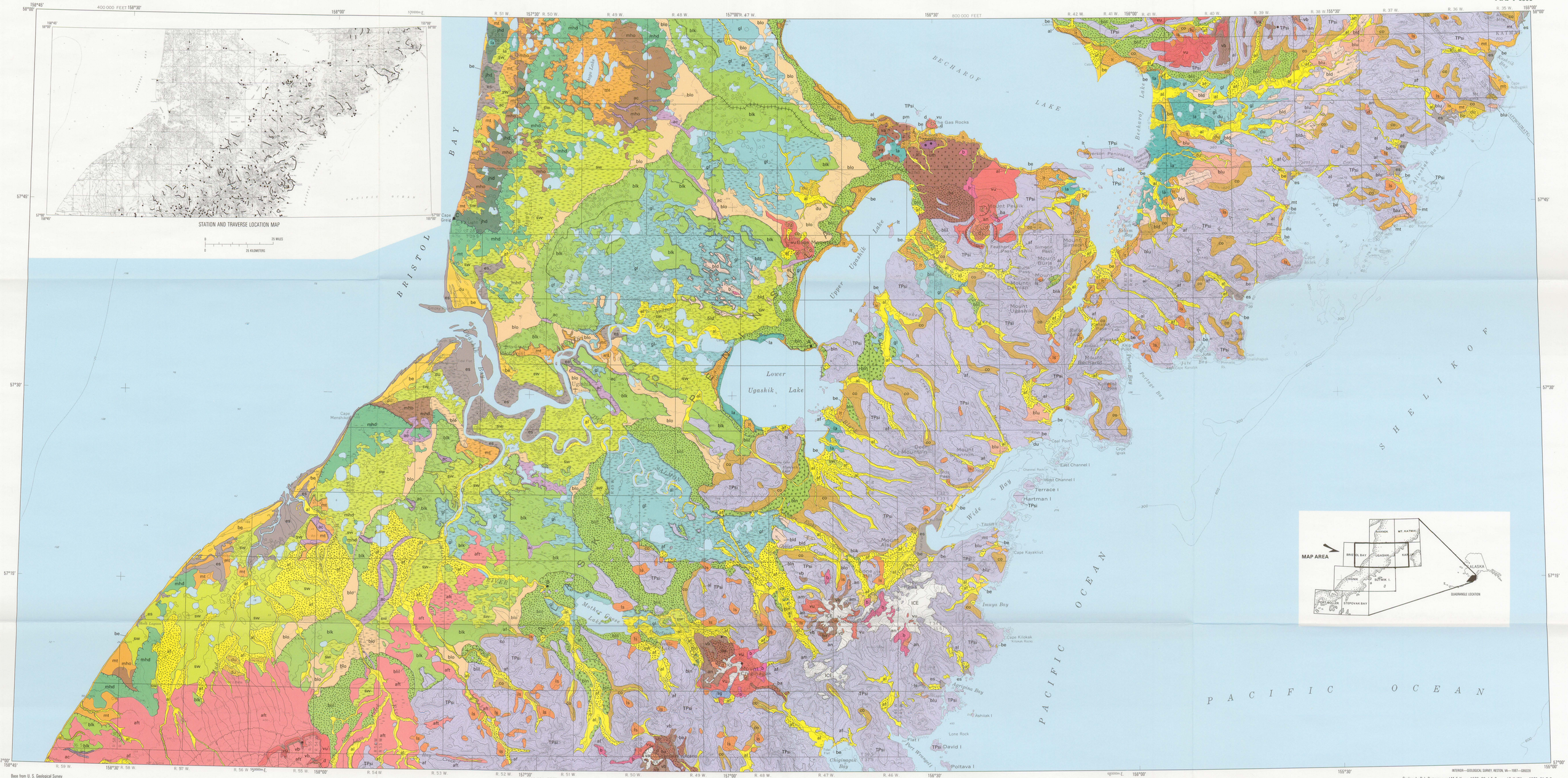


Base from U. S. Geological Survey Karluk, 1952; Bristol Bay, Ugashik, 1953

Geology by R. L. Detterman and M. E. Yount, 1979–83, J. E. Case and F. H. Wilson, 1979–81, T. P. Miller, 1979, 1982, J. W. Miller, 1980–83, W. H. Allaway, Jr., 1980–81, D. P. Cox, 1980, J. E. Riehle, 1980–83, Nora Shew, 1981

