Chapter 5

UPPER PALEOLITHIC TOOLSTONE PROCUREMENT AND SELECTION ACROSS BERINGIA

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ABSTRACT

Two lithic techno-complexes characterize the terminal Pleistocene archeological record of Beringia, a non-microblade complex and a microblade complex. Archeologists working in the region have given two interpretations to explain this lithic variability. Some have argued that the complexes represent two distinct cultural groups, while others have suggested the variability represents two technological features of a single complex used by a single group of people. These interpretations are deeply rooted in descriptive analysis and culture history. In this chapter we employ a behavioral approach to explore these explanations by focusing on differences in toolstone procurement and selection represented in two sets of non-microblade and microblade assemblages from the Dry Creek site, Alaska (USA) and the Ushki-5 site, Kamchatka (Russia). Our results show that toolstone procurement and selection were both unpatterned and unplanned in non-microblade assemblages, but patterned and planned in microblade assemblages. The differences seen between the techno-complexes may have resulted from the varied ways people were provisioning and using the landscape.

INTRODUCTION

For two decades, some archeologists have argued that the earliest inhabitants of Beringia are represented by two separate technological complexes, one with and the other without microblades. Both complexes have been consistently found in well-dated, stratigraphic contexts in central Alaska and Kamchatka, Russia (Figure 5.1). In central Alaska, non-microblade assemblages make up the Nenana Complex, whereas microblade assemblages comprise the Denali Complex (Powers and Hoffecker 1989; Hoffecker *et al.* 1993). In Kamchatka, these assemblages have been referred to as the early Ushki and late Ushki complexes, respectively (Dikov 1979;

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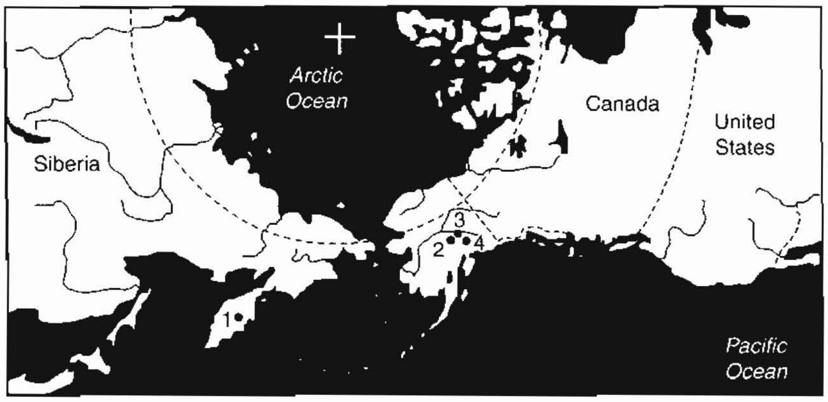

Figure 5.1 Map of Beringia with locations of archeological sites mentioned in text (1, Ushki sites; 2, Nenana Valley sites [Dry Creek, Moose Creek, Owl Ridge, Walker Road]; 3, Tanana River sites [Broken Mammoth, Swan Point]; and 4, Tangle Lakes sites [Phipps, Whitmore Ridge]).

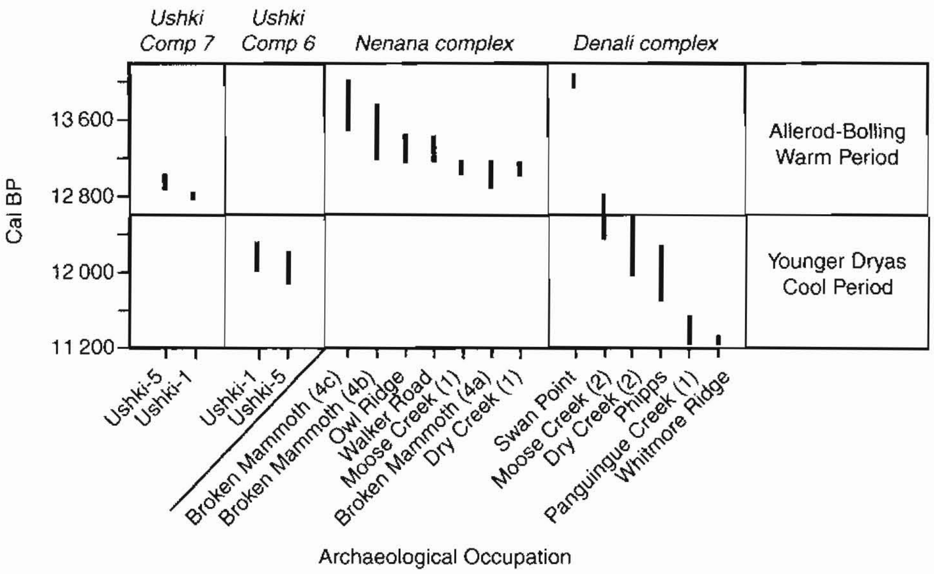

Figure 5.2 Comparison of calibrated AMS radiocarbon ages from Ushki Lake (components 7 and 6) and Alaskan archeological sites (Nenana and Denali complexes). (After Goebel *et al.* 2003.)

Goebel *et al.* 2003). The established radiocarbon record for these complexes suggests they are not coeval. Ages for the early non-microblade assemblages range from 13 800–12 200 cal BP, whereas earliest microblade assemblages span 12 200–11 100 cal BP (Hamilton and Goebel 1999; Hoffecker 2001; Goebel *et al.* 2003) (Figure 5.2).

There is, however, a significant exception to this non-microblade – microblade dichotomy, the Swan Point site in central Alaska, where C. Holmes and colleagues (Holmes *et al.* 1996; Crass and Holmes 2004) have uncovered a microblade industry associated with a buried paleosol dating to approximately 14 400 cal BP. The discovery of microblades at such an early age calls into question the notion that these complexes are temporally distinct, and has reopened arguments that they may represent behavioral facies of the same archaeological tradition (West 1996).

Clearly, resolution of the "non-microblade – microblade" question will require new approaches to studying the existing archaeological record. Previous investigations of Upper Paleolithic assemblages in Beringia have traditionally focused on describing and classifying them into complexes, phases, or traditions, to define culture histories. Typical questions asked include: Does variability exist? Were these complexes coeval or did one predate the other? What are the origins of these techno-complexes? Do they represent the same or different cultural groups (Dikov 1979; West 1981; Powers and Hoffecker 1989; Goebel *et al.* 1991, 2003; Hoffecker *et al.* 1993)? Even when explanations of variability call upon site activity instead of cultural differences (West 1983, 1996; Hoffecker 2001), studies have rarely provided evidence supporting said interpretations. At this point we need to move beyond description and cultural history and attempt to explain, from behavioral, ecological, and/or evolutionary perspectives, why there are two or more (Kunz and Reanier 1994) seemingly different techno-complexes in Beringia. We need to not only understand the origins of the first Beringians, but also the processes through which they colonized the New World's varied empty landscapes.

To begin to explain behaviorally the technological/typological patterns represented in the non-microblade and microblade techno-complexes of Beringia, research surrounding toolstone procurement and selection, technological organization, provisioning strategies, and foraging/land-use behavior needs to be undertaken. In this paper we take an initial step and address these questions by investigating toolstone procurement and selection at two multicomponent sites in Beringia that contain both industries. We focus on Dry Creek, Alaska and Ushki-5, Kamchatka (Figure 5.1). Each site and its associated lithic assemblages are described in detail below.

THE SITES: DRY CREEK AND USHKI-5

Dry Creek

Dry Creek is a multicomponent archeological site located about 5 km northwest of Healy, Alaska. It is situated upon a southeast-facing bluff that overlooks the braided floodplain of Dry Creek, a major tributary of the Nenana River (Figure 5.3). W. R. Powers directed

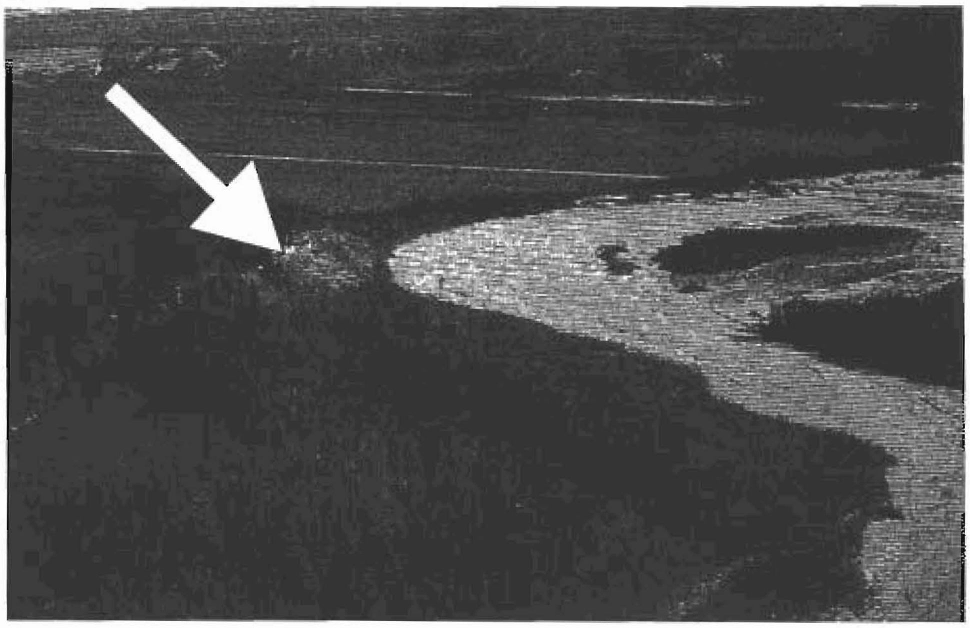

Figure 5.3 Aerial photograph of the Dry Creek site area (arrow points to site location). Note the braided floodplain of Dry Creek itself, containing numerous cobbles of potential toolstones. (Photograph by W. R. Powers.)

large-scale excavations of the site from 1973 to 1978 (Powers and Hamilton 1978; Powers *et al.* 1983); during this time an area of 347 m^2 was exposed (Powers *et al.* 1983). In 1992, N. Bigelow and Powers returned to the site to conduct geoarcheological investigations and collect additional carbon-14 samples (Bigelow and Powers 1994; Hoffecker *et al.* 1996).

