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I am submitting herewith a thesis written by Erin Elizabeth Pritchard entitled "The Prehistoric Use of Hubbards Cave, Warren County, Tennessee." 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.

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The Prehistoric Use
Of
Hubbards Cave
Warren County, Tennessee

A Thesis
Presented for the
Master of Arts
Degree
The University of Tennessee

Erin Elizabeth Pritchard
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ABSTRACT

Hubbards Cave, in Warren County, Tennessee, contains evidence of a prehistoric gypsum mine. Such evidence is rare in the southeastern United States and few caves have been identified as prehistoric mineral extraction locations. Evidence of mining at Hubbards was documented using a total station laser transit and ArcView© GIS program in order to identify and evaluate prehistoric activities throughout the cave. While much of the archaeological evidence pertaining to the prehistoric occupation of the cave has been removed as a result of later saltpeter (KNO_3) mining, traces of prehistoric evidence are documented in an attempt to interpret prehistoric use of the cave.

Results indicate that prehistoric people likely utilized the cave throughout the Woodland period for a number of different purposes. Evidence of a prehistoric occupation is present within the vast entrance shelter and extensive prehistoric activity is present throughout the lengthy passages of the associated cave. Spatial patterning of artifacts is examined to identify specific locations within the cave where prehistoric activity are concentrated.

Hubbards is compared to four other mineral mining caves in the Southeast in terms of chronological and geographical relationships. Statistical analysis suggests Hubbards was mined later than other mineral mining caves in the Southeast. Geographically, it appears that gypsum mining began further north at Mammoth and Salts caves. Hypotheses are presented in an attempt to explain this phenomenon.

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CHAPTER I
INTRODUCTION

Overview of Cave Archaeology

Prehistoric peoples were dependent upon nature to provide virtually every resource necessary to survive. Through ethnographic and archaeological research, we can learn to what extent prehistoric Native Americans utilized the natural resources available to them. Materials utilized by Native peoples include a variety of both plant and mineral resources that were collected and mined from various locations throughout their environment.

One such resource extraction is the collection and mining of minerals from deep cave settings. It was a difficult and often dangerous task to collect minerals of various forms from deep within the dark zone of caves. These minerals provided a number of different uses for Native peoples ranging from medicinal to ornamental purposes. The extent of mining in some regions leads to the suppostion that this practice was part of an economical network or interaction sphere, where local materials were exchanged for exotic resources not available in the local area. Examples of extensive mining have been documented in a number of caves located throughout the southeastern United States (Watson 1969, 1971; Crothers 1986; Munson and Munson 1990; Simek et al 1998; Franklin 1999). Previously collected evidence from these sites has helped to define this prehistoric phenomenon that is perhaps only partially understood by archaeologists. All that remains are the tools and artifacts that were left behind by ancient miners who either exhausted the resource or found no further need for

its collection. From these remains we can piece together fragments of a potentially large and widespread prehistoric economy that may shed light on the conditions under which these early societies began to flourish. While time has obliterated a great deal of physical data, what does remain can be employed to shed light on an important aspect of prehistoric life.

Research Goals at Hubbards Cave

This thesis attempts to expand our knowledge of prehistoric mining technologies through an extensive investigation of one such mining locale. Hubbards Cave, located in Warren County, Tennessee, contains evidence of a prehistoric gypsum mine that was exploited throughout the prehistoric Woodland Period. The cave was recently purchased by the Tennessee chapter of the Nature Conservancy and is currently used as a nature preserve and gray bat hibernaculum. Historically the cave was mined for saltpeter and much of the prehistoric component was disturbed. Traces of prehistoric activity were recovered through extensive survey of each chamber. Archaeological investigation of Hubbards Cave is examined and placed in its geographical and temporal setting through the comparison of contemporary sites in the region. The systematic documentation of Hubbards Cave has taken place in several stages:

- Although Hubbards Cave has been heavily impacted by modern activities that have altered and destroyed the archaeological deposits, survey was undertaken to map in detail what remained. This was accomplished

through the systematic survey of the two dry passages of the cave with a potential for archaeological preservation. Small passageways were explored to search for evidence of prehistoric utilization in these areas. Artifacts were also recovered through the sampling of various woodrat's nests found throughout both the North and West Passageways. Most perishable materials remaining in the cave are concentrated in midden deposits where woodrats (*Neotoma floridana*) live.

- In an attempt to reconstruct prehistoric movement throughout the cave's passageways, artifacts, mining activity, and other evidence of prehistoric utilization were mapped using a Nikon Total Station Laser Transit. Areas where gypsum mining occurred were measured and the central point of each individual episode along with associated artifacts were plotted in a three dimensional map constructed in ArcView©.
- Documentation of the exterior portions of the cave was made in order to identify activities that were occurring in this area and how it might relate to the prehistoric behavior within the cave.
- Chemical analysis of the minerals found within Hubbards was conducted in order to verify the materials present. X-Ray Diffraction analysis was completed on four mineral samples collected from various portions of the West Passage. Results are presented in Chapter XI.
- Chronological interpretations were made based on the assessment of radiocarbon dates collected from various river cane torch fragments found within the cave. An attempt to relate Hubbards to the broad scheme of

mineral mining in the prehistoric Eastern Woodlands was made. Chronological and geographical comparisons are presented here between Hubbards Cave and other major mining caves in the region.

In order to address the problem of mining in Hubbards Cave, my thesis will be organized as follows: Chapter II discusses the history of investigations at Hubbards Cave and place the site within its physiographic and geological setting; Chapter III summarizes the general culture history of the region as defined by archaeological investigations of the Normandy Reservoir along the Upper Duck River; Chapter IV discusses archaeological investigations of similar mining sites in the Southeast; Chapter V outlines the methods used for my investigations of Hubbards Cave; Chapter VI summarizes the results of these investigations; Chapter VII discusses the chronology of Hubbards Cave and its association with other mining sites in the region; and Chapter VIII summarizes the results and conclusions of my research.

CHAPTER II
ENVIRONMENTAL SETTING

Site History

Hubbards Cave has been extensively explored for more than two centuries. Over 1000 historic signatures have been documented within the cave, including one as early as 1809 (Joe Douglas, personal communication).

Gerard Fowke was the first to visit Hubbards Cave in search of archaeological evidence (1922). Fowke visited the site in 1921, noting some evidence of prehistoric activity, but showing little interest in the archaeological value of the cave. Archaeologists from the University of Tennessee visited the cave, under the direction of Dr. Charles Faulkner, in the 1970s (Faulkner, personal communication). It was noted that prehistoric remains were present in the cave; however, evidence of gypsum mining was not noticed at this time. Historic saltpeter mining evidence was found throughout the North, South and West Passages of the cave (Plates 1 and 2). Remains of this mining included historic cedar ladders, climbing poles and saltpeter vats. In 1998, cavers with the Southport Chronic Cavers Grotto notified Dr. Jan Simek of the University of Tennessee Department of Anthropology that the prehistoric archaeological resources in the cave were being threatened. At this time, Simek led a team of cave archaeologists to conduct a preliminary investigation of aboriginal remains. That work provided the basis of the thesis research presented here.



Plate 1. Historic Ladder in West Passage.



Plate 2. Saltpeter Mining Evidence in the North Passage.

Physiography and Geology

Hubbards Cave is located in the Appalachian Plateau Province along the western escarpment of the Cumberland Plateau (Fenneman 1938). The Cumberland Plateau is bounded by the Highland Rim to the west and to the east by the Great Valley.

Hubbards Cave is a limestone cave whose entrance is located within the Bangor Limestone/Hartselle formation of the Mississippian Epoch. The Bangor formation is characterized by a dark brownish-gray, thick-bedded limestone that ranges from 70 to 400 feet in thickness. The Hartselle formation is a “thin-bedded, fine-grained sandstone interbedded with gray shale” (Hardeman 1966). These formations are capped by the Pennington formation which is a reddish to greenish shale and siltstone; fine grained dolomite; dark gray limestone; and a thin bedded sandstone. Thickness of the Pennington formation ranges from 150 to 400 feet. Below the Bangor/Hartselle formations lies the Monteagle Limestone formation which is a light-gray, fragmental and oolitic limestone with a thickness of 180 to 300 feet (Hardeman 1966).

Hubbards Cave consists of over 8300 feet of passage that have been mapped thus far. The main entrance was formed from a large sink collapse, and three primary passages branch to the north, west and south. The North Passage opens with a large overhang and extends 450 feet. The West Passage begins with a small crevice that eventually opens up open passage that extends 2100 feet. The South Passage remains an active passage with hydraulic activity

present during certain times of the year. This passage extends 5730 feet with new passages continually being discovered.

CHAPTER III
CULTURAL HISTORY

Archaeological research in the vicinity of Hubbards Cave has been minimal. Known archaeological sites have been identified through a few Tennessee Division of Archaeology and Tennessee Department of Transportation (TDOT) surveys that have been conducted in the area. While historical documents mention the frequency of Native American sites and/or artifacts in the area (Goodspeed 1972; Womack 1960), very little controlled archaeological investigation has been conducted. Therefore, most of the cultural historical information has been drawn from the adjacent region of the Upper Duck River Valley in the Eastern Highland Rim (Figure 1), where extensive archaeological research has been conducted in the Normandy Reservoir (Faulkner and McCollough 1973, 1974; Faulkner and McCollough (eds) 1977, 1978. 1982a, 1982b; McCullough and Faulkner (eds) 1976, 1978). While occupation of Hubbards may have begun as early as the Archaic period, the research presented here focuses on the Woodland period for which the most extensive evidence for occupation exists.

Paleoindian and Archaic Period (8000 B.C. – 700 B.C.)

The Paleoindian period represents the first documented human occupation in the Southeast (Anderson 1996). Paleoindian technology is dominated by a lanceolate fluted point. The most common type is the Clovis projectile point. Other Paleoindian projectile point types in the Southeast include Beaver Lake, Cumberland, Hardaway, Quad, and Suwanee. Paleoindians are

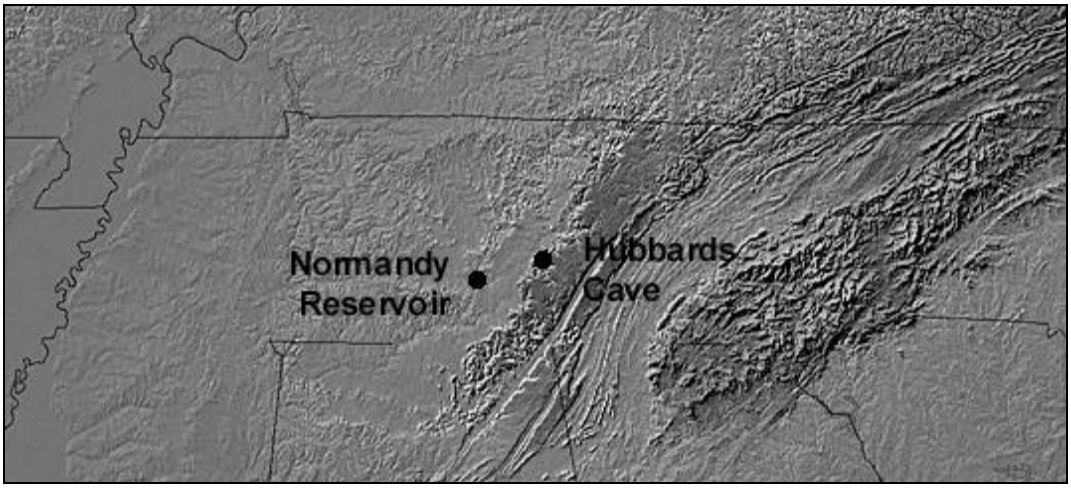


Figure 1. Map Showing Relationship of Hubbards Cave to the Upper Duck River Valley.

believed to have been highly mobile hunters of megafauna. In the Southeast, Paleoindian peoples may have hunted large megafauna, such as mammoth, but also subsisted on small game such as deer, rabbit, turtle and fish (Steponaitis 1986). While a large number of Paleoindian occupation sites have been identified in Tennessee (Broster and Norton 1996), a very limited number of these sites have been excavated.

The Archaic period begins at the transitional boundary between the Pleistocene/Holocene epochs, where the climate changes from cold and dry conditions to an environment more like our present day one. The Late Archaic period in the Southeast is a period of dramatic change in prehistoric society. Archaeological evidence from the Late Archaic represents a transition period where characteristic manifestations of the later Woodland and Mississippian periods begin. These manifestations include plant cultivation, evidence of long-term dwellings, use of containers such as steatite bowls and pottery, and increased evidence of long-distance trade. All of this evidence suggests Late Archaic groups were becoming more sedentary through time (Steponaitis 1986).

The first identified habitation sites in the upper Duck Valley date to the Early Archaic period. While evidence of Early Archaic components has been found, larger occupational sites were first established during the Eva-Morrow Mountain phase of the Middle Archaic period. Late Archaic sites are represented by the Ledbetter phase characterized by an increase in sedentism as suggested archaeologically by the presence of midden deposits and large storage pits (Faulkner and McCollough 1974). The Wade phase represents the transitional

period between the Archaic and Woodland cultures. Continuing with the pattern of increased sedentism, Wade sites exhibit larger deeper midden deposits, larger dwellings, concentrations of features, and the presence of steatite bowls.

Woodland Period (700 B.C. – A.D. 1000)

Based on radiocarbon dates and recovered artifacts, it appears that Hubbards Cave was predominately utilized during the Woodland period. Six distinct phases have been defined for the Woodland Period in the upper Duck Valley.

WATTS BAR PHASE (700B.C. – 400 B.C.)

The Watts Bar Phase represents the earliest Woodland culture in the upper Duck River Valley. This phase is characterized by quartz-tempered, fabric-marked pottery. Diagnostic pottery resembles Watts Bar Fabric Marked of the eastern Tennessee Valley (Lewis and Kneberg 1957). Diagnostic lithics found in this phase include Adena-like stemmed and Wade corner-notched points (Faulkner 2001). Features on Watts Bar phase sites within the Normandy Reservoir area suggest that these Early Woodland people lived in small units and occupied seasonal sites.

LONG BRANCH PHASE (*400 B.C – 200 B.C.)*

The Long Branch phase represents the Late Early Woodland cultural phase in the Upper Duck region (Faulkner 2001). Long Branch sites are characterized by a change from quartz tempered to limestone tempered pottery.

Diagnostic pottery vessels continue to be predominately fabric marked. Diagnostic lithic artifacts include stemless, triangular projectile points. Evidence gathered from Long Branch phase archaeological sites within the Normandy Reservoir suggests prehistoric peoples continued to occupy sites for short periods of time. Evidence for repeated occupation of such sites is found at the Jernigan and Aaron Shelton sites (Faulkner and McCullough 1982).

NEEL PHASE (*200 B.C – A.D. 1)*

The Neel Phase represents a brief period overlapping with and perhaps a variant of both the Long Branch and McFarland phases. Neel phase sites are characterized by a change in community size and configuration (Faulkner 2001). Specialized burial sites are found with exotic materials such as copper, mica, galena, and quartz crystals. Domestic sites of the Neel phase have also been excavated.

MCFARLAND PHASE (*A.D. 1 – A.D. 200)*

Following the Neel Phase is the McFarland phase. Similar to the preceeding phase, the McFarland phase is characterized by limestone tempered pottery and triangular and expanded stemmed projectile points. Pottery vessels exhibit a surface treatment of fabric-marking and check stamping. During this phase there is an increase in sedentism with an increased dependence on cultivated and domesticated plants such as maygrass, goosefoot, sunflower, sumpweed, squash, and maize (Faulkner 2001)

Considerable change in trade and ceremonial activity occurred during this phase. Evidence of this change is found with the construction of Old Stone Fort. Old Stone Fort is an earth and stone enclosure located in Coffee County, Tennessee, situated between the confluence of the two forks of the Duck River (Faulkner 1971; Weems 1995). Its incomplete wall construction, relatively low wall elevation, and lack of interior habitation debris suggest its' purpose was for ceremonial activities rather than for defense (Faulkner 1971). Several theories have been published concerning its ceremonial or supernatural meaning (Bacon 1993; Pearsall and Malone 1991). Its placement near major trails and water routes may have made it ideal as a trade center for local exchange networks. Whatever its function, construction of the Old Stone Fort coincides with an increase in ceremonial activity and trade.

OWL HOLLOW PHASE (A.D. 200 – A.D. 600)

The Owl Hollow phase began around A.D. 200 and represents a period of increased organization and occupation of village sites. Earth oven winter houses were placed in circular rings surrounding "plaza" areas that appeared to be open and "debris-free" (Faulkner 1977). The last construction date of the Old Stone Fort occurred during this period around A.D. 505, suggesting a continuance of the ceremonial behavior present in the preceding McFarland phase (Faulkner 2001). Owl Hollow pottery continues to be limestone tempered, but the surface treatment is now primarily simple stamped or smoothed. Typical projectile points are shallow side notched or lanceolate spike forms (Faulkner 2001).

MASON PHASE (A.D. 700 – A.D. 900)

During the Mason phase, archaeological evidence suggests a break in large community patterning occurs as evidenced by the presence of smaller, discrete habitation sites. Technological changes include the adoption of crushed chert tempered pottery with cord-marked and net-impressed surfaces (Faulkner 2001). Small triangular projectile points appear during this time.

Mississippian Period (A.D. 900 – 1700)

The Mississippian period is characterized by ranked societies and maize agriculture subsistence. Pottery tempering shifts from limestone to shell allowing for more unique vessel forms and sizes (Smith 1986). Mississippian culture flourished along the upper Duck River Valley. Mississippian shell-tempered pottery is found in association with Mason phase sites in this region, suggesting an earlier beginning of the Mississippian culture in this region compared to the surrounding regions (Faulkner and McCullough 1974).

Summary

The cultural history of the regions surrounding Hubbards Cave represents Paleoindian through Mississippian cultures. Activity in the cave; however, appears to be restricted to the Late Archaic and Woodland periods. In order to understand the context of activity at Hubbards, it is necessary to understand

when and where such activity has occurred in the region. This can be done through the examination of previous research of cave mining in the Southeast.

CHAPTER IV
PREVIOUS RESEARCH IN CAVE MINING

For several thousand years caves have provided people with many resources. Among these have been shelter and important materials for survival. Prehistoric people utilized the natural resources found in caves, such as chert (Franklin 1999; Simek et al. 1998) and minerals (Crothers 1986; Watson 1969; Watson, ed. 1971; Munson and Munson 1990), for a number of technological and other functional purposes. In the last several decades, much time and research has been devoted to interpreting prehistoric activities in dark zone environments (Crothers 1986; Crothers and Watson 1990; Franklin 1999; Munson and Munson 1990; Munson et al. 1988; Simek et al. 1998; Tankersley et al 1989; Watson 1969; Watson, ed. 1971). Mineral mining is one such activity that has been documented specifically in five caves in this region.

The majority of what we know about aboriginal cave mining has been defined by research conducted in Mammoth and Salts caves located within the Mammoth Cave National Park in Kentucky (Watson 1969; Watson, ed. 1974). Other caves that contain evidence of prehistoric mining activity include Wyandotte Cave in Indiana (Munson and Munson 1990) and Big Bone Cave in Tennessee (Crothers 1987). In these caves, minerals such as gypsum (including selenite and satinspar), mirabilite, aragonite and epsomite were mined extensively and an archaeological record associated with this resource procurement was also recovered.

Mammoth and Salts Caves

Mammoth and Salts Caves contain the most well-documented evidence of prehistoric mineral mining in the Southeast. Caves within the park were discovered in the late 18th and early 19th centuries. Since that time they have been popular tourist attractions. Historic mineral mining, modifications made for tourist use, and private artifact collectors have all impacted the archaeological record throughout these caves. Many early explorers collected archaeological materials for personal collections leaving only written documentation for archaeologists to study. Despite extensive disturbance, an impressive collection of perishable and non-perishable remains have been recovered. Gypsum (including selenite and satinspar), mirabilite, and some epsomite were extensively mined throughout the Early Woodland period (Watson 1969; Watson, ed. 1974; Munson et al. 1989).

Mineral procurement techniques in Mammoth differed according to the speleothem crystal habit (i.e. form) (Tankersley 1996). Depending upon the form and softness, minerals could be brushed with materials such as feathers, scraped and battered with shell or stones, or dug from floor sediments with sticks (Tankersley 1996:33-34). Several possible digging sticks have been found in association with the mining locales, each showing use-wear on the tips. Gourd bowls also played an important role in the extraction of gypsum. Tankersley et al. (1985) found traces of gypsum powder in one such bowl. Gypsum crystals were evidently ground in these bowls prior to exiting the cave. While evidence for epsomite and mirabilite mining is present in many caves, it appears that

gypsum procurement was the most “labor-intensive” mining activity within the Mammoth Cave system (Tankersley 1986:37).

Radiocarbon dates collected from charcoal, cane, slippers, and paleofecal material suggest that Mammoth and Salts caves were explored as early as the Archaic period (Tables 1 and 2). Dates from paleofecal specimens indicate human exploration and use of the cave occurred during the Late Archaic-Early Woodland period (Watson, ed. 1969).

Wyandotte Cave

Wyandotte Cave, located in Crawford County, Indiana was discovered in the early 19th century. Since its discovery, many historic explorers have traversed its passages and observed evidence of mining activities. Early accounts refer to climbing poles, antler tools, and other materials that have not been observed in recent investigations. Historically the cave was mined for epsomite. This activity, along with tourist traffic, left most of the prehistoric remains disturbed. Work has been done in recent decades to determine what deposits remain intact (Munson and Munson 1990). Dr. Patty Jo Watson of Washington University in St. Louis, visited the cave in the 1970s and did an initial evaluation of the remains. At that time, two radiocarbon dates were obtained. These samples resulted in the dates of A.D. 240 +/-80 years and 910 B.C. +/-60 years (Watson, ed. 1974). At this time, however, little attention was paid to any prehistoric mining activity.

