NEW EVIDENCE FOR THE TIMING OF ARCTIC SMALL TOOL TRADITION COASTAL SETTLEMENT IN NORTHWEST ALASKA

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ABSTRACT

This paper presents the results of a survey of the oldest beach ridges located on Cape Espenberg in Bering Land Bridge National Preserve, Alaska. The goals were to locate and test Arctic Small Tool tradition (ASTt) sites to develop a coastal settlement chronology and to establish whether marine resources were exploited. At the outset of this project four ASTt sites were known at Cape Espenberg, two with associated radiocarbon dates. Upon completion, ten new ASTt sites with eleven radiocarbon dates were added to the record. Analysis of the radiocarbon dates indicate ASTt occupations at Cape Espenberg began at least 4,500 years ago and lasted a millennium. Comparisons among ASTt sites throughout Alaska suggest the coast was settled prior to the interior. The site designated KTZ-325 yielded the oldest securely dated evidence for sea mammal use in Northwest Alaska, supporting the hypothesis that ASTt people had a maritime economy in place at the start of their florescence in Alaska and beyond.

This paper presents the results of a University of California at Davis (UC Davis) survey for ASTt sites at Cape Espenberg, located in the Bering Land Bridge National Preserve, Alaska (Fig. 1), and an analysis of new radiocarbon dates derived from samples collected there. The objective of this project was two-fold: (1) to collect organic material from ASTt sites to develop a chronology of coastal settlement, and (2) to locate direct evidence for maritime resource exploitation, including faunal remains or specialized technology.

The Arctic Small Tool tradition (ASTt), as defined by Irving (1957, 1964), is a stone tool technology produced by people 3,000 to 5,000 years ago in the circumpolar regions of Asia and North America. This tradition originated in the Siberian Neolithic (Hoffecker 2005; Mochanov 1969; Powers and Jordan 1990), spread across the Arctic from Alaska to Greenland, and is regarded as the earliest maritime culture in this region (Ackerman 1998; Dumond 1987; Giddings and Anderson 1986). The Denbigh Flint complex and the Brooks River Gravel phase are regional variants of the ASTt in Alaska. Anderson (1979) subsumes the Choris complex and Norton tradition into the ASTt, while Dumond (1982) makes a distinction between these archaeological concepts based on shifting settlement patterns and technological differences. In this study I follow Dumond (1982) by separating the aceramic ASTt from the ceramic-bearing cultures that follow.

When the ASTt appears in Alaska is a matter of debate, as are the timing and causal factors of their maritime adaptations (Tremayne and Rasic in press). Most agree ASTt people were the first seal hunters in northern Alaska (Ackerman 1998; Dumond 1975; Giddings and Anderson 1986), but it is unclear if their maritime capabilities were advanced or developmental. Therefore, it is uncertain whether the ASTt people invented maritime hunting skills *in situ* within Alaska, imported them from Asia, or acquired them through diffusion from southwest Alaska contemporaries.

ASTt hunters in Alaska are typically portrayed as caribou specialists, relying on a terrestrial-based economy with *occasional* forays to the coast to hunt seals in spring and summer (Ackerman 1998; Anderson 2005; Dumond 1975, 1982; Giddings 1964; Giddings and Anderson 1986; Stewart 1989). Their ASTt maritime adaptations are

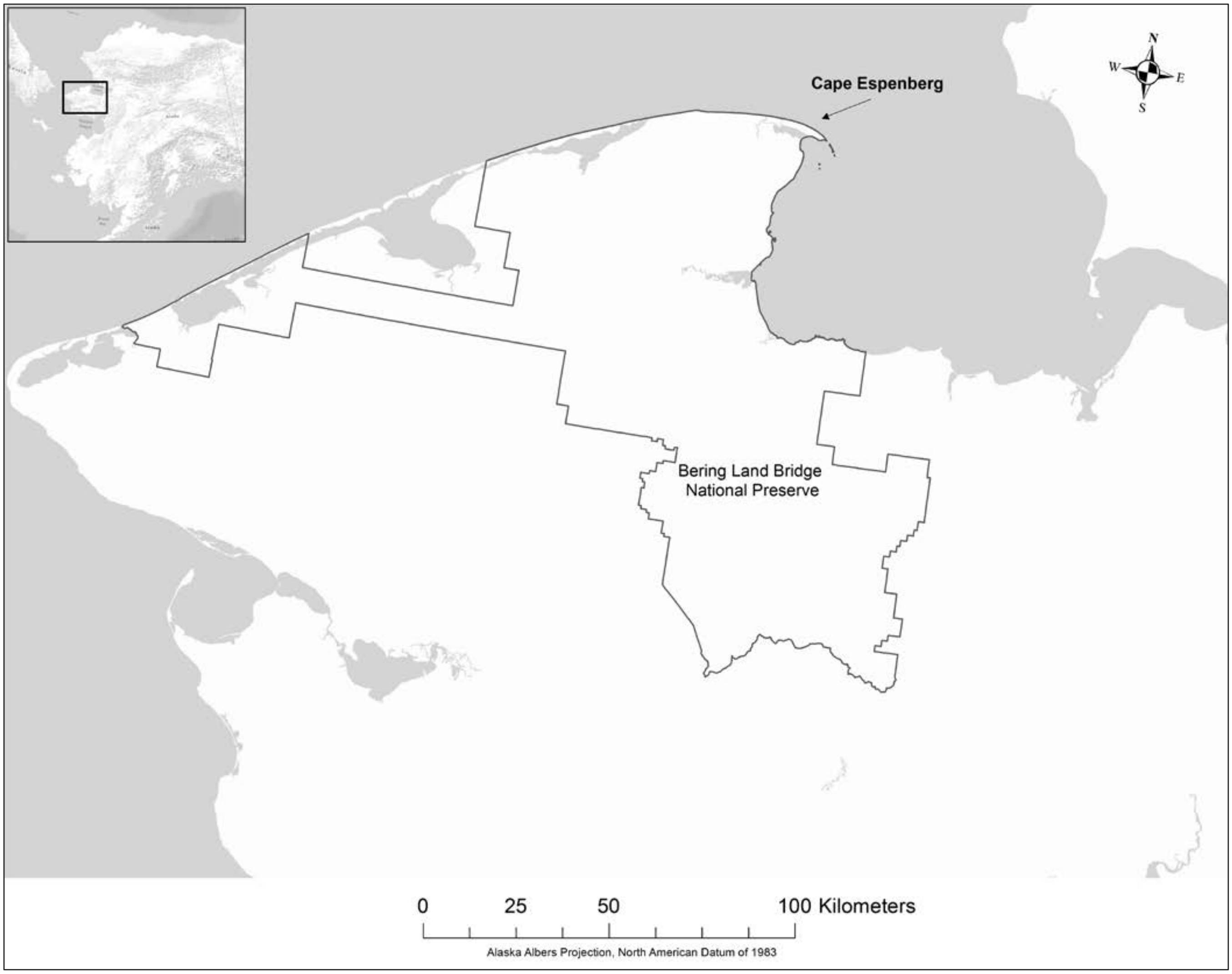

Figure 1. Location of Cape Espenberg within Alaska and Bering Land Bridge National Preserve.

considered incipient and the earliest stage in an evolutionary progression that culminates in the specialized whale-hunting Northern Maritime tradition around 2,000 years ago (Ackerman 1998; Dumond 1982; Giddings and Anderson 1986).

Such views contrast sharply with the eastern Arctic where ASTt hunters were clearly part of a marine economy (Grønnow 1994, 1996; Maxwell 1980; McCartney and Helmer 1989; McGhee 1976; Møbjerg 1999; Savelle and Dyke 2014). Boat parts, harpoons, and faunal assemblages that contain small and large seals, walrus, and whale indicate eastern ASTt maritime adaptations were complex and fully developed (Melgaard 2004; Møbjerg 1999). The lack of correspondence between the east and west ASTt has important implications for how researchers model the adaptive processes of the colonizing population. Are we seeing a process of cultural diffusion as maritime hunters spread east, or independent invention as new ecological opportunities/constraints emerged?

