WESTERN GULF OF ALASKA CULTURAL RESOURCE STUDY

FINAL REPORT

Volume 1

By

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INTRODUCTION

In the spring of 1975 the University of Alaska Museum was awarded a contract through competive bid procurement to conduct a study of possible human habitation on the Bering and Chukchi outer continental shelves. Alaska's outer continental shelf stretching westward to Siberia, was exposed as a dry land mass during the Pleistocene, a time of lower sea level. This area, commonly referred to as the Bering Land Bridge, connected North America and Siberia. It has long been postulated that the original colonization of the Americas occurred via this route by Pleistocene hunters and gatherers.

The specific goals of the study entitled the Bering Land Bridge Cultural Resource Study, were to ascertain if archeological sites were likely to exist on the former land bridge and, if so, to rank specific regions for the probability of archeological site occurrence. The need for the BLM/OCS office to fund the analysis was to comply with federal antiquities legislation relating to proposed outer continental shelf oil lease sales off the Alaskan coast. It was concluded from the Bering Land Bridge Cultural Resource Study that archeological sites were likely to occur on the outer continental shelf. In order to develop a model which would delineate regions of potentially high probability for archeological site occurence, specialists were asked to formulate criteria responsible for faunal distribution resulting from geographic and climatic conditions. These criteria were applied to a paleographic reconstruction of the former environment interpreted from relic bathymetry which was synthesized and projected into a series of paleogeographic maps. Sharma (1976) developed a series of stillstand maps based on thousands of bathymetric data points which he analyzed from numerous published and unpublished sources for both Bering and Chukchi outer continental shelves. These excellent maps served as the basis for projecting faunal distributions for the Bering Land Bridge.

Stoker (1976) utilized Sharma's reconstruction of Beringia geography to project marine faunal species distributions for Beringia. using principles of marine science, he established criteria responsible for high marine productivity and subsequent faunal distribution. These criteria were: 1) cyclonic nearshore upwelling; 2) regions of fresh water discharge into the marine environment; 3) postulated sea ice conditions inferred from paloenvironmental data; 4) suitable geographic habitat for marine rooking birds and 5) location of estuaries and river mouths suitable for concentrations of anadramous fish and their predators, which he later termed the "salmon complex".

Guthrie (1976) faced a somewhat more difficult task because many of the species he was analyzing were extinct. Factors controlling their distribution are poorly understood because there are no living representatives from which to extrapolate. However, he assumed that factors relevant to the distribution of modern grazers also would have applied to extinct grazing species. He (Guthrie, 1976:131-133) outlined the following mechanisms used to ascertain former distributions.

1. Irregular, rolling terrain tends to provide a longer succession of richer plant growth stages than do flat lowlands. This is particularly true of south-facing slopes.

2. High country adjacent to catabatic wind activity reduces winter snow cover, allowing access to winter range. If it becomes traditional winter range, it is unlikely to receive intensive use as summer range.

3. Areas in which mountain ranges interfinger with other ranges usually concentrate large mammal movement from one system to the other, either to (a) use the quality alpine vegetation, or (b) to exploit the more snow-free winter range.

4. Over long distance migration, the same is true, but for opposite reasons. Shorter distances or lower relief routes are used more often than others. This often means a movement through major "pass" systems or major gaps between mountain systems.

5. Because of its better footing and lack of relief, river valleys are frequently movement avenues for large mammals, both ungulates and their predators.

The probable distribution of the fauna was then projected to the paleogeographic maps in a sequence of four “snap-shots” through time, each represent a major stillstand in marine transgression throughout Wisconsin times. Utilizing this data, Dixon analyzed the potential for archeological site occurrence based on resource distribution. Projections of archeological site probability were based on an analysis of the subsistence strategies of northern hunting and gathering cultures. This analysis was culled from relevant ethnographic, historic, cultural ecological, and archeological literature. Regions of the former Bering Land Bridge were then ranked as being of either high, medium or low probability for archeological site occurrence.

Because the University Museum had developed a method for determining probability of archeological site occurrence on Alaska’s outer continental shelf and had amassed a great deal of data releveant to the subject, a second contract to analyze the Western Gulf of Alaska was signed by the University Museum and the BLM. The approach was essentially the same as that employed for the Bering Land Bridge Cultural Resource study, however, the study area was radically different. The Western Gulf of Alaska Cultural Resource Study analyzed the outer continental shelf stretching southward from the Alaska mainland east of Kodiak Island to the terminus of the Alaska Peninsula.

Relic bathymetric features indicate that ths region may have a comparatively complete record of sea level history and Sharma (this report) has delineated six major stillstands for the region. Although the basic predictive model for archeological site occurrence has remained unchanged from the Bering Land Bridge Cultural Resource Study to this report, a different ranking system has been employed. This was considered essential based on the greater regional complexity of the Western Gulf of Alaska outer continental shelf.

The following text consists of three major sections. In section one, Sharma briefly reviews the glacial and geological history of the study area. He also discusses his interpretation of submerged sills which he believes record six individual periods of sea level stability during periods of marine transgression. He presents data on the individual sills in an appendix to the text. Included in his chapter are paleographic maps based on his interpretation of sea level rise and bathymetric features.

Stoker discusses terrestrial and marine faunal distributions for the study area and delineates the factors upon which he based their projection to the study area in section two. Through the use of symbols, he has depicted the projected distributions on the paleographic maps prepared by Sharma.

In section three, Dixon reviews the Pleistocene/Holocene prehistory of the study area and the model for archeological site prediction developed for the Bering Land Bridge Cultural Resource Study. Based on Stoker's projection of faunal distributions for the study area and Sharma's paleographic maps, he delineates regions of high, medium, and low archeological probability and has transferred this data to BLM/OCS protraction diagrams. This chapter is followed by a short section which identifies data gaps for the study area and a bibliography of cited literature from all sections of the report.

E. James Dixon, Jr.

I. GEOLOGY, SEA LEVEL HISTORY AND BATHYMETRIC FEATURES OF THE NORTHWESTERN GULFOF ALASKA CONTINENTAL SHELF

G. D. Sharma

INTRODUCTION

The Northwestern Gulf of Alaska shelf lies between 59° . 56° N latitude and 148° - 164° w longitude. The shelf has a series of northeast-southwest oriented islands, the largest of which is Kodiak - Afognak Island group. The bathymetry surrounding this island group is complex because the islands bisect the shelf, forming 300 km long and 40-65 km wide Shelikof Strait (Fig. I-6 & I-12 pp: I-9 & 1-15). Southeast of Kodiak Island, the shelf is bordered by the Alaska Peninsula, a volcanic arc, to the north.

Characteristically the shoreline of the shelf is young and rugged, its steep mountainous terrain and a highly irregular coastline indented by bays, inlets, lagoons, fiords, and channels are major features. The shelf is widest in the northeast, about 250 km. Southwestwards, between Kodiak and Umank Islands, it gradually becomes narrower to about 50 km near Unmak Island. Throughout its length, the shelf contains troughs and valleys, and is dotted with islands of various sizes.

Seawards, the continental margin descends steeply to the Aleutian Trench to the southeast. A unique feature of the slope is its steep gradient; from the edge of the shelf it drops more than 5,000 m to the trench.

GEOLOGY

During the Pleistocene the shelf was repeatedly glaciated. Glaciers generally descended from the adjacent mountains and extended on to the lowlands. Substantial glaciation of the region is obvious from the fiord-indented coastline. During major glacial advances the sea level receded towards the shelf margin, and ice covered part of the shelf. Most sediments eroded by the glaciers during low sea levels probably were deposited on the shelf and trench.

Contemporary sediments on the shelf form a thin irregular veneer ranging to a maximum of tens of meters in thickness. Shallow banks are generally either devoid of, or have minimal amount of contemporary sediments, while the maximum thickness have accumulated in depressions.

BATHYMETRY

The shelf is characterized by numerous islands, plateau-like surfaces and sea valleys. The islands are generally found in the nearshore zone which forms a narrow belt adjacent to the coastline, extending to the 30-50 m isobaths. Numerous inlets and fiords are also found in this zone. The shallow zone is actively eroded by wave action.

Offshore, the main part of the shelf between 50 and 200 m isobaths contain large, broad, plateau-like surfaces with banks. The plateau-like surfaces have a low gradient of 1 to 5 minutes. These relatively smooth surfaces, however, are interrupted by many banks and shoals that rise, often abruptly, some reaching above sea level to form islands. The plateau-like shelf also includes a few depressions which are important clues to the paleo-sea level stands.

Sea valleys and fiords on the shelf are either aligned essentially parallel to the shelf length or they cut across the shelf. Those which run parallel or subparallel to the shelf are generally broad and flat-bottomed, with steep sides. The large size of these valleys suggests that they may have resulted from erogenic movement. The fiords generally traverse the shelf width. They extend seaward from bays and inlets along the nearshore zone. The U-shaped valleys are only 10 to 50 km wide, and vary greatly in length. The longitudinal profile of the valley generally shows the deepest part in the middle, typically of glacially formed channels.

METHODS

All available bathymetry charts (U.S. Coast & Geodetic Survey and National Oceanic Survey) covering the area were given detailed scrutiny for data on submerged topography. Salient features relating to former sea level stands were identified and plotted on these charts and are listed in Appendix I.

RESULTS

The rise in sea level accompanying melting of glacial ice generally results in sediment deposition on the shelf. During peak glaciation the sea level as well as the river influx, though minimal are stable.

With the advent of a warming trend the ice recedes and river discharge increases. During an interstade the recession of glacial ice results in increased river drainage and thus increased river flux. The larger influx of river detritus overwhelms the carrying capacity of the nearshore marine processes. A nearshore deposit distinctive of such processes is formed on the shelf.

During an interstadial, sea level is stabilized and establishes a firm shoreline. Depending upon the duration of stable sea level, wave action along the shoreline will erode sediments to form terrace. The eroded material accumulated in the nearshore region remains an identifiable deposit. In particular, stationary shoreline invariably will actively erode the intervening sill between two basins so as to interconnect the basins and to form a basin enclosure at that level. This process is further enhanced by tides which often generate swift tidal currents over sills.

Assuming that sea level during post glaciation was intermittently stabilized, the shoreline should be closely fixed in altitude and extend over large areas. These sea level stands should be manifested by their related sedimentary deposits and bathymetric features. Consistency in the distribution of sedimentary deposits and bathymetric features is extremely important and fundamental to the establishment of the phases of stable shoreline.

The data obtained from the bathymetric charts unequivocally and categorically demonstrate that almost all basin enclosures and nearshore deposits occur along one of the six submerged horizons. These levels are: -125m (68fm), -82m (46fm), -66m (-36fm), -55m (30fm), -38m (21fm), and -28m (15fm) (Figs. I-1 through I-36).

Clearly some of the submerged features do not precisely follow these horizons. However, these deviations are relatively few and do not exceed ± 3m from the norm. These variations are comparatively minor and probably have been caused by one of three factors.

Primarily, the bathymetric charts from which data were obtained provided depths in fathoms. Because depths were given in whole numbers (fathoms) the conversion to meters will inevitably result in error of ± 1 m. Depending upon the morphology of the nearshore shelf and

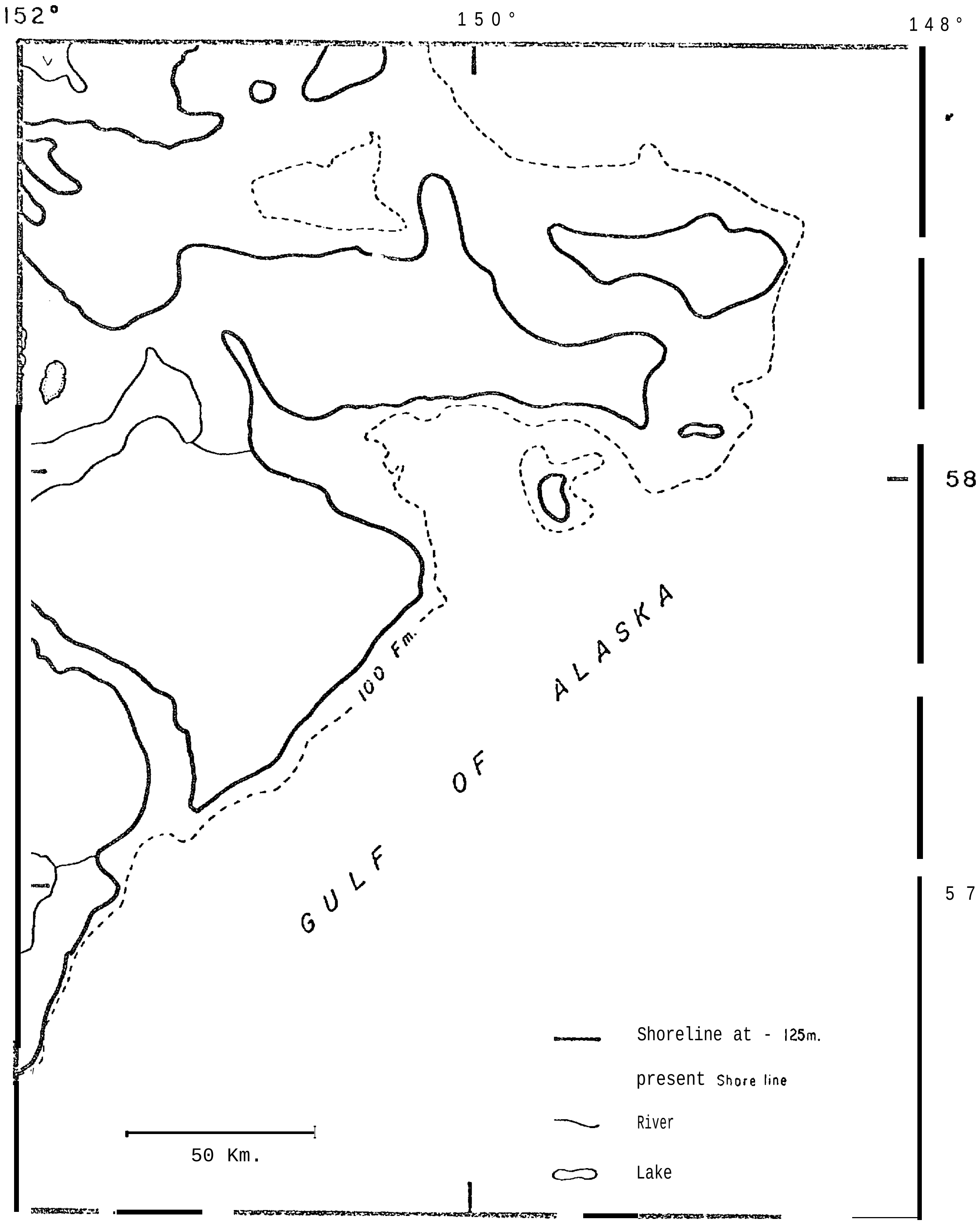


Fig. 1-1 Sea level stillstand 21,500-18,000 B.P.

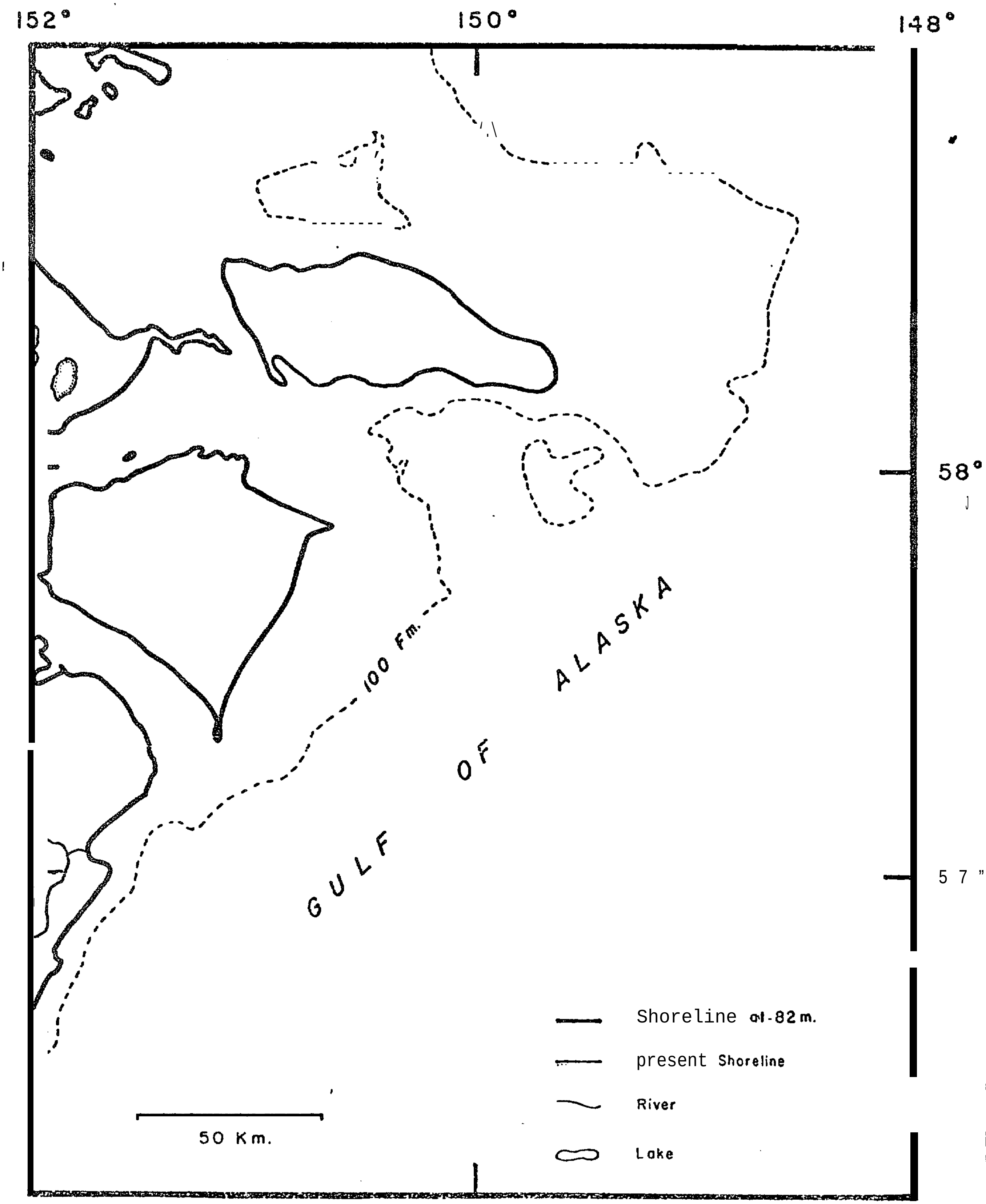


Fig. I-2 Sea level stillstand 15,000-14,800 B.P.

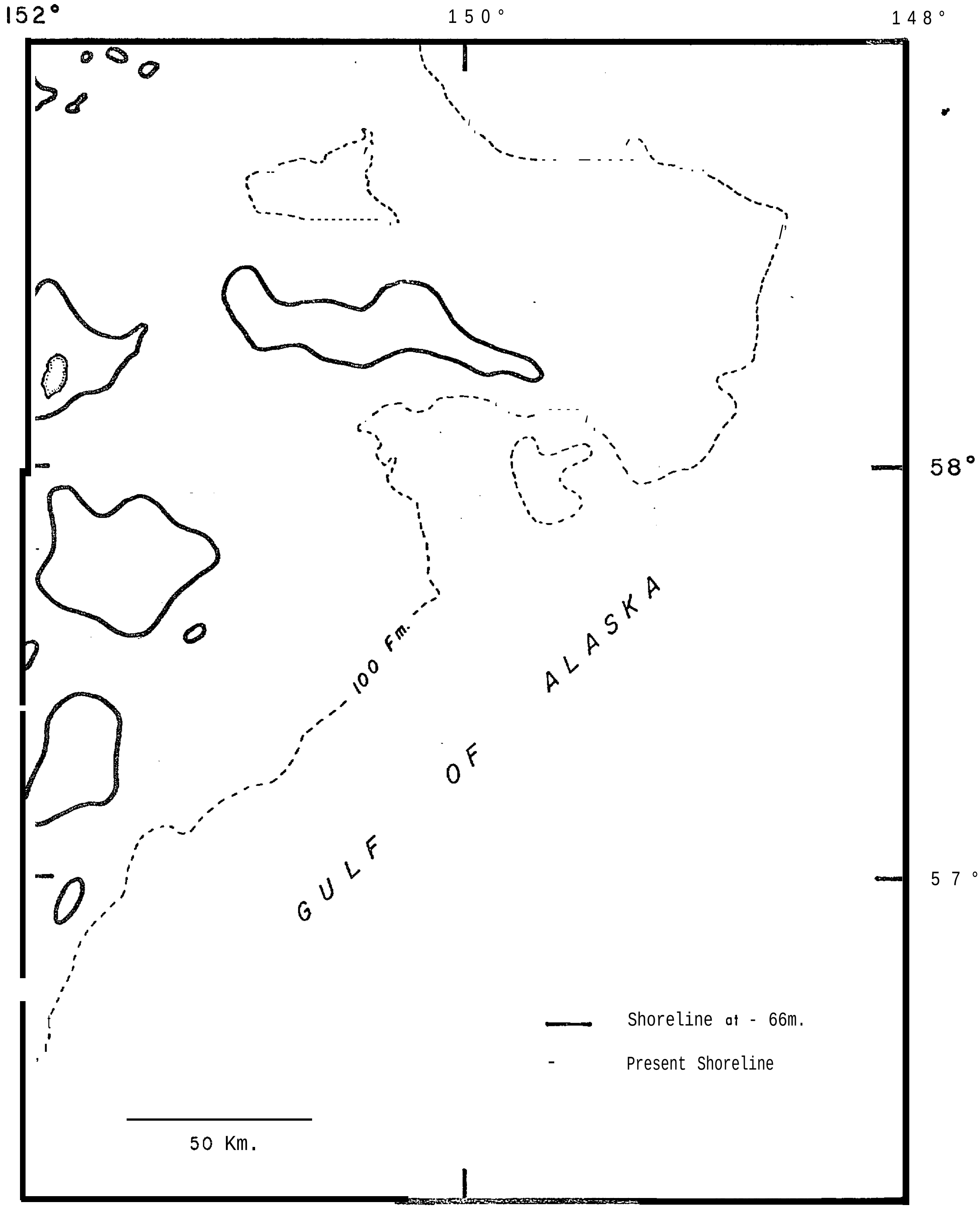


Fig. I-3 Sea level stillstand 13,750 B.P.

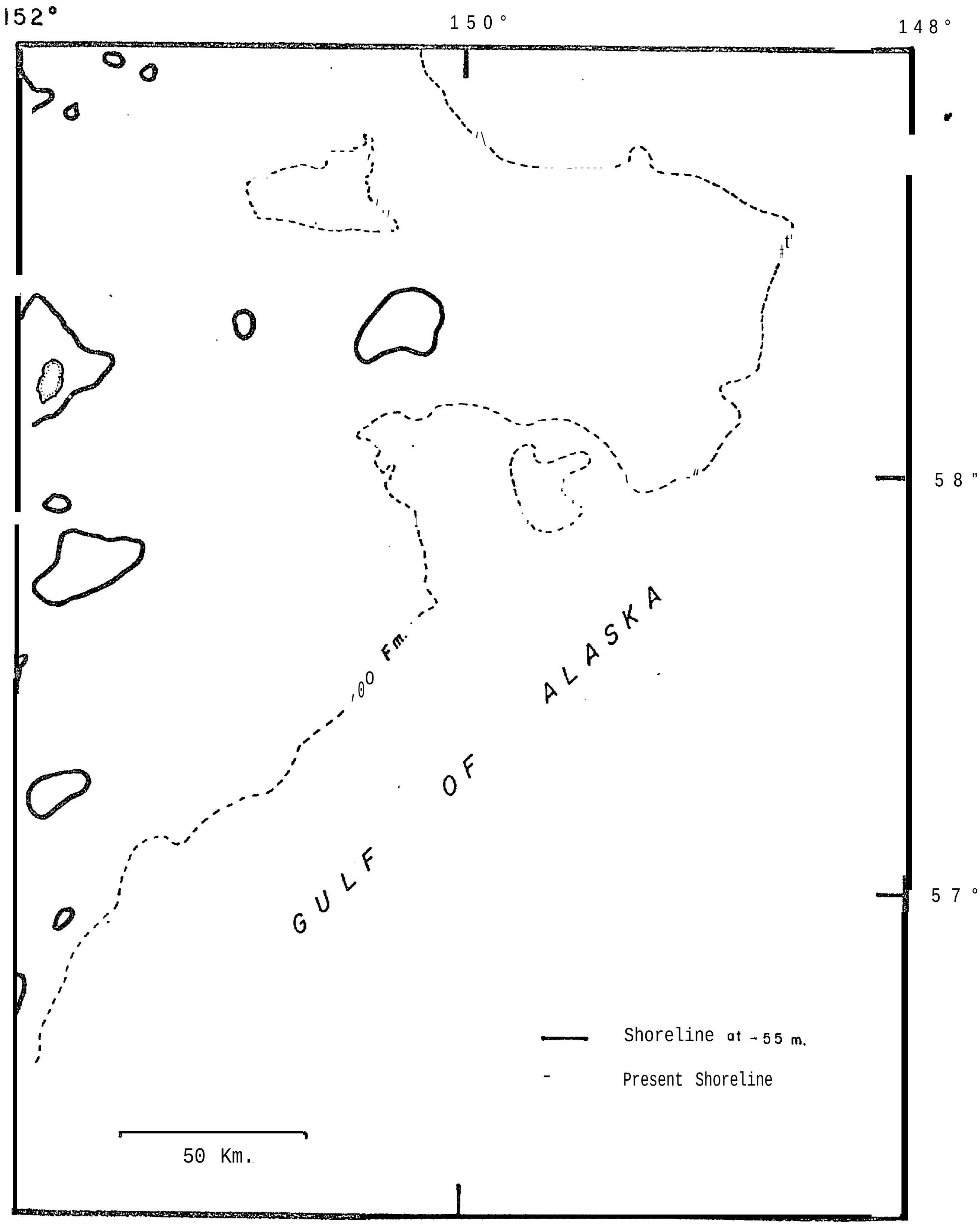


Fig. I-4. Sea level stillstand 12,700 B. I?.

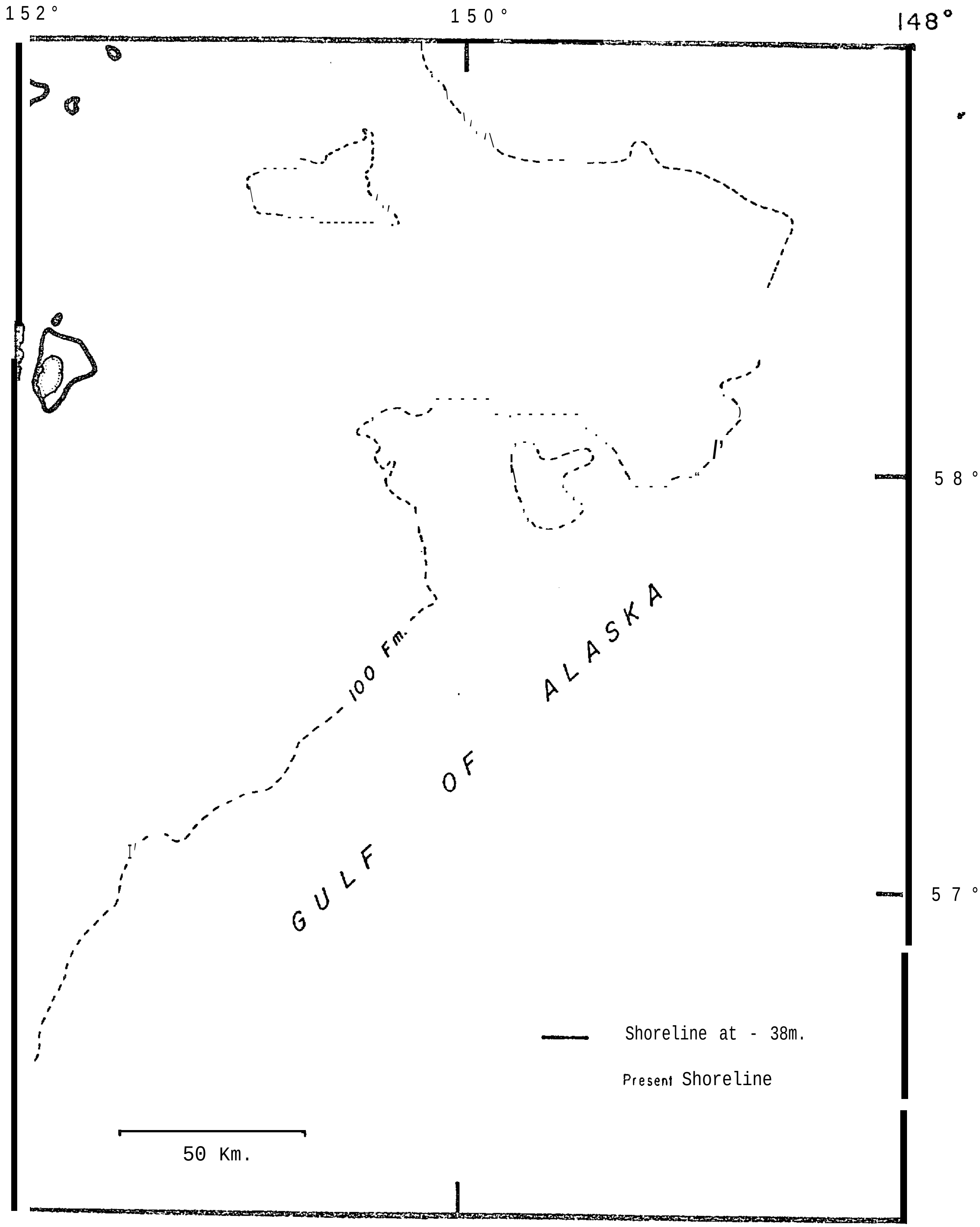


Fig. I-5 Sea level stillstand 9,400 B.P.

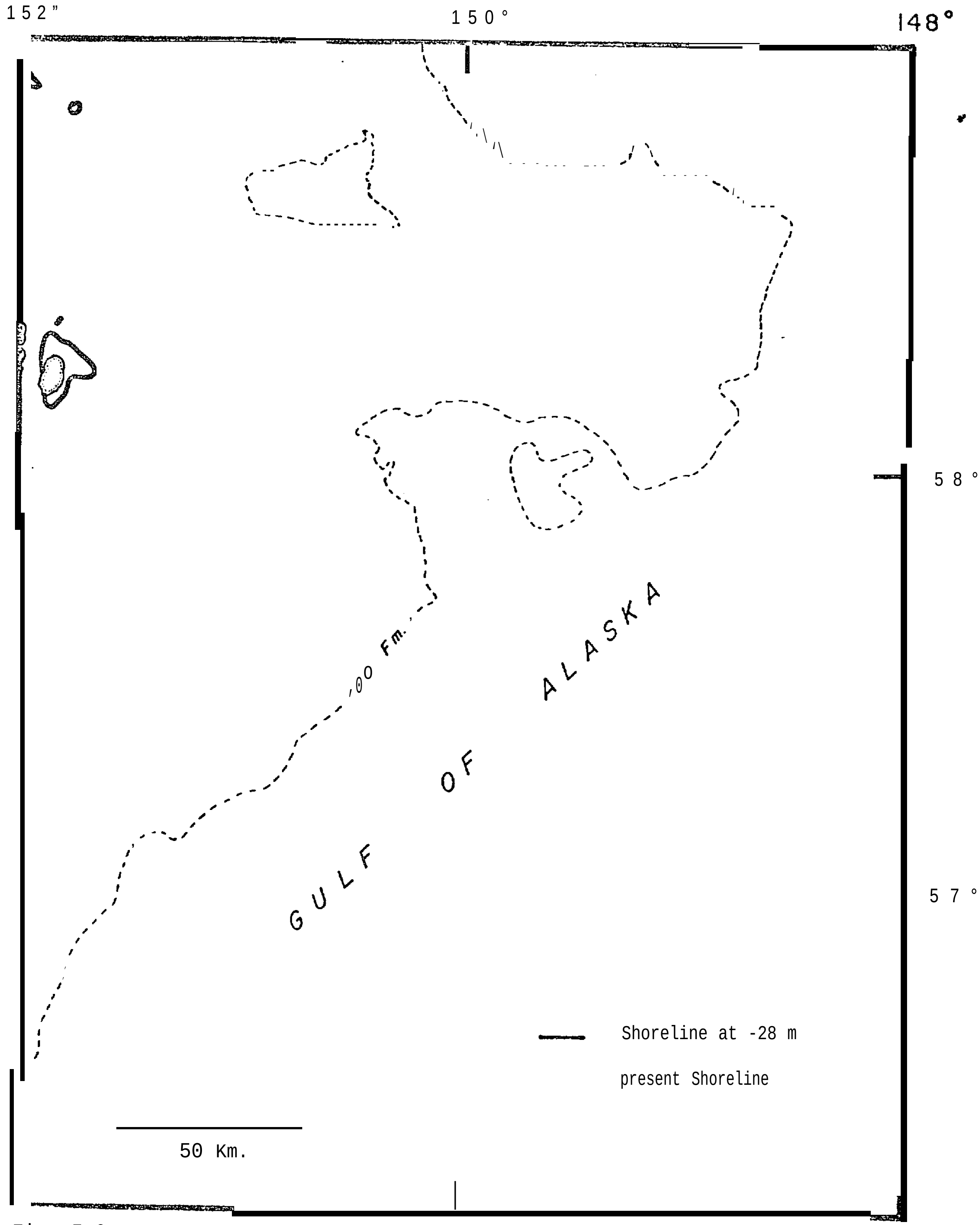


Fig. I-6 Sea level stillstand 8,700 B.P.

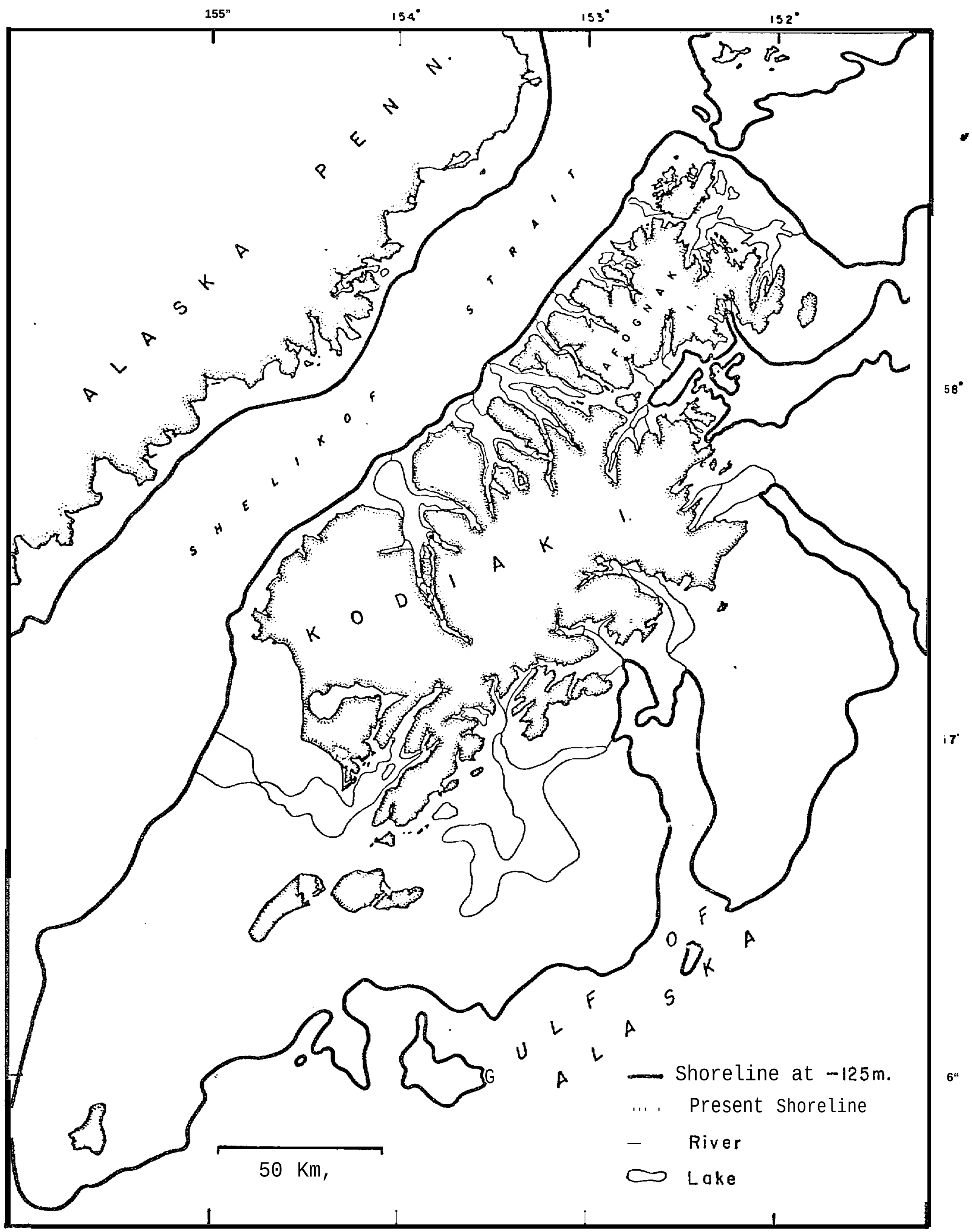


Fig. 1-7 Sea level stillstand 21,500-18,000 B.P.

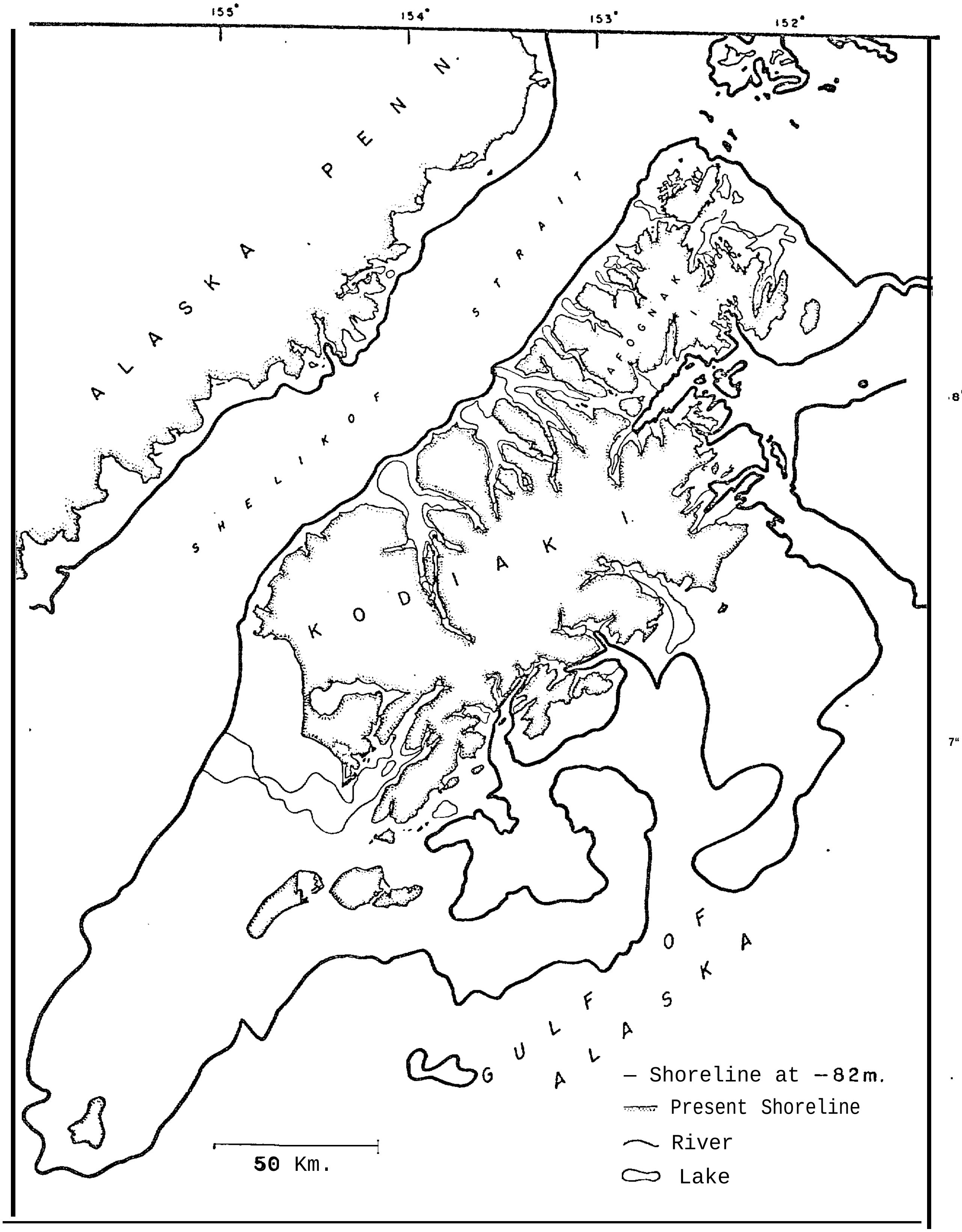


Fig. 1-8 Sea level stillstand 15,000-14,800 B.P.

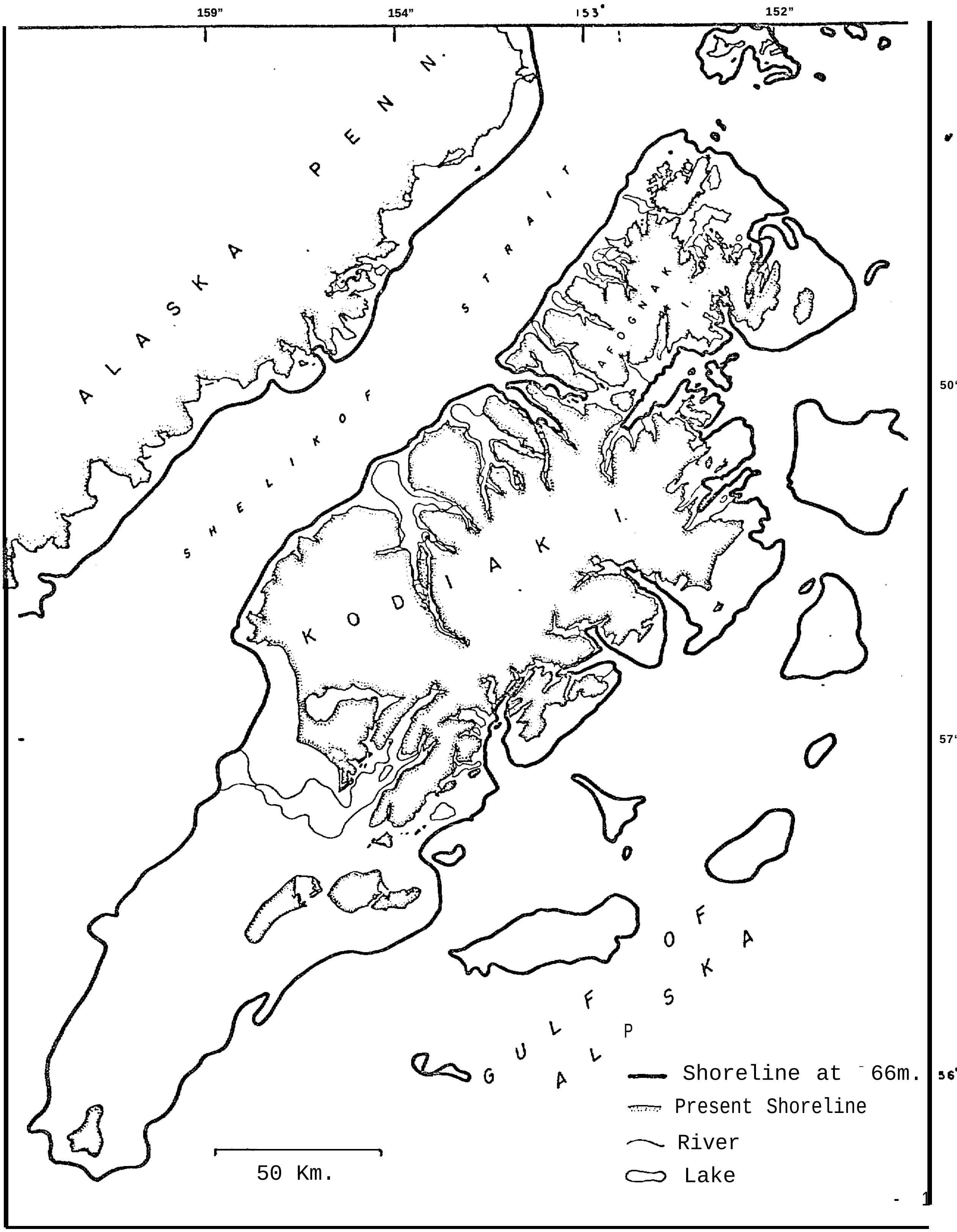


Fig. I-9 Sea level stillstand 13,750 B.P.

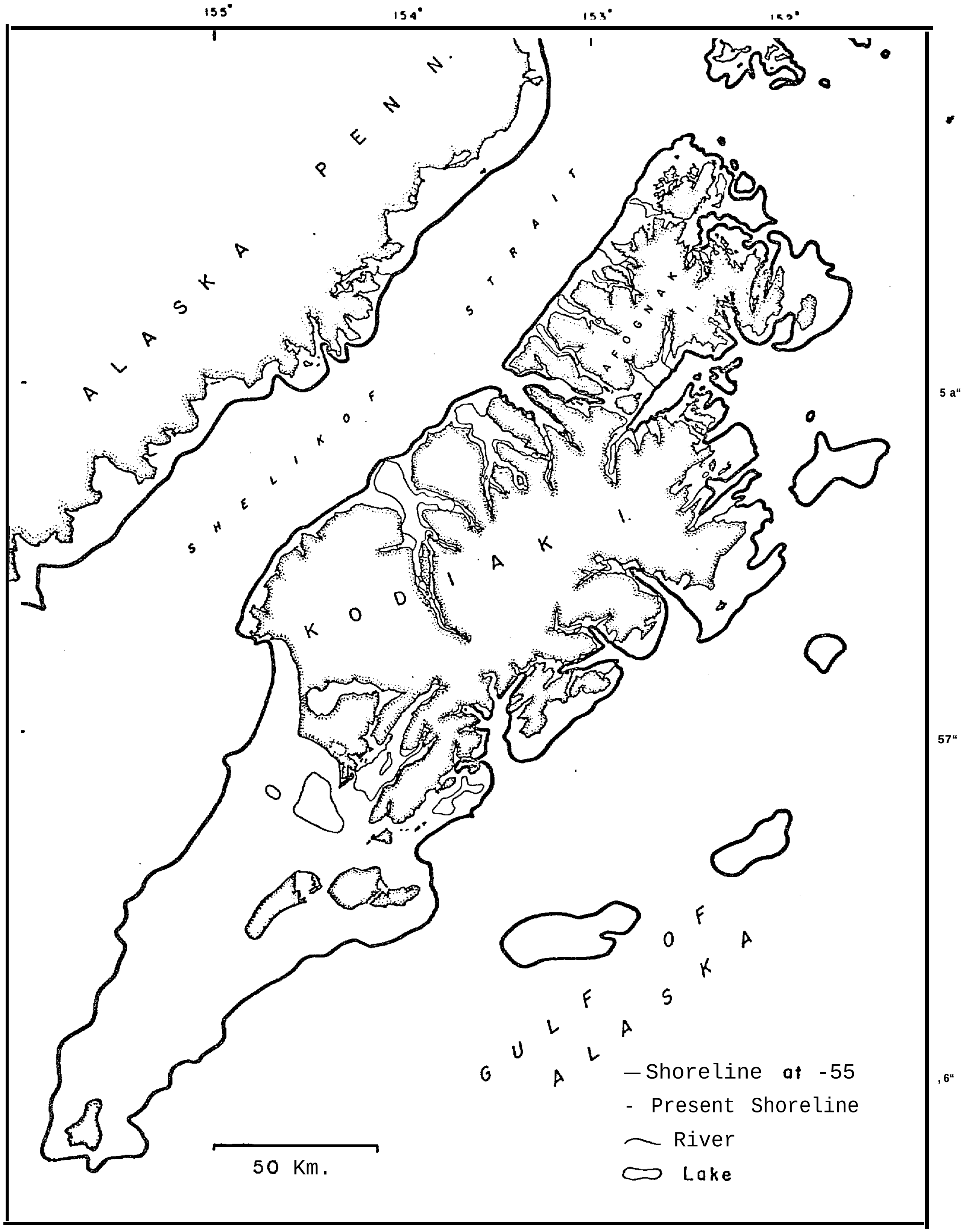


Fig. 1-10 Sea level stillstand 12,700 B.P.

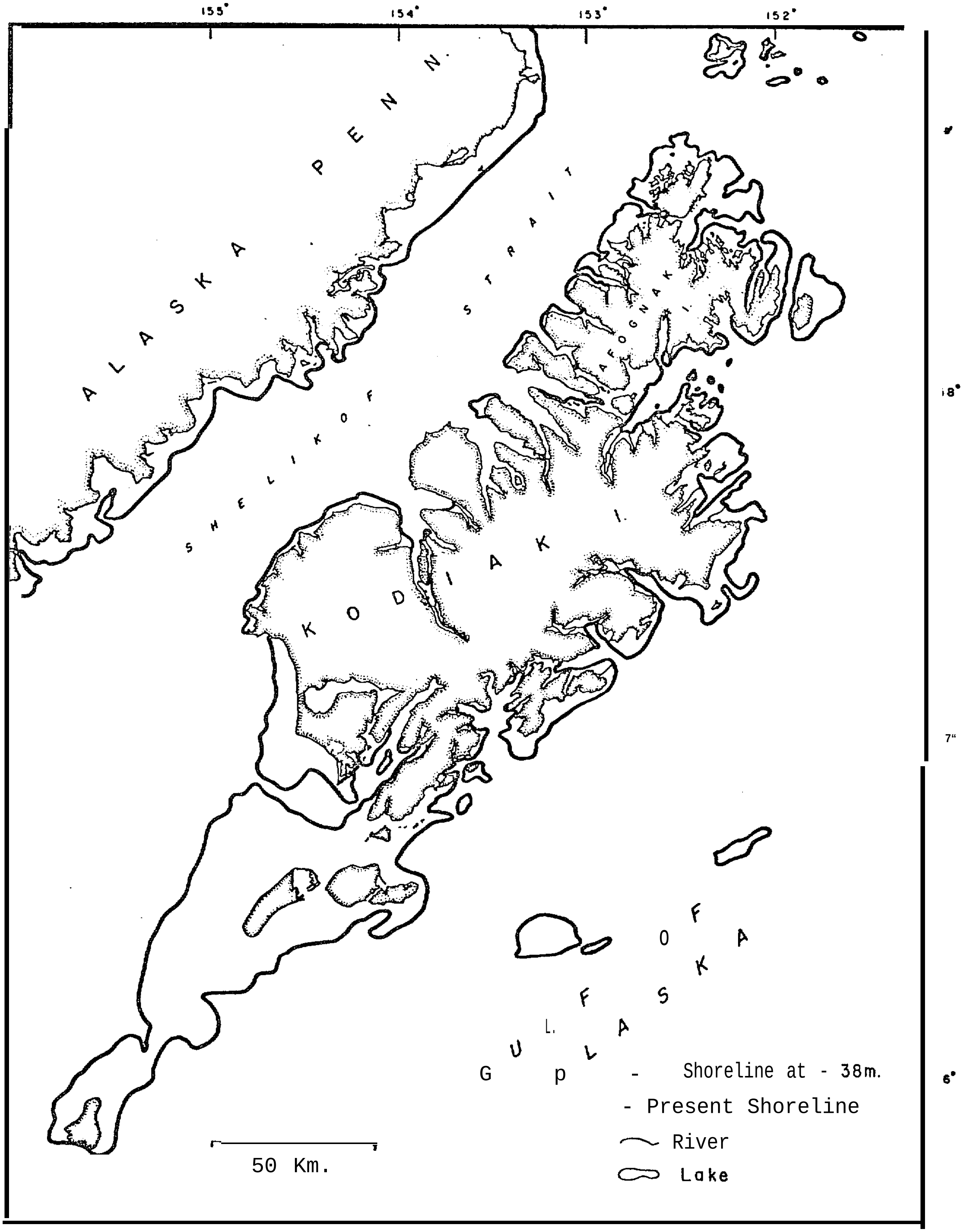


Fig. 1-11 Sea level stillstand 9,400 B.P.

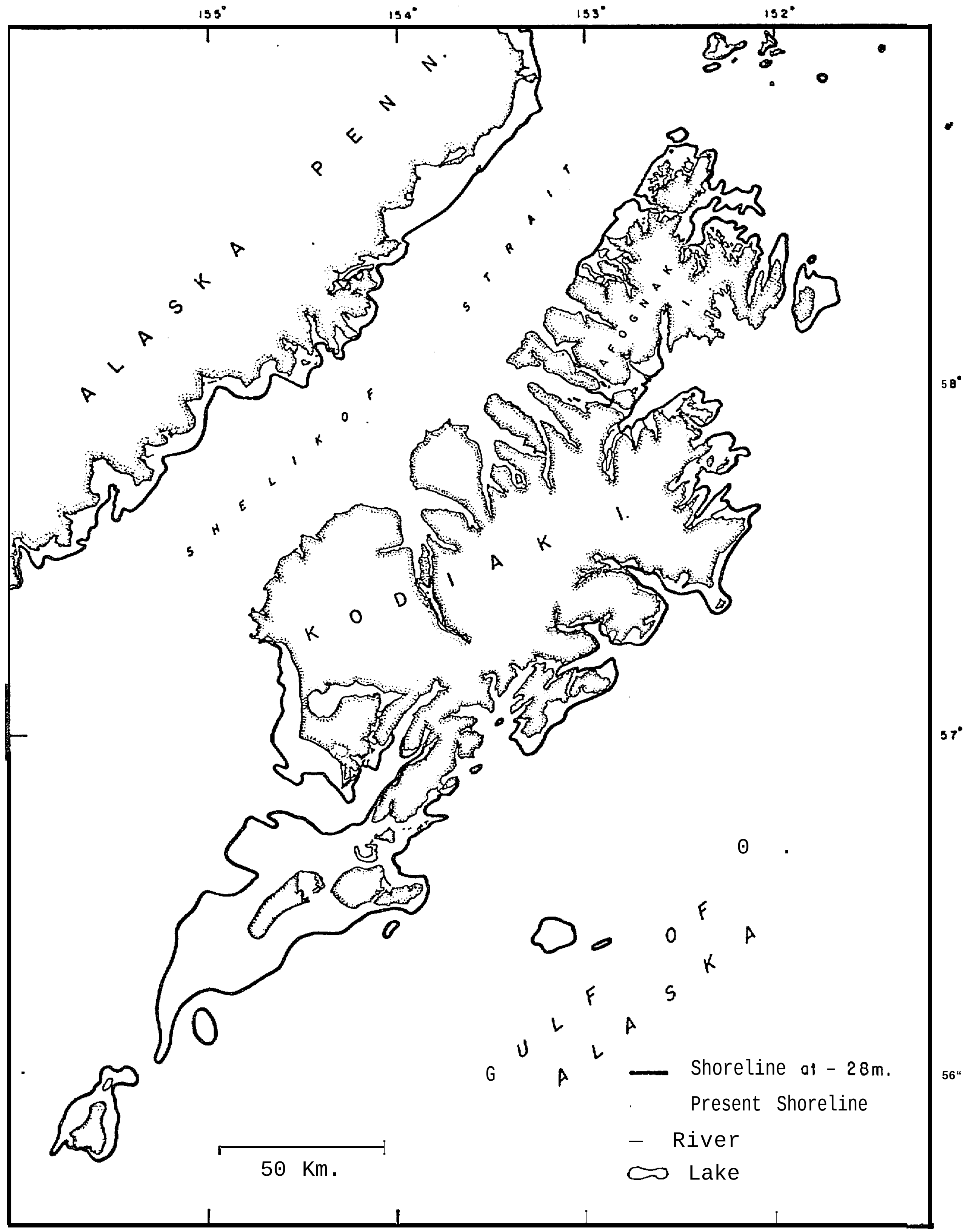


Fig. 1-12 Sea level stillstand 8,700 B.P.

