MIDCONTINENTAL JOURNAL OF ARCHAEOLOGY
2022, VOL. 47, NO. 1, xxx–xxx

The Mielke Clovis Site (33SH26), Western Ohio, USA, Geochemical Sourcing, Technological Descriptions, Artifact Morphometrics, and Microwear

Matthew T. Boulanger,[a] Briggs Buchanan,[b] G. Logan Miller,[c] Brian G. Redmond,[d] Bob Christy,[e] Brandi L. MacDonald,[f] David Mielke,[g] Ryun Mielke,[g] Connie Mielke,[g] Tate Maurer,[h] Bruce Meyer,[i] Monty Meyer,[g] Brian Trego,[j] Andy Wilson,[k] Pete Cartwright,[l] Leo Ott,[g] Michelle R. Bebber,[m] David J. Meltzer,[a] and Metin I. Eren[e, m]

[a]Department of Anthropology, Southern Methodist University, Dallas, Texas 75275, USA; [b]Department of Anthropology, University of Tulsa, Tulsa, Oklahoma 74104, USA; [c]Department of Sociology and Anthropology, Illinois State University, Normal, Illinois 61790, USA; [d]Department of Archaeology, Cleveland Museum of Natural History, Cleveland, Ohio 44106, USA; [e]University Communications and Marketing, Kent State University, Kent, Ohio 44242, USA; [f]Archaeometry Laboratory, University of Missouri Research Reactor, Columbia, Missouri 65211, USA; [g]Botkins, Ohio 45306; [h]Whitehouse, Ohio 43571; [i]Pierceton, Indiana 46562; [j]New Bremen, Ohio 45869; [k]Wapakoneta, Ohio 45895; [l]Sidney, Ohio 45365, deceased; [m]Department of Anthropology, Kent State University, Kent, Ohio 44224, USA

ABSTRACT
The Mielke site (33SH26) is a multicomponent locality in western Ohio, in an upland portion of the state that forms a drainage divide between the Great Lakes and Ohio River watersheds. The site possesses a prominent Clovis component that we describe here and assessed via test excavations, geochemical sourcing, technological descriptions, geometric morphometrics, microwear, and GIS analysis. Five different raw materials, whose outcrops are located 150+ km from the site in several different directions, appear to be present. Although our inferences about the activities that occurred here in Clovis times are constrained by the presence of later components and the collecting history of the site, its location and artifacts are suggestive of what type of Clovis site Mielke may have been and how its Late Pleistocene inhabitants may have moved across North America's midcontinent.

KEYWORDS
Clovis; stone tools; lithic sourcing; neutron activation analysis; microwear; morphometrics; stone acquisition distance

The Mielke site (33SH26) is a multicomponent locality near Botkins (Shelby County), Ohio, (Figure 1). It was discovered in 1969 and collected over the years by coauthor David Mielke, who provided his collections for analysis and, ultimately, permanent curation at the Cleveland Museum of Natural History.[1] Within that collection is a Clovis component, composed of 11 points and 15 point preforms.

The Clovis component is of particular interest to us given the scarcity of sites of this age in the region and especially owing to the diversity of and distances

CONTACT Matthew T. Boulanger mboulanger@smu.edu; David J. Meltzer dmeltzer@smu.edu; Michelle R. Bebber mbebber@kent.edu; Metin I. Eren meren@kent.edu

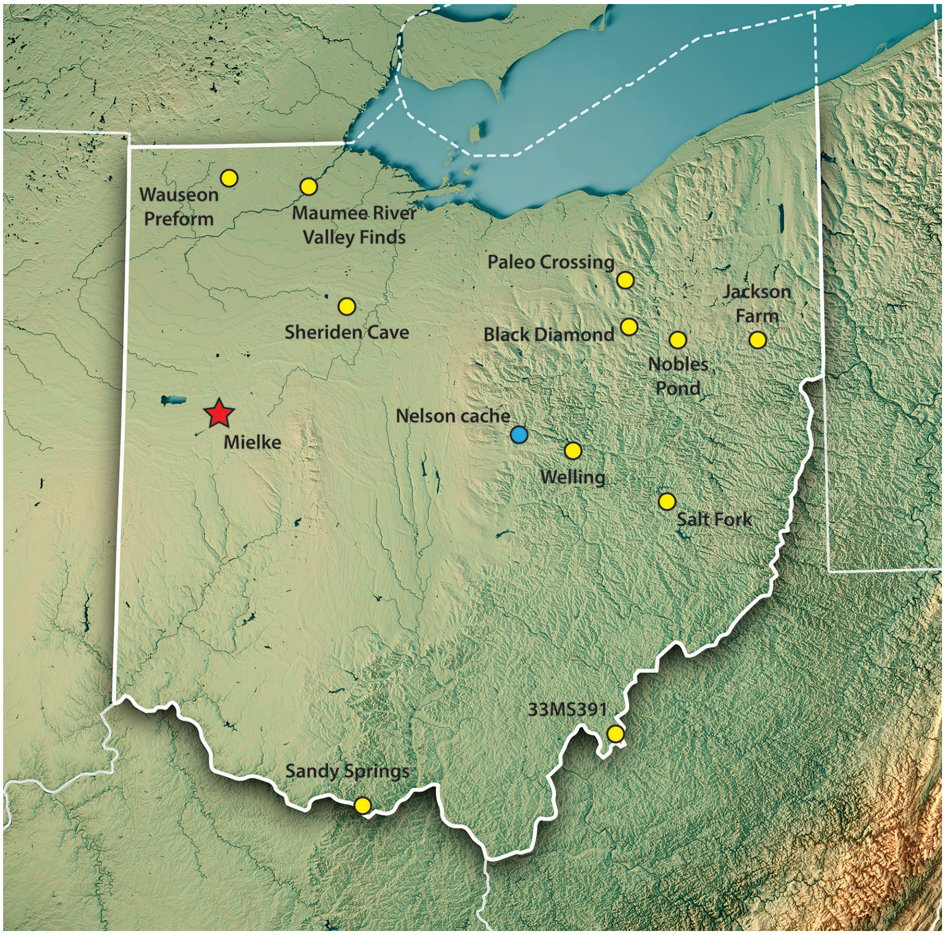

Figure 1. Map of published Clovis (*yellow*), and possible Clovis (*blue*), sites in Ohio. The Mielke site (*red star*) is located in the western part of the state.

to sources of the lithic raw material represented in the diagnostic Clovis materials from the site. As such, the Mielke site has the potential to inform on Clovis mobility and land use in the Great Lakes region, an issue that we explore here. Before discussing these topics, however, we describe the 26 Clovis points and preforms from the Mielke site collection (Table 1). Also included in our descriptions are an additional four Clovis points and one preform found by Mielke at varying distances outside the immediate site boundaries (Figure 2). We do not include these "off-site" specimens in the discussion of the site assemblage, but they are of interest in terms of the types of material represented, as discussed below.

In addition, we describe eight graver spurs from the Mielke site. These spurs are not unequivocally Clovis in age and association. However, in the Great Lakes region they occur at Clovis sites and, in our experience, do not often occur in post-Clovis assemblages in Ohio. Hence, we have included them in this study for such information as they may provide about activities at the Mielke site, while explicitly acknowledging that they may not be Clovis in age.

Table 1. Artifact Identification, Measurements, Macroscopically Identified Chert Type, and Portion of the 39 Mielke Site Clovis Artifacts.

No.	On or Near Site	Tool Type	Chert Type	Portion	Mass	Length	Basal Depth	Basal Width	Medial Width	Basal Thickness	Medial Thickness	Flute Length #1	Flute Length #2
1	On	Fluted point	Upper Mercer	Complete	3.62	30.72	3.29	15.86	19.02	2.63	6.11	16.61	13.01
2	On	Fluted preform	Upper Mercer	Proximal	3.82	n/a	0.98	37.88	n/a	4.42	n/a	n/a	n/a
3	On	Fluted preform	Burlington	Complete, one basal ear missing	6.72	39.49	2.84	19.88	21.9	5.41	9.01	15.11	8.39
4	On	Fluted point	Burlington	Complete, basal ears missing	3.52	37.46	n/a	17.08	17.91	3.04	4.73	21.57	13.58
5	On	Fluted preform	Flint Ridge	Proximal	6.28	n/a	0.95	18.84	23.11	3.33	5.9	27.68	21.46
6	On	Spur	Burlington	Distal	2.91	n/a	n/a	n/a	22.34	n/a	3.4	n/a	n/a
7	On	Spur	Wyandotte	Lateral	7.01	53.72	n/a	n/a	n/a	3.65	7.33	n/a	n/a
8	On	Fluted preform	Harrodsburg	Proximal	4.80	n/a	1	21.61	28.33	3.6	6.4	25.78	n/a
9	On	Fluted point	Burlington	Proximal	6.23	n/a	1.79	22.57	26.29	3.7	5.85	17.69	17.83
10	On	Fluted point	Burlington	Proximal	11.9	n/a	3.04	24.38	27.09	4.49	10.65	27.98	11.33
11	On	Fluted point	Wyandotte	Complete, ear and tip missing	3.60	32.48	4.13	n/a	18.16	3.46	5.84	19.14	17.51
12	On	Spur	Burlington	Complete	9.53	66.62	n/a	17.7	8.58	3.57	8.49	n/a	n/a
13	On	Fluted point	Harrodsburg	Proximal	2.96	n/a	5.49	24.58	n/a	2.99	n/a	n/a	n/a
14	On	Fluted preform	Harrodsburg	Proximal	8.12	n/a	3.68	23.91	24.81	2.9	7.56	23.21	n/a
15	On	Fluted point	Harrodsburg	Complete	11.48	56.51	6.97	23.51	26.73	2.78	6.69	37.46	37.58
16	On	Fluted point	Harrodsburg	Complete	19.6	70.12	6.65	24.55	30.54	3.48	8.12	42.32	29.4
17	On	Fluted preform	Harrodsburg	Proximal	8.03	n/a	5.95	24.41	26.12	3.3	7.24	25.73	20.57
18	On	Fluted point	Harrodsburg	Proximal	6.66	n/a	n/a	n/a	26.14	3.2	6.55	28.21	n/a
19	On	Fluted preform	Harrodsburg	Distal	23.63	n/a	n/a	n/a	37.08	n/a	11.48	n/a	n/a
20	On	Fluted preform	Harrodsburg	Proximal	6.68	n/a	0	18.74	23.65	4.9	7.97	15.18	n/a

continued

Table 1. Continued.

No.	On or Near Site	Tool Type	Chert Type	Portion	Mass	Length	Basal Depth	Basal Width	Medial Width	Basal Thickness	Medial Thickness	Flute Length #1	Flute Length #2
21	On	Fluted preform	Harrodsburg	Proximal	10.28	n/a	6.39	n/a	30.48	3.61	7.58	23.47	n/a
22	On	Fluted point	Harrodsburg	Proximal	10.90	n/a	4.74	25.37	26.33	3.07	6.81	41.3	23.99
23	On	Fluted preform	Burlington	Distal	19.26	n/a	n/a	n/a	43.45	n/a	11.08	n/a	n/a
24	Near - 1	Fluted point	Burlington	Proximal	4.54	n/a	3.67	23.7	25.63	2.68	7.12	19.45	13.84
25	Near - 2	Fluted point	Wyandotte	Complete, basal ears missing	8.17	36.8	n/a	25.6	25.73	4.71	8.14	16.57	13.6
26	Near - 3	Fluted point	Upper Mercer	Complete	12.34	54.13	4.76	24.77	26.35	3.13	8.46	27.63	15.09
27	Near - 4	Fluted preform	Burlington	Complete	10.80	44.77	0.57	23.82	27.23	4.91	8.02	14.09	7.74
28	Near - 5	Fluted point	Harrodsburg	Complete	8.44	43.62	3.76	22.32	22.82	2.89	6.43	26.85	31.66
296	On	Spur	Upper Mercer	Complete	1.13	22.75	n/a	11.91	17.76	2.1	2.87	n/a	n/a
297	On	Spur	Upper Mercer	Complete	2.93	24.5	n/a	20.5	25.94	5.59	4.11	n/a	n/a
299	On	Spur	Wyandotte	Complete	9.87	43.86	n/a	10.14	28.15	3.61	7.09	n/a	n/a
300	On	Spur	Upper Mercer	Distal	5.16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
304	On	Spur	Flint Ridge	Midsection	4.16	n/a	n/a	n/a	23.93	n/a	5.29	n/a	n/a
312	On	Fluted preform	Upper Mercer	Complete	19.78	63.16	0	23.39	28.43	8.15	8.71	23.67	n/a
313	On	Fluted preform	Upper Mercer	Distal	16.82	n/a	n/a	n/a	30.21	n/a	8.22	n/a	n/a
318	On	Fluted preform	Upper Mercer	Proximal	5.39	n/a	0	24.84	n/a	4.25	n/a	12.06	9
319	On	Fluted point	Harrodsburg	Proximal	10.02	n/a	9.3	27.74	24.46	2.69	7.69	21.92	25.16
333	On	Fluted preform	Harrodsburg	Proximal	9.40	n/a	0	29.91	34.83	3.75	6.4	26.64	17.24
443	On	Fluted preform	Burlington	Proximal	3.43	n/a	0	18.83	21.99	3.11	5.84	17.1	6.65

Note: Mass was recorded in grams (g); all other measurements were recorded in millimeters (mm).

