Chapter 10

Technology and Human Response to Environmental Change at the Pleistocene-Holocene Boundary in Eastern Beringia: A View from Owl Ridge, Central Alaska

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Introduction

Archaeological investigations in Alaska are significant in providing information about initial human occupation of Beringia, the entry point from an Asian homeland for first Americans (Meltzer 2004; Goebel et al. 2008). Recent research in eastern Beringia has revealed a complex record of terminal Pleistocene-aged sites important to understanding how the Americans were settled. Shortly after initial colonization of eastern Beringia, so far identified at the Swan Point site and dated to ~14,100 calendar years before present (cal. BP) (Potter et al. 2014a), the Beringian record became highly variable. One case of this variability comes from central Alaska and is represented by two technological complexes, Nenana and Denali (Powers and Hoffecker 1989; Hoffecker 2001; Graf and Bigelow 2011; Graf et al. 2015).

We explore this variability in central Alaska by examining how early and later inhabitants of the Owl Ridge site organized their technologies in response to Late Pleistocene and early Holocene environmental fluctuations. We use the established terms, Nenana complex and Denali complex, heuristically, not in an attempt to define human groups or archaeological traditions but to classify observed technologies that represent technological strategies humans adopted while responding to past environmental change. We focus specifically on lithic raw material (or toolstone) procurement and selection behaviors to explain how humans responded to climate change during this interval while arriving in central Alaska and subsequently settling in the region.

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Background

Archaeological Context

As mentioned above, the earliest unequivocal evidence of humans in eastern Beringia comes from Swan Point, located in the middle Tanana Valley 100 km southeast of Fairbanks, Alaska, dating to 14,100 cal. BP, and containing a Siberian late Upper Paleolithic technology based on wedge-shaped microblade-core production (Gomez Coutouly 2011, 2012; Holmes 2011). Following this, humans continued occupying central Alaska through the Late Pleistocene and early Holocene (Potter 2008; Graf and Bigelow 2011), but toolkits changed. The regional pattern of technological variability that emerged after initial exploration has led some to recognize a Nenana complex chronologically and technologically distinct from the Denali complex first identified by West (1967). In this view, Nenana complex assemblages, found at several multicomponent sites in the Nenana and Tanana valleys, date to 13,500–13,000 cal. BP and contain unifacial tools (end scrapers, retouched blades and flakes, gravers, and wedges), diagnostic Chindadn-type bifacial points that are teardrop-shaped or triangular-shaped and sometimes only marginally retouched, other bifaces, and cobble tools (Powers and Hoffecker 1989; Hoffecker et al. 1993; Goebel et al. 1991; Yesner 1996, 2001; Hoffecker 2001; Graf and Goebel 2009; Graf and Bigelow 2011; Graf et al. 2015). Similar technologies dating to the same period of time have even been reported from the Ushki Lake and Berelekh sites in western Beringia (Dikov 1977; Mochanov 1977; Goebel et al. 2003, 2010; Pitulko 2011).

In contrast, Denali complex assemblages, many from the same multicomponent sites with temporally and stratigraphically distinct lower Nenana complex components, date to 12,600–10,000 cal. BP and contain toolkits with lanceolate and concave-based bifacial points, unifacial tools (side scrapers and retouched flakes), as well as burin and microblade technologies. In Nenana Valley sites, lanceolate and concave-based points, burins, and microblade technologies are absent from older Nenana complex components (i.e., Owl Ridge, Dry Creek, Walker Road, Moose Creek) (Powers and Hoffecker 1989; Pearson 1999; Hoffecker 2001; Graf and Bigelow 2011; Graf et al. 2015). During recent investigations of the Teklanika West site, however, a lanceolate point was found in what appears to be a compressed stratigraphic context and palimpsest situation, where two horizontally overlapping artifact zones (components 1 and 2) were found in the same sedimentological unit unseparated by sterile deposits and associated with faunal remains dating to 13,100–9700 cal. BP. Coffman (2011: 106) concluded that the lanceolate point could be associated with component 1 but acknowledged it could be intrusive from component 2.

Mostly because a very early microblade-bearing component at Swan Point was found to predate 14,000 cal. BP, but also because two sites in the Tanana valley continue through the terminal Pleistocene to have bifacial points resembling Chindadn points from Nenana complex sites in the Nenana Valley, some archaeologists argue Nenana complex and Denali complex variability represents different behavioral facies of a pan-Beringian archaeological tradition lasting >4000 years (Holmes 2011; Potter et al. 2014a) and presumably reflects no significant adaptive change to major climatic fluctuation over this timeframe. Thereby, depending on the situation, people selected different technological strategies, bifacial versus composite osseous-microblade hunting weapons, for different immediate needs such as hunting different animals during different seasons, extracting resources in uplands versus lowlands, or proximity to toolstone sources (Holmes 2001; Gal 2002; Potter 2005; Wygal 2009, 2011; Graf and Bigelow 2011). A major issue with this reasoning is that we should expect to find Nenana and Denali complex artifacts together at some sites, but we do not observe this pattern. The only exception is the stratigraphically problematic Healy Lake site, where multiple components may have been excavated together as one (Erlandson et al. 1991; Cook 1996; Hamilton and Goebel 1999). Additionally, faunal data do not support expectations of the related different-animal-during-different-seasons hypothesis. From the Dry Creek site, fauna found in both the Nenana and Denali components indicates hunting activities during the same season (late fall/winter) as well as hunting of the same animal type (Dall sheep) with the different weapon-system technologies (first Chindadn points, then osseous-microblade composite and lanceolate points). At Broken Mammoth, hunters used the same weapon system (Chindadn points) to dispatch different animal types during different seasons. Clearly, we cannot simply claim that microblade technology was selected only during a specific season and for a specific animal type compared with bifacial technologies. We argue the use of a broad-sweeping "Beringian Tradition" oversimplifies complex patterns observed in the early Beringian record and lumping together varied technological strategies found in stratigraphically and temporally discrete contexts obscures evident variability that needs to be explained.

At least three sites in the Nenana Valley contain both Nenana and Denali assemblages in stratigraphically and chronologically separate geological contexts: Owl Ridge, Dry Creek, and Moose Creek (Pearson 1999; Graf and Bigelow 2011; Graf et al. 2015). Historically, proponents of separating Nenana and Denali complexes have argued this variability resulted from two different populations settling central Alaska from Northeast Asia (Goebel et al. 1991; Hoffecker et al. 1993; Hoffecker and Elias 2007). This interpretation certainly fits well with the recently proposed Beringian standstill model for development of Native American genetic population differentiation hypothetically staged in Beringia or far Northeast Asia (Tamm et al. 2007; Mulligan and Kitchen 2014; Raghavan et al. 2015). The hypothesis of different Beringian populations with different toolkits is difficult to test without abundant human skeletal remains preserving ancient DNA that would provide population-level genetic information. Recent skeletal finds associated with Denali complex technology at the Upward Sun River site in the Tanana Valley (Potter et al. 2011, 2014b) evidence at least two mtDNA clades present in the same population, giving us important clues about social organization at this time and genetic relatedness of early Holocene Alaskans with other Native Americans (Tackney et al. 2015);

however, we need preserved human DNA from earlier Beringian sites with Nenana complex technology to begin to test the different populations hypothesis.

What does the chronological patterning of Beringian archaeological variability mean? We are more interested in understanding whether the patterns of variability can be explained as human response to variation in resource distribution resulting from climate change (following Mason et al. 2001; Graf and Goebel 2009; Graf and Bigelow 2011; Wygal 2011). We contend humans will select necessary tool-provisioning strategies to be successful in a given environmental situation and perceived landscape. In this paper we consider the observed differences between Nenana and Denali complexes the result of humans selecting different hunting strategies as they became increasingly familiar with the local landscape and responded to climate change and shifts in habitat and resource availability. Before delving into the details of our lithics study, we first review the central Alaskan paleoecological record to establish ecological parameters humans faced at the Pleistocene-Holocene boundary.

Paleoenvironmental Context

Paleoecologists working in Alaska have long been interested in identifying climatic fluctuations between about 15,000 and 10,000 cal. BP. Therefore, the paleoenvironmental record for the region is reasonably robust and can be used to infer major climatic events and changes in biome composition. Such data allow us to predict resource distributions for humans inhabiting the region and provide a means to evaluate paleoecological constraints faced by the region's earliest inhabitants. In particular we are interested in the effects of Northern Hemispheric climatic events such as the Older Dryas, Allerød, Younger Dryas, and Holocene Thermal Maximum on central Alaskans (Bigelow and Edwards 2001; Bigelow and Powers 2001; Kaufman et al. 2004; Kokorowski et al. 2008; Graf and Bigelow 2011). These specific climatic events characterize the time before, during, and after hunter-gatherers inhabited Owl Ridge.

