

Late-Quaternary Geomorphic Processes: Effects on the Ancient Aleuts of Umnak Island in the Aleutians

ROBERT F. BLACK¹

ABSTRACT. Glaciation, volcanic activity, marine processes and wind action affected in various ways the lives of the ancient Aleuts of Umnak Island, who first settled at Anangula about 8,400 BP following deglaciation some 3,000 years earlier. Expanding alpine glaciers reached the sea in places about 3,000 BP without the nearby peoples being much affected. A catastrophic eruption of Okmok Volcano about 8,250 BP is suggested as the cause of the abandonment of the oldest known site of Anangula, and subsequent migration westward into the central Aleutians. Cutting of strandflats between 8,250 and 3,000 BP led to the development of a very large, accessible, year-round food resource, and an apparent proliferation of settlements. In marked contrast to other parts of Beringia, Umnak Island became the site most favourable for human settlement.

RÉSUMÉ: *Les processus géomorphologiques fini-quaternaires et leurs conséquences pour les anciens Aléoutes de l'île d'Umnak dans les Aléoutiennes.* La glaciation, l'activité volcanique, les processus marins et l'action du vent ont affecté de diverses façons la vie des anciens Aléoutes de l'île d'Umnak, qui s'établirent à Anangula vers 8400 AP, soit environ 3000 ans après la déglaciation. Les glaciers alpins en expansion atteignirent la mer par endroit vers 3000 AP sans que les habitants du voisinage soient beaucoup affectés. On suppose qu'une éruption catastrophique du volcan Okmok vers 8250 AP a causé l'abandon du plus vieux site connu d'Anangula et une migration vers l'ouest jusqu'au centre des Aléoutiennes. Entre 8250 et 3000 AP, le percement des cordons littoraux a amené le développement d'une importante source d'aliments accessible toute l'année, ce qui fait qu'en opposition avec d'autres parties de la Beringie, l'île d'Umnak devint le site le plus favorable à l'établissement humain.

РЕЗЮМЕ. *Геоморфные процессы позднего четвертичного периода и их воздействие на жизнь древних алеутов о.Уманак гряды Алеутских островов.* Оледенение, вулканическая деятельность, морские процессы и ветры в различной степени влияли на жизнь древних алеутов о.Уманак, обосновавшихся первоначально в Анангуле около 8400 лет назад, приблизительно 3000 лет спустя после конца оледенения. Распространявшиеся долинные ледники достигли в некоторых местах океана около 3000 лет назад, не затронув, однако, жизни алеутов. Предполагается, что катастрофическое извержение вулкана Окмок, произошедшее приблизительно 8250 лет тому назад, заставило алеутов покинуть древнейшее поселение Анангула и двинуться на запад на центральные Алеутские острова. Размыт берегов в период между 8250 и 3000 лет привел к образованию чрезвычайно больших и доступных в течение всего года резервуаров пищи, что в свою очередь способствовало заселению этих мест. В заметном контрасте с другими островами Берингова моря на о.Уманак возникли условия наиболее благоприятные для жизни человека.

INTRODUCTION

It has long been recognized that ancient peoples were markedly influenced, and even controlled at times, by geomorphic processes or events. It is probably impossible to ascertain the precise reasons why an ancient people settled where

¹Department of Geology, University of Connecticut, Storrs, Connecticut 06268, U.S.A.

