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Microdebitage analysis of 3rd Unnamed Cave : a terminal archaic chert mine on the Cumberland Plateau

Valerie Esther Altizer

To the Graduate Council:

I am submitting herewith a thesis written by Valerie Esther Altizer entitled "Microdebitage analysis of 3rd Unnamed Cave : a terminal archaic chert mine on the Cumberland Plateau." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Jan F. Simek, Major Professor

We have read this thesis and recommend its acceptance:

Charles H. Faulkner, Walter E. Klipper

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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MICRODEBITAGE ANALYSIS OF 3RD UNNAMED CAVE: A TERMINAL ARCHAIC CHERT MINE ON THE CUMBERLAND PLATEAU

A Thesis
Presented for the
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Degree
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Valerie Esther Altizer
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ABSTRACT

The purpose of this study was to examine the distribution of microartifacts in a prehistoric chert mine located deep within the dark zone of 3rd Unnamed Cave, which is located on the Cumberland Plateau of Tennessee. Previous research at this site concluded that prehistoric hunter-gatherers entered the cave about 3,000 years ago to mine and then extensively test and reduce chert nodules, subsequently leaving hundreds of piles of flintknapping debris in primary position. Microartifacts were used in this study to augment and strengthen the inferences made about the mining and flintknapping activities practiced in 3rd Unnamed Cave during the Terminal Archaic. Microartifact analysis has been shown to be particularly useful in the identification of activity areas, due to the fact that sediment-size artifacts are less subject to postdepositional disturbance than larger artifacts. In this research spatial distributions of microartifacts are analyzed and compared to macroartifact spatial distributions in order to test if the flintknapping concentrations are in fact primary accumulations or secondary deposits. It is proposed that if these lithic accumulations are in primary position, the distribution of macrolithics will have a corresponding distribution of microlithics. The microartifact distribution in stratified profiles within the mining chamber will also be analyzed in order to detect possible buried activity areas.

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Chapter I.

Introduction

This thesis examines the potential of microartifact analysis to interpret the prehistoric chert mining and knapping activity within 3rd Unnamed Cave, which lies at the base of the Cumberland Plateau escarpment in north-central Tennessee (Franklin 1999; Simek et al. 1998). The deep cave site was intensively utilized during the Terminal Archaic Period, as evidenced by torch stoke marks, chert mining pits with digging stick marks, accumulations of flintknapping debris, fireplaces, footprints, and petroglyphs. Charcoal samples from this site have yielded calibrated C^{14} ages ranging from 2908 to 4983 BP. According to these dates, this represents one of the earliest recorded cave art sites in North America. Refitting experiments using the macrolithics present on the surface suggest that chert nodules found in the cave were simply reduced on site to determine the quality of the raw material (Franklin 1999). High quality chert flakes were then transported out of the cave for future use, while inferior material was left in the mining chamber. There is no clear evidence that any further reduction or actual production of lithic tools occurred inside the cave. Of the more than 15,000 artifacts recovered from the site, the vast majority consisted of chert debitage, core fragments, and a few chalcedony hammerstones. Only two retouched lithic tools have been recovered; a partially retouched flake, and a Matanzas point associated with the Late Archaic in this region of Tennessee (Des Jean and Benthall 1994; Simek et al. 1998).

Additional archaeological research conducted at this site includes studies of the petroglyphs incised on the walls, the nature and patterns of the chert mining and flintknapping activities practiced deep within the cave, and analysis of the sedimentary history of the site (Franklin 1999; Simek et al. 1998). Core refitting experiments, mass analysis of the lithic debris, and radiometric dating of numerous and stratigraphically variable flintknapping concentrations have been undertaken in order to address the periodicity of chert mining in 3rd Unnamed Cave. The archaeological evidence indicates that intensive utilization of the cave for mining took place over a relatively short span of time. All of the radiocarbon dates obtained from charcoal samples within the mining chamber fall within a 400 year range. The addition of microartifact analysis can be used to test the interpretations of the chronology and the mining exploitation produced by the conventional archaeological research that has been conducted, and the remarkably stable cave environment in which this site is located provides a unique situation in which to utilize and develop this method of artifact analysis.

Microartifact analysis is the microscopic examination of artifacts smaller than 2.0 mm (Sherwood and Ousley 1995; Stein and Teltser 1989). The larger size limit is determined by Dunnell and Stein (1989) to be the point at which surface collection and excavation sieving cease to be practical. A major advantage of studying microartifact distributions is their relative abundance in the archaeological record, which allows for quantitative analysis (Fladmark 1982; Sherwood and Ousley 1995). The application of an automated computer program greatly increases the efficiency of point counting, which alleviates the problem of time-intensiveness associated with this type of analysis (Sherwood and Ousley 1995). Microartifact analysis has been shown to provide information unobtainable from other site data, particularly in interpreting the depositional history of a site and the identification of activity areas (Dunnell and Stein 1989; Sherwood et al. 1995). This is due to the fact that sediment-sized artifacts more accurately reflect activity areas than larger-sized artifacts, which are more likely to be subject to scavenging, reuse, and other post-depositional disturbance by humans and other agents (Dunnell and Stein 1989; Fladmark 1982; Hull 1987; Stein and Teltser 1989).

Certain site types are more suited to microartifact analysis than others; particularly areas inferred to have been inside structures (Hull 1987). In these constricted areas foot traffic and soil compaction are more intense, working the smaller objects into the soil. The deep cave passage in which the prehistoric mining took place in 3rd Unnamed Cave was a constricted area and experienced these same processes.

The interiors of structures were also found to be more suited to microartifact analysis because of their protection from environmental disturbances, such as aeolian transport and freezing/thawing which can affect these small-sized particles (Hull 1987). Hull (1987) found open air sites, such as temporary campsites and quarries, not especially appropriate due to poor pattern preservation. To this point, previous research undertaking microartifact analysis has been conducted on various sites including tipi rings in Canada (Hull 1987), a protohistoric longhouse on the northwest coast of the United States (Vance 1986), an Iron Age city in Israel (Rosen 1989), and Mississippian house floors in the southeast United States (Sherwood 1991; Sherwood et al. 1995). However, all previous microartifact analysis has been conducted within enclosed structures that subsequently became open-air archaeological sites. Third Unnamed Cave represents a unique opportunity because it has been exempt from many of the post-depositional processes that affect open air sites. The deep cave environment is protected from erosional processes such as aeolian transport, sheet wash, bioturbation, leaching, and many fluvial processes that may displace small artifacts. This mining site was also never subjected to the many cultural processes that routinely occur on residential sites, such as sweeping or cleaning of the interior of a structure, or historic plowing. The large number of *in situ* knapping debris concentrations in the primary mining chamber of 3rd Unnamed Cave provides an amazing archaeological record of prehistoric mining and lithic reduction activity with which to utilize microartifact analysis.

Ethnographic Evidence

The observation of modern populations and small-size artifacts has yielded information about the spatial organization of activities and formation processes of archaeological deposits. Schiffer (1983:679) states that size effects are a result of formation processes that can reduce the dimension of artifacts and sort artifacts by size. The term "McKellar Hypothesis" was first coined by Schiffer (1983:679) based on a study that McKellar conducted on the University of Arizona campus in 1983. During McKellar's observations of discard practices on campus, small artifacts were found to be left behind at activity areas that underwent regular maintenance. The McKellar Hypothesis states that smaller items are more likely to become primary refuse in regularly maintained activity areas (Schiffer 1976:679). In other activity areas that are not habitually cleaned, such as some lithic-quarry workshops and abandoned structures, larger items can accumulate as primary refuse (Schiffer 1976).

The size-sorting effects resulting from cleaning activities and refuse disposal are well documented in ethnoarchaeological studies. In Binford's (1978:304) ethnographic study of the Nunamiut in Alaska, he found that an accumulation of small objects occurred in activity areas that tended to be reused for specific tasks, resulting in what he termed a "drop zone". The larger debris was removed to an area peripheral to the activity area, resulting in a "toss zone". O'Connell's (1987) study of intrasite structure of the Alyawara in Australia also found that the principal activity areas of the camps were characterized by the prevalence of tiny items and the relative absence of larger debris, which was deposited in zones of secondary refuse. O'Connell suggests that because larger items are subject to cultural sorting, they are less informative than smaller items.

Nielsen (1991) carried out several experiments in order to study the transformations of the archaeological record affected by trampling. He concludes that “very small items (<2 cm) are trodden readily into the loose sediments that cover hard-packed substrates when they are exposed to trampling erosion. As a result, the horizontal movement of these small items is drastically reduced. Therefore, if other factors are held constant, very small items will be found close to their original place of deposition (Nielsen 1991:492).”

While there are many ethnographic and experimental studies indicating that the location of micro-size material has a high probability of predicting the location of the activity that produced them, it must always be considered that the patterning created by human activity can be significantly altered in the archaeological record by various post-depositional processes (Sherwood 1991).

Research Goals

The presence, location and relative density of microdebitage within this cave will be utilized to answer questions regarding the spatial organization and lithic reduction activity that was carried out within this cave. The chamber containing the chert mining activity and petroglyphs in the cave is located over a kilometer from the entrance in the dark zone of the cave (Simek et al. 1998). The surface of this chamber is highly undulating due to the extensive digging and redeposition associated with the mining activity and the breakdown of the roof. Crothers and Watson (1993:56) state that “there is no indication that the integrity of the prehistoric deposits has been altered by processes other than the original acts of quarrying and cobble reduction.” The present-day surface of the mining chamber is the same surface that was abandoned by the prehistoric miners, and provides an archaeological deposit relatively unaltered by natural and cultural post-depositional processes. Microarchaeological analysis of floor sediments provides a means of distinguishing primary from secondary refuse. The horizontal comparison of microartifact quantities within one stratigraphic unit should provide information on the spatial distribution of activities within the site (Rosen 1986:116).

Most of the mining activity occurred in the eastern half of the chamber and in this area, designated Area A, a profile was first produced during excavations in 1981 and has been recut and reexamined during recent study (Simek et al. 1998). This profile contains interstratified coarse and fine sediments, ranging from very fine sand particles to rounded gravel and cobble-size chert nodules (Figure 1). Anthropogenic material observed in this profile includes lithic debitage, charcoal, and ash. Seven distinct lithostratigraphic units in this profile are identified, distinct from one another with abrupt boundaries. Two buried surfaces are also present in the profile, evidenced by an approximately 5 mm thick white and black patina. The white silt and sand-sized particles were identified in thin section as weathered bedrock fragments by Sherwood (personal communication), probably originating from the chamber ceiling. The origin of the black material has yet to be determined (Simek et al. 1998). The top surface of the profile is covered by a concentration of chert

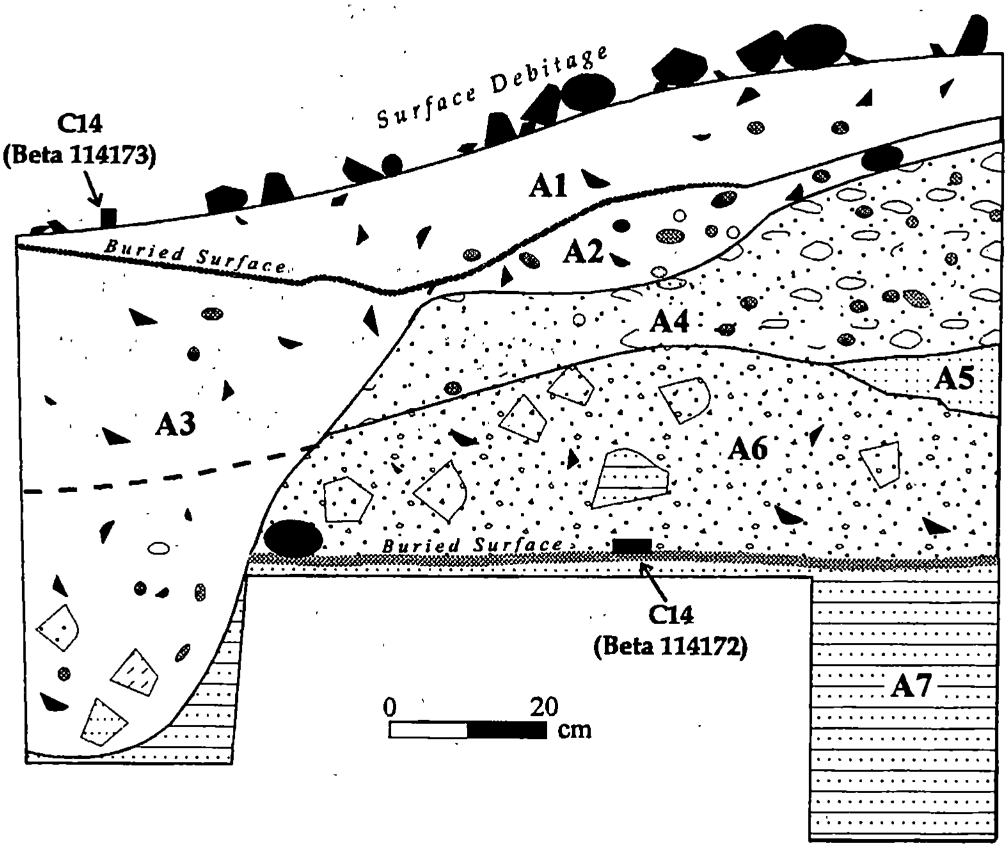

Figure 1. Area A: West Profile (after Simek et al. 1998:668, Figure 4).

nodules and debitage. The mixed nature of this profile is interpreted as a result of prehistoric mining activity (Franklin 1999; Simek et al. 1998). The presence of two buried surfaces and buried knapping debris indicate that it is possible that these scatters and buried concentrations represent discrete knapping episodes spanning an unknown length of time. The presence and quantity of microartifacts in these lithostratigraphic units will help determine whether these sediments are homogenized as a result of being disturbed and removed from primary context by prehistoric mining activities as put forth by Ferguson (1982:6), or do they represent discrete episodes of activity?

The primary goal of this research is to examine microartifact patterning within the primary mining chamber of 3rd Unnamed Cave in order to understand the prehistoric lithic reduction activity and its periodicity. The second goal is to compare the data obtained by microartifact analysis to the interpretations developed by studying the macro scale material from this site. Other researchers have pointed out that one of the past problems with this type of analysis is the exclusion of macro scale material in the interpretation of microartifacts. Dunnell and Stein (1989), Rosen (1986), and Sherwood (1991; 2000) have insisted that no microarchaeological study can stand alone without comparison with the results from conventional archaeological data. A thorough analysis of the macro scale material from this site is provided by Jay Franklin (1999), who undertook extensive study of the lithic workshop using core refitting analysis, mass analysis, Sullivan and Rozen's (1985) "interpretation free" approach, and Magne's (1985) debitage stage model. The microartifact analysis undertaken here is designed to enhance the interpretations of the associated macroartifact assemblage produced by Franklin for his 1999 M.A. thesis on 3rd Unnamed Cave.

Background Review

The following is a review of microartifact studies outlining the types of questions that this analysis has the potential to answer, and the general methodology being applied to microartifact studies. The definition of what qualifies as a microartifact varies somewhat in the literature, but size ranges generally fall within coarse to medium sand-sized particles (2mm to .25 mm).

Microartifacts were recognized several times in archaeological sites as being a result of human activity (Dincauze 1976; Farrand 1975; Hughes et al. 1981; Vance 1986, 1989), but were not specifically an object of study until Hassan first coined the term "microarchaeology" in 1978. At the Neville site in New Hampshire, Dincauze (1976:11) predicted that cultural lithic debris would be angular in contrast to the rounded floodplain sands present in the sediment. Two excavation levels at this site were said to be the result of cultural activities due to this criteria, but no other use was made of these data. Farrand (1975) conducted sedimentological analysis of the Abri Pataud in France and identified small stone chips and larger lithics in sediment samples as cultural in origin. The abundance of smaller cultural material was determined by Farrand (1975:16) to be "a more reliable estimate of the intensity of habitation than the large artifacts". In a similar study, Cinq-Mars (1979:21) conducted microscopic analysis of sediments from a cave in the northern Yukon and recognized "microchips" smaller than 3 mm. His report noted that these microchips fall within the morphological range of detrital material resulting from flint-knapping. These were also compared to traditional size lithic artifacts and were found to exhibit most of the attributes present on larger flakes (Cinq-Mars 1979:21). Microdebitage was used in this study to help define four different cultural horizons.

In a 1978 article, Hassan was the first to suggest applying the study of archaeological sediments to identify activity areas. His paper introduced the term microarchaeology, and he states that "microarchaeological remains are unlikely to suffer from the problems of intentional removal by man or other agents which may obfuscate any indications of the kind of activity" (Hassan 1978:208). At the Hungry Creek site in the northern Yukon (Hughes et al. 1981), microdebitage was noted in the microscopic examination of macrofossil samples. Odd-looking sand grains were noticed under the microscope and were initially believed to be cultural due to the angularity of the grains, the absence of "micro-cores" that they could have originated from, and their dissimilarity to the sand grains in the samples. Later comparison to experimentally produced microdebitage confirmed this.

In 1982, Fladmark published a seminal study on microdebitage in which he explored its potential for identifying cultural deposits and lithic reduction strategies. He (1982:205) defined microdebitage as "particles less than 1 mm in maximum dimension resulting from deliberate lithic reduction". Fladmark conducted experimental replication and found that microdebitage is produced in great quantities during flint knapping activity. In his study he addressed five questions regarding microdebitage:

> (1) "what quantities of microdebitage, in various size fractions, are produced by different lithic reduction techniques;
> (2) what procedures and criteria are necessary for the routine and reliable recognition of microdebitage of raw materials in site sediments;
> (3) what are the frequency relationships between Macrodebitage and microdebitage in archaeological sites;
> (4) what factors affect the deposition and relative frequencies of different size classes of debitage in archaeological contexts, and;
> (5) what would be the advantages of carrying out microdebitage analysis in archaeology" (Fladmark 1982:205).

To address the first question, Fladmark (1982) used hard hammer percussion to reduce two obsidian cobbles to large flake blanks. Then soft hammer (antler billet) percussion was used to reduce two of these flakes into biface preforms. The final reduction involved using pressure flaking to retouch the preforms into large stemmed projectile points. One hundred percent of the knapping debris was collected and size sorted. He concluded that although overall weight proportion tends to be low, very high numbers of microdebitage are produced. He also found that the relative proportion of microdebitage vs. macrodebitage varies greatly between the three different flaking techniques. However, Vance (1989:12) notes that he "does not discuss the possibility that the differences between macro and microdebitage for the different techniques may be due to the fact that each process began with a product of the process before it. Therefore the results of each process were constrained to a be a subset of those in the previous process, in grain size and weight". For this reason Vance believes his second conclusion is not established.

Fladmark (1982:208) addresses his second question by producing microdebitage samples from 14 types of raw material and examined them under a microscope. He found six general characteristics of microdebitage: (1) highly angular forms (particularly when seen in a context of well-rounded sedimentary clasts), (2) transparent to translucent under transmitted light, (3) often longer than the mean particle size of the sample (due to elongated thinness which allows it to slip through rectangular mesh), (4) usually regular geometric shapes, (5) usually some aspects of conchoidal fracture, and (6) the debitage usually lies close to the surface plane of the microscope slide.

Fladmark's third question addresses the frequency relationship between micro- and macrodebitage in archaeological sites. For this he analyzed an experimental knapping area, first by counting the concentration of macroflakes on the surface of the area by 1x1 m quadrats. Second, bulk sediment samples were removed from the center of each quadrat. Microdebitage was easily recognizable in the sand matrix and the samples were arbitrarily standardized by scanning 10,000 particles from each of four different size fractions (0.5, 0.125, and 0.063 mm). This was done in order to obtain statements of the density of microdebitage relative to natural sedimentary components. These results were then compared to a plot of surface macrodebitage. Fladmark (1982:212) concluded that "initial tests of correlation between macrodebitage and microdebitage density distributions indicate that small, systematically collected sediment bulk samples can yield microdebitage frequencies possessing close relative density correlations with total macro flake counts for adjacent 1 meter square areas".

Fladmark (1982:213) then examined potential uses for microdebitage analysis in archaeological studies. Samples from a stratified profile on an archaeological site were examined to determine whether or not the technique could be used to discriminate cultural from non-cultural sediment samples, and to determine what the actual relative densities might be in a true archaeological context. He found that the technique verified the presence of multiple components at the Farrell Creek site. The plot of microdebitage counts relative to the frequency of macrodebitage did not fit his prediction of positive correlation. They actually showed marked vertical displacement (Fladmark 1982:214). This he attributed to aeolian transport, as the site was on an active sand dune, probably the worst possible context to expect positive correlations between micro- and macrodebitage.