These studies confirmed the presence of two stratigraphically separated Upper Paleolithic components dating to the terminal Pleistocene (Thorson and Hamilton 1977; Powers and Hoffecker 1989). Component I, the site's basal occupation, occurs in Loess 2 and has a single age of 11 120 + 85 ^{14}C BP (Powers and Hamilton 1978). Sealing component I is a thin sheet of wind-blown sand (Sand I). Above this sand is component II, which occurs in Loess 3 and has three ages ranging from 10 060 + 75 to 10 090 + 250 ^{14}C BP, averaging 10 050 + 60 ^{14}C BP (Bigelow and Powers 1994). Powers (1983) observed clear stratigraphic separation of the two Upper Paleolithic components across the entire excavation, although in places they became quite close. Powers and Hoffecker (1989) assigned components I and II to two separate cultural complexes, Nenana and Denali, respectively. Lithic assemblages from these components are the subject of our study.

The excavated lithic artifact assemblage for component I has been described by Powers (1983) and Goebel (1990). Goebel (1990) reported that the assemblage consists of 4524 articles, including 4461 debitage pieces, 7 cores, and 56 tools. These data are used in our study. Splinters and flake fragments comprise the majority of debitage pieces, with tertiary flakes, retouch chips, blades, blade-like flakes, cortical spalls, and cobbles/split cobbles making up the rest of the debitage assemblage. Microblades and microblade-related debitage are absent (Goebel 1990). Cores include a bipolar flake core, a monofrontal unidirectional prismatic blade core fragment, unidentifiable core fragments, and a possible platform rejuvenation spall from a flake core (Goebel 1990). The tool assemblage includes end scrapers, retouched blades, retouched flakes, cobble tools, side scrapers, bifaces, bifacial points, notches, gravers, and an undiagnostic tool preform. End scrapers dominate the tool assemblage; among them are simple end scrapers on blades and flakes, round end scrapers, carinated end scrapers, double end scrapers, and fragments. Among cobble tools are unifacial choppers and a scraper-plane. Bifaces include preforms of triangular-shaped points and an undiagnostic biface fragment. Bifacial points include a complete triangular-shaped point and two basal fragments of triangular points. Among identifiable tool blanks, 50% are blades or blade-like flakes, and the rest are flakes and cobbles (Goebel 1990). In sum, the component I assemblage represents the "type-assemblage" for the central Alaskan Nenana complex – a blade-and-biface industry lacking any signs of microblade and burin technologies (Goebel *et al.* 1991; Hoffecker *et al.* 1993).

The component II lithic assemblage initially described by Powers (1983) consists of 28 881 lithic artifacts. Goebel (1990) analyzed complete sets of cores (109), core preforms (7), and tools (330), as well as a sample of 14 434 debitage pieces. The description that follows is based on Goebel's (1990) findings, and this assemblage is the subject of our study. While the vast majority of debitage is splinters and flake fragments, more expressive classes include tertiary flakes, microblades, microblade fragments, retouch chips, blades, blade-like flakes, cortical spalls, and whole or split cobbles. Cores consist primarily of wedge-shaped or "pseudo-wedge-shaped" microblade cores, "end" microblade cores, monofrontal subprismatic blade cores, and monofrontal unidirectional flake cores, as well as microblade core tablets, frontal rejuvenation spalls, undiagnostic core-like fragments, and several biface fragments interpreted to represent wedge-shaped core preforms. The tool assemblage includes burins, bifaces, retouched flakes, retouched microblades, side scrapers, retouched blades, cobble tools, bifacial points, gravers, notches, denticulates, and an end scraper. Burins dominate the tool assemblage; they consist of transverse burins, burins on snaps, dihedral burins, and angle burins. Bifaces occur in many recognizable shapes, including oval, spatulate, ellipitical, ovate, lanceolate, oblong, triangular, discoidal, and deltoid forms, as well as in unexpressive or fragmentary states. Bifacial points, however, occur in just two forms – lanceolate and straight-to-convex-based or lanceolate and concave-based. Side scrapers are typically convergent or double-convex, but transverse, single-convex, single-straight, single-concave, and fragmented forms also occur. Cobble tools include bifacial chopping tools, unifacial choppers, hammerstones, and a pebble retoucher. Among identifiable tool blanks, 49% are made on flakes, while the rest are made on blades or blade-like flakes, microblades, and cobbles (Goebel 1990). The component II assemblage represents a comprehensive Denali complex industry, one characterized not just by the presence of wedge-shaped cores and microblades, but also burins, unhafted bifaces, lanceolate bifacial points, cobble chopping tools and choppers (called *chi-thos* in Alaska), and large side scrapers (Powers and Hoffecker 1989).

Faunal remains were poorly preserved at Dry Creek. Nonetheless, Guthrie (1983) identified teeth of three kinds of large mammal grazers: *Ovis* sp. and *Cervus* sp. (probably Dall sheep and wapiti) in component I, and *Ovis* sp. and *Bison* sp. (probably Dall sheep and steppe bison) in component II. Guthrie (1983) argued that both cultural components represented autumn–winter occupations. In this area today, high winds from the central Alaska Range are funneled through the Nenana River gorge, creating snow-free autumn and winter pastures for sheep in the Healy-Dry Creek area. From the overlook at the Dry Creek site, Paleolithic hunters could have easily spotted sheep, bison, and wapiti grazing nearby.

No archeological features were found at Dry Creek; however, artifact concentrations were recognizable and hence could be analyzed as toolkits or activity areas (Hoffecker 1983). Hoffecker (1983) delineated three such concentrations in component I and 14 in component II. Component-I concentrations are fairly homogeneous and appear to represent (i) butchering and/or hide-processing activities, and (ii) tool production. Component-II concentrations are more variable, with some representing specific activities like microblade and osseous point production, bifacial point production, butchering, or hide-working, while others represent combinations or the full-complement of these activities (Hoffecker 1983). Based on the overall structure of the site (including the lack of permanent features) and the compositions of identified activity areas, Hoffecker (1983) and Guthrie (1983: 286) concluded that the site functioned as a "hunting spike camp and processing station" during both Nenana and Denali times.

Ushki-5

The Ushki-5 site is one of several multicomponent sites located along the south shore of Ushki Lake, central Kamchatka. It is situated upon a low cape that juts out into the lake, about 200 m northwest of the famous Ushki-1 site (Figure 5.4). N. Dikov discovered Ushki-5 in 1964 and conducted test excavations there in 1974 (Dikov 1977). Among his excavations was

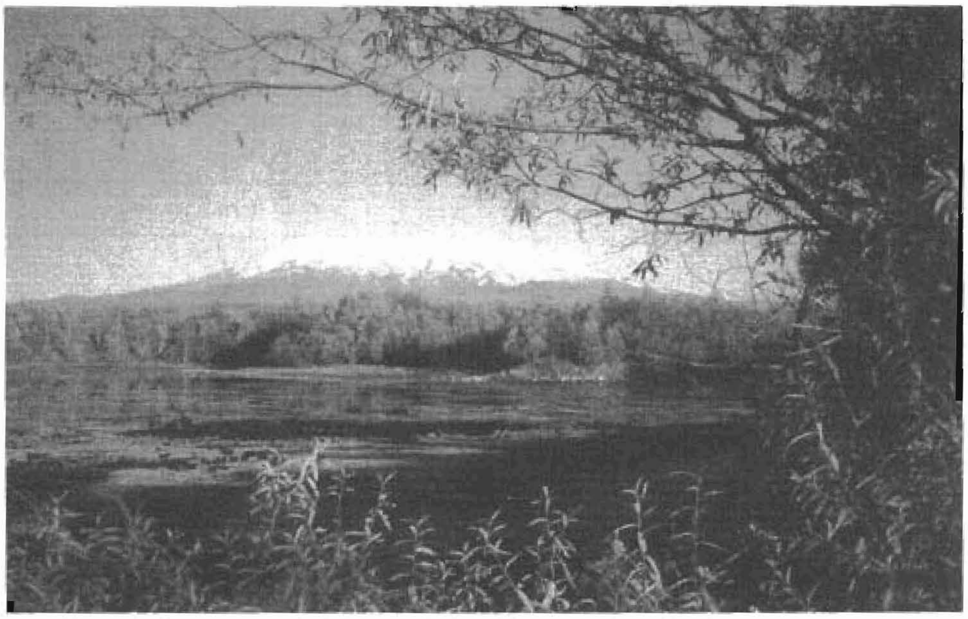

Figure 5.4 Photograph of Ushki-1 site taken from Ushki-5. Note Ushki Lake in foreground and Kliuchevskii volcano in background. (Photograph by T. Goebel.)