In Alaska a paucity of ASTt sites with faunal remains and organic technology has limited our ability to test hypotheses about ASTt maritime adaptations. Despite the lack of hard evidence in the form of bones, boat parts, or harpoon technology, researchers have used proxy data, such as site location (proximity to the coast), site size, house form, and the appearance of ceramic technology to infer changes in mobility and increased focus on marine resources (Dumond 1975, 1982; Giddings and Anderson 1986). For example, the appearance of semisubterranean houses on the coast is seen by some to indicate year-round occupation rather than seasonal use. Even if these interpretations are correct, many questions remain unanswered regarding ASTt subsistence and land-use patterns: e.g., whether ASTt originated in the interior and were ASTt people living on the coast actually hunting sea mammals or had they followed caribou herds there, as surmised for the Northern Archaic (Esdale 2008). To answer these questions, we need a larger sample of securely dated ASTt sites and some direct evidence for marine resource exploitation. This project adds sixteen new radiocarbon dates to the record and provides the earliest evidence for sea mammal use in Northwest Alaska.

BACKGROUND

To date 170 ASTt sites have been identified in Alaska. At least seventeen are from Southwest Alaska and are commonly referred to as the Brooks River Gravel or Russell Creek phases (Dumond 2005). ASTt artifacts are present on the Alaska Peninsula, the eastern Aleutian Islands (Davis and Knecht 2005; Maschner and Jordan 2001; Maschner et al. 2010), and along the shores of Cook Inlet (Reger 1998; Rogers et al. 2013; Workman and Zollars 2002). Hints of ASTt connections on Kodiak Island have also been reported (Steffian and Saltonstall 2005). The remaining 153 sites, regionally known as the Denbigh Flint complex, are primarily found in northern Alaska in the Brooks Range, the North Slope, the Seward Peninsula, and along the coasts of Norton Sound and the Chukchi and Beaufort seas (Tremayne and Rasic in press).

Despite the high number of known ASTt sites, less than a dozen have been intensively investigated through excavation. While a few of the best known ASTt sites are coastal (e.g., Iyatayet), a far greater number are found inland. This apparent disparity forms the basis for arguments that Denbigh people were primarily terrestrial hunters (Dumond 1975, 1982; Stewart 1989). According to Alaska Heritage Resources Survey (AHRS) data in 2013, 88% (n = 125) of ASTt sites in northern Alaska were recorded in the interior, mainly in the Brooks Range and the North Slope. At the outset of this project, only 12% (n = 17) of the ASTt sites were known from the coast. However, it must be pointed out that the Cape Krusenstern site complex has at least forty-six Denbigh features reported across numerous beach ridges (Giddings and Anderson 1986:275), all of which are subsumed by one site designation. Using current site designation criteria and including several additional Krusenstern sites (depending on proximity of the features to each other) would increase the percentage of coastal sites to 25–30% or greater. How a site is defined clearly conditions interpretations. Occupation intensity may be better gauged by factoring in site size and feature counts, but such work is beyond the scope of this project.

ASTt investigations in northern Alaska have focused most intensively on inland settlements (Anderson 1988; Gerlach 1989; Irving 1964; Kunz 1977; Schoenberg 1985; Tremayne 2011). For coastal ASTt sites, only Iyatayet and Cape Krusenstern have seen more than a cursory inventory. However, until recent work by Anderson and Freeburg (2013), there were no radiocarbon dates from the oft-cited Cape Krusenstern Denbigh beach ridges. Prior to this project a total of seventy-six radiocarbon dates from fourteen sites were known from the interior, but only sixteen dates had been reported from five coastal sites. Two dates are from Cape Espenberg sites, one of which lacked associated diagnostic tools. Ten dates are from the Denbigh type site of Iyatayet (Giddings 1964) and lack the accuracy and precision of modern radiocarbon dating methods. Two dates come from Walakpa (Stanford 1976), which has evidence of mixed deposits and unacceptably large standard deviations, and two dates come from the limited testing of the Central Creek Pingo site (Lobdell 1995). All sixteen of these dates were assayed through conventional methods. Four AMS dates were added to the dataset from recent investigations at Cape Krusenstern (Anderson and Freeburg 2013), along with one new AMS date from the Coffin site (Tremayne and Rasic in press), bringing the total number of coastal dates to twenty-one.

In Southwest Alaska research has also focused on interior locales (Dumond 1981; 2005), but the balance here is shifting towards the coast. Fifteen ASTt dates are reported from Ugashik Lake and Brooks River site complexes (Dumond 1981; Henn 1978; Mills 1994), while twenty-four dates have been reported from six coastal ASTt sites (Davis and Knecht 2005; Maschner and Jordan 2001; Maschner et al. 2010; Reger 1998; Rogers et al. 2013; Workman and Zollars 2002).

In addition to the limited number of dates, few faunal remains are preserved at north Alaska ASTt sites. On the coast, only Iyatayet yielded fauna from an unambiguous context: *three* fragmentary seal bones (Giddings 1964). The ASTt components at Walakpa and Coffin produced modest faunal assemblages that included ringed and bearded seals, porpoise, caribou, musk ox, migratory birds, and walrus ivory (Stanford 1971). The radiocarbon dates from both of these sites indicate there were multiple occupations by Denbigh and Choris/Norton peoples; it is unclear whether the bones date to the younger or older occupations (Tremayne and Rasic in press). In sum, ASTt research has been biased towards interior settlements, and an incomplete faunal record has fostered interpretations that downplay the importance of maritime resources to the ASTt economy.

METHODS

Survey methods employed in this study included systematic and random transects across all of the oldest beach ridges at Cape Espenberg (Fig. 2). Areas that appeared suitable for camping were investigated, including entire beach ridges, as these areas are elevated above the surrounding wetlands. All erosional landforms were inspected for artifacts that may have been exposed through erosional processes. Arctic ground squirrel burrows were tested when encountered, as a correlation was found between these disturbances and archaeological sites. All of the small knolls or raised landforms were surveyed and shovel tested, as these places provided good views or may have been sites where houses once stood. All tests were dug with a small shovel or trowel and screened through quarter-inch mesh. A sketch map for each site was produced and coordinates were recorded with a handheld Garmin GPS using the WGS-84 datum.

I define a site as any artifact or object whose position was due to human activities, even if the object was an isolate, such as a single flake or fire-cracked rock (Dunnell and Dancey 1983). My logic is that there may be more subsurface material associated with the apparent isolate, and without excavation and subsurface testing we cannot be certain how extensive the site is. Deposits found within 100 meters were recorded as seperate localities, rather than as new sites. Known sites were revisited with three main goals: (1) update coordinates, (2) assess the site for dis-

Figure 2. Areas surveyed at Cape Espenberg in 2011 and 2013.

turbances and potential threats, and (3) test the site for diagnostic artifacts and datable organic materials.

Diagnostic tools and/or radiocarbon dates were used to assign cultural affiliation where possible. Artifact classifications were made by comparison to Iyatayet (Giddings 1964) and Cape Krusenstern assemblages (Giddings and Anderson 1986). All radiocarbon dates were assayed using accelerator mass spectrometry (AMS) by Beta Analytic and Arizona AMS on charcoal (n = 15) or bone collagen (n = 1) collected from subsurface tests. Dates were calibrated with OxCal version 4.3.1 (Bronk Ramsey and Lee 2013) using the IntCal13 atmospheric curve (Reimer et al. 2013). The seal bone date was calibrated Marine13 curve (Reimer et al. 2013) with marine reservoir correction (delta r) of 486 ± 65 (Reuther, pers. comm., 2013).