Figure 2. Overhead image of the Mielke site and its surrounding area. The black oval represents the Clovis concentration of artifacts. (Figure was created by M. I. Erens. Base map from Google Earth Pro [version 7.3.4.8248], TerraMetrics, NOAA.)

We provide here geochemical characterization of the stone raw materials, technological descriptions of the artifacts, geometric morphometric analysis of the Clovis points, and microwear analysis. In addition, two sets of high-resolution multiview images of all artifacts described are included in the online supplemental materials (https://www.midwestarchaeology.org/mcja/supplemental-materials).

Our inferences regarding what the Mielke site may indicate of Clovis mobility and land use are based solely on the diagnostic Clovis points and preforms from the site. These inferences are constrained by several factors. For one, while the locality has produced a wealth of stone tools, because it is a multicomponent site our analysis must be limited to the tool classes that are unequivocally Clovis (fluted points and preforms) or reasonably inferred to be Clovis (graver spurs) in age. In addition, Mielke is not the only individual who has collected material from the site, and we lack information on what others may have recovered. Further, some material from Mielke's collection, including at least one Clovis point, has been inadvertently lost or discarded. Finally, and as discussed below, there is evidence to suggest that later groups may have used the site as a source of knappable stone, modifying and/or removing Clovis points from the site. Accordingly, we cannot be fully confident regarding the range, diversity, and abundance of Clovis material from this locality.

There is one further caveat regarding the identification of the preforms as "Clovis." Earlier-stage fluting and end thinning are increasingly recognized in non-Clovis bifaces (e.g., Eren, Meltzer, and Andrews 2018; Eren, Meltzer, and Andrews 2021; Eren, Bebber, et al. 2021; Nolan et al. 2015; Norris et al. 2019), and these could be mistaken for Clovis preforms. Had there been no finished Clovis points at the site, we would be reluctant to claim a Clovis presence here based solely on the presumed Clovis preforms. However, because finished Clovis points are present in the Mielke assemblage, we feel confident suggesting the fluted preforms are also Clovis in age. In spite of that, we grant the possibility, given the presence of post-Clovis projectile points as well, that some of the fluted preforms may have been manufactured in later Holocene times.

Site Setting and Fieldwork

The Mielke site is now a plowed field, situated on an elevated south–southeast sloping glacial kame near Loramie Creek, near the drainage divides between the Great Miami, Wabash, and Scioto Rivers, all of which empty into the Ohio River (see Figures 1 and 2; Converse 2002:26). This type of location is common for Clovis sites in the Great Lakes and Midwest, as elevated land surfaces drain well and may have provided better wind circulation and therefore better protection from insects (Eren 2009; Simons 1997). The plowed field on which the Mielke site is located had once been larger but was reduced in size circa 1956 owing to the expansion of a nearby cemetery. It is not known whether any Clovis materials have been recovered from the area of the cemetery.

In addition to the David Mielke's collecting activity on the site, coauthors Bebber and Eren visited the locality on several occasions. During their on-site pedestrian survey in 2019, they recovered a Clovis point tip that refit to a Clovis point base David Mielke had found 49 years earlier (Specimen #22, as described below; also Figure 3), confirming the location of the site. No other diagnostic artifacts were recovered on that occasion. On a subsequent visit in 2021, four test pits were excavated on the boundary between the plowed field and the cemetery. These were done to assess whether sub-plow-zone features were present in the area that had not been plowed since 1956 and to test whether the lithic artifact concentrations are centered on the elevated kame or extend into the cemetery. These 50 × 50 cm test pits were placed in the easternmost part of the cemetery, approximately 2 m west of the edge of the plowed field (Figure 4). Only 14 lithic chips (all less than 1 cm in maximum length) were recovered from the pre-1956 plow zone, which was approximately 30 cm in depth in all four test units. There were no sub-plow-zone artifacts or features. These results support the notion that the Mielke site is primarily located on the kame in the plowed field and does not extend substantially westward into the cemetery.

Geochemical Sourcing

There are, visually, a wide range of stone material types represented in the finished projectile points and fluted point preforms in the assemblage. Direct geochemical sourcing of these specimens was attempted using nondestructive X-ray fluorescence (see Supplementary Geochem Text S1); however, elements useful for geochemically sourcing cherts are typically well below the level of detection by

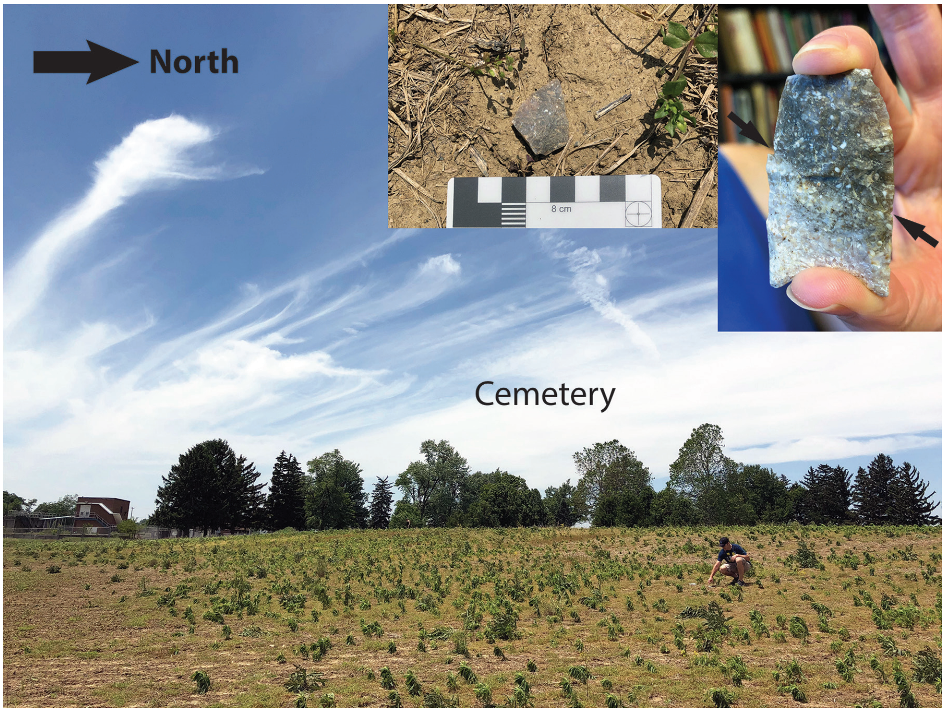

Figure 3. The midsection of a Clovis point (*left insert*) was found by Ryun Mielke in 2019. He is pointing to the find in the central image. His midsection refit to a Clovis point base found by his father, David Mielke, 49 years prior (*right insert*). The arrows indicate the snap.

Figure 4. Test excavations were conducted in 2021 to assess whether the artifact concentration extended into the cemetery.

this method (e.g., Luedtke 1992; Shackley 1998). Our results suggest that this is the case with the Mielke artifacts. Hence, to determine the types of stone that occur at the Mielke site, and in a manner that could help link the specimens' macroscopic identifications to their origins as diagnosed geochemically, we selected 62 chert specimens from the site for additional analyses. These included debitage, nondiagnostic tools, and diagnostic Holocene artifacts, all of which spanned the macroscopic variation apparent in the Clovis specimens from the site. These 62 specimens were then subjected to both macroscopic examination and destructive neutron activation analysis (NAA).

In terms of the former, Boulanger and Eren independently evaluated the sample of 62 artifacts for what they considered to be their most likely sources based solely on visual characteristics. (For additional information and references on raw material type descriptions, see Supplementary Geochem Text S1.) Results from their evaluations were broadly consistent. Sources they identified included Harrodsburg chert (Ramp Creek Formation; Mississippian) or Allens Creek chert (Muldraugh Formation; Mississippian); Flint Ridge or Plum Run chert (Alleghany Formation; Pennsylvanian); Upper Mercer chert (Pottsville Formation; Pennsylvanian); Wyandotte or Hopkinsville chert (Ste. Genevieve Limestone; Mississippian); Holland chert (Staunton Formation; Pennsylvanian); Paoli/Carter Cave chert (Paoli Limestone; Mississippian); and, finally, Burlington chert (Burlington Limestone; Mississippian). Neither Boulanger nor Eren could confidently identify a most likely source for the gray-to-white iron-stained chert present in the assemblage. DeRegnaucourt and Georgiady (1998) provide visually similar examples attributed to Illinois Burlington chert. However, this material is also visually similar to chert from the Onondaga Limestone that crops out across southern Ontario and central New York, and it falls within the range of variability described by Cantin (2008) for Kenneth and West Franklin cherts.

We then used neutron activation analysis (NAA) to compare these 62 specimens to the geochemical database for midwestern chert sources (Boulanger 2018; Boulanger et al. 2015; Chiarulli and Katz 2016; Eren, Bebber, et al. 2021; Glascock 2004; Morrow et al. 1992). NAA was conducted by researchers at the Archaeometry Laboratory of the University of Missouri Research Reactor (MURR) following standard MURR procedures (Glascock 1992; Glascock and Neff 2003). A summary of these analyses is provided below, and a detailed technical report is provided in the supplemental materials (https://midwestarchaeology.org/mcja/supplemental-materials).

Samples were extracted from larger specimens by removing a small portion using a diamond-edged rock saw. Some artifacts were too small for sampling in this manner. These were consumed entirely by the analysis. Specimens were placed between sheets of glassine paper and lightly crushed in an agate mortar. Portions of approximately 100 mg of the crushed fragments were weighed into high-density polyethylene vials for short irradiation at MURR. Portions of approximately 700 mg were weighed into high-purity quartz vials used for long irradiations at MURR. Along with the chert samples, standards made from NIST certified standard reference materials (SRM 1633b [Coal Fly Ash], SRM 278 [Obsidian Rock], and SRM 688 [Basalt Rock]) were similarly prepared. All analytical samples were subjected to standardized preparation and irradiation procedures performed by researchers at the MURR Archaeometry Laboratory. Readers are referred to detailed discussions of these procedures by Glascock (1992), Glascock and Neff (2003), and Neff (2000), as well as the supplementary material for specific information on irradiation and gamma count protocols used by the laboratory. A detailed presentation of the NAA results and subsequent statistical analyses of those data are also provided in the supplemental material.

As noted, chert and other cryptocrystalline silicates are often difficult to examine using geochemistry because the abundances of most chert elements are exceedingly low, and specific geological outcrops can show highly variable chemistries that overlap with those of other outcrops in multivariate space. These issues are further compounded here because the numbers of specimens representing each source are varied. For example, the existing sample in the MURR database for the Harrodsburg chert source consists of just 3 specimens, whereas the sample of Wyandotte chert-source specimens consists of 44.

Not all 62 specimens could be definitively tied to a particular chert source in our database. This is likely because (1) not all potential sources (e.g., Allens Creek) are represented in our database and (2) some source samples are made up of as few as three specimens, which are likely not representative of the lithic source(s) as a whole. Nevertheless, it is possible to assign the most likely provenance of most of the specimens to the above-mentioned chert sources with a fair degree of confidence given the multivariate transformations and statistical analyses of the geochemical data, supplemented by the visual megascopic characteristics of the chert artifacts.

