

## GEOLOGICAL AND CULTURAL CONTEXT OF THE NOGAHABARA I SITE

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*Interpretation of the Nogahabara I assemblage as a Late Pleistocene abandoned toolkit rests primarily on the premise of a single brief occupation at the site. The limited contextual data presented do not discount a palimpsest of non-contemporaneous assemblages in secondary contexts associated with a lag deposit. Spatial patterning, lithic assemblage patterning, artifact surface alteration, and disparate radiocarbon dates at the site, as well as geological data from the Nogahabara and nearby Kobuk dunes, indicate that the cultural material was subjected to post-depositional disturbance. Alternate hypotheses of site formation and avenues for testing these hypotheses are considered.*

*La colección de Nogahabara I ha sido interpretada como un conjunto de herramientas abandonadas durante el pleistoceno tardío. Esta interpretación asume como premisa una breve y única ocupación del sitio. Con los datos contextuales limitados que se han presentado, no se puede desacreditar un palimpsesto de contextos no contemporáneos en condiciones secundarias asociadas con un depósito de residuos sedimentarios. El patrón espacial, la composición del conjunto lítico, la alteración superficial en los artefactos, y la diferencia en los fechados de carbono<sup>14</sup> del sitio, así como los datos geológicos de las dunas de Nogahabara y Kobuk, indican que el material cultural estuvo sujeto a alteraciones post-deposición. En este artículo, se consideran hipótesis alternativas de la formación de sitios y vías para probarlas.*

While we find Odess and Rasic's (2007) theoretical discussion of toolkit composition and assemblage variability intriguing, their interpretation of the Nogahabara I site as a single, short-term occupation, reflecting a systemic assemblage unbiased by taphonomic disturbance, is unsubstantiated by the data presented in their article. Because their argument hangs on the premise that all of the artifacts are the same age and represent a toolkit or cache that belonged to one or possibly a small group of hunters, site context is critical to this interpretation. Odess and Rasic view the artifacts as having been freshly eroded

from a primary burial across a large blowout in a currently active dune field; yet there is a notable absence of discussion or references on northern eolian depositional environments and processes. Alternative interpretations of the geological context of the site and site formation processes, more consistent with the data, are evaluated here, as well as avenues for testing alternate hypotheses. Much of the data are consistent with the cultural materials being situated in an eolian lag deposit, and thus not in a primary context.

In addition to the contextual problems with the site, the assemblage data were not analyzed criti-

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cally against the regional archaeological record. Odess and Rasic suggest that side-notched and lanceolate projectile points, along with microblade and burin technology, "are not encompassed by any single analytical construct for interior Alaska" (Odess and Rasic 2007:708), which is incorrect (ref. Bacon 1977; Campbell 1961; Cook 1969; Dixon 1985; Holmes 1986; MacNeish 1964; Schoenberg 1985, 1995). It is now understood that notched points have a wide geographic distribution in Alaska, appearing between 6000-1000 cal B.P., and have been clearly associated both with lanceolate projectile points and microblade technology (Anderson 1988; Bacon 1987; Clark and Clark 1993; Clark 2001; and Cook 1969). The assignment of a Late Pleistocene age for the site lies entirely upon two disparate radiocarbon dates (Odess and Rasic 2007:710). Because of the contextual problems outlined here, we believe the archaeological data presented from Nogahabara I has relatively little to offer in terms of revising Alaskan prehistory (Odess and Rasic 2007:714). A review of relevant data on regional archaeology suggests a mid to late-Holocene age for these assemblage(s).

#### Data Recovery and Site Testing

From 2001 to 2006, a total of 588 lithic artifacts and animal bone fragments were collected from the surface of the site. Only 22 small flakes, microblades, and bones were recovered in subsurface context. The locations of the excavated material are not provided, nor do we know the depth(s) at which they were found. In addition, information on the spatial distribution and size of the geological trenches is lacking, and no stratigraphic profile or descriptions are given for any of the subsurface excavations.