Regional late glacial pollen records, predating 14,000 cal. BP, indicate herb-tundra vegetation. The landscape would have been open with few trees and dominated by an herbaceous plant combination of short grasses, sedges, and *Artemisia* sp. (Bigelow and Powers 2001; Anderson et al. 2004). Animals would have included woolly mammoth, horse, bison, wapiti, and moose as well as other smaller species (Guthrie 2017, 2006; Meiri et al. 2014). By about 14,000 cal. BP, a birch and willow shrub-tundra vegetation community came to dominate the region (Bigelow and Powers 2001; Anderson et al. 2004; Brubaker et al. 2005). Rises in lake levels through the Allerød (14,000–13,000 cal. BP) indicate relatively warmer temperatures and higher humidity than immediately before or after this time (Abbott et al. 2000; Bigelow and Edwards 2001). As a result, obligate grazers such as horse and mammoth went extinct by 13,500 cal. BP, while bison and wapiti (grazers who also browse) and moose (an obligate browser) populations were maintained (Guthrie 2006), and abundance of waterfowl in the Broken Mammoth faunal assemblage indicates the presence and use by humans of more mesophilic species (Yesner 2007).

In some regions of the Northern Hemisphere, the Younger Dryas was not significantly felt, but in northern latitudes its effects were more pronounced (Kokorowski et al. 2008). In fact, central Alaskan paleoecological records suggest much drier conditions, especially north of the Alaska Range due to an interior Alaskan rain-shadow effect, reflected by a significant increase in *Artemisia* sp. pollen, lowered lake levels, and deposition of eolian sand layers (Hu et al. 1993; Bigelow et al. 1990; Abbott et al. 2000; Bigelow and Edwards 2001; Bigelow and Powers 2001). Bison and wapiti populations were maintained during this arid interval; however, moose became far less prevalent (Guthrie 2006). Archaeological sites in the region also indicate the presence of caribou (Yesner 2001, 2007; Bowers and Reuther 2008).

Within a few centuries following the Younger Dryas and by 11,000 cal. BP, the onset of the Holocene Thermal Maximum had begun with expansion of *Populus*, representing the first trees to inhabit the Alaskan interior since marine oxygen isotope stage (MIS) 3 (~35,000–26,000 cal. BP). *Populus* is known to be cold-tolerant yet thrives in warm summer conditions. Regional lake levels were lower than today, indicating an early Holocene climate warmer and drier, especially during summer months. Following 10,000 cal. BP, *Picea* spread to the region and lake levels increased, signaling a shift from an open-forest parkland to boreal-forest biome and the relatively warm, moist conditions of today (Abbot et al. 2000; Barber and Finney 2000; Bigelow and Powers 2001; Lloyd et al. 2006). Faunal compositions during the early Holocene also mimic the later Holocene pattern with wapiti extinct, but populations of moose and bison maintained (Guthrie 2006).

The paleoecological record of central Alaska indicates initial migrants from Siberia were faced with a frigid, dry landscape with little woody vegetation for fire production and maintenance at 14,100 cal. BP, though large mammal populations of the herb tundra would have provided high-protein resources and a source of slow-burning fuel once a fire could be established with wood (Crass et al. 2011). A fire fueled with bones, however, burns with a high flame and does not carry embers, so it is good for lighting, drying, and curing, but not necessarily for more thorough cooking (Théry-Parisot et al. 2002). Perhaps this is why only one interior Alaskan archaeological site to date has been recorded for the period just prior to the Allerød (Hoffecker and Elias 2007). During the Allerød, wetter conditions resulted in spread of shrub-tundra vegetation increasing burning opportunities for people so they could maintain fires for both cooking and curing as well as drying and warmth. Bison, wapiti, and moose were available for hunting and so were smaller wetland resources, such as waterfowl. During the Younger Dryas, a brief reversal to drier conditions meant that more mesophilic taxa, such as moose, were less available for human use (Yesner 2007). Following the Pleistocene, warmer and eventually more humid conditions returned and persisted, altering the biome of central Alaska. The eventual emergence of the boreal forest led to lower numbers and more dispersed large fauna with bison relegated to lowland settings, wapiti eventually becoming extinct locally, and solitary moose widely dispersed across the landscape.

Below we use the archaeological record from Owl Ridge to test the hypothesis that technological changes during the terminal Pleistocene resulted from human response to climate change and associated changes in fuel and food resource distributions. We expect that human decisions to select specific adaptive strategies are reflected in the technologies they used and that these decisions were made in response to environmental change, such as change in composition, proportion, and distribution of natural resources around them (Nelson 1991; Kuhn 1995; Elston and Brantingham 2002; Andrefsky 2009; Graf 2010; Graf and Bigelow 2011).

Materials and Methods

Owl Ridge Basics

Owl Ridge is located in the northern foothills of the Alaska Range along the Teklanika River, a glacially fed tributary to the Nenana River (Fig. 10.1). The site is situated in interbedded loess, cliff-head sand, and colluvial deposits capping a glacial outwash terrace of the Teklanika River and resting approximately 61 m above the confluence of the river and First Creek, a small clear stream draining the immediate foothills. Given conditions of the herb-tundra and shrub-tundra landscape, this location would have provided hunter-gatherers of the terminal Pleistocene an advantageous, unobstructed view of game and lithic resources located in the surrounding area as well as a source of clear water. The Owl Ridge site was initially discovered in 1976 during a backcountry survey of the Teklanika River (Plaskett 1976), and it was tested in 1977–1979 and 1982–1984 by the University of Alaska Fairbanks archaeologists. Following the 1980s testing project, three cultural components were identified. Based primarily on stratigraphy and several conventional radiocarbon (^{14}C) dates, Phippen (1988) assigned the lowermost component to the then recently defined Nenana complex and the upper two components to the Denali complex, one dating to the Younger Dryas and the other dating to the middle-late Holocene. In 2007, 2009, and 2010, we returned to Owl Ridge to conduct full-scale excavations, opening an additional 54 m^2. We found site deposits to be approximately 125 cm thick, consisting of three sandy loams, separated by two sand layers (Fig. 10.2). The sandy loams represent three loess-deposition events: loess 1, loess 2, and loess 3. The lowermost sand, sand 1, is a relatively thin eolian deposit, most likely resulting from cliff-head sand deposition, and the upper sand, sand 2, is a thick set of colluvial deposits.

Three cultural components were found in three stratigraphically separated strata. The earliest, component 1, was found in the upper 5 cm of loess 1. One conventional ^{14}C date obtained by Phippen (1988) on a bulk charcoal sample provided an age of 11,340 ± 150 (Beta-11,209) ^{14}C BP, and an additional AMS date obtained by our

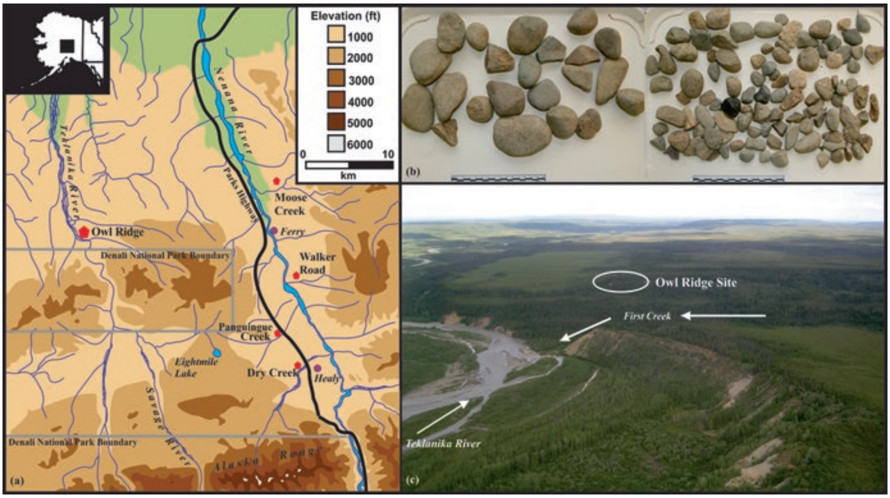

Fig. 10.1 Map of the Nenana and Teklanika River Valleys with the location of the Owl Ridge site (**a**). Picture of two rock samples from the glacial outwash terrace that the site rests on (**b**). Picture of location of Owl Ridge relative to the Teklanika River and First Creek floodplains (**c**)

team on a single piece of naturally occurring wood (*Salix* sp.) charcoal from loess 1 within a component 1 artifact cluster provided the age of 11,056 ± 59 (AA-86969) ^{14}C BP (Graf and Bigelow 2011). Together these dates indicate a range of occupation of about 13,300–13,000 cal. BP (all ^{14}C dates in this chapter were calibrated using the Intcal13 curve in the Calib 7.0.2 downloadable program for MS Windows [Reimer et al. 2013]). Component 1, therefore, dates to the end of the Allerød and immediately prior to the Younger Dryas (Graf and Bigelow 2011). Component 2 artifacts were consistently found associated with a paleosol (buried A/B horizon) in loess 2. In our excavations, we obtained 13 radiocarbon samples of naturally occurring wood (*Salix* sp.) charcoal isolated in the paleosol and found within component 2 artifact concentrations. These dates overlap at 2-sigma standard deviation and range from 10,485 ± 25 (UCIAMS-71261) to 10,020 ± 40 (Beta-289,378) ^{14}C (12,550–11,315 cal.) BP, dating the paleosol and deposition of artifacts to the Younger Dryas (Graf et al. 2010; Graf and Bigelow 2011). Given that dated materials and artifacts from component 2 were found in a paleosol of loess 2, signaling a stable surface and relatively mild climate, plus they are directly overlying cliff-head sand deposits signaling a relatively windy, dry period, we argue that locally the Younger Dryas climatic reversal was brief and can be dated to the intervening 450 years between component 1 and component 2 site visits. Finally, component 3 artifacts were found near the contact of sand 2 with overlying loess 3, most within the upper 5 cm of sand 2 (Melton 2015). Two AMS dates on two wood (*Salix* sp.) charcoal samples from a possible hearth feature produced ages of 9880 ± 40 (Beta-330,127) and 9790 ± 40 (Beta-289,379) ^{14}C (11,390–11,170 cal.) BP. Together, stratigraphic and AMS data establish the site was visited three times at the

