A PETROGRAPHIC STUDY OF MOUNDVILLE PALETTES

Cynthia Whitney, Vincas P. Steponaitis, and John J. W. Rogers

Research was conducted to determine the origin of the sandstone used to make palettes found at the Moundville site in west-central Alabama. Sandstone samples were taken from two localities: one near Tuscaloosa, Alabama, which contains an abundance of Upper Pottsville Formation sandstone; and one near Guin, Alabama, which contains an abundance of Lower Pottsville Formation sandstone. The sandstone samples were compared petrographically to artifact samples from Moundville. In terms of mineralogy, texture, and color, the Moundville palettes more closely resemble the Upper Pottsville Formation sandstone from Tuscaloosa than the Lower Pottsville Formation sandstone from Guin. This finding supports the conclusion that sandstone palettes were produced locally in the Moundville region.

The Moundville site, located on the Black Warrior River in west-central Alabama, was the major civic-ceremonial center of a Mississippian chiefdom that existed in the early second millennium AD (Knight and Steponaitis 1998). Over the years, excavations at this site have yielded many kinds of finely crafted artifacts, which are believed to have been used in ceremonial or elite contexts. Among the most distinctive of these is a class of carved and polished stone disks or "palettes," which were probably used for grinding pigments. These palettes are almost invariably made of a gray sandstone, which, based on visual comparisons, has long been thought to originate in the Pottsville Formation of northern Alabama.

Our goal here is to use petrographic techniques to compare the mineralogical composition of Moundville palettes to those of rock samples collected from the two Pottsville Formation sources that have previously been proposed. By means of this comparison, we hope to determine which source is the more likely to have been used.

Archaeologists often attempt to determine the geological sources of raw materials from which ancient artifacts were made. Geological sourcing is an important tool that helps archaeologists answer questions about artifacts, and about the people who made them (Lasca and Donahue 1990). Once the origin of the raw material is known, a solid foundation is set for consideration of broader archaeological issues, such as patterns of style, social interaction, and trade (e.g., Bishop and Canouts 1993:162-163, 168; Emerson and Hughes 2000; Findlow and Bolognese 1982:54; Steponaitis et al. 1996; Stoltman 2001; Walthall 1981).

We begin with a brief description of the artifacts that were analyzed and a discussion of the geological sources from which the stone may have been obtained. Second, we present our field and laboratory methods. Third, we summarize the results from the analyses of the artifacts and stone samples. And, finally, we discuss and interpret the results.

Background

Stone palettes found at Moundville have long been the subject of archaeological interest (Holmes 1883:277-279, 1906; Moore 1905, 1907; Steponaitis 1983; Webb and DeJarnette 1942:287-291). They are typically round, have a notched or scalloped rim, and are usually decorated on one face with three concentric lines incised just inside the circumference (Figure 1). A few rectangular specimens with similar decoration have also been found (Steponaitis 1983). The circular palettes usually measure 11-32 cm in diameter and about 1-2 cm in thickness. Many show traces of red or white pigment on

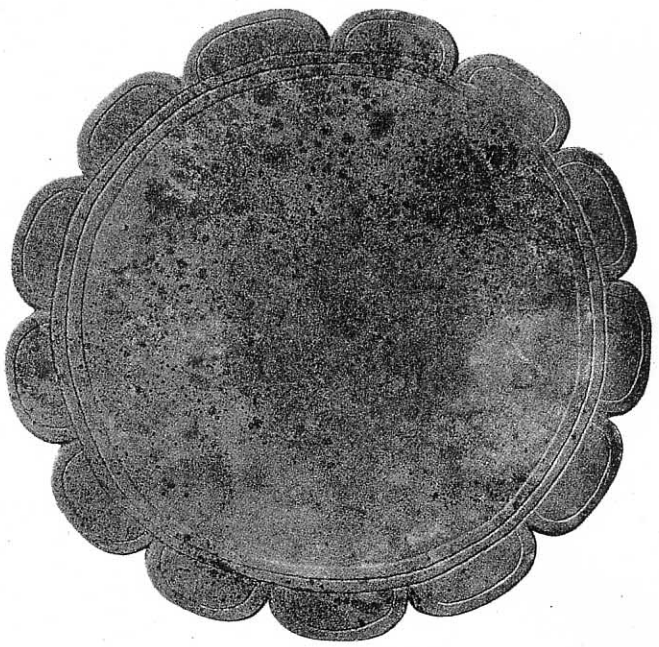


Figure 1. Sandstone palette, 26 cm in diameter, found at Moundville (reproduced from Moore 1905: Figure 19).

