defined mean. Temper grain sizes tended to emphasize the mean temper grain size, while the petrographic study focused on the maximum grain size. Diversity in temper types found in the petrographic study are reflected in the binocular study. Sand was the most common, with small numbers of sherd, hematitic material, and trachyte also observed. There appears to be some comparability between the two analyses that should allow some generalizations to be made about gray ware manufacture.

White Ware

Red Mesa Black-on-white

Vessel Form: Bowl (9, 60%); undifferentiated jar (6, 40%)

Vessel Portion: Rim (6, 40%); body (9, 60%),

Temper: Sand (2, 13.3%); sherd (6, 40%); sherd and sand (7, 46.7%)

Temper Grain Size: medium (14, 93.3%); coarse (1, 6.7%)

Temper Density: Less than 5% (7, 46.7%); 5 to 10% (8, 52.3%)

Paste Texture: Fine grained, hard (14, 93.3%); coarse grained, hard (1, 3%)

Paste Color: White (4, 26.7%); light gray (10, 66.7%); dark gray (1, 6.7%)

Carbon Streak: Absent (1, 6.7%), distinct edges, wide (8, 53.3%); distinct edges, narrow (1, 6.7%); diffuse edges, wide (5, 33.3%)

Paint Color: Black (8, 53.3%); brown (6, 40.0%); ghost, overfired (1, 6.7%).

Paint Texture: Absent (1, 6.7%); thick (10, 66.7%); washy (2, 13.3%); eroded (2, 13.3%)

Slip Location: Absent (3, 20%); interior, bowls (6, 40.0); exterior, jars (3, 20%); interior/exterior, bowls (1, 6.7%); slip slop bowl (1, 6.7%); floated interior, bowl (1, 6.7%)

Slip Color: Absent (3, 20%); flat white (8, 53.3%); lustrous white (4, 26.7%)

Slip Texture: Absent (2, 13.3%); smooth and creamy (6, 40%); thin, washy, and streaky (6 40%); eroded (1, 6.7%)

Polish Location and Quality: Absent (3, 20%); high, interior, bowls (1, 6.7%); medium, interior, bowls (2, 13.3%); low, interior, bowls (4, 26.7%); medium, jars (2, 13.3%); low, jars (2, 13.3%); eroded (1, 6.7%)

Primary Design Element: Opposing and single pendant triangles (4, 26.7%); broad parallel lines (2, 13.3%); triangle (2, 13.3%); broad line, spiral (1, 6.7%); rectilinear parallel (1, 6.7%); contiguous triangles (1, 6.7%); opposing and single chevrons (1, 6.7%); diagonal criss-cross (1, 6.7%); parallel narrow diagonal lines (1, 6.7%); indeterminate (1, 6.7%)

Primary Design Filler: Solid (11, 73.3%); diagonal hatchure "B" (1, 6.7%); indeterminate (3, 20%)

Primary Design Elaboration: Ticks (5, 33.3%); claws (2, 13.3); indeterminate (5, 33.3%)

Secondary Design Element: Diagonal parallel lines (3, 20%); diagonal dividers, parallel (1, 6.7%); parallel, narrow horizontal lines (1, 6.7%); triangles (1, 6.7%); broad rectilinear lines (1, 6.7%); parallel horizontal lines (1, 6.7%); none (7, 46.7%)

Secondary Design Filler: Solid (2, 13.3%); ticks (2, 13.3%); indeterminate (4, 26.7%); none (7, 46.7%)

Secondary Design Elaboration: Ticked (3, 20%); indeterminate (5, 33.3%); none (7, 46.7%)

Orifice Diameter: Range: 16-32 cm (n=3)

Sooting: Absent (15, 100%)

Comments: The 15 Red Mesa Black-on-white sherds show a high degree of consistency in paste characteristics. The paste is fine grained and hard, with medium-sized temper grains occurring in less than 10 percent density. Fired paste color is white to light gray with carbonaceous material in the clays. The pigment is brown to black and thickly applied. Most of the sherds are partly slipped and polished. Design elements vary, which is characteristic of Red Mesa Black-on-white. Sherds may only exhibit small portions of the motifs resulting in the tabulation of many elements. The design elements show the greatest affinity with Puerco Black-on-white, which is a descendant of the Red Mesa style for the Cibola White Wares.

Red Mesa Black-on-white is the main Cibola White Ware from A.D. 950 to 1025-1040. Red Mesa Style pottery occurs outside the Cibola region as Cortez Black-on-white, north of the San Juan River, and Black Mesa Black-on-white, to the west in the Kayenta region. Small numbers of Red Mesa Black-on-white commonly occur on sites that date between A.D. 1050 and 1140 (Toll and McKenna 1987; Lang 1982), so their presence is not unusual.

Puerco Black-on-white

Vessel Form: Bowl (19, 57.6%) undifferentiated jar (10, 30.3%); ladle, tubular handle (3, 9.1%); large jar (1, 3%)

Vessel Portion: Rim (11, 33.3%); body (20, 60.6%); double coil handle (2, 6.1%)

Temper: Sand (5, 15.2%); sherd (13, 39.4%); sherd and sand (14, 42.4%); sand and clay pellets (1, 3%)

Temper Grain Size: Medium (33, 100.0%)

Temper Density: Less than 5% (24, 72.7%); 5 to 10% (7, 21.2%); 10-20% (1, 3.0); 20-30% (1, 3.0%)

Paste Texture: Fine grained, hard (26, 78.8%); coarse grained, hard (1, 3.0%); fine, friable (4, 12.1%); coarse, friable (1, 3.0%); fine grained, soft (1, 3.0%)

Paste Color: White (6, 18.2%); light gray (25, 75.8%); dark gray (2, 6.1%)

Carbon Streak: Absent (5, 15.2%), distinct edges, wide (19, 57.6%); distinct edges, narrow (3, 9.1%); diffuse edges, wide (1, 3.0%); half and half (5, 15.2%)

Paint Color: Black (20, 53.3%); brown (10, 30.3%); red brown (1, 3.0%)

Paint Texture: Absent (2, 6.1%); thick (18, 54.5%); washy (4, 12.1%); eroded (9, 27.3%)

Slip Location: Absent (8, 24.3%); interior, bowls (11, 33.3); exterior, jars (10, 30.3%); interior/exterior, bowls (2, 6.1%); floated interior, bowl (1, 3.0%)

Slip Color: Absent (9, 27.3%); flat white (16, 48.5%); lustrous white (2, 6.1%); yellowish (1, 3.0%); grayish (5, 15.2%)

Slip Texture: Absent (7, 21.3%); smooth and creamy (8, 24.2%); thin, washy, and streaky (12, 26.4%); crackled (1, 3.0%); eroded (5, 15.2%)

Polish Location and Quality: Absent (11, 33.3%); medium, interior, bowls (3, 9.1%); low, interior, bowls (5, 15.2%); high, jars (1, 3.0%); medium, jars (1, 3.0%); low, jars (8, 24.2%); eroded (4, 12.1%)

Primary Design Element: Indeterminate (6, 18.2%); rectilinear parallel lines (5, 15.2%); broad line triangles (4, 12.1%); broad parallel lines (4, 12.1%); curvilinear parallel lines (2, 6.1%); broad lines, zig-zag (2, 6.0%); triangle (1, 3.0%); feather and pendant triangles (1, 3.0%); broad lines, undifferentiated (1, 3.0%); indeterminate solid element (1, 3.0%); contiguous triangles (1, 3.0%); checkerboard (1, 3.0%); medium width parallel lines (1, 3.0%); broad horizontal bands (1, 3.0%); polka dots (1, 3.0%); curvilinear broad lines (1, 3.0%)

Primary Design Filler: Solid (20, 60.6%); no filler (12:36.4%); negative squares (1, 3.0)

Primary Design Elaboration: None (30, 82.0%); ticks (2, 6.1%%); solid tips (1, 3.0%)

Secondary Design Element: Diagonal parallel lines (2, 6.1%); diagonal dividers, parallel (1, 3.0); vertical parallel lines (1, 3.0%); broad rectilinear lines (1, 3.0%); broad curvilinear lines (1, 3.0%); broad lines, horizontal lines (1, 3.0%); none (22, 66.7%)

Secondary Design Filler: Solid (6, 18.2%); negative horizontal squares (1, 3.0%); none (26, 78.8%)

Secondary Design Elaboration: Absent (33, 100.0%)

Orifice Diameter: Range: 5-26 cm (n=6)

Sooting: Present (2, 6.1%); absent (31, 93.9%)

Comments: The 33 sherds of Puerco Black-on-white have consistent paste characteristics with sherd and sherd/sand temper of medium grain size occurring in a fine-grained paste in densities of under 10 percent. Surfaces are mostly slipped or polished. Design elements reflect a close relationship to Red Mesa Black-on-white with triangles and medium and broad line elements common. One sherd had an indented corrugated exterior and is called Puerco Black-on-white/corrugated in this report. This sherd was selected for petrographic analysis.

Puerco Black-on-white roughly dates between A.D. 1000 and 1150. Puerco-style ceramics are comparable to Sosi and Black Mesa styles in the Kayenta region and Mancos and McElmo styles north of the San Juan River. Puerco and Escavada Black-on-whites are stylistically similar with Escavada Black-on-white assigned commonly to the central San Juan Basin and its peripheries. Puerco Black-on-white also commonly occurs in the southern Cibola region with Reserve Black-on-white having opposed solid and hatched design elements on the same vessel.

Gallup Black-on-white

Vessel Form: Bowl (10, 19.2%); undifferentiated jar (35, 67.3%); small jar (2, 3.8%); large jar (1, 1.9%); pitcher (1, 1.9%); olla (1, 1.9%); ladle (2, 3.8%)

Vessel Portion: Rim (8, 15.4%); body (42, 80.8%); double coil handle (2, 3.8%)

Temper: Sand (10, 19.2%); sherd (14, 26.9%); sherd and sand (28, 53.8%)

Temper Grain Size: Fine (5, 9.6%); medium (45, 86.5%); coarse (2, 3.8%)

Temper Density: Less than 5% (31, 59.6%); 5 to 10% (19, 36.5%); 10-20% (2, 3.8%)

Paste Texture: Fine grained, hard (46, 88.5%); coarse grained, hard (4, 7.7%); fine grained, friable (1, 1.9%); coarse grained, friable (1, 1.9%)

Paste Color: White (11, 21.2%); light gray (37, 71.2%); dark gray (1, 1.9%); brown (1, 1.9%); cream (2, 3.8%)

Carbon Streak: Absent (14, 26.9%; diffuse edges, wide (3, 5.8%); diffuse edges narrow (2, 3.8%); distinct edges, wide (15, 28.8%); distinct edges, narrow (4, 7.7%); half and half (14, 26.9%)

Paint Color: Absent (1, 1.9%); black (33, 63.5%); brown (13, 25%); red brown (12, 3.8%); dark gray (1, 1.9%)

Paint Texture: Absent (1, 1.9%); thick (27, 51.9%); washy (7, 13.5%); eroded (15, 28.8%)

Slip Location: Absent (14, 26.9%); interior, bowls (4, 7.7%); exterior, jars (26, 50%); interior/exterior, bowls (2, 3.8%); slip slop bowl (6.7%); floated interior, bowl (1, 1.9%); floated exterior, jar (5, 9.6%)

Slip Color: Absent (15, 28.8%); flat white (18, 34.6%); lustrous (5, 9.6%); yellowish (1, 1.9%); grayish (10, 19.2%); tan (1, 1.9%)

Slip Texture: Absent (12, 23%); smooth and creamy (13, 25%); thin, washy, and streaky (14, 26.9%); eroded (13, 25%)

Polish Location and Quality: Absent (13, 25%); high interior and exterior (2, 3.8%); high, interior, bowls (1, 1.9%); low, interior, bowls (3, 5.8%); medium, jars (7, 13.5%); low, jars (13, 25.0%); eroded (13, 25%)

Primary Design Element: Triangle (4, 7.7%); broad lines, zig-zag (1, 1.9%); feather and pendant (5, 9.6%); curvilinear parallel (8, 15.4%); rectilinear parallel (29. 55.8%); negative opposing ovals (1, 1.9%)

Primary Design Filler: Diagonal, Hachure "B" (42, 80.8%); solid (1, 1.9%); parallel, Hachure "A" (1, 1.9%); parallel, Hachure "B" (2, 3.8%)

Primary Design Elaboration: Solid tips (1, 1.9%); indeterminate (51, 98.1%)

Secondary Design Element: Broad line curvilinear (2, 3.8%); triangles (1, 1.9%); absent (49, 94.2%)

Secondary Design Filler: Solid (1, 1.9%); negative horizontal diamonds (1, 1.9%); absent (50, 96.2%)

Orifice Diameter: Range: 12-16 cm (n=2)

Sooting: Present (4 7.7%); absent (48, 92.3%)

Comments: The 52 Gallup Black-on-white sherds continued to exhibit the paste and surface treatment consistency found in Red Mesa and Puerco Black-on-white. Sand temper was more common than in other types. Temper grain sizes are medium, set in fine grained pastes that are light gray to white. Slip and polish are present on 73 percent of the sherds, which is lower than Red Mesa Black-on-white. This lack of surface treatment on Gallup-Black-on-white is noted by Windes (1981) for Chaco Canyon assemblages. He suggests that as more pottery was needed, extra treatments were sacrificed in place of faster production. Because this pattern occurs in an outlying area like McKinley Mine it seems that fast production is not the main reason for less attention to surface treatment. It seems just as likely that availability of adequate slip materials could explain its sparing use. The lack of polish may be a function of erosion of sherd surfaces as much as anything else. Gallup Black-on-white is lightly polished in most examples. Light polish might erode quickly without a change in slip or paint.

Gallup Black-on-white by definition has hatchured line designs without solid elements. The most common style is Hachure B, as defined by Toll and McKenna (1987:60-61). They show changes in angle of hachure, width of hatchure and framing lines, and space between hachure lines through time. Toll and McKenna's trajectory is based on Roberts' classifications (1931). Hachure B is the most common style on sites that post-date A.D. 1050, it is also the most common style for LA 59497 Gallup

Black-on-white.

Gallup Black-on-white is commonly dated between A.D. 1000 and 1125-1150, and in some cases, A.D. 1200. This hatchure style in combination or lacking solid elements is common on Reserve, Dogoszhi, Mancos, and Cebolleta Black-on-whites. Toll (1985) and Judge (1989) very tentatively suggested that the use of "pure" Gallup Black-on-white found its most frequent early expression in Chaco Canyon, and that the spread of the hatchured style was an indication of the growth of the Chaco system. Popelish (in Fehr et al. 1982) tabulates the co-occurrence of Puerco and Gallup styles along the southern and western periphery of the San Juan Basin. She found Puerco-style designs in 58.5 percent and Gallup Black-on-white on 18.5 percent of the Cibola White Wares from Black Creek, east of Lupton, Arizona. Conversely, Popelish notes that Windes (1977) found 58.6 percent Gallup Black-on-white and 12 percent Puerco-Escavada style in the CGP area in the Chuska Valley. LA 59497 has equal numbers of both styles. Under Toll and Judge's proposition, the mix of design styles might indicate association with the Chaco system but an equally strong affiliation with populations of the Rio Puerco of the West. The question remains if there are regions where Puerco-style pottery dominates, suggesting a connection between design style and cultural identity.

Puerco-Gallup Black-on-white

Vessel Form: Bowl (3, 23.1%); undifferentiated jar (8, 61.5%); small jar (1, 7.7%); canteen (1, 7.7%)

Vessel Portion: Rim (2, 15.4%); neck (1, 7.7%); body (9, 69.2%); base (1, 7.7%)

Temper: Sherd (2, 15.4%); sherd and sand (11. 84.6%)

Temper Grain Size: Fine (2, 15.4%); medium (10, 76.9%); coarse (1, 7.7%)

Temper Density: Less than 5% (7, 53.8%); 5 to 10% (6, 46.2%)

Paste Texture: Fine grained, hard (12, 92.3%); coarse grained, hard (1, 7.7%)

Paste Color: White (11, 21.2%); light gray (13, 100%)

Carbon Streak: Absent (2, 15.4%); diffuse edges, wide (1, 7.7%); diffuse edges narrow (2, 15.4%); distinct edges, wide (4, 30.8%%); half and half (4, 30.8%)

Paint Color: Absent (1, 7.7%); black (8, 61.5%); brown (4, 30.8%)

Paint Texture: Thick (8, 61.5%); washy (2, 15.4%); eroded (3, 23.1%)

Slip Location: Absent (4, 30.8%); interior, bowls (1, 7.7%); exterior, jars (6, 46.2%); Interior/exterior, bowls (1, 7.7%); floated exterior, jar (1, 7.7%)

Slip Color: Absent (5, 38.5%); flat white (5, 38.5%); lustrous (2, 15.4%); grayish (1, 7.7%)

Slip Texture: Absent (4, 30.8%); smooth and creamy (5, 38.5%); thin, washy, and streaky (3, 23.1%); eroded (1, 7.7%)

Polish Location and Quality: Absent (4, 30.8%); low, interior, bowls (3, 23.1%); high, jars (1, 7.7%); medium, jars (1, 7.7%); low, jars (3, 23.1%); eroded (1, 7.7%)

Primary Design Element: Triangle (1, 7.7%); curvilinear parallel (5, 38.5%); rectilinear parallel (7, 53.8%)

Primary Design Filler: Diagonal, Hachure "B" (12, 92.3%); parallel, Hachure "B" (1, 7.7%)

Primary Design Elaboration: Solid tips (1, 1.9%); indeterminate (51, 98.1%)

Secondary Design Element: Parallel, narrow, horizontal lines (1, 7.7%); broad line, curvilinear (6, 46.2%); broad, horizontal line (1, 7.7%); rectilinear medium parallel lines (1, 7.7%); triangles (1, 7.7%); broad, rectilinear lines (2, 15.4%); parallel medium lines (1, 7.7%)

Secondary Design Filler: Solid (8, 61.5%); negative horizontal diamonds (3, 23.1%); ticks (1, 7.7%); absent (1, 7.7%)

Orifice Diameter: Range 28.0 cm (n=1)

Sooting: Absent (13, 100%)

Comments: As might be expected the 13 examples of Puerco-Gallup Black-on-white, as it is defined by Lang (1983a), show a very close similarity in paste and surface treatment with the other types. In the past, this intermixing of design elements has been interpreted as the melding of different cultural groups (Lang 1982, 1983a). This is possible, but it is just as likely that wherever the two design styles occur a few sherds will have both design styles. At LA 59497, the double-cylinder jar is decorated with Puerco-style designs on one cylinder and Gallup style designs on the other. With the equal occurrence of the two styles in the sherd assemblage, this suggests that mixed design styles on a single vessel should be a common, if not frequent, occurrence. Toll and McKenna (1987) coined the term "Puesga" for this style. Popelish (in Fehr et al. 1982) found it common in the Black Creek Valley. She differentiated between Puerco-Gallup and Reserve by the former having unbalanced proportions of solid and hatched elements. Lang (1982) attributes the co-occurrence in the eastern Red Mesa Valley to an influx of people from the Rio Puerco of the West. Rather than evidence of intermarriage or population movement this is just a result of widespread use of two design styles. This is supported by the paste and surface treatment similarities, which suggests that the vessels were made by the same people.

Summary

The detailed ceramic study identified a fairly high degree of consistency in the white wares and less consistency in paste and surface attributes in the gray indented corrugated. On one hand this could result from more potters making gray wares and fewer potters making white wares. But the differences in gray and white wares may also result from less need to control paste and surface attributes in gray wares because they were used for cooking and storage. For white wares, the desire to retain design and aesthetic quality may have promoted more care in selecting clays and tempers, and in control of firing temperature, atmosphere, and duration. This control would be reflected in greater overall consistency within the white wares.

A high degree of control of white ware production might cloud distinctions between local and nonlocal pottery that are based on surface and paste attributes. While surface treatment may not be regionally distinctive, the frequencies of design elements may have more regional significance. Support for this assumption is suggested by the distribution of elements from Black Creek and the Chuska Valley (CGP area, Windes 1977) assemblages. The Black Creek assemblages have greater proportions of Puerco-style pottery (Fehr et al. 1982), while the Chuska Valley assemblages exhibited greater percentages of Gallup style pottery. LA 59497, which is geographically between Black Creek and the Chuska Valley, had almost equal percentages of both styles within the assemblage. The element percentages from these assemblages suggest that their areal distribution could be important and possibly relate to social and economic interaction between related groups under the umbrella of the Chaco political and economic system.

The Assemblage

A total of 2,464 sherds was recovered from surface and subsurface contexts. The sherds were assigned to 30 formal types and sorting categories (Table 3). The 30 types are separated into the three general ceramic wares: gray, white, and red. These three ware groups and commonly a fourth, brown, occur in varying proportions on all Anasazi sites. Commonly, the three ware categories are considered to be functionally distinct from one another. Gray wares are commonly assigned utility functions. White wares are for consumption, short-term storage, and exchange. Red wares are accorded a special status, as trade items, when they are found outside of their main manufacturing areas.

For further discussions, I would like to treat the assemblage as a single entity. Before making this assumption, the vertical distribution of types as defined by the arbitrary excavation levels should be examined to see if stratified distributions exist. A cross-tabulation of type by level within Stratum 4, which is the sheet trash deposit, shows no patterned decrease in later types like Gallup and Puerco Black-on-white or red wares nor increase in earlier types like Red Mesa Black-on-white or plain gray from upper to lower levels. This would be expected given the thin depth of the sheet trash deposit. Therefore, the assemblage will be treated as a single component.

The functional assumptions for the three wares only hold as long as they vessels are not broken or modified. Once they are broken, many secondary uses of sherds may occur. These functional transformations are labeled "cultural transforms" (Schiffer 1987). Because these sherds are primarily from a thin sheet trash deposit, and probably were discarded as their use-life ended, their secondary uses may not be evident. This factor, while difficult to detect, does condition assignment of sherds to functional categories. Recognizing the potential for secondary uses before final discard, this analysis will treat all sherds as if they are representative of their original inferred function.

Gray wares are the most common, led by PII-PIII Corrugated. Chuska Gray Wares are the most numerous nonlocal ware that is not a red ware. Gray wares occur primarily as body sherds of undifferentiated jars. Gray ware vessel shapes are fairly uniform, though sizes may differ. The same vessel could have been used for cooking and long and short-term storage. Nonjar vessels are rare in this assemblage. Gray ware temper reflects the results of the petrographic analysis, with sand/sandstone the most frequently identified temper. Sherd or sherd/sandstone was 11.5 percent, which was higher than expected based on the petrographic study. Hematitic sandstone was identified in 2.4 percent of the gray wares. Trachyte, which was observed in .9 percent of the assemblage, was not found in the petrographic analysis, which is not surprising because it occurs in low frequencies.

White ware sherds are the second most common, with Gallup and Puerco Black-on-whites occurring in similar percentages. Unidentified mineral white and unidentified white wares comprise 28.7 percent of the assemblage.

The unpainted sherds are probably from Gallup and Puerco Black-on-white vessels. If this is so the unidentified white ware vessel form counts should be similar to the Gallup and Puerco Black-on-white counts, and they are. Unlike gray wares, white wares were made in a wide variety of forms and sizes that were used for a variety of domestic tasks. Table 4 illustrates this vessel form diversity. White ware jar forms outnumber bowls almost 2 to 1, suggesting the importance of stored water to the site inhabitants.

Table 3. Ceramic Type Frequencies

Ceramic Type	Count	% in Assemblage	% of Ware
Gray Wares	31	1.3	
Plain Gray	2	.1	2.2
Wide Neckbanded	1	-	.1
Neck Corrugated	1	-	.1
PII Corrugated	62	2.5	4.5
PII-PIII Corrugated	1263	51.3	91.3
PIII Corrugated	1	-	.1
Chuska PII Corrugated	1	-	.1
Chuska PII-PIII Corrugated	11	.4	.8
Unidentified Utility	10	.4	.8
Unidentified Gray Smudged	1	-	.1
Sub-Total	1383	56.1	
White Ware			
Unidentified Black-on-gray	4	.2	.4
Puerco-Gallup B/w	21	.9	2.0
Puerco Style B/g	5	.2	.5
White Mound B/w	2	.1	.2
Red Mesa B/w	31	1.3	2.9
Puerco B/w	132	5.4	12.4
Gallup B/w	145	5.9	13.7
Chaco B/w	3	.1	.3
Unidentified Mineral White	361	14.6	34.0
Unidentified Carbon White	4	.2	.4
Unidentified White	348	14.6	32.8
Reserve B/w	6	.2	.6
Subtotal	1062	43.1	
Red Ware			
Deadmans B/r	5	.2	26.3
Wingate B/r	2	.1	10.5

Ceramic Type	Count	% in Assemblage	% of Ware
Wingate Polychrome	3	.1	15.8
Unidentified Smudged Red	1	-	5.3
Unidentified Red Ware	7	.3	36.8
Plain Red Ware	1	-	10.5
Subtotal	19	.8	
Grand Total	2464		

Table 4. Vessel Form by Ware

Count Row Pct Column Pct	Gray Ware	White Ware	Red Ware	Total
Vessel Form				
Bowl	.2 .6 .1	308 97.5 29.0	6 1.9 31.6	316 12.8
Ladle (undifferentiated)	1 16.7 .1	5 83.3 .5		6 .2
Ladle (gourd)		1 100.0 .1		1 -
Ladle (tubular)	1 33.3 .1	2 66.7 .2		3 .1
Undifferentiated jar	1313 67.9 94.9	610 31.6 57.4	9 .5 47.4	1932 78.4
Small jar	5 19.2 .4	21 80.8 2.0		26 1.1
Large jar		6 75.0 .6		8 .3
Pitcher		1 100.0 .1		1 -

Count Row Pct Column Pct	Gray Ware	White Ware	Red Ware	Total
Olla		7 100.0 .7		7 .3
Seed jar		1 100.0 .1		1 -
Canteen		3 100.0 .3		3 .1
Undetermined vessel	58 36.7 4.2	96 60.8 9.0	4 2.5 21.1	158 6.4
Miniature jar	1 50.0 .1	1 50.0 .1		2 .1
Total	1383 56.1	1062 43.1	19 .8	2464 100.0

If white ware forms are more diverse, then there should be a wider range of vessel portions. This is the case, as almost twice as many types of portions are found in the white wares compared to the gray wares. Rims are almost three times as common, a result of the high contribution of bowls rims. Broken bowls should leave more rim sherds than most jar forms, which tend to have smaller openings relative to body size (Table 5).

Temper frequencies are similar to the petrographic analysis; sherd or sherd/sandstone accounts for 82.2 percent (Table 6). At 16.6 percent sand/sandstone temper occurs more frequently than would be expected based on the random sample selected from the LA 59497 assemblage for petrographic analysis. In Gallup and Puerco Black-on-white, sand/sandstone temper occurs between 13 and 17 percent, so that neither type contributes more to the overall sand/sandstone temper.

Red wares occur as .8 percent of the assemblage. They come from the White Mountain and San Juan areas. Small numbers of red wares are common on all habitation sites in the McKinley Mine area. Both bowls and jars are represented. Crushed igneous temper, which is diagnostic of Deadmans Black-on-red (San Juan Red Ware), was identified in five sherds. The remainder were tempered with sand or sherd or sherd/sandstone, which is typical of White Mountain Redwares.

Table 5. Vessel Portion by Ware

Count Row Pct Column Pct	Gray	White	Red	Total
Vessel Portion				
Rim	64 25.0 4.6	188 73.4 17.7	14 .7 73.7	256 10.4
Neck	9 45.0 .7	11 55.0 1.0		20 .8
Body	1264 60.5 91.4	810 38.8 76.3		2088 84.7
Base	25 75.8 1.8	8 24.2 .8		33 1.3
Handle Strap (vertical)		4 100.0 .4		4 .2
Handle Strap (horizontal)	1 33.3 .1	2 66.7 .2		3 .1
Lug handle		2 100.0 .2		2 .1
Single coil handle		1 100.0 .1		1 -
Double coil handle	1 33.3 .1	2 66.7 .2		3 .1
Undetermined portion	19 35.8 1.4	33 62.3 3.1	1 1.9 5.3	53 2.2
Ladle handle (undifferentiated)		1 100.0 .1		1 -
Total	1383 56.1	1062 43.1	19 .8	2464 100.0

Table 6. Temper Type by Ware

Count Row Pct Column Pct	Gray	White	Red	Total
Temper type				
Sand	1014 85.7 73.3	167 14.1 15.7	2 .2 10.5	1183 48.0
Sandstone	131 92.9 9.5	10 7.1 .9		141 5.7
Sherd	27 9.2 2.0	261 89.4 24.6	4 1.4 21.1	292 11.9
Sherd and sand/sandstone	145 19.0 10.5	612 80.1 57.6	7 .9 36.8	764 31.0
Trachyte	11 100.0 .1			11 .4
Sherd and Trachyte	2 100.0 .1			2 .1
Crushed igneous rock			5 100.0 26.3	5 .2
Sand and clay pellets	20 62.5 1.4	11 34.4 1.0	1 3.1 5.3	32 1.3
Hematitic sand or sandstone	33 97.1 2.4	1 2.9 .1		34 1.4
Total	1383 56.1	1062 43.1	19 .8	2464 100.0

Whole and Partial Vessels

One whole and two partial vessels were recovered from LA 59497. All three vessels are from Feature 5, which is the burial of a young male in his mid-twenties. Feature 5 is described in Human Remains. Another burial was found nearby and it did not have nonperishable grave offerings.

Perhaps the most interesting find is the double-cylinder jar. The vessel consists of two upright cylinders that are attached to one another at the base by a wide clay strap (Fig. 7). Cylinder A is decorated with solid designs, 14 cm high, 11.5 to 11.9 cm in interior diameter at the mouth, and 6.8 cm in diameter at the base. The vessel walls are 0.6 cm thick. Most of the interior is smoothed, but twelve individual coils are still visible. Cylinder B is decorated with hatched designs, 14.5 cm high, 11.5 to 11.9 cm in interior diameter at the mouth and 6.3 cm in the interior diameter at the base. The vessel walls are between 0.6 and 0.7 cm thick. Most of the interior has been smoothed with twelve coils still visible.

Both cylinders were fired in a reducing atmosphere with fireclouds visible on the exterior of both and on the interior of Vessel B. The exterior surface color is light gray and is covered with a light, streaky slip that has been lightly polished. Both cylinders have rounded rims that are slightly pinched and smoothed. Four holes are just below the rim of each cylinder equidistant around the perimeter. These holes were for suspension or to attach a cover. The vessels are joined at the base by a pinched strap of clay. The strap is 5 cm long between the cylinders, 4.3 cm wide, and is pinched to 1 cm thickness. It is smoothed and lacks slip or polish.

The descriptive term, cylinder jar does not exactly fit, since the two vessels are wider at the top than at the bottom, and therefore, do not form perfect cylinders. In fact, the upper 3.7 cm of each cylinder is slightly flared. Toll (1990) questions whether this is a "true" cylinder jar because it is shorter than the other cylinder jars found at Chaco Canyon. It approximates the cylinder form, but its poor surface finish and decorative rendering mark it as a "low quality" imitation. The height of the cylinders is similar to shorter and squatter beakers. However, a double beaker would have been nonfunctional because the form would make pouring liquids difficult. This form may also be derived from the double bowl, small bowls that are joined at the rim or the base.

The cylinders are decorated with mineral paint. The designs on both vessels are difficult to describe because they lack symmetry and the layout is inconsistent (see Fig. 7). Interestingly, the design elements represent the two main design styles found in the LA 59497 assemblage and throughout the Cibola region between A.D. 1050 and 1100, the Gallup and Puerco styles.

The mixing of the two design styles on a single vessel may be common. The conscious separation of the two styles on a single vessel suggests something more. The significance of the design style separation may have more meaning when the context of the vessel and the implication for social status of the individual are considered.

The separation of the solid and hatchured layouts suggests a duality that cannot be fully appreciated by studying individual sherds or even individual vessels that have a single style represented. I doubt that the solid and hatchure design styles are indicative of cultural identity; instead, they are suggestive or symbolic of belief systems that led to the infrequent use of them together (Reserve Black-on-white excepted), on separate vessels commonly, and separately but together on a double vessel rarely. This seems to point to the significance of the vessel or the individual.

A case for the study of symbols of duality in prehistoric people's belief systems cannot be made from a single vessel, but I think that understanding design styles and their relationship to human behavior may be better served by the idiosyncratic artifacts that come our way, and not so much the usual run-of-the-mill daily ware.

Figure 7. Double-cylinder jar, Feature 5.

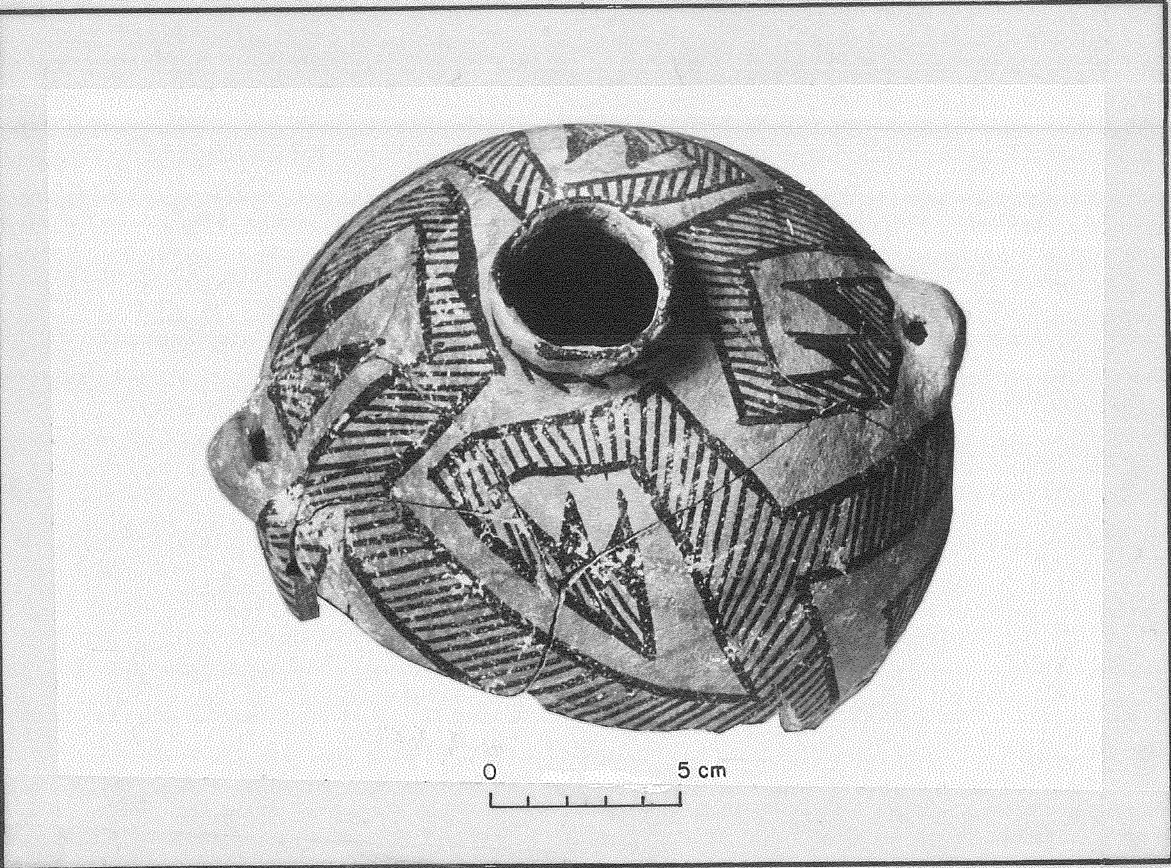

Figure 8. Partial canteen, Feature 5.

