A Preliminary Report of a Luminescence Date for a Hopewell Ceremonial Clay Basin from Seip-Pricer Mound

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Rediscovery of Fragments of a Hopewell Clay Basin from Seip-Pricer Mound

In late summer/early fall of 2018, while re-organizing some storage shelves within the archaeology collections at the Ohio History Connection, two large storage drawers that were covered with a thin sheet of paper were discovered on a shelf. A label written on the paper read, "Hopewell Culture Basin, AX152." The drawer was found to contain several fragments, ranging in size and shape, of a Hopewell clay basin. The fragments were reassembled on a large table and several fragments were found to be missing from the center where the basin is thinner and thus more fragile (Figure 1). The collection number on the paper covering, "AX152", was a temporary collection number assigned to these fragments, but no information as to their provenance was recorded in the available documentation. This basin clearly had been excavated with care from one of the Hopewell mound sites investigated by the Ohio History Connection and brought back to the museum presumably for display purposes.

The details of whether, when, or how this basin may have been put on display are unclear, but displaying Hopewell clay basins was not uncommon. As examination of published literature and unpublished field notes associated with known Hopewell sites, especially in Ross County (Greber 1983; Greber and Ruhl 2000; Mills 1907, 1922; Moorehead 1897, 1922; Shetrone 1922-1925, 1926, 2004 [1930]; Shetrone and Greenman 1931; Shetrone et al. 1925-1928), revealed that at least by the 1890s, such basins often were being removed for display purposes. It is possible that this basin was displayed at one time in one of the exhibitions at the Ohio State Museum. It is the only surviving example of a Hopewell clay basin in the collections of the Ohio History Connection.

Two Hopewell clay basins excavated by Warren K. Moorehead at the Hopewell Mound Group were placed on public display as recorded in this excerpt from the 1893 *Daily Inter Ocean* article "Noted Ohio Mounds": "two burned clay altars are here among the prehistoric remains. They are in cases with glass covers. Several were found; one was lost by breaking in transit, another went to the Smithsonian, and these two are at The Fair [1893 World's Columbian

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Figure 1. Reassembled fragments of the Hopewell clay basin determined to be from Basin #2 at the Seip-Pricer Mound.

Exposition]. These altars were filled with copper, bones, shells, clay, mica, and various stone relics." William C. Mills and Henry C. Shetrone continued this practice during their excavations at the Edwin Harness Mound (Mills 1907), Mound City Group (Mills 1922), Hopewell Mound Group (Shetrone 1926), and Seip-Pricer Mound (Shetrone and Greenman 1931).

Comparison of the reassembled clay basin fragments with published photographs of basins known to have been removed from Hopewell mound excavations provided the basis for establishing its provenance. Published examples included clay basins from Moorehead's Mound 18 at Hopewell Mound Group (1897:154, Figure III), Mound 8 at the Mound City Group (Mills 1922:437, Figure 5), and Shetrone's Mound 26 at Hopewell Mound Group (1926:106, Figure 38).

We determined that Basin #2 at the Seip-Pricer Mound (Figures 2 and 3) provided the best match for the reassembled clay basin. According to Shetrone and Greenman (1931:365-366), Basin #2 was "the smallest ever found in Ohio" at "19 by 26 inches, four inches deep." They described it as "very beautifully made" and indicated it had been "removed intact and taken to the Museum" (Shetrone and Greenman 1931:365-366). These measurements, along with the description, closely match the reassembled fragments of the rediscovered clay basin.

The rediscovery and identification of fragments of a Hopewell clay basin afforded the opportunity to contribute to our knowledge of the age and duration of cultural activities at a major Hopewell ceremonial earthwork. The Seip-Pricer Mound (Figure 2) is the dominant

