AN ANALYSIS OF OBSIDIAN AND OTHER ARCHAEOLOGICAL MATERIALS FROM THE SOUTHEAST PORTION OF NEELYS BEND ON THE CUMBERLAND RIVER, DAVIDSON COUNTY, TENNESSEE

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During the late 1930s, Kenneth Brown collected artifacts near his home in Neelys Bend along the Cumberland River in Davidson County, Tennessee. His collection included a number of Paleoindian and other temporally identifiable projectile points, as well as a Nashville Style marine shell gorget. The collection also contained the medial section of an obsidian projectile point. Analysis identified the obsidian source as Obsidian Cliff in Wyoming.

Mr. Kenneth Brown collected archaeological material near his home in Neelys Bend from approximately 1935 to 1940. Neelys Bend comprises a large meander loop of the Cumberland River northeast of Nashville in Davidson County, Tennessee (Figure 1). Mr. Brown's nephew, Mr. Stan Duke, received the collection from his uncle and contacted the Frank H. McClung Museum about documenting the collection for research purposes.

The authors examined the collection and observed several artifacts important to Tennessee's prehistory. Among the numerous temporally diagnostic projectile points in the collection were three Paleoindian projectile points (Figure 2). Mississippian period artifacts were present as well, including a duck effigy bowl, notched-rim bowl, small ceramic figurine, ceramic earplug, and a Nashville Style marine shell gorget (Figures 3-7).

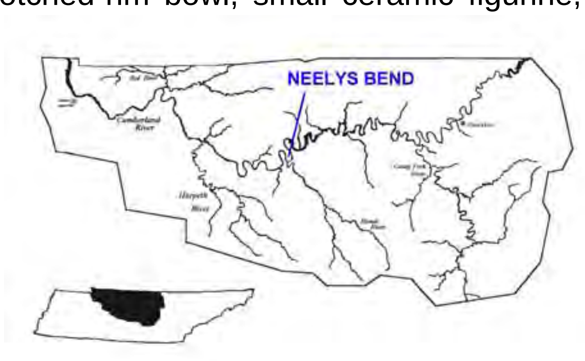

FIGURE 1. Location map of Neelys Bend on the Cumberland River.

The collection also contained a projectile point/knife fragment of obsidian. Obsidian, a non-local volcanic glass, occurs in the western United States, Mexico, and other regions. Obsidian artifacts are rare in Tennessee. Only a few previously recorded examples of obsidian are known in the state of Tennessee (Norton 2005).

The Collection: Contents and Context

Sixteen archaeological sites are recorded within the southern portion of Neelys Bend. Ten of these sites occur within one mile of Mr. Brown's house, with the remaining six located within 1.6 miles of his home. An archaeological survey of the general study area was conducted for proposed landfill construction on the southern portion of Neelys Bend (Taylor 1989). This survey identified 15 of the 16 sites recorded in the southern portion of Neelys Bend. This survey was based solely on surface collections in plowed fields and exposed or eroded surfaces. Many of these sites were limited to a few historic or prehistoric artifacts, but Taylor noted the potential for intact, deeply stratified archaeological deposits and large numbers of human burials in Neelys Bend.

FIGURE 2. Paleoindian projectile points, from left to right: Clovis; Clovis; Cumberland.

FIGURE 3. Duck effigy bowl, top and profile views.

FIGURE 4. Bowl with notched appliqué rim strip, top and profile views.

FIGURE 5. Ceramic figurine and other effigy fragments.

FIGURE 6. Ceramic earplug.

FIGURE 7. Nashville Style marine shell gorget.

FIGURE 8. Obsidian projectile point fragment.

Site 40DV194, identified as early as 1935 by the Works Progress Administration, represents the final site recorded for the southern portion of Neelys Bend. The Tennessee state site files list 40DV194 as a stone box cemetery and possible burial mound. Based upon conversations with Mr. Brown, this particular site area is likely the original location for materials in the collection.

The collection consists of 455 artifacts. Lithic materials (*n*=442) comprise the bulk of the collection and include both chipped stone (*n*=422) and ground stone (*n*=20) specimens. Projectile points/knives (*n*=349) are the most common chipped stone tool, followed by smaller amounts of drills, scrapers, and other bifacial tools. Shell-tempered ceramics (*n*=10) are the second most frequent material class, followed by bone (*n*=2) and shell (*n*=1). The ceramic artifacts include a duck effigy bowl, notched rim bowl, four sherds, a figurine, and an earplug.

Obsidian in Tennessee?

A single obsidian projectile point/ knife fragment was recorded in the collection (Figure 8). Obsidian is a fine-grained, amorphous, volcanic glass formed by the solidification of silica-rich magma (Carmichael et al. 1974). The homogenous character of obsidian results in prominent conchoidal fractures, making it an ideal choice for the manufacture of prehistoric chipped stone tools. The obsidian piece in the collection was sent to Northwest Obsidian Research Laboratory in Corvallis, Oregon for x-ray florescence (XRF) and obsidian hydration analysis (Skinner and Thatcher 2008).