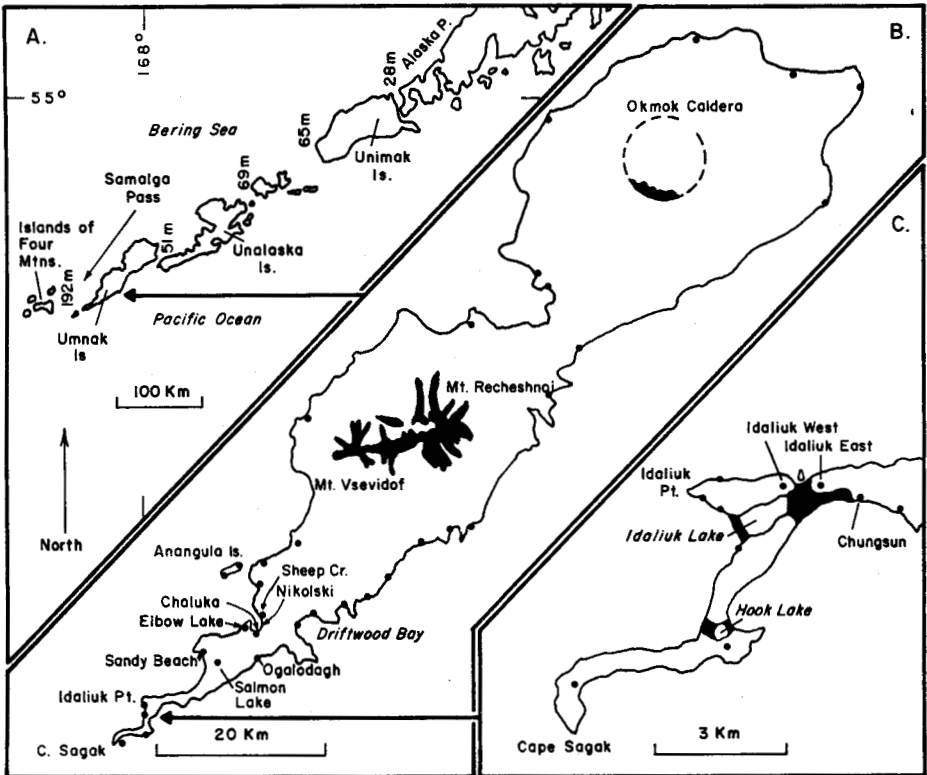


FIG. 1. A. Index map of eastern Aleutian Islands, including Umnak Island, with water depths in major passes indicated in metres; B. Outline map of Umnak Island, showing present alpine glaciers (black), most named features, and known archaeological sites (small circles); and C. Southwest tip of Umnak Island, showing archaeological sites (small circles) and marine deposits (black) that join small former islands.

they did or moved from one locality to another. However, geological reconstruction of their environment, as it related to food and water, to safety and shelter from the elements and natural enemies, and to other human needs, can provide in some instances a logical explanation for the settlement or abandonment of a particular site or area (Black 1972, 1973).

In this paper are indicated some aspects of glaciation, volcanic activity, marine processes, and wind that in varying degrees and at different times affected the ancient Aleuts of Umnak Island in the eastern Aleutians (Fig. 1). Actual correlations between natural phenomena and the activities of the ancient Aleuts are, however, purely speculative inasmuch as none has been established conclusively. A volcanic ash-soil stratigraphy dated by radiocarbon in peat and soil horizons has provided the chronology into which geomorphic events can be fitted and correlated with the activities of the ancient Aleuts (Black 1974a). Details of the dating problems cannot be repeated here, but the stratigraphy is outlined in Fig. 2 and the preferred chronology in Table 1. Named occupation sites and other places cited herein are found on Fig. 1. Interpretations given of the geology

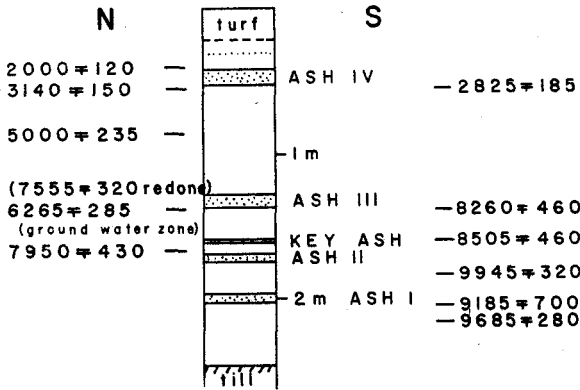


FIG. 2. Radiocarbon dates of ash stratigraphy, Airport Lake, Nikolski (see Fig. 1B for location of Nikolski). Airport Lake lies at the east end of the runway shown on Fig. 4. The dates obtained from peat on the south side of the lake are considered more accurate than those from soil on the north side. All dates are from Geochron.

