The Wauseon Clovis fluted point preform, Northwest Ohio, U.S.A.: Observations, geometric morphometrics, microwear, and toolstone procurement distance

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ABSTRACT

A Clovis fluted projectile point preform was discovered in 2006 from a freshly plowed farm field northwest of Wauseon in Fulton County, Ohio. We present here observations of the specimen’s flake-scar patterning and production, geometric morphometrics, microwear, as well as visual raw material identifications and straight-line and least-cost stone source distances. Overall, our examination is consistent with two hypotheses. First, central Ohio toolstones served as an important Clovis raw material for the northwesterly tri-state area of Ohio, Indiana, and Michigan, more than 230 km away. Second, Clovis colonizers of the Lower Great Lakes geared up and prepared well enough that they could afford to discard an unbroken, sizable specimen such as the Wauseon Clovis preform. We conclude with a possible explanation for why the preform was discarded.

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1. Introduction

A Clovis fluted projectile point preform (Fig. 1) was collected in 2006 from a freshly plowed farm field located approximately 10.5 km northwest of Wauseon in Fulton County, Ohio (41°38.062′ N, 84°11.403′ W) (Fig. 2). Also found in the vicinity were four other projectile points: one MacCorkle Stemmed and one Kirk Corner Notched (Early Archaic); one crudely-made side-notched point (Late Archaic); and one Kramer point (Early Woodland) (Justice, 1987). Specifically, these items were found in the same farm field, but not in direct association with each other. Images of these points were initially shown to B. Redmond by A. Hall, who subsequently acquired the Clovis preform from the former landowner and donated it to the Dept. of Archaeology, Cleveland Museum of Natural History in 2015.

2. The Wauseon Clovis preform description and morphometrics

Visual observations of the preform’s morphology and flake scars are consistent with current understanding of Clovis point variability, as is its size (36.9 g) and interlandmark morphometric distances and ratios (Length = 8.9 mm; Medial Width = 2.8 mm; Medial Thickness = 0.7 mm; Length:Width Ratio = 3.2; Width:Thickness Ratio = 4.0; Length:Thickness Ratio = 12.7) (Bradley et al., 2010; Eren and Buchanan, 2016; Miller et al., 2013; Patten, 2005; Smallwood, 2010; Smallwood and Jennings, 2015; Tankersley, 1989; Waters et al., 2011). There are several overface flake scars that extend from the bifacial edge to beyond the preform’s midline (Smallwood, 2010; Eren et al., 2013, 2014). Some portions of the lateral edges are smooth, likely the result of edge platform grinding. The preform’s basal edge exhibits a “nipple,” a prepared platform presumably for fluting. Fluting nipples have been found on preforms from other Clovis sites, such as Thunderbird (Virginia, Carr et al., 2013:199), Debra Friedkin (Texas, Waters et al., 2011:96), Gainey (Michigan, Morrow, 2015:96), Adams (Kentucky, Sanders, 1990:93, 98-99), among others. However, on these latter examples the nipple is preserved because during the act of fluting a crack failed to initiate at the platform and instead the
points broke in half. The Wauseon Clovis preform, however, is unbroken. Further, the nipple possesses a projecting “spur” (also known as “triangular area” or “triangle”) (Fig. 3), and such items have been suggested to cause vesse fractures or other fatal production failures when struck (Miller, 2006; Bradley et al., 2010:96). So it is all the more surprising that the Wauseon Clovis point preform both possesses a nipple and is intact. From these observations we can infer that no attempt at striking a flute from the preform had been made by a prehistoric knapper.

The Wauseon Clovis preform possesses a single beveled lateral edge (Fig. 4), which to our knowledge is a morphological feature not necessarily consistent with Clovis biface variability. Beveled edges do occur on bifaces from later temporal periods, for example Harahay knives from the Late Prehistoric period of the North American Plains (Creel, 1991; Sollberger, 1971), or Early Archaic projectile points such as Dalton, Hardin Barbed, Thebes, Lost Lake, St. Charles, Decatur, and Rice Lobed (Lipo et al., 2012; Pettigrew et al., 2015). Given this incongruous element on the preform, we conducted a geometric morphometric assessment of the specimen’s plan view shape to determine if it fell within the range of known shape variability of Clovis points.