Fladmark (1982:216) concludes his consideration of microdebitage studies by envisioning a number of potential uses for future work, including site verification and intra-site studies. He states that although more research needs to be undertaken, microdebitage provides a useful means of site determination since it is stable and not subject to such post-depositional processes of macrodebitage as re-use, collecting, etc. Microdebitage could be useful for site surveying in conditions unfavorable to normal survey, for location of deeply buried sites, and for verification of problematic sites. It could also be used in intrasite studies to indicate distance from flaking source, to determine whether macro-cultural material results from primary occupation or from secondary deposition, and Fladmark (1982:216) suggests that granulometric analysis of debitage in primary knapping areas may even indicate which lithic reduction process was carried out there.

Fladmark's study was used as the basis for subsequent work and prompted other researchers to use the technique to address questions of spatial distribution and activity area interpretation. Nicholson (1983) utilized four different survey techniques to recover macroartifacts and microdebitage in the field. The different techniques were evaluated on the proportion of the tests that recovered artifacts. These were also evaluated in terms of time intensiveness. He selected a known prehistoric site along the Assiniboine River, in southern Manitoba, to test the different techniques. At this location, microdebitage was generally found on the south side of the site under examination and macroartifacts found on the north side. This discrepancy was attributed to the presence of dunes in the area. Nicholson (1983:279) concluded that microdebitage may be useful in determining locations of prehistoric occupations in an area where any erosional process is operating.

The first activity area study was conducted by Hull for her master's thesis (1983; further reported in 1987) in which she applied the study of microdebitage to the Bow Bottom site (a group of tipi rings near Calgary, Alberta) in order to examine spatial patterning. She states that experimental and ethnographic information reveals that lithic manufacture areas can be identified by a cluster of microdebitage produced by reduction and pressure flaking, with or without a corresponding high density of macrodebitage. Using Schiffer's (1976) model of primary, secondary, and de facto refuse for intrasite analysis, she posits that microdebitage could aid in distinguishing between activity and disposal areas, as well as assessment of "tool kits". At the Bow Bottom site, samples were collected from the center of each excavation unit in three of the rings. Two phi (0.5-0.25 mm) particles were examined for analysis and frequency maps of microdebitage and macroartifacts were applied to a model. Hull's model for microdebitage distribution defines primary refuse as a cluster of macrodebitage corresponding to a cluster of microdebitage. Secondary refuse consists of macrodebitage with no corresponding cluster of microdebitage. De facto refuse is similar in composition to primary refuse, but occurs when large objects are left at the location of use because the area was to be abandoned (Hull 1987; Schiffer 1976). At areas where lithic tool manufacture took place, microdebitage should be the main constituent. Hull (1987) found that the distribution of macroartifacts does not correspond from one tipi ring to another, but when microdebitage is included, common patterns become visible. These patterns she believes show a fairly good fit to ethnographic accounts of space use by tipi-dwellers. Hull (1987:782) concludes that microdebitage can be useful in spatial analysis, but that not all sites are equally suited to this type of analysis. She (1987:773-774) discusses three site characteristics that would aid this type of analysis: long term use of the site in which the material forms patterns, enclosed structures which make the material less likely to be dispersed during manufacture or disturbed after deposition, and soil compaction to tread the microdebitage into the soil and help preserve the patterning. Hull also mentions the problem of the time and equipment requirements for this technique, making quantitative analysis of the data difficult (1987). Hull's work is significant because it expanded the range of microdebitage applications, and its influence can be seen in subsequent microarchaeological studies concerning site formation processes and activity area identification (Reese 1986, Rosen 1989, Vance 1989, Sherwood 1991, and Sherwood et al. 1995).

Reese (1986) examined an historic Chinese workers' bunk area at the Warrendale Cannery site in Oregon using historic data and microartifact distributions to identify activity areas. Three size fractions were analyzed ranging from 6.3 to 0.5 mm. The types of microartifacts present, including brick and mortar, glazed ceramics, glass, bone, and charcoal, were examined in terms of their associations with each other, with other features, and with historic data. The microartifact data correlated with macroartifact distribution and historic data and Reese's study proved to be successful. The data allowed her to locate three garbage dumps, a garden area, and several outbuildings known to have existed from informant accounts and photos.

Rosen (1989) also used microartifact analysis to study site formation processes at tell sites in Israel. Two problems were addressed by the analysis of microscopic remains: the identification of activity areas, and site formation processes during the period of occupation. She (1989:568) collected bulk sediment samples from courtyards, interior room floors, and streets and sorted them into five size fractions (>5 mm, 2 mm, 1 mm, .50 mm, and .25 mm). The artifacts were examined microscopically, and the artifact percentages were visually estimated with the aid of visual percentage charts. The presence or absence of different artifact types in the samples was used to infer specific activities within a room, primary or secondary use of a room, and the relative intensity of activities at different locations. Aquatic resources, undetected by conventional archaeological procedures, were found in microarchaeological samples. Rosen (1986:113) points out that her results from Tell Qasile do not support Gifford's (1978) hypothesis that trampling in coarse sediments results in size sorting of artifacts.

Vance (1989) used microdebitage data in a similar fashion to compare micro and macro artifacts at two different sites in the United States in order to test activity area hypotheses. The first site was a protohistoric longhouse near Renton, Washington where macroartifact distributions had been used to make inferences about activity areas. Vance collected bulk sediment samples representing each activity area and examined the 1.0 mm to 0.5 mm size fraction. Lithics, ocher, rust, bone, and shell were identified microscopically in the sediment samples. The microartifacts were analyzed in order to test earlier activity area interpretations that had been made based on macroartifact distributions. Vance's results were in concordance with some of the activity area interpretations and in discordance with others. The only ones that showed discordance were areas that had been interpreted as flint knapping areas. The second study area was a surface collection area in Dunklin County, Missouri. Vance (1989) used a stratified random sampling design to collect sediment samples from a plowed field that had been surface collected. She looked at the same size fraction (1.0-0.5 mm) and compared the micro and macro plow zone distributions. Prehistoric lithic and ceramic fragments were identified under microscopic examination. Correlation was found between the macro and micro artifacts, and Vance interpreted these concentrations as activity areas. However, this provided no information in addition to what had previously been obtained by surface collection of the larger-sized artifacts. Vance (1989:157) points out that her sampling interval was undoubtedly too coarse (20 m squares), possibly larger than the circumference of an activity area. Also, in a plow zone situation it was not possible to differentiate between multiple occupations at the microscopic scale.

Other researchers examining low density plow zone sites in Missouri incorporated microartifact data in their interpretations. Stein and Teltser (1989) studied site formation processes by examining the size distributions of artifact classes within the plow zone to test interpretations of site deposition created by the use of other site data. They found that mechanical weathering of ceramics and lithics produce relatively abundant sand-size particles. Madsen and Dunnell (1989) examined the use of microartifacts to compensate for the typical lack of macroartifacts in low density plow zone sites. They determined that the abundance of microartifacts can alleviate the problem of small sample size, which in turn aids the assessment of land use patterns in this type of site.

Other studies have used microartifact analysis to look at intrasite structures. Metcalf and Heath (1990) looked at the spatial distribution of microrefuse on the floors of a structure from a Nawthis Village in central Utah. The sediment was floated, and the material <4.75 to >2.38 mm in size was analyzed and tabulated. Their focus was on the variation of microrefuse within and between rooms, with the goal of making inferences about the structure of the inhabitants' activities in the structure. Bulk sediment samples were collected at 1 m intervals across the floor. Metcalf and Heath's (1990) study of microartifacts allowed them to identify possible activity areas and their association to the hearth. However, they did not provide a comprehensive approach to the study of assemblage variation because they failed to include the remainder of the artifact record, including macroartifacts and microartifacts falling under 2 mm (Sherwood 1991).

Simms and Heath (1990) utilized the study of microrefuse at a fifteenth century hunter/gatherer site in Utah. Sediment samples were collected from various deposits that had been previously interpreted as features, including hearths, activity areas, and secondary refuse deposits. These bulk samples were processed for microartifact analysis using the same laboratory protocol as that of Metcalf and Heath (1990). The goal of Simms and Heath was to address site structure, site function, seasonality, duration of occupation, and assemblage composition with microrefuse on the basis of ethnoarchaeological interpretation. The authors report that they had difficulty in distinguishing activity areas within the site because the microartifact distribution is fairly consistent, with no discernable concentrations. They were, however, more successful in using the microrefuse to interpret formation processes. They could distinguish some deposits as secondary and probably the result of dumping due to the relative absence of microrefuse. The minerals variscite and calcite were also identified in the sediment which were not present at the macro-scale. Simms and Heath (1990) report that the variscite morphology seen at the micro-scale indicates ornament manufacture and the calcite indicates possible ceramic manufacture (calcite is not natural to the local sediments).

Sherwood (1991) examined microartifacts from a late Mississippian Dallas Phase house floor from the Loy site in Tennessee. The goal of this research was to determine if the organization of interior space can be better defined with the addition of microartifact analysis to traditional methods of macroartifact analysis. The distribution of the macrolithics on the house floor was found to cluster around the hearth area. The microlithics, however, were found to cluster in the southern corner of the structure to the right of the entranceway. Sherwood

(1991:82) explains this as an out of the way location, away from the benches and central hearth where flintknapping could have been performed without endangering others with the resulting sharp debris. Sherwood also found microartifact clusters of charcoal, bone, and ceramics away from the central areas and underneath the benches, while the macro concentrations of these material classes are associated with the hearth. Sherwood (1991:90) interpreted the cluster of microlithic debitage with an absence of macrodebitage as an activity area with possible discard of the larger material. The micro distributions of charcoal, ceramics, and bone concentrated along the walls are attributed to cultural sorting processes, specifically sweeping. Cleaning activities to remove refuse away from foot traffic and from sight could have swept microartifacts in a direction away from the public center of the house to the area beneath the benches (Sherwood 1991:96).

In summary, the literature on microartifact analysis indicates its potential to address many archaeological questions concerning site formation processes, spatial analysis, and lithic reduction techniques in addition to enhancing interpretations generated from macroartifact assemblages. Past research has revealed deficiencies with this relatively new technique including sampling problems, the time required for analysis, and the exclusion of associated macroartifacts. More recent work focusing on microartifact analysis, particularly by Sherwood (1991;2000), has offered solutions to overcome these deficiencies by standardizing the protocol and applying computer programs to expedite quantification. Utilizing these techniques, microartifact analysis was used to examine the formation processes of the archaeological deposits in 3rd Unnamed Cave, and to test whether the lithic deposits were primary or secondary accumulations. I present the results of this research according to the following outline.

The environmental setting of the site is presented in Chapter II. First, the history of archaeological investigations of the site is summarized. Then the physiography and geology of the area are described.

In Chapter III, the cultural context of 3rd Unnamed Cave is presented. Relatively little archaeological research has been conducted in the Cumberland Plateau area where the site is located, so much of the culture history of this area is actually based on research in adjacent areas, such as the Highland Rim to the west and the Ridge and Valley Province to the east. What is known about the cultural context of the area is summarized here.

In Chapter IV, the field methods employed in the microartifact analysis of 3rd Unnamed Cave are described. Archaeological research concerning the cave has been carried out for over two decades, and an effort has been made to maintain continuity in research design and field techniques (Franklin 1999). The methods used in this research project were designed to incorporate previous research and artifact collections from the cave.

In Chapter V, the chronological context of the chert mining and flintknapping activities in 3rd Unnamed Cave is discussed. All radiocarbon assays and the lone diagnostic stone tool place these activities in the Late/Terminal Archaic Period, ca. 3000 years before present.

In Chapter VI, the laboratory and analytical methods used for microdebitage analysis are summarized. The modifications in procedure that were designed to improve convenience, precision, and speed are discussed.

In Chapter VII, the results of this study are demonstrated graphically. Microdebitage presence, location, and density are used to answer spatial and behavioral questions concerning the chert quarrying and lithic reduction activities carried out in 3rd Unnamed Cave.

In Chapter VIII, the results of this research are summarized. This study provides insights into the application of microartifact analysis to examine site formation processes, and specifically to answer spatial questions concerning lithic reduction activity areas.

Chapter II.

Environmental Setting

Physiography

3rd Unnamed Cave is located in a 300 m deep river gorge within the western escarpment of the Cumberland Plateau. The Cumberland Plateau is part of the Appalachian Plateau physiographic province which extends from northeastern Alabama to western Pennsylvania (Fenneman 1938). It is bordered on the west by the Eastern Highland Rim section of the Interior Low Plateau Province and on the east by the southern portion of the Ridge and Valley Physiographic Province. The Highland Rim contains abundant chert resources, while the Cumberland Plateau is generally a chert-poor region (Franklin 1999). There are exceptions, however, along the western escarpment where numerous rivers and streams have eroded deep gorges into the sandstone caprock and exposed chert deposits associated with the underlying Monteagle limestone formation (Des Jean and Benthall 1994:115). The vegetation of the Cumberland Plateau region is characterized as Mixed Mesophytic Forest including species such as oaks, sweetgum, blackgum, chestnut, ash, hickory, and birch (Delcourt 1979).

Geology

3rd Unnamed Cave is a limestone karst cave that is located in a gorge near the bottom of the Western Cumberland Plateau Escarpment. The cave lies completely within the Monteagle Limestone formation, a light-gray, fossiliferous limestone containing localized bands of chert nodules (Hardeman 1966: Simek et al. 1998). Over 100 caves have been recorded in the gorge and surrounding areas, all within the Monteagle Limestone. Other chert-bearing limestones underlie the Monteagle, such as the St. Louis, Warsaw, and Fort Payne. However, these are not exposed in this section of the river gorge (Franklin 1999). These caves were originally conduits for underground streams that are now hydrologically abandoned, as the Monteagle acts as a karstic aquifer throughout the gorge, channeling surface waters into springs (Sasowsky and White 1993: Simek et al. 1998). 3rd Unnamed Cave contains sediment resulting from allochthonous and autochthonous processes. The allochthonous sediments are mainly fluvial clastics: rounded gravels, sand, and silt-sized deposits from the Pennsylvanian sandstone caprock of the plateau. The autochthonous sediments are composed of travertine and limestone blocks from the mechanical breakdown of the cave interior (Simek et al. 1998:665).

The chert mining and knapping activity and petroglyphs are located in a large gallery or passage along an abandoned upper conduit over 1 km from the entrance of the cave. The elliptical shaped chamber measures 20 meters wide and more than 100 meters long with a height of 0.5 to 3.0 meters from the current sediment surface (Simek et al. 1998:665). The sediment surface of this chamber is undulating and irregular due to prehistoric quarrying and the presence of large limestone blocks from roof breakdown. Chert nodules were deposited into the sediments through chemical weathering of the bedrock within the chamber. Chert nodules may also have entered the chamber through fluvial processes which varied in strength, transporting different sized grains at different times. Prehistoric miners concentrated on the eastern (near the chamber entrance) and central sections of the chamber in their mining efforts, and evidence of human activity decreases as one moves west (Simek et al. 1998).

Site History

3rd Unnamed Cave was initially discovered by cavers in the summer of 1975. During the following two years of survey, the cavers noted several footprints well within the dark zone of the cave which they believed to be possibly prehistoric. They contacted Dr. Patty Jo Watson and asked if she would visit the cave to examine the footprints. In 1977, Watson first visited the cave and confirmed that the footprints were indeed prehistoric. At this time, she did not see the chert mine that lay about 60 meters farther down the same passage (Franklin 1999). Watson visited again in 1981, entering the cave via a different entrance. Over 1 km from the cave mouth, she began to notice worked chert along the sides of the passage (Figure 2). Watson and the cavers then climbed into a chamber above the main meander passage where they found a massive amount of chert debitage lying *in situ* upon the cave floor, evidence of intensive mining and reduction of chert nodules in this area of the cave. Petroglyphs were

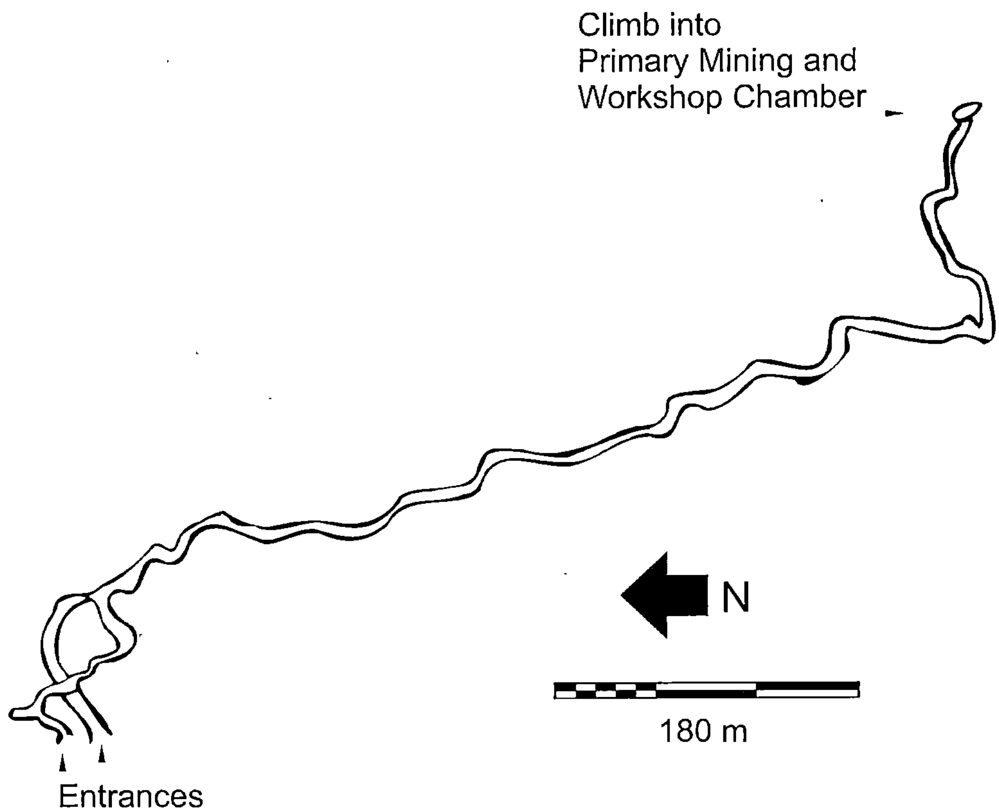

Figure 2. Plan View Schematic of Meander Passage (after Franklin 1999:21, Figure 1).

also discovered on the ceiling of the mining chamber during 1981 (Simek et al. 1998; Franklin 1999).

In September of 1981, archaeologists from the Department of Anthropology at the University of Tennessee began testing the primary mining chamber of 3rd Unnamed Cave. The goals of this investigation were to prepare a map of the mining chamber showing the dimensions and locating the natural and cultural features of the passage, to surface collect an area where aboriginal pits have exposed a profile of sediments with strata containing knapping debris, to excavate a test pit in this area to sample the buried debitage, and to make a collection from the surface of several intuitively selected knapping areas (L. Ferguson 1982:22). During the initial 1981 field season, four concentrations of lithic debitage were targeted for collection and designated A-D. These areas were chosen with the goal of obtaining a representative cross section of the entire assemblage and minimally disturbing the surrounding deposits (L. Ferguson 1982). At the time the macrolithic debitage was collected from these areas no plans existed to do microartifact analysis, therefore bulk sediment samples were not collected. Also, the lithic concentrations in Areas B and D were located on a surface of limestone breakdown, so sediment samples were not available for analysis in these areas. The first surface area to be collected, designated Area A, is located on a small mound in the primary mining chamber. The side of this mound has been cut into by aboriginal pits. Surface concentrations were collected by placing 50 x 50 cm wooden frames gridded at

10 cm intervals over the area. The lithic debris in each 10 cm square was bagged according to the provenience designated by the north and east coordinates of its southwest corner (L. Ferguson 1982; Franklin 1999). Three hundred and twelve 10 cm squares were collected from Area A. Lithic debitage was found in 123 of them (L. Ferguson 1982). The second surface area collected, Area B, lies on top of a large slab of limestone ceiling breakdown in the mining chamber (L. Ferguson 1982). The third surface area collected, Area C, is located in the mining chamber on the sediment surface above the main entrance from the lower meander passage. One hundred seventy-seven 10 cm squares were collected in this area. Seventy-three contained chert debitage. A hearth and two fairly distinct knapping concentrations were located in this area (L. Ferguson 1982). The fourth area collected in 1981, Area D, is located on a large slab of limestone breakdown in the side passage leading to the main chamber. Examination of the surface debris indicated that at least two and possibly three knapping concentrations were present (L. Ferguson 1982). Two adjoining 50 cm squares were excavated in Area A. Charcoal samples were also collected for radiocarbon age determination (L. Ferguson 1982). Due to time and labor limitations, only 39 meters of the mining chamber were mapped. The results of this initial project were never formally published.