The upper two-thirds of a canteen fragment (Fig. 8) was recovered during surface stripping above the skull in Feature 5. The canteen measures 13.0 cm high (projected), 11.6 cm in diameter (widest), and the opening is 2.4 cm in diameter. The shape is spherical; the lower half is globular and the upper half is more rounded. It is equipped with opposed single strap lugs containing punched holes. The exterior finish is smoothed and a mottled gray, but the exterior is neither slipped nor polished. The interior is smoothed by hand and is light gray. It has crushed sherd temper in medium abundance, with a half and half, light gray and gray core.

The design style is Dogoszhi or Gallup. The framing line widths are greater than the hatched line widths, which fits the Gallup B style. The overall layout is a continuous pattern of repeated scrolls with the tips filled in. The distance between hatchured lines is irregular and the lines are wobbly and irregular.

An olla fragment (Fig. 9) was at the right edge of the burial pit, next to the right arm. It was placed right side up. The interior dimension is estimated to be 25 to 30 cm. The exterior has a crackled slip with a light and spotty polish. The interior is well smoothed, probably by a pottery scraper. The core is half-and-half, with the exterior very light gray and the interior gray. It is tempered with sherd and sand and is present in medium abundance. A ghost of a solid broad line design is present, and the fragment can be typed as Puerco Black-on-white. No detailed description is possible because so little of the vessel remains.

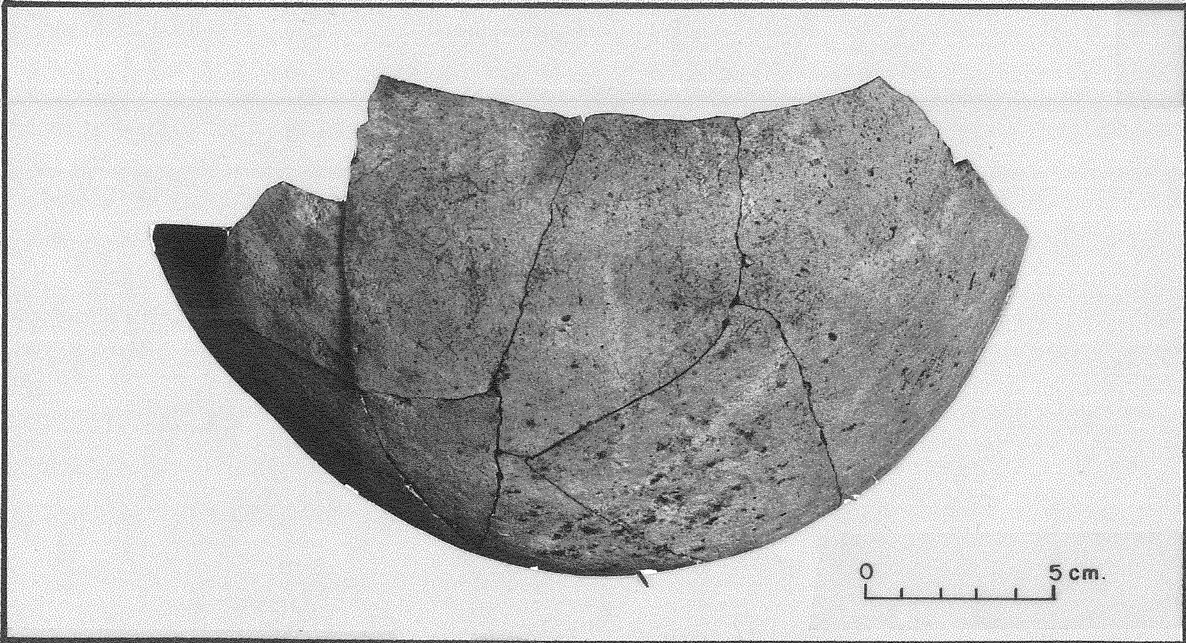

Figure 9. Partial olla from Feature 5.

Comparison with McKinley Mine Ceramic Assemblages

I would like to briefly compare LA 59497 with similar sites from the McKinley Mine excavations. These will be somewhat generalized comparisons because the data from the McKinley Mine analyses are less detailed than that presented here; however, general typological and technological information are presented and can be compared.

The McKinley Mine South ceramic database was presented primarily in summary form (Acklen 1982). Typological and functional data are grouped by site type and by site date. Similar site types and occupation periods are combined and then compared to examine the assemblage for changes in manufacturing tradition, site function, or exchange directions through time. The average percentage of vessel forms for the middle period (A.D. 1050-1120) proveniences was nearly equal, with jars totaling 51 percent and bowls totaling 46 percent of the sherds. Residential sites of all time periods yielded 69.6 percent utility wares (gray wares) and 30.4 percent decorated wares (white and red wares), with more variety in vessel forms noted for the residential sites versus nonresidential sites. Intrusive ceramic types were from the San Juan, Little Colorado, Tusayan, and White Mountain regions during the middle period.

Assemblages from three McKinley Mine North sites (NL 86, NL 141, and NL 142) (Hill 1985) are roughly contemporary with LA 59497. They were probably part-time residences. The McKinley

Mine North ceramic analysis provided summary data for residential and nonresidential sites and by individual site. Nine single-component residential sites (Hill 1985:153) had about 65 percent gray wares and 35 percent white wares. White ware bowls accounted for 11 percent, white ware jars for 25 percent, and gray ware jars for 64 percent. The largest assemblage, 5,605 sherds, came from the kiva excavation at NL 86. This site exhibits slightly different assemblage percentages. This assemblage contains higher amounts of plain gray wares and Red Mesa Black-on-white than LA 59497 and the McKinley Mine South sites, suggesting that it may be a little earlier. This is contradicted by the occurrence of over 25 percent sherd temper in the corrugated gray wares, which is usually associated with a later time period (post-A.D. 1100). Another interesting aspect of the NL 86 assemblage is the occurrence of Dogoszhi-style (Gallup) designs on 54 percent of sherds and Black Mesa- and Sosi-style (Puerco) designs on 18 percent of the sherds. These proportions are different from the LA 59497 assemblage. Red Mesa-style designs account for 21 percent of the assemblage, which indicates multiple occupations or that the Red Mesa style should be combined with Black Mesa and Sosi styles to provide a more accurate proportion of nonhatchured pottery.

All three analyses clearly show a dominance of Pueblo II period Cibola series design styles in the white wares. All three analyses suggest that sandstone or sherd was the preferred temper material. Unfortunately, the McKinley Mine analyses lacked the funds to complete petrographic studies. The petrographic analysis of a sample of sherds from McKinley Mine South sites and LA 59497 mostly showed consistency between assemblages with minor differences suggesting more than one manufacture area.

All residential sites (both leases and LA 59497) show gray wares as the most frequently discarded sherds. This is expected given the inferred frequency of gray ware jar use in daily activities. All of the residential sites show a relatively high variety of vessel forms in comparison with nonresidential sites. There is an interesting difference in the bowl and jar frequencies between McKinley Mine South and LA 59497 and McKinley Mine North. McKinley Mine South assemblages have almost equal percentages. The other two study areas have between 78 and 89 percent jars. The almost equal number of bowls and jars in the McKinley Mine South assemblage is unexplained. I would assume that the McKinley Mine North and LA 59497 assemblages should result in a high representation of broken white ware jars because all groups needed to store water. Perhaps the McKinley Mine South differences are due to sampling error rather than prehistoric behavior.

Chuska White and Gray Wares and White Mountain Redwares are common nonlocal ceramic types in all three analyses. There is greater variability of intrusive types in the McKinley Mine assemblages compared to the LA 59497 assemblage. This would suggest that the McKinley Mine site residents maintained more social or economic contacts, resulting in acquisition of pottery from more areas.

Evidence for pottery manufacture is present for the McKinley Mine sites in the form of unfired vessels and unfired clay at some residential sites. Direct evidence of pottery manufacture at LA 59497 was not found. Petrographic analysis (Garrett, this report) suggests that the pottery sources for LA 59497 and the McKinley Mine South sites are similar. Low level, localized specialization and exchange of gray and white wares is indicated.

In summary, the McKinley Mine lease assemblages and LA 59497 appear to be very similar. Residential sites tend to have a greater diversity of vessel forms commensurate with the expected site activities. Jars, white and gray, combine to dominate the vessel form assemblages. This reflects the multipurpose functions of gray ware jars and the need to transport and store water at all sites. Typological differences exist between NL 86 on the McKinley Mine North Lease and LA 59497; more Puerco-style pottery occurs at LA 59497. I pointed out that the assemblage from NL 86 is not separated into early and later occupations, which might provide results that are different and more comparable with LA 59497. McKinley Mine South type frequencies are not reported and could not be compared.

PETROGRAPHIC STUDY OF CERAMICS FROM LA 59497 AND MCKINLEY MINE SOUTH

by Elizabeth M. Garrett

Introduction

A sample of 61 sherds was selected randomly from the LA 59497 ceramic assemblage and 39 sherds were selected subjectively from three McKinley Mine sites (PM 218, PM 224, and PM 240) for petrographic study (Fig. 10). Sherds were chosen from both LA 59497 and the McKinley Mine sites in order to study ceramic manufacture and exchange for Pueblo II sites on a small regional scale. The LA 59497 sherds were selected randomly from the detailed study assemblage. Sherds from McKinley Mine South were selected from midden deposits if they were large and flat enough for thin sectioning.

The ceramic types and number of samples submitted for petrographic examination are shown in Table 7. Figures 11 to 16 show sample sherds from LA 59497. The McKinley Mine and LA 59497 site locations are shown in Figure 10.

Methods

The sherds were numbered 1 to 100 and submitted to the Geology Department, University of New Mexico, for thin-section preparation. Using standard geological techniques, the sherd was cut to the slide size, parallel to the sherd vessel wall, ground flat on one side, and then glued to a glass slide with epoxy. The sherd was carefully ground to a thickness of 30 microns, the required thickness for examination with a petrographic microscope. The ground sherd was covered with a slip cover, and the excess adhesive was removed.

The 100 thin sections were examined with a petrographic microscope, an instrument that uses a polarizer to force light to vibrate in two planes at right angles to each other. The light source is below the specimen, and when the polarizer is in place (that is, crossed nicols), the interference of these two lightwaves is expressed as color. When the polarizer is removed, the thin section may be examined in plane (that is, unpolarized) light. In addition, the microscope has other optical devices to aid in the identification of geological material. Individual temper grains may be measured and the angularity of the grains noted.

Petrographic analysis can be used to identify the natural nonplastic minerals and rock fragments within clay that may reflect the raw material source; temper, when it can be demonstrated that it was crushed or processed, then added to the clay; and paste characteristics such as homogeneity and vitrification. Petrographic analysis cannot be used to identify mineral or elemental composition of the clay and nonplastic additives. Clay minerals are too small (less than .0039 mm) in size to be observed with a polarizing microscope, and most clay mineral structure is destroyed in firing. Analytical techniques such as X-ray diffraction are required to analyze the attributes of clay minerals.

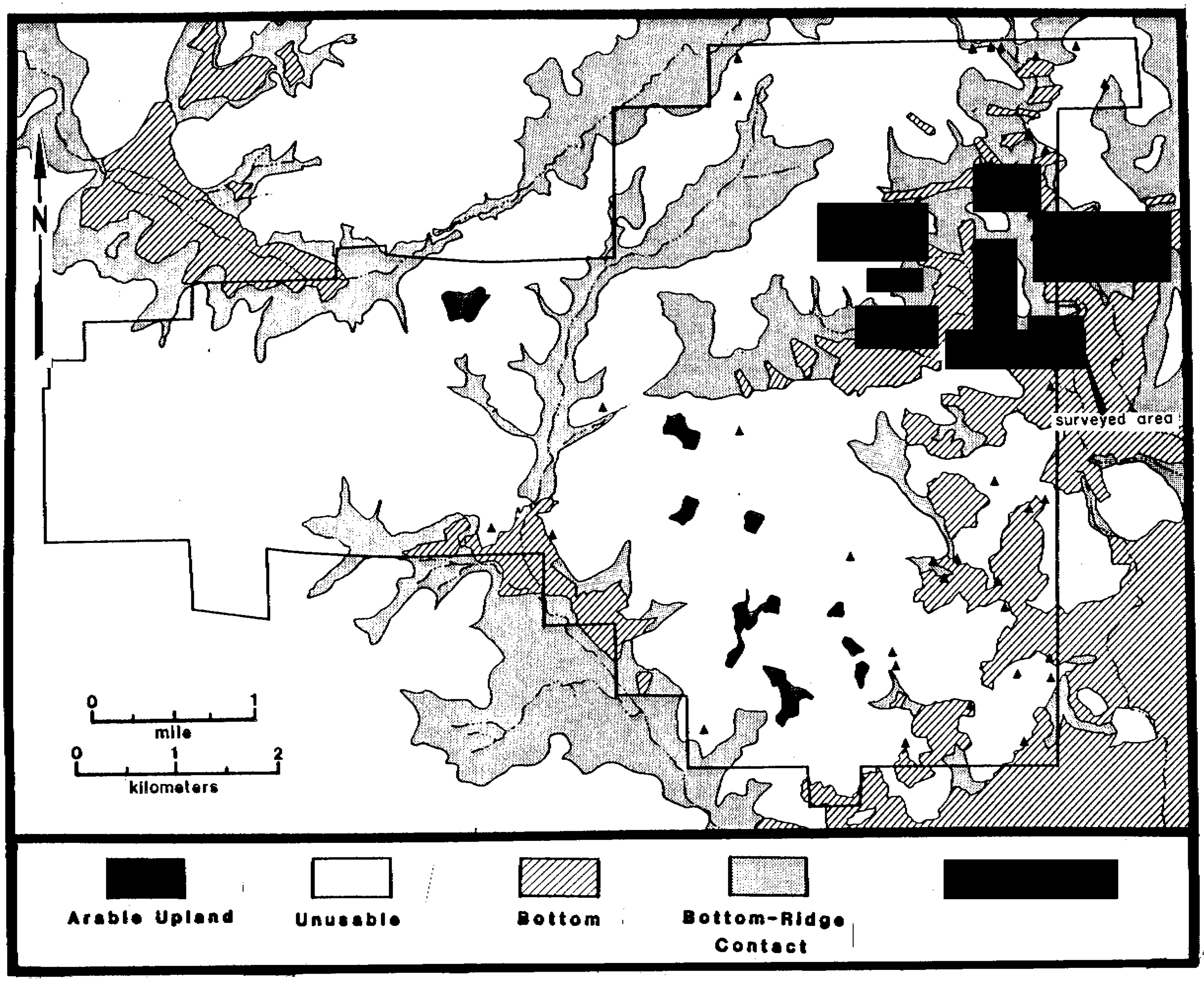

Figure 10. McKinley Mine South sites and LA 59497, showing proportion of agricultural lands (adapted from Allen and Nelson 1982).

Table 7. Petrographic Sample by Type and Project Area

Ceramic Type	LA 59497	McKinley Mine	Total
Gray Indented Corrugated	21	15	36
Gallup Black-on-white	18	12	30
Puerco Black-on-white	15	11	26
Puerco Black-on-white/corrugated	1		1
Red Mesa Black-on-white	1	1	2
Late Red Mesa Black-on-white	3		3
Chaco Black-on-white	1		1
Carbon Black-on-white	1		1
Total	61	39	100

Raw Material Source

Microscopic fragments of plant matter may be scattered throughout the matrix. The paleoenvironment of the project area contained abundant vegetal material that once flourished in a swampy deltaic terrain. Layers upon layers of decaying vegetal material built up to a thickness that, when buried by the overlying sediment and subjected to heat and pressure, were transformed into seams of coal. Fragments of this detrital plant matter became incorporated in the clay bodies formed in the vicinity of the coal beds. Thus, the presence of abundant organic debris in the clay matrix of ceramics supports an inference that the clay used in ceramic manufacture came from a coal-bearing area.

The amount of silt-sized material (.30 to .0625 mm) present in the raw clay may be an indicator of source. Some clays are very silty, while others have a sparse amount of silt-sized material. Clays with approximately 10 to 29 percent of silt by volume are interpreted as secondary deposits.

Primary clays remain in contact with the decomposing igneous rock body from which they are formed. These clay deposits tend to be shallow, restricted bodies, that exhibit a transition in material and texture from parent rock, to partially altered rock, to clay, and contain detrital material from the parent rock.

Secondary clay beds are made up of clays and minerals carried from their place of origin by water and redeposited under various conditions. Secondary clays carry along an intermixture of silt to sand-sized grains (usually quartz and feldspar) during transportation. Clay bodies formed in this manner are generally of marine origin, are usually widespread and thick, and vary in texture and composition depending on the terrain, length of transport, and velocity of the transporting water.

Temper

Potters add temper to raw clay to aerate the clay, which prevents breakage as the water in the clay heats to steam during firing. The coarser tempering grains allow steam to pass quickly to the surface of the vessel. Most temper is of geologic origin, that is, crushed rock fragments or loose sand. A second category of temper is of cultural origin, in the form of crushed fragments of previously fired sherds.

When temper is of geologic origin it can be identified, and its composition and grain size can be compared to the geologic material occurring at, or in the vicinity, of the site from which the ceramics under investigation were retrieved. This information allows inferences to be made as to whether or not the ceramics in question could have been locally produced.

When sherd fragments are used as temper, they can be observed in plane light. The fragments can be measured and contrasted to the clay matrix of the host pot, and any unusual attributes may be noted. Sometimes sherd fragments still retain the paint with which they were decorated; others contain temper that may come from a different manufacture area than the study sherd.

Paste Characteristics

An observable attribute of the paste is the apparent texture. Some thin sections, when viewed in plane light, appear to be thick-and-thin with a mottled look; others have a creamy, even, homogeneous appearance. It is unclear whether intrinsic attributes of the clay, or something in the manufacture technique, is responsible for the textural appearance of the clay matrix.

Fusing of the clay matrix or vitrification can be identified petrographically. The temperature attained in primitive firing was sometimes high enough to cause incipient vitrification or fusion of the clay particles (Shepard 1971:24). Shepard (1971:222) reports that the variability of clay creates wide differences in the vitrifying point of clays, creating an unreliable judgment of firing temperatures. One clay may vitrify at a temperature that leaves another clay still soft enough to scratch with a thumbnail. In addition, fine clay particles and clays high in fluxing impurities, such as alkalis, alkaline earth, or ferrous oxide, vitrify quickly (Shepard 1971:23).

The following data were recorded for each thin-section:

1. Maximum size of the quartz grains present, angularity of the grains, and interpreted origin of the quartz.

2. Maximum size of the feldspar grains, either untwinned (usually orthoclase), twinned (usually plagioclase), or microcline.

3. Maximum size of crushed sherd fragments, if present.

4. The presence of chert. Most chert is indicative of a limestone origin. The Cleary Coal Member (which is coal-bearing) is reported to contain limestone concretions. The presence or absence of chert, usually in trace amounts only, may be used as an added attribute to help differentiate sources. However, the thin sectioned portion of a sherd may not wholly represent the minor constituents

present, and therefore the occurrence of chert as a source delineator should be used cautiously.

5. The presence of ferro-magnesian minerals (eg. pyroxene, biotite, hornblende).

6. The apparent texture of the clay matrix when viewed in plane light, that is, whether it has an even, homogeneous appearance, or a thick-and-thin, uneven, mottled appearance.

7. The estimated amount, whether abundant or sparse, of the silt-sized material originally within the clay.

8. The estimated percentage of the amount of temper added to the raw clay during ceramic manufacture.

9. The degree of fusion and oxidation of the clay minerals was noted.

When the pertinent data for each of the 100 thin sections were recorded, the ceramic identifications and proveniences were added to the recording sheets. Tables containing raw data are on file at the Archeological Records Management System files, State Historic Preservation Division in Santa Fe, New Mexico.

Geology of the Area

LA 59497 is 20 km northwest of Gallup, New Mexico. This area, part of the Gallup Syncline, is in the southwestern corner of the San Juan Basin, a structural basin that occupied an area greater than 23,000 sq km in northwestern New Mexico, northeastern Arizona, and southeastern Utah. The basin is bounded to the west by the Chuska and Carrizo Mountains, and to the south by the Zuni Mountains and Mount Taylor (Speer et al. 1977:3).

The San Juan Basin contains thick deposits of sedimentary rocks of Cretaceous and early Tertiary age laid down during fluctuations of a large inland seas that averaged 1,600 km wide, and several thousand kilometers north to south. In general, the rocks are continental, but there are marine rocks deposited when the sea advanced over the shoreline as the water level rose and fell (Hewett 1982:28).

Volcanic rocks of Tertiary age occur in the Mount Taylor volcanic field to the southeast. Andesitic and basaltic lavas have intruded into the Chuska Mountains to the northwest of the site (Thornbury 1965:412-513).

During Cretaceous times lush vegetation grew on the sea's shoreline and in swampy areas. This vast accumulation of dead and decaying vegetal matter was eventually covered by advancing seas that deposited thick shale and sandstone layers. In time, when the volatiles were driven off by overlying pressure, seams of coal were formed. This cyclic fluctuation continues over long geologic periods, so that sandstones and shales that include seams of coal, alternate for hundreds of meters (Tabet and Frost 1979:32).

The surface rock at LA 59497 is the Menefee Formation, an Upper Cretaceous formation assigned to the Mesa Verde Group. It is 120 m thick and is mostly continental, but can be of marine origin. It was deposited in a deltaic environment. Its organic-rich sediments, associated with the accumulation of coal beds, contain sideritic nodules that indicate reducing conditions typical of the anaerobic, bacterial decay of vegetative debris in poorly drained, nonmarine, organic-rich sediments (Tabet and Frost 1979:38-40). The Menefee Formation is made up of two members, the younger, the Allison Barren, is made up of alternating beds of sandstone and shale. The geologically older Cleary Coal Member consists of alternating beds of tan and brown sandstone, claystone, shale with associated coal, and scattered beds of ironstone and limestone concretions. The Cleary Coal Member is the source rock from which the coal at the McKinley Mine is obtained (Hewett 1982:30).

LA 59497 was built on rolling land interspersed with flat topped ridges. One sandstone-capped ridge is located 50 m to the west of LA 59497, and a second ridge is located a similar distance to the north. To the south, where the land falls gently away towards the Defiance Draw, an intermittent stream that drains to the south, are flat areas where agriculture could be practiced.

Examination of the geologic material in the debris on top of the unexcavated part of the site revealed that the local sandstone, obtainable from the two nearby outcrops, was used for building material. Broken metate slabs were of a well-indurated sandstone that is mostly red in color with alternating thin, white bands. This sandstone did not match the locally available sandstones.

Clay and samples of the two sandstone layers were collected from the ridge to the north of the site. Loose, detrital material at the base of the ridge was also collected. The ridge is about 12 m high, the lower 6 m is disintegrating badland shale that is weathering to clay in shades of gray, purple, and brown. The clay is overlain by a friable sandstone, white in color, 3 m thick, composed of a well-sorted fine- to medium-grained quartz, that is weakly cemented.

This friable sandstone is overlain by a massive red-coated sandstone that is 1.5 m thick. The upper portion of this sandstone is cross-bedded, the angle of the beds suggests strong, unidirectional transport. A fresh break reveals that the sandstone is white; weathered surfaces are iron-stained.

A sample of clay collected from the ridge was soaked overnight and then made into four brickettes. The first contained clay only, the second had clay plus loose sand from the base of the ridge, the third had clay plus the friable, white sandstone (crushed), and the fourth had clay plus the upper sandstone, which proved very difficult to crush to temper size. These brickettes were fired at 950 degrees C.

Three of the brickettes were thin-sectioned and examined under the petrographic microscope revealing the following information.

Sample 2 consisted of clay collected from a local outcrop tempered with sand from the base of the ridge at LA 59497. The clay matrix is red in plane light, slightly mottled in appearance, and contains a moderate amount of silt-sized material. The clay matrix is fully oxidized from firing at 950 degrees C.

The temper has a few rock fragments, loose mineral grains, and particles of hematite cement, which are present in both of the ridge's sandstone bodies. The rock fragments are up to .6 mm in size, angular, and consist of individual grains of quartz and feldspar that are from .2 to .3 mm in size. The cement is thick hematite and is present in the upper, more heavily indurated sandstone. The lower sandstone is extremely friable and individual grains would erode easily from the parent material. The loose grains are .2 mm to .3 mm in size and are subangular to subround. They are composed of quartz grains that exhibit strained extinction (a few grains are polycrystalline), untwinned feldspars, with only traces of twinned feldspar, traces of mica flakes, fragments of loosened hematite cement, and traces of ferro-magnesian minerals altered to hematite. The rock fragments, loose grains, and hematite fragments are the erosional debris from the sandstone bodies outcropping in the adjacent ridge.

Sample 3 was a combination of the local clay plus crushed sandstone from the lower sandstone outcrop. The clay matrix is the same as described from Sample 2. The additive material consists of rock fragments, loose grains, and hematite fragments.

The rock fragments are from .5 to 2.3 mm in size, angular, and consist of individual grains of quartz and feldspars that are subangular to subround and .2 to .3 mm in size. The cement is hematite. It is generally thin, but is occasionally thick.

The loose grains are .2 to .3 mm in size, subangular to subround, and include quartz that exhibits strained extinction, untwinned feldspar, hematite fragments from the crushing of sandstone, and traces of twinned feldspar and ferro-magnesian minerals, which have been altered to hematite.

The probable original source for the individual grains that make up the lower sandstone is a rock body that has undergone low-grade metamorphism and was probably at some distance from the area of deposition where the sandstone was formed. The grains are well sorted and exhibit rounding, indicating long transport before final deposition.

Sample 4 is a combination of the local clay and crushed sandstone from the upper sandstone outcrop. The clay has the same attributes as Sample 2. The additive material consists mostly of rock fragments because the heavily indurated sandstone was extremely difficult to crush, in addition to some loose minerals and hematite fragments.

The rock fragments that make up the majority of the additive material are angular and are from .6 to 5.0 mm in size. The individual grains, cemented by an extremely thick hematite, are .2 to .3 mm in size, and are subangular to subround. They consist of quartz, feldspar, and altered ferro-magnesian minerals less than .2 mm in size.

The loose minerals are from .2 to .3 mm in size, subangular to subround, and consist of quartz with strained extinction and occasionally polycrystalline, untwinned feldspar, traces of twinned feldspar and ferro-magnesian minerals, and fragments of hematite cement.

The probable original source for the sandstone grains is the same as for Sample 3. The two crushed sandstones are similar lithologically and texturally, but the chemistry and depositional process underwent a fluctuating change in the deltaic terrain present in Cretaceous times. The lower sandstone is loosely cemented and quite friable, while the upper sandstone is heavily indurated and cross-bedded. Most probably, the mode of deposition for the sand grains changed from near shore to fluvial plain in the upper sandstone.

The information derived from the additive material in the brickettes allows comparison with the temper present in the ceramics under investigation to help determine whether the pottery was made at LA 59497 using locally available sand grains.

Findings

When all the data and pertinent information were recorded for each of the 100 thin-sections, the recording sheets were grouped according to ceramic type. The temper data for each ceramic type were examined for similarities between LA 59497 and the McKinley Mine sites, and in the ceramic group as a whole.

Gray Indented Corrugated

The study includes 36 samples of gray indented corrugated 21 from LA 59497 (Figs. 11-12 and 13f) and 15 from the McKinley Mine sites. Of the 21 thin sections from LA 59497, 20 are sand tempered and the remaining sample (Sample 1) contains sand and sherd fragments.

The maximum temper grain size ranges from 1.0 to 2.8 mm with a mean value of 1.7 mm. The predominant mineral is polycrystalline quartz of metamorphic origin, that is, the quartz grains are large, with crenulated grain boundaries, and exhibit undulose extinction. These temper grains do not appear to have originated in a sandstone because there are no fragments of aggregate minerals cemented together, nor is there any remnant cement attached to the grain boundaries.

In addition to the quartz, 18 contain a sprinkling of feldspar. Chert is present in 10 samples. Only 4 samples contain ferro-magnesian minerals, and their scarcity and small size precluded positive identification. This suite of minerals, the grain boundaries, and the undulose extinction are consistent with a coarse-grained metamorphic rock.

The clay matrix, except for those too black to see, contained carbonaceous material, which is consistent with an environment containing coal seams. Eighteen of the samples have a sparse amount of silt-sized material that was inherent in the raw clay. All 21 thin-sections have a homogeneous texture. In 16 of the thin-sections, the clay matrix is either completely fused or is partially fused in isolated areas, indicating exposure to high temperature. The estimated percentage of temper ranges from lightly tempered (10 percent) to moderately heavy tempered (35 percent).

Eleven of the 15 ceramic thin-sections from sites in the McKinley Mine area are also sand tempered. The remaining four thin sections had two specimens with more sand than sherd temper, and two specimens with more sherd than sand temper (Table 8). Except for the sherd fragments, the four thin sections are similar to the eleven sand-tempered samples.

The maximum size of the temper grains range from 1.0 to 1.9 mm, with a mean value of 1.2 mm. The sand grains are predominantly quartz of metamorphic origin, like the sand grains from the LA 59497 gray wares. There is also about the same percentages and species of feldspars present, and the same percentage of thin sections with chert (7, 46.7 percent). Two thin-sections contain brown biotite.

The clay matrix in these McKinley Mine area sherds have the same attributes as seen in the LA 59497 thin-sections. All the thin sections have carbonaceous material, a sparse amount of silt-sized material (14 samples) was present in the raw clay, and texture appeared homogeneous (13 samples). The estimated percentage of temper ranges from 15 percent to 25 percent. Only six of the thin

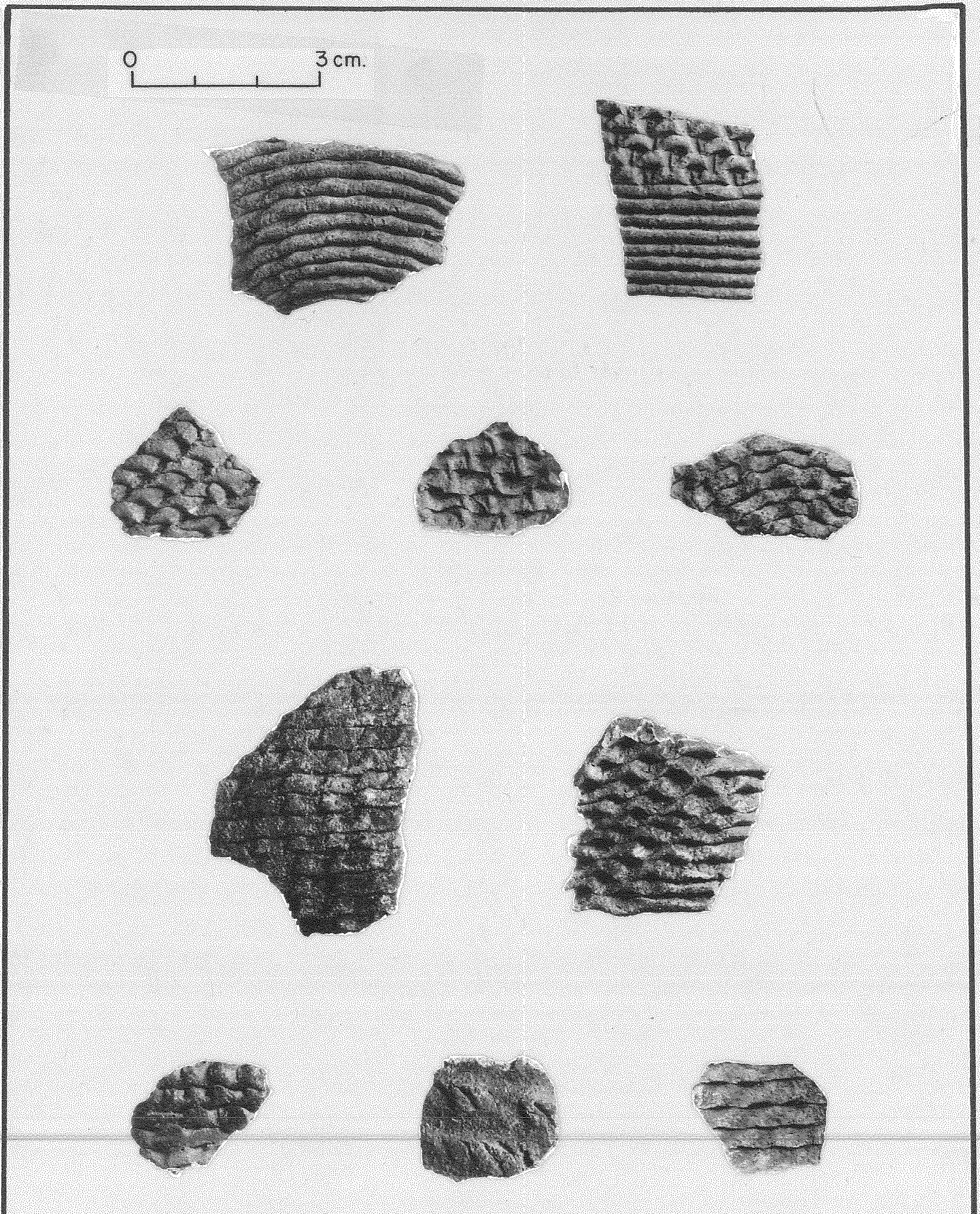

Figure 11. Petrographic analysis, LA 59497; Gray Indented Corrugated.

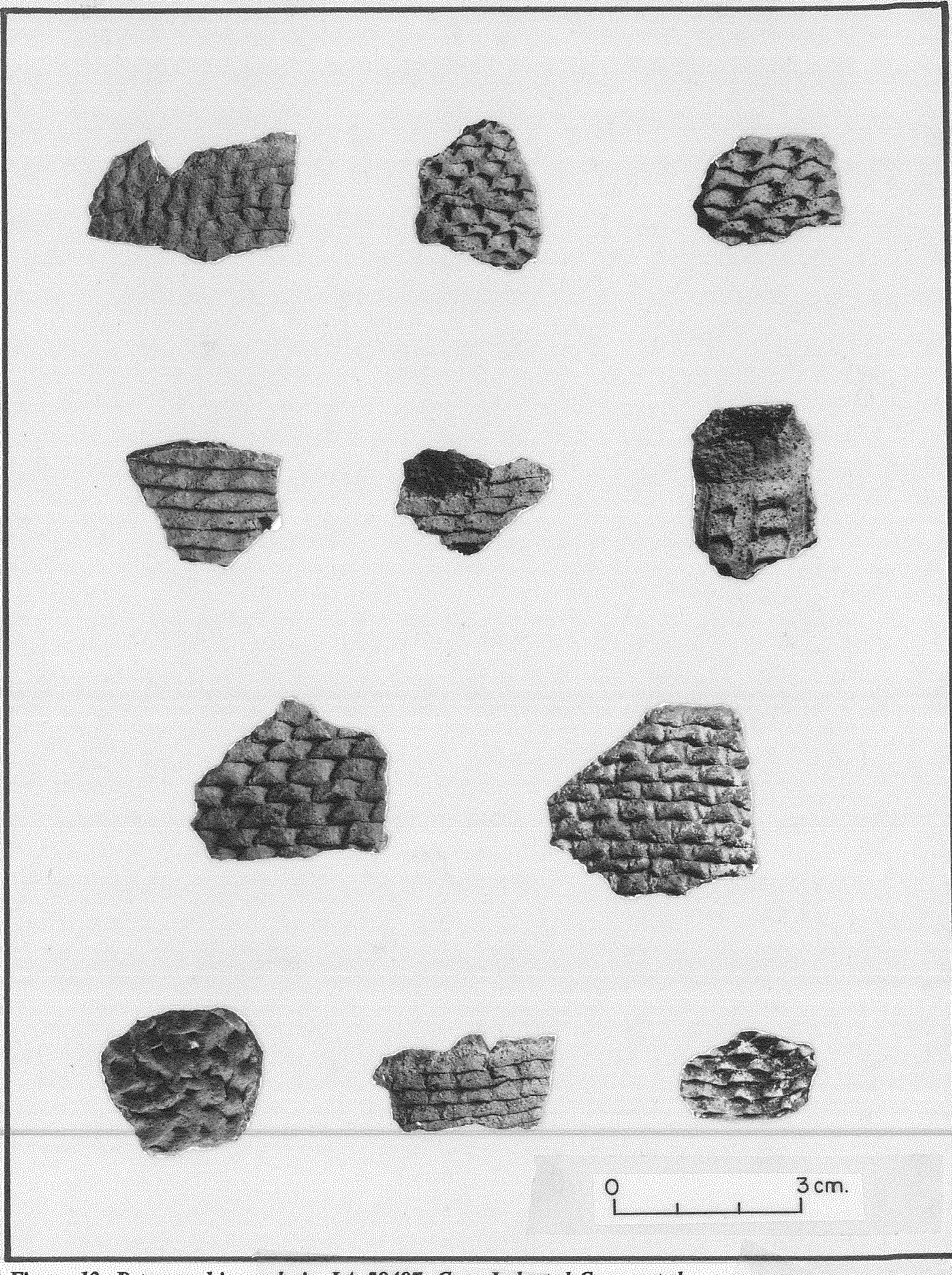

Figure 12. Petrographic analysis, LA 59497; Gray Indented Corrugated.

