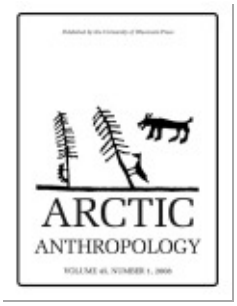
The Amaknak Bridge Site: Cultural Change and the Neoglacial in the Eastern Aleutians



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Abstract. Evidence from a series of excavations in Unalaska Bay indicates that the onset of the Neoglacial had begun to alter the cultural and natural landscape of the Aleutian Islands as early as 4500 rcybp. By 3500 rcybp deep semi-subterranean houses with stone walls and elaborate hearth systems were constructed at the Margaret Bay site. The nearby Amaknak Bridge site was occupied between 3300 and 2700 rcybp and faunal data reflect a very significant increase in the extent and duration of ice in the Bering Sea. Multiple room houses, elaborate labrets, complex burials, and other evidence of changes in social organization were among the cultural responses of the ancient Unangan to the colder conditions of the Neoglacial. We also find evidence for technological innovation, aggregated settlements, and resource intensification during this time.

Prehistoric Sequences in Unalaska Bay

Until recent years the prehistory of the Aleutians has been based on the view that long-term environmental stability and relative cultural isolation had combined to create a remarkably conservative archaeological tradition that exhibited only slight changes over time, particularly over the past 4,000 years (McCartney 1984, McCartney and Veltre 1999). Over the last decade, however, we have reexamined those assumptions in the light of data that have emerged from our research in Unalaska Bay, where we found good evidence for long-term cultural continuity and an archaeological sequence that reflected substantial environmental change as well as external cultural influences (Davis and Knecht 2005; Knecht and Davis 2001). The Amaknak Bridge site (UNL-050), a 3000 rcybp village site in Unalaska Bay has provided abundant evidence of environmental change during the Neoglacial and corresponding cultural responses to the changed conditions. Amaknak Bridge is a key site in the eastern Aleutian archaeological sequence, and in this preliminary report we will place it in its context as well as briefly describe its contents.

Unalaska Bay is located on the northern coast of Unalaska Island (Fig. 1). The bay offers protection from the Bering Sea as well as rich natural resources and has apparently been a population center since the earliest human occupation of the Aleutian Islands. Several sites in Unalaska Bay represent the Early Anangula phase beginning more than 8000 rcybp, well known in the literature from the Anangula Blade type site on Umnak Island (McCartney and Veltre 1996). The core and blade industry once thought to be unique to the Anangula phase actually persists in the Aleutians until about 3000 rcybp (Knecht, Davis, and Carver

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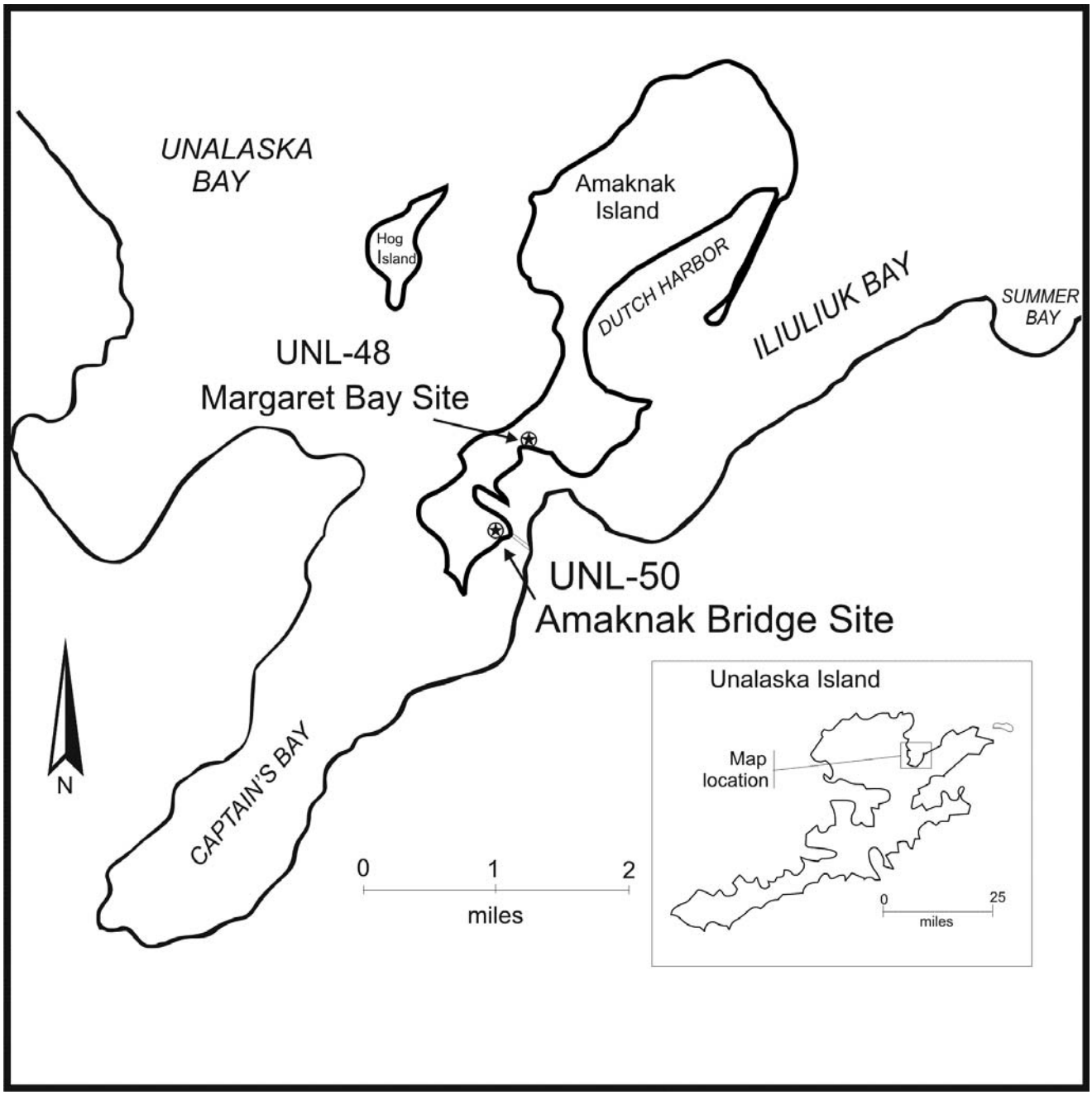

Figure 1. Site Location Map.

2001). The Early Anangula toolkit and the maritime adaptation it represented formed the foundation for the Aleutian Tradition. Over time technologies and house forms became increasingly elaborated.

During the first four thousand years of the Eastern Aleutian archaeological record, from about 8000 to around 4000 rcybp, culture change does indeed seem to proceed at a very measured pace (Table 1). Whether this is a product of ecological stability or our very limited sample from this time period remains to be seen. The Late Anangula phase (c. 7000–4000 rcybp) is distinguished from the Early Anangula phase chiefly by the addition of bifacially retouched knives and projectile points. This period is also represented by only a handful of known sites and until recently no sites in the Aleutians were known to date between c. 6900 and 8100 cal B.P., leading to suggestions of regional abandonment at the time (Mason 2001).

Table 1. Prehistoric Phases in the Eastern Aleutians (after Knecht and Davis 2001).

Phase	Approximate Chronology	Type Sites in Unalaska Bay	Diagnostic Artifacts and Features
Late Aleutian	1000–200 B.P.	Tanaxtaxak (UNL-55) Eider Point (UNL-19) Reese Bay (UNL-63) Morris Cove (UNL-9) Bishop's House (UNL-59)	Abundant ground slate, ulus, limited chipped stone inventory Multiple-room and longhouses, fortified refuge rocks.
Amaknak	3,000–1,000 B.P.	Summer Bay (UNL-92) Cahn's Site 'D' (UNL-18) Amaknax (UNL-54)	stemmed, notched lithics, elaborate barbing on bone points, toggling harpoons, asymmetrical knives, spall scrapers, *umqan*. Rectangular houses.
Margaret Bay	4,000–3,000 B.P.	Margaret Bay (UNL-48), Levels 2,3 Amaknak Bridge (UNL-50) Tanaxtaxak, (UNL-55), basal level Agnes Beach, (UNL-46), upper level	Blades, ASTt-like tools, stone bowls, plummets, angle and polished burins, bone socket pieces, net sinkers, labrets, exotic lithics. Stone-walled houses with chimneys.
Late Anangula	7,000–4,000 B.P.	Margaret Bay, Levels 4,5 Agnes Beach, lower level Airport site (UNL-105) Powerhouse site (UNL-114) Cahn site 'K' (UNL-47) Quarry Site (UNL-)	Abundant blades, stemmed points, bilateral barbed harpoons with lineguards, first bifacial tools. Shallow semi-subterranean houses.
Early Anangula	9,000–7,000 B.P.	Hog Island Blade Site (UNL-115) Oiled Blade Site (UNL-318)	Abundant blades, unifacial tools, transverse burins, large end scrapers, grooved cobble sinkers, ocher grinders, stone bowls, oil lamps. Tent-like houses on shallow depressions.

