Stone tool function at the paleolithic sites of Starosele and Buran Kaya III, Crimea: Behavioral implications

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Stone tools are often the most abundant type of cultural remains at Paleolithic sites, yet their function is often poorly understood. Investigations of stone tool function, including microscopic use-wear and residue analyses, were performed on a sample of artifacts from the Paleolithic sites of Starosele (40,000–80,000 years BP) and Buran Kaya III (32,000–37,000 years BP). The Middle Paleolithic levels at Starosele exhibit a typical variant of the local Micoquian Industry. The artifacts from Buran Kaya III most closely resemble an Early Streletskayan Industry associated with the early Upper Paleolithic. The results of the functional analyses suggest that hominids at both sites were exploiting woody and starchy plant material as well as birds and mammals. Both sites show evidence of hafting of a wide variety of tools and the possible use of projectile or thrusting spears. These analyses were performed by using two different techniques conducted by independent researchers. Combined residue and use-wear analyses suggest that both the Upper Paleolithic and Middle Paleolithic hominids at these sites were broad-based foragers capable of exploiting a wide range of resources.

stone tools | residue analysis | use-wear | Neandertal | modern humans

Neandertals have been portrayed as everything from obligate scavengers (1) to mixed hunters and scavengers (2) to hunters (3–8). They are often regarded as having poorly developed cognitive skills relative to anatomically modern humans, presumably because of the inferred lack of symbolic and speech capacities (9, 10). The presence of "modern human" behaviors, those typically associated with the Upper Paleolithic, has been attributed to acculturation through contact between Neandertals and modern humans (11, 12) as well as to independent invention by Neandertals (13). Recent applications of stable carbon and nitrogen isotopes derived from Neandertal bone collagen suggest that Neandertals from the sites of Vindija, Marillac, and Scladina occupied a trophic level of a top carnivore (14, 15) with most of their dietary protein derived from animal sources. Further evidence for Late Pleistocene hominid behavior comes from zooarchaeological studies designed to reconstruct prehistoric subsistence (2, 16). Faunal remains and stable isotope analysis, however, are not the only sources of behavioral information. Stone tools are typically the most abundant cultural remains at Late Pleistocene sites; however, their use and function remain largely unknown.

The results of a handful of functional studies of Middle Paleolithic tools (8, 17–22), primarily involving use-wear analysis, show that tools were used for a variety of tasks. Recently, archaeologists have recognized that residues of the worked material, such as fragments of wood, hair, and feathers, can survive on prehistoric tool surfaces (17, 20, 23–31). Microscopic analysis of residues can provide specific identification of the use-material. Furthermore, comparison of residue and use-wear patterns can produce a detailed picture of tool function. A sample of stone tools from two sites, Starosele and Buran Kaya III, both in Crimea, Ukraine, were examined for the presence of both residues and use-wear to better understand Middle and Early Upper Paleolithic stone tool function and late Neandertal subsistence.

Starosele

The site of Starosele is located in a small box canyon on the southern bank of the Churuksu River in southwestern Crimea (Ukraine). It was first discovered and excavated by Alexander Formosov in 1952. The excavations yielded abundant cultural material that was assigned to a single late Micoquian occupation (32). Early excavations also yielded human remains, including juvenile and partial adult skeletons, which were considered to be transitional between Neandertal and modern human morphology. Further excavations were undertaken as part of a joint Ukrainian-American Middle Paleolithic of the Crimea project from 1993 to 1995 (33). The recent excavations showed four discrete cultural horizons with lithic assemblages attributed to various facies of the late Micoquian. A more detailed understanding of the stratigraphy revealed that the human remains were most likely intrusive from the late-medieval time period (34). Apart from Skhul and Qafzeh in Israel, however, all Middle Paleolithic fossil associations in the northwestern Old World are with Neandertals. The newly defined levels range in age from ≈70–80,000 BP (Level 4) to ≈40,000 (Level 1), with the majority of cultural material coming from Level 3, ≈46,000 BP (32, 34–36). The faunal remains at the site are dominated by horse (*Equus hydruntinus*) but also include saiga (*Saiga tatarica*), various deer (*Cervus elaphus, Cervus* sp.), carnivores, and some birds. The paleoenvironmental reconstructions suggest dry, open conditions (forest and meadow-steppe) for Level 4 and the development of a riparian environment in Levels 3 through 1 (34–36).