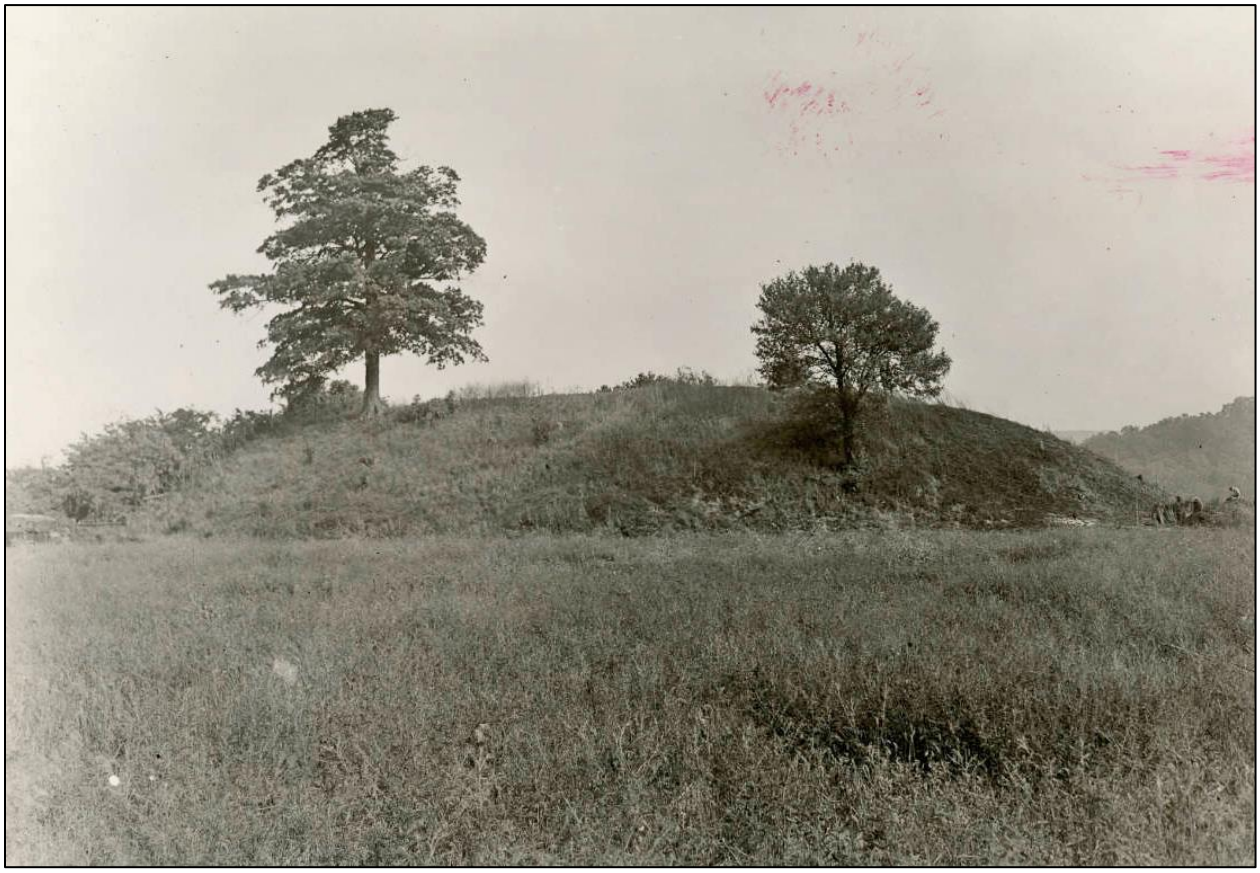

Figure 2. Seip-Pricer Mound as it appeared prior to its excavation. Ohio History Connection, AV17, B04, F03e01, 08, 1178.

feature of the Seip Earthworks, one component of Hopewell Cultural National Historical Park and one of eight sites encompassed in the Hopewell Ceremonial Earthworks, which is on the United States' Tentative List of sites being considered for nomination to the UNESCO World Heritage List. The clay basin was not associated with organic material that could have provided a radiocarbon date, but the burned clay itself potentially could be dated through luminescence dating.

Luminescence Date for a Seip-Pricer Clay Basin

Luminescence dating is based on the accumulation of stored energy in minerals such as quartz and feldspar as a function of natural radioactivity. This energy is released upon exposure to sufficient heat or sunlight, and some of this released energy is in the form of light called luminescence. The intensity of the luminescence is proportional to the amount of stored energy which is in turn proportional to the amount of absorbed radioactivity since the time of last heating or sunlight exposure. To date this "zeroing event", the intensity of the luminescence must

be calibrated against laboratory dose, a quantity called equivalent dose, which can be thought of as the amount of radiation necessary to produce the observed luminescence. Dividing the equivalent dose by the rate at which dose is absorbed, or the radioactivity, yields an age in calendar years.