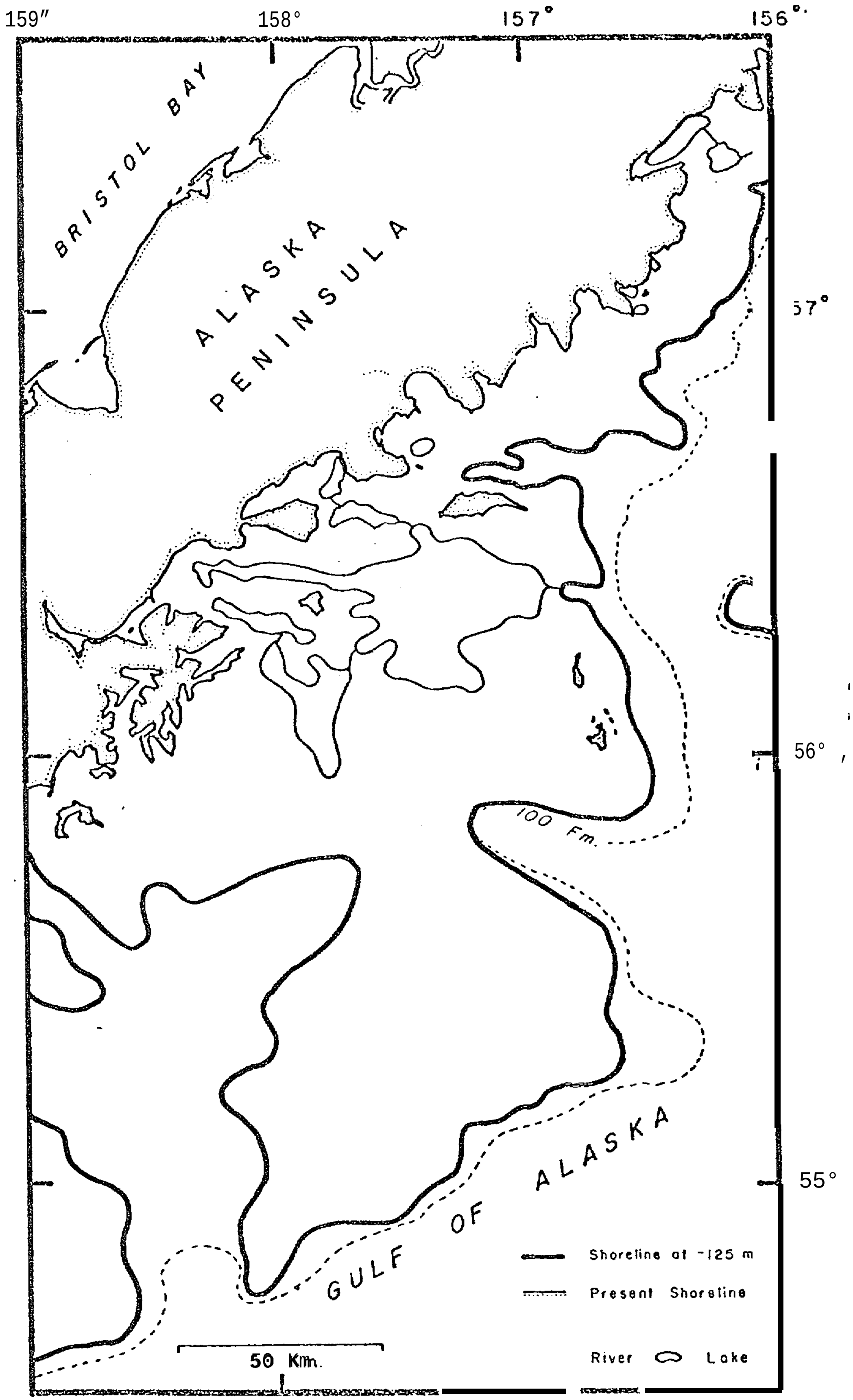


Fig. I-13 Sea level stillstand 21,500-18,000 B.P.

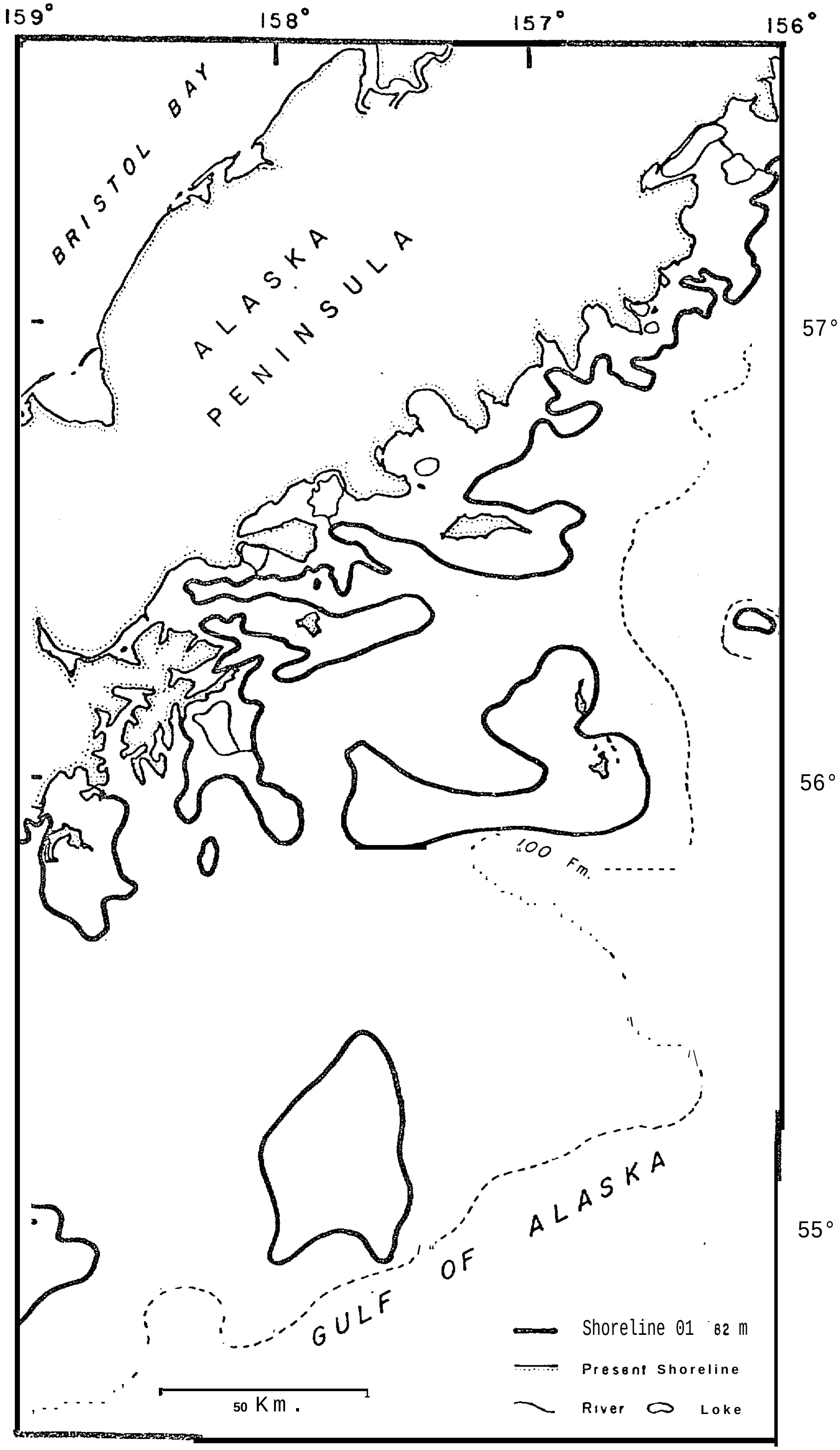


Fig. 1-14 Sea level stillstand 15,000-14,800 B.P.

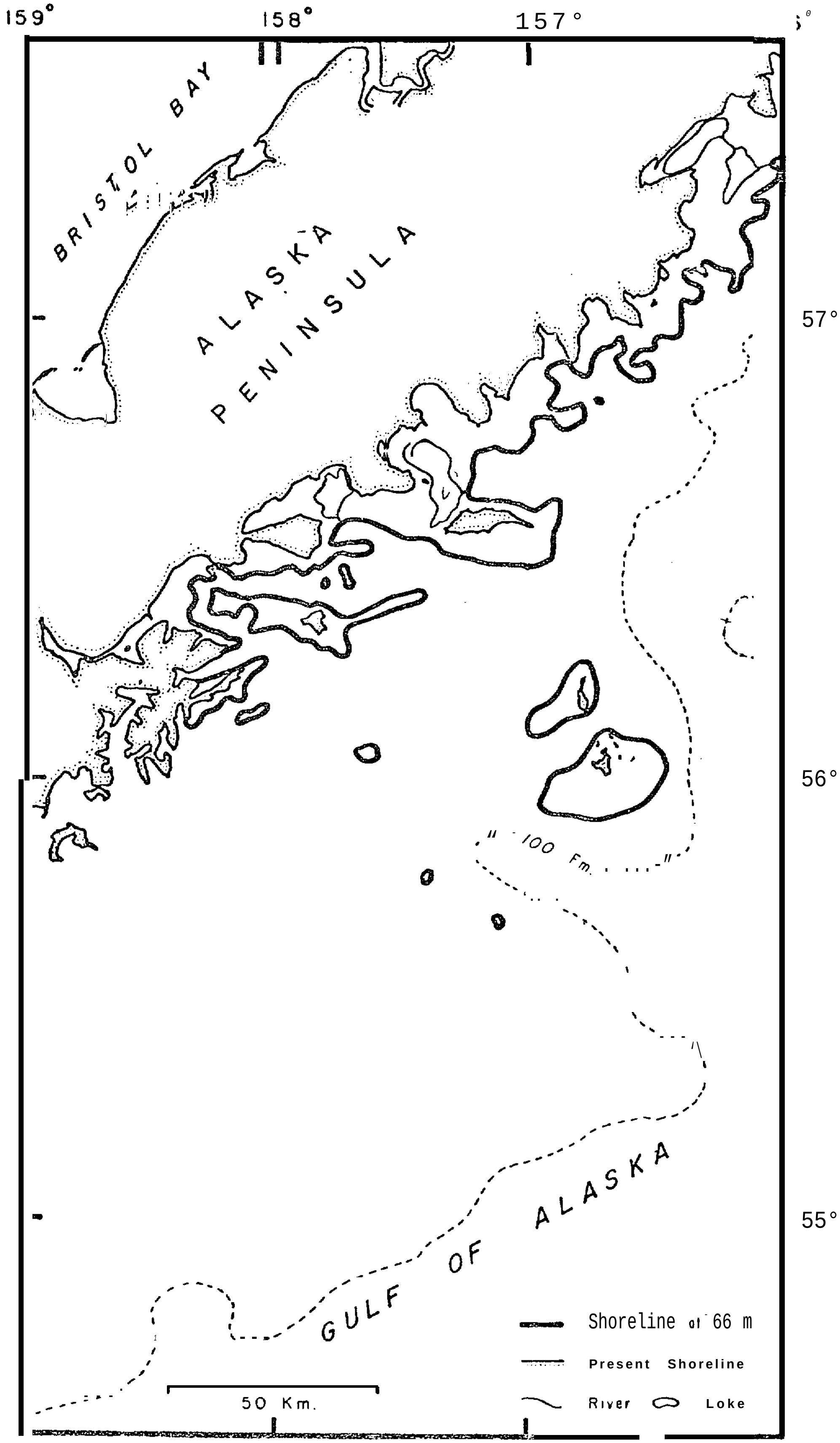


Fig. I-15 Sea level stillstand 13,750 B.P.

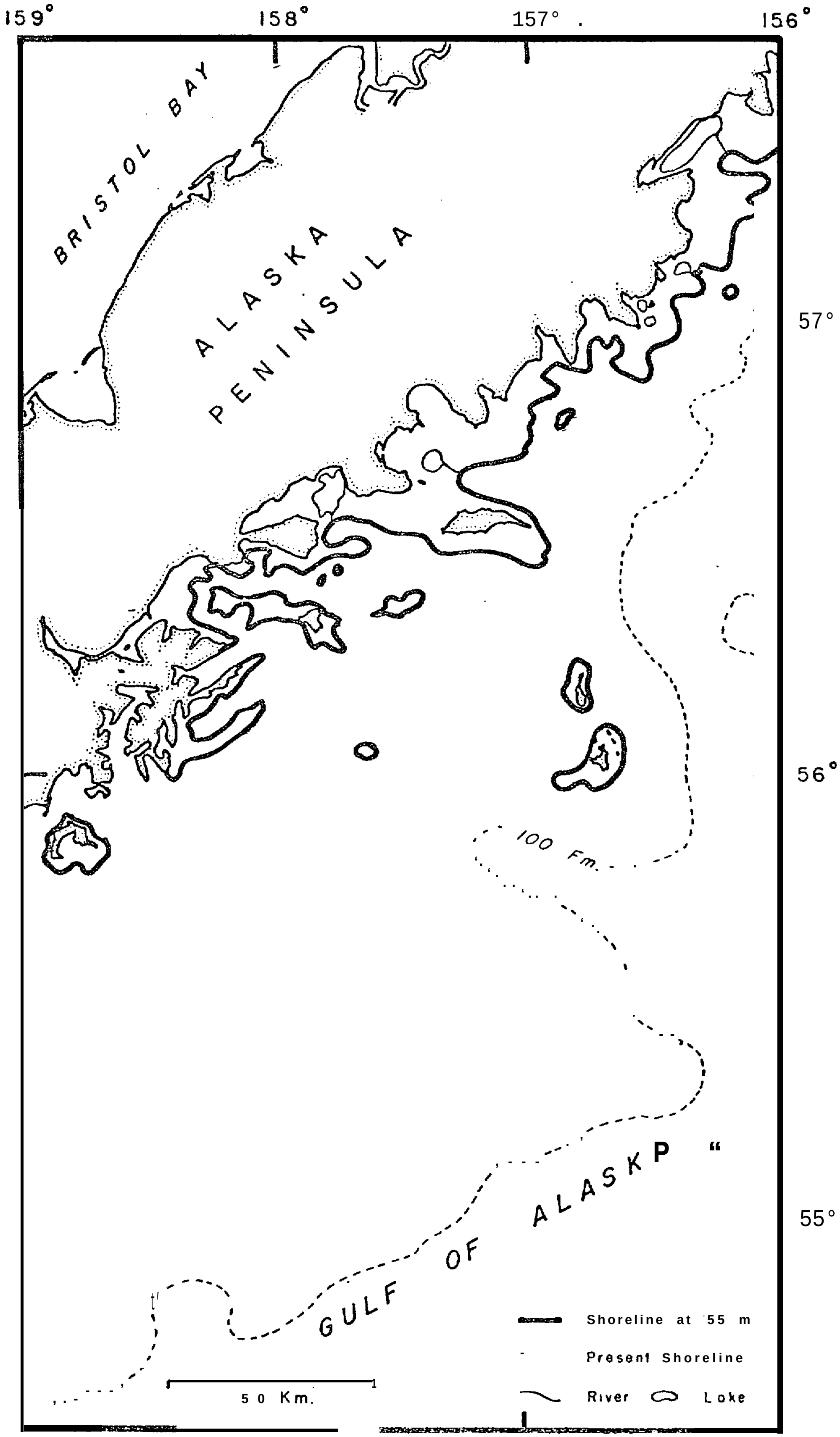


Fig. 1-16 Sea level stillstand 12,700 B.P.

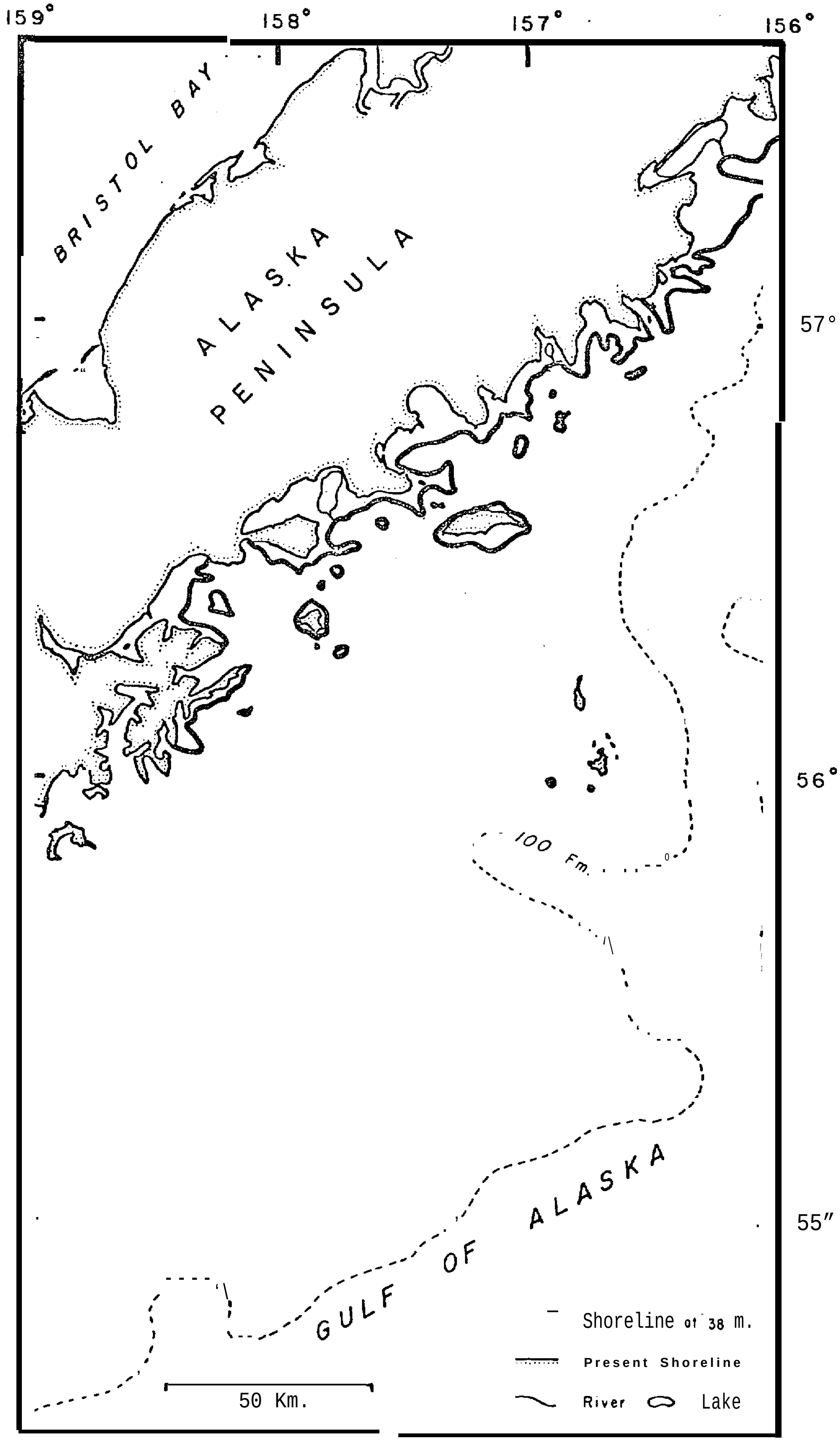


Fig. I-17 Sea level stillstand 9,400 B.P.

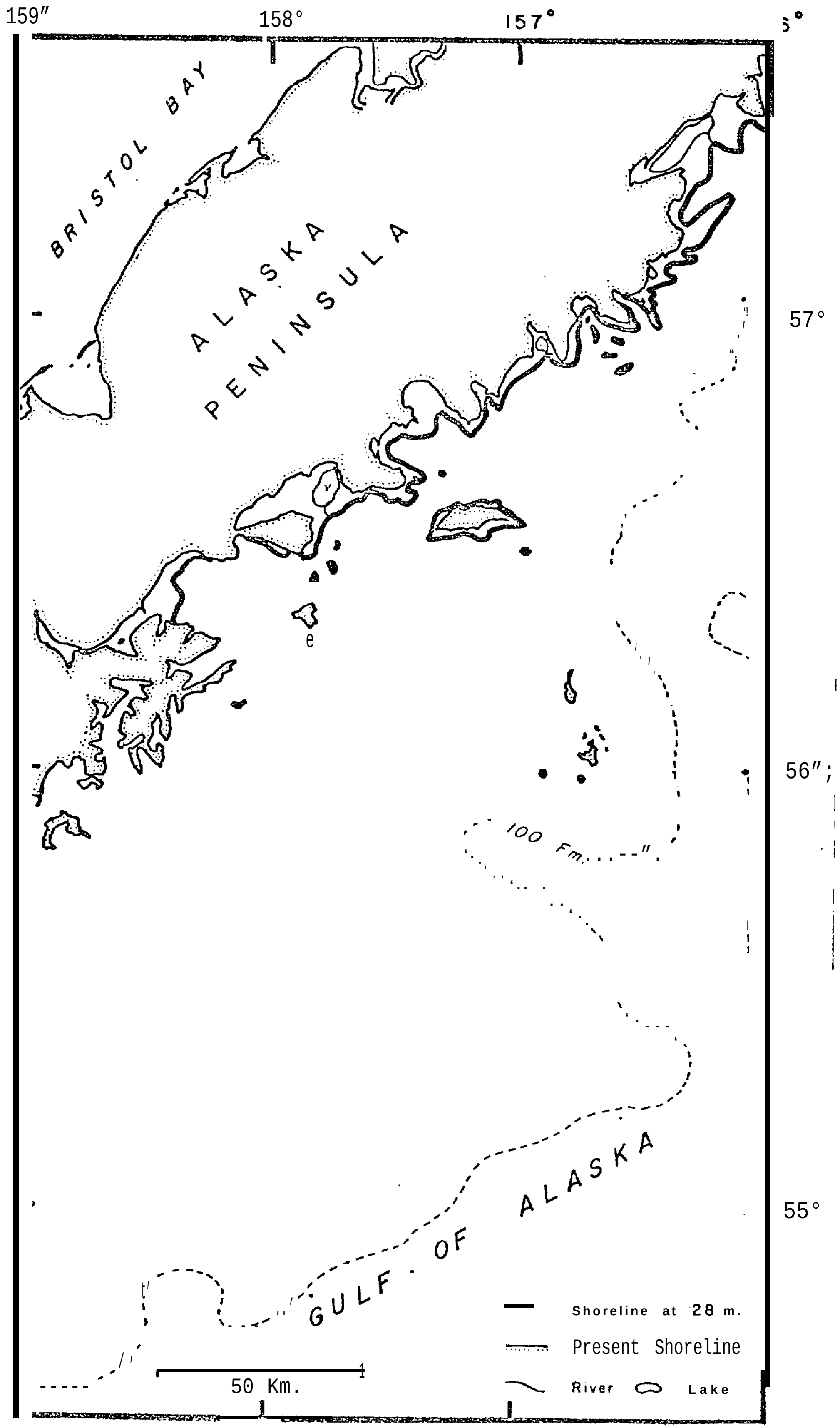


Fig. I-18 Sea level stillstand 8,700 B.P.

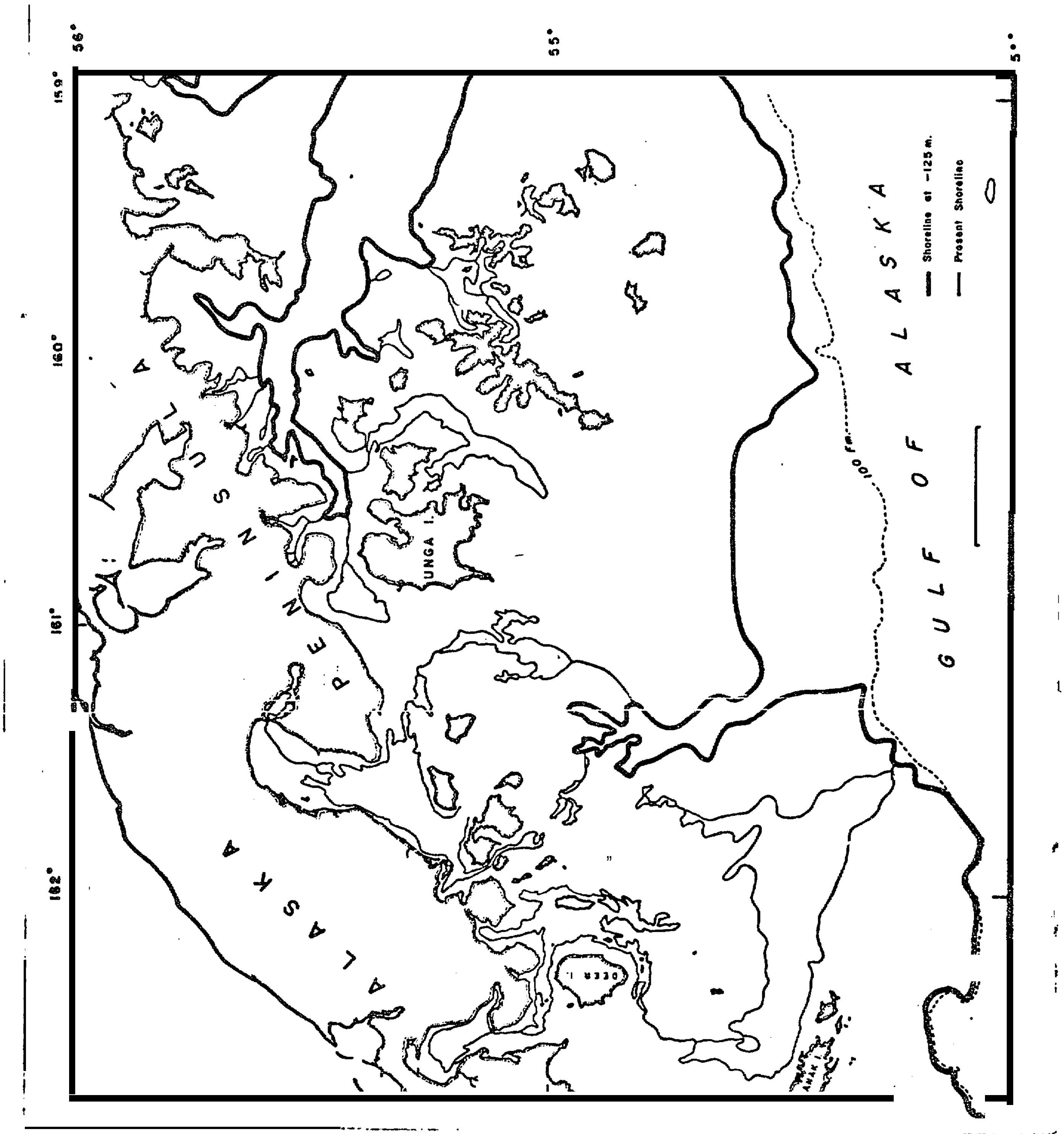


Fig. 1-19 Sea level stillstand 21,500-18,000 B.P.

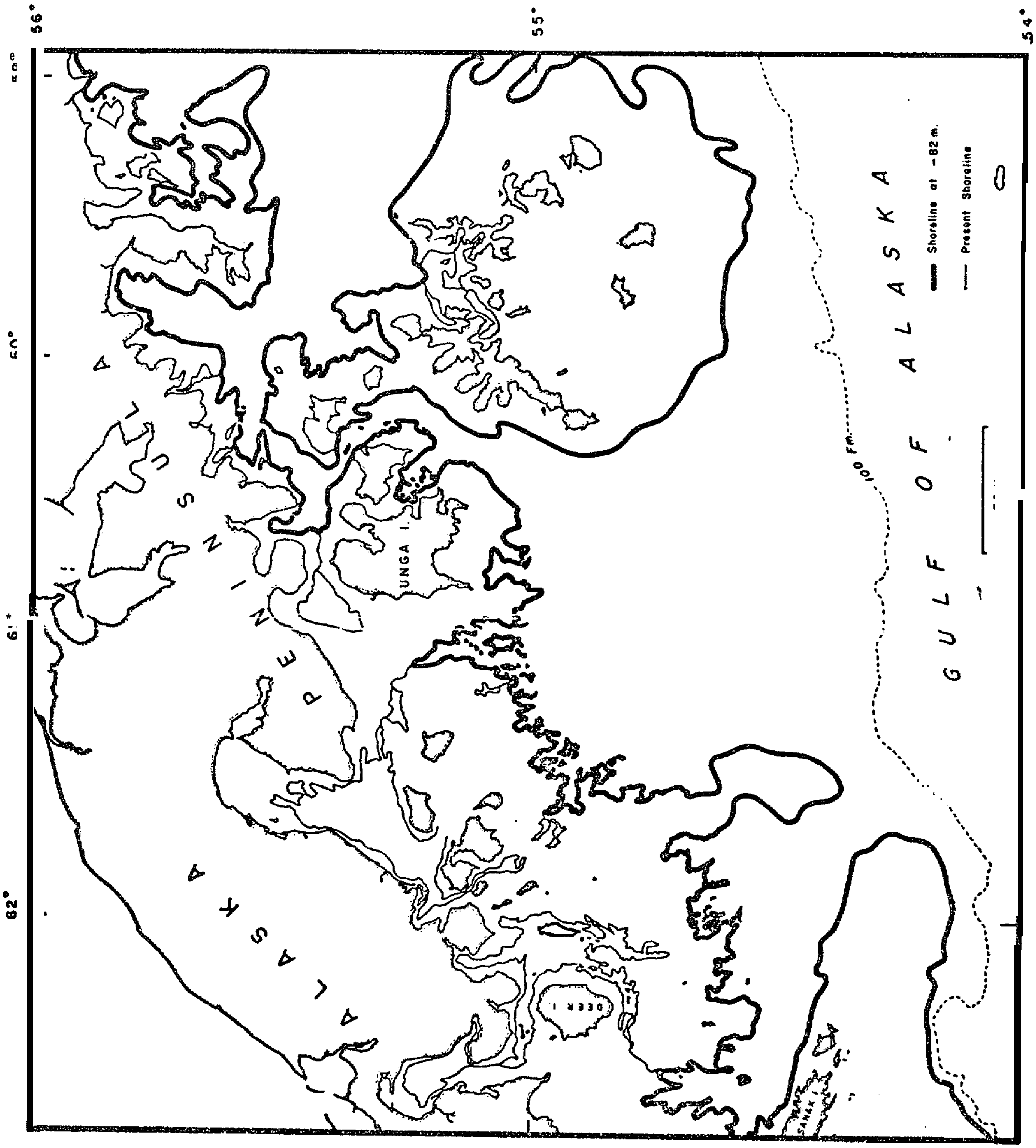


Fig. 1-20 Sea level stillstand 15,000-14,800 B.P.

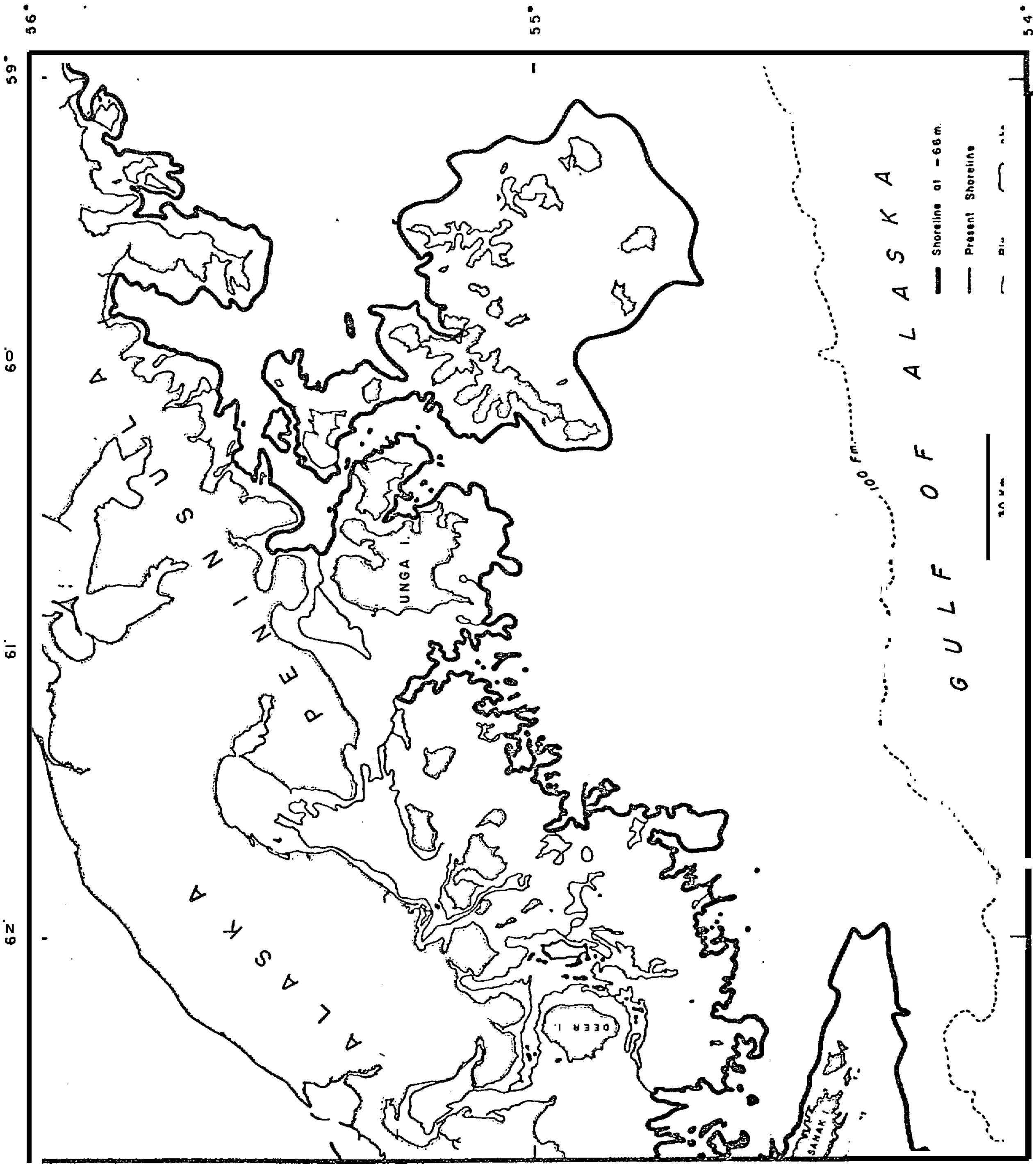


Fig. 1-21 Sea level stillstand 13,750 B.P.

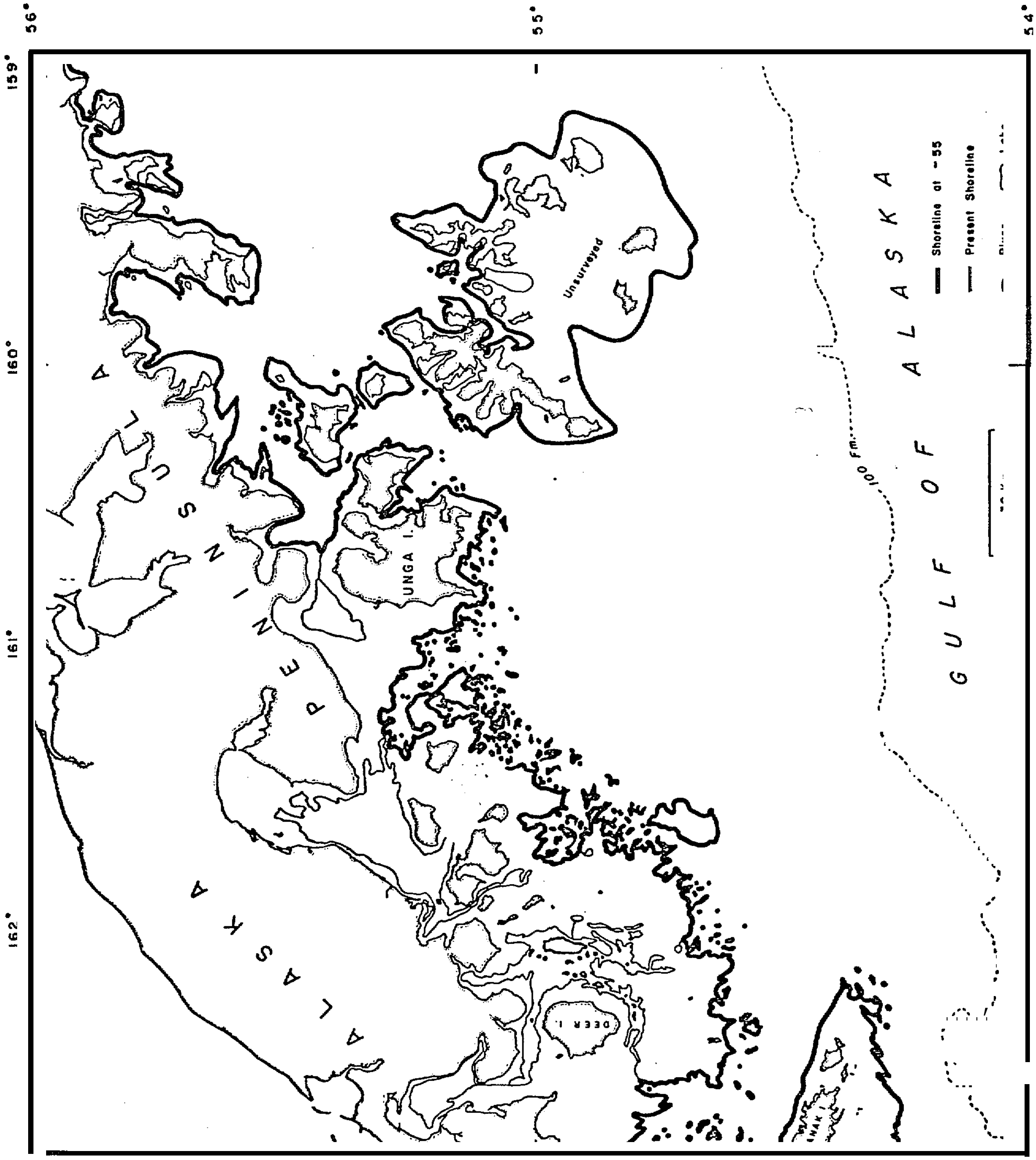


Fig. I-22 Sea level stillstand 12,700 B.P.

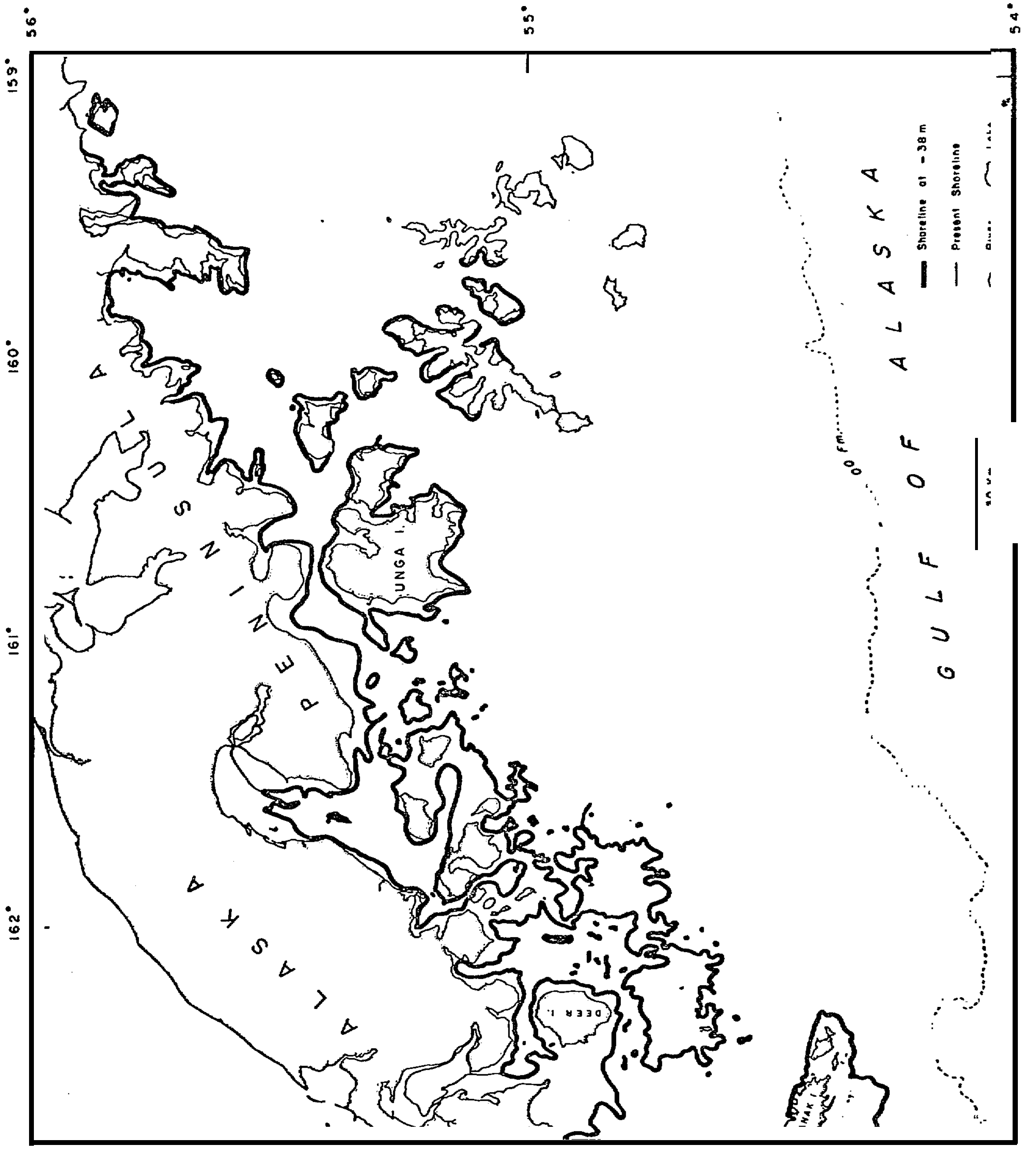


Fig. I-23 Sea level stillstand 9,400 B.P.

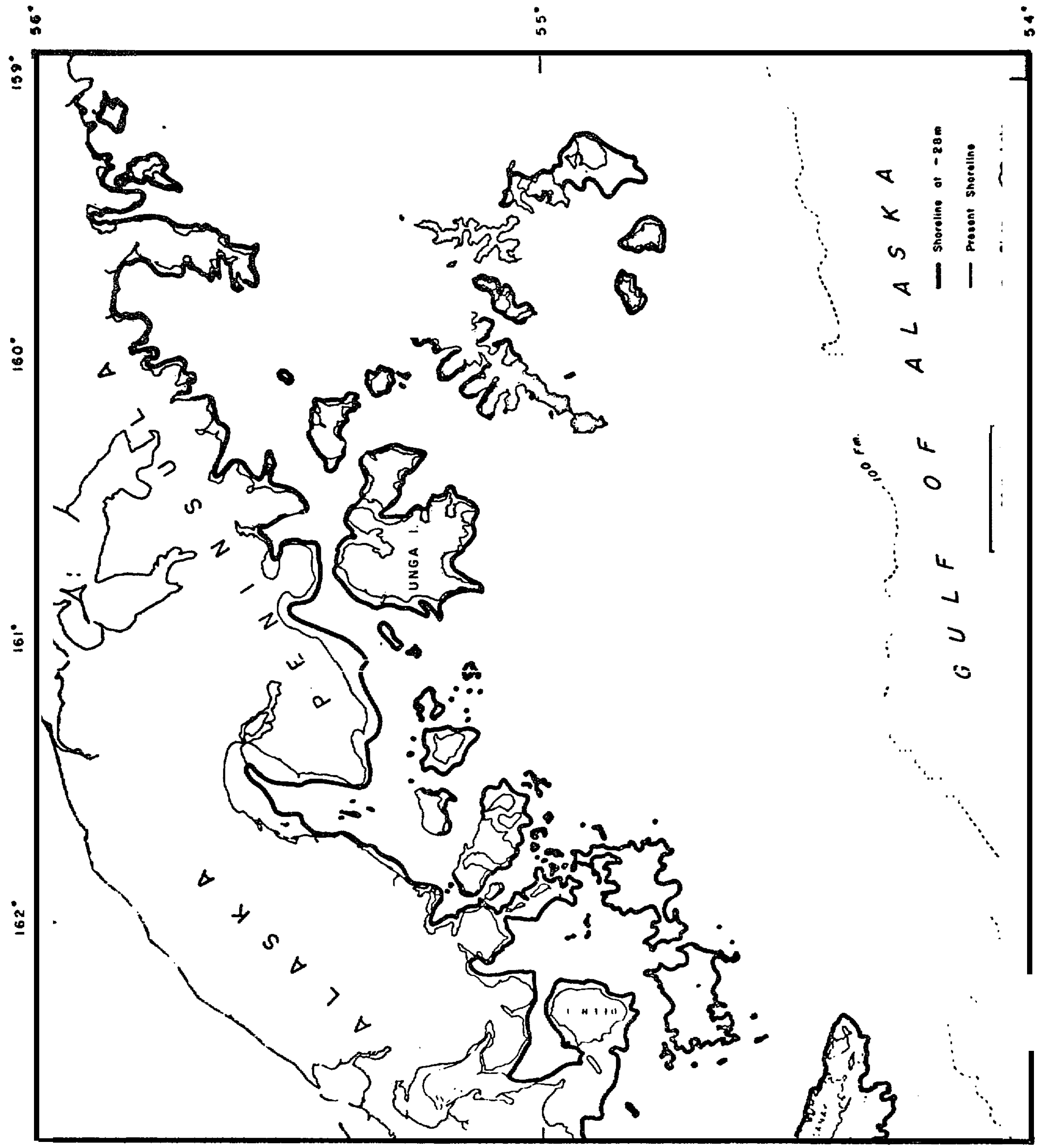


Fig. 1-24 Sea level stillstand 8,700 B.P.

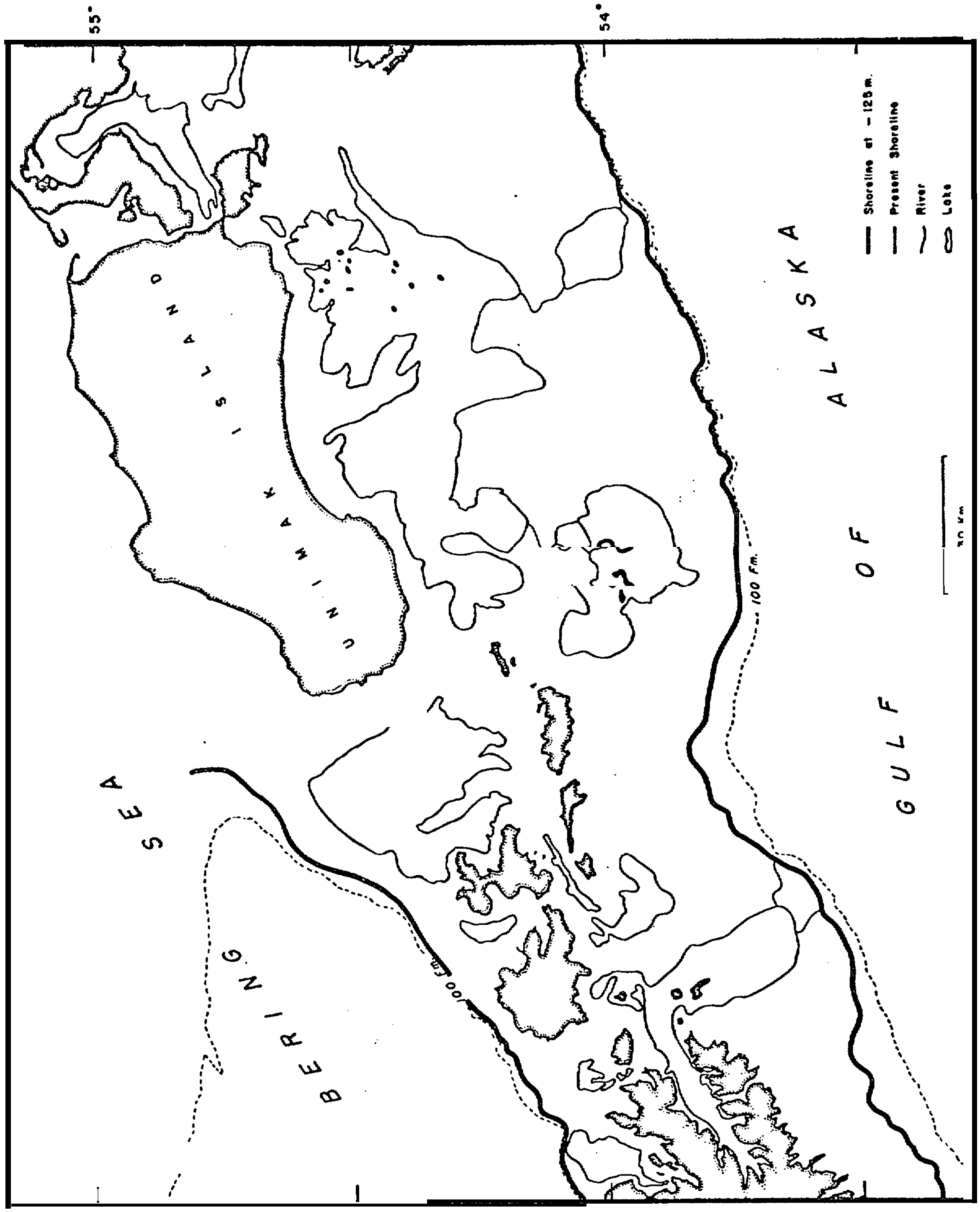


Fig. T-25 Sea level stillstand 21,500-18,000 B.P.

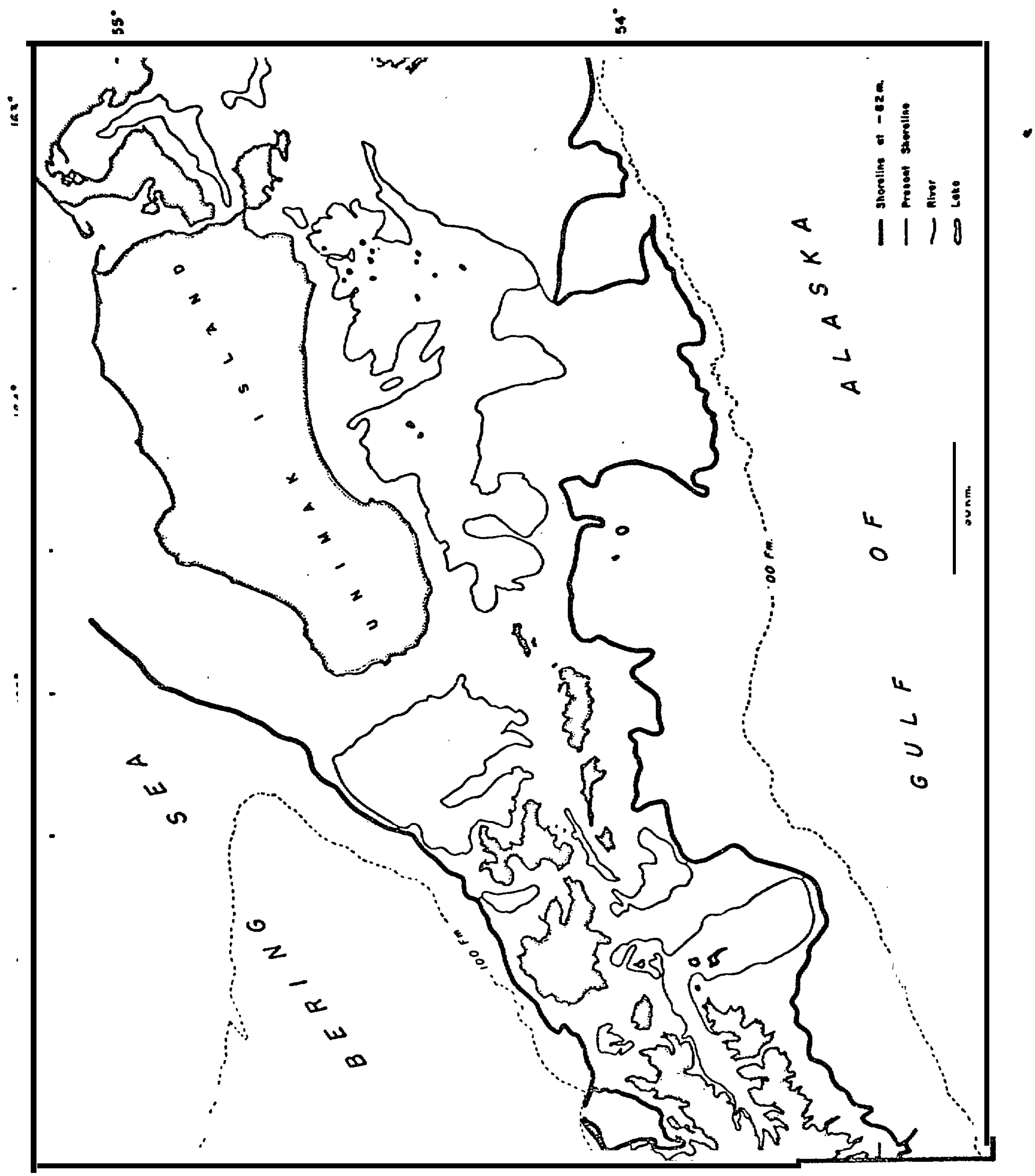


Fig. I-26 Sea level stillstand 15,000-14,800 B.P.

