

**EXCAVATIONS AT A COALITION PERIOD PUEBLO (LA 4624)
ON MESITA DEL BUEY, LOS ALAMOS NATIONAL LABORATORY**

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AREA G EXCAVATION REPORT

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CHAPTER 1 INTRODUCTION

BRADLEY J. VIERRA

Plans were made to expand the low-level radioactive waste disposal capacity at the Technical Area (TA) 54, Los Alamos National Laboratory (LANL) in the 1980s. This proposal involved the excavation of two new storage pits in Zone 4 at Area G. Beverly Larson had surveyed and revisited previously recorded sites at TA-54 in 1985 (Larson 1986). This work included a survey of the Area G expansion area which contained seven Coalition period pueblo sites: LAs 4620, 4621, 4622, 4623, 4624, 4625 and 4626. Maps of this area are provided in Appendix A. Surface collections and excavations were conducted at LA 4624 in 1993; however, these excavations were later suspended before the site was fully excavated. This report presents the findings of this work at LA 4624. It seems appropriate to provide a history of the events leading up to this decision, and the production of this final report.

A data recovery plan for the excavation of seven Coalition period sites was completed in May, 1991 (Larson 1991). This plan outlined the field methods and research design to be used in the excavation of the sites to be impacted by the expansion of Area G. This project involved building two large storage pits, with surrounding surface modifications. The Department of Energy sent a copy of the survey report and data recovery plan to the New Mexico State Historic Preservation Officer (SHPO) and San Ildefonso Pueblo on June 24, 1991. A copy of the data recovery plan was also sent to the Advisory Council for Historic Preservation (ACHP) on June 28, 1991. The data recovery plan was approved by the SHPO on July 9, 1991 and the ACHP on July 26, 1991.

Members of San Ildefonso Pueblo visited Area G to discuss these excavations on July 18, 1991. At that time, archaeologists reviewed the plan to excavate these sites and requested the Pueblo's comments on this undertaking. The archaeologists specifically asked for directions on how to treat burials that might be uncovered by the excavations. These would be reburied in accordance with San Ildefonso's direction and if the Pueblo desired the associated artifacts would also be repatriated. Council members did not directly respond to these questions, but Gilbert Sanchez (tribal spokesman), said that a written Memorandum of Understanding (MOU) on these issues should be drafted. Subsequent meetings were held at which the MOU was discussed in 1992.

Surface collections and the excavation of LA 4624 commenced in July, 1993. Beverly Larson was project director and Tim Binzen the field director. Field personnel included Matt Eiler, Todd Irving, Andrew Jandacek, Steve Lakatos, Martin Mueller, Jennifer Oakley, Nelson Parrish, Mike Schillaci, Quincey Simmons, and Eric Wheeler. These excavations were suspended by Los Alamos National Laboratory after approximately 50% of the site had been excavated. In a letter dated October 22, 1993, LANL notified San Ildefonso Pueblo of this action stating that,

out of respect for Native American concerns about the archeological procedures approved by federal and state agencies, and our desire to establish collaborative working relationships with the Tribes, the Laboratory has voluntarily decided to suspend remediation of any additional sites at Technical Area 54 while plans to expand Area G are being re-evaluated.

The Area G expansion project was incorporated into the LANL Site Wide Environmental Statement (SWEIS) in 1994. Representatives of San Ildefonso were again taken on a tour of the archeological sites within Area G on March 11, 1994. The MOU between LANL and San Ildefonso Pueblo was subsequently signed on April 16, 1996. The MOU detailed the Pueblo's role as a working partner in the performance assessment of Area G. The MOU was designed to facilitate communication and co-operation between the two parties in respect to the activities at Area G.

In May, 1998 the draft SWEIS was released to the public for comment. In a letter dated June 27, 1998, San Ildefonso Pueblo commented on the SWEIS and Area G expansion, stating that

the Pueblo of San Ildefonso in October 1997 submitted to DOE a statement of cultural affiliation to the area of LANL which lies within the Ancestral Domain, prehistoric land use and spiritual significance of the resources both cultural and natural within the boundaries of the facility...the Pueblo has identified that all cultural sites are of spiritual significance and hence TCPs. As such these sites that are within any project area (i.e., TA-54) must be avoided, and any non-avoidance of such sites will have an adverse effect to the Traditional, Spiritual and Cultural values of the People of the Pueblo of San Ildefonso.

On September 9, 1998 representatives from San Ildefonso Pueblo visited the archaeological sites at Area G. By January, 1999 the SWEIS had been approved by DOE. Five alternatives for expanding the low-level waste disposal areas at LANL were proposed, including Developing Zone 4 at TA-54. The Facilities and Waste Operations Division requested that ESH-20 produce a final report on the excavations conducted at LA 4624. Bradley Vierra supervised the production of the final report. Laboratory and report production personnel consisted of Jennifer Nisengard, Diane Curewitz, Brian Harmon, Kari Schmidt, Alan Madsen and Alysia McLain.

CHAPTER 2 CULTURE HISTORY OVERVIEW

BRADLEY J. VIERRA

INTRODUCTION

Overviews of the regional culture history are presented in Cordell (1979a, 1979b, 1997) Stuart and Gauthier (1981), and most recently by Riley (1995). The chronological sequence was developed by Wendorf (1954) and later modified by Wendorf and Reed (1955) for the northern Rio Grande. Table 2.1 illustrates the regional chronologies as defined by Cordell (1979a), Irwin-Williams (1973) and Wendorf and Reed (1955). The following outline briefly summarizes each cultural period, as it is understood for the central portion of the Pajarito Plateau.

Table 2.1. Culture Historical Chronology for the Northern Rio Grande

CULTURE	PERIOD	DATES
Paleoindian	Clovis	9500-9000 BC
	Folsom	9000-8000 BC
	Late Paleoindian	8000-5500 BC
Archaic	Jay	5500-4800 BC
	Bajada	4800-3200 BC
	San Jose	3200-1800 BC
	Armijo	1800-800 BC
	En Medio	800 BC- AD 400
	Trujillo	AD 400-600
Ancestral Pueblo	Early Developmental	AD 600-900
	Late Developmental	AD 900-1150
	Coalition	AD 1150-1325
	Classic	AD 1325-1600
Native American, Hispanic, and Euro-American	Spanish Colonial	AD 1600-1821
	Mexican	AD 1821-1846
	U.S. Territorial	AD 1846-1912
	Statehood to World War II	AD 1912-1945
	Recent	AD 1945-present

PALEO-INDIAN PERIOD: 10,000 BC to 5,500 BC

Small groups of Paleo-Indian hunter-gatherers may have followed bison herds up and down the Rio Grande, with trips onto the Pajarito Plateau to procure obsidian and other

subsistence resources. This period is represented on Los Alamos National Laboratory (LANL) land by a Folsom point found by Steen (1977:7) on a mesa north of Ancho Canyon. Clovis, Folsom and Planview points have also been identified at other locations on the Plateau (Acklen 1993, 1997; Lent et al. 1986; Traylor et al. 1990; Wiseman 1992). Obsidian obtained from Jemez Mountain sources have been found on Paleoindian sites located as far away as northern Colorado (Wilmsen 1974:114).

Archaic Period: 5,500 BC to AD 600

Archaic hunter-gatherer groups relied on a variety of small game and plant species, while hunting with the spear and atlatl. Piñon-juniper woodlands on LANL land contain evidence of these temporary campsites as scatters of obsidian lithic tools, chipping debris and diagnostic projectile points (e.g., Biella 1992; Moore et al. 1998; Baker and Winter 1981). These sites presumably reflect the seasonal use of these upland settings during the fall for pine nut collecting, hunting and lithic procurement activities. Winter sites with structures have been excavated at lower elevations near Otowi at the Rio Grande (Lent 1991) and at Abiquiu Reservoir (Stiger 1986). The Late Archaic continues the hunting and gathering pattern with the addition of maize cultivation to the subsistence base. Maize has been directly dated to 2440 ± 250 B.P. (uncorrected; M-466; Crane and Griffen 1958) and 2410 ± 360 B.P. (Arizona; Long in Ford 1985) at Jemez Cave located near the Soda Dam at Highway 4.

Early Developmental Period: AD 600 to AD 900

Maize horticulturists who lived in semi-subterranean pithouses characterized the early Developmental period. They began to make painted pottery with simple designs (e.g., Lino Gray or Kana'a Gray), and used the bow and arrow. Most habitation sites are located at lower elevations near the Rio Grande, with the Plateau continuing to be used on a seasonal basis. There is no archaeological evidence for this period at LANL.

Late Developmental Period: AD 900 to AD 1150

Late Developmental horticulturists still relied to a great extent on hunting and gathering. Pithouses persisted in some places, but sites are typically small adobe masonry structures that are found at lower elevations. Kawhe'e Black-on-white is a mineral painted pottery that is produced during this time period. Indented corrugated wares are used as cooking and storage vessels. Only a single roomblock site has been identified on LANL land.

Coalition Period: AD 1150 to AD 1325

The Coalition period saw a substantial increase in the number, size, and distribution of above-ground habitation sites, with year-round settlements expanding into upland areas

on the Pajarito Plateau. The long-term process of site aggregation begins during this period, with early sites containing adobe and masonry rectangular structures with 10-20 rooms. These small rubble mound sites are the most common at LANL. In contrast, later sites of this period consist of large masonry enclosed plaza pueblos that contain over 100 rooms. Figure 2.1 provides an illustration of a Coalition roomblock (LA 4715), late Coalition plaza pueblo (LA 4665) and Classic period plaza pueblo (LA 170) site types. The construction of agricultural features such as terraces, gravel mulch gardens, and dams suggest an even greater reliance on horticulture. Most researchers attribute the increase in site density to migration (Wendorf and Reed 1955, Cordell 1979b, Hill and Trierweiler 1986; Hill et al. 1996), but others see the increase in site numbers a result of local population growth (Steen 1982). The beginning of the Coalition Period coincides with the shift from mineral to organic painted pottery, including Santa Fe Black-on-white. Ceramic cooking and storage vessels are mainly produced using a smeared-indented corrugated style.

Classic Period: AD 1325 to AD 1600

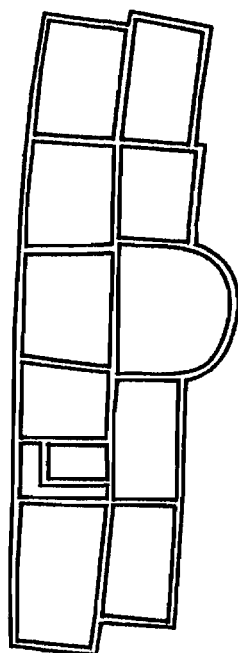
The Classic period is characterized by intensive maize agriculture. Ancestral Pueblo settlements on the Pajarito Plateau are aggregated into three population clusters with outlying one-to-two room fieldhouses. The central site cluster consists of four temporally overlapping sites: Tsirege, Navawi, Tsankawi and Otowi. Otowi and Tsirege are located on LANL land. Mera (1935) suggested that the initial occupation of these pueblos had occurred during the 14th century. Tsirege, Tsankawi and Otowi continued to be occupied during the 15th century, with only Tsirege and Tsankawi remaining by the 16th century. Oral traditions at San Ildefonso indicate that Tsankawi was the last of the plateau pueblos to be abandoned. The introduction of glaze-painted ceramics to the south of Frijoles Canyon and the production of Biscuit wares in the northern Rio Grande area mark the beginning of the Classic period. These Biscuit wares include a temporal sequence from Biscuit A (Abiquiu Black-on-gray), Biscuit B (Bandelier Black-on-gray) to Biscuit C (Cuyamungue Black-on-tan). Sankawi Black-on-cream, Potsuwi'i Incised and plainware cooking vessels are also produced during this time period. The latter utility pottery can include micaceous types. This central group of four Classic period ruins are ancestral to the Tewa speakers now living at San Ildefonso Pueblo.

Spanish Colonial Period: AD 1600-1821

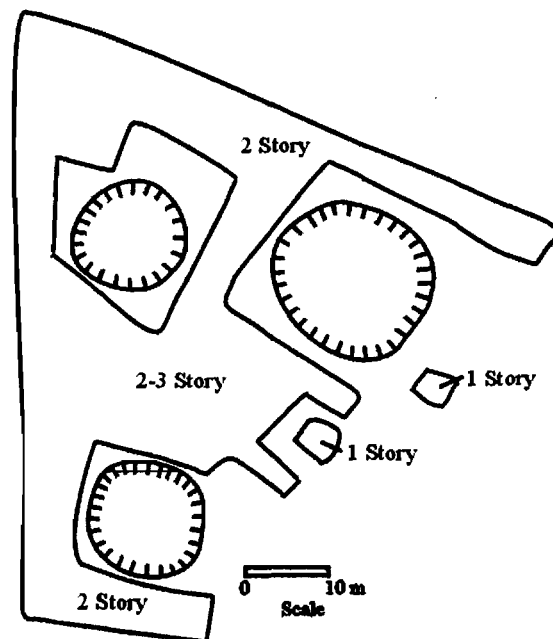
Due to a series of droughts, the plateau was eventually abandoned during the mid-1500s. New pueblos were occupied in the Rio Grande Valley. Although the historic period begins with Coronado's exploratory expedition up the Rio Grande in 1540-1541, most researchers date the period from about AD 1600. This date corresponds with Oñate's settlement in New Mexico and imposition of the Spanish ecomienda/estancia system on Rio Grande populations. The Spanish controlled Pueblo pottery production requiring the manufacturing of European vessel forms and taxation jars. These jars were sized to provide specific volumes for grain taxation. They often exhibited a distinctive shoulder at



LA 170 (Tsirege Pueblo)



LA 4715
(Not to scale)



LA 4665

Figure 2.1

the mid-point of the vessel. Historic ceramic types include Tewa Polychrome, Kapo Gray or Black, and Ogapoge Polychrome. The Pueblo Indians revolted against the Spanish in 1680, with some sites on the Plateau being reoccupied during this refugee period (e.g., Nake'muu).

With the reconquest and resettlement of New Mexico by de Vargas (1693-1696), the economic and settlement systems were completely overhauled (Simmons 1969). The huge mission establishments disappeared as did the estancias of the encomienderos. In their place land was granted to dozens of Hispanic communities and individuals that worked the property themselves. Hundreds of these small land holdings were scattered throughout the Rio Arriba and Rio Abajo.

Athabaskans have been present in northwestern New Mexico since the 15th century; however, the ethnohistorical evidence for Navajos and Jicarilla Apaches in the northern Rio Grande begins with the Spanish Colonial period (Forbes 1960; Friedlander and Pinyan 1980; Marshall 1995; Marshall and Hogan 1991; Opler 1936, 1971; Tiller 1992). The Navajos primarily resided in the Gobernador region, but made periodic visits to the Rio Grande valley and Jemez Mountains. The presence of Tewa Polychrome and Jemez obsidian at Pueblito sites attests to these contacts. Some Jicarilla groups wintered in the area of Abiquiu, with seasonal hunting and gathering trips made to the nearby mountains. Two rock rings that could possibly represent the remains of a tipi or wickiup were recorded in Rendija Canyon (Peterson and Nightengale 1993). Test excavations identified the presence of a hearth inside one of the structures that yielded a radiocarbon date of 130 ± 60 BP (Beta-58428). This would reflect a calibrated date for the feature within the 18th or 19th centuries. A single obsidian flake was the only artifact recovered. Possible Jicarilla rock ring sites with associated micaceous pottery have been reported for the Rio del Oso valley near Española (Anschuetz per. com. 1999) and at Pecos National Monument (Gunnerson and Gunnerson 1970). Schaasfma (1977, 1992) suggests a possible Navajo affiliation for Piedra Lumbre sites in the Abiquiu area, although Carrillo (1992) considers that some of these sites are associated with local Tewa peoples.

Mexican Period: AD 1821-1846

Mexico declared its independence from Spain in 1821, which brought about a more lenient land grant policy and expansion of the trade network (Levine et al. 1985). Trade between Missouri and Santa Fe along the Santa Fe Trail began soon after independence and dominated events in New Mexico for the next quarter century (Connor and Skaggs 1977). This introduced some comparatively inexpensive Euro-American goods to New Mexico which is reflected in the increase of manufactured items found on sites from this period (Moore 1993).

U.S. Territorial Period: AD 1846-1912

New Mexico remained a part of Mexico until war broke out with the United States. Troops led by Colonel Stephen W. Kearny raised the American flag at Santa Fe and took possession of New Mexico for the United States on August 18, 1846. Grazing and seasonal utilization of the Plateau occurred by non-Indians during the early historic periods, with the first homesteads being established on the Pajarito Plateau during the 1880s (Scurlock 1981:138). New Mexico was provided with a territorial government in 1850, and it remained a territory until it was granted statehood in 1912.

Statehood to World War II Period:AD 1912-1945

The early 1900s in New Mexico saw a continuation of traditional farming, cattle grazing, timbering and cultural practices. Seasonal homesteading continued on the Plateau, though mostly as a supplement to established year-round residences. Hispanic and Anglo homestead era sites are characterized by wooden cabin and corral structures, rock or concrete cisterns, and a scattering of debris associated with household and farming/grazing activities. In discussing the homestead occupation of current LANL lands in this report, it is noted that nearly all of the evidence for homesteading dates to the period of 1912-1945, likely reflecting response to the Enlarged Homestead Act of 1909 and the Grazing Homestead Act of 1916 (Scurlock 1981). Greater railroad and automobile use allowed for an increase in commerce and tourism, and by the 1940s, New Mexicans began to leave the village rural life for jobs in the larger cities, such as Albuquerque, or for jobs outside the state (Simmons 1993:182).

In 1942, Franklin D. Roosevelt gave the approval to develop the world's first atomic bomb. Because of its isolated location, Los Alamos, New Mexico, was selected as the site of the bomb's design and construction. This project came to be known as Project Y, a subset of the Manhattan Project. The creation of a modern town in Los Alamos influenced surrounding communities in Northern New Mexico. Lands owned by the Los Alamos Ranch School and mostly Hispanic homesteaders were appropriated for use by the Manhattan Project in 1942, thus effectively ending the homesteading era on the Pajarito Plateau (Los Alamos National Laboratory 1997).

CHAPTER 3 PREVIOUS RESEARCH

BRADLEY J. VIERRA AND BEVERLY M. LARSON

INTRODUCTION

Archaeologists have conducted research in the area of Mesita del Buey during most of the past century. This began with Hewett's excavations at the Classic period site of Tsirege and continued with Worman and Steen's excavation of approximately ten Coalition period sites during the 1950s to 1970s. Although there seemingly has been a great deal of work done in this area, very little of this information has been presented in any synthetic site report. This chapter will briefly summarize this research.

EDGAR LEE HEWETT

Archaeological investigations on Mesita del Buey began in the early 1900s with the work of Edgar Hewett (1906, 1938) at LA 170 (Tsirege). Hewett states that his excavations at Tsirege and Tsankawi were "devoted to the great community buildings, the burial places and to the small outlying ruins scattered over the adjacent mesas" (Hewett 1938:133). These Classic period pueblos were estimated to be four stories high and contained over a thousand rooms. There are approximately 600 ground floor rooms at Tsirege (Figure 2.1). Hewett states that about one hundred burials were removed from the midden and that Tsirege was said to be the last of the villages on the plateau to be abandoned (Hewett 1938:135, Hewett 1906: 25). Recent analyzes conducted at Tsirege indicate that the surface assemblage is dominated by Biscuit C, with less Biscuit B and Tsankawi Black-on-cream. Glaze D and E are also represented. These ceramic types reflect an occupation spanning the 15th and 16th centuries.

LOS ALAMOS NATIONAL LABORATORY: 1950s to 1970s

It was not until the 1950s and the establishment of the Los Alamos Scientific Laboratory that archaeological field work continued on lands that were then in the jurisdiction of the Atomic Energy Commission. Frederick Worman conducted archaeological surveys of the facility and excavation of four sites at TA-54 between 1957 and 1958: LAs 4628, 4631, 4632, and 4633 (Worman 1967). LA's 4634, 4658, 4659, 4660, and 4728 were also excavated by Worman in 1963 and 1964, and reported in Steen (1977). Due to facility expansions between 1974 and 1978, three additional sites were excavated LA 4627, 4629 (Steen 1982) and LA 4630 (Steen 1977). Four rooms at LA 4628, left unexcavated by Worman, were also dug (Steen 1982).

LA 4627 was a rectangular 17 room pueblo (Figure 3.1). One rectangular room was identified by Steen as “ceremonial” based on the presence of a collared hearth and deflector. Hearths were identified in the centers of three other rooms. A corner hearth was also identified in another possible room.

LA 4628 was an 11 room rectangular pueblo (Figure 3.1). Hearths were found against the walls in two rooms and towards the centers of another two rooms. One room had remnants in floor plaster.

LA 4629 was a 19 room rectangular pueblo (Figure 3.2). One interior room was modified to a D-shape. A hearth and deflector were present and it was interpreted as a kiva. Another five rooms contained hearths and an additional hearth was located on an exterior roomblock wall.

LA 4630 was a two-room structure without interior features (Figure 3.2). Only one course of masonry was found when excavated. Blocks were elongated and well dressed, typical of Classic period masonry (Steen 1977:46, 1982:37-38), but Coalition period ceramics were found on the site.

LA 4631 was a rectangular eight room pueblo (Figure 3.3). Only one room showed a prepared floor and a hearth. Worman notes that the “wall construction was much poorer than in LA 4632” (Worman 1967:11).

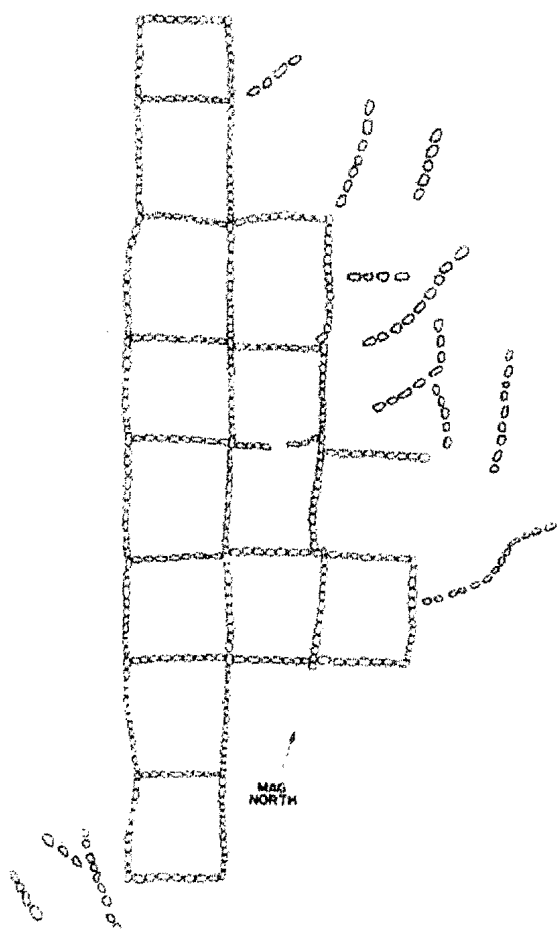
LA 4632 was the largest of the ruins excavated, with 20 rooms and a D-shaped semi-subterranean kiva attached to the roomblock (Figure 3.3). Construction was of tuff masonry blocks mortared with adobe. Several floors were found plastered. Kiva features included a double adobe-collared firepit, deflector, ventilator shaft, and vertical groove opposite ventilator opening. This was interpreted as a “kachina niche”. When found in the Acoma area they are considered to be sipapus (Worman 1967:7-8). Hearths were also found in three rectangular rooms, one in the room’s center and the others towards walls.

LA 4633 was a rectangular three-room rock outline (Figure 3.4). Building blocks were only one course high and were laid “sidewise instead of end to end, giving no indication that the masonry was laid as a foundation for adobe walls or other stones” (Worman 1967:3). Worman interpreted the site as an outlying ramada or habitation that was never used. Other interpretations are possible, such as use as a garden or as a structure cannibalized of building stones for later construction.

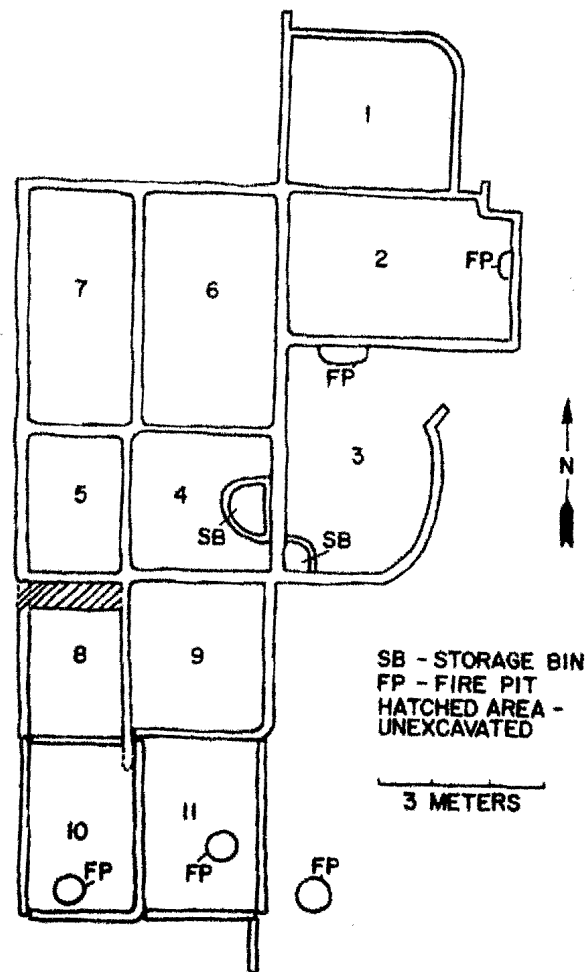
LA 4634 was an 11 room masonry and adobe pueblo (Figure 3.4). Four rooms contained adobe collared hearths. One room was unusual in that it contained a flagstone floor.

LA 4658 was a one-room structure of shaped tuff blocks (Figure 3.5).

LA 4659 was a 16 room pueblo of both tuff and adobe construction (Figure 3.5). A circular kiva was attached to the south end of the roomblock. Three centrally placed

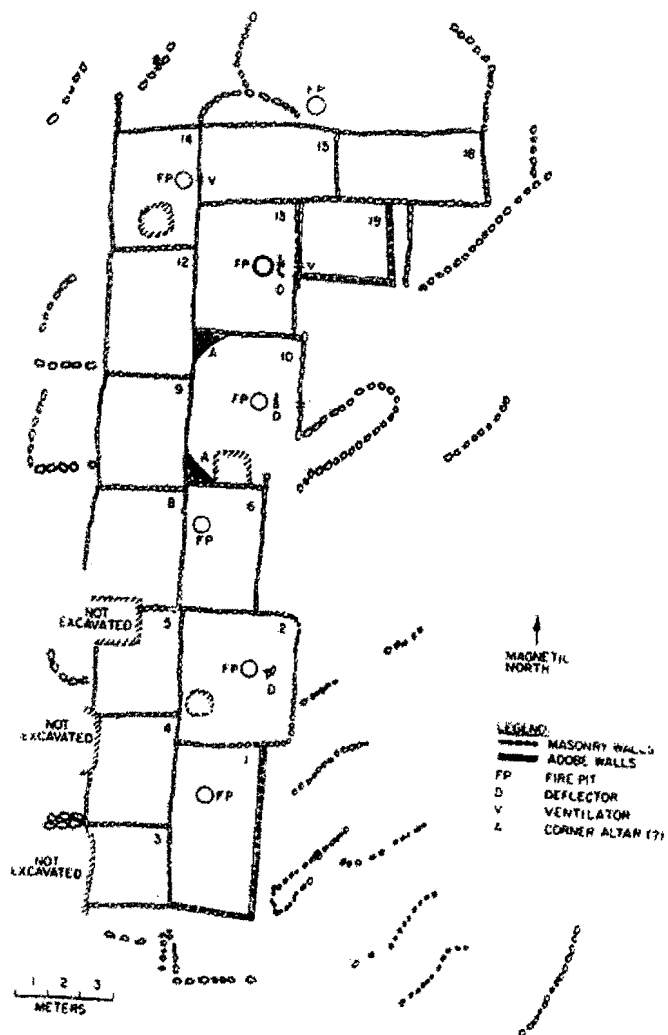


LA 4627 Ground Plan
With Stone Alignments

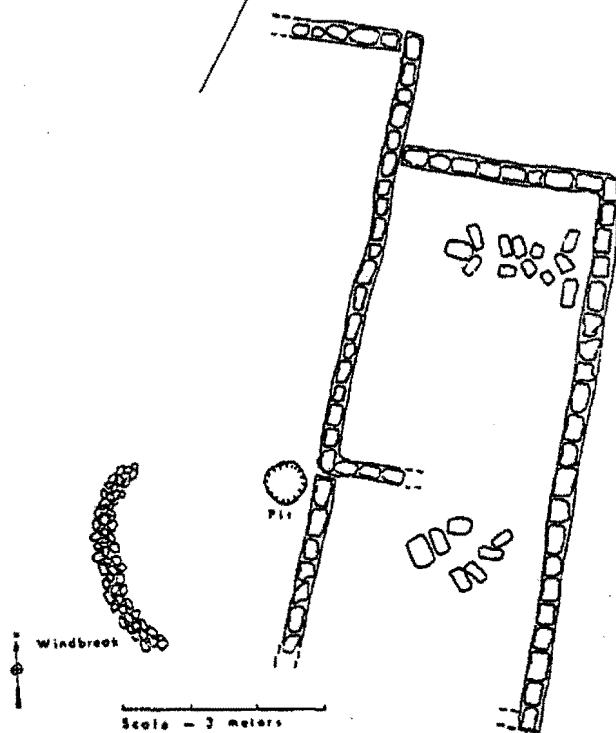
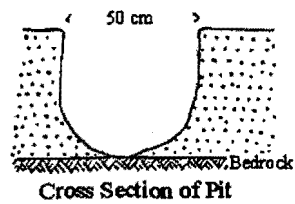


LA 4628 Ground Plan

Figure 3.1

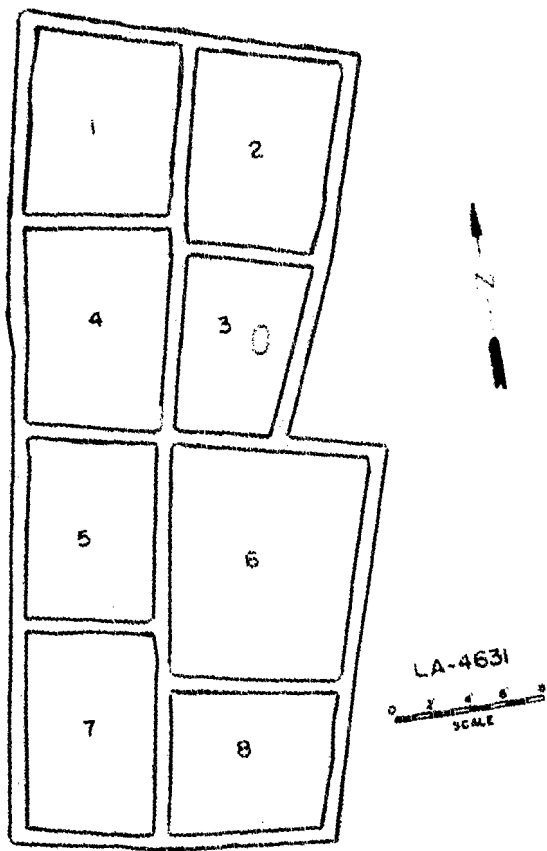


LA 4629 Ground Plan
with Stone Alignments

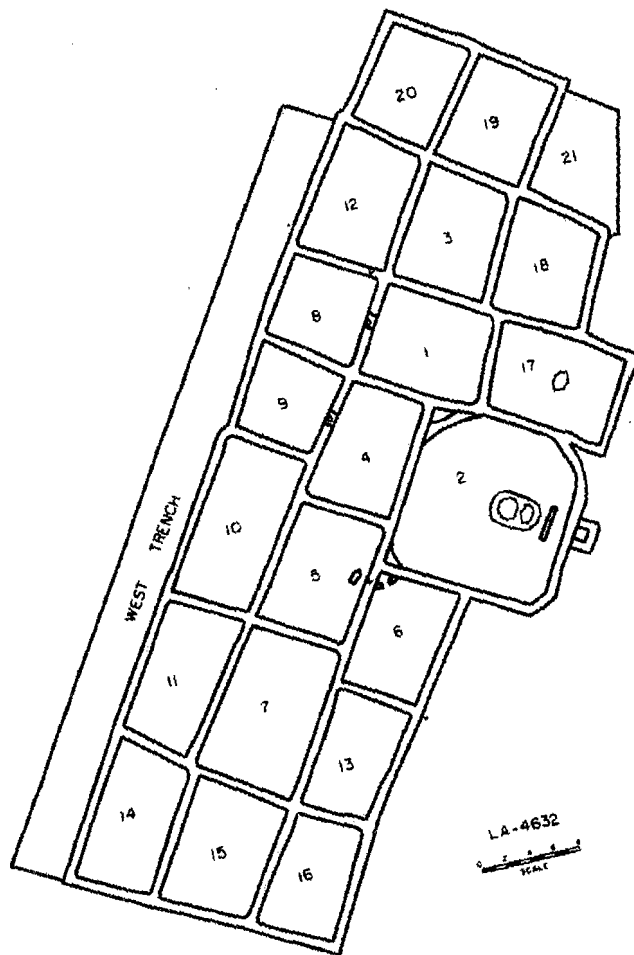


Plan of LA 4630 with profile of pit

Figure 3.2

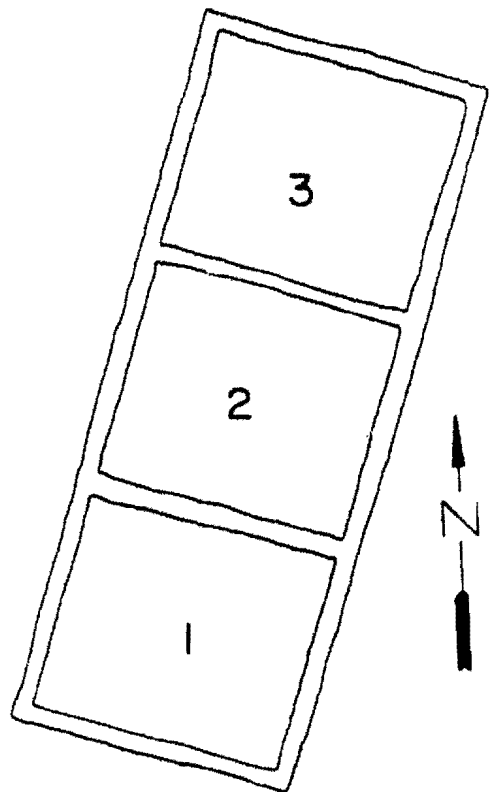


LA 4631 Ground Plan



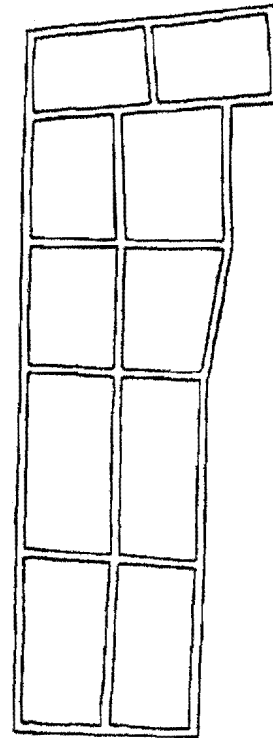
LA 4632

Figure 3.3



0' 2' 4' 6' 8'
SCALE

LA 4633

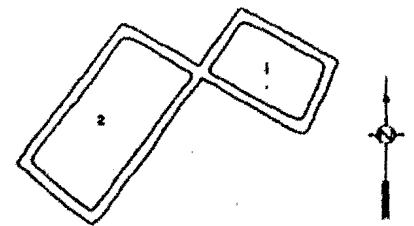


LASL Engineering Department drawing of
LA 4634 showing only 10 rooms

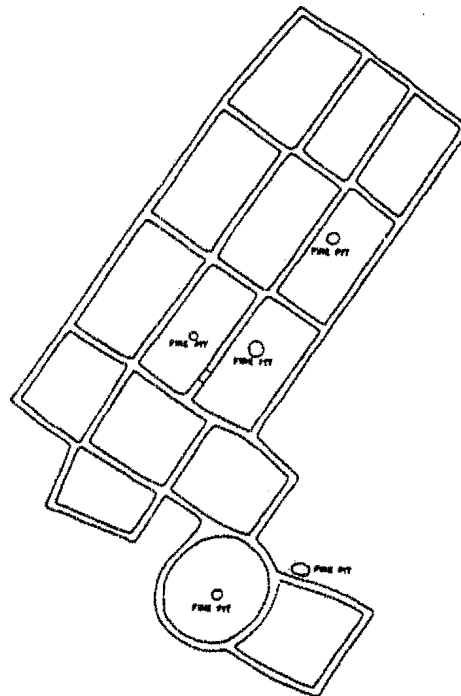
Figure 3.4



LA 4658



LA 4660



LA 4659 (shown as LA 4658) on LASL drawing
ENG-R 4448

Figure 3.5

interior hearths were located in the roomblock and another was found against an outside wall at the juncture of the kiva and roomblock.

LA 4660 was a two-room structure. Walls are indicated by upright tuff blocks (Figure 3.5).

LA 4728 was a one-room structure, interpreted by Worman as a summer shelter or ramada.

Worman indicates that sites were excavated by rooms. Apparently neither natural nor arbitrary levels of fill within rooms were bagged separately. Although artifact counts were made and the artifacts are available for study, the data's comparability for statistical purposes is limited because the fill was not screened (Worman 1967:2). Worman does mention the presence of middens although he does state that "exploratory trenches were dug to establish the outer limits of the ruins" (ibid:2). Steen does not indicate his techniques, although they were probably similar to Worman's; however, photographs indicate the presence of screens on sites excavated by Steen, so he presumably screened the sediments excavated from some of these sites.

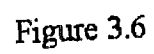
Ceramic analysis consisted of tabulating the frequencies of different pottery types. On this basis some chronological distinctions between sites were possible since Wiyo Black-on-white is acknowledged to be later in manufacturing than Santa Fe Black-on-white (Mera 1935). Worman placed LA 4628 and 4631 earlier than LA 4632 in this manner. Wiyo accounts for 7.8% of the LA 4628 assemblage and 5.4% of the LA 4631 assemblage. In contrast, it accounts for 41.3% of the black-on-white assemblage from LA 4632. Steen's ceramic analysis indicates that 100% of the painted ceramics at LA 4627 are Santa Fe Black-on-white, and at LA 4729, 96.3% are Wiyo Black-on-white (Steen 1982:9-29). The Steen and Worman data may not be comparable because, as Steen notes, the ceramics at LA 4628 analyzed by Worman are predominantly typed as Santa Fe Black-on-white while those analyzed by Steen are more often typed as Wiyo Black-on-white (Steen 1982:17).

Chipped stone is not mentioned except to describe projectile points or obvious artifact types such as scrapers. Ground stone consists of manos, mostly from vesicular basalt although some are listed as sandstone. Bone awls and clay pipes are also listed. Other illustrated artifacts include hammerstones of either river gravel or chalcedony (probably Pedernal chert), grooved axes and mauls.

LOS ARCHEOLOGICAL SOCIETY (1951-1981)

The Los Alamos Archeological Society was active from the 1950s to the 1980s. They conducted excavations at several site locations during the 1950s and late 1970s. The society conducted excavations at the Tsirege cave complex (LA 170) from 1956 to 1957 (Maxon 1969). A total of thirteen masonry rooms, an outside courtyard and six cavates were excavated (Figure 3.6). There is field documentation for a room 13, but

FT



none is illustrated on the site map. The rooms were single-story with viga sockets carved into the adjacent cliff face. Floors were plastered, but no interior features were identified. The cavates also contained plastered floors and walls to height of about 30 inches. The plaster was painted red or white. The walls were heavily covered with soot above the plaster. Some cavates contained ventilator holes and several were interconnected. The ceramic assemblage is dominated by plain non-micaceous utility (38.2%), Biscuit B (26.1%) and micaceous plain utility (11.8%), with fewer Sankawi Black-on-cream, slipped micaceous, Potsuwi'i incised, Biscuit A, Glaze A-D, Santa Fe Black-on-white and Wiyo Black-on-white (Table 3.1). The diagnostic ceramics reflect a Classic period, fifteenth to sixteenth century occupation for the site. Debitage, projectile points, manos, metates, mauls, axe, bone awls, and several corn cobs were also recovered during the excavations. Fragments of human bone from at least five individuals were found in rooms 1, 4 and 10, and cavates 2, 4 and 5. This includes the remains of two infants, one child, and two adults. The human remains are curated at the Maxwell Museum of Anthropology, University of New Mexico; whereas, the archaeological collections are curated at the Laboratory of Anthropology.

UNIVERSITY OF CALIFORNIA, PAJARITO PLATEAU ARCHAEOLOGICAL PROJECT: 1970s

A regional archaeological survey was conducted by the University of California at Los Angeles (UCLA) during the 1970s (Hill and Trierweiler 1986; Hill, Trierweiler and Preucel 1996). Approximately 800 sites were recorded by the project, including revisits to sites LAs 4616, 4619, 4620, 4621, 4622, 4623, 4624 and 4626 on Mesita del Buey. UCLA recorded a surface artifact scatter situated outside the facility fence as part of LA 4632. LANL records denote the excavated roomblock as LA 4632A and the surface scatter as LA 4632B. All of these sites are dominated by Santa Fe Black-on-white ceramics.

LOS ALAMOS NATIONAL LABORATORY: 1980s TO PRESENT

Jim Jorgensen was an employee at LANL who volunteered to record cavate sites during the 1980s. He conducted a survey of the cavates along the southern edge of Mesita del Buey in 1987. The following sites were recorded during his survey: LAs 86615, 86616, 86617, 86620, 86621, 86622, 86623, 86624, 86625, 86626, 86627, 86628, 86629, 86630 and 86631 (Jorgensen 1987).

Beverly Larson resurveyed and revisited previously recorded sites at TA-54 in 1985 (Larson 1986). This work included a survey of the Area G expansion area and the eventual development of a data recovery plan for seven Coalition period sites that were situated in the area of a proposed low-level waste disposal pit (LAs 4620, 4621, 4622, 4623, 4624, 4625 and 4626) (Larson 1991a, 1991b). Ms. Larson subsequently conducted excavations of a Coalition period pueblo at Area L from 1990 to 1991. This site was in danger of being impacted by building construction. A total of nine rooms and two kivas

were excavated at LA 4618 (Figure 3.7); however, no final report was completed for this project.

Acklen et al. (1990) conducted a survey on Mesita del Buey as part of the Ojo Line Extension Project. A semicircular shaped feature that had been cut into the bedrock was located along the mesa edge outside of the fence at Area G (LA 82607).

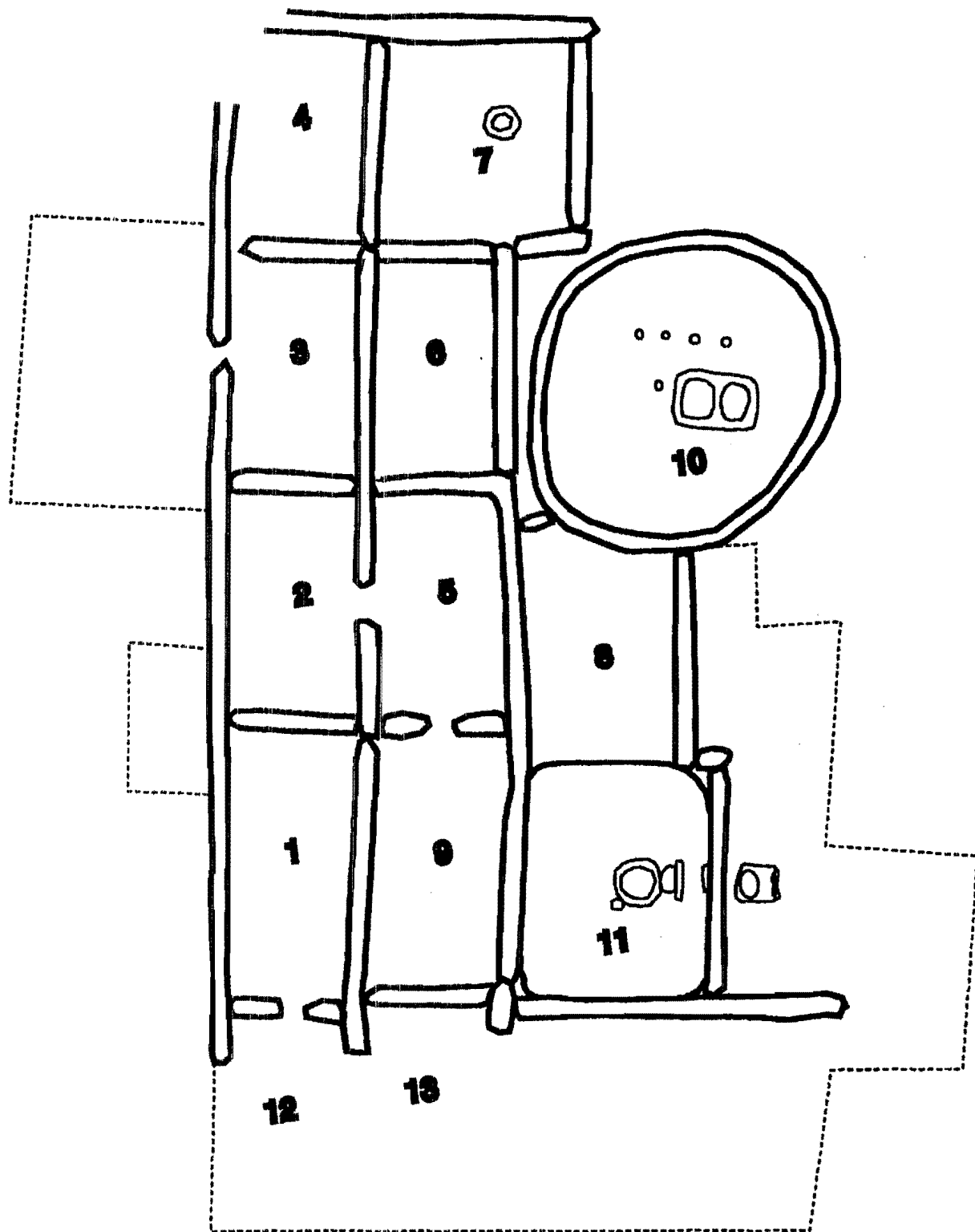
In 1993 excavations began at LA 4624 in Area G. An additional surface scatter (LA 89812) was defined within the mitigation area during preliminary surface-collection activities. However, excavations were terminated, with portions of 10 rooms and a kiva being exposed at LA 4624.

