LITTLE SOTOL UNEARTHED: THE EXCAVATION OF A LONG-TERM EARTH OVEN FACILITY IN THE LOWER PECOS CANYONLANDS OF TEXAS

by

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A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Arts
with a Major in Anthropology
December 2015

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ACKNOWLEDGEMENTS

My thanks goes to everyone who shared encouraging words and insights throughout the excavation of Little Sotol and the writing of this thesis. It was truly a collaborate effort, and only some of the individuals and organizations are named here.

I thank Rick and Mary Rylander for providing access to the Little Sotol site and generously opening their home to the ASWT research team for almost two years. Your knowledge, curiosity, and genuine interest make you exceptional stewards of the land. Thank you for hosting the 2011 and 2012 Texas State University field seasons. I look forward to soaking in the Devils River, watching the hummingbirds, and admiring your ranch with you again.

Thank you to my committee for their continued support and encouragement. Dr. Steve Black – you are true advocate and marvelous mentor. I feel lucky to have met you hiking around the Lower Pecos Canyonlands. Thank you for opening my eyes to earth oven research and Texas archaeology. I am grateful for the support of you and the Ancient Southwest Texas Research (ASWT) Project. Dr. Phil Dering – thank you for sharing your humor and insights, teaching me the valuable skill of flotation, and identifying the copious amounts of botanical material from Little Sotol. Dr. Brit Bousman – thank you for your contagious passion for archaeology and challenging my perspectives.

Thank you to the many archaeologists who sweat and scurry to contribute to the body of knowledge every day. My thanks go to Dr. Charles Frederick for showing me new ways to view the landscape and nurturing my love of rocks. Thank you Dr. Carolyn Boyd for introducing me to the Lower Pecos and for your vivid insights into the past. Thank you Dr. Alston Thoms for providing microfossil analysis and the conceptual premise on which this thesis is based. My thanks also go to Elton Prewitt for identifying all of the projectile points from Little Sotol, and answering all of my questions so thoughtfully. Thank you Mark Willis for visiting Little Sotol, taking aerial photographs, and impressing all of the field school students with your kite flying skills on such a windy day. Thank you to both radiocarbon laboratories for processing samples, especially Dr. Raymond Maudlin and the Center for Archaeological Research. Thank you Mike Quigg, Paul Matchen, Dr. Jodi Jacobson, and all of the extraordinary individuals at TRC Environmental for your support, knowledge, and understanding.

I must express my sincere gratitude to the 2011 Texas State University field school students, especially Holly Mello, Kat Pratt, and Sarah Himes for your shared desire to reach bedrock. Thank you Sean Zimmerman, Jacob Combs, Peter Shipman, Ashlea Evans, Nate Stanley, Kirsten Verostick, Amanda Castaneda, Charles Koenig, Ben Dwyer, Travis Metheny, Dan Rodriguez, Matt Basham, Chris Davis, Bob Wishoff, Jerod Roberts, Vicky Munoz, and Jack Johnson for volunteering your time towards this effort. I feel grateful for the surrounding archaeological community. Thank you to the Texas Parks and Wildlife Department, the Texas Archeological Society, the Shumla School, and the "Agave is Life" documentary team for visiting Little Sotol and taking interest in the research.

Thank you Mary Gibson for your behind-the-scenes support of the graduate students and anthropology department. You have helped me out of many tight places. I appreciate you and all that you do.

My deepest gratitude goes to my caring and loving family – Megan Knapp, Gary Knapp, Susan Knapp, Pearl Kimple, and Chase Kimple – for your continued support in the field, laboratory, and at home. It was such a joy to work with you at Little Sotol, and I wholly appreciate your enduring encouragement. Finally, I dedicate this thesis to my daughter, Pearl. You can accomplish anything if you set your mind to it, even when the odds (or burned rocks) are stacked against you.

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ABSTRACT

The Little Sotol Site (41VV2037) is a long-term earth oven facility used to bake desert succulents in the Lower Pecos Canyonlands of Texas. The site consists of a two-meter deep burned rock midden on a slowly aggrading terrace in front of two low-hanging caves within a small tributary canyon to Dead Man's Creek, a tributary of the Devils River. Macrobotanical remains of lechuguilla and sotol, prickly pear microfossils, heating elements of earth ovens, and plant processing tools were identified in burned rock midden and cave components. Radiocarbon assays range from approximately 5000 B.C. to A.D. 1200, spanning a considerable length of time from the end of the Early Archaic to the Late Prehistoric period.

The 6000-year record of burned rock discard preserved at the Little Sotol site allows for the examination of change in earth oven construction and use over time. It is argued that the higher degree of fracture in burned rock relates to the increased intensity of plant processing in earth ovens. Methods of burned rock quantification show evidence of landuse intensification through the increasing reuse of burned rocks through time, especially into the Late Archaic and Late Prehistoric periods. The Little Sotol site demonstrates the dynamic relationship between past populations and the landscape, and the changing role of earth ovens at a single location – an earth oven facility.

1. INTRODUCTION

The Little Sotol site (41VV2037) is an earth oven facility positioned on a low side-canyon terrace off Dead Man's Creek, a tributary of the Devils River in the Lower Pecos Canyonlands in southwest Texas. A large burned rock midden stands tall against two low-hanging cave openings in the limestone bluff. During the Archaic and Late Prehistoric periods, hunter-gatherers repeatedly returned to this picturesque location for the purpose of baking and processing desert succulents for over 6,000 years (Figure 1). My thesis is that Little Sotol is a long-term earth oven facility used to process desert succulents from roughly 5000 B.C. to A.D. 1200 with evidence for landuse intensification through time, particularly into the Late Archaic and Late Prehistoric periods.

Earth ovens are exactly what the name invokes – a cooking technology in which food is buried underground along with a heat source and cooked for a prolonged amount of time. Through archaeological investigation, experimental replication, and ethnographic analogy, earth oven construction is well understood. An earth oven is a layered arrangement of fuel, rocks, plant food, and packing material buried within an earthen pit (Black 1997:257; Black and Creel 1997:300; Black and Thoms 2014:205; Dering 1999). In the process of constructing an earth oven, heat is transferred from combustible fuel and retained in rocks that form a heating element at the bottom of the pit (Thoms 1989:317). The leftover heating element is what archaeologists identify as an earth oven (Black and Thoms 2014).

Figure 1. Photograph of Little Sotol with burned rock midden (foreground) and southernmost cave (background), facing north.

Transferring energy to rocks facilitates hydrolysis and creates a more steady source of heat within the earth oven (Black and Thoms 2014:208; Thoms 2008a:124). Species of agave and sotol store complex carbohydrates but require prolonged exposure to heat to transform the indigestible or poisonous compounds into simple sugars that are more palatable and nourishing (Black and Thoms 2014:206; Dering 1999:661; Nobel 1994:30; Thoms 2008a:122; Wandsnider 1997). Green packing material (e.g., agave and sotol leaves, prickly pear pads, etc.) is essential to earth oven plant baking to facilitate hydrolysis and to prevent the sotol and lechuguilla bulbs from burning (Black and Thoms 2014:209; Dering 1999:661; Thoms 2008a:122).

Earth ovens produce a significant amount of litter, mainly ash, charcoal, charred plant remains, and rocks that fractured due to the introduced heat (Black 1997:258; Black and Thoms 2014: 209; Dering 1999:665). While much of the organic debris may not preserve within shallow and slowly aggrading surfaces (Black 1997:259), the burned rocks[1] preserve in the archaeological record and are commonly visible traces of the past on the landscape (Black and Thoms 2014; Dering 1999:665, 2005:250). Earth oven beds (heating elements) are structurally resilient to natural site formation processes (Black and Thoms 2014:205; Thoms 2009:577), and often contain datable organic material sealed beneath the remnant heating element (Black and Thoms 2014:216).

The remains of single-use earth ovens are observed archaeologically in the Lower Pecos Canyonlands and surrounding regions (Black and Thomas 2014:212), but more often, earth ovens are repeatedly constructed in the same place. Over time discarded burned rock accumulates into a mound, or burned rock midden[2]. Burned rock middens are the cumulative result of repeated earth oven events producing large quantities of discarded burned rocks (Black 1997; Black and Thoms 2014:212; Shafer 1988:35). Burned rock middens are an “amalgam of cooking features” (Black and Creel 1997:270, 294), and may contain multiple heating elements amid the coarse matrix of burned rock (Black and Thoms 2014:213; Thoms 2009:577).

It is useful to conceive of burned rock middens as earth oven facilities where multiple ovens were constructed, fired, and dismantled over time (Black 1997:259). Earth oven facilities are points on the landscape that are specifically and intentionally returned to for a single, primary purpose of processing plants (Black and Creel 1997:270). Though burned rock middens contain artifactual material not associated with

[1] Synonyms for burned rock include burnt rock, fire-cracked rock (FCR), and thermally modified rocks. These terms may be used interchangeably, but burned rock is the more commonly accepted term in Texas.
[2] A burned rock midden (BRM) may also be referred to as a burned rock mound, burnt rock midden, and cooking mound. Variations may also include mescal pit, sotol pit, crescent midden, and circle mound.

plant baking the vast majority of cultural debris (i.e., burned rock, plant processing tools, charcoal, and charred macrobotanical material) is the result of a focused set of related on-site activities (Black 1997:265). Repeated earth oven firing events and discard of heavily fractured, exhausted burned rocks contribute the formation and expansion of burned rock middens, the archaeological signature of earth oven facilities (Black and Thoms 2014:211).

In the Lower Pecos, the plants baked in earth ovens are sotol (*Dasylirion texanum*), lechuguilla (*Agave lechuguilla*), and prickly pear (*Opuntia* sp.). Sotol is a shrub composed of a large sphere of sharp, “ribbon-like” leaves and tall flower stalk emerging from rosette-shaped bulb at the base of the plant (Cheatham and Johnston 1995; Turner 2009: 118). Coprolite evidence and historic observations indicate that prehistoric inhabitants of the Lower Pecos ate sotol blooms as well as the hearts (Williams-Dean 1978:138). The sweet pulp may be consumed directly or made into a storable and portable food product. Sotol prefers ground and deeper sediment patches as this plant species is more deeply rooted than lechuguilla (Brown 1991:108).

Agave lechuguilla is a common, petite type of agave that grows in dense patches (Cheatham and Johnston 1995:138). It is the only agave native to the Lower Pecos region of Texas (Correll and Johnston 1970:421-423). This agave is recognizable by the pointed, curving leaves formed in a rosette with a pink-purple flower stalk that emerges from the center (Sheldon 1980:377). In a year of average rainfall, lechuguilla blooms between May and July (Cheatham and Johnston 1995:138). Coprolite evidence and historic observations indicate that prehistoric inhabitants of the Lower Pecos ate lechuguilla blooms as well as the hearts at the base of the pointed leaves (Williams-Dean 1978:138). Lechuguilla grows in dense patches in uplands and on rocky slopes (Dering 1999).

Archaeological evidence indicates that prickly pear pads were eaten in frequency in the Lower Pecos Canyonlands through much of prehistory (Riley 2010). Prickly pear is a dominant type of cactus in Lower Pecos. Epidural remains of prickly pear pads are among the most observed in the Hinds Cave coprolite study (Williams-Dean 1978:189), and the pads were most likely baked prior to consumption to remove the spines. The pads may also be used as packing material protecting the lechuguilla bulbs and sotol hearts from hot rocks and providing moisture within the earth oven.

Logistical trips to distant sources to obtain the resources needed for earth oven construction are neither feasible nor economically viable. The use of an earth oven facility would have been episodic as forgers moved from location to location as local resources declined (Black and Creel 1997:270; Dering 2005:251; Kelly 1992). Favorable locales for earth oven construction are likely in proximity to required logistical resources (i.e., water, fuel, rocks, sediment, and also protection of the elements) as well as the targeted plant resources (Black and Creel 1997:270).

Burned rock middens and remnant heating elements dominate the landscape in the Lower Pecos Canyonlands and adjacent regions (Dering 1999:659). Perhaps due to the "redundancy" of burned rocks on the archaeological landscape, burned rock middens can be treated as castoffs and dismissed for lack of integrity. It is the premise of this thesis that that burned rock middens or earth oven facilities are a "critical component of subsistence and settlement systems" (Black and Creel 1997:302); and, therefore, demand the focused attention of archaeologists (Black and Thoms 2014). The Little Sotol site demonstrates the research value of sites containing burned rock middens as the durable archaeological signature of a cooking technology that endured for thousands of years.

The longevity and persistence of earth oven technology throughout prehistory in the Lower Pecos Canyonlands may draw researchers to the conclusion that earth ovens are the sustainable, unchanging means of exploiting commonly available plants. "Overall, the lower Pecos diet, as reflected by coprolites, has not changed drastically but has maintained a stable economic subsistence that has supported a population in the region for more than 9,000 years" (Sobolik 1989:123). This view assumes a static economic system in which the construction and use of earth ovens to bake desert succulents is continuous and unchanging throughout the Archaic period.

The Little Sotol Site

The Little Sotol site (41VV2037) gained the name in recognition of the modern abundance of sotol plants on the Rye's and Sons Ranch, and in honor of the nearest town of Comstock, formerly known as Little Sotol City. As evidence from the site shows, prehistoric inhabitants of the canyonlands baked sotol hearts, along with lechuguilla bulbs and prickly pear pads, in earth ovens at the Little Sotol site. The repeated use of the site as an earth oven facility produced the archaeological deposits investigated for this thesis.

The Little Sotol site is located in a dry tributary canyon only a short distance from the confluence of an unnamed tributary and Dead Man's Creek (Figure 2). The unnamed canyon is characterized by low terraces and limestone bluffs on both sides of

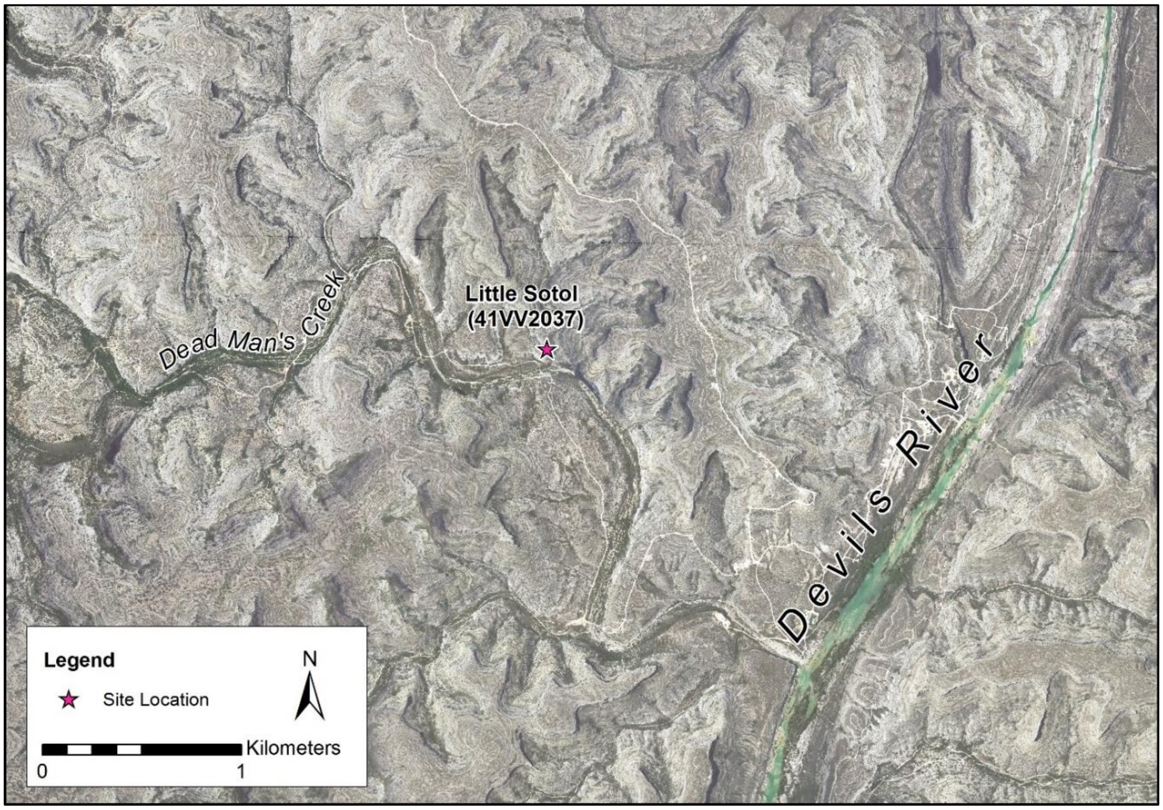

Figure 2. Location of the Little Sotol site in relation to Dead Man's Creek and the Devils River.

the canyon before the relatively gradual slope increases into a steep rocky terrain. The location is easily navigable walking along canyon bottoms. The tributary canyon was probably not watered on a consistent basis during the use of Little Sotol, but large tinajas in the canyon bottom and Dead Man's Creek are reliable water sources during periods of rain. The confluence of Dead Man's Creek and the Devils River is approximately two kilometers southeast of the site. The Devils River is a pristine, spring-fed river, and a major waterway of the region.

Because the canyon bottom, slopes, and uplands are accessible from the Little Sotol site, all resources needed for earth oven construction are well within reach. The alluvial deposits along the low terrace are shallow but suitable for excavating an earth oven pit. The canyon bottom contains small trees and woody shrubs for fuel, while the nearby slopes and uplands are the habitat of sotol, lechuguilla and prickly pear cactus. Limestone rocks are in high supply with an abundance of stream rolled cobbles in the canyon bottom, and weathered and cracked limestone formations in the slopes and uplands.

The Little Sotol site is an earth oven facility that served as a location for plant baking at least intermittently throughout the Archaic period and into the Late Prehistoric period. The 6000-year record of burned rock discard and stratified heating elements preserved at the Little Sotol site allows for the examination of change in the utilization of earth oven technology over time. In addition to burned rock, the site contained charred macrobotanical remains, and plant processing tools among other artifacts.   The midden and cave deposits demonstrate adequate structural integrity, stratification, and organic preservation. Research questions for the purpose of this thesis focus in four interrelated areas of burned rock midden investigation – long-term use, site formation, and excavation strategy.

<u>Long-Term Use</u>

Three imperatives in the excavation of Little Sotol were to determine the chronology of use, duration of midden formation, and the frequency of use. Archaeologists consider cooking with hot rocks a hallmark of the Archaic lifeway (Thoms 2008a:121, 2009:578). Burned rocks are infrequent in Paleoindian period and "epitomize the shift to Archaic lifeway emphasizing plant foods" (Black and Creel 1997:305). The cultural chronology of the Lower Pecos and temporal patterns of earth oven cooking at regional and continental scales are summarized in Table 1. For detailed

Table 1. Lower Pecos Earth Oven and Cultural Chronology.

<table>
<tr><th>Years B.P.</th><th>Period (Turpin 2004)</th><th>Inferred Patterns in Earth Oven Use</th><th colspan="2">Paleoenvironmental Trends (Brown 1991; Bryant and Holloway 1985)</th><th>Typical Diagnostics (Hester 1989)</th></tr>
<tr><td>0-350</td><td>Historic</td><td>Earth oven use continues into (Dering 2005:249).</td><td rowspan="9">↑ Increasing aridity through time ↑</td><td rowspan="3"></td><td>Metal points, brownware</td></tr>
<tr><td>1000-350</td><td>Late Prehistoric</td><td>Regional subsistence strategy may shift to intensive seasonal exploitation of earth oven resources around 750 B.P. (Brown 1991:87).</td><td>Perdiz, Toyah, Livermore</td></tr>
<tr><td rowspan="2">3000-1000</td><td rowspan="2">Late Archaic</td><td rowspan="2">Intensification of earth oven technology around 2000 B.P. with a peak at 1500 B.P. in response to increasing continental population (Thoms 2009).

In the Lower Pecos, the period between 3200 and 1300 B.P. witnessed a decrease in earth oven plant baking (Turpin 2004:272).</td><td>Frio, Ensor, Figueroa, Paisano</td></tr>
<tr><td>Mesic interlude with and expansion of a grassland environment from 3000-2500 B.P.</td><td>Shumla, Castroville, Montell</td></tr>
<tr><td rowspan="2">6000-3000</td><td rowspan="2">Middle Archaic</td><td rowspan="2">Initial continental intensification of earth oven technology around 4000 B.P. (Thoms 2009).

Increased frequency of earth oven use perhaps coinciding with the onset of Altithermal (Brown 1991; Bryant 1986, Turpin 1990:265, 1994:3).</td><td></td><td>Langtry, Val Verde</td></tr>
<tr><td rowspan="2">Intense drying event (the Altithermal) from 6800 to 5500 B.P. marked by increased erosion and change in pollen frequencies.</td><td>Pandale</td></tr>
<tr><td>9000-6000</td><td>Early Archaic</td><td>Earliest evidence of earth oven plant baking in Lower Pecos (Dering 2007).</td><td>Baker, Bandy, Gower, Early Barbed, Early Triangular</td></tr>
<tr><td>9800-9000</td><td>Late Paleoindian</td><td></td><td rowspan="2"></td><td>Angostura</td></tr>
<tr><td>14,500-9800</td><td>Paleoindian</td><td></td><td>Golondrina, Plainview, Folsom</td></tr>
</table>

cultural chronologies and cultural history summaries of the Lower Pecos archaeological region see Bement 1989; Dering 2002; Hester 1988; Riley 2010; Shafer 1988; Turpin 1984, 1991, 1994, 2004; and Turpin and Davis 1990.

An earth oven facility is an ideal place to gather material from radiocarbon analyses. The burning of fuel and plant foods within earth ovens preserves datable material that is in known context and association with the activities that took place on-site (Thoms 2009:585). For the purpose of this thesis, organic material identified as lechuguilla or sotol, and wood charcoal in direct association with heating elements were handpicked for radiocarbon analysis along with other short-lived plant species as the preferred samples. Radiocarbon assays obtained from the Little Sotol site range from 6980 B.P. to 720 B.P.[3]

Prior to the excavation of the Little Sotol site, it was hypothesized that the duration of burned rock midden accumulation was limited to the Late Archaic period with a small Middle Archaic component. This hypothesis was fostered by the prevailing view in the archaeological literature that deposits within domed burned rock middens generally date from 5000 to 2250 B.P (Prewitt 1991:26; Turpin 1994), and the surface diagnostic artifacts found at the site are all attributed to the Late Archaic period. Excavation quickly revealed much older components than anticipated with temporally diagnostic artifacts and radiocarbon assays dating to the end of the Early Archaic period. The lower reaches of the burned rock midden at the Little Sotol site are among the oldest dated heating elements and burned rock midden debris in the Lower Pecos Canyonlands. As a whole, radiocarbon assays and recovered temporally diagnostic artifacts span

[3] Throughout this study, the abbreviation B.P. denotes radiocarbon years before present.

several thousand years. The upper strata of the Little Sotol site date to the Late Prehistoric period, though no diagnostic artifacts of the period were recovered.

In order to understand the frequency of use of an earth oven facility, it is useful to estimate the number of earth oven firing events after determining the time and duration of use. Following the example of Black (1997), it is possible to extrapolate the number of firing events by estimating the total volume of burned rock in comparison to the amount of burned rock in single earth oven. Values for the amount of burned rock produced from a single earth oven firing event are obtained from archaeological literature (e.g., Dering 1999) and actualistic replication (e.g., Leach et al. 1998). The enumeration of earth oven events at the Little Sotol site is surely in the hundreds, but that is a relatively low frequency of use in that the duration of midden accumulation spans several thousand years. More detailed understanding were sought in the interpretation of the Little Sotol site.

Site Formation

It is challenging to fully realize the processes involved in the formation of burned rock middens because earth oven facilities have a complex history of use with many cultural and natural processes taking place simultaneously and over time. Natural formation processes evidenced by krotovina (faunalturbation), calcium carbonate accretions, and root masses (floralturbation), are observed at the Little Sotol site; however, this thesis research focuses on the cultural site formation processes in burned rock midden formation, particularly the construction and use of earth ovens followed by the discard of utilized burned rocks. In general the natural formation processes of burned rock middens are poorly understood by archaeologists.

The Little Sotol site rests on a slowly aggrading surface of a low terrace in a small tributary canyon. Because of this depositional environment, cultural episodes of earth oven construction, use, and disposal are not held within stratigraphically discrete layers. The Little Sotol burned rock midden, and the majority of burned rock middens, are cumulative palimpsests "in which the successive episodes of deposition, or layers of activity, remain superimposed one upon the other without loss of evidence, but are so re-worked and mixed together that it is difficult or impossible to separate them out into their original constituents" (Bailey 2007: 204; also see Black and Thoms 2014). Perhaps the investigation of cultural episodes blurred from original pattern of deposition is not ideal, but palimpsests are not a unique problem in archaeological inquiry as the majority of sites witness some degree of time averaging (Bailey 2007:209). Most archaeological sites are the product of repeated site formation and destruction on part of the landscape.

While it is understood the archaeological deposits at burned rock middens sites experience cultural mixing with repeated reuse, burned rock middens are structured and follow predictable patterns (Black and Creel 1997:284; Black and Thoms 2014:218). The majority of temporally diagnostic artifacts and dated organic material at the Little Sotol site are in the correct stratigraphic sequence, and earth oven features occur in expected locations at the center of the burned rock midden and mouth of the small cave. Through the examination of burned rock midden structure, the cultural processes of site formation may be understood at the Little Sotol site.

The patterning of primary structural elements (i.e., heating elements or earth oven beds) and the dispersal of structural elements after use (i.e., discarded burned rocks) are the archaeological signatures of earth oven plant baking (Black and Thoms 2014). The identification of primary structural elements is essential to discerning midden structure (Black 1997:83; Black and Thoms 2014). Heating elements typically composed of large rocks tend to be structurally resistant to a variety of formation processes (Black and Thoms 2014:205; Thoms 2009:577), but identifying features composed of burned rocks within a matrix of more burned rocks requires careful observation. "A reasonably intact midden should have evidence of numerous cooking facilities (hearths[4] or hot-rock beds and/or matrix-defined pits)" throughout the burned rock midden deposit (Black 1997:84).

According to previous investigations in the Lower Pecos Canyonlands, typical earth oven construction took place in the uplands, on open terraces, or at the mouth of limestone shelters (Shafer 1988:32). At the Little Sotol site, prehistoric plant bakers constructed earth ovens both at the center of the midden on the terrace and at the mouth of the southernmost cave. This fits expectations of both the intersecting hearth and central-focused cooking facility models discussed by Black (1997:85). The overall midden appearance is somewhat amorphous with the greatest accumulation of burned rock forming a cone of debris near the center of the burned rock midden and spilling from the mouth of the cave.

Though there are no observable, discrete discard events within the amalgam of burned rock at the Little Sotol site, the midden structure is patterned. The most visually apparent pattern amid the burned rocks is that they are more heavily fractured and burned in the upper reaches of the midden in comparison to the lower layers. The rocks at the bottom of the midden are only minimally thermally fractured. The fine matrix of the

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[4] Heating elements of earth ovens are often referred to as "hearths" in the archaeological literature. As discussed by Black and Thoms (2014:216), hearth is a "generic and functionless" term that misleads the interpretation of the more specialized cooking technology known as earth ovens.

midden (sediment, ash, and organic material) also differs between the upper and lower reaches of the midden with fine, dark, ashy sediments in the upper layers and light colored alluvium at the bottom of the midden.

The Little Sotol site is a cumulative palimpsest with cultural materials from distinct events mingling and intruding upon underlying cultural deposits (Black and Thoms 2014:210). The earliest and latest earth oven events are perhaps more clearly visible, but the overall patterning and organization of burned rocks, remnant heating elements, and artifacts demonstrate site integrity and research potential of large burned rock middens. Untangling archaeological palimpsests that span several thousand years is no easy feat, but sites with time depth are ideal for studying change over time. Later chapters present more detailed information regarding the excavation methods, internal structure of the burned rock midden, and site use through time.

Excavation Strategy

The excavation of the Little Sotol site was conducted as part of the 2011 Texas State University field school and the ongoing Ancient Southwest Texas (ASWT) Project. The overall excavation strategy at the Little Sotol site was aimed at targeting data pertaining to the aforementioned research questions and led by the conceptual challenges of untangling burned rock midden deposits. In other words, I experimented with innovative excavation strategies and changed approaches as needed (in collaboration with Dr. Steve Black, who directed the field school and is the ASWT principal investigator). The excavation of the Little Sotol site focused on the identification and sampling of remaining earth oven beds, and documenting the patterning of burned rocks in the most efficient means possible (see Chapter 4). The overarching ASWT methods emphasize broad windows of view through large vertical exposures.

> "Trying to understand the structure of a midden by digging small holes in it is roughly akin to trying to understand the meaning of a poem by studying random letters of random words. Scale and perspective matter greatly in most archeological endeavors" (Black and Creel 1997:284-285).

With an overall data dearth in radiocarbon assays from secure archaeological context in the Lower Pecos, the collection of datable material from earth oven context was a principle aim. (For a radiocarbon chronology of the Lower Pecos see Turpin 1991). The location excavation blocks were determined by the areas of highest potential to uncover remnant heating elements or earth oven beds – at the mouth of the southernmost cave and at the apex of the large burned rock midden. The aim was to uncover and identify heating elements and collect charred plant materials and associated charcoal for radiocarbon analysis. In the attempt to more completely understand role of time in the formation of the Little Sotol site, a total of 15 radiocarbon dates were obtained – a sizable number in comparison to the conventional practice of obtaining only a few dates from one site.

In order locate and document earth oven features I opted for a broad horizontal strategy, because remnant earth oven beds are often larger than the typical 1-x-1m excavation unit. The broad horizontal excavation strategy proved useful in documenting earth oven features as individual analytical units as opposed to features bisected inconveniently by the boundaries of traditional excavation units. This broad excavation strategy also afforded relatively large vertical profile views to examine structure and organization of the midden constituents (remnant heating elements and discarded burned rock).

The purpose of exposing profile views was to examine midden structure, vertical organization, and change in deposition of cultural materials (namely burned rocks) with depth. It is a prevailing view, though now somewhat outdated, that domed middens lack internal structure with homogeneous profiles (Black and Ellis 1997:7). One purpose of the Little Sotol excavation is to demonstrate that burned rock middens indeed have internal structure and organization that can be observed and documented by archaeologists in an efficient manner.

With efficiency in mind I selected three columns to quantify the burned rocks by size and surface characteristics. The purpose of these rock sort columns was to document patterns that may lead to interpretations of change over time. The excavated volume and mass of burned rocks was also calculated to estimate the total midden volume and enumeration the number of earth oven events that took place at the earth oven facility known as the Little Sotol site.

Organization of Thesis

Chapter 2 provides regional and theoretical background for this research. Chapter 3 includes a brief description of previous research in the Lower Pecos Canyonlands focusing on tested and excavated burned rock middens. Research aims and methods in the excavation of Little Sotol are presented in Chapter 4. Chapter 5 describes the eight cultural features uncovered at the Little Sotol site, seven of which are consistent with the archaeological signatures of earth ovens. Chapter 6 discusses the lithic assemblage that contributes to the interpretation that the Little Sotol site is a long-term earth oven facility. Discussions of cultural formation processes, mode of burned rock accumulation, and site use over time are presented in Chapter 7. Chapter 8 provides a summary of findings and future avenues of research. Inventories of artifacts and samples collected from the Little Sotol site are attached as Appendix A (artifacts) and Appendix B (samples).

2. REGIONAL AND THEORETICAL BACKGROUND

This chapter provides a brief overview of the Lower Pecos Canyonlands, a truly rich archaeological region in southwest Texas. The chapter closes with a discussion of competing perspectives regarding the role earth oven technology in the prehistoric economy of the region. The regional and theoretical background forms the framework for the interpretation of the Little Sotol site.

Physical Environment

The Lower Pecos Canyonlands archaeological region is located just below the southwestern edge of the Edwards Plateau and characterized by deeply incised canyons, dry caves, and dry rockshelters. Three major rivers – the Rio Grande, the Pecos River, and the Devils River – and their tributaries form the canyonlands (Dering 1999:660, 2002; Shafer 1988:323; Turpin 1994a, 2004:266). The landscape is comprised of arid-adapted plants, shallow sediment deposits, and limestone bedrock. Bluffs containing numerous rockshelters and caves border the canyon bottoms surrounded by rolling uplands (Shafer 1988:24).

The Rye's N Sons Ranch is located on the west bank of the spring-fed Devils River. In comparison to the steep canyon walls along the Pecos and its tributaries, the canyon bottoms along the Devils River are broad with more terrace sites (Turpin 2004:267). The biotic communities also differ slightly on the Devils River as the eastern side of the Lower Pecos Canyonlands is more mesic (Shafer 1988:25).

According to paleoenvironmental reconstructions of the region (Dering 2005:248; Bryant and Holloway 1985), the environment Lower Pecos Canyonlands was characterized by predominately arid conditions during the Holocene. The Altithermal drying event around 6800 B.P. saw an increase in aridity followed by slightly more mesic conditions around 3000 B.P. (Shafer 1988; Turpin 2004:266; Williams-Dean 1978:226). For more information regarding paleoenvironmental reconstructions and discussions of regional paleoecology see Brown 1991; Bryant 1969; Bryant and Holloway 1985; Bryant and Shafer 1977; Dering 1979; Johnson 1963; Patton and Dibble 1982; Shafer and Bryant 1977.

Presently, southwest Texas is a semidesert (Dering 1999:660, 2005:247) with drastic interannual variation in precipitation with an average rainfall of 40 centimeters per year (Dering 2005:253). The region experiences extreme temperatures with summers that are typically hot and wet in comparison to the more mild and dry winters (Shafer 1988:25). Rainfall peaks in the late spring and early fall (Dering 2002:2.4). In terms of plant life cycles, plants are more productive during warm and wet times (Shafer and Bryant 1986:118).

In the reconstruction of past vegetation communities at Hinds Cave, Dering (1979:69) asserted that there was change in the plant life over time, but that the availability of plants species such as lechuguilla and sotol remained relatively constant. Currently, there is a relatively homogeneous distribution of xeric adapted plants on the slopes and uplands with greater plant diversity within the canyon bottoms (Dering 1979; Shafer 1988:25).

Indigenous Prehistoric Populations

The ethnohistory of the Lower Pecos region is poorly known with thin ethnographic data and most tribal ties to the lands lost to history (Kenmotsu and Wade 2002:15). At times the regional enthnography generalized Native American populations not referring to any one tribal group (Brown 1988:6). The general understanding is that the indigenous peoples of the canyonlands were mainly small band groups of undetermined ethnic identity that later faded into prehistory with the intrusion of larger tribal groups (e.g., the Apache and Comanche) and eventually the Spanish and Euroamericans (Kenmotsu and Wade 2002). Despite what little is known about the indigenous prehistoric populations, the archaeological record is rich reflecting reasonably thriving populations for at least 9,000 years.

The cultural history of the Lower Pecos region is divided into Paleoindian, Archaic, Late Prehistoric and Historic periods and subperiods with tribal connections only mentioned during the Historic period (Bement 1989; Hester 1988; Riley 2010; Shafer 1988; Turpin 1984b, 1991, 1994a, 2004). Historical knowledge of the general Lower Pecos region is based mainly on the accounts of Caveza de Vaca (Krieger 2002) and Don Alonso de Leon (Brown 1988; de Leon 1971). Kenmotsu and Wade (2002) completed an ethnohistorical literature review for consultation and cultural resource management purposes that includes detailed lists of tribal names referred to in historical texts and modern affiliations with the lands surrounding Amistad Reservoir. This study reflects a complex and fluid history of occupation in the Lower Pecos. Many of the groups referred to historically did not survive Euroamerican colonization, or were relocated by force or coercion to other regions of North America and Mexico (Kenmotsu and Wade 2002).

The groups most useful for enthnographic analogy in interpreting the record of earth oven plant baking Lower Pecos Canyonlands are the Lipan (Wade 2003) and Mescalero Apache (Basehart 1974), and Comanche (Eastman 1879). Ethnohistorical documents describe these groups and others constructing earth ovens and baking sotol hearts and agave bulbs of various species. Banta Buckelew observed the Lipan gathering large quantities of the "'Soto' root, or bulb of the soto plant" to bake in earthen "kilns" for a number of days and later pound into flour to be made into cakes (Wilson 1930). William Corbusier (1886) recounted observing Apache bands collecting agave plants and cooking them underground, and Edwin Eastman (1879:115-116) bore witness to the consumption of mescal by Comanche and Apache groups. Though ethnographic analogy is valuable in archaeological interpretation, these tribal groups are relative latecomers to the region and continuity cannot be assumed.

Prehistoric Diet

The current understanding of the Archaic period economy and subsistence is informed by overarching models of hunter-gatherer subsistence (Binford 2001; Kelly 1995, Table 3-1), and several decades of archaeological work in the Lower Pecos Canyonlands. Historical ethnographic and environmental data indicate that inhabitants of southwest Texas probably relied more on gathering plant foods with big game densities relatively low (Thoms 2008a:125). Researchers agree that sotol (*Dasylirion texanum*), lechuguilla (*Agave lechuguilla*), and prickly pear (*Opuntia* sp.) are commonly exploited plant foods in the Lower Pecos Canyonlands throughout much of the Holocene (Black and Creel 1997:296; Bousman and Quigg 2006; Brown 1991; Bryant 1974; Dering 1999:659; Riley 2010; Shafer 1981, 1988, 1989:29, 44; Shafer and Bryant 1986:96; Sobolik 1991, 1996b; Turpin 1995, 2004:266; Williams-Dean 1978:243).

The preservation of coprolites affords archaeologists in the Lower Pecos a more direct way of learning the constituents of prehistoric diet. A number of coprolite studies analyzing samples from the Lower Pecos region (e.g., Bryant 1969, 1974; Edwards 1990; Lord 1984; Sobolik 1988, 1989, 1993, 1996; Stock 1983; Reinhard 1988; Riley 2010; Riskind 1970; Williams-Dean 1978) reconstruct the diet of Lower Pecos inhabitants and infer cultural subsistence strategies. According the dietary reconstructions of these studies, the inhabitants of the Lower Pecos consumed a large variety of small game, insects, fish, and plants with specific emphasis on prickly pear, lechuguilla and sotol (Sobolik 1989).

Archaeological investigations of midden deposits, studies in earth ovens, stable isotope analyses, and coprolite analyses contribute to the current argument that prehistoric inhabitants of the Lower Pecos practiced a broad-spectrum subsistence strategy focusing on lechuguilla, sotol, and prickly pear baked in earth ovens (Brown 1991; Bryant 1974; Shafer 1981, 1988; Sobolik 1991, 1996b; Williams-Dean 1978:243). "Most of the major studies emphasized the extreme stability of the Lower Pecos diet throughout the Holocene" but this may be an oversimplification and an effect of sampling strategy (Brown 1991:88). The view of the prehistoric Lower Pecos diet is heavily biased by work at only four sites, Hinds Cave, Conejo Shelter, Parida Cave and Baker Cave (Brown 1991:88), which points to the need to investigate questions of subsistence economy and diet at small sheltered and open terrace sites for a more holistic view.

Archaeological Record

The archaeology of the Lower Pecos Canyonlands is a 9,000-year record of mobile hunter-gatherer lifeways (Shafer 1988:46). The inhabitants of the region practiced a generalized hunter-gatherer subsistence strategy and did not transition to agriculture like groups in adjacent regions (Dering 2005:253; Shafer 1988:27).

Archaeological assemblages are typical of hunter-gatherer groups, including chipped stone and groundstone artifacts. The Lower Pecos region is distinct in the preservation of perishable materials in the many dry caves and rockshelters.

The aridity of the region permits the preservation of perishable materials including elements of a fiber industry (e.g., basketry, mats, nets, and sandals) and items belonging to rich artistic traditions (e.g., painted pebbles, monochromatic and polychromatic rock art) (Shafer 1988:27). The preservation of food refuse, cooking technology, and coprolites affords the opportunity for researchers to learn a great deal about past subsistence practices (Bement 1989; Brown 1991:87; Dering 1999:660; Turpin 2004). The incredible preservation conditions contain evidence of prehistoric technology and ideological systems in ways that are unparalleled in other hunter-gatherer studies (Shafer 1988:24). (For more detailed overviews of the Lower Pecos Canyonlands see Bement 1989; Hester 1988; Shafer 1988; Turpin 1984b, 1994a, 2004.)

The rich archaeological record has drawn archaeologists to the Lower Pecos Canyonlands for much of the past century. The promise of uncovering fascinating relics of the past has also attracted many collectors and vandals to the Lower Pecos, but many of the landowners in Val Verde County are committed to protecting the unique archaeology of the Lower Pecos Canyonlands. For these reasons – a long archaeological record, exceptional preservation, the legacy of previous research, and impressive landowner stewardship – the Lower Pecos is an ideal setting for earth oven research.

Earth oven technology first appears in the archaeological record of the Lower Pecos during the Early Archaic period (9000 B.P. to 6000 B.P.), most notably at Hinds Cave (Dering 2007). Evidence of earth oven plant baking is prevalent in the archaeological record of the Lower Pecos and surrounding regions continuing through the Archaic, Late Prehistoric, and Historic periods (see Table 1). Remnant earth oven beds are often found in association with diagnostic artifacts associated with these periods. The number of earth ovens represented in the archaeological record of the Lower Pecos and surrounding regions increases through time due to preservation bias and overall pattern of resource intensification (Black and Creel 1997; Black and Thoms 2014:211; Maudlin et al. 2003; Miller et al. 2011; Thoms 2008a, 2008b, 2009).

Views on Earth Oven Plant Baking

In the last several decades of archaeological research, the conceptual framework to understand earth oven use as part of a larger subsistence system has traveled through a number of hypotheses. The first theme in earth oven research is that earth oven technology provided the means to exploit the seemingly limitless amount of succulent plants available across the landscape – the desert bounty. The opposing theme suggests that a subsistence economy relying upon earth oven resources was a response to severe environmental constraints whether more prolonged or seasonal (Dering 1999). Though these views have valid arguments, it is the purpose of this thesis to argue that earth ovens are part of a subsistence system that was intensified in response to increasing populations through time.

Optimal foraging theory and diet breadth models are useful tools in the effort to evaluate hypotheses regarding the role of earth oven plant baking in the prehistoric economy of the Lower Pecos. The underlying assumption of optimal foraging theory is that the objective of prehistoric hunter-gatherers was to optimize caloric and nutritive return (Kelly 1995:53-54). Within the framework of a diet breadth model, the expectation is that a broad range of lower ranked food resources are utilized when high ranked resources are unavailable (Dering 1999:667, 2005:249; Kelly 1995:78).

In the words of Riley (2010:22) “very few plant foods in the Lower Pecos have a higher caloric value than sotol and agave,” but this does not consider the costs of preparing these foods in earth ovens. Dering (1999, 2005) developed a diet breadth model for baking lechuguilla and sotol in experimental earth ovens, and found that earth oven processing involves substantial energy requirements and relatively low caloric yields comparable with lower ranked plant resources (Dering 2005:250). Earth oven technology requires considerable investment in time and energy in plant gathering (pursuit time), preparing the plants for baking, and collecting rocks and fuel (handling time) for oven construction (Dering 1999:664-665).

According to Dering (1999:666, 2005:249), an oven containing lechuguilla yields more calories than an oven containing sotol, but the return rates for both plants are comparable to low-ranked food resources like seeds and roots. After approximately two days of baking, a single earth oven containing lechuguilla yields enough calories for 5.1 people per day or enough for a family-sized group for one or two days providing no surplus or accumulation for storage (Dering 2005:254). The return rates according to the diet breadth model for earth oven resources is staggeringly low leaving the question – why invest in such a costly technology?

Desert Bounty

The view that hunter-gatherers relied upon earth oven technology to successfully reap the bounty of the desert is repeated in the archaeological literature of the Lower Pecos (Shafer 1981, 1986; Shafer and Bryant 1986) and the adjacent region of central

Texas (Prewitt 1981, 1991). At first glance, the impressive visibility of countless burned rock middens and remnant earth oven beds on the landscape may lead researchers to the conclusion that earth oven technology is an immensely successful technological adaptation to a marginal environment. As Shafer (1986:46) explains, "What to us appears to be a marginal desert was, perhaps to [past populations] a veritable garden."

The persistence of hunting and gathering lifeways, and the abundance of xeric plants in the Lower Pecos region foster the view that prehistoric inhabitants were reaping the bounty of the desert regularly gathering and exploiting readily available plant foods. Williams-Dean (1978:257) argues for a relative "ease of life" based on the availability of a variety of food observed in the coprolites from Hinds Cave. The perception of a life of relative luxury due to readily accessible and abundant plant resources is echoed popular literature: "Given the prevalence of sotol where [the Lipan, Chiricahua, and Mescalero Apache] lived, it was virtually impossible for them to starve" (Turner 2009:120).

From the desert bounty viewpoint, the energy requirements of earth oven construction may be outweighed by the abundance of sotol, lechuguilla, and prickly pear plants available to hunter-gatherers. As Dering (1999:667) points out the argument that earth oven resources are the bounty of the desert hinges on the assumption that the inhabitants of the Lower Pecos practiced tethered mobility (Shafer 1981) and resided in large rockshelters for extended periods of time (Shafer 1981, 1986; Turpin 1995; Williams-Dean 1978). If the pursuit time in gathering lechuguilla and sotol for earth oven baking is limited to the uplands and slopes immediately surrounding large rockshelters, then perhaps the caloric return is high enough to support small residential groups (Turpin 1995).

Though it may seem as though the desert bounty viewpoint is well supported, it is important to consider that the major proponents formed the interpretation of the archaeological record from large dry rockshelters with deep cultural deposits giving the appearance of intensive residential occupations, like Hinds Cave (Shafer 1981, 1986; Williams-Dean 1978), Conejo Shelter (Alexander 1974), and Baker Cave (Sobolik 1991, 1996b). In other words, the desert bounty hypothesis is heavily biased by the excavations of large dry rockshelters and does not consider other common locations of burned rock middens in the uplands and on terraces. Sites located along minor tributaries and in low-hanging caves, like the Little Sotol site, do not fit the model of tethered mobility and extended residential stays.

