AN EVALUATION OF ANTELOPE CREEK PHASE INTERACTION USING INAA

THESIS

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AN EVALUATION OF ANTELOPE CREEK PHASE INTERACTION USING INAA

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DEDICATION

I dedicate this document to Neil Young and Gooseberry Pie.

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ABSTRACT

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Instrumental Neutron Activation Analysis (INAA) chemical analysis is used to determine ceramic production zones of Antelope Creek phase sites (A.D. 1200-1500). 41PT109, Landergin Mesa, and Alibates Ruin 28 provide samples from different architectural phases and population densities. The sherds recovered were submitted for INAA and data were used to examine ceramic manufacturing zones. This was then applied to help develop models to explain the movement of local materials within the Antelope Creek Borger Cordmarked ceramic type.

CHAPTER I

INTRODUCTION

The Antelope Creek phase refers to a group of Late Prehistoric Village occupations in the Texas and Oklahoma panhandles that generally dates from A.D. 1200 to 1500. Around A.D. 1200 settlements appeared rapidly on the Southern High Plain and seem to have been fairly stable until the abandonment of the area 300 years later (Brosowske 2005:94). The actual cause of abandonment is unknown, but was thought to be caused by environmental instability and possible threat from other Southern Plains groups (Lintz 1984:340). Generally these sites have similar architectural construction patterns and methods. The structures are pueblo-like, contiguous and isolated roomed buildings with vertical flagstone walls. The number of buildings and the number of rooms within each building varies through time. Large contiguous room villages are generally thought to be earlier (AD 1200 – 1350) than the isolated farmsteads, which date to AD 1350 – 1500 (Brooks 2004; Lintz 1986:29).

The Antelope Creek phase attracted many archaeologists since the early twentieth century (see Ererly 1907; Holden 1929, 1930; Studer 1931; Krieger 1946; Baker and Baker 2000). Initial interest in the area was to link the Antelope Creek Phase to their neighbors in the Southwestern United States. The presence of Southwestern trade goods coupled with a similar architectural style has caused some to trace the origins of Antelope

Creek people to the Southwest (Moorehead 1921). Studer referred to the phase as the "Post Basketmaker culture" and as the "Texas Panhandle Pueblo Culture" (Studer 1931, 1952, 1955). A direct lineage between the two areas was disproved and general archaeological interest in the area waned after the 1950's.

The Antelope Creek people had migrated from the Canadian River system before historic contact. The phase generally dates from A.D. 1200 to 1500 and sites are located in the Texas and Oklahoma panhandles. The architecture and evidence of farming suggests the population was fairly sedentary. The food sources were primarily domestic plants, including maze, subsidized by hunting. During this period of time, the Late Prehistoric differ from other cultural manifestations found along river systems in Texas, Oklahoma, and Kansas (Figure 1). The Antelope Creek Phase differs from cultural manifestations found before, during, and after A.D.1200 – 1500. The earlier Palo Duro and Lake Creek/ Plains Woodland occupations have different architectural styles and different ceramic types (Campbell 1976:109; Gunnerson 1987:126). The Buried City complex is contemporaneous and is found within the geographic span of Antelope Creek (Bousman and Weinstein 2004). There are many similarities between the two groups, but the differences are quite great. Buried City structures are very similar to those found in the Antelope Creek area, but are generally larger (Brosowske 2005:126). Another difference is the type of ceramics. Buried City ceramics are decorated while Antelope Creek ceramics are not. The cultures that postdate Antelope Creek, Tierra Blanca and Garza phases, also differ the architecture and ceramic assemblages.

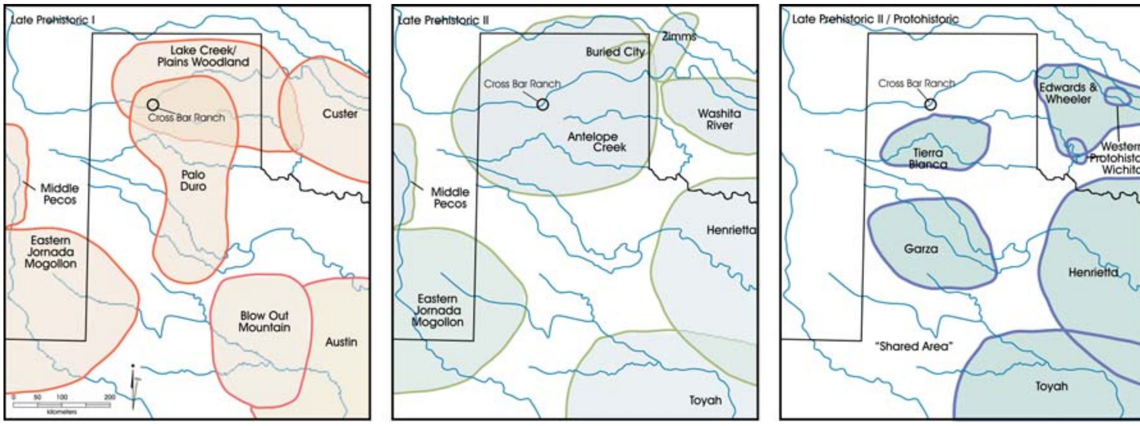

Figure 1. Map of Antelope Creek Phase and Neighboring Affiliations. (Bousman and Weinstein 2005)

The Antelope Creek Phases is unique from other phases based on architecture and the artifact assemblages, specifically ceramics. Antelope Creek Phase structures are semi-subterranean pueblo-like structures that range in size and function. There are large contiguous room structures and single room habitation structures and also smaller features that were used for storage. Another identifying feature of the phase is Alibates flint, the primary lithic material used. Alibates flint is a high quality silicified dolomite, which is usually banded in red, brown, and purple. This lithic material comprises nearly 95% of the Antelope Creek lithic assemblage (Baker and Baker 2000:83). Alibates National Monument near Fritch, Texas has preserved the quarries. The artifact assemblages are also diagnostic of the phase. Typical artifacts include the diamond-beveled knives, scapula bone hoes, and ceramics. The ceramics are typically Borger Cordmarked utilitarian ceramic cooking pots (Figure 2).

The Antelope Creek Phase, the environment, the artifact assemblage, and Borger Cordmarked ceramics are topic discussed further in Chapter Two.

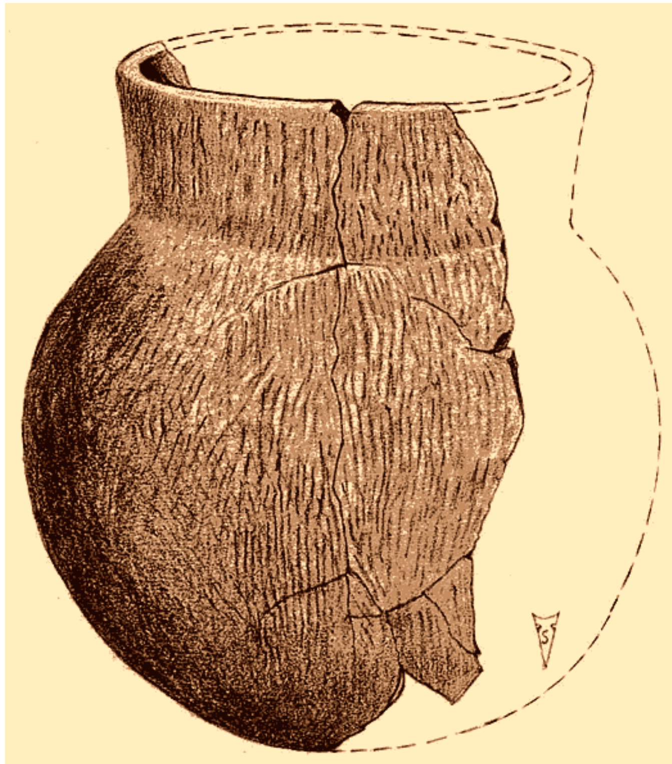

Figure 2. Struder's drawing of a typical Borger Cordmarked vessel. Image from Texas Beyond History 2007.

Borger Cordmarked ceramics were sampled using instrumental neutron activation analysis (INAA) to determine the chemical composition of a limited sample of ceramics from 41TP109, Landergin Mesa, and Alibates Ruin 28. An overview of each of these sites has been provided in Chapter Three.

Chapter Four describes the research questions and hypothesis, methodology of sample selection and the process of instrumental neutron activation analysis. Twenty-five sherds from each site and fifteen clay-sourcing/temper-sourcing samples were selected to determine production zones and trade networks within the sample of Antelope Creek Phase sites. The sherds were processed and irradiated at the University of Missouri Research Reactor (MURR).

The results of INAA are provided in Chapter Five. Cluster analysis isolated five distinct ceramic groups. Each group, the samples contained, and implications are the data detailed.

Chapter Six includes the conclusions and suggestions for possible future research. Appendix A is the final groupings, as assigned in this project. The correlation of sites and samples to the analytical identification number (ANID) is included in Appendix B. Appendix C is the raw data from the INAA as measured by MURR. Appendix D is the analysis preformed by Christopher Lintz on the ceramics from 41PT109 used in this study and the analysis from Landergin Mesa, and Alibates Ruin 28. This appendix includes ceramics context, dimension, color, and provenience.

CHAPTER II

ANTELOPE CREEK PHASE OVERVIEW (A.D. 1200-1500)

The Antelope Creek Phase refers to a group of Late Prehistoric Village occupations on the Southern High Plains in the Texas and Oklahoma panhandles. This phase has been dated to A.D. 1200 -1500 using a variety absolute dating techniques (Lintz 1986:30). Antelope Creek Phase sites are commonly located atop terraces near main waterways (Lintz 1986:250). Generally these sites have similar architectural construction patterns and techniques. The structures are pueblo-like, contiguous roomed buildings or isolated structures with vertical flagstone walls. The number of room within each building varies through time. Large contiguous room villages are generally thought to be earlier (A.D. 1200 – 1350) than sites dominated by isolated structures, which date to A.D. 1350 – 1500 (Lintz 1986:19).

Geology

The Antelope Creek Phase is on the Southern High Plains along the Canadian River. The area south of the Canadian River is known as the Staked Plains or the Llano Estacado. The Llano Estacado is an area characterized by steep escarpments that are slowly eroding (Sellards et al. 1990:771). Currently the Canadian River does not have flowing water, except during periods of heavy rain. The base of the Llano Estacado formation is Triassic red beds from a marine environment formed approximately 230 million years ago (Sellards et al. 1990:240). During the Permian Period Alibates silicified dolomite, other knappable material, and ingenuous rocks formed. The next geological deposition occurs in the Cretaceous period. This Jurassic deposits in the geologic sequence is represented by an unconformity that is found across the Llano Estacado (Sellards et al. 1990:239,248). Approximately 65 million years ago, coinciding with the mass extinction of the dinosaurs and the evolution of mammals, the Llano Estacado was developing (Sellards et al. 1990:767). Aeolian, eolian, and collivial processes eroded the eastern slopes of the Rocky Mountains. The material was then transported by wind and water to the east creating the Ogallala Formation. The Ogallala Formation extends northward into South Dakota, as far west as Wyoming, and underlies much of Nebraska (Figure 3).

Figure 3. Map of Ogallala formation and Aquifer. (North Plains Ground Water District 2006)

Water is trapped within the clays, sands, silts, and gravels of the Ogallala Formation to form the Ogallala Aquifer. Over time and due to pedogenetic processes the calcium carbonate leached from the ancient soils to form an extension and thick pedo calcrete known as the Llano Estacado caprock. The caprock has served as an erosional barrier and preserves the softer sediments and soils below. The Ogallala Aquifer supplies most of the water used for modern irrigation in the Llano Estacado area and was thought that have natural springs flowing from the aquifer that may have attracted many prehistoric people (Couzzourt and Schmidt-Couzzart 1996:8; Lintz 2003:23; Carlson 2005:102). It is suggested that the period of time corresponding to the onset of the Antelope Creek occupation was wetter than previous periods. This may have been why people were attracted to the area. During this time the Canadian River might have had flowing water (Lintz 1986:67).

Playa lakes and associated sand dune lunettes are common on the Llano Estacado. Radiocarbon dating of the lunette dunes suggests a chronology of deposition beginning around 25,000 and 15,000 B.P. (Holiday 1997:54). The Canadian River basin is comprised of Tertiary alluvial deposits (Pringle 1980). Typical topography of the area is rugged, with steep river terraces.

Environment, Flora, and Fauna

Presently the climate on the Southern High Plains is erratic. Periods of heavy rainfall are followed by drought (Etchieson and Couzzourt 1987:2-4). This directly affects the flora of the area (Figure 4). The area is mainly used for ranch land with intermittent agriculture areas. The growing season is 190-200 days per year. Flora is similar to the Kansas biotic area with more than four hundred native plant species (Blair 1950:110). Mixed prairie grasses and small trees are prominent. Short grasses aid in preservation of soils and sediments and would have been a primary food source for the large herds of buffalo (*Bison bison*) and pronghorn deer (*Antilocapra americana*). The common small trees, such as mesquite (*Prosopis glandulosa*), cholla (*Cylindropuntia acanthocarpa*), and yucca (*Yucca filamentosa*) may have served as an early wild food source (Weinstein 2005:12). The Antelope Creek Phase people exploited the bison and deer herds that were on the plains (Duffield 1970). Smaller animals, prairie dog (*Cynomys ludovicianous*) and jackrabbit (*Lepus californicus*) would also have been hunted (Weinstein 2005:13). The immediate river basin supports various omnivores such as opossums (*Odocoileus virginiana*) and beavers (*Castor canadensis*) and various aquatic species like turtles and fish.

Figure 4. Canadian River Basin. Canadian River basin after period of heavy rainfall in 2005. Photograph courtesy of Sonia Perez-Irvin.

Typically the Southern High Plains are a “marginal” area for corn cultivation, but the Antelope Creek Phase is known to have grown corn (Vehik 2002:39). Despite the presence of maize and horticultural activities at many sites, skeletal analysis suggests a diet high in wild C_4 grasses and not domesticated plants (Duncan 2002).

Architecture

Lintz divided Antelope Creek Phase architecture into three main categories based on analysis of twenty-eight Antelope Creek sites (1986:85-86). The first category consists of large contiguous room villages and is found earlier in the phase (A.D. 1200-1350). Examples of this architectural group can be found at Alibates Ruin 28 Unit I, Saddleback Ruin, and Black Dog Village. The second category is composed of isolated “homesteads.” These structures date to the latter part of the phase (A.D. 1350-1500). This type of structure can be found at Alibates Ruin 28, Unit II, and 41PT109. The third type consists of sites with structures that do not have a habitational function and are found equally across the phase. These are small isolated “field-hut” structures that typically are pits or storage rooms (Lintz 1986:85). The connection between earlier contiguous and later isolated room structures is unknown. Some have attributed the shift to an environmental change (Lintz 1986:19). Previous research of the area indicates a shift of population density, architectural style, and subsistence patterns around A.D. 1350 (Brooks 2004; Lintz 1986:243-244). Before this time, in the early phase, contiguous room structures forming large sites were common with a heavy reliance on bison as a food source (Brooks 2004). Around A.D. 1350, Lintz suggests that bison herds grew and were hunted more heavily. This, coupled with a warmer climate, limited the expansion of agricultural dependency (Lintz 1986: 243).

Regardless of the architectural category, the structures can be classified using eleven design and three miscellaneous “unit types” (Lintz 1986:87, Figure 5). The unit types were based on analysis of the structural design of excavated Antelope Creek structures. The most common design found at Antelope Creek Phase sites is the Unit type 1 (Lintz 1986:89). This study sampled ceramics found at type 1 and 2 habitation sites, and not at the “field-hut” type structures.

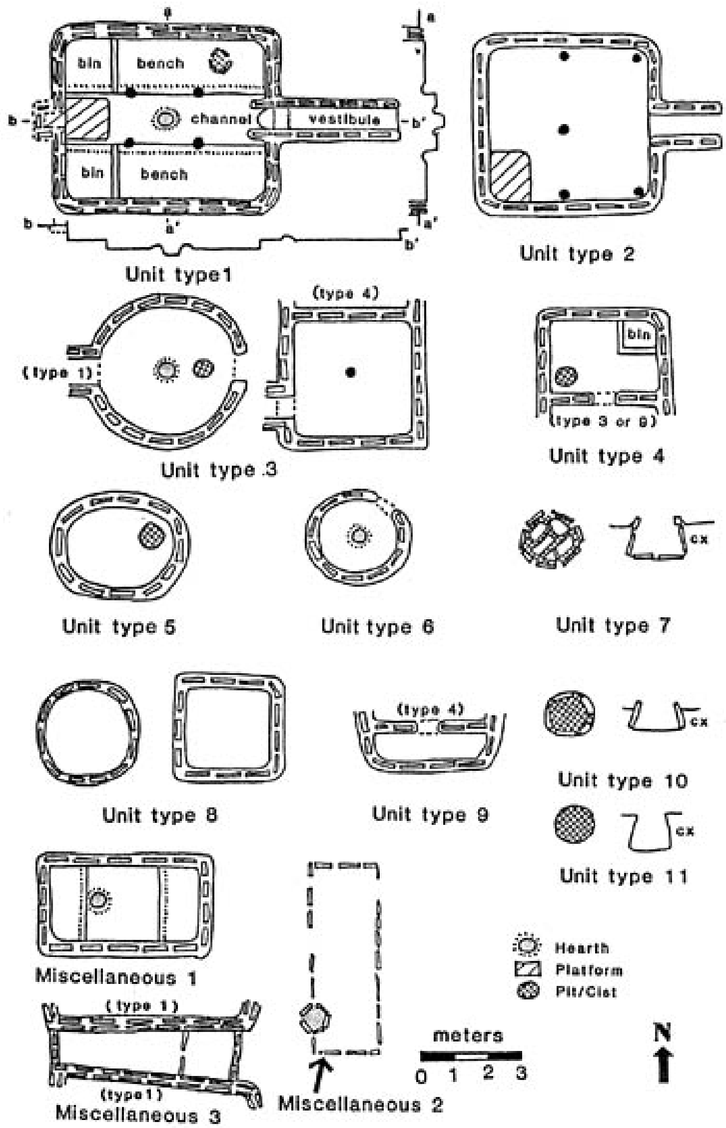

Figure 5. Antelope Creek Phase Architectural Types. (Lintz 1986:87)

Unit Type 1 and Unit Type 2 are considered habitational structures (Lintz 1986:106). Both types of structures are oriented with a crouched entry-tunnel to the east. Unit Type 1 has a central depressed channel that is flanked on the north and south by raised benches. Some excavations of this structure have exposed “altars” along the west wall. Lintz shows that altars are present in only 23 percent of the cases (1986:99). This many imply the feature is a temporal characteristic or, as Lintz suggests, the feature has not been properly identified and was thus destroyed during excavation (1986:99).

Large contiguous room villages are found at sites like Alibates Ruin 28 Unit I, Saddleback Ruin, and Black Dog Village. Lintz argues that the structures were built according to a “rigid” plan and not erected based on need (Lintz 1986:133). The main living spaces have been identified as unit type 1 and 2 (Lintz 1986:89, see Figure 5). Architectural units served as fire pits or storage areas. Lintz has identified six basic forms of aggregate sites (Lintz 1986:141). These sites typically have twenty or more habitational rooms and date to approximately A.D. 1200 – 1350.

Isolated homesteads are typically comprised of Type Unit 1 structures. These structures may be accompanied by other smaller pit or storage feature structures. This type of site is exampled by 41PT109 and the structures found at Alibates Ruin 28 Unit II. The architectural features found within type unit 1 in contiguous room villages are also found in the isolated structures

The construction of buildings is fairly consistent throughout the phase. Generally a site on a high terrace is chosen and the ground is prepared. Preparation usually consists of leveling of the area and the digging of a trench around the perimeter of the planned structure (Lintz 1986:91). Most are semi-subterranean and show signs builders trenches

(Lintz 1986:91). A builders trench aids in a structures stability. Flat native dolomite flagstones are placed vertically halfway into the trench for added structural support. Some of the structures show a double wall construction, where two sets of vertical flagstones are placed within the trench and the space between is filled with various debris (Green 1986:14). The single wall construction appears as consistent as the double wall (Lintz 1986: 91). There is often single and double wall construction within a site and at Black Dog Village archaeologists found evidence of single and double wall construction within an individual structure (Lintz 1986:112).

Burials

The burial practices of Antelope Creek people are relatively unknown and the known burials lack proper documentation (Lintz 1984:164). Early surveys in the area report cemeteries, but these have not been located. Many of the known burials were found within or near structures, but also at newly discovered cemeteries located 50 to 150 m from the living areas (Lintz 1986:175).