The Wildfire Prevention Project involved thinning brush along the periphery of the TA-54 facility fence in order to reduce a source of fuel for wildfires. Six archaeological sites were identified during the survey (Vierra 1998).

The most recent project conducted in the area was the Mesita del Buey cavate survey project. Seventeen sites with approximately 200 cavates and numerous rock art panels are located along the escarpment overlooking Pajarito Canyon. Thirteen cavate and four rock sites were systematically recorded and their condition assessed. The cavate complexes generally consist of about 12 rooms, with most of the sites also containing the remains of talus units. Therefore, the sites appear to represent Coalition period pueblos with a single set of masonry rooms in front and cavates in the rear (Vierra et al. 2000).

Table 3.1. Tsirege Cavate Complex (LA 170) Ceramic Assemblage (Maxon 1969:57)

Ceramic Type	Frequency
Plain utility	3152
Micaceous utility	975
Slipped micaceous utility	310
Other utility	10
Potsuwi'I incised	20
Cundiyo micaceous smeared indented	12
Sapawe Micaceous	80
Tesuque smeared indented	6
Biscuit A	61
Biscuit B	2141
Biscuitware	333
Sankawi B/c	177
Wiyo B/w	11
Santa Fe B/w	78
Und. B/w	16
Und. plainware	14
Agua Fria G/r	5
Cieneguilla G/p	6
Largo G/p	21
Espinosa G/p	31
San Lazaro G/p	29
Glazeware	752
Total	8231



LA 4618

2m

Figure 3.7

CHAPTER 4 DATA RECOVERY

BEVERLY M. LARSON

INTRODUCTION

During the 1980s, Los Alamos National Laboratory proposed to expand the low-level radioactive waste disposal capacity at the Technical Area (TA) 54. This proposal involved the excavation of two new storage pits in Zone 4 at Area G. The area was surveyed by Larson (1986) and a total of seven Coalition period pueblo sites were located: LA s 4620, 4621, 4622, 4623, 4624, 4625 and 4626. This chapter presents the data recovery plan as originally submitted by Larson (1991).

SITE DESCRIPTIONS

LA 4620

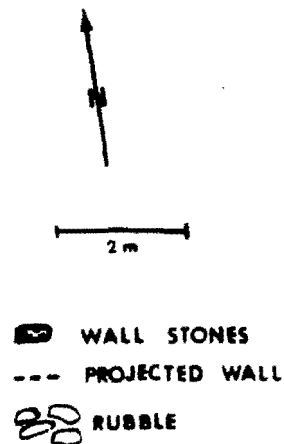
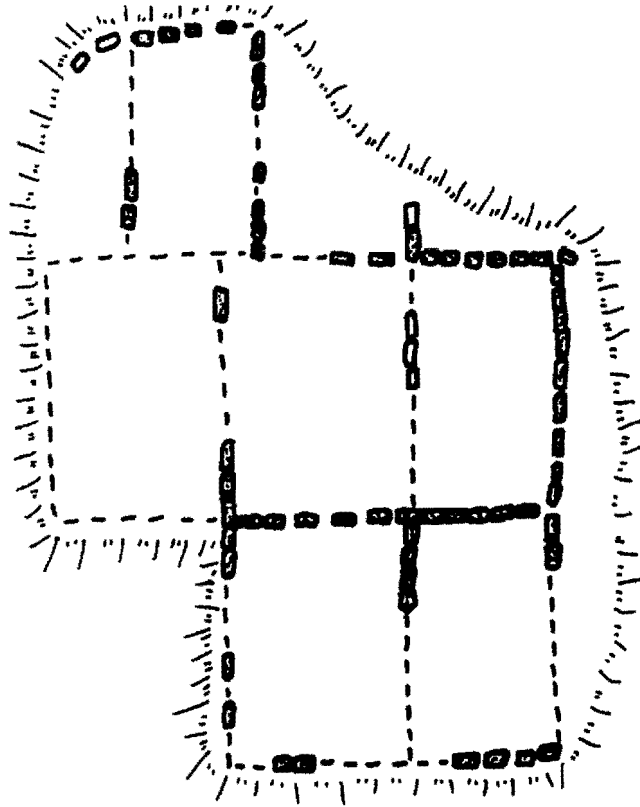
LA 4620 is a small, shaped tuff masonry pueblo of approximately six rooms (Figure 4.1). At least two rows of rooms are visible from the surface. The rubble mound measures 12 by 9 m. Based on the height of the mound (approximately 1 meter), the pueblo was one story high. Masonry consists of shaped tuff blocks laid lengthwise, except on the north side of the most northerly room. This wall is formed of smaller, unshaped tuff blocks/slabs placed upright and with definite empty spaces between them. This may have been the foundation for a jacal wall.

There is no defined midden area; artifacts extend from the roomblock in a 25 m radius but are inseparable from the scatter from LA 4621, located 45 m to the east. Santa Fe Black-on-white is the predominant painted pottery type present; utility wares are non-micaceous smeared indented. Many of the utility ware sherds show well-defined coil junctures and indentations. Based on the masonry style and pottery present, the site was occupied in the Early to Middle Coalition period, AD 1200 to 1300.

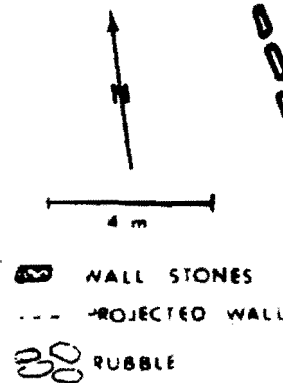
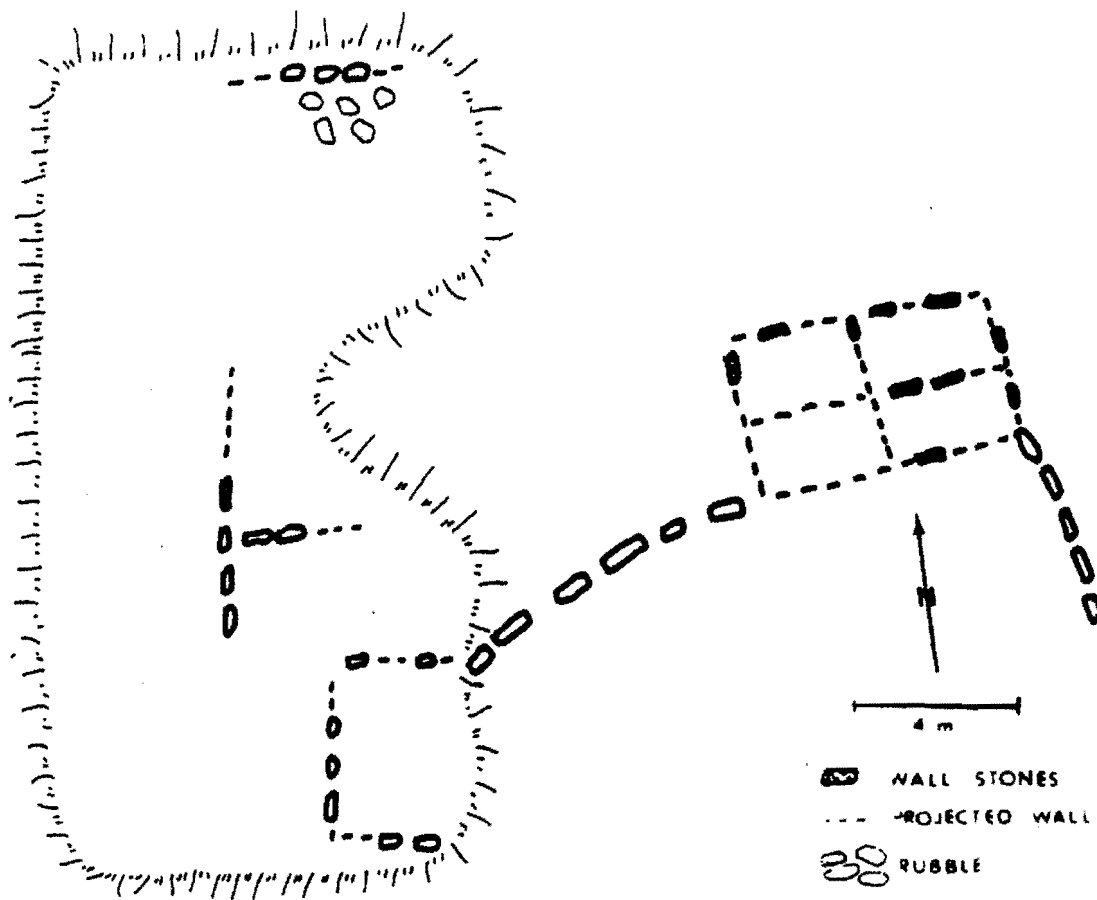
LA 4621

LA 4621 consists of two poorly defined pueblo roomblocks (Figure 4.1). Koogler and Pouls Engineers survey markers are located on the site, positively identifying Worman/Steen's LA 4621 with PARP 419. The remains of a small wooden shed are scattered over the site. The roomblock may have been damaged by this disturbance since the wall outlines are not visible on the surface of the site and there seems to be some erosional damage to the eastern side of the larger roomblock.

Roomblock I is the smaller of the two roomblocks and measures 4.4 by 4.6 m. Only one masonry course is visible, which roughly defines two to four rooms. There is no apparent



LA 4620



LA 4621

rubble mound. A row of tuff blocks one course high attached Roomblock I to Roomblock II.

Roomblock II measures 20 by 10 m. The rubble mound is less than 0.5 m high. No clearly defined walls are visible from the surface.

Sheet trash extends from the roomblocks for a 50 m radius, with no clear-cut definition from the surrounding sites. Painted ceramics are predominantly Santa Fe Black-on-white and utility wares are non-micaceous smeared indented. Again, many of the utility ware sherds show clear indentations. Based on the ceramic assemblage, the site was occupied during the Early to Middle Coalition Period, AD 1200 to 1300.

LA 4622

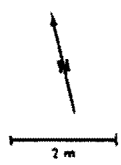
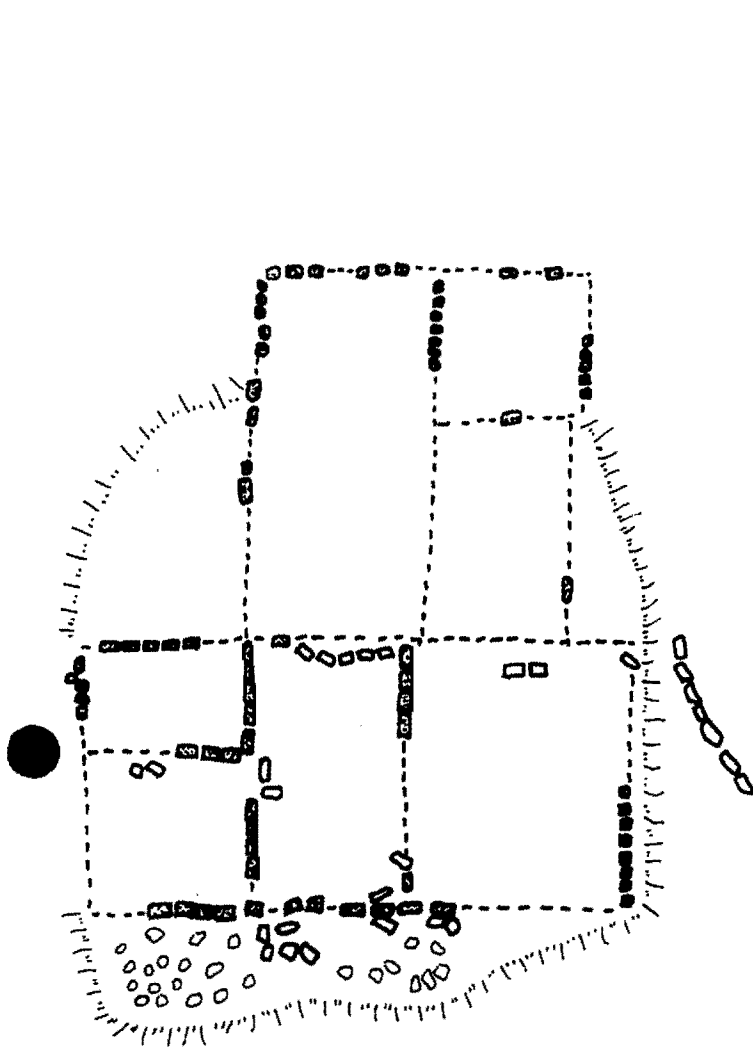
LA 4622 was recorded as one site by Worman and Steen, but as two sites by PARP (PARP 417 and 418). For this reason, PARP 418 is referred to as LA 4266-A and PARP 417 as LA 4622-B. The two roomblocks are located 20 m apart, making separation into two autonomous cultural units very tentative. LA 4621 is located 45 m to the west.

LA 4622-A measures 13 m by 11 m (Figure 4.2). At least seven rooms are visible from the surface. The three rooms visible in the southwestern corner of the pueblo are outlined by rectangular shaped tuff blocks which have been laid lengthwise. The northern wall of the pueblo as well as the southeastern wall are made of smaller, rounded tuff blocks which have been set as vertical slabs with spaces between them. These may have served as anchoring stones for a jacal wall.

LA 4622-B is 20 m to the east of LA 4622-A. Only three rooms are clearly defined (Figure 4.2). These are outlined by rectangular shaped tuff blocks laid lengthwise. Much of the site is covered by trees and pine duff; more rooms are undoubtedly present based on the height and shape of the mound, which measures 16 by 10 m and is 0.5 m high. The eastern side of the roomblock has been disturbed by some erosion, which may have left the roomblock with a C-shape, though it is possible that it was originally built in this configuration.

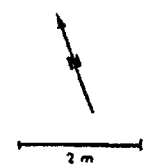
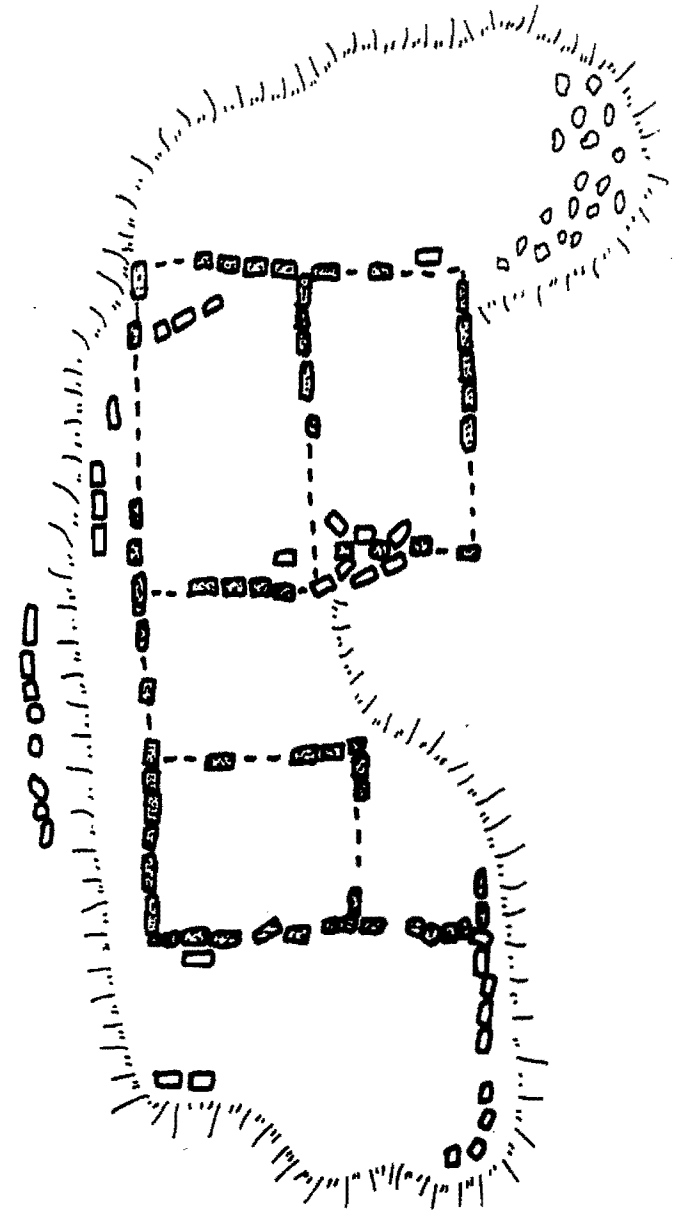
UCLA crews recorded a second roomblock to the west. A scatter of unshaped tuff blocks is located in this spot. There are no definable rooms nor is there any earth or rubble mound indicative of buried walls. This area may represent discarded rubble or may be the scatter foundation of a small, cannibalized structure.

The artifact scatter extends in all directions from both units. Painted wares are Santa Fe Black-on-white. Several small sherds of St. John's Black-on-red or St. John's Polychrome are present (no white paint is visible) or possibly Wingate Black-on-red (the slip is more red-tone than orange tone). Utility wares are non-micaceous smeared indented. A high percentage of the coil junctures show clear indentations.



-  WALL STONES
-  PROJECTED WALL
-  RUBBLE

LA 4622-A



-  WALL STONES
-  PROJECTED WALL
-  RUBBLE

LA 4622-B

Figure 4.2

Based on the ceramic assemblage and masonry style, both roomblocks date to the Early to Middle Coalition Period, AD 1200 to 1300.

LA 4623

LA 4623 is an eight to ten room shaped tuff masonry pueblo located 140 m to the east of LA 4622 (Figure 4.3). The visible rooms form a pueblo measuring 8 by 10 m and standing 1 m high. The northern and eastern walls are poorly defined, with the rubble mound extending two meters further in every direction.

Artifact scatter extends mainly to the east and southeast for 30 to 50 m. Painted wares are Santa Fe Black-on-white. A few fragments of St. John's Black-on-red (no white paint showing) or Wingate Black-on-red are present. Utility wares are non-micaceous smeared indented. Many show clear coil junctures and good corrugated indentations.

Based on the ceramic assemblage and masonry style, the Pueblo dates to the Early to Middle Coalition period, AD 1200 to 1300.

LA 4624

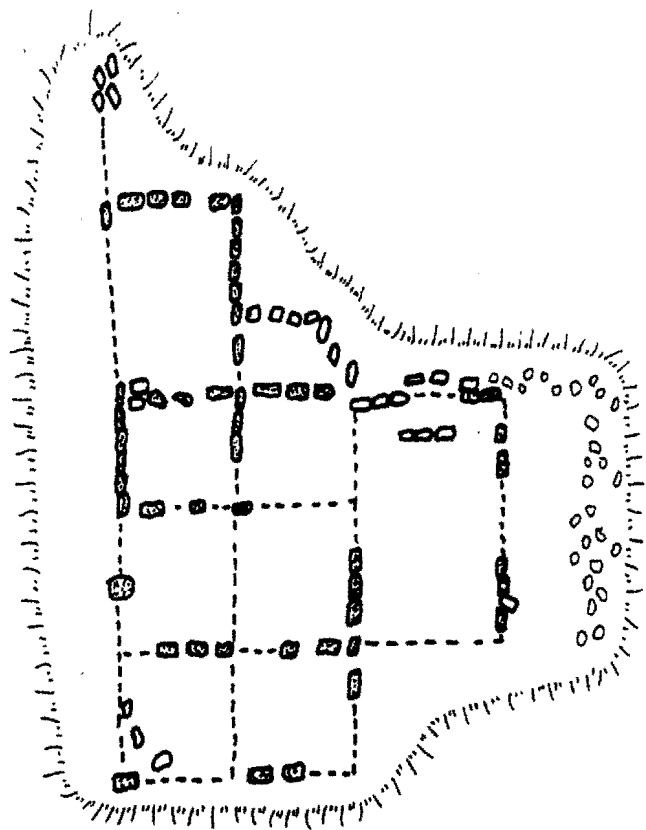
LA 4624 is located 110 m to the east of LA 4623 and is the largest of the pueblos described in this report. The rubble mound is 1.5 m high. Masonry consists of shaped tuff blocks. Sixteen rooms are visible on the mound, with another possible row of rooms off the mound, although a total of twenty-three to twenty-six rooms are probably present (Figure 4.3). A large D-shaped or circular mound in the northeastern corner of the site may mark a kiva, back filled at the time of site abandonment.¹

The artifact scatter is the densest to the east and to the south for 50 m; artifacts are also found to the north and west for 25 m. There is a definite reduction in artifact density between LA 4624 and LA 4623, the closest structure to the west of LA 4624. Painted ceramics are Santa Fe Black-on-white; several fragments of St. John's/Wingate Black-on-red are present. Utility wares are non-micaceous smeared indented; the majority of these have very clear indentations and good coil junctions.

Based on the masonry style and ceramic assemblage, the site dates to the Early to Middle Coalition period, AD 1200 to 1300.

LA 4625

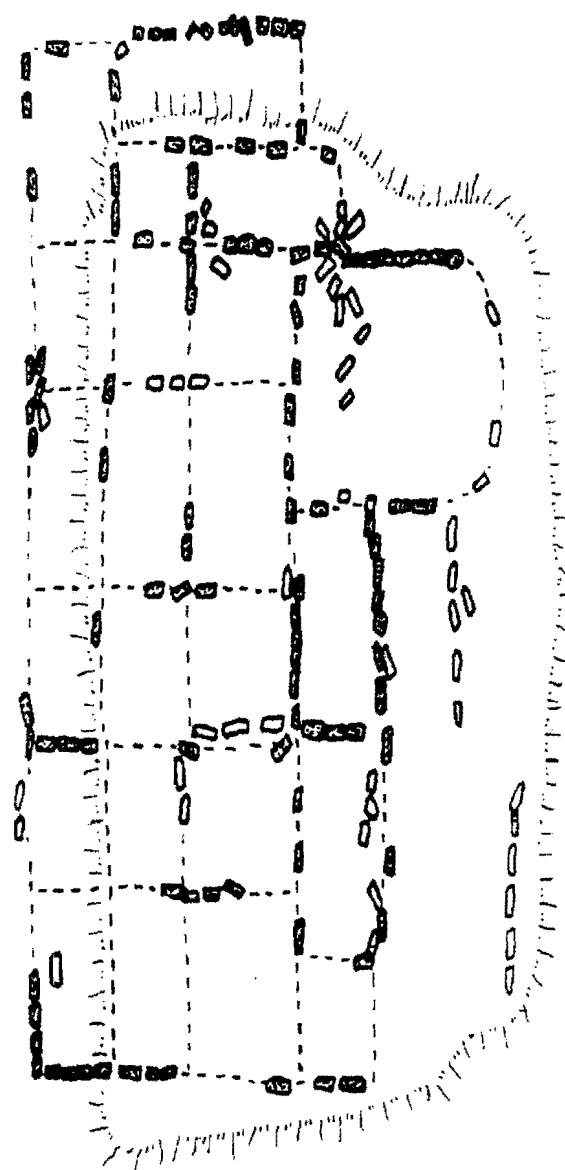
LA 4625 is located only 45 m to the south of LA 4623. There is no earth mound present. Rooms are defined by crudely shaped, lichen covered tuff blocks. These appear to be no more than one or two courses high. Two, possibly three, rows of rooms are visible (Figure 4.4). At least eight room outlines are present, although there may be several additional rooms. The roomblock measures 13 m in length and 6 to 10 m in width. An amorphous scatter of tuff blocks is located 20 m to the north-northeast (Feature A).



2 m

WALL STONES
 PROJECTED WALL
 RUBBLE

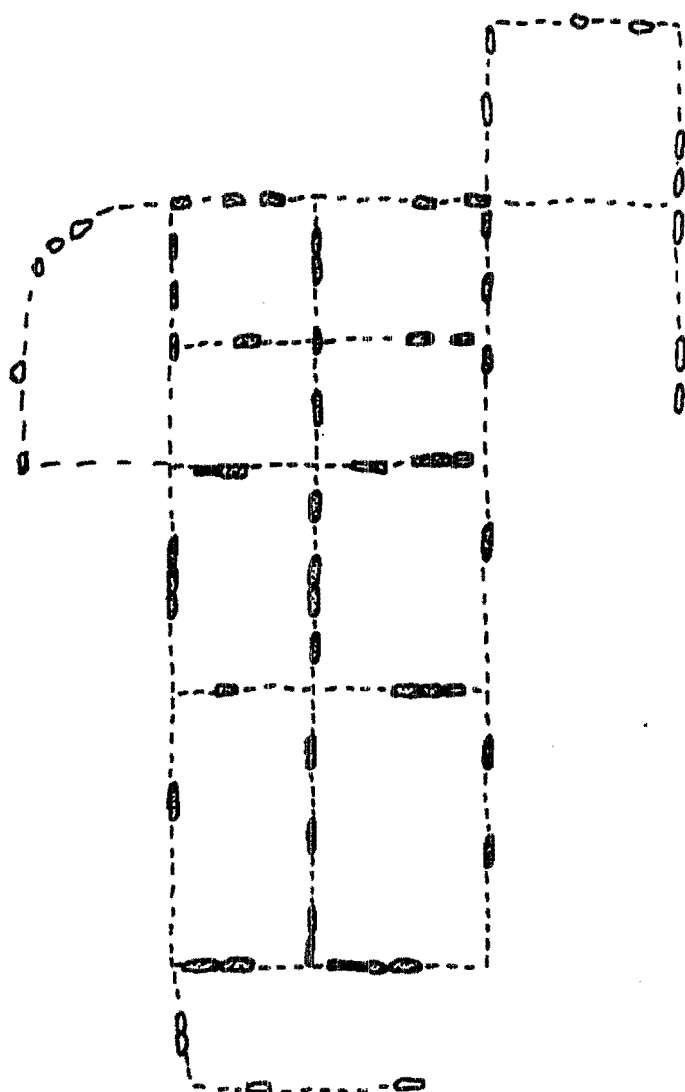
LA 4623



2M

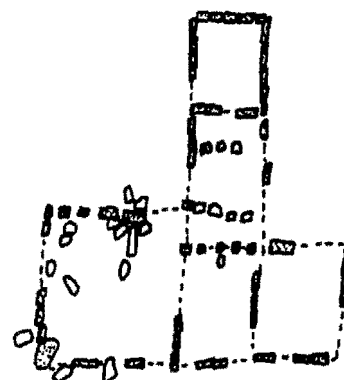
WALL STONES
 PROJECTED WALL
 RUBBLE

LA 4624



 WALL STONES
 --- PROJECTED WALL
 RUBBLE

LA 4625



 WALL STONES
 --- PROJECTED WALL
 RUBBLE

LA 4626

¹ On-going excavations at LA 4618 have revealed the presence of two unexpected rock-cut kivas. Both of these structures were intentionally back filled, with loose rubble, upon site abandonment; neither was visible until 0.5 to 1 meter of overburden was removed.

The masonry style and the ceramics types identified at the site are consistent with a Coalition Period Occupation, AD 1200 to 1325.

LA 4626

LA 4626 consists of two separate roomblock outlines, each only one course high (Figure 4.4). The masonry style is irregular, some blocks are well shaped rectangular tuff blocks, others are unshaped, and still others are upright slabs set on end.

The more northerly set of rooms (Roomblock I) is shaped like an inverted T and measures 16 by 14 m. Five to seven room outlines are visible; the most northerly room is clearly defined. Roomblock II consists of two room outlines and measures 12 by 4 m.

The artifact scatter between LA 4626 and LA 4624 is continuous. Since the sites are only 37 meters apart, most of the artifacts at LA 4626 may be associated with LA 4624. Ceramic types present at the site include Santa Fe Black-on-white and smeared indented utility wares. The site most likely dates to the Early to Middle Coalition period, AD 1200 to 1300.

INTERPRETATION

LA 4620, 4622, 4623, and 4625 appear to be contemporaneous (within a 100-year time span) roomblocks, that may have been part of a larger community centered on Pajarito Creek. These sites are located so close to one another that the artifact scatter from one site merges into the next. LA 4620, 4621, and 4622 form one continuous midden area. Likewise, the artifact scatter from LA 4624 extends to LA 4626, so that there is not clear-cut separation between these two features. LA 4623 and 4625 are less than 50 m apart. For this reason, the contemporaneity of sites is based on the frequency of pottery types found on the surface of sites and masonry styles.

The ceramic assemblages of all of the sites are similar in that they are all dominated by carbon-painted Santa Fe Black-on-white with early designs (deBarros 1981). There are no Galisteo Black-on-white and no clearly distinguishable Wiyo Black-on-white. White Mountain redware has been noted at all sites. In 1991, surveyors noted wares with a reddish slip commonly associated with Wingate Black-on-red rather than St. John's, although St. John's is also known to be red-hued rather than the orange or yellow-red hue usually associated with the type. Utility wares from all sites are all non-micaceous, tempered with quartz and feldspar crystals. These materials are from weathered tuff, and may have been collected from anthills and then ground slightly before being used for temper. Stream bed sand temper should show more rounded grains than seen in utility wares identified at these sites. Half of the utility ware sherds are corrugated and have

visible coil junctions; Kidder and Shepard (1936) referred to these as Rio Grande Corrugated or Indented Corrugated. Other utility wares are Tesuque Smeared Indented, characterized by smeared or partially obliterated corrugation (Mera 1935).

Based on the ceramic assemblages, it is reasonable to date site occupations between AD 1200 and 1300. Santa Fe Black-on-white (a catchall Coalition period ceramic type) dates between AD 1200 and 1350 (Breternitz 1966:95). Kwahe'e is usually dated from AD 1050/1115 to 1200/1250 (Breternitz 1966:81; Lang and deBarros 1981). Wingate dates from AD 1050 to 1200 and St. John's from AD 1175 to 1300 (Breternitz 1966:102-103). Rio Grande Corrugated first appears at approximately AD 1000 and disappears close to 1270 or 1300 (Lang 1980, quoted in deBarros 1981). The absence of ceramic types such as Wiyo Black-on-white and Galisteo Black-on-white, which appear circa 1300 (Breternitz 1966), supports the Early to Middle Coalition dates for the sites included in this survey. Pindi Pueblo, a ceramic period site located near Santa Fe, provides a useful comparison to these sites. A similar ceramic assemblage was recovered from Pindi; tree ring dates for the site are AD 1200-1300, with a concentration between AD 1270 and 1289 (Stubbs and Stallings 1953:23).

Tabulations from UCLA controlled surface collections at all seven Area G sites demonstrate a slight difference between sites, in terms of the frequencies of time sensitive ceramics (Trierweiler, Pruecel, and Larson 1986). Figure 4.5 depicts the ratio of Rio Grande Corrugated to the total number utility ware sherds from each site.² LA 4622-A has the highest frequency of Rio Grande Corrugated, followed by LA 4623, 4620, and 4626. These sites also have rooms with earlier masonry styles. The lowest frequency of early utility wares is found at LA 4624, which is the largest site in this site cluster and is totally constructed in the later masonry style. LA 4624 is also the only site to have any surface indications of a communal structure.

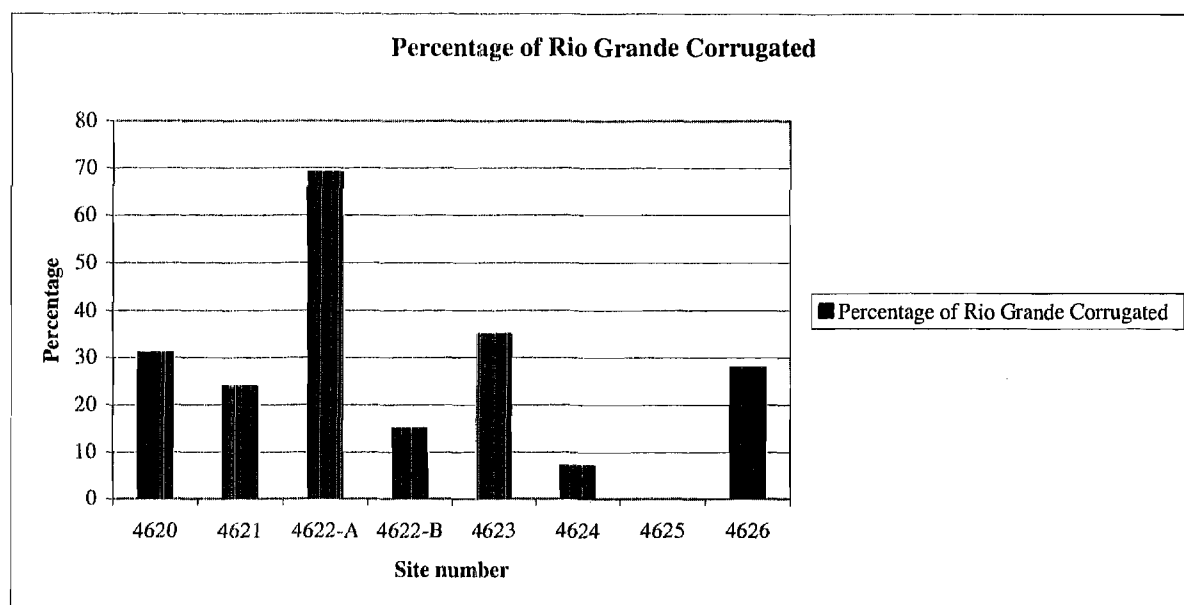


Figure 4.5 Rio Grande corrugated wares identified at Area G sites.

² The locations of collection units are mapped on UCLA site forms, found in Appendix A of Larson (1991). Units were placed in the areas of maximum artifact density, with an attempt to maximize unit distribution around each site. Collection units varied in size, so that the calculation of density indices is not reliable.

The frequency of St. John's Polychrome and Kwahe'e Black-on-white is shown graphically in Figure 4.6. Some differences between sites are depicted in Figures 4.5 and 4.6; for instance LA 4622-A and 4626, possibly the earliest of the sites, showing the highest ratio of St. John's. However, this is not statistically significant because the sample size is so small. A larger sample size, gained through excavation, may reveal temporal differences between sites.

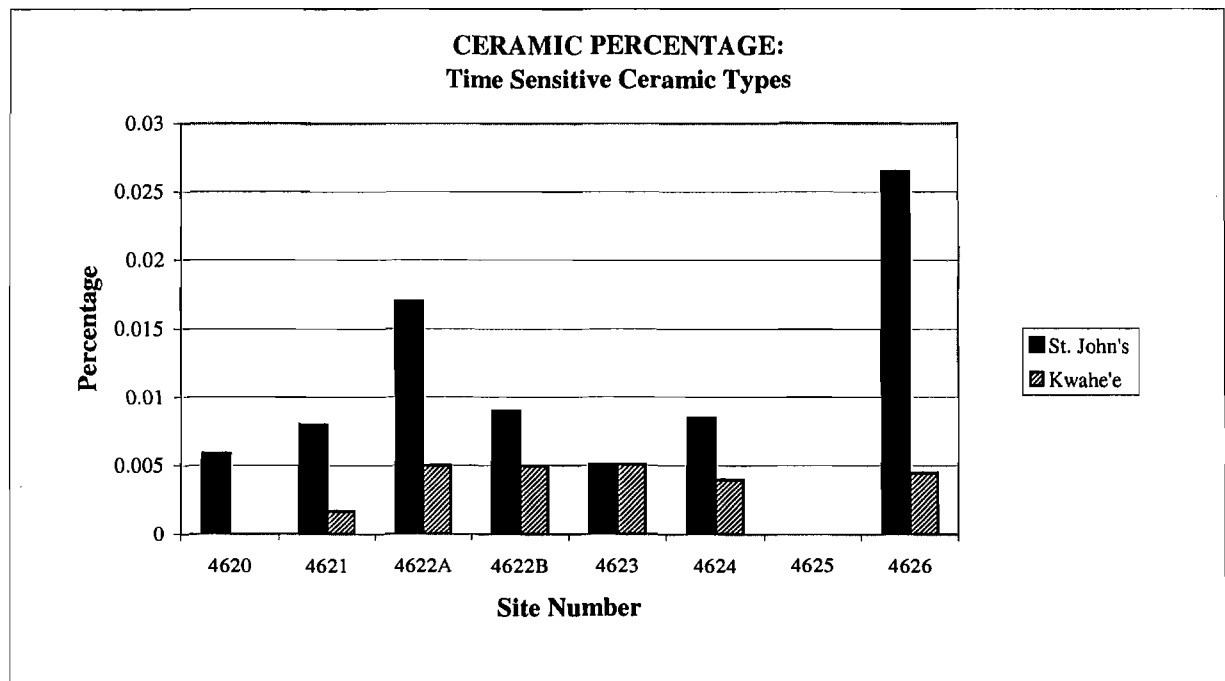


Figure 4.6. St. John's and Kwahe'e identified at Area G sites.

Contemporaneity is also supported by the masonry styles present at all sites, though several sites have earlier styles as well. Steen (1982:37-38) characterizes three types of Coalition period masonry styles on the Pajarito Plateau; these include, in chronological order, adobe with tuff footing stones, rough block masonry, and cut stone masonry. All sites in the Area G survey area have rough block masonry, with the exception of a few rooms at LA 4622-A and 4620, where adobe and tuff footing stone construction. Steen associates rough block masonry with Santa Fe Black-on-white; although he states that Wiyo is usually present as well. The masonry visible on the surface of Area G sites, does indicate an early to middle Coalition period occupation.

Figure 4.7 presents the ratio of lithic raw material types. The statistical significance of lithic trends is marginal, but it is suggestive of some patterning. The ratio of basalt to pedernal chert is highest at LA 4624 and 4622-A. Evidence from Burnt Mesa Pueblo excavations suggests that there was a temporal shift during the Coalition period away

from chert usage to greater basalt usage. The earlier tree-ring dated section of this site (AD 1250) contained 50% basalt and 42% chert, while the later tree-ring dated portion of the site (AD 1260-1270) contained 79% basalt and only 14% chert (Slaughter 1990:97).

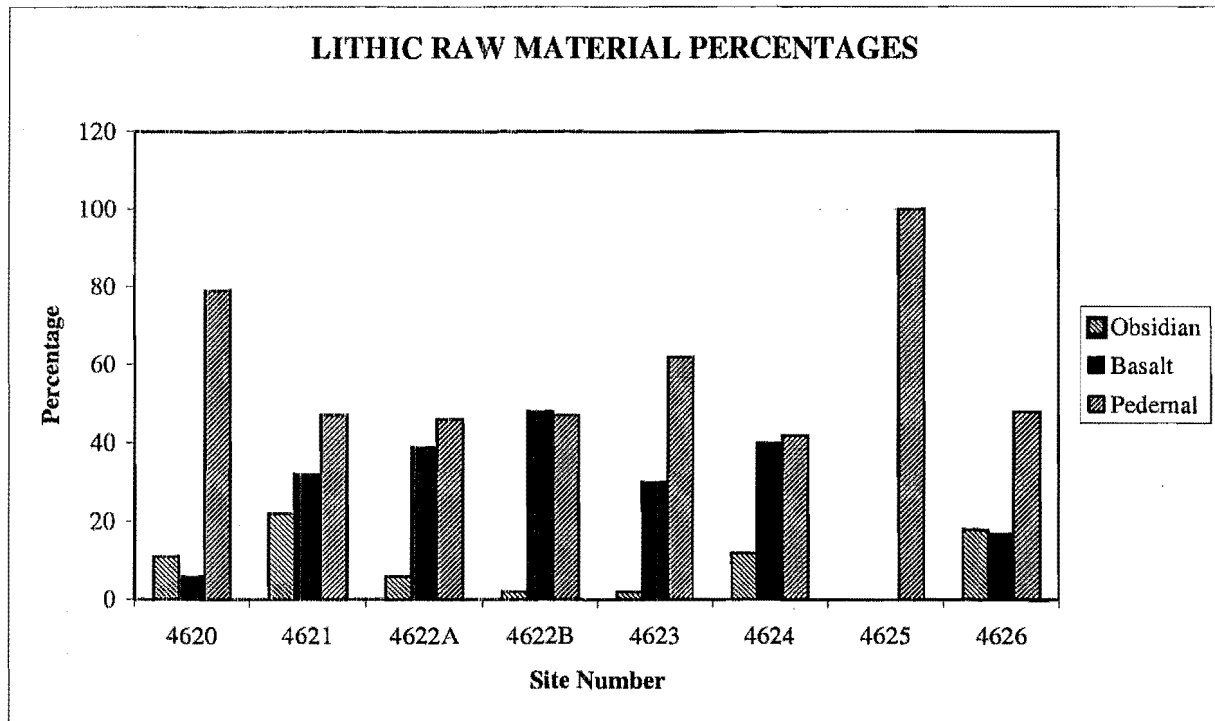


Figure 4.7. Lithic raw materials identified at Area G sites.

These data can be used to suggest that not all of these sites are contemporaneous. Tree-ring, archaeomagnetic, and additional analysis of the ceramics and masonry from the sites will allow for a more thorough evaluation of sites.

If all of the sites are contemporaneous, site variability, evidenced by artifact distributions, may be related to site function. LA 4625 and 4626, characterized by shallow deposits and no associated artifact scatter, may have been agricultural features, similar to waffle gardens. LA 4624 is the largest of this group of sites and is the only site with any surface indications of a communal structure. It is also the best preserved and has the highest mound. The substantial masonry and ceremonial structure at LA 4624 may be indicative of a longer period of occupation or its role of community center for all of the multiple pueblo sites examined during this survey.

This location is one of the more favorable for community formation on the Pajarito Plateau. There is a perennial water supply, the creek and the Rio Grande, approximately 7.5 km from the sites. This area was used well into the Late Coalition period, evidenced by at least five enclosed plaza roomblocks, dating to this time period, located on Potrillo Mesa immediately to the south of Pajarito Creek. Tsirege, a Late Classic period site, is also in the area, on the eastern tip of Mesita del Buey. In addition, agricultural potential in the area is excellent. Minimal labor investment would be needed to irrigate fields in

Pajarito Canyon. Canada del Buey would have provided a dry farming and North Slope alternative. The areas between Mesita del Buey and the Rio Grande are broad and flat with good soil depth.

RESEARCH GOALS

Regional Research Questions

Stuart and Gauthier's (1981) prospectus for New Mexico archaeological research suggests that the highest priority for research questions be given to

...reformations which address fundamental issues in archaeology and anthropology and, though derived from investigations here in New Mexico, are not confined to Southwestern archaeology in their application. Questions which promise to specify the conditions under which agricultural develops, the creation of stratified social systems, the relationships between population growth and technological change, or the relationship between genetic and cultural adaptation are all candidates for this priority of research (1981:383).

The Advisory Council on Historic Preservation's Treatment of Archaeological Properties: A Handbook, p. 35, also states that the relationships between environmental variables, population pressure, subsistence system, and technology and exchange are important research questions, which may be answered with archaeological data.

In accordance with the suggestions above, much of the recent research in the Southwest has been directed toward understanding the relationship between environmental variables and the variation observed in economic and social systems. As Cordell's (1984) overview of ancient southwestern societies is most likely due to differing responses to resource unpredictability. Working with this assumption, several recent studies on the Pajarito Plateau have attempted to address how environmental stress and resource unpredictability affect cultural systems. Several projects are discussed here.

All of these studies have attempted to understand cultural dynamics of the Coalition period on the Pajarito Plateau, but using survey data alone for the most part. The need for controlled excavation of Coalition period ruins is stressed in Cordell's final recommendations for future management decisions for the Santa Fe National Forest. She states

Excavation on the Pajarito Plateau has been biased toward the larger and later sites. The amount of variability in the smaller, predominantly "Santa Fe," sites needs to be addressed... Chronological control, independent of artifact types, is necessary for...all Rio Grande Back-on-white [Coalition period] wares...(1979:136).

Recent Regional Investigations on the Pajarito Plateau

The goal of research conducted by Hill, was to use survey and excavated midden data from the Pajarito Plateau to test propositions explaining how a society will respond to repeated and unpredictable food availability. Researchers propose three broad classes of response. Response 1 involves changes in the kinds of foods that are consumed, this is evidenced in increased diet breadth and specialization of diet. Response 2 involves changes in food production, evidenced by increased variability of field locations and specialization of field types, and increased production and storage. Response 3 involves changes in food distributed, which leads to increased regional economic interaction, aggregation, integration, centralization, and stratification (Hill and Trierweiler 1986:2-9).

Drought is assumed to bring about an increase in resource depression in this study. A retrodictive computer model of drought based on modern tree ring data was used to calculate periods of stress (Garza 1978). For a 450 year period, spanning the Coalition through the Classic periods, 31 years of subsistence stress were randomly distributed in 17 distinct episodes. Five of these periods lasted for two years, and three lasted for three years or longer (AD 1216-1218, 1417-1420 and 1581-1585). Test results depended heavily on the few test excavations, three Coalition period sites, and one Early Classic site; survey data alone could not provide conclusive answers. Nevertheless, the authors conclude that there is an increased diet breadth, evidenced by an increase in the number of animal species used for food: from 13 species during the Early Coalition to 20 during the Late Coalition, and 26 in the Early Classic (Hill and Trierweiler 1986:24). Specialization of diet, increased used of cultigens at the expense of wild species, is also confirmed in the 1986 paper in that the total weight of carbonized corn remains as a percentage of all carbonized specimens obtained from flotation samples increases from 2.4% in the Early Coalition, to 3.7% in the Late Coalition, to 3.9% in the Classic (ibid 1986:24).

A later and more detailed analysis, adding one Early Classic site to the analysis and using different methods, produced the opposite results. A decrease in the use of domesticates was indicated. Using different analytical methods, the raw specimen counts were "converted into total edible calories, based on the average number of specimens per gram (corrected for carbonization) and the caloric yield per gram... Viewing calories from all botanical sources as zero-sum game, the flotation samples indicate that reliance on cultigens actually decreased between the Coalition and Classic from 98% to 89% of all foods increased from 2% to 11% of all edible calories" (Trierweiler 1987:4). Data from faunal remains indicate that small game increased in importance from 9% to 15% of the diet but with domesticated turkeys increasing from 4% to 13% of the faunal diet.