There are several unanswered questions relating to excavation methods that bear on context and site formation. For example, Odess and Rasic (2007:709) suggest that what they have interpreted "as a paleosol from an ancient stabilized surface" serves as a potential stratigraphic marker. This "paleosol" is described as a dark discontinuous horizontal marker that co-occurs with the cultural material, but its distribution is not mapped. Are the paleosol and modern surface slopes concordant? Was the paleosol encountered in the block excavation or the test pits? A map showing artifacts col-

lected in the different years may reveal patterning based on depth before deflation. The size of the active blowout responsible for deflation exposure should be plotted. A map of the alignment and orientation of artifacts as vectors in a wind field would be informative as well. The low frequency of waste flakes to flaked tools may reflect cultural behavior, such as a transported toolkit discarded over a 2,000 m<sup>2</sup>+ area, or it may reflect size sorting near the deflated surface. Without more detailed methodological information there is no way to evaluate this possibility. The fact that the vast majority of the area where surface artifacts were encountered was not excavated introduces a bias that is not mitigated by the fact that so few artifacts were found in the 2004 excavation. Information on vertical distributions, strike and dip of the artifacts, and the horizontal and vertical locations of multiple years of surface exposure are required for a clear understanding of site formation. This level of detail is necessary when interpreting what are essentially surface sites within a dynamic depositional environment. The absence of these basic data sets diminishes the ability of the reader to evaluate the geological context of the site, which is critical to the authors' behavioral interpretation of a single brief occupation.

#### Geologic Context: Exhumed Paleosol or Lag Deposit?

The fact that Nogahabara I artifacts were found on the surface of a blowout within an active sand dune field, and as a surface site (excavated artifacts are not differentiated in the analysis), presents numerous challenges to the authors' interpretation. Galloway et al. (1992:102) describe the active area of the Nogahabara dune field as "exposed dune crests and slip faces, to interdune areas and wet dune slacks, to ventifact slopes and pebble-covered deflation surfaces." Odess and Rasic (2007:709) indicate that artifacts were scattered in decreasing frequency downslope immediately above or within a surface described as "a thin and discontinuous layer of coarse sand and ventifacted granules that coincides with what we interpret as a paleosol from an ancient stabilized surface." No other stratigraphy was noted, though it seems unusual that bedding features are absent. Bedding may be subtle, and much of the context might be homogenous, but a completely massive, isotropic block of sand

would be rare. A question arises, if all except for 22 of the recovered artifacts and bones were found on the surface, then how is it possible to determine the relationship of artifacts to the "paleosol?" It is not clear if the "paleosol" was encountered in the test pits, excavations, or geological trenches. Profiles of the excavations and geological trenches would have helped explain the relationship.

Exhumed paleosols have specific characteristics that can be determined with geoarchaeological tests, e.g., elevated organic carbon and clay content obtained through loss-on-ignition or Walkley-Black tests and particle size analysis (Garrison 2003; Holliday and Stein 1989). There are many reasons for darkening, e.g., dust that typically darkens soils relative to clean sands and preferentially accumulates on deflation lag. The same is true for the heavy mineral fraction, which will darken a lag. Particle-size analysis would also indicate if the darkening is the result of recent dust on the deflated surface.

Coarser sand, ventifacted granules, and resistance to wind erosion are not standard criteria for a paleosol; however, these characteristics are consistent with a lag deposit, which we argue better fit the archaeological data presented on Nogahabara I (see below). In cold climates, the interstratification of wind-driven snow and sand that preferentially occurs on slip faces of dune ridges produces a distinctive set of very mobile niveo-eolian sedimentary structures, e.g., snow ramparts, sinkholes, snow hummocks, snow meltwater fans, and tensional cracks (Koster 1988; Koster and Dijkmans 1988). This interaction of snow on sand can readily bury, truncate, and disrupt primary context; however, if distinguished, the structures could assist in detecting paleoclimatic conditions (Koster and Dijkmans 1988; Seppälä 1971, 2004).