Buran Kaya III

The site of Buran Kaya III is located on the eastern bank of the Burulcha River, 5 km south of Belogorsk in eastern Crimea (Ukraine). The collapsed rockshelter was first excavated in 1990 by Yanevich and colleagues (37) and consists of 13 archaeological levels ranging from the Late Bronze Age to the Middle Paleolithic. Excavations by the Joint Ukrainian/American/Belgian Project from 1996 to 1998 showed that the lowest level, Level C, contained an Early Streletskayan lithic industry stratified below a level of typical Middle Paleolithic Kiik-Koba Micoquian (38). This Early Streletskayan Industry is characterized by bifacial foliate points, endscrapers, and bifacial geometric microliths as well as ringed and snapped bone tubes and handles made from hare and wolf long bones (39). Direct radiocarbon dating of bone from Level C yielded dates ranging from 32,200 ± 650 BP (OxA-6869) to 36,700 ± 1500 (OxA-6868). The overlying Kiik-Koba Micoquian level dates to *ca.* 28,600 BP (37, 40). Paleoenvironmental reconstruction is incomplete although the Crimea was generally milder during the last glacial than other

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parts of Europe. Diagnostic human remains are not known from the Streletskayan levels, but similar initial Upper Paleolithic levels in central and western Europe have yielded only diagnostic Neandertal remains (12, 41, 42). Although the manufacturer of the Early Streletskayan Industry is unknown, it may represent a late Neandertal occupation.

Methods

Samples. A total of 50 artifacts (Starosele, $n = 31$; Buran Kaya III, $n = 19$) were subjected to both use-wear and residue analyses. Residue analysis requires unwashed, minimally handled tools, to reduce potential loss of residues or the introduction of modern contaminants. Therefore, an opportunistic sample of artifacts were selected during the process of excavation and were placed in clean, self-sealing plastic bags until the time of residue analysis.

Residue Analysis. Unwashed, minimally handled stone tools were examined for the presence of residues by B.L.H. by using incident light microscopy at magnifications of 100 to 500 diameters. All residues observed were photographed and their locations were recorded on line drawings. Sediment samples from areas adjacent to the artifacts were also examined for the presence of residues. If a residue was found on the tool surface and in the sediment surrounding the tool, it was not considered to be use-related (21, 22). Residues were identified through comparison with modern collections and published material. Fibers were identified as hairs based on the presence of either a medulla (inner layer) or cuticle with scale patterns (outer layer) (43). Feather barbules were identified by the presence and configuration of prongs on nodes that can be diagnostic to the Order level (44). Wood residues were identified based on the presence of diagnostic anatomy such as bordered pits in tracheids (45). Some residues from Starosele were removed from tool surfaces for examination with a scanning electron microscope and aided in the confirmation of hair and feather identification.

Plant Residue Preservation. The general assumption in archaeology is that plant remains do not survive from early time periods except under exceptional conditions of preservation (46). As archaeologists increasingly employ fine-scale recovery methods, however, including flotation and microscopic residue analyses, they are finding that plant microremains can survive and be recovered (21, 46, 47). Although the taphonomy and mechanisms of plant microremain preservation remain poorly understood, recent geochemical studies suggest that, as an organism enters the geological environment, biomolecules undergo alteration at the physical, chemical and isotopic level (48). Despite these changes, some molecular or structural information may remain intact (48–50). Part of the process of degradation involves the infiltration of soluble and structural proteins from fungi and other microorganisms into the decaying tissue. Chemical structures resistant to biological decay may be formed as proteins unfold and are modified by microorganisms or combine with free sugars. Experiments involving plant remains in litter bag studies demonstrate through changes in stable isotope ratios that plant biochemicals can be replaced by geological macromolecules within a few months of the beginning of diagenesis (48). Although this process alters biochemicals that may be of potential interest to archaeologists, it may preserve the overall structure of the tissue, making it possible to identify anatomically or taxonomically by using microscopic techniques.

Use-Wear Analysis. After residue analysis was complete, artifacts were sent to M.K. for use-wear analysis. The artifacts were subjected to ultrasonic cleaning in an ammonium-based detergent and water to remove adhering sediments and oils. Subsequently, they were examined by using differential-interference microscopy with polarized light Nomarski optics at magnifications ranging from 100 to 400 diameters for wear patterns, including both striations and polishes (51, 52). Wear patterns were photographed and their position on the artifact were recorded on macroscopic photographs. Residue and use-wear analyses were performed independently to use each method as a cross-check for the other. Only after both sets of analyses were complete were any of the results discussed or compared by B.L.H. and M.K.