In the spring of 1996, the Cave Archaeology Research Team from the University of Tennessee initiated new archaeological investigations of 3rd Unnamed Cave. During numerous visits to the cave over the next two years a great deal of work has been conducted. Several new petroglyphs have been discovered on the ceiling and floor of the mining chamber. Additional charcoal samples have been collected for radiocarbon dating. Four more flintknapping concentrations have been collected (Areas E-H). Geological, micro-morphological, and *in situ* bulk sediment samples have been taken in order to examine the depositional history of the cave (Simek et al. 1998). Also, cane charcoal and torch stoke mark distributions have been mapped in the main meander passage which leads to the primary mining chamber (Franklin 1999).

Macrodebitage Analysis

In addition to core refitting analysis, the macrodebitage in 3rd Unnamed Cave was analyzed by Franklin (1999) using Magne's (1985) debitage stage model, a modified version of Sullivan and Rozen's (1985) "interpretation free" approach, and the method of mass analysis as defined by Ahler (1989) and Ahler and Christensen (1983). Core refitting is a proven method of lithic analysis, and can be used to empirically infer the behavior of prehistoric people (Franklin 1999). Refits from the lithic concentrations in 3rd Unnamed Cave suggest cobble testing and core reduction using the bipolar technique. The remaining three methods of lithic analysis were compared to the interpretations obtained by the core refitting technique. As discussed here, these methods yielded varying degrees of success in determining the reduction sequence of the lithic assemblage from this site.

Magne's (1985) debitage stage model is a form of individual flake attribute analysis. In this analysis each flake is analyzed for a series of independent attributes which then are used to separate debitage into reduction stages. Franklin used debitage from 20 experiments and separated the flakes into early, middle, and late stages using Magne's criteria. Discriminant Function Analysis yielded an overall correct classification rate of 80%, but Franklin (1999:93) notes that the classifications are not very robust. He (1999:93) points out that Magne did not use blocky shatter in his analysis, while archaeological samples from 3rd Unnamed Cave contain large amounts of blocky shatter due to fracture planes in the raw material. This may be an explanation for the poor results obtained by this study.

Sullivan and Rozen's "interpretation free" approach is based on waste flake completeness (Franklin 1999). In this approach, primary reduction is largely characterized by complete flakes and blocky shatter, while tool manufacture is characterized by more flake fragments and broken platform remnant bearing flakes. Franklin (1999:55) points out two primary problems with this approach: experimental lithic reduction tests have not supported this method, and it has been shown to be too general and not sensitive to raw material variability. The same 20 experiments as above were chosen to test the utility of this approach for 3rd Unnamed Cave. Discriminant analysis indicates that only the soft hammer experiments are significantly distinguished based on flake types. Because only one significant function was generated, group classifications were not attempted, and no attempt was made to classify the archaeological samples (Franklin 1999:90).

Mass analysis focuses on characteristics of arbitrarily defined size classes of debitage, namely count, weight, and cortex distributions, in order to distinguish percussor and reduction types. The raw data recorded include counts, weights, number of cortex-bearing flakes, and the average weight of flake per size-grade. The theoretical assumption is that larger size classes will be over-represented in early reduction sequences while smaller size classes will be over-represented in later reduction sequences, and the number of cortex-bearing flakes should decrease as reduction continues from early to late stages (Ahler 1989; Franklin 1999:51). For an experimental assemblage, Jay Franklin and Andrew Bradbury obtained chert from 3rd Unnamed Cave and conducted a total of 53 flintknapping experiments. One hundred percent of the lithic debitage resulting from the experiments was collected on a drop cloth, and this debris was then size-graded into six classes. Groups of knapping experiments were conducted utilizing four specific reduction techniques, including hard hammer cobble testing, hard hammer freehand core reduction, hard hammer bipolar core reduction, and soft hammer tool production (Franklin 1999:53-54). Four separate models of mass analysis were examined for the analysis of the lithic assemblage from the cave. All four of these samples were classified as representative of hard hammer freehand core reduction, contrary to the refitting analysis, which suggests primarily bipolar core reduction (Franklin 1999:79). Franklin (1999:83) asserts that discrepancies between the results from his mass analysis and Ahler and Christensen's (1983) results are explained by the effect of raw material variability, specifically internal fracture planes that affect the workability of chert.

Franklin (1999:98) found that all three experimental models separate early stage from later stage reduction, and hard hammer from soft hammer percussion. However, each did not distinguish between the various hard hammer early stage reduction types. He believes that experimental models for lithic analysis are situationally dependent, and thus constrained by raw material variability, specifically nodule size, and configuration. Franklin (1999:97) determined that only generalized core reduction can be inferred with any degree of certainty for the archaeological assemblage from 3rd Unnamed Cave. The study did not achieve a fine-grained assessment of the archaeological materials, and Franklin concluded that the experimental data set is not suitable for evaluating the lithic assemblage from 3rd Unnamed Cave (1999:77).

Franklin (1999:106) also examined the microdebitage from 3rd Unnamed Cave by employing a particular type of mass analysis suggested by Behm (1983) to allow for delineation of primary and secondary lithic debris deposits. This delineation is made by comparing the ratio of Size 1 (1/8") flakes to Size 2 (1/4") flakes. Primary concentrations should have a ratio of 2:1, while secondary concentrations should have a ratio below 1.5. Materials from lithic concentrations E-H and data from the 53 experimental reductions were used for this analysis. Franklin (1999:106) reports that his results were poor for the experimental classification rates, and the ratios for the three early reduction groups are not statistically distinguishable. The analysis for the four lithic concentrations indicates primary core reduction concentrations. The poor results obtained by Franklin's use of mass analysis on his experimental assemblages indicate that Fladmark's assertion that granulometric analysis in knapping areas may reveal the predominate lithic reduction system carried out there is unlikely to be true.

Although the physiography and geology of the Cumberland Plateau has been well-researched, relatively little systematic archaeological research has actually been conducted in the area. Chapter III discusses the cultural context of 3rd Unnamed Cave, although it is noted that much of the culture history of the Cumberland Plateau is inferred from research conducted in adjacent regions.

Chapter III.

Cultural Context

Previous Archaeological Research in the Area of 3rd Unnamed Cave

The region of Middle Tennessee is divided into three physiographic regions: the Nashville Basin, the Highland Rim, and the Cumberland Plateau. The majority of the data on archaeological sites in this region is the result of archaeological surveys and excavations conducted due to the construction of reservoirs by the Tennessee Valley Authority, such as the Columbia Project in the inner Nashville Basin and Normandy Archaeological Project in the outer Nashville Basin and Highland Rim. The Cumberland Plateau region of Tennessee has long been considered an archaeological void, as little systematic research has been conducted there. However, due to the lack of systematic research and because of modern population distribution, the record of archaeological sites in Middle Tennessee is undoubtedly biased towards the surrounding physiographic regions. Areas such as the Plateau have been suggested to have served as buffer zones between areas of denser population, or possibly as hunting territories. Archaeologists have debated whether or not the general trends of increasing population and subsistence complexity in the Southeast as a whole during the Archaic also existed on the Cumberland Plateau. Some have suggested a more generalized, less complex pattern was present (T. Ferguson 1988). Des Jean and Benthall (1994:114) were able to identify diagnostic lithic artifacts from practically every identified prehistoric culture recognized in the upper Mid-South in examining local and institutional artifact collections from the Upper Cumberland Plateau.

The Archaic Period (10,000-2700 BP)

The beginning of the Archaic Period in the southeastern United States coincides with the Pleistocene/Holocene boundary approximately 10,000 years ago. Spanning over 7000 years of the Holocene epoch, the Archaic represents the longest period of cultural development in the southeastern United States, a time of adaptive response to the post-Pleistocene environment. Archaic peoples have been generally characterized as small groups of highly mobile hunter-gatherers with settlement patterns consisting of seasonal base camps and short-term, special-purpose camps (Bense 1994). Although these peoples have been generally characterized as mobile hunter-gatherers, the period as a whole was a time of transition due to changes in technology, subsistence, and social organization. One of the key archaeological traits of the Archaic Period are notched and stemmed triangular projectile point/knives. These differed from the earlier Paleoindian Period chipped stone points in that they were smaller, triangular in outline rather than lanceolate, and had notched or stemmed rather than straight bases. Archaeologists believe that these changes in form were due to the invention of the spearthrower (or atlatl) which, by increasing the velocity of projectiles, was more efficient in hunting the small, quick-moving game that populated the Southeast. The artifact assemblage expands as the Archaic Period progresses with advancements in the production of ground and polished stone tools (Bense 1994). One of the original defining characteristics of the Archaic Period was the absence of pottery (Chapman 1985:38). However, by the end of the period a fluorescence in ceramic technology and horticulture emerges. The Archaic Period is commonly divided into three sub-periods in order to reflect significant cultural and environmental changes: Early (10,000-8000 BP), Middle (7500-5000 BP), and Late (5000-2700 BP) Archaic periods (Bense 1994). Des Jean and Benthall (1994:120) state that "the Archaic stage of prehistoric cultural evolution on the Upper Cumberland Plateau can best be described as a period of Primary Forest Efficiency (Caldwell 1958:18) characterized by increasing regional specialization." Materials from Archaic Period cultures are present in thousands of rockshelter sites on the Upper Cumberland Plateau, possibly representing seasonal occupations. However, most of these sites have been identified as Early Archaic Period and Late Archaic Period, with very few Middle Archaic period sites or components represented (Des Jean and Benthall 1994:120).

Early Archaic Period (10,000-8000 BP)

The end of the Pleistocene brought about major environmental changes, and pollen and plant fossils from sediment cores have been used to reconstruct the environment of the Highland Rim and the adjacent Cumberland Plateau for the Holocene epoch (Delcourt 1979). In the early Holocene (12,000-8000 BP), a cool temperate environmental regime with mixed deciduous forests has been inferred for the area. The climate was warmer and much wetter than the previous epoch, and the grasslands of the Pleistocene were replaced by oak/hickory forests in the Southeast. These environmental changes brought about the extinction of the megafauna which had dominated the Pleistocene epoch. Early Archaic peoples adapted well to the changes however, subsisting by hunting large and small game animals, primarily white-tailed deer, and by exploiting acorns and other seeds (Steponaitis 1986). The increase in the number and size of archaeological sites from the earlier Paleoindian Period is an indication of the success of the Archaic population (Bense 1994).

In the artifact collections from the Upper Cumberland Plateau examined by Des Jean and Benthall, the great majority of the Early Archaic materials are from habitation sites in rockshelters. They (1994:120) found that "artifacts associated with the Early Archaic Bifurcate and Kirk point traditions are ubiquitous in every collection that was examined". Other projectile point types identified in the collections include St. Albans Side Notched, Kanawha Stemmed, Decater, LeCroy Bifurcated, MacCorkle Stemmed, Big Sandy I, Damron, Palmer, Pine Tree Side Notched, and Cypress Creek (Des Jean and Benthall 1994:120).

Middle Archaic Period (7500-5000 BP)

During the middle Holocene, around 8000 BP, evidence points toward a warming and drying climatic trend that lasted until about 4000 BP. This climatic change, termed The Hypsithermal, coincides with the Middle Archaic Period, which began about 7500 BP. As the climate became warmer and drier, the hardwood forests began to change to pine due to chronic forest fires. The subsistence of Middle Holocene peoples appears to be essentially the same as in the Early Archaic, with one exception. Archaeological excavations revealed large shell middens at sites such as Eva, located within the Tennessee River valley in central Tennessee (Lewis and Lewis 1961). Such sites, with middens often several meters deep, indicate that intensive utilization of riverine resources, especially shellfish, occurred during this period (Chapman 1985). This adaptive strategy was perhaps due to the relative scarcity of resources that occurred during the warming, drying phase of the Hypsithermal interval (Amick 1987).

Archaeological surveys that have been conducted on the Cumberland Plateau reveal a relative lack of archaeological materials which can be affiliated with the Middle Archaic Period, with the exception of Burke's Knob Rockshelter (Des Jean and Benthall 1994; T. Ferguson and Pace 1981; T. Ferguson 1988). Des Jean and Benthall (1994:123) found a paucity of diagnostic Middle Archaic materials in the collections from the Plateau that were examined for their lithic-based chronology. There appears to have been an overall decline in the population of the Cumberland Plateau during the Middle Archaic. Pace and Kline (1976) indicate that the few Middle Archaic sites that are recorded are predominantly located near stable water supplies. The inference is that the more arid climatic conditions during the Hypsithermal interval would have negatively affected the general suitability of the Cumberland Plateau, resulting in a general abandonment of the area (Des Jean and Benthall 1994; T. Ferguson 1988). The relative lack of Middle Archaic materials and context make site patterning unclear; however Sykes points have been found in rockshelter sites with freshwater seeps present, and one of two Eva type points was found in an open site near a freshwater spring (Des Jean and Benthall 1994). These may indicate that intermittent occupations took place in areas with available water (Des Jean and Benthall 1994).

Late Archaic Period (5000-2700 BP)

The mid-Holocene interval was followed by a shift to a cooler and less arid environment. The climatic shift coincides with the shift from the Middle to Late Archaic Period, which began about 5000 BP. The general population increase in the Southeast as evidenced by site frequency has been often attributed to this change to a less arid environment (Jolley 1978). By 2000 years BP the environment in this region had become essentially the modern conditions that we see today (Delcourt 1979). Caldwell (1958) suggests in his Primary Forest Efficiency Model that by Late Archaic times the population had reached an optimum adjustment to their environment. This was achieved through effective foraging skills based on the exploitation of a wide variety of plant and animal resources, and this efficiency resulted in the dense population during the Late Archaic Period. Caldwell, however, did not take into account plant domestication and other changes taking place.

The Late Archaic in the Southeast as a whole is marked by changes in lifeways that began developing around 4500 years ago. Four major trends can be seen in the archaeological record: the introduction of cultivated plants as an addition to the diet, the appearance of features such as large middens, storage pits, and structural evidence; the first production of vessels manufactured of stone and pottery; and the increase of long distance exchange (Steponaitis 1986). In addition, intensive deep cave exploration was conducted, and the earliest recorded cave art in the Southeast is believed to have been produced during the Late Archaic Period (DiBlasi 1996; Simek et al. 1998).

The Late Archaic is well represented in the Cumberland Plateau survey collection (T. Ferguson 1988). An increase in population density in the region is reflected by hundreds of sites and the presence of several diagnostic stemmed projectile points, including Wade, Morhiss, Ledbetter, Turkey Tail, Evans, Mud Creek, Beacon Island, Dickson, McIntire, Cotaco Creek, Matanzas/Damron, Motley, and possibly Big Sandy II types (Des Jean and Benthall 1994:130). Based on the distributions of sites, Pace and Kline (1976) suggest that the southern portion of the Plateau was utilized mainly in the summer and fall during the Late Archaic. They also interpret large Late Archaic sites near permanent water sources as evidence for increased sedentism. Other researchers have suggested that the lack of variability in site assemblages indicates a year round exploitation of the Plateau was practiced by Late Archaic peoples (T. Ferguson

1988).

The Big South Fork of the Cumberland River Valley in the Cumberland Plateau of Tennessee and Kentucky has more recorded rockshelters than any other prehistoric site type (Hoffman 1987). The floral and faunal remains indicate that some rockshelters were occupied during all seasons of the year. Hoffman (1987) believes that since the Big South Fork area contains many sites located on terraces and uplands, the utilization of rockshelters was part of an organizational system adapted to the exploitation of a spatially and seasonally variable environment. Survey and preliminary testing of sites in the Big South Fork that include Late Archaic components suggest that a more intensive utilization of the limited terrace areas in the Plateau region may have taken place during the Late Archaic Period (T. Ferguson 1988). Due to the limitations of these surveys, a general lack of information regarding site size and depth of deposits prevents a thorough assessment of these sites with regard to subsistence information.

The Terminal Archaic Period is marked by an increasing shift in subsistence towards a greater reliance on plant foods. Sites within the Upper Cumberland Plateau area exhibit frequent occurrences of steatite vessel fragments and the ethnobotanical remains of early cultigens, mainly gourds and squash (Benthall and Des Jean 1994:130). Delcourt et al. (1998:263) have discovered that rockshelters located along the Western Escarpment of the Cumberland Plateau in eastern Kentucky contain a rich record of ethnobotanical remains, indicating that this was a significant center for early domestication and cultivation of native plants during the Terminal Archaic and Woodland periods. Carbonized plant remains from these shelters indicate utilization of hickory nuts, acorns, chestnuts, and walnuts from late-Holocene deciduous forests, in addition to establishment of gardens for a suite of native plants, the "Eastern Agricultural Complex" (Cowan 1985; Delcourt et al. 1998:263). Fossil pollen and charcoal records from Cliff Palace Pond demonstrate that during the Late Archaic and Woodland periods fire was used by humans to clear plots in the forest for plant cultivation, and that these anthropogenic fires affected the composition of local forests, increasing populations of fire-tolerant oaks, chestnut, and pines in the upland forests of the northern Cumberland Plateau (Delcourt et al. 1998).

Obviously, more data are required before a clear picture of Archaic settlement/subsistence patterns in the region can be obtained. However, the existing archaeological evidence indicates that the Upper Cumberland Plateau was generally more intensively occupied by during the Early and Late Archaic periods and largely abandoned during the Middle Archaic, as prehistoric peoples responded to the drier climate of the Hypsithermal and moved into the lower river valleys of the Eastern Highland Rim and the Ridge and Valley provinces. The Terminal Archaic Period on the Cumberland Plateau was a time of increased human impact on the environment, accompanying a shift in subsistence. This shift is evidenced by the occurrence of ethnobotanical remains in rockshelters from domesticated native plants including gourd/squash, sunflower, sumpweed, goosefoot, and maygrass. After 3000 BP the increased use of fire by aboriginal peoples in order to clear tracts of land for cultivation of these plants impacted the forest composition, creating a mixed mesophytic forest of fire-tolerant oaks, chestnut, and pines in the upland forests of the northern Cumberland Plateau (Delcourt et al. 1998:276).

3rd Unnamed Cave was most heavily utilized by aboriginal peoples during the Late/Terminal Archaic Period. In the next chapter, the chronology of the prehistoric activity is discussed.

Chapter IV.

Chronology

Fifteen radiocarbon age determinations have been obtained on carbonized wood samples from various locations and contexts within 3rd Unnamed Cave (Table 1). Seven of these charcoal samples were recovered from the primary mining and workshop chamber in order to date the mining activity. Four samples are from the remnants of small hearths associated with particular flintknapping concentrations in this chamber (Areas A and E). Another charcoal sample comes from a chert quarry pit, one from the floor of the chamber, and the last sample had been reburied by mining activities (Franklin 1999). The ages obtained from the primary workshop chamber range from 2908 BP to 3258 BP, placing the mining activity within the Terminal Archaic Period. Of the two C^{14} age determinations obtained from charcoal samples collected from the Area A profile, one was collected from the buried surface of Unit A7 and one from the surface of Unit A1 (see Figure 1, Chapter 1). These samples were separated by more than 70 cm of sediments, yet yielded identical dates of 3,178 ± 40 BP. This supports the interpretation of Simek et al. (1998) that the Area A profile represents intensive sediment moving activity over a short time span.

Six other radiocarbon age determinations have come from charcoal samples collected from the meander passage below the primary mining and workshop chamber. One date comes from a fireplace associated with the

Table 1. Chronometric Age Determinations from 3rd Unnamed Cave (after Franklin 1999: 44, Table 1).

Sample Number	Radiocarbon Assay	Calibrated Date	Calibrated Age
SI-5063†	2805±75	1015 BC	2973 BP
SI-5064†	3115±65	1370 BC	3328 BP
SI-5065‡	2745±65	950 BC	2908 BP
SI-5066‡	2950±65	1190 BC	3148 BP
SI-5067†	4350±60	3025 BC	4983 BP
Beta-96623‡	2950±110	1175 BC	3133 BP
Beta-96624‡	3060±50	1300 BC	3258 BP
Beta-114172‡	2970±40	1220 BC	3178 BP
Beta-114173‡	2970±40	1220 BC	3178 BP
Beta-126038†	3330±70	1650 BC	3608 BP
Beta-126041†	3360±60	1645 BC	3603 BP
Beta-126040†	2010±60	30 BC	1988 BP
Beta-126039†	690±60	1310 AD	648 BP
ISGS-4232‡	3050±70	1275 BC	3233 BP
ISGS-4234†	3060±70	1305 BC	3263 BP

†Meander passage
‡Primary mining and workshop chamber

flintknapping concentration designated Area H (3330 ± BP). A large piece of charred wood from another flintknapping concentration approximately ten meters from Area H yielded a date of 3060 ± 70 BP. Another date obtained from a sample off of the passage floor yielded a similar date of 3360 ± 60 BP. A charcoal sample from the outer passage floor yielded a date of 2805 ± 75 BP, and charcoal from the inner passage yielded a date of 3115 ± 65 BP. The earliest date, from a charcoal sample collected from a ledge very near Area H, was 4350 ± 60 BP. This indicates that visitation to 3rd Unnamed Cave occurred earlier in the Late Archaic Period, making it probable that the prehistoric exploration and mining began in the meander passage before it was carried out in the primary mining and workshop chamber (Franklin 1999).