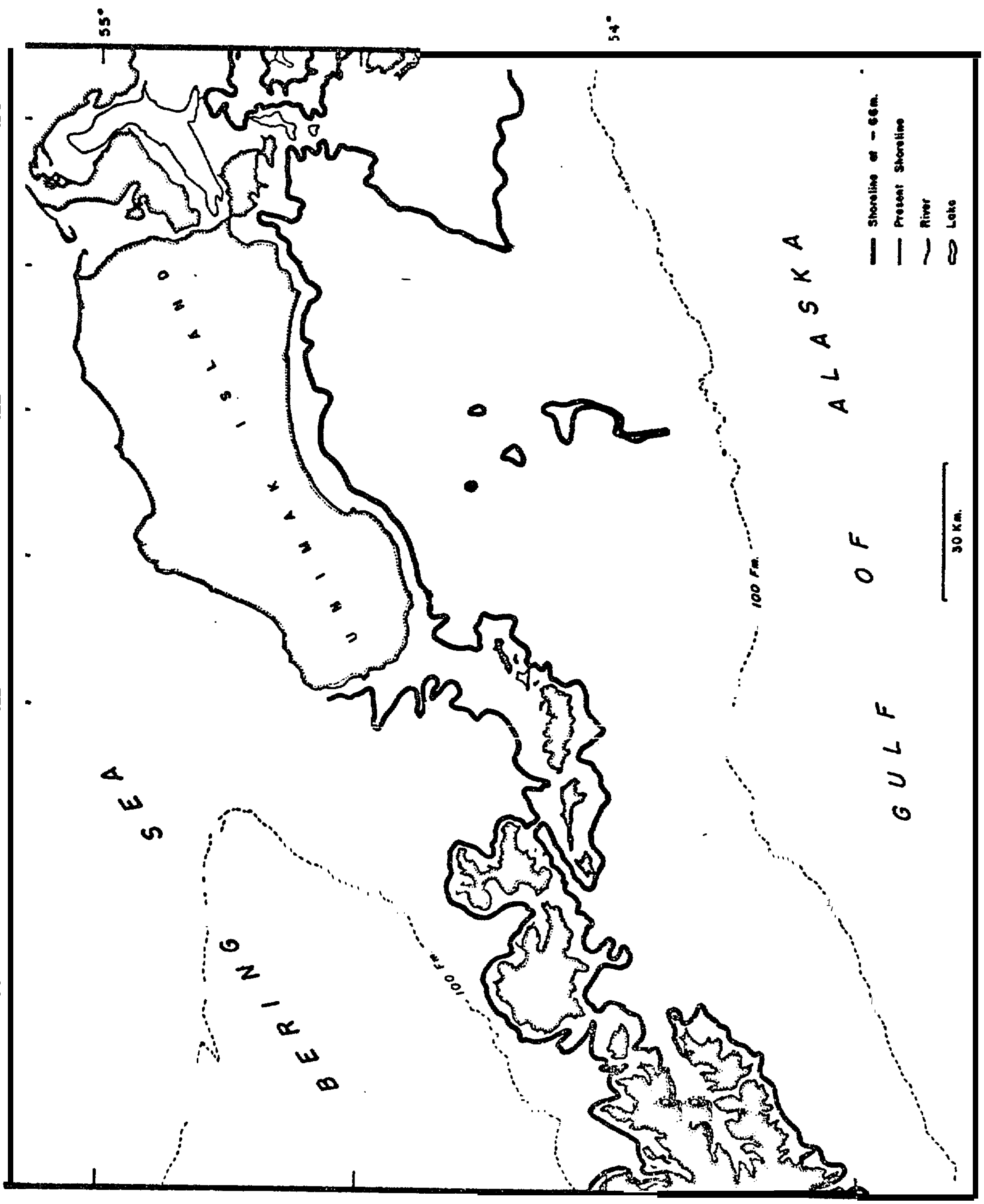


Fig. I-27 Sea level stillstand 13,750 B.P.

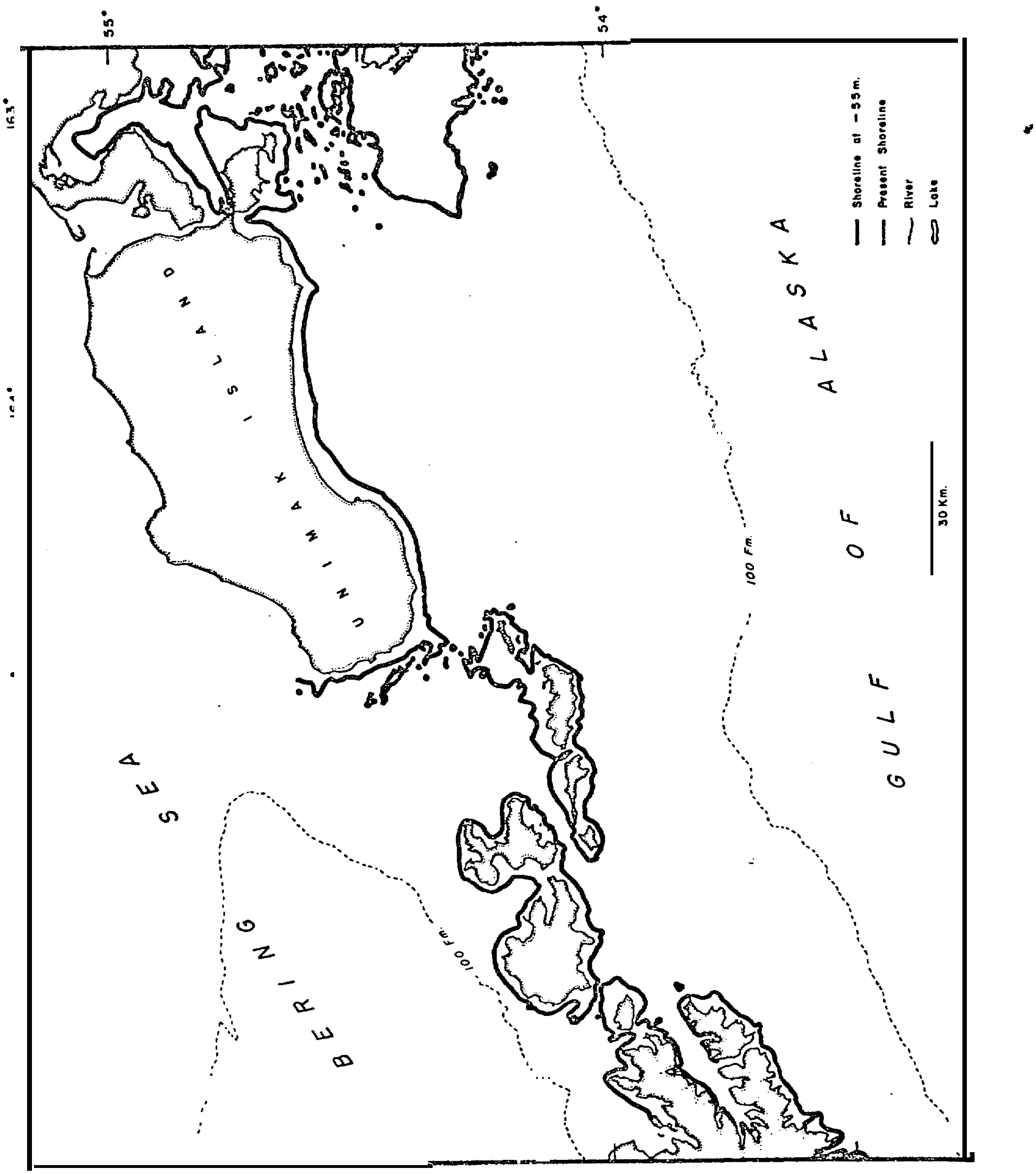


Fig. I-28 Sea level stillstand 12,700 B.P.

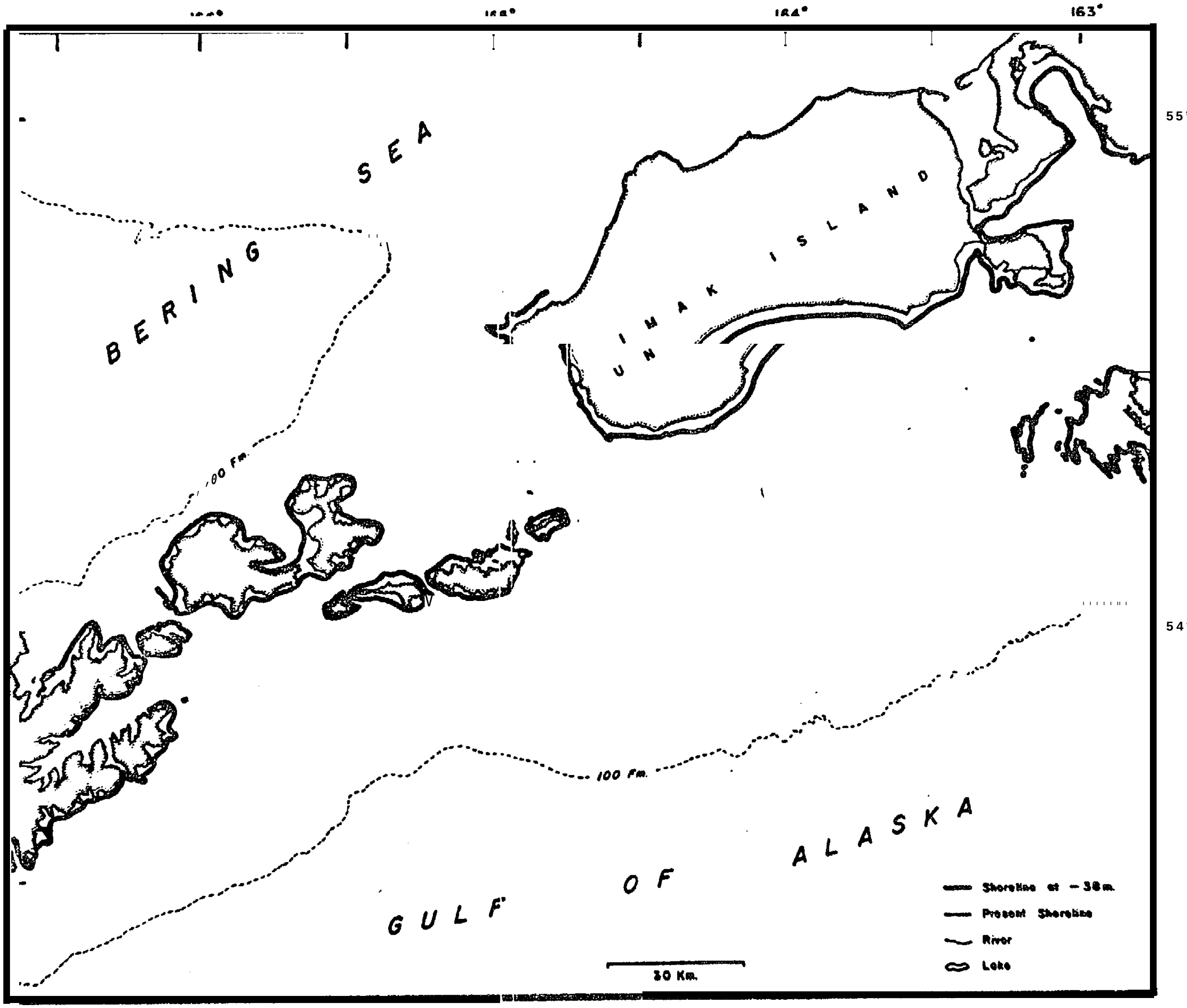


Fig. I-29 Sea level stillstand 9,400 B.P.

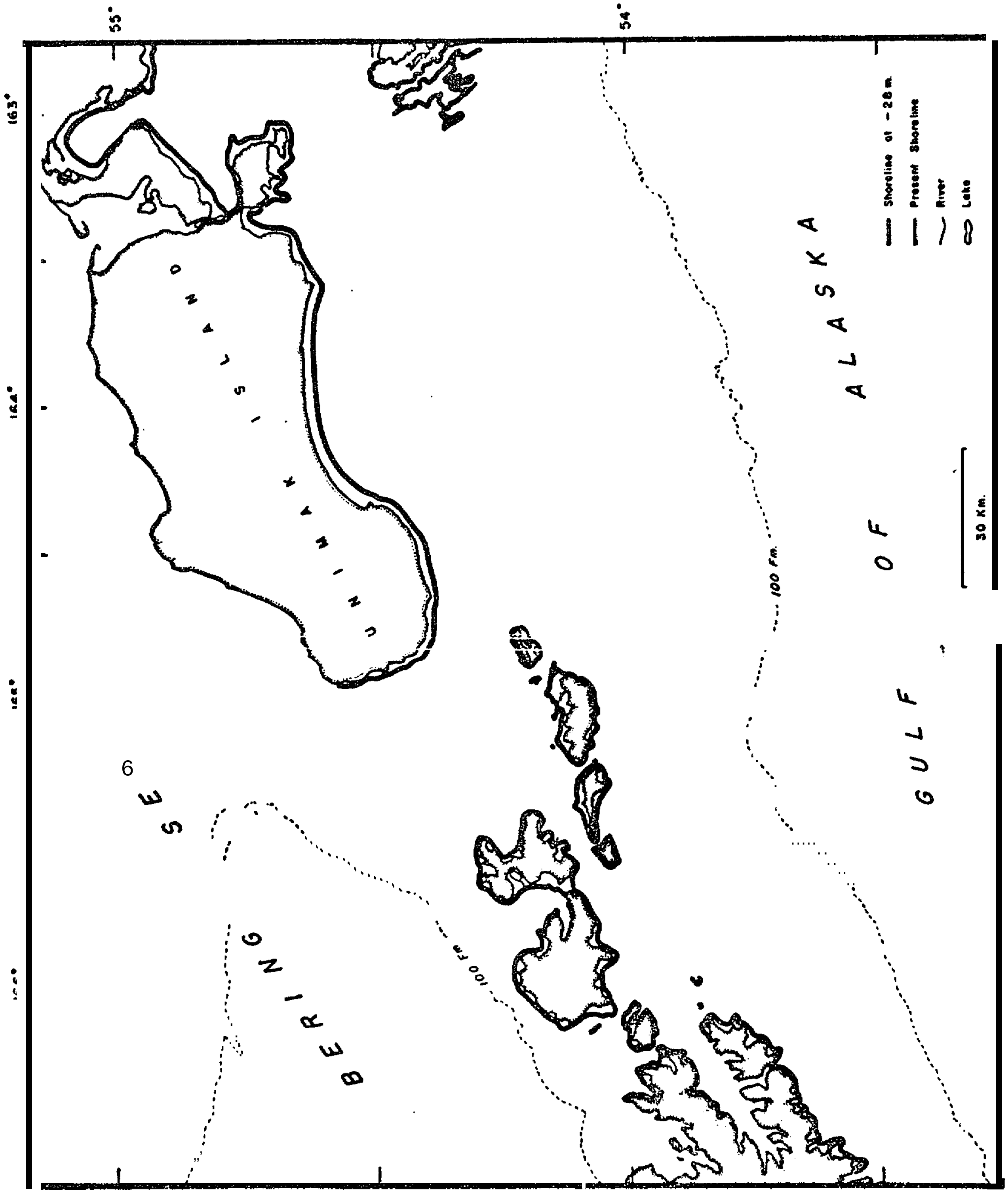


Fig. Z-30 Sea level stillstand 8,700 B.P.

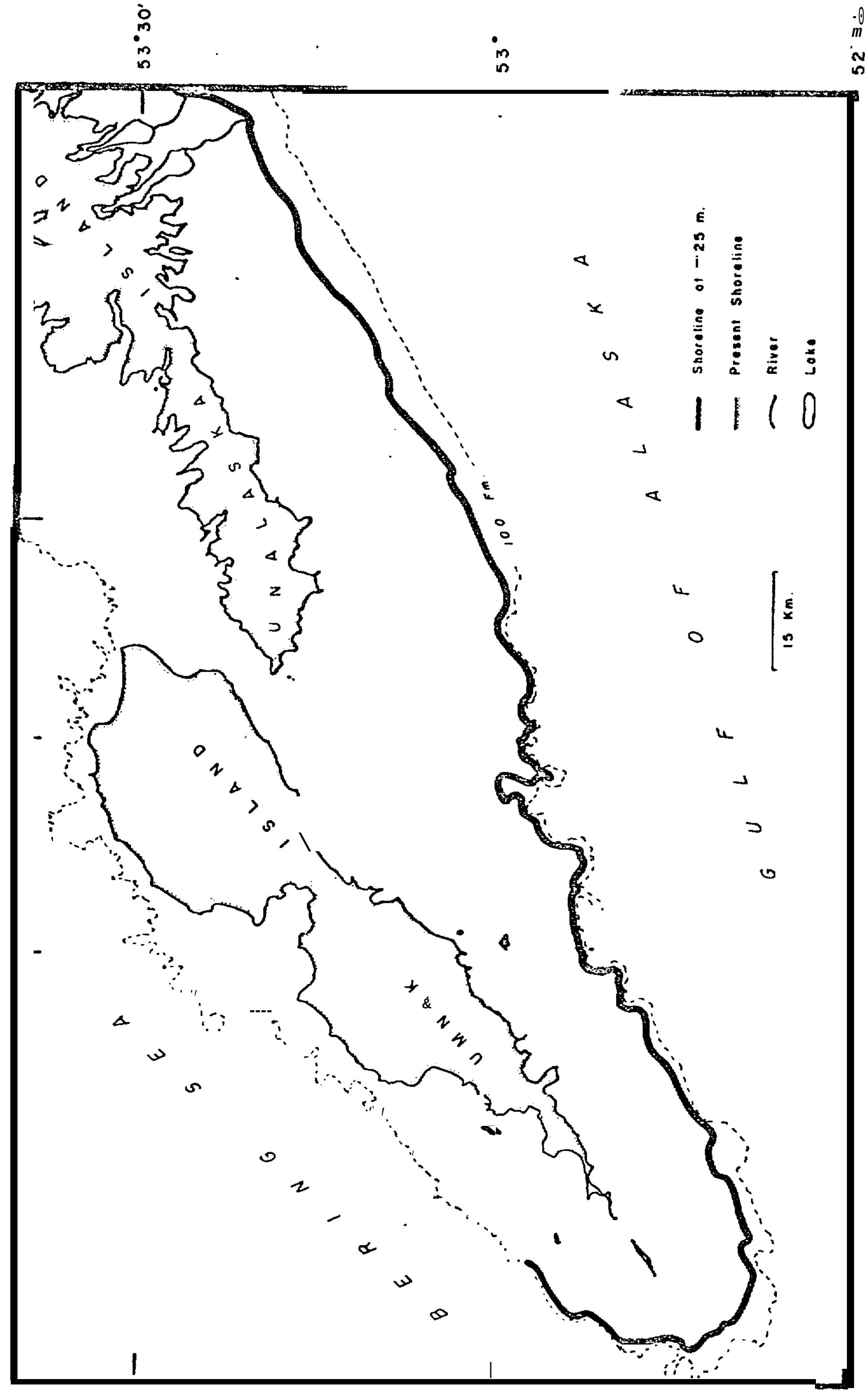


Fig. I-31 Sea level stillstand 21,500-18,000 B.P.

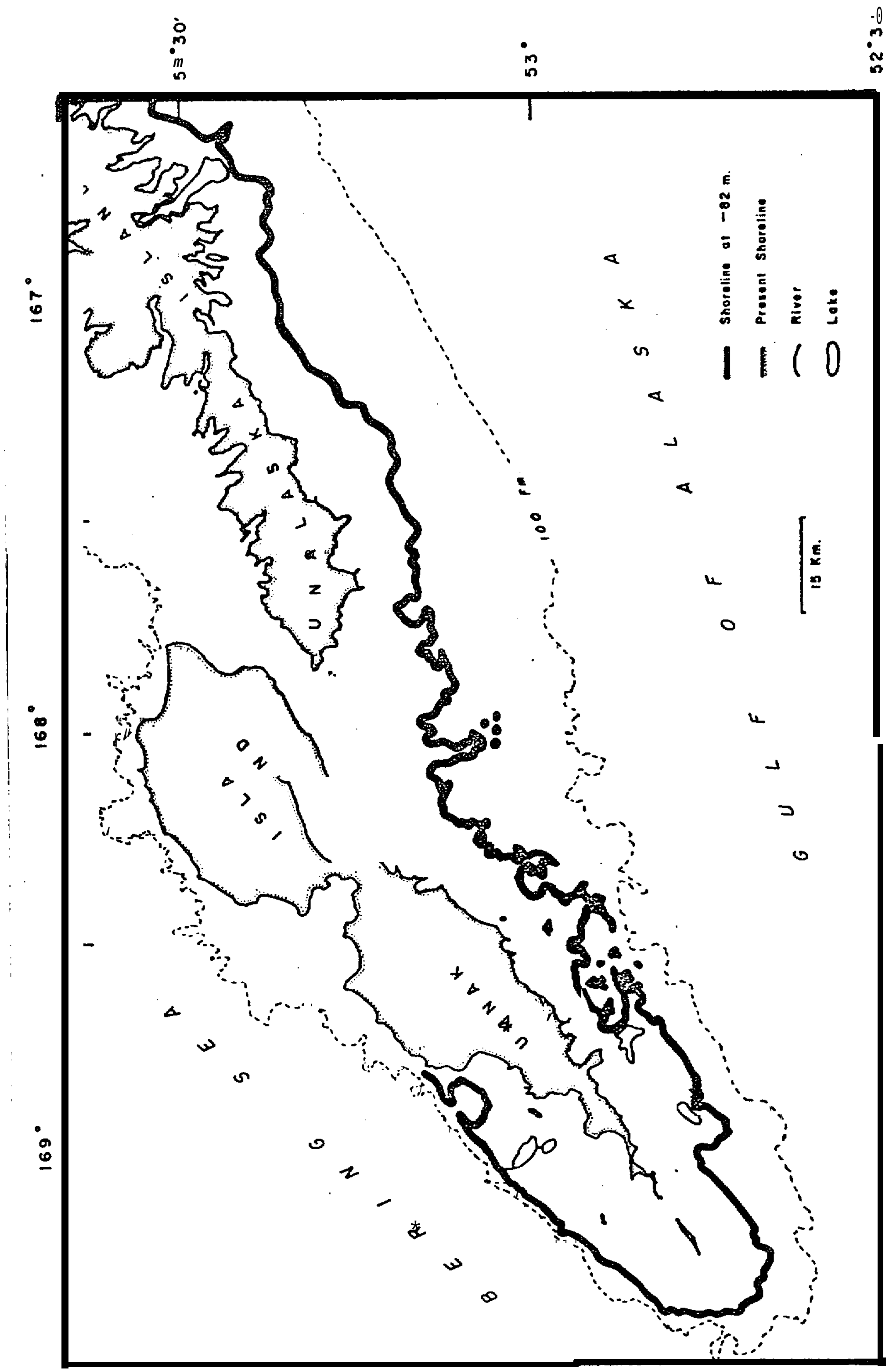


Fig. I-32 Sea level stillstand 15,000-14,800 B.P.

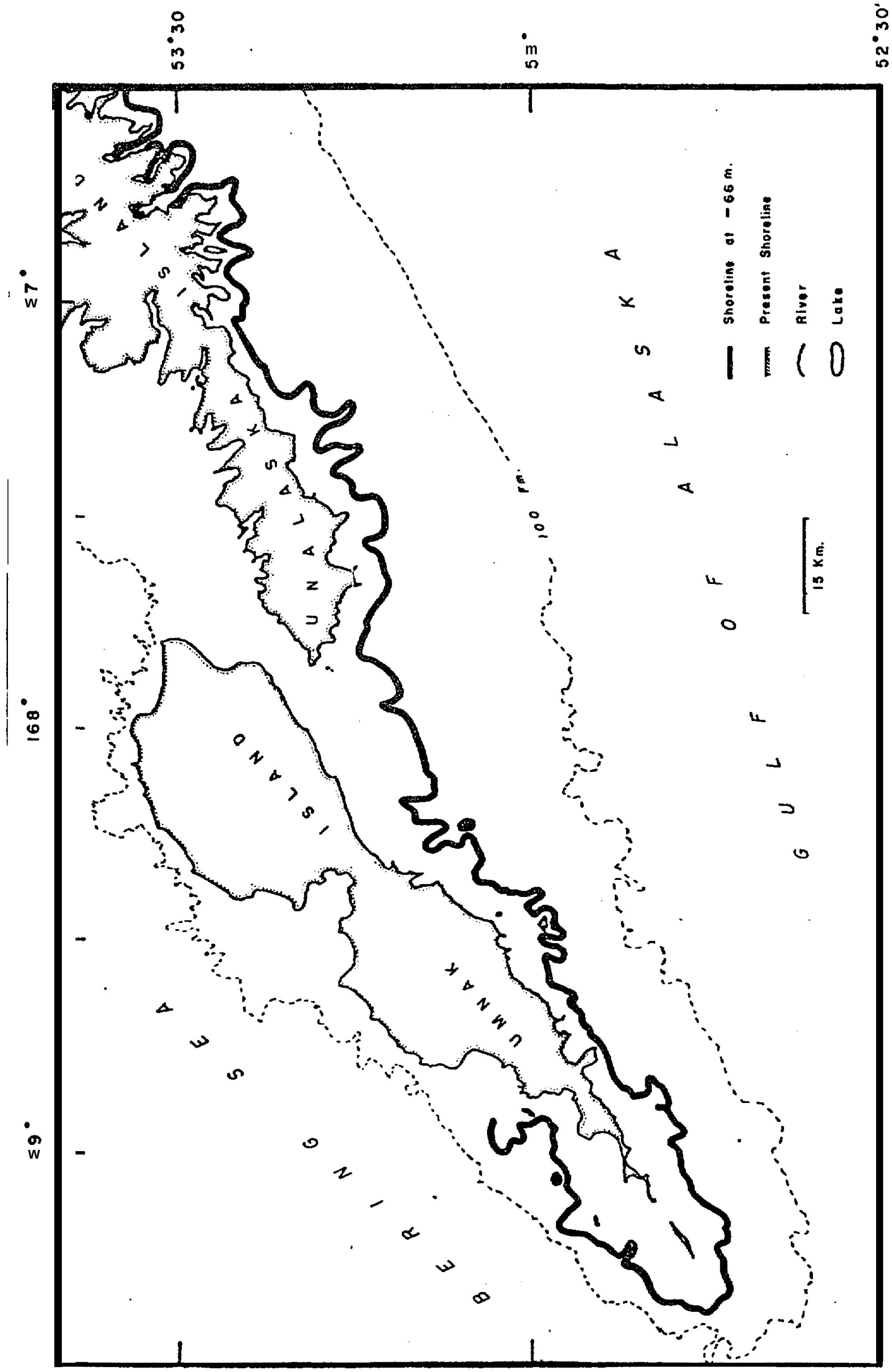


Fig. I-33 Sea level stillstand 13,750 B.P.

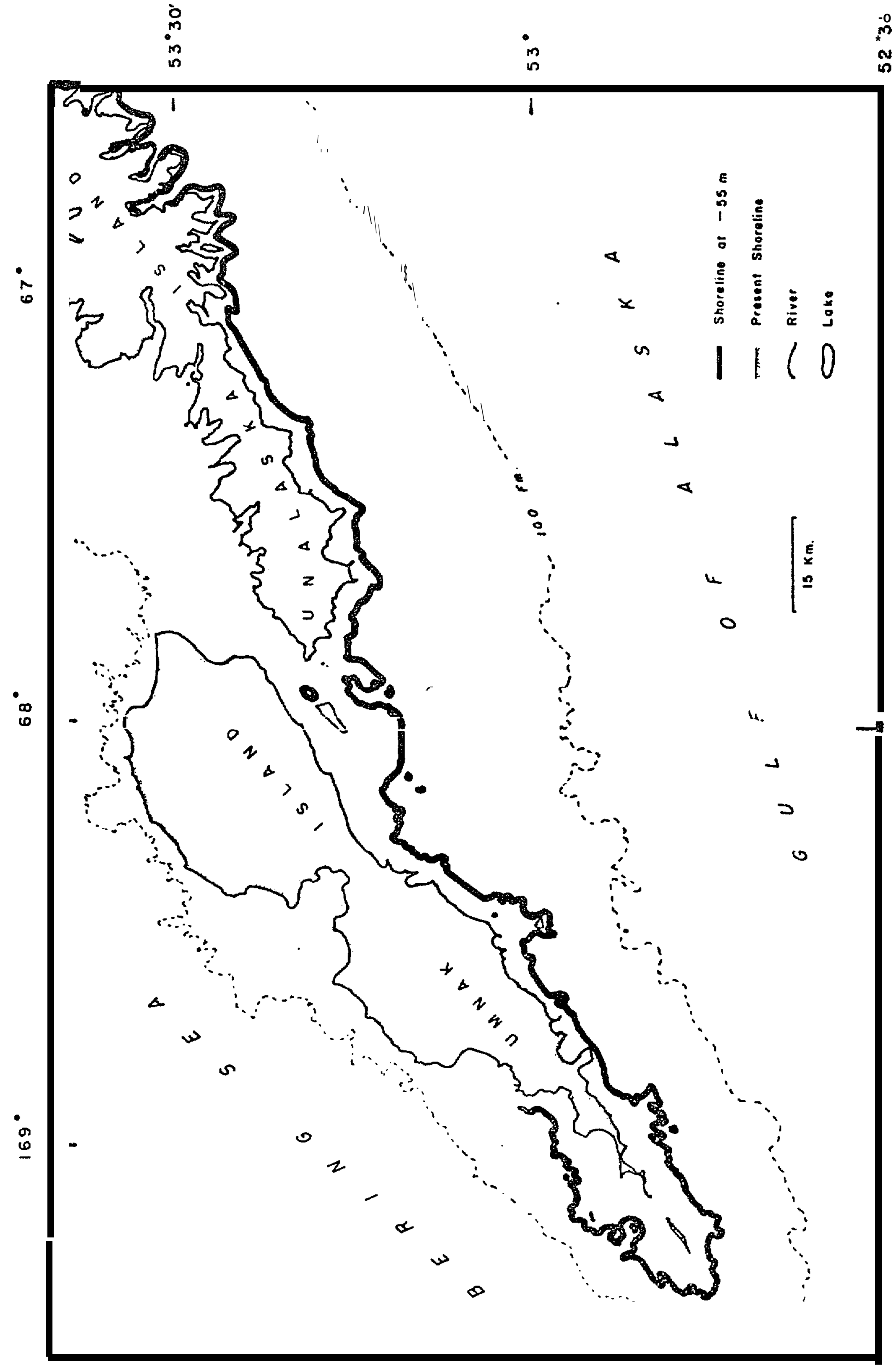


Fig. 1-34 Sea level stillstand 12,700 B.P.

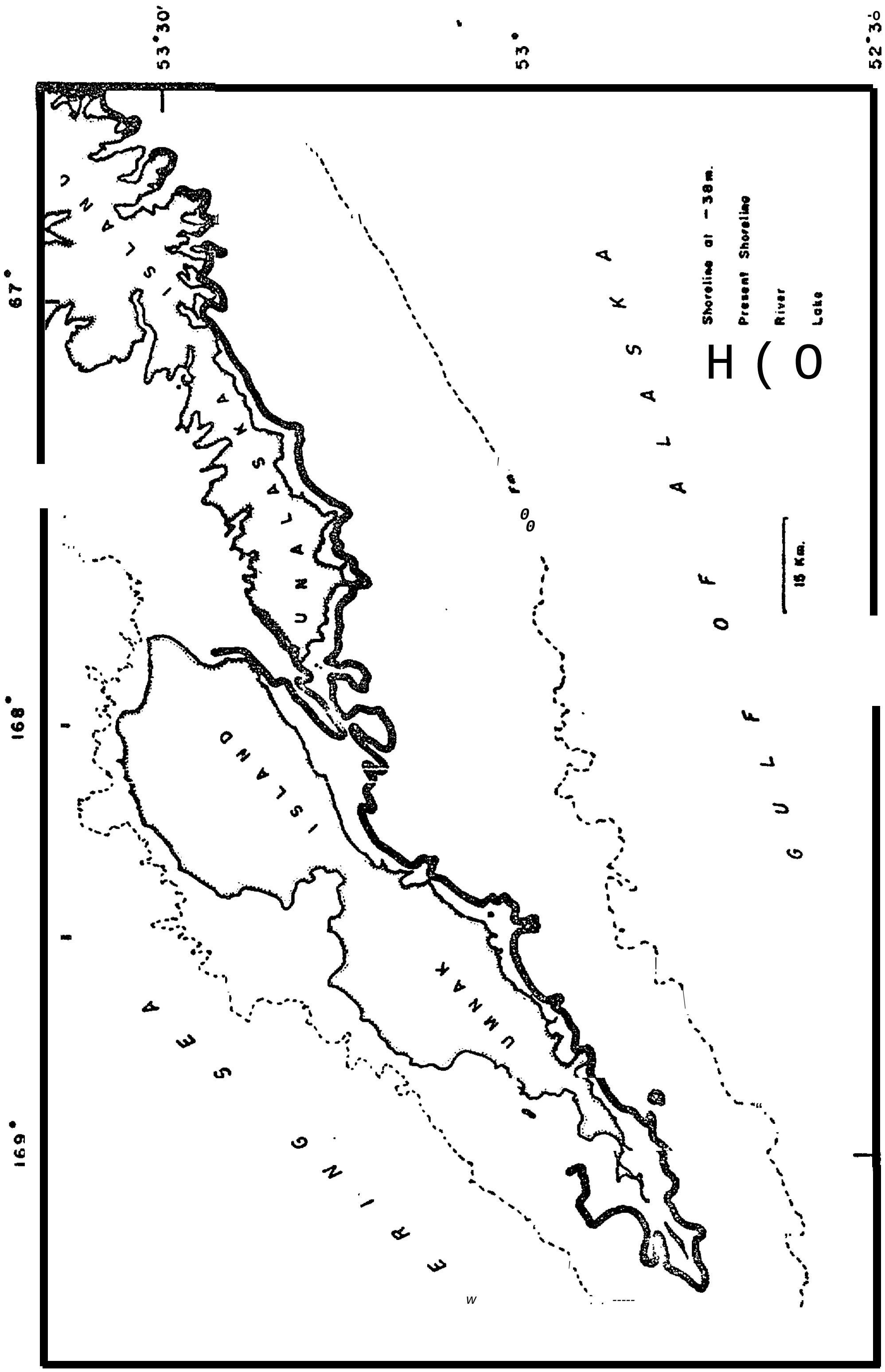


Fig. I-35 Sea level stillstand 9,400 B.P.

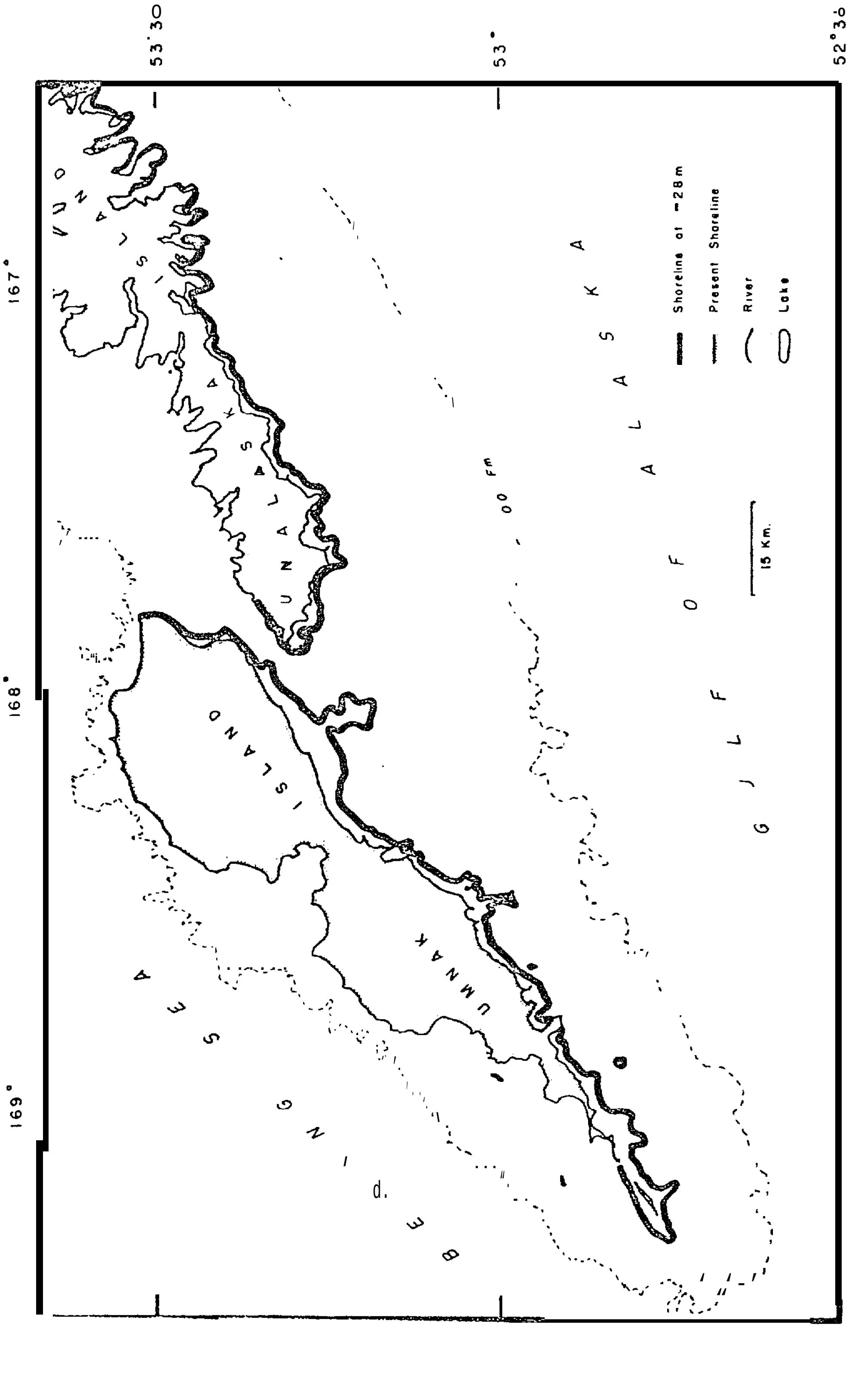


Fig. I-36 Sea level stillstand 8,700 B.P.

coastline, the height of washing by surf during exceptional storms should vary along the coast. Generally shoreline facing open ocean is subjected to frequent storms and surges with larger wave length and deeper wave action. In these regions the erosion by wave action is clearly much deeper than along protected shorelines. Location in relation to wave action will undoubtedly cause variation of up to 2 m. Similarly in regions with tidal amplification the surf zone should be much higher than normal.

Finally, in some regions, accumulation of sediments may be higher than other regions, because of local high detritus flux. Higher rates of sediment accumulation undoubtedly occurred in regions covered by volcanic ash. Differences in depositional rate may therefore cause minor deviations in relation to the six horizons listed.

The presence of bathymetric features thus indicate six paleo-sea levels stands in the Gulf of Alaska. These levels were chosen to prepare the paleo-geographic maps for the projection of past faunal distributions and probable human settlement locales. Four National Oceanic Survey charts No. 16580 (C & GS 8566, scale 1:350,000) No. 16540 (C & GS 8859, scale 1:300,000), No. 16520 (C & GS 8860, scale 1:300,000), and No. 16500 (C & GS 8861, scale 1:300,000) were chosen as base maps to outline the paleogeography of the regions east and west of Kodiak Island. Unfortunately, these charts did-not cover the entire region of the study area. Efforts were made to acquire base maps for the regions not included in the aforementioned charts. Because of the unavailability of charts of comparative scales, two additional base charts with much smaller scale (1: 1,250,000) served for mapping the paleography of the regions.

The paleographic maps (Figs. I-1 through I-36) essentially depict the relation of land and ocean during each sea level stand. In regions with sufficient bathymetric information an attempt is made to delineate paleo-drainage pattern and to interpret courses of major rivers. Due to lack of adequate bathymetry control in many regions it was not feasible to define the submerged river drainage.. Similarly in some cases it was diffcult to differentiate whether a particular fiordal depression was an ice free lake or was filled with glacial ice.

DISCUSSION

Marine geologists have mostly used submerged landforms and deposits as a guide to paleo-sea level stand. With the aid of pollen analysis, deep-sea sedimentation, C^{14} dating and various other isotopic measurements they have obtained a fairly detailed time-scale for at least the last major ice-advance and retreat. A general chronology for sea level stands has been developed and is subject to continual refinement and revision. When no actual dates are available, correlation can be based on bathymetric features. Determination of an eustatic curve primarily based on the bottom morphology requires a so called "stable area". But if well defined shorelevel displacements are consistent over large areas, the problems of tilting and isostaticy become minor.

The glaciated shelf off Alaska Peninsula and Kodiak Island has well preserved paleo-land forms and deposits. These submerged bottom geomorphological features invariably occur at six horizons with remarkable conformity throughout the shelf. The geomorphic elements observed include erosional as well as depositional features. The most prevalent erosional features are benches and sills. The entire shelf as a result of glaciation has numerous fiordal basins intervened by sills of various water depths. Because of their combined structural and glacial origin these linear basins are not always graded seaward and usually have reverse slopes. The most important and intrinsic character of the intervening sills is that they crest only at one of the six horizons.

The most significant submerged depositional feature for the purposes of this research within the study area are the extensive flat regions, or sills. Large flat areas are widely distributed and were probably formed by nearshore processes at a time of lower sea levels. These flat areas are mantled with sand and consistently occur only at certain water depths. These water depths closely correspond to sill depths.

The now submerged shoreline features of the transition period between late glacial regression and post glacial transgression are well preserved and were easily recorded over the entire area investigated. These paleo-shorelines were formed by transgressions and their respective well defined morphological elements are thus synchronal. Certain bathymetric features, such as depression along the axes of fiords provides the most reliable evidence for sea level stands. These include basin enclosures signified by sills which should invariably crest as a result of wave erosion during a pause of the trangressive sea.

The basins along the entire shelf exhibit closure uniformly at the same levels; -28m, -38m, -55m, -66m, -82m, and -125m. This suggests that sea level stood stationary for considerable time to form these closures. The continaum of each horizon along the entire shelf indicates that the shelf has been fairly stable. It is therefore, safe to consider that these horizons represent shorelines of dating to periods of glacial advances and subsequent glacial retreats.

Late Wisconsin and Holocene transgression was climatically very erratic and therefore the sea level stand history is complex. Fluctuations of sea level during this epoch have been postulated by numerous investigators and many of these fluctuations have been chronicled on the basis of radiocarbon dating. We shall attempt to correlate each of the horizons to those dated elsewhere.

The sea level curve of Curray (1960, 1961) showed a low stillstand at -27 m at about 8,700 years before present (BP). This corresponds well with -28 m sea level stand indicated by the sedimentary features on the shelf in the Gulf of Alaska. Zenlovich (1969) reported that during the Würmian regression the Black Sea was isolated from the ocean at about -40 m. The change from lake stage (neoeuxinic state) to marine state (the transgressions of the -40 m level) has been C^{14} dated at 9,400 ± 220 B.P. A period of syngression in Europe with a eustatic level -38.0 to 38.5m has been dated between 9,330 and 9,770 B.P. (Mörner, 1971). Both (-28m and -38) sea level still stands in the Gulf of Alaska represent Friesland Oscillation. Evidence for a still stand in Laptev Sea at -55m depth has been obtained by Holmes and Creager (1974). Creager and McManus (1965) similarly found bathymetric evidence for a sea level stand at -53m in the Chukchi Sea.

About 13,750 B.P. according to Mörner (1971) the sea level stood at -66 m. Soon after a drastic global climatic change from the Vintapper Interstadial to the low Baltic Stadial at about 13,100 B.P. took place. The rate of rise in sea level during this period is estimated to be 1 m/100 years (Mörner, 1969). Thus the sea level was again stabilized at -55 m at about 12,700 B.P. Both these sea levels left their imprints rather well on the Gulf of Alaska Shelf and probably represent climatic change during Alleröd period.

During 14,800 - 15,000 years B.P. a global climatic event took place. This generally corresponds to a major glacial regression. It is postulated that this period represents the sea level stand at -82 m in the Gulf of Alaska. A stillstand of sea level during this period has been also shown by Curray (1960, 1961, 1965).

The lowest sea level in the Gulf of Alaska was observed at -125 m. It is generally known that during the late Wisconsin peak glaciation between 21,500 and 18,000 years B.P. the sea level fell to -125 m to 130 m (Milliman and Emery, 1968).

The chronology of the sea levels in the Gulf of Alaska as described is tentative. The evidence for various sea levels is fairly conclusive, however, the features relating to each of the sea level stands have not been dated. Because of the absence of dated material from this region it is not possible to ascertain the sequence of sea level stands. Futhermore, it is not certain whether all of these sea level stands occurred duringthe last glacial ice retreat.

Distribution of ice and sequence of glaciation

Submerged marine geomorphic features interpreted as evidence of previous sea level stands, are widespread along the Kodiak and Alaska Peninsula shelves. Most important are the wave cut basin enclosures (sill depths) and the terraces or platforms. Sea level fluctuations Primarily are dependent on the extension and retreat of continental ice. Because of other factors which also control sea level it is difficult to assess and measure the ice extension during each sea level stillstand, especially along a coast such as the Alaska Peninsula where snow accumulation and ice flow could be greatly affected by the topography. Moreover, the omnipresent Alaskan Gyre near the shelf edge (100-200 m isobath) could have severely restricted ice extension on the shelf. In order to interrelate each sea level stand with the ice extension on the shelf it would be essential to examine the shelf sediments.

In contrast to offshore glaciation some studies of glaciation onshore have been completed. Five episodes of glaciation during the Pleistocene Epoch in Cook Inlet and adjoining Kenai Mountains were identified by Karlstrom (1964). The youngest of these glaciation, the Naptowne, reached its maximum approximately 25,000 years ago. Evidence for two post-Naptowne, glacial periods have also been reported by Karlstrom (1964). The Tustumena, the older of the two, reached its maximum stage between 3,200 and 5,500 years ago. While the youngest, named Tunnel, advanced between 500 and 1500 years ago.

Along the eastern Gulf of Alaska an impressive glacial advance of Malaspina Glacier reaching a peak between 700 and 1,400 years has been reported by Plafker and Miller (1958). This advance is believed to be one of the major advances and glacial ice probably covered part of the adjacent shelf.

The texture of sediments from various banks of the Alaska Peninsula Shelf suggests that some regions of the shelf have been glaciated. These glacio-marine sediments have not been dated and may have been deposited during early Pleistocene or Teritary times. The chronology and the ice advance on the shelf during the ice ages has not been studied in this region. Until a firm stratigraphy and chronology of glaciation on the shelf is developed it is difficult to estimate the extension of ice on the shelf.

The chronology of sea level stillstands described earlier is based on the assumption that sea level during late Wisconsin rose from -125 m to the present sea level. This, however, does not preclude minor advances and retreats which probably did not result in significant sea level changes. Although other investigators have dated similar sea level stands during late Wisconsin times, it is not certain that the submerged geomorphic features observed were formed during the last transgression.

This uncertainty is profoundly displayed by the near fit of the sea level stillstands with those observed world wide during late Illinoian and early Wisconsin glaciation. It is therefore, essential that the stillstands be dated in order to accurately reconstruct paleographic maps with sea-land-ice distributions along the Alaska Peninsula.

II. LATE WISCONSIN FAUNAL DISTRIBUTIONS

Sam W. Stoker

INTRODUCTION: General Geography, Ecological Conditions, and Faunal Distributions

During and as a result of the last Wisconsic glaciation, enough oceanic water was invested in continental glaciation to lower global sea level sufficiently to expose much of the presently-submerged continental margins of the world. Over some areas, such as that presently occupied by the Bering and Chukchi Seas, this shallow emergent shelf was exposed as vast plains of sub-continental proportions, In other regions, such as Western Gulf of Alaska, the generally steep gradients and relatively narrow breath of this continental shelf contained emergence to a much smaller and less contiguous area. As the enormous continental glacial masses wasted and retreated at the end of this last ice age, returning their captured water to the oceans, sea level rose once more to re-submerge these continental shelves.

At the last Wisconsin glacial maximum about 21,500 - 18,600 years ago, sea level was lowered to expose the sea bed shallower than about 125 meters. In the region under discussion, the Western Gulf of Alaska, this maximum sea level retreat would have exposed a relatively narrow band seaward of the present shore of the Alaska Peninsula in the Shelikof Strait, several broad, flat peninsulas projecting into the Gulf of Alaska form the outer half of the Alaska Peninsula, including the present islands of the Semidi and Shumagin groups, and a broad, flat plain adjoining the end of the Alaska Peninsula and including the proximal Islands of the Aleutian Chain. The land area of Kodiak Island would have been more than doubled during this maximum retreat, primarily by the emergence of a broad shelf adjoining its southwestern margin.

The conditions which may have prevailed during this glacial maximum and subsequent retreat in the Western Gulf are the subject of some disagreement. Previously it was assumed (Antevs, 1929; Cooper, 1942)

Heusser, 1960; Karlstrom, 1961; Klein,1965) that the Alaska Peninsula and Kodiak Island were almost entirely glaciated during the last Wisconsin advance, probably to the limits of the continental shelf. Recent evidence, however, resulting from analyses of submerged sill and shelf depths in this region (Sharma, this report), indicates that the Alaska Peninisula-Kodiak Island area may in fact have escaped major continental, ice-sheet type glaciation during the late Wisconsin, though valley glaciation generated in the higher altitudes probably was extensive. For purposes of this report it will be assumed that Sharma's analysis is correct and that the emergent shelf in this area was essentially unglaciated.

The climate during this period was probably cold, though ameliorated considerably by the relatively warm circulation of Pacific waters adjacent to the coast and through Shelikof Strait, and was probably very moist, with winds mostly out of the south and southeast. As opposed to Beringia, where summers were probably hot and dry and winter cold and dry during glacial maximum (Hopkins, 1972) the seasonal gardient in the Western Gulf was probably not great due to the marine environment, remaining persistently cold and wet year round.

TERRESTRIAL FAUNA

During the period of maximum glaciation, a considerable area of low-relief coastal plain would have been emergent adjoining the present southwestern coasts of Kodiak Island and the outer part of the Alaska Peninsula which might have provided suitable habitat for terrestrial mammalian fauna, including early man. Unlike Beringia, however, with its vast and contiguous reaches of dry grass steppe (Guthrie, 1968; Ager, 1975; Stoker, 1976), the coastal plains here were probably much wetter and probably supported, consequently, a vegetational regime more typical of a wet tundra complex, perhaps with birch or spruce timber in some areas (Heusser, 1960; Klein, 1965) . This environment might have supported fairly considerable populations of large mammals such as moose, caribou, and bear, but probably would not have been favorable habitat for the large herds of grazing mammals (horse, bison, mammoth) which are thought to have frequented the plains of Beringia. In addition to a climatic and vegetational environment not conducive to such grazing herds, this coastal plain, unlike the plains of Beringia, was not contiguous.

The mountains of the Alaska Peninsula would themselves have presented a considerable barrier to migrations between this coastal plain and the plains of Beringia, and while access would have been possible across the low divides near the end of the Peninsula and between the highlands presented by what are now the proximal islands of the Aleutian Chain, this coastal plain itself, once achieved, would have presented serious obstacles to free movement and migration. Numerous large freshwater lakes and rivers, probably muskeg swamps, and deep fiords and embayments all would have impeded the migratory movements which probably were essential to the survival of the large grazing populations, the "Mammoth Fauna", which frequented Beringia and the Alaskan interior. Elements of this grazing fauna might have frequented to some extent the outermost (Alaska Peninsula-Aleutian Shelf) part of this coastal plain, though probably on no more than a marginal basis. Paleontological evidence, or lack of such as the case appears to be, supports this view that the coastal plains of the Western Gulf were not frequented by the grazing herds of the Beringian "Mammoth Fauna".

But while it is unlikely that this region would have provided suitable habitat for large grazing herds, it might have been very suitable for browsing and tundra-adapted animals such as caribou and moose, and might have supported large populations of these species, at least along the coastal plains adjoining the Alaska Peninsula. All evidence, indicates that Kodiak Island was never joined to the mainland during this period and was never occupied to any extent by this terrestrial mainland fauna.

Other terrestrial species which would likely have inhabited the mainland and which would probably have been of interest to early human hunters are brown bear, possibly black bear, mountain goat, possibly Dan sheep, wolf, fox, land otter, hare, ground squirrel, and perhaps migratory waterfowl and ground-nesting birds. While any terrestrial hunting economy probably depended on moose and caribou for its mainstay, any or all of these other species might have provided a welcome supplement and an important alternate prey.

For predictive purposes it is assumed that, during this period, these terrestrial species would have exhibited behavior and migration patterns similar to those presently observed. River valleys and low passes would have been preferred migration routes across mountain ranges, while connecting or interlocking ridges would have been the main routes for lateral movement along ranges (Guthrie, 1976). During the spring and early summer, herbivore populations would have sought out early growths of high-protein vegetation on the low-lying southern slopes, and in the fall would have favored the late-growing vegetation of the northern slopes (Whitten, 1975).

During the winter these herbivores would probably have sought out areas that were either protected to some extent from the winds, and thus from drifting and crusting snow conditions, or which remained relatively wind-swept and free of deep snow conditions. Moose populations would likely have favored, for winter range, the shelter of river valleys and such timber as may have existed, while the caribou probably would have preferred the wind-swept areas. These winter range separations were probably not distinct, however, both species using both types of range depending on local conditions. Mountain goats probably remained on the higher,. glacier-free slopes during the summer, moving to lower elevations during the winter months as they do today. Dan sheep might also have inhabited the coastal mountains during this period and would have exhibited the same seasonal migration patterns. Based on present distributions and habitat requirements, however, it is considered doubtful.

MARINE FAUNA

The marine fauna which inhabited this Western Gulf region during the last Wisconsin glacial maximum and subsequent retreat was probably similar to that observed in the area today in terms of species composition, behavior, and habitat requirements.

Several Bering Sea marine mammal species, the Pacific walrus (Odobenus rosmarus divergins), bearded seal (Erignathus barbatus), ringed seal (puss hispida), and ribbon seal (Histriophoca fasciata) all probably extended their present range to southward during the glacial maximum, but primarily along the western, Siberian, side rather than along the Aleutian Chain or into the Western Gulf (Davies, 1958; Stoker, 1976). It is not entirely impossible that some or all of these species might have penetrated into the Western Gulf during or subsequent to this last glacial maximum , but it is considered highly improbable that significant populations would have been established there. The walrus and bearded seal are both bethnic feeders and are limited, apparently by their diving capabilities, to water of less than 100 meters depth for feeding purposes. The Western Gulf region would have provided no extensive habitat of such depth ranges, either during the glacial maximum or during the subsequent sea level, rise.

The ringed seal, solitary and adapted to denning on the shore-fast ice, might have expanded into the Western Gulf, though it seems unlikely. There is no paleontological evidence to indicate such expansion, and it seems doubtful that shore-fast ice condition would have existed, over most of the range at least, necessary to the denning habits of this species.

The other candidate for possible expansion into this region from the Bering, the ribbon seal, seems a remote possibility at best. This rather small and solitary phocid seems very strongly prejudiced toward the western, Siberian, side of the Bering in its distribution, and there is no evidence to indicate that it ever ventured as far east as the Gulf of Alaska.

TWO other species of marine mammals which might possibly have inhabited Western Gulf, at least marginally during this period, are the northern elephant seal (Mironga angustirostris) and Stellar sea cow (Rhytina stelleri).