Comparisons between Cape Espenberg occupations and the oldest known ASTt sites were made using OxCal's calibration and statistical software. Radiocarbon dates from key ASTt sites were acquired from Slaughter (2005); more recent studies contributed additional AMS dates (i.e., Anderson and Freeburg 2013; Maschner et al. 2010; Meitl 2008; Rogers et al. 2013; Tremayne 2011; Tremayne and Rasic in press). Split samples were pooled to determine the weighted average (Ward and Wilson 1978). The most likely start date for each site or site complex was modeled as a phase using OxCal 4.2.3 software (Bronk Ramsey 2009; Buck et al. 1996). This method is based on the assumption that we rarely, if ever, find the oldest evidence of any archaeological phenomena. Radiocarbon dates are inherently probabalistic. Any given date is an approximation of the age for an occupational event. Rather than relying on only the oldest date, the Bayesian approach uses all of the data and incorporates the uncertainty of the dates to predict the start or end of an occupational sequence (Buck et al. 1996). The larger the sample of dates, preferably AMS, the more accurate the predicted occupation span will be.

RESULTS

The results of this project led to the discovery of thirty-four previously undocumented archaeological sites, the reassessment of ten known sites, and the addition of sixteen new radiocarbon dates to the record (ASTt n = 11, Norton n = 4, not cultural n = 1) (Table 1). Of the new sites, ten are verifiably ASTt based on diagnostic artifacts and/or radiocarbon dates. Another six are likely ASTt, but no diagnostic artifacts or preserved organics were detected. Combined, there are now fourteen known ASTt sites with thirteen radiocarbon dates (Table 1). A small but informative sample of faunal remains and oil-soaked cemented sands provide empirical evidence that marine animals were exploited by the earliest ASTt groups to camp at Cape Espenberg. Furthermore, stone tool technology revealed new evidence for a Siberian connection before 4300 cal BP.

TIMING OF ASTt COASTAL SETTLEMENT

Prior to this work, only two of the four known ASTt sites at Cape Espenberg were dated. KTZ-096 produced a date of 3570 ± 100 ^{14}C yrs BP (Schaaf 1988) and KTZ-122 a date of 3750 ± 80 ^{14}C yrs BP (Harritt 1994). We added a second date of 3153 ± 41 ^{14}C yrs BP for KTZ-122 and dated the other two known sites as well: 3401 ± 41 ^{14}C yrs BP for KTZ-124 and 3190 ± 40 ^{14}C yrs BP for KTZ-126 (Table 1). Most of the new sites were dated with only one radiocarbon assay but KTZ-323 and KTZ-325 both had two dates. A ringed seal femur from KTZ-323 was submitted for AMS analysis as evidence for ASTt seal hunting but was rejected as much too young at 1770 ± 30 ^{14}C yrs BP, which calibrates to AD 1100–1250 (Table 1). A second sample directly associated with microblade and burin spall dated KTZ-323 to 3590 ± 40 ^{14}C yrs BP, an age typical of many Denbigh occupations. KTZ-325 produced the two oldest dates from Cape Espenberg: 4100 ± 40 and 3880 ± 30 ^{14}C yrs BP, which average to 3961 ± 25 ^{14}C yrs BP (4440 ± 50 cal BP). The ASTt dates range from 4100 ± 40 (KTZ-325) to 3153 ± 41 ^{14}C yrs BP (KTZ-122), bracketing the ASTt occupations within a 1,000-year interval (Fig. 3). The modeled start and end dates for the ASTt occupation events at Cape Espenberg are 4640 ± 135 cal BP and 3300 ± 110 cal BP.

Four Norton tradition sites were also radiocarbon dated (Table 1). Two of these sites lack diagnostic artifacts and were in contexts that suggested possible ASTt affiliation. Dates of 2434 ± 39 ^{14}C yrs BP (KTZ-369) and 1637 ± 38 ^{14}C yrs BP (KTZ-143) indicate Norton occasionally made use of the older ridges. The other two Norton sites that were dated have diagnostic artifacts: one a square-based projectile point and the other a linear-stamped pottery sherd. These sites were dated to better determine the timing of ASTt replacement at Cape Espenberg; they produced dates of 2117 ± 39 ^{14}C yrs BP (KTZ-164) and 2154 ± 39 ^{14}C yrs BP (KTZ-362). Using these new dates and those of previous studies (Harritt 1994:141), the modeled start and end dates for Choris/Norton occupations at Cape Espenberg

Table 1. Summary of new and revisited known sites at Cape Espenberg in 2011 and 2013.

AHRS #	New Site	Artifacts	Fauna Present	^{14}C Years BP (RCYBP)	Calibrated (mean BP)	Lab no.	Cultural Affiliation	Source
KTZ-096	no	burin spall FCR	no	3570 ± 100	3875 ± 140	Beta-19643	Denbigh	Schaaf 1988
KTZ-122	no	flake tool biface	no	3750 ± 80	4125 ± 125	Beta-33758	Denbigh	Harritt 1994
				3153 ± 41	3370 ± 55	AA102997		this study
KTZ-124	no	FCR flakes microblade	cemented sand	3401 ± 41	3655 ± 60	AA102998	Denbigh	this study
KTZ-126	no	flakes side blade microblades	no	3190 ± 40	3415 ± 45	AA102999	Denbigh	this study
KTZ-133	no	chert flake	cemented sand				Norton (?)	Schaaf 1988
KTZ-141	no	chert flake	no				undetermined	Schaaf 1988
KTZ-142	no	chert flake FCR	no				undetermined	Schaaf 1988
KTZ-143	no	chert flakes FCR biface	no	1637 ± 38	1525 ± 60	AA103000	Norton (?)	Schaaf 1988 this study
KTZ-164	no	chert flake biface	no	2117 ± 39	2100 ± 75	AA103001	Norton	AHRS this study
KTZ-323	yes	uniface microblade burin spall	seal bone cemented sand	3590 ± 40	3895 ± 60	AA95597	Denbigh	this study
				1770 ± 30	825 ± 75*	Beta-305873		this study
KTZ-324	yes	chert flake	bird ground squirrel cemented sand	3690 ± 50	4025 ± 70	AA95598	Denbigh	this study
KTZ-325	yes	end blade	cemented sand	4100 ± 40	4640 ± 95	Beta-305874	Denbigh	this study
				3880 ± 30	4320 ± 60	Beta-305875		this study
KTZ-326	yes	burin spall	no	3760 ± 40	4120 ± 70	AA95599	Denbigh	this study
KTZ-327	yes	chert flake	no				undetermined	this study
KTZ-328	yes	harpoon end blade microblade burin spalls	no	3530 ± 40	3800 ± 60	AA95600	Denbigh	this study
KTZ-329	yes	basalt adze	no				undetermined	this study
KTZ-330	yes	flake pot sherd	no				undetermined	this study
KTZ-331	yes	slate	unidentified calcined fragments				undetermined	this study
KTZ-332	yes	burin flakes	no				Denbigh	this study
KTZ-333	yes	FCR flakes	no	3880 ± 43	4310 ± 70	AA103002	Denbigh	this study
KTZ-334	yes	flakes	unidentified bone fragments				undetermined	this study
KTZ-348	yes	basalt cobbles	no				undetermined	this study

AHRS #	New Site	Artifacts	Fauna Present	^{14}C Years BP (RCYBP)	Calibrated (mean BP)	Lab no.	Cultural Affiliation	Source
KTZ-349	yes	burin spalls flakes	cemented sand				Denbigh	this study
KTZ-350	yes	slate	caribou rodent				undetermined	this study
KTZ-351	yes	chert flakes	unidentified bone fragments				undetermined	this study
KTZ-352	yes	sherds	no				Norton	this study
KTZ-353	yes	flake schist biface	no				Choris	this study
KTZ-354	yes	flake linear sherd	no				Choris / Norton	this study
KTZ-355	yes	biface plainware sherd	no				Norton (?)	this study
KTZ-356	yes	chert flakes	cemented sand				undetermined	this study
KTZ-357	yes	plainware sherd	no				Thule (?)	this study
KTZ-358	yes	schist flake plainware sherd	no				undetermined	this study
KTZ-359	yes	FCR	no				undetermined	this study
KTZ-360	yes	chert flake	no				undetermined	this study
KTZ-361	yes	hammerstone	no				undetermined	this study
KTZ-362	yes	chert flake, linear stamped sherd	cemented sand	2154 ± 39	2170 ± 85	AA102994	Norton	this study
KTZ-363	yes	lava rock	no				undetermined	this study
KTZ-364	yes	FCR	no				undetermined	this study
KTZ-365	yes	FCR	no				undetermined	this study
KTZ-366	yes	microblade schist	antler (not collected)				Denbigh / Historic	this study
KTZ-367	yes	FCR hammerstone	no				undetermined	this study
KTZ-368	yes	burin spalls flakes	no	3834 ± 42	4250 ± 80	AA102995	Denbigh	this study
KTZ-369	yes	flakes square-based projectile point	no	2434 ± 39	2515 ± 105	AA102996	Choris / Norton	this study

* Run on ringed seal bone collagen; date rejected as too recent.