Table 1. Radiocarbon age determinations from Mammoth Cave.

SAMPLE NUMBER	RC AGE BP	(+/-)	CALIBRATED DATE RANGE BP*
AA-10079	2335	75	2710-2631, 2610-2571, 2540-2151
AA-10080	2485	70	2730-2361
AA-10081	2575	65	2780-2431, 2410-2151
X(4)8	2230	40	2340-2141
X(4)9	2370	60	2710-2551, 2540-2301, 2230-2201
SI 3007A	2395	75	2730-2311
SI 3007C	1965	65	2290-2271, 2150-1811, 1790-1771
Beta 47470 ETH-8621	2500	55	2740-2431, 2410-2361
AA-10083	2485	70	2730-2361
AA-16566	2676	48	2880-2731
Beta 47292 ETH-8529	2630	55	2870-2701, 2630-2601, 2590-2491
AA-10084	2605	70	2860-2461, 2380-2361
UCLA 1730B	3000	70	3350-2971
AA-10085	2700	80	3020-2701, 2630-2611, 2580-2541
AA-10082	2365	70	2710-2301, 2240-2181
UCLA 1730A	4120	70	4820-4411
SI 6890A	2920	60	3260-2871
SI 6890B	2495	80	2850-2451, 2410-2361

(Modified from Kennedy 1997)
*Calibrated by the author in BCal©

Table 2. Radiocarbon age determinations from Salts Cave.

SAMPLE NUMBER	RC AGE BP	(+/-)	CALIBRATED DATE RANGE BP*
M 1574	2570	140	2920-2901, 2890-2341
M 1573	2240	200	2750-2121
1 256	3075	140	3130-2771
AA-10089	2590	70	2850-2461, 2410-2361
AA-10090	2580	70	2840-2821, 2800-2431, 2410-2361
M1777	2270	140	2710-2151
Beta 32684	2410	60	2710-2551, 2540-2341
AA-10087	2410	70	2710-2341
AA-10088	2605	80	2860-2441, 2410-2361
Beta 32685	2790	70	3020-2751
AA-10091	2500	80	2740-2361
Beta 47471 ETH-8622	2490	60	2730-2431, 2420-2361
Beta 47472 ETH-8623	2495	60	2740-2431-2410-2361
M 1584	2510	140	2860-2321
M 1585	2430	130	2770-2291, 2250-2211
M 1586	2840	150	3120-2701, 2640-2611, 2590-2491
M 1587	2520	140	2870-2321
AA-10086	2570	70	2780-2421, 2410-2361
M 1577	2350	140	2740-2201
M 1770	2660	140	2970-2361
AA-11738	2703	62	2950-2731
M 1588	2720	140	3050-2461, 2410-2391, 2380-2361
M 1589	3140	150	3150-2771
Beta 87915	2760	40	2950-2771
M 2259	1920	160	2700-2631, 2480-2011
M 2258	1960	160	2700-2631, 2490-2021

(Modified from Kennedy 1997)
*Calibrated by the author in BCal©

Research at Wyandotte began again in the 1980s through the Division of Forestry. Munson and Munson (1990) began an extensive archaeological survey of the many passages in the cave. At this time, more attention was focused on the extensive prehistoric mining of aragonite. One area of special interest was the large formation of aragonite referred to as the “Pillar of the Constitution.” Possible stones of non-local material were found near the mining areas, each showing signs of battering. Heat may have also played an important role in the mining of aragonite. It appears that miners built fires adjacent to the aragonite deposits, which probably caused them to crack. Once the cracked aragonite cooled, pieces were pried and chipped off with the antler, bone and/or hammerstones. In earlier accounts, deer antler “picks” were found in association with these hammerstones; however, only one deteriorating piece was found in recent investigations.

Work done by Tankersley et al. (1990) has shown that Wyandotte aragonite is unique in its mineralogy. Through trace element analysis, artifacts found at several sites around the region have been linked to Wyandotte aragonite. Pipes and gorgets are two such artifact types that were made out of this mineral. Aragonite was probably a major trade commodity, as well. Radiocarbon dates from materials associated with mining activity areas date to A.D. 55-1160 and A.D. 615-885 (Munson and Munson 1990). These dates associate prehistoric mining at Wyandotte with the Late Woodland Period. Radiocarbon dates from Wyandotte are summarized in Table 3.

Table 3. Radiocarbon age determinations from Wyandotte Cave.

SAMPLE NUMBER	RC AGE BP	(+/-)	CALIBRATED DATE RANGE BP*
Beta-17350	4150	90	4850-4411
SFU-200	3160	260	3990-2751
UCLA-1731b	2890	60	3210-2851
Beta-17351	2190	120	2470-1871
UCLA-1731a	1710	80	1810-1421
SFU-222	1560	150	1820-1221, 1210-1181
SFU-199	1400	270	1910-1891, 1880-861, 850-821
Beta-17349	1260	50	1290-1061
Beta-17352	1150	50	1220-1201, 1180-951

(Munson and Munson 1990)
*Calibrated by the author in BCal©

Big Bone Cave

Big Bone Cave, in Van Buren County, Tennessee, contains paleontological, historical, and archaeological evidence of human activity. Historically, the cave was mined for saltpeter and was extensively explored. This activity resulted in the removal of large amounts of sediments that likely destroyed most of the evidence for prehistoric mineral mining. Gypsum is found along the cave walls as well as in the sediments of the cave. No evidence for gypsum crust removal was found in Big Bone, but the mining activity is believed to have occurred in the cave sediments (Crothers 1987). This hypothesis is supported by the extensive amount of perishable material that has been recovered from the site. Recovered artifacts include paleofeces, cane torch fragments, gourd containers, woven sandals, and a woven bag. Historic documentation indicates that other materials, including fishing nets, moccasins, and a woven bag containing human remains were discovered in the cave (Crothers 1987). An additional woven bag found during a more recent survey contained a small piece of selenite, which lends strong evidence to the idea that gypsum was being mined from the sediments of Big Bone Cave (Kutruff 1986).

Nine radiocarbon dates were collected from Big Bone Cave. Eight of these samples were determined to be of prehistoric origin and span the Terminal Archaic through the Middle Woodland periods (Table 4).

Table 4. Radiocarbon Age determinations from Big Bone Cave.

SAMPLE NUMBER	RC AGE BP	(+/-)	CALIBRATED DATE RANGE*
SI – 6013	1595	75	1690-1651, 1630-1341
SI – 3012	1615	80	1700-1351
Beta – 13972	2120	80	2330-1921
Beta – 12970	2170	105	2350-1891
Beta – 13971	2230	85	2460-2441, 2430-2411, 2360-1991
Beta – 13969	2340	80	2710-2621, 2610-2551, 2540-2281, 2270-2151
Beta – 13967	2380	85	2730-2301, 2240-2171
Beta – 13968	3000	115	3350-2841, 2830-2781

(Crothers 1987)
*Calibrated by the author in BCal©

Discussion

A considerable amount of evidence has been presented to indicate that prehistoric peoples extensively utilized natural resources found in deep cave settings. Mining activity began as early as the Late Archaic and continued through the Mississippian period. Cave use, in general is far more wide spread, with the earliest examples dating to 2500 B.C. in Jaguar Cave (Watson 1986) and 3025 B.C. in 3rd Unnamed Cave in Tennessee (Franklin 1999). The caves described here are those where mining activity appears to have been the predominate activity. Other cave sites may have been used for mortuary or pit caves (Haskins 1983; Watson 1986) or as ceremonial caves (Faulkner 1986; Simek et al 1998). This thesis documents another procurement cave where it appears that the primary activity present is associated with mineral mining. Investigations into the prehistoric use of Hubbards cave include documentation of mining activity and associated artifacts, examination into the minerals present in the cave, and examination of the chronological events at Hubbards through the dating of river cane samples found in the cave.

CHAPTER V
FIELD METHODS

To understand the extent of prehistoric utilization of Hubbards Cave, a comprehensive survey and mapping project was undertaken. This endeavor included both intense surface observation as well as complete documentation of all evidence of prehistoric behaviors. Included in this documentation was any artifact, evidence of gypsum removal (both prehistoric and historic), as well as any other potentially informative evidence that might further our knowledge about the occupation of this cave.

West Passage

During the initial investigation it was noted that the West Passage contained the most extensive evidence of mineral mining and prehistoric utilization. The entrance to the passage is a small crevice along the western wall of the opening vestibule (Figure 2). The initial portion of the passage consists of a small winding path with several small climbs and crawl spaces. No evidence of prehistoric activity was present along this segment of passage. Historic graffiti is extensive along the cave walls in this area. Evidence of sediment removal is present in this small passage with nearly one foot of depth visible along the lower wall.

Once past this winding crevice-like passage, the cave opens up into a larger passage. It is in this room where the gypsum growth is evident along the

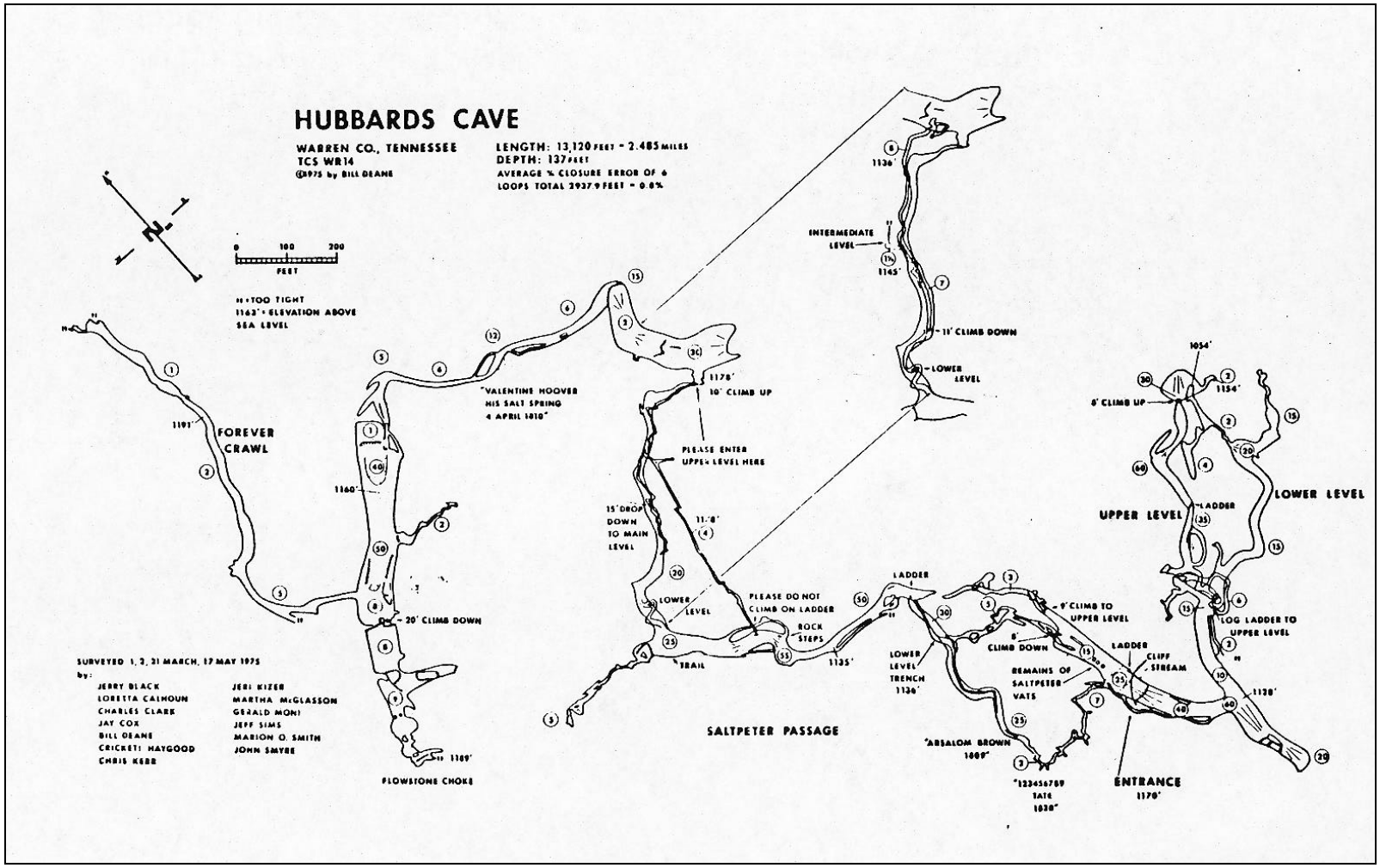


Figure 2. Original Map of Hubbards Cave (Drawn by Bill Deane 1975, Tennessee Cave Survey©).

walls. Thick (1-5cm) crusts are present along the northern walls and evidence of both prehistoric and historic gypsum removal is present. The passage continues with a large hallway that opens up into a larger cavern. An old historic ladder was used to climb into this passage during historic exploitation of the cave. The ladder is constructed with cedar wood that was braced together with wooden pegs. Prior to the cave's gating, the ladder was extensively vandalized with graffiti as well as some dismantling. A new ladder was built in order to preserve this unique historic artifact.

In the passage just beyond the historic ladder, it is apparent that much sediment has been removed presumably during saltpeter workings. This larger cavern continues west and consists of a series of climbs through the enormous amount of breakdown present throughout. Gypsum is seen regularly along the caves walls throughout the rest of the West Passage, although evidence for prehistoric usage appears to diminish. Prehistoric archaeological evidence is limited to the first third of the West Passage to the point where a small crevice climb would have made prehistoric travel difficult. Several potential stokemarks have been found beyond this climb; however, no additional evidence of prehistoric use was present. Beyond the climb, the passage continues through large rooms filled with immense breakdown broken up by small crawls. The most significant sources of gypsum crusts within Hubbards Cave are located in the very back portion of this passage. No evidence of prehistoric removal or prehistoric exploration is found in these areas.

SURVEY

Two full days were spent examining floor surfaces and ledges for any potential artifacts that might be related to prehistoric activity in the cave. Artifacts that were observed were recorded, flagged and photographed. Over 40 artifacts were identified during the initial survey of the West Passage. These items consisted predominately of stone artifacts that were presumed to be potential hammerstones. All artifacts were left *in situ* for the mapping project. Given the estimated large amount of sediment removal that occurred historically in this passage, artifacts found along the surface of the cave are in secondary deposits. Most prehistoric material was likely removed by the cave from the sediment removal or by curious collectors. The tremendous amount of historic traffic that has maneuvered its way through every small niche or accessible crevice of the cave destroyed much of what may have been left in place following the historic sediment removal. Prehistoric materials were mapped in place assuming they were not transported to great lengths.

North Passage

The North Passage represents the smallest of the three separate sections of the cave. In contrast to the small crevice entrance of the West Passage, the North Passage entrance is a large and open area suitable for occupation. It is within this large open entrance where most of the saltpeter processing occurred. Mining vats were present on the surface indicating that sediment processing occurred in this area. These vats were visible until recent vandalism called for

their removal to a secured location. The North Passage extends approximately 450 feet. The expansive opening gives way to a smaller passage where saltpeter mining evidence can be seen through ample sediment removal and “tally marks” along the cave walls. Tally marks are small etchings along the walls where miners would measure the amount of sediment to be mixed with water for the leaching the nitrates (Matthews 1971).

The passage continues to narrow until it is apparent that several meters of sediment were excavated to create one new small passage below and a higher passage that may represent former level ground. A large cedar pole is present where historic cavers climbed into the upper passage. This pole is believed to be of historic origin given the sharp point at the tip that appears to have been produced by an axe. Beyond the cedar pole is a small twisting passage that consists of a low dusty crawl. Several caverns open in this short section of passage. Gypsum can be seen all along the walls. The passage ends in a small room. The very end of the room is filled with sediment and is believed to be connected to a sediment filled area in the West Passage.

SURVEY

The survey of the North Passage was completed during one field day. The initial portion of this passage consists of a large shelter overlooking the sinkhole entrance. Intense investigation of the surface of this segment yielded several pottery sherds, animal bone, one projectile point, lithic flaking debris, and a nearly complete bone awl. The entrance to the North Passage is damp and would prohibit the preservation found throughout the West Passage. As the

passage progresses, the atmosphere changes from a cool moist to a cool dry environment.

Following the survey of each passage, close examination of the mineral mining activity was made in order to determine criteria for defining the various activities present in the cave. These criteria were crucial when mapping the evidence of mining activity. Close attention was paid to distinguishing between prehistoric versus historic evidence.

Evidence of Removal

Historic removal was identified as areas where metal tool marks were present (Plate 3). These areas tended to have relatively fresh, clean gypsum underneath that had not been exposed to extensive amounts of smoke or dust. It appeared as though much of this historic removal was intended for the removal of "gypsum flowers" that have a tendancy of forming beneath the wall crusts (Plate 4). Other evidence of historic removal seems to suggest that more recent cave explorers were removing crusts from the walls of the cave. It is possible that this evidence is merely the result of the historic sediment removal that occurred some time during the 19th or early 20th century.

Prehistoric removal is characterized has having a dark patination along the exposed gypsum surface. This patination is likely the result of prolonged exposure to the smoke and dust caused by later cave utilization. Evidence of prehistoric mining also differed from the historic removal in that no metal tool marks were present. Instead, evidence of bashing with stone hammers was

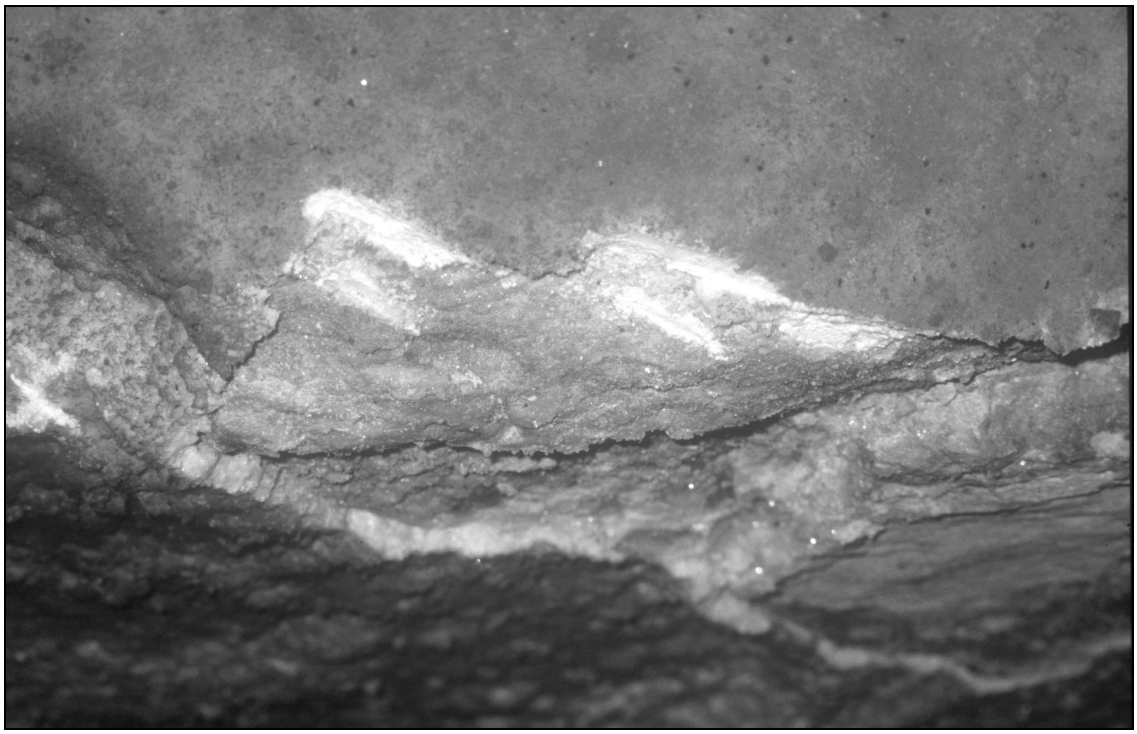


Plate 3. Historic Crust Removal (Metal tool marks present).

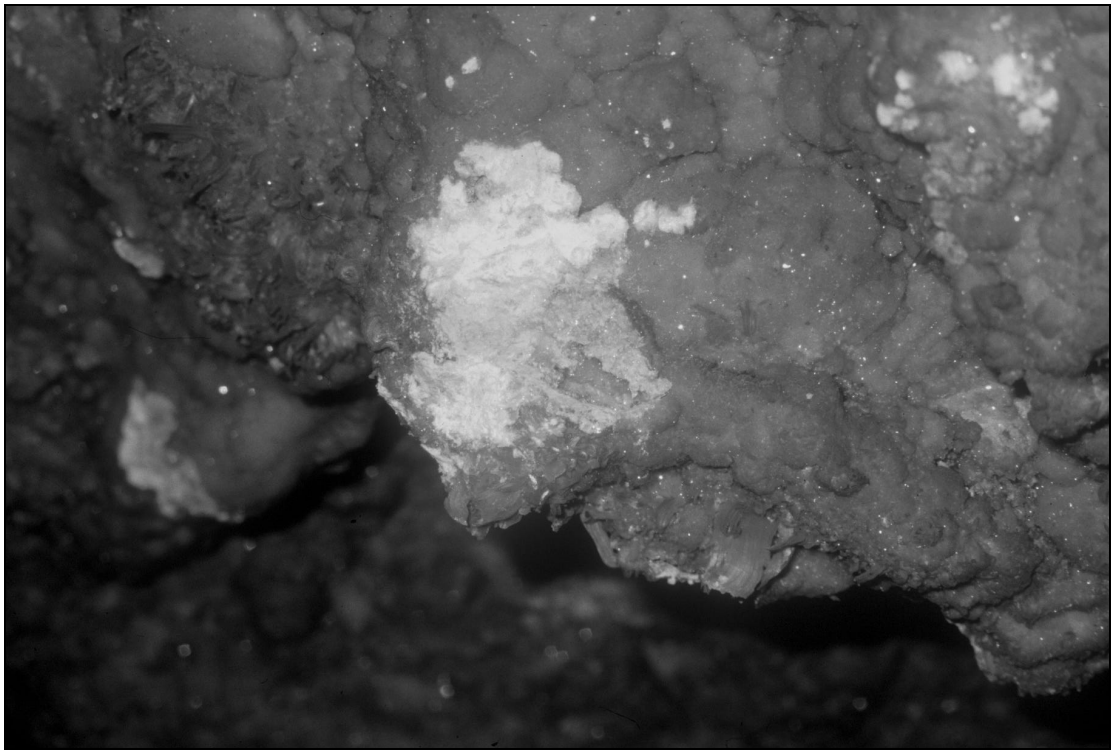


Plate 4. Evidence of Possible Gypsum Flower Removal.

found in these areas (Plate 5). In at least one area, cane torch stoke marks were present on the surface of gypsum removal (Plate 6). Prehistoric mining tended to be higher up along the cave walls. The ground surface may have been significantly higher in many areas of the cave, prior to sediment removals.