The final chronometric age determinations were obtained from charcoal samples collected from the meander passage closer to the cave entrance. One sample yielded a date of 2010 ± 60 BP, placing it in the early Middle Woodland Period. The charcoal sample collected closest to the cave mouth yielded a date of 690 ± 60 BP placing it within the Mississippian Period. These dates were obtained from cane charcoal well removed from any mining or flintknapping activity areas (Franklin 1999).

Only two retouched stone tools have been recovered from 3rd Unnamed Cave. A partially retouched flake made from local cave chert was found within a knapping concentration in the primary mining chamber. The single diagnostic stone tool is a Matanzas projectile point/knife that may or may not have been produced from the cave chert (Simek et al. 1998). This point was recovered from the buried knapping concentration in Area A which was radiocarbon dated to 2970 ± 40 BP (Franklin 1999). The occurrence of this point type is not common in Tennessee, although several have been recovered from other contexts on the Upper Cumberland Plateau (Des Jean and Benthall 1994:130; Franklin 1999; Simek et al. 1998). Matanzas points are associated with the Late Archaic Period in this area of Tennessee (Franklin 1999; Justice 1987:119; Simek et al. 1998). The occurrence of this point in the primary mining and workshop chamber is consistent with the radiocarbon determinations. No ceramics have been found in 3rd Unnamed Cave.

All of the chronometric determinations indicate that the intensive mining in 3rd Unnamed Cave occurred over a relatively short period of time in the Late or Terminal Archaic Period (Simek et al. 1998). It has been suggested that in general Archaic Period peoples entered dark zone caves mainly to explore, and that more intensive activities, such as mining and the production of artwork, were conducted by later Woodland and Mississippian peoples (Crothers 1987:83). Franklin (1999:47) points out that the reverse appears to have occurred in the case of 3rd Unnamed Cave. All radiocarbon age determinations obtained from the mining activity areas date to the Late/Terminal Archaic Period, while the dates obtained from evidence of simple exploration expeditions to the cave have yielded dates that place them within later prehistoric periods. The locations of the samples that yielded these later dates were also not far into the dark zone, indicating perhaps that Woodland and Mississippian peoples did not venture as far into the cave as the earlier Archaic peoples (Franklin 1999).

Chapter V.

Field Methods

The primary goal of this study is to examine the spatial distribution of microartifacts and to relate their distribution to the macroartifact distribution in a manner that is both statistically representative and time effective. When the initial field investigations were conducted at this site in 1981, microartifact analysis had not been considered as an avenue of study for this site. Consequently no microartifact samples were obtained when the initial four lithic concentrations, A-D, were collected. When field investigations were renewed in 1996, four more areas, labeled E-H, were designated for surface collection (Figure 3). At this time the research team collected microdebitage samples from selected squares within the collection areas.

The first three areas targeted for collection in 1996 were located within the primary mining chamber. Area H was located in the meander passage directly below the chamber. One meter square frames were strung with nylon cord at 20 cm intervals. The frames were placed over distinct concentrations of knapping debris, oriented by cardinal directions, and datum points were established. Each lithic concentration was entirely collected by 20 cm squares (Franklin 1999), then representative squares were arbitrarily selected from each concentration for collection of sediment samples for microdebitage analysis. The bulk sediment samples were scraped and collected from the sandy sediments directly below

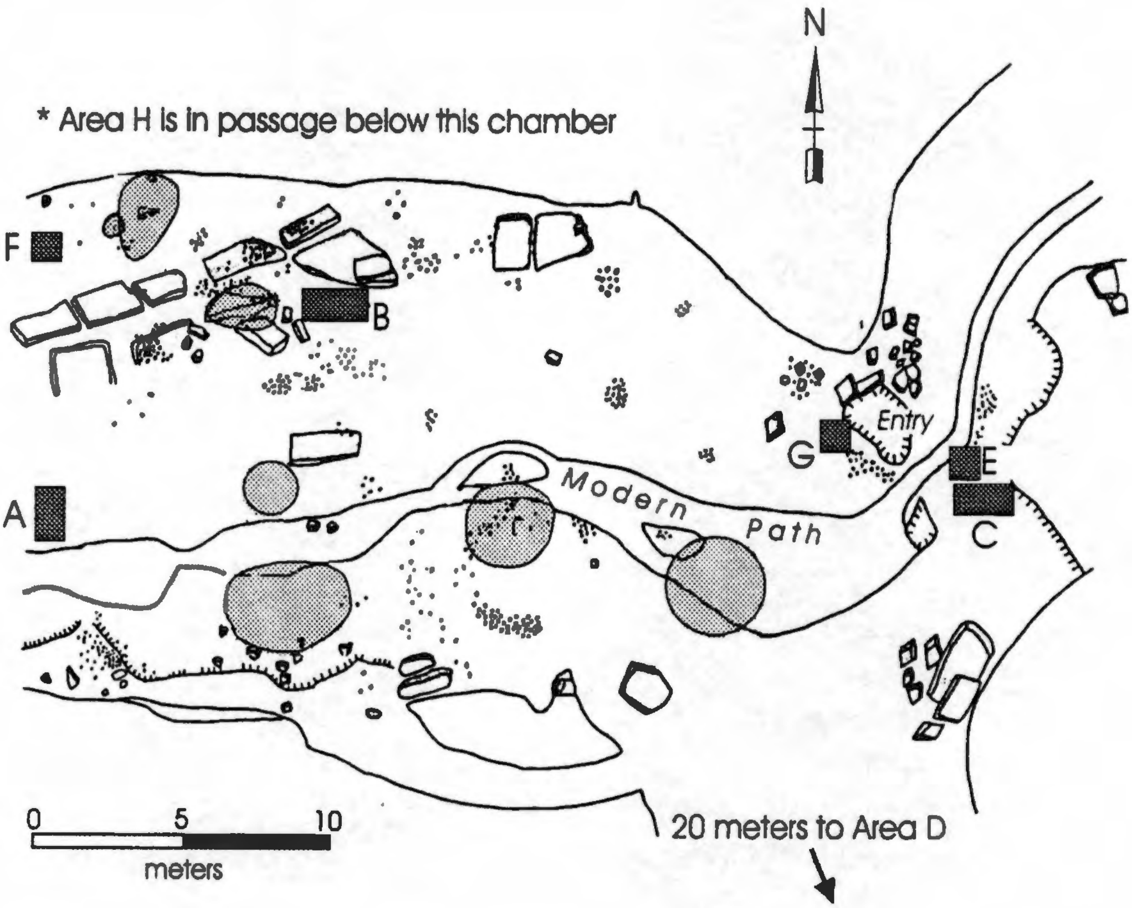

Figure 3. Plan View Schematic of the Primary Mining and Workshop Chamber (after Simek et al. 1998:665, Figure 1). Lithic collection areas are labeled A-G. Circled and shaded areas are petroglyph panels on the ceiling of the chamber.

each lithic concentration in areas E-H within the designated 20 cm squares (Franklin 1999).

Area E is situated on the sediment surface above the crawlway entrance to the mining chamber and just north of where Area C is positioned. Bulk sediment samples were collected from eight squares in this area (Figure 4). Area E is a large concentration of lithic debitage and may represent at least two flintknapping episodes (Franklin 1999).

Area F is located approximately 10 meters north of Area A under a 1.5 meter high ledge. The sediments here appear to have been completely dug out by the prehistoric miners in order to follow the chert-bearing facies in the chamber's north wall. Area F probably represents a single flintknapping episode according to Franklin (1999). Due to its small size, sediment was only collected from a single square in this area (Figure 5).

Area G is located two meters west of the entrances to the mining chamber. It is believed to represent a single intense flintknapping episode (Franklin 1999). Four squares were targeted for sediment collection in this area (Figure 5).

Area H is located in the meander passage below the mining chamber. Area H was positioned along the footpath to the mining chamber and in danger of being disturbed by modern caving traffic. This area was collected in order to determine if flintknapping activities practiced in this lower passage were similar to those practiced above in the primary mining chamber (Franklin 1999). Sediment

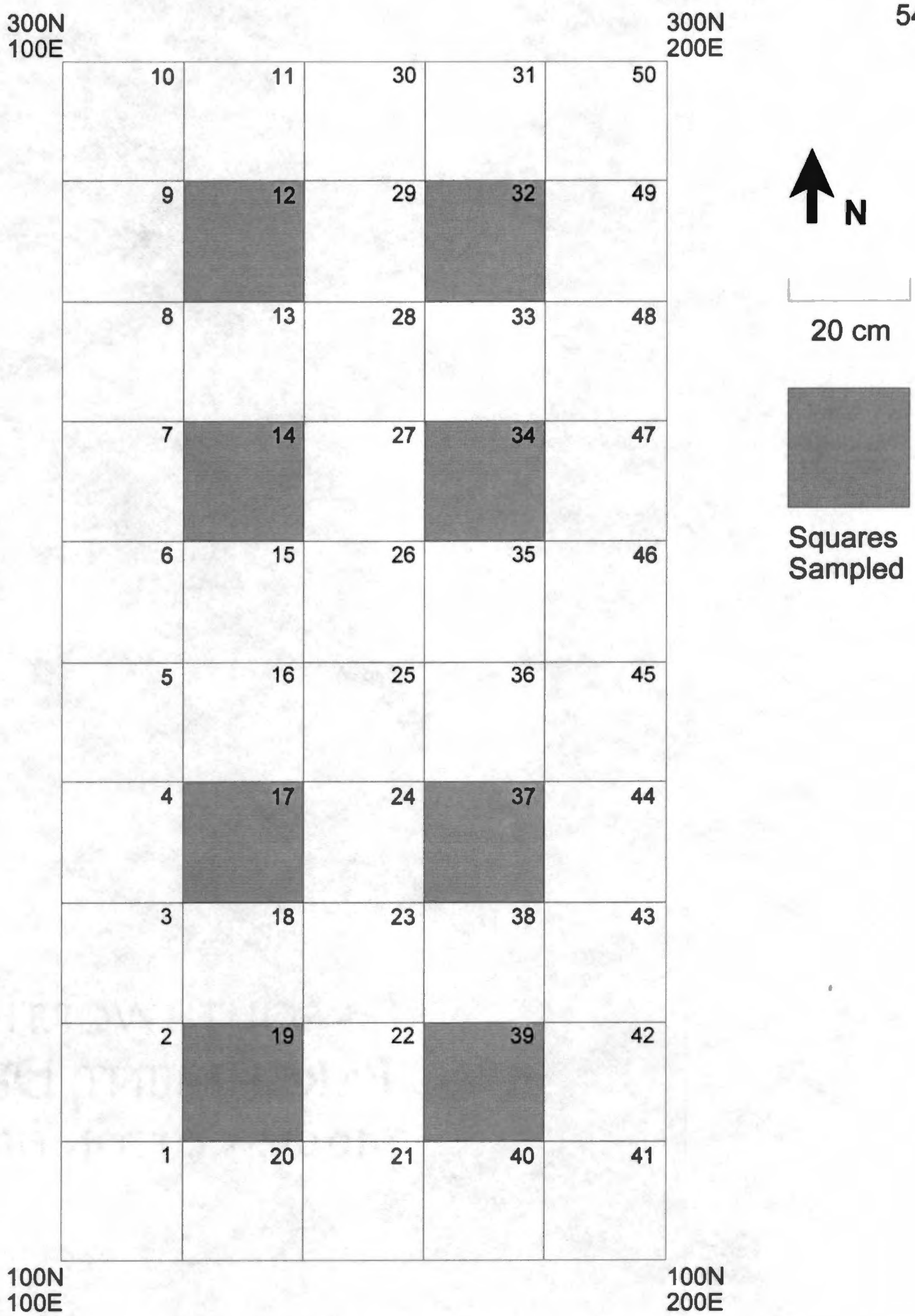

Figure 4. Plan View of Area E Grid Showing Provenience of Sampled Squares.

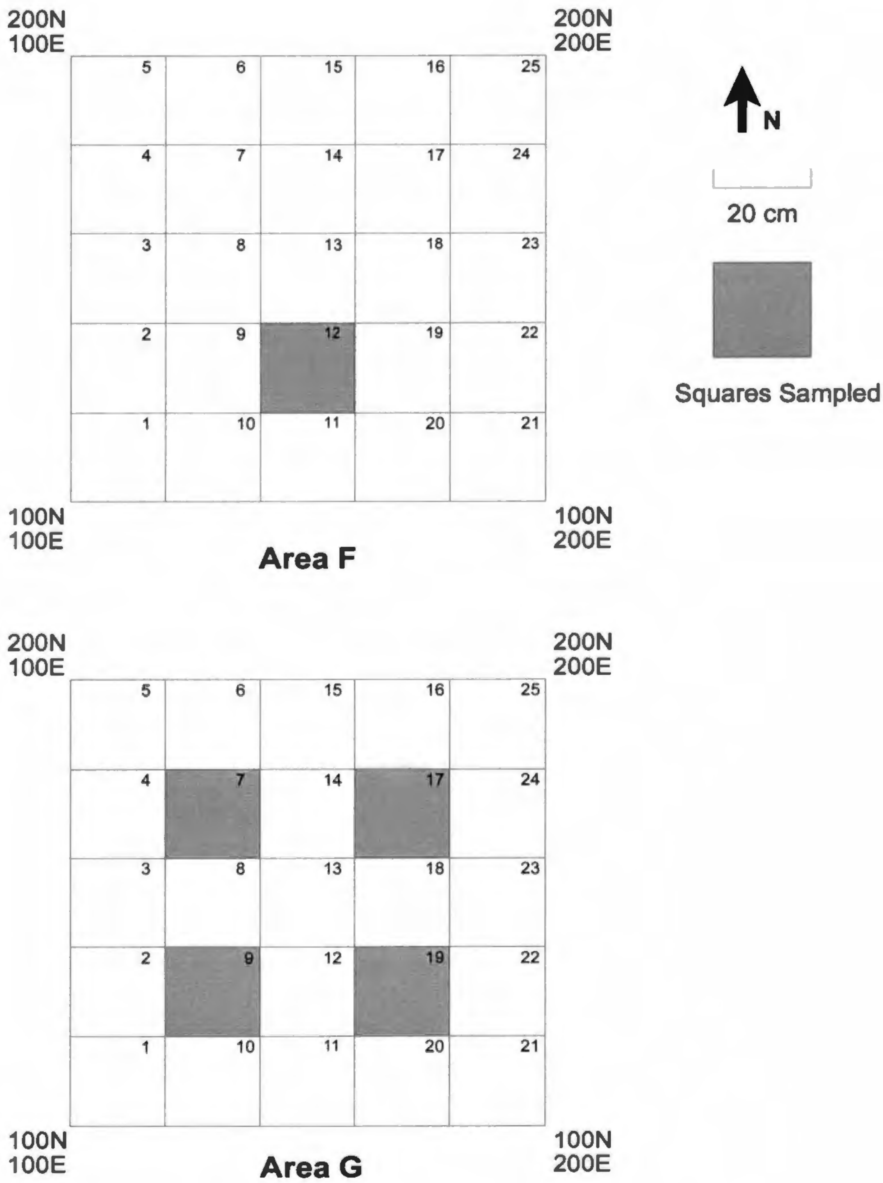

Figure 5. Plan Views of Area F and G Grids Showing Provenience of Sampled Squares.

samples were collected from seven squares in this area (Figure 6).

Vertical Samples

Vertical bulk sediment samples were collected from seven distinct lithostratigraphic units and from two distinct buried surfaces in the western profile in Area A (see Figure 1, Chapter I). These lithostratigraphic units were designated A1-7 and consist of sand and gravel-size rounded rock mixed with anthropogenic material including lithic debitage, ash, and charcoal (Simek et al. 1998). A bulk sediment sample was also collected from the horizontal surface of this profile.

Control Samples

In order to obtain control samples, vertical sediment samples were also collected from the south wall of the primary mining chamber by arbitrary 10 cm levels. The sediment in this profile shows no indication of human activity and was presumed to be sterile. These samples were collected in order to determine the natural sand-sized sediment particles of the mining chamber and aid in the identification of sediment particles that are a result of human activity. Also, for comparative purposes, additional horizontal sediment samples were taken in the main mining chamber away from the concentrations of chert knapping debris. One sample was collected adjacent to an area containing rimstone dams and another at some distance away from the main chamber near an area with

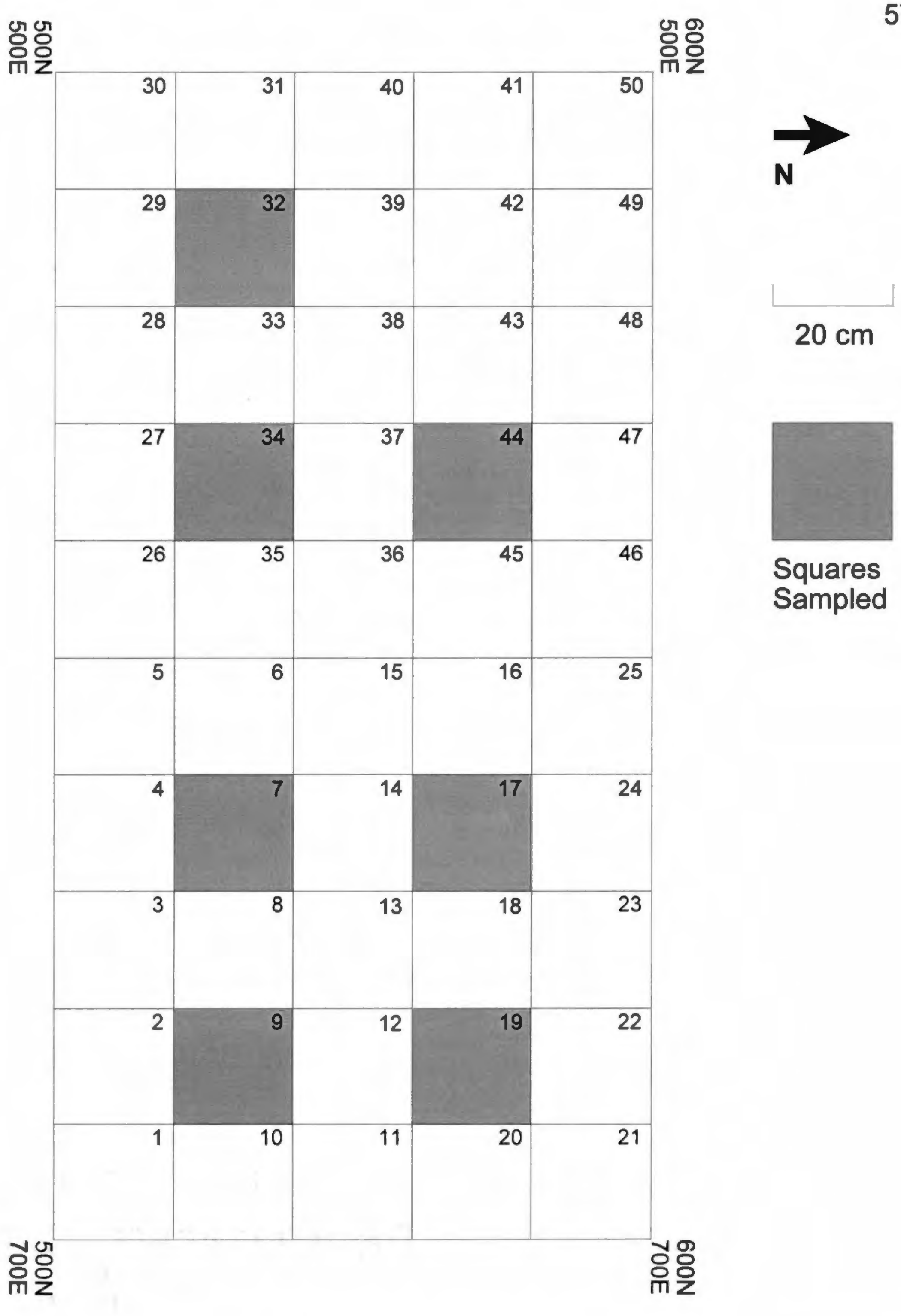

Figure 6. Plan View of Area H Grid Showing Provenience of Sampled Squares.

constant vertical water flow. Two horizontal samples were taken in an area within the primary mining chamber but away from the concentrations of knapping debris. A horizontal sediment sample was collected approximately 200 yards into the dark zone from the mouth of the cave, from the floor of the main meander passage leading to the mining chamber.