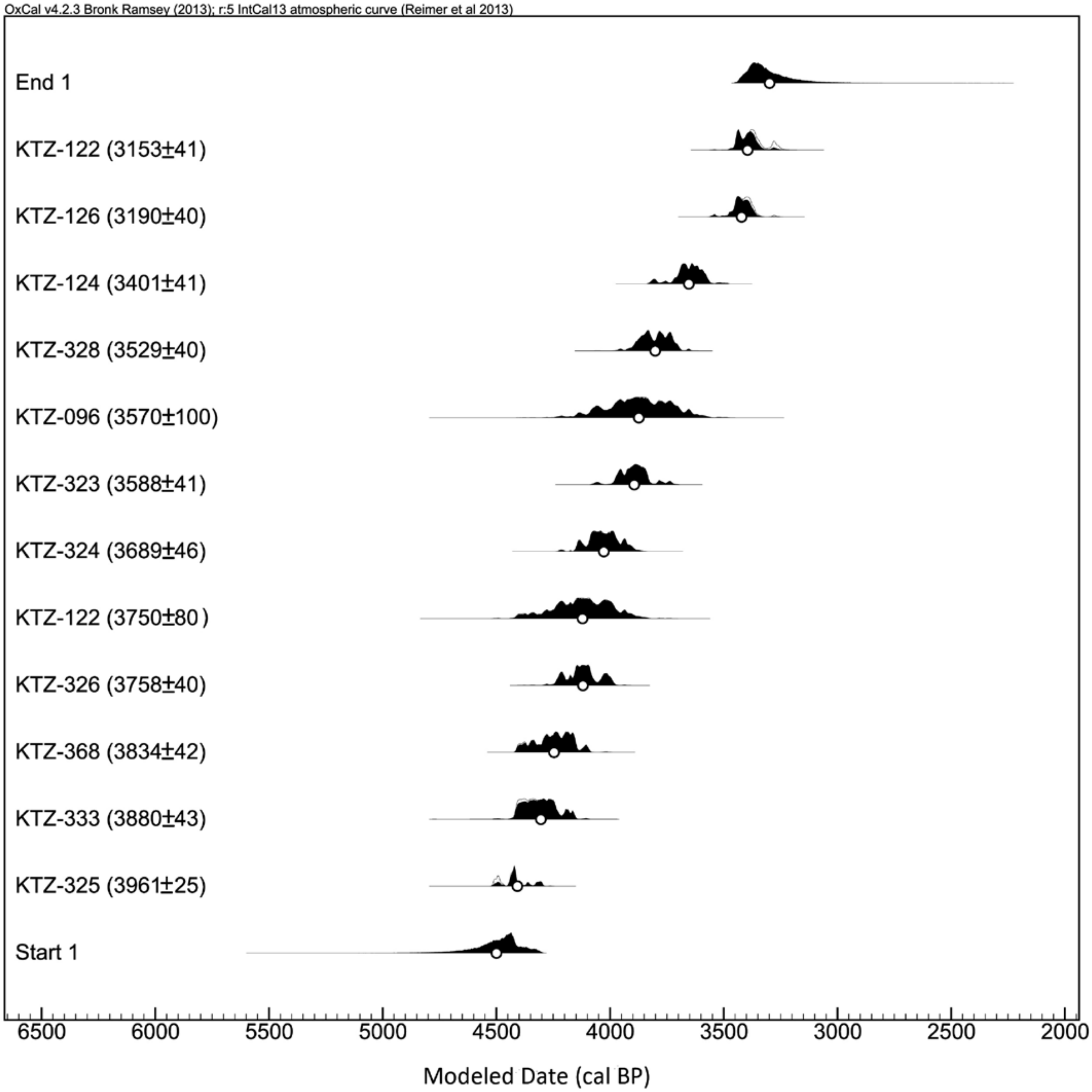

Figure 3. Plot of probability distributions for calibrated radiocarbon dates from the ASTt sites at Cape Espenberg. Start 1 and End 1 are the modeled start and end dates for ASTt settlements at Cape Espenberg.

are 2850 ± 250 cal BP lasting until 1410 ± 190 cal BP. This suggests an approximate 400 to 500 year hiatus between the end of the Denbigh occupations and start of the ceramic-bearing Choris/Norton sites at Cape Espenberg.

Table 2 provides the results of the Bayesian analysis of the radiocarbon dates from the oldest ASTt sites in the interior and coast (see Fig. 4 for site locations). As noted above, the statistical model predicts a start date of 4640 ± 135 cal BP for the ASTt settlement of Cape Espenberg. If the oldest samples from KTZ-325 are averaged, the model produces a slightly more recent age of 4500 ± 115 cal BP. Iyatayet has the oldest radiocarbon date of any known ASTt site in Alaska at 5063 ± 40 ^{14}C yrs BP (Giddings 1964), but a recent redating of this component using AMS methods shows the oldest dates are in error (Tremayne et al. 2015). Rejecting the anomalous dates, the modeled start date for Iyatayet is 4135 ± 150 cal BP. The modeled start date for Onion Portage is 4585 ± 215 cal BP when samples from the same levels are pooled. If each date is considered independent, the Onion Portage modeled start date is more recent at 4366 ± 65 cal BP. The modeled age for Matcharak Lake is 4555 ± 120 cal BP, if the 4020 ± 40 ^{14}C yrs BP date actually represents an ASTt event (see Tremayne 2015). A modeled age for the Croxton site is 4185 ± 145 cal BP, which includes the anomalous old date of 4420 ± 430 ^{14}C yrs BP. Punyik Point, another well-studied ASTt site from the Brooks Range, has the youngest modeled age of these sites at 3840 ± 140 cal BP.

Kuzitrin Lake has the earliest predicted age of 6085 ± 880 cal BP, if we accept the oldest dates as valid and assume each date represents an independent event (Harritt 1998). Modeled earliest ages for the Brooks River and Ugashik Narrows ASTt sites are 4135 ± 210 cal BP and 4515 ± 375 cal BP, respectively. The recently reported