Arc View ã Mapping

The mapping was conducted using a Nikon Laser transit that was maneuvered throughout the cave collecting points. Each point was tied into the datums associated with the on-going Hubbards Cave map provided by the Southport Chronic Cavers. Points were collected from the central locations of artifacts, cane concentration, stokemarks, evidence of gypsum removal and detailed notes were taken on the appearance of each. The approximated diameter of each patch of gypsum removal was recorded.

Once collected, the data were downloaded into the Nikon Transit® program. From this program, the data were imported into Quattro Pro® and added into the ArcView® GIS program as a table. Once generated as a map in ArcView®, each mapped point was given a special code and/or color designation. All features were designated by a different symbol (i.e. GR=Gypsum Removal, HGR=Historic Gypsum Removal, HM=Hammerstone, etc.)

Mining activity was divided into two groups: HGR and GR. Polygons were drawn for all points representing mining activity. These polygons were generated in a special extension file called Ellipse Tool in ArcView®. Polygons were given



Plate 5. Evidence of Crust Removal with Bashing Marks Present.

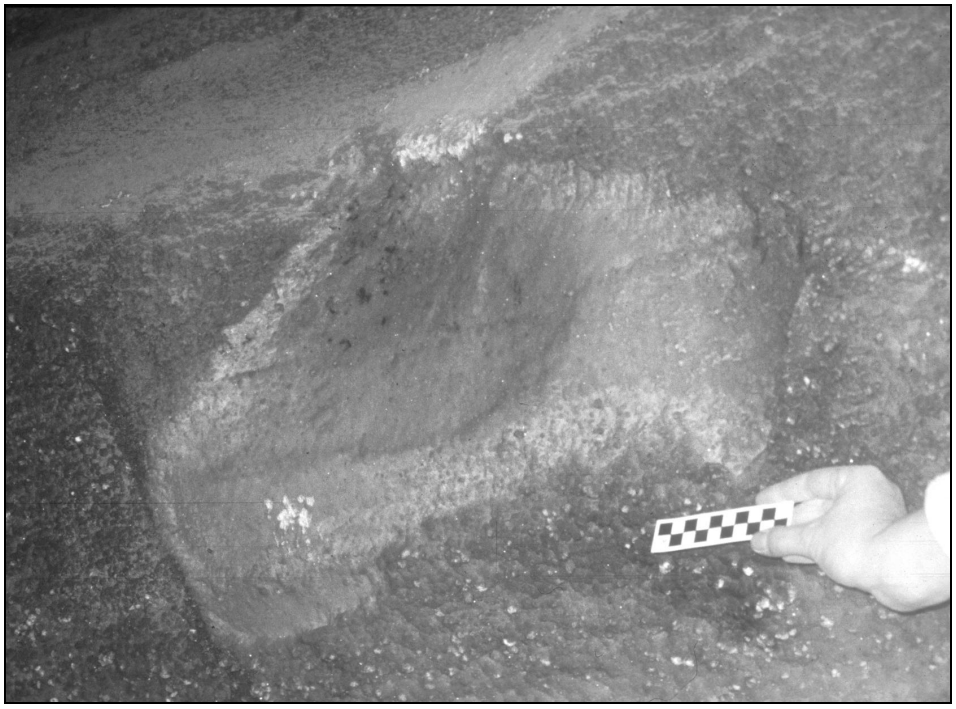


Plate 6. Evidence of Crust Removal with Subsequent Stoke Marking.

standard widths of one foot in order to compensate for the two-dimensional overview of the maps. Results of the mapping are presented in Chapter VIII.

Sinkhole Investigations

Initially, it was believed that the primary purpose for prehistoric activity at Hubbards focused on mineral extraction. A more intense investigation of surface material throughout the entrance sinkhole of the cave revealed evidence that prehistoric peoples may have been using this area primarily as a habitation site. Supporting evidence for this supposition was gleaned from surface materials recovered along the saltpeter mining talus located in the central part of the entrance vestibule, as well as within the shelter-like overhang of the North Passage. Extensive saltpeter mining has obliterated most evidence of prehistoric occupation in this area leaving very few, if any, intact archaeological deposits. Without these intact deposits it is impossible to clearly understand the extent of prehistoric behavior at this site. In the absence of such deposits, one can only make comparisons with diagnostic artifacts recovered from known archaeological deposits dated by scientific absolute dating techniques.

Given the nature of the preserve established by the Nature Conservancy, it was felt that excavations into the sediments of Hubbards Cave might cause negative impacts to the natural resources found within the cave. No excavations were made during this investigation. Future research at Hubbards will focus on identification of potential intact features that might be present in this area.

Diagnostic material collected during the initial surface investigation included eleven fragments of limestone-tempered pottery and two diagnostic

projectile points/knives. Further examination of the saltpeter mining talus and the opening chamber of the North Passage yielded an additional 14 pottery fragments and one additional projectile point. Recovered artifacts predominately date to the Late Middle Woodland suggesting an intense occupation during this period.

Summary

Archaeological investigations at Hubbards Cave took place over two summer field seasons. The following chapters discuss the results of the methods presented here. Recovered artifacts, including bone, pottery, lithics and shell are examined to determine their relationships to the potential mining activity mapped with the Total Station.

CHAPTER VI
RESULTS

Mineral Analysis

Sulfate minerals were mined for a number of practical and medicinal purposes. Aragonite appears to have been broken from large formations by the use of heat and cobble-like hammerstones or antler bone (Munson and Munson 1990). Artifacts manufactured from aragonite, such as gorgets, pipes, and bowls have been associated with Middle to Late Woodland sites in areas of Iowa, Indiana, Illinois, Ohio, as well as in Tennessee (Munson and Munson 1990). This suggests that aragonite may have been a valuable trade commodity during this period. It has been suggested that mirabilite and epsomite were used for medicinal purposes (Watson 1969). Experiments done by Watson (1969) showed that mirabilite and epsomite had cathartic properties and were also salty to the taste.

Evidence for the use of gypsum remains unclear. Historically, gypsum was used as a form of construction material. The significance of gypsum mining is one of the major research questions of this thesis. Why were the miners going to such an extent to collect this material within the dark zone of caves and why were they collecting so much? Ethnographic studies have shown that gypsum was used as a form of plaster or white paint (Watson 1969). When heated, gypsum crystals quickly turn into a chalky white powder that, when added to water, can form either a plaster or white paint. Bartram reported Native American groups painted their homes with white paints made from clay (Van

Doran 1928). Evidence from the Hopewell in the Ohio Valley indicates that prehistoric people may have painted themselves with white paint for decoration (Deuel 1952). Perhaps gypsum was used for these purposes. Experiments conducted by Watson indicated that gypsum does not have the same cathartic effects as salt minerals such as epsomite and mirabilite, nor does it have a salty taste. The extensive amounts of gypsum that have been removed from caves such as Mammoth and Salts suggest that gypsum played some important role in economic trade during this period. In its' pristine state, gypsum crystal can be white to translucent in color and can be quite beautiful. It is possible that it was extracted for ornamental purposes. However, while evidence has been found to suggest gypsum was extracted from cave sediments (Crothers 1987) and and cave walls (Watson 1969; Watson, ed. 1971), no evidence has been found to suggest that gypsum flowers (formations known for their aesthetic beauty) were mined prehistorically.

MINERALS AT HUBBARDS CAVE

Secondary mineral formations found in caves are referred to as speleothems (Moore 1952). Speleothems are often comprised of several different cave mineral types and are defined by their morphology, origin, and crystallography (Hill and Forti 1998). Examples include crusts, columns, stalagtites, stalagmites, flowers, fibrous speleothems, pearls, and cave powder. Several of these speleothem forms occur in Hubbards Cave. Speleothems

located in Hubbards include crusts, fibrous speleothems, spar, and cave powders.

Crusts

Crusts are found on the surface of walls, ceilings, and floor sediments (Hill and Forti 1998:62). Sulfate crusts, such as gypsum, can be found in two different forms, granular and fibrous. These variants differ in their crystal orientation, where granular crusts include “equant, curved, or tabular crystals” and fibrous crusts contain crystals that are “oriented perpendicular to the surface of the crust” (Hill and Forti 1998:62). Crusts are formed from the “deposit of solutions which seep out of bedrock or through porous floor sediments” (Hill and Forti 1998:63). This process often causes new crusts to form beneath the surface of the existing crust resulting in a “blister-like” formation (Hill and Forti 1998:63). The outer crust is continually forced outward causing its’ eventual collapse. Crust blisters are easy to identify along the surface because of their peeling or buckled appearance. In several areas of the West Passage, it appears that prehistoric people may have used these opportunities to easily break away outer crust surfaces with minimal bashing.

Fibrous Speleothems

Fibrous speleothems occur in a number of different varieties that include hair, cotton, rope, and snow. These sub-types vary with respect to crystal fiber length and manner in which the fibers “intertwine with each other” (Hill and Forti 1998:66). The only sub-type of fibrous speleothems located in Hubbards is hair. Cave hair, or angel hair, is made up of “single-fiber strands” that are “loosely

tangled together" (Hill and Forti 1998:66). Only a few examples of angel hair have been observed in Hubbards. No mineral samples were collected in order to preserve this unique variety of speleothem.

Cave Powder

Cave powder is described as an "incoherent speleothem" composed of small crystalline grains (Hill and Forti 1998:87). The most common cause of cave powder is the dehydration of hydrated minerals. A relatively dense cluster of cave powder is present in portions of the West Passage. The powder has formed on the surface of areas where it appears that mineral crusts have been removed.

Cave Flowers

Flowers are crystal petals radiating from a common center (Hill and Forti 1998:68). Most cave flowers are comprised predominately of gypsum, but can also contain minerals such as epsomite, mirabilite, halite, and ice. In many incidences, cave flowers form beneath crust surfaces. Gypsum flowers are found throughout Hubbards Cave but do not appear to have been mined prehistorically. Historic metal tool marks are scattered throughout the West Passage in areas where gypsum flowers may have been present. These unique crystals may have been mined historically for their aesthetic qualities.

Spar

Spar is defined by Hill and Forti (1998:101) as "any euhedral to subhedral crystal" with "crystal facets" that are "easily discernible". Spar present in

Hubbards includes selenite needles and satinspar (Plate 7). Selenite needles are commonly comprised of gypsum and are found within or on the surface of cave sediments. Selenite crystals are formed within sediment and are pushed up as new growth forms beneath. This growth is believed to be sporadic and requires a saturated environment.

MINERAL ANALYSIS

Mineral Extraction

In order to understand prehistoric mineral removal at Hubbards Cave it was necessary to test the mineral content of speleothems found in Hubbards Cave. Six mineral samples were collected from various parts of the West Passage (Figure 3). These samples are summarized in Table 5. Crusts were removed without leaving any marks that might be confused with mining activity. Any mineral samples collected were taken from obscure places in the cave. No samples were collected in areas where minerals have been removed archaeologically Chemical analysis requires only small samples of less than $2cm^3$.

X-Ray Diffraction

Mineralogical composition was determined through X-ray Diffraction (XRD). Similar analysis was conducted on minerals from Wyandotte cave (Tankersley et al 1990). Minerals are composed of crystals, which are three-dimensional solids composed of atoms in a symmetrical, repetitive pattern. The ordering of the atoms within the structure forms planes that are unique to each



Plate 7. Evidence of selenite crystals in the Cave Sediments of the West Passage.

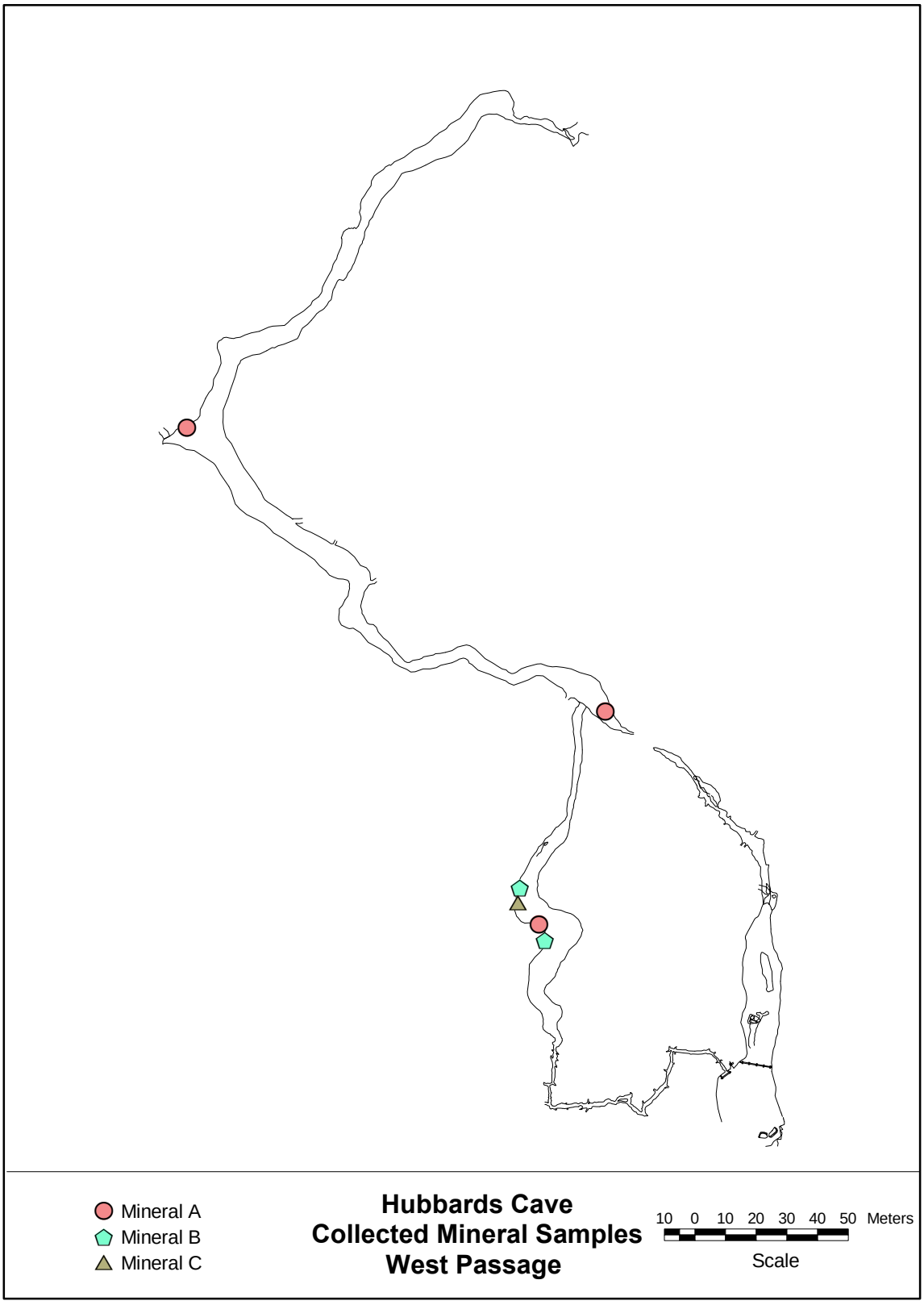


Figure 3. Mineral Sample Collections from the West Passage.

Table 5. Mineral Samples Collected from Hubbards Cave.

SAMPLE NUMBER	DESCRIPTION	MINING EVIDENCE
Mineral A1*	Collected from floor sediments. Fibrous speleothems	No evidence of prehistoric mining. Extensive amounts of sediments have been removed from this area.
Mineral A2*	Sample collect from the wall crusts. Thin crust peeling from wall "blister." Crust	These crusts were not mined. Evidence of mining present on similar crust nearby.
Mineral A3	Sample collected from thin wall crust along cave wall. Crust	Not associated with mining. No evidence of crust mining in this area. Located in room where sediments have been removed.
Mineral B1*	White powdery mineral located in area where Mineral A1 had been removed. Mineral has salty taste. Cave Powder	No evidence of mining Mineral B1. Mineral A mined all around (both historically and prehistorically).
Mineral B2	White powdery mineral intermixed with harder white mineral (perhaps C1). Cave Powder	No evidence of mining Mineral B2. Mineral A mined all around (both historically and prehistorically).
Mineral C1*	White flaky mineral located in area where Mineral A has been removed. Found in association with Mineral B. Crust	No evidence of mining Mineral C1. Mineral A mined all around (both prehistorically and historically).

*Denotes Mineral samples used for XRD experiment.

crystal (*d*=distance between planes) (Cullity and Stock 2001). XRD analysis examines crystal structure through the emission of X-rays that are bombarded with the crystal surfaces. X-rays are emitted at different angles (from 4-80 2θ), which are referred to as angles of incidence (θ) (Cullity and Stock 2001). These angles correspond to the various planes that may be present within a given sample of crystals. Each time an X-ray is diffracted from one of the characteristic planes, the program will register an intensity peak for that particular angle. The intensity of these peaks reflects the "positions of the atoms" in the crystal (Cullity and Stock 2001). Resulting peaks are unique for a given crystal making the technique useful for determining crystalline structure of mineral samples. Standard reference materials (SRMs) are available both as physical samples and computerized reference programs.

Several methods of XRD have been used by geologists to determine crystal composition. The method used for this analysis was the Powder Method using a Siemens D500 theta-theta Diffractometer instrument. Materials are ground into fine powders in order to produce multiple crystal fragments oriented in random patterns. This increases the likelihood of diffraction on a given plane from the incident beam, or source X-ray (Cullity and Stock 2001).

Proper sample preparation is essential in conducting XRD Analysis. Samples must be ground to a fine powder, and insufficient grinding or excessive grinding will affect intensity levels and may distort data results (Bish and

Reynolds 1989). Once ground, material is mounted on a slide within a small shallow depression. It is imperative that an appropriate amount of material is packed tightly into the small depression and that the surface is leveled to a flat, horizontal surface. Deviations from this will result in “intensity errors and peak breadth” (Bish and Reynolds 1989:76).

The XRD settings used in this experiment are listed in Table 6. Initially all angles of the spectrum were tested to identify the range (4-80) that would be necessary for the identification of minerals present in our sample. From this initial test it was determined that angles 4 through 50 were the important regions. As mentioned previously, crystalline structures produce unique diffraction patterns along the various angles of incidence. This phenomenon makes it simple to discern minerals present in a given sample tested in an XRD analysis (Klein and Hurlbut 1999). Once samples were run and the resultant data streams input through the Data Scan program for Windows® (Materials Data®, Inc. 1997), readings were viewed through the Jade® 5 XRD Pattern Processing program (Materials Data®, Inc. 1999).

Several methods for identifying the minerals present in a specific sample are available in Jade 5. The Search and Match function evaluates the peak intensities of the various angles that received hits and compares these values to known samples present in a database included within the program. While convenient, this method is not always accurate. Since there was a general idea of which minerals were present in our collections (based on physical properties of

Table 6. XRD Settings.

SAMPLE	ANGLE	THETA	STEP	STEP
A1	4-80	2	0.5	0.05
A2	4-50	2	0.5	0.05
B1	4-50	2	0.5	0.05
C1	4-50	2	0.5	0.05

the collected samples), samples were compared with known data of the following minerals: gypsum, mirabilite, epsomite, calcite, quartz, aragonite, kaolin, and anhydrite.

Results of X-ray Diffraction

Four samples were run through the XRD process. These samples were A1, A2, B1, and C1 (Table 7). Final results are listed in Table 8. Identified minerals are listed in color with their characterisitic peaks (Figures 4-7). The two major minerals present in Hubbards Cave are gypsum and epsomite. Properties for these minerals are presented in Tables 8 and 9.

SUMMARY OF MINERAL ANALYSIS

Cave speleothems found in Hubbards include powder, crusts, flowers, and spar. These speleothems are made up of a variety of minerals, predominately gypsum, epsomite, calcite and quartz. Gypsum is present as crust and flowers along the cave walls and selenite within the sediments.

Mineral sample A consisted of thick crusts that were originally believed to be gypsum. XRD results indicated that gypsum comprises the predominate makeup of these samples. The most extensive evidence of prehistoric gypsum removal was found in association with crusts similar to those included in this analysis. These crust surfaces would have been the most difficult to remove from the cave walls and would have required bashing. Evidence for bashing was found in association with this mineral. The sediment sample (A1) tested in this experiment included a number of other minerals such as calcite and quartz in

Table 7. Results of XRD Analysis.