A total of twenty-seven horizontal sediment samples was collected for analysis (Table 2). All bulk sediment samples were placed into zip-lock plastic bags, sealed, labeled with their provenience, and transported back to the Laboratory of Analytical Archaeology at the University of Tennessee for processing and analysis. The procedure for sediment processing and analysis is discussed in detail in Chapter VI.

Table 2. Horizontal Bulk Sediment Sample Locations from 3rd Unnamed Cave.

Sample Number	Provenience
1	200 yards into the Elephant Walk passage
2	Cobble Country
3	adjacent to rimstone dams
4	near Woods Wet Well; away from lithic debris
5	Area A: surface of cut profile
6	Area E: square 12
7	Area E: square 14
8	Area E: square 14
9	Area E: square 17
10	Area E: square 19
11	Area E: square 32
12	Area E: square 34
13	Area E: square 37
14	Area E: square 39
15	Area F: square 12
16	Area G: square 7
17	Area G: square 9
18	Area G: square 17
19	Area G: square 19
20	Area H: square 7
21	Area H: square 9
22	Area H: square 17
23	Area H: square 19
24	Area H: square 32
25	Area H: square 34
26	Area H: square 44
27	South Wall: surface of profile

Chapter VI.

Laboratory Methods

Sampling Procedure

As has been described, bulk sediment samples of approximately 300 grams were collected from the surface of the cave floor directly under four distinct areas of lithic debris. These areas were gridded off into 20 cm squares and representative units were designated for collection. Control samples were obtained from areas within the chamber with no evidence of lithic knapping activity on the surface. Vertical sediment samples were collected from stratigraphic layers in a profile which show evidence of multiple episodes of human activity. Additional control samples were obtained from a profile in the south wall of the mining chamber which shows no indication of human activity. These samples were placed into zip-lock plastic bags, brought back to the Laboratory of Analytical Archaeology at the University of Tennessee, Knoxville, and allowed to air dry. The laboratory procedure utilized follows the protocol set up at the University of Washington Laboratory for Archaeological Sediments and also used by Sherwood (1991) in the Loy site analysis conducted at the Laboratory of Analytical Archaeology at the University of Tennessee. The procedure was altered slightly for this analysis due to the fact that the task of removing organic material was not necessary for the sediments collected from 3rd Unnamed Cave.

Microartifact Size

The technique of microartifact analysis is relatively new in archaeology, and the protocol has been a subject of debate. As Sherwood (2000:2) points out "The size threshold between macro- and microartifacts is not universally defined." Following experimental and laboratory analysis, Fladmark (1982:205) defined microdebitage as stone flaking residue less than 1.0 mm in maximum dimension, which he found to be the smallest particle that can be recognized as a conchoidal flake by the naked eye. Dunnell and Stein (1989) believe Fladmark's upper boundary of 1.0 mm is too small, and defined microartifacts as those less than 2.0 mm in diameter, the sedimentological threshold between gravel and sand. Although the upward boundary of microartifact size is an arbitrary decision, an upper limit of 2.0 mm is suggested by Dunnell and Stein (1989:34) because this is the point at which surface collection and excavation sieving cease to be practical in recovering artifacts and a change in collection and identification techniques is necessary. The lower boundary of microartifacts is dependent upon the point at which artifacts can be reliably identified under a stereomicroscope. This varies considerably for different compositional artifacts, some of which (e.g. tempered ceramics) break down into their constituent elements at a larger size than others. For this reason Dunnell and Stein (1989:35) suggest the lower boundary be placed arbitrarily at 0.25 mm. Sherwood (2000:2) believes that these boundaries ignore those artifacts that fall between the 2.0 mm and the traditional field recovery size of >6.35 mm (>0.25

inch) by using standard wire mesh screens. Experimental lithic reduction shows that microdebitage is most abundant between 6.35 mm and 1.0 mm. Sherwood suggests that placing the upper boundary at 6.35 would allow for full-scale analysis linking the macroartifact and microartifact size range. The lower boundary is always restricted by reliable identification, and Sherwood (2000:3) suggests a lower threshold should rarely be less than 0.5 mm, and never below 0.25 mm. This is based on the tendency for some artifact classes to break down into their constituent elements, the success of past studies, and the potential for inter-observer error. For Franklin's lithic analysis, the lithic debris for each concentration targeted for study was totally collected by hand by 20 centimeter collection squares. Although the hand collected lithics included size grades from >25.4 mm (1.00") down to 3.175 mm (0.125"), the collection technique was not designed to recover large numbers of very small size debitage (Franklin 1999:61). After reviewing the literature and Franklin's analysis, and after preliminary examination of the sediment samples under a stereomicroscope, the 0.0 phi (2.0-1.0 mm) and 1.0 phi (1.0-0.5 mm) size fractions were selected for microartifact analysis in this study. Fladmark (1982) identified a lithic size class down to 4.0 phi (0.063) mm, but in this study it was determined that to quantify this size fraction would provide no information in addition to that already provided by the larger size fractions and would not justify the extra time required.

Procedure for Preparing Samples for Analysis

Each sediment sample that was analyzed for microartifacts underwent the following procedure:

1. The sample is divided using a Jones splitter. From one of the two pans approximately 300 grams of sediment is extracted and weighed to one tenth of a gram. The exact weight is recorded on a data sheet with the sample's provenience designation.

2. The weighed sediment is poured into a numbered flask. Approximately 100 ml of peptizing agent (sodium hexametaphosphate solution) is added to the sediment in the flask in order to separate the individual particles. The flasks are tightly sealed, put into a mechanical shaker for one hour, and then allowed to sit overnight.

3. After sitting overnight the contents of the flasks are shaken briefly by hand to return the contents to suspension. The contents are then wet sieved through a 4 phi screen with deionized water for approximately five minutes. This process removes all silt and clay sized particles from the sand sized particles. The 4 phi geologic sieve (0.063 mm or 63 microns) is used in microdebitage analysis to delineate between sand and silt sized particles. This is the scale most commonly used by geologists and sedimentologists.

4. The final wet sieving utilizes three nested sieves. Before it takes place, three beakers are labeled with numbers representing the contents of sieves -1.0 phi, 1.0 phi, and 4.0 phi. These empty beakers are weighed and their weight

recorded on the data sheet.

5. The sediment is poured from solution into three nested sieves, phi sizes -1.0, 1.0, and 4.0. Deionized water is used to rinse the material through the sieves. Once the material in the -1.0 phi sieve is thoroughly cleaned, it is removed from the set and washed into a beaker. The 1.0 and 4.0 phi sieves continue to be washed until all of the material less than 1.0 phi is in the 4.0 phi sieve below. This material is then washed, using deionized water, into its own beaker and set aside. The material in the 4.0 phi sieve is washed until all the silt and clay particles are removed. The contents are then rinsed with deionized water into a third corresponding beaker.

6. The three beakers are then put into a preheated oven at a temperature less than 100 degrees C. The samples remain until all of the water is evaporated, leaving only the grains. The beakers are then removed and allowed to cool to room temperature.

7. Each beaker is then weighed to 1/10,000 of a gram and its weight entered on the data sheet. The contents of the beakers containing -1.0 and 4.0 phi are stored in labeled vials. The beaker containing the 1.0 to 0.0 phi contents are put into a labeled vial. These grains are used for the microscopic analysis.

Material Classes

Preliminary microscopic examination was conducted upon the processed sediment samples. From these observations, five material classes were designated based on the artifact material classes and natural sediment present at the site. Comparative collections located in the Laboratory of Analytical Archaeology at the University of Tennessee were utilized to aid in the proper identification of material class. The designated material classes in this study are lithics, charcoal, rounded quartz grains, miscellaneous rocks and minerals, and carbonate fossils.

Lithic This material class consists of modified rock assumed to be the result of human activity, specifically the result of lithic reduction carried out by the prehistoric miners upon the Monteagle Chert nodules found in 3^{rd} Unnamed Cave. Due to the angularity of the lithics, especially in comparison to the rounded fluvial grains that comprise the natural background sediment, this material class was readily identifiable at the micro scale (Figure 7). In addition, a comparative collection of lithic debitage (including particles <2 mm in size) was created by Jay Franklin using Monteagle Chert obtained from within the primary found in the cave, and comprise the majority of the background sediment. mining chamber of 3^{rd} Unnamed Cave. This material class was identified using the following combination of attributes: angularity, thinness (sometimes translucent), remnants of conchoidal fracture features, and color (gray).

Charcoal This material class includes any black carbonized material. This class is easily identifiable microscopically because of its black color, luster, and fibrous texture. The general morphology of wood fibers is observable under microscopic examination.

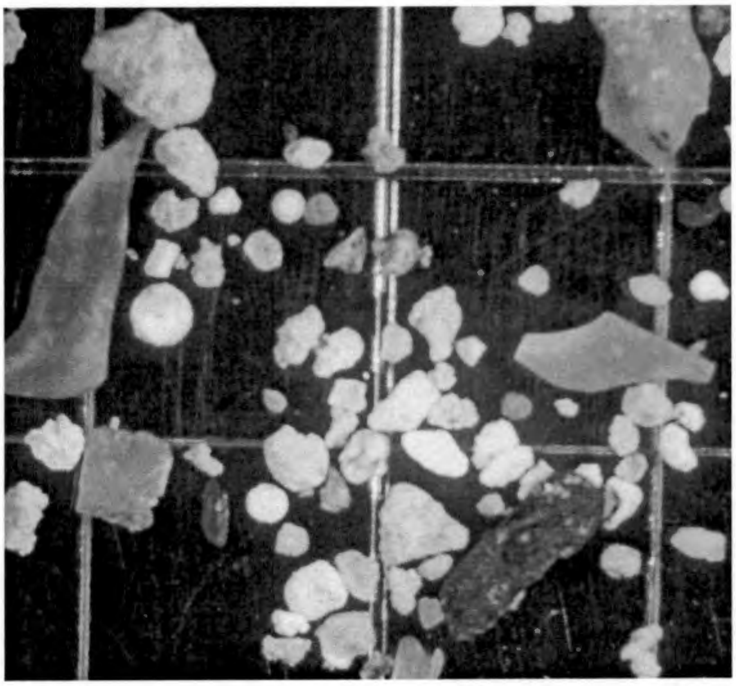

Figure 7. Photograph of processed 2-1 mm sediment sample from Area A profile under 200x magnification showing lithic debitage and charcoal.

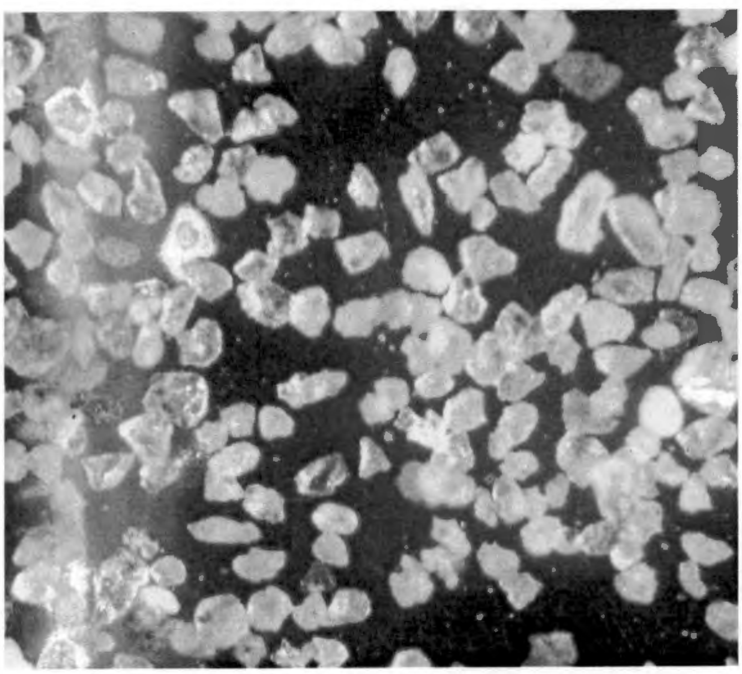

Figure 8. Photograph of processed 0.1-0.5 mm sediment sample from South Wall profile under 200x magnification showing nondisturbed fluvial sediment.

Quartz Rounded quartz sand grains are natural to the fluvial sediment. Although the quartz varies somewhat in size, color, and morphology, the vast majority is rounded, very light tan in color, with frosted surfaces. The roundedness of the quartz grains makes the grains easily distinguishable from the lithics, which have a high degree of angularity (Figures 7 & 8).

Miscellaneous rocks & minerals This material class serves as a "catch all" category for any mineral, concretion, or rock (other than quartz) determined to be natural to the fluvial sediment of the cave. Minerals commonly observed within the natural sediment include mica and galena.

Carbonate fossil This material class is a result of the weathering of the fossiliferous Monteagle Limestone within which the cave lies. The fossils are primarily crinoid stem fragments that are easily identifiable under microscopic examination due to their morphology.

Microartifact Quantification

Traditionally, microartifact quantification has been a long and tedious process (Sherwood and Ousley 1995). The significant amount of time required for point counting, the technique used to identify the material classes present in the sediment and to quantify them, often discouraged the utilization of this type of analysis. Determining the sample size to achieve a representative sample has also been an issue of concern. In order to streamline the process of point counting and to obtain a representative sample in a reasonable amount of time, a computer program called PARACOUNT was created by Ousley and Sherwood (1995). This program, written using PARADOX, has three objectives: 1) to operationalize the counting of material classes to produce volume percentages, 2) to provide for a statistically reliable sample and 3) to do it in an expedient and reliable manner. As the analyst identifies the sediment grains through the microscope, each one is tallied by class directly on the keyboard (each material class is designated a number on the key pad). As the identification is entered, the program calculates the frequency, percentage, and reliability statistic and displays these values on the monitor (Sherwood 1991).

In the past, various methods have been used to quantify microartifacts, including visual estimation of percentages by Hassan (1978) and Rosen (1989), and sorting and counting bulk samples by Metcalfe and Heath (1990). However, point counting is the technique most often applied to quantify microartifacts, as used by Sherwood (1991), Stein and Teltser (1989), and Vance (1989). This method was developed by geologists to identify and determine the percentages of various minerals in rock (Galehouse 1971; Sherwood and Ousley 1995). Sherwood and Ousley (1995:424) state that although the actual process of point counting is time intensive, with microartifacts the process can be expedited by following a few simple procedures. For example, artifacts can be systematically counted across a grid rather than physically separating the microartifacts by material class. Also, the use of an automated computer program to enter each material class as the artifacts are identified can significantly reduce the counting times reported in studies utilizing other methods.

To determine the percentage of microartifacts in an archaeological population a sample size must be determined. Sherwood and Ousley (1995:424) state that this "requires either a designated *weight* of a range or single mm or phi fraction, or a designated *number* of grains per sample" (commonly 1000-10,000). If a specific weight is used to determine the amount counted, this weight is assumed to be representative of an estimated number of grains. Sherwood and Ousley (1995:424) caution that this method may be suspect due to variation in grain size and specific gravity, and focusing on a specific number of grains is more straightforward.

A computer program called MMCOUNT was written "in an effort to streamline the process of point counting and quantify a representative number of the microartifact assemblage present within a reasonable time frame" (Sherwood and Ousley 1995:425). They designed the program so that as the analyst identifies the particles spread across a gridded petri dish, the material class of each grain is tallied by entering a number on the computer keyboard which corresponds to that class. The desired confidence level is determined by the analyst, usually 99% or 95%. For this project, a 95% confidence interval was chosen, and is estimated using ± 1.96 standard error. As each grain class is entered into the program and the sample size increases, the s.e. of each class should decrease, reflecting a greater reliability of those estimates due to a larger sample size. As each grain is counted, the counts, percentages, standard errors, and upper and lower 95% error bounds are displayed for each material class. When the predetermined confidence interval is achieved, the analyst can stop counting. The results of the analysis are then saved in a Paradox database file. The MMCOUNT program insures that no more grains are counted than necessary, which saves time while also providing reliable estimates of the percentage of each material class comprising the sediment sample (Sherwood and Ousley 1995:427).

Microartifact Quantification Protocol

1. The 0.0 and 1.0 phi grains are spread across a glass petri dish. The petri dish is grooved on the bottom with a grid made up of 1 cm squares. The counting starts in the upper left hand corner, moving down the designated column, carefully counting only those grains within the column. At the end of each column, counting continues to the right, moving up the column adjacent to the one just counted.

2. A magnification of 200x with a binocular microscope is used to count the grains. The magnification can be increased for grains of questionable identity. The light source used is a double flexed arm fiberoptic incident system.

3. The PARACOUNT computer program assigns computer keys to correspond with each material type. The identity of each grain is entered manually on the computer as the counting is done through the microscope. For each particle the program calculates the frequency, volume percentage, and

statistical information for each material class.

4. A statistically representative sample is usually reached between 600-1000 grains. Once that representative sample is reached the data are automatically entered into the spread sheet data management file in PARADOX, where it can be organized and manipulated.

Ethnoarchaeological and experimental observation shows that small-scale artifacts produced by human activity are better indicators of the location of activity than macro-scale artifacts. Grain sized artifacts are more likely to be worked into the floor by trampling and become part of the sediment, while larger artifacts are more likely to be subject to processes of cultural sorting. The fact that this is a non-residential site and the archaeological deposits are a product solely of the original acts of quarrying and cobble reduction creates a unique preservation situation in which the evidence of prehistoric activity is unaltered by post-depositional processes. The results of Franklin's (1999:136) mass analysis and core refitting of the lithic debris at this site indicate that the debris accumulations on the surface of the cave floor are a result of generalized core reduction and are in primary position. Hull (1987) created a model for microdebitage distribution based on Schiffer's (1976) model of primary, secondary, and de facto refuse for intrasite analysis. Hull's model defines primary refuse as a cluster of macrodebitage that corresponds to a cluster of microdebitage. Secondary refuse consists of macrodebitage with no corresponding cluster of microdebitage. De facto refuse is similar in composition to primary refuse, but occurs when large objects are left at the location of use because the area is to be abandoned (Hull 1987; Schiffer 1976). According to this model, if the knapping concentrations in 3rd Unnamed Cave are in primary position, the distribution of microdebitage within these concentrations should correspond to the frequency of the macrolithics produced by Franklin's analysis (1999).

Previous archaeological investigations have also hypothesized that the sediments in the mining chamber were largely homogenized by the prehistoric mining activities. L. Ferguson (1982:6) believes that the extensive digging disturbed the sediments and removed them from primary context. When the vertical profile in Area A was excavated, it was noted that a lithic debris concentration was present on the buried surface 15 cm below the present surface of this area as well as a concentration at the base on the lower buried surface (L. Ferguson 1982). These concentrations are separated by 65 cm of sediment. Radiocarbon dates from the present surface and the base of the cultural profile yielded the exact same age, 3178 BP. All of the cultural material in the mining chamber has been interpreted as contemporary. If this is true, the 65 cm of stratigraphy represents rapid movement of sediment by intense quarrying activity. Each stratigraphic layer could have been the surface for a short period of time, possibly experienced a knapping episode, then was quickly buried by continued quarrying activity. If any knapping concentrations are in primary position on the buried surfaces visible in the profile, a corresponding high frequency of microdebitage is expected.

After the percentage of each material class comprising the sediment sample was obtained from the MMCOUNT program, the microdebitage frequency percentages were used to generate density plots. These plots could then be compared with corresponding macrolithic density plots from the same lithic concentrations. The results of this analysis are discussed in the following chapter.

Chapter VII.

