CHRONOLOGY OF THE OCEAN BAY TRADITION ON KODIAK ISLAND, ALASKA: STRATIGRAPHIC AND RADIOCARBON ANALYSIS OF THE RICE RIDGE SITE (KOD-363)

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ABSTRACT

The Rice Ridge site provides the only known deeply stratified archaeological deposits on the Kodiak Archipelago that retain a substantial and well-preserved faunal assemblage associated with the Ocean Bay tradition. A suite of twenty-two radiocarbon dates was obtained from eleven discrete strata from the site, spanning several thousand years of the Early to Middle Holocene. Calibrated age estimates of the deposits range between about 7,600 and 4,200 years ago, corresponding with much of the Ocean Bay I and II periods. Alternating occupation surfaces and midden deposits accumulated during three discrete episodes, separated by two hiatuses of several hundred years each. Such periods of abandonment are not seen in the radiocarbon sequences of the few other well-dated Ocean Bay sites in the Kodiak Archipelago and highlight the data gaps that must be overcome to obtain a better understanding of Ocean Bay settlement and subsistence at the regional scale.

INTRODUCTION

Kodiak Island has one of the richest documented archaeological records in the North Pacific and one of the more well-established bodies of anthropological research, which provides a detailed picture of past Alutiiq lifeways extending back millennia.[1] Characterization of early Kodiak populations along the North Pacific coast remains elusive despite this record and a growing data set from which a culture historical sequence has been defined and models of settlement, subsistence, technology, and social complexity have been tested. Questions regarding the early period of the culture-historical framework persist, as well as uncertainty about the social, technological, and ecological dimensions of the people who lived here during the Early and Middle Holocene. Until recently, characterization of such dimensions during this early period on Kodiak Island, termed the Ocean Bay tradition, was limited to intensive investigation at only a few sites (Fig. 1).

Research conducted to date provides general chronological limits for the Ocean Bay tradition, defines broad patterns in its material culture and technology, and generates explanations for the evolution of social complexity on Kodiak Island (e.g., Clark 1979; Fitzhugh 2001, 2003). However, chronological data have rarely come from a fine-grained sequence of archaeological deposits at a single Ocean Bay site, and our understanding of basic parameters such as site formation processes is not at a level comparable with our knowledge of later periods spanning roughly the past 4,000 years leading up to Russian colonization. The research described here, analyzing Ocean Bay radiometric data, establishes a more detailed chronological framework well-suited for the exploration of early broad-scale land use patterns on Kodiak Island. The data set contributes to the largest aggregation of radiocarbon dates from a single Ocean Bay site, Rice Ridge (KOD-363), and is used to supplement the existing Ocean Bay chronology.

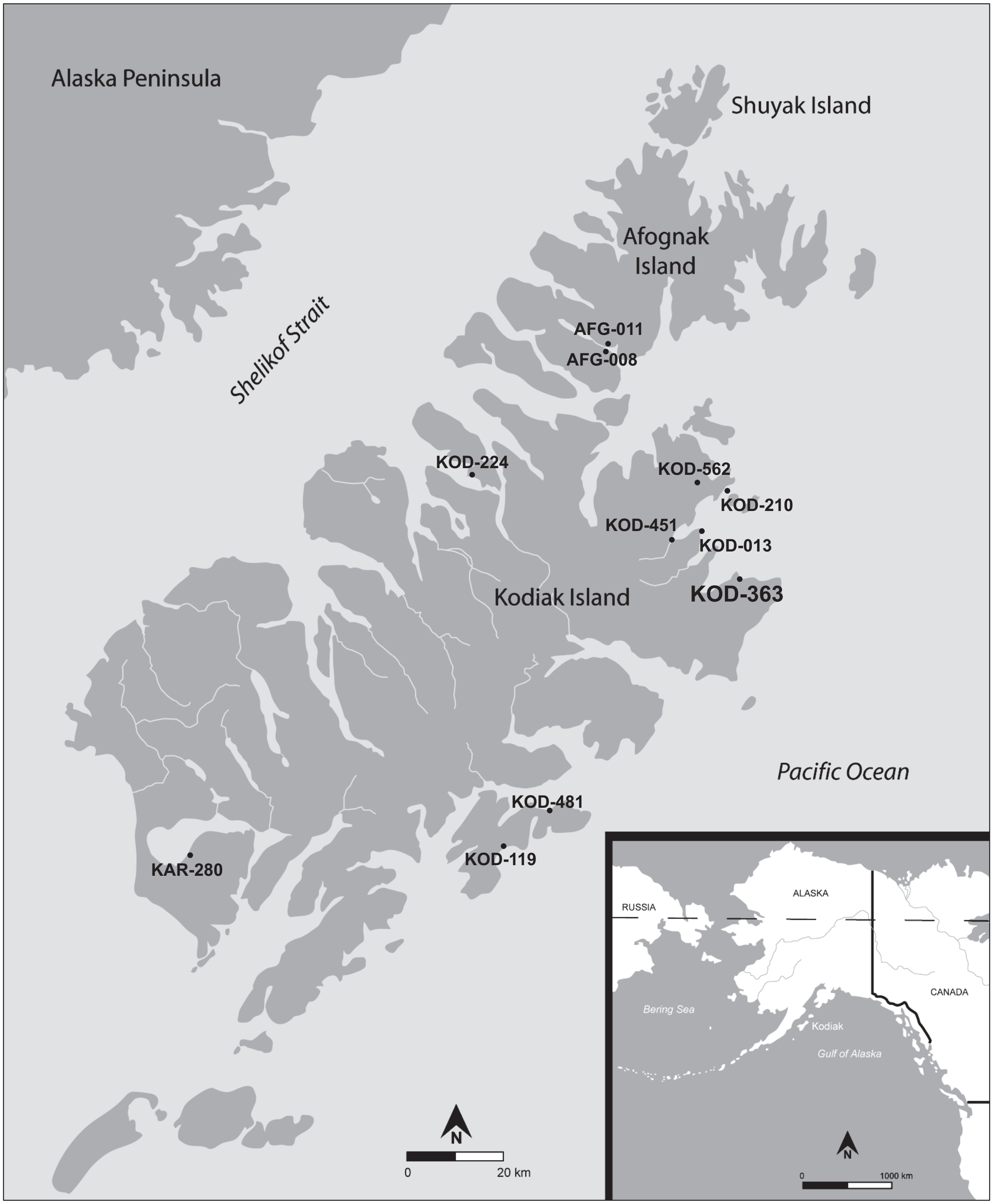

Figure 1. Kodiak Island, the Rice Ridge site, and other sites listed in Table 1. Base map courtesy Alutiiq Museum, Kodiak.

THE OCEAN BAY TRADITION

Early speculative attempts to create a culture history of the Kodiak Archipelago split prehistory into two periods manifested in the archaeological record: the Pre-Koniag and Koniag cultures (Hrdlička 1944:335–336). A more nuanced picture of the precontact history of Kodiak began to emerge in the 1960s as part of the University of Wisconsin's Aleut-Konyag Project (Laughlin and Reeder 1966), a trajectory that continued into the 1970s as participants in that project surveyed and tested more of the Kodiak Archipelago's rugged coastline and additional investigations began on behalf of government agencies (Clark 1984:136).