SAMPLE NUMBER	MINERALS PRESENT
A1	Gypsum, Calcite, Quartz,
A2	Gypsum
B1	Epsomite
C1	Gypsum

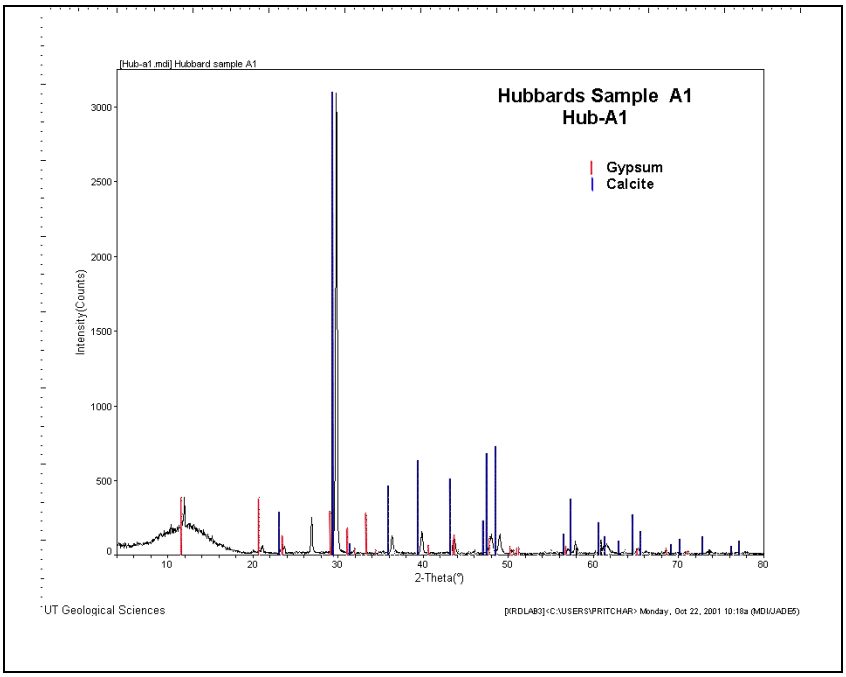


Figure 4. XRD Results – Mineral A1 (Predominately Gypsum).

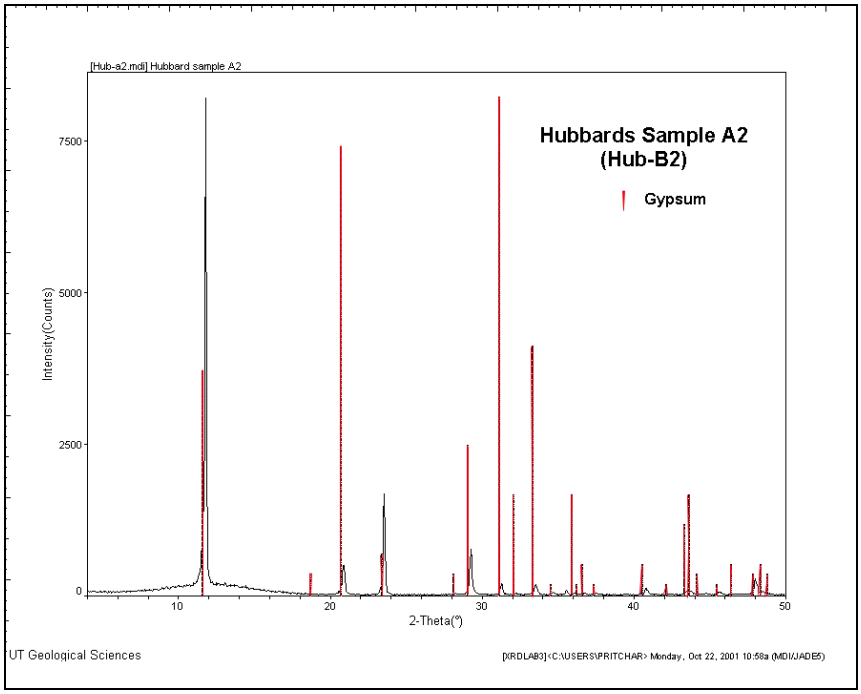


Figure 5. XRD Results – Mineral A2 (Predominately Gypsum).

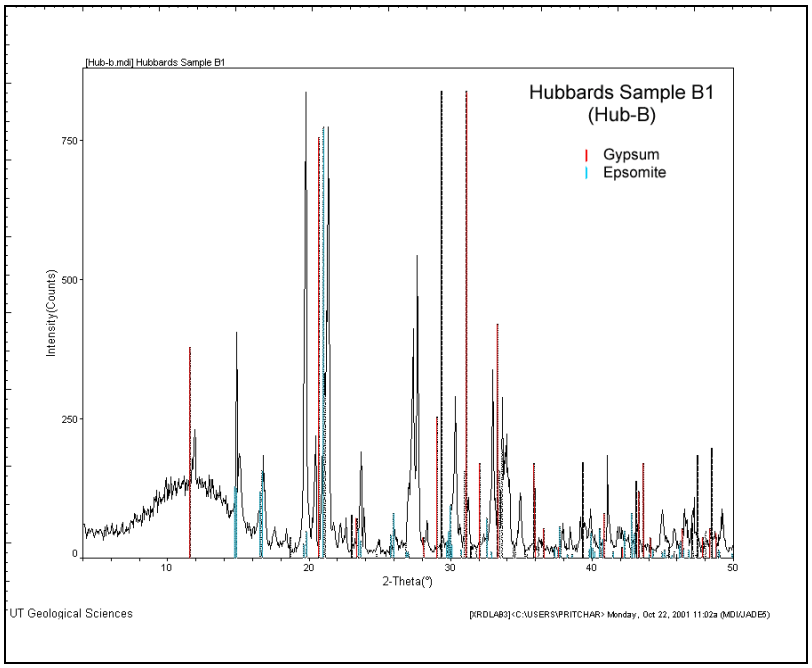


Figure 6. XRD Results – Mineral B1 (Epsomite and Gypsum present).

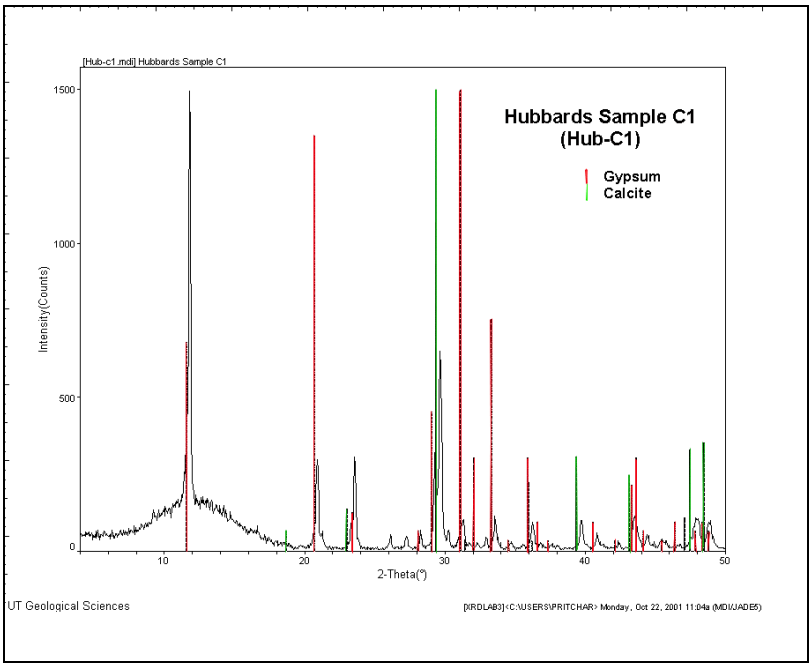


Figure 7. XRD Results – Mineral C (Predominately Gypsum).

Table 8. Properties of Gypsum (A1-3, C1).

PROPERTIES OF GYSUM $CASO_4 \cdot 2H_2O$	
Monoclinic (+)	
Cleavage	{010} perfect, {100} and {011} distinct
Color	Usually white to colorless, sometimes grey, red, yellow, brown, blue
Hardness	2
Density	2.30 – 2.37

(Modified from Chang et al 1997)

Table 9. Properties of Epsomite (B1-B2).

PROPERTIES OF EPSOMITE $MGSO_4 \cdot 7H_2O$	
Orthorhombic	
Cleavage	-
Color	White
Hardness	2-2.5
Density	1.6878
Other	Bitter Taste

(Klein and Hurlbut 1999)

addition to gypsum. Additional samples of sediments in other parts of the cave may indicated higher or low concentrations of gypsum.

Sample C was initially believed to be some mineral other than gypsum, given its different physical appearance. XRD results indicate that sample C consisted of predominately gypsum with traces of calcite. This form of gypsum consisted of a white to gray flaky material that was easily removed from the surface of the crust. No evidence of removal was found in association with this sample. Removal of this type of mineral would require very little effort and would leave virtually no trace of bashing, as no bashing would be required. It is possible that this thin, flaky gypsum crust was mined prehistorically.

Epsomite (B1) appears as a secondary growth in the form of powder along the surface of battered gypsum crusts. This evidence indicates that epsomite formed after gypsum crust had been removed, suggesting some potential change in the cave's environment since the time of removal.

Evidence for prehistoric mineral removal at Hubbards is only found in gypsum crusts. Mining activity at Mammoth and Salts Caves suggests that prehistoric peoples were utilizing mineral resources such as epsomite for possible medicinal purposes (Watson 1969; Watson, ed. 1971). Given the lack of mining evidence in association with this mineral, it is possible to assume that epsomite formations in Hubbards may have developed after prehistoric peoples were present.

Evidence was found to indicate that prehistoric people were retrieving minerals, specifically gypsum, from Hubbards cave. In order to understand the

extent of this behavior, documentation of the presence of mining evidence and associated artifacts is necessary.

Artifact Analysis

PREVIOUSLY RECORDED ARTIFACTS

Artifacts recovered from prehistoric mineral mining caves in the Eastern Woodlands include a variety of mining related tools such as hammerstones, large bivalve shell fragments, cane torch fragments and bundles, woven textiles such as bags and footware, and gourd containers (Crothers 1986; Munson and Munson 1990; Munson et al 1988; Tankersley 1985; Tankersley et al 1989; Watson 1969; Watson,ed. 1971).

Materials collected from Mammoth Cave represent one of the more impressive artifact collections found within a dark zone cave environment. Human coprolites have been found throughout the cave and over 1000 specimens have been collected thus far (Crothers, personal communication). From these specimens one can gather information on subsistence, disease, and environment (Dusseau and Porter 1971; Schoenwetter 1971; Yarnell 1969). Other significant materials recovered from Mammoth and Salts include gourd fragments, cordage, slipper fragments, seeds, cane fragments, and other woody materials (Watson 1969). These artifacts are often found near ledges and breakdown, safely hidden from passing traffic through the cave. It has been suggested by Tankersley that perishable materials such as gourd bowls were stashed within the cave in areas where mirabilite may regenerate (1986:37).

This would explain why intact artifacts appear to have been abandoned in these deep cave settings. Big Bone Cave, in Van Buren County, Tennessee, has yielded an impressive collection of well-preserved materials such as woven sandals and bags, gourd fragments and one complete gourd bowl (Crothers 1987).

Materials recovered at Hubbards Cave are similar to artifacts found in other mining caves. The intense historic utilization of the cave has had a major effect on preservation within the cave's passageways. It appears that every square foot of passage within the north and west portions of the cave were frequently explored for the last 200 years. It is possible Hubbards Cave also had these intact, well-preserved materials prior to this heavy exploratory period. What materials remain in the cave are located primarily within woodrat's (*Neotoma floridana*) nests located throughout the cave. Woodrats construct their nests from perishable materials that are gathered from the cave floors. Materials such as cane and gourd fragments, as well as fecal material, animal bone and dehydrated flesh, corncobs, etc. have been located in these collections. The most common material found in these areas are cane torch fragments. An incredible amount of cane was present within these woodrat assemblages.

HUBBARDS CAVE ARTIFACTS

Hammerstones

Initially, a total of 41 possible hammerstones was identified during surveys of Hubbards Cave. These stones were all located within the West Passage of the cave. Hammerstones, as defined in lithic studies, are cobbles or pebbles

used to remove flakes or chips (Andrefsky 1998). Because gypsum is such a soft mineral (H=2), it is possible that the use of limestone cobbles as hammerstones would result in very little edge damage. Further investigation of these hammerstones was made in order to determine whether these stones, found naturally throughout the cave, could have functioned as tools in the mining activity. This determination was difficult and artifacts designated as hammerstones were those with extensive characteristic bashing on the surface. Final assessments were based on the presence of abrasion due to natural deposition versus potential prehistoric wear. Eight cobbles were determined to be certain hammerstones based on battering edge damage present on the surface. Other stones were excluded based on their lack of clear surface damage or wear.

River Cane Fragments

It has been well documented in the archaeological literature that prehistoric peoples utilized river cane (*Arundinaria* sp.) for light sources within dark-zone cave environments. Abundant cane torch fragments were found throughout the dry portions of the cave. These remains were located primarily within large rat middens, but were also found scattered throughout the passages along the ground surface and on small ledges (Plate 8). It is likely that most of this material has been moved around extensively by both animals and cave explorers. It was from this material that our four radiocarbon assays were made.



Plate 8. Cane Concentration in Rat's Nest.

Gourd Material

Four fragments of gourd were recovered from the West Passage of the cave. One piece was located in a large rat's nest several meters from the present ground surface (Plate 9). It was recovered when Tim Curtis, Hubbard's Cave Monitor, noticed something unusual along a ledge above his reach. A detachable climbing pole was brought into the cave to investigate. From this nest came abundant animal bone, potential human fecal material, cane, and other non-perishable material. Further examination of the ground surface near this rat's midden revealed three additional gourd fragments. Of the four fragments collected, one appears to represent a rim sherd of a gourd bowl (Plate 10 and 11). Additional material is likely to be found further up along this ledge/midden. Further investigations of such nests will be conducted in the future to identify additional prehistoric material that may be present.

Possible Basket/Split Cane Fragment

During the mapping of the north passage, a fragment of split cane was recovered. This cane may have been part of a basket or mat and is likely associated with the prehistoric occupation of the cave.

Bone and Shell

A variety of animal bone and shell is present throughout both the North and West Passageways. Dry conditions within these passageways allows for the preservation of bone, flesh and hair of animal remains. Animal species present include deer, turtle, raccoon, and opossum. Given the disturbance found



Plate 9. Gourd Fragment Found in West Passage Midden.

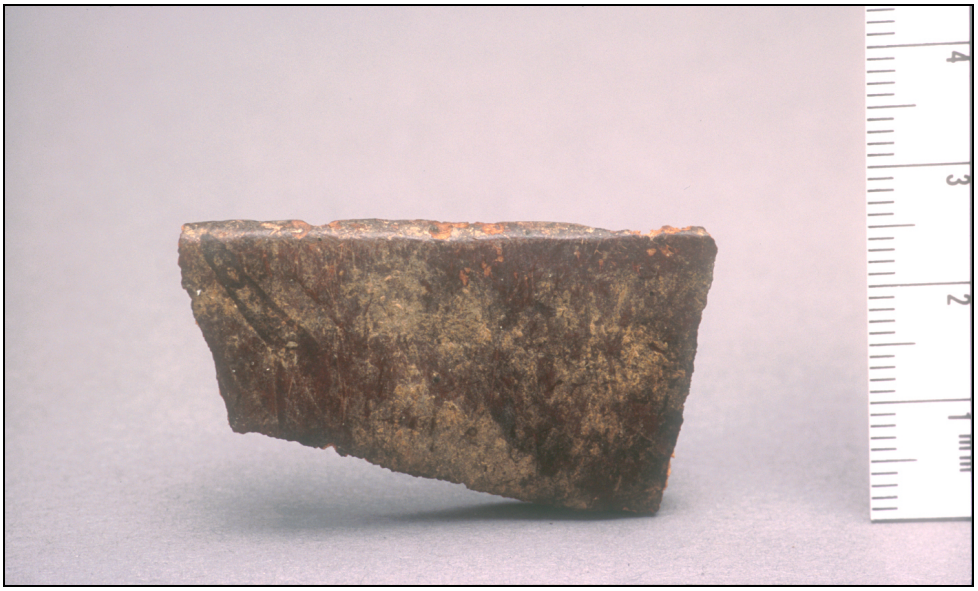


Plate 10. Gourd – Rim Fragment Found in West Passage Midden.



Plate 11. Close up of Rim Fragment

associated with the context of bone in Hubbards Cave, it is impossible to determine the origin of these remains without radiocarbon dating each artifact.

Bone Artifacts

While a considerable amount of bone was present throughout both the North and West passages, only one bone tool implement was recovered (Plate 12). This tool was found during the survey of the North Passage. The awl was formed from distal diaphysis of the tarsometatarsus of a wild turkey (*Meleagris gallopavo*).

Shell

Several bivalve shell fragments were present in both the mining talus location and the North Passage entrance. Shell has been linked to mining activity at other cave mining sites in the region (Watson 1969). Shell is also used for a number of other purposes such as ornamental objects, as evidenced by its association with burials throughout the Southeast, and the animal content of shells was consumed as a food source.

Prehistoric Pottery

Twenty-five fragments of prehistoric pottery were recovered from the entrance sinkhole and North Passage entrance of Hubbards Cave. These fragments were located on the surface of the eroding saltpeter mining talus and other back dirt piles located in the center of the vestibule and within the opening chamber of the North Passage. All recovered pottery was limestone tempered. Eight different types have been identified (Table 10). Photographs of diagnostic



Plate 12. Bone Awl

Table 10. Pottery found at Hubbards Cave.

POTTERY TYPE	N	DESCRIPTION
Smoothed Over Cord Marked	6	
Rectilinear Complicated Stamped	1	Rim sherd, body is plain, Similar to Napier type of Russell Cave in North AL (Broyles 1958; Griffin 1974) and Peter Cave in TN (Hartney 1962)
Plain/Scraped	6	Plain sherds with evidence of scraping with pebble or brushed
Plain	11	No evidence of surface treatment present/remaining
Cord Marked	1	Cord marking is vertical to rim

sherds are featured in Plates 13-16. Several sherds exhibit evidence of heating (sooting and pot-lidding) suggesting their use as cooking containers.

Chipped Stone Artifacts

Three projectile points were recovered from Hubbards Cave (Plate 17). Two of these, one McFarland and one Middle Woodland type point were recovered from the entrance area.

The McFarland point is a large triangular PPK that is common in Middle Woodland sites in the vicinity of Hubbards. A large mound site, located approximately 3-4 miles from Hubbards on the west side of the Collins River, contains a McFarland component that was partially excavated by collectors. Twenty McFarland points have been recovered from this site.

One point was recovered from the saltpeter mining talus of the opening sinkhole. This point resembles other Middle Woodland points found in the region (i.e. Bakers Creek, Lowe Flared Base) (Justice 1995).

One Late Archaic stemmed point was recovered from the South Passage of the cave in a wash deposit that may have originated in the entrance sinkhole area. This point was not found in association with any other artifacts. Two hypothesis have been developed to explain the origins of this artifact. First, it is possible that the prehistoric use of Hubbards Cave began during the Archaic period, although no other artifacts relating to this period have been identified. Second, the wash deposit that has been found in the South Passage may represent sediments that have washed in from outside the sinkhole entrance of



Plate 13. Smoothed Over Cord Marked Pottery Sherd.



Plate 14. Cord Marked Pottery Sherd.



Plate 15. Smoothed-Over Pottery Sherd.



Plate 16. Rectilinear Complicated Stamped Pottery Sherd.



Plate 17. Lithics Collected from Hubbards

the cave. Lithic flaking debris has been found on the ground surface above the cave's entrance.

An additional stone artifact, believed to be a potential digging implement, was found along the surface of the West passage (Plate 12). The surface has a heavy polish and the distal end of the tool has been chipped and worked into the form of a "hoe." The chamber in which this artifact was found has seen a fair amount of sediment removal. The shape and form of the artifact is strong evidence to suggest that prehistoric peoples were collecting gypsum from these floor sediments.

SUMMARY

A number of materials were identified in both the North and West Passages that support the interpretation that prehistoric gypsum mining occurred at Hubbards Cave. Hammerstones located in the West Passage suggest that crusts were mined in this area. The possible digging implement collected from the West Passage supports the idea that prehistoric people also mined the sediments for gypsum. Gourd bowls may have been used for collecting crystals from both the wall crusts and floor sediments.

Recovered artifacts in the North Passage and entrance area of the cave indicate that activity at Hubbards extended beyond mining. Prehistoric pottery fragments and bone tool implements in the opening chamber of the cave suggest that this area may have been occupied during the Middle Woodland period. Further investigation of this area is necessary in order to determine the extent of this occupation.



Plate 18. Possible Digging Implement.

Given the extensive amount of disturbance throughout the cave and the lack of preserved archaeological deposits, it is impossible to establish a direct link between the mining activity found within the cave and occupational activity found in the opening chamber. It is clear, however, that two discrete activities took place at Hubbards. In order to understand the behavior related to the mining activity within the West and North Passages, it is necessary to examine the relationships between mining activity and the associated artifacts.

Archaeological Survey Results

Archaeological investigations conducted at Hubbards Cave indicate that prehistoric peoples utilized the cave for its' vast mineral resources as well as occupied the opening area of the cave. Survey identified over 40 artifacts in the West Passage and 15 artifacts in the North Passage/sinkhole entrance. These artifacts included hammerstones, gourd fragments, pottery, and stone tools.

RESULTS OF ARC VIEWã MAPPING

All mining activity and associated artifacts were mapped into the Arc View® GIS program in order to interpret spatial patterning throughout the site. Resulting maps are presented in Figures 8-15.