a stratigraphic control trench that cut through the heart of the site. In it Dikov found two stratigraphically separate cultural components he labeled 7 and 6, based on stratigraphic correlations with nearby Ushki-1 (Dikov 1977: 81–82; Dikov and Titov 1984: 73). From component 7, the basal cultural component, he described a stemmed bifacial point and core tablet of a small prismatic blade core. From above-lying component 6, he did not describe any artifacts (Dikov 1977). Although unable to date these components at Ushki-5, at Ushki-1 Dikov (1977) carbon-14 dated components 7 and 6 to about 14400 and 10000 ^{14}C BP, respectively. Dikov defined two distinct Upper Paleolithic complexes for central Kamchatka: (i) the early Ushki Paleolithic culture, characterized by small stemmed bifacial points, bifaces, chisels (or gravers), and end scrapers; and (ii) the late Ushki Paleolithic culture, characterized by wedge-shaped cores, microblades, small leaf-shaped bifacial points, and side scrapers (Dikov 1977, 1979, 1985; Dikov *et al.* 1983).

In 2000, a team led by M. Dikova, T. Goebel, and M. Waters returned to Ushki-5 to further investigate the late Upper Paleolithic components preserved there (Goebel *et al.* 2003). In a 20 m^2-block excavation, they unearthed clear remains of cultural components 7 and 6. In a nearby test pit where the entire late Pleistocene-Holocene stratigraphic sequence was exposed (Goebel *et al.* 2003), component 7 occurred within a band of clay at a depth of nearly 250 cm below the modern surface, while component 6 occurred within a band of silty clay at a depth of around 200 cm. The two components were separated by about 30 cm of culturally sterile silt and clay (Goebel *et al.* 2003). Accelerator 'carbon-14 dating of charcoal samples recovered during the 2000 excavations yielded ages of 11 110 ± 115 and 11 130 ± 50 ^{14}C BP for component 7 and 10040 ± 75 and 10060 ± 80 ^{14}C BP for component 6. Lithic materials from these excavations were cursorily described in Goebel *et al.* (2003) and are the subject of our study.

The lithic assemblage from component 7 at Ushki-5 includes 318 debitage pieces and 10 tools. Debitage is dominated by resharpening chips; however, small tertiary flakes, flake fragments, splinters, bipolar flakes, bladelets, bladelet fragments, and cortical spalls also characterize the debitage assemblage. The small sample of tools includes stemmed bifacial points, bifacial point fragments, a leaf-shaped biface, and non-diagnostic biface fragments (Goebel *et al.* 2003). In addition to these flake-stone artifacts, three tiny stone beads and a bead preform were also recovered, similar to those Dikov (1977) found in component 7 at Ushki-1. Component 7 assemblages from Ushki-5 (described here) and Ushki-1 (Dikov 1977) clearly represent a non-microblade industry characterized by small bifacial points and knives and simple flake and blade tools.

The component 6 lithic assemblage at Ushki-5 consists of 601 articles, including 553 debitage pieces, 8 cores, and 38 tools. Debitage includes resharpening chips, microblades, microblade fragments, tertiary flakes, flake fragments, splinters, bladelets, bladelet fragments, blade-like flake fragments, and a cortical spall. Cores include wedge-shaped microblade cores, a subconical microblade core, and core tablets from wedge-shaped cores. Tools include retouched microblades, blades, and bladelets, burins, bifaces and biface fragments, cobble tools, side scrapers, an end scraper, bifacial point fragment, and smooth-backed knife (Goebel *et al.* 2003). In addition, one small stone bead was found. The component 6 assemblage from Ushki-5, like that from Ushki-1 (Dikov 1977), is a lithic industry characterized by microblade, blade, and bifacial technologies, similar to other microblade-rich late Upper Paleolithic complexes in Japan, Yakutia (Diuktai), and Alaska (Denali) (Goebel and Slobodin 1999; Mason *et al.* 2001).

The 2000 excavation at Ushki-5 revealed several archeological features. In component 7, two unlined hearth features were exposed (Goebel *et al.* 2003). These were roughly 1 m in diameter and consisted of charcoal, ash, and tiny burnt bone fragments. Lithic artifacts were dispersed around these hearths; however, the living floor itself was heavily bioturbated by rodent burrowing that appeared to be restricted to this stratigraphic layer. In component 6, Goebel *et al.* (2003) excavated a well-preserved semi-subterranean dwelling that was roughly 5 m in diameter and about 30 cm deep. In places it cut into the lower-lying component 7. The dwelling had a well-marked floor of charcoal and organic residue, a distinct shoulder traceable around the entire exposed perimeter of the dwelling, and a narrow "arctic-entry" passage that would have opened to the northwest. Near the center of the dwelling was a stone-lined hearth that contained evidence of multiple burning episodes, suggesting that the dwelling was occupied for an extended period of time. The hearth contained thousands of small fragments of burnt bone (Goebel *et al.* 2003). In sum, the permanent nature of the dwelling feature of component 6 suggests that the Ushki-5 site functioned as a habitation site. Although no recognizable dwelling features were found in component 7 at Ushki-5, Dikov (1977) reported the discovery of several dwelling features in component 7 at Ushki-1, indicating that during this time Ushki-5 also served as a habitation site.

RAW MATERIAL PROCUREMENT AND SELECTION

Our analyses focus on toolstone procurement and selection by human foragers during the late Pleistocene in Beringia. Admittedly, the current study is preliminary and data are limited; however, our hope is to take an initial step in understanding the technological organization and provisioning strategies of these humans. Dry Creek lithic data used in this paper are derived from those collected by the second author, Goebel (1990), and details on the local Dry Creek lithic landscape are based on a raw-material survey carried out by the authors in 2007. Analyses of the Ushki-5 assemblages are limited to those data collected during our 2000 field investigations; therefore numbers are small and in some cases statistically untestable. Despite these limitations, as we show below, several patterns are evident suggesting procurement and selection preferences.

Lithic variables used in our analysis are divided into two groups addressing two aspects of raw material use: procurement and selection. Variables that speak of procurement include toolstone availability, toolstone variability, presence/absence of cortex, and debitage size. Mapping availability of lithic raw materials on the landscape allows us to reconstruct the potential sphere of toolstone types available to foragers, and to consider these as a resource much as we do plant and animal foods (Blades 2001). Availability of toolstone resources clearly is a limiting factor on technology (Andrefsky 1994; Kuhn 1995). Characterizing toolstone variability by calculating actual frequencies of raw material types present in assemblages allows us to better understand the real sphere of toolstone procurement as well as relative distances traveled by foragers to acquire these resources. Frequencies in which cortex appears on different toolstone types can potentially help us infer which toolstones were locally (<5 km from sites) procured versus those that may have been procured extra-locally (≥5 km), especially in the context of our study where local toolstones are from secondary alluvial deposits. Variables addressing selection include toolstone use in formal versus informal tool production and microblades from formally prepared cores versus flakes from informally prepared cores. In this study, formal tools include bifaces, side scrapers, end scrapers, and combination tools, while informal tools include marginally retouched blades and flakes, burins, denticulates, notches, and cobble tools. Some toolstones may have been better suited for a given set of functions, or may have been more durable or flexible and hence more likely used for formal tools manufactured in anticipation of future or long-term use (Andrefsky 1998: 213). Retouched microblades were omitted from the formal versus informal tool production variable because these artifacts do not necessarily represent a single tool, but a component of a highly formalized composite tool. Counting each microblade as a single tool, then, could artificially inflate real tool counts. As with the production of formal and informal tools, some specific toolstone types may have been more beneficial for the production and use of microblades. Therefore, retouched microblades and associated microblade technology are compared with non-microblade-related technologies to determine whether this was the case. Study of these lithic variables can, we think, lead to an increased understanding of toolstone procurement and selection behaviors of late Pleistocene foragers in Beringia, and can thus help explain documented technological differences between the microblade and non-microblade industries.

Dry Creek toolstone procurement

Toolstone availability

The lithic landscape within 2 km of the Dry Creek site consists of cobble-rich moraines, terraces, and alluvial fans dating to the Upper Pleistocene, as well as the broad, braided floodplain of Dry Creek itself, dating to the Holocene (Figure 5.3) (Wahrhaftig 1970; Ritter and Ten Brink 1986). All of these deposits are unconsolidated and poorly sorted, and composed of cobble-sized to silt-sized, well-rounded to sub-rounded clasts (Thorson and Hamilton 1977). Although about 80% of Dry Creek's bedload is made up of quartz-mica schist originating from bedrock of the northernmost ridge of the Alaska Range, the remaining 20% is characterized by well-rounded igneous and metasedimentary cobbles derived from Tertiary-aged Nenana Gravel (Thorson and Hamilton 1977). Nenana Gravel is the major bedrock formation in the Nenana valley north of Healy; it is a conglomerate of cobbles in a coarse-grained sand matrix (Wahrhaftig 1958; Ritter 1982). Lithic materials with properties amenable to controlled flaking from the Dry Creek floodplain, Nenana River terraces, and Nenana Gravel include "degraded quartzite" (Powers 1983), rhyolite, diabase, and a variety of cherts and chalcedonies. Although the dark-gray colored degraded quartzite is quite common in Dry Creek, the Nenana River, and other nearby creeks, the other raw materials are today quite rare and difficult to find.