Preucel's (1982) study of settlement pattern change from the Early Coalition to Classic period on the Pajarito Plateau uses the same data base gathered by UCLA crews as that used by Hill and Trierweiler above. Following Hudson's (1969) succession model, the settlement process is viewed as a succession of strategies: colonization, spread, and

competition. This process results from a growing subsistence economy's attempt to minimize transportation and production costs. As populations grow and stress the balance between supply and demand in food producing systems, adaptive responses in both the mode and organization of the food producing system are required to maintain equilibrium (Preucel 1982:39). Initial changes should first occur in the spread stage and would consist of new methods to intensify production and make distribution more efficient. Three stages correspond to the observed archaeological pattern of dispersed single family dwellings first observed on the Plateau during the Early Coalition period, to the growth of large and small clustered settlements over the entire area, culminating in regularly spaced Late Coalition to Classic aggregates which compete for the resources of the stressed catchment. Catchment analysis in the same area as this study were conducted by Davis (1981) and Orcutt (1982), confirming that catchments became stressed through time, with aggregation and agricultural intensification as responses.

The focus of recent survey and test excavations at Bandelier National Monument is "to test the hypothesis that Anasazi settlement aggregation and organization complexity are cultural adaptations developed to reduce resource unpredictability and depletion" (Powers 1988:86). Population growth and concomitant reduction in the subsistence base, rather than drought, are the primary causes of stress in the model developed by Powers, et al. Population growth and aggregation in the Classic period are assumed to have resulted in food shortages. Aggregation is taken as only one response to supposed food shortages; warfare and raiding are also possibilities that will be tested. These changes in social organization, which lead to increased productivity through greater political and economic efficiency, are hypothesized as the "primary adaptive mechanism" used to cope with food shortages.

Kohler's (1989) test excavations at Bandelier National Monument have been structured to test a model of aggregation similar to that proposed by Powers (1988). According to Kohler's model (19), as population grows, either through natural increase or immigration, two previously used strategies (residential mobility and foraging) for coping with agricultural risk are no longer available. In other words, wild resources are increasingly depleted, and there is more competition for arable land and foraging territory. Larger aggregated populations have a selective edge in this situation because they spread out agricultural risk over a larger production unit. Even though aggregation increases the labor costs of agriculture, there are offsetting advantages: competition for land is decreased as social regulation increases, food sharing increases, clear territorial boundaries decrease actual conflict, and regional trade is facilitated by larger centers. Given an increase in population, wild resource depletion and a population aggregation should follow. This model will be tested by using "spatial simulation that examines the relationship between population and resource locations and the extent of agricultural catchment overlap" (Kohler 1989:9).

Although not specifically tested with Pajarito Plateau data, Cordell (1984) suggests that a Puebloan response to resource depletion is a patterned abandonment/migration process that proceeds on three levels. Individual sites may be abandoned, then localities, and finally whole regions. Each stage of abandonment has a different trigger, as well as

varying consequences for other cultural subsystems. For example, population increase on the Pajarito Plateau in the Coalition period and the subsequent decline in the Classic period may be accompanied by population declines and increases in other regions and localities. In particular, Cordell suggests that marginal areas surrounding population centers, especially mountainous upland areas, such as the Pajarito Plateau, were used as overflow areas.

It would appear that until the 1400's the mountainous areas provided an outlet for local population increase, since in essence, people could become hunters and gatherers if necessary. Following the abandonment of the Chaco area, however, this outlet was not sufficient for the numbers of people in the eastern area. The added constraint, I believe is reflected by the large and unstable aggregated communities of Pueblo IV (1979:103-104).

The role of low frequency environmental processes (LFP) such as changes in the water table, sedimentation and channel filling and cutting, versus high frequency processes (HFP) such as changes in rainfall pattern and drought, has been used by Orcutt (1991) to predict where populations will move on the Pajarito Plateau. Using a model first developed by Plog et al (1988) and Dean (1988), if low frequency processes are great enough to affect carrying capacity, societies will be forced to adapt. Because of the very short cycles associated with high frequency processes, on the other hand, societies usually have developed coping or buffering mechanisms, and these processes are unlikely to be the main drivers behind cultural change. Quoting from Dean et al. (1985:538), Orcutt states "As long as population density is low, and LFP conditions are stable, settlement mobility is a mechanism for coping with HFP variability" (1991:316). Using environmental data, population movement on the Pajarito Plateau follows the model until AD 1400. In the Early Coalition (AD 1150-1250), conditions were dry and fluctuations minimal, the model predicting a preference for sites located in high elevations. The population decrease and settlement aggregation at the lower elevations, seen during the Classic period, suggests that other factors, such as the increased adaptive value of aggregation under conditions of competition for land-based resources, may have contributed to organizational changes that took place between the Coalition and Classic periods.

The above summaries point out that different assumptions have been used in recent studies with often conflicting conclusions being drawn from Pajarito Plateau data:

- 1) UCLA researchers see climatic change occurring (Garza 1978) and as being sufficient to be the primary stress, leading to changes between the Coalition and Classic. NPS researchers, citing Cully's (1986) climatic analysis, feel that there has been little climatic change (1988:112).
- 2) Hill and Trierweiler (1986), Larson (1988), and Orcutt (1991) argue for a population decline in the Classic, while Powers (1988) assumes an increase.
- 3) An increase in Classic period craft specialization and trade are expected by powers (1988), accepted by Hagstrum (1983) and rejected by Larson (1988).

RESEARCH OBJECTIVES FOR THE EXCAVATION OF LA 4620, 4621, 4622, 4623, 4624, 4625, and 4626

Much of the recent data summarized above suggests that there is a succession of settlement types for the Coalition period to Classic period culminating in an aggregated system with a smaller population and a broader subsistence base. While Powers states, prior to his field work, that there is a “lack of evidence for a population decrease” (1981:91) between the Coalition and the Classic, field data from the LANL database argues to the contrary (Larson 1987a). Powers’ model acknowledges that a return to hunting and gathering would have made no sense unless accompanied by a decrease in population – both conditions suggested by Trierweiler’s (1987) and Larson’s (1987a) data. Preucel’s assumption of a large population in the Classic is derived from Mera’s (1935), which states that all Classic period sites on the Pajarito Plateau were occupied for longer time periods than tree ring dates and statistical pottery analysis would indicate (Larson 1988).

Crucial to all of these research questions is an analysis of population size and food production. This material can only be gathered through systematic excavations, of which there are few on the Pajarito Plateau. Both the UCLA and Bandelier surveys were hampered by the lack of excavated data and the Washington State excavations at Bandelier National Monument have been very limited. Either excavation of these seven sites will show a change through time or the workings of a contemporaneous settlement system may answer some of these questions.

SPECIFIC RESEARCH DOMAINS TO BE ADDRESSED

Regional Research Questions to be Addressed

- 1) What was the level of environmental stress and/or population pressure during the Coalition period on the Pajarito Plateau?
- 2) What were the economic and social responses to these stresses? Previous research has suggested several possibilities and data will be collected so that these, and others, can be evaluated.
 - a. There is a change in species exploited.
 - b. There is a change in agricultural production system and agricultural land use.
 - c. There is a change in settlement system.
 - d. There is a progression of site abandonments.

SITE SPECIFIC RESEARCH QUESTIONS TO BE ADDRESSED

- 1) The correct temporal placement of each site within the settlement system and estimation of the population size.
- 2) Description of the subsistence base at each site.
- 3) Estimation of stress level at each site.
- 4) Functional differentiation within each site (specialization of tasks and production) and between sites.
- 5) Evidence for regional procurement and exchange.
- 6) Reasons for site abandonment.

A discussion of methods and relevance for each of these objectives follows.

Temporal Placement of Sites within the Settlement System and Population Estimation

The importance of determining contemporaneity of sites and with it, population density, cannot be overemphasized. As Orcutt has cogently pointed out, "Population density is often viewed as an independent variable capable of causing changes in other variables, especially in resource availability, local group size, and competition. Changes in population density also have an indirect effect on many other variables" (1984:195).

Chronometric techniques will be used to date each site if suitable samples become available during excavation. Radiocarbon and tree ring dates will be processed with suitable materials. Archaeomagnetic samples will be taken from fired clay hearths and other suitable surfaces. Obsidian hydration measurements will be made on a sample of obsidian artifacts from a variety of depths and proveniencies within the site.

Microseriation of Santa Fe Black-on-white ceramics and utility wares from Coalition pueblos between Guaje and Santa Clara Canyons on the Pajarito Plateau revealed several time-sensitive ceramic attributes that can be used to arrange Coalition period sites in chronological order. Pronounced indentations on corrugated vessels, a higher frequency of hatched rather than solid designs, fewer framing lines and placement of framing lines closer to bowl rims are attributes found on Early Coalition ceramics (deBarros 1981). This trend culminates in the design characteristics commonly associated with Wiyo Black-on-white, a late Coalition ceramic type (Lang 1982; Mera 1935). Existing collections from Mesita del Buey Coalition sites will be incorporated into this study, as well as the ceramics obtained during surface collection and excavation, so that the time range of the seriation can be extended. Standard seriation techniques will be used (deBarros 1981; Marquardt 1977, 1979). As discussed above, a cursory examination of the ceramics from these sites and others on the Mesita seems to indicate that not all sites are contemporaneous. Worman's ceramic counts also indicate that an increase in frequency of Wiyo ceramics may be correlated with pueblos with D-shaped kivas or with certain mesas (Steen and Worman 1978; Worman 1967). This suggests that a pattern of site abandonments, either on local mesa tops or between mesas may be discernable through microseriation.

A progression of masonry styles also may be used to arrange ruins chronologically within the Coalition period (Steen 1982:37-38). The earliest Coalition period habitations are constructed with adobe and tuff footing stones laid in shallow trenches. Small stones were often used in the coursed adobe construction, but only as fillers. The latest pottery type found on these sites is Santa Fe Black-on-white. Rough block masonry follows, consisting of roughly shaped tuff blocks laid in an adobe mortar. Santa Fe is the predominant pottery type but Wiyo is also present. The final masonry style, cut stone masonry, appears in the Late Coalition and into the Classic period. Tuff blocks are pecked, well shaped, and extremely long, sometimes up to 1 meter in length. Walls were chinked and then adobe plaster was applied. Examination of ruins on Mesita del Buey indicates that not all sites have the same masonry style. This data will be compared with the ceramic microseriation described above.

A method for determining length of site occupation and site population has been proposed by Schlanger and Kohler (1984) using an index of accumulative trash on a site versus the number of rooms. In developing this technique, typical direct indicators of population size, such as site area and roomblock floor area, were correlated with the use lives of artifacts found on sites. The use-life of artifacts was ranked as follows, from shortest to longest: flaked lithic debitage, flaked lithic tools and non-flaked lithic tools, jar sherds, bowl sherds, and metates. This "time-rate" approach suggests that counts of bowl sherds and metates (long use items) might be good estimators of site population. The duration of site occupation can be recognized by using mid-range use items such as non-flaked lithic tools, sherds, and flaked lithic tools (Schlanger and Kohler 1984:88). Data received from each site will be compared and existing data from other Mesita del Buey sites, where available, will be used in an attempt to determine the length of site occupation.

A variety of methods for estimating population size from archaeological data are available (Hassan 1981); various methods appropriate to the data base available will be used and compared in the final analysis. The appropriateness of using more than one model in population estimation is well illustrated in Crown's (1991) summary of the room building sequence at Pot Creek Pueblo near Taos. She stresses that both room use life and site growth dynamics must be considered when calculating site size and population. To illustrate this point, she describes how two different models can be used to extrapolate population size from number of rooms present at a site, each of which will produce a very different population size. One model assumes that all rooms were added cumulatively and were all occupied simultaneously until the site was abandoned. The second model allows for sequential use of rooms. Any room showing a lack of remodeling is considered to have been abandoned, and is omitted from population estimate calculations, resulting in a smaller population estimate. In addition, she found that before making a population estimate for the site, the building sequence had to be taken into account. This involved comparing tree ring dates, wall abutments as a measure of building sequence, and room counts. Such prehistoric practices, such as stockpiling vigas, reusing old wood, and remodeling or repairing of existing wood, made this reconstruction difficult.

The implications of Crown's study for the present research are very important, room count alone is not a good indicator of population size. In addition, the problem on Mesita del Buey may be even more complicated since there is a high probability that all sites were stripped of wood upon abandonment, making tree-ring dating impossible. Other sites on the Pajarito Plateau also reflect site abandonment processes, which included cannibalizing abandoned pueblos of both building stone and vigas. This was the case at LA 4618, and has been documented by Kohler (1989) and Steen (1977, 1982).

Description of Subsistence System

To determine what resources were available in the local environment, standard site catchment techniques will be used (Findlow and Ericson 1980). While several problems exist with this technique, it can still be used, with caution, to approximate carrying capacity. While Vita-Frinzi and Higgs (1970) original estimate of a 5-kilometer catchment around sedentary agricultural sites is customarily used by archaeologists, contemporary accounts of Puebloan land usage suggest that a much larger area was used. Data collection by Florence Ellis for land claim court cases, reported by Cordell, show that the average non-automobile trip away from Taos pueblo is 14.29 miles and the average non-automobile trip away from Laguna pueblo is 29.6 miles. Because previous estimates of catchment size for prehistoric settlements on the Pajarito Plateau have been drawn around non-contemporaneous sites, therefore producing erroneous estimates of the resource base available for each site, care will be taken in this proposed study to first determine what sites are contemporaneous before applying catchment analysis.

To determine what resources were used at each site, all fill will be screened with ¼ " screen, and floral and faunal specimens analyzed and quantified. Flotation and pollen samples will be taken from levels within all rooms and features and compared to modern samples taken outside the site boundaries.

Determination of Stress Level and Subsistence Change Response

Retrodictive tree ring data (Cordell 1979; Cully 1988; Garza 1978) and other climate information (Bowen 1989) will be used to correlate periods of drought with chronometric and relative dates for each site. Population estimates for Mesita del Buey will be compared to available resources determined from catchment analysis to determine the level of food stress present during the site occupations. This will be compared to the plant and animal remains recovered from each site. If the site occupants were under stress, several responses have been predicted, which can be tested with the data to be recovered.

Trierweiler's (1988) analysis of the faunal remains from Coalition through Classic period on the Pajarito Plateau suggests an increase in the use of "garden species" through time. This is an indication that the labor investment required to hunt large game is too great to warrant the effort. This is usually assumed to be the result of population growth/density

(Earle 1980) and is also correlated to a heavier reliance on cultigens. A greater variety of species may be exploited, which leads to increased diet breadth, than would be expected under non-stress conditions (Hill and Trierweiler 1986).

Less favorable resources may be exploited as the more preferred varieties become more costly to obtain. This may be seen in the archaeological record as a change in the species of wood used for construction as well as for fuel. Assuming a stable catchment size, types that are more favorable would be used first, followed by a switch to less favorable species through time. Where possible, the species of wood used in construction and found as charcoal will be tabulated, and any statistical differences between stratigraphic levels or distribution differences between contemporaneous site activity areas evaluated for significance.

Storage facilities may increase as wild species become harder to collect and cultigens become a larger portion of the diet. As only small percentages of rooms within any excavated ruin on the Pajarito Plateau contain hearths, and therefore are classed as habitation rooms. Most of the rooms in Coalition pueblos must have been used for storage. The identification of rooms as habitation versus storage will be undertaken using the presence of living features such as hearths. The material found on or close to the floors of storage rooms, especially data derived from flotation samples, will be used to determine what was being stored in each room.

Responses Involving Task Specialization

Specialization of procurement activities may be one response to resource depletion, which will increase productivity and/or efficiency without increasing labor investment (Fisk and Shand 1969). Task specialization may occur at several levels within a settlement system, most noticeably between sites within a settlement system or also within the structure of activities at the site itself.

Functional differences between sites within a contemporaneous settlement system can be recorded as the presence/absence of specific features and their associated behaviors. Kivas have long been taken by archaeologists as indicative of community integration (Steward 1955). Even though the identification of kivas on Coalition sites on the Pajarito Plateau is obscured by their frequent placement within roomblocks, many excavated sites do not have kivas visible from the surface. Our on-going excavations at LA 4618 have uncovered two rock-cut kivas that were not visible from the surface of the site. Each was intentionally backfilled with tuff blocks upon site abandonment. If this was a common practice upon site abandonment, many more sites on the Pajarito Plateau may contain traditional subterranean kivas than has been previously thought.

However, if the absence of kivas on many Pajarito Plateau sites is real, it may indicate a functional difference between site types. Not all sites may be habitations; some may be seasonal or resource specific structures. If this is the case, these site types (with kivas and without) should show statistical variation in the types of artifacts present at each site

type. If this variation corresponds to differences in subsistence strategies, the types of pollen, floral, and faunal samples found at each site type may differ. Seasonal variation may be noted in the varieties of pollen and botanical samples present, the age of animal species procured, and the presence/absence of cultigens.

There is some indication that functional differences between the sites on Mesita del Buey may be indicated by the types of plants now growing on the roomblocks. A botanical survey of plants growing on the roomblocks of 18 sites on Mesita del; Buey (Foxy 1987) revealed differences which could indicate one of three possibilities. First, a different prehistoric distribution and use of plants at different site types (for contemporaneous sites). Second, a change in prehistoric plant use through time (if sites are not contemporaneous). Third, differences in the depth of fill and floor type between sites.

Within a specialized system, some sites may have been inhabited for longer periods of time than others, depending on their functions. As a system becomes more specialized, centralized planning should become evident. A comparison of site building sequences will reflect the degree of planning present within the settlement system as well as the degree of sedentism of the agricultural system. Wall abutments, chronometric dates (if available), and pottery seriation frequencies associated with each room can be used to determine if the site was constructed at one time or was constructed as a conglomerate. Sedentary systems will show growth through time while a shifting system will show little modification to the existing structures before the site is finally abandoned. Labor investment in short-term sites should be less than labor investment in more permanent sites. Evidence of this may be seen in the costs involved in constructing each site; this can be measured by types of materials selected, distances traveled to procure these resources, and estimated amount of time spent in construction.

Activity areas within a site may also indicate a division of labor beyond that of male and female tasks. Activity areas outside the roomblocks may contain different tool kits and sharpening debris resulting from special processing activities. Controlled surface collection, magnetometer survey and testing outside the roomblocks will be used to discover these areas. All lithic material recovered from outside the roomblock as well as material found on the floor or fill of rooms will be analyzed to identify use of artifacts and definition of activity areas.

Responses Involving Increases in Size of Procurement System

The model developed by Minnis (1985:187) to predict economic and organizational responses to food stress proposes "with greater food stress there will be a sequence of responses ordered by their degree of social inclusiveness, such that responses that involve greater numbers of social groups will occur after less inclusive responses are attempted...social groups faced with food provisioning problems will have to enlarge their economic network so as to have access to a more reliable food supply". An increase in the size of the exchange network is predicted. This process can be viewed as a strategy

that minimizes risk since the social bonds that reciprocal exchange strengthens will insure that allies can be called upon in times of stress.

The level of exchange present in a system can be divided into three categories (after Travis 1984), each of which encompasses a larger geographic area. The most localized level, the network consists of local kin groups. This is followed by an intra-regional network connecting areas of resource diversity, and controlled by a kin-based or socio-politically based alliance system. At the highest level, an inter-regional network controlled by political, economic, or religious functionaries. Different items may be traded at each level and each may be controlled by a different set of variables corresponding to the distinctions often made between local market exchange and long-distance prestige-chain exchange (Larson 1983).

The major drawback to using these models is the fact that the exchange of food stuffs themselves cannot be detected in the archaeological record with any assurance. However, other material items, especially "primitive valuables" (Earle 1983) associated with long-distance trade can often be traced to place of origin. Turquoise and other non-utilitarian items may have been used in exchange for agricultural surpluses, as proposed in Bronitsky's (1984) discussion of luxury items found at Arroyo Hondo, a Late Coalition to Early Classic period pueblo south of Santa Fe, New Mexico. Hill and Trierweiler (1986) found a differential distribution through time of luxury items at Pajarito Plateau sites, but could not correlate them to stress periods. All "luxury items" found at each site will be chemically characterized using non-destructive methods and compared to existing collections and data to determine the geographic extent of the long-distance prestige-chain exchange system.

A different set of principles may have controlled the exchange of ceramics and lithics. Lithic exchange in particular probably results from utilitarian concerns. The distribution of lithic resources on Pajarito Plateau Coalition period sites indicates that of the three most common lithic materials, chert, obsidian, and basalt, only obsidian was procured over any great distance; the percentage of chert and basalt at a particular site is a direct result of its distance to source (Larson 1987b)³. Lithic resource material will be tabulated and a sample of obsidian sourced.

Although a ceramic exchange network has been documented for the Galisteo Basin and Cochiti area during the Classic period (Shepard 1942; Warren 1969, 1977), petrographic (Larson 1988) and trace element studies (Larson and Olinger 1986) using controlled surface collections rather than grab samples have been inclusive in documenting a large amount of trade. No more than 5% of Classic period ceramics on the Pajarito Plateau appear to have been exchange wares.

No in-depth studies have been conducted for Coalition period ceramic exchange on the Pajarito Plateau although this is a research aim of work on-going at Bandelier National Monument. An appropriate sampling strategy will be used to select ceramics for temper analysis using a 40x binocular microscope. Depending on the numbers of sherds collected, this will most likely consist of all rim sherds and a random sample of body

sherds, stratified by ceramic type. Based on past examination of Coalition period ceramics, the majority will be tempered with volcanic ash; a widespread geologic occurrence over much of northern New Mexico. A typology based on textural varieties of ash will be made first, with samples from each type further analyzed petrographically and chemically. The goal of this analysis will be to determine the variability within tempering materials used and if possible, the size of the ceramic catchment and exchange network.

Reasons for Site Abandonment

A process of site abandonment as a response to resource depletion has been proposed by Cordell (1984). A population increase on the Pajarito Plateau during the Middle Coalition (Trierweiler and Hill 1986) is preceded by a decrease in sites in the Galisteo Basin (Dickson 1979), indicating the abandonment succession may affect districts or even regions in this case. A study conducted by Wyckoff (1977) at Mesa Verde suggests that if a site were abandoned after complete resource depletion, this should be reflected in the types of pollen and botanical remains found in the fill deposited immediately on top of the cultural remains after the site was abandoned. If found, these post abandonment shifts in pollen frequencies may reflect succession changes relating to the invasion of weedy species after nearby field areas have been abandoned.

An indication of a complete alteration of the natural landscape, at the time of site abandonment, was also noted in the Dolores Archaeological Program area. Following Dean's (1969) study of Tsegi phase shift in wood use at a site as an indicator of wood depletion, more favorable species of wood should be found during the initial period of site occupation, with the least favorable found in levels associated with occupation just prior to site abandonment.

DATA RECOVERY PLAN

Data recovery will be done in accordance with 36 CFR 66, Recovery of Scientific, Prehistoric, Historic, and Archaeological Data: Methods, Standards, and Reporting Requirements (proposed guidelines). Project personnel meet the requirements specified in "Archaeological and Historic Preservation, The Secretary of the Interior's Standards and Guidelines" (Federal Register 48:190 [29 September 1983] pp. 44716-44742). Qualified specialists in the fields of ethnobotany, (for floral, pollen remains), and osteology will be contracted to perform the final analysis of these materials. Field and laboratory techniques are detailed in Larson and McGehee (1991) and McGehee and Larson (1991). Field extraction techniques for pollen and flotation samples were provided by the experts who will perform the analyses and are included in Appendix B.

³ Data from Burnt Mesa Pueblo, discussed earlier, contradicts this statement (Slaughter 1989), but cannot be addressed until the Mesita del Buey sites have been more accurately dated.

Surface collections

The scatter between every site will be 100% surface collected in 5x5 meter units in order to define site boundaries, when possible, and calculate artifact density figures for each site. Permanent data will be established every 100 meters and each roomblock accurately located within this grid system. Artifacts from each unit will be bagged separately, labeled appropriately, and accessioned in the Site Accession Number Log.

Excavation

An independent metric grid system, aligned to the north-south axis of the pueblo, and a vertical datum will be established on each site before excavation begins. Small trenches, no more than 10-20 centimeters deep and 10 centimeters wide will be made along projected wall outlines in order to understand site architecture before excavation proper is initiated. The backdirt from these trenches will be left in place, and screened in the first level of excavation.

Excavation will be within rooms but be recorded not only by room quadrate, but by actual grid coordinates.⁴ Standard excavation unit size will be 1x1 meter, unless site architecture dictates otherwise. Units will be excavated in 10-20 centimeter levels, depending on fill characteristics. Natural levels will be used for excavation when they are visible. All fill will be screened through standard ¼ inch screens. All artifacts collected will be bagged and labeled in accordance with standard procedures developed for LANL (McGehee and Larson 1991). A 35-mm color slide photograph will be taken of each excavated level. The roll, frame, unit, recorder, direction, and description will be recorded in a site photo log. An excavation level form, that includes a scale map, will be filled out for each level. All notes, including feature notes, will be recorded on this form. Photo numbers, artifact bag accession numbers, date and excavator information is recorded for each level.

Excavation units within roomblocks will be excavated to living surfaces. The natural strata above living surfaces will be removed as a single unit not more than 10 centimeters in depth. All floor artifacts will be left in place, point provenienced, and bagged separately. Half of each room will be excavated to floor and a scale wall profile prepared. Natural strata or post-depositional events will be marked on this form. The location of pollen and flotation samples will be determined based on the profile of each room. Samples will be taken from the second half of each room to be excavated, and will be taken from each defined strata. Floor features will not be excavated, until the entire room has been cleaned of fill, mapped, and photographed.

After each room has been completely excavated, a room summary form will be prepared. This form will include any feature forms if necessary. Data from the level forms will be summarized and a narrative interpretation of the room made on this form. Color slide photographs and black and white photographs will be taken of each excavated room and all features. After a room has been completely excavated, all floor features will be excavated in natural levels. All fill from features (or a sample of the fill, depending on

the size of the feature) will be subject to flotation and pollen analysis. Any remaining wall plaster will be removed, the underlying masonry photographed and described on the room summary form and photographs taken. Living surfaces will be removed to look for sub-floor features, evidence of remodeling, or underlying floors or structures. If these are encountered, excavation will proceed as described above.

Exploratory trenches will be dug outside the roomblock to locate extramural features and activity areas. Excavation units outside the roomblocks will be dug to sterile soil. Backhoe trenches will be used when hand-dug trenching is not feasible.

Human Burials

In the event that a human burial is encountered during excavation, the appropriate agency and state personnel will be notified. The governor of San Ildefonso pueblo will also be notified at the same time. Early ethnographic accounts by Harrington (1916), Bandelier (1892) and Hewett (1906, 1938) indicate that this area of the Pajarito Plateau was occupied by the people ancestral to those now living at San Ildefonso pueblo. In accordance with the American Indian Religious Freedom Act (AIRFA) and 36 CFR 800.1(c)(2)(iii), their wishes will be taken into consideration in the treatment and disposition of any human remains and associated grave goods found during excavation.

⁴ For example, the northwest quad of a room will be recorded as N 106.3-107.3 and E 100-101.

CHAPTER 5 SURFACE COLLECTION

BRIAN C. HARMON AND TIMOTHY L. BINZEN

FIELD METHODS

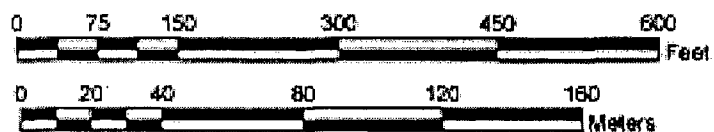
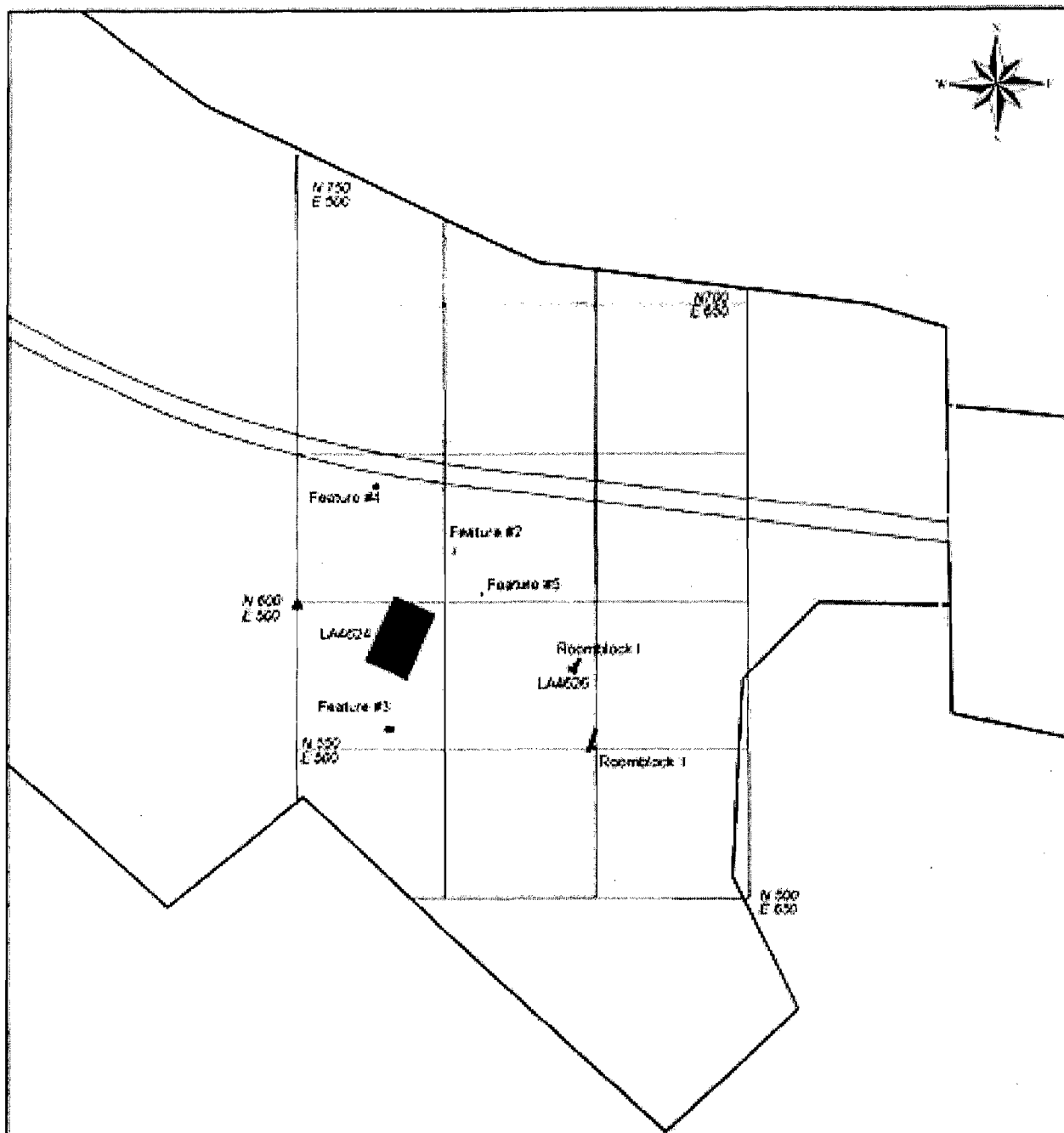
In May and July of 1993 a portion of Mesita del Buey, 150 m west of the old gate and fence at Area G in TA-54 was gridded for a surface collection (Figure 5.1). The grid covered roughly 30,000 m² and consisted of 5 by 5 m collection units; several collection units at the edges of the gridded area were wedge shaped and thus smaller than 25 m². The grid was oriented to true north and was situated so as to cover two pueblo ruins: LA 4624 and LA 4626. A datum of rebar was placed at the western edge of the collection area, 30 m west of LA 4624, and designated as E500/N600. Collection units were identified by the coordinates of their southwest corner. A total of 1,200 units were plotted and 100% of the artifacts in each unit were collected. All artifacts east of the E580 line were assigned to LA4626, and all artifacts west of E580 were assigned to LA4624. Accession numbers were assigned by bag, thus in the cases where there are multiple bags from a single collection unit, each bag has a unique accession number.

SURFACE FEATURES AND STRUCTURE OF LA 4624

Five features are associated with LA 4624 (Figure 5.2). The pueblo, which is centered on E535 N590, is Feature 1. Feature 2 (E555/N612) is a 6 m long alignment of unshaped tuff blocks; it runs northeast-southwest and may be the remains of an agricultural feature. Feature 3 (E532 N561) is a 2 m² alignment of six tuff blocks; two additional tuff blocks 1 m to the north. Feature 4 (E534/N632) consists of a scatter of approximately twenty tuff blocks and measures 3 m north-south by 2 m east-west. It appears that this feature was disturbed by road construction. Feature 5 (E562/N601) is a 1 by 1 m rubble concentration of ten to fifteen shaped tuff blocks. Features 2, 3, and 5 are located at the edge of the midden.

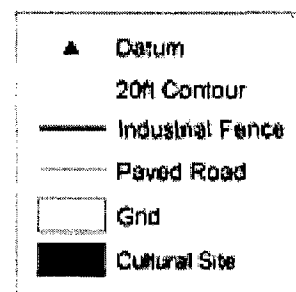
The site layout of LA 4624—linear, oriented northeast-southwest, a D-shaped room on the east, and a midden located to the east—is characteristic of Coalition period roomblock pueblos on the northern Pajarito Plateau (Carlson and Kohler 1990:9-10; Steen 1977, 1982).

The center of an Archaic period obsidian scatter (LA 89812) is located approximately 20 m south of the N500 line. The artifact scatter of this site overlaps with LA4624 and LA4626 to an unknown extent. Additionally, LA 89812 probably served as an obsidian source for the inhabitants of the Area G pueblos.



Area G Surface Collection Grid

Figure 5.1



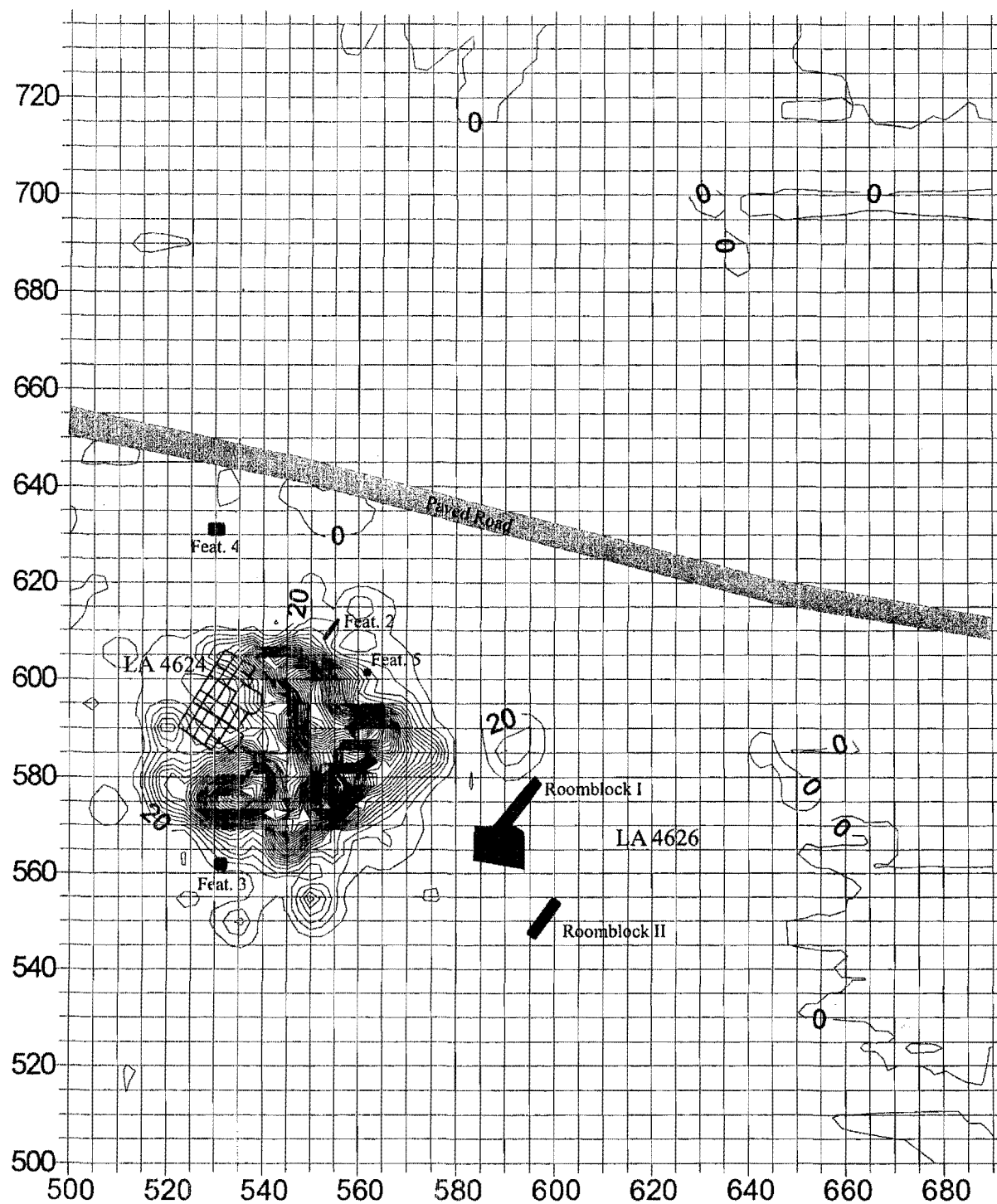


Figure 5.2 Surface Collection: Ceramic Distribution

0 100 meters

Contour Interval 20 Ceramic Sherds

ACT 2

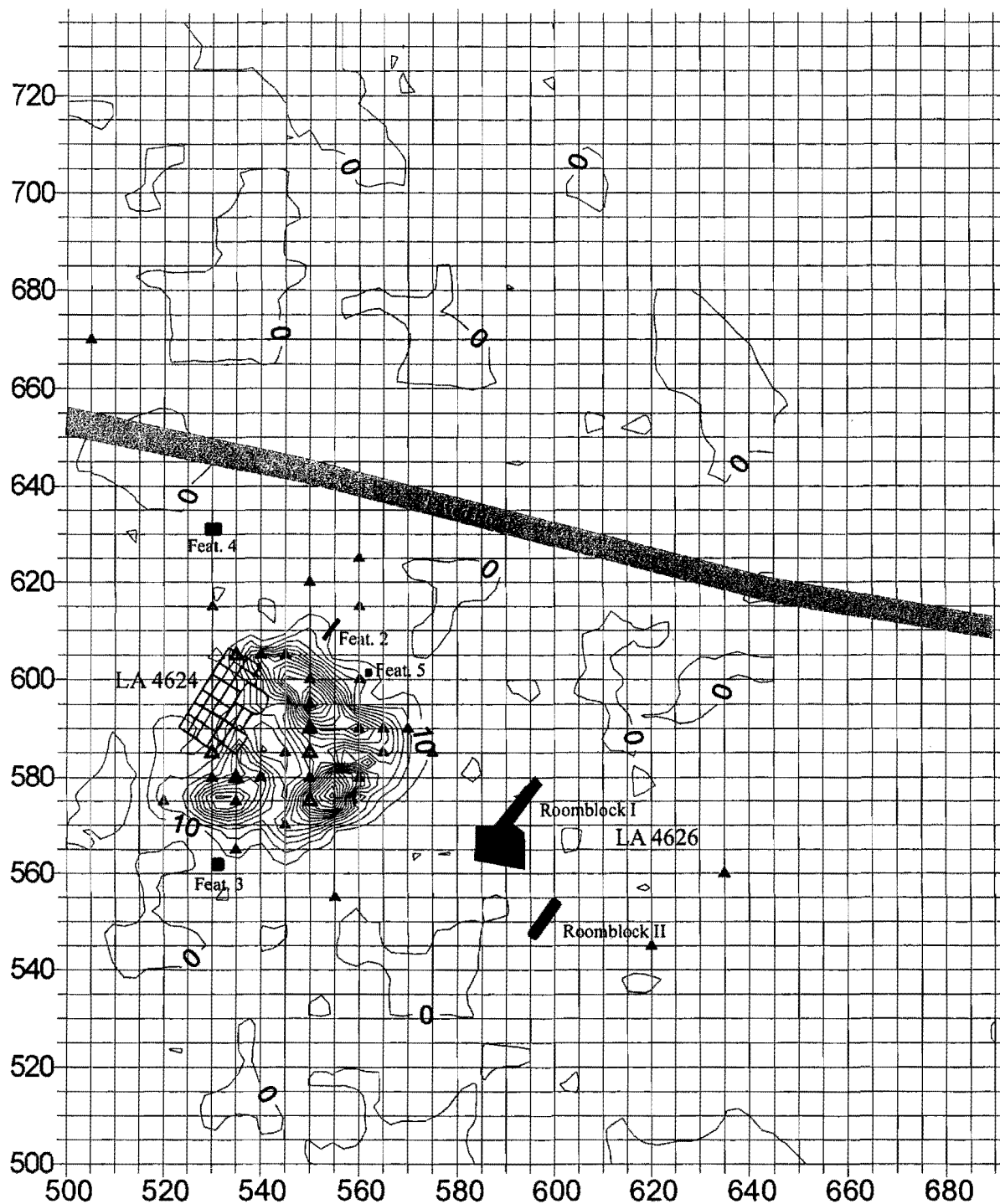


Figure 5.3 Surface Collection: Lithic Artifacts

0 100 meters

Contour Interval 10 Chipped Stone Pieces

Small triangles represent one ground stone fragment
Large triangles represent two ground stone fragments

AREA G ARTIFACT DISTRIBUTION

Pajarito Archaeological Research Project

Both LA 4624 and LA 4626 were visited by the Pajarito Archaeological Research Program (PARP) and surface collected in 1979. Even though a considerably smaller area was collected from LA 4624 than from LA 4626 the former site yielded nearly nine times as many artifacts

A chi-square analysis was used to compare the ceramic and chipped stone assemblages from each site (Table 5.1 and 5.2). The biscuitware sherds were not included in the chi-square analysis because of their small numbers. Table 5.1 illustrates that there is a statistically significant difference between the ceramic assemblages of the two sites. Adjusted residuals were examined to determine which cells were contributing to the difference (an adjusted residual of greater than 1.96 or less than -1.96 indicates statistical significance at the $p = <0.05$ level). LA 4626 contains more unidentified whiteware and Rio Grande Corrugated than expected, LA 4624 contained more non-Rio Grande Corrugated utilityware. This may indicate a slightly earlier date for LA 4626 (Larson, Chapter 4, this volume).

There is little difference between the chipped stone assemblages at the two sites, although more basalt was found at LA 4624 than would be statistically expected. Walsh (1997, 1998) examined the chipped stone artifacts from a number of sites along Mesita del Buey (including LA 4624) and recorded the frequencies of different raw material types. The proportional distribution of raw materials at LA 4626 is most similar to the other Early Coalition assemblages in Walsh's study, while being notably different from Late Coalition and Classic period assemblages.

Area G

The Area G surface collection recovered just under 25,000 ceramic sherds and 4,000 lithic artifacts, including forty-five fragments of ground stone. Nine bone fragments and four botanical items were also collected. Ninety-five percent of the artifacts came from LA 4624 (Table 5.3).

Figures 5.2 and 5.3 are isopleth maps showing the distributions of the ceramic and chipped stone artifacts. These distributions are essentially the same: there is a light artifact scatter across the entire area (63% of the collection units contained at least one artifact) with one major cluster around LA 4624. There is also a minor concentration of ceramics northwest of roomblock I of LA 4626.

If PARP's collections were to be incorporated into Figures 5.2 and 5.3 there would be very little change in the vicinity of LA 4624. PARP collected 119 ceramics from one 2

by 2 m unit (their Unit C) at LA 4626 that was in the vicinity of the minor concentration northwest of roomblock I. Excluding Unit C, PARP collected 2250 m² (the equivalent of ninety 5 by 5 m units). Assuming the artifacts were evenly divided into the hypothetical ninety 5 by 5 m units this would yield 5.5 ceramic sherds per unit. Using this data to plot an isopleth map with five-sherd intervals it would be impossible to distinguish a discrete cluster of ceramics for LA 4626. It would appear that the LA 4624 midden extended to LA 4626.

LA 4624 MIDDEN

The distributions of ceramic and stone artifacts around LA 4624 are virtually identical (Figures 5.4 and 5.5). The midden forms a U-shape: the legs of the U start at the northeast and southwest ends of the pueblo and curve around to meet in the east. Within the midden there is a very dense concentration of artifacts 20 m from the front of the pueblo and there are two other less dense concentrations off the northeast and southeast corners of the building. The lowest concentrations of artifacts occur on and behind the pueblo. It is difficult to define the boundary of a midden, but arbitrarily using the twenty-ceramic isopleth for this purpose results in a midden size of approximately 3300 m². Habitation sites in Bandelier National Monument dating to Bandelier Archeological Survey periods 4 to 7 (AD 1235 ± 15 to 1375 ± 25) have almost exactly the same mean refuse scatter area (Van Zandt 1999:fig. 6.23).

Artifacts from collection units E550/N600 and E550/N575 were analyzed as part of the ceramic and lithic analyses (see Curewitz and Harmon, and Vierra this volume). E550/N600 is part of the northern artifact concentration and E550/N575 is part of the central, and densest, concentration. Tables 5.4 and 5.5 summarize the ceramic and lithic artifacts found in these two units.

E550/N600 differs from E550/N575 by having a greater percentage of Santa Fe Black-on-white, a lower percentage of utilitywares overall (although plain utilityware is exclusive to E550/N600), and a greater percentage of micordebitage (Tables 5.6 and 5.7). The average sherd weight of ceramics from E550/N600 is also smaller: 1.98g/sherd (E550/N600) compared to 2.44g/sherd (E550/N575) (since sherds were weighed by lot it is not possible to calculate a standard deviation). There is no difference in lithic material types between units (Table 5.8). Since E550/N600 is located in a slight depression it seems likely that smaller artifacts are being washed into this area accounting for the variation in mean sherd weight and in the chipped stone artifact distribution. However, without more extensive analysis of midden artifacts the significance of the differences in the ceramic type distribution must remain unknown.

