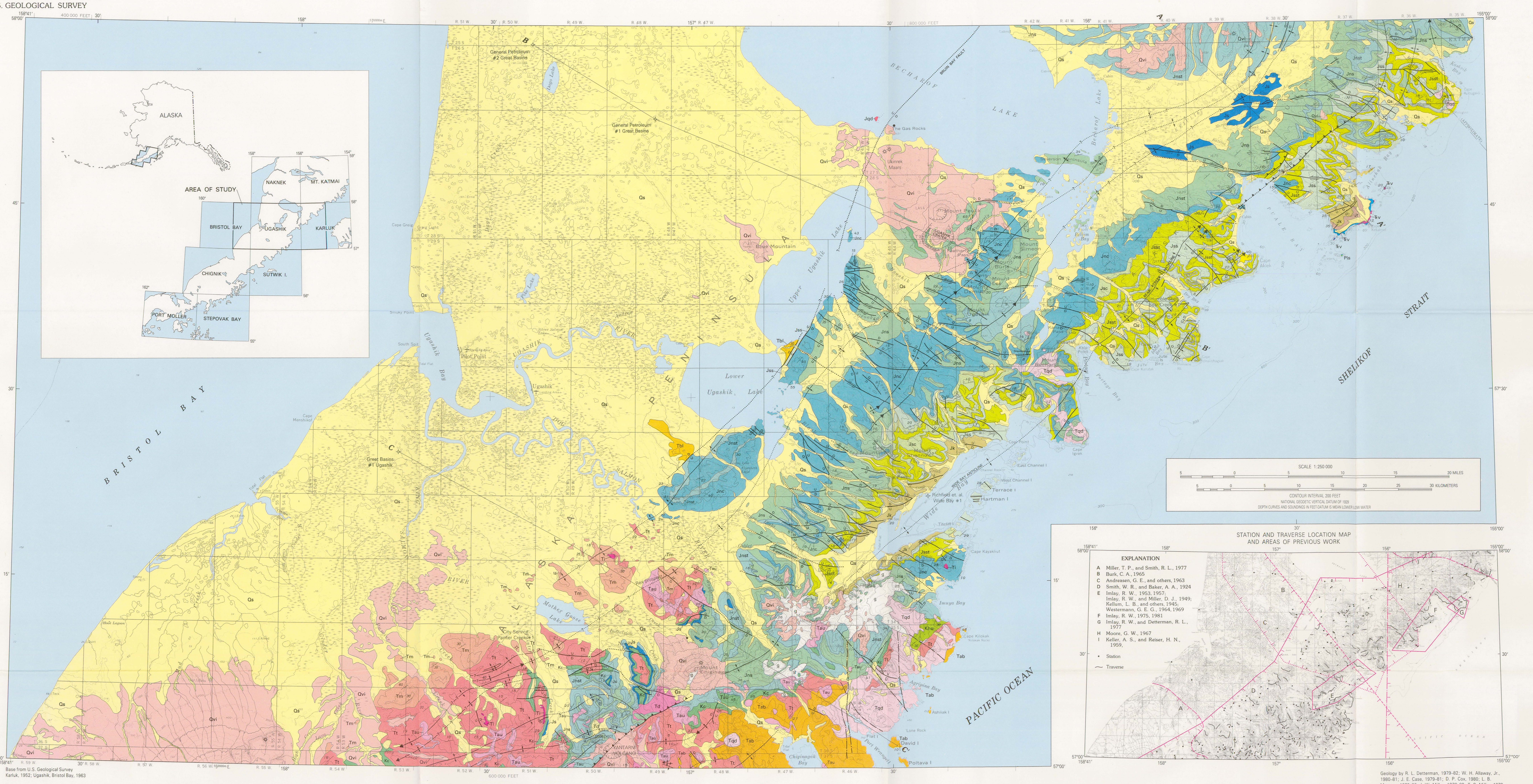
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-1685



INTRODUCTION

Geologic mapping of the Ugashik, Bristol Bay, and western part of Karluk 1° by 2° quadrangles, Alaska Peninsula, was conducted as part of the Alaska Mineral Resource Assessment Program (AMRAP). Geologic observations were made at 1,408 localities, including both spot locality and extended foot-traverses. Data for areas between points of surface observation were obtained from interpretation of vertical aerial photographs. Helicopter-supported investigation was conducted from a field camp at Painter Creek airstrip in 1979 and 1982, and from the U.S. Geological Survey Research Vessel *Don J. Miller II* in 1980 and 1981. Subsurface data from boreholes (Brockway and others, 1975) were used to extend cross sections into the Nushagak-Bristol Bay Lowland, which is mantled with unconsolidated surficial materials. Landsat and side-looking radar imagery were used to aid in structural interpretation.