East of the Nenana River, opposite the mouth of Dry Creek, local geomorphology is similar, but local lithology is very different. Lignite Creek, which empties into the river about 1.5 km north of the mouth of Dry Creek, flows through the same Nenana Gravel and Quaternary terrace formations as Dry Creek, has a bedload also consisting of quartz, quartzite, chert, and argillite originating from the Tertiary-aged Suntrana and Lignite Creek formations, the primary bedrock of the high foothills of the north Alaska Range east of the Nenana River (Wahrhaftig 1958). Our raw-material survey of Lignite Creek yielded many nodules of very hard but knappable quartzites, but surprisingly no knappable cherts or argillites. Panguingue Creek, located about 5 km north of Dry Creek, contains numerous cobble-sized clasts of knappable black chert. These can be found in the creek's floodplain, as well as in outwash-terrace alluvium of the Healy and Riley Creek glaciations.

Obsidian occurs in the Dry Creek component II assemblage; however, we do not think that this rock type was locally available. No natural occurrences of obsidian are known from the Dry Creek vicinity, but a small source does occur in the upper Teklanika River drainage in nearby Denali National Park, about 45 km southwest of Dry Creek. After this, the nearest sources of this valuable toolstone are Batza Tena and Wrangell Mountain, 300 km northwest and 350 km southeast of Dry Creek, respectively (Clark 1972; Cook 1995).

Thus, knappable materials locally available to the Upper Paleolithic occupants of the Dry Creek site include cobbles of cryptocrystalline silicates (CSS; cherts and chalcedonies) and dark-gray degraded quartzite, which are common, and rhyolite, diabase, and argillite, which are rare. These toolstones would have been retrievable from the surface of the braided floodplain of Dry Creek and nearby Nenana River, as well as from exposures of older glacio-fluvial deposits along the river and its side-valley streams.

Toolstone variability

The Dry Creek component I (DC I) assemblage analyzed here consists of 4491 lithic artifacts, including 48 (1.1%) manuports, 21 (0.5%) cores, 4366 (97.2%) pieces of debitage, and 56 (1.2%) bifacial and unifacial tools (Table 5.1). Artifact classes representing primary reduction, such as cores, cortical spalls, non-diagnostic debitage (i.e., shatter and flake fragments), flakes, and blades represent the overwhelming majority of artifacts (96%) in the DC I assemblage. Classes representing secondary reduction, such as resharpening chips and tools, are much less frequent (4%). Toolstone types utilized in DC I consist of degraded quartzite, nine varieties of CCS (black, gray, brown, green, tan, ferruginous, chalcedony, agate, and jasper), three varieties of fine-grained volcanics (FGV) (rhyolite, basalt, and dacite), and quartzite. Degraded quartzite and CCS clearly dominate the assemblage (about 95% of all artifacts are made of these two materials). Typical quartzite and FGV artifacts are relatively rare.

Comparing artifact class with toolstone type in DC I (Table 5.1), it is clear that nearly every artifact class has some elements made on degraded quartzite, brown CCS, rhyolite, and typical quartzite. Manuports and cores are made on six types of toolstones, and primary-reduction debitage pieces are made on 10 types of toolstones. Artifacts representing secondary reduction activities are characterized by a lot of the same raw materials; however, jasper CCS and basalt occur only in primary debitage, while green and agate CCS and dacite occur only in secondary debitage (Table 5.1).

The Dry Creek component II (DC II) assemblage analyzed here numbers 14454 lithic artifacts, including 15 (0.1%) manuports, 126 (0.9%) cores, 14483 (96.8%) pieces of debitage, and 330 (2.2%) bifacial and unifacial tools (Table 5.2). As with DC I, the majority of DC II artifacts are the result of primary reduction (with 90.5% of the assemblage consisting of cobbles, cores, and associated detached pieces), and only 9.5% of the assemblage being the result of secondary reduction (resharpening chips and tools). Unlike DC I, however, DC II contains microblade cores and associated microblades that represent a more formal level of tool production than the simple flake and blade core technologies of DC I. Toolstones utilized as artifacts include degraded quartzite, eight varieties of CCS (black, gray, brown, green, tan, chalcedony, jasper, and agate), and four varieties of FGV (rhyolite, diabase, basalt, and dacite), obsidian, quartzite, and argillite. Nearly 78%

Table 5.1 Dry Creek component I artifact class by toolstone type.

Toolstones	Artifact class								
	Blades	Flakes	Chips	Cortical Spalls	Shatter	Manuports	Cores	Tools	Total
Degraded quartzite	17	312	23	33	2433	0	6	9	2833 (63.1%)
CCS									1418 (31.6%)
Black	1	13	32	1	52	0	0	12	111 (2.5%)
Gray	4	38	31	13	192	0	0	12	290 (6.5%)
Brown	4	165	34	19	615	5	5	0	847 (18.9%)
Green	0	0	2	0	1	0	0	2	5 (0.1%)
Tan	0	1	0	3	8	0	0	2	14 (0.3%)
Ferruginous	2	30	4	2	80	0	0	9	127 (2.8%)
Chalcedony	0	0	0	0	12	1	1	4	18 (0.4%)
Jasper	0	0	0	0	0	2	3	0	5 (0.1%)
Agate	0	0	0	0	0	0	0	1	1 (0.02%)
FGV									89 (2%)
Rhyolite	0	13	8	2	56	2	1	2	83 (1.9%)
Basalt	0	1	0	0	3	1	0	0	5 (0.1%)
Dacite	0	0	0	0	0	0	0	1	1 (0.02%)
Quartzite	7	25	1	7	67	36	5	0	149 (3.3%)
Unidentifiable	0	0	0	0	0	0	0	2	2 (0.04%)
Total	35 (0.8%)	598 (13.3%)	135 (3.0%)	80 (1.8%)	3518 (78.3%)	48 (1.1%)	21 (0.5%)	56 (1.1%)	4491 (100.0%)

Table 5.2 Dry Creek component II artifact class by toolstone type.

Toolstones	Artifact class									
	Blades	Micro-blades	Flakes	Chips	Cortical Spalls	Shatter	Manuports	Cores	Tools	Total
Degraded quartzite	42	49	921	248	57	3796	0	1	25	5139 (34.8%)
CCS										6357 (43.1%)
Black	3	9	36	36	5	232	0	1	21	343 (2.3%)
Gray	21	649	298	233	23	1112	0	33	70	2439 (16.5%)
Brown	7	18	25	26	4	73	0	3	39	195 (1.3%)
Green	0	0	2	1	0	1	0	3	0	7 (0.05%)
Tan	5	7	84	70	2	108	0	1	16	293 (2.0%)
Chalcedony	10	461	403	252	12	1774	0	50	54	3016 (20.4%)
Jasper	0	24	7	1	0	23	0	4	3	62 (0.4%)
Agate	0	0	0	0	0	1	0	1	0	2 (0.01%)
FGV										2578 (17.5%)
Rhyolite	5	274	201	145	16	1340	0	18	54	2053 (13.9%)
Diabase	9	9	89	31	2	323	0	1	3	467 (3.2%)
Basalt	3	2	15	0	0	29	0	1	5	55 (0.4%)
Dacite	0	0	0	0	0	2	0	0	1	3 (0.02%)
Obsidian	0	71	16	20	2	268	0	2	19	398 (2.7%)
Other										282 (1.9%)
Quartzite	5	1	38	5	9	160	15	7	19	259 (1.8%)
Argillite	0	13	3	2	0	4	0	0	1	23 (0.2%)
Total	110 (0.7%)	1587 (10.8%)	2138 (14.4%)	1070 (7.3%)	132 (0.9%)	9246 (62.7%)	15 (0.1%)	126 (0.9%)	330 (2.2%)	14754 (100.0%)

of the DCII assemblage is on degraded quartzite or CCS. FGV artifacts are also common (17.5%), while obsidian artifacts (2.7%) and other toolstones (1.9%) including quartzite and argillite are rare.

By comparing DCII artifact classes with toolstone types (Table 5.2), we see that degraded quartzite, black, gray, brown, tan and chalcedony CCS, rhyolite, diabase, obsidian, and quartzite are represented in nearly every artifact class. Although manuports are represented only by quartzite, cores are represented by 14 varieties of toolstone. Primary-reduction debitage pieces are manufactured on all of these same raw material types as well as on dacite but not argillite. Artifacts of secondary reduction activities are also represented by most of the same toolstones, with the exception of agate CCS occurring only in the form of a piece of shatter and flake core (Table 5.2).