Geometric morphometrics (GM) is different from traditional morphometrics in that it utilizes coordinate data associated with landmarks defined on objects rather than interlandmark distances. Coordinate configurations are made comparable using the generalized Procrustes analysis (Slice, 2005, 2007). This method iteratively minimizes the sum of the squared distances among landmarks of each configuration by translating (shifting the configurations together in a fixed direction), rotating (“spinning” the configurations around a fixed point), and scaling (configurations are adjusted to equal sizes by dividing the configurations by their centroid size) sets of landmarks defined on objects. The remaining differences in landmark position, which are called the “Procrustes residuals,” represent the shape differences among the objects.

We used GM to compare the shape of the Wauseon Clovis preform to the shapes of Clovis points from across North America. We followed the GM protocols and landmark definition and placement described in a previous study (Buchanan et al., 2014) for this comparison. We did this because this study examined a large sample of Clovis points (n = 241) from well-documented assemblages (a list of the Clovis points used in this study appears in Buchanan et al., 2014, Table 1). Thus, we used the same procedure to digitize the Wauseon artifact to make the results comparable to this larger dataset. Specifically, we used three landmarks (one at the tip and two at the basal ears) and 20 semilandmarks to demarcate the outline of the Wauseon preform. The semilandmarks were placed using equally spaced line segments perpendicular to a line drawn between each pair of basal ear and tip landmarks using the freely available software MakeFan6 (www.canisius.edu/~sheets/morphosoft.html) (see Fig. 2 in Buchanan et al., 2014). The digitizing was carried out using the tpsDIG2 program (Rohlf, 2010). After digitizing the Wauseon preform we carried out the generalized Procrustes analysis for the Clovis sample and the Wauseon point using the tpsSuper software (Rohlf, 2004).

Following the generalized Procrustes analysis, we conducted a relative warp analysis (RW), which is similar to a principal components analysis, on the entire dataset using the tpsRelw software (Rohlf, 2008) (n = 242; 241 Clovis points and the Wauseon preform). Following the relative warp analysis, we extracted the first three relative warps for subsequent analysis. The first three RWs account for the overwhelming majority of the overall shape variation in the dataset (93.53%). We also plotted the distribution of the first three RWs in a scatter plot for visual examination. In addition to the RW analysis we calculated Procrustes distances (distances in shape space) from each specimen to the overall average specimen shape. We used a bootstrapping procedure to calculate the 95% confidence intervals for the mean and median of the first three RWs and the Procrustes distances for the Clovis points (n = 241). We then compared the RW scores and Procrustes distance for the Wauseon preform to the confidence limits calculated for the Clovis dataset point estimates to determine if the Wauseon preform is outside the confidence limits for Clovis.

The plot of the first three RWs shows that the Wauseon preform falls within the range of finished Clovis points found across North America (Fig. 5). The first RW accounts for a significant portion of the overall shape variation in the dataset (84.91%) and encompasses shape variation of narrow points located on the positive end of the RW1 axis and wider points on the negative end of the RW1 axis. The RW1 score for the Wauseon preform (0.0476) falls within the range (−0.2370, 0.1935) and the 95% confidence limits for the mean (−0.0002, C.I.: −0.0121, 0.0117) and median (0.0018, C.I.: −0.0153, 0.0173) of the Clovis dataset. The second RW scores for a small portion of the overall shape variation in the dataset (4.36%) and juxtaposes points with deep concave bases and excursive blade edges on the negative end of the RW2 axis with points having straight bases and blade edges on the positive end of the RW2 axis. The RW2 scores for the Wauseon preform (0.0289) falls within the range (−0.0769, 0.0858) of the RW2 scores of the overall Clovis dataset, but falls outside of the 95% confidence limits for the mean (−0.0001, C.I.: −0.0028, 0.0026) and median (0.0018, C.I.: −0.0014, 0.0041) of the Clovis dataset. The Wauseon preform falls along the upper positive range of the RW2 axis indicating that it has a relatively straighter base and blade edges than most Clovis points. The third RW primarily describes the location of maximum
width with points located along the negative end of the RW3 axis with maximum width closer to the base and points on the positive end of the RW3 axis having maximum width near the tip. The RW3 score for the Wauseon preform (−0.0203) falls within the range (−0.0493, 0.0575) of the RW3 scores of the overall Clovis dataset, but similar to the RW2 score the RW3 score falls outside of the 95% confidence limits for the mean (0.0000, C.I.: −0.0026, 0.0027) and median (−0.0012, C.I.: −0.0048, 0.0007) of the Clovis dataset. The Wauseon specimen falls on the lower end of the RW3 axis and as such has its maximum width closer to the base than to the tip.