this face, hence their functional designation (Moore 1905: 145-147, 1907:392). Two specimens also have elaborate designs engraved on the reverse face, these being the so-called Rattlesnake Disk (Moore 1905: Figure 7) and Willoughby Disk (Moore 1905: Figures 4-5). Based on their association with mound sites and their tendency to be found in elaborate graves (Peebles and Kus 1977: 439), palettes have often been characterized as "prestige goods" (Scarry 1998:95; Welch 1991:166-169), "luxury items" (Michals 1998:178), or "elite" artifacts (Steponaitis 1992:8).

Virtually all the palettes at Moundville are made of the same material: a gray, micaceous, fine-grained sandstone. Over the years, two possible sources for this material have been proposed: (a) outcrops of the Upper Pottsville Formation at the Fall Line near Tuscaloosa, about 30 km north of Moundville; and (b) outcrops of the Lower Pottsville Formation near the town of Guin, about 110 km north of Moundville (Figure 2).

The Pottsville Formation extends in a southwesterly direction from Pennsylvania to north-central Alabama and is divided into three major basins: the Pottsville Basin in Pennsylvania, the central Appalachian Basin centered in Virginia, and the Black Warrior Basin in Alabama (Mitchum 1960:1). The Pottsville Formation in Alabama (Figure 2) is bordered on the southeast by the Appalachian Valley and Ridge province, and on the northeast by the Plateau Coal Field, "which connects the Black Warrior Basin with smaller basins in southeastern Tennessee" (Rheams 1982:1). Generally speaking, the Upper Pottsville Formation is a high constructive deltaic complex, with a shale-sandstone sequence containing thick, continuous coal seams (Horsey 1981; Rheams 1982:1; Rheams and Benson 1986:41) and "coarsening upward sequences that grade from shales ... into siltstones and fine-grained sandstones" (Raymond et al. 1988: 72). The sandstone is characterized by its gray color and mica content (Smith 1979: 31; Szabo et al. 1988). The Lower Pottsville Formation was deposited in a beach or barrier-island system (Horsey 1981; Rheams 1982:1, 5; Smith 1979:29); its sandstones are described as a "massive pebbly quartzose sandstone" (Szabo et al. 1988) or "massive, conglomeratic, orthoquartzitic sandstones interbedded with varying amounts of shale, siltstone, and thin discontinuous coals" (Raymond et al. 1988:71-72).

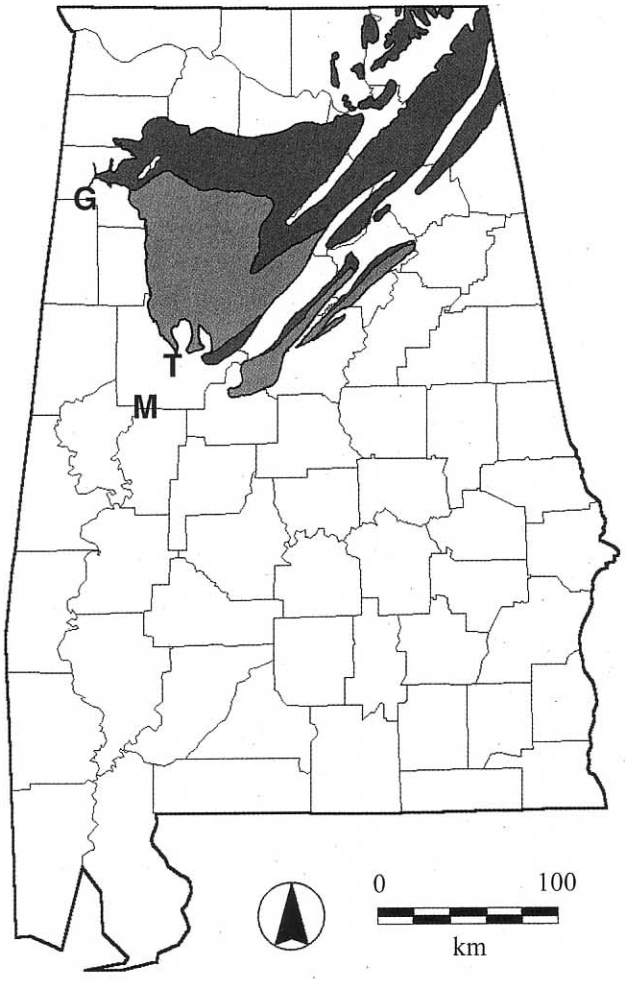


Figure 2. The Lower Pottsville Formation (dark gray) and Upper Pottsville Formation (light gray) in Alabama (after Szabo et al. 1988); M, Moundville site; T, outcrops near Tuscaloosa; G, outcrops near Guin.