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1987—G88029

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

## INTRODUCTION

Geologic mapping of the surficial deposits and Quaternary volcanic rocks in the Ugashik, Bristol Bay, and western part of Karluk quadrangles was based on observations of morphology, lithology, and stratigraphy in selected field areas. These observations were then extended to other parts of the map area by means of vertical aerial photographs. The map area contains an excellent record of multiple glacier advances and recessions, including the formation of large glacial lakes, and of repeated volcanic eruptions from several major volcanic centers.

The stratigraphic framework for the surficial map units is based on the Alaska Peninsula glacial sequence of Muller (1952, 1963), with modifications by Detterman and Reed (1973). Drift of four ice advances is preserved within the map area (fig. 1).

| Standard nomenclature | | | |
|---|---|---|---|
| Neoglacial | Alaskan glaciation | | |
| Late Wisconsin <25,000 ka | Brooks Lake glaciation | Iliuk stade | |
| | | Newhalen stade | |
| | | Illiamna stade | |
| | | Kvichak stade | |
| Early Wisconsin >40,000 ka | Mak Hill glaciation | | |
| Pre-Wisconsin | Johnston Hill glaciation | | |

*Figure 1.*—**Glacial sequence in Ugashik, Bristol Bay, and western Karluk quadrangles**

The fourfold division of the Brooks Lake glaciation is used by Detterman and Reed (1973) in the Iliamna quadrangle and Detterman and others (1981) in the adjoining Chignik and Sutwik Island quadrangles. Drift of the Holocene neoglacial interval is considered part of the Alaskan glaciation (Karlstrom, 1957).

Drift of Johnston Hill age is confined to a narrow belt about 5 km wide along the Bristol Bay coast north of Ugashik Bay. The segmented and highly modified morainal hills are a part of the more extensive deposits in the Naknek area, 65 km north of the mapped area, where Johnston Hill drift deposits were first defined and are best exposed (Muller, 1953). The deposits are undated, but, on the basis of morphology and their position underlying Mak Hill drift deposits dated at >40,000 ka, the deposits are correlated with pre-Wisconsin glaciations in Alaska (Karlstrom and others, 1960).

Drift of Mak Hill age (Muller, 1953) still retains a well-defined terminal moraine and associated outwash plain. The moraines are considerably modified: the crestal areas are broad, and most kettle ponds are partly filled. Good exposures of ice-contact features are present at Cape Greig and Cape Menshikof, north and south, respectively, from Ugashik Bay. A radiocarbon sample from Cape Greig is dated at >40,000 ka.

Most of the topographic features, lakes, and river systems in the lowland part of the Ugashik and Karluk quadrangles result from Brooks Lake (late Wisconsin) drift deposits (Muller, 1953; Detterman and Reed, 1973). Large, well-defined, arcuate to lobate end moraines enclose the major lakes and control the river systems. Four component stades are recognized; these are, from oldest to youngest, Kvichak, Iliamna, Newhalen, and Iliuk. The Kvichak advance reached nearly to the Bristol Bay coast, where the terminal moraine formed a dam for a large lake that formed from meltwaters of the glaciers and that covered much of the western part of the mapped area. The lake was at least 100 km long and 50 km wide at its maximum extent, and extensive wave-eroded scarps formed in both glacial deposits and bedrock. At least two recessional moraines of the Kvichak advance are present, generally as isolated morainal hills within the area of glacial lake deposits. The major existing lakes in the area—Becharof, Upper Ugashik, Lower Ugashik, and Mother Goose—are all retained behind moraines of the succeeding Iliamna advance. The Newhalen and Iliuk events were minor advances with morainal remnants preserved only locally in mountain valleys.