Here the view of prehistoric populations living in luxury is rejected. Historic observers speculate that agave was a prized and abundant food for the Mescalero Apache that could be gathered year-round (Basehart 1974), but there is no archaeological evidence that truly supports the desert bounty hypothesis. Castetter and Bell (1938) warn that the high visibility of the resource and procurement strategy exaggerates the role of earth oven resources. Dering (1999:671) reiterates this observation by stating that earth ovens produce a low caloric return especially in comparison to the amount of debris and archaeological visibility of burned rock middens. Because the return rate of earth ovens is consistent with the lowest ranked plant resources, it is far more likely that earth oven technology was used in response to an environmental constraint or demographic pressure.

Famine Food

In the unpredictable, semiarid region of the Lower Pecos Canyonlands with pronounced interannual variation in rainfall, it is reasonable to presume that prolonged drought signaled food shortages and lingering periods of dietary stress for past populations. Some Lower Pecos archaeologists (Brown 1991; Turpin 2004:269-270, 272) have hypothesized that earth oven resources served as famine foods during the prehistoric past. The key to the famine food hypothesis is the observation that remains of earth ovens appear in the archaeological record nearly coinciding with a several generation drought during the Middle Archaic period – the Altithermal drying event (Brown 1991:87).

By definition, famine foods are available when more preferable resources fail. In regions prone to drought, famine foods include drought resistant plants that survive and reproduce during enduring periods of limited precipitation, like cacti and agavacea (Minnis 2000:215). Due to the increased aridity and deteriorating environment during the Altithermal, the local environment may have favored xeric adapted plants like sotol, lechuguilla, and prickly pear (Brown 1991:106; see Collins 1995 and Johnson 1995:87-88). Earth ovens are viewed as part of a subsistence system that can tolerate periods of prolonged drought (Collins 1995: Table 2), and according to the famine food hypothesis the Altithermal triggered a subsistence shift dependent upon baked sotol and lechuguilla (Brown 1991:123).

Diet breadth models support the idea that plants baked in earth ovens are a response to dietary stress (Dering 1999:668). Famine foods must be fit for human consumption, but often require substantial processing and may yield products of low nutritional value (Minnis 2000:214-215). Dering (1999) demonstrates that sotol and lechuguilla are low-ranked resources with substantial energy requirements to process into a minimally nutritional food thus earth oven resources fit these criteria of famine foods. It is implied that famine foods are not part of the typical diet, and will be dropped as conditions relax and more preferable foods become available (Minnis 2000). If the use of earth ovens and reliance on sotol and lechuguilla is the effect of drought-induced famine, then there should be an apparent break in the archaeological record during the Late Archaic mesic interlude when grasslands expanded bringing more desirable, higher-ranked resources into the region.

Brown (1991) offers a more complex version of the famine food hypothesis suggesting that the Altithermal drying event signaled a need for increased diet breadth and a least-risk economic strategy answered by earth oven technology. According to this hypothesis, small scale earth oven use began around 5000 B.P. in response to food shortages, potentially exacerbated seasonal limitations, then shifted to large scale earth oven processing around 750 B.P., perhaps due to a second pronounced dry period. This view expressly limits the causal factors for the proliferation of earth oven technology to environmental constraints.

If famine foods are only exploited in times of severe need then these foods should be underrepresented in the archaeological record and in the ethnobotanical literature (Minnis 2000:217). With countless burned rock middens dotting the landscape of the Lower Pecos Canyonlands, prehistoric earth oven plant baking is not difficult to detect in the archaeological record. Further, references to agave and sotol baked in earth ovens occur frequently the ethnographic record of surrounding regions; therefore, agave and sotol do not fit the conditions of infrequently utilized famine foods.

Following the notion that famine foods are probably lost to history after Euroamerican contact with the introduction of new foods and technologies (Minnis 2000:228), it is fair to claim that the well-documented earth oven resources, such as lechuguilla and sotol, are not in fact famine foods. Riley (2010:6) suggests that the meal of prickly pear pads and onion represents famine food resources, while lechuguilla and sotol are seasonal staples. The paucity of ethnographic accounts of geophytes processed in earth ovens in central Texas (Thoms 2008a:127) and the Lower Pecos follows the expectation that famine foods should be more difficult to detect in ethnobotanical literature, as well as the archaeological record. According to this line of reasoning, lechuguilla and sotol may be more accurately considered seasonal staples.

No matter how the data is sorted, earth ovens are dated earlier than the Altithermal in adjacent regions like the Edwards Plateau (Thoms 2008a:122). The famine food hypothesis is inextricably linked to the archaeological appearance of earth oven technology roughly coinciding with the onset of the Altithermal drying events. I suspect that with the continued research in the Lower Pecos, archaeologists will uncover more and more earth ovens that predate the Altithermal drying event, finally rejecting the view that lechuguilla and sotol are famine foods. The hypothesis that prickly pear pads and onions baked in earth ovens served as famine food is intriguing and warrants further investigation.

Seasonal Staple

The hypothesis that earth oven resources served as winter seasonal staples is common in the archaeological literature of the Lower Pecos (e.g., Brown 1988, 1991; Riley 2010:21; Shafer 1988:41; Shafer and Bryant 1986:118; Sobolik 1996b:200), but it is only supported by circumstantial evidence. Referring to exceptional preservation of food refuse in the archaeological record, Shafer (1989:44) explains that "despite the seemingly ideal conditions in the Lower Pecos Region for studies in seasonality efforts to define seasonal movements and occupations have been met with only limited success." Further, it is a logical inconsistency to define lechuguilla and sotol as winter foods because the plants are more nutritionally productive in late spring and early summer around the time of flowering (Brown 1991:106; Dering 1999:668).

Shafer and Bryant (1986:118) speculate that the people of the Lower Pecos exploited food resources on a predictable seasonal basis. Yucca and cacti flowers are obtainable for consumption with enough rain in the spring. During the hottest summer months, fruits like mesquite beans and prickly pear tunas are readily available, while pecans, walnuts, and acorns are ready for harvest in the fall. Winter months are the leanest with subsistence focused on hunting and upland plant species like, sotol, lechuguilla and prickly pear (Shafer and Bryant 1986:118). In this model, lechuguilla, sotol, and prickly pear pads are selected as seasonal winter foods by process of elimination, not for any specific qualities of the plants that would make them desirable.

The ethnographic and archaeological data available regarding the seasonal exploitation of lechuguilla and sotol are muddled. There is the historical account by Alonso de Leon in 1649 and 1650 that unspecified bands of Indians in Nuevo Leon relied heavily on lechuguilla in the winter and prickly pear tunas in the summer (Brown 1988; de Leon 1971:22), but this account contradicts other ethnographic evidence that the preferred harvest of agave is in the late spring and early summer Castetter et al. 1938; (Riley 2010:126). Coprolite analysis is equally contradictory. In an analysis of coprolites from Hinds Cave, Williams-Dean (1978:254) suggests a broad-spectrum diet characteristic of generalized foraging and the summer exploitation of earth oven resources, which contradicts the mainstream view that earth oven resources served as a winter seasonal staple.

Riley (2010) follows up on many of the previous coprolite studies in the Lower Pecos region to address questions of diet breath and seasonality. He focuses on the meals or daily dietary choices represented in a sample of coprolites, and identifies three seasonal menus. Baked sotol hearts or lechuguilla bulbs dominate the first menu, which is interpreted as the preferred cold season meal (Riley 2010:5). The second menu consists of prickly pear pads and onion. Riley (2010:6) argues these foods are utilized in times of nutritional stress. The third menu consists of prickly pear tunas, which ethnographically are a preferred summer food with high caloric return. Numerous ethnographic accounts elsewhere support the seasonal exploitation of prickly pear tunas, but biological characteristics of the plants or additional lines of archaeological evidence do not support a seasonal interpretation of the remaining two menus identified in the study.

Ethnographic evidence suggests that prehistoric groups formed the products of earth ovens into cakes that could be stored for later consumption. Seasonal food shortages could be alleviated by storage. An indirect line of evidence to support the seasonal staple hypothesis is the storage of lechuguilla and sotol cakes. Evidence of storage of food for future need is lacking in Archaic sites in Texas (Williams-Dean 1978:254). Furthermore, Dering (1999, 2005:249) argues that the baking of lechuguilla in earth ovens does not produce a sufficient amount of food needed for surplus and storage according to diet breadth models.

To further compound the inconclusive information regarding the seasonal dependence of baked lechuguilla, sotol, and prickly pear pads, the annual cycle of available resources in the Lower Pecos is not predictable. The plants cycles respond to levels of precipitation, which is subject to interannual variation. Due to the unreliable annual pattern of rainfall, the Lower Pecos landscape does not follow foreseeable seasons. Interannual variation of precipitation can delay or cause multiple flowering events depending on the timing and amount of rainfall (Brown 19991:126). "Unpredictable rainfall distribution suggests that foragers followed relatively unpredictable pockets of diversity across the landscape" (Dering 2005:253). Thus, the seasonal subsistence hypotheses are not supported nor negated by the archaeological record of the Lower Pecos.

Evidence that may elucidate the annual timing of earth oven events (e.g., pollen and coprolites), or the production of surplus (e.g., storage facilities) are not preserved at the Little Sotol site. Site location also does not provide any clues to preferred season of earth oven plant baking. At the site, the caves and low limestone bluff face generally southeast protected from winter winds and exposed to summer breezes. From a purely subjective perspective, the location of the Little Sotol site seems to be an equally logical place to construct earth ovens year-round. If archaeological evidence cannot address questions of an environmental impetus for earth oven proliferation in the Lower Pecos Canyonlands, perhaps there is a social cause, such as population increase.

Landuse Intensification

The landuse intensification model refers to the continental trend toward the "expenditure of more energy per unit area to recover more food from the same landscape to feed more people" (Thoms 2009:575). Broad-spectrum foraging is indicative of landuse intensification because it expands diet breadth, but incorporated resources often require more energy and time in order to transform into nutritious foods (Thoms 2008a:123). Optimal foraging theory articulates that there is a positive correlation between increased diet breadth and the increased cost of producing food. Increasing population in a given area can provide the incentive to practice a more costly subsistence system (Thoms 2009:586).

In regions where environmental conditions are favorable for incipient agriculture, the pattern of landuse intensification is typified with the domestication of plants and horticulture (Binford 2001). The inhabitants of the Lower Pecos Canyonlands never adopted agriculture, but subsistence systems responded to demographic pressure through the intensification of plant food exploitation with the construction and use of earth ovens to bake sotol hearts, lechuguilla bulbs, and prickly pear pads. Various researchers comment on patterns of resource exploitation and landuse intensification through time due to increasing continental population and in relation to earth oven technology. Archaeological evidence from central Texas (Maudlin et al. 2003; Thoms 2008a, 2009) and the Sacramento Mountains of New Mexico (Miller et al. 2011) points to the intensification of earth oven technology throughout a large swath of the continent.

Thoms (2008a:122) uses the term “carbohydrate revolution” to challenge the view that hunter-gatherers on the Texas Edwards Plateau practices sustainable, static subsistence systems. Thoms (2008a:133) specifically refers to the intensive processing of geophytes (onions and camas) but makes the general argument that “the intensification of cook-stone technology is a manifestation of land-use intensification that was triggered by population packing.” It is a major aim of this thesis to test the hypothesis that the baking of desert succulents in earth ovens was intensified over time using the data collected from the Little Sotol site.

Thoms (2008a:122) contends “that the appearance of and subsequent increases in density of [burned rocks] and earth ovens, across a given landscape, are reasonable proxies for subsistence intensification in general and, in particular, for increased consumption of carbohydrates that require prolonged cooking.” The increased frequency and density of thermal rock features in the archaeological record over time could be and effect of preservation, but burned rock features and datable material within them tend to preserve well (Thoms 2008a:130). The veneer of Late Prehistoric material is referenced in central Texas literature (Black and Creel 1997:283) arguing that the exponential increase in the Late Prehistoric is a true pattern revealed with the advent of accelerator mass spectrometry (AMS) dating.

Based on the frequency of cookstone in the archaeological record of western North America, there is a punctuated increase in the use of cookstone technology across the continent over time. By the early Holocene, around 8500 B.P., the technology is archaeological visible, therefore well underway. Around 4000 B.P. there is a marked increase in the number and diversity of cookstone features, and this coincides with increasing complexity and population increase of hunter-gatherer groups in southeast and southwest. The period from 2000 B.P. to present witnesses the highest density and diversity of cookstone technology, increasing continental population, and the incorporation of ceramic technology (Thoms 2009:585, 588).

Black and Creel (1997:274, Figure 133) demonstrate an analogous pattern of landuse intensification through the distribution of radiocarbon ages gathered from earth oven facilities on the Edwards Plateau of central Texas. According to the data presented, earth oven technology appears in central Texas around 9000 years B.P. (between 8000 and 6000 B.C.) as hunter-gatherers began to depend more on plant resources (Black and Creel 1997:301). The use of earth ovens increases around 7000 years B.P. (5000 B.C.) until a brief gap in the archaeological record around 800 B.C. There is a drastic exponential increase in the frequency of earth ovens on the landscape for the past 2000 years of prehistory (Black and Creel 1997:304). "We see the development of earth oven facilities (burned rock middens) as a direct reflection of the increasing reliance on an assortment of starch based plant foods" (Black and Creel 1997:302). They describe the impetus as increasing population. Black and Creel (1997) acknowledge the potential of sampling bias known as the "Late Prehistoric veneer," but the data point to the construction of more earth ovens through time.

As Dering (1999:667) explains, archaeologists view the intensification of earth oven resources through the expansion of earth oven size or the construction of more earth ovens. Thus reasonable proxies to indicate an intensification of earth oven technology are an increase in oven size and oven frequency through time. According to Thoms (2009:586), "the landuse intensity model predicts a positive correlation between the amount of FCR generated as a byproduct of hunter-gatherer cooking, and the quantity of difficult-to-cook foods consumed." If the assumption is that the volume of burned rock in the archaeological record can predict the amount of food procured in the past, than archaeologists can measure change in the amount of food produced at sites with well-dated burned rock midden deposits.

Thoms (2009:575) suggests that earth oven technology can be understood in terms of use-life of the hot rocks – the processes employed to procure, use, and discard burned rocks. At the end of use-life, burned rocks are discarded outside earth oven features to form midden accumulations. Morphological characteristics of remnant earth oven beds and physical characteristics of the burned rocks, such as degree of fracture, can reveal details about the use of hot rocks. Surface weathering still visible on thermally fractured discarded burned rocks is a reasonable way to determine whether rocks were gathered from canyon bottom or upland settings.

Quantifying the change over time through examining character of discarded burned rock is a central aim of this thesis research, but the interpretation of burned rock quantification rests on two assumptions. First, the construction of more earth ovens through time many not result in an increased frequency of intact earth oven beds at a given site because earth ovens are often reused or dismantled. The assumption is that landuse intensification and the construction of more earth ovens would entail the recycling burned rocks for multiple earth oven firings. The second assumption is that that reuse of hot rocks can be observed archaeologically in that discarded rocks from earth ovens are more heavily burned and fractured than burned rocks after only a single use.

The proliferation of earth oven technology in the Lower Pecos during the Archaic period into the Late Prehistoric, and the frequency of archaeological sites containing burned rock, is a result of landuse intensification due to increasing demographic pressure through time. At a single site with a long record of earth oven use, a pattern of increased fracture and reuse of rocks in upper strata may represent the increased intensity of plant processing. The focus of this thesis is to demonstrate that the Little Sotol site is an earth oven facility that represents a pattern of landuse intensification at a single location.

3. LOWER PECOS ARCHAEOLOGICAL BACKGROUND

The spectacular archaeological record of the Lower Pecos Canyonlands has long attracted the interest of Texans and travelers to the region due the preservation of materials and rock art within dry caves and rockshelters. Looting of the rich archaeological record prevailed through much of the last century, and professional archaeologists also frequented the region throughout the 1930s. These early expeditions excavated dry rockshelters to acquire interesting relics for museum collections (Black 2013). The most prominent early research in the region includes excavations at Fate Bell Shelter (Pearce and Jackson 1933), Eagle Cave (Davenport 1938; McGregor 1985), the Shumla Caves (Martin 1933; McGregor 1985). Other early expeditions to the region served to document rock art (e.g., Jackson 1938; Kirkland 1937).

The late 1950s and 1960s brought an era of salvage archaeology with the construction of Amistad Reservoir at the confluence of the Rio Grande and Devils River. This era coincided with the increasing awareness on the part of national policy makers and archaeologists that such construction activities posed a threat to the record of the human past (Black 2013). In preparation for the inundation of vast areas of terraces and canyons, large reconnaissance surveys were conducted (e.g., Dibble and Prewitt 1967; Graham and Davis 1958; Taylor and Gonzales Rul 1961) and rock art panels were recorded (e.g., Gebhard 1965; Grieder 1965).

Numerous sites were selected for excavation during the Amistad era including but not limited to: Eagle Cave (Ross 1965); Bonfire Shelter (Dibble and Lorrain 1968); Centipede and Damp Caves (Epstein 1963); Devils Rockshelter (Prewitt 1966), Arenosa Shelter (Dibble 1967), the Devil's Mouth site (Johnson 1964, Sorrow 1968a); Nopal

Terrace (Sorrow 1968b), and the Javelina Bluff site (McClurkan 1968). The primary aim of the Amistad era was to establish a cultural chronology of the region aided by recent advancements in archaeology, particularly radiocarbon dating. Reconnaissance and excavation during the Amistad era served to document some of the sites later inundated by the reservoir (Black 2013).

In the mid-1960s, a National Science Foundation grand awarded to Dee Ann Story and Ed Jelks afforded the means to conduct technical analyses of faunal assemblages, botanical remains, and coprolites, which resulted in the first paleoenvironmental reconstruction of the Lower Pecos (Story and Bryant 1966). This new multidisciplinary approach provided a baseline of understanding for the regional paleoecology, which is still used today. The inundation of the reservoir beginning in 1969 effectively ended the Amistad era of research in the Lower Pecos Canyonlands (Black 2013; Black and Dering 2008).

During the following decades, archaeological research in the Lower Pecos Canyonlands continued at sporadic intervals. Universities conducted the bulk of research at two significant sheltered sites, Baker Cave and Hinds Cave, among others. This era of research produced numerous papers, theses, and dissertations (e.g., Bement 1986; Bryant 1974; Chadderdon 1983; Dering 1979; Edwards 1990; Jurgens 2005; Lord 1984; Marmaduke 1978; Saunders 1986; Sobolik 1991; Stock 1983; Williams-Dean 1978). The university-led research of the 1970s and 1980s focused on paleoecological questions making use of well-preserved environmental data recovered from dry, sheltered settings.

In the 1980s and 1990s, Lower Pecos research was dominated by Solveig A, Turpin and colleagues. She is perhaps most well-known for the documentation and interpretation of spectacular rock art panels (e.g., Turpin 1982, 1984a, 1986, 1990, 1994b), but her inquiries into the Lower Pecos archaeology record were quite diverse – including cultural chronology (e.g., Turpin 1991, 1995, 2004), mortuary and ritual practices (e.g., Turpin 1985, 1992a, 1994; Turpin et al. 1986), and environmental change (e.g., Turpin 1987). Largely due to her abilities to synthesize data and publish numerous papers, Turpin has played a central role in defining the past lifeways of the Lower Pecos.

The late 1990s issued in a new era of rock art research and interpretation in the region (e.g., Boyd 1998, 2003). By the early 2000s the Shumla Archaeological Research and Education Center, a non-profit research institution and educational facility founded by Dr. Carolyn Boyd, initiated an archaeological rejuvenation in terms of methods and practices of documenting and interpreting rock art compositions within the many dry caves and rockshelters of the Lower Pecos Canyonlands. The Shumla School continues to systematically and scientifically study the rock art of the region, while fostering lasting relationships with private landowners and Texas State University.

The management of public lands (e.g., Kenmotsu and Wade 2002; Labadie 1994; Tennis et al. 1996; Turpin and Davis 1993) and investigations ahead of construction activities (Burkett 1990; Cliff and Nash 2003; Cooper and Cooper 2000; Eaton 1991; Krapf et al. 1994; Peter et al. 1990) prompted the majority of cultural resource inventories and data recovery projects through much of the 1990s and 2000s. The Texas Parks and Wildlife Department (TPWD) and the National Parks Service (NPS) continue to contribute substantial amounts of information to the archaeological knowledge of the Lower Pecos through survey and excavation (e.g., Dering 2002; Howard 2012; Roberts and Alvarado 2011).

In 2009, Dr. Steve Black initiated the ongoing Ancient Southwest Texas (ASWT) Project, which has supported several graduate research projects to date (Basham 2015; Campbell 2012; Koenig 2012; Rodriguez 2015), including the excavation of the Little Sotol site. Central to the ASWT Project are the aims to develop and employ efficient methods to excavate burned rock middens and sample remnant earth oven heating elements. The excavation of the Little Sotol site coincided with the survey of Dead Man's Creek in 2011 (Koenig 2012), and the excavations of burned rock deposits at three sites (the Rancid Cactus site, Hibiscus Shelter, and the Tractor Terrace site) in 2012 (Black and Koenig 2014). In the past six years of research, collaborating senior researchers, students, interns, and volunteers for the ASWT Project have amassed data regarding burned rock midden formation, earth oven technology, plant processing, and other research topics.

Tested and Excavated Burned Rock Middens

Many tested and excavated sites have contributed to the body of knowledge regarding the prehistoric past of the Lower Pecos Canyonlands; however, relatively few investigations have focused on burned rock middens or earth oven facilities. A quick review of over 1880 sites containing burned rock artifacts in Val Verde County reveals only 58 tested or excavated burned rock middens to date (TARL Site Atlas, last accessed September 29, 2015) (Table 2). Other site types containing burned rock, but not included in Table 2, include isolated earth oven beds, "hearth fields," and burned rock scatters. I chose to focus on previous excavations of burned rock middens because the large accumulations of burned rock typify long-term earth oven facilities.

Because the majority of excavation in the Lower Pecos occurred during the Amistad era one might expect that most of the excavated burned rock middens are located within the reservoir boundaries. While many burned rock middens are documented in the vicinity of Amistad Reservoir, only six burned rock middens were tested in the 1960s. Two of the most notable excavations occurred at the Doss site (41VV3) in 1962 and Nopal Terrace (41VV301) in 1967 as a result of the survey conducted by Graham and Davis (1958).

The Doss site consisted of a 4-foot deep burned rock midden on a high bluff overlooking the Devils River. The aim of the excavation was to examine internal structure of the burned rock midden and recovered projectile points to expand upon the developing cultural chorology of the region. A 5-foot, T-shaped trench was excavated across the midden measuring 55 feet along the east-west axis and 40 feet along the north-south axis. Three additional test units were excavated along the periphery of the burned rock midden. The excavation revealed two zones (A and B) of burned rock and lithic artifacts and a culturally sterile layer just above bedrock. No internal "hearth" features were identified (Nunley et al. 1965).

Nopal Terrace consisted of stratified deposits of burned rock and culturally sterile alluvium at the confluence of a small tributary and the Rio Grande. Sorrow (1968b) described the excavation as "limited testing" in conjunction with the excavation of the Devil's Mouth site (Sorrow 1968a); although in comparison to modern excavation standards, a backhoe prepared profile, it was a substantial undertaking. The excavation included one 5-foot by 5-foot unit, seven 5-foot by 10-foot units, plus another large test pit, and backhoe trench. Numerous artifacts were collected and analyzed to contribute to the projectile point sequence of the region, but no internal cooking features were documented amid the burned rock (Sorrow 1968b).

After the Amistad era of research, the majority of archaeological testing has occurred along roadways – primarily ranch roads and state highways. Texas Department of Transportation (TxDOT) sponsored investigations of burned rock midden sites account for six of the tested burned rock middens, usually through a combination of trenching and shovel testing (TARL Site Atlas, last accessed September 29, 2015). Many sites documented by the TPWD and ASWT are along roads as well. Unfortunately, road construction, looting, and recreation negatively impact many of the sites. Aiming to excavate "off the beaten path" may afford the opportunity to excavate more intact burned rock middens.

In 2007, two buried burned rock middens were inadvertently discovered during the backhoe trenching for a recreational vehicle dump station at Seminole Canyon State Park and Historic Site. The subsequent mitigation of the Lost Midden Site (41VV1991) conducted by TPWD revealed an intact "roasting pit" within the larger of the two burned rock middens. Collected samples allowed for further analysis of the site. Macrobontanical analysis revealed sotol and lechuguilla as the likely food resources baked processed on-site. Radiocarbon dates were returned ranging from 1170 to 690 B.P. (Roberts and Alvarado 2011).

It is noteworthy to consider the level of effort involved in the testing of most burned rock middens in the Lower Pecos. Of the 58 tested or excavated burned rock middens, only 26 were probed beyond initial shovel testing and most collected *no* samples for analysis. Because burned rock middens were usually tested with shovel tests

30 to 40 cm in diameter, very few structural elements and interior remnant heating elements were identified. Only nine excavations of burned rock middens (at sites 41VV665, 41VV1020, 41VV1340, 41VV1904, 41VV1907. 41VV1908, 41VV1991, 41VV2053, and 41VV2055) successfully identified internal cooking features in addition to the excavation of the Little Sotol site (see Table 2). The identification of internal remnant earth oven beds is crucial to the interpretation of burned rock midden excavation results.

Recently, the Texas Parks and Wildlife Department (TPWD) completed an inventory of the Devils River State Natural Area South Unit (Howard 2012). This effort accounts for 26 of the 58 tested burned rock middens in Val Verde County. Almost immediately across the Devils River along Dead Man's Creek, the ASWT researchers tested three burned rock feature remnants and excavated three burned rock middens (in addition to the Little Sotol site) in 2011 and 2012. Burned rock middens in upland settings and pouring out of large rockshelters are relatively neglected in Lower Pecos research. One of the aims of the ASWT project is to excavated burned rock middens in variety of topographic settings (see Black and Koenig 2014; Koenig 2012).

Research along Dead Man's Creek

Formal archaeological research did not reach Dead Man's Creek until the 1990s when Solveig Turpin and team conducted an inventory of sites including, 41VV1230, 41VV1284, 41VV1340, 41VV1341, 41VV1342, 41VV1347, 41VV1348, and 41VV1349. The Bobcat Dug (41VV1349) was originally identified as a burned rock midden located in a road fill borrow pit with no intact features visible. At the landowner's request, ASWT researchers visited 41VV1349 in 2011 after a potential earth oven feature was exposed. ASWT researchers tested and sample the feature remnant, but excavation yielded no datable material and the feature was not intact. Reconnaissance in the area surrounding Bobcat Dug led to the finding of the Little Sotol site, the focus of this thesis.

At least four other burned rock middens recorded by Charles Koenig (2012) are located within the same tributary canyon as the Little Sotol site – Dead Man's Kitchen (41VV2036), Oven-Smashed-In (41VV2073), and Little Lechuguilla (41VV2117). Dead Man's Kitchen and Little Lechuguilla are located near the confluence of Dead Man's Creek and in proximity to the Little Sotol site; while Oven-Smashed-In is located upstream from Little Sotol. Coinciding with the Little Sotol excavation, Black and Koenig (2014) excavated three burned rock middens using ASWT methods – Hibiscus Shelter (41VV1340), Rancid Cactus Midden (41VV2053), and Tractor Terrace Midden (41VV2055). The methods and findings of the Little Sotol excavation along Dead Man's Creek are presented in the subsequent chapters of this thesis.

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County[5].

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV3 (Doss site)	Four-foot thick burned rock midden	Amistad Salvage Project	Nunley 1962	Uplands, a high bluff overlooking the Devils River	T-shaped trench and three excavation units	None	None
41VV44	Two multicomponent burned rock middens	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2013	Below low bluff on east side of gully	2 shovel tests, 40 cm diameter, 10 cm levels, 1/4 inch mesh screen	None	None
41VV48	Burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2011	Terrace at the confluence of Devils River and an unnamed tributary	2 shovel tests (40 cm diameter) excavated in 10 cm levels, screened through 1/4-inch mesh	None	None
41VV49	Large, multicomponent burned rock midden	Devils River SNA South Unit Survey and Testing	Francell and Howard (TPWD) 2013	Valley floor bordered by an intermittent drainage on the northeast and southeast	1 shovel test, 40 cm diameter, 10 cm levels, 1/4-inch mesh screen	None	None
41VV168 (Langtry Rock Midden)	Burned rock midden	Amistad Salvage Project	Graham and Davis 1958	Bluff on left side of Eagle Nest Canyon	Tested by Martin (1933) and trenched by Taylor (1949)	Unknown	Unknown
41VV216 (Zopilote Cave)	Small, multicomponent rockshelter with a midden deposit; a small burned rock midden was also inside the shelter	Amistad Salvage Project	Parsons 1962	Rockshelter	Site was tested by Parsons (1962) and excavated by Nunley (1963)	14C samples	Unknown

[5] Undefined abbreviations in the table include: State Natural Area (SNA), radiocarbon (41C), and shovel test (ST).

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV264 (Devil's Rock Shelter)	Multicomponent rockshelter with a buried midden deposit is in front of the shelter	Amistad Salvage Project	Dibble 1962, 1965	Rockshelter at the foot of bluffs on east site of Rio Grande canyon, and remnant terrace	Excavated by Prewitt and Tunnel in 1965; 41VV350 tested by Dibble and Prewitt 1967	A single 14C date of 5480 B.C.	Unknown
41VV277	Open burned rock midden of significant depth (~15 ft.)	Amistad Salvage Project	Dibble 1964	At mouth of short dry tributary entering Devils River Canyon from west	Test pits facing of cut bank	None	None
41VV279	Expansive, stratified, open burned rock midden	Amistad Salvage Project	Dibble 1964	Alluvial terrace near confluence of Devils River and tributary	Test pit facing of cut bank	None	None
41VV301 (Nopal Terrace)	Stratified burned rock midden deposits	Amistad Salvage Project	Sorrow 1967	Terrace at the confluence of the Rio Grande and small tributary	Combination of mechanical trenching and large excavation units	Unknown	None
41VV314 (Greasewood Midden)	Discontinuous concentrations of burned limestone rocks and lithics centered on six low mounds of burned rock	Amistad Salvage Project	Dibble 1964	Uplands	Excavated by Dibble and Prewitt (1967)	Unknown	Unknown
41VV353	Stratified burned rock midden	University of Texas Survey	Greer 1966	Hillside on left bank for Devils River	Tested by Greer 1965	Unknown	Unknown

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV661	Stratified burned rock midden	TAS Field School 1999	Kimdall 1999	Within terrace in Rio Grande canyon below cliff about 100 yards from river	Six 1-x-1m excavated to 95-100 cmbs	Burned rock, one 14C age 660 B.P.	None
41VV665	Burned rock midden "island" with central feature	TAS Field School 1999	Jones 1999	On a small island in Evans Creek	Feature excavation	Six archeomagnetic samples, 14C samples from F1	Hearth Feature 1
41VV691	Large burned rock midden	Devils River SNA South Unit Survey and Testing	Roberts (TPWD) 2013	On terrace/bench of tributary canyon to Devils River	One shovel test	None	None
41VV704	Burned rock midden and burned rock scatter	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2011	A small bench above river terrace at the base of a hill	One shovel test in midden, and three shovel tests on terrace below	None	None
41VV828 (Tonto Site)	Burned rock middens	Not listed	Turpin and Bement (TAS) 1986	On right bank of Cow Creek	Trowel excavation of Feature A	None	None
41VV837	Six burned rock middens	Devils River SNA South Unit Survey and Testing	Roberts (TPWD) 2011, 2013	On middle and upper terraces of Devils River and side canyon	Six shovel tests	14C sample from ST1, Level 7	None
41VV838	Two burned rock middens	Devils River SNA South Unit Survey and Testing	Alvarado (TPWD) 2011	On narrow alluvial terrace along left bank of Devils River	Two shovel tests	14C from ST1	None

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV1012	Burned rock midden	Deep Underground Explosive Project, Louisiana Army Ammunition Plant, Work Order #6	Anthony and Cloud (Geo-Marine, Inc.) 1989	On low first terrace above right bank of Little Satan Creek	Two shovel tests	None	None
41VV1014	Two burned rock middens	Devils River SNA South Unit Survey and Testing	Roberts (TPWD) 2013	On relatively level upland summit & divide; near head of unnamed tributary to Little Satan Canyon	Four shovel tests	None	None
41VV1015	Burned rock midden	Deep Underground Explosive Project, Louisiana Army Ammunition Plant, Work Order #6	Anthony and Cloud (Geo-Marine, Inc.) 1989	Above left bank of a tributary to Little Satan Creek on narrow first terrace	Three shovel tests	None	None
41VV1019	Burned rock scatter originally recorded as burned rock midden	Devils River SNA South Unit Survey and Testing	Gibbs (TPWD) 2013	On level upland west of Cedar Spring Canyon South Branch	Two shovel tests	None	None

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV1020	Early and Middle Archaic burned rock midden	Devils River SNA South Unit Survey and Testing	Margaret Howard, Texas Parks & Wildlife Department, 2013	On terrace at confluence of Little Satan Creek and short, unnamed side drainage	One shovel test	None	Possible feature identified in ST1
41VV1024	Burned rock midden	Deep Underground Explosive Project, Louisiana Army Ammunition Plant, Work Order #6	Anthony and Cloud (Geo-Marine, Inc.) 1989	On relatively wide terrace adjacent to canyon drainage	Two shovel tests	None	None
41VV1340 (Hibiscus Shelter or Spool Shelter)	Rock shelter with large talus of burned rock extending bottom of canyon	ASWT Research Project	Koenig 2012	Rockshelter high above canyon floor under overhand at head of canyon	Hand excavated units and rock sort columns in talus deposit	Burned rock, 14C, botanical, matrix samples	Yes
41VV1349 (Bobcat Dug)	Remnant of a burned rock midden	ASWT Research Project	Black, Koenig, Rush, Knapp 2011	Low terrace near confluence of Dead Man's Creek and small tributary canyon	Feature excavation	Burned rock, 14C, botanical, matrix samples	None
41VV1649	Three small, wet shelters with burned rock and ashy matrix	TARL-Sponsored Projects	Riemenschneider and Davis 1995	Just under canyon rim of a steep tributary canyon to Dry Devils River	Trowel scrapes to establish depth of deposit	None	None

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV1666	Thick burned rock midden with discrete lenses of ash and charcoal		University of Nebraska 1990	On terrace of dry tributary	Midden excavation - a total of 43 square meters	Unknown	Unknown
41VV1752	Surficial to shallowly buried burned rock midden with numerous hearths (ovens)	TAS Field School 1999	Black and Beene, 1999	On sloping to flat alluvial terrace	Feature excavation	Archaeomagnetic samples from FX-1, 2, 4; 14C and matrix samples from FX-1, 2, 4, 7	None
41VV1897	One burned rock midden	US 277: add shoulders from the Edwards County line to 8.0 miles south	Meade (TxDOT) 2000	On moderately steep northwest facing toe slope east of the Dry Devils River floodplain	One backhoe trench that bisected the midden was excavated to bedrock	None	None
41VV1904	Burned rock midden measuring 10m-x-5m and 50cm deep	SH 163: Reconstruct and Widen Roadway	Meade (TxDOT) 2001	Within large unnamed draw between intermittent drainage and relatively steep upland toe slope	One shovel test and three mechanical trenches	None	Two features observed near the base of the midden
41VV1906	Burned rock midden consisting of dark ashy soils and burned rock	RM 189 TxDOT Survey	O'Farrell and Carpenter (SWCA) 2001	South side of drainage	Four shovel tests	None	None

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV1907	Burned rock midden complex including seven burned rock middens	RM 189 TxDOT Survey	Miller, O'Farrell, and Carpenter (SWCA) 2001	On northern edges of the Devils River terraces	Four backhoe trenches	None	Intact subfeatures (hearths) in a few areas
41VV1908	Burned rock midden	RM 189 TxDOT Survey	O'Farrell and Carpenter (SWCA) 2001	On deep, clay loam terraces on the south side of Devils River	One backhoe trench	None	None
41VV1909	Burned rock midden with with dark ashy soils	RM 189 TxDOT Survey	O'Farrell and Carpenter (SWCA) 2002	On deep, clay loam terraces on the south side of Devils River	Three backhoe trenches	None	Multiple burned rock subfeatures
41VV1991 (Lost Midden)	Two burned rock middens and one hearth feature	Seminole Canyon State Park and Historic Site	Roberts (TPWD) 2007	On nearly level upland summit overlooking Seminole Canyon	Backhoe excavation, shovel tests, mechanical auger tests	14C sample	Lined feature
41VV2044 (Lone Flower Terrace)	Buried remnant of a burned rock midden or FCR feature	ASWT Research Project	Black and Koenig 2011	At confluence of Dead Man's Creek and large tributary	Exposed two smaller profiles of the feature, then connected the two profiles together	14C and matrix samples	None
41VV2053 (Rancid Cactus Midden)	Burned rock "ring" midden	ASWT Research Project	Koenig 2011, 2012	Uplands between two side canyons that flow into a small tributary of Dead Man's Creek	Hand trench and hand excavated units, rock sort columns	Burned rock, 14C, matrix samples	Yes

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV2055 (Tractor Terrace Midden)	Burned rock midden	ASWT Research Project	Koenig 2011, 2012	On downstream portion of terrace	Mechanical trench, and hand excavated units, rock sort columns	Burned rock, 14C, matrix samples	Yes
41VV2074 (Dead Man's Mouth)	Very large accumulation of burned rock (<10 acres) with numerous burned rock middens	ASWT Research Project	Koenig and Castaneda 2011	On upstream terrace at confluence of Dead Man's Creek and the Devils River	Profile of burned rock midden	Two 14C samples	None observed
41VV2120 (Summer House)	Buried burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2011	On sloping terrace overlooking Devils River	One shovel test	14C sample from ST1	None observed
41VV2123	Burned rock midden	Devils River SNA South Unit Survey and Testing	Alvarado (TPWD) 2011	On a small knoll between Devils River and limestone cliffs	One shovel test	None	None observed
41VV2124	Burned rock midden with rich black soil and burned rock	Devils River SNA South Unit Survey and Testing	Alvarado (TPWD) 2011	On colluvial slope and knoll	One shovel test	None	None observed
41VV2135	Burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2011	On small bench of an intermittent drainage flowing west to Devils River	One shovel test	None	None observed

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV2139	Burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2011	On north bank of an intermittent drainage flowing to Devils River	One shovel test	One burned mano fragment, and 14C collected from ST1	None observed
41VV2171 (Blue Lizard)	Burned rock midden	Devils River SNA South Unit Survey and Testing	Alvarado (TPWD) 2013	On level upland	One shovel test	None	None observed
41VV2173	Burned rock midden	Devils River SNA South Unit Survey and Testing	Gibbs (TPWD) 2013	On small, level bench above terrace/flood plain of Cedar Springs drainage	One shovel test	None	None observed
41VV2177	Burned rock midden	Devils River SNA South Unit Survey and Testing	Francell (TPWD) 2013	On top of ridge	One shovel test	None	None observed
41VV2181	Burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2013	On bench above an intermittent tributary in Fork Canyon	One shovel test	None	None observed
41VV2182	One large, dense burned rock midden	Devils River SNA South Unit Survey and Testing	Garrett (TPWD) 2013	On T_1 terrace and bench along Devils River	One shovel test	14C from ST	None observed

Table 2. Tested and Excavated Burned Rock Middens in Val Verde County (continued).

Site No.	Site Description	Project Name	Recorded By	Locational Setting	Testing/Excavation Method	Special Samples	Internal Features
41VV2186	Burned rock midden	Devils River SNA South Unit Survey and Testing	Francell (TPWD) 2013	On terrace at confluence of two tributaries to Big Satan Creek	One shovel test	None	None observed
41VV2187	Two burned rock middens, and two solution cavities located on the south canyon wall	Devils River SNA South Unit Survey and Testing	Lowe (TPWD) 2013	On relatively level terrace of unnamed drainage near confluence with Big Satan Creek	Two shovel tests	14C from ST	None observed
41VV2190	Burned rock midden	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2012	On edge of level upland area that slopes toward unnamed canyon	One shovel test	None	None observed
41VV2196	Large burned rock midden	Devils River SNA South Unit Survey and Testing	Gibbs (TPWD) 2013	On T_1 & T_2 terraces of Devils River	Two shovel tests	14C from ST	None observed
41VV2200	Burned rock midden	Devils River SNA South Unit Survey and Testing	Fisher (TPWD) 2013	On level upland divide bounded by Cedar Spring Canyon South Branch and Little Satan Canyon	One shovel test	None	None observed
41VV2201	Two burned rock middens and associated small rockshelter	Devils River SNA South Unit Survey and Testing	Howard (TPWD) 2013	On small terrace	Two shovel tests	None	None observed

4. EXCAVATION METHODS AND RESULTS

The Little Sotol site (41VV2037) is located on the west bank of Windmill Canyon only a short distance from its confluence with Dead Man's Creek. The site consists of two low-hanging, southeast-facing caves and a sizeable burned rock midden (approximately 10 m in diameter) fronting the drainage of Windmill Canyon. At the apex, the midden measures over 1.8 m deep with cultural material extending approximately 30 cm below the burned rock accumulation.

The burned rock accumulation at the Little Sotol site is impressive with many plant processing tools and a handful of projectile points associated with the Late Archaic period scattered across the surface of the midden. The total midden accumulation is an estimated 120 m^3 or 99 metric tons of burned rock. The excavation within the burned rock midden did not reach culturally sterile layers; however, the density of artifacts diminished significantly below the extent of the burned rock deposit. The steep-sided dome of burned rock with a distinct center at the apex of the midden gives the appearance of a volcano, hence offering the descriptive term "volcano midden."

The "center" is a flexible term defined by superficial depression, central earth oven features, decrease density of artifacts, increase density of ash and charcoal (Black and Creel 1997:295). Five overlapping remnant earth oven beds (Features 1, 3-6) encountered during excavation define a central focus to earth oven construction and use from the end of the Early Archaic to the Late Prehistoric period (Figure 3).

The burned rock midden is closely associated with the southernmost cave in terms of space and prehistoric site use. Excavations exposed two remnant earth oven beds (Features 9 and 10) and another limestone slab feature (Feature 2) located at the

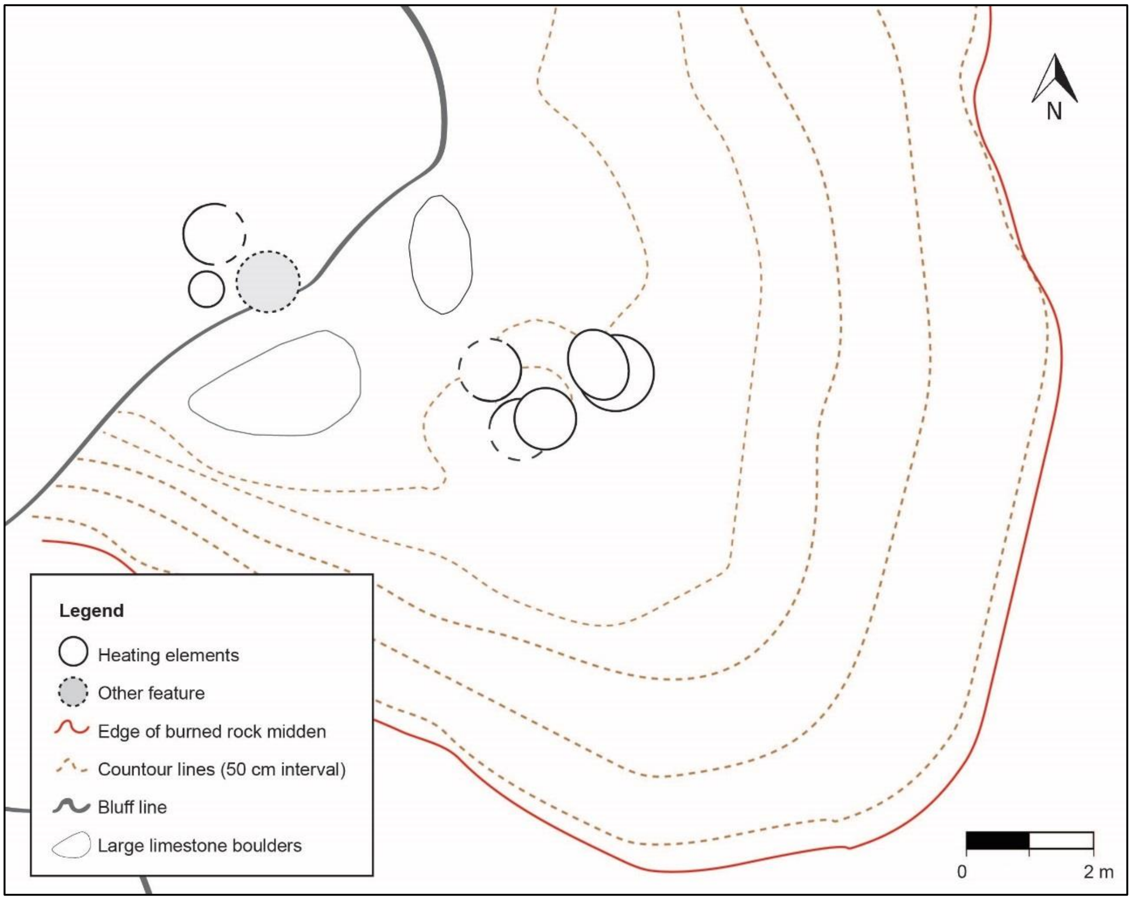


Figure 3. Plan map of the Little Sotol site showing feature locations within the burned rock midden and cave deposits.

mouth of the limestone opening. Discarded burned rocks from Little Sotol Cave spill onto the terrace forming an artifact-rich talus that merges with the steep-sided burned rock midden positioned in front of the small cave. A test unit excavation at the mouth of the northernmost cave revealed thin layer of burned rock and ashy sediment just above bedrock, which appears to the northern margin of the burned rock midden situated on the terrace. Both the caves at the Little Sotol site are intermittently wet and were found to contain few preserved organic remains aside from charcoal and charred plant remains.