Results

Starosele. Twenty-eight of the thirty-one artifacts (90.3%) from Starosele exhibited some type of functional evidence with the remainder (3/31, or 9.7%) showing neither use-wear nor residues. A large percentage (25/31, or 80.6%) of the artifacts had both use-wear and residue evidence. When the two types of evidence were compared, the results could classified in the following categories: (*i*) complete agreement (distribution and functional interpretation matched); (*ii*) consistent (use-wear indicated hard materials and residues were predictably not present); (*iii*) provided new insight (both types of evidence were present but did not overlap); (*iv*) not applicable (only use-wear was present); (*v*) contradictory (distribution and functional interpretation disagreed). Using these categories, 26/31 artifacts (83.9%) were in complete agreement. One artifact, a single hafted burin (STR95–22), exhibited use-wear indicative of contact with a medium hard material but no residues. This falls within the consistent category, because residues are often lacking with hard use-materials. Two artifacts, both cores from Level 3 (STR95–4, STR95–8), were classified as not applicable, because they had use-wear indicating soft to medium hard material but no residues. The final two tools had use-wear and residues that did not overlap but, when taken together, provided new insight. The two approaches produced no contradictory evidence.

The sample was grouped into broad tool classes (scrapers, points, denticulates, retouched pieces, flakes, and cores) to look for correlations between morphological form and tool function (Table 1). Because of the small sample sizes, Levels 1–4 will be examined together.

Scrapers. The sample contains 19 scrapers, 10 of which (52.6%) show evidence for hafting. Hafting was identified by the presence of striations confined to the proximal third to half of the tool or the presence of plant tissue such as wood fragments or starch grains that were also confined to the proximal portion of the tool. These residues were presumably part of a binding or mastic to hold the tool in the haft. Both hafted and hand-held scrapers were used on materials ranging from hard to soft, and many appear to have served multiple functions. Plant residues (starch grains, raphides, and cellular plant tissue) predominate, but animal residues (hair and feathers) are present as well. Two of the hafted artifacts are typologically scrapers but converge to a point. The tips of these artifacts show impact striae, suggesting that they were used as hafted points or projectiles.

Points. All five of the artifacts classified as points show evidence of hafting and may have served as thrusting or projectile points. Fig. 1 illustrates a unifacially retouched point that has been used as a projectile/thrusting tool and a cutting implement. The nodes of the feather in Fig. 1 *C* and *D* have single barb projections and probably come from the Order Falconiformes (44). The proximal half of the tool has starch grains that were likely involved in the binding or mastic of a haft.

Denticulates, cores, flakes, and retouched pieces. The one denticulate in the sample has hafting evidence (striae and starch grains) with use-wear, indicating a relatively soft material. Two cores have use-wear from contact with a soft to medium hard material and no residues. Two artifacts are unmodified flakes, one of which appears to be unused. The other flake shows evidence of use on a soft to medium hard plant. Both retouched pieces have functional evidence. The proximal half of one has an

Table 1. Summary of frequencies of functional results by site and tool type

Tool type	Hafted	Projectile/ thrusting	Wood	Plant	Feather	Hair	Unknown material	None
Starosele								
Points	5/5	5/5	0/5	4/5	1/5	0/5	0/5	0/5
Scrapers	10/19	2/19	1/19	14/19	1/19	2/19	1/19	2/19
Denticulates	1/1	0/1	0/1	1/1	0/1	0/1	0/1	0/1
Cores	0/2	0/2	0/2	0/2	0/2	0/2	2/2	0/2
Flakes	0/2	0/2	0/2	1/2	0/2	0/2	0/2	1/2
Retouched pieces	1/2	1/2	0/2	1/2	0/2	0/2	0/2	0/2
Total	17/31	8/31	1/31	21/31	2/31	2/31	3/31	3/31
Buran Kaya III								
Points	7/9	6/9	0/9	4/9	1/9	3/9	2/9	0/9
Scrapers	1/2	0/2	2/2	0/2	0/2	0/2	0/2	0/2
Pièces esquillées	1/3	0/3	0/3	1/3	0/3	0/3	0/3	0/3
Flake	0/1	0/1	0/1	1/1	0/1	0/1	0/1	0/1
Trapezoids	1/4	0/4	0/4	2/4	0/4	0/4	2/4	0/4
Total	10/19	6/19	2/19	8/19	1/19	3/19	4/19	0/19

amorphous black substance, possibly a resin, and plant tissue. The opposite end has cutting and impact striae, suggesting that the tool was hafted and used as a projectile or thrusting point. The other retouched piece was unhafted and has plant tissue and use-wear indicative of cutting or scraping a hard plant material.

