5-1-2010

Why Conical Pots? An Examination of the Relationship among Vessel Shape, Subsistence, and Mobility

Claire K. Helton-Croll

C. Kathleen Helton-Croll

Candidate

Anthropology

Department

This dissertation is approved, and it is acceptable in quality and form for publication:

Approved by the Dissertation Committee:

Patricia L. Crown, Chairperson

WHY CONICAL POTS?
AN EXAMINATION OF THE RELATIONSHIP
AMONG
CERAMIC VESSEL SHAPE, SUBSISTENCE, AND MOBILITY

BY

CLAIRE KATHLEEN HELTON-CROLL

B.A., Social Science, Troy State University 1997
M.A., Anthropology, University of New Mexico 2000

Dr. Patricia Crown, Dissertation Chair

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

May 2010

DEDICATION

For Mom and Dad
Thanks for always betting on me.

ACKNOWLEDGEMENTS

This dissertation could not have been completed without the help and support of my professors at the University of New Mexico, colleagues, family, and friends. This research also would not have been possible without the financial support provided by Graduate Research and Development Fund (GRD) from the Graduate and Professional Student Association at the University of New Mexico, and the National Science Foundation Dissertation Improvement Grant.

To my advisor and dissertation chair, Dr. Patricia Crown, thank you for your unwavering support in what has turned out to be a very long process. Your advice and professionalism will continue to aid me as I continue my archaeological career.

Committee members, Dr. James Boone, Dr. Eric Blinman, and Dr. Ron Towner contributed greatly to this research and it would not have been possible without your guidance and advice. My obsession with conical pots began in Jim's Prehistoric Europe class and for that, I am grateful. I am also especially thankful to Eric who arranged with Robert Gallegos for access to the private collection of Navajo cooking vessels that was then in Mr. Gallegos' possession.

Other UNM faculty that have aided in this endeavor are Dr. Ann Ramenofsky, Dr. Wirt Wills, and Dr. Keith Basso. Without Ann's unwavering support, I would not have finished even my first year of graduate school, much less this research. Thanks to Erika Gerety and Amy K. Hathaway for all their help and patience with my drop-in frantic visits.

The whole vessel and sherd analysis would not have possible without the help of museum staff at the Maxwell Museum (Dave Phillips, Dorothy Larson, and Catherine Baudoin); the Museum of Indian Arts and Culture; Laboratory of Anthropology; Museum of New Mexico (Julia Clifton, Tony Thibodeau, Melissa Powell, and Dodi Fugate); Smithsonian National Museum of Natural History (James Krakker); the Museum of Northern Arizona; the Robert S. Peabody Museum; Phillips Academy (Melinda Blustain); and the Pecos National Historical Park (Tim Burchett).

To my cohort and friends, thank you for being there throughout this process. Kari Schleher was always only a phone call away for encouragement in times of disillusionment and answers to the millions of random questions. I also owe thanks to my boss and good friend, Sean Larmore, for always being there to discuss ideas and read my chapters, and for letting me have time off to complete this research.

My sincerest thanks go out to my family without whom I would not be where I am today. My parents, Jimmy and Cheryl Helton, and my in-laws, Bob and Ann Croll, have supported me throughout this process. My parents' unfailing belief in me has given me the confidence and ambition to complete this research. I owe thanks to my mom for helping with the mathematics side of things. The experimental testing would not have been possible without help from my father-in-law, the family engineer. His aid in designing the testing equipment was instrumental.

I owe a large thanks to my husband, Dave Croll, for putting up with everything involved in this process. He has been with me almost from the beginning of this and he has provided invaluable support, advice, and friendship. I can never thank him enough.

Finally, thanks to my daughter, Cadence, without whom I might never have had the motivation to finish.

WHY CONICAL POTS?
AN EXAMINATION OF THE RELATIONSHIP AMONG CERAMIC VESSEL SHAPE, SUBSISTENCE, AND MOBILITY

BY

CLAIRE KATHLEEN HELTON-CROLL

B.A., Social Science, Troy State University 1997
M.A., Anthropology, University of New Mexico 2000

ABSTRACT OF DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

May 2010

WHY CONICAL POTS?
AN EXAMINATION OF THE RELATIONSHIP
AMONG
CERAMIC VESSEL SHAPE, SUBSISTENCE, AND MOBILITY

BY
C. KATHLEEN HELTON-CROLL

B.A., Social Science, Troy State University 1997
M.A., Anthropology, University of New Mexico 2000
Ph.D., Anthropology, University of New Mexico 2010

ABSTRACT

This study examines the functional relationship between ceramic cooking vessel shape and subsistence and mobility using vessels from Navajo and Towa-speaking Puebloan groups from the Protohistoric period (A.D. 1450-1700) in the southwestern United States. Conical shape vessels are found in association with mobile foragers throughout the past. Navajo peoples produced Dinetah and Navajo Gray wares, both of which have conical bases. Towa-speaking Puebloan peoples from the Jemez and Pecos areas produced rounded-base cooking vessels. The Navajo and Towa-speaking Puebloans practice different subsistence and mobility strategies. The primary goal of this research was to determine if variation in cooking vessel form was the result of this cultural variation. This research employed reviews of available ethnohistorical and archaeological data, analysis of archaeological specimens, and experimental testing of reproductions. Ethnohistorical and archaeological data provide evidence for variation in types of food resources exploited, food preparation techniques, and mobility strategies. The seasonally mobile early Navajo depended heavily on wild plant resources and supplemented their diet with agricultural resources. The Towa-speaking Puebloan groups

were primarily reliant on agricultural resources and occupied large year-round settlements with seasonal dispersal of a portion of the population to attend to agricultural fields. Analysis of archaeological specimens, using both whole vessels and sherds, showed substantive variation between the cooking vessels of the two groups that can potentially relate to transportability, thermal stress resistance, and thermal efficiency. Experimental testing of reproductions based on archaeological whole vessels also provided evidence for differences in strength, thermal stress resistance, and thermal efficiency. Results suggest that variation in cooking vessel form is more strongly related to variation in diet and cooking strategies than to mobility. Additional research is needed to further elucidate the cultural relationships examined here.

Table of Contents

Figures

Tables

Chapter 1: Introduction

"Yet this generally neglected material amply repays close attention, for technologically it is extremely interesting; some varieties of cooking pots, indeed, are marvels of skillful clay working and all of them were admirably suited to the special function for which they were intended."
-Kidder and Shepard 1936:297

"Simple tools and utensils which serve their purpose adequately are among the best guides to culture origins and continuities."
-Linton 1944

For the last seventy years, anthropologists and archaeologists have questioned why past peoples used conical-based cooking vessels. Scholars have examined this question using ethnographic and archaeological data and have found a correlation between conical-based vessels and mobile to semi-mobile hunter-gatherers (Braun 1983; Linton 1944; Mills 1985; Pavlů 1997); suggesting that pointed-base vessels might have advantages in this social and economic context. This association occurs among the Jomon in Japan, the Ertebølle of Southern Scandinavia, and both historic and prehistoric groups in North America, including some of the Apachean peoples in the southwestern United States (Aikens 1995; Braun 1983; Brugge 1981; Linton 1944; Mills 1985; Pavlů 1997). Some scholars have proposed that conical-based pottery is better suited to specific types of food preparation techniques more conducive to a mobile lifestyle (Linton 1944; Mills 1985). Correlates have also been found between base shape and the kinds of foods being cooked, although the ethnographic data are deficient in terms of conical bases (Mills 1985; Pavlů 1997).

This dissertation explores possible explanations for conical-base ceramics using an approach that combines the analysis of ceramic technology and experimental testing of reproductions to examine the functional significance of a potter's design decisions in

different cultural settings (Schiffer and Skibo 1987). Michael Schiffer, James Skibo, and others have created a foundation for the present research through studies conducted in the last 20 years (Braun 1983; Bronitsky 1986; Bronitsky and Hamer 1986; Mabry et al. 1988; Neupert 1994; Pierce 1999; Schiffer 1990a, 1990b, 1991; Schiffer and Skibo 1987, 1989, 1997; Schiffer et al. 1994; Skibo 1992). Inherent in all of this research is the assumption that technological choices have some functional significance (Braun 1983; Ramenofsky 1995; Schiffer and Skibo 1987; for exceptions, see Dobres and Hoffman 1999; Lemonnier 1993; Loney 2000, 2001).

Technological decisions are guided by many factors including the potter's environment, the intended use of a vessel and the context of that use, and the communication of social relationships, values, or ideas (Beck 2009; Braun 1983; Bronitsky 1986; Cackette et al. 1987; Hally 1983a, 1984, 1986; Lechtmann 1977; Rathje and Schiffer 1982; Schiffer 1991; Smith 1985, 1988; Van Hoose 2008). This research focuses on how intended use and context of use, particularly subsistence and mobility strategies, influence technological decisions about ceramic cooking vessel shape.

Research Problem

I specifically investigate how variation in Navajo and Puebloan cooking vessel shapes relates to variation in mobility and subsistence strategies during the Protohistoric period (A.D. 1450-1700) in the southwestern United States. To test the possible functional advantages of different basal shapes, I used multiple lines of evidence. First, I examined ethnographic and archaeological information on subsistence and mobility from two cultural groups, the Navajo and Towa-speaking Puebloans (Jemez and Pecos). I considered the contexts in which the vessels were used, the diets and cuisines of each

group, and the thermal features associated with each vessel form. I then analyzed ceramics, both whole cooking vessels and sherds, from each of these groups curated in museum and private collections. Finally, measurement data from the collection specimens were used to create replicas of each form. Replicas were used to test the performance characteristics of the vessels, particularly impact strength, thermal stress resistance, and thermal efficiency.

Navajo and Puebloans are ideal case studies for this research for several reasons. Although geographically close, potters from both groups made distinct cooking vessels over long periods of time, cooks used these vessels to prepare foods within the traditional diet and cuisine of each group, and each group is characterized by different settlement mobility patterns. Archaeological remains show that the Navajo during the Protohistoric Period had conical-base cooking vessels and were semi-mobile with limited reliance on agriculture (Brown 1996; Kelley and Whiteley 1989). Early Navajo sites reflect small, relatively mobile groups of people dependent primarily on wild plants and animals supplemented by cultigens (Brown 1996). Residential mobility appears to have decreased during historic times, and evidence suggests that by the early 1700s, the Navajo were growing corn, beans, and squash (Hill 1940; Reeve 1958). The transition from conical-based vessels to a more rounded-base vessel appears to occur around the same time as the transition to a more sedentary lifeway.

In contrast, Puebloan groups during the Early Protohistoric and later were primarily sedentary, although the archaeological record suggests that at least a portion of the population was logistically mobile, as evidenced by the presence of field houses across the Southwest. In the Jemez region, field houses are often situated on mesa tops

and are assumed to originate from the larger settlements nearby (Anschuetz and Merlan 2007). Seasonal dispersal did not involve the entire population at these larger, year-round settlements. Like the Navajo, Pueblos grew corn, beans, and squash, but agricultural features indicate a more intensive form of agriculture in many areas and dietary information indicates a long-standing high reliance on domesticated plants.

Mobility, Subsistence, and Conical Pots

Linton (1944) published the first attempt to understand the relationship between ceramic cooking vessel shape and social context. He examined the relationships among cooking vessel shape, subsistence, mobility, and regional distribution. He focused entirely on cooking vessels from North America, dividing these vessels using primarily base shape: 1) flat base, flower pot shape; 2) conical base, Woodland style; and 3) rounded base, globular form. Linton associated flat base and conical-base vessels with high height-to-diameter ratios, straight rims, relatively unrestricted orifices, and an absence of handles. Rounded-base vessels are associated with low height-to-diameter ratios, flaring rims, and restricted orifices.

Using archaeological and ethnographic data, Linton (1944) suggested that vessel form correlates with settlement patterns, subsistence strategies, heating method, boiling time, and ceramic assemblage variability. Specifically, Linton found that vessels with conical and flat bases often were used by highly mobile groups who practiced a foraging subsistence strategy, and who placed their vessels directly in the fire (Linton 1944:371). Linton argued that this method of boiling was quicker than placing the vessel over the fire. Rounded-base cooking vessels were used primarily by sedentary agricultural groups that placed the vessels over coals either by suspension or by placing them on rests.

Linton's conclusions have important ramifications for how ceramic vessel shape relates to subsistence and mobility. One drawback to his research is that he based his conclusions on his wide knowledge of general archaeological and ethnographic data but does not support them with reference to specific cases.

Forty-one years later, Mills (1985) tested Linton's correlations between behavior and cooking vessel morphology with specific cases. Her review of the Human Relations Area File (HRAF) ethnographic data from 37 ceramic-using North American groups incorporated seven variables based on information presented by Linton (1944): base shape, heating method, settlement pattern, dietary mix, assemblage variety, contents, and temper type. Although there is more variation than Linton indicated, Mills' review of the HRAF shows that conical bases correlated with placing the vessel directly in the fire, a foraging subsistence strategy, high mobility, short boiling time, and low ceramic variability (Mills 1985).

Following Linton (1944) and Mills (1985), I also examined ethnographic data (Table 1-1), and found that conical-base vessels correlate strongly with a foraging subsistence strategy and mobility. This is not to say that all foragers who adopted ceramics prior to full sedentism produced conical vessels. Indeed, the data show that many mobile foragers produced round vessels. Of the 47 groups examined in the HRAF database, 11 had conical-base vessels (Table 1-1). All 11 groups practiced hunting and gathering as their primary mode of subsistence, and were mobile at least part of the year. Presumably these groups transported their vessels during residential moves although the records did not often explicitly state this. Only Smith (1974:87) indicates that the

Table 1-1. Ethnographic data from North America showing relationship among base shape, settlement pattern, and subsistence in 47 cultural groups.

Group	Base Shape	Settlement Pattern	Subsistence Strategy	Group	Base Shape	Settlement Pattern	Subsistence Strategy
North Alaskan Eskimo	conical	nomadic	H-G	SE Yavapai	round	semi-sedentary	H-G/Agric
Western Shoshone	conical and flat	nomadic	H-G	Mohave	round	Unknown	H-G/Agric
Northern Paiute	conical	semi-nomadic	H-G	Yuma	round	semi-sedentary	H-G/Agric
Southern Paiute	conical and flat	semi-nomadic	H-G	Kamia	round	semi-sedentary	H-G/Agric
Owens Valley Paiute	flat, conical, and round	semi-sedentary	H-G	Havasupai	round	semi-sedentary	H-G/Agric
Shivwits Paiute	conical	nomadic	H-G	Walapai	round	semi-sedentary	H-G/Agric
Northern Ute	conical and flat	nomadic	H-G	Yavapai	round	semi-sedentary	H-G/Agric
Southern Ute	conical	nomadic	H-G	Maricopa	round	permanent	H-G/Agric
Navajo	conical and round	semi-sedentary	H-G/Agric	Cupeno	round	Unknown	Unknown
Southern Apache	conical	nomadic	H-G/Agric	Papago	round	semi-sedentary	Agric/H-G
Gros Ventre	flat	nomadic	H-G	Cocopa	round	semi-sedentary	Agric/H-G
Ingalik	flat	nomadic	H-G	Tarahumara	round	semi-sedentary	Agric/H-G
Bering Strait Eskimo	flat	nomadic	H-G	Papago	round	semi-sedentary	Agric/H-G
Sarcee	flat	nomadic	H-G	Winnebago	round	semi-sedentary	Agric/H-G
W. Mono/ Yokut	flat	semi-sedentary	H-G	Arapaho	round	semi-sedentary	Agric/H-G
Aleut	flat and round	semi-sedentary	H-G	Taos	round	permanent	Agric/H-G
Luiseno	round	unknown	H-G	Pawnee	round	permanent	Agric/H-G
Northern Diageno	round	unknown	H-G	Pima	round	permanent	Agric/H-G
Southern Diageno	round	semi-sedentary	H-G	Seminole	flat and round	permanent	Agric/H-G
Kiliwa	round	unknown	H-G	Mandan	round	permanent	Agric/H-G
Seri	round	semi-sedentary	H-G	Cherokee	round	permanent	Agric.
South Alaskan Eskimo	round	permanent	H-G	Hopi	round	permanent	Agric.
Cahuilla	round	unknown	H-G	Zuni	round	permanent	Agric.
Iroquois	flat and round	semi-sedentary	H-G/Agric				

Note: Data from Birket-Smith 1955; Brown 1979; Deland 1908; Dunning 1959; Fenton 1957; Flannery 1953; Gayton 1948; Goggin 1964; Hill 1937; Kelly 1934; Kroeber 1902–1907; Leftwich 1986; Linton 1922; Lowie 1924; Mills 1985; Morgan 1901; Pallas 1948; Quimby 1945; Radin 1923; Sattler 1989; Smith 1974; Spier 1928, 1933; Titiev 1944; Wedel 1936; Will and Spinden 1906.

Northern Ute transported their ceramics when mobile. Three different language groups are represented by the 11 cultural groups (Ballantien and Ballantien 1993:466) suggesting that the correlation between conical-base vessels and hunter-gatherers occurs in three historically separate populations observed by ethnographers. No agricultural societies examined used conical-base ceramics.

The archaeological record further supports the relationship among conical vessels, hunter-gatherer subsistence, and mobility as evidenced by data from Japan, Europe, and North America (Anfinson 1979; Ikawa-Smith 1986; Mithen 1994; Pavlů 1996; Rowley-Conwy 1984; Sassaman 1993). The earliest ceramics in the world are found along the southwest coast of Japan and are associated with the Jomon culture. Ceramics are open vessels with conical bases dated to 10,000 B.C. (Pavlů 1996; Rowley-Conwy 1984). Some of these vessels are sooted, suggesting use for cooking (Ikawa-Smith 1986). The Jomon were hunter-gatherers who depended heavily on shellfish (Ikawa-Smith 1986; Pavlů 1996). Degree of mobility of the early Jomon is debated, however, it is likely that they practiced a semi-mobile strategy (Habu 2004; Sakaguchi 2008).

Another cultural group with conical-based vessels is the Ertebølle of northern Europe. The Ertebølle were a group of Mesolithic foragers who occupied the southern parts of Scandinavia and the northern coast of mainland Europe from circa 5500 to 3200 B.C. They are unique in that they continued to practice a foraging subsistence economy after the rest of Europe had adopted agriculture. Until the Ertebølle adopted domesticates, they depended on aquatic resources, and ceramics consisted of conical pots with thick walls and oval bowls (Bogucki 1996; Mithen 1994; Price et al. 1995). It is assumed that these conical pots were used mainly for cooking; some have been found

containing charred food residues consisting of grass and fish (Mithen 1994). Ertebølle sites suggest a seasonally mobile settlement strategy and a dependence on terrestrial and marine resources. Other groups in Europe, such as the Narva and the Dnieper-Donets, were mobile hunter-gatherers who also used conical vessels (Dolukhanov 1993; Gimbutas 1991).

Many ceramic types from the Late Archaic to Early Woodland periods (2500-200 B.C.) in the Eastern Woodlands had conical bases (Anfinson 1979; Braun 1983; Sassaman 1993); a period preceding the advent of full-scale agriculture. Eastern Woodland groups during this time were at least semi-mobile, if not highly mobile; their transition to rounded-base vessels appears to have occurred contemporaneously with the transition to sedentism.

Preliminary Research

As a precursor to the current research, I conducted a preliminary experimental study of differences in strength between conical-base forms and rounded-base forms by constructing reproductions of each form and conducting impact tests on each vessel (Helton 2001). Eight vessels were constructed using both slab and mold techniques and varying in both base shape and thickness. Impact testing consisted of a ball bearing (weighing approximately one ounce) dropped until failure or 50 drops to the center of the base of the exterior of the vessel. Results of these tests show that both base shape and thickness have an effect on impact resistance. Conical bases in both thickness categories tended to be twice as strong as the rounded-base form (Figure 1-1). Results confirmed

that mobility considerations might influence vessel base shape along with dietary/cooking considerations and set the stage for my dissertation research.

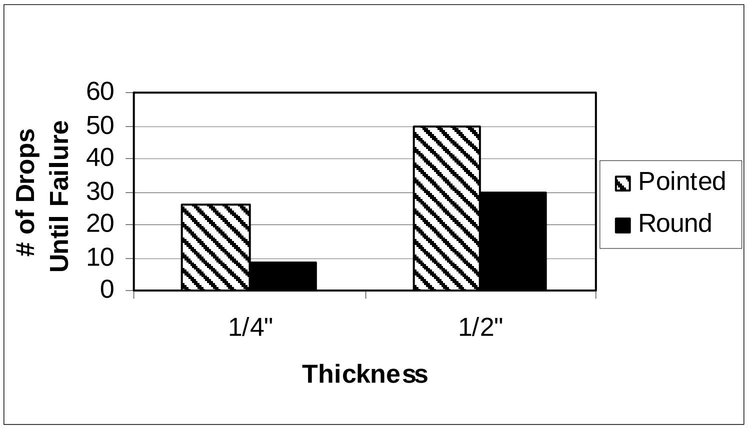

Figure 1-1. Results of Pilot Study.

Organization of Dissertation

The research is presented in the following format. Chapter 2 provides the research design including hypotheses and expectations; Chapter 3 presents a synopsis of what is known about the Navajo and Puebloan cultural groups and why they are valid case studies to use for examining the relationship between vessel shape and performance.

Chapter 4 reviews the ethnohistorical and archaeological information available on the diet and cooking strategies of the Navajo and Puebloan groups. My review shows that although the types of foods exploited by both groups were similar, the proportion of these foods in the diet varied. Thermal features varied in both size and shape between Navajo and Jemez sites suggesting variation in the cooking strategy employed.

Chapter 5 details the methods and results of the analysis of archaeological specimens. Archaeological samples showed definitive variation in ceramic technology among the Navajo and Puebloan groups. Navajo vessels had conical bases and were much larger than Puebloan vessels. Surface treatment, hardness, and breakage patterns

were varied. Similarities were found in firing atmosphere, and attrition and sooting patterns; most likely due to use in cooking in the latter two variables.

Chapter 6 covers the methods and results of the experimental testing. My methods were derived from the growing body of archaeological literature using reproductions and sherds to examine how different technological attributes affect performance (Braun 1983; Mabry et al. 1988; Neupert 1994; Schiffer 1990a, 1990b, 1991; Schiffer and Skibo 1987, 1989, 1997; Schiffer et al. 1994; Skibo 1992). Results show surprising variation between the two vessel groups in terms of performance. Conical vessels have greater basal impact strength at the base, but less side impact strength than round bottom vessels. Thermal tests demonstrate that conical-base vessels do have greater thermal stress resistance and have more consistent thermal efficiency.

A discussion of the results and conclusions are presented in Chapter 7. Results suggest that cooking strategies were a driving factor in the design decisions of both Navajo and Puebloan potters. Conical-base vessels were not shown to be more transportable and therefore, this base shape is not necessarily more advantageous than round bases for mobile groups. Although these results are informative, they are unfortunately not definitive in providing concrete explanations for the correlation of conical-base vessels, mobility, and forager subsistence. Continued research is needed to further understand these complex relationships.

Chapter 2: The Research Design

This dissertation explores why potters produced conical-based cooking vessels. As defined here, conical-based ceramic vessels have basal angles smaller than 90 degrees. Relative to rounded-base forms, conical-based pots have a higher center of gravity and are less stable and more easily tipped when placed on the ground; we might assume that these characteristics would be unfavorable in a cooking vessel. Although potters in the past may not have been aware of the engineering effects of their choices, they no doubt understood how their choices affected the performance of a vessel because these potters were often both the manufacturers and users of the ceramic vessels (Arnold 1971; Braun 1983). A potter would manufacture a vessel that functions appropriately for its intended uses (Braun 1983), and therefore, a conical-base most likely has some advantages in certain contexts. Indeed, Western Apache women who made conical-base vessels in the recent past did so because this form broke less often in transport than rounded-base vessels, and had a shorter boiling time due to their placement directly in the fire (Basso, personal communication 2001); suggesting that Apache cooking vessels were designed for both cooking and transport.

This research examines the functional significance of conical-base vessels using ceramic cooking vessel types of both Navajo and Puebloan groups in the southwestern United States from the Late Prehispanic to Early Historic periods. Navajo cooking vessels from these periods are typically conical, or pointed, in overall shape with flattened bases. The Navajo during the early Dinetah phase were semimobile and depended primarily on wild resources they supplemented with agricultural products

(Brown 1996). Puebloan cooking vessels are typically rounded at the base with slightly constricted necks and flaring rims. Puebloan groups were primarily sedentary and dependent on corn, beans, and squash supplemented by wild resources. I test the model that variation in ceramic vessel shape is directly related to variation in mobility and subsistence.

Model Hypotheses and Expectations

My model states that the differences between the basal shapes of Navajo and Puebloan vessels are due to the differences in the degree of mobility and subsistence choices between Navajo and Puebloans. Mobility and subsistence are related concepts and both no doubt influence ceramic manufacture. Mobility and subsistence are viewed here as a continuum (Binford 1980). At one end of the continuum are hunter-gatherer groups who depend primarily on wild resources and practice a mobile lifeway, and at the other are agriculturalists who are food producers and sedentary. Both of the groups in this study fall between these two extremes. The degree of mobility is represented in the archaeological record by sites that range from small short-term camps to long-term residential bases. It is understood that even sedentary groups often practiced seasonal or logistical mobility (Beck 2009; Darling et al. 2004).

I assume, based on the available evidence presented in Chapters 3 and 4, that the Navajo were more mobile than their Puebloan neighbors and that this increased mobility was, in part, the result of a greater focus on wild plant and animal resources. If Navajo and Puebloan potters made technological choices to maximize the functional efficiency of a vessel relative to mobility and subsistence strategies, I expect:

1) Navajo conical-base vessels to reflect greater mobility by having increased transportability; and 2) The Navajo and Puebloan vessels reflect variation in diet and cooking strategies.

The expectations are not mutually exclusive and both could contribute to differences in vessel morphology. The model and expectations are discussed below.

Mobility

Although archaeologists often assume that mobile groups do not manufacture ceramics because they are too fragile and cumbersome to transport, many mobile groups produced ceramics (Arnold 1985; Brown 1989; Eerkens 2001, 2003, 2004, 2008; Pavlů 1997; Reid 1990). Mobile groups also transported their vessels as evidenced by Reid's (1990) analysis of the ethnographic literature. At least five of the mobile hunter-gatherer groups discussed by Reid (1990) transported their vessels when they moved camps. It is unknown whether early Navajo groups transported their vessels.

Transportability of a vessel should directly correlate with the degree of mobility. In a mobile foraging group, vessel forms that are easily transported would be advantageous. If a vessel has a high degree of transportability, it has a lower probability of breakage during transport. Among sedentary groups where vessels are not moved often, the transportability of a vessel should not be as important. However, this relationship may not be clear in cases in which vessels are regularly exchanged or act as containers for exchanging other substances between mobile and sedentary groups.

While some mobile groups may choose not to transport vessels and simply cache vessels at sites to which they return repeatedly, others take vessels with them. Potters have several options for increasing transportability by making vessels easier to carry

and/or less likely to break. Some groups employ protective packaging, such as placing vessels in a basket and padding it with grass (Reid 1990). Other groups may have modified vessels so that they are more transportable. One option is to add holes or appendages to make vessels easier to transport (Beck 2009). Reid (1990) provided examples of several groups that made vessels with holes near the rim to which a handle could be attached for carrying either as a pail or suspended from a person's back by a thong.

Another option might be constructing lighter vessels. This can be accomplished by reducing the wall thickness or overall size of a vessel. Selection of certain clays and tempers also might produce this result (Beck 2009). Navajo vessels are large, but thin walled. It is possible the thin walls offset the cost of transporting such large vessels.

A third option is to modify vessel forms. Potters might produce different size vessels that "nest" within each other and thereby increase ease of transport (Whittlesey 1974). Due to the lack of nestability in Navajo and Puebloan vessels used in this study, this variable was not considered. Potters also might choose to manufacture a particular vessel shape that is stronger and more resistant to breakage.

All of these strategies can be evaluated in the ceramic vessels and sherds that past peoples deposited. Following the above discussion, I expect several variables to inform on transportability. Vessel size, wall thickness, paste, and the presence of appendages or holes might provide information. Surface attrition patterns provide evidence for whether a vessel was transported and the method of transportation. Strength also provides insight into transportability, and is the primary variable examined to represent the transportability of a vessel in the current study. It is assumed that a potter would make

technological choices that result in stronger vessels in order to increase the transportability of a vessel.

I suggest that Navajo conical-base vessels had greater transportability than Puebloan rounded-base vessels. Transportability is evaluated using: a) vessel size; b) wall thickness; c) presence/absence of appendages or holes used as handles or for attachment of handles; d) surface attrition patterns; and e) strength. Archaeological sherds and whole vessels were used to examine the first four criteria. Strength was examined using analysis of archaeological samples and experimental analyses. A vessel does not have to be small, thin walled, and strong with appendages or holes near the rim in order to be considered transportable. These variables simply inform on the relative transportability of the two forms.

Expectations

My first expectation is that Navajo and Puebloan vessels will differ in size. I expected that Navajo vessels would be smaller and, therefore, more transportable (Beck 2009). Some Plains groups made much smaller vessels than the Rio Grande Puebloan groups to the west from whom they most likely acquired their ceramic technology (Beck 2009; Habicht-Mauche 1991). Maximum height, width, aperture width, and neck width measurements were taken on whole vessels. Size also was measured in terms of volume due to variation in overall shape between the two vessels.

My second expectation is that Navajo vessels will tend to have thinner walls than Puebloan vessels, which would result in lighter vessels. The Seri of Sonora, Mexico employed this strategy. They were a highly mobile hunter-gatherer group who manufactured large thin-walled vessels to carry and store water. These vessels, although

large, were carried in nets on a yoke with the people when they moved (Beck 2009; DiPeso and Matson 1965). It is assumed that the Seri reduced the wall thickness in order to offset the cost of such large vessels. Wall thickness measurements were taken on both whole vessels and sherds.

My third expectation is that the presence of appendages or holes near the rim of the whole vessels would be more frequent in Navajo vessels. Several mobile groups, such as the Sarcee of Alberta and the Khoikhoi of southwestern Africa, had holes near the rim of their vessels to attach handles (Beck 2009; Bollong et al. 1997; Sapir 1923). The presence or absence of appendages or holes near the rim was noted on whole vessels. Appendages and/or holes would also be advantageous in suspending a vessel over a fire and for providing leverage for moving the vessel around the fire.

My fourth expectation is that Navajo vessels will have different surface attrition patterns than Puebloan vessels. These patterns can inform on the way in which the pots may have been transported (Griffiths 1978; Hally 1983a, 1983b; Rice 1987; Skibo 1992). Navajo vessels may have been transported in net bags with other vessels. Wear over the entire vessel might occur from vessels coming into contact with one another during transport. Navajo vessels also could have been transported by securing a rope around the neck of the vessel; wear around the necks would be indicative of this method of transport. However, wear in the neck area of a vessel also could be indicative of simply hanging a vessel for storage rather than transport. Wear patterns were examined on both whole vessels and sherds. Location and type of attrition on the interior and exterior of whole vessels and sherds was recorded.

My final expectation relative to mobility is that conical-based vessels will be stronger than rounded-based forms. Strength is defined here as the ability of a ceramic body to resist impact without fracturing or breaking. Increased strength would have implications for the durability of Navajo ceramics relative to that of Puebloan ceramics. Impact strength is a component of the durability of a vessel (Neupert 1994). Durability is the ability of a vessel to survive a long time without significant damage or failure. Archaeological and historical data suggest that the Navajo manufactured conical vessels during a period of moderate residential mobility (Brown 1996). Increased transport will positively correlate with both drop and breakage rates (Simms et al. 1997). If conical bases have greater impact strength than rounded bases, conical vessels would break less often during transport and, therefore, have greater durability. A pilot study using impact strength tests indicated that conical bases may be stronger, but these results are limited by small sample sizes (Helton 2001).

Analysis of archaeological sherds and experimental tests were employed to evaluate strength. Hardness and fracture patterns of sherds were examined to inform on the relative strength between the Navajo wares and the Puebloan wares. Experimental tests on reproductions were conducted to examine strength. The basal impact strength and the side impact strength were analyzed. Basal impact strength tests consisted of both dropping a ball bearing on the vessel and dropping the vessel. Side impact strength was evaluated by suspending the vessel and swinging it into a cinder block. Both of these tests are discussed in Chapter 6.

Diet and Cooking Strategy

Vessel morphology may be determined in part by food choice and preparation techniques. Ethnographically, conical-base vessels are often placed directly in the fire for cooking, but rounded-base vessels are most often placed over the fire (or coals) for cooking (Linton 1944; Mills 1985). Pavlů (1997:84) infers that vessel shapes differ according to cooking technique. He bases this statement on evidence from both ethnographic and archaeological records. Linton (1944) argued that building a fire around a vessel decreased boiling time and, consequently, conical-base vessel morphology would be more efficient for this cooking technique. The correlation between conical-base vessels and hunter-gatherer subsistence suggests that this form is somehow more adapted to preparing wild plant and animal resources.

Cooking strategies and efficiency are analyzed using the following data: a) available ethnohistorical and archaeological data on food and cuisine; b) soot patterns; c) surface attrition patterns; d) thermal stress resistance; and e) boiling time.

Expectations

My first expectation is that food and cooking strategies vary between Navajo and Puebloan groups. In order to analyze this variation, ethnohistorical and archaeological data were collected from available literature on the foods exploited by these two groups, the type of preparation used to cook these foods, and a description of the thermal features used at both Navajo and Puebloan sites. Differences in all three of these variables were expected. I expect that early Navajo groups were more dependent on wild resources relative to their Puebloan neighbors and that these two groups employed different

preparation techniques. I also expect thermal features to reflect placement of the vessel in relation to the fire.

If Navajo vessels were placed directly in the fire and Puebloan vessels were placed over the fire, this should be apparent in the morphology of thermal cooking features. Due to the lack of research on the relationship between cooking technique and thermal features, expectations of how the two types of features would differ was unknown, but features used with conical-base vessels were expected to show evidence for the conical depression in which the pot was placed. In contrast, thermal features for rounded-base vessels likely had fire dogs or other similar features. "Fire dogs" are rocks placed in plaster on the sides of hearths to stabilize vessels over the fire (Reiter 1938). Data on foods cooked, preparation strategies, and thermal features were gathered from the available ethnohistorical and archaeological literature.

My second expectation is that soot patterns on the conical-base and rounded-base vessels differ by cooking technique. Soot is deposited when unburned fuel gasses condense on the vessel wall. Soot patterns can inform on vessel placement in relation to the fire. For example, if soot occurs on the sides of the vessel from the base up to the maximum diameter and there is an oxidized area in the center of the base, the vessel was set directly in the fire or placed on rocks above an intense fire (Skibo 1992; Skibo and Blinman 1999). According to Hally (1983b), vessels with sooting on the upper portions of the walls but less on the rim and base were most likely placed in the fire. If, on the other hand, exterior soot is located only on the base, the vessel was probably placed over the fire (Crown and Wills 1995). A vessel placed directly in the fire was probably used for boiling, whereas a pot placed over a fire or coals was probably used for simmering or

frying (Rice 1987:235). The amount of sooting also can inform on vessel placement. Soot is expected to be heavier on vessels that come into direct contact with the flame as compared to a vessel that is placed over hot coals. If Navajo vessels were placed directly in the fire, I expect them to have heavy soot on the sides of the vessel and very little on the base. If Puebloan vessels were placed over a fire, they should have lighter soot deposition located on the base of the vessel. If Puebloan vessels were used with coals, there should be very little soot deposition. Soot patterns were examined on both whole vessels and sherds. The location and amount of soot were recorded.

My third expectation is that surface attrition will vary. Attrition patterns can inform on the types of food cooked, and vessel use in processing foods (Rice 1987; Skibo 1992). Interior surface wear can be indicative of physical abrasion from stirring contents, scraping residue from the surface of vessel, or processing food (Hally 1986). Abrasion also can indicate chemical erosion caused by pH imbalances between the ceramic and the contents (Skibo and Blinman 1999). Among the Kalinga, rice cooking vessels acquire thermal spalls when all water was absorbed in the rice (Skibo 1992). The meat/vegetable cooking vessels, in which there was always liquid, never acquired these spalls. Because Navajo and Puebloan vessels were presumably used to cook different types of food, it is expected that the interior attrition patterns would be different. Attrition patterns were examined on both whole vessels and sherds. The location and type of attrition was noted.

My fourth expectation is that Puebloan rounded-base vessels will be more resistant to thermal stress than Navajo conical-base vessels. Thermal stress resistance is the ability of a ceramic vessel to withstand repeated exposure to heat without failure. Repeated use of a cooking vessel results increasing weakening of the vessel wall through

the propagation of cracks (Pierce 1999). Thermal stress is a cumulative effect, and a vessel with greater resistance to thermal stress will have a longer use-life. Thermal stress resistance is expected to be higher in Puebloan vessels because cultigens often require longer cooking times than the wild resources of a foraging economy (Braun 1983; Crown and Wills 1995), and therefore, a ceramic vessel with higher thermal stress resistance would be better suited preparation of these resources. Thermal tests using reproductions were conducted to examine both thermal stress resistance and heating effectiveness. Ten vessels of each type went through 10 boiling cycles. Thermocouples were used to measure temperature changes in the wall of the vessel. Any failure of the vessel was noted.

My last expectation was that conical-base vessels would have a shorter boiling time than rounded-base vessels under identical heating conditions. This is an indirect measure of heating effectiveness. It has been assumed that conical-base vessels have a shorter boiling time when placed directly in the fire because more of the vessel surface is in contact with the heat source (Linton 1944; Mills 1985; Pavlů 1997). A vessel that can be placed directly in the fire with flames in contact with a large area of the pot would be ideal if the goal is to boil food quickly. When preparing foods that require long cooking times at lower temperatures or when preparing multiple meals in one pot; however, the goal is to simmer food for a long time. Rounded-base vessels are often placed over coals. Placing a vessel over coals would allow for greater control of temperature, which would be necessary for extended periods of simmering. Boiling time was recorded during each of the 200 boiling cycles discussed above.

All expectations assume that potters make technological choices during the manufacturing process to perform certain functions. In the Navajo case, it is assumed that potters would have needed to manufacture vessels that performed satisfactorily for cooking and transportation. Due to the more sedentary nature of Puebloan groups, creating a vessel more attuned to cooking may have been most important.

Chapter 3: Environmental and Cultural Overview

This research focuses on plainware cooking vessels from Navajo and Towa-speaking Puebloan groups, the Jemez and Pecos, in the southwestern United States (Figure 3-1). These groups provide relevant case studies to evaluate the functional differences between conical-base and rounded-base vessel types. The Navajo are an Athapaskan-speaking group whose Apachean predecessors entered the southwestern United States by A.D. 1500 and who produced conical-base vessels (Brown 1996; Brugge 1981; Hester 1962). The Navajo and Jemez lived in adjacent areas of northern New Mexico and evidence for interaction between these groups is abundant (Baldwin 1997; Dykeman 2003; Dykeman and Roebuck 2008; Oakes 2007).

The Jemez region and the site of Pecos are part of the Northern Rio Grande culture area that includes Towa-, Tiwa-, Tewa-, and Keres-speaking peoples. This culture area stretches from the Jemez Region on the west to the upper drainage of the Pecos River on the east. The northern boundary of Northern Rio Grande culture area is Taos Pueblo and Isleta Pueblo is the southern boundary (Powell 2002). People in the Jemez region and at the site of Pecos shared the Towa language and produced rounded-base vessels. Pecos Pueblo is located to the southeast of the Jemez in northern New Mexico.

Due to the limited sample size of cooking vessels from the Jemez in museum collections, the sample was expanded to include cooking vessels from Pecos. This is appropriate due to the cultural and linguistic links between the Jemez and Pecos groups.

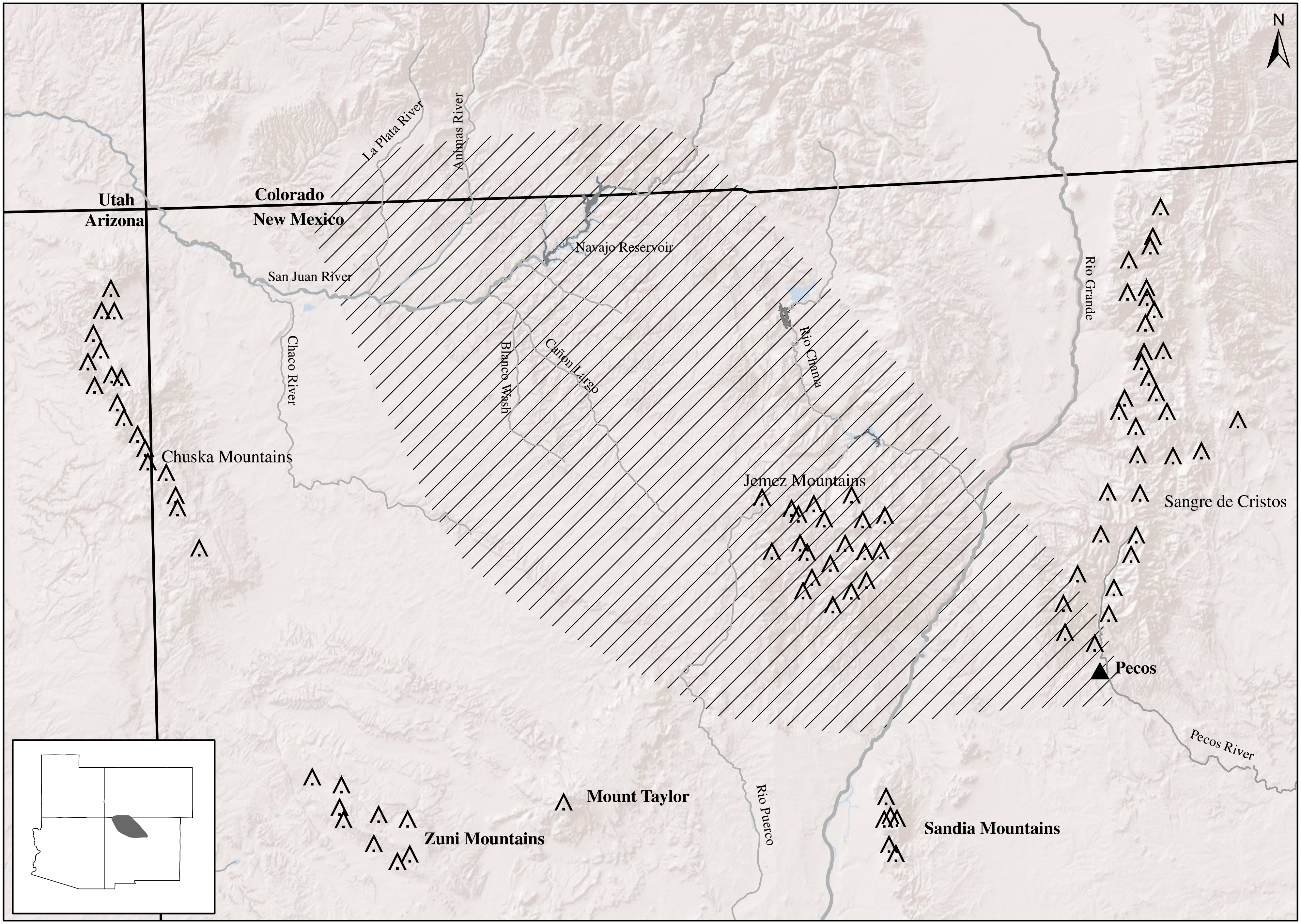

Figure 3-1. General Area of Interest

When Pecos was abandoned in 1838, the remaining people of Pecos Pueblo moved to Jemez Pueblo.

This chapter begins with a discussion of the arrival of Athapaskans into the southwestern United States followed by brief cultural histories and ceramic typologies of all three groups. A discussion of the available evidence for interaction between Apachean and Puebloan groups during the Early Historic period is presented at the end of the chapter.

Athapaskan Migrations into Southwestern United States

Athapaskan hunter-gatherers moved into the southwestern United States sometime before A.D. 1500 (Brown 1996). The Southern Athapaskan cultural group most likely split from Northern Athapaskan groups about 1,000 years ago (Magne and Matson 2003). Currently, the Athapaskan language group includes the Kiowa Apache, Jicarilla Apache, Lipan Apache, Mescalero Apache, Chiricahua Apache, Western Apache, and Navajo.

The reasons and methods of this migration are important to the current discussion because of their implications for Navajo ceramic technology. The origins of Navajo pottery have been greatly debated (Brugge 1981; Carlson 1965; Hester 1962; Marshall 1985; Reed and Reed 1996; Wilcox 1981). It was suggested by early archaeologists that the Navajo obtained ceramics from their Puebloan neighbors (Brugge 1981; Carlson 1965). Although Navajo groups most likely began producing painted wares, such as Gobernador Polychrome, after significant interaction with Puebloan groups, it also is probable they arrived in the Southwest with ceramics similar to Dinetah Gray (Reed 2007; Reed and Hensler 2003).

The original North American Athapaskan homeland is the northern Yukon. From there, some groups moved into Alaska and then later, some groups moved down to the west coast of California (Pacific Athapaskans), and others (Apacheans) moved into the southwestern United States. Based on linguistic evidence, this split most likely occurred in the first millennium A.D. (Hoijer 1938, 1956, 1971; Opler 1983; White 2005; Young 1983). Linguistic evidence suggests that Navajo, San Carlos, Chiricahua, Mescalero, Jicarilla, and Lipan are similar dialects of the same language and that Kiowa Apache is distinct from each of these dialects (Hoijer 1956, 1971). The Kiowa Apache most likely split from the other groups earlier in the northern Plains. The splitting of the remaining Southern Athapaskan groups seems to have occurred within the last 700 years, although this timeline is blurred by the continuous interaction among these groups and the imprecision of glottochronology as a dating technique. The separation of the Southern Athapaskan groups most likely occurred sometime around A.D. 1300 (Dykeman and Roebuck 2008; White 2005). Separation of groups must have been a relatively recent event because Benavides noted in 1630 that all of the Apache groups spoke the same language (Forrestal and Lynch 1954:42). Although it is likely that Benavides' experience with Apachean groups was limited, this suggests that although there may have been small differences in language among the Apachean groups, these differences were not significant enough to deter communication.

Apachean Migration Routes

Three Athapaskan migration routes into the Southwest have been suggested: an intermountain route that traversed eastern Utah and the western slope of Colorado (Hall 1944; Harrington 1940; Huscher and Huscher 1942; Jett 1964; Worchester 1951); a route

along the Front Range of Colorado (Gilmore and Larmore 2008); and another route that went through the High Plains (Gunnerson and Gunnerson 1971; Schaafsma 1974, 1996; Wilcox 1981) (Figure 3-2). It is possible that all of these routes were used. Recent research suggests that proto-Navajo groups may have used the intermountain route, whereas other groups may have used the western High Plains Route and/or the Front Range route (Brugge 2008; Gilmore and Larmore 2008; Towner 2003). Brugge (2008) suggests that the Promontory Culture of northern Utah may be early Athapaskan, based on the similarity of its moccasin forms and bone fleshers to those found at some Northern Athapaskan sites. There is little material evidence, however, to provide a link with Southern Athapaskans. Promontory material is distinct from neighboring Fremont sites, which led Jennings (1978) to conclude that this culture was not part of the Fremont tradition; others, however, have argued the opposite (Aikens 1970; Steward 1937).

Some researchers argue that all Southern Athapaskans entered the southwestern United States via the High Plains at roughly the same time and split into different groups after arrival (Gunnerson and Gunnerson 1971; Schaafsma 1996, 2002; Wilcox 1981). In this view, all Southern Athapaskans were Plains buffalo hunters until the sixteenth century. Schaafsma (1996:43) discounts the early Dinetah sites near the San Juan and La Plata rivers as early Ute sites. He believes that the location of these sites and the ambiguity of the ceramics at these sites make a definitive cultural affiliation of Navajo impossible. He uses seventeenth and eighteenth century Spanish accounts of the region north of the San Juan River as Ute territory to support his argument (Schaafsma 1996).

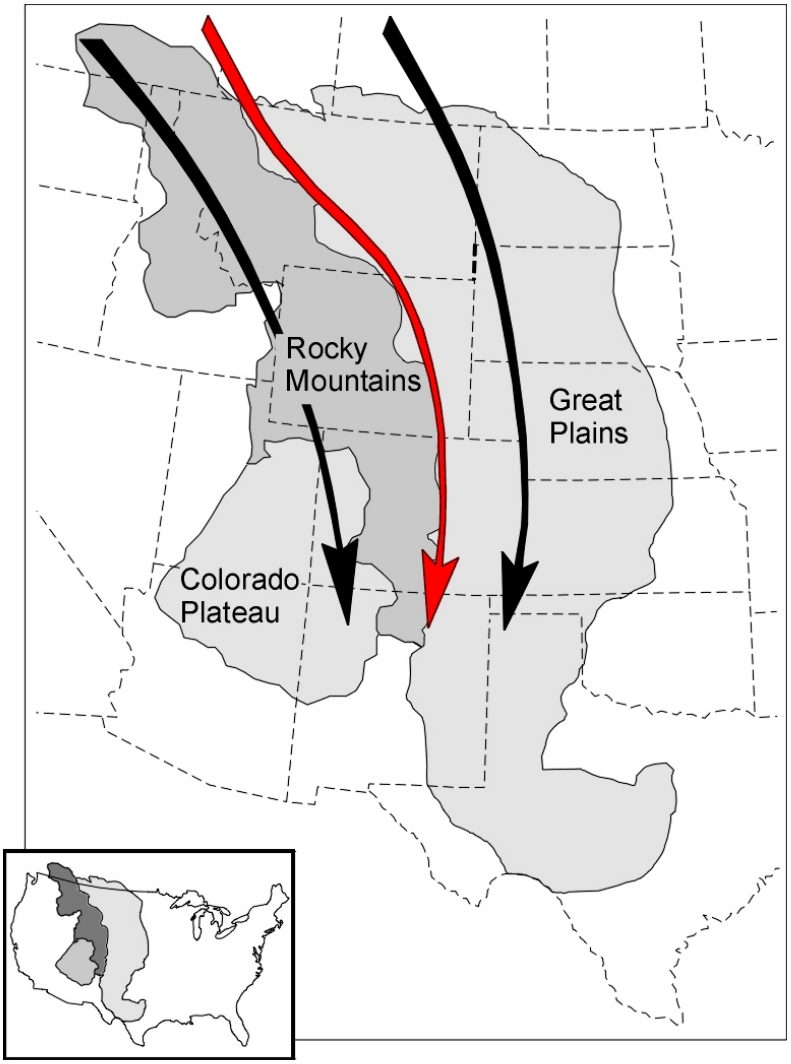

Figure 3-2. Migration schematic illustrating three possible Apachean migration routes (taken from Gilmore and Larmore 2008).

After arrival, Athapaskan groups quickly adapted to the environmental and cultural climate of the Southwest. Some of these groups maintained their mobile, primarily hunter-gatherer, lifestyle and are known today as Apaches. Others adopted a more sedentary lifeway and became the Navajo. Both of these groups share similar cultural traditions and the languages of the Athapaskan language family. Members of this language group extend from Canada to the southwestern United States.

Taken together, the evidence suggests the Navajo are a combination of many groups that migrated into the Southwest via several routes. Navajo emergence stories indicate that as the first Navajos wandered from the place of emergence and encountered other groups, they incorporated these groups. Groups then received clan names associated with their place of origin. The practice of incorporating new groups continued even after the Navajo settled the Dinétah (Brugge 2008). The Navajo are, therefore, an amalgamation of cultural traits from several different groups. Within the Southern Athapaskans, clan systems are only present among the Navajo and Western Apache groups, suggesting that the clan systems were acquired after leaving the north, or that the other Southern Athapaskan groups abandoned the clan system along the way (Brugge 2008).

Early Navajo ceramics are most likely the result of interaction with several different groups. The conical-base vessel form is common in Plains Woodland and Plains Village ceramic assemblages throughout the High Plains (Ellwood 1995, 2002; Gunnerson 1987; Vickers 1994). Early Plains Woodland conical vessels found in Eastern Colorado date from A.D. 150 to 1100 (Ellwood 1995). Although these vessels have a conical base, most lack the constricted neck and flaring rim of Navajo vessels.

Conical vessel forms also are common in Paiute and Ute ceramics. At the time of European contact, Southern Paiute groups were common in southwestern Utah, southeastern Nevada, and northwestern Arizona. Two conical forms are associated with these groups: a conical vessel with no neck and a straight rim; and a more globular form with a conical base, constricted neck, and flaring rim (Janetski 1990); forms present in the Late Prehistoric and Protohistoric periods (Janetski 1990). Ute vessels also had

conical bases, although Uncompaghre brownware vessels illustrated by Reed (1995:123) suggest that these forms have a higher width-to-height ratio than Navajo vessels. Dating sites with brownware ceramics suggests that Ute groups were in west-central Colorado by A.D. 1100 (Reed 1995). Wilson (2004) has recently shown that there are significant differences in construction methods, coil size, and placement between Navajo and Ute ceramics. Overall, while Ute conical vessels predate the Navajo in the Southwest, Navajo and Ute vessels are not similar enough to suggest a direct connection.

The conical-base vessel type also is common in ceramic assemblages from the Gallina region in northern New Mexico. The Gallina region spans from the eastern edge of the Dinétah to west of the Chama River (Lange 1941) and is assumed to be Puebloan. The dates of this occupation are A.D. 1150 to 1275. Sites tend to be located in defensible positions with massive towers and stockades. Conflict is evidenced by site location, burned sites, and human skeletal remains with attributes of violent death (Stuart and Gauthier 1996). Navajo ceramic technology may have been acquired from the remnant groups of the Gallina (Brugge, pers comm. 2008; Hibben 1949). The Gallina had three ceramic forms: black-on-white bowls, globular ollas, and plain conical utility jars (Hibben 1949). The plain conical is similar in shape to Dinetah Gray vessels. Surface treatment includes striations, pinching in rows or designs, and fingernail impressions. These variations in surface treatment also are seen in Navajo ceramics.

Reed and Hensler (2003) analyzed construction methods and texturing techniques of both Navajo and Puebloan (including Gallina) ceramics, and concluded that the Navajo did not learn ceramic technology from Puebloan groups. Reed (2007) devised a model for determining proto-Navajo ceramics, a type she classifies as Western

Athapaskan pottery and dates to circa A.D. 1300 to 1500. Reed's model is based on the construction methods and coil joining techniques of the Navajo, which are markedly different from Ancestral Puebloan, Rio Grande Pueblo, and Ute techniques (Reed 2007; Reed and Hensler 2003; Wilson 2004). Sherds believed to be from a vessel of the Western Athapaskan type were identified at Site 5SH2538 in Saguache County in south-central Colorado on the western periphery of the San Luis Valley (Figure 3-3) (Bevilacqua et al. 2007; Reed 2007). If these sherds are indeed of the Western Athapaskan type, they support an intermountain migration route for Navajo groups. Reed does allow for the possibility that these sherds have a Navajo affiliation dating to A.D. 1500 to 1600 and, therefore, may be representative of land use by the Navajo after they arrived in the Southwest.

Figure 3-3. Western Athapaskan ceramics from Site 5SH2538.
(Permission for use granted by Adrienne Anderson,
National Park Service, May 2008)

Analyzing vessels from areas of potential migration routes does not appear to resolve the questions surrounding the origins of Navajo ceramic technology. Regardless of the migration route, the earliest sites attributed to the Navajo are located near the San Juan River and date to approximately A.D. 1500. These sites have recognizable Navajo ceramics and site layouts similar to historic Navajo sites (Brown 1996). The earliest tree ring dated site is LA55979 (A.D. 1541), located southeast of the Navajo Dam (Towner 2003).

Navajo

The traditional Navajo homeland known as the Dinétah is centered around the Largo and Gobernador Canyons in the Upper San Juan River Basin (Dykeman 2003; Towner 2003) (Figure 3-4). Puebloan groups abandoned this region by A.D. 1300 (Brown 1996; Moore 2008).

The Dinétah is located in the Navajo section of the Colorado Plateau. It is comprised primarily of isolated mesas and buttes dissected by canyons and arroyos (Hester 1962). The Colorado Plateau stretches from northeastern Utah and western Colorado to northern Arizona and northwestern New Mexico, and is drained by the Colorado River and its main tributaries.

The term "Navajo" is first seen in the 1626 writings of the priest at Jemez, Fray Zarate Salmeron (Towner and Dean 1996). The Apache de Nabaxu refers to a group of people who lived on the Rio Chama, east of the San Juan River. Fray Alonso de Benavides described the "Apache de Nabajú" in 1630 as semisedentary farmers who planted maize and then left their fields to hunt game and gather wild plants (Brugge 1983; Reed and Horn 1988).

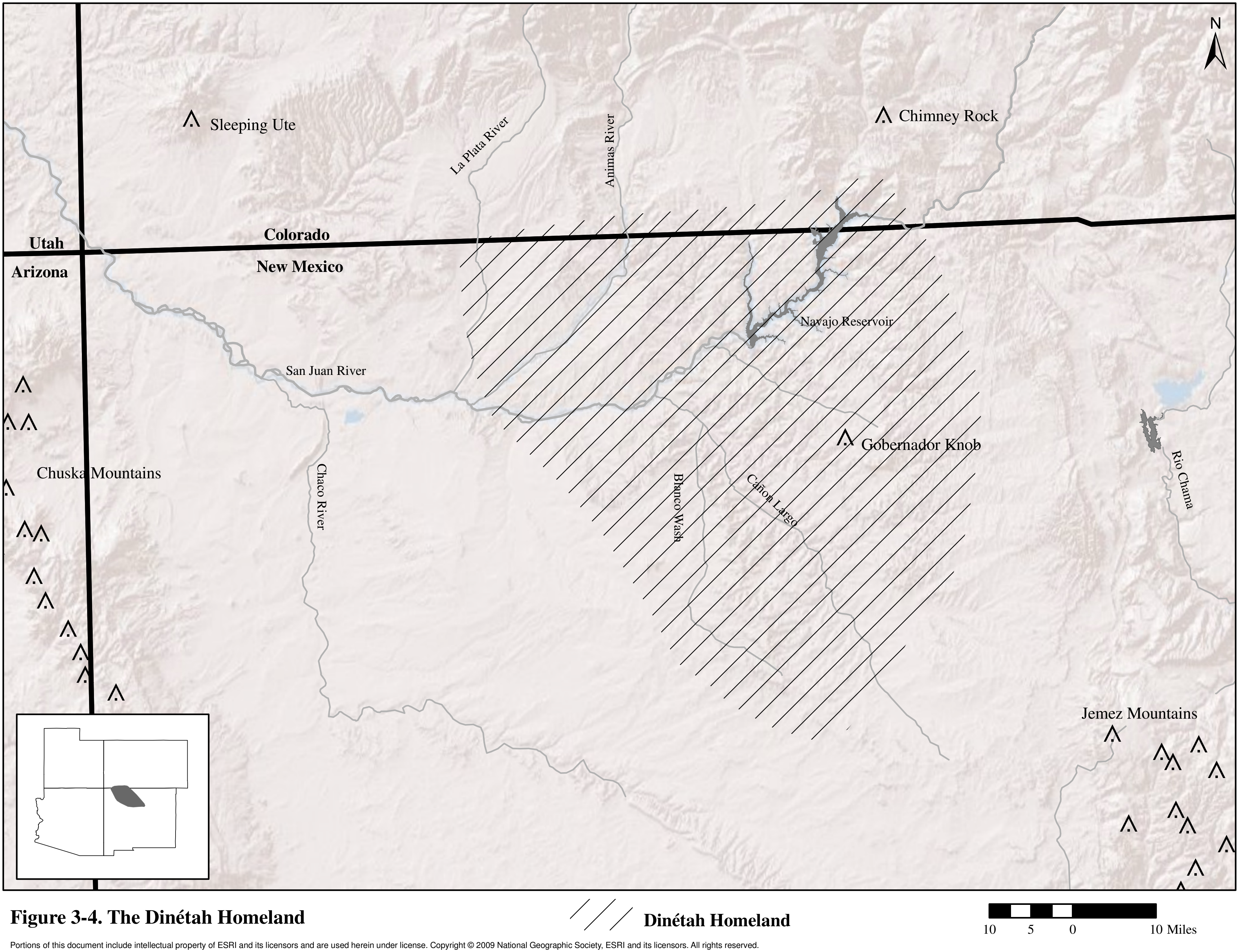

Figure 3-4. The Dinétah Homeland

The Navajo archaeological chronology consists of three phases most relevant to the current study: the Dinetah phase (A.D. 1500 to 1650); the Gobernador phase (A.D. 1650 to 1770); and the Cabezon phase (A.D. 1770 to 1862) (Brown 1996; Hester 1962) (Table 3-1). There has been some debate over the legitimacy of the Dinetah phase (Eddy 1966; Schaafsma 1996, 2002), but many archaeologists believe that the phase is valid in light of current dating and characteristic archaeological assemblages of these early sites (Towner 2003).

Table 3-1. The phase sequences for the Navajo, Jemez, and Pecos.

Date (A.D.)	Navajo	Jemez	Pecos	Northern/Central Rio Grande
1800				
	Cabezon 1770–1862			
1700		**Cañon Post-1700**		
	Gobernador 1650–1770			
1600		**Guadalupe 1600/1625–1700**	**Pueblo V 1600–present**	**Historic 1600–present**
1500				
	Dinetah 1450/1500–1650	**Jemez 1425/1450–1600/1625**		
1400				
		Paliza 1325/1350–1425/1450		**Classic 1325–1600**
1300			**Pueblo IV 1300–1600**	
1200		**Vallecitos 1200–1325/1350**		**Coalition 1200–1325**
			Pueblo III 1100–1300	

Note: Data from Brown 1996; Hester 1962; Kulishek 2005.

Archaeologists who argue that these sites are Navajo cite the Dinetah ceramics and site layouts including forked-pole hogan depressions and associated features (Brown 1996; Hancock 1992; Reed and Horn 1990). Other scholars have argued, however, that these sites are Ute and the sherds are actually a previously unrecognized southern variant of Uncompaghre Brown (Schaafsma 1996). Current research suggests that these sherds are of Navajo origin (Van Hoose 2008).

Dinetah Phase (A.D. 1500 to 1650)

The Dinetah phase is characterized by sites with brush structures and forked-pole hogans, Dinetah Gray ceramics, light lithic scatters, and intramural and extramural hearths. Evidence suggests that Navajo during this phase were semimobile hunter-gatherer bands with limited, but increasing dependence on horticulture for subsistence (Brown 1996; Reed and Reed 1992; Sesler and Hovezak 2002).

Dated Dinetah phase sites have been found in the La Plata Mine area in tributaries of the La Plata River near the New Mexico-Colorado border; and in Gobernador, Frances, Pump, Blanco, and Cereza Canyons, as well as in the Animas and Los Pinos River drainages (Brown 1991; Dykeman 2003). These sites tend to be found in upland areas along the northern and eastern sections of the Northern San Juan Basin. Dinetah sites share similar ceramic assemblages and architecture. Varieties of Dinetah Gray ceramics are found at all of these sites, including Dinetah Scored and Dinetah Indented Gray (Brugge 1981). These types are defined below. Structures consist of roughly circular shallow depressions that range from 2.5 to 4 m in diameter. The floors are most often unprepared surfaces with one hearth in either the center or southeastern quadrant of the structure (Brown 1991, 1996; Hogan 1992). These surfaces most likely represent

structures with a conical pole framework that were covered with juniper branches and reminiscent of more recent Navajo forked-pole hogans (Brown 1991; Hogan 1992). Architectural remains at different sites suggest that the Navajo were seasonally mobile during this phase. Sites with more substantial structures are most likely winter residential sites, whereas those sites with more outdoor-oriented features, such as ramadas, outdoor hearths, and roofless brush windbreaks, were most likely warm season camps (Hogan 1992).

Although there are early Spanish accounts of large fields of corn attributed to the Navajo, evidence for dependence on domesticates during the Dinetah phase is limited. Corncob and kernel fragments have been found at some sites (Dykeman and Roebuck 2008; Hogan 1992; Hogan and Munford 1992) and corn pollen has been found in sediments along the Upper San Juan River dating from A.D. 1300 to 1700 (Brugge 2008; Schoenwetter and Eddy 1964), suggesting corn was grown in this area during this period. In their study of Dinetah phase sites in the La Plata Valley, Brown and Hancock (1992) found only two examples of corn, one sample of domestic beans, and small samples of corn pollen at six sites. The use of corn is most likely the result of Puebloan influence and may have been grown by the Navajo or obtained from Puebloan groups through trade or raids, especially during the earlier part of the Dinetah phase (Brown 1996; Dykeman 2003).

More recent research suggests that the Navajo grew their own corn very early in the phase sequence (Dykeman 2004; Dykeman and Roebuck 2008). Excavations at Site LA55979 indicate that the Navajo grew corn in the Dinétah region by the 1540s (Dykeman 2004). Dykeman (2004:4) also believes that hunting, gathering, raiding, and

trading were traditional Athapaskan cultural attributes, and that it is not until Athapaskan groups added farming technology that they became "Navajo." Although farming technology is incorporated into Navajo culture, the maintenance of traditional technologies can be seen in the continuity of lithic technologies, as well as the lack of Puebloan style ground stone technology (Dykeman 2004; Torres 1999, 2003). It can also be seen in the maintenance of traditional Navajo food preparation techniques such as roasting (Dykeman 2004; Dykeman and Roebuck 2008).

Although the degree of Navajo dependence on corn during the Dinetah phase is unclear, evidence for wild plant use is abundant at Dinetah sites (Brown and Hancock 1992; Roebuck 2008). Macrobotanical remains at these early sites consist of amaranth, goosefoot, purslane, beeweed, dropseed, pinyon nuts, juniper berries, yucca, big sagebrush, lupine, tobacco, and barrel cactus seeds and fruits (Hogan 1992; Roebuck 2008). These resources most likely comprised the bulk of the Navajo diet, although additional wild plants were probably exploited and simply not represented in the limited remains of the archaeological record. Some of these plants had uses other than food. For example, yucca was used to create string, for soap, and in many ceremonies. Some plants also had medicinal uses (Elmore 1943).

The faunal assemblages also support the supposition that early Navajo groups were dependent primarily on wild resources. Deer, antelope, rabbit, and other small game are often found at Dinetah sites. No evidence for domesticated sheep, goat, or horses has been found (Hogan 1992).