Fig. 5 also identifies Clovis points that have been found in caches (see Buchanan et al., 2014, Table 1 for a list of these points). It is generally assumed that cached points are more likely to be unused or little used compared to points recovered from kill sites (Kilby, 2008), therefore we expected that the Wauseon preform should plot closer to Clovis points from caches than Clovis points found in other contexts. Fig. 5 shows that Clovis points from caches (open red circles) tend to cluster on the right side of the figure (high RW1 scores) and that the Wauseon preform falls within the same portion of the plot. This indicates that the shape of the Wauseon preform is more like the shape of the unused or little used Clovis points from caches.

Lastly, we compared Procrustes distances for the Wauseon preform and the overall Clovis dataset. The Wauseon preform had a distance of 0.0619 to the overall average shape. The Wauseon preform falls within

Fig. 2. The location of the Wauseon Clovis preform relative to other regional Clovis sites and toolstone sources. “1” represents the source of Flint Ridge chalcedony; “2” represents the source of Upper Mercer chert. The dotted lines are least cost paths between the preform’s possible stone sources and its ultimate location of discard.
the range of Procrustes distances (0.0227, 0.2422), but falls outside of the 95% confidence limits for the mean (0.0910, C.I.: 0.0850, 0.0967) and median (0.0810, C.I.: 0.0764, 0.0878) of the Clovis dataset.

Overall the geometric morphometric analysis indicates that the shape of the Wauseon preform falls within the range of the Clovis point sample. The Wauseon preform also falls within the range of the major axis of Clovis shape variation (RW1), although minor aspects (RW2 and RW3) of the shape of the Wauseon preform fall outside of the majority of Clovis shapes. Minor differences are likely due to the status of the specimen as an unfluted and unfinished preform.

3. Microwear examination

In order to examine use-related wear on the preform, we employed the method of microwear analysis developed by Keeley (1980), based on the initial work of Semenov (1964). This procedure can identify specific motions of use and categories of materials worked through the examination of micropolishes, striations, and damage scars that form on the edges of chipped stone tools. This is accomplished through the comparison of these same features on tools used in controlled experiments (Keeley, 1980; van Gijn, 1990, 2014; Vaughan, 1985; Yerkes and Kardulias, 1993). In addition to use, microwear analysis has been successfully employed in recognizing the extent of, and in some cases the materials employed in, hafting (Rots, 2010). Evidence of the manufacturing process, such as polish from hard hammer percussion or pressure flaking, can be recognized through microwear analysis as well (Keeley, 1980; Rots, 2010; van Gijn, 1990). Not all microscopic traces are the result of prehistoric activities, as numerous post-depositional processes related to soil, water, and human-activity (e.g. plowing or excavation) can also produce distinct edge damages and polishes (Kay, 1996; Levi-Sala, 1986; Penney, 2012). Evidence for each of these features was sought in the microwear analysis of the Wauseon preform.

Microwear analysis utilized an Olympus model BX51M metallurgical microscope equipped with bright field and dark field illumination as well as a polarizing filter. Examination was conducted under incident light at magnifications ranging between 50× and 500×. All lighting options were employed in the examination of the artifact, but for a fine grained chert such as this, bright field illumination provided optimal imaging. As suggested by others (e.g., Moore et al., 2016: Supplemental Text), magnifications of 100 to 200× proved to be most useful in the analysis of the artifact. An Olympus SC50 digital camera and Olympus Stream digital imaging software were used to process and capture microscopic images. To compensate for the narrow field of view, and reduced depth of focus encountered at high magnification, Multiple Image Alignment (MIA) was used to stitch several contiguous images.

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**Fig. 3.** A “spur” (also known as “triangle” or “triangular area”) on the fluting nipple of the Wauseon Clovis preform.

**Fig. 4.** The beveled edge of the Wauseon Clovis preform. Given the edge’s morphology and the lack of microwear, in addition to the “splayed out” flake scar adjacent to and centered above the edge (indicated by the arrows), we suggest this edge is the result of a diving overshoot mistake. The retouch present on this edge did not create the “bevel”, but instead was perhaps part of the process starting to correct the overshoot.

**Fig. 5.** Scatter plot of relative warp (RW) scores for North American Clovis points (open blue circles are Clovis points; open red circles are Clovis points from caches; n = 241) and the Wauseon Clovis preform (green circle).