The Alaskan glaciation (Karlstrom, 1957) was represented by only minor advances of alpine glaciers in the Ugashik and Karluk quadrangles. A few small deposits are present on Mount Chiginagak, Mount Kialagvik, and Icy Peak, generally within 1 km or less from the modern glaciers.

Radiocarbon samples from the map area are listed in table 1. The two samples from the archeological site between Upper and Lower Ugashik Lake that are dated at 8,425±115 and 8,995±295 ka (Dumond, 1980) are on drift of the Newhalen advance and represent a minimum age for that event. Three samples that are dated at >40,000 ka are of little value for establishing a glacial chronology except to set a maximum for the Iliamna advance and a minimum for the Mak Hill drift deposits.

**Table 1.**—*Radiocarbon dates*

**(SI, numbers by Smithsonian Institution; I, numbers by Teledyne Isotopes)**

| Sample site | Location | Age (ka) and laboratory number | Sample material | Stratigraphic data |
|---|---|---|---|---|
| A | Sec. 30, T. 30 S., R. 46 W., Ugashik C-3 quadrangle | 8,425±115 (SI-2641) | Charcoal | Archeological site overlying Newhalen drift deposits |
| A | Do.----- | 8,995±295 (SI-2492) | -----do.----- | Do. |
| B | Sec. 15, T. 34 S., R. 51 W., Ugashik A-5 quadrangle | >40,000 (I-13,057) | Wood | Glacial lake deposit underlying Iliamna drift deposits |
| B | Do.----- | >40,000 (I-13,058) | -----do.----- | Glacial lake deposit 7 m below I-13,057 |
| C | Sec. 30, T. 28 S., R. 51 W., Ugashik C-6 quadrangle | >40,000 (I-13,056) | Carbonized twigs and grass | Outwash from Mak Hill drift deposits |

Quaternary volcanic rocks are widespread in the map area and are part of the late Miocene to Quaternary Aleutian magmatic arc. Quaternary volcanic deposits in the map area include those of four stratovolcanoes, Ugashik caldera, two large dome clusters, Ukinrek Maars, and several other small-volume flows and domes. The stratovolcanoes are: Mount Peulik, Mount Kialagvik, Mount Chiginagak, and Yantarni volcano. Yantarni volcano, a previously unknown center 18 km southwest of Mount Chiginagak, discovered in 1979 by R. L. Detterman and J. E. Case during fieldwork on this project. Blue Mountain, a dome cluster on the west side of Ugashik Lake, has previously been mapped as a Jurassic (Beikman, 1974, 1980) or a Tertiary (Burk, 1965) intrusive body. The Gas Rocks, on the south shore of Becharof Lake, are also a dome cluster. Deposits from Aniakchak caldera (Detterman and others, 1981; Miller and Smith, 1977) to the south and from Keijulik volcano to the north also extend into the map area.

Radiometric age control on Quaternary volcanic activity is provided by K-Ar ages from Blue Mountain, Gas Rocks, Yantarni, Kialagvik, and VABM Lone (9.5 km west of Ugashik Lake) (F. H. Wilson, written commun., 1985). The Quaternary volcanic centers that yield the oldest ages are Yantarni and Kialagvik, although the age of the onset of volcanism at each center is a minimum one because of limited sampling. Three of the four stratovolcanoes and Ugashik caldera have had Holocene eruptive activity. The only recent eruption was a phreatomagmatic one at Ukinrek Maars in March and April, 1977 (Kienle and others, 1980; Self and others, 1980). At Yantarni, Chiginagak, and Peulik volcanoes, block and ash flows are altered very little by glacial action and in some places overlie glacial moraines. Domes in Ugashik caldera were emplaced in Holocene time (Miller, 1984). However, deposits from the caldera-forming eruption of Ugashik caldera are not preserved, which suggests that collapse of the caldera was pre-Brooks Lake ice advance. A small dome and flow 8 km northwest of Alinchak Bay are not significantly glacially modified, which also suggests Holocene emplacement. Evidence for Holocene eruption at Mount Kialagvik is equivocal. Volcanic deposits at Kialagvik are glacially eroded, and volcanic rocks along an ice-bound ridge 6-8 km east of Kialagvik may also represent Quaternary volcanic activity. The caldera-forming eruption at Aniakchak occurred approximately 3,500 ka (Miller and Smith, 1977); This eruption resulted in extremely mobile ash flows that extended into the map area, in places up stream drainages and over passes. Spectacular evidence of the mobility can be seen in the creek north of Ray Creek; ash flows swept up drainage and spilled over into the Pumice Creek drainage.