It is conjectured that the northern elephant seal could have expanded into this area during an apparent warm interval between 7,000 and 4,000 years ago (Cooper, 1942; Heusser, 1960; Karlstrom, 1960), when conditions might have been favorable. This animal, very large and easy to approach, is adapted to hauling and rooking in dense aggregations on remote sandy beaches and islands, habitat which probably would have been available in this area. There is, however, no paleontological evidence to support this premise.

The Steller sea cow, limited in historic times to the remoter islands of the Kommandorskis in the Bering Sea, could also have inhabited this region during and after this warming period of 7,000--4,000 years ago, though again, there is no hard evidence to indicate such was the case. This animal, large and relatively docile, frequented rocky bays and inlets rich in macrophytes, particularly the larger kelps, upon which it fed. Such habitat is available presently along the Aleutian Chain, parts of the Alaska Peninsula, and Kodiak Island, and might have once supported numbers of these animals. If SO they certainly would have provided a considerable attraction to early coastal hunters, who may have brought about their extinction in this area.

Without firm paleontological evidence, however, it probably should not be assumed that any of the potential immigrants discussed above were in fact present in the Gulf of Alaska during the late Wisconsin.

The marine mammal species which were almost certainly present throughout this period in the Western Gulf are the harbor (spotted) seal (Phoca vitulina), the Stellar sea lion (Eumetopias jubata), the northern fur seal (Callorinus ursinus), the sea otter (Enhydra lutris), and various cetaceans.

Of these, the harbor seal would probably have been the marine mammal species of greatest dependability and importance to an early coastal hunting economy, as was apparently the case shortly prior to and at the time of white contact (Clark, 1968). This species is of moderate body size, semi-gregarious, and seems to be equally satisfied using either pack ice, shore-fast ice, sandy spits and beaches, or offshore rocky islands as hauling and pupping grounds. It has been observed to congregate along glacier faces and in river mouths, presumably taking advantage of the enhanced primary productivity or detrital output and resultant concentrations of pandalid shrimps and fish, both anadramous and marine, present in such locales (Stoker, 1976). This species would probably have been a year-round resident of the area and would have been accessible to coastal hunters at all seasons, though to varying degrees, being most susceptible during the pupping season in the late spring and early summer and while feeding on summer spawning runs of anadramous fish in the bays and river mouths.

The only other pinneped species likely to have been a year-round resident is the Steller sea lion. Of fairly large body size, this animal is strongly gregarious, hauling and rooking in dense colonies on rocky capes, headlands, and offshore islands during the summer, when it would have been quite vulnerable to hunters. During the winter months it probably assumed more pelagic and less accessible during, though it may have been available as prey to some extent in all seasons of the year.

The northern fur seal was probably a seasonal resident or migratory visitor to this region. During the summer this species rooks in dense colonies on the Pribilof Islands in the Bering Sea, after which it returns to a pelagic existence in the southern Bering Sea and the North Pacific. It does frequent the coast to some extent during this pelagic and migratory existence, and would have been vulnerable as prey at certain seasons of the year, as evidenced from prehistoric midden remains on Kodiak Island (Clark, 1968).

Another species presently common in this region, the sea otter, was also probably present through much of the late Wisconsin, This species feeds on subtidal and intertidal invertebrates, is a shallow diver tied to a coastal existence, and prefers rocky bays and inlets where some shelter is afforded from the storms of the open sea. Of relatively small body size, it nevertheless must have provided some attraction to early coastal hunters for its extremely warm and water-repellant pelt, and perhaps for food.

In addition to such coastal-oriented or coastal dependant marine mammals, numerous cetacian species must have frequented this region of rich marine productivity. With the possible exceptions of the beluga whale and harbor porpoise, which are known to venture into estuaries, bays and river mouths in pursuit of anadramous fish, most of these cetaceans are not coastal-oriented, though stranded animals would have been a substantial prize.

In addition to such marine mammals, this coast probably would have hosted resources in the form of marine and anadramous fish, shellfish, and rooking marine birds. Numerous rivers of this region, particularly those of Kodiak Island, presently support large runs of salmon and char, along with their associated complement of predators, and probably did so for at least much of the period in question. These rivers have been historically, and presumably were throughout pre-history, very desirable locations for human habitation.

Other marine resources, particularly intertidal invertebrates such as urchins, clams, crabs., and mussels., might have played a considerable role in a coastal subsistance economy, particularly during seasons or periods when other prey, such as marine mammals or anadramous fish, were not available. The rocky inlets and fiords along the coast of Kodiak Island would appear to be particularly well suited to such intertidal resources. Rocky coastal regions would have been rich in urchins, limpets, crabs, tunicates, mussels, and holothurian echinoderms, while the stretches of sandy beach might have been suitable habitat for large clam populations.

Marine birds such as kittiwakes, cormorants, puffins, and gulls,. nesting in dense rookeries on capes and elevated headlands near the sea, could also have provided seasonal returns in both meat, eggs, and feathers.

ECOLOGICAL PROVINCES

Based on topography, coastal configuration, and probable patterns of faunal distribution, it seems feasible and desirable to subdivide the Western Gulf region under discussion into 4 provinces: Kodiak Island, the Alaska Peninsula coast within Shelikof Strait and southwest to about the Semidi Islands, the Alaska Peninsula coast from about the Semidi Islands to Pavlof Bay, and the remainder of the Alaska Peninsula and the proximal islands of the Aleutians (Fig. II-1).

Province I

Of these 4 regions or provinces, Kodiak Island is undoubtedly the most distinct, principally as a result of its isolation. It appears that Kodiak never attained a late Wisconsin "land bridge" connection to the mainland, even at the maximum sea level retreat of 125 meters (Sharma, this report), and so was never colonized by most of the mammalian terrestrial species which frequented the mainland across Shelikof Strait. There is no paleontological or archeological evidence, and no indications from historical mammalian distributions, to indicate that this large terrestrial mammal fauna was ever present on the island during the late Wisconsin. Of 20 mammalian species currently present on Kodiak, only 6 are indigenous (Clark, 1968). All 6 of these indigenous species (brown bear, land otter, short-tailed weasel, tundra vole, red fox, little brown bat) could have

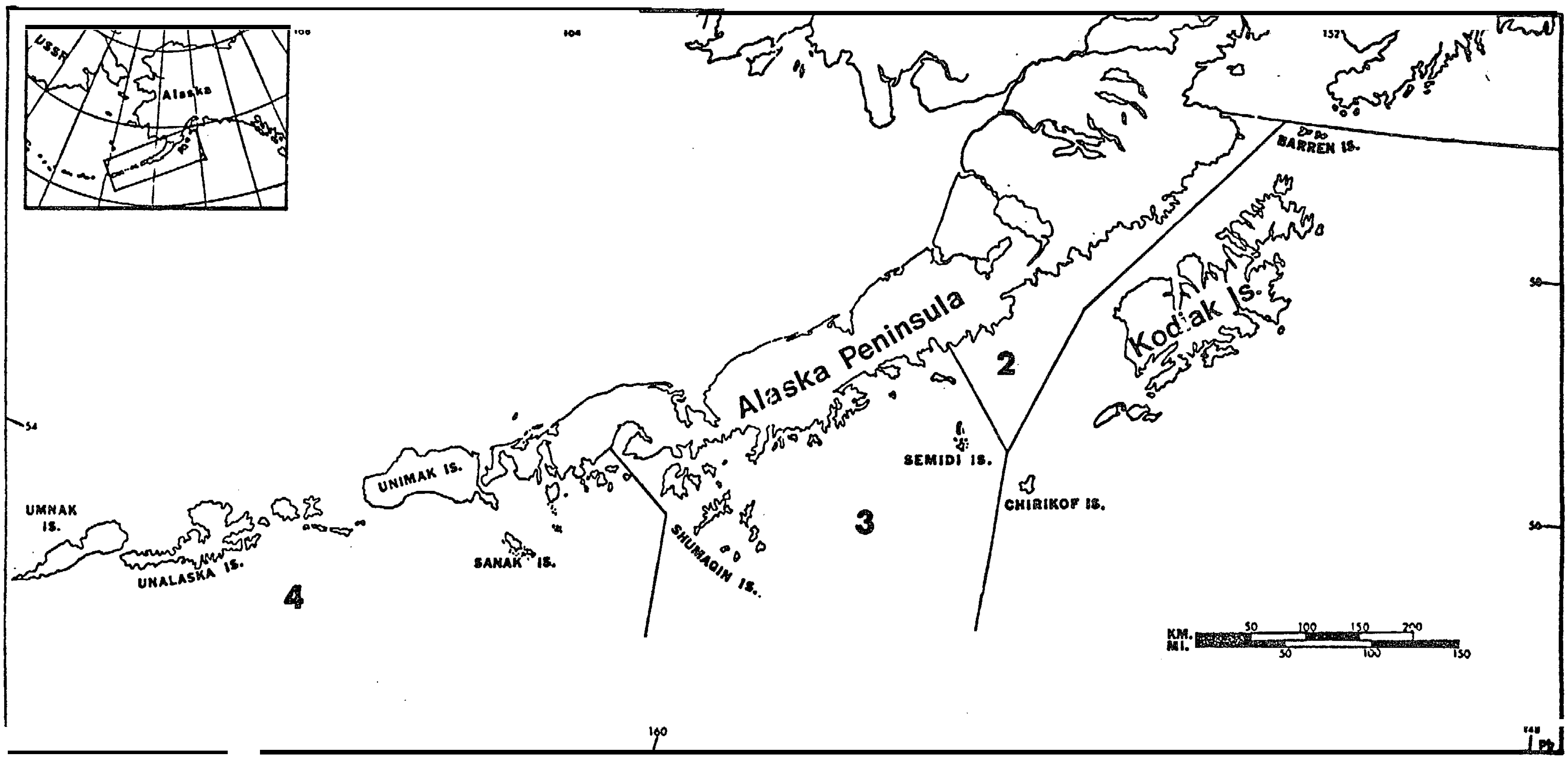


Fig. II-1

Ecological Provinces

swum, flown, or ice-rafted from the mainland across the relatively narrow strait.

Any hunting economy existent on Kodiak, then, must have been primarily oriented toward marine resources, with which Kodiak was probably well supplied. Situated in an area of rich marine productivity, the coasts of Kodiak could have supported considerable invertebrate populations of clams, crabs, urchins, limpets and other edibles, hosted runs of anadramous fish such as salmon and trout and coastal-spawning fish such as capelin, smelt, and herring, and been frequented by large numbers of harbor seal, sea lion, sea otter, fur seal and cetaceans large and small. The Shelikof Strait side of the island may have been somewhat richer as regards resources than was the outer coast throughout most of this period as a result of its more numerous deep bays and fiords and the greater protection it enjoyed from the storms and surf of the open sea, though both coasts were probably quite productive.

Province II

The second region, the mainland coast from Cook Inlet through Shelikof Strait to about the vicinity of the Semidi Islands, would also have very likely been an area strongly dominated by the marine environment and economy. The coastal plain in this region, even at maximum emergence, would have consisted of only a narrow band adjoining the present coast. This coastal band was probably dissected by swift glacial rivers which would have hindered movements along its length, and was virtually cut off from any contact with the Beringian plains of the interior by the mountain chain at its back. Only two possible passes, leading from Puale Bay to Lake Becharof and from Aniakchak Bay to Port Heiden, might have been useable as a route to and from the Bering Plains, and even this is questionable due to probable valley glaciation during this period.

A large mammal fauna might have existed within this narrow coastal belt, but it probably consisted of browsers and tundra-adapted forms such as moose and perhaps caribou, of mountain-adapted forms such as the mountain goat, and of predator/scavengers such as fox, wolf and brown bear. There is no indication that the large grazing fauna of the Bering Plain ever extended to this region, and considerations of climate, probable vegetation, and terrain make it seem unlikely that it would have done so. Even the tundra and mountain adapted species would have been relatively constrained by lack of suitable habitat and may not have reached large population levels in this region.

The emphasis here also, then, may have been on coastal marine resources, though probably augmented by terrestrial resources to a much greater extent than would have been feasible on Kodiak. The same marine resources would have been available here as on Kodiak, though perhaps to a lesser degree. In particular, it seems doubtful that anadramous fish would have utilized the coastal rivers of this region to any great extent. Such rivers were probably very swift and turbulent and heavily choked with glacial silt. The input of glacial silt might have had an adverse affect on coastal marine productivity of this area and could have retarded development of intertidal invertebrate resources. Glacial discharge may also have existed to some extent for Kodiak during this period though it was perhaps not so severe due to greater variation in terrain and drainage patterns.

Province III

The third major region, the mainland coast extending from the Semidi Island vicinity to Pavlof Bay, probably represents a transitional zone between a marine dominated and a terrestrially dominated habitat. This area, at maximum emergence, would have consisted of three broad, flat peninsulas separated by deep, sinuous bays or fiords extending almost to the present coast of the Alaska Peninsula. The present Semidi and Shumigan Islands would have existed on these peninsulas as hills of considerable relief, though for the most part the terrain was probably low and flat with numerous large lakes and rivers. The vegetation, as hypothesized from probable climate patterns, was likely that of a wet muskeg or shrub tundra, though grass plains might have existed in some parts of this range during this time period.

Again, however, it is felt that restrictions to migrational mobi lity,and general range limitations,would have limited the desirability of this region as habitat for large grazing populations. Access to the Beringian Plains across the Alaska Peninsula would have been severely limited, as for the preceding Shelikof Strait region, by the intervening mountainous, and probably glaciated, terrain. The only probable pass of any consequence would have been at the southeastern extreme of this region, via present Pavlof Bay itself. Movement along the coast and across the peninsulas forming this region would have been somewhat restricted also by the large lakes hypothesized for the peninsulas themselves and by the deep inlets separating them, though such restrictions to movement might not have been so severe as for the Shelikof Strait region.

While this region might not have been desirable habitat for grazing populations, it could have supported considerable populations of tundra adapted animals such as moose and caribou, might well have hosted large spawning runs of anadramous fish with their associated host of predators (bears, foxes, seals, cetaceans) , and may have provided very desirable nesting habitat for wildfowl. Small mammals, such as ground squirrels and hares, might, as for the preceding province, have heen plentiful, providing some argumentative support to a terrestrial economy.

The highlands in this region provided by the present Semidi and Shumagin Islands might have been quite attractive to large herbivore populations adapted to either plains or tundra, providing early spring growth on the southern slopes and tall growth on the northern slopes. These complex highlands may also have provided ideal cover and ambush sites for hunters in search of such prey.

Marine resources in this region may also have been considerable. Conditions appear more favorable here for anadramous fish populations, a very desirable resource, due to the proposed lake and river systems (Sharma, this report). These spawning fish populations would also, of course, have provided strong attractions for marine mammal predators such as harbor seals, sea lions, fur seals, beluga whales, and harbor porpoises. Intertidal invertebrate resources may also have been plentiful, particularly within the shelter of the deep inlets separating the peninsulas, and would have proved attractive for sea otters. Rooking marine birds also might have found these inlets favorable for colonizing. The outer peninsular coasts would probably have been less productive in terms of marine resources, -though harbor seals probably used these outer beaches and clams might have been plentiful in the intertidal zone.

Province IV

The fourth and last province, that extending from Pavlof Bay to just beyond present Umnak Island, would appear to be more favorably disposed toward terrestrial species and probably less so toward marine species of probable interest to man.

The coastal plains here, during maximum recession would have been quite broad and flat, with easy access to the Beringian Plain across the Peninsula through numerous passes (provided they were unglaciated) such as Pavlof Bay, Cold Bay, Morzhovoi Bay, Ikatan-Bchevin Bay, Unimak Pass, Akutan Pass, and Umnak Pass. It seems probable that this coastal plain, like those of the preceding provinces, consisted primarily of tundra, with numerous large lake and river systems, though the possibility of dry grass plains favorable to grazing populations is not ruled out. If such grasslands did exist on this side of the Peninsula they might have been very attractive to grazing herds in search of the early spring high-protein vegetation of these southward-facing slopes. Migration along the length of this plain may have been somewhat hampered by the very large lake hypothesized for the area (Sharma, this report), but migration and communication back and forth to the Beringian Plain would have been virtually unrestricted. These passes across the Peninsula would probably have provided ideal ambush sites for hunters preying on such migratory populations, as would have the restrictions to coastal movement imposed by the lakes.

Even if such grazing populations did not utilize this region due to adverse environments? or vegetational characteristics, probably it did support considerable large mammal populations of other species, notably moose, caribou, and bear, as well as small mammals. Waterfowl may have been very abunbant in this region, as in the preceding, and anadramous fish very probably took advantage of the lake and river systems for spawning purposes

Except for runs of anadramous fish and their retinue of predators, the marine environment may have been less productive than hypothesized for the preceding provinces, at least during the period of maximum recession. The coast would have been relatively straight and unprotected during this period, and though the offshore marine environment was probably quite rich, the beaches themselves may have been fairly inhospitable. The ubiquitous harbor seal was probably present along these beaches, possibly sea lions and fur seals, and maybe clam beds in the more sheltered intertidal zones.

SYNOPSIS AND COMPARISON OF PROVINCES

There are distinct differences in probable resource availabilities from one province to the other, particularly during the period of maximum sea level recession.

Province I, Kodiak Island, was probably without large land mammals, except possibly bears, and would have required a marine oriented economy. Marine mammals (harbor seals, sea lions, sea otters, fur seals, cetaceans) were probably common along all of the Kodiak coast. There were very likely large runs of anadramous fish, rich invertebrate populations in the intertidal zone, and probably large colonies of marine rooking birds. As regards marine resources, Kodiak was probably the richest and most diverse of the 4 provinces.

Province II, the mainland coast of Shelikof Strait, may have been the least desirable province in all respects. There would have been severe range limitations for large grazing mammals, and communication would have been difficult with the Beringian Plain across the peninsular mountains. Marine resources, including anadramous fish, may have been depressed as a result of the probable considerable outflow of silt down numerous swift glacial rivers into the sea.

Province 111, Semidi Islands to Pavlof Bay, might have been relatively rich in terrestrial mammal and bird resources and in marine resources alike. Considerable habitat diversity would have been available for terrestrial mammal populations, from highlands to low-lying plains, with plentiful cover. Diversity in marine habitat may have been equally great, with river and lake systems providing spawning grounds for anadramous fish, deep inlets providing shelter and habitat for marine mammal, intertidal invertebrate, and rooking marine bird populations, and with long stretches of open, surf-bound beach on the outer coasts. Of the 4 Provinces, this may have provided the greatest degree of resource diversity and, perhaps, the greatest overall resource availability.

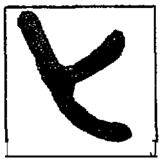
Province IV, Pavlof Bay to Umnak Island, would more probably have supported a terrestrial economy. Numerous broad passes would have provided free communication with the Beringian Plain and its large grazing herds, and though the vegetational regime of the area is uncertain large herbivore populations of any inclination might have found the south-facing slopes of the Peninsula very attractive for spring range. These passes would have funneled the movement of grazing species migrating between summer and winter range, thus making them highly vulnerable to human predation. The marine coastal resources of this province may have been somewhat limited, at least during maximum emergence, by the unsheltered and wave-beaten coast. The lake and river systems very possible hosted spawning runs of anadramous fish and their predators, and would have provided ideal habitat for nesting waterfowl.

TEMPORAL SEQUENCE

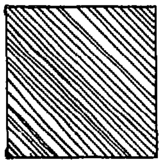
As proposed by Sharma (this report) there appear to have been 6 stillstands, or levels at which the coastal configuration stabilized for considerable time periods during the last Wisconsin submergence of the Continental Shelf of the Western Gulf. Based on deductions (Sharma, this report) from submerged marine sill and terrace bathymetry, these stabilizations appear to have occurred at -125 meters below present sea level (21,500-18,000 years B.P.), -82 meters (15,000-14,800 B.P.), -66 meters (13,750 B.P.), -55 meters (12,700 B.P.), -38 meters (9,400 ± 220 B.P.), and -28 meters (8,700 B.P.). The probable faunal distributions will be considered, by ecological province, for each stillstand, beginning with the earliest. Probable marine and terrestrial faunal concentrations and distributions are represented on each stillstand through symbols defined in Fig. II-2.

Stillstand I: 21,500-18,600 B.P.

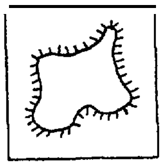
This level represents the maximum sea level recession during the last Wisconsin glaciation, At this time time the continental shelf was exposed to a maximum depth of about 125 meters, resulting in the emergence of a considerable land mass in the Western Gulf, particularly adjoining Kodiak Island, the extreme end of the Alaska Peninsula and the



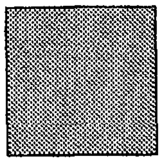
Passes or constrictions funneling movements of large terrestrial mammals.



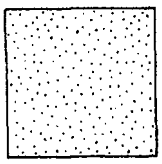
South or north facing slopes providing possible spring and fall attraction to large herbivores.



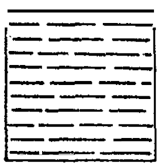
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Fig. II-2. Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

proximal islands of the Aleutian Chain. Included in this emergent land mass were the Shumagin Islands, the Semidi Islands, Chirikof Island, the Trinity Islands, Afognak, Shuyak and the Barren Islands, the Sanak Island, and all the Aleutian Islands east of and including Umnak Island.

It is assumed here, as proposed by Sharma (this. report) , that this region did not suffer massive, continental type glaciation even during this glacial maximum. though valley glaciers were probably extensive in the mountains of the Alaska Peninsula and Kodiak Island.

The climate during this period of maximum recession was probably colder than at present, during both summer and winter, though, as a result of its maritime environment, it would not have exhibited the extremes of warm dry summers and cold winters hypothesized for the Bering/ Chukchi shelf. (Hopkins, 1972). The marine currents sweeping through Shelikof Strait (which apparently remained open during this period as deduced from present bathymetry and faunal distributions), and along the Peninsular coast would have been as is presently the case, from the south and east. This relatively warm current probably precluded formation of extensive sea ice, though some local pack or shore-fast ice might have formed in the winter time, particularly in bays and inlets sheltered from the main effect of this warm current. Such bays and inlets might also have been of less than oceanic salinity, due to terrestrial fresh water input, which would have promoted the formation of winter ice.

This postulated current structure would also have fostered a wet maritime climate, probably with considerable precipitation year-round in the form of rain and snow. As a result of this inferred climatic reconstruction and the low-lying coastal nature of most of the emergent land masses, it seems, reasonable to assume that the vegetational regime was that of low-lying wet tundra, though it is possible that dryer, grassland environments did exist at least locally. The probability of such grasslands environments would have been greater toward the end of the Alaska Peninsula, where the emergent plains were broadest and where fewer high mountains 'were present to promote precipitation from the moist and relatively warm marine air masses.

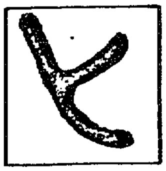
As discussed previously, it appe'ars that during maximum emergence, this Western Gulf area can be divided into 4 ecological provinces or regions. At least two of these, Kodiak and the mainland coast of Shelikof Strait, would have been of necessity almost strictly marine in terms of faunal distributions and resource availabiltiy, while the more westerly two could have supported a more diversified marine/terrestrial economy or might, in the case of the outermost Alaska Peninsula-Aleutian province, have been strongly terrestrial.

Province I, Kodiak Island, would probably have supported large populations of marine invertebrates, marine mammals (harbor seal, sea lions, fur seals, sea otters, cetaceans), anadramous fish, and rooking marine birds. Apparently no land mammals suitable as human food resources, with the possible exception of the brown bear, inhabited Kodiak Island during this period or at any subsequent time until recent years, when several species were artificailly transplanted from the mainland.

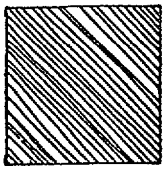
Local areas within this province which might have yielded maximum marine resources during this time period are the 3 deep inlets on the southeastern side of the emergent land mass, the narrow strait between the north end of the island and the Barren Islands, and the numerous river mouths along the Shelikof Strait side of the island (Figs. II-3 & II-4) . Inlets and river mouths might have supported rich intertidal invertebrate populations, hosted spawning runs of anadramous fish, and attracted concentrations of marine mammals and birds as a result of the fish and invertebrate concentrations and because of the shelter afforded from the surf and storms of the open sea. The Kodiak-Barren Islands strait would have acted as a funnel for marine mammal and anadramous fish movements from the outer coast to Shelikof Strait.

The extensive flat plains exposed on the southern end of the island may have been far less productive. There were apparently no terrestrial mammals to colonize these plains, and few if any rivers of consequence to support anadramous fish runs. This coast was probably frequented by marine mammals (seals and sea lions) to some extent, though its relatively straight and unsheltered configuration probably made it less attractive than the areas mentioned above.

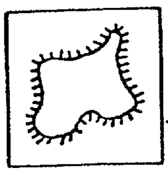
Province 11, the mainland side of Shelikof Strait, (Fig. II-4) may have been in all respects the least hospitable and productive of the 4 provinces during this or subsequence periods. It probably supported some terrestrial fauna of interest, notably moose, bear, mountain goat, and possible caribou and Dall sheep, though the range available would have



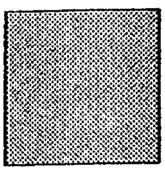
Passes or constrictions funneling movements of large terrestrial mammals.



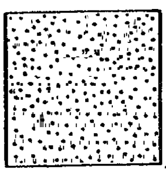
South or north facing slopes providing possible spring and fall attraction to large herbivores.



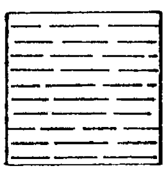
Lake margins providing. attraction to migratory waterfowl, ground nest-ing birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

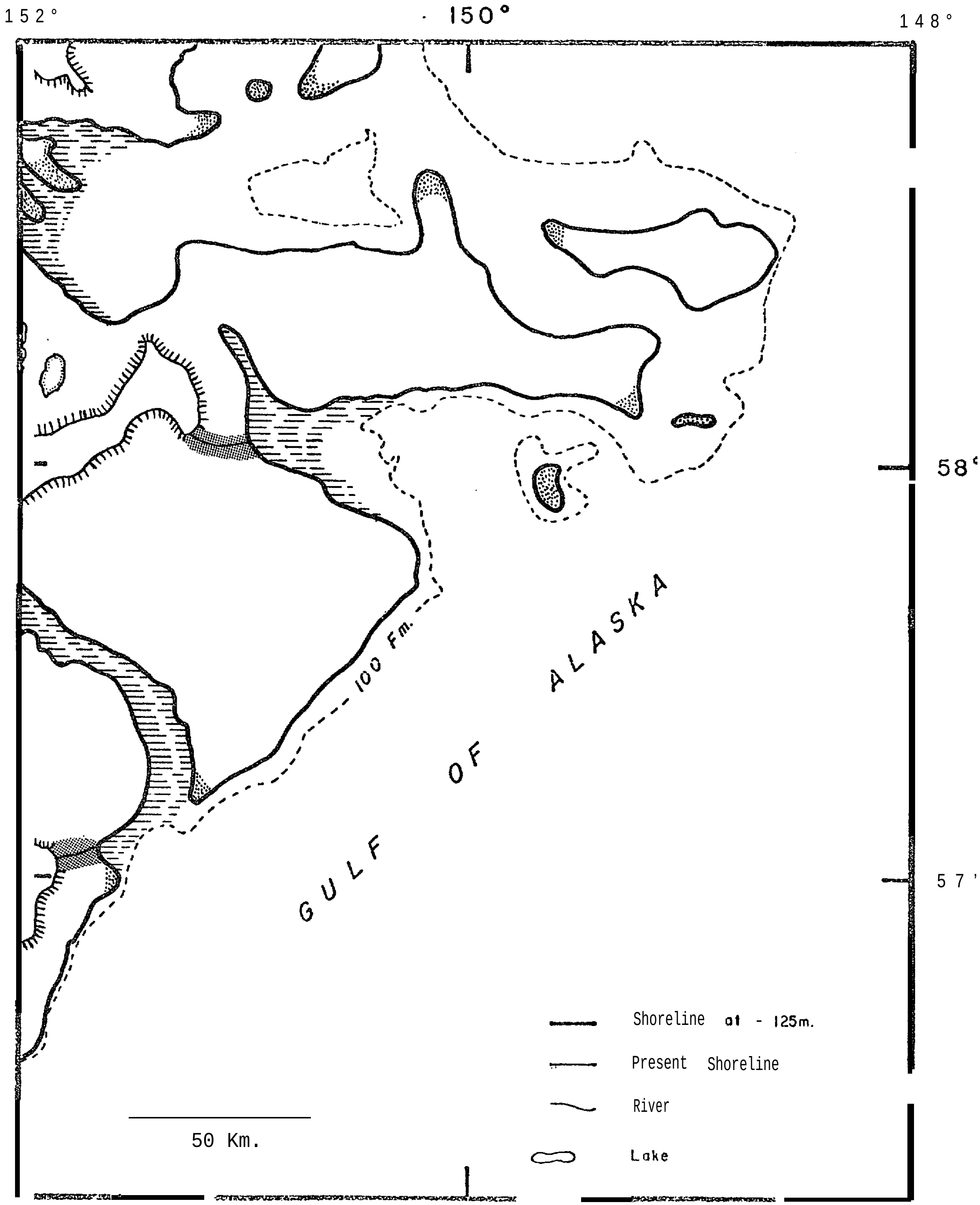
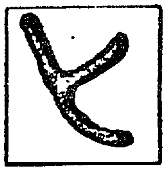
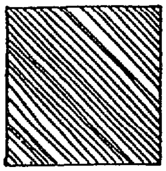


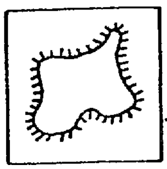
Fig. II-3. Stillstand I, Province I, 21,500 - 18,000 B.P.
East of Kodiak Island.



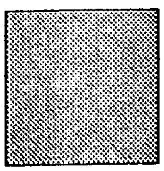
Passes or constrictions funneling movements of large terrestrial mammals.



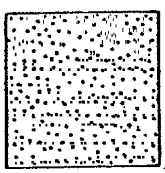
South or north facing slopes providing possible spring and fall attraction to large herbivores.



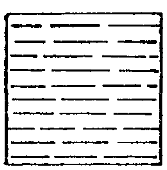
LaIce margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

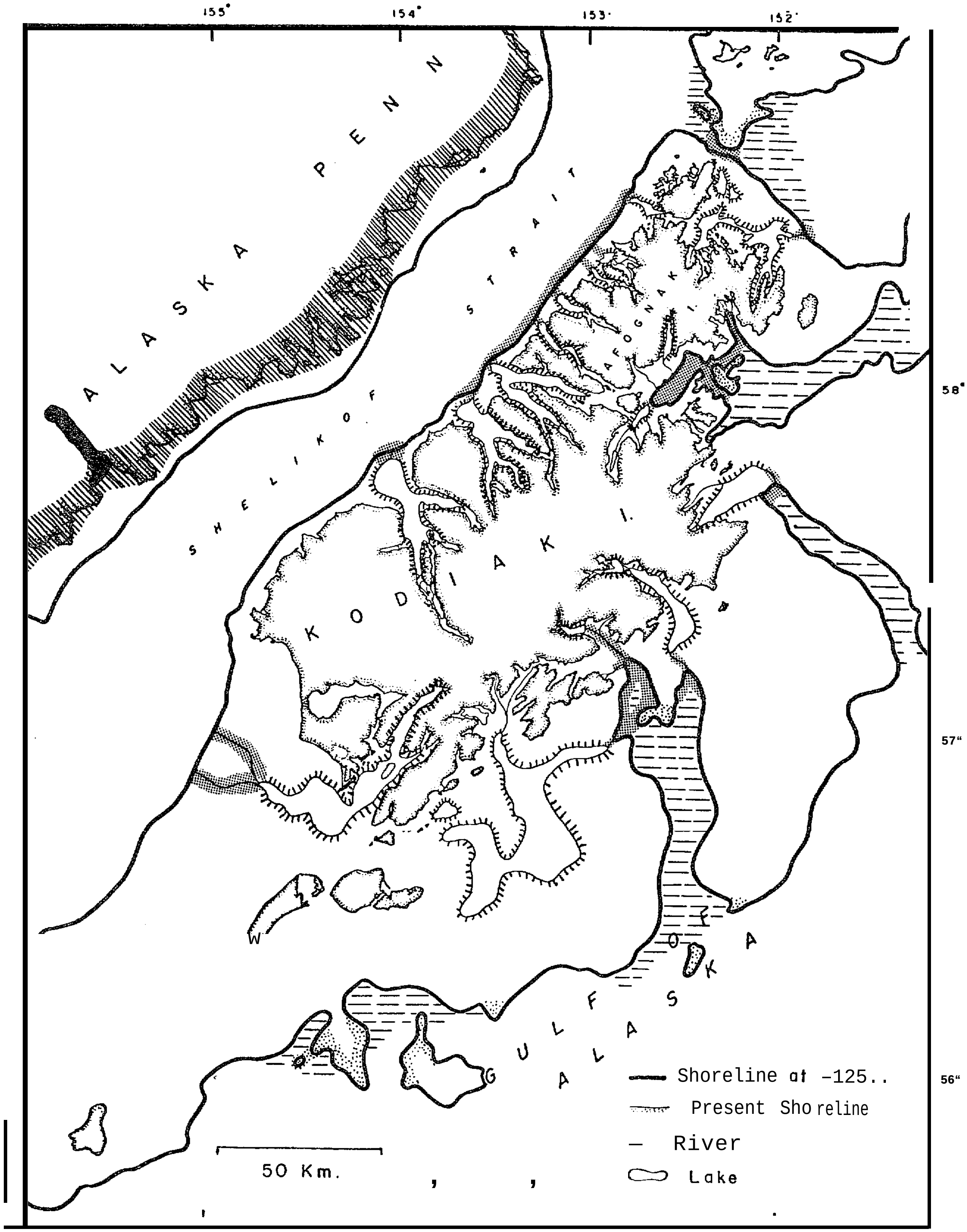


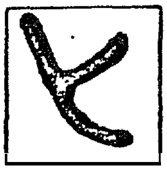
Fig. II-4. Stillstand I, Provinces I & II, 21,500 - 18,000 B.P.
Kodiak Island.

been quite limited, The mountian passes were probably heavily glaciated at this time, permitting very restricted access (if any at all) to the interior, and numerous swift glacial rivers and possibly glaciers themselves may have restricted movement along the coast. These rivers would likely have been very swift, turbulent, and clouded by glacial silt, with few if any lake systems or other desirable habitats available for spawning anadramous fish populations. Glacial silt might also have suppressed nearshore productivity along this coast, which was at any rate relatively straight and unprotected from surf and was possibly ice-scoured during the winter months.

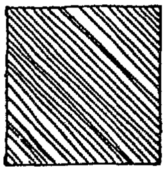
The only area which can be singled out as having somewhat more than the generally low potential evidenced by this province is the vicinity of Kukak Bay, which might have had a lake and stream system capable of supporting anadramous fish.

Province III, the Alaska Peninsula from Amber Bay to Pavlof Bay, consisted of 3 large peninsulas projecting into the Gulf of Alaska, each separated by deep, sinuous inlets. Included in this emergent land mass were the highlands of the Semidi (Fig. II-5) and Shumagin Island groups (Fig. II-6). This may have been the most ecologically diverse of all the provinces, supporting considerable marine as well as terrestrial resources.

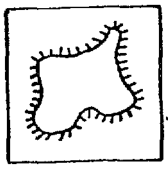
Large populations of moose and caribou might have frequented this range. Grazing animals, such as the horse, bison, and mammoth might also have been present, or might have been present instead of moose and caribou at this time, though the presence of these grazing mammals is contingent on the existence of dry grasslands. The highlands of the Semidis and Shumigans and the south facing slopes of the Alaska Peninsula would have provided alternate summer and winter range of large herbivores of any inclination, and communication with the Beringian plain was probably possible, though limited, through the pass at Pavlof Bay. Small mammals-hares and ground squirrels--may also have been abundant, and the numerous lake and river systems could have provided extensive nesting habitat for waterfowl and spawning grounds for anadramous fish.



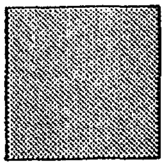
Passes or constrictions funneling movements of large terrestrial mammals.



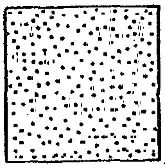
South or north facing slopes providing possible spring and fall attraction to large herbivores.



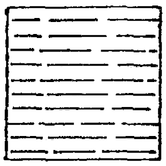
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islandsof probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

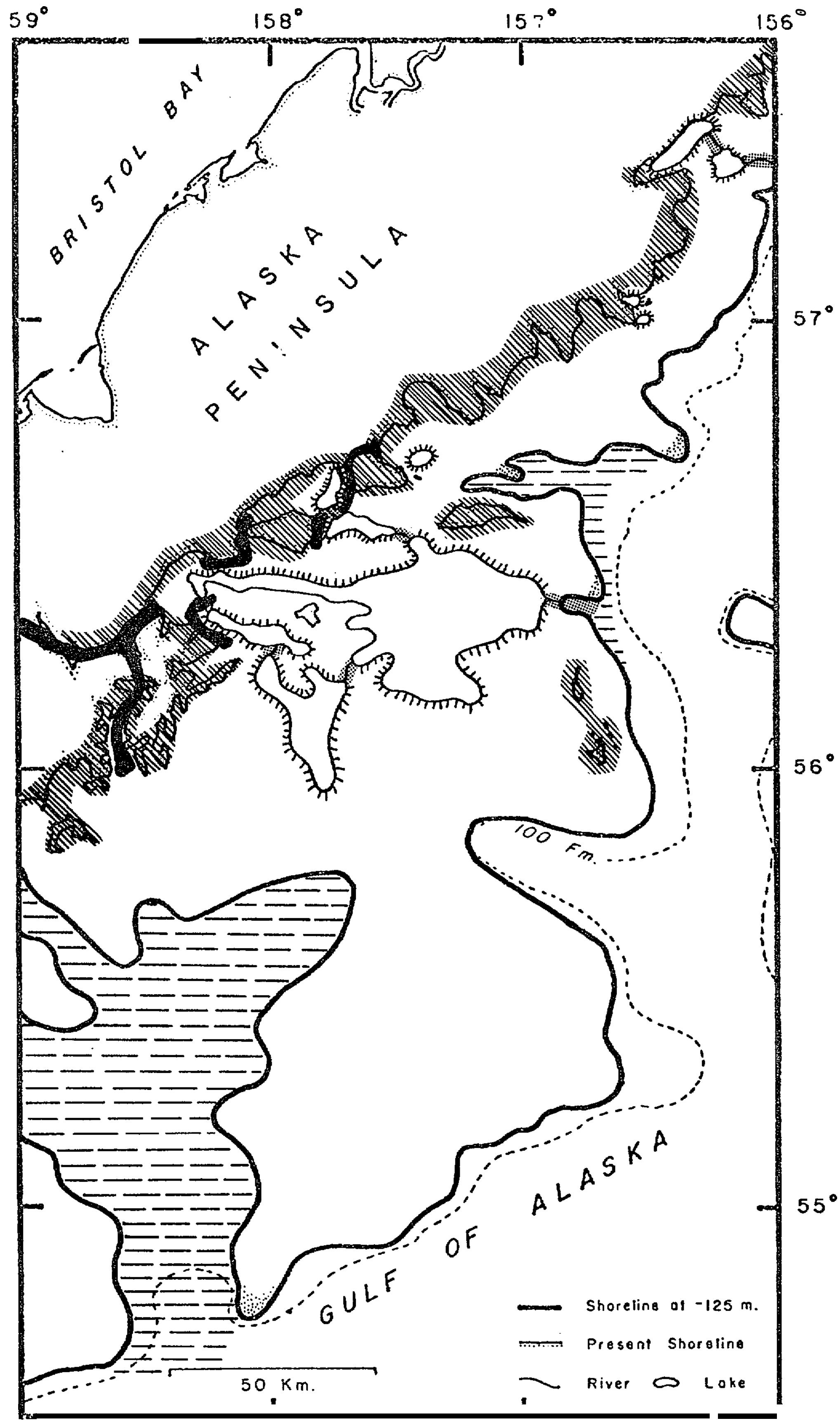
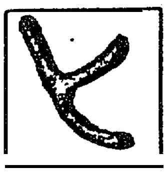
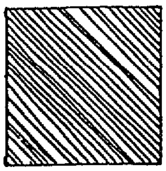


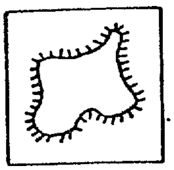
Fig. II-5. Stillstand I, Province III, 21,500 - 18,000 B.P.
Alaska Peninsula and Semidi Islands to Shumagin Islands.



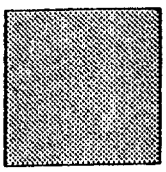
Passes or constrictions funneling movements of large terrestrial mammals.



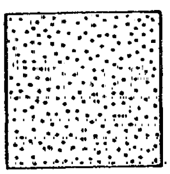
South or north facing slopes providing possible spring and fall attraction to large herbivores.



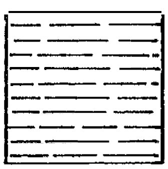
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

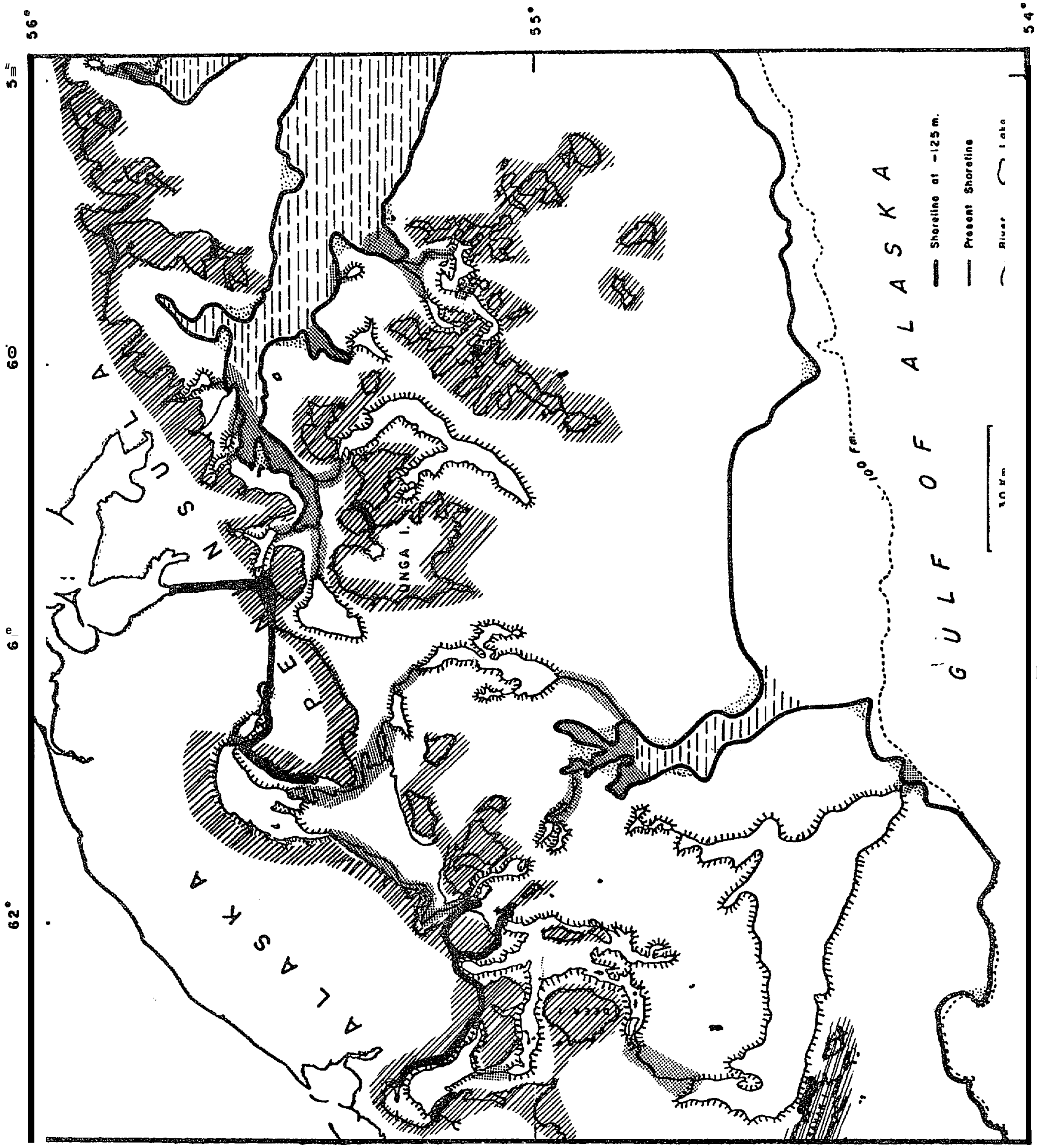


Fig. II-6. Stillstand I, Provinces III & IV, 21,500 - 18,000 B.P. Alaska Peninsula and Shumagin Islands to Sanak Island.

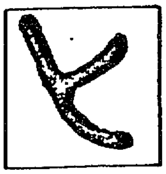
While the outer coasts of the peninsulas would have been exposed and may have been relatively unattractive to most marine species of probable interest, the deep inlets with their numerous river mouths may have been quite rich in marine resources of all types--anadramous fish, invertebrates and marine mammals.

The areas deemed most favorable within this province, in terms of resource availability, are the shores, particularly the river mouths, of these three deep inlets, the highlands of the Semidi and Shumagin Islands and the southern slopes of the Alaska Peninsula, the pass leading to the Beringian Plains at Pavlof Bay, and the corridors between the large basins inferred by Sharma (this report) as lakes. The highlands and slopes would have been attractive to herbivores and the passes and corridors would have tended to funnel movements of such herbivores between seasonal ranges.

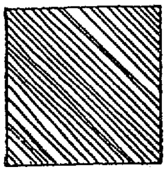
Province IV, the Aleutian Islands (Figs. II-7 & II-8). communication with the Beringian Plain would have been possible across at the end of the Alaska Peninsula and between what are now the Aleutian Islands of Unimak, Akutan, Unalaska, and Umnak. While the vegetational regime characterizing this region is uncertain. During stillstand I these passes might have encouraged at least seasonal migration into the area, from the Beringian Plain, of grazing populations which might have found the south slopes of the Peninsula, the Aleutian Highlands, and the Sanak Highlands very attractive spring and early summer range.

In addition to or, if conditions dictated, instead of grazing populations, this region may also have supported considerable populations of tundra-adapted large herbivores such as moose and caribou. The large lake and river systems might have provided nesting habitat for waterfowl and may have hosted large spawning runs of anadramous fish.

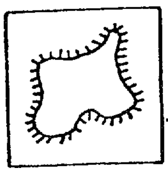
The marine resources of this province, however, may not have been so plentiful. The coast, except for the river mouths, was generally rather straight and unprotected, though some seals, sea lions, and intertidal invertebrates were probably present. The attractions provided by these marine resources, which were probably minimal, were likely overshadowed by terrestrial and anadramous fish resources.



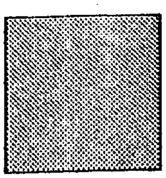
Passes or constrictions funneling movements of large terrestrial mammals.



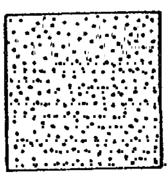
South or north facing slopes providing possible spring and fall attraction to large herbivores.



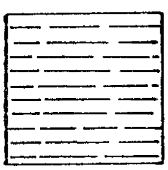
Lake margins providing. attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

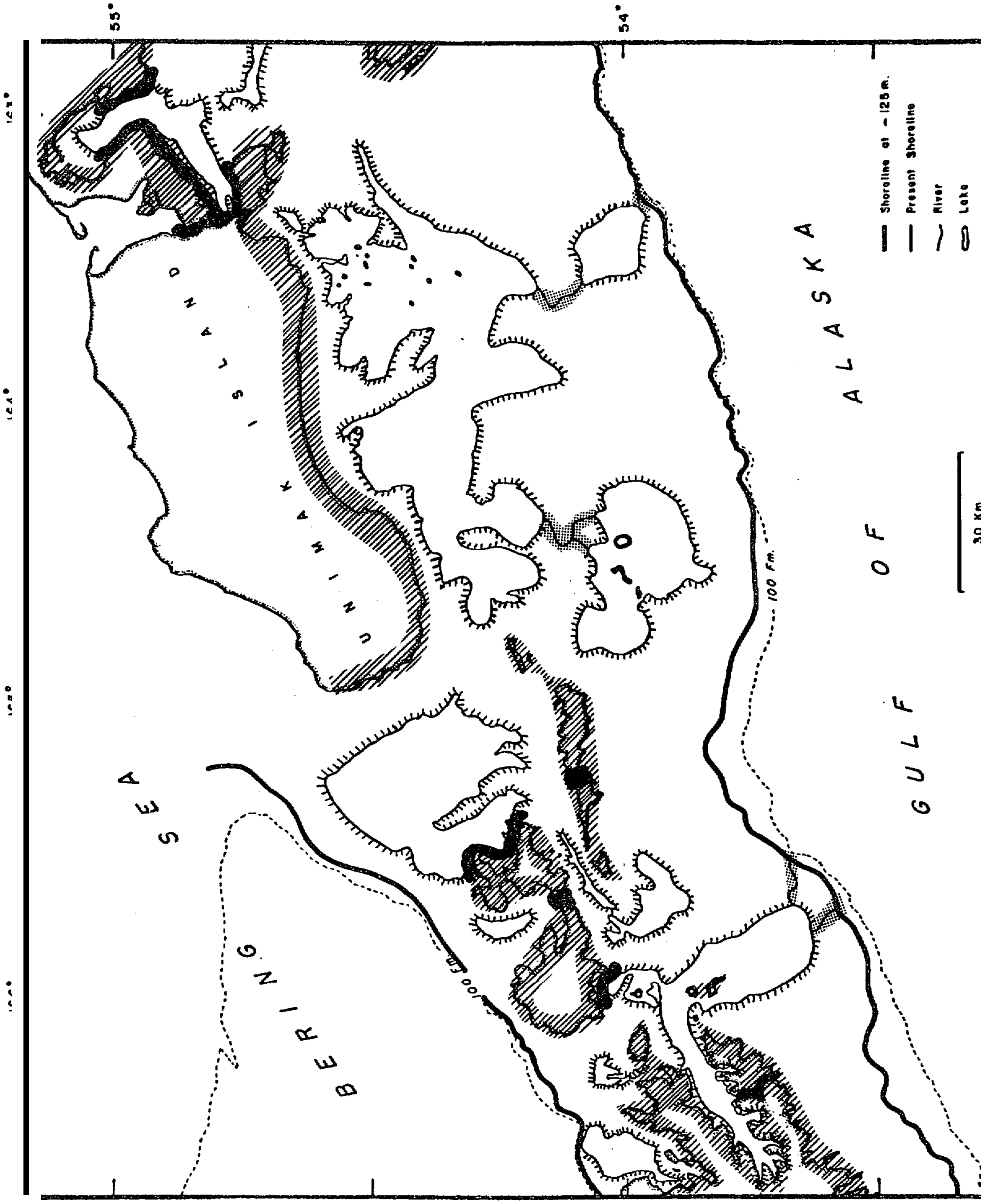
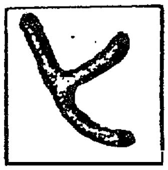
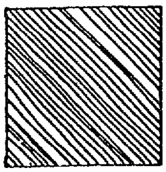


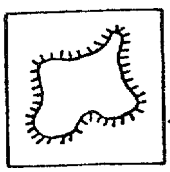
Fig. II-7. Stillstand I, Province IV, 21,500 - 18{000 B.P.
Unimak Island to Unalaska Island.



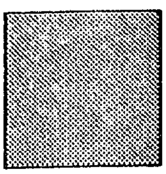
Passes or constrictions funneling movements of large terrestrial mammals.



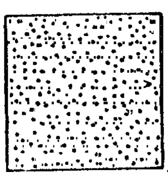
South or north facing slopes providing possible spring and fall attraction to large herbivores.



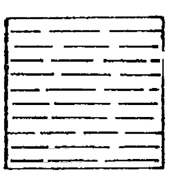
Lake margins providing. attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

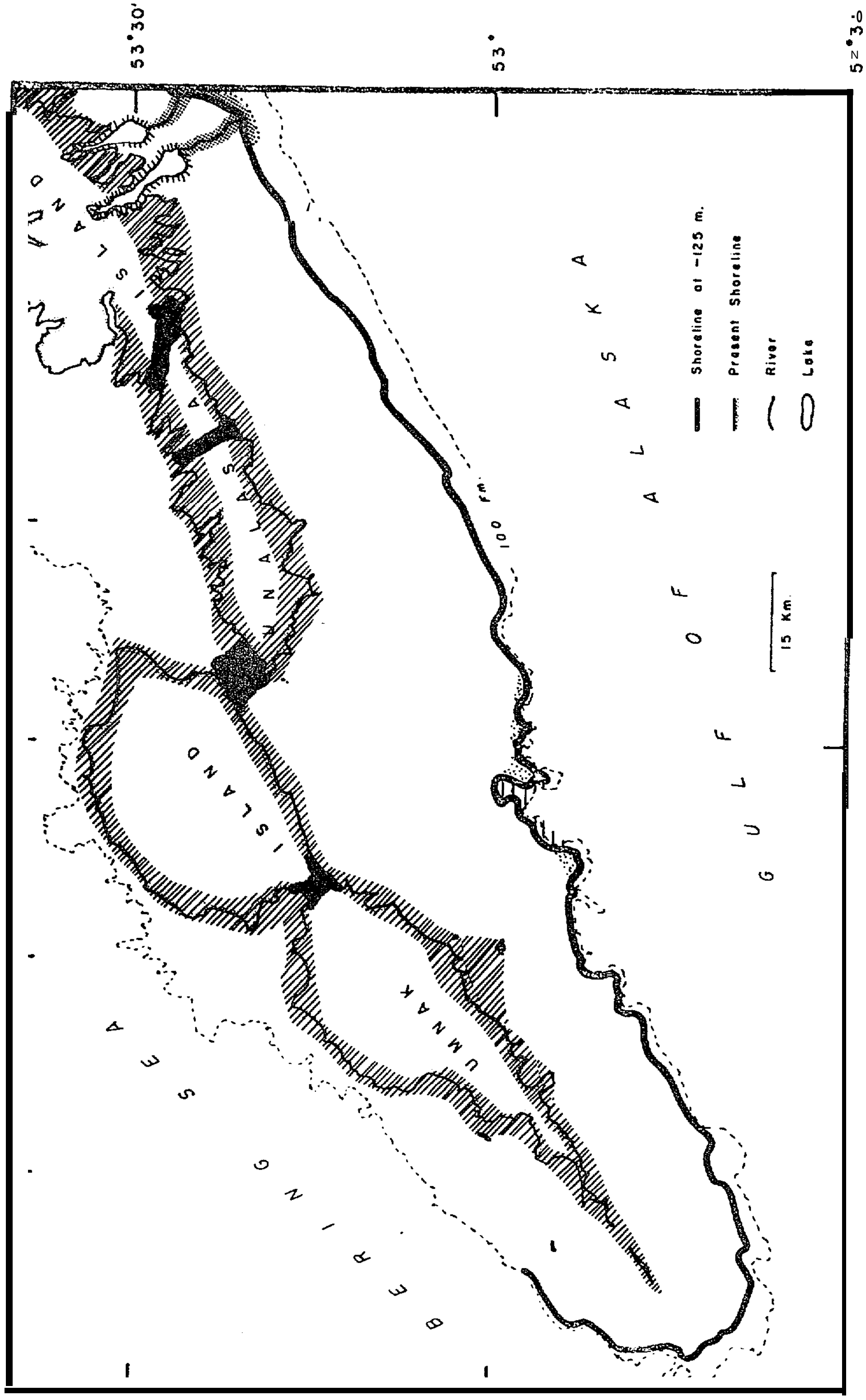


Fig. II-8. Stillstand I, Province IV, 21,500 - 18,000 B.P.
Unalaska and Umnak Islands.