The Amaknak Quarry site has, however, recently yielded dates that fit in that gap with bifacial technology and C-14 dates from around 7060 CALbP (Yarborough, personal communication 2007).

During the succeeding Margaret Bay phase, which lasted from about 4000 to 3000 rcybp, the technological continuity with the earlier phases is unmistakable (Knecht, Davis, and Carver 2001). However, the number and scope of cultural changes during this time are exponentially greater than in earlier periods. The Margaret Bay phase is distinguished by a series of innovations and shifts in technologies, house design, settlement pattern, and subsistence. Faunal remains and geological evidence of shoreline changes indicate that the marine ecosystem of the Eastern Aleutians was also undergoing rapid change from the onset of the Neoglacial, a period of cooling in the Northern Hemisphere. Our conclusion is that many of the changes that occurred during the Margaret Bay phase represent adaptations to the rapidly changing resource menu and climatic conditions of the time.

Bone preservation at the Margaret Bay site was generally poor; however, abundant shellfish remains in some levels had modified the acidic tephra soils to preserve sizeable faunal middens dating between 4100 and 4700 rcybp. These yielded remains of sea mammals that depend on the presence of sea ice; polar bear, ring seal, and walrus (Davis 2001). The Aleutian Islands lie well outside the modern range of these animals. The faunal data from Margaret Bay is consistent with other proxy data from the Bering Sea and the cir-

cumpolar north that mark the Neoglacial, a mid-Holocene episode of cold climate that impacted the Northern hemisphere from about 4700 to 2500 rcybp (Crockford and Frederick 2007). The onset of the Neoglacial also corresponds chronologically with the cultural changes that characterize the Margaret Bay phase.

A mid-Holocene sea level high stand has been documented by proxy records in many locations around the world, some research suggesting an increase of nearly 2 m over the modern average sea level (Kearney 2001). The high stand had retreated by about 3000 rcybp, leaving behind a series of beach ridges that are common along bays and estuaries of the Bering Sea. At Margaret Bay we excavated a trench at the base of the site and found a wave-cut shoreline angle 180 to 220 cm above the modern shoreline angle (Knecht, Davis, and Carver 2001:39). The reasons behind the mid-Holocene high stand and retreat are beyond the scope of this paper, however the retreating sea level occurred at the same time as the cooler conditions of the Neoglacial and would have also impacted the subsistence and settlement options available to the prehistoric Unangan. The Margaret Bay site was abandoned shortly after 3100 rcybp, perhaps because of falling sea levels. Several other early prehistoric sites in Unalaska Bay are separated from the sea by beach ridges and spits that formed by 3000 rcybp.

We found that the house pits at Margaret Bay were more deeply excavated than those in earlier phases and were reinforced by a ring of stone uprights and whalebone posts. By 3400 rcybp houses at the Margaret Bay site employed substantial and well constructed stone walls more than a meter high, creating virtual bunkers against the weather (Knecht, Davis, and Carver 2001:60). Hearth and ventilation features within the houses also became more elaborate.

As the Margaret Bay phase began, new chipped and ground stone tools were added to the core and blade tradition dating back to the Early Anangula phase. As the Margaret Bay phase progressed microblades became less frequent but large blades and tools made from snapped large blades remained common. A variety of chipped and polished burins also gradually replaced the Anangula style transverse burins at the Margaret Bay site. The chipped stone collection was dominated by large numbers of small bullet-shaped points of obsidian and fine-grained black basalt. Bowl fragments of ground volcanic tuff up to 45 cm in diameter were also common in the upper levels at Margaret Bay.

The Margaret Bay site was abandoned shortly after 3100 rcybp and preservation of bone and other organic artifacts from the higher levels at that site was poor. The later developments of the Margaret Bay phase were represented at the Amaknak Bridge site, where we now turn our attention.

Research at the Amaknak Bridge Site

The Amaknak Bridge site is located on Amaknak Island in Unalaska Bay (Fig. 1). The site is situated on a knoll adjacent to the narrowest point of the channel separating Amaknak and Unalaska Islands. The Amaknak Bridge site is 0.9 km southwest from the Margaret Bay site and overlapping C-14 dates (ca. 3100–3300 rcybp) suggest that for a brief time the sites were occupied simultaneously before the Margaret Bay site was abandoned.

The Amaknak Bridge site was first recorded by a WWII era survey by avocational archaeologist and navy officer Alvin Cahn, who designated it as "site F," although he apparently made no collections there (McCartney 1967:50). The first serious archaeological investigation at the site began in 1977 when a bridge linking Amaknak and Unalaska Islands was proposed and the University of Alaska Museum was contracted to test the site. A series of 1 m trenches were opened on the base of the knoll and about 1,000 artifacts were collected (Bacon 1983). Two C-14 dates were obtained; 3360 $\pm$ 95 and 3070 $\pm$ 95 (Bacon 1983). Ground stone bowls were tentatively identified as pottery fragments, which combined with the presence of core and blade technology, led to suggestions that the site could shed light on the origin of Norton culture. The 1977 testing found that although the site had been disturbed by WWII era construction, a substantial amount of intact midden remained along the base of the knoll and planners elected to avoid the site by reconfiguring the route of the bridge. This bridge, still locally known as "The Bridge to the Other Side," was constructed in 1978 and by 2000 was scheduled for replacement.

In 2000, under the auspices of the Museum of the Aleutians, we conducted test excavations along the base of the knoll at the Amaknak Bridge site. Like earlier excavators, we found that a dense WWII era overburden precluded opening excavation units on top of the knoll. We found stone-lined house structures and tool assemblages like those we had seen at the top levels of Margaret Bay, but at the Amaknak Bridge site bone artifacts and faunal middens were very well preserved in the bulk of the site. We opened 13 2 $\times$ 2 m excavation units, although the depth of the midden precluded safe excavation to sterile deposits in all but 4 units. As we had in Margaret Bay, we used water screens to recover more than 3,000 artifacts and 40 Hollinger boxes of faunal material in the 2000 season. A series of backhoe trenches were

Table 2. Amaknak Bridge Site (Unl-50) C-14 Dates.

Stratigraphic Unit	Radiocarbon Age	Calibrated Age 2 sigma, 95% probability	Reference Number
Structure 3, fill 2	2540 ± 60	B.C. 820–420	Beta-184635
Structure 3, hearth	2590 ± 90	B.C. 910–420	Beta-181341
Structure 4, fill	2670 ± 70	B.C. 940–780	Beta-184638
Structure 7, main room	2840 ± 90	B.C. 1280–820	Beta-184636
Structure 5, fill	2970 ± 60	B.C. 1390–1000	Beta-181339
Structure 5, floor	3000 ± 70	B.C. 1410–1010	Beta-184634
Level 1	3240 ± 90	B.C. 1720–1320	Beta-184637
Structure 2, floor	3370 ± 60	B.C. 1770–1520	Beta-181340
Structure 7, w. side room	3470 ± 70	B.C. 1950–1620	Beta-184633
Level 2 (2000 season)	2780 ± 70	B.C. 1110–810	Beta-151119
Level 4 (2000 season)	3310 ± 110	B.C 1880–1390	Beta-151120

used to penetrate the WWII overburden on top of the site to determine the site boundary which appeared to cover an area about 70 m by 80 m, with an average depth of cultural deposits of about 1.5 m (Knecht 2001). Like several earlier attempts to guess at the volume of the site, these figures also proved to be too conservative.

In 2003 field season the Museum of the Aleutians was contracted by the Alaska Department of Transportation and Public Facilities (ADOT&PF) to recover a 20% sample of the site, which stood in the way of an access road leading to the new bridge approach. We conducted a large block excavation in the thickest deposits on the site, as well a smaller block on the periphery. At least 240 m^3 of deposit were removed from about 50 2 × 2 m excavation units (Knecht and Davis 2005). Water screens were employed again and artifact recovery was excellent; in the 2003 season we recovered a sample of approximately 11,000 artifacts with point provenience data obtained on more than 2,000. A sample of the faunal material from the site yielded more than 40,000 pieces of identifiable bone (Crockford et al. 2004).

This report summarizes the results from the 2003 field season. Nearly all the remainder of the site was subsequently removed by heavy equipment in conjunction with an archaeological recovery effort under the auspices of ADOT&PF and directed by Michael Yarborough in 2006 and 2007. Results of that project will be forthcoming along with a future monograph that will summarize the results of all the work at the Amaknak Bridge site over the past decade.