Major-element chemical data (F. H. Wilson, written commun., 1985) indicate that most of the Quaternary volcanic deposits are typical of arc-related calc-alkaline volcanism. Compositionally, the deposits range from basaltic andesite (53-57 percent $SiO_2$) to dacite (63-70 percent $SiO_2$). However, alkaline basalt erupted at Ukinrek Maars and in the vicinity of VABM Lone. The chemical trends of the Quaternary centers are essentially unchanged from that of pre-Quaternary Aleutian arc volcanism and mostly Paleogene Meshik arc volcanism in the area (Wilson, 1985). Pre-Quaternary centers of volcanic and magmatic activity are shown on the compilation of Quaternary volcanic geologic map (Detterman and others, in press).

Many of the volcanic rock units shown on this map are lithologically similar to units shown on the companion geologic map (Detterman and others, in press). Designation of these as Quaternary units was primarily on the basis of proximity to Quaternary volcanic centers or radiometric age control.

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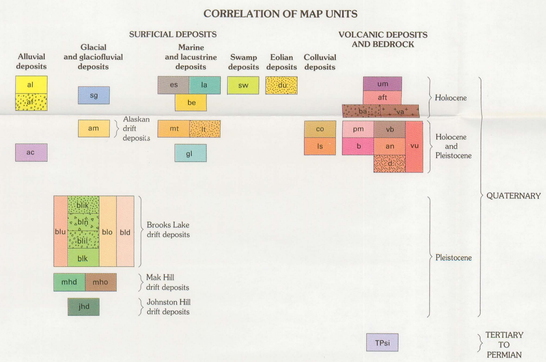
## CORRELATION OF MAP UNITS




## DESCRIPTION OF MAP UNITS

### SURFICIAL DEPOSITS

**Alluvial deposits**

al — ALLUVIUM (HOLOCENE)—Ranges from poorly sorted and poorly stratified, coarse, angular fragments near head of valleys to moderately well-sorted, well-rounded, and stratified sand and fine gravel on the coastal plain. Deposits along streams draining volcanoes consist mainly of pumice lapilli; streams cutting glacial moraines contain many large rock fragments. Includes both active and inactive deposits. Inactive deposits commonly vegetated; may include low terrace gravels

af — ALLUVIAL FAN DEPOSITS (HOLOCENE)—Range from coarse, poorly sorted rock debris near head of fans to moderately well-sorted and stratified fragments near margins. Most fans vegetated and inactive

ac — ABANDONED CHANNEL AND UNDERFIT STREAM DEPOSITS (HOLOCENE AND PLEISTOCENE)—Poorly to moderately well-sorted and stratified sand and gravel in channels fronting and along moraine of the Kvichak and Iliamna advances of the Brooks Lake glaciation. Many channels formed as outlets for glacial lakes

**Glacial and glaciofluvial deposits**

sg — SUPERGLACIAL DRIFT (HOLOCENE)—Coarse, angular rock fragments, pumice, and ash covering glacier surface. Debris entirely of volcanic origin and accumulated in large part by glacier ablation. Mapped only on Mount Chiginagak; small deposits accumulate on other glaciers