Typically a flexed body is placed in a shallow pit with no reference to direction (Lintz 1986:164&170). Some bodies were interred with grave goods, usually consisting of utilitarian local materials. The most common exotic grave goods are *olivella* shell beads, but also included Southwestern pottery, turquoise, and shell pendants (Lintz 1986:172). Burials suggest a sexual division of labor. Males are more commonly found with hunting accoutrements and females with horticultural items. Skeletal analysis shows no evidence of warfare (Lintz 1986:165). Mortuary data suggest that the Antelope Creek people were relatively egalitarian (Lintz 1086:176).

Artifact Assemblage

It is estimated that nearly one hundred and ten Antelope Creek homesteads have been identified. The characteristic architecture varies through time, but the artifact assemblage is more universal. The characteristic artifacts are projectile points, awls, diamond-beveled knives, bone/scapula digging implements, bone rasps and Borger Cordmarked ceramics.

The primary lithic material in this area is Alibates silicified dolomite. The material is brightly banded agatized flint that has been exploited by prehistoric people as early as 12,000 (National Parks Service 2004). The flint is high quality and requires no possessing, such as heat-treating, of any kind (Figure 6).

Figure 6. Alibates Silicified dolomite. Examples of color variation in Alibates Silicified dolomite. Image from Texas Beyond History 2007.

The tool assemblage indicates the need for generalized implements (Lintz 1986:35). This typically consists of projectile points, meat/hide processing implements, and horticulture tools. It was though that bone scapulas were used in horticultural activities, but due to the fragile nature of bone these tools may have been used in other ways (Brosowske 2005:98). The tool kit from this period indicates hunting subsidized by horticultural activities. Excavation of Antelope Creek trash middens and macrobotonical maize remains reinforce the conclusion. Many bison and pronghorn antelope remains have been excavated. The bones of these animals seem to have been split to extract marrow. Riverine species such as fish and turtle remains have also been recovered.

Borger Cordmarked Ceramics

Borger Cordmarked ceramics are found at Antelope Creek Phase villages. Early descriptions of Borger Cordmarked ceramics seem to emphasize a possible connection to the Southwest. The ceramics are described as being basket-like with a connection to the Basketmaker culture (Holden 1930:30; Studer 1931:71). Later it was remarked that the ceramics were “cord-paddled pottery (Wulfkuhle 1984:8). The vessels have been described as “thoroughly functional cooking pots” (Hughes 1984:74). The ceramics are globular in shape with a small opening and a high neck. The vessels are usually brown in color, but have been described as being black, gray, and orange (Hughes and Ellzey 1989:101). The vessels have been described as being undecorated, but as the type name suggests, the vessels have been paddled, or surface treated, with cord or smoothed-over cord imprints (Wulfkuhle 1984:17; Hughes and Ellzey 1989:104).

These sherds typically range from 5 to 6 mm in thickness. The rims and necks are the same thickness of the body of the vessels. The ceramics have not been painted or slipped. The cordmarked surface treatment was made from fiber twisted into cords, wrapped around a paddle, and then impressed into the soft unfired vessel surface (Hurley 1979:3; Lintz 2005:107; Figure 7). The cord impression are characteristic of the phase, but also include ceramics with a “smoothed-over marked” impression (Lintz 2005:107). These are vessels that have been imprinted by cordage and then the cord markings are smoothed-over with another object (Lintz 2005:107). The process of cord marking the vessels may have served to strengthen the pot, aid in the thermodynamic principles of the vessel, increasing the ability to handle to the vessels (Lynn 2004).

Figure 7. Borger Cordmarked Ceramics. Photograph of Alvin Lynn recreating a Cordmarked vessel. Image from Texas Beyond History 2007.

These vessels appear to have been used for cooking purposes based on the soot residue found on the exterior (Wulfkuhle 1984:28; Lintz 2005:107). The globular straight rimmed and flared rimmed vessels were made using coiling with various tempers and surface treated when almost dry (Lintz 1984:334; Lintz 2005:106; Lynn 2004). Common tempers used in this area are sand, shell, and occasionally grog.

Early analyses of Borger Cordmarked ceramics are varied and inconsistent. Some early scholars note the presence of slipping vessel surfaces, while others do not (Studer 1931:71; (Johnson 1939:196). There is also an inconsistency in the recording of temper types. Studer (1931) notes the exclusive use of shell temper in Borger Cordmarked ceramics, while Krieger (1946:44) remarks that shell temper is absent from these ceramics. The first systematic analysis of these ceramics appears in 1984 with the work of Virginia A. Wulfkuhle. In this study one hundred and seventy-three Borger Cordmarked sherds were analyzed from the surface collection taken in 1982 from Landergin Mesa. Wulfkuhle recoded the sherd type, thickness, sherd condition, any soot residue, tempering materials, other inclusions, inclusion density, the interior and exterior surface treatments, and the color of the interior, exterior and core of each sherd. No research was taken to determine the “type/function, shape, or method of forming/shaping” of the vessels due to the small size of the sherds recovered from the site (Wulfkuhle 1984:23). Wulfkuhle notes the most common tempers are sand, ferrous particles, and mica (1984:31). The inclusions were described using the Wentworth scale as being mostly poorly sorted with medium to fine inclusion (Wulfkuhle 1984:32). All colors were recorded using a Munsell Soil Color Chart. An additional fourteen sherds were identified as being from the Southwest. Some could be typed to Largo Glaze-on-Yellow and Cieneguilla Glaze-on-Yellow types (Wulfkuhle 1984:47). These types are known to have been produced between A.D. 1350-1425 near present day Santa Fe at the San Marcos Pueblo. She also noted the presence of six sherds having a red (n=5) and black (n=1) slip. Wulfkuhle concludes by reiterating the utilitarian nature of these ceramics and suggests future sourcing and compositional analysis should be research objectives (1984:50).

Exotic Trade Items

Previous research shows an increase in trade through the period with a majority being recovered from large sites like Alibates Ruin 28 and Landergin Mesa (Lintz 1991:94-95). Ceramic trade items from the Southwestern Puebloan societies have been identified, but ceramic trade items from the Plains, which are similar to Borger Cordmarked, make defining of an exact sphere of intra-regional trade difficult. Ceramics have been traced to the eastern Southwestern Pueblos. Some of the typed sherds are from St. Johns Polychrome, Agua Fris Glaze-on-red, and San Lazaro Polychrome (Brosowske 2005:217). The largest number of exotic sherds was recovered from Alibates Ruin 28 (Brosowske 2005:212). Other exotic materials found are turquoise, *olivella* shell beads, disc beads, and obsidian. Sourcing techniques have traced obsidian from Antelope Creek phase settlements to sources in New Mexico. Brosowske (2004) analyzed 66 obsidian artifacts from multiple sites and traced 62 samples to the Cerro Toledo Rhyolite source in Jemez Mountains of northern New Mexico (2004). The sourcing of these exotic materials links the Antelope Creek phase and the Southwest in trade.

CHAPTER III

SITE OVERVIEWS

Borger Cordmarked ceramics from 41PT109, Landergin Mesa, and Alibates Ruin 28 were selected for analysis. The three sites are Antelope Creek phase villages and have characteristic Borger Cordmarked ceramic assemblages. 41PT109 is centrally located in Potter County near the confluence of the Canadian River and West Amarillo Creek. This site is approximately 42 km east of Landergin Mesa and approximately 24 km west of Alibates Ruin 28 (Figure 8). Landergin Mesa is located in Oldham County and Alibates Ruin 28 is in eastern Potter County. The history of excavation at these three sites will be summarized to provide an overview of excavations.

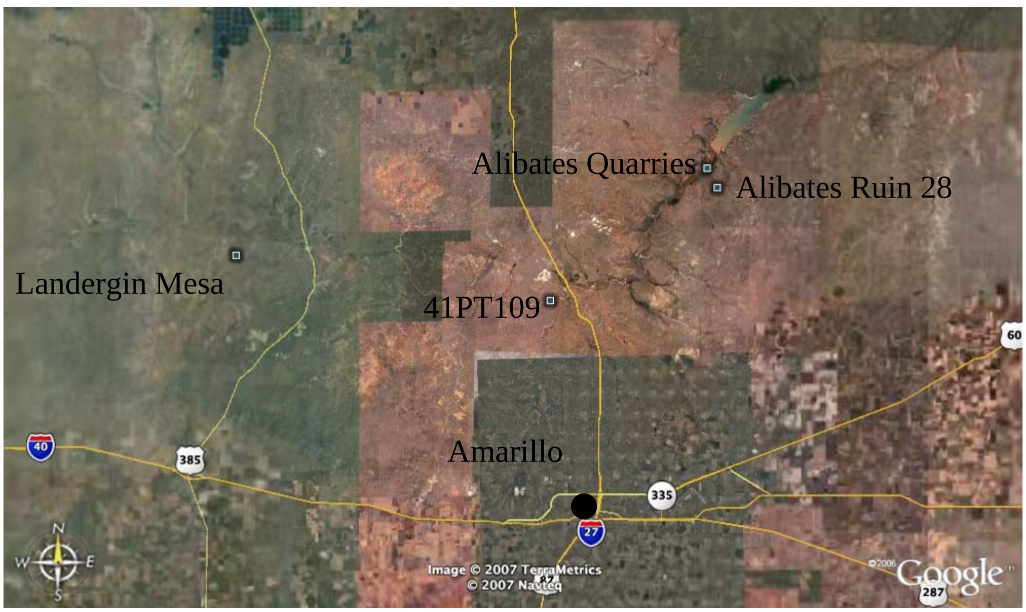

Figure 8. Map Showing the Relationship of Sites. Image from Google Earth Jan 2007.

41PT109

41PT109 is located in Potter County 15 miles north of Amarillo. 41PT109 is on the Bureau of Land Management (BLM) property known as Cross Bar Ranch. The ranch is an 11,833 acre property located on the southern bank of the Canadian River. The ranch became BLM property in 1996 (Lintz et al. 2002). 41PT109 is atop a bluff on the southern bank of the Canadian River where West Amarillo Creek joins the river (Figure 9).

Figure 9. Photo of 41PT109 across West Amarillo Creek. Courtesy of Sonia Perez-Irvin.

Jack Hughes first recorded the site in 1954. Meeks Etchieson later resurveyed the area in 1993. Etchieson described the site and the surface artifact distribution. He also noted the presence of looting and evidence of wind erosion (1993). In 2002 a portion of the Cross Bar Ranch was systematically surveyed and two new Antelope Creek Phase structures were identified (Lintz et al. 2002:122). In 2003, 41PT109 was evaluated to asses recent looting damage. Despite the site being on federal lands, this site is readily accessible from the Canadian River. The usually dry riverbed is open to the public. The basin is a popular location for all-terrain-vehicles and gun enthusiasts. 41PT109 was probably accessed from the public area. In order to preserve the site in accordance with the Archeological Resource Protection Act (USC 1979) the Center for Archaeological Studies, Texas State University-San Marcos was awarded the grant-in-aid for excavation in 2004 (Weinstein 2005:15).

Texas State University conducted two field schools under the direction of Dr. Britt Bousman at 41PT109, one in 2004 and in 2005. The 2007 Texas State field school will excavate a neighboring Antelope Creek site. The goal of the excavation was to recover and identify characteristics of Antelope Creek Phase culture and architecture before looting destroyed all potential for scientific study. Abbey Weinstein wrote an overview of the 2004 excavation and findings. This was published as a Masters of Arts Thesis at Texas State University in 2005. Weinstein noted site disturbances produced by looters and natural factors. A total of thirty-one 1x1 m units were excavated in both seasons (Figure 10). Units were placed to maximize to avoid areas most damaged from looting activities, the exposure of architectural features, to sample the middens, and other features.

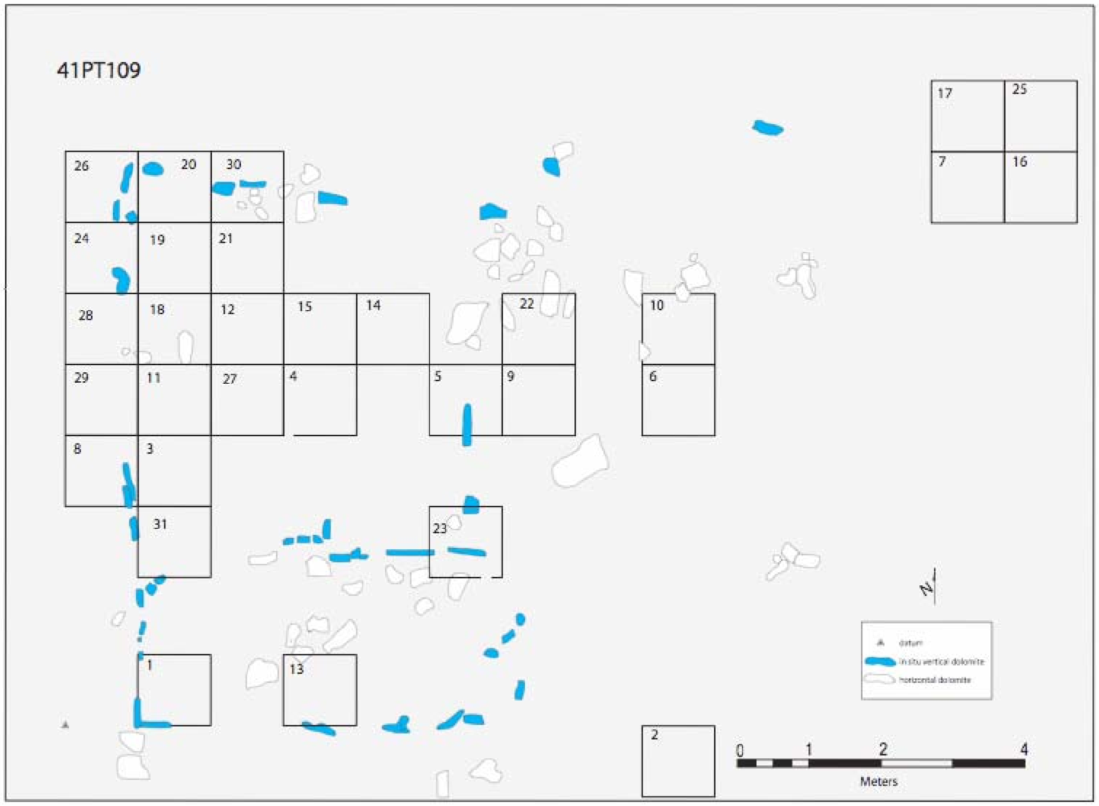

Figure 10. Site Map of 41PT109. Figure is adapted from Weinstein 2005.

Twenty-one units exposed the main structure. Very few artifacts were found in the structure. There was a hearth in the middle of the structure and four postholes were identified. The structure has many features typical of Antelope Creek architecture: east facing entryway, a central hearth, a four-post roof system, a depressed central channel, vertical flagstone walls, and clay flooring (Figure 11). The entryway opens to the east with a midden approximately 4 m northeast of the opening. The lack of cultural materials in the structure in conjunction with the lack of evidence of wood remains in the posts holes suggests a planned abandonment (Weinstein 2005:33). The units within the structure reached an average depth of 60 cm, to the top of an anthropogenic clay and gravel prepared floor. In 2005 the gravel floor was removed from a few units.

Excavations of the entry way show evidence of multiple floors. There are three distinct clay layers, possibly indicating multiple periods of habitation.

Figure 11. Photo of 41PT109. Photo courtesy of C. B. Bousman.

The main concentration of artifacts was recovered from the a trash deposit midden. Four units (1, 16, 17, and 25) were placed in this area reaching a maximum depth of 135 cm. Despite the many consistencies of the structure to the typical architecture, there are some variances. Some Antelope Creek structures have a raised ‘altar’ feature along the west wall. Here this feature was absent. There were also two pits found along the south wall. The exact function is unknown. Rudimentary analysis suggests the structures were used for storage, but additional testing is needed from confirmation.

Excavators kept level forms for each arbitrary 10 cm level for each unit. All sediments were screened using ¼ inch mesh. In 2004, all artifacts and rocks were recorded in place with a digital transit, mapped, and photographed. For the 2005 season excavators decided that only *in situ* artifacts/rocks would be shot in using the transit and every artifact would be mapped and photographed. The artifacts were bagged by material type within the respective unit and level. Excavators backfilled the site to aid in preservation and to assist in any future research. The site was lined with black polyurethane material and then the screened dirt was placed on top. Macrobotanical floatation samples and C-14 samples were taken during both seasons of excavation. The samples have only been analyzed from the 2004 season. Barbara Meissner analyzed the faunal assemblage and Phil Dering analyzed the botanical samples. Maize was discovered in 80% of the botanical samples (Dering 2005:138). A single radiocarbon assay dates the site to A.D. 1420 (Weinstein 2005:93). Four thin sections of the entryway floor were taken in 2005. The floor preserved several layers of clay. The clay within the flooring will be submitted for future INAA at MURR. The excavated materials were later prepared for curation and catalogued at the Center For Archaeological Studies. The lithics were preliminarily analyzed and appear to be all Alibates silicified dolomite. All ceramics recovered were Borger Cordmarked. Christopher Lintz analyzed the ceramics from both seasons. His report of the 2004 ceramics was included in Weinstein (2005 Appendix B). A small-carved shell pendent and a bone bead were recovered in 2005. These and other artifacts are currently held at CAS. Future curation is to be at the Panhandle-Plains Historical Museum in Amarillo, Texas. Instrumental neutron activation analysis (INAA) study sampled both 2004 and 2005 excavations season ceramic assemblages. Of the twenty-five sherds submitted for INAA from this site, 9 were recovered from the main structure, 14 from the midden, and 2 from a pit structure (Table 1).

Table 1. Counts and Locations of Sherds Submitted for INAA from 41PT109.

Count	Location
9	Main Structure
14	Midden
2	Pit Feature

Landergin Mesa

Landergin Mesa is located on top of a mesa south of the Canadian River in Oldham County. The site, on private property, is a State Archaeological Landmark and a National Historic Landmark. The mesa is 43 m above the valley floor with a surface area of 2,225 square meters (Lintz 1990:11; Figure 12). Of the three sites sampled in this study Landergin Mesa is the most isolated in terms accessibility (Lintz 1986:30). The nearest water source identified is a spring nearly one mile away from the site (Weiss 1975). Floyd Studer, an avocational archaeologist, gained “scientific lease” to many sites in the Canadian River basin including Landergin Mesa (Holden 1932:288). Studer was responsible for escorting many archaeologists to the site, possibly including W.C. Moorehead (Lintz 1990:25). Moorehead was the first to document the site in a 1921 (1921). Later visitors to the site include Dr. Ronald Olsen in 1929 and Dr. Richard Snodgrasse in 1931 both from the American Museum of Natural History.

Figure 12. Photo of Landergin Mesa. Photo courtesy of C. B. Bousman.

Texas Historical Commission conducted the first formal excavations at Landergin Mesa in 1981. Nearly one hundred depression recorded at this time and thought to be looter pits. Later evaluation discovered only three of these were looter pits and the depression thought to have been potholes were sunken architectural features collapsed (Lintz 1990:16). There had been no record of previous looting disturbances. The purpose of the first phase of excavation was to “establish a permanent datum and recording system for the site” (Wulfkuhle 1984:11). The map of the site recorded more than thirty structures, some of which some were described as possibly being contiguous (Lintz 1990:15). Archaeologists identified a central ‘plaza’ that has yet to be properly explored (Lintz 1990:2). Season I excavations were directed by Robert J. Mallouf and the ceramics recovered were analyzed by Virginia A. Wulfkuhle. Wulfkuhle provided the first systematic attempt of ceramic analysis at Landergin Mesa. This ceramic analysis examined surface sherds and found that Borger Cordmarked sherds were utilitarian cooking wares (Wulfkuhle 1984).

Phase II excavation in 1983-1984 was under the direction of Dr. Lintz with excavation funding from the Historic Preservation Jobs Program (Lintz 1990:1; Figure 13).

