EXAMINING EARLY NINETEENTH CENTURY SALTPETER CAVES: AN ARCHAEOLOGICAL PERSPECTIVE

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During the War of 1812, the southeastern United States experienced a drastic need for saltpeter to be used in gunpowder. The limestone caves of Kentucky became the focal point of a brief, but vital, mining industry. Two production models are drawn from the extant literature and compared to Saltpeter Cave, an archaeological case study site in northeastern Kentucky. Equipment types, production systems, and water-transport systems are discussed vis-à-vis their function in each production model.

In the early part of the nineteenth century, Kentucky led the southeastern United States in saltpeter production. Many of the state's limestone caves proved to be quite prolific sources for this critical ingredient of gunpowder. The arid conditions necessary for the presence of nitrates have also resulted in the excellent preservation of much of the equipment used in the mines (For a discussion of the origin of nitrates in limestone caves, please see Lewis, 1992, and a reply by Hill, 1992.) It seems that in many saltpeter mines when the war was over and the price of saltpeter plummeted, the miners literally dropped their tools where they were standing and left the caves. Given this unique behavior and the high state of preservation, surprisingly little archaeological research has been done at these sites. At Mammoth Cave, an architectural inventory has been completed of the extant saltpeter works, but most of the archaeological research conducted has focused on the prehistoric mining and other prehistoric components.

Some work has been conducted in terms of the origin of cave saltpeter (Lewis 1992; Hill 1992, 1981a, 1981b). It is not this author's intent to enter that debate. Instead, this article examines the operation of saltpeter mines, their equipment types, and their productivity. This paper discusses the results of archaeological investigations conducted at Saltpeter Cave (also referred to as 15Cr99, this site's unique archaeological number assigned by the Office of State Archaeology in Kentucky) in Carter Caves State Resort Park in northeastern Kentucky (Figure 1). Two models of saltpeter mines are drawn and discussed in terms of the case study site.

Most saltpeter caves display three basic categories of extant features: heavy soot deposits, large piles of spoil dirt, and casts of leaching vats. Not all of these categories are apparent in every saltpeter mine and, therefore, evidence of nineteenth century activity can be tenuous at times. Soot deposits and spoil dirt may be evidence of prehistoric rather than historic mining episodes (Munson et al., 1989). Another problem with sites from the early nineteenth century is that more often than not, there are few, if any, documents that refer to the mining operations. Therefore, we must rely on the archaeological evidence in order to discern the history of the site.

The question from these tenuous, empirical data, then, is can we discern any systematic, region-wide patterns of the 1812-era saltpeter industry? Many mines were in operation simultaneously. Were they operated in a similar manner? Previous work in 1812-era saltpeter caves has implied that there were only two types of mining operations and that each system tolerated only a small range of variation in equipment construction.

The first model (Type A) is the large-scale production system. Mammoth Cave and Great Saltpeter Cave are two of the best-known examples of this type (Figure 1). The large-scale system used leaching vats of the box type that held many tons of dirt. A large number of people were employed in the operation, and a complex water-transport system was used. For example, at Mammoth Cave a pump tower and water pipes were constructed to move water from remote areas to the hoppers (De Paepe, 1985). The miners at Type A sites were retrieving calcium nitrate from the cave sediments. This deliquescent form of nitrate had to be converted to potassium nitrate, so a conversion step was added to the production process.

The second model (Type B) involved small cottage-industry operations, which were most often located in rockshelters.

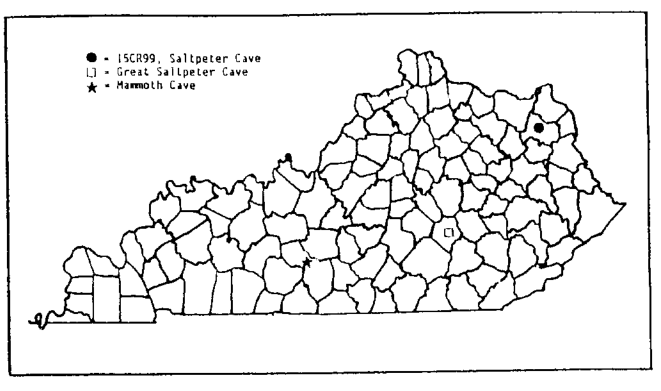

Figure 1. Map of Kentucky indicating locations of three major early nineteenth century saltpeter caves.