**Fig. 6.** Areas of the preform for which microscopic photos are included in Fig. 7.
together and Extended Focus Image (EFI) was used to provide complete depth of field for the microscopic images presented in Fig. 6. Initial examination of the artifact occurred prior to cleaning in order to identify any prehistoric residues adhering to the surface, but none were noted. Then the preform was cleaned in an ultrasonic cleaner, first in a bath of liquid soap and then in water to remove soil and finger grease that may mask (in the case of the former) or mimic (as the latter may) prehistoric use related patterns.

To our knowledge, no microwear studies have been conducted on Clovis preforms at this stage of production. However, numerous functional analyses of finished Clovis points indicate that they were used as projectiles in addition to use in animal butchery and even plant processing (Kay, 1996; Miller, 2013; Minchak et al., 2011; Shoberg, 2010; Smallwood, 2015; Tomenchuk, 1997). No evidence of utilization was identified through microwear analysis (Figs. 6 and 7), even on the tip (Figs. 6A, 7A). This is not unexpected considering the preform is presumed to be unfinished. The curious beveled edge of the blade appears to have been chipped for a non-functional purpose (in terms of cutting edge) as no evidence for use was identified along this margin (Fig. 7B, D). Also unsurprising given the lack of fluting, there is no evidence that the artifact was hafted. Another “unfinished” element to the artifact is that there is also no evidence for edge grinding along the haft element (Fig. 7C). Finally, no evidence for post-depositional modification, in the form of soil sheen or mechanical damage, was observed.

4. Toolstone

The stone raw material upon which the specimen has been flaked is visually consistent with the blue-grey variety Flint Ridge chalcedony (Vanport Limestone member), as revealed by its vitreous sheen, porcellaneous texture, and inclusions of microcrystalline quartz (vugs) and fusulinids (Carson, 1991: 14-16). Flint Ridge chalcedony outcrops in southeastern Licking County and adjacent sections of Muskingum and Perry counties, Ohio, a straight-line distance of approximately 235 km.
south of the preform locality (Fig. 2). A least cost path between Flint Ridge and the preform locality is approximately 295 km, and closely passes by the Sheridan Cave Clovis site (Redmond and Tankersley, 2005). Another possibility for the preform’s stone raw material is Upper Mercer chert, primarily from Coshoto County, Ohio, a straight line distance of 240 km southeast of the preform locality. A least cost path between the Upper Mercer source and the preform locality is 395 km (Fig. 2). Least cost paths between the findspot and the potential stone sources was calculated using the 30-m SRTM elevation dataset in ArcGIS v. 10. The SRTM grid was used to derive a slope grid, and both elevation and slope datasets were clipped and masked using age-appropriate glacial boundaries and proglacial-lake extents as reconstructed by Dyke (2004). The path-distance tool was used to account for uphill and downhill costs using vertical factors reported by Minetti et al. (2002).

It is noteworthy that despite being relatively close to each other geographically, the least cost path for the Upper Mercer chert source is so much greater than that of the Flint Ridge chalcedony source. This has to do with the location of the northern portion of the Upper Mercer source being nestled well within the Allegheny plateau. As such, its least cost path snakes along the Muskingum River until reaching the northeastern extent of the Till Plains, at which point the path essentially hugs the southeastern Lake Erie coast.

We would like to emphasize that our visual raw material identification should be confirmed via more objective analytical methods in the future (e.g. Boulanger et al., 2015). However, regardless if the Flint Ridge or Upper Mercer identification proves to be correct, the straight line and least cost distances between stone source and artifact discard fall within the normal long range of Paleoindian stone acquisition (Boulanger et al., 2015; Ellis, 2011; Holen, 2010; Speth et al., 2013).

5. Discussion

It is uncommon that observations of lithic production, inter-landmark morphometrics, geometric morphometrics, microwear, and raw material identifications are systematically applied to a single Clovis specimen. However, our rigorous treatment of the Wauseon Clovis preform both supports current understanding of the Clovis colonization of the Lower Great Lakes region, as well as provides a possible “snapshot” within this broader event.