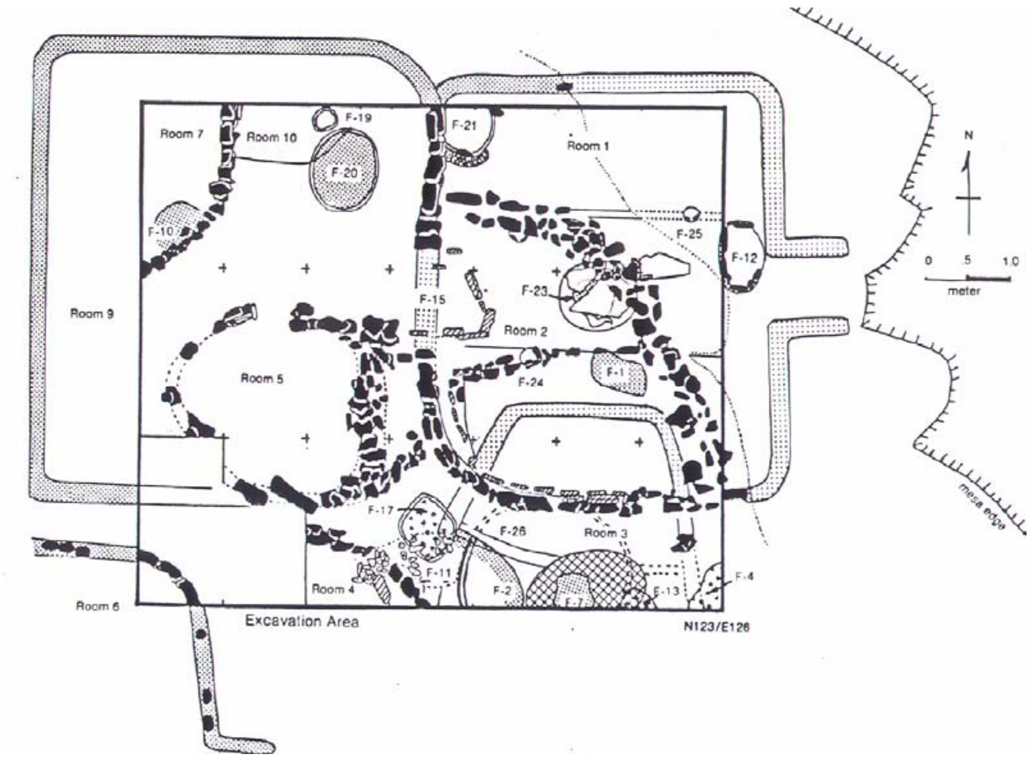

Figure 13. Site map of Landergin Mesa Phase II Excavation. (Lintz 1990).

I will focus on Phase II excavations because the ceramics sampled for this INAA study were collected from this excavation. Lintz placed twenty-one 1x2m units using the mapping points erected during Phase 1. Units were placed to expose “living surfaces” of the structures in three areas on the mesa (Lintz 1990:36). Despite the evidence of looters pits, the excavation area of Phase II was “mostly intact” (Lintz 1990:50). Excavation shows the site is a series of isolated room structures with a small amount of non-local ceramics. During the two excavations conducted, a total of 95 residential structures were identified, with an estimated occupation span of 130-250 years (Lintz 1990:193; Brosowske 2005:92). This site has been dated to A.D. 1250-1380 using seven radiocarbon assays and four obsidian hydration dates (Table 2).

Table 2. Landergin Mesa Dates. Dates obtained using radiocarbon and obsidian hydration methods. Adapted from Brosowske 2005.

Radiocarbon Age	Calibrated Age
780±70 B.P.	A.D. 1263
Obsidian Hydration Date	A.D. 1286
700±80B.P.	A.D. 1290
660±60 B.P.	A.D. 1299, 1375, 1375
630±70 B.P.	A.D. 1304, 1367, 1385
600±90 B.P.	A.D. 1327, 1346, 1393
Obsidian Hydration Date	A.D. 1378
Obsidian Hydration Date	A.D. 1389
490±70 B.P.	A.D. 1430
450±70 B.P.	A.D. 1411
Obsidian Hydration Date	A.D. 1474

Excavation of Landergin Mesa Phase II identified ten isolated structures (Lintz 1990:57). Typically during this early time period (A.D. 1250-1350) within the Antelope Creek phase, contiguous-room structures are most common. Lintz was unable to confirm that any of the Phase II structures were contiguous. Many of the isolated structures have incorporated previous buildings’ structural walls. It is unclear if this was to salvage materials or was in fact was the contemporaneous aggregation of rooms into a contiguous structure (Lintz 1990:59).

The excavation of the structures allowed for a building chronology to be established for Landergin Mesa. Lintz identified two components and three distinct building episodes on Landergin Mesa (Lintz 1990:61). The earliest of habitation pre-dates the Antelope Creek phase. Two radiocarbon assays were taken from an ash lens and a pit feature. There are no architectural features that correspond to this period.

The first episode of Landergin Mesa associated with the Antelope Creek phase is a single room. Erosional activities contributed to the poor preservation of this structure. The remains indicate affiliation to the Antelope Creek Phase and have been relatively dated to between A.D. 1250 and 1350.

The second building episode is an isolated residential structure. Later construction activities modified the remains of this structure. This can be seen in the truncation of the central portion of the west wall. The south wall is the only intact side of the structure and reveals a single row of vertical stone slabs construction toped by horizontal stone with clay pressed between (Lintz 1990:92). There is evidence of multiple flooring events. Within the structure a clay and stone lined pit was identified. This pit (feature 21) was capped with clay and contained "six scrapers, a stone pipe stem, a bone awl, a mano, bison bones, turtle carapaces, and a fresh water mussel shell" (Lintz 1990:82). Flotation samples from within the hearth produced evidence of corn and beans (Lintz 1990:83). Four postholes were identified. There was no evidence of any wood/organics within the holes or any evidence of burning. This indicates the salvage of roofing materials (Lintz 1990:85).

The third identified building episode of Landergin Mesa is a habitation structure and associated storage rooms. This structure utilizes the south and west walls from the structure (Room 84-1) identified in episode two. It is hypothesized that during this construction is when the room 84-1 west wall was modified (Lintz 1990:90). The structure is similar to that typical of the phase. The classic central channel and bench features are present. The north wall is an aberrant feature. The wall is an arc and has less structural material that other walls (Lintz 1990:93). There is a lack of cultural materials associated with this room, an indication of planned abandonment.

Excavators were placed in teams and recorded their findings on level forms. When possible, natural levels were used, but if unavailable each level was to be arbitrarily 5 cm (Lintz 1990:36). Between many of the units a balk was left in place. This assisted in preserving the stratigraphy and limited the mixing of sediments from neighboring units. The balks were intentionally left within the interior of each excavated room to provide a remnant sample of the previous excavation (Lintz 1990:36). Lintz and his excavation team attempted to preserve all wall and floor features (Lintz 1990:38). In very few instances were these features removed to explore deep deposits. For this reason, any earlier and deeper deposits/habitation have not been well sampled (Lintz 1990:38). The artifacts were recorded *in situ* using a transit and stadia rod. In addition all artifacts were plotted on maps and photographed. Trade/exotic materials that have been recovered from Landergin Mesa include obsidian, hematite, malachite, turquoise, Southwestern ceramics, and shell beads (Lintz 1990:22). Upon completion of Phase II excavations, the materials were transported to Austin, Texas where they were washed and prepared for curation. Now all excavated materials and associated documents are held at the

Panhandle-Plains Historical Museum. The sherds submitted for INAA were recovered from structures (n=9), from structural collapse (n=5), fill (n= 5), the surface (n=2), midden (n=2), and a pit feature (n=1). One sherd could not be defined to a geographic local on the site (Table 3).

Table 3. Count and Location of Sherds Submitted for INAA from Landergin Mesa.

Count	Location
9	Structure
5	Structural Collapse
5	Fill
2	Surface
2	Midden
1	Pit Feature

Alibates Ruin 28

Alibates Ruin 28 is one of the largest Antelope Creek sites and the occupants had direct access to the Alibates quarries. The site is only 1.2 km from the nearest agatized flint outcropping (Lintz 1986:323). The site is located west of Alibates Creek and 4 km south of the Canadian River.

The exact history of Alibates Ruin 28 is murky. Archaeologists have referred to the site by a number of different names (Davis 1985:20). The ruin was first noted by Warren K. Moorehead in 1921, but was not excavated until 1926 by Floyd Studer, the director of the Department of Archaeology for the Panhandle-Plains Historical Museum (Lintz 1986:323). Later in 1939 Ele M. Baker excavated the site in conjunction with a

Works Progress Administration (WPA) team from Potter County. A typical excavation crew at the site consisted of twenty relief WPA workers without training and two professional archaeologist workers (Baker and Baker 2000:1). Unit I was dug in 1938 and Unit II from 1939 to 1941 (Lintz 1986:328). Unit I is located 150 ft north of Unit II and few exotic materials were found (Figure 14, 15, 16). The two phases show contiguous and isolated room structures. Unit I structures are older and exhibit the contiguous aggregate room structure. Unit II is made up of twenty+ isolated structures. The rooms are typical of the period and Borger Cordmarked is the dominant pottery type. Radiocarbon assays date Unit 1 to A.D. 1310-1340 (Lintz 1986) (Table 4). Unit II has an unusual number of long distance exotic materials ranging from turquoise to glazed sherds. The later Unit II has been radiocarbon dated to A.D. 1340-1410 (Lintz 1986). It is estimated that between the two units, there was occupation for 163 years (Brosowske 2005:92).

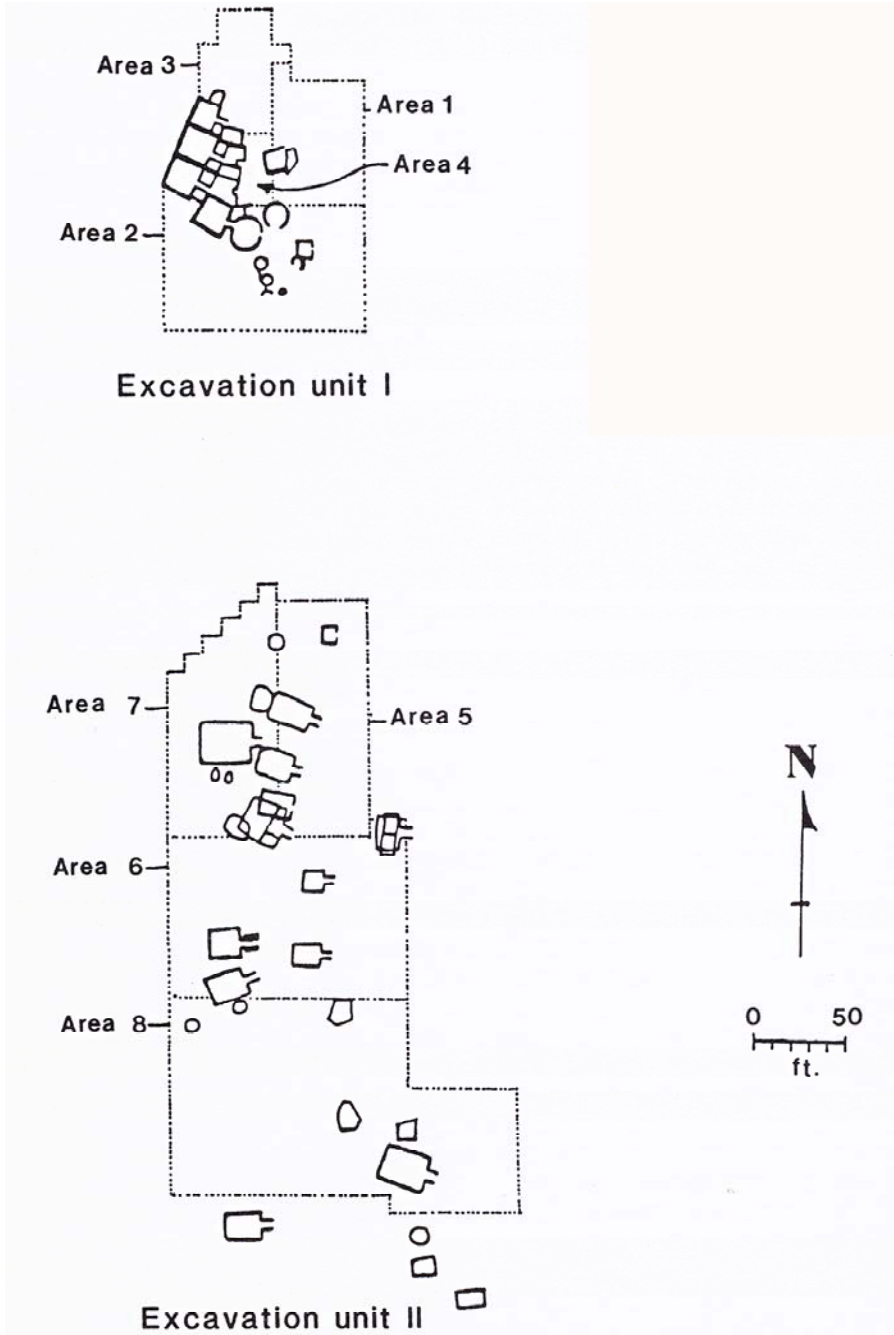

Figure 14. Alibates Ruin 28 Units I & II Site Map. (Figure from Lintz 1990:324)

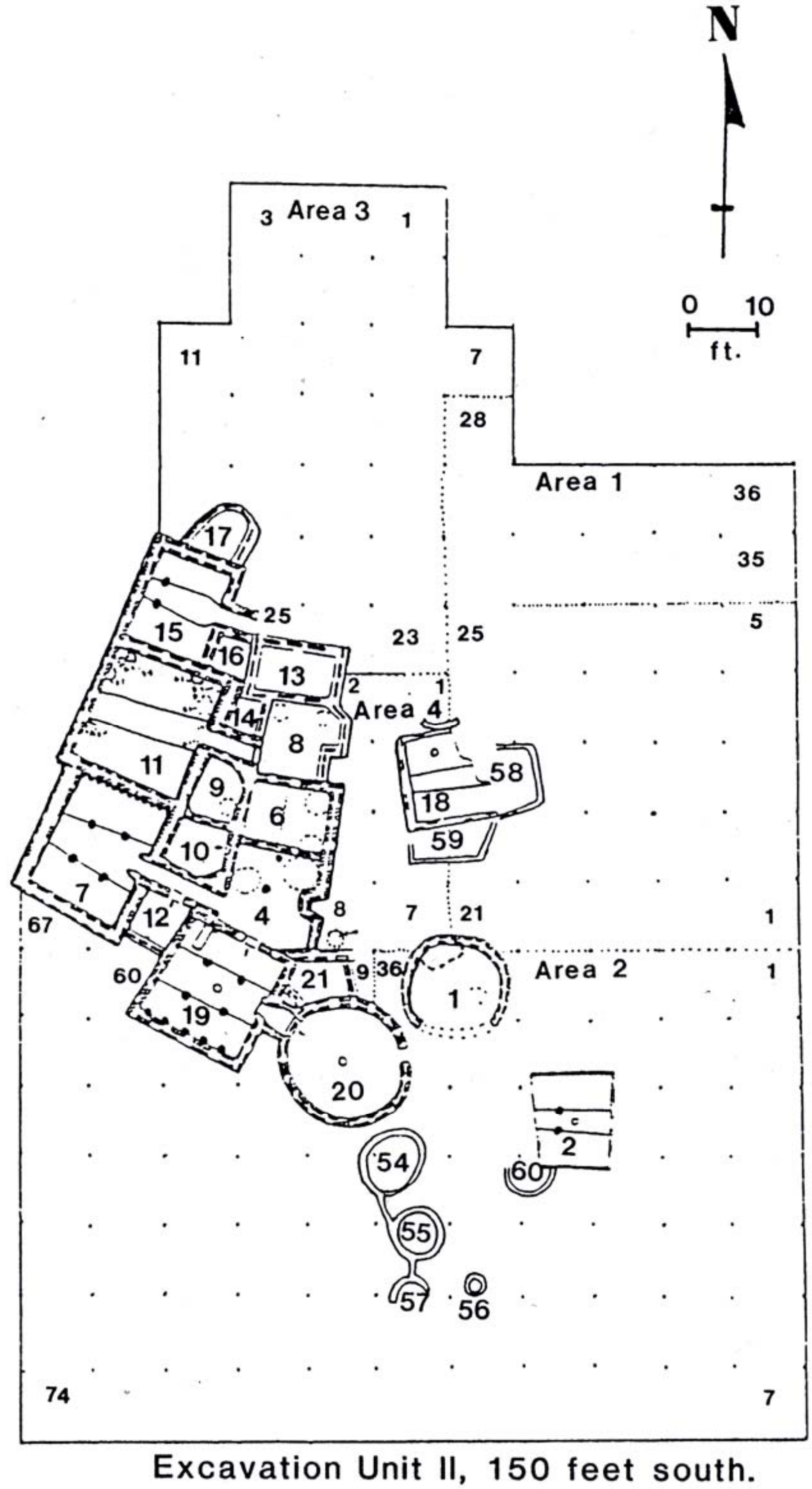

Figure 15. Detail of Unit I Excavation at Alibates Ruin 28 (Lintz 1986 Figure 45).

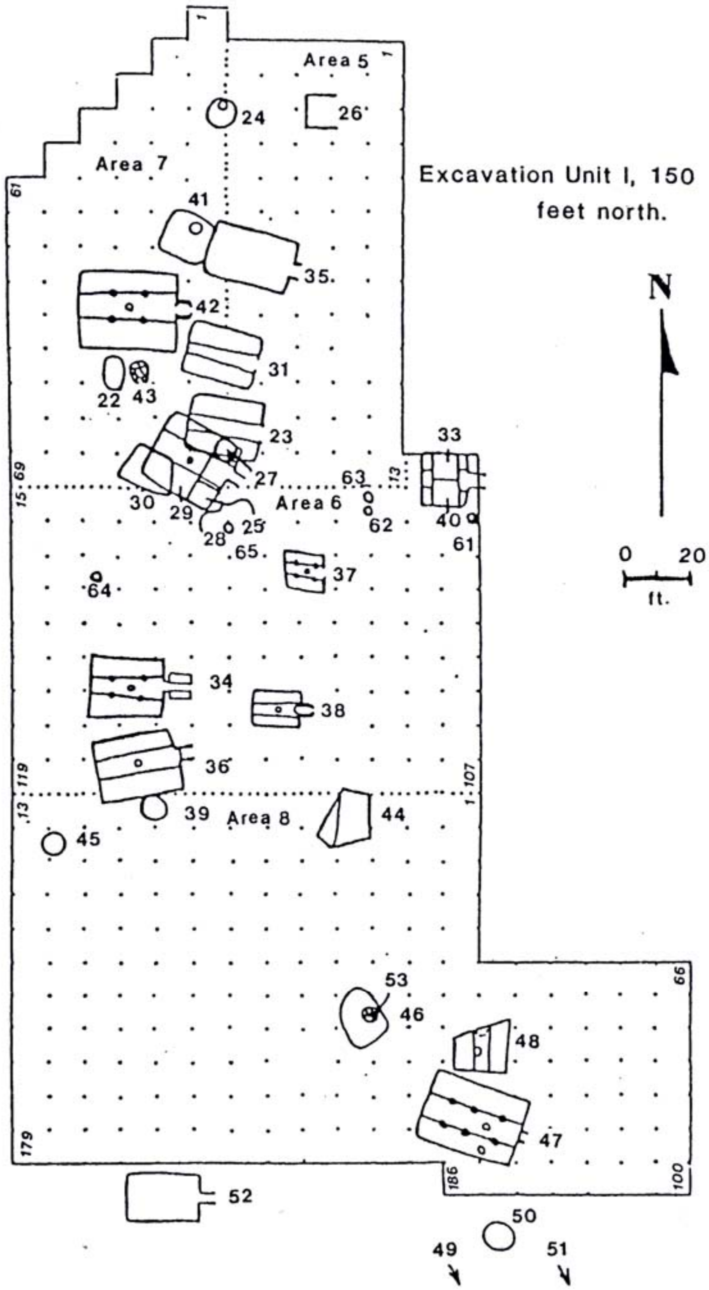

Figure 16. Detail Map of Unit II Excavations at Alibates Ruin 28 (Lintz 1986 Figure 50).

Table 4. Alibates Ruin 28 Radiocarbon Dates.

Alibates Ruin 28	Radiocarbon Age	Calibrated Age Stuiver et al. 1998
Unit 1, room 19	770±75 B.P.	A.D. 1271
Unit 1, room 19	630±70 B.P.	A.D. 1304, 1367, 1385
Unit 2, room 24	600±70 B.P.	A.D. 1327, 1346, 1393
Unit 1, room 1	600±75 B.P	A.D. 1327, 1346, 1393
Unit 2, room 24	480±80 B.P.	A.D. 1434

Alex Krieger used this site to help define the Antelope Creek phase (1946:47). For this reason Alibates 28 is one most important sites used to define the phase. All of the typical architectural features can be found at this site. Baker's excavations discovered many midden areas. These are thought to have been originally dug as borrow pits for clay used in the construction of the buildings and later used as refuse dumps (Baker and Baker 2000:131). The archaeologists note that the type and density of refuse does not change over time, indicating a single occupation. The raised altar that is generally found along to back west well is absent from all the excavated rooms in Unit I (Baker and Baker 2000:130). Lintz examines this in his dissertation. He attributes the lack of west wall features identification to inexperienced excavating techniques (Lintz 1986:99).