In addition to field mapping, each author was responsible for a particular part of the project. Individual responsibilities were as follows: R. L. Detterman, stratigraphy and depositional environments of sedimentary rocks, surficial geology, and mineral resource evaluation; J. E. Case, aeromagnetic interpretation and stratigraphy; F. H. Wilson, geochronology of igneous rocks and timing of mineralization; M. E. Yount, petrology and stratigraphy of volcanic rocks. In addition, T. P. Miller and James Riehle contributed significantly to mapping of Quaternary volcanic rocks, and J. W. Miller and R. W. Imlay identified many paleontologic specimens and contributed valuable data on paleoenvironments of the sedimentary rocks.

GEOLOGIC SUMMARY

The Ugashik, Bristol Bay, and western part of the Karluk quadrangles contain a record of late Paleozoic to Holocene sedimentation and igneous activity along a contemporaneously active volcanic arc at a plate boundary. Late Paleozoic (Permian) shelf-carbonate deposition continued into the Mesozoic with minor interbedded clastic and volcanic deposits laid down during the Triassic. Igneous activity along the Mesozoic arc (Reed and Lanphere, 1969) culminated during the Jurassic with the emplacement of the Alaska-Aleutian Range batholith, only a small part of which is exposed in the study area. Volcanism associated with the emplacement of the batholith is preserved as tuff and agglomerate interbedded with limestone in shallow-marine deposits of the Early Jurassic age.

Deposition during the remainder of the Mesozoic records a gradual filling of the Jurassic fore-arc basin, starting with Middle Jurassic submarine-fan turbidites, supplied mainly from a volcanic provenance, and ending with Upper Jurassic shallow-water shelf and nonmarine sediments, supplied mainly from the Alaska-Aleutian Range batholith. The depositional basin was differentially uplifted and eroded during most of the Cretaceous. A minor marine transgression near the end of the Cretaceous deposited a thin sequence of shallow-water clastic rocks derived locally from the reworking of eroded Jurassic sedimentary and igneous rocks.

The study area was again uplifted and eroded during early Tertiary time and detritus was deposited in the southern part as a thick sequence of fluvial and continental clastic rocks during late Paleocene and early Eocene time. A massive outpouring of basaltic and andesitic volcanic rocks (Meshik Formation) in the late Eocene and early Oligocene initiated a volcanic arc (Meshik arc), which lasted into early Miocene time. In the late Miocene, renewed volcanism initiated the modern volcanic arc. Subsequent erosion has exposed the intrusive cores of many of the volcanic centers of both the Meshik arc and the early Mesozoic arc. Sulfide mineralization accompanied magmatic activity at some of the centers. Episodic volcanic activity continued in the study area into historic time; the most recent eruptions occurred in 1977 at Ukinrek Maars; fumaroles are active on Mount Chiginagak. Six Holocene volcanic edifices are entirely, or partly, formed within the study area; two have had caldera-forming eruptions, Ugashik and just south of the study area, Aniakchak. The Aniakchak eruption occurred about 3,300 years B.P. (Miller and Smith, 1977).

Late Tertiary fluvial to shallow-water marine deposition, preserved mainly in the subsurface of the Nushagak-Bristol Bay Lowland (Brockway and others, 1975), reworked the products of the volcanic activity. Pleistocene glaciers mantled the study area on at least three occasions, leaving thick drift deposits mainly of volcanic rocks on the Nushagak-Bristol Bay Lowland. Detailed mapping of Quaternary units is being compiled.