Donald Clark was the first researcher to identify a technological complex and archaeological deposits predating Hrdlička's two successive culture-historical periods, by that time termed the Kachemak and Koniag traditions (Clark 1979, 2001:106–107). He first encountered the distinctive chipped stone artifact assemblages characteristic of the Ocean Bay tradition in 1961 on Sitkalidak Island off the southeast shore of Kodiak Island, as well as a separate component dominated by incipient ground slate technology, in a road-cut (KOD-119) through an old beach ridge of the bay after which the period is named. A follow-up investigation in 1971 along the Afognak River on Afognak Island yielded similar assemblages of chert and slate artifacts at the Chert (AFG-008) and Slate (AFG-011) sites. Radiocarbon dating and relative dating based on tephra correlations between sites allowed a preliminary chronology of the two periods. The earlier Ocean Bay I (OBI) deposits were characterized almost exclusively by chipped cryptocrystalline silicate (CCS) artifacts and some assemblages with microblades and yielded a range of uncalibrated radiocarbon age estimates between about 6000 and 4000 RCYBP. The later Ocean Bay II (OBII) deposits were characterized by fewer chipped stone artifacts and an abundance of sawn and snapped slate, yielding uncalibrated age estimates between about 4500 and 3900 RCYBP (Table 1; Clark 1979:42–43).[2] It was also during this period of archaeological research that affinities were first recognized between the Ocean Bay tradition of the

Table 1. Ocean Bay components identified in the Kodiak Archipelago

Site #	Site Name	Ocean Bay Components	Primary Reference	Uncalibrated Dates for Ocean Bay Components (RCYBP)
AFG-008	Chert Site	OBI	Clark 1979	5750 ± 240 (base of site) 4150 ± 200 (Late OBI)
AFG-011	Slate Site	OBII	Clark 1979	4480 ± 160 (base of site) 4200 ± 140 (base of site) 4475 ± 125 (lower strata) 3890 ± 110 (upper strata)
KAR-280	Qus'ituq	OBII	Saltonstall and Steffian 2007	4740 ± 40 (lowest layer)
KOD-119	Sitkalidak Roadcut	OBI/II	Clark 1979	5503 ± 78 (base of OBI component) 3929 ± 65 (OBII component)
KOD-224	Uganik Passage	OBI	Nowak 1978	6220 ± 70 (base of site) 5065 ± 135 (upper strata)
KOD-210	Blisky Site	OBII	Steffian et al. 1998	No radiocarbon dates for earliest component, attributed to OBII based on artifact assemblage
KOD-013	Zaimka Mound	OBI/II	Steffian et al. 2002, 2006	Seven dates on OBI components between 6390 ± 70 and 5360 ± 60; Three dates on OBII components between 4540 ± 180 and 4350 ± 70
KOD-481	Tanginak Spring	OBI	Fitzhugh 2003, 2004	Twenty dates between 6600 ± 230 and 5370 ± 60
KOD-363	Rice Ridge	OBI/II	Hausler-Knecht 1993; Kopperl 2003	See Table 3
KOD-562	Array Site	OBII	Steffian et al. 2006	No radiocarbon dates for earliest component, attributed to OBII based on artifact assemblage

Kodiak Archipelago and relatively early archaeological components identified on the Alaska Peninsula mainland across Shelikof Strait to the west, as well as on the southern Kenai Peninsula to the north (e.g., Clark 1977; Workman 1998). Similarities have also been highlighted between Ocean Bay lithic technology and the early archaeological record of the Anangula Phase of the eastern Aleutian Islands dating from about 9,000 to 4,000 years ago, specifically the use of blades and microblades in slotted bone points (e.g., Davis and Knecht 2010:515) and architectural features (Rogers 2011:106–107).

Since the 1970s, excavations at several sites in the vicinity of Chiniak Bay on northeast Kodiak Island (Hausler-Knecht 1990, 1991, 1993; Steffian et al. 2006) and on Sitkalidak Island on the southeastern side of Kodiak (Fitzhugh 2003) have filled important gaps in our knowledge of Ocean Bay subsistence and settlement patterns. The growing body of data available for the Ocean Bay tradition has both reinforced and added detail to Clark's culture-historical scheme for the period, spanning an interval of time from first human colonization before 7,500 years ago to approximately 3,700 years ago. The transition between Ocean Bay I and Ocean Bay II is most clearly marked by the change from reliance on chipped stone technology to ground slate technology that occurred approximately 5,000 years ago. During the Ocean Bay tradition, the Kodiak population expanded across the archipelago, settling in locations ideal for obtaining resources such as sea mammals, marine fish, salmon, and birds.

For much of the OBI phase, populations probably consisted of small but growing residentially mobile groups, inferred from the small size and thin deposits that characterize most excavated OBI components (Clark 1979; Fitzhugh 2002, 2003, 2004; Steffian et al. 2002). Known locations of Ocean Bay sites in the archipelago reflect a focus on places where hunter-gatherers could most easily access sea mammal haul-outs and rookeries and marine fish habitats along the coast from primary residential camps (Fitzhugh 2002). Whale bone found throughout the occupation sequence at the Rice Ridge site may indicate open-water whale hunting but may also reflect opportunistic processing of beached whales (Kopperl 2003:56). Excavated OBII components have yielded more complex deposits that occasionally include thick middens, post-hole features, and housepit depressions suggesting more substantial dwellings and settlement patterns that favored particular places on the landscape (Fitzhugh 2002; Hausler-Knecht 1993; Steffian et al. 2006). It is not until the subsequent Kachemak tradition, however, that the means of harvesting, processing, and storing surplus food resources were established (Steffian et al. 2006).

Even without organic preservation, several Ocean Bay sites provide a diverse picture of site types and settlement patterns during the Ocean Bay period. The Tanginak Spring site (KOD-481) has yielded some of the oldest radiocarbon dates in the archipelago situated within one of the most extensive and fine-grained Ocean Bay date sequences and is associated with a very large assemblage of OBI chipped stone artifacts from deposits almost a meter and a half thick (Fitzhugh 1996, 2003, 2004). Like Tanginak Spring, the Blisky (KOD-210) and Zaimka Mound (KOD-013) deposits on the shore of Chiniak Bay have survived to the present by fortuitous tectonic uplifting. Excavation at the Blisky Site uncovered an OBII component suggesting a small, seasonally restricted camp where people engaged in a limited range of hunting and processing activities (Steffian et al. 1998). Excavation of the deepest Ocean Bay strata at Zaimka Mound encountered thin layers of red ochre and a simple arrangement of post holes and a hearth, along with chipped stone tools, microblades, and a boat-shaped oil lamp also typical of the time period (Steffian et al. 2006). A small volume of deposits was excavated at the Array Site (KOD-562), located several kilometers upstream from Chiniak Bay near the outlet of Buskin Lake, and an assemblage dominated by large OBII slate bayonets was recovered, suggesting at least some use of inland riverine environments later in the Ocean Bay period for hunting or spear-fishing (Saltonstall and Steffian 2007; Steffian et al. 2006).

Research aimed at dating Ocean Bay components offers the potential to explore diachronic change in various aspects of early Alutiiq lifeways. Relative to other known Ocean Bay sites, the Rice Ridge site is exceptionally well-suited for such research, both because its components span the Ocean Bay I and II phases and because its excellent faunal preservation is extraordinarily rare for deposits of this age, including a very large assemblage of both modified and unmodified bone (Hausler-Knecht 1991, 1993).[3] During analysis and interpretation of mammal and fish remains from the site (Kopperl 2003), several critical questions were addressed regarding the chronology and basic site formation history of Rice Ridge. First, could faunal remains from the existing collections be aggregated into meaningful analytic units by stratigraphic differentiation? Second, was faunal deposition at the site a continuous or punctuated process, and is this reflected by the available analytic units? And third, under the assumption that this deep, well-stratified site is a product of periods of greater and lesser occupation intensity, what factors may account for such changes?