Table 8. Possible Manufacture Sources by Type

Paste and temper by manufacture source	Gallup B/w		Puerco B/w		Gray Indented Corrugated		Total
	59497	McKinley	59497	McKinley	59497	McKinley	
(Source 1a) Sherd/sand or sand and fused	9	10	2[a]		16	6	43
(Source 1b) Sherd/sand or sand and unfused	5	2	9[b]	11	4	5	36
(Source 1c) Sherd/sand or sand and oxidized	2		1		1	3	7
(Source 2) Sand/no carbonaceous material					2		2
(Source 3) Monocrystalline quartz and sherd	1		7[c]			1	8
(Source 4) Sand/sandstone/sherd	1						1
(Source 5) Monocrystalline quartz/sherd with fusing	1[d]						1
Total	19	12	19	11	23	15	99

[a] 2 Red Mesa Black-on-white
[b] 1 Puerco/Late Red Mesa Black-on-white
[c] 2 Red Mesa Black-on-white
[d] 1 Chaco Black-on-white
1 Carbon Black-on-white not included in the table

sections are fused, a much smaller proportion than within the LA 59497 gray wares.

Sand or sand and sherd temper were used in 31 of 36 gray/indented corrugated sherds. These samples are very similar except for the occurrence of fusing in 20 of the 31 sand or sand and sherd tempered samples. This suggests a single raw material class, and the differences in fusing could be evidence of two different "analytic potters." These primary temper groups with the differences in fusing will be referred to as Source 1a and Source 1b for the rest of this report.

Sources 1a and 1b do not occur at LA 59497. The local sandstone is composed of fine-grained sand predominantly .2 to .3 mm in size with occasional grains up to .5 mm. The temper in the sherds from Sources 1a and 1b range from 1.0 to 2.8 mm. They originate in a much coarser grained source than is available at LA 59497.

The four sherds (4, 63, 68, 76) with the red-yellow flecks in the matrix may represent a minor production area where the clay is iron-rich. The temper in these samples is similar to Sources 1a and 1b, but the iron content may be higher. Based on the temper, the sherds may be from Source 1a, but the higher iron content indicates a different clay source. The use of a different clay source may indicate manufacture by a third "analytic potter." This combination of temper and paste attributes will be referred to as Source 1c. The clay samples collected from near LA 59497 have a high iron content as shown by the firing experiment. The different temper indicates that the pots were not made from temper available at LA 59497.

Two samples (74, 75) are low in carbonaceous material and appear to be made from clays that did not form near coal seams. The temper is similar to Sources 1a, 1b, and 1c, but the clay is sufficiently different to suggest a different manufacture area. This second manufacture area will be called Source 2.

Gallup Black-on-White

Eighteen samples from LA 59497 were included in the analysis (Figs. 14d, 15a-d, f-i, 16a-i). All samples but one are tempered with more sherd fragments than sand grains. The different sample (#56) has sand grains plus more sandstone than sherd fragments.

The maximum temper grain size ranges from .9 to 2.3 mm with a mean value of 1.3 mm. Sample 46 has monocrystalline quartz in such a small size (.5 mm) and sparse abundance to suggest that the grains were present in the raw clay rather than being deliberately added by the potter as temper.

The quartz in the remaining 17 samples is polycrystalline exhibiting large-sized grains (mean value of .8 mm), crenulated boundaries, and undulose extinction typical of metamorphic rocks. The smaller size of the quartz grains suggests a different sandstone source than was used in the gray indented corrugated. This temper does not appear to have originated from a sandstone crushed by the potter during ceramic production. There are no multigrain fragments bound together by cement, nor is there evidence of minute fragments in which the grains are cemented together with a thin iron-stained cement. There is a sparse amount of feldspars in seven of the LA 59497 Gallup Black-on-white thin sections, and chert is in nine of the thin sections.

Four samples (49, 51, 52, and 58) contain the sanidine-bearing fragments like those found in Chaco Canyon ceramics. Brown biotite is recorded for Sample 52 and pyroxene for Sample 58. Both minerals occur in trachyte. The trachyte comes from Tertiary age lava flows intruded into the Chuska Sandstone of the Chuska Mountains. The very small size and the scarcity of the fragments indicates that they were incorporated into the clay body of these Gallup Black-on-white ceramics as part of the crushed sherd temper.

The matrix in 8 of the 18 thin-sections exhibited carbonaceous material. The remaining 10 were too black to determine if carbonaceous material was present. There appears to be some variability in the siltiness of the clay body, ranging from a very sparse amount in Sample 53 to an abundant amount in about one-third of the thin-sections. It is unclear whether this suggests different collection areas for the clay or different methods of preparation of the clay. Thirteen have clay matrix with a mottled texture. The estimated percentage of temper ranges from 15 to 30 percent, except for Sample 56, which is more heavily tempered in addition to other differences. Ten thin-sections display a matrix that is fused, and two have flecks of red-yellow where iron in the clay oxidized during the firing.

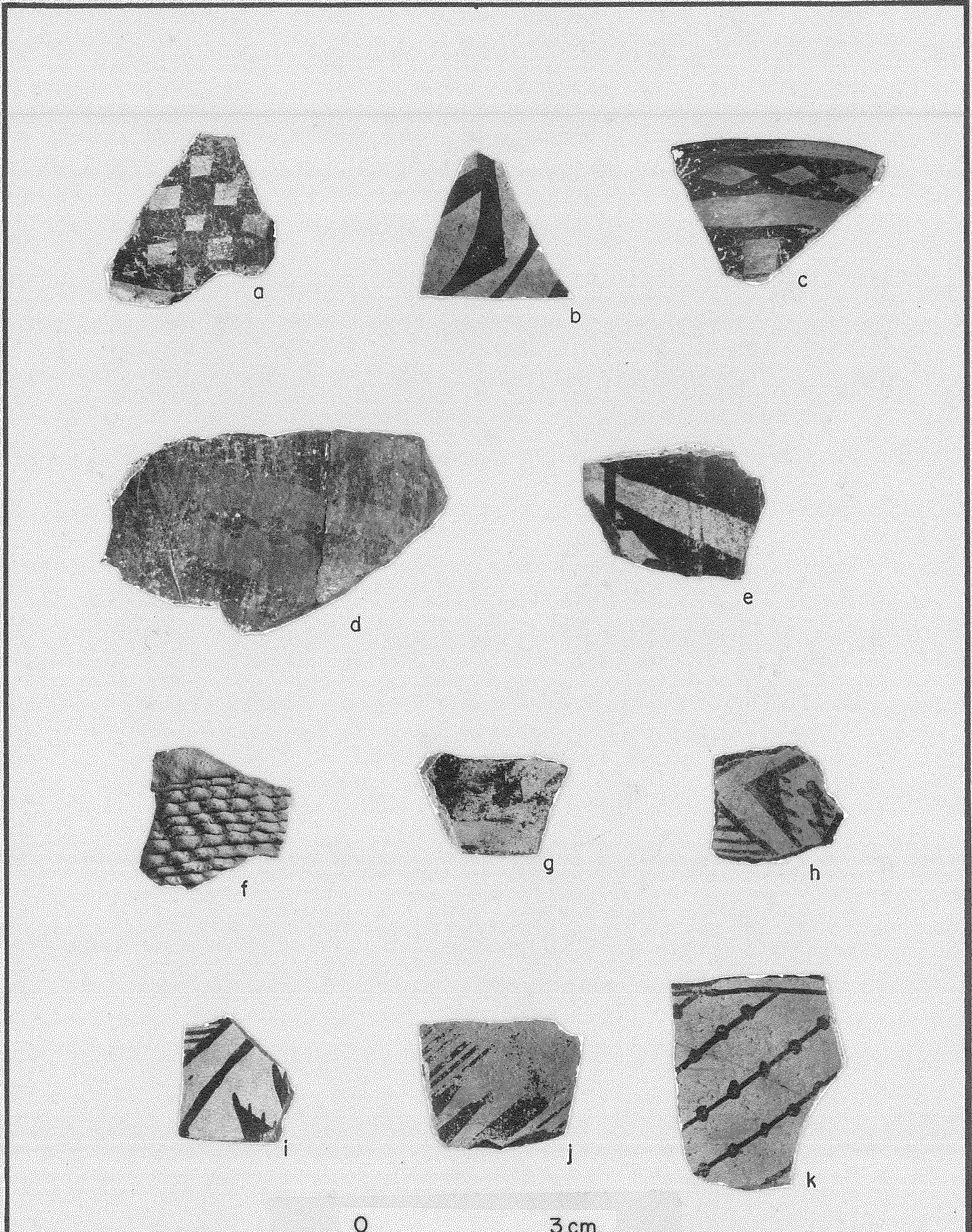

Figure 13. Petrographic analysis, LA 59497; (a-e) Puerco Black-on-white sherds; (f) Gray Indented Corrugated; (g) Late Red Mesa/Puerco Black-on-white; (h-j) Late Red Mesa Black-on-white; (k) Red Mesa Black-on-white.

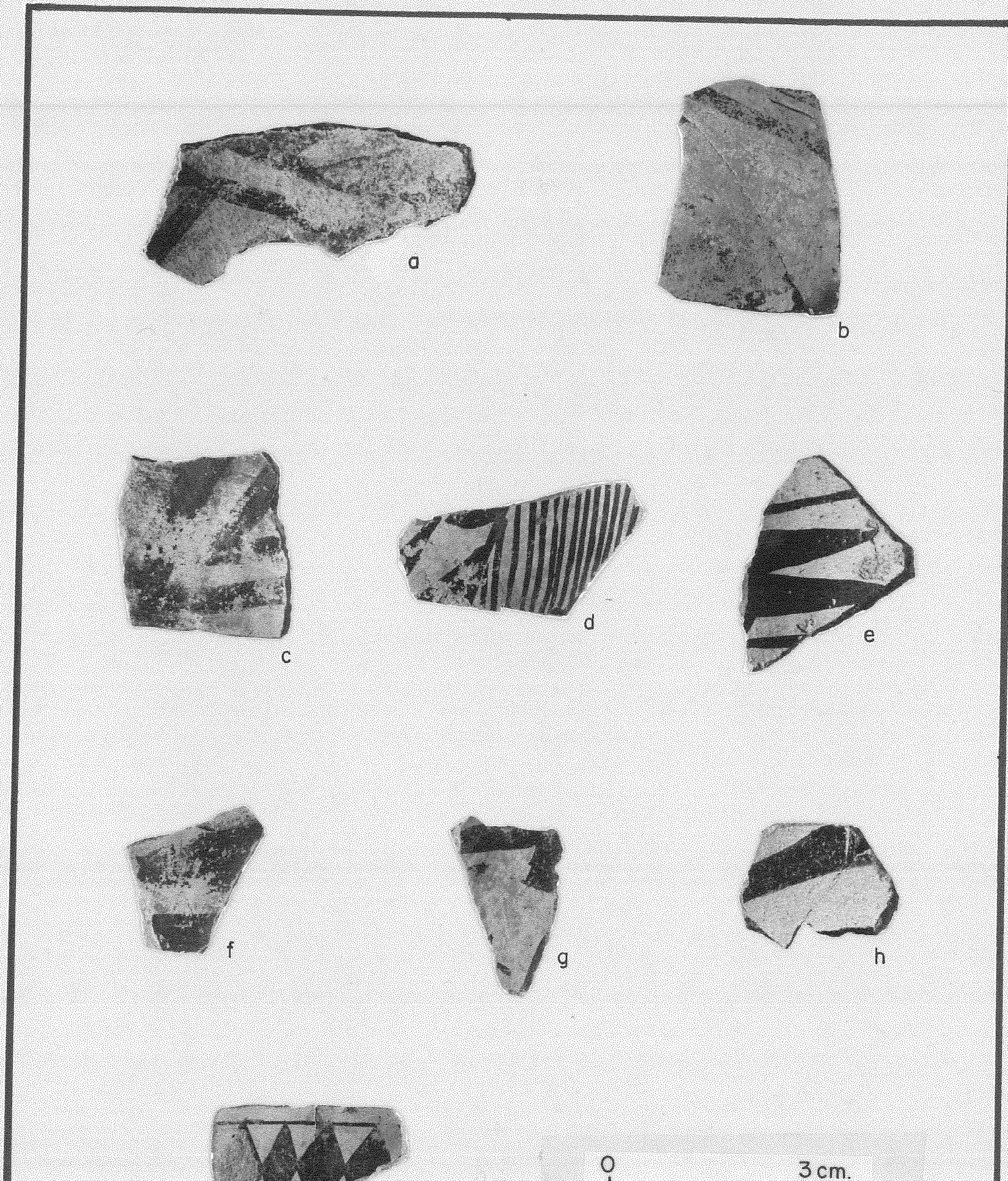

Figure 14. Petrographic analysis, LA 59497; (a-c, e-i) Puerco Black-on-white; (d) Gallup Black-on-white.

The twelve thin-sections from the McKinley Mine area are also tempered with more sherd than sand grains, except for Sample 100, which contains only sand grains. The maximum temper size ranges from 0.6 mm (Sample 100) to 1.3 mm (sherd temper 1.0 mm mean value and quartz 0.7 mm mean value). The sand grains display the metamorphic attributes previously described.

Eight samples have a sparse sprinkling of feldspars and approximately seven contain chert grains. Four thin-sections (77, 78, 79, and 85) have fragments of sanidine-bearing trachyte. Three of the four contain ferro-magnesian minerals consistent with trachyte composition. Like the LA 59497 ceramics with similar fragments, their inclusion in the pastes probably occurred with the addition of trachyte-tempered sherd fragments.

Carbonaceous material is present in all of the thin-sections that are not too black to determine. In general, the clay has a sparse amount of the silt-sized material. Eight thin-sections have the mottled texture, and 10 of 12 have fused or partially fused clay minerals. The estimated percentage of temper ranges from 15 to 40 percent, that is, moderate to heavily tempered.

The overall composition of 29 of the Gallup Black-on-white sherds from LA 59497 and the McKinley Mine sites is similar to Sources 1a, 1b, and 1c as defined for the gray indented corrugated sherds. The main difference between the two types is that the Gallup Black-on-white sand fragments are smaller. The smaller size indicates a different temper source than the sandstones at LA 59497 and those found in the gray indented corrugated sherds. While the temper grains are smaller, the paste attributes were similar. Rather than split these 29 sherds into three more subcategories of Source 1, they will be combined with Sources 1a, 1b, and 1c, as shown in Table 8. These three categories will also include the sherds with the trachyte temper since they are otherwise similar to the three categories.

Sample 46 has more sherd than sand temper but the quartz is monocrystalline. This sherd represents a new manufacture source that is more common in Puerco Black-on-white. It is assigned to Source 3. Sample 56 has sand, sandstone, and sherd fragments. Definite fragments of sandstone are very rare in this study. Because they are found in only this sample, they represent a different manufacturing source. This source is not area-specific. It will be called Source 4.

Puerco Black-on-white

Sixteen examples of Puerco Black-on-white were selected from LA 59497 (Figs. 13a-e, 14a-c, e-i). Most (13) are tempered with more sherd than sand grains. Two thin-sections are tempered with more sand grains than sherd. The one Puerco Black-on-white/corrugated is sand tempered.

The maximum temper size ranges from .6 mm to 1.5 mm (sherd mean value of 1.2 mm; quartz mean value of 0.8 mm). There is some diversity in the origin of the sand grains. Six thin-sections contain monocrystalline quartz in small amounts. They are so small (.5 mm or less) that they were probably inherent in the raw clay rather than added by the potter. The quartz grains in the remaining nine thin-sections are metamorphic in origin. Only four of the thin-sections contain feldspar grains; one-third contain chert fragments. Sample 24 has pyroxene.

The clay matrix contains carbonaceous material in all samples that are not too black to see, suggesting that the clay is from coal-bearing strata. Ten of the sherds contain clay with a sparse

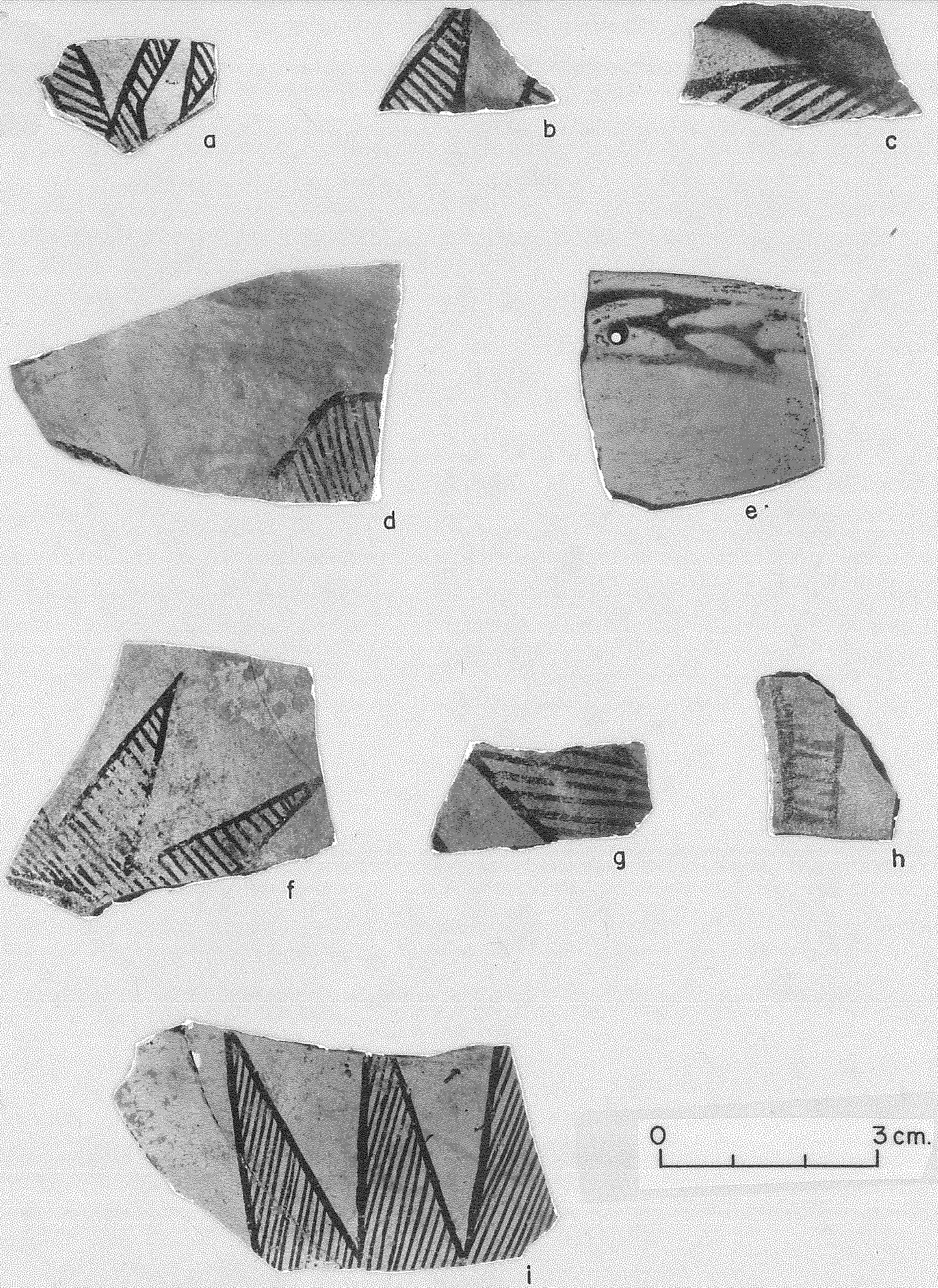

Figure 15. Petrographic analysis, LA 59497; (a-d, f-i) Gallup Black-on-white sherds; (e) Carbon Black-on-white.

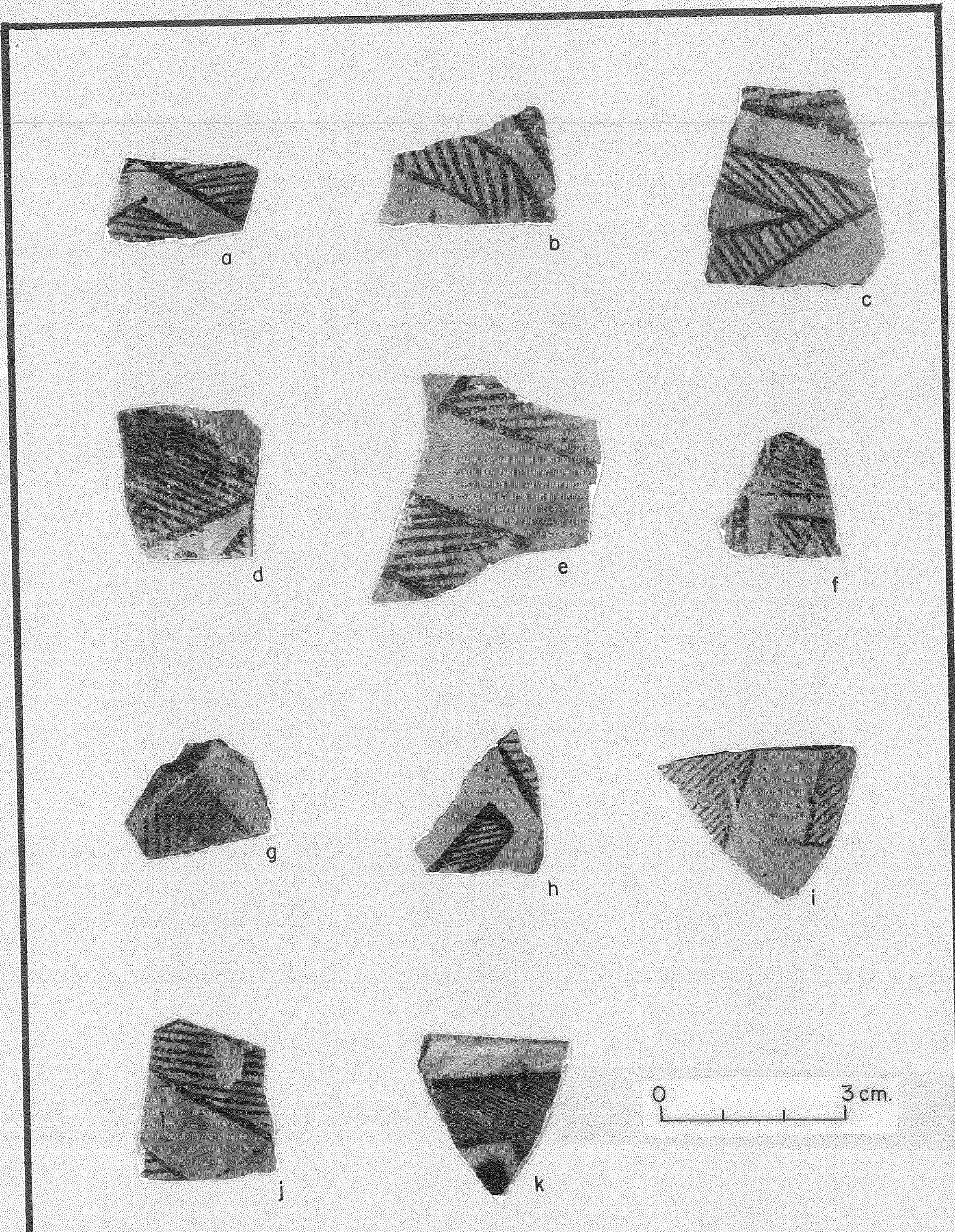

Figure 16. Petrographic analysis, LA 59497; (a-j) Gallup Black-on-white; (k) Chaco Black-on-white.

amount of silt-sized material; in the remaining five, the clay is considerably more silty. In two-thirds of the thin-sections, the clay matrix has a homogeneous texture; the other one-third has a mottled texture.

The estimated percentage of temper ranges from 5 to 25 percent, that is, lightly to moderately tempered, and only Sample 11 has a matrix of fused clay minerals.

The Puerco Black-on-white/corrugated (Sample 39) from LA 59497 is sand tempered. The sand grains are larger (maximum size 1.4 mm) and are of metamorphic origin. It has three species of feldspars, contains carbonaceous material, a sparse amount of silt-sized material, a homogeneous texture, and the iron in the clay has been oxidized to a red-yellow color.

Ten of the thin-sections of Puerco Black-on-white from the McKinley Mine area sites contain temper consisting of sherd fragments greater in abundance than sand grains. Sample 95 is sand tempered. The sand grains are metamorphic in origin and range in size from 0.5 mm to 1.6 mm (mean value 1.1 mm). Sherd fragments range in size from 0.8 to 2.4 mm (mean value 1.2 mm). Four thin-sections contain a few feldspar grains, chert is present in two of the samples, and pyroxene is present in one sample.

The clay matrix contains minute carbonaceous grains suggesting origins near coal-bearing strata, and there is a sparse amount of silt-sized material. In general, the clay matrix has a homogeneous texture. The estimated percentage of temper ranges from 10 to 45 percent, from lightly to heavily tempered. None of the thin-sections displays any fusing of the clay minerals.

Nineteen of the Puerco Black-on-white ceramics with more sherd than sand temper appear to correspond to Source 1b, as defined for Gallup Black-on-white and gray indented corrugated. This source is defined by the absence of fused clay minerals.

Six Puerco Black-on-white sherds contain more sherd than sand temper, but the quartz grains are monocrystalline rather than the more common polycrystalline. This is similar to Source 3. This temper was also identified for Sample 46 of Gallup Black-on-white and Sample 76 of the gray indented corrugated.

The Puerco Black-on-white/corrugated sample has red-yellow flecked minerals that are similar to a small number of Gallup Black-on-white and gray indented corrugated sherds. This is similar to Source 1c.

Red Mesa Black-on-white

The two Red Mesa Black-on-white samples are quite different in composition and maximum grain size (Fig. 13h-i). Sample 30, from LA 59497, has more sherd fragments than metamorphic sand grains. There are no feldspars or chert. The silt-sized material is sparse in abundance, the matrix is homogeneous and fused. The estimated percentage of temper is 15 percent. This corresponds to Source 1a. Sample 91 from the McKinley Mine area has more sherd fragments than sand, but the sand grains are too small (.3 mm) and too few in number to have been added by the potter. Trachyte fragments and loose pyroxene grains are present. The matrix contains carbonaceous texture, and the amount of temper is estimated at 10 percent. This temper is similar to Source 3.

Late Red Mesa Black-on-white

The three sherds of Late Red Mesa Black-on-white are from LA 59497 (Fig. 13h-j). They contain sherd fragments in greater abundance than the metamorphic sand grains. Their matrixes vary little in the amount of silt-sized material, texture, and the estimated amount of temper. Both have fused clay minerals, and are moderately tempered. They are similar to other types that have been assigned to Source 1a.

Puerco/Late Red Mesa Black-on-white

The one sample of Puerco/Late Red Mesa Black-on-white from LA 59497 has more sherd than the metamorphic sand grains (Fig. 13g). The clay matrix has carbonaceous material, a sparse amount of silt-sized material, a mottled texture, and a moderate amount of temper. This sample is similar in many of its attributes to Sample 30, the Red Mesa Black-on-white item. Although the maximum size of the sand grains is .5 mm, which is close to the range of the locally available sandstones, it is probably not a local product. Because the paste is not fused, it is assigned to Source 1b.

Chaco Black-on-white

One Chaco Black-on-white (Sample 59) sherd from LA 59497 has more sherd fragments than sand grains (Fig. 16k). There are few sand grains (monocrystalline); they were probably in the raw clay. Chert is present and the clay matrix has carbonaceous material, a sparse amount of silt-sized material, mottled texture, and a moderate amount of temper. The Chaco Black-on-white is not clearly more similar to either Puerco or Gallup Black-on-white. Because it has monocrystalline sand grains, it is similar to Source 2, except that it has a fused paste. This sherd may be a trade item, and it is assigned to Source 5.

Carbon Black-on-white

The lone sample of Carbon black-on-white (Sample 61) is from LA 59497 (Fig. 15e). It is sand tempered and the quartz is of metamorphic origin. The thin-section contains all three species of feldspars, a clay matrix with carbonaceous material, a sparse amount of silt-sized grains, and a homogeneous texture; it is lightly tempered. The paste appears to be similar to other samples from Source 1b.

Research Questions

1. Are there temper and paste distinctions that can be attributed to different pottery makers or clay or temper sources?

2. Do these differences cross-cut types, wares, or sites?

3. How do Red Mesa, Chaco, and Carbon black-on-whites compare to the three main study types?

4. How do the locally available raw materials compare to the sherd samples? Can some or all of the ceramics be called locally made?

Potters and Manufacturing Sources

The first research question deals with analytically defined potters and manufacture sources. The preceding characterizations of the temper and paste attributes yielded five different possible manufacture sources. The differences between potential manufacture sources are fairly subtle and do not clearly point to one or more known clay and temper sources.

Source 1 is medium to coarse grains of metamorphic sand with or without sherd, in varying proportions of each. The clays may be fused or not, and have an unpatterned distribution of homogeneous or mottled appearance. The clays come from a source that is high in organic material, suggesting a close association with coal-bearing strata. Source 1 has been divided into three subgroups that may reflect potters who used the same temper sources, but different clays and firing methods. Source 1a has a fused paste. Source 1b has an unfused paste. Source 1c has an unfused paste with oxidized iron particles.

Source 2 is found in two samples. It was singled out because the clay was not carbonaceous. Of the samples, 98 percent have carbonaceous clays, which reflects the common occurrence of coal seams throughout the McKinley Mine and surrounding area. Samples without carbonaceous material, based on the widespread local occurrence of coal, must be defined as nonlocal and from a different source than the rest of the sherds.

Source 3 has fine-grained monocrystalline quartz and crushed sherd. The paste is not fused, but it may be homogeneous or mottled in appearance. The source for the monocrystalline quartz is unknown. Its small size and rather sparse abundance suggests it may be part of the clay rather than an additive. This source is considered different from Source 1 because the quartz grains do not show up as even a small constituent with the coarser grained metamorphic materials.

Source 4 is a combination of sherd, sand, and sandstone. The sandstone cement is still visible in the matrix. This occurred in only one sherd. Because of its rare occurrence, it was classified as unique. Cement, when it shows up in the sherds, can be an important indicator of the source of the sandstone. Cements are sometimes described in the literature and can be more commonly recognized with binocular identification.

Source 5 is a fine-grained monocrystalline quartz with a fused paste. This was found in Chaco Black-on-white. There are enough differences between Source 3 and Source 5 sherds that they were separated rather than combined as subgroups.

These five temper and paste groups and three subclasses illustrate that there is variability in the assemblages from LA 59497 and the McKinley Mine sites. Previous McKinley Mine ceramic studies (Acklen 1982; Hill 1985) noted that there was too much similarity between the tempers to address local and nonlocal production except for the most obvious temper types (like trachyte). This study shows that there is variability, but that it is very subtle, and not likely to be identified with a binocular microscope.

The second question asks if the source groups and subgroups cross-cut pottery types. This question was aimed at addressing whether manufacture areas could be identified for each type or if all manufacturing areas made all types. The former implies specialization with regard to style, and the latter, the use of all styles by a variety of potters.

Table 8 shows that Sources 1a, 1b, 1c, and Source 3 cross-cut pottery types, though strong preferences are apparent in the Gallup and Puerco Black-on-whites. The Puerco Black-on-white ceramics from the McKinley Mine sites are all from Source 1b, suggesting a preference for unfused pottery. LA 59497 shows a bimodal preference for Puerco Black-on-white from Sources 1b and 3. All of the Source 3 pottery came from LA 59497. This suggests that LA 59497 residents obtained pots from a potter who did not supply vessels to the other the McKinley Mine sites analyzed in this study. This weakly supports a hypothesis of different exchange networks for closely neighboring groups.

The data suggest minor differences in pottery sources, with the majority of pottery being supplied to all four study sites by a single source. The single main source can be subdivided using technological attributes that might suggest different potters. Because most of the pottery from all four sites comes from the main source, I suggest that a unsourced local temper was used and that the pottery was probably made within the McKinley Mine area.

The third question asks if the less frequent types like Red Mesa, Chaco, and Carbon Black-on-whites were similar to the main study types. The Red Mesa, Late Red Mesa, Puerco/Late Red Mesa, and Carbon Black-on-whites are similar to the main sources, 1a and 1b. The Carbon Black-on-white, which is similar to Chaco-McElmo Black-on-white, appears to have been made at the main manufacturing source. This suggests that Chaco-McElmo Black-on-white was copied, instead of traded out of Chaco Canyon.

The fourth question deals with the specific problem of manufacture at LA 59497. Collecting temper and clay samples from at LA 59497 and thin-sectioning sherds allows us to assess if the pottery reflects local sources or not.

The three thin-sections of sample clay and temper combinations show that even though these materials may have been suitable for making pottery, they were not used. The temper from LA 59497 sandstones is finer than all of the thin-sectioned sherds. If suitable clay and sandstone were available for manufacture, as well as abundant sherds for temper, why were they not used? One hypothesis suggests that utility wares were commonly coarse tempered because coarse temper allows a vessel to better withstand repeated thermal shock (Hill 1985). It can be argued that the sandstone was too fine-grained and not suitable for the activities that were required of gray indented corrugated. If this model is correct, local manufacture of utility wares would have required importation of temper.

More fine-grained rock or sherd temper creates a very tight and strong, but inflexible clay body. These qualities might have been more desirable for water storage and cold food preparation or consumption (for example, white wares). If the local raw materials were suitable for these purposes, why were they not used? We are left with interesting, but largely untestable assumptions about pottery production and exchange mechanisms. One explanation invokes social and economic buffering against unpredicted food shortages with pottery exchange as one of the mechanisms (O'Shea 1981). Pottery, even though resources and technology were available to both groups, would be exchanged to maintain reciprocal relations, that at other times would include exchange of more critical subsistence items. Explanations that rely on environmental factors suggest that inadequate wood supplies for pottery firing forced potters to work at more distant locations. A lack of wood may partly explain the evidence for nonlocal manufacture given the high site density in the eastern McKinley Mine lease and the potential for depletion of resources after A.D. 1050. In other words, it may have been easier to move pottery production to the fuel, than carry fuel.