Buran Kaya III. All 19 of the artifacts from Buran Kaya III exhibited some type of functional evidence (Table 1). Twelve of the nineteen artifacts (63.1%) had functional evidence that was in complete agreement. Of the remaining seven artifacts, six had use-wear and no residue, and one had residue only.

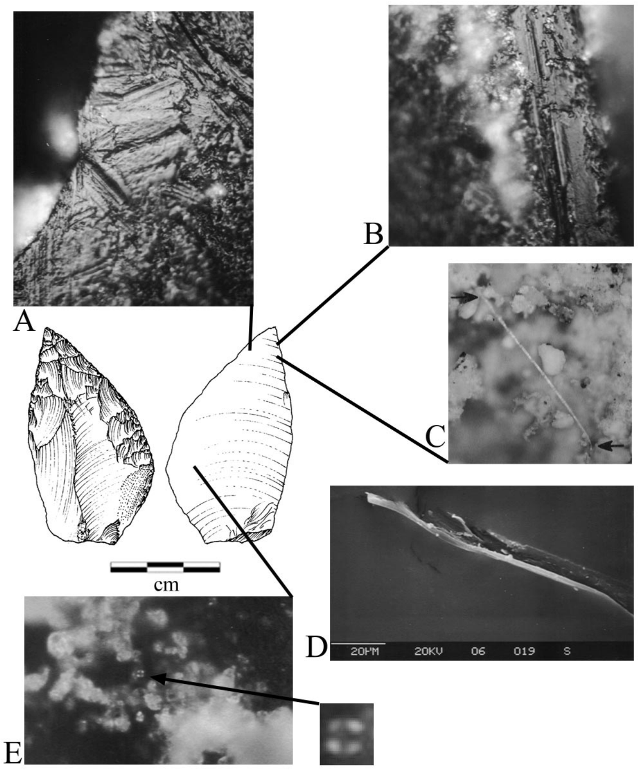

Fig. 1. Starosele (#95–6) Unifacially retouched point. (*A*) Complex striations from cutting. (*B*) Impact striations. (*C*) Feather barbule. (*D*) Fragment of feather barbule showing node with one projecting prong characteristic of Order Falconiformes. (*E*) Starch grains, confined to proximal half of tool, related to hafting as a binding or mastic.

Tool types in the Buran Kaya III sample include bifacial foliate points, scrapers, scaled pieces (pièces esquillées), trapezoidal microliths, and a flake. The trapezoidal microliths have two to three retouched edges and closely resemble microliths from the Mesolithic (40).

Bifacial foliate points. Nine artifacts are classified morphologically as bifacial points, either finished foliates or foliate shaped preforms. Six of the nine (66.7%) have distal snaps, and one (11.1%) has a proximal snap. Two of the snaps refit, making a total of three complete points. Fig. 2 illustrates the functional evidence from the refit point. This point shows evidence of both impact and cutting. Feather barbules and mammalian hair are both found on the distal end of the point. Striations on the proximal third of the tool suggest hafting. Finally, the snapped edge of the proximal portion appears to have been used after the tool was snapped. Plant material found near this snap is related either to hafting or to use