There are significant differences between the ceramic and lithic raw material types of PARP's collection and the two analyzed collection units (Tables 5.9 and 5.10). Many of the differences in the ceramics are due to analysis methods (see de Barros 1981b: Appendix B for PARP's methodology). For example, Curewitz's more detailed analysis reduced number of unidentified whiteware and there were significant differences between

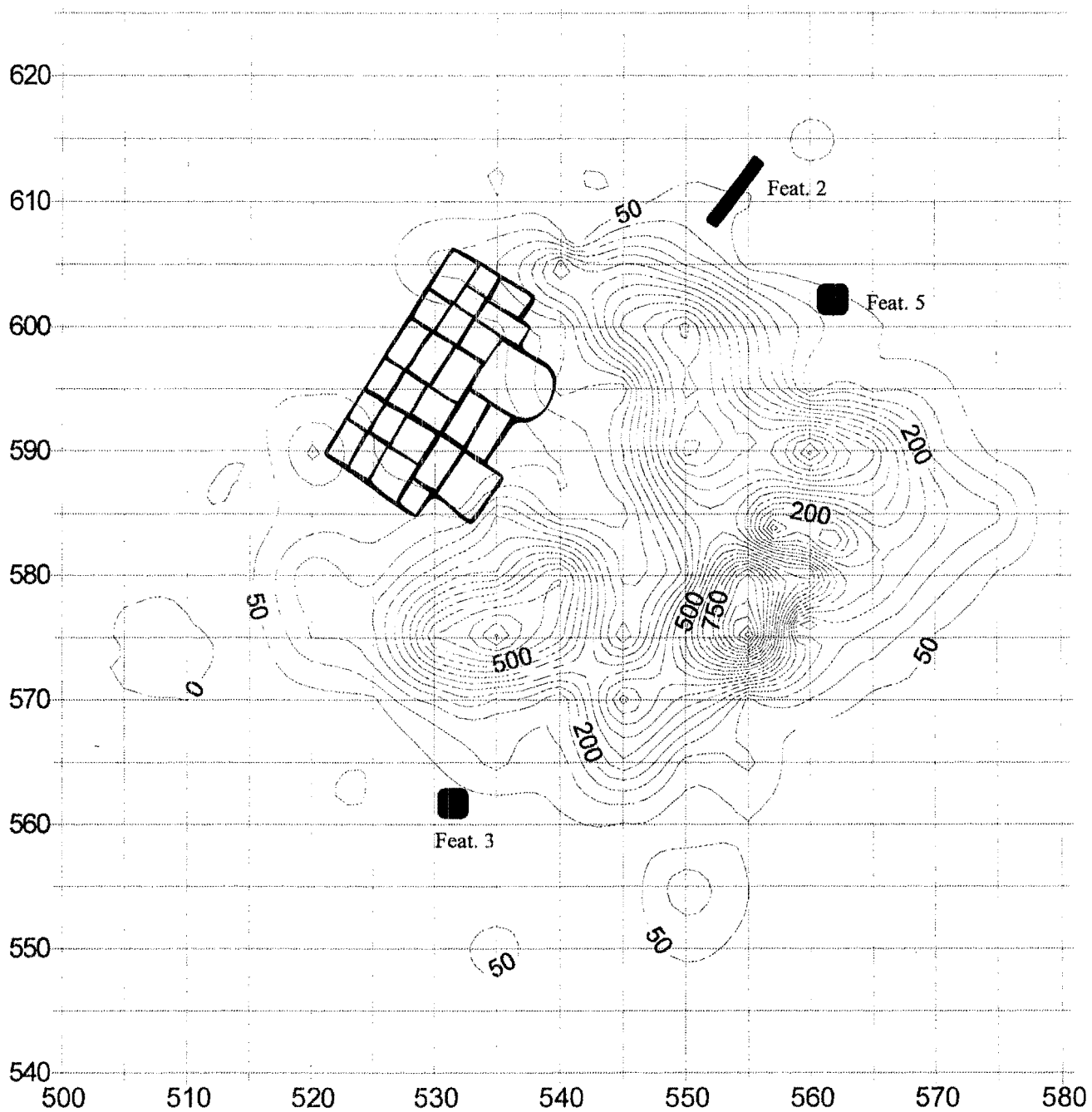
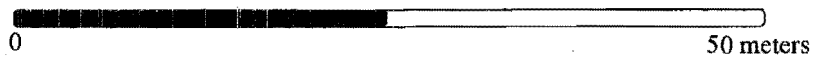


Figure 5.4 LA 4624: Ceramic Artifacts *Distribution*



Contour Interval 50 Ceramic Sherds

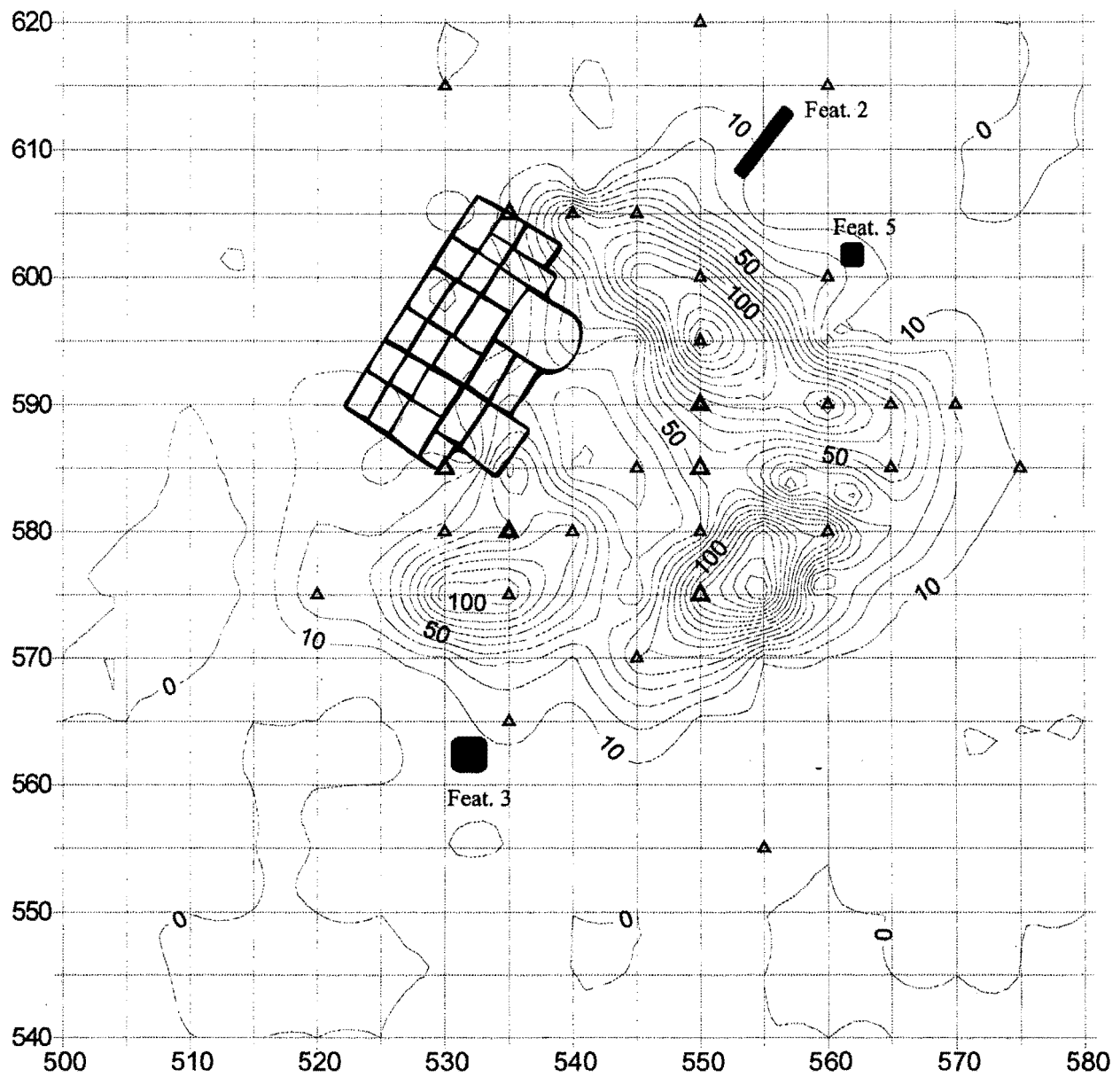


Figure 5.5 LA 4626: Lithic Artifacts Distribution



0 50 meters

Contour Interval 10 Chipped Stone Pieces

Small triangles represent one ground stone fragment

Large triangles represent two ground stone fragments

PARP and Curewitz in the definition of Rio Grande Corrugated. It is harder to account for the differences observed in the lithic materials and without further analysis it is unclear if these are due to collection strategies, intra-midden, or site-level variability that has not yet been detected, or some other factor(s).

Figure 5.1 Area G Overview

Figure 5.2 Surface Collection: Ceramics

Figure 5.3 Surface Collection: Lithic Artifacts

Figure 5.4 LA 4624: Ceramic Artifacts

Figure 5.5 LA 4624: Lithic Artifacts

Table 5.1 Ceramics from PARP collection

Ceramic Type/Ware	LA 4624	LA 4626
Unid. Black-on-white	269 5.1% -3.2	58 7.9% 3.2
Kwahe'e Black-on-white	5 0.1% -1.3	2 0.3% 1.3
Santa Fe/Wiyo Black-on-white	279 5.3% 1.7	28 3.8% -1.7
White Mountain Red Ware	7 0.1% -0.9	2 0.3% 0.9
Biscuit Ware	0 0.0% na	5 0.7% na
Other Utility Ware (Tesuque Smeared Indented?*)	4626 87.3% 4.6	593 81.1% -4.6
Rio Grande Corrugated	113 2.1% -7.0	48 6.6% 7.0
Total	5299	736
Sq. meters collected	127	2254

Chi-square = 65.044, df = 5, $p < 0.001$

Top value in cell represents count, center value represents percent within site and the bottom value represents adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold. Biscuit ware sherds were not included in Chi-square analysis.

*See Chapter 4

Table 5.2 Raw material type of lithic artifacts from the PARP collection

Raw Material Type	LA 4624	LA 4626
Obsidian	96 9.1% -1.4	9 14.3% 1.4
Pedernal Chert	478 45.4% -1.6	35 55.6% 1.6
Basalt	441 41.9% 2.3	17 27.0% -2.3
Other	37 3.5% 0.1	2 3.2% -0.1
Total	1052	63
Sq. meters collected	127	2254

Chi-square = 6.252, df = 3, $p = 0.1$

Top value in cell represents count, center value represents percent within site and the bottom value represents adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold.

Table 5.3 Total artifact count from LA 4624 and LA 4626

	LA 4624			LA 4626			Total
	PARP	Area G	Total	PARP	Area G	Total	
Ceramics	5299	23777	29076	736	1129	1865	30941
Chipped Stone	1052	3739	4791	63	192	255	5046
Ground Stone	-	43	43	-	2	2	45
Bone	-	9	9	-	0	0	9
Macrobotanical	-	4	4	-	0	0	4
Total	6351	27572	33923	799	1323	2122	36045

Table 5.4 Ceramic Artifacts from Collection Units E550/N575 and E550/N600

Ceramic Type		Count	Weight (g)
Service ware	Santa Fe B/w	152	408
	Wingate B/r	3	4
	Indeterminate whiteware	7	11
Utilityware	Plain	211	616
	Plain Corrugated	10	26
	Indented Corrugated	160	406
	Smeared Indented Corrugated	480	974
	Indeterminate utilityware	10	40
Subtotal		1033	2485
Unanalyzed (< 1 cm ²)		200	213
Total		1233	2698

Table 5.5 Lithic Artifact Type by Material Type for Surface Collections

Artifact Type										
		Basalt	Rhyolite	Obsidian	Chalcedony	Chert	Pedernal	Sand stone	Quartzite	Total
Debitage	Angular Debris	11	0	2	18	0	20	0	0	51
	Core Flake	55	1	12	47	3	54	0	2	174
	Biface Flake	0	0	0	1	0	0	0	0	1
	Microdebitage	7	0	1	12	0	5	0	0	25
	Subtotal	73	1	15	78	3	79	0	0	251
Ground Stone	Grinding Slab	0	0	0	0	0	0	1	0	1
	Und. Ground Stone	0	3	0	0	0	0	0	0	3
	Subtotal	0	3	0	0	0	0	1	0	4
Total		73	4	15	78	3	79	1	2	255

Table 5.6 Ceramic Type Weight (g) by Collection Unit

Ceramic Type	E550/N575	E550/N600
Santa Fe B/w	150 11.8% -6.4	258 21.3% 6.4
Indeterminate*	26 2.1% 0.0	25 2.1% 0.0
Plain utilityware	354 27.9% 3.6	262 21.6% -3.6
Plain Corrugated	0 0.0% -5.2	26 2.1% 5.2
Indented Corrugated	206 16.2% -0.1	199 16.4% 0.1
Smeared Indented Corrugated	532 42.0% 2.8	442 36.5% -2.8

Chi-square = 75.559, df = 5, $p < .000$

Top value in cell represents count, center value represents percent within collection unit and the bottom value represents the adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold.

* Combination of Indeterminate whiteware and Indeterminate utilityware in Table 5.4

Table 5.7 Chipped Stone Artifacts by Type

Collection Unit	Angular Debris	Core Flake	Microdebitage
E550/N575	31 23.3% 1.2	100 75.2% 2.0	2 2.2% -4.8
E550/N600	20 17.1% -1.2	74 63.2% -2.0	23 19.7% 4.8

Chi-square = 22.968, df = 2, $p < 0.001$

Top value in cell represents count, center value represents percent within collection unit and the bottom value represents the adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold.

Table 5.8 Lithic Material Type by Collection Unit

Collection Unit	Basalt	Obsidian	Chalcedony*	Other
E550/N575	37 27.6% -0.5	6 4.5% -1.1	88 65.7% 1.1	3 2.2% -0.2
E550/N600	36 30.8% 0.5	9 7.7% 1.1	69 59.0% -1.1	3 2.6% 0.2

Yates' corrected chi-square = 1.68, df = 3, $p = .622$

Top value in cell represents count, center value represents percent within collection unit and the bottom value represents the adjusted residual.

*Both Chalcedony and Pedernal from Table 5.4

Table 5.9 Ceramics: PARP Collection and Area G Surface Collection for LA 4624

Ceramic Type/Ware	PARP	Area G
Unid. Black-on-white	269 5.1% 6.3	7 0.7% -6.3
Kwahe'e Black-on-white	5 0.1% na	0 0.0% na
Santa Fe/Wiyo Black-on-white	279 5.3% -11.0	152 14.7% 11.0
White Mountain Red Ware	7 0.1% na	3 0.3% na
Other Utility Ware (Tesuque Smeared Indented?*)	4626 87.3% 15.0	711 68.8% -15.0
Rio Grande Corrugated	113 2.1% -19.3	160 15.5% 19.3

Chi-square = 544.695 , df = 3, $p < .001$

Top value in cell represents count, center value represents percent within collection unit and the bottom value represents the adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold.
na = not included due to small sample size

Table 5.10 Chipped Stone: PARP Collection and Area G Surface Collection for LA 4624

Raw Material Type	PARP	Area G
Obsidian	96 9.1% 1.6	15 6.0% -1.6
Pedernal Chert	478 45.4% -5.0	157 63.1% 5.0
Basalt	441 41.9% 3.7	73 29.3% -3.7
Other	37 3.5% 1.6	4 1.6% -1.6

Chi-square = 25.497, df = 3, $p < 0.001$

Top value in cell represents count, center value represents percent within collection unit and the bottom value represents the adjusted residual. Significant ($p = < 0.05$) positive values are shown in bold.

CHAPTER 6 EXCAVATIONS AT LA 4624

JENNIFER E. NISENGARD

INTRODUCTION

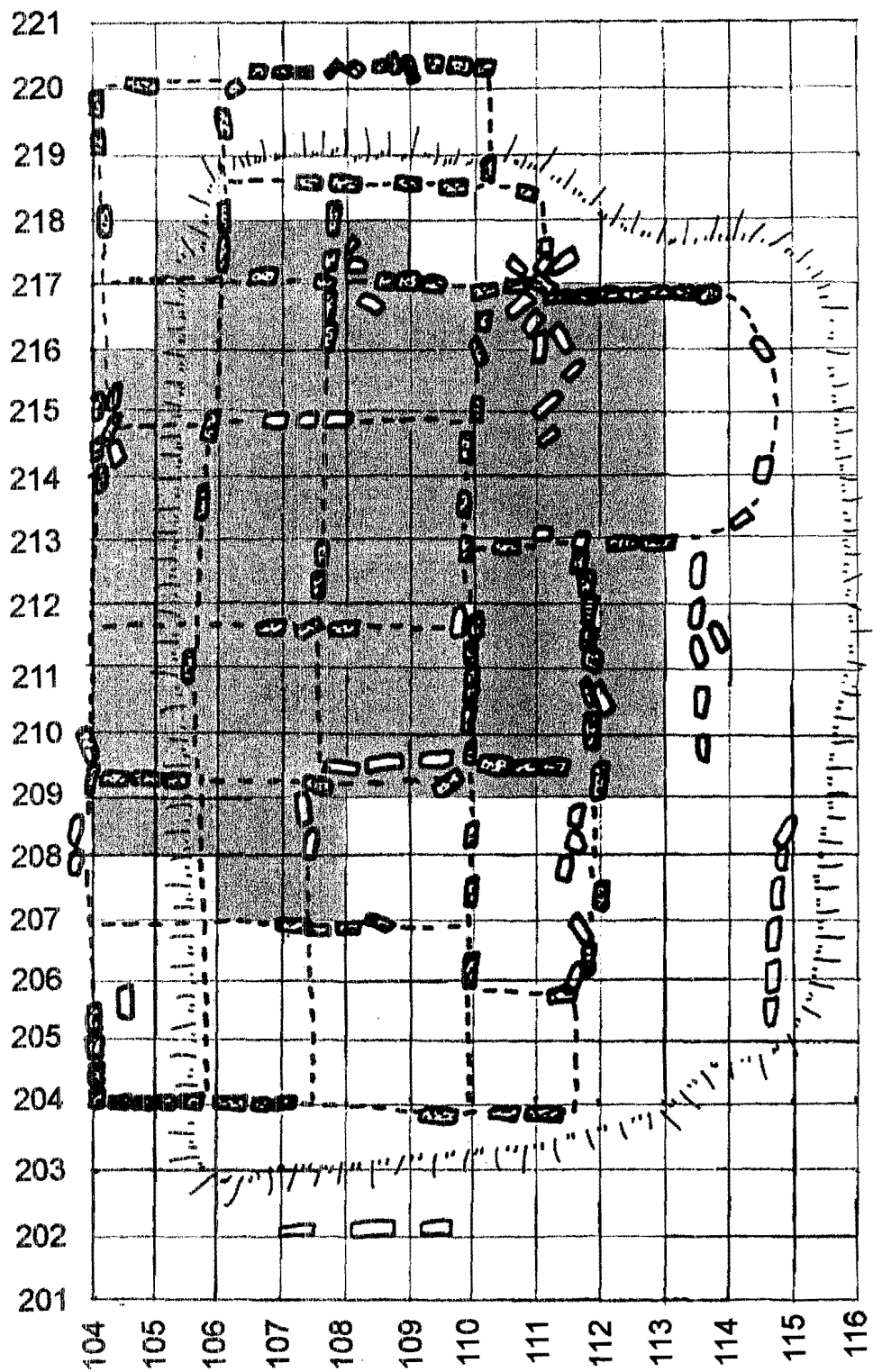
LA 4624 is a large rubble mound representing a 25 room Coalition period pueblo. The site is situated on Mesita del Buey over looking Pajarito Canyon in Technical Area 54. The mesa is sparsely covered with piñon-juniper trees at an elevation of 2060 m (6760 ft). There is a large midden area located to the immediate east of the rubble mound, with a sparse artifact scatter distributed around the site periphery. This chapter presents the results of the partial excavation of LA 4624. This work was conducted at the site from July 13 to August 26, 1993.

Ten of the approximately 25 rooms at the site were partially or completely excavated (Figure 6.1). Most of the excavated rooms are located in the central portion of the roomblock. The excavation included rooms from the entire width of the roomblock, including at least one room in each of the three rows, and portions of one of the two communal structures.

FIELD METHODS

Excavation at LA 4624 proceeded using an independent grid system, distinct from the larger Area G surface collection grid (see Chapter 5). The LA 4624 grid was established along the back wall of the roomblock mound, rather than along a true North/South line to facilitate the identification of rooms. Each grid unit consists of a 1 by 1 square meter area. A baseline for the grid was placed in the southwest corner of the site (at the edge of the mound) at 200N/100E; the southwest corner of the pueblo itself is located at 204N/104E (Figure 6.1). Two data, Datum A and Datum B, were used to calculate levels within the roomblock; however, while most of the elevations presented here are calculated as *below ground surface*, others were noted as *below datum*. In general, excavation proceeded in 20-cm arbitrary levels. *Floor* was the only non-arbitrary level designation. Artifacts encountered in direct contact with the floor were point provenienced.

Identification of room walls and the determination of room size were of paramount importance from the onset of the project. Before excavation began, shallow trenches, 10 to 20 cm deep, were dug in order to outline the general location of room walls; walls became excavation boundaries. Figure 6.2 illustrates the general configuration of the roomblock. As testing proceeded, units were frequently expanded as identification of wall segments occurred. A three-stage excavation strategy was employed throughout the project. The first step was to excavate down to the floor in half the room, keeping track of stratigraphic changes throughout. The second step was to excavate the remainder of the



2 M

LA 4624

Excavated to floor

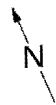
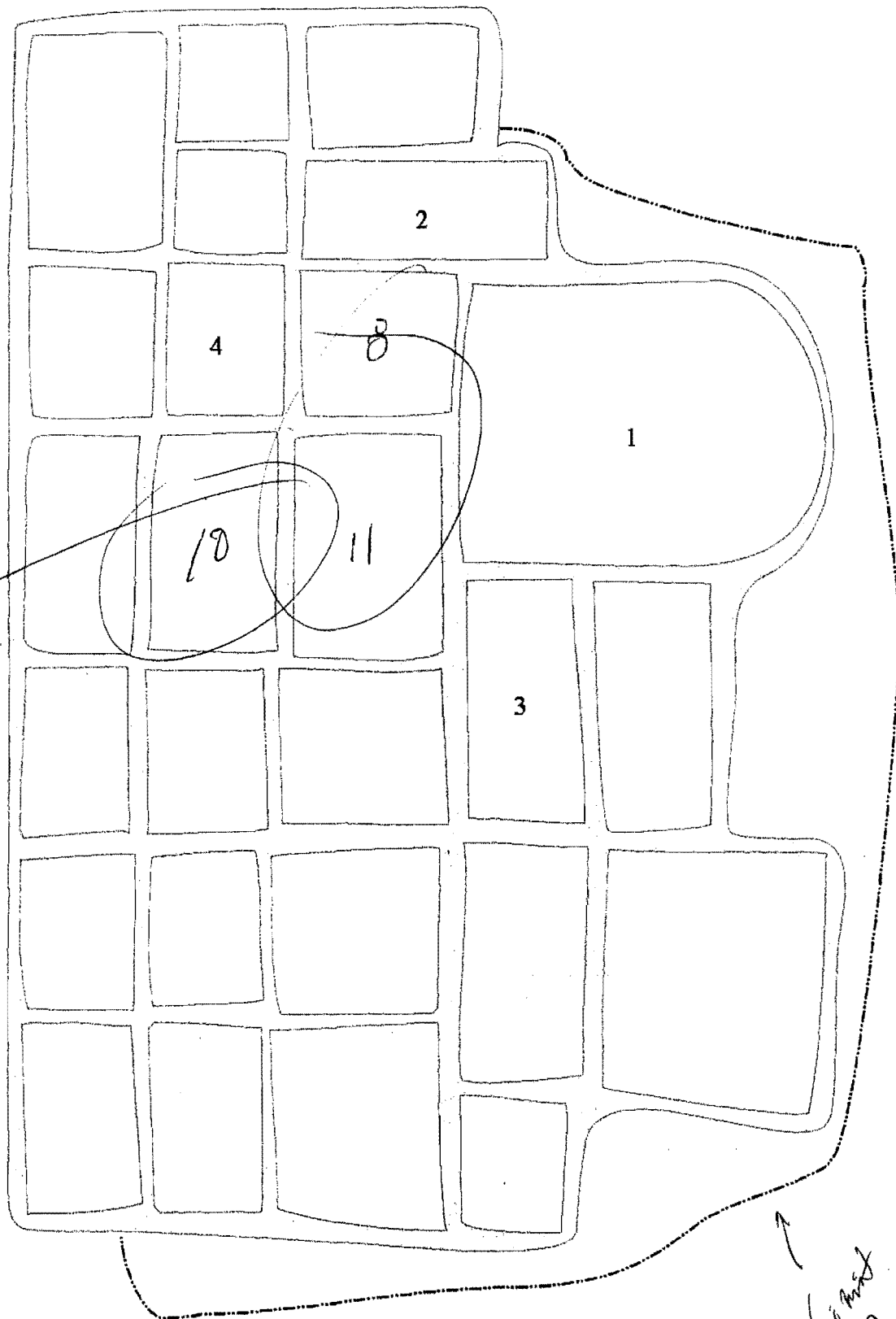


Figure 6.1a

add
here



LA 4624

0 2m

↑
Limit
of
road? /

N

6.2
Figure 6.1b

room and to identify potential floor features. Finally, portions of the floor were removed in search of sub-floor features, as well as to understand floor construction and to find evidence for room remodeling. Throughout the excavation, fill was screened using 1/4" mesh with a goal of 100% artifact collection. When feasible, diagnostic artifacts were point provenienced as they were encountered. Flotation, pollen, botanical, and C¹⁴ samples were also collected (see the *Samples* sections below).

The following discussion focuses on data collected from two of the most intensely tested rooms, Rooms 1 and 3, at LA 4624. Room 1 is located in the northeastern portion of the site and is a D-shaped structure. Room 3 is centrally located and situated near the front of the roomblock. These two rooms are adjacent to one another and share one wall. Room 1 is likely a communal structure, based on its location, in the front of the roomblock, its size, it is larger than all of the other rooms in the room block, and its shape, D-shaped communal structures are common features of Ancestral Pueblo sites. The presence of a floor feature within Room 3 indicates that this room is most likely a habitation room.

SITE STRATIGRAPHY

The information concerning the stratigraphic levels encountered during excavation is derived from site forms, plan views, and profile drawings. There are at least four stratigraphic levels identified within the excavation units at LA 4624. The first of these levels represents post-occupational fill. The second is largely representative of wall fall, and is composed of shaped and unshaped tuff blocks along with some chunks of adobe. Roof fall, the third stratigraphic level, consists primarily of hard packed adobe and small pieces of charcoal. The room floors are located at the bottom of level three; the floor is hard-packed, largely patchy, and has some smoke staining. A large portion of the fill from the units is the result of post-occupational deposition, although roof and wall fall materials were encountered throughout (Table 6.1).

In general, the majority of the fill matrix is a loose sandy to silty loam mixed with tuff blocks, flecks of charcoal, plant roots, and burned daub. Rodent and root bioturbation has disturbed the fill, the floors, and the walls of these rooms. Three flotation and multiple macrobotanical samples were collected from fill contexts during excavation.

Table 6.1 Stratigraphic Units Associated with Room 3

Stratigraphic Unit	Centimeters Below Ground Surface	Munsell	Description of Matrix	Cultural Context
1	0 to 25	10YR 4/3 Brown to Dark brown	Loose aeolian sandy loam; small, unshaped tuff blocks.	Post abandonment deposition
2	25 to 50	7.5YR 5/4 Brown	Compact sandy loam; unshaped tuff blocks,	Wall fall

			charcoal flecks. Rodent disturbance.	
3	50-63 to 78	10YR 5/3 Brown	Loose sandy loam with hard adobe clumps, artifacts, and charcoal. Ash present and associated with the floor.	Roof fall and floor
4	60+/- to 80	Unknown	Loose sandy loam, charcoal, artifacts and small adobe chunks. Rodent disturbance.	Sub-floor

Room 1

The profile illustration of one Room 1 wall depicts two strata; both of these units are comprised of mixed roof and wall fall. The wall fall consists of tuff blocks and adobe, while the roof fall is composed mostly of burned daub (Figure 6.3). A roof fall boundary is not identified in the profile, but the floor of the room is drawn between 63 and 78 cm below the ground surface. Evidence of soot staining and burned daub on the floor suggests that portions of the roof may have collapsed directly onto the floor. The mixed appearance of the Room 1 stratigraphy may be related to rodent activities or root disturbance.

Room 3

The stratigraphy of Room 3 is illustrated by the eastern and western wall profiles (Figures 6.4 and 6.5). These two sketches provide a detailed depiction of the occupational and postoccupational history of the site, and depict the appearance of the room during excavation. In Room 3, a portion of the sub-floor was investigated; however, no sub-floor features or evidence for room remodeling was identified.

The matrix of stratigraphic unit 1, a 25 cm level, is a loose, aeolian sandy loam with roots and some unshaped tuff blocks. This level consists primarily of post-occupational fill; the tuff blocks are likely wall rocks that collapsed into the room over time.

Stratigraphic unit 2, another 25 cm level, is a compacted sandy loam and a bit lighter in color than unit 1 (Table 6.1). Chunks of burned and unburned adobe mixed with charcoal (likely pieces of both wall and roof materials) are encountered throughout the level.

Flecks and pieces of charcoal are quite common. This unit represents a mixture of post-occupational fill, wall fall and roof fall.

Stratigraphic unit 3, ranges from 13 cm to 30 cm in depth, and is the heart of the roof fall. Preserved portions of the original room floors were revealed at the bottom of this level. Larger chunks of adobe, charcoal, soot staining, and some small ash lenses were encountered during the excavation of the level.

Handwritten notes:
 6263
 100m
 0.5m
 0.1m



□ Loose fill with root inclusions and mixed with wall fall. Silty loam, brown color, 10 YR/5.3

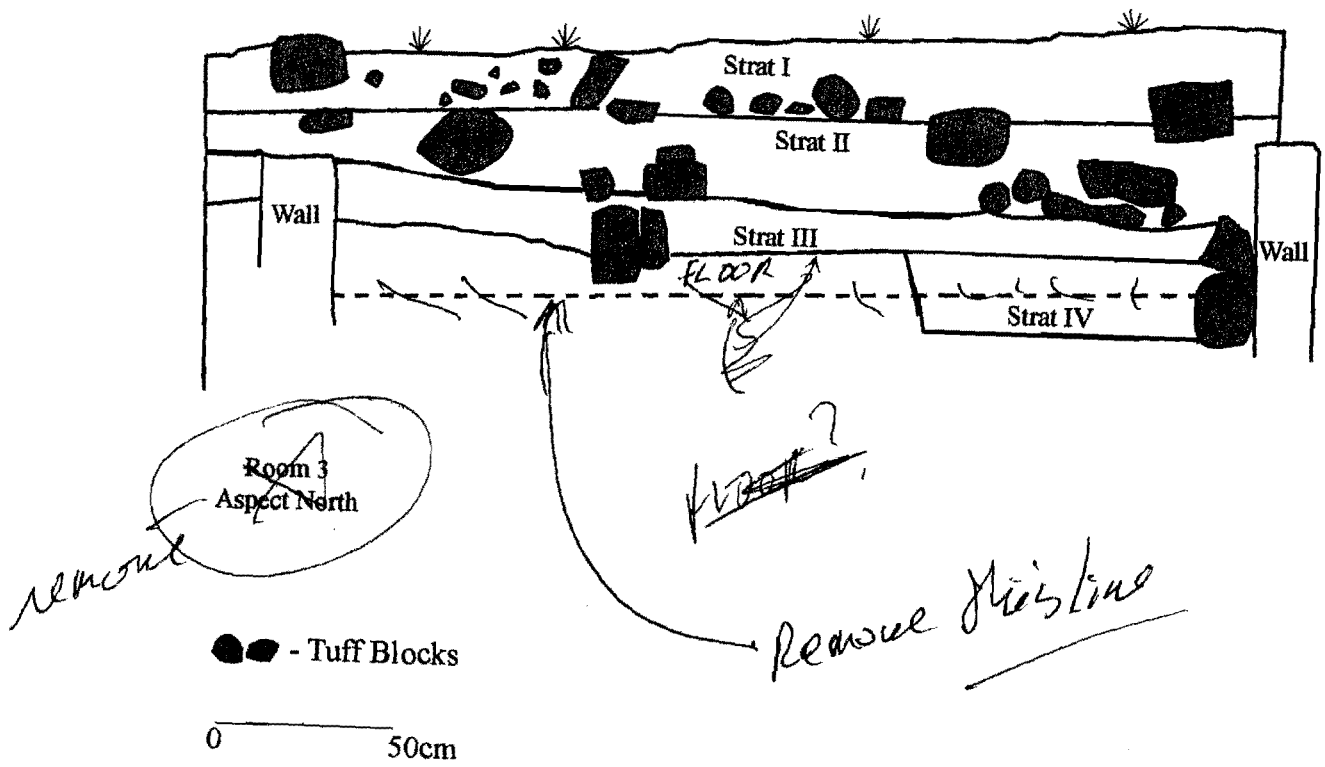
■ Compact adobe (possible wall material), root inclusions, a few tuff blocks, and a higher clay content than upper strat. Pale brown color, 10YR/6.3

● - Tuff Blocks

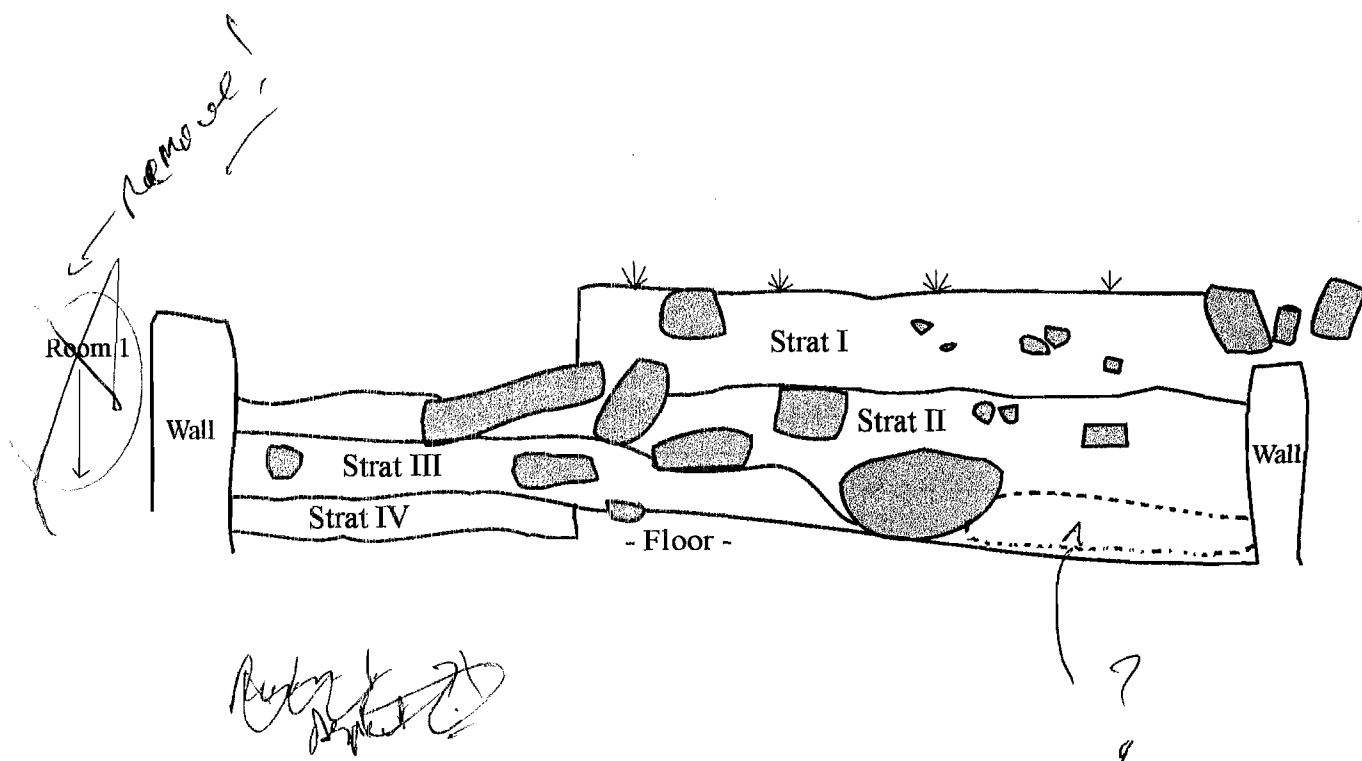
0 — 20cm

Handwritten notes:
 6263
 100m
 0.5m
 0.1m

Figure 6263



6.4
Figure 8.3



● ■ - Tuff Blocks

0 ————— 50cm

Figure 6.4

Stratigraphic unit 4 was excavated as an arbitrary 20 cm level below the floor in Room 3. It consists of a loose sandy loam that is largely disturbed by rodent and root activity. Charcoal and small chunks of adobe were encountered throughout the level. Bioturbation has resulted in the mixing of cultural and non-cultural materials. This unit likely represents a portion of the room where the occupational floor was not identifiable, because it was heavily disturbed.

FEATURES FROM POST-OCCUPATIONAL FILL CONTEXTS

Only a few features were identified during excavation. An ash pit was uncovered in Room 1 about 20 cm from the south side of the unit next to the East wall. No samples were collected from this pit. A possible burned adobe feature (Point Location #2) was identified in association with an ash stain (Point Location #1). Charcoal and charred bone fragments were located within the 210N/105E unit, at a depth of 0 to 45 cm below ground surface. The bone and charcoal were recovered, but no flotation or pollen samples were taken from either feature. Neither of these features appears to be associated with the floor, although it is possible that one or both of them articulated with the roof of the structure.

At 210N/106E, there is a possible “upside down hearth.” This feature consists of ash and a 13 by 11 cm piece of adobe found at a depth of 40 cm below ground surface in the southwest corner of the unit. Initially, it was believed that this adobe represented the remains of a collared hearth. However, no artifacts were found in association with this possible feature, although a flotation sample was collected (AN 159). During excavation of the subsequent level, it was determined that this was not a feature, but rather a piece of wall or roof fall.

In the northeastern corner of grid unit 210N/107E, there was a possible posthole, or burned circular feature. The feature is 7 cm in diameter. It is not clear from the field notes if this feature is associated with a floor.

SAMPLES FROM POST-OCCUPATIONAL FILL CONTEXTS

Adobe Samples

A variety of samples were collected throughout the excavation (e.g., adobe, charcoal, and pollen). Pieces of burned daub and other hard packed adobe were collected from 211N/106E at a 40 cm level (28-67 cm below ground surface). Several additional pieces of daub and adobe melt were collected throughout the course of the project. These materials represent roof and wall fall.

Macrobotanical Samples

Table 6.2 provides a list of macrobotanical, flotation and pollen samples collected during the excavations. A detailed analysis of these materials is presented in Chapter 10. *Zea mays* cobs and/or kernels were also identified in all the site deposits, including post-occupational fill, wall/roof fall, fill above the floor and floor contexts (see AS 55, 73, 74, 84, 92, 104, 139, 159, 164, 199, and 200; McBride and Smith this volume). A burned corncob (AN 164) preserved in hard packed wall and roof fall sediments was recovered from 210N/107E at a depth of 25-64 cm. This sample was sent for AMS dating. Several “large” pieces of charcoal and other burned wood samples were removed from 212.94N/112E at 79 cm below ground surface; at the same level, a large, hard soot/ash stain was identified. Most of the charcoal was derived from post-occupational fill and wall/roof fall deposits, consisting of ponderosa pine, juniper, piñon pine, mountain mahogany, oak and cottonwood.

Flotation Samples

Four flotation samples were collected from non-floor contexts. One of these was taken from underneath what excavators believed to be part of an adobe collared hearth. This feature was encountered during excavations in grid 210N/106E at a depth of 45 cm below ground surface. It was later determined that this was not a feature, but rather a chunk of adobe. Data from the flotation sample (AN 159) indicates that charred maize was the most highly represented botanical remain, although cheno-ams, cottonwood, juniper, dropseed grass, saltbush, piñon, ponderosa pine, globemallow, and hedgehog cactus were all identified in this sample.

An additional flotation sample (AN 199) was collected from 217N/106E at a depth of 40-50 cm below ground surface, in the northwest corner of one of the partially excavated rooms. This sample was collected from a dark soot stained area within roof/wall fall. Very few botanical materials were identified in the sample, including some charred juniper, maize, oak, and piñon, as well as a few pieces of uncharred spurge and goosefoot.

A flotation sample (AN 84) collected from provenience 212N/110E at a depth of 40-60 cm below ground surface in roof/wall fall. Charred cottonwood, four-wing saltbush, goosefoot, juniper, maize, oak, piñon, and purslane were identified within the sample. Uncharred goosefoot, juniper, pigweed, and pricklypear were also observed.

A concentration of ash was identified, between 40 and 60 cm below the ground surface, in Room 3 near one of the walls. A flotation sample (AN 200) was collected from this location (210N/105E, 45 cm below ground surface). Analysis of this sample produced quite a few charred and uncharred remains. Charred remains include cacti, cheno-ams, cottonwood, goosefoot, maize, pigweed, piñon, and other woods. Uncharred saltbush, juniper, pigweed, piñon, and prickly pear were also identified.

Pollen samples

A total of three pollen samples were collected from LA 4624. One of these samples was a control sample collected from the site's surface to provide data about naturally occurring pollens within the site area (AN 201). The most prolific pollen present in the sample is tree pollen including that from piñon, juniper, and other pines; together these represent 89.3 percent of the total sample. While tree pollens were also observed in the pollen samples collected from subsurface deposits (e.g., AS 65 and 162), these samples are much more diverse.

A pollen sample (AN 65) was collected from grid 214.16N/107.18E, at a depth of 25 cm below ground surface. The sample was taken from the bottom of an over turned metate situated in post-occupational fill. Most of the identified pollen is from cheno-ams, with less sunflower, piñon, pine, grasses, sagebrush, juniper, cholla, prickly pear, and maize. An additional sample (AN 162) came from 217.07N/107.46E, beneath a ceramic vessel at a depth of 40-60 cm below ground surface in fill above floor. Again cheno-am pollen is the most prevalent, although cholla, maize, prickly pear, and sunflower pollen is more common in this sample. Piñon, pine, and sagebrush pollens are also present.

Table 6.2. Botanical Remains from LA 4624.

Acc. No.	North	East	Room	Level (cm)	Specimen	Count	Context
1	211	108		0-20	Macrobotanical	4	Post-occupational fill
2	213	108		0-20	Macrobotanical	3	Post-occupational fill
3	214	108		0-20	Macrobotanical	1	Post-occupational fill
4	212	108		0-20	Macrobotanical	7	Post-occupational fill
4	212	108		0-20	Macrobotanical/possible dendro	100+	Post-occupational fill
7	212	109		0-20	Macrobotanical	3	Post-occupational fill
8	214	110		0-20	Macrobotanical	14	Post-occupational fill
9	211	109		0-20	Macrobotanical	4	Post-occupational fill
10	214	109		0-20	Macrobotanical	3	Post-occupational fill
11	213	109		0-20	Macrobotanical	2	Post-occupational fill
12	212	109		20-40	Macrobotanical	29	Post-occupational fill/Wall fall
13	211	109		20-40	Macrobotanical	20	Post-occupational fill/Wall fall
14	213	110		0-20	Macrobotanical	2	Post-occupational fill
15	214	105		0-20	Macrobotanical	3	Post-occupational fill
16	213	105		0-20	Macrobotanical	1	Post-occupational fill
18	213	108		20-40	Macrobotanical	4	Post-occupational fill/Wall fall
20	214	107		0-20	Macrobotanical	12	Post-occupational fill
21	212	110		0-30	Macrobotanical	25	Post-occupational fill
24	211	110		20-31	Macrobotanical	11	Post-occupational fill/Wall fall
26	215	105		0-20	Macrobotanical	1	Post-occupational fill
28	210	109		0-20	Macrobotanical	3	Post-occupational fill
31	215	107		0-20	Macrobotanical	9	Post-occupational fill
35	211	107		0-28	Macrobotanical	8	Post-occupational fill
40	211	106		0-28	Macrobotanical	29	Post-occupational fill
41	211	108		20-44	Macrobotanical	10	Wall and roof fall
43	212	106		0-44	Macrobotanical	13	Post-occupational fill/Wall fall
44	212	108		20-48	Macrobotanical	15	Wall and roof fall
48	211	111		0-20	Macrobtanical	12	Post-occupational fill
55	215	111		0-20	Macrobotanical (Maize and charcoal)	58	Post-occupational fill
56	211	105		0-40	Macrobotanical (Maize)	17	Post-occupational fill/Wall fall
57	212	111		0-27	Macrobotanical	38	Post-occupational fill
62	212	104		0-30	Macrobotanical	20	Post-occupational fill/Wall fall
65	214.16	107.18		25 cm bgs	Pollen	1	Post-occupational fill
68	211.26	107.77		44-60	Macrobotanical	75	Wall and roof fall
69	212	107.9		48-60	Macrobotanical	85	Post-occupational fill
72	209	108		20-40	Macrobotanical (Maize and charcoal)	8	Wall and roof fall
73	215	108.24		20-40	Macrobotanical (Maize)	4	Wall and roof fall
74	211.26	107.77		60-75	Macrobotanical	11	Floor

Acc. No.	North	East	Room	Level (cm)	Specimen	Count	Context
74	211.26	107.77		60-75	Macrobotanical (burned seed/nut?)	1	Floor
75	214.30	109	2	20-40	Macrobotanical	5	Post-occupational fill/Wall fall
76	208	108		0-20	Macrobotanical	1	Post-occupational fill
77	212	104		0-35	Macrobotanical	36	Post-occupational fill
78	208	108		20-40	Macrobotanical	10	Wall and roof fall
79	211.16	109		40-60	Macrobotanical	74	Wall and roof fall
80	212	109		55	Macrobotanical	48	Wall and roof fall
81	211.1	110		40-60	Macrobotanical	68	Wall and roof fall
82	210	108		40-60	Macrobotanical	5	Wall and roof fall
83	215	109	2	20-40	Macrobotanical	76	Wall and roof fall
84	212	110		40-60	Macrobotanical	17	Wall and roof fall
84	212	110		40-60	Flotation	1	Fill above floor
85	214.3	109	2	40-60	Macrobotanical	12	Wall and roof fall
86	214.3	109	2	60-80	Macrobotanical	4	Floor and subfloor
87	209	108		40-60	Macrobotanical (maize kernels and reeds)	4	Wall and roof fall
88	210	104		0-35	Macrobotanical	79	Post-occupational fill/Wall fall
89	208	108		46-60	Macrobotanical	3	Wall and roof fall
90	210	108		60-80	Macrobotanical	22	Sub-floor
91	209	108		60-73	Macrobotanical	59	Fill above floor
92	208	108		60-floor	Macrobotanical	18	Fill above floor
92	208	108		60-floor	Corn kernel	1	Fill above floor
92	208.85	108.80		32	Flotation	1	Wall and roof fall
100	215	108.24		60-80	Macrobotanical	14	Floor and subfloor
102	214.3	110		40-80	Macrobotanical	7	Wall and roof fall, floor and sub-floor
103	210	107		0-25	Macrobotanical	5	Post-occupational fill
104	214	107		40-60	Macrobotanical	41	Wall and roof fall
104	214	107		40-60	Macrobotanical (maize) bgs	1	Fill above floor
106	211	110.33		31-41	Macrobotanical	10	Wall and roof fall
107	214.3	111		0-20	Macrobotanical	2	Post-occupational fill
108	212	107.9	1	60-71	Macrobotanical	58	Roof fall and floor
110	212	107		0-25	Macrobotanical	35	Post-occupational fill
112	212	107		25-40	Macrobotanical	3	Wall and roof fall
121	214	111		40-60	Macrobotanical	19	Wall and roof fall
123	215	108		0-60	Macrobotanical	55	Narrow wedge west of wall
126	215	107		40-60	Macrobotanical	20	Wall and roof fall
130	211.16	109		60-73	Macrobotanical	40	Fill above floor
131	212	107		70-72	Macrobotanical	11	Floor
132	211	107		28-61	Macrobotanical	7	Wall and roof fall
133	212	110		60-70	Macrobotanical	26	Roof fall and floor
134	212	110.35		60-80	Macrobotanical /possible dendro	200+	Floor and subfloor
136	209	107.66		60-70	Macrobotanical	7	Roof fall and floor
138	210	105	3	0-45	Macrobotanical	27	Post-occupational fill

Acc No.	North	East	Room	Level (cm)	Specimen	Count	Context
139	211	106		28-67	Macrobotanical	71	Wall and roof fall, possible floor
140	210	106		0-25	Macrobotanical	8	Post-occupational fill
147	210	106		25	Macrobotanical	43	Post-occupational fill
	212	110.35		40-67	Macrobotanical	10	Fill above floor
151							
152	211	110.40		66-82	Macrobotanical	35	Floor and subfloor
159	210	105	3	25-45	Macrobotanical	12	Wall fall
159	210	106		45	Flotation	1	Roof fall
162	217.07	107.46		61	Pollen	1	Fill above floor
164	210	107		25-64	Burned corn cob	1	Wall and roof fall
166	210	106		0-52	Macrobotanical	18	Post-occupational fill, and wall fall
170	207	109		40-53	Macrobotanical	26	Wall fall
175	207	109		20-40	Macrobotanical	5	Wall fall
180	207	107.5		60-floor	Macrobotanical	41	Fill above floor
194	203	109		0-20	Macrobotanical	21	Post-occupational fill
196	207	107.5		40-60	Macrobotanical	4	Wall and roof fall
199	217	106		40-50	Flotation	1	Wall fall
200	210	105	3	45	Flotation	1	Wall fall
203	212	112		0-24	Macrobotanical	8	Post-occupational fill
204	212	112		24-30	Macrobotanical	12	Wall and roof fall
393	585	530		surface	Macrobotanical	1	South area of roomblock

ARTIFACTS FROM POST-OCCUPATIONAL FILL CONTEXTS

Most of the artifactual material recovered from the excavations were encountered within the post-occupational fill or wall/roof fall stratigraphic units.