Thus, DC I and DC II share a few similarities in terms of toolstone variability. In both assemblages, green CCS, agate CCS, and dacite are present in such low frequencies that they may represent relatively extra-local toolstones (Tables 5.1 and 5.2). A couple of other toolstone types, such as jasper CCS and basalt, also occur in low frequencies; however, these are represented by manuports and other primary reduction pieces in DC I and by both primary and secondary debitage pieces in DC II. Likely, these toolstones were locally procured.

There are also some differences in toolstone variability between the DC I and DC II assemblages. Although both assemblages share 13 of 17 toolstone types, ferruginous CCS appears only in DC I, while argillite, obsidian, and diabase appear only in DC II. The DC I assemblage also has some raw materials that were used as tools (e.g., green and agate CCS and dacite) that are not present in the primary-reduction debitage assemblage. These toolstones may represent relatively extra-local toolstones carried to the site as finished tools (all of them are end scrapers). Nearly all of the DC II toolstones were subjected to both primary and secondary reduction activities; all finished tools appear to have related cores and/or debitage (although as shown below some of the obsidian came from sources hundreds of km distant).

Differences in toolstone variability between DC I and DC II can be further seen in the diversity of frequently used toolstone types. The most frequently used types in the DC I assemblage include degraded quartzite and brown, gray, and ferruginous CCS, whereas in DC II frequently used toolstone types include degraded quartzite, chalcedony and gray CCS, rhyolite, and diabase. While FGV types are more common in DC II, none of the FGV types are present in high frequencies in DC I. Chi-square analysis of toolstones by assemblage further underscores this pattern. Degraded quartzite appears more frequently than expected in DC I (63.1%) and less frequently than expected in DC II (34.8%). In contrast, CCS, FGV, and obsidian occur more frequently than expected in DC II (63.3%) and less frequently than expected in DC I (33.6%) (χ^2 value of 1524.441, 4 *df*, $p<0.001$) (Tables 5.1 and 5.2). These results suggest that preferred toolstones are less diverse in DC I than in DC II. These data may suggest that DC I foragers were more discriminating users of a smaller set of toolstones than DC II foragers, or that DC I foragers were not as knowledgeable of the lithic landscape as DC II foragers. This is further explored below.

Presence of cortex and debitage size

In DC I cortex is present on 3.2% of the assemblage (Table 5.3). There is less degraded quartzite with cortex than expected and more CCS, FGV, and typical quartzite with cortex than expected (Table 5.3). These statistical results, though, should be treated cautiously since 25% of the cells fall below 5 in expected counts. Likely, they mean that degraded quartzite nodules were being worked more intensively than those of other toolstones. In DC II cortex is present on about 1.1% of the assemblage. In contrast to DC I, there were more cortical artifacts than expected on degraded quartzite and less cortical artifacts than expected on CCS, FGV, and obsidian (Table 5.3). These results suggest that in DC II some of the CCS, FVG, and obsidian toolstones were brought to the site from non-local sources in the form of finished or near-finished tools. In fact, 20 obsidian samples were sourced by J. Cook (pers. comm., 2004). Known sources include Batza Tena and Wrangell Mountain, which are located more than 300 km from Dry Creek, so that some of the obsidian was definitely procured from extremely distant sources and is therefore exotic. More than half of the obsidian artifacts sourced, however, came from unknown sources. Given the presence of cortex on several obsidian artifacts, perhaps some of the obsidian was procured in the Alaska Range relatively close to Dry Creek.

We also examined toolstone class by debitage size (Table 5.4). In DC I there seems to be a significantly higher than expected presence of large flakes made on degraded quartzite, and a higher than expected number of tiny resharpening chips made on CCS and FGV.

Table 5.3 Dry Creek presence of cortex by toolstone

DC I[a]		Toolstone					
		Degraded quartzite	**CCS**	**FGV**	**Obsidian**	**Quartzite**	**Total**
Cortex	Count	34	53	6	0	49	142
	Expected count	90.4	44.1	2.8	0.0	4.8	142.0
	Percentage of total	0.8%	1.2%	0.1%	0.0%	1.1%	3.2%
No cortex	Count	2785	1321	80	0	100	4286
	Expected count	2728.6	1329.9	83.2	0.0	144.2	4286.0
	Percentage of total	62.9%	29.8%	1.8%	0.0%	2.3%	96.8%
Total	Count	2819	1374	86	0	149	4428
	Expected count	2819.0	1374.0	86.0	0.0	149.0	4428.0
	Percentage of total	63.7%	31.0%	1.9%	0.0%	3.4%	100.0%
DC II[b]		**Degraded quartzite**	**CCS**	**FGV**	**Obsidian**	**Other**	**Total**
Cortex	Count	57	50	19	2	29	157
	Expected count	56.1	66.5	27.4	4.1	2.9	157.0
	Percentage of total	0.4%	0.3%	0.1%	0.0%	0.2%	1.1%
No cortex	Count	5056	6012	2477	375	231	14151
	Expected count	5056.9	5995.5	2468.6	372.9	257.1	14151.0
	Percentage of total	35.3%	42.0%	17.3%	2.6%	1.6%	98.9%
Total	Count	5113	6062	2496	377	260	14308
	Expected count	5113.0	6062.0	2496.0	377.0	260.0	14308.0
	Percentage of total	35.7%	42.4%	17.4%	2.6%	1.8%	100.0%

[a]Chi-Square Test: Value 464.990[a], 3 *df*, $p < 0.001$. Note: 2 cells (25.0%) have an expected count less than 5. Minimum expected count is 2.76.
[b]Chi-Square Test: Value 250.169[a], 4 *df*, $p < 0.001$. Note: 2 cells (20.0%) have an expected count less than 5. Minimum expected count is 2.85.

These results suggest that most toolstones procured during the DC I occupation were being used for both primary and secondary reduction activities, but CCS and FGV tools may have been worked more intensively than degraded quartzite tools. Again, nearly all of these toolstones were probably procured locally, possibly from Dry Creek or Panguingue Creek alluvium or adjacent glacio-fluvial terrace deposits (as noted above, degraded quartzite and CCS are available today in cobble form along the creeks' stream beds). In DC II there is also a significant relationship between toolstone and debitage size. Specifically, there are more large debitage pieces made on degraded quartzite, quartzite, and argillite than expected, and more tiny resharpening chips made on CCS than expected, suggesting that degraded quartzite, quartzite, and argillite were primarily reduced on site, while other toolstones (especially some obsidian and CCS) were brought to the site in finished tool forms and resharpened there.

Dry Creek toolstone selection

Formal versus informal tool production

On investigating toolstone selection, no identifiable pattern is present in DC I (Table 5.5). All three classes of tools (bifaces, formal unifaces, and informal unifaces) were predominantly made on CCS (77.8%). The sample size was too small for statistical analysis, though it is clear that during the DC I occupation, selection was directed toward the use of CCS with no real preference of this toolstone in the manufacture of formal or informal tools. Degraded quartzite (16.7%) was predominantly used to manufacture unifacial tools (both formal and informal), while FGV was used only in the manufacture of formal unifaces.

Tool production in DC II is more directed, with degraded quartzite, FGV, and CCS being the toolstones of choice for manufacture and maintenance of

Table 5.4 Dry Creek debitage size by toolstone.

DC I[a]		Toolstone					
		Degraded quartzite	**CCS**	**FGV**	**Obsidian**	**Quartzite**	**Total**
Very small (<1 cm²)	Count	23	103	8	0	1	135
	Expected count	87.6	41.9	2.6	0.0	3.0	135.0
	Percentage of total	0.5%	2.4%	0.2%	0.0%	0.0%	3.2%
Small (1–3 cm²)	Count	2645	1190	70	0	88	3993
	Expected count	2595.1	1232.1	76.3	0.0	89.5	3993.0
	Percentage of total	62.4%	28.1%	1.7%	0.0%	2.1%	94.2%
Medium-large (>3 cm²)	Count	87	15	3	0	6	111
	Expected count	72.1	34.3	2.1	0.0	2.5	111.0
	Percentage of total	2.1%	0.4%	0.1%	0.0%	0.1%	2.6%
Total	Count	2755	1308	81	0	95	4239
	Expected count	2755.0	1308.0	81.0	0.0	95.0	4239.0
	Percentage of total	65.0%	30.9%	1.9%	0.0%	2.2%	100.0%
DC II[b]		**Degraded quartzite**	**CCS**	**FGV**	**Obsidian**	**Other**	**Total**
Very small (<1 cm²)	Count	248	619	176	20	7	1070
	Expected count	426.9	411.8	186.4	26.0	18.8	1070.0
	Percentage of total	2.0%	4.9%	1.4%	0.2%	0.1%	8.5%
Small (1–3 cm²)	Count	4624	4207	1985	286	180	11 282
	Expected count	4501.7	4342.1	1965.8	274.3	198.1	11 282.0
	Percentage of total	36.7%	33.4%	15.8%	2.3%	1.4%	89.6%
Medium-large (>3 cm²)	Count	150	18	32	0	34	234
	Expected count	93.4	90.1	40.8	5.7	4.1	234.0
	Percentage of total	1.2%	0.1%	0.3%	0.0%	0.3%	1.9%
Total	Count	5022	4844	2193	306	221	12 586
	Expected count	5022.0	4844.0	2193.0	306.0	221.0	12 586.0
	Percentage of total	39.9%	38.5%	17.4%	2.4%	1.8%	100.0%

[a]Chi-Square Test: Value 172.996[a], 6 *df*, $p < 0.001$. Note: 4 cells (33.3%) have an expected count less than 5. Minimum expected count is 2.12.