Areas of maximum resource availability during this period within Province IV may have been the passes across the peninsula and through the Aleutians, the highlands and slopes of the Sanak and Aleutian Islands and the Alaska Peninsula, river mouths leading to large lake systems, and corridors between lake systems.

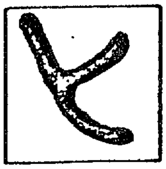
Stillstand II 15,000-14,800 B.P.

During this period sea level would have stabilized at below present. This rise from the former level would have restricted the emergent terrestrial area, widened Shelikof Strait and the strait between Kodiak and the Barren Islands, wasted the former large peninsulas Of Province III, and returned the Shumagins and Semidis to their island status.

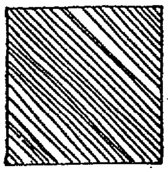
Province I, Kodiak Island, would have not been altered greatly on the Shelikof Strait side due to the relatively steep bathymetric gradient, though on the seaward side of the configuration would have been considerably changed. The broad plains adjoining the southern end of the island would have shrunken, and the deep inlets along the western side would have expanded, joined in the case of the more northerly two, and become generally much more complex (Fig. II-9 & 11-10).

The resources available and the areas in which they would have been available in greatest quantity and diversity would probably have altered little for this province over the preceding stillstand. The deep inlets on the seaward side would still have been areas rich in marine life, perhaps even more so than during the previous stillstand. The Shelikof Strait side would likely have remained productive in marine resources and anadrarnous fish. The narrow straits on the northern end of the island would have constricted and made available to coastal hunters migrations of marine mammals and anadramous fish.

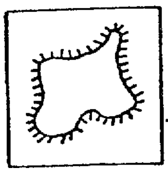
Province II would have been less altered, in terms of both configuration and resource availability, than any of the others (Figs. II-10 & II-11). It"might, in fact, have been even less desirable than during the previous stillstand in terms of resource availability. The coastal plains would be considerably narrowed by this time, and the rivers might have been even more turbulent and silt-laden as a result of accelerated glacial wastage.



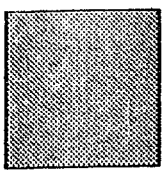
Passes or constrictions funneling movements of large terrestrial mammals.



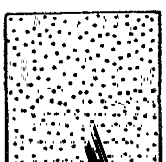
South or north facing slopes providing possible spring and fall attraction to large herbivores.



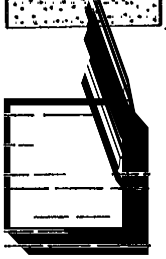
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

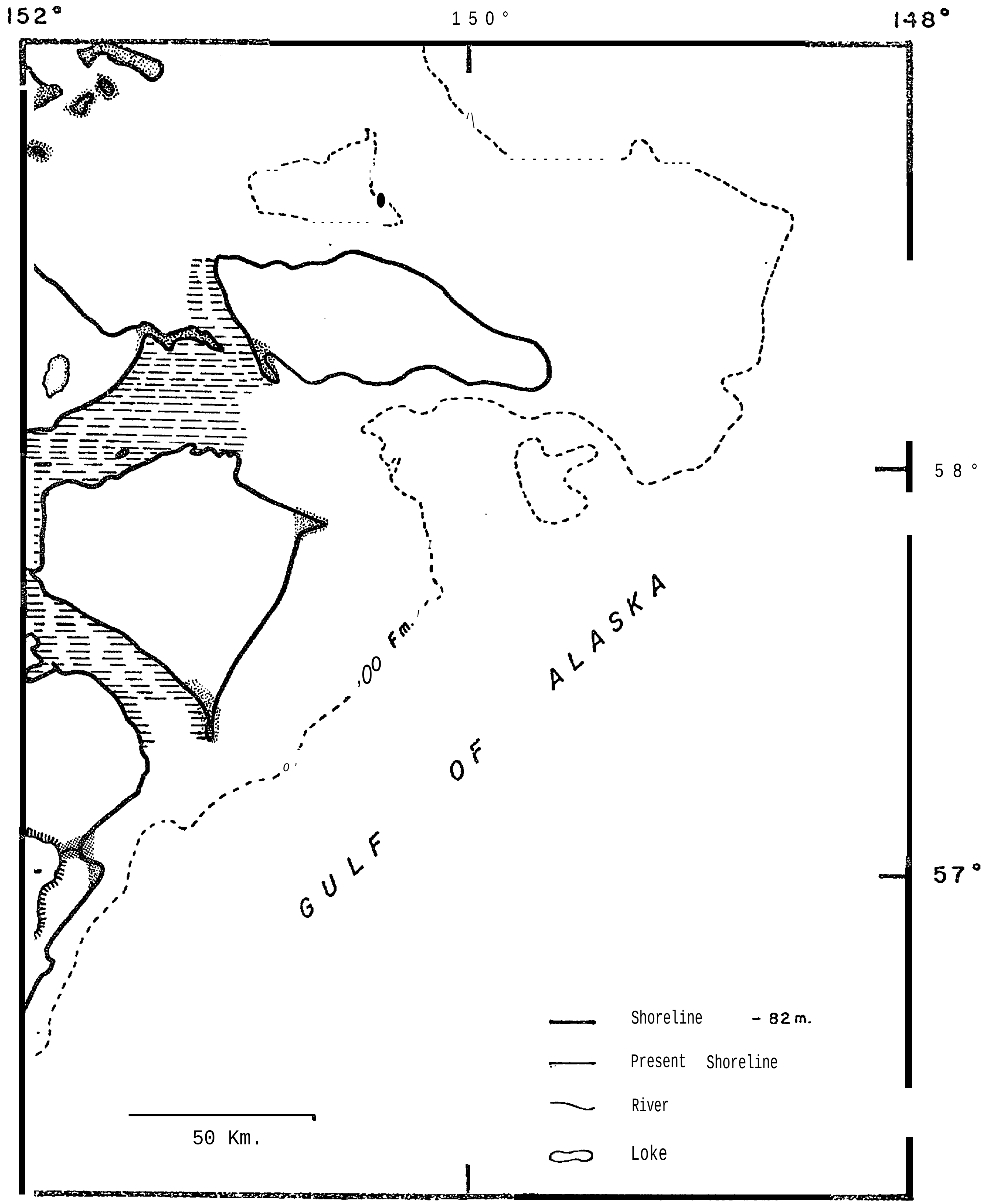
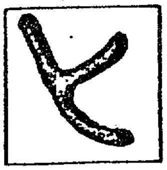
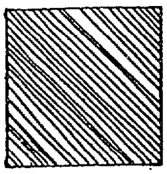


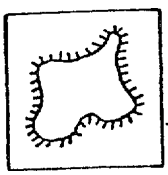
Fig. II-9. Still stand II, Province I, 15,000 - 14,800 B.P. East of Kodiak Island.



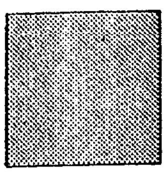
Passes or constrictions funneling movements of large terrestrial mammals.



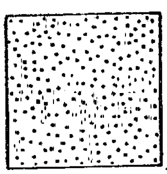
South or north facing slopes providing possible spring and fall attraction to large herbivores.



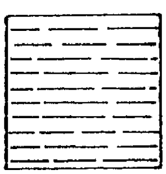
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through 11-38).

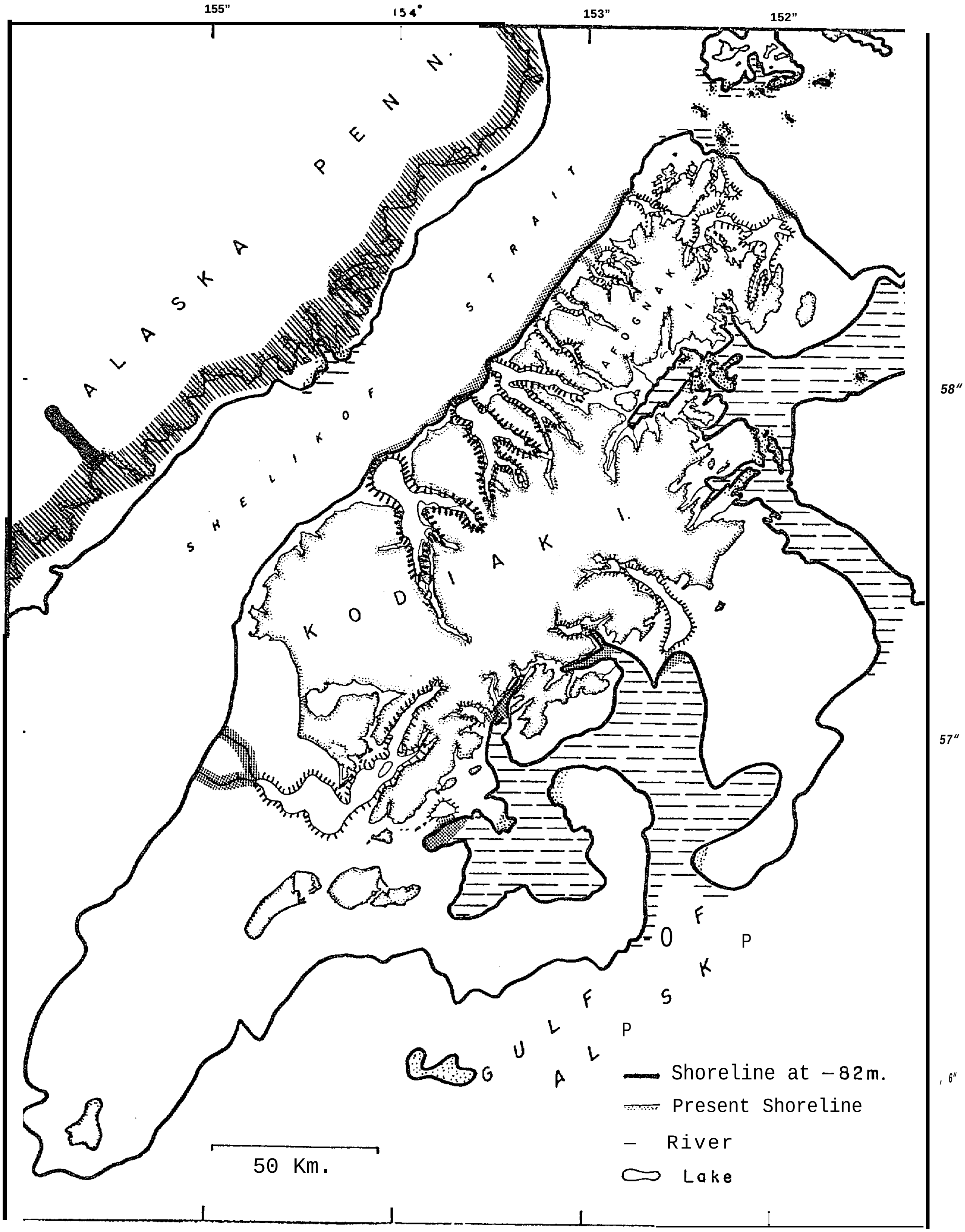


Fig. 11-10. Stillstand II, Provinces I & II, 15,000 - 14,800 B.P. Kodiak Island.

Within this province during this second stillstand the only local area showing signs of promise, at least in terms of marine resources, is the Kukak Bay-Kinik Bay vicinity, which might have hosted runs of anadramous fish and provided some shelter from the open sea for marine mammals, birds, and intertidal invertebrates.

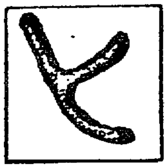
Province III would be greatly altered over the previous stillstand. The large Peninsulas would have virtually wasted away, with two of them, encompassing the Semidi and Shumagin highlands, converted to island status. The mainland coast now would have consisted of a very complex configuration of inlets, headlands, and nearshore islands (Figs. 11-11 & 11-12) .

Terrestrial resources within this province were probably somewhat diminished by this time as a result of shrinking range if nothing else, while marine resources might have expanded in terms of both availability and diversity due to the increased complexity of the coast. Virtually all of this coast, including the large islands, shows considerable potential during this stillstand for the support of anadramous fish, marine mammals of all types, marine birds, and marine intertidal invertebrates.

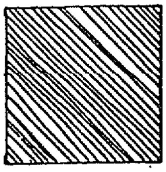
The one avialable pass leading to the Beringian Plain, across Pavlof Bay, might have been more open this time due to glacial wastage, and might have permitted some influx or exchange or terrestrial species across the Peninsula, though to what extent is questionable. The highlands and slopes of what is presently Unga Island, the nearshore islands along the Alaska Peninsula and the Peninsula itself would in particular have provided attractive seasonal range.

Province IV would also have been considerably altered by this time. The broad plains would be considerably reduced, and the coastline would have become much more complex, particularly that part of it north and east of what is presently Sanak Island (Fig. 11-12). Sanak Island itself would now form part of a large jutting peninsula enclosing the west -em margin of a large, complex bay. Another peninsula would have enclosed the eastern margin of this bay.

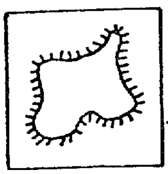
It could, in fact, be argued that the limits of Province III would be expanded by this time to include the coast as far west as the



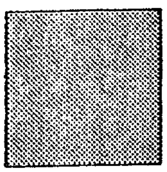
Passes or constrictions funneling movements of large terrestrial mammals.



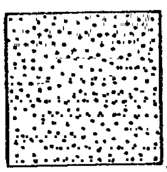
South or north Sating slopes providing possible spring and fall attraction to large herbivores.



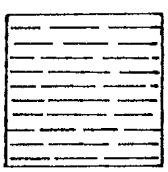
Lake margins providing attraction to migratory waterfowl ground nest-ing birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

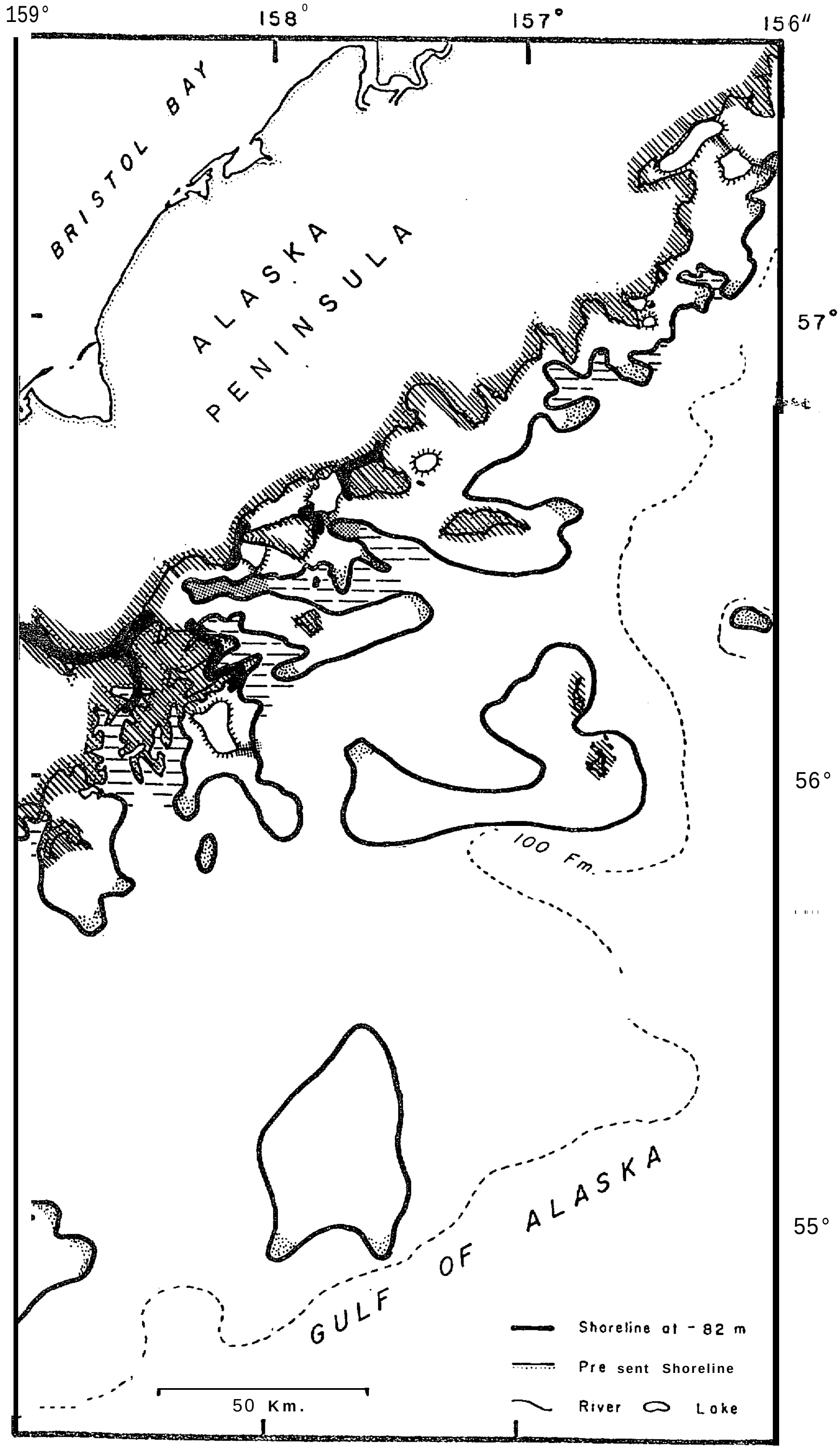
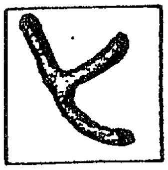
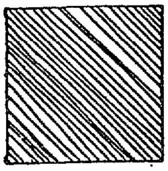


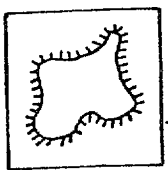
Fig. 11-11. Stillstand II, Province 111, 15,000 - 14,800 B.P. Alaska Peninsula and Semidi Islands to Shumagin Islands.



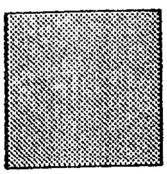
Passes *or* constrictions funneling movements of large terrestrial mammals.



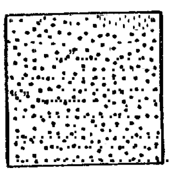
South or north facing slopes providing possible spring and fall attraction to large herbivores.



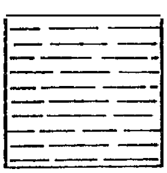
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

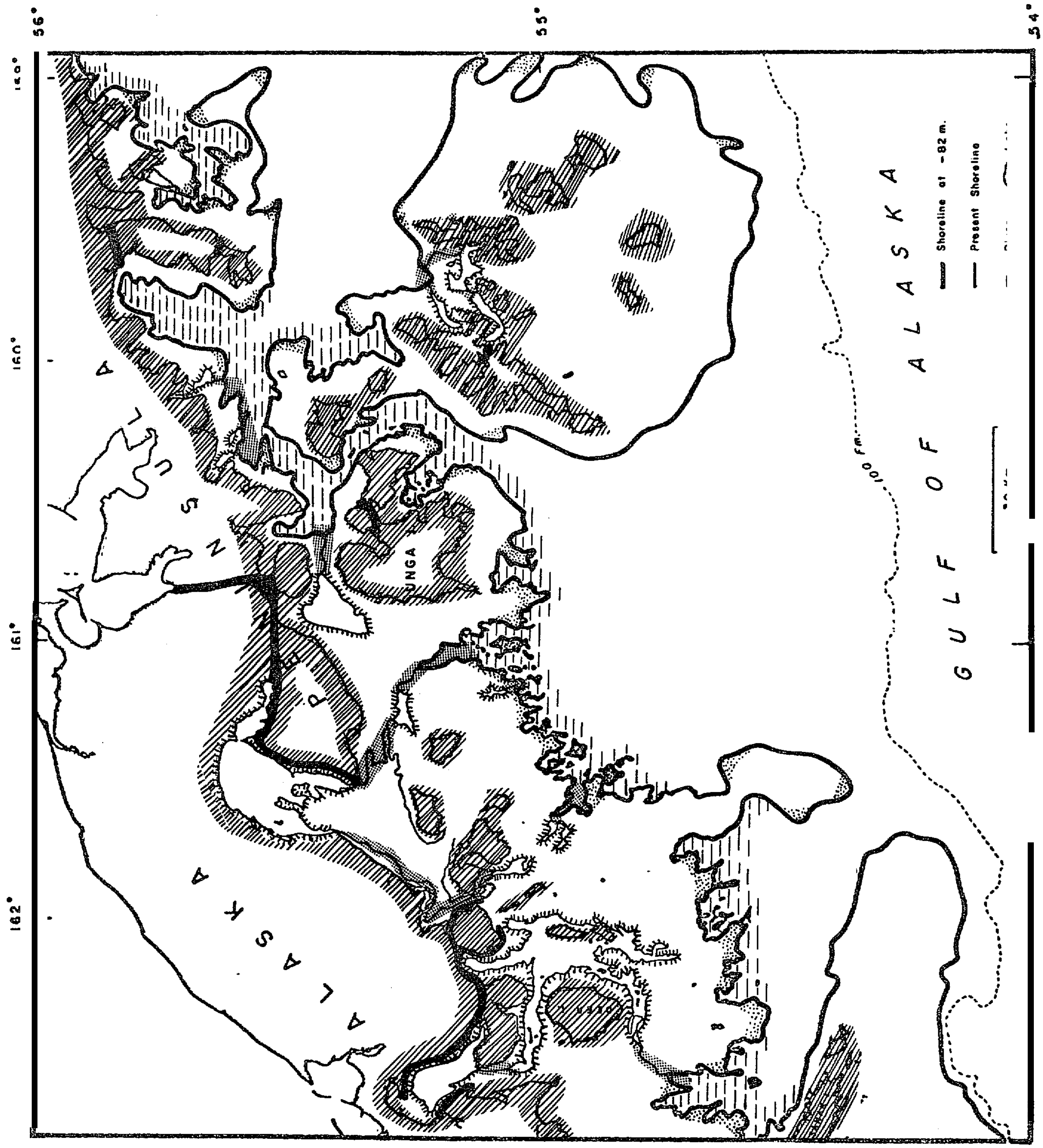


Fig. 11-12. Stillstand II, Provinces III & IV, 15,000 - 14,800 B.P.
Alaska Peninsula and Shumagin Islands to Sanak Island.

Sanak Peninsula. The coast from Sanak westward is generally straighter, less complex and indented and more exposed than that east of Sanak (Figs. 11-13 & 11-14) --more similar, in short, to that of the preceding still-stand for Province IV while the coast east of Sanak is now more similar to that of Province III.

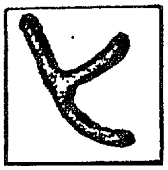
Terrestrial resources may have been somewhat reduced in this province by now simply as a result of diminishing range, though a considerable extent of favorable habitat would still seem to be available, particularly the highlands and slopes of the Sanak and proximal Aleutian Islands. The large lake and river systems would still have existed and still probably hosted waterfowl and runs of anadramous fish.

Though terrestrial resources might have been diminished by this time the potential would have greatly increased, particularly east of the Sanak Peninsula and south of Umank Island. The greatly increased complexity of coastal configuration in both these regions would have provided both shelter and habitat diversity, probably leading to an overall increase in diversity and availability of marine resources.

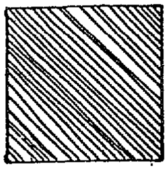
Stillstand 111: 13,750 B.P.

Apparently stabilizing at 66 meters below present level during this period, the encroaching sea would have further reduced the emergent terrestrial regime in the Western Gulf. In the first three provinces this encroachment appears to have been relatively gradual and minor while in Province IV the flooding of the extensive low-lying very drastically reduced the terrestrial area.

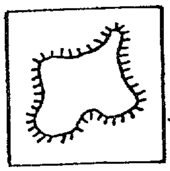
Within Province I, Kodiak, the major flooding would have been along the outer coast. The peninsulas separately the deep inlets would by now be much reduced and would have in many cases been cut off from the main body of the island to leave flat, low-lying islands of the southeast shore (Figs. 11-15 & II-16) . The deep inlets would be proportionally reduced as the peninsulas flooded, though as some compensation the southeast coast would still be somewhat sheltered by the large off-shore islands left behind by the flooding of these peninsulas. Along the northern coast and the Shelikof Strait coast other deep, fiord type inlets were now starting to appear as sills were crested and the deep freshwater lakes hypothesized fox these areas were flooded by the sea (Fig. 11-16).



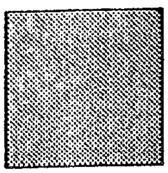
Passes or constrictions funneling movements of large terrestrial mammals.



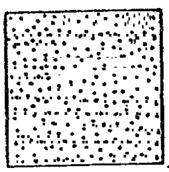
South or north f-acing slopes providing possible spring and fall attraction to large herbivores.



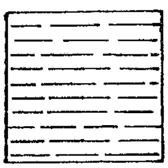
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

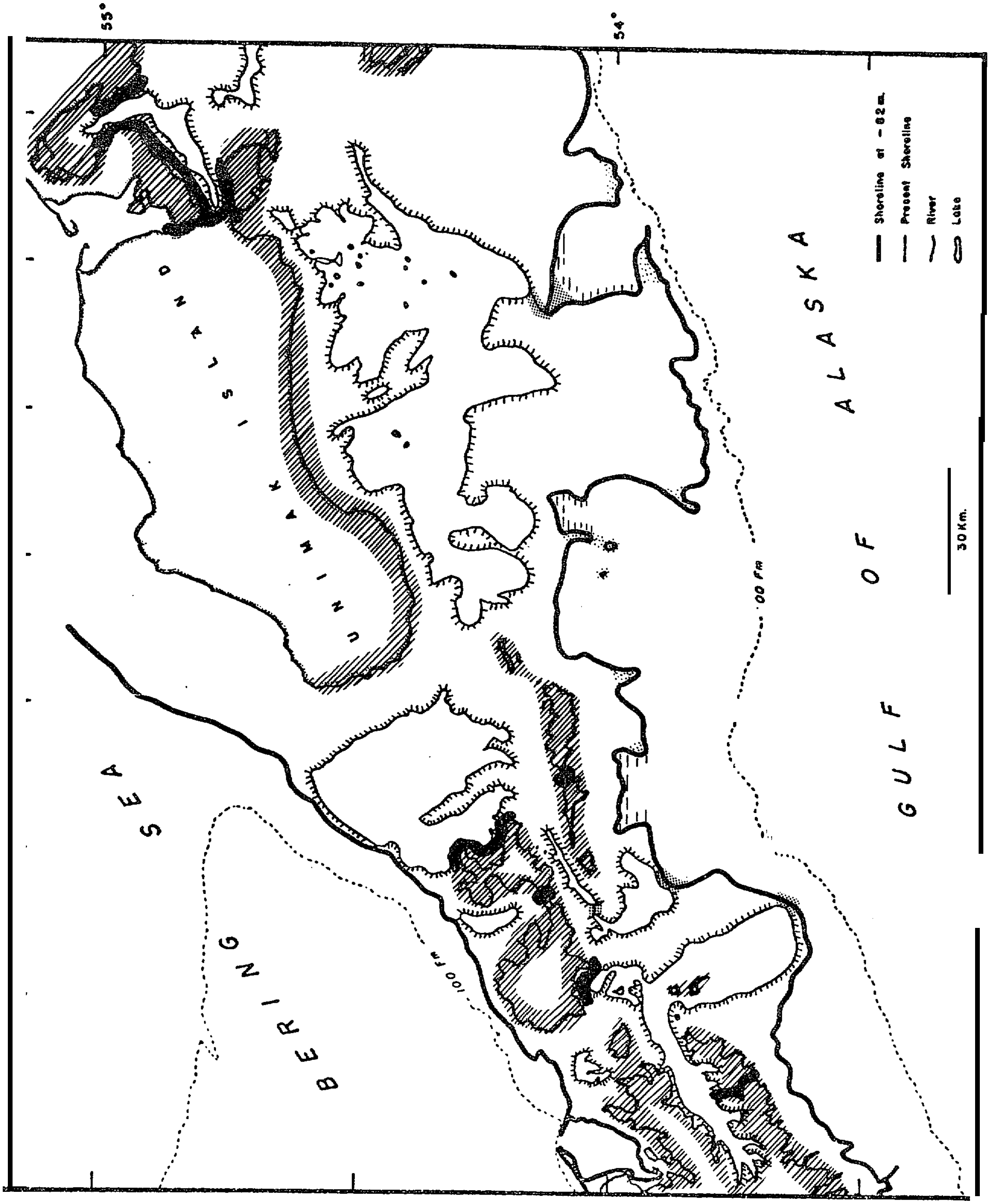
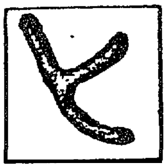
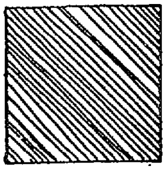


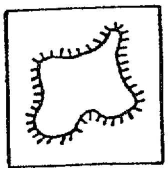
Fig. II-13. Stillstand", Province IV, 15,000 - 14,800 B.P.
Unimak Island to Unalaska Island.



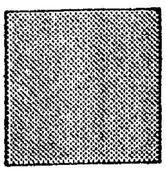
Passes or constrictions funneling movements of large terrestrial mammals.



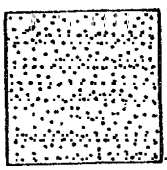
South or north facing slopes providing possible spring and fall attraction to large herbivores.



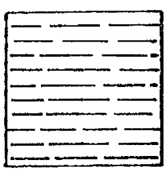
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38)-

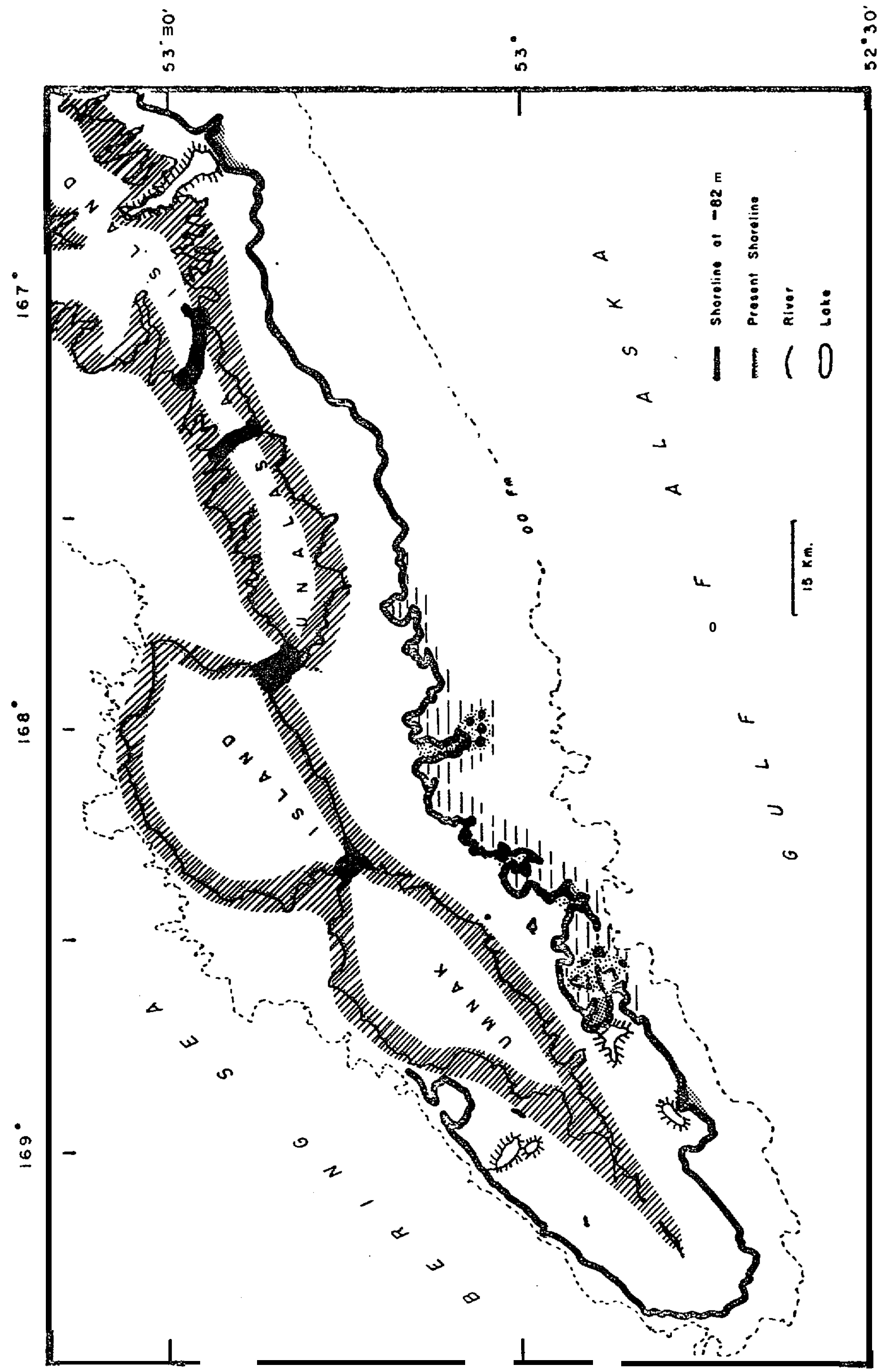
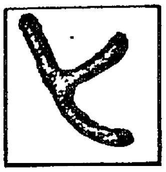
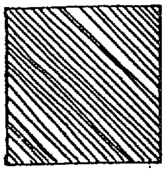


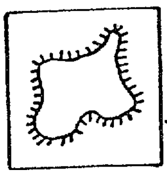
Fig. 11-14. Stillstand II, Province IV, 15,000 - 14,800 B.P.
Unalaska and Umnak Islands.



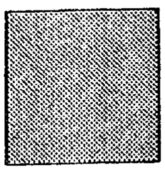
Passes or constrictions funneling movements of large terrestrial mammals.



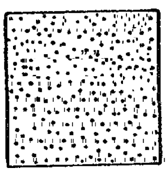
South or north facing slopes providing possible spring and fall attraction to large herbivores.



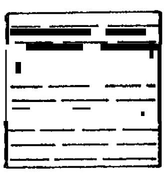
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

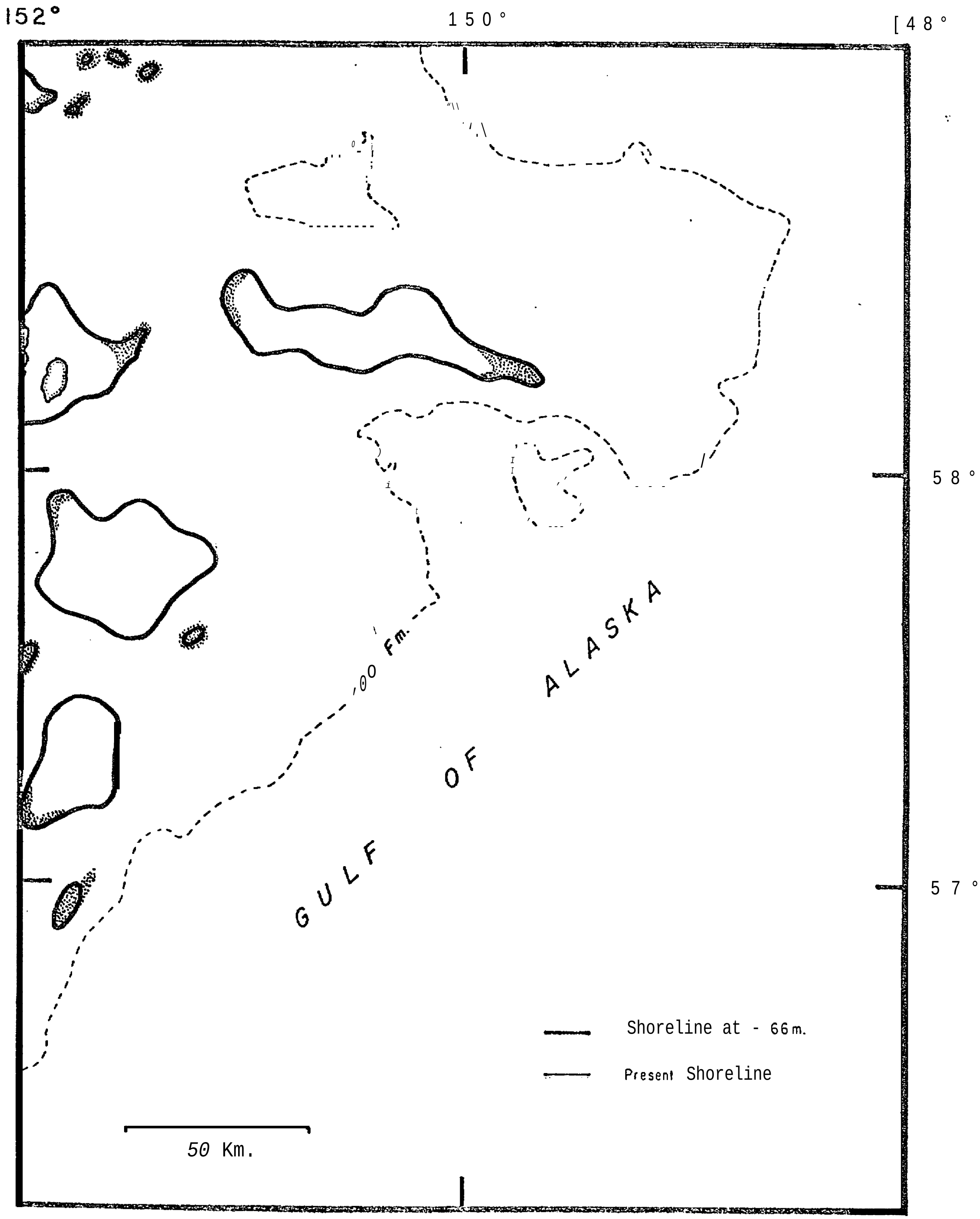
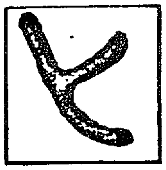
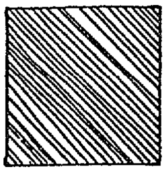


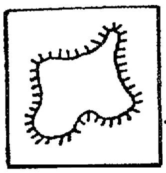
Fig. 11-15. Stillstand III, Province I, 13,750 B.P.
East of Kodiak Island.



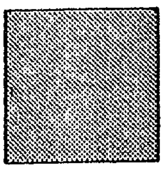
Passes or constrictions funneling movements of large terrestrial mammals.



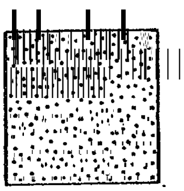
South or north facing slopes providing possible spring and fall attraction to large herbivores.



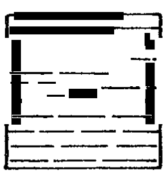
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

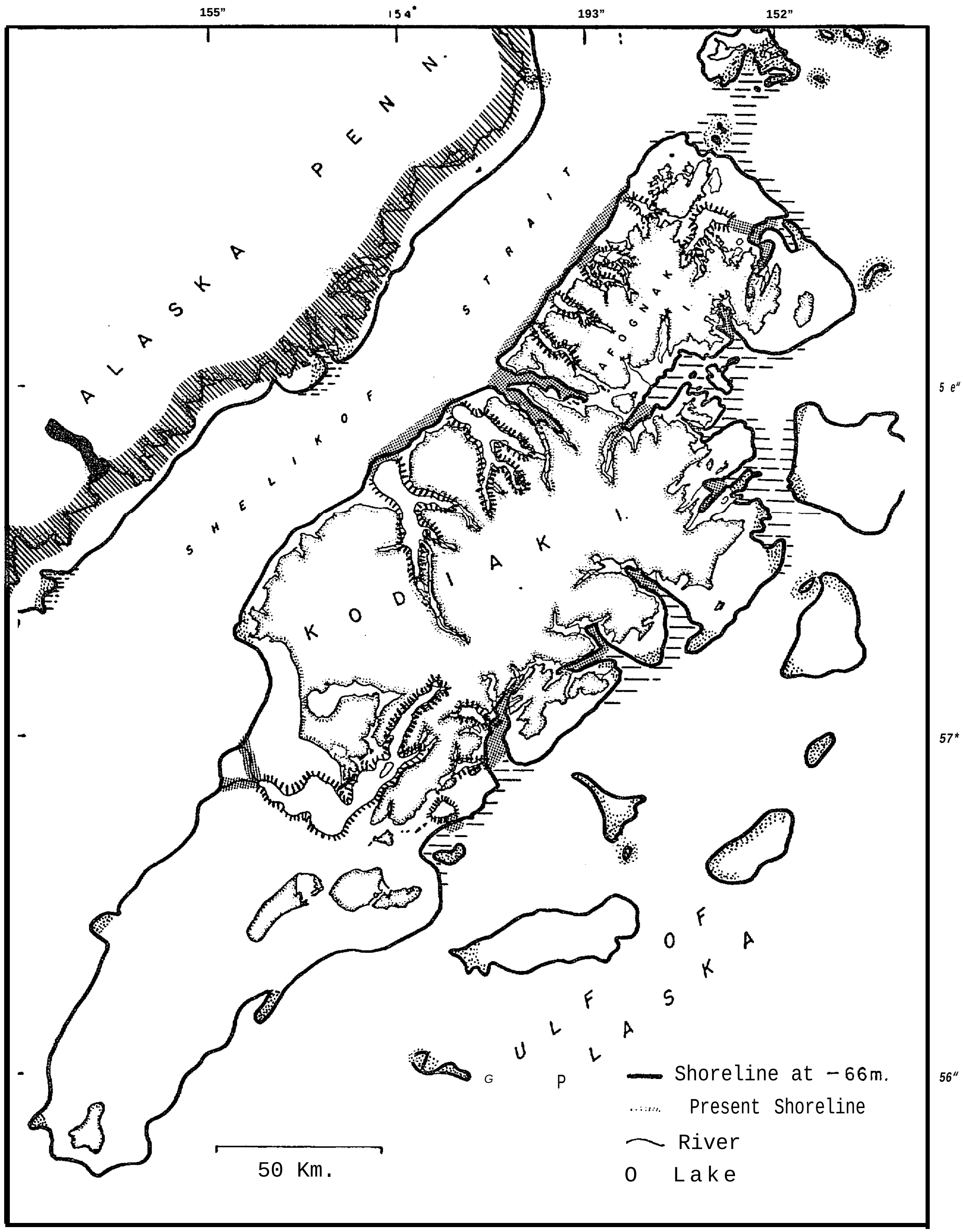


Fig. 11-16. Stillstand III, Provinces I & II, 13,750 B.P. Kodiak Island.

As previously indicated, all of the inlets and river mouths around the northern half of the Kodiak coast, both outer coast and Shelikof Strait, might have provided admirable habitat for marine mammals and birds of all types present in the area, marine invertebrates, and both anadramous and marine fish. The southern half of the coast and the low-lying offshore islands would be less attractive, with little or no terr-estrial shelter or resources and open, unprotected shores.

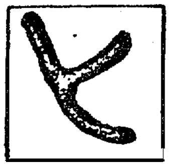
Province II, across Shelikof Strait, would be little changed in coastal configuration by this second rise in sea level (Fig. 11-16). The coastal plain would be narrowed somewhat over the previous stillstand and a few inlets and bays would be starting to appear, but basically the situation would remain the same as before.

As before, the areas of most probable desirability for marine resources would be the Kukak-Kinik Bay vicinity, perhaps the headland at Cape Douglas, and some of the river mouths and shallow bays near the southwest end of the strait.

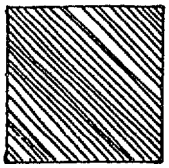
The coast of Province III would not be greatly altered in character over the previous stillstand, remaining very convoluted and complex, and consequently very probably rich in marine resources and diversity (Figs. 11-17 & 11-18). Virtually all of this coast might have been attractive to coastal subsistence hunters at this time.

Province IV, however, would by now be greatly altered. The broad plains adjoining the end of the Alaska Peninsula and the proximal Aleutians would virtually have disappeared beneath the rising sea, though the Aleutian passes would not as yet have flooded (Figs. 11-18, 11-19, 11-20) . By now it appears that the terrestrial resources of this pro-vince, in terms of large herbivore populations at least, could not have been great. Both sides of the outer Alaska Peninsula were by now flooded, drastically reducing available range and assuring that by now this region experienced a wet, maritime climate.

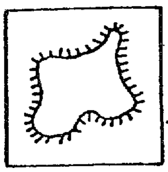
Attention must by now have turned to marine resources, which might have been available in considerable quantity and diversity. The coast to the north and east from the peninsula which included the Sanak Islands may have been particularly rich and diverse, as may have been the many bays and inlets now developing along the sinuous length of the



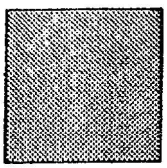
Passes or constrictions funneling movements of large terrestrial mammals.



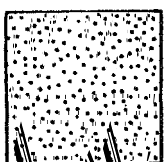
South or north facing slopes providing possible spring and fall attraction to large herbivores.



Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.

Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

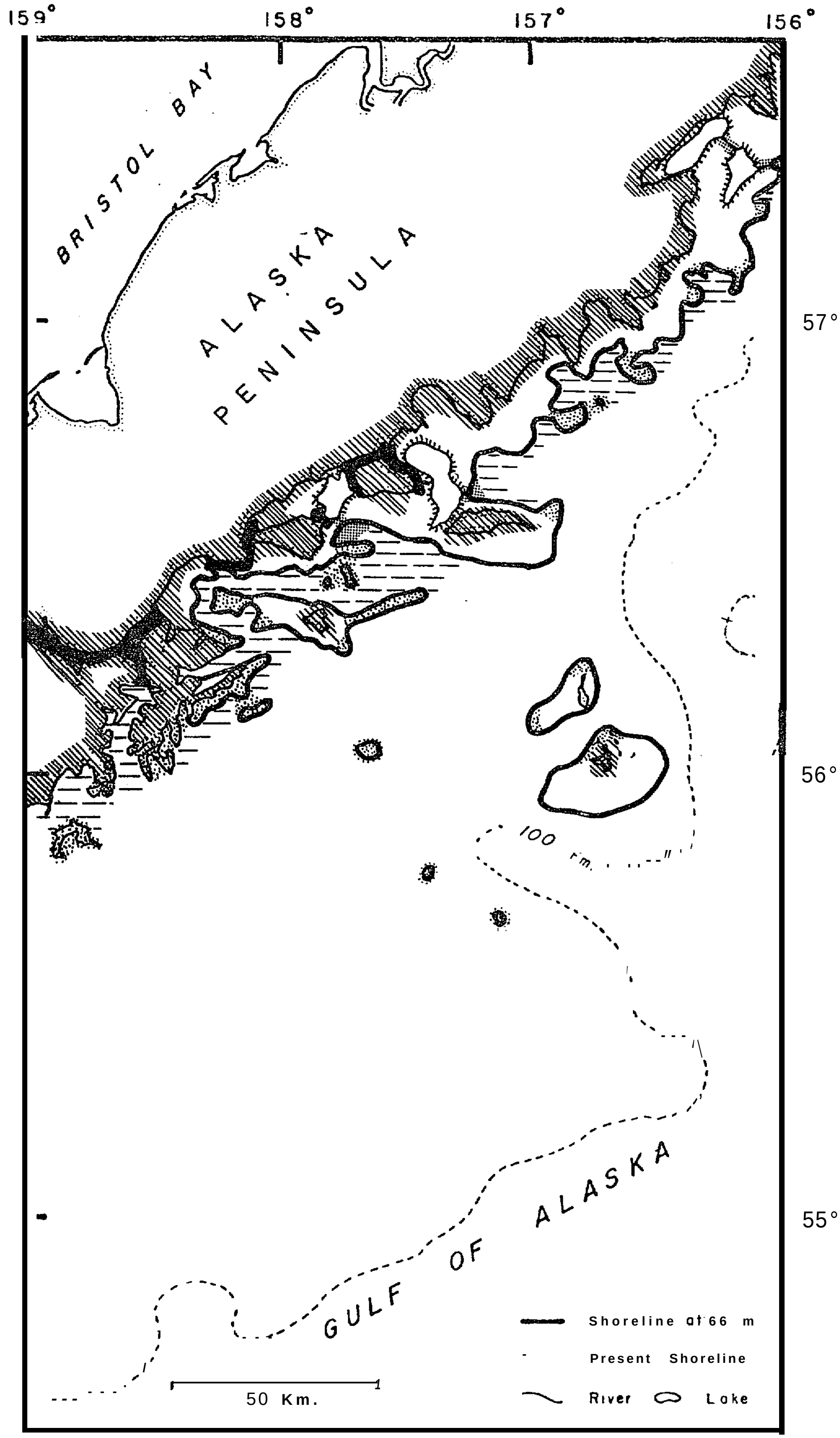
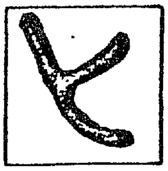
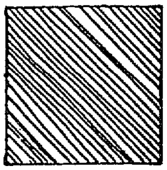


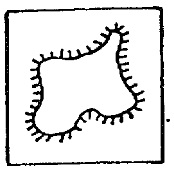
Fig. 11-17. Stillstand III, Province III, 13,750 B.P.
Alaska Peninsula and Semidi Islands to Shumagin Islands.



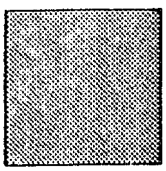
Passes or constrictions funnelling movements of large terrestrial mammals.



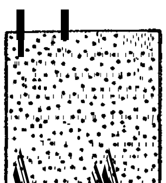
South or north facing slopes providing possible spring and fall attraction to large herbivores.



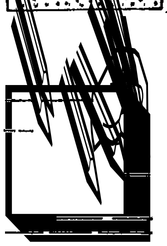
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

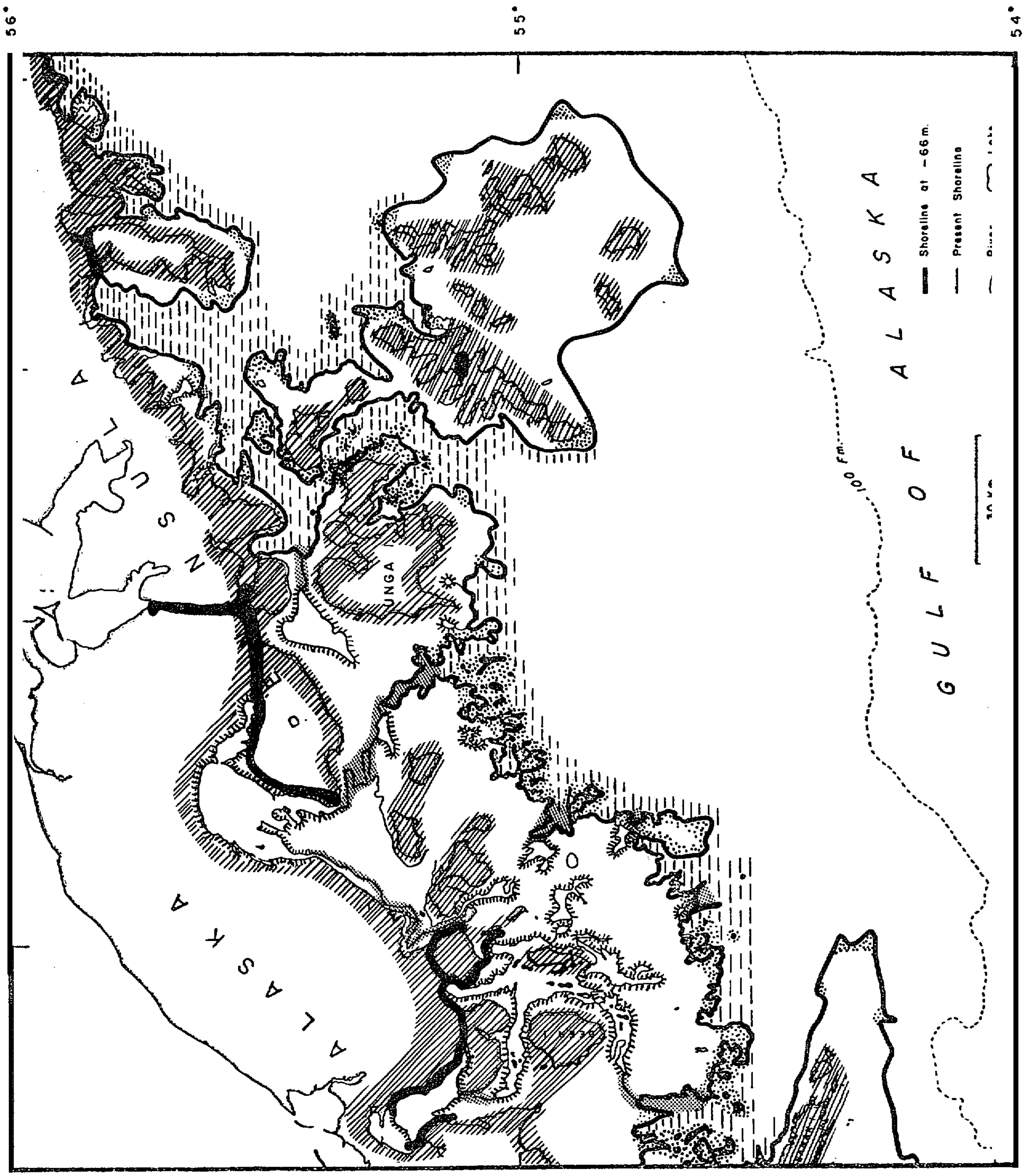
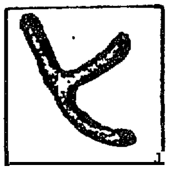
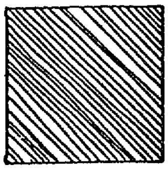


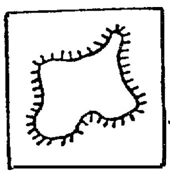
Fig. 11-18. Stillstand III, Provinces III & IV, 13,750 B.P.
Alaska Peninsula and Shumagin Islands to Sanak Island.



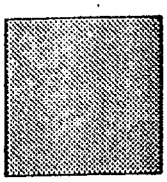
Passes or constrictions funneling movements of large terrestrial mammals.



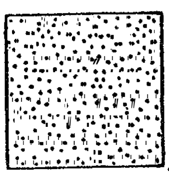
South or north facing slopes providing possible spring and fall attraction to large herbivores.



Lake margins providing. attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.

Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

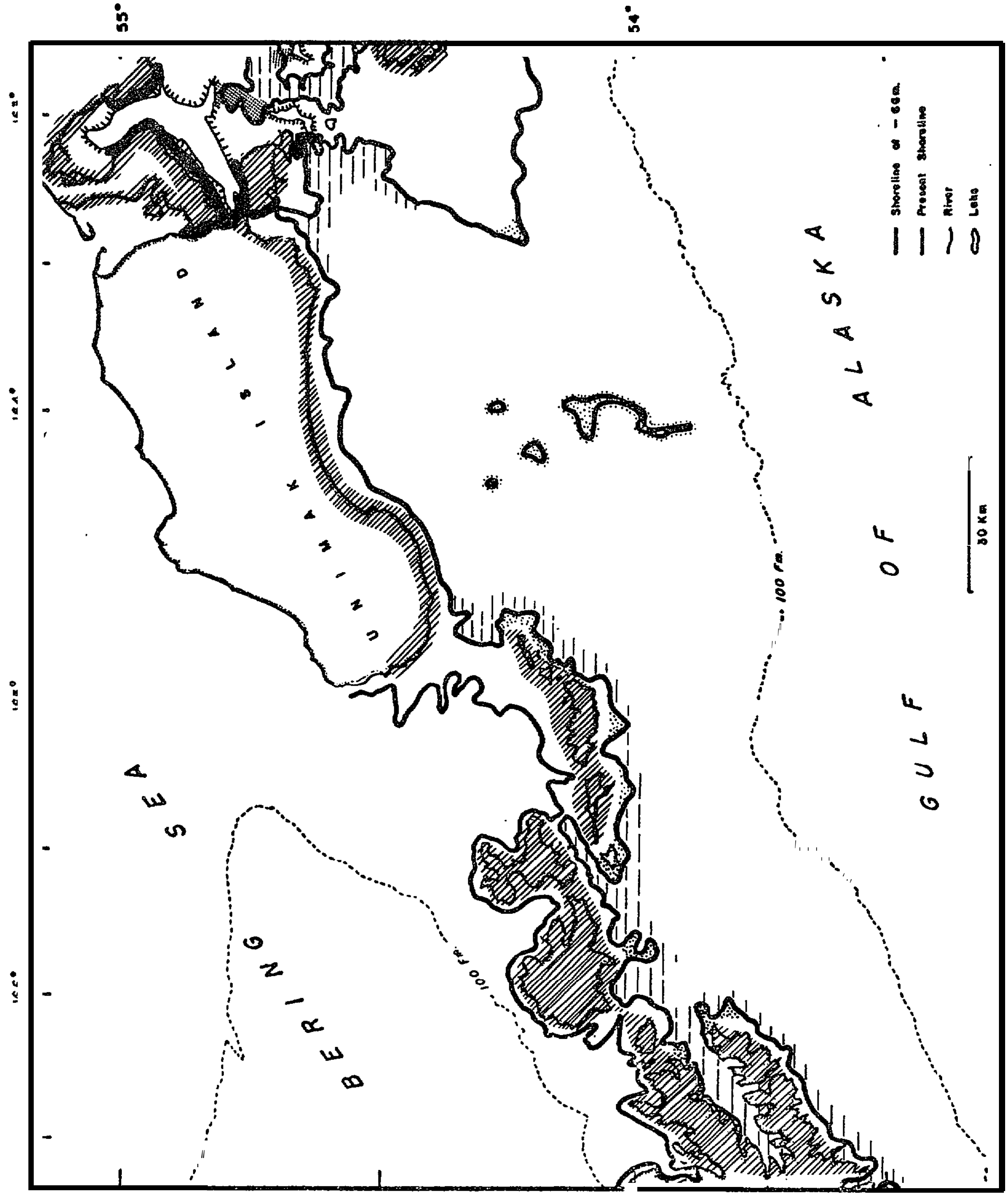
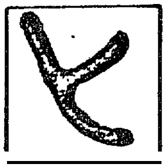
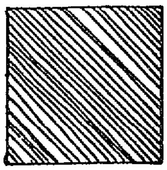


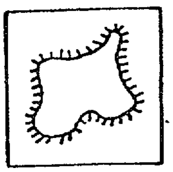
Fig. 11-19. Stillstand III, Province IV, 12,750 B.P.
Unimak Island to Unalaska Island.



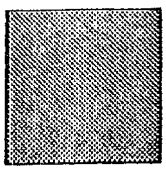
Passes or constrictions funneling movements of large terrestrial mammals.



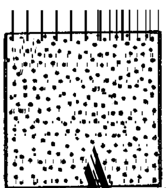
South or north facing slopes providing possible spring and fall attraction to large herbivores.



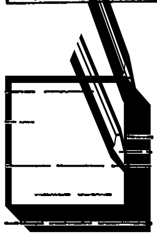
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through 11-38].

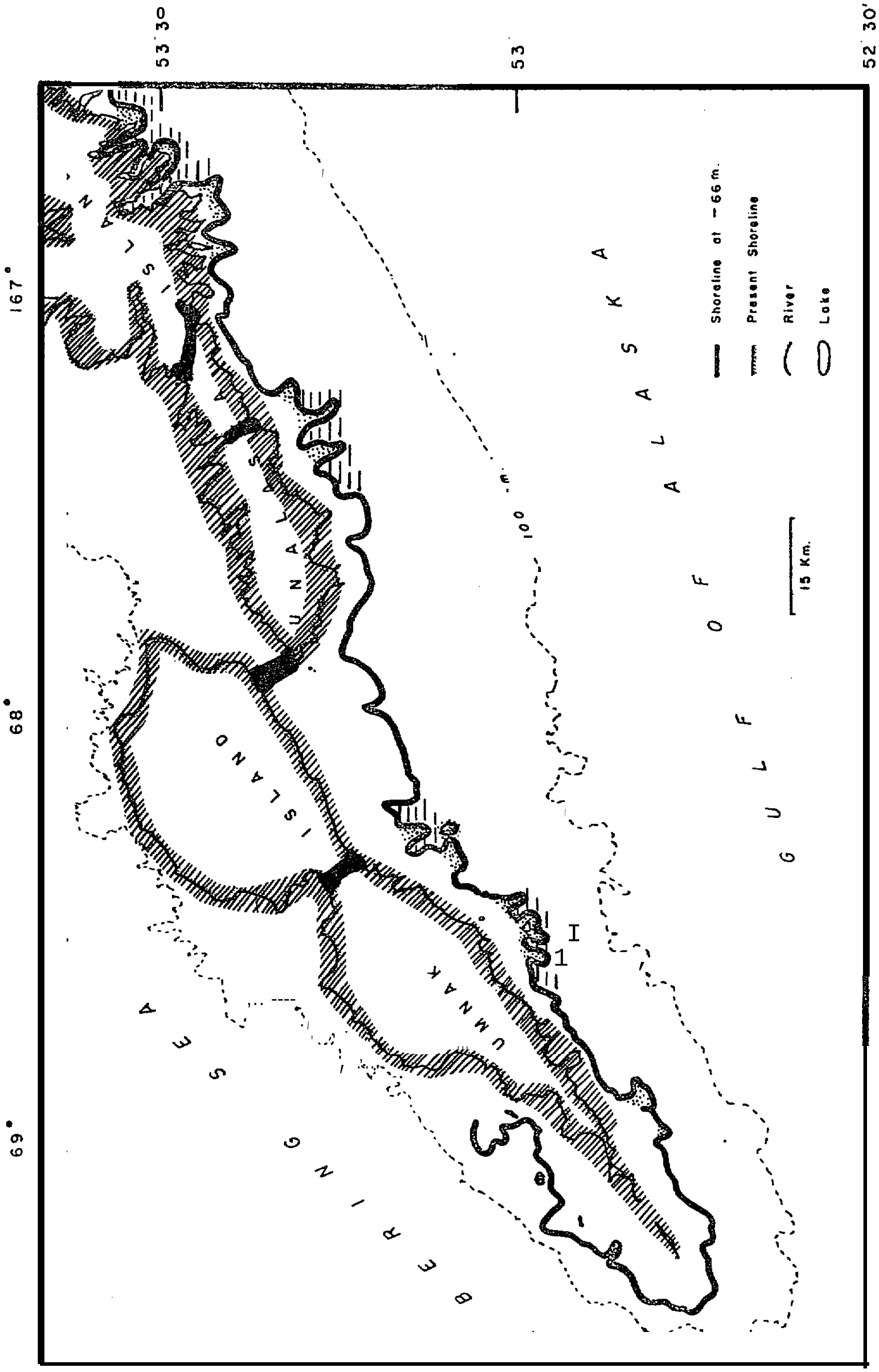


Fig. 11-20. Stillstand III, Province IV, 13,750 B.P. Unalaska and Umnak Islands.

main body of the peninsula from Unimak to Umnak Islands (Figs. 11-19 & 11-20) . Anadramous fish probably did not find conditions favorable for spawning along this narrow outer peninsula, but probably did utilize the area northeast of the Sanak Peninsula. As mentioned for the previous stillstand, this area northeast of the Sanaks should more properly be included in Province III by this time. Except for anadramous fish, however, all of the marine species hypothesized for the Western Gulf area could have found desirable habitat along this outer peninsula coast. The narrow constrictions of the peninsula might have been particularly attractive to coastal hunters, permitting alternate access to the marine resources of both the Bering and Pacific shores.

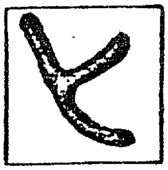
Stillstand IV: 12,700 B.P.

This rise in sea level of 11 meters, to 55 meters below the present level, would have most drastically altered the conditions of Province IV, with the other three remaining similar in character to the descriptions for the previous stillstand.

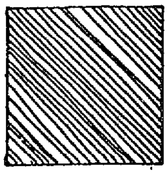
Kodiak, Province I, would be changed only in that the peninsulas and islands along the southeastern shore would be diminished and the bays and inlets along the northern and western shore would be more extensive (Figs. 11-21 & II-22). Coastal marine resource distributions would remain essentailly the same as previously described, with richer potential existing within the bays and inlets along the northern half of the island's coast.

Province II would also be virtually unchanged by this latest rise in sea level, with the Kukak-Kinak Bay vicinity, Cape Douglas, and the southern extremity of the Shelikof Strait coast presenting the most favorable possibilities (Fig. II-22).

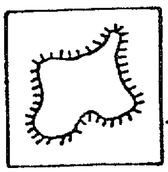
Province III would probably have retained the same general character and faunal distributions as during the earlier stillstands, though this latest rise would have compounded the already considerable complexity of that coast. By now the Sanak Peninsula would be cut off from the mainland and returned to island status and the coast all the way from the vicinity of the Shumagins to Unimak Island would present an extremely complicated maze of inlets, bays and myriad nearshore islands, all of which could have been very rich and diverse in marine resources



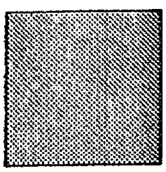
Passes or constrictions funnelling movements of large terrestrial mammals.



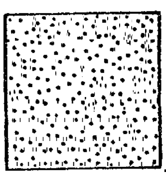
South or north facing slopes providing possible spring and fall attraction to large herbivores.



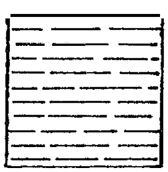
Lake margins providing attraction to migratory waterfowl, ground nest-ing birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

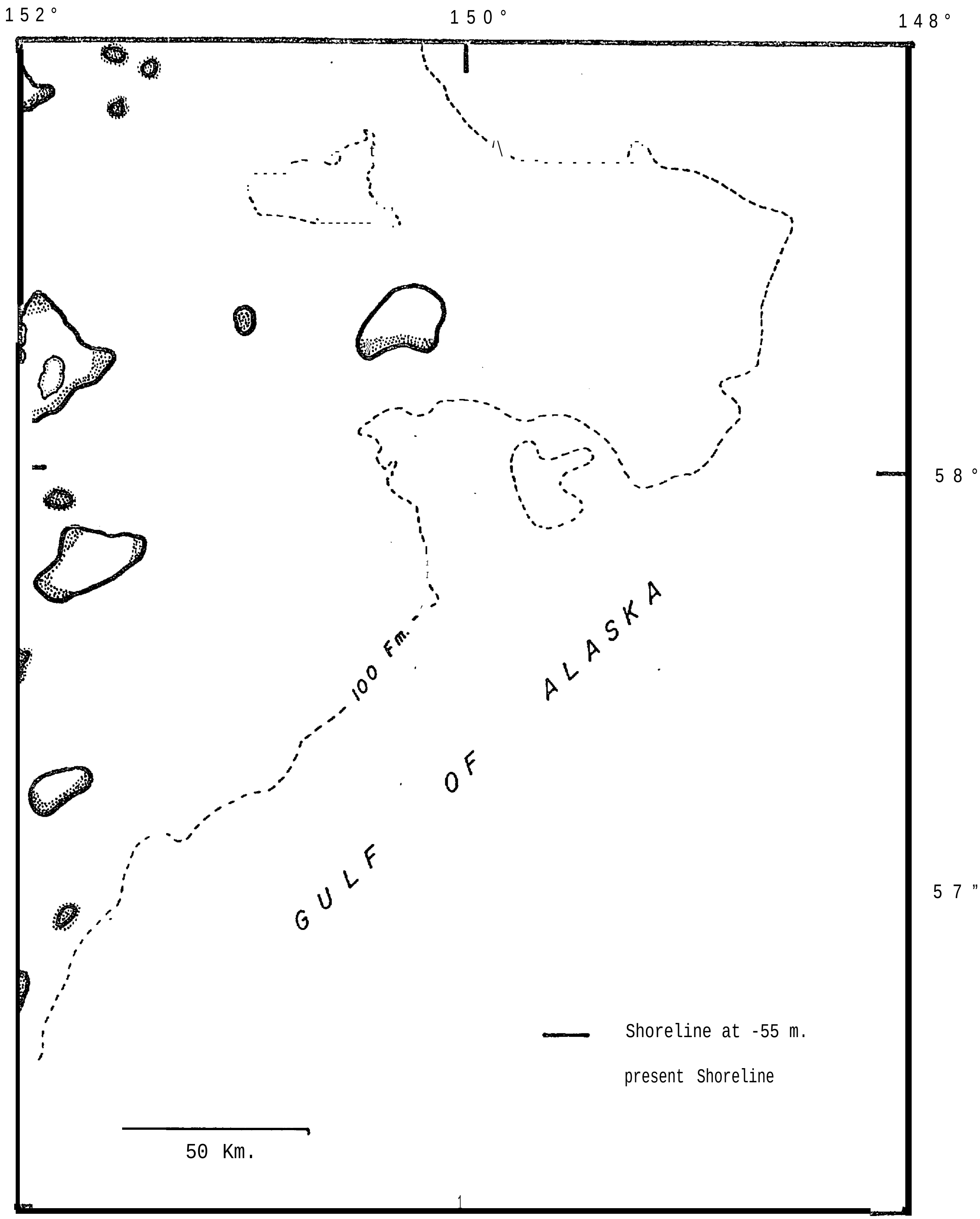
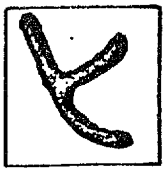
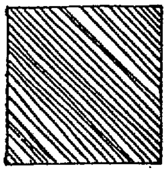


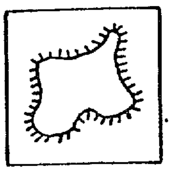
Fig. 11-21. Stillstand IV, Province I, 12,700 B.P.
East of Kodiak Island.



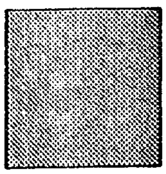
Passes or constrictions funneling movements of large terrestrial mammals.



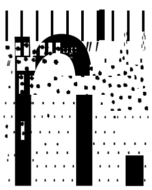
South or north facing slopes providing possible spring and fall attraction to large herbivores.



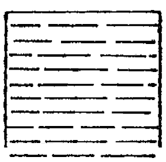
Lake margins providing, attraction to migratory waterfowl, ground nest-ing birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

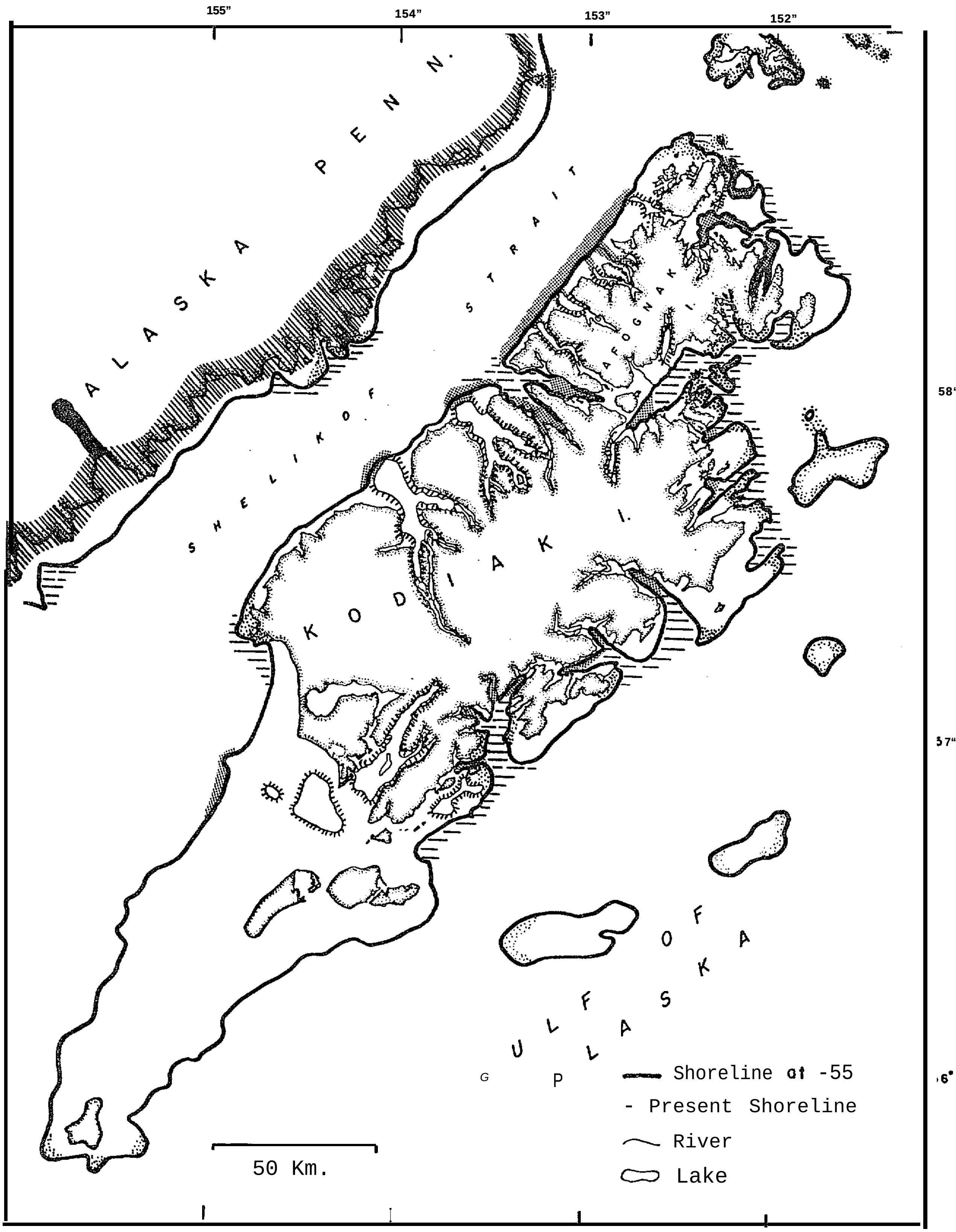


Fig. II-22. Stillstand IV, Provinces I & II, 12,700 B.P. Kodiak Island.

(Figs. II-23, II-24, II-25). By this time Province III can definitely be considered as extending as far southwest as the proximal end of Unimak Island. Though curtailed in range, terrestrial mammal resources might still present an attraction within Province III, perhaps the only province where such resources remained in abundance. By this time period the general warming trend and encroaching marine environment would almost certainly have given rise to a wet tundra type terrestrial environment with large mammal populations probably limited to moose, perhaps caribou, and brown bear.

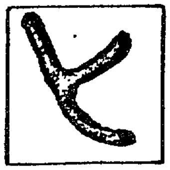
It is perhaps worth mentioning at this time that this coastal complexity of Province III could have provided, throughout a long time period encompassing several stillstands, very attractive habitat for the Steller sea cow if this species did in fact inhabit the Western Gulf region during the late Wisconsin.

Province IV by now would have largely returned to an insular status with the flooding of several of the Aleutian passes (Figs. II-25 & II-26). Terrestrial resources were by now almost certainly curtailed, with no terrestrial large mammal populations remaining. The marine resources, conversely, may have presented considerable variety and richness. Deep bays and inlets, and the narrow passes between the islands might have been particularly attractive locations for subsistence hunters.

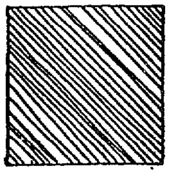
Stillstand V: 9,400 ± 220 B.P.

By this time the warming trend and glacial wastage was well advanced, with sea level standing approximately 38 meters below present. The climate now would have been almost certainly that of a wet maritime coast, perhaps not too dissimilar from that observed at present in this region. Terrestrial vegetation would probably have been wet tundra, with perhaps some birch, willow, and alder timber (Heusser, 1960; Klein, 1965).

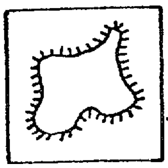
The Kodiak coast would now have increased in complexity all around the island, with many deep bays and fiords offering shelter and habitat for marine flora and fauna, though the extreme southern coast, now an elongate peninsula, would have been more exposed and probably less productive than the northern two-thirds of the island (Figs. II-27 & II-28). Much of this complex coast could have furnished habitat for the Steller sea cow if it was present in the area at this time.



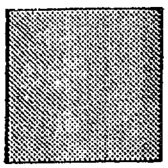
Passes or constrictions funneling movements of large terrestrial mammals.



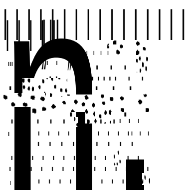
South or north facing slopes providing possible spring and fall attraction to large herbivores.



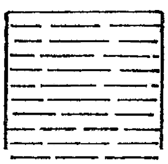
Lake margins providing attraction to migratory waterfowl ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

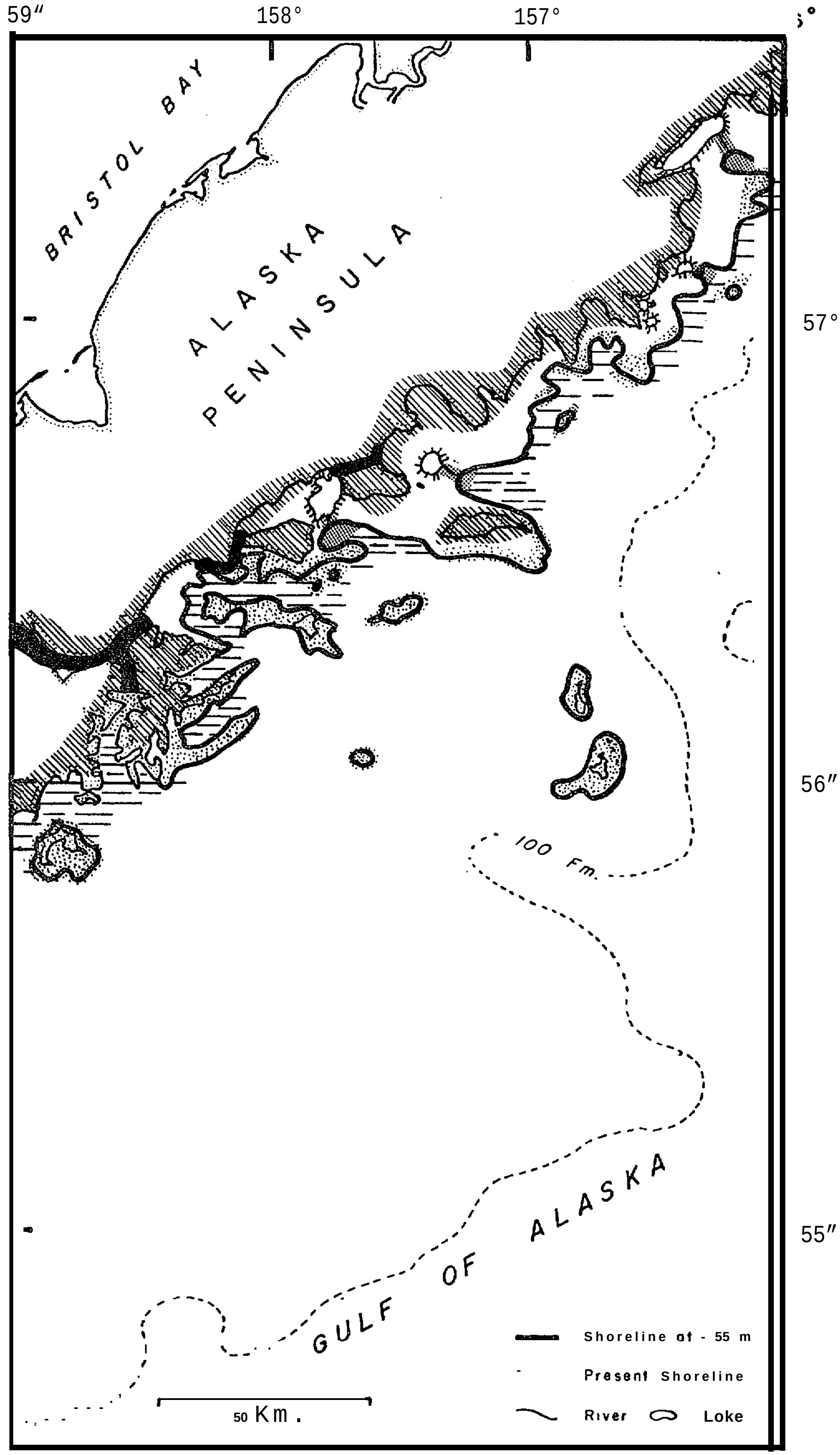
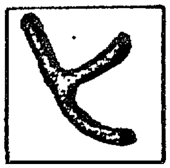
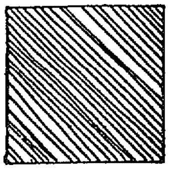


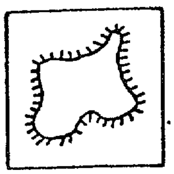
Fig. II-23. Stillstand IV, Province III, 12,700 B.P.
Alaska Peninsula and Semidi Islands to Shumagin Islands.



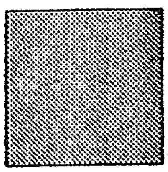
Passes or constrictions funneling movements of large terrestrial mammals.



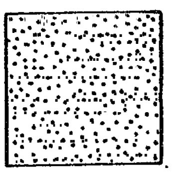
South or north facing slopes providing possible spring and fall attraction to large herbivores.



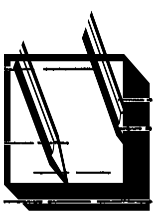
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

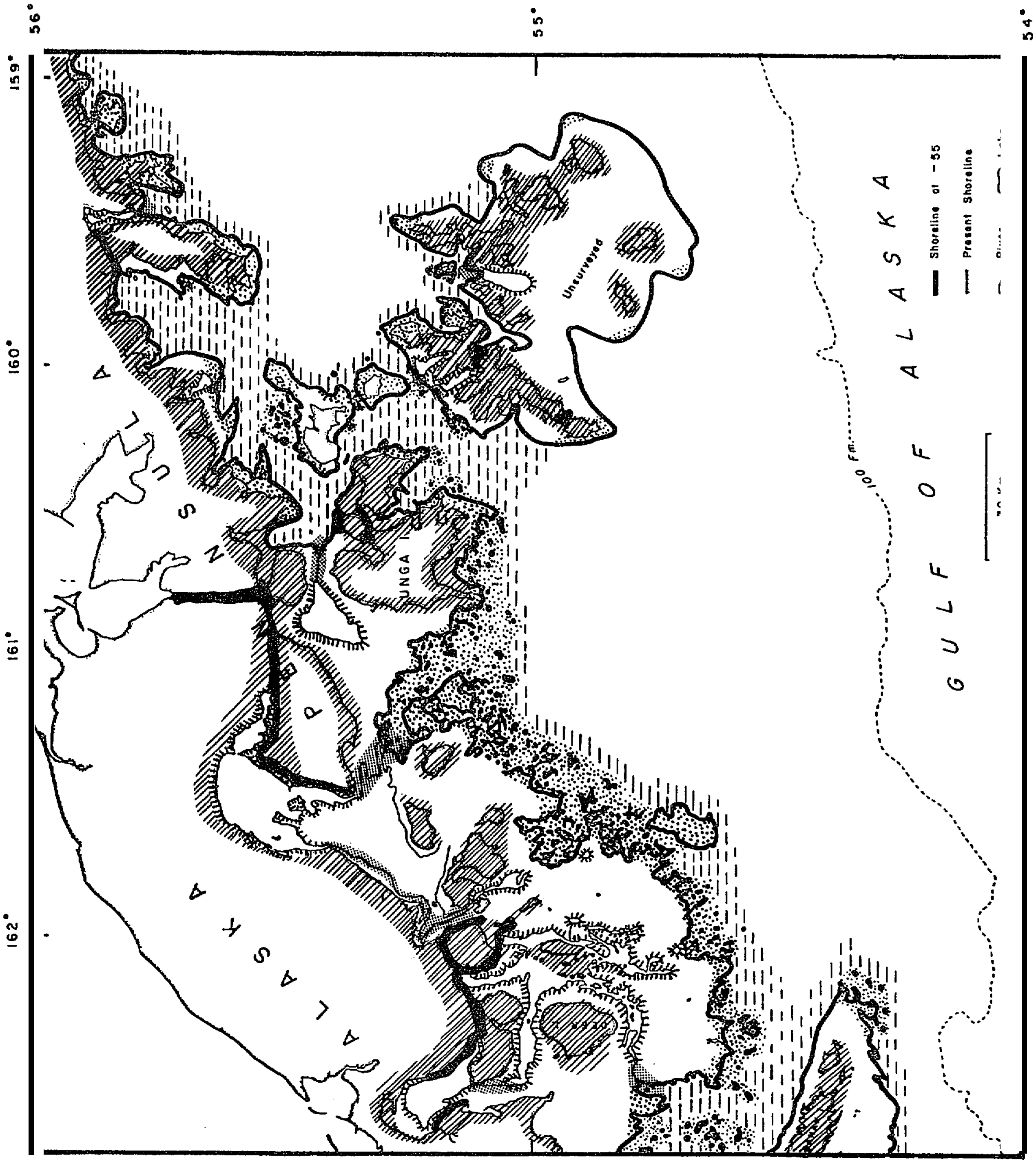
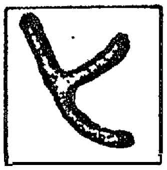
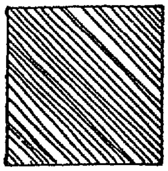


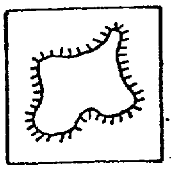
Fig. II-24. Stillstand IV, Provinces III & IV, 12,700 B.P.
Alaska Peninsula and Shumagin Islands to Sanak Island.



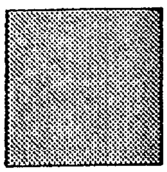
Passes or constrictions funneling movements of large terrestrial mammals.



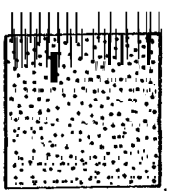
South or north facing slopes providing possible spring and fall attraction to large herbivores.



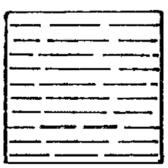
Lake margins providing. attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

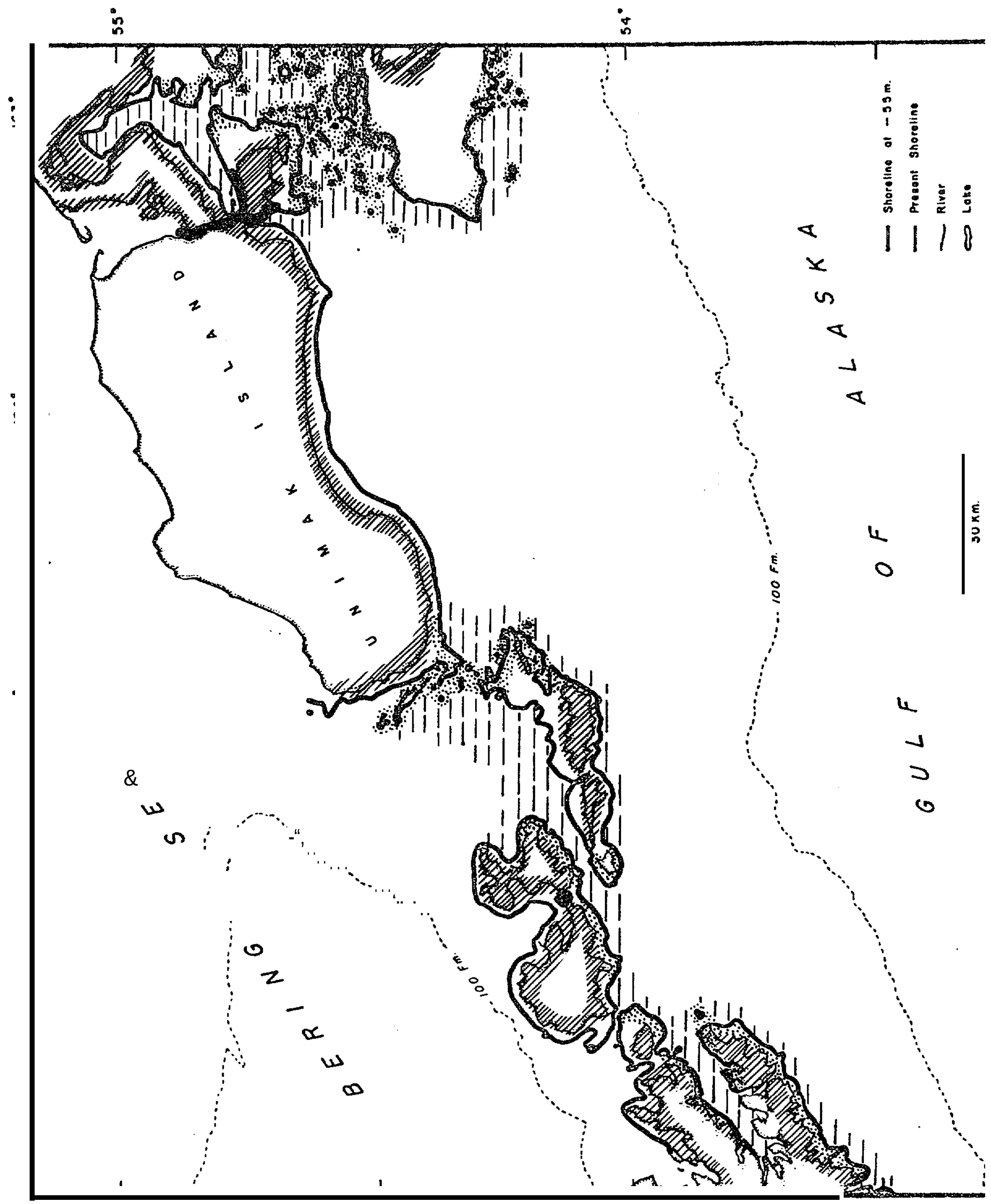
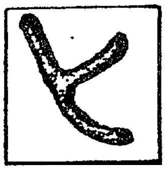
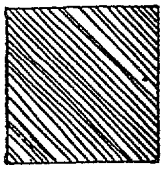


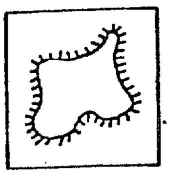
Fig. II-25. Stillstand IV, Province IV, 12,700 B.P.
Unimak Island to Unalaska Island.



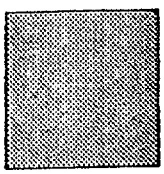
Passes or constrictions funneling movements of large terrestrial mammals.



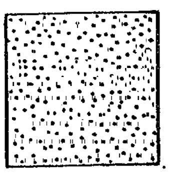
South or north facing slopes providing possible spring and fall attraction to large herbivores.



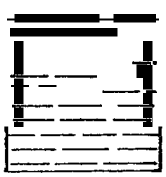
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

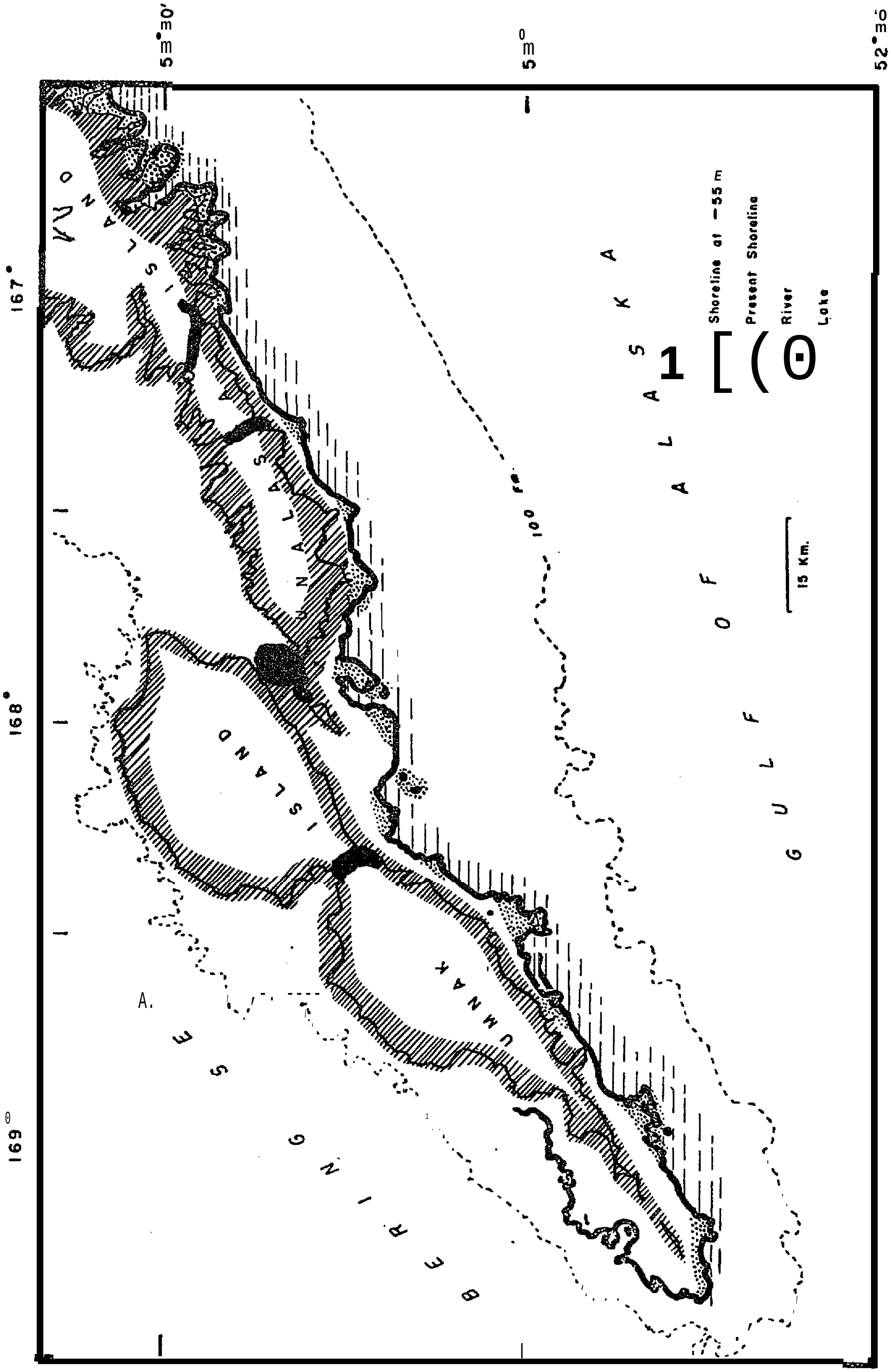
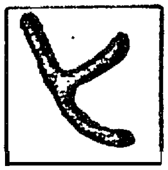
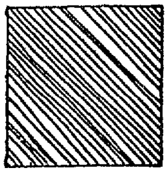


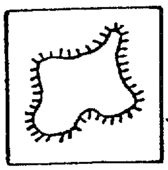
Fig. II-26. Stillstand IV, Province IV, 12,700 B.P. Unalaska and Umnak Islands.



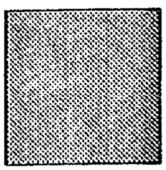
Passes or constrictions funneling movements of large terrestrial mammals.



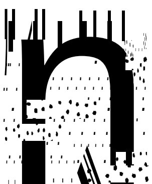
South or north facing slopes providing possible spring and fall attraction to large herbivores.



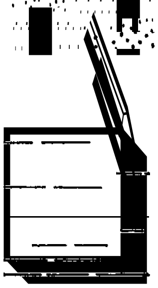
Lake margins providing. attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II–38).

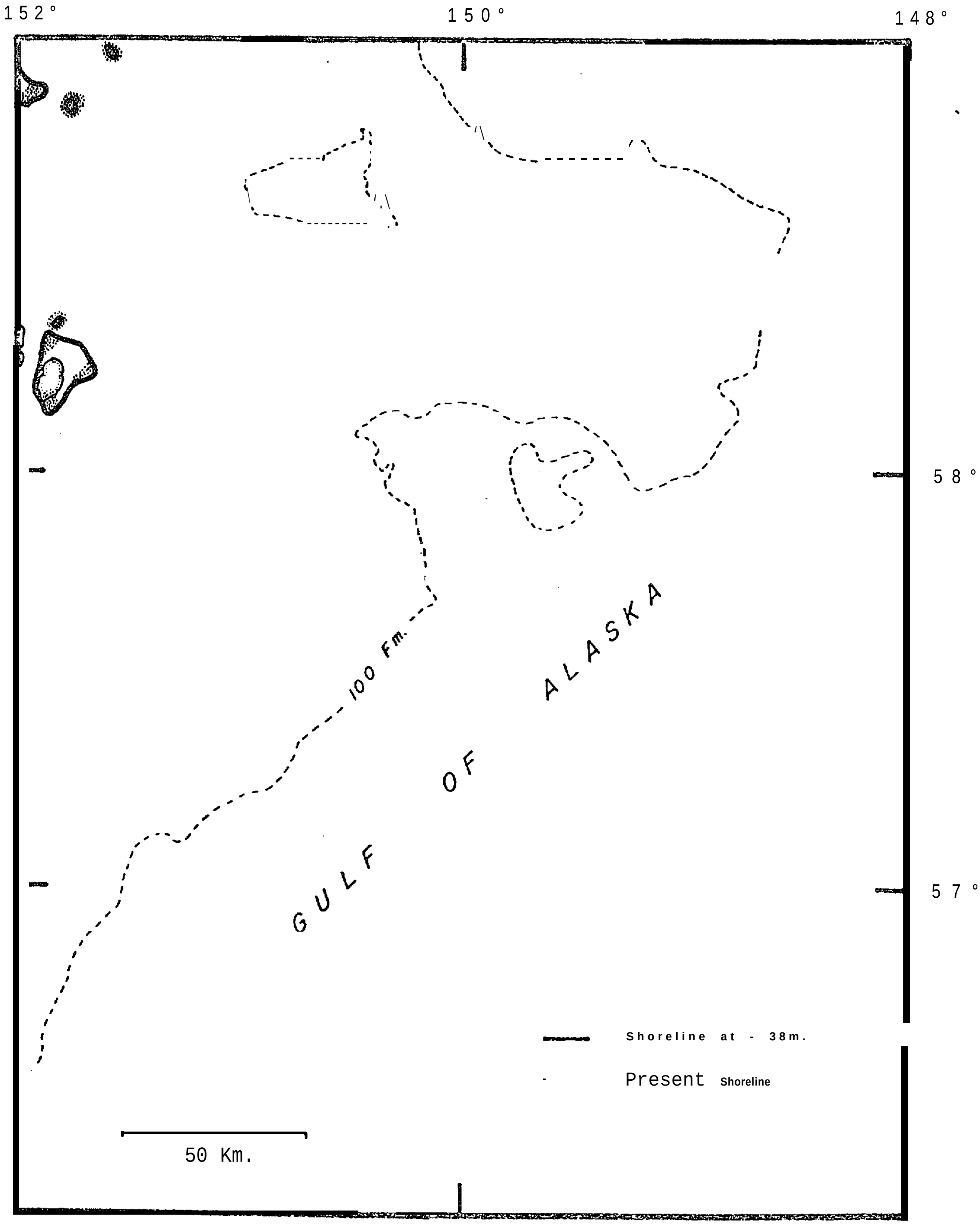
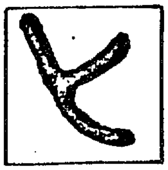
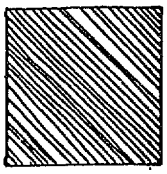


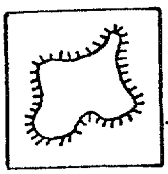
Fig. II-27. Stillstand V, Province I, 9,400 B.P.
East of Kodiak Island.



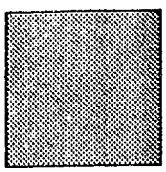
Passes or constrictions funneling movements of large terrestrial mammals.



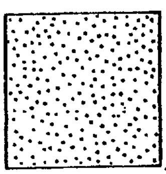
South or north facing slopes providing possible spring and fall attraction to large herbivores.



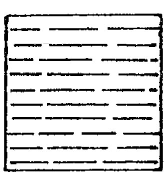
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

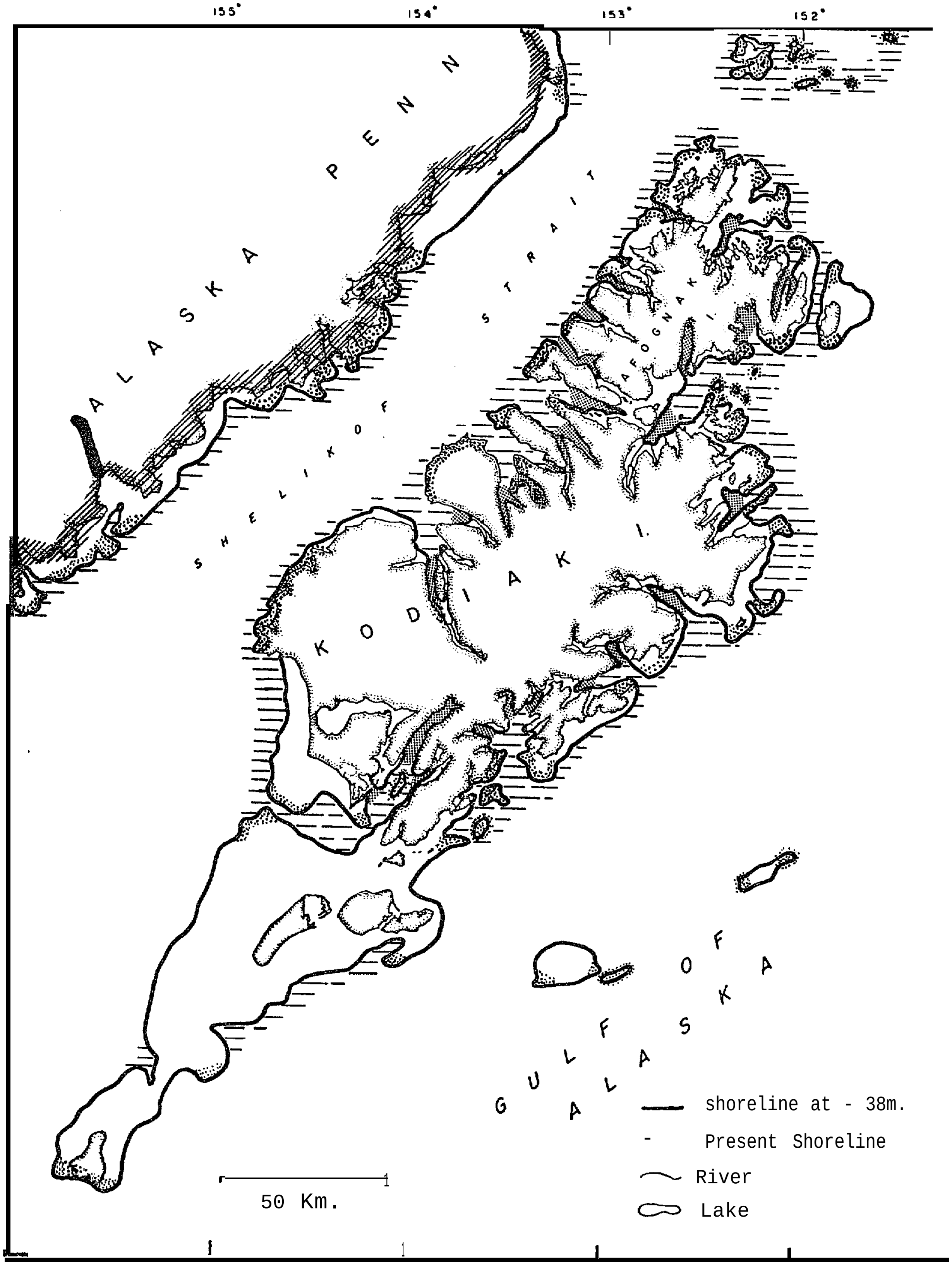


Fig. II-28. Stillstand V, Provinces I & II, 9,400 B.P.
Kodiak Island.

Province II would also have become more complex in coastal configuration by Stillstand V, with several deep bays and headlands providing possible attraction to early hunters (Fig. 11-28). Again the Kukak-Kinik Bay vicinity and the coast near the southern end of the strait would appear to be the more desirable areas.

Province 111 would still retain its extreme complexity (Figs. II-29 & 11-30), with the major bays now widened and extended further into the interior of the Alaskan Peninsula. As before, all of this province could have been very rich and diverse in marine resources of all types present in the Western Gulf. Terrestrial resources in the form of large mammals might now have declined severely due to range restrictions, however, and were probably limited for the most part to the present mainland of the Alaska Peninsula.

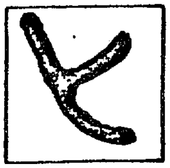
Province IV was now almost strictly insular (Figs. 11-31 & II-32) Unimak Island would remain attached to the main body of the Alaska Peninsula by a narrow corridor. The increasingly complex marine habitat offered by this area along all of the island shores except perhaps for Unimak, which retained a relatively straight and unprotected coast, could have supported a rich and varied marine fauna.

Stillstand VI : 8,700 B.P.

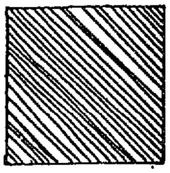
Sea level during this interval would have stood at 28 meters below present, only 10 meters higher than that of the previous stillstand. The climate would have been relatively warm and wet, probably not much different than at present.

The Kodiak coast would not be greatly different than presently observed with all of the present bays and fiords once more open to the sea (Figs. II-33 & II-34). The only major difference would have been that Trinity Islands would still be connected to Kodiak proper as an elongate peninsula, as during the previous stillstand (Fig. II-34). Marine resources probably remained abundant and diverse all around the Kodiak coast, again with the possible exception of the more exposed southern peninsula.

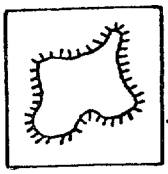
Conditions within Province II would have remained about the same as previously and not too different than at present, with the most favorable areas, in terms of marine resources, distributed among the



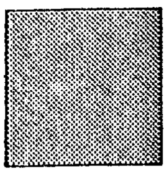
Passes or constrictions funneling movements of large terrestrial mammals.



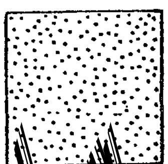
south or north facing slopes providing possible spring and fall attraction to large herbivores.



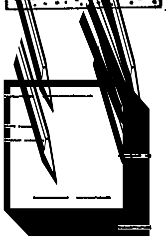
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

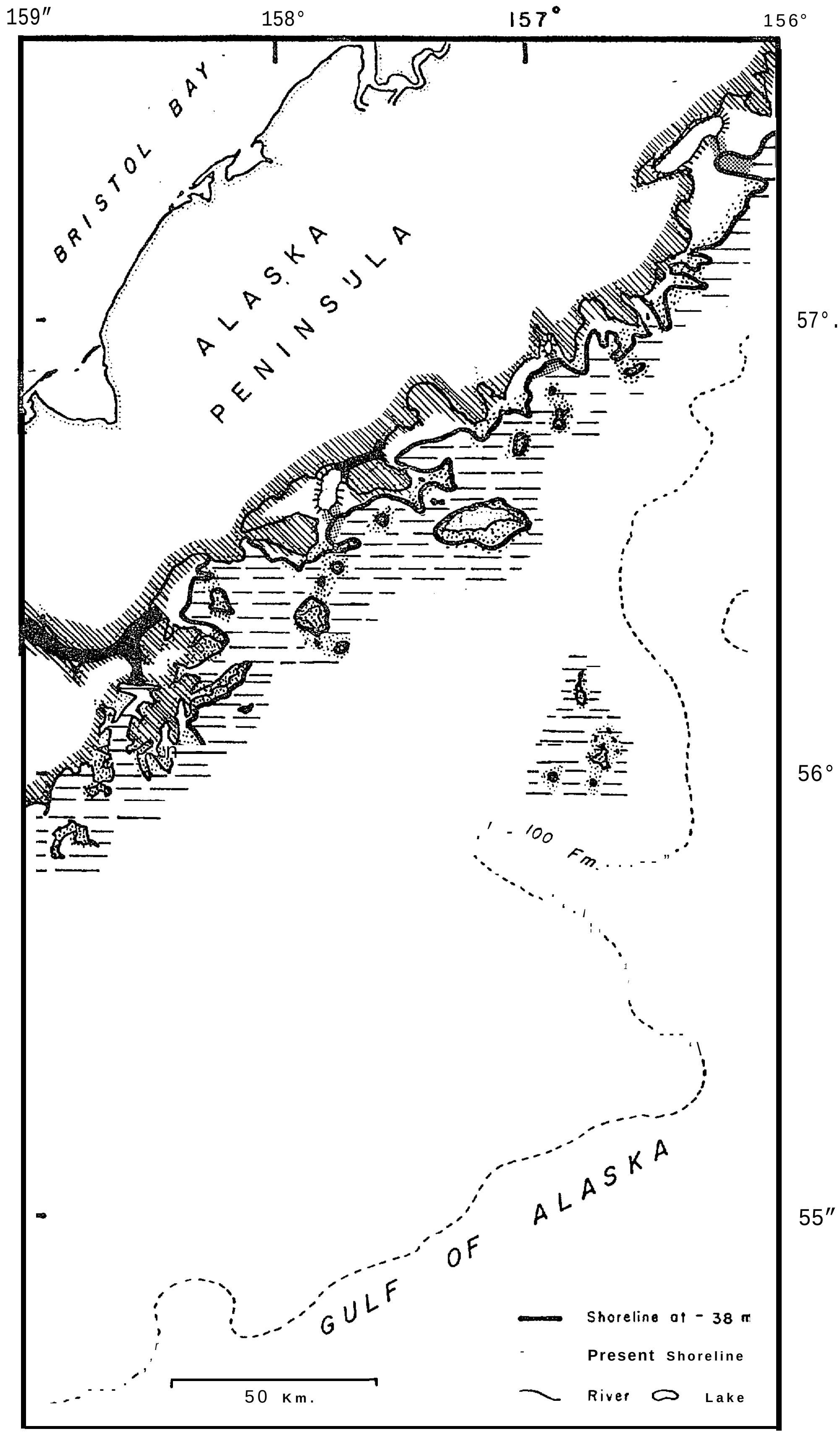
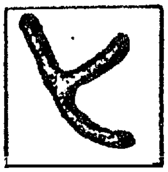
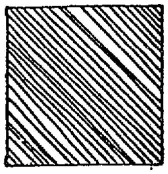


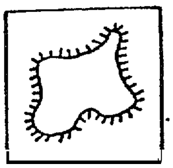
Fig. II-29. Stillstand V, Province III, 9,400 B.P.
Alaska Peninsula and Semidi Islands to Shumagin Islands.