THE RICE RIDGE SITE

The Rice Ridge site represents a relatively large occupation based on the thickness and horizontal extent of its deposits, which span the Ocean Bay I and II phases and have yielded one of the largest well-preserved faunal assemblages dating to this early time (Hausler-Knecht 1993; Knecht 1995:32–33). These deposits, over two meters thick in some places, are situated atop a ridge of land that formerly extended into Chiniak Bay, in the lee of a small nearshore island, during the middle Holocene (Fig. 2). Today, however, the site is located over 300 meters inland from the present coastline and about four meters above sea level because of tectonic uplift (Hausler-Knecht 1991:1). During much of the period of time that Rice Ridge was occupied, relative sea level was much higher than at present (Crowell and Mann 1996). Chiniak Bay is a very biologically productive place in the Kodiak Archipelago and probably has been for much of the Holocene, based on the relative density and time depth of many archaeological sites on the bay. Today, nearby subsistence resource microhabitats available within a five-kilometer radius include small streams with runs of pink salmon, seal and sea lion haul-outs, rocky and sandy nearshore environments providing marine fish and sea mammals, and a variety of littoral environments with abundant shellfish beds and marine birds. At greater distances are a large sea lion rookery at Cape Chiniak east of Rice Ridge and larger rivers, such as the Olds River at the head of Kalsin Bay west of the site, which provide significant runs of pink, coho, and chum salmon (NOAA 1997). However, physiographic changes in the local environment caused by various geomorphological processes have undoubtedly changed the microhabitats and harvestable prey located in the proximity of Rice Ridge (e.g., Gilpin 1995).

Between 1988 and 1990, archaeological excavation units were dug, clustered in several blocks and concentrations across an area of at least three acres, as part of the dissertation research of a Harvard University anthropology graduate student (Hausler-Knecht 1990, 1991, 1993:10). In the first two field seasons, a four-by-six meter block of two-meter-square units was excavated, centered on the ridge and extending northward from an initial two-meter-square test unit. These units contained cultural deposits an average of 2.5 meters thick, separable into at least eleven distinct strata containing abundant artifacts, faunal remains, and charcoal. Artifacts and faunal remains were recovered by hand during excavation, both *in situ* by natural stratigraphic layers and from ¼"-mesh screened spoils from each stratum (Hausler-Knecht 1991). The third field season in 1990 resulted in excavation of a four-by-six-meter block in the southwest corner of the site, as well as several noncontiguous test units in the northwest corner, exploring later OBII and Early Kachemak deposits. Almost no site documentation is available from this excavation, although a schematic map was produced (Hausler-Knecht 1990). Fig. 2 was adapted from this map and verified by a site visit by the author in the summer of 2003, guided by landowners Dale and Marie Rice. Excavation Units 2, 3, 5, and 6 from the 1988–1989 block excavation were the focus of this analysis. They provided the largest faunal sample representing the greatest span of time within the site, based on earlier estimates from a limited radiocarbon chronology and artifact typology to be about 2,500 years, including both the OBI and OBII periods.

RICE RIDGE STRATIGRAPHY

The stratigraphy of the excavation units was inferred primarily from narrative descriptions of the deposits written on what were designated "level bags"[4] of faunal remains collected during excavation, as well as from personal communications in 2001, 2002, and 2012 with Donald Clark, one of the excavators of the site. General descriptions of the depositional stratigraphy of the 1988–1989 excavation block were gleaned from Hausler-Knecht (1991); Photographs of the fieldwork corroborate that the excavation block stratigraphy was undisturbed below the 1912 Katmai ash and generally sequential in vertical orientation (Fig. 3). Despite the near-absence of synthetic stratigraphic information for the excavation, precisely recorded provenience information was written on each bag of faunal remains, including depth below datum (cm bd) as well as color, texture, and content characteristics of the deposits from which the faunal remains came. Cases where stratigraphically recent deposits cut into relatively older ones were clearly noted on the bags. Eleven sequential stratigraphic units, designated A through K, were derived from this information and developed as stratigraphic profiles (Kopperl 2003:122–125). The term "floor" is used here to denote strata interpreted as occupation surfaces that often

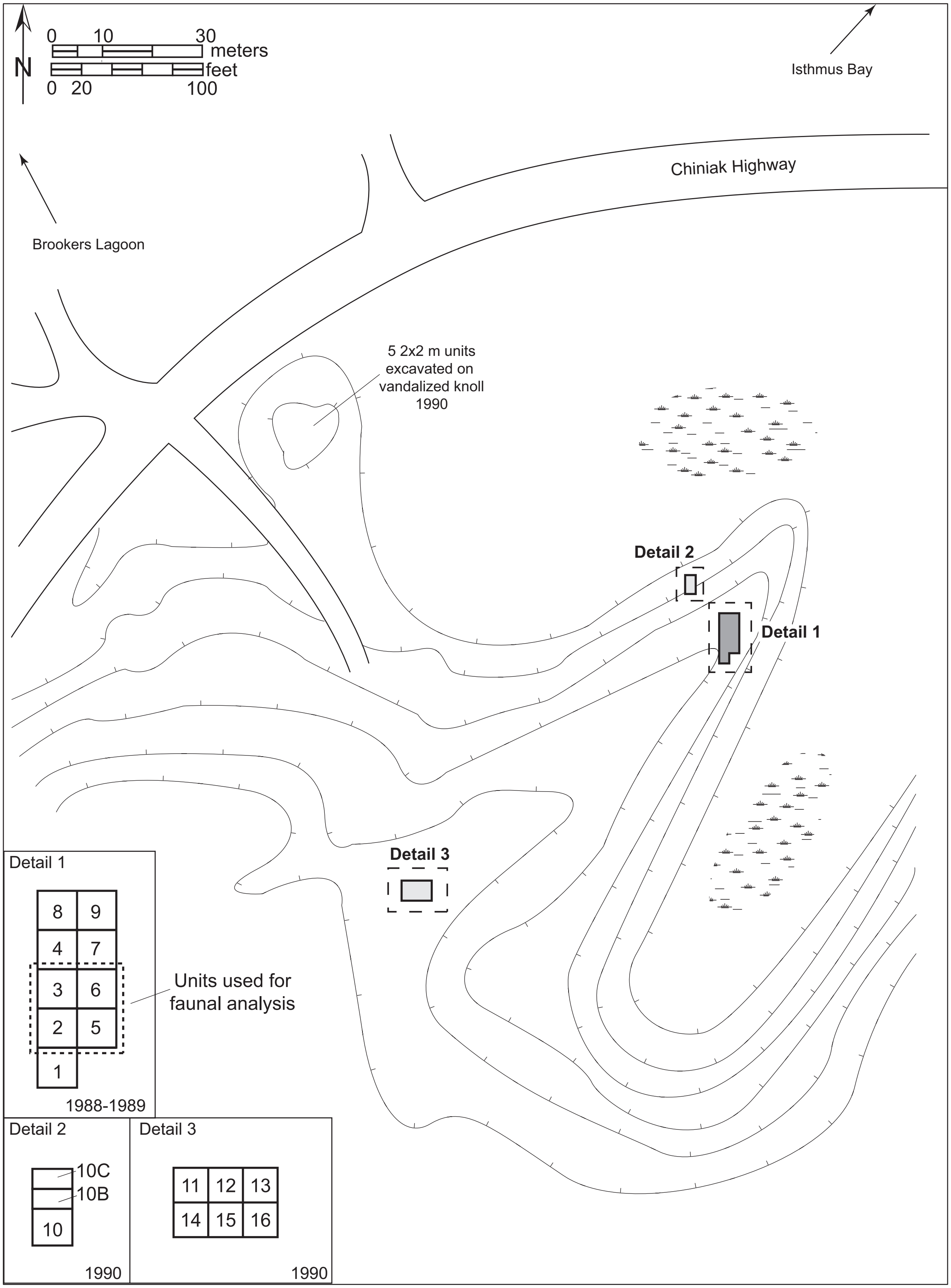

Figure 2. Sketch map of the Rice Ridge site. Insets show configurations of excavation units. Adapted from Hausler-Knecht (1990) and Kopperl (2003:121).