The Upper Pottsville source was first suggested in the 1870s by Thomas Maxwell during an address to the Alabama Historical Society. Describing the three palettes (one of which was rectangular) that were found with a burial unearthed at Moundville in 1866, he remarked:

> *Two circular stones, 8 inches in diameter, were found beneath the head of the skeleton, and on top of these, as a pillow for his head, another stone about 20 inches long and 10 inches wide. The kind of stone was such as is found along North river, but of which there is none in the vicinity of* [Moundville] (Maxwell 1876: 70).

The North River, a tributary that enters the Black Warrior River just above the Fall Line at Tuscaloosa, flows through the Upper Pottsville Formation for its entire length (Szabo et al. 1988), so there can be little doubt of the geological deposits to which Maxwell referred. Some 60 years later, Walter B. Jones and David DeJarnette made a similar geological attribution in print. Describing the palettes found at Moundville, they wrote:

> *In this division, we have the well-known "rattlesnake" disc, beautifully fashioned from fine-grained sandstone. Stone disks and slabs are characteristic of the Moundville culture, some 80 having been recovered to date.... The discs are invariably made of sandstone, similar to material outcropping (Coal Measures formation) above Tuscaloosa, some 18 miles north of Moundville* (Jones and DeJarnette 1936:4).

The Lower Pottsville source was proposed by Amos Wright and Bart Henson (1968), based on evidence they

found in Lamar County, Alabama, at the Cantrell Mill Quarry (1Lr39), about 12 km northwest of the town of Guin—an area with an abundance of Lower Pottsville deposits (Szabo et al. 1988). The site contained a sandstone outcrop with numerous shallow, circular holes that appear to have been carved with stone tools, examples of which were found nearby. Based on the size and shape of the holes, Wright and Henson suggested that the slabs of stone cut from the outcrop might have been used to make "ceremonial disks" or palettes.

Methods

Here we describe our sandstone samples, explain how they were obtained, and outline the methods used to determine the samples' mineralogical composition.

Archaeological Samples

The six palette fragments used in this study all came from Moundville (Table 1). One fragment (Figure 3b) was found southwest of Mound M during the Depression-era excavations directed by David L. DeJarnette (Peebles et al. 1981). Another fragment (Figure 3a) was recovered north of Mound R during the 1978-1979 University of Michigan excavations directed by C. Margaret Scarry (1986). The rest were obtained during the University of Alabama's 1989-1995 mound excavations directed by Vernon J. Knight (1995): three fragments from Mound E (Figure 3c-d, f) and one from Mound Q (Figure 3e).

Geological Samples

Thirteen samples of the Upper Pottsville Formation sandstone were collected in the field by the senior author in March 1999 (Table 2; Figure 4). All are a micaceous medium-gray sandstone. Eight of these samples were taken from the vicinity of Marr's Spring, which runs from the intersection of Marr's Spring Road and Campus Drive to the Black Warrior River in Tuscaloosa; seven were taken directly from outcrops and one was float retrieved from the spring itself. In addition, four samples were collected from an outcrop along the left bank of the Black Warrior River adjacent to River Road in Tuscaloosa. Finally, one float sample was retrieved near Holt Dam in Tuscaloosa. Each sample was broken off of exposed rock with a rock hammer (in the case of outcrop samples) or picked up by hand (in the case of float samples) and labeled with a unique

Table 1. Palette samples.