Nine of the ten NAA samples identified as Indiana Harrodsburg or Allens Creek chert—sources of which on a least cost path (LCP) are approximately 320 km west/southwest and approximately 255 km south/southwest of Mielke, respectively—form a distinct cluster (Figure 5). They are both geochemically and visually distinctive from all other chert sources and artifacts in this study.

Eight of the NAA samples can be confidently identified based on the geochemical data and their visual consistency as Indiana/Kentucky Wyandotte chert, which on an LCP is roughly 320 km south/southwest of the site (see Figure 5). However, several of the pieces that were visually classified as Wyandotte chert are, based solely on their geochemistry, more closely associated with sources of Upper Mercer chert, which outcrops on an LCP approximately 200 km east of Mielke. As noted in an earlier study (Boulanger et al. 2015), this suggests that there is either an Upper Mercer look-alike variety of Wyandotte chert or some Wyandotte chert does not exhibit the very high uranium profile exhibited for most of the current source sample. Similarly, Upper Mercer and Flint Ridge (which outcrop ~180 km east of Mielke on an LCP) can be clearly distinguished from other chert sources.

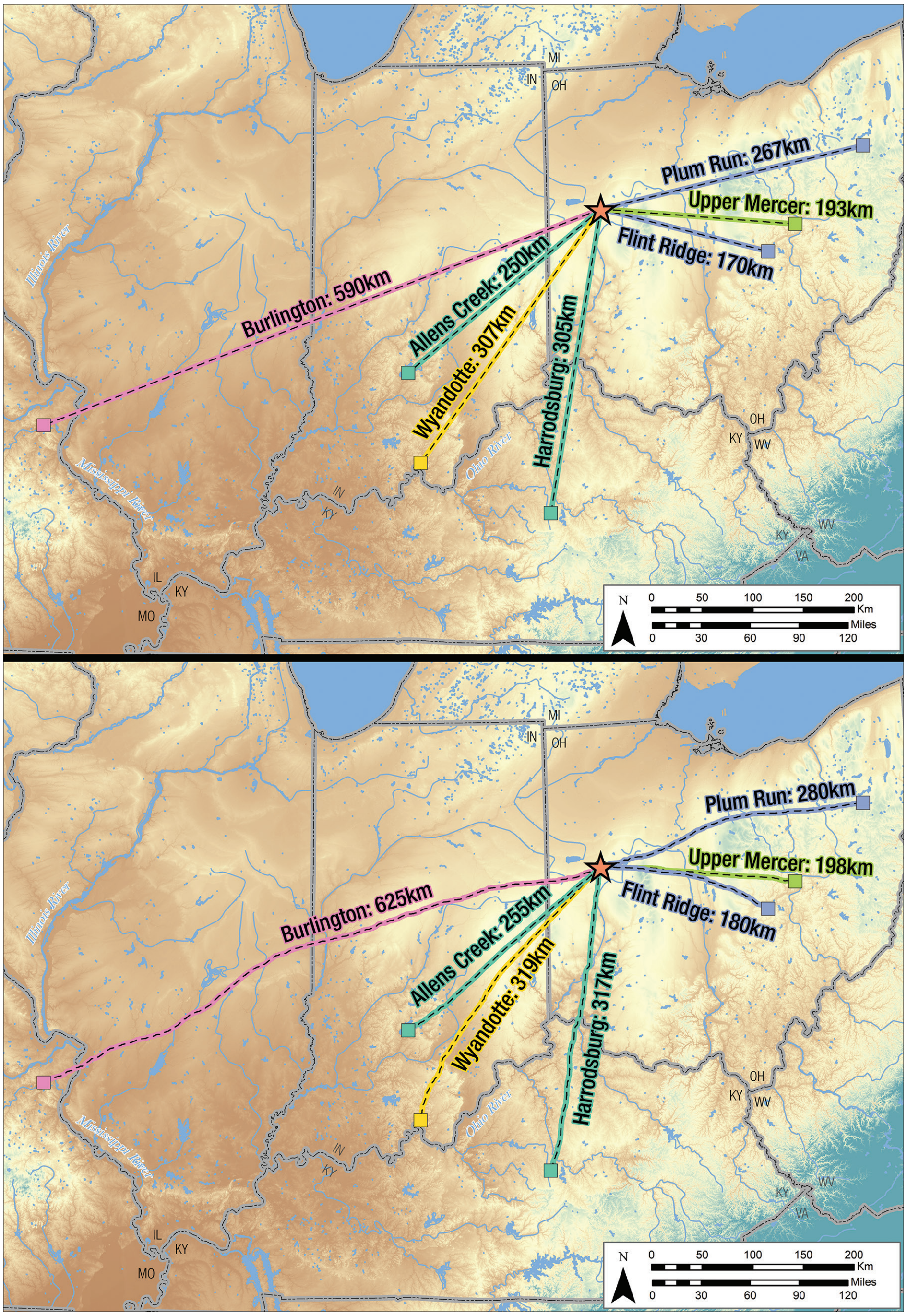

Figure 5. Straight-line and least-cost paths from the Mielke site to chert outcrops. (Base-map elevation and hillshade from SRTM data provided by USGS and NASA.)

The single artifact (an end scraper) that was visually consistent with heat-treated Burlington chert, the source of which on an LCP is about 625 km west-southwest of Mielke, is chemically consistent with source samples from the Crescent Hills quarry collected by Ives (1975; see also Figure 5). Other sources of Burlington chert in the Mississippi Valley share a similar composition.

No matches were found for the gray-white iron-stained chert from Mielke. This seems to suggest that Onondaga chert can be ruled out as a potential source, as this material is well represented in the MURR database. Lastly, the geochemical data for the two Paoli-like artifacts in our sample suggest that these are indeed made of chert from the Paoli Limestone; however, as with the Harrodsburg source, our source sample from the Paoli Limestone is composed of fewer than a handful of specimens.

Based on this effort, we then conducted a corresponding macroscopic examination of the stone raw material types evident in the Clovis diagnostic forms from the Mielke site (Figure 6). Our assignments were broadly consistent and are the basis for the raw material assignments that follow. Insofar as can be determined, five stone sources are unevenly represented in this group (Simpson's diversity index = 0.657)

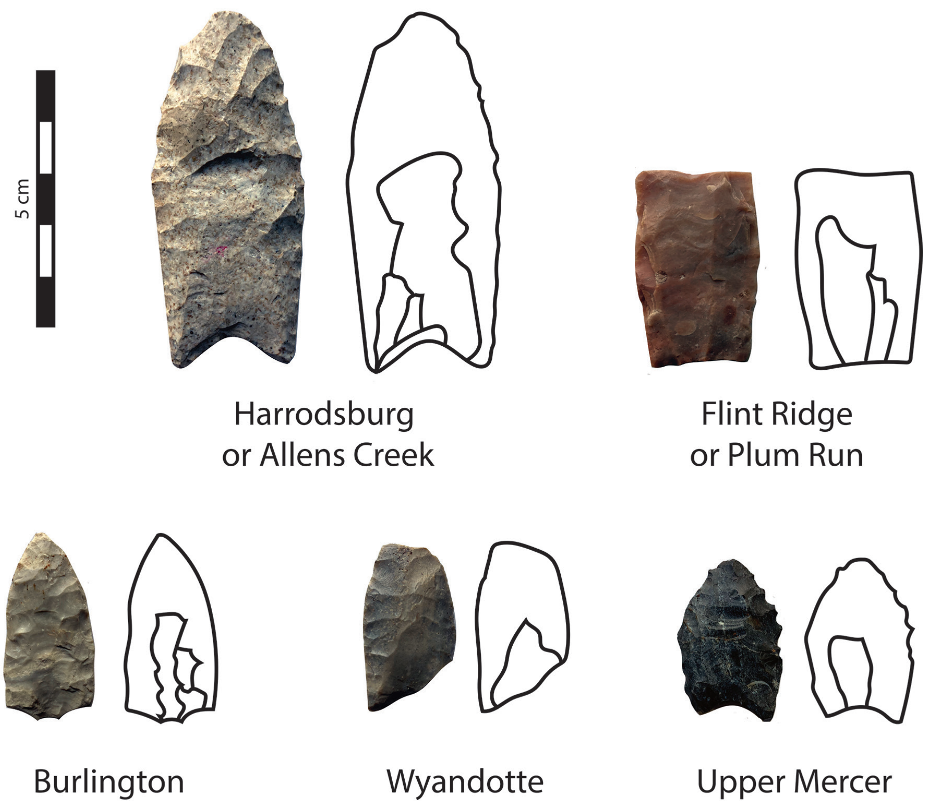

Figure 6. Examples of Clovis points from the Mielke site made on Harrodsburg, Flint Ridge/Plum Run, Burlington, Wyandotte, and Upper Mercer cherts. Compare with Figure 9.

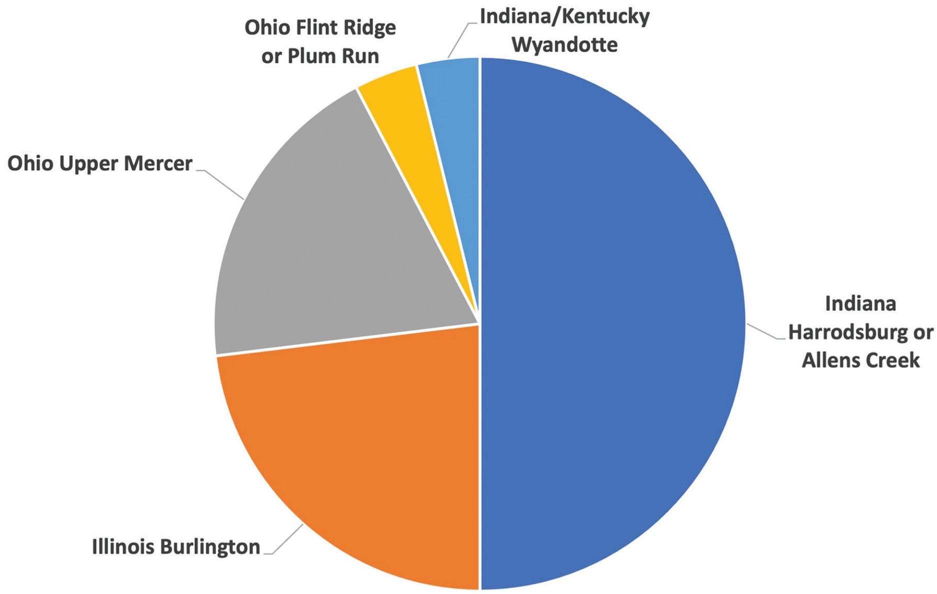

Figure 7. The distribution of macroscopically identified chert raw materials for the Mielke site Clovis points: Indiana Harrodsburg or Allens Creek (*n* = 13); Illinois Burlington (*n* = 6); Ohio Upper Mercer (*n* = 5); Ohio Flint Ridge or Plum Run (*n* = 1); and Indiana/Kentucky Wyandotte (*n* = 1).

and come from multiple outcrops. Represented in the assemblage, in decreasing order, are Clovis points and/or preforms made of Indiana Harrodsburg or Allens Creek chert (*n* = 13); Illinois Burlington chert (*n* = 6); Ohio Upper Mercer chert (*n* = 5); Ohio Flint Ridge or Plum Run chert (*n* = 1); and Indiana/Kentucky Wyandotte chert (*n* = 1; see Table 1; Figure 7). Assuming these identifications are correct, it is apparent from this study that none of the stone used and discarded by Clovis groups at Mielke was obtained locally, or within approximately 150 km of the site.

The lithic raw material diversity seen in the diagnostic Clovis specimens from the site is very similar (as determined by nonsignificant chi-square values) to the lithic raw material richness seen in the gravers recovered from the site, as well as in the projectile points recovered from beyond the site's boundaries (Table 2). Underlying these observations is the fact that Mielke is in a lithic raw material "desert." All readily knappable stone at this site had to have been brought in from substantial distances by Clovis groups. That raw material is scarce also helps explain the occasional Archaic-age projectile point from the site (including one made of Wyandotte chert that was refurbished from a lanceolate fluted point; Figure 8). For that matter, there are Holocene-age tools that are made of the same macroscopically identified suite of cherts as the Clovis tools (Figure 9; compare with Figure 6), and the overall lithic raw material diversity at the site is more or less the same regardless of antiquity, except for the presence of a few additional macroscopically identified cherts from post-Clovis times (see Supplemental Materials: NAA Samples).