TABLE 1. Geologic timetable: Umnak Island, Aleutians

Radiocarbon years BP	Geologic Event
3,000	Ash IV Sea level starts dropping from 2-3 m Strandflat-cutting completed Main berm of most major bars End of Hypsithermal Neoglaciation Basalt flow from Mt. Recheshnoi
8,250	Ash III Start of Hypsithermal End of major Okmok eruptions Sea level reaches 2-3 m Start cutting of strandflats
8,300	Anangula abandoned
8,400	Key Ash Anangula occupied
8,750	Ash II
10,000	Ash I End of permafrost Deglaciation of higher southwest Umnak Island
11,000	Inland deglaciation of lowland southwest Umnak Island
11-12,000	Deglaciation at Airport Lake

of southwest Umnak Island, as related to the ancient Aleuts, are based mainly on brief visits of the author during 1962-63 and 1970-72 and a previous study by Byers (1959).

GLACIATION

An ice cap of late Wisconsinan age covered all southwest Umnak Island and the adjacent island of Anangula. It likely was correlative, at least in part, with the Brooks Lake Glaciation on the Alaska Peninsula (Muller 1953; Determan and Reed 1973) and the Unaluk Glaciation of southwestern Alaska (Porter 1967). Probably only small portions of the highest peaks on Umnak Island stood at times above the perennial ice and snow. Hence, until deglaciation of the shores of the Alaska Peninsula and lowland areas of the eastern Aleutian Islands,

perhaps 11,000 to 12,000 years BP (all ages are given in radiocarbon years), habitation of the area was not possible. No sites that old are known.

The oldest site known, Anangula, was settled about 8,400 years BP at the stratigraphic level of "key ash" (Black and Laughlin 1964). The shoreline then on the southwest part of Umnak Island and on Anangula was essentially the same as that of today (Black 1974a). Glaciation controlled the evolution of the shoreline in that a eustatic sea-level curve and probably a combined glacial isostatic and a water isostatic curve are likely to be common to any solution. Tectonism and volcanism may also be involved (Black 1974a). Regardless of the nature of the control of sea level, it seems clear that the ancient Aleuts must have used boats to reach Anangula (Black 1974a). The wide deep passes eastward to mainland Alaska were flooded (Fig. 1) and did not freeze in the winter to provide passage for larger animals and man as does the Bering Strait. Proof of this is the failure of caribou, bears, and other large vertebrates to migrate west of Unimak Island in spite of the existence of suitable habitat on other islands (Collins *et al.* 1945).

Deglaciation of southwest Umnak Island left many basins to become filled with fresh water and provide spawning areas for anadromous fish. Numerous Aleut sites are found on streams leading to those lakes, such as Chaluka, Sheep Creek, and Salmon Lake.

Expanding alpine glaciers reached the sea on both the north and south sides of Umnak Island about 3,000 years BP. However, Aleut sites of the same period more than 10 km distant seem to have been unaffected by the presence of the ice or significantly by the cooler, wetter climate that brought about an increase in the area covered by ice (Heusser 1973). With their boats the Aleuts could easily travel around the termini of the alpine glaciers in their supposed movements between opposite ends of the island. Walking over the glaciers would have been more difficult, because of abundant crevasses.

VOLCANIC ACTIVITY

Three prominent volcanoes, Mounts Vsevidof, Recheshnoi, and Okmok, occupy most of Umnak Island except for the southwest lowland (Byers 1959). Of these, Mounts Vsevidof and Okmok have been active since 1760 (Coats 1950). Mount Recheshnoi was the source of at least one lava flow that reached the sea as recently as about 3,000 years BP, i.e., contemporary with the Neoglaciation. Hence, all three volcanoes were active during the occupation of Umnak and Anangula Islands by the ancient Aleuts, and have at times very likely drastically affected that occupation. In addition, other active volcanoes, notably on Islands of Four Mountains (Fig. 1), probably contributed to the rain of ash.