A large boulder rests in front of Little Sotol Cave (Figure 4) and represents a sizable roof collapse that occurred at some time in prehistory. Excavations uncovered burned rocks and lithic artifacts beneath the large boulder indicating that the collapse occurred after prehistoric occupants began using the Little Sotol site as an earth oven facility. The roof collapse at the entrance of southernmost cave created a sediment trap, potentially creating favorable circumstances for earth oven construction at the mouth of the cave.

Unfortunately, no datable material was recovered from beneath the boulder to date the timing of the roof collapse. Large limestone boulders and exposed bedrock are common locations for grinding facets in Lower Pecos rockshelters; however, none were found during the investigation of the Little Sotol site.

Fieldwork at the Little Sotol site was conducted sporadically over a period of 18 months, from January 2011 to June 2012. The initial surface documentation of the site occurred early in 2011 and excavations began as part of the 2011 Texas State University

Figure 4. Overview of the Little Sotol site during excavation. Note the domed-shaped burned rock midden (right), and the opening of the small cave and large boulder (left).

archaeological field school. The field school excavation lasted the month of June 2011 with as many as 12 student archaeologists on site at a given time. Student volunteers continued the excavation of the Little Sotol site in July and August 2011 following the field school, and for shorter field excursions in October 2011, January 2012 and March 2012. The excavation of the Little Sotol site was completed with the continued assistance of enthusiastic volunteers in May and June 2012.

During the course of the excavation, four excavation areas were opened. A large excavation block atop the burned rock midden (Area 1) serves as the focus of this thesis highlighting evidence of earth oven plant baking, midden formation and structure, and excavation strategy of a challenging archaeological feature. A second excavation block at the mouth of Little Sotol Cave (Area 2) was opened in search of remnant earth oven beds, while the third excavation area in front of the cave (Area 3) was opened to learn more about the underlying bedrock formation. The final excavation area at the mouth of the northernmost cave (Area 4) was selected to test the hypothesis that the burned rock midden is more closely associated with the southernmost cave. The relative locations of each excavation area are illustrated in Figure 5.

Excavation units atop the burned rock midden were excavated from the existing ground surface, while the units within the caves required the removal of one to two centimeters of very loose limestone dust prior to excavation. Excavation units within the caves were excavated to bedrock, while the excavation block in Area 1 was terminated beyond the extent of the burned rock midden; time constraints and an impenetrable calcium carbonate layer amid large boulders prohibited excavation to bedrock. Shovel tests were excavated to bedrock, gravel, or to a depth of 1 m.

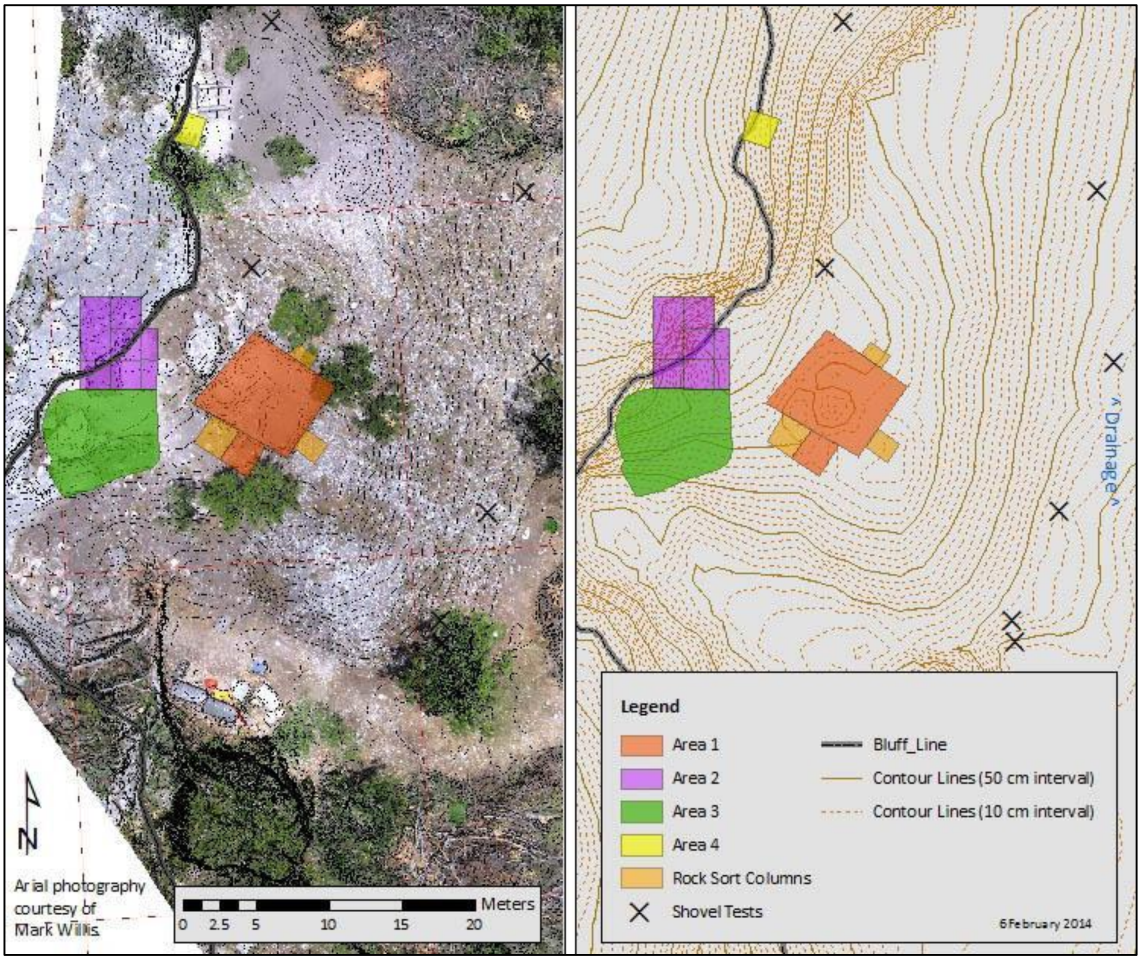


Figure 5. Overview of the Little Sotol site excavation areas with arial photography (left) and geographical contours (right).

Excavation depth measurements were taken in centimeters below datum, and a Total Data Station (TDS) was used to map collected samples, excavation areas, and site contours. Comparisons of elevation data from hand measurements and the TDS revealed user error in one or both of the methods. Some errors have been corrected through examining field notes, while some errors remain unresolved. Datum Z was the primary datum for Area 2 and used for all measurements within the cave; however, the elevation of Datum Z was mistakenly set at 97.77 m when field school students intended to set the datum at an elevation of 100 m. Datum V was the primary datum for Area 1, but Datums

R and W were also used when necessary. A unit-level excavation record was completed for each excavated level – some in greater detail than others. Not all unit-level forms indicated which datum was used, and spatial data was lost. Errors in backsighting the TDS also resulted in loss of spatial data. As the focus of an archaeological field school, the excavation of the Little Sotol site was a learning experience where procedure and methodology were tested and refined during the course of the fieldwork.

Three Rock Sort Columns (RSC 1-3) were placed around the large Area 1 excavation unit (Figure 6). The purpose of the Rock Sort Columns was to establish an expedient method of sampling and documenting large burned rock accumulations in a way that produces useful and comparable datasets. The sample of burned rocks were counted, sorted by size class, classified by surface morphology, and weighed in aggregate to quantify and characterize the burned rocks on-site. The Rock Sort Columns were excavated at regular vertical intervals (20 or 30 cm layers), but the horizontal dimensions of the Rock Sort Columns varied in order to angle walls for stability and provide a large enough window of excavation with depth. The burned rock size classes were informed by previous burned rock midden research and divided into small (<7.5 cm in length), medium (7.5-15 cm), and large (>15 cm). The morphological classifications of burned rocks (pitted, rounded, and other) were aimed at determining the source (upland, canyon bottom, and unknown) of limestone rocks gathered for earth oven construction following the recommendation of Dr. Charles Frederick (personal communication 2011). Small-sized rocks were (<7.5 cm) excluded from morphological classification because they were often too fragmentary to characterize.

Concentrations of large heat-modified pieces of limestone located in association with charcoal may be identified as the remnants of central heating elements of earth ovens. To identify heating elements amid the coarse matrix of burned rocks, excavators sought closely spaced, large burned rocks (>15cm in length) organized in roughly circular patterns with charcoal immediately beneath largest of the rocks. The association of charcoal with large burned rocks is key to identifying remnant earth oven beds (Black 1997:259; Black and Thoms 2014). Other helpful criteria for identifying heating elements including a basin-shaped cross section and large burned rocks cracked in place. Remnant earth oven beds (F1, F3-F6) clearly exhibit these defining characteristics, but vary in construction and degree of preservation. Details regarding the earth oven features at the Little Sotol site are explored in the Chapter 5.

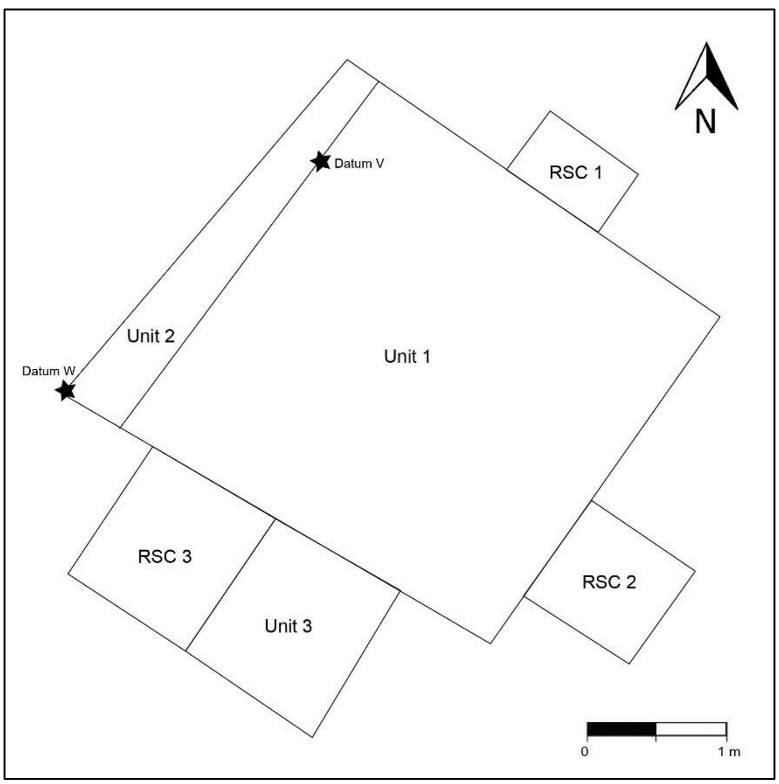


Figure 6. Area 1 excavation units (Units 1-3) and Rock Sort Columns (RSC 1-3).

Matrix samples for flotation were collected from a variety of contexts, including all remnant heating elements, anomalies such as dark sediment patches, and amid nondescript portions of the burned rock accumulation. Typically, 4-liter samples of fine matrix were collected, but where fine matrix was limited samples were smaller. The flotation of matrix samples was conducted with a bucket-and-hose method preferred by Dr. Phil Dering (personal communication 2011). Dry matrix samples were measured and poured into a bucket then filled with water. The sample was agitated with a smooth-surfaced stirring stick, and light fraction poured off the top of the bucket into chiffon fabric pouches for drying. Heavy fraction was water screened through 1/16" mesh. Using the field flotation method, the field school students and I achieved a high recovery rate of botanical material comparable to more expensive laboratory methods. Dering identified microbotanical remains from the light fraction, as well as charred plant fragments and charcoal samples hand-collected during excavation. Heavy fraction from flotation yielded identical material to the excavation as a whole.

As discussed in Chapter 1, questions of time of use and duration of midden formation are essential to this thesis research. To address these questions, a major aim of the excavation was to sample the extent of the cultural deposits in both the cave and burned rock midden by excavating to depth. Middens may form over thousands of years and require numerous assays to be well-dated (Black and Creel 1997:272). Following a similar strategy called for by Black and Ellis (1997:18), *in situ* samples and fine matrix for flotation were collected from the Little Sotol site. Charcoal and plant material were collected from the screen as insurance in case flotation and excavation of features did not yield adequate datable material. Charcoal samples and charred botanical material from earth oven context are the ideal candidates for radiocarbon analysis. When possible, short-lived economic plants (i.e., sotol and lechuguilla) were selected.

Area 1 – Burned Rock Midden

During the 2011 Texas State University field school, the excavation of Area 1 (see Figure 5) began with a 3m-x-3m excavation unit (Unit 1) at the apex and presumed center of the midden. An additional unit (Unit 2) was later added in order to expand the window of view both vertically and horizontally. The Area 1 excavation block was placed with the morphological characteristics of the midden in mind and not on a cardinal grid system (see Figure 6). A series of shovel tests (ST1-ST8) were excavated around the margins of the midden to find the extent and depth of burned rock accumulation. During the course of the excavation, field school students and volunteers excavated three Rock Sort Columns (RSC 1-3) staggered around the large excavation block on the northeast, southeast and southwest sides. A 1-x-1m excavation unit (Unit 3) was opened in the spring of 2012 to explore a potential remnant earth oven bed encountered during the excavation of one of the RSC3.

Developing an efficient strategy for burned rock midden excavation was a major research aim, and largely inspired by the strategies for exposing and documenting midden structure suggested by Black et al. (1997:312) and methods explored at the Higgens site (41BX184) in central Texas (Black et al. 1993). Removing vegetation of non-cultural debris from the surface of the midden allowed for proper examination of surface midden morphology in order to locate the central depression (Black et al. 1997:312). Surface investigations at the Little Sotol site revealed a slight but suggestive central depression near the apex of the cone of burned rock debris. After the burned rock midden surface is sufficiently documented, Black et al. (1997:312) advocate rapid horizontal excavation, trenching, or combination of these techniques to expose horizontal views and vertical profiles.

The large excavation block (Area 1) was positioned over the presumed center of the midden to sample the extent of the burned rock debris at the greatest depth below surface, to expose large vertical profiles, and to reveal remnant earth oven beds. In order to facilitate rapid horizontal excavation, field school students and volunteers excavated with trowels, small hand rakes, shovels where necessary, and hand picks to penetrate layers of calcium carbonate encountered at depth. During the initial days of excavation, all fine matrix recovered from Area 1 was screened through the standard ¼" mesh, which proved quite time consuming. In-field evaluation of the method convinced the author that the massive screening process was slowing excavation and yielding little significant data pertaining to the research, and ½" mesh screen was deemed sufficient for the remainder of the excavation of Area 1. Fine matrix from feature context was either collected for flotation, or screened through 1/8" mesh in order to recover charred plant material. The size of screen mesh should be considered in research design and vary based on research questions (Black et al. 1997:312).

Excavating a midden largely consisting of clast-supported matrix, meaning rock deposited directly atop rock, is a significant challenge and potentially dangerous as unit walls are unstable and prone to collapse during excavation. Angled walls increase stability, but require opening horizontal dimensions large enough to account for a narrowing excavation area and window of view with depth. The burned rock accumulation at the Little Sotol site was deeper than expected and provided logistical challenges in entering and exiting the excavation area. To remedy this challenge a sizable portion of the burned rock deposit was left unexcavated as a step further reducing the window of excavation with depth.

Modern photogrammetic technology was intended to be an integral part of the research strategy at the Little Sotol site in documenting fine-grained spatial details, and in calculating the size and shape of the burned rock midden accumulation. In 2011 and 2012, the pole aerial photogrammetric (PAP) methods used at Little Sotol were largely experimental and yielded unusable data. The method developed by Campbell (2012) was intended for discrete, isolated heating elements on relatively level surfaces. At Little Sotol, the total volume of burned rock was estimated instead with a combination of aerial kite photography conducted by Mark Willis and TDS data points. Coinciding with the excavation of Little Sotol, ASWT researchers developed the digital photogrammetric methods that came to be known as Structure from Motion (Black and Koenig 2014). Photogrammetric methods compatible with modern mapping software (e.g., ArcGIS) require a short amount of time in the field and produce impressive, informative visuals.

As stated in Chapter 1, burned rock middens evidence a high level of cultural mixing with repeated reuse of the site, and repetitive earth oven construction and firing events. Foreseeable issues in the radiocarbon analysis of material from burned rock midden context are stratigraphic reversals (i.e., older radiocarbon assays above younger). The stratigraphic location of temporally diagnostic artifacts, such as projectile points, served as another line of evidence to support radiocarbon analysis. When possible, the find locations of projectile points recovered during the excavation of the burned rock midden at the Little Sotol site were plotted. Though projectile points are not functionally associated with plant baking activities, these artifacts are useful temporal markers. The combination of radiocarbon assays and projectile point data provide sufficient chronological evidence of past earth oven plant baking activities at the Little Sotol site. Chapter 7 includes a discussion of radiocarbon dates, data from the Rock Sort Columns, and estimates for the number of earth oven firing events.

The excavation of the Little Sotol site documented five stratigraphically organized heating elements (F1, F3-F6) with the burned rock midden (Figure 7). Two anomalies – a dark sediment patch containing a high amount of organic material (F7) and a small cluster of large limestone rocks (F8) – were documented as potential earth oven features, and were later deemed insignificant. The apex of the cone of debris successfully demarcates the center of the accumulation and the location of earth ovens (see Figure 3). The identification of five roughly central heating elements demonstrate the success of the strategy employing a large excavation window at the apex of the burned rock midden. The excavation uncovered an abundance of *in situ* plant material in association with heating elements and through flotation methods, which afforded the opportunity to date the extent of the midden strategically selecting charcoal for earth oven context and plant remains identified as sotol or lechuguilla. A total of ten samples were selected for radiocarbon analysis, and these results are presented in Chapter 7.

The archaeological deposits at the Little Sotol site were deeper than expected. Field school students and volunteers excavated approximately 1.8 meters to the extent of the burned rock midden and into the underlying alluvial terrace. The underlying terrace contained some lithic artifacts, no burned rocks, and a number of large limestone

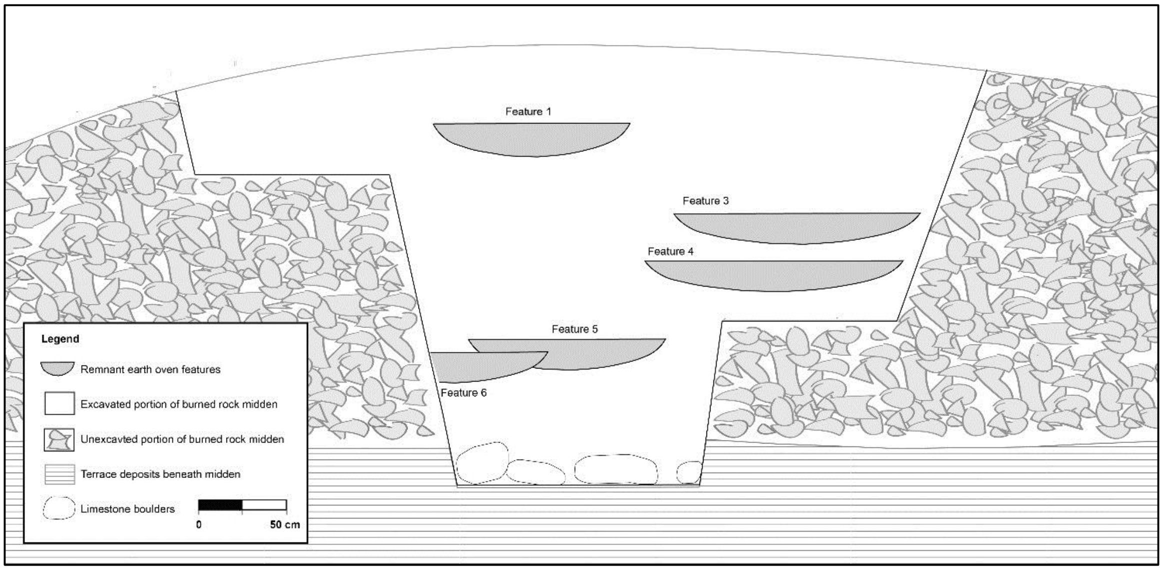


Figure 7. Schematic cross-section of the Area 1 excavation showing relative feature locations, facing northeast at 41VV2037.

boulders. Despite the aim to reach bedrock or culturally sterile deposits, the excavation of the Little Sotol burned rock midden concluded just under 2 meters below surface because sediment solidified by calcium carbonate amid large immovable boulders prevented further progress. Of the total estimated 120 m^3 of burned rock accumulation, Texas State University archaeologists excavated a volume of approximately 10.7 m^3. Table 3 summarizes the excavation of Area 1. While excavation layers were arbitrary and variable, stratigraphic zones were thick bands of similar sediment and burned rock constituents representing a gradient of burned rock discard deposits with no discrete layers of cultural episodes.

Table 3. Area 1 Excavation Summary.

Unit	Layer	Layer elevations[6] (thickness)[7]	Volume excavated (m^3)	Features	Sediment description
1	1-2[8]	96.50 to 96.41 (9 cm)	0.83	-	Loose, light brown in color, organics and many roots
1	3	96.41 to 96.18 (23 cm)	2.23	-	Very fine, ashy, silty, well-sorted, dark in color, typical of midden fine matrix
1	4	96.18 to 95.76 (42 cm)	3.80	Feature 1	Change from fine, dark and ashy to lighter color
1	5	95.76 to 95.50 (26cm)	1.76	Features 3 & 4	Silty loam
1	6	95.50 to 95.18 (32 cm)	0.85	Feature 5	Silty loam to yellow sediment containing stream rolled pebbles approximately 150cm below dat v
1	7	95.18 to 94.86 (32 cm)	0.62	Feature 6	Yellow-brown coarse grained sediment with increasing amount of calcium carbonate at depth
1	8	94.86 to 94.71 (15 cm)	0.15	-	Yellow-brown sediment solidified with calcium carbonate
1	9	94.71 to 94.64 (7 cm)	0.06	-	Light silty sediment solidified with calcium carbonate, and the only layer containing no burned rocks
2	1-3[9]	no data	no data	-	Loose, light to dark brown in color, organics and many roots
3	1	97.38 to 97.28 (10 cm)	0.10	-	Loose, light brown in color, organics and many roots
3	2	97.28 to 97.10 (17 cm)	0.21	-	Brown silt and organics with many roots into fine, dark, ashy sediment typical of midden fine matrix
3	3	97.10 to 97.02 (9 cm)	0.13	-	Fine, dark, ashy sediment containing fewer roots

[6] Average beginning and ending elevations.
[7] Inconsistencies between the difference between beginning and ending elevation and layer thickness are due to uneven surface contours, unlevel layers, and rounding.
[8] Data from Layers 1 and 2 of Unit 1 are combined.
[9] The poor documentation of Unit 2 excavation provides little in the way of spatial data to calculate layer elevations and volume of excavation. Units 1 and 2 are combined Layer 4 onward.

The material types recovered during excavation include burned rock samples, sediment samples, botanical samples and charcoal, bone[10], mussel shell, groundstone, projectile points, bifaces, flake tools, scrapers, cores, and debitage. Appendix A provides an inventory of artifacts, and Appendix B provides an inventory of samples. Chapter 6 includes the preliminary analysis and descriptions of stone tools interpreted as plant processing tools. Detritus unrelated to earth oven plant baking (i.e., animal bones, mussel shell, debitage, and discarded tools) may be discarded in and around open earth oven pits (Black and Thoms 2014:210). The presence of these artifacts reflects the deposition of waste and debris, a secondary behavior to plant baking.

All surface diagnostics from the Area 1 excavation are attributed to the Late Archaic period and no projectile points from the Late Prehistoric period were observed on-site (Table 4). A single Arenosa point recovered from Layer 2 is not in stratigraphic order, but this can easily be explained by cultural mixing and/or bioturbation. Layers 3 and 4 contain a mixture of Late and Middle Archaic diagnostics. The increased frequency of points recovered from Layer 4 is due to the increased volume excavated in the layer. The remaining projectile point sequence within the burned rock midden is stratigraphically correct. Layer 5 contained Middle Archaic points and Early Archaic diagnostics at the lower extent. Layers 6, 7 and 9 yielded only Early Archaic projectile points securing the Early Archaic association of the lower burned rock deposits.

[10] The animal bone recovered from the Little Sotol site includes small fragments of burned and unburned bone. The collection was not analyzed, though the majority of the bone fragments appear consistent with small mammals.

Table 4. Projectile Points Recovered from Area 1 Excavation by Depth and Archaeological Period.

		Area 1 Excavation Layer									
Archaeological Periods	**Projectile Point Types**	**Surface**	**Layer 2**	**Layer 3**	**Layer 4[a]**	**Layer 5[a]**	**Layer 6**	**Layer 7[a]**	**Layer 8**	**Layer 9[b]**	**Total**
	Untyped		1		3						4
Late Archaic	Ensor	1									1
(3000-1000 B.P.)	Fio	1									1
	Shumla	1									1
	Pedernales	1		1	2						4
	Marcos			1							1
	Castroville	1									1
Middle Archaic	Val Verde			1	1						2
(6000-3000 B.P.)	Langtry				1						1
	Arenosa		1		2						3
	Almagre					1					1
	Pandale				3						3
	Kinney?				1	1					2
Early Archaic	Bandy					3	1				4
(9000-6000 B.P.)	Untyped Early Archaic							1		1	2
	Total	5	2	3	13	5	1	1	0	1	31

[a] Data for layer includes projectile recovered from Rock Sort Columns of coinciding elevation.

[b] Projectile recovered from lowest layer was not observed in context, but recovered from wall fall with sediment unique to the lowers layer adhered to the artifact.

Area 2 – Little Sotol Cave

The Little Sotol site contains two low-hanging limestone solution caves. The southernmost cave, Little Sotol Cave, is a secondary focus of this thesis due to the clear association with earth oven plant baking activities. Little Sotol Cave measures 4.4 meters wide and 8.0 meters deep. The cave opens to the southeast, sheltered from winter winds and exposed to summer breezes. During the initial field investigations, the deposits appeared dry and were thought to hold promise for the preservation of perishable material. However, a small spring vent at the back of the cave discharges water into the cave with any substantial rain completely saturating all deposits to depth.

The seven excavation units at the mouth of Little Sotol Cave (Area 2) were positioned with the aim to locate and sample remnant earth ovens. A concentration of burned artifacts at the mouth of the cave and a large roof spall thought to possibly preserve earth ovens beneath the surface dictated the placement of the initial excavation block of four 1-x-1m units (Units 1-4). Two 1-x-0.5m units (Units 5 and 6) were later opened in order to expose truncated feature (Figure 8). The 2-x-1m unit in Area 2 (Unit 7) was excavated in order to better understand the stratigraphy the cave deposits. The excavation units in Area 2 were organized in a block instead of isolated units with the purpose of exposing a large window to examine cultural stratigraphy. Units were excavated by arbitrary level intervals of 10 cm (or 20 cm to expedite excavation in some situations). Unit 7 was excavated by natural layers exposed in profile in order to investigate cultural stratigraphy. The excavation block was excavated to bedrock in order to sample cultural deposits to depth. The powdery limestone matrix was prone to collapse during excavation and required angled walls for stability. The excavated cave

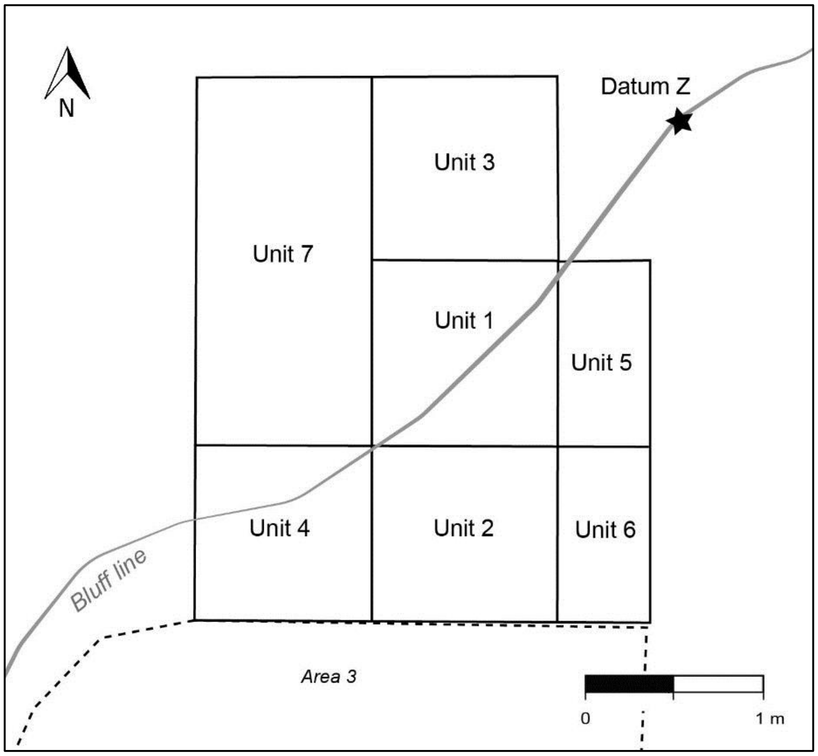
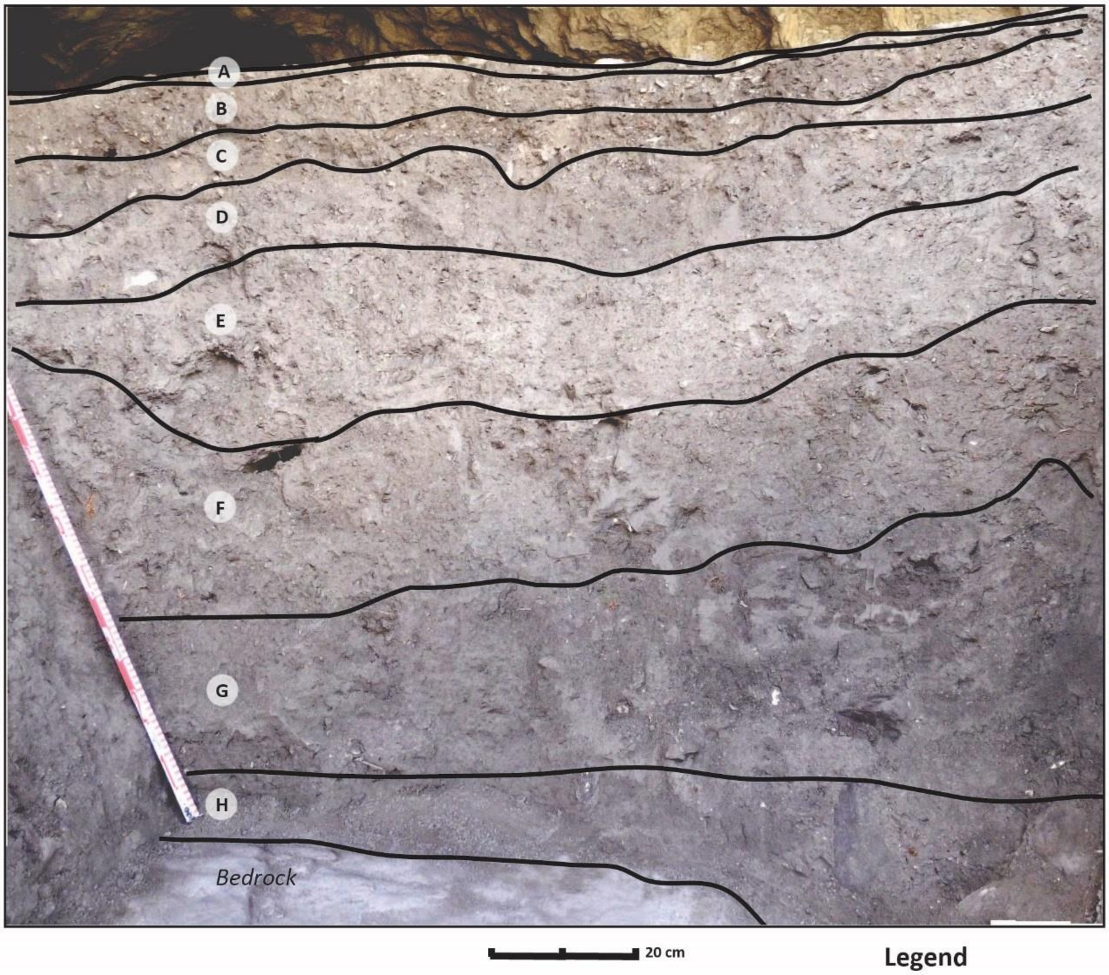


Figure 8. Area 2 excavation units (Units 1-7) in relation to Area 3 and the bluff line.

deposits were screened through standard ¼" mesh. The cave deposits contained an abundance of charcoal and charred plant material, but preserved no artifacts of the rich perishable industry (e.g., basketry, quids, etc.) known in the Lower Pecos archaeological region.

Evidence of earth oven construction at the entrance of the cave and on the terrace lead to questions as to why earth ovens were constructed at both locations on-site. It is doubtful that the motivation was seasonal, constructing ovens within a shelter environment as a way to keep ovens dry, because the cave is wet particularly during the periods of rain. It seems probable that the location preference for earth oven construction changed over time. The sampling of datable material in Area 2 was similar to that of Area 1 targeting *in situ* material from earth oven context and material recovered from the flotation of fine matrix. Temporally diagnostic artifacts within the cave serve as an additional means of assessing time.

The cave deposits were initially thought to be quite shallow due to the visible limestone formation at the opening of the cave; however the excavation of Area 2 revealed that cultural deposits extend over a meter below the modern surface. The cave opening from bedrock to ceiling was approximately two meters tall. The stratigraphy within the cave is difficult to discern with similar texture and color throughout the deposit; however, eight stratigtraphic zones are distinguishable and illustrated in Figure 9. Sediment within the cave is a combination of endogeneous and exogeneous fill. Much of the cave fill is fine-grained limestone dust and roof spalls originating from within the cave (endogeneous), while the lower deposits appear to consist of mainly water-borne, or perhaps wind-borne, silts and clays (exogeneous). Some of the sediment is anthrogenic consisting of ash and debris associated with plant baking activities. Field school students and volunteers uncovered and sampled three archaeological features at the mouth of the cave – two earth oven beds (Features 9 and 10) and a unique circular arrangement of limestone slabs (Feature 2). These features are discussed in more detail in the following chapter. Evidence oven construction is sparse in the upper cave dust deposits (e.g. Zones A-C) in comparison to the lower strata (Zones E-G). The darker sediment in these lower layers consists of clays and silts mixed with endogeneous fill, ash, charcoal, scattered charred sotol and lechuguilla leaves, and burned rocks. The three hot rock features uncovered within the cave are within Stratigraphic Zone E (Feature 2) and Stratigraphic Zone F (Features 9 and 10).



Legend

Stratigraphic boundary

Stratigraphic Zone

A - light tan limestone cave dust with roof spalls (1-7cm)

B - tan limestone cave dust with roof spalls (1-7cm), slightly consolidated

C - light grey silt, very loose

D - limestone cave dust and silty clay, highly bioturbated

E - brown silty clay with subrounded gravels (1-2cm) and roof spalls (1-4cm)

F - brown silty clay with subrounded gravels (1-2cm) and roof spalls (1-7cm),slightly more consolidated

G - dark grey clay with subrounded gravles (1-2cm)

H - dark grey clay with subrounded gravels and an abundance of burned rocks

Figure 9. Profile of the Area 2 excavation, facing north at 41VV2037.

Radiocarbon assays from Area 2 date to the Late Prehistoric period (Table 5), and coincide with the construction and use of Feature 1 within the burned rock midden. In other words, ovens were constructed at the mouth of the cave and the apex of the burned rock midden during the same time period. The lack of radiocarbon dates attributed to the Archaic period is most likely an effect of sampling as diagnostic artifacts attributed to the Middle and Late Archaic periods were recovered from the cave. The Late Prehistoric dates, and artifacts diagnostic of the Middle and Late Archaic periods, coincide nicely with dated deposits within the burned rock midden; however, the earliest material expected on-site dating to the Early Archaic period is absent from the cave deposits. This could be an effect of scouring or clean-out episodes, but it seems more plausible that the significant accumulation of sediment within cave began after the Early Archaic period.

Temporally diagnostic projectile points retrieved from within the cave were not recovered in correct stratigraphic sequence. Mixing due to bioturbation is evident and profuse throughout these upper deposits of the cave with numerous krotovina and large root masses. Further, I expect some cultural mixing in the construction of earth ovens and the repeated reuse of the site as an earth oven facility. In my view, a small reversal is acceptable under these site formation conditions. It is important to note that the radiocarbon assays associated with the cultural features are in the correct sequence providing assurances of good context for the dates acquired from Area 2.

The material types recovered during excavation include, burned rock samples, sediment samples, botanical samples and charcoal, bone, shell, groundstone, projectile points, bifaces, flake tools, scrapers, cores, and debitage (see Appendices A and B). The

Table 5. Radiocarbon Results from Features within Little Sotol Cave.

Sample No.	Context	Provenience	Material	^{14}C Years B.P.	Cal B.P. (2σ)	Median Cal. B.P.
Bot-10	Feature 2	Area 2, Unit 1	*Agavaceae* leaf	765 ± 15	726 to 671	700
Bot-14	Feature 2	Area 2, Unit 1	*Agavaceae* leaf	785 ± 15	730 to 680	710
Bot-27	Feature 2	Area 2, Unit 1	Indeterminate	800 ± 15	733 to 687	710
Bot-9	Cave deposit	Area 2, Unit 3, Layer 4	*Quercus* wood	935 ± 20	917 to 795	860
CS-31	Feature 9	Area 2, Unit 7	*Agavaceae* leaf	960 ± 65	981 to 730	860

artifact assemblage recovered from within Little Sotol Cave is consistent with the expectations for the use of an earth oven facility; however, no perishable materials often associated with the consumption of baked plants, such as quids, were observed likely due to the relatively poor preservation conditions within the sheltered environment. Though the preservation conditions at the Little Sotol site pale in comparison to dry sheltered settings, there is a significant amount of organic material, including, bone, charcoal, and charred plant material, recovered from Little Sotol Cave.

<u>Area 3 – Limestone Bench and Roof Collapse</u>

The aims the Area 3 excavation were to look for potential bedrock features, sample the kinds of artifacts within the talus, and learn more about underlying limestone formation and partially buried roof collapse in front of the cave. A moderate density of groundstone implements at the mouth of the cave suggested the possibility that bedrock grinding facets may be located on the limestone bench and boulder. Small, circular bedrock grinding facets near and within the mouths of caves and shelters are common occurrences in the Lower Pecos Canyonlands.

The excavation of Area 3 removed sediment and debris in three “units” (a term used loosely only to indicate rough provenience) and mapped after the fact (Figure 10 and 11). Because Area 3 clearly consisted of loose talus deposits where material spilling out of the cave merges with material from the burned rock midden, layers were removed in bulk employing shovels and hand picks. Artifacts were collected as encountered, and sediment was not screened. The total volume excavated in Area 3 is approximately 2.2 m^3.

Unit 1 exposed the underlying limestone bench and outward edge of the roof collapse in front of Little Sotol Cave. The excavation revealed a sloping bedrock formation descending away from the mouth of the cave suggested that the bedrock beneath the burned rock midden could be at least 3m below surface. Artifacts encountered during excavation of Area 3 include cores, a chopper, edge modified flakes, bifacial tools, groundstone, and small to medium-sized burned rocks (see Appendix A).

Figure 10. View of Area 3 excavation in progress, facing northeast (left); and view of exposed limestone boulder and bench, facing north-northwest (right) at 41VV2037.

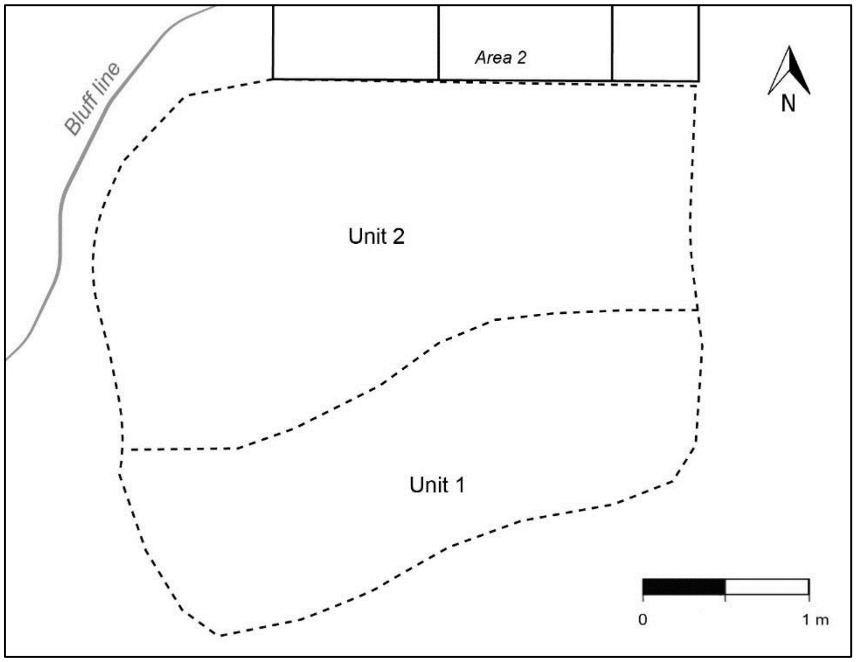


Figure 11. Area 3 Excavation Units 1 and 2 in relation to Area 3. (Unit 3 is located beneath Units 1 and 2 and not illustrated.)

No grinding facets were uncovered on the limestone bench; therefore, the excavation area was expanded to remove the sediment atop the large roof collapse boulder (Unit 2) in search of grinding facets. No grinding facets were found.

The excavation of Area 3 revealed a layer of burned rocks between the limestone bench and large boulder indicating that the roof of the cave collapsed sometime after the site began use as an earth oven facility. A small tunnel approximately 30 cm in diameter (Unit 3) was excavated beneath the roof collapse in the attempt to recover diagnostic artifacts or material for radiocarbon analysis in order to estimate the timing of the roof collapse. Unfortunately, only a handful of flakes and a nondescript biface were recovered from the narrow excavation window beneath the boulder giving no clear indication of when the roof collapse occurred. I collected two matrix samples and four sediment samples, nearly all of the removable sediment from “Unit 3,” and recovered no datable material. The sediment between the roof fall and limestone bench is generally light in color and similar to the deposits in the lower layers of the burned rock midden associated with Early Archaic artifacts and radiocarbon assays. Attributing the time of the roof collapse to the end of the Early Archaic period (~6000 years B.P.) is speculative at best.

The timing of the roof collapse at Little Sotol Cave is unknown; however, the effect of the fortuitous positioning of a large boulder at the mouth of the cave significantly influenced site formation processes. The boulder created a sediment trap providing a place for the accumulation of alluvial and perhaps aeolian deposits within the small cave; thus creating a sheltered location for earth oven construction at an existing earth oven facility, and the opportunity for the preservation of remnant earth oven beds at the mouth of the cave. The observation that cultural material was recovered from Little Sotol Cave is associated with only Middle and Late Archaic periods adds credence to the proposition that cultural deposits did not accumulate within the cave until the cave roof collapse formed a sediment trap. The effect of the sediment trap is perhaps why the deposits within Area 2 differ so drastically from the deposits in Area 4.

Area 4 – Northern Cave Test

The northernmost cave is positioned near the northwest margin of the burned rock midden and appears to contain less cultural material than the more thoroughly investigated portions of the site. The cave also faces southeast, but is significantly smaller than the southernmost cave in depth and ceiling height. Like the southernmost cave, the deposits are intermittently wet holding little promise for the preservation of perishable materials. Volunteers excavated a single 1-x-1m unit at the mouth of the cave to test hypothesis that the northern cave is not associated with earth oven plant baking activities. The test unit was placed beneath a large roof spall at the cave opening following the strategy of feature identification and recovery in Area 2. The excavation was conducted with trowel, shovel, and ½" screens.

The excavation of Area 4 uncovered few artifacts, no features, and a thin layer of burned rock just above bedrock (Figure 12). The cave fill consisted primarily of fine-grained limestone dust and small roof spalls above a relatively thin anthropogenic deposit consisting of burned rock, charcoal, and ash mixed with alluvial sediment. As Figure 12 illustrates, the lower layers contain more evidence of earth oven plant baking, while the upper deposits are culturally sterile in comparison to the other excavated portions of the Little Sotol site. In Area 4, artifacts are sparse and consisted of primarily debitage, particularly in the upper 60 cm of deposition. Flake tools and bifaces were observed out of context in sediment dislodged from excavation unit walls, and Ellis dart point, associated with the Late Archaic period was recovered (see Appendix A). Seemingly modern or historic (fresh-looking) bone fragments, an animal tooth, and a glass fragment were collected from the upper 30 cm of excavation in Area 4 indicating more recent deposition of the limestone cave dust and bioturbation within the northernmost cave deposits excavated in Area 2.