[b]Chi-Square Test: Value 515.515[a], 8 *df*, $p < 0.001$. Note: 1 cell (6.7%) has an expected count less than 5. Minimum expected count is 4.11.

formal tools (Table 5.5). Formal unifacial tools were most commonly manufactured on CCS, while formal bifaces tended to be manufactured on degraded quartzite and FGV. CCS, obsidian, and other toolstones were selected for the manufacture of expedient, informal tools. Clearly, in DC II there is a recognizable pattern in toolstones selected for formal versus informal tool production. Formal unifaces, such as scrapers, were selectively being manufactured on durable CCS, while bifaces were being manufactured on degraded quartzite and FGV toolstones.

Production of microblades

Considering toolstone by technological industry in DC II, a comparison of microblade-related, burin-related, and flake- and blade-related materials was made (Table 5.6). Microblades were manufactured more frequently than expected on CCS and obsidian, burins were manufactured more frequently than expected on CCS, and blades and flakes were manufactured more frequently than expected on degraded quartzite and other toolstones. These data show that local and extra-local, durable, high-quality toolstones were being

Table 5.5 Dry Creek formal versus informal tool production

DC I[a]		Toolstone					
		Degraded quartzite	**CCS**	**FGV**	**Obsidian**	**Quartzite**	**Total**
Bifaces	Count	0	7	0	0	0	7
	Expected count	1.2	5.4	0.4	0.0	0.0	7.0
	Percentage of total	0.0%	13.0%	0.0%	0.0%	0.0%	13.0%
Formal unifaces	Count	3	16	3	0	0	22
	Expected count	3.7	17.1	1.2	0.0	0.0	22.0
	Percentage of total	5.6%	29.6%	5.6%	0.0%	0.0%	40.7%
Informal unifaces	Count	6	19	0	0	0	25
	Expected count	4.2	19.4	1.4	0.0	0.0	25.0
	Percentage of total	13.2%	35.9%	0.0%	0.0%	0.0%	46.3%
Total	Count	9	42	3	0	0	54
	Expected count	9.0	42.0	3.0	0.0	0.0	54.0
	Percentage of total	16.7%	77.8%	5.6%	0.0%	0.0%	100.0%
DC II[b]		**Degraded quartzite**	**CCS**	**FGV**	**Obsidian**	**Other**	**Total**
Bifaces	Count	16	25	26	2	2	71
	Expected count	6.0	43.7	13.5	2.9	4.8	71.0
	Percentage of total	5.4%	8.5%	8.8%	0.7%	0.7%	24.1%
Formal unifaces	Count	3	83	17	4	4	111
	Expected count	9.4	68.3	21.1	4.5	7.6	111.0
	Percentage of total	1.0%	28.2%	5.8%	1.4%	1.4%	37.8%
Informal unifaces	Count	6	73	13	6	14	112
	Expected count	9.5	69.0	21.3	4.6	7.6	112.0
	Percentage of total	2.0%	24.8%	4.4%	2.0%	4.8%	38.1%
Total	Count	25	181	56	12	20	294
	Expected count	25.0	181.0	56.0	12.0	20.0	294.0
	Percentage of total	8.5%	61.6%	19.0%	4.1%	6.8%	100.0%

[a]Sample size too small for statistical analysis.
[b]Chi-Square Test: Value 58.565[a], 8 *df*, $p < 0.001$. Note: 4 cells (26.7%) have an expected count less than 5. Minimum expected count is 2.90.

selected for the production of microblades and burins. Again, data suggest during DC II times toolstone selection was patterned, unlike during DC I times.

Ushki-5 toolstone procurement

Toolstone availability

Our knowledge of the lithic landscape of Ushki-5 is based on several important references (Dikov and Titov 1984; Ivanov 1990), as well as observations of the local geology made while excavating there in 2000 (Goebel *et al.* 2003). Ushki Lake is situated along the Kamchatka River, the major watercourse draining the Central Kamchatka Depression. This tectonic depression is flanked on the east by the Kliuchevskii volcano group and on the west by the Sredinnyi mountain range. Bedrock in the vicinity of Ushki Lake is mainly volcanic and composed primarily of andesites and basalts (Dikov and Titov 1984); an outcropping of this bedrock occurs at the Ushki-1 site along the south shore of the lake (Figure 5.4). Other than these isolated volcanic bedrock exposures, surface geology is characterized by an unconsolidated mantle of fine-grained alluvial (sand, silt, and clay) and aeolian (loess and tephra) deposits reaching more than 7 m thick in

Table 5.6 Dry Creek component II technology types by toolstone.

		Toolstone					
		Degraded quartzite	**CCS**	**FGV**	**Obsidian**	**Other**	**Total**
Microblade-related materials	Count	49	1265	310	80	14	1718
	Expected count	598.4	740.2	300.2	46.3	32.8	1718.0
	Percentage of total	0.3%	8.6%	2.1%	0.6%	0.1%	11.7%
Burin-related materials	Count	0	75	5	4	0	84
	Expected count	29.3	36.2	14.7	2.3	1.6	84.0
	Percentage of total	0.0%	0.5%	0.0%	0.0%	0.0%	0.5%
Flake- and blade-related materials	Count	5090	5017	2263	314	268	12952
	Expected count	4511.3	5580.6	2263.1	349.4	247.6	12952.0
	Percentage of total	34.5%	34.0%	15.3%	2.1%	1.8%	87.8%
Total	Count	5139	6357	2578	398	282	14754
	Expected count	5139.0	6357.0	2578.0	398.0	282.0	14754.0
	Percentage of total	34.8%	43.1%	17.5%	2.7%	1.9%	100.0%

Chi-Square Test: Value 1128.602[a], 8 *df*, $p < 0.001$.

Note: 2 cells (13.3%) have an expected count less than 5. Minimum expected count is 1.61.

some exposures (Goebel *et al.* 2003). Cobble beds are exceedingly rare, even in modern point bars exposed along the Kamchatka River near Ushki Lake. Even when cobble deposits can be found, they do not appear to contain knappable materials. Our impression of the Ushki Lake vicinity is that it is a "toolstone desert", one largely devoid of lithic materials with properties amenable to controlled flaking. Our observations, however, are limited to the eastern, Kliuchevskii side of the Kamchatka River, and we know nothing about the lithic resources potentially available on the western, Sredinnyi side.

Toolstone variability

The Ushki-5 component 7 assemblage described here consists of 327 lithic artifacts, including 0 (0%) cores, 318 (97.2%) debitage pieces, and 9 (2.8%) bifacial and unifacial tools (Table 5.7). Artifact classes representing primary reduction, such as shatter, flakes, and blades characterize less than a quarter of the artifacts (23.2%). Classes representing secondary reduction, such as resharpening chips and tools, occur much more frequently (76.8%). Toolstone types utilized in this assemblage are numerous and consist of obsidian, 11 varieties of CCS (black, gray, brown, green, tan, white, jasper, and brown, gray, tan, and white chalcedony), and basalt. CCS dominates the assemblage, making up approximately 94.2% of all toolstones utilized, while basalt (3.7%) and obsidian (2.1%) are much less common.

Comparing artifacts with toolstones in component 7, gray, green, and tan chalcedony CCS is represented by nearly every class of artifact. Debitage pieces characterizing primary reduction activities are manufactured predominantly on green, white, and tan chalcedony CCS, with basalt and jasper, white, brown chalcedony, tan and gray CCS appearing in lower frequencies. In contrast, gray chalcedony, black, and brown CCS, and obsidian are either not represented by these artifacts or they occur in very low frequencies. Artifacts associated with secondary reduction activities are characterized by the same toolstones, with the exception of brown chalcedony and tan CCS, which are absent, and gray chalcedony CCS, which only occurs as a single resharpening chip.

The Ushki-5, component 6 assemblage contains 621 lithic artifacts, including 8 (1.3%) cores, 574 (92.4%) pieces of debitage, and 39 (6.3%) tools (Table 5.8). Unlike component 7, most of the component 6 assemblage is the result of primary reduction: 57.3% of the assemblage consists of cores and associated detached pieces, while 42.7% consists of resharpening chips and tools resulting from secondary reduction activities.

Table 5.7 Ushki-5, component 7 artifact classes by toolstone type.

Toolstones	Artifact class						
	Blades	Flakes	Chips	Cortical spalls	Angular shatter	Tools	Total
Obsidian	0	3	4	0	0	0	7 (2.2%)
CCS							308 (94.2%)
Black	0	1	2	0	0	0	3 (0.9%)
Gray	1	15	136	0	5	3	160 (48.9%)
Brown	0	3	14	0	0	2	19 (5.8%)
Green	0	6	30	1	1	1	39 (11.9%)
Tan	0	1	0	0	1	0	2 (0.6%)
White	0	0	1	1	0	0	2 (0.6%)
Brown Chalcedony	0	1	0	0	0	0	1 (0.3%)
Gray Chalcedony	0	0	1	0	0	0	1 (0.3%)
Tan Chalcedony	1	22	40	1	0	1	65 (19.9%)
White Chalcedony	0	7	3	0	1	0	11 (3.4%)
Jasper	0	1	4	0	0	0	5 (1.5%)
Basalt	1	2	7	0	0	2	12 (3.7%)
Total	3 (0.9%)	62 (19.0%)	242 (74.0%)	3 (0.9%)	8 (2.4%)	9 (2.8%)	327 (100.0%)

Another difference is that component 6 contains microblade cores and microblade-related debitage. Toolstones include obsidian, 10 varieties of CCS (gray, brown, green, tan, white, brown chalcedony, gray chalcedony, green chalcedony, tan chalcedony, and white chalcedony), and basalt. CCS artifacts (72.1%) dominate the assemblage, while basalt (16.9%) and obsidian (10.8%) are less common.