Despite the importance of Alibates Ruin 28, the excavations of the site have been poorly recorded (Lintz 1986:323). Collection techniques and provenience methodologies are out dated when compared to current standards. The WPA excavations under Baker collected only whole lithic tools. The only broken materials collected from the site were the ceramic sherds. There are no specific excavation records regarding the ceramic artifacts (Figure 17). The artifacts are currently held at the Panhandle-Plains Historical

Museum in Canyon, TX. Only the ceramics from Bakers excavations of Unit I and Unit II were sampled in this INAA study. The sherds were from the site, exact provenience is undetermined, but thirteen of the sherds were recovered from structures.

Figure 17. Borger Cordmarked Vessel from Alibates Ruin 28. Image from Texas Beyond History 2007.

CHAPTER IV

METHODOLOGY AND RESEARCH HYPOTHESIS

Three sites were chosen for analysis based on their relative locations, architectural type, size, and location. More sites were not included in this initial study in order to determine the variation within a sample of Antelope Creek Phase ceramics and due to financial limitations. Samples were obtained from the Center for Archaeological studies and from the Panhandle-Plains Historical Museum. The samples were prepared, irradiated, and counted at the University of Missouri Research Reactor (MURR). MURR awarded a mini-NSF grant for subsidized INAA sample costs. A grant from Texas Archeological Society Donors Fund covered much of the remaining costs. A grant-in-aid from the Bureau of Land Management funded excavation and helped to cover sample selection expenses. Twenty-five sherds from each site were selected primarily based on size and provenience. Clay samples were attained from 41PT109, Landergin Mesa, and Alibates Ruin 28 in July and September 2006. Mike Glascock, Jeff Ferguson and Leslie Cecil of MURR aided in the statistical analysis of the samples for this study.

Research Hypothesis

Initial analyses lead me to a hypothesis and develop research questions centered on the possible production zones of the Borger Cordmarked ceramics samples. The use of

INAA will provide data that can be analyzed to help determine the production zones of the ceramics of Antelope Creek phase sites. By using both isolated and contiguous room structures, the analysis of trade within the different architectural phases and different social groups can be examined. This study will seek to answer what sources are preferred for ceramic production. Is there trade of locally produced ceramics within the Antelope Creek phase? What is the relationship between settlement size and exchange? Is trade reciprocal or uni-directional between large and small villages? Can these data be used to determine patterns of trade and exchange? What wider implications can be made from determining possible trade routes? Can different models of exchange be used to explain the movement of utilitarian wares vs. long distance exotic wares? Is there a correlation between lithic materials and ceramic materials in terms of the nature and scale of trade?

Site Selection

41PT109, Landergin Mesa, and Alibates Ruin 28 were selected because of variation of site architectural type, size, and location. All of the sites are Antelope Creek phase villages and have characteristic Borger Cordmarked ceramic assemblages. The three sites have relatively contemporaneous occupations, but display variation of settlement size and architectural style (Table 4). 41PT109 is a small isolated structure, or a complex homestead site (Lintz 1990:148). Landergin Mesa is a large site comprised of many isolated structures. Alibates Ruin 28 is a large conglomerate site, consisting of both contiguous and isolated structures. Site architectural type and size were primary concerns when determining which sites to sample. It has been proposed that the outlying isolated sites maybe farming communities that support larger sites (Bousman 1973:42). For this reason, I selected one small site, 41PT109, and two sites of comparable size, Landergin

Mesa and Alibates Ruin 28.

Table 5. A Composite of the Ranges of Information used in Site Selection for INAA.

Site	Date of Occupation	Architectural style	Social Size	Types of Ceramics Expected
41PT109	A.D. 1420	Isolated structure	Small	Local production only
Landergin Mesa, Phase II	A.D. 1250-1380	Multiple Isolated structures	Large	Local and regional production, and minimal long distance trade ceramics
Alibates Ruin 28	A.D. 1340-1410	Isolated and Contiguous room structures	Large	Local, regional, and long distance ceramics present

The 41PT109 artifacts are currently housed at the Center for Archaeological Studies (CAS). I assisted with the excavation and curation of these materials. Dr. Britt Bousman, excavator and director of CAS approved permission for INAA analysis. The cultural materials from Landergin Mesa and Alibates Ruin 28 are curated by the Panhandle-Plains Historical Museum. The Panhandle-Plains Historical Museum granted permission for destructive analysis in August 2006.

Sherd Sample Selection

Twenty-five sherds were selected from 41PT109, Landergin Mesa, and Alibates Ruin 28. The primary purpose of this study was to analyze the chemical variability within multiple Antelope Creek Phase ceramic assemblages. For this reason, all sherds selected were Borger Cordmarked ceramics. The sherds were selected based on two characteristics. First the size of the sherd was considered. Sherds less than 1 cm^2 may not produce accurate INAA results and only sherds larger than this size were selected. Secondly, sherds that had been grouped for possible re-fits were evaluated. Only one sherd from a possible re-fit was chosen to obtain the most varied results possible within the Antelope Creek Phase assemblage.

The twenty-five sherds analyzed from 41PT109, were collected during the 2005 and 2006 Texas State field schools. Over ninety percent of the sherds recovered from this site were found in the midden to the east of the entry way from units 1, 7 17, and 25. Christopher Lintz analyzed the ceramics from this site (Appendix E).

The sherds from Landergin Mesa and Alibates Ruin28 were attained from the Panhandle-Plains Historical Museum. The sherds were selected purposely from varying areas across Landergin Mesa, Phase II to gain the most varied data possible. Small sherds were avoided.

The sampled sherds from Alibates Ruin 28 were from both areas of excavation (see Figure 13). A number of sherds from Alibates Ruin 28 were generally not recorded by detailed provenience. Some sherds lacked any provenience information and these were not selected. The sherds from this site were larger than those from 41PT109 and Landergin Mesa (Table 6).

Table 6. Average Weight of Sherds for the INAA study.

Site	Average Weight in Grams
41PT109	3.7
Landergin Mesa	14.1
Alibates Ruin 28	19.5

The seventy-five sherds were assigned a unique number, analyzed and described before submitting for neutron activation analysis. The number, an ANID, was assigned according to MURR guidelines and consists of the submitter's initials and the numbered in sequential order (i.e. HAM001). The ANID numbers are referenced in Appendix B, but for ease of undstandibility the site name will replace my initials. Samples 001-025 are from 41PT109, 026-050 are from Landergin Mesa, and 051-075 are from Alibates Ruin 28. Christopher Lintz analyzed all of the sherds from 41PT109. His procedure was used as a template for the analysis of the sherds from Landergin Mesa and Alibates Ruin 28 conducted by C. A. Conlee and myself. Sherd Munsell colors, size, thickness, inclusions such as mica, and temper types were recorded (Appendix D).

Clay/Temper Sample Selection

The clay samples were selected via ground survey and by the advice of local expertise (Table 7). Research and ethnographic evidence suggests that prehistoric potters traveled 1-6 km to a raw clay source (Sinopoli 1991:15). According to the Geologic Map of Texas, there are five possible materials that may have been sampled: The Ogallala, Blaine, Tecovas, and Trujillo Formations, or Holocene alluvium (1992). Paul Tanner, BLM Biologist for Cross Bar Ranch, assisted with the recovery of the clay samples from West Amarillo Creek in the vicinity of 41PT109. Sheriff Medlin of Oldham County and Dr. C. B. Bousman sampled clay from the Canadian River and alluvial deposits from Alamosa Creek near Landergin Mesa. Paul Eubank, Chief of Resource Management, and Arlene Wimer, Environmental Protection Specialist, assisted in the survey and recovery of the clay samples from near Alibates Flint Quarries National Monument in the Lake Meredith vicinity. Eubank and Wimer had assisted a local potter in sampling an ash deposit. Two samples of this material were taken to determine the possible inclusion in the ceramics.

Table 7. Locations and Types of Clays/Temper Sampled.

Sample Number	Location	Clay Sampled
Alibates Ruin 28-076	Alibates Quarries	
Alibates Ruin 28-077	Alibates Quarries	
Alibates Ruin 28-078	Alibates Quarries	
Alibates Ruin 28-079	Alibates Quarries	
Alibates Ruin 28-080	Alibates Quarries	Ash
Alibates Ruin 28-081	Alibates Quarries	Ash
Alibates Ruin 28-082	Alibates Quarries	
Landergin Mesa-083	Canadian River	Alluvial Deposit
Landergin Mesa-084	Alamosa Creek	Alluvial Deposit
Landergin Mesa- 085	Alamosa Creek	Alluvial Deposit
Landergin Mesa-086	Alamosa Creek	Alluvial Deposit
Landergin Mesa-087	Alamosa Creek	Alluvial Deposit
41PT109-088	West Amarillo Creek	Alluvial Deposit
41PT109-089	West Amarillo Creek	Alluvial Deposit
41PT109-090	West Amarillo Creek	Alluvial Deposit

Method of Analysis

Instrumental neutron activation analysis (INAA) was chosen as the method for analysis based on reliability, precision, and universal acceptance of data (Neff 2000:103). The method was first developed in 1954 at Brookhaven National Laboratory (Harbottle 1976; Neff 2000:81). Following the 1960's, with the invention of reliable detection systems to count the decay periods, INAA became relied upon by archaeologist to assist provenance (Neff 2000:81, 107). INAA is a bulk method of ceramic analysis because a sample consists of the primary matrix of a vessel. INAA is mainly criticized due to high cost and the addition of nuclear waste. Sample cost is directly proportional to the "cost of neutrons, costs for disposal of radioactive waste, and costs of all supplies and labor consumed" however the addition of nuclear waste with such a small sample size is nominal (Neff 2000:105).

Sample Preparation

The processing of clay samples for INAA is very similar to that of the sherds. The clay was not sieved or processed in any way before it was sent to MURR for analysis. The clay was not processed to account for any additive or subtractive elements that potter many use for paste. This is primarily because the paste of the sherds cannot be sorted, so any sort of inclusion, such as temper natural or otherwise, is included in the INAA assay. All samples were assigned a number and photographed as instructed by the Missouri University Research Reactor (MURR) protocol. Sample preparation for Instrumental Neutron Activation Analysis (INAA) is fairly simple, yet time consuming and extreme care is taken not to contaminate samples. Each sherd has two 1-2 cm^3 portions removed. The remaining sherd is sent back to the researcher. One portion is prepared for INAA analysis and the other portion is archived at MURR. The first step of INAA analysis is to remove the surface of the sherd using a diamond bit Dremmel tool. The piece is then rinsed with distilled water and desiccated before pulverization. Each sample is the crushed and placed into vials and weighed. The clay samples are thoroughly dried, weighed, and treated as a normal sample. All samples weighed within 10±mg of each other to insure similar counts after irradiation. There are a total of two vials of equal weights prepared for each sherd. The short count in polyvials and long count in quartz vials. All of the vials are then sealed and are ready for insertion into the core of the reactor (Figure 18).

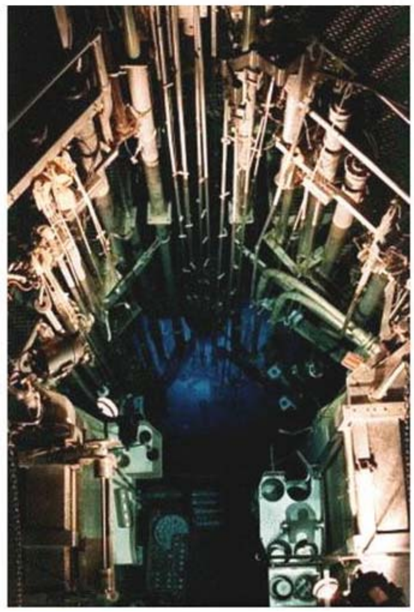

Figure 18. View of the Core of MURR from Observation Deck. Photo courtesy of Dr. Gary J. Ehrhardt.

The short count consists of a 5 second irridation, followed by a 25 minute decay period. The sample is then counted for 12 minutes in a H-resolution, high-purity germanium detector (HPGe). The short-lived elements such as, aluminum (Al), barium (Ba), calcium (Ca), dysprosium (Dy), potassium (K), manganese (Mn), sodium (Na), titanium (Ti) and vanadium (V) are detected in this count. The long count samples are irridated for 24 hours and then allowed to decay for approximately 7 days. The samples are then placed into the HPGe and counted for 2,000 seconds, which is known as the mid-count. After a second decay period of 4-5 weeks the samples are counted nickel (Ni), rubidium (Rb), antinomy (Sb), scandium (Sc), strontium (Sr), tantalum (Ta), terbium (Tb), thorium (Th), zinc (Zn), and zirconium (Zr) are counted.

Statistical Analysis

In January of 2007 I traveled to MURR to assist with the final statistical analysis of the Antelope Creek Phase sherds. The raw data are supplied in the form of an EXCEL spreadsheet (Appendix C). All of the samples had high calcium levels. The high Ca concentrations may have been due to tempering material or naturally occurring calcium carbonates in the raw materials. The high Ca readings may reduce the results for the other elements. To correct this, a mathematical formula was used to alleviate any distortion caused by the Ca readings (Cogswell et al 1998:64). Typically Ni is not a strong element to use for ceramic analysis, as it is commonly not detected. Thus, the results for Ca and Ni were removed before beginning initial statistical analysis. With the removal of Ca and Ni, the final analysis considered 31 elements. The GAUSS program aided in the analysis and identification of groups within the Antelope Creek phase ceramics sampled. All data were analyzed in base-10 logarithms parts per million (ppm).

CHAPTER V

RESULTS

The initial goals of the NAA were to test the validity of Borger Cordmarked ceramics as a type and to identify clustering within the sherds (n=75) and clay (n=15) samples. When compared to other INAA samples groups processed at MURR, the samples (n=90) from this study form a distinct group. This reinforces the assumption that Antelope Creek phase ceramics, Borger Cordmarked ceramics are a distinct morphological type for the sites sampled. Future INAA Borger Cordmarked analysis is needed to confirm this.

Ceramics Samples

The next step taken during analysis was plot the chemical elements measured in each sherd (n=75) according to the excavated site: 41PT109, Landergin Mesa, Alibates Ruin 28. This simple graphical method of analysis produced very little clear information and shows a lot of overlap between the ceramics from each site (Figure 19).

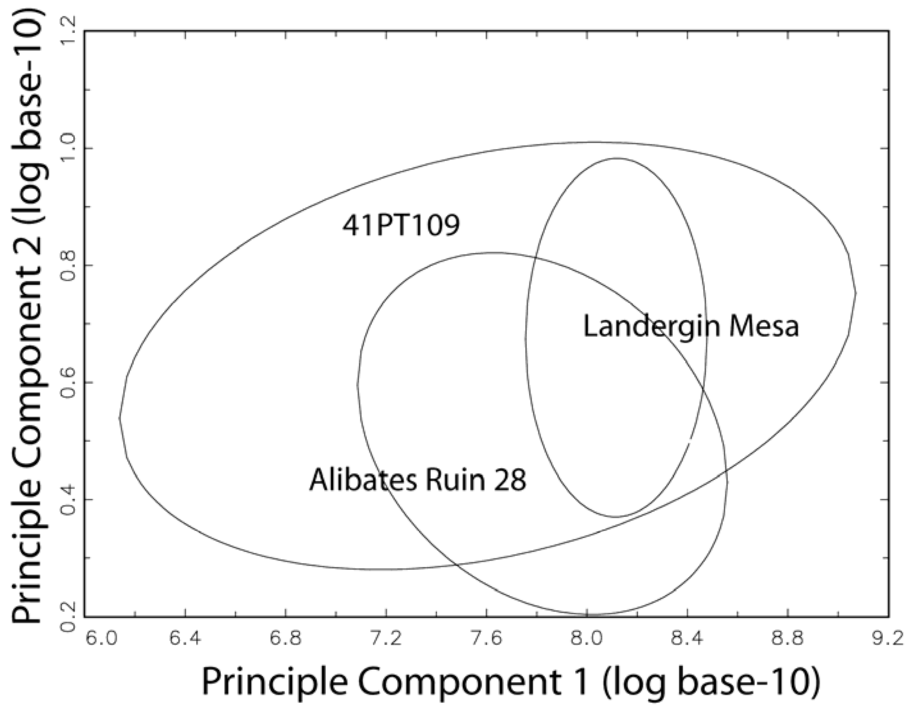

Figure 19. Bivariate plot of Principle Component 1 and 2 log base-10 Showing the Relationship of the samples from 41PT109, Landergin Mesa, and Alibates Ruin 28. Confidence ellipse is 90%.

Closer examination, with the aid of cluster analysis, produced the formation of independent clusters, producing five distinct groups with the comparison of principle component analysis (Figure 20). Principle component analysis combines elemental concentrations that are high in the entire sample group. This type of analysis is most valuable when comparing the first two principle components. Here principle component 1 and 2 provide the most distinct clustering. The group's affiliations were checked using Mahalanobis statistic (Bishop and Neff 1989). This is a measurement of the distance between group centroids to each individual sample.

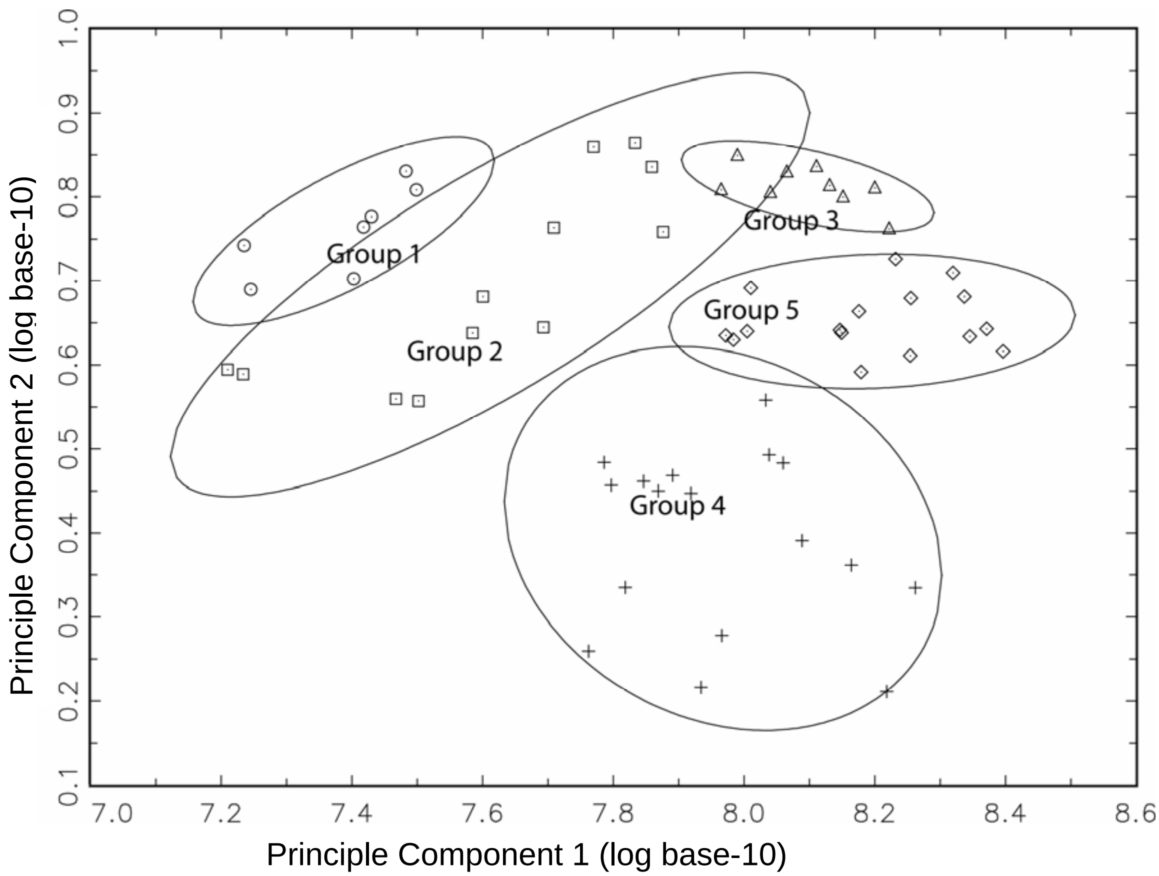

Figure 20. Bivariate Plot of Principle Components 1 and 2 log base-10 Showing the Relationship of Groups 1 through 5. Confidence ellipse is 90%.

Group 1 is comprised of seven sherds. Six of the sherds were from the 41PT109 sample group and one from Alibates Ruin 28 (Table 8). The sherds for 41PT109 were from units 9, 12, 14, and 16. Units 9, 12, and 14 are from within the structure and unit 16 is in the midden feature (see Figure 10). The sherd from Alibates was from within Unit II, Area 5, Room 32 (see Figure 16).