Mount Recheshnoi is clearly the oldest of the volcanoes, to judge from the degree of dissection of its slopes and the relation of some of its flows to those of Mount Vsevidof (Byers 1959). Presumably its lower flanks on the Pacific Ocean offered sites of possible occupation for ancient man. Only post-Hyp-sithermal sites have so far been recognized there, however — perhaps because of marine erosion or inundation.

Mount Vsevidof, the highest and most symmetrical of the volcanoes, is very young (Byers 1959). Lava flows that are post-Hypsithermal, and possibly post-1760, reached the sea on the west side of the cone, and older flows indicate a long history of similar eruptions. Hence, ancient man, if he were living at the base of the volcano, would have been forced to move frequently. Any very old sites are buried beneath lava or were destroyed. None of the later eruptions of Mount Vsevidof, however, seems to have been so catastrophic as to bring widespread death and instant destruction to the area around the base of the mountain.

In contrast, Mount Okmok, today commonly referred to as Okmok Caldera or Okmok Volcano, has had a violent history of eruptions that were at times critical for the ancient Aleuts. It is more than double the combined size of Mounts Vsevidof and Recheshnoi, and has spread death and destruction far beyond its perimeter. Byers (1959 p. 341) has calculated that 7-16 cubic miles (29-67 km³) of erupted material created the caldera during early Holocene times. In essence, the entire northeast part of Umnak Island is a product of its activity.

Timing of the last major eruption that produced the caldera is crucial with respect to occupation of Anangula by ancient man. That eruption deposited an average thickness of 30 m of pyroclastic debris at the coast, i.e., at an average distance of 9 km from the rim of the caldera (Byers 1959 p. 315) and so would have extinguished all life in the vicinity. In the words of Byers (1959 p. 351): "The earlier phase of the eruption appears to have been peléean and consisted of gas-charged glowing avalanches (nuées ardentes). As the eruption increased in violence, red-hot glowing avalanches of molten bombs were welded together when they stopped moving to form continuous beds of welded agglomerate close to the source vents. The flowing avalanches were gas-charged and had great mobility as they moved swiftly down the slopes of Okmok Volcano. By the time they came to rest on the lower slopes, the avalanche had cooled and incorporated water from snow and ice so that they became partly palagonitized. The later phase of the eruption appears to have been violently vulcanian and consisted of showers of dark andesitic ash, bombs, lapilli, and large xenolithic blocks of earlier basalt and palagonitized rock to form a widespread blanket as much as 300 feet thick near the source vents.

"Very soon after the catastrophic eruption, the central part of the caldera collapsed to form Okmok Caldera inside a new ring fissure eccentric and one mile south with respect to the hypothetical earlier ring fissure suggested by the arcuate ridges . . ."

Byers (1959 p. 322) infers that the eruption postdates the last major glaciation (presumably the late Wisconsinan ice cap) of Okmok Volcano, but preceded the catastrophic cutting of a 150-metre-deep gorge from the breakout of a lake in the caldera. Both events preceded the alpine advance of 3,000 BP.

The dates of the Holocene (Recent) age assigned by Byers can be more closely ascertained by a correlation of events with the dated ash stratigraphy of southwest Umnak Island, if correlation by distribution and by general lithic comparisons of the ashes is valid (Black 1974b). So far no diagnostic properties permitting absolute correlation of the ashes have been recognized by means of

petrographic studies or electron microprobe (James M. Funk, geologist, University of Connecticut, personal communication, 1973).