Gobernador Phase (A.D. 1650 to 1770)

The beginning of the Gobernador phase was thought to coincide with the Pueblo Revolt and the increased interaction between Navajo and Puebloan groups (Hester and Shiner 1963; Reed and Reed 1992) that resulted in the production of Gobernador Polychrome by Navajo potters. Recent research, however, suggests that production of this ware predates the Pueblo Revolt by at least 50 years (Dykeman 2003; Reed and Goff 2007; Reed and Reed 1996).

The beginning of the Gobernador phase appears to coincide roughly with the entry of Franciscan missionaries into the Southwest (Dykeman 2003). Both Puebloan and Spanish culture influenced Navajo culture during this phase. According to Dykeman (2003), Franciscan friars began establishing a relationship with Navajo groups in the mid-1620s with the intent of converting them to Christianity. European trade goods began to appear in the artifact assemblages of Gobernador phase sites, perhaps as a result of these attempts at conversion. Livestock, such as horses and sheep, also were introduced during this phase (Brown 1996; Kelley and Whitely 1989; Reeve 1958). Herding subsequently became an important part of the subsistence economy (Dykeman 2003). Brown (1996) argued that the horse did not dramatically alter the semisedentary lifestyle of the Navajo, and acquisition of sheep served to further decrease the residential mobility of the Navajo. It was also during the late seventeenth century that the archaeological record indicates a more sedentary lifestyle for the Navajo and a higher number of sites indicative of population aggregation (Dykeman 2003).

Another defining characteristic of the Gobernador phase is the construction of pueblitos. Pueblitos are masonry-walled structures usually built on major topographic

features and ranged in size from one to more than 40 rooms, with four to five rooms being most common (Towner 2003). These structures combined both Puebloan and Spanish traits, such as masonry walls (Puebloan) and a "hooded" fireplace (Spanish) (Figure 3-5). Also common at these sites are forked-pole hogans, lean-tos, and ramadas (Reed and Reed 1996; Towner 2003). It must be noted, however, that not all Gobernador phase sites are pueblitos.

Figure 3-5. "Hooded" fireplace at hooded fireplace ruin (Site LA5662) (photo by author).

One other important aspect of Gobernador phase sites is a significant increase in the number and variety of Puebloan ceramics. These tradewares include Rio Grande glazeware; Rio Grande Biscuit ware; Jemez Black-on-white; Tewa polychromes; and Eastern Keres, Zuni, and Hopi wares. The presence of these ceramic types on Navajo sites has been regarded as evidence of increased interaction and exchange that may have resulted from the Pueblo Revolt (Reed and Reed 1996).

The Refugee Hypothesis proposes that large numbers of Puebloan peoples moved into the Dinétah region following the Spanish Reconquest of 1692. The production of Gobernador Polychrome, the construction of pueblitos, and the increase in tradewares were all thought to coincide with the Reconquest and, therefore, support the Refugee Hypothesis (Bailey and Bailey 1986; Brugge 1981; Hester 1962; Hogan 1991; Towner 1996). Recent research, however, suggests that the dates of both Gobernador Polychrome and many of the pueblitos do not coincide with the Reconquest (Dykeman 2003; Reed and Reed 1996; Towner 2003). Gobernador Polychrome is thought to be an effort by Navajo potters to copy Puebloan painted wares (Marshall 1985, 1991), but production of this ware began before the Pueblo Revolt and, therefore, was not a result of direct interaction with Puebloan refugees (Reed and Reed 1996; Towner 2003).

Navajo settlement expanded to the south and west during this phase, with most settlements in and around Gobernador and Largo canyons. By the end of the period, Navajo groups had moved to the Mount Taylor area to the south and the Chuska Mountains to the west. At this time, the area around Gobernador and Largo canyons were largely abandoned (Dykeman 2003; Hester 1962). The Gobernador phase ends with movement of Navajo groups south to Mount Taylor and westward into northwestern New Mexico and eastern Arizona. This movement is thought to be the result of warfare and population pressure from Ute groups to the north.

Cabezon Phase (A.D. 1770 to 1862)

The Cabezon phase (Hester and Shiner 1963) is not as relevant to the current research, but deserves a brief mention. It is defined by the expansion of the Navajo to the west and south and the increased dependence on sheepherding as a primary economic

activity. The Blessingway was revived during this period; it called for the reassertion of Athapaskan lifeways (Brugge 1981). The Cabezon phase ended with the forced removal of Navajo peoples to Fort Sumner in 1864, which ultimately failed and led to the return of the Navajo to the Four Corners area and the establishment of the Navajo Reservation.

Navajo Ceramics

Brugge (1981) defines five Navajo pottery types: Dinetah Gray, Navajo Gray, Pinyon Gray, Gobernador Polychrome, and Navajo Painted. The current study focuses on two of the Navajo utility wares: Dinetah Gray and Navajo Gray (described below). Because Gobernador Polychrome has been used to examine the relationship between Navajo and Puebloan groups, it also will be discussed.

Dinetah Gray

Dinetah Gray is found at both Dinetah and Gobernador phase sites. Gobernador Polychrome is associated with Gobernador phase sites. The absence of this type at early Navajo sites has been used as evidence to support a Dinetah phase occupation. The ambiguity of using negative evidence to support temporal associations has been discussed (Reed and Goff 2007), and sites with only Dinetah Gray are often given a Dinetah/Gobernador phase association.

Dinetah Gray dates from ca. A.D. 1500 to 1800 (Brugge 1981; Dykeman et al. 2002; Hill 1995; Reed and Goff 2007; Wilson and Blinman 1993). This type also has been referred to as Navajo Utility ware (Keur 1941), Dinetah Scored (Farmer 1942), Dinetah Utility (Dittert 1958; Dittert et al. 1961), and Gobernador Indented (Dittert 1958; Dittert et al. 1961). All of these vessels were constructed by coiling and scraping, and were most commonly fired in a reducing atmosphere. Dinetah Gray typically had a

flaring rim, a constricted neck, a wide shoulder, and a conical base with a flattened tip. Both the exterior and interior of the vessel was typically scraped until coils were completely obliterated, although scrape marks were often left on the surface. The average wall thickness was between 4.0 and 5.5 mm and the core color was primarily gray to black. Dinetah Gray was usually tempered with quartz sand that protruded slightly on the surface. Both the interior and exterior surfaces were typically scored, and Dinetah Gray vessels were very rarely decorated with incised lines or lugs (Brugge 1981).

Brugge (1981) discusses three varieties in addition to the plain variety: Western, Micaceous, and Indented. The Western variety had a fine textured paste, red and black particles in the temper, and has been recovered from the Black Mesa area in Arizona (Brugge 1981). The Micaceous variety, as the name suggests, had mica in the paste and has been found from Mount Taylor to Chacra Mesa, New Mexico. The final variety, Indented, is found in the Dinetah region; and had indented, dimpled, or finger-impressed surfaces (Brugge 1981; Reed and Goff 2007). Dittert (1958) referred to this variety as Gobernador Indented.

Navajo Gray

Navajo Gray differs from Dinetah Gray in temper, surface treatment, and decoration. Navajo Gray dates from A.D. 1800 to the present (Brugge 1981). Vessel construction was by coiling and scraping, and temper consisted of ground sherd and sand, although the sand may derive from existing sands in the ground sherds. Average wall thickness ranged from 4.0 to 5.5 mm. Interior surface finish was usually smoothed or lightly polished, and the exterior was usually scraped and sometimes smoothed.

Decorations consisted of single, double, or triple fillets, usually applied around the necks of jars, and rims were sometimes notched (Brugge 1981). Navajo Gray varied from Dinetah Gray in both the addition of fillets and a more rounded base.

Gobernador Polychrome

Gobernador Polychrome, although not analyzed in the current study, is relevant to the discussion of Puebloan influence and Puebloan-Navajo interaction. Gobernador Polychrome was the first painted ware produced locally by the Navajo beginning in the early 1600s to 1760 (Reed 2007; Reed and Reed 1996). Many researchers have attributed Gobernador Polychrome to interaction with Puebloan groups after the Pueblo Revolt of 1680, but this type was actually produced prior to the Revolt. It does seem to be a mixture of Puebloan styles and technologies. The ware has characteristics of Hopi ceramics, Rio Grande glazewares, and Jemez Black-on-white (Reed and Goff 2007).

Jemez

The Jemez Province is located approximately 72 km to the southwest of the Dinétah in the Jemez Mountains in north-central New Mexico and is in the Southern Rocky Mountain ecoregion (Figure 3-6). This area is comprised of uplands and mesas incised by large canyons created by downcutting of perennial and intermittent creeks and rivers. The waterways drain into the Rio Grande basin.

The Jemez are a Towa-speaking Upper Rio Grande Puebloan group. Towa is one of the three subdivisions of Tanoan languages. The other two are Tiwa spoken by people from Taos, Picuris, Sandia, and Isleta Pueblos; and Tewa spoken in San Juan, Santa Clara, San Ildefonso, Pojoaque, Nambe, and Tesuque Pueblos. By 1880, the only other

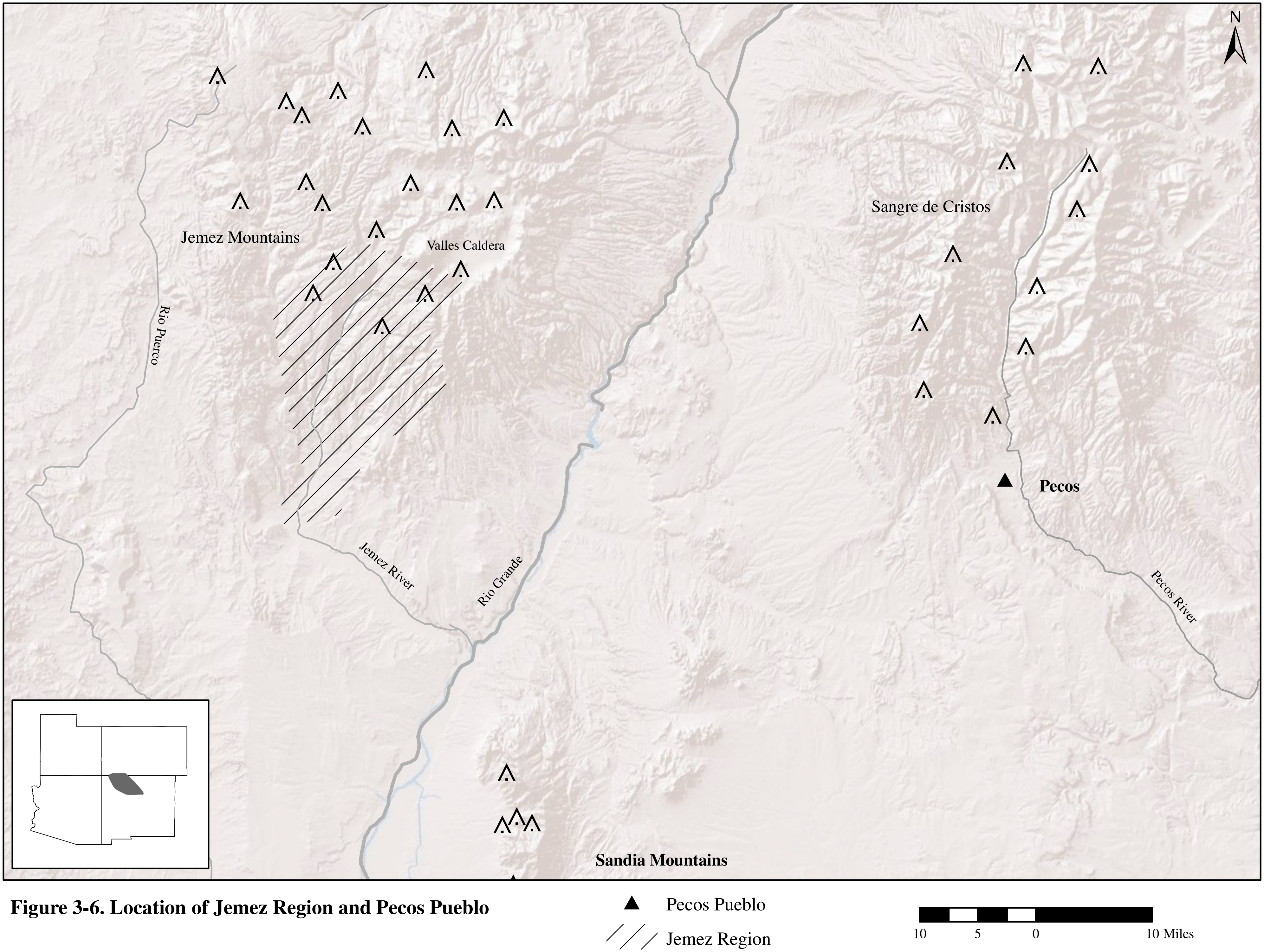

Figure 3-6. Location of Jemez Region and Pecos Pueblo

historic pueblo that spoke Towa was Pecos, which suggests that people from Jemez and Pecos were more closely related than the other Rio Grande Pueblos (Sando 1979).

The earliest evidence of maize in the Jemez Province was found at Jemez Cave. A corn specimen from excavated contexts was radiocarbon dated to approximately 400-500 B.C. (Gauthier and Elliott 1989; Vierra and Ford 2006). Another similar site in Bandelier National Monument, Ojala Cave (Site LA12556), yielded corn dating from 970 to 1050 B.C. (Gauthier and Elliott 1989). Agriculture was an important part of the subsistence economy by theClassic Period (A.D. 1325 to 1600) across the northern Rio Grande. Agricultural features increased in number across the Jemez Region in the Classic Period (Acklen and Railey 1999). Wild plants and animals were used, but plant domesticates made up the bulk of the diet.

The periods of interest to the present study are the Vallecitos phase (A.D. 1200 to 1325/1350), the Paliza phase (A.D. 1325/1350 to 1425/1450), the Jemez phase (A.D. 1425/1450 to 1600/1625), the Guadalupe phase (A.D. 1600/1625 to 1700), and the Cañon phase (after A.D. 1700) (Kulishek 2005) (Table 3-1). Jemez phases correspond roughly to the following Northern/Central Rio Grande periods: Coalition (A.D. 1200 to 1325), Classic (A.D. 1325 to 1600), and the Historic (A.D. 1600 to present) (Acklen and Railey 1999; Elliot 1998; Kulishek 2005). It is during the Classic period that the distinctive Jemez culture appeared; however, uniquely Jemez cultural traits began during the Vallecitos phase. Jemez culture is defined by the appearance of Jemez Black-on-white ceramics, increased population, changing land use patterns, and expansion into high elevation mesa tops. The large pueblo and field house pattern in which dry land farming occurs on the mesa tops also is a part of Jemez cultural traits (Elliott 1998).

Vallecitos Phase

The Vallecitos phase is characterized by small settlement occupation and the presence of Vallecitos Black-on-white, Santa Fe Black-on-white, Wiyo Black-on-white, St. Johns Black-on-red and Polychrome, and Rio Grande Corrugated plainwares. Only Vallecitos Black-on-white and Rio Grande Corrugated appear to be made locally (Kulishek 2005). Sites tended to be small (5 to 40 rooms) and located in the lower portions of the major drainages of the Jemez region. There are at least two very large pueblos dating to this period (Patokwa, LA96, and Little Boletsakwa, LA136). Kulishek (2005:241) suggests that settlement patterns during this period consist of a larger site surrounded by satellite communities, creating site clusters in many of the larger canyons.

Paliza and Jemez Phases

The Paliza and Jemez phases correspond to the Classic Period. Settlement layout, and to some degree location, are similar to other patterns seen in the Northern/Central Rio Grande area. The exception is the location of large village sites on mesa tops in the Jemez Province relative to major drainages in most of the other parts of the region (Kulishek 2005; Wendorf and Reed 1955). The Paliza and Jemez phases were initially defined by Mackey (1982) and Elliott (1991, 1998) by changes in geographic location, as well as changes in material culture (Elliott 1998).

Sites dating to the Paliza phase are located near Paliza Canyon. This phase is characterized by medium and large pueblos with sites ranging in size from 350 to 1,400 rooms. Such an increase in site size suggests an increase in population and aggregation into larger settlements. The abandonment of the northern San Juan and Mesa Verde regions occurred by A.D. 1300 and it has been suggested that these peoples migrated into

the Rio Grande area. It is possible that population increase and aggregation in the Jemez region can be partially explained by this migration (Cameron 1995; Cordell 1995; Kulishek 2005). It also has been argued that the increase in population was a local phenomenon (Cameron 1995).

Also common during this phase are agricultural features in the valley bottoms and field houses in the drainages and on the mesa tops, suggesting agricultural intensification. Common ceramic types included late Vallecitos Black-on-white, Jemez Black-on-white (Type A), Agua Fria Glaze-on-red, San Clemente Glaze Polychrome, Cieneguilla Glaze-on-yellow, Largo Glaze-on-red and Glaze Polychrome, and Rio Grande Blind Corrugated plainwares (Kulishek 2005). Field house ceramic assemblages most often consisted of only plainware and Jemez Black-on-white. These two types and Vallecitos Black-on-white are most likely the only three local types. Sites from this period appear to have been abandoned around A.D. 1425 and larger pueblos appeared about this time on the mesa tops to the west of Jemez Springs and Paliza Canyon.

A few large settlements and many medium-sized settlements were abandoned during the Jemez phase. Most of the large settlements, however, showed growth during this period suggesting a further increase in aggregation and population at these large sites (Kulishek 2005). As stated above, most of this growth occurs to the west of the major sites of the Paliza phase. Agricultural intensification continued, as evidenced by the agricultural features and field houses seen during the Paliza phase. Many of these sites were probably used during both phases. Painted wares associated with this phase include Jemez Black-on-white (Type B), Espinosa Glaze Polychrome, San Lazaro Polychrome, and Puaray Glaze Polychrome. Rio Grande Plain replaced Rio Grande Blind Corrugated

by A.D. 1500/1525 (Elliott et al. 1988; Kulishek 2005). The replacement of corrugated ware by plainware follows the pattern seen in other parts of the Northern/Central Rio Grande area. Plainware was fired in a reducing atmosphere and had smoothed or polished interiors (Kulishek 2005). Jemez Black-on-white and the plainware continued to be the only ceramics made locally. Jemez Black-on-white was also exported to the northwest, as evidenced by its presence on Navajo sites (Reed and Reed 1992). Overall, the Jemez region appears to have been a part of a social network during the Classic Period that includes most of the Northern/Central Rio Grande region.

The first recorded contact between the Jemez and the Spanish occurred during the Jemez phase. Captain Francisco de Barrionuevo of the Coronado Expedition visited Jemez villages in A.D. 1541. The Jemez people most likely had heard of the Spanish entry into New Mexico prior to this time through their trade and communication networks, but the Coronado Expedition was the first recorded face-to-face interaction (Elliott 1998; Hammond and Rey 1940).

Guadalupe Phase

The Guadalupe phase, defined by Kulishek (2005), is the first phase during which significant Spanish contact occurred. The largest settlements were still occupied and reoccupation of many smaller sites that were previously abandoned occurred. The number of medium-sized settlements was greatly reduced. This is consistent with a pattern observed in other Northern/Central Rio Grande areas. Use of field houses also persisted during this phase, as evidenced by the ceramics and Spanish artifacts at these sites (Acklen and Railey 1999; Elliott 2002; Kulishek 2005). Many of these field houses were associated with the larger settlements. Jemez Black-on-white (Type C), Kotyiti

Glaze-on-red and Polychrome, and Rio Grande plainwares are found at Guadalupe phase sites. These types included a new European form, the soup plate. This form was found at both mission sites and field house sites, suggesting that the form was not made solely for Spanish use (Kulishek 2005).

The first Spanish priest assigned to Jemez, Fray Alonso de Lugo, came to the Jemez Province in A.D. 1598. It is unclear if he actually established a mission, although he most likely conducted his mission work at Guisewa (Elliott 1998). Two other missions were established during this phase. The first of these was established at Guisewa between A.D. 1621 and 1622, and abandoned in 1623. The Guisewa mission was reoccupied in A.D. 1628, and later abandoned between A.D. 1632 and 1638. The mission at Walatowa was first established around A.D. 1621 and occupied until A.D. 1623. This mission also was reoccupied in A.D. 1628 and remained until the Pueblo Revolt in A.D. 1680 (Elliott 1998; Reiter 1938; Scholes 1938). Fray Jeronimo Zarate Salmeron established the Walatowa mission and began instituting *congregacíon*, an attempt by the Spanish to coerce the Jemez people down from the mesa tops and into the Jemez Valley. The remaining two missions were not established until after the Spanish regained control of New Mexico in 1692, and the majority of occupation at these missions occurred during the Cañon phase, described as follows.

Cañon Phase

The Cañon phase was also first defined by Kulishek (2005). This phase is characterized by the abandonment of most of the Jemez region. The only permanent site remaining was Walatowa, which is still occupied today. Some seasonal use of sites along the Jemez River and mesa tops is demonstrated by the presence of ceramics at some field

houses on Holiday Mesa. This phase postdates the Spanish Reconquest and it was during this period that the migration of Jemez peoples into northwestern New Mexico and into Navajo settlements may have occurred.

Jemez Ceramics

Five Jemez ceramic types appear to have been made locally: Vallecitos Black-on-white; Jemez Black-on-white; Rio Grande Corrugated, Jemez variety; Rio Grande Blind Corrugated, Jemez variety; and Rio Grande Plain, Jemez variety (Kulishek 2005). Because Vallecitos Black-on-white and Rio Grande Corrugated, Jemez variety most likely predate Navajo occupation of the region, they are not described here. Jemez Black-on-white is relevant to the current study because of its occurrence on Navajo sites, which provides evidence of interaction between the two areas. The major ceramic types of interest to the present study are Rio Grande Blind Corrugated, Jemez variety and Rio Grande Plain, Jemez variety because these types overlap in time and are analogous in function to Navajo plainwares.

Jemez Black-on-white

Jemez Black-on-white has been described by Elliott (1991, 1998); Habicht-Mauche (1993); Mera (1935); and Shepard (1938). The dates for this type range from A.D. 1350 to 1700. Jemez Black-on-white typically had a lower ratio of bowls to jars than earlier types, and a thick white slip on the exterior of closed forms and on both surfaces of bowls. The slip was well polished on open forms. Jemez Black-on-white is divided into three subtypes (A, B, and C) that correspond temporally to changes in slip, paint, and form (Kulishek 2005). Type A dated from A.D. 1350 to 1500 (Elliott 1994; Kulishek 2005) and had a larger ratio of open to closed forms than B and C. The slip was

white with fine black lines painted on the exterior of closed forms and the interior of bowls. Paint was rarely applied to the exterior of open forms. Type B had a gray to tan slip and paint on the exterior of closed forms and both surfaces of open forms. The painted lines are often faded to gray, brown, or yellow. Type B dated from A.D. 1500 to 1700 (Elliott 1994; Kulishek 2005). Type C is defined on the basis of Spanish forms. The slip and paint attributes were the same as Type B, but soup plates, chalices, and candlesticks were common forms. Type C dated from A.D. 1620 to 1700 (Kulishek 2005; Lambert 1981).

Rio Grande Blind Corrugated, Jemez Variety

Rio Grande Blind Corrugated, Jemez variety was defined by Kulishek (2005) and corresponds to Habicht-Mauche's (1993) definition of Tesuque Gray. It also is the same as the Blind Corrugated type defined by Kidder and Shepard (1936) at Pecos. Reiter (1938) used this term in his ceramic descriptions at Unshagi, as well. The Jemez variety is distinguished by the presence of tuff temper, but all other aspects are similar to other ceramics found in the Northern/Central Rio Grande region. "Blind corrugations" are created when coils are added to the interior wall of the vessel. This type dates from A.D. 1250 to 1500.

Rio Grande Plain, Jemez Variety

Rio Grande Plain, Jemez variety is defined by the lack of any surface modification (Kulishek 2005). This includes corrugation, indentation, punctuation, incision, and application of a slip. Kulishek's definition (2005) is based on surface treatment and, therefore, includes a range of paste characteristics and tempering

materials. Following Reiter (1938), there is variability in thickness, paste color, visual firing effects, and surface manipulation within Rio Grande Plain, Jemez variety. Sherd colors range from mustard yellow to light gray to a dark reddish brown to black. The majority of Rio Grande vessels are smoothed, but some exterior surfaces may be scratched or slightly corrugated in sections (Reiter 1938). The most common plainware vessel form is the jar. These generally have a constricted neck, flaring rim, and hemispherical base (Reiter 1938). Most vessels examined were from the general Jemez area, but those with site provenience were from Unshagi, Nanishagi, Amoxiumqua, or Guisewa.

Kulishek (2005) further divides Rio Grande Plain, Jemez variety, into two subtypes (A and B) based on changes in surface finish through time. Type A had roughly smoothed interior and exterior surfaces on closed forms and dates from A.D. 1200 to 1700. Type B had a more constricted temporal range (A.D. 1500 to 1825) and consisted of vessels with partially to completely polished interiors, and reduced or smudged interiors on closed forms. This is a pattern found throughout the Northern/Central Rio Grande region, but the tempering material used separates the Jemez varieties from other Puebloan plainwares. Tuff and andesite tempers were common in the Jemez plainwares. Based on excavations at Unshagi, Shepard (1938) argued that tuff temper was more common in earlier plainware, while black glassy vitreous andesite was more common later. Formally finishing surfaces of plainware vessels appears to coincide with the disappearance of corrugated wares across the Northern Rio Grande. Type B corresponds to the Pecos Striated discussed later in this chapter.

Pecos

The Pecos Site (LA625) is located in the Pecos River Valley in northeastern New Mexico approximately 80 km to the east/southeast of the Jemez Province. The Pecos Site is near the northern edge of the Upper Sonoran life-zone (Schroeder 1979). Pecos is considered a gateway village due to its location on the boundary between the Puebloan world and the Plains (Powell 2002).

Francisco Vasquez de Coronado was the first European to visit the pueblo during his exploration of the area in 1540. It was the largest pueblo seen at this time. Pecos became the location of a mission in the early seventeenth century (Kidder 1916; Schroeder 1979). The population at Pecos had dwindled to 17 by 1838, and the remaining people moved to Jemez; this relocation has been explained by the shared language, Towa, of these two groups (Schroeder 1979). Vessels from Pecos were included in this study in order to increase the sample size of rounded-base vessels. The documented cultural relationship between these two groups made Pecos a logical site from which to expand the sample (Schroeder 1979).

Spanish documents indicate a developed relationship between the Puebloan people of Pecos and the nomadic groups of the Plains (Hammond and Rey 1953, 1966; Winship 1896). The location of Pecos at a pass between the Plains and the Rio Grande Valley was ideal for interaction. Archaeological evidence suggests that this interaction did not begin until the mid-fifteenth century, and continued into the Historic period (Powell 2002; Spielmann et al. 1990). This interaction was both hostile and friendly (Spielmann 1991). The Apache, Comanche, and other Plains tribes are mentioned often in the Spanish records concerning Pecos and other eastern and northern Rio Grande Pueblos (Gallegos 1927; Hammond and Rey 1940, 1953). There has been no

archaeological evidence for Navajo groups near Pecos. Ethnographically, Navajo and Apache groups consider themselves distinct, although they share a common language and aspects of their culture (Levine and LaBauve 1997). There is no definitive relationship between the people of Pecos and the Navajo and, therefore, it is unlikely that the people of Pecos had a significant impact on the material culture of the Navajo.

Basketmaker peoples first occupied the area around Pecos during the Early Developmental Period sometime around A.D. 800 (Powell 2002). People continued to live in dispersed hamlets until sometime in the fourteenth century when they aggregated at the site that is now known as Pecos Pueblo. Pecos Pueblo was very large; early descriptions indicate the settlement was four stories high with side porches that made it possible to walk all the way around the town without setting foot on the ground (Hewett 1904). Archaeological estimates suggest that Pecos had at least 1,100 ground floor rooms (Kidder 1916).

Pecos Pueblo is considered part of the Northern Rio Grande Pueblos, and was occupied from approximately A.D. 1300 to 1838 when it was abandoned and the remaining population moved to Jemez (Kidder 1916; Levine and LaBauve 1997; Schroeder 1979; Spielmann et al. 1990). Occupation spans two periods: Classic/ Pueblo IV (A.D. 1300 to 1600) and Historic/ Pueblo V (A.D. 1600 to 1838).

Classic/Pueblo IV (A.D. 1300 to 1600)

The Rio Grande Classic Period also has been referred to as the Pueblo IV period (Cordell 1979; Habicht-Mauche 1993; Wendorf 1954; Wendorf and Reed 1955). Some archaeologists end this period at the time of contact in A.D. 1540, while others extend it until A.D. 1600 when Spanish influence became more prominent (Cordell 1979). Many

of the pueblos visited during early expeditions, including Pecos Pueblo, were first occupied during this period. Large population aggregations characterized this period, and Pecos Pueblo followed this pattern. Sites during this period are very large and consisted of multiroom blocks with plazas and large and small kivas (Powell 2002). Many have argued for ceramic specialization during the Classic Period (Powell 2002). Glazewares were produced and traded among the Northern Rio Grande Pueblos in the Albuquerque area, Santa Fe area, Galisteo Basin, and Pecos. Pecos was an important trade center for the glazewares (Cordell 1979). Corrugated wares continue to be produced in the early part of this period although plain types, such as Faint and Heavy Striated, are more common in ceramic assemblages toward the end of this period (Kidder and Shepard 1936; Kulishek 2005).

Spanish contact occurred during the Pueblo IV period, beginning with Coronado in 1540. This visit was followed by brief stops by Antonio de Espejo in 1583 and Gaspar Castaño de Sosa in 1590 to 1591 (Castaño de Sosa 1965; Pérez de Luxàn 1929; Schroeder 1979). The end of the Pueblo IV period coincides with substantial Spanish occupation of the area, specifically the onset of Spanish colonization and the assignment of missionaries to Pecos Pueblo (Schroeder 1979).

Pueblo V (A.D. 1600 to 1838)

Spanish colonists arrived in New Mexico in 1598. Shortly thereafter, Juan de Oñate visited Pecos Pueblo, and a church and convento were constructed a short time later (Schroeder 1979). Spanish occupation had a large impact on the native peoples at Pecos. Tribute in the form of food and labor served to lower crop production for the people of Pecos and their trading partners on the Plains (Spielmann et al. 1990). Pecos

Pueblo participated in the Pueblo Revolt in 1680 by razing the church, but aided the Spanish upon their return in 1692 (Schroeder 1979). Comanches moved into the Plains adjacent to Pecos, and proceeded to launch attacks against the pueblo. These attacks, combined with European diseases, greatly reduced the population of Pecos until 1838 when the remaining population migrated to Jemez (Schroeder 1979).

Pecos Ceramics

Kidder and Shepard (1936) described several culinary wares that were found at Pecos Pueblo. Six ceramic types were used from A.D. 1100 to 1500: Plain, Corrugated, Blind Corrugated, Indented Corrugated, Indented Blind Corrugated, and Clapboard Corrugated. These types are primarily based on surface treatments (Powell 2002). Micaceous versions of these types became common around A.D. 1300. All of these types were coiled with the interior scraped and usually fired in a reducing atmosphere; only the surface treatment varied (Kidder and Shepard 1936).

Plain, Corrugated, Blind Corrugated, Indented Corrugated, Indented Blind Corrugated, and Clapboard Corrugated

Plain ceramics are scraped and smoothed with no polish or slip. Sherds of this type are thought to be from the bases of blind corrugated jars. The junctions of the coils are still distinct in corrugated jars. Corrugated jars appear to have been replaced by Blind Corrugated around A.D. 1200. Blind corrugated surface treatment consists of obliterated coil junctures that have not been entirely smoothed. Indented corrugated is the most common type and consists of coils that are overlapped, pressed down, and pinched. Indented blind corrugated consists of partially obliterated coils with strong and weak pinch marks visible. Clapboard corrugated is characterized by strongly overlapping coils with no indentations (Kidder and Shepard 1936).

Pecos Striated

Pecos Faint Striated replaces the above types about A.D. 1500 at Pecos. This type is in use from A.D. 1500 to 1700 when it is replaced by Pecos Heavy Striated that dates from A.D. 1700 to 1838 (Powell 2002). These two types differ only by the depth of striations on the exterior surface. These vessels are coiled and most often incompletely oxidized. Exterior surface treatment consists of striations made by rubbing some sort of tool across the surface; possibly a finger or corncob (Kidder and Shepard 1936). Striations are often horizontal on the upper portion of the vessel and diagonal, horizontal, or vertical on the lower portion (Powell 2002). Interior surface treatment varies from smoothed and really black interiors on Faint Striated vessels and smoothed brownish gray to red interiors on Heavy Striated vessels. Jars are common and tend to be high in proportion to width. They typically have a slightly constricted neck and slightly flaring rim (Kidder and Shepard 1936).

Evidence for Interaction

Interaction between Navajo and Puebloan groups was both friendly and hostile. Spanish documents mention trade of products, such as meat, hides, and minerals. The Navajo also at different times raided their Puebloan neighbors (Hester 1962; Reeve 1956, 1957, 1958). Historical documentation suggests this occurred at Jemez, Zuni, and Santa Clara, and most likely other pueblos (Reeve 1956, 1957, 1958). Navajo groups participated in the Pueblo Revolt of 1680; and during the Reconquest, some Puebloans fled to the Navajo region (Brugge 1983; Hogan 1992). Maize agriculture may have come to the Navajos through Puebloan groups, but when and how this transmission occurred is

unclear. The earliest Navajo sites do have evidence of corn although the subsistence economy was mixed and wild resources still made up a large portion of the diet. Corn remains found at early Dinetah sites are similar to those found at contemporaneous Puebloan sites, which suggests that corn was obtained from Puebloan groups (Dykeman and Roebuck 2008). Navajo origin legends and myths maintain that corn was always part of Navajo culture (Dykeman and Roebuck 2008).

Ceramic assemblages at early Navajo sites often consist of Navajo wares, as well as a few Puebloan wares, such as Jemez Black-on-white, some polychromes, and some late glazes (Keur 1944). Ten Jemez Black-on-white sherds were found in a Navajo habitation structure at Site LA71263 (Oakes 2007). The presence of Puebloan tradewares, such as Jemez Black-on-white and glaze wares, at Dinetah phase sites confirms interaction between the two groups (Dykeman 2003; Oakes 2007).

Puebloan culture affected Navajo culture, although probably not as dramatically as previously postulated (Bailey and Bailey 1986; Hester 1962). The Refugee Hypothesis has been used to explain the adoption of masonry defensive settlements (pueblitos), the introduction of kachina-like figures in Navajo rock art, the presence of Puebloan clans in the Navajo clan system, an increase in Puebloan ceramics, and the beginning of polychrome ceramics in Navajo ceramic technologies (Brugge 1981; Hogan 1991; Towner 1996, 2003). This hypothesis is built on the assumption that the Puebloan refugees fled to the Dinétah region after the Spanish Reconquest of 1692. Close interaction with Puebloan groups led to dramatic changes in Navajo culture. Recent research suggests that Puebloan influence on Navajo culture was more gradual and occurred over a period of 200 years (Hogan 1991; Reed and Reed 1996; Towner 2003).

The construction of pueblitos has been among the most often cited evidence in support of the Refugee Hypothesis. Dendrochronological data suggest that most pueblito sites were built after 1710, which does not coincide with the Spanish Reconquest of 1692 (Towner 2003). This is not to say that Puebloan refugees did not migrate into the Dinétah around 1692, only that it was not the massive migration that has been previously proposed. Some sites, such as Tapacito Ruin, were constructed during the Refugee period and most likely represent refugee activity. Tree-ring dates suggest that the pueblito at Tapacito Ruin was built in 1694 during the Pueblo Revolt/Spanish Reconquest time period (Towner 2003). The higher frequency of nonlocal ceramics at this site relative to other pueblitos also supports a refugee site (Marshall 1991, 1995; Towner and Dean 1992).

The flow of ideas was not unidirectional. Puebloan groups also obtained ideas and technology from the Navajo. Some have suggested that the sinew-backed bow, the mountain lion skin quiver and bow case, and the bison-hide shield, as well as some motifs in Puebloan rock art from around A.D. 1400, are of Athapaskan origin (Baldwin 1997; Dykeman and Roebuck 2008). Motifs include the four-pointed star and the heartline. Sinew-backed bows have been found at Hopi, Jemez, and Pecos pueblos (Dykeman 2003, 2008). Arctic-style microblades and Dinetah Grayware have also been found at Jemez sites (Acklen and Railey 1999:69; Dykeman and Roebuck 2008; Torres 1999).

Conclusions

Based on both the archaeological record and historical Spanish documents, the Navajo in the Dinetah phase practiced a mixed economy that was primarily dependent on

wild plants and animals, and supplemented by corn and other agricultural products (Brown 1996; Hancock 1992; Hogan 1992). The Navajo appear to have been seasonally mobile with winter and summer camps. Although the Navajo may have returned to the same camps repeatedly, these camps were not occupied year-round. The Navajo were more mobile than their Puebloan neighbors.

Puebloan subsistence and settlement strategies were decidedly different. These groups depended heavily on agricultural products and supplemented their diet of corn, beans, and squash with wild plant and animal resources. The Puebloan groups practiced a settlement strategy of logistical mobility where portions of the population were mobile in order to obtain particular resources or tend the fields. The large sites from which these people derived were occupied year-round.

The Navajo and the Towa-speaking Puebloan groups present a relevant case study to evaluate the relationship among ceramic vessel shape, subsistence, and mobility. The evidence for interaction among these groups is strong. During the Dinetah phase, the Navajo were a semimobile group that depended primarily on wild resources, whereas their Puebloan neighbors had rounded-base cooking vessels and practiced a more sedentary agricultural lifeway.

Chapter 4: Food and Cooking Methods

Variation in both the types of foods exploited and the preparation methods of these foods could help explain differences in vessel form between Navajo and Puebloan groups. In order to better understand the variation in diet and cooking methods between the Navajo and Puebloans, a review of the available ethnohistorical and archaeological data was conducted. The assumption that the Navajo and Puebloan groups were practicing different subsistence patterns must be evaluated. The ethnohistorical data are drawn from sources that are somewhat unsatisfying and vague, and all of the historical information postdates the primary time period of interest for this research, as evidenced by use of goat's milk in some of the food preparation (Elmore 1943).

Important to food preparation is how a vessel was placed in relation to the fire. I assume that Navajo vessels were placed directly in the fire whereas Puebloan groups placed their vessels above the fire. This should be reflected in the shape and size of hearths at archaeological sites of both groups. Therefore, an evaluation of thermal features from the available literature on both Navajo and Jemez sites was conducted. The ethnographic literature suggests that the Navajo and Puebloan groups used their cooking vessels differently in terms of vessel placement relative to fire. A prepared hearth implies longer use of a site, but it may also provide an idea of how vessels were heated. These differences should be reflected in differences in the profile and shape of hearths between the two types of sites.

Food Choice and Preparation Techniques

Navajo

Archaeological data support the assumption that Navajo groups did not depend heavily on cultigens. The majority of plant remains recovered from Dinétah sites are wild plants such as goosefoot, cholla, amaranth, dropseed, rice grass, pine nuts, and juniper seeds (Brown 1991; Kendrick 2001). Corn cupules and pollen have also been recovered (Brown 1991; Hogan and Munford 1992). Corn and squash remains have been found at Dinetah and Gobernador Phase sites in Dinètah (Brown 1991; Dykeman 2004; Keur 1944; Hogan and Munford 1992). Medium to large mammal bone is common, suggesting that deer was commonly exploited. Faunal evidence also indicates that cottontail and jackrabbit were also commonly on the menu (Brown 1991; Hogan and Munford 1992; Kendrick 2001).

Although it is difficult to know exactly how the Navajo prepared wild foods during the Protohistoric period, ethnographic information is available on how they cooked these foods historically. Many of these plants thrive in disturbed areas and were abundant prehistorically. Amaranth was used by all of the native peoples in the southwestern United States. Both amaranth greens and seeds were used. Greens were collected in the late spring and boiled, and seeds were collected at the end of the growing season, ground, and combined with goat's milk to make a porridge (Dunmire and Tierney 1997; Elmore 1943). The addition of goat's milk to the porridge recipe suggests that this form of preparation was a more recent addition to the diet. Goosefoot, or *Chenopodium*, was also a common plant used by the Navajo. The young plants were boiled alone or with other food. They were also eaten raw. The seeds were parched and ground to make tortillas and bread (Elmore 1943). Purslane seeds were used by the Navajo to make mush

and bread, and the greens were boiled or stewed. Purslane also was used medicinally for stomach aches (Dunmire and Tierney 1997; Fewkes 1896). The greens from beeweed, or Rocky Mountain bee plant, were boiled or added to stew with wild onion, wild celery, and bits of meat. Elmore (1943:51) states that after boiling young plants, the Navajo would roll the plants into balls and eat them, or dry them to store for later. Beeweed also has been used medicinally, ceremonially, and as a dye for yarn (Dunmire and Tierney 1997). Dropseed is a grass from which the seeds were removed and ground to make dumplings, rolls, griddle-cakes, and tortillas (Elmore 1943).

Pinyon and juniper trees are abundant in the Dinétah homeland, as well as the greater Colorado Plateau, and are important for subsistence, as architectural material, and for ceremonies. Pinyon nuts were used extensively throughout the Southwest. Nuts were gathered in late August and roasted in pots or skillets. The Navajo also used them to make butter similar to peanut butter (Dunmire and Tierney 1997; Elmore 1943). Pinyon pitch was used on the exterior wall of some ceramic vessels as evidenced on several of the whole vessels examined in the current study (Figure 4-1); perhaps to decrease permeability or to reinforce repairs. Pitch also was mixed with sumac and yellow ocher to make a black dye for wool. Juniper played an important role in Navajo ceremonies as well as diet. Sweatlodges were built with juniper logs and covered with juniper bark. Berries, leaves, and twigs of the juniper tree were boiled to make a dye for wool. Twigs and leaves also were boiled to make a tea to treat colds, headaches, stomach aches, and nausea (Dunmire and Tierney 1997; Elmore 1943). The juniper berry also was roasted or boiled for food (Vestal 1952:11).

Figure 4-1. Vessel GC9 with pinyon pitch on exterior.

Corns, or *Zea mays*, also was eaten by the Navajo, although the degree to which this resource contributed to the diet during the Dinetah and early Gobernador phases is unclear. According to Elmore (1943), corn meal was made by roasting, shelling, grinding, and then drying green corn. Corn meal was used to make porridge, although the means of preparation of this porridge are not clear. Hominy was made by boiling corn and meat overnight. Corn was most commonly roasted over an open fire or in a roasting pit.

The most common way of preparing meat was in stew, including mutton, beef, goat meat, as well as venison and antelope. Elmore (1938:149) writes that meat was boiled overnight until the meat fell off the bone. Baking or boiling over live coals was common for almost every animal exploited (Elmore 1938).

Ethnographic data suggest that seeds and greens of many of the resources that the Navajo exploited were boiled. Many of the other cooking techniques, such as making

tortillas out of seeds or baking, do not involve the use of ceramic vessels. As previously stated, one possible preferred quality of the conical cooking vessel is that it has a shorter boiling time than a rounded-base vessel. Boiling over live coals in a ceramic vessel is a common type of food preparation used by the Navajo. If one of the primary uses of a ceramic vessel is boiling, manufacturing a vessel that is well suited to this purpose would be ideal.

Puebloan

Due to the limited excavation that has occurred in the Jemez region, there is little direct evidence for food use during Protohistoric times. Sites have yielded floral remains of *Zea mays*, prickly pear, cholla, chenopodium, amaranth (or pigweed), Rocky Mountain bee plant, and sagebrush (Acklen and Railey 1999; Reiter 1938; Scott 1989). At Site BJ 74, which dates from A.D. 1550 to 1700, 144 corncobs were recovered from Rooms 1 and 3 and the walled activity area (Leubben et al. 1988). Faunal remains found at field house excavations in Horseshoe Springs include deer, bird, and possibly mountain goat or bighorn sheep.

Studies in other areas, such as Arroyo Hondo Pueblo and Pecos Pueblo, have suggested that wild plants comprised about 20 percent of the diet (Wetterstrom 1986; Spielmann et al. 1990). In Wetterstrom's study at Arroyo Hondo (1986), she estimates that maize could have constituted up to 100 percent of the diet in good growing years, beans up to 20 percent, amaranth and chenopodium seeds and pinyon up to 15 percent, rabbit and bison up to 10 percent each, and pronghorn antelope up to 5 percent. The environment surrounding Arroyo Hondo was similar to both Pecos and many of the

Jemez sites, and diet was most likely similar among the three areas (Spielmann et al. 1990).

Preparation of plant remains varied. Reagan (1917) states that most plants were cooked in a ceramic jar suspended over the fire. Historically, vessels were suspended using an iron tripod, but prior to European goods, vessels were hung over the fire or set on a rock over the fire (Reagan 1917). Reiter (1938) mentions the presence of "fire dogs" in association with a few hearths at Unshagi. He defines fire dogs as "long ovate or cylindrical stones which rest upright with the lower ends buried in the floor-plaster" (Reiter 1938:49). Typically three to four fire dogs were set into a hearth so that vessels could be placed atop these stones to hold the vessel above the fire.

Corn, or *Zea mays*, was a staple domesticate and was prepared in many ways. Corn kernels were made into hominy by parching, soaking in water with juniper ash, and then boiling (Scott 1989). Ethnographically, corn was often parched in a basket by placing hot stones or coals in the basket with the kernels. The ingredients of the basket were tossed until parched. Corn kernels were then ground in trough metates. Corn meal was used to make corn cakes, which were baked in ashes or wrapped in husks and baked in an oven (Reagan 1917), a Spanish introduction. Mush was made by first bringing the cornmeal and water mixture to a boil and then simmering. Mush also was often used to make very thin bread. This "paper bread" was made by spreading a thin layer of mush over a heated flat rock (Reagan 1917).

Prickly pear is a *Opuntia* cactus with a series of fleshy flat pads, the fruit of which can be eaten raw or cooked over a fire. The spines are removed from the fruits by rolling them on the ground or singeing them (Cook 1930; Dunmire and Tierney 1997;

Harrington 1967). Prickly pear was important to Ancestral Puebloans as evidenced by the presence of spines in 90 percent of the coprolites found at Mesa Verde (Harrington 1967). Prickly pear appears to have remained important to the Jemez people into historic times (Cook 1930).

Cholla is another type of *Opuntia* cactus, but it is taller than the prickly pear and has cylindrical stems. The fruit and seeds of this plant are edible. Puebloan groups, including the Hopi and Zuni, boiled or stewed cholla. They also dried and ground it into flour and used it to make mush (Dunmire and Tierney 1997). There is no direct ethnohistorical information on how the Jemez used this plant, but their use was most likely similar to other Puebloan groups.

Goosefoot, or *Chenopodium*, and pigweed, or *Amaranthus*, are related genera. Both are common in disturbed areas and are often found growing among crops. Goosefoot seeds were ground into a meal for bread or gruel. The young leaves can be eaten raw or cooked like spinach (Harrington 1967). Pigweed was most likely encouraged to grow among crops (Harrington 1967). It was probably prepared in similar ways to goosefoot (Dunmire and Tierney 1997; Harrington 1967). In her ethnobotanical study of the Jemez, Cook (1930:20) states that pigweed was once important to the diet of the Jemez, but was no longer used by 1930.

The Rocky Mountain bee plant, or *Cleome*, also is common in disturbed areas. Pollen from this plant, as well as corn and squash, has been found in prehistoric Ancestral Puebloan coprolites, suggesting that it was important to prehistoric diet (Dunmire and Tierney 1997). The Hopi boiled young plants with green corn (Dunmire and Tierney 1997). The thick black remains of boiling the plant were used as black paint. Cook

(1930) does not mention this plant, but it has been found during pollen analyses of field house sites in the Jemez region (Scott 1989).

Sagebrush appears to have been used more as a fuel or a fiber than for food. Some parts of the plant have been found in small quantities of Ancestral Puebloan coprolites, suggesting it was used as a food source or possibly as a spice (Dunmire and Tierney 1997).

The limited ethnohistorical data available suggest that boiling also was an important cooking strategy for many of the resources used by the Jemez. This also appears to be the case for meat. Historic accounts of Zuni Pueblo provide evidence that meat was most often boiled in stews (Stevenson 1904; Mills 1999). It is likely that the Jemez practiced this strategy as well.

Summary of Food Choice and Preparation Techniques

It was expected that archaeological and ethnohistorical data would show that the Navajo and Puebloan groups practiced different subsistence strategies in terms of resources and preparation, but this does not appear to be the case. The Navajo and Puebloan groups exploited the same suite of resources, which is not surprising considering they occupied similar environments in adjacent areas. It is also not shocking that the Navajo and Puebloan groups prepared many of these resources in similar ways. There does appear to be variation, however, in the proportion of different resources in their diets. Archaeologists have estimated that corn comprised 65 to 80 percent of the prehistoric Puebloan diet (Snow 1991). Because corn was much more important to the Puebloan diet, it was likely prepared in more variable ways, which might explain the differences in vessel form between the Navajo and Puebloan groups. Some preparation

techniques for corn do require simmering, but this is not always the case. Unfortunately, the ethnographic data are not specific enough to provide substantive information on this topic.

Thermal Features

Hearths excavated at Navajo sites and Jemez sites were very different. These differences are possibly due to differences in cooking strategies between the two groups.

Navajo Thermal Features

Thermal features excavated at 11 Navajo sites are included in the sample (Figure 4-2). These sites were LA16151, LA16153, LA16257, LA49498, LA61828, LA61838, LA61848, LA61852, LA71263, LA115767, and LA115776 (Table 4-1). LA16151 is a Dinetah phase site with two forked-pole hogans; two hearths inside the structures were included in the sample (Hogan and Munford 1992). LA 16153 is most likely a Cabezon phase site (Munford 1992); one hearth in the sample was excavated at this site. LA16257 had six hearths associated with the Navajo component of the site (Hensler et al. 1999).

Table 4-1. Navajo thermal feature by site.

Site #	Hearth	Thermal Pit	Warming Pit	Total
LA115767	2			2
LA115776		1		1
LA16151	2			2
LA16153	1			1
LA16257	6			6
LA49498	2			2
LA61828	5			5
LA61838	2		1	3
LA61848	3			3
LA61852	6		2	8
LA71263	1			1
Total	30	1	3	34

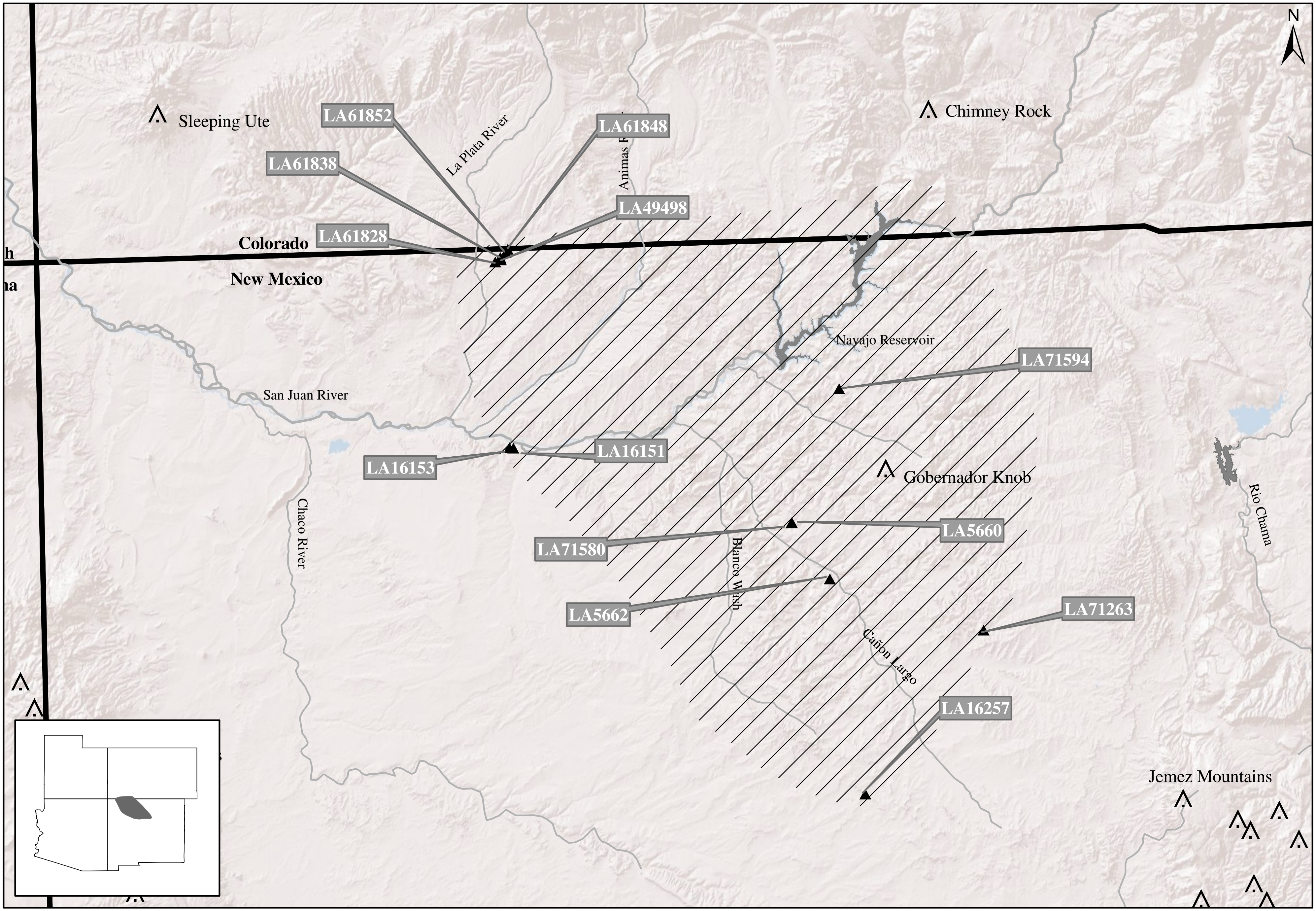

Figure 4-2. Location of Navajo Sites Discussed in the text

▲ **Site Location**

Dinétah Homeland

10 5 0 10 Miles

LA49498 is a Basketmaker II and Dinetah phase site with at least one possible forked-pole hogan and associated activity areas (Reed and Horn 1988). Two hearths are included from this site; one was in the structure and the other was in one of the activity areas.

LA61828 is a multicomponent site with Archaic, Ancestral Puebloan, and Dinetah occupations. One structure and five hearths date to the Dinetah phase (Brown 1991). These five hearths were included in the sample. Four of these hearths are overlapping and may be the result of maintenance of one hearth. LA61838 has both Late Archaic and Dinetah components. The Dinetah occupation is represented by a forked-pole hogan with a central hearth and an associated outdoor activity area. Two hearths excavated at this site are included in this analysis. Three hearths from LA61848 are included in the sample. This site is another multicomponent site with Basketmaker II, Pueblo III, and Dinetah occupations. LA61852 has both Pueblo III and Dinetah phase components. Three structures with hearths and an extramural and refuse area with three more hearths and a roasting pit were excavated (Brown 1991). All but the roasting pit are included in the sample.

LA71263 is an early Navajo habitation site with one structure and associated features. One hearth located near the center of this structure is included in the sample. It is also interesting to note that although Dinetah Gray sherds made up the majority of the ceramic assemblage (90.7 percent), 11 Jemez Black-on-white sherds also were recovered from this site. Radiocarbon dates of the site place its occupation between A.D. 1600 and 1650 (Oakes 2007).

LA115767 is a multicomponent site with Archaic and early and recent Navajo occupations (Kendrick 2001). Due to the absence of structures, the early Navajo occupation appears to have been a seasonal or short-term camp. Two hearths excavated at this site are included in the current sample. Only one possible hearth was excavated at LA115776 and is used in the current sample. This site is an early Navajo site that was most likely a seasonal or short-term camp; no structures were found (Kendrick 2001).

Navajo thermal features examined include 30 hearths, three warming pits, and one thermal pit. Twenty-nine of these thermal features were basin shaped, alternatively described as basin, oval basin, oblong basin, or lenticular. The shape of four of these features was indeterminate due to shallow or disturbed deposits. The size of these pits averaged 61.17 cm in diameter and had a standard deviation of 23.35 cm. Mean depth was 9.5 cm with a standard deviation of 7.95 cm; depth ranged from 2 to 50 cm. Some of these depths may not be entirely accurate due to post-depositional factors that may have disturbed soils above the features. Juniper and pinyon appear to be the most common fuel types. No formal preparation was apparent, none were slab lined, and although shape was consistent, there was a fair amount of variation in width and depth of these features. Eight hearths contained fire cracked or burned rock. Some of these rocks were no doubt used to ring the hearth for fire containment. It is also possible that some are the result of indirect boiling. I believe that some burned and fire cracked rocks may also have been used to support a conical vessel in the fire.

Jemez Thermal Features

Jemez thermal features included in the sample consisted of 72 hearths excavated at nine sites (Figure 4-3). Fifty-six of these features were excavated at Unshagi (LA123)

by Reiter in the 1930s (Table 4-2). Data on each individual hearth are not available and Reiter gives only the range of sizes in his excavation report (Reiter 1938). Little excavation has occurred in the Jemez Mountains in recent years. Of those sites excavated, the majority are small one- to two-room field house sites. The remaining 17 hearths were excavated at LA24595, LA24925, LA24926, LA38962, LA69562, LA69563, and LA102677.

Table 4-2. Jemez thermal features by site.

Site #	Hearth	Total
LA102677	2	2
LA123	56	56
LA69562	1	1
LA69563	1	1
LA24595	1	1
LA24925	3	3
LA24926	1	1
LA38962	7	7
Total	72	72

LA24595 is a field house site with a single-room Pueblo IV structure (Gauthier and Elliott 1989). One hearth was excavated and is included in the current sample.

LA24925 is a two-room field house site from the Classic Period (or the Paliza phase, as used here) (Gauthier and Elliott 1989). Three slab-lined hearths or bins excavated at this site are included in the current sample. LA24926 also is a field house site dating to the Classic Period (Gauthier and Elliott 1989). Data on one hearth at this site are included in this analysis. Reiter excavated LA38962 (BJ 74) in the 1930s. The site consists of a single-story five-room pueblo and an associated walled activity area (Leubben et al. 1988). Seven hearths at this site are included in this analysis. Four hearths were within rooms and three were in the activity area.

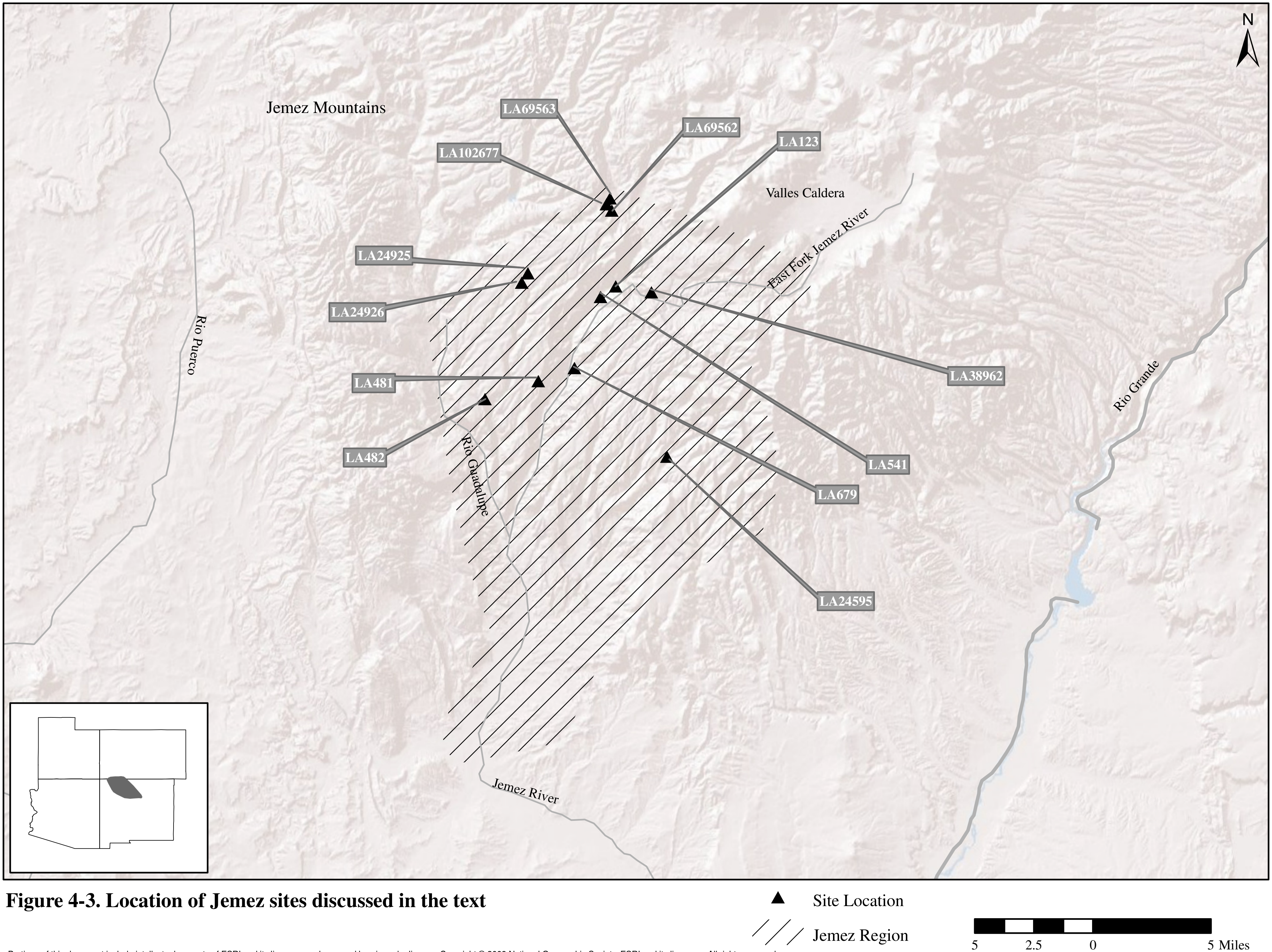

Figure 4-3. Location of Jemez sites discussed in the text

Sites LA69562, LA69563, and LA102677 are field house sites excavated for the Horseshoe Springs project in the late 1990s (Acklen and Railey 1999). One hearth was excavated at each of these sites and all are included in the current study.

The excavators defined all thermal features as hearths. Sixty-seven of these features were slab-lined, and 70 were rectangular. Three other hearths were lined with small stones, slabs, and plaster. Three hearths were located outside in a walled activity area; two of which were circular and one of which was rectangular. Mean length was 61.56 cm with a standard deviation of 18.9 cm, and mean width was 41.67 cm with a standard deviation of 15.31 cm. Mean depth was 16.31 cm with a standard deviation of 7.26 cm. These measurements show substantial variation in size among Jemez hearths. The consistency in shape and slab-lining, especially within room blocks, shows much less variability. Reiter also noted the presence of "fire dogs" in association with two hearths at Unshagi. Fire dogs are cylindrical or oval stones with the bottoms buried in the plaster floor. These were most likely used for placement of vessels above the fire of the hearth.

Summary of Thermal Features

I expected the shape of hearths to be variable between Navajo and Jemez sites, and this is supported by the available archaeological data. Shape is consistent in both the Navajo and Jemez hearths. There is consistency within the types of hearths built by two groups, although the size of the hearth varied. This variation in size may be a reflection of the site type, group size, hearth location (inside or outside), or could be related to the preference of the builder. The way in which each group built their hearths was distinct; however, as evidenced by variation in overall hearth shape between the Navajo and

Jemez sites. Navajo hearths were primarily basin-shaped and appeared to have been more expedient and shallowly excavated. Jemez hearths were rectangular and slab-lined and appeared to have been excavated and formally prepared.

These differences likely reflect the way in which the hearths were used, and the duration of use. If the Navajo placed their pots in the center and then built the fire around the vessel, a shallow basin-shaped hearth would be expected. This expedient hearth would be easy to build and clean for reuse. The Jemez may have placed their vessels over the fire or coals, raised them on rocks over the fire, or used fire dogs along the edge of the fire. Jemez hearths had more prepared construction and were part of a suite of features built into the floor of Puebloan rooms. The construction of these hearths, as well as their maintenance, was likely more time consuming than expedient shallow basin-shaped hearths.

The floor plan of architectural features was no doubt related to cultural norms, but the original conception of these plans was likely the result of finding the best available alternative to satisfy the intended function or use of a habitation structure. This would include the shape, size, and location of a hearth within a structure. The shape and size of a ceramic vessel must be related to the shape and size of the hearth upon which it was placed. A conical vessel would be well suited to a shallow basin-shaped hearth. It would be easy to build a fire around a vessel placed in a shallow basin. Some of the fire cracked and burned rock in many of the Navajo hearths most likely was used to provide support for conical vessels. Also, building a fire around a conical vessel would expose more surface area of the vessel to the heat. A deep-sided rectangular hearth would be more suited to a vessel that is suspended above or placed next to the fire. The rounded-base

would serve to expose more surface area of the vessel to heat if it were suspended over the fire.

It also must be noted that a hearth is not necessarily used only for cooking; it also may be used for warmth, heat treating lithic material, or firing ceramic vessels. These functions no doubt influenced hearth variables. The type of structure also would impact these variables (e.g., closed adobe structures with restricted ventilation vs. round to octagonal brush structures with more ventilation).

Chapter 5: The Archaeological Data

Introduction

To address the issues raised in Chapter 2, I collected data from museum and private collections. This chapter presents the data collected from these archaeological collections. The sample of whole vessels and sherds is discussed first, followed by a discussion of the methods used for both of these ceramic remains. The results of the analysis and a summary of this data are presented at the end of the chapter. The results show both variability and similarity between Puebloan and Navajo vessels andsherds.

The Sample

Whole Vessels

I examined both whole vessels and sherds for this study. I analyzed 158 vessels including 87 Navajo vessels and 71 Puebloan vessels; most (n=103, or 65 %) lack provenience (Table 5-1). This is common in museum collections, and seems particularly true in the case of whole vessels. Many of these vessels were donated to the museums from private collections and provenience was often not known. Some donors provided general locations for their vessels, but actual site names and numbers were rarely included. Although this is unfortunate, it is often unavoidable when using museum collections.