Table 8. The Location, Number, and Context of Samples in Group 1.

Sherd Site Location and Number in Group 1	Context within Site
41PT109-001	Midden
41PT109-015	Midden
41PT109-022	Midden
41PT109-023	Midden
41PT109-024	Midden
41PT109-025	Midden
Alibates Ruin 28-062	Structure

Group 2 has fifteen sherds. Seven of the samples are from 41PT109, two from Landergin Mesa, and six from Alibates Ruin 28 (Table 9). The 41PT109 sherds were recovered from within and outside the structure in the trash midden. One sample was found in unit 9, level 2 while the other was in unit 9, level 3. One sherd was from the pit feature in unit 12 within the structure. Four samples were from within differing units in the structure, units 1, 9, and 12. There were two samples from the midden area; one from unit 7 and one from unit 16.The two sherds from Landergin Mesa are from unit 90 and 97. The six sherds from Alibates Ruin 28 were recovered from Unit I and II. Samples Alibates Ruin 28-058, 060, 067, 074 are from Unit I and 065, 066 are from Unit II.

Table 9. The Location, Number, and Context of Samples in Group 2.

Sherd Site Location and Number in Group 2	Context within Site
41PT109-002	Structure
41PT109-003	Structure
41PT109-006	Pit
41PT109-008	Structure
41PT109-010	Structure
41PT109-012	Midden
41PT109-016	Midden
41PT109-019	Structure
Landergin Mesa-035	Exterior Wall Fall
Landergin Mesa-039	Exterior Wall Fall
Alibates Ruin 28-058	Structure
Alibates Ruin 28-060	Structure
Alibates Ruin 28-065	Structure
Alibates Ruin 28-066	Structure
Alibates Ruin 28-067	Structure
Alibates Ruin 28-074	Unknown

Group 3 has nine sherds (Table 10). This group is entirely comprised of sherds from Landergin Mesa. These sherds were all recovered from varying areas across the site.

Table 10. The Location, Number, and Context of Samples in Group 3.

Sherd Site Location and Number in Group 3	Context within Site
Landergin Mesa-029	Aeolian Fill
Landergin Mesa-031	Structure
Landergin Mesa-032	Fill Over Structure
Landergin Mesa-036	Exterior Wall fall
Landergin Mesa-037	Exterior Wall fall
Landergin Mesa-038	Exterior Wall fall
Landergin Mesa-040	Fill Over structure
Landergin Mesa-044	Fill
Landergin Mesa-046	Structure

Group 4 has sixteen samples. Four of the sherds were from the 41PT109 sample group, three from Landergin Mesa, and nine from Alibates Ruin 28 (Table 11). Three of the 41PT109 sherds were found within the structure in differing units and one sherd was recovered from the midden. Of three sherds from Landergin, one was found *in situ* (Landergin Mesa-026) and the other two were found on the surface (Landergin Mesa-028 and 042). The contexts of the nine samples from Alibates Ruin 28 are from Unit I and II excavation phases. Alibates Ruin 28-051, 053, 054, 056, 068, 070, and 071 are from Unit I area excavations. Alibates Ruin28-063, 064 are from Unit II.

Table 11. The Location, Number, and Context of Samples in Group 4.

Sherd Site Location and Number in Group 4	Context within Site
41PT109-004	Structure
41PT109-007	Structure
41PT109-009	Structure
41PT109-017	Midden
Landergin Mesa-026	Structure
Landergin Mesa-028	Surface
Landergin Mesa-042	Surface- Base of mesa
Alibates Ruin 28-051	Unknown
Alibates Ruin 28-053	Unknown
Alibates Ruin 28-054	Unknown
Alibates Ruin 28-056	Unknown
Alibates Ruin 28-063	Structure
Alibates Ruin 28-064	Structure
Alibates Ruin 28-068	Structure
Alibates Ruin 28-070	Structure
Alibates Ruin 28-071	Structure

Group 5 has twenty samples (Table 12). Five of the samples are from 41PT109, eleven from Landergin Mesa, and four from Alibates Ruin 28. The samples from 41PT109 are pit, midden, and structure. None of the samples are from the same units. The Landergin Mesa sherds are from differing areas and differing units from across the site, except for Landergin Mesa-046 and 047. These two sherds were recovered from within the structure. Two of the Alibates Ruin 28 sherds were from the Unit I area and one sherd from the Unit II area.

Table 12. The Location, Number, and Context of Samples in Group 5.

Sherd Site Location and Number in Group 5	Context within Site
41PT109-005	Pit
41PT109-013	Midden
41PT109-018	Midden
41PT109-020	Structure
41PT109-021	Structure
Landergin Mesa-027	Structure
Landergin Mesa-030	Not Given
Landergin Mesa-033	Structure
Landergin Mesa-034	Pit
Landergin Mesa-041	Fill Over Structure
Landergin Mesa-043	Structure
Landergin Mesa-045	Structure
Landergin Mesa-047	Structure
Landergin Mesa-048	Midden
Landergin Mesa-049	Midden
Landergin Mesa-050	Structure
Alibates Ruin 28-057	Unknown
Alibates Ruin 28-061	Structure
Alibates Ruin 28-069	Structure
Alibates Ruin 28-073	Unknown

Six sherds were unable to be assigned to any of the groups defined in this study (Table 13). This sample accounts for 8% of the total sherds submitted for INAA. Two of the sherds were from 41PT109 and four from Alibates Ruin 28. All of the sherds from Landergin Mesa were assigned to a group.

Table 13. The Location, Number, and Context of Samples Unassigned.

Sherd Site Location and Number that were Unassigned	Context within Site
41PT109-011	Structure
41PT109-014	Midden
Alibates Ruin 28-055	Unknown
Alibates Ruin 28-059	Structure
Alibates Ruin 28-072	Unknown
Alibates Ruin 28-075	Unknown

Clay/Temper Sourcing Samples

The clay/temper samples provided interesting results. After plotting, two samples were discarded. Alibates Ruin 28-080 and 081. Both samples were taken from an ash deposit from Alibates National Monument to discern the use as a possible tempering material. It is assumed form these results that the ash deposit was not exploited as a temper material. After discarding of the two samples, they were projected on the bivariate plot comparing principle components 1 and 2 (Figure 21). Of the remaining clay/temper samples (n=13), only six plotted within or near existing groups. Alibates Ruin 28-077 plotted within group 5 and was confirmed using the Mahalanobis distance calculation. This clay sample was taken from the stream adjacent to Alibates Ruin 28 on Alibates National Monument. Landergin Mesa-084 plotted near the boundary of group 4.

According to Mahalanobis, this classification is correct. Sample Landergin Mesa-084 was taken from an alluvial clay deposit in Almosa Creek. Landergin Mesa-085 plotted with Landergin Mesa-084 near to group 4. This sample was taken from Landergin Mesa. 41PT109-088 plotted in group 2 and is most likely to belong to that group based on Mahalanobis distance calculations. This sample was taken from West Amarillo Creek near 41PT109. 41PT109-090 plotted with group 2 but according to Mahalanobis has a higher probability of belonging to group 1. This sample was taken from West Amarillo Creek near 41PT109.

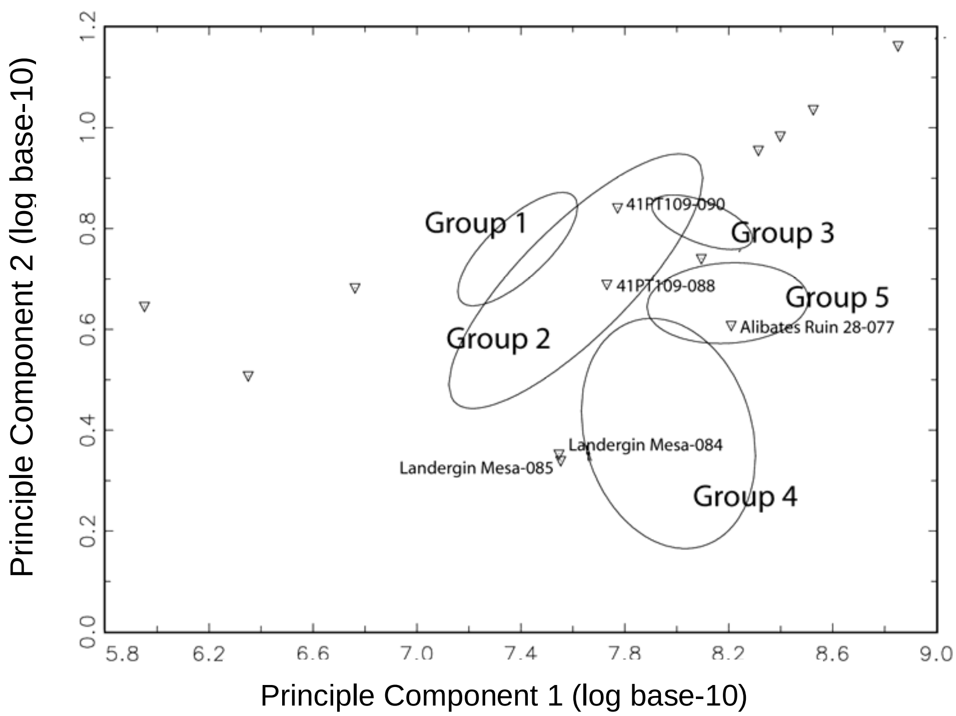

Figure 21. Bivariate Plot of principle components 1 and 2 log base-10 Showing the Relationship of Groups 1 through 5 to Clay Samples. Confidence ellipse is 90%.

The INAA analysis of clay may provide complications to the results. 1. The raw material is not paste 2. Potters may have used the same source and different pastes 3. The manipulation of the raw material may make true provenience difficult to impossible to locate (Neff 2000:118).

Implications of Data

Analysis suggest that group 1, samples 41PT109-22, 23,24,25 maybe from the same vessel. A similar sequence of sample numbers is in group 3. This sequential order is merely coincidence. Sample numbers were used arbitrarily and have no correlation to provenience. Each sherd is linked by number to the site excavation number and then linked to provenience information. This is supplied in Appendix B.

When using elemental comparisons, with the same groups discussed above, the most separation occurred when plotting chromium and cerium on a bivariate plot in log base 10 part per million (Figure 22). There is overlap between Groups 1 and 2, Groups 2 and 3, and Groups 4 and 5.

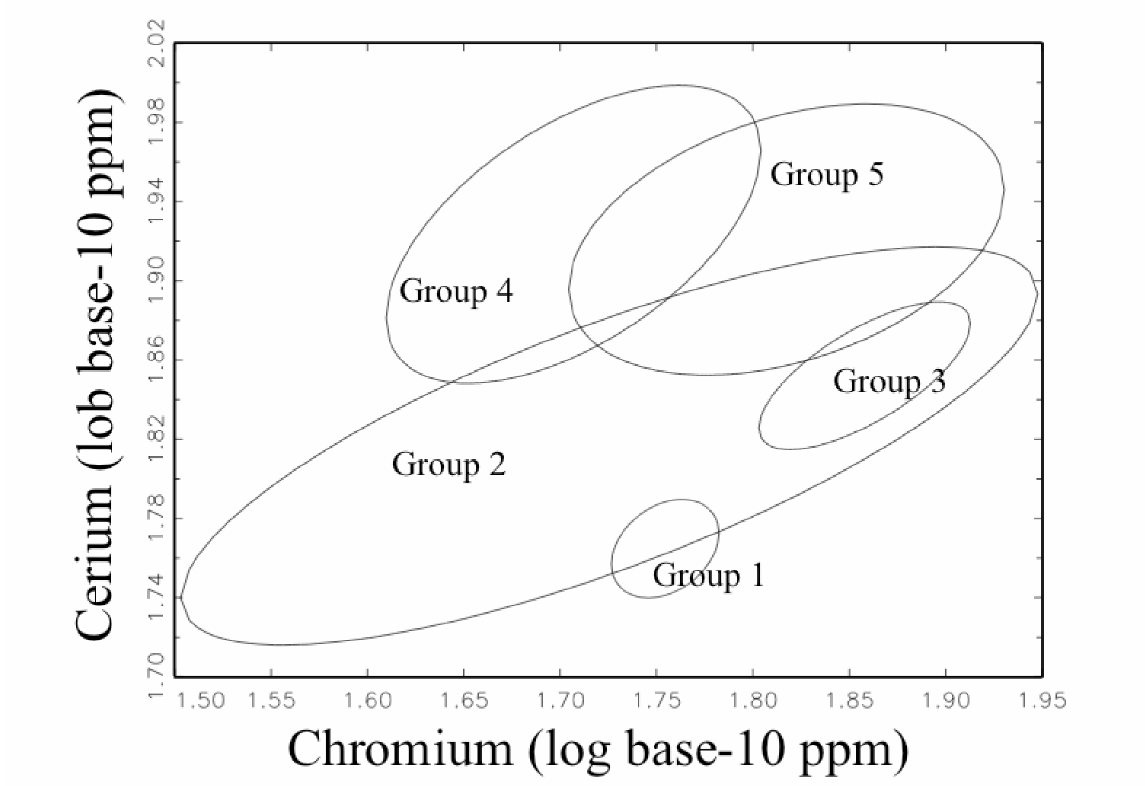

Figure 22. Bivariate plot of Chromium and Cerium log base-10 Showing the Relationship Between Groups 1 through 5. Confidence ellipse is 90%.

Areas of manufacture can be identified by sourcing clays or by the "criterion of abundance" (Bishop et al. 1982:275). This is a concept that higher concentrations indicate a locus of manufacture (Neff 2000:112). Using this principle, group 1 would indicate 41PT109 as a manufacturing site; group 2 is a split between 41PT109 and Alibates Ruin 28, group 3 from Landergin Mesa, group 4 from Alibates Ruin 28, and group 5 from Landergin Mesa.

Group 1 is primarily sherds from 41PT109 (n=6). There is one sherd from Alibates Ruin 28. Group 1 may be at 41PT109. This assumption is enforced with association of 41PT109-090 sourced from the isolated site, 41PT109, belonging to group 1. Group 2 has nearly equal parts of 41PT109 (n=7) an Alibates Ruin 28 (n=6). There are also two sherds from Landergin Mesa. Using the “criterion of abundance,” group 2 is probably manufactured near 41PT109 (Bishop et al. 1982:275). 41PT109-088 and 089 are from West Amarillo Creek and point to of production at 41PT109 and confirm the “criterion of abundance” assumption. This would indicate the potters from 41PT109 were using various clay sources and exporting them to the larger sites. Another possibility is the paste, clay and tempering materials, of these vessels may have been similar but variable and thus caused overlap in elemental bivariate plots, but not in principle component plots.

There is also overlap between group 2 and group 3. Group 2 has been described and linked to 41PT109 as a production site. Group 3 is comprised only of sherds from Landergin Mesa (n=9). No clay samples could be sourced to this group. This may be a case of similar ceramic recipe. The sherds in group 2 from Landergin Mesa show little similarity to group 3.

Groups 4 and 5 have overlap in the elemental bivariate plot. These two are the largest groups with sixteen and twenty samples respectively. Group 4 has a majority of samples from Alibates Ruin 28 (n=9), four from 41PT109, and three from Landergin Mesa. Two clay samples, Landergin Mesa-084 and 085, belong to group 4 and were both recovered from Alamosa Creek near Landergin Mesa. These sample plot very close the group 4, but not within the 90% confidence ellipse. Group 5 has eleven sherds from Landergin Mesa, five from 41PT109, and four from Alibates Ruin 28. Once again using the “criterion of abundance” suggests that group 4 is manufactured at Alibates Ruin 28, but the sourcing analysis suggests otherwise. This group is sourced to Landergin Mesa. Using the “criterion of abundance,” group 5 should be from Landergin Mesa, but clay sourcing, sample Alibates Ruin-077, suggests that manufacture occurred at Alibates Ruin 28 (Bishop et al. 1982:275). The inclusion of sherds from Landergin Mesa and Alibates Ruin 28 into groups 4 and 5 may account for the overlap between the two groups. Another reason for overlap, maybe a similar recipe for these ceramics when comparing chromium and cerium on a bivariate plot.

When looking at the groups in principle component analysis there is little overlap. This may be due to the very nature of principle component analysis. Principle component analysis links the largest concentrations of elements in thirty-one components. Elemental discriminate analysis examines every element concentration.

CHAPTER VI

CONCLUSION AND FUTURE RESEARCH

Initial analyses lead me to a research questions and hypothesis centered on the possible production zones of the Borger Cordmarked ceramics samples. The use of INAA provided data that can be analyzed to help determine the production zones of the ceramics of Antelope Creek phase sites. By using both isolated and contiguous room structures, the analysis of trade within the different architectural phases and different social groups can be examined. This study sought to answer what sources are preferred for ceramic production. Is there trade of locally produced ceramics within the Antelope Creek phase? What is the relationship between settlement size and exchange? Is trade reciprocal or uni-directional between large and small villages? Can this data be used to determine patterns of trade and exchange? What wider implications can be made from determining possible trade routes? Can different models of exchange be used to explain the movement of utilitarian wares vs. long distance exotic wares? Is there a correlation between lithic materials and ceramic materials in terms of the nature and scale of trade?

The results in this study disprove my original hypothesis. I had theorized that the variation of ceramics would be greatest at larger sites. This would be due to an influx of cultivated foods carried in the vessels from the smaller site into the larger sites. The data shows otherwise and upon re-analysis, my initial hypothesis could not be correct (see Figure 16).

According to Lintz and various absolute dating methods, aggregate villages occur earlier in the phase than isolated structures. This would also imply that the three sites selected for analysis are not as contemporary as the radiocarbon dates suggests (Table 4). Landergin Mesa (A.D. 1250-1380) and Alibates Ruin 28 (A.D. 1340-1410) may overlap, but the single radiocarbon assay dating 41PT109 to A.D. 1420 may be a misleading date. This can be evaluated by submitting more samples from 41PT109 for dating. The late date of A.D. 1420 suggests that there would have been no direct exchange between 41PT109 and either Landergin Mesa or Alibates Ruin 28. But this is still not the case. Ceramics from both large sites are present at 41PT109 in group 1, group 2, group 4, and group 5. Unfortunately, due to the small samples size no definitive conclusions can be made. I suggest two hypotheses: 1) Antelope Creek people were traveling from their habitation sites to these larger sites to exploit raw materials or 2) The chronology of site habitation is incorrect and there was interaction between contiguous and isolated sites.

The chemical variation of the ceramics recovered from 41PT109 may also be attributed to exploitation of clay sources that the larger sites had previously used. In this case, the people would not have traveled with their vessels, but would have procured the raw material closest to the larger sites of former habitation at Alibates Ruin 28 and Landergin Mesa. The traveling of the habitants of 41PT109 to Alibates Ruin, approximately 24 km west, is not likely. The two sites are relatively close and Alibates is near to the quarries. Despite the close proximity of 41PT109 to the quarries, the archaeologists recovered very few Alibates cores and those catalogued were very small. This could indicate limited control and restricted access to the Alibates area. Further research is needed to test these hypotheses.

Travel from 41PT109 to Landergin Mesa is a bit more difficult, nearly 42 km from 41PT109 over rugged terrain. Landergin Mesa may have been a defensive location or possibly a ceremonial site of some kind (Lintz 1990). The precarious nature of the site and the identification of a central plaza suggest a different purpose for this site. The INAA evidence suggests some sort of interaction, but is relatively unclear at this time. Interaction between Alibates Ruin 28 and Landergin Mesa have primarily dealt with the procurement of raw lithic material.

Future Research

In order to better evaluate the possible situations regarding vessel variability, I suggest additional radiocarbon dates along with excavation of more isolated homesteads, and expansion of the INAA database of Borger Cordmarked ceramics. The radiocarbon assays will help to further refine the architectural switch within the Antelope Creek Phase and to better understand the cultural migration. Ceramics are an indicator of the people who made them. I believe that further analysis of the Borger Cordmarked style, as opposed to Alibates silicified dolomite, will lead to a greater understanding of the interaction within the Antelope Creek society. Additional excavations of isolated homesteads are needed to gain a better sample of sherds found at this type of site. Further INAA samples need to be run from all Antelope Creek phase structures to expand the database of chemical compositions within the Texas and Oklahoma panhandles. This can be used to help determine the interactions between sites within the Antelope Creek Phase regardless of the architectural sub-phase.