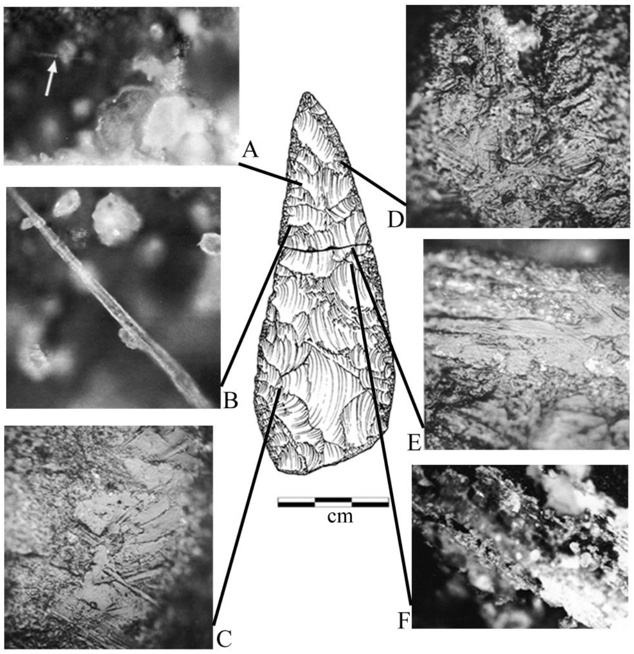

Fig. 2. Buran Kaya III (#1, 2) Snapped bifacial point. (*A*) Feather barbule. (*B*) Hair fragment. (*C*) Striations related to hafting. (*D*) impact and cutting striations. (*E*) Striations along snap from use on a hard material. (*F*) Fragment of woody plant tissue related to either use of snapped point or to the haft itself.

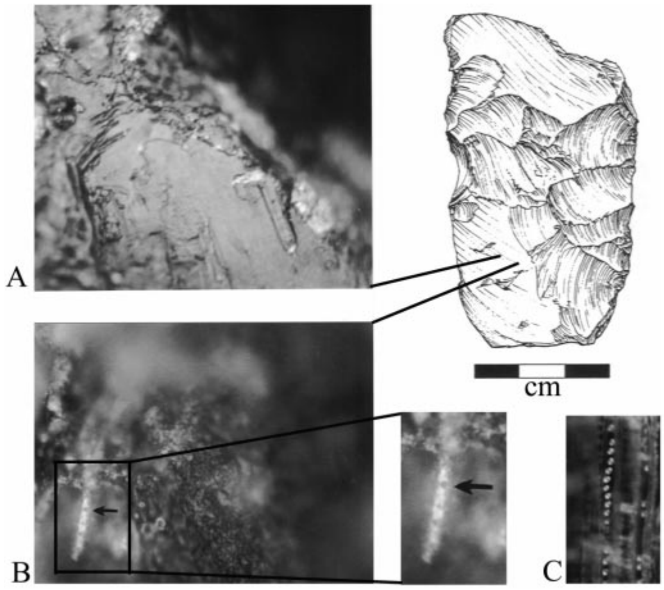

Fig. 3. Buran Kaya III (#4) Bifacial scraper. (*A*) Striations relating to hafting. (*B*) Fragment showing bordered pits indicative of gymnosperm wood, remains of haft. (*C*) Modern sample of pine (*Pinus* sp.) showing bordered pits.

of the snapped tool. Use-wear suggests that all of the points were used also as cutting tools. Residues show that the materials cut included animal and avian tissue, as well as plants (woody and nonwoody). Five of nine (55.6%) points show evidence of hafting through impact striae, striae on the proximal portion of the tool, or residues on the proximal portion of the tools from the haft itself. The evidence for hafting may be underrepresented because of the lack of the proximal portions.

Scrapers. The two scrapers examined had fragments of wood tissue adhering to their surfaces. Use-wear results concur that these tools were used to cut or scrape relatively hard material and further suggest that one scraper was hafted. Fig. 3 shows one scraper with both striations related to hafting and woody tissue confined to the proximal half of the tool. The woody tissue exhibits bordered pits indicative of gymnosperm (softwood) tissue.

Scaled pieces. Of the three scaled pieces in the sample, two have no residues but do have use-wear, implying that they were used as wedges. The third shows evidence of hafting with plant tissue found in association with use-wear on the proximal portion of the tool.

Flake. The flake examined has striations indicating invasive scraping. Plant tissue is found to be consistent with the distribution of the use-wear, suggesting that the tool was used for scraping plant material.

Trapezoidal microliths. Two trapezoidal microliths have no residues, but use-wear suggests that they were used for cutting with at least one being hafted. One other trapezoid has no use-wear but does show plant tissue. The plant tissue consists of starch grains and raphides, but the lack of use-wear makes functional interpretation unclear. Plant tissue with visible cellular structure is the only functional evidence found on the final trapezoid.