Navajo vessels include both Dinetah Gray (n=57) and Navajo Gray (n= 30) types. Although none of the Dinetah Gray vessels had precise provenience, four vessels had some general locational information. Two are part of the Smithsonian National Museum of Natural History collection and were recovered from Chaco Canyon. They were

donated to the museum by Neil Judd in the early 1920s. One Dinetah Gray vessel was from the Keur excavations in the Gobernador area, and the remaining provenienced vessel was in the collections of the Museum of Northern Arizona and was recovered from Paiute Mesa, Arizona. Five vessels were donated by Mike W. Kelly or C.O. Erwin, and are from the "Navajo Project," which most likely refers to the work they did in Frances and Gobernador canyons in 1934 (Powers and Johnson 1987).

The majority of Dinetah vessels (n=29) were, at the time of analysis, in a private collection of Mr. Robert Gallegos of Albuquerque, New Mexico. Mr. Gallegos obtained this collection from two men who had worked as cowboys in the Dinétah area for decades. Although they did not give Mr. Gallegos the exact proveniences, they did indicate that the vessels were found in storage contexts (e.g., rockshelters and caves) in the Gobernador/Largo Canyon area. This collection, known as the Allen-Moore Dinetah Collection, is now at the Museum of Indian Arts and Culture in Santa Fe, New Mexico.

Table 5-1. Current location of vessels by type.

Ceramic Type	Gallegos Collection	Maxwell Museum	Museum of Indian Arts and Culture	Pecos National Monument	Museum of Northern Arizona	Santa Fe National Forest	Smithsonian National Museum of Natural History	Total
Cundiyo Smeared Indented			1					1
Dinetah Gray	27	7	14		4		3	55
Dinetah Gray, Indented Variety	2							2
Faint Striated				10				10
Faint Striated/Punctuated				1				1
Heavy Striated				1				1
Navajo					1			1
Navajo Gray	3	3	1		20		3	30
Pecos Plain				2				2
Rio Grande Plain			2				1	3
Rio Grande Plain-Heavy Striated			1					1
Striated				6				6
Zia		1						1
Blind Corrugated			1	1				2
Rio Grande Plain, variety Jemez		11	16			5	9	41
Tool marked				1				1
Faint Indented Blind Corrugated				2				2
Total	32	22	36	24	25	5	16	160

Other Dinetah Gray vessels were from collections at the Maxwell Museum (n=7), the Museum of Northern Arizona (n=4), and the Smithsonian National Museum of Natural History (n=3). The remaining Dinetah vessels (n=14) were found in collections at the Museum of Indian Arts and Culture. None of these vessels retain provenience information.

The Navajo Gray vessels with limited locational data were found in northeastern Arizona from areas such as Klethla Valley Wash; the Little Colorado River; "near Pinion, Arizona"; Ganado, Arizona; Kayenta, Arizona; and south of Hunters Point, Arizona. At least three of these vessels were found in northwestern New Mexico (Chaco Canyon and near Gallup, New Mexico), and one was recovered from the Mesa Verde region around 1900. Of the 30 Navajo Gray vessels analyzed, most were found at the Museum of Northern Arizona (n=20). Other vessels analyzed were found in collections at the Maxwell Museum, and in the private Gallegos Collection.

Puebloan vessel types were dominated by Rio Grande Plain, variety Jemez (n=42) and Pecos Striated (Faint and Heavy) (n=18), although a few vessels of Rio Grande Plain (n=4), Faint Indented Blind Corrugated (n=2), Blind Corrugated (n=1), Cundiyo Smeared (n=1), and Zia Utility (n=1) were included in the sample due to the limited number of Jemez variety vessels available. There are important similarities among ceramics of different Puebloan groups in the Northern/Central Rio Grande region during the Protohistoric period. Although these groups can be divided into three different subdivisions of the Tanoan language, technology appears to have been shared, and general temporal trends in ceramics are consistent across the region.

Twenty-five of the Jemez variety vessels retain site provenience. These sites include Unshagi (LA123), Nanishagi (LA541), Amoxiumqua (LA481), Kwastiyukwa (LA482), Guisewa (LA679), and Horseshoe Springs (LA69562). The majority of these vessels were found in collections at the Museum of Indian Arts and Culture (n=11), Maxwell Museum (n=4), the Smithsonian National Museum of Natural History (n=6), and the Santa Fe National Forest (n=4).

Unshagi is a large pueblo excavated by the University of New Mexico and the School of American Research from 1928 to 1934. This site is located in San Diego Canyon in the Jemez Mountains just below the confluence of the Jemez River and the East Fork of the Jemez River. The estimated number of rooms at this site is 263, and there are three kivas. The site was occupied from the Paliza phase to the Guadalupe phase (Pueblo III to the Historic Period) (New Mexico State Site Files 2008; Reiter 1938). Nanishagi also was excavated in the 1930s. It is larger than Unshagi, but very similar in terms of architecture. Much less of the Nanishagi site was excavated, but it appears to be contemporaneous with Unshagi (Elliot 1989; Reiter et al. 1940). Six vessels used in this analysis are from Unshagi or Nanishagi.

Amoxiumqua is another large pueblo located on Virgin Mesa to the west of San Diego Canyon. It has an estimated 1,200 rooms and six kivas. The site dates from the Paliza phase to the Historic period (A.D. 1350 to 1650) and is approximately 30,000 m^2 (Elliot 1989). At least 130 burials were excavated at this site and artifacts were found in association with many of the burials (n=49). This is more than the number of burials accompanied by artifacts at Unshagi (Reiter 1938). Architecturally, the rooms at this site tend to be larger and better constructed than those at Unshagi (Reiter 1938). At least 12

Jemez culinary vessels from this site are listed in the catalog in Appendix 5 of Part II Reiter's 1938 report on excavations at Unshagi and earlier excavations at Amoxiumqua and Guisewa. Seven vessels from this site were included in the current research.

Kwastiyukwa, a pueblo located on Holiday Mesa, consists of an estimated 1,250 rooms with three to five kivas. It dates from the Paliza phase through the Historic Period. Six vessels included in the current analysis were recovered from this site. Guisewa is a large pueblo that became one of the first missions in the Jemez region. There are approximately 350 rooms and three kivas at this site. Dates are contemporaneous with the other sites discussed above. Three vessels from this site were included in the current analysis.

Five Rio Grande Plain, variety Jemez vessels are in storage at the Santa Fe National Forest District Office in Santa Fe, and four of these are from excavations at Horseshoe Springs (Acklen and Railey 1999). This site is located in the northern portion of the Jemez region on a small finger ridge, and consists of a single masonry two-room field house. The fifth vessel was taken from a site adjacent to a drainage near the mesa edge on Mesa de Guadalupe.

All 18 Pecos Striated vessels were from excavations at Pecos (LA625) and are located in collections at Pecos National Monument. Other vessels recovered from Pecos include two Pecos Plain, two Faint Indented Blind Corrugated, one Blind Corrugated, and one Plain with punctations around the neck. The two Pecos Plain vessels are shoe-shaped.

Sherds

Sherds were analyzed in order to obtain information that cannot be obtained from whole vessels. Attributes such as paste texture, temper type, hardness, and fracture pattern are often difficult to analyze on whole vessels. Samples were selected from collections at the Maxwell Museum of Anthropology and the Museum of New Mexico Laboratory of Anthropology. Sherds were examined from different sites in order to avoid sampling biases due to analysis of sherds from the same vessel.

A total of 271 sherds from at least 14 different sites were examined. One hundred and thirty-two Dinetah Gray sherds, 17 Navajo Gray sherds, 121 Rio Grande Plain sherds, and one Jemez smeared indented corrugated sherd were included in the analysis. Seventy-three of these sherds were from the Archaeological Research Collections of the Laboratory of Anthropology at the Museum of New Mexico. Although the majority of these sherds are unprovenienced, the fact that these sherds were already classified was an advantage.

The majority of Dinetah Gray sherds (n=94) were from Maxwell Museum collections. Fifty-one of these sherds were recovered from different sections of LA5660. This site is a pueblito also known as Crowfoot Ruin, Shaft House, or Shaft Ruin. It is a rockshelter site located in the Crow Canyon drainage, which is a side canyon of Largo Canyon, and was excavated by the Office of Contract Archaeology in 1989. This site may have been a refuge shelter for people living at Ridgetop House and/or Crow Canyon Pueblito, and has a dendrochronological near cutting date of 1712 +B (Towner 2003).

Thirty-nine Dinetah Gray sherds were recovered from excavations at Hooded Fireplace Ruin (LA5662). The cutting dates of roof beams from this site range from A.D.

1721 to 1723 (Towner 2003). This site is a multiroom pueblito that dates to the Gobernador phase and is located on a bench above Largo Canyon. There are up to 11 rooms and one stone hogan. The name of the site comes from an intact Spanish-style hooded fireplace in one room.

The remaining Dinetah Gray sherds from the Maxwell Museum were recovered from LA71580 (n=3) and LA71594 (n=1). These sites are both Gobernador phase sites in the Dinétah area. LA71580 is located on the bench above Shaft Ruin (LA5660) in Crow Canyon drainage. LA71594 is located in a side canyon of Frances Creek. Only eight Navajo Gray sherds included in the sherd sample were from the Maxwell Museum. Seven of the sherds were from LA71580 and one was from LA5662.

Sixty-nine Rio Grande Plain sherds were analyzed from Maxwell Museum collections. Fifty were recovered from Unshagi (LA123). Some sherds also were recovered from Nanishagi, another large pueblo site excavated in the 1930s. Forty-three percent of Jemez sherds (n=53) were from the Laboratory of Anthropology type collection and their provenience is unknown. Only 20 Dinetah and Navajo Gray sherds (13 percent) were from this collection.

Methods

Whole Vessels

Each whole vessel was first photographed upside down. Photographs were used to evaluate the overall "pointedness" of each vessel by measuring the angle of the base. The angle was computed by taking the inverse tangent of the radius at the maximum diameter divided by the height of the vessel from the base to the maximum diameter ($\tan^{-1}(r/h)$) (Figure 5-1). The resultant value was then multiplied by two to calculate the

angle of the entire base. All vessels with basal angles of less than 90 degrees were considered conical, or pointed, while all vessels with basal angles greater than 90 degrees were considered rounded. Measurements taken on vessels in the photographs also were

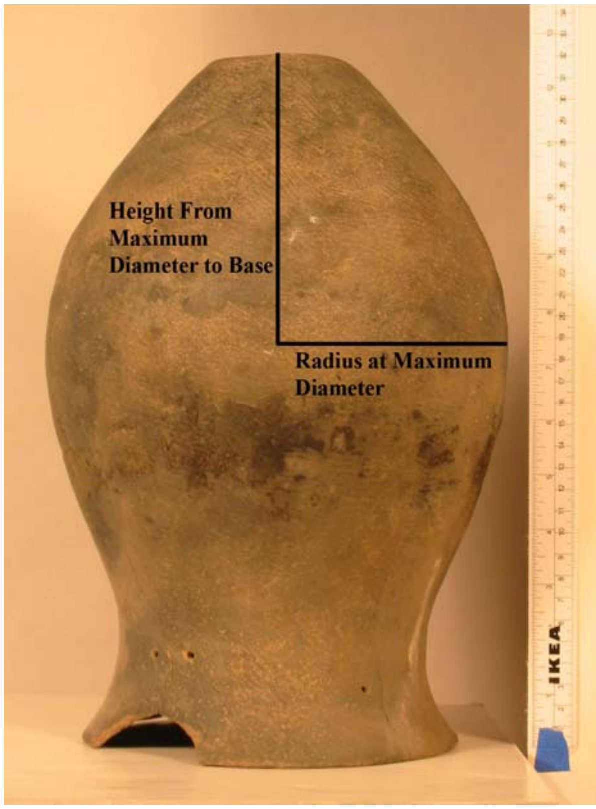

Figure 5-1. Measurements used for determining angle.

used to create the reproductions discussed in the following chapter.

Measurements taken on whole vessels were height, maximum diameter, aperture diameter, neck diameter, wall thickness at the neck and rim, and, when measurable, coil height. The first four measurements were taken using a Haglof aluminum 65-cm tree caliper. Wall thickness was measured with a Fowler external arm caliper. Coil height was measured using a sliding digital caliper.

The amount and location of surface attrition were noted. Attrition was noted on both the interior and exterior surfaces in order to evaluate both the transportation method

and the cooking strategy. It is recognized that post-depositional erosion and/or incorrectly equating certain types of attrition with certain types of uses could lead to inaccuracies. Therefore, I used this analysis carefully in reaching any conclusions.

The amount and location of sooting on a vessel, as well as the location of residue, also were recorded. These data have the potential to provide information on vessel use as well as placement in the hearth.

Sherds

Macroscopic analysis was conducted on Navajo and Jemez sherd samples, and comparisons between the two are presented below. Variables recorded on sherds include paste texture, temper type, and hardness. The clay used and the amount, size, grading, and shape of aplastics determine the paste texture of ceramics (Shepard 1956). This analysis included low, medium, or high amounts of fine, medium, or coarse grain size temper. Paste color was measured using a Munsell Soil color chart. Temper type was recorded for both samples.

Fracture patterns were analyzed in order to examine the difference in strength between the two vessel types. Following Pierce (1999), fracture patterns were recorded as nonrandom or random. Nonrandom fractures show "parallel fracture edges in the horizontal plane of the vessel resulting from the fractures occurring along the joints between coils or horizontally applied construction elements" (Pierce 1999:62)." Random fractures do not display an edge orientation preference (Pierce 1999:62). Vessel types with fewer nonrandom fractures are assumed to be stronger.

Hardness tests using the MOHs scale were conducted. Hardness can inform on the likelihood of a ceramic body being broken (Shepard 1956). This is important because

these measurements indicate the durability of Navajo ceramics relative to Jemez ceramics. The MOHs scale gives a relative measure of how well a ceramic surface will resist abrasion. Generally, harder ceramics are more resistant to abrasion and more brittle, while softer ceramics are less resistant to abrasion and less brittle.

Results: Whole Vessels

Dinetah Gray Whole Vessels

Fifty-seven Dinetah Gray vessels were examined. Due to inclusion of two partial vessels in the sample, height could not be measured for both of these vessels and maximum diameter, neck diameter, and aperture diameter could not be attained on one vessel. The mean height is 40.3 cm with a standard deviation of 8.36 cm and the mean maximum diameter is 29.1 cm with a standard deviation of 6.57 cm (Table 5-2). Average wall thickness is 3.77 mm at the lip and 4.13 mm at the neck.

Height and maximum diameter appear to be positively correlated as shown in the scatter plot in Figure 5-2. They both increase at a constant rate. This does not appear to be the case for the relationship of height to neck diameter and height to aperture diameter. Neck and aperture diameter measurements appear to stay relatively constant as height increases (Figure 5-2, Figure 5-3). This suggests that the diameter of the opening of a Dinetah Gray jar was somewhat standardized among potters. It is possible that no matter the height and maximum diameter of the vessel, the neck and opening had to be within a certain size range to function properly. Ease of access to contents might necessitate a certain opening size.

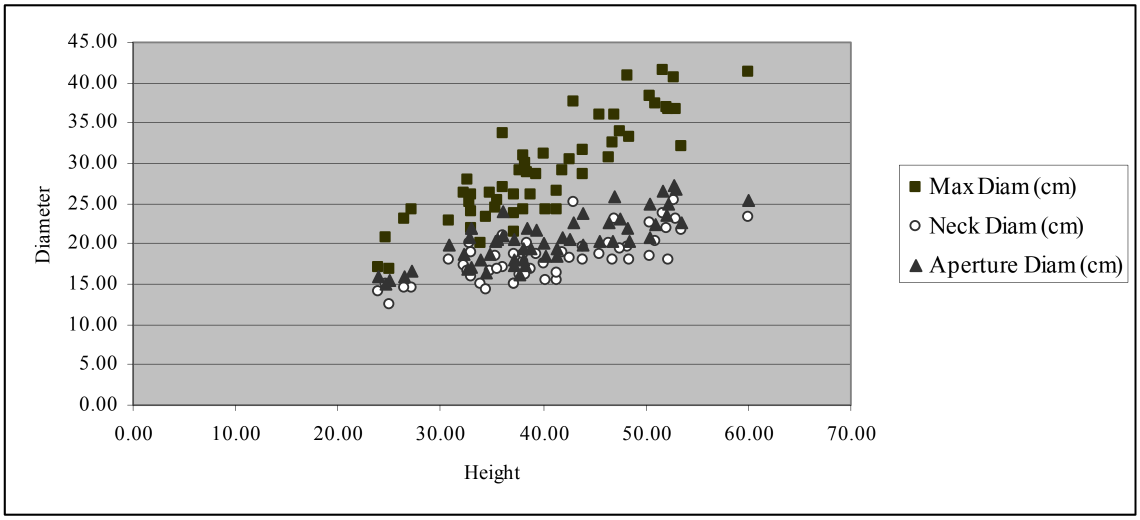

Figure 5-2 Scatter plot showing relationship of height to maximum, aperture, and neck diameter (in cm) in Dinetah Gray vessels.

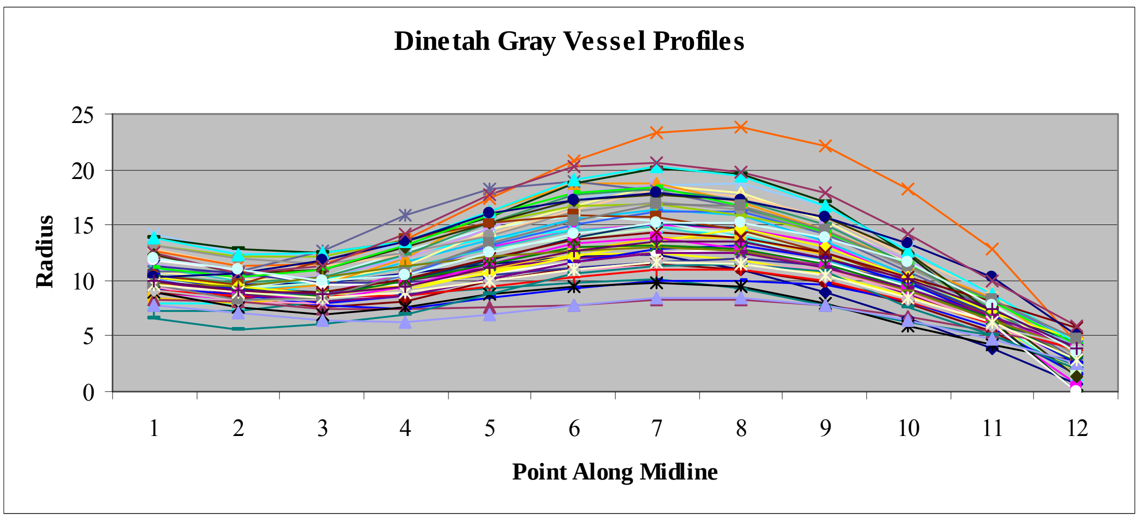

Figure 5-3. Dinetah Gray vessel profiles.

Table 5-2. Dinetah Gray descriptive statistics.

Height (cm)		Max Diam. (cm)		Neck Diam. (cm)		Aperture Diam. (cm)	
Mean	40.296364	Mean	29.0625	Mean	18.276786	Mean	20.446429
Standard error	1.1270532	Standard error	0.8780312	Standard error	0.388052	Standard error	0.41389
Median	38.8	Median	28.7	Median	18.1	Median	20.25
Mode	33	Mode	29	Mode	19	Mode	18
Standard deviation	8.3584502	Standard deviation	6.5705835	Standard deviation	2.9039153	Standard deviation	3.0972694
Sample variance	69.86369	Sample variance	43.172568	Sample variance	8.432724	Sample variance	9.5930779
Range	36	Range	26.1	Range	12.8	Range	12.3
Minimum	24	Minimum	15.5	Minimum	12.5	Minimum	14.9
Maximum	60	Maximum	41.6	Maximum	25.3	Maximum	27.2
Sum	2216.3	Sum	1627.5	Sum	1023.5	Sum	1145
Count	55	Count	56	Count	56	Count	56

The interior surfaces of the Dinetah Gray vessels are primarily scraped parallel to the coils (n=42, or 76 percent). The majority of the remaining vessels (n=11) have smoothed interiors. The exterior surface of most of the vessels were obliquely scraped (scraped diagonally to the coils). According to Brugge (1981), this surface treatment was most likely made by a corncob being scraped across the surface of the vessel.

Surface attrition was found primarily on the interior of vessels. Forty-seven vessels have pitting on the interior surface. This may be due to fire cracking; however, this is unlikely due to the lack of exterior surface pitting on most of these vessels. It is more likely that this surface attrition is the result of thermal stress, chemical corrosion, or physical abrasion (Hally 1983b; Skibo and Blinman 1999). All three of these possibilities can be related to the use of these vessels for cooking. Interior attrition most likely is not related to transportation techniques. The remaining vessels (n=9) have no evidence of attrition on the interior surface, or the interior surface is covered and attrition could not be evaluated (n=1).

Only six vessels have evidence of attrition on the exterior surface of the vessel. Of these, grinding on the base, pitting below the maximum diameter, and exposed temper on the base are dominant. The location, usually between the maximum diameter and the base, suggests the attrition is due to cooking and not to transportation techniques. In other words, none of the attrition patterns observed on either the interior or exterior of the vessels indicate how these vessels may have been transported. None show wear around the neck that would be indicative of rope or other transport techniques.

Two Dinetah Gray vessels show limited evidence of having been transported. One vessel had a crisscrossed network of fibers covered by pitch around the base of the

vessel from the maximum diameter to the base (Figure 5-4). This network of fibers could have been used to carry the vessel. Another vessel has several pairs of holes drilled near the rim that did not appear to be the result of crack repair and may have been used during transport by attaching fibers to these holes to create loop handles. These holes might also be a preventative repair although no hairline fractures were visible.

Figure 5-4. Dinetah Gray vessel with crisscrossed fibers and pitch.

Of the 57 vessels, 51 have exterior sooting, and 78 percent of these (n=40) exhibit heavy to moderate sooting (Table 5-3). Most sooting occurred from the edge of the base of the vessel to above the maximum diameter. Sooting was often heaviest around the maximum diameter. This sooting pattern is most likely because the vessels were placed directly in the fire with the flame in contact with the sides of the vessel (Hally 1983b).

Very few of the vessels retain residue on the interior surface. Ninety percent of the Dinetah Gray vessels (n=51) show no evidence of interior residue (Table 5-4). This is

surprising considering the fact that most of these vessels are whole or nearly whole cooking vessels. Many of the vessels from the Gallegos Collection were recovered from storage contexts. Many of these vessels, as well as vessels from other collections, have multiple repair holes. Some of these repair holes and the associated vegetal or animal residue were still present, suggesting that these vessels were first used for cooking followed by use as storage containers after they had been damaged or cracked. It is possible that they were cleaned prior to repair and used as storage vessels.

Table 5-3. Exterior sooting distribution by ceramic type.

Ceramic Type	Heavy	Light	Moderate	None	Unknown	Total
Blind Corrugated (indented and not)		2	2			4
Cundiyo Smeared Indented			1			1
Dinetah Gray	20	11	20	4	2	57
Striated	1	8	6	3		18
Navajo Gray	2	11	2	15		30
Pecos Plain		2				2
Rio Grande Plain	8	17	13	7		45
Unknown		1		1		2
Zia	1					1
Tool marked				1		1
Total	32	52	44	31	2	161

Table 5-4. Interior residue distribution by ceramic type.

Ceramic Type	Heavy	Light	Moderate	None	Unknown	Total
Blind Corrugated				4		4
Cundiyo Smeared Indented				1		1
Dinetah Gray	2			51	4	57
Striated			1	17		18
Navajo Gray		2	3	25		30
Pecos Plain				2		2
Rio Grande Plain		4		39	2	45
Unknown				2		2
Zia				1		1
Tool marked				1		1
Total	2	6	4	143	6	161

The basal angle of Dinetah Gray vessels averages 78.57 degrees (Table 5-5). All Dinetah Gray vessels have basal angles less than 90 degrees and all are considered conical. The standard deviation of the basal angle is 6.27 degrees. These results suggest

that the conical vessel shape is the dominant, if only, form of Dinetah Gray vessels and that this was the standard form manufactured by Navajo potters during this early period.

Table 5-5. Summary statistics for basal angle in Dinetah Gray and Navajo Gray vessels.

Basal Angle of Dinetah Gray		Basal Angle of Navajo Gray	
Mean	78.56824561	Mean	85.27225806
Standard error	0.830961642	Standard error	1.413933787
Median	79.65	Median	84.58
Standard deviation	6.273622821	Standard deviation	7.872450152
Sample variance	39.3583433	Sample variance	61.9754714
Range	27.33	Range	35.62
Minimum	65.57	Minimum	73.16
Maximum	92.9	Maximum	108.78
Sum	4478.39	Sum	2643.44
Count	57	Count	31

Navajo Gray Whole Vessels

Thirty Navajo Gray vessels were examined. The mean height is 26.8 cm with a standard deviation of 5.97 cm. The mean maximum diameter is 17.94 cm with a standard deviation of 4.33 cm (Table 5-6). Navajo Gray vessels tend to be smaller in both height and maximum diameter relative to Dinetah Gray vessels. Differences could be the result of differences in sample size, however. The average wall thickness is 5.35 mm at the lip and 5.41 mm at the neck.

Table 5-6. Navajo Gray descriptive statistics.

Height (cm)		Max Diam. (cm)		Neck Diam. (cm)		Aperture Diam. (cm)	
Mean	26.85	Mean	17.94	Mean	14.59	Mean	16.64
Standard error	1.09	Standard error	0.79	Standard error	0.59	Standard error	0.66
Median	26.95	Median	17.15	Median	14.20	Median	16.45
Mode	27.80	Mode	24.00	Mode	19.00	Mode	15.00
Standard deviation	5.97	Standard deviation	4.33	Standard deviation	3.24	Standard deviation	3.64
Sample variance	35.69	Sample variance	18.75	Sample variance	10.50	Sample variance	13.22
Range	22.50	Range	16.00	Range	16.10	Range	15.50
Minimum	17.90	Minimum	11.00	Minimum	7.90	Minimum	10.80
Maximum	40.40	Maximum	27.00	Maximum	24.00	Maximum	26.30
Sum	805.60	Sum	538.20	Sum	437.80	Sum	499.10
Count	30.00	Count	30.00	Count	30.00	Count	30.00

Like Dinetah Gray vessels, height and maximum diameter of the Navajo vessels also appear to be positively correlated as shown in the scatter plot in Figure 5-5. Height and maximum diameter both increase at a constant rate. Unlike Dinetah Gray vessels, positive correlation also appears to be the case for the relationship of height to neck diameter and aperture diameter (Figure 5-5). Both measurements appear to increase as height increases.

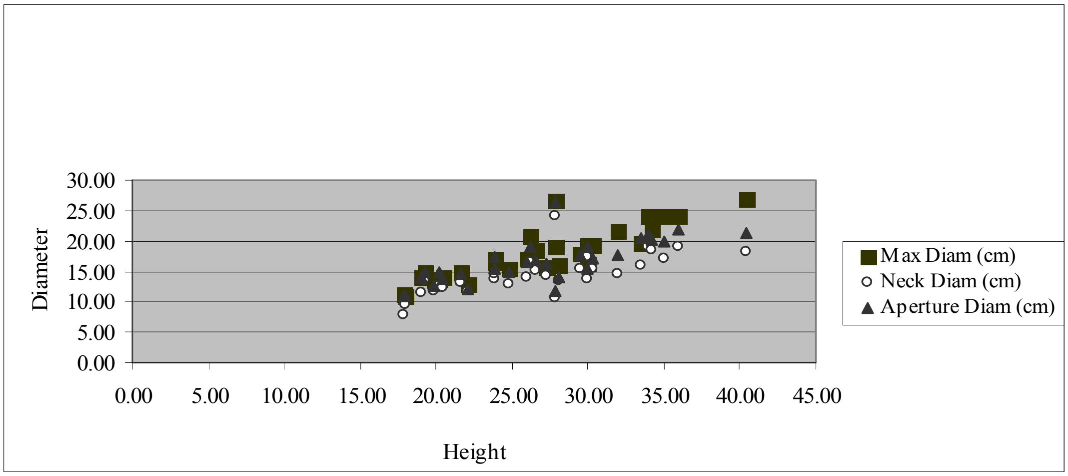

Figure 5-5. Relationship of height to maximum, aperture, and neck diameter in Navajo Gray vessels.

Scraping, primarily parallel scraping, is slightly more common for interior surface treatment on Navajo Gray vessels. Smoothing is the next most common. Some polishing also was observed in association with both of these types of surface treatment. Oblique scraping is the most common type of exterior surface treatment (83 percent). This is also the most common exterior surface treatment for Dinetah Gray vessels.

Attrition patterning for Navajo Gray was similar to Dinetah Gray. Only four vessels show signs of exterior attrition. Attrition consisted of pitting and scratches, and was located below the maximum diameter primarily on the base of the vessel. This

suggests that attrition is the result of use in cooking and not in transport. None of the Navajo vessels had appendages or holes that may have been used to attach loop handles to the vessel for transportation. Just over half of Navajo Gray vessels (n=19) had interior attrition. Vessels with interior attrition comprised 63 percent of the sample compared to 82 percent of the Dinetah Gray vessels. Most attrition (n=16) consisted of pitting and most likely was caused by repeated heating cycles that would be expected for a cooking vessel.

Fifty percent of Navajo Gray vessels (n=15) exhibit evidence of exterior sooting, and 11 of these had only light sooting (Table 5-3). Sooting was usually located above the maximum diameter. This type of sooting is indicative of placement directly in the fire. The majority of vessels with soot (n=13) also had a conical base whereas only 2 rounded-base vessels had sooting; suggesting that Navajo Gray vessels with conical bases were more often placed in direct contact with the fire and not over coals. Five vessels had evidence of interior residue; most likely the result of use (Table 5-4). Some of this residue could be carbon deposited by contents being boiled (Skibo and Blinman 1999).

The mean basal angle of Navajo Gray vessels is 85.27 degrees with a standard deviation of 7.87 degrees (Table 5-5). The basal angle is higher in the Navajo Gray vessels than the Dinetah Gray vessels, most likely due to the presence of nine Navajo Gray vessels with basal angles larger than 90 degrees in the sample. Thirty percent of the Navajo Gray samples have a rounded base, suggesting more variation in overall vessel shape in the Navajo Gray vessels relative to Dinetah Gray vessels.

Rio Grande Plain Whole Vessels

Forty-five Rio Grande Plain vessels were examined. The mean height of these vessels is 18.42 cm, which is significantly different than the height of the Dinetah and Navajo Gray vessels (Table 5-7). The mean maximum diameter is 22.34 cm. The maximum diameter in Rio Grande Plain vessels is slightly less than Dinetah Gray vessels and slightly larger than Navajo Gray vessels. These measurements show quantitatively that Rio Grande Plain vessels have a shorter and squatter appearance than the Dinetah Gray and Navajo Gray vessels (Figure 5-6).

Table 5-7. Rio Grande Plain descriptive statistics.

Height (cm)		Max Diam. (cm)		Neck Diam. (cm)		Aperture Diam. (cm)	
Mean	18.422727	Mean	22.338	Mean	16.79778	Mean	18.12444
Standard error	1.2288028	Standard error	1.3430113	Standard error	0.840109	Standard error	0.995836
Median	16.25	Median	20.4	Median	16.1	Median	17.5
Mode	16.7	Mode	28.2	Mode	16	Mode	12
Standard deviation	8.1509555	Standard deviation	9.00919369	Standard deviation	5.635621	Standard deviation	6.680268
Sample variance	66.438076	Sample variance	81.1655709	Sample variance	31.76022	Sample variance	44.62598
Range	38.6	Range	36.5	Range	20.9	Range	30.9
Minimum	7.9	Minimum	11.3	Minimum	8.3	Minimum	1.9
Maximum	46.5	Maximum	47.8	Maximum	29.2	Maximum	32.8
Sum	810.6	Sum	1005.21	Sum	755.9	Sum	815.6
Count	44	Count	45	Count	45	Count	45

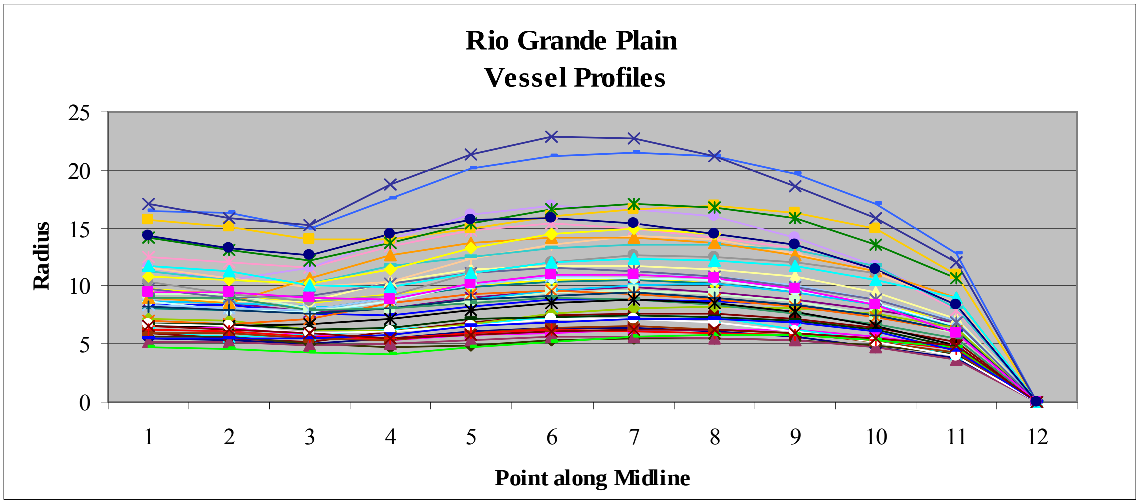

Figure 5-6 Rio Grande Plain vessel profiles.

The relationship of height to the maximum diameter, neck diameter, and aperture diameter measurements appears to be consistent (Figure 5-7). As height increases, so do maximum diameter, neck diameter, and aperture diameter. This holds true except in a few of the taller Rio Grande Plain vessels. Based on this very limited sample, neck and aperture diameter do not increase much above 30 cm no matter how tall the vessel. This implies that height and the three diameter measurements are positively correlated up to a certain height.

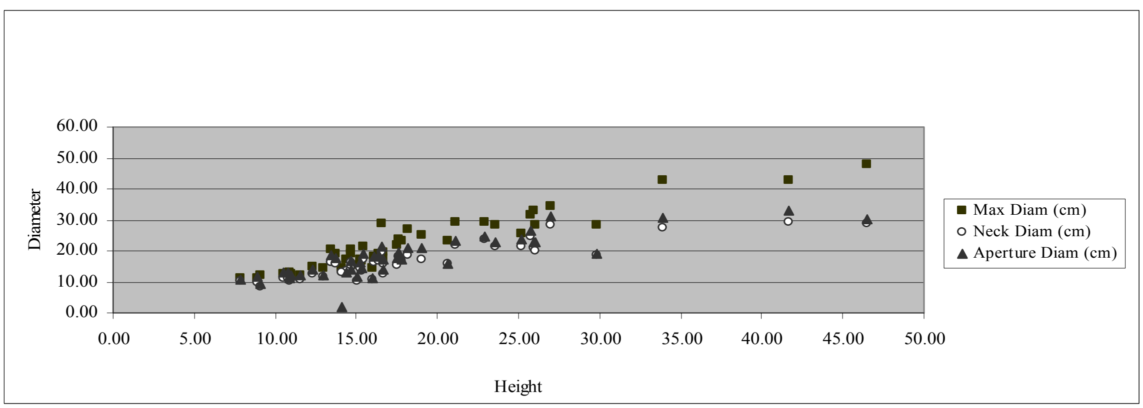

Figure 5-7. Relationship of height to maximum diameter, neck diameter, and aperture diameter in Rio Grande Plain vessels.

Interior surface treatment is most commonly lightly polished, although one vessel was highly polished on the interior. The other type of interior surface treatment is smoothing. The exterior of most of the vessels are smoothed, although coils are still visible on two vessels, and two vessels are obliterated corrugated.

The exterior of the Rio Grande Plain vessels show significantly more attrition than both Dinetah Gray and Navajo Gray vessels. Attrition type also was more variable than both of the Navajo types. Seventy-two percent of the vessels (n=32) exhibit exterior attrition. Grinding and pitting on or near the base are the most common types of attrition observed. Other types of attrition include exposed temper, scratches, spalling, and unidentifiable wear. These attrition patterns are more indicative of use in cooking than transportation. The only possible evidence of transportation is the presence of handles on two Rio Grande Plain vessels, although these handles could serve other functions as well. Handles on both of these vessels are vertical coils approximately 4.5 cm high on opposite sides of the vessel attached at the neck and the body (Figure 5-8).

Figure 5-8. Rio Grande Vessel with handles.
(Vessel 39-21-100 of the Maxwell Museum collection)

Interior attrition was found on 77 percent of the vessels (n=34). Most of this attrition consists of pitting (n=18) with scratches the second most common (n=8). Other attrition types observed include exposed temper and spalling. Most of the attrition is located below the maximum diameter down to the base of the vessel. As previously stated, this attrition is consistent with cooking vessels. Stirring the contents of the vessel might cause scratches and pitting, particularly below the maximum diameter. Repeated heating cycles also might be responsible for the pitting.

Eighty-four percent of the Rio Grande Plain vessels exhibit exterior sooting (n=38); only eight of these are heavily sooted (Table 5-3). The remaining have light to moderate sooting on the exterior of the vessel. Most of this sooting is located from the edge of the base to the rim, most likely the result of placing the vessel in the fire with flames contacting the sides of the vessel. Four vessels have light residue on the interior surface (Table 5-4). Thirty-nine vessels have no evidence of interior residue, and the interiors of two vessels are obscured and residue could not be assessed. Because most of these vessels have been in museum collections, they have most likely been washed and residue could have been removed.

The basal angle of the Rio Grande Plain vessels averages 103.8 degrees with a standard deviation of 9.05 degrees. Only one vessel has a basal angle less than 90 degrees and the majority of vessels have a basal angle of approximately 100 degrees. This is significantly greater than the angles of both Dinetah Gray and Navajo Gray vessels and further quantitatively illustrates the overall differences in vessel shape between the Navajo and Puebloan types.

Pecos Striated Whole Vessels

Eighteen Striated vessels were examined from Pecos Pueblo. The majority of vessels have a polished interior and striated exterior surface treatment. Smoothed interiors and exteriors also were observed. The average height of these vessels is 22.46 cm and the average maximum diameter is 29.03 cm (Table 5-8). These vessels tend to be wider than they are tall. Both the average neck diameter and average aperture diameter also are larger than the average height.

Table 5-8. Pecos Striated descriptive statistics.

Height		Maximum Diam.		Neck Diam.		Aperture Diam.	
Mean	22.45714	Mean	29.0308	Mean	23.2063	Mean	24.7733
Standard error	1.910729	Standard error	1.07914	Standard error	1.56654	Standard error	1.66755
Median	23	Median	29.3	Median	21.55	Median	23
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	23
Standard deviation	5.055313	Standard deviation	3.89088	Standard deviation	6.26615	Standard deviation	6.45838
Sample variance	25.55619	Sample variance	15.139	Sample variance	39.2646	Sample variance	41.7107
Range	15.3	Range	12.2	Range	25.5	Range	26.5
Minimum	14	Minimum	22.3	Minimum	15.5	Minimum	16.7
Maximum	29.3	Maximum	34.5	Maximum	41	Maximum	43.2
Sum	157.2	Sum	377.4	Sum	371.3	Sum	371.6
Count	7	Count	13	Count	16	Count	15

The relationship of height to the maximum diameter, neck diameter, and aperture diameter measurements is variable. Maximum diameter does appear to increase slightly as height increases, but this does not appear to be consistent. Neck and aperture diameter appear to remain relatively constant (Figure 5-9). These results are constrained by the small sample size.

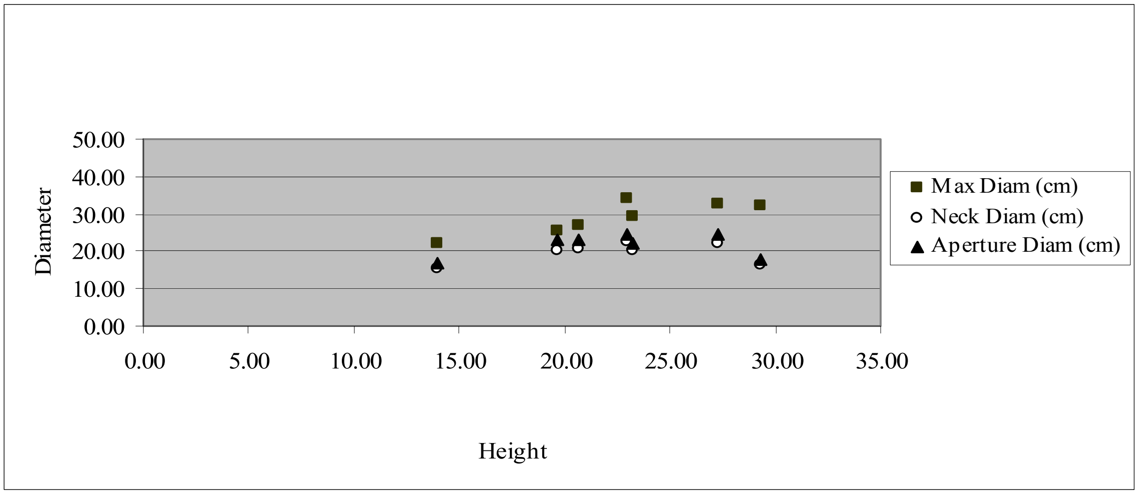

Figure 5-9. Relationship of height to maximum diameter, neck diameter, and aperture diameter in Pecos Striated vessels.

Exterior attrition on Pecos Striated vessels was found on four of the 18 vessels examined. This attrition consists of pitting (n=2), spalling (n=1), and grinding (n=1). Attrition is primarily located below the maximum diameter to the base. These types of attrition suggest cooking use; however, the sample is very small and the lack of macroscopic attrition on the exterior of most of the vessels severely limits any conclusions that may be drawn based on this single attribute. One Pecos Striated vessel has handles near the rim that might have been used to transport the vessel or suspend it over a fire. Handles might also provide leverage for moving the vessel around the fire.

Interior attrition is common on Pecos Striated vessels. Attrition was found on all but two vessels and consists of pitting and/or scratches. Most attrition is located around or below the maximum diameter of the vessel. This is consistent with their use as cooking vessels. Heating and stirring contents could result in both of these attrition types.

Exterior sooting was found on 83 percent of the vessels (n=15); most is light to moderate with only one vessel having heavy sooting (Table 5-3). This further supports the proposition that these vessels were primarily used for cooking. Sooting occurred in patches on many vessels and was located from the base up to the rim. Soot on the base of nine vessels suggests that these vessels were placed over the fire during the initial stage of combustion while an open flame was still present. Interior residue was found on only one vessel.

The average basal angle of Pecos vessels is 100.65 degrees. This is slightly less than the Rio Grande Plain vessels. This average is based on only 11 vessels. Basal angle could not be calculated on several of the Pecos vessels due to a missing base or otherwise fragmentary condition.

Summary of Whole Vessels

As expected, the quantitative data showed marked differences between the Navajo and Puebloan types. Dinetah Gray vessels are taller and wider than the other types examined. Dinetah Gray vessels are on average 22 cm taller and 7 cm wider than Rio Grande Plain vessels. The various types were combined based on basal type (conical vs. round) for statistical comparisons. The height of the Navajo types (both Dinetah Gray and Navajo Gray) is statistically significantly different from the Puebloan types at the .05 level (Figure 5-10).

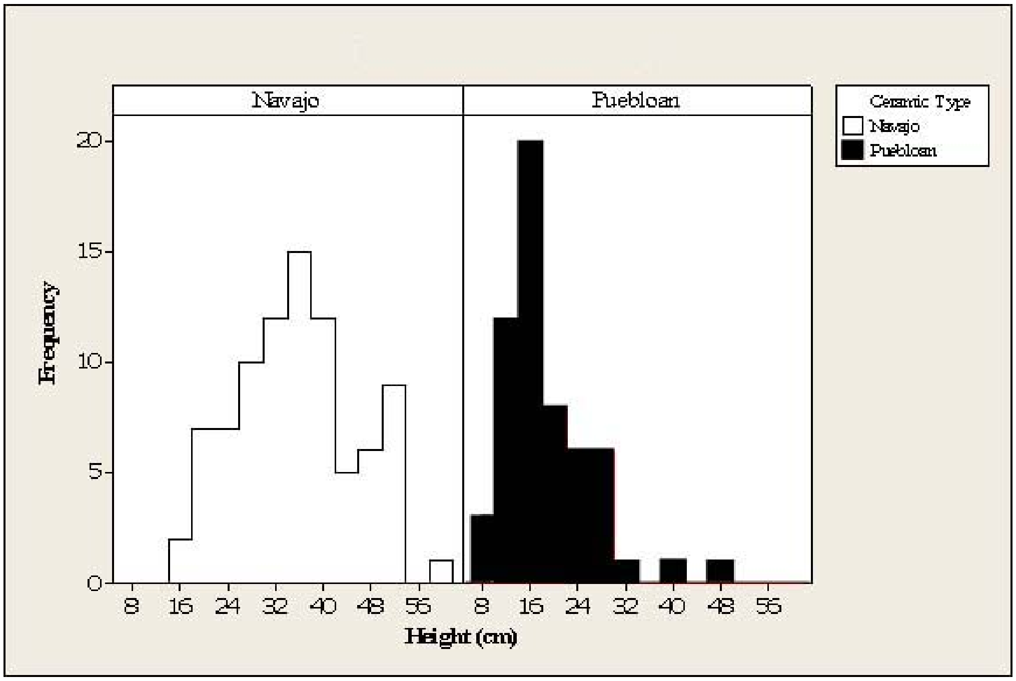

Figure 5-10. Histogram of whole vessel height (cm).

Maximum diameter, neck diameter, and aperture diameter, however, are not significantly different. All of these measurements were similar between the two ceramic groups. This means that although Navajo types were much taller on average than Puebloan types, the widths of the two forms were very similar. Puebloan vessels had more variation in these measurements than the Navajo vessels (Figure 5-11 through 5-13).

The relationship between height and diameter is variable between the Navajo and Puebloan groups. Not unexpectedly, height is positively correlated with maximum diameter, aperture diameter, and neck diameter in both ceramic groups. There are observable differences, however. The maximum diameter increases with height in both ceramic groups, but the aperture and neck diameters increase with height at a much greater rate in the Puebloan types. Aperture and neck diameter increase at a much smaller rate in the Navajo types (Figures 5-14 through 5-16).

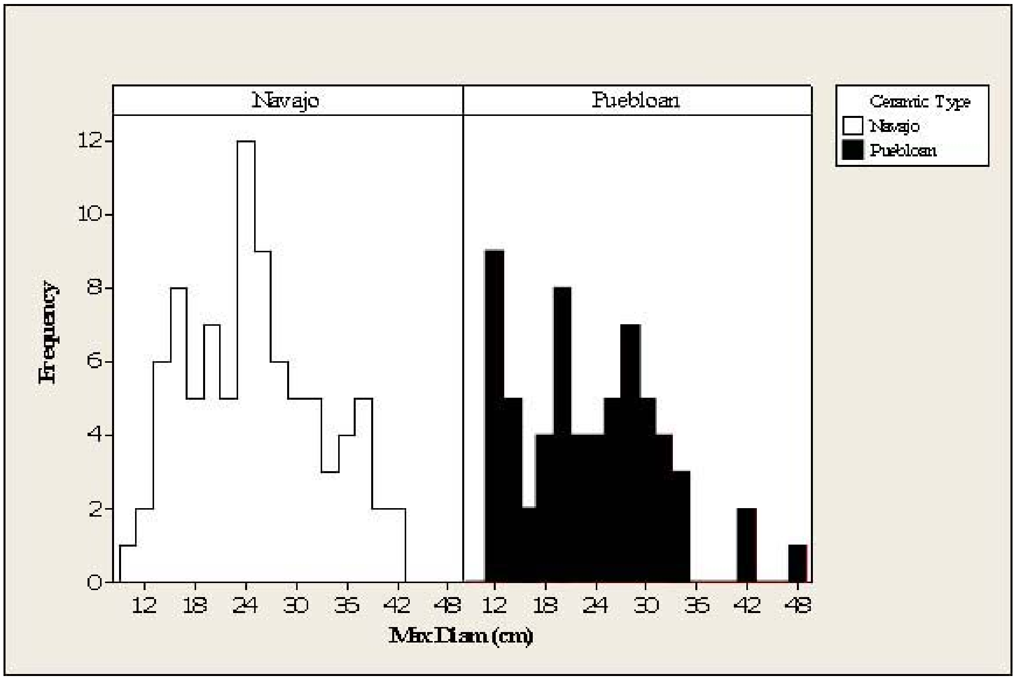

Figure 5-11. Histogram of maximum diameter (cm).

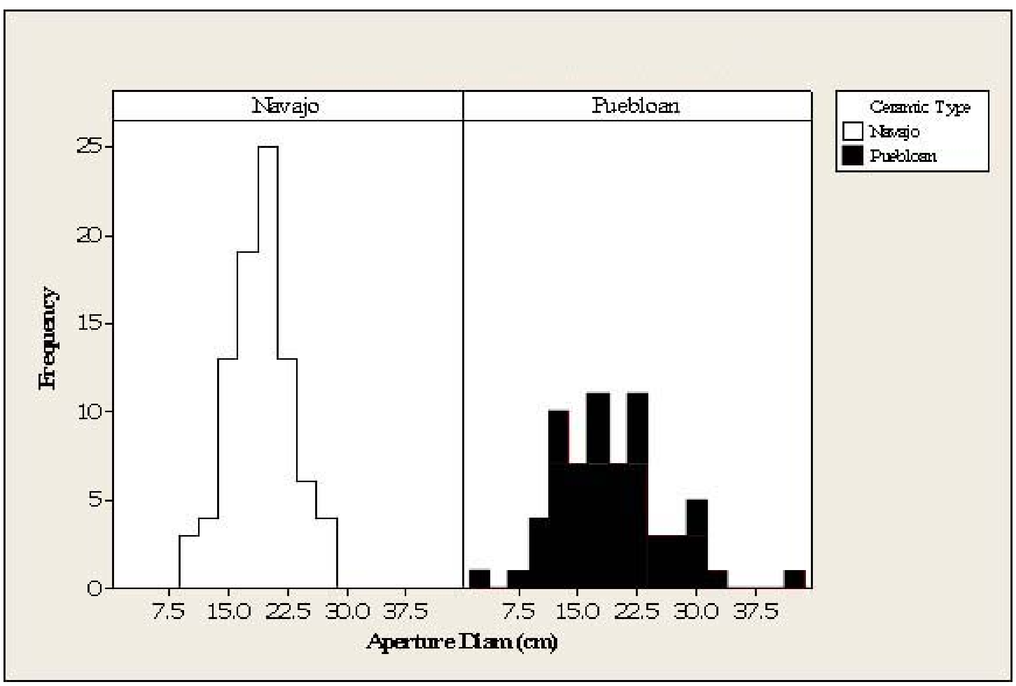

Figure 5-12. Histogram of aperture diameter (cm) of whole vessels.

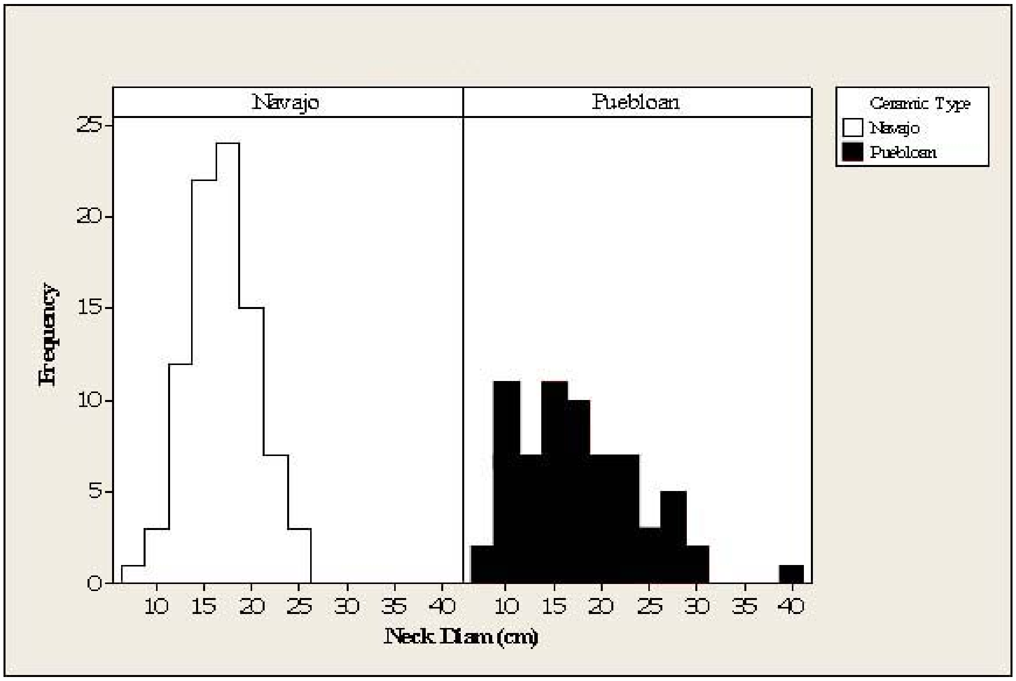

Figure 5-13. Histogram of neck diameter (cm) of whole vessels.

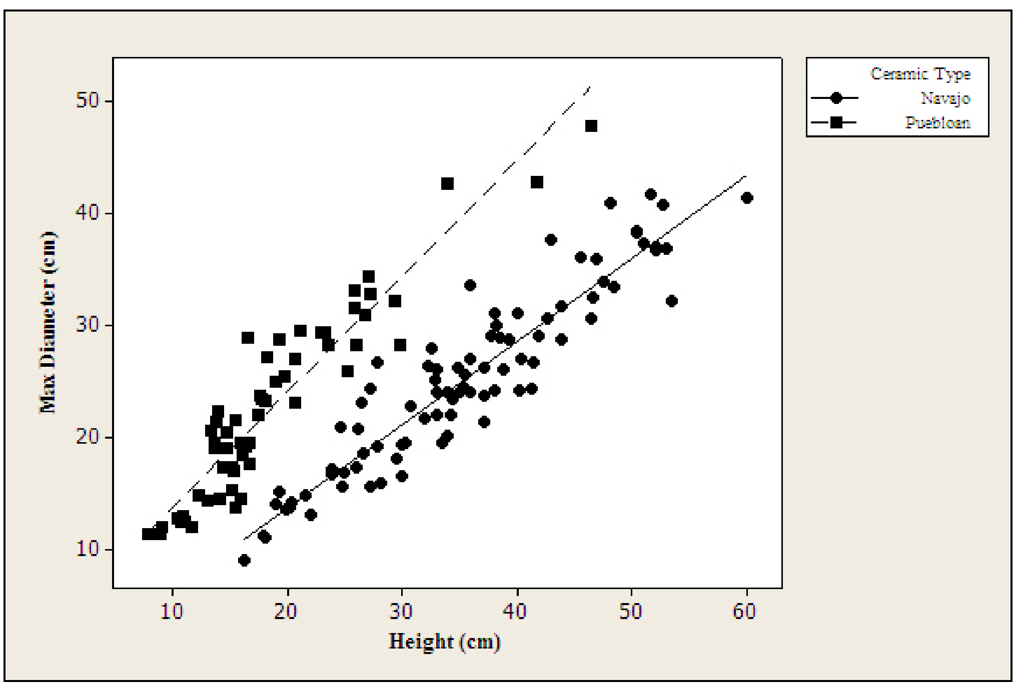

Figure 5-14. Scatter plot of relationship between height and maximum diameter of the two groups.

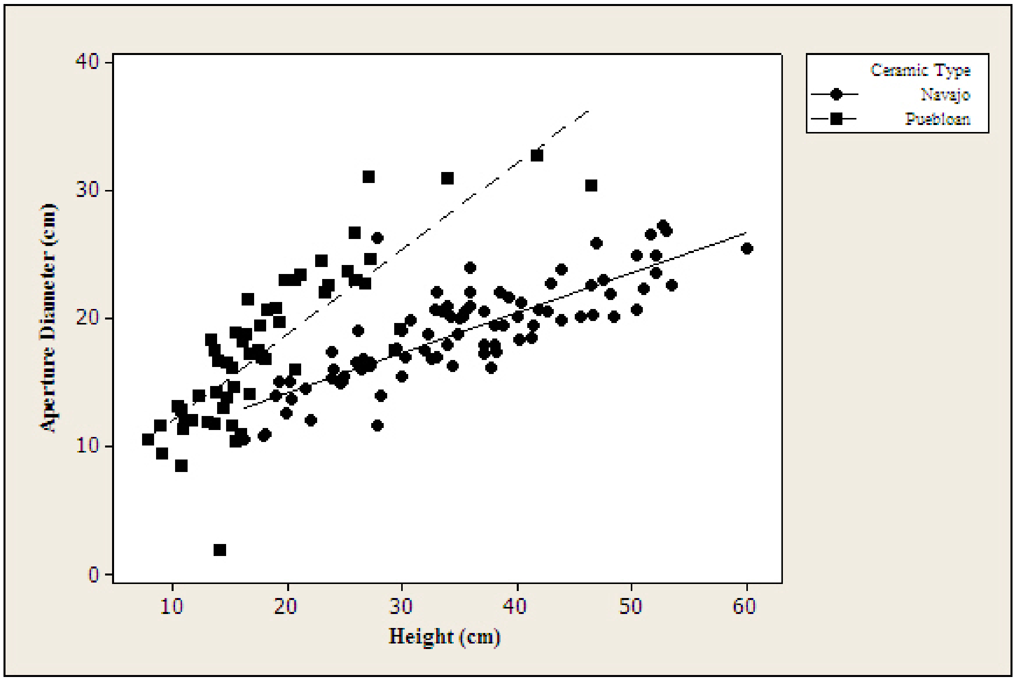

Figure 5-15. Scatter plot of relationship between height and aperture diameter of the two groups.

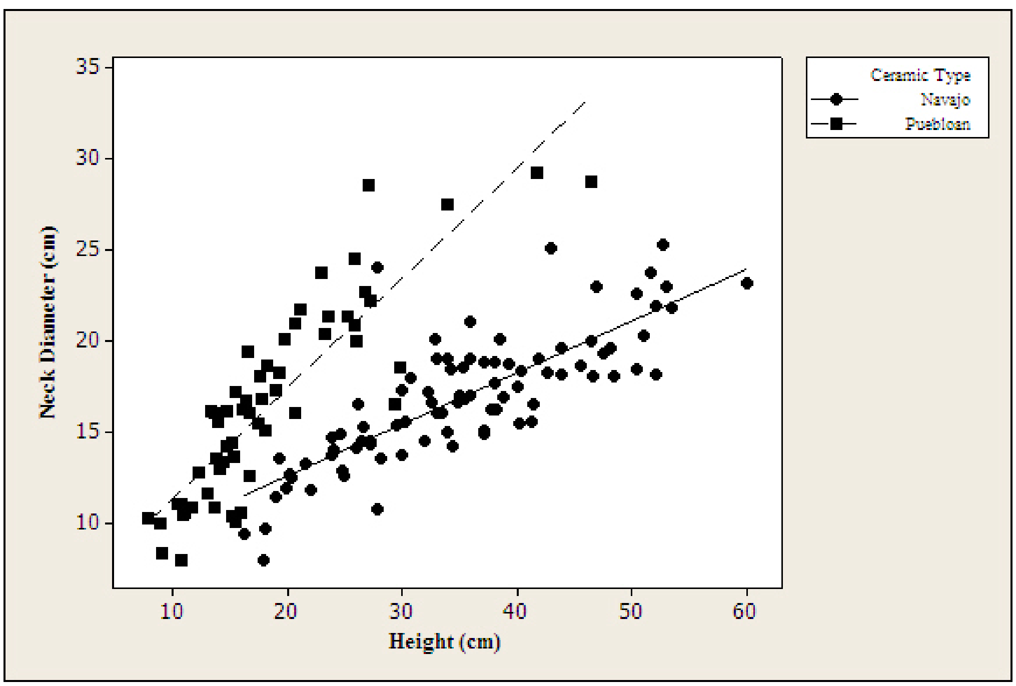

Figure 5-16. Scatter plot of relationship between height and neck diameter of the two groups.

Average volume (v=18,261 cm³) of the Navajo types differed from the Rio Grande Plain vessels (v=7,177 cm³) by 11,084 ml (Figure 5-17). A t-test was performed on the volume data, and it was determined that the difference between these two means is statistically significant at the .05 level. This difference in size necessitated a reduction in size of the reproductions of the Navajo types in order to accurately assess differences in performance due to variation in vessel shape.

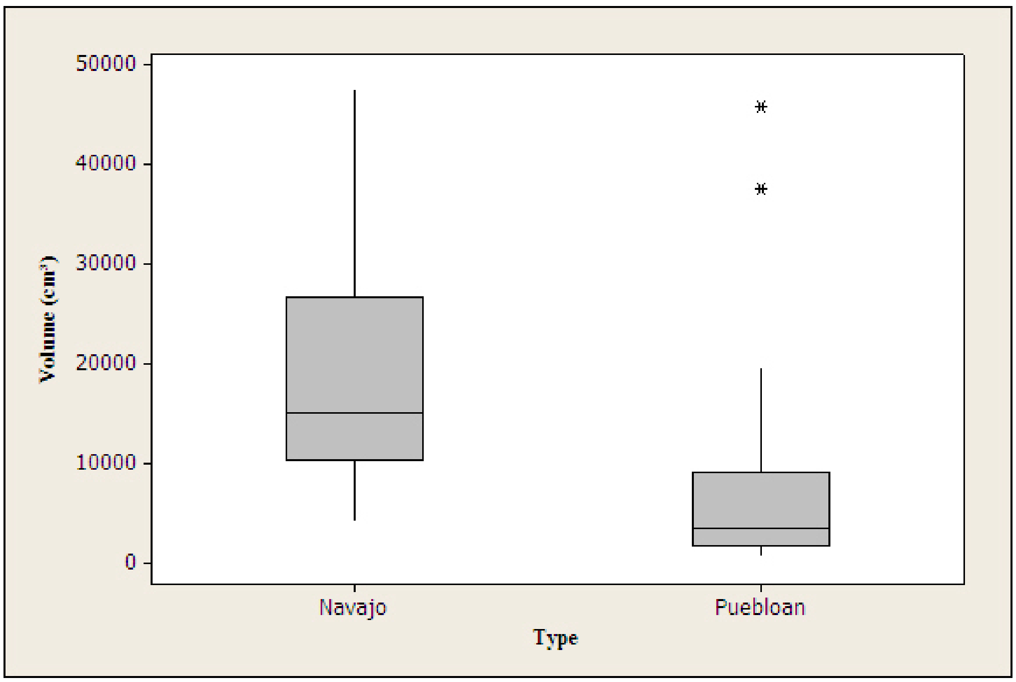

Figure 5-17. Box-and-whisker plot showing variation in volume between the two groups.

However, this difference in size would no doubt affect the performance characteristics and use of the two vessels. Larger vessels would be heavier and, therefore, more likely to break when dropped. Variation in size might reflect differences in foods cooked and methods of preparation, household size, household wealth or status, or feasting (Mills 1999). A larger cooking vessel could be used to feed more people, and

might reflect a more communal structure at mealtime. Large vessels also may have been used for long-term simmering and eating throughout the day.

Mean wall thickness is greater in Rio Grande Plain vessels relative to Navajo types. The average wall thickness of Dinetah Gray vessels is 3.95 mm compared to 5.72 mm for Rio Grande Plain vessels. Wall thickness was measured at the lip and neck, and increased from the lip to the neck. Thinner walls may have been a strategy that Navajo potters employed to reduce the cost of making larger vessels and improve thermal efficiency. Having thinner walls also may have offset the cost of manufacturing such large vessels in terms of weight (Beck 2009).

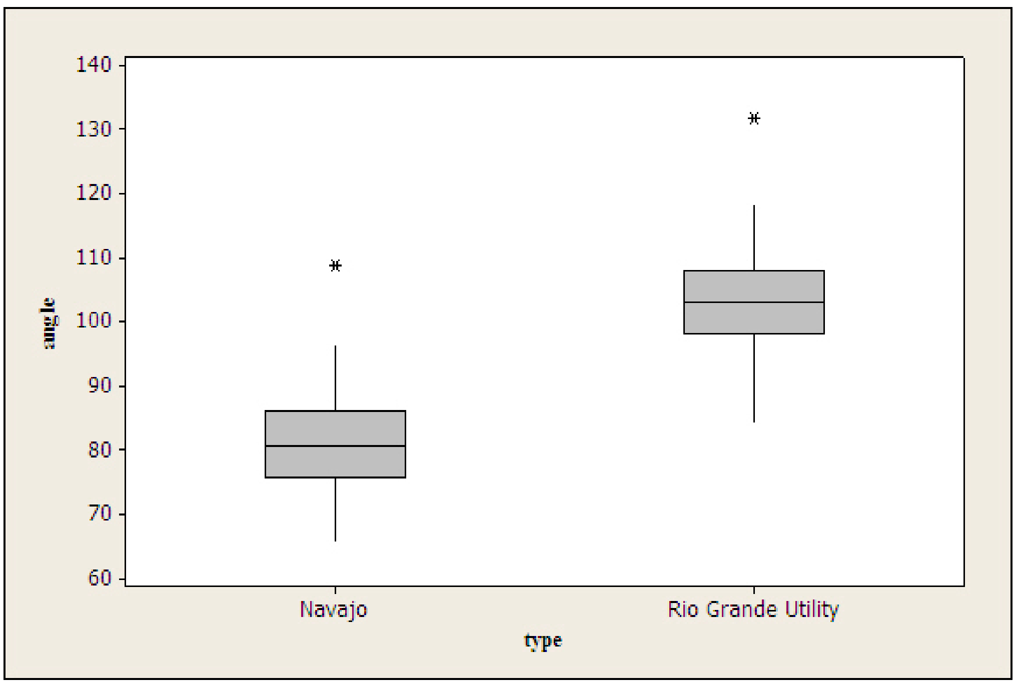

Figure 5-18. Box-and-whisker plot showing relationship between basal angles of the two groups.

Data on basal angles and vessel profiles also illustrate these differences. The difference in average basal angle between the Dinetah Gray vessels and the Rio Grande Plain vessels is 25 degrees (Figure 5-18). All of the basal angles of both Navajo types

were grouped as well as the Rio Grande Plain varieties. A t-test was performed on these two groups, and the difference between the two is statistically significant at the .05 level. The graphs of vessel profiles show variation in shape between the two categories (Figure 5-19).

