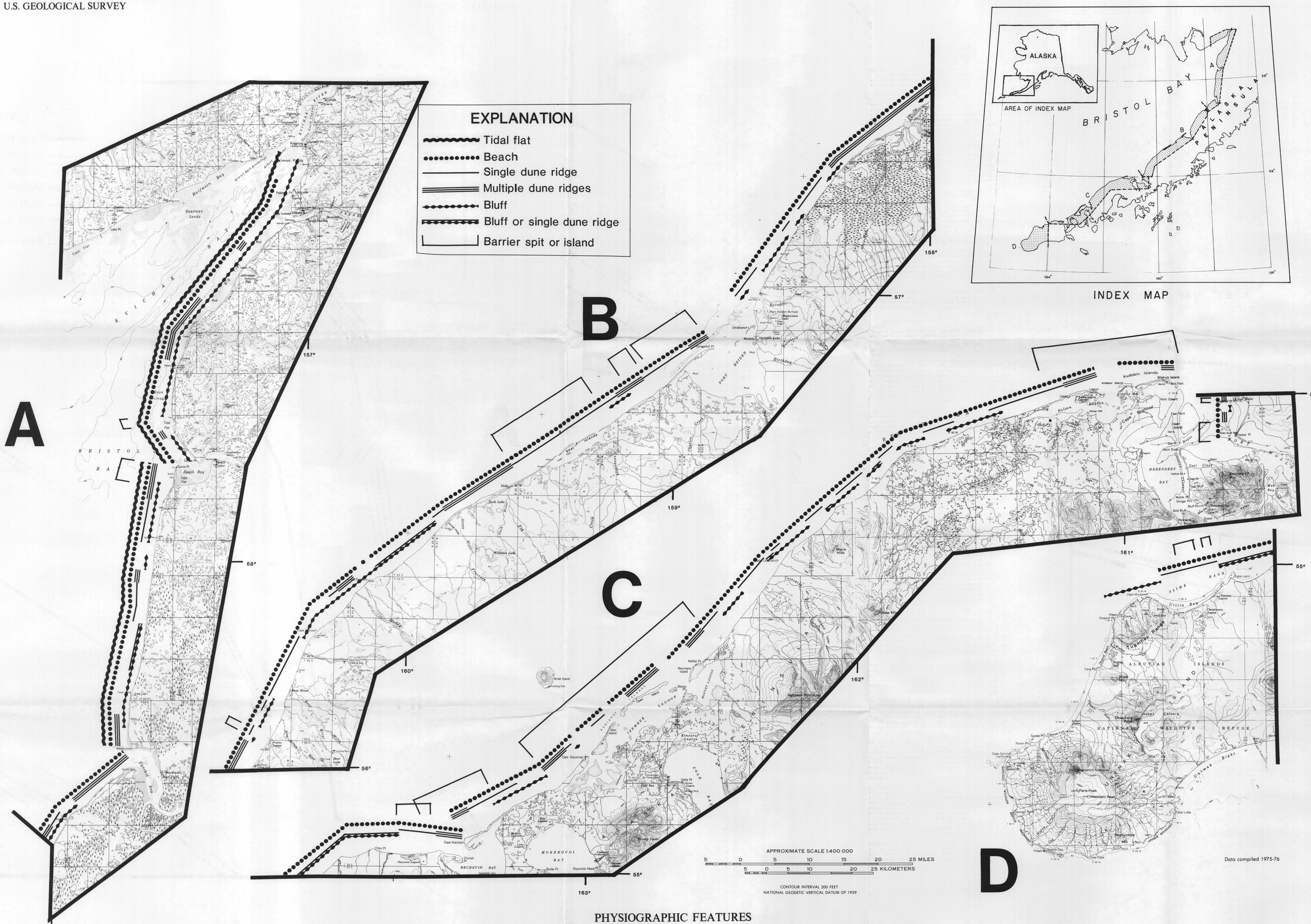

INDEX MAP

INTRODUCTION

Sheets 1 and 2 and this accompanying text describe the coastal morphology of the Bristol Bay coast of the Alaska Peninsula. Bristol Bay is a large, funnel-shaped embayment of the southeastern Bering Sea, bordered by mainland Alaska to the north and the Alaska Peninsula to the southeast.

Physiographic features that occur on the Bristol Bay coast of the Alaska Peninsula, from Unimak Pass in the south to Kvichak Bay in the north, are shown on sheet 1 of this report. Shown on sheet 2 are interpretations of the depositional, erosional, or stable condition of the coast. Also shown on sheet 2 are the directions of net longshore sediment transport; these directions can be compared to the interpretations of morphology in order to determine sources and sinks of littoral sediments.

METHODOLOGY

Physiographic features shown on sheet 1 are tidal flats, beaches, single dune ridges, multiple dune ridges, bluffs or cliffs, and barrier spits or islands. The symbols for each type of feature, shown in the explanation of sheet 1, are arranged so that the seawardmost feature is plotted farthest from the shoreline, with more shoreward features closer to the shoreline in sequence. Definitions that we used in discriminating these features are given in table 1. The data compiled on sheet 1 were gathered primarily from aerial reconnaissance flights during the summer of 1975 and 1976.