Comparing artifact forms with toolstones in the component 6 assemblage, gray CCS and basalt are represented by nearly every artifact class (Table 5.8). Cores are represented by obsidian, gray CCS, and basalt. Primary reduction debitage is predominantly manufactured on gray and green CCS and basalt, and white CCS is the only toolstone not represented by these artifact classes. Secondary reduction debitage is dominated by gray and green CCS, obsidian, and basalt. Brown chalcedony CCS is the only toolstone not represented by secondary pieces.

Components 7 and 6 share a couple of similarities in toolstone variability. In both assemblages, tan, white, brown-chalcedony and gray-chalcedony CCS are present in such low frequencies that these may represent non-local toolstones (Tables 5.7 and 5.8). For both assemblages all of the materials occurring as tools are also represented by both primary and secondary reduction activities. Though most of the toolstones in both assemblages are the same, black and jasper CCS occur only in component 7, whereas green-chalcedony CCS occurs only in component 6.

The range of toolstone variability in components 7 and 6 can further be seen in the diversity of frequently occurring toolstones. In component 7 these include gray, green and tan-chalcedony CCS. In component 6 these include gray CCS, basalt, and obsidian. Chi-square analysis of toolstones by assemblage further underscores this pattern: CCS appears more frequently than expected in component 7 (94.2%) and less frequently than expected in component 6 (72.1%). In contrast, obsidian and basalt occur more frequently than expected in component 6 (27.9%) and less frequently than expected in component 7 (5.9%) (χ^2 value of 64.487, 2 *df*, $p < 0.001$) (Tables 5.7 and 5.8). These results suggest that frequently occurring toolstones are less diverse in non-microblade component 7 than in microblade-rich component 6. These data may suggest that component 7 foragers were either more discriminating in their use of certain raw materials, or that they were not as knowledgeable of the lithic landscape as component 6 foragers.

Table 5.8 Ushki-5, component 6 artifact classes by toolstone type.

Toolstones	Artifact class								
	Blades	**Microblades**	**Flakes**	**Chips**	**Cortical spalls**	**Angular shatter**	**Cores**	**Tools**	**Total**
Obsidian	0	35	10	8	0	0	4	11	68 (11%)
CCS									448 (72.1%)
Gray	8	157	26	99	1	2	3	11	307 (49.4%)
Brown	0	3	4	11	0	4	0	0	22 (3.5%)
Green	1	6	11	30	0	0	0	4	52 (8.4%)
Tan	0	0	2	2	0	0	0	2	6 (1.0%)
White	0	0	0	2	0	0	0	0	2 (0.3%)
Brown Chalcedony	0	0	2	0	0	0	0	0	2 (0.3%)
Gray Chalcedony	0	0	2	1	0	0	0	1	4 (0.8%)
Green Chalcedony	0	0	2	1	0	0	0	0	3 (0.5%)
Tan Chalcedony	0	0	7	18	0	0	0	1	26 (4.2%)
White Chalcedony	0	0	8	13	0	0	0	3	24 (3.9%)
Basalt	3	0	60	41	0	4	1	6	105 (16.9%)
Total	12 (1.9%)	201 (32.4%)	124 (20.0%)	226 (36.4%)	1 (0.1%)	10 (1.6%)	8 (1.3%)	39 (6.3%)	621 (100.0%)

Presence of cortex and debitage size

In component 7, cortex is present on 0.6% of the assemblage. There does not appear to be a relationship between toolstone class and presence of cortex (Table 5.9), but the sample size is very small. Lack of cortex suggests that few if any raw materials were procured nearby the site; however, since all cortical pieces are of CCS, some of these toolstones may have been of local origin. We also examined toolstone class by debitage size; results suggest no relationship (Table 5.10). The preponderance of tiny resharpening chips and small flakes suggests that most toolstones were not being procured locally and that secondary reduction dominated reduction activities.

In component 6 cortex is present on four artifacts, 0.7% of the total assemblage. Therefore, only negligible primary reduction activities occurred in component 6. Further, there is no apparent relationship between toolstone and presence of cortex (Table 5.9); however, as with component 7, all pieces with cortex are of CCS. Further, when examining debitage size according to toolstone, small-sized debitage is more commonly represented by CCS and obsidian (Table 5.10), while large-sized debitage is more commonly represented by basalt. Although these data suggest that some CCS and basalt were procured locally, the differential package size between basalt and CCS and obsidian may be the result of differential package size.

Ushki-5 toolstone selection

Formal versus informal tool production

In terms of toolstone selection, the component 7 tool assemblage, which consists of just nine bifaces, is too small to characterize statistically; however, of these tools seven were manufactured on CCS and two on basalt. In component 6 bifaces and informal unifaces are made on CCS, basalt, and obsidian, while formal unifaces are only made on CCS (Table 5.11). This may

Table 5.9 Ushki-5 presence of cortex by toolstone.

Component 7		**Toolstone**			
		Obsidian	**CCS**	**Basalt**	**Total**
Cortex	Count	0	3	0	3
	Expected count	0.0	2.8	0.1	3.0
	Percentage of total	0.0%	0.9%	0.0%	0.9%
No cortex	Count	7	298	10	315
	Expected count	6.9	298.2	9.9	315.0
	Percentage of total	2.2%	93.7%	3.1%	99.1%
Total	Count	7	301	10	318
	Expected count	7.0	301.0	10.0	318.0
	Percentage of total	2.2%	94.7%	3.1%	100.0%
Component 6		**Obsidian**	**CCS**	**Basalt**	**Total**
Cortex	Count	0	4	0	4
	Expected count	0.4	2.9	0.7	4.0
	Percentage of total	0.0%	0.7%	0.0%	0.7%
No cortex	Count	52	400	98	550
	Expected count	51.6	401.1	97.3	550.0
	Percentage of total	9.4%	72.2%	17.7%	99.3%
Total	Count	52	404	98	554
	Expected count	52.0	404.0	98.0	554.0
	Percentage of total	9.4%	72.9%	17.7%	100.0%

Sample sizes too small for statistical analysis.

Table 5.10 Ushki-5 debitage size by toolstone.

Component 7		Toolstone			
		Obsidian	CCS	Basalt	Total
Very small (<1 cm²)	Count	2	55	3	60
	Expected Count	2.8	54.4	2.8	60.0
	Percentage of total	2.4%	64.7%	3.5%	70.6%
Small (1–3 cm²)	Count	2	19	1	22
	Expected count	1.0	19.9	1.0	22.0
	Percentage of total	2.4%	22.4%	1.2%	25.9%
Medium-large (>3 cm²)	Count	0	3	0	3
	Expected count	0.1	2.7	0.1	3.0
	Percentage of total	0.0%	3.5%	0.0%	3.5%
Total	Count	4	77	4	85
	Expected count	4.0	77.0	4.0	85.0
	Percentage of total	4.7%	90.6%	4.7%	100.0%
Component 6		**Obsidian**	**CCS**	**Basalt**	**Total**
Very small (<1 cm²)	Count	2	46	9	57
	Expected count	2.0	46.1	13.9	57.0
	Percentage of total	2.3%	53.5%	10.5%	66.3%
Small (1–3 cm²)	Count	1	15	8	24
	Expected count	0.8	17.3	5.9	24.0
	Percentage of total	1.2%	17.4%	9.3%	27.9%
Medium-Large (>3 cm²)	Count	0	1	4	5
	Expected count	0.2	3.6	1.2	5.0
	Percentage of total	0.0%	1.2%	4.7%	5.8%
Total	Count	3	62	21	86
	Expected count	3.0	62.0	21.0	86.0
	Percentage of total	3.5%	72.1%	24.4%	100.0%

Sample sizes too small for statistical analysis.

Table 5.11 Ushki-5, component 6 formal versus informal tool production by toolstone.

		Toolstone			
		Obsidian	CCS	Basalt	Total
Bifaces	Count	1	2	3	6
	Expected count	1.6	3.1	1.3	6.0
	Percentage of total	3.7%	7.4%	11.1%	22.2%
Formal unifaces	Count	0	3	0	3
	Expected count	0.8	1.6	0.7	3.0
	Percentage of total	0.0%	11.1%	0.0%	11.1%
Informal unifaces	Count	6	9	3	18
	Expected count	4.6	9.3	4.0	18.0
	Percentage of total	22.2%	33.3%	11.1%	66.7%
Total	Count	7	14	6	27
	Expected count	7.0	14.0	6.0	27.0
	Percentage of total	25.9%	51.9%	22.2%	100.0%

Sample size too small for statistical analysis.