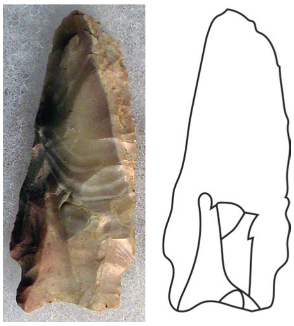

Figure 8. A post-Clovis style point made from what appears to have originally been a Clovis point. Unfortunately, this artifact from the Mielke site was lost as it was passed among various collectors. Note that no scale was included when this photograph was taken.

Figure 9. Post-Clovis point types are made on the same suite of raw materials as the Clovis artifacts: Harrodsburg (unidentified Holocene point type); Flint Ridge/Plum Run (Brewerton); Burlington (Table Rock); Wyandotte (Kirk Stemmed); and Upper Mercer (Early Woodland stemmed). Compare with Figure 6.

One explanation for this pattern is that, in this region barren of high-quality stone, people who came to the site in later millennia exploited usable stone discarded by Clovis groups (as opposed to the less likely possibility that Holocene foragers happened to procure the same suite of stone raw materials, all from different directions and distances, and used and discarded it in the same spot in western Ohio). In effect, Clovis groups unintentionally created a stone source at

Table 2. Lithic Raw Material Represented in Diagnostic and Nondiagnostic Artifacts at the Mielke Site and Nearby Off-Site Area.

	Burlington	Flint Ridge	Harrodsburg	Upper Mercer	Wyandotte	Totals
Mielke—finished points	3		6	1	1	11
Mielke—preforms	3	1	7	4		15
Subtotal	6	1	13	5	1	26
Off-site—finished points	1		1	1	1	4
Off-site—preforms	1					1
Subtotal	2	0	1	1	1	5
Graver spurs	2	1		3	2	8

the Mielke site that could be used by later groups. This is not an uncommon phenomenon in other areas largely devoid of stone. It is not known how common this might be in the upper Midwest, but obviously it is a matter to be considered in calculating later period lithic raw material "supply zones," procurement distances, and the like (e.g., Seeman et al. 2020).

Another possible explanation for the fact that there are Clovis and post-Clovis diagnostics made from the same set of distant stone raw materials is that Clovis patterns of direct procurement or exchange continued into later periods (Lewis et al. 2022). We cannot at present distinguish among these possibilities, though we lean toward the notion that stone left at the spot by Clovis groups was repurposed and reused by later inhabitants of the locality.

Artifact Technological Descriptions

Each artifact's basic measurements, macroscopically identified chert type, and portion are described below and summarized in Table 1. Additional, more detailed descriptions follow. Data and high-resolution images are available in the supplemental materials.

Finished Clovis Points

Specimen #1 This small fluted point, manufactured from Upper Mercer chert, exhibits two prominent impact scars on one face. An attempt to remove them by resharpening, evidenced by small lateral flake scars invading the impact scar, seems to have been abandoned, leaving the blade edges with a serrated appearance. The serrated appearance may also be due to postdepositional factors. The proximal lateral edges are ground, and the opposite face possesses an overface scar that extends from the lower right ground edge toward the upper left blade lateral edge (but does not reach it). The basal edge is ground and exhibits some minor crushing.

Specimen #4 Made from Burlington chert, this small and relatively thin fluted point is missing both basal ears. One face possesses a flute that extends more than halfway up the length of the point, while the other face exhibits a flute that it almost entirely covered up with flake scars extending along the lateral edges. However, small remnants of this latter flute are visible in the middle of the specimen and at the base. When viewing the face with the long flute, the right proximal lateral edge is ground, and the left lateral edge is partially burinated. More specifically, and curiously, roughly half the lateral edge is burinated, yet proximally and distally to the burinated portion of the edge, the lateral edges are finished. This suggests this burination is a remnant of flaking or a knapping accident that took place during the point's production or over its life history.

Specimen #9 This well-made, snapped fluted point base is made from Burlington chert. Its lateral and basal edges are heavily and continuously ground. Each face exhibits flutes, and one lateral edge still exhibits a small remnant surface of the original stone from which the point was knapped.

Specimen #10 This relatively thick fluted point, made from Burlington chert, lost its tip and a portion of its distal half, perhaps from impact. The proximal lateral edges are ground and waisted. Both faces exhibit a flute scar, one of which extends more than halfway up the length of the specimen. To the right of this long flute scar is a prominent step fracture; it is possible that a goal of the flute was to remove that step. When viewing this same face, the left lateral edge exhibits a notch, perhaps from some postdepositional damage, as might have occurred as a result of trampling or plowing.

Specimen #11 Made from Wyandotte chert, this small fluted point is missing both its tip and one of its ears. There is no clear evidence of impact, so it is possible the snaps are postdepositional. Additionally, the distal portion of the point exhibits an inclusion, which may have weakened the tip. Each flute on each face extends beyond halfway up the point's length. The proximal lateral edge that is present is ground.

Specimen #13 This finely made fluted point base is fluted on both sides and ground on both proximal lateral edges as well as along its relatively deeply concave basal edge. A step fracture on one face likely occurred when the point snapped, possibly while it was within the haft. The specimen is made of Harrodsburg chert, and in its basal size and morphology, it is strikingly similar to Specimen #15.

Specimen #15 This complete and finely made fluted point was manufactured on a dark variety of Harrodsburg chert. The slight tip damage, asymmetry, and step fractures in the distal half are consistent with resharpening but may also be the result of other factors—such as time pressure, knapper skill, or original stone form—or multiple factors in combination. Each face exhibits at least two well-executed flutes, some of which extend well into the point's distal half. The proximal lateral edges are straight and heavily ground, as is the deeply concave basal edge. The basal portion of this specimen, as noted, is strikingly similar to that of Specimen #13.

Specimen #16 This complete fluted point is larger than but otherwise very similar in shape to Specimens #13 and #15, though it is made of a lighter variety of Harrodsburg chert. The tip is missing, perhaps from impact as there is a small impact scar present. One face possesses a flute that extends into the point's distal half, while the opposite face's flute extends to just below half the point's length. Also, like Specimens #13 and #15, the proximal lateral edges are straight and heavily ground, as is the deeply concave basal edge.

Specimen #18 This heavily damaged fluted point made on Harrodsburg chert is missing its distal half and the corner ear and edge of its proximal portion. It also appears to have been burned, as evidenced by a large pot-lid and darker, seared-looking sections on its surface. Prior to this, however, both faces had been successfully fluted, and the remaining proximal lateral edge is heavily ground.

Specimen #22 This specimen is in two pieces, found 49 years apart (as earlier described). Made of Harrodsburg chert, it is unclear whether the medial and distal snaps are from use or postdepositional processes. The proximal lateral and concave basal edges are heavily ground, and both faces are successfully fluted. One of the flutes extends well into the point's distal half, almost to the tip.

Specimen #24 (NOS1 [NOS = Not on Site]) This specimen, made on Burlington chert, was found approximately 500 m southwest of the Mielke site. Possessing ground proximal lateral and basal edges, this snapped fluted point base has flutes on each face that do not extend beyond the lateral grinding.

Specimen #25 (NOS2) This specimen was found approximately 2.5 miles north of the site. This short and relatively thick fluted point is made of Wyandotte chert. It is missing both proximal ears and is fluted on both faces. The proximal lateral edges are only slightly ground. The distal half of this specimen appears bulbous. One distal face is simply convex due to poor thinning, while the other exhibits a prominent stack close to the right distal lateral edge.

Specimen #26 (NOS3) This specimen was found approximately 7 miles east of the site. Made from Upper Mercer chert, its two faces are plano-convex; the flute is longer on one and shorter on the other. The edges are irregular, perhaps from postdepositional factors; the distal blade edges exhibit more recent breaks that are a darker color than the rest of the point. The base is relatively concave.

Specimen #28 (NOS5) This specimen was found approximately 2 miles east of the Mielke site. It is made from Harrodsburg chert and exhibits an impart scar at the distal tip. Each flute on each face extends well into the distal half. The proximal lateral grinding reaches about halfway up the point's length. The slight asymmetry in the blade might suggest resharpening. Like other specimens of this material, the base is concave.

Specimen #319 This oddly shaped fluted point base is made of Harrodsburg chert. It possesses a very deep basal concavity and blade edges that are straight and seemingly triangular in shape as they converge toward the (missing) tip. Several factors could be responsible for its unusual morphology: the toolmaker's individual style or skill, resharpening, and the like. There is an inclusion evident in the cross section of the snapped edge, which likely contributed to the point breaking. Each face exhibits several short flute scars.

Preforms

Specimen #2 Made of Upper Mercer chert, this very short preform base exhibits several flute scars on each face and possesses a slight basal concavity. Unfortunately, not much else can be said given that such a small portion of the original preform is present. This specimen's relatively large width (~1.5–2× more than most specimens) may be due to the early stage at which it was broken and abandoned.

Specimen #3 This fluted point, made from Burlington chert, is nearly finished and thus may also be classified as a late-stage preform. One face possesses a prominent flute that ends in a hinge termination. The opposite face is fluteless because of an apparent fluting failure, as evidenced by a missing ear and several step fractures extending from the basal edge. When looking at the fluted face, the left proximal lateral edge is slightly wasted, but this would have perhaps been corrected during the final proximal lateral grinding phase, which had not yet occurred when this point was discarded.

Specimen #5 This fluted point–preform base is made from Flint Ridge chert and fluted on both faces. One face exhibits a "reverse flute" that extends proximally from the distal tip—perhaps indicating some sort of anvil support used during the fluting process. However, this process may have also broken the preform. On this same face, there are several step fractures. Heat cracks and incipient pot-lids are evident all over this pinkish-hued specimen, indicating that it was burned at some point. On the opposite face, the preform exhibits two flutes.

Specimen #8 This fluted point–preform base is made of Burlington chert. It is fluted twice on one face but not on the other, suggesting it broke during the first face's second flute removal. It possesses a plano-convex morphology as a result, possibly indicating it was made from a flake.

Specimen #14 Similar to Specimen #3, Specimen #14 could be classified as a very late-stage preform. Its proximal lateral edges are not ground, suggesting that it was never finished. Made of Harrodsburg chert, this specimen possesses very straight lateral edges. The first flute removal resulted in a long scar that extended beyond the break. The second flute removal resulted in a step fracture, perhaps because of the extra mass the fracture propagated into. It is likely that the point broke during this second flute removal. A small conchoidal fracture, evident in the cross section of the snap, may not have been able to withstand the bending force during flute removal.

Specimen #17 This specimen, made on Harrodsburg chert, is very similar in size and shape to Specimen #14. It also lacks ground proximal lateral edges and is snapped, suggesting that it was never finished and broke during the second flute removal. Also, like Specimen #14, the second flute removal resulted in step fractures. One of the ears appears broken compared to the other; this could have been rectified in the final finishing had the point been finished.

Specimen #19 Made from Harrodsburg chert, this large specimen (the thickest, heaviest, and nearly widest of any specimens in the collection) represents the distal half of a bifacial preform. One face exhibits the distal portions of two flute removals or a single flute that distally split in two, and the other face exhibits several overface scars. The fluted face also possesses a prominent step fracture near the left lateral edge.

Specimen #20 This fluted preform base, made from Harrodsburg chert, is only fluted on one face. The fluting process may have snapped the preform in half, as well as clipped the left proximal lateral edge, resulting in a burination. The opposite face shows a large step fracture near its left lateral proximal edge.

Specimen #21 This is yet another specimen made from Harrodsburg chert that was snapped during its second flute removal. The first flute removal seems to have been very successful, running past the current snapped portion. The second flute removal was less so, resulting in a few small flutes, one of which appears to be a perverse fracture that removed an ear. A remnant of the fluting "nipple" is still present on a relatively deeply concave base. The proximal lateral edges are not ground.

Specimen #23 This fluted bifacial preform distal half is made from Burlington chert and plano-convex in cross section. Its convex face shows the distal portions of two flute removals; its opposite face shows several overface scars. One of these scars (near the snap) almost reaches the other lateral edge but does not overshoot it.

Specimen #27 (NOS4) This plano-convex specimen was found approximately 3 miles north of the site. Made of Burlington chert, it appears to be burned, as one face and edge seem to be charred. It is fluted or end thinned on the charred face. None of the edges are ground.