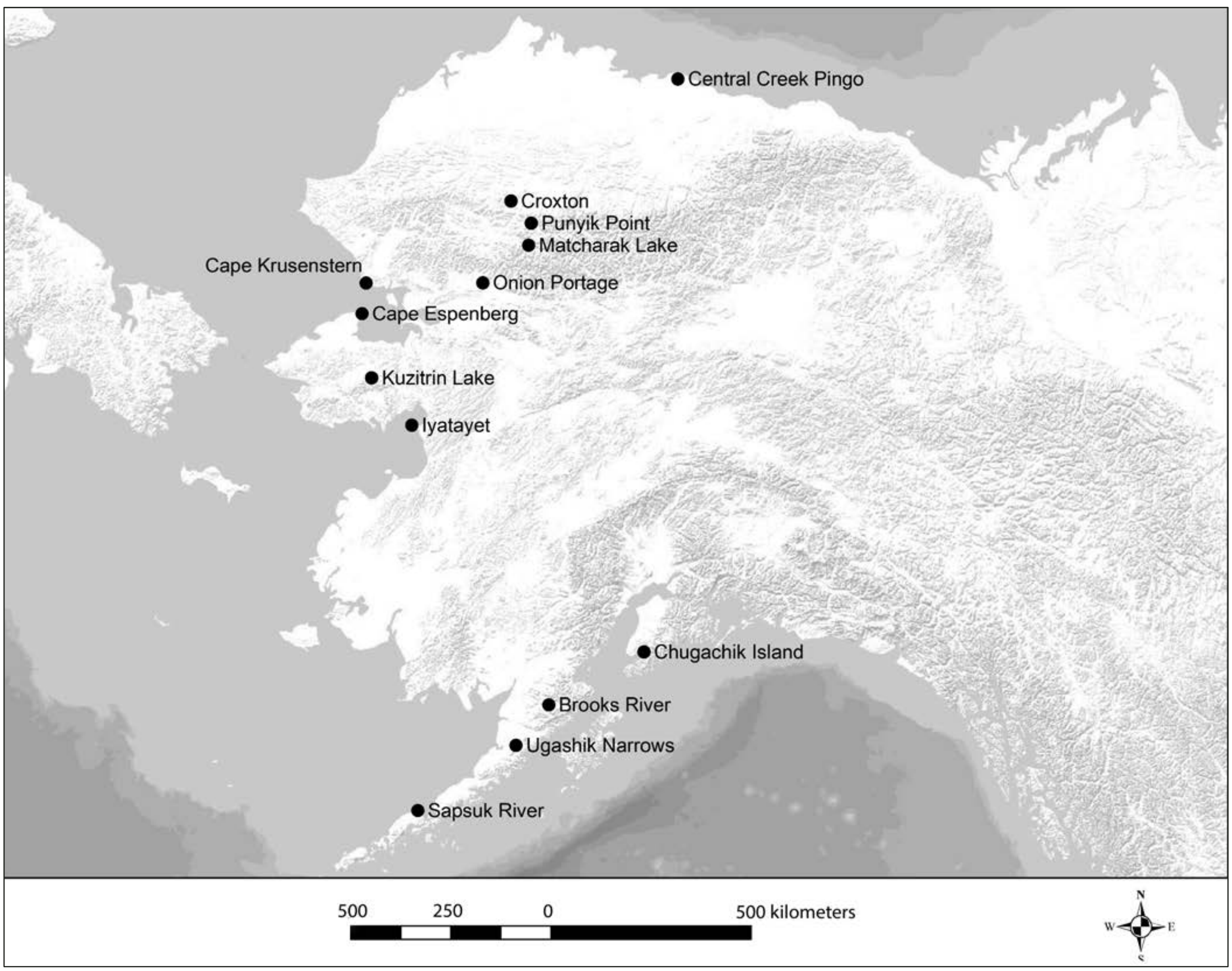

Figure 4. Map of Alaska depicting the oldest ASTt sites included in this study.

Table 2. Summary of modeled ages and earliest occupation dates of key ASTt sites.

Site/Site Complex	Earliest RCYBP	Number of Dates	Modeled Age cal BP at 2σ (Calendar Age at 3σ)	Source
Coast				
Iyatayet[1]	4625 ± 254	10	5140 ± 440 (4050–2290 BC)	Giddings 1964; Tremayne et al. 2015
Iyatayet[2]	3974 ± 600	8	4135 ± 150 (2485–1960 BC)	Giddings 1964; Tremayne et al. 2015
Cape Espenberg	4100 ± 40	13	4640 ± 135 (2955–2495 BC)	this study
Cape Espenberg[1]	3961 ± 25	12	4505 ± 115 (2795–2355 BC)	this study
Cape Krusenstern	3760 ± 40	4	4400 ± 370 (3365–2035 BC)	Anderson and Freeburg 2013
Central Creek Pingo	4060 ± 130	2	4565 ± 180 (2915–2205 BC)[3]	Lobdell 1995
Interior				
Kuzitrin Lake	4770 ± 260	4	6085 ± 880 (7910–4955 BC)	Harritt 1998
Kuzitrin Lake[2]	3810 ± 65	2	4210 ± 110 (2470–2040 BC) [3]	Harritt 1998
Onion Portage[1]	3966 ± 38	25	4585 ± 215 (3050–2330 BC)	Anderson 1988; Meitl 2008
Onion Portage	3966 ± 38	25	4365 ± 65 (2560–2300 BC)	Anderson 1988; Meitl 2008
Matcharak Lake	4020 ± 40	10	4555 ± 120 (2865–2360 BC)	Tremayne 2011
Croxton	4420 ± 430	9	4185 ± 145 (2530–2040 BC)	Slaughter 2005
Punyik Point	3660 ± 150	6	3840 ± 140 (2165–1690 BC)	Kunz 2005
Southwest Alaska				
Sapsuk River	4390 ± 50	1	4970 ± 90 (3310–2900 BC)[3]	Maschner et al. 2010
Chugachik Island[1]	4220 ± 110	2	4635 ± 115 (2880–2480 BC)[3]	Workman and Zollars 2002
Ugashik Narrows	3880 ± 60	4	4515 ± 375 (3390–2050 BC)	Henn 1978; Slaughter 2005
Brooks River	3900 ± 130	9	4135 ± 210 (2310–1945 BC)	Dumond 1981; Slaughter 2005
Combined[4]				
Interior	4770 ± 260	85	4450 ± 40 (2580–2400 BC)	
Interior[2]	3961 ± 38	82	4280 ± 40 (2400–2270 BC)	
Coast	5063 ± 315	49	4960 ± 60 (3140–2910 BC)	
Coast[2]	4100 ± 40	41	4590 ± 70 (2770–2500 BC)	

1. Includes all dates but samples from same context were pooled.
2. Anomalous dates were rejected.
3. Not modeled, only calibrated.
4. Includes all ASTt dates.

Sapsuk River site XPM-098 (Maschner et al. 2010) produced the oldest calibrated date from Southwest Alaska at 4970 ± 90 but could not be modeled due to sample size. Both the Central Creek Pingo (Lobdell 1995) and Chugachik Island (Workman and Zollars 2002) sites have too few dates to model; calibrated ages are 4565 ± 180 and 4635 ± 115 cal BP.

The modeled ages for all of the ASTt sites in a coastal context versus those from the interior indicate that occupation on the coast likely began a century or more before the interior (Table 2). If we use all dates in the models, including the oldest reported from Kuzitrin Lake, Iyatayet, and Sapsuk River, coastal occupations likely began by 4960 ± 60 cal BP, while occupation of interior sites most likely did not begin until 4450 ± 40 cal BP. By discriminating and excluding contentious dates, coastal occupations likely began by 4590 ± 70 cal BP, while the interior appears to lag by about 300 years at 4280 ± 40 cal BP.

ASTt TECHNOLOGY AT CAPE ESPENBERG

While the artifact collection was limited, the recovered specimens from Cape Espenberg provide a remarkably rich assortment of ASTt stone tools. Diagnostic artifacts include burin spalls (Fig. 5a–g) and microblades (Fig. 5h–m), end blades (Fig. 6e–f), side blades (Fig. 6c), and a number of unifacially worked flake knives or scraper fragments (Fig. 6d, h). These small lithic assemblages are important for determining cultural affiliation, interpreting on-site activities, and in some cases, regional trade patterns.

One spear point tip found at KTZ-122 has straight lateral margins suggestive of a stemmed base (Fig. 6a). Stemmed-base points are known from a few Denbigh assemblages, but become common in Choris and Norton assemblages. The association of this artifact with the 3153 ± 40 ^{14}C yrs BP date may lead some to interpret this site as early Choris. The associated beaked flake tool (Fig. 6b) is also culturally ambiguous, as this tool form is known from both Denbigh and Choris contexts (Giddings and Anderson 1986). However, no pottery was found at this site or on this beach ridge, and ceramics are a major artifact class that separates Choris from Denbigh. A lack of pottery tends to support the hypothesis that the occupation was a late manifestation of the aceramic Denbigh people.