Typically, these operations were located near water sources and used a V-vat type of hopper. The rockshelters were quickly exhausted of their nitrate deposits, and the V-vats were easily dismantled, moved to the next rockshelter and reused. Often, these mines yielded potassium nitrate and since there was no need for a conversion step, as in the Type A systems, these were less complex in their organization. Type B systems are also found in small caves, in which calcium nitrate was being mined. The scale of the production system in use was partially due to the particular substance being retrieved. The major factor affecting the type of production system, however, was the size of the cave. Each production system was modified somewhat to adjust to the working room available at each site.

Each production stage required different types of equipment. In Type A systems, necessary equipment included: those objects and tools involved in water transport; leaching vats; smaller tools such as mattocks, shovels, ladles, paddles, buckets, and hoes; and boiling kettles. The amount and variety of equipment involved suggests a complex system. Type B systems did not involve many tools, so few were left behind as the miners exhausted one site and moved to the next. Often the only signs of mining activity at Type B sites are tally marks, spoil piles, and occasionally casts of V-vats. These casts are rare, however, as the vats were typically dismantled and moved from shelter to shelter.

One of the requirements of the lixiviation of saltpeter from cave earth is an abundant supply of fresh water. Type A systems devised a variety of solutions to obtain water for processing the soil. At Mammoth Cave the miners installed a pump tower and complex water pipe system within the cave. At Great Saltpeter Cave, a pump tower was used to bring water from the creek below the entrance of the cave up the hill and into the cave where the leaching vats were located. Most Type B sites were located adjacent to a water supply, and water was probably transported in buckets.

How does the archaeological evidence from Saltpeter Cave compare to these models? Saltpeter Cave has a surveyed distance of over 2700 m and has passages of both walking and crawling height (Figure 2). Unlike the typical Type A caves, Saltpeter Cave does not have enormous trunk passages with ceiling heights of more than three meters. In the areas of the heaviest mining activity in this cave, the ceiling height has been reduced by nearly 60 cm due to the dumping of spoil dirt on the floor. Today the ceiling height is between 1.8 to 2.4 m. These relatively low ceilings did not allow for the construction of the large vats that are found at Mammoth Cave and Great Saltpeter Cave. On the other hand, there was more than enough room to construct vats on a slightly larger scale than those at the transient Type B rockshelter sites.

Vat types have been employed in the past as diagnostic artifact types. As noted earlier, Type A operations used primarily large, box-shaped vats that could hold tens of tons of earth, while the rockshelter operations used V-vats (De Paepe, 1985). However, the case study site, Saltpeter Cave, has a totally different type of vat (Figures 3 & 4), combining features of both Type A and Type B containers. Like Type A vats, these contain sideboards that are horizontal, rather than like the vertical board-and-batten sides of Type B vats. Like Type B vats, the water trough is placed beneath the vats, and the Carter Caves hoppers have a slight V-shape. They have an average volume of approximately one cubic meter, closer in size to type B vats than to Type A vats. However, Type B operations generally seem to have used only one or two vats per site. The primary operation at Saltpeter Cave involved more than 25 vats. Three of these represent post-1814 mining episodes. The remainder of the existing observable vats, and others that the miners subsequently buried beneath spoil dirt piles, were most likely used in pairs.

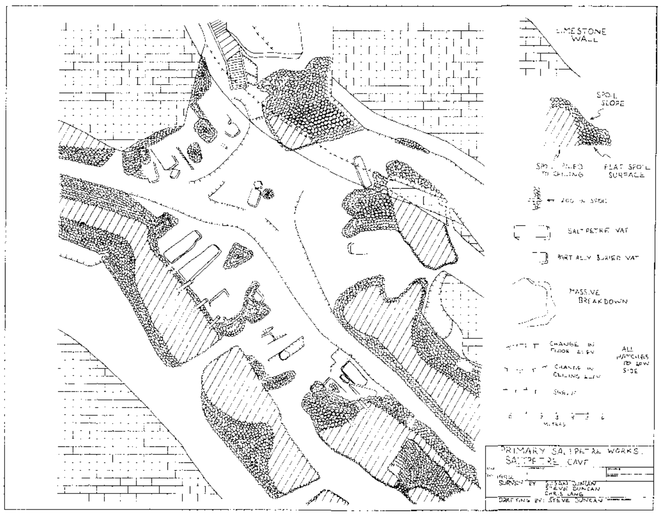

Figure 2. Map of Room A in 15Cr99, Saltpeter Cave. This is the major area of mining activity. Map by Steve Duncan.