Specimen #312 This relatively thick preform is made of Upper Mercer chert. Both faces are convex, with mass equally distributed on each side of the biface plane. One face is fluted. The flute was removed from a squared edge, perhaps the original surface of a tabular piece of chert. There are a pair of small notches on each lateral edge, at about one-third the length of the preform from the base. These were apparently pressure flaked into each edge and face. One possibility for their occurrence is that a knapper in post-Clovis times began to transform this fluted preform into another type of point but ultimately abandoned the efforts.

Specimen #313 Made of Upper Mercer chert, this distal half of a preform possesses no clear flute scars. However, the lower right edge is burinated, which could represent a failed fluting attempt whereby the knapper missed the flute platform and hit the ear. This event may have also snapped the specimen.

Specimen #318 This badly burned Upper Mercer preform base is fluted on one side and possesses heat cracks and pot-lids.

Specimen #333 This preform base is made from a highly silicious (and less fossiliferous) piece of Harrodsburg chert. It is fluted twice on one face and once on the other. The single-fluted face also possesses a large overface scar.

Specimen #443 This very thin preform base is fluted only on one face. It is made on Burlington chert.

Graver Spurs

Specimen #6 This long-spurred specimen is made from Burlington chert. It is made on the distal end of a curved flake, possibly a bifacial thinning flake, and it is missing its proximal platform and bulb of percussion. The other edges are retouched. A small snapped section may have been an additional graver; if so, then this specimen was a multiple graver.

Specimen #7 Made on a blade-like flake of Wyandotte chert, this specimen possesses two spurs and a notch. When looking at the dorsal face, the first spur is located on the proximal right lateral edge and is fully formed by retouch. The second spur is located on the distal-most left lateral edge and is partially formed by retouch and partially formed by a natural "back." The notch is on the distal right lateral edge.

Specimen #12 This long, strangulated piece made from Burlington chert is heavily retouched and/or shows use wear in its medial section on both edges. When viewing the dorsal face, the spur is located on the distal-most right lateral edge.

Specimen #296 Both spurs on this thin flake of Upper Mercer chert are located on the right lateral edge: one is pointing proximally; the other is pointing to the right. The distal portion of the flake has been snapped.

Specimen #297 This double-spurred specimen, made of Upper Mercer chert, is on a flake with an "edge-bite" platform. Both spurs have been retouched on the distal edge.

Specimen #299 This Wyandotte flake possesses two spurs: one in each distal "corner" of the flake. When viewing the dorsal face, the right lateral edge appears to have been retouched and the left lateral edge appears to have been utilized.

Specimen #300 Made of Upper Mercer chert, this fragment exhibits a fully retouched spur. However, where on the flake this spur occurred is hard to tell as orienting the fragment is difficult.

Specimen #304 When viewing the dorsal face of this medial portion of a flake made from Flint Ridge chert, it possesses a spur on its right lateral edge. The left lateral edge is also retouched.

Clovis Point Geometric Morphometrics

We identified six complete projectile points in the Mielke assemblage that are consistent with typological descriptions of Clovis points. In principle, these six should also fall within the known shape parameters of Clovis. To assess this, we plotted the outline shape of the six Mielke Clovis points among a sample (n = 241) of Clovis points from assemblages recovered across North America. Our Clovis sample is derived from well-known Clovis assemblages of points recovered from sites and has been used previously as our standard Clovis sample (see Buchanan et al. 2014; Eren et al. 2016; Perrone et al. 2020; Werner et al. 2017). We used geometric morphometric (GM) procedures for capturing the outlines of individual points, using landmarks, statistically decomposing those landmark configurations to remove the effect of size, and then analyzing the residual shape variation (for details on these procedures including the landmark digitization, superimposition, and relative warp analysis see Buchanan et al. 2014; Eren et al. 2016; Perrone et al. 2020; Werner et al. 2017). We used relative warp analysis, akin to a principal components analysis, to explore and examine the shape variation in Mielke points against the Clovis standard because we assume that the Mielke assemblage is Clovis.

The results of the relative warp analysis indicate that the first four warps comprise more than 95% of the overall variation in the data set and that the succeeding warps represent less than 2% of the remaining variation. The first warp contains most of the variation (84.77%), followed by the second (4.4%), the third (4.25%), and the fourth (2.39%) warps. We examined the first four relative warps (Figures 10 and 11) and show that five of the six Mielke points fall well within the established Clovis shape variation. Specimen 1 (8308) falls outside the shape boundaries in the relative warp 1 by relative warp 2 plot. This point appears battered, almost diamond-shaped, with expanding basal sides nearly equal in length to the tip edges and a rounded basal concavity. In the second plot of third and fourth relative warps representing less than 7% of the overall variation, a different point is outside the Clovis parameters (see Figure 10). Specimen 3 (8314) has a flat base with asymmetrical short basal edges (one flaring, one straight). Both points 1

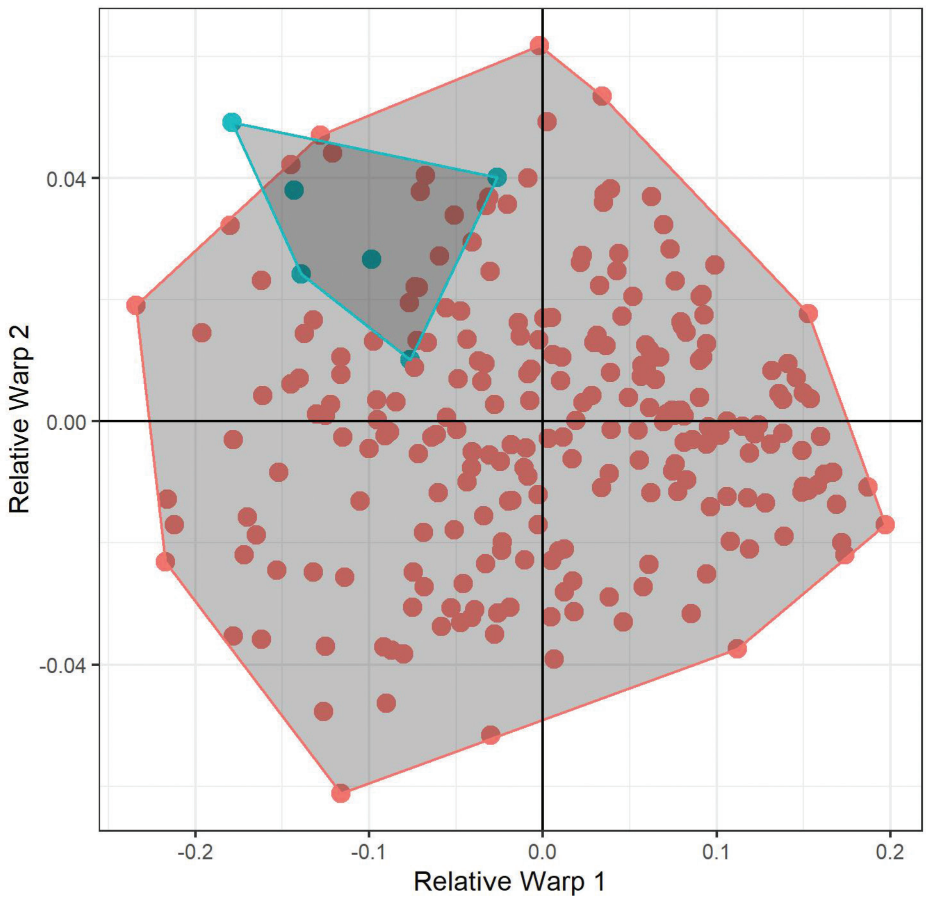

Figure 10. Scatter plot of relative warp 1 (84.77% of the overall shape variation) on the x-axis and relative warp 2 (4.4% of the overall variation) on the y-axis, with Clovis points identified by red circles and the Mielke points shown as turquoise circles.

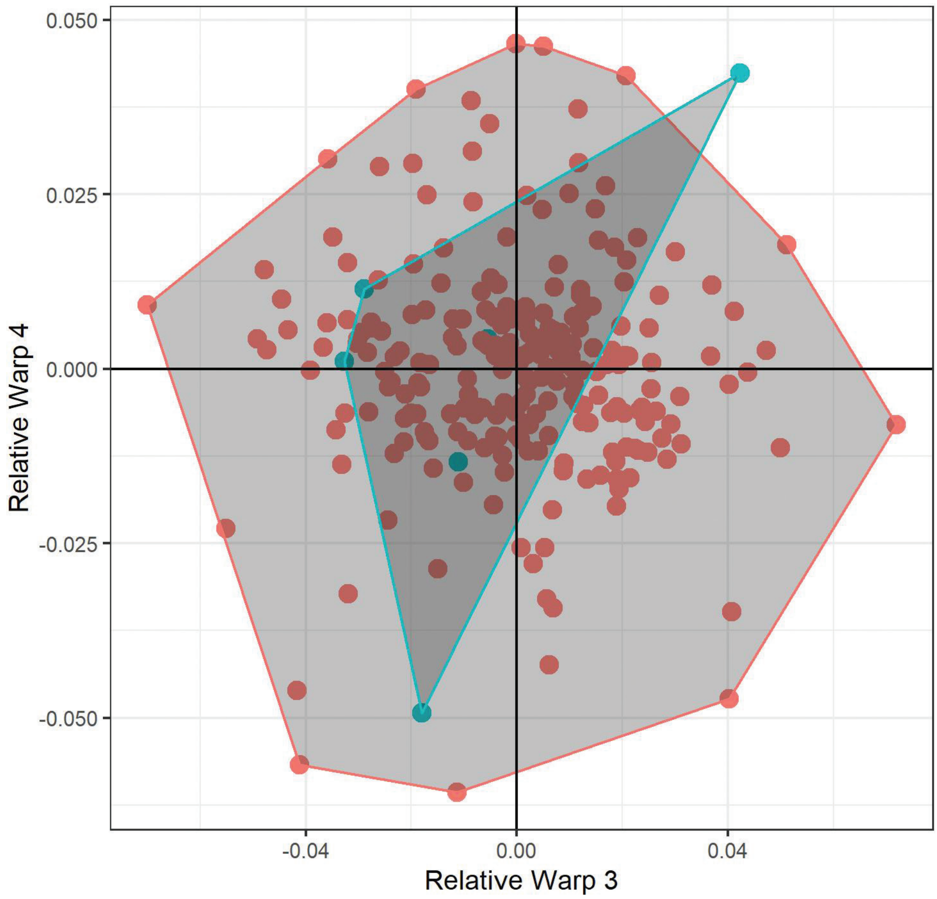

Figure 11. Scatter plot of relative warp 3 (4.25% of the overall shape variation) on the x-axis and relative warp 4 (2.39% of the overall variation) on the y-axis, with Clovis points identified by red circles and the Mielke points shown as turquoise circles.

and 3 appeared to have been damaged and reworked to some extent, which may explain why they fall outside the known Clovis shape variation.

Microwear

We employed lithic microwear analysis to identify the polishes, striations, and edge modifications related to utilization and postdepositional alteration on 32 points, preforms, and graver spurs from Mielke and 5 bifaces not found on-site but in the nearby surrounding area. Microwear analysis is used to infer the method of use, along with the contact material, by matching distinct qualitative patterns in use wear on archaeological artifacts, in this case to those identified in published experiments (i.e., Keeley 1980; Van Gijn 1990, 2010; Vaughan 1985) and those on experimental tools curated at Illinois State University. We found this method effective in interpreting the function of numerous Paleoindian chipped-stone assemblages in the region (Bebber et al. 2017; Eren et al. 2016, 2019; Eren, Bebber, et al. 2018, 2021; Miller 2013, 2014; Miller et al. 2019; Perrone et al. 2020; Werner et al. 2017). Following the procedures of these previous studies, we first washed the artifacts in liquid soap and then in fresh tap water using an ultrasonic cleaner. After air drying them, G. Logan Miller examined 37 artifacts from the Mielke collection using an Olympus BX51M metallurgical microscope at magnifications ranging from 50× to 400×.