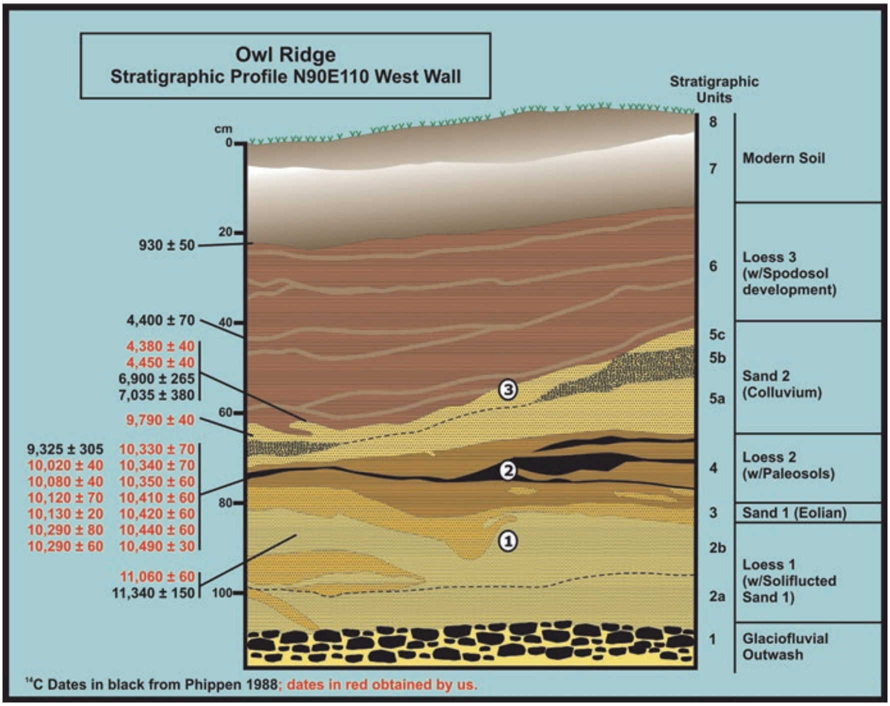

Fig. 10.2 Representative stratigraphic profile of the Owl Ridge site, showing stratigraphic locations of radiocarbon dates obtained and cultural components (*1*, *2*, and *3*) identified during site investigations

Pleistocene-Holocene boundary: the first occupation at about 13,300–13,000 cal. BP or during the last centuries of the Allerød; the second some time between 12,550–11,320 cal. BP during the global Younger Dryas chronozone, but after the local Younger Dryas climatic event; and the third occupation at about 11,390–11,170 cal. BP, immediately before the Holocene Thermal Maximum as forests were emerging in central Alaska. Given the regional sequence of climatic and biome changes that occurred from the Allerød through the Holocene Thermal Maximum, with Owl Ridge, we have a unique opportunity to examine human adaptive response by members of a small-scale society to fairly rapid shifts in local climate.

Lithic assemblages analyzed for this paper include excavated materials collected by Peter Phippen currently housed at the University of Alaska Fairbanks Museum of the North, as well as materials collected from our excavations during the 2007–2010 field seasons. Taken together, the analyzed Owl Ridge lithic assemblage presented here totals 4104 artifacts. An additional 223 artifacts were found in excavation squares at the bluff edge where stratigraphy was compressed into <50 cm of deposits, and assignment of these pieces to specific stratigraphic units and cultural components could not be confidently undertaken, and therefore are omitted from our analysis presented here.

Technological Organization and Human Response to Environmental Change

One way to gain a clearer picture of how people responded to environmental change is to explore how they organized their technologies, subsistence, and land-use strategies. The terminal Pleistocene archaeological record in central Alaska, however, is largely a lithic record. Faunal preservation is almost nonexistent with only a handful of sites preserving identifiable specimens (e.g., Dry Creek, Broken Mammoth, Carlo Creek, Swan Point, Upward Sun River, and Gerstle River Quarry) (Bowers 1980; Yesner 2001; Potter 2007; Graf and Bigelow 2011; Graf et al. 2015), and of these only the Gerstle River Quarry and Broken Mammoth assemblages have been analyzed beyond number of identified specimens (Potter 2007; Yesner 2007). Therefore, with the data at hand, little about subsistence organization can be directly garnered from the record. We are left to rely mostly on the lithic record to reconstruct how people organized themselves on the landscape, how they made a living, and why. Owl Ridge is no exception to this pattern. Here we analyze the lithic assemblages from the site's three terminal Pleistocene components to explore changes in technological organization, provisioning, and use of the lithic landscape.

Because climate in central Alaska was variable during the terminal Pleistocene and resource distributions changed as a result of this variability, we expect humans to have altered their mobility and technological strategies in response. We approach this problem from a human ecology, resilience theory perspective (Redman 2005; Cooper and Sheets 2012; Birks et al. 2015). Humans organize mobility, subsistence, and technological strategies around solving the problem of procuring food (Binford 1980; Bleed and Bleed 1987; Nelson 1991; Kuhn 1995; Morgan 2009). Human interaction with the environment guides technological, subsistence, and land-use decisions. In response to changing climate and resource availability and distribution, humans may show resilience by staying in the changing environment but making necessary alterations to behavioral strategies and adapting to the changing ecosystem. In contrast, however, they may decide to migrate or even resist change and be driven to extinction (Redman 2005; Fitzhugh 2012; Birks et al. 2015). Decisions to alter technological organization or the selection of specific strategies for making, curating, transporting, and discarding tools happen in response to resource distribution, productivity, and predictability (Binford 1979; Shott 1986; Bamforth 1991; Nelson 1991; Andrefsky 2009). To explain technological behavioral patterns reflected in the archaeological record in central Alaska and how these patterns may represent human response to climate and environmental change, this paper will examine toolstone procurement and selection behaviors represented in components 1, 2, and 3 at Owl Ridge. By analyzing variables that inform on ways toolstones were procured then selected for tool manufacture, we can make inferences regarding how site occupants used their landscape. By comparing the cultural occupations, we will detect behavioral responses to environmental change through time.

As central Alaskan climate, biomes, and landscapes changed throughout human occupation (13,300–11,200 cal. BP) at Owl Ridge, we expect to see changes in the technological strategies and ways people used the site and surrounding landscape as they responded to these shifts. This will help us document and consider the resilience of hunter-gatherers in the region during the last major global warming event.

We examine lithic raw material availability (lithic landscape), variability, and transport to explain toolstone procurement at the site. The availability and distribution of potential toolstones affect decisions to procure those materials (Kuhn 1995; Andrefsky 2009; Graf 2010). Below, we discuss current knowledge of the lithic landscape local to the site and within the greater Nenana and Teklanika Valleys. We consider frequency of raw material classes, such as cryptocrystalline silicate (CCS) or the fine-grained cherts and chalcedonies, microcrystalline silicate (MCS) or coarse-grained cherts, andesite, basalt, rhyolite, and other less common raw materials or quartzites, granodiorites, and greywackes, by archaeological component to understand toolstone variability. This allows us to assess which available resources in the lithic landscape were economically significant to the inhabitants of Owl Ridge and whether these procurement patterns changed through time. In our analyses we identified toolstones through visual inspection. Geochemical characterization and sourcing studies have been successfully accomplished on Alaskan obsidians (Reuther et al. 2011); however, because obsidian is lacking from the Owl Ridge assemblage and little is known about specific basalt and rhyolite sources in central Alaska (but see Coffman and Rasic 2015 for preliminary investigation of rhyolite use), we did not use geochemical characterization to identify specific raw material source locations. One of us (Gore) is currently working on geochemical characterization of all local basalts and andesites from the Nenana Valley. In this study, we identified the presence of cortex on toolstones to explore relative degrees of transport. We assume specific toolstone types always found without cortex originated offsite and were not locally procured. Toolstone types expressing cortex, especially alluvial cobble cortex, were locally procured on-site in the glacial outwash or nearby in the creek and river alluvium. Variables we used to highlight toolstone transport behaviors include number of toolstone types expressing cortex and, therefore, representing locally procured raw materials, frequency of nonlocal toolstone types in the site assemblage, and frequency of local versus nonlocal toolstones by component.