Figure 3. Don Clark excavating in the 1988–1989 block at Rice Ridge. Note 1912 Katmai ash layer visible as the distinct light-colored stratum at the top of the profile. Photo courtesy of Elizabeth Odell.

contained hearths and other features (Fig. 4), as opposed to midden strata, and does not connote an association with a particular kind of structure or house.

Table 2 summarizes the stratigraphy of faunal-bearing deposits from Excavation Units 2, 3, 5, and 6, describing the eleven strata that comprise these units. The June 6, 1912, Novarupta pyroclastic event on the Alaska Peninsula blanketed most of northern Kodiak Island with 30 to 60 cm of "Katmai" ash (Griggs 1922), which formed a protective cap over the archaeological deposits at Rice Ridge. Below the Katmai ash and above the archaeological deposits are 40 to 60 cm-thick bands of culturally sterile deposits, representing postabandonment sedimentation and soil development prior to the 1912 ashfall. The uppermost archaeological stratum is a layer of black, organic-rich sediment that includes loose rubble, occasional thin bands of shell, and faunal material. Designated Stratum A, it is found across all four excavation units under consideration and represents the terminal cultural midden deposit in this area of the Rice Ridge site. Stratum designation proceeds from A to K with increasing depth. Excavation in all four units was terminated at an orange tephra, thought at the time of excavation to be a weathered volcanic ash deposited shortly after glaciation and before human occupation. The stratigraphic sequence characterizing each unit is shown schematically in Fig. 5.

Radiocarbon dating of this sequence, discussed below, indicates that deposition occurred in three discrete episodes. To avoid confusion with either the lettered alphabetical stratigraphic sequence (A–K) or the culture-historical division between the earlier and later Ocean Bay phases using Roman numerals (OBI and OBII), the stratigraphic aggregates are referred to here as Early, Middle, and Late portions of the Rice Ridge sequence,

Figure 4. Molly and Kelly Odell observe Philomena Hausler-Knecht excavating a feature within the 1988–1989 block at Rice Ridge; Don Clark in background. Photo courtesy of Elizabeth Odell.

Table 2. *Stratigraphic summary of Rice Ridge deposits sampled for faunal analysis.*

Stratum	Units	Disposal Context	Description
Katmai Ash	2, 3, 5, 6	postdeposition	Ash fall from Novarupta eruption
overburden	2, 3, 5, 6	postdeposition	Natural deposition and soil development
A	2, 3, 5, 6	midden	Black, organic-rich sediment with loose rubble and shell bands
B	3, 5, 6	floor	Charcoal and red ochre-banded occupation surfaces with hearth and pit features
C	2, 3	midden	Mixed rocky/clay sediment with shell flecks
D	3, 5, 6	floor	Red ochre-stained occupation surface
E	2, 3, 5, 6	midden	Shell midden mixed with brown weathered ash
F	3, 5, 6	floor	Red ochre surface with “cooking pit” features
G	3, 5, 6	midden	Pebbly, brown weathered ash with small pockets of shell midden fill
H	2, 5, 6	midden	Dense shell midden and some grayish-brown ashy and rocky matrix
I	2, 5, 6	floor	Red ochre-stained occupation layer with charcoal and several gravel-filled pit features
J	2, 3, 5, 6	midden	Fairly compact tan weathered ash and fragmented bone, shell, and charcoal
K	5, 6	floor	Red ochre and black charcoal-rich occupation floor; basal cultural layer
sterile	2, 3, 5, 6		Culturally sterile orange tephra

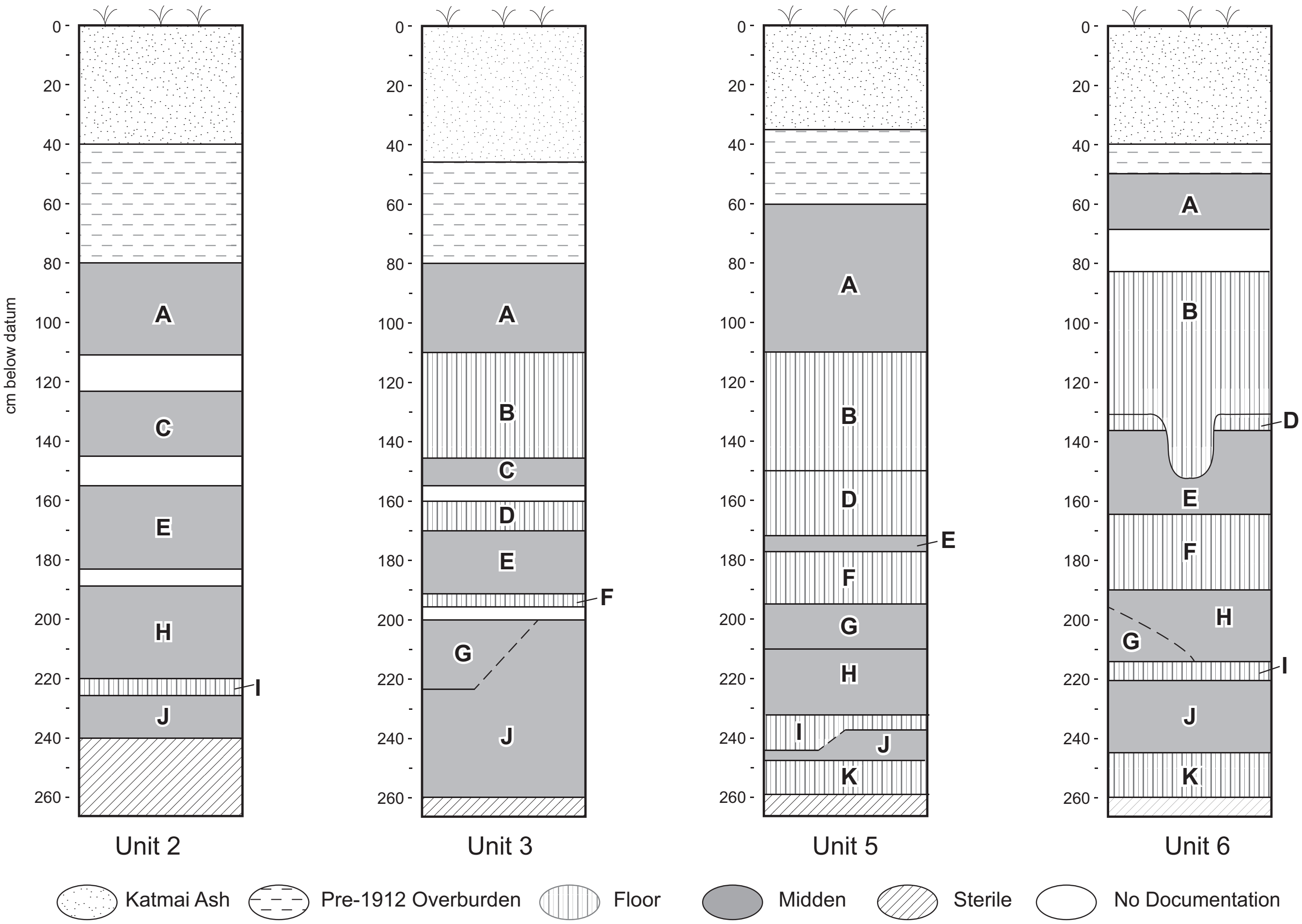

Figure 5. Schematic stratigraphic sequence of floor and midden deposits in excavation units 2, 3, 5, and 6. Adapted from Kopperl (2003:122–125).

corresponding with Strata G–K, Strata C–F, and Strata A and B, respectively.

RICE RIDGE RADIOCARBON CHRONOLOGY

Bulk sample bags from the Rice Ridge excavation curated at the Alutiiq Museum were examined for datable charcoal. From these bags, twenty-two charcoal samples were submitted to Beta Analytic in September 2002 for radiocarbon dating to establish absolute chronological control of the stratigraphic sequence identified in excavation units 2, 3, 5, and 6 and to clarify their depositional history. The plant taxa of the charcoal specimens were not identified prior to radiocarbon analysis, but small-diameter branch and twig wood was isolated for each sample bag to minimize interpretive problems resulting from the dating of old wood (e.g., Shaw 2008; Tennessen 2000; West 2011). Charcoal suitable for radiocarbon analysis was submitted from all strata except E.