If the artifacts are associated with a matrix of ventifacted granules, this also is consistent with a lag deposit. As wind deflates the fine particles (sand, silt, and clay) from dune slopes at their angle of repose, coarser material (including bones and lithic artifacts) would move to the base of the slope. Over time this process could account for materials from multiple occupations accumulated onto a single surface as lag deposited from inclined surfaces. In this environment we would expect some artifacts to display the effects of wind abrasion. The fact that more material was exposed for each year of obser-

vation and collection indicates an extremely active erosional environment with episodes of artifact exposure, and perhaps reburial and re-exposure (Thorson 1990:401–402). It is unlikely that the time period when the artifacts were noted and collected (after exposure during every year of observation) represented the first time those objects were exposed. In sum, a comparison of the limited geological information provided in the article together with other data from the Nogahabara and nearby Kobuk dunes indicates considerable uncertainty about the integrity of the lithic and faunal remains at this site and the interpretation of a single component context.

Lag deposits can form via different mechanisms, such as an association with a calcrete. "Calcretes" have been described at the Nogahabara dune field by Galloway et al. (1992), and indurated calcretes are an effective limit to erosion. Material above the interface is consequently concentrated as a lag on the less-erodible surface. Blowout erosion also is highest at the margins, a process that concentrates artifact scatters within the centers of deflation hollows (Lancaster 1986). Cemented horizons in Subarctic Alaskan sand dunes can develop vertically as high as 50 cm and could have acted as windbreaks, providing another explanation for the co-occurrence of artifact scatters with calcretes (Cox and Lawrence 1983:371). If a calcrete is present at the site, this has implications for human land use. Dune fields across northern Alaska underwent activation and stabilization during climatic warming, and calcretes are associated with interdune seasonal ponds that indicate a warm, moist climate (Carter and Galloway 1979; Carter 1993; Dijkmans et al. 1986; Dijkmans and Koster 1990; Galloway et al. 1992; Mann et al. 2002; see also Bigelow et al. 1990). Aerial photographs of the Nogahabara dunes show numerous shallow basins, only occasionally filled. In view of the millennia long persistence of interdune ponds in the Kobuk dunes (Mann et al. 2002), a similar setting might explain repeated visits at Nogahabara I, with the ponds serving as an attraction for both humans and animals.

### Dating the Site

The radiocarbon dates provided by Odess and Rasic also contradict the hypothesis of a single

component. Two bone samples from Nogahabara I produced dates that are statistically different. For clarification, we provide calibrated age ranges ( $2\sigma$ ) for each assay, calibrated with the Calib program (Stuiver and Reimer 1993, version 5) and the Int-Cal04 curve (Reimer et al. 2004):  $10,780 \pm 70$  (12,888–12,692 cal B.P.) and  $11,815 \pm 70$  (13,795–13,552 cal B.P.). There are numerous possible sources of variation in radiocarbon dating, whatever the material. To simply say that collagen dates are less than ideal (Odess and Rasic 2007:710) does not explain the divergence of the dates (but see Holliday et al. 1999). Small sample size does not necessarily correlate with contamination; the preservation of the original structure of the collagen is more relevant, which can be affected by a variety of cultural and environmental processes (e.g., cooking methods, soil chemistry). Beyond any potential variation in the radiocarbon method, combining multiple fragments of bird bone for a single date raises the question of contextual relationship of the fragments: to each other, to the mammal bone producing the second date, and to other bones and lithic artifacts. Are the fragments from the same element, individual, or cultural event?

The divergence in dates suggests multiple events that may result from: (1) natural sources of variation (i.e., contamination), or (2) contextual sources of variation, e.g., target event and radiocarbon event incongruities (Dean 1978). If we assume the bones were culturally accumulated, then the two different ages indicate multiple occupations; however, the antiquity of both dates raises other problems (see below). The relationships of the dated bones to the artifacts are unclear and should have been indicated on the artifact distribution map. Also, the thermally altered rock is not shown in relation to the burned and unburned bones. The wide distribution of bones, mostly small calcined fragments, does not suggest any localized spatial clusters. We would expect calcined bones from within a hearth to be confined to a small area in and around the burning event, especially given the purported brief occupation. Although the presence of calcined bones may indicate the presence of camp fires, no oxidation, common in wind-deposited site contexts throughout Alaska, was noted in the matrix or in the paleosol. This suggests that the occupation(s) were not actually associated with the pale-

osol but with depositional surface(s) that have been entirely deflated.

