

Why Radiocarbon Dates on Bulk Sediment from Serpent Mound Are Problematic

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In 2011, Edward Herrmann and colleagues (2014:119) collected 18 “continuous solid-earth cores” from various points along Serpent Mound from which they extracted small sediment samples for dating purposes. The samples included material from what they asserted was a buried A horizon as well as material incorporated into the mound fill. The resulting dates on “organic sediment” (actually soil humates) ranged from 2320 ± 30 B.P. (Beta-337168) to 2170 ± 30 B.P. (Beta-337163) for the supposed paleosol (2014:119). Samples from the mound fill yielded a similar range of from 2530 ± 80 B.P. (Beta-337136) to 2180 ± 30 B.P. (Beta-337167) (Herrmann et al. 2014:119).

Based on these data, Herrmann and colleagues (2014:124) concluded that Serpent Mound was “initially constructed 2,300 years ago during the Early Woodland (Adena) period.” They cited the “complete lack of post-Adena charcoal” in the soil cores they analyzed as “the strongest evidence for when the submound paleosol was buried and Serpent Mound construction began” (Herrmann et al. 2014:124).

In a series of responses to these claims, Lepper and various colleagues have disputed the conclusion that the dates reported by Herrmann and colleagues provide an accurate determination of the age of Serpent Mound (Lepper 2018, 2020; Lepper et al. 2018; Lepper et al. 2019). These arguments need not be repeated here, but recent research on the difficulties with obtaining accurate radiocarbon dates for burial mounds in Denmark independently validates the arguments of Lepper and colleagues and clarifies the nature of the problems with dates obtained on bulk sediment extracted from soil cores taken from mounds.

Peter Steen Henriksen, Sande Holst, and Henrik Breuning-Madsen (2019) obtained radiocarbon dates on charcoal extracted from soil cores taken from the “lower parts” of 18 mounds in Denmark in order to determine their chronological relationships. Their results are instructive for evaluating Herrmann and colleagues’ claims. All but one of the samples produced ages that were unexpectedly old. In an effort to understand the anomalously early dates, they used the same procedures to obtain new dates for mounds that already had been dated by more reliable means. For example, one mound had been dated with dendrochronology to AD 970-971, whereas the charcoal extracted from the soil core “gave a date that was 550-700 years older” (Henriksen et al. 2019:174). In another case, the charcoal from the soil core yielded an age that was “around 3000 years older than that of a charcoal sample from the funeral pyre at the base of the mound” (Henriksen et al. 2019:174-175).

Henriksen and colleagues (2019:177) concluded that “charcoal from turf layers... cannot be used for secure dating,” because “charcoal can survive in the very topmost soil layer for

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thousands of years, unaffected by frost, tillage, etc.” This research makes it clear that radiocarbon dates on charcoal, or soil humates, from bulk sediment cores extracted from Serpent Mound, whether from a buried A horizon or from a surface from which the A horizon had been stripped, are very likely to yield dates much older than the actual age of mound construction.

Henriksen and colleagues’ data (2019:177) also provide a possible explanation for the apparent consistency in the radiocarbon dates Herrmann and colleagues obtained from across Serpent Mound. They observed that “large amounts of charcoal produced through burning of vegetation” can dominate the pool of charcoal in the upper soil layers for following millennia” (Henriksen et al. 2019:177). Therefore, assuming for the sake of argument that the Fort Ancient culture built Serpent Mound, if the Adena had burned off the vegetation of a large portion of the Serpent Mound bluff during their occupation of the site, then charcoal produced during that burning episode still could have dominated the pool of charcoal in the upper soil layers when the Fort Ancient culture occupied the site a thousand years later. Even if the Fort Ancient culture also used burning to clear the landscape prior to constructing the serpent effigy, Putnam (1890:875) observed that the upper, organic-rich layer of dark topsoil had been removed prior to the initiation of mound construction. This would have removed all or much of the charred material from what would become the surface on which Serpent Mound was constructed. As a result, whatever residual charcoal remained in the truncated soil profile would likely date to the Adena occupation.

Of course Herrmann and colleagues obtained their dates on soil humates, not charcoal, so there are additional reasons for concern regarding their attempts to apply the resulting dates to the original construction of Serpent Mound. Astrid Strunk and colleagues (2020) explain that “the radiocarbon contained in bulk sediment samples originates from allochthonous and autochthonous organic carbon sources all potentially integrating over different time scales”; and dates obtained on this material “frequently yield ages clearly exceeding the depositional timeframe...” (Strunk et al. 2020:1). They note that “while the cause for too-old bulk (humic fraction) ages is well established – namely influence of older carbon remobilized from the catchment and/or adhering to sediment grains – it remains unresolved how to avoid erroneous dates....” (Strunk et al. 2020:2). They propose a number of ways to increase the reliability of radiocarbon dates on bulk sediment samples, including “addressing which sample fraction was used for dating (humic, fulvic, humin, or all)” (Strunk et al. 2020:11). As Thomas Stafford concluded in his report on the age of the Wilson-Leonard site, accurately dating bulk sediment or soils is an extremely difficult and complicated process:

“...geophysical idiosyncrasies at each site might preclude dating any chemical fraction, or a nontypical chemical fraction might be required, for example fulvic acids instead of humic acids or humins. The appropriate chemical fraction for each stratum cannot be identified until initial radiocarbon experiments are completed on the sediments or soils” (Stafford 1998:1065).

None of these issues appear to have been appreciated by Herrmann and colleagues. Therefore, as they originally concluded, the radiocarbon dates they obtained on bulk sediment

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from Serpent Mound can demonstrate only that Serpent Mound “could have been constructed any time *after* 300 BC” (Herrmann et al. 2014:121; emphasis added). And the work of Henriksen and colleagues (2019) suggests the actual age of construction could be several hundred or even a thousand years after that date.

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