On Anangula and southwest Umnak Island, Ash I, which is a pumice, thickens and coarsens markedly towards the west, whereas Ashes II to IV thicken and coarsen towards the east (Black 1974b). Ash IV is mainly pumice and too young to be related to the main eruption of Okmok Volcano. In the Nikolski area, 70 km from Okmok Volcano, Ash II and Ash III are mixtures of yellow pumice and glassy, dense, and vesicular rock fragments that are olive to grey and vary considerably in texture and composition. The pumice fragments are mostly less than 4 mm, but some are as large as 6 mm; the rock fragments are of fine to coarse sand size. Especially in Ash III the pumice rests without break on the olive-to-grey rock fragments; pumice underlies the rock fragments in Ash II. Some glass has an index of refraction of 1.525 as does glass from Okmok deposits (Byers 1959 Table 11); however, a wide range of indexes exists. Byers (1959 p. 314-323; 1961) described the wide variety of rocks in the Okmok volcanics of caldera age which fit best in composition and timing with the Nikolski sequence of Ashes II to III. No reasonable alternative correlation is available.

Almost continuous eruption is recorded by ash falls in the 500 years suggested by radiocarbon dates between Ashes II and III. Between those ashes a very thin weak humic horizon lies at the cultural horizon on Anangula, dated about 8,400 years BP (Black and Laughlin 1964). Internal inconsistency from contamination in a group of radiocarbon dates has so far prevented the length of occupancy being defined. The very immature "A" horizon at the cultural hiatus and an almost constant rain of ash preclude a length of time of occupancy of more than perhaps a generation of Aleuts. The cultural horizon is covered by a few centimetres of fine yellow-brown to dark red-brown ash and then 10-20 cm of Ash III without intervening soil breaks.

The conclusion here reached is that the last major catastrophic eruption of Okmok Volcano produced Ash III and the immediately underlying fine ash that rests directly on the cultural horizon at Anangula which is dated by charcoal remains. Between 20 cm and 30 cm of ash fell in a time too short for any significant discontinuities to be shown. Presumably a brief period of quiescence permitted the ancient Aleuts to migrate past Okmok Volcano prior to the formation of the caldera. They would have been marine oriented and have used boats. The desolate ash-strewn slopes of Okmok Volcano would have been almost, if not entirely, devoid of any life, even vegetable, for tens of kilometres.

The caldera eruption would have been a fearsome spectacle for those primitive people, who may even have heard it as well. It seems reasonable to suppose that the eruption and ash fall were responsible for the abandonment of Anangula, as suggested by McCartney and Turner (1966 p. 37), and migration westward, away from the eruption. To judge from archaeological evidence, withdrawal was fairly precipitous (Jean S. Aigner, archaeologist, University of Connecticut, personal communication, 1972). The eruption may have provided the stimulus for those people to brave the strong tidal rips in the difficult crossing of Samalga Pass to the Islands of the Four Mountains and other islands westward in the Aleutian chain. A date of $8,045 \pm 309$ BP (Jean S. Aigner, personal communica-