Odess and Rasic also contend that artifact potlidding, fire-cracked rock, and calcined bones indicate human induced fires. Potlidding was noted on some artifacts (not mapped) but this could have occurred after initial deposition, especially in the presence of forest fires. The fire-cracked rock also could have been altered by forest fires after discard and is not necessarily linked to human induced fires. No charcoal was observed in the site. Given the presence of calcined bones, the lack of charcoal appears unexpected if this was a preserved living surface. The charcoal originally present within campfires would be subjected to the same taphonomic processes as the unburned and calcined bones and should have been preserved. Alternatively, if the site represents a lag deposit, charcoal could have been lost through deflation, downslope movement, and/or fluvial processes during snow melt and seasonal rains. Although Koster and Dijkmans (1988) speculate that the deflation and eolian processes observed for the Kobuk dunes are activated by forest fires, they also remark on the general absence of charcoal. The absence of charcoal and the wide scatter of burned and unburned bones are additional evidence indicating that the cultural material is not within a primary depositional context.

#### **Spatial Patterning: Discrete Flaking Episodes or Palimpsests?**

Odess and Rasic estimate the maximum site size at  $345 \text{ m}^2$  and suggest that the small site size supports their hypothesis of a single occupation. Yet Figure 1 (Odess and Rasic 2007:695) indicates artifacts are spread over  $\sim 2,000 \text{ m}^2$ , or to use their more restrictive box that includes all but 24 of the artifacts, the area is  $\sim 675 \text{ m}^2$ . Archaeological sites with excavated areas smaller than  $345 \text{ m}^2$  have been shown to be palimpsests of multiple occupations, e.g., the Campus site at  $300 \text{ m}^2$  (Mobley 1991) and Minchumina MMK-004 at  $91 \text{ m}^2$  (Holmes 1986); therefore, site size does not necessarily correlate with numbers of occupations. Furthermore, without testing for horizontal site limits and excavating where surface artifacts appeared outside the block, it seems premature to estimate total site area. The use of site size to argue for or against a single occupation in this case appears spurious.

Spatial data provide valuable means for testing hypotheses about site formation and post-depositional disturbance processes. However, no alternate hypothesis to a single occupation was fully evaluated. Odess and Rasic (2007:709) argue that there is "little evidence of size sorting," but their Figure 5 clearly shows congregation of heavier artifacts ( $> 10$  g) near a break in slope and a wide dispersal of lighter artifacts ( $\leq 10$  g) downslope across the blowout to the southeast and north. The bones also appear to be differentially associated with the scatters to the north and southeast of the gridded area (Odess and Rasic 2007:Figure 4). Given this distribution, the lack of small debris may be (1) due to lack of excavation of the area directly to the east of the grid, where the materials shown in Figure 3 (primarily waste flakes and bones) were found on the surface; or (2) the redistributive effects of wind on debitage populations within blowouts may have played a significant role. Experimental studies have shown that nearly 40 percent of debitage  $< 1$  cm in length can be deflated from a blowout in only five days of strong wind (Lancaster 1986).

There appears to be a separation of bifaces and microblades, with the bifaces in a small,  $\sim 30$  m<sup>2</sup> area, and the microblades scattered to the southeast and north of this biface-rich scatter. These distributions may relate to artifact surface area or weight, but also could indicate a separate component/occupation. The authors note discrete episodes of reduction activities, including "two small clusters of microblades" (Odess and Rasic 2007:709). A perusal of Figure 3 shows four microblades in a 3 m<sup>2</sup> area within the grid, another four within a 25 m<sup>2</sup> area to the east, and four microblades scattered to the north within  $\sim 15$  m<sup>2</sup>. Two more are within the grid about 3 m north of the first group. The remaining three microblades are difficult to locate in the maps provided. With a population of only 17 microblades it is hard to see meaningful clusters. This pattern does not appear to support localized flaking episodes. Small discrete knapping episodes representing particular material types also are not evident, again suggesting considerable post-depositional disturbance.

Distribution plots of material type provide strong evidence for spatial patterning. Within the excavated area, the yellow-green chert shows a strong alignment with grid north, though outliers of this material are clearly present. In contrast, the

obsidian assemblage, both tightly clustered within the center of the excavated area and in the broader distribution of the remains, is aligned along an azimuth  $\sim 40$  degrees west of grid north. In an aligned landscape (such as within sand dunes), two populations of aligned cultural materials may indicate different primary distributions. The fact that chert was used to make different tools (microblades rather than bifaces) also suggests they may represent a different occupation.