Each of the eight gravers from Mielke were utilized. Seven of the gravers contained bright polish with micropits restricted to the edge or high points of ridges on the graver spurs. This polish is consistent with that produced experimentally by working bone or antler (Figure 12A–C). One artifact (Specimen #7) contained two graver spurs on opposing sides of the tool, and both were used on bone/antler. Three artifacts (Specimens #296, #297, and #300) had two graver spurs used on bone antler. The dual graver spurs on two of these (#296 and #297) may have functioned in tandem to create a compass graver (Tomenchuk and Storck 1997). One graver (Specimen #304) was used on dry hide as evidenced by the presence of heavy edge rounding and a dull, invasive polish

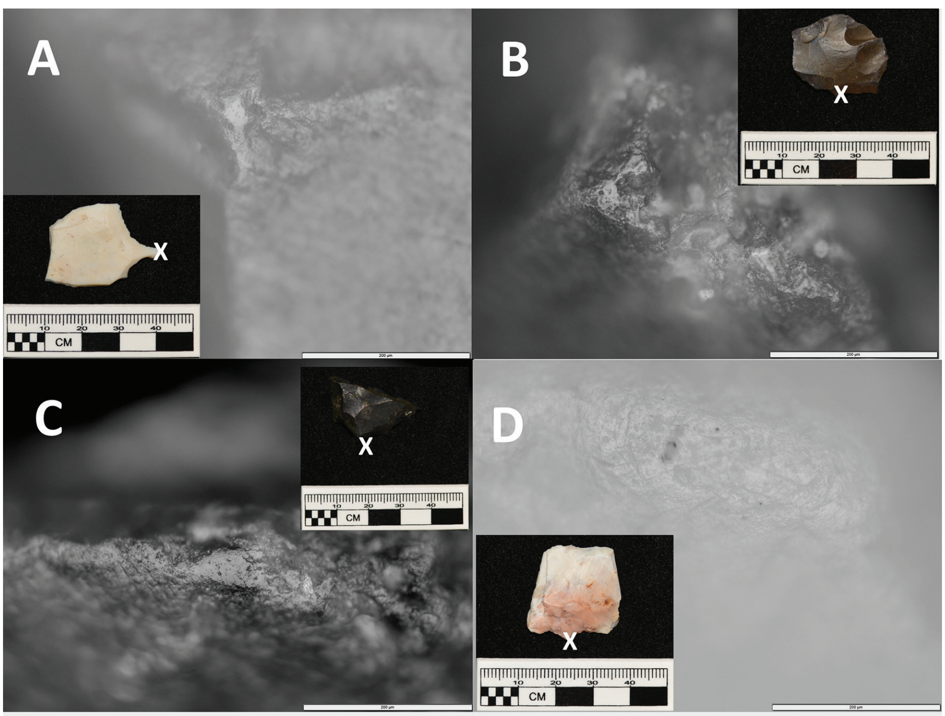

Figure 12. (A) Bright, micropitted bone/antler polish on the dorsal side of the graver spur on artifact #7; (B) bright, micropitted bone/antler polish on the dorsal side of a graver spur on artifact #297; (C) bright, micropitted bone/antler polish on the dorsal side of a graver spur on artifact #300; and (D) edge rounding and dull hide polish on the dorsal side of a graver spur on artifact #304. All photos taken at 200× magnification and their locations are indicated by the white *X* in the inset photos.

(Figure 12D). The presence of similar rounding and polish on the ridges of the dorsal face of the tool resulted from prehension, indicating that it was a hand-held tool. Two of the gravers used on bone/antler contained definitive evidence of prehension in the form of bone/antler like polish and rounding on the dorsal flake ridges. As no evidence of hafting was noted on any of the gravers, it is likely that they were all handheld tools.

Of the 24 Clovis points, point fragments, and preforms examined, 21 had no definitive evidence of utilization. Surface modification in the form of scattered bright spots of polish and minor ridge rounding was noted on 13 of these unutilized bifaces and biface fragments. It is possible that some of these traces are the result of hafting or transport, but given the unpatterned distribution of bright spots and rounding along the tool surface and the surface context of the finds, it is most likely that these represent postdepositional surface alterations. The lack of evidence for utilization is not surprising given the number of preforms included and the fragmented state of the finished fluted points. For example, no evidence of use was noted on the 13 preforms examined as would be expected for tools discarded during manufacture. Seven of the eleven finished Clovis points were either basal fragments or otherwise lacked portions of the tip/blade and could not contain evidence of edge utilization on the blade. Thus, three of the four complete finished Clovis points contained evidence of utilization. The lone exception is Specimen #4, which, as described above, may have been accidently burinated during manufacture.

Two fluted points (Specimens #15 and #16, both made of Harrodsburg chert) were likely used as projectiles. Numerous bright spots of polish were noted on each point (Figure 13A and C). These bright spots were restricted to the haft area of each point, indicating that each had been hafted. Flake scars, potentially related to projectile impact, also occur at the tip of each of these points. Each break is also associated with micropolish. The polish on Specimen #15 is very bright, most closely resembling polishes produced from contact with bone or wood (Figure 13B). The polish on the tip of Specimen #16 is duller and associated with edge rounding, resembling wear consistent with working soft tissue or hide (Figure 13D).

Numerous ridges throughout the blade and haft area of both sides of the small fluted point (Specimen #1) contained well-developed bright, micropitted polish similar to that produced from contact with bone/antler (Figure 14). The use wear on this is difficult to associate with particular activities. It is possible that the point was loosely placed in a bone or an antler haft as increased movement within a haft tends to result in higher rates of polish formation (Rots 2010). However, this use wear does extend far up on the blade of the miniature point, raising doubt that it results from hafting. An alternative explanation is that this wear formed from transporting the point in a bag along with other bone or antler items (Rots 2010:44). In this case, contact between bone/antler and the point would not have been restricted to the haft area but would have included the blade as well.

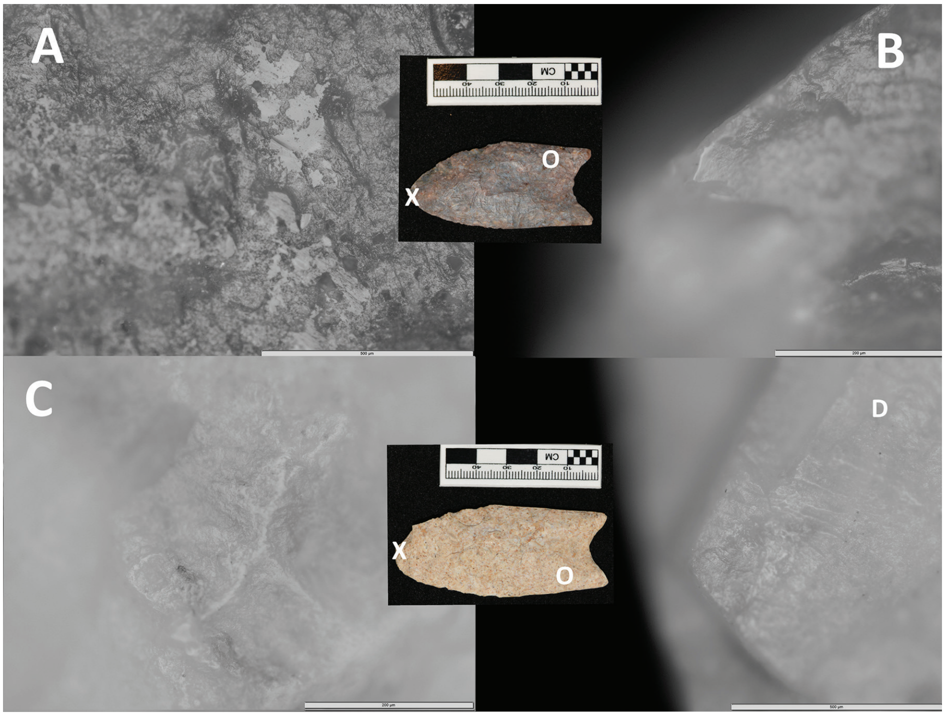

Figure 13. (A) Hafting bright spot in the haft area of artifact #15 as indicated by the circle in the upper inset photo. Magnification is 100×. (B) Bright polish from a hard material such as bone or wood near a potential impact flake scar at the tip of #15 as indicated by the *X* in the upper inset photo. Magnification is 200×. (C) Hafting bright spot in the haft area of artifact #16 as indicated by the circle in the lower inset photo. Magnification is 200×. (D) Rounding and dull polish near a potential impact flake scar at the tip of #16 as indicated by the *X* in the lower inset photo. Magnification is 200×.

None of the five bifaces recovered from nearby, but off-site, contained evidence for use as projectiles or knives. Similar to the majority of bifaces from Mielke, these tools all contained scattered bright spots of polish and minor ridge rounding. In some cases, notably the fluted point base, this pattern may be the result of hafting. Given their surface context, and similar wear patterns to the majority of bifaces from Mielke, we cannot rule out the possibility that postdepositional factors created these patterns.

Discussion

The small assemblage of Clovis projectile points and preforms, and possible Clovis graver spurs, from the Mielke site provides a window, albeit a narrow one, into Clovis activities in this region of the upper Midwest. The Clovis points that were collected directly on the site ($n = 11$) generally fall within known Clovis shape variation, save for a few that owing to reworking or other postmanufacture modifications fall outside that range. The same holds true for the specimens collected nearby. Not

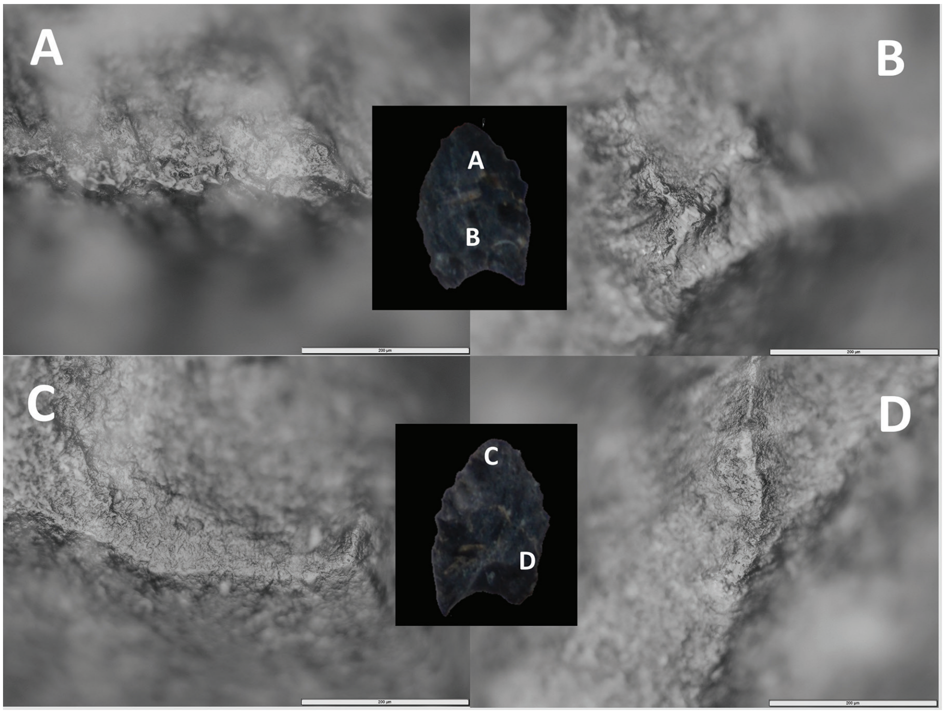

Figure 14. Examples of bright, micropitted bone/antler polish on the ridges of the miniature fluted point (Specimen #1). All magnifications are 200× and locations are indicated by letters on the inset photos.

surprisingly, wear is more apparent on the handheld graver spurs from Mielke than on the great majority of the finished Clovis points, although there lingers the question as to whether those gravers date to the Clovis period.

What is perhaps more telling and interesting with regard to the Clovis presence at this site and region is the patterning seen in the lithic raw materials that were used to manufacture the diagnostic Clovis forms recovered at the site. From that evidence, it is apparent that Clovis groups were stopping over and/or transiting in this region, having visited the source of or received in exchange stone from outcrops in very different directions and at various distances from the Mielke site. It is, however, difficult to differentiate between stone acquired by forager groups directly from its source as opposed to stone gotten via exchange (Meltzer 1989).

If, for the sake of discussion, we set aside the possibility that the lithic raw material patterns are the result of exchange, then we can envision multiple scenarios that may account for the presence of these diverse stone sources at the site.