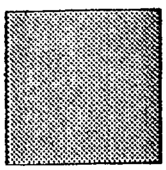
Passes or constrictions funneling movements of large terrestrial mammals.



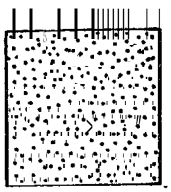
South or north facing slopes providing possible spring and fall attraction to large herbivores.



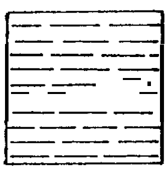
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

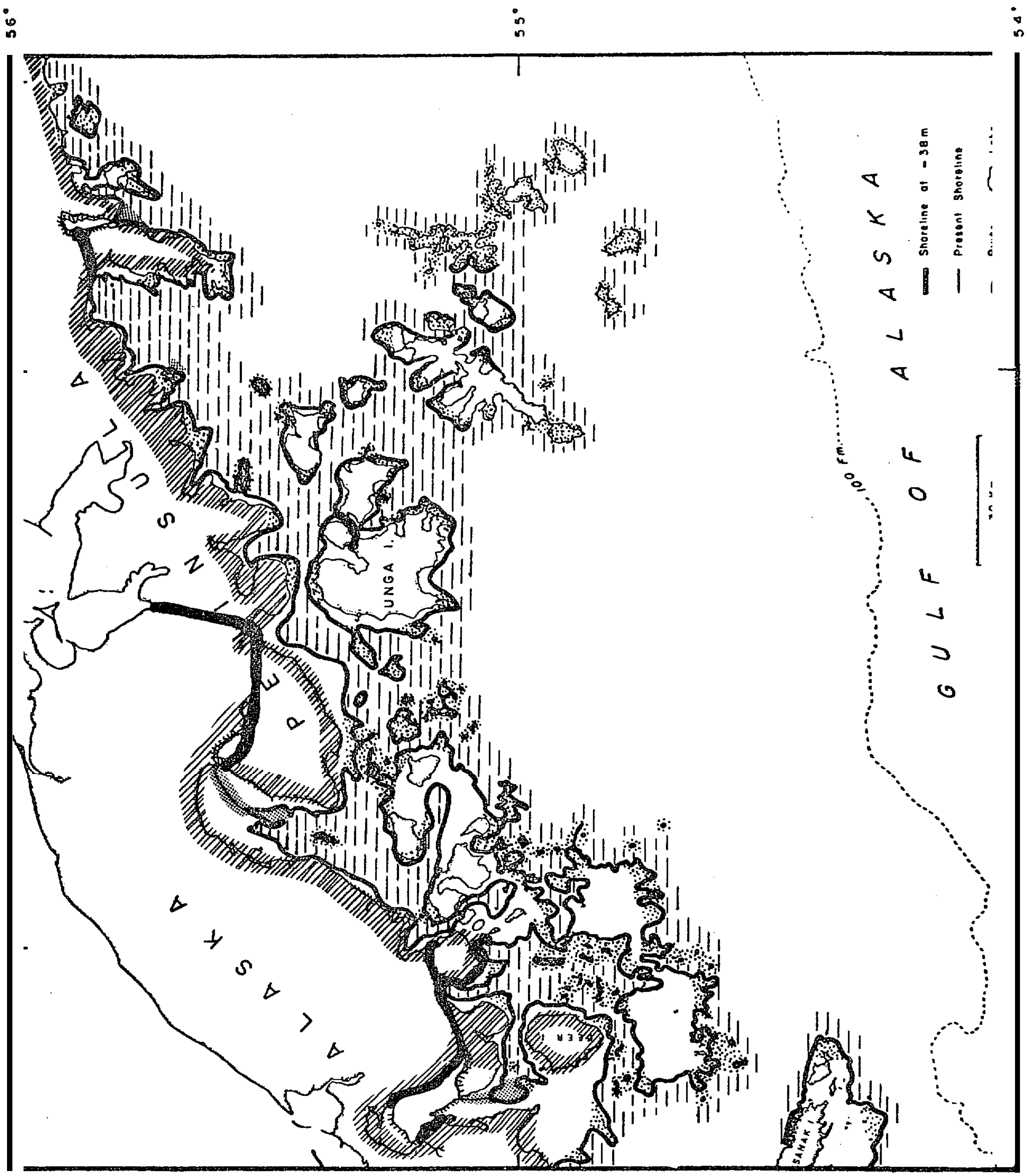
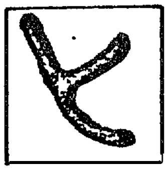
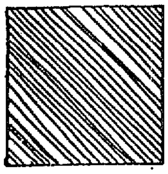


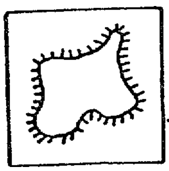
Fig. II-30. Stillstand V, Provinces III & IV, 9,400 B.P.
Alaska Peninsula and Shumagin Islands to Sanak Island.



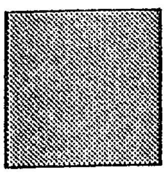
Passes or constrictions funneling movements of large terrestrial mammals.



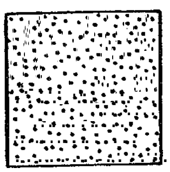
South or north facing slopes providing possible spring and fall attraction to large herbivores.



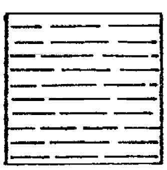
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

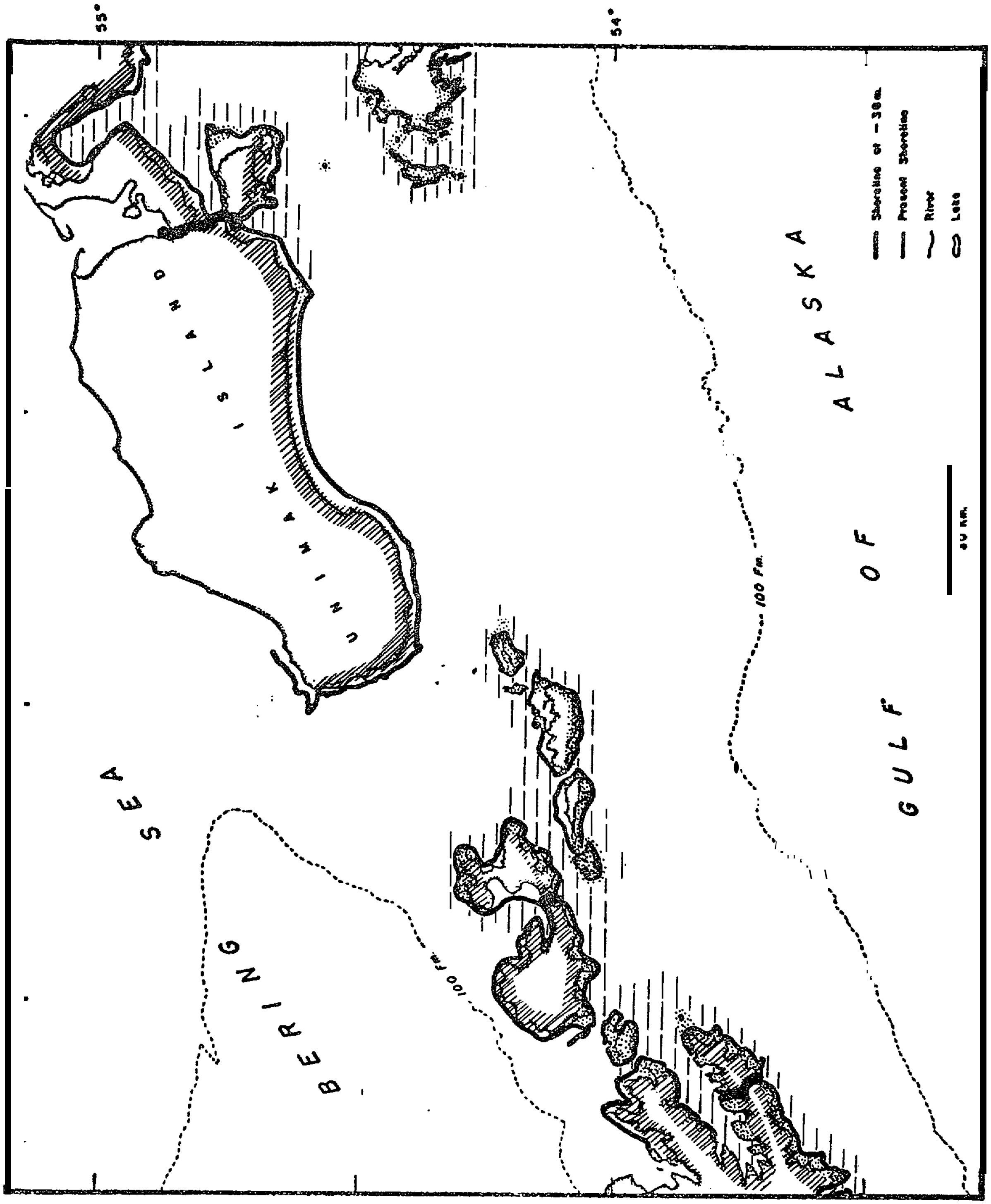
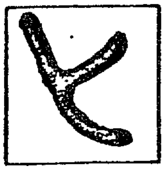
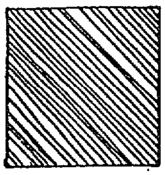


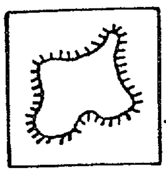
Fig. 11-31. Stillstand V, Province IV, 9,400 B.P.
Unimak Island to Unalaska Island.



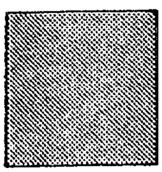
Passes or constrictions funneling movements of large terrestrial mammals.



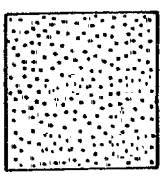
South or north facing slopes providing possible spring and fall attraction to large herbivores.



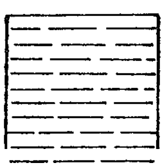
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

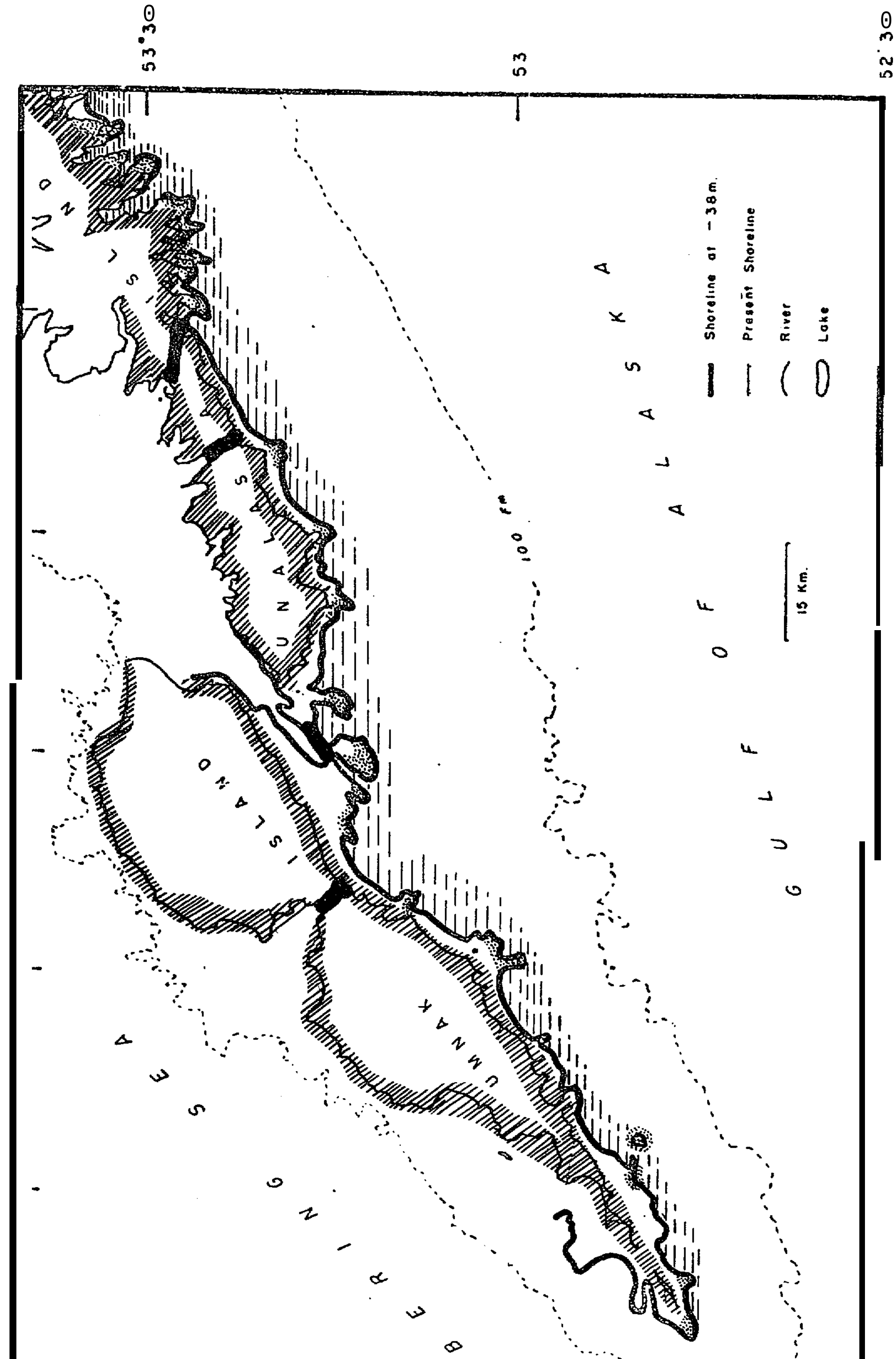
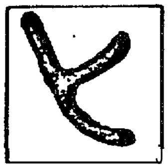
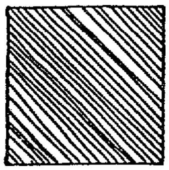


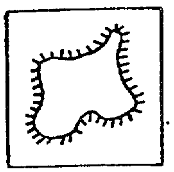
Fig. II-32. Stillstand V, Province IV, 9,400 B.P. Unalaska and Umnak Islands.



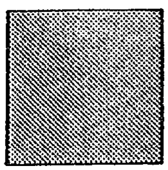
Passes or constrictions funnelling movements of large terrestrial mammals.



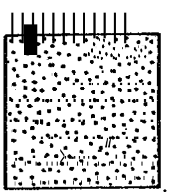
South or north facing slopes providing possible spring and fall attraction to large herbivores.



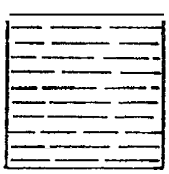
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

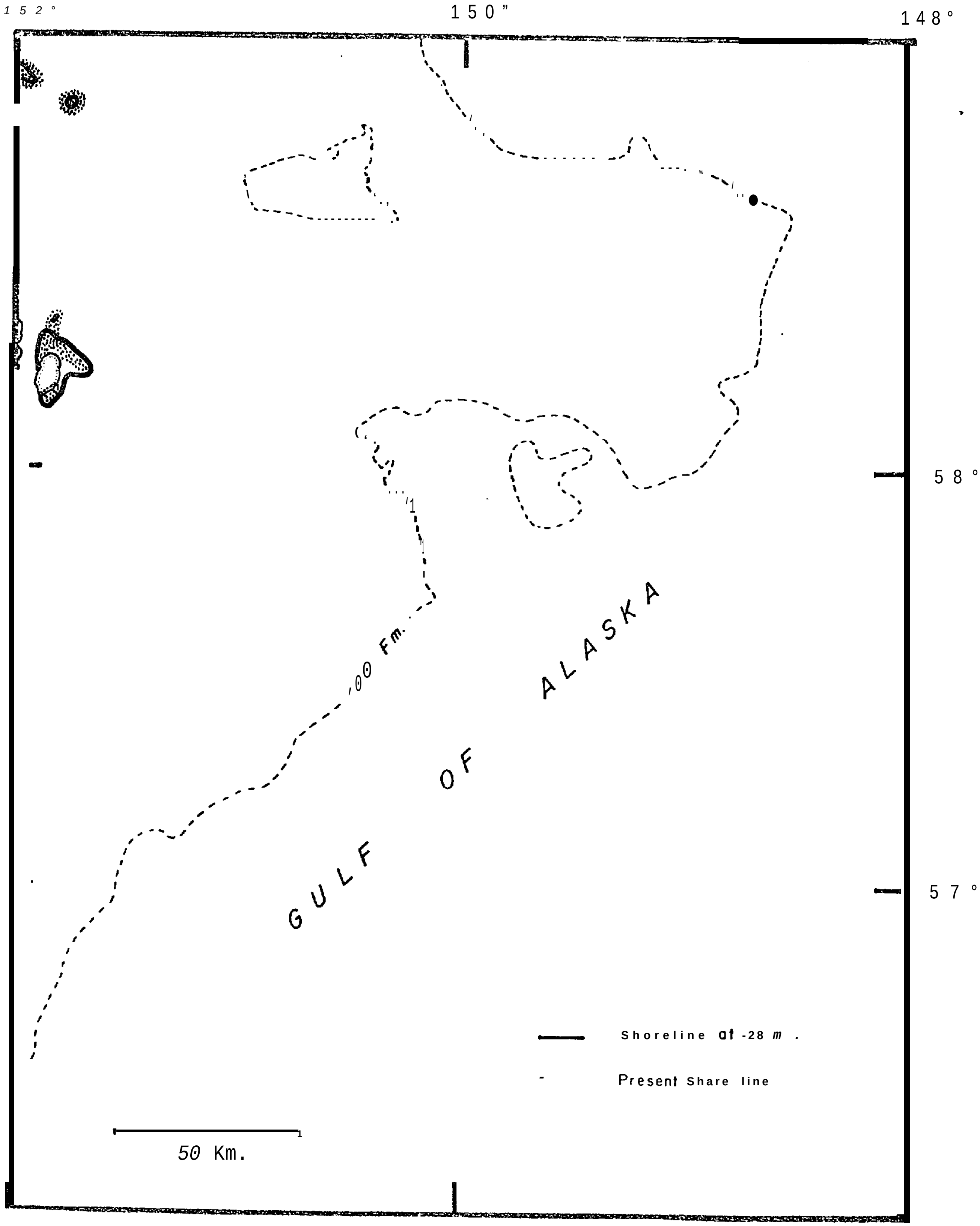
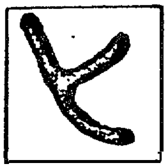
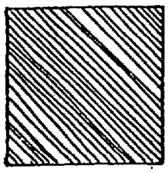


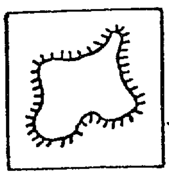
Fig. II-33. Stillstand VI, Province I, 8,700 B.P.
East of Kodiak Island.



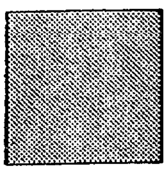
Passes or constrictions funneling movements of large terrestrial mammals.



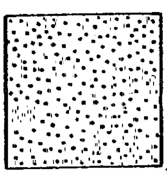
South or north facing slopes providing possible spring and fall attraction to large herbivores.



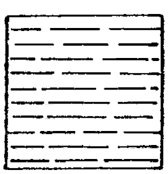
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

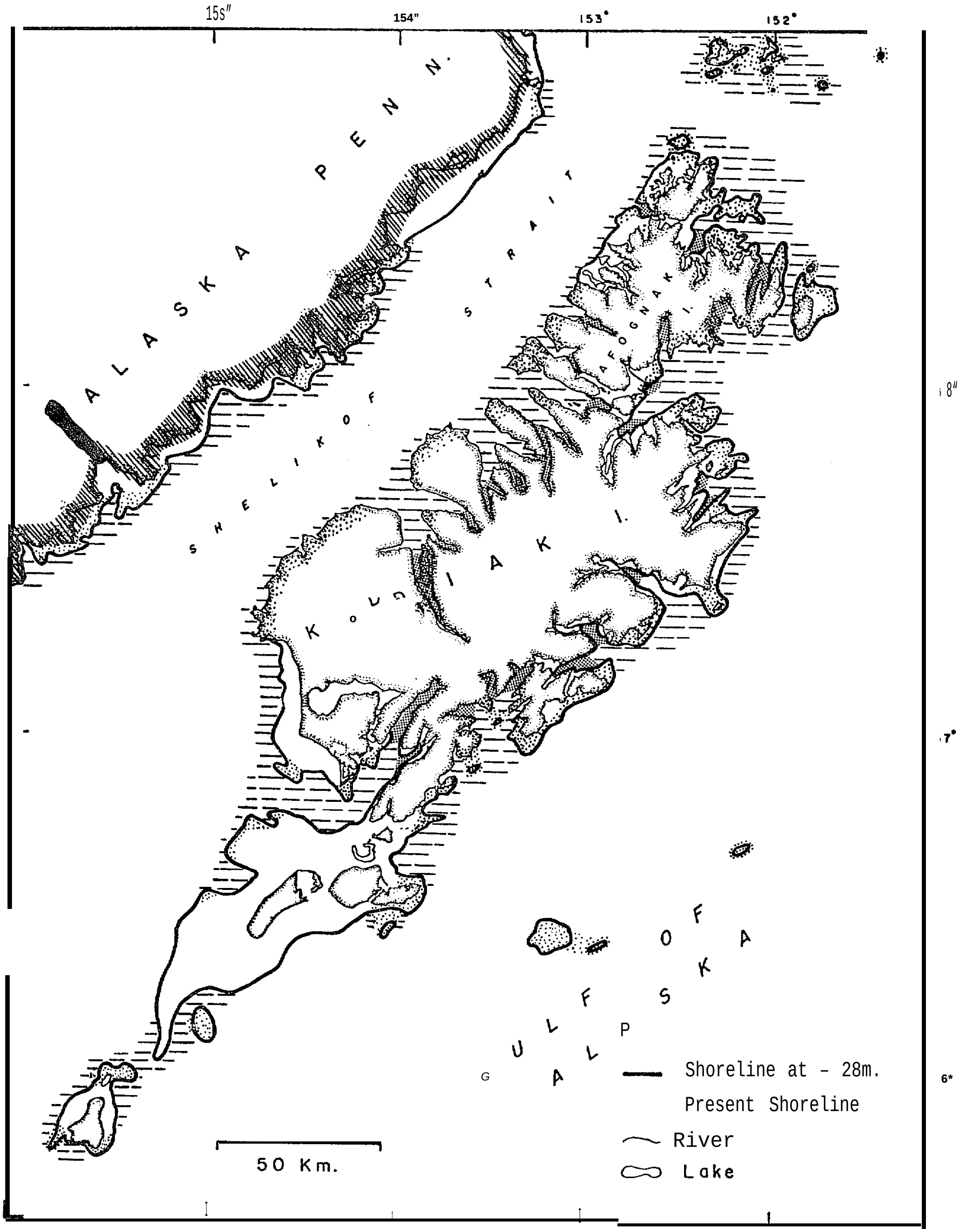


Fig. II-34. Stillstand VI, Provinces I & II, 8,700 B.P.
Kodiak Island.

bays along the southern half of the strait (Fig. II-34).

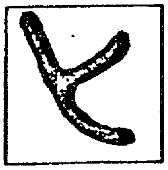
Province 111 would have retained much of its previous character and potential, though now the bays would have become enlarged and simplified to some extent (Figs. II-35 & II-36). Numerous nearshore islands still were scattered along the coast, providing plentiful shelter and habitat for the proliferation of marine species including, perhaps the Steller sea cow. Even more than previously, terrestrial mammal resources would have been limited to the present mainland of the Alaska Peninsula.

Province IV would have presented about the same environment and configuration as today, (Figs. II-37 & 38) the only alteration of any significance being that Unimak Island was still joined to the Alaska Peninsula. The coasts of all of these islands, again with the possi ble exception of Unimak, might have been very productive in marine resources.

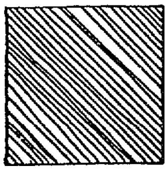
SYNOPSIS

Throughout this sequence of stillstands or periods of stabilized coastal configuration, the region which stands out as maintaining its potential for diversity and richness of resource availability is Province III, Amber Bay to Pavlof Bay and extending southwest as far as Unimak Island during the latter half of the sequence. It appears that this province could have been extremely rich and diverse in all types of marine life present in the Western Gulf throughout all this period. Up until the 5th stillstand at -38 meters, about 9,400 years ago, this province may also have supported terrestrial resources in the form of large mammals-moose, bear, perhaps caribou and possibly horse, mammoth and bison-small mammals, waterfowl, and anadramous and freshwater fish.

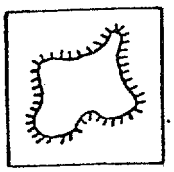
Province I, Kodiak Island, would probably likewise have maintained a richness and diversity of marine fauna and flora throughout this sequence, though no terrestrial mammalian resources were available with the possible exception of the brown bear. Marine resources were probably richer along the coast of the northern half of the emergent island land mass throughout this period, perhaps increasing in both richness and diversity with time due to the ameliorating climatic conditions and increasing complexity of the coastal configuration.



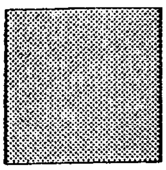
Passes or constrictions funneling movements of large terrestrial mammals.



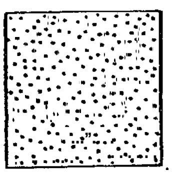
South or north f-acing slopes providing possible . spring and fall attraction to large herbivores.



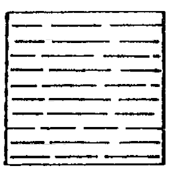
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

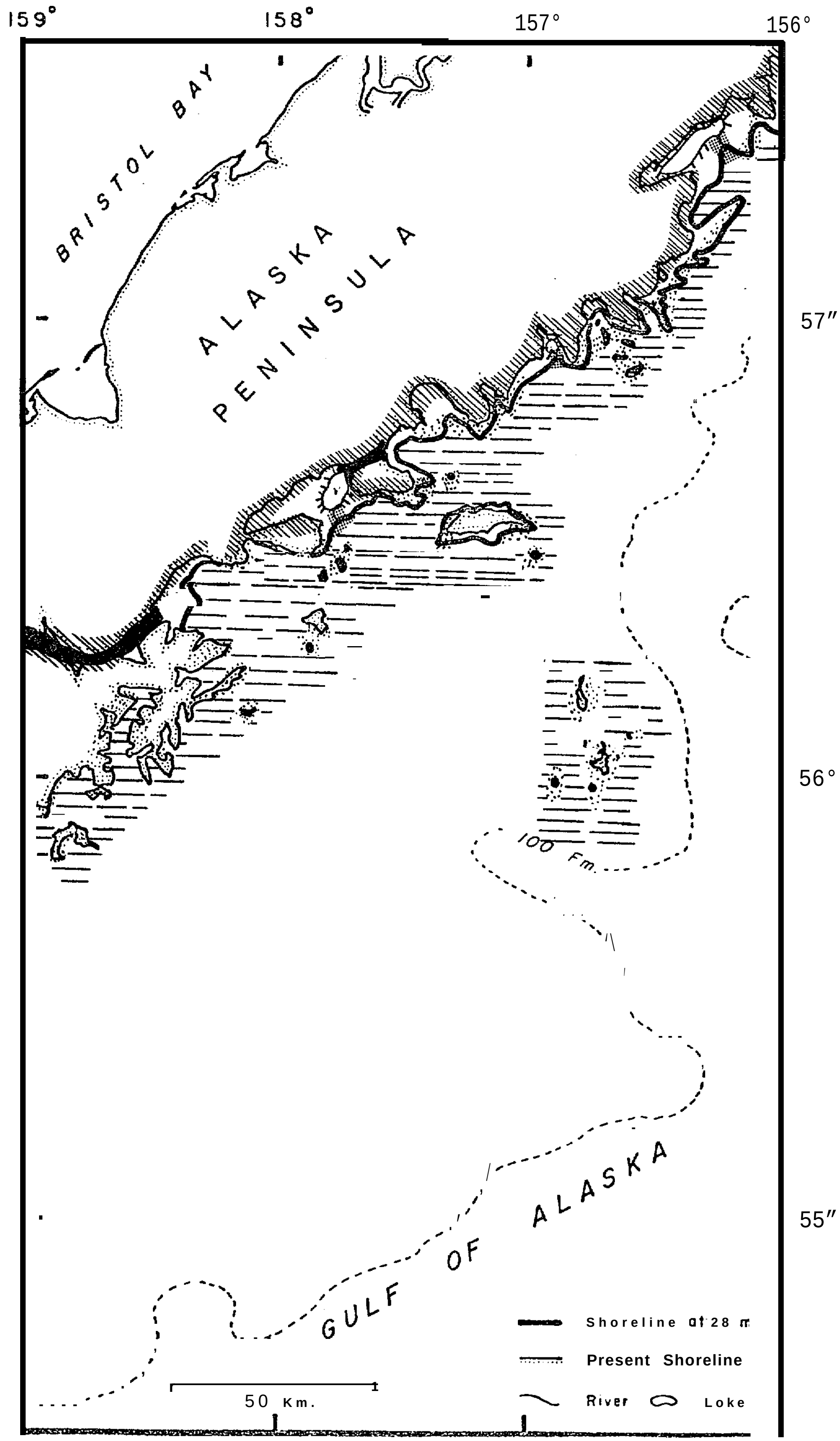
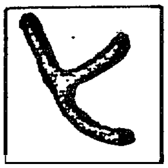
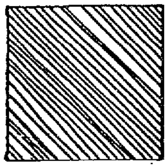


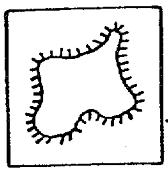
Fig . II-35. Stillstand VI, Province III, 8,700 B.P.
Alaska Peninsula and Semidi Islands to Shumagin Islands.



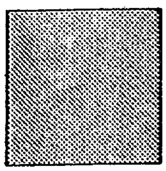
Passes or constrictions funneling movements of large terrestrial mammals.



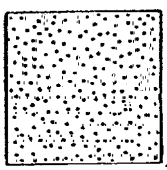
South or north facing slopes providing possible spring and fall attraction to large herbivores.



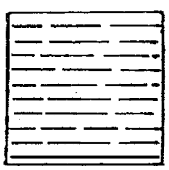
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

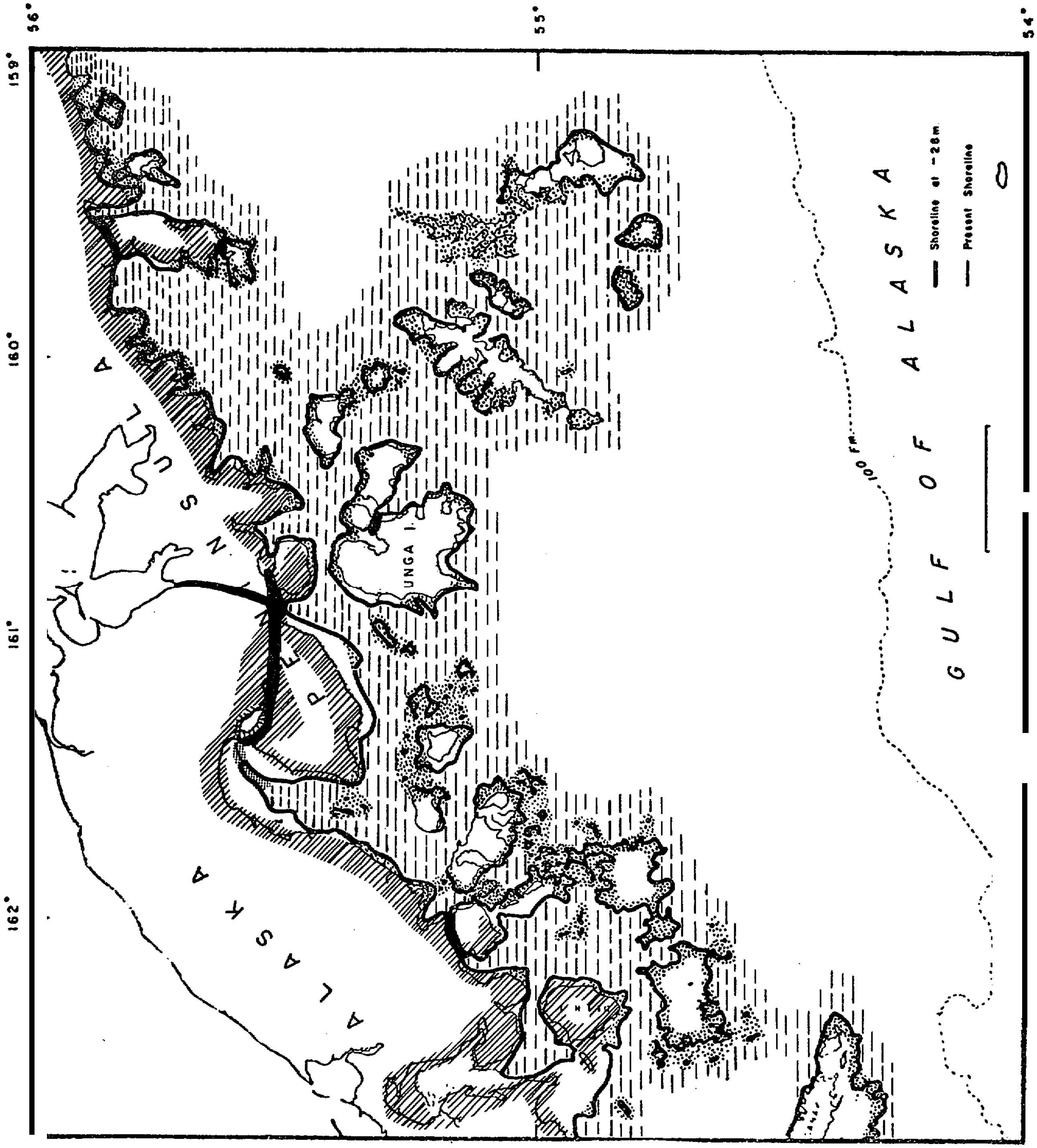
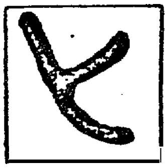
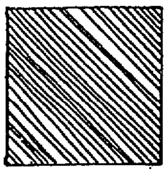


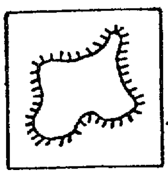
Fig. II-36. Stillstand VI, Provinces III & IV, 8,700 B.P.
Alaska Peninsula and Shumagin Islands to Sanak Island.



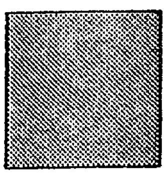
Passes or constrictions funneling movements of large terrestrial mammals.



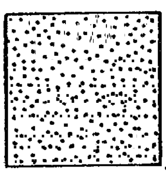
South or north facing slopes providing possible spring and fall attraction to large herbivores.



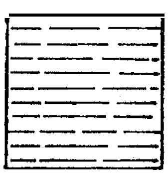
Lake margins providing attraction to migratory waterfowl, ground nest-ing birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid arid otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

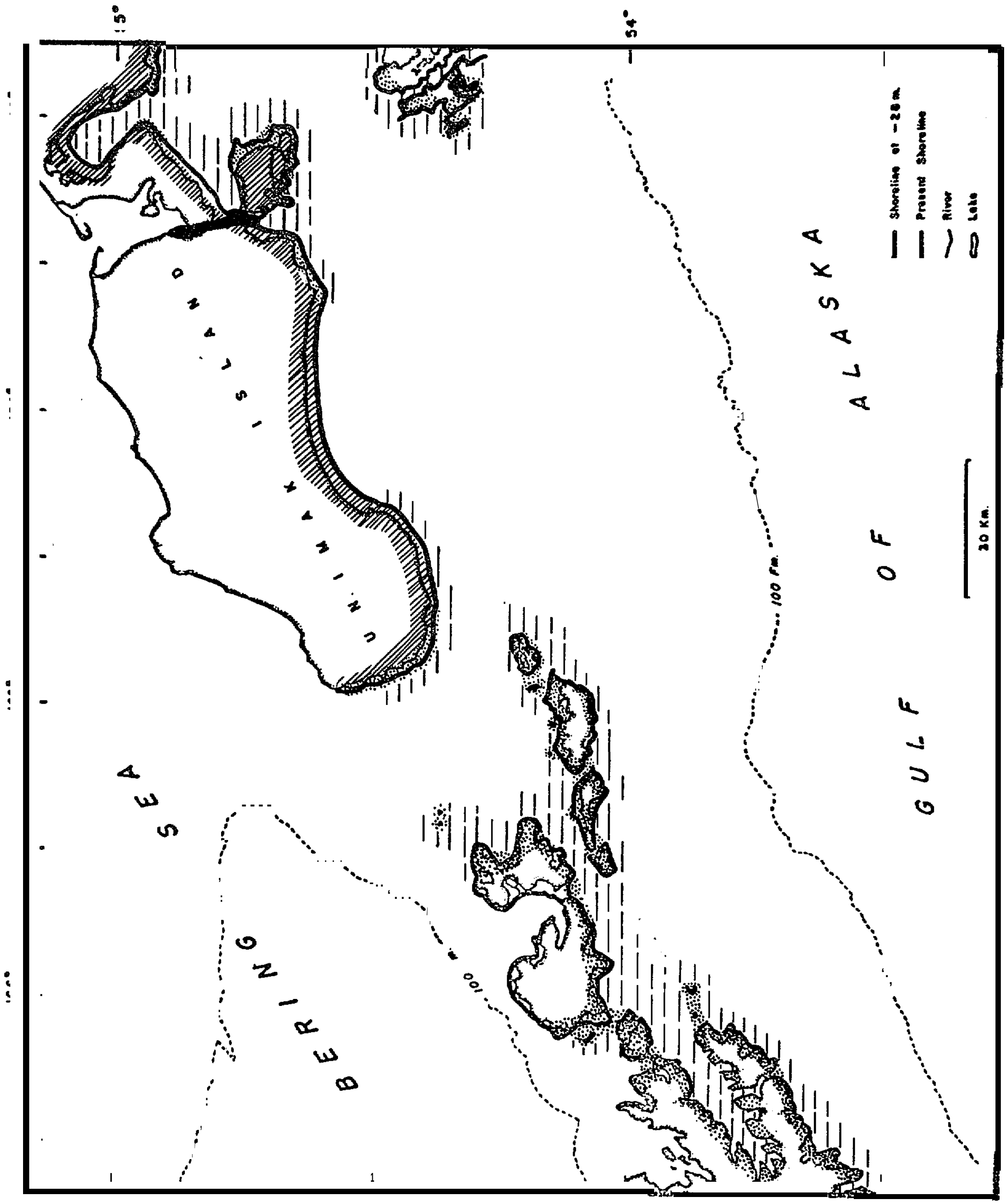
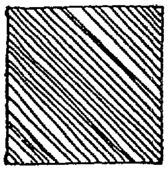
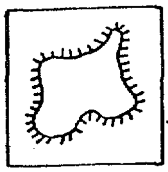


Fig. II-37. Stillstand VI, Province IV, 8,700 B.P.
Unimak Island to Unalaska Island.

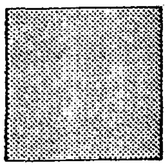
Passes or constrictions funneling movements of large terrestrial mammals.



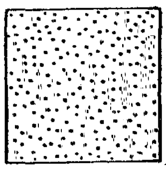
South or north facing slopes providing possible spring and fall attraction to large herbivores.



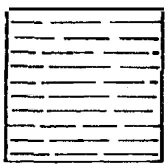
Lake margins providing attraction to migratory waterfowl, ground nesting birds and their predators.



Concentrations of anadramous fish and their predators (Salmon Complex).



Points, headlands, or islands of probable attraction to phocid and otarid seals and marine birds.



Coastal regions or probable elevated diversity, productivity, and availability.

Key to symbols used for probable marine and terrestrial faunal distributions (Figs. II-3 through II-38).

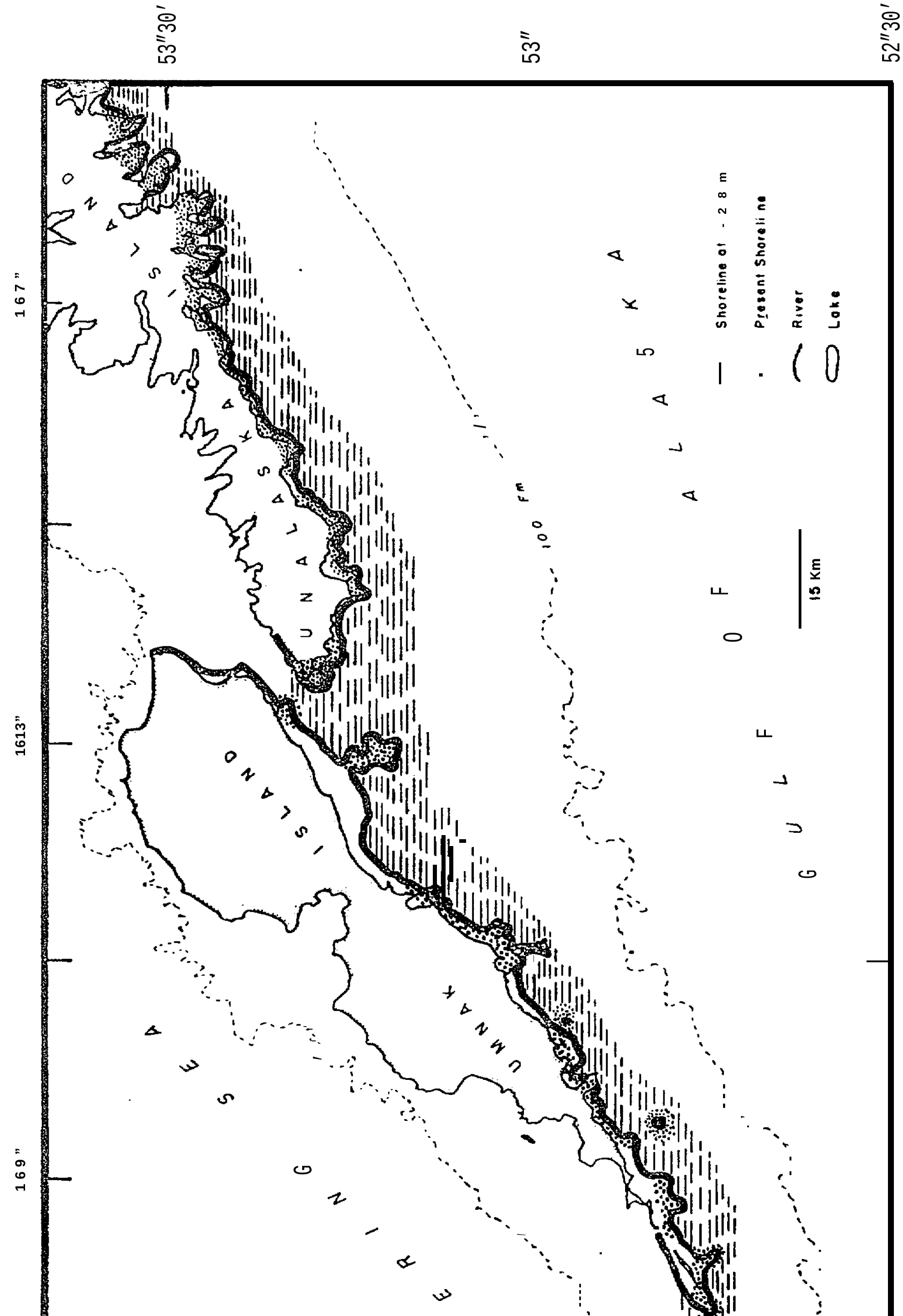


Fig. II-38. Stillstand VI, Province IV, c. 700 B.P.
Unalaska and Umnak Islands.

Province IV, extending from Pavlof Bay (Unimak Island during the latter half of the sequence) to the emergent end of Umank Island would originally, during maximum emergence, have presented the best prospects for terrestrial resources as a result of its broad plains and easy access to Beringia. This plain flooded early in the sequence, however, after which the province reverted to an increasingly marine and insular condition. Late in the sequence of the events, subsequent to the third stillstand (about 13,750 years ago), marine resources along both the Pacific and Bering coasts of this province, with the possible exception of Unimak Island, may have presented considerable attraction though the increasingly insular character of the area might have created difficulties.

Province II, the mainland side of Shelikof Strait, appears to have held the least potential of all the provinces in terms of both marine and terrestrial resources throughout the time period in question. The emergent terrestrial area would have been restricted at most to a relatively narrow coastal strip isolated from the Beringian Plain by high mountains and glaciers and dissected by numerous swift, silt-laden glacial rivers. These rivers would not likely have supported anadramous or freshwater fish in any numbers, and might have compromised coastal marine productivity as a result of their discharge of silt into the sea. Until rather late in the sequence this coast presented a rather unprotected and probably not overly hospitable expanse, exposed to surf and storms and probably scoured by ice at least early in the sequence.

III. SYNTHESIS OF PREHISTORY AND DELINEATION OF AREAS OF HIGH, MEDIUM AND LOW ARCHEOLOGICAL POTENTIAL ON THE CONTINENTAL SHELF OF THE WESTERN GULF OF ALASKA

E. James Dixon, Jr.

PRECONTACT CULTURES & SUBSISTENCE

At the time of historic contact the Western Gulf of Alaska study area was occupied by two distinct groups, Eskimos and Aleuts. The Eskimo occupied Kodiak and adjacent islands as well as the Alaska Peninsula as far west as Port Moller. The Aleut inhabited the tip of the Alaska Peninsula westward from Port Moller as well as the entire Aleutian "chain" and the Shumagin Islands. No detailed ethnographic studies were undertaken before the impact of European cultures had greatly altered the population structure and life ways of both the Eskimo and Aleut peoples in the Western Gulf region. Although there are references to, and limited descriptions of, subsistence activities in the early historic literature, no "detailed documentation of the subsistence strategies of these cultures at the time of contact is known.

However, faunal remains from archeological sites within the study area which have been analyzed by Clark (1968) demonstrate extensive exploitation of the nearshore environment as the major economic focus on Kodiak Island during precontact times. Clark does note inland fishing sites and the occurrence of land otters and bear remains in midden refuse, however these are relatively insignificant. This data is not surprising when one considers the impoverished terrestrial mammalian fauna of Kodiak Island.

Laughlin and Aigner (1975b) have indicated that at least 30% of the Aleut diet consisted of littoral biota gathered in intertidal areas. In addition, Love (1976) has presented an analysis of Nikolski Strandflat adjacent to Umnak Island, which documents the productivity and distribution of biomass resources of the littoral zone. The significance of these resources coupled with marine mammal exploitation and fishing cannot be ignored as the primary economic focus within the study area as documented by the archeological record. Although information on faunal remains from archeological sites on the Alaska PenInsula is scanty, the major emphasis is also exploitation of the nearshore environment. However, the Alaska Peninsula by virtue or its size and an extension of the mainland, does today, and has in the past provided the opportunity for the harvest of terrestrial mammals in sufficient quantity to make them important factors in the economy of subsistence hunters. Additionally, the harvest of avian fauna is documented in virtually every site which had adequate preservation to enable identification of these faunal remains.

ARCHEOLOGICAL RESEARCH WITHIN THE STUDY AREA

The most concerted arid sustained arhceological research effort conducted within the study area is that directed by William S. Laughlin, presently based from the University of Connecticut. Laughlin, his students, and colleagues have studied an exceptional and well dated archeological sequence in the vicinity of Nicolski village located on Umnak Island, Alaska. Located on Anangula Island, an inlet of Umnak Island, Laughlin and his fellow researchers have sampled two archeological sites which they feel span the last 8,500 years. Ash deposits resulting from four distinct volcanic eruptions have established unique horizon markers for establishing the relative chronology for a series of archeological sites within the Nikolski area. These deposits have been labeled Ash I, Ash II, Ash III and Ash IV from oldest to the youngest respectively.

The Blade Site, is the earliest site in the sequence and is characterized according to A.P. Okladinikov and reported by Laughlin (1975a:513) by seven Asiatic traits. These are 1) blades of the Levallois tradition, 2) the Gobi or Frontal core (torzove core), 3) pebble tools, 4) triangular "Mousteroid" projectile points, 5) the "Siberian Scraper" or Tchi-the, 6) angle of diagonal burins, and 7) transverse burins. The dating for the Anangula Blade Site is derived from a suite of forty-five radiocarbon dates, thirty-three of which are reported by W. Laughlin (1975a) & S. Laughlin (1975), and are illustrated in figure .111-l." The additional thirteen dates have been published by Aigner (1976) and she has questioned the accuracy of Laughlin's estimated duration of occupation of the Blade Site. For the purposes of this analysis, this is a comparatively small point of contention, and it may safely be assumed that no matter how long "the Blade Site has been occupied, the occupation began approximately *8,500*

SPECIMEN	Date (years ago) Libby half-life (5570 years)	 Penn half-life (5740 years)
0. GX 2232	6600 ± 320	6798 ± 330
	Hiatus (ash III)	
1. P 1836	6992 ± 91	7202 ± 93
2. P 1835	7000 ± 91	7210 ± 93
3. GX 2233	7070 ± 240	7282 ± 247
4. GX 2235	7120 ± 240	7334 ± 247
5. GX 2241	7175 ± 240	7390 ± 247
6. GX 2237	7180 ± 250	73952258
7. GX 2243	7260 ± 320	7478 ± 330
8. P 1108	7287 ± 87	7506 ± 90
9. S1-2177	7360 ± 100	7581 ± 103
10. GX 2246	7395 ± 160	7617 ± 165
11. S1-2180	7600 ± 100	7828 ± 103
12. P 1107	7657 ± 95	7887 ± 98
13. W 1180	7660 ± 300	7890 ± 309
14. P 1102	7701 ± 93	7932 ± 96
15. P 1837	7793 ± 116	8027 ± 119
16. I 1046	7796 ± 230	8030 ± 237
17. GX 2234	7870 ± 260	8106 ± 268
18. S1-2181	7885 ± 335	8122 ± 345
19. S1-2175	7920 ± 100	8158 ± 103
20. P 1105	7932 ± 497	8170 ± 512
21. GX 2229	8055 ± 160	8297 ± 165
22. GX 2238	8060 ± 240	8302 ± 247
23. P 1104	8129 ± 96	8373 ± 99
24. S1-2182	8140 ± 485	8384 ± 500
25. GX 2240	8170 ± 240	8415 ± 247
2.6. P 1103	8173 ± 87	8418 ± 90
27. S1-2179	8235 ± 125	8482 ± 129
28. GX 2239	8280 ± 220	8528 ± 227

Fig. III-1 Anangula Blade Site Radiocarbon Dates.

SPECIMEN	Date (years ago) Libby half -life 45570 years)	Penn half-life (5740 years)
29. GX 2231	8290 ± 240	8539 ± 247
30. S1-2176	8390 ± 95	8642 ± 98
31. 1715	8425 ± 275	8678 ± 283
32. GX 2809	8435 ± 500	8688 ± 515
33. GX 2230	8480 ± 350	8734 ± 361
	Hiatus (ash II)	
34. S1-2178	9055 ± 95	9327 ± 98
35. GX 2244	9805 ± 480	10099 ± 494
Summary (specimens 1 to 33)		
Range	6992-8480	7202-8734
Actual span	1488	1532
Mean	7785	8019
S.D.	460.5	474.3
S.E.	80.5	82.6
Statistical range*	6864-8706	7070-8968
Statistical span	1842	1898

*± 2 S.D.

Directly from Laughlin: 1975,510

Fig. III -1 (continued)

radiocarbon years ago. Figs. III-2 and III-3 (Laughlin 1975a, Aigner 1976) depict two stratigraphic sections from the Anangula Blade Site. Possibly five compressed occupational levels are sandwiched between Ash II and Ash III, and apparently some archeological material from the Blade Site predates Ash II.

Laughlin states that:

> No one archoelogical site can provide a type section for the entire Holocene Epoch because the Aleuts had to adjust their occupation to a rising sea level and to tectonic uplift. However, a reliable composite stratotype can be based on data from the three sites on Nikolski Bay. Ash I, well marked in all three sites appears to be the first dramatic event after deglaciation.

He feels that the three sites - Chaluka, (located near Nicolski Village), the Village site, and the Blade Site (both located on Anangula Island) - document a relatively constant record of human occupation on Umnak Island for the past 8,500 years. In addition, excavations at Sandy Beach Bay have documented additional occupation on the Umnak Island between 4,300 and 5,600 radiocarbon years ago (Aigner, Fullem, Veltre, and Veltre, 1976).

Although these sites define prolonged and seemingly continuous occupation of the most western margin of the study area, it does not necessarily follow that the occupation of the inunediate vicinity has been totally uninterrupted. Black (1974:36-37) suggests that local cataclysmic events most probably resulted in abandonment of the region for brief periods of time. One particularly significant event, and eruption of Okmok Volcano which created Okmok Caldera is considered significant by Black and he states:

> Dating the Caldera eruption is crucial with respect to the timing of human occupation of Anangula. That eruption deposited an average thickness of 30 meters of pyroclastic debris at the coast, an average distance of nine kilometers from the rim of the caldera (Byers, 1959:315). Clearly, all life in the vicinity would have been wiped out. (Black 1974:136)

Black (ibid:37) has tentatively correlated this eruption with Ash III in the Anangula stratigraphic sequence.