**Alaskan drift deposits**

am — DRIFT (HOLOCENE AND PLEISTOCENE)—Unsorted, nonstratified, coarse to fine rock debris within cirques and in upper valleys within 0.5 km of modern glaciers. Forms arcuate lobes and end moraines of unstable and nonvegetated rubble

**Brooks Lake drift deposits**

blu — DRIFT, UNDIVIDED (PLEISTOCENE)—Unsorted and nonstratified till in irregular knob and kettle topography; fresh to moderately weathered

blik — DRIFT OF ILIUK ADVANCE (PLEISTOCENE)—Unsorted and nonstratified till forming well-preserved, vegetated, arcuate end and lateral moraines with irregular surfaces. Confined to mountain valleys

bin — DRIFT OF NEWHALEN ADVANCE (PLEISTOCENE)—Unsorted till and stratified ice-contact deposits forming well-developed arcuate end and lateral moraines with prominent knob and kettle topography little modified by erosion. Found mainly in mountain valleys and formed by a major glacial stillstand or minor readvance

bil — DRIFT OF ILIAMNA ADVANCE (PLEISTOCENE)—Large arcuate, in part lobate, end and lateral moraines 40 to 70 km from valley heads. Enclose major lake basins. Mainly unsorted till but locally contains sorted and stratified ice-contact deposits. Knob and kettle topography considerably modified by mass wasting; many kettles partly filled and morainal crests rounded. Fronted by large outwash plains

blk — DRIFT OF KVICHAK ADVANCE (PLEISTOCENE)—Large arcuate, in part lobate, end moraines with locally at least two prominent recessional moraines. Mainly unstratified, with minor sorted and stratified ice-contact deposits; extends as much as 75 km from source areas. Knob and kettle topography considerably weathered; many kettles filled, streams integrated, and knobs broadly rounded. Moraines enclose large glacial lakes and are fronted by broad outwash plains

blo — OUTWASH DEPOSITS (PLEISTOCENE)—Moderately well-sorted sand and gravel forming nearly flat to gently sloping plains in front of end moraines of Brooks Lake age; slightly modified by erosion

bld — DRUMLIN FIELD DEPOSITS (PLEISTOCENE)—Formed of unsorted till of Brooks Lake age in elongate, roughly elliptical hills as much as 1.5 km long and 50 m high. Found mainly in Keijulik River valley and Bellini Bay area of Becharof Lake, where orientation indicates ice flow was southwest towards Becharof Lake. A small drumlin field lies west of Ugashik Lake. Stream erosion reveals some drumlins cored by bedrock in the Keijulik River valley

**Mak Hill drift deposits**

mhd — DRIFT (PLEISTOCENE)—Unsorted and nonstratified till forming highly modified knob and kettle topography near Bristol Bay coast. Knobs rounded and much reduced in size by solifluction and covered by marine terrace deposits and outwash from Brooks Lake glaciation; kettle ponds mostly filled and reduced in size; end moraine highly segmented. Stratified ice-contact and glaciomarine deposits present in some beach-cliff exposures along Bristol Bay

mho — OUTWASH DEPOSITS (PLEISTOCENE)—Moderately well-sorted, stratified, and consolidated deposits forming flat to gently sloping plains in front of end moraines of Mak Hill age. Deposits generally small and segmented by streams

**Johnston Hill drift deposits**

jhd — DRIFT (PLEISTOCENE)—Highly modified drift forming distinct but much subdued morainal ridges along Bristol Bay coast. Knobs broadly rounded to flat and segmented, locally with wave-cut scarps along sides; kettles and swales filled with thick organic silt and marine terrace deposits