Identification Number	Moundville Provenience	Catalog Number	Weight (g)	Maximum thickness (mm)	Munsell Color
P-1	Southwest of Mound M	A930.3.94	183	10	2.5Y 5/0, gray
P-2	North of Mound R	M664.1	294	25	2.5Y 6/0, gray [a]
P-3	Mound Q	A989.40.426.1	50	15	2.5Y 5/0, gray
P-4	Mound E	A993.41.1638.2	97	15	2.5Y 5/0, gray
P-5	Mound E	A993.41.2968.1	57	11	2.5Y 5/0, gray
P-6	Mound E	A993.41.3001.1	15	7	2.5Y 6/0, gray

[a] A portion of this artifact was also coded as 2.5YR 5/2, weak red. This reddish color may have resulted from post-depositional heating, a possibility supported by informal experimentation.

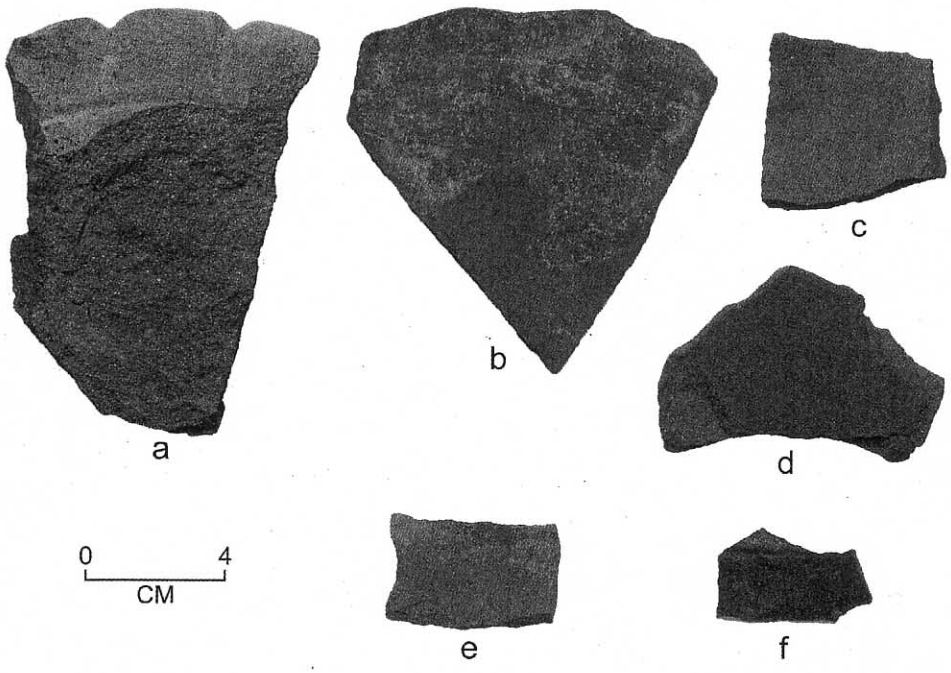


Figure 3. Palette fragments used in this study: (a) P-2, (b) P-1, (c) P-5, (d) P-4, (e) P-3, (f) P-6.

identification number. Multiple rock fragments were collected at each site. Each sampling location was tagged with orange flagging tape, marked with a spot of orange spray paint, photographed, and marked on a U.S. Geological Survey 1:24,000 topographic map for identification.

Two samples of the Lower Pottsville sandstone were collected by the second author at the Cantrell Mill Quarry in 1985 (Wright 1986). The rocks are a quartzose, pale-orange sandstone. Both samples were obtained from the surface of the outcrop in the immediate vicinity of the circular holes produced by ancient quarrying.

Table 2. Rock samples.

Identification Number	Source	Sample Context	Munsell Color
85-S1-1	Guin Quarry	Bedrock	10YR 6/6, brownish yellow
85-S1-2	Guin Quarry	Bedrock	10YR 7/6, yellow
99-S1-1	Marr's Spring	Bedrock	2.5Y 6/0, gray
99-S2-1	Marr's Spring	Bedrock	2.5Y 6/0, gray
99-S3-1	Marr's Spring	Bedrock	2.5Y 5/0, gray
99-S3-2	Marr's Spring	Bedrock	2.5Y 5/0, gray
99-S3-3a	Marr's Spring	Bedrock	2.5Y 6/0, gray
99-S3-3b	Marr's Spring	Bedrock	2.5Y 6/0, gray
99-S4-1	Marr's Spring	Bedrock	2.5Y 6/2, light brownish gray
99-S5-1	River Road	Bedrock	2.5Y 5/0, gray
99-S6-1a	River Road	Bedrock	2.5Y 6/0, gray
99-S6-1b	River Road	Bedrock	2.5Y 5/0, gray
99-S7-1	River Road	Bedrock	2.5Y 7/0, light gray
99-S8-1	Marr's Spring	Float	2.5Y 6/0, gray
99-S9-1	Holt Dam	Float	2.5Y 5/0, gray