Dating and Stratigraphy

Despite the depth and volume of cultural deposits at the Amaknak Bridge site the C-14 dates are remarkably close, with a mean date of 3016 rcybp. The C-14 determinations listed in Table 2 were obtained from wood charcoal, which is relatively uncommon in archaeological sites in the Aleutians. Soils on Unalaska are largely derived from air fall episodes of volcanic tephra, and are normally rock free. The archaeological deposits at the site are heavily mixed with beach gravel, cobbles, and small boulders, all of which represent cultural activities such as house construction, manufacture, and cooking. The remains of barnacles and other calcified marine growth were present on some larger rocks used in constructing house walls and other features. The site was excavated in natural stratigraphic units and midden deposits were mapped and removed as a unit. Soils from lower, earlier deposits in the site were less organic and more heavily mixed with lighter color tephras. About 30 cm of culturally sterile tephra soils were found at the base of the site. Like other early prehistoric sites in Unalaska and Kodiak, beach gravel was particularly abundant at the site and was found in heaviest concentrations when mixed with fish bone middens. Other than the World War II remains, we consider the Amaknak Bridge site a single component site from the later part of the Margaret Bay phase, with assemblages from the upper levels of the site clearly showing a transition into the Amaknak phase.

House Features

Early in the Margaret Bay phase house walls were reinforced with a single row of large upright rocks, and as the phase progressed house walls became more massive, utilizing multiple courses of large cobbles and small boulders. Margaret Bay phase houses had remarkably complex heating and ventilation systems. The hearths were small but deeply excavated and lined with stone, located along one

wall of the house (Knecht, Davis, and Carver 2001). At Margaret Bay the hearth locations in the structure varied, but at the Amaknak Bridge site the hearths were uniformly located adjacent to, and slightly under the east walls of the houses, in the direction of the strongest prevailing winds. Smoke exited through a chimney that was built either inside the wall or between the wall and the exterior sods. Leading out from the hearth in a V-shaped configuration were sub-floor trenches that extended nearly the length of the house interior. Typically they were lined on the sides and lidded with flat stone slabs. The precise function of this sub-floor feature is unclear to us, however engineers have suggested that it may have functioned to provide sufficient draft for the hearth so that smoke would not be forced back into the room because of the combination of high winds and relatively short chimney stacks. The channels may have also helped distribute heat under the floor and may be functionally analogous to the so-called axial or mid-passage hearth features known from early prehistoric houses in the eastern Arctic (Damkjar 2003).

The Amaknak Bridge site was quite remarkable in terms of the density and preservation of houses and interior features. In the 2000 field season we had encountered a stone-walled house that had been partially truncated by marine erosion at the base of the knoll and subsequent testing with ground penetrating radar suggested that other structures were present in the site. In the 2003 season we uncovered the remains of six additional houses as well as partial segments of walls representing six others (Fig. 2). Soon after abandonment the house pits were used opportunistically for rubbish disposal and were filled quickly enough to help preserve house walls, artifacts on the house floors, and interior features. There was little evidence of building stones being robbed for new structures. Houses were found in close proximity to one another, however their relative sequential relationship was easily determined through overlapping vertical superposition.

Amaknak Bridge site houses constructed after 3000 rcybp featured heavily constructed stone walls made from multiple courses of large cobbles and small boulders, often separated by layered soils that represent the remains of blocks of sod (Fig. 3). The first course of rock in house walls utilized large flat stones up to 50 cm across, usually upright slabs of angular bedrock or water worn boulders. In some cases worn ocher pallets were reused as uprights. Stone walls completely encircled the houses, leaving no obvious entrances. It seems possible that houses were entered through the roof, similarly to historically known sod houses in the Aleutians. House floors were often covered by top rows of wall rocks that had collapsed inward after the house was abandoned. Despite those events and some settling of former sod blocks, the heights of extant house walls still ranged between 70 and 150 cm.

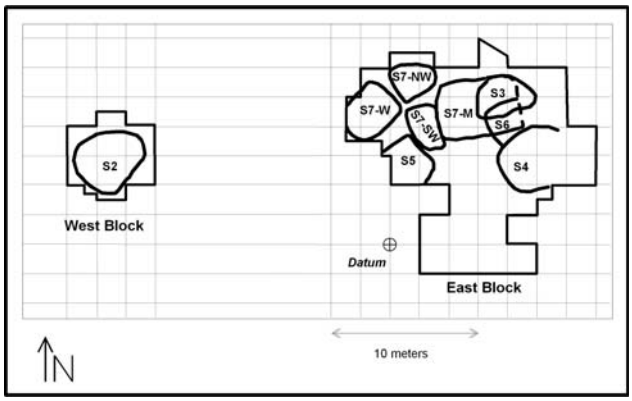

Figure 2. Amaknak Bridge (UNL-050) site plan showing excavation units and structure locations.

Figure 3. Wall construction showing multiple stone courses and intervening sods. Scale in decimeters.

The earliest house we encountered at the Amaknak Bridge site was Structure 2, located in an excavation block near the western edge of the site, which was less intensively occupied and where midden deposits were consequently thinner (Figs. 2 and 4). Unlike other houses we encountered at the site, after abandonment and collapse the Structure 2 house pit had gradually filled with 60 cm of air fall deposits of tephra instead of culturally derived refuse. It is possible that there was a hiatus of a century of two in the occupation at the site, because the bulk of the site also yielded slightly later dates than the charcoal recovered from the floor of Structure 2, which dated to 3370 ± 60 B.P. (Knecht and Davis 2005). The architecture of Structure 2 was typical of earlier

houses in the Margaret Bay phase in that it was reinforced with a single row of large upright rocks rather than the thick stone walls employed later in time. The rocks in Structure 2 were also supplemented with whalebone and possibly wooden uprights. A slightly older analogue to this house form was recorded at the Margaret Bay site dating to about 3630 ± 70 B.P.

The hearth channels in Structure 2 were of uneven length, with the longer channel measuring nearly 4 m (Fig. 4). A chimney structure of stone slabs was found on the west side of the house with the flue interior only loosely filled with soil. Another prominent feature in this house was a large and still hollow sub-floor storage pit located near the hearth and between the hearth channels and lidded with stone slabs. Sub-floor storage pits were also found in houses at Margaret Bay but not in the later houses at the Amaknak Bridge site, suggesting that an alternative solution to storage needs must have been used after c. 3000 rcybp.

Structure 3 was the youngest of the house remains encountered at the Amaknak Bridge site, with wood charcoal from the hearth dating to 2590 ± 90 rcybp and refuse filling the house pit yielding a date of 2540 ± 60 B.P. (Knecht and Davis 2005). Structure 3 was typical of the majority of the houses at Amaknak Bridge in that it was a round, single room house surrounded by a thick stone wall (Fig. 5). It was smaller than the other houses, however, with the interior space measuring under 4 m in diameter. The northeast portion of the wall of the site had been lost to erosion. Like other houses the floor of Structure 3 consisted of tightly packed soils with abundant artifacts, in this case including caches of cooking stones and a

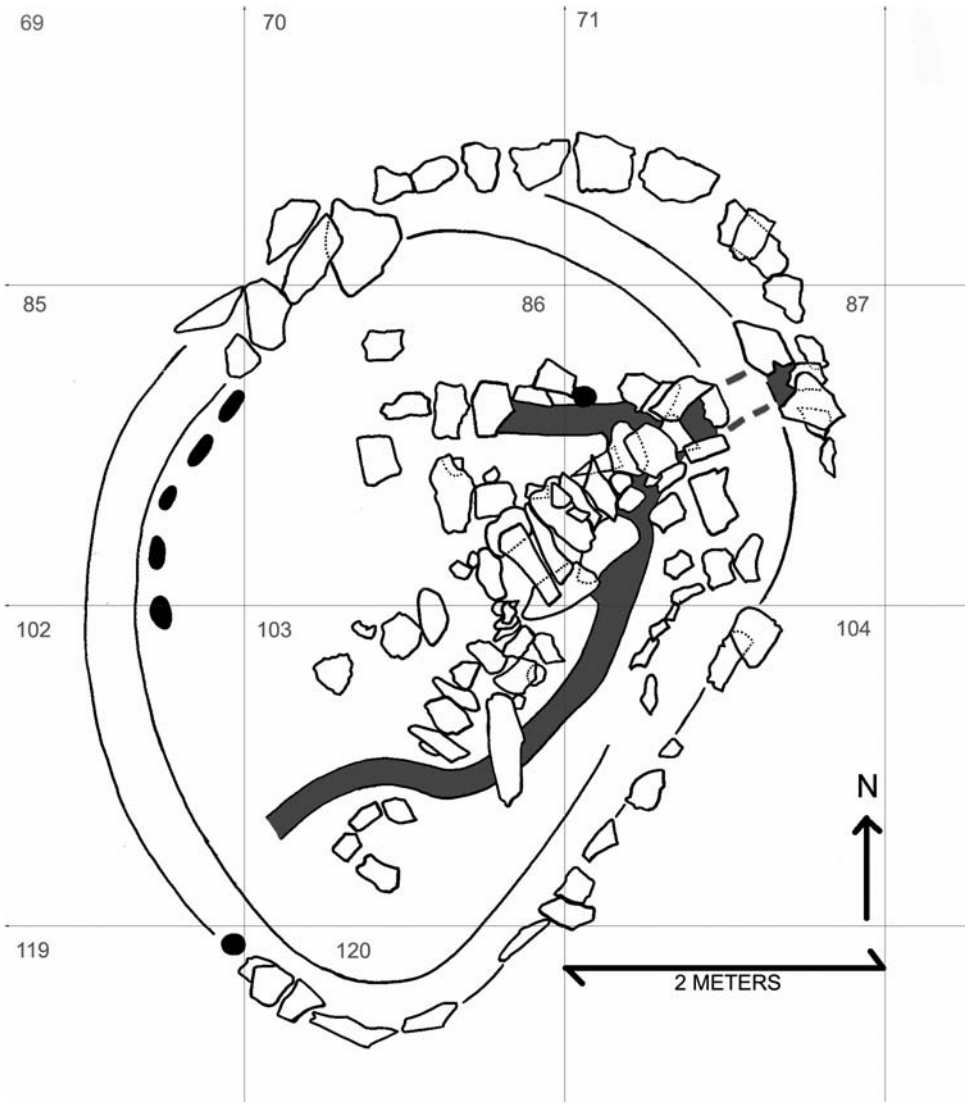

Figure 4. Structure 2 plan.