Questions of local and nonlocal production are further addressed in the Ceramic Refiring section, where the results of both studies are combined and discussed.

CERAMIC REFIRING

The ceramic refiring experiment used 88 of the 100 sherds from the petrographic study. Ceramic refiring can be used to identify gross differences in clays used by prehistoric potters. Refiring combined with petrographic data provide a look at variability in clay and temper. The variability may reflect different manufacturing areas, and by inference, interaction between local and regional populations. This brief report includes a description of the methods, clay color sorting criteria, assumptions that may be tested with the refiring and petrographic data, and a discussion of the results.

Methods

The methods used here are derived from earlier clay source studies. Shepard (1939) was the first to extensively use refiring to study iron content in clays and ceramics from prehistoric sites in the La Plata River Valley. The most basic assumption for refiring is that the higher the iron content in a clay the redder a clay should turn when refired.

The 88 sherd samples were fired in an electric kiln at 950 degrees C, with unrestricted access to oxygen (Shepard 1939). Once 950 degrees C was reached, the kiln was turned off and the sherd chips left to cool. Once the chips were cool, the refired paste color was compared with a Munsell Soil Color Chart (1975 edition) and the matching color was recorded. From the refired colors, four basic groups were formed: white, very pale brown, pink, and red-yellow. Within each of these groups there was some minor variability that was smoothed by placing all sherds into one of the four groups.

The final step was to tabulate the refired colors and temper groups by site (LA 59497 and McKinley Mine sites) and by ceramic type. Using these data on clay composition, we can address questions that pertain to local and regional ceramic manufacture and exchange from a different perspective than provided by temper and petrography.

General Assumptions

A number of general assumptions about the effect environmental and social factors might have had on pottery production and exchange are often used to direct studies of paste composition. These assumptions guide the archaeologist's attempt to understand socio-economic interaction at local and regional scales, and in some cases pan-regional scales (Hantman and Plog 1982; Upham et al. 1981; Plog 1980).

One assumption deals with change in pottery manufacture organization through time. Pottery manufacture may have first been a home-based industry, producing most pots for home use and few for exchange. Through time, pottery production may have developed into a more specialized industry with utility wares produced locally and decorated pottery produced by local or regional specialists (Cordell and Plog 1979). Recent studies suggest that small-scale specialization occurred in the Pueblo

I period, affecting decorated wares more than utility wares (Blinman and Wilson 1989). Therefore, by A.D. 1050 or 1100, if specialized decorated ceramic production occurred, we would expect to find evidence of this specialization in the presence of nonlocal pastes and tempers. Correspondingly, utility wares, which were used daily with more frequent replacement, should have clay and temper composition that reflect local manufacture.

An alternate assumption holds that pottery (prior to Pueblo III times) was always made at the household level, and that evidence for regional or local specialization outside of a few cases (like the Dolores Area and Chaco Canyon) is rare. Under this assumption, most pottery should reflect local raw material sources, with nonlocal pottery occurring as social markers and in very low numbers.

Environmental factors may complicate the picture. One factor is the depletion of fuel in the woodland or parkland plant communities (Kohler and Matthews 1988). Fuel scarcity would have limited where production could have occurred. It is likely that fuel was first used for cooking and heating, and then if additional fuel were available it was used for other purposes such as pottery-making. If the land around a residence lacked fuel, then the potters may have set up pottery production sites in areas where fuel, clay, and temper were available. The option of moving pottery manufacture to nonresidential locations would have been conditioned by population growth in the San Juan Basin and its peripheries during the Pueblo II period (Cordell and Plog 1979; Allen and Nelson 1982). During this time, wood may have been a very important and locally scarce resource. Movement in response to resource scarcity by individual household potters may not have been economically feasible due to distance. Movement may have been socially constrained as group boundaries became more tightly defined and maintained. Therefore, pottery production may have been restricted to those groups with abundant fuel and suitable raw materials. This may have promoted specialization (Arnold 1985).

Important for this discussion is the definition of local and nonlocal pottery manufacture. Rather than go into a lengthy discussion of definitions proposed by other studies, I will give the definitions by which this study was guided.

Local pottery manufacture refers to pottery that was made using materials that are from sources close to the site. Arnold (1985:19), from an ethnographic sample, shows that over 75 percent of groups usually travel between 0 and 2.5 km for temper. Groups are more willing to travel greater distances for clay. Therefore, 2.5 km is adopted as the upper limit for temper acquisition.

Nonlocal pottery manufacture refers to pottery that is made within the region (in this case the McKinley Mine area) but from materials that are different from what is available within the 2.5 km range of LA 59497. A second type of nonlocal pottery manufacture refers to pottery that is made from materials that are available from distant sources. This pottery would then be part of a long-distance exchange network, of which there is very little evidence at LA 59497 or the McKinley Mine sites.

The most obvious problem with the local and nonlocal distinction comes from potters establishing pottery-producing sites away from the residential site, and then returning with the pottery for use and discard at the residential site. A consequence of this practice would be the occurrence of a high frequency of nonlocal pottery. Possible evidence of this strategy was found at LA 53497, near Laguna, New Mexico, which was a seasonally occupied agricultural site (Hannaford 1991). Unfired gray and white ware clays were recovered that strongly suggest the manufacture of pots at the site. Wilson (pers. comm., 1990) describes pottery kilns found on the La Plata Mine in northwest New Mexico that are located at a distance from residential sites. Fuel may have been a major factor in the location of kilns.

Scheick (1983) suggests that sites in the Gamerco area were occupied when environmental conditions were suitable for farming. Excavations at the McKinley Mine sites (Allen and Nelson 1982) suggest that seasonal abandonment and reoccupation over short periods of time was possible for Pueblo II and Pueblo III periods. If these are plausible characterizations of settlement, then it is possible that nonlocal pottery might occur more commonly than expected. Therefore, we can ask if the paste and temper data from the study area reflect population movement, which might be petrographically or mineralogically different from the local resources.

Another environmental factor that limits source identification is variation in iron content of individual clay beds. Are clays sufficiently homogeneous within a spatially limited source to produce refired clay colors that would be indicative of a particular source or formation? Others have shown that iron content may vary dramatically within a restricted source (Franklin 1983; Windes 1977). Based on these studies, we might expect that clays have highly variable iron content in the McKinley Mine area. Prehistoric potters would have been aware of this variation, and if a light gray or white paste color was desired, then we expect that low iron clays were selected. When surface color was less important (like for gray wares), clays that have more iron content variability could have been selected.

To direct the study, I would like to propose a number of hypotheses that can be tested with the refiring data alone and then in combination with the petrographic and refiring data. These hypotheses pertain to the overarching research questions for the project.

Test Hypotheses

Hypothesis 1: The refired clay colors are primarily one color, suggesting a single clay source for all types and sites in the study area.

Hypothesis 1a: The refired clay colors are many different colors that cross-cut types and sites, suggesting multiple production locales or intrabed compositional variability.

Hypothesis 2: The refired clay colors are similar within types but different across types, suggesting different production locales or clays sources for different types.

Hypothesis 2a: The refired clay colors are variable within types, with similar variability between types. Potters at individual production areas may make all three types rather than specializing in a particular ware or design style, and control of iron content was not important.

Hypothesis 3: The refired clay colors and the defined production areas from the petrographic analysis show patterning that suggest production sources that cross-cut sites and types.

Hypothesis 3a: The refired clay colors and the defined production areas from the petrographic analysis show no patterning.

Hypothesis 4: The refired clay colors and the defined production locales combine to form groups that correspond to types from each study sample (LA 59497 and McKinley Mine sites), suggesting that microregional pottery manufacture and exchange operated on a site-by-site basis.

Hypothesis 4a: The refired clay colors and the defined production locales combine to form groups that cross-cut sites, suggesting that all villages may have participated in microregional production and exchange.

Ceramic Firing Results

The results of the ceramic refiring are presented in Table 9, which is organized by ceramic type and shows a cross-tabulation of temper groups by refiring colors by study sample.

A glance at Table 9 suggests little consistency in the results. Sources 1a and 1b, which are the most common, are represented by almost all refired colors for each group. In general, the refired colors cross-cut study areas, with very pale brown and pink the most common for all types.

Hypotheses 1 and 1a address consistency in clay color across ceramic types and sources. Examination of Table 9 shows that all four clay colors from white to reddish yellow are present in most ceramic and temper types from LA 59497 and McKinley Mine South sites. The lone exception is in Puerco Black-on-white, which only has one reddish yellow sample. The overall pattern suggests that there is considerable iron content variability and it was not of apparent concern to the potters. Local clays from LA 59497 fired reddish yellow, but only a single source is represented, and the source was not sampled in a way to check for variability.

As indicated by the petrographic study, some of the Puerco Black-on-white may come from a different manufacturing source than the majority of Gallup Black-on-white, gray indented corrugated, and the rest of the Puerco Black-on-white. Reddish yellow clay is not found with Temper Type 4, which is the fine-grained monocrystalline quartz, suggesting that this temper may be nonlocal and from a distinct manufacturing source. Overall, Hypothesis 1a is best supported by the data, with the clay colors cross-cutting ceramic types and sources, suggesting a high amount of intrabed variability in iron content.

Hypotheses 2 and 2a address clay color variability by type, looking for consistencies or differences that would suggest type-specific manufacturing sources or mixed type manufacture for manufacturing sources. The scattered distribution of clay colors across the ceramic types suggests that Hypothesis 2a holds true for this study. Type-specific manufacturing areas are not indicated by clay iron content; instead, the production of all three types occurred at one or more manufacturing sources. Selection of a particular clay for a type is not indicated. The occurrence of 46 pink to reddish yellow samples suggests knowledge of the clay qualities and an effort by prehistoric potters to control for them.

Hypotheses 3 and 3a address intra- and intersite variability in refired color and petrographic composition that might have resulted from McKinley Mine sites and LA 59497 obtaining pottery from

Table 9. Refire Colors by Type, Manufacture Source, and Project Area

Refired Color	White		Very Pale Brown		Pink		Reddish/Yellow		Total
Study Area	LA 59497	McKin. Mine	LA 59497	McKin. Mine	LA 59497	McKin. Mine	LA 59497	McKin. Mine	
Gallup Black-on-white									
Source 1A		1	2	2	3	6	3	1	18
Source 1B	1		1	1	2	1	1		7
Source 1C							1		1
Source 3	1								1
Total	2	1	3	3	5	7	5	1	27
Puerco Black-on-white									
Source 1A			1						1
Source 1B	1	2	4	3	3	5		1	19
Source 1C	1								1
Source 3	1		3		2				6
Total	3	2	8	3	5	5		1	27
Gray Indented Corrugated									
Source 1A	2		6	1	5	3	1	2	20
Source 1B		1	3	2	1	1		1	9
Source 1C			1			1		2	4
Source 3				1					1
Total	2	1	10	4	6	5	1	5	34

distinct manufacturing areas. It appears that Hypothesis 3 is supported as the majority of the pottery appears to come from a distinct, but unknown manufacturing area near a metamorphic sandstone source. Although differences in the fusing of clay minerals occur among Puerco Black-on-white and Gallup Black-on-white, and gray indented corrugated, petrographic composition and clay color are very similar, suggesting a single source for all three types. Low-level pottery manufacturing specialization is indicated for white and gray wares; residents of LA 59497 and the McKinley Mine sites acquired pottery from a similar source.

Hypotheses 4 and 4a look for consistency or difference by color and temper within or across study areas that might suggest villages acquiring pottery from different sources. This might be used to infer differences in local and regional social interaction. Higher frequencies of white and very pale brown from LA 59497 might suggest a different manufacture area than for the McKinley Mine sites. Puerco Black-on-white and gray indented corrugated are the main contributors. This contradicts the petrographic results that suggested more similarities between Gallup Black-on-white and gray indented corrugated. Perhaps Puerco Black-on-white and gray indented corrugated were made from a seam in a clay bed with less iron. The contradiction makes interpretation of type-specific and site-specific manufacturing sources a moot point.

To summarize, the refiring results combined with the petrographic study suggest that clays with variable iron content were selected by potters. This variability effectively masks individual manufacturing sources giving the impression of a well-integrated local exchange network for gray and white wares. Unusual manufacture sources like 1c and 3 do not have color specificity, and therefore are as nondiagnostic as the other more common manufacturing sources. The comparison of refired clay color with ceramic types shows that clays were used for white and utility wares without regard for iron content. This demonstrates a high level of control of firing temperature and atmosphere by prehistoric potters.

LITHIC ARTIFACT ANALYSIS

The lithic artifact analysis was guided by two basic goals. The first goal was to provide a descriptive summary of the lithic artifacts. The second goal was to provide information that could be used to address the general research problems outlined in the Data Recovery Plan. Because the sample size recovered from the excavation is small, some of the initial research expectations were reduced to better suit the available data.

A basic attribute analysis of all lithic artifacts provided a descriptive summary of the assemblage. This study was based on an analysis methodology and format outlined by Vierra (1985). The analysis formats are in Appendix 2.

The descriptive artifact analysis tried to identify patterns in prehistoric lithic artifact production and use. It also provided a foundation for comparison with McKinley Mine North and South assemblages. Comparison of the different assemblages might result in the identification of patterns attributable to different activities. These differences may be manifest as different proportions of lithic reduction debris, formal tools, utilized flakes, ground stone, and miscellaneous stone objects. Because only a part of the midden was excavated, a more restricted variety of material from LA 59497 should be expected in comparison to the McKinley Mine sites, which included the excavation of structures, features, and middens.

One assumption of the analysis is that lithic reduction fulfilled two main purposes. One purpose was the reduction of raw material into flakes that could then be used as tools with little or no further modification. The other is that materials were turned into formal tools for specific tasks.

Expedient use of waste flakes is expected in residential situations where raw material and waste products were abundant. Abundance of raw material allowed a dulled flake to be discarded and replaced by a new one. Modification of edges occurred when material was scarce and flakes had to be used more intensively.

The production of formal tools implies design for specific tasks or functions. Obvious examples of formal tools are projectile points, drills, and hafted blades. Early stages of expedient and formal tool production would have produced similar kinds of debitage. Later stages in the production of formal tools leave distinctive biface flakes. The occurrence of a large number of biface flakes would result from extensive formal tool production.

Maintenance and reuse of formal tools generate debris, such as rejuvenation flakes, that can be identified and separated from formal tool manufacture and core reduction. While formal tools may not be common in an assemblage, maintenance or resharpening flakes indirectly indicate that tools were used or modified at the site.

The McKinley Mine lithic artifact analysis partitioned the lithic reduction process into primary, secondary, and tertiary stages (Carmichael 1985; Eck 1982). Tertiary stage reduction included all of the waste flakes that resulted from production of unifaces and bifaces, and sometimes the by-products of maintenance and reuse. Another common term is retouch flake, which is often used to describe the small flakes that resulted from late-stage tool production. Core reduction, however, may produce numerous small flakes during core platform preparation or as shatter during flake removal, depending on the fracture properties of the raw material.

In this analysis, tertiary flakes are defined as biface or uniface flakes, thereby giving some idea of the tool that was produced. Because a polythetic definition based on morphological attributes was used, there should be less chance of misidentification of small flakes, thereby inflating late-stage reduction frequencies.

The research problems focused on identifying changes in subsistence and social and economic interaction between site residents and nearby population centers (Post 1987). The small sample collected is only expected to yield a limited contribution to the understanding of these problems.

Differences in subsistence may be inferred from the lithic artifact assemblage by looking at tool and debitage frequencies. For example, a high frequency of biface or uniface flakes may suggest an emphasis on the production of formal tools used in hunting and meat processing. Hammerstones, flakes with battered ridges, and numerous ground stone fragments would be indicative of the production of grinding implements and corn processing. A diverse lithic artifact assemblage with no one tool set predominating would suggest a strategy more equally balanced between cultivation and hunting and gathering.

Using lithic artifacts to infer changes in social and economic interaction between McKinley Mine populations and more distantly located groups is solely based on the identification of known nonlocal material types. Potential nonlocal lithic materials would include Washington Pass chert from the east slope of the Chuska Mountains, Chinle and San Andres chert from the Zuni Mountains to the south, obsidian from Mt. Taylor or the Jemez Mountains, and Pedernal chert from the north end of the Jemez Mountains. Local materials include undifferentiated chert, silicified wood, and quartzite.

As the direction and extent of communication and exchange networks changed, access to nonlocal materials may have changed. Connections with populations located to the east and northeast may have declined with the abandonment of Chaco Canyon, and contacts with the Manuelito Canyon population center may have become important. The occurrence of nonlocal materials of east and northeast origin would suggest that the Chacoan system was still in place during the occupation of the LA 59497, while a lack of east and northeast nonlocal materials might indicate that the system was no longer operating, and the materials were no longer available through exchange.

Lithic artifact assemblages from Black Creek to the west and the McKinley Mine Coal Lease yielded similar local lithic raw material types to LA 59497. Undifferentiated chert and silicified woods predominate, while lesser amounts of siltstone, quartzite, and fine-grained igneous materials also occur in both areas. The similarity in material types makes it impossible to look at whether the populations interacted. Thus, monitoring lithic raw materials may provide information about long-range interaction, while monitoring local interaction is hampered by similarities in lithic raw material availability.

Analytic Methods

The lithic analysis methodology is divided into two parts: recording techniques and artifact and attribute definitions for the analysis. Recording techniques include how the lithics were processed, measured, and examined. The artifact and attribute definitions are the criteria used to describe and classify each lithic artifact.

Lithic artifacts collected in the field were placed in paper bags and labeled with the provenience information, including the site number, project number and name, grid designation, vertical level, feature, date, and excavator's initials. Formal tools, large lithic artifacts, and unique artifacts were bagged separately from the smaller pieces of chipped stone. Each bag of lithic artifacts was field catalogued and assigned a specimen number.

The artifacts were brought to the processing lab, checked for missing or uncatalogued artifact bags, and then washed. The lithic artifacts were numbered with the specimen number and a consecutive artifact number. The artifacts within each artifact bag started at number 1. Numbers were applied to the artifacts with a waterproof ink, and then sealed with a fixative. After the artifacts were numbered, they were placed in plastic Zip-loc bags, which were labeled with the same information listed on the paper bag. The paper bag label was cut out of the bag and placed with the artifacts, preserving the original provenience information.

The artifacts were analyzed using the artifact definitions and attribute criteria. Artifacts were measured with metric calipers and weighed to the nearest 0.1 g. Artifact edges were examined for use-wear with a 40x binocular microscope. Utilized or modified artifact edge angles were measured by imprinting the edge in clay and then measuring the angle of the impression with a calibrated glass comparator. Artifact data were coded onto computer forms for data entry. Formal tools or unique lithic artifacts were separated for photography or illustration.

The artifact definitions and attribute criteria are compiled from Vierra (1985). A copy of the lithic analysis computer code format is also included in Appendix 2.

The Assemblage

The lithic artifact assemblage totals 238 specimens. Artifact types include 225 pieces of core reduction and tool production debitage, 3 cores, 1 reworked biface fragment, 1 scraper, 2 hammerstones, 5 hammerstone fragments, and 1 mano fragment. Included in the debitage are 128 core flakes, 29 of which have at least one utilized edge, 1 undetermined tool flake, 13 undetermined flakes, and 83 pieces of angular debris. The material types include undifferentiated chert, Washington Pass chert, Chinle chert, fossiliferous chert, silicified wood, chalcedony, quartzite, undifferentiated igneous, basalt, meta-siltstone, siltstone, and fine-grained sandstone.

Debitage

Summary data for the debitage are contained in Tables 10-12. These tables contain frequencies of debitage types by material types, material type by dorsal cortex, debitage type by dorsal cortex, and debitage type by platform.

The debitage data show that the most common artifact type was core flake (Table 10). Uniface and biface reduction flakes were not identified and only one undetermined tool flake was present.

This would seem to indicate that the reduction of raw material was geared toward the production of flakes for immediate use or transport for use in hunting and gathering. If core reduction had focused on formal tool production or was equally distributed between formal tool production and maintenance, then higher frequencies of uniface flakes, biface flakes, and broken tools would be expected. Because tool reduction and maintenance flakes are almost nonexistent, the question no longer concerns the proportion of reduction that was devoted to tool production or core reduction and expedient flake tool production. Instead, the focus can be shifted to the core reduction strategy and expedient tool use.

In this study the focus includes how much reduction occurred before the raw materials were brought to the site. Were raw materials differentially reduced based on grain size and suitability? Were certain materials used for a restricted range of tasks determined by their suitability or were materials used interchangeably?

The best indicators of off-site material reduction are cortex and platform type. Presence of cortex is identified with early and middle stages of production, when raw materials are prepared for flake removal, and when primary cortical flakes are further modified. Dorsal cortex by material type is shown in Table 11. The absence of cortex is correlated with the later stages of production, when a core no longer has any of the original cortical rind to remove. Cortical platforms occur with earlier stages of manufacture, while faceted or multifaceted platforms are from later stages of manufacture.

Table 12 shows the distribution of cortex for core flakes by material type. The two indicators of primary stage core reduction, platform and dorsal surface cortex, are poorly represented. This immediately suggests that materials were usually brought to the site in a reduced state. Cortex is absent from only 70 (54.7 percent) of the core flakes, suggesting that materials were not reduced to noncortical cores or tool blanks before they were transported to the site. Cortex is present on 49 (59.0 percent) of the nonflakes, again suggesting that materials were not fully reduced before they were brought to the site. It appears that the distribution of cortex is inconclusive with regard to the question of off-site raw material reduction.

Another indicator of reduction strategy is the platform type. In this analysis, cortical and faceted platforms were considered to be the two best indicators. If there was a heavy focus on primary core reduction then a greater frequency of cortical platforms would be expected. Conversely, a greater number of faceted platforms may suggest that materials were brought to the site in a more reduced form. The cross tabulation of platform type by material type for whole flakes shows that faceted platforms outnumber cortical platforms by nearly 2:1 (Table 13). This would suggest that materials were partly reduced off-site.

Scatter plots and linear regression lines were plotted for the variables of length and width and length and thickness to test whether material types were reduced differently (on file, ARMS). A scatter plot of length and width for all flakes shows noticeable, though not strong, correlation between length and width. When scatterplots and regression lines for individual material types are calculated, the regression correlations are low, and in the case of quartzite the distribution is almost totally random. This illustrates that the assemblage as a whole shows weak correlation between length and width, with flakes generally getting wider as they get longer.

Table 10. Debitage Type by Material Type

Debitage Type	Angular Debris	Core Flake	Undetermined Tool Flake	Indeterminate Flake	Total
Chert	15 31.9 18.1	29 61.7 22.7		3 6.4 23.1	47 20.9
Washington Pass chert	1 50.0 1.2	1 50.0 .8			2 .9
Chinle chert		1 100.0 .8			1 .4
Fossiferous chert	1 100.0 1.2				1 .4
Silicified wood	47 49.0 56.6	42 43.8 32.8		7 7.3 53.8	96 42.7
Chalcedony		1 100.0 .8			1 .4
Quartzite	1 14.3 1.2	6 85.7 4.7			7 3.1
Fine quartzite	8 27.6 9.6	51 72.4 16.4			29 12.9
Coarse quartzite	1 11.1 1.2	7 77.8 5.5		1 11.1 7.7	9 4.0
Igneous	8 42.1 9.6	9 47.4 7.0		2 10.5 15.4	19 8.4
Basalt		3 60.0 2.3	1 20.0 100.0		5 2.2
Meta-siltstone		1 100.0 .8			1 .4
Siltstone		7 100.0 5.5			7 3.1
Total	83 36.9	128 56.9	1 0.4	13 5.8	225 100.0

Table 11. Material by Cortex

Cortex	Absent	Platform Only	Dorsal Only	Platform and Part Dorsal	Platform and 100% Dorsal	Present	Total
Chert	29 61.7 25.9	4 8.5 33.3	5 10.6 11.6	2 4.3 40.0		7 14.9 14.3	47 20.9
Washington Pass chert			1 50.0 2.3			1 50.0 2.0	2 .9
Chinle chert			1 100.0 2.3				1 .4
Fossiliferous chert						1 100.0 2.0	1 .4
Silicified wood	40 41.7 35.7	3 3.1 25.0	19 19.8 44.2		1 1.0 25.0	33 34.4 67.3	96 42.7
Chalcedony			1 100.0 2.3				1 .4
Quartzite	4 57.1 3.6	1 14.3 8.3	1 14.3 2.3		1 14.3 25.0		7 3.1
Fine quartzite	18 62.1 16.1	1 3.4 8.3	4 13.8 9.3	1 3.4 20.0	1 3.4 25.0	4 13.8 8.2	29 12.9
Coarse quartzite	4 44.4 3.6	1 11.1 8.3	2 22.0 4.7	1 11.1 20.0	1 11.1 25.0		9 4.0
Igneous	11 57.9 9.8	2 10.5 16.7	3 15.8 7.0			3 15.8 6.1	19 8.4
Basalt	3 60.0 2.7		1 20.0 2.3	1 20.0 20.0			5 2.2
Meta-siltstone			1 100.0 2.3				1 .4
Siltstone	3 42.9 2.7		4 57.1 9.3				7 3.1
Total	112 49.8	12 5.3	43 19.1	5 2.2	4 1.8	49 21.8	225 100.0

Table 12. Debitage Type by Dorsal Cortex

Debitage Type	Angular Debris	Core Flake	Undetermined Tool Flake	Undetermined Flake	Total
Absent	34 30.4 41.0	70 62.5 54.7	1 .9 100.0	7 6.3 53.8	112 49.8
Platform only		12 100.0 9.4			12 5.3
Dorsal only		37 86.0 28.9		6 14.0 46.2	43 19.1
Platform and part dorsal		5 100.0 3.9			5 2.2
Platform and 100% dorsal		4 100.0 3.1			4 1.8
Present	49 100.0 59.0				49 21.8
Total	83 36.9	128 56.9	1 .4	13 5.8	225 100.0

Table 13. Debitage Type by Platform

Platform Type	Angular Debris	Core Flake	Undetermined Tool Flake	Undetermined Flake	Total
Absent		44 81.5 34.4	1 1.9 100.0	9 16.7 69.2	54 24.0
Cortical		20 100.0 15.6			20 8.9
Faceted		41 95.3 32.0		2 4.7 15.4	43 19.1
Collapsed		8 100.0 6.3			8 36.9
Battered		8 100.0 6.3			8 3.6

Platform Type	Angular Debris	Core Flake	Undetermined Tool Flake	Undetermined Flake	Total
Not applicable	83 100.0 100.0				83 36.9
Retouched		7 100.0 5.5			7 3.1
Total	83 36.9	128 56.9	1 .4	13 5.8	225 100.0

When length and thickness are plotted there is a much stronger positive correlation. Chert and silicified wood, however, only show an average correlation. The medium-grained materials (quartzite, siltstone, and igneous rock) show a much higher correlation between the two variables. One might say that the correlation shows some intentional control of flintknapping to produce flakes of certain lengths and thicknesses. Instead, it is more likely that the thicker flakes result from the quality of the material. The coarser-grained materials do not fracture as thinly as the fine-grained materials.

Mean thickness by material type shows that quartzite, igneous, and siltstone tend to be thicker than silicified wood and chert. More than one-half of the fine-grained materials are less than .7 cm thick, while more than one-half of the medium-grained materials are .7 cm or greater.

Mean flake dimensions (Table 14) further illustrate the pattern of a random reduction strategy. Fine-grained material whole flakes are not consistently smaller than medium-grained materials, and the standard deviations for nearly all dimensions are high, further supporting the idea that materials were not used or reduced differently.

To summarize the debitage analysis, patterns are evident that might not have been expected based on previous studies. The flake type frequencies show that the primary production activity was core reduction, probably aimed at producing flakes to be used as expedient tools for the wide variety of tasks at a residential site. The cortex by material type frequencies show that no one material was more commonly brought to the site in a reduced form. Also, core reduction was carried out on both previously unmodified and reduced raw materials. This seemingly unplanned strategy was further supported by the flake dimension data that showed no patterning between fine- and medium-grained materials. Dimensions showed a more random distribution with very low correlations. Correlation between length and thickness may be attributable to material differences rather than the flintknappers intention to create a thicker flake.

The question of task-specific use of materials can be explored through utilized flakes. Within the assemblage, 30 core flakes showed evidence of use. This is 13.7 percent of the debitage. Attributes that were monitored for utilized edges include edge outline, edge angle, and edge wear. These three attributes are considered to be the most indicative of tool use.

Table 14. Length, Width, and Thickness Descriptive Statistics, All Whole Flakes

Variable	Mean	Standard Deviation	Cases
Length			
For Entire Population	28.1795	11.7669	78
Chert	23.9500	10.3490	20
Silicified Wood	32.2083	12.1476	24
Quartzite	23.3158	9.2979	19
Igneous	30.6250	13.6270	8
Siltstone	36.8571	10.0404	7
Width			
For Entire Population	23.2436	9.3977	78
Chert	21.7500	10.7404	20
Silicified Wood	25.4167	9.4727	24
Quartzite	20.4737	8.2420	19
Igneous	20.7500	3.1960	8
Siltstone	30.4286	9.4491	7
Thickness			
For Entire Population	7.2051	4.0399	78
Chert	5.4500	3.5015	20
Silicified Wood	7.4167	3.4252	24
Quartzite	6.4211	3.1325	19

Variable	Mean	Standard Deviation	Cases
Igneous	8.87 50	4.79 40	8
Siltstone	11.71 43	5.43 80	7

Table 15 shows silicified wood (n=17) and chert (n=8) as the most common utilized flake materials. They are also the two most abundant material types in the overall assemblage. Twenty-three core flakes are utilized, with 13 (56.5 percent) whole core flakes. Only 4 of the 23 core flakes exhibit marginal or facial retouch. Most only have one utilized edge.

Observed evidence of edge damage included unidirectional scarring, bidirectional scarring, unidirectional scarring/rounding, bidirectional rounding, and bidirectional scarring/rounding on 35 edges. Of these, unidirectional scarring is the most frequent edge wear with 16 (45.7 percent) edges. The seven pieces of utilized angular debris are actually hammerstone spalls. They exhibit crushing on a ridge.

The most common edge outline is straight (n=12, 34.3 percent), although concave, convex, and irregular edge outlines are represented. Utilized flakes with straight edges that exhibit unidirectional wear are the most common.

Edge angles were measured in 5-degree increments but were combined into 10 degree categories for the purpose of interpretation. The bar graph of edge angles shows a bimodal distribution between edge angles of 30-40 degrees and edge angles of 60-70 degrees (Fig. 17). There are 17 different combinations of edge damage, edge outline, and material type possible for 20 edge-angle measurements. It is unlikely that they would form a meaningful distribution. Instead, it appears that edge angles have a broad distribution across the utilized flake category. The edge angles from the second and third utilized edges fall within the bimodal distribution.

Utilized flakes are present in small numbers. Seven appear to be hammerstone spalls. If the hammerstone flakes are not counted, we find that 61 percent of the utilized edges show unidirectional edge damage. Unidirectional edge damage results from scraping hard or rough materials. Processing soft materials may not show visible edge damage. Because many uses do not have wear patterns, wear is not an exact indicator of stone tool use on site.

Table 15. Utilized Debitage by Material, Edge Outline, and Edge Damage

Material Type	Chert	Silicified Wood	Quartzite	Coarse Quartzite	Igneous	Siltstone	Total
Straight							
Unidirectional scarring	2 28.6	1 5.9			1 100.0	1 50.0	5 17.2

Bidirectional scarring		2 11.8					2 6.9
Bidirectional scarring		1 5.9		1 100.0			2 6.9
Unidirectional scarring/rounding		1 5.9					1 3.4
Concave							
Unidirectional scarring	1 14.3	2 11.8					3 10.3
Bidirectional scarring		1 5.9					1 3.4
Unidirectional scarring/rounding						1 50.0	1 3.4
Convex							
Unidirectional scarring		2 11.8	1 100.0				3 10.3
Unidirectional rounding	1 14.3						1 3.4
Sinuous							
Unidirectional scarring	2 28.6						2 6.9
Unidirectional scarring/rounding		1 5.9					1 3.4
Ridge							
Crushing	1 14.3	6 35.3					7 24.1
Total	7	17	1	1	1	2	29

The bimodally distributed edge angles are represented by light cutting or scraping (30-40 degrees) and heavy scraping or shaping (60-70 degrees). This distribution might be expected from a residential site because of the potential variety of tool uses.

Straight edges are the most frequent tool outline, but the other categories are also common. Again this is indicative of the type of tool use on a residential site. Because straight edges may be the most versatile, they might have been suitable for a variety of tasks, and therefore the most common. Straight edges could also wear down into concave or sinuous edges with extensive use. High frequencies of straight edges are more indicative of versatility, rather than specialized tool use.

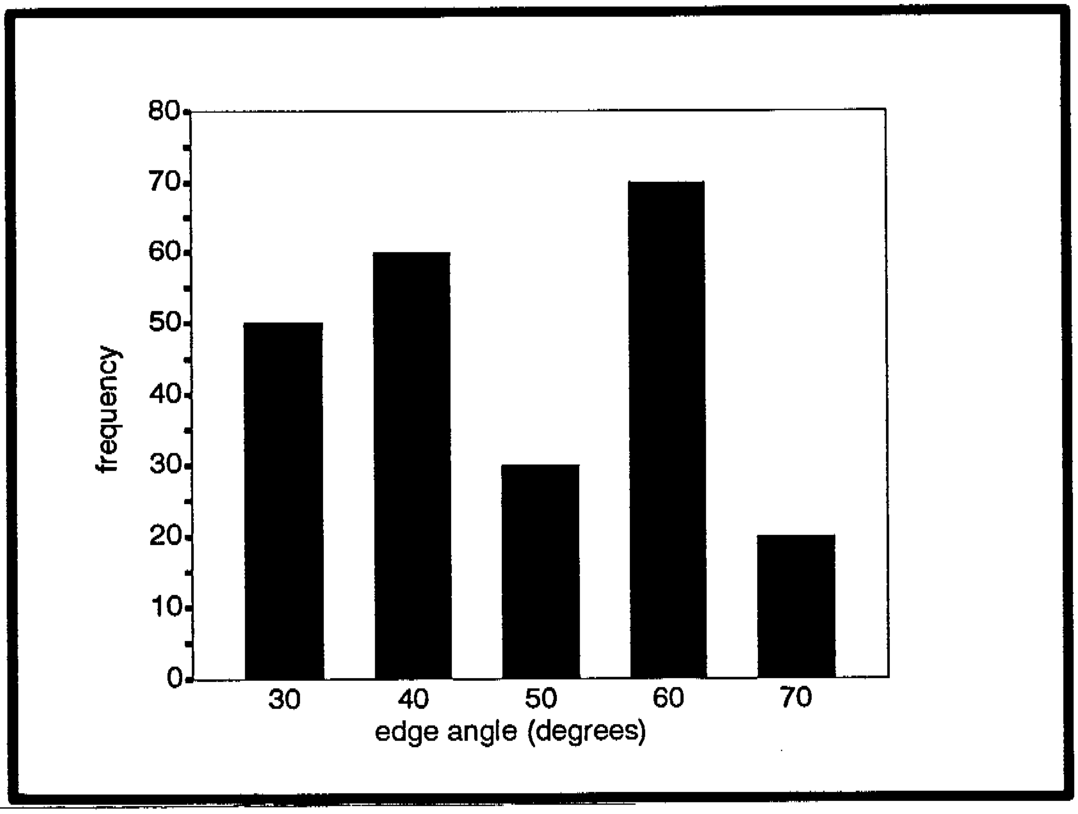

Figure 17. Bar graph of utilized flake edge angles.