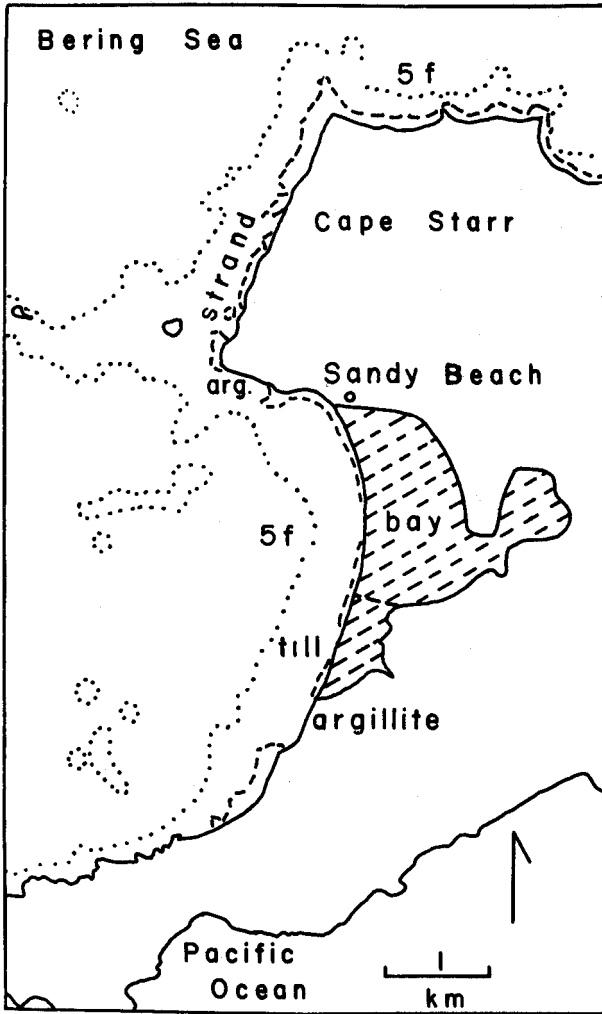


FIG. 3. Sketch of Sandy Beach area (see Fig. 1B for location). The oldest archaeological site is at the open circle. A former bay is shown by parallel dashed lines.

tion) from an archaeological site at Sandy Beach (Fig. 3) possibly may be linked to the westward migration from Anangula.

Several cinder cones and lava flows have formed within Okmok Caldera during the last few decades, but have had little effect on man.

MARINE PROCESSES

Marine processes include the effects of changing sea level, lateral erosion and cutting of strandflats, deposition of bars and beaches, infilling between islands, and effects of tsunamis (earthquake waves). The Aleuts clearly obtained most of their living from the sea, travelled on its surface, and lived as close as possible to the shore line. Thus, most house sites occupied prior to the high stand of sea level on Umnak and Anangula Islands, about 8,250 to 3,000 years BP (Black

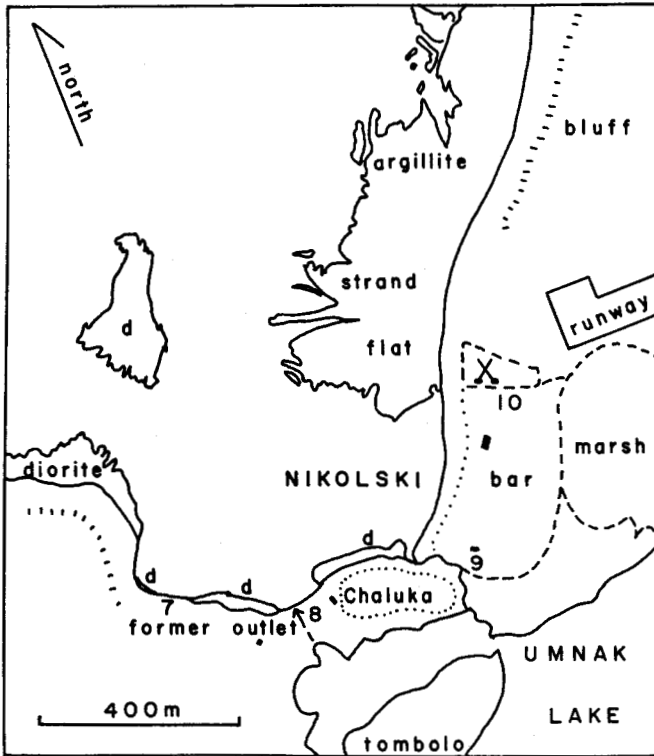


FIG. 4. Part of strandflat at Nikolski (see Fig. 1B for location), constructional bars with elevations in metres, and the archaeological site at Chaluka protected by diorite outcrop (d).

1974a), would have been destroyed or covered by rising water. Lateral cutting by the sea in the last 8,250 years, judging by the widths of strandflats, has been many hundreds of metres (Fig. 4). In the last few decades rates of lateral erosion of 0.1-0.2 m per year have been measured on exposed points (Black 1966). However, in protected bays and passes simultaneous infilling and building of bars and beaches have occurred (Fig. 1C). All massive bars and infilled areas which have been examined are postglacial, and many have exposed surfaces less than 3,500 years old (Black 1974a). Thus, special conditions must be met for old sites to be preserved intact. One such site covered most of southwest Anangula Island and fronts on deep water (Fig. 5). Steep cliffs precluded the siting of any houses below the level of the southwest end which is 11-22 m above present sea level. At the time of settlement, about 8,400 years BP, the shoreline on Anangula Island probably was very close to that of today (Black 1974a). The Anangula site has suffered minimal erosion since occupation, because of seaward-dipping lava flows up which waves could wash with limited undercutting. Few other sites on Umnak Island were so well protected.