The Northern Cave Test yielded little evidence of plant baking activities, especially in comparison to the dense cultural deposits elsewhere on-site, supporting the assumption that the northern cave was not associated with earth oven construction and use. The scattered burned rock, charcoal, and ash observed in the Area 4 excavation

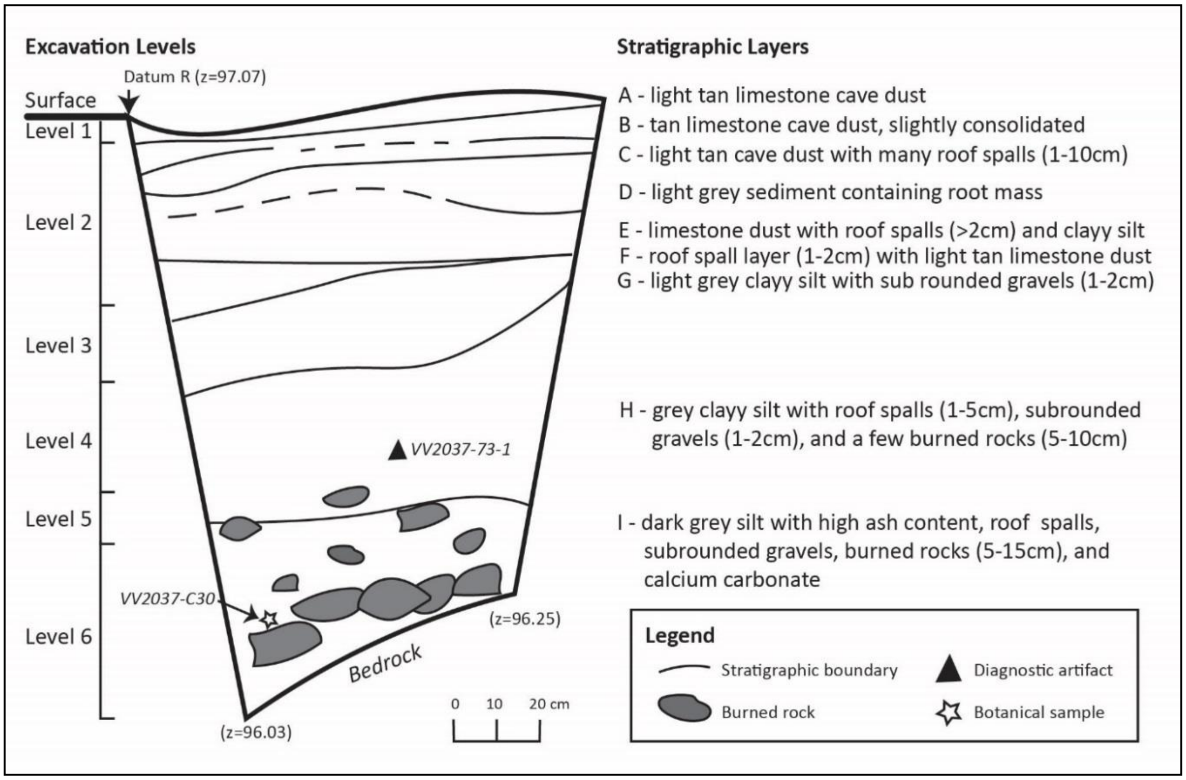


Figure 12. **Schematic profile of Area 4 test excavation at 41VV2037.**

probably represent the northern extent of the burned rock midden. The excavation of Area 4 also proved useful in comparison the Area 2 excavation at the mouth of the southernmost cave. It seems as though the cultural and natural formation processes differ between the two caves on-site largely due to the effect of the sediment trap formed at the mouth of Little Sotol Cave. The deposition within the northern cave is much more recent, perhaps indicating that the northern cave was not used for earth oven construction because there was not enough sediment available with the smaller cave during the Archaic and Late Prehistoric periods.

5. EARTH OVEN FEATURES THROUGH TIME

This chapter describes and interprets of the eight cultural features identified during the excavation of the Little Sotol site. Five features (F1, F3, F4, F5, and F6) were discovered within the burned rock midden at varying depths, while three features (F2, F9, and F10) were located at the mouth of Little Sotol cave. All these features are interpreted as the remains of earth ovens, except for Feature 2. Remnant earth oven beds used to bake semisucculant plants have specific characteristics resultant from construction and use within a circular, basin-shaped pit – closely spaced burned rocks in a circular arrangement (approximately 1.0 to 3.0 m in diameter) and a basin-shaped profile (Black and Thoms 2014).

To reiterate, earth ovens are the layer arrangement of fuel, rocks, and plants (e.g., lechuguilla bulbs, sotol hearts, and prickly pear pads) within a pit sealed with earth, as previously discussed in Chapter 1. The rocks that settle to the bottom of the pit with charcoal and bits of charred plants are termed the heating element, thermal storage layer, or earth oven bed (Black and Thoms 2014:205). Within burned rock midden context, heating elements are distinguished from the surrounding matrix of discarded burned rocks due to the larger relative size of feature rocks and presence of rocks fractured in place with some showing clear evidence of cooling in place – large rocks thermally fractured and still coupled together (Black and Thoms 2014:215). A heating element is usually in clear association with charcoal sealed below large burned rocks and often contains the burned remains of economic plants. Earth ovens are fuel sparing cooking features because heat is transferred to and retained within hot rocks, and only require small fuel loads consisting of soft woods, lesser branches, and dry leaves (Black and

Thoms 2014:209). Preserved charcoal within earth oven context typically includes smaller trees and bushy plants (e.g., small species of ash, oak, and Condalia).

The act of opening earth ovens to remove cooked foods partially dismantles the overall structure of the utilized feature; specifically the earthen cap and overlay of packing material are pulled away and the food is removed, leaving only the lower layer of packing material, the heating element, and remains of charcoal and ash layers below (Black and Thoms 2014:209). In terms of the archaeological signature of earth ovens, the heating element is the primary identifiable remnant of the technology. The construction and firing of subsequent earth ovens and recycling the leftover rocks from previous ovens, as well as chemical weathering, bioturbation, and erosion, may disguise, exaggerate, and/or destroy some of the telltale characteristics of heating elements (Black et al. 1997; Black and Thomas 2014). Though heating elements are relatively durable features, time degrades the preservation of earth oven beds, as with most other types of archaeological features. Human behaviors such as pit digging and rock reuse as well as various forms of bioturbation often result in the preservation of only partial remnants of once-intact heating elements, oven pits, and other earth oven elements.

For the purpose of discussion, the seven of the hot rock features at the Little Sotol site are segregated into types – heating element with pit lining, pit lining remnant, intact heating elements, and heating element remnants. These categories reflect differences in construction, appearance, and preservation. Pit linings, as the term suggests, are the remains of earth ovens that were constructed with a tightly arranged rock pavement at the base of the earth oven pit. Intact heating elements exhibit all (or nearly all) the characteristics of an earth oven heating element as discussed above. Heating element remnants demonstrate enough characteristics to be identified as a once-intact heating element, while some characteristics are not well defined. For more detail regarding the characteristics of pit linings, intact heating elements, heating element remnants, and other archaeological signatures of earth oven cookery see Black and Thoms 2014. The three categories of features discussed in the following sections are all consist with the archaeological signatures of earth oven construction, but are set apart by differences in design and preservation. The rock rosette (Feature 2) is described at the close of this chapter.

Heating Element with Pit Lining

The archaeological signature of earth ovens minimally includes closely spaced, large burned rocks with some cracked in place, charcoal sealed beneath burned rocks, and a circular outline. A basin-shaped profile, ash, and distinguishable dark staining of surrounding sediments may be observed if preservations conditions permit. At times, tabular rocks were used to line the earth oven pit prior to typical construction and firing with a second layer of burned rocks that functioned as the heating element. Black and Thoms (2014:217) suggest that pit linings serve as a barrier to moisture while also retaining heat for earth oven baking. Wet sediments extract heat from the closed earth oven environment; therefore, the addition of pit linings to earth ovens during wet periods seems like a plausible scenario. Heating elements with pit linings are relatively common in the Lower Pecos, and presumably function in the same way as a typical, unlined heating element.

Feature 1

This pit lining consists of a partially intact pavement of tabular burned rocks discovered and exposed near the southwest wall of the Area 1 excavation block in the burned rock midden (Figure 13). As the feature was arranged in a basin excavated within the burned rock midden, the first signal of the feature appeared as a ring of vertically inclined rocks in Layer 2, and the rock-lined oven feature was fully exposed in Layer 3. Feature 1 was 39 to 60 cmbs, 1.04 m in diameter, and consists of a rock lining filled with additional burned rocks forming the heating element. This feature was well preserved, especially in the west side. Feature 1 was sectioned along a diagonal axis in order to view the well-preserved west side in profile. The sectioned profile of F1 revealed a distinct sediment change with dark, ashy matrix above the lining, and lighter sediment below as seen in Figure 14.

Eighty-six burned rocks were documented weighing a total of 55.3 kg. The mass and quantity of rocks represents the lining of the oven and only a portion of the interior rocks. Some of the interior rocks were not quantified inadvertently. The sizes of burned rocks within the feature range from small to large in length. The liner rocks included, 35 large (> 15cm), 33 medium (7.5-15 cm), and 8 small (<7.5 cm) rocks, while the interior included, 6 large, 16 medium, and 3 small rocks (a partial documentation). In general, all rocks included in the pit lining were tabular and at least 6 cm in thickness, and interior rocks were more angular. The feature included limestone rocks from both upland and canyon bottom sources. Charcoal was observed between several feature rocks and within the contents of the rock lining. One burned rock, three *in situ* charcoal samples, and six 2-to 4-L bags of fine matrix were collected from in and around the feature. All matrix

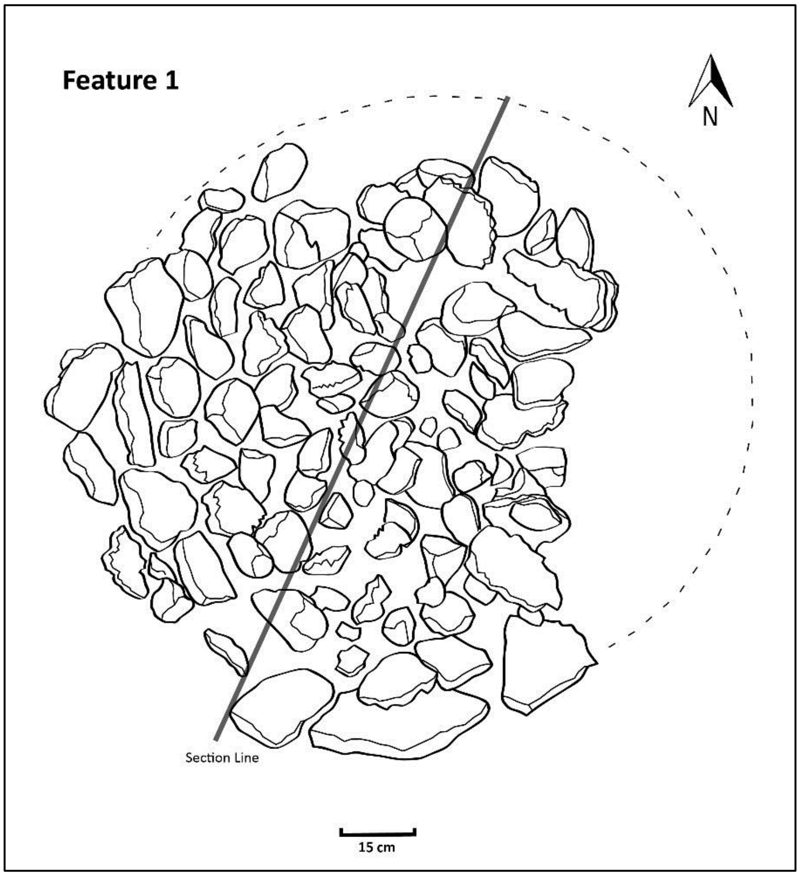


Figure 13. Plan drawing of Feature 1 with a dotted line indicating the missing portion of the pit lining.

Figure 14. Profile of Feature 1 with dark grey sediment above the pit lining and light sediment below.

remaining after sampling was screened with 1/8” mesh. Associated artifacts include, lithic debitage and a piece of groundstone recycled as a hot rock.

The pit lining was in excellent condition with a nearly intact rock lining and good preservation of botanical material associated with the heating element. Dering identified live oak (*Quercus virginiana*) wood charcoal within the fine matrix, as well as fragmentsof agave-sotol[11] leaves (presumably *Agave lechuguilla*). The presence of burned semisucculent leaves indicates that F1 was used to bake sotol and/or lechuguilla. The radiocarbon assay (Bot-16) returned on an agave-sotol leaf dates to 815±15 B.P.[12], and the radiocarbon assay returned on the wood charcoal dates to 860±15 B.P. Researchers at Texas A&M University analyzed the feature rock collected for microfossil analysis, and identified prickly pear starch grains (Dr. Alston Thoms, personal communication 2011). Notably, charred prickly pear was not identified within the botanical remains collected with matrix samples and *in situ*.

Remnant Pit Lining

Pit linings are carefully arranged giving the remnant earth oven a bowl-shaped appearance. Indicators of true pit linings include the thermal modification of the upper surface of feature rocks and charcoal above the lining resulting from the position of the fuel above the lining during earth oven firing (Black and Thoms 2014:217). At the Little Sotol site, some feature rocks were strategically fractured and examined for thermal alteration such as differential color change within the interior of feature rocks. This method was implemented after the identification of the only true heating element with pit

[11] Plant material identified as agave-sotol is not distinguishable to species.
[12] Radiocarbon years before present. See Chapter 7 for more on radiocarbon assays.

lining (F1); however, examining the signs of internal heat modification of feature rocks was crucial to identifying Feature 10 as a remnant pit lining.

The method of fracturing rocks to assess the position of the rock in relation to the fire during a firing event was suggested by Dr. Alston Thoms (personal communication 2011). Prior to sampling and the removal of feature rocks, each feature rock was assigned an individual specimen number and the orientation of each rock documented. A sample of feature rocks was broken in half in order to examine patterns of heat modification on the interior of feature rocks. Color change in burned rocks is a result of minerals within the stone and exposure to high temperatures. Burned limestone ranges from reddish pink to dark gray. A single burned rock may exhibit a range of color change depending on the position, or series of positions, during the earth oven firing event. For example, a liner rock positioned below a fire may have an oxidized rind only on the top surface that was exposed to direct heat, while a rock exposed to even temperatures or repeated events may exhibit through color change throughout. Though color change may indicate the positioning of hot rocks in earth ovens, it is not a measureable indicator of reuse.

Feature 10

This feature was a remnant pit lining discovered and exposed in the southern end of Unit 7 in the Area 2 excavation block (Figure 15). Feature 10 was roughly 65 to 82 cmbs and approximately 0.45 m in diameter. Thirty-six burned rocks were documented weighing a total of 11.3 kg. The feature rocks are noticeably smaller, and thinner with lower mass than the other earth oven features observed on-site. One piece of groundstone was recycled as a hot rock, and one feature rock was cracked in place. The sizes of

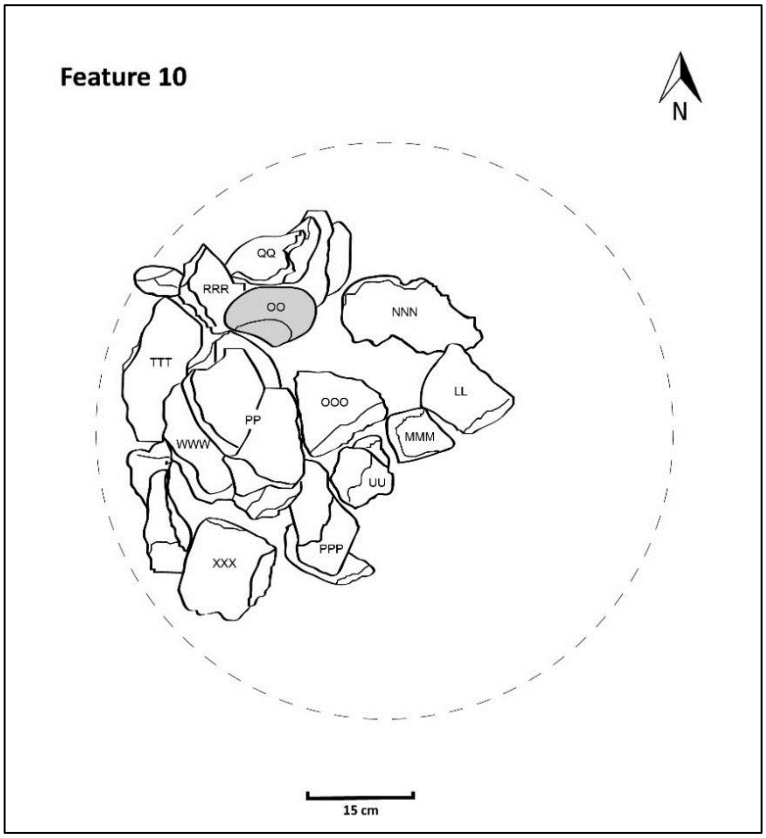


Figure 15. Plan drawing of Feature 10 with groundstone implement (gray) incorporated into the feature. The dotted line indicates the missing portion.

burned rocks within the feature range from large to small – 4 were large, 18 were medium, and 13 were small. Three *in situ* charcoal samples were collected in association with F10, and one 4-L bag of fine matrix. The macrobotanical remains were not examined and the feature was not dated, but samples are retained for future analysis. The only associated artifacts consist of lithic debitage.

It was initially thought that this feature was the cleanout from F9; however, excavation of F10 revealed tight pavement of rocks at the bottom of a shallow pit. Any remaining portion of a heating element in addition to the pit lining was likely removed during excavation prior to the identification of the feature. The vast majority of lining rocks were pitted, and none were described as rounded in contrast to F9. This

Figure 16. View of the interior of Feature 10 lining rock with distinct dark gray color change on the upper surface.

distinguishes F10 from the adjacent F9, because an associated feature, such as a clean out pile, would likely contain a similar ratio of limestone rocks from upland and canyon bottom sources. Furthermore, some of the feature rocks exhibit characteristics indicative of pit lining in that the top surface of the rock is more thermally altered indicating the fire was set above the lining rocks (Figure 16).

As presented in Table 6, only one rock examined (Rock WWW) was clearly defined as a liner rock based on signs of internal heat modification. This small feature was the remnant of a truncated pit lining, the preserved portion was likely the center of the earth oven. Rock PP (the rock overlying Rock WWW) was cracked in place indicating that it cooled in that position; hence Rock WWW cooled in the current position as well with heat medication only on the upper surface, what would have been the interior basin of a lined earth oven. The documented portion of Feature 10 was the western

Table 6. Patterns Of Internal Heat Modification of Feature 10 Rocks.

Specimen	Observations
Rock PP	Lightly burned with a bit of color change to orange specks on interior – much heavier rind in the bottom of rock.
Rock NNN	Burned all the way around – dark rind surrounds rock. Reddened on one side but does not appear to be heavily burned – not very dark on the interior and the thinness of the rock would not have withstood high temperatures.
Rock RRR	Differential heat modification with more reddened interior on bottom of rock – lightly burned.
Rock TTT	Pretty even heat modification around rock – orange specks throughout and even rind.
Rock WWW	Burned more intensively on what would have been the inside of the feature – darker interior on that half – probably liner rock. Collected a fragment of feature rock.

portion of the feature. No feature rocks were observed surrounding the feature or in wall fall. The lost feature rocks were likely “robbed” for a subsequent earth oven firing event or disrupted for another reason prior to excavation.

Intact Heating Elements

Intact heating elements follow a cohesive pattern easily recognized in the archaeological record. As discussed above, the defining characteristics of an earth oven bed include closely spaced, large burned rocks in a circular outline. Depending of preservation conditions, charred plant remains, ash, carbon stained sediment are typically in association with intact heating elements (Black and Thoms 2014:213). These features are not neatly arranged like pit linings, but appear as a jumble of rocks resulting from burning down with fuel and settling into an earthen pit during the construction and firing of the earth oven. In cross section, intact heating elements should exhibit a concave lens as a result of construction within a basin-shaped pit.

As pointed out by Black and Thoms (2014:215), flat profiles may occur as a result of deflation where the horizontal position of burned rocks is maintained while the vertical orientation and basin-shaped profile are lost to natural processes and the passage of time. The word “intact” is used in a relative sense to indicate features that exhibit the tell-tale characteristics of earth oven beds. Two intact heating elements (F3 and F4) were found partially overlapping in the mid-strata of the burned rock midden, and another, smaller intact heating element (F9) was uncovered at the month of the Little Sotol cave.

Feature 3

This feature was a tightly spaced, roughly circular arrangement of very large burned rocks discovered and exposed in the east corner of the Area 1 (Figure 17). Feature 3 was located roughly 86 to 99 cmbs and measured approximately 1.27 m in diameter. The intact heating element was exposed and photographed, but no profile shape was documented because the feature was not sectioned. Specks of charcoal were observed beneath several feature rocks amid the dark, ashy sediment characteristic of the upper strata of the burned rock midden. One matrix sample was collected for flotation, and from the sample Dering identified charred fragments of agave-sotol leaves and indeterminate wood charcoal. The radiocarbon assay returned on an agave-sotol leaf (Bot-6) dated to 995±15 B.P.

Thirty-nine burned rocks were documented weighing a total of 59.0 kg accounting for a sample of approximately half of the heating element. The majority of the rocks display karstic features indicating upland weathering, and a couple appear to be stream rolled, indicating that feature rocks were gathered from sources above and below the site.

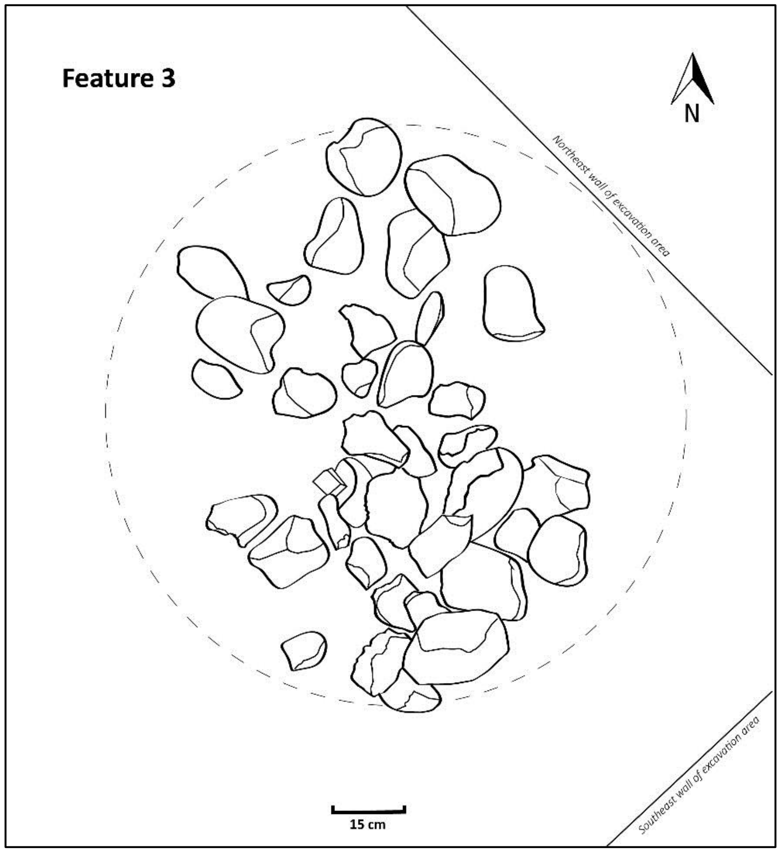


Figure 17. Plan drawing of Feature 3 with the dotted line indicating possible missing portion.

The feature was made up of 21 large rocks (average length for feature was 21.6 cm), 17 medium rocks (average length 11.4 cm), and 1 small rock (length 6.0 cm). A large flat rock was collected from the center of the feature for future microfossil analysis.

Feature 4

Immediately beneath F3, another intact heating element was identified. Feature 4 consisted of a tight arrangement of large burned rocks that measured approximately 1.66 m in diameter (Figure 18). The elevation of this feature was not well documented, but was located approximately 110 cmbs. The feature was photographed, cross-sectioned, and sampled. A slight basin shape in the arrangement of feature rocks was observed in

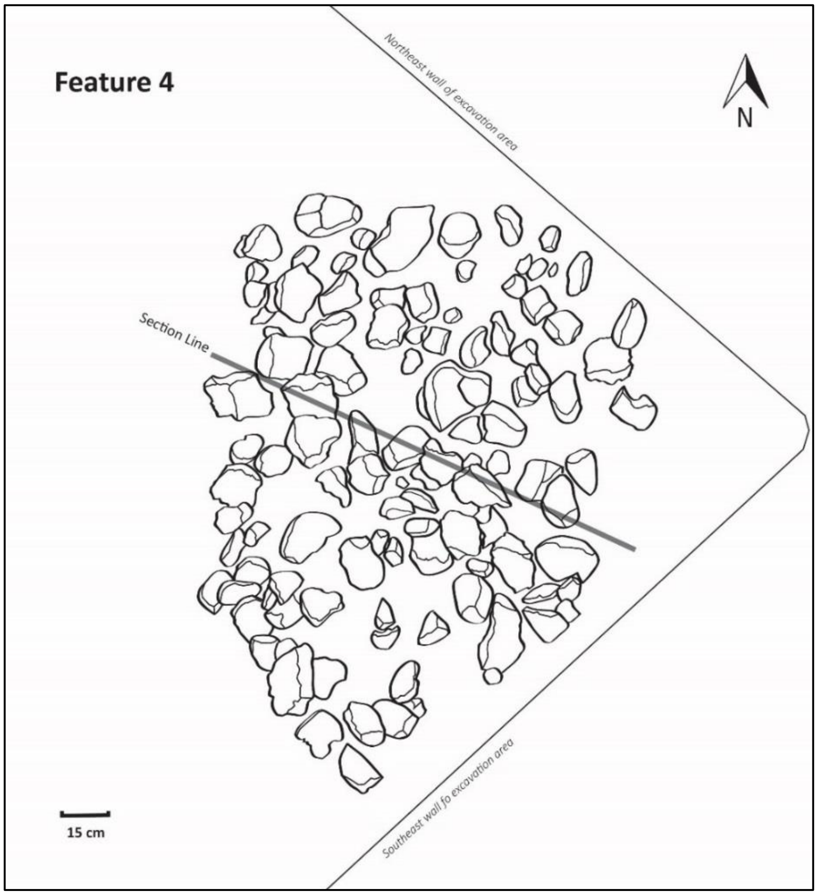


Figure 18. Plan drawing of Feature 4.

Figure 19. Profile of Feature 4 showing basin-shaped cross section with dotted line.

profile, but there was no discernable ashy lens or sediment change (Figure 19). The lack of an observable basin-shaped pit is likely due to the dispersal of charcoal and the accretion of calcium carbonate to feature rocks and the surrounding matrix over time. Feature 4 is similar to F3 in size and shape, but is not as well preserved. The increased amount of calcium carbonate and decreased amount of organic material in and around the feature gave F4 a more aged appearance.

Unfortunately, these feature rocks were not quantified prior to discard. Field observations indicate that most feature rocks averaged 20 to 22 cm in length, which was similar to rock sizes observed in F3. Three feature rocks were cracked in place indicating they cooled in the observed position. All feature rocks are coated with calcium carbonate, adhering charcoal to the bottom of several feature rocks. This is clear association of a heating element with charcoal; however, the encased charcoal could not be extracted for radiocarbon analysis. Two burned rocks, two *in situ* charcoal samples, and two 4-L samples of fine matrix were collected. One piece of indeterminate wood charcoal (Bot-3) recovered from a matrix sample returned a radiocarbon date if 4785±20 B.P.

<u>Feature 9</u>

This feature consists of a quasi-circular arrangement of burned rocks within a particularly ashy layer of cave deposits in Unit 7, Area 2 (Figure 20). Feature 9 was roughly 63 to 80 cmbs and approximately 0.87 m in diameter. This feature appeared to be truncated on its eastern side, and as much as half the feature seemed to be missing when initially exposed. There were no feature rocks observed in the adjacent units; although, a large amount of large burned rocks were found in the remains of an excavation wall collapse between seasons of fieldwork. Volunteer excavators were only able to document a portion of the feature.

A total of 105 burned rocks was documented weighing a total of 30.4 kg accounting for approximately a quarter of the feature. Of the rocks quantified, most were described as rounded and attributed to the canyon bottom source of limestone cobbles. The burned rocks within the feature ranged in size from small to large – eight were large, 53 were medium, and 43 were small. Unlike most other features, F9 contained far more medium-sized rocks and fewer large feature rocks. Charcoal was observed beneath

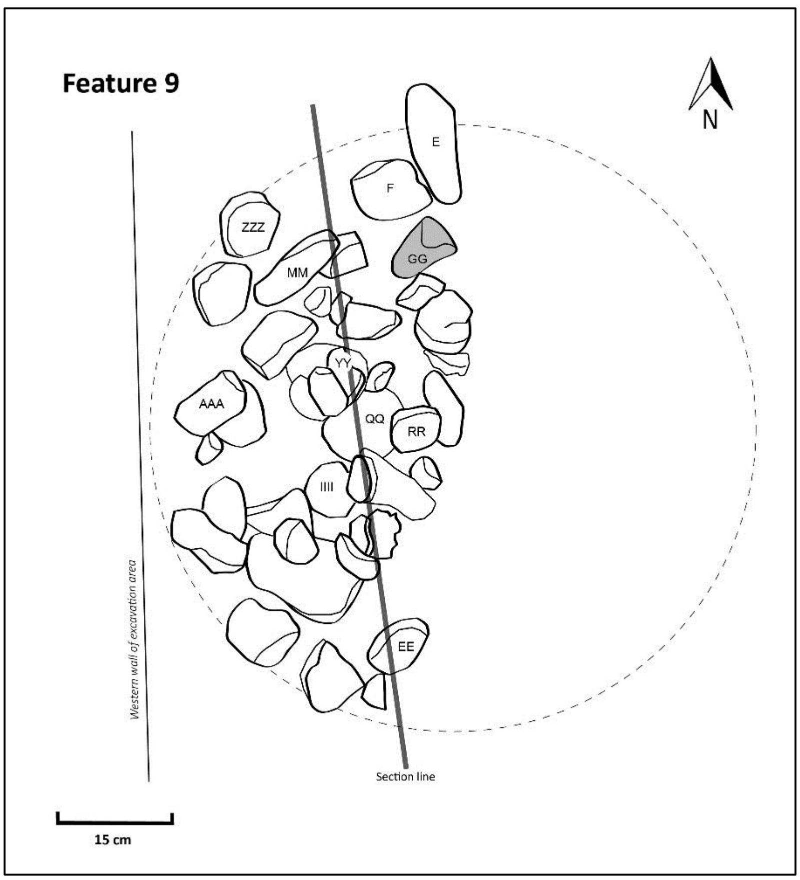


Figure 20. Plan drawing of Feature 9 with groundstone implement (gray) incorporated into the feature. The dotted line indicates the missing portion.

Figure 21. Profile of Feature 9 with faint basin-shaped lens and sediment change directly beneath the heating element.

several feature rocks in a faint basin-shaped lens (Figure 21). One burned groundstone incorporated into the heating element and two 2-to-4-L matrix samples were collected, but no samples were submitted for analysis and are retained for future use. Lithic debitage was observed in and around the feature, and an Almagre projectile point was found directly beneath the heating element.

Prior to sampling and the removal of feature rocks, each feature rock was assigned an individual specimen number and the orientation of each rock documented. A sample of feature rocks was broken in half in order to assess the position of the rock in relation to the fire during an earth oven firing event. These observations are presented in Table 7. In general, there was a range of internal heat modification from grey rinds bordering most surfaces of feature rocks to reddened and dark gray interiros. All of the fractured feature rocks exhibit consistent color change throughout with no differentiation among surfaces indicating that Feature 9 was constructed as earth oven heating element.

Table 7. Patterns Of Internal Heat Modification of Feature 9 Rocks.

Specimen	Observations
Rock A	Heavily burned with reddened and dark grey interior – no real rind or differentiation of heat mod between top and bottom.
Rock B	Heavily burned with dark grey interior and dark rind all around – no real differentiation of heat mod between top and bottom.
Rock E	Burned but probably not heavily – orange interior and no observable rind – no differentiation between top and bottom.
Rock F	Burned but probably not heavily – texture of rock is crumbly – more orange on bottom surface than top – burning on bottom indicates that it is not a liner rock.
Rock EE	Not heavily burned, but perhaps more reddening on the bottom with a slightly darker rind.
Rock MM	Potential liner rock, though heavily burned on surface that would have been the exterior of the feature.
Rock RR	Difficult to break, little to no color change – not convinced it is burned or only minimally burned.
Rock YY	Burned consistently through – dark grey interior and hairline fractures throughout.

Heating Element Remnants

As discussed by Black and Thoms (2014), the identification criteria of heating elements include, closely spaced, relatively large burned rocks with some cracked in place, charcoal sealed beneath burned rocks, and a circular outline. Overall dimension is not necessarily a defining characteristic but most heating elements range from 1.0 to 3.0 m in diameter. A basin-shaped profile and distinguishable dark staining of surrounding sediments are typical of intact heating elements though not critical to interpretation as an earth oven bed. Heating element remnants are once-intact earth oven beds disrupted by cultural mixing and postdepositional taphonomic processes (Black and Thoms 2014:216). Heating element remnants are common in disturbed context, and I reason that they are also more prevalent in earlier components due to preservation bias with the passage of time. Heating element remnants (F5 and F6) were observed near the deepest extent of the burned rock midden, more than a meter below surface. These features appeared to be clusters of large burned rocks of similar vertical position, and identified as heating element remnants upon close examination.

Feature 5

The observable portion of this heating element remnant consisted of a roughly circular arrangement of very large burned rocks overlying a faint charcoal staining (Figure 22). Located in the northwest wall of the Area 1, Feature 5 was only partially exposed during excavation and no profile was documented. The vertical position of the feature was not well documented, but was observed nearly 145 cmbs. Fourteen burned rocks were recorded weighing a total of 48.6 kg account for approximately half of the feature. The sizes of burned rocks within the feature range from medium to large – 11 were large, and 3 were medium. The majority of rocks appear similar to large limestone rocks (almost boulders) in the nearby canyon bottom. Unlike the heating elements documented in higher elevations, the feature rocks were slightly dispersed with observable space between most. One very large rock fractured *in situ* was key to identifying this feature as a heating element remnant.

Charcoal was observed beneath several feature rocks, and one 4-L bag of fine matrix was collected for flotation. Dering identified a shell fragment from a little walnut (*Juglans microcarpa*), and indeterminate pieces of wood charcoal. Radiocarbon assays returned on the walnut shell (Bot-31) date to 6100±20 B.P. Associated artifacts include, the basal portion of a Bandy point from between feature rocks and lithic debitage. The temporal association of Feature 5 with the Early Archaic period may explain why only some of the tell-tale characteristics of earth oven beds are not readily observable.

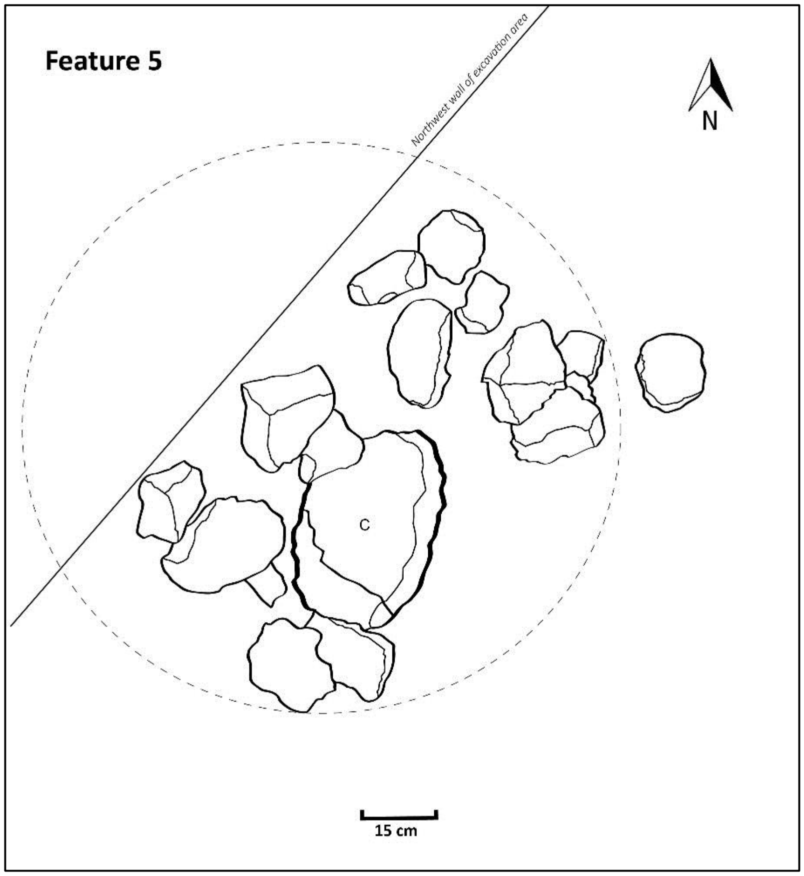


Figure 22. Plan drawing of Feature 5 with dotted line showing hypothesized feature shape and unexcavated portion.

Feature 6

Feature 6 was a relatively loose concentration of large burned rocks with a clear circular outline, which was identified and exposed in the southwest wall of the Area 1 excavation block approximately 148 to 175 cmbs (Figure 23). Like F5 only a portion of this feature was documented with the remaining portion concealed in the wall of the burned rock midden. The feature was sectioned along the excavation block wall, but I could not identify a basin-shaped pit in profile because the fragile excavation wall was prone to collapse. It did appear that the earth oven bed was constructed in a pit as larger vertically-oriented rocks make up the westernmost portion of the feature lay against a very large, flat unburned rock. Three rocks that were cracked in place lined the eastern extent of the feature, and all show evidence of burning on the interior. Seventy-two burned rocks were documented weighing a total of 75.7 kg accounting for approximately half of the heating element. Of these rocks, 28 were large, 35 were medium, and 9 were small.

Feature 6 was within a fine, yellow-brown sediment containing far less organic material than upper stratigraphic layers. Essentially, the majority of charcoal at this elevation was observed directly beneath several feature rocks. Four *in situ* charcoal samples, and one 4-L sample of matrix were collected. Feature contents beyond the

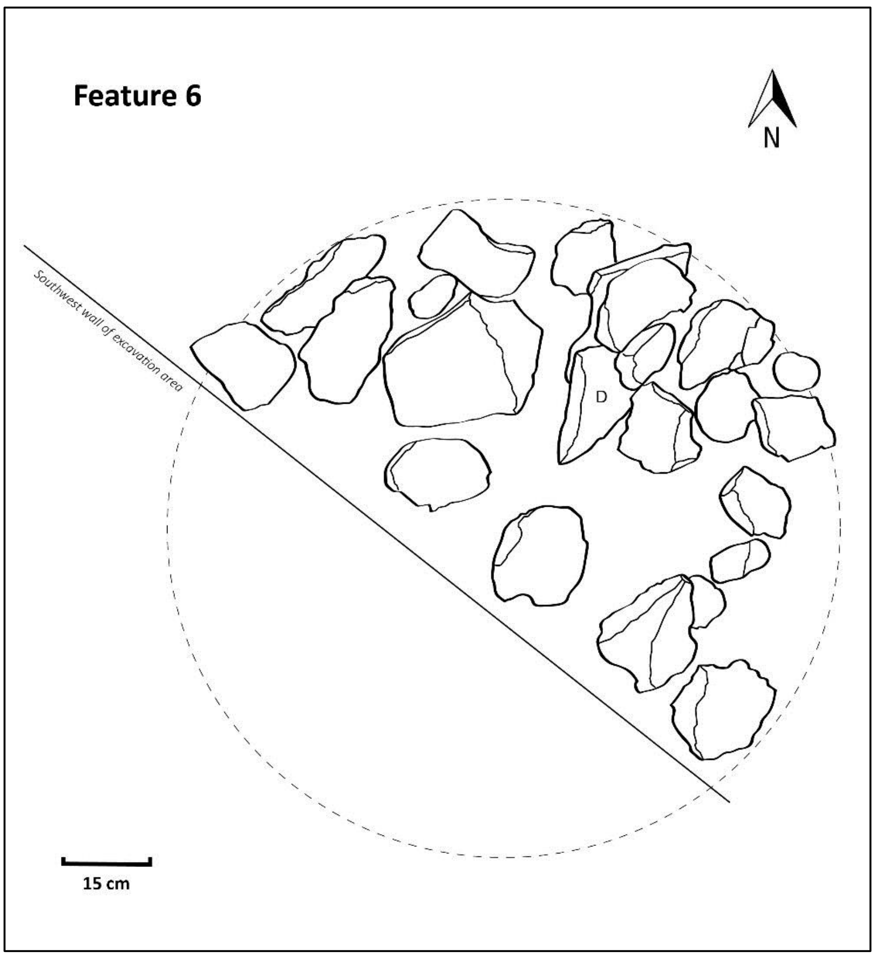


Figure 23. Plan drawing of Feature 6 with dotted line showing unexcavated portion.

matrix collected for flotation were screened through 1/8” mesh. Dering identified Condalia (*Condalia* sp.) wood charcoal, and a charred fragment of an agave-sotol central stem. The Condalia charcoal (Bot-19) dates to 6115±20 B.P and the agave-sotol central stem (Bot-12) dates to 4755±15 B.P.[13] Associated artifacts include, a piece of groundstone and lithic debitage. Feature 6 is categorized as heating element remnant based on patterns of construction and associated materials, especially the charred plant material. Some earth oven characteristics did not preserve well, but this is understandable as the location of the feature at the bottom of the midden. Feature 6 was perhaps the remains of one of the first earth ovens constructed at the Little Sotol site.

Rock Rosette (Feature 2)

Feature 2 was an unusual arrangement of limestone rocks termed a “rock rosette.” The feature consists of flat slabs with river rounded edges visually consistent with rocks found in the drainage below the site. The concentric circles of limestone slabs greatly resembling configurations observed in flowering plants (Figure 24). Feature 2 measured approximately 1.0 m in diameter, and was uncovered at the mouth of the southernmost cave within the Area 2 excavation block roughly 26 to 41 cmbs. The feature was sectioned in order to learn more about the rock arrangement in cross-section, and revealed a basin-shaped profile. The feature rocks on the east side of the feature overlay a large bolder; and interestingly, the rosette feature was constructed with shorter limestone rocks over the boulder to create a level surface from east to west atop the surface of the

[13] Though there is a discrepancy in the radiocarbon dates from Feature 6, the sample that returned the Early Archaic date (Bot-19) was collected from directly beneath Rock D of the heating element – a preferred context.

Figure 24. Oblique (left) and plan view (right) photographs of Feature 2 prior to feature excavation (upper panel) and during sampling (lower panel). In the lower panel, the rock-free gap in the central area of the feature is an artifact of the excavation sequence. Unfortunately, the rocks were removed from this area prior to the decision to fully expose the feature.

concentric, rock rings. During excavation and sampling a handful of feature rocks from the southern section were broken in half to examine the interior for evidence of heat modification. The surfaces of the feature rocks do not clearly indicate heat modification or burning; however, the interior of some feature rocks exhibit color change (i.e., dark grey interior, reddened interior speckling, or darkened rind around the margin) characteristic of burned limestone. All together, these feature rocks exhibit very little thermal alteration.

The northern section was more intensively sampled than the southern section. Within the four concentric half-rings of the north section, all feature rocks were pointed plotted at top and bottom, measured, weighed, and collected with an individual specimen number. Prior to removal, the orientation of each feature rock was documented and photographed. All matrix from between the rocks was also collected for flotation. Within the concentric rings of the feature, the fine matrix is slightly more grey and ashier than the sediment within the cave in general. A handful of charcoal and charred plant material was observed between the section rings and collected.

Though the sediment within the feature was somewhat darker and ashier, no clear boundary between sediment types was observed. On the exterior of the feature, the surrounding sediment gradually transitions from dark and unconsolidated to more compacted and lighter-colored clay containing roof spalls. Dark ashy sediment similar to the burned rock midden deposits intrudes on the feature from the east and calcium carbonate accumulations to the southwest may have obscured any outline of a basin-shaped profile. Regardless, the sediment change boundary between feature rocks and the surrounding cave matrix suggests that the feature rocks were arranged in an excavated pit with the tops of the limestone rocks in the rosette pattern visible from above.

A sample of 50 burned rocks were collected from the north section of F2 accounting for approximately half of the feature. The sizes of burned rocks within the feature range from large to small – 38 were large, 12 were medium, and one was small.

Charcoal and charred plant remains were observed between several feature rocks within a faint lens. Over 50 charcoal fragments were collected with five directly beneath feature rocks, far fewer charcoal fragments than observed in association with earth oven heating elements. Additionally, nine 2-to-4-L samples matrix were collected for flotation, and 19 smaller sediment samples were collected from in and around F2. Dering identified three species of wood charcoal including, Agarito (*Berberis trifoliolata*), live oak, and Gregg's Ash (*Fraxinus gregii*), as well as charred agave-sotol leaves. Radiocarbon assays returned on two of the agave-sotol leaves were 765±15 B.P. and 785±15 B.P. A third radiocarbon assay returned from context directly beneath feature rocks was 800±15 B.P. Associated artifacts include, five thin bifaces, a flake tool, and lithic debitage. Fragments of mussel shell are dispersed around the Little Sotol site, but there seems to be an increased frequency adjacent to F2 within Unit 4 of Area 2 in particular.

In the discovery of F2, field school participants and visitors immediately began speculating on the intended function of this rock rosette feature. The radiocarbon dates indicate that the feature was constructed contemporaneously with earth oven firing events. The manner of construction indicates that an intended function of the feature required a level surface. Suggested hypotheses include, another type of cooking feature, a heat radiator (Shafer and Bryant 1986:99), a storage feature (Wilke and McDonald 1989), and a social symbol related to earth oven plant baking. These and other possible interpretations have not been fully explored. Feature 2 should be the subject of future research with a focus on critically evaluating the hypothesis that rock rosette served a symbolic purpose (see Chapter 8). Feature rocks and samples collected during the excavation of the Little Sotol site were retained for future study and analyses.