The resulting dates are listed in Table 3, along with five dates previously acquired during the active field project (Hausler-Knecht 1991, 1993; Mills 1994). Focusing on small-diameter twig wood resulted in low quantities of carbon extracted from over half of the specimens, necessitating AMS dating or, in a few cases, extended counting. Probabilistic age measurements for all radiocarbon dates are shown in Fig. 6, created using OxCal 4.1 (Bronk Ramsey 2009) and calibrated using the IntCal09 curve (Reimer et al. 2009). 1σ probability intervals are indicated by the accompanying bars. Stratigraphic association for each date is indicated where such information is available, and the Early, Middle, and Late aggregated units are separated by lines. Although age estimates for the previously submitted samples are included, their stratigraphic position is fitted into the sequence based on their age estimates alone, owing to a paucity of fine-grained provenience information.

The measured radiocarbon age estimates of the samples do not proceed unidirectionally through time up the sequence of lithostratigraphic units. This is not surprising, given the reuse of this location within the site for both concentrated disposal (midden) and occupation (floor) at different times. Visual inspection and statistical evaluation of the September 2002 dates, however, indicate that most of the apparent reversals may be mere artifacts of measurement error and therefore that the sequence of strata is chronologically consistent (Brown 2012 and pers. comm.). Importantly, the strongest statistical evidence for stratigraphic integrity obtains when the database of ages is divided into subsets according to the Early–Middle–Late stratigraphic scheme defined above. Only Beta-171560, from Stratum A, is significantly older than the remaining three dates from Strata A and B.

The overall time frame of occupation for this portion of Rice Ridge thus begins possibly as early as 6000 cal BC and ends by about 2100 cal BC when considering the 2σ limits of the dates within the sequence, generally conforming to the established time-frame of the entire Ocean Bay tradition. However, accumulation of cultural deposits in this

Table 3. Rice Ridge (KOD-363) radiocarbon dates

Sample #	Date (RCYBP)	Calibrated Range, 1σ (BC)	Calibrated Range, 2σ (BC)	Site Context/Stratum (Dating Method)
Dates obtained from samples submitted during and shortly after excavation (Hausler-Knecht 1991; Mills 1994)				
Beta-43135	3850 ± 80	2458–2206	2563–2043	Ocean Bay II Layer, 1990 block
Beta-43134	3860 ± 90	2464–2206	2570–2040	Ocean Bay II Layer, 1988–1989 block
Beta-26230	4310 ± 60	3012–2886	3262–2703	Ocean Bay II Layer, 1988–1989 block
GX-14674	5030 ± 250	4225–3528	4438–3117	Hearth outside structure, Ocean Bay I Layer
GX-14673	6180 ± 305	5466–4793	5665–4403	Ocean Bay I Layer
New Dates				
Beta-171559	3900 ± 70	2475–2245	2571–2150	A—Charcoal lens in midden, 80 cm bd (standard)
Beta-171560	4310 ± 80	3090–2873	3327–2668	A—Sample from trench, 87 cm bd (ext. count)
Beta-171564	4100 ± 70	2860–2505	2877–2489	A—145 cm bd in pit (standard)
Beta-171561	3930 ± 80	2563–2296	2831–2146	B—Occupation layer hearth, 112 cm bd (ext. count)
Beta-171562	5070 ± 40	3946–3802	3963–3779	C—Base of midden/above ochre, 160 cm bd (AMS)
Beta-171563	5130 ± 40	3980–3811	4037–3800	D—Between ochre floor layers, 170 cm bd (AMS)
Beta-171565	4960 ± 110	3935–3645	3981–3521	F—Base of ochre floor, 189 cm bd (ext. count)
Beta-171566	6050 ± 40	5003–4854	5055–4837	G—Charcoal-stained ashy midden, 215 cm bd (AMS)
Beta-171567	5990 ± 60	4945–4797	5020–4725	G—Charcoal-stained ashy midden, 203 cm bd (AMS)
Beta-171568	6090 ± 150	5212–4843	5368–4619	H—Charcoal layer in midden, 205 cm bd (ext. count)
Beta-171569	5980 ± 40	4932–4802	4988–4750	H—Loose fill layer in midden, 204 cm bd (AMS)
Beta-171570	5970 ± 40	4907–4795	4953–4729	I—Midden fill on floor, 235 cm bd (AMS)
Beta-171571	6060 ± 50	5035–4855	5206–4803	I—Mottled ash and charcoal lens, 219 cm bd (AMS)
Beta-171572	6040 ± 40	4996–4853	5048–4810	I—Red ochre floor w/ pit features, 237 cm bd (AMS)
Beta-171573	5970 ± 50	4932–4793	4982–4726	J—Brown/tan ashy midden, 225 cm bd (AMS)
Beta-171574	6020 ± 100	5047–4790	5212–4709	J—Tan/clayey midden, 214 cm bd (standard)
Beta-171575	5990 ± 40	4936–4809	4991–4786	J—Tan/clayey midden, 234 cm bd (AMS)
Beta-171576	6580 ± 220	5715–5319	5974–5048	J—Shell band in tan midden, 216 cm bd (ext. count)
Beta-171577	6040 ± 50	5000–4849	5193–4796	J—Tan/clayey midden, 225 cm bd (AMS)
Beta-171578	6080 ± 90	5205–4848	5287–4778	K—250 cm bd (ext. count)
Beta-171579	6140 ± 60	5207–5004	5289–4859	K—Charcoal-stained floor, 252 cm bd (standard)
Beta-171580	5900 ± 60	4841–4709	4936–4615	K—Organic stain in tephra layer, 256 cm bd (AMS)

Calibrated using Calib 6.1.0 and IntCal09 (Reimer et al. 2009; Stuiver and Reimer 1993).