One chert side blade, exhibiting ASTt flaking patterns, was recovered from KTZ-126 (Fig. 6c). This artifact, along with two microblades (Fig. 5i, l), was found associated with a charcoal sample that dated to 3190 ± 40 ^{14}C yrs BP. Again this is a young ASTt date that would overlap with the proposed Choris age range (Anderson 1988; Harritt

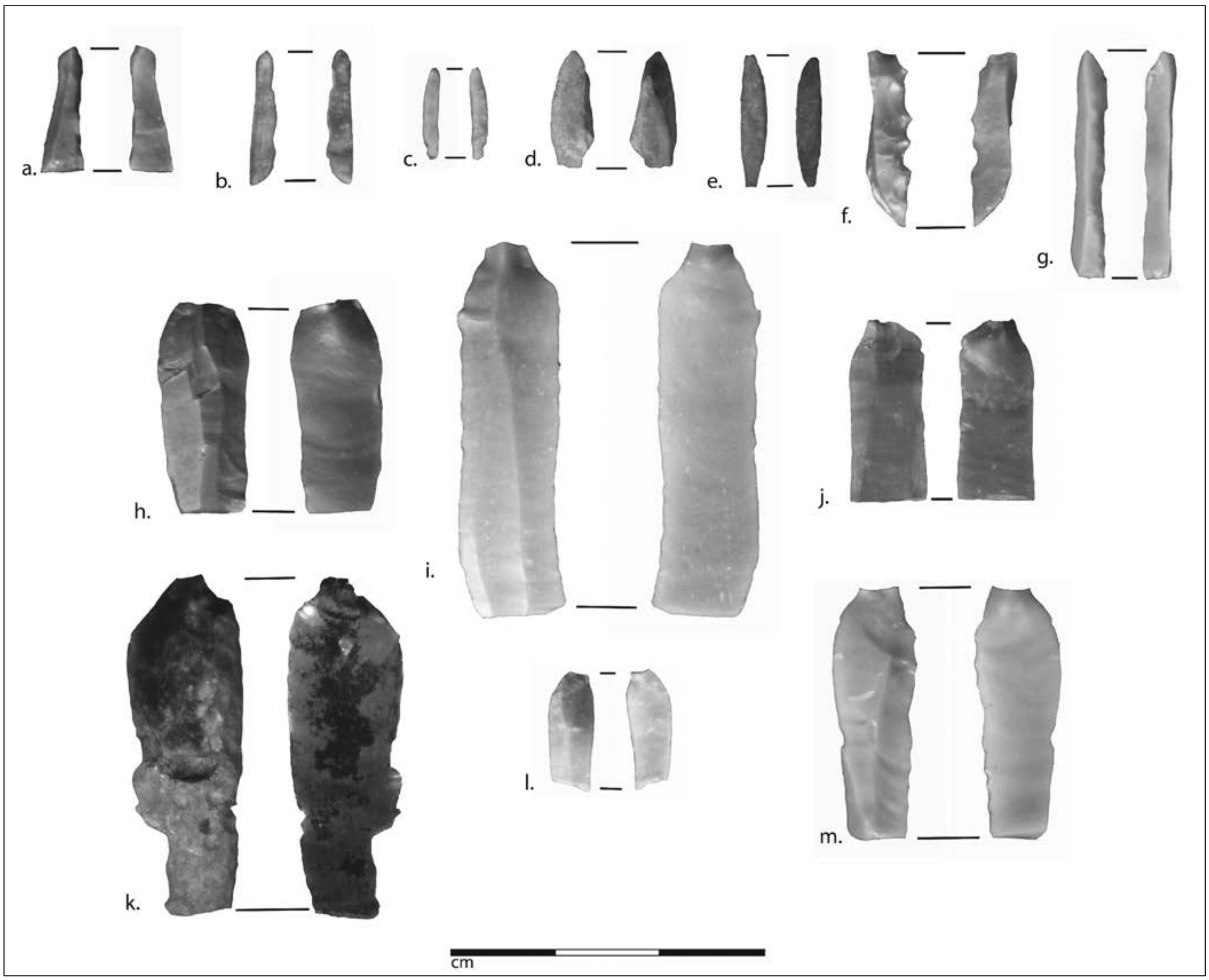

Figure 5. Burin spalls (a–g) and microblades (h–m) collected from ASTt sites at Cape Espenberg.

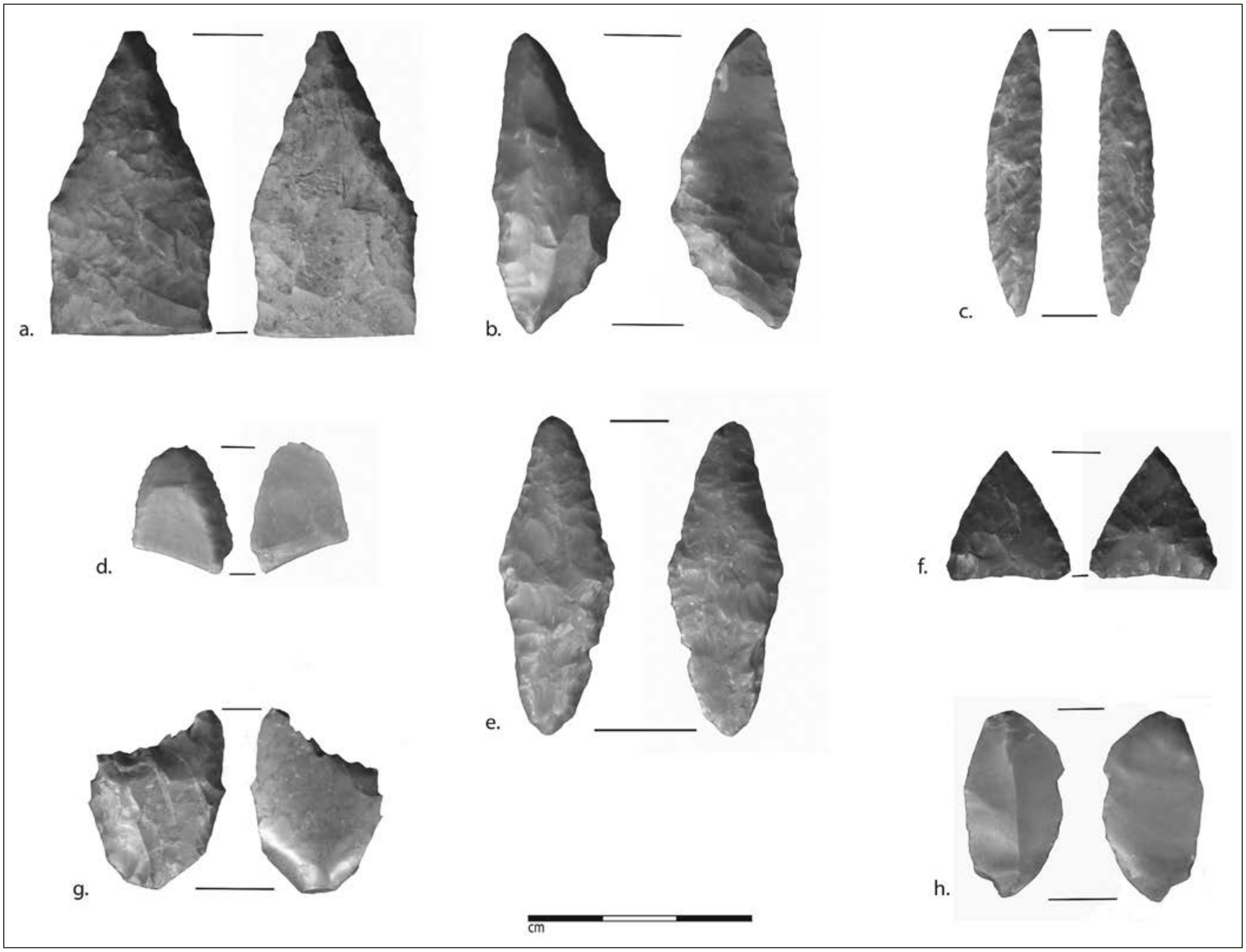

Figure 6. Formal tools recovered from ASTt sites at Cape Espenberg: (a) biface (KTZ-122); (b) flake knife (KTZ-122); (c) side blade (KTZ-126); (d) uniface (KTZ-323); (e) end blade (KTZ-325); (f) harpoon end blade (KTZ-328); (g) mitten-shaped burin (KTZ-332); (h) utilized blade (KTZ-333).