Analysis

South Wall Expectations

The South Wall profile is a vertical exposure, probably the result of prehistoric digging and subsidence (Simek et al. 1998:666). This profile was cleaned for observation, and the lithostratigraphic units visible showed no sign of anthropogenic disturbance. The units appear to be natural fluvial deposits, and for this reason bulk sediment was collected from this area to serve as control samples. The profile is located in the eastern half of the primary mining chamber. Twelve lithostratigraphic units were identified and designated S1-S12 (Figure 9). The surface above the profile is covered by a fairly dense concentration of chert nodules and lithic debris; however, no clasts larger than sand-sized were associated with any of the units, and no artifacts were visible in the profile. Simek et al. (1998:666) found that the profile exhibits composite fluvial structures such as interlayered sand and mud beds and cross-beds, a result of regular changes in the source and transport of material under a generally low-velocity and periodically slack-water current. Sometime during the early Pleistocene it is estimated that this conduit was abandoned and the stream moved to lower levels of the cave. This profile has been interpreted as the accumulation of natural fluvial material deposited in this upper conduit when it was still hydrologically active (1998:666). The sediment in this profile is not

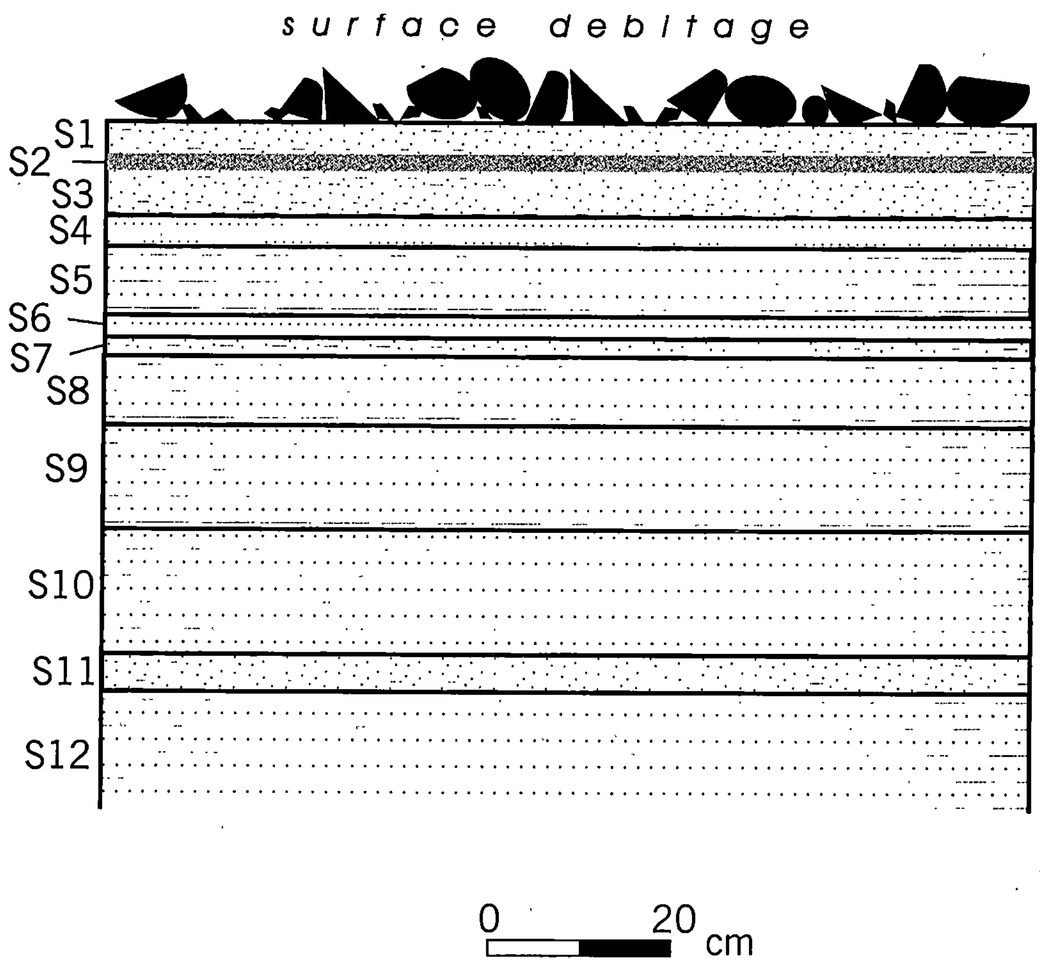

Figure 9. South Wall Profile (schematic). Although chert nodules and debitage lie on the surface, no clasts larger than sand sized are associated with any of the 12 lithostratigraphic units. (after Simek et al. 1998:667, Figure 3).

believed to be the result of any anthropogenic postdepositional processes, or to have been otherwise affected by human activity. No microartifacts are expected to be found within any of the sediments from the South Wall profile.

South Wall Results

Bulk sediment samples were collected from the South Wall profile by arbitrary 10 cm levels. The arbitrary levels were chosen due to the fact that the natural litho- stratigraphic units in the profile are thin (< 5 cm in most cases) and the boundaries between them are difficult to distinguish. Five samples total were collected, extending 60 cm below the surface of the profile. These samples were processed, divided into two size classes, and examined microscopically. The samples were overwhelmingly made up of medium to very fine sand sized quartz grains with some minerals and carbonate fossils. In fact, in each of the five samples, there was no material above the 0 phi (1 mm) size to be quantified as all of the grains in the sample fell below this size class. No artifacts were identified in any of the five samples, supporting the interpretation that the sediments in this profile had not been affected by human activity.

Lithic Concentrations E-H

Area E-H Expectations The results of Franklin's mass analysis of the flintknapping concentrations in 3rd Unnamed Cave reveal that the knapping debris in the primary mining chamber are in primary position and the result of generalized core reduction (1999:136). Core refitting of the lithic debris indicated that chert nodules were tested by the miners using the split cobble, or bipolar, percussion technique (Franklin 1999:60). Hull's model of microdebitage distribution defines primary refuse as a cluster of macrodebitage that corresponds to a cluster of microdebitage (Hull 1987). According to this model, if the knapping concentrations in 3rd Unnamed Cave are in primary position, the distribution of microdebitage within these concentrations should correspond to the frequency of the macrolithics obtained by Franklin's study. Fladmark's experimental analysis of a primary knapping concentration indicates that "small sediment samples analyzed for microdebitage will produce plots of debitage density closely paralleling total counts of macroflakes" (1982:210). The density plots generated by the macrolithic counts from lithic concentrations E-H and density plots generated by the microlithic frequency counts should show correspondence between the frequency of macro- and microlithics if these concentrations are indeed in primary position. Following are the results of the microdebitage analysis.

Results from Area E

Area E is a large concentration of lithic debitage and may represent at least two flintknapping episodes (Franklin 1999). Using the Surfer® program, three-dimensional wireframe maps of both the total macrolithic density and the microdebitage density were generated. The microdebitage density is obtained by using the total percentage of microdebitage in the sediment resulting from point counting and entering the data into the PARACOUNT program (Figures 10 & 11). The macrolithic density map reveals two discrete areas of higher frequency of lithic debris within Area E. The microdebitage density map exhibits only one area of higher frequency in the center of Area E. The fact that it does not show two discrete areas is quite possibly due to sampling error, because no squares were sampled directly in the center of this concentration, where the macrolithic density map shows a lower frequency of lithics. However, the macrodebitage concentrations in Area E could also represent toss zones for lithic reduction activity conducted in the center of the area. The maps overall show a correspondence between the frequencies of macro- and microdebitage within the same 10 x 20 m area, and support the interpretation that this lithic concentration is in primary position.

Results from Area F

Area F is interpreted as a single, brief knapping event comprised of a total of 213 pieces of debitage (Franklin 1999:60). Refitting analysis indicates that cobbles were being tested and cores reduced using bipolar percussion. A wireframe density map was created using the Surfer® program for the total macrolithic counts for Area F (Figure 12). Due to the fact that this is a very small and sparse concentration of lithic debris located under a 1.5 meter high ledge, only one sediment sample was collected from the center of the concentration

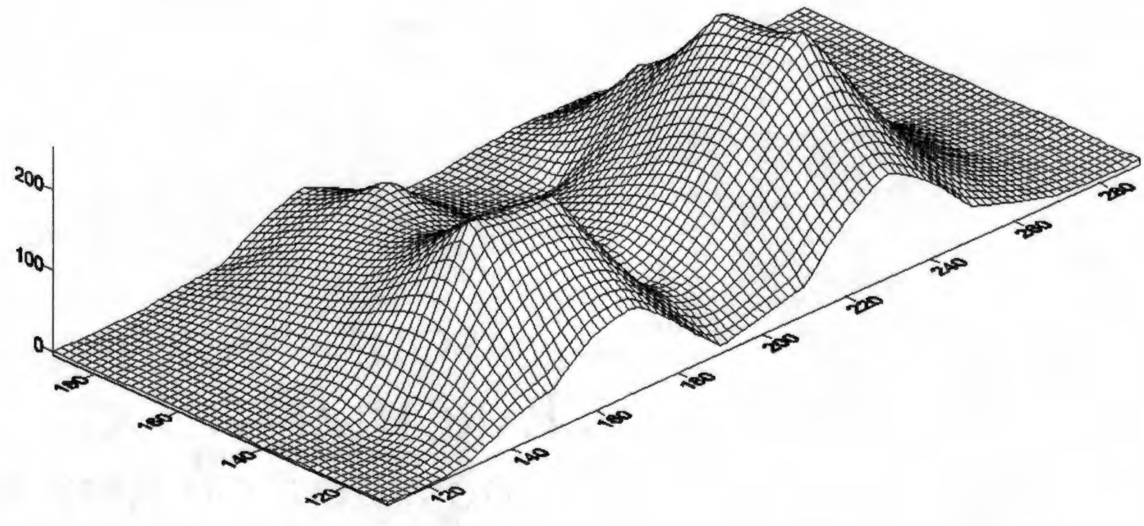

Figure 10. Area E Macrolithic Density.

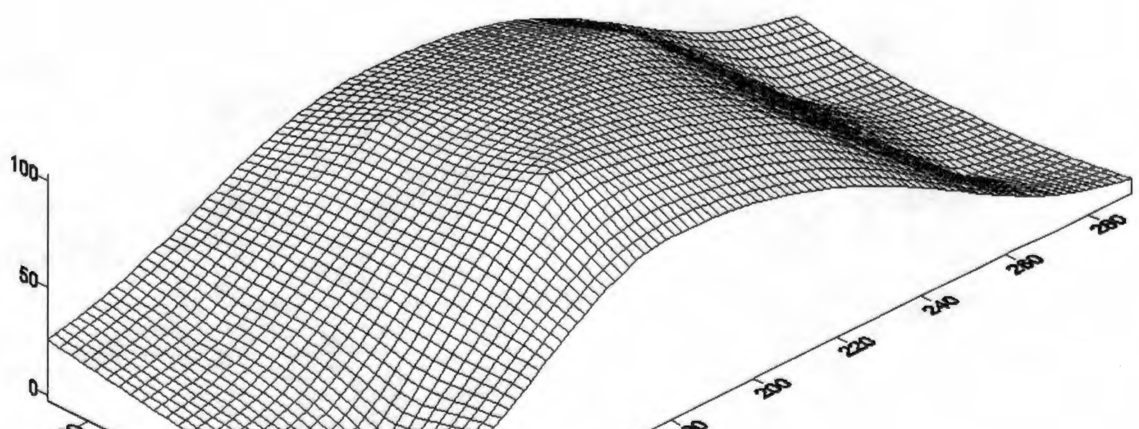

Figure 11. Area E Microlithic Density.

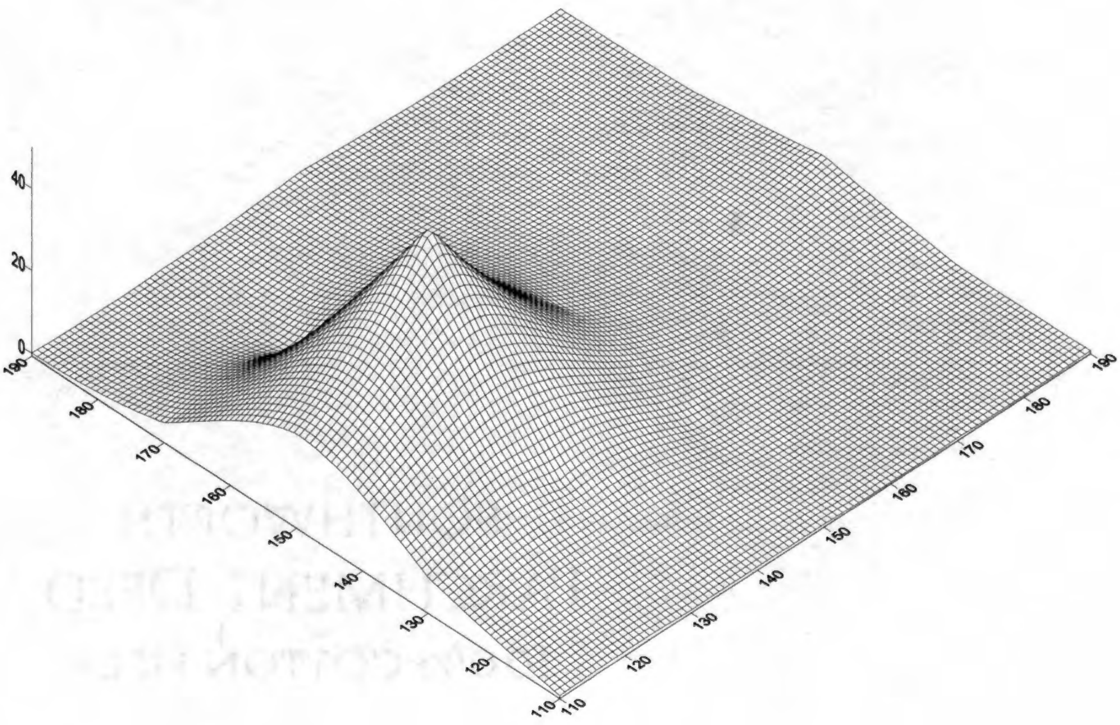

Figure 12. Area F Macrolithic Density.

where the highest frequency of macrolithics are located (no density map could be generated for the microdebitage). The total microdebitage percentage in this sample, obtained from the PARACOUNT program, is 37.28%. This high frequency corresponds well to the frequency of macrolithics, and indicates that this knapping concentration is in primary position.

Results from Area G

Area G is believed to represent a single but intense episode of flintknapping. A total of 538 pieces of debitage was collected, and the results of refitting analysis suggest bipolar reduction was conducted (Franklin 1999:60). Three-dimensional wireframe maps of both the total macrolithic density and the microdebitage density were generated using the Surfer® program. The microdebitage density is obtained by using the total percentage of microdebitage in the sediment resulting from point counting and entering the data into the PARACOUNT program (Figures 13 & 14). The macrolithic density map shows one discrete area of higher frequency. This corresponds well to the interpretation that this represents a single intense knapping episode; however, the microdebitage density corresponds fairly well, but not perfectly, to the area of highest macrolithic density. The area with the highest frequency of microdebitage is situated slightly to the west of the highest frequency of macrolithics. This may be due to a slight tossing effect by the flintknapper, resulting in a toss zone of arger lithic debitage slightly to the west of the area of

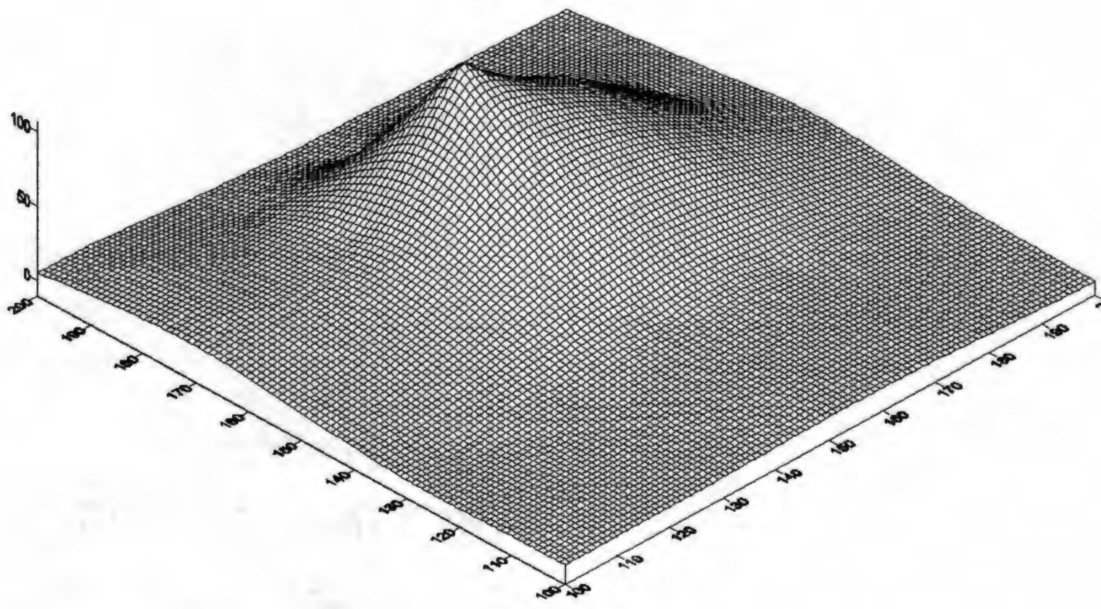

Figure 13. Area G Macrolithic Density.

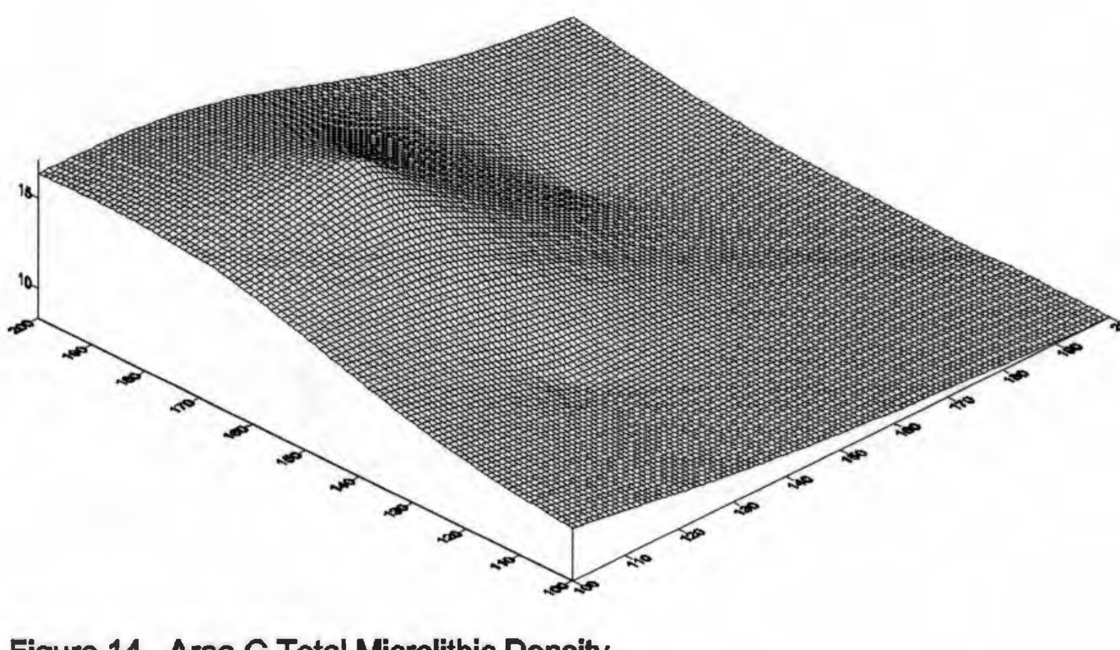

Figure 14. Area G Total Microlithic Density.

activity.

Results from Area H

Area H is located in the main passageway of the cave just below the entrances to the mining chamber. This area was collected in order to determine if flintknapping activities practiced in this lower passage were similar to those practiced above in the primary mining chamber. Three-dimensional wireframe maps of both the total macrolithic density and the microdebitage density were generated using the Surfer® program. The wireframe map generated by the macrolithic counts reveals one discrete area of higher lithic density. The microlithic density map corresponds well, indicating a higher concentration of microdebitage in the same location (Figures 15 & 16). This indicates that the knapping concentration in Area H is in also in primary position.

Area A

Expectations A profile was originally cut in the Area A knapping concentration during the 1981 excavations and was recut when research was reinitiated in 3rd Unnamed Cave in 1996. Seven distinct lithostratigraphic units are distinguishable in the Area A profile. These units are composed of a mix of coarse and fine material ranging from sand to gravel-size rounded rock, and anthropogenic material including ash, charcoal, and lithic debitage. Simek et al. (1998:667) have interpreted the mixed nature of the units in the Area A profile to

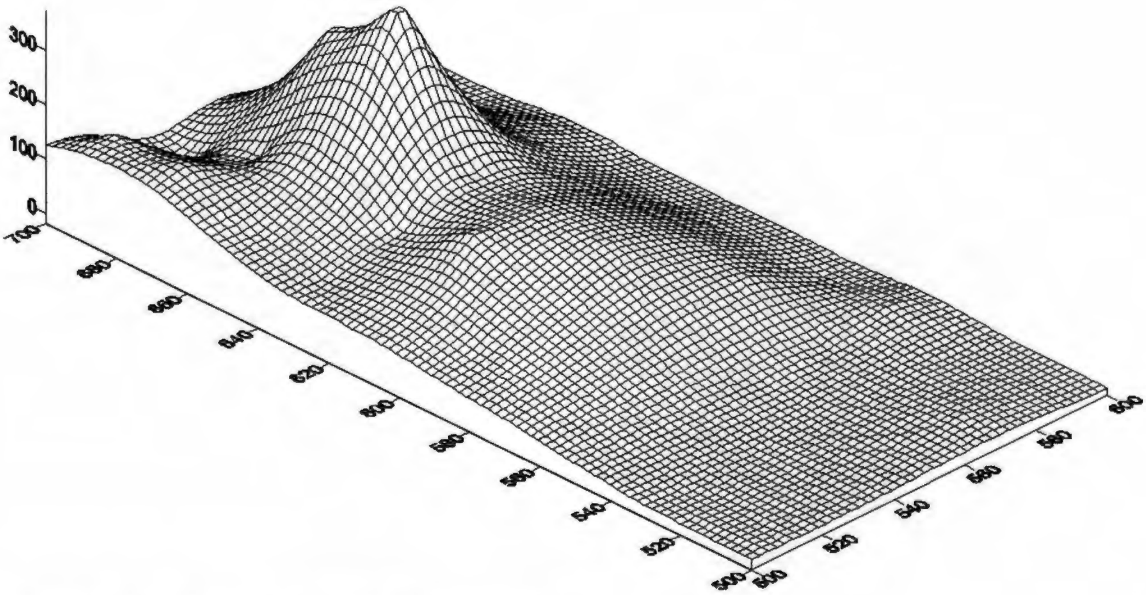

Figure 15. Area H Macrolithic Density.