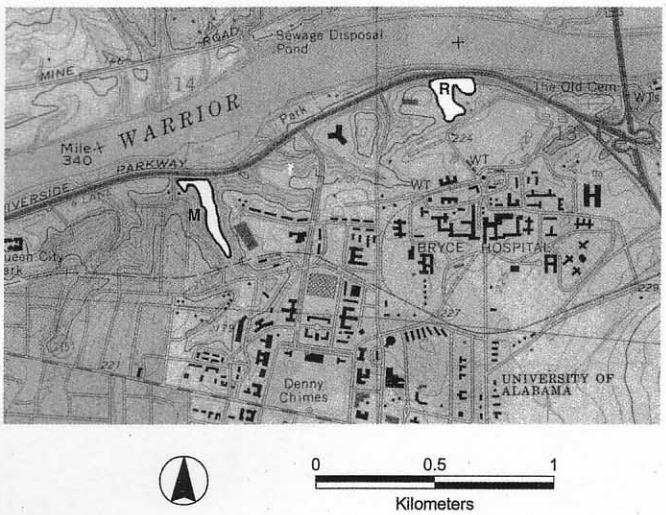


Figure 4. Localities where the Upper Pottsville Formation rock samples were collected from outcrops near Tuscaloosa: M, Marr's Spring locality; R, River Road locality (from 1:24,000 Tuscaloosa quadrangle, U.S. Geological Survey, 1983). The Holt Dam locality is off the map, approximately 10 km upstream (northeast) of the River Road locality.

Analysis

The color of each palette and rock sample was recorded using a *Munsell Soil Color Chart*. Because thin sectioning is a destructive process, the palette samples were measured for maximum thickness and weighed beforehand.

The rock and palette samples were sent to commercial laboratories for thin sectioning, and a total of 21 slides were prepared. Each thin section was examined with a petrographic microscope at 40× and 100× and point counted using a mechanical stage (Stoltman 2001:305-307). A total of 500 points were counted on each slide and minerals and matrix were identified at each point. After each slide was point counted, the slides were examined for a second time to identify mineral phases present in quantities too small to appear in the point counts. Any phase present but uncounted was labeled as "trace" mineral.

Results

The point-count data were compiled and, for each sample, the relative abundance of each phase was estimated by calculating its proportion of the total count (Table 3). The vast majority of the points counted were identified as quartz, mica, or matrix. As quartz is difficult to distinguish from feldspar unless twinning is observed, the quartz count for each slide may contain some feldspar. When twinning was observed, the mineral was identified as feldspar. Mica was easily distinguished under crossed polars because of its high birefringence and perfect cleavage; no attempt was made to distinguish between biotite and muscovite in the mica count. The matrix—all material too fine to count at 40× magnification—appeared to be a mixture of clay, iron oxide, and other fine sediments.

Other mineral phases identified included apatite, chert, chlorite, magnetite, sphene, tourmaline, and zircon. Void spaces were also counted. When a mineral could not be conclusively identified, it was counted as an "unknown."

Figures 5-7 show representative thin sections of the Moundville palettes, the Upper Pottsville samples, and the Lower Pottsville samples, respectively. Quartz (visible in all the photographs) appears as gray, angular or rounded grains. Mica (visible only in Figures 5 and 6) is represented by slender, elongated grains. Matrix largely comprises the dark background against which the aforementioned grains are visible.

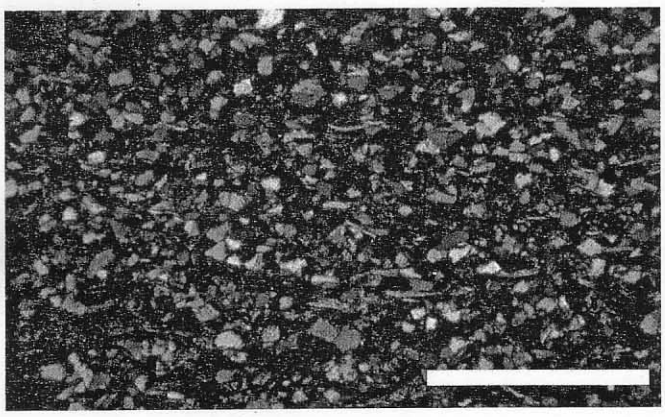
Comparisons and Conclusions

The compositional relationships among the samples are best illustrated in a ternary diagram (Figure 8) that plots the relative percentages of quartz, mica, and