The groupings of physiographic features can be used to attribute the origin of a segment of coast to depositional or erosional processes. For example, a bluff or cliff is formed by erosion and can be considered a source of sediment. However, the presence of multiple dune ridges seaward of a wave-cut cliff indicates a segment of coast that is now depositional but in the past has been erosional. The presence of a barrier island or spit indicates that the segment is or has been depositional or a sink for sediment. Segments of coast that have no clear evidence of continued deposition or erosion are classified as stable. Stable segments are those that have a single dune ridge. However, when a single dune ridge occurs on a barrier, such a segment is interpreted as depositional.

Interpretations for specific types of physiographic features and sequences of features are given in table 2. These interpretations are not intended to be necessarily an indication of present coastal stability. For example, a barrier, which must have been formed by deposition, may now be eroding at a much faster rate than a wave-cut bluff. The interpretations are applicable, however, to assessments of long-term sources and sinks of littoral sediments.

The interpretations of coastal stability are shown on sheet 2 in a format similar to the one used on sheet 1. For example, if a segment of coast was interpreted as being presently depositional but in the past has been erosional, the symbol for deposition is plotted seaward of the symbol for erosion.

ENVIRONMENTAL SETTING

Factors that influence coastal morphology vary greatly along the Bristol Bay coast of the Alaska Peninsula. These factors include astronomical tides, incident waves, and ice.

The tidal bulge enters Bristol Bay with an amplitude of approximately 2 m (Arctic Environmental Information and Data Center, 1974). As the bulge progresses along the axis of Bristol Bay, it is highly amplified; this amplification causes a considerable increase in tidal range northeastward along the Alaska Peninsula shoreline. Tidal range is greater than 6 m at the north end of the study area, Kvichak Bay, to less than 2 m at the south end, Unimak Island. Thus, all environments of Davies' (1964) classification of coasts based on tidal range are present. These environments are the microtidal (less than 2 m), the mesotidal (2 to 4 m), and the macrotidal (greater than 4 m). However, most of the shoreline, 75 percent, falls within the mesotidal environment.

Incident wave energy varies inversely with tidal range along the coast. The northern part of the study area has relatively low wave energy due to refraction and frictional dissipation of swell waves as they propagate across the wide and relatively shallow Bristol Bay shelf. In contrast, the proximity of the southern part of the study area to deep water makes that area much higher in wave energy.

Sea ice and shorefast ice are apparently minor factors in the southern part of the study area. Here, ice concentrations during the winter months are negligible. However, ice may be significant in the northern part, where as much as ten percent of the area is ice covered during the coldest winter months (U.S. Department of Commerce, 1979).

PHYSIOGRAPHIC FEATURES (SHEET 1)

The Bristol Bay coast of the Alaska Peninsula is a relatively straight coastline that is segmented by a number of large and small embayments; the embayments are more or less protected from the Bering Sea by barrier spits and islands. These barriers occupy 24 percent of the total coastline. (Percent occurrences of physiographic features are given in table 1).

Barrier islands are best developed in the south half of the study area. Examples are the Kudiakof Islands enclosing Izembek Lagoon and the Kudobin Islands at the mouth of Port Moller. From Port Heiden northward, barrier islands are generally absent; here, barrier spits enclose the embayments. Examples are the narrow spits enclosing Port Heiden and Egegik Bay. At the extreme north end of the study area, Kvichak Bay, barriers are absent. This distribution of barriers is in general agreement with models of coastal morphology based on tidal range and wave energy. Barrier islands are common in mesotidal enviroments of medium wave energy, but are generally absent in macrotidal enviroments of low wave energy (see, for example, Hayes, 1979).

Seventeen percent of the coastline with barriers has no dune-ridge development (table 3). These low-lying barriers are subject to relatively frequent overwash, particularly on the southern parts of some barrier islands, such as the Kudiakof Islands and Kudobin Islands. On the northern parts of these islands, multiple dune ridges are common. These dune ridges indicate longshore growth of the islands to the north; such growth is in general agreement with the net northerly longshore transport of the region (Hunter and others, 1979).

Subtle headlands lie between the large embayments. Here, bluffs eroded into unconsolidated sediments are common. Locally, as in the vicinity of Black Hills, bedrock cliffs are present. Bluffs and cliffs occupy 40 percent of the total coastline (table 1). Beaches are locally absent in such areas, as at Cape Seniavin and along a 15-km segment of coast on Unimak Island. Twenty percent of the coastline with bluffs or cliffs has dune-ridge development seaward of the bluff or cliff (table 3); 15 percent has multiple dune ridges seaward of the bluff or cliff.

Tidal flats occur along 23 percent of the coastline (table 1). They are extensive along the northern part of the coast, in some areas exceeding 3 km in width. Tidal flats are generally absent south of Ugashik Bay. This distribution of tidal flats correlates well with the variation in tidal range and wave energy along the coast; the flats are more extensive where the tidal range is largest and wave energy is smallest.