Discussion

Starosele. Evidence from Neandertal skeletal morphology and paleopathology has been used to argue that Neandertal prey capture techniques involved high-risk, close-quarters confrontation (4). Furthermore, linear enamel hypoplasias in Neandertals occur throughout development, but they occur more frequently before or during weaning among Upper Paleolithic, anatomically modern humans (53, 54). Combined with a relatively low average age at death, the hypoplasia evidence suggests that Neandertals underwent periods of nutritional stress or famine on a frequent basis (55). Ambrose (56) has suggested that this nutritional stress may be a function of the amount of animal protein in the diet and that Neandertals may have differed trophically from anatomically modern humans by having a higher incidence of plants in their diet. By contrast, stable carbon and nitrogen isotope studies suggest that Neandertals were top carnivores who obtained almost all of their protein from animal sources, at least in Europe (14, 15). Residue and use-wear analyses of stone tools can be used to help test these hypotheses.

First, evidence from Starosele indicates that stone tools were being hafted for a variety of purposes. Hafting evidence includes use-wear confined to the proximal areas of a tool, as well as starchy and other plant materials, which may be part of a binding or mastic or may be remnants of hafts. Furthermore, use-wear indicative of impact suggests that many of the pointed pieces were subject to strong forces during use, possibly because they were thrown or thrust forcefully into an object. One point having both impact and butchery use-wear also had complementary feather barbules from a raptor. Feather barbules from the Order Anseriformes (waterfowl such as geese, ducks, and swans) are also present on Starosele tools. Recently, Boëda *et al.* have shown that some Middle Paleolithic tools at Umm el Tlel in Syria were hafted with bitumen (19) and used as projectiles (57). The results from Starosele add to the growing evidence of hafting in the Middle Paleolithic in general (8, 18, 57) and suggests that Neandertals may not have been limited to close-quarters battles to obtain prey. Experiments with replicated Clovis points, similar in weight and mass to some of the Starosele points, show that they can be both thrown and thrust effectively (58). Although it is clear that many of the tools were being used as spear tips, it is not possible to distinguish between throwing or thrusting with the available evidence. Nevertheless, if one envisions a single mode for spear use and considering prey variability, then the more likely interpretation is indirect, long-distance killing, or what could be accomplished only by throwing (projecting).

Other artifacts were hafted for use as scrapers or cutting and used for the cutting of animal and plant tissue. Although it is not possible to specifically identify the plant material to taxon, both woody and nonwoody tissues are present. Much of the starchy material observed is probably related to the binding or mastic of a haft but also occurs on the working area of tools and may, therefore, represent food residue.

The question of the importance of plant foods in the Middle Paleolithic is generally given token acknowledgment while most of the attention is focused on carnivory. Carnivory is often emphasized because modern high-latitude foragers are the most common ethnographic model used for reconstructing Neandertal behavior. High-latitude foragers typically rely heavily on meat because plant productivity is generally limited. Some Neandertals would have faced similar constraints because they were living in glacial conditions (59). Plant foods, however, are available in extreme cold environments, at least periodically or seasonally (59, 60). Moreover, Neandertals would have lived in a variety of habitats because of the climatic fluctuations of the late Pleistocene and their wide latitudinal range from northern Europe to modern-day Israel (11, 59). The perception that plant materials were unavailable to Middle Paleolithic hominids also stems from the differential preservation of macroscopic plant and animal remains (46). As more investigators look for plant microremains, however, more are being found (21, 22, 46, 47), and the results presented here suggest that residue analysis may be one way to detect plant remains that might otherwise be unrecovered. Although microscopic residue and use-wear studies may not yield quantitative data about the trophic level of Neandertals, they do at least begin to demonstrate that plants were exploited and may yield evidence of which plants were important.

Woodworking is clearly indicated at Starosele, either indirectly through evidence for hafting or directly through the observation of wood remains on tool surfaces. Use-wear studies from these time periods have repeatedly found evidence of woodworking (17, 18, 61, 62). Although it is not possible to accurately reconstruct the behaviors reflected by woodworking, some of it is certainly related to the preparation of hafts.