APPENDIX A

FINAL GROUPS

Site and Number	Group
41PT109-001	Group 1
41PT109-002	Group 2
41PT109-003	Group 2
41PT109-004	Group 4
41PT109-005	Group 5
41PT109-006	Group 2
41PT109-007	Group 4
41PT109-008	Group 2
41PT109-009	Group 4
41PT109-010	Group 2
41PT109-011	Unassigned
41PT109-012	Group 2
41PT109-013	Group 5
41PT109-014	Unassigned
41PT109-015	Group 1
41PT109-016	Group 2
41PT109-017	Group 4
41PT109-018	Group 5
41PT109-019	Group 2
41PT109-020	Group 5
41PT109-021	Group 5
41PT109-022	Group 1
41PT109-023	Group 1
41PT109-024	Group 1
41PT109-025	Group 1
Landergin Mesa-026	Group 4
Landergin Mesa-027	Group 5
Landergin Mesa-028	Group 4
Landergin Mesa-029	Group 3
Landergin Mesa-030	Group 5
Landergin Mesa-031	Group 3
Landergin Mesa-032	Group 3
Landergin Mesa-033	Group 5
Landergin Mesa-034	Group 5
Landergin Mesa-035	Group 2
Landergin Mesa-036	Group 3

Landergin Mesa-037	Group 3
Landergin Mesa-038	Group 3
Landergin Mesa-039	Group 2
Landergin Mesa-040	Group 3
Landergin Mesa-041	Group 5
Landergin Mesa-042	Group 4
Landergin Mesa-043	Group 5
Landergin Mesa-044	Group 3
Landergin Mesa-045	Group 5
Landergin Mesa-046	Group 3
Landergin Mesa-047	Group 5
Landergin Mesa-048	Group 5
Landergin Mesa-049	Group 5
Landergin Mesa-050	Group 5
Alibates Ruin 28-051	Group 4
Alibates Ruin 28-052	Group 4
Alibates Ruin 28-053	Group 4
Alibates Ruin 28-054	Group 4
Alibates Ruin 28-055	Unassigned
Alibates Ruin 28-056	Group 4
Alibates Ruin 28-057	Group 5
Alibates Ruin 28-058	Group 2
Alibates Ruin 28-059	Unassigned
Alibates Ruin 28-060	Group 2
Alibates Ruin 28-061	Group 5
Alibates Ruin 28-062	Group 1
Alibates Ruin 28-063	Group 4
Alibates Ruin 28-064	Group 4
Alibates Ruin 28-065	Group 2
Alibates Ruin 28-066	Group 2
Alibates Ruin 28-067	Group 2
Alibates Ruin 28-068	Group 4
Alibates Ruin 28-069	Group 5
Alibates Ruin 28-070	Group 4
Alibates Ruin 28-071	Group 4
Alibates Ruin 28-072	Unassigned
Alibates Ruin 28-073	Group 5
Alibates Ruin 28-074	Group 2
Alibates Ruin 28-075	Unassigned

APPENDIX B

SITE AND SAMPLE NUMBER CORRELATED TO ANID

41PT109-001	HAM001
41PT109-002	HAM002
41PT109-003	HAM003
41PT109-004	HAM004
41PT109-005	HAM005
41PT109-006	HAM006
41PT109-007	HAM007
41PT109-008	HAM008
41PT109-009	HAM009
41PT109-010	HAM010
41PT109-011	HAM011
41PT109-012	HAM012
41PT109-013	HAM013
41PT109-014	HAM014
41PT109-015	HAM015
41PT109-016	HAM016
41PT109-017	HAM017
41PT109-018	HAM018
41PT109-019	HAM019
41PT109-020	HAM020
41PT109-021	HAM021
41PT109-022	HAM022
41PT109-023	HAM023
41PT109-024	HAM024
41PT109-025	HAM025
Landergin Mesa-026	HAM026
Landergin Mesa-027	HAM027
Landergin Mesa-028	HAM028
Landergin Mesa-029	HAM029
Landergin Mesa-030	HAM030
Landergin Mesa-031	HAM031
Landergin Mesa-032	HAM032
Landergin Mesa-033	HAM033
Landergin Mesa-034	HAM034
Landergin Mesa-035	HAM035
Landergin Mesa-036	HAM036
Landergin Mesa-037	HAM037

Landergin Mesa-038	HAM038
Landergin Mesa-039	HAM039
Landergin Mesa-040	HAM040
Landergin Mesa-041	HAM041
Landergin Mesa-042	HAM042
Landergin Mesa-043	HAM043
Landergin Mesa-044	HAM044
Landergin Mesa-045	HAM045
Landergin Mesa-046	HAM046
Landergin Mesa-047	HAM047
Landergin Mesa-048	HAM048
Landergin Mesa-049	HAM049
Landergin Mesa-050	HAM050
Alibates Ruin 28-051	HAM051
Alibates Ruin 28-052	HAM052
Alibates Ruin 28-053	HAM053
Alibates Ruin 28-054	HAM054
Alibates Ruin 28-055	HAM055
Alibates Ruin 28-056	HAM056
Alibates Ruin 28-057	HAM057
Alibates Ruin 28-058	HAM058
Alibates Ruin 28-059	HAM059
Alibates Ruin 28-060	HAM060
Alibates Ruin 28-061	HAM061
Alibates Ruin 28-062	HAM062
Alibates Ruin 28-063	HAM063
Alibates Ruin 28-064	HAM064
Alibates Ruin 28-065	HAM065
Alibates Ruin 28-066	HAM066
Alibates Ruin 28-067	HAM067
Alibates Ruin 28-068	HAM068
Alibates Ruin 28-069	HAM069
Alibates Ruin 28-070	HAM070
Alibates Ruin 28-071	HAM071
Alibates Ruin 28-072	HAM072
Alibates Ruin 28-073	HAM073
Alibates Ruin 28-074	HAM074
Alibates Ruin 28-075	HAM075

APPENDIX C

INAA RAW DATA

Data begins on Page 70.

Long Count

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM001	2.5781	26.0871	0.3713	24.3460	5.0444	1.7881	2.4623	54.7055	11.9828	52.5740	3.7252	1.0179	25933.8	4.0533	0.00	78.12	0.4478	10.8484	198.50	0.7736	0.7629	9.0592	63.34	98.52
HAM002	6.2673	33.5570	0.3746	30.3159	6.0114	3.1649	2.6021	68.2519	7.0981	61.0075	6.4169	1.1012	30459.0	4.3245	0.00	81.55	0.8887	11.3230	265.42	1.0244	0.7118	11.9030	101.05	124.22
HAM003	5.7156	33.7977	0.3847	26.7830	5.9307	3.4677	2.6194	70.6684	7.4732	58.6311	6.1922	1.1222	30319.6	4.7028	0.00	82.06	1.0036	11.3617	241.46	1.0440	0.8114	11.5836	96.92	143.11
HAM004	2.8570	37.3789	0.4649	32.6319	6.9361	2.5546	3.3620	73.0257	6.7968	44.8894	3.4868	1.3140	28328.4	5.0884	18.83	71.50	0.5268	10.0567	305.74	0.9327	0.9799	10.7828	86.76	135.36
HAM005	10.5602	38.3280	0.7295	35.9585	7.4794	2.9587	4.9642	82.4782	13.1268	63.5721	5.9833	1.2685	34595.4	5.3258	31.19	117.84	1.8378	13.2371	189.44	1.0822	1.1911	12.1926	79.85	139.14
HAM006	7.8026	25.6955	0.3335	22.0887	4.6227	3.3659	2.3003	52.4361	7.5989	32.7667	3.0195	0.9115	21007.4	5.1237	0.00	63.30	0.5539	7.2866	321.02	0.7894	0.5725	8.0764	53.70	166.31
HAM007	3.7297	37.4343	0.4664	33.6484	7.0632	3.0225	3.3268	76.6555	7.2335	46.9499	3.2781	1.3544	30177.4	5.2143	41.99	68.86	0.5996	10.3195	367.55	0.9706	0.8943	10.9351	86.75	139.24
HAM008	4.3054	33.0116	0.3885	27.4925	5.7252	2.9752	2.6529	65.2421	7.5399	56.0321	5.0771	1.0767	29471.9	4.9142	0.00	74.00	0.8114	10.9691	235.55	1.0197	0.6686	11.2818	85.75	127.19
HAM009	3.4919	37.4486	0.4579	32.5899	7.0443	2.7441	3.1443	77.1790	7.6158	46.1963	3.0237	1.3662	29102.9	5.0863	32.14	67.60	0.6725	10.3326	265.48	0.9247	0.9017	10.9845	82.95	156.25
HAM010	4.7811	28.1481	0.4074	26.0757	5.6683	2.6809	2.9380	60.4669	9.3806	60.1503	3.5112	1.1461	28357.2	6.0996	0.00	72.51	0.7210	9.5097	130.28	1.3572	0.8012	9.3170	54.95	175.09
HAM011	2.0452	4.3927	0.0471	0.0000	0.8363	1.7413	0.3208	7.5470	1.0566	4.0108	0.2954	0.1532	2892.1	1.1357	0.00	7.46	0.0999	0.7796	902.99	0.0869	0.1011	1.1037	9.83	35.78
HAM012	5.2153	34.3226	0.4027	27.9209	6.0274	3.6807	2.7938	68.2074	7.9510	60.2920	6.7819	1.1385	26692.7	4.7223	0.00	92.28	0.8014	10.8526	218.46	0.9567	0.7530	11.4359	81.49	131.19
HAM013	5.6796	33.6477	0.4889	29.6806	6.3146	4.0159	3.4365	73.3500	9.6521	57.5426	5.0200	1.0995	30292.9	4.7024	23.18	123.42	0.7646	10.6780	253.23	1.1375	0.8170	16.7236	91.46	142.84
HAM014	1.2968	5.1764	0.0771	4.0411	0.8519	1.1953	0.4745	8.7791	0.9784	4.0229	0.3363	0.1874	2962.3	1.2623	0.00	14.40	0.1069	0.7787	393.56	0.0739	0.1162	1.1137	9.84	46.33
HAM015	3.0387	26.5434	0.3455	24.2469	5.1502	2.1715	2.2972	55.1857	8.4000	55.8373	3.4735	1.0189	26320.0	5.9855	0.00	64.16	0.5809	8.7482	190.02	0.8251	0.6529	8.5607	58.25	167.87
HAM016	8.4707	25.2505	0.3644	22.2408	4.5726	3.0051	2.5015	51.7018	7.8454	34.6017	2.9782	0.9080	20722.0	5.2997	0.00	60.53	0.5119	7.1999	390.52	0.7476	0.6003	7.9063	53.08	144.11

Long Count Continued

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM017	5.5355	29.7953	0.6091	26.9882	6.1173	3.4223	4.4425	69.2563	7.2668	42.3734	4.5104	1.0002	26453.3	7.9200	0.00	117.09	0.5991	8.0059	168.14	1.3837	0.8708	13.3213	79.63	182.64
HAM018	5.7251	38.3537	0.6069	32.7613	7.1237	3.1710	4.1493	78.9723	14.6619	69.9254	7.0997	1.3319	37157.4	5.2916	38.65	139.39	1.2314	14.3581	190.14	1.0592	0.9320	12.3135	85.61	139.82
HAM019	9.2141	33.2449	0.3479	27.5949	5.6548	3.2547	2.3890	66.2925	7.5976	59.1634	5.0743	1.0501	27926.4	4.6940	29.99	59.29	0.9089	10.0546	421.21	1.0965	0.6358	11.3030	63.70	129.21
HAM020	7.2016	37.8645	0.5711	36.9253	6.8933	3.5959	4.0960	80.3978	9.8072	74.6391	6.1760	1.2059	38580.4	5.3557	24.85	89.78	0.7303	13.6996	448.32	1.2207	0.9569	13.1603	100.30	151.24
HAM021	8.2110	38.8455	0.4631	32.6127	6.9457	3.7129	3.3025	82.0914	9.3226	61.4402	5.4244	1.2660	31320.4	5.8684	0.00	90.94	1.0151	11.2373	267.89	1.1058	0.9044	12.2125	90.24	153.54
HAM022	4.4425	27.8199	0.3611	25.2779	5.5659	2.1985	2.5469	59.2012	9.2031	57.1495	3.5271	1.1095	28100.2	6.3171	0.00	71.12	0.7043	9.3022	179.68	0.8649	0.6832	9.1741	58.37	162.08
HAM023	2.6284	25.9209	0.3649	23.2860	5.1221	1.7635	2.7107	55.3814	12.2778	53.2174	3.6961	1.0336	25924.9	4.1953	0.00	80.35	0.4716	10.9833	201.44	0.7525	0.6651	9.1188	64.42	115.73
HAM024	3.4233	26.8623	0.3408	24.1682	5.0864	1.9836	2.3880	55.4305	12.6494	52.9918	4.2033	1.0291	25648.4	4.2031	0.00	82.34	0.4931	10.9202	227.87	0.7461	0.6073	9.1089	61.16	106.91
HAM025	2.8871	27.2694	0.3488	24.9558	5.1021	1.8752	2.6405	56.3157	12.4596	53.4955	4.1395	1.0180	26217.8	3.9829	0.00	80.20	0.4945	11.1132	224.92	0.7800	0.6038	9.2759	65.63	141.51
HAM026	5.2689	36.0693	0.4584	29.5849	6.5786	4.6130	3.2756	74.6658	10.0045	53.8106	5.5502	1.1719	30846.9	5.4735	0.00	112.62	0.5013	11.3544	173.98	1.2659	0.9727	12.5373	83.87	139.06
HAM027	11.3051	31.7007	0.4107	32.6579	7.4007	16.5237	2.7575	68.0279	22.7858	60.2474	4.6065	1.1292	25277.3	6.8389	0.00	116.26	0.6005	10.8432	211.65	1.0149	0.7660	10.7797	69.46	287.96
HAM028	3.0512	35.2204	0.5243	36.2490	7.5263	2.0767	3.7981	78.8425	9.1379	46.2192	5.2833	1.1286	29139.9	7.4524	33.40	121.77	0.5312	8.9679	143.22	0.8475	0.9925	9.8339	62.97	192.78
HAM029	7.3889	29.0312	0.3628	26.9702	5.3123	2.1717	2.4716	60.1068	11.1679	57.2608	5.3565	0.9867	35888.5	4.4577	27.56	101.64	1.2783	10.8852	298.34	0.8416	0.8583	9.5725	70.30	131.24
HAM030	7.1920	39.7138	0.6772	35.9383	7.9333	5.0822	4.6918	85.0281	15.7952	72.6038	6.4715	1.3647	31007.2	5.9812	27.94	147.08	0.5877	13.8980	182.79	1.1701	1.0865	11.5059	95.27	150.10
HAM031	7.8720	28.7642	0.3581	36.8312	5.3005	2.0562	2.3726	59.7896	11.5913	60.9412	5.4168	1.0304	37141.2	4.4529	32.45	104.22	1.3128	11.2845	262.52	0.9299	0.5913	9.8102	70.38	113.91
HAM032	3.4411	32.8522	0.4209	26.9977	6.0898	3.4046	2.6792	70.0586	14.2082	70.4654	5.9724	1.1968	38335.6	4.8542	0.00	126.35	1.1091	13.4405	323.46	0.9902	0.7143	11.6222	75.72	121.16
HAM033	5.7261	37.0314	0.5324	33.2751	7.1099	3.1778	3.6300	81.6177	11.7552	68.7019	5.6423	1.2149	40832.1	5.8422	37.41	127.69	1.1245	13.2368	178.43	1.1714	0.9147	12.5217	81.90	157.34
HAM034	5.5921	35.8381	0.4576	31.2809	6.4498	5.1391	3.0683	79.0236	9.9553	50.4522	6.7871	1.1909	31099.5	6.0574	22.33	103.77	0.6963	11.2066	332.91	1.0165	0.9178	11.7199	89.80	162.31

Long Count Continued

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM035	3.8255	26.7861	0.3589	24.2051	5.1379	4.5013	2.3689	56.7347	12.6341	53.2384	4.3501	0.9942	23038.9	6.8079	0.00	76.16	0.5713	9.8669	158.94	0.9020	0.5937	10.1660	57.51	213.80
HAM036	5.3487	30.2271	0.3691	33.9321	5.3305	2.5553	2.6211	63.5368	12.5335	64.4545	4.7710	1.0432	40904.6	5.0091	0.00	112.18	0.8509	12.2358	345.62	0.8848	0.6168	11.1065	72.11	135.90
HAM037	4.0628	33.3378	0.4235	31.0909	6.1816	3.4188	3.0632	70.5783	14.1296	72.6177	6.1245	1.2212	38725.0	5.1401	0.00	133.27	1.2138	13.7885	297.80	0.9579	0.7109	11.3483	77.32	172.09
HAM038	5.6858	28.2509	0.3513	35.5634	5.1075	2.0160	2.4064	59.2249	11.2472	58.4572	4.8715	0.9990	36168.0	4.4231	0.00	95.60	1.0704	10.9305	305.44	0.8727	0.5922	9.4306	70.39	124.21
HAM039	5.2093	30.0009	0.3736	31.2748	5.6088	2.2905	2.6051	62.9285	11.1335	58.3344	4.6166	0.9983	36076.6	4.4457	0.00	89.96	1.0856	11.0199	239.12	0.8186	0.7697	10.0834	63.90	102.78
HAM040	7.2434	30.2301	0.4053	20.4222	5.4006	2.5513	2.8320	63.5961	12.4059	62.9616	5.0104	1.0260	40273.8	4.7974	0.00	111.75	0.9112	12.1044	300.85	0.9575	0.7951	10.7613	71.23	129.54
HAM041	6.5593	37.6236	0.4022	30.4811	5.9033	2.7575	2.8322	76.0497	12.4187	63.1015	4.6851	1.0647	40636.8	5.0201	0.00	110.82	0.8607	12.2360	359.37	0.9330	0.8094	13.6538	73.55	130.82
HAM042	6.0284	38.0671	0.5503	32.9989	7.4180	3.0972	3.8248	79.3256	9.6827	52.7556	4.7439	1.1684	29616.1	7.1646	0.00	131.14	0.7227	10.0003	152.08	1.1693	0.9463	11.6205	59.98	176.71
HAM043	5.8840	36.1364	0.3459	24.4790	5.0410	2.4532	2.3759	69.3994	10.6673	54.0487	5.2993	0.9790	30054.5	4.5516	0.00	119.22	0.4867	11.0744	215.64	1.1506	0.7301	12.6711	60.27	118.41
HAM044	5.4758	32.2113	0.4088	40.2574	6.0786	3.8144	2.9465	67.6891	13.5728	69.2567	5.9327	1.1829	37762.6	4.6236	0.00	125.73	1.1335	13.2370	335.24	0.9154	0.8814	11.0920	78.47	140.09
HAM045	4.4203	42.9074	0.5241	39.4425	8.2668	5.1487	3.7991	93.1705	16.7057	74.2942	5.8527	1.3919	32416.3	6.1512	33.59	140.94	0.6389	14.5036	202.75	1.0900	1.1620	12.1199	106.46	161.06
HAM046	3.7031	31.5538	0.3755	28.3924	5.5930	2.5494	2.6769	65.3472	14.0435	72.4829	6.1844	1.1215	38448.1	4.4886	37.07	141.94	0.6624	14.1800	240.52	1.0019	0.6829	12.0396	83.59	121.64
HAM047	5.6654	41.3914	0.5190	37.6098	7.9073	4.7268	3.5640	88.8158	15.4700	68.5472	5.7392	1.2835	31329.7	6.0259	46.43	137.03	0.5929	13.5214	162.15	1.1192	0.9226	11.8889	94.05	169.49
HAM048	4.8899	35.1193	0.5084	31.4256	6.7981	4.2823	3.5728	74.7637	12.0166	63.8473	6.5200	1.2102	37376.4	5.3414	30.23	133.08	0.8148	12.3862	170.82	1.2716	0.8687	12.0698	75.05	138.87
HAM049	5.2852	37.0074	0.5720	33.4260	7.1306	5.1967	4.0199	77.9323	13.0151	66.2918	7.6676	1.3440	43110.8	5.8956	38.45	149.81	1.0915	13.4667	184.00	1.1900	1.1040	12.3110	80.62	165.40
HAM050	6.6020	32.3124	0.4350	27.5142	6.3943	5.4048	3.0856	69.5740	13.8496	56.7996	4.5497	1.1190	31201.1	6.0959	26.64	111.64	0.5397	11.5008	207.33	0.9738	0.7331	10.9038	66.60	168.83
HAM051	6.5962	33.6667	0.4348	30.4696	6.5243	2.9445	3.2896	72.2615	8.4503	43.2526	2.7095	1.2492	27403.9	6.7242	36.06	74.43	0.5040	8.9797	153.99	0.9071	0.8653	10.0233	79.05	173.31
HAM052	7.0062	33.2649	0.4402	31.9320	6.2871	2.4127	2.9918	73.3939	9.8426	36.4854	2.9307	1.1305	24146.6	6.2510	40.97	82.57	0.5803	8.0880	152.59	1.0163	0.9567	10.0261	70.51	154.08