Discussion

The intended function of hot rock features may explain variability in morphology (see Thoms 2008b, 2009; Wandsnider 1997); however, in the case of the Little Sotol site, seven of features are consistent with the archaeological signatures of earth ovens interpreted as heating elements (Black and Thoms 2014). The rock-lined ovens (F1 and F10) differ slightly in construction from the other features with the addition of pit linings. The passage of time is the greatest variable in the appearance of these features as heating elements range from obvious to more subtle with depth. Tellingly, the heating elements located stratigraphically higher are more intact and contain more botanical material than remnant ovens located lower in stratigraphy. The excavation through the burned rock midden provided a view of preservation bias of earth ovens at the same location on the landscape. Numerous heating elements of varying ages shows that the Little Sotol site functioned as an earth oven facility intermittently from the end of the Early Archaic to into the Late Prehistoric period.

The features also afford the opportunity to evaluate whether or not earth oven construction changes through time, particularly with the intensification of earth oven plant baking. The intensification of earth oven technology can occur through at least two processes of expansion – increasing the number of earth ovens and increasing the size of earth ovens (Dering 1999:667). The relatively intact heating elements recorded at the Little Sotol site average 1.2 meters in diameter, while in the surrounding regions some earth oven heating elements measure 3.0 meters in diameter (Black and Thoms 2014). Relatively speaking, the earth oven features at the Little Sotol site were small and did not demonstrate increase in dimensions over time. The increasing number of earth oven firing events cannot be observed simply with more frequent heating elements because not all traces of ovens preserve in the archaeological record well enough to be identified by archaeologists. Intensification through the reuse of heating elements and more frequent earth oven firing events may be demonstrated by studying the entire burned rock midden deposit, including both the heating elements and discarded burned rock (see Chapter 7).

6. LITHIC ASSEMBLAGE OF AN EARTH OVEN FACILITY

Lithic assemblages routinely inform archaeologists about site function and activities performed during the prehistoric past. The patterns in curated and expedient tool types may also reflect task organization. The excavation Little Sotol site yielded over 435 lithic tools and nearly 30 kg of debitage. Identified plant processing tools recovered from the Little Sotol site account for more than a quarter of the total lithic assemblage in terms of artifact counts, and includes 85 agave knives[14], 17 scrapers, 10 choppers, and 5 pounding tools.

Lithic assemblages from other sites in the Lower Pecos and elsewhere are first discussed briefly to typify the kinds of plant processing tools used to cut and prepare sotol, lechuguilla, and prickly pear plants for earth oven baking. The thoughtful discussions of plant processing tools recovered from earth oven facilities in the southern Sacramento Mountains (Dering et al. 2011; Miller et al. 2011) are useful points of reference. According to Miller (2011a), tools considered diagnostic of processing of semisucculent plants include agave knives, scraper planes, and battering stones[15]. Choppers are commonly referred to as plant processing tools in the Lower Pecos literature (e.g., Dibble and Prewitt 1967; Sorrow 1968a, 1968b; Word and Douglas 1970), and are also discussed as part of the plant processing toolkit.

Some researchers (e.g. Fish et al. 1992, Miller 2011a) equate minimally edge-modified flakes to agave knives. In Lower Pecos literature, agave knives are described as

[14] The term agave knife is used to describe and imply function for lithic tools used to cut and prepare sotol, lechuguilla, and prickly pear for earth oven baking. Artifacts termed edge-modified flakes or side scrapers may also be considered agave knives, especially if polish indicative of plant processing is observed on cutting edges. Analogous terms in the literature include, mescal knife and sotol knife.

[15] Scraper planes and battering stones are called scrapers and pounding tools in the following discussion.

heavy, hafted unifaces or bifaces. Stone tools used to prepare plants for earth oven baking were also handheld. According to Gifford (1932:225-226), "the old style mescal knife was a broad flint flake shaped like that of a pole axe, but without a handle. The cutting edge was three to five inches wide. It was used to saw rather than chop. The mescal leaf was held taut in one hand and the knife manipulated in the other." Large flakes or "knife blades" often exhibit polish and residues indicate of cutting plants such as lechuguilla, sotol, and prickly pear. Arguably, there is considerable morphological range in agave knives from expedient handheld tools to formally produced hafted tools.

In the tool assemblages of hunter-gatherers, groundstone artifact are viewed as diagnostic plant processing tools. Though groundstone artifacts were observed at the Little Sotol site, ethnographic data suggests these tools are not required to prepare plants earth oven plant baking. Of the 35 pieces of groundstone collected from the Little Sotol site, 20 of the groundstone implements are handstones (i.e., manos and pestles), 13 are metate fragments, and 2 are possible abraders. The majority of groundstone recovered were burned, and five pieces of groundstone (Specimens 19.1, 29.7, 43.1, 78.1, and 78.2) were incorporated into identified heating elements. No bedrock grinding surfaces were located during fieldwork leading me to question if prehistoric occupants used groundstone tools on-site. Other researchers have observed the recycling of groundstone tools as hot rocks incorporated into heating elements, and sometimes groundstone artifacts were reclaimed as plant procurement or processing tools (Miller 2011a:33; Quigg et al. 2002). The original use of the groundstone recovered from Little Sotol is ambiguous, but excavators found sufficient evidence of groundstone recycled as cook stone.

The presence of projectiles and other types of artifacts not associated with plant baking in burned rock midden context warrants brief mention. Most researchers attribute cultural assemblages containing more than the required tools for plant processing as the result of comingling of “incidental” artifacts (Black and Creel 1997:270). Incidental artifacts, like projectile points and debitage from tool manufacture, may be the result of “gearing up” for hunting activities occurring during the downtime of earth oven firing events (Miller 2011a:33). Utilized earth ovens were often left open creating a ready depression for containing and catching cultural material related and unrelated to plant baking activities (Black and Thoms 2014:209). Incidental artifact types include debitage, nondescript edge-modified flakes (e.g., Specimen 67.4), cores (e.g., Specimen 5.1), pebbles (e.g., Specimen 8.6), and bifacial tools (e.g., Specimens 18.6 and 58.11). An inventory of artifacts is included in Appendix A.

Plant Processing Toolkit

A brief review of the archaeological research of the region reveals some consensus in the kinds of tools typically associated with earth oven plant baking facilities, while some researchers employ less ubiquitous terms like “chisel-chopper” (Word and Douglas 1970), old-fashioned terms like “fist axe” (Pearce and Jackson 1933), or exotic terms like “ulu-hafted knives” (Shafer 1986). The analytical techniques and terms used in the discussion of lithic assemblages often speak to the time in which the investigation occurred. The terms used to discuss plant processing tools differ by researcher, but provide useful comparison for the interpretation of the lithic assemblage at the Little Sotol site. Some of the sites discussed below are large habitation shelters with large, diverse lithic assemblages, and here particular attention is given to the kinds of tools potentially used for plant processing for earth oven plant baking.

In general, archaeologists afforded more attention to regionally distinct materials of the perishable industry prior to the Amistad era of site investigation (e.g., Pearce and Jackson 1933; Woolsey 1936). Among descriptions and photographs of the rich perishable assemblage at Fate Bell Shelter, Pearce and Jackson (1933), briefly mention lithic plant processing tools. "Other flint artifacts," meaning chipped stone tools other than projectile points, potentially consistent with plant processing tools include 313 scrapers, 8 fist axes, and one flint axe (Pearce and Jackson 1933:71). The flint axe appears to be a hafted agave knife with one modified edge (Pearce and Jackson 1933:63). In describing expedient lithic tool assemblage at Shumla Caves, Martin (1933:85) reported "crude unworked flakes which had been used as knives were quite numerous."

During the Amistad era, plant processing tools (i.e., agave knives, scrapers, pounding tools, and choppers) were observed in great frequency in the surface documentation and excavation of many of the large sheltered and terrace sites containing extensive burned rock deposits (e.g., middens), further clarifying the association of tool types with earth oven plant baking. A number of cutting tools were termed "scrapers" during this era of research due to steep edge angles. While cutting tools used for plant processing can exhibit steep edge angles, scrapers are morphologically distinct with much steeper edge angles and location of tool edges, mainly along the lateral margins; hence expedient agave knives are sometimes classified as side scrapers.

Excavations at the Devil's Mouth site yielded a variety of scrapers (n=85) some with convex dorsal surfaces suitable for pounding and scraping (Sorrow 1968a:37), and consistent with Miller's (2011b) discussion of scrapers used for plant processing. Sorrow (1968a) reported a number of utilized flakes (some are likely expedient agave knives) recovered during the 1967 excavation (n=33) and the 1961-1962 excavations (n=1005) (Johnson 1964). These tools are made from large cortical and secondary flakes. In addition to scrapers and utilized flakes, Sorrow (1968a:40) observed chopping and battering stones (n=26) with pitted margins made from quartzite, limestone, and chert.

In the survey near and west of the confluence of the Devils River and Rio Grande, Dibble and Prewitt (1967) made similar observations of the stone tools collected from the surface of sheltered and open sites. Numerous scrapers (n=110) exhibit steep edge angles along at least one modified edge. Many of these were termed "sequent flakes" with large negative bulbs of percussion on the dorsal surface (Dibble and Prewitt 1967:53), and some were described as cortical flakes (Dibble and Prewitt 1967:56). Dibble and Prewitt (1967:56) also described nine choppers as "oval to irregular-shaped, crudely chipped tools" made from quartzite and chert. Extensive evidence of battering along at least one edge distinguished choppers from cores.

The test excavations at Nopal Terrace also yielded a lithic assemblage containing numerous likely plant processing tools. Sorrow (1968b) described two large "butted knives" with cortex remaining on one edge, bifacial edge modification on the other, and silica polish (use-wear evidencing plant processing) on the utilized edge. Sorrow (1968b:21) noted that these tools were consistent with "fist axes" reported by several researchers of the Amistad era (i.e., Johnson 1964, Nunley et al. 1965, McClurkan 1968). Sorrow asserted that the functional name was misleading and these tools were used for cutting plants indicated by polish on the utilized edge. Sorrow (1968b:22-25) also reported a variety of scrapers (n=29), some consistent with plant processing tools; utilized flakes (n=41), many with cortex and negative bulbs of percussion on the dorsal surface; and choppers (n=3), one with evidence of extensive battering.

Nunley and colleagues (1965) describe the results from the excavations of four sites – Mosquito Cave, the Doss site, Zopilote Cave, and the Coontail Spin site. The lithic assemblages of these sites are discussed collectively and contain a number of probable plant processing tools – 185 choppers, 529 knives, 362 scrapers, and 4 fist axes. In terms of morphological analysis, the authors categorized tools into groups called forms. Some of these tool classifications lump tools consistent with expedient agave knives into other functional categories. For example, some of the chopper forms are minimally modified or worked flakes, but classified otherwise due to the large size (Nunley et al. 1965:64). I infer that many of these tools are agave knives, but without obvious use-wear patterns function is speculative.

After the inundation of the Amistad Reservoir, Word and Douglas (1970) reported numerous kinds of chipped stone tools recovered from the excavations at Baker Cave, many of them consistent with the kinds of plant processing tools observed in the Lower Pecos. At Baker Cave, a number of chopping and pounding tools were documenting including chert choppers each with a battered working edge (n=30), “chisel-choppers” described as heavy flake tools (n=8), “fist axes” described as triangular cutting tools (n=10), and hammerstones (n=5) (Word and Douglas 1970:49). Very large numbers of scrapers (n=490) and utilized flakes (n=1023) were documented at Baker Cave. Flake tools with steep edge angles were categorized as scrapers, while utilized flakes exhibit no evidence of intentional edge modification. For taxonomic purposes, Word and Douglas (1970) classified scrapers and flake tools by the number of utilized edges.

Shafer and Holloway (1979) reported on the residue analysis of stone tool specimens from Hinds Cave to find correlation between stone tool type and function. That study, and a later study conducted by Sobolik (1996), found that most tools clearly exhibit multipurpose use with evidence of processing desert succulents, but also the processing of animal material (e.g., rodents). Polish or sickle sheen were the most common types of use-wear observed and were indicative of plant processing (Sobolik 1996:466). The residue analysis of many tools yielded rhaphid phytoliths and epidermal fiber fragments of agave, yucca, and grass; as well as residues indicative of animal processing.

The tools Sobolik (1996a) selected for residue analysis include large blade-like or oval unifacial chert flakes – a description consistent with expedient agave knives. Most of the artifacts in the study exhibit a steep edge angle ranging from 30-49 degrees (Sobolik 1996a:466), a slightly small range than the stone tools analyzed in the previous study with edge angles ranging from 20-50 degrees (Shafer and Holloway 1979:394-395). Tools with edge angles of 50 degree or greater exhibit use-were consistent with scraping and chopping, tools with highest occurrence of rhaphid phytoliths correlate have edge angles of 30-39 degrees (Sobolik 1996a:467). For these reasons, many researchers consider edge angle as a useful diagnostic trait of function.

Shafer and Holloway (1979: 398) and Sobolik (1996a:468) explicitly oppose the premise of specialized tools for plant processing because residue analysis revealed that most tools were used for multiple purposes. Though stone tools may serve generalized functions, consistency in tool manufacture allows us to identify a distinctive toolkit for plant processing at earth oven facilities. Based on previous research and observations at the Little Sotol site, the typical plant processing toolkit includes, agave knives, scrapers, choppers, and pounding tools.

Analyzed Sample of Lithic Assemblage

For the purpose of this thesis, a sample of 41 tools, biased toward more complete specimens, was selected for comparison. The analyzed sample includes 2 formal agave knives, 25 expedient agave knives, 6 scrapers, 3 choppers, and 5 pounding stones. In addition to metric measurements and mass, attributes following the approach suggested by Andrevsky (2005:171-175) were documented for scraping and cutting tools – including edge angle (on an ordinal scale), tool edge length, tool circumference, and index of invasiveness of tool modification. All tools within the sample were examined for macroscopic use-wear. Unwashed specimens are reserved for residue analysis at a later date.

Calculating index of invasiveness values as outline by Clarkson (2002) is a fast and replicable means to measure retouch and variability of stone artifacts. Index of invasiveness values rely of examining the complete artifact, therefore, these values are not calculated for incomplete or fractured tools. To calculate the index of invasiveness, the complete tool is partitioned into eights zones on both the ventral and dorsal surfaces totaling 16 zones. Each zone contains a portion of an inner area and outer area of the tool. Each zone is scored with a value ranging from 0 to 1, and the values are summed and divided by the total number of zones. Low index of invasiveness values indicate minimal retouch while high values (~1) indicate complete bifacial modification.

Agave Knives

The agave knives recovered from the Little Sotol site range from formal to expedient types. Consistent with other studies of plant processing tools, formal tools are relatively less common in the assemblage (Miller 2011a). As stated previously, there is considerable range in the kinds of formally and expediently produced agave knives. If the agave knives were hafted, the distal end was the utilized margin, which is distinct from handheld cutting tools with modified edges along the lateral margins

Two tools within the sampled lithic assemblage (Specimens 27.4 and 46.3) are morphologically consistent with formal, hafted agave knives (Figure 25). Specimen 27.4 is the distal end of bifacial, oval-shaped tool. Specimen 46.3 is the distal portion of a symmetrical, bimarginal flake tool more heavily modified on dorsal surface. The location and type of fractures may indicate that these tools broke in the haft. No macroscopic use-wear is evident on specimen 27.4. A heavy polish consistent with use-wear from plant processing is observable at the distal end on both the ventral and dorsal surfaces of Specimen 46.3.

Both identified examples of formal agave knives were recovered from lower elevations of excavated areas. Specimen 27.4 was recovered at the western edge of the mouth of Little Sotol cave just above the sloping limestone bedrock. No radiocarbon samples were obtained for dating the lower portions of the cave deposits. Specimen 46.3 was recovered from the lowest extent of the burned rock midden with radiocarbon dates and projectile point types associated with the end of the Early Archaic. In comparison, the expedient agave knives (discussed below) were all recovered from younger contexts

Figure 25. Formal agave knives, Specimen 27.4 (left) and Specimen 46.3 (right).

in the burned rock midden and cave deposits. The relative stratigraphic location of the cutting tools within the sample may indicate that hafted agave knives were preferred earlier in time.

The function of large, expedient agave knives is more speculative because the ethnographic literature addresses formal tools more frequently (Miller 2011b:304). According to Fish et al. (1992:83), “broad flat stone tools made from raw materials with naturally tabular fracture” that vary in shape from rectangular to round were used to cut leaves from the hearts of the plants. Miller (2011b:298) considers these expedient and minimally modified tools diagnostic of agave plant processing activities. Focused use-wear studies (e.g., Shafer and Holloway 1979; Sobolik 1996a) certainly help to support the function of these expedient tools as agave knives among other uses. As alluded in the discussion of the plant processing toolkit, there is no historical consensus of terminology to discuss expedient cutting tools. As evidenced by use-wear and residue studies (Shafer and Holloway 1979; Sobolik 1996a), flake tools with steep edge angles (at least 30-49º) were used as cutting tools to prepare desert succulents. When steep edge angles were used as defining characteristic for scrapers (a functional category), expedient agave knives may be overlooked. For the purpose of this thesis, polish indicative of plant processing along at least one lateral margin are considered diagnostic traits of expedient agave knives.

Of the 80 expedient agave knives collected during the excavation of the Little Sotol site, a sample of 25 was selected for analysis (Table 8). Formal tools exhibit more consistency in form than expedient tools. To capture the variability of these expedient tools, I categorized the expedient agave knives into three groups (Groups A-C) with four subgroups within Group C. Morphological characteristics that distinguish theses groups include, degree of modification, number of cutting edges, and edge angles. Despite the morphological variability of these tools, consistent characteristics of expedient agave knives within the sample include large size, intact platform and bulb of percussion, dorsal ridge along the vertical axis. Other less commonly observed characteristics include a negative bulb of percussion of the ventral surface (sequent flake) and cortex serving as a backed edge along one lateral margin[16].

Group A (n = 3) consists of the largest and thickest expedient agave knives in the assemblage (Specimens 12.2, 57.5, and 69.6) (Figure 26). Each flake within Group A is unimarginally modified on the right margin to create one cutting edge with a steep edge angle (30-60°). Though no macroscopic use-wear was observed in the group, these were likely handheld cutting tools with cortex remaining on the dorsal surface and serving as a

[16] Morphological observations were made ventral surface up to due to visibility of flake attributes. Photographs were taken of the dorsal surfaces to view modified edges.

Figure 26. The largest and thickest of the expedient agave knives (Group A), Specimens 12.2, 57.5, and 69.6 (from left to right).

backed edge. In general, Group A specimens are minimally modified and retain characteristics of the flake blank. Index of invasiveness values are low ranging from 0.125 to 0.250.

To briefly describe Group A tools, Specimen 12.2 looks like a split cobble with one suitable cutting edge along the right margin, a dorsal ridge, and cortex remaining along left margin. Specimen 57.5 consists of a large, minimally modified flake with cortex and previous flake scars on the dorsal surface. Specimen 69.6 is not as large as the others in the group, and looks like a wedge-shaped flake detached from a small chert cobble with a cutting edge along the right margin. These very expedient agave knives and were only recovered from cave deposits.

Table 8. Metric Attributes and Descriptions of Expedient Agave Knives.

Group	Specimen No.	Provenience	Max. Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Mass (g)	% Cortex	Polish	Loc. Tool Edge	Edge Angle	Edge Length (mm)	Tool Circum. (mm)	Index of Invasiveness (Clarkson 2002)
A	12.2	A2 U2 L3	89.86	65.92	24.33	171.7	25-50	no	right	30-60	9	25.75	0.250
A	57.5	A3 U2	106.09	45.09	20.82	114.1	25-50	no	right	30-60	10.25	27.5	0.125
A	69.6	A2 U7 L5	70.37	43.17	23.33	70.5	25-50	no	right	30-60	8.5	18.75	0.125
B	2.21	A1 U1 L2	38.87 (i)	38.88 (i)	6.98	11.5 (i)	<25	yes	distal	0-30	(i)	(i)	(i)
B	10.10	A2 U2 L1	43.54 (i)	43.75 (i)	7.8	17.4 (i)	<25	no	right	30-60	(i)	(i)	(i)
B	59.10	A1 FCR3 L2	36.42	45.03	9.82	19.5	<25	yes	left	30-60	(i)	(i)	(i)
C1	4.2	A1 U2 L1	87.28	38.62	13.83	46.5	<25	yes	left, right	0-30, 30-60	6.75, 6.75	23	0.281
C1	20.5	Surface	87.19	50.3	12.88	60.8	<25	yes	left, right	30-60, 0-30	9.75, 10.5	22.5	0.313
C1	41.9	A1 FCR2 L3	89.61	54.68	20.66	93.8	>75	no	left, right	30-60, 30-60	9.75, 8.5	23.25	0.313
C1	41.10	A1 FCR2 L1	74.5	48.67	16.41	66.7	25-50	no	left, distal	0-30, 30-60	(i), (i)	21.25	0.313
C1	58.24	A1 U1	41.53 (i)	46.07 (i)	9.4	19.2 (i)	0	yes	left, right	30-60, 0-30	(i), (i)	(i)	(i)
C1	67.5	A2 U7 L3	77.1	45.69	16.32	49.7	<25	yes	left, right	30-60, 30-60	6.5, 5.5	21	0.219

Table 8. Metric Attributes and Descriptions of Expedient Agave Knives (continued).

Group	Specimen No.	Provenience	Max. Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Mass (g)	% Cortex	Polish	Loc. Tool Edge	Edge Angle	Edge Length (mm)	Tool Circum. (mm)	Index of Invasiveness (Clarkson 2002)
C2	2.5	A1 U1 L2	96.53	62.15	15.1	87.5	<25	yes	left, right	0-30, 30-60	9.0, 10.5	25.75	0.406
C2	20.13	Surface	73.19	64.11	19.72	112.1	<25	no	left, right	0-30, 30-60	6.75, 7.5	23.75	0.313
C2	20.24	Surface	84.52	64.38	20.67	113	<25	no	left, right	0-30, 30-60	9.75, 8.5	25.5	0.313
C3	2.7	A1 U1 L2	86.44	43.31	12.38	42.1	25-50	yes	left	0-30	9	23	0.188
C3	57.6	A3 U2	59.97 (i)	47.62	16.04	51.4	50-75	yes	right	30-60	(i)	(i)	(i)
C3	20.11	Surface	98.96	72.68	20.57	131.4	<25	yes	left	30-60	10.75	28.5	0.094
C3	59.11	A1 FCR3 L2	91.16	54.05	17.51	94.3	<25	no	right	0-30	8.75	24	0.250
C4	8.4	A2 U1 L4	67.37	48.7	11.88	37.9	<25	yes	left, right, distal	30-60, 0-30, 0-30	7.0, 6.5, 4.5	20	0.406
C4	20.14	Surface	59.01	41.31	12.4	26.1	0	no	left, right, distal	30-60, 0-30, 0-30	6.5, 6.75, 3.0	17	0.375

Table 8. Metric Attributes and Descriptions of Expedient Agave Knives (continued).

Group	Specimen No.	Provenience	Max. Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Mass (g)	% Cortex	Polish	Loc. Tool Edge	Edge Angle	Edge Length (mm)	Tool Circum. (mm)	Index of Invasiveness (Clarkson 2002)
n/a	3.11	A1 U1 L3	82.04	37.03	8.93	26.3	0	yes	left, right	0-30, 0-30	9.75, (i)	(i)	0.188
n/a	57.3	A3 U2	37.49	49.82	7.88	17.8	<25	no	proximal, distal	30-60, 0-30	5.5, 7.25	14.5	0.406
n/a	58.27	A2	55.25	56.04	13.03	43.3	<25	yes	left, distal	30-60, 0-30	6.5, 5.5	19.75	0.188
n/a	58.29	A2	78.27	36.35	15.05	44.8	0	no	right	30-60	5	19.25	0.313

(i) Denotes unobtainable measurements for incomplete specimens.

Group B (n = 3) includes tools with one unimarginally modified edge, and are thinner and smaller than other groups of expedient agave knives (Specimens 2.21, 10.10, and 59.10) (Figure 27). These are also cortical flakes with cortex serving as a backed edge, but with relatively less cortex remaining (~25%) than tools within Group A. All specimens attributed to this group are fragments and no index of invasiveness was calculated. Like Group A, the cutting edges are only minimally worked. Group B tools were likely expedient, hand-held cutting tools.

Specimen 2.21 consists of the distal portion of an expedient agave knife with a gradual edge angle, and polish on both the ventral and dorsal surfaces consistent with the cutting and processing plants. Specimen 10.10 is the proximal end of flake with retouch on the right margin perhaps consistent with resharpening the tool edge. No macroscopic use-wear was observed on the cutting edge of this tool. Specimen 59.10 is the proximal fragment of an expedient flake tool exhibiting heavy polish along the right margin on both the ventral and dorsal surfaces. These tools are also expedient and exhibit heavier use-wear and seem more prone to fracture. Group B expedient agave knives were recovered from the upper layers of cave and burned rock midden deposits.

Figure 27. The thinner and smaller expedient agave knives (Group B), Specimens 2.21, 10.10, and 59.10 (from left to right).

Group C tools exhibit more variety of shape (ranging from rectangular to ovular/pointed) and size (maximum length ranging from 59.0 mm to 96.5 mm). Flakes within this group have two utilized edges, one steep edge angle and one relatively gradual. This specific contoured shape with two different edge angles is achieved through the shape of the detached flake (Subgroup C1) or through additional edge modifications during tool manufacture (Subgroup C2). Some of these tools are cortical flakes with only one, long cutting edge (Subgroup C3). Another variation of Group C includes expedient agave knives with a cutting edge along the distal margin in addition to the lateral margins (Subgroup C4).

Subgroup C1 (n = 6) consists of flakes with two cutting edges typically on each lateral margin – one gradual edge angle and one more steep (Specimens 4.2, 20.5, 41.9, 41.10, 58.24, and 67.5) (Figure 28). Because these tools are consistent in shape, specifically the prominent dorsal ridge creating different edge angles between the lateral margins, I suspect that these flakes were selected and utilized as cutting tools based on the morphological attributes of the flake blank. The flakes with Subgroup C1 this group are less modified and have lower index of invasiveness values than the others within Group C, but more utilized than those in Group A. Some exhibit polish indicative of plant processing, and all were recovered from higher elevations in burned rock midden and cave contexts.

For example, Specimen 4.2 appears to be knapped from a small river cobble with cortex only at the distal and proximal ends, and maintains original flake shape with a dorsal ridge, platform, and bulb of percussion still observable. A high polish consistent

Figure 28. Expedient agave knives with two cutting edges (Subgroup C1), Specimens 4.2, 20.5, 41.9, 41.10, 58.24, and 67.5 (from left to right and top to bottom).

with plant processing is visible on both the ventral and dorsal surfaces along the left margin. Specimen 20.5 is a sequent flake retaining the original flake shape and a negative bulb of percussion on the dorsal surface. The ventral surface of the expedient agave knife exhibits polish discernable from the slight sheen of the raw material.

Specimen 41.9 is a cortical flake with cortex remaining over the entire dorsal surface, and is similar shape to the other tools within Subgroup C1. The contour of cobble creates two suitable cutting edges with different edge angles that characterize Group C. Evidence of utilization, such as use-wear or retouch, is not clearly discernable through the calcium carbonate coating the surface of the artifact, but is recognizable as an expedient agave knife due to morphological attributes.

Specimens 41.10, 58.24, and 67.5 are smaller in size, and retain flake attributes such as platform, bulb of percussion, dorsal ridge, and feather terminations. Specimen 41.10 exhibits no use-wear but is clearly utilized. Specimen 58.24 is a distal fragment of an expedient agave knife with polish along distal left margin. Specimen 67.5 exhibits minimal working along the lateral margins with high polish on both ventral and dorsal surfaces right margin, and more faint polish along the left margin.

Subgroup C2 (n = 3) consists of expedient agave knives with exhibit two worked edges along the lateral margins, little cortex on the dorsal surface (<25%), and original flake attributes like prominent dorsal ridge, platform, and bulb of percussion (Specimens 2.5, 20.13, and 20.24). The edges of Subgroup C2 flakes are modified to create the contoured shape and edge angle to similar to Subgroup C1 tools. These cutting tools are large with consistent dimensions, particularly tool circumference and cutting edge lengths (Figure 29). Only one specimen within the group (Specimen 2.5) exhibits a high polish

Figure 29. Expedient agave knives with two cutting edges and more edge modification (Subgroup C2), Specimens 2.5, 20.13, and 20.24 (from left to right).

on the dorsal and ventral surfaces extending from the left margin to the midline of the artifact. All Subgroup C2 tools were recovered from the surface and upper layers of the burned rock midden.

Subgroup C3 (n = 4) expedient agave knives exhibit the most variation of Group C with similar contoured shape of the flake but with only one long cutting edge along the right or left lateral margin (Specimens 2.7, 20.11, 57.6, and 59.11) . Complete specimens range from 86.4 to 99.0 mm in length; the longest tool in the sample is Specimen 20.11. Subgroup C3 includes tools that are minimally worked with lowest index of invasiveness values of Group C and maintain flake attributes like dorsal ridge, platform, and bulb of percussion. All specimens within Subgroup C3 are cortical flakes with cortex clearly serving as a backed edge for handheld cutting on Specimens 20.11 and 59.11. The edge angle and overall shape of these tools vary, and most exhibit polish suggestive of plant processing (Figure 30). The specimens sampled were recovered from varied context on the surface and upper elevations of the burned rock midden and cave talus.

From the sample, Specimen 2.7 is a rectangular, expedient agave knife with cortex along right margin. The concave cutting edge exhibits polish along left margin on both ventral and dorsal surfaces. Specimen 20.11 is a sequent flake with negative bulb of percussion on the dorsal surface with polish on ventral left surface and dorsal right proximal corner. Specimen 56.7 is the medial fragment of an expedient agave knife with polish observed along the cutting edge. Specimen 59.11 exhibits no macroscopic use-wear.

Figure 30. Expedient agave knives with one cutting edge (Subgroup C3), Specimens 2.7, 20.11, 57.6, and 59.11 (from left to right and top to bottom).

Figure 31. Expedient agave knives with three cutting edges (Subgroup C4), Specimens 8.4 and 20.14 (from left to right).

Subgroup C4 (n = 2) consists of two flake tools with three modified edges (Specimens 8.4 and 20.14) (Figure 31). Consistent with Group C, the contour of the flake creates different edge angles along the edge of the cutting tools. Both specimens in sample exhibit similar cutting edge lengths along each margin, and a steeper edge angle on left margin. These tools are more modified versions of cutting tools with three modified edges and higher index of invasiveness values (0.375 to 0.406). Within the sample, Subgroup C4 flakes are smaller than others in Group C, and were recovered from the surface of the midden or within the upper meter of cave deposits.

Specimens 8.4 and 20.14 exhibit flake attributes like a prominent dorsal ridge, platform with cortex, and bulb of percussion. The lateral and distal margins of the Specimen 8.4 are worked and polish is observed on the right ventral surface. Specimen 20.14 also exhibits evidence of utilization along the right, left, and distal margin, but no polish is observed.

Four tools (Specimens 3.11, 57.3, 58.27, and 58.29) are not morphologically consistent with the other expedient agave knives within the sample (Figure 32), but exhibit suggestive characteristics and are potentially other forms of expedient agave knives. Specimen 3.11 is a long and narrow minimally modified flake with two cutting edges, but lacks the contoured shape of Group C cutting tools – both edge angles are gradual. A faint polish is observed along the left margin on the ventral and dorsal surfaces. This tool was recovered from the upper layers of the burned rock midden. Specimen 57.3 is modified along two edges on opposite faces – the ventral proximal and dorsal distal margins. This tool is smaller and perhaps reworked with a higher index of invasiveness value (0.406), and was recovered from the limestone boulder in front of the

Figure 32. Four flake tools potentially variants of expedient agave knives, Specimens 3.11, 57.3, 58.27, and 58.29 (from left to right).

cave. The precise provenience of Specimens 58.27 and 58.29 is unknown, though both were recovered from cave contexts. Specimen 58.27 resembles Group C tools; however, in that the ventral surface of the detached flake is countered to achieve two different edge angles and the platform on the long edge of the flake making the distal and left margins the primary cutting edges. Polish is observed on both cutting edges. Specimen 58.29 is a patinated flake fragment exhibiting one cutting edge. This flake was modified after the patina formed indicating that the flake was detached, discarded, and later recycled as a cutting tool.

<u>Scrapers</u>

In general, scrapers are a specific type of flake tool with an edge angle of 60-90º (Andrevsky 2005) with a circular or ovoid shape, but range in size and number of modified edges. At least 17 scrapers were recovered from the Little Sotol site, 12 were from cave deposits, and five from midden context. Many of the scrapers in the assemblage are broken and few are burned. A sample of six scrapers that characterized the assemblage was selected for analysis and description (Table 9, Figure 33).

Miller (2011b) argues that the some scrapers with heavy pitting on the rounded dorsal surface may be more accurately termed "pulping scrapers". Experimental studies (Hester and Heizer 1972; Osborne 1965), and archaeological and ethnographic observations (Parsons and Parsons 1990), provide evidence of scrapers used as tools for mashing agave leaves and separating fibers from flesh, as well as removing spines from

Table 9. Metric Attributes and Descriptions of Scrapers within Analyzed Sample.

Spec No.	Provenience	Max. Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Mass (g)	Description	Edge Angles (degrees)
8.5	A2 U1 L4	46.82	39.51	9.31	18.3	Round, complete scraper with distal, right and left margins modified	0-30, 0-30, 30-60
17.3	A2 U3 L4	38.3(i)	54.29	14.86	29.1	Round, distal fragment of scraper with three modified edges, resharpened	60-90, 60-90, 30-60
20.20	Surface of midden	52.64	39.65	12.2	24.4	Round, complete, end scraper with left margin also modified	0-30, 30-60
26.1	A2 U3 L6	42.41	49.27	17.3	40.9	Round, complete scraper with distal end (unimarginal), right and left margins (bimarginal) modified	30-60, 30-60, 60-90
63.1	A1 U3 L2	30.39(i)	43.4	9.91	14.0	Distal fragment of end scraper with one modified edge, cortex on dorsal surface	60-90
67.9	A2 U7 L3	48.49	35.49	17.9	26.2	Fragment of scraper with one modified edge	60-90

(i) Denotes unobtainable measurements for incomplete specimens.

Figure 33. Six scrapers from the Little Sotol site, Specimens 8.5, 17.3, 20.20 and 26.1 (top row from left to right) and Specimens 63.1 and 67.9.

cactus pads (Fish et al. 1992). Pulping scrapers, as Miller (2011b: 302) describes them, are much larger in size than the scrapers documented at the Little Sotol site, and no scrapers in the assemblage display macroscopic use-wear, specifically pitted markings on the dorsal surface, indicative of pounding.

Based on morphology and the number of modified edges, the Little Sotol assemblage appears to contain at least two types of scrapers. Some exhibit only one modified edge with a steep edge angle (60-90º) and were likely used for the single function (e.g., Specimens 63.1, 67.9). Most scrapers exhibit a steep edge angle suitable for scraping as well as one or two edges with gradual edge angles (0-30º) more suitable for cutting. The edges interpreted as cutting margins are often bimarginally worked. These tools (e.g., Specimens 8.5, 17.3, 20.20, 26.1) with more than one modified edge are likely multifunctional tools used to scrape and cut a variety of materials. Previous residue studies (Shafer and Holloway 1979; Sobolik 1996a) examining tools with steep edge angles demonstrate that chipped stone tools suitable for scraping often serve multiple functions.

Three complete scrapers (Specimens 8.5, 20.20, 26.1) were measured for the index of invasiveness (Clarkson 2002) and display a wide range of values between limited retouch (0.1875) and complete unifacial retouch (0.5938). Index of invasiveness correlates with number of worked margins with higher values associated with three-edged scrapers. With a small sample size, no correlating relationships among index of invasiveness values, raw material type, context, and vertical provenience were observed. The index of invasiveness, however, appears to be a useful measure for quantifying the degree of modification and multifunctional use of a tool.

Choppers

Ten chert choppers were documented at the Little Sotol site. Choppers consist of large, chert core tools often with large flake scares, some cortex remaining, and a "convex bit" end (Nunley et al. 1965:61) sometimes pitted indicative of battering. Choppers are quite large and demonstrate characteristics consistent with chopping activities. At the Little Sotol site, choppers occur in the upper 120 cm of cave and burned rock midden deposits. Three choppers were selected as a sample for description and characterize the tool type (Table 10, Figure 34). Choppers are sometimes interpreted as hunting and butchery tools, but are known to have functioned as plant processing tools.

Table 10. Metric Attributes and Descriptions of Choppers within Analyzed Sample.

Spec No.	Provenience	Max. Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Mass (g)	Description
21.6	A2 U4 L2	131.31	77.01	21.3	229.1	Complete chert chopper with 0 percent cortex, all margins exhibit retouch
57.2	A3 U2	80.29(i)	65.19(i)	25.91	147.4	Broken chert chopper with more than 75 percent cortex, made from thin river cobble
81.9	A2 U7 L6	115.55	79.04	38.54	407.5	Complete chert chopper with 25-50 percent cortex, minimally worked with one battered edge, coated in calcium carbonate

(i) Denotes unobtainable measurements for incomplete specimens.

Figure 34. An example of a chopping tool from the Little Sotol site (Specimen 89.1).

Pounding Tools

Miller (2011:302) includes hammerstones in the plant processing toolkit suggesting that these tools were used to maintain agave knives and scraper planes in addition to pounding and mashing baked agave. Limestone pounding tools are represented by three hammerstones (Specimens 13.29, 58.51, and 79.1) and one pestle (29.1). Pounding tools are limestone cobbles with heavy pitting along at least one margin. The pestle is distinguished from the hammerstones by shape and the presence of a possible grinding facet. Without residue analysis is it difficult to definitively determine the use of these tools, but they are briefly included in the discussion because they are a potentially important but sometimes overlooked part of the plant processing toolkit. Nondescript rocks used as plant processing tools may be misclassified as hammerstones or cores; and if so, the function is overlooked (Miller 2011a:30). Miller (2011c:355) also recognized a rarely discussed type of plant processing tool described as a large, wedge-shaped pounding rock recognizable by pitting on the pointed edge. Tools of these kinds were sought after, but not observed, during the excavation at the Little Sotol site.

Summary and Discussion

In summary, the lithic assemblage is consistent with the interpretation that the Little Sotol site served as an earth oven facility where prehistoric inhabitants performed activities primarily associated with earth oven plant baking. Drawing from previous research and observations during excavation and analysis, the types of stone tools diagnostic of plant processing at earth oven facilities include formal and expedient agave knives, scrapers, choppers, and pounding stones. The consistency in tool manufacture for both formal and expedient tools may assist archaeologist in identifying functionally diagnostic tools in lieu of technical analysis, though more weight can be given to the interpretation with continued residue and use-wear analyses. Though the majority of expedient tools analyzed for residues in the Lower Pecos (Shafer and Holloway 1978; Sobolik 1996a) and the adjacent Sacramento Mountains (Dering et al. 2011) yield plant and animal proteins, use-wear analysis indicates a predominance of plant preparing activities. Microscopic use-wear and phytolith identification are likely means to refine our understanding of the duplicitous use of these kinds of tools.

As discussed previously, the only two formal agave knives (likely hafted with distal end modification) identified in the Little Sotol sample occurred in lower elevations of the burned rock midden and cave deposits. The upper layers contained only expediently produced agave knives. A change towards more expedient lithic technology could be an effect of the intensification of earth oven technology into the Late Archaic and Late Prehistoric periods (see Chapters 2 and 7). Due to the small sample of formal agave knives and lack of dates in the lower cave deposits, I posit this hypothesis of a transition to more expedient tools with caution. Focused study of the change in plant processing tools over time is warranted and may promote insightful interpretations regarding task organization at long-term earth oven facilities.

7. CULTURAL FORMATION PROCESSES OF A LONG-TERM EARTH OVEN FACILITY

As discussed in previous chapters, several researchers have called attention to the trend of increasing frequency and density of burned rock over the landscape through the Archaic into the Late Prehistoric period (e.g., Black and Creel 1997; Maudlin et al. 2003; Miller 2011; Thoms 2009). With the proliferation and intensification of earth ovens technology through time, the increasing reuse of long-term earth oven facilities, like the Little Sotol site, should also be expected. Fuel and plants are limiting resources in earth oven plant baking, but in the Lower Pecos sufficient amounts of sediment, or a suitable place to repeatedly excavate and build earth ovens, is perhaps the foremost limiting resource (Koenig 2012). Due to topographic limitations and low availability of suitable places for repetitive earth oven construction, it stands to reason that existing earth ovens and facilities should be reused more and more through time as landuse intensifies.

Due to access to resources, low alluvial terraces are ideal locations for long-term earth oven facilities. Black and Creel (1997:303) made the observation that burned rock middens with relatively early components occur along waterways and resource-rich areas. Radiocarbon ages and diagnostic artifacts demonstrate continued, though intermittent, use of the Little Sotol site from the late Early Archaic to the Late Prehistoric period. The depth and age of the burned rock deposits at the Little Sotol site is proportionate to the persistence of its place as an earth oven facility within a small tributary canyon of Dead Man's Creek. The majority of artifacts observed at the Little Sotol site, an estimated 99 metric tons of burned rock, represent a "persistent place" (Schlanger 1992) demonstrating the repeated reuse of the locale for earth oven plant baking. Earth oven facilities may be categorized as limited activity loci, also described as logistical use sites (Binford 1982), functionally specific to earth oven plant baking. That said, earth oven plant baking cannot be inflated as part of logistical subsistence strategy tied to long-term residential occupations because "sotol and lechuguilla are slow growing perennials that do not recover quickly from intense harvesting" (Dering 1999:668).

More than likely, earth oven facilities are part of a blended foraging and collecting subsistence system adapted interannual variation of precipitation and resource availability (Dering 1999). There is considerable debate in the literature regarding the relative importance of subsistence strategies employed in the Lower Pecos (see Chapter 2); however, it is clear that earth oven facilities, including the Little Sotol site, represent a limited scope of activities centered around the baking of sotol and lechuguilla in earth ovens. As well established, burned rock middens are the result of repeated earth oven firing events and successive discard of burned rocks (e.g., Black and Thoms 2014).

Because earth oven technology requires the investment of time and energy, researchers argue that circumstances, such a significant social or environmental change, are required to compel past populations to construct earth ovens. It is the purpose of this chapter to present stratigraphic evidence of reuse to support the landuse intensification model. Patterns in burned rock deposits at the Little Sotol site indicate more reuse and more frequent earth oven events through time, which arguably indicates the intensification of earth oven technology perhaps due to population increase in the region.

Cultural Stratigraphy

Due to the depositional environment of the slowly aggrading terrace of Windmill Canyon, there were no discrete layers of alluvium separating cultural episodes earth oven plant baking at the Little Sotol site. The lowest remnant earth ovens were observed in light colored alluvium likely representing the initiation of the site as an earth oven facility. The 2-meter accumulation of burned rocks, artifacts, and detritus related to earth oven plant processing represents over 6000 years of use, which is marked by only a few remaining remnant heating elements of subsequent earth ovens amid the mass of burned rock.

While some heating elements representing earth oven use events preserve within burned rock middens, most earth ovens were dismantled and obscured in the archaeological record through the construction of subsequent earth ovens and other site formation processes. The repeated reuse of the Little Sotol site resulted in a cumulative palimpsest of cultural events embodied by a massive accumulation of burned rocks. "Such cumulative palimpsests are prominent in the archaeological record precisely because they are formed by the repeated accumulation of materials in the same place, from which derives their archaeological visibility and relative ease of discovery and analysis, and also their symbolic significance for the people who used them" (Bailey 2007:205, cf. Luby and Gruber 1999).

As in all archaeological palimpsests, cultural mixing is the norm. Acts of reuse by intruding upon previous burned rock deposits to excavate pits for subsequent earth ovens perpetually mixed deposits at the earth oven facility. That said, the majority of radiocarbon assays and temporally diagnostic projectile points recovered at the Little Sotol site were in the expected stratigraphic sequence – younger above older. I believe this indicates a higher degree of archaeological integrity of the burned rock midden than sometimes presumed. Though much of the burned rock midden deposits are mixed and stratigraphic boundaries are at times unclear, the general sequence of events is observable.

There were nine stratigraphic layers observed within the burned rock midden (Figure 35). These layers were distinguished by slight changes in sediment, burned rocks, and artifactual material. Radiocarbon assays (Table 11) and projectile point styles (see Chapter 4) were acquired from most stratigraphic layers. The projectile point sequence includes specimens attributed to the Early Archaic through Late Archaic, while the radiocarbon ages range from the end of Early Archaic to the Late Prehistoric period from bottom to top. The relative locations of temporally diagnostic artifacts were used to tentatively associate bands of cultural stratigraphy to archaeological periods.

The uppermost layer (Layer A) carried evidence of the thick vegetation stripped away from the site prior to excavation, and consisted of leaf litter, dark silt with organic constituents, and only a few burned rocks. This organic-rich upper layer measured 25 cm thick across the top of the midden. The next stratigraphic layer (Layer B) consisted of dark gray, fine silty clay with small, subrounded gravels, and an abundance of burned rock and other cultural artifacts. Layer B measured 25 to 50 cm thick. No radiocarbon samples were obtained for these layers, and the projectile points include a mixture of Late Archaic and Middle Archaic dart points (i.e., Pedernales, Marcos, Almagre, and Val Verde points).