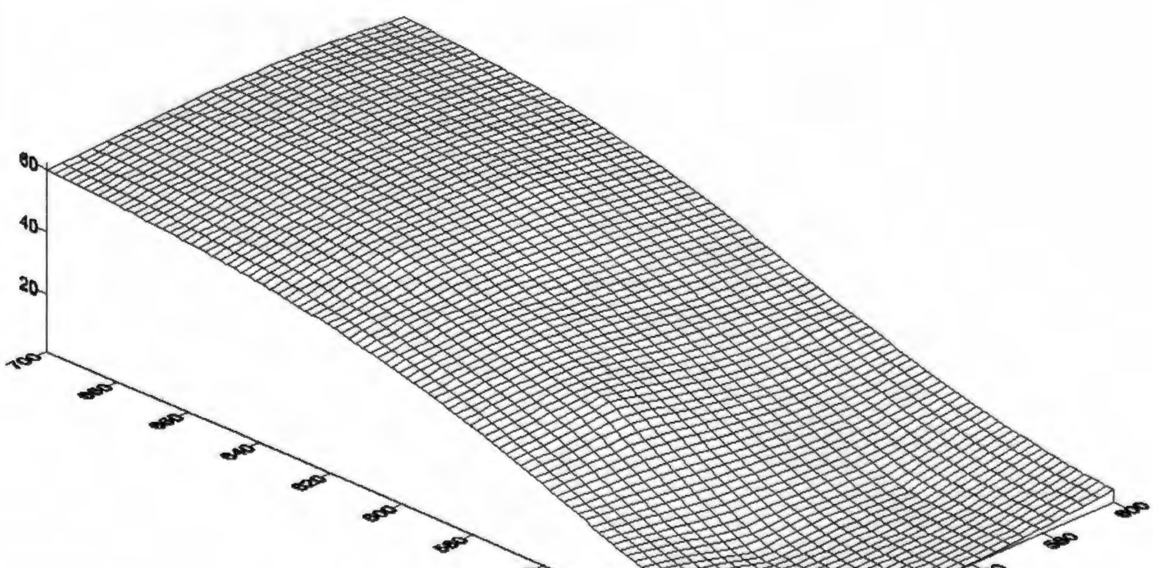

Figure 16. Area H Microlithic Density.

be the result of the prehistoric mining activity; the intensive digging and movement of sediment in the eastern part of the chamber. This interpretation is based on the presence of anthropogenic materials visible in the profile in units A1, A2, A3, and A6 and the mixed nature of all the units above A7. Large clasts around 10 cm in diameter, consisting of interbedded and variably textured sediments are present, particularly in Unit A6. These clasts differ from the matrix surrounding them. Simek et al. (1998:667) interpret this unit as a distinct deposit with a stable surface that was subsequently disturbed by digging; this disturbance broke the sediments apart and created a fabric of pieces of the matrix "floating" in a new mixed matrix. Upon the resulting deposit another stable surface developed and new material was deposited.

The earliest of two buried surfaces in the profile overlies Unit A7. The sediment of Unit A7 is identical to the lithostratigraphic units observed in the undisturbed fluvial deposits of the South Wall profile. Units A4, A5, and A6 are thought to be remnant chert-bearing deposits that were churned up as a result of mining activity. These do not appear to be mixed areas of Unit A7, since the patina of the buried surface is still intact overlying A7, and the coarse fraction present in upper units is absent in A7. Simek et al. (1998:668) state that "The exact geologic source of these upper deposits has yet to be determined. Nevertheless, the anthropogenic aspect of their history is evident in their structure and the artifacts they contain."

Units A1, A2, and A3 are also interpreted as the result of prehistoric disturbance and movement of sediment. These strata vary from the units below by being slightly different in color and consisting of a finer matrix. The second buried surface overlies units A2 and A3, suggesting that the profile was stable for some period of time before Unit A1 was deposited. Lithostratigraphic Unit A3 is interpreted as a possible backfilled digging pit created by miners presumably searching for chert nodules. This is based on its fill contents and structure, its overall shape and size similar to unfilled pits in the chamber, and the fact that it intrudes into units A4, A6, and A7 (Simek et al. 1998). Most recently, lithic reduction activity deposited a concentration of chert nodules and lithic debitage upon the surface of Area A. This concentration of macrolithics is believed to be in primary position and should be accompanied by a concentration of microdebitage.

Results With the exception of Unit A7, microdebitage was present in all units in this profile (Figure 17). Point counting was not conducted on the processed sample from Unit A7 because all of the sediment particles fell under the 1.0 phi fraction utilized for this study. The sample was, however, examined microscopically and no anthropogenic materials were identified. This supports the interpretation that Unit A7 is undisturbed sediment. Unit A6 has a very obviously mixed matrix containing colors and textures represented in units 1 through 5 and an estimated 5% large (~10 cm) clasts, chert nodules, and lithics Simek (et al. 1998). The sediment in this unit is comprised of a total of 17.69% microdebitage. This unit is the only one in which the percentage of microlithics

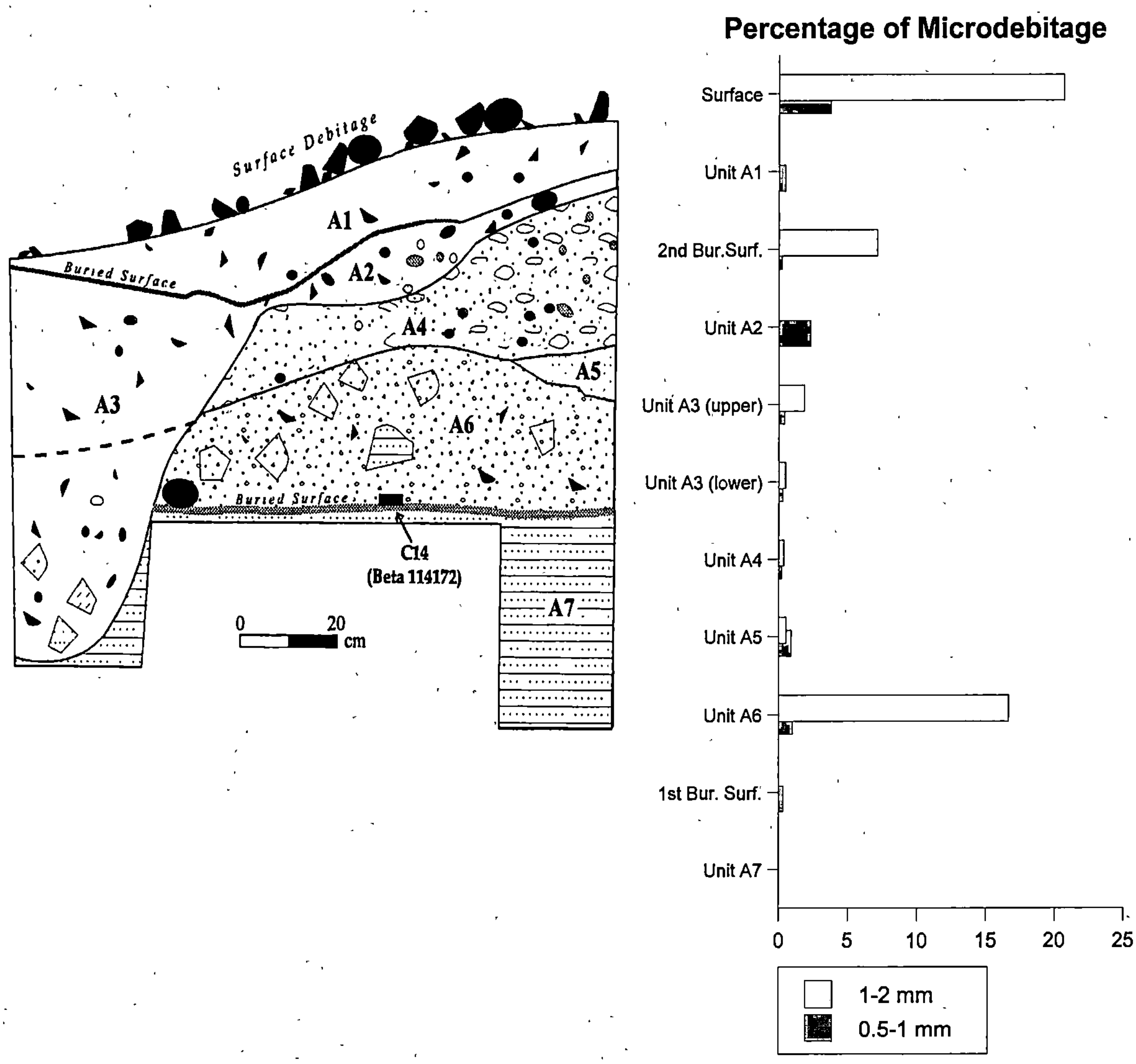

Figure 17. Area A: West Profile (after Simek et al. 1998:668, Figure 4) and Graph Showing Percentages of Microdebitage in Sediment.

approaches that from the knapping area of the Area A profile surface. However, due to the highly mixed nature of Unit A6, it does not appear that it represents an intact buried knapping activity area, but rather is possibly the result of the movement of sediment from adjacent lithic activity areas during subsequent mining activity. Unit A5 is comprised of sand with no macrolithics visible in the profile. A5 was found to contain a total of 1.45% microdebitage. Unit A4 consists of a sand matrix with rounded gravel and cobble-size chert nodules. Analysis found that the sediment in this unit is composed of a total of 0.56% microdebitage. Unit A3 is believed to be a backfilled prehistoric digging pit, and consists of silt and sand matrix with approximately 5% macrolithics and rounded gravel. The sediment sample from the lower half of Unit A3 contains a total of 0.78% microdebitage, and the upper half contains a total of 2.27% microdebitage. Unit A2 consists of a silt matrix containing an estimated 10% macrolithics. A total of 2.28% of the sediment in Unit A2 is comprised of microdebitage. Unit A1 consists of a silty clay matrix containing an estimated 5% macrolithics. This unit was found to have a total of 0.47% microdebitage. The surface of the Area A profile was found to have the highest percentage of microdebitage, 24.44%. This corresponds well to the dense concentration of chert nodules and macrodebitage found on this surface. The combination of macrodebitage and microdebitage indicates that this is primary refuse of the lithic debris generated by the reduction activity.

Two buried surfaces are visible in the profile due to their patina, which is probably a result of weathered bedrock fragments from the chamber ceiling (S.

Sherwood, personal communication 1998). One would expect that if these represent a duration of time when the profile was stable, there might be an accumulation of microdebitage directly upon these buried surfaces if lithic reduction activity was subsequently conducted in that location. This was not found to be the case. Sediment samples were collected directly above the patinated surfaces. The earlier buried surface contains a total of 0.32% microdebitage. The later buried surface contains 7.32% microdebitage.

In conclusion, while there are anthropogenic materials throughout the sediments above the sterile unit and undisturbed buried surface, there is not a high percentage of microdebitage similar to those present in lithic concentrations E-H or that on the surface of Area A. This supports the interpretation that these deposits are the result of physical disturbance by the prehistoric mining activity and there was no stable surface present and subsequently buried within the profile for any significant temporal duration. The microdebitage analysis also does not give any indication of buried concentrations of knapping debris present within the profile in primary context.

Chapter VIII.

Summary and Conclusions

When examining the spatial patterning of artifacts within a site, it is crucial to examine the relationships between microartifacts and macroartifacts in order to make inferences about the organization of activity. Dunnell and Stein (1989) assert that microartifacts *cannot* be used in place of larger artifacts, but the information that archaeologists derive from larger artifacts can be supplemented and complemented by microartifact analysis. 3rd Unnamed Cave provided an excellent opportunity to utilize this type of analysis because the larger artifacts had already been extensively analyzed by Franklin (1999). The microartifact sampling strategy in this study was designed to be comparable with the macroartifact samples. The predominantly lithic material present at this site was also well suited to this type of analysis because lithics are stable, and relatively constant with respect to size once they are introduced into the archaeological record (Sherwood 2000). Microartifacts, especially microdebitage, can be used effectively in activity analyses because enough is known about the creation and behavior of lithic microartifacts that their presence and absence within a site are both meaningful (Vance 1989:204). The primary message of this study is that microartifacts are an important part of the artifact assemblage making up an archaeological deposit. Without consideration of the different size classes of artifacts present at a site and their variation we are sampling a biased fraction of the archaeological record (Sherwood 1991:102). The presence and relative density of microdebitage was used to prove activity hypotheses at 3rd Unnamed Cave generated by more conventional archaeological methods.

Microartifacts were used in this study to augment and strengthen the inferences made about the mining and flintknapping activities practiced in 3rd Unnamed Cave during the Terminal Archaic. Previous archaeological work concluded that prehistoric hunter-gatherers entered the cave about 3,000 years ago to mine and then extensively test and reduce chert nodules, subsequently leaving hundreds of piles of flintknapping debris in primary position. Initial investigations of this site indicated the presence of buried knapping debris, possibly representing discrete knapping episodes spanning an unknown length of time. The intensity of the flintknapping activity within 3rd Unnamed Cave and the lack of subsequent disturbance to the deposits also provided an excellent opportunity to test Hull's three-dimensional activity area classification for microdebitage. The results of both the macrodebitage and the microdebitage analysis indicate that the lithic concentrations are the result of generalized core reduction in primary context, with some knapping areas exhibiting a slight toss-zone effect, possibly the result of the knappers' discard of inferior material. This analysis suggests that the stratigraphy present in Area A is a result of continuing quarrying activity, with no stable surfaces present for any significant duration of time. This supports the hypothesis that the cave was extensively exploited for chert for a relatively short span of time, perhaps 400 years, and then for some unknown reason abandoned as a raw material source (Franklin 1999:37). Although the conditions of this site were perhaps uniquely well suited to microdebitage analysis, this study illustrates the interpretive potential of microartifacts, particularly microdebitage, in delineating activity areas and sorting out formation processes within a site.

LIST OF REFERENCES

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Ahler, S. A.
1989 Mass Analysis of Flaking Debris: Studying the Forest Rather than the Trees. In *Alternative Approaches to Lithic Analysis,* edited by D. O. Henry and G.H. Odell, pp. 85-118. Archaeological Papers of the American Anthropological Association Number 1.

Ahler, S. A. and R. C. Christensen
1983 *A Pilot Study of Knife River Flint Procurement and Reduction at Site 32DU508, a Quarry and Workshop Location in Dunn County, North Dakota.* Department of Anthropology and Archeology, University of NorthDakota. Submitted to the State Historical Society of North Dakota, Bismarck.

Amick, D. S.
1987 *Lithic Raw Material Variability in the Central Duck River Basin: Reflections of Middle and Late Archaic Organizational Strategies.* Tennessee Valley Authority Publications in Anthropology 50, University of Tennessee, Department of Anthropology, Report of Investigations 46.

Behm, J. A.
1983 Flake Concentrations: Distinguishing Between Flintworking Activity Areas and Secondary Deposits. *Lithic Technology* 12(1):9-16.

Bense, J. A.
1994 *Archaeology of the Southeastern United States: Paleoindian to World War I.* Academic Press, San Diego.

Binford, L. R.
1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. *American Antiquity* 43(3):330-331.

Caldwell, J. R.
1958 Trend and Tradition in the Prehistory of the Eastern United States. *American Anthropological Association, Memoir 88.*

Cinq-Mars, J.
1979 Bluefish Cave I: A Late Pleistocene Eastern Beringian Cave Deposit in the Northern Yukon. *Canadian Journal of Archaeology* 3:1-32.

Chapman, J.
1985 *Tellico Archaeology: 12,000 Years of Native American History.* Reports of Investigations No. 43, Occasional Paper No. 5, University of Tennessee, Knoxville. Tennessee Valley Authority Publications in Anthropology No. 41.

Cowan, C. W.
1985 Understanding the Evolution of Plant Husbandry in Eastern North America: Lessons from Botany, Ethnography and Archaeology. In *Prehistoric Food Production in North America,* edited by R. I. Ford, pp. 205-243. Anthropological Papers No. 75. Museum of Anthropology, University of Michigan, Ann Arbor.

Crothers, G. M. and P. J. Watson
1993 Archaeological Contexts in Deep Cave Sites: Examples from the Eastern Woodlands of North America. In *Formation Processes in Archaeological Context*, edited by P. Goldberg, D.T. Nash, and M. D. Petraglia, pp. 53-60. Monographs in World Archaeology No. 17. Prehistory Press, Madison, Wisconsin.

Delcourt, H. R.
1979 Late Quaternary Vegetation History of the Eastern Highland Rim and Adjacent Cumberland Plateau of Tennessee. *Ecological Monographs* 49(3):255-280.

Delcourt, P. A., H. R. Delcourt, C. R. Ison, W. E. Sharp, and K. J. Gremillion
1998 Prehistoric Human Use of Fire, the Eastern Agricultural Complex, and Appalachian Oak-Chestnut Forests: Paleoecology of Cliff Palace Pond, Kentucky. *American Antiquity* 63(2):263-278.

Des Jean, T. and J. L. Benthall
1994 A Lithic Based Prehistoric Cultural Chronology of the Upper Cumberland Plateau. *Tennessee Anthropologist* 19(2):115-147.

DiBlasi, P. J.
1996 Prehistoric Expressions from the Central Kentucky Karst. In *Of Caves and Shell Mounds,* edited by K. C. Carstens and P. J. Watson, pp. 40-47. University of Alabama Press, Tuscaloosa.

Dincauze, D. F.
1976 *The Neville Site: 8000 years of Amoskeag, Manchester, New Hampshire. Peabody Museum Monographs 4.* Peabody Museum of Archaeology and Ethnology, Cambridge, MA.

Dunnell, R. C. and J. K. Stein
1989 Theoretical Issues in the Interpretation of Microartifacts.

Geoarchaeology 431-42.

Farrand, W. R.
1975 Sediment Analysis of a Prehistoric Rockshelter: the Abri Pataud. *Quaternary Research* 5(1):1-26.

Fenneman, N. M.
1938 *Physiography of the Eastern United States.* McGraw-Hill, New York.

Ferguson, L.
1982 *A Preliminary Report of Archaeological Investigations at a Chert Quarry Cave in Fentress County, Tennessee.* Ms. on file, McClung Museum, University of Tennessee, Knoxville.

Ferguson, T. A. and R.A. Pace
1981 *Toward the Effective Management of Cultural Resources on the Cumberland Plateau of Tennessee: The Distribution of Prehistoric Cultural Resources. Final Report of the Cumberland Archeological Research Project.* Submitted to the Tennessee Historical Commission. Nashville.

Ferguson, T. A., R.A. Pace, J. W. Gardner, and R. W. Hoffman
1986 *Final Report of the Big South Fork Archaeological Project: Survey, Testing, and Recommendations.* Department of Anthropology, University of Tennessee, Knoxville.

Ferguson, T. A.
1988 *Lithic Analysis and the Discovery of Prehistoric Man-Land Relationships in the Uplands of the Big South Fork of the Tennessee Cumberland Plateau.* Unpublished Ph.D. dissertation, Department of Anthropology, University of Tennessee, Knoxville.

Fladmark, K. R.
1982 Microdebitage Analysis: Initial Considerations. *Journal of Archaeological Science* 9:205-220.

Franklin, J.
1999 *Rime of the Ancient Miners.* Unpublished M.A. thesis, University of Tennessee, Knoxville.

Galehouse, J. S.
1971 Point Counting. In *Procedures in Sedimentary Petrology,* edited by R. Carver, pp. 385-407. Wiley, New York.