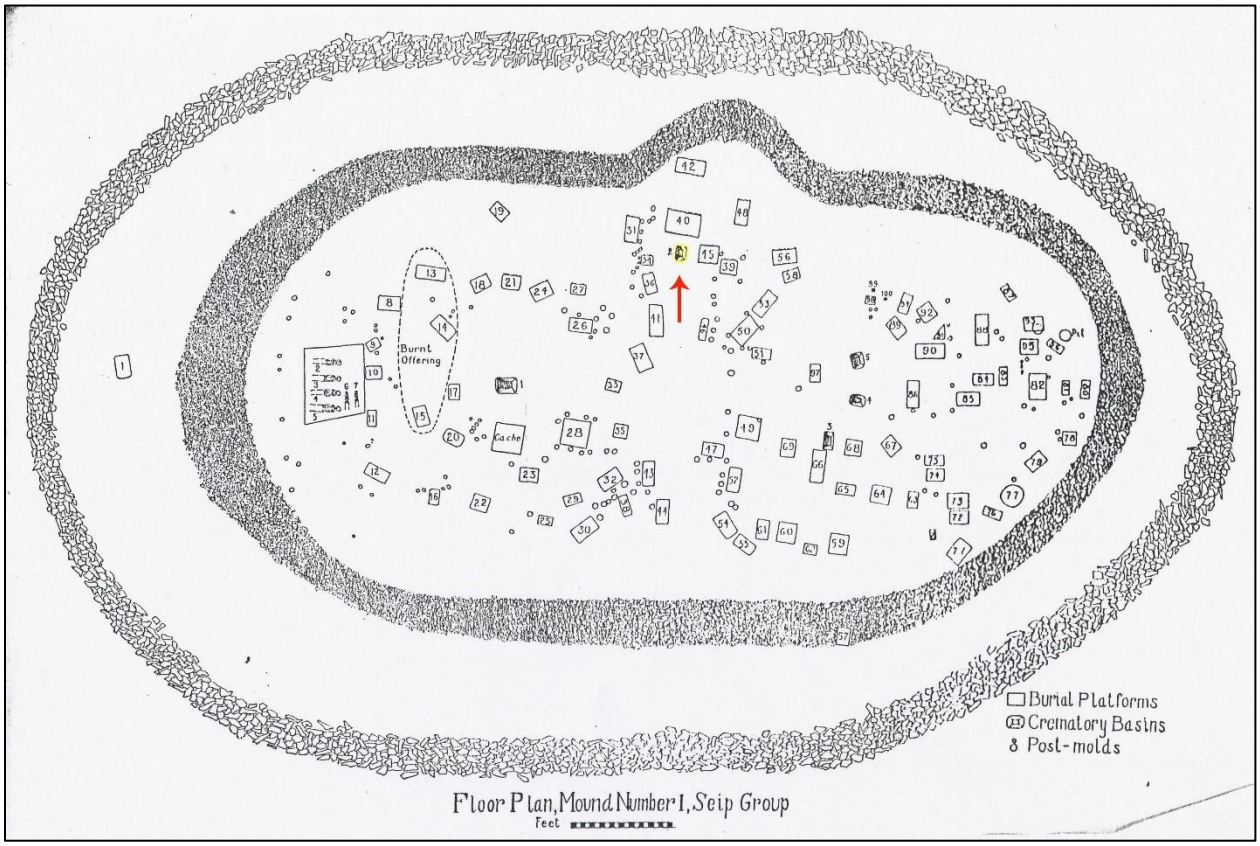

Figure 3. The floor plan of the Seip-Pricer Mound ("Mound Number 1") showing the location of Basin #2 (Shetrone and Greenman 1931)

Methods

The clay basin was heated high enough to become a ceramic, which means it would not return to clay upon exposure to water. This much heat is sufficient to reset the luminescence signal, so the time when the basin was heated can be dated. Presumably this was just prior to the construction of the mound over it.

A piece of the basin was sent to the Luminescence Dating Laboratory at the University of Washington. After removing all light-exposed parts of the piece, the remainder was crushed and sieved to obtain the 180-212 µm size fraction. Extracts of both quartz and potassium feldspar were isolated from this fraction chemically. It was not known at the outset which of these would be most suitable for dating, so both were analyzed. Because they have different luminescence properties, agreement in age between the two will lend confidence to the results. Measurement of luminescence was on single grains, meaning that an equivalent dose value was obtained for each

grain. This can be done on hundreds of grains by employing a finely focused laser to stimulate the luminescence signal.