Table 3. Relative abundances of mineral phases.[a]

Identification Number	Quartz[b] (%)	Mica[c] (%)	Matrix (%)	Feldspar[d] (%)	Chert (%)	Apatite (%)	Chlorite (%)	Magnetite (%)	Sphene (%)	Tourmaline (%)	Zircon (%)	Void (%)	Unknown[e] (%)
85-S1-1	61.4	2.8	34.4		T		T					1.4	T[f]
85-S2-1	69.0	2.4	28.2									0.4	
99-S1-1	60.4	16.8	19.6	0.8	2.4		T				T		
99-S2-1	58.2	18.8	21.0	0.6	1.4								
99-S3-1	54.8	20.4	24.2	T	0.6								
99-S3-2	56.0	20.0[f]	22.0	1.2	0.8								
99-S3-3a	61.8	15.8	21.4	0.4	0.6								
99-S3-3b	60.2	17.6	21.8	T	0.2		0.2						
99-S4-1	64.4	13.4	21.2	0.6	0.4								T[g]
99-S5-1	60.8	11.6	25.4	0.4	1.8						T		
99-S6-1a	66.0	14.0	17.2	1.0	1.8								
99-S6-1b	72.0	12.8	12.0	0.2	3.0								
99-S7-1	72.6	13.6	10.6	0.8	2.4								T[h]
99-S8-1	66.6	20.2	12.2	0.6	0.4						T		
99-S9-1	65.6	18.8	15.2	0.4					T				
P-1	57.6	26.6	15.4	0.2							T		0.2[i]
P-2	59.0	15.8	22.8	0.6	1.8								
P-3	63.2	24.8	12.0	T									
P-4	58.4	19.2	22.4	T						T	T		
P-5	64.8	17.2	17.4	0.6				T					
P-6	65.0	17.0	17.2	T	0.2	0.2					0.4		

[a] Percentages are estimated based on systematic counts of 500 points per sample. "T" stands for trace, meaning the mineral was observed, but did not fall in the sample of points counted.
[b] Quartz totals may include feldspars that did not exhibit twinning.
[c] Muscovite or bleached biotite.
[d] Feldspars were identified through the observation of twinning.
[e] Minerals in this column were not conclusively identified.
[f] Either mica or illite.
[g] Opaque oxide, possibly magnetite or ilmenite.
[h] Calcite or dolomite.
[i] Xenotime, monazite, or sphene.



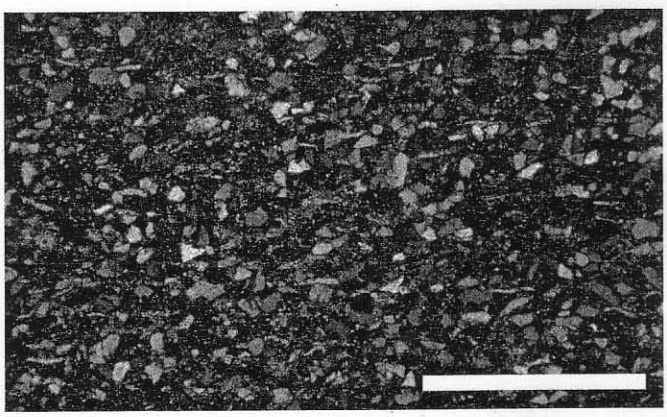
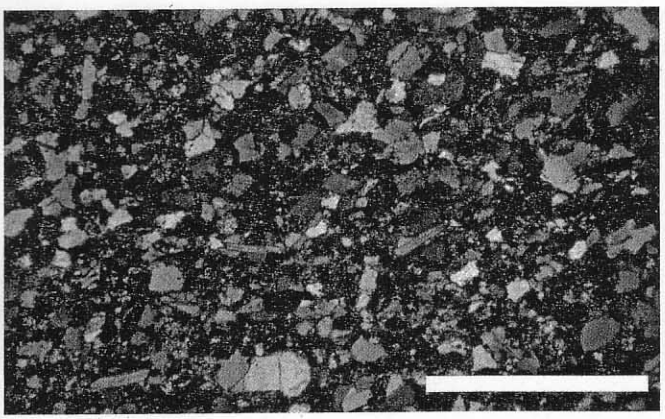


Figure 5. Thin sections of palette samples from Moundville at 40× magnification under crossed polars: (top) P-3, (bottom) P-2. Scale bar equals 1 mm.