Long Count Continued

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM053	3.7408	36.0581	0.4352	32.4151	6.9742	2.6075	3.0916	79.5089	8.3520	45.4491	3.3967	1.3212	30219.1	6.4687	0.00	94.71	0.6228	10.1695	278.20	0.9374	1.0312	11.9249	90.94	142.75
HAM054	4.2749	34.3237	0.4441	37.7760	6.7261	2.8935	3.1899	71.0753	8.1404	48.2173	3.4076	1.2771	27105.8	5.4487	30.96	85.42	0.7079	9.3519	223.86	0.9375	1.0555	9.9360	91.66	154.13
HAM055	5.2012	38.8598	0.4824	38.3849	7.5780	3.1018	3.5782	82.9106	7.2536	48.7990	4.1746	1.4208	30696.9	6.4258	0.00	89.04	8.5268	10.4867	214.35	1.0262	1.0158	11.5912	90.50	169.27
HAM056	3.5220	38.4995	0.5481	32.4151	7.3989	3.3227	4.2327	80.7971	9.4069	46.8806	4.4628	1.4112	30121.2	5.9969	34.32	133.80	0.7159	10.3654	239.76	1.2702	1.0310	11.3792	93.01	163.46
HAM057	3.5779	37.9018	0.4601	35.1129	7.2765	2.7022	3.3831	81.7761	6.6638	47.2609	3.6718	1.3662	29257.3	6.0162	0.00	76.77	10.4398	10.2515	216.34	1.0229	1.0811	11.4171	91.62	163.30
HAM058	6.2484	29.2151	0.3206	30.3792	5.3911	1.9658	2.4465	63.8753	12.4686	48.2082	4.1757	1.0719	31075.8	5.2470	45.57	86.99	0.6423	9.7003	180.97	0.8702	0.6877	9.7396	54.14	132.97
HAM059	5.7242	28.4334	0.3154	28.0754	5.2656	1.8762	2.5234	64.1610	12.8762	48.9310	4.5187	1.0379	31375.4	6.2488	0.00	83.43	0.7233	9.6967	112.97	0.8339	0.7280	9.2526	53.75	147.49
HAM060	3.2389	32.2333	0.3737	26.1696	6.3212	2.5261	2.9373	66.8824	10.8103	72.1962	4.0159	1.2313	32349.7	6.6853	0.00	91.61	0.4985	9.9516	284.37	0.9530	0.9741	9.6719	39.12	168.11
HAM061	6.8930	31.4641	0.3556	32.0945	5.9888	1.9537	2.8937	70.8221	9.9038	51.4149	4.5703	1.0846	27046.4	7.4066	21.62	82.54	1.1243	8.8981	136.62	0.9915	0.7189	10.6409	73.18	164.08
HAM062	6.0559	24.3763	0.3258	22.9665	4.4056	1.4057	2.3561	58.4383	9.7671	60.4656	3.2168	0.8211	28916.5	6.8749	33.45	67.80	0.6012	9.3513	85.60	0.8698	0.5593	9.1584	40.72	148.85
HAM063	7.1131	36.4456	0.4443	33.5499	6.7500	3.0918	3.3696	74.8496	13.4016	47.7840	3.0923	1.2252	31589.8	6.4704	0.00	71.70	0.6482	9.9873	267.38	1.0267	0.8837	9.9436	91.71	145.99
HAM064	7.8046	35.3507	0.4328	31.3747	6.5066	2.7906	3.4704	80.4146	9.6157	45.9982	4.2461	1.2182	29414.3	6.9311	45.94	94.40	0.9860	10.0538	121.80	0.9469	0.9826	11.2640	55.52	170.70
HAM065	3.7311	26.0959	0.2907	24.8695	4.7466	2.2720	2.2685	56.1125	5.9097	35.1939	2.8348	0.9348	16066.2	4.7040	0.00	82.13	0.5557	6.7147	229.28	0.7026	0.6190	7.8707	61.20	115.29
HAM066	4.0486	23.8369	0.2927	22.9599	4.4012	2.3661	2.2317	51.4811	5.6190	34.9020	2.8776	0.8840	14871.9	4.9415	0.00	84.17	0.5696	6.2645	231.22	0.6795	0.6095	7.3092	61.46	112.53
HAM067	4.5725	23.7499	0.3003	18.6985	4.0514	2.2226	2.3785	49.3164	7.0545	40.0826	2.5249	0.7932	19983.8	7.1258	0.00	86.67	0.4814	6.7922	147.38	0.6435	0.5877	9.9495	44.87	152.85
HAM068	3.6277	37.2250	0.5915	35.3590	7.8071	3.9813	4.2225	84.3795	8.6892	55.4123	5.0902	1.2777	28024.8	7.4597	0.00	128.95	0.7178	11.3052	191.14	1.1653	1.2218	11.5002	95.10	181.84
HAM069	3.5883	33.9869	0.4188	31.6051	6.6934	4.1341	2.9466	74.2595	11.4643	61.5029	5.9238	1.1317	34613.0	5.2876	0.00	164.33	0.6876	12.0318	147.96	0.9884	0.8063	11.2517	67.30	125.62
HAM070	2.1833	41.0262	0.6815	42.8780	8.9906	3.6473	4.9362	94.0598	8.3187	50.7631	4.5488	1.5063	27872.7	8.0705	0.00	120.50	0.7303	10.7224	192.46	1.2306	1.3034	11.7212	75.98	193.10

Long Count Continued

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM071	5.3616	32.5717	0.4386	28.8700	5.9651	3.4648	3.2770	73.1829	9.9053	45.4311	4.2153	1.0666	28145.9	6.5607	0.00	97.50	0.6464	9.3922	176.13	0.9923	0.8582	10.2236	62.50	162.78
HAM072	4.1969	44.5801	0.4061	38.4530	6.8823	2.9429	2.8828	90.8404	6.2107	39.8947	3.1024	1.2335	27307.4	5.1215	21.76	68.16	0.7496	8.7229	193.71	0.9061	0.8648	11.8202	81.66	113.85
HAM073	9.2891	37.1234	0.4860	32.6968	7.0144	2.9583	3.8494	81.1613	13.6385	55.9729	6.5673	1.3133	36416.5	6.0344	43.74	116.23	1.2176	11.6685	161.81	1.0979	0.9997	11.5729	66.33	155.34
HAM074	7.4636	30.4385	0.3533	26.9850	5.5102	2.3070	2.6485	69.8560	10.6295	47.6590	4.5575	1.0539	28437.3	6.2636	0.00	85.15	0.7160	9.3452	148.10	0.9384	0.6708	9.4214	70.94	158.97
HAM075	3.1805	32.3565	0.4503	27.4481	6.1080	2.3667	3.4372	72.8746	11.6380	62.8489	5.1094	1.0647	37997.9	5.8737	51.06	134.39	0.5921	11.9736	182.67	1.1341	0.8480	10.5234	69.55	109.55
HAM076	1.5435	13.0670	0.1912	13.7038	2.7112	3.5822	1.1164	27.2260	3.6632	34.5061	1.8686	0.5209	6422.5	4.1201	0.00	72.88	0.2215	5.2856	81.86	0.4890	0.3223	4.2213	23.20	128.44
HAM077	33.6830	29.6593	0.4159	28.3048	5.6775	3.1783	3.1367	66.0866	7.9148	49.9904	4.1022	1.1147	25414.7	8.6208	24.35	74.01	1.2929	8.5615	178.01	0.8682	0.8937	9.6450	63.12	209.21
HAM078	0.7512	9.7552	0.2331	11.8942	2.6880	3.1648	1.3598	21.1188	2.2743	30.9388	1.0585	0.6007	3960.9	3.7073	0.00	37.74	0.1581	5.1229	168.33	0.3901	0.4058	2.8723	16.60	102.77
HAM079	6.6575	18.8134	0.2605	18.5530	3.8132	1.7232	1.7940	40.4913	5.8941	66.6838	2.0242	0.8338	17090.6	6.6745	40.98	64.83	0.5205	6.4041	163.02	0.6309	0.5149	5.0831	34.93	155.92
HAM080	4.9228	122.6961	1.2328	97.9285	19.6229	5.7811	9.5820	332.5831	0.7638	2.4705	2.5262	0.9668	19358.8	16.2519	0.00	116.23	0.2333	2.1562	53.07	7.0158	3.0975	46.8032	117.26	283.58
HAM081	9.2224	125.8888	1.2692	94.1773	21.1977	5.1238	10.1170	317.6343	4.0375	8.6037	2.2900	0.8751	25232.6	20.2498	0.00	62.26	0.2455	2.8242	143.45	9.8916	3.3692	61.7104	137.69	315.29
HAM082	14.5160	36.3092	0.4239	35.6307	6.6364	5.7629	2.7995	75.6732	12.5819	69.4346	8.6176	1.2221	35256.1	4.2967	54.38	96.74	1.7584	12.2874	518.87	1.0787	0.7927	12.2612	117.69	156.82
HAM083	9.4567	36.2144	0.3676	27.8802	6.2192	3.4761	2.3931	82.5182	17.8733	89.5919	8.8597	1.3469	50933.8	4.4792	0.00	169.80	0.9070	14.7012	261.84	1.2166	0.7991	12.2882	98.97	102.33
HAM084	5.6863	27.1820	0.3225	26.1318	5.1825	2.0893	2.3530	58.7092	7.5351	41.0171	2.8192	1.0789	16785.9	7.7861	0.00	62.48	0.4853	7.5736	226.44	0.6168	0.7857	7.4242	36.70	189.58
HAM085	9.9171	23.8271	0.3267	22.5254	4.6556	2.5439	2.4907	53.4004	9.4238	39.7146	2.8239	0.9719	11234.9	9.7814	16.87	64.52	0.4820	6.9055	290.43	0.7345	0.7438	7.6518	36.81	228.77
HAM086	7.7357	32.7370	0.3834	28.9881	6.0137	4.2782	2.8479	73.0738	16.9091	84.2649	8.0276	1.2837	48217.9	5.2203	83.83	157.39	0.9848	15.0703	144.42	1.0409	0.7371	11.6500	100.97	141.16
HAM087	9.0756	35.6543	0.3894	29.9279	6.5320	5.2926	2.8034	79.6765	19.1090	98.9834	9.3704	1.3651	57392.9	5.6566	63.97	182.82	1.1127	17.1311	195.81	1.1149	0.8808	13.2590	117.48	127.21

Long Count Continued

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
HAM088	5.9984	27.4203	0.3251	25.8239	5.0006	2.3926	2.5948	59.1736	9.2635	47.4175	3.9552	1.0307	23564.8	6.4509	0.00	67.76	0.6932	8.4543	340.79	0.7945	0.7341	8.3697	68.92	162.46
HAM089	8.0798	28.9307	0.3806	26.0648	5.5088	3.2984	2.7803	63.3250	10.1856	57.1007	4.2637	1.1629	26693.1	8.3926	0.00	77.01	0.7329	9.2469	479.28	0.8779	0.8203	9.2472	71.20	208.71
HAM090	8.3444	26.9602	0.3252	27.6662	5.3987	2.5450	2.4866	66.4942	11.1528	43.4511	3.5540	1.1673	22676.4	6.1913	0.00	68.87	0.5227	8.5285	244.28	0.7300	0.7674	7.1173	63.40	144.47

Short Count

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
HAM001	62725.8	1227.8	20015.3	4.0442	19048.3	225.18	3726.3	2962.5	82.25
HAM002	76252.4	906.2	14124.2	4.2823	17902.9	209.74	2415.0	3408.3	133.16
HAM003	76407.4	877.4	14274.4	4.7000	16734.9	258.34	2477.0	3264.6	135.62
HAM004	64122.5	852.4	39078.9	5.9048	21873.4	237.05	3098.4	3029.5	78.95
HAM005	78978.6	1121.2	11200.5	7.3233	30697.3	275.93	7184.5	3748.3	103.73
HAM006	53180.3	1061.0	48459.9	3.7736	19305.5	452.28	5355.1	2125.4	75.25
HAM007	66296.9	2032.5	34183.3	5.6705	20638.1	249.18	3121.2	3258.1	75.80
HAM008	67067.5	2527.4	13862.1	4.4310	15572.9	239.83	1842.2	3295.0	118.45
HAM009	65337.3	2060.9	31989.0	5.4022	21539.0	278.26	2843.0	2772.7	75.37
HAM010	59770.2	1483.2	7162.6	4.6199	19125.2	303.28	2607.1	2975.7	70.62
HAM011	5524.0	3730.2	333524.8	0.4566	2741.0	109.55	1081.8	297.5	10.27

Short Count Continued

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
HAM012	73272.7	1245.3	20021.0	5.0252	19086.5	278.77	3669.8	2964.2	130.68
HAM013	82629.0	1209.7	10563.4	5.3849	29456.4	429.02	8687.1	2933.9	108.54
HAM014	8985.1	2821.3	198816.5	0.7269	4968.0	131.17	1833.8	404.9	9.22
HAM015	53835.4	901.6	7844.6	4.5773	19636.5	272.19	2299.9	3027.0	63.43
HAM016	54327.2	2381.5	47063.8	3.8122	18300.6	485.32	5155.7	2819.5	78.32
HAM017	74297.9	1646.1	14789.3	6.5401	29782.2	397.50	12041.5	2620.1	90.03
HAM018	83402.9	1185.3	12060.9	7.3408	29294.2	354.50	7766.3	4026.8	107.86
HAM019	74866.0	1714.1	24787.5	4.1583	14625.5	205.05	1977.1	3544.0	123.87
HAM020	84139.5	2638.7	14041.6	5.8584	18917.0	376.63	3053.0	4057.0	151.44
HAM021	74161.0	916.0	7948.4	5.1089	21447.3	451.32	4897.9	3529.5	125.21
HAM022	58264.3	951.2	7523.5	4.3373	17794.2	314.20	2739.5	3000.6	73.32
HAM023	62628.0	1461.5	19165.9	3.8676	18443.4	202.76	3822.2	3471.5	80.98
HAM024	62449.7	938.1	23762.8	4.3299	20236.6	219.29	4083.3	3250.6	82.36
HAM025	62759.5	1031.1	23521.5	4.1546	19767.4	241.52	3896.2	3139.7	86.22
HAM026	79456.0	1375.7	18119.1	5.3268	28495.9	293.11	13320.1	3870.1	120.16
HAM027	75308.5	653.0	34244.5	4.7996	28940.6	318.11	11534.0	3796.3	78.49
HAM028	68441.3	1292.7	35024.3	6.0254	32886.1	501.87	10136.8	3522.9	56.78
HAM029	64082.4	3464.2	49082.2	4.0538	22017.7	352.64	4098.4	3007.0	86.33
HAM030	88531.5	955.9	21907.1	6.2333	37486.3	391.77	7081.2	3751.6	127.40
HAM031	65084.3	3668.5	54606.3	4.2924	21823.8	378.57	3836.4	3246.7	87.10
HAM032	80806.5	3773.4	14091.1	4.6710	29030.1	375.82	6311.7	3627.2	112.39

Short Count Continued

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
HAM033	82334.3	1017.5	20849.6	5.2414	33443.0	419.29	5820.5	4043.2	99.45
HAM034	79082.5	516.4	34552.1	4.4197	28990.8	369.32	9299.3	3329.7	94.60
HAM035	56809.3	450.5	28110.0	3.6818	17764.3	329.05	9343.4	3896.9	80.81
HAM036	74338.0	4770.9	61726.3	3.7574	31155.0	381.94	4753.9	3236.9	111.17
HAM037	80660.6	3689.0	13884.1	4.5987	28432.4	378.28	6466.5	3577.5	115.16
HAM038	63958.7	3941.0	47910.3	3.7416	24037.0	385.04	3944.4	3409.2	80.78
HAM039	63538.4	3877.2	50926.1	4.3429	24665.7	383.44	3910.3	3316.0	79.05
HAM040	74010.3	4853.0	59651.7	4.2525	29691.0	407.84	5572.5	3318.3	99.98
HAM041	73854.0	4907.4	58928.3	4.6786	29160.3	387.13	5637.0	3544.4	102.11
HAM042	73025.5	1190.1	25998.2	6.2621	30691.3	286.56	9058.3	3765.6	81.46
HAM043	72882.6	754.2	54239.7	3.8160	31711.0	374.91	8495.1	2827.6	79.68
HAM044	76843.4	3832.9	16416.2	4.4823	32255.1	370.92	6087.2	3366.3	116.81
HAM045	85520.5	935.1	19129.6	6.4324	39801.7	374.24	5913.1	3564.8	117.59
HAM046	83963.1	901.2	23399.7	4.0134	35009.9	331.77	7153.6	3172.0	94.35
HAM047	84439.7	823.4	20146.5	5.7640	39184.0	290.36	7539.5	3358.1	116.77
HAM048	79299.5	859.2	19637.9	5.2661	35817.9	265.05	6833.3	3397.1	94.63
HAM049	81956.6	561.4	19156.2	6.4651	34175.6	294.29	6224.5	3657.2	97.35
HAM050	76114.8	1017.1	32319.4	4.4376	32060.3	217.56	8443.3	3573.2	98.69
HAM051	63824.4	2305.1	37671.7	5.3210	21286.7	396.33	4762.0	2707.5	75.94
HAM052	61928.7	2516.7	32293.6	4.5797	27773.2	309.09	6368.6	2406.4	57.46
HAM053	68312.6	1156.3	35713.0	4.9625	32401.1	310.83	5105.3	2580.1	79.82

Short Count Continued

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
HAM054	62897.8	641.9	52472.3	4.5409	35592.9	402.20	5970.5	2696.5	71.64
HAM055	64251.5	1182.6	38836.5	5.5238	22182.6	260.04	3772.1	3039.2	72.85
HAM056	70871.0	1108.3	42594.6	5.5043	26437.9	335.24	8429.6	2683.3	78.00
HAM057	64285.4	1046.5	32935.4	5.1669	22431.0	218.67	3951.3	3023.1	74.33
HAM058	63527.1	978.8	14365.0	3.2610	20528.7	1114.70	5339.1	2326.3	59.53
HAM059	62571.2	1108.3	1223.1	3.1767	19480.3	1051.49	4584.3	2222.9	67.33
HAM060	53165.2	666.4	46428.9	4.0015	18011.6	597.64	5303.6	3175.6	43.62
HAM061	61368.1	1313.1	52535.5	4.1849	17786.2	712.27	3422.6	3061.2	94.45
HAM062	56591.1	1176.5	9424.0	3.3752	16077.0	389.53	2181.9	3088.4	70.89
HAM063	60533.7	2262.8	41006.0	4.9740	19159.8	1015.26	4627.8	2652.4	89.93
HAM064	68194.0	1283.5	10031.9	4.6072	23628.4	567.38	7927.4	3163.2	87.88
HAM065	51647.9	514.3	38659.6	3.1985	22752.4	175.13	6424.5	2148.6	77.81
HAM066	57283.3	575.5	38369.1	3.3021	25991.4	172.14	6869.5	2212.9	78.05
HAM067	49970.4	1404.5	33423.4	2.6791	18311.2	379.43	6852.6	2241.5	46.34
HAM068	75365.4	1253.9	39448.2	7.4533	32356.3	366.27	8063.6	2962.5	87.31
HAM069	77390.5	830.0	19733.0	4.4764	36779.6	308.62	9061.7	3051.5	84.48
HAM070	72152.1	1229.2	33818.7	6.6214	32600.8	497.95	9195.2	2865.5	81.39
HAM071	66989.3	1353.9	25826.9	4.8764	25851.1	519.55	8680.0	3285.3	81.34
HAM072	56858.8	1073.7	26561.5	4.7348	17286.2	237.15	3999.8	2587.7	66.94
HAM073	79447.0	967.8	7543.0	5.9702	24616.0	1129.04	6439.7	3273.1	98.58
HAM074	61563.2	606.7	20254.0	3.8015	17368.2	544.00	6340.4	3112.6	79.15

Short Count Continued

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
HAM075	80020.2	1375.8	21361.0	4.9230	34796.5	336.60	8157.6	3139.9	66.17
HAM076	45105.2	365.6	2218.2	1.9813	30218.4	114.83	8077.9	2022.7	52.28
HAM077	49900.0	2214.0	68592.7	4.8712	16690.3	330.29	4063.8	3149.1	117.42
HAM078	25664.4	226.5	135814.1	2.2317	12869.5	1091.10	5776.9	1535.5	39.58
HAM079	45486.5	360.2	3831.6	3.1462	21124.9	219.57	10150.0	2941.2	42.34
HAM080	104320.2	2563.3	3984.6	17.4388	29492.5	393.06	17167.2	1190.5	12.09
HAM081	132745.9	3428.2	8552.6	18.8021	15593.8	345.38	10087.3	1185.1	1.91
HAM082	80040.7	1048.1	108055.6	4.5386	18575.6	315.95	1033.9	3141.2	209.98
HAM083	94967.6	472.8	22388.7	4.9194	29688.2	585.99	11147.8	4843.3	113.84
HAM084	40833.0	2071.9	70211.4	3.7088	14080.6	855.92	8698.2	2695.8	47.89
HAM085	42680.9	2707.5	69747.4	3.7871	13317.8	626.76	8631.6	2758.3	48.89
HAM086	88017.4	508.5	23259.3	4.3430	29643.7	500.38	8089.0	4143.2	118.92
HAM087	103752.6	505.2	18875.2	4.6566	34625.2	494.46	7087.7	4325.3	136.04
HAM088	53240.5	480.9	59967.4	4.0204	16210.5	512.97	4559.0	3445.9	63.38
HAM089	52880.1	444.6	76622.0	4.3756	22140.9	961.72	3468.7	3728.4	75.85
HAM090	45897.1	267.4	83154.7	3.9685	16176.4	1453.60	721.9	2717.0	58.72

APPENDIX D

DATABASE OF SHERDS

Data begins on Page 81.