**Marine and lacustrine deposits**

es — ESTUARINE DEPOSITS (HOLOCENE)—Dark-gray silt and clay commonly laminated with interbeds of fine sand; locally rich in organic material. Extensively developed around Ugashik Bay where the deposits extend from the high tide line to as much as 2 m above high tide

la — LACUSTRINE DEPOSITS (HOLOCENE)—Silt and sand deposited in partly drained lake basins; locally includes beach deposits too small to map separately

be — BEACH DEPOSITS (HOLOCENE)—Moderately well-sorted and stratified sand and gravel. Deposits along shore of Bristol Bay mainly derived from glacial deposits with some pumiceous sand in southern part near Aniakchak caldera. Along Pacific side of Alaska Peninsula deposits consist mainly of locally derived bedrock

mt — MARINE TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Stratified and moderately well-sorted sand and gravel forming nearly level plains locally ending at prominent wave-cut scarps. Terraces along Bristol Bay formed at 15 to 18 m elevation and between 40 and 65 m elevation on the Pacific Ocean side of Alaska Peninsula

lt — LAKE TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Well-sorted and stratified sand and gravel forming nearly level plains locally ending at wave-cut scarps. Two terrace levels along east end of Becharof Lake at about 15 and 45 m elevation; one level at about 15 m elevation along Ugashik Lake

gl — GLACIAL LAKE DEPOSIT (HOLOCENE AND PLEISTOCENE)—Highly organic silt and clay locally with stratified sand and pebbles near moraine fronts. Enclosed by moraine of Kvichak age. Associated with terrace levels cut into bedrock and moraine at about 22 to 25 m elevation. Terraces extend inland 58 km along Dog Salmon River valley. Most of the area poorly drained with numerous lakes, ponds, and quaking bogs

**Swamp deposits**

sw — SWAMP DEPOSITS (HOLOCENE)—Dark-brown to black highly organic silt and clay. Locally an accumulation of sedge and *Sphagnum* peat that locally forms quaking bogs. Largely formed between moraines of Brooks Lake and Mak Hill drift deposits.

**Eolian deposits**

du — DUNE DEPOSITS (HOLOCENE)—Fine- to medium-grained sand and pumice, forming dunes up to 15 m high. Occurs mainly along beaches and terraces; locally near distal end of ash-flow deposits. Includes both active and stabilized forms

**Colluvial deposits**

co — COLLUVIUM (HOLOCENE AND PLEISTOCENE)—Coarse, angular rubble and talus mixed with fine-grained organic-rich solifluction deposits. Unsorted to weakly sorted or stratified; forms thin sheets along valley walls and along lower slopes of mountains

ls — LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Unsorted, nonstratified, coarse, angular rubble forming lobate masses at base of steep rock walls. Common in areas underlain by poorly consolidated Tertiary rocks; also present in areas of soft Mesozoic shale. Particularly abundant in southwestern part of area

### VOLCANIC DEPOSITS AND BEDROCK

um — UKINREK MAARS (HOLOCENE)—Well-bedded tuff ring deposits (Self and others, 1980), include accidental blocks of conglomerate and sandstone (Naknek Formation) and juvenile scoriaceous cinders, lapilli, and bombs of alkali olivine basaltic composition (Kienle and others, 1980). Poorly sorted, massive, poorly vesiculated ash-flow tuff of Ugashik caldera(?) is exposed in the maar walls. Result of 1977 phreatomagmatic eruption 3 km south of The Gas Rocks (Kienle and others, 1980)

aft — ASH-FLOW TUFF AND AIR FALL OF ANIAKCHAK CALDERA (HOLOCENE)—Ash-flow sheet and associated air fall from the climactic eruption of Aniakchak caldera in the Chignik quadrangle (Detterman and others, 1981); dated 3300-3700 ka (Miller and Smith, 1977). Ash-flow tuff unsorted, poorly stratified, and composed mainly of pumice and scoria bombs as much as 60 cm in diameter in a matrix of coarse ash and lapilli; juvenile material of high-silica andesite (57-59 percent $SiO_2$) and dacite (65-70 percent $SiO_2$) (Smith, 1979). Ash-fall tuff moderately well sorted, well stratified, and composed chiefly of fine- to medium-grained dacitic ash