Cores

Two cores and one core fragment were identified. Each will be briefly described. From Grid 98N/127E, Stratum 4, Level 1, a multidirectional, cortical and faceted platform core made from a silicified wood nodule was recovered. It is 8.4 cm long by 6.2 cm wide by 5.4 cm thick, and weighs 307 g. It shows no platform preparation or wear suggesting reuse.

The core fragment was recovered from Grid 105N/125E, Stratum 2. It is a unidirectional, faceted platform core, made from a silicified wood nodule. It is 3.5 cm long by 3.4 cm wide by 3.2 cm thick and weighs 15.5 g. It may have been removed from the tip of a large core and then further reduced. There is no wear to suggest reuse.

From Grid 105N/124E, Stratum 4, Level 1, a unidirectional, faceted platform core, made from an igneous cobble fragment, was recovered. It is 6.0 cm long by 4.3 cm wide by 2.8 cm thick and weighs 80.2 g. No wear was observed.

Miscellaneous Lithic Artifacts

Two fine-grained brown sandstone tools were collected. One is a unimarginally retouched scraper, and the other is a two-hand mano fragment.

The scraper is complete and measures 10.0 cm long by 9.5 cm wide by 2.4 cm thick, and weighs 265.0 g. Two of the edges are unidirectionally retouched, with concave edge outlines and edge angles that are between 70 and 80 degrees. A third edge has light unimarginal retouch, a straight edge outline, and a 20 to 30 degree edge angle. This is a multipurpose tool that could have been used for scraping, incising, or cutting hard or coarse materials.

The two-hand mano fragment is broken in half perpendicular to the long axis. The incomplete length is 12.2 cm, the width is 13.0 cm, and the thickness is 2.3 cm. The incomplete weight is 741.0 g. The plan view is rectangular, with only one side very lightly ground. The cross section is plano-convex. All three edges have been shaped by pecking and flaking. There is no evidence to suggest how the mano broke, but it appears to have been broken very soon after it was made.

Comparison with the McKinley Mine Residential Sites

The excavation at LA 59497 resulted in the recovery of 225 pieces of chipped stone debitage. The analysis of the debitage has provided information about raw material procurement and reduction strategies. The main emphasis was on making core flakes that could be used as tools requiring little or no additional modification. The raw material was brought to the site in a variety of forms and consisted primarily of "locally available" materials. The local materials were reduced and probably used for very similar tasks, since there seemed to be little correlation between flake sizes and material type that would suggest otherwise.

The small amount of lithic debris recovered from the excavation left doubt if the assemblage was representative. In order to address this concern the LA 59497 assemblage was compared to 10 residential sites excavated during the McKinley Mine North (NL 86, NL 141, NL 142, NL 250, NL 311) (Kauffman 1985) and South (PM 203, PM 205, PM 218, PM 224, PM 240) (Allen and Nelson 1982) Coal Lease projects. These sites had excavated architecture and middens and are roughly contemporaneous with LA 59497.

The McKinley Mine Coal Lease excavations involved a large number of sites for which the chipped stone data are summarized. Only some of the attribute data by site are available. For this reason, comparisons were made only between frequency of flakes and small angular debris, frequency of cortex on flakes and small angular debris, material type frequencies, and utilized flake percentages.

Figure 18 shows the distribution for the five major material types that occurred on all 11 sites. In all but two cases, silicified wood is the most common material type, followed by chert and quartzite. The two exceptions are from NL 141 and PM 205, which have small assemblages. The similar distributions indicate that throughout the Mckinley Mine area site residents were exploiting the same lithic raw material sources. The high numbers of silicified wood suggest that it is the main suitable rock type in the gravel deposits.

Figure 18 shows that lithic artifacts were found at McKinley Mine sites in relatively low numbers. Only NL 86 has over 500 lithic artifacts, and this site was probably multicomponent. Low lithic artifact frequencies were not noted as unusual by the McKinley Mine analysts. A number of factors could contribute to the low frequency of lithic artifacts at residential sites in the McKinley Mine area. I think that the major reason may be scarcity of material. Scarcity of material could result in the use of substitute materials for tool production, and therefore lower artifact frequencies.

Figure 19 shows the unutilized to utilized flake proportions for McKinley Mine South sites and LA 59497. In the McKinley Mine South assemblages, Eck (in Allen and Nelson 1982) found that 25 percent of the debitage exhibited use wear. He attributed this to a raw material to tool production trajectory that was geared toward producing large flakes that could be used for the tasks of cutting, scraping, cleaning, and shaping. Low numbers of uniface or biface reduction flakes and formal chipped stone tools were found. Perhaps what Eck saw in addition to the production of "expedient" flake tools was reuse of the available chipped stone material because locally available raw material was scarce. By comparison, only 13.3 percent of the debitage was utilized at LA 59497.

While there may be many reasons for variability in utilized debitage percentages between LA 59497 and the McKinley Mine South lease sites, a few possibilities will be offered here. One possible reason for less utilized debitage in the LA 59497 assemblage could be the sample: only the midden was sampled and very limited feature contexts were collected. The McKinley Mine South sites included rooms, exterior activity areas, and kivas, in addition to midden samples. Perhaps the floor and feature proveniences contained greater numbers of utilized flakes. NL 86, which was an excavated kiva on the McKinley Mine North project, showed somewhat higher frequencies of utilized debitage within the kiva. This was attributed to specialized activities instead of more general tool production and core reduction (Carmichael 1985).

The seemingly high frequencies of utilized debitage on the McKinley Mine South sites also could be caused by a shortage of raw material. If lithic raw material was scarce, flakes would have been used more intensively than if materials were locally abundant. This more intensive use of debitage might result in an accumulation of wear patterns that are more visible to the laboratory analyst. If this is true, then assemblages from areas where raw material is abundant should have lower percentages of edge damage than the McKinley Mine South sites and LA 59497.

Comparison with a site located along the La Plata River in northwest New Mexico (Vierra 1986), where lithic raw materials are abundant in the terrace gravel, shows that this is not the case. LA 50337 had 19.1 percent occurrence of utilized debitage. This might be an indication that material availability did not influence utilized debitage percentages.

Figure 20 shows the proportion of flakes to small angular debris and Figure 21 shows cortical (primary/secondary) to noncortical flake (tertiary) proportions on McKinley Mine sites. Both of these attributes are indicators of lithic reduction stages. If lithic reduction focused on biface production, there should be very high flake to angular debris proportions. This pattern is only found at NL 141, PM 203, and PM 205. These are small assemblages and they may be specialized activity sites. The larger assemblages are indicative of core reduction, probably to produce flakes for use as tools with a very limited amount of facial and marginal retouch. The expedient flake tools might be more functionally flexible, and therefore more frequent on residential sites, where a wide range of activities occurred.

To conclude, it appears that the residential sites of the McKinley Mine North and South projects and LA 59497 exhibit similar patterns of lithic material procurement, reduction, and use. Close similarity between LA 59497 and most of the McKinley Mine assemblages indicates that LA 59497 may indeed be representative of the range of tool production and use that occurred. Although there are fluctuations within the sample, the overall picture is that residential site tool production and use

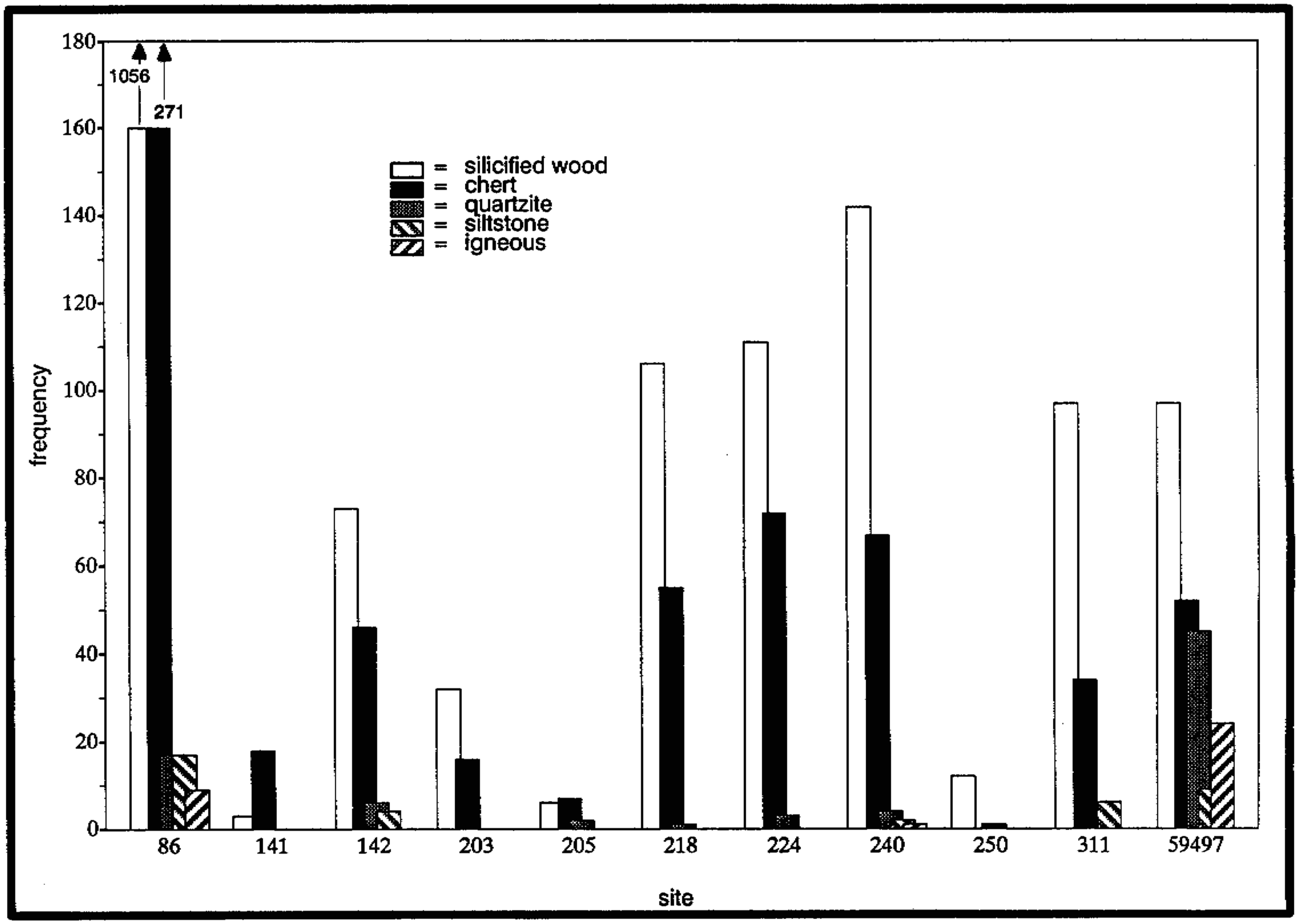

Figure 18. Material type distributions for LA 59497 and McKinley Mine sites.

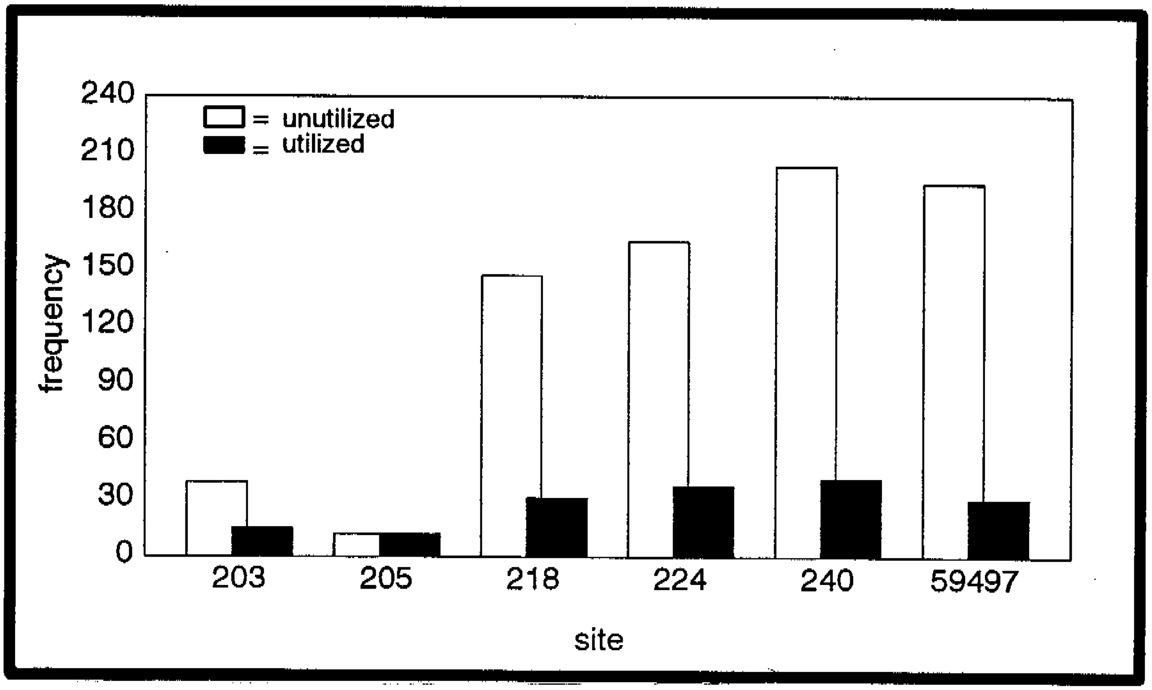

Figure 19. LA 59497 and McKinley Mine South flake use.

were geared to locally available materials, though not abundant raw materials. The materials were transported to the sites in partly or unreduced forms to be made into flakes, which could then be used with only limited modification for a wide range of tasks. Specific use of material for specific tasks is not indicated.

Miscellaneous Artifacts

Two small chunks of red ocher were collected from Stratum 4. One is from Grid 98N/133E (FS 323) and the other is from Grid 105N/127E (FS 492). Red ocher was used as pigment. Mixed with water it could be used to decorate wood and leather objects, and as face paint. Stone palettes bearing traces of red ocher are common in Southwestern prehistoric contexts. FS 323 appears to have been well used; the surface is rounded and no corners or edges remain. FS 492 is a larger piece and it has edges and corners, suggesting that the chunks of pigment were broken off the main piece and then ground and mixed.

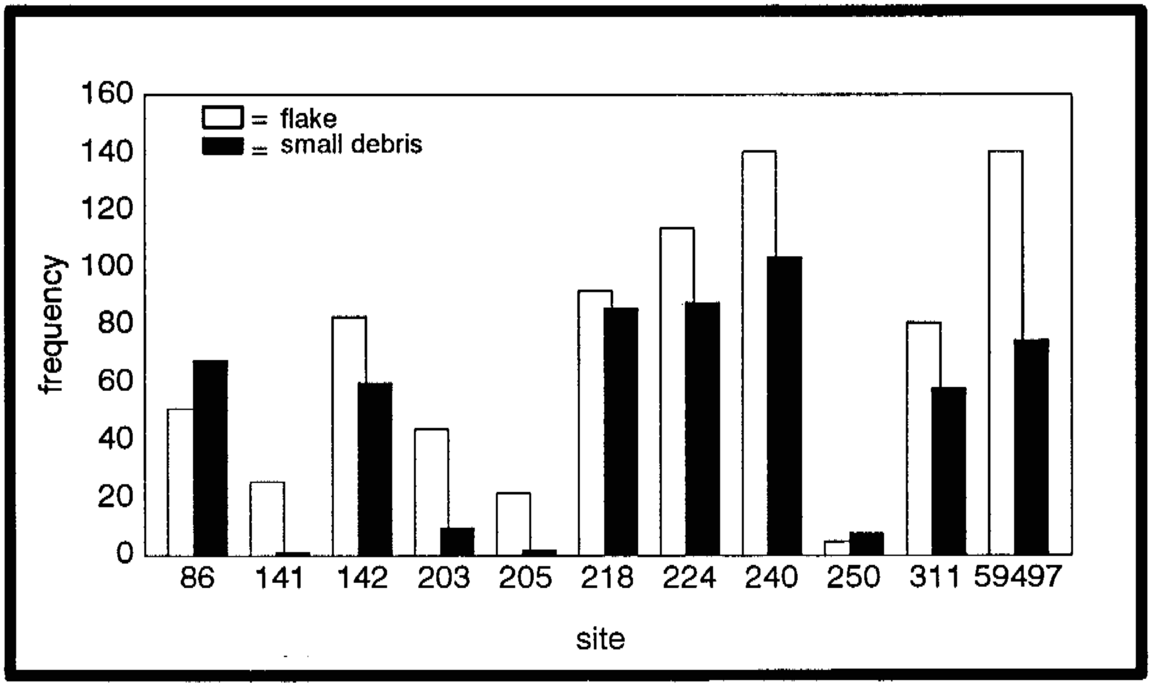

Figure 20. Debitage frequencies for LA 59497 and McKinley Mine sites.

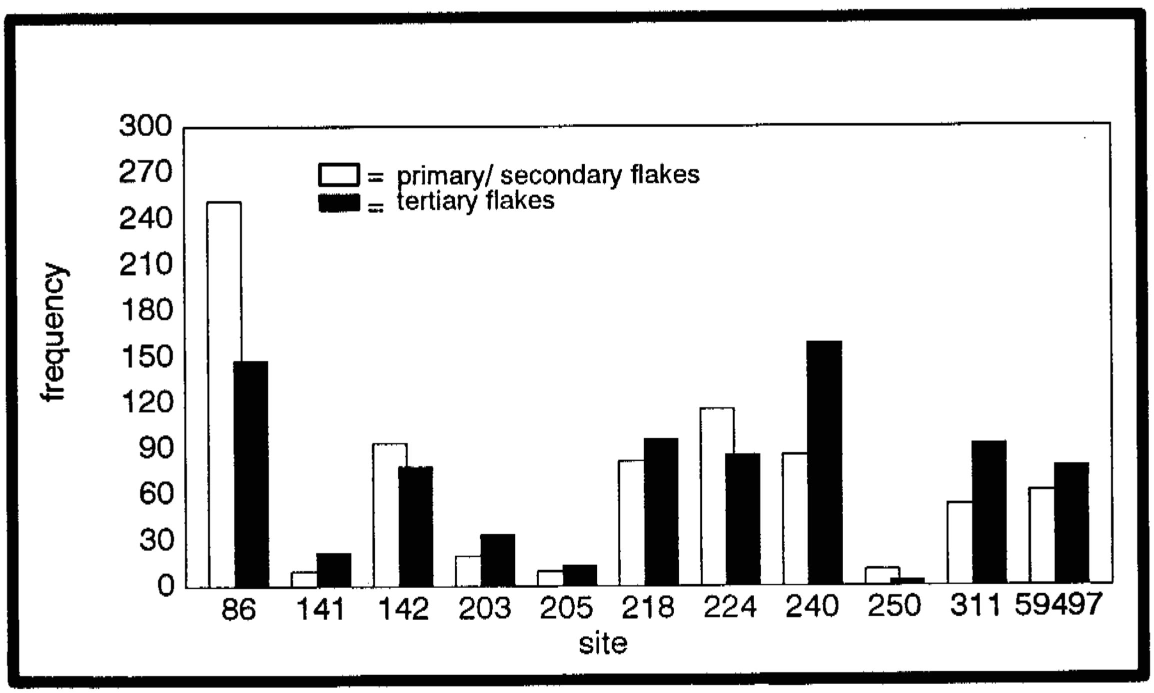

Figure 21. Flake types for LA 59497 and McKinley Mine sites.

IDENTIFIED FAUNAL REMAINS FROM LA 59497

by
Linda Mick-O'Hara

The small amount of faunal material recovered from the excavations at LA 59497 allows for only a basic inventory (see Table 16). No interpretation of the dietary variety or overall landscape use is possible. These specimens do, however, give us some material to compare with other sites of the same period. The following brief report will discuss the species found and their association with different subsistence strategies that may have been used during the Pueblo II and III periods.

The faunal remains were identified using the comparative specimens housed in the collections of the Office of Archaeological Studies, Santa Fe, New Mexico. All fragments were identified to the most specific level possible given the size and preservation of each bone fragment. Along with species identification, the element, portion, side, age, and any environmental alteration were noted.

A total of 16 pieces of bone were recovered from the excavations at LA 59497. Turkey was the most frequently identified species, while one element each could be assigned to Botta's pocket gopher, desert cottontail, and black-tailed jack rabbit. Table 16 summarizes these identifications. All specimens came from a general midden area and are most likely trash from village subsistence activities. The species represented are all common subsistence items for this time period (Lang 1983; Binford et al. 1982; Mick-O'Hara, in prep.). The presence of turkey in this small sample and the lack of large mammal remains is representative of the Pueblo II-Pueblo III regional faunal procurement pattern.

The argument has been made that faunal assemblages from various sites in this region are representative of a game depletion period where availability of larger game decreased from over-hunting. The depletion resulted in the increased use of cultigens and a greater use of less desirable faunal species that frequented field areas (Mick-O'Hara, in prep.). All of the specimens identified in this sample would be attracted to gardens and could have been hunted or trapped there (Linares 1976). This would have reduced the time needed to travel to more distant localities to hunt for larger game, thus increasing time that could be spent tending fields or gathering.

This scenario is feasible for LA 59497. The evidence for trauma on the human bone suggests intercommunity stress (see Human Remains section). This could add support to a game depletion argument where a reduction in resources is a primary catalyst for increased intercommunity stress. The violence that is apparent in the human remains at other sites during this period would indicate a regional rather than local stress phenomena. More data are needed to support these arguments but an intriguing picture is unfolding for the Pueblo II and III periods in the northern Southwest.

Table 16. Faunal Remains Identified from LA 59497

Species	Element	Portion	Side	Age	Burning
Small mammal	1 long bone	diaph. frags.	indeterminate	indeterminate	none
	2 long bone	diaph. frags	indeterminate	indeterminate	black

Species	Element	Portion	Side	Age	Burning
Medium mammal	1 long bone	diaph. frag.	indeterminate	Indeterminate	none
Botta's pocket gopher	1 tibia	proximal 2/3	left	mature	none
Desert cottontail	1 mandible	horizontal ramus	left	mature	none
Black-tailed jack rabbit	1 femur	distal epiph. frag.	right	indeterminate	black
Turkey	1 vertebra cervical	damaged	absent	indeterminate	none
	1 carpometacarpus	complete	left	mature	none
	1 digit II, phalanx I	proximal 1/2	left	indeterminate	

CONCLUSIONS

The data recovery efforts focused on providing data on subsistence practices and social and economic interaction at local and regional scales. The subsistence information derived from archaeological survey, and artifact, faunal remains, pollen, and ethnobotanical analyses is used to identify and interpret subsistence practices at LA 59497 and within the broader context of the McKinley Mine Lease area. Social and economic interaction are examined by inference from the human remains, burial offerings, and technological, stylistic, and functional ceramic attributes.

Subsistence Practices at LA 59497

Examining the evidence for change in subsistence practices was an important avenue of investigation for the McKinley Mine South lease study (Allen and Nelson 1982). Settlement distribution data, evidence of farming technologies, and subsistence data provided contradictory conclusions about changing subsistence practices. The research design for LA 59497 proposed to evaluate the subsistence data recovered from LA 59497 in terms of the McKinley Mine patterns. The following is a brief discussion of the McKinley Mine South lease conclusions and the results of the LA 59497 investigation.

Nelson and Cordell (1982) were interested in abrupt-peopling and gradual-peopling models of settlement and how these models would relate to the settlement and use of agriculturally productive land. They were also interested in changes in settlement patterns through time that might reflect additional pressure on agricultural land, which could have resulted in more labor-intensive farming methods.

In order to address their settlement and subsistence models, they plotted the McKinley Mine South Anasazi sites on a large-scale topographic map displaying three zones that were rated as having agricultural potential. The three land types were bottom-ridge contact, bottom lands, and arable uplands. By plotting the Anasazi sites against the land types, they found that the sites were primarily located in the eastern half of the project area, which corresponded well with a relative abundance of potential farmland.

Their study did not confirm or refute either model as site frequencies in and near arable land remained stable through time. There was also no strong support for the assumption that large sites occupied the best land and then smaller, later sites were relegated to agriculturally less productive land. Site distribution, however, conforms with the hypothesis that Anasazi settlement patterns are focused on inhabiting the most abundant and productive farm land. This was confirmed by selecting a random sample of points in nonsettled land, measuring a .5 mi radius, and recording the percentages of land types. This exercise showed a definite emphasis on settling near agricultural land for the prehistoric Anasazi inhabitants (Nelson and Cordell 1982).

LA 59497 is in the abundant arable land area (as defined in the McKinley Mine South study) and it is one of the largest architectural sites in the immediate area. Presumably, the area required for sustaining the LA 59497 inhabitants would be as large or larger than other smaller sites in the eastern portion of the McKinley Mine South lease.

The large size of LA 59497 strongly supports the hypothesis of population increase between A.D. 1050 and 1150 in the McKinley Mine lease area. Nelson and Cordell (1982) proposed that an increase in population co-occurred with a need for greater agricultural productivity. The clustering of small settlements in the eastern portion of the lease suggests that expansion into new farm lands was not an option for the prehistoric inhabitants. Instead, increased production through the use of labor-intensive farming methods may have been practiced. As a result of the intensified farming effort, evidence of soil and water control might be present. No water and soil control features were identified by the McKinley Mine survey. We surveyed potential agricultural lands around LA 59497 to further look for prehistoric agricultural features.

A limited survey of the bottom-ridge contact zone, as shown in Figure 14, was conducted. The intent of the survey was to record agricultural features only and not other archaeological resources. The surveyed area covered 11.8 ha (30 acres). A crew of four, spaced at 10-m intervals, walked contours within the bottom-ridge contact zone.

As might have been expected based on the McKinley Mine data, no agricultural features were identified during the survey. Possible explanations for the lack of agricultural features include both cultural and natural causes. The most obvious culturally determined explanation is that McKinley Mine South prehistoric populations did not use labor-intensive farming methods. Natural causes for the absence of agricultural features include burying by gradual soil deposition and washing away by arroyo cutting caused by heavy rainfall in conjunction with a lack of maintenance once prehistoric populations either abandoned the area or the strategy.

Faunal remains were the second potential avenue for studying change in subsistence practices. If faunal remains were abundant enough in the midden deposit, and the deposit was stratified, then a study of changes in faunal consumption would be possible. Unfortunately, only 16 animal bone fragments were recovered. The low frequency of bones in the sheet trash deposit is due to natural and cultural factors. Sheet trash deposits would certainly be subject to trampling and consumption by resident dogs. Room fill might contain higher numbers of bone; trash-filled rooms, serving as "garbage cans," protected the trash deposits from trampling and continued re-exposure to natural elements that cause erosion and deterioration.

Individual species included cottontail, jackrabbit, and turkey. The presence of turkey is interesting because if it was not domesticated, its presence suggests hunting forays into the ponderosa parkland of Beautiful Mesa to the west or the southern end of Chuska Mountains and Fort Defiance Plateau. Mick-O'Hara (this report) suggests that the presence of species that readily inhabit garden habitats results from a focus on corn agriculture combined with a depletion in larger game mammals through over-hunting. Prehistoric farmers more often take advantage of animals that are drawn to their gardens than make long-range forays into higher elevation habitats for larger game. She suggests that this is a common pattern in Pueblo II-Pueblo III Anasazi sites. Though this pattern does not imply subsistence stress, Mick-O'Hara suggests that the evidence of trauma on human remains from LA 59497 and other sites in the region does suggest social unrest.

Subsistence stress resulting from increased population pressure and greater demands for land and other natural resources may have been a primary cause of the social unrest. Scheick (1983) suggests that the drought that occurred between A.D. 1090 and 1110 may have put additional pressure on populations. We cannot conclusively date the human burials from LA 59497 to this period, but it would be one possible explanation for the occurrence of relatively large numbers of human remains that have been recovered from the McKinley Mine and Gamerco sites.

The third avenue by which subsistence practices could be investigated was through the analysis of ground stone artifacts. Again, only one ground stone fragment, possibly derived from a slab metate, was recovered. Because of its durability, ground stone may have had many uses after its life as a grinding implement ended. Ground stone is commonly used in construction. The likelihood that it was discarded close to the last activity area where it was used is high and therefore abundant ground stone would not end up in the fringe of a midden deposit.

The fourth avenue of subsistence study was the palynological and ethnobotanical analyses that were conducted on samples collected from the two hearths, burial contexts, and from samples of Stratum 4 from excavation units. Reports of these investigations are in Appendixes 4 and 5. The studies focused on identifying differences in the occurrence of economic plant remains and their significance with regard to burial and subsistence practices.

The pollen analysis (Holloway, Appendix 4) yielded little subsistence data or differences in pollen frequencies that could be attributed to burial practices. Cactus pollen was identified in both of the hearths, suggesting that they were used as roasting pits. Cactus was a common economic plant species identified in the Gamerco excavations (Gish 1983). High concentrations were found in room contexts at Gamerco, leading to the conclusion that there was a heavy reliance on cactus for subsistence.

Pollen sample controls were inadequate to determine if differences in pollen between burial and nonburial contexts were due to ritual offering of plants or pollen. The modern pollen sample was very similar to the prehistoric spectra, although it had a greater variety of pollen types. This suggests that either the environment was similar to what it is today or that most of the contexts were contaminated. The macrobotanical study revealed evidence for post-depositional disturbance in most contexts.

The pollen study did not yield results that were indicative of subsistence stress or changing subsistence practices. This is in part due to the small number of samples that were analyzed, and because so few feature contexts existed.

The macrobotanical study (Toll, Appendix 5) yielded limited information about subsistence. Eleven samples were processed. The pollen results suggest that the local plant species were similar to today. The presence of cactus was not noted in the macrobotanical study, so that cactus roasting for the two hearths cannot be confirmed.

Five of the eleven samples had charred economic plant remains including goosefoot, pigweed, purslane, and corn. All of the charred remains are common on prehistoric sites in the McKinley Mine area. The charred species occur more frequently in the LA 59497 samples than in the McKinley Mine South samples. This may be partly due to the trash context of the LA 59497 samples, where burned or consumed food may have been discarded. Features may contain less evidence of consumption because the living areas were probably routinely cleaned and the charred remains discarded into the trash areas.

The charred remains are indicative of subsistence based on gathered and cultivated plants. A heavy reliance on gathered plants at LA 59497 in comparison to other McKinley Mine South sites could be inferred from the samples. This difference may be due to context of sample collection rather than major differences in subsistence.

The presence of mostly burned juniper and unidentified conifer in the wood charcoal suggests that juniper was available for fuel for at least some of the occupation. The lack of burned annuals suggests that they were not regularly used for heating or cooking.

In the Ceramic Refiring section, I suggest that off-site pottery production might have occurred with the depletion of local fuel. The occurrence of juniper without perennials implies that juniper may not have been scarce. If juniper were scarce, then annuals would have been used because of their abundance and proximity. This is not the case, indicating the juniper was probably not scarce and was therefore available for pottery firing. Thus, the macrobotanical remains do not lend support to the fuel scarcity hypothesis as a factor limiting on-site pottery production at LA 59497.

Like the pollen study, the macrobotanical study yielded little information that could be used to infer changes in subsistence for the LA 59497 residents. The hypothesized fuel scarcity, which could be an indicator of a depleted local landscape, was not supported. The presence of charred economic plant remains in more than the McKinley Mine South samples is not perceived as evidence of a difference in subsistence but instead may be a result of the contexts from which the samples were collected.

The four studies did not provide information that could be used to support a hypothesis of subsistence stress or change at LA 59497 during its occupation. This result is largely due to the excavation focusing in a sheet trash deposit rather than the main part of the site. The best evidence for stress is in the possible evidence of trauma on a small sample of the human bone. The violent death of the female in Feature 2, and the extraction of teeth from the male in Feature 5, could have resulted from social unrest, economic stress, or a combination of the two.

Social and Economic Interaction, Local and Regional

Social and economic interaction at local and regional levels and population movement into the McKinley Mine area were to be addressed by the ceramic and lithic analyses. Interaction was to be investigated by identifying local and nonlocal sources of pottery manufacture and lithic raw material.

Pottery manufacturing sources were investigated through petrographic analysis combined with local and regional geological data, and refiring of sherds and local clay samples. These combined with design and surface treatments, were intended to allow an assessment of proportions of nonlocal to local pottery, identification of nonlocal sources, and perhaps changes in exchange mechanisms through time.

Pottery and People

The McKinley Mine coal lease area and the Gamerco Coal lease to the southwest are in a "marginal environment." The annual rainfall is and probably was low, there is little available surface water, and soils are subject to erosion and rapid mineral and nutrient depletion with repeated use. Several investigators (Scheick 1983; Allen and Nelson 1982; Kauffman 1985) have suggested that environmental marginality would limit occupation to years when environmental conditions would support agriculture. McKinley Mine sites exhibit remodeling and expansion followed by a short hiatus and reoccupation (Allen and Nelson 1982). This settlement pattern might be expected if the area was farmed only when conditions allowed. The question is, then, where did the people come from?

The question of where the McKinley Mine residents came from was to be addressed by petrographically examining a sample of sherds from the McKinley Mine sites and LA 59497, recording the temper composition and then associating the composition with the regional geology to see if temper could be matched with temper types from sherds recovered from population centers, like Manuelito, Allantown, or Toh-la-kai. In addition, the detailed ceramic study looked for patterns in surface treatment and design style in combination with unique temper, which could then be associated with local or regional production.

Known tempers with identifiable sources include the trachyte from the Chuska Mountains, a chalcedonic-cemented sandstone from the Black Creek area, and crushed igneous rock from the northern San Juan Basin. We lack source data from Toh-Lah Kai and the Manuelito area. Only small amounts of trachyte temper were observed in the LA 59497 assemblage. Other tempers, like hematitic sandstone, sandstone with clay pellets, and these mixed with sherd, are not indicative of a particular source area.

The petrographic analysis reinforced the observations by Hill (1985) and Acklen (1982) that the ceramics were primarily tempered with the widespread and inscrutable sandstone and sherd and sandstone. Sandstone collected from LA 59497 tended to be hematitic or very fine grained. The white and gray ware tempers were of a coarser-grained sandstone that could not have originated in the immediate area, although an exhaustive search was not carried out. The coarse-grained sandstone was also present in the McKinley Mine ceramics suggesting a manufacture source similar to LA 59497, which led to the inference of low-level, small-scale local specialization of pottery manufacture.

While temper composition was fairly consistent across types and sites, the different incidence of fused clay matrix in the gray indented corrugated and Gallup and Puerco Black-on-white indicated that different firing temperatures were used. This suggests that different potters made Puerco Black-on-white and Gallup Black-on-white and gray indented corrugated or that different firing regimes were used. Similar temper composition across types indicates that these are differences that occur within the same temper source area. Similarities in temper and paste across sites is interpreted as evidence of localized specialization, with McKinley Mine residents getting their pottery from potters who had access to similar clays or temper, but who fired their pots in different ways.

Different social or economic relations for LA 59497 and the McKinley Mine South sites is tentatively indicated by Manufacture Source 3, which only shows up in the LA 59497 sample. This indicates that all groups did not trade with the same potters. Because the origin of Source 3 is unknown, we cannot make inferences about its bearing on the problem of changing social-economic alliances or its importance with regard to interregional transhumance.