DEPOSITIONAL, STABLE, AND EROSIONAL LANDFORMS
AND PATHWAYS OF LONGSHORE TRANSPORT (SHEET 2)

Along the Alaska Peninsula coast of Bristol Bay, net longshore sediment transport is to the northeast, with local reversals in the vicinity of the embayments. These transport direction are shown on sheet 2; the data are summarized from Hunter and others (1979).

On the basis of these directions of transport, the coast can be divided into a series of seven littoral cells. A litoral cell is defined as a reach of coastline bounded by points, or zones, of divergence of net longshore transport. Because a cell has divergence points on either end, it must have a convergence point somewhere within the cell. In our study area, convergence points are at the large embayments and divergence points are a relatively short distance northeast of each embayment. These seven cells are named on sheet 2 after the embayment which defines the convergence point of each cell.

Depositional landforms are found at convergences of longshore transport. This type of landform occupies 33 percent of the total coastline (table 2). Between convergence points, erosional and stable landforms are common. These landforms occupy 26 and 16 percent of the coastline respectively (table 2). Another 10 percent is classified as either stable or erosional. Additional segments of coast that were erosional in the past, but are interpreted as being presently stable (8 percent) or presently depositional (6 percent). The latter occur primarily in the vicinity of the large embayments and indicate areas that were once sources of sediment but are presently sinks of sediment.

The long-term trend is erosion of the subtle headlands and deposition at the embayments. Net effects of these processes are the straightening of the coastline and the ultimate merging of the littoral cells. Several smaller cells have already disappeared. An example is a cell whose convergence point was once an embayment at the mouth of the Cinder River. This cell has been incorporated into the much larger Ugashik Cell by filling in of the embayment. Another example is a former cell whose convergence point was at the embayment enclosed by the Seal Islands. This cell is now incorporated into the Port Heiden cell. Other cells will be combined as coastal straightening continues.

The Kvichak cell, at the north end of the study area, differs from the other cells. The head of Kvichak Bay is a convergence zone for transport, but no depositional landforms are present. Here, sediment movement by tidal currents dominates over wave-driven longshore transport, and depositional landforms associated with waves are absent.

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Table 1.--Percent occurrence and definitions of coastal physiographic features

Physiographic feature	Percent occurrence
Tidal Flat: Gently sloping intertidal area found seaward of the beach. It is unvegetated and is commonly composed of relatively fine sediment.	23
Beach: Accumulation of unconsolidated sediment (sand or gravel) found between the low-tide line and the next physiographic feature shoreward.	96
Single beach or dune ridge: Ridge composed of unconsolidated sand or gravel found landward of the beach. It is commonly vegetated and is oriented parallel to the present shoreline. Formed by eolian or swash processes or a combination of the two.	32
Multiple beach or dune ridges: Multiple occurrences of beach or dune ridges. Individual ridges are oriented parallel to past shorelines.	27
Barrier spit or island: A spit or island that partly or completely separates a body of water from the open sea.	24
Bluff or cliff: A nearly vertical slope landward of the beach that is eroded into unconsolidated deposits or rock.	38

Table 2.--Types of coast classified by coastal stability, the physiographic features on which the classification is based, and percent occurrence of coastal types

Type of coast	Physiographic features or sequence of features	Percent occurrence
Now or very recently depositional	Barrier islands and spits, and beaches with multiple dune ridges	33
Now or very recently depositional, in the past erosional	Multiple dune ridges seaward of a wave-cut bluff or cliff	6
Now or very recently erosional	Wave-cut bluffs or cliffs	26
Now or very recently stable	Single dune ridge not occurring on a barrier	16
Now or very recently stable, in the past erosional	Single dune ridge seaward of a wave-cut bluff or cliff	8
Now or very recently either stable or erosional	Local occurrences of either single dune ridges or small bluffs, too small in extent to be mapped separately	10

Table 3.--Percent occurrence of physiographic features associated with barriers and bluffs or cliffs

BARRIER ISLANDS AND SPITS

Barriers with:	% of total coastline	% of barrier coastline
Single dune ridge	8	33
Multiple dune ridge	12	50
No dune ridge	4	17

BLUFFS OR CLIFFS

Bluffs fronted by:	% of total coastline	% of bluff coastline
No beach	4	10
Only a beach	22	55
Single dune ridge	8	20
Multiple dune ridge	6	15

PHYSIOGRAPHIC FEATURES

MAPS SHOWING THE COASTAL MORPHOLOGY OF THE BRISTOL BAY COAST OF THE ALASKA PENINSULA

By
Asbury H. Sallenger, Jr. and Ralph E. Hunter
1984

Base from U.S. Geological Survey, 1:250 000. Ugashik, Bristol Bay, Chignik, 1963; Naknek, Port Moller, 1952; Cold Bay, 1943; and Unimak, 1945

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