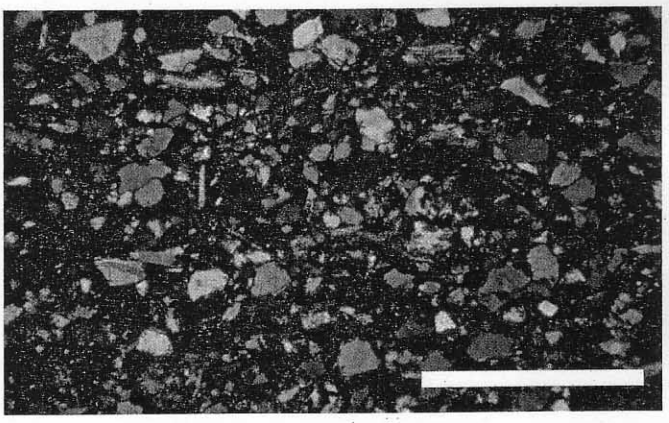


Figure 6. Thin sections of rock samples from Upper Pottsville sources at 40× magnification under crossed polars: (top) 99-S3-3a, (bottom) 99-S2-1. Scale bar equals 1 mm.

"other" (which refers to all other phases combined, but consists mostly of matrix). The Upper Pottsville Formation rock samples have virtually the same amounts of quartz (ca. 55-73%), mica (ca. 12-20%), and other phases (ca. 11-25%) as the palette samples. The Lower Pottsville samples also exhibit a similar quartz content (ca. 61-69%), but are much lower in mica (ca. 2-3%) and higher in other phases (ca. 28-34%) than the palette samples. As a result, the Upper Pottsville and palette samples form a single cluster in the center of the diagram, while the Lower Pottsville samples appear as outliers at the bottom.

A comparison of the thin-section photographs reinforces this pattern. Note that the Upper Pottsville samples (Figure 6) are virtually identical to the palettes (Figure 5) in grain size, shape, and structure. In contrast, the texture of the Lower Pottsville samples (Figure 7) is markedly coarser.

It should also be noted that the Munsell colors of the Upper Pottsville rock samples are very similar to those of the palette fragments, mostly identified as 2.5Y 5/0 or 6/0 gray (Tables 1-2). Colors of the Lower Pottsville samples were identified as 10YR 6/6 brownish yellow and 10YR 7/6 yellow (Table 2), not at all like those of the palettes.

In sum, our observations of mineralogy, texture, and color all point to the same conclusion: the Moundville palettes are indistinguishable from the Upper Pottsville samples, but substantially different from the Lower Pottsville samples. These results support the idea that the Moundville palettes were made from sandstones quarried near the Fall Line at Tuscaloosa, only 30 km north of Moundville, as originally proposed by Maxwell more than a century ago. The uses of the Lower Pottsville sandstone that was quarried near Guin remain unknown.

Of course, the Upper Pottsville Formation covers a large area that includes not only Alabama, but extends northeast into Pennsylvania. Although similar sandstones may well occur elsewhere in this large geological deposit, the striking similarities between the Tuscaloosa sandstones and the Moundville palettes, as well as the proximity of the Tuscaloosa outcrops to the center of the palettes' archaeological distribution, make it unlikely that another source would have been used by the inhabitants of the Moundville region.

All in all, this research strengthens the long-held belief that the Moundville palettes were locally produced, whether at Moundville itself or at outlying villages (cf. Johnson 2001; Johnson and Sherard 2000; Scarry 1998:95; Sherard 1999; Welch 1991:166-169).