Pairs of vats have been identified in Saltpeter Cave and the individual members seem to have been functionally related. Each half of a pair is closer to its partner than to any other vat, and its dimensions are more similar to its partner than to the rest of the vats. Each half is oriented in the same direction, while neighboring vats are placed at different angles. Finally, structural links have been found that connect the pairs. This partnership between vats is not completely understood, but the most likely hypothesis is that one vat was filled with sediments that were being leached, while fresh cave earth was being mined and placed in the second vat. This would have been made for more efficient use of the vats and of the labor involved, and would have produced a more concentrated leachate.

There are also indications of a water transport system at Saltpeter Cave that involved pipelines. Like the pairing of vats, the water transport system has not been thoroughly investigated, but it appears to have been more complex than those employed by Type B systems. Type B miners moved water from nearby streams to the vats in buckets. However, at Saltpeter Cave, the closest water source of any volume is locat-

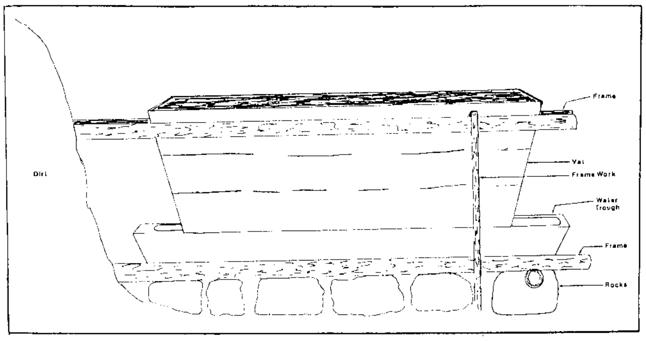

Figure 3. Side view of author's reconstruction of one leaching vat from 15Cr99, Carter Caves vat style. Artists: Paul J. Tierney and Heather Marek.

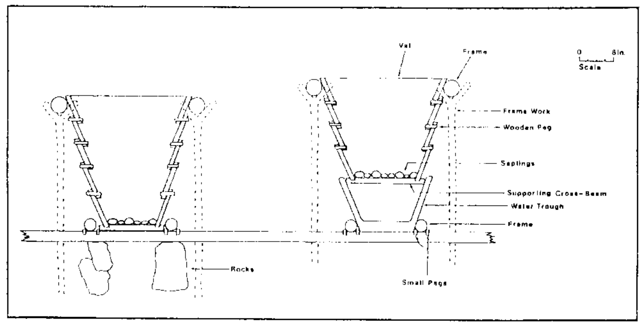

Figure 4. Cross-section of author's conception of a leaching vat pair from 15Cr99, Carter Caves vat style. Artist: Heather Marek.

ed outside and over a hill below the cave entrance. Hauling water in buckets at least 200 m uphill to the entrance and then down another 50 m to the leaching vats would have been quite expensive in terms of time, labor, and yield. There are sections of small wooden troughs or pipes that may have been used to move water uphill or through the cave. This resembles those systems used at Type A mining operations.

Saltpeter Cave was potentially one of the top two producers of saltpeter in Kentucky during the War of 1812. Mammoth Cave was the other major producer, the production at Great Saltpeter Cave having greatly diminished by 1811. Although the cave does not have the great size of Mammoth or Great Saltpeter Caves, it seems to have been a highly productive mine, based on soil analyses and comparison with the results of the 1981 mining experiments at Mammoth Cave (Eller, 1981).

At Saltpeter Cave, at least 620 cubic meters (17,200 bushels) of earth were processed. Applying the Mammoth Cave yield of between three and five pounds per bushel of cave earth (Eller, 1981) to the operation at Saltpeter Cave gives us a range of between 51,600 and 86,000 pounds (23,400 and 39,000 kg) of saltpeter. Kentucky's total production of saltpeter in 1812 was over 312,000 pounds (142,000 kg) (De Paepe and Hill, 1981). In other words, Saltpeter Cave at Carter Caves had the potential to have produced 29% of the total output in 1812, in a state that had more than 200 saltpeter caves and rockshelters. During the height of the war, saltpeter was selling for 75 cents to $1.00 a pound ($1.65 to $2.20 a kilogram). The operation at the Carter Caves Saltpeter Cave, then, could have potentially generated at least $38,000 during the War of 1812. These numbers indicate that this site was one of the highest producers of saltpeter during the War of 1812.