If we assume that all the diagnostic Clovis materials are the result of a *single Clovis occupation*—though we hasten to add that this is hypothetical as there is no evidence to support that assumption—then the diversity of the stone types may reflect one of several possibilities. The first possibility is that the Mielke assemblage represents that created by an aggregation of individuals or groups who converged on this locality from different directions and regions, bringing with them stone they had collected from whence they came. If that was the case, it would imply that there had been ample resources or other attractions at this spot that would have warranted and supported a rendezvous of people. If there were, we have not identified them yet, but investigations at the site have been limited. A second, alternative, possibility is that the Mielke assemblage is the product of a single well-traveled group who made a circuit around a wide expanse of the upper Midwest, collecting stone where they found it. If this was the case, one might argue that, based on the relative proportion of the different types of stone and assuming all other things being equal, this group arrived at the Mielke site having come most recently from the region of the Harrodsburg source approximately 300 km to the south—the assumption being that stone from the source(s) most recently visited would dominate the raw material assemblage. The third and final possibility, and something of a mirror image of the prior scenario, is that a group might have been using the Mielke site as a logistical hub, from which they moved out and back to different areas, returning with stone collected in those areas.

Of course, it is possible that the diagnostic Clovis materials represent one or more *separate occupational episodes*, having been left behind by different groups who came through the site at different times. This possibility seems a priori less likely, in part for a reason noted above: namely, that there are no obvious resources that might have attracted different Clovis groups to this very same spot on separate occasions.

That said, there is one additional observation that might bear on the question of whether this was an aggregation of different groups or, alternatively, different groups on separate occasions came through the site. In general, all the finished points from the site are stylistically similar, but in one respect they differ: The points made on Harrodsburg chert have significantly deeper basal concavities than the points made on the other chert types (as measured by t-test and Mann-Whitney test; Table 3).[2] This difference may be stylistic; it may be related to hafting; it may be related to where different groups were in their seasonal rounds relative to the lithic landscape; or it may be a by-product of the fluting process and the tools and production strategies used. Regardless of which (or combination of

Table 3. Results of *t*-test and Mann-Whitney Test Comparing Depth of Basal Concavity in Finished Fluted Points Made on Harrodsburg Chert *versus* Other Chert Types.

Variable	Raw Material Type	*N*	Mean	Median	Standard Deviation	Coefficient of Variation	*t*-test		Mann-Whitney		
							t	*p*	*U*	*z*	*p*
Basal concavity	Harrodsburg chert	5	6.63	6.65	1.74	26.25					
	All other chert types	4	3.06	3.16	0.96	31.61	3.89	0.008	0	2.327	0.0199

Note: This table only includes points from the Mielke site; however, similarly significant results are obtained when "off-site" points are included in the analysis.

which) of these might apply, that a significant difference exists suggests that it is unlikely that the assemblage was made by the same set of individuals. Were it so made, we would expect the depth of basal concavity in all the points in the assemblage to be random with respect to the lithic raw material. We note that this analysis was done just on the points from the site proper. Nonetheless, the significant difference is still present when including the "off-site" points. Granting that this difference exists, and implies more than one group were involved, there is still insufficient information to determine whether this was a single occupation (aggregation) or separate occupations.

All of this raises a broader question: Why this site, at this place? Obviously, it must have had some resources that enabled or attracted foragers to stop over at this spot, though perhaps just not in sufficient abundance to support a substantial group aggregation or draw different groups to this spot. In the absence of further investigations, including excavations at the site, what those resources might have been cannot be ascertained. However, there is one element of geography that may shed some light on why groups were moving through this region. This is not a region where the topography strongly influences the movement of people and their acquisition of lithic raw material across the landscape as it does, for example, in and through regions of the Rocky Mountains (e.g., Boulanger et al. 2021). Nor do the least cost paths that would have taken Clovis groups between the sources represented at the site pass by the site itself (Figure 15).

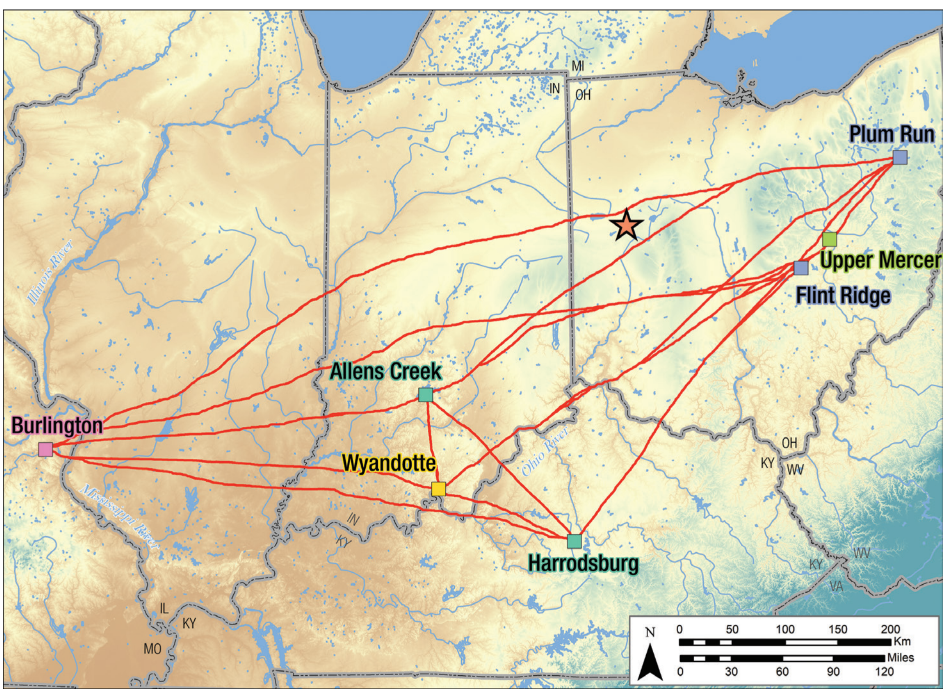

Figure 15. Least-cost paths between outcrops of chert represented at the Mielke site. (Basemap elevation and hillshade from SRTM data provided by USGS and NASA.)

However, Mielke is in an upland portion of western Ohio that forms a drainage divide between the Lake Erie and Ohio River watersheds. Groups moving between those regions could well have found themselves traveling through this area, from which they could descend the upper tributaries of either the Great Miami River, Scioto River, or (farther west) Wabash River and follow those to the south into the Ohio River valley or use those corridors to travel in the opposite direction, down the Maumee River or Sandusky River, for example, to the shores of Lake Erie (see Figure 15).

Conclusions

The Mielke assemblage contains some two dozen Clovis fluted points and preforms, which almost certainly represent just the recognizable artifacts from this time period at the site. Surely, other nondiagnostic specimens from this component are present as well but are simply not identifiable as such against the background of other specimens from the unknown number of later periods of occupation at this locality.

Why Clovis groups came through this area and apparently briefly occupied this particular spot is not known, though may in a broader sense be a result of their movements—perhaps seasonal—in and around the upper Midwest and across drainage divides.

Regardless, the evidence demonstrates that their movements were extensive, which to judge by the least-cost distances between the most remote sources they exploited (assuming, of course, that the stone was not acquired by exchange), was roughly 900 km west to east and approximately 300 km south to north. Of course, this does not account for travel on more circuitous and longer routes along drainages, between stone sources, or around what was still a relatively recently deglaciated landscape, which may have still presented challenges to movement for these foragers (e.g., poorly drained and impassable wetlands, areas still not fully restocked with plant and animal resources, and the like).

In the absence of intensive investigations, including excavations at the site to supplement and complement the surface record we report on here, little more can be said about the nature of the Clovis occupation at the Mielke site. We might speculate, in the absence of more diagnostic forms, that it was a relatively brief stay and involved groups who while there discarded a dozen of their finished points and set about replacing them using stone that was already well traveled across the landscape. It is not possible in most instances to determine the forms in which the stone was transported, whether as bifaces or flakes, though in at least one instance (Specimen #8) the preform was a large flake. Fluted points made from flakes are not uncommon in this region (Eren, Redmond, et al. 2018; Wernick 2015).

It is perhaps easier to understand why the Mielke site was also occupied in later periods (see Figures 8 and 9). In a region with a dearth of lithic raw material, the stone discarded here in Clovis times may have attracted later groups passing through the area, who took advantage of this unearned, if unexpected, resource. Or perhaps later groups simply carried on with the stone acquisition patterns that had been established over thousands of years prior.

Notes

1. Mielke contacted Kent State about the possibility of examining the site and his collection. Following Kent State's now standard practice (e.g., Bebber et al. 2017; Eren et al. 2016, 2019; Eren, Bebber, et al. 2021; Werner et al. 2017), we agreed to analyze the assemblage with the understanding that it would be donated to a public institution. Mielke agreed to donate his collections to the Cleveland Museum of Natural History, where they will hereafter be permanently curated and freely available for study.
2. It is entirely possible that Specimen 319 is a Dalton point given its deep basal concavity and blade irregularities (Tom Jennings, personal communication 2022). However, the presence of points with deep basal concavities and blade irregularities at other eastern Clovis sites—such as Paleo Crossing (Eren, Redmond, et al. 2018:Figure 9.8d), Vail (Gramly 1984), and others (Miller and Gingerich 2013; O'Brien et al. 2014)—suggests that such morphologies are not beyond Clovis point variability. We also note there is no other evidence for a Dalton presence at Mielke that would support the supposition that Specimen 319 is Dalton. For these reasons, we do not think Specimen 319 is Dalton. Nevertheless, we reran our analysis of raw material and basal concavity differences without Specimen 319. The results were unchanged.

Acknowledgments

Support for neutron activation used in this study was provided by a National Science Foundation laboratory-support grant to the Archaeometry Laboratory at the University of Missouri Research Reactor (#1912776). Michelle R. Bebber and Metin I. Eren are supported by the Kent State University College of Arts and Sciences.

Supplementary Materials

Supplementary materials for this article can be found at https://www.midwestarchaeology.org/mcja/supplemental-materials.

Artifact Measurements.xlsx
Mielke Clovis Artifact Pictures, First Set.pdf
Mielke Clovis Artifact Pictures, Second Set.pdf
NAA Samples.pdf
Post-Clovis or Nondiagnostic Mielke Specimens.xlsx
Supplementary Geochem data.xlsx
Supplementary Geochem Text S1.pdf

Data Availability Statement

The authors confirm that the data supporting the findings of this study are available within the article or its supplementary materials.

Declaration of Interest Statement

The authors declare no conflict of interest.

Notes on Contributors

Matthew T. Boulanger is a lecturer in anthropology at Southern Methodist University in Dallas, Texas.

Briggs Buchanan is an associate professor of anthropology at the University of Tulsa, in Oklahoma.

G. Logan Miller is an associate professor in the Department of Sociology and Anthropology at Illinois State University in Normal, Illinois.

Brian G. Redmond is John Otis Hower Chair and Curator of Archaeology at the Cleveland Museum of Natural History.

Bob Christy is a photographer in University Communications and Marketing at Kent State University, Kent, Ohio.

Brandi L. MacDonald is assistant research professor in the Archaeometry Laboratory at the University of Missouri Research Reactor in Columbia, Missouri.

David Mielke is an avocational archaeologist who lives in Botkins, Ohio.

Ryun Mielke is an avocational archaeologist who lives in Botkins, Ohio.

Connie Mielke is an avocational archaeologist who lives in Botkins, Ohio.

Tate Maurer is an avocational archaeologist who lives in Whitehouse, Ohio.

Bruce Meyer is an avocational archaeologist who lives in Pierceton, Ohio.

Monty Meyer is an avocational archaeologist who lives in Whitehouse, Ohio.

Brian Trego is an avocational archaeologist who lives in New Bremen, Ohio.

Andy Wilson is an avocational archaeologist who lives in Wapakoneta, Ohio.

Pete Cartwright was an avocational archaeologist who lived in Sidney, Ohio.

Leo Ott is an avocational archaeologist who lives in Botkins, Ohio.

Michelle R. Bebber is an assistant professor in the Department of Anthropology at Kent State University, Kent, Ohio.

David J. Meltzer is the Henderson-Morrison Professor of Prehistory at Southern Methodist University in Dallas, Texas.

Metin I. Eren is an associate professor of anthropology in the Department of Anthropology at Kent State University, Kent, Ohio.