The south-to-north direction of the proposed stone source(s) to the preform discard locality (Fig. 2) is consistent with an overall south-north axis of Clovis stone transport (e.g. Ellis, 2011; Ellis et al., 2011; Loebel, 2005; Simons, 1997) into the Lower Great Lakes region. Indeed, more specifically, a Clovis stone transport route from central Ohio to the northwesternly direction has been frequently documented. A majority amount of the Gainey Clovis site assemblage from Michigan is made from Upper Mercer chert (Simons, 1997; Simons et al., 1984a, 1984b, 1987). The Leavitt Clovis site, also located in Michigan, exhibited three artifacts visually consistent with Upper Mercer chert (Shott, 1993). The Grogitsky Clovis site assemblage exhibited 54% (n = 6) and 27% (n = 3) of its fluted biface to be made from Flint Ridge and Upper Mercer cherts (Stothers, 1996). Clovis point isolates found in Michigan, Northeast Indiana, and Northwest Ohio made from central Ohio toolstones have been documented by Tankersley (1989), White (2014), and Stothers (1996). In his review of Clovis points from Lake Erie’s western basin, Payne (1982:15-16) noted, “the heavy utilization of southern derived raw lithic materials may have been a result of demographic expansion of Ohio Valley (Upper Mercer chert variants and Flint Ridge chalcedony) bands”. A final non-projectile point example is from the Lux Clovis site in Saginaw County, Michigan (Wright, 1996). There an endscraper made from Upper Mercer chert was found, resulting in a distance between stone source and artifact discard of 390 km. This Clovis south-north stone transport patterning is attributed to both colonization processes as Clovis foragers moved into the Lower Great Lakes from more southern regions, as well as seasonal movements, i.e. northern occupation in the warmer months and southern occupation in the winter (Ellis, 2011; see Boulanger et al., 2015; Ellis et al., 2011; Eren and Redmond, 2011; Simons, 1997; also see Speth et al., 2013; White, 2014). The apparent connections between the central Ohio stone sources and the more northwesterly tri-state area of Ohio, Michigan, and Indiana led Stothers (1996) to envision a Clovis hunter-gatherer “band territory” between these two locations.

Although we cannot rule out the possibility that the Wauseon Clovis preform was accidentally lost, we find this scenario unlikely as our microwear analysis suggested it was not shot, hafted, or used in any way. Nor can we rule out the possibility that the preform was placed in a cache or storage pit for future use, but we also find this scenario unlikely because no other Clovis stone tools were recovered and Clovis caches predominately contain multiple implements (e.g. Kilby, 2008; Huckle and Kilby, 2014; Waters and Jennings, 2015). If our interpretations are correct, then it would then follow that the preform was intentionally discarded. That an unbroken, unfinished preform made from a stone source 230 + km away was deliberately abandoned speaks to the idea that Clovis colonizers could afford to cast away stone resources. In other words, the owner(s) of the Wauseon Clovis preform had previously geared up and prepared well enough that they would discard an otherwise functional specimen for any real or perceived imperfections or manufacturing errors (Smallwood, 2010: 2417). Such gearing up is consistent with the hypothesis that Clovis utilization in the Lower Great Lakes region was a planned and conscious endeavor (Eren, 2011, 2013; Eren and Andrews, 2013).

So what real or perceived imperfections could have caused a Clovis knapper to discard the Wauseon preform? While we can never know for certain, our negative microwear result, in conjunction with point form and flake scar patterning can provide one possible scenario. Recall the beveled edge (Fig. 4) and the absence of any evidence for use on that edge. One might initially be tempted to suggest that resharpening could have eliminated any microwear on this edge, a hypothesis recently proposed by Loebel (2013) for the lack of microwear evidence on Clovis endscrapers’ distal bits. However, the endscrapers in the Loebel (2013) study possessed wear evidence of hafting, whereas nowhere on the Wauseon preform is there any microwear, suggesting that it was not used at all. So why go to the trouble of beveling an edge only to disregard it? Speculatively, we suggest that this edge only incidentally has the form of a bevel because it may have instead been the result of an overshot mistake (Eren et al., 2013, 2014). As shown in Fig. 4, the flake scar adjacent to and centered above the beveled edge splay outward, just as a diving overshot mistake would have done. Indeed, the morphology of the “bevel” itself is reminiscent of a diving overshot scar. Unfortunately, we cannot say for sure because the distal end of this proposed phantom overshot mistake has been removed by flaking. But if indeed the flake scar in question was a massive overshot mistake, the subsequent flaking over its distal end (which appears to be a single “pass” or “set” of flake removals), rather than creating the “bevel”, may have been alternately an attempt to create an appropriate space to strike flakes from the opposite face in order to correct the overshot mistake by realigning the preform’s two faces. We note that the beveled edge is straighter and slightly asymmetrical to the opposite edge (Fig. 1), another possible casualty of the proposed overshot mistake, and one that could account for the minor differences found in the geometric morphometric assessment of the specimen. However, speculatively, despite the Wauseon preform’s size making it potentially salvageable, it seems in the end the Clovis knapper decided that the work involved to correct the overshot mistake, as well as to fix the fluting nipple and its spur, was not worth the effort.

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