Only one other early Hypsithermal site is known — that of older Sandy Beach (Fig. 3). It lies in the protection of a rocky point. Deposition of a bay-mouth bar about 3,500 years ago isolated the site from the sea, doubtless causing the Aleuts to move closer to the sea where they still live today. The late Hypsithermal site of Chaluka was built on a bedrock knob which was protected by additional bedrock towards the bay (Fig. 4). However, it was too low to be oc-

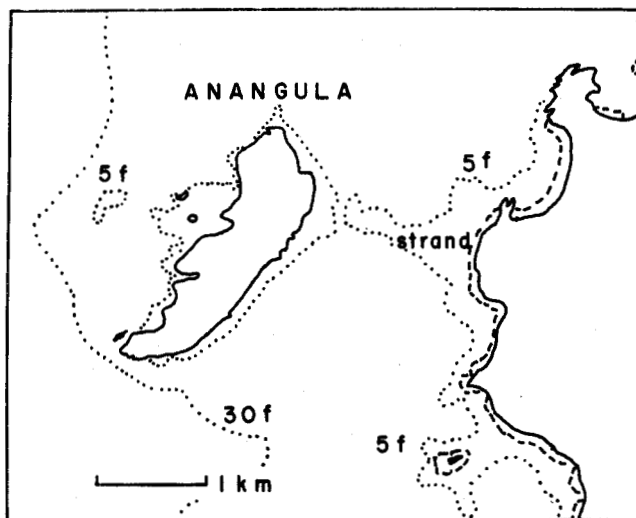


FIG. 5. Relation of Anangula Island to Umnak Island (see Fig. 1B for location). The dotted lines indicate water depths in fathoms (1 f. = 1.8 m).

cupied during most of the high sea-level stand. It was not occupied until deposition of bars linked it to the mainland, and shoaling water and growth of kelp provided adequate protection, about 4000 BP. A site southwest of Idaliuk Lake (Fig. 1C) can be dated to about 4,000 BP, but all other sites excavated to date are post-Hypsithermal.

Many low-lying sites on the Pacific Ocean, such as those at Cape Sagak, Ogalodagh, and Driftwood Bay, were overrun by a tsunami in 1957. Doubtless other still-more-exposed low-lying sites were affected at different times in the past.

WIND ACTION

The most important effect of wind action on the ancient Aleuts would have been the generation of waves, which would have prevented them from hunting from their small boats. Other effects would have been: exceptional waves at high tides which doubtless inundated or destroyed low-lying sites, and the formation of coastal dunes (by onshore winds) at Sandy Beach and near Idaliuk and Hook Lakes which were used as temporary shelters, as evidenced by distribution of fire pits and artefacts. During recent years the Aleuts reportedly moved back and forth, as they apparently did in earlier times, across peninsulas and the narrows of the island to take advantage of better sea conditions for hunting and food gathering. It is interesting to note, however, that many occupation sites were not located for protection from the wind, but were on exposed ridges, points and bars. The important consideration must have been a view of the sea. Idaliuk East, a large site, is particularly notable in that it has no satisfactory water supply, is an estimated 30-60 m above sea level, and is especially wind-swept. The site faces on an infilled pass connecting two former islands (Fig. 1C), and occupation existed to recent times. The date of its original settlement is not known, but presumably predates the infilling. Whether the site was occupied in

order that migrating birds and animals in the pass, or enemies from the west, might be observed is not known.