After the war, it appears that the mine at Saltpeter Cave changed from a major, organized industry to a small, cottage industry production system. Stated another way, it seems that there was a transition from a Type A production site to a Type B production site, as the result of a drastic change in the market. Following the conflict, the price of saltpeter dropped from between 75 cents and $1.00 per pound to 15 cents per pound (33 cents per kilogram) (Kleber, 1992). At that time, the Carter Caves area was part of a large land grant. No individuals are named in the earliest deeds, so we do not know who were the owners and/or operators of this mine. If local farmers became miners during the war, they must have been working together in a cooperative, or working for the actual owner of the mine. Once the war ended, presumably they returned home.

There are indications in the cave that limited, sporadic mining events occurred after the war. This evidence includes two V-vats that are separate and distinct from the more typical Carter Caves vats described earlier. These V-vats resemble Type B vats and they are different in size, construction, and preservation from the majority of the vats in this cave. These V-vats suggest that the local farmers-former miners-occasionally returned to the cave to mine saltpeter, presumably for their own use. This activity is suggestive of cottage industries. They could have used the saltpeter to make their own gunpowder, cure meat, pickle food, or for medicinal purposes.

So, what can we infer about 1812-era saltpeter mines as a regional industry? The evidence seems to indicate that rather than two discrete types of saltpeter production (i.e., large- and small-scale operations) each with its own specific kinds of equipment, a variety of production techniques were employed. Miners probably heard about successful techniques in other caves and adopted what seemed to best fit their specific cave environment. While saltpeter caves shared a basic production technology, the equipment and operation of each mine was unique. Production was not limited to any particular type based on the size of the cave.

I have considered archaeological evidence such as spoil dirt piles, casts of leaching vats, and wooden artifacts among other data in an attempt to understand the operation of 1812 saltpeter mines. The data exist and are still available (although conditions at each site are generally deteriorating due to modern site use). Archaeological research can be employed to gain increased awareness and understanding of the history of these caves before they are forever and irrevocably damaged. Additional research will lead us to further understanding of this early nineteenth century industry that must have drastically, if briefly, changed the economy in many rural areas of the southeastern United States.

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REFERENCES

De Paepe, D. (1985). *Gunpowder from Mammoth Cave: The Saga of Saltpeter Mining before and during the War of 1812. Kansas*. Cave Pearl Press.

De Paepe, D. (1981). Saltpeter Mining Features and Techniques. *National Speleological Society Bulletin 43*(4): 103-105.

De Paepe, D. & Hill, C.A. (1981). Historical Geography of United States Saltpeter Caves. *National Speleological Society Bulletin 43*(4): 88-93.

Duncan, M.S. (1993). *Kentucky's Saltpeter Caves: A Review and Comparison of an Early Nineteenth Century Industry*. MA thesis for the Department of Anthropology, the University of Kentucky, Lexington.

Eller, P.G. (1981). Chemical Aspects of the Conversion of Cave Nitrates to Saltpeter. *National Speleological Society Bulletin 43*(4): 106-109.

Faust, B. (1967). *Saltpeter Mining in Mammoth Cave, KY*. Louisville The Filson Club Incorporated.

Fig, D. & Knutsen, G. (1984). Niter Mining: An Incipient Industry of the Red River Gorge, Kentucky. *Proceedings of the Symposium on Ohio Valley Urban and Historic Archaeology, Volume II*. D.B. Ball & P.J. DiBlasi, (eds). Louisville: Archaeological Survey, University of Louisville.

Hill, C.A. (1992). Reply to: On the Origin of Cave Saltpeter. *National Speleological Society Bulletin 54*(1):31-32.

Hill, C.A. (1981a). Origin of Cave Saltpeter. *National Speleological Society Bulletin 43*(4): 110-126.

Hill, C.A. (1981b). Mineralogy of Cave Nitrates. *National Speleological Society Bulletin 43*(4): 127-132.

Kleber, J.E. (1992). Saltpeter Industry. *The Kentucky Encyclopedia.* Lexington. The University of Kentucky Press.

Lewis, W.C. (1992). On the Origin of Cave Saltpeter: A Second Opinion. *National Speleological Society Bulletin 54*(1): 28-30.

Munson, P.J., Tankersley, K.B., Munson, C.A. & Watson, P.J. (1989). Prehistoric Selenite and Satinspar Mining in the Mammoth Cave System, Kentucky. *Midcontinental Journal of Archaeology 14*(2): 119-145.

Prentice, G. (1983). Cottage Industries: Concepts and Implications. *Midcontinental Journal of Archaeology 8*(1): 17-48.