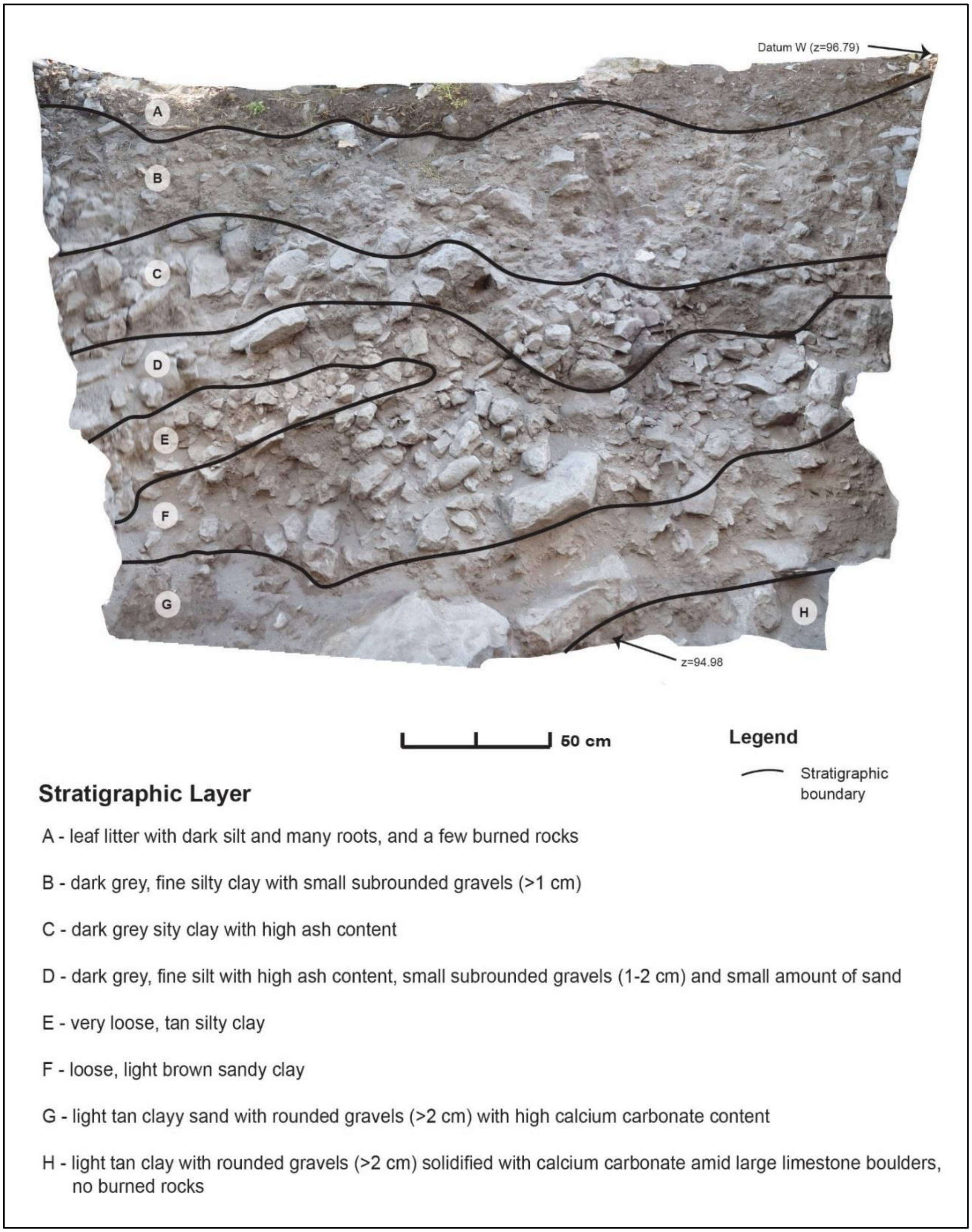


Figure 35. Southwest profile of excavation within the burned rock midden at the Little Sotol site.

Table 11. Radiocarbon Dates from the Burned Rock Midden at the Little Sotol Site.

Sample No.	Context (Stratigraphic Layer)	Provenience (Excavation Layer)	Material	^{14}C Years B.P.	Cal B.P. (2σ)	Median Cal. B.P.
Bot-16	Feature 1 (Layer B)	Area 1, Unit 1, Layer 4	*Agavaceae* leaf	815 ± 15	745 to 687	720
Bot-18	Feature 1 (Layer B)	Area 1, Unit 1, Layer 4	*Quercus* wood	860 ± 15	790 to 732	760
CS-33	Midden (Layer C)	Area 1, RSC 3, Layer 3	*Agavaceae* leaf	894 ± 22	907 to 739	820
Bot-6	Feature 3 (Layer D)	Area 1, Unit 1, Layer 5	*Agavaceae* leaf	995 ± 15	957 to 832	930
CS-32	Midden (Layer D)	Area 1, RSC 3, Layer 4	*Fraxinus* wood	1634 ± 24	1606 to 1417	1540
Bot-25	Midden (Layer D)	Area 1, Unit 1, Layer 4	*Agavaceae* leaf	3795 ± 15	4238 to 4098	4190
Bot-3	Feature 4 (Layer F)	Area 1, Unit 1, Layer 5	Indeterminate	4785 =± 20	5589 to 5475	5510
Bot-31	Feature 5 (Layer G)	Area 1, Unit 1, Layer 6	*Juglans microcarpa* nut	6100 ± 20	7145 to 6897	6970
Bot-12	Feature 6 (Layer G)	Area 1, Unit 1, Layer 7	*Agavaceae* stem	4755 ± 15	5584 to 5468	5530
Bot-19	Feature 6 (Layer G)	Area 1, Unit 1, Layer 7	*Condalia* wood	6115 ± 20	7155 to 6907	6980

The next two layers also contained quantities of burned rocks and other artifacts, and the sediment texture changed to what is commonly called “midden soil” – a dark silt or silty clay almost greasy to the touch (Black and Thoms 2014:218). Burned macrobotanical remains (lechuguilla/sotol leaves and charcoal) increased in size and count in these layers. Layers C and D contained burned rock, artifacts, and burned botanical material amid the midden soil, while Layer D also contained small, subrounded gravels consistent with alluvial terrace deposits.

Layer C fluctuated from 10 cm thick at the west corner and 30 cm at the south corner. A possible feature (partially explored but not confirmed as remnant heating element) at the bottom boundary of Layer C intruded in to the lower layers of sediment and burned rock. The undulating boundary interrupted Layers D, which disappeared toward the west corner. At the south corner, Layers D measured 25 cm thick. Diagnostic projectile points in these layers also consist of a mixture of Late Archaic and Middle Archaic dart points (i.e., Pedernales, Val Verde, Langtry, Arenosa, Almagre, Pandale, and Kinney).

The uppermost remnant heating element (Feature 1) was observed near the boundary of Layers B and C approximately 60 cmbs. Radiocarbon assays[17] (Bot-16 and Bot-18) obtained from the earth oven feature date to 720 cal. B.P. and 760 cal. B.P. Approximately 30 cm below Feature 1, another remnant earth oven bed (Feature 3) was identified near the lower boundary of Layer C. The radiocarbon assay (Bot-6) attained from Feature 3 dates to 930 cal. B.P. at 90 cmbs.

Features 1 and 3 were surrounded by older deposits expected in a scenario where earth oven construction intruded upon previous burned rock deposits. Extra-feature radiocarbon assays in Layers B and C date to 820 cal. B.P. at 65 cmbs (CS-33), 1540 cal. B.P. at 85 cmbs (CS-32), and 4190 cal. B.P. (Bot-25). Due to the location of earth oven beds, I estimate conservatively that the upper 60 cmbs represent the burned rock discard accumulated during the Late Archaic and Late Prehistoric periods with earth ovens excavated into the Middle Archaic deposit effectively mixing components. That said, cultural features were resistant to these processes.

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[17] Radiocarbon dates presented in this section are the midpoint of the calibrate age rounded to the nearest decade.

Layer E, also truncated by Layer C, was strikingly distinct from all previous stratigraphic layers in color and texture. This 25 cm thick layer contained the highest density of burned rocks and consisted of very loose, tan clay. The lighter colored sediment also contained the projectile points attributed to the Early Archaic period (i.e., Bandy dart points). The lowest layers of the midden deposit were very light in color compared to the ashy deposits of the upper layers. Field school students and I observed relatively less charcoal outside of cultural features in these layers. The remnant heating element (Feature 4) documented at 110 cmbs, yielded a radiocarbon age of 5510 cal. B.P. (Bot-3).

Layer F consisted of a loose, light brown sandy clay measuring 40 cm thick at the west corner nearest the caves and 25 cm thick nearest the drainage. The lowest layer containing burned rocks (Layer G) measured 40 cm thick in the west corner and tapered to 25 cm thick towards the drainage, and consisted of a light tan clayy sand with rounded gravels. Only projectile points affiliated with the Early Archaic period (i.e., Bandy and untyped Early Archaic) were recovered from Layers F and G. Two remnant heating elements (Features 5 and 6) were observed within these layers and yielded similar Early Archaic radiocarbon ages. Feature 5 dated to 6970 cal. B.P. at 145 cmbs (Bot-31). Feature 6 returned two radiocarbon ages from approximately 175 cmbs, 6980 cal B.P. (Bot-19) and 5530 cal. B.P. (Bot-12). The later radiocarbon age is not easily explained, but probably due to the cultural mixing expected at an earth oven facility; however, the earlier date for Feature 6 is from context clearly associated with the heating element.

The boundary between Layers G and H marks the vertical extent of the burned rock midden as Layer H contained no burned rocks. Layer H consisted of light tan clay and rounded gravels among large boulders some more than a half-meter in length. Few botanical remains were observed within this stratigraphic layer, and no matrix samples collected yielded datable material. A single, untyped Early Archaic projectile point was recovered within the light-colored matrix of Layer H. At most the excavation extended 30 cm among the boulders and sediment solidified with calcium carbonate.

Burned Rock Quantification

A major aim of this research is to use evidence of earth oven reuse to evaluate the landuse intensification model as discussed in Chapter 2. At the Little Sotol site, I adopted a method of Rock Sort Columns (RSC) to sample and quantify burned rock size and morphology by relative vertical position, and essentially estimate the degree of hot rock reuse through time. The volume and mass of burned rocks excavated with the three Rock Sort Columns was used to extrapolate the volume and mass of the entire burned rock accumulation on-site (see Chapter 4).

At the Little Sotol site burned rocks vary in color, shape, size, and surface morphology. Though color change and shape provide useful information regarding mineralogy and thermodynamics of hot rocks, as well the heating environment contained within earth ovens, they are not easily measurable indicators of burned rock reuse. Like other researchers (e.g., Lucas and Frederick 1998), I view rock size as the most distinguishing characteristic to measure reuse. In general, rocks used in earth ovens fracture into progressively smaller sizes the more they are reused.

Based on my personal experience with experimental earth ovens, some limestone materials may fracture more readily than others and in a single firing, and this is largely dependent on the type and source limestone. Limestone collected from uplands exhibit karstic weathering (pitted outer surface and tabular cleavage), while cobbles from the canyon bottom are round, dense and durable. Stream-rounded limestone cobbles are often more resistant to thermal fracture (Charles Frederick, personal communication 2011).

No standard method to sort burned rocks by different size classes is used in the archaeological literature, as most researchers adopt independent strategies. Most size class sorting methods use arbitrary size class breaks with equal intervals in the aim of removing bias from size classes. Experimental study serves to inform size class breaks. For example, in a burned rock kiln experiment Leach et al. (1998) designed sorting system using seven size classes but observed no burned rocks in the two largest size classes (20-24 cm and >24 cm).

Experimental studies demonstrate that under typical conditions native limestone rocks fracture in predictable patterns. The thermal stress of cooling from very high temperatures results in deep angular to jagged fractures (Black and Thomas 2014:208; Lucas and Frederick 1998). After one or two firing events limestone rocks retain near original size and thermal storage capacity (Leach et al. 1998). Black (1997) used the term “pristine” to describe these still useful burned rocks. Experimental study demonstrates that rocks greater than 15 cm are more effective conductors of heat and were probably selected for use in earth ovens for size (Lucas and Frederick 1998). For the purpose of this research, it is assumed that all pristine limestone rocks used in earth ovens at the Little Sotol site measured 15 cm or greater in length.

Large rocks represent and early stage in the use-life of a hot rock, while smaller rocks consist of exhausted components of heating elements and spalls from larger rocks. Spalling of the exterior surface of limestone rocks occurs at any point during the heating and cooling cycle of hot rocks, and is not a good measure of reuse. The documentation of burned rocks at the Higgins site (41BX184) demonstrated a clear size bias for discarded rocks at 7 cm or smaller in maximum length (Lucas and Frederick 1998).

Burned rocks excavated from the Rock Sort Columns were sorted into three size classes by maximum linear dimension – large (>15cm), medium (7.5-15cm), and small (<7.5cm). Large rocks retain the capacity as thermal storage devices, while small rocks are no longer useful and discarded. Large and medium-sized burned rocks were counted, weigh collectively by size class, and sorted by surface morphology to determine the percentage of rocks utilized from upland or canyon bottom sources. Small burned rocks were weighed collectively but not counted individually or sorted by surface morphology.

The medium size class is a catchall category for rocks that are too small to be truly effective thermal conductors, but large enough to be potentially utilized in earth ovens. Lucas and Frederick (1998:206) found a “discard threshold” at 11.5 cm where rocks are presumably too small to be useful, but this is an approximated break based on one attribute – length. Mass and surface area of rocks of the same length can vary greatly depending on overall shape of a limestone rock. At the Little Sotol site, I chose to accommodate this variability and include rocks above and below the approximate discard threshold in the same size category.

The sample of burned rock attribute data from three columns (RSC 1-3) was collected in vertical increments of 20 to 30 cm levels to quantify the overall nature of the burned rock midden deposits. The location of the columns was selected around the center of the midden in the attempt to sample discard zones outside the center of the midden where remnant earth oven beds were observed. Tables 12-17 present the frequency data and mass of burned rocks in each size class by column and elevation. Because the volume excavated differed greatly among layers of each column, volume and density values are presented to facilitate comparison and estimate the sizes of burned rocks contained in the entire burned rock midden deposit.

The burned rocks documented ranged in size from greater than 35 cm to 1-2 cm in length with a visually observed higher frequency of smaller burned rocks in the upper layers of the burned rock midden. Figure 36 presents the combined size class data by relative elevation. In general, burned rock size increases with depth supporting the visually observed trend. A higher ratio of large, pristine burned rocks in lower layers of the midden coupled with more small and medium rocks representing burned rock discard is indicative of greater reuse in the upper portion of midden.

Table 12. Summary of Rock Sort Column 1 Excavation and Burned Rock Frequency Data.

	Layer elevations (thickness)	Volume excavated (m^3)	Medium size FCR (7.5-15cm)		Large size FCR (>15cm)	
			#	#/m^3	#	#/m^3
Layer 1	96.52 to 96.20 (32 cm)	0.12	166	1383.3	4	33.3
Layer 2	96.20 to 95.92 (28 cm)	0.10	119	1190.0	3	30.0
Layer 3	95.92 to 95.63 (29 cm)	0.11	72	654.5	1	9.1
Layer 4	95.63 to 95.50 (13 cm)	0.05	182	3640.0	11	220.0
Total	96.52 to 95.50 (1.02 m)	0.38	539		19	

Table 13. Burned Rock Quantification for Rock Sort Column 1.

	Small size FCR (<7.5cm)			Medium size FCR (7.5-15cm)			Large size FCR (>15cm)			Total FCR	
	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3
Layer 1	32.7	272.5	45.6	35.8	298.0	49.9	3.2	26.7	4.5	71.7	597.2
Layer 2	30.8	308.0	39.4	41.1	411.0	52.6	6.3	63.0	8.1	78.2	782.0
Layer 3	17.2	156.4	39.5	24.5	222.7	56.3	1.8	16.4	4.1	43.5	395.5
Layer 4	41.6	832.0	30.0	86.2	1724.0	53.8	32.5	650.0	20.2	160.3	3206.0

Table 14. Summary of Rock Sort Column 2 Excavation and Burned Rock Frequency Data.

	Layer elevations (thickness)	Volume excavated (m^3)	Medium size FCR (7.5-15cm)		Large size FCR (>15cm)	
			#	#/m^3	#	#/m^3
Layer 1	96.47 to 96.17 (30 cm)	0.17	98	576.5	3	17.6
Layer 2	96.17 to 95.87 (30 cm)	0.17	71	417.6	5	29.4
Layer 3	95.87 to 95.57 (30 cm)	0.13	297	2284.6	46	353.8
Layer 4	95.57 to 95.28 (29 cm)	0.11	197	1790.9	47	427.3
Layer 5	95.28 to 94.97 (31 cm)	0.11	205	1863.6	12	109.1
Total	96.47 to 94.97 (1.50 m)	0.69	868		113	

Table 15. Burned Rock Quantification for Rock Sort Column 2.

	Small size FCR (<7.5cm)			Medium size FCR (7.5-15cm)			Large size FCR (>15cm)			Total FCR	
	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3
Layer 1	104.2	613.1	70.8	40.3	236.8	27.3	2.8	16.3	1.9	147.3	866.2
Layer 2	83.5	491.2	57.5	53.8	316.6	37.1	7.8	45.8	5.4	145.1	853.6
Layer 3	41.7	320.9	21.5	105.7	813.3	54.6	46.3	355.8	23.9	193.7	1490.0
Layer 4	15.5	140.6	11.9	65.5	595.2	50.5	48.7	422.9	37.6	129.7	1178.7
Layer 5	23.1	209.5	20.8	66.7	606.5	60.2	21.1	191.9	19.1	110.9	1007.9

Table 16. Summary of Rock Sort Column 3 Excavation and Burned Rock Frequency Data.

	Layer elevations (thickness)	Volume excavated (m^3)	Medium size FCR (7.5-15cm)		Large size FCR (>15cm)	
			#	#/m^3	#	#/m^3
Layer 1	96.65 to 96.45 (20 cm)	0.2	34	170.0	3	15.0
Layer 2	96.45 to 96.25 (20 cm)	0.2	272	1360.0	13	65.0
Layer 3	96.25 to 96.05 (20 cm)	0.16	88	550.0	8	50.0
Layer 4	96.05 to 95.84 (21 cm)	0.16	269	1681.3	8	50.0
Layer 5	95.84 to 95.65 (19 cm)	0.11	165	1500.0	5	45.5
Layer 6	95.65 to 95.52 (13 cm)	0.06	108	1800.0	3	50.0
Layer 7	95.52 to 95.31 (21 cm)	0.06	97	1616.7	8	133.3
Layer 8	95.31 to 95.12 (19 cm)	0.04	45	1125.0	5	125.0
Layer 9	95.12 to 95.01 (11 cm)	0.02	14	700.0	2	100.0
Total	96.65 to 95.01 (1.64 m)	1.01	1092		55	

Table 17. Burned Rock Quantification for Rock Sort Column 3.

	Small size FCR (<7.5cm)			Medium size FCR (7.5-15cm)			Large size FCR (>15cm)			Total FCR	
	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3	%kg	kg	kg/m^3
Layer 1	11.8	59.0	50.5	9.6	47.8	40.9	2.0	10.0	8.6	23.4	116.8
Layer 2	51.8	259.1	38.4	66.8	333.9	49.5	16.4	91.8	12.1	134.9	674.7
Layer 3	40.3	251.9	47.7	37.9	236.9	44.8	6.3	39.6	7.5	84.5	528.4
Layer 4	41.0	256.1	33.2	75.3	470.8	61.0	7.2	44.9	5.8	123.5	771.7
Layer 5	24.7	224.4	29.0	50.8	461.4	59.6	9.7	87.9	11.4	85.1	773.6
Layer 6	11.3	189.0	23.5	34.3	571.7	71.2	2.5	42.3	5.3	48.2	803.0
Layer 7	13.4	223.7	26.6	27.6	460.2	54.7	9.4*	157.3	18.7	50.5	841.2
Layer 8	4.9	122.3	21.7	11.2	280.3	49.7	6.5	161.5	28.6	22.6	564.0
Layer 9	1.7	86.5	24.1	1.9	96.0	26.8	3.5	176.0	49.1	7.2	358.5

Figure 36. Burned rock frequency data by relative elevation with Rock Sort Column nearest the center of the midden to the left. Note the general patterns of small rock frequency decreasing with depth and large rock frequency increasing with depth.

Pitted limestone is a result of karstic weathering characteristic of upland limestone formations, while rounded, durable limestone is sourced to the canyon bottom. Burned rocks from all depths of the burned rock midden clearly exhibit surface characteristics of upland formations and canyon bottom limestone sources (Tables 18-20). By recording rock size in conjunction with surface morphology (rounded vs. pitted), I was able to determine that layers of small burned rocks are the effect of reuse rather than the use of upland limestone sources more prone to fracturing. If fact, the data collected impart no pattern for selective preference between available limestone sources surround the site.

Table 18. Surface Morphology of Burned Rocks from Rock Sort Column 1.

	Pitted			Rounded			Other			Total	
	#	**#/m^3**	**%**	**#**	**#/m^3**	**%**	**#**	**#/m^3**	**%**	**#**	**#/m^3**
Layer 1	82	683.3	48.2	4	33.3	2.4	82	683.3	48.2	170	1416.7
Layer 2	45	450.0	36.9	10	100.0	8.2	66	660.0	54.1	122	1220.0
Layer 3	14	127.3	19.2	5	45.5	6.8	54	490.9	74.0	73	663.6
Layer 4	60	1200.0	31.1	24	480.0	12.4	107	2140.0	55.4	193	3860.0

Table 19. Surface Morphology of Burned Rocks from Rock Sort Column 2.

	Pitted			Rounded			Other			Total	
	#	**#/m^3**	**%**	**#**	**#/m^3**	**%**	**#**	**#/m^3**	**%**	**#**	**#/m^3**
Layer 1	60	352.9	59.4	16	94.1	15.8	25	147.1	24.8	101	594.1
Layer 2	54	317.6	48.6	21	123.5	18.9	36	211.8	32.4	111	652.9
Layer 3	135	1038.5	39.4	86	661.5	25.1	79	607.7	23.0	343	2638.5
Layer 4	82	745.5	33.6	61	554.5	25.0	94	854.5	38.5	244	2218.2
Layer 5	18	163.6	8.3	47	427.3	21.7	149	1354.5	68.7	217	1972.7

Table 20. Surface Morphology of Burned Rocks from Rock Sort Column 3.

	Pitted			Rounded			Other			Total	
	#	#/m^3	%	#	#/m^3	%	#	#/m^3	%	#	#/m^3
Layer 1	8	40.0	21.6	6	30.0	16.2	22	110.0	59.5	37	185.0
Layer 2	58	290.0	20.4	48	240.0	16.8	78	890.0	62.5	285	1425.0
Layer 3	33	206.3	18.6	19	118.8	10.7	125	781.3	70.6	177	1106.3
Layer 4	61	381.3	22.0	41	256.3	14.8	171	1068.8	61.7	277	1731.3
Layer 5	25	227.3	14.6	21	190.9	12.3	125	1136.4	73.1	171	1554.5
Layer 6	13	216.7	11.7	20	333.3	18.0	77	1283.3	69.4	111	1850.0
Layer 7	22	366.7	21.0	8	133.3	7.6	67	1116.7	63.8	105	1750.0
Layer 8	5	125.0	10.0	8	200.0	16.0	37	925.0	74.0	50	1205.0
Layer 9	3	150.0	18.8	2	100.0	12.5	10	500.0	62.5	16	800.0

Within the three Rock Sort Columns at Little Sotol, a total of 2.08 m^3 was excavated sampling 1715.3 kg of burned rock. The average density of burned rock to fine matrix of the midden is 824.7 kg/m^3. Based on topography of the midden and observed depth of the burned rock deposit, I estimate that the total volume of the burned rock midden deposit was approximately 120 m^3, and represents approximately 99,000 kg of burned rock. Of the sampled portions of the midden, the burned rock deposit consists of 35.5 percent (%) small rocks, 47.7 percent medium rocks, and 17.5 percent large rocks. The vast majority of burned rocks deposited at the Little Sotol site were reused and represent discard after repeated earth oven firing events.

Crucial to the research aim of documenting reuse of burned rocks within the burned rock midden, is the ultimate goal of estimating the number of earth oven firing events represented in by the accumulation of burned rocks. Based on experimental earth ovens and archaeological observations, researchers estimate that the mass of hot rocks required to sustain temperatures for baking lechuguilla and sotol in different ways. Dering (1999:665) estimates that 250 kg of hot rocks are required per each earth oven event resulting in 0.13 m^3 of burned rock discard. Based on recent experimental ovens performed by Texas State University students, I prefer a more conservative estimate of 100 kg of hot rocks per earth oven firing event.

For the purpose of this thesis, it is assumed that the large rocks are pristine and subjected to one earth oven firing event, medium rocks subjected to two or three firing events[18], and small rocks four firing events. If the estimated volume of burned rock is multiplied by the number of assumed earth oven firing events, the number of earth oven firing events can be extrapolated accounting for the mass and use-life of burned rocks. This method of extrapolating the number of earth oven events is, of course, a simplified means to quantify use events represented in the burned rock midden. The enumeration of earth oven firing events is best presented as equations, though the results should be thought of as an estimate rather than a precise measure. The number is not meant to be taken literally, but as a tool useful in characterizing the use and reuse of the earth oven facility. The equations used to calculate number of earth oven firing events are:

$$\text{Total kg of once hot rocks} = [(kg_{small} \times \%_{small})4] + [(kg_{medium} \times \%_{medium})2.5] + [(kg_{large} \times \%_{large})1]$$

$$\text{Number of firing events} = \frac{\text{Total kg of once hot rocks}}{100 \text{ kg}}$$

[18] Rock Sort Column data collected by ASWT at other sites, divides the medium size class into two (7.5-11 cm and 11-15 cm). For these sites, Black and Koenig (2014) assume that burned rocks in smaller medium size class where subjected to 3 earth oven firing events, while the large medium size class was assumed twice-fired. I use the value 2.5 in the attempt to produce comparable data.

If the burned rocks sampled in the Rock Sort Columns are representative of the midden as a whole, then the 99,000 kg accumulation of burned rock includes 35,145 kg (35.5 percent) small rocks, 46,530 kg (47.7 percent) medium burned rocks, and 17,325 kg (17.5 percent) large rocks. If multiplied by the number of assumed earth oven firing events, the total mass of once hot rocks used in earth ovens at the Little Sotol site is 274,230 kg. According to our estimates, this volume of once hot rocks resulted from 2,742 earth oven firing events. At first glance, nearly three thousand earth oven firing events at one location seems like a lot of debris resulting from a significant amount of food production. The radiocarbon ages attained from the Little Sotol site range from 6980 cal B.P. to 720 cal. B.P., a span of 6,260 years. All things being equal, this averages to less than one earth oven every two years.

According to the landuse intensification model advocated by Thoms (2009), the final intensification of earth oven technology occurred during the Late Archaic into the Late Prehistoric period around 2000 B.P. with a peak at 1500 B.P. Based on radiocarbon assays and diagnostic artifacts in relation to cultural stratigraphy, the upper 60 cm of the midden (or 43 m^3) is associated with the Late Archaic/Late Prehistoric component. The average density of burned rock to fine matrix (ashy sediment) in the Late Archaic component is 630.7 kg/m^3. Therefore, the total mass of burned rock associated with the Late Archaic is 27,133 kg.

Of the sampled portion of the Late Archaic/Late Prehistoric component, the burned rock deposit consisted of 51.3 percent small rocks, 42.2 percent medium rocks, and 6.6 percent large rocks. Because the burned rocks were observably smaller in the upper strata associated with Late Archaic/Late Prehistoric and originate from the same limestone sources (both upland and lowland), I can ascertain that rocks were reused more often and intensively. If the burned rocks sampled in the upper layers of the Rock Sort Columns are representative, then the component includes 13,919 kg small burned rocks, 11,450 kg medium rocks, and 1,791 kg large burned rocks. When multiplied by the number of earth oven firing events, the total mass of once hot rocks used in earth ovens during the Late Archaic/Late Prehistoric is 86,093 kg. According to my estimates, this volume of once hot rocks resulted from nearly 861 firing events.

The radiocarbon ages associated with the Late Archaic/Late Prehistoric component range from 930 cal. B.P. to 720 cal. B.P., a span of only 210 years. A total of 861 earth oven firing events over 210 years averages to four earth ovens every year during the last period use at the earth oven facility. This is a marked increase when compared to the average annual earth oven events represented in the burned rock midden as a whole (0.4/year). The higher ratio of small rocks in the upper component and more frequent earth oven events per year support the landuse intensification model and the escalation of earth oven technology during the Late Archaic and Late Prehistoric periods at the Little Sotol site.

Site Use over Time

The data collected from the Little Sotol site clearly indicate an increased reuse of burned rocks through time. I believe that reuse of burned rocks in earth ovens is directly related to landuse intensification and the increased use of hot rock cooking technology in the Lower Pecos from Early Archaic to the Late Prehistoric period. Limestone rocks are in abundant supply in the immediate vicinity of the site; therefore, the reuse hot rocks cannot be explained by resource scarcity. More frequent reuse of the earth oven facility would compel the recycling of hot rocks in recurring earth oven events and generate smaller sized burned rocks.

What appears to us as a jumble of burned rocks, artifacts, and ashy sediment, are the tangible remains of a significant cultural place of the past – an earth oven facility. As Binford (1981:197) puts it, “the greater the apparent disorganization, the more intense the use of the place in the past.” This was certainly evidenced at the Little Sotol site were the upper layers attributed to the Late Archaic/Late Prehistoric component were subjected to more frequent earth oven firing events, while the lower Early Archaic layers were relatively less mixed and witnessed few earth oven events.

As discussed in the introductory chapters, the Little Sotol site is one of many earth oven facilities on the surrounding landscape. I expect that similar sites would demonstrate a similar pattern of increased intensification of earth oven technology through time. The intensification of earth oven plant baking was most likely related to an increased need for reliable food production due to population packing throughout the region. As Thoms (2009:557) describes it, the “integration of cook-stone technology into land-use strategies affords an important means of utilizing a greater proportion of a given landscapes food-resource potential.” Little Sotol is, therefore, a fixed location on the landscape, an earth oven facility, where plant baking was intensified to produce more food as part of the carbohydrate revolution. A pattern observed in Dead Man’s Creek, the Lower Pecos Canyonlands, and throughout much of western North America.

8. SUMMARY AND SPECULATION

The preceding chapters describe the conceptual framework, methods, and results of the excavation of a long-term earth oven facility used for baking lechuguilla, sotol, and prickly pear. Due to the cyclical nature of earth oven construction and the accretional nature of burned rock midden formation, discrete cultural events are only observed through fortuitously preserved structural traces, specifically partially intact heating elements and remnants thereof within burned rock midden and cave contexts. Radiocarbon dates acquired from remnant earth oven features at the Little Sotol site range from 6980 to 720 cal. B.P. thus spanning almost 8,000 years. Burned rock quantification shows evidence of landuse intensification through the increasing reuse of heating element rocks through time at a fixed point on the landscape.

In general the methods of excavation were effective, especially in identifying and sampling heating elements. The successful interpretation of burned rock middens relies on the recovery of heating elements to evaluate depositional environment and integrity, and collect datable material, as well as identifiable plant materials. Seven heating elements were documented exhibiting a range of variation consistent with hunter-gatherer earth oven features (Black and Thoms 2014), and reflecting the passage of time and preservation bias. I do not assume that all heating elements within the main excavation block through the BRM were identified during fieldwork. At least one substantial heating element was unrecognized by a student excavator and removed prior to documentation. With no intention of discounting the wealth of data recovered from Little Sotol, gaps in data may have been avoided with more experienced crews. Even so, recognizing remnant earth oven features within the jumbled mass of fire-cracked rock debris making up a burned rock midden is a challenge.

The total excavated volume of the burned rock midden (10.7 m^3) is estimated to have contained more than 14,000 burned rocks, and collecting attributes of this many burned rocks is time prohibitive and likely to yield redundant data. A sample of 2,800 burned rock documented in three Rock Sort Columns is considered to adequate characterize the overall burned rock accumulation in terms of size and mass. The Rock Sort Columns at the Little Sotol site were positioned pragmatically and focused on the central area of the midden. Based on the Little Sotol experience, quantification data could be improved with more strategic placement of the sampling columns and excavation by natural layers. Given that the sole object was to quantify the burned rock, this could have been done more efficiently without collecting and screening the sediment through ½" screens. Nonetheless, the quantification of burned rocks through the excavation of Rock Sort Columns proved to be an effective and efficient way to gather critical data on burned rock middens, and a sufficient proxy to measure burned rock reuse. Combined with relatively extensive radiocarbon dating, these data provide compelling evidence of the intensification of earth oven technology through time at Little Sotol.

The excavation of Little Sotol did not escape oversights, mistakes, and errors in judgment. Perhaps the biggest challenge of the research was tying data together spatially. In retrospect, an excavation strategy of beginning with a narrow hand-excavated or mechanical trench bisecting the center of the midden would have more easily reveal the structure of the burned rock deposits and allowed more effective placement of excavation blocks and sampling columns. I suspect that the excavation of units by natural layer after defining stratigraphic layers in a trench profile would relieve some of the interpretive challenges experienced during the excavation of deep burned rock middens. In my opinion, the most effective excavation strategy to interpret long-term earth oven facilities should include hand-excavated units to explore signs of central features, and strategic sample of burned rocks in Rock Sort Columns, in addition to trench excavation.

Patterns in the cultural stratigraphy within the burned rock midden at the Little Sotol site were informed by the relative positions of temporally diagnostic artifacts and radiocarbon assays (Figure 37). Notably, the two lowest heating elements date to the end of the Early Archaic period and prior to the onset of the Altithermal drying event (ca. 6800 B.P.) (Bryant and Holloway 1985). The presence of Early Archaic heating elements may suggest that earth oven technology was not a response to drought-induced stress, though it will require the excavation and dating of more burned rock middens to depth to determine whether earth oven technology was well-established earlier than currently known by archaeologists.

Turpin (2004:272) suggested that the period between 3200 and 1300 B.P witnessed a decrease in earth oven plant baking due to a mesic interlude in the Lower Pecos. The hypothesis is that the expansion of the grasslands brought high-ranked resources (i.e., bison) to the region relieving the need for earth ovens and the processing of low-ranked resources like sotol and lechuguilla. Intriguingly, one radiocarbon assay from burned rock midden context (CS-32) dated to 1540 B.P., while another radiocarbon sample from a similar elevation (Bot 25) dated much earlier to 4190 B.P. The difference between dates could be indicative of a stratigraphic hiatus; however, two projectile points

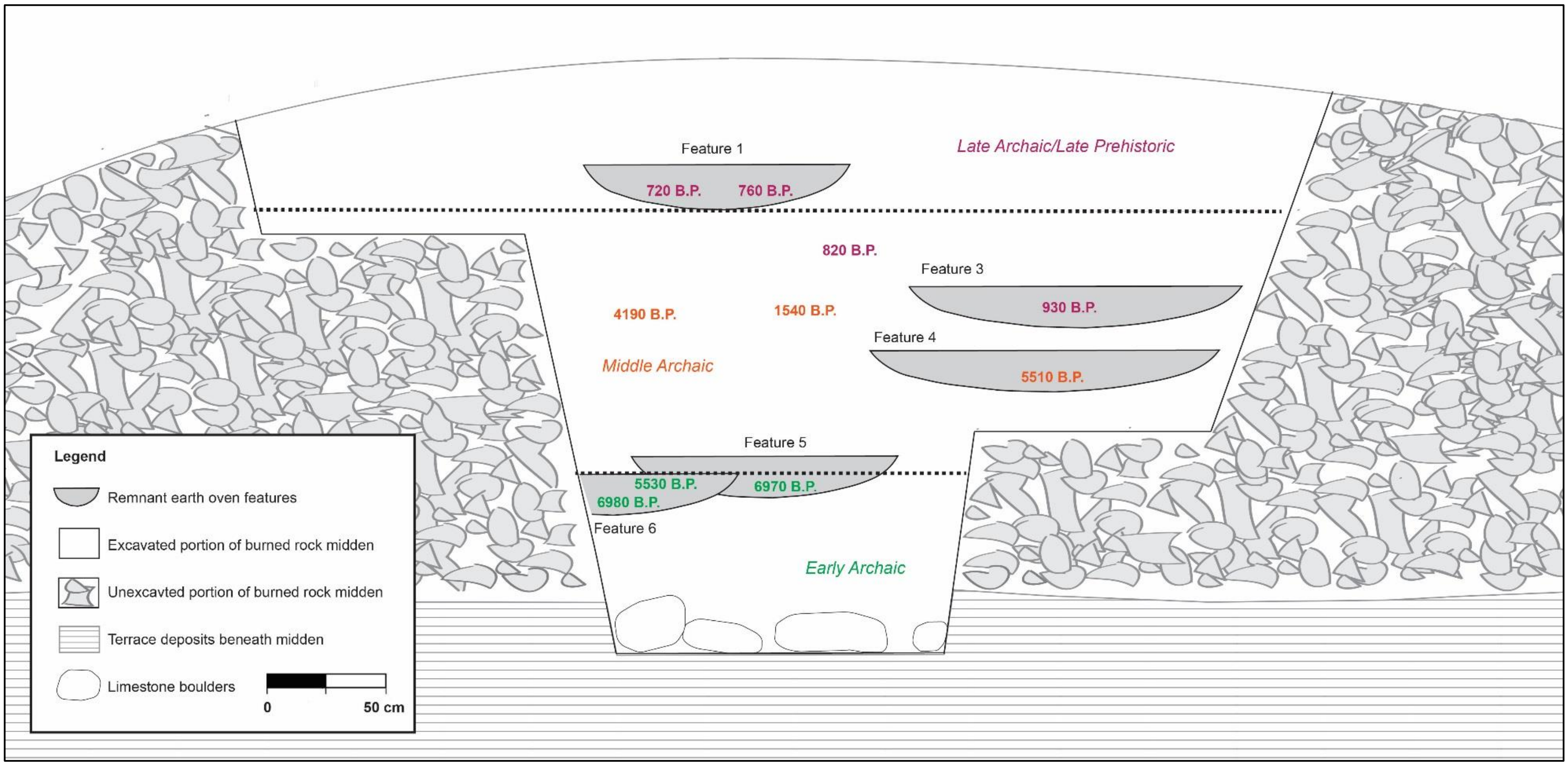

Figure 37. **Schematic of burned rock midden showing relative feature locations, hypothesized stratigraphy zones based on projectile points, and radiocarbon dates (median cal. B.P.).**

attributed to this time period were also recovered from the Late Archaic/Late Prehistoric component. I suspect that the date coinciding with the inferred mesic interlude was an effect of sampling and not an indication of a regional hiatus in earth oven construction, and that continued excavation of burned rock middens will identify heating elements dating to this period at nearby earth oven facilities.

The data from the Late Archaic/Late Prehistoric component at Little Sotol seems to fit the hypothesized intensification of earth oven use. Thoms (2009) proposed that there is a continent-wide peak in the use of earth ovens around 1500 B.P., while Brown (1991:87) proposed seasonal intensification of earth oven plant baking around 750 B.P. in the Lower Pecos. As discussed in Chapter 7, the quantification of burned rocks reflects greater reuse in the later component when compared to the earlier components. Based on the Rock Sort Column data, the number of earth oven firing events increased from an average of one per year in Early Archaic times to four per year into the Late Archaic and Late Prehistoric periods. The delineation of the Late Archaic/Late Prehistoric component was very conservative based on the positioning of radiocarbon dates and Late Archaic projectile points; therefore, the estimate of landuse intensification is also quite conservative.

Dering (1999:666) surmises that "the caloric contribution of earth-oven processing of sotol and lechuguilla to the Archaic period economy may have been overestimated because of the overwhelming archaeological visibility, especially in the dry rock shelters in which most of the plant material remains preserved." This is probably true in that the typical Archaic diet was likely much more varied than sometimes insinuated in earth oven research. That said, the massive archaeological signature of earth oven plant baking and the density of earth oven facilities across the landscape underscores considerable investment in terms of time and energy. The intensification of earth oven plant baking for caloric demands due to demographic pressure only partially satisfies the question – Why did such a costly technology endure (and intensify) through time?

Beyond Subsistence

As discussed in Chapter 7, the intensification of landuse and earth oven technology is thought to have occurred throughout much of western North America. A recent, well-documented study of numerous burned rock middens in the Sacramento Mountains (Miller et al. 2011)[19] provides many useful insights into the parallel patterns observed in the Lower Pecos Canyonlands and Little Sotol, specifically. As reasoned by Miller (2011c:359), "the causal factors leading to this pronounced increase in pit baking are probably as complex and multivariate as those involved in the adoption and spread of agriculture." Optimal foraging theory provides insights regarding the role of earth oven plant baking in terms of subsistence, but the focus on calories and nutritive yields only a dim understanding of the sociocultural particulars of earth oven construction and use. "Food preference patterns are clearly embedded within their social, economic, historical, and political contexts and are not simply a function of the biological character of these plants" (Minnis 2000:214). The following discussion presents some speculation and avenues of future research regarding the Little Sotol site, earth oven facilities, and role of earth oven technology beyond subsistence.

[19] The title of this chapter is borrowed from Miller (2011c).

Fiber

This thesis to has attempted demonstrate evidence of landuse intensification with the increased use of earth ovens to bake desert succulents for human consumption, but it is important to recognize that these plants were also used as a major fiber resource for indigenous populations (Miller 2011c:355). It is reasonable to speculate that the frequency and density of burned rock in the Lower Pecos Canyonlands is the result of landuse intensification to meet the increasing demands of both food and fiber for growing populations.

Prehistorically, lechuguilla fiber is the primary plant material for cordage used to make sandals, baskets, and mats in southwest Texas. Sotol leaves are also used as a major fiber source and used for woven mats in the Lower Pecos Canyonlands, and prickly pear pad containers are also identified in the region (Andrews and Adavasio 1980; McGregor 1991, 1992; Williams-Dean 1978:245). Historic tribes that used lechuguilla fiber include, Jumano, Coahuiltecan, Lipan Apache, among others. Lechuguilla is currently harvested for fiber or “ixtle” in north central Mexico for the durable, abrasive, and water absorbent qualities (Sheldon 1980:383). Combining the dietary and fiber needs of prehistoric inhabitants of the Lower Pecos, prickly pear, lechuguilla, and sotol contributed significantly to the prehistoric economy.

Through actualistic experimentation, Parsons and Parsons (1990:361) demonstrate that the extraction of fiber from maguey, a larger agave species, requires baking or decomposition to extract fiber from the rigid flesh of the leaves. Miller (2011c:355) makes a strong argument that the presence of charred leaves and plant processing tools, like anvils and scrapers, at earth oven facilities is indicative of fiber extraction in addition to plant baking for consumption.

To test the simple hypothesis that fiber is more easily extracted from baked lechuguilla leaves, the 2011 Texas State University field school students constructed an experimental earth oven and included cut lechuguilla leaves in the upper packing material. Field school students used materials gathered from the surrounding landscape to extract fiber from baked and unbaked lechuguilla leaves, and found that the fiber is much more easily extracted from baked leaves and yet remains very strong. This line of inquiry certainly warrants more focused attention. Detailed use-wear analysis of the plant processing tools recovered from Little Sotol and further actualistic replication are means to evaluate the use of earth ovens for purposes other than the production of food.

The view that earth oven facilities served multiple simultaneous functions opens avenues of research in a number of directions. Ethnographic evidence suggests the many uses of desert succulents - food, fiber, distilled alcohol, soap, medicine, etc. (Latorre and Latorre 1977:345, 347; Nobel 1994:34; Sheldon 1980:385). A more holistic view of earth oven facilities and the many purposes of plant processing in hunter-gatherer lifeways may provide insight in future research of the proliferation of earth oven technology in the Lower Pecos.

Gender

In general, gender roles are often overlooked in archaeological studies of landuse systems, but earth oven facilities provide a great opportunity to examine gender relations of indigenous populations. Ethnography indicates that women and children were responsible for earth oven cooking (Murdock 1967). Nobel (1994:30) reports that men and boys typically gather the agave bulbs ("cabezas"), while women and girls oversee the baking of agave in earth ovens. If gender roles consistent with historic observations apply, then women and children in particular were responsible for the accumulation of burned rock across the landscape that preserved in the archaeological record for thousands of years. I feel that researchers will be rewarded with more attention devoted to gender roles in the interpretation of earth oven facilities and comparative landscape studies.

Social Symbols

As discussed in Chapter 5, Feature 2 is an unusual arrangement of limestone slabs in concentric circles located at the month of the southernmost cave. These rocks were thoughtfully set in fine matrix and above large boulders to create a geometric shape reminiscent of the rosette of a sotol heart or agave bulb. It is not clear how Feature 2 is associated with earth oven plant baking, or what role it served at an earth oven facility. It is associated with the Late Prehistoric, and I speculate that there may be more of these kinds of features located at earth oven facilities.

I have yet to find reference to feature akin to Feature 2 in archaeological or ethnographic literature. The continued study of Feature 2 has compelled many suggestions of the intended function of Feature 2. It is possible that the feature is a type of cooking rock feature intended to prepare other kinds of foods, like steaming mussels or drying prickly pear pads; however, these activities probably require temperatures high enough to thermally modify the limestone rocks. Some of the Feature 2 rocks appear to be only minimally heated if at all. Replicative experiments of may help determine what kinds of cooking environments produce only faint evidence of heat modification.

I sense that Feature 2 has social and symbolic significance. The feature resembles the rosette of a sotol bulb or agave heart, which could serve as a social symbol for the earth oven baking of desert succulents. Further, the location of the feature at the mouth of a cave seems like an appropriate location of a symbolic portal. Many tribal groups have traditional belief systems with portals between worlds, while anthropomorphic transformation and travel between worlds are themes observed in Pecos River style rock art (Boyd 2003). Seeking the interpretations of tribal groups in and around Texas may help draw inferences regarding the social and symbolic meaning of Feature 2, and agave processing in general, as some Native American groups in the Southwest continue to practice agave rituals today holding lifeways of the past in cultural memory.