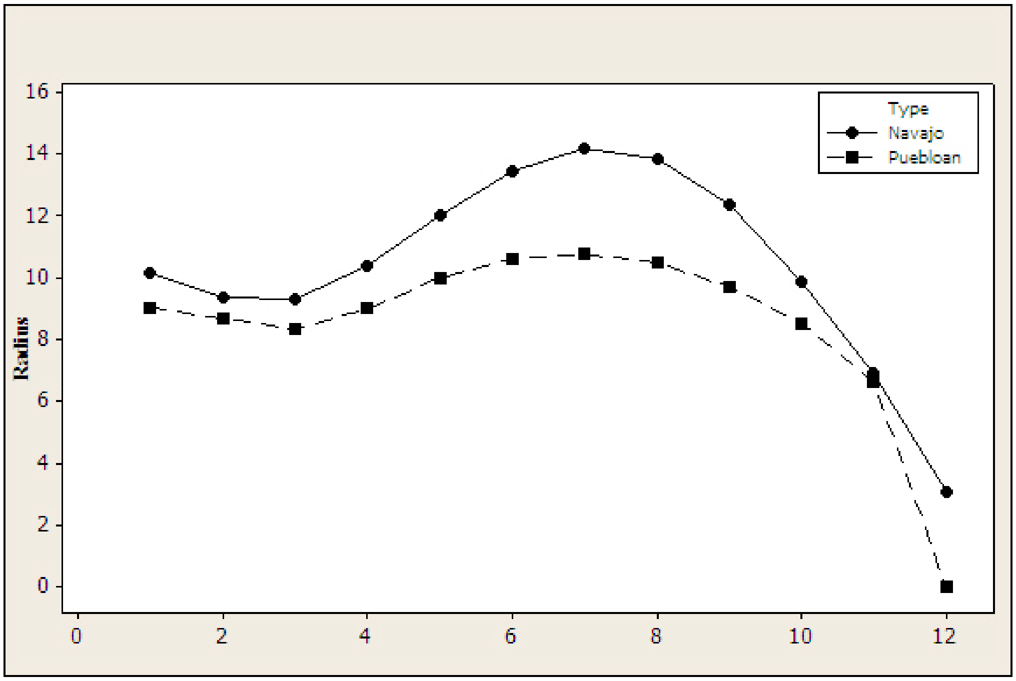

Figure 5-19. Comparison of the vessel profile between the two groups.

Attrition and sooting patterns are similar between the Navajo and Puebloan groups. This is most likely due to the similar use as cooking vessels by both groups. Attrition appeared to be primarily the result of cooking as opposed to transportation. Both exterior and interior attrition appear to be primarily located below the maximum diameter to the base.

Exterior attrition is more common on Rio Grande Plain vessels (71 percent) than the Navajo types (12 percent for both Dinetah and Navajo Gray). The most common exterior attrition types are grinding and pitting. The location and type of attrition on Rio Grande Plain vessels is most likely due to cooking. Removing a vessel from and placing

a vessel on a fire dog would most likely cause wear along the base and edges of the base. Pitting on the exterior below the maximum diameter could be caused from repeated exposure to heat. Pitting is associated with thermal stress, chemical corrosion, or physical abrasion. The increased frequency of pitting on Rio Grande Plain vessels suggests that these vessels are less resistant to thermal stress.

Interior attrition was found on 76 percent of vessels analyzed and is most common on Pecos Striated and Plain (88 percent) followed by Dinetah Gray vessels (82 percent), Rio Grande Plain (77 percent), and finally Navajo Gray (63 percent). The most common type is pitting (60 percent). A combination of scratches and pitting is the second most common interior attrition type (12 percent). Most of this attrition is located around and below the maximum diameter of the vessel and, therefore, most likely is the result of stirring and heating contents. As stated above, pitting may be the result of thermal stress, chemical corrosion, or physical abrasion. Because the frequency of this type of attrition was similar across types, it is not readily apparent if these results exhibit any substantive differences between the two basal shapes.

Appendages and holes are not common on any of the vessels (n=5). Two Dinetah Gray vessels (three percent) show such evidence; one has holes near the rim that did not appear to be repair holes, and one has fibers crisscrossed across the base and held in place with resin. No Navajo Gray vessels have holes or appendages. Two of the Rio Grande Plain vessels (four percent) and one Pecos Striated vessel (five percent) have handles. These modifications to the vessels may have been related to the transportation or placement relative to the fire.

Exterior sooting was found on 80 percent of the vessels examined. Exterior sooting is heaviest on Dinetah Gray vessels, but this could be the result of differences in the nature of the collections used. Most of the Dinetah Gray vessels examined were from a private collection and had never been washed. The other vessels are from museum collections and may have been cleaned at some time in the past. There was some variation in the location of sooting between the Navajo types and Rio Grande Plain vessels. Sooting on Dinetah Gray vessels is located primarily below the maximum diameter to the edge of the base, but on Rio Grande Plain vessels, sooting was observed up to the rim of many vessels.

This difference in sooting most likely represents variation in how vessels were placed in the fire. If a vessel was placed directly in the fire, the bottom half of the vessel from the maximum diameter to the base would be directly in contact with the flame so that soot would be deposited on the vessel surface during heating. The primary location of sooting on Dinetah Gray vessels is between the maximum diameter and the outer edge of the base. On a vessel that is placed above a fire, the most extreme heat would be on the base with flames going up the sides and possibly depositing soot. The area of most intense heat would not leave deposits because soot in this area would be oxidized. This type of soot deposition would not be expected to create as heavy a layer as direct exposure to flame, which may explain why Dinetah Gray vessels tend to have heavier soot deposition than Rio Grande Plain vessels. Both vessel types have little soot deposition on the base of the vessel, most likely resulting from the placement of this part of the vessel over or in the hottest portion of the fire. These patterns may also be the

result of the stage of the fire when the vessel was placed in contact with it. Coals do not leave heavy soot deposition relative to flame.

Ninety-three percent of all vessels show no evidence of residue on the interior. Residue is most common in Navajo Gray vessels, although only 17 percent (n=5) of these vessels have residue compared to four percent (n=2) of the Dinetah Gray. Eight percent (n=4) of the Rio Grande Plain vessels have interior residue. The location of residue on Navajo Gray vessels is primarily from the neck to the rim while Rio Grande Plain vessels have residue near the base.

Results: Sherds

Dinetah Gray

A total of 132 Dinetah Gray sherds was examined. These sherds were recovered from at least six different sites and, therefore, are from at least six different vessels. Sherds were taken from different units and areas of the same site to avoid biasing the sample. The majority of these are body sherds (n=121, or 92 percent). Nine rim sherds, one base sherd, and one neck sherd also were included in the analysis (Table 5-9).

Thickness of these sherds averages 4.32 mm with a standard deviation of .65 mm. This suggests that vessel thicknesses were relatively consistent across vessels, even those recovered from different sites. This average thickness also is similar to the average thickness of the Dinetah Gray whole vessels examined. The slight difference of .37 mm between the whole vessels and sherds is most likely the result of the difference in the location of the vessel at which the measurement is taken. Wall thickness was taken at the neck and lip of the whole vessels, and because most of the sherds were body sherds, wall

thickness was taken primarily on the body of the vessel. It would appear that wall thickness increases from the lip of a vessel to the body.

Table 5-9. Sherds by ceramic type and sherd type.

Ceramic Type	Base	Body	Neck	Rim	Rim and Body	Total
Dinetah Gray	1	121	1	9		132
Jemez Smeared Indented Corrugated				1		1
Navajo Gray		13		4		17
Rio Grande Plain	2	53	1	64	1	121
Total	3	187	2	78	1	271

The majority of Dinetah Gray sherds have crushed rock temper (n=96, or 73 percent) (Table 5-10). The next most common temper is sand (n=31, or 23 percent). The remaining sherds have a combination of crushed rock and sherd temper. The temper for three sherds was unidentifiable. Most of this temper is fine. Extra fine is the next most common size grade, followed by medium size temper.

Table 5-10. Temper of sherds by ceramic type.

Ceramic Type	Crushed Rock	Crushed Rock and Sherd	Sand	Sand and Tuff	Sherd	Tuff	Unknown	Andesite	Total
Dinetah Gray	96	1	31		1		3		132
Navajo Gray	12		4						16
Rio Grande Plain	49	3	6	32	8	15	4	2	119
Total	157	4	41	32	9	15	7	2	267

All Dinetah Gray sherds were fired in a reducing atmosphere (Figure 5-20; Table 5-11). The majority were fully reduced (n=114, or 86 percent). This is similar to the results obtained from the whole vessel sample as well. Eighteen sherds were only partially reduced and none were oxidized.

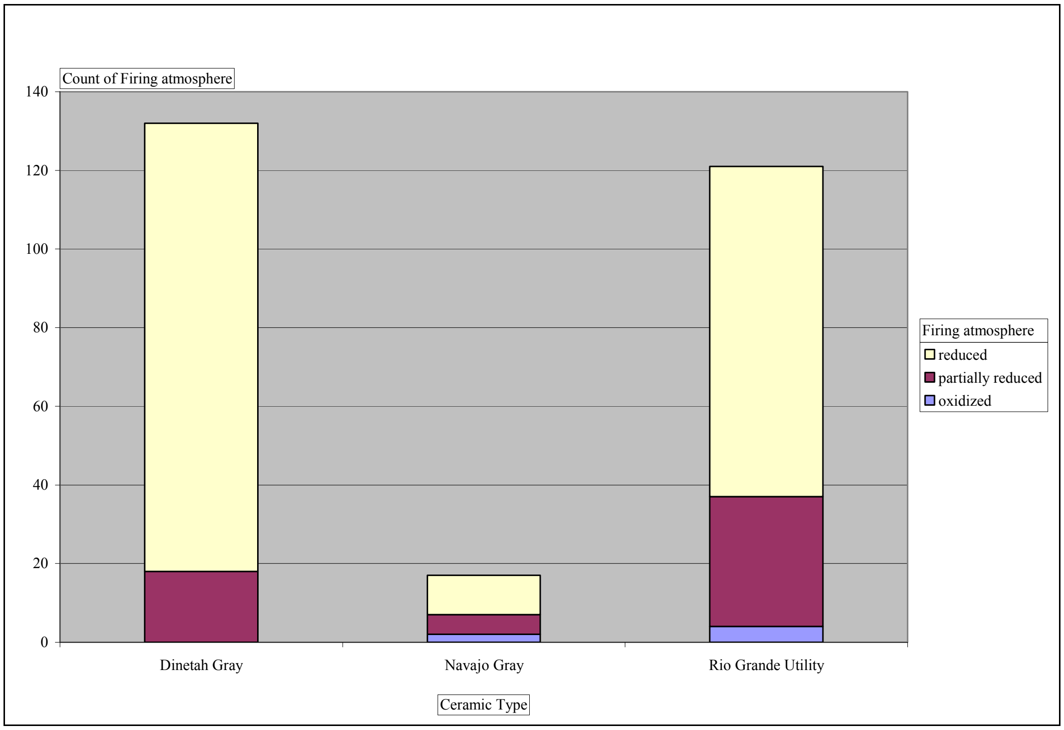

Figure 5-20. Firing atmosphere by type.

Table 5-11. Firing atmosphere of sherds by ceramic type.

Ceramic Type	Oxidized	Partially Reduced	Reduced	Total
Dinetah Gray		18	114	132
Navajo Gray	2	5	10	17
Rio Grande Plain	4	33	84	121
Total	6	56	208	270

Breakage patterns in Dinetah Gray sherds are primarily random (Table 5-12). Most breaks did not appear to follow coils. A small portion of the sample (n=17, or 13 percent) has breaks that did follow coils. This would suggest that coils in Dinetah Gray vessels were well joined and cohesive. Hardness was measured using the MOHs Scale. Fifty-seven percent of Dinetah Gray sherds had a hardness of 3.5 (Table 5-13). The remaining 57 sherds had a hardness of 2.5.

Table 5-12. Breakage patterns by ceramic type.

Ceramic Type	Nonrandom	Random	Total
Dinetah Gray	17	115	132
Navajo Gray	2	15	17
Rio Grande Plain	35	86	121
Total	54	216	270

Table 5-13. Hardness of sherds by ceramic type.

Ceramic Type	2	2.5	3.5	4.5	Total
Dinetah Gray		57	75		132
Navajo Gray		4	12	1	17
Rio Grande Plain	3	77	40	1	121
Total	3	138	127	2	270

Interior and exterior surface treatment varies within and between ceramic types (Table 5-14, Table 5-15). The interior surfaces of most Dinetah Gray sherds are smoothed (n=76, or 58 percent) (Table 5-14). The next most common surface treatment is parallel scraping (n=49, or 37 percent). This is slightly different than what was observed on the interior surface treatments of the whole vessels. Parallel scraping is by far the most common interior surface treatment in whole vessels. This difference may be caused by the difference in level of analysis. Some portions of the interior surface of a whole vessel might appear smoothed only if that portion were visible, as in sherds. Some vessels had interior surfaces that had been obliquely scraped (diagonal scrapes relative to the coils) or a combination of vertical, oblique, and parallel. One sherd appeared to have a slip and minimal paint on the interior surface, but this is very rare in Dinetah Gray ware.

Table 5-14. Interior surface treatment of sherds by ceramic type.

Ceramic Type	Lightly Polished	Obliquely Scraped	Parallel Scraped	Polished	Scraped	Slipped and Painted	Smoothed	Total
Dinetah Gray		3	49		3	1	76	132
Navajo Gray		1	3				13	17
Rio Grande Plain	50			33			38	121
Total	50	4	52	33	3	1	127	270

The exterior surface of the Dinetah Gray sherds examined is most commonly obliquely scraped (n=58, or 44 percent) or smoothed (n=57, or 43 percent) (Table 5-15). The remaining sherds also are scraped either parallel to the coils or a combination of oblique and parallel scrapes. The whole vessels were primarily obliquely scraped on the exterior surface of the vessel, although some also were smoothed.

Table 5-15. Exterior surface treatment of sherds by ceramic type.

Ceramic Type	Lightly Polished	Lightly Scraped	Obliquely Scraped	Parallel Scraped	Roughly Smoothed	Scraped	Smoothed	Vertical Scraped	Total
Dinetah Gray		1	58	6		9	57	1	132
Navajo Gray			6	3	1		7		17
Rio Grande Plain	2		1		59		59		121
Total	2	1	65	9	60	9	123	1	270

Attrition and sooting were not common on Dinetah Gray sherds (Table 5-16, Table 5-17). Eighty-six percent (n=113) of sherds had no evidence of sooting (Table 5-17). Attrition also had a low frequency of occurrence. Eighty percent of the Dinetah Gray sherds (n=105) had no evidence of attrition (Table 5-16). Pitting was found on the interior surface of the 27 Dinetah Gray and Navajo Gray sherds that showed signs of attrition (Table 5-16).

Table 5-16. Interior attrition on sherds by ceramic type.

Ceramic Type	Abrasion	Crazing	Crazing and Pitting	None	Pitting	Pitting and Scratches	Pitting and Spalling	Total
Dinetah Gray				105	26		1	132
Navajo Gray				15	1	1		17
Rio Grande Plain	2	1	2	99	17			121
Total	2	1	2	219	44	1	1	270

Table 5-17. Sooting on sherds by ceramic type.

Ceramic Type	Heavy	Light	Light to None	Moderate	None	Total
Dinetah Gray	3	12	1	3	113	132
Navajo Gray					17	17
Rio Grande Plain	3	23		7	88	121
Total	6	35	1	10	218	270

Navajo Gray

Only 17 Navajo Gray sherds were examined. The majority of these (n=9, or 53 percent) are from unknown proveniences. The remaining eight are from two sites. The majority of these are body sherds (n=13, or 76 percent) (Table 5-9). The remaining four sherds are rim sherds. The thickness of these sherds averages 4.5 mm with a standard deviation of .55 mm. The average thickness of sherds is smaller than the average thickness of Navajo Gray whole vessels examined. The difference of .88 mm between the whole vessels and sherds is most likely the result of the difference in measurement location between the two categories of ceramic. The pattern for Navajo Gray vessels and sherds appears to be the opposite of the pattern of Dinetah Gray wares, in that body sherds are thinner than the neck and lip of a vessel. This may be due to the presence of fillets around the neck and lip of most Navajo Gray vessels.

The most common temper type for the Navajo Gray sherds is crushed rock followed by sand (Table 5-10). Most sherds were fired in a reduced or partially reduced

atmosphere (Figure 5-20; Table 5-11). Only two sherds were oxidized and these could represent small oxidized portions of the vessel. Breakage patterns of these sherds are primarily random (Table 5-12). Hardness of sherds rated a 3.5 (n=12, or 71 percent) on MOHs Scale followed by 2.5 (n=4, or 24 percent) (Table 5-13).

The interior surfaces of most Navajo Gray sherds are smoothed (n=13, or 76 percent) (Table 5-14). Parallel and oblique scraping also was observed. In the whole vessels, parallel scraping is the most common interior surface treatment, although smoothing is also common. Exterior surface treatment of sherds is primarily smoothed (n=7, or 41 percent) or obliquely scraped (n=6, or 35 percent) (Table 5-15). Obliquely scraped is the most common exterior surface treatment on whole vessels.

Sooting and attrition are rare on Navajo Gray sherds. Attrition was found on only two sherds. Attrition is located on the interior of both of these sherds and consisted of pitting and/or scratches (Table 5-16). No sherds showed evidence of sooting (Table 5-17).

Rio Grande Plain

One hundred and twenty-one Rio Grande Plain sherds were examined. Just over half of these (n=62) were recovered from 10 different sites. The provenience of the remaining 59 sherds is unknown. Therefore, these sherds are from at least 10 different vessels. The sample consists of 64 rim sherds, 57 body sherds, two base sherds, one neck sherd, and one rim and body sherd (Table 5-9). The thickness of these sherds averages 5.99 mm with a standard deviation of one mm. This average thickness also is similar to the average thickness of the neck and lip of the Rio Grande Plain whole vessels examined (mean=5.7 cm). The difference between the means is .3 mm and is most likely the result

of the difference in measurement location between the two categories of ceramic. Wall thickness was taken at the neck and lip of the whole vessels. Because many of the sherds are body sherds, many thickness measurements for sherds were taken on the body of the vessel. Wall thickness increases from the lip of a vessel to the body much like Dinetah Gray vessels.

The majority of sherds were manufactured with sand and/or tuff temper (n=53, or 44 percent) (Table 5-10); crushed rock also is common. Sherd and andesite were observed, although at a much lower frequency. Mica also was observed in one sherd. The most common size grade was fine followed by extra fine and medium.

The majority of Rio Grande Plain sherds were fired in a reduced (n=83) or partially reduced (n=33) atmosphere (Figure 5-20; Table 5-11). Four sherds were oxidized. This is consistent with the results of analysis of Rio Grande Plain whole vessels. The low frequency of oxidized sherds suggest that these sherds may be from an oxidized portion of a vessel and not necessarily from a vessel that was fired in an oxidizing atmosphere.

Breakage patterns for these sherds are primarily random, although almost 30 percent of sherds have nonrandom patterning (Table 5-12). This suggests that the coil junctures of some vessels were not cohesive and that breaks along these coil junctures were common. The hardness of the sherds is 2.5 (n=77) or 3.5 (n=40) (Table 5-13).

The interior surface treatment of most of these sherds is polished to lightly polished (n=83) (Table 5-14). This is consistent with Rio Grande Plain, Jemez variety, Type B defined by Kulishek (2005). The next most common interior surface treatment is smoothed (n=38), and this corresponds to Type A (Table 5-14). These differences are

most likely the result of changes in ceramic technology through time. Polished to lightly polished interiors also are most common in whole vessels. Exterior surface treatment on sherds is most commonly smoothed (Table 5-15). This is consistent with results from the whole vessels.

The majority of Rio Grande Plain sherds have no sooting (n=88) or attrition (n=99) (Table 5-16, Table 5-17). The most common type of attrition is pitting followed by crazing and abrasion. Thirty sherds have light to moderate sooting and seven had heavy sooting.

Summary of Sherds

Some differences between the two ceramic wares are apparent in the qualitative and quantitative data. Variation in surface treatment is common. The interior surface of Dinetah Gray sherds is most commonly parallel scraped while Rio Grande Plain sherds are polished (Table 5-15). Some of the Rio Grande Plain sherds also have smoothed interiors with no polish (n=33). Navajo Gray sherds are mostly smoothed on the interior. Exterior surfaces on Dinetah Gray vessels were most commonly scraped, although a large percentage of the sample (n=57, or 43 percent) were smoothed. Rio Grande Plain sherds are smoothed to roughly smoothed (Table 5-15).

Dinetah and Navajo Gray sherds are on average thinner than the Rio Grande Plain sherds (Figure 5-21). A t-test showed that the difference in mean thickness is statistically significant at the .05 level. The temper type appears to be slightly variable between the types. Dinetah Gray sherds are mostly tempered with crushed rock while Rio Grande Plain sherds have more variability with sand and/or tuff making up the largest category (n=53) and crushed rock being second (n=49) (Table 5-10).

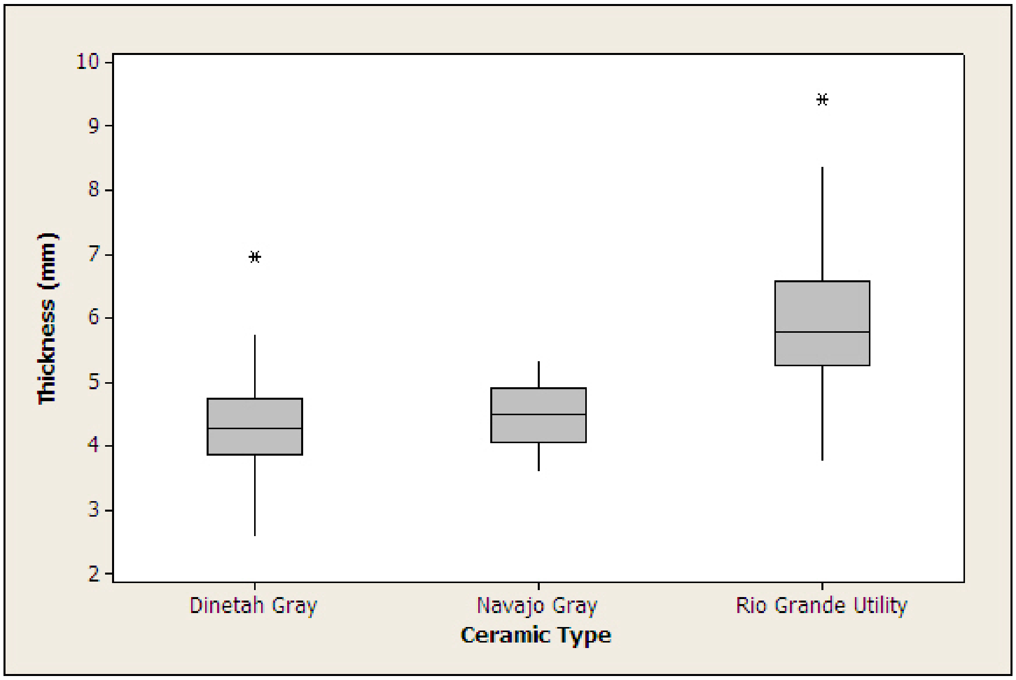

Figure 5-21. Box-and-whisker plot showing differences in sherd thickness.

Two other slightly variable attributes between the types are breakage patterning and hardness. Although both the Dinetah Gray sherds and the Rio Grande Plain sherds appear to have random breakage patterning, the latter type has slightly more nonrandom breakages than the Dinetah Gray (29 percent compared to 13 percent). This pattern may be due to variability in surface treatment. Scraped surfaces appear to have the lowest percentage of nonrandom breakages (seven percent) while this nonrandom breakage pattern is more common in sherds with smoothed to roughly smoothed surfaces (27 percent). Also, hardness for the Rio Grande Plain sherds is less than both the Dinetah Gray and Navajo Gray sherds. A t-test was performed on the mean hardness for each group that showed the difference between the Navajo types and the Puebloan types is statistically significant at the .05 level. The variation in hardness combined with the

higher number of nonrandom breakages, suggest that the Rio Grande plainwares were not as resistant to breakage as Dinetah wares.

All types are similar in terms of firing atmosphere, sooting, and attrition. All Dinetah Gray sherds and 97 percent of the Rio Grande Plain sherds were fired in reduced to partially reduced atmospheres. The majority of both of these types have no sooting and little evidence of attrition (Table 5-16, Table 5-17). Some sherds have light to moderate sooting. The lack of sooting may be attributable to the common practice of washing sherds after their recovery from excavation. Although little attrition was observed, the most common type of attrition is pitting in both types. This is not unexpected given that both Dinetah Gray and Rio Grande plainwares were used for cooking.

Summary

Vessels are more useful than sherds in addressing the issues of the current research; however, sherds did provide information on wall thickness, temper type, and breakage patterns that was not readily available from whole vessels. The archaeological sample shows marked variability between the two Navajo types and the Rio Grande plainwares. This variability appears to reflect differences in ceramic technology and the strategies used in producing a vessel.

I expected the vessels to vary in shape, size, and wall thickness. Navajo and Puebloan types are different in terms of overall shape and, as expected, “pointedness” of the base. Two expectations of transportability are vessel size and wall thickness. I expected Puebloan vessels to be larger and have thicker walls due to their hypothetical decreased transportability. The latter expectation was true, but Puebloan vessels are

much smaller than the Navajo vessels. The interesting thing about these two variables is their relationship. Dinetah Gray vessels have thinner walls on average than the Rio Grande plainwares, but are much taller. It is plausible that a larger vessel would need thicker walls to support the weight of taller walls, but that does not appear to have been the case of the Dinetah vessels. Thin walls would have less impact strength but greater thermal efficiency. Thin walls also would serve to lighten the weight of the vessel. It is possible that the size of Dinetah vessels was determined by another techno-function, such as cooking strategy, and that thin walls serve to offset the cost of size in terms of transportation. The average hardness of Dinetah walls (3.5), however, suggests that these walls would not have been very durable. Differences in surface treatment also were common, reflecting variation in ceramic technology. Surface treatment has been shown to affect thermal shock resistance and heating effectiveness (Schiffer 1990b; Schiffer et al. 1994).

I also expected variation in the presence of appendages or holes between Navajo and Puebloan wares. This was not the case. Only three percent of the vessels have modifications that may be related to transportability.

Variation in sooting and attrition patterns was expected, but the differences in these variables between the two groups are not very strong. The similarities between the types appear to be related to use in cooking.

Variation in the location and amount of exterior sooting between the two groups is not as large as expected. Navajo vessels are heavily sooted primarily on the sides of the vessels up to the maximum diameter. Puebloan vessels have lighter sooting, but soot tended to be located on the sides of the vessel as well. This is most likely due to

differences in cooking strategy, particularly how vessels were heated. Differences in hearth shape and size also reflect this disparity. The lighter sooting on the Puebloan vessels suggests that these vessels were used more often with coals as opposed to open flame. The Navajo vessels likely were placed in the fire.

Attrition patterns are comparable and can be predominantly attributed to use as cooking vessels. The increased frequency of exterior attrition on Rio Grande Plain vessels suggests that these vessels may be less resistant to thermal stress. Variation in exterior attrition could also be attributable to Rio Grande Plain vessels' softer paste and more frequent use with fire dogs. The presence of sooting on the exterior of both vessel groups also was consistent.

The measurements and photographs of the whole vessels discussed in this chapter were used to manufacture conical and rounded vessel reproductions. These reproductions and the tests in which they were used are discussed in the next chapter.

Chapter 6: The Experimental Data

This chapter includes two parts. In the first section, I explain how I made reproductions of the two cooking vessel groups. The goal of my research was to determine how vessel shape affected performance. Therefore, I controlled all other variables, including clay type, temper, and firing atmosphere and temperature. The use of slip casting, as well as consistency in clay, temper type, and firing temperature, insured that vessels were uniform internally and among vessels.

In the second section, I describe the testing equipment and procedures used during analysis of the reproductions, as well as the results of those tests. These tests examined the proposition that the difference in base shape between Navajo and Puebloan vessels is related to the difference in subsistence and mobility strategies. Three tests were employed to evaluate basal impact strength, side impact strength, and thermal stress resistance and efficiency. By testing performance characteristics, it is possible to examine the choices that potters made when manufacturing a vessel. I assume that these choices are influenced by the function of the vessel within a social context, particularly subsistence and mobility (Schiffer and Skibo 1987).

Reproductions

I made two sets of reproductions. The first set consisted of one vessel of each shape that was subsequently used to create two plaster molds of each vessel type (n=4). These molds were then used to make 90 reproductions of each vessel type: 30 vessels of each shape for each of the three tests. Not all of the reproductions were used in the tests because significant results were obtained before all of the vessels were used. Although

there is a wide range in size within each archaeological vessel type, no size classes were readily apparent from the archaeological sample and, therefore, only one size was produced.

First Set of Reproductions

Photographs of 61 Navajo vessels and 42 Rio Grande Plain vessels were used to determine the shape and size of the initial set of reproductions. A midline from the base to the rim was drawn on the photo of each vessel (Figure 6-1). This midline was then divided into 12 points. This strategy served to equalize the height difference between vessels within each group. Measurements were taken at each point from the midline to the edge of the vessel using Image J software in order to develop the profile of each vessel. The profile measurements of all vessels of each group were then averaged and multiplied by two to determine the diameter at each of the 12 points along the midline of

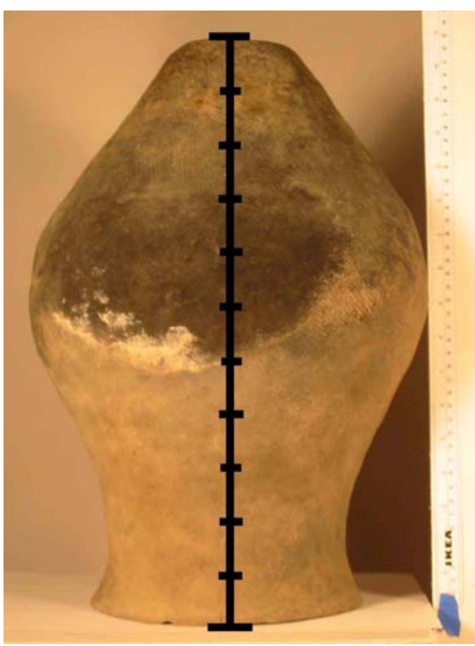

Figure 6-1. Navajo vessel GC37 with midline delineated.

the average vessel.

The height of the average Navajo vessel was more than twice the height of the average Rio Grande Plain vessel. Because this difference in height could influence the results, it was determined that reproductions must be the same size to attain accurate results. Because it would be impossible to make the two vessel groups have the same dimensions in terms of height and width, the size of the two vessel groups was equalized by making each group the same volume. The volume of the average vessel was attained by first calculating the volume between each of the 12 points along the midline using the following formula, which represents the volume of a frustum. A frustum is the portion of a cone that lies between the two parallel planes that cut it. A frustrum was used because the area between two points along the midline could be viewed as a cone with a parallel plain on the top and bottom. The volume is calculated as follows:

$V=\frac{1}{3}h\,(b1+b2+\sqrt{(b1*b2)})$

Where:

h=height between points along midline

$b1=\prod r^2$ (where r=upper radius)

$b2=\prod r^2$ (where r=lower radius)

The volume of all segments of the average vessel was then summed. It was determined that the volume of the average Navajo vessel was 16,007.68 ml (cm^3) and the average Rio Grande Plain vessel had a volume of 4,959.29 ml (cm^3) (Table 6-1). These values are slightly different than the average volume of each vessel group presented in the previous chapter due to variation in calculation. In the previous chapter, volume was calculated for each vessel and then averaged. In order to create the reproductions, all vessel radii were averaged and volume was calculated for the average vessel of each type.

Table 6-1. Original vessel midpoint measurements (cm).

Vessel Type	Navajo				Rio Grande Plain			
Midpoint	Height	Radius at Midpoint	b	Volume between Midpoints	Height	Radius at Midpoint	b	Volume between Midpoints
	41.7				19.21			
1		10.16	324.52			9.04	256.59	
2		9.35	274.52	1,130.87		8.68	236.5	428.87
3		9.31	272.43	1,033.74		8.32	217.32	394.71
4		10.37	338.06	1,151.6		9.00	254.64	410.18
5		12.02	454.03	1,491.67		9.99	313.76	493.61
6		13.46	569.51	1,930.38		10.62	354.64	581.14
7		14.17	631.14	2,268.23		10.77	364.03	625.23
8		13.82	600.24	2,327.08		10.49	345.37	617.11
9		12.36	480.15	2,037.73		9.71	296.01	557.45
10		9.88	306.8	1,475.15		8.54	229.02	455.53
11		6.95	151.59	849.28		6.62	137.64	315.63
12		3.06	29.32	311.94			0	79.83
Total volume				16,007.68 ml				4,959.29 ml

The Navajo average vessel measurements were reduced by 52 percent and the Rio Grande Plain average vessel measurements were reduced by 29 percent in order to create vessels of equal volume. The size of both vessels was reduced because the sheer size of each average vessel, particularly the Navajo vessel, would have been difficult to work with for the planned testing. Therefore, the average measurements of each vessel type were modified not only to produce two vessel types that would have approximately the same volume but also attain a size that would be more manageable for testing. Results of testing should only reflect variation in vessel shape.

Volumes and diameters of the vessel during construction and after firing are different. Therefore, these measurements were then increased by 12.5 percent in order to take into consideration the shrinkage factor of the clay used in the reproductions (Table 6-2). All clays have a certain amount of shrinkage due to water loss during the drying

process. The slip clay used here has an average shrinkage of 12.5 percent. Furthermore, the eventual reproductions made with the plaster molds had an additional 12.5 percent shrinkage relative to the vessels used to make the plaster molds. Therefore, the finished vessels were approximately 25 percent smaller than the original wet vessels used to produce the plaster molds.

Table 6-2. Final measurements used for the reconstructions.

Vessel Type	Navajo		Rio Grande Plain	
Midpoint	Height	Diameter	Height	Diameter
	22.5		15.4	
1		10.96		14.5
2		10.08		13.92
3		10.06		13.34
4		11.18		14.44
5		12.98		16.03
6		14.54		17.05
7		15.3		17.27
8		14.92		16.82
9		13.32		15.57
10		10.67		13.7
11		7.49		10.62
12		3.31		0
Total volume		2,522 cm^3		2,530 cm^3

The measurements in Table 6-2 were used to construct the initial set of reproductions. Two vessels (one of each type) were produced. The clay used was Anasazi Cone 5 Stoneware, and the method of construction was coiling. Coils were applied to the interior of each prior coil (Figure 6-2). Vessels were constructed so that diameters listed in Table 6-2 were attained every 2 cm for the Navajo vessel and every 1.4 cm for the Rio Grande Plain vessel (height divided by number of divisions). After construction, vessels were allowed to dry and then fired by potter Mark Jaramillo in his

gas kiln to Cone 5 (1168ºC). These fired vessels served as the templates to make the four plaster molds described below (Figure 6-3).

Figure 6-2. Creation of coils for vessel construction.

Figure 6-3. Final hand-built vessels after firing.

Plaster Mold Construction

Two molds of each type (n=4) were made. All molds had two halves. Creation of molds followed a five-step process:

1. Building of box;
2. Setting of original in clay;

3. Application of a release agent;

4. Mixing and pouring plaster; and

5. Setting up and creating part 2 of mold.

Figure 6-4. Plaster mold construction.

The box for each mold was constructed of ½-inch thick plywood held together with wood screws and heavy-duty bar clamps (Figure 6-4). The bottom half of the box was filled with the original vessel surrounded by wet clay. A release agent (Murphy's Oil Soap) was applied to the top surface of the clay and the original. The plaster (USG Number 1 Pottery Plaster) was then mixed and poured over the top half of the original vessel. After setting, the box was deconstructed and the first half of the mold was flipped over and placed on the bottom. The box was then reconstructed and the original vessel was placed into the mold. The releasing agent was applied to the original and plaster, and new plaster was then mixed and poured into the second half of the mold. This process was repeated for each two-part mold (Figure 6-5).

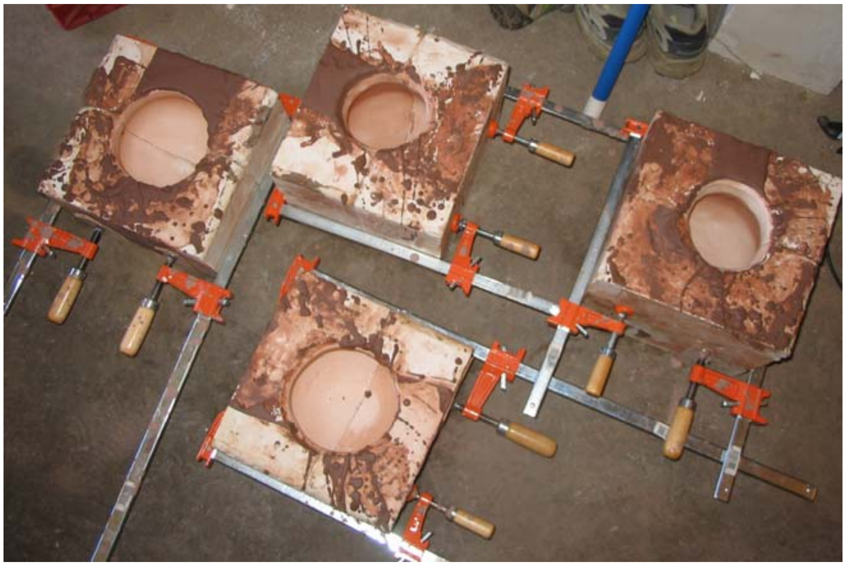

Figure 6-5. Final two-part molds used for second set of reproductions.

Second Set of Reproductions

Ninety reproductions of each type were made using slip casting. The vessels were made of a low fire red casting slip. Slip casting is a ceramic production technique that uses casting slip and a two-part mold to repeatedly create the same form. Although vessels were not made in the same way as the archaeological pots, this technique allows for mass production of a form that is consistent within a vessel and among vessels. It is unlikely that an experienced potter can make 180 reproductions exactly the same every time using traditional methods. These methods would have created too much variation and could have biased the results of the testing.

The first step in slip casting, after production of the two-part mold, was to clamp the two parts of the mold together to create a tight seal. After mixing the casting slip, the slip was poured into the mold and allowed to sit for 35 minutes. This allowed time for liquid from the slip to be absorbed by the mold and for the vessel wall to form. Vessel walls averaged approximately 7 mm wet. After this, the excess slip was poured out of the

mold. Vessels remained in the mold for approximately 12 hours to dry long enough to be pulled out of the molds without damage. After removal from the mold, vessels were allowed to dry to leather hard and then the exterior of each vessel was sanded and smoothed. All vessels were fired by potter Mark Jaramillo in a gas kiln to Cone 06 (999°C). Vessels were fired in three sessions in groups of 60 (30 of each type). These three groups correspond to the three testing phases discussed below.

Testing Procedures and Equipment

Two aspects of performance were tested: strength and thermal performance. Impact strength tests were conducted on 30 vessels of each type for each test. Three impact tests were conducted: two tests to examine basal strength of the two types and one to examine side impact strength (Pierce 1999). Thermal tests examined both thermal stress resistance and efficiency. All tests were conducted in the researcher's garage on a cement slab foundation.

Before testing, each vessel was measured and weighed. Volume was measured for the vessels that underwent thermal tests. Due to the difference in shape, it was important to ensure that all vessels had a similar volume, weight, and wall thickness. Because of the modifications made to the original vessels in terms of volume, I believed that weight and wall thickness also needed to be controlled to determine if vessel shape was the driving factor in any functional differences between the two vessel shapes. The first basal strength test was a falling-weight impact test consisting of a ball bearing (weighing 80 grams) dropped on the center of the base of the exterior of the vessel repeatedly until failure (Mabry et al. 1988). This test examines the strength of the base of the pot when an object is dropped on it. It does not take into consideration how the

weight of the vessel itself affects impact strength. A drop impact tester was constructed using a tripod and ½-inch" PVC pipe. This pipe was just wide enough to allow the ball bearing to drop through unobstructed, but small enough to maintain stability and consistency between drops. The pipe was attached vertically to the tripod and the top was either .5 or .75 m above the ground. Vessels were placed upside down, and the ball bearing was dropped from the top of the PVC pipe until failure or 200 drops; the number of drops to pitting and/or cracking was recorded. The ball bearing was originally dropped from .5 m (n=3). Results from these initial tests indicated that a higher drop zone was appropriate and, therefore, the ball bearing was dropped from .75 m on the remaining vessels (n=30).

In reality, the vessel would most likely be the object dropped. Because the first test does not take into consideration the weight of the vessel in its impact strength, I conducted a second test by repeatedly dropping a vessel from the same height. The tripod with attached PVC pipe was used in this test as a measurement tool. A wool blanket was placed under the tripod and the top of the pipe measured either .75 or 1 m above the surface of the blanket. The blanket was placed on the cement slab foundation to soften the impact and simulate a dirt floor. The top of each vessel was aligned with the top of the PVC pipe and then released. Five vessels of each type were dropped from .75 m and five of each were dropped from 1 m. The number of drops to pitting and/or cracking and failure for each vessel was recorded. A second test aligning the bottom of the vessel with the PVC pipe was also performed after it was determined that the difference in height may have biased the results. Eight vessels of each form were dropped from .75 meter.

The third strength test was a pendulum impact test. This test analyzes the relative side impact strength of each vessel type. An armature set was constructed of five pine 2” x 4” Boards. A free-swinging thin metal rod was attached to the center of the connecting 2” x 4”, and a three-screw globe light fixture was attached to end of the rod opposite the beam. The top of each vessel was attached to the rod using this lighting fixture. Vessels were suspended and three concrete blocks were stacked close enough to the vessel so that they would touch the pillar when hanging freely (Figure 6-6).

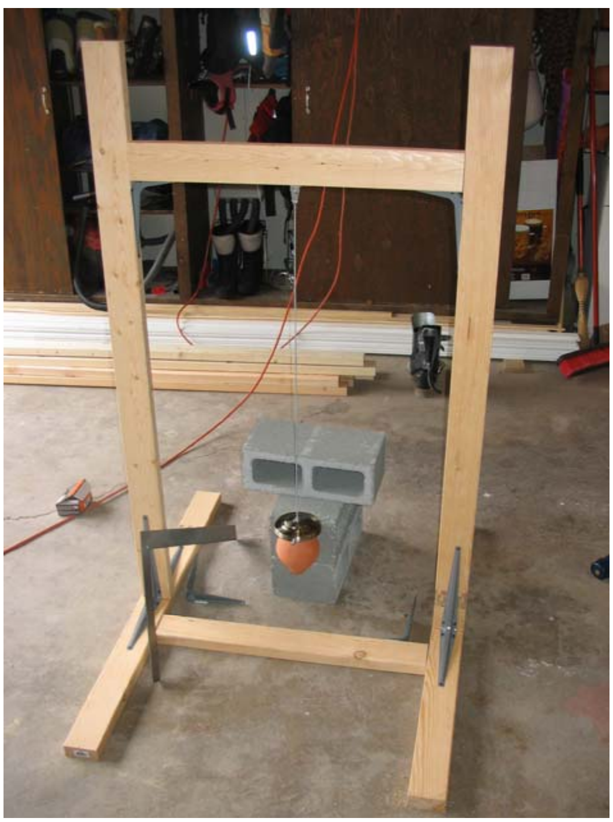

Figure 6-6. Side impact strength tester.

Two versions of this test were performed. An inclinometer was placed on the metal rod to measure the angle in both of these versions. In the first, vessels were raised at 5-degree intervals ranging from 10 degrees to 35 degrees from the pillar and released to swing into the cinder block until failure (Figure 6-7). Fifteen of each vessel type was


Figure 6-7. Side impact testing of a conical vessel.

tested. Vessels were examined after each drop for cracking or pitting. The second version of this test consisted of raising vessels to the same degree from the pillar and dropping repeatedly until failure. Initially, a 20-degree angle was used, but it was determined that 25 degrees would be more appropriate due to the lack of failure of half of these six vessels after 100 hits at this angle. Nine Navajo vessels and 10 Rio Grande Plain vessels were dropped from 25 degrees until failure. Vessels were examined after each hit for pitting or cracking and the number of hits to cracking and failure was recorded. Both of these versions examine the effect of side impacts on both vessel types.

The velocity of each vessel at different degrees also was determined. The velocity was measured to determine if vessel shape has any major influence on the velocity at which the vessel swings freely. If significant differences in velocity were found, it could help in explaining any differences in side impact strength between the two vessel types. Velocity was determined by first calculating the period of each vessel. The period is defined as the amount of time it takes a vessel to swing freely from one end of a

pendulum to the other. This was measured by suspending the vessel, pulling it up to the top of the pendulum, and allowing it to swing freely for 10 swings while timing it with a stop watch. The total time was then divided by 10 to establish the period. This process was repeated 10 times for each vessel and the resulting 10 periods averaged. The period was then used to calculate the length of the pendulum with the following formula:

$L=(g/\Pi^2) \times (t^2/4)$

where:

g=gravity (9.8 m/s)

$\Pi^2=9.86$

t=period

Velocity was then determined for each vessel at degree of failure using the following formula:

$V=\sqrt{(2gL\sin(theta))}$

Where:

g=gravity (9.8 m/s)

L=equivalent length of the pendulum

Theta=angle

Velocity was calculated for both the angle at which a vessel failed and at a standard angle of 30 degrees. The resulting numbers for each vessel type were averaged and compared to determine if significant differences existed between the velocity at which the two types swing. Any differences would help explain the variation in strength between the two types.

Twenty of the remaining reproductions underwent thermal stress resistance and efficiency experiments. Following Schiffer et al. (1994), thermal tests consisted of placing the vessel on a metal framework over the grate of a gas burner. A large cast iron camp stove was used in the tests. All tests were conducted in Durango, Colorado at an elevation of approximately 1,980 m above sea level. A set of four thermocouples were used: two type K thermocouples with a spring-loaded tip for examining temperature change at two points on the exterior of each vessel, and two 12-inch type K thermocouple probes. One of these probes was placed in the flame to maintain flame temperature, and one was placed in the liquid in the vessel to measure the rate of temperature change. All four of these thermocouples were connected to a Universal Serial Bus (USB) data acquisition module (Model OMB-DAQ-54) that was connected to a Toshiba Satellite M45 laptop computer.

Vessels were filled with 600 ml of water and placed on the cast iron stove (Figure 6-8). One spring-loaded thermocouple was placed near the rim of the vessel and the other was placed just below the maximum diameter of the vessel. The thermocouple

Figure 6-8. Thermal stress test.

probe in the flame was not moved between boiling cycles. The flame was then turned on and the data logger was set to record. Each boiling cycle was timed with a stopwatch. Boiling time was recorded to evaluate heating effectiveness. Vessels were macroscopically examined for cracking and spalling after each heating cycle. Ten vessels of each type were put through 10 heating cycles. Real time temperatures were recorded using Omega Personal DaqView software.

Results

Basal Impact Strength

A total of 34 conical and 35 rounded reproductions were tested for basal strength. One less Navajo vessel was tested because of the redundancy in the results. For the vessels used in the basal strength test, the average weight was 520 g for conical-base vessels and 507 g for rounded-base vessels. The average thickness was 5.32 mm with a standard deviation of .48 mm for conical-base vessels and 5.59 mm with a standard deviation of .62 mm for rounded-base vessels.

Sixteen of the conical vessels and 17 of the rounded vessels were tested by dropping a ball bearing on the base of each vessel. The ball bearing was dropped from a height of .5 m on two conical vessels and one rounded vessel; and a height of .75 m on the remaining 30 vessels. This variation in height is the result of early experimentation in determining the best height from which to drop the ball bearing. A height of .75 m was determined to be the most appropriate due to the smaller number of hits to failure.

Conical vessels are stronger in the ball-bearing drop test (Figure 6-9). No failure occurred in the two vessels on which a ball bearing was dropped from .5 m after 200 drops. I stopped the test after 200 drops. The height of the drop was then raised to .75 m.

Failure also did not occur at this height. All 14 vessels had a circular nick at the center of the base that increased in size but did not fail. The number of drops at which this nick was macroscopically visible on the base of each vessel ranged from 12 to 68.

All but one rounded vessel failed during the ball bearing drop tests (Figure 6-9). The single vessel used in the .5-meter drop tests failed in nine drops with cracking visible after four drops. The number of drops to failure in the .75-meter test ranged from two to 15 with cracks visible at one to 14 drops. A ball bearing was dropped 200 times on the single rounded vessel that did not fail.

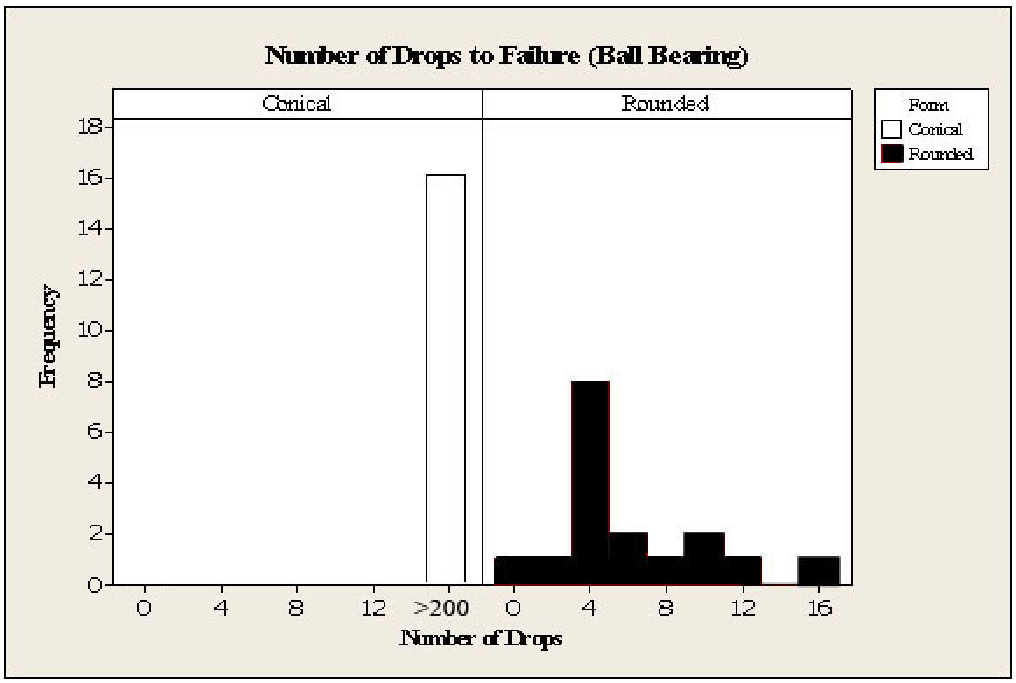

Figure 6-9. Histogram of ball bearing results.

The basal strength of the remaining 36 vessels was tested by dropping the vessel itself (Figure 6-10). The top of ten of each type were aligned with the PVC pipe and dropped from .75 m (n=5) and from 1 m (n=5). An additional 16 vessels of each type were added to the sample. The bottom of these vessels was aligned with the PVC pipe

and dropped from .75 meter. Results of tests aligning both the top and the bottom of the vessel with the PVC pipe were similar.

Dropping the conical vessels from a height of .75 m produced more variable results than dropping from 1 m. All of these vessels failed, but macroscopic cracking tended to occur prior to total failure. The number of drops to failure ranged from five to 16 drops. Cracks could normally be observed on the drop prior to failure. Of the five vessels dropped from 1 m, all failed within six drops. Two vessels failed on the first drop, one at two drops, one at four drops, and one at six drops. Number of drops ranged from 1 to 14 with an average of 8.75 drops to failure for the vessels that were tested by aligning the bottom of the vessel with the PVC pipe.

Of those 10 rounded vessels dropped from a height of .75 m and 1 m, all failed. All five vessels dropped from a height of .75 m failed after only one drop. At 1 m, all five vessels failed after only one drop. These results were the driving factors behind lowering the drop height to .75 m. However, the decrease in height had no effect on the results. Aligning the bottom of the vessel with the PVC pipe also did not significantly alter the result. Of the eight vessels, seven failed after one drop and one failed after two drops.

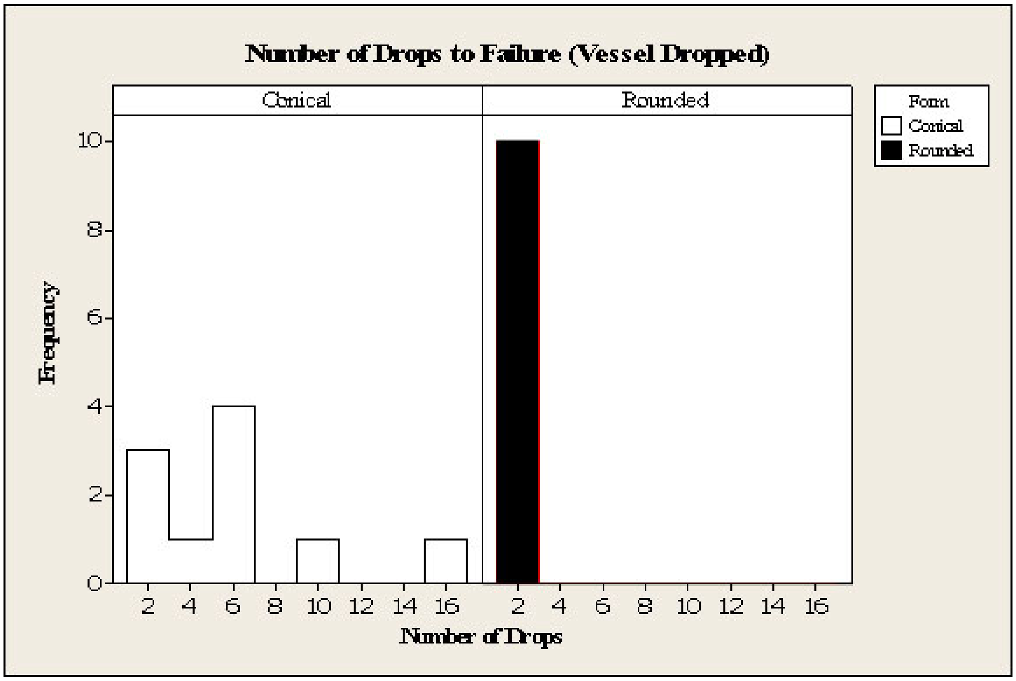

Figure 6-10. Histogram of vessel drop results
(Top of the vessel aligned with the PVC pipe.)

These results unequivocally show that in terms of basal strength, the conical vessel shape is stronger. These results were not unexpected given the results of earlier preliminary tests and ethnographic studies of the people who used this type of vessel.

Side Impact Strength

A total of 30 vessels were used in the first version of this test (15 conical and 15 rounded vessels). Twenty-seven vessels were used in the second version of this test (14 conical and 12 rounded vessels). Results from these tests differed from the basal impact strength test. Conical vessels used in the side impact strength tests had an average weight of 606 g and an average thickness of 6.36 mm. Rounded vessels averaged 571 g in weight and 6.47 mm in thickness.

In the first version, 11 of the 15 conical vessels tested underwent total failure at 30 degrees. Macroscopic damage (spalling) in these 11 vessels was observed after the

first hit at 10 degrees, which increased in size and extent until cracking occurred at 25 degrees and failure occurred at 30 degrees. The remaining four vessels failed at 25 degrees, with cracking at 20 degrees. Not unexpectedly, it appears that after cracking occurred, a vessel was unable to withstand another hit without failure.

Of the 15 rounded vessels, seven did not fail until swung from 35 degrees. Some of these vessels showed no damage after impact from 10 degrees, but all showed abrasion after impact from 15 degrees. Cracking tended to occur at 30 degrees on the impact prior to the impact that caused failure.

In the second version of the test, six vessels (conical, n=5; rounded, n=1) were dropped from 20 degrees and the remainder (conical, n=9; rounded, n=10) were dropped from 25 degrees (Figure 6-11). Of the five conical vessels tested at 20 degrees, two did not fail after 100 drops. The remaining three vessels failed after three to 57 impacts. One of these vessels cracked after the first drop and failed at three drops, and the second did not crack until 12 drops and failed at 13 drops. The strongest of these three vessels developed cracks after 54 drops and failed at 57 drops. The nine conical vessels tested at 25 degrees all failed by 10 drops; seven developed cracks after only one drop and failed after two drops. Of the remaining two vessels, one failed after three drops and the other failed after 10 drops. The average number of drops was three and the median number was two.

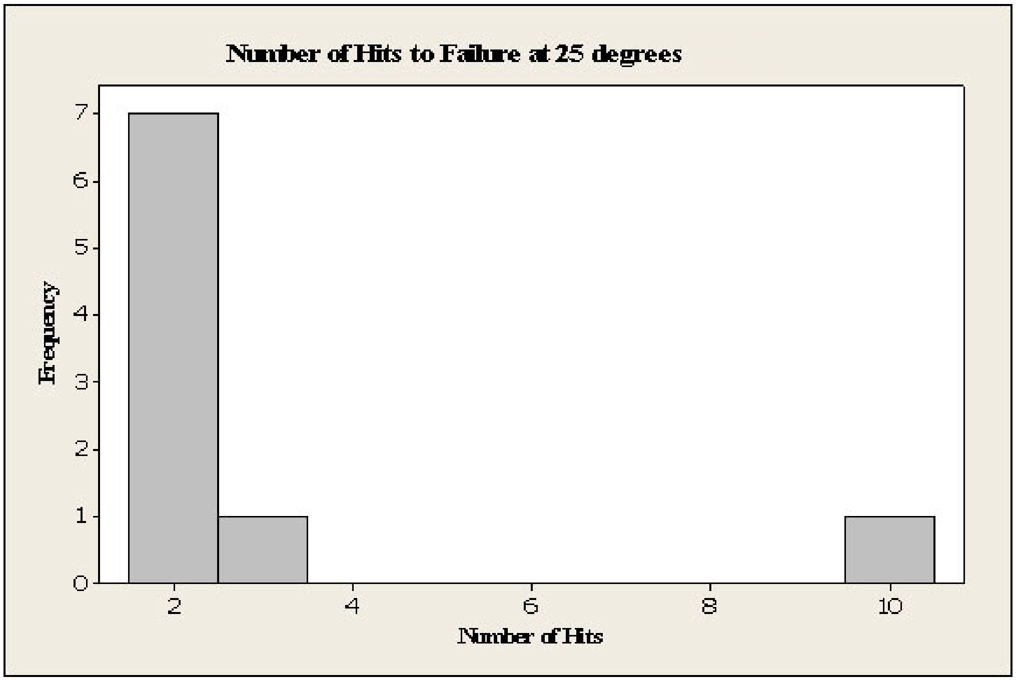

Figure 6-11. Histogram showing conical vessel results.

There was more variation in the rounded vessels tested. Only one of these vessels was tested at 20 degrees, and this vessel did not fail after 200 drops. The number of drops to failure in the 10 vessels dropped from 25 degrees ranged from two to 16 (Figure 6-12). Three vessels failed at two drops, one at three drops, two at four drops, one at seven drops, one at eight drops, and one at 16 drops. The average number of drops was slightly more than five and the median number was four.

The velocity of the two vessel types was variable. When calculated at the same angle (30 degrees), the conical vessel had a slightly higher velocity than the rounded type. A t-test also was performed on the mean velocity and the difference is statistically significant at the .05 level. It is plausible that if the conical type swings at a higher velocity, then it would be more likely to break from a side impact. Interestingly, when calculated at the angle of failure, velocity was smaller for the conical vessels, suggesting that conical vessels cannot withstand as great an impact from the side as rounded vessels.

A t-test performed on the mean velocity at failure also resulted in a statistically significant difference at the .05 level.

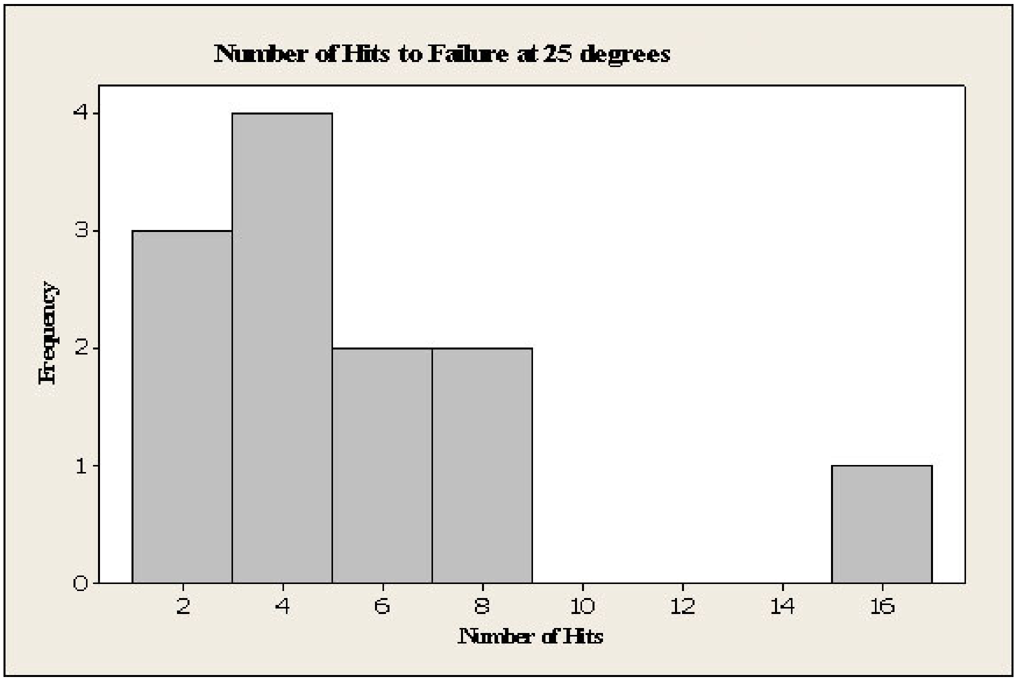

Figure 6-12. Histogram of side impact strength results for rounded-base vessels.

It appeared that the rounded vessel type is stronger in terms of side impact than the conical vessel type. This is true in both versions of the testing. Forty-seven percent of the rounded vessels reached a 35-degree angle before failure. None of the conical vessels exceeded 30 degrees. This increase in angle equates to an increase in velocity at which the vessel hits the cement pillar. In other words, the force it took to break a rounded vessel type on its side is greater than that for a conical vessel type. The rounded vessel type also was stronger during the second version of the test. The median number of drops for the rounded vessel type (median=4) was twice the number for the conical vessel type (median=2).

Thermal Tests

Ten heating cycles for each vessel type were planned. Before heating, each vessel was weighed and volume and vessel wall thickness were measured. There was some small variation between the two vessel types in these measurements, but it is not statistically significant at the .05 level. Rounded vessels averaged 556 g in weight and 975 ml in volume; conical vessels averaged 532 g in weight and 952.5 ml in volume.

Vessels were placed on a metal grate over the fire in contact with the flame. The temperature of the flame was raised to between 400 and 450°C. The shape of the conical type caused the base of these vessels to be deeper in the flame than the rounded type.

Not all of the vessels survived 10 heating cycles. All of the conical vessels completed 10 boiling cycles, but only six of the rounded vessels survived. One rounded vessel failed during the first cycle. Macroscopic damage to the pot, such as pitting or spalling, was not visible on any of the vessels during the heating cycles. All vessels showed some slight darkening of the surface due to the contact with the flame. Six of the rounded vessels cracked during the heating cycles. This failure suggests that this vessel type was not as resistant to thermal stress when placed in direct contact with the flame.

The mean boiling time for conical vessels was 451.46 seconds (7.525 minutes) with a standard deviation of 45 seconds (.75 minute) (Table 6-3, Table 6-4). As the standard deviation illustrates, the time for water to boil in this vessel type was fairly consistent. The difference between the longest and shortest boiling time was only 139.1 seconds (Table 6-3, Table 6-4). Because of the shape of the vessel, the flame came up on the sides of the vessel so more of the exterior surface was exposed to the flame.

Table 6-3. Conical vessel thermal test results.

Vessel No.	Weight (g)	Volume (ml)	Thickness (mm)	Boiling Time (seconds)	Average Flame Temperature (Celsius)	Average Boiling Temperature (Celsius) (6500 feet asl)
N.F3.2	564	1000	5.52	495.10	426.41	91.48
N.F3.3	574	1000	5.82	469.80	405.96	91.35
N.F3.5	580	1050	5.71	466.90	404.7	91.58
N.F3.6	640	900	6.63	465.30	420.66	91.89
N.F3.9	596	950	5.77	482.33	380.71	90.96
N.F3.16	486	900	4.67	382.00	388.1	90.34
N.F3.19	488	950	4.81	477.50	411.64	90.67
N.F3.24	454	925	4.53	356.00	394.08	90.52
N.F3.27	444	950	4.47	463.00	401.61	90.89
N.F3.29	494	900	4.96	456.70	430.17	90.69
Mean	532	952.5	5.29	451.46	406.404	91.037
Standard deviation	66.81	50.62	0.71	45.22	16.22	0.51

Table 6-4. Conical vessel statistics (in seconds).

Conical Boiling Time (in seconds)	
Mean	451.4633333
Standard error	14.29837636
Median	466.1
Standard deviation	45.21543615
Sample variance	2044.435667
Range	139.1
Minimum	356
Maximum	495.1
Count	10

The mean boiling time for rounded vessels was 485.95 seconds (8.09 minutes) with a standard deviation of 217 seconds (3.61 minutes) (Table 6-5; Table 6-6). The longest average boiling time was 12.75 minutes and the shortest was 4.95. This large variation suggests that the thermal efficiency of the rounded-base type is not consistent over repeated firing cycles. An explanation for this variation is not readily apparent, and may be the result of factors other than the thermal efficiency of the vessel shape.

Table 6-5. Rounded-base vessel thermal test results.