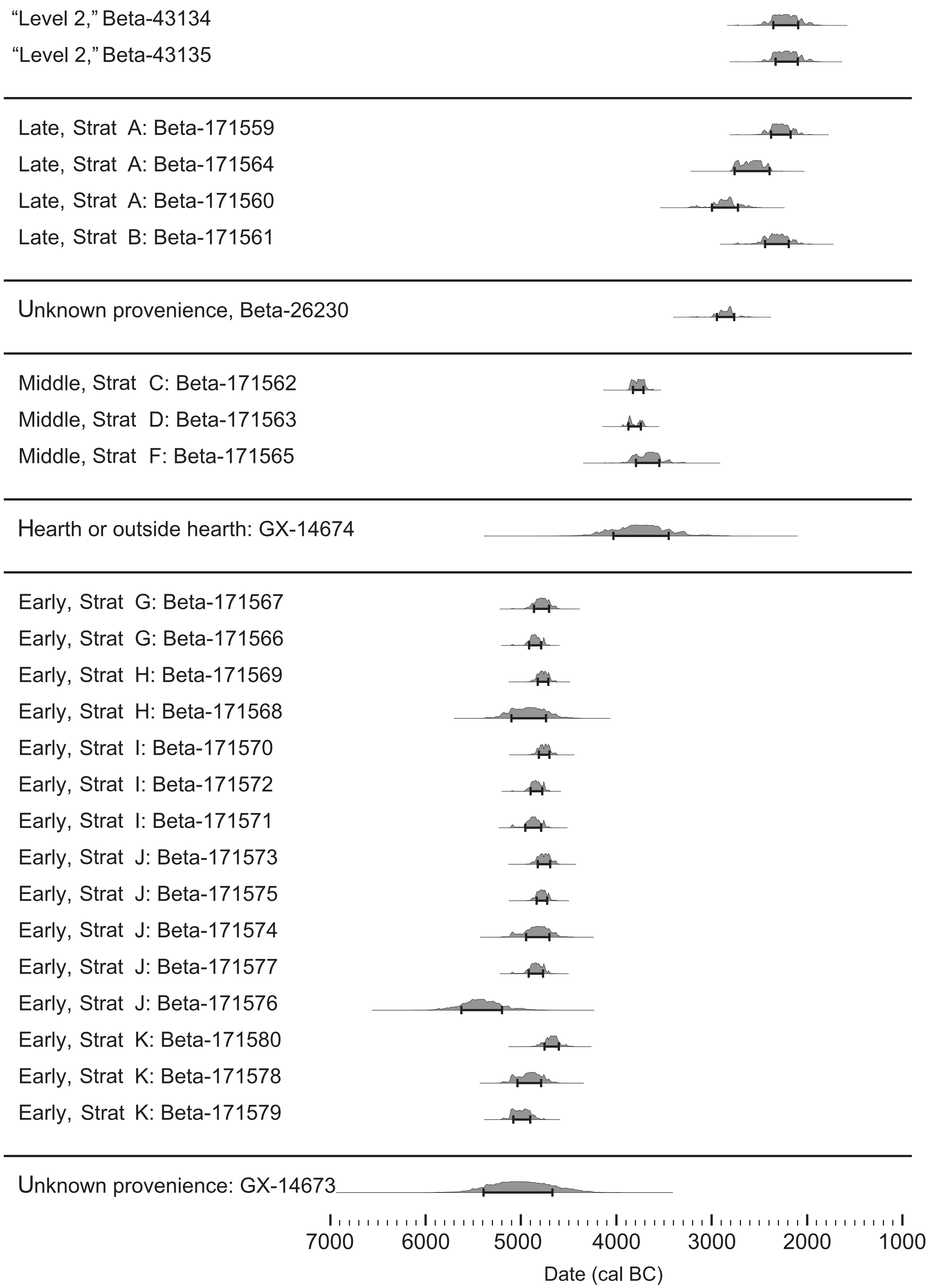

Figure 6. Calibrated age-estimate curves of radiocarbon dates acquired from the Rice Ridge site. Curves adapted from data generated by OxCal 4.1 (Bronk Ramsey 2009).

location appears punctuated, with superimposed midden and floor strata sequentially deposited during three discrete episodes, the first two spanning intervals of no more than a few hundred years each, the latest lasting perhaps somewhat longer. These three episodes are separated by gaps of several hundred years. While calibrated intercepts as point-specific age estimates can be misleading when considered singly (Telford et al. 2004), in the aggregate the pattern still affords a relatively straightforward means of exploring accumulation rates (Stein et al. 2003).

Fig. 7 illustrates weighted means of calibrated dates using OxCal 4.1 (Bronk Ramsey 2009) and the IntCal09 curve (Reimer et al. 2009). Within the Early strata, G through K, 53 cm of deposits accumulated in approximately 314 years between 5091 and 4777 cal BC if the anomalously old date from Stratum J (Beta-171576) is omitted, implying an accumulation rate of about 0.17 cm/year. Weighted means of calibrated age estimates within the Middle strata, C through F, range between 3908 and 3770 cal BC, at depths between 189 and 160 cm below datum, which implies an average accumulation rate of about 0.21 cm/year. The third group of weighted means, between 2960 and 2374 cal BC within deposits approximately 65 cm thick, suggests an accumulation rate of about 0.11 cm/year. In sum, the rate of deposition at Rice Ridge accelerated as represented by the Middle strata relative to the Early strata, and then substantially decreased for the Late strata.

IMPLICATIONS OF THE RICE RIDGE DATA

The initial research questions identified earlier regarding the depositional history and occupation span of the Rice Ridge site are successfully addressed with the chronometric and depth data described in the preceding section. These data suggest that the Rice Ridge deposits represent human occupation between about 7,600 and 4,200 years ago, corresponding with most of the age range conventionally defined for the Ocean Bay tradition. The eleven stratigraphically discrete units defined by this analysis provide a diachronic sequence spanning the major technological shift between Ocean Bay I and II, though in a punctuated

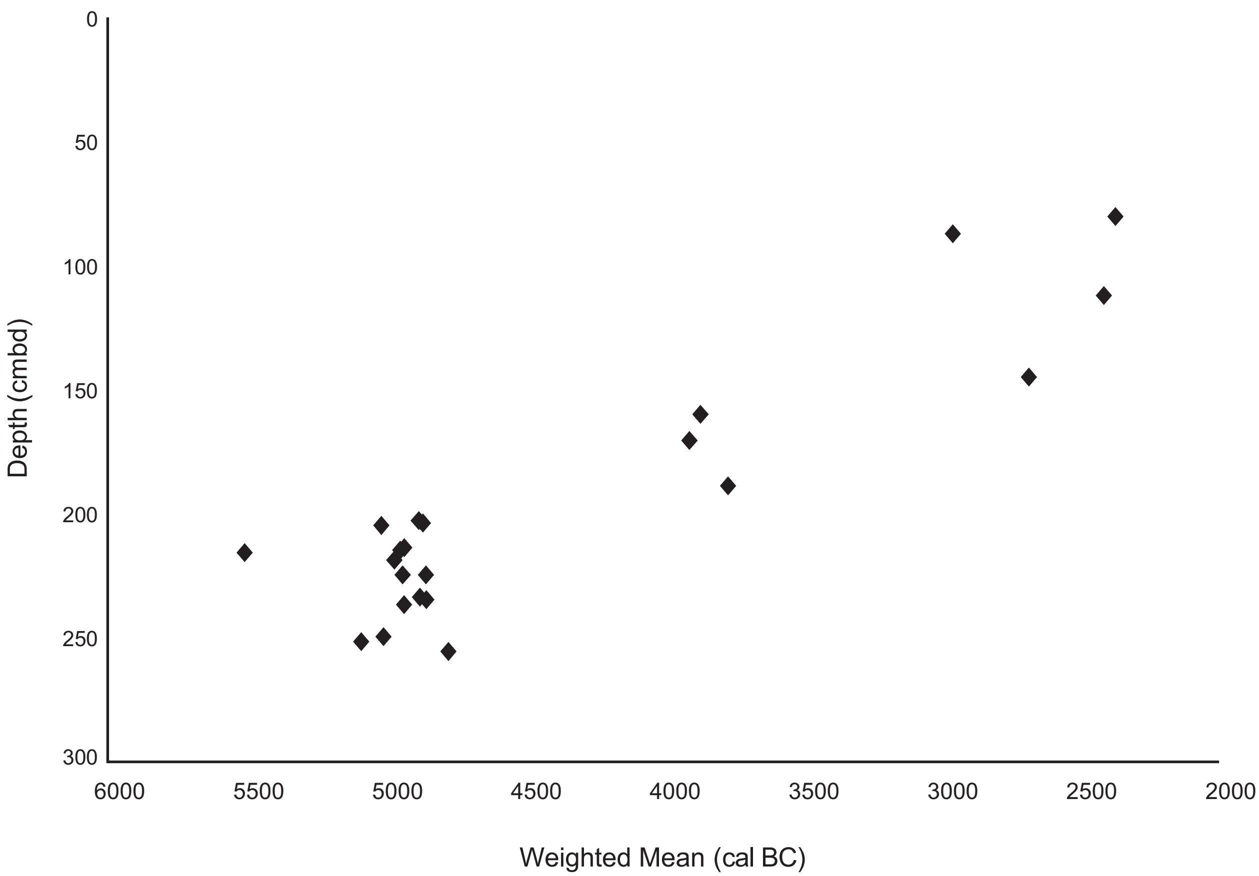

Figure 7. Scatterplot of weighted means of calibrated 2002 radiocarbon dates from Rice Ridge excavation units 2, 3, 5, and 6. Adapted from Kopperl (2003:126); reanalyzed with OxCal 4.1 (Bronk Ramsey 2009).

rather than continuous manner, divided between three discrete periods—Early (ca. 5700–4700 cal BC), Middle (ca. 3950–3650 cal BC), and Late (ca. 3100–2250 cal BC)—with consecutive episodes separated by hiatuses of several hundred years. The radiocarbon dates from the Early and Middle Rice Ridge deposits correspond with the Ocean Bay I period, and they accumulated at a faster pace than the Late deposits that correspond with the Ocean Bay II period. Concomitant changes in artifact assemblage composition are expected that reflect technological differences between these two Ocean Bay periods—for example, the dramatic shift away from chipped stone tools, notably microblades, towards ground stone tools (cf. Steffian et al. 2002; Steffian and Saltonstall 2005).