Possible manufacture areas based on temper and paste attributes and iron content of local clays and sherds were looked for by refiring the petrographically examined sherds and clays collected from the immediate area of LA 59497. The refired clay colors cross-cut the four temper and paste groups. The reddish yellow color of the LA 59497 clay occurred in all types. Gray ware, which may require less firing control, had as much clay color variability as the white wares. Similar variability across types suggests that the prehistoric potters did not select for clays low in iron or they were unable to cull high-iron clays.

We can look at surface treatment and design for combinations that may be indicative of manufacturing areas. The assumption is that if surface treatment and design style co-occur, standardization by a specific potter or manufacture area might be indicated. Table 17 shows that diagonal-hatchured pottery when slipped is equally smooth and creamy and thin and washy, while the solid-design pottery when it is slipped tends to be thin and washy. Both diagonal-hatchured and solid-design pottery tend to be slipped more often than not. While the numbers in the diagonal-hatchured pottery are large enough to support the pattern, the solid-design numbers are too low to be conclusive. Therefore, there are not enough data to confidently state whether there is a correlation between slip and design element.

Table 17. Cross-tabulation of Slip Texture by Design Element

Slip Types Design Elements	Absent	Smooth and Creamy	Thin, Washy, and Smoothed	Crackled	Eroded	Total
Puerco Style	2 22.2 14.3	3 33.3 14.3	3 33.3 13.0		1 11.1 5.9	9 11.8
Diagonal Hatchure	8 15.4 57.1	15 28.8 71.4	15 28.8 65.2	1 1.9 100.0	13 25.0 76.5	52 68.4
Solid Elements	3 27.3 21.4	2 18.2 9.5	5 45.5 21.7		1 9.1 5.9	11 14.5
Parallel Hatchure A					1 100.0 5.9	1 1.3
Parallel Hatchure B	1 50.0 7.1				1 50.0 5.9	2 2.6
Checkerboard		1 100.0 4.8				1 1.3
Total	14 18.4	21 27.6	23 30.3	1 1.3	17 22.4	76 100.0

Gray indented corrugated ware was monitored for type of coil decoration for comparison with temper differences, which might suggest different manufacturing sources. Without presenting all of the recorded coil decorations, it can be said that sand or sandstone temper accounted for 83.5 percent of all coil decorations for PII Corrugated, PII-PIII Corrugated, and PIII Corrugated. The next most common temper type was sherd or sherd and sand, and this type basically mimicked the sand and sandstone-tempered gray wares except for occurrence in smaller amounts. This suggests that at LA 59497 there is no correlation between coil decoration and temper.

If surface treatments do not indicate manufacturing areas when combined with temper and design, perhaps different decorated types were associated with particular vessel forms. For this question, I will look at the distribution of vessel forms for Gallup Black-on-white and Puerco Black-on-white. Table 18 shows that Puerco Black-on-white occurs in 68.1 percent of the sample as bowl sherds, while Gallup Black-on-white occurs in 69.2 percent of the sample as jar sherds. In other words, Puerco Black-on-white came to the site as bowls and Gallup Black-on-white more frequently as jars. This vessel function by ceramic type dichotomy is not a common occurrence in the literature. While white ware jar and bowl percentages may vary from site to site, on sites where bowls are the most common form, they also predominate within the most frequently occurring types (Toll and McKenna 1984, 1987; Scheick 1983, for a few examples). In the Gamerco assemblages that postdate A.D. 1100, there is a slight dichotomy between McElmo Black-on-white and Puerco Black-on-white, with Puerco Black-on-white comprising a greater percentage of the white ware jars and McElmo occurring more commonly as bowls (Scheick 1983).

This apparent dichotomy is interesting but cannot be explained. Traditional explanations may include that bowls can be transported farther and in greater quantity than jars. There might be a ring of truth to this statement, as there are some differences in the manufacturing areas among Puerco Black-on-white and Gallup Black-on-white and gray indented corrugated; however, we do not know the actual distance between the source and LA 59497. In response to bowls being transported a long distance, the Chaco Canyon assemblages show that a large number of gray ware jars were transported a relatively long distance--from the Chuska Valley to Chaco Canyon (Toll 1985). The dichotomy between form and type could be better explored if comparable data were available from the McKinley Mine reports, but because those data are not available, we do not know if this is an isolated occurrence or if it is a regional pattern.

To summarize, it is not possible to isolate local types for the LA 59497 assemblage and compare them to nonlocal types based on temper, surface finish, or design. Therefore, we cannot address the problem of where the site residents were moving from at times of environmental amelioration. The ceramic data suggest a similar source for the most common pottery types that were used at McKinley Mine South sites and LA 59497. The lack of pottery with distinctive temper in great numbers suggests that pottery was made within the McKinley Mine area and not brought to the sites from more distant locations.

Table 18. Gallup and Puerco Black-on-white by Vessel Form

Vessel Form	Puerco Black-on-white	Gallup Black-on-white	Total
Bowl	79 68.1 59.8	37 31.9 25.5	116 41.9
Ladle (tubular)	1 100.0 .8		1 .4
Undifferentiated jar	45 30.8 34.1	101 69.2 69.7	146 52.7
Small jar	2 40.0 1.5	3 60.0 2.1	5 1.8
Large jar	1 50.0 .8	1 50.0 .7	2 .7
Pitcher		1 100.0 .7	1 .4
Olla	1 33.3 .8	2 66.7 1.4	3 1.1
Seed jar	1 100.0 .8		1 .4
Undetermined vessel	1 100.0 .8		1 .4
Miniature jar	1 100.0 .8		1 .4
Total	132 47.7	145 52.3	277 100.0

LA 59497 and the Chaco/Anasazi System

In the San Juan Basin and its peripheries, the Chaco system may have been an important vehicle for social and economic integration between A.D. 950 and 1150. The most obvious archaeological evidence of this system is the great houses of Chaco Canyon and the over 70 outliers, some of which are connected by over 400 linear miles of roadways (Marshall et al. 1977; Powers et al. 1983; Judge 1989). Cordell (1982) suggested that the McKinley Mine area was populated from the ring of outliers that borders the McKinley Mine area. The people moved in and out of the McKinley Mine area in response to population pressure at the outliers, which resulted in the need for more agriculturally suitable land. This movement occurred when environmental conditions suited agriculture in the McKinley Mine area, which has been termed more agriculturally marginal than surrounding areas. The Chaco outliers served as organizational nodes for population movement.

Cordell provides no suggestion as to the demographic composition of these scion communities. Graves (1983) suggests that members of scion communities were overwhelmingly young individuals who lacked claims to established farm lands around primary communities.

McKinley Mine burials show that women's life span averaged 18 years, while men's averaged 31 years (Eck 1982). This very limited demographic sample suggests that the women's ages fit colonization models while the men appear to be older than would be expected. This small sample may not be representative of the actual population ages.

The LA 59497 skeletal population had three prime aged individuals and one woman older than 40 years. The three younger individuals fit with Graves's (1983) suggestion, but the older woman does not fit this profile. She may have followed one of her children to the new community where she could be supported.

Interpretation of the age distribution is complicated by the circumstances that surrounded the death of two prime-aged individuals. One of these individuals shows evidence of a violent death, and another was honored with an unusual grave offering. Cause of death in women for the McKinley Mine burials is blamed on childbirth, complicated by nutritional deficiencies. The LA 59497 burial data suggest that there may have been social unrest that resulted in violent deaths of individuals. Death occurred before nutritional deficiencies affected these individuals.

The violence and evidence for social unrest does not fit a hypothesis of colonization by younger populations of marginal areas during environmentally favorable years. Instead, the violence and possible unrest suggest that colonization may have occurred when times were lean. The A.D. 1090-1110 period of below-average precipitation may have fueled hostile competition between groups in the densely packed east periphery of the McKinley Mine lease. Interaction between McKinley Mine inhabitants is suggested by similarities in the ceramic tempers. This interaction, however, may have been strained by disputes over prime farmland.

There is little evidence from the McKinley Mine and LA 59497 excavations that suggests a strong relationship with Chaco outliers. Significant numbers of status or exotic goods have not been found on these sites. Nonlocal or trade ceramics do not suggest a strong relationship between McKinley Mine sites and any particular area. The presence of the double-cylinder jar as a grave good with a young male is very curious, however.

As mentioned in the double-cylinder jar description (this report) and further emphasized by Toll (1989), cylinder jars occur almost exclusively in Chaco Canyon sites, with Pueblo Bonito accounting for the majority. Such a rare vessel form occurring in a peripheral area suggests that there was some level of knowledge of, or participation in, more regional social or economic activities. The double-cylinder jar is probably a local product and is decorated in a way that reflects the local use of both solid-line and hatched-line designs.

The presence of the double-cylinder jar also begs the question of status. Why was this prime-age individual buried with such an unusual object that strongly suggests a relationship with Chaco Canyon or Chacoan populations. While issues of status in the American Southwest are becoming less popular, the double-cylinder jar with a burial makes it difficult to maintain that the individual did not have some special position in the community. Did this individual travel to Chaco Canyon, see cylinder jars, and come home to make or have one made? Is the difference in size a result of the potter not having a model to copy, resulting in a shorter version? Finally, if the double cylinder was a personal item, why do we not find more of them in the Anasazi world? No answers are offered here, only questions. These questions illustrate how much more we have to learn about smaller subsystems before we can begin to address the issue of the greater Anasazi world.

REFERENCES CITED

Acklen, John C.
1982 Ceramic Analysis. In *Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 578-598. Office of Contract Archeology, University of New Mexico, Albuquerque.

Allen, Christine G., and Ben A. Nelson (editors)
1982 *Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico.* 3 vols. Office of Contract Archeology, University of New Mexico, Albuquerque.

Arnold, Dean E.
1985 *Ceramic Theory and Cultural Process.* New Studies in Archaeology, Cambridge University Press.

Bass, William M.
1987 *Human Osteology: A Laboratory and Field Manual.* Third Edition, Missouri Archaeological Society, Inc.

Bennett, M. Ann
1974 *Basic Ceramic Analysis.* Eastern New Mexico Contribution in Anthropology Vol. 6, No. 1, Portales.

Binford, Martha, W. Doleman, N. Draper, and K. Kelley
1982 Anasazi and Navajo Archeofauna. In *Anasazi and Navajo Land Use in the McKinley Mine Area Near Gallup, New Mexico,* vol.1(1), edited by C. Allen and B. A. Nelson. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Blinman, Eric, and C. Dean Wilson
1989 Mesa Verde Ceramics. Paper presented at the New Mexico Archaeological Council ceramic symposium, Gallup, New Mexico, on file Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Breternitz, David A.
1966 *An Appraisal of Tree-Ring Dated Pottery in the Southwest.* Anthropological Papers of the University of Arizona 10. University of Arizona Press, Tucson.

Breternitz, David A., Arthur H. Rohn, Jr., and Elizabeth A. Morris
1974 *Prehistoric Ceramics of the Mesa Verde Region.* Museum of Northern Arizona Ceramic Series 5. Flagstaff.

Carlson, Roy L.
1970 *White Mountain Redware: A Pottery Tradition of East-Central Arizona and Western New Mexico.* Anthropological Papers of the University of Arizona 19. Tucson.

Carmichael, David
1985 Lithic Analysis. In *The Archeology of McKinley Mine,* vol. 1, *Prehistory,* edited by Barbara Kauffman, pp. 165-204. Submitted to Pittsburgh and Midway Coal Company. Report No. 621. Cultural Resources Management Division, New Mexico State University, Las Cruces.

Cibola White Ware Conference
1958 Conference Paper, manuscript on file at the Laboratory of Anthropology library, Santa Fe, New Mexico.

Colton, Harold S.
1955 *Pottery Types of the Southwest: Wares 8A, 8B, 9A, 9B, Tusayan Gray and White Ware, Little Colorado Gray and White Ware.* Museum of Northern Arizona Ceramic Series 3. Flagstaff.

Cooley, M. E., J. W. Harshbarger, J. P. Akers, and W. F. Hardt
1969 *Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah.* Professional Paper 521-A. U.S. Geological Survey, Washington, D.C.

Cordell, Linda S.
1979 Escaping the Confines of Normative Thought: A Reevaluation of Puebloan Prehistory. *American Antiquity* 44(3):405-429.

1982 An Overview of Prehistory in the McKinley Mine Area. In *Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 75-120. Office of Contract Archeology, University of New Mexico, Albuquerque.

Dane, Carl H., and G. O. Bachman
1965 *Geologic Map of New Mexico.* USGS, Department of the Interior, Washington, D. C.

Eck, David C.
1982 Intersite Patterning in the Assemblages of Chipped and Ground Stone Tools. In *Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico,* 3 vols., edited by C. G. Allen and B. A. Nelson, pp. 527-549. Office of Contract Archeology, University of New Mexico, Albuquerque.

Fehr, Russell T., Klara B. Kelley, Linda Popelish, and Laurie E. Warner
1982 *Prehistoric and Historic Occupation of the Black Creek Valley, Navajo Nation,* vol. 1, Navajo Nation Papers in Anthropology No. 7. Navajo Nation Cultural Resource Management Program, Window Rock, Arizona.

Franklin, Hayward H.
1983 Preliminary Ceramic Analysis. In *Economy and Interaction along the Lower Chaco River: The Navajo Mine Archeological Program, Mining Area III, San Juan County, New Mexico,* edited by Patrick Hogan and Joseph C. Winter, pp. 291-310. Office of Contract Archeology, University of New Mexico, Albuquerque.

Garrett, Elizabeth A.
1984 Petrographic Analysis of Ceramics from Early Pueblo III Sites in the Prewitt Area and Chaco Canyon, New Mexico. In *The S.F. Coal Rail Corridor Project: A Study in the Internal Dynamics of Eastern Red Mesa Valley Communities,* compiled by Cherie Scheick, pp. 170-185. Southwest Archaeological Consultants, Contract No. 117, Santa Fe.

Genoves, S.
1967 Proportionality of the Long Bones and Their Relation to Stature among Mesoamericans. *American Journal of Physical Anthropology* 26:67-78.

Gladwin, Harold Sterling
1945 *The Chaco Branch: Excavations at White Mound and in the Red Mesa Valley.* Medallion Papers No. 33. Gila Pueblo, Globe, Arizona.

Graves, Michael W.
1983 Growth and Aggregation at Canyon Creek Ruin: Implications for Evolutionary Change in East-Central Arizona. *American Antiquity* 49(2):290-315.

Gregory, Herbert F.
1916 *The Navajo Country, A Geographic and Hydrographic Reconnaissance of Parts of Arizona, New Mexico, and Utah.* Professional Paper 93. U.S. Geological Survey, Washington, D.C.

Gumerman, George J., and Alan P. Olson
1968 Prehistory in the Puerco Valley, Eastern Arizona: A Preliminary Report. *Plateau* 39(2):80-87.

Hannaford, Charles A.
1991 *Archaeological Testing of LA 53497, Near Paguate, Cibola County, New Mexico.* Office of Archaeological Studies, Archaeology Note No. 48. Museum of New Mexico, Santa Fe.

Hantman, Jeffrey L., and Stephen Plog
1982 The Relationship of Stylistic Similarity to Patterns of Material Exchange. In *Contexts for Prehistoric Exchange,* edited by J. E. Ericson and T. K. Earle. Academic Press.

Hewett, Nancy S.
1982 A Review of the Literature Concerning the Geology and Hydrology in the Vicinity of Gallup New Mexico. In *Anasazi and Navajo Land Use of the McKinley Mine Area near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 22-48. Office of Contract Archeology, University of New Mexico, Albuquerque.

Hill, David V.
1985 Ceramic Analysis. In *The Archeology of McKinley Mine,* vol. 1, *Prehistory,* edited by Barbara Kauffman, pp. 139-164. Submitted to Pittsburgh and Midway Coal Company. Report 621. Cultural Resources Management Division, New Mexico State University, Las Cruces.

Judge, W. James
1989 Chaco-San Juan Basin. In *Dynamics of Southwest Prehistory,* edited by L. S. Cordell and G. J. Gumerman. Smithsonian Institution Press, Washington, D. C.

Kauffman, Barbara
1985 Overview of Regional Prehistory: An Update. In *The Archeology of McKinley Mine,* vol. 1, *Prehistory,* edited by Barbara Kauffman, pp. 19-30. Submitted to Pittsburgh and Midway Coal Company. Report No. 621. Cultural Resources Management Division, New Mexico State University, Las Cruces.

Kauffman, Barbara, and David Hill
1985 Interpretation: The Data in Light of the Research Questions. In *The Archeology of McKinley Mine,* vol. 1, *Prehistory,* edited by Barbara Kauffman, pp. 417-428. Submitted to Pittsburgh and Midway Coal Company. Report 621. Cultural Resources Management Division, New Mexico State University, Las Cruces.

Knight, Paul J.
1982a The Climate of the McKinley Mine Lease Area. In *Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 49-55. Office of Contract Archeology, University of New Mexico, Albuquerque.

1982b The Flora in the Area of McKinley Mine, New Mexico. In *Anasazi and Navajo Land Use in the McKinley Mine near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 55-74. Office of Contract Archeology, University of New Mexico, Albuquerque.

Kohler, Timothy, and Meredith Mathews
1988 Long-Term Anasazi Land Use and Forest Reduction: A Case Study from Southwest Colorado. *American Antiquity* 53(3):537-564.

Lang, Richard W.
1982 Ceramics and Site Chronology in the Eastern Red Mesa Valley: A Reevaluation of the Local Uses of Pueblo I-III Pottery for Phase Sequencing, Kiatuthlanna through Wingate. In *Archaeological Investigations in the Eastern Red Mesa Valley: The Plains Escalante Generating Station,* by John D. Beal, pp. 62-138. Submitted to Plains Electric, Inc., Contract Archeology Report 005. School of American Research, Santa Fe.

1983a Ceramics from Pueblo III Sites in the Gamerco Area of the Upper Rio Puerco. In *The Gamerco Project: Flexibility as an Adaptive Response,* by Cherie L. Scheick, pp. 330-383. Submitted to Carbon Coal, Inc. Archeology Division Report 071. School of American Research, Santa Fe.

1983b Appendix C: Animal Remains from Pueblo III Sites on Burned Death Wash, McKinley County, New Mexico: SAR 067-104 and 290. In *The Gamerco Project: Flexibility as an Adaptive Response,* compiled by Cherie Scheick, School of American Research, Archaeology Division, Santa Fe, New Mexico.

Lancaster, James W.
1983 *An Analysis of Manos and Metates from the Mimbres Valley, New Mexico.* Unpublished Master's thesis, Department of Anthropology, University of New Mexico, Albuquerque.

Linares, Olga F.
1976 "Garden Hunting" in the American Tropics. *Human Ecology* 4(4):331-349.

Marshall, Michael P., John R. Stein, Richard W. Loose, and Judith E. Novotony
1977 *Anasazi Communities in the San Juan Basin.* State Historic Preservation Division and Public Service Company of New Mexico, Santa Fe and Albuquerque.

Mick-O'Hara, Linda
In prep Identification and Analysis of the Bolack Faunal Assemblage. Office of Contract Archaeology, University of New Mexico, Albuquerque, New Mexico.

Mick-O'Hara, Linda, and Stephen S. Post
1991 *Disposition of Human Remains from LA 59497, along State Road 264, McKinley County, New Mexico.* Office of Archaeological Studies, Archaeology Notes No. 39. Museum of New Mexico, Santa Fe.

Nelson, Ben A., and Linda S. Cordell
1982 Dynamics of the Anasazi Adaptation. In *Anasazi and Navajo Land Use in the McKinley Area near Gallup, New Mexico,* vol. 1, edited by Christine G. Allen and Ben A. Nelson, pp. 867-893. Office of Contract Archeology, University of New Mexico, Albuquerque.

Nickens, Paul R.
1975 Prehistoric Cannibalism in the Mancos Canyon, Southwestern Colorado. *The Kiva* 40(4):283-293.

Olson, Alan P., and William W. Wasley
1956 An Archaeological Traverse Survey in West-Central New Mexico. In *Pipeline Archaeology,* edited by F. Wendorf, N. Fox, and O. L. Lewis, pp. 256-390. Laboratory of Anthropology and the Museum of Northern Arizona, Santa Fe and Flagstaff.

O'Shea, John
1981 Coping with Scarcity: Exchange and Social Storage. In *Economic Archaeology,* edited by A. Sheridan and G. N. Bailey, pp. 167-183. British Archaeological Reports, International Series 96, Oxford.

Peckham, Stewart L., and John P. Wilson
1964 The Chuska Valley Survey. Unpublished manuscript on file, Laboratory of Anthropology, Santa Fe.

Plog, Stephen
1980 *Stylistic Variation in Prehistoric Ceramics: Design Analysis in the American Southwest.* New Studies in Archaeology, Cambridge University Press.

Post, Stephen S.
1987 *Testing Results and Research Design for Three Sites along State Road 264, McKinley County, New Mexico.* Laboratory of Anthropology Note 349. Santa Fe.

Post, Stephen S., and Frederick P. York
1992 *Investigations at Wildcat Springs Trading Post, LA 55647, along State Road 264, McKinley County, New Mexico.* Office of Archaeological Studies, Archaeology Notes No. 84. Museum of New Mexico, Santa Fe.

Powers, Robert P., William B. Gillespie, and Stephen H. Lekson
1983 *The Outlier Survey: A Regional View of Settlement in the San Juan Basin.* Division of Cultural Research, National Park Service, Albuquerque.

Roberts, Frank H. H., Jr.
1931 *The Ruins at Kiatuthlanna, Eastern Arizona.* Bulletin 100. Bureau of American Ethnology, Washington, D.C.

Rugge, Dale
1985 Petrographic Analysis. In *Prehistoric Settlement Patterns in West-Central New Mexico: The Fence Lake Coal Lease Surveys,* by Patrick Hogan, pp. 135-158. Office of Contract Archeology, University of New Mexico, Albuquerque.

Rugge, Dale, and David A. Doyel
1980 Petrographic Analysis of Ceramics from Dead Valley. In *Prehistory in the Dead Valley, East-Central Arizona: The TG&E Springerville Report,* edited by David A. Doyel and Sharon S. Debowski. Arizona State Museum Archaeological Series 144. Tucson.

Rye, Owen S.
1981 *Pottery Technology: Principles and Reconstruction.* Manuals in Archeology 4. Taraxacum Press, Washington, D.C.

Scheick, Cherie L.
1983 *The Gamerco Project: Flexibility as an Adaptive Response.* Report 071. Prepared for Carbon Coal, Inc. Archeology Division, School of American Research, Santa Fe.

Schiffer, Michael B.
1987 *Formation Processes of the Archaeological Record.* University of New Mexico Press, Albuquerque.

Shepard, Anna O.
1939 Technology of La Plata Pottery. In *Archaeological Studies in the La Plata District,* by Earl H. Morris, pp. 249-287. Carnegie Institution of Washington Publication 519, Washington, D.C.

1971 *Ceramics for the Archaeologist.* Publication 609, Carnegie Institution of Washington, Washington, D.C.

Speer, W. R., E. C. Beaumont, and J. W. Shomaker
1977 Coal Resources of the San Juan Basin, New Mexico. On file, Office of the State Geologist, New Mexico.

Tabet, D. E., and S. J. Frost
1979 *Environmental Characteristics of Menefee Coals in the Torreon Wash Area, New Mexico.* Open file report #102, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico.

Thornbury, W. D.
1965 *Regional Geomorphology of the United States.* John Wiley and Sons, Inc., New York.

Toll, H. Wolcott III
1985 *Pottery Production, Public Architecture, and the Chaco Anasazi System.* Unpublished Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

1988 La Plata Preliminary Ceramic Analysis Format. On file, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1990 A Reassessment of Chaco Cylinder Jars. In *Clues to the Past: Papers in Honor of William M. Sundt,* edited by M. S. Duran and D. T. Kirkpatrick, pp. 273-301. The Archaeological Society of New Mexico, vol. 16. Albuquerque.

Toll, H. Wolcott, III, and Peter J. McKenna
1984 Ceramics. In *The Architecture and Material Culture of 29SJ1360,* by P.J. McKenna, pp. 103-222. Reports of the Chaco Center No. 7. Division of Cultural Research, U.S. Department of the Interior, National Park Service, Albuquerque, New Mexico.

1987 The Ceramography of Pueblo Alto. In *Investigations at the Pueblo Alto Complex, Chaco Canyon,* edited by F. J. Mathien and T. C. Windes, vol. 3(2), pp. 19-230. Publications in Archeology 18F, Chaco Canyon Studies, National Park Service, Albuquerque.

Toll, H. Wolcott, III, Thomas C. Windes, and Peter J. McKenna
1980 Late Ceramic Patterns in Chaco Canyon: The Pragmatics of Modeling Ceramic Exchange. In *Models and Methods in Regional Exchange,* edited by Robert E. Fry, pp. 95-117. SAA Papers No. 1.

Upham, Steadman, Kent G. Lightfoot, and Gary M. Feinman
1981 Explaining Socially Determined Ceramic Distributions in the Prehistoric Plateau Southwest. *American Antiquity* 46(4):822-833.

Vierra, Bradley J.
1985 Lithic Analysis Methodology. Manuscript on file, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1986 *The Excavation of a Multicomponent Anasazi Site (LA 50337) in the La Plata River Valley, Northwestern, New Mexico.* Office of Archaeological Studies, Archaeology Note No. 49.

Museum of New Mexico, Santa Fe.

Warren, A. Helene
1977 Source Area Studies of Pueblo I-III Pottery of Chaco Canyon, 1976-1977. Ms. on file, Laboratory of Anthropology, Santa Fe, New Mexico.

Weaver, Donald E., Jr.
1978 *Prehistoric Population Dynamics and Environmental Exploitation in the Manuelito Canyon District, Northwestern New Mexico.* Unpublished Ph.D. dissertation, Arizona State University, Tempe.

White, Tim
1989 Mancos: Prehistoric Cannibalism in the American Southwest. Manuscript under review.

Windes, Thomas C.
1977 Typology and Technology of Anasazi Ceramics. In *Settlement and Subsistence along the Lower Chaco River: The CGP Survey,* edited by Charles A. Reher, pp. 279-369. Office of Contract Archeology, Department of Anthropology, University of New Mexico, University of New Mexico Press, Albuquerque.

1981 *A View of Cibola White Ware from Chaco Canyon.* Division of Cultural Research, National Park Service, Albuquerque.

APPENDIX 1. CERAMIC ANALYSIS FORMAT FOR BULK STUDY

Provenience

Grid North (1-3)
Grid East (4-6)
Feature (7)
Stratum (8)
Level (9)
Specimen number (10-12)
Artifact number (13-14)

Type (15-16)

Utility Wares

1. Plain Gray
2. Wide Neckbanded
3. Narrow Neckbanded
4. Neck Corrugated
5. PII Corrugated
6. PII-PIII Corrugated
7. PIII Corrugated
8. Chuska Plain
9. Chuska Banded
10. Chuska PII Corrugated
11. Chuska PII-PIII Corrugated
12. Chuska PIII Corrugated
13. Mesa Verde Utility
14. Unidentified Utility Ware
15. Undeterminate Gray Smudged
16. Undeterminate Black-on-gray

White Wares

Cibola Series

26. Gallup/Red Mesa
27. Puerco/Gallup
28. Puerco Style Black/gray
29. Undeter. mineral white/corrugated
30. White Mound
31. Kiatuthlanna/Red Mesa
32. Red Mesa
33. Escavada
34. Puerco
35. Gallup
36. Chaco
37. Undeter. mineral
38. Undeter. carbon
39. Undeter. white

Chuska Mineral

40. Taylor
41. Brimhall
42. Undeter. Chuska mineral

Chuska Carbon

43. Tunicha
44. Newcomb
45. Burnham
46. Chuska
47. Toadlena
48. Nava
49. Crumbled House
50. Undeter. Chuska Carbon

Exotics

71. Reserve
72. Klagetoh
73. Mancos
74. McElmo
75. Mesa Verde

Red Wares

80. Deadmans B/r
81. Sanostee R/o, B/r
82. Puerco B/r
83. Wingate B/r
84. Wingate Polychrome
85. St. Johns Polychrome
86. St. Johns B/r
87. Tusayan B/r
88. Und. smudged red ware
89. Und. red ware
90. Plain red ware

Vessel Portion

Open

1. Bowl
2. Ladle (undeter.)
3. Ladle (gourd)
4. Ladle (tubular)

Closed

9. Undifferentiated jar
10. Small jar
11. Large jar
12. Pitcher
13. Olla
14. Seed jar
15. Canteen
16. Mug
17. Pipe
18. Undeter. vessel form

Miscellaneous

20. Miniature bowl
21. Miniature jar

Vessel Form

1. Rim
2. Neck
3. Body
4. Base
5. Handle strap vertical
6. Handle strap horizontal
7. Lug handle
8. Single coil
9. Double coil
10. Undeter. vessel portion
11. Ladle handle
12. Braided handle

Temper

1. Sand
2. Sandstone
3. Sherd
4. Sherd and sand/sandstone
5. Trachyte
6. Sherd and trachyte
7. Crushed igneous rock
8. Crushed sandstone with chalcedonic cement
9. Sand and clay pellets
10. Hematitic sand

Sooting

1. Present
2. Absent

DETAILED CERAMIC ANALYSIS FORMAT

Gray Wares and White Wares

Temper grain size (40)

1. Fine <.25 mm
2. Medium .25-.75 mm
3. Coarse .75-1.25 mm
4. Very coarse >1.25 mm

Temper density (41)

1. < 5%
2. 5-10%
3. 10-20%
4. 20-30%
5. 30-40%
6. > 40%

Paste texture (42-43)

1. Fine hard
2. Coarse hard
3. Fine friable
4. Coarse friable
5. Vitreous fine
6. Vitreous coarse
7. Coarse soft
8. Fine soft

Paste color (44)

1. White
2. Black
3. Light gray
4. Dark gray
5. Tan
6. Brown
7. Orange
8. Red
9. Cream

Core (45)

0. Absent
1. Diffuse edges, wide (>1/2)
2. Diffuse edges, narrow (<1/2)
3. Distinct edges, wide
4. Distinct edges, narrow

Decoration (46-47)
0 = Undetermined

Bands

1. Irregular bands
2. Regular bands
3. Clapboard
4. Tooled bands

Corrugated

5. Oblique, finger, right
6. Oblique, finger, left
7. Oblique, tooled, right
8. Oblique, tooled, left
9. Vertical, finger, right
10. Vertical, finger, left
11. Vertical, tooled, right
12. Vertical, tooled, left
13. Zoned, 5
14. Zoned, 6
15. Zoned, 7
16. Zoned, 8
17. Zoned, 9
18. Zoned, 10
19. Zoned, 11
20. Zoned, 12
21. Smeared, right
22. Smeared, left
23. Undeter. zoned
24. Plain
25. Indeter. smeared
26. Undeter. oblique, finger
27. Undeter. vertical, finger
28. Smeared, tooled, banded
29. Tooled, vertical incised
30. Oblique and vertical, left
31. Smeared and ridged, left
32. Clapboard, vertical incised

Length of rim, mm (48-50)

Orifice diameter, mm (51-53)

Rim fillet width, mm (54-55)

Width of three coils, mm (56-57)

DETAILED CERAMIC ATTRIBUTE ANALYSIS

White Wares

Paint Color (58)

0. Absent
1. Black
2. Brown
3. Red-brown
4. Dark gray
5. Ghosted/over-fired
6. Ghosted/glazed
7.
8.
9. Eroded

Paint texture (59)

0.
1. Thick
2. Washy
3. Glazed
4. Ghost
5. Eroded

Slip location (60)

0. Absent
1. Interior
2. Exterior
3. Interior/exterior
4. Slip slop bowl
5. Slip slop jar
6. Floated interior
7. Floated exterior
8. Floated interior/exterior

Slip color (61-62)

0. Absent
1. Flat white
2. Lustrous white
3. Yellowish
4. Grayish
5. Tan
6. Red
7. Red interior/cream exterior

Slip texture (63-64)

0. Absent
1. Smooth and creamy
2. Thin, washy, and streaky
3. Crackled
4. Eroded
5.
6.
7.
8.
9. n/a

Polish quality and location (65)

0. Absent
1. High interior/exterior
2. High interior
3. Medium interior
4. Low interior
5. High jars
6. Medium jars
7. Low jars
8. Interior/exterior medium
9. Eroded

Design primary element (66-67)

0. Indeterminate
1. Triangle
2. Broad lines--zig-zag
3. Pendant triangles, feathers
4. Broad lines, indeter.
5. Broad lines spiral
6. Curvilinear parallel lines
7. Rectilinear parallel lines
8. Broad lines triangles/opposed
9. Indeter. solid
10. Pendant triangles/opposed
11. Broad parallel lines
12. Contiguous triangles
13. Checkerboard 90%
14. Chevrons opposing
15. Medium width parallel lines
16. Diagonal crisscross
17. Broad horizontal band
18. Polka dots
19. Parallel diagonal lines, narrow
20. Negative opposing ovals
21. Curvilinear broad lines
22. Broad zig-zag
23. Opposed hatchured solid elements

Primary filler (68-69)

1. Diagonal hatchure "B"
2. Solid
3. Parallel Hatchure "A"
4. Parallel Hatchure "B"
5. Negative Squares
6. Hatchure "C" very fine diagonal

Primary elaboration (70-71)
1. Ticked
2. Solid tips
3. Sawtooth
4. Claws
5. Spiral

Design secondary element (72-73)
1. Diagonal dividers, parallel
2. Parallel, narrow, horizontal lines
3. Diagonal parallel lines, narrow
4. Broad line, curvilinear
5. Broad horizontal line
6. Rectilinear medium lines
7. Triangles
8. Broad line rectilinear
9. Indeterminate
10. Parallel medium width lines
11. Horizontal and vertical lines, parallel
12. Vertical parallel, narrow

Design secondary filler (74-75)
1. Solid
2. Negative horizontal diamonds
3. Ticks

Design secondary elaboration (76-77)
1. Ticked

Rim Decoration (78)
1. Solid line
2. Eroded
3. Plain
4. Ticks

APPENDIX 2. DEBITAGE ANALYSIS FORMAT

Grid N (1-3)
Grid E (4-6)
Feature number (7)
Strat. number (8)
Level (9)
Specimen number (10-12)
Artifact number (13-14)

Material (15-17)

10 chert
11 Washington Pass
12 Chinlee
13 Brushy Basin
14 fossiliferous
15 clastic
16 oolitic
20 silicified wood
21 yellow wood
22 chalcedonic
23 palm wood
30 chalcedony
40 quartzite
41 fine-grained
42 coarse-grained
50 igneous
51 basalt
52 vesicular basalt
53 andesite
54 rhyolite
55 diorite
56 granite
57 obsidian
60 sandstone
61 cobble
62 massive
70 metamorphic
71 gneiss
72 schist
73 metasiltstone
80 limestone
90 siltstone
100 gypsum
102 calcite

Material color (18-19)

1 clear
2 white
3 gray
4 black
5 light brown
6 dark brown
7 cream
8 yellow
9 orange
10 green
11 blue
12 red
13 pink
14 gray green
15 green brown
16 purple
17 red gray
18 red brown

Measurements

Length mm (20-22)
Width mm (23-25)
Thickness mm (26-28)
Weight gm (29-31)

Debitage type (32)

1 flake
2 small angular debris
3 bipolar flake

Flake type (33)

0 n/a (small angular debris)
1 core
2 biface
3 scraper
4 undetermined tool
5 blade
6 undetermined core/tool
7 cobble uniface flake
8 cobble biface flake

Condition (34)

0 angular debris
1 whole flake
2 proximal fragment
3 midsection
4 distal fragment
5 undetermined fragment
6 lateral fragment

Cortex (35)

0 absent
1 platform only
2 dorsal only
3 platform and partial dorsal
4 platform and 100% dorsal
5 present (for angular debris)

Platform kind (36)

0 absent
1 cortical
2 faceted
3 unidirectional retouch
4 bidirectional retouch
5 collapsed
6 battered
7 n/a (angular debris)
8 retouched
9 abraded

Number of modified edges

Edge number 1 (37); 2 (45); 3 (53); 4 (61)

Retouch 1 (38); 2 (46); 3 (54); 4 (62)

0 absent
1 unidirectional dorsal debris
2 unidirectional ventral
3 bidirectional

Edge outline 1 (39); 2 (47); 3 (55); 4 (63)

1 straight
2 concave
3 convex
4 straight/concave
5 straight/convex
6 flat (abraded surface)
7 concave/convex

Serration 1 (40); 2 (48); 3 (56); 4 (64)

0 absent
1 present

Edge angle 1 (41-42); 2 (49-50); 3 (57-58); 4 (65-66)

0 projection
edge angle

Type of damage 1 (43); 2 (51); 3 (59) 4 (67)

0 absent	4 bidirectional rounding
1 unidirectional scarring	5 1/3
2 bidirectional scarring	6 2/4
3 unidirectional rounding	7 abraded/ground

Projection 1 (44); 2 (52); 3 (60); 4 (68)
0 absent
1 rotary (drill)
2 edge (graver)

APPENDIX 3. HUMAN REMAINS INVENTORY FORMS

Project No.: 41.401
Project Name: Burned Death Wash
Site No.: LA 59497
Site Name:
Field Specimen No.: 404
Provenience:
Feature: 2, Burial

Inventoried: one adult female approximately 23 yrs of age

Sex Estimation: Female

1. Brow ridge - very slight
2. Upper edge of orbital - intermediate
3. Posterior zygomatic - extended crest
4. Mastoid processes - large
5. Occipital muscle ridges - prominent
6. Chin - square
7. Pelvis - sciatic notch intermediate
8. Pelvis - sacroiliac joint male
9. Pelvis - subpubic angle - narrow
10. Sacrum - flat - female

Age Estimate:
1. Occlusal wear pattern on upper right maxillary dentition - 25-35 years
2. Pubic symphysis (III-1, Brothwell 1981:69, fig. 3.7) - 23 years
3. Sacrum - fused with fissures present between first two vertebral bodies.