Vessel No.	Weight (g)	Volume (ml)	Thickness (mm)	Boiling Time (seconds)	Average Flame Temperature (Celsius)	Average Boiling Temperature (Celsius) (6500 feet asl)
J.F3.1	516.00	950.00	5.25	493.83	435.64	93.11
J.F3.5	504.00	1,050.00	5.77	765.00	476.17	92.68
J.F3.7	508.00	1,100.00	5.45	643.80	449.30	90.98
J.F3.8	576.00	950.00	6.20	546.10	455.25	93.03
J.F3.12	598.00	1,000.00	6.25	442.00	416.12	92.79
J.F3.15	562.00	900.00	6.23	297.00	334.16	92.79
J.F3.17	640.00	900.00	6.56	0.00	356.59	
J.F3.23	568.00	950.00	6.30	527.40	415.55	92.31
J.F3.28	500.00	1,000.00	5.11	457.50	420.74	92.19
J.F3.31	588.00	950.00	6.48	686.90	442.61	92.32
Mean	556.00	975.00	5.96	485.95	420.21	92.47
Standard deviation	47.34	63.46	0.52	216.83	44.02	0.64

Table 6-6. Rounded vessel statistics (in seconds).

Rounded Boiling Time (in seconds)	
Mean	485.953333
Standard error	68.5691224
Median	510.616667
Standard deviation	216.834604
Sample variance	47017.2455
Range	765
Minimum	0
Maximum	765
Count	10

Thickness of the vessel does not appear to be the cause, as evidenced by the slightly smaller thickness of the vessel with the longest boiling time relative to the one with the shortest boiling time (Figure 6-13). The overall volume of the vessel with the longest boiling time is slightly larger than the one with the smallest boiling time; however, it is not the largest (by volume) of the vessels tested.

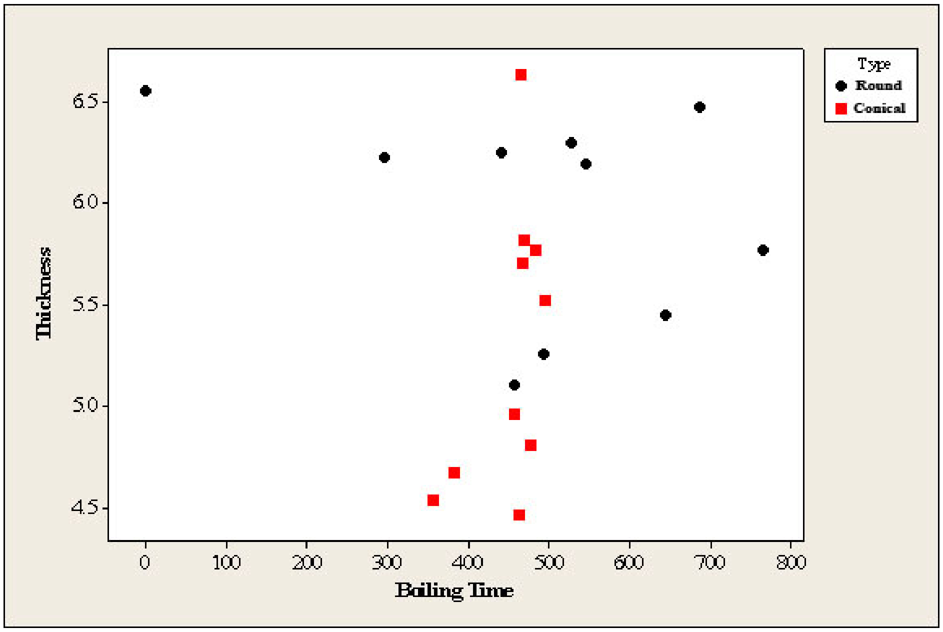

Figure 6-13. Scatter plot of relationship of vessel thickness to boiling time by type.

Statistically, a t-test indicates the difference in boiling time means between the conical and rounded vessels is not significant at the 0.5 level; however, variation was much higher in the rounded type (Figure 6-14). This suggests that thermal efficiency is more consistent in conical types when the vessel is in direct contact with the flame.

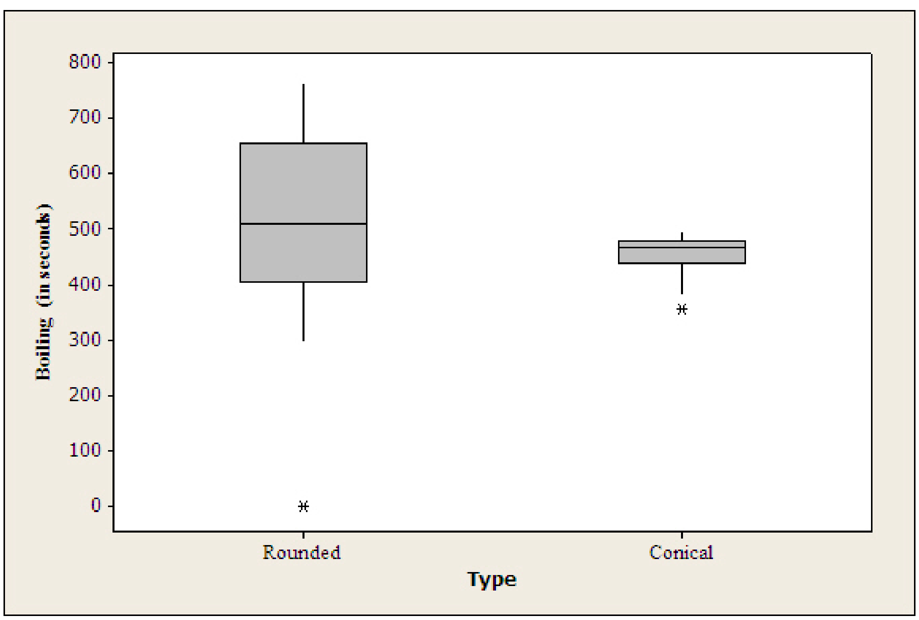

Figure 6-14. Box and whisker plot of boiling time.

Summary

The construction processes employed produced reproductions of the two vessel types that were used for analyzing the strength and thermal stress resistance. Comparisons of volumes, thicknesses, and weight of the reproductions of both types showed that although there was some small variation in these measurements, manufacturing procedures produced vessels that differed in shape only. Using the same clay and plaster to create the vessels also contributed to the constancy of all other variables relative to vessel shape.

The results of the experimental tests provide quantitative differences between the two vessel types. Some of these results were expected while others were not. Strength was expected to be greater for the conical type. This was not entirely true. Basal strength was shown to be greater in the conical type, whereas the rounded type had greater side impact strength.

Thermal stress resistance was expected to be greater in the rounded vessel type due to the hypothetical longer cooking times of these vessels. This was not the case. Thermal tests suggest that the conical type has greater thermal stress resistance and more consistent thermal efficiency. It is likely better for a vessel that is placed directly in the flame to have greater thermal stress resistance because of the temperature extremes to which this vessel would be exposed. These results, as well as the results of the ethnohistorical and archaeological data, are discussed further in the following chapter.

Chapter 7: Summary and Conclusions

Linton (1944) first demonstrated the correlation of conical vessels with mobility and forager subsistence. Other researchers have followed this important study and shown that this relationship is fairly constant across time and space (Mills 1985; Reid 1990). Conical vessels have been found in association with mobile foraging groups cross-culturally in prehistoric and ethnographic contexts. Rarely do we find conical vessels used by groups that practice full-time agriculture and long-term sedentism. This research contributes to a growing body of knowledge that will allow us to better understand the relationship among ceramic vessel shape, subsistence, and mobility. A case study from the southwestern United States was used to evaluate how conical- and rounded-base vessels differed in terms of use in prehistory and performance characteristics.

Reviews of the ethnohistorical literature show a distinct correlation among conical vessels, mobility, and hunter-gatherer subsistence (Linton 1944; Mills 1985). Experimental and ethnoarchaeological studies have been effective in evaluating the function and performance of archaeological ceramics (Linton 1944; Mills 1985; Pierce 1999; Schiffer 1990a, 1990b, 1991; Schiffer and Skibo 1987, 1989; Schiffer et al. 1994). Through these studies, we now have a better understanding of how ceramic vessel shape and function are related.

The research design for the current study evaluates two variables: 1) transportability, and 2) diet and cooking strategies. Transportability is analyzed by examining variation in vessel size, wall thickness, the presence or absence of appendages or holes, surface attrition, and strength between the two vessel shapes. The cooking

strategy, and by extension the thermal properties of a vessel, were evaluated by examining variation in foods exploited and preparation techniques from the ethnohistorical and archaeological literature, sooting and attrition patterns on archaeological whole vessels and sherds, variation in thermal cooking features described in the archaeological literature, and thermal stress resistance and efficiency of reproductions.

Chapter 3 presented a summary of the cultural and environmental information on the Navajo and the Towa-speaking Puebloan groups (the Jemez and Pecos) of the southwestern United States based on the available archaeological and ethnohistoric data. These groups made an ideal case study primarily because of the variation in ceramic vessel shape, mobility, and subsistence among them, as well as their geographic and temporal proximity. The Towa Puebloans were relatively sedentary and produced rounded-base vessels, whereas the Navajo were more mobile and manufactured conical-base vessels. The primary goal of this research is to determine if there is a functional explanation for the variation in vessel shape.

The Navajo and Jemez were neighbors during the Late Prehistoric and Protohistoric, occupying areas in northern New Mexico. The Pecos people shared a common language with the Jemez and are considered their closest Puebloan relative. Vessels from Pecos Pueblo were included in order to increase the rounded-base vessel sample size. Interaction between the Navajo and Jemez has been demonstrated by the presence of Jemez ceramics at Navajo sites. Evidence suggests that some Puebloan groups migrated into the Dinetah region after the Pueblo Revolt and subsequent Reconquest, further increasing interaction between these groups.

Chapter 4 presents data obtained from a review of the available ethnohistorical and archaeological literature on the foods exploited, preparation techniques used by the Navajo and Puebloan groups, and thermal features excavated at Navajo and Puebloan sites. Although both the Navajo and Puebloan people used a similar suite of food resources, the relative contribution of each of these resources to their diets appears to have been variable. The focus of the Puebloan groups on agricultural products may have led to more variation in preparation of these foods. Navajo groups appear to have mainly roasted corn, which would not have required ceramic vessels. Puebloan groups most likely depended heavily on corn mush, which would have required longer cooking times with ceramic vessels.

Thermal features were very different between the Navajo and Jemez sites. Navajo hearths tended to be basin-shaped and expedient with little excavation. Jemez hearths, on the other hand, are rectangular and slab-lined. They tended to be deeper than Navajo hearths. There is variation in size within each hearth class, but shape appears to be consistent. This difference most likely reflects how the vessel was placed in the fire, as well as the mobility strategies employed. A basin-shaped hearth fits well with the idea that Navajo vessels were placed directly in the fire. Jemez hearths took more time to build and maintain. In sites that are occupied for shorter periods, the energy spent building and maintaining a hearth would most likely be less than in long term settlements. These thermal features suggest that hearths at Navajo sites were used for shorter periods than Puebloan hearths. Hearths at both site types would have been used for activities other than cooking, and these functions no doubt also influenced the shape and size of the hearth.

The results of this research show quantitative differences between Navajo and Puebloan cooking vessels. Archaeological and experimental data provide information about different aspects of the variation between the two shapes. Data presented in Chapter 5 show definitive variation between the archaeological types; some similarities also were observed. Data collected on whole vessels, sherds, and thermal features were informative, although whole vessels were the most useful in examining the major issues of this research. The overall shape of the vessels is quantitatively different. Difference in the average basal angle of the conical types relative to the rounded types was almost 23 degrees; Navajo types also were taller than the Puebloan types.

Navajo vessels were much larger than Jemez vessels. Vessel size can be related to transportability, types of foods prepared, preparation techniques, household size, household status, or feasting (Beck 2009; Mills 1999). It is unlikely, given the social structure of the Navajo during the Dinetah phase, that status or feasting were the cause of large vessel size. Variation is most likely related to the types of food prepared, preparation techniques, or household size. It may also be the result of sampling bias. The majority of Navajo vessels were from storage contexts. Large vessel size would actually decrease the transportability of a vessel; therefore, Navajo vessel size was most likely not the result of a mobile settlement pattern.

There was not as great a distinction between the diameters of the conical types and rounded types. These characteristics create a rounded vessel that had a short, squat appearance and a conical form that was more elongated and bullet-shaped. Both whole vessel and sherd data show a marked difference between the wall thickness of Navajo and Puebloan types. Puebloan types had a larger average wall thickness relative to the

Navajo types. The thinner walls of the Navajo vessels may represent an attempt to increase thermal efficiency for better cooking or decrease the weight of the large vessels in order to increase the ease of transport (Beck 2009).

Navajo and Puebloan vessels were both fired in a reducing atmosphere, but surface treatment varied between the two. Puebloan vessels tended to have smoothed exteriors and polished or smoothed interiors. Navajo vessels had obliquely scraped exteriors and parallel scraped or smoothed interiors. Surface texture has been shown to increase thermal stress resistance (Schiffer 1990b; Schiffer et al. 1994). Navajo potters may have scraped their vessels in order to create well-bonded coil junctions or to increase thermal stress resistance. Navajo vessels were most likely placed directly in the fire, resulting in rapid heating and cooling cycles, and resistance to thermal stress would be necessary to extend use life.

Attrition and sooting patterns were similar between the two groups, most likely the result of similarities in use. These patterns provide evidence of cooking use and not transportation techniques. Whole vessels exhibited more sooting and attrition than sherds. Although Navajo vessels exhibited exterior attrition, it was more common on the Puebloan vessels, with the most common wear consisting of grinding and pitting near or on the base of the vessel. Interior attrition was more common on the Navajo vessels, particularly Dinetah Gray vessels. Pitting was the dominant type of attrition, most likely caused by repeated heating and stirring of contents.

Exterior sooting was common on all vessels. There was limited variation in the location of sooting, although almost no sooting was found directly on the base of any of the vessels. Interior sooting was rare, as would be expected in cooking vessels.

Breakage pattern and hardness were slightly different between the Navajo vessels and Puebloan vessels. The Puebloan vessels exhibited slightly more nonrandom breaks than the Navajo vessels. Nonrandom breakage patterns appeared to be more common in sherds with smoothed to roughly smoothed surfaces. Because most of the Rio Grande Plain sherds had this type of surface treatment, it is reasonable to expect this type to have more nonrandom fractures. Hardness was lower in the Rio Grande Plain sherds, further supporting the hypothesis that these vessels were not as durable as the Navajo vessels.

The experimental data provide information on the performance characteristics of the conical shape versus the rounded shape. The archaeological samples were used to derive an average vessel of each shape. Impact strength tests showed that the conical type is stronger in terms of basal impact, but the rounded type was stronger in terms of side impact. The increased basal strength of conical vessels might be explained by the small surface area of the base relative to rounded vessels. This small surface area and angle of the walls to the base provides structural strength when impact occurs at the base. Results of the side impact strength tests are most likely a product of the relationship of the maximum diameter to the base. It is possible that the closer the maximum diameter is to the base, the stronger the vessel is on its side. In the side impact test, the vessel strikes the cement blocks at its maximum diameter; if the maximum diameter is close to the base (as is the case in the rounded type), then the base may provide additional structural support to the side of the vessel. These results have implications for transportability and use, and provide potential hypotheses for future testing.

The thermal tests also suggest marked differences between the thermal properties of the two types. Macroscopically, spalling and cracking were not observed prior to total

failure during boiling cycles. Four of the rounded-base vessels failed during the tests but none of the conical vessels failed after 10 boiling cycles. This indicates that conical vessels have greater thermal stress resistance when placed in a fire. The average boiling time was not significantly different between the types, but variation in boiling times for the rounded type was much greater than the conical type. Although the variation in the average thermal efficiency of the two types was not significant, the conical type was more consistent in its efficiency.

Discussion

The research presented herein provides evidence for how cooking vessel shape impacts performance. Although not definitive, the results contribute to the discussion of the hypotheses that: 1) Navajo conical-base vessels reflect greater mobility through greater transportability, and 2) Navajo and Pueblo vessel shapes relate to how and what people cooked.

Mobility

In order to examine the first hypothesis, I analyzed transportability of the different vessel shapes. I assume a vessel would have an increased probability of being dropped or damaged during frequent transport, and therefore, potters in mobile populations would want to increase the transportability of their ceramics.

Transportability of a vessel can be increased in two ways—by protecting the vessel during transport in some way, perhaps by carrying it in a burden basket with grass padding or by altering the design of a vessel in some way to make it easier to carry. Alteration might consist of adding appendages or putting holes in a vessel in order to attach a handle. Potters also may decrease the thickness of the vessel walls or the overall

size of the vessel and thereby decrease the weight of the vessel (Beck 2009). Overall vessel shape also might be modified in order to increase durability. Conical vessels strongly correlate with mobility ethnographically (Helton 2001; Linton 1944; Mills 1985). If a conical-base vessel survives falls better than another, it is assumed to have greater transportability and would be advantageous for mobile groups.

Based on these observations, I expected Navajo vessels to be smaller and thinner-walled, have a higher frequency of appendages or holes, be stronger, and show signs of transport through attrition patterns. Puebloan vessels were smaller than Navajo vessels, and this suggests that they were more transportable. Variation also may be the result of a sampling bias. Many of the Dinetah Gray vessels examined were from storage contexts, and although these vessels were used for cooking, they may have survived as whole vessels in the archaeological record because of their subsequent use for storage. Navajo groups may have repaired these larger vessels because of their preference for this size of vessel for storage. It is possible that smaller cooking vessels were also common, but that when they broke, they were not repaired and used for storage.

The second expectation, Navajo vessels would have thinner walls, was shown. Decreasing wall thickness may have been employed by Navajo potters to increase the transportability of their vessels. Although these vessels are large, the thin walls would have decreased the overall weight, resulting in a vessel with greater ease of transport. The Seri of Sonora, Mexico employed a similar strategy (Beck 2009). The Seri are mobile hunter-gatherers that used large thin-walled ceramic vessels to carry and store water. These vessels, often referred to as "eggshell" pottery because of its very thin hard walls, were carried using nets on a yoke (Beck 2009; Bowen and Moser 1968; DiPeso

and Matson 1965). Brugge (1981) argued that the thin walls of Dinetah Gray made these vessels less transportable, but that does not appear to be the case with the Seri. Thinner walls also may be the result of an attempt to increase thermal efficiency.

Vessels also did not conform to the third expectation. Very few of the vessels (three percent) have appendages or holes for attachment of handles. Three Puebloan vessels had handles. Two Dinetah Gray vessels had modifications that could have been for transport; one had holes near the rim that do not appear to be repair holes, and one had a lattice work of fibers held in place with resin. These results do not provide meaningful information on the relative transportability of the two vessel types.

The conical type was expected to be stronger than the rounded type. Conical vessels are stronger in terms of basal impact strength, but the rounded type has more side impact strength. These results suggest that transportability is not significantly different if the vessel had an equal chance of falling in any direction; however, they also imply that the design of each type has advantages over the other in terms of impact location. Western Apache women have stated that they made conical vessels because they broke less often during transport and because the fire was built around the vessel. It is unknown how the vessel was suspended from the horse. The angle at which a pot is suspended (e.g., orientation with the base down or on its side) would no doubt influence what part of the vessel hit the ground first. Qualitative testing of dropping each vessel type on its base and its side did not suggest that conical vessels right themselves during a fall. It is assumed that the impact point on a vessel during a fall is related to the starting angle of the vessel at the moment of release. If I assume that vessels were transported with base down (which is not necessarily the case), the conical type would have greater

transportability. Some ethnographic groups who transported their vessels carried them by either attaching a handle at the rim and carrying them like a pail or suspending them down a person's back with a thong. Vessel orientation in both of these types of transportation would be with the base down. Impact would most likely be at the base if the vessel was dropped, and a conical type would be stronger. However, if a vessel was transported on its side, perhaps suspended in a net bag with other vessels, then first impact to the vessel might be on its side. In that case, the rounded type would have less chance of breaking upon impact than the conical type according to the results of the current research.

Attrition patterns were expected to provide information on whether or not vessels were transported and if so, how they were transported, but this did not prove to be the case. Attrition was present on the exterior of some of the vessels, but the most common type was pitting and grinding below the maximum diameter on or near the base. Pitting most likely represents cooking activities (e.g., repeated exposure to heat) and grinding could be the result of placing the vessel down on hard surfaces such as rocks. No wear most likely reflects transport in net bags.

Because none of the expectations for transportability was definitively met, the hypothesis that Navajo vessel shape reflects greater mobility must be rejected. Navajo conical vessels do not appear to have greater transportability than Puebloan rounded vessels. There are differences in strength between the two types, but how this translates to mobility is unclear. Perhaps Navajo vessels were not transported or were protected during transport in some way and vessel design is not reflective of mobility. It is also possible that the Navajo during this early period were not as mobile as is suggested by

some of the archaeological evidence. The greater basal impact strength is significant; however, and potters may have been aware of this in designing their pots. Further research is needed to clarify this issue.

Cooking Strategy

The second hypothesis is that the two groups employed different vessel shapes due to variation in the cooking strategies and the types of food cooked. Ethnographic accounts and archaeological remains do not provide a clear distinction in the resources exploited by the Navajo relative to Puebloan groups. Both groups used the resources that were available in the surrounding environment in addition to domesticates, which is not surprising given that they lived in similar environments.

The difference, however, is in the contribution of each resource to the overall diet. Corn was much more important in the Puebloan diet than in the Navajo diet, specifically during the early period when conical vessels were more common. Some evidence of domesticates has been found at early Navajo sites; however, this evidence is small relative to the amount of wild resources that have been recovered from these sites (Brown and Hancock 1992; Brugge 2008; Dykeman and Roebuck 2008; Hogan 1992; Hogan and Munford 1992). The opposite seems to be the case for the Jemez. Domesticates comprised the bulk of the diet, as evidenced by the abundance of domesticates recovered from archaeological sites, as well as the increasing number of agricultural features observed over time (Acklen and Railey 1999; Leubben et al. 1988; Reiter 1938).

Quantitative differences between cooking strategies used by each group is not evident in the ethnohistoric literature. It appears that boiling and stewing were common

types of food preparation employed by both groups. Simmering also was common in at least one type of corn preparation.

I expected potential differences in cooking strategies to be reflected in soot patterns, surface attrition patterns, thermal features, thermal stress resistance, and boiling time. Soot patterns were similar between the two types, although deposits tended to be heavier on the Navajo types. It is not clear if variation in the amount of sooting reflects post-depositional processes or differences in use. Most of the Dinetah Gray vessels are from a private collection and had never been washed. It is unknown how many of the Puebloan vessels (all but five from museum collections) have been washed. If I assume the amount of sooting represents use, then the placement of Navajo vessels in the fire, and subsequently directly in the flame, would likely have created a thicker layer of soot than a vessel that is suspended over the fire. The Navajo vessels exhibited soot patterning consistent with vessel placement directly in the fire. Soot was deposited from the base up to the maximum diameter with an oxidized area at the flattened portion of the base. A few of the Puebloan vessels had sooting on the base, but the sooting on many of them extended to the rim. The surface area of the base of the Puebloan vessels is much larger than the flattened point of the Navajo vessels. This indicates a much larger area of the vessel with no soot deposition. It may be that although Puebloan vessels were placed over the fire, they were placed close enough to the fire for the base to be in direct contact with the most intense heat of the flame, and this area was oxidized instead of sooted. This evidence, although not definitive, suggests differences in placement in the fire between the two forms.

Variation in the type of interior surface attrition was expected, but was not identified. Interior and exterior surface attrition patterns are similar, although the frequency of attrition varied between the two groups. The types of attrition common on both Navajo and Puebloan types are consistent with cooking use. Pitting is the result of thermal stress, chemical corrosion, or physical abrasion (Hally 1983b). Exterior attrition is more common on Puebloan types whereas interior attrition is similar in type, location, and frequency between the two groups. Although no definitive variation in the specific cooking strategy could be ascertained from analysis of the two ceramic groups, it does appear that the rounded types were less resistant to thermal stress. This is further supported by the results of the experimental thermal tests.

Thermal features were expected to differ between the two groups. This expectation was met. Thermal features suggest that Navajo and Jemez groups heated their vessels in different ways. The basin-shaped, relatively shallow hearths built by the Navajo were well suited for building a fire around the vessel. This hearth type is also consistent with a less sedentary settlement strategy because such a hearth would be less time consuming to construct. Hearths at Jemez sites are rectangular and slab-lined and some had associated fire dogs. Historically, Puebloan groups placed their vessels over the fire using a metal tripod, and it is assumed that some other support system was employed prior to European contact, particularly fire dogs. It would be costly in terms of time and energy to clean out a deep, rectangular hearth in order to build the fire around the vessel. It would be much easier to do this with a more open basin-shaped hearth. This evidence suggests that a vessel's placement in the fire was different between the two groups.

Rounded-base vessels were expected to have greater thermal stress resistance than the conical types because vessels used to simmer contents over heat for long periods would need greater resistance to thermal stress. This does not appear to be true. Although thermal stress resistance was variable between the two groups, conical vessels were generally more resistant to thermal stress. Spalling and cracking were not observed on any of the experimental vessels during the boiling cycles, but four of the rounded-base vessels failed. All of the conical vessels survived the boiling cycles. Archaeological evidence also suggests that the conical type has more thermal stress resistance. Exterior pitting was much more common in the Rio Grande Plain vessels than the Navajo types. Sooting was prevalent on both types and, therefore, variation in frequency of use between the vessels examined does not appear to explain variation in frequency of attrition. Risk of vessel failure would be great for a vessel with limited thermal stress resistance placed directly in the fire. Rapid boiling and cooling would be common with this form of heating strategy. Increased thermal stress resistance would therefore be advantageous in vessels placed directly in the fire. It may be that a vessel placed over a fire or coals, and used for slow simmering would not need to be as resistant to thermal stress.

Conical vessels were expected to have greater thermal efficiency expressed as shorter boiling times. They did not. The difference between the mean boiling times of both vessel shapes was not statistically significant. Variation within the boiling time was much greater in the replicated rounded-base vessels, suggesting thermal efficiency is much more consistent for conical vessels. This might be important if the primary use of a cooking vessel is for boiling; for vessels primarily used for simmering above a fire, consistency in boiling time might not be as imperative.

The results of the analysis provide support for the argument that Navajo and Puebloan groups employed different cooking strategies. Differences in what these groups were cooking were not apparent in the data, although differences in the proportion of cultigens to wild resources are shown. Variation in vessel shape appears more related to the strategy of building the fire around conical vessels and placing rounded vessels above the fire.

Conclusions

Conical-base vessels have been associated almost exclusively with mobile groups or semi-mobile groups practicing a foraging economy, a relationship that appears to be consistent across time and space. In many prehistoric cases, this relationship is found immediately prior to the transition to agriculture. This is true with the Ertebølle of Southern Scandinavia (Gebauer 1995) and groups in the Eastern Woodlands of North America (Braun 1983). In many cases, archaeologists have assumed that these hunter-gatherers adopted their ceramic technology from their agricultural neighbors.

The Navajo most likely did not adopt their ceramic technology from Puebloan groups, but migrated to the Southwest with a ceramic tradition in place. Their utilitarian ceramic technology does appear to have been impacted by Puebloan influence. The adoption of domesticates was most likely the result of interaction between the two groups. The subsistence strategy of Athapaskan peoples at the time of their entrance into the Southwest is assumed to have been hunting and gathering. Although the Navajo were not entirely dependent on wild resources, they most likely arrived in the Southwest with conical vessels and a foraging economy (Bevilacqua et al. 2007; Brown 1996; Reed 2007; Reed and Hensler 2003).

This research is, unfortunately, inconclusive for definitively answering the questions posed. Variation in the performance of the two shapes is apparent, but the meaning of this variation is unclear. Archaeological and experimental data suggest that there are functional differences between rounded and conical vessels. Impact strength varies between the two vessel shapes according to impact location and, therefore, this variable does not necessarily inform on the transportability of a vessel. The difference in shape may be more attributable to differences in cooking techniques. It is also possible that Navajo groups manufactured conical vessels because of historic continuity rather than performance characteristics. The conical vessel shape may be a cultural "leftover" from a period of high mobility and complete dependence on wild resources.

This study shows that ceramic vessel shape affects impact strength and thermal stress resistance and efficiency. Future research is needed to better understand the implications of vessel shape on mobility and subsistence strategies. Expanding the archaeological sample to include ceramic vessels from other groups with conical-base vessels would elucidate the variation in conical-base ceramic types. Comparing these vessels with rounded vessels from nearby contemporaneous groups also would be useful. Creating reproductions of vessels from these other groups and testing them for strength and thermal properties would most likely provide a better understanding of the relationship between ceramic vessel shape and performance. Better data on the types of food and food preparation techniques of contemporaneous groups with the two vessel shapes would also be helpful. The research presented here has shown that the relationship between ceramic vessel shape and culture is complex, and it will take more research to fully understand it.

References Cited

Acklen, J.C. and J.A. Railey
1999 *Ancestral Jemez Archaeology: Excavations at Three Field House Sites at Horseshoe Springs Sandoval County, New Mexico*. Project 23245. Submitted to United States Forest Service Santa Fe National Forest, Santa Fe, New Mexico.

Aikens, C.M.
1995 First in the World: The Jomon Pottery of Early Japan. In *The Emergence of Pottery*, edited by W.K. Barnett and J.W. Hoopes, pp. 11-21. Smithsonian Institution Press, Washington.
1970 *Hogup Cave*. University of Utah Anthropological Papers 93, Salt Lake City.

Anfinson, S.F.
1979 *A Handbook of Minnesota Prehistoric Ceramics*. Minnesota Archaeological Society, pp. 45-46, St. Paul.

Anschuetz, K. and T. Merlan
2007 In *More than a Scenic Mountain Landscape: Valles Caldera National Preserve Land Use History*. Prepared for the United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-196.

Arnold, D.
1971 Ethnomineralogy of Ticul, Yucatan Potters: etics and emics. *American Antiquity* 36:20-40.
1985 *Ceramic Theory and Cultural Process*. Cambridge University Press, England.

Bailey, G.A. and F.G. Bailey
1986 *A History of the Navajos: The Reservation Years*. School of American Research Press, Santa Fe, New Mexico.

Baldwin, S.J.
1997 Apacheans Bearing gifts: Prehispanic Influence on the Pueblo Indians. *The Arizona Archaeologist No. 29*, Arizona Archaeological Society, Phoenix.

Ballantien, B. and I. Ballantein
1993 *The Native Americans: an illustrated history*. Turner Publishing, Atlanta.

Beck, M.
2009 Residential Mobility and Ceramic Exchange: Ethnography and Archaeological Implications. *Journal of Archaeological Method and Theory*: DOI 10.1007/s10816-009-9073-0. Published online on September 15, 2009.

Bevilacqua, C., R. Wunderlich, and S. Dominguez
2007 *Final Report on the Archaeological Inventory and National Register Evaluation of the Baca Land Exchange BLM Parcels, Biedell Creek Project Area, Saguache County, Colorado*. Prepared for the National Park Service, Intermountain Support Office; Bureau of Land Management, Colorado State Office; Lakewood, and the U.S. Fish and Wildlife Service, Lakewood.

Binford, L.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4-20.

Birket-Smith, K.
1955 *The Chugach Eskimo*. Copenhagen Nationalmuseets Skrifter, Ethnografisk Raekke, 6. Nationalmuseets Publikationsfond, København.

Bogucki, P.
1996 The Spread of Early Farming in Europe. *American Scientist* 84:242-253.

Bollong, C.A., C.G. Sampson, and A.B. Smith
1997 Khoikoi and Bushmanpottery in the Cape Colony: Ethnohistory and Later Stone Age ceramics of the South African interior. *Journal of Anthropological Archaeology* 16: 269-299.

Bowen, T. and E. Moser
1968 Seri Pottery. *Kiva* 33:89-132.

Braun, D.
1983 Pots as Tools. In *Archaeological Hammers and Theories*, edited by J. Moore and A. Keene, pp. 107-134. Academic Press, New York.

Bronitsky, G.
1986 The use of materials science techniques in the study of pottery construction and use. In *Advances in Archaeological Method and Theory*. Vol. 9, edited by M.B. Schiffer, pp. 209-276. Academic Press, New York.

Bronitsky, G. and R. Hamer
1986 Experiments in Ceramic Technology: The effects of various tempering materials on impact and thermal-shock resistance. *American Antiquity* 51(1):89-101.

Brown, D.
1979 Picuris Pueblo. In *Southwest*, edited by Alfonso Ortiz, pp. 268-277. Handbook of North American Indians, vol. 9: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.

Brown, J.A.
1989 The Beginnings of Pottery as an Economic Process. In *What's New? A Closer Look at the Process of Innovation* edited by S.E. van der Leeuw and R. Torrence, pp. 203-24. Unwin Hyman, London.

Brown, G.M.
1991 *Archaeological Data Recovery at San Juan Coal Company's La Plata Mine, San Juan county, NM.* Prepared for San Juan Coal Company BHP-Utah International, INC., vol. 1-4
1996 The Protohistoric Transition in the Northern San Juan Region. In *The Archaeology of Navajo Origins,* edited by R.H. Towner, pp. 47-40. University of Utah Press, Salt Lake City.

Brown, G.M. and P.M. Hancock
1992 The Dinetah Phase in the La Plata Valley. In *Cultural Diversity and Adaptation: The Archaic, Anasazi, and Navajo Occupation of the Upper San Juan Basin,* edited by L. Reed and P. Reed, pp. 69-90. Cultural Resources Series No. 9. New Mexico Bureau of Land Management, Farmington, New Mexico.

Brugge, D.M.
1981 *Navajo Pottery and Ethnohistory.* Navajo Nation Papers in Anthropology #4. Navajo Nation Cultural Resource Management Program, Window Rock, Arizona.
1983 Navajo Prehistory and History to 1850. In *Southwest*, edited by Alfonso Ortiz, pp. 489-501. Handbook of North American Indians, vol. 10: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.
2008 Emergence of the Navajo People. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, British Columbia, Canada.

Cackette, M., J. D'Auria, and B. Snow
1987 Examining earthenware vessel function by elemental phosphate content. *Current Anthropology* 28(1):121-127.

Cameron, C.
1995 Migration and the Movement of Southwestern Peoples. *Journal of Anthropological Archaeology* 14:104-124.

Carlson, R.L.
1965 *Eighteenth Century Navajo Fortresses of the Gobernador District*. Museum Series in Anthropology, vol. 10. University of Colorado, Boulder.

Castaño de Sosa, G.
1965 *A Colony on the Move: Gaspar Castaño de Sosa's Journal, 1590-1591*, edited and translated by A.H. Schroeder and D.S. Matson. The School of American Research, Santa Fe.

Cook, S.L.
1930 *The Ethnobotany of Jemez Indians*. Master's Thesis, University of New Mexico, Albuquerque.

Cordell, L.
1979 Prehistory: Eastern Anasazi. In *Southwest*, edited by Alfonso Ortiz, pp. 131-151. Handbook of North American Indians, vol. 9: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.
1995 Tracing Migration Pathways from the Receiving End. *Journal of Anthropological Archaeology* 14:203-211.

Crandall, W.G. and J. Ging
1955 Thermal Shock Analysis of Spherical Shapes. *Journal of the American Ceramic Society* 38:44-54.

Crow Canyon Archaeological Center
2008 Pueblo Indian History [HTML Title]. Electronic document, http://www.crowcanyon.org/education/pueblo_indian_history.asp, accessed November 15, 2009.

Crown, P. and W. Wills
1995 Economic Intensification and the Origins of Ceramic Containers in the American Southwest. In *The Emergence of Pottery*, edited by W.K. Barnett and J.W. Hoopes, pp. 241-254. Smithsonian Institution Press, Washington.

Darling, J.A., J.C. Ravesloot, and M.R. Waters
2004 Village drift and riverine settlement: modeling Akimel O'odham land use. *American Anthropologist*, 106(2), 282–295.

Deland, C.E.
1908 The Aborigines of South Dakota*: Part II: The Mandan Indians*. South Dakota Historical Collections, vol. IV, pp. 273-748. State Historical Society of South Dakota, Pierre.

DiPeso, C.C. and D.S. Matson
1965 The Seri Indians in 1692 as described by Adamo Gilg, S.J. *Arizona and the West* 7:33-56

Dittert, A.E., Jr.
1958 *Preliminary Archaeological Investigations in the Navajo Reservoir Project Area of Northwestern New Mexico*. Museum of New Mexico Papers in Anthropology No. 1. Museum of New Mexico Press and the School of American Research, Santa Fe.

Dittert, A.E., Jr., J.J. Hester, and F.W. Eddy
1961 *An Archaeological Survey of the Navajo Reservoir District, Northwestern New Mexico*. Monographs of the School of American Research and the Museum of New Mexico, No. 23, Santa Fe.

Dobres, M. and C. Hoffman
1999 *The Social Dynamics of Technology: Practice, Politics, and World View*. Smithsonian Institution Press, Washington.

Dolukhanov, P.M.
1993 Foraging and Farming Groups in North-Eastern and North-Western Europe: Identity and Interaction. In *Cultural Transformations and Interactions in Eastern Europe*, edited by J. Chapman and P. Dolukhanov, pp. 122-145. Ashgate Publishing Company, Aldershot.

Dunmire, W.W. and G.D. Tierney
1997 *Wild Plants and Native Peoples of the Four Corners*. Museum of New Mexico Press, Santa Fe.

Dunning, R.W.
1959 *Social and Economic Change among the Northern Ojibwa.* University of Toronto Press, Toronto.

Dykeman, D.
2003 *The Morris Site 1: Early Navajo Land Use Study, Gobernador Phase Community Development in Northwestern New Mexico.* NNAD Fruitland Data Recovery Series No. 4. Navajo Nation Papers in Anthropology No. 39, Window Rock, Arizona.
2004 *Shifting for Success in the Southwest*: *Early Navajo Culture Change, A.D. 1500-1800*. Paper presented at the Fall Arizona Archaeological council Meetings, October 22-23, 2004. Tucson.

Dykeman, D., R. Towner, and J. Feathers
2002 Correspondence in Tree Ring and Thermoluminescence Dating: A Protohistoric Navajo Pilot study. *American Antiquity* 67(1):145-164.

Dykeman, D.R. and P. Roebuck
2008 *Navajo Emergence in Dinetah: Social Imaginary and Archaeology*. Paper presented at the 2008 SAA Meetings, Vancouver, BC.

Eddy, F.W.
1966 *Prehistory in the Navajo Reservoir District, Northwestern, New Mexico*. Museum of New Mexico Papers in Anthropology No. 15, Santa Fe.

Eerkens, J.W.
2001 *The origins of ceramics among late prehistoric hunter–gatherers of the western Great Basin*. Unpublished Ph.D. dissertation. Santa Barbara: Department of Anthropology, University of California, Santa Barbara.
2003 Residential mobility and pottery use in the western Great Basin. *Current Anthropology* 44(5):728–738.
2004 Privatization, small-seed intensification, and the origins of pottery in the western Great Basin. *American Antiquity* 69(4):653–670.
2008 Nomadic potters: Relationships between ceramic technologies and mobility strategies. In, *The archaeology of mobility: Old World and New World nomadism*, edited by H. Barnard and W. Wendrich, pp. 307–326. Los Angeles: Cotsen Institute of Archaeology, University of California, Los Angeles.

Elliott, M.L.
1989 *Overview and Synthesis of the Archaeology of the Jemez Province, New Mexico*. Museum of New Mexico Office of Archeological Studies, Archaeology Notes 51, Santa Fe.
1991 *The Jemez Falls Campground Project: Archeological Investigations at Four Small Sites in Jemez Mountains, New Mexico*. Jemez Mountains Research Center. Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwest Region, Albuquerque.
1994 Jemez Area Ceramics. Manuscript on file, USDA, Forest Service, Santa Fe National Forest, Santa Fe.
1998 *Coalition Period Adaptations in the Jemez Region: Origins of the Jemez Phenomenon*. Paper presented at the Annual Meeting of the Society for American Archaeology, Seattle, Washington.
2002 *Lower Virgin Mesa Heritage Resources Inventory, Jemez Ranger District, Santa Fe National Forest.* Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Elliott, M., S. Marshall, and A. Darling
1988 *Archeological Investigations at Small Sites in the Jemez Mountains, New Mexico*. Cultural Resources Report 6. Santa Fe National Forest, Santa Fe.

Ellwood, P.B.
1995 Pottery of Eastern Colorado's Early and Middle Ceramic Periods. In *Archaeological Pottery of Colorado: Ceramic Clues to the Prehistoric and Protohistoric Lives of the State's Native Peoples*, edited by R.H. Brunswig, Jr., B. Bradley, and S. M. Chandler. Colorado Council of Professional Archaeologists, Denver.
2002 *Native American Ceramics of Eastern Colorado*. Natural History Inventory of Colorado, No. 21. University of Colorado Museum, Boulder.

Elmore, F.H.
1938 Food animals of the Navajo. *El Palacio* 44:149-154.
1943 *Ethnobotany of the Navajo*. The University of New Mexico Bulletin, Monograph Series, vol. 1, no. 7. University of New Mexico Press, Albuquerque.

Farmer, M.F.
1942 Navaho Archaeology of the Upper Blanco and Largo Canyons, Northern New Mexico. *American Antiquity* 8(1):65-79.

Fenton, W.N.
1957 *Factionalism at Taos Pueblo, New Mexico*. Anthropological Papers 56, Bureau of American Ethnology Bulletin 164:277-344.

Fewkes, J.W.
1896 A Contribution to Ethnobotany. *American Anthropologist* 9:14-21.

Flannery, R.
1953 *The Gros Ventres of Montana: Part 1: Social Life*. Anthropological Series. The Catholic University of America, No. 15, Washington, D.C.

Forrestal, P.P. and C.J. Lynch (editors and translators)
1954 *Benavides' Memorial of 1630*. Documentary Series 2. Academy of American Franciscan History, Washington, D.C.

Gallegos, L.H.
1927 *The Gallegos Relation of the Rodriguez Expedition to New Mexico*, translated and edited by G.P. Hammond and A. Rey. El Palacio Press, Santa Fe.

Gayton, A.H.
1948 *Yokuts and western Mono ethnography: Vol. 1, Tulare Lake, Southern Valley, and Central Foothill Yokuts*. University of California Press, Berkeley.

Gauthier, R. and M. Elliott
1989 *Archaeological Investigations in the Jemez Mountains, New Mexico*. Cultural Resources Document Number 5, Santa Fe National Forest, Santa Fe.

Gebauer, A.B.
1995 Pottery Production and the Introduction of Agriculture in Southern Scandinavia. In *The Emergence of Pottery*, edited by W.K. Barnett and J.W. Hoopes, pp. 99-112. Smithsonian Institution Press, Washington D.C.

Gilmore, K. and S. Larmore
2008 Migration Models and the Athapaskan Diaspora as viewed from the Colorado High Country. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, BC, Canada.

Gimbutas, M.
1991 *The Civilization of the Goddess*. Harper Collins Publishers, San Francisco.

Goggin, J.M.
1964 Seminole Pottery. In *Indian and Spanish: Selected Writings*, edited by J.M. Goggin, pp. 180-213. University of Miami Press, Coral Gables.

Griffiths, D.
1978 Use-marks on historic ceramics: a preliminary study. *Historical Archaeology* 12:68-81.

Gunnerson, J.H.
1987 *Archaeology of the High Plains*. Colorado State Office, Bureau of Land Management, Denver, CO.

Gunnerson, J.H. and D.A. Gunnerson
1971 Apachean Culture: A Study in Unity and Diversity. In *Apachean Culture History and Ethnology*, edited by K. Basso and M. Opler, pp. 7-27. Anthropological Papers of the University of Arizona, No. 21. University of Arizona Press, Tucson.

Habicht-Mauche, J.
1991 Evidence for the manufacture of Southwestern-style culinary ceramics on the Southern Plains. In *Farmers, hunters, and colonists: Interaction between the Southwest and the Southern Plains*, edited by K.A. Spielmann, pp. 51-70. University of Arizona Press, Tucson.
1993 *The Pottery from Arroyo Hondo Pueblo, New Mexico: Tribalization and Trade in the Northern Rio Grande.* Arroyo Hondo Archaeological Series 8. School of American Research Press, Santa Fe.

Habu, J.
2004 Ancient Jomon of Japan. Cambridge University Press, Cambridge.

Hall, E.T., Jr.
1944 Recent Clues to Athabaskan Prehistory in the Southwest. *American Anthropologist* 46:98-105.

Hally, D.
1983a The Interpretive Potential of Pottery from Domestic Contexts. *Midcontinental Journal of Archaeology* 8:163-196.
1983b Use alteration of pottery vessel surfaces. *North American Archaeologist* 4:3-26.
1984 Vessel Assemblages and Food Habits: a Comparison of Two Aboriginal Southeastern Vessel Assemblages. *Southeastern Archaeology* 3:46-64.
1986 The Identification of Vessel Function: a Case Study from Northwest Georgia. *American Antiquity* 51:267-295.

Hammond, G. and A. Rey
1940 *Narratives of the Coronado Expedition*. University of New Mexico Press, Albuquerque. Don Juan de Onate, Colonizer of New Mexico. *Coronado Cuarto Centennial Publication*, vols. 5 and 6. University of New Mexico Press, Albuquerque.
1953 *The Rediscovery of New Mexico, 1580-1594*. University of New Mexico Press, Albuquerque.

Hancock, P.M.
1992 Evidence of the Dinetah Phase in the La Plata River Valley, San Juan County, New Mexico. In *Current Research on the Late Prehistory and Early History of the New Mexico*, edited by B.J. Vierra, pp. 287-298. New Mexico Archaeological Council. Special Publication 1. Albuquerque.

Harrington, H.D.
1967 *Edible Native Plants of the Rocky Mountains*. University of New Mexico Press, Albuquerque.

Harrington, J.P.
1940 *Southern Peripheral Athapaskan Origins, Divisions and Migrations*. Smithsonian Miscellaneous Collections, vol. 100, 503-532. Washington, D.C.

Helton, C.K.
2001 *The Pointed Pot Phenomenon: Testing Strength*. Paper presented at the 66th Annual Meeting of the Society for American Archaeology, New Orleans.

Henrickson, E. and M. McDonald
1983 Ceramic form and function: an ethnographic search and an archaeological application. *American Anthropologist* 85:630-643.

Hensler, K.N., P.F. Reed, and J.A. Torres
1999 *Archaeological Testing at Three Sites along the Proposed N46(1) Road in Sandoval County, New Mexico for the Bureau of Indian Affairs, Navajo Area Office, Branch of Roads, and a Research Design for Data Recovery Excavations at NM-G-53-19/LA16257*. Final Report. Navajo Nation Archaeology Department. Gallup, NM. NMCRIS #56248.

Heron, C. and R. Evershed
1993 The analysis of organic residues and the study of pottery use. In *Archaeological Method and Theory*, vol. 5, edited by M.B. Schiffer, pp. 247-284. Academic Press, New York.

Hester, J.J.
1962 *Early Navajo Migrations and Acculturation in the Southwest*. Museum of New Mexico Papers in Anthropology No. 6. Museum of New Mexico Press, Santa Fe.

Hester, J.J. and J. Shiner
1963 *Studies at Navajo Period Sites in the Navajo Reservoir District*. Museum of New Mexico Papers in Anthropology No. 9. Santa Fe.

Hewett, E.L.
1904 Studies on the Extinct Pueblo of Pecos. *American Anthropologist* 6(4):426-439.

Hibben, F.
1949 The Pottery of the Gallina Complex. *American Antiquity* 14(3):194-202.

Hill, D.V.
1995 A Brief Overview of the Navajo Presence in the Upper San Juan Drainage and South Colorado and their Ceramics. In *Archaeological Pottery of Colorado: Ceramic Clues to the Prehistoric and Protohistoric Lives of the State's Native Peoples,* edited by R.H. Brunswig, Jr., B. Bradley, and S.M. Chandler, pp. 98-119. Colorado Council of Professional Archaeologists, Denver.

Hill, W.W.
1937 *Navajo Pottery Manufacture*. New Mexico University Bulletin, 2 No. 3. University of New Mexico Press, Albuquerque.
1940 *Some Navajo Culture Changes during Two Centuries (With a Translation of the Rabal Manuscript)*. Smithsonian Miscellaneous Collections, Essays in Historical Anthropology of North America 100. Smithsonian Institution, Washington, D.C.

Hogan, P.
1991 Navajo-Pueblo Interaction During the Gobernador Phase: A Reassessment of the Evidence. In *Rethinking Navajo Pueblitos*. Cultural Resources Series, vol. 8. USDI New Mexico Bureau of Land Management, Albuquerque.
1992 *Archeology of the San Juan Breaks: The Navajo Occupation*. Prepared for the Bureau of Land Management, Farmington Resource Area, New Mexico. Prepared by the Office of Contract Archaeology, University of New Mexico, Albuquerque.

Hogan, P. and B. Munford
1992 Excavations at LA16151. In *Archeology of the San Juan Breaks: The Navajo Occupation,* edited by P. Hogan. Prepared for the Bureau of Land Management, Farmington Resource Area, New Mexico. Prepared by the Office of Contract Archaeology, University of New Mexico, Albuquerque.

Hoijer, H.
1938 The Southern Athapaskan Languages. *American Anthropologist* 40(1):75-87.
1956 The Chronology of the Athapaskan Languages. *International Journal of American Linguistics* 22:219-232.
1971 The Position of Apachean Languages in the Athapaskan Stock. In *Apachean Culture History and Ethnology*, edited by K. Basso and M. Opler, pp. 3-6. Anthropological Papers of the University of Arizona, No. 21. The University of Arizona Press, Tucson.

Huscher, B. and H.H. Huscher
1942 Athapaskan Migration via the Intermontane Route. *American Antiquity* 8(1):80-88.

Ikawa-Smith, F.
1986 Late Pleistocene and Early Holocene Technologies. In *Windows on the Japanese Past: Studies in Archaeology and Prehistory*, edited by Richard Pearson, Gina Barnes, and Karl Hutterer, pp. 199-216. Center for Japanese Studies, University of Michigan, Ann Arbor.

Janetski, J.
1990 *The Ute of Utah Lake*. University of Utah Press, Salt Lake City.

Jennings, J.
1978 *Prehistory of Utah and the Eastern Great Basin*, Anthropological Papers, No. 98. University of Utah Press, Salt Lake City.

Jett, S.
1964 Pueblo Indian Migrations: An evaluation of the possible Physical and Cultural Determinants. *American Antiquity* 29: 281-300.

Kelley, K.B. and P.M. Whiteley
1989 *Navajoland: Family and Settlement and Land Use.* Navajo Community College Press. Tsaile, Arizona.

Kelly, I.
1934 *Ethnography of the Surprise Valley Paiute*. University of California Publications in American Archaeology and Ethnology, vol. 31, No. 3., pp. 67-210. Berkeley.

Kendrick, J.W.
2001 *Archaeological Nature and Extent Testing at Eight Sites along Navajo Route 474(4) in Sandoval County, New Mexico*. Zuni Cultural Resource Enterprise Report No. 644. Report on file at ARMS Laboratory of Anthropology, Santa Fe, NM.

Keur, D.
1941 *Big Bead Mesa: An Archaeological Study of Navajo Acculturation, 1745-1812*. Memoirs of the Society for American Archaeology No. 1. Washington, D.C.
1944 A Chapter in Navaho-Pueblo Relations. *American Antiquity* 10(1):75-86.

Kidder, A.
1916 Archeological Explorations at Pecos, New Mexico. *Proceedings of the National Academy of Sciences of the United States of America*, vol. 2, no. 3, pp. 119-123.

Kidder, A. and A.O. Shepard
1936 *The Pottery of Pecos, Volume 2: The Culinary, Glaze-Paint, and Other Wares, and the Technology of Pecos Pueblo*. Papers of the Phillips Academy Southwestern Expedition 7. Yale University Press, New Haven.

Kroeber, A.
1902-1907 *The Arapaho*. American Museum of Natural History, Bulletin 18, (1902-1907), pp. i-xiv, 1-229, 279-406. New York: Published by the Order of the Trustees.

Kulishek, J.
2005 *The Archaeology of Pueblo Population Change on the Jemez Plateau, A.D. 1200 to 1700: The Effects of Spanish Contact and Conquest*. Unpublished Ph.D. Dissertation, Dedman College, Southern Methodist University, Dallas.

Lambert, M.
1981 Spanish Influences on the pottery of the San Jose de Los Jemez and Guisewa, Jemez State Monument (LA679), Jemez Springs, New Mexico. In *Collected Papers in Honor of Erik Kellerman Reed*, edited by Albert H. Schroeder, pp.

215-236. Archaeological Society of New Mexico Papers 6. Albuquerque Archaeological Society, Albuquerque.

Lange, C.H.
1941 *The Evans Site: A Contribution to the Archaeology of the Gallina Region, Northern New Mexico*. Master's Thesis, Department of Anthropology, University of New Mexico, Albuquerque.

Lechtman, H.
1977 Style in Technology: Some Early Thoughts. In *Material Culture: Styles, Organization, and Dynamics of Technology,* edited by H. Lechtman and R.S. Merrill, pp. 3-20. West Publishing Company, New York.

Leftwich, R.
1986 *Arts and Crafts of the Cherokee*. Cherokee Publications, Cherokee, NC.

Lemonnier, P.
1993 *Technological Choices: Transformation in material cultures since the Neolithic*. Routledge, London and New York.

Leubben, R., L. Blake, H. Cutler, J. Herold, and E. Reed
1988 BJ 74: A Small Rock Overhang Containing an Occupational Surface and a Small, Post-Spanish Pueblo, Jemez Mountains, New Mexico. In *Reflections: Papers on Southwestern Culture History In Honor of Charles H. Lange*, edited by Anne Van Arsdall Poore. Papers of the Archaeological Society of New Mexico: 14. Santa Fe, New Mexico.

Levine, F. and A. LaBauve
1997 Examining the Complexity of Historic Population Decline: A Case Study of Pecos Pueblo, New Mexico. *Ethnohistory* 44:75-112.

Linton, R.
1922 *The Thunder Ceremony of the Pawnee*. Field Museum of Natural History, Department of Anthropology. Leaflet No. 5, pp. 3-19. Chicago.
1944 North American Cooking Pots. *American Antiquity* 9(4):369-380.

Loney, H.
2000 Society and Technological Control: A Critical Review of Models of Technological Change in Ceramic Studies. *American Antiquity* 65(4):646-668.

2001 Pots and Evolution: Response to Neff and Schiffer et al. *American Antiquity* 66(4):738-741.

Longacre, W.
1988 Ceramic Ethnoarchaeology: An Introduction. In *Ceramic Ethnoarchaeology,* pp. 1-10. University of Arizona Press: Tucson.

Lowie, R.H.
1924 *Notes on Shoshonean ethnography*. American Museum of Natural History. Anthropological Papers, 20, Part 2. American Museum Press, New York.

Mabry, J.J., M. Skibo, M.B. Schiffer, and K. Kvamme
1988 Use of a Falling-Weight Tester for Assessing Ceramic Impact Strength. *American Antiquity* 53:829-839.

Mackey, J.
1982 Vallecitos Pueblo (A Fourteenth Century A.D., Ancestral Jemez Site), and LA12761 (A Late Prehistoric-Early Historic, Jemez Phase Farm House Site) in New Mexico. *Journal of Intermountain Archeology* 1(2):80-99.

Magne, M. and R.G. Matson
2003 *A New Look at the Intermontane Model of Athapaskan Migration*. Paper presented at the Rocky Mountain Anthropological Conference, Estes Park, Colorado.

Marshall, M.P.
1985 *Excavation of the Cortez CO2, Pipeline Project Sites, 1982-1983*. Office of Contract Archaeology, University of New Mexico, Albuquerque.
1991 The Pueblito as a Site Complex: Archaeological Investigations in the Dinetah District. In *Rethinking Navajo Pueblitos*. Cultural Resources Series, vol. 8. USDI New Mexico Bureau of Land Management, Albuquerque.
1995 *A Chapter in Early Navajo History: Late Gobernador Phase Pueblito Sites of the Dinetah District*. Office of Contract Archaeology, University of New Mexico Report No. 185-469B. Albuquerque.

Mera, H.P.
1935 *Ceramic Clues to the Prehistory of North Central New Mexico*. Museum of New Mexico, Laboratory of Anthropology Technical Series, Bulletin 8: 22-24. Santa Fe.

Mills, B.
1985 "North American Cooking Pots" Reconsidered: Some Behavioral Correlates of Variation in Cooking Pot Morphology. Paper presented at the 50th Annual Meeting of the Society for American Archaeology, Denver.
1999 Ceramics and social contexts of food consumption in the northern Southwest. In *Pottery and People*, edited by J.M. Skibo and G.M. Feinman, pp. 99-114. The University of Utah Press, Salt Lake City.

Mithen, S.J.
1994 The Mesolithic Age. In *The Oxford Illustrated Prehistory of Europe,* edited by B. Cunliffe, pp. 79-135. Oxford University Press, Oxford.

Moore, J.
2008 Rethinking Thirteenth and Fourteenth Century Migration into the Northern Rio Grande. In *Chasing Chaco and the Southwest. Papers in Honor of Frances Joan Mathien*, edited by Regge Wiseman, Thomas O'Laughlin, Cordelia Snow, and Cathy Travis. The Archaeological Society of New Mexico No. 34, Albuquerque.

Morgan, L.H.
1901 *League of the Ho-De-No-Sau-Nee or Iroquois*. Vol. 1, edited and annotated by H.M. Lloyd. Dodd, Mead, and Company, New York.

Munford, B.
1992 Excavations at LA16153. In *Archeology of the San Juan Breaks: The Navajo Occupation*, edited by P. Hogan. Prepared for the Bureau of Land Management, Farmington Resource Area, New Mexico. Prepared by the Office of Contract Archaeology, University of New Mexico, Albuquerque.

Neupert, M.
1994 Strength Testing Archaeological Ceramics: A New Perspective. *American Antiquity* 59(4):709-723.

New Mexico State Site Files
2008 Site form for LA123. Report run on NMCRIS on March 4, 2008. On file at the New Mexico Lab of Anthropology, Santa Fe.

Oakes, Y.
2007 *Dinetah-Phase Occupation and the Twin War Gods on the Jicarilla Apache Reservation: Excavations along NM537, Rio Arriba County, New Mexico*.

Museum of New Mexico Office of Archaeological Studies, Archaeology Notes 344.

Opler, M.E.
1983 The Apachean Culture Pattern and Its Origins. In *Southwest*, edited by A. Ortiz. Handbook of North American Indians, Vol. 10, W. Sturtevant, general editor, pp. 368-392. Smithsonian Institute Press, Washington D.C.

Pallas, P.S.
1948 *Bering's Successors: 1745-1780*. University of Washington Press, Seattle.

Pavlů, I.
1997 *Pottery Origins: Initial Forms, Cultural Behavior, and Decorative Styles*. Karolinum, Univerzita Karlova.

Pérez de Luxàn, D.
1929 *Expedition into New Mexico Made by Antonio de Espejo, 1582-1583, as revealed in the Journal of Diego Pérez de Luxàn, a Member of the Party*, edited by George Hammond and Agapito Rey. The Quivera Society, Los Angeles.

Pierce, C.
1999 *Explaining Corrugated Pottery in the American Southwest: An Evolutionary Approach.* Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington, Seattle. UMI, Ann Arbor.

Powell, M.
2002 *The Organization of Ceramic Production in the Upper Pecos Valley, New Mexico, A.D. 1200 to 1400.* Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque. UMI, Ann Arbor.

Powers, M.A. and B.P. Johnson
1987 *Defensive Sites of Dinetah*. Cultural Resource Series No. 2. United States Department of Interior, Bureau of Land Management, Albuquerque District, Albuquerque, NM.

Price, T.D., A.B. Gebauer, and L.H. Keeley
1995 The Spread of Farming into Europe North of the Alps. In *Last Hunters, First Farmers*, edited by T.D. Price and A.B. Gebauer, pp. 95-126. School of American Research Press, Santa Fe.

Quimby, G.I.
1945 *Pottery from the Aleutian Islands*. Fieldiana Anthropology, vol. XXXVI, no. 1. Chicago Natural History Museum, Chicago.

Ramenofsky, A.F.
1995 Evolutionary Theory and Native American Artifact Change in the Postcontact Period. In *Evolutionary Archaeology, Methodological Issues*, edited by P. Teltser, 129-148. The University of Arizona Press, Tucson.

Radin, P.
1923 The Winnegabo Tribe. *Thirty Seventh Annual Report of the Bureau of American Ethnology*, pp. 35-560. Smithsonian Institution, Washington D.C.

Rathje, W.L. and M.B. Schiffer
1982 *Archaeology*. Harcourt Brace Jovanovich, New York.

Reagan, A.B.
1917 The Jemez Indians. *El Palacio* 4:25-72.

Reed, A.D.
1995 Ute Ceramics. In *Archaeological Pottery of Colorado: Ceramic Clues to the Prehistoric and Protohistoric Lives of the State's Native Peoples,* edited by R.H. Brunswig, Jr., B. Bradley, and S.M. Chandler, pp. 120-128. Colorado Council of Professional Archaeologists, Denver.

Reed, A.D. and J.C. Horn
1988 *Archaeological Investigations of Kin 'Atsa" (LA49498): A Late Archaic-Basketmaker Transition, Basketmaker II, and Dinetah Phase Navajo Habitation Site in San Juan County, New Mexico*. Prepared for BHP-Utah International San Juan Coal Company, La Plata Mine. Nickens and Associates, Montrose.
1990 Early Navajo Occupation of the American Southwest: Reexamination of the Dinétah Phase. *Kiva* 55:283-300.

Reed, L.S.
2007 Appendix E: Ceramic Analysis. In *Final Report on the Archaeological Inventory and National Register Evaluation of the Baca Land Exchange BLM Parcels, Biedell Creek Project Area, Saguache County, Colorado*. Prepared for the National Park Service, Intermountain Support Office; Bureau of Land Management, Colorado State Office; and the U.S. Fish and Wildlife Service. Denver.

Reed, L.S. and J. Goff
2007 *A Field Guide to Upper San Juan Anasazi and Navajo Pottery*. Prepared for the NMAC Ceramic Workshop, Farmington District Office, Bureau of Land Management, Farmington, NM.

Reed, L.S. and K.H. Hensler
2003 Navajo Pottery Origins. Paper presented at the 12th Navajo Studies Conference, San Juan College, Farmington, NM.

Reed, L.S. and P.F. Reed
1992 The Protohistoric Navajo: Implication of Interaction, Exchange, and Alliance Formation with the Eastern and Western Pueblos. In *Cultural Diversity and Adaptation: The Archaic, Anasazi, and Navajo Occupation of the Upper San Juan Basin*, edited by L. Reed and P. Reed, pp. 91-91-104. Cultural Resources Series No. 9. New Mexico Bureau of Land Management, Albuquerque.

Reed, P. and L. Reed
1996 Reexamining Gobernador Polychrome: Toward a New Understanding of the Early Navajo Chronological Sequence in Northwestern New Mexico. In *The Archaeology of Navajo Origins,* edited by R.H. Towner, pp. 83-108. University of Utah Press, Salt Lake City.

Reeve, F.D.
1956 Early Navaho Geography. *New Mexico Historical Review* 31: 290-309.
1957 Seventeenth Century Navaho-Spanish Relations. *New Mexico Historical Review* 32: 36-52.
1958 Navaho-Spanish Wars, 1680-1720. *New Mexico Historical Review* 33:205-231.

Reid, K.C.
1990 Simmering Down: A Second Look at Ralph Linton's "North American Cooking Pots." In *Hunter-Gatherer Pottery from the Far West*, edited by J. M. Mack. Nevada State Museum Anthropological Papers No. 23. Nevada State Museum, Carson.

Reiter, P.
1938 *The Jemez Pueblo of Unshagi, New Mexico*. The University of New Mexico Bulletin. University of New Mexico Press, Albuquerque.

Reiter, P., W.T. Mulloy, and E.H. Blumentahal, Jr.
1940 *Preliminary Report of the Jemez Excavation at Nanishagi, New Mexico*. University of New Mexico Bulletin, Anthropological Series 3:3, Albuquerque.

Rice, P.
1987 *Pottery Analysis: A Sourcebook*. University of Chicago Press, Chicago.
1996 Recent Ceramic Analysis: 1. Function, Style, and Origins. *Journal of Archaeological Research* 4(2):133-163.

Roebuck, P.
2008 *Ethnobotany of the Early Navajo*. Anthropological Investigations No. 3, Dykeman Roebuck Archaeology, Farmington, New Mexico. Electronic document, http://www.drarchaeology.com/publications/earlynavajoethnobot.pdf, accessed May 2008.

Rowley-Conwy, P.
1984 Postglacial foraging and early farming economies in Japan and Korea: a west European perspective. *World Archaeology* 16(1):28-42

Sakaguchi, T.
2008 Storage Adaptations among Hunter Gatherers: A Quantitative Approach to the Jomon Period. *Journal of Anthropological Archaeology* 28: 290-303.

Sando, J.
1979 The Pueblo Revolt. In *Southwest*, edited by Alfonso Ortiz, pp. 194-197. Handbook of North American Indians, vol. 9: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.

.

Sapir, E.
1923 A note on Sarcee Pottery. *American Anthropologist* 25: 247-253.

Sassaman, K.
1993 *Early Pottery in the Southeast*. The University of Alabama Press, Tuscaloosa.

Sattler, R.
1989 *Seminoli Italwa: sociopolitical change among the Oklahoma Seminoles between Removal and Allotment, 1836-1905*. PhD Dissertation, University of Oklahoma, Norman, 1987. UMI, Ann Arbor.

Schaafsma, C.F.
1974 *Final Report on a Survey of Abiquiu Reservoir*. School of American Research, Santa Fe.
1996 Ethnic Identity and Protohistoric Archaeological Sites in Northwestern New Mexico: Implications for Reconstructions of Navajo and Ute History. In *The Archaeology of Navajo Origins,* edited by R.H. Towner, pp. 19-46. University of Utah Press, Salt Lake City.
2002 *Apaches de Navajo: Seventeenth-Century Navajos in the Chama Valley of New Mexico.* University of Utah Press, Salt Lake City.

Schiffer, M.
1990a Technological change in water-storage and cooking pots: some predictions from experiments. In *The changing roles of ceramics in society: 26,000 BP to the present*, edited by W. Kingery, pp. 119-136. The American Ceramic Society, Westerville, Ohio.
1990b The Influence of Surface Treatment on Heating Effectiveness of Ceramic Vessels. *Journal of Archaeological Science* 17:373-381.
1991 Human Behavior and Artifacts. In *Technological Perspectives on Behavioral Change*, edited by M. Schiffer, pp. 1-21. The University of Arizona Press, Tucson.

Schiffer, M. and J. Skibo
1987 Theory and Experiment in the Study of Technological Change. *Current Anthropology* 20:595-622.
1989 A provisional theory of ceramic abrasion. *American Anthropologist* 91:101-115.
1997 The Explanation of Artifact Variability. *American Antiquity* 62(1):27-50.