Appendix D. DATABASE OF SHERDS.

ANID	SPECIFIC #	CONTEXT	TYPE	SIZE (cm)	THICKNESS (mm)	WEIGHT (g)
HAM001	2004 9-1	Midden	body	3x3	2.5	2.2
HAM002	2004 9-2	Midden	body	2x3	2.2	2
HAM003	2004 9-3	Midden	body	4x5	9.1	8.8
HAM004	2004 3-1	Structure	body	2x3	2.6	2.5
HAM005	2004 18-1	Pit	body	2x2	2	2
HAM006	2004 12-1	Pit	body-base	3x3	5.4	5.1
HAM007	2004 8-1	Structure	body	2x3	1.7	1.6
HAM008	2004 6-1	Structure	rim (ind angle)	2x3	2.4	2.2
HAM009	2004 1-2	Structure	body	2x2	1.5	1.2
HAM010	2004 1-1	Structure	body	2x3	2.5	2.2
HAM011	2005 U15 L5	Structure	body	2x2		1.6
HAM012	2005 U16 L6; 5-1/2	Midden	body	3x4	4.8	4.6
HAM013	2005 U16 L6; 5-4	Midden	body	3x4	6.1	5.8
HAM014	2005 U16, L7; 6-1	Midden	body	3x3	2.9	2.8
HAM015	2005 U16 L1	Midden	body	2x3	3.5	3.5
HAM016	2005 U17, L5; 7-8	Midden	base	5x3	20.1	9.6
HAM017	2005 U17, L5; 7-5	Midden	body	2x2	1.6	1.4
HAM018	2005 U17, L6; 8-1	Midden	body	2x3	1.9	1.9
HAM019	2005 U21, L4; 9-1	Structure	neck	2x4	5.3	3
HAM020	2005 U22, L3; 10-1	Structure	body	2x4	4	4.1
HAM021	2005 U22, L5; 11-1	Structure	body	3x4	8.6	8.6
HAM022	2005 U25, L6; 14-1	Midden	body	2x2	1.2	1.1
HAM023	2005 U25, L2; 12-2	Midden	body	2x2	1.1	1.4

ANID	SPECIFIC #	CONTEXT	TYPE	SIZE (cm)	THICKNESS (mm)	WEIGHT (g)
HAM024	2005 U25, L2; 12-1	Midden	body	3x4	3.8	3.7
HAM025	2005 U25, L2; 12-4/5	Midden	body	5x4	9	8.4
HAM026	416-1(1)	Structure	Rim (angle aprox. 30 digress w/ <10% of rim)	95.7x42.7	rim1 4.4 rim2 6.0 body1 7.3 body 2 8.5 (1&2 are respective)	32.1
HAM027	416-1(2)	Structure	Body	57.1x52.6	4.8	18.3
HAM028	78-5	Surface	Body	37.5x27.2	5.7-7.8	7.6
HAM029	82-6	Aeolian fill	Body	51.2x43.6	7.1	21.3
HAM030	86-15	Not given	Body	57.3x38.1	5.4	12.4
HAM031	96-1	Structure	rim (ind angle)	71x47.3	rim 4.8 neck 8.2	28
HAM032	114-1	Fill over structure	Shoulder	50.8x41.7	neck 12.3 body 4.9	19.1
HAM033	99-11	Above laminated floor	Shoulder	39.2x32.7	neck 5.6 body 5.2	6.8
HAM034	108-1	Pit	shoulder	47.4x28.8	neck 9.6 body 4.7	12.1
HAM035	90-1(1)	Exterior wall fall	shoulder	62.1x42.7	neck 7.9 body 6.5	21
HAM036	90-1(2)	Exterior wall fall	body	57.2x25.8	6.7	11.7
HAM037	97-1(1)	Exterior wall fall	rim (ind angle)	46.9x43.8	rim 4.5 n/b 6.0	15.7
HAM038	97-1(2)	Exterior wall fall	body	49.3x35.0	4.9	9.4
HAM039	97-1(3)	Exterior wall fall	body	52.6x40.0	6.4-7.7	18.2
HAM040	112-3(1)	Fill over structure	body	53.4x30.0	6.7	12.4

ANID	SPECIFIC #	CONTEXT	TYPE	SIZE (cm)	THICKNESS (mm)	WEIGHT (g)
HAM041	112-3(2)	Fill over structure	body	49.5x43.1	6.8-7.3	15.3
HAM042	63-4	Base of mesa	body	67.8x69.1	5.9	35.5
HAM043	147-1	Structure	rim (ind angle)	22.4x20.7	rim 3.6 body 5.3	2.2
HAM044	157-1	Fill	body	34.7x30.9	4.1-5.6	5.1
HAM045	243-1(1)	Structure	shoulder	43.8x33.7	neck 6.3 body 5.5	9.7
HAM046	243-1(2)	Structure	body	43.5x32.5	4.6-5.6	8.2
HAM047	243-1(3)	Structure	body	37.3x23.8	4.5	4.9
HAM048	182-1	Midden	body	36.6x26.0	5.2	5.1
HAM049	181-1	Midden	body	45.0x40.8	5	9.6
HAM050	178-2	Hearth	rim (angle aprox 14 degrees w/<5% of rim)	39.8x38.8	rim 5.1 neck/body 5.9	10.4
HAM051	28 A2-52/2(1)	not individual I.D.	Body	39.9x30.3	4.8	6.7
HAM052	28 A2-52/2(2)	not individual I.D.	Body	43.4x27.0	5.5	7.9
HAM053	28 A2-37a/3(1)		Body	55.8x39.7	4.6	12.2
HAM054	28 A2-37a/3(2)		Body	54.6x44.8	5.7-7.1	18.1
HAM055	28 A2-8/3(1)		Body	54.3x42.4	8.0-9.3	21.2
HAM056	28 A2-8/3(2)		Body	57.5x56.0	4.8	24.1
HAM057	28 A2-8/4		Body	55.4x48.7	7.5-8.4	30.3
HAM058	28 A1-18-R2/2		Shoulder	70.7x51.6	7.3	22.5
HAM059	28 A1-18-R2/3		Body	38.9x31.3	7.4	13.3
HAM060	28 A1-18-R2/4		Body	56.6x36.1	5.7-6.4	15

ANID	SPECIFIC #	CONTEXT	TYPE	SIZE (cm)	THICKNESS (mm)	WEIGHT (g)
HAM061	28 A5-R32/1		Rim	33.3x29.7	Rim 3.8 neck/body? 6.2	5.2
HAM062	28 A5-R32/3(1)		Body	72.8x43.0	3.6-5.9	23.9
HAM063	28 A5-R32/3(2)		Body	54.9x45.6	4.4-5.4	16.8
HAM064	28 A5-R32/3(3)	not individual I.D.	Body	54.9x38.7	4.7-5.8	13.9
HAM065	28 RM5/1(1)		Body	57.7x53.1	6.7	31
HAM066	28 RM5/1(2)		Body	52x51.0	4.4-4.7	14
HAM067	28 A1-14-R1/1,2	not individual I.D.	body	35.3x35.9	neck 4.2 body 3.3	6.5
HAM068	28 A1-14-R1/2(1)		Shoulder	69.4x45.3	neck 9.2 body 5.3	28
HAM069	28 A1-14-R1/3,4	not individual I.D.	Body	53.8x35.6	4.6	12.9
HAM070	28 A1-14-R1/2(2)		Body	60.0x54.8	4.9	21.1
HAM071	28 A1-14-R1/4		Body	54.5x50.9	5.7-9.0	31.2
HAM072	28 A1-10/3(1)		Body	58.0x36.0	5.9	16.5
HAM073	28 A1-10/3(2)		Body	89.9x73.0	5.3-8.9	46
HAM074	28 A1-10/1		RIM	63.3x48.9	rim 4.5; neck 7.5; body 6.2	28.5
HAM075	28 A1-10/2		Shoulder	54.7x31.4	5.7-9.2	20

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM001	Grog, Quartz sand grit	1.1	None	None	7.5YR 5/2	7.5YR 5/0	7.5YR 4.5/0	cordmarked, no fiber
HAM002	Grog, Quartz sand grit	1.6	None	None	7.5YR 3/2	7.5YR 4/1	2.5YR 4.5/6	cordmarked, few fibers
HAM003	Grog, Quartz sand grit	1.3	None	None	5YR 3.5/2	7.5YR 3.5/0	7.5YR 5/2	cordmarked, fibers not clear
HAM004	Grog, Quartz sand	0.5	Rare	Rare	7.5YR 2/0	7.5YR 3/1	7.5YR 5/2	cordmarked, unknown fibers
HAM005	Grog, Quartz sand grit	1	None	Rare	7.5YR 2/0	7.5YR 3/1	7.5YR 2/0	cordmarked, many fibers
HAM006	Grog	3	None	Maybe; hard to identify	7.5YR 7/2	7.5YR 3/0	7.5YR 2/0	cordmarked, no fibers
HAM007	Grog, Quartz sand grit	1	None	Common	7.5YR 3.5/2	7.5YR 2/0	7.5YR 2/0	cordmarked? No fibers
HAM008	Grog, Quartz sand grit	1.2	None	Rare	7.5YR 5.5/4	7.5YR 4.5/0	7.5YR 3.5/0	cordmarked, with fibers
HAM009	crushed Quartz grit	1.1	Rare	Rare	7.5YR 3.5/2	7.5YR 3/0	7.5YR 4/2	cordmarked, faint fibers
HAM010	Grog?, Quartz grit	0.8	Rare	Rare	7.5YR 4.5/2	7.5YR 5/2	5YR 5/4	cordmarked, with fibers

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM011	Grog, Quartz sand	2	None	Rare	ind			cordmarked
HAM012	Grog, Rare Quartz	1.3-1.7	Mica	None	5YR 5/1.5			cordmarked
HAM013	Grog, Rare Quartz	0.5	minute Mica	minute Mica	5YR 4.5/2			cordmarked
HAM014	Quartz sand	0.5-1.1	nd	Quartz	ind			cordmarked
HAM015	Grog	1.6	None	None	10YR 5/6			cordmarked
HAM016	Grog	1.6	None	None	7.5YR 7/2			cordmarked
HAM017	Grog, Rare Mica	0.9	Mica	None	5YR 3.5/1			cordmarked
HAM018	Grog, some Mica	1	Mica Rare	Mica Rare	7.5YR 4.5/0			cordmarked
HAM019	Quartz sand	2.5	Mica	Quartz	5YR 5/2			cordmarked
HAM020	Grog, Quartz sand, Mica	1.9	Mica	Mica	2.5YR 5/3			cordmarked
HAM021	Grog, Quartz sand, Mica	q-2.8, m-0.8	Mica	Mica	2.5YR 5/4			cordmarked

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM022	Grog, Mica	0.9	None	None	5YR 6/2			cordmarked
HAM023	Grog	1	None	None	7.5YR 5.5/2			cordmarked
HAM024	Grog, Rare crushed Quartz, Mica	1.1, 1.3	None	Mica	7.5YR 6/2			cordmarked
HAM025	Grog, Quartz sand, fine Mica	0.7	None	Mica	7.5YR 6/2			cordmarked
HAM026	Quartz sand, Mica	1.1	Mica	Mica	5YR 3/1	5YR 4/1	5YR 6/3	cordmarked
HAM027	Grog, Quartz sand	1.5	Mica	Mica	5YR 4/1	7.5YR 6/3	7.5YR 6/1	cordmarked
HAM028	Quartz sand	1	None	Mica	2.5YR 6/4	2.5YR 4/1	5YR 4/1	cordmarked
HAM029	quart sand	0.8	Rare Mica	Rare Mica	5YR 2.5/1	5YR 6/3	2.5YR 6/2	cordmarked
HAM030	Mica	ind	Rare Mica	Rare Mica	7.5YR 5/2	7.5YR 6/2	5YR 6/3	cordmarked
HAM031	Quartz sand	ind	Mica	Mica	7.5YR 2.5/1	7.5YR 6/3	7.5YR 3/1	cordmarked
HAM032	Grog, Quartz sand, Mica	0.9	Mica	Mica	5YR 5/4	7.5YR 5/1	7.5YR 6/3	cordmarked

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM033	Mica	ind	Mica	Mica	5YR 5/1	7.5YR 5/1	10YR 5/1	cordmarked
HAM034	Quartz sand, Mica	ind	Mica	Mica	10YR 5/3	10YR 4/1	7.5YR 5/1	cordmarked
HAM035	Grog, Quartz sand, Mica	1.4	Mica	Mica	10YR 5/2	10YR 6/3	10YR 6/2	cordmarked
HAM036	Quartz sand, Rare Grog	1.2			5YR 4/1	2.5YR 5/4	5YR 4/1	cordmarked
HAM037	Grog, Quartz sand	1	Mica	None	(body) 2.5YR 5/4 & (RIM) 2.5YR 4/1	5YR 4/1	5YR 5/3	cordmarked
HAM038	Quartz grit, Mica	1.4, 3.9	Mica	Mica	10YR 3/1	10YR 5/3	7.5YR 4/1	cordmarked
HAM039	Grog, Quartz grit, Mica	1.4	Mica	Mica	7.5YR 2.5/1	7.5YR 5/3	7.5YR 5/1	cordmarked
HAM040	Quartz sand, Mica	1.4	Mica	Mica	7.5YR 4/2	2.5YR 5/6	5YR 5/1	cordmarked
HAM041	quart sand, Quartz grit	1.2, 1.8	Rare Mica	Mica, Quartz	5YR 2.5/1	2.5YR 6/4	5YR 5/4	cordmarked

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM042	ind	ind			5YR 6/3	5YR 5/3	5YR 5/3	cordmarked
HAM043	Quartz sand, Mica	ind	Rare Mica	Rare Mica	7.5YR 5/4	7.5YR 5/4	5YR 5/3	cordmarked
HAM044	ind	ind	None		5YR 3/1	5YR 3/1	5YR 2.5/1	cordmarked
HAM045	Quartz sand, Mica	ind	Mica	Mica	5YR 6/2	7.5YR 5/3	7.5YR 5/3	cordmarked
HAM046	ind	ind			5YR 4/1	10YR 6/2	10YR 3/1	cordmarked
HAM047	Quartz sand	ind	Rare Mica	None	7.5YR 5/3	5YR 6/3	5YR 5//3	cordmarked
HAM048	Mica	ind	Mica	Mica	5YR 2.5/1	5YR 5/3	5YR 5/1	cordmarked
HAM049	Quartz sand, Mica	ind	Mica	Mica	5YR 5/3	5YR 4/1	5YR 5/1	cordmarked
HAM050	ind	ind	ind		5YR 3/1	7.5YR 4/1	5YR 4/1	cordmarked
HAM051	Quartz sand, Mica	ind	None	Rare Mica	2.5Y3/1	2.5Y 3/1	2.5Y 6/1	cordmarked
HAM052	Quartz sand, Mica	ind	None	Mica	7.5YR 4/1	2.5Y 2.5/1	10YR 4/1	cordmarked
HAM053	Grog, Quartz	0.9	None	Quartz sand	10YR4/1	10YR 2/1	7.5YR 2.5/1	cordmarked

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
	sand							
HAM054	Quartz sand	1	Rare Mica	Quartz sand	2.5Y 4/1	2.5Y 2.5/1	2.5Y 5/2	cordmarked
HAM055	Quartz sand, Mica	ind	Rare Mica	None	2.5Y 4/1	2.5Y 3/1	10YR 4/1	cordmarked
HAM056	Quartz	ind	None	Rare Mica	10 YR 2/1	10YR 3/2	2.5Y 6/1	cordmarked
HAM057	Quartz sand, Mica	0.8-2.4	Rare Mica	Mica, pebble inclusions	7.5YR 4/1	10YR 4/1	10 YR 4/1	cordmarked
HAM058	Quartz sand, Mica	1.0-2.1	None	Rare Mica	2.5Y 2.5/1	7.5YR 5/3	5YR 4/4	cordmarked
HAM059	Quartz sand	1.0-1.7	ind	None	5YR 4/1	5YR 5/3	5YR 4/3	cordmarked
HAM060	Quartz sand	<1.0	Mica	ind	7.5YR 3/1	7.5YR 6/3	7.5YR 5/2	cordmarked
HAM061	Grog, Mica	ind	Mica	Rare Mica	10YR 4/1	5YR 6/4	5YR 4/1	cordmarked
HAM062	ind	ind	Rare Mica	ind	5YR 4/1	5YR 4/1	7.5YR 4/1	cordmarked
HAM063	ind	ind	ind	None	7.5YR 4/1	7.5YR 3/1	7.5YR 2.5/1	cordmarked
HAM064	Quartz sand	.8-1.5	Rare Mica	ind	10YR 3/1	5YR 5/4	5YR 3/2	cordmarked
HAM065	Quartz sand	1.4-2.5	Rare Mica	None	10YR 3/1	10YR 3/1	7.5YR 5/1	cordmarked

ANID	TEMPER TYPE	GRIT TEMPER SIZE (mm)	EXTERIOR SURFACE TEMPER	INTERIOR SURFACE TEMPER	EXTERIOR SURFACE COLOR	INTERIOR SURFACE COLOR	CORE COLOR	EXTERIOR FINISH
HAM066	Quartz sand	1.3-1.7	None	None	7.5YR 3/1	7.5YR 3/1	7.5YR 6/3	cordmarked
HAM067	Quartz sand	1	None	Rare Mica	7.5YR 4/1	7.5YR 6/3	5YR 5/4	cordmarked
HAM068	Quartz sand	ind	Rare Mica	None	5YR 5/1	5YR 6/3	7.5YR 5/1	cordmarked
HAM069	Quartz sand	ind	None	None	7.5YR 3/1	7.5YR 4/1	7.5YR 2.5/1	cordmarked
HAM070	Quartz sand, Mica	ind	Rare Mica	None	7.5YR 4/1	10YR 5/3	10YR 3/1	cordmarked
HAM071	Quartz sand, Mica	ind	None	None	10YR 3/1	10YR 6/3	2.5Y 4/1	cordmarked
HAM072	Quartz sand	0.8-1.2	None	None	10YR 2/1	7.5YR 5/4	7.5YR 4/1	cordmarked
HAM073	Quartz sand, Mica	ind	None	None	7.5YR 4/1	7.5YR 5/4	7.5YR 3/3	cordmarked
HAM074	Quartz sand	1.2-2.2	None	None	7.5YR 6/3	5YR 6/4	5YR 5/1	cordmarked
HAM075	Quartz sand	ind	None	None	5YR 6/4	5YR 5/4	5YR 4/1	cordmarked

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VITA

Holly A Meier was born in Clinton, Iowa on February 17, 1979, the daughter of James and Claudia Meier. After graduation from Dulles High School and starting at Texas A&M University, she decided to study Anthropology. At TAMU, Ms. Meier had the opportunity to work on an INAA project of the Mimbres area under H. J. Shafer. Upon graduation, she moved to Chicago and volunteered at the Field Museum. Deciding to pursue an archaeology career she applied and was admitted to Texas State University-San Marcos Masters program in Anthropology. An opportunity arose to study in the Texas panhandle with Dr. C. B. Bousman and became the topic of Ms. Meier's thesis. Ms. Meier received support for the project from University of Missouri Research Reactor (MURR), Texas Archeological Society (TAS) Donors Fund, and the Bureau of Land Management.

Ms. Meier would like to continue research in the Texas panhandle area and will be attending Baylor University to pursue a PhD in geology.

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