Ceramics

A total of 3790 ceramic artifacts were recovered during the site excavations. The majority of the painted wares are Santa Fe Black-on-white; whereas, the utility wares are mostly composed of smeared-indentated corrugated with less indentated corrugated and plainwares. See Chapter 7 for a detailed discussion of the ceramic assemblage.

Chipped Stone

A total of 190 chipped stone artifacts were recovered during the site excavations. A small corner-notched projectile point (AN 171) made of Polvadera Peak obsidian was encountered within one of the excavated rooms. Other lithic materials recovered from non-floor contexts are largely core reduction debitage, with no evidence of tool production/maintenance. The materials are chalcedony, basalt, Pedernal chert/chalcedony, and obsidian. See Chapter 8 for a detailed discussion of the lithic assemblage.

Ground Stone

A total of 18 pieces of ground stone were recovered during excavation and several of these were given point provenience locations. Most of the ground stone items are made of rhyolite or basalt. Ground stone tools recovered from LA 4624 include two two-handed manos, three mano fragments, two metate fragments, five undetermined ground stone fragments and four abrading stones. A large slab metate, from which a pollen sample was collected, was also recovered.

Faunal Remains

A total of 112 nonhuman bones were recovered during the site excavations. The majority of the faunal remains were identified as either undetermined bird remains or as turkey. In addition, the remains of deer, pronghorn, jackrabbit and cottontail were also identified. Although a polished bone tool that was "perhaps used as a needle" is mentioned in the field notes, it does not appear to have been collected. This artifact was encountered in grid 211N/107E at a depth of 29 and 61 cm below ground surface. See Chapter 9 for a detailed discussion of the faunal assemblage.

ROOFING MATERIALS

Roofing materials consist of hard packed adobe and burned wood fragments. Remnants of the roof include chunks of adobe and pieces or flecks of charcoal. These materials were often found lying directly on the floor. Juniper, piñon pine, ponderosa pine, cottonwood, mountain mahogany and oak were all identified in the site botanical assemblage. The presence of such variety of tree suggests that several materials were used in construction, and as fuel wood. All of these species are locally available, with cottonwood being present in nearby Pajarito Canyon (Foxy and Hoard 1995; Powers and Van Zandt 1999:12-14). The macrobotanical remains recovered from Stratigraphic unit 3 (50 to 89 cm below ground surface), support the contention that this stratum represents the remains of burned roof and wall fall materials. Ponderosa pine, piñon pine, and juniper are the most well represented species in the Stratum 3 samples (see McBride and Smith, this volume). Ponderosa pine is a commonly used in roof construction, particularly as central postholes for roof support (Carlson 1993:76). Juniper and piñon are also used for roof construction, juniper acts as support for adobe roofs and piñon is often observed in secondary postholes (Carlson 1993:76).

MASONRY WALLS

Wall construction was investigated at various locations at LA 4624. The grid system was not always conducive to identifying walls, as wall segments were often located in the center of 1 by 1 m units. For this reason, as walls were revealed, excavation units were expanded to facilitate room definition. Not all of the walls were intact and at times during excavation, portions of a wall “disappeared.”

Shaped and unshaped tuff blocks were encountered in almost every excavation level, and represent wall fall. Some wall segments consisted of hard-packed adobe and repairs appear to have been made using small chinking stones and ceramic sherds. Preserved plaster was noted on some of the walls in Rooms 1 and 3. In at least one case, the wall plaster slopes down to meet the floor. Construction of the walls is exemplified best in Room 3, where the northern wall is well preserved from the ground surface to the occupational floor. This wall was constructed with relatively small (10 by 20 to 20 by 20 cm), unshaped tuff blocks and larger tuff slabs (averaging 54 by 37 cm) and blocks. The larger slabs appear to have been used as foundation stones. Preserved adobe plaster on the northern wall of Room 3 is 2 cm thick and slopes down to the floor.

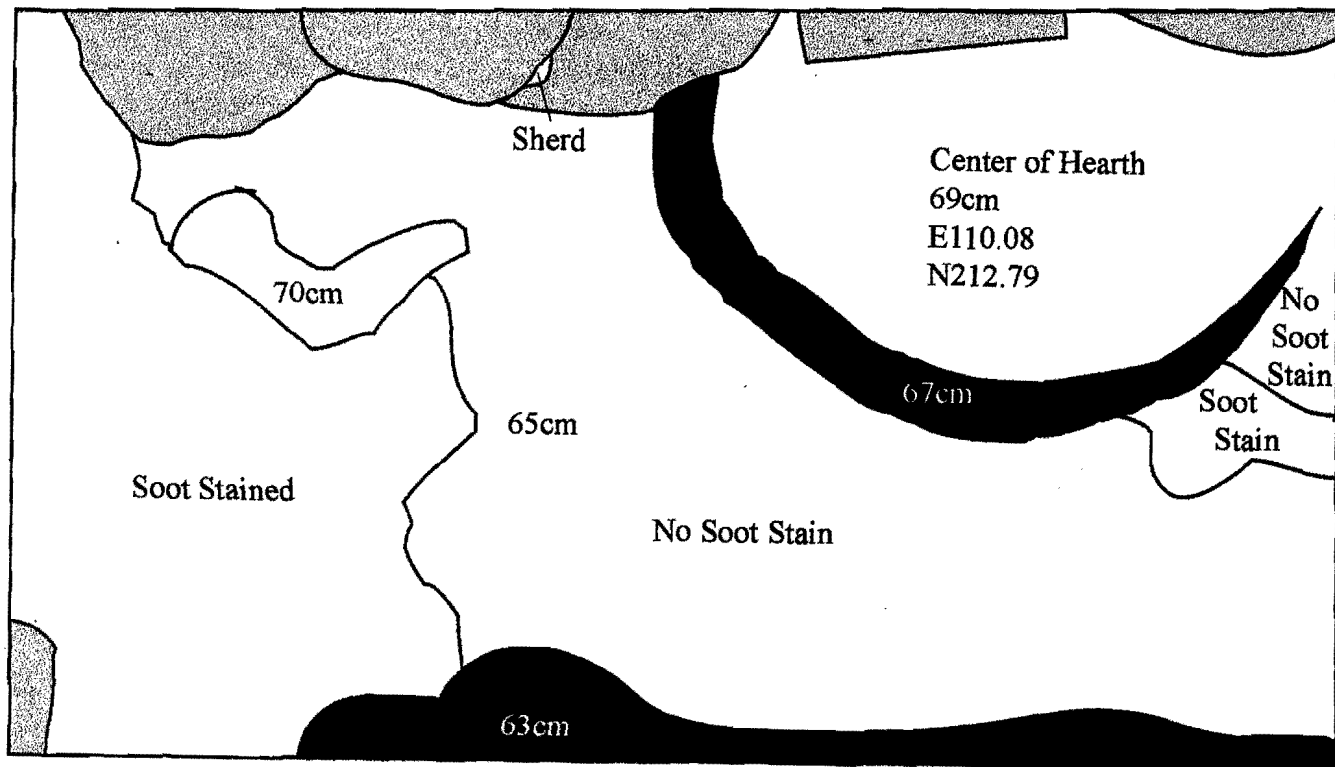
ROOMS EXCAVATED TO FLOOR

Floor Contexts

At least four rooms were mostly excavated to the level of the original occupation floor (Rooms 1-4). Sections of two other rooms were also excavated to floor. The floors at LA 4624 were primarily encountered at a depth of 63 to 78 cm below ground surface. They consist of hard packed sediments with intermittent areas of ash and smoke staining. In some instances, the dark charcoal staining is likely the result of burned roof materials that had collapsed onto the floor. Charred piñon, juniper, and ponderosa pine were all identified in samples collected from floor contexts. Although there are substantial pieces of floor that remain intact, large portions have been heavily disturbed by rodent activities and root growth. In general, floors at LA 4624 are described as “patchy, disturbed, and soot stained.” Multiple artifacts were discovered *in situ* on a floor and were point plotted during excavations.

Room 1

Point provenience information is provided for five artifacts on the floor of Room 1. These consist of a flake, a Santa Fe Black-on-white bowl rim sherd and three undetermined white ware bowl body sherds. In addition, a single feature was excavated in association with a floor. This was a collared hearth situated in Room 1 (Figure 6.6). The adobe collar was encountered at a depth of 67cm below ground surface. The center point of the feature is located at N 212.76/110.08E, at an elevation of 69 cm below ground surface. Because the feature was not excavated, no samples were collected from this context.



0 20cm

■ - Adobe Hard Pack/
Wall Plaster

□ - Floor

■ - Hearth Collar

●● - Tuff Blocks



Figure 6.5

Room 2

A shell pendant (AN 94) and a small piece of hide (AN 95) were recovered from the original occupational floor (60-80 cm) in Room 2 at 214.30N/109.00E.

Room 3

Figure 6.7 illustrates the distribution of floor artifacts in Room 3. Six lithic artifacts were identified as being present on the floor. These consist of a Pedernal chert/chalcedony flake and biface (AN 141), an undetermined rhyolite ground stone fragment, a sandstone abrading stone (AN 116), a quartz pebble polishing stone (AN 91) and a Pedernal chert/chalcedony hammerstone. Two of these artifacts were given the same point provenience and map location. The biface is bi-pointed and was manufactured on a thin flake. The hammerstone exhibits heavy battering on both of its ends.

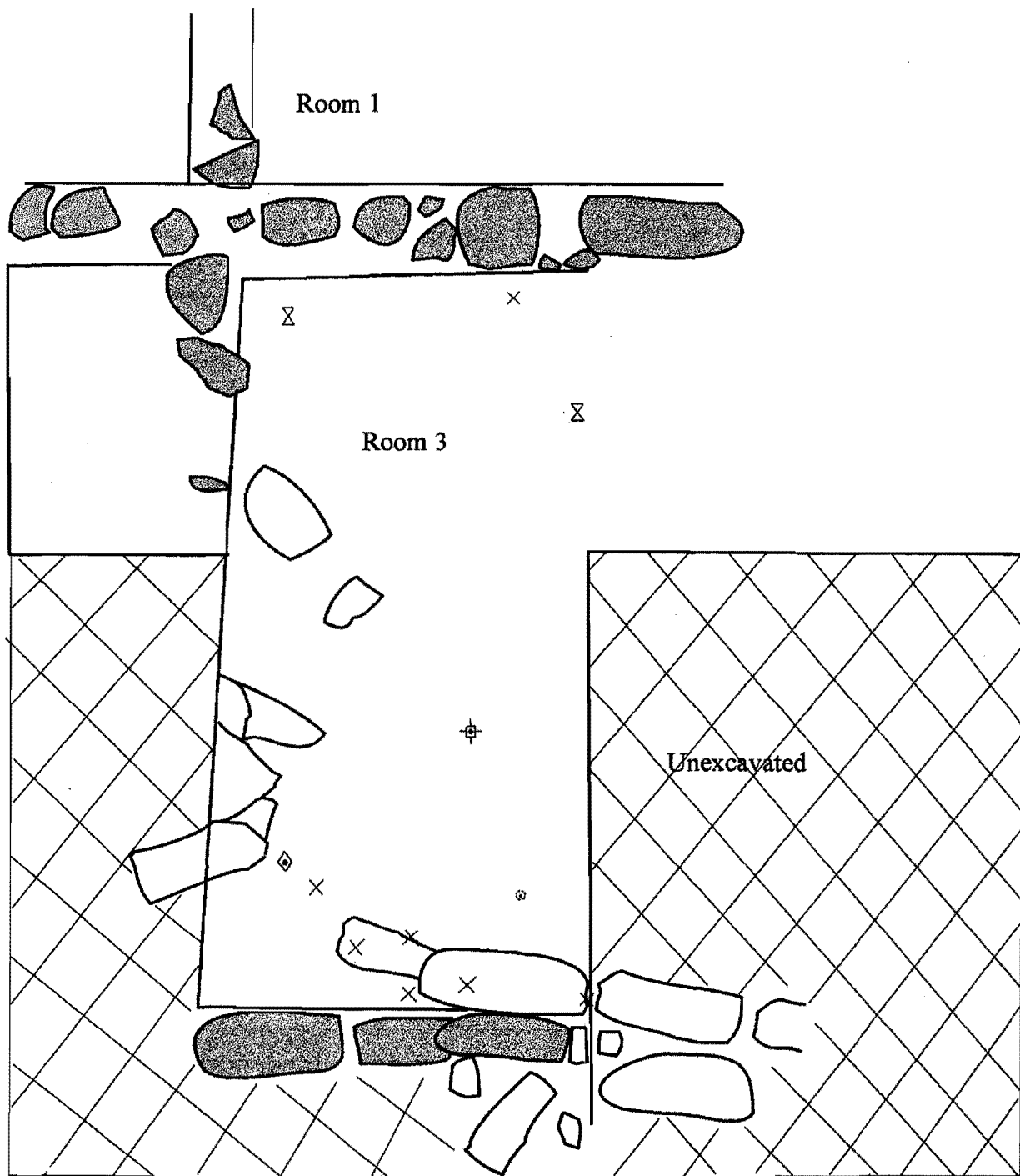
Seven ceramic artifacts are denoted on the floor map. These consist of a Santa Fe Black-on-white bowl sherd, 2 undetermined whiteware sherds, 3 smeared indented corrugated jar sherds and an indented corrugated jar sherd.

One flotation sample was collected from the floor context of Room 3. The flotation sample (AN 92) came from 208.85N/108.80E, at a depth of 32 cm below Datum A. Fourteen charred maize cupules were identified in the sample with some charred juniper, goosefoot, cheno-ams, piñon, and purslane. Uncharred botanical remains were also observed in the flotation sample and include spurge, goosefoot, piñon, prickly pear, and purslane.

Room 4

A large portion of a smeared indented corrugated jar was recovered from the floor of Room 4 (217.10N/106.95E). The presence of the vessel in this small room (4 sq m) may indicate that this structure was a storage room. Its location in the rear of the roomblock provides further support for this assertion. Four Santa Fe Black-on-white sherds were also identified as part of the floor assemblage.

Room Function



- - Tuff Block
- - Tuff Block Wall
- ⊗ - Ground Stone
- × - Sherd
- ⊕ - Polishing Stone

◆ - Biface

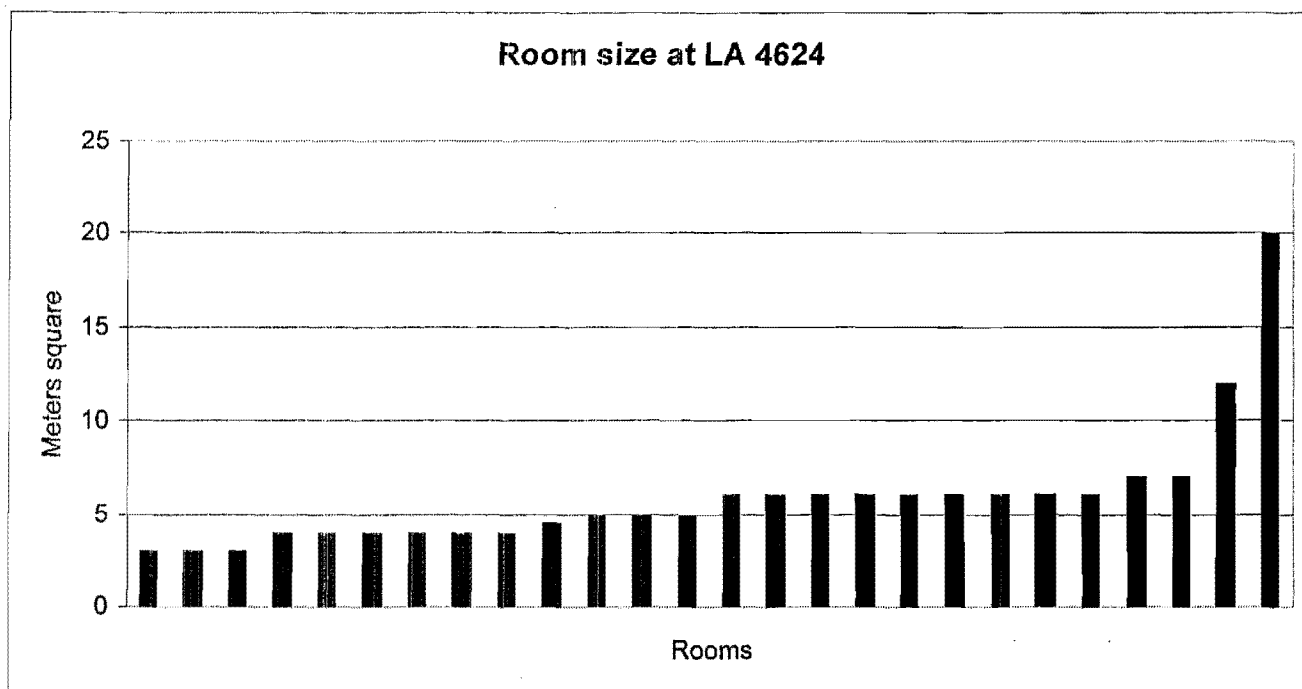
⊙ - Float

Figure 6.6

0 1m

N

from Hohokam sample to B6.7



The lack of excavated features makes it difficult to identify the function(s) that these rooms may have served (e.g., habitation vs. storage vs. communal structures). There is, however, some information that can be derived from the architectural data at the site.

LA 4624 is linear pueblo similar to other Coalition period sites on the Plateau. It is also oriented north-south, 2 to 3 rooms deep, contains 25 rooms and faces east. Average room size at the site is 6.9 m², with rooms being divided into three size groupings (Figure 6.8). Rooms smaller than 5 m² were probably used as storage rooms. Medium sized rooms, ranging from 5 to 7 m² most likely served as habitation rooms. The largest rooms (greater than 10 m²) may have functioned as communal structures. For example, the D-shaped room (Room 1) is 20 m² in size and is situated on the east facing side of the pueblo. Recent studies of the Coalition period pueblo of Nake'muu also identified a trimodal distribution of room sizes: 4-7 m², 7-8.5 m², and greater than 8.5 m² (Vierra et al. 2001).

Figure 6.8. Room size at LA 4624.

RADIOCARBON DATES

Two *Zea mays* samples from floor contexts were selected for radiocarbon dating. One maize kernel (AN 92) from a floor context and one maize cob (AN 164) from a wall/roof fall context were sent to Beta Analytic Inc. for dating. The results of the analysis are presented in Table 6.3.

Table 6.3. Radiocarbon dates for LA 4624.

Sample Number	Measured Radiocarbon Age	$^{13}\text{C}/^{12}\text{C}$ Ratio	Conventional Radiocarbon Age	2 Sigma Calibration
AN 92 Beta- 164641	760 +/- 40 BP	-8.7 o/oo	1030 +/- 40 BP	Cal AD 960 to 1040 Intercept date: AD 1010 (Cal BP 990-910)
AN 164 Beta- 164642	520 +/- 40 BP	-10.9 o/oo	750 +/- 40 BP	Cal AD 1220 to 1300 Intercept date: AD 1270 (Cal BP 730 to 650)

The date for the maize kernal from the floor context appears to be too old, with an intercept of AD 1010. In contrast, the maize cob intercept date of AD 1270 seems more accurate given that the ceramic assemblage is dominated by Santa Fe Black-on-white.

Figures

Figure 6.1. LA 4624 site map.

Figure 6.2. LA 4624 excavated rooms.

Figure 6.3. Room 1, wall profile.

Figure 6.4. Room 3, west wall profile.

Figure 6.5. Room 3, east wall profile.

Figure 6.6. Collared hearth, Room 1, 212.89N/110.08E.

Figure 6.7. Room 3, floor assemblage.

Figure 6.8. Room size at LA 4624.

Tables

Table 6.1. Stratigraphic level descriptions from LA 4624.

Table 6.2. Analyzed botanical specimens from LA 4624.

Table 6.3. Radiocarbon dates for LA 4624.

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CHAPTER 7
CERAMIC ANALYSIS
DIANE C. CUREWITZ and BRIAN C. HARMON

INTRODUCTION

This chapter presents the results of the analysis of 2985 ceramic artifacts from LA 4624. The site consists of about twenty-five rooms, including a D-shaped kiva. Analysis of the artifact scatter revealed the presence of Santa Fe Black-on-white and several fragments of St. John's/Wingate Black-on-red. Larson (this volume) characterized the utility wares as non-micaceous smeared indented, the majority of which exhibited clear indentations and good coil junctions.

The goals of this ceramic analysis is to describe the artifacts collected, provide some analysis of trends within the collection, compare the collection with sites from similar time periods on the Pajarito Plateau, address issues of ceramic temper sources and exchange patterns, and provide support to analyses of site function and social organization.

METHODS

A total of 27,328 ceramic sherds were recovered from the partial excavation of LA 4624. 3790 were excavated from the roomblock and 23,538 were collected from the surface of the site. However, only 1952 sherds were selected from 56 excavation units (78.8% of the total excavated from the room block) and 1033 sherds from two surface units (3.8% of the total collected from the surface) for analysis. The latter were selected from two separate areas of the midden.

All sherds recovered from five rooms ($n = 1351$) were analyzed. These correspond to the four rooms (1, 2, 3, and 4) described by Nisengard (this volume), plus one additional room situated between rooms 1, 2 and 4 (i.e., room 8). In addition, sherds were analyzed from portions of two rooms that abutted rooms 4 and 8 (i.e., rooms 10 and Room 11), situated north and west of rooms 1 and 3 and south and west of rooms 4 and 8 ($n = 504$). The designations for Rooms 8, 10 and 11 were determined from grid square units, using the room numbers as provided by the Pajarito Plateau Archaeological Project's site survey recording form and not the excavation crew.

Ceramics were sorted by type, temper, pigment, interior and exterior manipulation, form, and post-firing modification using codes developed by the Office of Archaeological Studies of the Laboratory of Anthropology, Museum of New Mexico. Sherds smaller than 1 by 1 cm were counted, weighed, and labeled as discards. Each sherd was examined under a Leica StereoZoom5 binocular microscope to determine its temper, pigment type, and surface finish. Several new temper types were defined during the sorting process. These were based on mineralogy visible under the binocular microscope and represent an attempt to define the characteristics of "anthill sand." Anthill sand consists of quartz and feldspar crystals and lithic fragments mined from the Bandelier tuff formations on the Pajarito Plateau and brought to the surface by Western Harvester ants as they build nests.

WARE TYPES

Ware types represented in the assemblage are summarized in Table 7.1. Service wares make up 19.95% of the total assemblage, and 22.23% of the room block assemblage, but only 15.68% of the assemblage for the surface units. The only white ware identified in the surface units is Santa Fe Black-on-white. Within the rooms, however, Kwahe'e Black-on-white (1.08%) and Wiyo-like sherds (0.15%) were identified. Wingate Black-on-red, a variety of White Mountain Red Ware, made in the Western Pueblo area, and widely traded throughout the Greater Southwest, was found both on the surface (0.29%) and in the room block (0.10%). No Biscuit or Glaze Wares were found either on the surface or in the room block. The predominance of Santa Fe Black-on-white and the presence of only four undecorated sherds with a soft, Wiyo-like paste, dates this site to the earlier part of the Coalition period.

Utility wares make up 80.03% of the total assemblage. The percentage of utility wares is 84.32% for the surface and 77.77% for the room block. Plain ware makes up 20.42% of the surface assemblage but only 15.98% of the room block assemblage. Indented corrugated ware makes up 15.49% of the surface assemblage, but only 10.25% of the room block assemblage. The room block, however, contains a higher proportion of smeared indented corrugated ware (49.18%) than the surface (46.47%). The plain ware, with a high proportion of light igneous rock temper containing mica, is thought to be an early Coalition type (C. Dean Wilson, personal communication). None of the plain ware found has a micaceous paste or slip, characteristic of wares that begin to appear at Bandelier sites in the late Coalition (Vint 1999).

NON-VESSEL ARTIFACTS

Two non-vessel ceramic artifacts were found. The first is a fragment of pipe stem weighing 3 grams and measuring 22.14mm long, 14.48mm in diameter, with a wall thickness of 6.07mm. The ceramic is tempered with Anthill A. The second is a pendant 15.7mm long, 9.6mm wide at the bottom, tapering to 4.1mm at the top, and 1.48mm thick. A hole approximately .26mm in diameter is drilled 2.3mm from the top. The pendant is fashioned from light red (2.5YR 6/6) untempered clay.

TEMPER TYPES

The major temper types (Table 7.2), which appeared in 98.9% of all ceramics analyzed, are described as follows:

- *Sand*: rounded quartz and accessory mineral particles, fine-to-medium size (.0625-.499 mm).
- *Fine tuff and sand*: fragments of pumice mixed with fine rounded sand in varying proportions.

- *Medium coarse tuff and sand*: larger fragments of pumice mixed with medium-to-coarse (.25-.99 mm) rounded sand particles.
- *Anthill A*: Fine sand, quartz and feldspar crystals (both whole and crushed) and mafic inclusions (probably iron and titanium oxides and/or hornblende crystals)
- *Anthill B*: Fine sand, quartz and feldspar crystals (whole and crushed), but with no mafic inclusions
- *Light Igneous*: Fine sand, igneous rock fragments, mica, with some quartz and feldspar crystals.
- *Other temper types* (Table 8.3) can be grouped by rock and mineral composition. They include:
 - Andesite (or diorite) and sand; Andesite, (diorite) sand and sherd;
 - Self-temper (no added aplastic inclusions);
 - Dark Igneous and sand; Basalt and Sand; Dark Crystalline Particles & Tuff;
 - Mica, tuff, and sand;
 - Dark sand; Very fine sand (Silt);
 - Granite schist;
 - Sherd; Sand and sherd

DISTRIBUTION OF TEMPER TYPES

Service Wares

Eighty-eight percent of all service wares (Table 7.2) are tempered with fine tuff and sand. This includes 90.8% of the Santa Fe Black-on-white, 66.7% of the Kwahe'e Black-on-white, 100.0% of the few Wiyo-like sherds, and 25.0% of the unpainted indeterminate white-slipped ware. Medium tuff and sand makes up the next largest temper category, representing 7.7% of the total service wares. 9.5% of the Kwahe'e Black-on-white and 7.85% of the Santa Fe Black-on-white contain this temper.

"Other" temper types identified in service wares (Table 7.3) include sherd, sherd with sand, and andesite with sherd and sand, found in the decorated and undecorated White Mountain Red Wares. Two decorated white ware sherds are tempered with micaceous schist, and are probably also imported, but possibly from the east. This temper has been identified in Rowe Black-on-white, Arroyo Hondo variety, by Habicht-Mauche (1993).

Utility Wares

Utility wares appear to contain a greater variety of aplastics than service wares (Table 7.2, Figure 1). The two major temper types are Anthill A (50.6%) and Anthill B (35.7%). These two temper types together make up between 61.3% and 92.6% of the major utility wares (plain, plain corrugated, indented corrugated, smeared -indented corrugated). Light igneous temper is the next largest category (8.8% of the total) and is found mainly in plain ware and indeterminate utility ware. As noted above, this rock temper, which contains mica, is thought to be early and the ware may have been imported. Sand temper, characterized by rounded grains, forms a small

percentage of the total. Each of the major utility ware types has a small proportion of sherds with added stream sand (2.2% of the total), with plain corrugated showing the largest percentage. Medium tuff and sand (2.0% of the total) is also used mainly in plain corrugated sherds.

Plain ware has the largest number of "other" temper types, including sand and sherd, dark igneous and sand, mica, tuff and sand, and dark sand. One sherd of indented corrugated is tempered with basalt and sand and one sherd of smeared-indented corrugated is tempered with mica, tuff and sand.

PETROGRAPHIC ANALYSIS

Eighteen sherds were selected, to represent all the possible combinations of ware types and tempers, and sent to Elizabeth Miksa at Desert Archaeology, Inc. in Tucson, AZ for analysis. Table 7.4 lists the provenience information and attribute values for each.

The petrographic analysis (see Appendix B), shows that there are two main temper groups. The first group is dominated by felsic volcanic lithic fragments, while the second group is dominated by mineral grains, with feldspar generally in greater abundance than quartz. Within the first group there are two subdivisions. The first subdivision is probably derived from unit Qbt1g, vitric tuff, the lowest unit of the Tsirege member of the Bandelier Tuff. The best examples of this glassy temper are samples 5, 10, and 11, two decorated sherds of Santa Fe Black-on-white and one undecorated sherd with a characteristic Santa Fe paste. The second lithic subdivision is clastic, probably from Qbt2. The best examples of this are two plain gray sherds, samples 2 and 18.

The report does not specify possible source rock for the mineral-grain-dominated group, since there are no intrusive rocks or crystal-rich volcanic deposits that could include that quantity of mineral grains. Anthills are a possible source, but another possible source is gravels and cobbles from the Puye formation, found in Los Alamos and White Rock Canyons, which contain "silicic to intermediate volcanic rocks and Precambrian quartzite, granite, and pegmatite" (Broxton 2001:6)

The report concludes that, in general, corrugated wares are dominated by feldspar and quartz mineral grains, while Santa Fe Black-on-white, Santa Fe paste (undecorated), and plain wares can have either mineral-grain-dominated or lithic-dominated tempers.

Binocular microscope temper classifications were compared with the results of the petrographic analysis, and the raw data from the petrographic analysis was converted to percentages, subjected to a factor analysis, and plotted (Figure 2). Temper type 2 (A = "Sand") was represented by three samples, one Plain sherd, one Indented Corrugated sherd, and one Santa Fe Black-on-white jar sherd. All three are lithic-dominated, with the gray ware types less so than the Santa Fe. The indented corrugated sherd and the Santa Fe jar sherd are both glassy, while the Plain ware is clastic.

Temper type 7 (B = "Sherd") consists of only one plain sherd. Grog (sherd) was observed during the petrographic analysis, but did not appear along the point-counting grid. Although this was the only sherd-tempered sample sent for analysis, "possible" to "fairly common" amounts of grog were observed in five other samples. This means that six out of 18 samples, or 1/3, of the sherds sent for analysis had some sherd temper.

Temper type 10 (C = "Fine Sand and Tuff") is considered diagnostic of Santa Fe Black-on-white produced on the Pajarito Plateau. Two samples, one Santa Fe Black-on-white sherd and one Santa Fe paste sherd (undecorated), were submitted for analysis. The Santa Fe Black-on-white sherd is rich in glassy lithics, while the undecorated sherd is mineral rich, dominated by feldspars (plagioclase and alkali feldspars) and quartz.

Temper type 65 (D = "Medium Sand and Tuff") is similar to temper type 10, but with larger particles of sand and/or tuff. Three samples include one plain sherd, one Santa Fe paste sherd (undecorated) and one Santa Fe Black-on-white sherd. The plain sherd and the undecorated Santa Fe paste sherd are lithic-rich, with the Plain dominated by clastic grains and the Santa Fe sherd dominated by vitric grains. The decorated Santa Fe sherd is mineral-rich, dominated by quartz and feldspars (plagioclase and alkali feldspars).

Temper types 66 and 67 are both varieties of "Anthill Sand." Type 66 (E = "Anthill A") is dominated by quartz and feldspar grains, with mafic inclusions visible under a binocular microscope. Type 67 (F = "Anthill B") is similar to 66, but without visible mafic inclusions.

Four samples of type 66 were submitted: one indented corrugated, one smeared-indented corrugated, one plain sherd, and one pinch pot sherd. All four are mineral rich, containing 73-81% quartz and alkali feldspar, with not more than about 10% total plagioclase. In three cases, the amount of alkali feldspar is greater than quartz. Only the pinch pot has more quartz than alkali feldspar. The sherds contain traces of mafic minerals: biotite, chlorite, pyroxene and/or amphibole, opaques (iron-titanium oxides), and epidote.

Three samples of type 67 were submitted: one indented corrugated, one smeared-indented corrugated, and one plain. The indented corrugated and smeared-indented corrugated sherds are mineral rich with volcanic input, while the plain sherd is mineral rich. All three are dominated by quartz and alkali feldspar (72.0% to 78.7%) with alkali feldspar either greater than or just about equal to the quartz amount. One sample lacks opaques, but contains some pyroxene and amphibole; the other two contain 2.4% and 7.7% opaques, but no pyroxene or amphibole.

In general, the sherds classified as Anthill B contain Lfvb (biotite-bearing felsic volcanics) whereas Anthill A does not, contain more Lvv (glassy volcanics) than Anthill A, and contain less Lvsch (chert). They contain no Lmm (metamorphic microgranular quartz aggregate) whereas Anthill A does. Only one sample in the Anthill B group has any pyroxene or amphibole and none contain chlorite. Anthill A-group sherds tend to have a higher percentage of opaques.

Temper Type 70 (G = "Light igneous rock with [visible] mica") is characteristic of much of the plain ware found at the site. Two sherds were submitted for petrographic analysis, one indented corrugated and one plain. The two Type 70 sherds are the most mineral-rich of all those

submitted (98.1% and 99.3% mineral grains). The muscovite mica and microcline (potassium feldspar) found in these sherds are characteristic of plutonic igneous rocks such as granite and in metamorphic rocks such as gneiss and schist, and less common in felsic volcanic rocks. The source for this temper may be Puye Formation gravels.

The results of the factor analysis support the temper groupings derived through binocular microscope analysis. Factor 1 consists of high loadings for minerals only. It has positive loading for biotite, chlorite, epidote, microcline, muscovite, and plagioclase, and negative loading for alkali feldspar. Factor 2 consists of high loadings for both mineral grains and lithic fragments. It has positive loading for calcium carbonate, chlorite, metamorphosed sedimentary rock, glassy volcanics, and opaques, and negative loading for volcaniclastic rocks and alkali feldspar. Factor 3 consists of high loadings for lithic fragments only. It has positive loading for microgranular quartz aggregate, quartz-feldspar-mica tectonite (schist or gneiss), argillaceous lithics, and felsic volcanics such as rhyolite. The plot of Factor 1 and Factor 3 (Figure 3) shows that sherds with the same or similar temper designations are, for the most part, clustered together.

RIM SHERD ANALYSIS

Service wares

Thirteen Santa Fe Black-on-white bowl rim sherds (15.3% of the total, $n = 85$) were large enough for radius measurement. Rim radii range from 3 cm to 25 cm. 77% of the bowl rims measured indicate vessel radii above 10 cm. Despite the small sample size, four natural groups of rim sizes can be distinguished: 3-5 cm, 10-12 cm, 17-20 cm, and 24-25 cm (Figure 4).

Utility Wares

Ninety-four rim sherds from utility ware jars were recovered (Table 7.5). Of these, 57 (60.6%) are plain rims and 37 (39.4%) are corrugated. Of the corrugated jar rims, 34 (91.9%) were made using exterior coiling, 2 (5.4%) were made using interior coiling, and 1 (2.7%) could not be determined. Interior coiling is believed by Blinman (2000) to be the indigenous method of construction. Migrants from the Four Corners are thought to have brought exterior coiling as a construction method to the Pajarito Plateau.

VESSEL FORMS

Utility ware jars are the dominant vessel form (Table 7.6), making up 99.5% of all utility wares and 97.6% of all jars (Table 7.6a). The ratio of all bowl sherds to all jar sherds is ~1:5. The ratio of service ware bowl sherds to service ware jar sherds is ~1:9.

Eight handles or straps were recovered, two service ware (25%), and six utility ware (75%). Eleven sherds from miniature pinch pots were recovered - seven rim sherds (63.6%) and four body sherds (36.4%) (Table 7.6b).

SURFACE TREATMENT AND CONDITION

Slip

Forty-seven percent of the service ware sherds were slipped both inside and outside. 32.9% were slipped on the interior only and 11.7% were slipped on the exterior only. 8.0% of service wares were not slipped on either surface (Table 7.7a).

Missing Surfaces

One hundred twenty-six sherds were missing either interior or exterior surfaces. Four utility ware sherds and 63 service ware sherds were missing interior surfaces (53.2%). Five utility ware and 54 service ware sherds were missing exterior surfaces (46.8%) (Table 7.7b).

Fire Spalling

The large proportion of service ware sherds missing surfaces may be related to the effects of fire spalling. All sixty-six sherds (2.2%) showing some evidence of fire spalling were service ware sherds (Table 7.7c). 65.2% of these showed interior spalling, 27.3% showed exterior fire spalling, and 5 (7.5%) were unspecified.

Other Surface Treatments

Not included in Table 7.7a are four red ware sherds slipped on both interior and exterior, one red ware sherd slipped on the interior and missing its exterior surface. In addition, two service ware sherds were polished and smudged, three service ware sherds had exterior basket impressions, and one plain ware sherd had linear punctate impressions.

MODIFICATIONS

Sooting

Four hundred and seventy-nine sherds showed evidence of sooting (Table 7.8). Of these, 60.6% of service wares and 73.8% of utility wares showed evidence of sooting on both surfaces or on the interior surface. Exterior sooting on cooking pots is expected, however, interior sooting is not, nor is sooting on either surface of service wares. This may indicate burning of rooms at abandonment or post-abandonment.

Other Modifications

Three Santa Fe Black-on-white sherds and one utility ware sherd contained partial or complete drill holes. One Santa Fe Black-on-white sherd and 10 utility ware sherds had worn interiors, indicating use wear. One Santa Fe Black-on-white rim sherd was notched.

FLOOR ASSEMBLAGES

Floor assemblages were calculated for rooms 1, 3, and 4 (see Nisengard, this volume), and rooms 8 and 11 (Table 7.9). Floor assemblages included items found lying directly on the floors and within the level immediately above the floors. Approximately half of all sherds found on room floors showed some evidence of sooting (Table 7.10).

The floor assemblage for room 1 consisted of one Santa Fe Black-on-white bowl rim sherd and three bowl body sherds, one plain ware sherd, one indented corrugated sherd and three smeared indented corrugated sherds.

The floor assemblage for room 3 consisted of 134 ceramic sherds, including 4 Santa Fe Black-on-white bowl rim sherds, 19 Santa Fe Black-on-white bowl body sherds, 7 jar rim sherds and 102 jar body sherds. 72.5% of the jar sherds were smeared-indented corrugated.

The floor of room 4 contained only 15 total sherds, but ten of these sherds made up most of a smeared-indented corrugated jar, tempered with Anthill A, and heavily sooted on interior and exterior surfaces. Also present were four Santa Fe Black-on-white body sherds and one indeterminate ware.

The floor of room 8 contained one Kwahe'e Black-on-white sherd, nine Santa Fe Black-on-white sherds, five plain ware sherds, three indented corrugated sherds, one plain corrugated sherd, and six smeared indented corrugated sherds.

The floor of room 11 contained one Kwahe'e Black-on-white-herd, two Santa Fe Black-on-white sherds, one plain ware sherd, and three smeared indented corrugated sherds.

LA 4624 IN CONEXT: A COMPARISION WITH LA 3852 (CASA DEL RITO) and LA 60372 (BURNT MESA PUEBLO)

LA 3852 (Casa del Rito) and LA 60372.2 (Burnt Mesa Pueblo) are Coalition sites excavated by the Bandelier Archaeological Excavation Project (BAEP) (Kohler and Root, 1992). LA 3852 is located on the mesa above Lummis Canyon and was excavated in 1990. It is considered an early Coalition site (AD 1175-1250), based on pottery typology (Root 1992). LA 60372, located on Burnt Mesa, just north of Frijoles Canyon, was excavated in 1989 and has two components. Dates for LA 60372 are derived from a combination of archaeomagnetic and tree-ring samples. Area 2 dates to the mid-1200s (AD 1230-1275) (Kohler and Root 1992:44), and Area 1 dates to the early 1300s (Linse et al. 1992:87-88).

The composition of the service ware assemblages varies between these sites. For example, LA 3852 contains mostly Santa Fe Black-on-white (64.0%) and Kwahe'e Black-on-white (19.7%). In contrast, Area 1 at LA 60371 contains mostly Santa Fe Black-on-white (64.0%) with some Wiyo Black-on-white (9.6%) and very little Kwahe'e (<0.1%) (Gray 1992). The service ware assemblage at LA 4624 is temporally intermediate, containing mostly Santa Fe Black-on-white (91.7%), with a little Kwahe'e Black-on-white (3.5%).

LA 3852 also has a large number of decorated jar sherds (20.5%), whereas LA 60372, Area 2, has none. Decorated jar sherds make up 10.5% of the LA 4624 assemblage. Some areas of LA 3852 also have larger percentages of indented corrugated utility ware than smeared indented corrugated. Between 49.4% and 65.1% of utility ware sherds are indented corrugated, while smeared indented corrugated accounts for only between 5.6% and 16.1%. At the later site of LA 60372, smeared indented corrugated sherds make up between 83.3% and 86.5% of utility wares. In contrast, smeared indented corrugated sherds account for 60.3% of the utility ware at LA 4624.

These preliminary comparisons indicate that the ceramic assemblage from LA 4624 may be temporally intermediate to the two BAEP sites (i.e., early-middle Coalition period). The vast majority of ceramics found at the site were produced on the Pajarito Plateau, indicating minimal exchange of ceramics outside of the local area. The exceptions are six sherds of White Mountain Red Ware from the Western Pueblo area, and two decorated white ware sherds tempered with micaceous schist, probably imported from the east, in the Arroyo Hondo area.

Table 8.1 Percentage of Ware Types
a) As a percentage of the total assemblage

Type	Surface	%	Roomblock	%	Total	%
Service Wares						
Kwahee Black-on-white	0	0.00	21	1.08	21	0.70
Santa Fe Black-on-white	152	14.71	395	20.23	547	18.32
Unpainted Wiyo paste	0	0.00	3	0.15	3	0.10
Undifferentiated mineral paint	0	0.00	2	0.10	2	0.07
Indeterm. white ware, organic paint	7	0.68	2	0.10	9	0.30
Unpainted white ware	0	0.00	8	0.41	8	0.26
Wingate Black-on-red	3	0.29	2	0.10	5	0.17
Indeterminate redware	0	0.00	1	0.05	1	0.03
Subtotal for Service Wares	162	15.68	434	22.23	596	19.95
Utility Wares						
Plain ware	211	20.42	312	15.98	523	17.52
Plain corrugated	10	0.97	21	1.08	31	1.04
Indented corrugated	160	15.49	200	10.25	360	12.06
Smeared indented corrugated	480	46.47	960	49.18	1440	48.24
Smeared plain corrugated	0	0.00	2	0.10	2	0.07
Incised neckbanded	0	0.00	2	0.10	2	0.07
Clapboard neck	0	0.00	2	0.10	2	0.07
Indeterminate utility	10	0.97	19	0.97	29	0.97
Subtotal for Utility Wares	871	84.32	1518	77.77	2389	80.03
Non-vessel ceramic object	0	0.00	1	0.05	1	0.03
	1033	100.00	1952	100.00	2985	100.00

b) As percentages within each ware category

Type	Surface	%	Rooms Total	%	Total	%
Service Wares						
Kwahee Black-on-white	0	0.00	21	4.84	21	3.52
					54	
Santa Fe Black-on-white	152	93.83	395	91.02	7	91.78
						0.5
Unpainted Wiyo paste	0	0.00	3	0.69	3	0
Undifferentiated mineral paint	0	0.00	2	0.46	2	0.34
Indeterm. white ware, organic paint	7	4.32	2	0.46	9	1.51
Unpainted white ware	0	0.00	8	1.84	8	1.34
Wingate Black-on-red	3	1.85	2	0.46	5	0.84
Indeterminate redware	0	0.00	1	0.23	1	0.17
Subtotal for Service Wares	162	100.00	434	100.00	596	100.00
Utility Wares						
Plain Ware	211	24.22	312	20.55	523	21.89
Plain corrugated	10	1.15	21	1.38	31	1.30
Indented corrugated	160	18.37	200	13.18	360	15.07
Smeared indented corrugated	480	55.11	960	63.24	1440	60.28
Smeared plain corrugated	0	0.00	2	0.13	2	0.08
Incised neckbanded	0	0.00	2	0.13	2	0.08
Clapboard neck	0	0.00	2	0.13	2	0.08
Indeterminate utility	10	1.15	19	1.25	29	1.21
Subtotal for Utility Wares	871	100.00	1518	100.00	2389	100.00
Non-vessel ceramic object	0		1		1	
	1033		1952		2985	

Table 8.2 Percentage of Types and Tempers.