The depositional hiatuses observed for this location within the site may be explained by several alternative scenarios. Because charcoal samples were collected from level bags at the Alutiiq Museum that correspond most closely with the analyzed faunal samples, the possibility exists that cultural deposits from interstices without faunal remains fill these chronological gaps but were biased against in date sample selection. However, samples were sought from as many strata as possible with the goal of obtaining as complete a span of dates as possible. Coverage of dates by stratum and depth was almost complete, omitting only Stratum E. Sampling bias is therefore not a likely explanation for the pattern seen in the Rice Ridge radiocarbon data.

Alternatively, the hiatuses in occupation may be real but limited to just the part of the site examined for the faunal analysis (Kopperl 2003). In this scenario, occupants of the site deposited cultural debris, and perhaps also resided, away from the location of the 1988–1989 excavation block during the observed depositional hiatuses. A potential housepit and later Ocean Bay and Early Kachemak deposits found elsewhere at the site leave open the possibility that shifts in site function and/or in the spatial organization of activities account for both the gaps and the changes in accumulation rates of deposits. Further examination of data from the other portions of the Rice Ridge site is necessary, however, to evaluate this hypothesis.

A third possible explanation is that the gaps represent periods of erosion, during which several hundred years of cultural deposits were removed from the sequence, each followed by a return to a depositional regime. Erosion by water is a common process that frequently acts against archaeological preservation in this way, especially in coastal settings in this region where the dynamic interactions between tectonic, isostatic, and eustatic processes have created a complex sea level history (Crowell and Mann 1996; Mann and Hamilton 1995). Subsidence and uplift could have led to the gaps seen in the Rice Ridge radiocarbon sequence. However, while microstratigraphic evidence for these two geomorphic processes at locations elsewhere in the region includes the presence of tsunami deposits (e.g., Saltonstall and Carver 2002) and buried peat (e.g., Combellick 1991; Hamilton and Shennan 2005), no such lenses of sterile sand or peat were identified during the 1988–1989 excavation at Rice Ridge. This lack of evidence must, however, be treated with caution because, as noted, the available documentation is insufficient to characterize the nature of the contacts between particular strata. It is therefore not possible to say whether consecutive strata are conformable (e.g., Waters 1992:68–74).

A final explanation is that the entire site may have been abandoned during the two apparent hiatuses. As noted above, archaeologists and geologists have asserted that changes in relative sea level caused by frequent tectonic activity have had profound effects on the physical integrity of archaeological deposits across this region. While these events would have entailed major alterations to the local coastal landscape, the Native residents of Kodiak were well-adapted to such events from the earliest times (Fitzhugh 2003:41; Gilpin 1995:180–182; Mann 1998; Saltonstall and Carver 2002). Because coastal settlements on the Kodiak Archipelago were particularly susceptible to the effects of large subduction earthquakes, both in terms of changes in the position of shorelines and subsidence-generated erosion, their abandonment following such events was probably commonplace. Alternatively, other kinds of environmental perturbations could have played a role in site abandonment, though we know little about those to which Ocean Bay populations may have been either particularly well-adapted or vulnerable, nor about what perturbations actually transpired. As noted above, sterile sand, peat, and tephra deposits indicative of catastrophic events such as great earthquakes or volcanic eruptions are either lacking or unobserved in the excavation block stratigraphy. Furthermore, faunal remains from the block excavation exhibit long-term trends towards increased harvest of marine fish relative to sea mammals, as well as a rather uniform abundance of salmonid remains over time, with no indication of wholesale changes in mammal or fish use or extirpation within the Rice Ridge sequence (Kopperl 2003). Thus, changes in encounter rates with certain key subsistence resources were apparently ongoing and cannot be specifically tied to the gaps in the depositional sequence at Rice Ridge.

A related question that would provide further insight into Ocean Bay settlement patterns at a regional scale during these two gaps is whether other dated Ocean Bay components fall within the time periods in question. A conservative comparison using calibrated 1σ age estimates of Ocean Bay components listed in Table 1 indicates that almost all of the other sites have at least one component that falls within one or both of the Rice Ridge gaps. Table 4 summarizes the Rice Ridge radiocarbon data relative to the established culture-historical sequence for Kodiak and to age estimates of other radiocarbon-dated Ocean Bay sites (rounded to nearest century),[5] as well as the Ocean Bay components of the Lower Midden at the Mink Island site (XMK-030), across Shelikof Strait (Casperson 2012:21).

The Zaimka Mound (KOD-013) radiocarbon chronology corresponds most closely to the Rice Ridge sequence; its earliest OBI deposits are contemporaneous with the Early Rice Ridge components but also extend later in time through the first depositional gap at Rice Ridge. Three of its later house floor deposits date to the gap between the Middle and Late Rice Ridge components, as does the earliest date from the Qus'ituq site from the interior southwest of Kodiak Island (Saltonstall and Steffian 2007). The OBI Chert Site (AFG-008), located northwest of Chiniak Bay on Afognak Island, yielded a date from the basal stratum that overlaps the earlier gap in the Rice Ridge sequence, while the OBII Slate Site (AFG-011) yielded two dates from its early deposits that correspond with the later gap at Rice Ridge (Clark 1979). On Sitkalidak Island south of Rice Ridge, one date from the base of the Sitkalidak Roadcut (KOD-119) deposit and several dates from the upper deposits of Tanginak Spring (KOD-481) correspond with the earlier Rice Ridge gap (Clark 1979; Fitzhugh 2004:16). Only the Uganik Passage site (KOD-224) on the northwest side of Kodiak Island yielded 1σ age estimates within the ranges found at Rice Ridge (Nowak 1978), but as shown in Table 4, they bracket undated deposits that may coincide with the earlier gap in the Rice Ridge sequence. In contrast to these sites on the Kodiak Archipelago, midden deposits at the Mink Island site span the entire range of OBI and OBII in a continuous sequence (Casperson 2012; Schaaf 2009).

In summary, the radiocarbon dates of other Ocean Bay components from the Kodiak Archipelago suggest that the two gaps in the Rice Ridge sequence, 700–800 years between the Early and Middle periods and 500–600 years between the Middle and Late periods, were localized phenomena. The two Ocean Bay sites with comparably high chronological resolution, Tanginak Spring and Zaimka Mound, show continuity of occupation through both Rice Ridge gaps. The most direct and ideal way to evaluate shifts in the nature and intensity of occupation at Rice Ridge would be to analyze stratigraphic and chronometric archaeological data collected elsewhere within the site, coupled with local geomorphological and paleoecological data. Such analysis would further clarify the nature of the gaps as well as changes in accumulation rates documented within this particular sequence of deposits.