We used three integrative lithic variables to explore technological activities: primary versus secondary reduction activities, formal versus informal technologies, and bifacial versus unifacial technologies (Graf and Goebel 2009). To understand how Owl Ridge foragers selected toolstones for these activities, we considered each variable first by toolstone type and second by nonlocal/local toolstone. Primary reduction artifacts related to core reduction and tool-blank production include cores, cortical spalls, flakes (>1 cm^2 in total dimension), blade-like flakes, bladelets, microblades, technical spalls (diagnostic of blade or microblade-core production), and angular shatter (Graf and Goebel 2009). Secondary reduction artifacts related to tool manufacture and rejuvenation include tool trimming flakes or “retouch chips” (<1 m^2 in total dimension), biface-thinning flakes, burin spalls, and tools (Graf 2008; Graf and Goebel 2009). Formal technologies include prepared cores (blade and microblade cores) and tools manufactured to have long use-life histories (bifaces, side scrapers, end scrapers, and combination tools). Informal or expediently produced cores and tools include flake cores, tested cobbles, retouched flakes and blades, gravers, burins, and cobble tools. These tools evidence little retouch, shaping, preparation, and short use-life histories (Kuhn 1995; Graf 2008, 2010; Andrefsky 2009; Graf and Goebel 2009). Bifacial technologies include all bifaces and bifacial thinning flakes (Graf 2008; Graf and Goebel 2009). Unifacial technologies include all unifacial tools and retouch chips with smooth platforms, representing debitage removed from unifacial edges (Graf 2008; Graf and Goebel 2009).

Results

Character of Owl Ridge Lithic Assemblages

The analyzed Owl Ridge assemblage totaled 4104 artifacts (Table 10.1), 894 from component 1, 1343 from component 2, and 1867 from component 3. Within component 1 there was 1 tested cobble, 870 debitage pieces, and 23 tools. Debitage includes cortical spalls, flakes and flake fragments, blade-like flakes, bladelets, a blade core tablet, angular shatter, retouch chips, biface-thinning flakes, and burin spalls. Four triangular-shaped bifacial points manufactured on flake blanks were identified in the tool assemblage, but only one of these was found in a nearly complete condition, only missing its tip (Fig. 10.3a). Other tools included bifaces, retouched flakes, and an anvil stone. In component 2 there were 9 cores, 1300 debitage pieces, and 34 tools. Cores included tested cobbles and unidirectional flake cores. Debitage consisted of cortical spalls, flakes and flake fragments, blade-like flakes, one proximal blade, microblades, microblade-reduction technical spalls, angular shatter, retouch chips, biface-thinning flakes, and one burin spall. Three lanceolate-shaped bifacial points made on biface tool blanks were identified in the tool assemblage. The rest of the tools included bifaces, a scraper-biface combination tool, side scrapers, end scrapers, a dihedral burin, retouched flakes, and cobble tools (scraper planes, hammerstones, and an abrader). In component 3, there were a total of 9 cores, 1835 debitage pieces, and 23 tools. Cores included tested cobbles, bidirectional flake cores, and a multidirectional flake core. Debitage included cortical spalls, flakes and flake fragments, a blade-like flake, a blade midsection, a microblade, angular shatter, retouch chips, and biface-thinning flakes. Tools consisted of bifaces, a scraper-biface combination tool, side scrapers, an end scraper, retouched flakes, a cobble-spall scraper, a cobble tool, and hammerstones.

Table 10.1 Presentation of artifact types by component

Artifact class	Component 1	Component 2	Component 3
Cores			
Tested cobbles	1 (0.1%)	6 (0.5%)	6 (0.3%)
Unidirectional flake cores	0 (0.0%)	1 (0.1%)	0 (0.0%)
Bidirectional flake cores	0 (0.0%)	0 (0.0%)	2 (0.1%)
Multidirectional flake cores	0 (0.0%)	2 (0.1%)	1 (0.1%)
Subtotal	*1 (0.1%)*	*9 (0.7%)*	*9 (0.5%)*
Debitage			
Cortical spalls	87 (9.7%)	83 (6.2%)	367 (19.7%)
Flakes and flake fragments	527 (58.9%)	694 (51.7%)	1141 (61.1%)
Blade-like flakes	7 (0.8%)	11 (0.8%)	2 (0.1%)
Blades	3 (0.3%)	1 (0.1%)	2 (0.1%)
Microblades	0 (0.0%)	3 (0.2%)	1 (0.1%)
Technical spalls	1 (0.1%)	2 (0.1%)	1 (0.1%)
Angular shatter	9 (1.0%)	65 (4.9%)	78 (4.2%)
Resharpening chips	158 (17.8%)	342 (25.5%)	162 (8.6%)
Biface thinning flakes	77 (8.6%)	95 (7.1%)	81 (4.3%)
Burin spalls	1 (0.1%)	4 (0.3%)	0 (0.0%)
Subtotal	*870 (97.3%)*	*1300 (96.8%)*	*1835 (98.3%)*
Tools			
Bifaces	15 (1.7%)	10 (0.7%)	4 (0.2%)
Side scrapers	0 (0.0%)	4 (0.3%)	3 (0.1%)
End scrapers	0 (0.0%)	2 (0.1%)	1 (0.1%)
Combination tools	0 (0.0%)	1 (0.1%)	1 (0.1%)
Burins	0 (0.0%)	1 (0.1%)	0 (0.0%)
Retouched flakes	7 (0.8%)	5 (0.4%)	7 (0.3%)
Scraper on cobble	0 (0.0%)	0 (0.0%)	1 (0.1%)
Planes	0 (0.0%)	3 (0.2%)	0 (0.0%)
Hammerstones	0 (0.0%)	6 (0.4%)	6 (0.3%)
Anvil	1 (0.1%)	0 (0.0%)	0 (0.0%)
Abraders	0 (0.0%)	1 (0.1%)	0 (0.0%)
Flaked pebble	0 (0.0 %)	1 (0.1%)	0 (0.0%)
Subtotal	*23 (2.6%)*	*34 (2.5%)*	*23 (1.2%)*
Component totals	*894 (100%)*	*1343 (100%)*	*1867 (100%)*

Raw Material Procurement

Lithic Landscape

Today, the local lithic landscape within 5 kilometers surrounding the Owl Ridge site is characterized by glaciofluvial outwash terraces, alluvium and floodplain deposits of the Teklanika River and First Creek, and exposures of adjacent bedrock formations and associated colluvium. Bedrock formations include the Nenana Gravel

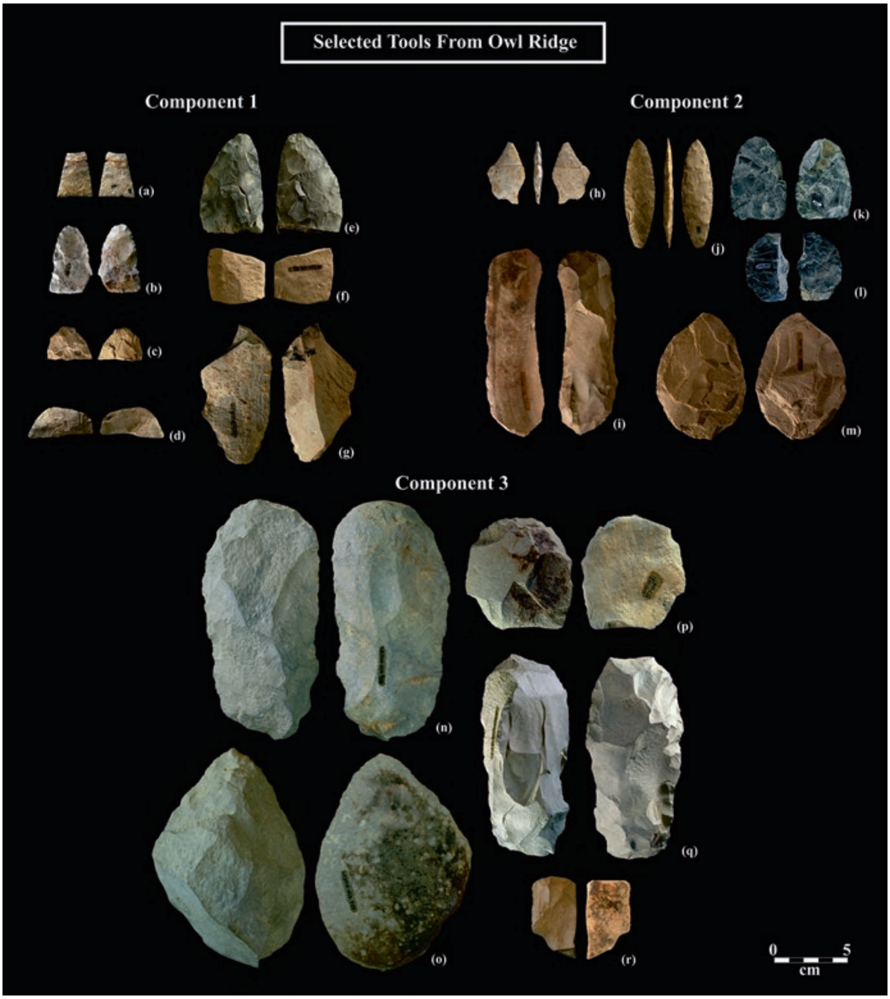

Fig. 10.3 Representative sample of tools in each component at Owl Ridge. *Component 1* artifacts shown include triangular-shaped Chindadn point (**a**), bifaces (**b**–**e**), scraper fragment (**f**), and retouched flake (**g**). *Component 2* artifacts include concave-based point (**h**), lanceolate point (**j**), bifaces (**k**, **m**), concave-based point (**h**), double-ended scraper (**i**), and retouched flake fragment (**l**). *Component 3* artifacts include bifaces (**n**, **q**), an end scraper (**r**), a retouched flake (**p**), and a cobble-spall scraper (**o**)