Gifford, D. P.
1978 Ethnoarchaeological Observations of Natural Processes Affecting Cultural Materials. In *Explorations in Ethnoarchaeology*, edited by R. Gould, pp. 77-101. University of New Mexico Press, Albuquerque.

Griffin, J. B.
1952 *Archeology of the Eastern United States.* University of Chicago Press, Chicago and London.

Hardeman, W. D.
1966 *Geologic Map of Tennessee*. State of Tennessee Division of Geology, Nashville.

Hassan, F. A.
1978 Sediments in Archaeology: Methods and Implications for Paleo-environmental and Cultural Analysis. *Journal of Field Archaeology* 5:197-213.

Hoffman, R. W.
1987 *Taphonomy and Zooarchaeology of Rockshelters of the Big South Fork Area of the Cumberland Plateau, Tennessee and Kentucky.* Unpublished Ph.D. dissertation, Department of Anthropology, University of Tennessee, Knoxville.

Hughes, O. D., C. R. Harington, J. A. Janssens, J. V. Matthews, R. E. Morlan, N. W. Rutter, and C. E. Schweger
1981 Upper Pleistocene Stratigraphy, Paleoecology and Archaeology of the Northern Yukon Interior, Eastern Beringia. I. Bonnet Plume Basin. *Arctic* 34(4):329-365.

Hull, K.
1983 *Application of Microdebitage and Spatial Analysis*. Unpublished M.A. thesis, Department of Anthropology, University of Calgary, Calgary.

Hull, K.
1987 Identification of Cultural Site Formation Processes through Microdebitage Analysis. *American Antiquity* 52(4):772-783.

Jolley, R. L.
1979 Archaeological Reconnaissance in the Headwaters of the Caney Fork River in Middle Tennessee. *Tennessee Anthropologist* 4(1):32-62.

Justice, N. D.
1987 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States.* Indiana University Press, Bloomington.

Lewis, T. M. N. and M. Kneberg Lewis
1961 *Eva: An Archaic Site.* University of Tennessee Press, Knoxville.

Madsen, M. E. and R. C. Dunnell
1989 The Role of Microartifacts in Deducing Land Use from Low Density Records in Plowed Surfaces. Paper presented at the 54th Annual Meeting of the Society for American Archaeology, Atlanta, GA.

Magne, M. P. R.
1985 *Lithics and Livelihood: Stone Tool Technologies of Central and Southern Interior British Columbia.* Mercury Series Archaeological Survey of Canada Paper No.133. National Museum of Man, Ottawa.

Metcalfe, D. and K. M. Heath
1990 Microrefuse and Site Structure: The Hearths and Floors of the Heartbreak Hotel. *American Antiquity* 55(4):781-796.

Nicholson, B. A.
1983 A Comparative Evaluation of Four Sampling Techniques and of the Reliability of Microdebitage as a Cultural Indicator in Regional Surveys. *Plains Anthropologist* 28:273-281.

Nielsen, A. E.
1991 Trampling the Archaeological Record: An Experimental Study. *American Antiquity* 56(3):483-503.

O'Connell, J. F.
1987 Alyawara Site Structure and Its Archaeological Implications. *American Antiquity* 52(1):74-108.

Pace, R. E. and G. W. Kline
1976 An Archaeological Survey of Huber Field, in Bledsoe, Sequatchie and Van Buren Counties, Tennessee. Ms. on file, Department of Anthropology, University of Tennessee, Knoxville.

Reese, J. A.
1986 Microarchaeological Analysis of the Chinese Worker's Area at the Warrendale Cannery Site, Oregon. Paper presented at the 51st Annual Meeting of the Society for American Archaeology. New Orleans, LA.

Rosen, A. M.
1986 *Cities of Clay: The Geoarchaeology of Tells.* University of Chicago Press, Chicago.

Rosen, A. M.
1989 Ancient Town and City Sites: A View from the Microscope. *American Antiquity* 54(3):564-578.

Sasowsky, I. D., and W. B. White
1993 Geochemistry of the Obey River Basin, North-central Tennessee: A Case of Acid Mine Water in a Karst Drainage System. *Journal of Hydrology* 146:29-48.

Schiffer, M. B.
1976 *Behavioral Archaeology.* Academic Press, New York.

Schiffer, M. B.
1983 Towards the Identification of Formation Processes. *American Antiquity* 48(4):675-706.

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

Sherwood, S. C.
1991 *Microartifact Analysis of a Dallas Phase House Floor.* Unpublished M.A. Thesis, Dept. of Anthropology, University of Tennessee, Knoxville.

Sherwood, S. C., and S. D. Ousley
1995 Quantifying Microartifacts Using a Personal Computer. *Geoarchaeology* 10:423-428.

Sherwood, S. C., J. F. Simek, and R. R. Polhemus
1995 Artifact Size and Spatial Process: Macro- and Microartifacts in a Mississippian House. *Geoarchaeology* 10:429-455.

Sherwood, S. C.
2000 Microartifacts. In *Earth Science and Archaeology,* edited by P. Goldberg, V. Holliday, and R. Ferring, pp. 327-351. Plenum Press, New York.

Simek, J. F., Franklin, J. D., and S. C. Sherwood
1998 The Context of Early Southeastern Prehistoric Cave Art: A Report on the Archaeology of 3rd Unnamed Cave. *American Antiquity* 63(4):663-677.

Simms, S. R. , and K. M. Heath
1990 Site Structure of the Orbit Inn: An Application of Ethnoarchaeology. *American Antiquity* 55(4):797-813.

Stein, J. K., and P. A. Teltser
1989 Size Distributions of Artifact Classes: Combining Macro- and Micro-Fractions. *Geoarchaeology* 4:1-30.

Steponaitis, V.
1986 Prehistoric Archaeology in the Southeastern United States, 1970-1985. *Annual Reviews of Anthropology* 15:363-404.

Sullivan, A. P., III, and K. C. Rozen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50:755-779.

Vance, D. E.
1986 Microdebitage Analysis in Activity Analysis: An Application. *Northwest Anthropological Research Notes* 20:179-198.

Vance, D. E.
1989 The Role of Microartifact in Spatial Analysis. Unpublished doctoral dissertation, Department of Anthropology, University of Washington, Seattle, Washington.

APPENDIX

DATA TABLES

Area A; Surface (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	39	31	168	763	34
Percentage	3.77	3	16.23	73.72	3.29
Standard Error	0.59	0.53	1.15	1.37	0.55

Area A; Surface (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	118	34	11	395	13
Percentage	20.67	5.95	1.93	69.18	1.28
Standard Error	1.69	.99	.58	1.93	.89

Area A; Level A1 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	8	3	586	1071	24
Percentage	0.47	0.18	34.63	63.3	1.42
Standard Error	0.17	0.10	1.16	1.17	0.29

Area A; Level A1 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	5	126	2
Percentage	0	0	3.76	94.76	1.5
Standard Error	0	0	1.65	1.94	1.06

Area A; Upper Buried Surface (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	2	0	446	357	159
Percentage	0.21	0	46.27	37.03	16.49
Standard Error	0.15	0	1.61	1.56	1.39

Area A; Upper Buried Surface (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	14	0	0	180	3
Percentage	7.11	0	0	91.37	1.52
Standard Error	1.83	0	0	2.00	.87

Area A; Level A2 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	25	1	556	507	7
Percentage	2.28	0.09	50.73	46.26	0.64
Standard Error	0.45	0.09	1.51	1.51	0.24

Area A; Level A2 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	142	447	1
Percentage	0	0	24.07	75.76	0.17
Standard Error	0	0	1.76	1.76	0.17

Area A; Level A3-upper portion (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	3	0	387	234	69
Percentage	0.43	0	55.84	33.77	9.96
Standard Error	0.25	0	1.89	1.80	1.14

Area A; Level A3-upper portion (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	8	0	84	343	0
Percentage	1.84	0	19.31	78.85	0
Standard Error	0.64	0	1.89	1.96	0

Area A; Level A3-lower portion (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	3	3	577	407	5
Percentage	0.3	0.3	57.99	40.9	0.5
Standard Error	0.17	0.17	1.56	1.56	0.22

Area A; Level A3-lower portion (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	3	60	167	387	2
Percentage	.48	9.69	26.98	62.52	0.32
Standard Error	.28	1.19	1.78	1.95	0.23

Area A; Level A4 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	4	1	1330	670	5
Percentage	0.2	0.05	66.17	33.33	0.25
Standard Error	0.10	0.05	1.06	1.05	0.11

Area A; Level A4 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	2	4	181	375	0
Percentage	0.36	0.71	32.21	66.73	0
Standard Error	0.25	0.35	1.97	1.99	0

Area A; Level A5 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	6	7	234	375	22
Percentage	0.93	1.09	36.34	58.23	3.42
Standard Error	0.38	0.41	1.90	1.94	0.72

Area A; Level A5 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	3	0	193	381	5
Percentage	0.52	0	33.16	65.46	0.86
Standard Error	0.30	0	1.95	1.97	0.38

Area A; Level A6 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	8	19	251	501	2
Percentage	1.02	2.43	32.14	64.15	0.26
Standard Error	0.36	0.55	1.67	1.72	0.18

Area A; Level A6 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	4	0	8	12	0
Percentage	16.67	0	33.33	50	0
Standard Error	7.61	0	9.62	10.21	0

Area A; Lower Buried Surface (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	3	0	1	869	70
Percentage	0.32	0	0.11	92.06	7.42
Standard Error	0.18	0	0.11	0.88	0.85

Area A; Lower Buried Surface (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

200 yards into Elephant Walk Passage (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	24	688	124
Percentage	0	0	2.87	82.3	14.83
Standard Error	0	0	0.58	1.32	1.23

200 yards into Elephant Walk Passage (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	43	11
Percentage	0	0	0	79.63	20.37
Standard Error	0	0	0	5.48	5.48

Within Cobble Country (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	63	0	227	487	3
Percentage	8.08	0	29.2	62.44	0.38
Standard Error	0.98	0	1.63	1.73	0.22

Within Cobble Country (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

Adjacent to rimstone dams (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	1	0	214	5
Percentage	0	0.45	0	97.27	2
Standard Error	0	0.45	0	1.10	2.27

Adjacent to rimstone dams (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	40	0
Percentage	0	0	0	100	0
Standard Error	0	0	0	0	0

Near Woods Wet Well, away from knapping debris (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	3	214	5
Percentage	0	0	1.21	97.27	2.27
Standard Error	0	0	0.69	1.10	1.00

Near Woods Wet Well, away from knapping debris (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	14	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

Area A: 0-10 cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	18	330	425	6
Percentage	0	2.31	42.36	54.56	0.77
Standard Error	0	0.54	1.77	1.78	0.31

Area A: 0-10 cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	18	28	1
Percentage	0	0	38.3	59.57	2.13
Standard Error	0	0	7.09	7.16	2.10

Area A: 10-20 cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	480	417	3
Percentage	0	0	53.33	46.33	0.33
Standard Error	0	0	1.66	1.66	0.19

Area A: 10-20 cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	1	0	193	385	3
Percentage	0.17	0	33.16	66.15	0.52
Standard Error	0.17	0	1.95	1.96	0.30

Area A: 20-30cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	11	10	30	352	19
Percentage	2.61	2.37	7.11	83.41	4.5
Standard Error	0.78	0.74	1.25	1.81	1.01

Area A: 20-30cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	28	0	12	104	0
Percentage	19.44	0	8.33	72.22	0
Standard Error	3.30	0	2.30	3.73	0

Area A: 30-40cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	10	2	28	391	8
Percentage	2.28	0.46	6.38	89.07	1.82
Standard Error	0.71	0.32	1.17	1.49	0.64

Area A: 30-40cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

Area A: base-70cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	551	126
Percentage	0	0	0	81.39	18.61
Standard Error	0	0	0	1.50	1.50

Area A: base-70cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	61	1
Percentage	0	0	0	98.39	1.61
Standard Error	0	0	0	1.60	1.60

South Wall: 0-10cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	378	52
Percentage	0	0	0	87.90	12.09
Standard Error	0	0	0	1.82	1.57

South Wall: 0-10cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

South Wall: 10-20cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	151	521	2
Percentage	0	0	22.4	77.3	0.3
Standard Error	0	0	1.61	1.61	0.21

South Wall: 10-20cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

South Wall: 20-30 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	334	486	5
Percentage	0	0	40.44	58.95	0.61
Standard Error	0	0	1.71	1.87	0.27

South Wall: 20-30 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

South Wall: 40-50cm (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	336	485	5
Percentage	0	0	40.68	58.71	0.61
Standard Error	0	0	1.88	1.71	0.27

South Wall: 40-50cm (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

South Wall: 50-60 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	73	374	0
Percentage	0	0	16.33	83.67	0
Standard Error	0	0	1.75	1.75	0

South Wall: 50-60 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	0	0	0	0	0
Percentage	0	0	0	0	0
Standard Error	0	0	0	0	0

Area E; Square 12 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	5	0	49	372	4
Percentage	1.16	0	11.4	86.51	0.93
Standard Error	0.52	0	1.53	1.65	0.46

Area E; Square 12 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	15	0	38	287	1
Percentage	4.4	0	11.14	84.16	0.29
Standard Error	1.11	0	1.70	1.98	0.29

Area E; Square 14 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	115	0	143	408	4
Percentage	17.16	0	21.34	60.9	0.6
Standard Error	1.46	0	1.58	1.89	0.30

Area E; Square 14 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	337	0	12	302	6
Percentage	51.29	0	1.83	45.97	0.91
Standard Error	1.95	0	0.52	1.94	0.37

Area E; Square 17 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	226	0	77	460	3
Percentage	29.5	0	10.05	60.05	0.39
Standard Error	1.65	0	1.09	1.77	0.23

Area E; Square 17 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	238	0	0	89	0
Percentage	72.78	0	0	27.22	0
Standard Error	2.46	0	0	2.46	0

Area E; Square 19 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	4	1	14	265	1
Percentage	1.4	0.35	4.91	92.98	0.35
Standard Error	0.70	0.35	1.28	1.51	0.35

Area E; Square 19 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	29	0	0	236	0
Percentage	10.94	0	0	89.06	0
Standard Error	1.92	0	0	1.92	0

Area E; Square 32 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	7	5	61	400	0
Percentage	1.46	1.04	12.68	84.82	0
Standard Error	0.55	0.46	1.52	1.64	0

Area E; Square 32 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	8	0	34	272	1
Percentage	2.54	0	10.79	86.35	0.32
Standard Error	0.89	0	1.75	1.93	0.32

Area E; Square 34 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	97	1	66	449	1
Percentage	15.8	0.16	10.75	73.13	0.16
Standard Error	1.47	0.16	1.25	1.79	0.16

Area E; Square 34 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	375	7	20	257	0
Percentage	56.9	1.06	3.03	39	0
Standard Error	1.93	0.40	0.67	1.90	0

Area E; Square 37 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	216	54	73	428	12
Percentage	27.59	6.9	9.32	54.66	1.53
Standard Error	1.60	0.91	1.04	1.78	0.44

Area E; Square 37 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	382	127	1	113	0
Percentage	61.32	20.39	0.16	18.14	0
Standard Error	1.95	1.61	0.16	1.54	0

Area E; Square 39 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	35	72	20	566	5
Percentage	5.01	10.32	2.87	81.09	0.72
Standard Error	0.83	1.15	0.63	1.48	0.32

Area E; Square 39 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	90	101	0	1.77	0
Percentage	24.46	27.45	0	48.1	0
Standard Error	2.24	2.33	0	2.60	0

Area F; Square 12 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	92	95	56	429	0
Percentage	13.69	14.14	8.33	63.84	0
Standard Error	1.33	1.34	1.07	1.85	0

Area F; Square 12 (1.2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	151	47	79	361	2
Percentage	23.59	7.34	12.34	56.41	0.31
Standard Error	1.68	1.03	1.30	1.96	0.22

Area G; Square 7 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	14	23	34	420	1
Percentage	2.85	4.67	6.91	85.37	0.2
Standard Error	0.75	0.95	1.14	1.59	0.2

Area G; Square 7 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	40	7	77	429	37
Percentage	6.78	1.06	13.05	72.71	6.27
Standard Error	1.03	0.45	1.39	1.83	1.00

Area G; Square 9 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	19	8	160	460	3
Percentage	2.927	1.232	24.49	70.87	0.4622
Standard Error	0.6617	0.4331	1.688	1.783	0.2662

Area G; Square 9 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	34	3	55	354	9
Percentage	7.47	0.66	12.09	77.8	1.98
Standard Error	1.23	0.38	1.53	1.95	0.65

Area G; Square 17 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	27	75	116	516	4
Percentage	3.66	10.16	15.72	69.92	0.54
Standard Error	0.69	1.11	1.34	1.69	0.27

Area G; Square 17 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	30	5	78	404	29
Percentage	5.49	0.92	14.29	73.99	5.31
Standard Error	0.98	0.41	1.50	1.88	0.96

Area G; Square 19 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	40	82	79	483	5
Percentage	5.81	11.9	11.47	70.1	0.73
Standard Error	0.89	1.23	1.21	1.74	0.32

Area G; Square 19 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	62	40	42	387	16
Percentage	11.33	7.31	7.68	70.75	2.93
Standard Error	1.36	1.11	1.14	1.95	0.72

Area H; Square 7 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	85	67	46	405	5
Percentage	13.98	11.02	7.56	66.61	0.82
Standard Error	1.41	1.27	1.07	1.91	0.37

Area H; Square 7 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	288	77	28	308	1
Percentage	41.03	10.97	3.99	43.87	0.14
Standard Error	1.86	1.18	0.74	1.87	0.14

Area H; Square 9 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	87	321	29	225	4
Percentage	13.06	48.2	4.35	33.78	0.6
Standard Error	1.31	1.94	0.79	1.83	0.30

Area H; Square 9 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	257	161	14	224	5
Percentage	38.88	24.36	2.12	33.89	0.76
Standard Error	1.90	1.67	0.56	1.84	0.34

Area H; Square 17 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	102	88	15	496	5
Percentage	14.45	12.46	2.12	70.25	0.71
Standard Error	1.32	1.24	0.54	1.72	0.32

Area H; Square 17 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	263	32	22	352	2
Percentage	39.2	4.77	3.28	52.46	0.3
Standard Error	1.88	0.82	0.69	1.93	0.21

Area H; Square 19 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	114	162	62	312	4
Percentage	17.43	24.77	9.48	47.71	0.61
Standard Error	1.48	1.69	1.15	1.95	0.30

Area H; Square 19 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	282	74	35	246	0
Percentage	44.27	11.62	5.49	38.62	0
Standard Error	1.97	1.27	0.90	1.93	0

Area H; Square 32 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	6	8	35	406	6
Percentage	1.3	1.74	7.59	88.07	1.3
Standard Error	0.53	0.61	1.23	1.51	0.53

Area H; Square 32 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	10	0	25	310	3
Percentage	2.87	0	7.18	89.08	0.86
Standard Error	0.90	0	1.38	1.67	0.50

Area H; Square 34 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	50	194	80	368	16
Percentage	7.06	27.4	11.3	51.98	2.26
Standard Error	0.96	1.68	1.19	1.88	0.56

Area H; Square 34 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	175	24	46	415	1
Percentage	26.48	3.63	6.96	62.78	0.15
Standard Error	1.72	0.73	0.99	1.88	0.15

Area H; Square 44 (0.5-1mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	44	39	27	403	6
Percentage	8.48	7.51	5.2	77.65	1.16
Standard Error	1.22	1.16	0.97	1.83	0.47

Area H; Square 44 (1-2mm)					
	Lithics	Charcoal	Quartz	Misc. Rocks & Minerals	Carbonate Fossils
Total Count	71	0	19	353	3
Percentage	15.92	0	4.26	79.15	0.67
Standard Error	1.73	0	0.96	1.99	0.39

VITA

Valerie Esther Altizer was born in Knoxville, TN on December 28, 1971. She attended grade school and junior high in Knox County and graduated from Halls High School in 1990. In September of 1990, she enrolled in the University of Tennessee, Knoxville. She began working in contract archaeology for the University of Tennessee in September of 1993 on projects in East Tennessee. Valerie graduated in May of 1995 with a Bachelor of Arts degree in Anthropology and a minor in Geology. She spent the following year working as an archaeologist for the Tennessee Department of Environment and Conservation. In the fall of 1996 she enrolled in the Master's Program in Anthropology at the University of Tennessee. Beginning in the spring of 1998 she worked as a contract archaeologist for the Tennessee Valley Authority in the Cultural for two years while attending graduate school. Her primary research interests are prehistoric North America, geoarchaeology, and cave archaeology. Valerie received a Master of the Arts degree in Anthropology from the University of Tennessee in December 2001. She is currently pursuing her doctorate in anthropology at the University of Tennessee.