1994), but it has all the hallmarks of a Denbigh site and no sign of pottery.

Other ASTt tools found include a small, unifacially worked flake tool (Fig. 5d) from KTZ-323 associated with a microblade (Fig. 5j) and a burin spall (Fig. 5b) associated with a radiocarbon date of 3599 ± 41 ^{14}C yrs BP. KTZ-325 turned out to be one of the most important sites, as it produced the oldest radiocarbon dates associated with oil-cemented sand, seal bones, and a bipointed end blade (Fig. 6e). This end blade is not as finely flaked as other Denbigh examples but does fall within the range of variation for tools of this form (Anderson 1988:92). KTZ-328 provided possible evidence of specialized maritime technology in the form of a harpoon end blade (Fig. 6f). Triangular end blades are only known from coastal Denbigh sites (Anderson 2005:84), excepting one possible example from Kuzitrin Lake (Harritt 1994:73), located 80 km from the coast. Finally, a mitten-shaped angle burin (Fig. 6g) and a utilized blade (Fig. 6h) were recovered from two sites located near each other, KTZ-332 and KTZ-333. KTZ-333 produced a date of 3880 ±43 ^{14}C yrs BP, one of the oldest dates at Cape Espenberg, associated with an obsidian flake sourced to Krasnoye Lake Group S from Siberia (J. Rasic, pers. comm., 2015).

FAUNA AND CEMENTED SAND

At Cape Espenberg the evidence for ASTt sea mammal exploitation comes from cemented-sand nodules and three seal (Phocidae) sesamoid bones (Fig. 7). Cemented sand is thought to form through the mixing of seal oil with the sandy matrix. These concretions occur in thick deposits

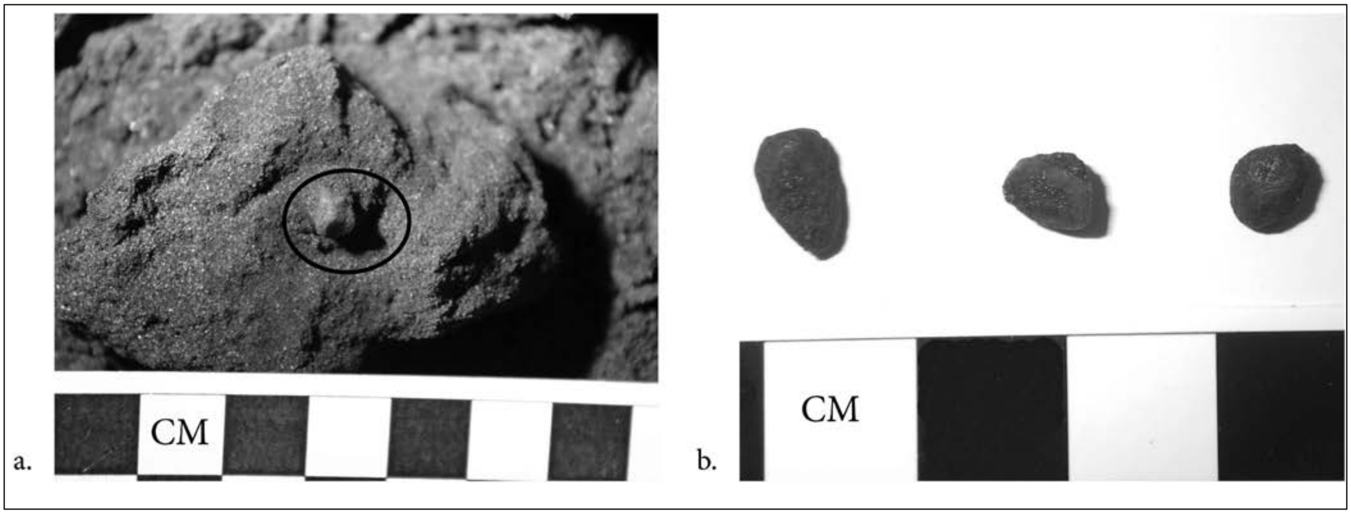

Figure 7. Seal sesamoid bone (circled) embedded in cemented sand at KTZ-325.

in Thule house kitchen areas and are commonly observed in erosional blowouts across the younger beach ridges at Cape Espenberg (Harritt 1994; Schaaf 1988).

During the UC Davis project cemented-sand samples were collected from both ASTt and Norton sites. The largest sample was discovered at KTZ-325, the oldest of the ASTt sites recorded, revealing a 6–10 cm thick deposit buried at a depth of 25 cm. The full extent of the deposit remains unknown as the test only exposed a section of it. Subsequent analysis revealed charred seal sesamoid bones, charcoal, and chert micro-debitage embedded within. Attempts were made to extract aDNA to confirm the visual identification of the bones, but they were too charred. However, Buonasera et al. (2015) used gas chromatography and compound-specific isotope analysis to demonstrate the ASTt and Norton cemented-sand samples were similar in composition to samples taken from Thule houses found on the younger ridges at Cape Espenberg. All samples were formed from marine-based fatty lipids, providing direct evidence of early ASTt sea mammal exploitation.

DISCUSSION

Analysis of radiocarbon dates indicates the oldest known ASTt settlements in Alaska are located on the coast (Table 2). Granted, the earliest modeled date is from Kuzitrin Lake, located 80 km from the coast, but this result is problematic for many reasons. The imprecision of the modeled age is due to both the small sample size ($n = 4$) and the large time gap between the two sets of dates (Fig. 8). Harritt (1998:66) considers at least one of the old dates suspect because of its large standard error and the "superposition of the older sample above the younger." Interestingly, the second "old" date has an even larger standard error but was not rejected by Harritt. Charcoal was combined to form a sample large enough to conventionally date (Harritt 1998:69). One AMS date—the most reliable from the site—produced an age of 3810 ± 85 ^{14}C years BP (ETH-7037), making Kuzitrin Lake contemporaneous with the early Cape Espenberg sites. In my opinion the oldest dates from Kuzitrin Lake should be rejected until additional work can replicate the findings using AMS dating techniques.

The second earliest age for an ASTt site comes from Iyatayet, if the oldest dates are included (Table 2); however, these are most likely erroneous (Slaughter 2005; Tremayne et al. 2015). The oldest Iyatayet dates were rejected for this study due to large standard deviations, the fact that widely varied dates were obtained from the same samples, and because the samples included "charcoal, charred twigs and mud" (Giddings 1964:245). New AMS dates from the Denbigh levels at Iyatayet failed to replicate the earliest dates (Tremayne et al. 2015). The earliest of four new AMS dates is 3717 ± 39 ^{14}C years BP (lab no. AA102990). Rejection of the problematic Iyatayet dates results in a model 1,000 years younger at 4135 ± 150 cal BP (Table 2).

While based on one date of 4390 ± 40 ^{14}C yrs BP, the third earliest possible age for an ASTt site is XPM-098 from the Sapsuk River in Southwest Alaska (Maschner et al. 2010) (Table 2). This site produced a small assemblage that possesses "widely distributed elements of the ASTt" (Maschner et al. 2010:171). However, most of the tool forms appear to be crude representations of the exquisitely crafted ASTt stone tools found in northern Alaska. Published images of artifacts (Maschner et al. 2010:122–125) lack the diagnostic ASTt flake patterns, the microblades are very crude in appearance, and burin technology is apparently absent. While data reported by Maschner et al. (2010) are highly suggestive of an early ASTt influence on the southern Alaska Peninsula, more work is needed to adequately demonstrate this.

Ignoring the problematic Kuzitrin and Iyatayet dates, while leaving open the Sapsuk River site as a possible exception, Cape Espenberg has yielded the earliest modeled date for ASTt settlement in Alaska (Fig. 8). What these results suggest, based on the data at hand, is that ASTt people radiated out of the Seward Peninsula area to colonize areas north and south along the Chukchi and Bering Sea coasts; soon thereafter, they moved up the Kobuk and Noatak rivers to settle in the Brooks Range. If the dates from Kuzitrin and Iyatayet are included, this scenario becomes more likely. The key point is that the earliest known ASTt sites in Alaska are found on the coast, both in the south and the north.