Ongoing and Future Research

Studies of earth oven technology and burned rock middens in the Lower Pecos are part of an exciting era of research with a strong baseline of understanding of earth oven construction and midden formation. Archaeologists are able to address a variety of specific research questions with advances in many kinds of technical analyses attune to detecting previously imperceptible archaeological information (Black and Thoms 2014). Residue and microfossil analyses of tools and burned rocks certainly provide valuable data for the interpretation of earth oven facilities. Furthermore, researchers are developing ways to make specialized kinds of analyses (e.g., radiocarbon dating of short-lived samples) more affordable and accessible. Samples and artifacts recovered from the Little Sotol site are curated for future study. Unrealized analytical potential of the Little Sotol collection includes microscopic use-wear studies, faunal analysis, synthesis of archaeobotanical remains, and sediment analysis.

Ongoing and future archaeological research in the region have the means to employ more analytical rigor and acquire robust, comparable datasets. Dering (2002) pointed out over a decade ago that there are glaring data gaps in the understanding of past lifeways in the Lower Pecos, and these can be alleviated with the adoption consistent recording methods and consensus in the terms we use to discuss archaeological sites, including burned rock middens. More recently, Black and Thoms (2014:205) noted that earth oven studies suffer from lack of "unifying nomenclature equivalent to lithic and ceramic technologies or soil formation processes."

Currently, research design and terminology used in burned rock midden research varies by researcher. Individual agencies (e.g., TPWD) and research programs (e.g., ASWT) have developed internal standards and strategies for investigating burned rock middens. Following the excavation at the Little Sotol site and witnessing the research potential at earth oven facilities, I am a strong advocate for establishing a burned rock midden and earth oven research protocol similar to statewide the lithic and ceramic protocols now required by Texas Department of Transportation (TxDOT).

Minimally, a burned rock midden and earth oven protocol should advocate for standards in burned rock quantification, flotation of matrix samples, analysis of archaeobotanical remains, radiocarbon dating, and excavation procedures including options for sampling remnant earth ovens. An excavation strategy focused on hand-trenching through the centers of burned rock middens may be more easily applied to various forms of middens as opposed to the large square unit excavated in the burned rock midden at the Little Sotol site. The application of regional (and ideally statewide) burned rock midden and earth oven research protocol would undoubtedly provide insights only attainable through comparative analyses.

The Little Sotol site is one earth oven facility of the landscape that contains evidence of landuse intensification. The excavation of other burned rock middens, large and small, in various settings is key to evaluate the landuse intensification hypothesis on a landscape scale. In 2012 three other sites in Dead Man's Creek were excavated by ASWT researchers using methods similar to, and based on, those used at Little Sotol. The comparison of the Rock Sort Column data will undoubtedly reveal patterns of landuse along Dead Man's Creek that may be applied to regional landuse models in the Lower Pecos Canyonlands.

APPENDIX SECTION

APPENDIX A: ARTIFACT INVENTORY

Appendix A presents a complete inventory of artifacts collected from the Little Sotol site (41VV2037). The artifacts are sorted first by lot and specimen number in ascending order, then by material class and type. Provenience information (i.e., excavation area, unit, and layer) are also provided. If applicable, the field number (FN) identifying the TDS data point, and information regarding the context (e.g., association with a feature) are also listed. The description includes some observations made during analysis. Mass (g) and count of artifacts are also included if documented.

Nine artifact were returned to the landowners, including eight dart point (Specimens 20.9, 20.10, 20.16, 58.1, 58.5, 58.6, 58.7, 58.9) and one mano (Specimen 20.34). All other artifacts will be curated at the Center for Archaeological Studies (CAS) at Texas State University, San Marcos.

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
1	1	1	1	1	1259		lithic	biface	tear-shaped, thin, complete	16.2	1
1		1	1	1			lithic	debitage			127
2	1	1	1	2			lithic	projectile point	dart point, base, AK-Arenosa, EP-Langtry/Arenosa/Val Verde, burned	3.7	1
2	2	1	1	2			lithic	biface	thin, complete	22.9	1
2	3	1	1	2			lithic	biface	possible drill *, thin, distal, burned	3.2	1
2	4	1	1	2	1345		lithic	biface	thin, distal	0.8	1
2	5	1	1	2	1525		lithic	flake tool	sotol knife? - bulb, dorsal scars, edge mod, polish	87.5	1
2	6	1	1	2	1692	matrix sample 2	lithic	biface	thin, distal	0.3	1
2	7	1	1	2			lithic	flake tool	unmarginal, complete, cortex, polish	42.1	1
2	8	1	1	2			lithic	flake tool	bimarginal, fragment, some cortex	26.5	1
2	9	1	1	2			lithic	biface	thin, medial, burned	2.0	1
2	10	1	1	2			lithic	biface	thin, fragment, burned	2.2	1
2	11	1	1	2			lithic	biface	thin, fragment, burned	3.6	1
2	12	1	1	2			lithic	core	multidirectional, cortex	291.4	1
2	13	1	1	2			lithic	flake tool	uniface, fragment, burned	4.9	1
2	14	1	1	2			lithic	biface	thin, medial, burned	8.4	1
2	15	1	1	2			lithic	flake tool	possible scraper, proximal, bimarginal	25.2	1
2	16	1	1	2			lithic	biface	thin, distal tip	1.0	1
2	17	1	1	2			lithic	biface	thin, basal, burned	5.3	1
2	18	1	1	2			lithic	biface	thin, nearly complete, burned	12.9	1
2	19	1	1	2			lithic	flake tool	unimarginal, proximal, some cortex, burned	33.4	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
2	20	1	1	2			lithic	projectile point	dart point, base, need to type	10.3	1
2	21	1	1	2			lithic	flake tool	unmarginal, fragment, some cortex, polish	11.5	1
2	22	1	1	2			lithic	flake tool	bimarginal, fragment	17.2	1
2	23	1	1	2			lithic	biface		10.1	1
2		1	1	2	1692		faunal	shell	mussel shell fragments	0.4	4
2		1	1	2	1666		faunal	shell	mussel shell fragments from matrix sample 1, two with hinges	0.3	5
2		1	1	2			faunal	shell	mussel shell fragment	0.6	3
2		1	1	2			lithic	debitage			350
2		1	1	2			lithic	debitage			62
2		1	1	2			lithic	debitage			296
2		1	1	2			lithic	debitage			17
2		1	1	2			lithic	debitage			401
2		1	1	2			lithic	debitage			49
2		1	1	2	1692		lithic	debitage	from M2 heavy fraction		165
2		1	1	2	166		lithic	debitage	from M1 heavy fraction		80
3	1	1	1	3	2444		lithic	biface	thick, complete	83.2	1
3	2	1	1	3			lithic	projectile point	dart point, base, AK-untyped, EP-untyped/Marcos	7.2	1
3	3	1	1	3	2056		lithic	projectile point	dart point, base, AK/EP-Pedernales	16.2	1
3	4	1	1	3		southwest corner	lithic	projectile point	dart point, complete, AK/EP-Val Verde	3.7	1
3	5	1	1	3			lithic	biface	thin, distal	1.7	1
3	6	1	1	3			lithic	biface	possible knife, thin, fragment, burned	7.5	1
3	7	1	1	3			lithic	biface	thin, medial, burned	11.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
3	8	1	1	3			lithic	biface	thin, distal, burned	0.9	1
3	9	1	1	3			lithic	biface	thin, fragment, burned	6.4	1
3	10	1	1	3			lithic	biface	thin, fragment	4.0	1
3	11	1	1	3			lithic	flake tool	unimarginal, complete	26.3	1
3	12	1	1	3			lithic	biface	thin, proximal?	11.8	1
3	13	1	1	3			lithic	flake tool	bimarginal, complete, some cortex, weathered?	27.0	1
3		1	1	3			faunal	shell	mussel shell, hinge portion, well preserved	10.8	1
3		1	1	3			faunal	shell	mussel shell fragments, one with hinge	0.8	2
3		1	1	3			lithic	debitage	37% burned	611	315
3		1	1	3			lithic	debitage	40% burned	48	43
3		1	1	3			lithic	debitage			4
3		1	1	3			lithic	debitage			2
3		1	1	3			lithic	debitage			43
3		1	1	3			lithic	debitage			10
3		1	1	3			lithic	debitage			54
3		1	1	3			lithic	debitage			34
3		1	1	3			lithic	debitage			
3		1	1	3			lithic	debitage			82
3		1	1	3			lithic	debitage			
3		1	1	3	2003	outside F1	lithic	debitage	from M3 heavy fraction		70
3		1	1	3			lithic	debitage		135	61
3		1	1	3			lithic	debitage		11	5
3		1	1	3			lithic	debitage		346	155
4	1	1	2	1			lithic	biface		4.6	1
4	2	1	2	1			lithic	flake tool	sotol knife? - bulb, dorsal scars, edge mod, polish	46.5	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
4	3	1	2	1			lithic	biface		18.7	1
4	4	1	2	1			lithic	flake tool	polished	57.9	1
4		1	2	1			lithic	debitage	38% burned	79	68
4		1	2	1			lithic	debitage	0% burned	48	1
4		1	2	1			lithic	debitage			4
4		1	2	1			lithic	debitage			
4		1	2	1			lithic	debitage			60
4		1	2	1			lithic	debitage			
4		1	2	1			lithic	debitage			12
5	1	2	1	1			lithic	core	multidirectional, cortex	148.5	1
5	2	2	1	1			lithic	flake tool	unimarginal, medial, burned	6.8	1
5	3	2	1	1			lithic	biface	thick, proximal	69.4	1
5	4	2	1	1			lithic	biface		18.6	1
5		2	1	1			faunal	bone	tooth	0.4	1
5		2	1	1			lithic	debitage			78
5		2	1	1			lithic	debitage			31
5		2	1	1			lithic	debitage			407
6	1	2	1	2			lithic	biface	possible perforator, thick, complete, some cortex, burned	24.7	1
6	2	2	1	2			lithic	biface	thin, fragment, burned	11.9	1
6	3	2	1	2			other	hematite		6.8	1
6		2	1	2			faunal	bone	fragment, well preserved	0.3	1
6		2	1	2			faunal	shell	mussel shell fragment	1.9	1
6		2	1	2			lithic	debitage			184
7	1	2	1	3			lithic	flake tool	scraper	28.6	1
7		2	1	3			faunal	bone	well preserved	18.8	1
7		2	1	3			faunal	bone	well preserved	15.4	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
7		2	1	3			faunal	shell	mussel shell fragment with hinge	0.2	1
7		2	1	3			lithic	debitage			3
7		2	1	3			lithic	debitage			
7		2	1	3			lithic	debitage			
8	1	2	1	4			lithic	projectile point	dart point, complete, AK/EP-untyped	6.6	1
8	2	2	1	4			lithic	biface	thin, fragment, heavily patinated	20.7	1
8	3	2	1	4			lithic	flake tool	unimarginal, complete, cortex	60.4	1
8	4	2	1	4			lithic	flake tool	bimarginal, complete, cortex, polish	37.9	1
8	5	2	1	4			lithic	flake tool	scraper	18.3	1
8	6	2	1	4	2115		other	pebble	potentially polished	68.4	1
8		2	1	4			lithic	debitage			61
8		2	1	4			lithic	debitage			
9	1	2	1	5			lithic	biface	thin, distal	9.0	1
9	2	2	1	5		elev. 95.85	lithic	flake tool	sotol knife, unimarginal, complete, some cortex	24.3	1
9		2	1	5			lithic	debitage			262
10	1	2	2	1	2420		lithic	biface	possible preform, thin, complete, burned	7.5	1
10	2	2	2	1			lithic	projectile point	dart point, base, AK-Arenosa, EP-Langtry	7.5	1
10	3	2	2	1			lithic	biface	thin, distal, burned	6.2	1
10	4	2	2	1			lithic	biface	thick, fragment, cortex *	46.5	1
10	5	2	2	1			lithic	biface	thin, distal	3.0	1
10	6	2	2	1			lithic	biface	thin, fragment, burned	39.1	1
10	7	2	2	1			lithic	biface	thin, distal, burned	1.6	1
10	8	2	2	1			lithic	biface	thin, fragment, burned	12.8	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
10	9	2	2	1			lithic	biface	thin, fragment	0.9	1
10	10	2	2	1			lithic	flake tool	unimarginal, proximal, some cortex	17.4	1
10	11	2	2	1			groundstone	handstone		26	1
10		2	2	1			lithic	debitage		115	19
10		2	2	1			lithic	debitage	37% burned	493	440
11	1	2	2	2	2478		lithic	projectile point	dart point, base, EP-Ensor/Figuroa, AK-Palmillas	5.8	1
11	2	2	2	2	2479		lithic	projectile point	dart point, medial, AK-Frio, EP-untyped, burned	3.0	1
11	3	2	2	2	2477		lithic	biface	thin, distal	11.7	1
11	4	2	2	2	2481		lithic	biface	thick, complete, burned	118.0	1
11	5	2	2	2			lithic	flake tool	uniface, unimarginal, distal, some cortex, burned	7.3	1
11	6	2	2	2			lithic	biface	thin, distal	1.2	1
11	7	2	2	2			lithic	flake tool	sequent flake, unimarginal, proximal, some cortex	39.8	1
11	8	2	2	2			lithic	biface		0.5	1
11		2	2	2			faunal	bone	fragment, encrusted with CaCO3	1.6	1
11		2	2	2			lithic	debitage	29% burned	333	240
11		2	2	2			lithic	debitage		87	67
11		2	2	2			lithic	debitage		178	14
12	1	2	2	3			lithic	biface	thin, distal	1.5	1
12	2	2	2	3			lithic	flake tool	unimarginal, nearly complete, cortex	171.7	1
13	1	1	1	4			lithic	biface	thin, distal	2.4	1
13	2	1	1	4			lithic	biface	thin, fragment, burned	6.9	1
13	3	1	1	4			lithic	projectile point	dart point, base, AK/EP-Arenosa	4.5	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
13	4	1	1	4			lithic	projectile point	dart point, base, AK/EP-Pandale	5.7	1
13	5	1	1	4			lithic	projectile point	dart point, base, AK-Palmillas, EP-Pandale	8.5	1
13	6	1	1	4			lithic	projectile point	dart point, base, AK/EP-Pedernales	5.8	1
13	7	1	1	4			lithic	projectile point	dart point, complete, AK-Nolan, EP-Pandale	9.3	1
13	8	1	1	4			lithic	projectile point	dart point, base, AK-Pedernales, EP-La Broad/Castroville, burned	15.3	1
13	9	1	1	4			lithic	biface	thin, medial	6.5	1
13	10	1	1	4		F1 pedestal	lithic	biface	thin, fragment, burned	13.6	1
13	11	1	1	4			lithic	biface	thin, distal	3.4	1
13	12	1	1	4			lithic	biface	thin, medial, burned	14.9	1
13	13	1	1	4			lithic	biface	thin, fragment, burned	7.8	1
13	14	1	1	4			lithic	core	bifacial core, nearly complete, perhaps a chopper	154.5	1
13	15	1	1	4	2717		lithic	projectile point	dart point, base, AK-Nolan, EP-Pandale preform, burned	18.2	1
13	16	1	1	4			lithic	projectile point	dart point, base, AK/EP-Arenosa	4.1	1
13	17	1	1	4			lithic	projectile point	dart point, base, AK-Travis, EP-Val Verde	7.5	1
13	18	1	1	4			lithic	projectile point	dart point, base, AK/EP-Kinney, burned	9.6	1
13	19	1	1	4			lithic	biface	possible knife, thin, fragment	9.3	1
13	20	1	1	4			lithic	biface	thin, distal	10.2	1
13	21	1	1	4			lithic	biface	thin, medial	2.3	1
13	22	1	1	4			lithic	biface	thin, distal	7.4	1
13	23	1	1	4			lithic	flake tool		68.8	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
13	24	1	1	4			lithic	biface		54.5	1
13	25	1	1	4		F1 pedestal	lithic	biface	thin, fragment, burned	5.2	1
13	26	1	1	4			lithic	flake tool	unimarginal, nearly complete, cortex	51	1
13	27	1	1	4			other	pebble		104.9	1
13	28	1	1	4			other	pebble	potentially painted?	47.5	1
13	29	1	1	4		south corner	other	hammerstone		765	1
13	30	1	1	4			other	hematite		17.4	1
13	31	1	1	4			lithic	biface		33.0	1
13	32	1	1	4			lithic	flake tool		16.3	1
13	33	1	1	4			lithic	flake tool		33.5	1
13	34	1	1	4			lithic	flake tool		59.0	1
13	35	1	1	4			lithic	core		155.0	1
13	36	1	1	4			lithic	biface		50.0	1
13		1	1	4			faunal	bone	fragment, encrusted with CaCO3, burned perhaps	11.3	1
13		1	1	4			faunal	bone	fragment	0.9	1
13		1	1	4			faunal	bone	fragments	0.5	3
13		1	1	4			faunal	shell	mussel shell fragments	0.6	4
13		1	1	4			faunal	shell	mussel shell fragments	2.4	6
13		1	1	4			lithic	debitage			
13		1	1	4			lithic	debitage			
13		1	1	4			lithic	debitage			1
13		1	1	4			lithic	debitage			33
13		1	1	4			lithic	debitage			
13		1	1	4			lithic	debitage			
13		1	1	4			lithic	debitage		262	68
13		1	1	4			lithic	debitage			

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
13		1	1	4			lithic	debitage		681	252
13		1	1	4			lithic	debitage		761	130
13		1	1	4			lithic	debitage		49	19
14	1	2	3	1			lithic	projectile point	dart point, base, burned, AK-Shumla, EP-reworked Castroville, burned	5.7	1
14		2	3	1			faunal	bone	tooth and bone fragment	2.6	2
15	1	2	3	2		elev. 97.02	lithic	flake tool	possible sotol knife, unimarginal, distal	33.6	1
15	2	2	3	2			lithic	biface	thin, complete	32.2	1
15	3	2	3	2			lithic	biface	thin, fragment, burned	7.3	1
15	4	2	3	2			lithic	biface	thin, fragment	19.9	1
15	5	2	3	2			lithic	biface	thin, fragment, burned	1.4	1
15	6	2	3	2			lithic	biface	thin, fragment	5.8	1
15	7	2	3	2			lithic	flake tool		2.2	1
15	8	2	3	2			lithic	biface		13.3	1
15		2	3	2			faunal	bone	fragments, well preserved	1.2	2
15		2	3	2			lithic	debitage	34% burned	446	367
15		2	3	2			lithic	debitage		261	105
16	1	2	3	3			lithic	biface	thin, fragment	10.1	1
16	2	2	3	3			lithic	biface	thick, nearly complete, burned, cortex	64.8	1
16	3	2	3	3			lithic	biface	thin, fragment, burned	8.2	1
16	4	2	3	3			lithic	biface	possible dart base, thin, fragment	0.9	1
16	5	2	3	3			lithic	biface	possible dart base, thin, fragment	1.0	1
16	6	2	3	3	2-3-3.1		other	pebble		59.4	1
16		2	3	3			faunal	bone	various fragments, including possible cranial fragment	7.3	4

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
16		2	3	3			faunal	shell	mussel shell fragments	2.4	13
16		2	3	3			lithic	debitage	38% burned	526	416
16		2	3	3			lithic	debitage		174	162
17	1	2	3	4			lithic	core	bifacial core	59.2	1
17	2	2	3	4			lithic	projectile point	dart point, base, AK-untyped, EP-untyped/Early Side Notch *	17.0	1
17	3	2	3	4			lithic	flake tool	scraper, unimarginal, distal	29.1	1
17		2	3	4			faunal	shell	mussel shell fragments	0.5	2
17		2	3	4			lithic	debitage	0% burned		1
17		2	4	3			lithic	debitage			
17		2	3	4			lithic	debitage		425	406
18	1	2	4	1			lithic	biface	thin, distal	2.2	1
18	2	2	4	1			lithic	projectile point	dart point, base, AK/EP-Langtry	1.9	1
18	3	2	4	1			lithic	biface	thin, medial, burned	26.7	1
18	4	2	4	1			lithic	flake tool	complete, bimarginal	9.7	1
18	5	2	4	1			lithic	biface	thin, fragment, burned	1.9	1
18	6	2	4	1			lithic	biface	possible drill, thin, distal	0.5	1
18	7	2	4	1			lithic	biface	thin, fragment	3.5	1
18	8	2	4	1			lithic	biface	thin, fragment	6.4	1
18	9	2	4	1			other	red ocher		28.7	1
18		2	4	1			faunal	shell	mussel shell fragment	0.1	1
18		2	4	1			lithic	debitage	39% burned	149	133
18		2	4	1			lithic	debitage			
19	1	1	1		2381	Feature 1	groundstone	handstone		374	1
19		1	1			Feature 1 east	faunal	shell	mussel shell fragment	0.3	1
19		1	1		2004	Feature 1	faunal	shell	mussel shell fragment from matrix sample 4	0.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
19		1	1			Feature 1	faunal	shell	mussel shell fragments	0.5	2
19		1	1			Feature 1	faunal	shell	mussel shell from matrix sample 11	1.4	2
19		1	1			Feature 1	lithic	debitage	0% burned	82	2
19		1	1			Feature 1	lithic	debitage	55% burned	88	51
19		1	1			Feature 1	lithic	debitage			1
19		1	1		2004	Feature 1	lithic	debitage	from M4 heavy fraction		
19		1	1			Feature 1	lithic	debitage			
19		1	1			Feature 1 east	lithic	debitage			
19		1	1			Feature 1	lithic	debitage			
20	1			surface		Area 2*	lithic	biface	thin, medial, burned	1.7	1
20	2			surface	1065		lithic	projectile point	dart point, base, AK/EP-Frio	5.0	1
20	3			surface	1079		lithic	projectile point	dart point, base, AK-Shumla, EP-Comstock	5.3	1
20	4			surface	1839		lithic	biface	thin, medial	6.6	1
20	5			surface		near mouth of cave	lithic	flake tool	sotol knife? - bulb, dorsal scars, edge mod	60.8	1
20	6			surface	2498		lithic	flake tool	uniface, distal, burned	11.5	1
20	7			surface	2199		lithic	biface	thick, fragment, burned	65.1	1
20	8			surface	1256		lithic	core	multidirectional, cortex, burned	273.9	1
20	9			surface	3379		lithic	projectile point	dart point, complete, AK/EP-Pedernales	9.3	1
20	10			surface	2766		lithic	projectile point	dart point, base, AK-Castroville, EP-Lange	10.9	1
20	11			surface	3588		lithic	flake tool	sotol knife? - bulb, dorsal scars, edge mod	131.4	1
20	12			surface	3597		lithic	core	multidirectional, cortex	232.4	1
20	13			surface	3569		lithic	flake tool	sotol knife, unimarginal, complete, cortex	112.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
20	14			surface	3600		lithic	flake tool	unimarginal, complete	26.1	1
20	15			surface	3573		lithic	biface	thin, medial portion	4.1	1
20	16			surface	3598		lithic	projectile point	dart point, base, AK-Ensor, EP-Marcos	15.3	1
20	17			surface	3595		lithic	biface	thick, lateral, burned, some cortex	56.8	1
20	18			surface	3594		lithic	flake tool	unimarginal, fragment, some cortex, patina	66.6	1
20	19			surface	3599		lithic	biface	possible chopper, thick, complete, cortex	146.5	1
20	20			surface			lithic	flake tool	scraper, unimarginal, complete, cortex	24.4	1
20	21			surface	1343		lithic	flake tool	unimarginal, distal	6.2	1
20	22			surface	1074		lithic	flake tool	unimarginal, medial	16.1	1
20	23			surface	1252		lithic	flake tool	unmarginal, fragment	18.6	1
20	24			surface			lithic	flake tool	possible sotol knife, unimarginal, complete, some cortex	113.0	1
20	25			surface	1278		lithic	core	multidirectional, cortex	402.6	1
20	26			surface			lithic	core	bifacial core/chopper, some cortex	193.8	1
20	27			surface		mouth of cave	lithic	core		189.9	1
20	28			surface		mouth of cave	lithic	flake tool		4.1	1
20	29			surface	1266		groundstone	netherstone		255	1
20	30			surface	1063		groundstone	other	possible abrader	267	1
20	31			surface		south of Area 3	groundstone	handstone	basalt	69	1
20	32			surface	1059		groundstone	handstone		487	1
20	33			surface	1072		groundstone	netherstone		317	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
20	34			surface	1265		groundstone	handstone		296	1
20	35			surface	1276		other	pebble		73.1	1
20	36			surface	1073		other	pebble	ground	57.4	1
20				surface	1260		faunal	shell	mussel shell fragment with possible hinge, well preserved	1.6	1
20				surface			lithic	debitage	0% burned	3	1
20				surface	1258		lithic	debitage	0% burned	6	1
20				surface	1262		lithic	debitage	50% burned	7	2
20				surface	1253		lithic	debitage	100% burned	7	1
20				surface	1255		lithic	debitage	100% burned	12	1
20				surface	1346		lithic	debitage	100% burned	14	1
20				surface	1257		lithic	debitage	0% burned	46	1
20				surface	1250		lithic	debitage	0% burned	66	1
20				surface	1261		lithic	debitage	100% burned	5	1
20				surface	1268		lithic	debitage	100% burned	10	1
20				surface	1069		lithic	debitage	0% burned	120	1
20				surface	1264		lithic	debitage	100% burned	36	1
20				surface	1344		lithic	debitage	100% burned	12	1
20				surface	1251		lithic	debitage	0% burned	54	1
20				surface	1254		lithic	debitage	50% burned	10	2
20				surface	1267		lithic	debitage	0% burned	35	1
20				surface	1062		lithic	debitage	100% burned	6	1
20				surface	1068		lithic	debitage	100% burned	2	1
20				surface	1064		lithic	debitage	100% burned	37	1
20				surface	1071		lithic	debitage	100% burned	25	1
20				surface	1060		lithic	debitage	100% burned	15	1
20				surface	1075		lithic	debitage	0% burned	7	2

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
20				surface	1342		lithic	debitage	100% burned	36	1
20				surface	1061		lithic	debitage	100% burned	53	1
20				surface	1080		lithic	debitage	0% burned		1
20				surface	1077		lithic	debitage	0% burned		1
20				surface	1081		lithic	debitage	0% burned		1
20				surface	1083		lithic	debitage	100% burned		1
20				surface	1082		lithic	debitage	100% burned		1
20				surface	1084		lithic	debitage	100% burned		1
20				surface		mouth of cave	lithic	debitage			13
20				surface			lithic	debitage			1
20				surface			lithic	debitage	100% burned		1
20				surface	1272		lithic	debitage	100% burned		1
20				surface	1078		lithic	debitage	0% burned		1
20				surface	1275		lithic	debitage	0% burned		1
20				surface	1273		lithic	debitage	100% burned		1
20				surface	1274		lithic	debitage	100% burned		1
20				surface		mouth of cave	lithic	debitage			4
21	1	2	4	2			lithic	projectile point	dart point, base, AK-Ensor, EP-wide base Ensor, burned	7.5	1
21	2	2	4	2			lithic	biface	tear-shaped, thin, complete, burned	9.8	1
21	3	2	4	2			lithic	biface	thin, distal	3.2	1
21	4	2	4	2			lithic	biface	thin, fragment	15.1	1
21	5	2	4	2			lithic	flake tool	unimarginal, nearly complete, cortex	60.4	1
21	6	2	4	2			lithic	biface	possible chopper or cutting tool *, complete, thin	229.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
21	7	2	4	2			groundstone	handstone		255	1
21		2	4	2			lithic	debitage			111
21		2	4	2			lithic	debitage			59
21		2	4	2			lithic	debitage			
22	1	1	2	3	2184		groundstone	handstone		593	1
22		1	2	3			lithic	debitage			37
23	1	2	3	5			lithic	biface	possible knife, thin, fragment, burned	4.4	1
23	2	2	3	5			lithic	flake tool	bimarginal, fragment, burned	4.6	1
23	3	2	3	5			lithic	biface	thin, fragment, burned	11.5	1
23	4	2	3	5			lithic	flake tool	scraper, uniface, fragment	20.5	1
23	5	2	3	5			lithic	flake tool	unimarginal, medial	8.2	1
23	6	2	3	5			lithic	biface	thin, fragment	9.3	1
23	7	2	3	5			other	pebble		96.1	1
23	8	2	3	5			other	pebble		36.0	1
23		2	3	5			faunal	shell	mussel shell fragments	0.9	10
23		2	3	5			faunal	shell	mussel shell fragment	0.2	1
23		2	3	7			faunal	shell	mussel shell fragments	0.5	3
23		2	4	4			faunal	shell	mussel shell fragment	0.9	1
23		2	3	5			lithic	debitage	100% burned	25	1
23		2	3	5			lithic	debitage			
23		2	3	5			lithic	debitage			
24	1	3	1			limestone bench	lithic	biface	possible drill *, thin, nearly complete	4.4	1
24	2	3	1			limestone bench	lithic	biface	distal tip	4.7	1
24	3	3	1			limestone bench	lithic	core		261.0	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
24	4	3	1			limestone bench	lithic	core	bifacial core	108.6	1
24	5	3	1			limestone bench	groundstone	netherstone		348	1
24	6	3	1			limestone bench	groundstone	handstone		412	1
24	7	3	1			limestone bench	groundstone	netherstone		736	1
24		3	1			limestone bench	lithic	debitage			25
25	1	1	1	5			lithic	projectile point	dart point, complete, AK/EP-Bandy	3.6	1
25	2	1	1	5			lithic	projectile point	dart point, nearly complete, burned, AK/EP-Bandy, burned	3.5	1
25	3	1	1	5			lithic	projectile point	dart point, base, AK/EP-Kinney, SLB-Early Triangular	5.8	1
25	4	1	1	5			lithic	biface	thin, fragment	5.1	1
25	5	1	1	5			lithic	biface	thin, distal	1.6	1
25	6	1	1	5			lithic	biface	thick, complete	47.0	1
25	7	1	1	5			lithic	biface	thin, distal	1.4	1
25	8	1	1	5			lithic	projectile point	dart point, complete, AK-Bandy, EP-untyped	6.9	1
25	9	1	1	5			lithic	biface	thin, fragment, burned	5.5	1
25	10	1	1	5			lithic	biface	thin, medial	14.2	1
25	11	1	1	5			lithic	biface	thin, fragment, burned	3.2	1
25	12	1	1	5			lithic	biface	thin, medial	3.3	1
25	13	1	1	5			lithic	flake tool	unimarginal, complete, cortex	80.0	1
25	14	1	1	5			lithic	biface	thin, fragment	4.7	1
25	15	1	1	5			lithic	biface	possible perforator, thin, complete	9.0	1
25	16	1	1	5			other	pebble		81.4	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
25	17	1	1	5			other	pebble	not complete	27.6	1
25	18	1	1	5			other	pebble		32.6	1
25		1	1	5			faunal	bone	fragments, encrusted with CaCO3	6.3	2
25		1	1	5			faunal	bone	fragments, burned and encrusted with CaCO3	5.7	7
25		1	1	5			faunal	shell	mussel shell fragment	1.7	1
25		1	1	5			faunal	shell	mussel shell fragment	5.1	1
25		1	1	5			lithic	debitage			1
25		1	1	5			lithic	debitage			
25		1	1	5			lithic	debitage			
25		1	1			Feature 5	lithic	debitage			
25		1	1	5			lithic	debitage			
25		1	1	5			lithic	debitage			
25		1	1	5			lithic	debitage			
25		1	1	5			lithic	debitage			
26	1	2	3	6			lithic	flake tool	end scarper, bimarginal, complete	40.9	1
26	2	2	3	6			lithic	biface	possible perforator, thick, base	38.9	1
26	3	2	3	6			lithic	flake tool	unimarginal, fragment, burned	4.2	1
26	4	2	3	6			groundstone	handstone		675	1
26		2	3	6			faunal	shell	mussel shell fragments, one with hinge	0.6	4
26		2	3	6			lithic	debitage			
26		2	3	2			lithic	debitage			
26		2	3	6			other	cobbles	chert, fractured during excavation	870	2
27	1	2	4	3			lithic	projectile point	dart point, base, AK/EP-Langtry, burned	6.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
27	2	2	4	3			lithic	projectile point	dart point, base, AK-Langtry, EP-Val Verde	4.9	1
27	3	2	4	3			lithic	projectile point	dart point, base, AK-Travis, EP-Val Verde	11.6	1
27	4	2	4	3			lithic	biface	thin, fragment	38.3	1
27	5	2	4	3			lithic	flake tool	bimarginal, proximal	13.0	1
27	6	2	4	3			lithic	flake tool	unimarginal, complete	10.9	1
27	7	2	4	3			lithic	flake tool	bimarginal, nearly complete, burned, some cortex *	64.6	1
27		2	4	3			faunal	shell	mussel shell fragments, one relatively complete with hinge	11.1	9
27		2	4	3			lithic	debitage	25% burned	154	53
27		2	4	3			lithic	debitage	100% burned	169	1
27		2	4	3			lithic	debitage			
27		2	4	3			lithic	debitage			
27		2	4	3			lithic	debitage			
28	1	2	3	7			lithic	biface	thin, medial	5.7	1
28	2	2	3	7			lithic	biface	thin, distal	0.4	1
28		2	3	7			faunal	bone	fragments	2.2	3
28		2	7	3			lithic	debitage	100% burned	15	1
28		2	3	7			lithic	debitage		231	249
29	1	2				F2 south pedestal	lithic	biface	thin, fragment, burned	17.8	1
29	2	2				Feature 2	lithic	flake tool	nearly complete, burned	27.3	1
29	3	2				F2 south pedestal	lithic	biface	thin, fragment	41.6	1
29	4	2				F2 south pedestal	lithic	biface	thin, medial portion, burned	2.2	1
29	5	2				F2 south pedestal	lithic	biface	thin, complete	21.2	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
29	6	2				Feature 2	lithic	biface	thin, complete, burned	12.6	1
29	7	2				F2 south pedestal	groundstone	pestle		504	1
29		2				F2 course 3	faunal	bone	many fragments from matrix sample 29	0.9	48
29		2				F1 course 1	faunal	bone	many fragments from matrix sample 27	0.5	6
29		2				F2 south pedestal	faunal	bone	fragment	0.2	1
29		2				F2 south pedestal	faunal	bone	fragments, encrusted with CaCO3	2.7	2
29		2				F2 course 4	faunal	bone	many fragments from matrix sample 30	0.1	9
29		2				F2 course 3	faunal	shell	mussel shell fragments from matrix sample 29	0.1	7
29		2				F2 south pedestal	faunal	shell	mussel shell fragments	0.3	2
29		2				F2 within feat rocks	lithic	debitage	40% burned	28	5
29		2				F2 south pedestal	lithic	debitage			
29		2				Feature 2	lithic	debitage			1
29		2				F2 course 4	lithic	debitage	from M30 heavy fraction		
29		2				F2 course 2	lithic	debitage	from M28 heavy fraction		
29		2				F2 course 3	lithic	debitage	from M29 heavy fraction		
29		2				F2 course 2	lithic	debitage	from M27 heavy fraction		
29		2				Feature 2	lithic	debitage			
29		2				Feature 2	lithic	debitage		116	42
29		2				F2 south pedestal	lithic	debitage		207	157
30	1	1	1			Feature 4	other	pebble		38.3	1
30		1	1			Feature 4	faunal	bone	fragments	15.5	5

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
30		1	1	5			faunal	bone	fragment	0.3	1
30		1	1			Feature 4	lithic	debitage		56	74
30		1	1			Feature 4	lithic	debitage		138	156
31		1	ST6	3			lithic	debitage			
32		1	ST1				lithic	debitage		16	3
34		1	ST3				lithic	debitage		69	3
35		1	ST4				lithic	debitage	40% burned	98	10
35		1	ST4				lithic	debitage		58	15
37	1		ST6			23 cm bs	lithic	biface	thin, medial portion *	8.2	1
37	2		ST6				lithic	biface	thin, lateral	9.4	1
37	3	1	ST6				lithic	biface	thick, complete	58.7	1
37	4	1	ST6				lithic	biface	thick, complete, cortex	45.0	1
37	5	1	ST6				lithic	biface	thin, fragment, burned	3.2	1
37	6	1	ST6	3			lithic	biface	thin, fragment, burned	3.8	1
37		1	ST6	1			faunal	shell	mussel shell fragment with hinge, well preserved	4.6	1
37		1	ST6				lithic	debitage	70% burned	27	10
37		1	ST6	2			lithic	debitage			
37		1	ST6				lithic	debitage			
37		1	ST6	3			lithic	debitage		29	17
38	1	2	4	4			lithic	biface	thin, fragment, burned	39.1	1
38	2	2	4	4			lithic	biface	thin, fragment	18.5	1
38	3	2	4	4			lithic	biface	thin, fragment	4.6	1
38	4	2	4	4			lithic	flake tool		89.1	1
38		2	4	4			faunal	shell	mussel shell fragments	0.2	6
38		2	4	4			faunal	shell	mussel shell fragments, many well preserved, one with possible hinge	71.0	97

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
38		2	4	4			faunal	shell	mussel shell fragments	1.8	14
38		2	4	4			lithic	debitage	0% burned	81	1
38		2	4	4			lithic	debitage			
38		2	4	4			lithic	debitage		107	76
38		2	4	4			lithic	debitage		79	1
40	1	1	FCR1	4			lithic	projectile point	dart point, base, burned, AK/EP-Alamagre, burned	11.3	1
40	2	1	FCR1	2			lithic	biface	thin, distal	8.0	1
40	3	1	FCR1	2		~60 cm bs	lithic	projectile point	dart point, base, AK/EP-Langtry	2.1	1
40		1	FCR1	4			lithic	debitage		200	61
40		1	FCR1	3			lithic	debitage			
40		1	FCR1	1			lithic	debitage		254	29
40		1	FCR1	2			lithic	debitage		33	4
40		2	5	2	3410		other	burned earth	possibly oxidized sediment?		
41	1	1	FCR2	2			lithic	projectile point	dart point, complete, AK-untyped, SLB-Early Triangular, EP-Baird	6.5	1
41	2	1	FCR2	2			lithic	biface	possible perforator, thick, fragment, burned	27.4	1
41	3	1	FCR2	2			lithic	biface	possible drill, thin, distal, burned	1.0	1
41	4	1	FCR2	3			lithic	biface	thin, fragment	11.9	1
41	5	1	FCR2	3			lithic	biface	thin, fragment, burned	0.5	1
41	6	1	FCR2	2			lithic	core	bifacial core, cortex, complete	145.4	1
41	7	1	FCR2	3			lithic	flake tool	side scraper, unimarginal, proximal, cortex	36.0	1
41	8	1	FCR2	2			lithic	core	multidirectional, cortex	45.1	1
41	9	1	FCR2	3			lithic	flake tool	possible sotol knife, unimarginal, complete, cortex	93.8	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
41	10	1	FCR2	1			lithic	flake tool	unimarginal, nearly complete, cortex	66.7	1
41	11	1	FCR2	2			lithic	biface	thin, fragment, burned	2.5	1
41	12	1	FCR2	2			groundstone	netherstone		143	1
41	13	1	FCR2	4			other	pebble		7.9	1
41		1	FCR2	4			faunal	bone	fragment	0.1	1
41		1	FCR2	5			faunal	bone	fragments, poorly preserved	0.3	7
41		1	FCR2	4			faunal	bone	fragments, some burned, variation in preservation	1.1	7
41		1	FCR2	4			faunal	bone	fragments, variation in preservation	1.0	2
41		1	FCR2	2			faunal	shell	mussel shell fragment	0.1	1
41		1	FCR2	1			lithic	debitage	20% burned	63	10
41		1	FCR2	2			lithic	debitage	41% burned	195	59
41		1	FCR2	1			lithic	debitage	67% burned	70	15
41		1	FCR2	3			lithic	debitage	42% burned	187	31
41		1	FCR2	4			lithic	debitage	33% burned	73	142
41		1	FCR2	4			lithic	debitage	39% burned	32	49
41		1	FCR2	5			lithic	debitage			
41		1	FCR2	3			lithic	debitage		170	172
41		1	FCR2	5			lithic	debitage		38	45
42	1	1	1			Feature 5	lithic	projectile point	dart point, base, AK-Bandy, EP-untyped	1.1	1
42		1	1			F5 beneath rock C	lithic	debitage	from M25 heavy fraction		
42		1	1			Feature 5	lithic	debitage	1/4" screen	21	19
43	1	1	1		3436	Feature 6	groundstone	other	possible abrader	1293	1
43		1	1			Feature 6	faunal	bone	fragment	0.1	1
43		1	1			Feature 6	lithic	debitage		15	19

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
43		1	1		3430	Feature 6	lithic	debitage			
44	1	1	1	6			lithic	flake tool	scraper, unimarginal, lateral	20.9	1
44	2	1	1	6			lithic	biface	thin, distal	3.9	1
44	3	1	1	6			lithic	biface	thin, medial	10.7	1
44	4	1	1	6			other	hematite		4.8	1
44		1	1	6			faunal	bone	fragments	3.0	2
44		1	2	1			lithic	debitage			
44		1	1	6			lithic	debitage		46	15
44		1	1	6			lithic	debitage		329	67
45	1	1	1	7		near F6	lithic	flake tool	possible scraper, unimarginal, fragment	8.0	1
45	2	1	1	7	3531		lithic	flake tool	unimarginal, fragment, some cortex	100.7	1
45		1	1	7			lithic	debitage	50% burned	10	4
46	1	2	5	1			lithic	biface	thin, distal	4.6	1
46	2	2	5	1	3402		lithic	biface	thick, complete	66.2	1
46	3	1	1	8	3463		lithic	flake tool	possible hafted mescal knife, bimarginal, distal, polish	22.1	1
46	4	1	1	8	3538		lithic	flake tool	possible sotol knife, unimarginal, nearly complete, cortex	51.2	1
46		1	1	8			lithic	debitage	0% burned	13	1
46		1	1	8			lithic	debitage			1
46		1	1	8			lithic	debitage		10	4
47	1	2	2	4			lithic	biface	thin, fragment, burned	7.3	1
47	2	2	2	4			lithic	biface	possible knife, thin, fragment	6.5	1
47		2	2	4			faunal	bone	small fragments, fairly well preserved	0.8	2
47		2	2	4			faunal	bone	fragment	0.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
47		2	2	4			lithic	debitage	29% burned	85	66
47		2	2	4			lithic	debitage		47	53
48	1	2	5	1			lithic	biface	possible knife, thin, fragment	2.8	1
48	2	2	5	1			lithic	biface	thin, distal	10.4	1
48		2	5	1			lithic	debitage			177
49	1	2	5	2	3408		lithic	biface	thin, basal	24.3	1
49	2	2	5	2			lithic	biface	thin, distal	1.7	1
49	2	2	5	2	3409		lithic	core	multidirectional, cortex	277.5	1
49	4	2	5	2			lithic	biface	thin, fragment, burned	2.0	1
49		2	5	2			faunal	bone	tooth	0.4	1
49		2	5	2			faunal	shell	mussel shell fragment	0.1	1
49		2	5	2			lithic	debitage	31% burned	89	106
49		2	5	2			lithic	debitage	55% burned	86	89
49		2	5	2			lithic	debitage		252	145
50	1	2	5	3			groundstone	netherstone		509	1
50	2	2	5	3			lithic	biface		1.5	1
50		2	5	3			lithic	debitage		28	28
50		2	5	3			lithic	debitage			
51	1	2	6	1			lithic	core	multidirectional, cortex	125.3	1
51	2	2	6	1			lithic	biface	thin, fragment	2.2	1
51	3	2	6	1			other	pendent top	chert fragment with drilled hole?, burned	0.3	1
51		2	6	1			lithic	debitage			226
52		2	6	2			lithic	debitage			
53	1	2	6	3			lithic	core	bifacial core, cortex, nearly complete	182.2	1
53		2	6	3			lithic	debitage	33% burned	11	6
53		2	6	3			lithic	debitage		8	10