Type	Sand	Fine Tuff & Sand	Medium Tuff & Sand	Anthill A	Anthill B	Light Igneous	Other	Total
Kwahe'e Black-on-white	0.00	66.67	9.52	0.00	0.00	0.00	23.81	100.00
Santa Fe Black-on-white	0.73	90.88	7.85	0.18	0.00	0.18	0.18	100.00
Unpainted Wiyo paste	0	100.00	0	0	0	0	0	100.00
White Ware, Mineral paint	0	0	0	0	0	50.00	50.00	100.00
White Ware, Organic paint	11.11	66.67	0	0	0	0	22.22	100.00
Unpainted White Ware	0	25.00	0	0	0	0	62.50	100.00
Wingate Black-on-red	0	0	0	0	0	0	100.00	100.00
Red ware	0	0	0	0	0	0	100.00	100.00
Total for Service Wares	0.84	87.60	7.71	0.17	0.00	0.34	3.35	100.00
Plain Ware	2.87	0.00	2.87	45.12	25.62	21.61	1.91	100.00
Incised Neckbanded	0	0	0	50.00	50.00	0	0	100.00
Clapboard Neck or Rim	0	0	0	50.00	50.00	0	0	100.00
Indented Corrugated	3.30	0.80	1.40	57.50	28.60	8.10	0	100.00
Plain Corrugated	9.70	3.20	16.10	35.50	25.80	9.70	0	100.00
Smeared Plain Corrugated	0	0	0	100.00	0	0	0	100.00
Smeared Indented Corr.	1.50	0	1.60	51.00	41.60	4.10	0	99.90
Indeterminate Utility Ware	0	0	0	55.20	20.70	24.10	0	100.00
Total for Utility Wares	2.18	0.17	2.01	50.61	35.71	8.83	0.50	100.00
Total for All Wares	1.91	17.65	3.15	40.52	28.57	7.13	1.07	100.00

Type	Schist	Sherd	Sand and Sherd	Andesite, Sand and Sherd	Self	Dark Igneous and Sand	Basalt and Sand	Dark Crystalline and Tuff	Mica, Tuff and Sand	Dark Sand	Very Fine Sand (Silt)	Andesite and Sand
Kwahe'e			2			2					1	
Santa Fe						1						
White Ware, Mineral												1
White Ware, Organic	2											
Unpainted White Ware						3		2				
Wingate		2	2	1								
Red Ware		1										
Plain Ware			2			1			6	1		
Indented							1					
Smearred Indented									1			
Non-vessel					1							
Total												

Table 8.3 Number of Sherds with "Other" Temper Types

Table 8.4. Sherds Selected for Petrographic Analysis

Accession No.	Catalogue No.	Room	East	North	Vertical	Temper	Vessel Type	Vessel form
143	123	surf	550	575	Surface	66	Indeterminate Utility	Miniature pinch pot body
143	124	surf	550	575	Surface	65	Plain ware	Jar body
1	142	15	108	211	0-20	2	Plain ware	Jar body
12	279	11	109	212	0-20	70	Plain ware	Jar neck
21	360	3(16)	110	212	0-30	10	Santa Fe B/w	Bowl body
49	595	K(12)	110	215	0-5	2	Indented Corrugated	Jar body
50	606	K(12)	110	215	20-40	10	Santa Fe paste	Jar body
61	695	K(12)	111	216	0-20	66	Plain ware	Bowl rim
154	780	K(12)	110	216	40-60	67	Smeared Indented corrugated	Jar body
48	794	3(16)	111	211	0-20	2	Santa Fe B/w	Jar body
152	833	3(16)	110.4	211	60-82	65	Santa Fe paste	Bowl rim
152	847	3(16)	110.4	211	60-82	67	Indented Corrugated	Jar body
126	991	4(7)	107	215	40-60	70	Indented Corrugated	Jar body
185	1021	4(7)	106	216	20-40	65	Santa Fe B/w	Bowl body
125	1043	4(7)	107.16	216.89	54	66	Smeared Indented Corrugated	Jar body
95	1080	8	109	215	60-80	67	Plain ware	Jar body
85	1149	11	109	214.3	40-60	66	Indented Corrugated	Jar body
86	1151	11	109	214.3	60-80	7	Plain ware	Jar body

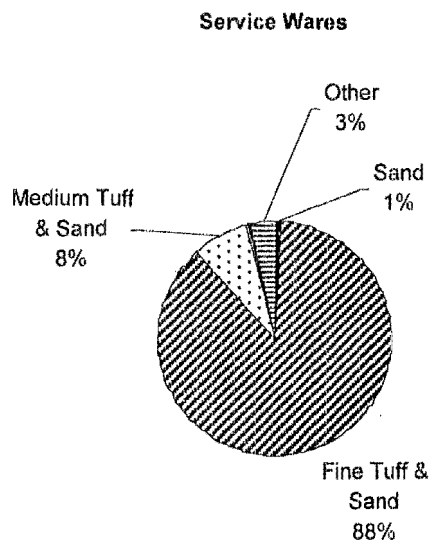
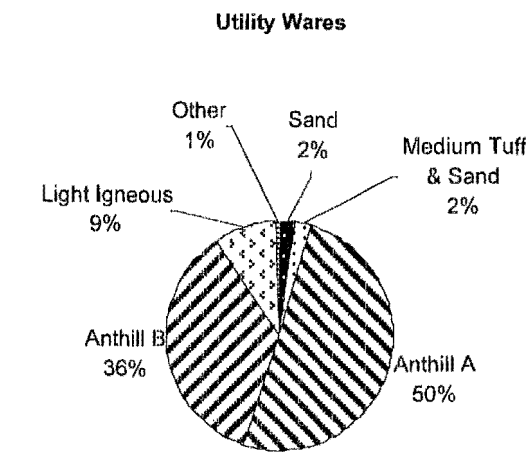


Figure 1. Distribution of Temper Types for Service and Utility Wares

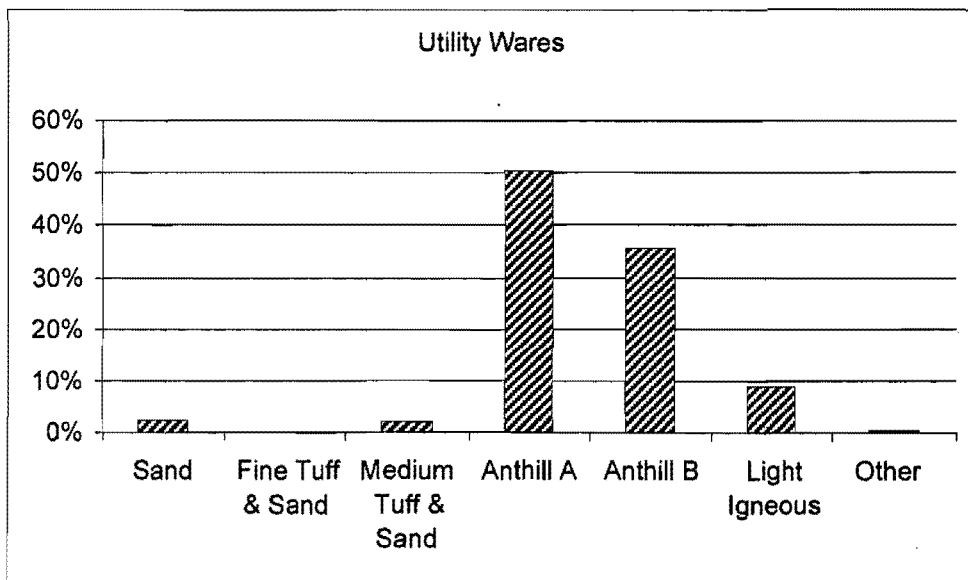
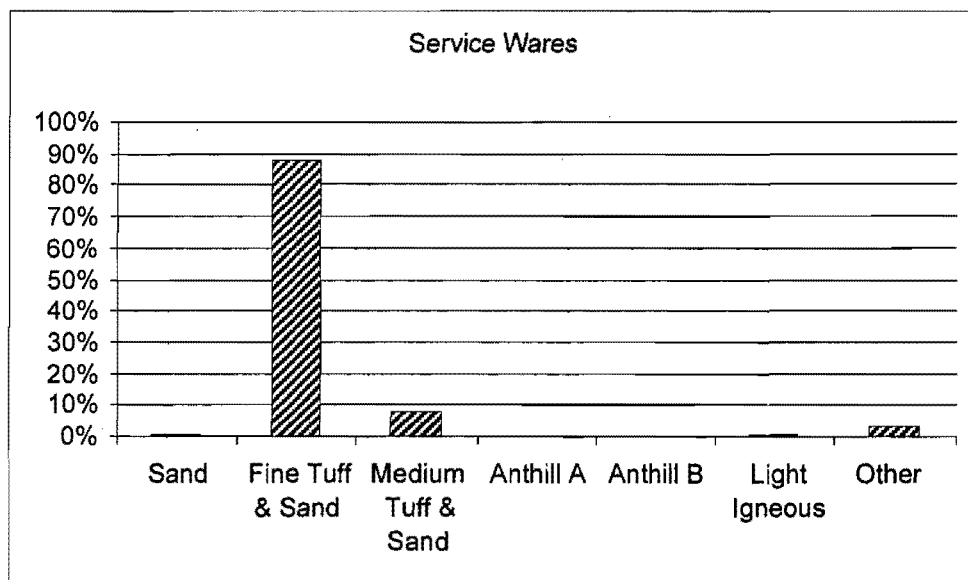


Figure 2. Temper Distributions for Service Wares and Utility Wares

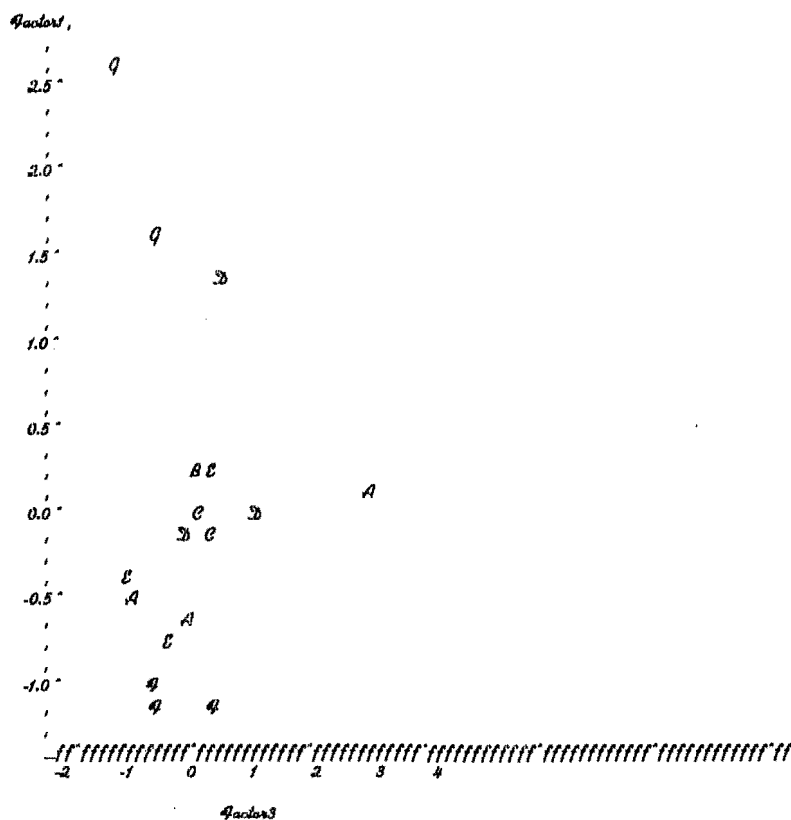


Figure 3. Plot of Factors 1 and 3 from factor analysis of petrography data.

Key to temper types:

A = 2 (sand)

B = 7 (sherd)

C = 10 (fine sand and tuff)

D = 65 (medium sand and tuff)

E = 66 (Anthill A)

F = 67 (Anthill B)

G = 70 (light igneous rock with mica)

NOTE: 1 observation for type 66 (E) is hidden.

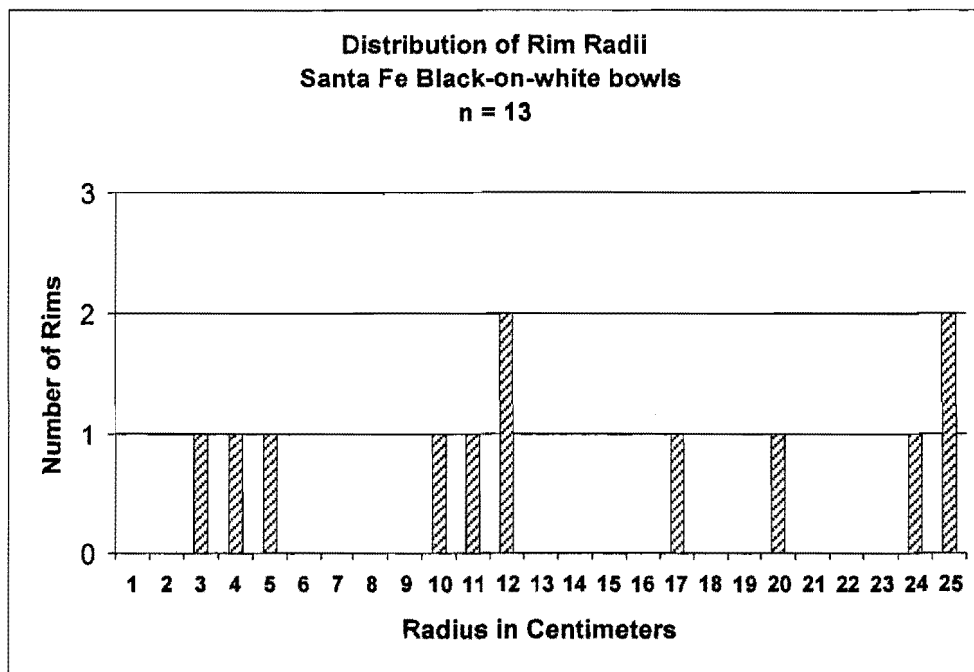


Figure 4. Distribution of rim radii for Santa Fe Black-on-white bowls

Table 8.5. Jar Rim Construction Type

Jar Rim Type	N	%
Plain	57	60.64
Indeterminate coil	1	1.06
Interior coil	2	2.13
Exterior coil	34	36.17
Total	94	100.00

Table 8.6 Vessel Forms

a)

	Service Wares	Utility Wares
Bowl	485	11
Jar	57	2339
Handle	2	6
Miniature	0	11

b)

	Service Wares	%	Utility Wares	%	Total
Bowl	485	89.5	11	0.5	496
%	97.8		2.2		100.0
Jar	57	10.5	2339	99.5	2396
%	2.4		97.6		100.0
Total	542	100.0	2350	100.0	2892

Table 8.7 Surface Treatment

a) Slipping

	Service Wares	%	Utility Wares	%	Total
Unslipped	39	8.02	2373	99.66	2412
Exterior Slip	57	11.73	1	0.04	58
Interior Slip	160	32.92	7	0.29	167
Both Slipped	230	47.33	0	0.00	230
	486	100.00	2381	100.00	2867

b) Missing Surfaces

	n	%
Missing Interior	67	53.2
Missing Exterior	59	46.8
Total	126	100.0

Note: These are all service ware sherds

c) Fire Spalling

	n	%
Fire Spalling nfs	5	7.5
Exterior Fire Spalling	18	27.3
Interior Fire Spalling	43	65.2
Total	66	100.0

Note: These are all service ware sherds

Table 8.8. Sooting

	Service	%	Utility	%	Total
Interior/Exterior	17	51.5	304	68.2	321
Interior	3	9.1	25	5.6	28
Exterior	13	39.4	117	26.2	130
Total	33	100.0	446	100.0	479

Table 8.9 Floor Assemblages

a) By Vessel Form

Form	Room 1	%	Room 3	%	Room 4	%	Room 8	%	Room 11	%	Total	%
Indeterminate	0	0.0	2	1.5	1	6.7	0	0.0	0	0.0	3	1.6
Bowl Rim	1	11.1	4	3.0	0	0.0	4	16.0	0	0.0	9	4.7
Bowl Body	3	33.3	19	14.2	4	26.7	6	24.0	3	42.9	35	18.4
Jar Rim	0	0.0	7	5.2	0	0.0	0	0.0	0	0.0	7	3.7
Jar Body	5	55.6	102	76.1	10	66.7	15	60.0	4	57.1	136	71.6
Total	9	100.0	134	100.0	15	100.0	25	100.0	7	100.0	190	100.0

b) By Ware Type

Ware	Room 1	%	Room 3	%	Room 4	%	Room 8	%	Room 11	%	Total	%
Indeterminate	0	0.0	2	1.5	1	6.7	0	0.0	0	0.0	3	1.6
Kwahe'e B/w	0	0.0	0	0.0	0	0.0	1	4.0	1	14.3	2	1.1
Santa Fe B/w	4	44.4	23	17.2	4	26.7	9	36.0	2	28.6	42	22.1
Plain	1	11.1	14	10.4	0	0.0	5	20.0	1	14.3	21	11.1
Indented												
Corr	1	11.1	14	10.4	0	0.0	3	12.0	0	0.0	18	9.5
Plain Corr	0	0.0	2	1.5	0	0.0	1	4.0	0	0.0	3	1.6
Smrd Ind												
Corr	3	33.3	79	59.0	10	66.7	6	24.0	3	42.9	101	53.2
Total	9	100.0	134	100.0	15	100.0	25	100.0	7	100.0	190	100.0

Table 8.10 Sooting on Vessel Surfaces – Floor Assemblages

a) Service Ware

	Room 1	%	Room 3	%	Room 4	%	Room 8	%	Room 11	%
Both Surfaces	0	0.0	3	50.0	4	100.0	2	66.7	1	33.3
Interior Only	0	0.0	3	50.0	0	0.0	0	0.0	0	0.0
Exterior Only	0	0.0	0	0.0	0	0.0	1	33.3	2	66.7
Total	0	100.0	6	100.0	4	100.0	3	100.0	3	100.0

b) Utility Ware

	Room 1	%	Room 3	%	Room 4	%	Room 8	%	Room 11	%
Both Surfaces	0	0.0	59	83.1	10	100.0	8	100.0	1	100.0
Interior Only	1	33.3	5	7.0	0	0.0	0	0.0	0	0.0
Exterior Only	2	66.7	7	9.9	0	0.0	0	0.0	0	0.0
Total	3	100.0	71	100.0	10	100.0	8	100.0	1	100.0

CHAPTER 8 LITHIC ANALYSIS

BRADLEY J. VIERRA

INTRODUCTION

This chapter presents the results of the analysis of 215 lithic artifacts recovered from the partial excavations of LA 4624. The site consists of a Coalition period roomblock with 25 rooms. Most of the artifacts were recovered from post-occupational fill, although a few are from floor contexts. These artifacts consist of 3 cores, 176 pieces of debitage, 14 retouched tools, 18 ground stone artifacts, a hammerstone, two manuports and a piece of fire-cracked rock. The lithic analysis methods are explicitly defined in Appendix C. The lithic summaries are divided into three sections: material selection, lithic reduction and tool use. The material selection section describes the variation in lithic materials used and the possible sources of these materials. Local materials are defined as those from known or probable sources within a 15 km (10 miles) radius of the site, and nonlocal as those from known or probable sources outside this 15 km catchment. The lithic reduction section provides information on core reduction techniques, stages of reduction represented and evidences of tool production/maintenance. This includes describing the variation in cores, debitage and retouched tools. The section on tool use presents information on tool function, including the presence/absence of use-wear.

MATERIAL SELECTION

Table 9.1 presents the information on artifact type by material type. Most of the cores and debitage are made of chalcedony (45.2%), with less basalt (24.5%), Pedernal chert/chalcedony (14.5%), obsidian (10.0%) and other materials. The majority of these are fine-grained (n=118; 65.9%), with some medium (n=10) and coarse-grained (n=51) materials. Pedernal chert/chalcedony was distinguished from chalcedony by exhibiting shades of black, red and/or yellow coloring. Nonetheless, it is presumed that much of the chalcedony is probably Pedernal chert/chalcedony that simply contains little or no coloring.

Only 1.3 percent of the debitage exhibit cortex, of which roughly half is waterworn (n=12) and half is nodular (n=11). Waterworn or stream-rolled cortex is present on the chalcedony, chert and Pedernal chert/chalcedony materials, indicating that they were obtained from secondary gravel deposits. The closest source for these materials are the Rio Grande terraces near Totavi. Nodular cortex is the natural weathered cortex that is present on primary source materials. This type of cortex was present on basalt and obsidian items, indicating that they were obtained from original source locations. The obsidian can be visually segregated into translucent (n=15), opaque (n=2) and green (n=1) varieties. X-ray fluorescence (XRF) analysis of a sample of debitage indicates that

they are all made of Cerro Toledo obsidian derived from the Rabbit Mountain/Obsidian Ridge source area (Table 9.2; also see Appendix D). Obsidian that was visually distinguished as translucent, opaque and green during the analysis were all obtained from this source area.

The retouched tools are all made of fine-grained materials like obsidian, chalcedony and Pedernal chert/chalcedony. The obsidian was visually distinguished as translucent (n=2), opaque (n=3) and dusty (n=1). The translucent materials were derived from the Valle Grande source, the opaque materials from the Cerro Toledo source and the single dusty material from the El Rechuelos source (Table 9.2). Therefore, the materials used for the production of obsidian debitage were obtained from a single source, vs. materials for the retouched tools that were derived from three separate sources. Both the Cerro Toledo (i.e., Rabbit Mountain/Obsidian Ridge) and Valle Grande (i.e., Cerro del Medio) source areas are located about 15 km (10 miles) as the "crow flies" to the southwest and west of the site. In contrast, the El Rechuelos (i.e., Polvadera Peak) source is located about 24 km (15 miles) to the northwest.

Most of the ground stone is composed of local rhyolite, although vesicular basalt and quartzite was also used for the manos and the slab metate. The abrading stones are made of sandstone, quartzite and rhyolite and the polishing stone is a quartz pebble. The rhyolites and basalts are locally available, but the quartzite and quartz pebbles were probably obtained from terrace gravels. The source of the sandstone is difficult to determine, but it could be derived from formations as nearby as Totavi, or from more distant sources in the Santa Fe and Abiquiu areas.

The hammerstone consists of a Pedernal chert/chalcedony pebble and the manuports are two small fragments of mica. Large pieces of mica can be obtained from pre-Cambrian formations near Ojo Caliente. The fire-cracked is a large burned rhyolite cobble fragment.

LITHIC REDUCTION

The cores consist of a bidirectional core, a flake core and a core fragment. The bidirectional core exhibits an opposed-different-face shape, and the flake core was worked along a single face. Both cores exhibit non-prepared single-faceted platforms and were discarded due to exhaustion. The whole cores have a flaking surface length of 16 and 24 mm, width of 43 and 45 mm, thickness of 32 mm, and weight of 25.5 and 39.0 g.

The debitage primarily consists of core flakes (73.8%), with some angular debris, microdebitage and undetermined flake fragments. These reflect both core reduction and tool production/maintenance activities. Table 9.3 summarizes the various stages of reduction represented by whole flakes. The stages of reduction are defined differently than that used by some Southwestern researchers. Primary reduction refers to core flakes with 100% dorsal cortex, secondary cortical reduction to core flakes with a cortical

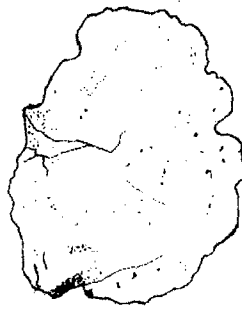
platform and/or partial dorsal cortex, secondary noncortical to cores flakes with no cortex and tertiary reduction to tool retouch flakes (e.g., biface flakes). The debitage assemblage is composed of secondary noncortical (71.5%) and secondary cortical flakes (28.5%), with a total absence of primary and tool retouch flakes. The overall cortical:noncortical ratio of 0.40 reflects this emphasis on the later stages of core reduction. However, there is some variation within specific material types. For example, Pedernal chert/chalcedony is more highly represented in the earlier stages of core reduction with a ratio of 2.5, vs. basalt and chalcedony which are more highly represented in the later stages of core reduction (0.27 and 0.10, respectively).

The majority of the flakes have single-faceted platforms (78.1%; n=68), with less cortical (n=11), collapsed/crushed (n=5) and dihedral (n=2) platforms. Twelve (13.7%) of the platforms exhibit evidence of preparation by abrasion. Most of the core flakes are whole (51.5%; n=67), with some proximal (n=17), midsection (n=14), distal (n=28), lateral (n=3) and undetermined fragments (n=1). The whole core flakes have a mean length of 22.5 mm (sd=7.8) and weight of 3.6 g (sd=3.9). The mean weight of angular debris (3.0 g; sd=5.9) is slightly less than that exhibited by the core flakes.

The retouched tools consist of three retouched pieces, a denticulate, five bifaces, and five projectile points. Two of the retouched pieces are roughly worked thick flakes. One exhibits alternating percussion retouch with a steep edge angle of 65 degrees and the other two unidirectionally retouched edges with angles of 65 and 70 degrees, respectively. The remaining retouched piece was manufactured on a thin flake that exhibits a single bidirectionally retouched edge with acute angle of 45 degrees. The denticulate (AN 138) is a core flake with three narrow notches along one edge and a single notch on the opposite edge (Figure 8.1). The bifaces consist of an ovate biface, a small ovoid biface, two lanceolate-shaped biface base fragment and a lateral fragment (Figure 8.1). The ovate biface (AN 141) is bi-pointed biface made on a thin Pedernal chert/chalcedony flake. The small ovoid biface (AN 187) and one of the lanceolate-shaped base fragments (AN 191) may represent point preforms. All three biface fragments appear to have been broken during manufacturing.

Metrical and descriptive information on the projectile points is presented in Table 9.4. Four of the points are side-notched (AN 117, 121, 157 and 194) and one is corner-notched (AN 171) (Figure 8.1). All are presumably arrow points, with neck widths ranging from 6.0 to 10.8 mm. The point with the larger neck width (AN 121) is probably unfinished. Otherwise, three of the four side-notched points are whole, as is the corner-notched point. The broken point is missing both its tip and a lateral section of the base. It presumably was broken during use. The corner-notched point has been resharpened and exhibits two beveled lateral edges. This artifact is made of Polvadera obsidian, whereas, the two other obsidian points are made of Jemez obsidian.

TOOL USE



138



141



191



187



121



157



117



171

Figure 9.1



Only eight flakes (4.4 %) exhibit evidence of damage or ground surfaces that could be attributed to use-wear. Four flakes exhibit ground dorsal surface indicating that they were removed from ground stone artifacts. One of these surfaces is finely ground with striations. It resembles similar items identified by Vierra (2000) at a Classic period pueblo site south of Albuquerque. These artifacts were classified as possible palette fragments. Otherwise, there are three obsidian flakes that exhibit damage along their lateral edges, with acute angles of 35, 45 and 45 degrees. Lastly, one hammerstone flake was identified. This is a primary flake with a heavily battered cortical platform.

Two projectile points exhibit use-wear. The blade of a side-notched point (AN 157) has rounded edges and the blade on the corner-notched point (AN 171) exhibits micro-scarring and rounding along both edges.

Seventeen pieces of ground stone were recovered during the excavations. These consist of two two-hand mano fragments, three undetermined mano fragments, a slab metate, two undetermined metate fragments, a polishing stone, four abrading stones and five small pieces of undetermined ground stone.

The two-hand manos were intensively used. Both opposing surfaces are pecked and ground, with the artifacts exhibiting a wedge-shaped cross-section. One of the fragments has finger grips along the leading edge. The three undetermined manos fragments are broken ends. The slab metate (AN 207) is whole, measuring 43.5 cm wide by 48.5 cm long. It has a flat and slightly concave grinding surface that covers the total surface of the artifact. The two metate fragments are probably pieces of slab metates. Both have flat pecked and ground surfaces, and one fragment has a shaped and rounded edge.

The polishing stone is a quartz pebble with a finely ground surface. The generalized abrading stones are pebbles with irregular flat grinding surfaces. These items are made of a sandstone, rhyolite and quartzite. The undetermined ground stone artifacts are small fragments that exhibit a single flat grinding surface.

The hammerstone consists of a Pedernal chert/chalcedony pebble that is heavily battered and rounded on opposite ends.

A COMPARISON OF SURFACE VS. SUBSURFACE ARTIFACTS AT LA 4624

Surface collections were made across the area of LA 4624. This included the midden located to the immediate east of the roomblock. Analyses were conducted of two 5 by 5 m collection units that were situated on the midden: N575/E550 and N600/E550. A total of 251 pieces of debitage and four ground stone artifacts were recovered from these grids. A comparison can be made between the surface collected and excavated debitage items. Table 9.4 presents this information. A chi-square analysis of the table indicates that there is no significant difference between the two assemblages ($\chi^2=6.68$, $df=3$, $p=0.08$). However, the cells for "other debitage" do contain significant adjusted residual values. It appears that there are relatively more of these items in the excavated sample. These

artifacts consist of ground stone flakes and undetermined flake fragments, vs. a single biface flake in the surface collections.

TEMPORAL CHANGES IN CHIPPED STONE MATERIAL SELECTION

Studies at the Coalition and Early Classic period sites of LA 3852 (Casa del Rito) and LA 60372 (Burnt Mesa Pueblo) indicated possible long-term changes in material selection during the Coalition and early Classic periods (Root 1992). That is, the Coalition period chipped stone assemblages contained relatively more basalt materials, vs. more Pedernal chert in the Classic period assemblage. A comparison of these assemblages with the LA 4624 assemblage would determine if this site also fit the same pattern.

Table 9.5 is a contingency table of archaeological site by material type for LA 4624, LA 3852 and LA 60372 (Areas 1 and 2). LA 3852 and Area 2 at LA 60372 date to the Coalition period, vs. Area 2 at LA 60372 that dates to the early Classic period. A chi-square analysis was run on the table to determine if there is a significant difference in the distribution of material types across the sites. A significant chi-square value of 376.64 ($df=9$, $p=<0.001$) indicates that there is a significant difference. Therefore, adjusted residuals were calculated in order to identify which of the cells were contributing to the significant chi-square values. Adjusted residuals greater than 1.96 or -1.96 are significant at the 0.05 level. It appears that LA 3852 contains relatively more basalt and obsidian, LA 60372 (Area 2) more basalt and LA 60372 (Area 1) more Pedernal chert as expected. However, LA 4624 contains relatively more chalcedony/chert. Since most of this is a clear chalcedony that was probably derived from Pedernal chert/chalcedony nodules, the site is actually more similar to the Classic period assemblage than the other Coalition period assemblages.

SUMMARY

The lithic assemblage at LA 4624 is similar to other Coalition period roomblock sites in the area (e.g., see Vierra 2000). That is, the assemblage is dominated by the core reduction of locally available Pedernal chert/chalcedony, basalt and rhyolite materials. In contrast, there is little evidence for biface production/maintenance. Obsidian is present, although in small amounts, with mostly Jemez Mountains obsidian being represented. The retouched tool assemblage does, however, contain more formal tools (i.e., bifaces and projectile points) than informal tools (i.e., retouched pieces and denticulates), and the points reflect the typical side and corner-notched arrow forms. The small ground stone assemblage represents the use of two-hand manos and slab metates for processing maize. The hammerstone and other ground stone items reflect the diversity of domestic activities conducted at the site.

Table 9.1 Artifact type by Material Type

Artifact Type		Basalt	Rhyolite	Andesite	Tuff	Obsidian	Chalcedony	Chert	Peder-nal	Sand-stone	Quartzite	Quartz	Mica	Total
Cores	Cores	0	0	0	0	0	2	0	1	0	0	0	0	3
	Subtotal	0	0	0	0	0	2	0	1	0	0	0	0	3
Debitage	Angular Debris	8	0	1	0	0	14	1	5	0	0	0	0	29
	Core Flake	30	0	1	1	16	60	2	20	0	0	0	0	130
	Microdebitage	6	0	0	0	0	5	1	0	0	0	0	0	12
	Und. Flake	0	0	0	0	2	0	0	0	0	0	0	0	2
	Ground Stone Flake	0	0	1	2	0	0	0	0	0	0	0	0	3
	Subtotal	44	0	3	3	18	79	4	25	0	0	0	0	176
Retouched Tools	Retouched Piece	0	0	0	0	0	2	0	1	0	0	0	0	3
	Denticulate	0	0	0	0	0	0	0	1	0	0	0	0	1
	Biface	0	0	0	0	3	1	0	1	0	0	0	0	5
	Projectile Point	0	0	0	0	3	2	0	0	0	0	0	0	5
	Subtotal	0	0	0	0	6	5	0	3	0	0	0	0	14
Ground Stone	2-hand Mano Frag.	0	2	0	0	0	0	0	0	0	0	0	0	2
	Und. Mano Frag.	1	1	0	0	0	0	0	0	0	1	0	0	3
	Slab metate	1	0	0	0	0	0	0	0	0	0	0	0	1
	Und. Metate Frag	0	2	0	0	0	0	0	0	0	0	0	0	2
	Polishing Stone	0	0	0	0	0	0	0	0	0	0	1	0	1
	Abrading Stone	0	1	0	0	0	0	0	0	2	1	0	0	4
	Und. Ground Stone	0	5	0	0	0	0	0	0	0	0	0	0	5
	Subtotal	2	11	0	0	0	0	0	0	2	2	1	0	18
Other	Hammerstone	0	0	0	0	0	0	0	1	0	0	0	0	1
	Manuport	0	0	0	0	0	0	0	0	0	0	0	2	2
	Fire-cracked Rock	0	1	0	0	0	0	0	0	0	0	0	0	1
	Subtotal	0	1	0	0	0	0	0	1	0	0	0	2	4
Total		46	12	3	3	24	86	4	30	2	2	1	2	215

Table 9.2. Obsidian Source Samples

LA No.	Acc #	East	North	Artifact	Color	Source
4624	90	108	220	Biface	Opaque	Cerro Toledo
4624	117A	109	215	Point	Translucent	Valle Grande
4624	117B	109	215	Flake	Translucent	Cerro Toledo
4624	131	107	212	Biface	Opaque	Cerro Toledo
4624	136	107.66	209.00	Flake	Translucent	Cerro Toledo
4624	154A	110	216	Flake	Opaque	Cerro Toledo
4624	154B	110	216	Flake	Opaque	Cerro Toledo
4624	154C	110	216	Flake	Green	Cerro Toledo
4624	154D	110	216	Flake	Translucent	Cerro Toledo
4624	157A	111	216	Flake	Translucent	Cerro Toledo
4624	157B	111	216	Point	Opaque	Cerro Toledo
4624	171	109.08	207.90	Point	Dusty	El Rechuelos
4624	181	106	218	Flake	Translucent	Cerro Toledo
4624	187	109	207	Biface	Translucent	Valle Grande

Table 9.3 Debitage Reduction Stages

Material	Primary	Secondary-cortical	Secondary Non-cortical	Tertiary	Cortical: Non-cortical ratio
Basalt	0	3	11	0	0.27
Andesite	0	1	0	0	--
Obsidian	0	2	4	0	0.50
Tuff	0	0	1	0	--
Chalcedony	0	3	29	0	0.10
Chert	0	1	1	0	1.0
Pedernal	0	10	4	0	2.5
Total	0	20	50	0	0.40
Percentage	0.0	28.5	71.5	0	

Table 9.4 Projectile Point Metrical (mm) and Descriptive Data

Acc #	Material	Condition	Overall Length	Blade Length	Neck Width	Stem Length	Stem width	Thickness	Weight (gm)	Haft type	Blade shape	Base shape
117	Obsidian	Whole	23.4	16.0	7.7	7.4	14.5	2.8	1.0	Side-notched	Straight	Straight
121	Chalcedony	Whole	23.7	13.5	10.8	10.2	16.3	4.1	2.0	Side-notched	Straight	Straight
157	Obsidian	Whole	22.5	14.0	6.0	8.5	10.3	3.2	0.5	Side-notched	Straight	Convex
171	Obsidian	Whole	25.5	16.2	6.3	9.3	9.4	5.1	1.5	Corner-notched	Straight	Straight
194	Chalcedony	Base	--	--	--	--	--	--	0.5	Side-notched	--	--

Table 9.4 Debitage Types for Surface vs. Excavated Debitage. *

Type	Surface	Excavation	Total
Angular Debris	51 1.0	29 -1.0	80
Core Flake	174 -1.0	130 1.0	304
Microdebitage	25 1.1	12 -1.1	37
Other debitage	1 -2.1	5 2.1	6
Total	251	176	427

Chi-square=6.68, df=3, p=0.08

* Top value in cell represents artifact count and bottom value represents adjusted residuals.
Significant ($p < 0.05$) positive values are shown in bold.

Table 9.5 Chipped Stone Material Selection by Archaeological Site. *

Site	Basalt	Obsidian	Pedernal	Chalcedony/ chert	Total
LA 4624	44 -5.6	24 -2.0	28 -4.7	88 18.4	184
LA 3852	52 2.8	28 3.2	11 -3.9	2 -2.7	93
LA 60372 (Area 2)	50 2.6	20 1.0	18 -2.1	3 -2.3	91
LA 60372 (Area 1)	266 1.2	105 -9	229 7.4	9 -11.8	609

Chi-square =376.64, df=9, $p < 0.001$

* Top value in cell represents artifact count and bottom value represents adjusted residuals.
Significant ($p < 0.05$) positive values are shown in bold.

FIGURES

Figure 9.1. LA 4624 Retouched Tools

CHAPTER 9 FAUNAL ANALYSIS

KARI M. SCHMIDT

INTRODUCTION

This chapter presents the results of the analysis of 112 well-preserved and unmodified non-human bones recovered from the partial excavations of LA 4624. The site consists of a Coalition period roomblock with 25 rooms. Most of the artifacts were recovered from post-occupational fill, although a few are from floor contexts. The chapter is organized into three parts: methods, results and discussion. The methods section provides information on the specific methods used to analyze the assemblage. The results section presents the descriptive results with a brief comment about prehistoric diet at LA 4624. The discussion section contrasts the LA 4624 assemblage with Coalition period faunal assemblages excavated at Bandelier National Monument.

This brief study represents one of the few quantifiable studies of faunal data from the Coalition period on the Pajarito Plateau. Although only 112 elements were recovered, information from this analysis will be an important first-step to understanding Coalition period subsistence.

METHODS

The faunal remains were analyzed and assigned to the lowest taxonomic level whenever possible. Genus and species identifications remained the ideal goal throughout the analysis, but were not always possible. Identifications were made using the comparative collection of the primary author as well as that housed at TA-21, Los Alamos National Laboratory, and were augmented by osteological manuals when necessary (Cohen and Serjeanston 1996; Gilbert 1993; Lawrence 1951; Olsen 1964, 1968). Provenience data recorded for each specimen included site number, accession number, room number (where applicable), easting, northing, and level (where applicable).

The analysis followed standard zooarchaeological procedures (Grayson 1984; Klein and Cruz-Urbe 1984), and recorded the following attributes for each bone: lowest taxonomic identification, element (e.g., tibia, ulna), portion of element present (e.g., proximal, distal, or complete), side (if able to be determined), age (presence or absence of epiphyseal fusion line, epiphyses, etc.), fusion (fused or unfused), presence and degree of burning, natural taphonomic factors (e.g., root-etching, weathering), break patterns (if other than natural), pathologies, and numbers of specimens present. In addition, other surface modifications (e.g., rodent or carnivore gnawing), if present, were recorded. The majority of specimens were weighed.

Unidentifiable materials classified as mammal were separated based on size. Following Shaffer and Baker's (1992) criteria, distinctions were made between small mammals

(small rodents and leporids), medium-sized mammals (large rodents such as beaver, and carnivores such as coyotes and foxes), medium-large sized mammals (deer, pronghorn, and bighorn sheep), and large-sized mammals (elk, bison, and bear). Similar distinctions were made for birds if element identification was not possible.

RESULTS

In general, the overall preservation of the bones from LA 4624 is good. For the most part, bones tended to be in large fragments, although very few complete bones were recovered. Weathering on the faunal remains was present, although the frequency and severity was generally low, suggesting the remains may not have been exposed to the elements for a long period of time prior to deposition. The bones show no evidence of root-etching, carnivore gnawing or carnivore-digestion. One specimen, a proximal metacarpal from a deer (*Odocoileus* sp.), displays signs of rodent-gnawing. Burning, while also present, was noted on only 12% ($n=10$) of the remains. No pathologies were identified on any of the faunal remains. Most of the 112 bones were very small; specimen weight ranged from an immeasurable trace to a maximum of 36.5 g. Only five bones weighed more than 5.0g, all of which were identified as deer. No worked bones were identified from the assemblage, although one small-to-medium-sized mammal long bone shaft fragment did display signs of polishing.

Of the 112 faunal remains recovered from the excavations at LA 4624, 68% ($n=76$) were identified to at least the level of class. The 76 identified remains come from both excavated ($n=70$) and surface ($n=6$) contexts. The majority of the identified fauna (44 percent) consists of indeterminate bird remains (37%, $n=24$) and probable turkey (*Meleagris gallopavo*) remains (7%, $n=5$). The indeterminate bird remains clearly represent bird bone, but could not be identified to element or species. It is possible that the indeterminate bird remains come from the identified turkey elements as they derive from the same context, but this assignation could not be confidently made.

In addition to the bird remains, an additional 28% of the identified assemblage is comprised of medium-to-large-sized mammal remains, with 12% ($n=9$) identified as deer (*Odocoileus* sp.), 3% ($n=2$) having been identified as pronghorn (*Antilocapra americana*), and 13% ($n=10$) identified as medium-to-large-sized mammal. Most of these identifications were made on long bone shaft fragments and were based on the overall thickness of the shaft wall. Three of the deer specimens came from a single element, an unfused distal metatarsal. The diaphysis and both unfused distal condyles were recovered from the same context. No other juvenile remains were identified in the assemblage. Both of the identified pronghorn elements were distal, or third, phalanges.

Indeterminate small-to-medium-sized mammals comprised 12% ($n=9$) of the assemblage, and medium-sized mammals comprised 5% of the identified assemblage ($n=4$). The remaining identified remains are comprised of jackrabbit (*Lepus* spp.; 3%, $n=2$), cottontail rabbit (*Sylvilagus* spp.; 1%, $n=1$), indeterminate squirrel (Sciuridae; 1%, $n=1$),

pocket gopher (*Geomys* sp.; 4%, $n=3$), indeterminate rodent (1%, $n=1$), and weasel (*Mustela frenata*; 1%, $n=1$).

Table 9.1 presents summary information for all of the faunal remains recovered from the excavations at LA 4624. Table 9.2 presents information similar to that presented in Table 9.1, but with the unidentified remains ($n=20$) removed from tabulations. The 36 unidentified remains came from excavated contexts and surface collections. Despite their exposure to elements, however, their composition and appearance remained similar to the other remains recovered.

Recovery techniques at LA 4624 were differentiated between excavation activities and surface collections. Of the 76 total identified remains, 70 came from excavated contexts while 6 were recovered from surface collections. Table 9.3 lists the six remains recovered from surface collections, their surface coordinates, and number of specimens identified.

The majority of the identified remains ($n=70$, 92%) came from excavated contexts. Table 9.4 presents the identified remains from excavated contexts. All of the identified deer, pronghorn, weasel, pocket gopher, and bird remains, including turkey, came from these areas. Nine of the ten medium-to-large sized mammal remains came from excavated contexts as well. Only a single specimen identified to species (jackrabbit) did not come from the excavated contexts. While the majority of the remains were removed from fill contexts above floor, the indeterminate bird and probable turkey remains came from the floor, or from the fill just above floor. These are the only remains that came from this context. The following species were identified in the fill in the levels right above the floor (60 to 80 cm below ground surface): weasel, small-to-medium sized mammals, indeterminate rodents, pocket gopher, and medium-to-large sized mammal. All of the other remains came from the levels between the surface and 60 cm below the surface.

Despite the small sample size, the presence of artiodactyls, rodents, birds, and leporids suggests the inhabitants of LA 4624 were exploiting a wide range of taxa from a variety of biotic zones, most accessible within the immediate vicinity of the Plateau. The two pronghorn remains, however, represent a species that is not available on the Plateau. During the period of time when LA 4624 was occupied, it is probable that the closest access to herds of pronghorn would have been two days distant from the Plateau, either around Cuba, New Mexico, or on the eastern slopes of the Sangre de Cristo and Sandia mountain ranges (J. Biggs, personal communication, 2001). The presence of pronghorn remains in the assemblage suggests that the inhabitants of LA 4624 were either trading with other groups for meat, or that they were procuring the remains themselves at locations far removed from the roomblock. Given the presence of a high percentage of deer remains in the assemblage, a locally available species, it seems more likely that the former option is more viable.

The presence of rodent remains from the levels just above the floor suggests that the site has either experienced a significant amount of post-depositional activity, or that the inhabitants of LA 4624 were exploiting these resources. The lack of burning on the

rodent remains might suggest that the remains were not of cultural origin, but this can not be determined from the few remains recovered.