Spatial Patterns in West Passage

Spatial examination of materials mapped in ArcView® indicates that gypsum crust mining was limited to the front portions of the West Passage (Figures 8-10). Artifacts found in association with mining activity in the West

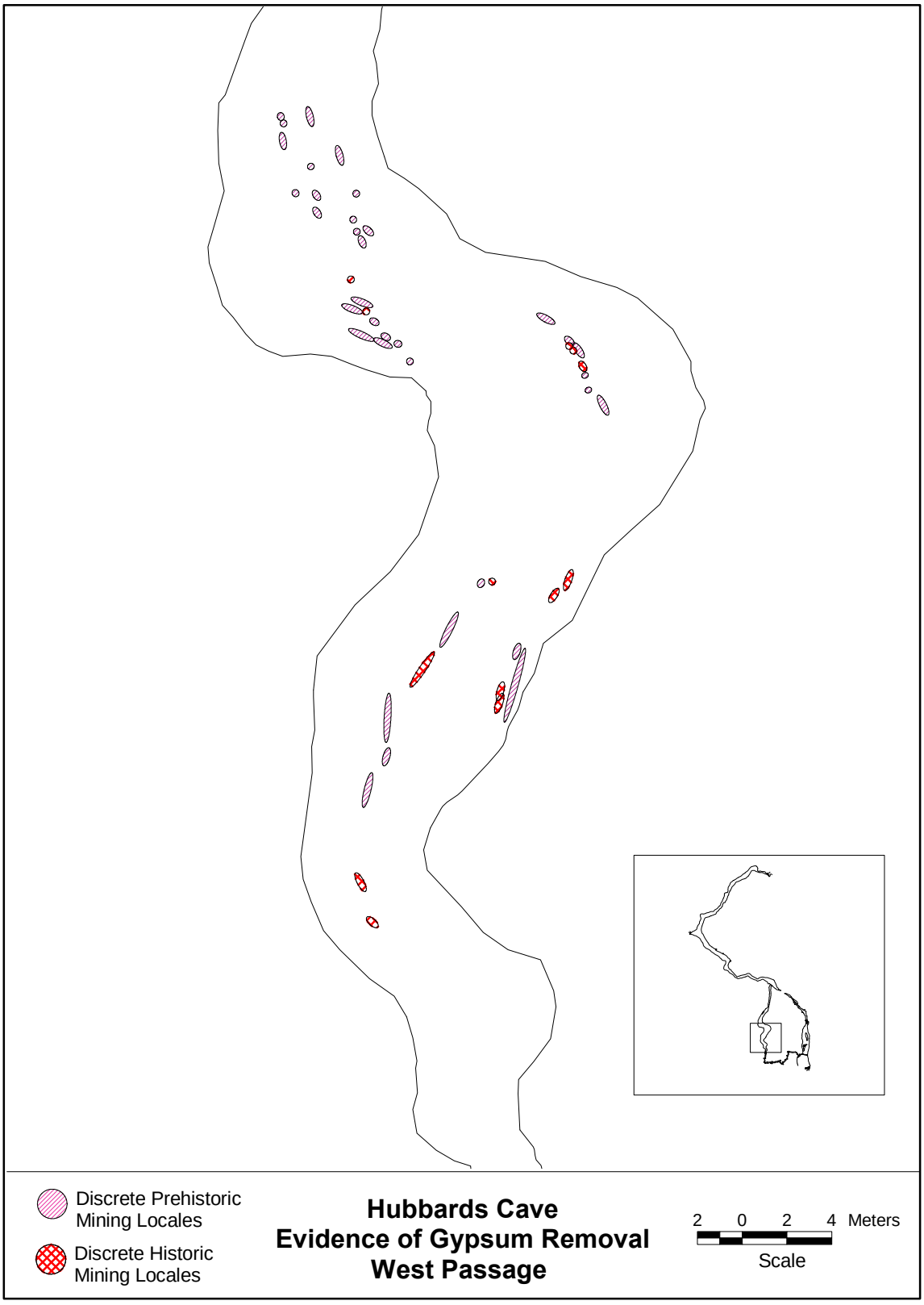


Figure 8. Gypsum Removal in West Passage - View 1.

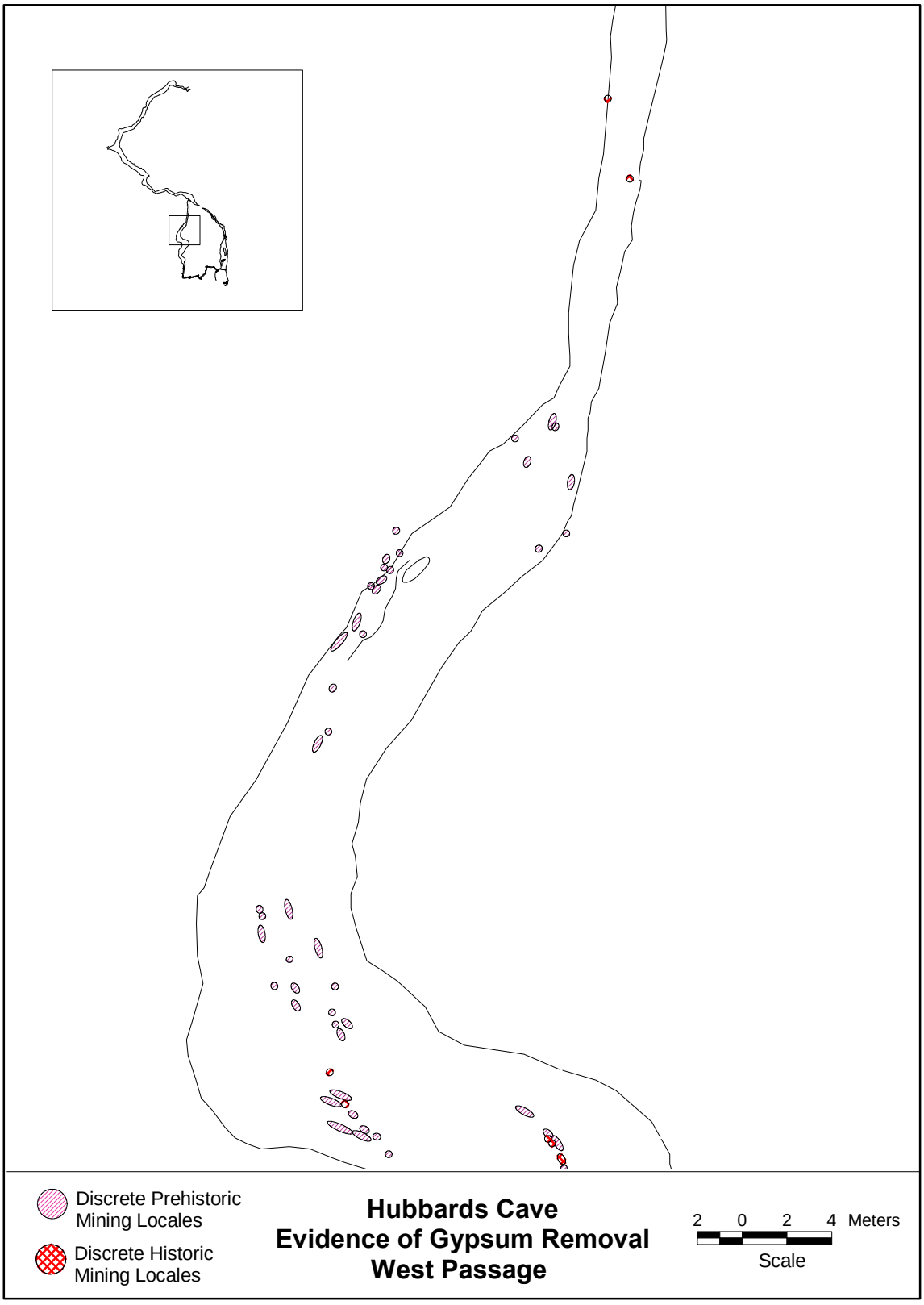


Figure 9. Gypsum Removal in West Passage - View 2.

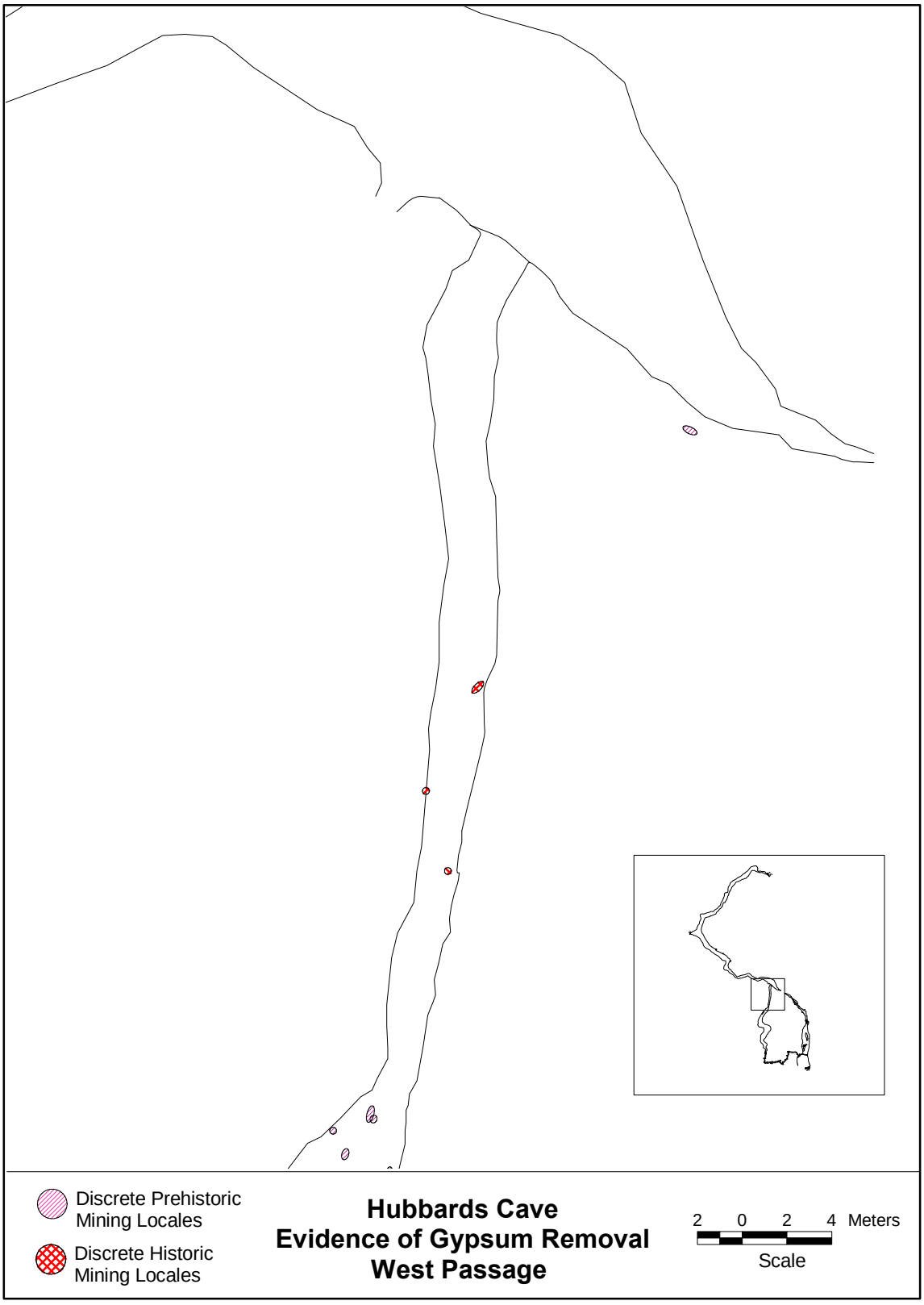


Figure 10. Gypsum Removal in West Passage - View 3.

Passage include hammerstones, gourd fragments and cane torch remains. Artifacts and stoke mark evidence in the West Passage are also concentrated in the initial part of the passage, but extend beyond evidence of prehistoric mining activity (Figures 11-12). Historic sediment removal is likely to have had a major impact on prehistoric artifacts scattered throughout the cave. Most of the perishable materials are concentrated in rat middens that are scattered throughout the cave. Heavier materials, such as hammerstones, are less likely to have been transported long distances from their original placement in the cave. One would expect these artifacts to be located within a short vicinity of actual mining evidence. The presence of hammerstones in passages beyond where mining activity is evident on the cave walls is puzzling, but may be explained by the extensive amount of sediment removal in the West Passage. Concentrations of rocks are located along the side of this passage. These stones may have been sorted from sediments that were removed from the West Passage.

An additional explanation may be that the prehistoric activity in these areas represented mining for selenite crystals located in the sediment. The potential digging implement recovered from the West Passage was located in an area were a great deal of sediment had been removed. Four hammerstones were located in the vicinity of this removal. Prehistoric people may have been mining sediments in this area and deposited their tool kits nearby.

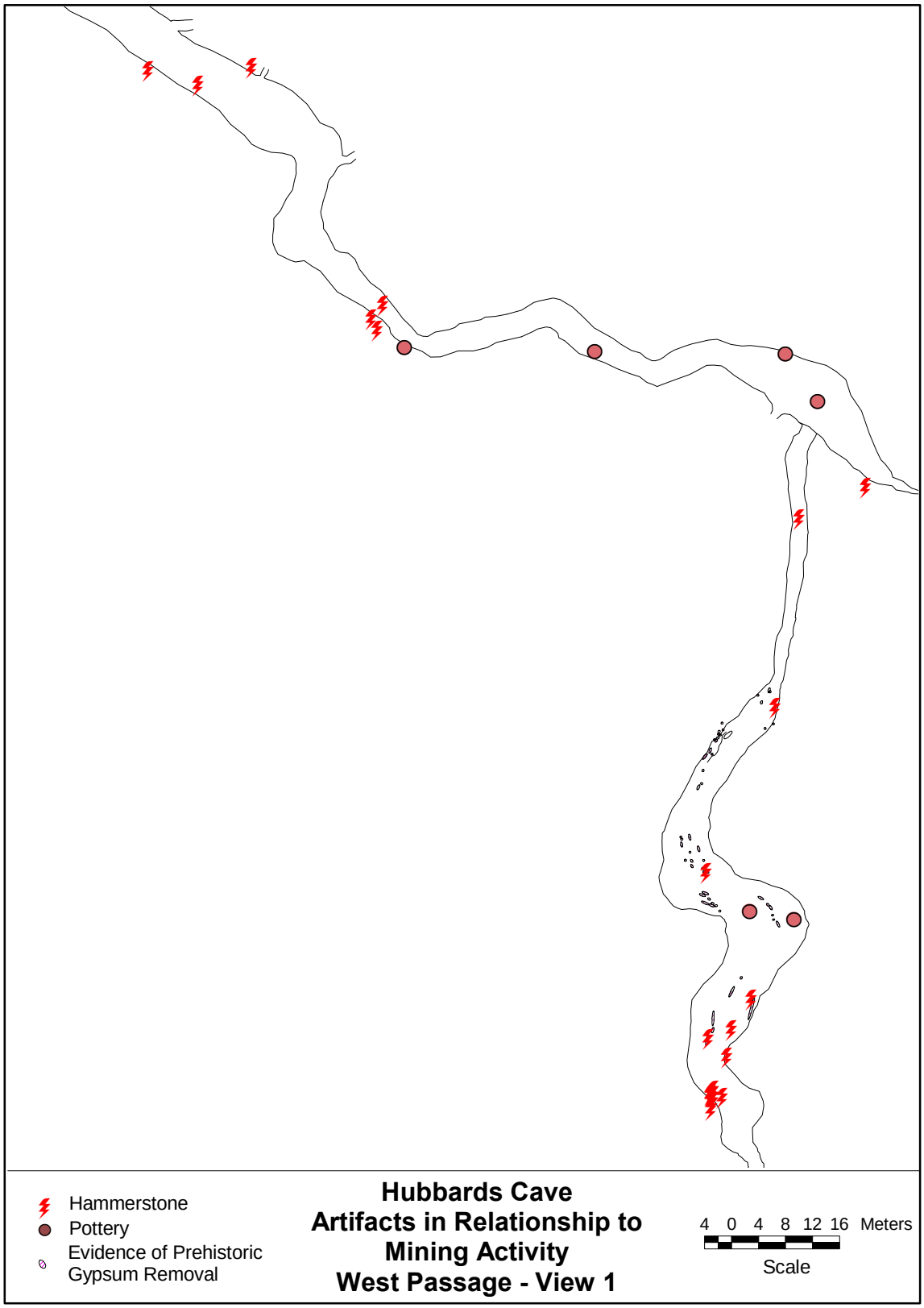


Figure 11. Artifacts Associated with Prehistoric Mining West Passage - View 1.

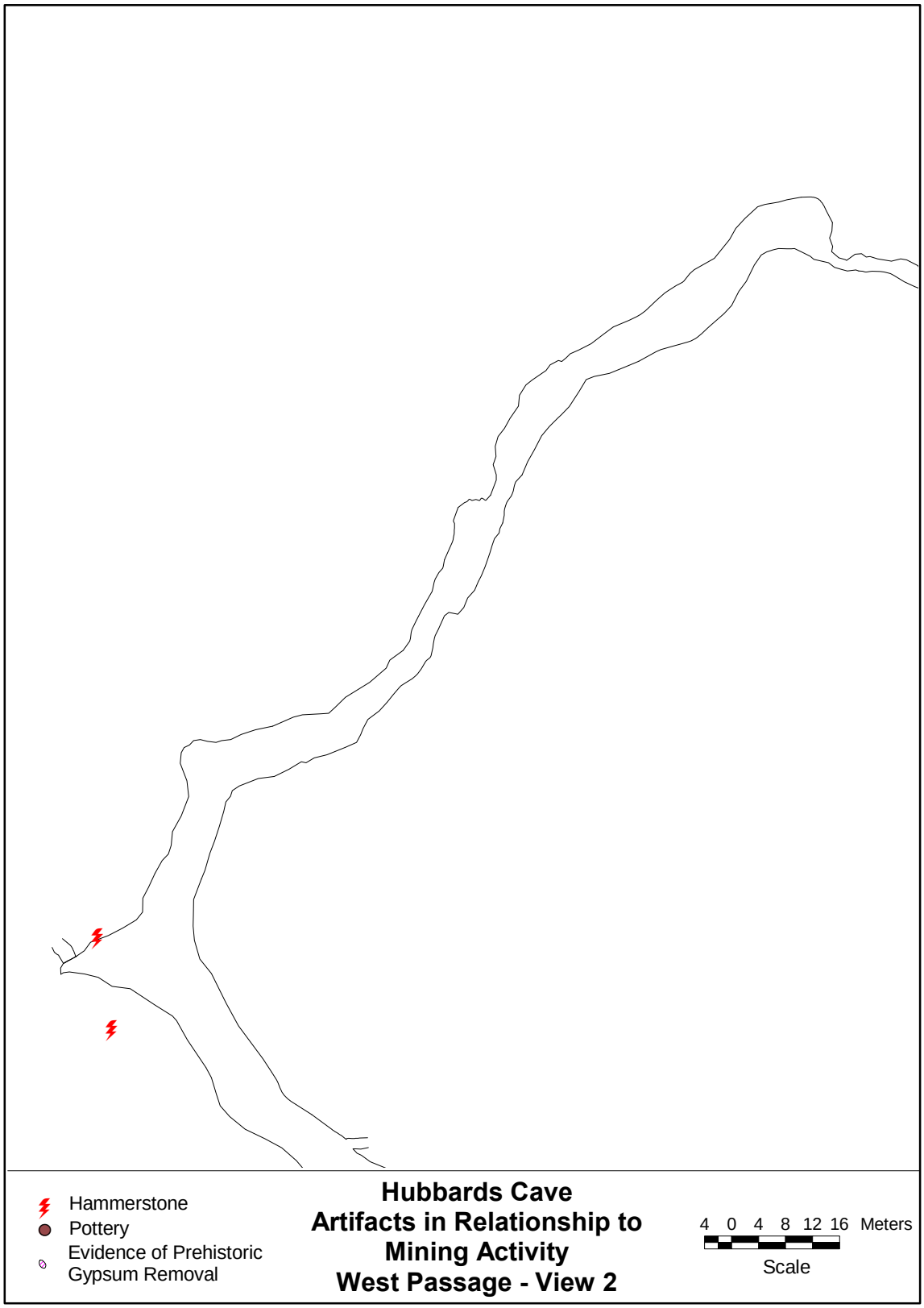


Figure 12. Artifacts Associated with Prehistoric Mining West Passage - View 2.

Spatial Patterns in North Passage

Mining activity is located throughout the North Passage of the cave (Figure 13-14). In contrast, artifacts concentrate in the front portions of the passage (Figure 15). Sediment removal has severely altered the ground surface of the North Passage and has likely removed a large percentage of material remains previously left by prehistoric peoples. Most of the identified materials in the North Passage are likely to be linked to the occupation of this portion of the cave (such as pottery and lithic material). The front portion of the North Passage is a large, expansive shelter that would have provided an ideal shelter in prehistoric times. Recovered artifacts are located along the exterior portions of the passage. One possible explanation for this is that saltpeter mining activity primarily occurred in the center of this passage, pushing other materials to the sides. Sediments along the edge could be less disturbed than other sediments in the cave. Excavations in these areas would be necessary to confirm this hypothesis. Artifacts could have been evenly dispersed across the surface prior to modern caving traffic. Extensive exploration during the post-saltpeter mining period may have damaged, buried, or resulted in the removal of visible materials in the central part of the passage.