Early ASTt charcoal dates from the coast have been critiqued because of the potential for an "old wood" bias (Slaughter 2005). Most of the wood collected at Cape Espenberg and Cape Krusenstern likely originated in the Alaska interior and floated to these beaches as driftwood. While it is possible the wood sat on the beach for many decades, it is unlikely that the wood was adrift longer than a few years. According to Alix (2005), most tree species in Alaska (spruce, poplar, and birch) retain maximum buoyancy for less than two years, although wood trapped in sea ice could be decades old. Wood transported in ice tends to become damaged and fragmented, leading to more rapid decomposition once beached. The length of time wood is preserved on the beach is harder to estimate, but the time between plant death and use by humans is probably not significant. The oldest charcoal samples from KTZ-325 were tenta-

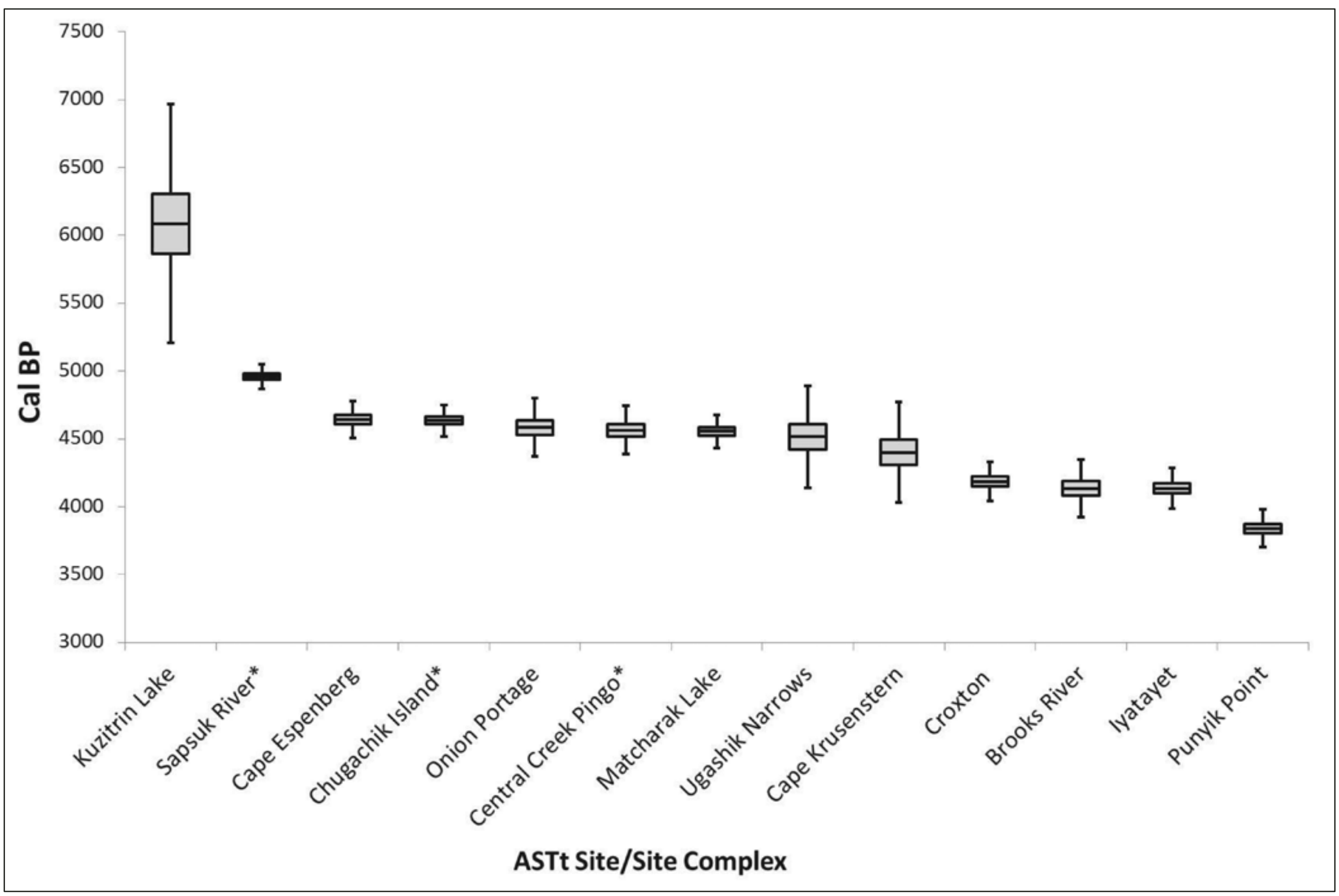

Figure 8. Box and whisker plot of the modeled start date for selected ASTt sites in Alaska. An asterisk indicates a small sample size; dates were not modeled, only calibrated.

tively identified through comparative methods to *Salix*, the short-lived willow genus.

Coastal habitation by ASTt people is not sufficient to demonstrate ASTt maritime subsistence. Empirical evidence for the exploitation of maritime resources associated with these early habitation dates is required. This survey recovered direct evidence of seal exploitation in the form of oil-soaked cemented sand, seal bones associated with an ASTt end blade, and radiocarbon ages of over 4000 ^{14}C yrs BP.

Stone tool technology is less demonstrative of a specifically maritime economy than faunal remains, but the emphasis on burin technology and inset blades does indicate persistent use of composite tools and likely some form of harpoon. The strongest evidence for specialized technology necessary for taking swimming seals is the triangular chert harpoon end blade from KTZ-328 (Fig. 6f). As noted above, this tool form is typically only found at coastal ASTt/Denbigh sites and is reminiscent of end blades from known seal hunting tool kits (Anderson 2005). If the Kuzitrin end blade (Harritt 1994:73) was indeed part of a harpoon, and the oldest dates are confirmed, an early ASTt connection to the sea would be even more secure.

If ASTt maritime adaptations originated in Alaska, rather than Asia, the earliest ASTt sites should occur in the interior and later shift to the coast. The results of this analysis support an alternative hypothesis: the ASTt colonizing population arrived from Siberia with a set of maritime skills already in place or, alternatively, developed such skills through interaction with maritime populations in Southwest Alaska and the Aleutian Islands. The most parsimonious explanation is that the colonizing population possessed maritime hunting skills sufficient to cross Bering Strait. The presence of Chukotkan obsidian at a 4,300-year-old occupation at Cape Espenberg further demonstrates a connection to Asian ASTt populations and that crossing Bering Strait was routine.

CONCLUSION

Surveys at Cape Espenberg in 2011 and 2013 discovered ten new coastal ASTt sites. Analysis of the radiocarbon dates suggests that ASTt people settled the unoccupied coastal habitats of Alaska prior to moving inland to exploit terrestrial resources. Their absence in the interior forest habitat suggests competition with other groups but also a preference for an economy that included the harvest of both maritime and terrestrial resources. This adaptation differs markedly from that of the Northern Archaic people who came before and overlapped with ASTt, but is reminiscent of subsistence and land use strategies of ethnohistoric Iñupiat in Northwest Alaska (Burch 2006:31–57). The discovery and analysis of cemented-sand deposits, some of which contained seal bones, associated with the oldest radiocarbon dates at Cape Espenberg confirms that ASTt people were on the coast to hunt maritime prey. It is still unclear how developed their maritime skills were, but they were sufficient to rapidly colonize the coastlines from southern Alaska to Greenland. If ASTt people spread from Siberia to Alaska, as is the most accepted scenario (Raghavan et al. 2014), then it would seem they invented or adopted their maritime adaptations prior to their migration into Alaska and beyond. The fact that there are ASTt dates in a coastal context in western Canada that appear older than those found in Alaska (Savelle and Dyke 2002) would seem to indicate the oldest ASTt sites in Alaska have yet to be discovered. A renewed search for ASTt origins along the Asian side of the Bering and Chukchi coasts is necessary to test these hypotheses.

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