CONCLUSION

The stratigraphic information and radiocarbon dates from Rice Ridge document a more complex depositional history than previously surmised for Kodiak's Ocean Bay tradition. Definition of stratigraphic units, tied to a firm radiocarbon sequence, is a necessary first step towards meaningful interpretations of the various constituents of the Rice Ridge archaeological deposits. This framework provides context for past, present, and future analyses of the Rice Ridge archaeofauna (Kopperl 2003; Mike Etnier and Molly Casperson 2012, pers. comm.). Furthermore, the data described here contribute not only chronological and site formation contexts to site-specific investigations, but also highlight the value of detailed pictures of individual sites for our understanding of broader Ocean Bay settlement patterns throughout the Kodiak Archipelago.

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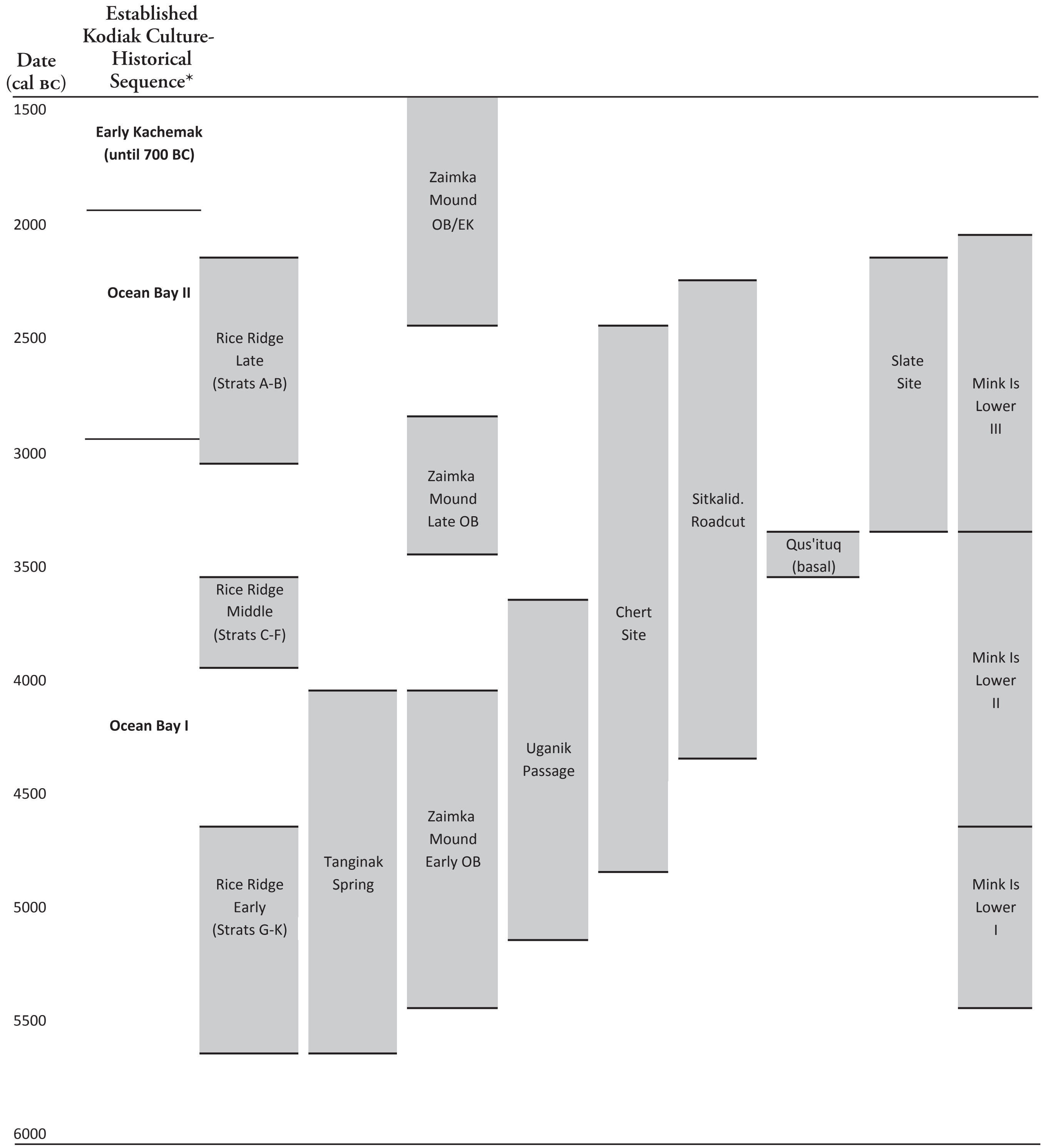
Table 4. *Ocean Bay radiocarbon data relative to the established culture-historical sequence for Kodiak Ranges bracket the 1σ age estimates, which are rounded to the nearest century (except Mink Island age limits, based on Casperson 2012:21).*



* Kodiak sequence presented as ranges based on calibrated dates (e.g., Saltonstall and Steffian 2006:11, 2007:21)

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NOTES

1. I maintain that Alutiiq lifeways extend back through the entire culture-historical sequence that continues to be developed for the Kodiak archaeological record. Although peripheral to the research described here, there has been a long-standing debate regarding the influx of, and transitions between, certain technological traditions manifested in the archaeological record and whether this represents migration and replacement of the human residents of the Kodiak Archipelago. The debate is centered primarily on the transition between the Kachemak and Koniag traditions (e.g., Clark 1992; Dumond 1988; Knecht 1995) as well as Alutiiq exchange and interaction with bearers of Arctic Small Tool tradition technology on the Alaska mainland. Such technology is occasionally associated with Early Kachemak components in the Kodiak Archipelago (Steffian and Saltonstall 2005). I take the continuity in the archaeological record between the major cultural traditions of Ocean Bay, Kachemak, and Koniag to be "evolutionary, not revolutionary" (Fitzhugh 2003:53) and, following Crowell et al. (2001), I view the roots of Alutiiq identity in the earliest archaeological traditions on the Kodiak Archipelago.
2. Discussion of age estimates based on calibrated radiocarbon data has become much more common amongst archaeologists working in this region over the past several decades (e.g., Clark 1984; Mills 1994; West 2011). Uncalibrated radiocarbon dates were the means of establishing the general culture historical framework during earlier years. The general discussion of Ocean Bay chronology at the beginning of this article gives both uncalibrated age ranges established at those times and rounded approximations of their calibrated intercepts using the IntCal09 curve (Reimer et al. 2009). After the introductory discussion, all ages are based on calibrated radiocarbon dates.
3. Although Rice Ridge has yielded, to date, the only substantial Ocean Bay faunal assemblage from the Kodiak Archipelago, there are other assemblages of similar time depth from nearby areas, including the Mink Island site (XMK-030) in Katmai National Park and Preserve, across Shelikof Strait from Kodiak (e.g., Casperson 2012; McKinney 2013; Schaaf 2009).
4. The term "level" is used here to refer to natural stratigraphic units. This terminology was adopted based on the "level bags" into which all faunal remains were aggregated when originally collected. Descriptions written on the level bags allowed reconstruction of the depositional sequence in this part of the Rice Ridge site. There is no indication that arbitrary excavation levels were used during fieldwork.
5. A related issue is the arbitrariness of the chronological line we draw between OBI, OBII, and Early Kachemak. This is readily apparent as we attempt to reconcile the recognized changes in the archaeological record through time—important shifts in technological, economic, and social strategies that are fundamental to our definitions of the Ocean Bay and Early Kachemak traditions—with calibrated age estimates of the sites from which we make such inferences. Understandably, broad gaps characterized the chronological sequence several decades ago when it was based on a few dated Ocean Bay components and even fewer dated Early Kachemak components (e.g., Clark 1984). Excavations across the archipelago have exponentially increased, most notably under the research program of the Alutiiq Museum. Consequently, chronologies based on both radiometric age estimates and the characteristics of artifact assemblages and features merge, and the dates used to divide the culture-historical sequence constantly shift on a centenary scale as new data are obtained (e.g., Saltonstall and Steffian 2007:21).

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