XRF is a chemical sourcing technique where lithic samples are irradiated with X-rays that produce secondarily emitted X-rays characteristic of a particular element (Kooyman 2000:177). The material origin can then be determined by comparing the elemental composition of the artifact sam-

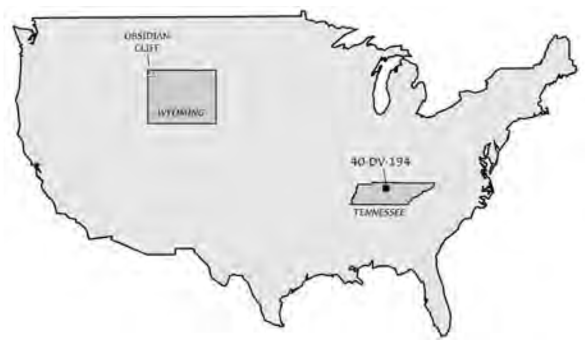

FIGURE 9. Location map of site 40DV194 and the Obsidian Cliff source in Wyoming (Skinner and Thatcher 2008)

ple with that of samples collected from known source locations. The obsidian from Neelys Bend was sourced to Obsidian Cliff, Wyoming (Skinner and Thatcher 2008:2) located in present day Yellowstone National Park (Figure 9).

Obsidian hydration (OH) analysis, an absolute dating method first proposed by Friedman and Smith (1960), measures the hydration rind of the artifact. The exposed surface portions of obsidian artifacts absorb water, resulting in visible rims that can be measured and used as a calculation of the artifact age (Riciputi et al. 2002). This measurement, based on absorbed moisture relative to a diffusion front, is measured under polarized light.

Two basic types of OH dating exist. The simplest form, referred to as empirical-rate dating, correlates the width of the optically measured hydration rim with independent chronometric data such as ^{14}C dates (Riciputi et al. 2002:1056). The second and most widely used form of OH dating is a more complex technique known as intrinsic-rate dating. This fully independent chronometric method requires experimentally determined rate constants and a measure of site temperature (Riciputi et al. 2002:1056). The hydration process over time is extremely complex and many problems exist in the intrinsic-rate method when experimental data are not available (Anovitz et al. 1999; Beck and Jones 2000). The absorption rate of the artifact is affected by numerous factors including, but not limited to, geologic context, chemical composition of the sample, temperature, and relative humidity. Numerous hydration rate equations exist, but these variables have not been adequately explored in Tennessee, as well as most of the eastern United States.

The hydration rim measurement for the Neelys Bend specimen is 6.2 +/- .01 microns. Based on general data, this result would place this piece within the Archaic period. However, the authors feel that due to severe limitations with intrinsic-rate OH dating in the region, this result, as well as others (using similar methods) should be taken with great skepticism. While OH dates are wonderful in theory, many factors have to be considered before discussing them in terms of the southeast United States. Some of these limitations are briefly presented below.

Absolute dating methods, such as OH dating, require precise methods. Error in assigning absolute dates to intrinsic-rate OH samples lies in four fundamental methodological shortcomings. The first, a procedural error, stems from measurement technique. Sample measurement with an optical microscope (like the value reported here) versus other more accurate techniques such as Secondary Ion Mass Spectrometry (or SIMS) have been show to vary as much as 0.8 microns and over 1000 years (Riciputi et al. 2002:1069). Furthermore, many of the optically measured samples from Chalco were older than ^{14}C controls (Riciputi et al. 2002:1069). Much of the improvement in error using SIMS has resulted from the work of Anovitz et al. (1999), which identified several measurement factors complicating the traditional optical method.

Additional factors in intrinsic-rate OH dating stem from mathematical shortcomings of formula variable assumptions. These three values include soil temperature, relative humidity, and diffusion rate of the obsidian. Diffusion is a complex function that can be modeled mathematically by time, temperature, hydration rate, and other variables with fewer effects. If we know the diffusion measurement, other variables can be substituted to solve for time (or age of the artifact). Prehistoric temperature reconstructions for soil temperature are unknown at this time, but studying paleoclimatic changes through time and extrapolating these to known current temperatures would be beneficial. This variable, however, becomes circular when solving the equation. To assign a value for soil temperature at time x has invoked a temporal moment in which we are trying to solve for. Inversely, recent research has used OH to calculate paleoclimate when all other variables are controlled (Anovitz et al. 2006).

Relative humidity has been shown to affect the hydration rate of obsidian artifacts. This overall effect has recently been shown to be rather small (Anovitz et al. 2006:5661), but attention must still be given to this value in the equation. The final mathematical error to be discussed is the diffusion rate of obsidian. Many types of obsidian exist, each with its own hydration rate. To accurately estimate the age of an artifact using the intrinsic-rate method, hydration rate data must be determined experimentally. Anovitz et al. (2004) determined this rate for Pachuca obsidian from Mexico. No known similar studies have been carried out on obsidian recovered in the southeast United States. The date for the Neelys Bend projectile point/knife fragment in the Brown collection would have to be calculated using a diffusion rate for this particular source in Wyoming. Other factors exist as well, but these three in conjunction with measurement are the primary errors that must be accounted for.

Conclusions

Obsidian, while rare, has previously been documented in Tennessee and the southeast (Norton 2005). The recovery of a specimen on Neelys Bend in Davidson County, Tennessee and sourced to Wyoming suggests extensive trade distance. While undoubtedly of prehistoric origin (based on the sizeable hydration rim), the OH dating of this sample is seen as preliminary. As previously discussed, many errors are involved in assigning absolute dates to artifacts using OH dating. The combination of potential procedural and mathematical errors in intrinsic-rate dating may skew the dating of an artifact by thousands of years. Any intrinsic-rate OH dating must proceed carefully when mathematically modeling the diffusion process with respect to the three variables pointed out (soil temperature, relative humidity, and hydration rate of specific obsidian types). Empirical-rate OH dating, using multiple samples from multiple levels coupled with traditional ^{14}C dating, is more applicable. This method, however ideal, is improbable in the region due to the lack of multiple obsidian samples from a single site. Possible future directions for OH dating in the region should focus on modeling, as accurate as possible, the mathematical variables discussed and subjecting archaeological samples to Secondary Ion Mass Spectrometry (SIMS) rather than traditional optical measurement.

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