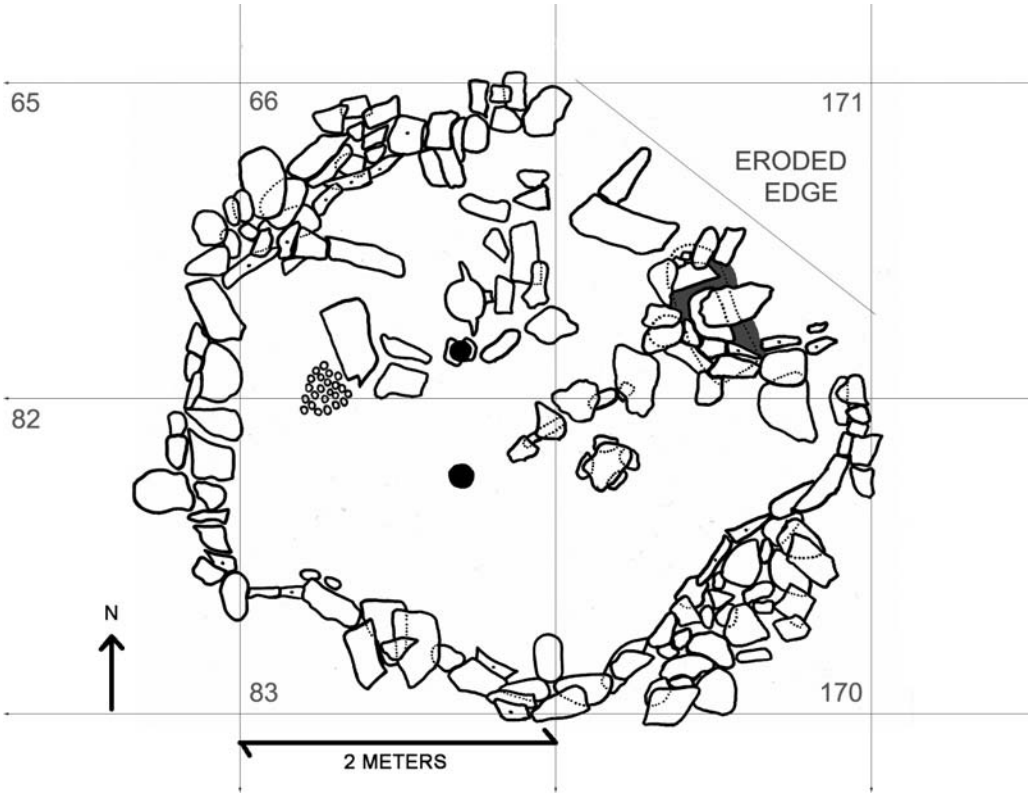

Figure 5. Structure 3 plan.

bundle of albatross long bones, probably intended for the manufacture of sewing needles. The roof was supported by a cluster of central posts, some set into holes, others placed atop stones and/or a whale vertebra. Use of stone supports for house posts, presumably to prevent decay from contact with the damp Aleutian soil, has been documented in protohistoric houses in the Aleutians (Veltre and McCartney 2001). At Amaknak Bridge, despite the abundance of rock at the site, the preferred material for interior house post supports seems to have been whale vertebrae, some of which had holes that were worn into or placed in their centers.

Structure 7 was the largest and most complex house we recorded at the site, consisting of a semi-rectangular main room with three smaller rooms attached to its western side (Figs. 6 and 7). It was a surprising find, and lacking a large block excavation that exposed the entire structure, we would have otherwise misinterpreted any of the side rooms as discrete houses. It is entirely possible that other houses at this site or perhaps at Margaret Bay in fact were attached to larger structures. Charcoal recovered from the floor of the main room dated to 2840 ± 90 rcybp. The southwest and northwest side rooms were entered from the main room through step-up entryways, however an interior entryway to the large side room on the west side of the house was not found. It is possible that the west side room may represent a separate house, especially in that it has its own hearth and chimney system. Regardless of entryways, the walls of Structure 7 were integrated and level with each other to the extent that the house clearly represented a corporate living arrangement.

The main room of Structure 7 had interior dimensions of about 6 by 4 m (Knecht and Davis 2005) and featured stone walls that seemed to have been built with more care than other houses at the site, with the exception of a 4 meter section that was casually rebuilt after a collapse. Episodic wall collapses may have been a distinct disadvantage of this building technique in an earthquake prone region such as the Aleutian Islands.

The roof of the main room in Structure 7 was supported by at least two parallel rows of posts, evident from lines of flat stone and whale vertebrae supports. The main room was dominated by an extensive hearth, chimney, and sub-floor hearth channel complex. The chimney hole extended from a small hearth opening near the floor 150 cm upward through the east wall of the main room, ending in soils or former sods well outside of interior walls of the main room. It was apparent from

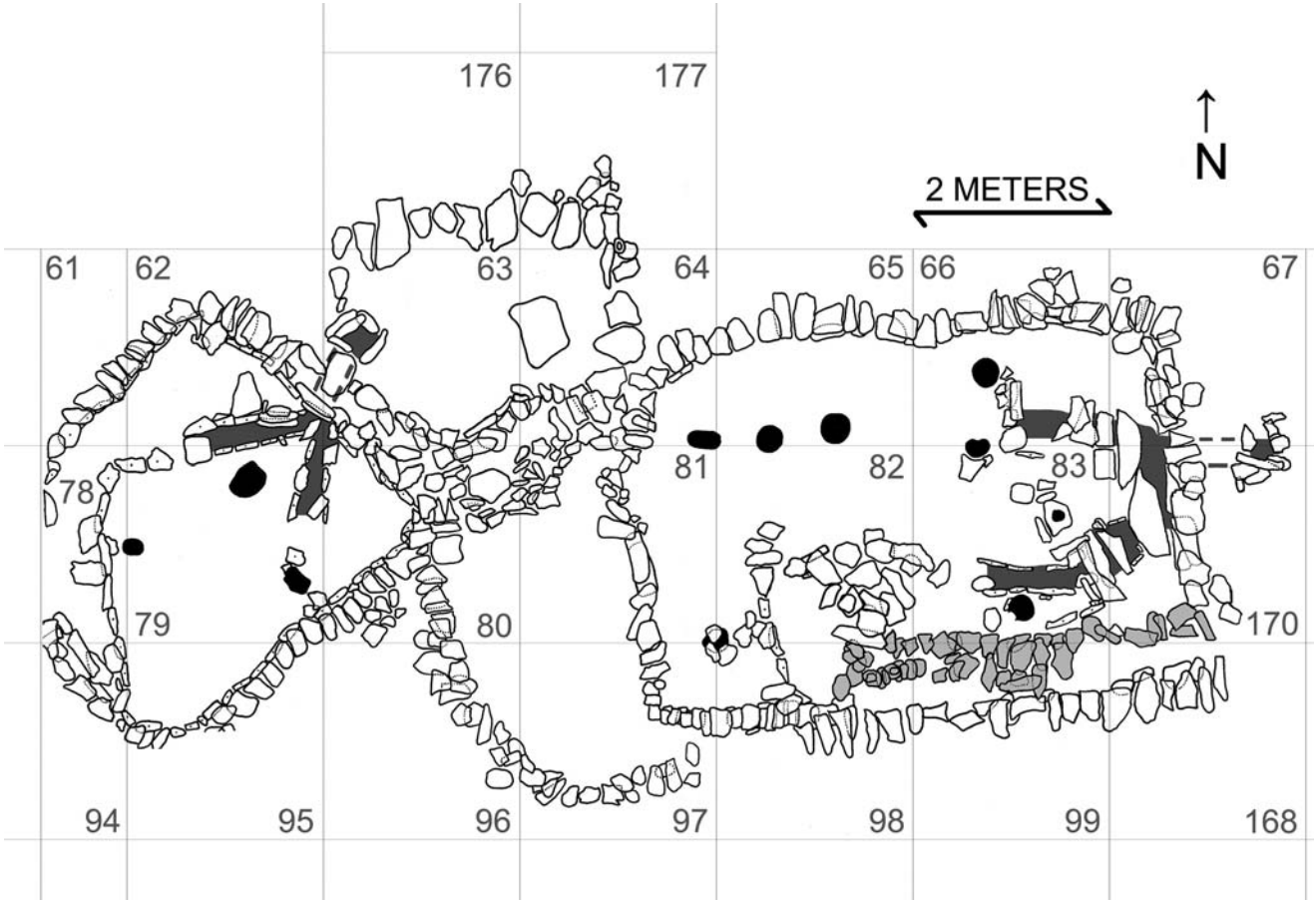

Figure 6. Structure 7 plan.

the outline of the house pit that it had been excavated to accommodate construction of the chimney. Collapsed whalebone and stone remains of the chimney suggested that it had extended from the ground surface for at least 50 or 60 cm. The interior flue of the chimney was only partially and loosely filled with soil and its interior was supported by a preserved cribbing of sea mammal ribs on the side facing the house and on the other sides supported by an arrangement of stacked stones.