formation, a Tertiary-aged conglomerate of ancient northern Alaska Range alluvium (Wahrhaftig 1958, 1970a), and the Metamorphic Rocks North of Fish and Panguingue Creeks (MRNFPC) formation complex primarily composed of schist and slate and presumed to date to the Paleozoic/Precambrian (Wahrhaftig 1970a). The site rests directly on the Healy glacial outwash terrace of the Teklanika River, presumed to date to MIS 3 or before (Wahrhaftig 1958; Thorson 1986; Dortch et al. 2010).

Table 10.2 Toolstone variability by component

Raw material classes	Component 1	Component 2	Component 3	Total
CCS	308 (7.5%)	255 (6.2%)	91 (2.3%)	654 (16.0%)
MCS	209 (5.1%)	190 (4.6%)	95 (2.3%)	494 (12.0%)
Andesite	248 (6.0%)	734 (17.9%)	1241 (30.2%)	2223 (54.1%)
Basalt	37 (0.9%)	48 (1.2%)	256 (6.2%)	341 (8.3%)
Rhyolite	74 (1.9%)	3 (<0.1%)	46 (1.1%)	123 (3.0%)
Others	18 (0.4%)	113 (2.8%)	138 (3.4%)	269 (6.6%)
Total	*894 (21.8%)*	*1343 (32.7%)*	*1867 (45.5%)*	*4104 (100%)*

Glacial outwash in this area contains gravels reworked from the Birch Creek formation in the Alaska Range and from both Nenana Gravel and MRNFPC formations in the foothills immediately nearby the site. Together the common rock types include gneiss, gabbro, diabase, andesite, basalt, quartz-sericite schist, quartzite, slate, and metachert (Wahrhaftig 1958, 1970a; Wahrhaftig and Black 1958).

A few dispersed basalt and rhyolite dikes, presumed to have formed during the early Tertiary, are mapped in the Birch Creek formation far upslope in the Alaska Range. Today, the nearest of these include several basalt dikes located about 30 km south of the site along the divide (western slope of Mt. Healy) between the Nenana and Teklanika Rivers (Wahrhaftig 1970a). The nearest rhyolite dikes are mapped about 31 km east of Owl Ridge at the headwaters of Eva Creek and 43 km southeast on Sugarloaf Mountain, both locations lie on the east side of the Nenana River (Wahrhaftig 1970b, c). A raw material survey in the immediate vicinity of Owl Ridge during the 2007, 2009, and 2015 field seasons confirmed that all raw material classes discussed above are present in both the glacial outwash on-site and in the creek and river floodplain deposits near the site. These locally available stone clasts come in the form of well-rounded to sub-rounded small boulders, cobbles, and pebbles of more brittle stones (e.g., schist, slate, and metachert) found mostly in the small cobble to pebble sizes (Fig. 10.1b).

Raw Material Variability

Raw material classes present in the Owl Ridge lithic assemblage in order of prevalence included andesite, CCS, MCS, basalt, rhyolite, and other toolstones such as quartzite, granodiorite, and greywacke (Table 10.2). Examining toolstone variability, two general patterns emerged. First, more artifacts were manufactured on andesite than all other raw materials combined, and its use dramatically increased through time. In contrast, the pattern is reversed for the next economically important raw materials. CCS and to a lesser extent MCS decreased in importance through time. Basalt and rhyolite show a similar relationship, where the use of basalt increased through time in tandem with andesite, but rhyolite use decreased through time, similar to CCS and MCS (Table 10.2).

Table 10.3 Frequency of toolstone types never expressing cortex

	Total number of toolstone types	Number of toolstone types without cortex
Component 1	35	21 (60%)
Component 2	31	14 (45%)
Component 3	38	13 (34%)

Raw Material Transport

We expect the presence of cobble cortex on specific raw material types to indicate these as local toolstones, whereas complete absence of cortex on specific raw material types establishes these as nonlocal toolstones. Table 10.3 illustrates the number of individual toolstones never expressing cortex by component and, therefore, the frequency of nonlocal toolstone types by component. Sixty percent of the toolstone types in component 1 are nonlocal varieties, 45% are nonlocal in component 2, and 34% are nonlocal in component 3. The number of nonlocal toolstones transported to the site decreased after initial occupation of the site.

Further examination of which of these toolstone types appear to be local and nonlocal shows some varieties of CCS, MCS, and nearly all rhyolites were nonlocal (Fig. 10.4), whereas all andesites and basalts were procured locally. Examining transport more closely, local toolstones dominated the Owl Ridge assemblage; however, there were differences through time (Fig. 10.5). Though frequencies of nonlocal toolstones were relatively low in all three components (12–1%), there were significantly more-than-expected nonlocal materials transported to the site by component 1 inhabitants and significantly less than expected procured by both component 2 and component 3 inhabitants of the site. Together, raw material transport variables indicate that through time site occupants became increasingly reliant on the procurement of local toolstones.

Raw Material Selection

Primary and Secondary Reduction Activities

Primary reduction activities dominated all three components with 71% of the component 1, 63% of the component 2, and 85% of the component 3 assemblages comprised of primary reduction pieces; however, there was more-than-expected secondary reduction during the component 1 and component 2 occupation episode but more-than-expected primary reduction during the component 3 occupation (Table 10.4). Technological activities during the occupation events reflected by components 1 and 2 centered more on tool shaping and maintenance, while activities during component 3 occupation centered more on initial steps of tool-blank production.

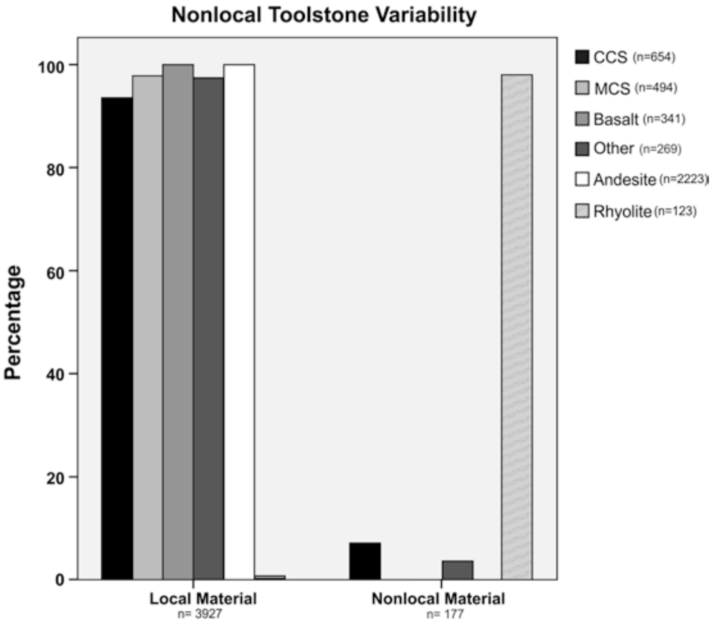

Fig. 10.4 Bar chart expressing which toolstone types are local versus nonlocal

Generally speaking, chert (CCS and MCS) and/or fine-grained igneous (FGI) toolstones (basalt, andesite, and rhyolite) dominated both primary and secondary reduction activities in all three components (Fig. 10.6), meaning higher-quality, fine-grained toolstones were selected over lower-quality, coarse-grained alternatives. Examining toolstone selection by component for primary versus secondary reduction, we found some interesting patterns. For primary reduction activities, cherts were selected more than expected compared with other toolstones and FGI in component 1, but during the component 2 occupation, chert and other toolstones were selected more than expected compared with FGI, and in component 3 other toolstones and FGI were selected more than expected compared with chert. For secondary reduction activities, component 1 occupants again preferred chert over the other toolstones, component 2 occupants preferred other toolstones and FGI over chert, and component 3 inhabitants selected FGI over the others. Through time, the importance of chert as a toolstone decreased and was eventually replaced by FGI.

When examining reduction activities by local versus nonlocal toolstones, component 1 exhibited greater-than-expected selection of nonlocal toolstones for both primary and secondary reduction activities, whereas both components 2 and 3 evidenced greater-than-expected selection of local raw materials for both primary and secondary reduction (Fig. 10.6b), indicating the use of more nonlocal toolstones during the initial site visit, especially for secondary reduction activities, compared with later visits to the site.