References

Bebber, Michelle R., G. Logan Miller, Matthew T. Boulanger, Brian N. Andrews, Brian G. Redmond, Donna Jackson, and Metin I. Eren (2017) Description and Microwear Analysis of Clovis Artifacts on a Glacially-Deposited Secondary Chert Source near the Hartley Mastodon Discovery, Columbiana County, Northeastern Ohio, USA. *Journal of Archaeological Science: Reports* 12:543–552.

Boulanger, Matthew T. (2018) Chemical Characterization of Cryptocrystalline Silicates from Sources in the U.S. Southeast and from Smith Mountain (44PY152), Pittsylvania County, Virginia. Report to Joseph A. M. Gingerich, Smithsonian Institution, Washington, DC, from Matthew T. Boulanger, Southern Methodist University, Dallas, Texas.

Boulanger, Matthew T., Briggs Buchanan, Michael J. O'Brien, Brian G. Redmond, Michael D. Glascock, and Metin I. Eren (2015) Neutron Activation Analysis of 12,900-Year-Old Stone Artifacts Confirms 450–510+ km Clovis Tool-Stone Acquisition at Paleo Crossing (33ME274), Northeast Ohio, USA. *Journal of Archaeological Science* 53:550–558.

Boulanger, Matthew, Robert J. Patten, Brian N. Andrews, Michelle R. Bebber, Briggs Buchanan, Ian Jorgeson, G. Logan Miller, Metin I. Eren, and David J. Meltzer (2021) Antelope Springs: A Folsom Site in South Park, Colorado. *PaleoAmerica* 7:114–132.

Buchanan, Briggs, Michael J. O'Brien, and Mark Collard (2014) Continent-Wide or Region-Specific? A Geometric Morphometrics-Based Assessment of Variation in Clovis Point Shape. *Archaeological and Anthropological Sciences* 6:145–162.

Cantin, Mark (2008) *Provenience, Description, and Archaeological Use of Selected Cherts in Indiana*. Technical Report 05–01. Indiana State University Anthropology Laboratory, Terre Haute, Indiana.

Chiarulli, Beverly, and Gregory Katz (2016) Chert Sourcing Studies in Western and Central Pennsylvania. Paper presented at the Pennsylvania Archaeological Council Symposium, 87th Annual Meeting of the Society for Pennsylvania Archaeology, West Middlesex, Pennsylvania.

Converse, Robert N. (2002) The Mielke Site—A Newly Documented Paleo-American Site in Ohio. *Ohio Archaeologist* 52:24–27.

DeRegnaucourt, Tony, and Jeff Georglady (1998) *Prehistoric Chert Types of the Midwest*. Occasional Monographs of the Upper Miami Valley Archaeological Research Museum, No. 7. Western Ohio Podiatric Medical Center, Greenville.

Eren, Metin I. (2009) Paleoindian Stability during the Younger Dryas in the North American Lower Great Lakes. In *Transitions in Prehistory: Papers in Honor of Ofer Bar-Yosef*, edited by John J. Shea and Daniel E. Lieberman, pp. 385–417. Harvard University American School of Prehistoric Research Press, Cambridge, Massachusetts.

Eren, Metin I., Michelle R. Bebber, Anna Mika, Kat Flood, Leanna Maguire, Dusty Norris, Alyssa Perrone, et al. (2021) The Nelson Stone Tool Cache, North-Central Ohio, USA: Assessing Its Cultural Affiliation. *Journal of Archaeological Science: Reports* 37:102972.

Eren, Metin I., Michelle R. Bebber, G. Logan Miller, Briggs Buchanan, Matthew T. Boulanger, and Robert J. Patten (2018) Description, Morphometrics, and Microwear of Late Pleistocene–Early Holocene Artifacts from Southwestern Kentucky, USA. *Journal of Archaeological Science: Reports* 20:516–523.

Eren, Metin I., David J. Meltzer, and Brian N. Andrews (2018) Is Clovis Technology Unique to Clovis? *PaleoAmerica* 4:202–218.

Eren, Metin I., David J. Meltzer, and Brian N. Andrews (2021) Clovis Technology Is Not Unique to Clovis. *PaleoAmerica* 7:226–241.

Eren, Metin I., G. Logan Miller, Briggs Buchanan, Matthew T. Boulanger, Michelle R. Bebber, Brian G. Redmond, Charles B. Stephens, Lisa Coates, Patricia Boser, Becky Sponseller, and Matt Slicker (2019) The Black Diamond Site, Northeast Ohio, USA: A New Clovis Occupation in a Proposed Secondary Staging Area. *Journal of Paleolithic Archaeology* 2:211–233.

Eren, Metin I., Brian G. Redmond, G. Logan Miller, Briggs Buchanan, Matthew T. Boulanger, Ashley Hall, and Lee Hall (2016) The Wauseon Clovis Fluted Point Preform, Northwest Ohio, U.S.A.: Observations, Geometric Morphometrics, Microwear, and Toolstone Procurement Distance. *Journal of Archaeological Science: Reports* 10:147–154.

Eren, Metin I., Brian Redmond, G. Logan Miller, Briggs Buchanan, Matthew T. Boulanger, Brooke Morgan, and Michael J. O'Brien (2018) The Paleo Crossing Site (33ME274): A Clovis

Site in Northeastern Ohio. In *In the Eastern Fluted Point Tradition*, Vol. 2, edited by Joseph A. M. Gingerich, pp. 187–212. University of Utah Press, Salt Lake City.

Glascock, Michael D. (1992) Characterization of Archaeological Ceramics at MURR by Neutron Activation Analysis and Multivariate Statistics. In *Chemical Characterization of Ceramic Pastes in Archaeology*, edited by Hector Neff, pp. 11–26. Prehistory Press, Madison, Wisconsin.

Glascock, Michael D. (2004) Neutron Activation Analysis of Chert Artifacts from a Hopewell Mound. *Journal of Radioanalytical and Nuclear Chemistry* 262:91–102.

Glascock, Michael D., and Hector Neff (2003) Neutron Activation Analysis and Provenance Research in Archaeology. *Measurement Science and Technology* 14:1516–1526.

Gramly, Richard Michael (1984) Kill Sites, Killing Ground and Fluted Points at the Vail Site. *Archaeology of Eastern North America* 12:110–121.

Ives, David J. (1975) *The Crescent Hills Prehistoric Quarrying Area*. Museum Briefs 22. Museum of Anthropology, University of Missouri, Columbia.

Keeley, Lawrence H. (1980) *Experimental Determination of Stone Tool Uses: A Microwear Analysis*. University of Chicago Press, Chicago.

Lewis, Angela R., Jeremy C. Williams, Briggs Buchanan, Robert S. Walker, Metin I. Eren, and Michelle R. Bebber (2022) Knapping Quality of Local versus Exotic Upper Mercer Chert (Ohio, USA) during the Holocene. *Geoarchaeology*, in press.

Luedtke, Barbara E. (1992) *An Archaeologist's Guide to Chert and Flint*. Archaeological Research Tools 7. Cotsen Institute of Archaeology, University of California, Los Angeles.

Meltzer, David J. (1989) Was Stone Exchanged among Eastern North American Paleoindians? In *Eastern Paleoindian Lithic Resource Use*, edited by Christopher J. Ellis and Jonathan C. Lothrop, pp. 11–39. Westview Press, Boulder, Colorado.

Miller, D. Shane, and Joseph A. Gingerich (2013) Paleoindian Chronology and the Eastern Fluted Point Tradition. In *In the Eastern Fluted Point Tradition*, edited by Joseph Gingerich, pp. 9–21. University of Utah Press, Salt Lake City.

Miller, G. Logan (2013) Illuminating Activities at Paleo Crossing (33ME274) through Microwear Analysis. *Lithic Technology* 38:97–108.

Miller**,** G. Logan (2014) Lithic Microwear Analysis as a Means to Infer Production of Perishable Technology: A Case from the Great Lakes. *Journal of Archaeological Science* 49:292–301.

Miller, G. Logan, Michelle R. Bebber, Ashley Rutkoski, Richard Haythorn, Matthew T. Boulanger, Briggs Buchanan, Jennifer Bush, C. Owen Lovejoy, and Metin I. Eren (2019) Hunter-Gatherer Gatherings: Stone-Tool Microwear from the Welling Site (33-Co-2), Ohio, USA Supports Clovis Use of Outcrop-Related Base Camps during the Pleistocene Peopling of the Americas. *World Archaeology* 51:47–75.

Morrow, Carol A., J. Michael Elam, and Michael D. Glascock (1992) The Use of Blue-Grey Chert in Midwestern Prehistory: The Need for Baseline Data. *Midcontinental Journal of Archaeology* 17:166–197.

Neff, Hector (2000) Neutron Activation Analysis for Provenance Determination in Archaeology. In *Modern Analytical Methods in Art and Archaeology*, edited by Enrico Ciliberto and Giuseppe Spoto, pp. 81–134. John Wiley and Sons, New York.

Nolan, Kevin C., Paul Sciulli, Samantha Blatt, and Christine K. Thompson (2015) A Late Woodland Red Ocher Burial Cache from Madison County, Ohio. *North American Archaeologist* 36:197–236.

Norris, James D., Charles Stephens, and Metin I. Eren (2019) Early- and Middle-Stage Fluted Stone Tool Bases Found near Fox Lake, Wayne County, Ohio: Clovis or Not? *Journal of Archaeological Science: Reports* 25:1–6.

O'Brien, Michael J., Matthew T. Boulanger, Briggs Buchanan, Mark Collard, R. Lee Lyman, and John Darwent (2014) Innovation and Cultural Transmission in the American Paleolithic: Phylogenetic Analysis of Eastern Paleoindian Projectile-Point Classes. *Journal of Anthropological Archaeology* 34:100–119.

Perrone, Alyssa, Michelle R. Bebber, Matthew Boulanger, Briggs Buchanan, G. Logan Miller, Brian G. Redmond, and Metin I. Eren (2020) Description, Geometric Morphometrics, and Microwear of Five Clovis Fluted Projectile Points from Lucas and Wood Counties, Northwest Ohio, USA. *Journal of Paleolithic Archaeology* 3:1034–1047.

Rots, Veerle (2010) *Prehension and Hafting Traces on Flint Tools: A Methodology*. Leuven University Press, Leuven, Belgium.

Seeman, Mark F., Amanda N. Colucci, and Charles Fulk (2020) Hunter-Gatherer Mobility and Versatility: A Consideration of Long-Term Lithic Supply in the Midwest. *American Antiquity* 85:113–131.

Shackley, M. Steven (1998) Gamma Rays, X-rays and Stone Tools: Some Recent Advances in Archaeological Geochemistry. *Journal of Archaeological Science* 25:259–270.

Simons, Donald B. (1997) The Gainey and Butler Sites as Focal Points for Caribou People. In *Caribou and Reindeer Hunters of the Northern Hemisphere*, edited by Lawrence J. Jackson and Paul T. Thacker, pp. 105–131. Avebury, Aldershot, United Kingdom.

Tomenchuk, John, and Peter L. Storck (1997) Two Newly Recognized Paleoindian Tool Types: Single- and Double-Scribe Compass Gravers and Coring Gravers. *American Antiquity* 62:508–522.

Van Gijn, Annelou L. (1990) *The Wear and Tear of Flint: Principles of Functional Analysis Applied to Dutch Neolithic Assemblages*. Analecta Praehistorica Leidensia 22. Modderman Stichting/Faculty of Archaeology, Leiden University, Leiden, Netherlands.

Van Gijn, Annelou L. (2010) *Flint in Focus: Lithic Biographies in the Neolithic and Bronze Age*. Sidestone Press, Leiden, Netherlands.

Vaughan, Patrick C. (1985) *Use-Wear Analysis of Flaked Stone Tools*. University of Arizona Press, Tucson.

Werner, Angelia, Kathleen Jones, G. Logan Miller, Briggs Buchanan, Matthew T. Boulanger, Alastair J. M. Key, Crystal Reedy, Michelle R. Bebber, and Metin I. Eren (2017) The Morphometrics and Microwear of a Small Clovis Assemblage from Guernsey County, Southeastern Ohio, U.S.A. *Journal of Archaeological Science: Reports* 15:318–329.

Wernick, Christopher D. (2015) Clovis Points on Flakes: A Technological Variation Seen in Long Distance Lithic Transport. *Plains Anthropologist* 60:246–265.