Racial Estimate: Mongoloid (Native American)
Incisors slightly shoveled
Inferior zygomatic projection
Nasal bone projection

Cranium
Craniometrics-
Max. cranial length: 167.5 mm
Max. cranial breadth: 140.0 mm
Basion-bregma ht: 131.0 mm
Minimum frontal breadth: 91.0 mm
Upper facial ht: 78.0 mm
Nasal ht: 44.9 mm
Nasal breadth: 21.3 mm
Bizygomatic breadth (facial width): not possible
Orbital ht: 31.0 mm
Orbital width: 39.5 mm

Cranial Inventory-
Unhealed perforation at the right parietal, lambdoidal suture line near the sagittal suture that was partially obliterated by the missing right parietal and occipital fragments. The perforation evidence is generally triangular in form and measured approximately 7 mm in width. (Probable cause of death.)

The cranium exhibits slight flattening in the posterior parietal/occipital region (cradle board deformation). The posterior right parietal and upper right occipital are missing. The left zygomatic and maxilla are also fragmented with all teeth and maxillary fragments present. The sutures are partially obliterated on the endocranial aspect.

Mandible-
Mandible broken transversely at the left lateral incisor. The left mandibular canine and 1st premolar are dislodged but present. The lateral incisors exhibit some shoveling. The left half of the mandible is heavily weathered. Both condyles and the left coronoid process are missing. Symphysis ht: 32.5 mm; Ascending ramus ht: 60.2 mm. No other measurements possible.

Vertebrae-

Cervical-
All seven are present, in excellent condition, and exhibit complete fusion.

Thoracic-
Numbers 1 through 11 are present, in excellent condition, and exhibit complete fusion. Centrums have some resorption of the compact tissue table.

Lumbar-
Numbers 3, 4, and 5 are present, in excellent condition, and fully fused. All centrums display some resorption of the compact tissue table.

Sacrum-
Complete (no coccygeal vertebrae), 2 through 5 fused with fissures between 2 and 3, and 3 and 4 still present. Sacral breadth: 114.0 mm; Sacral ht: 119.0 mm; Sacral Index: 95.8 mm

Age estimate: approximately 25 years

Sternum-
Superior fragment of the corpus sterni present.

Scapula-
Right: Vertebral border eroded away, fully fused.
Left: Slight plate erosion, completely fused.
L scapula breadth: 97.0 mm; L scapula length: 135.0 mm
L glenoid cavity length: 31.0 mm
Scapular Index: 71.8 mm

Clavicle-
Right: Sternal epiphysis unfused, ends slightly eroded.
Left: Sternal epiphysis unfused, ends slightly eroded.
Age estimate: 23 years

Rib-
Right: 12 present; 9 ribs are complete and in excellent condition. Three (3) are slightly eroded and fragmentary.
Left: 11 present; all with fragmented ventral ends and slight to moderate erosion.

Humerus-
Right: complete, excellent condition, both epiphyses fused, line present around proximal.
Length: 30.9 cm.
Max. diameter shaft: 2.5 cm. Min. diameter shaft: 1.5 cm
Max. diameter of head: 3.5 cm
Least circumference: 5.5 cm
Left: complete with damage to proximal lateral epiphysis. Element displays moderate erosion at epiphyses and midshaft.
Length: 29.9 cm
Max. diameter shaft: 2.1 cm. Min. diameter shaft: 1.6 cm
Max. diameter of head: 3.5 cm
Least circumference: 5.5 cm
Age Estimate: 23-25 years
Sex Estimate: Humeral head-female

Radius-
Right: Distal end missing, excellent condition, proximal epiphysis fused with line present.
No length possible.
Left: Fragmentary distal and shaft + proximal fragments. Distal epiphysis fused with line present.
No length possible.

Ulna-
Right: Distal end missing, proximal epiphysis completely fused. The bone is in excellent condition.
Max. length: (est.) 25.0 cm.
Left: Complete but broken and slightly eroded proximal end. Both epiphyses fused distal epiphysis with line present.
Max. length: 25.2 cm.
Least circumference: 3.0 cm.

Innominate-
Right: Fragment of pubis and ilium only.
Left: Damage to inferior ilium, nearly complete.
Union of the iliac and ischial epiphyses nearly complete.
Age Estimate: 22-24 years

Femur-
Right:
Femur head broken off but present. Distal end eroded with partial epiphysis present.
Circumference: 7.1 cm. Length: (est.) 42.0 cm
Vertical dia. femur head: 3.8 cm
Ant/post. dia.: 2.5 cm. Mediolat. dia.: 2.1 cm
Left: Complete, eroded slightly at epiphyseal junctures, lines still present.
Circumference: 7.2 cm. Length: 41.9 cm.
Vertical dia. femur head: 3.65 cm.
Ant/post. dia.: 2.6 cm. Mediolat. dia.: 2.1 cm.

Bicondylar width: 6.8 cm.

Sex Estimate: Vert. diameter of femur head - female
Stature Estimate: 2.59(41.9 cm) + 49.742 $\pm$ 3.816
mean = 158.26 cm - 2.5 cm = 155.76 cm = 61.32 in = 5 ft 1 in

Tibia-
Right: Damage to both proximal and distal ends but nearly complete with proximal epiphysis separated but present. Both epiphyses are completely fused.
Circumference: 8.7 cm. Length: (est.) 36.0 cm.
Ant/post. dia.: 3.2 cm. Mediolat. dia.: 2.1 cm.
Left: Complete with slight damage to the proximal end. Epiphyses are completely fused with no line.
Circumference: 8.5 cm. Length: 36.6 cm.
Ant/post. dia.: 3.2 cm. Mediolat. dia.: 2.1 cm.

Age Estimate: 23 years
Sex Estimate: Circumference at foramen - female
Stature Estimate: 2.72(36.6 cm) + 63.781 $\pm$ 3.513
mean = 163.33 cm - 2.5 cm = 160.83 = 63.32 in = 5 ft 3 in

Fibula-
Right: Shaft only, both ends missing.
Left: Complete, good condition with ends slightly eroded. Both epiphyses are completely fused.
Length: 34.4 cm.
Age Estimate: 22+ years

Patella-
Right and left: Complete

Bones of the Hand-
Carpals-
Right and left: lunate
Right: navicular (partial)
Right: 1 through 5 metacarpals with 1 and 5 being partial
Left: 3, 4, and 5 metacarpal; 5 is just a fragment.
5 1st phalanges
2 2nd phalanges

Bones of the Feet-
Right and left: talus
Right and left: calcaneus
Right: cuboid
Right: navicular
Left: 2nd cuneiform
Left: 3rd cuneiform

35 fragments from disintegrated innominate and ribs that were not clearly identifiable.

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Human Remains Inventory Form

Project No.: 41.401
Project Name: Burned Death Wash
Site No.: LA 59497
Site Name:
Field Specimen No.: 405
Provenience:
Feature: 5, Burial

Inventoried: one adult male approximately 22 yrs of age

Sex Estimation: Male
1. Brow ridge - slight but present
2. Upper edge of orbital - blunt
3. Posterior zygomatic - extended crest
4. Mastoid processes - large
5. Frontal sinuses - large
6. Chin - square
7. Pelvis - sciatic notch narrow
8. Pelvis - sacroiliac joint male
9. Pelvis - subpubic angle - narrow

Age Estimate:
1. Mandibular 3rd molars both impacted and not erupted; slight polish on right 3rd molar cusp; 17-25 yrs
2. Maxillary wear pattern 2nd stage (25-35 yrs) but anomalous due to bite problems.
3. Medial epiphysis of both clavicles unfused; 22 yrs
4. Tibial and femoral epiphyses fully fused.

Racial Estimate: Mongoloid (Native American)
Incisors slightly shoveled
Inferior zygomatic projection
Nasal bone projection

Cranium -

Craniometrics-
Max. cranial length: (est.) 155 mm
Max. cranial breadth: 148 mm
Basion-bregma ht: 131.0 mm
Minimum frontal breadth: 91.0 mm
Upper facial ht: 78.0 mm
Nasal ht: 44.9 mm
Nasal breadth: 21.3 mm
Bizygomatic breadth (facial width): not possible
Orbital ht: 31.0 mm
Orbital width: 39.5 mm

Cranial Inventory-
Posterior parietals and most of occipital missing. There are numerous fragments of the posterior skull present but they could not be refitted. The parietal regions still intact, suggest some cradle board deformation. The sphenoid and condyles are broken off but present. All sutures are fused with some obliteration endocranially.

The maxilla and palatine area of this individual is unusually small and crowded. The palatine region is more concave due to this crowding, which has also produced dental anomalies. All teeth are permanent and fully erupted but very crowded. This crowding has produced a rotation of the 1st and 2nd premolars on the right side of the palate, so that these teeth are positioned on a buccal/lingual plane. The dental wear pattern is anomalous due to this crowding with both maxillary M1s exhibiting extreme wear on the lingual aspect. The central incisors of this individual appear to have been extracted at or near the time of death; there is no apparent tissue resorption. The posterior skull was eroded but the anterior is in excellent condition.

Palate length: internal - 46.5 mm; external - 54.0 mm
Palate breadth: internal - 42.5 mm; external - 64.0 mm

Mandible-
The mandible is small and wide with crowded dentition. The 3rd molars are impacted and unerupted with a small amount of polish on the posterior cusp of the right 3rd molar. The left central incisor and the right 1st premolar appear to have been extracted near the time of death; again there is a lack of any tissue resorption. The mandible as a whole is in excellent condition.

Bicondylar breadth: 12.1 cm; Bigonial breadth: 10.1 cm
Symphysis ht: 3.5 cm

Vertebrae-
Cervical: All 7 present, spinal processes eroded. Vertebral arch on #6 is broken off but present. No lipping is evident.
Thoracic: All 12 are present but heavily eroded. Most of the vertebral arches are eroded or absent.
Lumbar: All 5 are present but heavily eroded. Only centrums with partial transverse processes remain.
Sacrum: Only part of the 1st and 2nd sacral vertebrae are present and no measurements were possible. Coccygeal vertebrae are completely absent.

Scapula-
Right and left are present. Most of the body and vertebral border of both are eroded away. No measurements of length or breadth were possible.
LA 59497 FS# 405

Right Glenoid cavity length: 39.0 cm. (Male)

Clavicle-
Right and left are complete.
Both are in excellent condition; sternal epiphyses are unfused.

Rib-
Right: 10 present; 7 are fairly complete, 3 are shaft only.
Left: 10 present; 7 are complete but broken and eroded, 3 are shaft only.

Humerus-
Right: The proximal head is eroded and separated; distal is also eroded. Both ends were fused completely. Length was not possible.
Max. dia.: 2.0 cm. Min. dia.: 1.6 cm.
Max. dia. of head: 4.0 cm.
Left: The distal end is eroded and broken; proximal end is fused with line present. The entire bone is slightly eroded with some purple staining on the shaft.
Max. dia.: 1.8 cm. Min. dia.: 1.4 cm.
Max. dia. of head: 4.1 cm.

Radius-
Right: Complete, fused both ends with line present on distal; ends are eroded.
Max. length: 24.1 cm.
Left: Complete, fused both ends with heavily eroded epiphyses.
Max. length: 24.1 cm.

Ulna-
Right: Complete, both epiphyses fused with line present; distal end slightly eroded.
Max. length: 25.8 cm.
Left: Complete, both epiphyses fused with line present; erosion at both ends.
Max. length: 25.7 cm.

Innominate-
Right: Eroded anterior and iliac spine with slight red staining in spots (root concentrations).
Age Estimate:
Iliac crest not fully fused - 21-22 yrs
Pubic symphysis - 20-21 yrs.
Max. length: 23.5 cm. Max. breadth: not possible
Left: The element is heavily eroded with approximately 50% of the ilium missing. A few of the ilium fragments are present but could not be refitted.
No measurements were possible.

Femur-
Right: Complete with slight to moderate erosion. Epiphyses are fully fused; femur head still has line present. Root staining present on shaft.
Circumference: 8.1 cm. Length: 44.4 cm.
Max. dia. head: 4.3 cm.
Ant./post. dia.: 2.7 cm. Mediolat. dia.: 2.6 cm.
Left: Complete with damaged and heavily eroded ends. Heavily root stained.
Circumference: 8.1 cm. Length: 44.8 cm.
Max. dia. head: 4.3 cm.
Ant./post. dia.: 2.6 cm. Mediolat. dia.: 2.5 cm.

Stature Estimate: 2.59(44.8 cm) + 49.742 $\pm$ 3.816
mean = 165.77 cm - 2.5 cm = 163.27 = 64.28 in = 5 ft 4 in

Patellae: absent

Tibia-
Right: Complete, fused both ends with proximal slightly eroded; purple to black root staining.

Circumference: 8.5 cm. Length: 38.2 cm.
Ant./post dia.: 3.25 cm. Mediolat. dia.: 2.1 cm.
Left: Complete, fused both ends with proximal end slightly eroded; purple to black root staining on shaft.
Circumference: 8.6 cm. Length: 38.4 cm.
Ant./post dia.: 3.3 cm. Mediolat. dia.: 2.2 cm.

Age Estimate: Complete epiphyseal union - Approx. 23 years
Stature Estimate: 2.72(38.2 cm) + 63.781 $\pm$ 3.513
mean = 167.68 cm - 2.5 cm = 165.185 = 65.03 in = 5 ft 5 in

Fibula-
Right: Complete with both epiphyses fused, all slightly eroded.
Length: 36.8 cm.
Left: Complete with both epiphyses fused and heavily eroded.
Length: Not possible

Bones of the Hand:
Right: carpals - navicular, lunate, multangular, lesser multangular, and capitate; all moderately eroded.
1st metacarpal fragment
2nd metacarpal
Unsided - 1st phalange, digit one.

Bones of the Foot:
Right and left - talus

Right and left - calcaneus
Left - navicular
Left - 1st cuneiform
Left - 3rd metatarsal
Left - 4th metatarsal
Unsided - 1 1st phalange
Unsided - 1 2nd phalange

OFFICE OF ARCHAEOLOGICAL STUDIES
Human Remains Inventory Form

Project No.: 41.401
Project Name: Burned Death Wash
Site No.: LA 59497
Site Name:
Field Specimen No.: 331
Provenience:
Feature: 4, Burials

Inventoried: Individual #1 - adult female approximately 39-44 yrs of age

Vertebrae-
Lumbar: Fragments of the vertebral arches of all 5 with centrums occurring as unidentifiable fragments.
Sacrum: Vertebrae 2 through 5 and part of one are present. Element heavily eroded. There is a moderate amount of arthritic deformation on the dorsal aspect.
No measurements are possible.

Rib-
Right: 6 rib fragments eroded and broken.
Left: 2 ribs broken but almost complete.
2 rib fragments.
2 rib fragments that appear to have been split along an oblique plane.

Radius-
Left: Distal posterior fragment with fully fused epiphysis. Evident canid bite marks and gnawing.

Innominate-
Right: Fragmentary ilium and acetabulum with partial ischium; no evident pathologies.
Left: Fairly complete, pubis fragmented but present; epiphyses are completely fused.
Max. length: 23.5 cm. Max. breadth: 14.1 cm.

Age Estimate: pubic symphysis - 39-44 years

Femur-
Right: Proximal end and diaphysis present with part of distal end. Completely fused with no obvious pathologies.
Ant./post dia.: 2.2 cm. Mediolat. dia.: 2.5 cm.
Vertical dia. of femur head: 4.1 cm. (female)

Patella-
Right: Medial aspect present; heavily eroded.

Bones of the Hand-
1st phalange- complete, not sided

Unidentified fragments - Most of these are from the vertebral centrums and ribs. Approx. 75.

Inventoried: Individual #2 - adult female approximately 23 years of age.

Vertebrae-
Lumbar: Spinal process fragment and a vertebral arch fragment that could not be refitted.
Sacrum: The ventral aspect of the 3rd sacral vertebra plus part of the dorsal aspect that is heavily eroded and stained purple. The ventral portion is very flat (female) and exhibits evidence of fusion (approx. age 23).

Rib-
7 shaft fragments, all heavily eroded.

Innominate-
Not sided - Iliac crest fragment fused with line present.

Inventoried: Individual #3 - adult male (no age possible)

Cranial Fragments-
Left mastoid - large (male) with impact fractures at the superior border.
Left zygomatic and anterior temporal fragments which exhibit evidence of splitting.
Left parietal and occipital fragments (8) - three of these were conjoinable and appear to have been split above the occipital protuberance. Three of the other fragments also display evidence of perimortem splitting.

Inventoried: Individual #4 - probable male (no age possible)

Cranial fragments-
Left: Superior orbital which is weathered white and eroded. The superior border is blunt (male). The lateral fracture line is very straight and appears to have been produced by a splitting of the bone across a thick tissue table.

5 cranial fragments, weathered white that could not be refitted.

2 long bone fragments, weathered white.

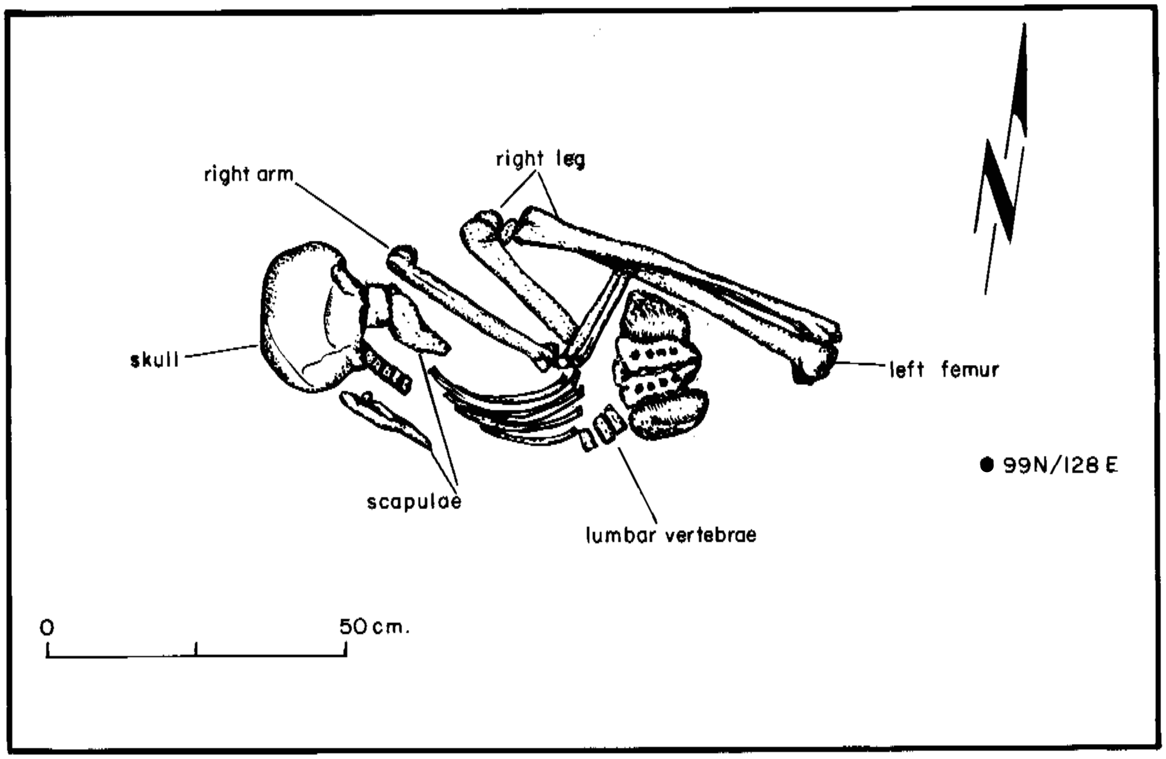

Figure A3.1. Plan view of Feature 2.

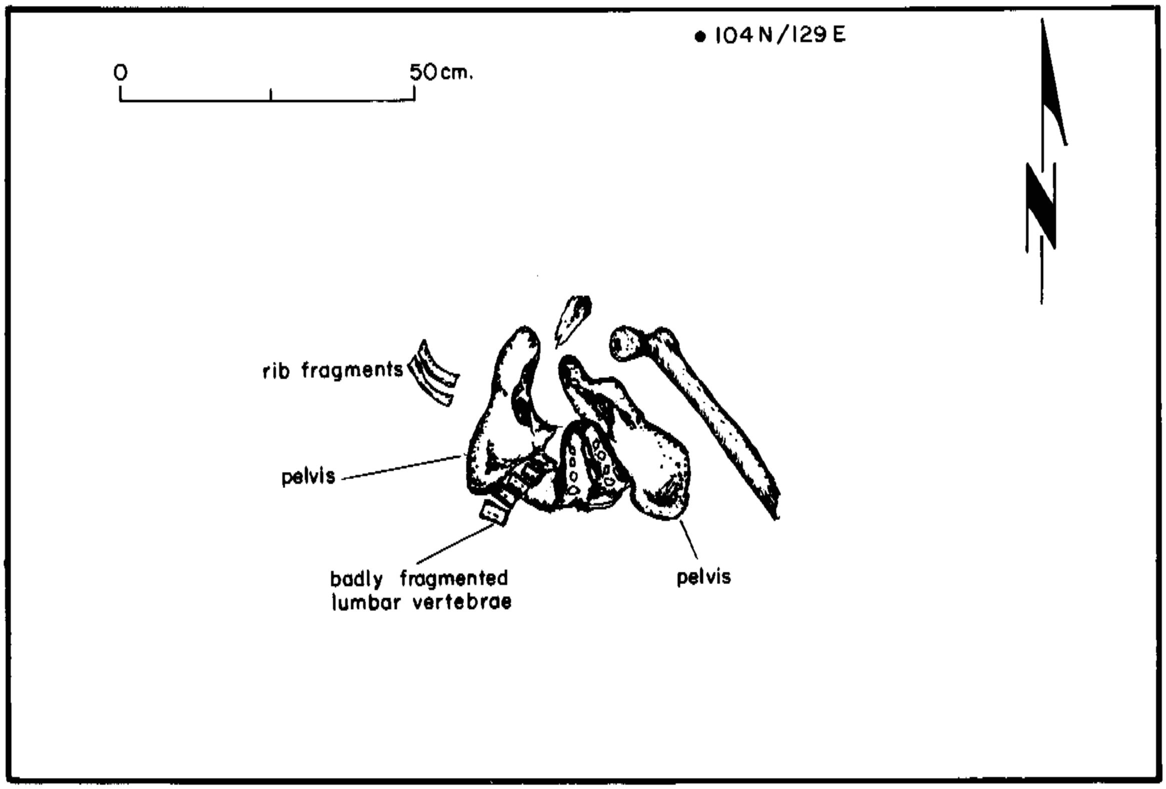

Figure A3.2. Plan view of Feature 4.

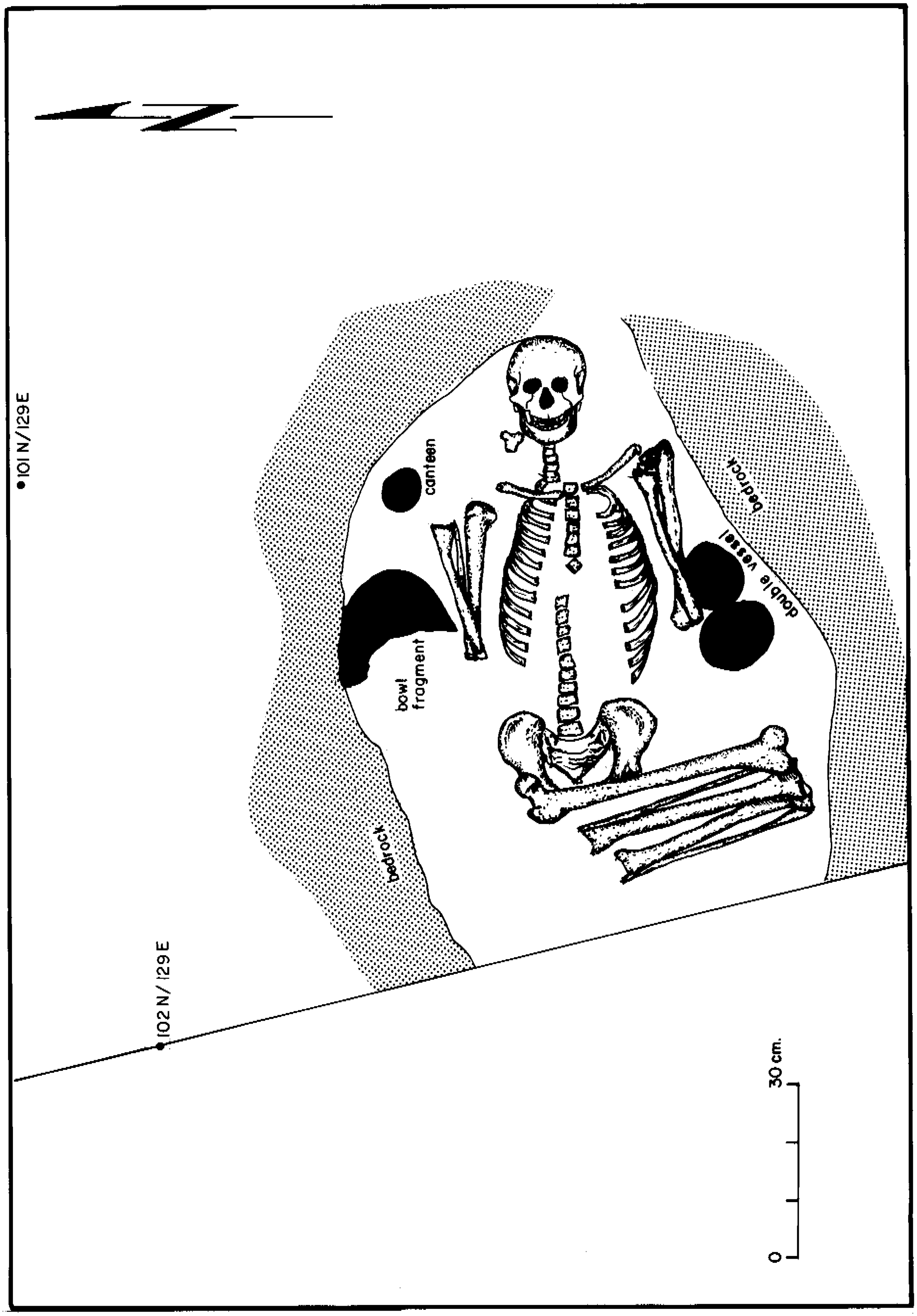

Figure A3.3. Plan view of Feature 5.

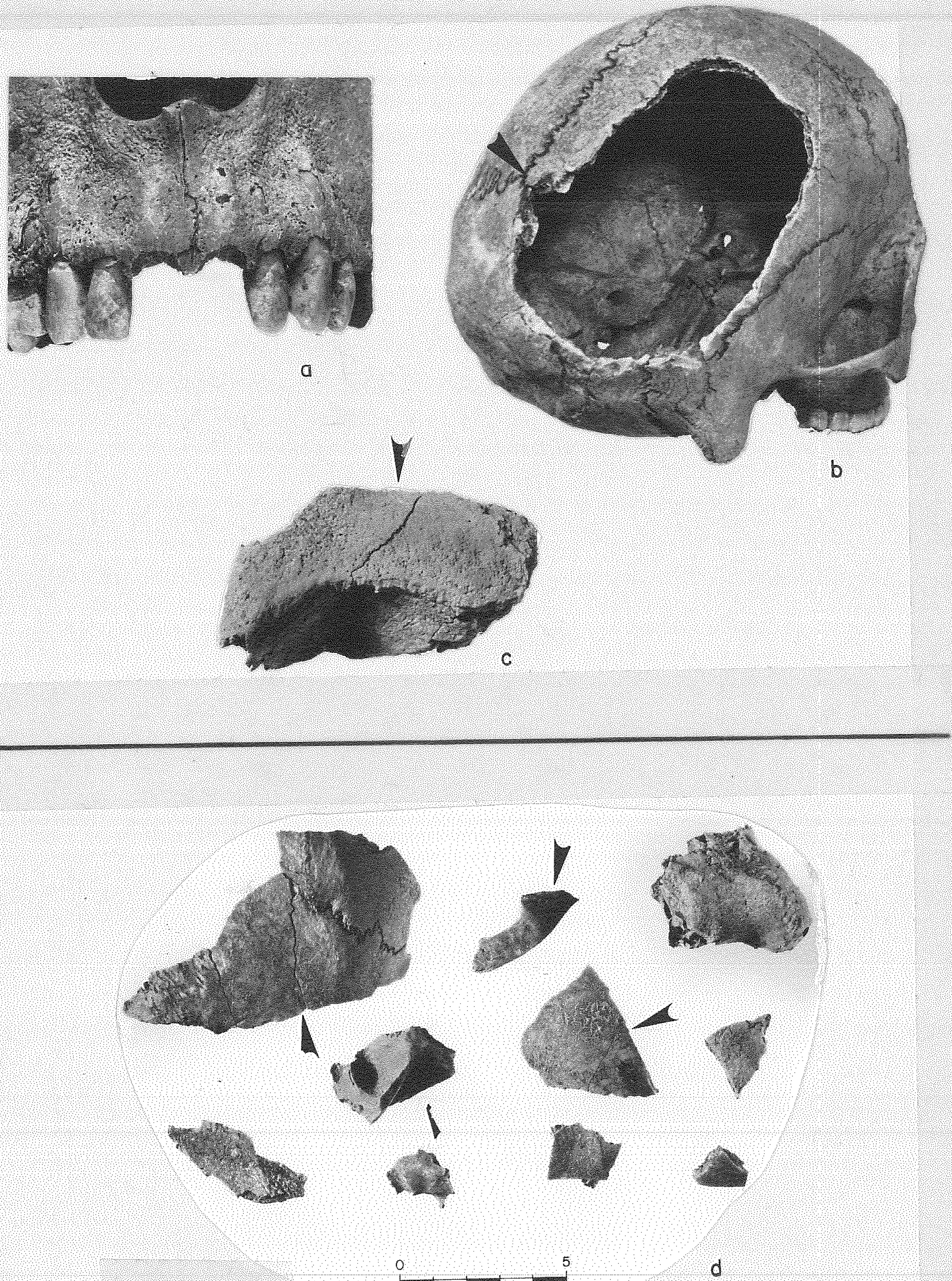

Figure A3.4. Skeletal anomalies from Features 2, 4, and 5; (a) Feature 5; male with evidence of evulsion of maxillary incisors; (b) Feature 2; female with perforation at the parietal-occipital juncture; (c) Feature 4, Individual 4; apparent impact mark on adult male orbital; (d) Feature 4, Individual 3, adult male cranial fragments; arrows indicate apparent impacts to skull.

APPENDIX 4. POLLEN ANALYSIS OF LA 59497

Richard G. Holloway[1]

Introduction

Ten samples were submitted for analysis to the Laboratory of Quaternary Studies at Eastern New Mexico University. The ten samples were collected from various features from LA 59497. The site consists of a 1-m high sandstone rubble mound with associated artifact scatter covering 1,000 square meters. The principal period of occupation is presumed to be between A.D. 1050 and 1150 based on a preliminary pottery analysis. Likewise, there may be an earlier occupation between A.D. 950 and 1050 (S. Post, pers. comm., 1988).

Methods and Materials

The soil samples were initially subsampled by removing 30 ml of soil from each sample for pollen extraction. Prior to pollen extraction, two tablets of concentrated *Lycopodium* spores were added to each 30 ml subsample. Pollen extraction procedures generally followed Faegri and Iversen (1975) and consisted of an initial treatment of HCl, which removed carbonate materials as well as releasing the *Lycopodium* spores from their bicarbonate matrix. The residue was treated in 70% cold HF overnight in order to remove the silicates. The small silicate particles and other inorganic compounds remaining after this treatment were removed using a heavy density separation of zinc chloride ($ZnCl_2$, S.G. 1.99-2.00). The light, organic fraction was removed by pipet, diluted until the specific gravity approached 1.0 and concentrated. The residue was dehydrated using an ethanol series and safranin stain was added at this stage in order to more quickly identify the pollen and spores during the analysis phase. The residues were transferred to a mounting media of 1000 cs silicon oil with Tertiary Butyl Alcohol.

A drop of this residue was mounted on a microscope slide and routine examination of the residues were made at 400X magnification and the entire slide was counted to avoid the nonrandom distribution of palynomorphs on microscope slides (Brookes and Thomas 1967). A standard count of a least 200 grains was attempted for each sample as suggested by Barkely (1934). Results of the pollen analysis of these samples are presented in Table A4.1. Quantitative analysis of the data was performed using MVSP, a multivariate statistical package designed for the evaluation of vegetational data.