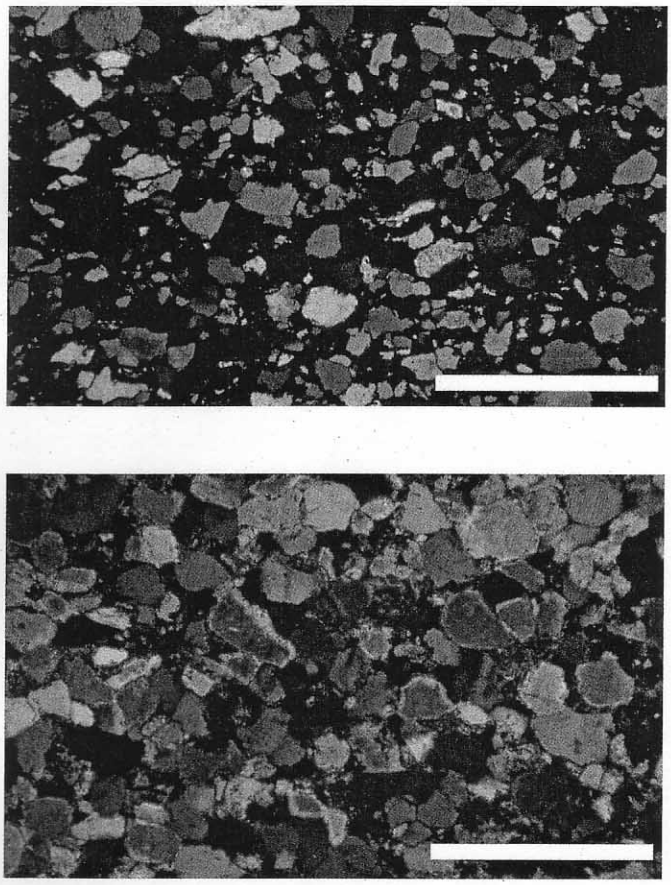


Figure 7. Thin sections of rock samples from Lower Pottsville sources at 40× magnification under crossed polars: (top) 85-S1-1, (bottom) 85-S1-2. Note that the bottom section is a bit thick, which makes the quartz grains look darker than usual. Scale bar equals 1 mm.

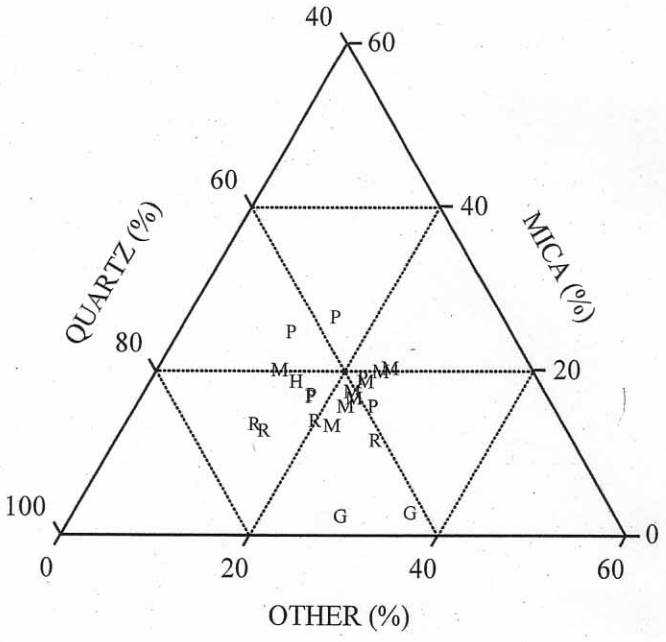


Figure 8. Ternary diagram showing percentages of mica, quartz and other phases for the analyzed palette and rock samples. The "other" category consists largely of matrix (see Table 3). Key to samples: P, palette sample; M, Marr's Spring rock sample (Upper Pottsville Formation); R, River Road rock sample (Upper Pottsville Formation); H, Holt Dam rock sample (Upper Pottsville Formation); G, Guin rock sample (Lower Pottsville Formation).

Additional work must still be done to learn how and exactly where this production took place. Even so, the finding that these palettes were likely made by local artisans has two implications. First, it adds the gray, micaceous sandstone palettes to the body of artifacts with iconographic representations that can be specifically attributed to the Moundville region, thereby better defining one of the many local styles that comprised the Southeastern Ceremonial Complex (Brain and Phillips 1996; Knight et al. 2001:129-132). Second, it lays the groundwork for studies of long-distance exchange, as palettes of this general type are known to occur at Mississippian sites from eastern Tennessee to the lower Mississippi valley (Webb and DeJarnette 1942: Figure 94). Identifying the raw materials of palettes that occur elsewhere may well reveal that many of them were made at Moundville, thereby shedding light on broader patterns of interaction across the Mississippian world.

Notes

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