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
53		2	6	3			lithic	debitage		11	4
54	1	2	1	6			lithic	biface	thin, medial, burned	11.1	1
54	2	2	1	6		north pedestal	other	pebble	not complete	55.2	1
54		2	1	6			faunal	shell	mussel shell fragments	0.1	2
54		2	1	6			lithic	debitage	29% burned	18	7
54		2	1	6			lithic	debitage	40% burned	25	25
54		2	1	6			lithic	debitage			115
54		2	1	6			lithic	debitage		36	29
55	1	2	1	7			lithic	projectile point	dart point, complete, AK-untyped, EP-untyped/Early Side Notch *	2.8	1
55	2	2	1	7			lithic	biface	distal tip	0.9	1
55	3	2	1	7			lithic	projectile point	dart point	7.9	1
55	4	2	1	7			lithic	biface			1
55		2	1	7			faunal	bone	fragments, encrusted with CaCO3	0.8	2
55		2	1	7			faunal	bone	fragments, some burned	1.4	3
55		2	1	7			faunal	shell	mussel shell fragment	0.1	1
55		2	1	7			faunal	shell		0.1	1
55		2	1	7			faunal	shell	mussel shell fragments, two with hinges	1.8	16
55		2	1	7	3559		lithic	debitage	0% burned	35	1
55		2	1	7			lithic	debitage			290
55		2	1	7			lithic	debitage			204
55		2	1	7			lithic	debitage			
56	1	1	1	9	3571		lithic	flake tool	sotol knife/sequent flake, unimarginal, complete	59.1	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
56	2	1	1	9		under roof fall	lithic	flake tool	unimarginal, fragment, some cortex	18.4	1
56	3	1	1	9	3570	CaCO3 layer	lithic	flake tool	unimarginal, fractured during excavation, some cortex	37.9	1
56		1	1	9			lithic	debitage	50% burned	4	2
56		1	1	9			lithic	debitage		252	31
57	1	3	2			above boulder	lithic	core		374.6	1
57	2	3	2			above boulder	lithic	biface	chopper	147.4	1
57	3	3	2			above boulder	lithic	flake tool	unimarginal, complete, cortex	17.8	1
57	4	3	2			above boulder	lithic	biface		61.6	1
57	5	3	2			above boulder	lithic	flake tool	unimarginal, complete, cortex	114.1	1
57	6	3	2			above boulder	lithic	flake tool	unimarginal, medial, cortex, polish	51.4	1
57	7	3	2			above boulder	lithic	biface		6.5	1
57	8	3	2			above boulder	groundstone	netherstone		154	1
57	9	3	2			above boulder	other	pebble	fragment	2.4	1
57		3	2			above boulder	lithic	debitage			9
57		3	2			above boulder	lithic	debitage			6
57		3	2			above boulder	lithic	debitage			3
58	1	1	1			wall fall*	lithic	projectile point	dart point, complete, DY-Baker, EP-Untyped Early Archaic, AK-untyped	4.3	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
58	2	4	1			wall fall	lithic	flake tool	unimarginal, complete, cortex	43.0	1
58	3	4	1			wall fall	lithic	flake tool	unimarginal, fragment	4.8	1
58	4	2	3		PP-May21-1	in situ	lithic	projectile point	dart point, complete, AK/EP-Pedernales	13.7	1
58	5	2				wall fall	lithic	projectile point	dart point, complete, AK/EP-Kinney, SLB-Early Triangular	6.0	1
58	6	2				wall fall	lithic	projectile point	dart point, complete, AK/EP-Pandale	6.3	1
58	7	2				wall fall	lithic	projectile point	dart point, complete, AK/EP-Pandale	4.6	1
58	8	2				wall profile *	lithic	projectile point	dart point, lateral, EP-untyped/Late Archaic broad blade, AK-untyped	6.0	1
58	9	2				wall fall	lithic	projectile point	dart point, base, EP-Comstock, AK-Palmillas	8.6	1
58	10					backdirt	lithic	projectile point	dart point, complete, AK-Langtry	7.8	1
58	11	2				wall profile *	lithic	biface	thin, distal, serrated	5.1	1
58	12	4	1			wall profile	lithic	biface	thin, fragment	1.9	1
58	13	4	1			wall profile	lithic	biface	thin, fragment *	12.3	1
58	14					backdirt	lithic	biface	possible knife or preform, thin, complete	50.8	1
58	15					north wall	lithic	biface	possible chopper or cutting tool, thick, complete, cortex	90.9	1
58	16	2				wall fall	lithic	flake tool	unimarginal, fragment, some cortex, polish	22.4	1
58	17					wall profile *	lithic	biface	thin, distal	6.0	1
58	18					wall profile *	lithic	biface	thin, complete	22.1	1
58	19	2				wall fall	lithic	biface	possible knife, thin, complete, burned	9.3	1
58	20	2				wall fall	lithic	biface	thin, fragment	5.6	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
58	21	2				wall fall	lithic	flake tool	uniface and possible side scraper, unimarginal, complete	14.1	1
58	22	2				wall fall	lithic	flake tool	unimarginal, distal, cortex	13.4	1
58	23	2				wall fall	lithic	flake tool	uniface, unimarginal, medial	8.7	1
58	24	2	1		FK-May21-1	wall	lithic	flake tool	unimarginal, distal, polish	19.2	1
58	25					wall profile *	lithic	biface	thin, fragment	23.9	1
58	26					unknown	lithic	flake tool	unimarginal, fragment	8.8	1
58	27	2				wall fall	lithic	flake tool	sotol knife, unimarginal, complete, some cortex, polish	43.3	1
58	28	2				wall fall	lithic	core	multidirectional, cortex	67.9	1
58	29	2				wall fall	lithic	flake tool	unimarginal, complete, patina	44.8	1
58	30	2				wall fall	lithic	biface	thin, fragment, burned	2.0	1
58	31	2				wall fall	lithic	biface	thin, lateral	4.0	1
58	32	2				wall fall	lithic	biface	thin, fragment	4.4	1
58	33					backdirt	lithic	core	multidirectional	191.4	1
58	34					backdirt	lithic	core	multidirectional, some cortex	126.3	1
58	35					backdirt	lithic	core	multidirectional, cortex	279.5	1
58	36					backdirt	groundstone	netherstone		394	1
58	37	1	1				lithic	flake tool		8.9	1
58	38					unknown	groundstone	handstone		160	1
58	39					backdirt	groundstone	handstone		220	1
58	40					backdirt	groundstone	netherstone		840	1
58	41					backdirt	groundstone	netherstone		430	1
58	42					backdirt	groundstone	netherstone		153	1
58	43					backdirt	groundstone	handstone		267	1
58	44	2				wall fall *	other	pebble	fragment, ground	3.6	1
58	45	2				north wall	other	manuport	non-local limestone	1169	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
58	46					backdirt	groundstone	netherstone		143	1
58	47					backdirt	groundstone	handstone		538	1
58	48					backdirt	groundstone	handstone		100	1
58	49					backdirt	groundstone	handstone		455	1
58	50					backdirt	groundstone	netherstone		429	1
58	51					backdirt	other	pounding tool		2199	1
58	52					unknown	lithic	flake tool	sequent flake, unimarginal, nearly complete, some cortex	23.6	1
58		2				wall fall *	faunal	bone	well preserved	3.4	1
58		2				wall fall *	faunal	bone	fragment	3.6	1
58		2				wall fall *	faunal	bone	fragments, some burned	1.1	5
58		2				wall fall *	faunal	bone	fragment	1.1	1
58		2				wall fall *	faunal	shell	mussel shell fragment with hinge	0.2	1
58		1	1				faunal	shell	mussel shell fragment, well preserved	1.1	1
59	1	1	FCR3	4			lithic	biface	thin, distal, burned, serrated	3.2	1
59	2	1	FCR3	2			lithic	biface	possible knife, thin, fragment, burned *	16.9	1
59	3	1	FCR3	9	PP-May15-1	in situ	lithic	projectile point	dart point, complete, AK/EP-untyped	2.1	1
59	4	1	FCR3	4			lithic	projectile point	dart point, fragment, AK/EP-untyped, burned	2.2	1
59	5	1	FCR3	1			lithic	flake tool		10.1	1
59	6	1	FCR3	1			lithic	flake tool		2.1	1
59	7	1	FCR3	2			lithic	flake tool		68.3	1
59	8	1	FCR3	2			other	pebble	ground	27.6	1
59	9	1	FCR3	3			lithic	biface	chopper	143.3	1
59	10	1	FCR3	2			lithic	flake tool	unimarginal, proximal, cortex	19.5	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
59	11	1	FCR3	2			lithic	flake tool	bimarginal, complete, cortex	94.3	2
59		1	FCR3	2			faunal	shell	mussel shell fragments, one with possible hinge	0.6	8
59		1	FCR3	5			lithic	debitage	28% burned	174	34
59		1	FCR3	7			lithic	debitage	36% burned	39	14
59		1	FCR3	6			lithic	debitage	63% burned	80	8
59		1	FCR3	8			lithic	debitage	38% burned	14	16
59		1	FCR3	4			lithic	debitage			
59		1	FCR3	3			lithic	debitage			194
59		1	FCR3	4			lithic	debitage			3
59		1	FCR3	2			lithic	debitage			105
59		1	FCR3	1			lithic	debitage			161
59		1	FCR3	4			lithic	debitage			
59		1	FCR3	2			lithic	debitage			
62	1	1	3	1			lithic	biface	drill	12.0	1
62	2	1	3	1			lithic	flake tool		10.0	1
62		1	3	1			faunal	shell	mussel shell fragments	1.0	11
62		1	3	1			lithic	debitage			
62		1	3	1			lithic	debitage			
63	1	1	3	2			lithic	flake tool	scraper, unimarginal, distal, cortex	14.0	1
63		1	3	2			lithic	debitage			
64	1	1	3	3	GS-Mar13-2		groundstone	handstone		589	1
64	2	1	3	3			lithic	flake tool	complete, unimarginal, polish	24.2	1
64		1	3	3			lithic	debitage	65% burned	117	20
65	1	2	7	1	FK-May22-1		lithic	flake tool	scraper, unimarginal, distal, burned	22.7	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
65	2	2	7	1	CR-May22-1		lithic	core	multidirectional, cortex, burned	80.0	1
65		2	7	1			faunal	bone	fragments, various animal size	2.2	3
65		2	7	1	BN-May22-1		faunal	bone	limb bone, good preservation	29.1	1
65		2	7	1			lithic	debitage			223
66	1	2	7	2			lithic	projectile point	dart point, base, AK-Ensor, EP-reworked Marcos, burned	10.0	1
66	2	2	7	2	BF-May23-1		lithic	biface	possible chopper or cutting tool, thick, complete, cortex	235.2	1
66	3	2	7	2			lithic	biface	thin, medial, burned	7.7	1
66	4	2	7	2			lithic	biface	thin, fragment	8.5	1
66	5	2	7	2	FK-May22-2		lithic	flake tool	scraper, unimarginal, fractured during excavation, burned	36.7	1
66	6	2	7	2	BF-May22-2		lithic	biface	thin, fragment, burned	23.2	1
66	7	2	7	2	FK-May23-2		lithic	flake tool	unimarginal, distal	43.7	1
66	8	2	7	2	BF-May22-1		lithic	biface	thin, fragment, some cortex	16.5	1
66	9	2	7	2	PB-May23-1		other	pebble		38.1	1
66		2	7	2			faunal	bone	fragment	0.1	1
66		2	7	2			faunal	bone	fragment	0.4	1
66		2	7	2			lithic	debitage			360
66		2	7	2			lithic	debitage	0% burned	20	1
66		2	7	2			lithic	debitage			288
66		2	7	2		surrounding F10	lithic	debitage			61
67	1	2	7	3	PP-May24-1	in situ	lithic	projectile point	dart point, base, EP-Taylor, AK-Matamoros, burned	2.7	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
67	2	2	7	3			lithic	projectile point	dart point, medial, EP-untyped/Late Archaic Broad Blade, AK-untyped	2.7	1
67	3	2	7	3	CR-May23-3		lithic	core	multidirectional, cortex	271.4	1
67	4	2	7	3			lithic	flake tool	uniface, unimarginal, distal	15.8	1
67	5	2	7	3			lithic	flake tool	sotol knife, unimarginal, complete, some cortex, polish	49.7	1
67	6	2	7	3			lithic	biface	thin, distal	3.6	1
67	7	2	7	3			lithic	biface	thin, fragment	0.8	1
67	8	2	7	3			lithic	biface	thin, fragment, burned	4.8	1
67	9	2	7	3			lithic	flake tool	scraper, fragment	26.2	1
67	10	2	7	3	PB-May24-1		other	pebble		124.3	1
67		2	7	3			faunal	bone	fragments, good preservation	3.4	2
67		2	7	3			faunal	shell	mussel shell fragments, very fragile	0.1	3
67		2	7	3			faunal	shell	mussel shell fragment	0.1	1
67		2	7	3			lithic	debitage			316
67		2	7	3			lithic	debitage		92	81
67		2	7	3			lithic	debitage			162
68	1	2	7	4			lithic	biface	possible preform, thin, complete	7.6	1
68	2	2	7	4			lithic	biface	thin, lateral	10.6	1
68		2	7	4			faunal	shell	mussel shell fragments, one with hinge	0.6	4
68		2	7	4			lithic	debitage			123
68		2	7	4			lithic	debitage			
69	1	2	7	5	UF-Jun18-1		lithic	flake tool	unimarginal, proximal, cortex	64.3	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
69	2	2	7	5	PP-Jun14-1		lithic	projectile point	dart point, base, AK-Almagre	23.9	1
69	3	2	7	5			lithic	flake tool	scraper, unimarginal, fragment	8.3	1
69	4	2	7	5			lithic	biface	thin, distal	10.5	1
69	5	2	7	5			lithic	biface	thin, medial	6.6	1
69	6	2	7	5			lithic	flake tool	unmarginal, complete, cortex	70.5	1
69	7	2	7	5			lithic	biface	thin, fragment	3.9	1
69	8	2	7	5			lithic	biface	thin, fragment, burned	3.6	1
69	9	2	7	5			lithic	biface	thin, distal tip, burned	1.2	1
69	10	2	7	5	GS-Jun14-1		groundstone	handstone		1234	1
69		2	7	5			faunal	bone	fragment, encrusted with CaCO3	0.4	1
69		2	7	5			faunal	shell	mussel shell fragments	0.4	6
69		2	7	5			lithic	debitage	42% burned	190	62
69		2	7	5			lithic	debitage	46% burned	254	228
69		2	7	5			lithic	debitage			329
70		4	1	1			faunal	bone	tooth	2.6	1
70		4	1	1			lithic	debitage	50% burned	10	6
71	1	4	1	2			other	glass		1.5	1
71		4	1	2			faunal	bone	fragments	1.3	2
71		4	1	2			lithic	debitage		15	9
72		4	1	3			lithic	debitage		112	18
73	1	4	1	4		~69.5 cm b dat r *	lithic	projectile point	dart point, nearly complete, AK-Ensor, EP-Ellis	2.8	1
73		4	1	4			lithic	debitage		41	23
74		4	1	5			lithic	debitage			9
75		4	1	6			lithic	debitage		191	19
75		4	1	6			lithic	debitage			6

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
75		4	1	6			lithic	debitage			8
77		1	1	3		Feature 8	lithic	debitage	50% burned	4	2
78	1	2	7		Rock OO	Feature 9	groundstone	handstone		579	1
78	2	2	7		Rock G	Feature 9	groundstone	handstone		159	1
78		2	7			Feature 9	faunal	shell	mussel shell fragments from matrix sample 48	0.1	6
78		2	7			Feature 9 - south	lithic	debitage		22	5
78		2	7			Feature 9 - north	lithic	debitage		79	19
78		2	7			Feature 9	lithic	debitage		43	38
78		2	7			Feature 9	lithic	debitage		7	5
78		2	7			Feature 9	lithic	debitage		10	1
78		2	7			Feature 9	lithic	debitage	from M49 heavy fraction		
78		2	7			Feature 9	lithic	debitage	from M48 heavy fraction		
79	1	2	7		Rock KKK	Feature 10	other	hammerstone		638	1
81	1	2	7	6		north in unit	lithic	projectile point	dart point, complete, EP-Marshall, AK-untyped	8.3	1
81	2	2	7	6		south pedestal	lithic	projectile point	dart point, complete, EP-Kinney, AK-Early Triangular	7.9	1
81	3	2	7	6			lithic	projectile point	dart point, base, AK/EP-Pandale	7.1	1
81	4	2	7	6			lithic	biface	thin, complete, burned	45.1	1
81	5	2	7	6			lithic	biface	thin, complete	49.1	1
81	6	2	7	6			lithic	biface	thin, fragment	8.8	1
81	7	2	7	6			lithic	biface	thin, distal	1.3	1
81	8	2	7	6			lithic	flake tool	uniface, unimarginal, medial	8.1	1
81	9	2	7	6			lithic	biface	possible chopper, thick, complete, cortex	407.5	1

Lot No.	Spec. No.	Area	Unit	Layer	FN	Context	Class	Type	Description	Mass (g)	Count
81	10	2	7	6			lithic	biface	possible chopper, thick, distal, cortex	204.6	1
81	11	2	7	6			lithic	biface	thick, fragment, burned	26.5	1
81	12	2	7	6			lithic	flake tool	possible scraper, fragment, burned	15.1	1
81	13	2	7	6			lithic	biface	thick, complete, some cortex	102.3	1
81	14	2	7	6			other	pebble	not complete	32.6	1
81		2	7	6			faunal	bone	fragment	2.4	1
81		2	7	6			faunal	shell	mussel shell fragments, one with hinge	0.6	7
81		2	7	6			lithic	debitage	30% burned	387	181
81		2	7	6			lithic	debitage	35% burned	698	746
81		2	7	6			lithic	debitage	0% burned	49	1
82		2	7	7		north in unit	faunal	bone	fragment	0.5	1
82		2	7	7		north in unit	lithic	debitage			
83	1	3	3			beneath boulder	lithic	biface	thin, fragment, burned	5.6	1
83		3	3			beneath boulder	lithic	debitage			44
85		1	ST8				lithic	debitage	66% burned	26	3

APPENDIX B: SAMPLE INVENTORY

Appendix B presents a complete inventory of samples collected from the Little Sotol site (41VV2037). The samples are sorted first by lot and specimen number in ascending order, then by sample type. The first character of specimen numbers denote the type of sample – matrix (M), *in situ* charcoal (C), sediment (S), and burned rock (BR) samples. Charcoal samples collected from screens only include a lot number. Provenience information (i.e., excavation area, unit, and layer) are also provided; and the feature number is also listed, if applicable. Context provides information regarding context from which the sample was recovered, whether that be a site feature or screen. Description and notes includes other information pertaining to the sample, including field number (FN) identifying the TDS data point, counts, and other notes (e.g., field observations, information potential, etc.).

The flotation of all matrix samples is complete, yet many of the samples are left unanalyzed. All samples will be curated at the Center for Archaeological Studies (CAS) at Texas State University, San Marcos.

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
2	M01.1	1	1	2	-	top of midden deposit	FN 1666
2	M02.1	1	1	2	-	surface of midden	FN 1692
2	M02.2	1	1	2	-	surface of midden	FN 1692
3	-	1	1	3	-	1/4" screen	charcoal count = 5
3	-	1	1	3	-	1/4" screen	charcoal count = 3
3	-	1	1	3	-	1/4" screen	charcoal count = 2
3	M03.1	1	1	3	-	from outside feature 1	background noise, but not from column, FN 2003
3	M03.2	1	1	3	-	from outside feature 1	background noise, but not from column, FN 2003
3	M03.3	1	1	3	-	from outside feature 1	background noise, heavy fraction charcoal, FN 2003
3	M05.1	1	1	3	-	from outside feature 1	background noise, but not from column, FN 2005
3	M05.2	1	1	3	-	from outside feature 1	background noise, but not from column, FN 2005
5	-	2	1	1	-	1/4" screen	charcoal count = 3
5	-	2	1	1	-	1/4" screen	charcoal count = 2
5	-	2	1	1	-	1/4" screen	charcoal count = 20+
6	-	2	1	2	-	1/4" screen	charcoal count = 15
7	-	2	1	3	-	1/4" screen	charcoal count = 11
7	-	2	1	3	-	1/4" screen	charcoal count = 4
8	-	2	1	4	-	1/4" screen	charcoal count = 9
9	-	2	1	5	-	1/4" screen	charcoal count = 20+
9	M06.1	2	1	5	-	from beneath large groundstone	possibly a good date from cave, FN 2163
9	M06.2	2	1	5	-	from beneath large groundstone	possibly a good date from cave, FN 2163
10	-	2	2	1	-	1/4" screen	charcoal count = 13
11	-	2	2	2	-	1/4" screen	charcoal count = 9
11	-	2	2	2	-	1/4" screen	charcoal count = 6
11	C15	2	2	2	-	FN 2532, in situ	charcoal count = 2
12	-	2	2	3	-	1/4" screen	charcoal count = 14
13	-	1	1	4	-	1/4" screen	charred leaves
13	-	1	1	4	-	1/2" screen	charcoal count = 1
13	M13.1	1	1	4	-	collected where charcoal observed	plenty of samples from better context - maybe not
13	M13.2	1	1	4	-	collected where charcoal observed	plenty of samples from better context
14	-	2	3	1	-	1/4" screen	charcoal count = 1
14	-	2	3	1	-	1/4" screen	charcoal count = 19

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
15	-	2	3	2	-	1/4" screen	charcoal count = 20+
16	-	2	3	3	-	1/4" screen	charcoal count = 20+
16	-	2	3	3	-	1/4" screen	charcoal count = 1
16	-	2	3	3	-	1/4" screen	charcoal count = 2
17	-	2	3	4	-	1/4" screen	charcoal count = 9
17	-	2	3	4	-	1/4" screen	charcoal count = 4
17	-	2	3	4	-	1/4" screen	charcoal count = 20+
17	C11	2	3	4	-	charcoal sample from under burned rock	charcoal
17	M14.1	2	3	4	-	from beneath rocks with observed charcoal	possibly a good date from cave, E1002.5 N998.12, 128 cm b dat z
17	M14.2	2	3	4	-	from beneath rocks with observed charcoal	E1002.5 N998.12, 128 cm b dat z
17	M16.1	2	3	4	-	collected due to charcoal smear	possibly a good date from cave
17	M16.2	2	3	4	-	collected due to charcoal smear	possibly a good date from cave
17	S1	2	5	6	-	collected due to charcoal smear	possibly a good date from cave, from matrix 16,
18	-	2	4	1	-	1/4" screen	charcoal count = 4
18	-	2	4	1	-	1/4" screen	charcoal count = 3
19	-	1	1	-	F1	in situ, from between rocks G and S	charcoal
19	-	1	1	-	F1	in situ, from between rocks G and R	charcoal
19	-	1	1	-	F1	1/8" screen, from between feature rocks	charcoal
19	-	1	1	-	F1	1/4" screen	charcoal count = 13
19	C10	1	1	-	F1	charcoal sample west of section line	charcoal
19	C28	1	1	-	F1	1/8" screen	charred agave leaf
19	M04.1	1	1	-	F1	from within feature 1	feature contents but association not strong, FN 2004
19	M04.2	1	1	-	F1	from within feature 1	heavy fraction charcoal
19	M07.1	1	1	-	F1	within feature 1 lining	already have dates from F1, FN 2198
19	M07.2	1	1	-	F1	within feature 1 lining	FN 2198
19	M08.1	1	1	-	F1	within feature 1 lining, north side	already have dates from F1, FN 2383
19	M08.2	1	1	-	F1	within feature 1 lining, north side	already have dates from F1, FN 2383
19	M11.1	1	1	-	F1	feature contents west of section line	already have dates from F1, FN 2859

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
19	M11.2	1	1	-	F1	feature contents west of section line	FN 2859
19	M12.1	1	1	-	F1	feature context west of section line	already have dates from F1, FN 2860
19	M12.2	1	1	-	F1	feature context west of section line	already have dates from F1, FN 2860
19	M15.1	1	1	-	F1	from beneath feature rocks	already have dates from F1
19	M15.2	1	1	-	F1	from beneath feature rocks	directly beneath lining
19	S25	1	1	-	F1	from beneath feature rocks	directly beneath lining, from matrix 15
21	-	2	4	2	-	1/4" screen	charcoal count = 2
23	-	2	3	5	-	1/4" screen	charcoal count = 20+
23	-	2	3	5	-	1/4" screen	charcoal count = 20+
23	2-3-5.1	2	3	5	-		collected for microfossil analysis 6/24/2011
24	M36.1	3	1	-	-	between limestone bench and boulder	aim to date the timing of the roof collapse
24	M36.2	3	1	-	-	between limestone bench and boulder	aim to date the timing of the roof collapse
24	M47.1	3	1	-	-	from tunnel between boulder and bench	aim to date the timing of the roof collapse, better context
24	S56	3	1	-	-	from above limestone bench, east of boulder	
24	S57	3	1	-	-	from above limestone bench, west of boulder	FN 3606
24	S71	3	1	-	-	from tunnel between boulder and bench	from matrix 47,
25	-	1	1	5	-	1/2" screen	charcoal count = 4
25	-	1	1	5	-	1/4" screen	charcoal count = 7
25	-	1	1	5	-	1/2" screen	charcoal count = 1
25	C14	1	1	5	-	FN 3013, in situ	charcoal
26	-	2	3	6	-	1/4" screen	charcoal count = 20+
26	C17	2	3	6	-	in situ, northeast corner of unit	charcoal count = 8
28	-	2	3	7	-	1/4" screen	charcoal count = 16
28	-	2	3	7	-	1/4" screen	charcoal count = 1
29	-	2	-	-	F2	FN 3472, in situ, beneath FR24 and FR25	charcoal from very bottom of feature
29	-	2	-	-	F2	FN 3467, in situ, in front of FR24	charcoal
29	-	2	-	-	F2	FN 3525, in situ, behind FR62	charcoal
29	-	2	1	-	F2	1/4" screen	charcoal count = 1

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
29	-	2	1	-	F2	1/8" screen	charcoal count = 20+
29	-	2	1	-	F2	1/4" screen	charcoal count = 17
29	-	2	-	-	F2	1/4" screen	charcoal count = 5
29	-	2	1	-	F2	in situ but not documented	charcoal
29	C16	2	-	-	F2	FN 3522, in situ feature 2	charcoal
29	C7	2	1	-	F2	FN 3534, in situ, north pedestal F2	charcoal
29	FR11	2			F2		feature rock
29	FR12	2			F2		feature rock
29	FR13	2			F2		feature rock
29	FR14	2			F2		feature rock
29	FR15	2			F2		feature rock
29	FR16	2			F2		feature rock
29	FR17	2			F2		feature rock
29	FR18	2			F2		feature rock
29	FR19	2			F2		feature rock
29	FR20	2			F2		feature rock
29	FR21	2			F2		feature rock
29	FR22	2			F2		feature rock
29	FR24	2			F2		feature rock
29	FR25	2			F2		feature rock
29	FR26	2			F2		feature rock
29	FR27	2			F2		feature rock
29	FR28	2			F2		feature rock
29	FR29	2			F2		feature rock
29	FR30	2			F2		feature rock
29	FR31	2			F2		feature rock
29	FR32	2			F2		feature rock
29	FR34	2			F2		feature rock
29	FR35	2			F2		feature rock
29	FR36	2			F2		feature rock
29	FR37	2			F2		feature rock
29	FR38	2			F2		feature rock
29	FR40	2			F2		feature rock
29	FR41	2			F2		feature rock
29	FR42	2			F2		feature rock
29	FR43	2			F2		feature rock
29	FR44	2			F2		feature rock
29	FR45	2			F2		feature rock
29	FR46	2			F2		feature rock
29	FR47	2			F2		feature rock

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
29	FR48	2			F2		feature rock
29	FR53	2			F2		feature rock
29	FR54	2			F2		feature rock
29	FR55	2			F2		feature rock
29	FR56	2			F2		feature rock
29	FR57	2			F2		feature rock
29	FR61	2			F2		feature rock
29	FR62	2			F2		feature rock
29	FR63	2			F2		feature rock
29	FR64	2			F2		feature rock
29	FR65	2			F2		feature rock
29	FR66	2			F2		feature rock
29		2			F2	south section	feature rocks collected for thermal evaluation 6/29/2011
29	M09.1	2	-	-	F2	from within south section of feature 2	already have dates from F2, FN 2644
29	M09.2	2	-	-	F2	from within south section of feature 2	mid elevation within feature, FN 2644
29	M10.1	2	-	-	F2	feature context south of section line	lower elevation, already have dates from F2
29	M10.2	2	-	-	F2	feature context south of section line	lower elevation within feature
29	M18.1	2	1	-	F2	from east center of feature	already have dates from F2
29	M19.1	2	1	-	F2	from potential center of feature	already have dates from F2
29	M19.2	2	1	-	F2	from potential center of feature	unknown elevation
29	M22.1	2	1	-	F2	from south center of feature	already have dates from F2
29	M22.2	2	1	-	F2	from south center of feature	already have dates from F2
29	M27.1	2	-	-	F2	from course 1 of feature 2	mid to low elevation
29	M27.2	2	-	-	F2	from course 1 of feature 2	mid to low elevation, heavy fraction charcoal
29	M27.3	2	-	-	F2	from course 1 of feature 2	mid to low elevation, heavy fraction leaves?
29	M28.1	2	-	-	F2	from course 2 of feature 2	already have dates from F2
29	M28.2	2	-	-	F2	from course 2 of feature 2	mid to low elevation
29	M28.3	2	-	-	F2	from course 2 of feature 2	mid to low elevation, heavy fraction charcoal
29	M29.1	2	-	-	F2	from course 3 of feature 2	already have dates from F2
29	M29.2	2	-	-	F2	from course 3 of feature 2	already have dates from F2

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
29	M29.3	2	-	-	F2	from course 3 of feature 2	mid to low elevation
29	M29.4	2	-	-	F2	from course 3 of feature 2	mid to low elevation, heavy fraction charcoal/charred plants
29	M30.1	2	-	-	F2	from course 4 of feature 2	mid to low elevation
29	M30.2	2	-	-	F2	from course 4 of feature 2	heavy fraction charcoal/charred plant material
29	S2	2	1	-	F2	from east center of feature	from matrix 18
29	S32	2	-	-	F2	within in feature rocks	interior sediment sample
29	S33	2	-	-	F2	from course 1 of feature 2	mid to low elevation, from matrix 27
29	S34	2	-	-	F2	from course 2 of feature 2	mid to low elevation, from matrix 28
29	S35	2	-	-	F2	dark/light sediment from feature 2	labeled D1 on map
29	S36	2	-	-	F2	dark/light sediment from feature 2	labeled D2 on map
29	S37	2	-	-	F2	from course 3 of feature 2	mid to low elevation, from matrix 29
29	S38	2	-	-	F2	from course 2 of feature 2	mid to low elevation, from matrix 30
29	S4	2	1	-	F2	from east center of feature	from matrix 18
29	S40	2	-	-	F2	feature 2, from behind FR3	
29	S41	4	-	-	F2	feature 2, from behind FR27	
29	S42	5	-	-	F2	feature 2, from behind F34	possible fill dirt
29	S43	6	-	-	F2	feature 2, from behind FR37	
29	S44	7	-	-	F2	feature 2, from behind FR14 and FR64	
29	S45	8	-	-	F2	feature 2, from behind FR16	
29	S5	2	1	-	F2	from potential center of feature	unknown elevation, from matrix 19
29	S6	2	1	-	F2	from south center of feature	from matrix 22
29	S7	2	1	-	F2	from potential center of feature	unknown elevation, from matrix 19
29	S8	2	1	-	F2	from south center of feature	from matrix 22
29	S9	2	1	-	F2	from south center of feature	from matrix 22
29		2	1	-	F2	feature	rock for starch analysis, collected 6/26/2011

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
29		2	1	-	F2	feature	rock #2 for starch analysis, collected 6/28/2011
30	M20.1	1	1	-	F4	beneath feature rocks	good context to date
30	M21.1	1	1	-	F4	beneath feature rocks	already have date from F4
30	S10	1	1	-	F4	beneath feature rocks	from matrix 21
30	S11	1	1	-	F4	beneath feature rocks	from matrix 20
30	S12	1	1	-	F4	beneath feature rocks	from matrix 21
30	FCR Sample 1	1	1	-	F4	feature, beneath rock HH	collected for microfossil analysis
30	FCR Sample 2	1	1	-	F4	feature	collected for microfossil analysis 6/28/2011
30	FCR Sample 3	1	1	-	F4	feature	collected for microfossil analysis 6/28/2011
30	FCR Sample 4	1	1	-	F4	feature	collected for microfossil analysis 6/28/2011
31	M17.1	1	1	-	F3	beneath feature rocks	already have date from F3
31	M17.2	1	1	-	F3	beneath feature rocks	directly beneath feature rocks
31	S3	1	1	-	F3	beneath feature rocks	directly beneath feature rocks, from matrix 17
31		1	1	-	F3	feature	collected for microfossil analysis
38		2	4	4			calcium carbonate sample collected 6/27/2011
39	-	2	3	-	-	in situ, east wall, 59.7 cm b dat z	charcoal
39	S22	2	2	-	-	east wall of area 2	column sample 1
39	S23	2	2	-	-	east wall of area 2	column sample 2
39	S24	2	2	-	-	east wall of area 2	column sample 3
40	-	1	FCR1	4	-	1/4" screen	charcoal count = 2
41	-	1	FCR2	4	-	1/4" screen	charcoal count = 8, charred leaf count = 1
41	-	1	FCR2	4	-	1/4" screen	charcoal count = 9
41	-	1	FCR2	4			sample of large burned rocks with dark interior, collected 1/8/2012
41	C2	1	FCR2	5	-	FN 3596, in situ on rock	charcoal
42		1	1	-	F5	feature	sample of feature rocks with various levels of heat modification

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
42	-	1	1	-	F5	1/8" screen, from between feature rocks	charcoal
42	M25.1	1	1	-	F5	beneath feature rock C	good context to date
42	M25.2	1	1	-	F5	beneath feature rock C	heavy fraction charcoal
42	S28	1	1	-	F5	beneath feature rock C	from matrix 25
42	S29	1	1	-	F5	beneath feature rock C	from matrix 25
42	S30	1	1	-	F5	beneath feature rock B	
43	-	1	1	-	F6	FN 3429, in situ, beneath feature rock D	charcoal
43	-	1	1	-	F6	1/8" screen	charcoal count = 5
43	C5	1	1	-	F6	in situ, beneath feature rock H	charcoal
43	M26.1	1	1	-	F6	beneath feature rocks	FN 3430, good context to date
43	M26.2	1	1	-	F6	beneath feature rocks	FN 3430, heavy fraction charcoal
43	S31	1	1	-	F6	beneath feature rocks	FN 3430, from matrix sample 26
43	Rock D	1	1	-	F6	feature	FN3429, collected for microfossil analysis 8/4/2011
43	Rock I	1	1	-	F6	feature	collected for microfossil analysis 8/4/2011
45	-	1	1	7	-	FN 3437, beneath feature 6	charcoal
46	-	1	1	8	-	charcoal in CaCO3	charcoal, not extracted
46	S54	1	1	8	-	profile sample, beneath large rock layer 1	sediment column sample A
46	S55	1	1	8	-	profile sample, beneath large rock layer 2	sediment column sample B
48	-	2	5	1	-	1/4" screen	charcoal count = 13
49	-	2	5	2	-	1/4" screen	charcoal count = 14
49	-	2	5	2	-	1/4" screen	charcoal count = 7
49	M23.1	2	5	2	-	shelter deposit at mouth of cave	FN 3410
49	M24.1	2	5	2	-	midden deposit at mouth of cave	FN 3411
49	S26	2	5	2	-	shelter deposit at mouth of cave	FN 3410, from matrix 23
49	S27	2	5	2	-	midden deposit at mouth of cave	FN 3411, from matrix 24
49	S74	1	FCR3	6	-	fcr column sample	from matrix 40

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
50	-	2	5	3	-	1/4" screen	charcoal count = 11
50	-	2	5	3	-	1/4" screen	charcoal count = 1
51	-	2	6	1	-	1/4" screen	charcoal count = 4
53	-	2	6	3	-	1/4" screen	charcoal count = 5
54	-	2	1	6	-	1/4" screen	charcoal count = 16
54	-	2	1	6	-	1/4" screen	charcoal count = 20+
54	C12	2	1	6	-	sample from possible displaced F2 rock	charcoal
54		2	1	6	-	possible displaced rock from F2	collected 8/20/2011, flat side up
55	-	2	1	7	-	1/4" screen	charcoal count = 7
55	-	2	1	7	-	1/4" screen	charcoal count = 15
55	C1	2	1	7	-	FN 3549, in situ, beneath F2	charcoal
55	C19	2	1	7	-	FN 3544, in situ, below F2	charcoal
55	C20	2	1	7	-	FN 3550, in situ below F2	charcoal
55	C4	2	1	7	-	FN 3548, in situ, below F2	charcoal
55	C8	2	1	7	-	FN 3551, in situ, below F2	charcoal
55	C9	2	1	7	-	FN 3547, in situ, below F2	charcoal
56		1	1	9			rocks and calcium carbonate sample, collected 1/8/2012
57	S58	3	2	-	-	beneath small boulder atop large boulder	
58		1	1	7&8		midden	decomposing (?) burned rocks from lower layers of midden
59	-	1	FCR3	3	-	1/4" screen	charcoal count = 7
59	-	1	FCR3	4	-	1/4" screen	charcoal
59	C22	1	FCR3	9	-	CH-MAR15-1, in situ, deep in midden	charcoal
59	M32.1	1	FCR3	2	-	midden column	background noise
59	M32.2	1	FCR3	2	-	midden column	background noise
59	M32.3	1	FCR3	2	-	midden column	background noise
59	M32.4	1	FCR3	2	-	midden column	background noise
59	HF32.1	1	FCR3	2	-	midden column	background noise
59	HF32.2	1	FCR3	2	-	midden column	background noise
59	HF32.3	1	FCR3	2	-	midden column	background noise
59	HF32.4	1	FCR3	2	-	midden column	background noise
59	M33.1	1	FCR3	3	-	midden column	background noise
59	M33.2	1	FCR3	3	-	midden column	background noise
59	M33.3	1	FCR3	3	-	midden column	background noise

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
59	M34.1	1	FCR3	4	-	midden column	background noise
59	M34.2	1	FCR3	4	-	midden column	background noise
59	M34.3	1	FCR3	4	-	midden column	background noise
59	M38.1	1	FCR3	4	-	midden column	background noise
59	M38.2	1	FCR3	4	-	midden column	background noise
59	M39.1	1	FCR3	5	-	midden column	background noise
59	M39.2	1	FCR3	5	-	midden column	background noise
59	M40.1	1	FCR3	6	-	midden column	background noise
59	M41.1	1	FCR3	7	-	midden column	background noise
59	M42.1	1	FCR3	8	-	midden column	background noise
59	M43.1	1	FCR3	9	-	midden column	background noise, deepest charcoal in CaCO3 layer
59	S66	1	FCR3	4	-	fcr column sample	from matrix 38
59	S68	1	FCR3	9	-	fcr column sample	from matrix 43
59	S75	1	FCR3	5	-	fcr column sample	from matrix 39
59	S79	1	FCR3	7	-	fcr column sample	from matrix 41
59	S80	1	FCR3	8	-	fcr column sample	from matrix 42
59		1	FCR3	3		fcr column sample	burned rock collected as examples of variety in medium size class
60	-	2	3	-	-	in situ, north wall, 89.5 cm b dat z	charcoal
60	S13	2	3	-	-	north wall of area 2	column sample 1
60	S14	2	3	-	-	north wall of area 2	column sample 2
60	S15	2	3	-	-	north wall of area 2	column sample 3
60	S16	2	3	-	-	north wall of area 2	column sample 4
60	S17	2	3	-	-	north wall of area 2	column sample 5
60	S18	2	3	-	-	north wall of area 2	column sample 6
60	S19	2	3	-	-	north wall of area 2	column sample 7
60	S20	2	3	-	-	north wall of area 2	column sample 8
60	S21	2	3	-	-	north wall of area 2	column sample 9
60	S84	2	-	-	-	north profile of area 2	sediment sample 4, bioturbated
60	S85	2	-	-	-	north profile of area 2	sediment sample 5, silty clay
60	S86	2	-	-	-	north profile of area 2	sediment sample 7, dark clay
60	S87	2	-	-	-	north profile of area 2	sediment sample 8, clay with FCR
60	S88	2	-	-	-	north profile of area 2	sediment sample 3, "fluff"
60	S89	2	-	-	-	north profile of area 2	sediment sample 6, "silty clay"
61	S46	1	1	-	-	southwest profile of area 1	sediment column sample 1

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
61	S47	1	1	-	-	southwest profile of area 1	sediment column sample 2
61	S48	1	1	-	-	southwest profile of area 1	sediment column sample 3
61	S49	1	1	-	-	southwest profile of area 1	sediment column sample 4
61	S50	1	1	-	-	southwest profile of area 1	sediment column sample 5
61	S51	1	1	-	-	southwest profile of area 1	sediment column sample 6
61	S52	1	1	-	-	southwest profile of area 1	sediment column sample 7
61	S53	1	1	-	-	southwest profile of area 1	sediment column sample 8
63	-	1	3	2	-	1/2" screen	charcoal count = 1
63	M35.1	1	3	2	-	midden column, replacing FCR3 L2	background noise
63	M35.2	1	3	2	-	midden column, replacing FCR3 L2	background noise
63	M35.3	1	3	2	-	midden column, replacing FCR3 L2	background noise
63	M35.4	1	3	2	-	midden column, replacing FCR3 L2	background noise
64	C26	1	3	3	-	CH-MAR13-2, in situ	charcoal
64	C27	1	3	3	-	CH-MAR13-1, in situ	charcoal
65	-	2	7	1	-	1/4" screen	charcoal count = 20+
65	M44.1	2	7	1	-	cave column	background noise
65	M44.2	2	7	1	-	cave column	background noise
65	S73	2	7	1	-	cave column sample	from matrix 44
66	-	2	7	2	-	1/4" screen	charcoal count = 20+
66	-	2	7	2	-	1/4" screen	charcoal count = 20+
66	M45.1	2	7	2	-	cave column	background noise
66	M45.2	2	7	2	-	cave column	background noise
66	S78	2	7	2	-	cave column sample	from matrix 45
67	-	2	7	3	-	1/4" screen	charcoal count = 20+
67	-	2	7	3	-	1/4" screen	charcoal count = 20+
67	-	2	7	3	-	1/4" screen	charcoal count = 20+
67	-	2	7	3	-	1/4" screen	charcoal count = 7
67	-	2	7	3	-	1/4" screen	charcoal
67	M46.1	2	7	3	-	cave column	background noise
67	M46.2	2	7	3	-	cave column	background noise
67	S67	2	7	3	-	cave column sample	from matrix 46
67	BR-May24-1	2	7	3	-		sample burned rock from cave context
68	-	2	7	4	-	1/4" screen	charcoal count = 20+
69	-	2	7	5	-	1/4" screen	charcoal count = 20+

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
69	-	2	7	5	-	1/4" screen	charcoal count = 20+
69	-	2	7	5	-	1/4" screen	charcoal count = 20+
69	C31	2	7	5	-	1/4" screen	charred lechuguilla leaf?
69	M51.1	2	7	5	-	beneath roof spall south end of unit	non-feature context
69	M51.2	2	7	5	-	beneath roof spall south end of unit	non-feature context
69	S77	2	7	5	-	beneath roof spall south end of unit	non-feature context, from matrix 51
70	-	4	1	1	-	1/4" screen	charcoal count = 3
71	-	4	1	2	-	1/4" screen	charcoal count = 1
72	-	4	1	3	-	1/4" screen	charcoal count = 11
73	-	4	1	4	-	1/4" screen	charcoal count = 12
74	-	4	1	5	-	1/4" screen	charcoal count = 4
75	-	4	1	6	-	1/4" screen	charcoal
75	-	4	1	6	-	1/4" screen	charcoal count = 7
75	C30	4	1	6	-	CH-JUN7-1, in situ	charcoal
76	C3	1	FCR2	4	F7	FN 3587, potentially feature context	charcoal
76	C6	1	FCR2	4	F7	FN 3593, potentially feature context	charcoal
76	M31.1	1	FCR2	4	F7	potential feature context	from possible feature missed in context, FN 3572
77	M37.1	1	3	-	F8	between and beneath feature rocks	little plant material from feature context
77	M37.2	1	3	-	F8	between and beneath feature rocks	little plant material from feature context
78	-	2	7	-	F9	1/4" screen	charcoal count = 5
78	-	2	7	-	F9	1/4" screen	charcoal count = 4
78	C18	2	7	-	F9	CH-JUN8-1, in situ, weak association	charcoal count = 20+
78	C21	2	7	-	F9	CH-JUN7-2, in situ, fair association	charcoal
78	M48.1	2	7	-	F9	beneath feature rocks G-R	many large bits of charcoal from feature context
78	M48.2	2	7	-	F9	beneath feature rocks G-R	some mid-sized bits of charcoal from feature context
78	M48.3	2	7	-	F9	beneath feature rocks G-R	heavy fraction charcoal
78	M49.1	2	7	-	F9	beneath feature rocks HH-NN	some small bits of charcoal
78	M49.2	2	7	-	F9	beneath feature rocks HH-NN	heavy fraction charcoal
78	M52.1	2	7	-	F9	from beneath rocks FFFF and GGGG	fair context, south margin of feature

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
78	M52.2	2	7	-	F9	from beneath rocks FFFF and GGGG	fair context, south margin of feature
78	M53.1	2	7	-	F9	feature context, beneath rock QQ	good context to date feature
78	S59	2	7	-	F9	from beneath feature rocks	
78	S62	2	7	-	F9		
78	S64	2	7	-	F9	from beneath rocks FFFF and GGGG	south margin of feature, from matrix 52
78	S65	2	7	-	F9	beneath feature rocks HH-NN	from matrix 49
78	S69	2	7	-	F9	feature context, beneath rock QQ	from matrix 53
78	S70	2	7	-	F9	beneath feature rocks G-R	from matrix 48
78	Rock QQ	2	7	-	F9	feature	collected for microfossil analysis 6/18/2012
78	Rock C	2	7	-	F9	feature	collected as groundstone 6/7/2012, covered in salt crystals
78	Rock U	2	7	-	F9	feature	collected as groundstone 6/7/2012
78		2	-	-	F9	feature	cleanup/dislodged small burned rocks
79	Rock WWW	2	7	-	F10	feature	sample feature rock, broken to examine interior color change
79	C23	2	7	-	F10	CH-JUN14-2, in situ	charcoal
79	C24	2	7	-	F10	CH-JUN14-1, in situ	charcoal
79	C25	2	7	-	F10	CH-JUN14-3, in situ	charcoal
79	M50.1	2	7	-	F10	beneath feature rocks east of section line	little observable charcoal
79	S81	2	7	-	F10	beneath feature rocks east of section line	from matrix 50
80	C13	1	1	-	-	northeast profile wall, z=95.1957	charcoal
81	-	2	7	6	1	1/4" screen	charcoal count = 20+
81	M54.1	2	7	6	-	cave column	background noise
81	M54.2	2	7	6	-	cave column	background noise
81	S76	2	7	6	-	cave column sample	from matrix 54
82	C29	2	7	7	-	1/4" screen	charred sotol leaf?
82	M55.1	2	7	7	-	cave column - lowest	good opportunity to date the extent of cave deposits
82	M55.2	2	7	7	-	cave column - lowest	lowest but less charcoal observed than M55.1
82	S72	2	7	7	-	cave column - lowest	from matrix 55
86	S60	2	-	-	-	west wall of area 2	sediment sample 4

Lot No.	Spec. No.	Area	Unit	Layer	Feature	Context	Description/Notes
86	S61	2	-	-	-	west wall of area 2	sediment sample 1
86	S63	2	-	-	-	west wall of area 2	sediment sample 3
86	S82	2	-	-	-	west wall of area 2	sediment sample 2
86	S83	2	-	-	-	west wall of area 2	sediment sample 5

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