Animal residues found on Starosele tools demonstrate that both hair and feather fragments can survive and be recognized. The hair fragments are not unexpected, because the faunal remains at the site are dominated by large mammals (38). Avian remains are typically rare at Middle Paleolithic sites either because of preservation bias or because they were not heavily exploited, and avian resources are only rarely considered in behavioral reconstructions (63). The avian bones found at Starosele probably represent fledglings fallen from the cliff above (38). While it is not possible to say whether the feather residues represent food procurement or some other activity, they do suggest that birds were being exploited. Microscopic residue analysis may provide another method of recovery of avian remains that might otherwise be underrepresented.

Buran Kaya III. The tool functions observed at Buran Kaya III are broadly similar to those at Starosele. A wide range of materials were exploited, including animal and avian resources as well as woody and nonwoody plants. Many of the artifacts at Buran Kaya III show evidence of hafting. This evidence includes both use-wear and residues such as plant remains that may be remnants of the original haft or binding. However, unlike Starosele, the Buran Kaya III hafted artifacts are not associated with starch residues. Starch grains and raphides (calcium oxalate crystals) are present on only one of the trapezoidal microliths, but they are not patterned in a manner that suggests hafting. The more likely explanation in this case is that the microlith was hafted and used to plane or scrape a starchy substance. Although it is not possible to specifically identify the source of the starch, the presence of raphides suggests that it derives from a starchy storage organ such as a root or tuber (64). Hafted artifacts at Buran Kaya III include a scraper, two of the trapezoids, a wedge, and seven bifacial points. The bifacial points, six of which are broken, show impact striations indicative of use as projectile or thrusting spears. Many of these bifacial points were also used in cutting plants, mammals, and birds. The similarity of this evidence to the points from Starosele supports the hypothesis that hominids at these sites may not have been restricted to close-quarters, high-risk battles for prey capture. Hair and feather residues on Buran Kaya III artifacts indicate that both mammalian and avian resources may have been prey. Although faunal analysis is incomplete, both mammalian and avian bones are present at the site.

Plant remains, both woody and nonwoody, are also frequent and support the findings suggesting that plant microremains are more common than is generally believed (21, 22, 46, 47). Woody plant tissue, in one case identifiable as gymnosperm, is found on both the hafted area of artifacts and on the working edge. Artifacts at Buran Kaya III were not only hafted with wood but also used in the elaboration of wooden implements. The nonwoody plant tissue is not presently identifiable to taxon, but it may well represent food remains, particularly the starch and raphides present on one trapezoid.

The tool functions interpreted for artifacts at Starosele and Buran Kaya III are broadly similar despite the differences in typology and age. Based on the use-wear and residue evidence, the behaviors of the hominids at Buran Kaya III, Level C, and Starosele were not markedly different in terms of tool use. Other lines of evidence, particularly faunal and zooarchaeological data, are needed to further test this hypothesis.

Conclusions

Microscopic use-wear and residue analyses were performed by independent researchers and used to cross-check functional interpretations on a sample of Middle and Early Upper Paleolithic stone tools. Although the artifacts from the early Upper Paleolithic level at Buran Kaya III are technologically more sophisticated and reflect a greater emphasis on economy of raw material in manufacture than those from the Middle Paleolithic levels at Starosele, the functional results at both sites show the exploitation of a wide range of resources as well as tools that served multiple functions. The presence of feather barbule fragments on tools from both sites hints that avian resources may have been more important to Middle and Early Upper Paleolithic hominids than is generally considered. Evidence for mammal exploitation provides another line of evidence to complement zooarchaeological and isotopic studies. Microscopic residue analysis of stone tools seems particularly promising in the recognition and identification of plant remains. Although much work remains to be done on specific identification of plant residues, their mere recovery at Paleolithic sites is noteworthy.

Functional analysis of stone tools also allows the testing of hypotheses about stone tool typology and function. Although traditional stone tool typologies often have names that imply function (e.g., hand-axe and scraper), archaeologists have very little direct evidence of tool use. The findings here suggest that tool types in the Middle and Early Upper Paleolithic of the Crimea served multiple rather than discrete functions. Although the results of this study cannot precisely reconstruct the behaviors reflected at these sites, they do indicate that Middle and Early Upper Paleolithic hominids in the Crimea were exploiting a similarly wide range of resources and do not support a major change in tool use with the advent of the Upper Paleolithic. Because the maker of the Early Streletskayan lithic industry is unknown, these results suggest that different hominid groups, possibly all late Neandertals, had similar subsistence strategies despite changes in lithic and bone technologies that traditionally have been associated with modern behavior and anatomically modern hominids.

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