ab — BLOCK AND ASH FLOWS (HOLOCENE)—Small volume, andesitic to dacitic block-and ash-flow deposits associated with domes. Block and ash flows at Mount Peulik, Yantarni volcano, and southeast of Mount Chiginagak are not glacially modified, suggesting an age younger than drift of Iliuk age; the block and ash flow at Yantarni overlies glacial moraine. The matrix-poor, dacitic, block and ash flow west of Mount Peulik in part overlies terminal moraine of Iliamna age. Block and ash flows at Mount Kialagvik and northwest of Mount Chiginagak partly overlie drift of Iliamna age and possibly may be younger than drift of Newhalen age

vb — VOLCANIC AVALANCHE DEPOSITS (HOLOCENE)—Irregularly-shaped mounds 10-20 m high, composed of unconsolidated volcanic rock debris. Avalanche northwest of Mount Peulik covers an area of 74 $km^2$; dominant rock type varies from mound to mound, ranging from andesite to biotite-bearing rhyodacite. Avalanche at Yantarni volcano originated from the south rim of the present crater and traveled southward, probably onto ice; main volume of avalanche is to the south in the Sutwik Island quadrangle (mapped as explosion debris, Detterman and others, 1981)

pm — PHREATOMAGMATIC DEPOSITS (HOLOCENE AND PLEISTOCENE)—Possible littoral cone deposit. Well-bedded lapilli tuff and coarse-ash tuff exposed in a cliff on the shore of Becharof Lake 5 km west of The Gas Rocks. Parallel strata 1-8 cm thick; continuous laterally for meters. Bedding defined by differences in clast size (each stratum of one predominant size); lapilli-rich strata are fines-depleted. Clasts predominantly medium ash to fine lapilli (<2 cm); approximate ash:lapilli ratio is 1:4; rare bombs, some with bomb sags. Moderately indurated, highly porous

b — BASALT AND BASALTIC ANDESITE FLOWS (HOLOCENE AND PLEISTOCENE)—Medium- to dark-gray, fine to coarsely crystalline; porphyritic with plagioclase, olivine, clinopyroxene, and orthopyroxene as common phenocrysts; hornblende and quartz rare. Individual flows to 20 m thick; locally with columnar jointing. Includes some interlayered tuff and volcanic rubble

an — HIGH-SILICA ANDESITE AND DACITE FLOWS (HOLOCENE AND PLEISTOCENE)—Light- to dark-gray, holocrystalline to vitrophyric, porphyritic; common phenocrysts include plagioclase, orthopyroxene, hornblende, quartz, and magnetite; rare olivine and clinopyroxene. Locally includes interlayered units of tuff and volcanic rubble. Individual flow units to 50 m thick, commonly columnar jointed

vu — VOLCANIC DOMES (HOLOCENE AND PLEISTOCENE)—Light- to dark- to pinkish-gray, holocrystalline, porphyritic domes of high-silica dacite, dacite, and rhyodacite (F. H. Wilson, written commun., 1985; Miller, 1984)

TPsi — VOLCANIC ROCKS, UNDIVIDED (HOLOCENE AND PLEISTOCENE)—Flows and volcaniclastic rocks

SEDIMENTARY AND IGNEOUS ROCKS (TERTIARY TO PERMIAN)—Includes sedimentary rocks of Permian, Triassic, Jurassic, Cretaceous, and Tertiary age and volcanic and intrusive rocks of Triassic and Tertiary age (Detterman and others, in press)

CONTACT

END OR LATERAL MORAINE

MEDIAL MORAINE

RECESSIONAL MORAINE

TERRACE SCARP—Ticks on downhill side

RIM OF VOLCANIC CRATER OR CALDERA

HOT SPRING

VOLCANIC VENT

SAMPLE SITE

DRUMLIN

# QUATERNARY GEOLOGIC MAP OF THE UGASHIK, BRISTOL BAY, AND WESTERN PART OF KARLUK QUADRANGLES, ALASKA

By
R. L. Detterman, F. H. Wilson, M. E. Yount, and T. P. Miller

1987

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