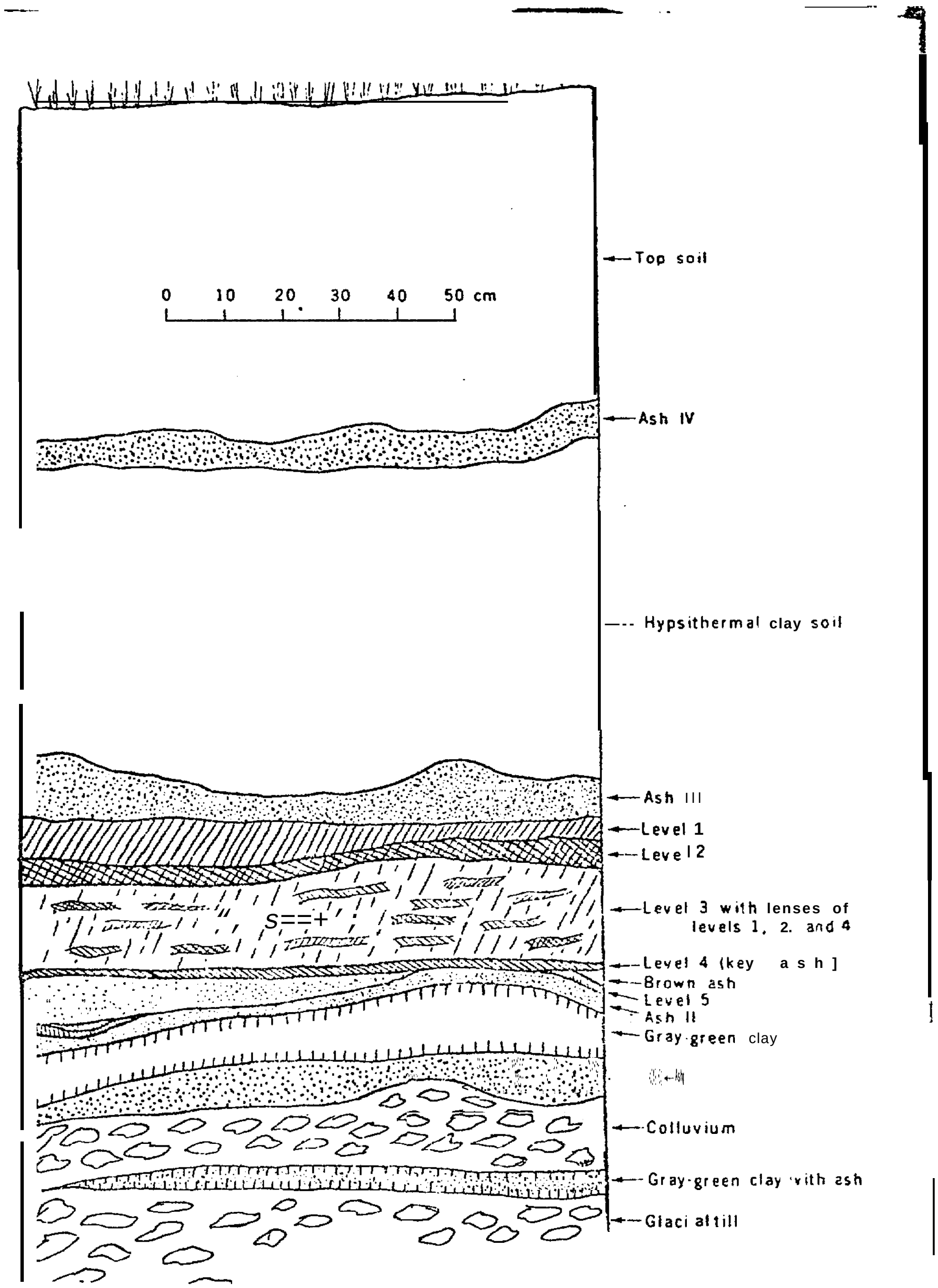


Fig. III-2

Stratigraphic section of the southwest wall, Anangula Blade Site, 1974. From Laughlin (1975a:511)

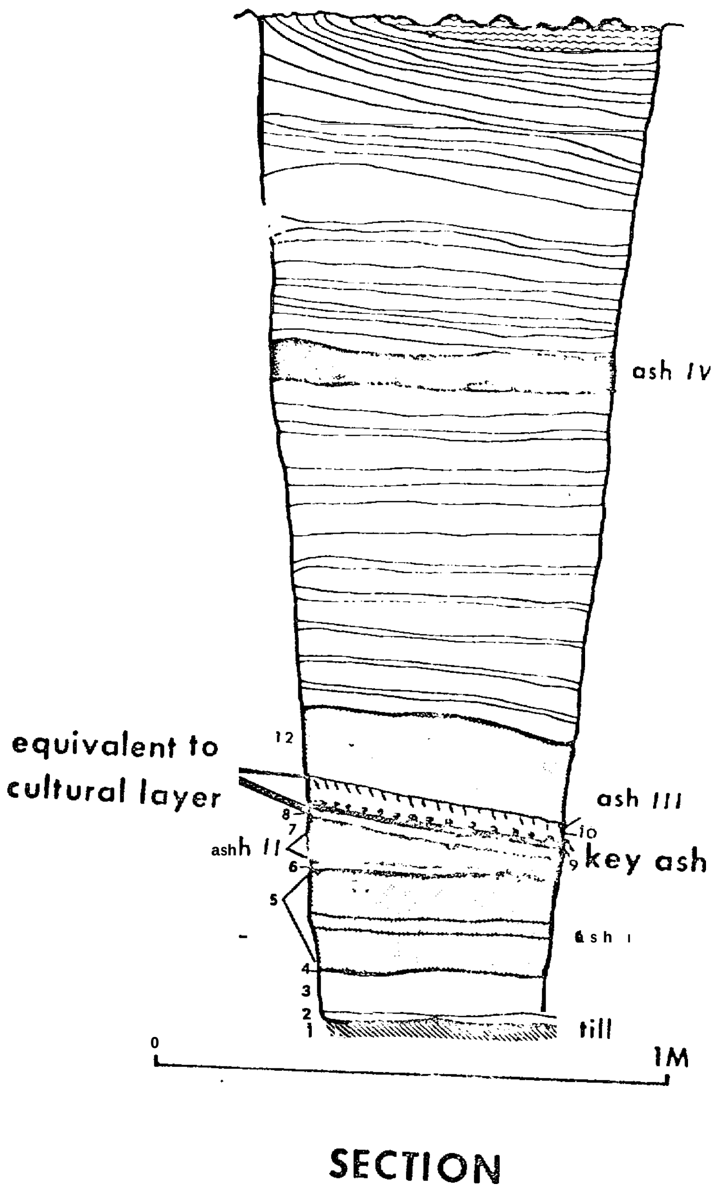


Fig. III-3

Stratigraphic section, Anangula Blade Site, From Aigner (1976:53)

This is significant, for Laughlin has proposed a model of simultaneous sea level rise and tectonic uplift to explain the relative positions of the Blade and Village sites. His model presumes that sea level rise occurred at a greater rate than uplift and consequently the location of the Blade Site relative to sea level became lower by approximately 7,000 B.P. He feels that a wave cut terrace (Fig. III-4), documents a brief period when sea level rise and tectonic uplift reached a uniform rate, thus maintaining their relative positions to one another permitting enough time to erode the terrace. Following this event, he postualtes that the land continued to rise and raised the terrace above sea level. He attributes the abandonment of the site at approximately 7,000 B.P. to spindrift resulting from stormwaves soaking the site and thus making occupation uncomfortable for the Blade Site residents.

An alternate explanation may be that the eruption of Okmok Volcano which formed Okmok Caldera may have forced abandonment of the Blade Site. If Black's correlation with Ash III is correct, then this would have occurred at approximately 7,000 B.P. and thus provide an equally plausable explanation for cession of occupation at the Blade Site. An additional argument for this hypothesis discussed by Black (1974:134) places the chronological placement of the wave cut terrace (cited by Laughlin as evidence of uplift) in question. Black states:

> Powers (1961) advocates a + two to three meter beach level through out the length of the Aleutains as evidence of higher sea level about 5,000 years ago. Many reports of the geology of the Aleutians support this position, e. g. Schafer (1971:794), Byers (1959:345) and Simons and Mathewson (1955:38) Black (1974) concurs that sea level at least around Umank Island must have been about + two meters during the Holocene because of the variety of youthful wave-cut and wave-deposited features which are now just above the reach of the highest waves.

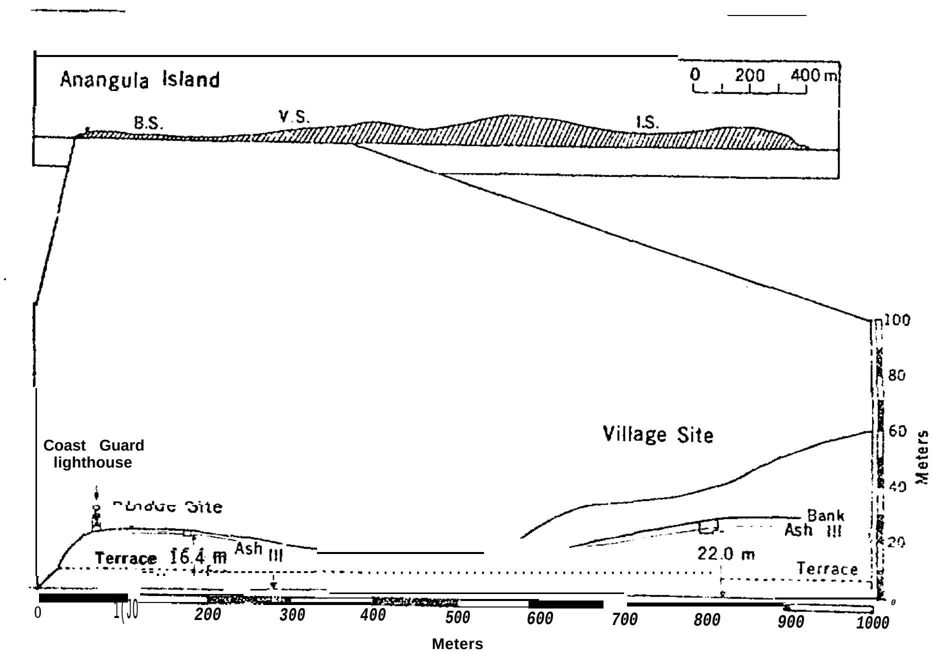


Fig. III-4 Village and Blade sites, Anangula Island.

Anangula Island (Ananiuliak on U.S. Coast Guard Charts). The Blade Site on the low southern tail was occupied first (8700 to 7200 years ago); than the occupants moved to the 6-m-higher elevation of the Village Site in response to rising sea level. The dotted terrace line shows the high point of wave action prior to tectonic uplift of the entire island. The solid baseline is the present mean sea level. The site on the neck of the island is Ikchigh Site (1.S.).

From Laughlin (1975a:511)

Black's argument for sea level rise above the present level is persuasive, and is supported by preliminary observation of research conducted on Amaknak Island by the University of Alaska Museum during the summer of 1977. At the Amaknak Bridge Site (ULS 050) being excavated under the direction of Glenn H. Bacon, what appears to be water polished bedrock overlain by marine sands underlies a human occupation which has been tentatively dated, based on topological comparison with other dated sites) between 4,000 and 6,000 years ago. These deposits are approximately 7 meters above present sea level, a surprisingly close correlation to the height of the wave cut terrace on Anangula Island.

On the basis of the available data it is plausable that the Anangula Blade Site was abandoned in response to an eruption of Okmok Volcano rather than due to rising sea level outpacing tectonic uplift. The formation of the marine terrace below the Blade Site has not been subject to absolute dating, however, Laughlin (1975a) indicates that Ash IV overlays the terrace but the older Ashes are not represented. Aigner (1976) cautions that stratigraphic interpretations from this portion of the Blade Site are extremely difficult and should be taken with reservation. This interpretation of the available data suggests that uplift within this portion of the study area may have been insignificant within the past 10,OOO years, and possibly much longer (ea. 18,000 years) according to Sharma's (this report) interpretation of the submerged sills and former sea level stands which correlate in depth with other areas of the world which are known to be tectonically stable.

Dumond (1977) and Dumond et al (1976) have briefly described archeological remains from the Ugashik River and the Naknek River regions of the Alaska Peninsula. He has named these assemblages the Ugashik Narrows phase and the Koggiung complex and considers both assemblages as part of the American Paleoarctic tradition. Five radiocarbon determinations indicate that these specimens range between approximatley 7,000 B.C. and 5,500 B.C. Wedge-shaped microcores, microblades, burins, leaf shaped bifaces, and core bifaces are the artifact types which Dumond (1977) indicates typify the collection. Dumond et al (1976) have defined four additonal stages of cultural development on the Alaska Peninsula which terminate approximately at the time of historic contact with Western culture.

At the eastern extreme of the study area lies Kodiak Island, which has been the focus of pioneering research by Donald W. Clark. Clark led excavations and survey on the Island for four field seasons from 1961 to 1964. Clark surveyed much of the coast of Kodiak Island and the results of his surveys are reported in A :heological Surveys and Site Catalog, Kodiak Island, Alaska (1965). The field work was sponsored by the Departments of Anthropology and Zoology Aleut-Koniag Project on Kodiak Island, Alaska under the overall supervision of W.S. Laughlin and W.G. Reeder. Clark delineated five major cultural phases of Kodiak Island. These are from the oldest to the youngest 1) Ocean Bay I, 2) Ocean Bay II, 3) Old Kiavak, 4) Three Saints, and 5) Koniag. Clark (1968) has established a radiocarbon chronology for the sequence and these five major phases span the period from 3,500 BC to historic contact. A table of the radiocarbon dates for the Kodiak sequence are listed in (Fig. III-5).

Ocean Bay I, the oldest phase in the sequence is characterized by chipped stone tools and a low incidence of abraded slate artifacts. During Ocean Bay II times the chipping of stone ceases (except for preforming pieces to be ground later). With advent of Old Kiavak, chipped stone once again is a method of manufacture for stone implements, however, it is not the prevalent form of manufacture. The Three Saints phase is quite similar to Old Kiavak, but the quality of workmanship in ground slate improves and plummets and flaked slate “blades” are dropped from the artifact inventory. Based on topological analysis of the series, Clark feels that there is discontinuity between the two Ocean Bay phases and that Old Kiavak and Three Saints are closley related to Kachemak I and II traditions respectively as defined by de Laguna (1934).

The Konaig phase is linked through the direct historic approach to the Koniag Eskimo inhabiting the Island at the time of contact. Clark (1966, 1968, and 1974) recognizes two variants of this phase,

TABLE LXVI I

RADIOCARBON DATES FOR THE PACIFIC ESKIMO AREA[1]

Laboratory Number	Date	Site	Dates
		Kodiak Region	
P-1034	3553 B.C. ± 78	Sitkalidak Roadcut, 438	Ocean Bay I, early
P-1036	1979 B.C. ± 65	Sitkalidak Roadcut, 438	Ocean Bay II, middle
P-1039	1313 B.C. ± 71	Kiavak 419	Old Kiavak phase
P-1042	78 B.C. ± 55	Three Saints 401	Three Saints phase, early
P-1057	83 B.C. ± 52	Crag Point 241	Three Saints equivalent, early
P- 1043	831 A.D. ± 49	Three Saints 401	Three Saints phase, late
P-1041	1013 A.D. ± 49	Kiavak 419 (Old Kiavak site)	Early Ceramic (B) component
P-1045	1559 A.D. ± 48	Kiavak 418	Ceramic Koniag, base of site
P-1044	1670 A.D. ± 44	Kiavak 418	Ceramic Koniag, base of site
IJ-1047	1557 A.D. ± 40	Rolling Bay 420, Area I	Ceramic Koniag, base of site
P-1048	1597 A.D. ± 44	Rolling Bay 420, Area I	Same feature as P-1047
P-1049	1652 A.D. ± 44	Monashka Bay 223	Nonceramic Koniag,middle
		Other Regions	
P-1050	2079 B.C. ± 63	Chirikof Island, site 9	Ground slate and flaked stone industries in exhumed site
P-139	748 B.C. ± 118	Yukon Island, great midden	Kachemak I (Old Kiavak related)
P-138	589 A.D. ± 102	Yukon Island, outer Cook Inlet	Kachemak III(Three Saints related)
P-192	231 A.D. ± 105	Palugvik, Prince William Sound	Palugvik I (proto Chugach?)
P-174	205 A.D. ± 105	Palugvik, Prince William Sound	Same feature as above
I-524	1187 A.D. ± 95	Kukak, Alaska Peninsula[2]	Ceramics like that of Koniags

(Directly from Clark,1968:611 & 612)

Fig. III-5 Kodiak Radiocarbon Sequence.

one ceramic and the other non-ceramic. Ceramic bearing sites are apparently restricted to the southern portions of the Island and are also reported from Chirikoff Island. Clark sees discontinuity between the Three Saints and Koniag pahses.

Clark (1966:369) indicates that the colonizers of Kodiak Island must be derived from a maritime adapted culture, which must predate the earlies phase (Ocean Bay I) recovered by him. Because occupation of Kodiak required substantial ocean going craft (for it has not been connected to the mainland during Late Wisconsin or Holocene times) occupation of the Island could have occurred as early as or earlier than ca. *8,500* years ago. The well dated Blade Site on Anangula Island implies the use of ocean going craft sometime prior to 8,500 BP. in this area of Alaska. On the basis of archeological data derived from two islands, Umnak and Kodiak, within this study area we can be reasonably certain that by approximately 8,500 years ago a well adapted maritime culture occupied the coast margins of the study area. Most sites dating to this time period have not been discovered due to two probable factors; 1) The post Wisconsin sea level rise has inundated much of the former coastline, and 2) very little archeological survey within the study area has been conducted in locales where sites dating to this time period might be expected to occur.

PROBABILITY MODELING FOR THE STUDY AREA

Prior to probability modeling, a brief discussion of the sea level chronology for the study area is essential. Fig. III-6 depicts Sharma's (this report) attempt to correlate marine transgression in an orderly sequence with his geomorphological interpretation of the bathymetric data and other published references. The assumption made for purposes of this report, based on the best available data is that the observed sills and terraces represent periods of long-term stabilization in sea level rise and are of Late Wisconsin age. However, it is difficult to account for the formation of the observed six very distinct sequences of sills and terraces within the comparatively brief period of 18,000 years.

AGE	SEA LEVEL	REFERENCE
21,500 - 18,000	-125 meters	Milliman & Emery, 1968
15,000 - 14,800	-82 meters	Curray 1960, 1961, 1965
13,750 BP	-66 meters	Morner 1971
12,700 BP.	-55 meters	Holmes and Creager 1974 Creager & McManus 1965
9,400 BP.	-38 meters	Zenkovich 1969 Morner 1971
8,700 BP.	-28 meters	Carray 1960, 1961

*Sharma cautions that the age correlations are tenative and formulated on the basis of only published reports which support the sequential chronological placement of the geomorphic data compiled for the Western Gulf of Alaska.

Fig. III-6 Speculative sequence for sea level rise
After Sharma, this report.

It is also possible that there may have been a continuous rise in sea level for the past 18,000 years. If this is the case, the higher stillstands delineated by Sharma may represent periods of earlier (early or pre-Wisconsin) sea level height, and could reflect former coastal margins dating many thousands of years earlier than the speculative correlations imply. If this is the case, it could greatly affect the modeling of the near shore environment presented in this report.

The chronological problem manifests itself in two major hypotheses when modeling for former species habitat and human settlement locales. The two hypotheses Present themselves as 1) If the geomorphological features which have been interpreted as evidence of former sea level stillstands date to period earlier than 18,000 years ago, then during Late Wisconsin times they would have been exposed as prominent terraces during marine regression. As sea level rose at a presumably constant rate, these terraces would temporally have serves as comparatively stable coasts during this transgression. Thus their potential for human habitation is twofold: a) as prominent overlooks, these terraces would have served as excellent locales for hunting large terrestrial mammals during the period of maximum regression. b) as coastal margins during comparatively brief periods when they were arresting the encroaching sea they would have served as stable margins for marine resource exploitation. Such features would not be expected to support prolonged human occupation based on marine subsistence strategies because these coasts would themselves not have been extant for prolonged periods. 2) If the five recorded stillstands date to within the last 18,000 years as is indicated some referenced geological data, then a model of periods of very rapid sea level rise followed by prolonged periods of coastal stability would have provided environmental situations suitable for human habitation of the coastal areas for thousands of years.

The problems related to modeling the study area of the probability of former human habitation are compunded not only by the complex nature and diversity of the coastal environment but also by basic problems in interpretating inadequate bathymetric data and temporal interpretation of sea level history. Until such time as adequate dating of these submerged bathymetric features is accomplished, any interpretation will remain high speculative. For the purposes of this analysis we have selected to interpret the six major stillstands as having occurred within the past 18,000 years. This is not so much based solely on the available data but also on the assumption that even if the inferred coastlines date prior to 18,000 years ago, they would have stablized sea level rise for relatively brief periods of time during the Late Wisconsin transgression, and created periods of comparatively stable coastal configuration. They would also have served as prominent, well drained, overlooks suitable for hunting large terrestrial mammals during the period of maximum regression.

THE MODEL

The model implemented in the Bering Land Bridge Cultural Resource Study has been implemented for this study. However, a different ranking system has been employed due to the very different nature of the projected ecological provinces analyzed by Stoker (this report). The ethnographic data discussed in detail in the Bering Land Bridge" Cultural Resource Study strongly supports our assumption that the subsistence strategy of precontact hunters varied depending on the faunal resources available. A brief synopsis of the Bering Land Bridge model is appropriate before discussing the ranking system employed in this study.

Biomass peaks concentrated precontact hunting populations, which through collective efforts were able to maximize the faunal harvest. This form of subsistence strategy resulted in predictable settlement locales which coincided with the occurrence of biomass peaks. Biomass concentrations were restricted to specific locations at specific periods in the seasonal cycle. By this method, precontact northern hunting populations were focused into primary settlements.

One universal in northern 'hunting cultures is the presence of some form of winter settlement. Such camps may be expected in regions of high productivity which provide seasonal surplus energy harvest necessary to sustain a winter settlement, with these surplus energy stores being supplemented by species in winter range and/or local small game or marine resources. These factors, coupled with the difficulty of transporting large quantities of fresh meat any great distance from the point of capture result in the formation of primary settlements. Generally, winter settlements required substantial modification of the natural environment in the construction of some form of winter shelter. It seems probable that such sites will be the easiest to detect using the geophysical instruments presently available for marine archeological survey. Large winter settlements will be located in areas where the greatest possibility exists of securing surplus faunal harvest. For the purposes of this study we consider the following environmental conditions to be the locales most likely to sustain winter settlements.

<u>High Probability Areas</u>

1) Non-glacial river mouths and constricted marine approaches to these river mouths, river margins and lake outlets. Estuaries and rivers, particularly those issuing from lakes, would have concentrated anadramous fish and their predators, delineated as the "salmon complex" by Stoker (1976:74 & 88 and this report).

2) Natural terrestrial constriction, such as passes, which funnel large mammal movements. Such locales cannot be considered high probability areas on Kodiak Island due to the paucity of terrestrial mammals resulting from its isolation from the mainland during Pleistocene and Holocene times.

3) Prominent spits, points, rocky capes, headlands and islands such as might have provided habitat for Phocid and Otarid seals and for marine birds. Such habitat is only considered high probability if it occurs in conjunction with one or more additional habitat types, or if there is a natural constriction which would tend to concentrate these species.

4) Areas of habitat diversity and general high marine interidal productivity, particularly those which might have promoted extensive

macrophyte development. An example of this type of environment would be deep sinuous embayments.

Medium Probability Areas

1) Lake margins. Although the presence of fish and waterfowl resources enhance these areas as settlement locales, they are less likely to be productive (and consequently less likely to foster winter settlements) as those listed above.

2) North and south facing slopes. Guthrie (1976) indicated that south facing slopes tend to concentrate grazing mammals during early spring plant maturation and that many times north facing slopes provide wind blown snow free winter range. However, neither of these habitat types concentrate grazers into specific locations where large aggregates of animals can be harvested. Although these areas are generally more productive, the mammals are scattered over a comparatively large area.

Low Probability Areas

1) Any habitat types not listed above.

High , Medium & Low Probability areas have been transposed to the standard Bureau of Land Management Outer Continental Shelf Office protraction diagrams for the study area. Twenty-one protraction diagrams have been stamped with H, M, L, to indicate high, medium and low probability areas (See Volumes 2 and 3 of this report for maps NO 4-6, NO 4-8, NO 5-3, NO 5-4, NO 5-5, NO 5-6, NO 5-7, NO 5-8, NN 2-6, NN 2-8, NN 3-2, NN 3-3, NN 3-4, NN 3-5, NN 4-1, NN 4-2, NN 4-3, NN 4-4, NN 5-1, NN5-2, NN5-3).

IV. DATA GAPS

E. James Dixon Jr., G. D. Sharma, and Sam W. Stoker

1) The most significant lack of information regarding this as well as all outer continental shelf cultural resource studies, is the lack of firm archeological sites in North America prior to 11,000 B.C. Although the existing evidence is interpreted as strongly supporting human occupation of the Americas prior to this time, unequivocal evidence is lacking. It is essential to document the presence of man in North America coeval with the emergent Bering Land Bridge.

2) The second most critical problem in attempting to analyze data relevant to human occupation of the outer continental shelf is the lack of an established chronology for sea level fluctuations. The geomorphic features related to sea level stillstands are excellent clues for the study of land/sea distributions during the Pleistocene Epoch. Based on such features, we have delineated various sea level stillstands in the study area. During each sea level stillstand, the juxtaposition of land and sea is projected on paleogeographic maps. The maps depict six sea level stillstands identified for the region. However, the sequence for these stillstands has not been established. For example, it is not certain whether sea level rose from -125 m to present sea level with six major interruptions, or if it fluctuated periodically during late Wisconsin times. Furthermore, we are not certain that the submerged features observed were formed as a consequence of late Wisconsin sea level rise. It is possible that some submerged features are indicative of one or more paleo-sea-level stillstands and thus may have formed during earlier glacial epochs. It is pertinent that these sea level stands be dated. Through dating it would be possible to determine which of the features were formed during late Wisconsin time, thereby deciphering the rate of sea level rise and stillstand ages. A sequence and chronology of sea levels would provide better tools to project sea-land-ice distributions during each stillstand.

3) There presently exists very little Pleistocene paleontological data from terrestrial regions adjacent to the study area. This has greatly hampered our ability to project former species distributions for paleogeographic reconstructions.

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VI. APPENDIX

COOK INLET - SOUTHERN PART

CHART NO. 16640 [C & GS8554)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
KENNEDY ENTRANCE	59°04'	152°14′	SILL	68
KENNEDY ENTRANCE	58°53′	151°40′	SILL	68

SHUYAK AND AFOGNAK ISLANDS AND ADJACENT WATERS

CHART NO. 16604 (C & GS 8533)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURE	DEPTH MIN.-MAX.
SHELIKOF STRAIT	58°31'	152°48'	SILL	31
SHELIKOF STRAIT	58°14.5'	153°10.5"	SILL	31
SHELIKOF STRAIT	58°23.5'	152°57.5'	SILL	36
SHELIKOF STRAIT	58°22.5'	152°56.5'	SILL	31
SHELIKOF STRAIT	58°20.5'	152°59'	SILL	31
SHELIKOF STRAIT	58°37'	15.2°39' 152°41'	SILL	29
SHELIKOF STRAIT	58°23.3'	152°57.7'	SILL	35
SHELIKOF STRAIT	58°22'	152°55.7' 152°57.2'	TERRACE	30-29
SHELIKOF STRAIT	58°40.1' 58°41$	152°32.8' 152°34.8'	TERRACE	32-31
GULF OF ALASKA	58°23.7'	152°11.5'	SILL	31
GULF OF ALASKA	58°26'	152°9'	SILL	36
GULF OF ALASKA	58°11' 58°7.5'	151°55' 152°05'	TIDAL FLAT	31-28
GULF OF ALASKA	58°19.5'	152"02'	SILL	36
GULF OF ALASKA	58°22'	151°54'	SILL	31
GULF OF ALASKA	58°26.5'	151°53.5'	SILL	46
GULF OF ALASKA	58°26.8'	151°57'	SILL	46
GULF OF ALASKA	58°28.5'	152°14'	SILL	21
GULF OF ALASKA	58°34.3'	152°15.5'	SILL	21
GULF OF ALASKA	58°34'	152°14.5'	SILL	21
GULF OF ALASKA	58°25.5'	152"	SILL	36
GULF OF ALASKA	58°23.3' 58°25'	151°50.5' 151°55.5'	TERRACE	32-31

CHART NO. 16604 (C & GS 8533)

NAME	LATITUDE	LONGITUDE	MORPHOLOG CAL FEATURE	DEPTH MIN.-MAX.
GULF OF ALASKA	58°28′ 58″29.5I	151°55.5′ 151″57.5′	TERRACE	32-31
GULF OF ALASKA	58°30' 58°31 '	152''04′	TERRACE	31-28
GULF OF ALASKA	58°29.5′	152°02.5′	TERRACE	32
GULF OF ALASKA	58014′.	152°15′	SILL	29
GULF OF ALASKA	58°40.9'	152°32′	TERRACE	30
GULF OF ALASKA	58°40.4′	152°28′	SILL	31
GULF OF ALASKA	58°36.68	152°12.6′	SILL	36
GULF OF ALASKA	58°34.4' 58°35.4′	152006.1 ' 152″10′	SILL	36
GULF OF ALASKA	58°29.4'	152°14.2′	SILL	21
GULF OF ALASKA	58°30.61	152°15.8′	SILL	21
GULF OF ALASKA	58°30.61	152°16.6′	SILL	21
GULF OF ALASKA	58°28.2′	152°07.9′	SILL	31
GULF OF ALASKA	58°28.11	152°10′	SILL	21
GULF OF ALASKA	58°24 ′ 58°25.2′	152°05.6′ 152°07.7′	TERRACE	32-31
GULF OF ALASKA	58°24.8′ 58°27.6′	152°08.1′	TERRACE	28
GULF OF ALASKA	58°31.4′	152°13.9'	SILL	29
GULF OF ALASKA	58°24.5′	152°01.7′	SILL	46
GULF OF ALASKA	58°25.9′	151″55′	SILL	′36

UGANIK AND UYAK BAYS

CHART NO. 16597 (C & GS 8542)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
SHE LIKOF STRA T	57°42′ 57″48.3′	154° 154°10′	TIDAL FLAT	32-28
SHELIKOF STRAIT	57°45.4′	154°07.5′	SILL	30
SHELIKOF STRAIT	57°47.5′	154°02.4′	SILL	31
UGANIK BAY	57°57′	153042.3′″	SILL	30
UGANIK BAY	57°57.7′	153°40.3′	SILL	30
UGANIK BAY	57°58′	153°39.2′	SILL	30
UGANIK BAY	57°43.7′	153°31.5′		16
UGANIK BAY	57°23.4′	153°49.7′		16
VIEKODA BAY	57°54.4′ 57°.51.2′	153°16.5′	SILL	36

KUKAK BAY

CHART NO. 16603 (C & GS 8667)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
KUKAK BAY	58°19′ lo″ 58°19′ 45″	154°07′ 25″	SILL	15

CAPE IKOLIK TO CAPE KULIUK

CHART NO. 16598 (C & GS 8541)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURE	DEPTH MAX.-MIN.
SHELIKOF STRAIT	57°41.8′ 57°47.9′	153°59″ 154°08.2″	TERRACE	30
UYAK BAY	57°32.6′ 57°33.5"	153°53.9″ 153°55.2′	SILL	30

CHINIAK BAY TO DANGEROUS CAPE

CHART NO. 16593 (C & GS 8535)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
GULF OF ALASKA	57°16′ 57°24.1′	152°21.3′ 152°30.8′	TIDAL FLAT	31-27
	57°38′	151°59.3′	SILL	46
UGAK BAY	57°29.1′ 57°27.7′	152°44.8′ 152°47.2′	SILL	16-14
CHINIAK BAY	57°41.4′	152°06.2′	SILL	68

KODIAK AND ST. PAUL HARBORS

CHART NO. 16595 (C & GS 8545)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
CHINIAK BAY	57°45′42″	152°22′50″	SILL	30
WOODY ISLAND CHANNEL	57°48′35″	152°18′59″	SILL	16
WOODY ISLAND CHANNEL	57°47′ 10″	152°20′50″	SILL	16

KODIAK ISLAND

CHART NO. 16580 (C & GS 8556) (cent inued)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
SEAL BAY	58°37.5′ 58°35′	152″45′ 152°40′	TERRACE	30-29
	58°27′ 58°18.2′	153°06′ 152°52′	TERRACE	17-15
	58°22.7′	152°56.5′	TERRACE	28
	58°15.5' 58°09′	153°08′ 153°19.5′	TERRACE	33-28
	58°05.6' 58°14'	152°03' 151°37.5′	TERRACE	31-28
	58°50′ 58°52.5'	151°32′ 152°03.5'	TERRACE	22-19
	58°58.4'	151°34'	TERRACE	20
	58°15.5′	154°08′	SILL	30
	58°20'	154°08.5'	SILL	14
	58°18.7′	154°03′	SILL	28
ALBATROSS BANK	56°25' 56°46.7'	152°18.5′ 151°57.2'	TIDAL FLAT	32-22
	56°16 56°3 '	153°42' 152°44′	TIDAL FLAT (PREVIOUSLY AN ISLAND)	38-23
SITKINAK STRAIT	56°33 9'	153°48.5′	TERRACE	31-30
SITKINAK STRAIT	56°35′	153°56.4′	TERRACE	27
SITKINAK STRAIT	56°40.5′ 56°31.5′	153°46.5′ 153°40′	TERRACE	33-29
	56°16.5′ 56°36′	154°16.5′ 153°46.7′	TERRACE	21-19
	56°25.5'	154°10.8′	TERRACE	32-28
	56°54'	153°30′ 153°38.4′	TERRACE	21-19

GULL POINT TO KAGUYAK BAY

CHART NO. 16592 (C & GS 8536)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
KAGUYAK BAY	56°55.5'	153°37.6'	SILL	22
KAGUYAK BAY	56°53.6'	153°39'	SILL	20
KIAVAK BAY	57°01.7'	153°30.2'	SILL	46
KIAVAK BAY	57°01.5'	153°33'	SILL	36
KIIUDA BAY	57°18.7'	153°01 '	SILL	16
GULF OF ALASKA	56°56.5'	152°59.2'	S LL	68
	56°58.2'	152°49.5' 152°52.7'	S LL	68
	57°13.5'	152°33.6'	SILL	46
	57°13.2' 57°20.5'	152°33.4' 152°44'	TERRACE	30
	57° 56°59'	152°53,2' 152°50'	SILL	68

MARMOT BAY AND KUPREANOF STRAIT

CHART NO. 16594 (C & GS 8534)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
TERROR BAY	57°51.5'	153°13'	SILL	30
RASPBERRY STRAIT	58°06.3'	153°10.2'	SILL	- - - x -
KUPREANOF STRAIT	57"59.4' 58°.03'	153°12.7' 153°08'	TERRACE	32-29
KUPREANOF STRAIT	58°01 '	153°12.8'	TERRACE	33-31
KUPREANOF STRAIT	57°57.7' 57°58.9'	153°.05' 152°57.7'	TERRACE	30-28
VIEKODA BAY	57°59.7'	153°24.21	TERRACE	33-32
WHALE PASSAGE	57"54.7'	152°46'	SILL	14
MARMOT BAY	57°48.2'	152°05.8'	TERRACE	36
MARMOT BAY	57°52.3'	152°08.21	SILL	36
MARMOT BAY	58°.08'	152°16.4'	SILL	36
MARMOT BAY	58°01 '	152°26.9'	SILL	68
CHINIAK BAY	57°43.7'	152°11.1'	SILL	36
KAZAKOF BAY	58°04.3'	152°32.5'	SILL	16
KAZAKOF BAY	58°4.41	152°34.1'	SILL	16-14
KAZAKOF BAY	58°03.9'	152°33.7'	TERRACE	14
KAZAKOF BAY	58°03.1'	152°35.5'	SILL	14
KAZAKOF BAY	58°02.8'	152°39.2'	SILL	14
KAZAKOF BAY	58"03.2'	152°34.4'	SILL	14
KAZAKOF BAY	58°02.6'	152°34.4'	SILL	14
KAZAKOF BAY	58°02.4'	152°34.4'	SILL	14
AFOGNAK BAY	58°.08'	152°42.5'	SILL	14
AFOGNAK BAY	58°01.9'	152°42.6'	SILL	14
AFOGNAK BAY	58°02.8'	152°44.3'	SILL	14
AFOGNAK BAY	58°.02'	152°41.6'	SILL	14

MARMOT BAY AND KUPREANOK STRAIT(CONTINUED)

CHART NO. 16594 (C & GS 8534)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
IZHUT BAY	58°13.9′	152°14.8′	SILL	16
SHELIKOF STRAIT	58°16′ 58°09.5′	153°08′ 153°18′	TERRACE	31-28
SHELIKOF STRAIT	58°01.11 58°04.1′	153°31 ' 153°25.2′	TERRACE	45-41
SHELIKOF STRAIT	58°02.2′ 58°04,2′	153°32.5′ 153°26.7′		

KODIAK ISLAND

CHART No. 16580 (C & GS 8556)(continued)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
PARPMANOF BAY	58°17.8′	152°52.5′	SILL	28
	58°31.4′	152°47.5′	SILL	29
	58°06′	153°10′	SILL	30
	57°59.4′	153°18.5′	SILL	33
TERROR BAY	57°52.2′	153°27.9′	SILL	30
(V IEKODA BAY)	57°47.4′	153°10.7′	SILL	18
PEREONSA BAY	58°24′	152°23.5′	TERRACE	31
UGAK BAY	57°28.1′	152°47.5′	SILL	16
KILIUDA BAY	57°18.5′	153°01′	SILL	16
			SILL	37
PORTAGE BAY	57°31′ 57°28.5′	155°40′ 155°45.5′	TERRACE	28-29
PORTAGE BAY	57°27.5′	155°53.5′	TERRACE	31-27
	57°25′	155°53′	TERRACE	33
AL TAK BAY	56°52.7′	154°17.2′	TERRACE	33-27
	56°55.5′	154°	TERRACE	3 2
	56°57.6′	154°15.5′	TERRACE	28
	57°26.6′ 57°33.5′	152°04.1′ 152°13.5′	TERRACE	31-28
	58°28.2′ 58°31.3′	151°55.5′ 152°05′	TERRACE	33-31
SEAL BAY	58°23.41	52°10.5′	TERRACE	17-14
SEAL BAY	58°21′ 58°28.5′	52°15′ 152°04.4′	TERRACE	31-30
	58°33′ 58°35′	152°15′ 152°.07′	TERRACE	31-28

KODIAK ISLAND

CHART NO. 16580 (C & GS 8556)(continued)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
KAIUGNAK BAY	57°01.8′	153°32′	TERRACE	38
THREE SAINTS BAY	57°07'	53°27.6′	SILL	37
ALBATROSS BANK	56°39.6' 56°52.3'	53°02.5' 152045,2	TERRACE	37-34
	56°45 4'	152°51 ′	SILL	33
	56°49 3'	152°56'	SILL	33
	56°57	151°50′	TERRACE	-33-31
	57°123′ 57°19.2′	152°34′ 152°44.5′	TERRACE	33-29
CHINIAK BAY	57°40'	152°16.5′	SILL	16
	57°43.5′	152°17.8′	TERRACE	30
	57°24' 57°34'	152009.5 1.52°14	TERRACE	22-21
LATEX ROCK OF DARK ISLAND STRAIT	58°40'	152°26′ 152″37′	TIDAL FLAT	29-27
	58°37' 58°39'	152°411	PENEPLAINED HEADLAND	29-27
	58°37'	152°18.5'		
	58°31.5′	152°48.5'	SILL	31
	58°36.7'	152°13'	SILL	36
	58°35.5'	152°09'	SILL	36
	58°35.0′	152°06.51	SILL	36
	58°31 ′	152°18′	SILL	31

SITKINAK STRAIT & ALITAK BAY

CHART NO. 16590 (C & GS 8517)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
SITKINAK STRAIT & ALITAK BAY	56°45.8'	153°41.5'	SILL	30
	56°46.7'	153°37.5'	SILL	30
	56°48.8'	153°34'	SILL	36
	56°49.5'	153°40'	SILL	30
	56°36.8' 56°37.4'	153°39.5'	SILL	46
	56°38.1 56°38.5'	153°41'	SILL	46
	56°39 '	153°41.5' 153°45.2'	SILL	46
	56°53.5'	153°38.5'	SILL	19
	56°55'	153°37.6' 153°40'	TIDAL FLAT	34-31
	56°54.2'	153°39 7' 153°4 .1'	TIDAL FLAT	32-31
	56°47' 56°54.5'	153°50 ' 153°30.5'	TERRACE	23-20
	56°56,6'	153°32'	SILL	30
	56°49.8' 56°53.3'	153°27.4' 153°32.5'	TERRACE	32-31
	56°46.5' 56°43.9'	154°33 ' 154°25.2'	TERRACE	30-29
	56°43' 56°44.4'	154°13.9'	SILL	20
	56°52.4'	154°04.1'	SILL	30
	56°51.1' 56°48.61	154°10.5' 154015.8	TERRACE	21-19

SITKINAK STRAIT & ALITAK BAY

CHART NO. 16590 (C & GS 8517)(continued)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
SITKINAK STRAIT & ALITAK BAY	56°52.8′	154°05.7′	SILL	30
	56°48′	154°31′	SILL	30
	56°43.5′ 56°52.9′	154°17′ 154°30.5′	TERRACE	31-22
KIAVAK BAY	57°01.5′	153°33′	SILL	31
	56°51.5′ 56°53.3′	153°37′ 153°40.5′	TIDAL FLAT	23-20
	56°40.9′ 56°41.7′	153°51.5′	TERRACE	46
	56°40.4′ 56°42.1′	153°52.5′	TERRACE	36
	56°41′ 56°42′	153°54′	TERRACE	21-20
	56°41.5′ 56°42′	153°55′	TERRACE	16
	56°37.8′	153°55.5′ 153°50.5′	TIDAL FLAT	30-27
	56°35.5′ 56°37.5′	153°48.5′ 153°53.5′	TIDAL FLAT	30-28
	56°28′ 56°35.5′	153°48′	TERRACE	30-27
	56°30.2′	153°45.5′	TIDAL FLAT	30-28
	56°31.5′	153°45.7′	TIDAL FLAT	30-27
	56°48.5′ 56°50.2′	153°34′ 153°37.5′	T DAL FLAT	32-33

CAPE AL ITAK TO MOSER BAY

CHART NO. 16591 (C & GS 8575)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	56°51'05" 56°53'	154°02.4' 154°05.7'	TIDAL FLAT	32-31
	56°54'20"	154°11 30"	TERRACE	14
	56°53'50" 56°54'	154 10 50" 154°11'40"	SILL	20
	56°53'49"	154°11 25"	SILL	20
	56°54'40" 56°55'30"	154°04 40" 154°05'25"	SILL	46

KOD AK ISLAND

CHART NO. 6580 (C & GS 8556)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	57°27.2'	153°55'	SILL	16-14
	57°41.6'	153°48'	SILL	38
SHELIKOF STRAIT	57°43.3'	153°57'	SILL	31-29
	57°49.4'	154°11.8'		
	57°57.1'	153°36.5'	SILL	29
	58°	153°28.7'	TERRACE	30-26
	57°57'	153°39.5'		
	57°43'	155°29.9'	SILL	16
	57°41.8'	153°32.4'	SILL	14
	57°30'	155°51.1'	SILL	16-14
	57°19'	156°02'	SILL	33
	56°33.1'	154°54.6'	T DAL FLAT	16-14
	56°06.4'	155°16.4'		
	56°05'	155°35'		17-12
	.54°58'	155°22.4'		
	57"39.2'	151012'	TIDAL FLAT	35-25
	57°55.5'	151°53.6'		
	57°32.2'	151°56'	SILL	29-27
	57°11.2'	151°35.5'	TIDAL FLAT	34-27
	57°21.9'	151°53.2'		
	57°48.6'	152°10.4'	TERRACE	32-29
	57*53.81	152°05.4'		
MARMOT STRAIT	58°17'	151°55.5'	SILL	28
	58°07.4'			
TONKI BAY	58°27.5'	151°56'	SILL	34
	58°23.6'	151°52.5'		
TONKI BAY	58°24.6'	151°57.5'	SILL	17-14

PORTAGE AND WIDE BAYS

CHART NO. 16564 (C & GS 8666)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	57°28.6′	155°54.1′	SILL	36
	57°29.3′	155°52.8′	SILL	30
PORTAGE BAY	57°28.2′ 57°29.4′	155°56′ 155°58′	TERRACE	28-27
PORTAGE BAY	57°28.8′	155°55.7′ 155°55.2′	TERRACE	29-28
PORTAGE BAY	57°29′ 57°29.7′	155°49.5′ 155°48.5′	TERRACE	28
SHELIKOF STRAIT	57°21.8′	156°14′	SILL	21
SHELIKOF STRAIT	57°23.6′	156°13.7′	SILL	21
WIDE BAY	57°23.2′	156°18.4′	SILL	15
WIDE BAY	57°24.1′	156°16.8′	SILL	15
	57°21′	156°13.2′	SILL	36
SHELIKOF STRAIT	57°21′	156°55.9′	SILL	46
SHELIKOF STRAIT	57°25.8′	156°50′	SILL	46

WIDE BAY TO CAPE KUMLIK

CHART NO. 16568 (C & GS 8868)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
WIDE BAY	57°22.8′	156°18.2′	SILL	15
	57°24.1′	156°15.9′		
	57°21.6′	156°13.5′	SILL	21
	57°06.5′	156°12.5′	SILL	36

CHIGNIK & KUJULIK BAYS

CHART NO. 6566 (C&GS 8710)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
CHIGNIK & KUJULIK BAYS	56038.1	157°46'	SILL	21
	56°33.1'	157°44.5'	SILL	30
	56°27.9'	157°44.3'	SILL	21
	56°32.8'	157°37.7'	SILL	30
	56°26.2'	157°37.3'	SILL	46
	56°23.2'	158°20.6'	SILL	46
	56°22.1'	158°20.8'	SILL	31
	56°22.1 56°21.3'	158°21.3'	SILL	36
	56°22.8'	158°17'	SILL	30
	56°21 '	158°01.6'	SILL	56
	56°20.7'	158°48.7'	SILL	52

UNGA SLAND AND PAVLOF BAY

CHART NO 16551 (C & GS 87o4)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	55°06.7′	160°55.2′	SILL	46
	55°20.6' 55°17.2′	160°58.3' 161°01′	SILL	29
	55°17.7'	160°56.4' 160°58.6'	SILL	29
	55°14.3' 55°18.8'	161°	SILL	29
UNGA STRAIT	55°25.4'	160°46.4' 160°43.2'	TERRACE	32-27
	55°18.3'	161°18′	SILL	31
	55°16'	161°10'	SILL	34
	55°13.6' 55°16'	161°11.8'	SILL	28
	55°19.7' 55°17.5'	161°11.3' 161°20.5'	TERRACE	31-28
	55°17' 55°17.8'	161°09' 161°12.5'	TERRACE	31-28
PAVLOF BAY	55°22.7' 55°21.9'	161°34.6'	SILL	47
	55°03.6'	161°07.5'	SILL	68
	55°03.6′	161°05.3′	SILL	68
	55°04.7'	161°05.4'	SILL	68

SHUMAGIN ISLANDS

CHART NO. 16552 (C & GS 8700)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
NAGAI ISLAND TO UNGA ISLAND	55°05.4'	160°56,5'	SILL	46
	55°13.7' 55°16.4'	160°05.7' 160°01.2'	TERRACE	36
W. NAGAl STRAIT	55°14.8'	160°01.9'	SILL	35
	55°11.2'	160°05.2'	SILL	30
GORMAN STRAIT	55°21.2'	160°06.9'	SILL	36
	55°38.7'	160°04.5'	SILL	31
	55°26'	160°40.9'	SILL	29
	55°20.9' 55°17.4'	160°56' 160°59'	SILL	29
	55°06.8'	160°54'	SILL	36
	55°17.7' 55°17.9'	160°56.7' 160°58.1'	SILL	30
	55°17.6'	160°58.7'	SILL	30
POPOF STRAIT	55°16'	160°32.3'	SILL	29

DOLGOI HARBOR

CHART NO. 16281 (C & GS 8851)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
DOLGOI HARBOR	55°04.5′	161°49.5′	SILL	30

SANAK ISLAND & SANDMAR REEF

CHART NO. 16547 (C & GS 8705)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	54°47.7'	162°01,3'	SILL	29
	54°48.9'	161°59.2'	SILL	29
	54°47.5'	162°02'	SILL	29
	54°42.5'	162°05.3'	SILL	31
	54°42'	162°02.4'	SILL	31
	54°41'	161°59.3'	SILL	30
	54°41.5'	161°57.8'	SILL	30
	54°41.7'	161°58.2"	SILL	30
	54°43.8'	162°04.6'	SILL	20
	54°45.6'	162°05.5'	SILL	30
	54°49.1'	161°40.7'	SILL	36
	54°49'	161°35'	SILL	36
	54°49.7'	161°36,6'	SILL	36
	54°48.8'	161°38.2'	SILL	36
	54°41.3'	161°33.3'	SILL	36
	54°41.4'	161°34.5'	SILL	40
	54°41.9'	161°34.5'	SILL	36
	54°37.5'	161°56.4'	SILL	68
	54°38.5'	161°58'	SILL	68
	54°35.2'	162°17.5'	SILL	32
	54°33.7'	162°22.8'	SILL	46
	54°34.8'	162°24.1'	SILL	45
	54°45'	162°40.9'	SILL	46

COLD BAY AND APPROACHES

CHART NO. 16549 (C & GS 8703)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
LENARD HARBOR	55°08.3′	162027.1 '	SILL	29
LENARD HARBOR	55°07.4′	162°22.9′	TERRACE	30
	55°01.6′	162°30.21	SILL	32
	55°1.9'	162°26.4'	SILL	37
	54°58.9'	162°12.4′	SILL	20
	54°48.6'	162°22.9'	SILL	36
DOLGOI HARBOR	55°04.3′	161°49.6′	SILL	30
DOLGOI HARBOR	55°05'	161°50.2'	SILL	30
STRAIT	55°18.4'	161°18.2'	SILL	31
VOLCANO BAY	55°11.4'	161°52.5'	SILL	36
	55°11'	161°42.2'	SILL	48
DEER PASSAGE	55°01'	162°15.2'	SILL	48

CHART NO. 16547 (C & GS 8705)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	54°42.6'	162°42.6'	SILL	48
	54°40'	162°42.8'		48
	54°181	162°10'	TERRACE	30-28
	54°25'	162018.8		
	54°16.8'	162°18.8'	TERRACE	30-28
	54"19.3'	162°30'		
	54°19.3'	162°10.7'	TERRACE	30-29
	54°21 '	162°13'		
	54°18.1'	162°25'	TERRACE	30-29

MORZHOVOI BAY & ISANOTSKI STRAIT

CHART NO. 16535 (C &GS 8701)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
	54°48'	162°55.5' 162°57.2'	SILL	36
	54°46.7'	162°49'	SILL	29
	54°47.8'	162°48.7'	SILL	30
	54°49.6' 54°48.9'	162°45'	SILL	29
	54°46.4' 54°48.4'	162°41.4'	SILL	30
	54°48.5' 54°48.6'	162°42'	SILL	30
	54°45.8' 54°45'	162°34' 162°32.1'	SILL	36
IKATAN BAY	54°46.2' 54°46.8'	163°20'	SILL	30
ISANOTSKI STRAIT	54°49.7'	163°22.8'	SILL	15
ISANOTSKI STRAIT	54°51.4'	163°24.7'	SILL	15

UNALASKA ISLAND TO AMUKTA ISLAND

CHART NO. 16500 (C & GS 8861)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
USOF BAY	53°26′	166°411	SILL	46
UMNAK PASS	53°38'	167°24'	SILL	48
	53°38'	167°14	SILL	46
	53°31.4'	167°25.8'	SILL	48
	53°30.8'	167°23.7'	SILL	46

KRENITZIN ISLANDS

CHART NO. 16531 (C & GS 8720)

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
DERBIN STRAIT	54°07.2′	165015.5	SILL	35
DERBIN STRAIT	54° 04.5'	165°12.7'	SILL	29
ROOTOK STRAIT	54°01.8'	165°27.8' 165°27'	SILL	31
AVATANAK STRAIT	54°08'	165°24.4'	SILL	36
AVATANAK STRAIT	54°06.7′	165°22.7′	SILL	36
UGAMAK STRAIT	54°07.7′ 54°08.2′	164°49.8′	SILL	36
UGAMAK STRAIT	54°09.5′	164°48′ 164°49.8′	SILL	36
UGAMAK STRAIT	54°09 ′	164°48′	SILL	36
UGAMAK STRAIT	54°08.3′	164°49.5′	SILL	36
UGAMAK STRAIT	54°10.8' 54°09.8'	164°59.2' 164°57.2'	SILL	28
	54°11.6' 54°10.7'	165°15.1'	SILL	36
	54°11.6′	165°20.4′	SILL	46
	54°17'	165°46.3'	SILL	45
AKUTAN PASS	54°01.6′	166°03′ 166°01.6′	SILL	31
	54°02′	165°42.3′	SILL	46
	53°57.8' 54°01.2'	165°40.5' 165°37.7'	SILL	46
	53°58.4'	165°54'	SILL	54
BERING SEA	54°17.3' 54°18.2'	165°47.3'	SILL	46

CAPTAIN’S BAY (UNALASKA)

CHART NO. US C & G 9006

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
CAPTAIN’S BAY	53°52’41”	166°33’35”	SILL	14
CAPTAIN’S BAY	53°50’30”	166°36’	SILL	16

CAPTAIN'S BAY (UNALASKA)

CHART NO. US C & G 9007

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
TERRACE	54°01 '	166°35'	TERRACE	46-47
AKUTAN PASS	54°01'30"	166°02'30"	SILL	32
BABY PASS	54°00 00	166°06'30"	SILL	15

UNALASKA ISLAND (CHERNOFSKI HARBOR TO SCAN BAY)

CHART C & GS 9022

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN
PUMICESTON BAY	53°31'5"	167°04'	SILL	21
PUMICESTON BAY	53°31' 17"	167°04'	SILL	14

BEAVER INLET

CHART No. c & GS 9018

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
ERSKINE BAY	53°44′20″	166°35′ 10″	SILL	22
FINAL BAY	53°42′00	166°31 '	SILL	22
UNIKTALI BAY	53°47′ 15″	166°29′ 15″	SILL	46
UNIKTALI BAY	53°47′ 15″	166°31′ 10″	SILL	31
UDAGAK STRAIT	53°43′55″	166°17115″	SILL	23
UDAMAK BAY	53°48′40″	166°13′30″	SILL	37
UDAMAK BAY	53°48′35″	166″13'00	SILL	30

MAKUSHIN BAY

CHART C & GS 9023

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
NAGINAK COVE	53°38'40"	166°51 '	SILL	15
CANNERY BAY	53°42'55"	166°48'40"	SILL	46
PORTAGE BAY	53°43'30"	166°47'35"	SILL	31

UMNIAK PASS

CHART NO. C & GS 9021

NAME	LATITUDE	LONGITUDE	MORPHOLOGICAL FEATURES	DEPTH MAX.-MIN.
ISLAND TERRACE	53°11′	167°54′		30
	53°11′45″	167° 56′ 30″	SILL	
UNMAK PASS	53°11′30″	167″ 57′	SILL	36
UNMAK PASS	53°11′30″	167°54′	SILL	32

PROTECTION BAY TO EAGLE BAY

CHART NO. C & GS 9019

NAME	MORPHOLOGICAL FEATURES	DEPTH MAX.- MIN.
U.S.O.F.	Multi-sill	46

WESTERN GULF OF ALASKA CULTURAL RESOURCE STUDY

FINAL REPORT

Submitted to

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Outer Continental Shelf Office

Anchorage, Alaska

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