OBSERVATIONS OF MINERAL MINING ACTIVITY AT HUBBARDS CAVE

Mineral analysis indicates that a variety of mineral types were available at Hubbards Cave. Gypsum crusts and flowers are present throughout both the North and West Passages with abundant sources of selenite and satinspar within the sediments. While evidence of historic bashing is present in both

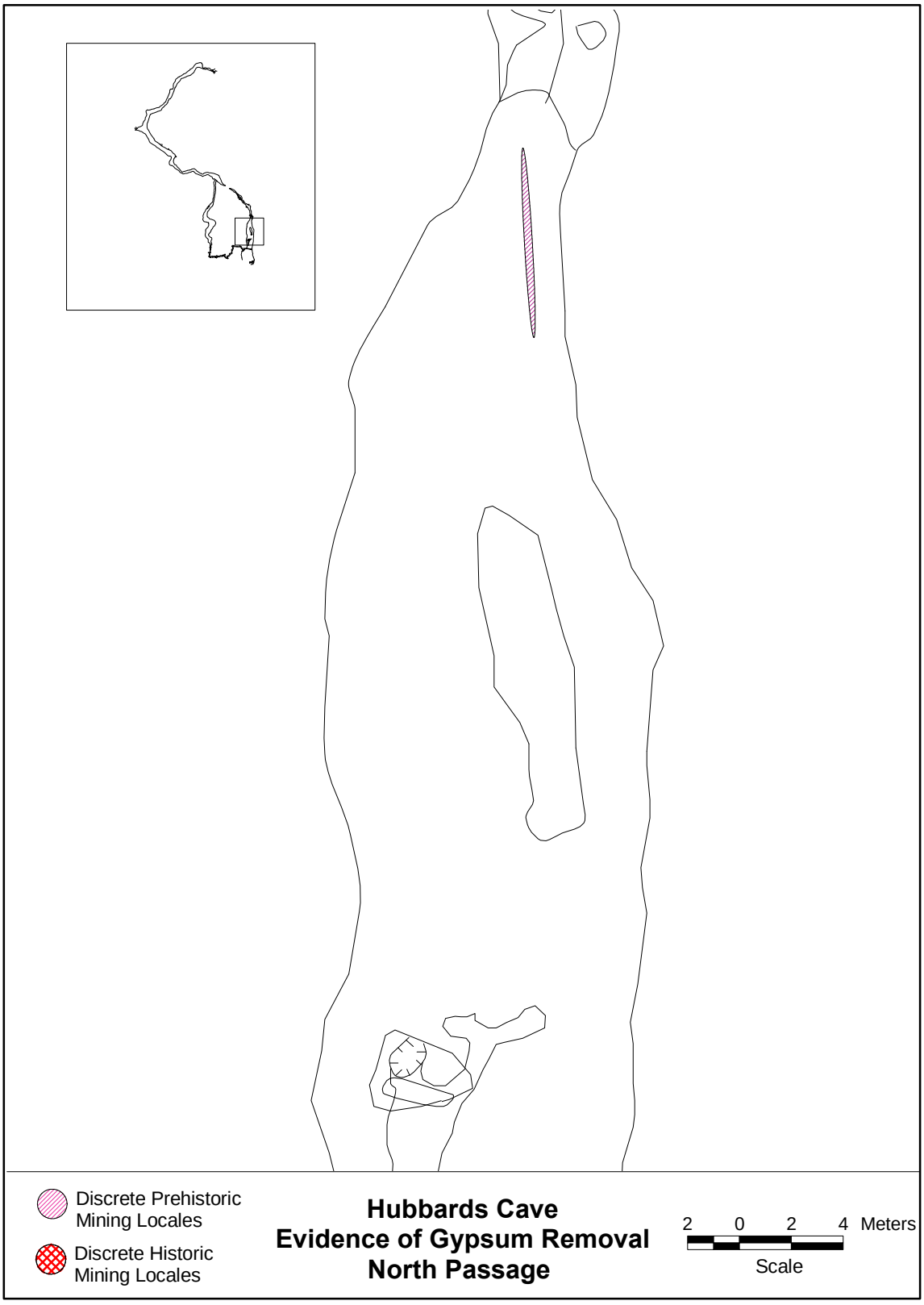


Figure 13. Gypsum Removal in North Passage - View 1.

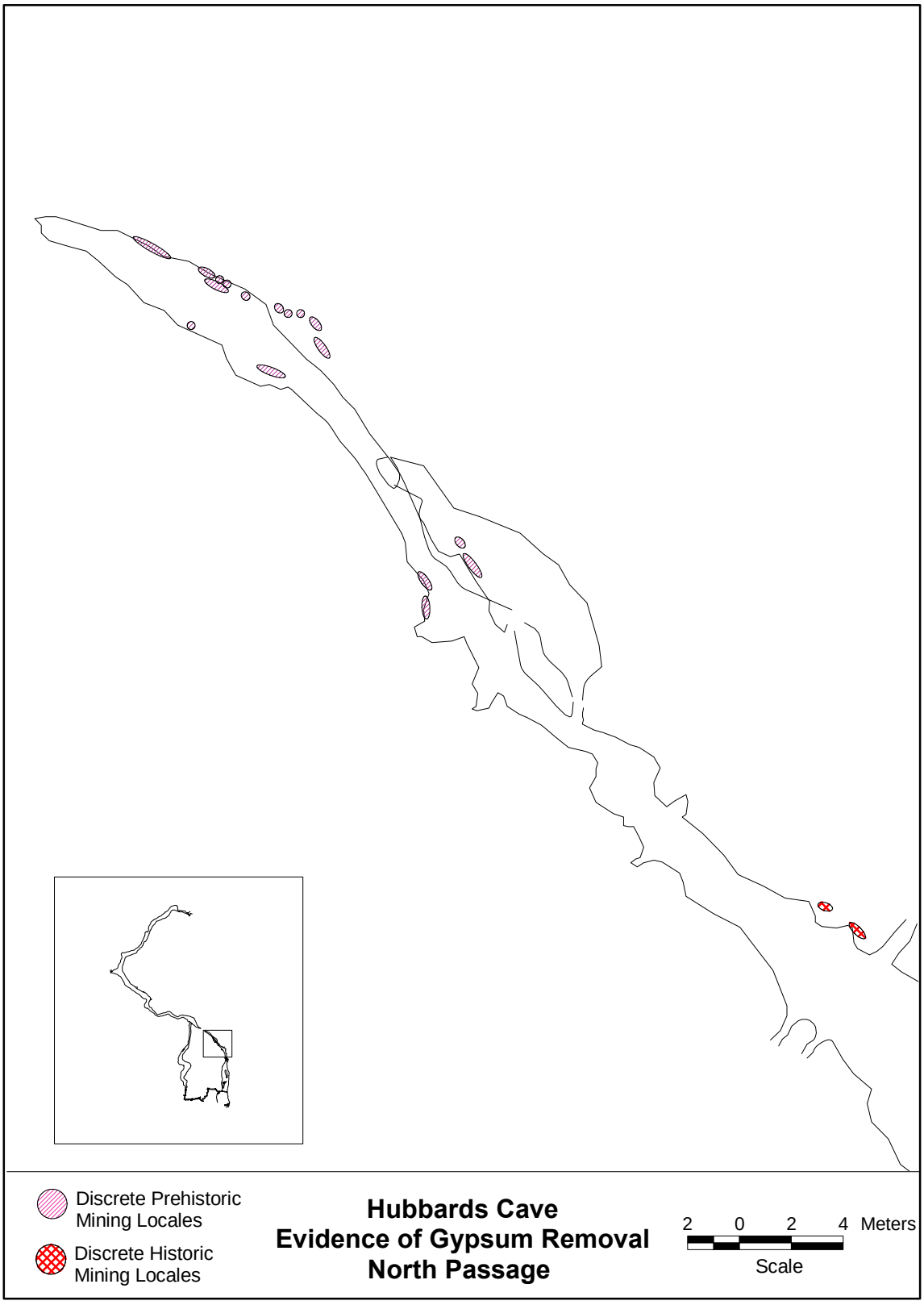


Figure 14. Gypsum Removal in North Passage - View 2.

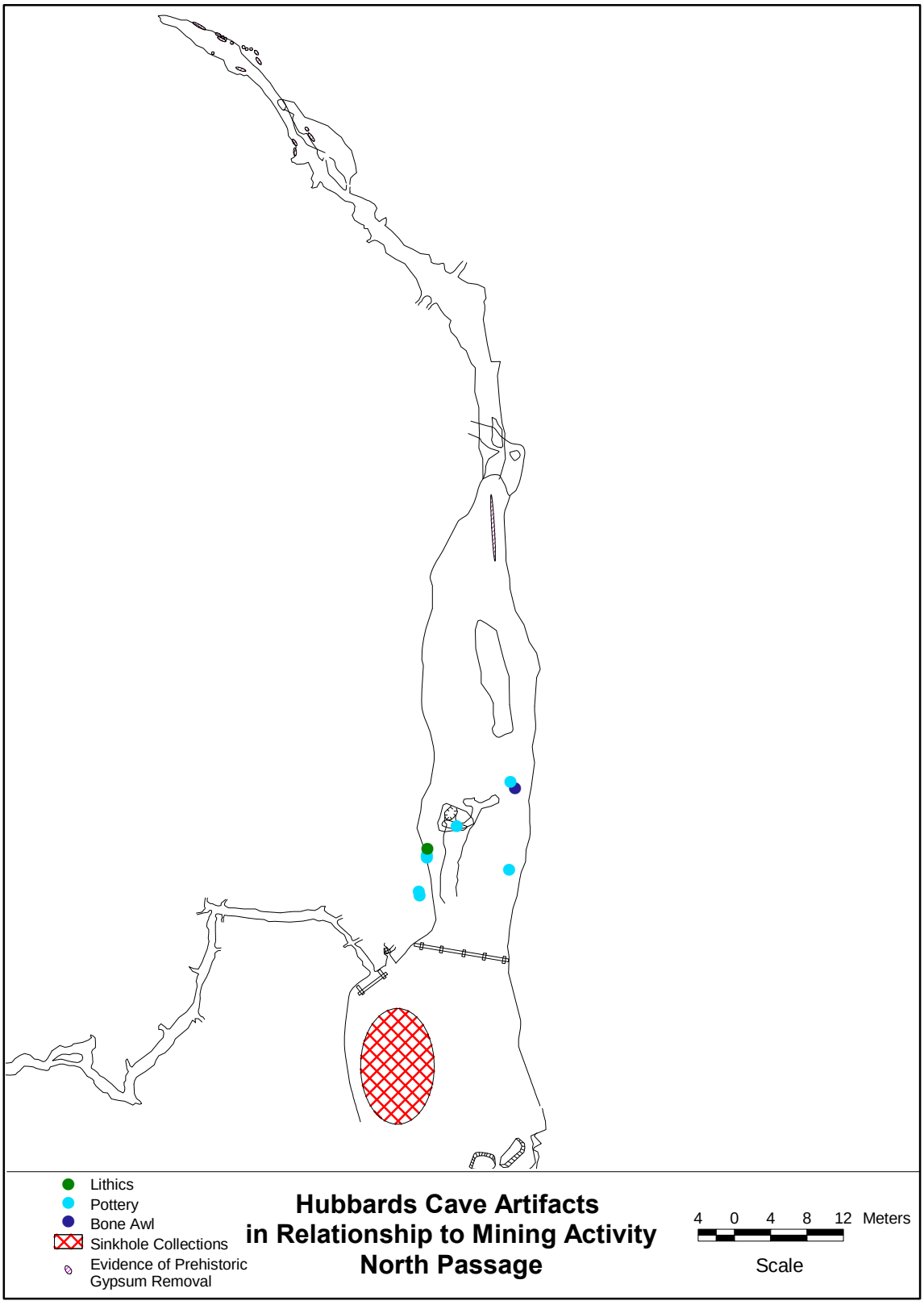


Figure 15. Artifacts Associated with Prehistoric Mining - North Passage.

passageways, only minimal amounts of material have been removed compared to other gypsum mining sites to the north. Extensive cane torch debris is scattered throughout the West Passage, suggesting prehistoric peoples spent considerable amounts of time within the dark zone. Two hypotheses are presented to explain the lack of extensive mineral removal:

1. Prehistoric mining activity in Hubbards Cave focused on sediment removal. Subsequent historic saltpeter mining has significantly altered the sediments throughout both the North and West Passageways leaving no evidence of prehistoric sediment extraction.
2. Hubbards Cave was valued for its ritual power and the mining evidence present represents small discrete episodes of gypsum extraction that may or may not be tied to ritual behavior. A vast amount of research has been conducted on the spiritual and ceremonial values of caves (Faulkner 1986; Simek et al 1997; Simek et al 1998). No evidence of art has been identified at Hubbards (unlike other cave sites believed to be associated with ritual activities). Historic graffiti covers a large percentage of walls in Hubbards, making it difficult, if not impossible to recognize prehistoric art of any kind.

CONCLUSIONS

Based on the investigations presented, it is clear that prehistoric peoples traveled well within the dark zone of Hubbards Cave for some purpose. Both artifact concentrations and mining evidence suggest that prehistoric people utilized the extent of the North Passage, but only focused on the first part of the

West Passage. Evidence for crust removal is minimal and cannot account for the extent of prehistoric activity within the cave. Subsequent saltpeter removal has obliterated possible evidence of prehistoric sediment removal in both the North and West Passages of the cave. Despite the overwhelming amount of disturbance, it is clear that prehistoric people frequently visited the cave. Cane concentrations throughout both the North and South Passageways suggest that this prehistoric activity extended beyond small discrete trips. In order to understand the extent to which prehistoric people utilized the cave and to establish a chronological relationship between Hubbards and other similar sites in the region, it is necessary to examine the radiocarbon data available for mining activity in the Southeast.

CHAPTER VII
CHRONOLOGY

Four radiocarbon samples were collected from Hubbards Cave. These samples came from the variety of well preserved cane torch fragments that were found throughout the West and North Passageways. The availability of large well-preserved samples made it possible to do conventional radiocarbon dating. Radiocarbon dates were provided by Dr. Jan Simek and Geochron Laboratories. These dates are summarized in Table 11.

Dates obtained from Hubbards indicate that prehistoric people explored the passages of the cave during the Early Middle Woodland and Late Middle Woodland periods. These dates are consistent with the material culture associated with the entrance sinkhole occupation component of the site. Mining activities at other cave locations occurred predominately during the Early Woodland through Middle Woodland periods. In order to assess the relationship of Hubbards to other mineral mining sites in the Southeast region, a statistical analysis was conducted on dates obtained from the five major mining sites: Mammoth, Salts, Wyandotte, Big Bone, and Hubbards caves.

Radiocarbon Analysis

Sixty-five uncalibrated radiocarbon dates were obtained from the above mentioned caves with mineral mining evidence. These dates and their standard errors were entered into the BCal® program. BCal® is an on-line Bayesian

Table 11. Radiocarbon Age Determinations from Hubbards Cave.

SAMPLE NUMBER	RC AGE BP	(+/-)	CALIBRATED DATE RANGE
Beta-126035	2730	60	2950-2741
Geochron-GX-27203	2310	70	2700-2631, 2610-2591, 2490-2121
Beta-126034	2260	60	2360-2111
Geochron-GX-27204	1280	60	1300-1061

.

radiocarbon calibration tool that was developed at the School of History and Archaeology at Cardiff University in Wales. The calibration software is available at the BCal® Web site, allowing users to interpret radiocarbon data and *a priori* chronological information. BCal® allows the user to compare the date ranges individually and by grouping, and also performs statistical analysis including probability tests.

BCal® was applied in this study in order to determine relationships between Hubbards Cave and other mining caves in the region. Based on the initial assessment of radiocarbon dates from the five major mining sites in the Southeast, it was hypothesized that mining activity may have began earlier in some locales and may have spread from a "source area" into other regions. To test this probability, uncalibrated dates were grouped by site and entered into the program. Each date was given a lab number. A total of five cave groupings was created. For each date, the option of entering any prior absolute chronological information is given. No absolute prior information or relative chronological relationships were selected for the five groups of dates. The calibration curve selected for our calibration was Atmospheric 1998. After all information was submitted, the dates were calibrated online within several hours. The calibrated date ranges are given in highest posterior density regions of the distributions for each individual date. Each grouping was automatically assigned an alpha and beta value identifying the absolute earliest and latest possible dates for each group. From these values, BCal® developed a model identifying relative

relationships between the five groups included in the study (Figure 16). This preliminary model simply identifies the comparative relationships between the beginning and ending use of one cave to the beginning and ending of the others. The following section details the results of this study.

RESULTS

Calibrated radiocarbon dates indicate that the mining activity of Wyandotte, Mammoth, Salts, Big Bone, and Hubbards caves predominately dates to the Woodland period (Table 12). Wyandotte Cave appears to have been utilized continuously while the others appear to have been utilized during discrete periods. This information is not surprising, given the different type of prehistoric mining activity that took place at this site. For this reason, Wyandotte cave was removed from the statistical analysis. The results indicate that this chronological pattern is found in four of the five caves included in this analysis. These caves include Mammoth, Salts, Big Bone, and Hubbards. Initial parameters indicate that Mammoth was the earliest mined cave site, followed by Salts, Big Bone, and Hubbards.

Examining the geographical positions of these sites suggests that a southward trend is present in the mining activity of gypsum in the Southeast. Mammoth and Salts caves, located in Kentucky, appear to contain the earliest evidence of mining activity. Big Bone and Hubbards caves, both located in South Central Tennessee, appear to have been mined later. Given the small sample,

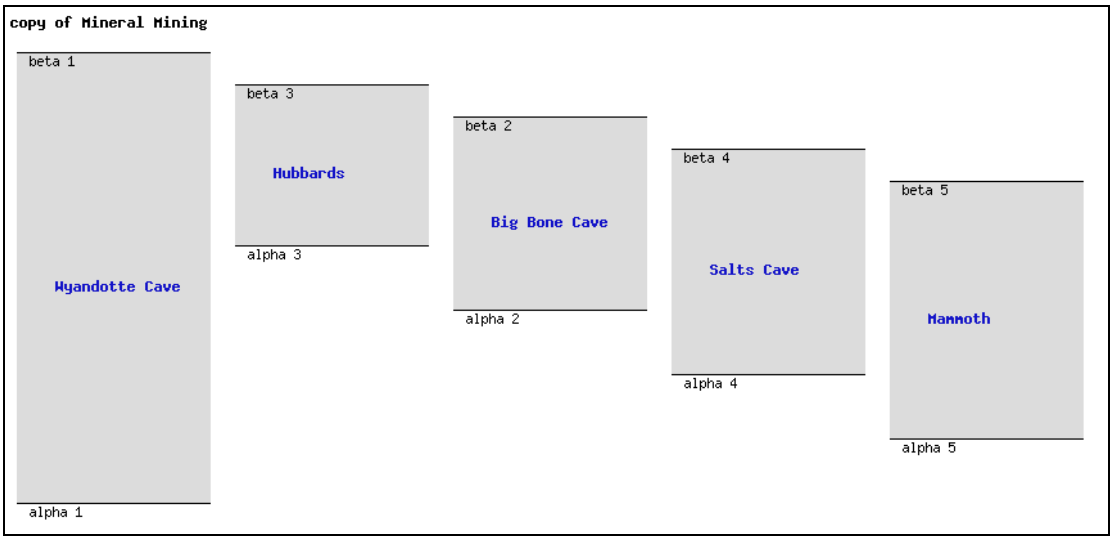


Figure 16. Relative Chronology of Mineral Mining Caves in the Southeast (Original Model)

Table 12. Chronology of Prehistoric Activity.

CAVE	DATE RANGE	CULTURAL PERIOD
Wyandotte Cave	2901 BC to AD 999	Late Archaic to Late Woodland
Mammoth Cave	2871 BC to AD 179	Late Archaic to Middle Woodland
Salts Cave	1201 BC to AD 62	Terminal Archaic to Middle Woodland
Big Bone Cave	1401 BC to AD 609	Late Archaic to Late Woodland
Hubbards Cave	1001 BC to AD 889	Woodland

Calibration Dates determined by BCal®

this trend is speculative and will require additional data in order to test it thoroughly. Still, an initial statistical analysis might prove informative.

Probability Tests

In order to test chronological relationships between mineral mining caves, probability tests were performed. These tests were based on the initial model set up by the BCal® program (Figure 16). This model predicted that the relative relationship between the five mining caves were as follows:

> Mammoth is earlier/overlaps with Salts
> Mammoth is earlier/overlaps with Big Bone
> Mammoth is earlier/overlaps with Hubbards
> Salts is earlier/overlaps with Big Bone
> Salts is earlier/overlaps with Hubbards
> Big Bone is earlier/overlaps with Hubbards
> Wyandotte overlaps with Mammoth, Salts, Big Bone and Hubbards
> Or
> Big Bone, Hubbards, Salts and Mammoth dates are contained in Wyandotte

From this model, the first probability test conducted tested these initial predictions. Results are presented in Table 13. Small to moderate probabilities were found that indicated that there may have been a chronological pattern to the mining activity. Results indicate only a small probability that Mammoth Cave was mined earlier than Salts Cave. This is expected given the close geographic location of these two sites. There is a high probability that Mammoth Cave was mined earlier than both Big Bone Cave and Hubbards Cave, both located at a greater distance away from the Mammoth Cave System. A moderate probability indicates that Salts Cave was occupied earlier than both Big Bone and Hubbards

Table 13. Results of Probability Tests I.

PROBABILITY	RESULTS
Mammoth Cave overlaps or is earlier than Salts Cave	0.022606784
Mammoth Cave overlaps or is earlier than Big Bone Cave	0.9511339
Mammoth Cave overlaps or is earlier than Hubbards Cave	0.8620011
Salts Cave overlaps or is earlier than Big Bone Cave	0.14253798
Salts Cave overlaps or is earlier than Hubbards Cave	0.2289757
Big Bone Cave overlaps or is earlier than Hubbards Cave	0.37667334

and that Big Bone was utilized earlier than Hubbards. Overall, there is some statistical evidence that mining activity began farther north in the Kentucky region of the Southeast and that this activity moved south over time.