The authors may be correct in that there is spatial patterning according to raw materials, but there is also a correlation with raw materials and size, typically indicative of post-depositional disturbance. The larger artifacts are mostly obsidian and clustered toward the west side of the excavation block; the chert artifacts are mostly smaller and distributed, along with bones, to the north and southeast. Subsurface excavation in the areas to the east and north could allow for better estimates of material and size class abundance and distributions. Given all of these data, the alternate hypothesis, that multiple occupations have been mixed in a lag deposit at Nogahabara I, cannot be refuted. To use these data to infer behavioral patterns, i.e., systemic toolkit reconstruction, seems premature without more geoarchaeological investigation into site formation processes.

### Lithic Assemblage Patterning

Predominance of obsidian does not necessarily represent a single component assemblage; rather, it could reflect a range of possibilities where one or more groups recently acquired raw material from the Batza Téna obsidian source about 160 km east. The location of this lithic source relative to prehistoric trade and travel routes, and any prehistoric logistical and residential mobility patterns, are a few of many unknowns in this region. At the Onion Portage site, 160 km north of Nogahabara I, obsidian is the dominant material used for Northern Archaic, Interior Choris, and Ikillik artifacts (Anderson 1988).

We agree with the authors that the Nogahabara I assemblage variability is unusual; however, numerous sites have intermediate forms with and without finished/hafted tool forms. We consider the primary dissimilarity of the Nogahabara I assemblage with many surface sites in Alaska to

be its relatively low frequency of flake debris. Until the geological context of the cultural material is investigated and the area more fully excavated (including the eastward downslope area), questions will remain as to how representative the collected sample is, especially given the horizontal size-sorting of artifacts and other evidence for post-depositional disturbance. Future erosion and artifact exposure also may alter interpretations about the assemblage.

The only alternate hypothesis of assemblage formation considered by Odess and Rasic (other than as a systemic toolkit) is purposeful placement of artifacts as “symbolic offerings or ritual deposits” (Odess and Rasic 2007:710). However, there are a number of other plausible explanations. For instance, one or more occupations could have occurred over a period of years, centuries, or millennia, or multiple occupations within a short time. Even a single occupation representing a cache of bifacial tool preforms alongside episodes of tool maintenance is a possibility. The authors do not identify a mechanism that could have caused the systemic toolkit to be discarded intact at this one place over such a large area (2,000 m<sup>2</sup>). For example, there is no evidence of a structure or any human remains to indicate untimely death or purposeful burial. The authors suggest that Nogahabara I could represent an intentional cache, yet the evidence described (wide dispersal of artifacts with no discrete clusters, tool maintenance and production episodes, and culturally accumulated bone) exhibits few characteristics of known lithic caches (Collins 1999; Frison and Bradley 1999).

It is difficult to evaluate the statement that there were no obvious attractions in the immediate area absent any information on local environs, ungulate migration routes and calving areas, regional topography, and paleoenvironmental reconstructions of waterways and lakes. As noted above, dunes often have seasonal transient ponds and snowbanks that offer ambush possibilities in otherwise open terrain. Furthermore, when Nogahabara I was occupied the dune area may have been a stable landscape in the boreal forest, similar to the “arrested dune sand deposits” at the Hahanudan Lake site 90 km east (Clark 1977:5).

### Artifact Surface Alteration: Transport Damage or Wind Abrasion?

The authors posit that transport damage on the tools and blanks indicate that the assemblage is in a systemic context rather than in a typical archaeological context, suggesting “it is highly unusual in that Nogahabara I contains the tools people were carrying when they arrived” (Odess and Rasic 2007:711). In general, *all lithic artifacts are transported*, except in rare cases of quarry sites or use of expedient cobbles. Tools may be distinguished as manufactured from a core or blank in situ at a site versus transported as finished and later discarded at the site; however, evidence for transport damage cannot be used a priori as evidence for contemporaneity. Even assuming that the damage observed by the authors directly reflects transport in a container, this does not necessarily imply a single transport in the same container.