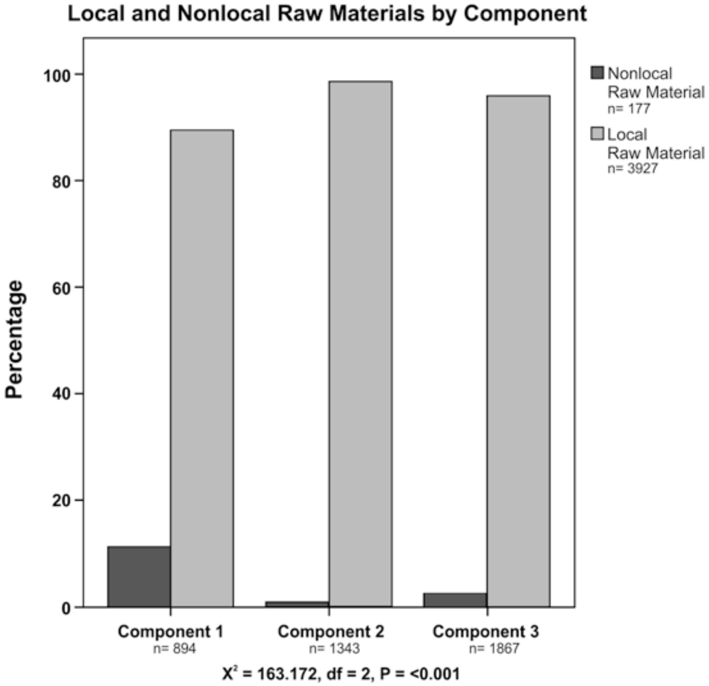

Fig. 10.5 Bar chart showing local and nonlocal toolstones by component

Table 10.4 Primary and secondary reduction activities by component

		Primary	Secondary	Total
Component 1	Count	627	258	885
	Expected count	662.1	222.9	885
	% total (within component)	(70.8%)	(29.2%)	(100.0%)
Component 2	Count	806	472	1278
	Expected count	956.2	321.8	1278
	% total (within component)	(63.1%)	(37.0%)	(100.0%)
Component 3	Count	1523	265	1788
	Expected count	1337.7	450.3	1788
	% total (within component)	(85.2%)	(14.8%)	(100.0%)
Total	Count	2956	995	3951
	Expected count	2956	995	3951
	% of total	(74.8%)	(25.2%)	(100.0%)

$\chi^2 = 202.935$; df = 2; $P < 0.001$. Note no (0.0%) cells have expected counts less than 5. The minimum expected count is 222.87

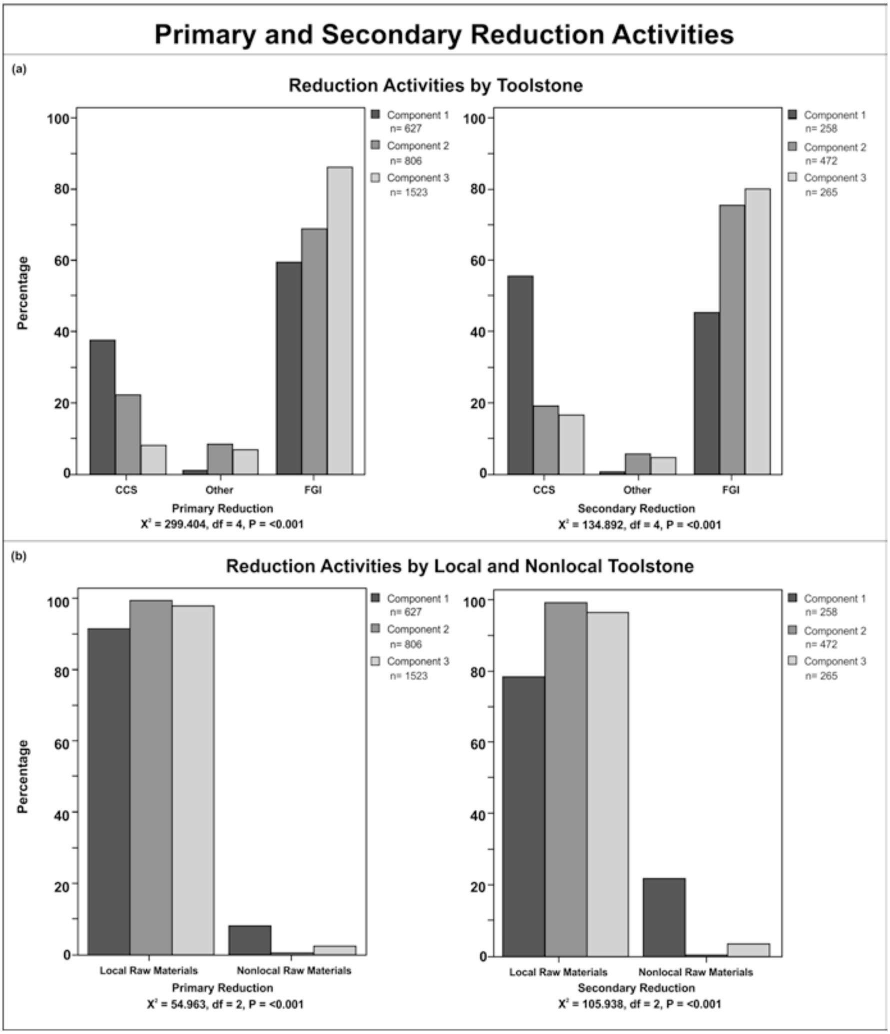

Fig. 10.6 Primary and secondary reduction activities by (**a**) toolstone types and (**b**) local and nonlocal toolstones

Formal and Informal Technologies

Comparing the frequencies of formal versus informal technologies, both components 1 and 2 had more-than-expected formal technologies, whereas component 3 had less-than-expected formal technologies (Table 10.5). Through time, more effort was spent on production and maintenance of informal technologies at Owl Ridge. Similar to reduction activities, formal and informal technologies were patterned in toolstone selection (Fig. 10.7). For formal technologies, chert was selected at the expense of the other toolstones in component 1, but during the component 2 and

Table 10.5 Formal and informal technologies by component

		Formal	Informal	Total
Component 1	Count	262	632	894
	Expected count	221.3	672.7	894
	% total (within component)	(25.8%)	(70.7%)	(100.0%)
Component 2	Count	481	862	1343
	Expected count	332.5	1010.5	1343
	% total (within component)	(35.8%)	(64.2%)	(100.0%)
Component 3	Count	273	1594	1867
	Expected count	462.2	1404.8	1867
	% total (within component)	(14.6%)	(85.4%)	(100.0%)
Total	Count	1016	3088	4104
	Expected count	1016.0	3088.0	4104
	% of total	(24.7%)	(75.3%)	(100.0%)

$\chi^2 = 201.044$; df = 2; $P < 0.001$. Note no (0.0%) cells have expected counts less than 5. The minimum expected count is 221.32

component 3 occupations, other toolstones were selected more than chert. For manufacturing informal activities, component 1 occupants again preferred chert over the other toolstones, but component 2 occupants selected both chert and other toolstones over FGI, and component 3 inhabitants preferred both FGI and other toolstones over the chert. Through time, Owl Ridge foragers came to prefer cherts less and FGI more. This is especially true for the production and maintenance of more formal technologies. Examining local versus nonlocal selection for production and maintenance of formal versus informal technologies, the main difference between components is nonlocal toolstones were preferred more for formal technologies by component 1 flintknappers, whereas for both components 2 and component 3 occupants preferentially selected local toolstones for both formal and informal technologies (Fig. 10.7b).

Unifacial and Bifacial Technologies

There was no significant difference between the components in the production and maintenance of unifacial versus bifacial industries; however, component 1 had more bifacial and less unifacial technologies present compared with the other two components (Table 10.6). This pattern was upheld when looking at the number of bifacial tools relative to unifacial tools in Table 10.1. Toolstone selection for bifacial versus unifacial reduction was patterned (Fig. 10.8). For bifacial technologies, both components 1 and 2 evidenced greater-than-expected selection of chert over other toolstones, whereas component 3 evidenced greater-than-expected selection of FGI over the others. For unifacial reduction, component 1 had more-than-expected chert, component 2 had more-than-expected other toolstones, and component 3 preference was for FGI (Fig. 10.8a). Similar to the other variables, these data indicate