Table 5.12 Ushki-5, component 6 technology types by toolstone.

		Toolstone			
		Obsidian	**CCS**	**Basalt**	**Total**
Microblade-related materials	Count	43	177	0	220
	Expected count	23.9	159.0	37.1	220.0
	Percentage of total	7.0%	28.7%	0.0%	35.7%
Flake- and blade-related materials	Count	24	269	104	397
	Expected count	43.1	287.0	66.9	397.0
	Percentage of total	3.9%	43.6%	16.9%	64.3%
Total	Count	67	446	104	617
	Expected count	67.0	446.0	104.0	617.0
	Percentage of total	10.9%	72.3%	16.9%	100.0%

Chi-Square Test: Value 84.547, 2 *df*, $p < 0.001$. Note: 0 cells (0.0%) have an expected count less than 5. Minimum expected count is 23.89.

suggest CCS was intentionally selected for the manufacture of formal unifaces due to its durability.

Production of microblades

To consider toolstone by technological industry, microblade-, flake- and blade-related materials were compared. Only four artifacts resulting from burin manufacture were present in the assemblage, so these artifacts were omitted from the chi-square analysis. As shown in Table 5.12, during the component 6 occupation microblades were manufactured more frequently than expected on CCS and obsidian, while flakes and blades were manufactured on these toolstones and basalt. Basalt, however, was used for the manufacture of flakes and blades more frequently than expected. Thus, toolstone selection in the Ushki microblade complex appears to have been relatively patterned and planned.

DISCUSSION AND CONCLUSIONS

Our goal in this essay has been to determine whether differences in lithic raw material procurement and selection can be detected between non-microblade and microblade techno-complexes of Beringia, by examining in some detail the records from two Upper Paleolithic sites, Dry Creek, central Alaska and Ushki-5, central Kamchatka. These sites are unique in that they both contain two Upper Paleolithic complexes, so that through our comparisons we can hold at least two things constant: site location and lithic landscape. Dry Creek represents a bluff-edge overlook site occurring in an environment with some locally available toolstones, while Ushki-5 represents a stream-side site occurring in a relatively toolstone-poor environment. Further, the original excavators of Dry Creek argued that both Upper Paleolithic components are the result of a series of short-term hunting occupations (probably during the fall-winter) (Guthrie 1983; Hoffecker 1983), and the original excavators of the Ushki sites argued that both components are the result of long-term habitations (Dikov 1977, 1979; Goebel *et al.* 2003). Obviously, Dry Creek and Ushki-5 are excellent places to investigate the non-microblade – microblade dichotomy in the Upper Paleolithic record of Beringia.

Toolstone procurement at Dry Creek. Lithic assemblages for both component I (non-microblade) and component II (microblade-rich) are dominated by local toolstones, primarily degraded quartzite and CCS. Few, if any, cores or tools can be clearly shown to have been transported in finished form from another location to the site. Just about the only difference that can be detected is that in component II FGV increases and obsidian and argillite appear for the first time. We do not think that obsidian or argillite were available along Dry Creek. Some of the obsidian came from more than 300 km from the site, while some of the argillite likely came from some other stream or terrace deposit in the Nenana Valley. Thus, toolstone procurement during the non-microblade occupation appears to have been locally oriented, while procurement during the microblade occupation appears to have been local and non-local. This may be an indication that the earliest occupants of the Dry Creek site did not know the lithic landscape of central Alaska as well as the site's later occupants, or it may reflect differences in provisioning strategies and logistical transport of toolstones. Perhaps settlement during the Nenana complex occupation of Dry Creek was more locally oriented, while settlement during the Denali complex occupation was more mobile and far-reaching.

Toolstone selection at Dry Creek. Our analyses suggest that the component I occupants of Dry Creek did not necessarily prefer any toolstone over another for production of formal or informal tools, indicating unpatterned selection of toolstones by the non-microblade occupants. The component II occupants, however, did inordinately manufacture side scrapers and burins on CCS, bifaces on degraded quartzite, and informal tools and microblades on CCS and obsidian, indicating patterned selection of toolstones by microblade-producing occupants. Possibly the early inhabitants of Dry Creek were place-oriented and had just begun to familiarize themselves with local resources, whereas later far-ranging, microblade-producing inhabitants were much more familiar with both local and non-local resources and thus able to more selectively use certain toolstones to meet specific needs

Toolstone procurement at Ushki-5. Both components 7 and 6 are dominated by what appear to be non-local toolstones, probably the result of a scarcity of knappable material in the vicinity of the site. Nevertheless, as at Dry Creek, the later microblade assemblage contains significantly more basalt and obsidian. This difference in toolstone procurement may indicate that initial, component 7 inhabitants of Ushki-5 were learning the lithic landscape, while later, component 6 inhabitants were more knowledgeable of the lithic landscape and made use of a wider array of regionally available toolstones. It is also possible that the differences reflect changes in provisioning strategies, with microblade-producing inhabitants being more mobile, effectively having more opportunities to access and transport a greater variety of non-local resources to the site.

Toolstone selection at Ushki-5. Unfortunately the tool assemblage from components 7 and 6 are really too small to say much about toolstone selection, but it is clear from our analysis that microblades were always made on CCS or obsidian and never basalt, possibly indicating a more selective behavior of component 6 inhabitants.

Conclusions. Even though raw materials were relatively plentiful at Dry Creek and relatively scarce at Ushki-5, toolstone procurement and selection was unpatterned and unplanned during the non-microblade occupations of both sites. In contrast, the results of this study suggest that toolstone procurement and selection was both patterned and planned during the microblade occupations of the two sites. Based on the results of this meager analysis, there are two, admittedly speculative, alternative explanations of the different archeological complexes of late Pleistocene Beringia. First, perhaps both assemblages represent different populations. In this case the non-microblade assemblages may represent initial inhabitants settling-in and actively learning the landscape, whereas microblade assemblages may represent later landscape experts, who had become familiar with the widespread distribution of lithic resources. Second, perhaps the two assemblages represent different ways of organizing technology that may have resulted from differing land-use strategies. In this case, the non-microblade assemblages may represent less mobile, place-oriented foragers, whereas the microblade assemblages may represent more logistically mobile, technology-oriented foragers. Finally, it is likely that both of these alternative explanations are correct. Early non-microblade complexes of Beringia may indeed represent hunter-gatherer groups who were conservatively and gradually expanding into new territories. Raw material procurement was local and technological organization was expedient, implying either infrequent residential moves or short-distance moves. As time passed, Beringia's early hunter-gatherers became more knowledgeable of the landscape, as evidenced by the presence of non-local toolstones, transport of these between sites, and preferential selection of certain toolstones for specific uses. This may imply a less conservative, far-reaching land-use strategy by microblade occupants. In this setting, microblade production may have become better suited as a technological choice.

We think our conclusions complement those offered to explain resource procurement, land-use, and landscape learning at the Broken Mammoth site in the Tanana Valley, central Alaska. Yesner *et al.* (2004)

suggest that hunter-gatherers at Broken Mammoth focused on local resources as they began to learn the local landscape. Near the end of the Late Glacial the Beringian landscape likely offered its initial inhabitants a complex set of ecological opportunities. Our study presented here, along with interpretations of Yesner *et al.* (2004), suggest that the non-microblade complexes of interior Beringia, especially Broken Mammoth, the Nenana Complex, and Ushki, represent a special adaptation during the Allerød interstadial, a period that Hoffecker and Elias (2007) argue was characterized by significant warming and the spread of the shrub-tundra biotic community. We argue that these non-microblade Beringian complexes represent a "settling-in" phase of interior Beringian colonization, as hunter-gatherers were learning the landscape and becoming more locally oriented. The early microblade occupation at Swan Point in the Tanana Valley, nearly 1000 years older than the non-microblade complexes analyzed here, may represent initial human exploration of central Alaska's unfamiliar landscapes. Further studies of the Swan Point lithic assemblage should help discern whether these first central Alaskans organized technology and procured lithic raw materials in a manner different from the later occupants of Broken Mammoth and the Nenana Complex sites. If Swan Point does indeed represent the initial exploration of the upper Tanana Valley, we predict that the technological strategies of its occupants would have been radically different from those of the later sites and would better match predictions of how initial explorers may have dispersed across unfamiliar landscapes of North America (Beaton 1991; Kelly 1996, 2003; Meltzer 2002, 2003, 2004)

Though the Dry Creek and Ushki data generally fit the model of Beringian colonization presented by Yesner *et al.* (2004), we think the non-microblade complexes of Beringia represent the settling-in phase following initial exploration and colonization. However, we stress that our findings require more rigorous testing with more detailed technological analyses of the Dry Creek, Ushki, and other early assemblages. We caution readers that our study of the Dry Creek assemblage was done nearly 20 years ago under a very different theoretical framework – one focusing on measurement of typological and technological similarities and differences to identify assemblage relationships (Goebel *et al.* 1991), not one focusing on reconstruction and explanation of raw-material provisioning and technological organization. Only through such organizational studies will we be able to reconstruct the environmental and behavioral context of lithic assemblage variability in Paleolithic Beringia. This approach will ultimately help explain the apparent dichotomy between the non-microblade and microblade industries of Beringia and how they relate to the colonization of the New World.

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