Results

One modern pinch sample (464) was collected upwind of the excavation units (Fig. A4.1). This assemblage was dominated by Cheno-am pollen (47%) and pine (31%). This particular sample had

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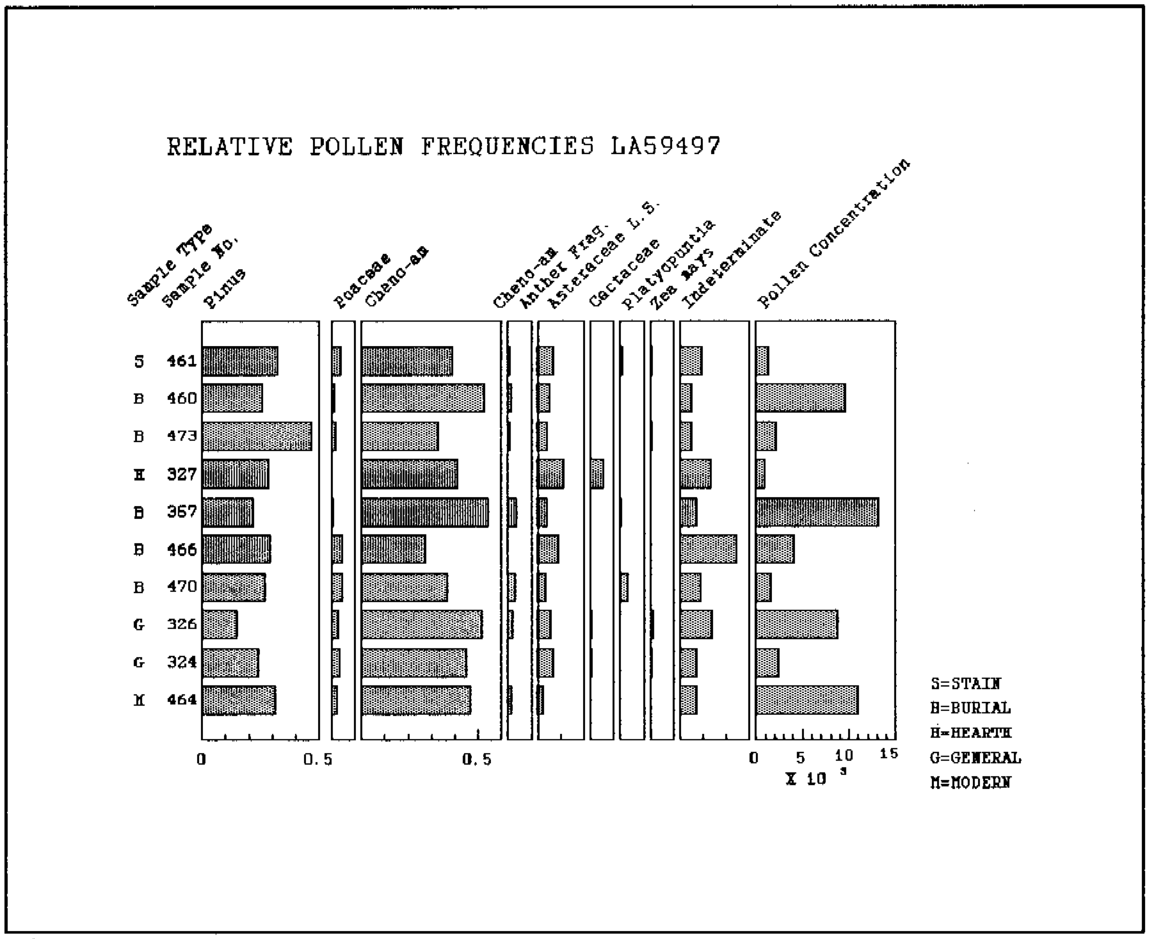

Figure 1

a wider diversity of taxa than many other samples but all remaining taxa were present in quantities less than 10%. The pollen taxa present in this single sample are all expected within the area.

Sample 461 was recovered from Feature 1 and is a stained area in Stratum 4 (cultural layer) from grid unit 104N/131E. This pollen assemblage was dominated by *Pinus* and Cheno-am pollen. Likewise there is a significant percentage (7%) of low spine Asteraceae pollen. However, the indeterminate pollen is somewhat high at 9.5%.

Feature 3 contained a hearth area and a sample was obtained from beneath a slab (327). Cheno-am pollen is dominant (41%) with *Pinus* (28%) and indeterminate pollen (13%) a close second. No Cheno-am anther fragments were recovered in this preparation. However, low spine Asteraceae and Cactaceae pollen were quite high.

Two samples (324,326) were used as controls from the grid unit 104N/132E from the cultural zone. Cheno-am pollen is quite high in both with somewhat reduced pine frequencies. Both produced small quantities of *Artemisia*, low spine Asteraceae, and Cactaceae. Both contained trace amounts of *Zea mays* pollen.

Table A4.1. Relative Pollen Frequencies, LA 59497

Sample	461	460	473	327	357	466	470	326	324	464
Type	S	B	B	H	B	B	B	G	G	M
Pine	0.324	0.260	0.466	0.283	0.218	0.292	0.270	0.149	0.242	0.312
Juniper	0.010	0.003			0.003		0.011	0.011	0.011	0.019
Quercus										
Populus		0.003			0.013		0.022	0.011	0.006	0.019
Ulmus	0.010						0.011			
Salix		0.009			0.008				0.028	0.006
Solanacea		0.019	0.005							
Fabaceae					0.003					0.003
Eriogonum		0.003	0.010		0.003					
Liliaceae		0.009	0.005		0.005					0.012
Rosaceae								0.005		0.003
Brassicac.										0.003
Lamiaceae	0.010									
Euphorb					0.003					
Poaceae	0.038	0.013	0.016		0.008	0.046	0.045	0.027	0.034	0.025
Cheno am	0.390	0.530	0.332	0.415	0.544	0.277	0.371	0.516	0.449	0.467
Cheno am anther	0.010	0.013	0.010		0.039		0.034	0.021		0.016
High spine		0.006			0.005	0.015			0.017	
Low Spine	0.067	0.050	0.041	0.113	0.044	0.092	0.034	0.059	0.067	0.025
Artemisia	0.019	0.013	0.010		0.008	0.015	0.022	0.037	0.017	0.003
Liguliflo		0.003				0.015				0.003
Platyopun	0.010				0.003		0.034			
Ephedra			0.005				0.022	0.005		
Cactaceae				0.057				0.005	0.006	
Cyperacea		0.009			0.003		0.022		0.011	
Typha								0.005		
Unknown	0.010	0.003	0.036		0.018		0.011		0.034	0.009
Indeter.	0.095	0.053	0.052	0.132	0.075	0.246	0.090	0.138	0.073	0.072
Zea mays	0.010		0.010					0.011	0.006	

S = stain; B = burial; H = hearth; G = general from cultural unit; M = modern

Five of the ten samples were recovered from burial associations (460, 473, 357, 466, and 470). Only one (473) contained *Zea mays* pollen and this was extremely low frequency. Cheno-am pollen was high in all samples but in 473, 466, and 470 dropped to below 40% whereas only in sample 473 did the pine pollen exceed 30%. Three of the five samples contained clumped pollen of Cheno-ams, which is thought to represent the deposition of whole anthers or flowers.

Discussion

A single sample (327) was obtained from beneath a slab within a hearth area. In general, this assemblage is not significantly different from the others and thus no definitive interpretation can be offered. This sample contained the highest percentages of both Cactaceae and low spine Asteraceae pollen, even though the percentages are still rather low. The presence of both taxa are consistent with an interpretation of this hearth as a possible cholla roasting pit. In their ethnoarchaeological study, Greenhouse and others (1981) noted low frequencies of both these taxa. Their samples for both flotation and palynological analyses were taken immediately after use and 1 year later. On the basis of their analysis they identified three pollen criteria: low pollen frequencies; possible aggregates of *Opuntia* pollen; and size variation of *Opuntia* pollen. Admittedly, the latter two criteria were not present from this investigation but this may be a factor of preservation. The low pollen frequencies, however, are entirely expected. According to Greenhouse and others (1981), the buds were preferentially selected prior to flowering. *Opuntia* is a zoophilous (insect pollinated) plant and thus produces far fewer pollen grains than do anemophilous (wind pollinated) plants. In fact, Bryant (pers. comm.) was able to recover only 2% *Opuntia* pollen from a surface sample collected in the middle of a flowering *Opuntia* plant.

In their analysis, Greenhouse and others (1981) reported that the macrobotanical remains provided more conclusive data for utilization than did pollen. Examination of the macrobotanical remains from this feature should strengthen this interpretation.

Sample 461 was taken from a shallow pit feature containing a charcoal stain. The sides of the pit were not charred thus inferring that the feature was used once or at most a few times. A small percentage of *Platyopuntia* pollen was recovered from this sample. *Platyopuntia* refers to the prickly pear group of the genus *Opuntia*. Again, there is nothing absolute in these frequencies but it is suggestive. It is possible that this feature likewise was used in roasting cactus plant parts for the same reasons as outlined above. The short-term use of this feature agrees well with the observations of Greenhouse and others (1981). Again, macrobotanical data would be important in determining the validity of this interpretation. It should be remembered that the inferred function from both samples is highly subjective and based on the pollen data cannot be more than suggestive.

General from Stratum 4: Cultural Unit

Two samples (324, 326) were taken from arbitrary levels from within Stratum 4, which is primarily a cultural unit consisting of a prehistoric sheet trash deposit. Based on the pollen assemblages recovered from this stratum there is no great discrepancy in the assemblages. Both appear to have been recovered from the same assemblage. Although minor variations occur among the taxa (Table A4.1), none are deemed significant. Both, however, contained traces of corn *(Zea mays)* pollen. This would be entirely expected due to its deposition as a trash deposit. The presence of corn in these areas is therefore not considered significant.

Burials

Five of the ten samples analyzed were recovered from burial contexts. These burial samples varied quite considerably and as such no direct comparisons could be made. Three statistical tests were employed to test the null hypothesis that the pollen assemblages recovered from burial contexts were significantly different from the control samples recovered from the sheet trash deposit.

First, the five samples from burials were grouped and compared to the two samples from the sheet trash. The results of this analysis are presented in Table A4.2, which provide summary statistics and the analysis of variance for each pollen type. Many of the minor taxa contained no variance and thus could not be directly compared. Of those which could, none were statistically significant.

Since the burial samples contained assemblages taken from two contexts: in association with human remains (pelvis or skull), and two samples in association with a vessel; I next compared only those in association with human remains with the control samples. Again, many of the pollen taxa exhibited no variance and only Poaceae (grass) proved to be significant at the .05 level.

Finally, the burial samples themselves were grouped by vessel vs. human bone associations and compared. Many of the pollen taxa again exhibited no variance and again only Poaceae pollen was significant at the .05 level.

On the basis of the three statistical tests, I concluded that there was no statistical difference between the samples recovered from the burial associations and those recovered from the general cultural deposit. This is due in part to the selection of the samples. The two samples recovered from the cultural strata and which were used as control samples were taken several units removed from the burial locations. In order to be effective, control samples should be taken from the same unit as the burial. In this way, it could be demonstrated that the burial pollen assemblages either were or were not sufficiently distinct as to allow identification. This would have permitted possible identification of graveside ritual use of plants. However, without this control, it is speculative.

Likewise additional samples are required from the vessel. A sample collected either at the base or immediately along the sides could be compared with the vessel fill and in some cases it is possible to assign vessel function. This technique was pioneered during the excavation of Antelope House by Bryant and Morris (1986). In this case, they were able to assign possible use to various vessels only after the possibility of contamination had been ruled out. The authors used a simple Chi-square test for homogeneity of the samples between fill and bottom samples (Bryant and Morris 1986).

In spite of the difficulty in demonstrating a statistically significant difference between cultural samples and the controls, some subjective interpretations may be possible. Several pollen types, which appear as trace percentages in these assemblages, are known to have been utilized economically by prehistoric inhabitants of the Southwest. This is not to say that all taxa with small percentages were utilized in this manner but rather only that the possibility exists. As a result, it would prove beneficial at this point to examine potential economic plant usage of members present in the pollen assemblage. These data are included in Table A4.3 and are drawn from various sources from the Southwest.

Table A4.2. Statistical Results, LA 59497

The following results are for:
Label = Burials

Total observations: 5

	Pine	Juniper	Populus	Ulmus	Salix
N of cases	5	5	5	5	5
Mean	0.301	0.003	0.008	0.002	0.003
St. dev.	0.096	0.005	0.010	0.005	0.005

	Solanaceae	Fabaceae	Eriogonum	Liliaceae	Rosaceae
N of cases	5	5	5	5	5
Mean	0.005	0.001	0.003	0.004	0.000
St. dev.	0.008	0.001	0.004	0.004	0.000

	Brassicaceae	Lamiaceae	Euphorbiaceae	Poaceae	Cheno-am
N of cases	5	5	5	5	5
Mean	0.000	0.000	0.001	0.026	0.411
St. dev.	0.000	0.000	0.001	0.018	0.120

	Cheno-am anther fragment	hs Asteraceae	ls Asteraceae	Artemisia	Liguliflorae
N of cases	5	5	5	5	5
Mean	0.019	0.005	0.052	0.014	0.004
St. dev.	0.017	0.006	0.023	0.005	0.007

	Platyopuntia	Ephedra	Cactaceae	Cyperaceae	Typha
N of cases	5	5	5	5	5
Mean	0.007	0.005	0.000	0.007	0.000
St. dev.	0.015	0.010	0.000	0.009	0.000

	Unknown	Indeter	Zea mays
N of cases	5	5	5
Mean	0.014	0.103	0.002
St. dev.	0.014	0.081	0.004

The following results are for:
label = General grid units

Total observations: 2

	Pine	Juniper	Populus	Ulmus	Salix
N of cases	2	2	2	2	2
Mean	0.196	0.011	0.009	0.000	0.014
St. dev.	0.066	0.000	0.004	0.000	0.020

	Solanaceae	Fabaceae	Eriogonum	Liliaceae	Rosaceae
N of cases	2	2	2	2	2
Mean	0.000	0.000	0.000	0.000	0.003
St. dev.	0.000	0.000	0.000	0.000	0.020

	Brassicaceae	Lamiaceae	Euphorbiaceae	Poaceae	Cheno-am
N of cases	2	2	2	2	2
Mean	0.000	0.000	0.000	0.030	0.483
St. dev.	0.000	0.000	0.000	0.005	0.047

	Cheno-am anther fragment	hs Asteraceae	ls Asteraceae	Artemisia	Liguliflorae
N of cases	2	2	2	2	2
Mean	0.011	0.009	0.063	0.027	0.000
St. dev.	0.015	0.012	0.006	0.014	0.000

	Platyopuntia	Ephedra	Cactaceae	Cyperaceae	Typha
N of cases	2	2	2	2	2
Mean	0.000	0.003	0.006	0.006	0.003
St. dev.	0.000	0.004	0.001	0.008	0.004

	Unknown	Indeter	Zea mays
N of cases	2	2	2
Mean	0.017	0.106	0.009
St. dev.	0.024	0.046	0.004

Summary statistics for **Pine**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .195
approximate F = .144 DF = 1, 24 probability = .708
Overall mean = 0.271 Standard deviation = 0.098
Pooled within groups standard deviation = 0.091
T statistic = 1.392 Probability = .223

Summary statistics for **Juniper**
One or more of your groups has no variance.

Summary statistics for **Populus**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 1.059
approximate F = .800 DF = 1,24 probability = .380
Overall mean = 0.008 Standard deviation = 0.008
Pooled within groups standard deviation = 0.009
T statistic = .122 Probability = .907

Summary statistics for **Ulmus**
One or more of your groups has no variance.

Summary statistics for **Salix**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 4.514
approximate F = 3.818 DF = 1, 24 probability = .062
Overall mean = 0.006 Standard deviation = 0.010
Pooled within groups standard deviation = 0.010
T statistic = 1.294 probability = .252

Summary statistics for **Solanaceae**
One or more of your groups has no variance.

Summary statistics for **Fabaceae**
One or more of your groups has no variance.

Summary statistics for **Eriogonum**
One or more of your groups has no variance.

Summary statistics for **Liliaceae**
One or more of your groups has no variance.

Summary statistics for **Rosaceae**
One or more of your groups has no variance.

Summary statistics for **Brassicaceae**
One or more of your groups has no variance.

Summary statistics for **Lamiaceae**
One or more of your groups has no variance.

Summary statistics for **Euphorbiaceae**
One or more of your groups has no variance.

Summary statistics for **Poaceae**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 1.599
Approximate F = 1.229 DF = 1, 24 probability = .279
Overall mean = 0.027 standard deviation = 0.015
pooled within groups standard deviation = 0.017
T statistic = .353 probability = .739

Summary statistics for **Cheno-am**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .935

Approximate F = .704 DF = 1, 24 probability = .410
Overall mean = 0.431 standard deviation = 0.106
Pooled within groups standard deviation = 0.109
T statistic = .783 probability = .469

Summary statistics for **Cheno-am anther fragments**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .019
Approximate F = .014 DF = 1, 24 probability = .907
overall mean = 0.017 standard deviation = 0.015
pooled within groups standard deviation = 0.016
T statistic = .639 probability = .551

Summary statistics for **hs Asteraceae**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .901
Approximate F = .677 DF = 1, 24 probability = .419
overall mean = 0.006 standard deviation = 0.007
pooled within groups standard deviation = 0.008
T statistic = .513 probability = .630

Summary statistics for **ls Asteraceae**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 1.763
Approximate F = 1.362 DF = 1, 24 probability = .255
overall mean = 0.055 standard deviation = 0.020
pooled within groups standard deviation = 0.021
T statistic = .623 probability = .560

Summary statistics for **Artemisia**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 1.942
Approximate F = 1.508 DF = 1,24 probability = .231
overall mean = 0.017 Standard deviation = 0.010
pooled within groups standard deviation = 0.008
T statistic = 2.011 Probability = .101

Summary statistics for **Liguliflorae**
One or more of your groups has no variance.

Summary statistics for **Platyopuntia**
One or more of your groups has no variance.

Summary statistics for **Ephedra**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = 1.036
Approximate F = .783 DF = 1, 24 probability = .385
Overall mean = 0.005 Standard deviation = 0.008
Pooled within groups standard deviation = 0.009
T statistic = .400 Probability = .706

Summary statistics for **Cactaceae**
One or more of your groups has no variance.

Summary statistics for **Cyperaceae**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .045
Approximate F = .033 DF = 1, 24 probability = .857
Overall mean = 0.006 Standard deviation = 0.008
Pooled within groups standard deviation = 0.009
T statistic = .173 Probability = .869

Summary statistics for **Typha**
One or more of your groups has no variance.

Summary statistics for **Unknown**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .508
Approximate F = .378 DF = 1, 24 Probability = .545
Overall mean = 0.015 Standard deviation = 0.015
Pooled within groups standard deviation = 0.017
T statistic = .243 Probability = .818

Summary statistics for **Indeterminate**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .411
Approximate F = .304 DF = 1, 24 Probability = .586
Overall mean = 0.104 Standard deviation = 0.069
Pooled within groups standard deviation = 0.076
T statistic = .036 Probability = .972

Summary statistics for **Zea mays**
BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES = .080
Approximate F = .059 DF = 1, 24 Probability = .810
Overall mean = 0.004 Standard deviation = 0.005
Pooled within groups standard deviation = 0.004
T statistic = 1.806 Probability = .131

Conclusions

Unfortunately, there is no clear demonstration of variation among the ten pollen samples analyzed. There is an indication that two of the features may have been utilized as roasting pits but the pollen evidence is inconclusive. Secondly, there appears to be no real difference between the two levels of the cultural zone, at least palynologically, and thus the possibility exists that it represents a single, continuous, depositional event. In the case of the burials, no clear indication of cultural practices were obtained. This deficiency may possibly be overcome by more controlled sampling.

Table A4.4. Selected Plant Usage

ASTERACEAE
Ambrosia artemisiifolia L. medicine
Ambrosia chamissonis (Less.) Green stems toy dye
Ambrosia trifida L. seeds roots food, medicine
Artemisia frigida Willd. aromatic
Artemisia absinthium L. leaves tops medicine
Artemisia biennis Willd. seeds food
Artemisia dracunculus L. aromatic
Artemisia frigida Willd. medicine
Artemisia ludoviciana Nutt. aromatic
Artemisia tridentata Nutt. aromatic basketry
Chrysothamnus nauseosus (Pall)Britt. aromatic cooking, kiva fuel
Cirsium arvense (L.) Scop. medicine
Coreopsis palmata Nutt. flowers medicine dye
Eupatorium purpureum L. medicine ceremony
Helenium autumnale L. medicine
Helianthus annuus L. seeds flowers food medicine dye
Helianthus tuberosus L. tubers food
Senecio aureus L. medicine
Senecio vulgaris L. medicine
Solidago gigantea Ait. flowers medicine
Sonchus arvensis L. leaves herb medicine ceremony
Tanacetum vulgare L. leaves flowers oil medicine technology dye
Taraxacum officinale Weber plant flowers medicine dye smoking
Xanthium commine Britt. seeds food

BRASSICACEAE
Capsella bursa-pastoris (L.) Medic. medicine
Dithyrea wislizeni Engelm. medicine
Lepidium virginicum L. plant medicine
Stanley albescens Jones food

CACTACEAE
Echinocereus fendleri (Engelm) Rumpl. sweetening
Opuntia fragilis (Nutt)Haw. tech food
Opuntia polycantha Haw tech food

CHENOPODIACEAE
Atriplex canescens (Pursh) Nutt. food, kiva fuel
Chenopodium album L. pollen leaves medicine dye

FABACEAE
Astragalus canadensis L. roots food
Melilotus officinalis (L.) Lam. herb medicine
Robinia pseudoacacia L. seeds bark food medicine
Trifolium pratense L. herb medicine

LAMIACEAE
Salvia carnosa Dougl. medicine
Stachys palustris L. medicine

LILIACEAE
Allium cernuum Roth GL bulbs food
Nolina sp. fiber plant
Yucca sp. food, basketry

POLYGONACEAE
Eriogonum spp. medicine
Polygonum aviculare L. herb seeds medicine

SOLANACEAE
Nicotiana tabacum L. leaves smoking mixture medicinal food
Datura stramonium L. plant seeds leaves medicine smoking
Physalis heterophylla Nees fruit food medicine
Solanum americanum Mill. fruit leaves food medicine

References Cited

Brookes, D., and K. W. Thomas
1967 The Distribution of Pollen Grains on Microscope Slides. Part I. The Non-Randomness of the Distribution. *Pollen et Spores* 9:621-629.

Bryant, V. M., and D. P. Morris
1986 Uses of Ceramic Vessels and Grinding Implements: The Pollen Evidence. In *Archaeological Investigations at Antelope House,* edited by D. P. Morris, pp. 489-501. National Park Service, Washington, D.C.

Faegri, K., and J. Iversen
1975 *Textbook of Pollen Analysis.* Hafner Press, New York.

Greenhouse, R., R. E. Gasser, and J. W. Gish
1981 Cholla Bud Roasting Pits: An Ethnoarchaeological Example. *The Kiva* 46:227-242.

APPENDIX 5. FLOTATION FROM BURNED DEATH WASH (LA 59497)

Mollie S. Toll[2]

Introduction and Methods

LA 59497, a Pueblo III house mound and midden, sits near the confluence of three arroyos, a short distance from the floodplain of Defiance Draw, between Window Rock, Arizona, and Gallup, New Mexico. At an elevation of 2,048 m (6,720 ft), potential natural vegetation for this area is characterized as a mixed grama-juniper association (Donart et al. 1978). Sideoats, black, and blue gramas dominate the understory, along with considerable amounts of western wheat-grass. Mexican pinyon and scrub oaks occur nearby.

The excavated portion of LA 59497 consists of a 10-14 cm thick sheet trash deposit to the south of the six- to eight-room residence. The 11 flotation samples submitted for analysis document two features in the midden area, as well as a variety of locations within the primary trash stratum. Occupation of the house mound is gauged at approximately A.D. 1050 to 1150. A sampled hearth (Feature 3) below the midden may belong to an activity area utilized during an earlier occupation, about A.D. 950 to 1050.

Soil samples were processed at the Office of Archeological Studies by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Sample volume (ranging from 1,450 to 3,850 ml; average 2,836 ml) was measured to allow comparison of seed density between samples. Each sample was immersed in a bucket of water, and a 30-40 second interval allowed for settling out of heavy particles. The solution was then poured through a fine screen (about 0.35 mm mesh) lined with a square of "chiffon" fabric, catching organic materials floating or in suspension. The fabric was lifted out and laid flat on coarse mesh screen trays, until the recovered material had dried. Each sample was sorted using a series of nested geological screens (4.0, 2.0, 1.0, 0.5 mm mesh), and then reviewed under a binocular microscope at 7-45x.

All 11 flotation samples were initially scanned to assess general productivity of cultural floral remains. All materials caught in the larger screens (4.0, 2.0, and usually 1.0 mm mesh) were sorted completely, and a brief sample of materials from the 0.5 mm (and 1.0 mm) screen were examined. Material passing through all screens (usually containing very few fragmentary remains of seed taxa occurring in the larger screens) was not examined at all. Examples of each taxon encountered were collected, but no effort was made to retain every seed present, and seeds were not counted. Scanning provides a reliable record of presence and absence of seed taxa in flotation samples. Where cultural materials are present in low frequency, scanning is a cost-efficient method of providing an overview of botanical conditions at sites, without spending a great deal of laboratory time counting and labeling modern, intrusive seeds. Six of the 11 samples showed no evidence of cultural botanical activity; the remaining five, containing *Zea mays* and/or carbonized economic seed taxa, were then fully sorted.

Seeds were counted and retained in labeled vials in the full-sort samples. As these samples were large, it was necessary to subsample some screen sizes in each sample and calculate an estimated

[2] Castetter Laboratory for Ethnobotanical Studies, Technical Series 281.

number of seeds for the total sample. In four samples, 10 to 25% by weight of the 0.5 mm screen was examined; in all five samples, 5 to 25% of the material smaller than 0.5 mm was examined.

From each flotation sample with sufficient charcoal, a sample of 20 pieces of charcoal was identified (10 from the 4 mm screen, and 10 from the 2 mm screen). Each piece was snapped to expose a fresh transverse section, and identified at 45x. Low-power, incident light identification of wood specimens does not often allow species- or even genus-level precision, but can provide reliable information useful in distinguishing broad patterns of utilization of a major resource class.

Results

Six flotation samples, which showed no carbonized floral remains at all in the preliminary scan (Table A5.1), included five grid locations within Stratum 4 (the primary cultural level, consisting of a prehistoric sheet trash deposit) and Feature 3, a shallow hearth, which may belong to an earlier occupation period. Modern weed seeds (chiefly goosefoot and purslane) are present in all of these samples, and abundant in most. Roots, insect parts, and rodent and/or insect feces are common in all eleven samples, indicating that modern biological activity is an active factor in disturbing all the sampled proveniences.

Of full-sorted proveniences, four (FS 475, 477, 478, and 574), a burial and several Stratum 4 locations contained carbonized corn and economic annuals (Table A5.2). Charred wild annuals occurred without corn in FS 474. The array of weedy annuals includes several (goosefoot, pigweed, and purslane) that occur commonly in Anasazi sites throughout the Colorado Plateau; these taxa, plus winged pigweed and beeweed, all occur at Anasazi period sites from the nearby Pittsburgh-Midway project and farther north at Navajo Mines (Table A5.3). Differences between the projects in frequency of a given taxon may well be largely artifacts of saltbush sampling. Other taxa prominent at Pittsburgh-Midway but missing in the small Burned Death Wash assemblage include juniper (carbonized twigs and scale leaves, probably associated with fuel use, and unburned twigs probably present as contaminants), pinyon nutshell (burned in 7 out of 8 samples it occurs in), and hedgehog cactus (found in a third of Anasazi sites).

Though LA 59497 flotation remains show little evidence of utilization of conifer species, charcoal showed fuel use to be overwhelmingly coniferous, and predominantly juniper (Table A5.4). Pittsburgh-Midway charcoal was unfortunately not monitored, while Anasazi wood use at Navajo Mines (all non-coniferous, with saltbush/greasewood the largest component: 38% by number and 47% by weight) is clearly conditioned by local availability.

Summary

Five of eleven flotation samples from a Pueblo III house mound and sheet midden produced carbonized plant remains attributable to the prehistoric occupation. Tiny, eroded fragments of corn cobs were present in four of the samples in very low frequency (one or two per sample). All other cultural floral remains were weedy annuals occurring in other Anasazi assemblages in the northwest sector of New Mexico (goosefoot, pigweed, purslane, winged pigweed, and beeweed/caper family). Juniper, pinyon, and hedgehog cactus turned up in the much larger

Table A5.1. Flotation Scan Results, LA 59497

	104N/130E Strat 4 Level 1 FS 329	104N/131E Strat 4 Level 2 FS 476	104N/127E Strat 4 Level 2 FS 479	101N/132E Strat 4 Level 2 FS 546	104N/132E Strat 4 Level 1 FS 548	Fea. 3 Hearth FS 549
Chenopodium goosefoot	+++	+	+++	++	+++	++
Portulaca purslane	+++		++	+	+	+
Compositae sunflower family			+			
Atriplex saltbush			+			+
Disturbance indicators	R I F	R I F	R I F B	R I F	R	R I MV

+ 1-10 seeds present; ++ 11-25 seeds; +++ more than 25 seeds; R roots; I insect parts; F feces; B bone; MV obviously modern vegetation

Table A5.2. Flotation Full-sort Results, LA 59497

	Vessel in Fea. 5 West half FS 474	Burial East ½ FS 475	105N/128E Strat 4, Level 1 FS 477	105N/124E Strat 4, Level 1 FS 478	104N/132E Strat 4, L. 2, FS 547
Chenopodium goosefoot	5/ 3.4*	6/12.0*	26/37.9*	19/19.1*	55/65.7
Amaranthus pigweed	1/ 0.7*		5/ 7.3*	2/ 1.4*	
Portulaca purslane	2/ 1.4*	5/11.4*	66/122.2	10/10.6*	3/ 7.8
Solanaceae nightshade family	1/ 0.7		2/ 2.9		
Capparidaceae caper family cf. *Cleome*		3/ 1.7*			
Cycloloma winged pigweed	1/ 0.7*	1/ 0.6*			
Mentzelia albicaulis stickleaf			3/ 4.4		
Zea mays corn		c*	c*	c*	c*
total seeds total taxa total burned taxa	10/ 6.9 5 4	16/26.3 6 5	106/180.6 8 3	33/31.7 5 4	59/73.8 4 2

	Vessel in Fea. 5 West half FS 474	Burial East ½ FS 475	105N/128E Strat 4, Level 1 FS 477	105N/124E Strat 4, Level 1 FS 478	104N/132E Strat 4, L. 2, FS 547
Disturbance indicators	R I	R I F	R I	R I B MV	R I F

a/b: number before slash indicates actual number of seeds recovered; number after slash indicates estimated number of seeds per liter of soil, taking into account subsampling and sample volume

* some or all items charred

R roots; I insect parts; F feces; B bone; MV obviously-modern vegetation

Table A5.3. Ubiquity (Percent of Samples) of Charred Economic Plant Taxa in Flotation Samples at Burned Death Wash, Pittsburgh-Midway,[1] and Navajo Mines[2] Anasazi Sites

	Burned Death Wash	Pittsburgh-Midway	Navajo Mines
n of samples n of sites	5 1	76 12	37 7
Zea mays corn	80	24	49
Chenopodium goosefoot	80	30	49
Amaranthus pigweed	60	3	11
Portulaca purslane	60	11	3
Cycloloma winged pigweed	40	5	11
Cleome/Capparidaceae beeweed/caper family	20	3	5

1 Toll and Donaldson 1982
[2] Toll 1983

Table A5.4. Charcoal Composition of Four Flotation Samples, LA 59497

Taxa	F.5, FS 474 #	g	F.5, FS 475 #	g	S.4, FS 478 #	g	S. 4. FS 547 #	g	Total/Percent #	g
Juniper	15	0.5	17	0.6	19	0.4	19	0.6	70/88	2.1/81
Undeter. conifer	4	0.3	3	0.1	1	<0.05	1	<0.05	9/11	0.4 15
Total non-conifers	1	0.1							1/1	0.1 4
Total Sample	20	0.9	20	0.7	20	0.4	20	0.6	80	2.6g

Pittsburgh-Midway flotation sample from nearby, but were absent at Burned Death. Wood use was almost entirely coniferous (predominantly juniper), with a single incidence of saltbush.

References Cited

Bohrer, Vorsila L., and Karen R. Adams

1977 *Ethnobotanical Techniques and Approaches at the Salmon Ruin, New Mexico.* San Juan Valley Archeological Project, Technical Series 2. Eastern New Mexico University Contributions in Anthropology 8(1).

Donart, G. B., D. D. Sylvester, and W. C. Hickey

1978 *Potential Natural Vegetation, New Mexico.* New Mexico Inter-agency Range Committee, Report II. USDA, Soil Conservation Service, Albuquerque.

Toll, Mollie S.

1983 Changing Patterns of Plant Utilization for Food and Fuel: Evidence from Flotation and Macrobotanical Remains. In *Economy and Interaction along the Lower Chaco River: The Navajo Mines Archeological Program, Mining Area III,* edited by Patrick Hogan and Joseph C. Winter. Office of Contract Archeology, University of New Mexico, Albuquerque.

Toll, Mollie S., and Marcia L. Donaldson

1982 Flotation and Macrobotanical Analyses of Archeological Sites of the McKinley Mine Lease: A Regional Study of Plant Manipulation and Natural Seed Dispersal Over Time. In *Anasazi and Navajo Land Use in the McKinley Mine Area, near Gallup, New Mexico,* vol. 1(2), edited by Christina G. Allen and Ben A. Nelson, pp. 712-786. Office of Contract Archeology, University of New Mexico, Albuquerque.

APPENDIX 6. AUGER HOLE DATA

Auger holes were used to examine subsurface deposits in unexcavated areas within the right-of-way that did not have surface artifacts. Augering continued to sterile soil or bedrock. In all, 16 auger holes were placed primarily west of the midden deposit. Auger and soil depths are presented in Table A6.1.

Table A6.1. Auger Data

Test	Grid	St. 1	St. 2	St. 8	St. 9	Bedrock
1	101N/104E	70	71-86			
2	101N/106E	30	31-40			40
3	101N/108E	25	26-30			30
4	101N/110E	25				25
5	101N/112E	18				18
6	101N/114E	10				10
7	101N/116E	8	9-15			15
8	103N/116E		25-40	0-25		40
9	105N/116E		41-70	0-40		70
10	105N/114E	0-37	38-75	75-80		80
11	105N/115E	0-50	51-85			85
12	101N/84E				0-150	
13	101N/80E				0-115	115
14	101N/76E				0-80	80
15	W. of site				0-80	80
16	W. of site				0-80	80

APPENDIX 7. RADIOCARBON RESULTS

Beta-29189	FS 322 Feature 3, 96N/135E 40-44 cm below datum	1640 ± 70 BP	(0.66 gram carbon)
Beta-29190	FS 330 Strat 4, Level 1 104N/130E	1450 ± 90 BP	(0.39 gram carbon)

Note: the small samples were given extended counting time.

Table 9. Refire Colors by Type, Manufacture Source, and Project Area

Refired Color	White		Very Pale Brown		Pink		Reddish/Yellow		Total
Study Area	LA 59497	McKin. Mine	LA 59497	McKin. Mine	LA 59497	McKin. Mine	LA 59497	McKin. Mine	
Gallup Black-on-white									
Source 1A		1	2	2	3	6	3	1	18
Source 1B	1		1	1	2	1	1		7
Source 1C							1		1
Source 3	1								1
Total	2	1	3	3	5	7	5	1	27
Puerco Black-on-white									
Source 1A			1						1
Source 1B	1	2	4	3	3	5		1	19
Source 1C	1								1
Source 3	1		3		2				6
Total	3	2	8	3	5	5		1	27
Gray Indented Corrugated									
Source 1A	2		6	1	5	3	1	2	20
Source 1B		1	3	2	1	1		1	9
Source 1C			1			1		2	4
Source 3				1					1
Total	2	1	10	4	6	5	1	5	34