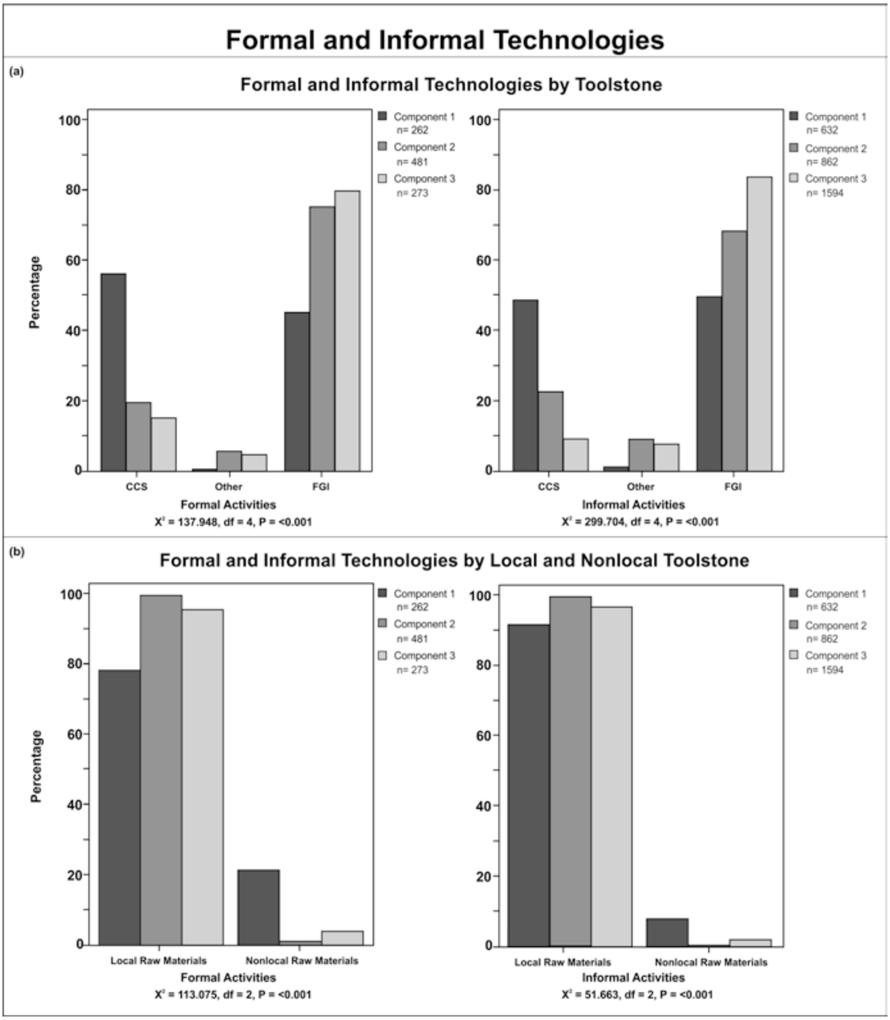

Fig. 10.7 Informal and formal technologies by (**a**) toolstone types and (**b**) local and nonlocal toolstones

preference for chert in component 1 for both bifacial and unifacial reduction with an increased reliance on volcanic raw materials and other toolstones for production of all tool technologies in both components 2 and 3.

Exploring local versus nonlocal toolstone selection for bifacial and unifacial technologies, again we found similar patterning. For bifacial reduction, component 1 had more-than-expected nonlocal toolstone and components 2 and 3 had more-than-expected local toolstones. For unifacial reduction, component 1 had more-than-expected nonlocal toolstones, component 2 had more-than-expected local toolstones, and component 3 evidenced no selective differences between nonlocal

Table 10.6 Unifacial and bifacial tool production by component

		Unifacial	Bifacial	Total
Component 1	Count	119	92	210
	Expected count	128.3	82.7	210.0
	% total (within component)	(56.4%)	(43.6%)	(100.0%)
Component 2	Count	168	106	274
	Expected count	166.7	107.3	274.0
	% total (within component)	(61.3%)	(38.7%)	(100.0%)
Component 3	Count	154	86	240
	Expected count	146	94.0	240
	% total (within component)	(64.2%)	(35.8%)	(100.0%)
Total	Count	441	284	725
	Expected count	441.0	284.0	725.0
	% of total	(60.8%)	(39.2%)	(100.0%)

$\chi^2 = 2.888$; df = 2; $P = .236$. Note no (0.0%) cells have expected counts less than 5. The minimum expected count is 82.65

and local toolstones (Fig. 10.8b). During the component 1 occupation, there was clear preference for nonlocal toolstones for both bifacial and unifacial activities. For component 2, the preference was for local toolstones, and for component 3 there was a preference for local toolstones for bifacial reduction, but no clear preference in unifacial reduction.

Discussion

The goals of this study were threefold. We wanted to detect differences in toolstone procurement and selection behaviors between three temporally distinct cultural components at the Owl Ridge site. We also aimed to explore how these differences inform on lithic variability in Late Pleistocene-early Holocene archaeological sites in central Alaska. Finally, we wanted to understand how humans responded to global warming at the Pleistocene-Holocene boundary. Below we discuss findings of our study of the Owl Ridge lithic industries in the context of these goals.

Do Lithic Raw Material Procurement and Selection Behaviors Change Through Time at Owl Ridge?

The three cultural components at Owl Ridge have small artifact assemblages with low tool counts and diversity and the landform on which the site rests is very narrow (45 m wide). These factors, combined with lithic refit analysis, indicated the site was a repeatedly used logistical camp (Melton 2015). The site was used for

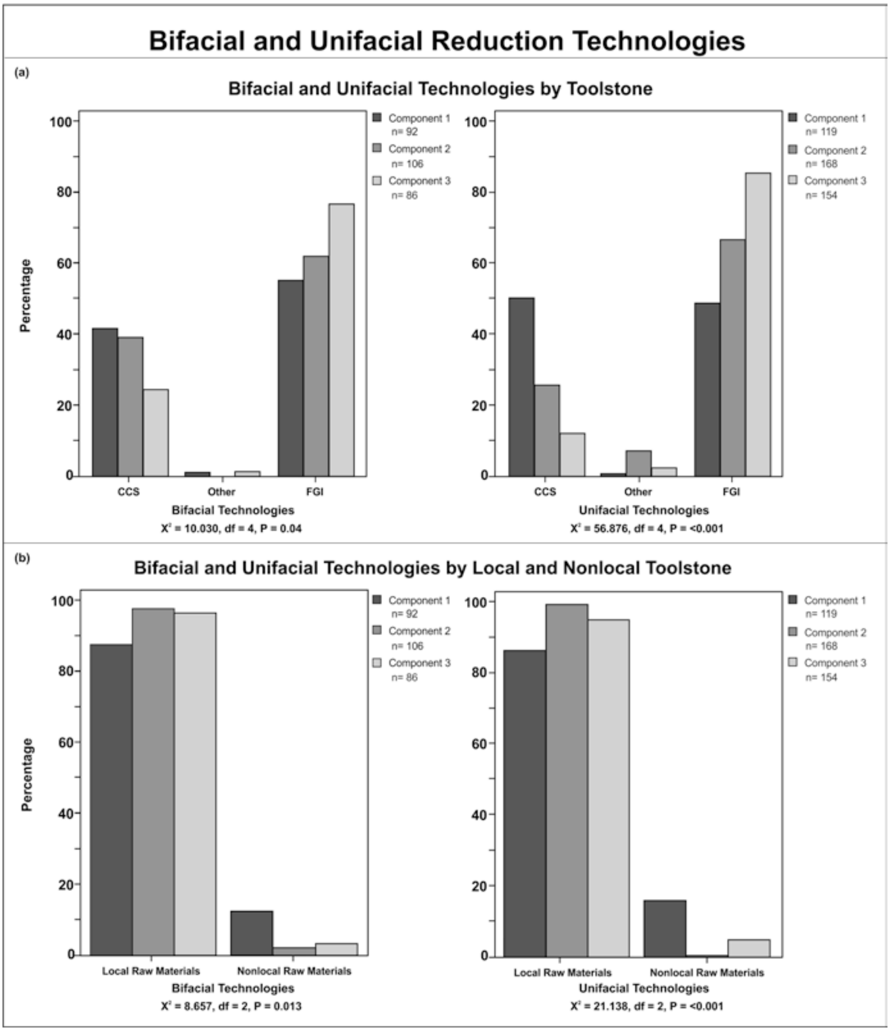

Fig. 10.8 Bifacial and unifacial reduction technologies by (**a**) toolstone types and (**b**) local and nonlocal toolstones

special tasks and never as a long-term base camp location. We did not excavate the entire surface area; however, of the nearly 80 m^2 excavated, only 4327 artifacts were found in total. Despite the fact that the site served a similar purpose through time, data presented in this paper establish clear differences in the specific ways the site was used.

Beginning with component 1, we found the tools left behind were few but dominated by bifaces, including four triangular Chindadn points, and retouched flakes, indicating the site served as a hunting camp where hunted resources were procured and initially processed presumably for transport elsewhere. No extensive processing occurred at this time because few formal processing activities were represented. Technological activities centered on both primary and secondary reduction with greater focus on informal, expedient core reduction and both bifacial and unifacial tool production and maintenance. Component 1 hunters selected both nonlocal and local toolstones for all reduction activities but preferred chert, especially the nonlocal variety. They brought nonlocal toolstones with them, mostly as finished and formal tools that they refurbished, but they also procured some of the local toolstones found in the glacial outwash at the site or in floodplain deposits nearby. These toolstones were also used to manufacture tools transported away from the site, suggesting component 1 inhabitants retooled while visiting Owl Ridge.