In an attempt to explain the lower probability results for the relationship between Salts and Mammoth and Salts and Big Bone, additional probability tests were run to see if other relationships may exist. Probability Test II examined the probability that date ranges from one cave may be contained within those of another. It was expected that dates from Salts Cave were contained within the range of Mammoth and dates from Big Bone were contained within those of Salts, given their lower probabilities in Test I and their positions in the original model. Results of these tests are presented in Table 14. There is a significant probability that the date range for Salts is contained within those of Mammoth. This information does not contradict the idea that prehistoric utilization of Mammoth Cave began prior to activity at Salts, rather, it merely suggests that activity at Salts occurred within the span of time in which Mammoth was utilized. The probability that activity at Big Bone is contained within activity at Salts is 0.0. This result is surprising given the close relationship between these two ranges. Other tests indicate a low probability for the tested relationships between the other caves.

Refined Calibration

The original model identified a chronological pattern between Mammoth, Salts, Big Bone, and Hubbards caves. Subsequent probability tests confirmed

Table 14. Results of Probability Tests II.

PROBABILITY	RESULTS
Salts Range contained in Mammoth Range	0.9773932
Big Bone Range contained in Mammoth Range	0.03241192
Big Bone Range contained in Salts Range	0.0
Hubbards Range contained in Mammoth Range	0.0049468963
Hubbards Range contained in Salts Range	0.0
Hubbards Range contained in Big Bone	0.08248373

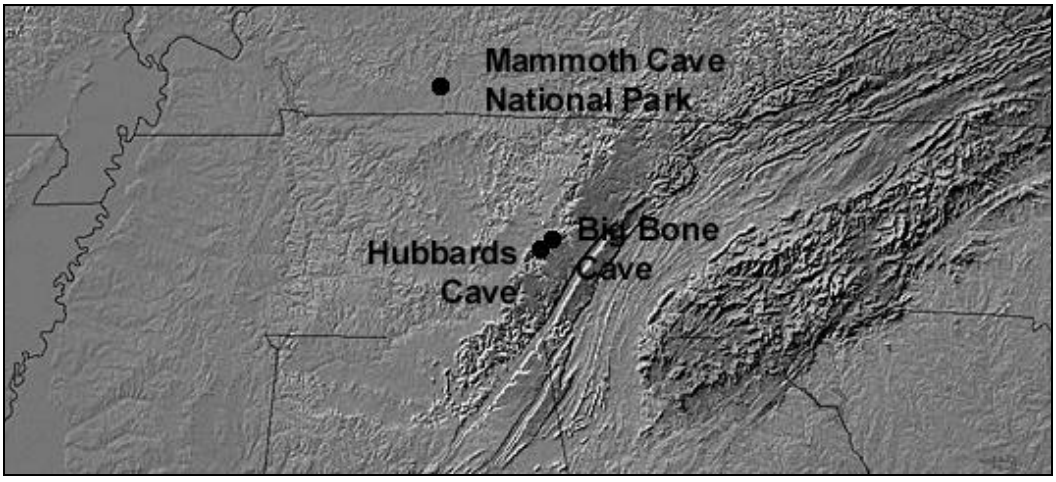


Figure 17. Relative Geographical Relationship between the Four Cave Sites.

these relationships. As a result, it was possible to refine the data set to include only these four groups of dates with pre-selected relative chronological relationships. The four groups (Mammoth, Salts, Big Bone, and Hubbards) were redefined based on these relative relationships:

Mammoth is earlier/overlaps with Salts
Mammoth is earlier/overlaps with Big Bone
Mammoth is earlier/overlaps with Hubbards
Salts is earlier/overlaps with Big Bone
Salts is earlier/overlaps with Hubbards
Big Bone is earlier/overlaps with Hubbards

The four groups were then re-submitted for calibration. In addition to chronological relationships, an external floating parameter was set at A.D. 1800. This parameter is based on the assumption that materials used for dating in all four cave sites are products of prehistoric occupation, rather than historic, and should not date later than A.D. 1800, or the post-contact period. Redefined dates resulted in a similar model when relative chronological relationships were included in the project definition. This model is presented in Figure 18. The refined calculations allow for a tighter estimate on time elapsed between discrete events (such as beginning of mining activity to end of mining activity). From this it was possible to interpret the time elapsed between the mining activities at the caves included in this study. These results are presented in Figures 19-22. Figure 18 shows time elapsed from the absolute beginning to absolute end of activity in Hubbards Cave. Each individual date from Hubbards was then calibrated (Figures 19-22). Calibrated dates indicated that activity at Hubbards took place in two stages. The first evidence of use began around 800 B.C and

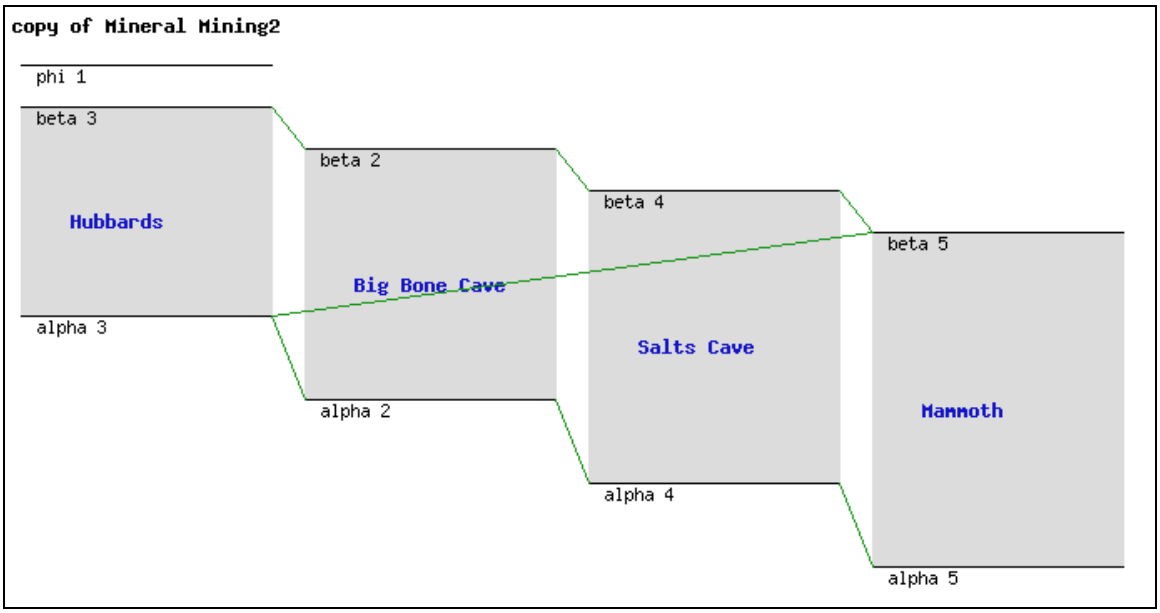


Figure 18. Relative Chronology of Mineral Mining Caves in the Southeast (*Refined Model*).

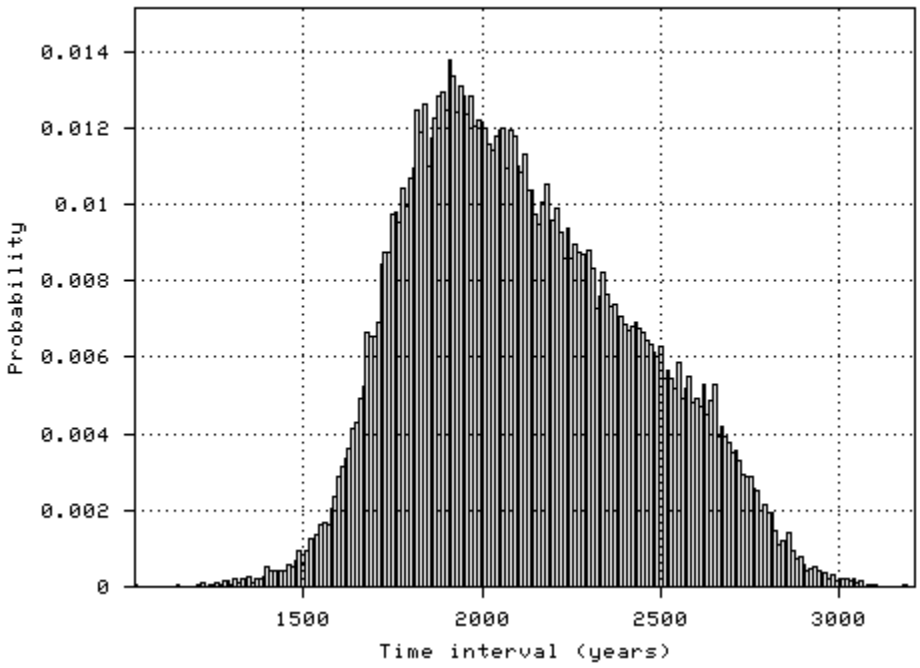


Figure 19. Time Elapsed Interval – Alpha 4 to Beta 4 – Hubbards Cave.

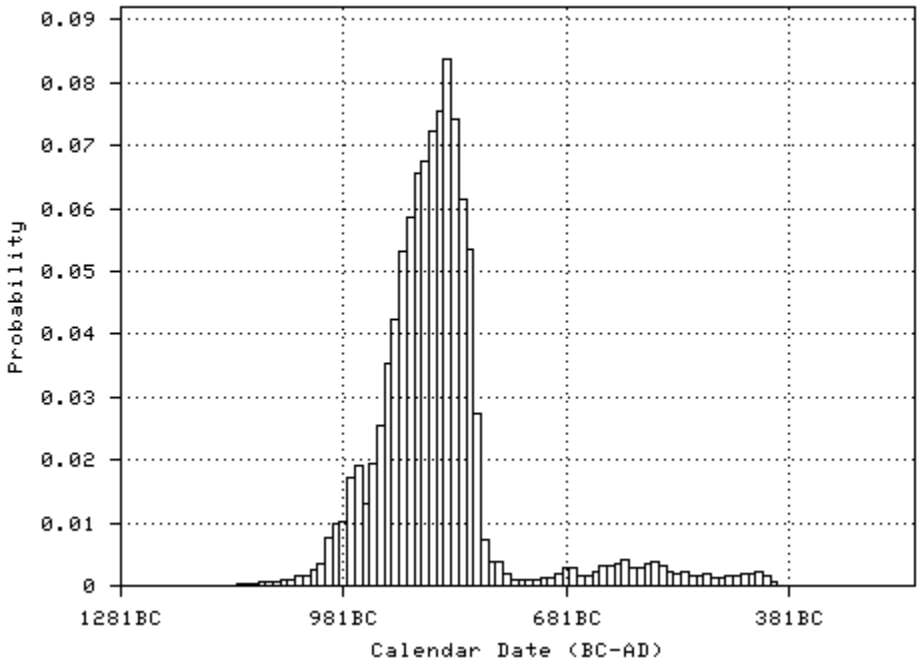


Figure 20. Calibrated Age Range – Hub1 - 2730±60 (Beta-126035).

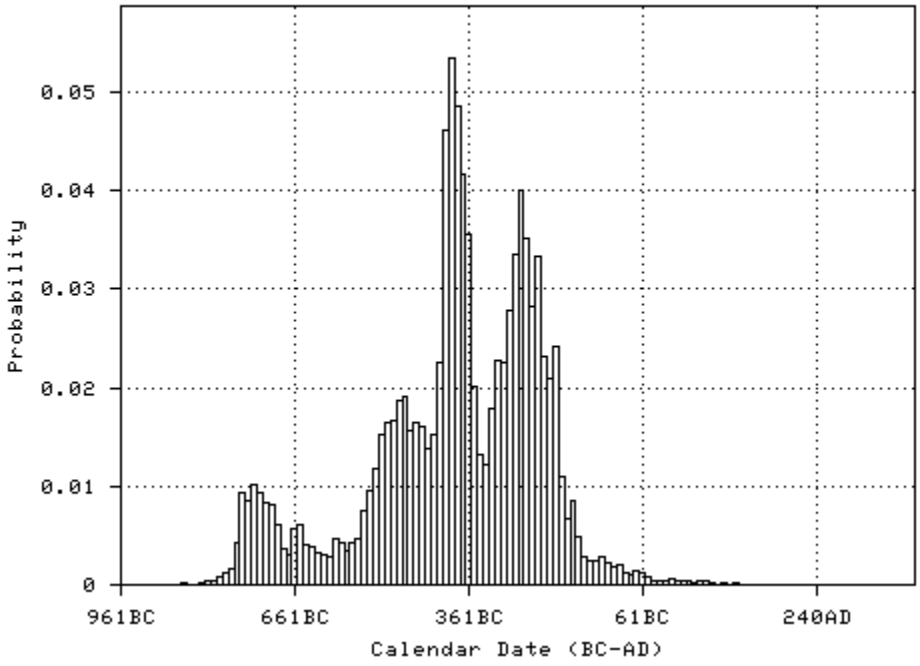


Figure 21. Calibrated Age Range – Hub 2 - 2310±70 (Geochron-GX-27203).

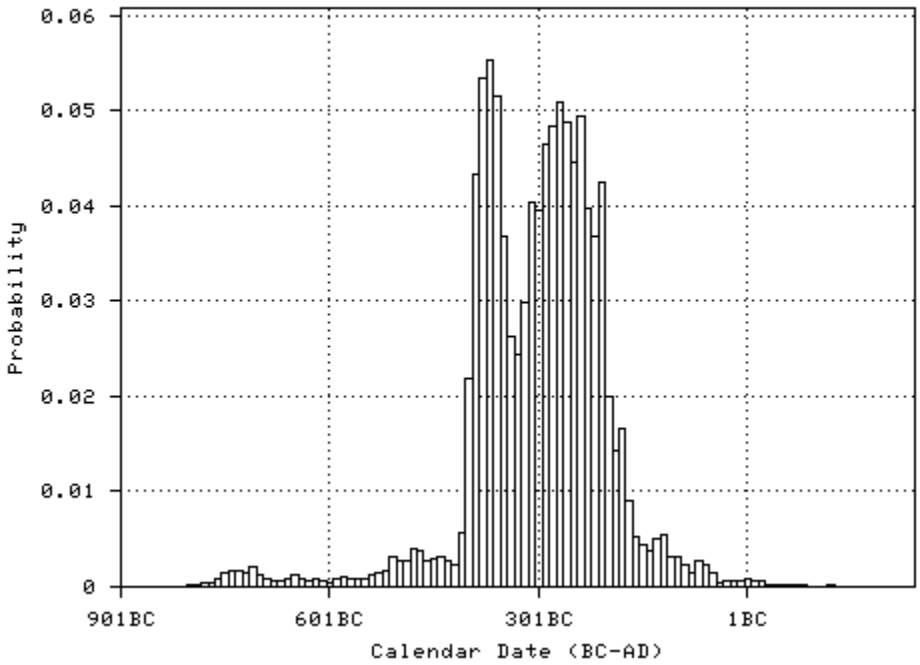


Figure 22. Calibrated Age Range – Hub 3 - 2260±60 (Beta-126034).

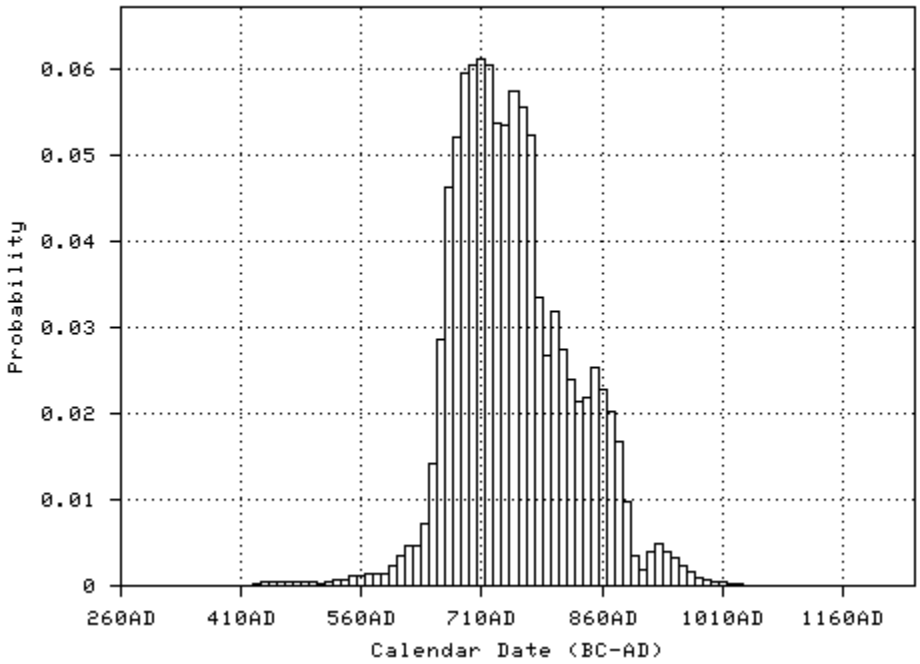


Figure 23. Calibrated Age Range – Hub 4 - 1280±60 (Geochron-GX-27204).

lasted through 200 B.C. The last date indicates that an additional discrete period of use occurred around A.D. 700. Since only four dates have been collected thus far from Hubbards, it would be premature to suggest that these dates represent the complete history of prehistoric use of the cave. Additional dates will be required to assess the extent of occupation and use of the cave.

Summary

Based on our original model, it was proposed that mining activity in Mammoth, Salts, and Big Bone all preceeded activity at Hubbards. From this model it was possible to test the probabilities that mining activity at these sites began earlier and overlapped with activities at Hubbards. These tests confirm that the gypsum mining phenomenon began further north and spread southward to Big Bone and then Hubbards cave. Results indicate a significant amount of elapsed time between the earliest known dates from Mammoth and those from Hubbards (Figure 24). Similar, yet less extensive time elapsed periods can be found in relationship to Salts and Hubbards (Figure 25) and Big Bone and Hubbards (Figure 26). The results of these analyses make it attractive to suggest that mineral mining activity is linked to other activities (i.e. trade, increased complexity) that might reflect increased interaction between Tennessee and groups far to the north. In other words, the interaction sphere of Tennessee's prehistoric people began to expand. Dates from Hubbards begin in the Terminal Archaic period. During this period, human groups are beginning to become more sedentary, practice horticulture, construct large mound centers

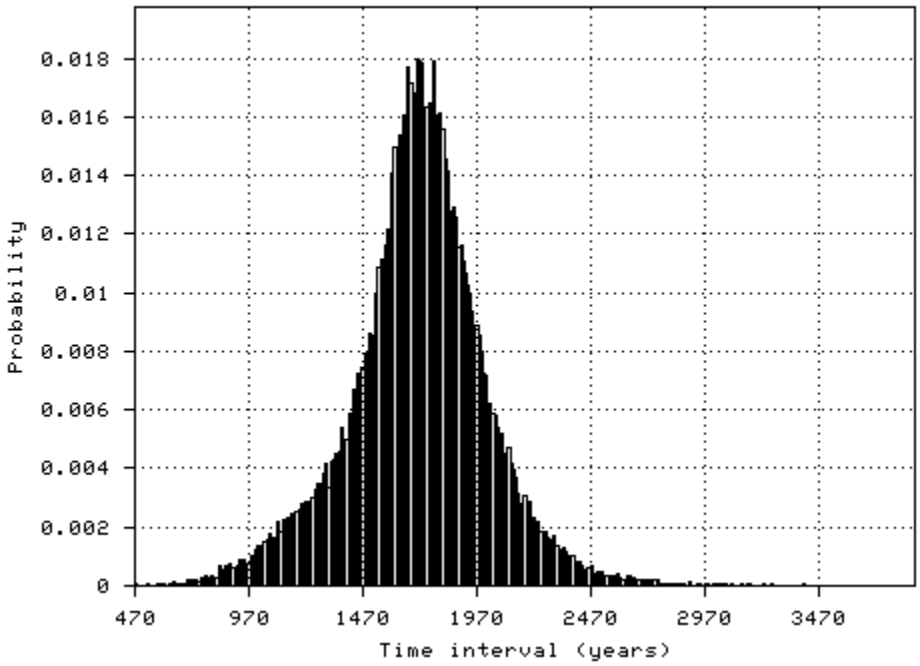


Figure 24. Time Elapse between Earliest Mammoth Date and Earliest Hubbards Date.

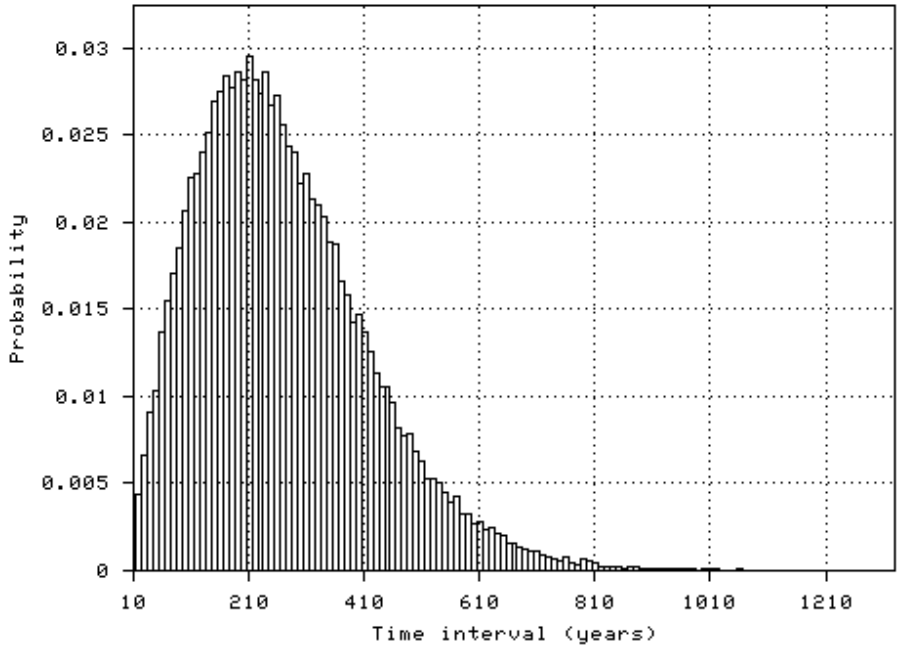


Figure 25. Time Elapse between Earliest Salts Date and Earliest Hubbards Date.