Transport damage observations are interesting from a behavioral standpoint, and we agree with the authors that more attention should focus on this type of damage. However, other types of cultural processes can lead to the same conchoidal fractures and linear scratches observed on some Nogahabara I artifacts. Yet the authors fail to present or reference any experimental observations that can discount the possibility that such natural processes caused this damage. The citation of an article on stream abrasion of flint artifacts (ref. Shackley 1974) seems inappropriate for a site within an eolian depositional and erosional environment. Could wind abrasion or trampling produce similar damage patterns? These possibilities are not evaluated. The authors state that “flaked stone tools lack signs of windblown sand abrasion” (Odess and Rasic 2007:709), yet several bones were wind-abraded and both artifacts and bones were intermixed with ventifacted granules. There should be some evidence of wind abrasion on the artifacts if the cultural material is in primary depositional context and reflect a single occupation. This may indicate that (1) the “transport wear” is actually wind abrasion and/or some other post-depositional process that affected the surface of the obsidian artifacts and the bones; or (2) the artifacts, fauna, and/or ventifacted granules are from different occupational or primary depositional events that have been

differentially subject to post-depositional alterations, and now are intermingled in the same horizontal space due to deflation of the dune.

However, there may be evidence of wind abrasion on the artifacts. The clouded surfaces on the obsidian are interpreted to result from long-term hydration (Odess and Rasic 2007:710), yet there is no evidence or reference cited for this assertion. It is conceivable that the clouded surface characteristics on some of the obsidian artifacts could result from a combination of water, deposition in an abrasive environment, and continuous freeze-thaw cycling. While it is likely there is a rind present on the artifacts, the possibility that all of the rind is a result of what we typically think of as hydration does not seem likely. If it were so, we would expect Batza Téna obsidian artifacts from other sites to exhibit similar characteristics, and they do not. The fact that artifacts continued to be exposed during the collection period, 2001–2006, attests to the dynamic nature of the dune field and argues against very recent exposure to the surface from primary context. It is highly probable that this cycle of burial and exposure of artifacts happened multiple times in the past. In such an environment, sand abrasion could produce the “clouded surface” described for obsidian artifacts.<sup>1</sup> A better explanation for the surface scatter of artifacts and the “clouded surface” on obsidian artifacts involves multiple episodes of lag deposition resulting in windblown sand abrasion of artifacts at Nogahabara I. Controlled experiments, focused on the effects of sand abrasion, hydration, and freeze-thaw cycles on obsidian materials, may help sort out competing mechanisms for the source of wear exhibited on these artifacts.

Chert artifacts do not exhibit this type of abrasion (Odess and Rasic 2007:707), perhaps reflecting differences in size as well as material. There is no indication that the chert was gathered from a nearby source, such as bedrock outcrops or stream cobbles; thus, they would have been subjected to the same proposed transport process and effects as the obsidian. The use of the transport damage as an indicator for a single brief occupation appears specious. Any transport in bags (or other containers) would not be restricted to a specific time, as objects brought to the site within bags would share similar characteristics whether deposited at one time or several times separated by hundreds or thousands of years. Alternate causes of damage

should be explored. Some of the damage could also be due to spatial clustering of obsidian artifacts and potential for contact and abrasion during deflation episode(s) and downslope movement. The western extent of the concentration of larger artifacts ends beneath the slope, suggesting the possibility that these artifacts may have once been positioned higher on the slope. Spatial distribution maps of abraded versus non-abraded artifacts may help in evaluating this phenomenon.