The hearth channels in the main room of Structure 7 extended under the floor level in the usual V-shaped configuration, covered and lined with flat rock. An adjacent pair of large flat rocks nearest the hearth were the largest of these, measuring up to 70 cm long. The most common artifact recovered from the hearth channels were stone beads, which apparently accumulated in the channels after falling through spaces in the slabs that covered them. The floor deposits in Structure 7 averaged about 15 cm deep and preservation was excellent. Patches of thin but identifiable traces of rotten wood were found on the surface of the floor, possibly the remains of former roof beams or perhaps floor planking. Some alignments of interior rock within the main room may have functioned as storage features or even as supports for room dividers.

The floor of the southwest side room adjoining the main room of Structure 7 was elevated 40 cm above the level of the main room, suggesting that it may have functioned as a sleeping room with the lower main room acting as a cold trap. The wall separating the southwest side room was high, but constructed of smaller rocks than the stout exterior walls. At least two large and well-worn ocher pallets were re-used as construction elements in this part of the house. At some point after Structure 7 was abandoned, this side room was used to bury six individuals and an arrangement of associated grave goods. Previous agreements with tribal authorities in Unalaska preclude illustrating or providing details in this report other than to say the remains were found several cm above the house floor, which was well defined by its dense texture and contained in situ domestic artifacts such as a ground stone oil lamp and bone harpoon points.

Figure 7. Structure 7.

The west side room of Structure 7 was the largest of the side rooms and had the most carefully constructed stone interior wall of any we observed on the site, with each rock in the wall seeming to have been carefully fitted and sized. The east wall that accommodated the hearth and chimney was more than 120 cm high and the other walls were 60 to 70 cm high (Knecht and Davis 2005:85). The top surface of the floor in this room was heavily stained with charcoal and ash, with

Figure 8. Chimney in Structure 7 west. Note large stone resting on top of wall which may have been used as a chimney plug.

burned remains of log and whale ribs evident on the floor. The hearth and a pair of hearth channels excavated to 40 cm below the surrounding house floor were found under a layer of flat rock slabs piled against the eastern wall (Fig. 8). The chimney flue was more than 150 cm long and was made from a combination of horizontally placed sea mammal ribs and stacked stone. A large boulder balanced near the opening of the chimney may have been used to plug the opening when not in use. The smoke hole may have been intended to direct smoke into the northwest side-room of the house, which was quite small and casually constructed. A large flat slab was found on the floor of the northwest side-room which may have been intended for food processing and/or storage and possibly for smoking meat and fish. Alternatively the chimney may have emptied into an exterior space between side rooms.

Lithic Artifacts

In the 2003 field season alone we recovered 8,000 chipped stone, 1,000 ground stone, and 2,000 bone and ivory artifacts in addition to 470 worked bone fragments, and the debitage numbered more than 25,000 (Knecht and Davis 2005). A complete accounting of this large collection is well beyond the scope of this paper, however, we can make some observations about the nature of technological change during the latter part of the Margaret Bay phase as represented at the Amaknak Bridge site.

Core and blade technology is present in the lithic assemblage from the site, however it does not form the basis of the chipped stone industry as it had in earlier phases of the Eastern Aleutian sequence. Rather, the vast majority of the tools were shaped from flakes, primarily from chert, basalt, and obsidian. While raw materials at the Amaknak Bridge site were found in about the same proportion as at Margaret Bay, there was a noticeable difference in the lithic industries at these sites in that there was far less evidence for primary reduction in the form of flake cores and debitage at Amaknak Bridge than at the Margaret Bay site.

The lithics from Margaret Bay Level 2 were also distinguished by the presence of a toolkit bearing the diagnostic characteristics of the Arctic Small Tool tradition (ASTt). The collection included small round and beaked endscapers, bell-shaped scrapers, polished burins, polished adze blades, and stone tools bearing the fine pressure flaking that ASTt is known for (Knecht, Davis, and Carver 2001). The presence of ASTt among collections from the Eastern Aleutians, the Alaska Peninsula and along the Gulf of Alaska has long been the subject of debate (Dumond 2001, Maschner and Jordan 2001, Workman and Zollars 1996). Based on all the evidence, our conclusion was that there was minimally some contact with an influx of ASTt bearing peoples beginning sometime around 3500 B.P. (Davis and Knecht 2005). At the Amaknak Bridge site, however, tools bearing these ASTt characteristics are missing from the assemblage, which leads us to conclude that this exchange with ASTt bearing peoples had ended in the Eastern Aleutians sometime before 3000 rcybp.

Another major development reflected in the lithic industry was an unprecedented amount of innovation and experimentation with new technologies. Tool classes such as asymmetrical knives appear early in the Margaret Bay phase but by 3000 rcybp exist in a wide variety of stemmed and unstemmed varieties (Fig. 9). Unifacially retouched asymmetrical scrapers also appear in a variety of shapes, many bearing substantial use wear and polish on their flat ventral surfaces. The shapes of asymmetrical scapers fall into a number of classes and may represent specialize tools for carving bone and wood. Points are the most numerous lithic tool class at Amaknak Bridge other than bifaces, and also occur in a wider variety of sizes and forms than those made a few centuries earlier at Margaret Bay. Missing from Amaknak Bridge are the large numbers of small bullet-shaped points of obsidian and fine grained black basalt that dominated the lithic collection from Margaret Bay, which may offer some hints about the nature of the earlier contact with outsiders at that site. At Amaknak Bridge, stemmed points predominated. The possible introduction of bow and arrow technology from ASTt influences may have taken permanent root in the Aleutians during the Margaret Bay phase. A sample of 411 points from