DISCUSSION

Although the very small sample size from LA 4624 hinders meaningful interpretation of Coalition period subsistence practices on the Pajarito Plateau, the analysis is significant in that it represents one of only a very small number of subsistence studies (but see Head 1988; Hill and Trierweiler 1986; Trierweiler 1987, 1990) from the area. The most substantial of these subsistence studies come from the southern end of the Plateau in Bandelier National Monument. The analysis of faunal remains from a number of sites around Burnt Mesa Pueblo (Kohler 1988, 1990; Kohler and Linse 1993; Kohler and Root 1992) represents a large sample analyzed from the same area as LA 4624. And, despite the small sample at LA 4624, the overall composition of the assemblage closely mirrors those from the vicinity of Burnt Mesa Pueblo. As at LA 4624, bird and large mammal dominated the assemblages in the Bandelier area. Cottontail, jackrabbit, and other small mammals were also relatively abundant. While these species are not represented in great numbers at LA 4624, their presence suggests that had sample sizes been larger, the composition of the subsistence assemblage may have been similar to the most well documented subsistence assemblage on the Plateau.

Table 9.1. Faunal remains recovered from LA 4624

Class/species	NISP*	Percent of Total Remains
Unidentified	36	31
Cottontail	1	1
Jackrabbit	2	2
Sm/med. Mammal	9	8
Squirrel	1	1
Pocket gopher	3	3
Weasel	1	1
Indet. Rodent	1	1
Medium mammal	4	4
Med/lg mammal	10	9
Pronghorn	2	2
Deer	9	8
cf. Turkey	5	25
Indeterminate bird	28	4
Total	112	100

*Number of identified specimens present

Table 9.2. Identified faunal remains from LA 4624

Class/species	NISP	Percent of Total Remains
Cottontail	1	1
Jackrabbit	2	3
Sm/med. mammal	9	12
Squirrel	1	1
Pocket gopher	3	4
Weasel	1	1
Indet. rodent	1	1
Medium mammal	4	5
Med/lg mammal	10	13
Pronghorn	2	3
Deer	9	12
cf. Turkey	5	37
Indeterminate bird	28	7
Total	112	100

Table 9.3. Identified faunal remains from surface contexts.

Class/species	East	North	NISP
Medium mammal	560	580	1
Medium mammal	560	585	1
Medium mammal	550	585	1
Med/lg. Mammal	550	585	1
Jackrabbit	555	585	1
Sm/med. Mammal	555	585	1
Total	--	--	6

Table 9.4. Identified faunal remains from excavated contexts at LA 4624

Class/species	East	North	Level	NISP
Med/lg. Mammal	105	210	0-45	3
Med/lg. Mammal	105	210	0-45	1
Deer	106	210	0-52	1
Deer	106	210	0-52	1
Deer	106	210	0-52	1
Sm/med. mammal	107	210	25-64	1
Deer	107	210	25-64	1
Med/lg. Mammal	107	216	40-60	1
Pronghorn	107	216	40-60	1
Cottontail	107	217	40-60	1
Jackrabbit	107	217	40-60	1
Med/lg. mammal	107	217	40-60	1
Deer	107	217	40-60	1
Med/lg. mammal	107.77	211.26	60	1
Pronghorn	108	212	20-48	1
Squirrel	109	203	0-20	1
Deer	109	211.16	40-60	1
Deer	109	212	20-40	1
Sm/med. mammal	109	212	40-60	2
Med/lg. mammal	109	212	40-60	2
Indeterminate bird	109	214.3	80-floor	24
Indeterminate bird	109	214.3	80-floor	4
Turkey	109	214.3	80-floor	1
Turkey	109	214.3	80-floor	4
Sm/med. mammal	109	215	60-80	2
Sm/med. mammal	109	215	60-80	1
Weasel	109	215	60-80	1
Medium mammal	110	213	0-20	1
Deer	110	214.3	0	1

Pocket gopher	110.35	212	60-80	3
Indet. rodent	110.35	212	60-80	1
Sm/med. mammal	110.4	211	60-80	1
Sm/med. mammal	111	214	0	1
Total	--	--	--	69*

*one identified remain came from "QRS" last level";
no other provenience provided

CHAPTER 10 ARCHAEOBOTANICAL AND POLLEN ANALYSIS

PAMELA J. McBRIDE AND SUSAN J. SMITH

INTRODUCTION

Five flotation, 90 macrobotanical (i.e., vegetal), and three pollen samples were analyzed from LA 4624. The site consists of a 25 room pueblo that was occupied during the Coalition period. It is situated at an elevation of 2060 m (6760 ft) on Mesita del Buey that overlooks nearby Pajarito Canyon. The majority of samples were collected from fill, either post-occupational in origin, and from either wall or roof fall from ten of the rooms excavated during the 1993 season. A few samples were from the floor or fill above the floor. One flotation sample (Accession number 159) is from a possible feature on the floor of Room 3. Wild Plant resources identified consisted of at least three weedy annuals, one grass, and four perennial genera. Wood charcoal was primarily coniferous, but a diverse array of shrubs was present as well as representatives from the riparian community (cottonwood/willow). Maize was the only domesticate identified. Wild plant resources would have derived from the Great Basin Conifer Woodland (Brown 1994) where the site is located.

The dominant evergreen species in this biotic community are one-seed juniper (*Juniperus monosperma*) and piñon (*Pinus edulis*). Stands of ponderosa pine (*Pinus ponderosa*) occur where elevations exceed 7,000 feet. Shrubby species include oak (*Quercus* sp.), skunkbush (*Rhus trilobata*) yucca (*Yucca angustissima*, *Y. baccata*), and pasture sage (*Artemisia frigida*). Understory consists largely of grasses like blue grama (*Bouteloua gracilis*), dropseed (*Sporobolus cryptandrus*), or muhleys (*Muhlenbergia* sp.) and herbaceous plants including those in the aster, goosefoot, and mallow families among many others. Cacti include prickly pears *Opuntia* sp., hedgehogs (*Echinocereus* sp.), and chollas (*Opuntia* sp.). A vegetation survey conducted at the historic Romero cabin site at an elevation of 2133 m (7,000 ft) in the adjacent Technical Area 55, describes the site as bordered on the east by piñon/juniper woodland, on the south by a mixture of ponderosa pine, piñon, and juniper and on the west by a ponderosa pine forest (Foxy and Tierney 1999:30). This description may bear some resemblance to that found at LA 4624.

The method followed and results obtained from archaeobotanical analysis of flotation, and vegetal samples are presented in this chapter. The goals of this report are to 1) describe plant taxa exploited by prehistoric populations, 2) to compare resource use patterns with other archaeobotanical analysis results from sites in the region, 3) and to address research questions such as season of occupation, diet, and subsistence practices.

METHODS

Archaeobotanical analysis of material from the project involved vegetal sample analysis, flotation processing, full sort analysis, quantification, and pollen analysis as described below. Identification was aided by the use of a modern comparative collection. Scientific nomenclature and common names followed those presented in Martin and Hutchins (1980). Identifications were made to different taxonomic levels: families (e.g., Gymnospermae), genus (e.g., *Chenopodium*), species (e.g., *Pinus edulis*) and non-Linnaean categories (e.g., cheno-am). The cheno-am category refers to seeds that could be either in the genus *Chenopodium* or *Amaranthus*. This category is used when the condition of a seed prohibits a more specific identification.

Table 10.1 lists the Latin and common name, plant part, and plant category (annuals, perennials, etc...) of all charred plants recovered from the project. For ease of reporting, taxa in all other tables are recorded using the common name only. Plant remains designated as “unknown” indicate remains that might be identified later using a more extensive comparative collection. “Indeterminate” plant remains are unidentifiable due to erosion or fragmentation.

Vegetal Sample Analysis

Macrobotanical field samples are fortuitous plant specimens collected as they are encountered in the field either during excavation or the screening of fill and are not associated with an exact provenience. In spite of this, vegetal specimens can offer further insight into the diet and subsistence of prehistoric populations.

Vegetal specimens are identified, counted and weighed, and placed in protective containers such as film canisters or polypropylene vials, depending on specimen size. The taxon, plant part, confidence of the identification, condition, count, and weight of the specimen are recorded along with any observations that may be important in the interpretation of the material in Table 10.12.

Flotation Samples

Flotation Processing

The Los Alamos National Laboratory uses a standard decant flotation system as described by Hammett and McBride (1993). The five flotation samples ranged in volume from 1.4 to 4.0 liters (Table 10.2). Each flotation sample was poured into a bucket of water, agitated gently until the botanical material floated to the surface, and then decanted onto a clean piece of chiffon material to dry. The residue at the bottom of the bucket (called the heavy fraction) was rinsed to eliminate soil matrix, dried, and examined in order to recover lithic and bone material.

Full Sort Analysis

The floated material was passed through a series of graduated screens (U.S. Standard Sieves with 4 mm, 2 mm, 1 mm, and .5 mm mesh sizes). The material from each screen size was then examined using a binocular microscope at a magnification of .7x to 4.5x. Charred reproductive plant parts like seeds and fruits were identified and counted. Charred non-reproductive plant parts (bark, needles, etc...) and uncharred plant parts were also identified and quantified as an estimate of abundance/liter.

If more than 20 pieces of wood charcoal were present in a sample, then 20 pieces (selected randomly from the 4 mm and 2 mm screens) were identified, separated by taxon, counted, and weighed. Then the remainder of each fraction was scanned to identify any taxa that might have been missed. Otherwise, all identifiable wood charcoal from a sample was analyzed.

Several problems that arise consistently during wood identification in the southwest are addressed by placing specimens in more general categories. The identification of unknown conifer is used when a specimen is too fragmentary to enable the analyst to differentiate between juniper and other conifers such as piñon or fir. Pine is designated when resin ducts are present, but the fragmentary nature of a specimen does not allow for identification to species. Several species of shrubs that are in the Chenopodiaceae (goosefoot) family are impossible to distinguish from each other (four-wing saltbush, greasewood, winterfat, etc...). For this reason, identification to species is impossible and specimens are placed in the combined saltbush/greasewood taxon.

All wood and reproductive plant parts that were counted and identified from each sample were placed in polypropylene capsules or plastic bags and labeled for future reference. An example of each uncharred or non-reproductive charred plant part encountered during analysis was also separated and placed in a polypropylene capsule or plastic bag.

Non-cultural remains such as roots and insect parts observed during flotation analysis were also recorded. These observations are reported along with sample volumes (before flotation) and sample weights (after flotation) in Table 10.2.

In addition to taxon, plant part, and quantity, the confidence of the identification (positive, fairly certain, resembles taxon) and condition of the plant part (charred, partially charred, or uncharred) were recorded by accession number (Table 10.11).

Quantification

Three forms of quantification were used during flotation analysis: abundance, ubiquity, and minimum number of individuals (MNI's). Each of these is described below.

Abundance

To determine the estimated abundance of charred non-reproductive plant parts and uncharred taxa present in a sample, an estimate of the number of these materials per liter of soil is recorded. This allows for an approximate quantification of non-reproductive plant parts and an estimation of the degree of contamination.

Ubiquity

Many factors can affect the number and type of taxa recovered from flotation samples including differential preservation of plant remains, plant processing techniques, and archaeological sampling strategies. Seeds and nuts with hard testa will preserve, while tubers and leafy greens rarely, if ever preserve. Plants that were parched during processing are more likely to preserve due to “kitchen accidents” than those that do not require this step during food preparation. A 5- liter flotation sample has a greater probability of yielding a diverse number of plant taxa than a 1- liter sample.

When the first two factors are considered, it can be difficult or impossible to determine the exact composition of the prehistoric diet or the degree of dependence on one plant as compared to another. The latter problem of differential sample size can be resolved by standardizing flotation sample volumes or by applying statistical analyses to determine the effects of sample size on archaeobotanical analysis results. Ubiquity is a quantification method used by archaeobotanists to identify possible trends or patterns that can lead to the identification of plant processing or storage loci or changes in plant exploitation through time.

To determine which plant remains were most common in samples, ubiquity tables were created for non-wood plant taxa recovered from the project. Ubiquity tallies the presence or absence of a taxon in each sample. The number of remains of a particular taxon found in a sample is not reported in this method of quantification. Presence is recorded for one specimen of a taxon or 200. Therefore, ubiquity measures the frequency of occurrence of taxa as opposed to absolute counts that measure abundance. The flotation analysis results are reported in ubiquity tables as a count (the number of samples in which the taxon is present) and percent presence (the number of samples in which the taxon is present expressed as a percentage of the total number of samples) as Popper describes (1988). For example, if goosefoot occurs in two samples out of ten the count would be two and the percent presence would be 20%.

Absolute Counts and MNIs

Absolute counts measure the absolute abundance of taxa in a sample and become especially useful in situations where the absolute abundance of taxa changes over time, but the frequency of those taxa does not. During full-sort analysis, absolute counts and

minimum number of individuals (MNI) were recorded for charred seeds and other reproductive plant parts. Absolute counts and MNI were recorded for charred and uncharred reproductive plant parts during vegetal sample analysis. The absolute count includes fragments as well as whole reproductive plant parts. The MNI count was used effectively by Hammett and McBride (1993) on the Transwestern Pipeline Project. This is a quantification measure borrowed from faunal analysts and osteologists, which allows the archaeobotanist to clearly distinguish between the presence of whole or fragmented remains when reporting results. An MNI value of 1 was given to a seed or fruit if more than one half of that reproductive unit was present.

Conventional Pollen Analysis Methods

Subsamples (7-20 cc volume) were collected from the sample bags and spiked with a known concentration (25,084 grains) of tracer spores (*Lycopodium*) to monitor the chemical extraction procedure and to make it possible to calculate pollen concentrations. Processing steps included overnight hydrochloric and hydrofluoric acid treatments, followed by a density separation in zinc bromide (1.9 specific gravity). Pollen assemblages were identified by counting grains on slide transects at 400x magnification to at least a 300 grain sum (pollen sum), then scanning the entire slide at 100x magnification to record additional taxa. Aggregates (clumps of the same taxon) were counted as one grain per occurrence, and the taxon and size recorded separately. Numerous large aggregates in protected contexts can reflect plant processing.

Three measures were calculated from the data – taxa richness, pollen concentrations, and pollen percentages. Taxa richness is the number of pollen types identified in each sample. Pollen concentration was calculated by taking the ratio of the pollen sum to the number of tracers counted, and then multiplying by the initial tracer concentration (25,084 grains). This result is divided by the sample volume, which yields the number of pollen grains per cubic centimeter of sample sediment, abbreviated gr/cc. Concentrations can be used as an index to the abundance of plant material that may have been associated with cultural activities and provide the first level of sample comparisons, followed by comparison of pollen percentages. Pollen percentages normalize sample counts to 100 ($[\text{taxon count/pollen sum}] * 100$), so that each taxon is expressed as a proportion of the sample pollen sum.

Intensive Scanning Microscopy Pollen Analysis Methods

Conventional pollen microscopy methods are based on describing the pollen population on one microscope slide, which represents just a fraction of the processed sample. Dean (1998) developed an extended microscopy method called Intensive Scanning Microscopy, abbreviated ISM, which is based on increasing the probability of finding rare pollen types by examining more than one microscope slide, but at lower magnifications than the typical 400x. If preservation is moderate, pollen greater than 30 μm in size can be easily identified at 100x magnification, including corn, squash, cotton, bean, agave, yucca, cholla, cacti, and some herb types. The ISM method is also designed

to quantify the abundance or absence of scan-identified taxa by documenting the number of tracer grains encountered during scans. The ability to quantify pollen at low magnification scans is important, because the analysis can be evaluated as to whether it was adequate to find a rare type, and the numbers provide an objective basis to compare pollen representation from different sites.

ISM was used on three pollen samples submitted from LA 4624 to ensure rare cultigen pollen, such as cotton, would not be missed using only conventional microscopy methods. After the 400x magnification counts, one to three additional slides from each sample were scanned at 100x magnification until the sample was analyzed to at least a level of 1.0 gr/cc. The target concentration of 1.0 gr/cc was chosen based on previous studies of agricultural fields (Dean 1998) that have documented the lowest levels of rare pollen occur at 1.0 gr/cc. The target concentration is reached by solving the pollen concentration equation (Methods Section) for the number of tracers, using one grain as the pollen sum. In order to observe a 1.0 gr/cc rare grain in the LA 4624 samples, it was necessary to view greater than 1600 to 3500 tracer grains in each sample, dependent on the sample volume.

RESULTS OF FLOTATION, VEGETAL AND POLLEN SAMPLE ANALYSIS

The following sections describe the results of analysis of charred and uncharred plant remains, as well as wood, from flotation samples. Full-sort analysis results are itemized by accession number in Table 10.11. The discussion of flotation sample analysis results is followed by the results of vegetal and pollen sample analyses.

Uncharred Plant Remains from Flotation Samples

Archaeobotanists have struggled with the interpretation of uncharred seeds recovered from subsurface samples. The uncertainty as to whether uncharred seeds were deposited because of cultural activity, from rodent and insect activity, or from seed rain, precludes their clear interpretation. Minnis (1981) discussed problems inherent in interpreting uncharred seeds recovered from open-air sites. He tested a modern facsimile of an archaeological site to compare the presence of taxa known to have been used (called "economic taxa") to the number of contaminants. Three economic taxa were recovered, as well as 16 taxa that had been deposited by non-human processes such as seed rain or rodent movement. Because of these kinds of questions about the origins of uncharred seeds found in open-air sites, this report will focus on charred plant remains. Therefore, when present, uncharred remains were recorded during full-sort analyses, but were considered intrusive and not associated with the prehistoric use of the site.

Uncharred plant material included 14 taxa (Table 10.3). Only one of the nine charred non-wood taxa recovered from the project were not recovered uncharred. This suggests a significant degree of contamination by non-cultural intrusives. In fact four out of the five

flotation samples contained rodent feces and gnawed uncarbonized piñon nuts and prickly pear cactus seeds.

Charred Plant Remains from Flotation Samples

Perennial species and maize dominate the floral assemblage from the LA 4624 flotation samples (Table 10.4). While the number of perennial taxa is greater than other categories, the frequency of each taxon is restricted to a singular occurrence. The plants in this category have documented economic uses and piñon in particular was an important source of protein, but their low frequency presents interpretation problems. Whether the plant parts are included in the archaeobotanical record unintentionally (deposited by wind, on clothing, or by rodents) or as part of the firewood debris (four-wing saltbush fruit still adhering to branches), or are kitchen accidents from processing plants for food or medicine is impossible to determine.

Maize cupules and cheno-am seeds were the most commonly identified plant remains from the site. Annual species are represented by goosefoot, pigweed, and purslane seeds that are found in nearly every flotation sample examined from all different time periods and biotic communities in the southwest. The propensity of weedy annuals to proliferate in the disturbed ground around habitation sites, agricultural fields, and middens make them a readily available resource. Maize cob parts are usually part of the prehistoric record as a result of the practice of using cobs for fuel. A single occurrence of dropseed grass was the only evidence of the use of this resource class.

Differences in plant remain distribution occur, but are difficult to interpret. Four-wing saltbush fruit and seeds only occur in a sample from fill above the floor, cactus areola and piñon nutshell are present solely in one of the wall fall samples, and hedgehog cactus, dropseed, and globemallow were only identified in Accession Number 159, a possible feature. The greatest number of taxa was recovered from Accession Number 159, indicating the sample represents general fill and therefore, the floral remains do not help to define feature use. This supports the contention that the possible feature actually represents wall or roof fall.

The flotation sample wood assemblage reflects the ready availability of juniper and piñon (Table 10.4); the two most commonly occurring taxa are also the most common arboreal species in the area. Ponderosa pine was restricted to the sample from the possible feature. Saltbush/greasewood, oak, and rose family woods were shrubby species identified. Cottonwood/willow was the only evidence of riparian resource use at the site.

Results of Vegetal Sample Analysis

Juniper and ponderosa pine woods were the most common plant remains identified in vegetal samples, followed by piñon, pine, and mountain mahogany woods (Table 10.5). Juniper, piñon, and ponderosa pine were the three most common woods identified from all contexts except floor samples, where juniper, ponderosa pine, and mountain

mahogany had the highest occurrence frequencies. Mountain mahogany may have been collected for special purposes. It is a very hard wood and was used to make boomerang-shaped sticks for hunting rabbits and prayer and digging sticks (Dunmire and Tierney 1995:137). Ponderosa may have been used for roof beams. At Bandelier for example, ponderosa was the primary material used for vigas (Dunmire and Tierney (1995:100). Juniper and piñon are prized for their resinous, dense wood primarily for firewood, but for construction material as well. Common chokecherry, rabbitbrush, and rose family woods were only recovered in samples from post-occupational fill, reflecting the broader spectrum of taxa generally recovered from trashy deposits or points of debris collection such as postholes.

The most interesting vegetal remains were the remains of a fused mass of at least 12 kernels (Accession Number 56). The kernels had been stored loose either in a container, in a bin, or on the floor and ended up in post-occupational fill. Along with some fused kernels from a possible floor sample (Accession Number 139) they provide evidence that corn was stored shelled, but whether it was for a short or long term is unknown. Two cob fragments from wall/roof fall (Accession Number 164) and post-occupational fill (Accession Number 55) were measurable. Cob measurements along with measurements of four kernels are presented in Tables 10.6 and 10.7. The measurements in themselves do not provide insight into the maize assemblage from the site as sample size is obviously too small, but they may be valuable additions to a regional database in the future.

Results of Pollen Analysis

Two pollen samples from cultural contexts (Accession numbers 65 and 162) and one control sample (Accession number 201) were analyzed from LA 4624. Table 10.8 presents the results with a list of all the pollen types identified, the sample taxa richness, pollen concentration, the pollen counts, the percentages of each taxon by sample, and the ISM results. The samples were productive and 20 different pollen types were identified. The surface control sample contrasted with the two archaeological samples in two significant ways. First, pollen concentration was extremely high in the surface sample at greater than 100,000 gr/cc. The majority of the surface sample pollen was pine (85 percent), which is interpreted to reflect environmental pollen rain from local forests. Pollen concentrations in the two subsurface samples were less than 6000 gr/cc, and the dominant taxon was Cheno-Am followed by pine. The high representation of Cheno-Am pollen in samples 65 and 162 could reflect use of Cheno-Am taxa for food, fuel, brush for jacal construction, or weedy taxa growing in disturbed ground around the site. Intensive subsistence use of Cheno-Am seeds and greens is well documented throughout the Southwest (Dunmire and Tierney 1997).

The second significant contrast between the control and the subsurface samples was that maize and cholla occurred only in the subsurface archaeological samples, and prickly pear frequencies were higher in the subsurface samples than the control. Maize, cholla, prickly pear, and Cheno-Am are interpreted as representing the main economic resources at LA 4624 visible from the pollen perspective. All of the cacti produce important food resources. Harvests of flower buds, fruits, and new growth (young shoots, pads, and

joints) were year-to-year dependable and products could be dried and stored (Dunmire and Tierney 1997; Moerman 1998).

The sample from beneath a corrugated jar (Accession Number 162) found in fill above the floor yielded 10 percent maize, 5 percent prickly pear, 11 percent cholla, and an aggregate of cholla pollen. All of the cacti species are insect-pollinated and produce relatively little pollen that is poorly dispersed, which means any cacti pollen occurrence is significant. The high frequency of cholla and the occurrence of a cholla pollen aggregate in Accession Number 162 is good evidence for use of cholla flower buds, which is a special crop still harvested by modern Pima in southern Arizona (Rea 1997:271).

Sample Accession Number 65 was collected from underneath a metate situated in post-occupational fill. This sample produced a high percentage of a rose family type that compares favorably (cf) to chokecherry (*Prunus*). Chokecherry grows around the site today and the fruit, wood, and bark were important resources (Dunmire and Tierney 1997:140-141). The cf. chokecherry pollen type may well represent past use of chokecherry fruits at the site.

The ISM results show that all three samples were analyzed to a minimum level of 1.0 gr/cc, called the threshold concentration. This level of effort should have maximized the probability of finding the three rare cultigen types squash, cotton, and agave in the two subsurface samples that were collected. These economic resources were not identified in either the conventional pollen analysis or the macrobotanical analysis. Although a statistically low number of pollen samples was analyzed, the ISM results can be used to bolster the macrobotanical evidence that cotton, squash, and agave were not grown at the site in the past site.

LA 4624 PLANT REMAINS IN A REGIONAL CONTEXT

Maize is the only plant remain recovered from all sites compared in Table 10.9, indicating the importance of this domesticated in the diet during the Coalition period. Beans were only recovered at LA 60372. Beans are rarely recovered from open-air sites, possibly because of differential preservation. Beans have a thin, fragile seed coat that can break easily, leaving the endosperm exposed to environmental factors that cause deterioration (Gasser and Adams 1981). Other seeds with tougher seed coats have a distinct preservation advantage. There is also some suggestion that beans rarely survive carbonization except under low oxygen conditions. Squash rind recovered at LA 3852 and LA 50972 comprise the only other evidence of cultigens.

Annuals dominate the floral assemblage at LA 4624 and LA 60550, while taxa from LA 60372 are pretty evenly distributed in the four categories. Perennial diversity is greatest at LA 4624 and might indicate perennial plants were a more important element of the diet at LA 4624 than elsewhere. Several cactus species were recovered from sites, emphasizing the significance of the fall-ripening fruits. Pollen results from LA 4624 also highlight the use of cholla and prickly pear. Grasses were not abundant, but dropseed grass, an

important resource because of its' abundant seed production and the retention of the grains by the plant after maturation, was recovered at LA 4624.

Juniper and piñon were the most common wood taxa recovered at LA 3852 and LA 50972, but at the other three sites compared in Table 10.10, piñon and ponderosa are the most common. The differences in wood taxa dominance are most likely due to sample size and the fact that LA 50972 is a cavate site and ponderosa would probably not be as abundant there as it would be in situations where the primary use was for construction. Taxa diversity appears to be greatest at LA 60372, but when dubious categories such as unknown conifer and pine family are excluded, diversity is actually greatest at both LA 60372 and LA 4624. Again, this may have a lot to do with sample size differences. The two sites with the smallest number of samples also have the lowest diversity.

The archaeobotanical assemblages from three sites in Table 10.9 indicate that prehistoric people living on the Pajarito Plateau were using a variety of annual and perennial plants, cultivating maize and beans, and exploiting a limited number of grasses. Although up to nine taxa were recovered from sites, only maize, pigweed, and chenopods had absolute counts of at least five. This makes it difficult to interpret the origins of other charred remains like globemallow and pincushion cactus with low abundance and frequency. Low frequency may be a reflection of differential preservation and preparation methods rather than the actual degree of plant utilization. Low frequency could also indicate seeds were incorporated into the record through animal transport or other vectors rather than as a direct result of food preparation or other economic uses.

Maize was probably grown on mesa tops, in canyon bottoms, or along drainages. It would be reasonable to assume that prehistoric people who farmed the Pajarito Plateau region would have occupied sites from late spring when planting begins and into the fall during harvest and preparation of plant foods for storage. Important spring seed crops like tansy mustard and ricegrass are missing from the record. While the young leaves of tansy mustard and goosefoot can be collected in early April, such fragile plant parts do not preserve in open-air sites.

While the macrobotanical wild plant assemblage consists of plants with seeds or fruits that could only have been gathered during late summer and into the fall (Knight 1982), the pollen record at LA 4624 (particularly the presence of a cholla pollen aggregate), suggests the site was also occupied during the spring. The seeds of goosefoot, pigweed, and purslane can be collected in late summer, while cactus fruit and piñon nuts can be collected as late as October or November. Cholla buds can be collected when they begin to emerge as soon as the weather warms (Rea 1997:271). The importance of incorporating pollen analysis as well as other lines of evidence is apparent when trying to determine seasonality. Based on macrobotanical evidence alone, sites in the Pajarito Plateau area appear to have been occupied only from late summer into the fall. The pollen record at LA 4624 suggests otherwise and this may have also been the case at other sites in the region.

SUMMARY AND CONCLUSION

Maize, cholla, prickly pear, and Cheno-Am were interpreted as representing the main economic resources at LA 4624 visible from the pollen perspective. Maize was the only cultigen identified in macrobotanical samples and was the most abundant plant remain recovered, suggesting an economic system based on maize agriculture. Three weedy annuals, one grass, and four perennial taxa were present; cheno-am, goosefoot, and purslane were the most common in flotation samples. Conifers dominate the wood assemblage, with juniper, piñon, and ponderosa the most abundant coniferous genera. Cottonwood/willow wood is the only evidence of riparian plant exploitation and could have been collected at the bottom of nearby Pajarito Canyon or in some of the deeper side canyons. Pollen results from under a metate indicated chokecherry was probably utilized at the site. Comparison to other sites in the Pajarito Plateau region suggests a similar subsistence regime of maize agriculture with beans and squash in evidence at three of the other sites. The major difference in wild plant exploitation is the greater number of perennial genera recovered at LA 4624 compared to other sites in the area. This may be a real difference or a reflection of differential preservation or sampling biases.

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CHAPTER 11

RESEARCH ISSUES AND CONCLUSIONS

BRADLEY J. VIERRA

INTRODUCTION

Ten of the approximately 25 rooms at LA 4624 were either partially or completely excavated. However, these excavations were suspended prior to the fieldwork being completed. Nonetheless, the preliminary information derived from this project can be used address several of the research questions presented in Chapter 4.

RESEARCH QUESTIONS

The Coalition period is represented by the expansion of populations onto the Pajarito Plateau, and a shift from seasonal to year-round occupation. It is generally believed that Coalition period pueblos were occupied for relatively short periods of time. That is, until local agricultural field productivity declined. Mobility and wild food resources were therefore important backup strategies to declining crop returns (Kohler 1989; Hill et al., 1996; Powers and Orcutt 1999). Given the limited amount of detailed research conducted on the Pajarito Plateau, the answers to the following questions will certainly help us understand this poorly documented period.

- 1) The correct temporal placement of each site within the settlement system and estimation of the population size.**

Results of the ceramic analysis indicate that the site may date to the early-middle Coalition period. This is based on the presence of mostly Santa Fe Black-on-white (91.7%) with a little Kwahe'e Black-on-white (3.5%), and mostly smeared indented corrugated (60.3%) with some non-micaceous plain ware (21.8%; early variety) and indented corrugated (15.0%) utility wares. In addition, Wiyo Black-on-white is absent from the ceramic assemblage, whereas, a small amount of Wingate Black-on-red is present.

At least one radiocarbon date supports a 13th century period occupation at the site. A maize sample yielded an AMS date of AD 1220 to 1300 (calibrated at two sigma), with an intercept of AD 1270 (Beta-164641). This contrasts markedly from a separate AMS date on maize of AD 960 to 1040 (calibrated at two sigma) with an intercept of AD 1010 (Beta-164641). The former sample was obtained from a roof/wall fall context, whereas,

the latter sample was recovered for a floor context. Nonetheless, the floor sample does not correspond to the ceramic assemblage, appearing to be too old.

Estimating population size is a difficult task given that the site was only partially excavated. The general room outline indicates that the pueblo contained about 25 rooms that were five rooms deep. There is no information available on the construction history at the site, so it is impossible to determine if all the rooms were contemporaneous, or reflect later additions and remodeling. Nonetheless, Nisengard's study of room size did identify a trimodal distribution. She suggests that rooms smaller than 5 m² were probably storage rooms, 5 to 7 m² likely served as habitation rooms and greater than 10 m² may have functioned as communal structures. A collared hearth was exposed in Room 1, which appears to be a D-shaped kiva located on the east-facing side of the roomblock. If we assume that a family occupied a set of four rooms (habitation and storage), then a total of about six families may have resided at the site during its occupation. This assumption is based on the presence of farmsteads on the Plateau that represent habitation sites with only four rooms.

2) Description of the subsistence base at each site.

Several lines of information provide evidence on past subsistence activities at the site. The archaeobotanical and pollen data reflect the importance of maize, cholla, prickly pear and cheno-ams as economic resources. Cotton and squash pollen were also identified at the site, however, maize was the only cultigen identified in the archaeobotanical assemblage and was the most abundant plant remain on the site. Otherwise, cheno-am, goosefoot and purslane were also common in the flotation samples.

Cottontail, jackrabbit, squirrel, pronghorn, deer and turkey remains were all recovered from the site. With the exception of pronghorn, all of the species were present on the Pajarito Plateau. Schmidt suggests that the pronghorn might have been obtained in the San Juan Basin near Cuba, New Mexico or the plains east of the Sangre de Cristo Mountains. However, it seems more likely that they would have been present in the broad open areas of the northern Chama and Rio Grande Valleys. Indeed, antelope can be seen today in the area around San Antonio Mountain west of Taos. In addition, antelope remains have also been identified at a historic site (LA 25322) near Abiquiu Reservoir (Lord 1986). The presence of antelope remains at LA 4624 probably indicates that logistical trips were being made to the Chama River valley.

3) Estimation of stress level at each site.

Several archaeological indicators can be used to measure subsistence stress and intensification. These include evidence for greater subsistence diversity (e.g., fauna and flora), milling of maize (i.e., ground stone) and storage (e.g., facilities and jars). However, the lack of temporal comparisons between the sites precludes any long-term temporal comparison.

The ubiquity of maize in the flotation and macrobotanical samples indicates that this was an important subsistence item at the site. The presence of two-hand manos and formal slab metates also reflect the importance of milling activities. Lastly, no storage facilities were identified at the site, with only 2.4% of service vessels being jars. This is similar to the 5.9% figure for Coalition period sites in the Land Conveyance and Transfer (LCT) survey project area. But differs markedly from the 13.6% and 19.1% figure for service vessel jars represented in Coalition/Classic and Classic period ceramic assemblages. These higher percentages reflect a marked increase in the use of service vessels for storage during these later periods (Vierstra 2000).

4) Functional differentiation within each site (specialization of tasks and production) and between sites.

This question cannot be addressed given the partial excavation of LA 4624 and the lack of excavation at the other sites in the area.

5) Evidence for regional procurement and exchange.

There is some limited information concerning regional exchange. For example, Wingate Black-on-red comprises less than one percent of the service vessel assemblage. This is similar to the LCT Project where Coalition period sites contained about 3% White Mountain redwares. Nonetheless, the site occupants did participate in the regional Pueblo 3 exchange network. In addition, Curewitz reports that two decorated white ware sherds are tempered with a micaceous schist and presumably represent imports from the nearby Tewa villages in the Rio Grande Valley. Similar tempers have been identified for Rowe Black-on-white ceramics from Arroyo Hondo (Habicht-Mauche 1993). Ruscavage-Barz's (1999) study at Bandelier National Monument also identified several nonlocal Santa Fe Black-on-white sherds with pastes containing fragments of granite. Nonetheless, the majority of the ceramics from LA 4624 and Ruscavage-Barz's study appear to be tempered with local materials reflecting an emphasis on household pottery production during the Coalition period.

6) Reasons for site abandonment.

As suggested at the beginning of this chapter, the general view is that most Coalition period pueblo sites were occupied for relatively short periods of time (also see Steen 1977, 1982). That is, until local agricultural productivity declined. Then the site occupants simply packed up and moved to a new location. This was a viable option given the presumed low population densities during the earlier segments of this time period. Again, no comparisons can be made between LA 4624 and other nearby Coalition and Classic period sites that would indicate obvious signs of subsistence diversification and resource depletion.

The stratigraphic profile at the site appears to represent a sequence as follows: floor, roof fall, wall fall and post-occupational fill. Although chunks of adobe and pieces of charcoal were recovered from the roof fall stratum, no wood beams were found. It may be that the roofing material was scavenged soon after abandonment. The excavators note that sections of walls were missing, presumably indicating that wall materials were also scavenged after the site was abandoned.

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APPENDIX A

MAPS

These maps are only available on a need-to-know basis. Please contact the Ecology group for assistance.

APPENDIX B
RESULTS OF THE CERAMIC PETROGRAPHIC ANALYSIS

Preliminary Petrographic Analysis of Sherd Samples from the Los Alamos National Laboratory Area

Sergio F. Castro-Reino
Carlos Lavayen

Submitted to:

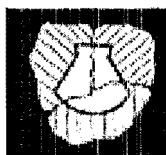
Mr. Bradley J. Vierra
Los Alamos National

Group ESH-20, Mailstop M887
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Los Alamos, NM 73019

Laboratory

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Project Report No. 2002-01
Desert Archaeology, Inc.

3975 North Tucson Boulevard, Tucson, Arizona 85716 \$ 17 July 2002

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PRELIMINARLY PETROGRAPHIC ANALYSIS OF SHERD SAMPLES FROM THE LOS ALAMOS NATIONAL LABORATORY AREA.

INTRODUCTION

A set of eighteen ceramic sherds corresponding to six ceramic types found at site LA 4624 in the area of the Los Alamos National Laboratory were submitted by Mr. Bradley J. Vierra for petrographic analysis.

METHODOLOGY

The eighteen sherds were thin sectioned and stained by Quality Thin Sections of Tucson, Arizona, according to standard procedures used in petrographic analysis (Miksa and Heidke, 2001). A quick evaluation of lithic and monomineralic grain types, and textures in the temper, was done at low magnification (40x) under the petrographic microscope. This was followed by point counting at higher magnification (200x). The point-counting procedure followed the Gazzi-Dickinson technique as described in Miksa and Heidke (2001) and discriminates a total of 50 different rock and mineral grain types, of which only 32 were actually encountered in the present study. Definitions of the different grain types, which may be used as parameters for statistical evaluation, can be found in Table 1. Raw point count data and observations are summarized in Table 2.

RESULTS

Preliminary results from the point-counting indicate two main temper groups in the examined ceramics: one characterized by lithic grains, mainly of felsic volcanic origin, and the other comprising mainly mineral grains, with feldspar predominant over quartz.

The Los Alamos National Laboratory is located in the upper part of the Pajarito Plateau, an area dominated by a sequence of pyroclastic flows with intercalated surge deposits known as the Bandelier Tuff. The upper member of these pyroclastic flows is known as the Tshirege Member. Preliminary examination of the proportions of different volcanic lithic types in the sherds suggests they are derived from one of two possible sources within the Tshirege Member: a glassy volcanic source, possibly Unit Qbt 1g (Broxton, 2002), and a volcanoclastic source, possibly Unit Qbt 2 (Broxton, 2002). The first source is exemplified by samples PAX-33-005, PAX-33-011 and possibly PAX-33-010, while the second source is represented by samples PAX-33-002 and PAX-33-018. The other volcanic-bearing samples show similarities to the latter source.

The mineral grain tempered samples on the other hand have no certain source, since there are no intrusive rocks, hypabyssal volcanics or metamorphic outcrops known within the Pajarito Plateau or the adjacent Valles Caldera. Furthermore none of the units within the Bandelier Tuff are rich enough in crystals as to provide deposits selectively enriched in mineral grains. It has been suggested in the archaeological literature that ant mound deposits could be considered a source for mineral grains (personal communication, Diane Curewitz, 2002). This hypothesis however, can neither be proven, nor disproven in this preliminary investigation.

Classification of samples by ware results in an interesting distribution of temper types. Specifically, the majority of corrugated wares have temper compositions dominated by feldspar-quartz mineral grains, while Santa Fe black on white and Santa Fe paste ceramics, as well as plainwares can have both mineral grain dominated and lithic dominated tempers.

FINAL RECOMMENDATIONS

In view of the results of this investigation, the following recommendations are made:

- Sample the different geologic outcrops in the vicinity of the Los Alamos National Laboratory, to serve as a reference for possible sources of temper (geologic resource base);

- Sample the drainage system in the project area in order to establish a baseline of sand deposits available in the area, which could be comparable to sand deposits available to ancient potters and would potentially allow the recognition of different provenance areas.
- Sample other potential sources of mineral-rich deposits as they are encountered.

These recommendations follow closely the methodology for provenance studies outlined in Miksa and Heidke (2001). Similar studies have been carried out in other volcanic rich areas (Dickinson 2001; Dickinson and Shutler 1979, 2000; Miksa et al. 2002; Stark et al. 2000).

Table 1. Grain type definitions used in point-counts of sherds from the Los Alamos area.

Parameter	Description
<i>Monomineralic Grains</i>	<i>Monomineralic Grains</i>
<i>Grains</i>	<i>Monomineralic Grains</i>
<i>Grains</i>	<i>Monomineralic Grains</i>
<i>Grains</i>	<i>Monomineralic Grains</i>
QTZ	All quartz types.
KSPAR	Alkali feldspars: yellow-stained potassium feldspars or unstained sodium feldspars, perthite, antiperthite.
SANID*	Sanidine (alkali feldspar of volcanic origin)
MICR	Microcline/anorthoclase: alkali feldspar with polysynthetic (cross-hatch) twinning, stained yellow or unstained.
PLAG	Plagioclase feldspar stained pink, commonly with albite twinning, occasional carlsbad twinning, alteration or sericitization affects less than 10% of the grain.
PLAGAL	Altered plagioclase: alteration affects 10% to 90% of the grain. Alteration products include sericite, clay minerals, carbonate, and epidote.
PLAGGN	Considerably altered plagioclase, with alteration affecting more than 90% of the grain.
Ptot	Total plagioclase from sand = PLAG + PLAGAL + PLAGGN
MUSC	Muscovite mica.
BIOT	Biotite mica.
CHLOR	Undifferentiated chlorite group minerals.
PX	Undifferentiated members of the pyroxene group.
AMPH	Undifferentiated members of the amphibole group.
OLIV*	Undifferentiated members of the olivine group.
OPAQ	Undifferentiated opaque minerals such as magnetite/ilmenite, rutile, and iron oxides.
GAR*	Undifferentiated members of the garnet group.
EPID	Undifferentiated members of the epidote group
SPHENE*	Sphene.
CACO	Undifferentiated calcium carbonate minerals (not aggregates; see LSCA below)
SQTZ	In schist-tempered sherds: All quartz derived from or contained within schist. This parameter was not used for sand.
SPLAG*	In schist-tempered sherds: Plagioclase feldspar (sodic or calcic, altered or fresh) derived from or contained within schist. This parameter was not used for sand.
SKSPAR*	In schist-tempered sherds: Alkali feldspar (sodic or potassic) derived from or contained within schist. This parameter was not used for sand.
SMUSC*	Muscovite mica derived from or contained within schist. This parameter was not used for sand.
SBIOT*	Biotite mica derived from or contained within schist. This parameter was not used for sand.
SCHLOR*	Undifferentiated chlorite group minerals derived from or contained within schist. This parameter was not used for sand.
SOPAQ*	Undifferentiated opaque minerals derived from or contained within schist. This parameter was not used for sand.
<i>Volcanic Lithic Fragments</i>	
LVF	Felsic volcanic such as rhyolite: microgranular nonfelted mosaics of submicroscopic to microscopic quartz and feldspars, commonly with microphenocrysts of feldspar, quartz, or rarely ferromagnesian minerals. Groundmass is fine to glassy, always has well-developed potassium feldspar (yellow) stain, may have calcium plagioclase (pink) stain as well.
LVFB	Biotite-bearing felsic volcanic: microgranular nonfelted mosaics of submicroscopic quartz and feldspars, often with microphenocrysts of feldspar, quartz, always with phenocrysts of biotite. Groundmass is fine to glassy, always has well-developed potassium feldspar (yellow) stain.
LVI	Intermediate volcanic rock such as rhyodacite, dacite, latite, and andesite.

LVM*	Mafic volcanic: visible microlites or laths of feldspar crystals in random to parallel fabric, usually with glassy, devitrified, or otherwise altered dark groundmass. Often with phenocrysts of opaque oxides, occasional quartz, pyroxene, or olivine. Rarely yellow-stained, usually has well-developed pin stain, representing intermediate to basic lavas such as latite, andesite, quartz-andesite, basalt, or trachyte.
LVV	Glassy volcanics: vitrophyric grains showing relict shards, pumiceous fabric, welding, or perlitic structure, sometimes with microphenocrysts, representing pyroclastic or glassy volcanic rocks.
LVH*	Hypabyssal volcanics (shallow igneous intrusive rocks): equigranular anhedral to subhedral feldspar-rich rocks with no glassy or devitrified groundmass, coarser-grained than LVF, most have yellow and pink stain.
LVC	Volcanoclastic rocks (extrusive rocks deposited by sedimentary processes): variably clast- or crystal-supported to matrix-supported often quartz-bearing to feldspar-bearing rocks with fine grained but not glassy or devitrified groundmass, more heterogeneous than LVF, most have variable pink or sometimes yellow stain. Extremely mud-rich compositions may be classified as argillaceous sediment, while extremely clast- or crystal-rich compositions may be classified as sandstone or arkose.

Sedimentary Lithic Fragments

LSS*	Siltstones: granular aggregates of equant subangular to rounded silt-sized grains with or without interstitial cement. May be well to poorly sorted, with or without sand-sized grains. Composition varies from quartzose to lithic-arkosic with some mafic-rich varieties.
LSA	Argillaceous: dark, semi-opaque, extremely fine-grained, without visible foliation, may have mass extinction, variable amounts of silt-sized inclusions, representing shales, slates, and mudstones.
LSCH	Chert: microcrystalline aggregates of silica.
LSCA	Carbonate: mosaics of very fine calcite crystals with or without interstitial clay- to sand-sized grains. Most appear to be fragments of soil carbonate and are subround to very round.

Metamorphic Lithic Fragments

LMM	Microgranular quartz aggregate: non-oriented polygonal aggregates of newly grown strain-free quartz with sutured, planar, or curved grain boundaries.
LMF*	Foliated quartz aggregate: planar-oriented fabric developed in mostly strained quartz crystals with sutured crystallite boundaries. Quartzite.
LMA*	Quartz-feldspar (mica) aggregate: quartz, feldspars, mica, and opaque oxides in aggregates with highly sutured grain boundaries but no planar-oriented fabric. Some represent schists or gneisses viewed on edge, some are metasediments or metavolcanics.
LMT	Quartz-feldspar-mica tectonite (schist or gneiss): quartz, feldspars, mica, and opaque oxides with strong planar-oriented fabric. Often display mineral segregation with alternating quart-felsic and mica ribbons. Grains are often extremely sutured and/or elongated.
LMTP*	Phyllite: like LMT but the grains are silt-sized or smaller, with little to no mineral segregation. Also argillaceous grains which exhibit growth of planar-oriented, silt-sized or smaller micas.
LMVF	Metamorphosed felsic volcanic rock such as rhyolite. Massive to foliated aggregates of quartz and feldspar grains with relict phenocrysts of feldspar.
LMSS	Metamorphosed sedimentary rock, such as meta-siltstone. Massive fine-grained aggregates of quartz and feldspar with or without relict sedimentary texture.
LMAMPH*	Amphibolite: a high-grade metamorphic rock made up largely of amphibole.