CONCLUSIONS

Because the Aleuts were marine hunters and travellers in small boats, daily winds and sea conditions were very important to them. Because of a complex coastal configuration, resulting from marine work on a variety of rocks of different structure, the Aleuts on Umnak Island could move overland freely to protected bays under all but the worst conditions. After the main period of strandflat cutting between 8,250 and 3,000 years BP, the Aleuts on Umnak Island had available an enormous base of food resources that could be used throughout the year, in marked contrast to the case in other parts of Beringia. It would seem to have made possible a considerable increase in population, especially around the southwest part of the island. Alpine glaciation had no apparent effect on occupancy of the island. However, a catastrophic volcanic eruption at the northeast end of Umnak Island may have caused abandonment of Anangula and induced westward migration. Marine work likely has destroyed many sites, but changes of sea level during occupancy by the Aleuts seem to have been less than in any other part of Beringia.

ACKNOWLEDGEMENTS

Comments supplied by David M. Hopkins, Stephen C. Porter, and Allen P. McCartney on a draft of this paper are much appreciated.

Acknowledgement is made gratefully to the U.S. National Science Foundation, the Connecticut Research Foundation, the Wisconsin Alumni Research Foundation, and the Wenner-Gren Foundation for Anthropological Research, for financial support of field studies.

REFERENCES

- BLACK, R. F. 1966. Late Pleistocene to recent history of Bering Sea — Alaska coast and man. *Arctic Anthropology*, 3 (2): 7-22.
- . 1972. Geologic evidence pertaining to the migration of the Paleo-Aleuts. *Geological Society of America Abstracts with Programs*, 4 (7): 452.
- . 1973. Late Quaternary geomorphic events related to Paleo-Aleuts, Umnak Island, Alaska, *Menasha, Wis.: Society for American Archaeology Abstracts*, pp. 21-22.
- . 1974a. Late Quaternary sea-level changes, Umnak Island, Aleutians: their effects on ancient Aleuts and their causes. *Quaternary Research*, 4 (3): 264-81.
- . 1974b. Geology and ancient Aleuts, Amchitka and Umnak Islands, Aleutians. *Arctic Anthropology*, 11 (2): 126-40.
- and LAUGHLIN, W. S. 1964. Anangula: a geologic interpretation of the oldest archeologic site in the Aleutians. *Science*, 143: 1231-2.
- BYERS, F. M., JR. 1959. Geology of Umnak and Bogoslof Islands, Aleutian Islands, Alaska. U.S., *Geological Survey, Bulletin* 1028-L, pp. 267-369.
- . 1961. Petrology of three volcanic suites, Umnak and Bogoslof Islands, Aleutian Islands, Alaska. *Geological Society of America Bulletin*, 72: 93-128.

- COATS, R. R. 1950. Volcanic activity in the Aleutian arc. *U.S., Geological Survey, Bulletin* 974-B, pp. 35-47.
- COLLINS, H. B., JR., CLARK, A. H. and WALKER, E. H. 1945. *The Aleutian Islands: Their People and Natural History*. Washington, D.C.: Smithsonian Institution (War Background Studies no. 21).
- DETERMAN, R. L. and REED, B. L. 1973. Surficial deposits of the Iliamna Quadrangle, Alaska. *U.S., Geological Survey, Bulletin* 1368-A.
- HEUSSER, C. J. 1973. Postglacial vegetation on Umnak Island, Aleutian Islands, Alaska. *Review of Paleobotany and Palynology*, 15: 277-85.
- MCCARTNEY, A. P. and TURNER, C. G., II, 1966. Stratigraphy of the Anangula unifacial core and blade site. *Arctic Anthropology*, 3 (2): 28-40.
- MULLER, E. H. 1953. Northern Alaska Peninsula and eastern Kilbuck Mountains, Alaska. In *Multiple Glaciation in Alaska; U.S., Geological Survey, Circular* no. 289, pp. 2-3.
- PORTER, S. C. 1967. Glaciation of Chagvan Bay area, southwestern Alaska. *Arctic*, 20(4): 227-46.