Schiffer, M.B., J. Skibo, T. Boerlke, M. Neupert, and M. Aronson
1994 New Perspectives on Experimental Archaeology: Surface Treatments and Thermal Response of the Clay Cooking Pot. *American Antiquity* 59:197-217.

Schoenwetter, J. and F.W. Eddy
1964 *Alluvial and Palynological Reconstruction of Environments, Navajo Reservoir District*. Museum of New Mexico Papers in Anthropology No. 13. Museum of New Mexico Press, Santa Fe.

Scholes, F.
1938 Notes on the Jemez Missions in the Seventeenth Century. *El Palacio* 44:61-71, 93-102.

Schroeder, A.
1979 Pecos Pueblo. In *Southwest*, edited by Alfonso Ortiz, pp. 430-437. Handbook of North American Indians, vol. 9: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.

Scott, L.
1989 Pollen Analysis at Sites 1513 and 1515. In *Archaeological Investigations in the Jemez Mountains, New Mexico*, edited by Rory Gautier and Michael Elliott, pp. 103-106. Cultural Resources Document Number 5, Santa Fe National Forest, Santa Fe.

Sesler, L. and T. Hovezak.
2002 Synthesis: Cultural and Adaptational Diversity in the Fruitland Study Area. In *Archaeological Investigations in the Fruitland Project Area: Late Archaic, Basketmaker, Pueblo I and Navajo Sites in Northwestern New Mexico, Volume 1*, edited by Timothy Hovezak, Leslie Sesler, and Steven Fuller, pp. 109-238. La Plata Archaeological Consultants Research Papers No. 4. La Plata Archaeological Consultants, Dolores, Colorado.

Shepard, A.O.
1938 Appendix VI: Technological Notes on the Pottery from Unshagi. In *The Jemez Pueblo of Unshagi, New Mexico, with Notes on the Earlier Excavations at "Amoxiumqua" and Guisewa*, edited by Paul Reiter, pp. 205-211. University of New Mexico and School of American Research Monograph 1(4-5). Two parts. University of New Mexico Press, Albuquerque.
1956 *Ceramics for the Archaeologist.* Publication 609, Carnegie Institution of Washington, Washington, D.C.

Simms, S.R., J. Bright, and A. Ugan
1997 Plain-ware Ceramics and Residential Mobility: A Case Study from the Great Basin. *Journal of Archaeological Science* 24:779-792.

Skibo, J.
1992 *Pottery Function: A Use-Alteration Perspective*. Plenum Press, New York.

Skibo, J. and E. Blinman
1999 Exploring the Origins of Pottery on the Colorado Plateau. In *Pottery and People*, edited by James Skibo and Gary Feinman, pp. 171-183. University of Utah Press, Salt Lake City.

Smith, A.
1974 Ethnography of the Northern Ute. *Museum of New Mexico Papers in Anthropology 17*, Santa Fe.

Smith, M.F.
1985 Toward an Economic Interpretation of Ceramics: Relating Vessel Size and Shape to Use. In *Decoding Prehistoric Ceramics*, edited by B. Nelson, pp. 254-309. Southern Illinois University Press, Carbondale.
1988 Function from whole vessel shape: a method and an application to Anasazi Black Mesa, Arizona. *American Anthropologist* 90:912-923.

Smith, M.F. and J.E. Miles
1984 Assessing Function on Southwestern Ceramics: Restorable Vessels from Black Mesa. Paper Presented at the 49th Annual Meeting of the Society for American Archaeology, Portland.

Snow, D.
1991 Upland Prehistoric Maize Agriculture in the Eastern Rio Grande and Its Peripheries. In *Farmers, hunters, and colonists: Interaction between the Southwest and the Southern Plains*, edited by K.A. Spielmann, pp. 71-88. University of Arizona Press, Tucson.

Spielmann, K.
1991 Coercion or Cooperation? Plains-Pueblo Interaction in the Protohistoric Period. In *Farmers, hunters, and colonists: Interaction between the Southwest and the Southern Plains*, edited by K.A. Spielmann, pp. 36-50. University of Arizona Press, Tucson.

Spielmann, K., M. Schoeninger, and K. Moore
1990 Plains-Pueblo Interdependence and Human Diet at Pecos Pueblo, New Mexico. *American Antiquity* 55(4):745-765.

Spier, L.
1928 Havasupai Ethnography. Anthropological papers of the American Museum of Natural History, vol. 29. New York.
1933 *Yuman Tribes of the Gila River*. University of Chicago Press, Chicago.

Stevenson, M.C.
1904 *The Zuni Indians: Their Mythology, Esoteric Fraternities, and Ceremonies*. Twenty-third Annual Report of the Bureau of American Ethnology,

Smithsonian Institution, 1901-1902. U.S. Government Printing Office, Washington, D.C.

Steward, J.
1937 *Ancient Caves of the Great Salt Lake Region*. Smithsonian Institution, Bureau of American Ethnology. Bulletin 116. Washington D.C.

Stuart, D. and R. Gauthier
1996 *Prehistoric New Mexico: Background for Survey*. University of New Mexico Press, Albuquerque. (Original Version 1981)

Tilley, C.
1996 *An Ethnography of the Neolithic: Early Prehistoric Societies in Southern Scandinavia*, edited by C. Tilley, pp. 1-69. Cambridge University Press, Cambridge.

Titiev, M.
1944 Old Oraibi: A Study of the Hopi Indians of the Third Mesa. Peabody Museum of Archaeology and Ethnology Papers, vol. 22, no. 1.

Torres, J.A.
1999 Adapting Old Lithic Traditions to a New World Order. Paper presented at the 64th Annual Meeting of the Society for American Archaeology, Chicago.

Towner, R.
1996 The Pueblito Phenomenon: A New Perspective on Post-Revolt Navajo Culture. In *The Archaeology of Navajo Origins*, edited by R.H. Towner, pp. 149-170. University of Utah Press, Salt Lake City.
2003 *Defending the Dinetah: Pueblitos in the Ancestral Navajo Homeland*. The University of Utah Press, Salt Lake City.

Towner, R. and J.S. Dean
1992 LA 2298: The Oldest Pueblito Revisited. *Kiva* 59:315-331.
1996 Questions and Problems in Pre-Fort Sumner Navajo Archaeology. In *The Archaeology of Navajo Origins*, edited by R.H. Towner, pp. 3-18. University of Utah Press, Salt Lake City.

Trigger, B.
1982 Ethnohistory: problems and prospects. *Ethnohistory* 29(2): 1-19.

Van Hoose, J.
2008 *Learning Lineages as Reflected in Ceramic Production in Early Historic Northwest New Mexico*. Unpublished Dissertation. Department of Anthropology, University of New Mexico, Albuquerque. UMI, Ann Arbor.

Vestal, P.
1952 *Ethnobotany of the Ramah Navaho*. Reports of the Ramah Project Report No. 4. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University vol. XL, no. 4.

Vickers, J.R.
1994 Cultures of the Northwestern Plains: From the Boreal Forest Edge to Milk River. In *Plains Indians, A.D. 500-1500*, edited by K.H. Schlesier, pp.3-33. University of Oklahoma Press: Norman.

Vierra, B.J. and R.I. Ford
2006 Early Maize Agriculture in the Northern Rio Grande Valley, New Mexico. In *Histories of Maize: Multidisciplinary Approaches to the Prehistory, Linguistics, Biogeography, Domestication, and Evolution of Maize*, edited by J. Staller, R. Tykot, and B. Benz, pp. 497-510. Academic Press, New York.

Wedel, W.R.
1936 *An Introduction to Pawnee Archaeology*. Smithsonian Institution, Bureau of American Ethnology, Bulletin 112. United States Government Printing Office, Washington, D.C.

Wendorf, F.
1954 A Reconstruction of Northern Rio Grande Prehistory. *American Anthropologist* 56(2):200-227.

Wendorf, F. and E. Reed
1955 An Alternative Reconstruction of Rio Grande Prehistory. *El Palacio* 62(5-6):131-173.

Wetterstrom, W.
1986 *Food, Diet, and Population at Prehistoric Arroyo Hondo Pueblo, New Mexico*. Arroyo Hondo Archaeological Series Volume 6, School of American Research Press, Santa Fe.

Whittlesey, S.
1974 Identification of Imported Ceramics through Functional Analysis of Attributes. *The Kiva* 40: 101-112.

Wilcox, D.
1981 The Entry of the Athapaskans into the American Southwest: The Problem Today. In *The Protohistoric Period in the North American Southwest, A.D. 1450-1700,* edited by David Wilcox and Bruce Masse, pp. 213-256. Arizona State University Anthropological Research Papers no. 24. Tempe.

Will, G.F. and J. Spinden
1906 *The Mandans: A Study of their Culture, Archaeology, and Language*. Papers of the Peabody Museum of American Archaeology and Ethnology. Harvard University, vol. III, pp. 79-222. Cambridge.

Wilson, S.S.
2004 *Ute and Navajo Ceramic Technology: Distinguishing Protohistoric and Ethnic Tradition*. Unpublished Master's Thesis, Department of Anthropology, University of Colorado, Boulder.

Wilson, C. D. and E. Blinman
1993 *Upper San Juan Pottery Typology*. Archaeology Notes 80. Office of Archeological Studies, Museum of New Mexico, Santa Fe.

Winship, G.P.
1896 *The Coronado Expedition, 1540-1542.* Bureau of American Ethnology Annual Report, part 2. Smithsonian Institution, Washington, D.C.

White, D.
2005 *Seinanyédi: An Ethnographic Overview of Great Sand Dunes National Park and Preserve*. Submitted to the National Park Service, Great Sand Dunes National Park and Preserve, Colorado.

Worchester, D.E.
1951 The Navaho during the Spanish regime in New Mexico. *New Mexico Historical Review* 26: 101-118.

Wylie, A.
1985 The Reaction against Analogy. In *Advances in Archaeological Method and Theory*, vol. 8, edited by M.B. Schiffer, pp. 63-111. Academic Press, Orlando.

Young, R.W.
1983 Apachean Languages. In *Southwest*, edited by Alfonso Ortiz, pp. 393-400. Handbook of North American Indians, vol. 10: W. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.

Appendix A: Archaeological Data

Table A1. Whole Vessel Data.

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
1	Maxwell Museum	69.31.2	Dinetah Gray	Hemispherical	FALSE	33.00	24.00	19.00	22.00
2	Maxwell Museum	63.6.1	Dinetah Gray	Conical	FALSE	33.00	26.00	19.00	22.00
3	Maxwell Museum	54.18.1	Navajo Gray	Conical	FALSE	36.00	24.00	19.00	22.00
4	Maxwell Museum	67.78.1	Navajo Gray	Conical	FALSE	34.00	24.00	19.00	21.00
5	Maxwell Museum	65.14.1	Dinetah Gray	Conical	FALSE	24.00	17.00	14.00	16.00
6	Maxwell Museum	66.123.1	Dinetah Gray	Conical	TRUE	33.00	22.00	16.00	17.00
7	Maxwell Museum	63.49.1	Dinetah Gray	Conical	TRUE	34.00	20.00	15.00	18.00
8	Maxwell Museum	65.14.2	Dinetah Gray	Conical	TRUE	36.00	27.00	17.00	21.00
9	Maxwell Museum	78.32.14	Navajo Gray	Conical	TRUE	35.00	24.00	17.00	20.00
11	Gallegos Collection	GC1	Navajo Gray	Conical	TRUE	31.90	21.70	14.50	17.60
15	Museum of Northern Arizona	E68	Navajo Gray	Conical	TRUE	40.40	27.00	18.30	21.30

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
16	Museum of Northern Arizona	E5117	Dinetah Gray	Conical	TRUE	40.20	24.20	15.40	18.40
17	Museum of Northern Arizona	OC394	Navajo Gray	Conical	FALSE	30.00	19.30	17.30	19.10
18	Museum of Northern Arizona	OC317	Navajo Gray	Conical	FALSE	18.00	11.00	9.60	10.90
19	Museum of Northern Arizona	E702	Navajo Gray	Conical	FALSE	26.60	18.50	15.20	16.90
20	Museum of Northern Arizona	OC471	Navajo Gray	Hemispherical	TRUE	22.10	13.00	11.80	12.10
21	Museum of Northern Arizona	E210	Navajo Gray	Conical	FALSE	20.20	13.60	12.60	15.00
22	Museum of Northern Arizona	E703	Navajo Gray	Hemispherical	FALSE	17.90	11.10	7.90	10.80
23	Museum of Northern Arizona	E1089	Navajo Gray	Conical	TRUE	26.20	20.70	16.50	19.10
24	Museum of Northern Arizona	E9012	Dinetah Gray	Conical	TRUE	30.80	22.80	17.90	19.80
25	Museum of Northern Arizona	E1090	Navajo Gray	Conical	FALSE	20.40	14.10	12.40	13.70
26	Museum of Northern Arizona	E1458	Navajo Gray	Conical	FALSE	27.30	15.60	14.30	16.30

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
27	Museum of Northern Arizona	1516D/L	Navajo Gray	Conical	FALSE	24.80	15.50	12.80	15.00
28	Museum of Northern Arizona	E1105	Navajo Gray	Conical	FALSE	19.00	13.90	11.40	14.00
29	Museum of Northern Arizona	E8856	Navajo Gray	Conical	FALSE	23.90	17.10	13.70	17.40
30	Museum of Northern Arizona	E8528	Navajo Gray	Conical	FALSE	26.00	17.20	14.10	16.60
31	Museum of Northern Arizona	E9437	Navajo Gray	Conical	FALSE	29.50	18.00	15.30	17.70
32	Museum of Northern Arizona	E9015	Navajo Gray	Hemispherical	FALSE	28.10	15.90	13.50	14.00
33	Museum of Northern Arizona	E1032	Navajo Gray	Hemispherical	FALSE	30.00	16.40	13.70	15.50
34	Museum of Northern Arizona	E7746	Navajo Gray	Conical	FALSE	19.90	13.50	11.90	12.60
35	Museum of Northern Arizona	E2169	Navajo	Cylindrical	TRUE	16.20	9.00	9.40	10.60
36	Museum of Northern Arizona	E2010	Navajo Gray	Hemispherical	FALSE	23.90	16.60	14.70	15.30
37	Museum of Northern Arizona	E1112	Navajo Gray	Hemispherical	FALSE	21.60	14.80	13.20	14.50

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
38	Museum of Northern Arizona	E2210	Dinetah Gray	Conical	FALSE		15.50		
39	Museum of Northern Arizona	E6169	Dinetah Gray	?	FALSE			15.10	16.70
40	Museum of Indian Arts and Culture	16201/11	Dinetah Gray	Conical	TRUE	52.80	40.70	25.30	27.20
41	Museum of Indian Arts and Culture	16152/11	Dinetah Gray	Conical	TRUE	41.40	26.60	16.50	19.50
42	Museum of Indian Arts and Culture	702/12	Dinetah Gray	Conical	TRUE	41.90	29.00	19.00	20.70
43	Museum of Indian Arts and Culture	16204/11	Dinetah Gray	Conical	TRUE	38.50	28.80	20.10	22.00
44	Museum of Indian Arts and Culture	16206/11	Dinetah Gray	Conical	TRUE	38.80	26.00	16.90	19.40
45	Museum of Indian Arts and Culture	16202/11	Dinetah Gray	Conical	TRUE	52.20	36.60	18.10	25.00
46	Museum of Indian Arts and Culture	11043/12	Navajo Gray	Conical	FALSE	30.30	19.40	15.50	17.00
47	Museum of Indian Arts and Culture	16198/11b	Dinetah Gray	Conical	TRUE	34.80	26.20	16.60	18.80
48	Museum of Indian Arts and Culture	16203/11	Dinetah Gray	Conical	TRUE	35.50	25.50	16.80	20.50

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
49	Museum of Indian Arts and Culture	1431/11	Dinetah Gray	Conical	TRUE	34.40	23.30	14.20	16.30
50	Museum of Indian Arts and Culture	55699/11	Dinetah Gray	Conical	TRUE	35.30	24.50	18.50	20.20
51	Museum of Indian Arts and Culture	8611/12	Dinetah Gray	Conical	TRUE	46.70	32.50	18.00	20.30
52	Museum of Indian Arts and Culture	53644/11	Dinetah Gray	Hemispherical	FALSE	26.50	23.00	14.50	16.00
53	Museum of Indian Arts and Culture	8299/11	Dinetah Gray	Conical	FALSE	25.00	16.80	12.50	15.50
55	Museum of Indian Arts and Culture	44358/11	Dinetah Gray	Conical	TRUE	51.70	41.60	23.70	26.60
56	Museum of Indian Arts and Culture	8590/11	Cundiyo Smeared Indented	Hemispherical	FALSE	19.30	28.70	18.20	19.70
57	Museum of Indian Arts and Culture	21904/11	Rio Grande utility	Hemispherical	FALSE	22.90	29.30	23.70	24.50
58	Museum of Indian Arts and Culture	21884/11	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	25.90	33.00	20.80	23.00
59	Museum of Indian Arts and Culture	21851/11	Rio Grande Utility	Hemispherical	FALSE	23.60	28.20	21.30	22.60
60	Museum of Indian Arts and Culture	21784/11	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	17.80	23.30	16.80	17.00

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
61	Museum of Indian Arts and Culture	45121/11	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	26.00	28.20	20.00	23.00
62	Museum of Indian Arts and Culture	21766/11	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	21.10	29.40	21.70	23.40
63	Gallegos Collection	GC3	Dinetah Gray, Indented Variety	Conical	FALSE	32.90	25.10	20.10	20.70
64	Gallegos Collection	GC5	Dinetah Gray, Indented Variety	Conical	FALSE	38.30	30.00	16.20	17.40
65	Gallegos Collection	GC6	Dinetah Gray	Conical	TRUE	37.20	23.70	15.10	18.00
66	Gallegos Collection	GC7	Dinetah Gray	Conical	TRUE	37.70	29.00	16.20	16.20
67	Gallegos Collection	GC8	Dinetah Gray	Conical	TRUE	32.20	26.30	17.20	18.80
68	Gallegos Collection	GC9	Dinetah Gray	Conical	TRUE	27.20	24.30	14.50	16.60
69	Gallegos Collection	GC10	Dinetah Gray	Conical	TRUE	24.60	20.80	14.90	14.90
70	Gallegos Collection	GC11	Dinetah Gray	Conical	TRUE	37.10	21.40	14.90	17.30
71	Gallegos Collection	GC18	Dinetah Gray	Conical	TRUE	40.10	31.10	17.50	20.10

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
72	Gallegos Collection	GC19	Dinetah Gray	Conical	TRUE	38.10	31.00	17.70	18.00
73	Gallegos Collection	GC20	Navajo Gray	Conical	FALSE	33.50	19.50	16.00	20.50
74	Gallegos Collection	GC21	Navajo Gray	Hemispherical	FALSE	27.80	19.10	10.70	11.70
75	Gallegos Collection	GC22	Dinetah Gray	Conical	TRUE	39.30	28.70	18.70	21.70
76	Gallegos Collection	GC23	Dinetah Gray	Conical	TRUE	51.00	37.30	20.30	22.30
77	Gallegos Collection	GC24	Dinetah Gray	Conical	TRUE	53.00	36.80	23.00	26.80
78	Gallegos Collection	GC25	Dinetah Gray	Conical	TRUE	41.30	24.30	15.50	18.50
79	Gallegos Collection	GC26	Dinetah Gray	Conical	TRUE	50.50	38.40	22.60	25.00
80	Gallegos Collection	GC27	Dinetah Gray	Conical	TRUE	46.90	35.90	23.00	25.90
81	Gallegos Collection	GC28	Dinetah Gray	Conical	TRUE	48.50	33.30	18.00	20.20
82	Gallegos Collection	GC29	Dinetah Gray	Conical	TRUE	46.40	30.60	20.00	22.60

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
83	Gallegos Collection	GC30	Dinetah Gray	Conical	TRUE	53.50	32.10	21.80	22.60
84	Gallegos Collection	GC32	Dinetah Gray	Conical	TRUE	32.60	27.90	16.60	16.90
85	Gallegos Collection	GC33	Dinetah Gray	Conical	TRUE	50.40	38.30	18.40	20.70
86	Gallegos Collection	GC34	Dinetah Gray	Conical	TRUE	48.20	40.90	19.60	21.90
87	Gallegos Collection	GC35	Dinetah Gray	Conical	TRUE	43.00	37.60	25.10	22.70
88	Gallegos Collection	GC36	Dinetah Gray	Conical	TRUE	36.00	33.60	21.00	24.00
89	Gallegos Collection	GC37	Dinetah Gray	Conical	TRUE	42.60	30.50	18.20	20.60
90	Gallegos Collection	GC38	Dinetah Gray	Conical	TRUE	45.60	36.10	18.60	20.20
91	Gallegos Collection	GC39	Dinetah Gray	Conical	TRUE	60.00	41.30	23.20	25.50
92	Gallegos Collection	GC40	Dinetah Gray	Conical	TRUE	47.60	33.90	19.30	23.00
93	Gallegos Collection	GC41	Dinetah Gray	Conical	FALSE	43.90	31.70	18.10	19.80

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
94	Gallegos Collection	GC42	Unknown	Conical	FALSE	53.00	46.50	24.50	27.60
95	Maxwell Museum	61-12	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	16.00	14.50	10.50	11.00
96	Maxwell Museum	USAG Amnesty 2004-2	Dinetah Gray	Conical	TRUE	52.10	37.00	21.90	23.50
98	Smithsonian National Museum of Natural History	A262760	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	16.40	19.20	16.70	18.70
99	Smithsonian National Museum of Natural History	A262801	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	14.70	20.40	16.10	16.60
100	Smithsonian National Museum of Natural History	A262744	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	13.00	14.30	11.60	11.90
102	Smithsonian National Museum of Natural History	A271978	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	16.70	19.40	16.00	17.30
103	Smithsonian National Museum of Natural History	A314055	Rio Grande utility	Hemispherical	FALSE	33.90	42.60	27.50	30.90
105	Smithsonian National Museum of Natural History	A272070	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	10.80	12.40	11.00	12.90

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
106	Smithsonian National Museum of Natural History	A271979	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	13.70	19.00	16.00	17.50
107	Smithsonian National Museum of Natural History	A272073	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	15.10	15.20	10.30	11.70
108	Smithsonian National Museum of Natural History	A272072	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	15.20	17.30	14.40	16.10
109	Smithsonian National Museum of Natural History	A272071	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	10.90	12.90	10.40	11.30
113	Smithsonian National Museum of Natural History	E381098	Navajo Gray	Hemispherical	FALSE	27.80	26.70	24.00	26.30
114	Smithsonian National Museum of Natural History	E326909	Navajo Gray	Conical	TRUE	34.20	22.00	18.40	20.20
115	Smithsonian National Museum of Natural History	E326910	Dinetah Gray	Conical	TRUE	43.90	28.70	19.60	23.80
116	Smithsonian National Museum of Natural History	ET05477	Dinetah Gray	Conical	FALSE	38.00	24.20	18.80	19.40

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
117	Smithsonian National Museum of Natural History	E292724	Navajo Gray	Conical	TRUE	19.30	15.00	13.50	15.00
118	Smithsonian National Museum of Natural History	A317169	Dinetah Gray	Conical	TRUE	37.10	26.10	18.80	20.50
120	Maxwell Museum	39.21.27	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	18.20	27.10	18.60	20.70
121	Maxwell Museum	39.21.100	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	17.50	22.00	15.40	17.60
122	Maxwell Museum	39.21.96	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	13.40	20.60	16.10	18.40
123	Maxwell Museum	39.21.21	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	20.60	23.10	16.00	16.00
124	Maxwell Museum	77.1.18	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	16.70	17.50	12.50	14.10
126	Maxwell Museum	71.7.3**	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	27.00	34.30	28.60	31.10
136	Maxwell Museum	76.78.1	Zia	Hemispherical	TRUE	26.70	30.90	22.70	22.70
137	Maxwell Museum	65.38.1	Rio Grande Utility, variety Jemez	Hemispherical	TRUE	29.80	28.20	18.50	19.20

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
145	Maxwell Museum	82.48.7	Rio Grande Utility, variety Jemez	Hemispherical	TRUE	14.70	19.00	14.20	13.80
146	Maxwell Museum	82.48.5	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	17.60	23.60	18.00	19.50
147	Maxwell Museum	46.16.1/BJ10/11	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	19.00	25.00	17.30	20.80
151	Museum of Indian Arts and Culture	21720	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	15.30	16.90	13.60	14.60
152	Museum of Indian Arts and Culture	21674	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	16.10	18.31	16.20	18.20
153	Museum of Indian Arts and Culture	21702	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	12.30	14.70	12.70	14.00
154	Museum of Indian Arts and Culture	21701	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	8.90	11.30	9.90	11.70
155	Museum of Indian Arts and Culture	18517	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	11.00	12.40	10.50	12.00
156	Museum of Indian Arts and Culture	21634	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	7.90	11.30	10.20	10.60
157	Museum of Indian Arts and Culture	21086	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	41.70	42.80	29.20	32.80
158	Museum of Indian Arts and Culture	21714	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	14.40	17.20	13.30	13.00

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
159	Museum of Indian Arts and Culture	21732	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	14.10	14.50	12.90	1.90
160	Museum of Indian Arts and Culture	21721	Rio Grande Utility, variety Jemez	Hemispherical	TRUE	11.60	11.90	10.80	12.00
161	Museum of Indian Arts and Culture	21801	Rio Grande Utility, variety Jemez	Hemispherical	TRUE	9.10	11.90	8.30	9.40
162	Museum of Indian Arts and Culture	21711	Blind corrugated	Hemispherical	FALSE	15.50	13.70	10.00	10.40
163	Museum of Indian Arts and Culture	21771	Rio Grande Utility, variety Jemez	hemispherical?	FALSE	16.60	28.80	19.40	21.50
164	Museum of Indian Arts and Culture	19515	Rio Grande Utility-Heavy Striated	Hemispherical	FALSE	15.40	21.50	17.20	18.90
165	Santa Fe National Forest	RRP-5	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	46.50	47.80	28.80	30.40
166	Santa Fe National Forest	9	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	25.20	25.80	21.30	23.70
167	Santa Fe National Forest	5	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	10.50	12.70	11.00	13.20
168	Santa Fe National Forest	8	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	unknown	34.90	26.10	30.40
169	Santa Fe National Forest	7	Rio Grande Utility, variety Jemez	Hemispherical	FALSE	25.80	31.50	24.50	26.70

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
170	Pecos National Monument	5005	Faint Striated	Hemispherical	FALSE	14.00	22.30	15.50	16.70
171	Pecos National Monument	3378	Pecos Plain	shoe shaped	FALSE	13.80	21.30	13.50	14.30
172	Pecos National Monument	3360	Pecos Plain	shoe shaped	FALSE	13.60	19.40	10.80	11.80
173	Pecos National Monument	3099	Unknown	Hemispherical	TRUE	9.60	10.95	8.50	9.50
174	Pecos National Monument	5105	Faint Striated	Hemispherical	FALSE		27.30	19.20	21.00
175	Pecos National Monument	3077	Faint Striated/Punctated	Hemispherical	FALSE	unknown	25.70	17.90	21.50
176	Pecos National Monument	5015	Faint Striated	Hemispherical	FALSE				
177	Pecos National Monument	2841	Blind corrugated	Hemispherical	FALSE	18.00	23.20	15.10	16.90
178	Pecos National Monument	5106	Faint Striated	Hemispherical	FALSE			26.20	
179	Pecos National Monument	5107	Heavy striated	Hemispherical	FALSE	unk	unk	41.00	43.20
180	Pecos National Monument	3079	Faint Indented Blind Corrugated	Hemispherical	FALSE	10.80	12.40	7.90	8.50

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
181	Pecos National Monument	3819	Faint Indented Blind Corrugated	Hemispherical	FALSE	15.90	19.40	unk	unk
182	Pecos National Monument	3547	Tool marked	Hemispherical	FALSE	11.10	15.30	10.00	111.00
183	Pecos National Monument	3994	striated	Hemispherical	FALSE	unk	unk	28*	30*
184	Pecos National Monument	6017	Faint Striated	Hemispherical	FALSE	19.70	25.40	20.10	23.00
185	Pecos National Monument	3008	Faint Striated	Hemispherical	FALSE		31.90	27.90	29.40
186	Pecos National Monument	3389	Faint Striated	Hemispherical	FALSE		30.10	26.30	26.60
187	Pecos National Monument	1114	Faint Striated	Hemispherical	FALSE	29.30	32.20	16.50	17.60
188	Pecos National Monument	3023	Faint Striated	Hemispherical	FALSE	20.70	26.90	20.90	23.00

Vessel Number	Location	Museum Acc No	Ceramic Type	Vessel Shape	Flattened Base	Height (cm)	Max Diam (cm)	Neck Diam (cm)	Aperture Diam (cm)
189	Pecos National Monument	5111	striated	Hemispherical	FALSE	unk	34.5*	27.50	28.50
190	Pecos National Monument	5113	striated	Hemispherical	FALSE	unk	unk	unk	unk
191	Pecos National Monument	3333	Faint Striated	Hemispherical	FALSE	23*	34*	22.70	24.50
192	Pecos National Monument	3998	striated	Hemispherical	FALSE	23.2	29.30	20.40	22.00
193	Pecos National Monument	3993	striated	Hemispherical	FALSE	27.3	32.80	22.20	24.60
194	Pecos National Monument	3085	striated	Hemispherical	FALSE	unk	25*	19*	20*

Table 2. Whole vessel data.

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
1	0	3.58	4.08	3.44	4.1	4.19	3.88	2.9	2.9	3.2	3.4	3.3	3.14	Moderate
2	0	3.6	4.3	3.9	3.8	3.6	3.84	4.9	4.2	3.3	2.5	2.7	3.52	Unknown
3	0	3.6	3.9	4.8	4.5	4.8	4.32	6.20	5.90	5.60	5.00	5.50	5.64	Light
4	0	3.2	3	2.8	3.4	3.4	3.16	3.40	3.20	3.50	3.00	2.50	3.12	Moderate
5	0	3.6	4.3	3	3	2.7	3.32	2.3	3.3	3.3	2.7	2.7	2.86	Light

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
6	0	3.76	3.81	3.27	3.95	3.94	3.75	3.21	3.22	3.87	4.15	3.37	3.56	Heavy
7	0	3.77	3.06	2.88	2.63	2.39	2.95	3.33	3.98	3.85	2.76	3.24	3.43	Heavy
8	0	3.67	2.23	2.95	3.37	3.67	3.18	5.21	5.28	4.82	5.15	5.8	5.25	Moderate
9	0	4.01	4.94	5.69	4.43	4.23	4.66	3.04	3.45	3.70	3.63	3.76	3.52	none
11	0	0						2.93	2.59	2.94	3.40	2.76	2.92	Moderate
15	2.2	4.32	4.19	4.12	4.16	4.53	4.26	5.17	5.64	4.51	5.38	5.18	5.18	Light
16	1.5	3.63	3.71	3.59	3.76	3.5	3.64	3.55	3.44	4.14	2.76	4.35	3.65	Moderate
17		5.58	5.07	5.25	5.8	6	5.54	6.20	4.84	5.90	5.91	5.53	5.68	Moderate
18		5.83	5.64	6.16	5.75	5.93	5.86	6.54	6.10	6.56	6.31	6.25	6.35	Light
19	2.5	5.84	5.61	6.86	6.91	6.6	6.36	6.97	6.80	7.39	7.83	7.49	7.30	Light
20		4.81	6.09	5.54	5.6	6.24	5.66	7.60	8.06	7.83	7.20	6.98	7.53	Light
21		5.6	5.17	4.51	5.88	5.4	5.31	4.32	5.07	5.38	5.59	5.60	5.19	none
22		5.93	6.59	6.8	5.99	7.69	6.60	6.29	5.48	5.87	5.18	5.78	5.72	none
23		5.11	5.6	6.19	6.08	6.79	5.95	5.88	5.58	5.62	4.65	5.27	5.40	none
24		4.16	3.36	3.58	3.73	4.27	3.82	4.96	3.26	4.55	4.05	3.65	4.09	Heavy
25		3.97	4.44	4.44	4.31	4.12	4.26	5.31	4.80	4.66	4.88	5.46	5.02	none
26		5.9	5.04	4.43	5.71	5.44	5.30	7.32	7.44	6.48	6.50	7.40	7.03	Light
27		6.23	5.93	5.34	4.94	5.59	5.61	4.81	4.45	4.80	4.42	4.37	4.57	Moderate
28		4.18	4.98	5.08	4.69	3.71	4.53	3.52	4.65	4.11	3.99	3.88	4.03	none
29		4.78	6.79	5.37	6.7	6.7	6.07	7.21	6.66	6.65	6.29	7.14	6.79	none

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
30		5.15	5.15	4.76	5.64	4.98	5.14	4.66	4.19	4.40	4.38	3.95	4.32	none
31		6.89	6.41	6.99	7.13	6.6	6.80	5.93	5.61	5.71	5.82	5.72	5.76	Light
32		6.37	5.59	4.66	5.88	4.99	5.50	6.55	5.22	5.94	6.30	5.80	5.96	none
33		5.84	5.6	6.95	6.06	6.71	6.23	6.11	6.49	6.16	6.49	5.83	6.22	none
34		4.85	6.19	5.48	5.01	7.01	5.71	4.93	6.91	7.06	5.65	5.42	5.99	none
35		8	6.95	5.65	5.75	7.52	6.77	8.15	7.99	6.74	7.20	7.65	7.55	Moderate
36		5.86	5.74	6.11	5.82	5.85	5.88	6.31	5.99	6.72	5.83	6.65	6.30	Light
37	1.5	5.68	5.02	5.69	4.96	5.49	5.37	7.33	7.37	6.30	3.62	7.15	6.35	Light
38								6.30	5.34				5.82	
39		4.49	4.84	3.79			4.37	5.37	5.47	5.30			5.38	Unknown
40	1.5	4.52	5.05	4.77	4.87	5.27	4.90	5.35	6.80	6.34	6.77	5.86	6.22	Light
41	1.5	5.47	3.73	4.78	4.05	5.17	4.64	5.55	5.47	5.95	5.56		5.63	Heavy
42	1.5	3.48	3.18	3.79	3.69	2.86	3.40	4.48	4.48	4.34	4.23	4.01	4.31	none
43	2	4.13	5.34	4.17	4.45	4.27	4.47	5.37	4.60	5.21	5.33	4.83	5.07	Light
44		4.1	3.78	3.99	4.22	4.15	4.05	3.15	3.78	4.23	4.01	3.88	3.81	Heavy
45		4.97	4.81	5.34	4.95	5.94	5.20	4.56	5.18	5.31	5.22	4.22	4.90	none
46	1.95	5.51	5.16	5.03	5.56	5.25	5.30	5.25	4.89	5.45	5.66	5.00	5.25	Light
47	3.1	3.31	3.18	3.15	3.41	3.21	3.25	4.11	3.48	3.27	3.60	3.60	3.61	Heavy
48	1.64	4.24	3.92	3.78	2.89	4.27	3.82	3.76	4.76	4.12	4.33	4.75	4.34	Moderate
49	2.2	3.38	4.26	4.15			3.93	3.87	4.67	4.40	4.67	4.47	4.42	Light

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
50		3.97	4.01	4.14			4.04	4.42	4.53	4.03	4.81	4.25	4.41	Light
51		3.73	3.79	4.33	3.99	3.92	3.95	4.69	4.48	4.89	3.60	3.98	4.33	none
52		4.44	4.92	3.94	4.48	4.03	4.36	5.33	5.46	4.35	5.14	4.87	5.03	Light
53	1.7	4.77	4.19	4.32	3.86	4.62	4.35	4.86	4.84	5.07	4.64	4.68	4.82	Light
55		6.04	5	4.88	5.6	5.57	5.42	5.08	4.39	4.44	4.78	4.81	4.70	Light
56		5.91	6.23	6.46	4.45	6.26	5.86	4.94	6.65	5.66	5.67	5.79	5.74	Light
57		6.35	6.37	5.42			6.05							Unknown
58	1	6.46	5.72	4.71	6.5	6.72	6.02	6.89	6.19	7.30	5.84	6.74	6.59	Light
59		5.06	4.77	4.79			4.87	4.92	5.94	5.02			5.29	Unknown
60	1.5	5.42	5.55	5.75	5.69	6.22	5.73	5.32	6.41	5.38	5.79	6.92	5.96	Light
61	1.5	6.86	5.3	6.3	6.74	7.32	6.50	6.76	7.64	6.62	7.78	7.04	7.17	Heavy
62	1-2	5.12	5.31	6.38	4.88	4.33	5.20	7.33	5.37	6.81	6.56	6.94	6.60	Moderate
63	~1cm							4.73	5.05	4.72	4.36	5.42	4.86	Heavy
64	1.3	4.27	4.91	4.16	4.12		4.37	5.08	4.70	3.64	4.49	4.89	4.56	none
65	1.30	3.99	3.86	3.54	3.45	3.98	3.76	3.60	3.75	3.66	3.47	3.71	3.64	Moderate
66	1.80	3.29	3.12	2.69	2.89	3.69	3.14	2.75	2.96	3.54	3.11	2.69	3.01	Light
67		3.86	2.51	3.22	3.20	3.53	3.26	2.81	2.60	3.20	3.18	2.44	2.85	Moderate
68	1.49	2.88	2.76	2.83	3.21	3.81	3.10	3.80	3.73	3.37	4.10	4.43	3.89	none
69	1.40	2.54	2.60	3.12	2.75	3.15	2.83							Light
70		3.90	3.40	4.30	4.20	4.00	3.96	2.66	2.66	3.07	3.47	2.71	2.91	Moderate

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
71		3.68	3.27	3.57	3.41	3.43	3.47	2.97	3.38	3.29	3.23	3.12	3.20	Moderate
72	.9-1.5	4.74	4.98	4.92	4.77		4.85	2.93	2.81	3.24	2.87	2.87	2.94	Light
73		4.74	4.76	4.56	5.18	4.27	4.70	4.28	4.67	4.54	4.22	5.39	4.62	Light
74		5.1	5.2	5.08	5.42	6.56	5.47	6.14	5.58	5.95	6.21	6.77	6.13	Light
75	1.50	4.23	2.63	2.86	3.14	3.50	3.27	3.92	3.19	2.64	3.65	3.42	3.36	Moderate
76		3.63	3.82	3.23	3.57	3.71	3.59	4.08	3.76	3.77	4.08	3.98	3.93	Moderate
77		3.11	3.51	3.33	3.99	2.85	3.36	4.83	3.70	4.74	4.90	4.68	4.57	Heavy
78	1.90	3.21	3.45	3.22	4.72	2.93	3.51	3.66	3.48	3.20	3.27	2.84	3.29	Light
79		3.04	3.77	3.25	3.74	3.17	3.39	4.51	4.38	4.53	4.44	3.76	4.32	none
80		5.64	5.33	4.03	4.49	3.49	4.60	4.07	5.08	4.81	4.25	4.15	4.47	Light
81	2.20	3.82	3.58	3.50	3.19	4.01	3.62	4.46	3.77	4.48	5.49	4.21	4.48	Moderate
82		3.27	2.78	2.85	2.9	3.26	3.01	3.95	2.97	3.99	3.61	3.42	3.59	Moderate
83	1.97-1.64	2.69	1.79	2.59	2.47	2.19	2.35	3.11	2.76	2.86	3.65	3.04	3.08	Light
84	1.1-1.6	2.99	4.08	3.22	2.66	3.63	3.32	4.01	3.92	3.50	3.07	3.70	3.64	Heavy
85	1.1-2.5	4.21	2.64	4.34	3.29		3.62	4.36	5.39	4.49	5.49	4.92	4.93	Light
86		3.71	4.43	3.22	3.21	4.39	3.79	5.83	4.78	4.76	5.84	6.99	5.64	Light
87		3.62	3.48	3.54	3.18	3.32	3.43	3.76	3.10	3.84	3.47	3.60	3.55	Moderate
88	2.8-3.1	3.07	4.02	3.53	2.98	3.03	3.33	3.94	2.91	3.54	3.59	3.68	3.53	Light
89	1.6-2.0	3.27	3.45	2.96	3.17	3.62	3.29	2.80	3.71	3.79	3.35	3.33	3.40	Light
90	1.9-4.0	4.24	4.51	3.53	3.35	3.36	3.80	5.02	4.59	4.98	5.05	5.25	4.98	Light

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
91	2							3.05	3.13	2.03	3.34	2.32	2.77	Light
92		2.84	1.96	3.39	2.94	2.52	2.73	2.20	2.46	2.92	2.27	2.60	2.49	Moderate
93	1.1-1.6	3.03	3.06	2.28	3.36	3.26	3.00	3.86	3.51	3.92	4.89	4.48	4.13	Moderate
94	2.7-3.6	4.89	3.51	3.87	4.84	4.15	4.25	5.03	5.07	5.76	5.42	6.04	5.46	none
95		4.83	3.8				4.32	5.02	5.44				5.23	none
96	2.3	4.47	4.57	4.66	4.09	4.06	4.37	5.29	5.62	5.61	4.81	4.64	5.19	Moderate
98	1.2	5.74	7.02	6.12	5.73	5.56	6.03	7.06	7.45	6.85	7.59	7.25	7.24	Light
99		4.83	4.81	5.32	4.86	5.14	4.99	6.66	6.27	6.15	6.46	5.91	6.29	Light
100	1.1-1.2	4.95	5.98	5.66	5.79	4.92	5.46	6.01	5.81	6.25	6.89	6.45	6.28	none
102	1	5.06	4.69	6.31	6.13	5.88	5.61	6.31	6.22	5.55	5.79	6.86	6.15	Moderate
103	1.8	5.39	5.19	4.71	4.95	4.49	4.95	6.48	6.29	6.45	6.57	5.73	6.30	Light
105	1.7	4.18	4.15	5.01	4.32	5.13	4.56	5.43	4.94	4.58	5.45	5.14	5.11	Light
106		5.36	4.55	4.33	5.18	4.73	4.83	4.95	4.18	4.32	4.5	5.07	4.60	none
107		4.03	4.2	4.37	4.18	3.25	4.01	4.76	6.33	5.37	5.24	4.98	5.34	Light
108		5.31	5.64	7.17	4.84	5.71	5.73	5.55	5.7	5.83	5.37	5.82	5.65	Light
109	.7-1	2.65	4.15	4.18	4.78	5.37	4.23	5.35	5.3	5.82	4.69	5.93	5.42	none
113		5.32	6.44	5.57	5.99	5.33	5.73	4.87	5.77	5.08	4.9	4.87	5.10	Moderate
114	1.5-2.3	5.41	4.92	5.38	5.13	4.4	5.05	4.96	5.13	5.58	5.5	4.11	5.06	Heavy
115		5.71	5.33	5.47	5.14	4.44	5.22	5.29	5.42	3.92	4.59	4.61	4.77	Light
116							unknown(plaster int)						unknown(plastered int)	Unknown

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
117	0.9	4.3	4.91	4.44	5.27	5.19	4.82	4.24	4.43	4.56	4.28	4.44	4.39	Moderate
118		3.76	4.09	3.65	3.45	4.13	3.82	4.94	4.41	5.09	5.64	5.09	5.03	Light
120	1.5	4.75	4.87	5.09	5.88	6.87	5.49	8.13	7.83	7	7.48	8.25	7.74	Light
121	1.5	6.82	5.54	6.05	5.63	6.57	6.12	5.92	5.05	5.62	5.84	5.89	5.66	Light
122	1.3	4.86	4.86	4.92	4.44	6.79	5.17	6.24	6.44	5.16	6.09	5.48	5.88	none
123	1.5	5.26	5.83	5.99	5.07	5.22	5.47	7.33	6.65	7.15	6.66	7.27	7.01	Light
124	1.75	4.87	4.98	5.621	6.45	5.72	5.53	6.29	6.17	6.66	5.43	5.69	6.05	Unknown
126	1.7	5.08	7.83	6.18	5.23	9.63	6.79	5.44	6.33	6.31	6.56	7.01	6.33	Moderate
136		6.23	6.88	6.56	6.94	7.04	6.73	8.2	7.81	8.17	10.22	6.76	8.23	Light
137		6.6	6.74	8.18	7.29	7.72	7.31	10.94	10.54	10.05	10.21	11.16	10.58	none
145		5.03	4.12	4.91	5.42	5.03	4.90	4.01	3.9	3.95	4.03	3.93	3.96	Light
146		6.78	6.38	5.68	5.3	6.22	6.07	6.01	5.54	6.14	6.6	5.92	6.04	Light
147		4.38	4.54	4.62	4.89	4.55	4.60	6.26	6.97	6.87	6.27	6.87	6.65	Light
151	1.2-1.5	4.73	4.55	4.96	5.01	5.82	5.01	6.28	5.6	6.38	6.56	5.81	6.13	Light
152		6.45	5.31	6.22	5.19	4.66	5.57	5.93	5.21	5.03	5.93	5.84	5.59	Light
153	1.3-1.5	4.39	5.6	4.09	3.35	5.63	4.61	5.93	7.34	6.75	6.41	4.67	6.22	Light
154		4.24	4.08	3.52	4.03	4.4	4.05	5.48	5.28	5.56	5.62	5.12	5.41	Light
155	1.1	5.75	4.31	4.71	4.58	5.61	4.99	3.7	5.3	3.9	3.95	3.9	4.15	Light
156		4.58	4.4	4.07	3.42	4.03	4.10	5.1	6.24	4.92	5.15	4.96	5.27	Light
157	1.4-1.8	5.18	6.2	4.48	7.7	5.7	5.85	5.94	6.11	6.65	7.68	5.69	6.41	Heavy

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
158	1.2	8.23	5.9	7.56	5.69	6.67	6.81	5.99	6.93	6.43	6.87	7.43	6.73	none
159	1.1	4.2	4.74	3.67	4.46	4.32	4.28	4.14	4.48	5.31	5.52	4.68	4.83	Light
160	1.4	5.27	4.03	5.46	5.25	4.84	4.97	4.25	5.14	5.63	6.64	5.88	5.51	Light
161		5.6	4.68	4.65			4.98	5.12	6.08	5.59			5.60	none
162	0.70	4.43	4.30	4.89	4.28	4.52	4.48	5.26	5	3.96	6.22	5.75	5.24	none
163	1.4	4.56	6.13	5.05	4.87	5.92	5.31	6.27	7.34	6.62	6.74	6.78	6.75	Light
164		4.42	4.93	3.98	4.6	4.77	4.54	6.16	6.3	6.61	6.17	7.22	6.49	Light
165	2.3	5.83	5.18	5.81	5.4	5.88	5.62	6.09	5.59	7.27	7.26	6.87	6.62	none
166		4.79	4.92	5.52	5.41	4.46	5.02	6.37	7.27	5.74	5.87	6.06	6.26	none
167	1.5	3.74	3.55	4.2	3.25	3.91	3.73	4.65	6.1	6.38	4.92	4.28	5.27	Light
168	1.2	5.72	5.87	4.77	5.03	5.11	5.30	6.51	5.97	6.17	6.49	6.52	6.33	Heavy
169		4.82	7.02	5.82	5.24		5.73	7.99	9.02	9.09	9.5	6.45	8.41	Moderate
170	2	6.42	5.74	5,46	6.12	5.86	6.04	5.95	6.17	6.98	6.9	6.59	6.52	Moderate
171	2.5	5.57	5.8	4.86	4.83	5.99	5.41	5.91	6.7	6.25	5.98	5.65	6.10	Light
172		5.76	5.02	5.05	4.77	4.41	5.00	4.77	5.66	5.92	6.5	4.95	5.56	Light
173	0.6	6.04	4.61	5.41	3.99		5.01	3.53	4.13	3.97	4.06		3.92	Light
174		8	6.77	8.34	6.12	8.95	7.64	6.34	6.45	5.97	6.09	7.02	6.37	Light
175		3.51	3.54	3.95	5.04	3.49	3.91	4.94	5.14	5.34	4.6	5.84	5.17	Moderate
176		6.58	6.6.39	6.93	6.92	8.03	7.12	6.01	6.39	6.67	6.5	5.88	6.29	Light
177	1.10	5.01	4.41	4.99	4.67	5.04	4.82	4.71	4.96	5.11	4.98	4.62	4.88	none

Vessel Number	Coil Height (cm)	lip1 (mm)	lip2	lip3	lip4	lip5	Average Lip Thickness	neck1	neck2	neck3	neck4	neck5	Thickness at neck (mm)	Int attrition
178	unk	5.67	5.38	5.95	5.65	5.55	5.64	5.97	6.5	5.71	6.3	6.55	6.21	Light
179	unk	8.57	9.68	10.25	9.26	11.74	9.90	7.32	7.34	6.98	7.34	6.6	7.12	none
180		4.16	4.45	4.64	4.63	4.58	4.49	5.3	4.07	4.96	5.53	5.9	5.15	none
181	1.2	5.99	4.28	3.89			4.72	5.8	6.48	6.78			6.35	none
182		4.81	4.761	3.84	4.2	4.42	4.41	5.18	4.91	4.83	4.64	4.44	4.80	none
183		6.52	7.25	7.05	6.69	6.9	6.88	6.91	6.03	6.81	6.37	6.27	6.48	Moderate
184		5.24	6.07	5.82	4.65	5.87	5.53	5.46	6.2	5.36	5.83	5.06	5.58	Heavy
185		5.92	5.43	5.83	6.06	5.87	5.82	6.37	6.11	6.23	6.46	6.16	6.27	Light
186	1.5-1.9	6.22	6.45	5.82	5.53	6.37	6.08	7.52	6.74	7.7	7.75	7.97	7.54	Heavy
187		4.44	6.11	5.52	5.42	5.72	5.44	6.42	7.72	6.74	6.07	7.73	6.94	Moderate
188	1.5	4.63	5.77	5.25	5.47	5.23	5.27	6.16	6.69	6.79	6.14	6.66	6.49	Heavy
189	1	8	8.31	8.16	7.84	8.17	8.10	7.59	8	7.7	8.37	7.13	7.76	none
190		7.3	7.96	7.22	6.31		7.20	7.23	8.17	7.27	8.85		7.88	Moderate
191		7.58	7.57	7.34	6.09	6.98	7.11	7.07	6.47	6.63	6.28	6.5	6.59	Light
192		5.32	6.71	7.26	7.08	7.38	6.75	6.56	6.21	7.14	6.48	5.55	6.39	Light
193	1.5-2	6.03	5.46	6.83	6.41	5.72	6.09	5.14	5.1	5.29	5.29	5.27	5.22	Heavy
194		6.76	7.04	6.8	7.93	6.85	7.08	6.75	5.46	6.76	5.94	6.73	6.33	Light

Table 3. Whole Vessel Data.

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
1	Pitting	around max diam	Light	Pitting	around base to max diam	none		Moderate
2	None		Unknown	none		Unknown		Light
3	Pitting	around max diam	none	none		Light	in patches around rim	Light
4	Pitting	up to max diam; prevalent on one side	none	none		none		none
5	Pitting	around max diam	none	none		none		Heavy
6	Pitting	from ~2cm from base to max diam	Light	Pitting	around max diam.; could be post depositional	none		Moderate
7	Pitting	from ~3cm upto just above max diam	none	none		none		Light
8	Pitting	from just above base to max diam	none	none		none		Heavy
9	None	none	none	none		none		none

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
11	Pitting	4cm up from base, highest on one side, up to 20cm on one side	none	none		none		Heavy
15	Pitting	in a few small patches below max d.	none	none		none		Light
16	Pitting	in patches below max d to approx. 3cm above base	none	none		none		Moderate
17	Pitting	in patches below max d. to approx 4cm above base	none	none		none		none
18	Pitting	one small patch right at max d	none	none		none		none
19	Pitting	from base to max d. could be fingeer impressions from construction	Light	Pitting	just on base	none		Light
20	Scratches/Pitting	from base to max d	Light	Pitting	small patches near base	none		none
21	none		none	none		Moderate	from neck to rim in patches	Light

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
22	none		none	none		none		none
23	none		none	none		Moderate	from approx 8cm above base to neck	Heavy
24	Pitting	partially obscured by repair material, pitting may be from use or post depositional with the break	none	none		none		Light
25	none		none	none		none		Light
26	Pitting	from neck to rim	none	none		none		none
27	Pitting	from max d to base, more on one side than the other	none	none		none		none
28	none		none	none		none		none
29	none		none	none		none		Light

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
30	none		Moderate	Pitting	in patches all below the max d.	Light	a small creosote deposit in base of vessel but could be a result of large fire cloud that goes all the way through the vessel	Moderate
31	Scratches	from base up one side	none	none		none		none
32	none		none	none		none		Light
33	none		none	none		none		none
34	none		none	none		Moderate	in patches-could be pitch	Light
35	Pitting	in base	none	none		none		none
36	Pitting	from max d to just above base	none	none		none		none
37	Scratches	on base near fur that is probably rodent-scratches could be result of rodent	none	none		none		none

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
		activity						
38	none					Unknown		Unknown
39	unknown		Unknown	unknown		Unknown		Unknown
40	Pitting	along one side around max d.	none	none		none		Heavy
41	Pitting	from ~2cm above base to base of neck.	Light	Exposed Temper	several "spalls" on base and side, could be post depositional	none		Heavy
42	none		none	none		none		Moderate
43	Pitting	in one patch near max d.	none	none		none		Moderate
44	Pitting	from ~3cm from base to neck	none	none		none		Moderate
45	none		none	none		none		Moderate
46	Pitting	in one small patch near max d.	none	none		none		none

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
47	Pitting	around max d. to bottom of neck	none	none		none		Moderate
48	Pitting	around max d	none	none		none		Moderate
49	Pitting	from ~3cm from base to max d	none	none		none		Light
50	Pitting	around max d	none	none		none		none
51	none		none	none		Heavy	from ~8cm from base to rim	Heavy
52	Pitting	small patches around max d	none	none		none		Light
53	Pitting	small patches just below max d	none	none		none		none
55	Pitting	small patches all below max d. near cracks.	none	none		none		Moderate
56	Pitting	small patches on base	Moderate	Exposed Temper	circle on base	none		Moderate
57	unknown		Light	Scratches	on base	Unknown		none

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
58	Pitting	on base and one small patch on side below max d	Light	Exposed Temper	on base	none		Light
59	unknown		none	none		none		none
60	Exposed Temper	small section of surface has popped off	none	none		none		Light
61		on base up to max d	Light	Exposed Temper	on base	Light	on base	Light
62	Scratches/Pitting	on base and sides	Light	Pitting	on base	none		Light
63	Pitting	temper protruding fro surface around waist of body more than around base	none	none		none		Moderate
64	none		none	none		none		none
65	Pitting		Light	Grinding	very slight on base	none		Heavy
66	Pitting	from above base to waist of vessel	none	none		none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
67	Pitting	extends to waist of vessel	none	none		none		Heavy
68	none		none	none		none		Light
69	Pitting	begins ~5cm above base and extends to 10 above base	none	none		none		none
70	Pitting	around waist primarily, starts ~2cm above base to waist	none	none		none		Heavy
71	Pitting	from right above base to max d	none	none		none		Heavy
72	Pitting	in small patches up to max d	none	none		none		Heavy
73	Pitting	some small patches	none	none		none		Moderate
74	Pitting	some right at base	none	none		none		Light
75	Pitting	from just above base to max d	none	none		none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
76	Pitting	begins ~3cm above base to max d	none	none		none		Moderate
77	Pitting	up to max d.	none	none		none		Moderate
78	Pitting	up to max d	none	none		none		Moderate
79	none		none	none		none		Moderate
80	Pitting	from base to max d	none	none		none		Light
81	Pitting	starts ~4 cm above base up to max d	none	none		none		Heavy
82	Pitting	in patches from base to max d	none	none		none		Heavy
83	Pitting	difficult to see because of dirt and staining	none	none		none		Heavy
84	Pitting	moderate from base to max d,heavy around and just above max d.	none	none		none		Heavy

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
85	Pitting	in small patches from base to max d	none	none		none		Light
86	Pitting	in patches from base to max d.	none	none		none		Heavy
87	Pitting	from ~3cm above base to ~35cm above base	none	none		none		Heavy
88	Pitting	patches up to max d	Light	Grinding	edge of base	none		Light
89	Pitting	in patches up to max d	none	none		none		Moderate
90	Pitting	maybe some small patches around max d	none	none		none		Light
91	Pitting	patches up to max d	none	none		none		Heavy
92	Pitting	from ~2cm above base to ~2cm above max d	none	none		none		Heavy
93	Pitting	starts ~4cm above base to ~16cm above base	none	none		none		Heavy

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
94	none		none	none		none		Light
95	none		none	none		none		Light
96	Pitting	around max d and below	Light	Pitting	on outer base	none		Moderate
98	Scratches	not directional, could be post use, all below neck	Light	Pitting and exposed temper	exposed temper on base (abrasion?) pitting all below max diameter	none		Light
99	Scratches	not directional, may not be related to arch use,	none	none		none		Light
100	none		Light	Pitting	few pitted areas around and below max d	none		Light
102	Pitting	all below max d. and above base	Light	Pitting	on base-light pitting and exposed temper (abrasion?)	none		Heavy
103	Pitting	in a band approximately 5cm below max d	none	none		none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
105	Scratches	on base and around vessel below max d	Light	Pitting	on base	none		Moderate
106	none		none	none		none		none
107	spalling	2 small spalls next to each other about halfway b/t edge of base and max d.	Light	Pitting	just below constricted neck primarily	none		Heavy
108	Scratches	light-could be recent	Light	spalling	1 spall ~1.5cm in diameter right at the max d of the pot on one side	none		Heavy
109	none		none	none		none		Heavy
113	Pitting	below max d but above base	Light	Scratches	all around base	none		none
114	Pitting	below max d and above base	none	none		none		Light
115	Pitting	below max d.	none	none		none		Light
116	none		none	none		Unknown		Heavy

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
117	Pitting	below max d	none	none		none		Light
118	Pitting	right around max d	none	none		Heavy		Moderate
120	Pitting	outside ring of base	none	none		none		Light
121	Pitting	from base up to neck	Light	wear	on base and around handles at the neck	none		Light
122	none		Light	Grinding	on base	none		Moderate
123	Scratches	on base and sides; could be modern	none	none		none		Light
124	unknown	lots of plaster on interior holding pot together	Unknown	unknown	plaster on base	Unknown		Light
126	Pitting	on base and in patches up to max d	Light	scratches and exposed temper	on base	Light	questionable-in patches on base	Light
136	Pitting	on base	none	none		none		Heavy
137	none		none	none		none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
145	Pitting	around max d	Moderate	Grinding	on base	Light	looks like residue of some sort	Heavy
146	Pitting	on base	Light	Grinding	on base	none		Moderate
147	Pitting	around max d*but base of vessel is missing	Unknown	unknown		none	*base is missing	Heavy
151	Pitting	on base	Moderate	Grinding	on base	none		Light
152	Scratches/Pitting	on base and at max d	none	none		none		Light
153	Pitting	on base	Light	Grinding	on base	none		Moderate
154	pitting and exposed temper	on edge of base and up to max d	Light	Pitting	on base	none		Light
155	Pitting	on base	Light	Grinding	on base	none		Moderate
156	Scratches	from base up to max d	none	none		none		none
157	Pitting	from edge of base up to ~4cm above edge	Moderate	Grinding	on base, also what looks like a "kill hole" on base	none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
158	none		Light	Grinding	on base	none		Moderate
159	Scratches	on base	Moderate	Pitting	on base, in patches from around base up to neck	none		Moderate
160	Pitting	on base	Light	Grinding	around edge of base	none		Moderate
161	none	lots of plaster smeared	Moderate	Pitting	around edge of base	none		none
162	none		Light	Pitting	on base	none		Moderate
163	Scratches	base of vessel missing. But scratches both perpindicular and parallel from max d. to neck.	none	none		none		none
164	Pitting	on base	Moderate	Pitting	on base	none		none
165	none		Heavy	Pitting	heaviest on base and up to max d.	none		Moderate
166	none	could be some light pitting on base but	Light	Grinding	around edge of base	none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
		diffcult to tell						
167	Pitting	one spot around max d.	Light	grinding and exposed temper	around edge of base up to max d.	Light	on base up to max d. in patches-looks more like residue of some sort rather than soot-almost looks slip like	Light
168	Pitting	on body sherds	Light	Pitting	on body sherds	none		Heavy
169	Pitting	around max d. and below but above base	Moderate	Exposed Temper	on base and just above.	none		Heavy
170	Scratches/Pitting	around max d and just below	none	none		none		Moderate
171	Scratches/Pitting	pitting at "duck butt", scratches at max d and below	Heavy	Pitting	in patches all over pot-could be from final failure or use or post d processes	none		Light
172	Pitting	very slight over base	Heavy	Exposed Temper	on base-wear?	none		Light
173	Scratches	max d and near base	Moderate	Grinding	on rim of base	none		none
174	Pitting	max d and below	none	none		Moderate	on max d and above -base missing***	Heavy

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
175	Pitting	on small section of base left	none	none		none		Light
176	Scratches	on body	none	none		none		Moderate
177	none		Heavy	Pitting	on base and neck	none		Light
178	Pitting	below max d	none	none		none		Light
179	none		none	none		none		none
180	none		Moderate	Grinding	smoothed on base	none		Light
181	none		none	none		none		Moderate
182	none		none	none		none		none
183	Scratches	from max d down to base	none	none		none		Light
184	Pitting	on base primarily but extending up to max d in patches	none	none		none		Light

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
185	Pitting	from max d down	none	none		none		Light
186	pitting and light scratches	pitting mostly on one side of vessel. Light scratches all over	none	none		none		Light
187	Pitting	on base	Heavy	Pitting	on one side of vessel from edge of base to neck	none		none
188	Pitting	around max d	Moderate	spalling	one 2.5 cm spall below max d	none		Light
189	none		none	none		none		Light
190	Pitting	below neck- unclear b/c vessel is not reconstructed	none	none		none		Moderate
191	Pitting	just above base and below max d	Light	Grinding	right on base (4 cm diamter	none		Moderate
192	Pitting	one small patch above max d	Moderate	Pitting	few patches above max d	none		Moderate
193	Pitting	from base almost up to rim	none	none		none		Moderate

Vessel Number	Interior Attrition Type	Description	Ext attrition	Exterior Attrition Type	Ext Description	Interior Residue	Interior Description	Exterior Sooting
194	Pitting	on small area on base	none	none		none		none

Table 4. Whole Vessel Data

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
1	from base to neck	mica		Gley 1 3/N	2.5Y6/1	Flat	
2	from base to neck	unknown		Gley 1 3/N		Incised	
3	in patches from base to neck	sherd		Gley1 2.5/N	10YR 5/2	Incised	parallel scraped
4	none	crushed rock		2.5Y5/2		Rounded	parallel scraped
5	from ~2cm from base to rim in some places	unknown		Gley1 2.5/N		Rounded	
6	from ~2cm from base to neck			Gley 1 3/N		Rounded	
7	in patches from ~2cm up to neck	unknown		Gley 1 3/N		Rounded	
8	in one patch about 16cm x 15cm in size from about max diam up	sherd		Gley 1 4/N	7.5YR5/3	Unknown	
9	none	unknown		Gley1 2.5/N	5YR4/4	Unknown	smoothed
11	banded along max d. from ~3.5cm up from base, extends almost to rim	Unknown		10YR4.5/1	Gley 1 2.5/N	Rounded	parallel scraped
15	all above max d, vessel has probably been washed	Unknown		7.5YR6/4	7.5YR3/1	Rounded	parallel scraped and slightly polished
16	all below max d. heavy in patches, vessel nhas probably been washed	Unknown		10YR 6/2	Gley 1 3/N	Rounded	smoothed

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
17	fire clouds could be sooting, very dark-vessel could have been washed	Unknown		10YR 6/2	Gley 1 3/N	Flat	parallel scraped, and slightly polished
18		Unknown		10YR 5/4	Gley 1 3/N	Flat	smoothed and slightly polished
19	could be fire clouds but probably washed sooted areas	Unknown		10YR 4/2	Gley 1 3/N	Rounded	parallel scraped
20		Unknown		10YR 5/3	Gley 1 3/N	Flat	parallel scraped and pitched?
21	on one side from max d to rim	Unknown		10YR 6/2	Gley 1 3/N	Rounded	parallel scraped
22		Unknown		10YR 6/2	Gley 1 3/N	Rounded	smoothed and very slightly polished
23	from max d to neck	Unknown		Gley 1 3/N		Rounded	parallel scraped
24	in patches from edge of base to max d.	Unknown		10YR 5/2	Gley 1 3/N	Flat	parallel scraped
25	few small patches	Unknown		Gley 1 3/N		Flat	smoothed
26		Unknown		10YR 6/3	Gley 1 3/N	Flat	smoothed
27		Unknown		10YR 6/2	10YR 5/1	Rounded	smoothed
28		Unknown		10YR 5/2	7.5YR6/3	Flat	parallel scraped
29	a few small patches all above max d	crushed rock	fine	7.5YR6/2	Gley 1 3/N	Rounded	smoothed and slightly polished
30	all within outline of large fire cloud that covers almost all of base. Whether this is from use or firing is unknown	crushed rock	fine	7.5YR6/4	Gley 1 3/N	Incised	smoothed
31		crushed rock or sherd?	fine	10YR6/2	Gley 1 4/N	Rounded	smoothed

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
32	all from max d up to rim	Unknown		10YR6/2	Gley 1 3/N	Flat	polished
33		crushed rock or sherd?	fine	10YR 5/3	Gley 1 4/N	Flat	smoothed
34	in small patches-could be pitch	Unknown		Gley 1 3/N		Flat	smoothed
35		Unknown		10YR 4/1		Rounded	smoothed
36		Unknown		10YR 6/2	Gley 1 4/N	Flat	smoothed
37		Unknown		10YR 5/1	Gley 1 3/N	Rounded	smoothed
38				10YR 6/3	Gley 1 4/N	Scalloped	smoothed
39		crushed rock		10YR 4/1	Gley 1 3/N	Rounded	parallel scraped
40	extends from base to amx d all around the vessel; to rim on one side	crushed rock	moderate	Gley 1 3/N	7.5YR5/1	Rounded	parallel scraped
41	heaviest just above max d., but covers most of vessel with exception of base	mica and crushed rock	fine	Gley 1 3/N		Rounded	parallel scraped
42	from just below max d. to rim	Unknown		Gley 1 4/N	10YR 5/1	Rounded	parallel scraped
43	from base to neck	Unknown		Gley 1 3/N	10YR 6/2	Rounded	parallel scraped
44	heavy in sections, from ~4cm above base to neck	sand and tuff	extra fine	Gley 1 3/N		Flat	obliquely scraped
45	from max d to rim	Unknown		Gley 1 2.5/N	10YR 6/2	Flat	parallel scraped
46		sherd?	fine	Gley 1 3/N		Flat	obliquely scraped
47	in patches from max d to rim	Unknown		Gley 1 3/N	10YR 4/1	Rounded	parallel scraped
48	heavier on one side than the other, extends from base(on base) to neck	Unknown		Gley 1 3/N		Rounded	smoothed