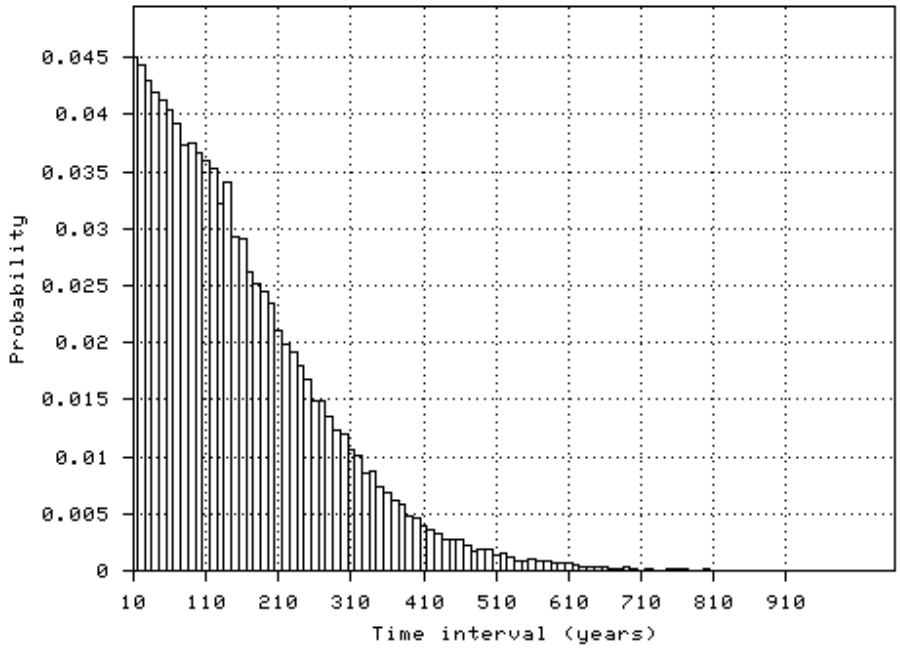


Figure 26. Time Elapse between Earliest Big Bone Date and Earliest Hubbards Date.

and villages, and utilize large container vessels (Steponaitis 1986). Archaeological data from this period indicates that exotic materials, such as chert, were being utilized (Faulkner 1982). Gypsum mining and other activity found at Hubbards may have been related to this increasing complexity among prehistoric groups. In order to test this hypothesis, additional radiocarbon dates and site data from the region would be needed.

Note Regarding Possible Contamination

While allowing for pristine preservation, deep cave environments often contain other factors that might result in the contamination of specimens available for radiocarbon analysis. The primary contaminant in Hubbards Cave is the presence of small wood rats (*Neotoma floridana*) who make their nests from surface contents found within the cave. Light-weight, organic materials are often transported throughout the cave by these small animals. In maneuvering around these dark cave environments, wood rats leave urine tracks to follow. This process inevitably leaves traces of urine on artifacts and other organic remains located within the cave. Radiocarbon samples collected from Hubbards are likely contaminated with such wastes. Other caves have probably experienced similar contamination, as well. Future investigations into the effects of such pollutants will expand our knowledge of its effects on radiocarbon dating. Every effort was made to obtain samples from locations where rat activity was low (such as lower passages where this activity was limited).

CHAPTER VIII
SUMMARY AND CONCLUSIONS

Hubbards Cave represents a prehistoric gypsum mining locale located along the western escarpment of the Cumberland Plateau. Prehistoric peoples made use of the vast entrance area for shelter, traversed the interior caverns in search of valuable resources, and perhaps viewed the site as a spiritual place as suggested by some ethnographic accounts (Mooney 1886) and recent cave research (Simek et al 1997).

Spatial patterning of artifacts and mining activity in the cave indicates that prehistoric people utilized the extent of the North Passage, occupying the vast shelter of its opening and traversing its small passage for the purpose of extracting gypsum from the wall crusts and perhaps from the floor sediments. Recovered artifacts indicated that the occupation of the North Passage shelter occurred predominately during the Late Middle Woodland period but may have begun during the Late Archaic as suggested by a Late Archaic stemmed point recovered from the South Passage.

Prehistoric activity in the West Passage is restricted to the first few hundred meters. Artifacts found in association with mining activity include hammerstones, gourd fragments, and one possible digging implement. The presence of hammerstones extends beyond the evidence of mining activity. Extensive sediment disturbance in the West Passage is one possible explanation. Gypsum crusts, selenite needles, and gypsum flowers extend throughout the entire length of the West Passage and it is difficult to determine

why prehistoric peoples restricted their activity to the first few hundred meters. Evidence of their presence in the West Passage extends beyond the mining activity as suggested by the presence of stokemarks and cane torch debris. These early explorers did not traverse the entire length of the cave, as no evidence was found in the last half of the passage. Perhaps prehistoric people entered the cave for other reasons than mining. The lack of prehistoric art suggests the cave was less likely to have been used for ceremonial purposes; however, extensive graffiti may have concealed such evidence. It is possible that the presence of stokemarks in the passages extending beyond evidence of mining activity merely indicates exploration. It is speculated here that sediments within the West Passage were mined as well. Subsequent sediment removal precludes our determinations of this behavior. Prehistoric sediment mining may well have extended the full length of passage where evidence of a prehistoric presence is found.

Chronologically, Hubbards was occupied somewhat later than the other Southeasternmineral mining sites where gypsum was the primary objective. Hubbards represents the southernmost of the sites where prehistoric mining has been documented thus far. Geographically, it appears that gypsum mining began further north at Mammoth and Salts caves. Additional dates are necessary in order to determine the true extent of prehistoric occupation at Hubbards Cave.

The value of gypsum to these prehistoric people is less clear. The minimal amount of crusts removed from the cave would seem to suggest that it

was not used as a paint. In its pristine state, gypsum has a vitreous luster and is colorless to transparent in color (Klein and Hurlbut 1999). At the time of prehistoric occupation, gypsum crystals in Hubbards may have exhibited these characteristics. It is therefore reasonable to suspect that gypsum was valued for its aesthetic value. For whatever purpose, it is clear that prehistoric people were traveling well within the dark zone of Hubbards Cave to extract gypsum crusts along the cave walls.

Cultural History of Hubbards Cave

Prehistoric occupation of Hubbards Cave probably began sometime during the Archaic period. One Late Archaic stemmed projectile point was recovered in a secondary wash deposit deep in the lower South Passage. The earliest radiocarbon date from Hubbards indicates that activities within the cave began during the Terminal Archaic period (ca. 800 B.C.). In the Upper Duck River Valley, archaeological excavation of the Wade phase sites (1000-800 B.C.) show evidence of increased sedentary patterns which are apparent in the presence of larger, more permanent structures, use of rare lithic resources, and burial of exotic goods (Faulkner 1982). Trade activity, along with increased sedentism appear to be the trend occurring during this period. Mineral procurement at Hubbards, and perhaps other cave sites in the region, may represent sources of trade goods.

Remaining artifacts and radiocarbon dates from Hubbards indicate that the cave was used predominately during the Woodland period. Radiocarbon

dates suggest an occupation during the late Early Woodland (ca. 300 B.C.) as well as the Late Middle Woodland (ca. A.D. 700). Early Woodland cultures in the region include the Watts Bar phase and Long Branch Phases where there is evidence for a continued increase in sedentism in the archaeological record. The early Middle Woodland Neel phase (ca. 200 B.C.) is believed to overlap with the Long Branch phase. Neel phase sites are characterized by a change in community size and configuration (Faulkner 2001). Specialized burial sites are found with exotic materials such as copper, mica, galena, and quartz crystals. Participation in the Hopewell Interaction sphere is indicated. More dates from Hubbards are required in order to link activity at this locale with such larger trade economies occurring in the region. The latest date obtained from Hubbards is around A.D.700. This range corresponds with the Mason phase of the Upper Duck Valley where a break in large community patterning occurs as evidenced by the presence of smaller, discrete habitation sites. Mason phase sites post-date those where we see the most extensive evidence for trade and increased ceremonialism as associated with the Neel and McFarland phases.

Activity at Hubbards cave spans a long period of time, beginning around 800 B.C. and extending through A.D. 900. The closest geographical correlate (Upper Duck River Valley) shows an increase and subsequent decrease exotic trade and ceremonialism occurring during this time (Table 15). It is possible to speculate that activities at Hubbards may have been linked to this rise and fall of local or long distance trade. Further documentation of Woodland period sites in the vicinity of Hubbards Cave and additional radiocarbon dates from Hubbards,

Table 15. Culture History of Hubbards Cave.

GENERAL CULTURE HISTORY OF THE SOUTHEAST	CULTURE HISTORY OF THE UPPER DUCK RIVER VALLEY	CULTURAL MANIFESTATIONS PRESENT AT HUBBARDS
Paleoindian		
Early Archaic	Kirk Phase	
Middle Archaic	Eva-Morrow Mountain Phase	
Late Archaic	Ledbetter Phase	Possible occupation in entrance sinkhole, one radiocarbon date
	Wade Phase	
Early Woodland	Watts Bar Phase	Radiocarbon dates from within the cave
	Long Branch Phase	
Middle Woodland	Neel Phase	
	McFarland Phase	Occupation present in entrance sinkhole
Late Woodland	Owl Hollow Phase	
	Mason Phase	One radiocarbon date from within Hubbards Cave
Mississippian		

as well as other mining sites in the region, will be required in order to further interpret this relationship.

Future Research

While evidence from Hubbards Cave is minimal compared to other mining sites in the Southeastern region (such as Mammoth and Salts caves), it is clear that the prehistoric mineral mining phenomenon in this region is more widespread than originally thought. Additional caves containing gypsum mining have been reported in Tennessee and further investigation of these sites will be done. Prehistoric people were utilizing many resources within the dark zones of caves throughout the Southeast. More cave archaeological sites are being discovered and as this research progresses, it is expected that additional gypsum procurement sites will be discovered.

Investigations at Hubbards Cave are on-going. Future studies of Hubbards and other mineral mining caves in the region will be required to complete our understanding of prehistoric gypsum mining in the Southeastern region.

REFERENCES CITED

REFERENCES CITED

Anderson, D.G.
1996 Models of Paleoindian and Early Archaic Settlement in the Southeast. In *The Paleoindian and Early Archaic of the Southeast.* University of Alabama Press, Tuscaloosa, Alabama.

Anderson, D.G. and K.E. Sassaman (Editors)
1996 *The Paleoindian and Early Archaic Southeast.* University of Alabama Press, Tuscaloosa, Alabama.

Andrefsky, W.
1997 *Lithics: Macroscopic Approaches to Analysis.* Cambridge University Press, Cambridge.

Bacon, W.S.
1993 Factors in Siting a Middle Woodland Enclosure in Middle Tennessee. *Midcontinental Journal of Archaeology* 18(2):245-281.

Bailey, T.L.
1918 Report on the Caves of the Eastern Highland Rim and the Cumberland Mountains. In *The Resources of Tennessee,* pp. 85-138. Tennessee Division of Geology, Nashville.

Barr, T.C.
1961 *Caves of Tennessee*. Bulletin 64, Tennessee Division of Geology, Nashville.

Bish, D.L. and R.C. Reynolds, Jr.
1989 Sample Preparation for X-Ray Diffraction. In *Modern Powder Diffraction. e*dited by D.L. Bish and J.E. Post, pp. 73-100. Reviews in Mineralogy, Vol. 20, Minerological Society of America, Washington, D.C.

Broster, J.B. and M.R. Norton
1996 Recent Paleoindian Research in Tennessee. In *The Paleoindian and Early Archaic of the Southeast.* University of Alabama Press, Tuscaloosa, Alabama.

Broyles, B.
1958 *Russell Cave in Northern Alabama.* Tennessee Archaeological Society, Miscellaneous Paper No. 4, Knoxville.

Chang, L.L.Y., R.A. Howie, and J. Zussman
1997 *Rock Forming Minerals,* Vol. 5B, Non-silicates. The Geological Society, London.

Crothers, G.M.
1987 Archaeological Survey of Big Bone Cave, Tennessee and Diachronic Patterns of Cave Utilization in the Eastern Woodlands. Unpublished M.A. thesis, Department of Anthropology, University of Tennessee, Knoxville.

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. Prehistory Press, Madison.

Cullity, B.D. and S.R. Stock
2001 *Elements of X-Ray Diffraction*. Prentice Hall, New Jersey.

Deuel, T.
1952 Hopewellian Dress in the Lower Ohio Valley. In *Archaeology of the Eastern United States*, edited by James B. Griffin, pp. 165-175. University of Chicago Press, Chicago.

Douglas, Joe
1997 Hubbards Cave: Preliminary Historic Preservation Report. A proposal to The Nature Conservancy.

Dusseau E.M. and R.J. Porter
1971 The Search for Animal Parasites in Paleofeces from Upper Salts Cave. In *Archaeology of the Mammoth Cave Area.* Edited by P.J. Watson, Cave Books, St. Louis, Missouri.

Faulkner, C.H.
1977 The Winter House: An Early Southeast Tradition. *Midcontinental Journal of Archaeology* 2(2):131-159.

2001 Continuity and Change in the Woodland Cultures of the Elk and Duck River Valleys, Tennessee. In *The Woodland Southeast*, edited by D. Anderson and R. Mainfort, in press.

Faulkner, C.H. (Editor)
1986 *The Prehistoric Native American Art of Mud Glyph Cave.* The University of Tennessee Press, Knoxville.

Faulkner, C.H. and M.C.R. McCullough
1973 *Introductory Report of the Normandy Reservoir Salvage Project: Environmental Setting, Typology and Survey.* University of Tennessee, Department of Anthropology, Report of Investigations No. 11, Knoxville.

1974 *Excavations and Testing, Normandy Reservoir Salvage Project: 1972 Seasons.* Normandy Archaeological Project, Vol. 2. Reports of Investigations No. 12, Department of Anthropology, University of Tennessee, Knoxville.

1982 Excavation of the Jernigan II Sites (40CF37). In *Seventh Report of the Normandy Archaeological Project,* edited by C.H. Faulkner and M.C.R. McCollough, pp. 8-151. Department of Anthropology, Report of Investigations 32 and TVA Publications in Anthropology 29, Knoxville.

Faulkner, C.H. and M.C.R. McCollough (editors)
1977 *Fourth Report of the Normandy Reservoir Project*. University of Tennessee, Department of Anthropology, Report of Investigations 19, Knoxville.

1978 *Fifth Report of the Normandy Archaeological Project.* University of Tennessee, Department of Anthropology, Report of Investigations 20, Knoxville.

1982a *Seventh Report of the Normandy Archaeological Project.* University of Tennessee, Department of Anthropology, Report of Investigations 32, TVA Publications in Anthropology 29. Knoxville.

1982b *Eighth Report of the Normandy Archaeological Project*. University of Tennessee Department of Anthropology Reports of Investigations No. 33, TVA Publications in Anthropology No. 30.

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

Fowke, G.
1922 Cave Explorations in Other States. In *Archaeological Investigations.* Bureau of Ethnology, Volume 76, pp. 101-150.

Franklin, Jay D.
1999 *The Rime of Ancient Miners*. Unpublished M.A. thesis, Department of Anthropology, University of Tennessee, Knoxville.

Goodspeed
1973 *Goodspeed's General History of Tennessee.* Reprinted from Goodspeed's *History of Tennessee.*

Griffin, J.W.
1974 *Investigations in Russell Cave, Russell Cave National Monument, Alabama.* Publication in Archaeology 13, National Park Service, U.S. Department of Interior, Washington.

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

Hartney, P.C.
1962 Peter Cave, Tennessee: Report of the 1959-1961 Excavations. *Tennessee Archaeologist* 18(1):23-45.

Haskins, V.A. (Abstract)
1983 The Archaeology of Prewitts Knob, Kentucky. Proceedings of the National Speleological Society's Annual Meeting June 27-July 1, 1983. *The NSS Bulletin* (45(2).

Hill, C. and P. Forti
1987 *Cave Minerals of the World.* National Speleological Society, Huntsville, Alabama.

Justice, N.D.
1995 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference.* Indiana University Press, Bloomington and Indianapolis.

Klein, C. and C.S. Hurlbut, Jr.
1999 *Manual of Mineralogy*. John Wiley and Sons, Inc, New York.

Kutruff, J. T.
1986 A Twined Bag from Big Bone Cave, TN: Manufacture, Repair and Use. Paper presented at the 43rd Southeastern Archaeological Conference, Nashville, Tennessee.

Lewis, T.M.N. and M. Kneberg
1957 The Camp Creek Site. *Tennessee Archaeologist.* 13(1):1-48.

Materials Data, Inc.
1997 Data Scan for Windows: An Automated Control and Data Acquisition System for X-ray Diffractometers. Liverpool, California.

1999 Jade 5: XRD Pattern Processing. Liverpool, California.

McCollough, M.C.R. and C.H. Faulkner (Editors)
1976 *Third Report of the Normandy Reservoir Salvage Project.* University of Tennessee, Department of Anthropology, Report of Investigations 16. Knoxville.

1978 *Sixth Report of the Normandy Archaeological Project.* University of Tennessee, Department of Anthropology, Report of Investigations 21, Wright State University, Laboratory of Anthropology, Notes in Anthropology 4, TVA Publications in Anthropology 19, Knoxville.

Matthews, L.E.
1971 *Descriptions of Tennessee Caves.* State of Tennessee Department of Conservation, Division of Geology, Bulletin 69, Nashville, Tennessee.

Mooney, J.
1886 *The Sacred Formula of the Cherokees.* Seventh Annual Report of the Bureau of Ethnology. Washington, DC.

Moore, G.W.
1952 Spelethem: A New Cave Term. *National Speleological Society News.* 10(6):2.

Munson, P.J., K. Tankersley, C. Munson, and P.J. Watson
1988 Prehistoric Selenite and Satinspar Mining in the Mammoth Cave System, Kentucky. *Midcontinental Journal of Archaeology* 14(2):119-145.

Munson, P.J., and C. Munson
1990 Prehistoric and Early Historic Archaeology of Wyandotte Cave and Other Caves in Southern Indiana. *Indiana Historical Society Prehistory Research Series,* 7(1).

Pearsall, J.E. and C.D. Malone
1991 A Middle Woodland Solstice Alignment at Old Stone Fort. *Tennessee Anthropologist* 16(1):20-28.

Schoenwetter, J.
1971 Pollen Analysis of Human Paleofeces from Upper Salts Cave. In *Archaeology of the Mammoth Cave Area.* edited by P.J. Watson, pp. 97-106. Cave Books, St. Louis, Missouri.

Simek, J.F., C.H. Faulkner, S.R. Frankenberg, W.E. Klippel, T.M. Ahlman, N.P. Herrmann, S.C. Sherwood, R.B. Walker, W.M. Wright, and W.R. Yarnell
1997 A Preliminary Report on the Archaeology of a New Mississippian Cave Art Site in East Tennessee. *Southeastern Archaeology* 16(1):51-73.

Simek, J.F., J.D. Franklin, 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):663-678.

Smith, B.D.
1986 The Archaeology of the Southeastern United States: From Dalton to de Soto, 10,500-500 B.P. In *Advances in World Archaeology,* Vol. 5, edited by F. Wendorf and A. Close, pp. 1-92. Academic Press, Orlando, Florida.

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

Tankersley, K.B.
1996 Prehistoric Mining in the Mammoth Cave System. In *Of Caves and Shell Mounds*, edited by K. Carstens and P. J. Watson, pp. 33-39. University of Alabama Press, Tuscaloosa and London.

Tankersley, K., J. Bassett, and S. Frushour
1985 A Gourd Bowl From Salts Cave, Kentucky. *Tennessee Anthropologist* 10(2):95-104.

Tankersley, K.B., C.A. Munson, P.J. Munson, N.R. Shaffer, and R.L. Leininger
1990 The Mineralogy of Wyandotte Cave Aragonite, Indiana, and Its Archaeological Significance. *In Archaeological Geology of North America,* edited by N.P. Lasca and Jack Donahue, pp. 219-30. Geological Society of America, Boulder, Colorado.

Van Doren, M. (editor)
1928 *Travels of William Bartram.* Dover Publications, Inc, New York.

Wagner, M.J.
1982 The Aaron Shelton Site (40CF69): A Multicomponent Site in the Normandy Reservoir. In *Eighth Report of the Normandy Archaeological Project*, edited by C.F. Faulkner and M.C.R. McCollough, pp. 389-526. University of Tennessee Department of Anthropology Reports of Investigations No. 33, TVA Publications in Anthropology No. 30.

Walthall, John A.
1980 *Prehistoric Indians of the Southeast: Archaeology of Alabama and the Middle South.* The University of Alabama Press, University, Alabama.

Watson, P.J.
1969 The Prehistory of Salts Cave, Kentucky. *Illinois State Museum, Reports of Investigation* 16.

1986 Prehistoric Cavers of the Eastern Woodlands. In *The Prehistoric Native American Art of Mud Glyph Cave.* University of Tennessee Press, Knoxville, Tennessee.

Watson, P.J. (editor)
1974 *Archeology of the Mammoth Cave Area*. Academic Press, New York and London.

Weems, C.W.
1994 The Old Stone Fort Site: A History of the Early Descriptions and Maps and Their Relevance to Modern Research. *Tennessee Anthropologist* 20(2):96-125.

Womack, W.
1960 *McMinnville at a Milestone: 1810-1960.* Standard Publishing Co., Inc, McMinnville, Tennessee and Womack Printing Co., McMinnville, Tennessee.

Yarnell, R. A.
1969 Contents of Human Paleofeces. In *The Prehistory of Salts Cave, Kentucky,* by P.J. Watson et al. Ilinois State Museum Reports of Investiations, No. 16.

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