Quartz was stimulated by a green laser and the resulting luminescence was measured in the ultraviolet. Potassium feldspar was stimulated by an infrared laser and the resulting Luminescence was measured in the blue. About 400 grains were measured for quartz and 200 grains for feldspar.

Results

Of the 400 grains measured for quartz, 74 yielded a measurable signal. Statistical analysis of the equivalent dose values from each grain showed that 95% of them were consistent with a single value, which would be expected for material that was uniformly heated. A weighted average of these values gave an equivalent dose of 5.9 ± 0.3 Gy. (Gy stands for gray, the international unit for absorbed dose.)

Of the 200 grains measured for potassium feldspar, 98 yielded a measurable signal. Feldspar is more sensitive to luminescence than quartz, but it suffers from an athermal loss of signal through time, called anomalous fading. This has to be corrected through application of a fading test in the laboratory. This test was conducted on each grain, so that a corrected age was obtained for each grain. The average equivalent dose was 5.3 ± 0.3 Gy. The average fading rate was 4.1 ± 0.4 %/decade (where a decade is a power of 10). Of the corrected ages, more than 97% were consistent with a single value.

Natural radioactivity consists of contributions from trace amounts of uranium, thorium, and ^{40}K and to a small degree from cosmic radiation. Because of their long half-lives, the concentration of these is nearly constant over time, unless some geological process interferes, which is not likely in a closed system like a ceramic. The concentrations were measured by alpha counting for U and Th and flame photometry for K. Additional measurements using beta counting will be conducted in the future. The cosmic radiation dose was estimated from global values, but its contribution is negligible given the thickness of the mound. It was assumed that all the terrestrial radioactivity stemmed from the clay basin itself, which is not exactly true, but given its thickness it is mostly true and we did not have available any sample of the adjacent sediment to measure the small amount that might originate from there. For the potassium feldspars there is also an internal contribution to the dose rate from ^{40}K, which we assumed to be 12 ± 3%. The resulting dose rate was 3.1 ± 0.1 Gy/ka for quartz and 3.9 ± 0.2 Gy/ka for feldspar.

The resulting ages are 1.90 ± 0.13 ka (or AD 120 ± 130) for quartz and 1.92 ± 0.11 ka (or AD 100 ± 110) for feldspar. These not only closely agree but are within the range of radiocarbon dates previously obtained for Seip-Pricer Mound (Table 1). These ages should be considered preliminary estimations. Additional work is planned to confirm them.

Table 1. Chronometric dates for Seip-Pricer Mound

Context	^{14}C Date BP	Date BC/AD*	Lab number	Reference
Clay basin luminescence date	1920 ± 110	AD 100 ± 110	UW3885 (feldspar)	Feathers (this report)
Clay basin luminescence date	1900 ± 130	AD 120 ± 130	UW3885 (quartz)	Feathers (this report)
"Seip Mound 1"	1840 ± 100	cal AD 120 ± 120	UCLA-292	Griffin (1965:125);
Textile from Seip-Pricer Mound A957/218306	1830 ± 35	cal AD 185 ± 50	CAMS-168012	Armitage and Jakes (2016), Table 1
Burial 32	1650 ± 30	cal AD 400 ± 50	Beta-142076	Greber (2003:102, Table 6.1)
Burial 16	1640 ± 40	cal AD 420 ± 60	Beta-142075	Greber (2003:102, Table 6.1)

* Oxcal ^{14}C calibration provided by Kevin Nolan.

Conclusions

These results indicate that luminescence dating can be successfully applied to burned clay basins; and should similar basins be identified in museum collections, or encountered in reinvestigations of the floors of previously excavated and restored Hopewell mounds (as suggested by Mark Lynott, quoted in Lepper 2015: x), they can be potential sources of dates for the terminal uses of these features. Given that the luminescence date relates directly to the final use of the clay basin prior to its decommissioning and burial, the resulting date theoretically provides a high level of precision in dating this episode of burning, which likely either preceded the construction of the Seip-Pricer Big House or followed its dismantling since the wooden structure presumably could have been set afire by its proximity to such intense fires burning within its walls. In either case, this new luminescence date adds to our understanding of the chronological placement of the Seip-Pricer Mound in the timeline of the Hopewell culture.

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