### Discussion

Odess and Rasic raise some interesting points regarding Late Pleistocene and Early Holocene lithic assemblages that may affect typological and behavioral constructs. However, they are not the first to suggest that each site will not reflect the entirety of the technological repertoire or that assemblage variability is likely conditioned by many factors, such as, seasonality and activity related toolkits (e.g., Bacon 1977; Bowers 1980; Dixon et al. 1985; Holmes 2001; Mason et al. 2001; Sheppard et al. 1991). There is absolutely no support for the statement that “Nogahabara I represents the first unambiguous co-association of microblade technology, lanceolate bifaces, and notched bifaces in a Late Pleistocene Alaskan archaeological site” (Odess and Rasic 2007:708). First, the site has not been shown to unequivocally date to the Late Pleistocene. Second, the archaeological context is far from unambiguous. Third, the association of microblade technology with lanceolate and notched bifaces has already been widely recognized in numerous mid to late-Holocene sites. These three forms are encompassed by numerous analytical constructs in the broader region, the quantity reflecting their clear and unambiguous association; these include the Northwest Microblade tradition (MacNeish 1964), Athabaskan tradition, Tuktu and Denali phases (Cook 1975; cf. Clark 1981), Tuktu complex (Campbell 1961), Late Denali Complex (Dixon 1985), Minchumina tradition (Holmes 1986), and the Brooks Range tradition (Schoenberg 1985, 1995). The diversity and combinations of tool types at Nogahabara I is neither surprising nor unsuspected and do not rule out more than a single component occupation. Individual elements in this assemblage can be found in numerous sites throughout Alaska.

The utility of lanceolate points and microblades as temporal markers is questionable. Lanceolate points (in many forms) are present from the Late Pleistocene to the Late Holocene, and cannot be used as temporal markers without considerable typological analysis. Likewise, microblade technology is present for the same time period in Subarctic Alaska, and for much of this time in Arctic Alaska (Anderson 1984; Bacon 1987; Bowers 1999; Clark 1981; Potter 2005). Two different styles of microblade core forms at Nogahabara I may be age sensitive. The small wedge-shaped core made on a thick flake could occur in both a Late and Early Holocene context, and the large blocky, subconical core form could date to the Middle Holocene. Notched bifaces, however, are well-dated from ~ 6000 cal B.P. through the Late Holocene in Arctic and Subarctic Alaska, providing a useful temporal marker for the mid to late-Holocene. Both dates from Nogahabara I contradict the known temporal distribution for notched bifaces in Northwest North America. The age estimate for Nogahabara I is incongruent with regional chronologies established over decades by researchers at numerous sites supported by radiocarbon dates and stratification.

The idea that individual components do not reflect the full technological variability of the complex, phase, or tradition to which it is assigned is not new (e.g., Dixon 1985:47–48). The use of techniques to evaluate data from multiple sites, such as contrasting shared characteristics and dates, is a key component to most cultural chronologies in a region (Clark and Clark 1993; Dixon 1985; Holmes 2001; Workman 1978). In addition, ethnographic data inform us that many factors condition how hunter-gatherers use space and organize their technology within settlement and subsistence systems (e.g., Binford 1978, 1987; Kent 1991; Whitelaw 1991). The discussion of toolkit scales of analysis is worthwhile; however, the idea as formulated by Odess and Rasic is not translated into a testable hypothesis. Implicit in the concept of toolkit is the idea of use. For example, how were artifacts (as conceptual types and as empirical objects) used and transported together within a system? Also, to what extent is artifact variability likely conditioned by toolstone provisioning strategies, subsistence economies, land use strategies, etc.? This variability is difficult to control for, and likely requires the

synthesis of many components within clear stratified contexts supported by tests for post-depositional disturbance and mixing. The toolkit concept as formulated by Odess and Rasic is problematic because individual archaeological sites (like Nogahabara I) typically are based on a variety of cultural and natural processes that resists direct linkages among: artifacts brought to the site, artifacts used onsite, and artifacts transported from the site. The hypothesis that the Nogahabara I site represents a single assemblage with a larger portion of a systemic toolkit present is supported by some data, e.g., a preponderance of preforms and tools and relatively few waste flakes; however, alternate hypotheses, e.g., multiple occupations superimposed due to deflation and co-occurrence within a lag deposit, cannot be refuted by the evidence presented. Strategies to test these hypotheses have been provided, and further investigations should resolve competing expectations.

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### Note

1. A simple experiment performed by Holmes produced a surface effect on laboratory obsidian very similar to that found on Nogahabara I obsidian artifacts. Obsidian artifacts from experimental knapping were gently tumbled with fine to coarse dry sand in a 20 oz. jar for 12 hrs. Tape was used to protect part of the experimental artifacts from sand abrasion for comparison of before and after treatment. Sand used was comparable in size to that described for the Nogahabara sand dunes (Weber and Péwé 1970:Map Sheet 2).

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