Unknown or Indeterminate Grains

UNKN	Grains that cannot be identified, grains that are indeterminate, and grains such as zircon and tourmaline that occur in extremely low percentages.
GROG*	Sherd temper: Dark, semiopaque angular to subround grains with discrete margins, including silt to sand size temper grains in a clay, iron oxide, and/or micaceous matrix. The grains differ in color and/or texture from the surrounding matrix of the "host" ceramic. <i>This parameter is counted only in sherd samples.</i>
CLAY LUMP	Dark semiopaque round grains with discrete margins and a clay, iron oxide, and/or micaceous matrix. The grains have a color and texture similar to the paste in which they occur, but lack silt- or sand-sized fragments. <i>This parameter is counted only in sherd samples.</i>

Totals and Other Paste Components

Total	The total number of point-counted sand-sized grains.
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Paste	The total number of points counted in the silt- to clay-sized fraction of the paste.
Voids	The total number of points counted in open spaces within the paste.

*These parameters were looked for but not found in the samples.

Table 2a. Monomineralic grains counted in sherds from the Los Alamos area.

Sample	Prelim. Classif. *	Qtz	Kspar	Micr	Ptot	Musc	Biot	Chlor	Px	Amph	Opaq	Epid	Caco	Sqtz	Unkn
PAX33-001	M	62	50	0	17	0	1	1	0	1	11	1	0	0	0
PAX33-002	V (Lvc-rich)	25	15	0	13	0	1	1	0	0	9	0	0	0	0
PAX33-003	V	42	10	0	27	0	0	2	0	1	18	0	1	0	1
PAX33-004	M	90	24	3	69	3	5	4	2	1	5	1	0	0	1
PAX33-005	VV (Lvrv rich)	31	18	0	20	0	3	1	3	0	22	0	0	0	0
PAX33-006	V	27	32	0	5	0	0	0	0	1	10	0	0	0	1
PAX33-007	M	42	18	0	25	0	2	0	1	1	26	0	0	0	0
PAX33-008	M	35	82	0	13	0	2	0	0	1	12	0	0	0	0
PAX33-009	M-V	26	77	0	5	0	2	0	0	0	11	0	0	0	0
PAX33-010	VV (Lvrv-Lvrv),	40	15	0	3	0	2	0	4	1	5	0	0	0	0
PAX33-011	VV (Lvrv rich)	5	3	1	9	2	1	1	0	0	8	0	0	0	0
PAX33-012	M-V	27	80	0	8	0	1	0	2	1	0	0	0	0	0
PAX33-013	M	58	10	5	46	4	4	2	0	0	5	2	0	0	1
PAX33-014	M	45	13	0	14	0	1	1	2	0	12	0	0	0	0
PAX33-015	M	61	105	0	9	0	1	0	1	1	4	0	0	1	0
PAX33-016	M	32	33	0	4	0	3	0	0	0	2	0	0	0	0
PAX33-017	M	20	67	0	4	0	1	0	2	0	7	1	0	0	0
PAX33-018	M-V (Lvc present)	55	37	1	13	1	1	1	0	0	5	0	0	0	0

* M stands for mineral rich, M-V stands for mineral rich with volcanic input, V stands for volcanic-bearing, VV stands for volcanic rich.

Table 2b. Lithic grains, grog and totals counted in sherds from the Los Alamos area.

Sample	Prelim. Classif. *	Lvf	Lvfb	Lvi	Lvm	Lvv	Lvh	Lvc	Lss	Lsa	Lsch	Lsca	Lmm	Lmt	Lmss	Clay lump	Total
PAX31-001	M	0	0	0	0	2	0	0	0	0	4	0	0	0	2	0	152
PAX31-002	V (Lvc-rich)	4	4	1	0	2	0	3	0	0	3	0	0	0	0	0	81
PAX31-003	V	7	4	1	0	1	0	0	0	0	1	0	0	0	2	0	118
PAX31-004	M	0	1	0	0	1	0	0	0	0	2	0	0	0	0	0	212
PAX31-005	VV (Lvv rich)	5	0	1	0	25	0	3	0	0	2	0	0	0	1	0	135
PAX31-006	V	7	0	0	0	12	0	1	0	0	2	0	0	1	0	0	100
PAX31-007	M	4	0	0	0	5	0	0	0	0	0	0	0	0	0	0	124
PAX31-008	M	1	0	0	0	1	0	3	0	0	2	0	0	0	0	0	152
PAX31-009	M-V	4	5	0	0	7	0	4	0	0	1	0	0	0	1	0	143
PAX31-010	VV (Lvf~Lvv),	10	0	1	0	17	0	3	0	0	0	0	0	1	0	0	102
PAX31-011	VV (Lvv rich)	0	0	0	0	20	0	0	0	0	0	0	0	0	1	1	52
PAX31-012	M-V	2	1	0	0	10	0	4	0	0	0	0	0	0	0	0	136
PAX31-013	M	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	138
PAX31-014	M	2	0	1	0	6	0	2	0	0	2	1	1	0	0	0	103
PAX31-015	M	4	0	0	0	4	0	5	0	0	7	0	1	1	0	0	205
PAX31-016	M	2	1	0	0	4	0	1	0	0	0	1	0	0	0	0	83
PAX31-017	M	4	0	0	0	6	0	3	0	0	2	0	1	1	0	0	119
PAX31-018	M-V (Lvc present)	9	6	0	0	6	0	0	0	1	3	0	3	3	0	0	145

* M stands for mineral rich, M-V stands for mineral rich with volcanic input, V stands for volcanic-bearing, VV stands for volcanic rich.

Table 2c. Paste components counted in sherds from the Los Alamos area and other characteristics observed under the petrographic microscope.

Sample	Prelim. Classif. *	Paste	Voids	Comments
PAX31-001	M	375	100	One Lvc, defined as volcanoclastic lithic, has been observed. Also very rare clay lumps and no grog have been observed. One piece of sericite-altered volcanic.
PAX31-002	V (Lvc-rich)	285	85	Sample rather rich in Lvc, defined as volcanoclastic lithic, however almost no clay lumps and no grog observed.
PAX31-003	V	400	50	Grog is fairly common in the sample. Less common are clay lumps and rare to very rare Lvc, defined as volcanoclastic lithic.
PAX31-004	M	185	265	Perthitic intergrowths observed. Tourmaline observed.
PAX31-005	VV (Lvv rich)	345	155	Biotite has been observed, that is slightly to moderately altered to chlorite.
PAX31-006	V	0	0	Data for paste and voids are missing. Relevant presence of glassy shards. Tuff fragments occur as accessory or trace. Some hornblende crystals have been observed as well.
PAX31-007	M	0	0	Data on paste and voids is missing. Abundant phenocrysts of K-feldspar. Glassy fragments and shards are present, as well as some tuff fragments. Some plagioclase fragments are zoned. Rare to present clay lumps, one or two possible pieces of grog were observed as well.
PAX31-008	M	0	0	Data on paste and voids is missing. Abundant phenocrysts of K-feldspar. Glassy fragments and shards are present, along some tuff fragments. Some plagioclase fragments are zoned. Rare to present clay lumps, with one or two possible pieces of grog.
PAX31-009	M-V	335	99	Some pyroxene and epidote present. Clay lumps are present, while grog is rare. Lvc, defined as volcanoclastic lithic, may be doubtful.
PAX31-010	VV (Lvf~Lvv)	126	52	Relevant presence of glassy shards and fragments; subrounded fragments of Lvf and Lvfb, defined respectively as felsic volcanic and biotite-bearing felsic volcanic lithics. Orthopyroxene and clinopyroxene were observed as individual crystals. Some hornblende crystals were noticeable (~2). Lvc, defined as volcanoclastic lithic, seems to be a moderately welded tuff.
PAX31-011	VV (Lvv rich)	158	26	Clay lumps are common in this sample (sample is particularly good for showing clay lumps). Abundant glassy shards and fragments, some of them well banded. Plagioclase crystals are strongly altered.
PAX31-012	M-V	285	67	Amphibole and pyroxene are present. Good examples of Lvc, defined as volcanoclastic lithic, are present (welded tuff). Large K-feldspar phenocrysts in their majority euhedral, not so with quartz, often in subhedral fragments. Rare clay lumps, not very distinctive.
PAX31-013	M	139	81	Quartzite fragments, chert and quartz-feldspar myrmekites observed; occasionally perthite/antiperthite also. Hornblende, pyroxene are present, also some biotite altered to chlorite. Plagioclase, microcline and K-feldspar phenocrysts moderately sericitized. Muscovite, biotite occur as matrix and crystals.
PAX31-014	M	395	24	Rare clay lumps, much more noticeable are pieces of grog which are present in moderate amounts (good sample to show grog). K-feldspar includes some perthitic crystals.
PAX31-015	M	359	47	Amphibole, biotite, pyroxene, and chert were present in bigger quantities than the point count, however they did not fall within the grid. Biotite in fact is more common as part of the paste. Volcanic shards and fragments, glassy and devitrified lithics are present.
PAX31-016	M	0	0	Data for paste and voids are missing. Lvc and Lvf, defined respectively as volcanoclastic and felsic volcanic lithics, are present. Some chalcedony was observed. A few, small clay lumps were observed.
PAX31-017	M	302	39	Abundant K-feldspar, also some fragments of chalcedony, and devitrified volcanic (tuffs). A few clay lumps are present as well.
PAX31-018	M-V (Lvc present)	210	75	Lvc, defined as volcanoclastic lithic, is common (good sample for it). A few, rare clay lumps and possibly one grog piece. Well preserved, mostly euhedral K-feldspar; moderate to highly sericitized plagioclase. Chert xenolith fragments. Some amphibole, chlorite after biotite present. Micas common in the paste.

* M stands for mineral rich, M-V stands for mineral rich with volcanic input, V stands for volcanic-bearing, VV stands for volcanic rich.

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APPENDIX C
LITHIC ANALYSIS METHODS

CORES AND CORE TOOLS

Cores are nodules that have faceted platforms from which specific kinds of flakes are removed; however, large flakes or angular debris with flakes removed from cortical platforms were also classified as cores. *Tested materials* are nodules with a single flake removed from an unprepared cortical platform at one or more isolated locations. They may represent nodules that have been tested for material quality and were then rejected. *Cobble unifaces* have two or more flakes unifacially removed along a single edge margin, usually at one end of a pebble or cobble. Cobble unifaces probably represent unprepared cobble cores, but they might also have been used as heavy-duty tools. *Cobble bifaces* have two or more flakes bifacially removed from a single edge at the end of a pebble or cobble. They probably represent formal heavy-duty chopping tools (i.e., choppers), but they might also have been used as a source for flakes. Cobble bifaces differ from bifacial cores in that bifacial cores are generally made of siliceous materials and have more than one or a continuous bifacially retouched edge perimeter. A *hammerstone* is a nodule that exhibits battering on an otherwise unmodified cortical portion of its surface. This battering usually occurs on the end or along the perimeter of the nodule or cobble. In contrast, *anvils* are artifacts that exhibit repeated battering in a specific isolated location, so that a small circular depression is created on a planar surface.

Material type and material grain were recorded. Material grain is defined as fine, medium and coarse. Fine-grained materials are translucent, medium-grained are smooth to the touch, and coarse-grained are grainy to the touch.

Measurements for cores, tested materials, cobble unifaces and cobble bifaces were slightly different than those for the other artifacts. Length was measured in mm along the axis through the major flaking surface. The width was measured perpendicular to the length and the thickness was measured as the remaining dimension. In contrast, the length of hammerstones and anvils was measured in mm along the longest axis, the width was measured perpendicular to length and the thickness was the smallest dimension of the artifact. Each artifact was weighed to the nearest tenth of a gram with an Ohaus electronic beam. Weight was the only measurement recorded for core fragments.

Several core types were recorded based on platform orientation and core shape. These consist of single-directional cores, bidirectional cores, multi-directional cores, bipolar cores, core fragments and flake cores. The first three core types are made on nodule blanks, whereas, flake cores are made on large flake blanks. Bipolar cores and core fragments can be made on either nodule or flake blanks. In addition, these core types were then subdivided into specific subtypes. The single-directional cores are single-face, multi-faced, prismatic or pyramidal cores with flakes removed from a single striking platform. Bidirectional cores are change-of-orientation, discoidal, bifacial, opposed same face, opposed different face, and ninety-degree cores with flakes removed from two separate striking platforms. Multi-directional cores are globular, opposed/ninety degrees, and opposed same/different face cores with flakes being removed from three or more platforms. Bipolar cores exhibit battering, crushing and/or negative or positive bulbs of percussion at one or both opposing ends of the core. Core fragments are broken cores.

Number of platforms, platform type and platform preparation were recorded. Number of platforms was monitored as zero for non-cores and core fragments; whereas, bipolar cores were arbitrarily assigned a single platform. Platform type was cortical, single-faceted, multi-faceted, cortical/single-faceted and undetermined/non-applicable (i.e., core fragments or non-cores). Platform preparation, either on the platform or along the platform edge, was recorded as none, abraded/crushed, ground, abraded/ground, and undetermined/non-applicable (i.e., core fragments and non-cores).

Cortex type was recorded as nodular, tabular, waterworn, quartz crystal and undetermined. Nodule or tabular cortex is the natural weathered surface of a nodule or tabular-shaped rock; whereas, waterworn cortex is the rolled surface created through water transport of a rock. The percentage of the cortical or unflaked surface was measured for whole artifacts as less than 25%, 25 to 50%, 51 to 75%, more than 75%, and undetermined for fragments. The reason for discard was monitored for cores, tested materials, cobble unifaces and cobble bifaces. This consisted of broken (material flaw), broken culturally induced fracture), extensive hinging/stepping, exhausted, still useable, extensive battering, burned, undetermined and non-applicable (e.g., hammerstones). The presence or absence of burning was recorded. This could be represented by the presence of discoloration, pot lids and/or crackling.

The number of damaged loci was also recorded. This damage refers to possible use-wear and not to any kind of platform preparation. Each damaged locus was given a sequential number for each artifact. The type of damage present was monitored as battering, rounding, scarring and abrasion/ground. Battering is the pounding application of force to a specific locus when one object is struck against another. This action can produce conical impact rings (hertzian cones) on a natural surface, or bidirectional step fracturing and the deterioration of an edge margin. Rounding is the damage that results in the rounding of an edge margin and scarring from the removal of microflakes along an edge margin. Abrasion/ground is the presence of any abraded or ground surface on an artifact.

The location of the damage was recorded as an edge, convex surface, ridge, flat surface, flake scar ridge or all over the artifact. An edge is the intersection of one or more negative flake scar facets and edge damage is associated with the artifact being used as a chopper or pecking stone. A convex surface is a nonacute, natural convex surface of an object; damage in this location reflects use as a hammerstone. A ridge is an acute, naturally sharp surface; the damage of a ridge reflects use as an angular hammerstone. Flat is a naturally flat surface; damage on this surface reflects use as a hammerstone or anvil. Flake scar ridges (arrises) are the high points along the edge of negative flake scars; sometime these areas are ground (e.g., on cobble unifaces) indicating that the tool may have been used as a plane or adze. Damage over the entire surface of an artifact presumably reflects a multifunctional use of the artifact (e.g., heavily battered hammerstone or pecking stone).

DEBITAGE

Debitage are the by-products of core reduction and tool production. *Flakes* are pieces of material that have been detached from a core or tool by percussion or pressure, as opposed to *angular debris* which are pieces that are incidentally broken off during core reduction. These pieces of

shatter lack definable flake characteristics, such as a platform, bulb of percussion, ventral/dorsal surfaces, and proximal/distal ends. *Core flakes* are flakes that have been detached from a core. A polythetic set (Clark 1968:36-37) of attributes for core flakes includes: single or dihedral platform, a platform angle of greater than 50 degrees, a platform that is roughly equal in width to the remainder of the flake, cortex present on the dorsal surface, dorsal scars that may be absent, parallel or perpendicular to the platform, a thickness of greater than about 5 mm, a pronounced bulb of percussion and an erailure scar. To be classified as a core flake, the flake must exhibit at least five of the eight defining attributes. *Bipolar flakes* are flakes that have been detached from a core through the use of a bipolar reduction technique. The resultant flake differs from a core flake in that it may have two bulbs of percussion, erailures and/or scaling/crushing at one or both opposing ends. *Core trimming flakes* are pieces that have been struck at a 90 degrees angle to the major flaking axis of the core, along the edge of the core platform and dorsal flaking surface. They are sometimes referred to as platform renewal flakes, since they often remove the step fractures than can occur adjacent to the edge of the platform. They may also represent an attempt to change the orientation of the core, by preparing and reorienting a new flaking surface that is perpendicular to the previous major flaking axis. Core trimming flakes flakes are similar to uniface rejuvenation flakes (Highley 1995:482). *Core tablets* are also flakes that have been struck perpendicular to the major flaking axis of a core; however, they have been struck just below the platform to remove the whole striking platform from the core (Marks 1976:374). *Opposing core flakes* have been detached from the bottom of a core by striking it at a 90 degree angle to the major flaking axis. This then acts to create a platform from which flakes are removed in the opposite direction from that previously done. They may also reflect a type of overshot flake which has removed the bottom of the core (Montgomery 1978:67). *Blades* are specialized forms of flakes that are twice as long as they are wide, with parallel lateral sides, and one or more parallel dorsal arrises (Bordes 1981:16).

Biface flakes are flakes that have been detached from a bifacially retouched artifact. A polythetic set of attributes for biface flakes includes: a multi-faceted platform, a lipped platform, an isolated platform that is narrower than the maximum width of the flake; a platform angle of less than 50 degrees, a weak bulb of percussion, cortex absent on the dorsal surface, dorsal scars that are parallel to each other and perpendicular to the platform, a thickness of less than 5 mm that is relatively even from proximal to distal ends and a pronounced ventral curvature. A flake must exhibit at least five of the nine attributes to be classified as a biface flake. *Uniface flakes* are flakes which have been detached from a unifacially retouched artifact (Shafer 1970). A polythetic set of attributes for uniface flakes consists of a single-faceted platform, a platform angle of greater than 60°, dorsal scars that are parallel to each other and perpendicular to the platform, a single distal scar on the dorsal surface of the flake (sometimes separated by an arris), and marked ventral curvature.

Overstruck flakes are flakes removed from the edge of a biface, but go over and beyond the face of the artifact detaching a portion of the opposite edge. *Notching flakes* are flakes which exhibit a negative dorsal scar originating from the platform, a small indentation at the platform, a convex ventral profile and a salient bulb of percussion (Titmus 1985:251-252). *Pièces esquillées* (also referred to as "wedges" or scaled pieces), are thin rectangular-shaped flakes with bidirectional scaling or crushing on one or both ends. They are also the by-product of bipolar reduction technique (Flenniken 1981:56; Parry 1987:207). Burin spalls are pieces that have been struck

from the edge of a flake, so the resulting scar (or facet) approaches 90 degrees to the plane of the blank from which it was removed. *Pot lids* are hertzian cones produced when siliceous rocks are subjected to heat. *Hammerstone flakes* are flakes with cortex on the platform and dorsal surface, with the platform being heavily battered. *Ground stone flakes* are flakes that exhibit a heavily ground dorsal surface. *Microdebitage* are debitage that are smaller than 10 mm in size. *Undetermined flake fragments* are fragments for which flake type could not be determined.

Fire-cracked rocks and manuports were also monitored with the debitage. *Fire-cracked rocks* are lithic materials that have been physically altered by the application of heat by a human agent. This artifact category specifically represents cobbles used as heat retainers in the processing of foodstuffs for consumption (e.g., stone boiling or earth ovens). *Manuports* are unmodified pieces of lithic raw material that have been transported from their source to another location as a result of human behavior. This may include materials to be used in lithic reduction, ceramic production or other miscellaneous functions. Material type and weight were the only attributes monitored for these artifacts.

Material type and material grain was recorded. The condition of the artifact was recorded as either whole, proximal, midsection, distal, lateral or undetermined (e.g., flakes smaller than about 10 mm). All pieces of angular debris were considered to be whole.

Measurements were taken on all whole flakes. Length, width and thickness of whole flakes were measured in mm. using a sliding digital caliper. Length was defined as the distance along the proximal-distal axis of a flake (i.e., perpendicular to the platform). The width measurement was taken perpendicular to the length at the widest point. Thickness was the greatest distance between the ventral and dorsal surfaces, excluding the bulb of percussion. Weight was recorded for all debitage items to the nearest tenth of a gram using an Ohaus digital scale. Weight was the only measurement recorded for angular debris and flake fragments.

The type of platform was recorded for all flakes as absent, cortical single-faceted, dihedral, multi-faceted, crushed, collapsed, battered, and non-applicable (e.g., angular debris). A cortical platform is unprepared and situated on cortex. A single-faceted platform consists of a single flake scar; whereas, a dihedral platform consists of two flake scars and a multi-faceted platform as three or more flake scars. A crushed platform is one in which the proximal end of the flake is covered with step fractures, indicative of crushing along the edge of the core platform. A collapsed platform is identified on whole flakes that lack a clear platform and any traces of crushing. A battered platform is a cortical platform that is covered with battering and impact marks, which may be indicative of a hammerstone spall. Platform preparation was monitored as none, abraded/crushed, ground, abraded/ground, retouched, retouched/abraded, retouched/ground and non-applicable (e.g., collapsed, crushed or battered platforms, flake fragments, angular debris or microdebitage). Evidence of preparation must cover more than 50 percent of the platform edge to be monitored. Retouched platforms must be invasive and are generally multi-faceted.

Cortex type was monitored using the same attributes as for the cores. The placement of the cortex was recorded on whole flakes only. It was monitored as absent, on the platform only, on the dorsal surface only, on the platform and partially on the dorsal surface, orange rind (i.e., along the platform and lateral edge), and covering the total dorsal surface. The presence or absence of

burning was recorded.

The presence or absence of edge damage was recorded as a possible indication of artifact use. A 10x hand lens was used, with possible damage being recorded if it was consistent along the edge margin. All damaged edges were given a sequential number for each artifact. The location (end, lateral or projection), edge angle and edge outline (straight, concave, convex, or projection) were noted for each edge. The edge angle of all the damaged edges was recorded to the nearest five degrees. This measurement is equivalent to the "spine plane angle" (Tringham et al. 1974), which measures the intersection of the dorsal and ventral surfaces of the edge. If the angle varied along the edge, then a mean edge angle or the angle that characterized the majority of the edge was recorded. A "shurikan" edge-angle template was used for this analysis. It consists of a circular disk template with angles cut into its side at five degree increments from twenty to ninety degrees. The edge to be measured is placed within a notch until the angle that fits most accurately is found.

RETOUCHED TOOLS

Retouched tools are the result of the secondary percussion or pressure flaking of a piece in order to produce a specific tool shape. *Retouched pieces* are marginally retouched pieces of debitage whereby the retouch extends over less than one-third of the surface of the artifact (Chapman and Schutt 1977:86). These expedient tools are generally made on flakes and rarely occur on angular debris. *Notches* are flakes with one or two contiguous notches along the edge of the piece; whereas, *denticulates* are flakes with three or more contiguous notches along the edge of the piece. *Perforators and graters* are flakes with unidirectionally retouched projections. Graters exhibit a blunt end and perforators a pointed end. *Unifaces* are "artifacts which exhibit retouch scars over one-third or more of only one of their surfaces" (Chapman and Schutt *ibid*:93). This kind of retouched can be defined as invasive. In contrast, *scrapers* are specialized forms of unifaces which exhibit secondary edge retouch producing a formal-shaped tool with an edge angle between about 60 to 80 degrees. Scrapers were classified as end, side, nosed, or transverse scrapers. The difference between an endscraper and a transverse scraper is that endscrapers are retouched on the ends of flakes with their length greater than their width; whereas, transverse scrapers are retouched on the ends of flakes with their width greater than their length. *Bifaces* are "artifacts which exhibit retouch scars extending over one-third or more of both their opposing surfaces" (Chapman and Schutt 1977:93). This type of retouch can be defined as invasive retouch. Generalized bifaces tend to be ovate or lanceolate in shape, with edge angles between about 30 to 50 degrees. Drills and projectile points are specialized forms of bifaces. *Drills* are bifacially retouched flakes that are twice as long as they are wide, about as thick as they are wide and often exhibit a diamond-shaped cross-section. *Projectile points* are bifaces that exhibit hafting modifications that distinguish a stem from the blade.

Material type, material condition, cortex type, cortex placement and burning were recorded for retouched tools using the same attributes as those monitored for the debitage. Measurements were taken in mm for whole tools. Length was measured along the proximal-distal axis. Width was measured at a ninety-degree angle to the proximal-distal axis. Thickness was the greatest measurement once the proximal-distal axis was rotated ninety degrees. The proximal end is the

same as that defined for flakes on informal retouched tools, and the possible hafted end on formal tools (e.g., bifaces, projectile points and scrapers). Weight was measured to the nearest tenth of a gram. Tool fragments were only weighed.

The number of separate retouched edges was monitored on each tool. Each edge was given a sequential number. Only one edge was recorded on tools that exhibited a continuously retouched edge (e.g., scrapers, bifaces, drills and projectile points). It is the marginally retouched flakes that most often exhibit separate retouched edges. Retouch type was recorded as unidirectional ventral (inverse), unidirectional dorsal (obverse), bidirectional (both faces), alternating (continuous inverse and obverse retouch along the same edge), alternate (inverse and observe retouch along opposite edges), beveled, alternate/beveled, use-wear, burination, and backed. The use-wear attribute was monitored when a retouched flake exhibited separate retouched and utilized edges. Perforators with inverse retouch along one edge and obverse retouch along the opposite edge were classified as exhibiting alternating retouch. Edge outline was monitored in the same manner as it was for the debitage, with the addition of straight/concave, straight/convex, concave/convex, and undetermined (e.g., point fragments). Edge outlines and edge angles were monitored on the blades of bifaces and projectile points, and the retouched edges on scrapers. Edge angles were measured using the same technique as for the debitage. The presence or absence of obvious edge damage that might attributed to use was recorded.

A separate analysis was conducted on the projectile points. Twelve metrical and qualitative measurements were taken of these artifacts: material type, condition, overall length, blade length, neck width, stem length, stem width, thickness, weight, haft type, blade shape and base shape. Material type, condition and weight are the same as monitored for the retouched tools. The hafting type was described as side-notched, corner-notched, stemmed, contracting stemmed, lanceolate, fluted, basal-notch, side-notched/basal-notch, other, or undetermined. The shape of the blade was monitored as straight (angled), parallel, convex, serrated, concave, irregular, other or undetermined. The shape of the base was described as straight, concave, notched, convex, other, and undetermined. Evidence of hafting polish, and breakage due to either tool manufacturing (e.g., perverse break) or use (e.g., impact fracture) was noted.

GROUND STONE TOOLS

Ground stone tools are artifacts that exhibit ground and/or abraded surfaces. *Manos* are cobbles or slabs with at least one surface characterized by one or more smooth facets produced through grinding. They were handheld artifacts that were primarily used to crush and grind vegetal foodstuffs against a metate (Chapman and Schutt 1977:95; Christenson 1987:44). Polished surfaces on manos may indicate a function other than vegetal processing (e.g., hide processing [Adams 1988]). One-hand manos are less than 170 mm in length and two-hand manos have a length equal to or greater than 170 mm. Undetermined manos are fragments where the projected length of the artifact could not be determined.

Metates are artifacts characterized by at least one large grinding surface upon which vegetal foodstuffs may have been crushed and ground with a mano. They generally have a grinding surface greater than 450 cm² in size (Christenson 1987:47). *Millingstones* are informal unmodified

slabs with flat grinding surfaces. Although the grinding surface may exhibit some pecking, the slab itself exhibits little in the way of formal shaping. *Basin metates* are slabs with concave basin-shaped grinding surfaces. These two metate types are usually associated with generalized seed processing and the use of a one-hand mano in a rotary motion, although millingsstones can also be used with two-hand manos in a longitudinal grinding fashion. *Slab metates* are formal-shaped metates with large flat prepared grinding surfaces. *Trough metates* have a deep prepared trough as a grinding surface. The trough may be open at one or both ends. These two metate types are usually associated with more specialized corn milling and the use of two-hand manos in a longitudinal back-and-forth motion. If the type of metate could not be determined, it was classified as an undetermined metate fragment. *Grinding slabs* were, however, distinguished from millingsstones by having a length less than 250 mm. These artifacts may have been used for a variety of purposes. Grinding slab fragments were separated from undetermined ground stone fragments by having a length greater than 100 mm. Undetermined metate fragments are fragments sufficiently large to determine that they represent portions of metates, but specific metate type could be determined.

Polishing stones are pebbles with finely ground and polished surfaces. These generally consist of small quartzite pebbles that could have been used to polish ceramic vessels. *Palettes* are tabular-shaped artifacts with finely ground and polished flat surfaces. *Mortars* are artifacts with large, deep, pecked and ground concavities. *Pestles* are oblong artifacts with one or more ground ends. They presumably were used with the mortars to pulverize and grind various substances. *Abrading stones* are artifacts with localized but irregularly ground surfaces, with a distinction being made between generalized abrading stones and *grooved abraders*. *Axes* exhibit a prepared bit, whereas *mauls* exhibit battering on one or both butts. Either can be grooved for hafting. *Ornaments* are beads, pendants and other forms of jewelry. *Effigies* are anthropomorphic or zoomorphic figurines. *Stone ceramic lids* are thin circular-shaped artifacts whose perimeters have been bidirectionally retouched. These lids may have been used to cover storage or cooking vessels. *Undetermined ground stone* are unclassifiable ground stone fragments. These fragments often exhibit a single flat grinding surface. *Shaped slabs* are large rectangular-shaped slabs that have been bidirectionally flaked along their perimeters. These artifacts were often used to cover ventilator shafts or door openings.

Material type and condition was monitored the same as for cores. Measurements were recorded in mm for all whole artifacts. Length was the greatest measurement along the longest axis of the artifact. Width is the greatest measurement perpendicular to the longest axis. Thickness is the greatest measurement on a 90 degrees plane to the length and width. Weight was recorded in grams. Ground stone fragments were only weighed. It should be noted that the length measurement for some manos is actually perpendicular to the actual grinding motion. In addition to these measurements, the maximum length and width of the primary grinding surface was also recorded for manos and metates.

Use location was recorded as single unopposed surface, two opposed surfaces, perimeter (e.g., on abrading stones), edge (e.g., on axes), other (e.g., ornaments), undetermined, and non-applicable (e.g., stone lids). Tool cross-section was monitored for ground stone tools with single or double grinding surfaces as plano (flat), concave, convex, bi-plano, plano-convex, bi-convex, wedge-shaped (beveled), other (i.e., tools without grinding surfaces) and undetermined. Surface shape

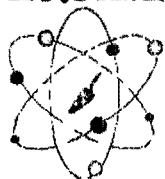
provides a general description of the primary grinding surface shape. It was recorded as roughly ovoid, rectangular, irregular and other. Surface modification describes the nature of the modification to the primary worked surface. It was monitored as ground, pecked, ground/pecked and polished.

The presence or absence of fingerholds on manos were recorded as absent, one side, two side and non-applicable (i.e., non-manos). Non-ground stone use-wear was recorded as absent, battering (e.g., mauls or manos used as hammerstones), and flaked/rounded (e.g., axes). The presence or absence of burning (heating) was monitored (e.g., blackening or fire-cracked).

APPENDIX D
RESULTS OF THE OBSIDIAN SOURCING ANALYSIS

31.1.8

BERKELEY ARCHAEOLOGICAL



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SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM LA 4624, PAJARITO PLATEAU, NORTHERN NEW MEXICO

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INTRODUCTION

The following report documents a geochemical analysis of 14 obsidian artifacts from LA 4624, Mesita del Buey, northern New Mexico. All of the obsidian artifacts were produced from obsidian procured from one of the domes and chemical groups in the Toledo and Valles Caldera collapse phases of the Jemez Mountain Volcanic Field, as well as one specimen from the earlier El Rechuelos member of the Polvadera Group. In addition to a discussion of the results, a short summary of the silicic petrology in the Jemez Mountains is included relevant to archaeological obsidian and attendant recent field studies.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

ANALYSIS AND INSTRUMENTATION

All samples were analyzed whole with little or no formal preparation. The results presented here are quantitative in that they are derived from “filtered” intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984).

The trace element analyses were performed in the Department of Geology and Geophysics, University of California, Berkeley, using a Philips PW 2400 wavelength x-ray fluorescence spectrometer using a LiF 200 crystal for all measurements. This crystal spectrometer uses specific software written by Philips (SuperQ/quantitative) and modifies the instrument settings between elements of interest. Practical detection limits have not been calculated for this new instrument, but but the variance from established standards is shown in

Table 1. Sample selection is automated and controlled by the Philips software. X-ray intensity $K\alpha$ -line data with the scintillation counter were measured for elements rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). X-ray intensities for barium (Ba) were measured with the flow counter from the $L\alpha$ -line. Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1 and SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLM-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994).

The data from the SuperQ software were translated directly into Excel™ for Windows software for manipulation and on into SPSS™ for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. An analysis of RGM-1 is included in Table 1. Source nomenclature follows Baugh and Nelson (1987), Glascock et al. (1999), and Shackley (1988, 1995, 1998a). Further information on the laboratory instrumentation can be found at: <http://obsidian.pahma.berkeley.edu/> and Shackley (1998a). Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight.

SILICIC VOLCANISM IN THE JEMEZ MOUNTAINS

Due to its proximity and relationship to the Rio Grande Rift System, potential uranium ore, geothermal possibilities, an active magma chamber, and a number of other geological issues, the Jemez Mountains and the Toledo and Valles Calderas particularly have been the subject of intensive structural and petrological study particularly since the 1970s (Bailey et al. 1969; Gardner et al. 1986; Heiken et al. 1986; Ross et al. 1961; Self et al. 1986; Smith et al. 1970; Figure 1 here). Half of the 1986 *Journal of Geophysical Research*, volume 91, was devoted to the then current research on the Jemez Mountains. More accessible for archaeologists, the geology of which is mainly derived from the above, is Baugh and Nelson's (1987) article on the relationship between northern New Mexico archaeological obsidian sources and procurement on the southern Plains.

Due to continuing tectonic stress along the Rio Grande, a lineament down into the mantle has produced a great amount of mafic volcanism during the last 13 million years (Self et al. 1986). Earlier eruptive events during the Tertiary more likely related to the complex interaction of the Basin and Range and Colorado Plateau provinces produced bimodal andesite-rhyolite fields, of which the Paliza Canyon (Keres Group) and probably the Polvadera Group is a part (Smith et al. 1970). While both these appear to have produced artifact quality obsidian, the nodule sizes are relatively small due to hydration and devitrification over time (see Hughes and Smith 1993; Shackley 1990, 1998b). Later, during rifting along the lineament and other processes not well understood, first the Toledo Caldera (ca. 1.45 Ma) and then the Valles Caldera (1.12 Ma) collapsed causing the ring eruptive events that were dominated by crustally derived silicic volcanism and dome formation (Self et al. 1986). The Cerro Toledo Rhyolite and Valles Grande Member obsidians are grouped within the Tewa Group due to their similar magmatic origins. The slight difference in trace element chemistry is probably due to evolution

of the magma through time from the Cerro Toledo event to the Valle Grande events (see Hildreth 1981; Mahood and Stimpac 1990; Shackley 1998c; see Figure 1 here). This evolutionary process has recently been documented in the Mount Taylor field (Shackley 1998c). Given the relatively recent events in the Tewa Group, nodule size is large and hydration and devitrification minimal, yielding the best natural glass media for tool production in the Jemez Mountains.

Recent study of the secondary depositional context of these sources and their relationship to the Rio Grande Rift have indicated that only two of the major sources enter that stream system (Shackley 2000). Cerro Toledo Rhyolite erodes from the domes in the Sierra de Toledo along the northeast scarp of the caldera, and in much greater quantity due to the ash flow tuff eruptive event associated with the Rabbit Mountain dome on the southeast margin of the caldera. This latter eruption created large quantities of glass that have continually eroded into the Rio Grande system (see Figure 1). Most likely the Cerro Toledo obsidian present in these sites was procured directly from the Rio Grande alluvium, or in the Puye Formation to the northeast of Santa Fe. El Rechuelos obsidian present on a number of minor domes northeast of the caldera, and slightly earlier than the caldera event, erodes north into the Rio Chama and ultimately into the Rio Grande.

Obsidian from the Valle Grande member, however, does not leave the caldera floor, although some small nodules have been recovered from the East Jemez River, but does not erode outside the caldera area (Shackley 2000). This is likely due to the recent event that occurred as a resurgence on the caldera floor. Importantly, this would indicate that Valle Grande obsidian must be procured from the caldera floor proper (i.e. at Cerro del Medio) either directly or through exchange with groups with direct access. The Cerro Toledo Rhyolite and El Rechuelos obsidian could also be procured in this way, but they are also available, albeit in smaller nodule sizes in local alluvium (i.e. the Puye Formation).

SUMMARY AND CONCLUSION

LA 1624 exhibits artifacts produced from obsidian procured from both Cerro Toledo and Valle Grande members of the Valles Caldera (Table 1, Figures 2 and 3). Marekanites exhibiting the identical signature as Cerro Toledo Rhyolite are incorporated into the upper member of the Bandelier Tuff, and the obsidian at LA 4624 could have been procured from this context. These nodules however, are generally small, so larger artifacts would have to be produced from more primary sources. One projectile point was produced from El Rechuelos glass, and could have entered archaeological context as a finished artifact rather than raw material.

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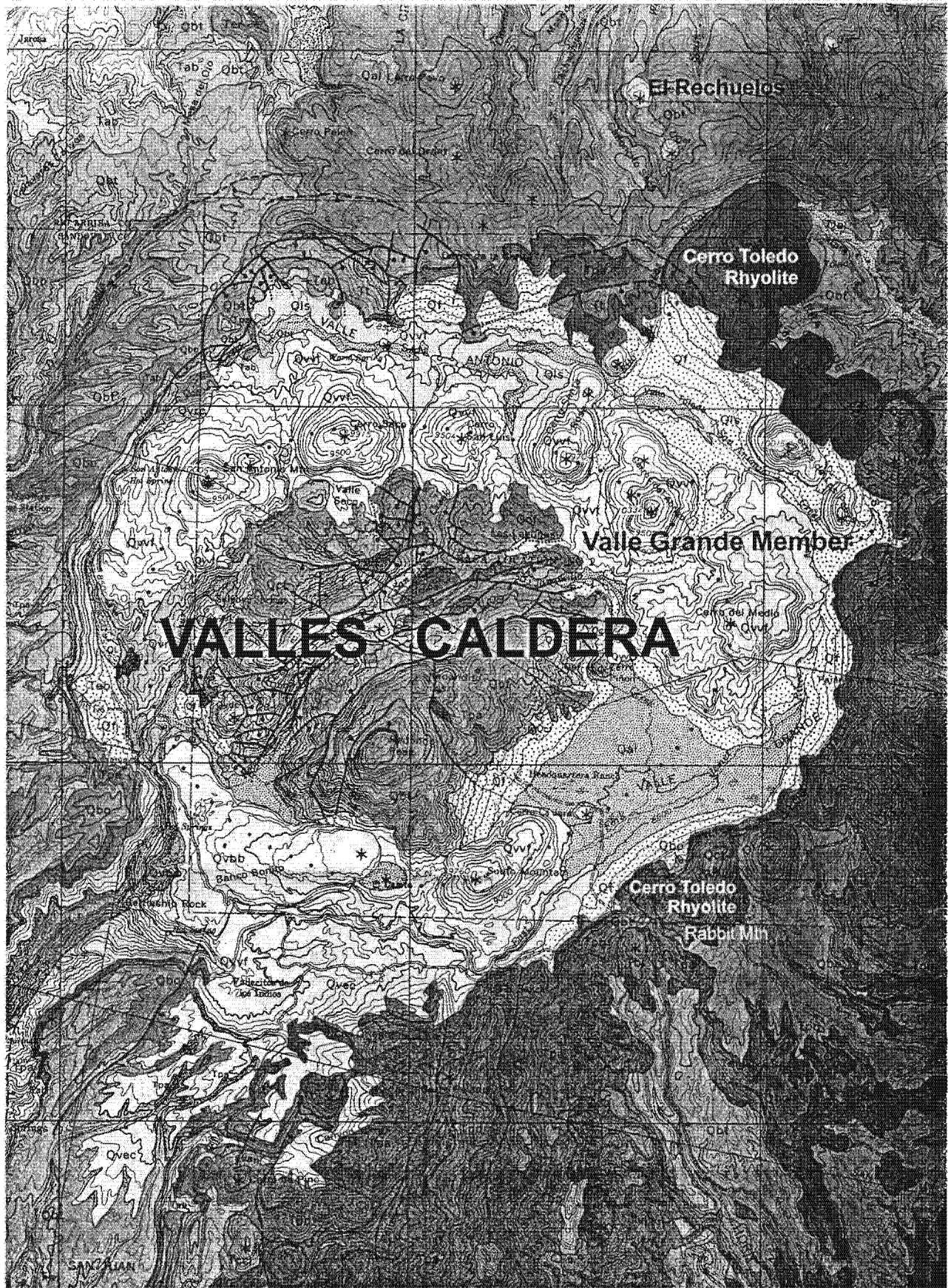
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Table 1. Elemental concentrations for the archaeological specimens. All measurements in parts per million (ppm).

Sample	Rb	Sr	Y	Zr	Nb	Ba	Source
LA 4624-90	199	8	62	177	95	15	Cerro Toledo Rhy
LA 4624-117A	160	11	44	173	56	51	Valle Grande
LA 4624-117B	200	6	61	177	96	2	Cerro Toledo Rhy
LA 4624-131	192	7	60	176	95	6	Cerro Toledo Rhy
LA 4624-136	198	7	62	178	96	6	Cerro Toledo Rhy
LA 4624-154A	201	7	62	181	98	15	Cerro Toledo Rhy
LA 4624-154B	202	7	62	180	98	2	Cerro Toledo Rhy
LA 4624-154C	201	6	62	182	97	11	Cerro Toledo Rhy
LA 4624-154D	202	7	62	181	97	2	Cerro Toledo Rhy
LA 4624-157A	198	6	61	178	96	1	Cerro Toledo Rhy
LA 4624-157B	198	7	60	173	95	1	Cerro Toledo Rhy
LA 4624-171	149	10	23	78	45	21	El Rechuelos
LA 4624-181	199	7	62	186	97	0	Cerro Toledo Rhy
LA 4624-187	152	11	43	171	54	52	Valle Grande
RGM H-1	144	103	25	218	9	812	standard



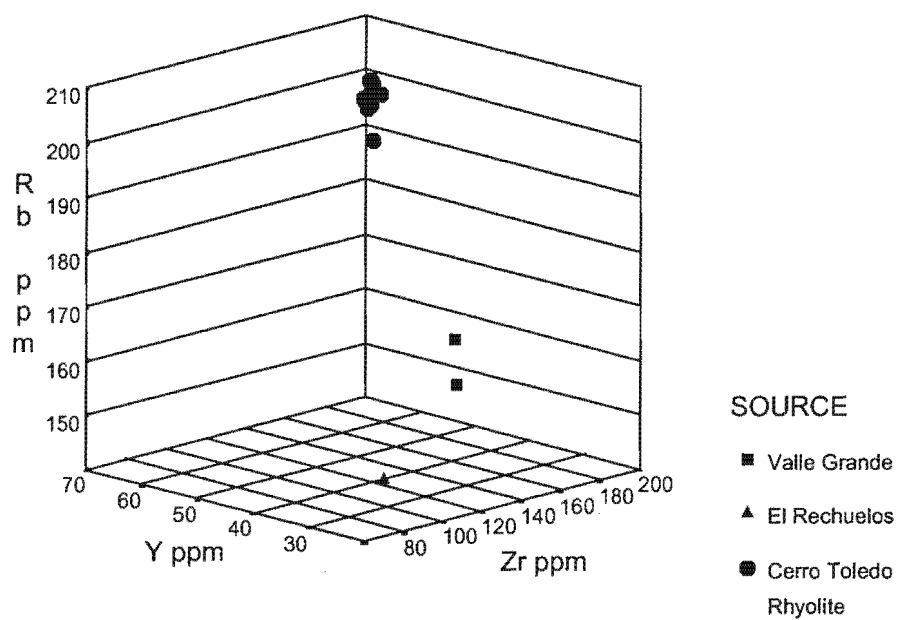


Figure 2. Rb, Y, Zr plot of archaeological samples from all sites.

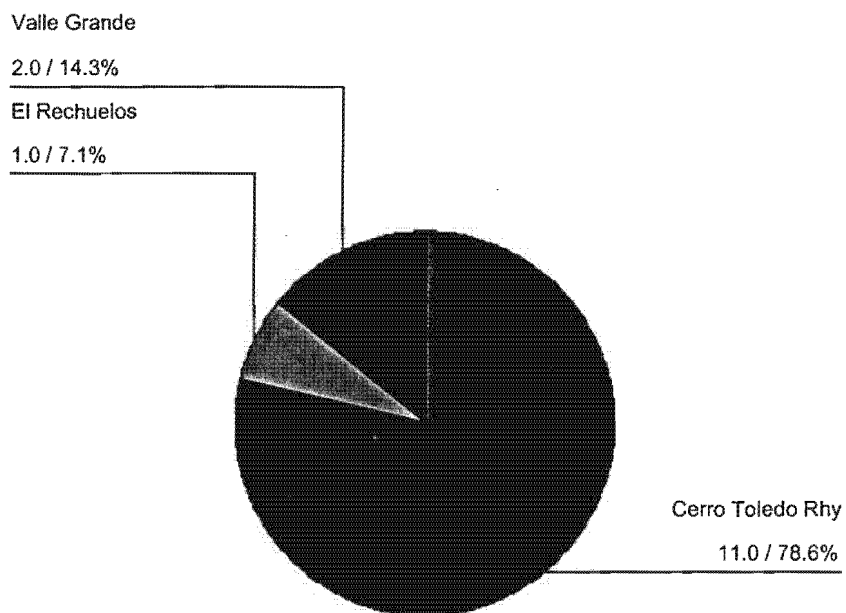


Figure 3. Frequency distribution of obsidian source provenance in LA 4624.