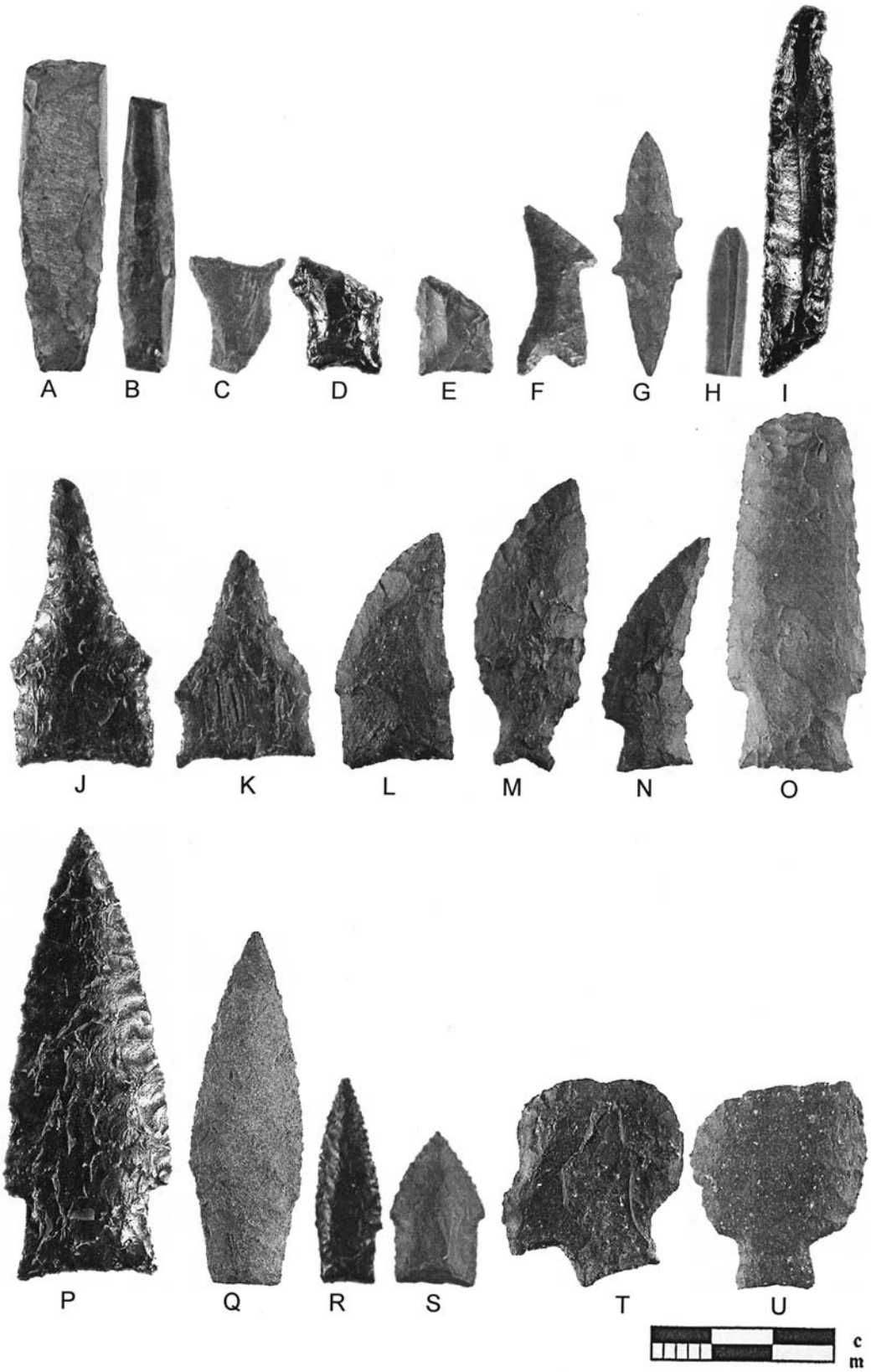

Figure 9. Lithic artifacts from the Amaknak Bridge site: *a* and *b*, chisels; *c*, graver; *d* and *e*, asymmetrical scrapers; *f* and *g*, chipped effigies; *h*, microblade; *i*, retouched blade; *j* and *k*, broad base knives; *l–n*, asymmetrical knives; *o*, stemmed knife; *p–s*, projectile points; *t–u*, stemmed knives.

Amaknak Bridge had a mean weight of 3.1 g and preliminary measurements of length and shoulder width demonstrate a clear similarity to arrow points (Knecht and Davis 2005:96). Some points exhibit grinding on their stemmed bases.

Chipped and heavily ground chisels in the Amaknak Bridge collection appear to be a functional replacement for the ground burins that were present along with other ASTt like tools at Margaret Bay. Adze blades were chipped out of green chert and extensively ground only on their ventral surfaces.

Ground Stone Artifacts

Ground stone sinkers are abundant throughout the sequence in the Aleutians, however in terms of quantity and variety those from the Amaknak Bridge site far exceed any other collection we have seen. The simple notched form of sinkers are nearly absent at Amaknak Bridge, where sinkers were carefully ground into symmetrical shapes and with well-defined grooves that encircle nearly the entire piece. Large plummets are present as they are in sites of this age throughout southern Alaska. The most common form of sinker found at Amaknak Bridge is an elongate, cigar-shaped form grooved along the long axis and it is unique to the site except for a single miniature specimen from Margaret Bay (Fig. 10). Also unique to the Amaknak Bridge collection are a number of large pieces of light pumice drilled on opposite sides so the holes meet in the middle, suggesting use as a float.

Ground stone oil lamps are well represented at Amaknak Bridge, some of which have pecked decoration in the form of grooves around the rim. The ventral surface of one complete oil lamp has pecked eyes and a faintly visible set of whiskers, creating a visual pun on the head of a seal emerging from the water. Others have a pecked and polished shallow circle within the oil basin. Similar designs are known on Kachemak phase lamps from the Kodiak and elsewhere in the Gulf of Alaska (Hrdlicka 1945).

Stone bowls ground from variously colored and textured volcanic tuff are a common diagnostic artifact early in the Margaret Bay phase; 434 fragments representing vessels as large as 45 cm in diameter were found in the Margaret Bay site (Knecht, Davis, and Carver 2001: 49). Quantities of charred sea mammal fat on the exteriors of these vessels suggest that they were used for heating fat to extract liquid sea mammal oil. In the large excavation block at Amaknak Bridge we recovered only 71 stone bowl fragments indicating that this technological practice was on the decline by around 3,000 rcybp.

Another ground stone artifact is also both abundant and unique to the Amaknak Bridge site; a small knife-shaped hone made from a light, pastel colored sandstone. Hundreds of these artifacts were recovered; they strongly resemble small hones used today by fly fisherman to sharpen hooks. Coupled with the abundance and variety of sinkers and fish hook components, this would minimally suggest that a wider variety of fish were exploited during the Neoglacial than had been previously the case.

Bone and Ivory Artifacts

Fish hooks made from bone and/or split sea mammal canines representing composite and one-piece forms were abundant at the Amaknak Bridge site and occurred in a wider number of styles and sizes than at any other time in the prehistoric sequence from Unalaska Bay. The same can be said for the variety and sizes of bone harpoons, which also seem to be highly specialized. Most of the harpoon heads are self-tipped, unilaterally barbed, and have keystone shaped bases for insertion into bone socket pieces. The latter make their first appearance in the prehistoric inventory around 3000 rcybp. The small but significant toggling harpoons from the Amaknak Bridge site are the earliest dated examples from the Aleutians, and their presence at this time may relate to hunting marine mammals on the sea ice conditions of the Neoglacial. The eight toggling harpoons recovered from the site in the 2003 season have an enclosed socket, a single spur, and an end-blade slot (Fig. 10: o–q). Bone foreshafts from the site were sometimes decorated with elaborate geometric designs (Fig. 10: h). Bone lance tips also feature end blade slots and were elaborately decorated and barbed. Bone throwing board pins, probably made for the distal end of the throwing board, are also present in the collection.

Excavation as well as root gathering activities are represented by 10 complete and 44 fragmentary root picks made from sea mammal ribs, most of which are decorated with geometric designs or parallel lines that run down the center of the pick. The use of a bow or pump drill is well represented at the Amaknak Bridge site by a number of deeply socketed drill caps of dense sea mammal bone and ivory (Fig. 10: r). Eyed bone needles were common in the collection, with recovery heavily biased by the relative experience and visual acuity of our water screeners, one of whom found more than 200 of the 532 needles in the collection (Knecht and Davis 2005:107).

Labrets, Beads, and Artwork

Labrets signaled status and social information, and in the Alaskan literature they are often considered diagnostic of an increase in social complexity in

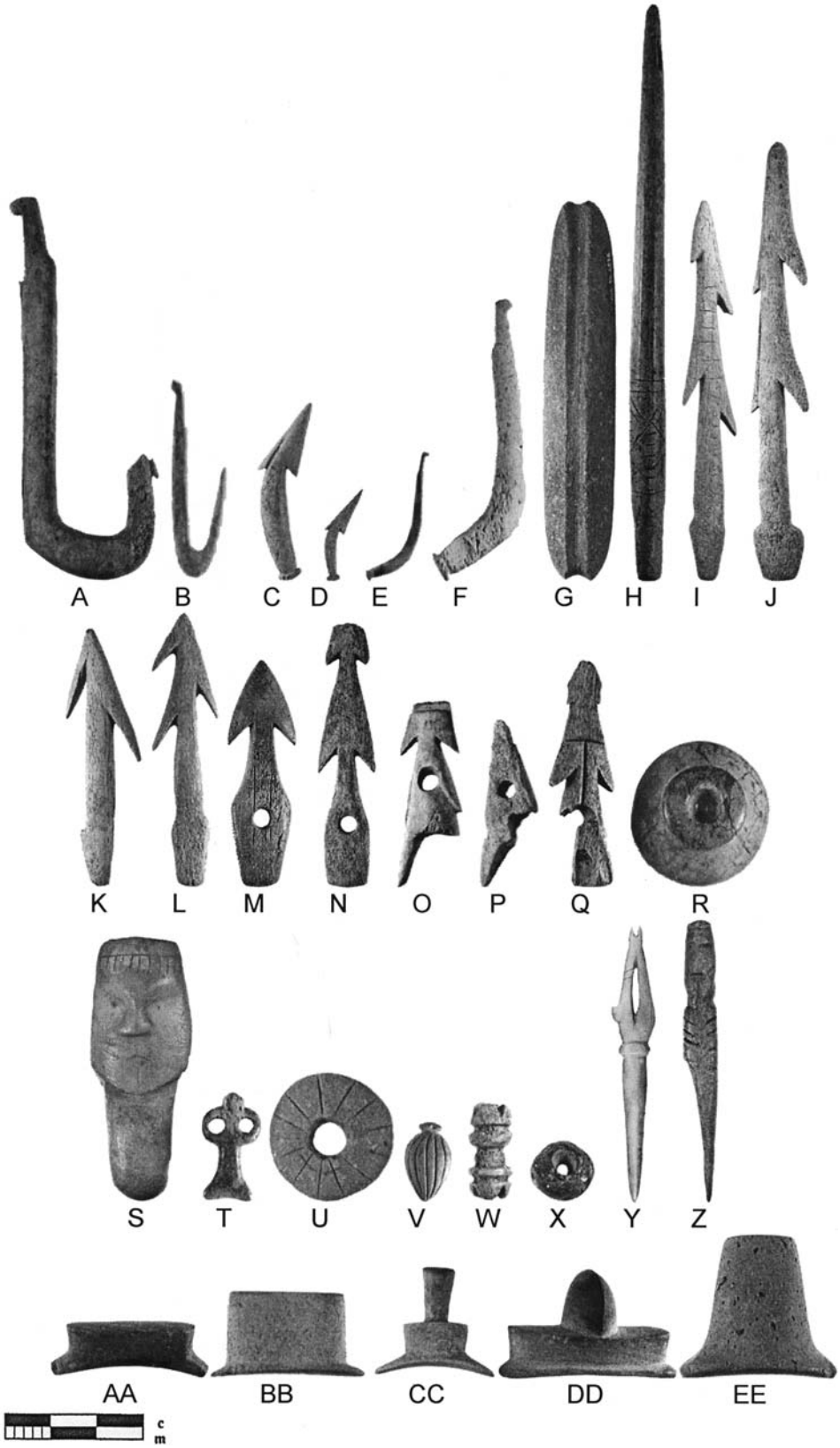

Figure 10. Bone and ground stone artifacts from the Amaknak Bridge site: *a* and *b*, fish hooks; *c* and *d*, composite fish hook barbs; *e* and *f*, composite fish hook shanks; *g*, ground stone sinker; *h*, foreshaft; *i–n*, harpoons; *o–q*, toggling harpoons; *r*, drill rest; *s*, pendant; *t–v*; beads/pendants; *w–x*, beads; *y–z*, decorated pins; *aa–ee*, ground stone labrets.