The content of tools discarded during the component 2 occupation signals manufacture and maintenance of lanceolate bifacial points, scrapers, and other processing tools, suggesting component 2 occupants produced and maintained both a hunting and processing toolkit at the site. Very few nonlocal toolstones were carried to the site at this time. Mostly foragers procured locally available stones during their visit, arriving to the site nearly empty handed. Presumably, they took tools made on the local raw materials with them when they abandoned the site.

The artifact assemblage from component 3 indicates mostly primary reduction activities coupled with the manufacture and maintenance of unifacial tools. Therefore, site activities seem to be centered on processing behaviors. Different from component 1 but similar to component 2, toolstone procurement by component 3 hunter-gatherers was mostly local; however, slightly more nonlocal toolstones make up the component 3 assemblage compared with component 2. Toolstone-selection variables indicate these hunter-gatherers focused on local FGI for all reduction activities, but again these activities concentrated on primary reduction and expedient tool production, behaviors differing from earlier visits to the site.

How Can We Explain Lithic Variability at Owl Ridge and in Central Alaska During the Late Pleistocene-Early Holocene?

Our results indicate toolstone procurement and selection changed through time at Owl Ridge. As the site was first visited during the late Allerød, just a few hunters carried with them lightweight, Chindadn-type projectile points and camped at this spot for a short period of time, given that only 894 artifacts make up the component 1 assemblage. Perhaps they found the ridge provided an excellent lookout for fauna traversing this stretch of the Teklanika River Valley. To date, this occupation event represents the first known in the valley. Toolstone procurement and selection centered on both nonlocal and local toolstone. Hunters seem to have retooled with some local fine-grained chert and FGI resources. Our data suggest component 1 was a visit by foragers relatively unfamiliar with the local lithic landscape and, therefore, represents landscape learners in this specific context (Kelly 2003; Meltzer 2003).

About 500 years later the site was revisited by hunters using different hunting technologies, based on presence of lanceolate bifacial points and perhaps microblade-osseous composite projectile technology as microblades and two microblade-core technical spalls were also discovered in the component 2 assemblage. Component 2 occupants may have stayed longer at the site because both hunting and processing tools were made, refurbished, and discarded there. Procurement and preference for mostly local toolstones indicate they knew the lithic landscape better than initial visitors half a millennium earlier.

Component 3 represents the third and final visit to Owl Ridge about 200 years following component 2 and by a group focused even more on processing activities. Though one bifacial point and one microblade were found, the rest of the tool assemblage consists of various processing tools. Very similar to component 2, toolstone procurement and selection were almost exclusively local raw materials. We are certain that the foragers visiting Owl Ridge during this final, early Holocene occupation episode knew the local lithic landscape well because they preferred, and relied on, the local raw materials. Perhaps they came to Owl Ridge to procure and use andesite from the alluvium as well as capture and process food resources other than medium-large game, given the composition of their toolkit. Though speculative, these data may indicate that women used the site at this time, given that northern hunter-gatherer groups are known to focus primarily on hunted resources with men contributing most directly to hunting, and women engaging in tasks more supportive in nature, such as procuring smaller game, preparing food and other hunted resources, and mending or fixing tools (Halperin 1980; Jarvenpa and Brumbach 2006; Waguespack 2005) and processing activities were the focus during this final visit.

Our results indicate the behaviors responsible for production and maintenance of tool technologies and procurement and selection of toolstone during both the component 2 and component 3 occupations were much more similar to each other than either was to those reflected in the component 1 assemblage. We find that Phippen's (1988; Hoffecker et al. 1996) separation of components 1 and 2 into two temporally and technologically distinct complexes, Nenana and Denali, was warranted chronologically, descriptively, and now behaviorally. Component 1 and components 2 and 3 represent two different toolstone procurement and selection strategies, a strategy employed prior to the local Younger Dryas event and one used immediately following it. This does not necessarily mean the site was visited by two different groups of people. In contrast, our data indicate Owl Ridge inhabitants became increasingly knowledgeable of their local (Teklanika valley) environment through time in a stepwise fashion. We contend these changes reflect gradual behavioral adaptation by hunter-gatherers to their surroundings, a settling in process, as they became part of a changing ecosystem responding to fluctuating terminal Pleistocene climatic conditions. We recognize the limitation of basing interpretations for a region on analyses from a single site; however, this study is unique and future work considering additional sites should either support or refute our hypothesis.

How Did Central Alaskans Respond to Changing Environments at the Pleistocene-Holocene Boundary?

Climatic data for central Alaska indicates that between about 14,000 and 10,000 cal. BP, the region experienced several climatic shifts and associated environmental changes. In a nutshell, late glacial climate was first cold and dry, shifted to warmer and moister conditions during the Allerød, reversed to cool and arid conditions during the Younger Dryas, gradually warmed into the Holocene with the first Holocene millennium warm and arid, and increasingly warmer and wetter by the onset of the Holocene Thermal Maximum at ~10,000 cal. BP. During this 4000-year period, the biome shifted from herb tundra to shrub tundra to open-forest parkland to closed boreal forest.

Though our data at the Owl Ridge site are not robust enough to provide detailed answers to the question of how central Alaskans responded to Pleistocene-Holocene boundary climatic and environmental change, it does support findings in the Nenana Valley of initial occupation of the Alaska Range foothills during the Allerød. In the Teklanika valley, they were beginning to learn the local lithic landscape when the Younger Dryas occurred. Given data from other sites in the region and Owl Ridge, these initial inhabitants were not manufacturing or maintaining lanceolate or microblade-composite spear technologies, but using thin triangular-shaped and teardrop-shaped bifacial points as weapon tips (Powers and Hoffecker 1989; Goebel et al. 1991; Pearson 1999; Graf and Goebel 2009). Their technologies were relatively expedient, and based on faunal data from the Broken Mammoth site in the Tanana Valley, foragers at this time were subsisting in a shrub-tundra biome, hunting a wide variety of small and large faunal resources (Yesner 2007).

Between about 13,000 and 12,500 cal. BP, the Younger Dryas cold and dry period is evidenced at regional archaeological sites by the appearance of culturally sterile sand units (Bigelow et al. 1990; Goebel et al. 1996; Graf and Bigelow 2011; Graf et al. 2015). This period of colder and drier climate affected the distribution and composition of floral and faunal resources, perhaps limiting availability of subsistence resources and the presence of humans. After this brief dry period, however, we see people using the region again. In fact, at Owl Ridge component 2 artifacts are found in a paleosol, indicating development of a relatively stable land surface and slightly moister conditions than during the previous centuries. The hunting technology, lanceolate bifacial points and microblade-composite-tool technology, was strikingly different from that used by initial inhabitants and suggests a focus on larger-game hunting (Guthrie 2006; Graf and Bigelow 2011). Paleoecological data are still too coarse-grained to understand faunal resource composition and availability for this period, but perhaps relatively dry conditions from the Younger Dryas still prevailed, and bison, wapiti, and caribou were sought after in an open-forest parkland environment (Guthrie 2006; Graf and Bigelow 2011). Certainly, the changes in toolstone selection represent an increased familiarity of the Teklanika valley as hunter-gatherers settled into the region.

Stratigraphically between components 2 and 3, the Owl Ridge profile evidences a major colluvial depositional event when humans were not present. Deposition of 15–25 cm of colluvial sands in about 200 years indicates a brief period of torrential rains and likely relatively warm, wet conditions. Immediately following this, humans revisited the site one final time, but this time focused on other resources since they did not leave behind hunting tools as before. After 11,000 cal. BP as climate became even warmer and more humid, boreal-forest vegetation and biome spread into the region, and humans never returned to Owl Ridge. Perhaps the spread of the boreal-forest vegetation limited views from the site so that it no longer provided an overlook of the river valley to humans.

Through the Pleistocene-Holocene transition, evidence suggests humans were present at sites like Owl Ridge until boreal forest spread into the region. We contend terminal Pleistocene hunter-gatherers in central Alaska were reasonably resilient, only leaving the immediate foothills during the coldest several centuries of the Younger Dryas interval. Given that occupation events immediately following the Younger Dryas evidence foragers with learned knowledge of the local lithic landscape, we assume these were the descendants of people who visited the Teklanika River before.

Conclusions

With this paper, we set out to compare the lithic assemblages of components 1, 2, and 3 from the Owl Ridge site to investigate how people were using lithic raw materials through time as they settled in the region and responded to climate change and local environmental shifts. The study of toolstone procurement and selection strategies helps us address how people responded to changing resource availability. Our results indicate that initial occupants were not as familiar with the local lithic landscape compared with later inhabitants. These later inhabitants had learned where to find local raw materials and obviously had become familiar with the landscape around them. Our findings confirm clear chronostratigraphic, technological, and land-use differences between Nenana complex and Denali complex assemblages in the greater Nenana Valley. We conclude that the differences in toolstone procurement and selection strategies and organization of technologies observed at Owl Ridge represent increased landscape familiarity as people settled in the region and responded to changing environmental conditions at the end of the Pleistocene.

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