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
49	only traces in one patch, maybe part of fire cloud	mica	extra fine	10YR 6/2		Rounded	parallel scraped
50		Unknown		10YR 5/2		Rounded	parallel scraped
51	from ~max d. to rim.	Unknown		Gley 1 3/N		Rounded	smoothed
52	from ~4cm above base to rim	Unknown		Gley 1 3/N	10YR 6/2	Rounded	smoothed
53		Unknown		Gley 1 3/N		Rounded	smoothed
55	from ~3cm above base to ~4cm above max d.	Unknown		Gley 1 3/N	10YR 5/2	Rounded	parallel scraped
56	from base to max d	mica	fine	Gley 1 3/N	10YR 5/1	Rounded	smoothed
57		Unknown		10YR 51		Rounded	unknown
58	from ~5cm from base to max d.	tuff?	fine	Gley 1 3/N	7.5YR5/3	Rounded	smoothed and polished
59		crushed rock?	fine	10YR6/3	10YR 4/1	Flat	smoothed
60	small amount on base up to rim on one side	tuff	fine	Gley 1 3/N	10YR 4/1	Flat	polished
61	on edge of base up to rim only on one side of vessel	mica and crushed rock	moderate	Gley 1 3/N	10YR 5/1	Rounded	polished
62	on edge of base up to rim only on one side of vessel, could be from firing	crushed rock- andesite?	moderate	Gley 1 3/N	5YR6/3	Rounded	polished
63	on 1 side-starts 6cm from base all the way to the rim	crushed rock	moderate	Gley 1 2.5/N	Gley 1 4/N		
64				10YR6/3	10YR5/1		
65	begins 2.8cm from base and extends no farther than 24cm from base			Gley 1 3/N	Gley 1 5/N		parallel scraped
66	from 1.5 cm from base to ~24 cm from base	Unknown		Gley 1 3/N	Gley 1 4/N	Flat	

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
67	extends from ~2cm from base to rim almost all the way around	Unknown		Gley1 2.5/N	10YR3/1		parallel scraped
68	small amount visible and seems to extend under pitch	Unknown		Gley 1 3/N			parallel scraped
69		crushed rock	fine	7.5YR5/4			parallel scraped
70	starts at edge of base and extends to rim in some places, heaviest around base	Unknown					parallel scraped
71	from base to rim	Unknown				Flat	parallel scraped
72	from edge of base to rim	Unknown				Unknown	parallel scraped
73	from ~6cm above base and goes to ~24cm above base					Scalloped	parallel scraped
74	1 small spot of soot near base	Unknown				Scalloped	parallel scraped
75	begins ~3cm above base and extends to rim in places			Gley 1 3/N		Rounded	parallel scraped
76	from edge of base ot rim in some portions	Unknown					parallel scraped
77	from outer edge of base to rim	Unknown				Rounded	parallel scraped
78	from base to rim	Unknown		Gley 1 3/N		Rounded	parallel scraped
79	1/4 of the lower half of the vessel	Unknown				Rounded	parallel scraped
80	in patches	crushed rock	fine			Rounded	parallel scraped
81	from base to rim					Flat	parallel scraped
82	from outer edge of base to rim					Rounded	parallel scraped

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
83	from edge of base to rim in some areas						parallel scraped
84	from outer edge of base to ~3cm above max d					Flat	parallel scraped
85	from ~3 cm above base to max d					Rounded	parallel scraped
86	from base to ~30 cm above base						parallel scraped
87	from ~2.5cm above base to ~35cm above base					Flat	parallel scraped
88	maybe some small patches near base to max c					Rounded	parallel scraped
89	in patches up to ~22cm above base					Rounded	smoothed
90	a few very small light patches	crushed rock	fine				smoothed
91	extends from outer edge of base to rim on some portions					Unknown	parallel scraped
92	extends from ~2cm above base to ~32 cm above base					Rounded	parallel scraped
93	from base to ~34cm above base					Flat	smoothed
94	from edge of base to max d						parallel scraped
95	on base	tuff	fine	10YR2/1	10YR4/1	Rounded	lightly polished
96	on outer part of base up to max d.	Unknown		Gley 1 3/N	2.5Y 5/1	Rounded	parallel scraped
98	could be very light sooting-unsure-on rim primarily but also all over vessel with the exception of the very base of the vessel	mica (and crushed rock/Tuff?)	extra fine	Gley 1 3/N	10YR 4/1	Rounded	smoothed and polished
99	very light-not restricted to different portions along the vertical axis	tuff	fine	Gley 1 2.5/N	10YR 4/1	Rounded	slightly polished

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
	although most seems to below max. diam.						
100	very light small areas unrestricted vertically could be soot	crushed rock and mica	extra fine	Gley 1 3/N	10YR 4/1	Rounded	smoothed
102	all over vessel except for bottom, patches range from light to heavy	crushed rock/tuff	extra fine	Gley 1 2.5/N	10YR3/1	Rounded	smoothed
103	from max d down to edge of bottom	mica	extra fine	Gley 1 3/N	10YR5/3	Flat	smoothed
105	all over vessel except for base	crushed rock/tuff	extra fine	Gley 1 3/N	10YR 5/2	Rounded	slightly polished
106		crushed rock	fine	Gley 1 2.5/N	10YR 5/2	Tapered	smoothed
107	all over vessel but heaviest below max d. to edge of base	crushed rock	fine	Gley 1 2.5/N	10YR4/1	Tapered	smoothed
108	light to heavy patches all over vessel but primarily below max d.	crushed rock/tuff	fine	Gley 1 2.5/N	10YR4/2	Rounded	slightly polished
109	heavy all over exterior with exception of very bottom	crushed rock	extra fine	Gley 1 2.5/N	10YR4/1	Rounded	smoothed
113		crushed rock	fine	Gley 1 3/N	10YR3/2	Rounded	parallel scraped
114	traces remain all above max d. Pot has been washed	Unknown		Gley 1 3/N	10YR5/1	Scalloped	parallel scraped
115	traces remain around max d and below with exception of base			Gley 1 3/N	10YR 3/1	Rounded	parallel scraped
116	in patches all over vessel	Unknown		Gley 1 3/N		Unknown	unknown
117	very light above max d.	Unknown		Gley 1 3/N	10YR 3/1	Scalloped	parallel scraped
118	from max d to rim more on one side of pot than the other	crushed rock	extra fine	Gley 1 3/N	10YR5/3	Rounded	parallel scraped
120	all above base to rim	crushed rock		Gley 1 3/N		Rounded	smoothed
121	near one of the handles on the neck. Surface has probably been washed	crushed rock (tuff?)		Gley 1 3/N		Rounded	slightly polished

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
122	from max diam to lip	Unknown		Gley 1 3/N		Rounded	slightly polished
123	a few spots on base and sides but it is not clear	Unknown		Gley 1 3/N		Flat	slightly polished
124	in patches-vessel probably washed	Unknown		Gley 1 3/N	10YR3/1	Rounded	slightly polished
126	small patches very light could be fire clouds	tuff	fine	10YR 6/2	Gley 1 3/N	Rounded	smoothed
136	from base up to rim in heavy patches	Unknown		Gley 1 3/N	10YR 4/1	Rounded	smoothed slightly polished
137	in patches all above base up to just above max d	Unknown		Gley 1 3/N	10YR 5/3	Rounded	polished
145	from edge of base to max d	mica	extra fine	Gley 1 3/N	10YR 4/2	Rounded	smoothed
146	from edge of base up to rim. Probably washed b/c majority in recessed areas	Unknown		Gley 1 3/N	10YR 4/2	flat and beveled	smoothed
147	up to neck-base is missing	crushed rock and sherd?	fine	Gley 1 3/N	10YR 5/2	Rounded	Smoothed
151	questionable-on one side from base to neck very light could be firecloud	crushed rock	fine	Gley 1 3/N	10YR 3/1	Rounded	slightly polished
152	in very light patches above base up to rim	Unknown		Gley 1 3/N	10YR 4/2	Rounded	slightly polished
153	outside edge of base to neck	crushed rock	fine	Gley 1 3/N	10YR 3/1	Rounded	slightly polished
154	from base up to neck	crushed rock/tuff	fine	Gley 1 3/N	10YR 4/1	Rounded	slightly polished
155	from base to rim. Heavy in recessed areas of pot	crushed rock	fine	Gley 1 3/N	10YR 4/1	Rounded	slightly polished
156		mica	extra fine	Gley 1 3/N	gley 1 2.5N	Rounded	smudged-highly polished
157	from outside edge of base up to just above max. d. mainly in recessed areas	crushed rock-quartz and tuff	fine	gley 1 2.5/N	10YR 3/1	Rounded	slightly polished

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
158	from edge of base to rim	crushed rock-quartz	fine	gley 1 2.5/N	10YR 4/1	Rounded-bevelled	smoothed
159	from edge of base up to rim in some patches	crushed rock-quartz, sherd	fine	10YR 3/1	Gley 1 2.5/N	Rounded	smoothed, striations parallel to coils
160	from edge of base to rim	crushed rock	fine	Gley 1 3/N	10YR 3/1	Rounded	smoothed
161		Unknown		Gley 1 3/N		Rounded	smoothed
162	from around edge of base up to neck	sherd	fine	10YR 4/2	Gley 1 3/N	Rounded	smoothed
163		crushed rock	fine	7.5YR5/3	Gley 1 3/N	Rounded	slightly polished
164		crushed rock	fine	10YR 5/3	Gley 1 3/N	Flat	smoothed
165	from edge of base in patches up to max d.	crushed rock	fine	10YR 5/2	Gley 1 3/N	Flattened w/very slight fold	slightly polished
166	from baes to rim-heaviest above max d.	crushed rock	fine	gley 1 2.5/N	10YR 4/2	Rounded	slightly polished
167	questionable-a few very light patches-looks more like soot than firecloud base on shape of patches	crushed rock	extra fine	5YR5/4	7.5YR5/3	Rounded	slightly polished
168	on body sherds up to rim	crushed rock	extra fine	10YR 4/2	gley 1 2.5/N	Rounded	slightly polished
169	around edge of base up to just above max d	crushed rock-quartz?	fine	5YR6/4	10YR 3/1	rounded-w/very slight fold	slightly polished
170	up to neck on one side-base missing	mica and sherd?	fine	10YR3/1	Gley 1 3/N	Rounded	polished
171	on base up to neck	mica and crushed rock	fine	10YR3/1	Gley 1 3/N	Rounded	polished
172	on base and up "duck chest"	crushed rock	moderate	10YR3/1	10YR2/1	Rounded	smoothed

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
173		Unknown		5YR4/3	5YR4/3	Rounded	slightly polished
174	*base missing-heavy patches all over	mica and crushed rock	fine	7.5YR4/3	10YR 2/1	Rounded	polished
175	below max d	mica	extra fine	10YR 4/2	10YR 3/1	Rounded	polished
176	all over vessel	crushed rock	moderate	10YR 2/1	gley 1 2.5/N	Rounded	polished
177	few patches above base	mica and crushed rock	fine	10YR 4/2	10YR 3/1	Rounded	polished
178	below neck	mica and crushed rock	fine	10YR 2/1	10YR3/1	Rounded	smoothed
179		mica and crushed rock	fine	7.5YR4/2	gley 1 2.5/N	Rounded	polished-slipped/glazed?
180	from max d to rim in patches	mica and crushed rock	extra fine	7.5YR4/2	gley 1 2.5/N	Rounded	smoothed
181	from edge of base up to shoulder	crushed rock	fine	Gley 1 3/N	10YR 3/1	Rounded	smoothed
182		crushed rock	fine	10YR 4/1	10YR 3/1	Rounded	smoothed
183	from max down	crushed rock	moderate	10YR 2/1	10YR 4/1	Flat	polished
184	from base up to rim on one side-may have been washed	crushed rock	fine	10YR 4/1	10YR 2/1	Rounded	polished
185	in patches up to rim	crushed rock	fine	10YR 4/2	7.5YR4/2	Rounded	polished
186	in patches from max d up to rim	mica and crushed rock	fine	5YR4/3	5YR4/4	Rounded	polished
187		crushed rock	fine	7.5YR5/3	7.5YR4/4	Rounded	polished
188	in patches on base	crushed rock	fine	Gley 1 3/N	Gley 1 2.5/N	Rounded	polished at neck
189	in patches below neck	crushed rock	fine	2.5Y5/4	2.5Y3/1	Rounded	polished

Vessel Number	Exterior Soot Description	Temper Type	Temper Size	Munsell Color	Color 2	Lip Shape	Interior surface treatment
190	in patches up to rim	crushed rock	fine	10YR 3/1	10YR 4/2	Rounded	smoothed
191	from base to rim	crushed rock	fine	Gley 1 3/N	10YR 3/1	Flat	polished
192	on base and below max d	crushed rock	moderate	10YR 2/1		Rounded	polished
193	from edge of base up to max d	crushed rock	fine	gley 1 2.5/N	10YR4/1	Rounded	polished at neck
194		crushed rock	fine	10YR4/1	10YR2/1	Rounded	polished

Table 5. Whole Vessel Data.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
1		reduced		
2		reduced		
3	obliquely scraped	reduced		
4	obliquely scraped	reduced		
5		reduced		
6		reduced		
7		reduced		
8		partially reduced		
9	obliquely scraped	partially reduced		

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
11	obliquely scraped	reduced		very indistinct possible puki mark, 3 pairs of repair holes-2 along rim probably repaired right after firing, 1 pair still has repair material probably sumac or willow.
15	obliquely scraped	partially reduced		two fillets just below rim (~1cm)-each about 1 cm wide and finger impressed onto vessel-there is no break in the fillets-they fully circle the vessel. The neck is constricting with flaring rim. Vessel is conical with flattened rounded base. Vessel has be
16	obliquely scraped	reduced		could be later than Dinetah Gray, constricted neck with flaring rim, conical with flattened bottom, probably constructed starting with puki and small pinched bottom (finger impressions can be seen in the base). Crack goes thru base, some reconstruction
17	obliquely scraped	partially reduced		one fillet approx 2 cm below rim appears to be thin coil attached by finger impression-no real opening-fillet circles whole vessel although almost flat in places, neck only very slightly constricted. Rim diameter almost same as shoulder. Repaired at rim.
18	smoothed and slightly polished	reduced		one fillet approx 2.5cm from rim-consists of coil added and joined and then oblique incisions all the around the coil. Neck is slightly constricted, very low shoulder. Rim is almost same diam as shoulder. No cracks
19	obliquely scraped	reduced		one fillet approx 3cm below rim-obliquely incised. Slightly constricted neck, rim only very slightly flares. Crack on outside around middle does not seem to go all the way through the wall. Crack does not go through base.
20	obliquely scraped and pitched?	reduced		one fillet approx 2cm below rim-consists of coil applied with finger impressions-there is an opening, the fillet does not close on itself. Vessel is somewhat cylindrical with a rounded bottom. Neck is barely constricted.complete-no repairs.
21	obliquely scraped	reduced		two fillets in a chevron pattern approx 1-3cm below rim-punctated. Slightly constricted neck with flaring rim. Base is slightly pointed but mainly rounded. Vessel has been reconstructed with some missing sherds replaced with putty. Cracks go through b

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
22	obliquely scraped	reduced		one fillet in a chevron pattern from .5 from rim to 3.5 cm below rim-incised perpindicular to the coil. Base is rounded, constricted neck and flaring rim. Might have pitch on it. Complete no repairs
23	obliquely scraped	reduced	near Pinon, AZ	vessel has probably been in a fire indicated by the blackened surface, constricted neck with flaring rim. One fillet approx 2.5cm below rim-finger impressed.
24	obliquely scraped	partially reduced	Keur excavation-area around Governador Canyon	base is rounded but overall shape is conical, large portion of vessel is missing but vessel has been reconstructed no cracks through the base. Constricted neck with flaring rim.
25	obliquely scraped	reduced	near Pinon, AZ	one fillet approx 1cm below rim, vessel contained shale when is was discovered. There is a residue that covers most of the interior that may be the result of the shale or some other substance. It almost looks like creosote but is not the right color. N
26	obliquely scraped	reduced	klethla Valley	two fillets in slight chevron from 2 to 2.5cm from rim-two coils applied with punctations. Very slightly constricted neck. Reconstructed-crack through one side of base.
27	obliquely scraped	partially reduced	Little Colorado River at Black Falls	two fillets in chevron pattern with incisions diagonal across coils-top coil ranges from .5 to 1.5 cm from rim. Constricted neck with flaring rim. Some repair for one crack. Pitch present in patches.
28	smoothed	partially reduced	Oraibi T.P.	one fillet in chevron pattern does not close, applied with punctations. Constricted neck and flared rim. Rounded pointed base, sponge marks on ext surface. One surface spall probably from original firing-looks like air bubble blow out. Portions of vesse
29	obliquely scraped and slightly polisshed	partially reduced		one fillet in chevron pattern with fingernail impressions perpindicular to the coil.fillet does not close but has opening. Museum description says inside is pitched but I don't agree. Looks more like polishing to me. Very bell shaped. Wide shoulders,
30	obliquely scraped	partially reduced	Ganado	two fillets that circle the vessel from the neck to approx 1cm from the rim. Three areas have a chevron connecting the two fillets. Looks like coils applied with punctations. Theres is a large fire cloud that covers the base and a small portion of one

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
31	obliquely scraped	partially reduced	T13N/R20W/S35/ NE1/4	vessel found in a tree on a MNA survey on BIA land-isolated find. Lichen covers one side of vessel. Temper can be seen on surface.Two fillets at rim and just below-coils applied with punctations. Slightly constricted neck with slightly flaring rim. Id
32	obliquely scraped	reduced	mesa verde area approx 1900	vessel is cylindrical with round bottom. One chevron fillet around rim.(angles are rounded)-punctated. Lichen on rim. Neck only very slightly constricted. Complete vessel
33	obliquely scraped	partially reduced	new mexico T13N/R21/S14 surface	vessel is cylindrical with rounded bottom. Most of actual base is missing-bottom half has been glued back together. Three fillets-two circular and one chevron connecting other two-extend from rim to approx. 5 cm below rim. Applied with punctations. Ve
34	obliquely scraped	reduced		vessel is conical. Possible sooting is more than likely pitch not soot. One chevron fillet around neck with circular punctations in it. Constricted neck slightly flasring rim. No cracks-good condition. Probably pretty young piece.
35	smoothed	reduced	in a "sing Ramada" near Painted Mesa (NA7720) by Christy Turner in 9/60	vessel would make a perfect pint glass. Bottom is flattened. No real neck. One very thin fillet approx. 4cm below rim. Punctated.
36	obliquely scraped	reduced	4miles s. of Hunters Point T.P., on road from St. Michaels to Lupton,AZ. On ridge west of road under sandstone ledge	two obliquely incised fillets just below rim. They seem to close on themselves. Chip on rim but good condition otherwise. Barely constricted neck. Cylindrical overall with round bottom.
37	obliquely scraped	reduced	Warren T.P Kayenta	two chevron fillets that are obliquely incised starting approx 2 cm below rim. Very thin and slight. Barely constricted neck. Almost cylindrical with rounded bottom.chip at base and one crack at rim but good condition. Nice vessel.
38	obliquely scraped	partially reduced	Paiute Mesa NA7743	partial vessel that has been partly glued back together. One fillet punctated below rim. Pointed base. Breaks do not follow coils
39	obliquely scraped	reduced	excavated N-64, NPS Spur Roads, CDM 102	partial vessel only half of upper half of vessel has been reconstructed, sherds are with the vessel. Two repair holes near rim. Cracks do not seem to follow coils. No fillets. Constricted neck and flaring rim.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
40	obliquely scraped	reduced	Navajo Arch. Proj	nine pairs of repair holes with repair material still intact; cracks are not obvious-could these "repairs" not be repairs but some sort of carrying device? pitch also present on interior and exterior around repairs. Cracks do not follow coils. Vessel in
41	obliquely scraped	reduced	C.O. Erwin, Navajo Arch. Proj	one crack repaired recently. This crack follows coil.
42	obliquely scraped	reduced	Navajo Arch Proj	one crack perpindicular to coils with one pair of repair holes. Two other croacks near this one near rim going across coils repaired recently, puki line can be seen ~5cm from base.
43	obliquely scraped	reduced	Navajo Arch Proj	chips off of rim, white speckles on surface of neck and rim-probably recent, no cracks in good condition. Somewhat assymetrical-vessel is wider from one side than the other.
44	obliquely scraped	reduced	donated by C.O. Erwin; Navajo Arch Proj	reconstructed vessel; crack goes through base. Cracks follow coils and are perpendicular to coils.very light
45	obliquely scraped	reduced	donated by Mike W. Kelly, Navajo Arch project	very large vessel. Three pairs of repair holes with repair material present (yucca?), pitch on exterior of vessel around repairs. Assymetrical wider from one side view than the other.
46	obliquely scraped and polished	reduced		double fillet in chevron pattern around neck, no cracks although two spalls on interior with holes in center going through to exterior. Less conical than previous five vessels.
47	obliquely scraped	reduced		reconstructed vessel-some sherds are missing, assymetrical-wider from one side view than the other. Constricted neck, flaring rim
48	obliquely scraped	reduced	donated by Mike W. Kelly, Navajo Arch project	vessel in good condition, few chips around rim. Constricted neck and flaring rim
49	obliquely scraped	partially reduced		cracks following coils and perpendicular to coils near base of vessel, part of rim and neck missing, unsure of type could be later, constricted neck, flaring rim. Puki imprint can be seen up to max d.
50	obliquely scraped	partially reduced		one pair of repair holes with repair material (animal hide), vessel is reconstructed-several portions some sort of puddy (mainly parts of rim), crack goes through edge of base, all cracks perpendicular to coils, constricted neck, flaring rim.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
51	obliquely scraped	reduced		rim chipped in several places. Almost entire vessel is sooted. One crack follows coils. Constricted neck flaring rim. Very nice vessel.
52	parallel scraped	reduced		portions of rim and neck missing. Vessel has been glued back together with some sherds missing. Two pairs of repair holes near rim with no repair material. Constricted neck and flaring rim, base is more hemispherical than conical. Several cracks go thro
53	smoothed	reduced		two pairs of repair holes on opposite sides of vessel. Each of these cracks are perpendicular to the coils and are repaired with pitch. The repair material is still present on the inside of one of the pairs of repair holes. Rim is chipped in several pla
55	obliquely scraped	reduced		vessel has been reconstructed, many cracks and a few missing sections. Cracks do not follow coils. Constricted neck, slightly flaring rim. Very large.
56	smoothed	reduced	LA547 Velarde Upper Rio Grande; gift of Elenor Bartlett	portions of rim and neck are missing, cracks are perpendicular to coils, crack goes through part of base. Surface is rough, but coils have been obliterated. Constricted neck, flaring rim
57	smoothed	reduced	Bandelier's Puaray	this vessel has been reconstructed, about half of the vessel is puddy. The base is present as well as part of the side and part of the rim, entire interior is filled with plaster. Constricted neck, flaring rim.
58	obliterated coils	reduced	1929 Reiter excavation	excellent condition. No cracks, no repairs. Is this obliterated corrugated? Constricted neck and flaring lip. Polished around rim on interior.
59	smoothed	partially reduced	Kuaua Section 16	1/3 of vessel is plaster, rest of vessel is reconstructed and plastered together. Constricted neck flaring rim. No evidence of cooking. Any possible interior attrition is difficult to see due to plaster and other stuff adhered to interior surface.
60	smoothed	reduced	gift of John Lock, prov. Unknown	vessel is great condition, cracks follow coils on ext. but none go all the way through wall. Ext. is roughly smoothed-some coil joints slightly visible., constricted neck, very very slightly flaring rim.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
61	smoothed	reduced	found in crevice in cleft on north side of East Fork of Jemez above Los Conchas Campground	one chip in rim, good condition, constricted neck, flaring rim. No cracks and no repaires
62	slightly corrugated	reduced	Nonshagi excavation	few cracks repaired and missing sherd in base filled in with puddy. Surface is slightly corrugated, coils get smaller from bottom to top. Some cracks follow coils, others are perpendicular to coils. One crack goes through center of base.
63	slightly corrugated	reduced		
64	slightly corrugated	partially reduced		4 pairs of repair holes with repair material, pitch on base
65	obliquely scraped	reduced		one small hole in side of vessel similar to a pot lid in chert
66	obliquely scraped	reduced		several cracks along coils
67	parallel scraped up to waist, oblique to rim	reduced		rounded slab with vessel, unsure whether found this way or not, vegetal material and salt still inside vessel
68	obliquely scraped	reduced		patched with pitch, small indent in flattened base
69	parallel scraped	oxidized		neck and lip same on this vessel, not well fired probably a misfire, can see slight finger impressions on exterior
70	obliquely scraped	reduced		rim is not symmetrical
71	obliquely scraped	reduced		corn in vessel, some cracks have been repaired with glue
72	none	reduced		coils still visible as well as finger impressions, puki impression can be seen. Lip is broken off all the way around
73	obliquely scraped	reduced		fillet around neck-applied as a coil and punctated, puki impression slightly visible
74	obliquely scraped	reduced		spiral fillet begins just below neck and spirals up to ~1cm below rim
75	obliquely scraped	reduced		two repair holes, can see coilds slightly with finger impressions

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
76	obliquely scraped	reduced		1 crack has 3 repairs and pitch covering a crack, 2 sets of holes still have repair material
77	obliquely scraped	reduced		1 cracks has 3 repairs hole sets
78	obliquely scraped	reduced		corn cob associated with this vessel
79	obliquely scraped	reduced		hole in side ofvessel, fire clouds apparent on interior and exterior of vessel
80	obliquely scraped	reduced		coils difficult to see but finger impressions visible, 2 sherds missing from base
81	obliquely scraped	reduced		
82	obliquely scraped	reduced		is not symmetrical, orifice is oval in shape, bundled corn husk in vessel
83	obliquely scraped	reduced		is not symmetrical, slightly indented base
84	smoothed	reduced		from base to max d to base is covered with patches of pitch with some vegetal material woven around base as though for carrying or hanging? Vessel has several cracks one, in one area near base wall is curvy, one has some paper-like material filling it-uns
85	obliquely scraped	reduced		lip undulates, scoring is slight, on one side patch of pitch from base to max d. on base there is vegetal material adhering to pitch, interior coil joints still visible.
86	obliquely scraped	reduced		17 pairs of repair holes along 3 cracks that are connected, two have these stilll have repair material on ext. 1 hole was started but not finished. 6 more pairs of repair holes have repair material on interior
87	obliquely scraped	reduced		one crack system appears to have been repaired with pitch, neck is not symmetrical (elongated)
88	obliquely scraped	reduced		lip is undulating, bottom half is damaged and held together by masking tape, this was once part of a packrat midden
89	obliquely scraped	reduced		part of base is missing

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
90	smoothed	reduced		coil joints are slightly visible, a rectangular historic nail was inside vessel, some areas of vessel indicate a inconsistent firing, large sherd is missing from side of vessel
91	obliquely scraped	reduced		lip is missing all the way around, some coils can still be seen
92	obliquely scraped	reduced		a crack has been patched with pitch on the ext. there are creosote deposits over pitch indicating use as cooking after vessel repair
93	corrugated?	reduced		texture on ext. is small slight vertical folds
94	corrugated?	reduced		this vessel not really conical, puki mark visible in vessel-looks like a bowl, coil junctions visible, but not really corrugated, huge coils, very dirty
95	smoothed	reduced	B10/580	this vessel is not whole-about half of the vessel is present and this part is broken into four sherds with these sherds being made up of some sherds glued back together.
96	obliquely scraped	reduced		vessel has four cracks that have been repaired with pitch.
98	smoothed	reduced	Sandoval Co., Jemez Valley *from Hewitt	Small vessel with constricted neck, everted flaring (beveled) rim,rounded base; small evidence of soot but could have been washed
99	smoothed	reduced	Sandoval Co., Jemez Valley *from Hewitt	Small rounded vessel with constricted neck and very short flared rim. It has been reconstructed from sherds and some are missing. Also-in its reconstruction it was warped and there is a small (<2mm) overlap on one side.
100	smoothed	reduced	Sandoval Co., Jemez Valley *from Hewitt	very small rounded vessel, slightly constricted neck, slightly flaring rim, one crack extends from rim approx. 7.5cm down vessel on one side
102	obliterated corrugated	reduced	Kwastiyukwa; Jemez *Hewitt donation	rounded vessel with constricted neck and slightly flaring rim (almost straight up from neck); heavily sooted; reconstructed vessel with ~1/3 missing.
103	obliterated corrugated	reduced	Rio Arriba Co. Near Abiquiu	very large vessel made of micaceous clay with constricted neck and flaring rim. String wrapped around neck several times. Plaster on inside at base to prevent furthering of cracks seen on

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
				exterior. Probably not Jemez
105	partially smoothed	reduced	Kwastiyukwa; Jemez *Hewitt donation	small hemispherical vessel with constricted neck and flaring rim. Evidence used for cooking
106	partially smoothed	reduced	Kwastiyukwa; Jemez *Hewitt donation	hemispherical vessel with no obvious signs of use as a cooking vessel. Slightly constricted neck and flaring rim. Some reconstruction.
107	partially smoothed	reduced	Kwastiyukwa; Jemez *Hewitt donation	hemispherical vessel with constricted neck and flaring tapered rim, globular body. Heavily sooted-thick crust of soot covers much of exterior. Partially reconstructed-some areas have been filled with plaster.
108	smoothed	reduced	Kwastiyukwa; Jemez *Hewitt donation	hemispherical globular vessel with constricted neck and flaring rim. Heavily sooted-can only see underneath at spall on exterior. Has 1 small chip on rim-otherwise complete
109	partially smoothed-coils still visible	reduced	Kwastiyukwa; Jemez *Hewitt donation	small vessel with constricted neck and slightly flared rim. Heavily sooted-possibly some pigment stains in interior?.
113	obliquely scraped	partially reduced		interior is covered with sooty residue. Vessel more globular than pointed probably later vessel possibly ethnographic, probably has been washed(ext) slightly constricted neck with flaring rim
114	obliquely scraped	reduced	found in Chaco Canyonby Neil Judd 1924	large Navajo pointed vessel with scalloped rim and scalloped fillet (~1cm below rim). One set of repair holes right below fillet. Vessel has very slightly constricted neck and little flaring of the rim. Appears to have resin(?) on the exterior base of
115	obliquely scraped	reduced	Chaco Canyon by N. Judd 1924	large Dinetah gray vessel reconstructed, constricted neck, flaring rim
116	obliquely scraped	reduced		large vessel-base is more globular than most, slightly constricted neck with slightly flared rim. Reconstructed. Entire interior is plastered as well as most of rim. No thickness measurements taken.
117	obliquely scraped	reduced	McKinley Co. Gallup, 10 miles NE of Kit Carson ruin by Jesse Walter Fewkes 1916	small navajo gray vessel with one scalloped coil wrapped 2.5 times just below rim (adjacent fillets ~1cm below rim. Slightly constricted neck and barely flaring rim.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
118	obliquely scraped	reduced	Chaco canyon	classic Dinetah gray, constricted neck, flaring rim, some reconstruction-although may be before museum accession because glue looks like resin.
120	slightly smoothed	reduced	Nanishagi excavation 1938; 1'7" from North wall of Room 8 in Room 9. 15'4" from NW corner of Room 7; 10 1/2" deep	This is a reconstructed Jemez Plain ceramic vessel. Base is rounded but slightly flattened. (slightly corrugated?) coils have not totally been obliterated. Neck is contracted with flaring lip. Probably an early Jemez plain.
121	slightly smoothed	reduced	Field session-Unshagi? Nanishagi?	hemispherical Jemez plain ceramic vessel with round base, constricted neck, rounded flaring lip, and two opposing handles at neck. Exterior is almost slightly polished in places. Late plainware. Handles are vertical coils approximately 4.5 cm high. Ext
122	smoothed	reduced	Unshagi	Jemez plain ceramic vessel with round base, constricted neck, and rounded flaring lip. interior is slightly polished (more polished at neck and lip. There is a small (~10x9) repair with unknown material. Late plainware.
123	smoothed	reduced	excavated at Guisewa	hemispherical Jemez plain vessel with round base, constricted neck and straight rim. Lip is flattened but rounded. Exterior slightly scored in some places
124	smoothed	reduced	jar from Jemez	small culinary vessel-Jemez plain. Large portion of base is filled in with plaster but there seems to be enough of the vessel to show that plaster fill is accurate. Interior is slightly polished on at least the neck and rim difficult to tell beyond this
126	smoothed	partially reduced	burial found between Banco Bonito and Battleship Rock	large hemispherical vessel with constricted neck and flaring rim. No obvious signs of use as cooking vessel. Exterior surface slightly scored. One small area shows evidence of puki line-large bowl?.
136	smoothed	reduced	Zia cooking pot; gift from Mr. and Mrs. J. A. Joe of ABQ	large ~hemispherical vessel with flattened base and short constricted neck and straight rim. Heavily sooted. Probably late vessel.
137	smoothed	reduced	gift of Dr. Frederick Ball-Jemez utility	large ~hemispherical vessel with flattened base constricted neck and slightly flaring rim, masking tape stuck to rim says "Jemez $3" sooted in patches. Reconstructed but over 90%complete with

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
				only a few missing sherds
145	smoothed	reduced	gift of Natachee Momaday from Jemez Springs-could be Jemez Jar	hemispherical vessel with flattened bottom and very small indention on base. Probably not right for this. Wrong shape. Probably very late pot. One spall on side of vessel
146	smoothed	reduced	gift of Natachee Momaday from Jemez Springs-could be Jemez Jar	hemispherical bowl with constricted neck and flaring rim. Two handles on opposite sides of vessel at neck measure ~4.5cm high. Probably a late vessel
147	Smoothed	reduced	Jemez culinary given by Dr. Dorothy Woodward	Hemispherical cooking vessel with constricted neck and flaring rim. Base is missing but enough is there to indicate a rounded bottom. ~70%complete.
151	smoothed	reduced	Amoxumqua	medium sized hemispherical jemez culinary jar with constricted neck and slightly flaring rim. Chips on rim but otherwise intact. Bottom is somewhat flattened.
152	smoothed	reduced	Amoxumqua	medium sized hemispherical jemez culinary jar with constricted neck and flaring rim with slightly flattened base. Reconstructed-~70% complete with missing portion filled with plaster
153	smoothed	reduced	Amoxumqua	small hemispherical jemez culinary jar with constricted neck and flaring rim. Reconstructed with some plaster fill ~70%complete
154	smoothed	reduced	Guisewa	small hemispherical jemez culinary jar with constricted neck and flaring rim. Rim is chipped but otherwise intact.
155	smoothed	reduced	LA679 Guisewa; Room 109. Jemez State Monument	reconstructed small hemispherical jemez culinary jar with constricted neck and flaring rim. ~70%complete
156	smoothed	reduced	Jemez at foot of Mesa donated by Juan Guachupin	small hemispherical jemez vessel with smudged interior, slightly constricted neck and slightly flaring rim. Chips on rim but otherwise intact.
157	roughly smoothed	reduced	Unshagi	very large hemispherical (slightly conical) Jemez culinary jar with constricted neck and flaring rim. Few sherds missing from rim area but otherwise intact
158	smoothed	reduced	Jemez area	small hemispherical jar with constricted neck and straight rim. Reconstructed with some areas filled with plaster. ~70%complete
159	smoothed	reduced	Amoxiumqua, Jemez	small very slightly conical vessel with constricted neck and flaring rim.some patches of pitting with exposed temper all over vessel.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
160	smoothed	reduced	Amoxiumqua, Jemez	small hemispherical vessel with constricted neck and flaring rim with flattened bottom.
161	smoothed	reduced	Jemez area	reconstructed small hemispherical vessel with constricted neck and flaring rim. Many missing pieces filled with plaster and reconstruction is messy-lots of smeared plaster even on original sherds.
162	slightly corrugated	reduced	Amoxiumqua	reconstructed small hemispherical vessel with constricted neck and slightly flaring rim. Slightly corrugated. Missing pieces filled with plaster.
163	smoothed	partially reduced	Amoxiumqua	reconstructed hemispherical vessel missing the bottom third of the vessel. Constricted neck and flaring rim. Some pieces filled with plaster. Bottom third missing-almost straight across-coil break?. Other breaks do not seem to follow coils.
164	heavy striated	partially reduced	Rio de los Frijoles-LA82-Bandelier?	hemispherical vessel with several pieces missing along the rim. Vessel looks like Kidder's descriptions of heavy striated plain at Pecos.
165	smoothed	reduced	Mesa de Guadalupe-vessel delivered to Judy Reed when she was with ARPA Task Force-obtained from someone w/ initials of DK who said he had taken them from said Mesa-area marked on map.	very large hemispherical vessel with constricted neck and flaring rim. Paperwork refers to it as a lg. plainware olla-but there is sooting so use in cooking is likely. It has been reconstructed using glue and tape(on the inside) many small sherds . Some
166	smoothed	reduced	LA69562-Floor of Structure-fieldhouse excavated as part of the Horseshoe Springs Project 1999	poorly reconstructed vessel-very bad condition. Hemispherical vessel with constricted neck and flaring rim. Vessel has been reconstr. With tape and glue-many sherds missing. Difficult to see interior because removal of packing material could be detrimen
167	smoothed	partially reduced	LA69562-Floor of Structure-fieldhouse excavated as part of the Horseshoe Springs Project 1999	small reconstructed hemispherical vessel with constricted neck and flaring rim. Abrasion on rim interior. ~75% complete. Breaks do not follow coils.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
168	smoothed	reduced	LA69562-Floor of Structure-fieldhouse excavated as part of the Horseshoe Springs Project 1999	partially reconstructed hemispherical vessel with constricted neck and flaring rim. Only about 25% of vessel is reconstructed, but there are a lot of sherds associated with vessel and it could probably be almost entirely reconstructed.
169	smoothed	partially reduced	LA69562-Floor of Structure-fieldhouse excavated as part of the Horseshoe Springs Project 1999	partially reconstructed hemispherical vessel with constricted neck and flared rim. ~50%reconstructed(basically two halves); breaks do not follow coils.
170	smoothed	reduced		partially reconstructed vessel missing majority of base with rounded lip, constricted neck and flaring rim
171	smoothed	reduced		shoe or duck pot with no handles, a constricted neck and slightly flaring rim. Partially reconstructed but missing base
172	smoothed	reduced		reconstructed shoe or duck pot with constricted neck and flaring rim. Two ~2x1cm "knobs" on pot-1 is on "duck chest" and one on side (not symmetrical on vessel). Some sherds missing and filled with filler.
173	slightly scraped	oxidized		very small reconstructed pot with constricted neck, flaring rim, and indented base
174	roughly smoothed	partially reduced		large reconstructed vessel missing its base. Interior is reduced-ext is oxidized although heavily sooted. Sooting on both int and ext may indicate burning after failure. Constricted neck and flaring rim. Vessel is coming apart due to drying out of glu
175	roughly smoothed	reduced		large reconstructed vessel missing its base with constricted neck and extremely flaring rim. Three rows of vertical punctations at shoulder just below neck-looks like small fingernail or pinching punctations
176	roughly smoothed	reduced		large partially reconstructed vessel-mainly just sherds. Constricted neck, flaring rim.
177	roughly smoothed (coils still visible	partially reduced	LA625	hemispherical jar with constricted neck, flaring rim, and two twisted handles on opposing sides at neck. Coils still visible-obliterated corrugated?
178	roughly smoothed	reduced		partially reconstructed vessel with constricted neck and slightly flaring rim. Mica in paste is probably from clay source and not

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
				additive. ~1/2 of vessel missing.
179	roughly smoothed	reduced		very large partially reconstructed vessel (~1/4 is here). Heavily striated ext. Probably not used for cooking. Interior surface treatment may by glazed or it may just be highly polished-some areas look slightly bubbly
180	slight vertical corrugations	partially reduced		small corrugated? Jar with constricted neck and slightly flaring rim.
181	slight vertical corrugations	reduced		reconstructed jar with constricted neck and flaring rim. Corrugated. ~1/3 of vessel is missing.
182	smoothed*	reduced		small reconstructed jar with *banded punctations from shoulder to neck. Constricted neck and slightly flaring rim. No evidence of use as cooking vessel; Kidder assigns a temporal period of Glaze V (fig 277 g; Kidder The Pottery of Pecos)
183	striated	reduced		large most unreconstructed vessel with constricted neck and flairing rim. Unable to determine height and max diameter due to sherd state of vessel. Aperture and neck diameters are estimates, breaks do not follow coils.
184	faint striated	reduced		complete jar with only on small sherd from rim missing. Whole (no reconstruction). Constricted neck, flaring rim, round bottom. Base of the interior is heavily pitted and may have some residue from use.
185	faint striated	oxidized		although dark fire clouds exist over the body of the vessel, overall color indicates that the vessel was fired in oxidation. Base of vessel is missing making height determinations impossible. Following the profile, however, it appears that the vessel is
186	faint striated	oxidized		although dark fire clouds exist over the body of the vessel, overall color indicates that the vessel was fired in oxidation. Base of vessel is missing making height determinations impossible. Following the profile, however, it appears that the vessel is
187	faint striated	oxidized		large globular reconstructed vessel with short constricted neck and flaring rim. Plaster fills many holes. ~85% of vessel is present. Most breaks do not appear to follow coils.

Vessel Number	Exterior Surface Treatment	Firing Atmosphere	Provenience	Additional comments
188	faint striated	reduced		large partially reconstructed vessel with constricted neck and flaring rim. Polishing on interior is confined to the neck, vessel is roughly smoothed (some coils still visible) for most of interior.breaks do not follow coils.
189	striated	oxidized		partially reconstructed vessel fired in oxidation with constricted neck and flaring rim. Some patches of residue on interior all below max d.
190	faint striated	partially reduced		unreconstructed vessel with some sherd glued together but mostly not. Constricted neck with flaring rim. Moderate pitting across most interior sides of sherds with the exception of the rim sherds.
191	faint striated	reduced		un reconstructed vessel with some shreds glued together (base glued and some of rim sherds). Most of vessel appears to be present.
192	faint striated	reduced		reconstructed vessel with round bottom, constricted neck and flaring rim. 95% complete.
193	faint striated	reduced		reconstructed vessel with constricted neck and flaring rim. Polishing from rim to neck on interior but difficult to tell remaining because of pitting.~95% complete. Some breaks follow coils, some don't
194	faint striated	reduced		unreconstructed vessel with constricted neck and flaring rim. Only a few sherds are still glued back together.

Table 6. Sherd Data.

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
1	unknown	LOA type sherd			Dinetah Gray	rim	3.73	14.2	12.5
2	unknown	LOA type sherd	LOA201		Dinetah Gray	body	4.44	15.9	10.9

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
3	unknown	LOA type sherd	LOA201		Navajo Gray	body	4.06	8.4	6.8
4	unknown	LOA type sherd	La Ventana area		Navajo Gray	rim	4.87	3.5	2.9
5	unknown	LOA type sherd	La Ventana area		Navajo Gray	rim	4.92	3.3	2.8
6	unknown	LOA type sherd	La Ventana area		Navajo Gray	body	4.67	4.3	2.5
7	unknown	LOA type sherd	La Ventana area		Navajo Gray	body	4.5	3.9	2.4
8	unknown	LOA type sherd	La Ventana area		Navajo Gray	body	4.9	3.7	3.2
9	unknown	LOA type sherd	La Ventana area		Navajo Gray	body	5.25	4.7	4
10	unknown	LOA type sherd	La Ventana area		Navajo Gray	rim	5.34	3.4	3
11	unknown	LOA type sherd	La Ventana area		Navajo Gray	body	4.4	3.5	3.3
12	unknown	LOA type sherd	16/3494		Dinetah Gray	rim	3.9	3.9	2.7
13	unknown	LOA type sherd	16/3494		Dinetah Gray	body	3.85	4.3	2.8
14	unknown	LOA type sherd	16/3494		Dinetah Gray	body	3.3	3	2.3
15	unknown	LOA type sherd	16/3494		Dinetah Gray	body	5.33	3.9	2.6
16	LA4199	LOA type sherd	26183		Dinetah Gray	body	5.29	6.5	5.6
17	LA4199?	LOA type sherd	B2 26 11/33		Dinetah Gray	body	4.6	20	16

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
18	LA4199?	LOA type sherd	28		Dinetah Gray	base	3.66	10.8	8.6
19	unknown	LOA type sherd	375 Navajo U		Dinetah Gray	body	3.7	9.7	6
20	unknown	LOA type sherd			Dinetah Gray	body	4.34	10.4	10.1
21	unknown	LOA type sherd			Rio Grande Utility	rim	5.8	12.3	5.1
22	unknown	LOA type sherd			Rio Grande Utility	rim	5.01	6.3	4.6
23	unknown	LOA type sherd			Rio Grande Utility	rim	5.4	4.2	3.7
24	unknown	LOA type sherd			Rio Grande Utility	rim	6.14	5.2	4.5
25	unknown	LOA type sherd			Rio Grande Utility	rim	5.3	6.7	4.6
26	unknown	LOA type sherd			Rio Grande Utility	rim	5.52	3.8	3.5
27	unknown	LOA type sherd			Rio Grande Utility	rim	5.8	5.7	4
28	unknown	LOA type sherd			Rio Grande Utility	rim	5.8	5.1	3.9
29	unknown	LOA type sherd			Rio Grande Utility	rim	6.08	5.4	4.3
30	unknown	LOA type sherd			Rio Grande Utility	rim	6.65	8.8	4.2
31	unknown	LOA type sherd			Rio Grande Utility	rim	6.1	6.3	3
32	unknown	LOA type sherd			Rio Grande Utility	rim	5.6	5.6	2.3
33	unknown	LOA type sherd			Jemez smeared indented corrugated	rim	4.55	4.5	4.2
34	unknown	LOA type sherd			Rio Grande Utility	rim	5.5	5.8	3.4
35	unknown	LOA type sherd			Rio Grande Utility	rim	5.91	5.6	4.3
36	unknown	LOA type sherd			Rio Grande Utility	rim	5.26	4.1	3.2
37	unknown	LOA type sherd			Rio Grande Utility	rim	4.92	3.7	3.4

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
38	unknown	LOA type sherd			Rio Grande Utility	rim	5.44	4.5	3.8
39	unknown	LOA type sherd			Rio Grande Utility	rim	5.33	5.7	4.8
40	unknown	LOA type sherd			Rio Grande Utility	rim	5.26	5.4	3.2
41	unknown	LOA type sherd			Rio Grande Utility	rim	6.46	7	1.8
42	unknown	LOA type sherd			Rio Grande Utility	rim	6.22	4.7	3.2
43	unknown	LOA type sherd			Rio Grande Utility	rim	5.63	5.6	4.3
44	unknown	LOA type sherd			Rio Grande Utility	rim	6.52	4.5	4.7
45	unknown	LOA type sherd			Rio Grande Utility	rim	6.57	3.8	3.9
46	unknown	LOA type sherd			Rio Grande Utility	rim	5.74	6.1	4
47	unknown	LOA type sherd			Rio Grande Utility	rim	5.4	3.8	2.8
48	unknown	LOA type sherd			Rio Grande Utility	rim	6.48	4.5	3.2
49	unknown	LOA type sherd			Rio Grande Utility	rim	6.44	4.8	2.8
50	unknown	LOA type sherd			Rio Grande Utility	rim	7.62	5.6	3.8
51	unknown	LOA type sherd			Rio Grande Utility	rim	5.8	4.3	3.3
52	unknown	LOA type sherd			Rio Grande Utility	rim	7.8	3.4	3.3
53	unknown	LOA type sherd			Rio Grande Utility	rim	6.8	3.1	2.9
54	unknown	LOA type sherd			Rio Grande Utility	rim	5.09	4.4	3.1
55	unknown	LOA type sherd			Rio Grande Utility	rim	5.28	3.5	2.8
56	unknown	LOA type sherd			Rio Grande Utility	rim	6.65	3.9	2.8
57	unknown	LOA type sherd			Rio Grande Utility	rim	6.8	3.3	3
58	unknown	LOA type sherd			Rio Grande Utility	rim	6.58	3.8	3.5
59	unknown	LOA type sherd			Rio Grande Utility	rim	6.17	2.7	2.6
60	unknown	LOA type sherd			Rio Grande Utility	rim	5.17	3.6	1.7

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
61	unknown	LOA type sherd			Rio Grande Utility	rim	7.72	3.9	3.5
62	unknown	LOA type sherd			Rio Grande Utility	rim	4.91	4.7	2
63	unknown	LOA type sherd			Rio Grande Utility	rim	5.36	4	3.5
64	unknown	LOA type sherd			Rio Grande Utility	rim	5.24	3.6	2.8
65	unknown	LOA type sherd			Rio Grande Utility	rim	5.53	3.6	2.7
66	unknown	LOA type sherd			Rio Grande Utility	rim	5.76	3	1.6
67	unknown	LOA type sherd			Rio Grande Utility	rim	7.16	3	2
68	unknown	LOA type sherd			Rio Grande Utility	rim	6.56	2.9	2.1
69	unknown	LOA type sherd			Rio Grande Utility	rim	7.96	4.8	3.6
70	unknown	LOA type sherd			Rio Grande Utility	rim	7.02	4.3	2.5
71	unknown	LOA type sherd			Rio Grande Utility	rim	7.27	2.4	1.8
72	unknown	LOA type sherd			Rio Grande Utility	rim	6.44	2.6	2.2
73	unknown	LOA type sherd			Rio Grande Utility	neck	5.2	4.9	2.7
74	LA4515	mera room LOA	16		Dinetah Gray	rim	4.16	7.5	7.1
75	LA4515	mera room LOA	16		Dinetah Gray	body	4.31	8.6	8
76	LA4515	mera room LOA	16		Dinetah Gray	body	4.43	8.1	7
77	LA4515	mera room LOA	16		Dinetah Gray	body	4.02	15.3	5.2
78	LA4515	mera room LOA	16		Dinetah Gray	body	4.61	7.2	5.8
79	LA4515	mera room LOA	16		Dinetah Gray	body	4.6	9.3	7.1

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
80	LA4515	mera room LOA	16		Dinetah Gray	body	4.36	6.9	5.8
81	LA4515	mera room LOA	16		Dinetah Gray	body	4.4	10.4	7.3
82	LA4515	mera room LOA	16		Dinetah Gray	body	4.18	11.2	5.5
83	LA4515	mera room LOA	16		Dinetah Gray	body	4.6	9.6	6
84	LA4515	mera room LOA	16		Dinetah Gray	body	4.3	6.5	6.2
85	LA4515	mera room LOA	16		Dinetah Gray	body	4.29	7.9	6.7
86	LA4515	mera room LOA	16		Dinetah Gray	body	3.74	6.4	3.7
87	LA4515	mera room LOA	16		Dinetah Gray	body	3.85	7.2	4.5
88	LA4515	mera room LOA	16		Dinetah Gray	body	4.12	7.6	5.6
89	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.38	9.3	3.9
90	LA4515	mera room LOA4.38	16		Dinetah Gray	body	3.77	7.4	5.3
91	LA4515	mera room LOA4.38	16		Dinetah Gray	body	5.61	4.5	4.2
92	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.23	7.3	4.4
93	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.32	6.2	5
94	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.27	5.5	4.3

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
95	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.59	5.9	3
96	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.31	4.2	3.7
97	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.97	3.8	2.6
98	LA4515	mera room LOA4.38	16		Dinetah Gray	body	3.55	4.1	4.1
99	LA4515	mera room LOA4.38	16		Dinetah Gray	body	4.27	4.6	3.6
100	LA4515	mera room LOA4.38	16		Dinetah Gray	body	3.77	3.7	2.8
101	BJ 10/40, 64.54.2, B10/580, B10/305, B10/549	Maxwell Museum	B. 1503		Rio Grande Utility	body	9.43	5.96	4.06
102	BJ 10/40, 64.54.2, B10/580, B10/305, B10/549	Maxwell Museum	B.1503		Rio Grande Utility	body	5.41	28.8	21.9
103	BJ 10/40, 64.54.2, B10/580, B10/305, B10/549	Maxwell Museum	B.1503		Rio Grande Utility	body	6.56	18.6	9.85
104	B10/580	Maxwell Museum	B.1503	61-12*	Rio Grande Utility	rim	4.8	12.43	8.65

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
105	BPM10/188 -LA416	Maxwell Museum	B.1503	66.102.14	Rio Grande Utility	body	4.77	9.98	6.46
106	B10/549	Maxwell Museum	B.1503		Rio Grande Utility	rim	5.3	13.54	9.98
107	BJ10/40	Maxwell Museum	B.1503		Rio Grande Utility	rim and body	5.74	27.1	18.9
108	123	Maxwell Museum	B.93		Rio Grande Utility	body	4.28	3.56	3.38
109	123	Maxwell Museum	B.93		Rio Grande Utility	body	7.79	4.94	4.32
110	123	Maxwell Museum	B.93		Rio Grande Utility	body	8.37	7.49	4.9
111	123	Maxwell Museum	B.93		Rio Grande Utility	body	5.3	5.01	3.37
112	123	Maxwell Museum	B.93		Rio Grande Utility	body	6.7	5.93	4.32
113	123	Maxwell Museum	B.93		Rio Grande Utility	body	6.71	4.48	3.93
114	123	Maxwell Museum	B.93		Rio Grande Utility	body	5.09	6.37	3.81
115	123	Maxwell Museum	B.93		Rio Grande Utility	body	7.62	5.76	3.66
116	123	Maxwell Museum	B.93		Rio Grande Utility	body	6.89	4.25	3.07
117	123	Maxwell Museum	B.93		Rio Grande Utility	body	4.14	3.5	2.34

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
118	123	Maxwell Museum	B.93		Rio Grande Utility	body	6.11	4.54	4.04
119	123	Maxwell Museum	B.93		Rio Grande Utility	body	7.73	4.88	2.6
120	123	Maxwell Museum	B.93		Rio Grande Utility	body	6.27	5.21	4.15
121	123	Maxwell Museum	93B		Rio Grande Utility	body	6.26	4.56	4.04
122	123	Maxwell Museum	93B		Rio Grande Utility	body	7.87	4.25	2.64
123	123	Maxwell Museum	93B		Rio Grande Utility	body	5.74	4.29	2.56
124	123	Maxwell Museum	93B		Rio Grande Utility	body	4.81	4.49	3.55
125	123	Maxwell Museum	93B		Rio Grande Utility	body	5.4	3.91	2.56
126	123	Maxwell Museum	93B		Rio Grande Utility	body	5.19	3.7	2.74
127	123	Maxwell Museum	93B		Rio Grande Utility	body	4.82	5.34	3.89
128	123	Maxwell Museum	93B		Rio Grande Utility	body	3.74	4.25	2.31
129	123	Maxwell Museum	93B		Rio Grande Utility	body	5.75	4.89	3.29
130	123	Maxwell Museum	93B		Rio Grande Utility	body	6.99	4.59	3.73
131	123	Maxwell Museum	93B		Rio Grande Utility	body	6.04	4.07	2.7
132	123	Maxwell Museum	93B		Rio Grande Utility	body	5.32	3.12	2.26

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
133	123	Maxwell Museum	93B		Rio Grande Utility	body	6.48	4.16	2.61
134	123	Maxwell Museum	93B		Rio Grande Utility	body	7.87	4.17	3.58
135	123	Maxwell Museum	93B		Rio Grande Utility	body	6.15	4.19	3.24
136	123	Maxwell Museum	93B		Rio Grande Utility	body	7.05	3.98	3.07
137	123	Maxwell Museum	93B		Rio Grande Utility	body	6.44	3.26	2.22
138	123	Maxwell Museum	93B		Rio Grande Utility	body	6.29	2.95	2.23
139	123	Maxwell Museum	93B		Rio Grande Utility	body	5.76	3.92	2.55
140	123	Maxwell Museum	93B		Rio Grande Utility	body	5.56	4.54	3.18
141	123	Maxwell Museum	93B		Rio Grande Utility	body	7.14	3.76	3.39
142	123	Maxwell Museum	93B		Rio Grande Utility	body	5.15	3.01	2.83
143	123	Maxwell Museum	93B		Rio Grande Utility	body	4.41	3.21	2.11
144	123	Maxwell Museum	93B		Rio Grande Utility	body	5.57	3.43	2.79
145	123	Maxwell Museum	93B		Rio Grande Utility	body	5.25	3.87	3.04
146	123	Maxwell Museum	93B		Rio Grande Utility	body	5.09	2.9	1.84
147	123	Maxwell Museum	93B		Rio Grande Utility	body	5.42	3.31	1.94

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
148	123	Maxwell Museum	93B		Rio Grande Utility	body	5.96	2.54	2.45
149	123	Maxwell Museum	93B		Rio Grande Utility	rim	7.99	5.08	4.01
150	123	Maxwell Museum	93B		Rio Grande Utility	rim	5.79	3.66	3.28
151	123	Maxwell Museum	93B		Rio Grande Utility	rim	6.97	5.28	4.06
152	123	Maxwell Museum	93B		Rio Grande Utility	rim	5.15	3.14	2.22
153	123	Maxwell Museum	93B		Rio Grande Utility	rim	5.5	3.88	2.67
154	123	Maxwell Museum	93B		Rio Grande Utility	rim	6.53	3.19	2.45
155	123	Maxwell Museum	93B		Rio Grande Utility	rim	5.16	3.28	1.92
156	123	Maxwell Museum	93B		Rio Grande Utility	rim	5.68	2.89	1.97
157	123	Maxwell Museum	93B		Rio Grande Utility	body	6.59	3.96	3.49
158	541	Maxwell Museum	93B		Rio Grande Utility	rim	7.73	12.42	8.27
159	541	Maxwell Museum	93B		Rio Grande Utility	body	5.15	15.77	13.8
160	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.45	3.65	3.27
161	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.24	2.78	2.47
162	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	5.04	2.68	1.92

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
163	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.45	2.91	2.17
164	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	4.01	2.3	2.16
165	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.39	2.47	1.7
166	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	4.21	2.26	1.7
167	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.65	1.89	1.63
168	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	3.49	2.34	1.65
169	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery; midden 1	1	Dinetah Gray	body	2.57	2.13	1.83
170	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	4.25	5.87	5.41
171	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	4.43	3.56	2.13
172	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	5.1	3.07	2.28
173	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	3.64	2.48	2.29
174	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	4.18	2.19	2.11
175	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	3.52	2.4	1.73
176	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	5.1	2.23	2.17
177	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	4.15	2.55	1.82

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
178	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	4.34	2.22	2.16
179	LA5660	Maxwell Museum	Shaft House Pueblito; Midden 2	2	Dinetah Gray	body	3.72	1.85	1.32
180	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	4.66	3.43	3.32
181	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	3.44	2.45	2.11
182	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	4.25	2.81	2.58
183	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	5.27	2.85	1.89
184	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	5.23	2.73	2.29
185	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, East Lower Ledge	5	Dinetah Gray	body	4.21	2.19	15.9
186	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	rim	4.85	2.76	2.33
187	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	rim	4.52	3.96	2.76
188	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	4.91	4.94	3.16

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
189	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	4.12	5.5	4.71
190	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	3.8	4.78	3.67
191	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	4.82	4.85	2.81
192	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	4.92	3.09	2.35
193	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	5.74	4.82	2.78
194	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	6.97	3.78	3.02
195	LA5660	Maxwell Museum	Shaft House Pueblitos Data Recovery, west Lower Ledge	3	Dinetah Gray	body	3.09	4.14	2.04
196	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	4.25	2.81	2.48
197	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	5.75	3.14	2.78
198	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	4.77	3.49	2.75

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
199	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	4.6	2.74	2.18
201	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	3.91	2.91	2.43
202	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	5.18	3.03	2.34
203	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	4.46	4.1	3.16
204	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	3.92	2.68	2.33
205	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	3.91	2.18	2.05
206	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, west upper ledge	4	Dinetah Gray	body	3.47	2.81	2.58
207	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, cliff/ledge debris	6	Dinetah Gray	body	3.66	5.55	2.98
208	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, cliff/ledge debris	6	Dinetah Gray	body	5.18	3.08	2.63

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
209	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, cliff/ledge debris	6	Dinetah Gray	body	5.03	2.81	1.95
210	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, cliff/ledge debris	6	Dinetah Gray	body	5.27	2.79	2.72
211	LA5660	Maxwell Museum	Shaft House Pueblito Data Recovery, cliff/ledge debris	6	Dinetah Gray	rim	5.02	3.37	2.75
212	71594	Maxwell Museum	Frances Canyon Cache Site		Dinetah Gray	rim	3.67	8.48	6.21
213	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	rim	3.61	3.31	2.96
214	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	4.06	5.74	3.71
215	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	4.26	5.09	3.59
216	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	3.59	3.92	2.8
217	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	5.23	4.12	2.57
218	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Dinetah Gray	body	3.82	3.94	3.85
219	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Dinetah Gray	body	5.12	3.24	2.71
220	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	4.14	3.52	2.54
221	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Navajo Gray	body	4.79	3.03	1.82

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
222	71580	Maxwell Museum	Pueblitos Data Recovery; Grid 10N 98E, Level 2	10	Dinetah Gray	body	4.88	3.11	2.19
223	Bj10/15?	Maxwell Museum			Rio Grande Utility	body	4.32	8.97	6.43
224	unknown	Maxwell Museum			Rio Grande Utility	base	7.37	18.2	12.9
225	Ba 11/53	Maxwell Museum	L. 4		Rio Grande Utility	body	5.03	13.04	12.63
226	unknown	Maxwell Museum			Rio Grande Utility	body	5.47	11.18	7.75
227	unknown	Maxwell Museum			Rio Grande Utility	body	4.78	12.29	6.46
228	unknown	Maxwell Museum			Rio Grande Utility	body	4.67	4.21	2.69
229	unknown	Maxwell Museum			Rio Grande Utility	body	5.35	9.27	7.64
230	unknown	Maxwell Museum			Rio Grande Utility	rim	6.6	22.6	8.8
231	unknown	Maxwell Museum			Rio Grande Utility	rim	5.14	2.45	1.34
232	Bj 81 10/15	Maxwell Museum			Rio Grande Utility	base	6.25	2.83	2.36
233	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	4.17	3.83	3.11
234	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	5.38	4.02	2.48
235	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	5.04	2.97	2.84
236	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	neck	4.42	3.67	2.97

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
237	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	4.75	3.58	3.45
238	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	5.45	2.61	2.4
239	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	4.59	3.4	2.98
240	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	3.83	2.82	2.77
241	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	4.77	2.97	2.3
242	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden Scatter	1: Surface	Dinetah Gray	body	4.74	2.35	2.23
243	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.71	3.26	2.73
244	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.12	2.83	1.59
245	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.12	3.23	2.02
246	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.14	2.43	1.92
247	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.49	2.19	1.79
248	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	3.93	3.5	2.07
249	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.57	2.88	1.94
250	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	4.36	2.7	2.29
251	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	body	3.56	3.04	2.38

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
252	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 3	3: Surface	Dinetah Gray	rim	3.3	2.21	1.58
253	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	rim	4.33	4.62	3.34
254	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	3.53	3.7	2.38
255	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	4.12	3.56	3.26
256	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	4.26	3.51	3.07
257	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	4.9	2.79	2.67
258	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	3.69	3.2	2.79
259	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	4.87	3.34	3.14
260	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	3.07	3.38	2.05
261	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	3.97	3.04	2.38
262	LA5662	Maxwell Museum	Pueblitos Data Recovery Hooded Fireplace	7: Surface	Dinetah Gray	body	3.98	3.15	2.68
263	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.13	7.29	5.78
264	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.04	4.58	4.4
265	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.9	4.63	4.42

Sherd Number	LA Number	Museum collection	Additional information	FS_no	Ceramic Type	Sherd type	Thickness (mm)	Length (cm)	Width (cm)
266	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Navajo Gray	body	3.97	4.61	4.54
267	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.01	3.71	2.89
268	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.75	4.03	2.75
269	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.4	3.68	3.56
270	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.37	2.96	2.84
271	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	4.95	2.75	2.54
272	LA5662	Maxwell Museum	Pueblitos Data Recovery Midden 8	8: Surface	Dinetah Gray	body	3.68	3.5	2.2

Table 7. Sherd data.