late prehistory (Fitzhugh 2003). Two labrets were found in the upper layers at Margaret Bay and are among the earliest ever found in the North Pacific (Knecht, Davis, and Carver 2001). At the Amaknak Bridge site 61 labrets were recovered in the 2003 season alone, in a wide range of materials and styles (Fig. 10: aa–ee). Tabular labrets are a simple bar form with a flange at on the proximal end and resemble Kachemak phase labrets of the Kodiak Island area (Knecht 1995). Tabular labrets at Amaknak Bridge were made from bone, ivory, slate, and white calcite. Ground stone figural labrets were made in various forms ranging from stylized bird beaks to trumpet-shapes. The trumpet shapes were also found at the Margaret Bay site and appear to have been worn in pairs, judging by the asymmetrical shape of the flanged proximal ends. White calcite was a commonly used raw material in the manufacture of ornamental artifacts in the Late Aleutian phase sites and the labrets from Amaknak Bridge represent the earliest recorded use of this mineral. Spike shaped labrets of bone or ivory require a relatively small incision and may have been used by children during the Margaret Bay phase as they were later in time.

Stone, ivory, and bone beads were also recovered in far greater quantity than from earlier prehistoric contexts in Unalaska Bay, ranging from simple ground and drilled spheres to ornately carved beads that are more appropriately considered works of art. Another form of personal adornment found at Amaknak Bridge were pendants made from ivory and stone, again running the gamut from drilled pieces of stone to intricately carved anthropomorphic forms (Fig. 10: s). Ivory pins with anthropomorphic and zoomorphic themes are also present in the collection and represent some of the earliest artwork recovered from the Bering Sea (Fig. 10: y–z).

Faunal Remains

The faunal remains were abundant and well preserved, and they convey a wealth of information concerning subsistence behavior and the local environment. Shell midden deposits filled many abandoned structures and the resulting leached calcium neutralized the acidic volcanic soil and thus preserved not only the vertebrate fauna but the large sample of bone and ivory tools and carvings. In all some 42,359 identified specimens (NISP) came from the site from a total of 86,176 specimens examined (NSP) (Crockford et al. 2005:7). These numbers represent only a fraction of the total faunal recovered and are predominantly samples from subfloor, floor, and fill deposits in Structures 3, 6, and 7. The dominant vertebrate taxa (NISP) categorized by order are 25% mammals, 32% birds, and 43% fish. Ringed seal (*Phoca hispida*) and fur seal (*Callorhinus ursinus*) were the dominant marine mammals (18% and 15% respectively of total mammal NISP), birds were represented by alcids (particularly the common murre *Uria aalge*) and anatids (especially a variety of large duck species). The overwhelming fish species was the Pacific cod (*Gadus macrocephalus*) which amounted to 89% of the 13,372 fish NISP. Halibut and salmon were also represented, but comprised only 3% and 4% respectively of the fish NISP.

The basic subsistence picture which emerges from the identified fauna indicates spring/early summer hunting for seals on local pack ice and the continued hunting of seals taken off rookeries in the summer/fall (Crockford et al. 2005:74). The Pacific cod and halibut come closer to shore during the summer, and this is when these bottom feeders were caught with hook and line technology. The migratory sea ducks found at the site were predominantly winter residents in Aleutian waters.

Sub-floor storage features appear in houses early in the Margaret Bay phase and appear to have been replaced by larger structures soon thereafter, such as the northwest side room of structure 7, which appears to have functioned as a storage and/or food processing area. The faunal analysis also gave a clear indication of a much colder climate at the time when the Amaknak Bridge site was occupied. This pronounced cooling is correlated with the Neoglacial (approximately 4700 to 2500 B.P.) (Crockford and Frederick 2007). The evidence for cooling is based on a number of pagophilic seal species present at the site and their known modern habitats and behavior. Bearded seals (*Erignatus barbatus*) comprised 4% of the mammalian NISP and this species was represented by a high proportion (49%) of newborns or newly weaned young less than two months of age. Young pups and adults are strongly associated with sea ice during the spring and summer and so their high frequency at the site attests to sea ice close to Unalaska during this time. Similarly ringed seals (*Phoca hispida*) are an ice-obligate species and newly weaned individuals (approximately 2–6 months of age) "make up 90% of all ringed seal remains for which age could be estimated" (Crockford and Frederick 2007:703). At present sea ice does not reach Unalaska and generally only extends southward of the Pribilov Islands to about 56° N. Crockford and Frederick conclude

> Together, juvenile remains of the two pagophilic species, ringed and bearded seal, provide incontrovertible evidence that at the height of the Neoglacial, sea ice must have been present off Unalaska Bay well into summer most years, a phenomenon unprecedented historically. (2007:704)

Conclusions

The Amaknak Bridge site has provided a significant corpus of new data which will continue to stimulate discussion and research in the eastern Aleutians for some time to come. Although the site has now been substantially destroyed in the process of a new bridge construction, a significant proportion totaling perhaps 15% of the original extent was excavated in 2000 and 2003, and most of the remainder during continuing salvage archaeology in 2006 and 2007. The impressive structural remains, elaborate artifact inventory, and abundant faunal remains combine to form a dynamic picture of a thriving community living on the Bering Sea coast some 3000 years ago.

During the Margaret Bay phase there is good evidence for the development of substantial semi-subterranean domestic structures which featured well constructed multiple course stone walls, sub floor features, storage facilities, elaborate hearths, and probable roof entrances. Structures of this type are found in Level 2 at the Margaret Bay site and throughout the Amaknak Bridge deposits. Prior to the Margaret Bay phase, we have evidence only for more temporary, tent like structures. Multiple room structures at Amaknak Bridge, as exemplified by Structure 7, clearly reflect a fairly permanent settlement, and there is also clear evidence for repair and rebuilding of these buildings. The complex hearth, flue, and chimney system is without parallel before or after the Margaret Bay phase in the Aleutians or elsewhere to our knowledge. Their origins and fate are a mystery to us. By the time the Russians and other Europeans documented Aleut domestic structures in the nineteenth century, the large communal houses had simple hearths with the smoke exiting through the roof entrance. Perhaps the Margaret Bay phase complex hearth systems were more advantageous during the cold Neoglacial, but we have no empirical data on how they actually functioned.

The Amaknak Bridge faunal evidence testifies to the colder temperatures of the Neoglacial which resulted in sea ice close to Unalaska during the late spring and early summer months. The ice-obligate bearded and ringed seal were frequent targets, and toggling harpoons, which appear for the first time in the Eastern Aleutian archaeological sequence at Amaknak Bridge, may have been used for ice edge hunting. Toggling harpoons are generally associated with pack ice hunting in the Bering Sea (Fitzhugh and Kaplan 1982:67) and hence their presence at Amaknak Bridge strongly supports the expansion of sea ice into the Unalaska vicinity. Bone socket pieces also make their appearance during the Margaret Bay phase and they are well represented at Amaknak Bridge. Socket pieces are generally thought to give more weight and impact to the head of the harpoon allowing a deeper penetration of the tip. Socket pieces can be paired with either toggling or non-toggling harpoon heads.

Fishing technology is well advanced during the Margaret Bay phase as has been detailed above. Long line techniques for catching Pacific cod and halibut using composite hooks is well documented at Amaknak Bridge.

It is difficult to reconstruct the form of social organization of the people who built the substantial semi-subterranean domiciles and who utilized such elaborate material culture. Certainly, one of the issues frequently discussed in northern archaeology and in the Aleutians in particular is the timing and emergence of complex social organization. Basically we know at the very beginning of the Aleutian archaeological sequence during the Anangula phase that all evidence points toward small, temporary occupations with essentially egalitarian social organization, and at the end of the sequence we know from the Russian commentaries as well as the archaeological remains that permanent or semi permanent villages were widespread in the eastern Aleutians and the social structure may be characterized as ranked with chiefs, common people, and slaves (Lantis 1984, Veltrie and McCartney 2001, Veniaminov 1984). The question is what sort of social organization is reflected from the structural and artifactual remains from Amaknak Bridge.