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
1	Crushed Rock	medium	reduced	10YR4/1	10YR4/1		none	none	none
2	Crushed Rock	medium	reduced	10YR4/1	Gley 1 3/N		Moderate	covers all ext of sherd	pitting
3	Crushed Rock	fine	partially reduced	10YR5/2	10YR5/1		none		none
4	Sand	extra fine	reduced	10YR5/2	10YR5/1		none		none
5	Crushed Rock	fine	reduced	10YR6/1	10YR6/2		none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
6	Crushed Rock	fine	reduced	10YR6/2	10YR5/1		none		none
7	Sand	fine	reduced	10YR5/1	10YR5/1		none		none
8	Crushed Rock	fine	reduced	10YR6/2	10YR5/2		none		none
9	Sherd and Sand	fine	reduced	10YR5/2	Gley 1 4/N		none		none
10	Sand	fine	reduced	10YR6/2	10YR5/2		none		none
11	Sand	fine	reduced	Gley 1 4/N	10YR6/2		none		none
12	Crushed Rock	fine	reduced	10YR5/1	10YR6/2		none		none
13	Sand	fine	reduced	10YR5/2	10YR5/2		none		none
14	Sand	fine	reduced	10YR4/1	10YR5/2		none		none
15	Sand	fine	reduced	10YR6/2	10YR6/1		none		none
16	Unknown	Unknown	reduced	Gley1 3/N	Gley1 3/N		Light to none	sherd very dark on both sides but creosote not obvious	none
17	Sand	fine	reduced	10YR3/1	Gley1 3/N		Heavy	from shoulder up on ext	pitting
18	Sand	fine	reduced	10YR5/2	Gley1 3/N		Light	covers entire ext. (even portion of base present)	none
19	Sand	fine	reduced	10YR5/1	Gley1 3/N		Light	creosote covers ext. of sherd	pitting
20	Sand	fine	reduced	10YR6/2	10YR4/1		none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
21	Sand	fine	reduced	Gley 1 3/N	Gley1 3/N		none		none
22	Tuff	fine	reduced	Gley 1 3/N	Gley1 4/N		none		none
23	Tuff	fine	oxidized	5YR5/3	7.5YR5/3		none		none
24	Tuff	fine	partially reduced	10YR5/2	7.5YR5/2		none		none
25	Sand and Tuff	fine	reduced	Gley1 3/N	10YR3/1		none		none
26	Mica	fine	reduced	Gley1 3/N	10YR3/1		none		none
27	Sand and Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		Light	covers ext. of sherd up to lip	none
28	Sand and Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		none		none
29	Sand	fine	reduced	Gley1 3/N	10YR4/1		none		none
30	Sand and Tuff	extra fine	reduced	Gley1 3/N	Gley1 3/N		none		none
31	Sand and Tuff	fine	partially reduced	10YR4/1	10YR5/2		none		none
32	Sand and Tuff	fine	partially reduced	Gley1 3/N	7.5YR5/1		none		none
33	Sand and Tuff	fine	reduced	Gley1 3/N	7.5YR5/2		none		none
34	Sand and Tuff	fine	oxidized	7.5YR5/4	7.5YR5/2		none		none
35	Sand and Tuff	fine	partially reduced	7.5YR5/1	7.5YR5/3		none		none
36	Sand	extra fine	reduced	10YR5/2	Gley1 3/N		none		none
37	Sand and Tuff	fine	reduced	Gley1 4/N	10YR5/2		none		none
38	Sand and Tuff	fine	reduced	10YR3/1	10YR4/1		none		none
39	Sand and Tuff	fine	partially reduced	10YR3/1	7.5YR5/2		none		none
40	Sand and Tuff	fine	reduced	Gley1 3/N	10YR4/1		none		none
41	Sand and Tuff	fine	reduced	10YR3/1	10YR3/1		none		none
42	Sand and Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
43	Sand and Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		none		none
44	Sand and Tuff	fine	reduced	10YR4/1	10YR3/1		none		none
45	Sand and Tuff	fine	reduced	Gley1 3/N	10YR4/1		none		none
46	Sand and Tuff	fine	reduced	Gley1 3/N	10Yr3/1		none		none
47	Unknown	extra fine	reduced	10YR3/1	10YR3/1		none		none
48	Sand and Tuff	fine	reduced	Gley1 3/N	10YR3/1		none		none
49	Sand and Tuff	fine	reduced	10YR3/1	10YR3/1		none		none
50	Sand and Tuff	fine	partially reduced	7.5YR5/2	7.5YR4/3		none		none
51	Sand and Tuff	fine	reduced	7.5YR3/2	7.5YR4/2		none		none
52	Sand and Tuff	fine	partially reduced	5YR6/3	7.5YR6/2		none		none
53	Sand and Tuff	fine	reduced	10YR4/1	7.5YR5/1		none		none
54	Sand and Tuff	fine	reduced	10YR3/1	10YR5/2		none		none
55	Sand and Tuff	extra fine	reduced	10YR4/1	7.5YR4/2		none		none
56	Sand and Tuff	fine	partially reduced	Gley1 3/N	10YR5/1		none		none
57	Unknown	extra fine	reduced	Gley1 3/N	7.5YR2.5/1		none		none
58	Sand and Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		none		none
59	Sand and Tuff	fine	partially reduced	Gley1 3/N	7.5YR4/2		none		none
60	Sand and Tuff	fine	partially reduced	Gley1 3/N	10YR3/1		none		none
61	Sand and Tuff	fine	partially reduced	Gley1 3/N	5YR5/3		none		none
62	Sand and Tuff	extra fine	reduced	Gley1 4/N	Gley1 3/N		none		none
63	Tuff	fine	reduced	10YR4/1	10YR4/1		none		none
64	Tuff	fine	reduced	Gley1 3/N	10YR4/1		none		none
65	Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		Light	on whole of ext.	none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
66	Unknown	extra fine	partially reduced	Gley1 3/N	7.5YR5/2		none		none
67	Andesite	fine	reduced	Gley1 3/N	7.5YR4/2		none		none
68	Tuff	fine	reduced	Gley1 3/N	Gley1 3/N		none		none
69	Tuff	fine	partially reduced	Gley1 3/N	2.5YR5/4		none		none
70	Unknown	extra fine	oxidized	5YR4/3	2.5YR4/4		none		none
71	Tuff	extra fine	partially reduced	Gley1 4/N	7.5YR4/1		none		none
72	Tuff	extra fine	reduced	Gley1 4/N	Gley1 4/N		none		none
73	Tuff	extra fine	partially reduced	Gley1 3/N	5YR4/3		none		none
74	Sand	extra fine	reduced	10YR5/2	10YR5/1		none		none
75	Sand	extra fine	reduced	10YR5/2	Gley1 3/N		Moderate	on whole of ext	none
76	Sand	fine	reduced	10YR3/1	10YR4/1		none		none
77	Sand	extra fine	reduced	Gley1 3/N	10YR4/2		none		none
78	Sand	extra fine	reduced	10YR5/2	Gley1 3/N		none		none
79	Sand	fine	reduced	Gley1 3/N	10YR5/2		none		none
80	Sand	extra fine	reduced	10YR4/1	10YR6/2		none		none
81	Sand	extra fine	reduced	10YR5/2	10YR5/1		none		none
82	Sand	extra fine	reduced	Gley1 3/N	10YR4/1		none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
83	Unknown	extra fine	reduced	10YR6/1	Gley1 4/N		none		none
84	Sand	extra fine	reduced	10YR6/2	10YR5/1		none		none
85	Sand	extra fine	reduced	10YR5/2	Gley1 3/N		none		none
86	Crushed Rock	medium	reduced	10YR4/1	10YR5/1		Light	small patch on ext	pitting
87	Sand	fine	reduced	10YR5/2	10YR5/1		none		none
88	Sherd	fine	reduced	10YR5/2	10YR5/2		none		none
89	Sand	extra fine	reduced	10YR6/2	10YR6/1		none		none
90	Sand	fine	reduced	10YR5/1	10YR5/1		none		none
91	Sand	extra fine	reduced	10YR6/2	10YR4/1		none		none
92	Sand	extra fine	reduced	10YR5/2	10YR4/1		none		none
93	Sand	extra fine	reduced	10YR5/2	10YR3/1		none		none
94	Sand	extra fine	reduced	10YR4/1	10YR5/1		none		none
95	Sand	extra fine	reduced	10YR5/1	10YR3/1		none		none
96	Sand	extra fine	reduced	10YR5/2	10YR3/1		none		none
97	Sand	extra fine	reduced	10YR5/1	10YR5/2		none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
98	Sand	extra fine	reduced	10YR5/2	10YR5/1		none		none
99	Sand	fine	partially reduced	7.5YR6/3	10YR5/1		none		none
100	Sand	fine	reduced	10YR5/2	10YR5/1		none		none
101	Crushed Rock, Sherd, and Tuff	medium	partially reduced	10YR5/3	10YR6/2	10YR4/1	none		none
102	Crushed Rock and Sherd	fine	partially reduced	10YR5/2	10YR2/1	10YR3/1	none		abrasion
103	Andesite	fine	reduced	10YR4/1	10YR3/1	10YR4/1	none		none
104	Tuff	fine	reduced	10YR4/1	10YR2/1	10YR2/1	Light	primarily on ext. base	none
105	Sherd	fine	reduced	Gley1 2.5N	10YR4/1	10YR4/1	Heavy	on entire ext.	pitting
106	Crushed Rock	fine	reduced	Gley1 3/N	10YR2/1	10YR3/1	Light	on ext. over surface	none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
107	Sherd	fine	reduced	Gley1 3/N	10YR4/1	10YR5/3	none		crazing and pitting
108	Crushed Rock	fine	partially reduced	10YR3/1	7.5YR5/3	7.5YR5/3	none		none
109	Sherd	extra fine	reduced	10YR3/1	Gley 1 2.5/N	10YR4/1	Heavy	on ext.	none
110	Sherd	extra fine	partially reduced	10YR3/1	10YR2/1	7.5YR5/3	Light	only small patches on ext	crazing and pitting
111	Sherd	fine	partially reduced	10YR4/1	7.5YR5/2	7.5YR4/1	none		none
112	Crushed Rock	fine	reduced	10YR3/1	10YR4/1	10YR3/1	Light	ext. of sherd	none
113	Crushed Rock	extra fine	reduced	10YR3/1	10YR3/1	10YR3/1	none		none
114	Crushed Rock	extra fine	reduced	10YR4/1	10YR2/1	10YR3/1	none		none
115	Sherd	extra fine	reduced	10YR2/1	10YR4/1	10YR4/1	none		none
116	Sherd	extra fine	reduced	10YR2/1	10YR2/1	10YR2/1	Light	on ext.	none
117	Sherd	extra fine	reduced	10YR3/1	10YR2/1	10YR3/1	Moderate	on ext.	none
118	Crushed Rock	extra fine	reduced	10YR3/1	10YR2/1	10YR3/1	Light	on ext.	none
119	Crushed Rock	extra fine	reduced	10YR2/1	10YR2/1	10YR2/1	Light	on ext.	none
120	Crushed Rock	extra fine	reduced	10YR3/1	10YR4/2	7.5YR5/2	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
121	Crushed Rock	fine	reduced	10YR3/1	10YR3/1	10YR3/1	none		none
122	Crushed Rock	extra fine	reduced	10YR3/1	Gley1 3/N	10YR5/2	Moderate	on ext	none
123	Crushed Rock	fine	reduced	Gley 1 3/N	Gley1 3/N	Gley1 3/N	none		none
124	Crushed Rock	extra fine	reduced	Gley 1 3/N	Gley1 3/N	10YR5/3	Light	on ext	pitting
125	Crushed Rock	extra fine	partially reduced	Gley 1 3/N	7.5YR4/2	7.5YR5/2	none		abrasion
126	Crushed Rock	fine	reduced	Gley 1 3/N	Gley1 2.5/N	10YR5/2	Light	on ext	none
127	Crushed Rock	fine	partially reduced	Gley 1 3/N	7.5YR5/2	7.5YR5/2	none		none
128	Crushed Rock	extra fine	reduced	Gley 1 3/N	Gley1 3/N	7.5YR4/2	Light	on ext	pitting
129	Crushed Rock	extra fine	reduced	Gley 1 3/N	7.5YR4/1	7.5YR3/1	none		none
130	Crushed Rock	fine	partially reduced	7.5YR4/1	7.5YR4/2	7.5YR4/2	none		none
131	Crushed Rock	extra fine	reduced	10YR3/1	10YR3/1	10YR3/1	Light	on ext	none
132	Crushed Rock	fine	reduced	Gley1 3/N	10YR3/1	10YR4/1	Light	on ext	none
133	Crushed Rock	fine	partially reduced	10YR3/1	10YR4/2	7.5YR4/2	none		none
134	Tuff	extra fine	partially reduced	Gley1 3/N	10YR4/2	10YR3/1	none		none
135	Crushed Rock	fine	reduced	Gley1 3/N	10YR3/1	10YR3/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
136	Crushed Rock	fine	reduced	Gley1 3/N	Gley1 3/N	7.5YR4/2	none		none
137	Crushed Rock	fine	reduced	Gley1 3/N	10YR3/1	10YR4/1	none		crazing
138	Crushed Rock	extra fine	reduced	Gley1 3/N	10YR3/1	10YR4/2	none		none
139	Crushed Rock	extra fine	reduced	10YR4/1	10YR3/1	10YR4/2	none		pitting
140	Crushed Rock and Sherd	fine	reduced	Gley 1 3/N	10YR3/1	10YR3/1	none		pitting
141	Crushed Rock and Sherd	fine	reduced	Gley 1 3/N	10YR4/1	10YR5/2	none		none
142	Sand	extra fine	partially reduced	Gley 1 3/N	Gley1 2.5/N	7.5YR5/2	Heavy	on ext	none
143	Crushed Rock	fine	reduced	Gley 1 3/N	Gley1 2.5/N	10YR4/1	Moderate	on ext	pitting
144	Crushed Rock	fine	reduced	10YR3/1	10YR3/1	7.5YR5/2	none		none
145	Crushed Rock	fine	reduced	Gley1 4/N	Gley 1 3/N	10YR3/1	Moderate	on ext	pitting
146	Crushed Rock	extra fine	partially reduced	Gley1 4/N	10YR5/1	10YR5/1	none		none
147	Crushed Rock	extra fine	reduced	Gley1 3/N	10YR3/1	7.5YR5/3	none		pitting
148	Crushed Rock	fine	reduced	Gley1 3/N	Gley 1 3/N	10YR3/1	none		pitting
149	Crushed Rock	extra fine	reduced	10YR3/1	10YR3/1	10YR4/1	Light	near rim on ext	none
150	Crushed Rock	fine	reduced	10YR3/1	10YR3/1	10YR3/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
151	Tuff	fine	reduced	10YR3/1	10YR3/1	10YR4/1	Light	near rim on ext	pitting
152	Sand	fine	reduced	10YR3/1	10YR3/1	10YR3/1	none		none
153	Crushed Rock	fine	partially reduced	10YR3/1	7.5YR5/2	7.5YR5/2	none		none
154	Sand	fine	reduced	10YR3/1	10YR2/1	7.5YR4/1	none		none
155	Crushed Rock	fine	reduced	Gley1 3/N	10YR4/1	7.5YR5/2	none		none
156	Crushed Rock	extra fine	reduced	10YR3/1	10YR3/1	10YR3/1	none		none
157	Crushed Rock	extra fine	reduced	10YR3/1	10YR3/1	10YR4/1	Moderate	on ext	pitting
158	Tuff	medium	reduced	10YR3/1	10YR3/1	10YR4/1	none		none
159	Crushed Rock	fine	reduced	10YR3/1	10YR3/1	10YR4/1	Light	on ext	none
160	Crushed Rock	extra fine	reduced	10YR3/1	10YR6/1	10YR4/1	none		none
161	Crushed Rock	extra fine	reduced	10YR6/1	10YR5/1	10YR6/1	none		none
162	Crushed Rock	fine	reduced	Gley1 4/N	10YR6/1	10YR3/1	none		none
163	Crushed Rock	fine	reduced	10YR4/1	10YR5/1	10YR3/1	none		none
164	Crushed Rock	extra fine	reduced	10YR5/1	10YR5/1	10YR3/1	none		none
165	Crushed Rock	fine	reduced	Gley1 4/N	10YR5/1	10YR3/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
166	Crushed Rock	extra fine	reduced	Gley1 4/N	10YR6/2	10YR3/1	none		none
167	Crushed Rock	fine	reduced	10YR6/1	10YR5/1	10YR3/1	none		none
168	Crushed Rock and Sherd	fine	reduced	10YR6/2	Gley1 5/N	10YR3/1	none		pitting
169	Crushed Rock	extra fine	reduced	10YR7/1	Gley1 4/N	Gley1 3/N	none		none
170	Crushed Rock	fine	reduced	10YR3/1	Gley1 3/N	10YR3/1	Light	on ext.-sherd has been washed	pitting
171	Crushed Rock	fine	partially reduced	10YR6/3	10YR5/3	10YR6/3	none		none
172	Crushed Rock	fine	partially reduced	10YR6/3	2.5Y 6/1	10YR6/2	none		none
173	Crushed Rock	fine	reduced	10YR5/1	Gley1 4/N	10YR5/1	Light	on ext.-sherd has been washed	pitting
174	Crushed Rock	medium	reduced	10YR5/1	Gley1 4/N	10YR3/1	none		pitting
175	Crushed Rock	medium	reduced	Gley1 4/N	10YR5/1	10YR5/2	none		pitting
176	Crushed Rock	fine	partially reduced	10YR6/1	10YR6/2	10YR4/1	none		none
177	Crushed Rock	medium	reduced	10YR5/2	10YR5/1	10YR3/1	none		pitting
178	Crushed Rock	extra fine	reduced	2.5Y 5/1	2.5Y 5/1	2.5Y 3/1	none		none
179	Crushed Rock	extra fine	reduced	10YR2.1	10YR3/1	10YR3/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
180	Crushed Rock	fine	partially reduced	10YR6/2	10YR7/3	10YR5/1	none		none
181	Crushed Rock	fine	reduced	10YR5/1	Gley1 4/N	10YR5/1	none		none
182	Crushed Rock	fine	reduced	10YR5/1	10YR6/2	10YR6/2	none		none
183	Crushed Rock	fine	reduced	Gley1 3/N	2.5Y 6/1	2.5Y 6/2	none		none
184	Crushed Rock	fine	reduced	10YR5/2	Gley1 3/N	Gley1 3/N	none		none
185	Crushed Rock	fine	partially reduced	10YR5/2	10YR5/2	10YR5/2	none		none
186	Crushed Rock	extra fine	reduced	10YR5/1	Gley1 5/N	10YR6/2	none		none
187	Crushed Rock	fine	reduced	Gley1 4/N	Gley1 4/N	10YR6/2	none		none
188	Crushed Rock	fine	reduced	10YR6/2	2.5Y 6/1	2.5Y 5/1	none		none
189	Crushed Rock	medium	reduced	2.5Y 6/2	2.5Y 6/2	2.5Y 5/2	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
190	Crushed Rock	fine	reduced	10YR5/1	2.5Y 5/1	10YR6/2	none		none
191	Crushed Rock	fine	reduced	10YR6/2	2.5Y 6/1	10YR6/2	none		none
192	Crushed Rock	fine	reduced	2.5Y5/1	Gley1 3/N	10YR2/1	none		none
193	Crushed Rock	fine	reduced	Gley1 4/N	2.5Y 5/1	Gley1 3/N	none		pitting
194	Crushed Rock	fine	reduced	Gley1 4/N	Gley1 4/N	Gley1 3/N	none		none
195	Crushed Rock	medium	reduced	Gley1 3/N	Gley1 3/N	Gley1 3/N	none		pitting
196	Crushed Rock	fine	reduced	2.5Y 5/1	2.5Y 6/1	2.5Y3/1	none		none
197	Crushed Rock	extra fine	reduced	10YR4/1	10YR3/1	10YR3/1	none		none
198	Crushed Rock	extra fine	reduced	2.5Y5/1	2.5Y7/1	10YR3/1	none		none
199	Crushed Rock	fine	reduced	2.5Y 6/1	10YR4/1	10YR5/2	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
201	Crushed Rock	extra fine	reduced	Gley1 4/N	Gley1 3/N	Gley1 3/N	none		none
202	Crushed Rock	fine	reduced	10YR4/1	Gley1 3/N	Gley1 3/N	Light	on ext.- may just be fire cloud, but sherd is very clean-so probably been washed	pitting
203	Crushed Rock	extra fine	reduced	10YR5/1	10YR3/1	10YR3/1	Light	on ext.- may just be fire cloud, but sherd is very clean-so probably been washed	pitting
204	Crushed Rock	extra fine	reduced	Gley1 3/N	Gley1 4/N	Gley1 3/N	none		pitting
205	Crushed Rock	fine	reduced	10YR5/2	Gley1 4/N	10YR2/1	none		none
206	Crushed Rock	fine	reduced	Gley1 4/N	Gley1 4/N	Gley1 3/N	none		none
207	Crushed Rock	fine	reduced	Gley1 3/N	10YR5/2	Gley1 3/N	none		none
208	Crushed Rock	medium	reduced	Gley1 4/N	Gley1 4/N	Gley1 3/N	none		pitting
209	Crushed Rock	fine	reduced	10YR6/2	2.5Y5/1	10YR4/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
210	Crushed Rock	fine	reduced	Gley1 4/N	Gley1 3/N	Gley1 3/N	Light	on ext.- may just be fire cloud, but sherd is very clean-so probably been washed	none
211	Crushed Rock	extra fine	reduced	10YR5/2	Gley1 4/N	Gley1 3/N	none		none
212	Crushed Rock	extra fine	reduced	Gley 1 4/N	Gley1 2.5/N	Gley1 5/N	Light	ext to rim	none
213	Crushed Rock	extra fine	reduced	Gley1 5/N	10YR5/1	10YR5/1	none		none
214	Crushed Rock	extra fine	partially reduced	10YR6/2	10YR4/6	10YR6/4	none		none
215	Crushed Rock	extra fine	partially reduced	10YR5/1	10YR7/2	10YR5/2	none		none
216	Crushed Rock	extra fine	partially reduced	Gley1 4/N	10YR6/3	Gley1 3/N	none		none
217	Crushed Rock	fine	partially reduced	10YR6/2	10YR6/3	10YR4/1	none		pitting
218	Crushed Rock	fine	reduced	Gley1 3/N	Gley1 4/N	10YR6/2	none		none
219	Crushed Rock	extra fine	reduced	Gley1 3/N	Gley1 3/N	Gley1 2.5/N	none		none
220	Crushed Rock	fine	oxidized	10YR6/3	10YR7/3	10YR7/2	none		none
221	Crushed Rock	fine	oxidized	10YR6/2	7.5YR5/2	7.5YR3/2	none		pitting and scratches
222	Crushed Rock	extra fine	reduced	Gley1 3/N	10YR3/1	2.5Y4/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
223	Crushed Rock	fine	reduced	10YR5/2	10YR3/1	7.5YR4/3	Moderate	on ext in patches	none
224	Crushed Rock	medium	reduced	10YR4/1	10YR3/1	10YR3/1	none		pitting
225	Crushed Rock	fine	partially reduced	10YR4/1	7.5YR4/3	7.5YR4/4	Light	on ext. in two small patches	pitting
226	Crushed Rock	fine	oxidized	7.5YR5/3	10YR4/2	5YR4/4	Light	on ext. in 1 small patch	none
227	Crushed Rock	fine	partially reduced	10YR3/1	10YR4/1	7.5YR4/2	Moderate	on ext. in patches	pitting
228	Crushed Rock	fine	partially reduced	10YR5/3	10YR4/1	10YR5/2	Light	on ext	none
229	Crushed Rock	fine	partially reduced	10YR4/1	10YR5/3	7.5YR4/4	Light	on ext. covers over half sherd	pitting
230	Crushed Rock	medium	reduced	10YR5/1	10YR4/1	10YR4/1	none		none
231	Crushed Rock	medium	partially reduced	7.5YR5/2	7.5YR4/1	7.5YR4/3	Light	on ext in patches	pitting
232	Crushed Rock	fine	reduced	10YR5/2	10YR4/1	10YR5/2	Light	on ext. Could be fire clouding	pitting
233	Crushed Rock	fine	reduced	10YR5/3	10YR4/1	10YR3/1	none		none
234	Crushed Rock	fine	partially reduced	10YR6/3	10YR5/2	10YR6/1	none		none
235	Crushed Rock	medium	partially reduced	10YR6/3	10YR5/1	10YR5/3	none		none
236	Crushed Rock	fine	partially reduced	10YR5/1	10YR5/1	10YR5/2	none		none
237	Crushed Rock	medium	partially reduced	10YR5/3	10YR5/3	10YR5/3	none		pitting

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
238	Crushed Rock	fine	partially reduced	10YR5/3	10YR5/1	10YR5/3	none		none
239	Crushed Rock	fine	partially reduced	10YR6/2	10YR6/2	10YR5/2	none		none
240	Crushed Rock	fine	partially reduced	10YR6/3	10YR4/2	10YR5/3	none		none
241	Crushed Rock	fine	partially reduced	10YR6/2	10YR4/3	10YR5/3	none		none
242	Crushed Rock	fine	partially reduced	10YR6/2	10YR4/1	10YR4/1	none		pitting
243	Crushed Rock	fine	partially reduced	10YR6/2	10YR6/2	10YR6/2	none		pitting
244	Unknown	Unknown	reduced	Gley1 3/N	Gley1 2.5/N	Gley1 2.5/N	Heavy	over whole sherd-even crossection	none
245	Crushed Rock	fine	reduced	Gley1 3/N	10YR5/1	Gley1 2.5/N	Light	int	none
246	Crushed Rock	fine	reduced	10YR4/1	10YR3/1	10YR3/1	Light	ext	pitting
247	Crushed Rock	fine	reduced	10YR5/2	10YR5/1	10YR5/1	none		pitting
248	Crushed Rock	fine	reduced	10YR5/1	10YR4/1	10YR3/1	none		pitting
249	Crushed Rock	fine	partially reduced	10YR6/2	10YR6/3	10YR5/2	none		none
250	Crushed Rock	medium	partially reduced	10YR5/2	10YR5/1	10YR5/2	none		none
251	Crushed Rock	fine	reduced	2.5Y5/1	Gley1 4/N	Gley1 3/N	none		none
252	Crushed Rock	medium	reduced	10YR5/1	10YR5/1	10YR5/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
253	Crushed Rock	fine	reduced	Gley1 3/N	10YR5/1	Gley13/N	none		none
254	Crushed Rock	extra fine	reduced	10YR5/1	10YR6/1	10YR4/1	none		none
255	Crushed Rock	fine	reduced	10YR5/1	10YR4/1	10YR4/1	Light	ext	pitting
256	Crushed Rock	fine	reduced	Gley1 3/N	Gley1 3/N	Gley1 3/N	Moderate	ext	pitting
257	Crushed Rock	medium	reduced	10YR5/2	10YR5/2	10YR5/2	none		none
258	Crushed Rock	medium	reduced	10YR5/1	Gley1 4/N	Gley1 4/N	none		pitting
259	Crushed Rock	fine	reduced	10YR4/1	Gley1 4/N	10YR3/1	none		none
260	Crushed Rock	fine	reduced	10YR5/1	2.5Y5/1	10YR6/2	none		none
261	Crushed Rock	medium	reduced	Gley1 4/N	10YR5/2	10YR5/2	none		none
262	Crushed Rock	medium	reduced	10YR5/1	10YR4/1	10YR5/1	none		none
263	Crushed Rock	extra fine	reduced	10YR4/1	Gley1 3/N	10YR4/1	Heavy	ext	pitting
264	Crushed Rock	fine	reduced	10YR4/1	2.5Y4/1	10YR4/1	none		pitting and spalling
265	Crushed Rock	medium	reduced	10YR4/1	10YR5/1	10YR3/1	none		none
266	Crushed Rock	medium	reduced	2.5Y6/1	2.5Y6/1	2.5Y3/1	none		none

Sherd Number	Temper	Size of temper	Firing atmosphere	Int Color	Ext Color	crosscolor	Amount of sooting	SootingDescription/ Location	Attrition
267	Crushed Rock	fine	reduced	2.5Y6/1	2.5Y4/1	2.5Y3/1	none		none
268	Crushed Rock	fine	reduced	2.5Y6/1	2.5Y5/1	2.5Y5/1	none		none
269	Crushed Rock	fine	reduced	2.5Y6/1	2.5Y6/1	2.5Y6/1	none		none
270	Crushed Rock	fine	reduced	10YR4/1	10YR4/1	10YR5/1	none		none
271	Crushed Rock	fine	reduced	10YR4/1	10YR5/1	10YR3/1	none		none
272	Crushed Rock	extra fine	reduced	10YR5/1	10YR3/1	10YR4/1	none		none

Table 8. Sherd Data.

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
1			parallel scraped	obliquely scraped	3.5	random	32 sherds (some glued together) from same vessel in one box-rim and body sherds. No sooting or attrition visible on any of vessel sherds, base is missing
2	Moderate	covers 1/4 of int. of sherd	parallel scraped	obliquely scraped	3.5	random	orientation difficult
3			parallel scraped	obliquely scraped	3.5	random	
4			smoothed	smoothed	3.5	random	
5			smoothed	parallel scraped	4.5	random	
6			parallel scraped	parallel scraped	3.5	random	orientation difficult
7			smoothed	smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
8			smoothed	obliquely scraped	3.5	random	
9			smoothed	obliquely scraped	3.5	random	
10			smoothed	obliquely scraped	3.5	random	
11			smoothed	obliquely scraped	3.5	random	orientation difficult
12			slipped and painted	obliquely scraped	3.5	random	
13			smoothed	obliquely scraped	3.5	random	orientation difficult
14			smoothed	parallel scraped	3.5	random	orientation difficult
15			smoothed	smoothed	3.5	nonrandom	orientation difficult
16			smoothed	obliquely scraped	3.5	random	two holes drilled in sherds near edges (repair holes?) scores are deep
17	Light	below shoulder on int. could be from manufacture	parallel scraped	obliquely scraped	3.5	random	very large sherd
18			parallel scraped	obliquely scraped	3.5	random	edge goes through center of base
19	Light	int. only	scraped	smoothed	3.5	random	orientation difficult
20			parallel scraped	obliquely scraped	3.5	random	orientation difficult
21			polished	smoothed	2.5	nonrandom	
22			polished	smoothed	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
23			smoothed	smoothed	2	nonrandom	**this one may not be jemez plain even though it is in that box (Jemez culinary). Rim may indicate earlier vessel type
24			smoothed	smoothed	2.5	nonrandom	
25			polished	smoothed	2.5	random	lip slightly folded
26			polished	smoothed	2.5	nonrandom	ext. surface is sparkley
27			polished	smoothed	2.5	random	
28			polished	smoothed	2.5	random	
29			polished	smoothed	2.5	random	
30			polished	smoothed	3.5	random	
31			polished	smoothed	2.5	random	
32			polished	smoothed	2.5	nonrandom	
33			polished	corrugated	2.5	random	pinched vertically along coils.
34			smoothed	smoothed	2.5	random	slightly flaring rim
35			smoothed	smoothed	2.5	random	coils can be seen on ext. surface. Coils not totally smoothed.
36			smoothed	smoothed	2.5	random	slightly incurving rim
37			smoothed	smoothed	2.5	random	constricted neck, slightly flaring rim
38			smoothed	smoothed	2.5	random	flaring rim, neck low (3.3cm below rim)
39			smoothed	smoothed	2.5	random	flaring rim
40			polished	smoothed	2.5	random	flaring rim
41			smoothed	smoothed	2.5	nonrandom	lip folded in one small section
42			polished	smoothed	2.5	nonrandom	
43			polished	smoothed	2.5	random	
44			polished	smoothed	2.5	nonrandom	small fold on lip

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
45			polished	smoothed	2.5	random	
46			polished	smoothed	2.5	random	ext surface is almost corrugated. Coils have been smoothed out but you can still see them
47			polished	smoothed	2.5	random	
48			polished	smoothed	2.5	random	
49			smoothed	smoothed	3.5	nonrandom	
50			smoothed	smoothed	2.5	random	
51			smoothed	smoothed	2.5	random	
52			smoothed	smoothed	2.5	nonrandom	coils can be seen on ext.
53			polished	smoothed	2.5	random	
54			smoothed	smoothed	2.5	random	vertical punctate-like impressions can be seen on ext. surface
55			smoothed	smoothed	2	random	flaring rim
56			polished	smoothed	2.5	random	flaring rim
57			polished	smoothed	2.5	random	flaring rim
58			polished	smoothed	2.5	random	flaring rim
59			polished	smoothed	2.5	random	slightly flaring rim
60			smoothed	smoothed	2.5	nonrandom	
61			polished	smoothed	2.5	nonrandom	slightly flaring rim
62			polished	smoothed	2.5	nonrandom	
63			smoothed	smoothed	2.5	random	
64			polished	smoothed	2.5	random	lip slightly folded on ext.
65			polished	smoothed	3.5	nonrandom	
66			polished	smoothed	2.5	nonrandom	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
67			polished	smoothed	3.5	random	
68			polished	smoothed	2.5	random	slightly rolled rim to ext.
69			smoothed	smoothed	2.5	random	slight fold below rim on ext.
70			polished	smoothed	2.5	random	flaring rim
71			polished	smoothed	2.5	random	
72			smoothed	smoothed	2.5	nonrandom	
73			polished	smoothed	2.5	random	vessel would have had flaring rim
74			parallel scraped	obliquely scraped	3.5	random	
75			parallel scraped	obliquely scraped	2.5	random	
76			parallel scraped	obliquely scraped	2.5	random	
77			parallel scraped	obliquely scraped	3.5	random	
78			parallel scraped	obliquely scraped	2.5	random	difficult to orient
79			parallel scraped	obliquely scraped	2.5	random	difficult to orient
80			parallel scraped	obliquely scraped	3.5	nonrandom	
81			obliquely scraped	obliquely scraped	2.5	random	
82			parallel scraped	obliquely scraped	2.5	random	
83			smoothed	obliquely scraped	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
84			parallel scraped	obliquely scraped	2.5	random	
85			parallel scraped	obliquely scraped	2.5	random	
86	Light	very slight on int. could be from manufacture	smoothed	obliquely scraped	3.5	nonrandom	
87			parallel scraped	vertical scraped	2.5	random	
88			scraped	scraped	3.5	random	difficult to orient
89			parallel scraped	obliquely scraped	2.5	random	
90			smoothed	obliquely scraped	3.5	random	
91			smoothed	obliquely scraped	3.5	random	
92			parallel scraped	obliquely scraped	2.5	random	
93			parallel scraped	obliquely scraped	3.5	random	
94			parallel scraped	obliquely scraped	2.5	nonrandom	
95			parallel scraped	obliquely scraped	2.5	random	
96			parallel scraped	obliquely scraped	2.5	random	
97			parallel scraped	obliquely scraped	2.5	random	
98			smoothed	obliquely scraped	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
99			scraped	obliquely scraped	3.5	random	
100			smoothed	smoothed	3.5	random	
101			smoothed	smoothed	3.5	random	
102	Light	interior-very slight scratches around max d	smoothed	smoothed	3.5	random	three sherds glued together to make one sherd. Includes portion of neck and body but no base or rim
103			lightly polished	smoothed	3.5	random	ext-very very slightly corrugated.
104			lightly polished	smoothed	2.5	random	seven sherds make up almost half of a small vessel. Measurements reflect large rim sherd that is made up of three sherds glued back together.
105	Light	in small patches on int.	smoothed	smoothed	3.5	random	this sherd is a part of a large Jemez plain vessel that looks as though it could be reconstructed. It appears that the majority of the vessel is here.
106			Smoothed	smoothed	3.5	nonrandom	this sherd is part of a bowl. There is no neck. Approximately 1/3 of the vessel is in bag and could be reconstructed.
107	Light	on int. around max d and down	lightly polished	smoothed	4.5	nonrandom	this is a very large reconstructed sherd made up of seven sherds- approx. 1/4 of a vessel.

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
108	none		lightly polished	roughly smoothed	2.5	random	
109			lightly polished	roughly smoothed	2.5	nonrandom	
110	Light	on int.	lightly polished	roughly smoothed	2.5	random	
111			lightly polished	roughly smoothed	3.5	random	
112			lightly polished	roughly smoothed	3.5	random	
113			lightly polished	roughly smoothed	2.5	random	dirt obscures surfaces
114			lightly polished	roughly smoothed	2.5	random	dirt obscures surfaces
115			lightly polished	roughly smoothed	3.5	nonrandom	dirt obscures surfaces
116			lightly polished	roughly smoothed	3.5	random	all surfaces same surface. Could be some sooting on cross sections-burning after pot broken?
117			lightly polished	roughly smoothed	3.5	nonrandom	
118			lightly polished	roughly smoothed	3.5	random	
119			lightly polished	roughly smoothed	3.5	random	
120			lightly polished	roughly smoothed	3.5	random	
121			smoothed	roughly smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
122			smoothed	roughly smoothed	2.5	random	
123			lightly polished	roughly smoothed	2.5	random	
124	Light	on int. Visible with 10x magnifier	lightly polished	roughly smoothed	2.5	random	
125	Light	scratches-could be post depositional	lightly polished	roughly smoothed	2.5	random	
126			lightly polished	roughly smoothed	2.5	random	
127			lightly polished	roughly smoothed	2.5	random	
128	Light	on int. visible with 10x magnifier	lightly polished	roughly smoothed	2	random	
129			lightly polished	roughly smoothed	2.5	nonrandom	
130			lightly polished	roughly smoothed	2.5	random	
131			lightly polished	roughly smoothed	2.5	random	
132			lightly polished	roughly smoothed	3.5	nonrandom	
133			lightly polished	roughly smoothed	3.5	random	
134			lightly polished	roughly smoothed	3.5	random	crossection in lighter towards ext. and darker toward int. of sherd
135			lightly polished	roughly smoothed	3.5	random	
136			lightly polished	roughly smoothed	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
137	on ext		lightly polished	roughly smoothed	3.5	random	
138			lightly polished	roughly smoothed	2.5	random	
139	Light	on int	smoothed	roughly smoothed	2.5	nonrandom	
140	Heavy	on int	smoothed	roughly smoothed	2.5	random	
141			lightly polished	roughly smoothed	3.5	nonrandom	
142			lightly polished	roughly smoothed	2.5	random	
143	Moderate	on int	lightly polished	roughly smoothed	2.5	nonrandom	
144			lightly polished	roughly smoothed	3.5	random	
145	Light	on int	lightly polished	roughly smoothed	3.5	random	
146			lightly polished	roughly smoothed	3.5	nonrandom	
147	Light	on int	lightly polished	roughly smoothed	2.5	random	
148	Light	in int	lightly polished	roughly smoothed	3.5	random	
149			lightly polished	roughly smoothed	3.5	nonrandom	
150			lightly polished	roughly smoothed	3.5	random	ext. could be considered smeared corrugated
151	Light	on int	lightly polished	roughly smoothed	3.5	nonrandom	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
152			lightly polished	lightly polished	3.5	random	bowl
153			lightly polished	roughly smoothed	3.5	random	
154			lightly polished	roughly smoothed	3.5	nonrandom	
155			lightly polished	roughly smoothed	3.5	nonrandom	
156			lightly polished	lightly polished	3.5	random	
157	Light	very small patch on int	lightly polished	roughly smoothed	3.5	random	
158			lightly polished	roughly smoothed	3.5	nonrandom	
159			smoothed	roughly smoothed	3.5	nonrandom	
160			smoothed	obliquely scraped	3.5	random	
161			smoothed	Scraped	3.5	random	
162			smoothed	smoothed	3.5	random	
163			smoothed	obliquely scraped	2.5	random	
164			smoothed	smoothed	3.5	random	
165			smoothed	smoothed	3.5	random	
166			smoothed	obliquely scraped	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
167			smoothed	obliquely scraped	3.5	random	
168	Moderate	int.	smoothed	smoothed	3.5	random	
169			smoothed	obliquely scraped	3.5	random	
170	Moderate	int.	smoothed	scraped	3.5	nonrandom	
171			smoothed	smoothed	3.5	random	
172			smoothed	obliquely scraped	3.5	random	
173	Light	on int.	smoothed	obliquely scraped	3.5	random	
174	Moderate	exposed temper on int	smoothed	smoothed	3.5	random	
175	Moderate	exposed temper on int	smoothed	smoothed	3.5	random	
176			smoothed	smoothed	3.5	random	
177	Heavy	on int	smoothed	smoothed	3.5	random	
178			parallel scraped	obliquely scraped	3.5	random	
179			smoothed	smoothed	2.5	random	
180			smoothed	smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
181			smoothed	smoothed	3.5	random	
182			smoothed	smoothed	3.5	random	
183			smoothed	smoothed	2.5	random	
184			smoothed	smoothed	2.5	random	
185			smoothed	smoothed	3.5	random	
186			smoothed	smoothed	3.5	random	lip is rounded
187			smoothed	smoothed	3.5	random	lip is rounded
188			smoothed	obliquely scraped	3.5	random	
189			smoothed	smoothed	3.5	random	
190			smoothed	scraped	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
191			smoothed	smoothed	3.5	random	
192			smoothed	parallel scraped	2.5	random	
193	Light	int	smoothed	smoothed	3.5	random	
194			smoothed	smoothed	3.5	random	
195	Light	int	smoothed	smoothed	3.5	nonrandom	
196			smoothed	obliquely scraped	2.5	random	
197			smoothed	smoothed	2.5	random	
198			smoothed	smoothed	3.5	random	
199			smoothed	smoothed	3.5	random	
201			smoothed	smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
202	Light	int	smoothed	smoothed	3.5	random	
203	Light	int	parallel scraped	obliquely scraped	3.5	random	
204	Light	int	smoothed	smoothed	2.5	random	
205			smoothed	smoothed	3.5	nonrandom	
206			parallel scraped	obliquely scraped	3.5	random	
207			smoothed	scraped	3.5	nonrandom	
208	Moderate	int	smoothed	smoothed	2.5	nonrandom	
209			smoothed	smoothed	3.5	random	
210			smoothed	smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
211			parallel scraped	lightly scraped	3.5	random	
212			parallel scraped	smoothed	3.5	random	
213			smoothed	smoothed	3.5	random	
214			smoothed	smoothed	3.5	random	
215			obliquely scraped	parallel scraped	3.5	random	
216			smoothed	roughly smoothed	2.5	random	
217	Moderate	int	smoothed	smoothed	2.5	nonrandom	
218			parallel scraped	smoothed	3.5	nonrandom	
219			smoothed	smoothed	3.5	nonrandom	
220			parallel scraped	obliquely scraped	3.5	random	
221	Light	int.	smoothed	smoothed	2.5	nonrandom	
222			smoothed	smoothed	3.5	nonrandom	
223			smoothed	obliquely scraped	2.5	random	two sherds glued together
224	Light	on ext. base	smoothed	roughly smoothed	3.5	nonrandom	three sherds glued together. Actually base and body sherds. Vessel was probably hemespherical with a flattened bottom

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
225	Light	on int.	smoothed	roughly smoothed	2.5	random	four sherds glued together
226			smoothed	roughly smoothed	2.5	random	two sherds glued together
227	Light	on int	smoothed	roughly smoothed	2.5	random	three sherds glued together
228			smoothed	roughly smoothed	2.5	random	
229	Light	int	smoothed	roughly smoothed	2.5	random	three sherds glued together
230			smoothed	roughly smoothed	2.5	nonrandom	rim is incurving but straight
231	Moderate	int	smoothed	roughly smoothed	2.5	random	13 sherds glued together
232	Light	in one patch on int	smoothed	roughly smoothed	2.5	random	11 sherds glued together. Base is hemispherical.
233	none		smoothed	smoothed	2.5	random	
234	none		parallel scraped	smoothed	2.5	random	
235	none		parallel scraped	smoothed	2.5	random	
236	none		obliquely scraped	smoothed	3.5	random	
237	Light	int	parallel scraped	obliquely scraped	2.5	random	
238			smoothed	smoothed	2.5	nonrandom	
239			parallel scraped	smoothed	3.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
240			parallel scraped	smoothed	2.5	random	
241			parallel scraped	smoothed	2.5	random	
242	Light	int	parallel scraped	smoothed	2.5	random	
243	Light	int	smoothed	parallel scraped	3.5	random	
244			smoothed	scraped	2.5	random	
245			smoothed	scraped	3.5	random	
246	Light	int	smoothed	scraped	3.5	random	
247	Light	int	smoothed	scraped	2.5	random	
248	Light	int	smoothed	parallel scraped	2.5	random	
249			parallel scraped	obliquely scraped	2.5	random	
250			smoothed	obliquely scraped	2.5	random	
251			parallel scraped	smoothed	2.5	random	
252			parallel scraped	smoothed	2.5	nonrandom	
253			parallel scraped	obliquely scraped	2.5	random	
254			parallel scraped	obliquely scraped	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
255	Light	int	smoothed	obliquely scraped	2.5	random	
256	Light	int	smoothed	obliquely scraped	3.5	random	
257			parallel scraped	smoothed	2.5	nonrandom	
258	Moderate	int	parallel scraped	obliquely scraped	2.5	random	
259			parallel scraped	smoothed	2.5	random	
260			parallel scraped	parallel scraped	2.5	random	
261			obliquely scraped	obliquely scraped	2.5	random	
262			smoothed	smoothed	2.5	random	
263	Light	int	parallel scraped	obliquely scraped	3.5	random	
264	Light	spalling on ext.- surface popped off; pitting on int.	smoothed	obliquely scraped	2.5	nonrandom	
265			parallel scraped	smoothed	2.5	nonrandom	
266			Smoothed	smoothed	2.5	random	
267			smoothed	obliquely scraped	2.5	random	
268			smoothed	parallel scraped	2.5	random	

Sherd Number	Amount of Attrition	AttritionDescription/ Location	Int surface	Ext surface	Hardness	Breakage Pattern	Additional comments
269			smoothed	obliquely scraped	2.5	random	
270			parallel scraped	smoothed	2.5	random	
271			smoothed	obliquely scraped	2.5	random	
272			parallel scraped	smoothed	3.5	random	

Table 5. Jemez hearth data.

Site #	Feature #	Type	Length	Width	Depth	Shape	Associated Artifacts	Notes
LA123	56 excavated	hearth	11.75	7.5	4	rectangular		all slab lined-most on all sides and bottom-few with no bottom, others with one side missing; placements were usually in center of structure, proximal to the deflector, and in a corner prosimal to and paralleling one wall. All paralleled the walls. Two firepits had "firedogs"-long ovate or cylindrical stones which rest upright with the lower ends furied in the floor plaster and perhaps 2 or 3 along each side of the pit.
LA123	measurement range	hearth	31	18	16	rectangular		
LA69562	2	hearth	74	30	25	rectangular		slab lined on all sides and bottom, located at center of north wall of southern room of structure (dividing wall of structure) (<30cm from wall)
LA69563	2	hearth	65	45	20	rectangular	obs. Nodule, jemez b/w sherd; 4 cupules of zea mays	slab lined on all sides and bottom, located center of the southern half of structure (free standing ~1m from southern wall), remnants of plaster found b/t slabs and in fill
LA102677	2	hearth	67	48	17	rectangular		slab lined on all sides and bottom located in western room of structure, adjacent to the northern end of the interior dividing wall (~20cm from wall)
LA102677	5	hearth	75	44	26	rectangular		slab lined on all sides but bottom compact native soil. Located along south wall of east room <30cm from wall
LA24595		hearth	50	50		rectangular	charcoal, one sherd, corn cob fragment	northeast corner of the room
LA24925	Room 1/Feature1	hearth	54	31	8	rectangular		slablined

Site #	Feature #	Type	Length	Width	Depth	Shape	Associated Artifacts	Notes
LA24925	Room 2/ Feature 1	hearth	45	33	10	rectangular	gray ashy soil	slab lined
LA24925	Room 2/ Feature 2	hearth	43	30	12	rectangular	gray ashy soil	slab lined
LA24926		hearth	50	30		rectangular		slab lined on south and west sides and bottom, east abuts wall
LA38962	1.1	hearth	63.5	51.8	15.2	rectangular	plastered bottom (previous floor)	in room 1; partially slab lined
LA38962	1.2	hearth	61	45.8	15.2	rectangular	plastered bottom (previous floor)	in room 1; partially slab lined
LA38962	1.3	hearth	51.8	30.5	14	rectangular	small quantity of ash	in room 1, slab lined on bottom, west and south
LA38962	5.1	hearth	66.1	40.6	30.5	rectangular	ash, charcoal, and sherds	in room 5;
LA38962	Y.1	hearth	91.4	73.7	20.2	rectangular	ash	in yard on unplastered surface; floored and rimmed with small stones, slabs, and plaster; outside-larger-maybe communal???
LA38962	Y.2	hearth	82.4		7.6	circular	ash	in yard on unplastered surface; floored and rimmed with small stones, slabs, and plaster; outside-larger-maybe communal???
LA38962	Y.3	hearth	45.7		7.6	circular	ash	in yard on unplastered surface; floored and rimmed with small stones, slabs, and plaster; outside-larger-maybe communal???
			61.556	41.671	16.307			
			18.899	15.306	7.2603			
LA66859	1b	hearth	22	20	6	circular	pine wood charcoal, goosefoot seeds,	semicircular rock alignment on eastern side-hearth deflector- *******in Tewan or Genizaro structure-site located to the north of Caldera and east of Canones.

Table 6. Navajo hearth data.

Site #	Feature #	Type	Diam	2nd dimesion	Depth	Shape	Associated Artifacts	Notes
LA115767	6	hearth	48		16	basin	5 charred pine seed frags, 3 charred bone frags	for processing pine nuts?
LA115767	9	hearth	58		12	basin	charred pine seeds, pieces of calcined bone	for processing pine nuts?
LA115776	7	thermal pit	28		4	unk	pieces of charred vitrified tissue	
LA16151	1	hearth	44		12	basin	flakes, several sherds, 2 gs frags, chenopod, juniper seeds, grass stems, amaranth seeds, corn kernal frags	in Structure 1
LA16151	6	hearth	55		8	basin	cheno-am and juniper seeds, possible corn kernel and cupule fragments; 2 flake frags	within Structure 2
LA16153	1	hearth	75	63	8	oval basin	charcoal and cheno-am seeds	Cabezon Phase-Navajo Gray at site
LA16257	6	hearth	68		10	basin	18 debitage, 1 core, 8 faunal bones(1burned med to lg mammal long bone, 3burned indet. Size, 1 unburned small to med mammal long bone, 3 unburned indet. Animal.	top been removed from previous road construction
LA16257	8	hearth	40		7	unk	4 debitage frags, 1 arrowpt. Near feature	top been removed from previous road construction
LA16257	12	hearth	60		5	basin	28 debitage, 1 core	top been removed from previous road construction
LA16257	22	hearth	60		4	unk	1 obs flake	extremely shallow and somewhat eroded
LA16257	59	hearth	70		10	basin	burned sandstone slabs, 2 bone frags(1 lg mammal, 1 indet., FCR	

Site #	Feature #	Type	Diam	2nd dimesion	Depth	Shape	Associated Artifacts	Notes
LA16257	74	hearth	50		5	unk	1 dinetah gray sherd, 3 deb frags, 8 burned lg animal bone (one w/ cut marks), 2 broken burned bone tools (1-metapodial frag w/polishing along groove, 2-shaped long bone frag w/ polish and striations: bone awl?)	surface disturbed by small rill running through feature resulting in wash
LA49498	cluster 1	hearth	80		7	basin		center of structure in cluster 1
LA49498	cluster 2	hearth	50	45	8	oblong basin		part of cluster 2-also pot drop within cluster-no apparent structure-activity area
LA61828	4a	hearth	100		10	basin	18 La Plata Gray sherds, charcoal, 84 pieces of burned rock	this and the following three are superimposed hearths, all rock were cobbles and possibly used as boiling stones.; possibly used for parching goosefoot (one seed found)
LA61828	4b	hearth	70		9	basin		
LA61828	4c	hearth	40		5	basin		
LA61828	4d	hearth	60		4	lenticular		
LA61828	7	hearth	20		8	basin	charred seed frag (unident.); 1 LaPlata Gray sherd	located within structure 1(, Feat.3); no lining or prep of surface;
LA61838	5a	hearth	50		5	basin	juniper charcoal and charred juniper seed	located within structure 2 dated AD1640-1700

Site #	Feature #	Type	Diam	2nd dimesion	Depth	Shape	Associated Artifacts	Notes
LA61838	7a	hearth	84		6	basin	juniper charcoal	within activity area adjacent to structure 2- most likely outside activity area with Structre 2 an inside activty area; excavated prehistorically; c14 AD1415-1634
LA61838	7b	warming pit	24	22	14	basin	charred pinyon and juniper, 4 ind. Mammal bones	within activity area adjacent to structure 2- most likely outside activity area with Structre 2 an inside activty area; excavated prehistorically; dendro-AD1564 or later
LA61848	2	hearth	110		5	lenticular	juniper charcoal, charred juniper wood, uncharred goosefoot seds, 2 unident. Mammal bone frags, 5 debitage, core, basin metate frag, 18 La Plata gray sherds, 1 pIII whiteware sherd, ceramic bead, FCR	Locus A; SW of structure 1; outdoor activity area
LA61848	4	hearth	95		9.5	basin	charcoal, saltbush seeds, uncharred goosefoot seeds, burned rocks, 3 debitage	Locus A; SW of structure 1; outdoor activity area
LA61848	8	hearth	80		16	basin	charcoal, charred juniper leaf, 18 charred goosefoot seeds	Block F
LA61852	1a	hearth	44		8	basin	unident. Charcoal, charred juniper seed frags, flake frag	within Structure 1

Site #	Feature #	Type	Diam	2nd dimesion	Depth	Shape	Associated Artifacts	Notes
LA61852	4a	hearth	109	83	12	basin	excavated into the floor of F4, slab-lined, carbonized log fragments, charred juniper seed, burned sandstone	in Structure 2
LA61852	5a	hearth	72		7	basin	charcoal, FCR	in Structure 3
LA61852	7	hearth	52		4	basin	charcoal, core flake, biface flake, Dinetah gray sherd, cottontail bone, FCR	block B-extramural area
LA61852	8	hearth	80	70	2	lenticular	charcoal, two uncharred goosefoot seeds, 15 FCR	block B-extramural area
LA61852	9	hearth	80	70	6	basin	charcoal, charred juniper stick and seed, core flake, 2 cottontail bones, 26 FCR	block B-extramural area
LA61852	13	roasting pit	80	63	12	basin	slab-lined pit, charcoal, charred juniper seeds, core flake, med-lg mammal bone frags, burned sandstone.	Block E, around Structure 3
LA61852	5b	warming pit	35	33	16	basin	charcoal, charred juniper seeds	in Structure 3
LA61852	5c	warming pit	32	30	8	basin	juniper charcoal, core flake, FCR	in Structure 3
LA71263		hearth	38	34	50	basin	three Dinetah Gray sherds, 81 lithic artifacts; sterile sand in bottom 20 cm.	In Structure; walls not smoothed; may have been used from heat treating lithics

Appendix B: Experimental Data

Table B1. Drop Test Results.

Vessel No.	Shape	height of drop	weight of ball	# of drops to crack	# of drops to fail	Comments
F2.N20	conical	1 m	22			nick occurred at 35 and continually increased in size and depth, but no failure after 300 hits
F2.J4	round	1 m	22	68	70	
F2.N9	conical	1 m	22			nick occurred at 12 and continually increased in size and depth, but no failure after 300 hits
F2.J15	round	1 m	22			nick occurred at 27 and continually increased in size and depth, but no failure after 200 hits.
F2.N6	conical	0.5	80			no fail after 200 hits
F2.J25	round	0.5	80	4	9	pitted at 4, hole through at 9 (similar to "kill hole")
F2.N8	conical	0.5	80			hit 300 times at 50 cm and 200 times at 75 cm and still did not fail. Large chips off of base and around (almost concoidal in appearance) but no thorough failure.
F2.J6	round	0.75	80	12	12	cracked into 3 pieces
F2.J26	round	0.75	80	3	4	cracked into 3 pieces
F2.J19	round	0.75	80	3	4	cracked from impact point to rim on one side at 3; failed into 3 pieces
F2.J29	round	0.75	80		4	cracking before failure was not visible macroscopically, failed in two pieces
F2.J14	round	0.75	80	2	3	failed in three pieces although neck and rim remained intact
F2.J28	round	0.75	80	8	9	nick appeared at 3, crack at 8 from impact to rim on one side, failed into two pieces with neck and rim intact
F2.J30	round	0.75	80		5	small indent at 3, failed at five with some cracks not all the way through (2 pieces)
F2.J22	round	0.75	80	1	2	failed in four pieces
F2.J1	round	0.75	80	2	3	failed into two pieces rim and neck intact
F2.J5	round	0.75	80	2	3	failed into two pieces
F2.J17	round	0.75	80	7	8	nick at 3, failed in 3 pieces although rim and neck intact
F2.J12	round	0.75	80	5	6	nick at 2, failed in 2 pieces
F2.J16	round	0.75	80			hit 200 times without fail, very thick pot-throw out?
F2.J11	round	0.75	80	3	4	cracking on interior but just nick on exterior at 3, failed with kill hole
F2.J13	round	0.75	80	14	15	failed in three pieces
F2.J18	round	0.75	80		3	failed in three pieces
F2.N32	conical	0.75	80			nick appeared at 68 and got substantially larger but no failure at 300 hits

Vessel No.	Shape	height of drop	weight of ball	# of drops to crack	# of drops to fail	Comments
F2.N23	conical	0.75	80			small nick at 12, large "flake" off one edge of based into body at 111. a second connected flake at 120. no fail at 200
F2.N25	conical	0.75	80			nick appeared at 36, no fail at 200
F2.N15	conical	0.75	80			nick appeared at 34, no fail at 200
F2.N27	conical	0.75	80			nick appeared at 12, no fail at 200
F2.N26	conical	0.75	80			nick appeared at 4, no fail at 200
F2.N18	conical	0.75	80			nick at 22, no fail at 200
F2.N28	conical	0.75	80			nick at 25, no fail at 200
F2.N17	conical	0.75	80			nick at 16, no fail at 200
F2.N30	conical	0.75	80			nick at 28, no fail at 200
F2.N31	conical	0.75	80			nick at 38, no fail at 200
F2.N24	conical	0.75	80			nick at 38, no fail at 200
F2.N3	conical	0.75	80			nick at 15, no fail at 200
F2.N4	conical	0.75	80			nick at 49, no fail at 200
F2.N19	conical	1	vessel		6	
F2.N21	conical	1	vessel		4	
F2.N22	conical	1	vessel		1	
F2.N13	conical	1	vessel		2	
F2.N2	conical	1	vessel		1	
F2.J2	round	1	vessel		1	
F2.J9	round	1	vessel		1	
F2.J7	round	1	vessel		1	
F2.J23	round	1	vessel		1	
F2.J27	round	1	vessel		1	
F2.N1	conical	0.75	vessel	8	9	
F2.N5	conical	0.75	vessel	15	16	
F2.N7	conical	0.75	vessel	5	6	
F2.N10	conical	0.75	vessel		5	
F2.N11	conical	0.75	vessel	5	6	
F2.J3	round	0.75	vessel		1	
F2.J8	round	0.75	vessel		1	
F2.J10	round	0.75	vessel		1	
F2.J20	round	0.75	vessel		1	
F2.J24	round	0.75	vessel		1	

Table B2. Side Impact Strength Results; fixed angle.

Vessel No	Shape	Angle	Period	#hits at to crack	#hits to failure	comments
F1.N26	conical	20	2.008	---	----	8 hits-no cracks-fell from mount, broke from force on cement
F1.N30	conical	20	2.002	----	----	maxed out at 100 hits-slight chipping and abrasion increases with #of hits but only slightly- no cracking and no failure.
F1.N7	conical	20	2.001	1	3	vertical crack from rim through impact point into base on first hit (put on new release string right before test)
F1.N19	conical	20	2.006	54	57	vertical crack from impact point up to rim and at135deg and 235deg from rim, crack propagation with continuing hits, failure at 57(135deg crack continued in arc up to rim.
F1.N18	conical	20	2.009	----	----	maxed out at 100 hits-slight chipping and abrasion increases with #of hits but only slightly- no cracking and no failure.
F1.N5	conical	20	2.003	12	13	vertical crack from rim through impact point into base on 12th hit; total failure at 13
F1.N1	conical	25	2.004	1	3	
F1.N3	conical	25	2.012	1	2	
F1.N4	conical	25	1.999	9	10	
F1.N6	conical	25	2.001	1	2	
F1.N13	conical	25	2.007	1	2	
F1.N20	conical	25	2.005	1	2	
F1.N23	conical	25	1.903	1	2	
F1.N27	conical	25	2.005		2	
F1.N29	conical	25	2.003	1	2	
F1.J3*	round	25	1.991			at 20 no fail after 100 hits
F1.J7	round	25	1.986	3	5	
F1.J8	round	25	1.987		2	
F1.J9	round	25	1.99	6	8	
F1.J10	round	25	1.986	1	2	
F1.J1	round	25	1.987		16	
F1.J12	round	25	1.984	3	4	
F1.J14	round	25	1.989	1	2	
F1.J15	round	25	1.992	6	7	
F1.J18	round	25	1.977	3	4	
F1.J29	round	25	1.99		3	

Table B3. Side Impact Strength; increasing angle test.

Vessel No	Shape	Average Period	Drop #	Angle (in degrees)	Effect on vessel
F1.J26	round	2.009	1	10	no damage
	round		2	15	no damage
	round		3	20	no damage
	round		4	25	vertical crack from just above base to rim at impact point
	round		5	30	crack all the way from rim to rim but off center of the base and second crack system initiating from impact point at 135 degrees from rim
	round		6	35	total failure at multiple fractures
F1.J22	round	1.997	1	10	no damage
	round		2	15	minimal abrasion
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	crack system initiating from impact point but not failure
	round		6	35	total failure at multiple fractures
F1.J13	round	1.992	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	light crack system initiating from impact point
	round		5	30	total failure along one off center crack from rim to rim
F1.J31	round	1.997	1	10	no damage
	round		2	15	abrasion
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	total failure at multiple fractures
F1.J19	round	2.008	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	crack off center from rim to rim (approximately 1/4 of vessel) failure but remains in instrument mount
	round		5	30	multiple crack systems
	round		6	35	total failure at multiple fractures
F1.J17	round	2	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	pot dropped from mount with no additional damage
	round		4	25	no additional damage
	round		5	30	crack from rim through impact point into base but not all the way through
	round		6	35	total failure at multiple fractures
F1.J25	round	2.006	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	crack system from rim into base but not all the way through
	round		5	30	total failure at multiple fractures
F1.J28	round	2	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage

Vessel No	Shape	Average Period	Drop #	Angle (in degrees)	Effect on vessel
	round		4	25	no additional damage
	round		5	30	crack from rim to rim and some oblique cracks. FAILURE but remains in instrument mount
	round		6	35	total failure at multiple fractures
F1.J20	round	2.002	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	vessel dropped out of mount, but no additional damage
	round		5	30	total failure with one crack running from rim to rim just off center
F1.J30	round	2.003	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	total failure-crack from rim to rim off center
F1.J27	round	2	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	total failure-crack from rim to rim -only ~1/3 of vessel cracked off
F1.J16	round	1.996	1	10	abrasion
	round		2	15	no additional damage
	round		3	20	vessel dropped out of mount, but no additional damage
	round		4	25	no additional damage
	round		5	30	total failure-crack from rim to rim -only ~1/3 of vessel cracked off
F1.J24	round	1.998	1	10	no damage
	round		2	15	abrasion
	round		3	20	no additional damage
	round		4	25	vessel dropped out of mount, but no additional damage
	round		5	30	cracked but intact
	round		6	35	total failure with multiple fractures
F1.J21	round	2.008	1	10	no damage
	round		2	15	abrasion
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	total failure-crack from rim to rim -only ~1/3 of vessel cracked off
F1.J23	round	2.001	1	10	no damage
	round		2	15	abrasion
	round		3	20	no additional damage
	round		4	25	no additional damage
	round		5	30	vertical crack from just above base to rim at impact point
	round		6	35	total failure at multiple fractures
F1.N11	conical	2.013	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion

Vessel No	Shape	Average Period	Drop #	Angle (in degrees)	Effect on vessel
	conical		4	25	vertical crack from rim above impact point following through off center of base but not complete failure
	conical		5	30	total failure with multiple fractures
F1.N9	conical	2.032	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	more abrasion
	conical		5	30	total failure along one off center crack from rim to rim
F1.N25	conical	2.024	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	more abrasion
	conical		5	30	total failure with multiple fractures
F1.N14	conical	2.024	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	vertical crack from rim above impact point following through off center of base but not complete failure
	conical		5	30	total failiure with multiple fractures
F1.N15	conical	2.009	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	Failure although still in mount, crack from rim to rim just through the base but off center
F1.N24	conical	2.017	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	small chip from rim
	conical		4	25	crack system initiating from impact point-one to rim and into side of base, one oblique to rim
	conical		5	30	total failure with multiple fractures
F1.N2	conical	2.014	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	crack system initiating from impact point-one to rim and into side of base, one oblique to rim
	conical		5	30	total failure with multiple fractures
F1.N8	conical	2.014	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	crack system initiating from impact point-one to rim and into side of base, one oblique to rim
	conical		5	30	total failure with multiple fractures
F1.N12	conical	2.023	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	more abrasion
	conical		5	30	total failure with multiple fractures
F1.N28	conical	2.018	1	10	abrasion

Vessel No	Shape	Average Period	Drop #	Angle (in degrees)	Effect on vessel
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	more abrasion
	conical		5	30	total failure with multiple fractures
F1.N21	conical	2.018	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	vertical crack from rim above impact point following through off center of base but not complete failure
	conical		4	25	total failure
F1.N22	conical	2.011	1	10	minimal abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	vertical crack from rim above impact point following through off center of base but not complete failure
	conical		5	30	total failure with multiple fractures
F1.N17	conical	2.004	1	10	minimal abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	vertical crack from rim above impact point following through off center of base but not complete failure
	conical		5	30	total failure with multiple fractures
F1.N10	conical	2.01	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	total failure with multiple fractures
F1.N16	conical	2.011	1	10	abrasion
	conical		2	15	more abrasion
	conical		3	20	more abrasion
	conical		4	25	total failure from rim to rim-one crack just off center of base

Table B.4. Thermal Test Results.

Vessel No.	Type	Height	Weight	Volume (ml)	Thickness	Boiling Time	avg flame temp	avg boil temp
J.F3.1	Jemez	10.7	516	950	5.2533333	493.83333	435.64	93.11
J.F3.5	Jemez	10.7	504	1050	5.77	765	476.17	92.68
J.F3.7	Jemez	11.3	508	1100	5.4516667	643.8	449.3	90.98
J.F3.8	Jemez	11	576	950	6.1983333	546.1	455.25	93.03
J.F3.12	Jemez	11.3	598	1000	6.2516667	442	416.116	92.79
J.F3.15	Jemez	10.5	562	900	6.225	297	334.16	92.79
J.F3.17	Jemez	11	640	900	6.555	0	356.59	
J.F3.23	Jemez	10.7	568	950	6.2983333	527.4	415.55	92.31
J.F3.28	Jemez	11.2	500	1000	5.105	457.5	420.74	92.19
J.F3.31	Jemez	10.9	588	950	6.475	686.9	442.61	92.32
N.F3.2	Navajo	16.3	564	1000	5.5183333	495.1	426.41	91.48
N.F3.3	Navajo	16.6	574	1000	5.8183333	469.8	405.96	91.35
N.F3.5	Navajo	17.1	580	1050	5.7066667	466.9	404.7	91.58
N.F3.6	Navajo	16.2	640	900	6.6333333	465.3	420.66	91.89
N.F3.9	Navajo	16.4	596	950	5.7666667	482.33333	380.71	90.96
N.F3.16	Navajo	15.9	486	900	4.67	382	388.1	90.34
N.F3.19	Navajo	16.5	488	950	4.8083333	477.5	411.64	90.67
N.F3.24	Navajo	15.8	454	925	4.5333333	356	394.08	90.52
N.F3.27	Navajo	15.7	444	950	4.465	463	401.61	90.89
N.F3.29	Navajo	15.9	494	900	4.9566667	456.7	430.17	90.69