The Structure 7 complex of rooms is based on a rectangular, not an oval plan. Many years ago in a comparative study of early settlements, Kent Flannery observed a change in domestic architecture from circular to rectangular in the Near East during the transition from the Natufian to the Pre Pottery Neolithic (Flannery 1972). He interpreted this as a reflection of a change of social organization from simple egalitarian bands to a society based more on extended kinship with intensified production. Rectangular structures, Flannery argued, are expandable; it is possible to add adjacent rooms with shared walls. Expansion occurs as families grow and incorporate more kinsmen and also as they increase the quantity of their possessions. Flannery's observation on social organization and architecture has direct relevance to the Amaknak Bridge case. We interpret the large, rectangular plan of Structure 7 as a convincing indication of an initial change in social organization from an egalitarian society to one based more on some ranking.

In addition to architecture, features at Amaknak Bridge that suggest greater organizational complexity include larger population aggregates, labrets, and other items of personal adornment. We do not have an accurate means of estimating the population size of the Amaknak Bridge settlement, and can only suggest that there

may have been as many as a dozen contemporaneous structures with a population somewhere between 50 and 80 individuals. Maritime hunting, fishing, and foraging demands detailed knowledge about the environment, animal behaviors, and technical skills. Information may have been among the most important of the resources shared among larger households and settlements, particularly in a time of relatively rapid ecological change such as the Neoglacial. The large number of small projectile points (greater than 400) deserves some attention in this context. As discussed above, they share many characteristics with arrow points. Given that there was no terrestrial game, and that bows are not reliable for hunting from a kayak platform, by elimination we suggest they might have been used for inter village or inter island hostilities. Admittedly this is quite speculative, but we have not discovered alternative uses for these small points which were first introduced to the Unalaska along with ASTt elements at the Margaret Bay site.

The Amaknak Bridge site has provided a wealth of data which will be discussed for some time to come. The site contains many of the features that became hallmarks of the ensuing Aleutian Tradition (McCartney 1984). It was one of the last remaining major sites on Amaknak Island and has now been largely destroyed by development. We are fortunate to have had the opportunity to excavate a portion of it.

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References Cited

Aigner, Jean. S.
1978 Activity Zonation in a 4000-Year-Old Aleut House, Chaluka Village, Umnak Island, Alaska. Anthropological Papers of the University of Alaska 19:11–25.

Bacon, Glenn
1983 The Amaknak Bridge Site. Report to the Office of History and Archaeology, Alaska Department of Natural Resources, Anchorage.

Crockford, S. J. and S. G. Frederick
2007 Sea ice expansion in the Bering Sea during the Neoglacial: evidence from archaeozoology. The Holocene 17:699.

Crockford, S. J., S. G. Frederick, R. Wigen and I. Mc-Kechnie
2005 Final Report on the analysis of the vertebrate fauna from Amaknak Bridge, Unalaska AK. Supplement to Knecht, R. and R. Davis 2005.

Damkjar, Eric
2003 Transitional occupations of southeastern Somerset Island, Nunavut. Etudes/Inuit/Studies 27(1–2).

Davis, Brian L.
2001 Sea Mammal Hunting and the Neoglacial: An Archaeological Study of Environmental Change and Subsistence Technology at Margaret Bay, Unalaska. *In* Archaeology in the Aleut Zone: Some Recent Research. Don E. Dumond, ed. University of Oregon Anthropological Papers, 58 (Recent Archaeology in the Aleut Zone of Alaska):71–85.

Davis, Richard S. and Richard A. Knecht
2006 Evidence for the Arctic Small Tool Tradition in the Eastern Aleutians. Alaska Journal of Anthropology 3(2):3–17.

Dumond, D. E.
2001 Toward a (Yet) Newer View of the (Pre)History of the Aleutians in Archaeology in the Aleut Zone of Alaska. *In* Archaeology in the Aleut Zone: Some Recent Research. D. E. Dumond, ed. Pp. 298–309. Anthropological Papers, 58. Eugene: University of Oregon.

Etnier, M. A.
2002 The effect of human hunting on northern fur seal (*Callorhinus ursinus*) migration and breeding distribution in the late Holocene. Ph.D. dissertation, Department of Anthropology, University of Washington.

Fitzhugh, Ben
2003 The Evolution of Complex Hunter-Gatherers: Archaeological Evidence from the North Pacific. New York and Boston: Kluwer Academic/Plenum.

Fitzhugh, William W., and Susan A. Kaplan
1982 Inua: Spirit World of the Bering Sea Eskimo. Washington, D.C.: Smithsonian Institution Press.

Flannery, Kent F.
1972 The Origins of the Village as a Settlement Type in Mesoamerica and the Near East: A Comparative Study. *In* Man, Settlement and Urbanism, P. J. Ucko, Ruth Tringham, and G. W. Dimbleby, eds. Pp. 23–53. London: Duckworth.

Frohlich, Bruno and Sara B. Laughlin
2002 Unangan Mortuary Practices and the Umqan Burials on Anangula Island, Aleutian Islands, Alaska. *In* To the Aleutians and Beyond. Ethnographical Series Vol. 20. Bruno Frohlich, Albert

B. Harper, and Rolf Gilberg, eds. Pp. 89–119. Copenhagen: The National Museum of Denmark.

Hoffman, Brian
2002 The Organization of Complexity: A Study of Late Prehistoric Village Organization in the Eastern Aleutian Region. Ann Arbor: University Microfilms.

Hrdlicka, Ales
1945 The Aleutian and Commander Islands. Philadelphia: Wistar Institute of Anatomy and Biology.

Kearney, Michael S.
2001 Late Holocene Sea Level Variation. *In* Sea Level Rise; History and Consequences. Bruce Douglas, M. Kearney, and Stephen Leatherman, eds. Pp. 13–36. New York: Academic Press.

Knecht, Richard A.
1995 The Late Prehistory of the Alutiiq People. Ann Arbor: Unversity Microfilms.

2001 ADOT Boundary Survey of the Amaknak Bridge Site (UNL-50). Unalaska: Museum of the Aleutians.

Knecht, Richard A. and Richard S. Davis
2001 A prehistoric sequence for the Eastern Aleutians. University of Oregon Anthropological Papers 58 (Recent Archaeology in the Aleut Zone of Alaska): 269–288.

2005 South Channel Bridge Project No. MGS-STP-BR-0310(S)/52930, Amaknak Bridge Site Data Recovery Project Final Report. On File: Alaska Department of Transportation and Public Facilities, Anchorage.

Knecht, Richard A., Richard S. Davis, and Gary Carver
2001 The Margaret Bay Site and Eastern Aleutian Prehistory. University of Oregon Anthropological Papers 58 (Recent Archaeology in the Aleut Zone of Alaska): 35–70.

Lantis, Margaret
1984 Aleut. *In* Handbook of the North American Indians, vol. 5, Arctic. D. Damas, ed. Pp. 161–184. Washington, D.C.: Smithsonian Institution Press.

Laughlin, William
1980 Aleuts: Survivors of the Bering Land Bridge. New York: Holt, Rinehart, & Winston.

Maschner, Herbert D. G. and J. W. Jordan
2001 The Russell Creek Manifestation of the Arctic Small Tool Tradition on the Western Alaska Peninsula. University of Oregon Anthropological Papers, 58 (Recent Archaeology in the Aleut Zone of Alaska):152–171.

Mason, Owen
2001 Catastrophic Environmental Change and the Middle Holocene Transition in the Aleutian Islands. University of Oregon Anthropological Papers, 58 (Recent Archaeology in the Aleut Zone of Alaska):105–122.

McCartney, Allen P.
1967 An Analysis of Bone Industry from Amaknak Island, Alaska. M.A. thesis, Department of Anthropology, University of Wisconsin, Madison.

1984 Prehistory of the Aleutian Region. *In* Handbook of North American Indians, vol. 5, Arctic. D. Damas, ed. Pp. 119–135. Washington, D.C.: Smithsonian Institution Press.

McCartney, Allen P. and Douglas Veltre
1996 Anangula Core and Blade Site. *In* American Beginnings: The Prehistory and Paleoecology of Beringia. F. H. West, ed. Pp. 443–450. Chicago: University of Chicago Press.

1999 Aleutian Island Prehistory: Living in Insular Extremes. World Archaeology 30(3):503–515.

Veltre, Douglas. W. and Allen. P. McCartney
2001 Ethnohistorical Archaeology at the Reese Bay Site, Unalaska Island. University of Oregon Anthropological Papers, 58 (Recent Archaeology in the Aleut Zone of Alaska):87–104.

Veniaminov, Ivan
1984 Notes on the Islands of the Unalashka District. Richard A. Pierce, ed. L. T. Black and R. H. Geoghegan, trans. Alaska History, 27. Kingston: Limestone Press.

Workman, W. B. and P. Zollars
2002 The Dispersal of the Arctic Small Tool Tradition into Southern Alaska: Dates and Data from the Kenai Peninsula. Anthropological Papers of the University of Alaska 2(1):39–49.