The map units are, for the most part, the same units used in the adjoining Chignik and Sutwik Island 1° by 1° quadrangles to the south (Detterman and others, 1981a). Additional units near Puale Bay include middle Permian limestone (Pls), Triassic limestone (Ŧls) and volcanic rocks (Ŧv), Lower Jurassic volcaniclastic rocks (Talkeetna Formation), and Lower and Middle Jurassic clastic rocks (Kialagvik Formation).

SUMMARY OF STRATIGRAPHY

Permian limestone (unit Pls) is exposed on one island at the mouth of Puale Bay, along a major fault just offshore as determined from a marine seismic profile (Fisher and Detterman, unpub. data, 1983). The exposures are too limited and too poor to afford a correlation with other Permian rocks in southern Alaska. Upper Triassic limestone (unit Ŧls) and volcanic rocks (unit Ŧv) exposed at the mouth of Puale Bay are age equivalent to the Kamishak Formation of the Cook Inlet area 225 km to the northeast (Detterman and Reed, 1980), but lithologically and faunally are considerably different. Consequently, the term Kamishak Formation is not applicable to the Triassic rocks at Puale Bay.

Lower Jurassic volcaniclstic sedimentary and volcanic rocks (unit Jt) are lithologically similar to the same age rocks in the Talkeetna Mountains 645 km to the northeast (Martin, 1926) and Cook Inlet (Detterman and Hartsock, 1966), so the Talkeetna Formation is here extended into the Puale Bay area where these rocks are exposed on the peninsula between Puale and Alinchak Bays.

Graywacke, mudstone, and siltstone exposed at Wide (Kialagvik) Bay were named the Kialagvik Formation by Capps (1923, p. 91–94). These rocks are similar to the lower part of the Tuxedni Group in the Cook Inlet area (Detterman and Hartsock, 1966). However, the Kialagvik Formation is well established in the Alaska Peninsula literature, and therefore the name is retained here.

The Shelikof and Naknek Formations comprise a major part of the bedrock exposures in the study area. Both formations exhibit rapid facies changes across the area, and in order to show these changes the two formationa are each informally divided into conglomerate, sandstone, and siltstone members. The contacts between the members are generally sharp, but locally the contacts are gradational and have been placed arbitrarily with the dominant lithology. Coarse clastic rocks in the Shelikof are mainly the result of submarine fan deposition, whereas in the Naknek Formation coarse clastic rocks generally represent fluvial deposits.

Thin-bedded fine-grained brown sandstone and siltstone are mapped as the Staniukovich Formation. Although deposition was essentially continuous between the Naknek and Staniukovich Formations, there are compositional and color differences which distinguish the two units. Indeed, future detailed stratigraphic studies may show that the Staniukovich is best considered as a member of the Naknek Formation.

The Chignik Formation and the undivided Hoodoo and Chignik Formations crop out mainly in the southern part of the study area where they unconformably overlie the Staniukovich and Naknek Formations. Farther north they have been removed by erosion prior to deposition of the Tolstoi Formation, so a direct correlation cannot be made with the Kaguyak Formation (Keller and Reiser, 1959) in the Katmai area. Lithologically the shallow-water deposits of mudstone, siltstone, and calcareous brown sandstone in the Ugashik-Karluk map area more closely resembles the Chignik Formation exposed to the south rather than age equivalent deep-water turbidite deposits of thick-bedded sandstone and shale of the Kaguyak Formation exposed in the Katmai area.

Thick-bedded continental sandstone and conglomerate with interbedded siltstone, coal, and tuff are mapped as the Tolstoi Formation. The Tolstoi Formation is exposed only in the southern part of the study area and is a continuation of more extensive outcrops to the south. Exposures south of the study area contain a late Paleocene and early Eocene megaflora (Detterman and others, 1981b), whereas rocks in the Ugashik-Karluk study area have only an early Eocene megaflora (J. A. Wolfe, written commun., 1982), indicating a progressive northward onlap of sedimentation during Tolstoi time.

A major episode of volcanism and associated hypabyssal intrusions was initated on the Alaska Peninsula in late Eocene time and continued throughout the Oligocene. The bedded extrusive rocks, mainly andesite and basalt, are mapped asa the Meshik Formation. Potassium-argon ages for the extrusive rocks, as well as the hypabyssal porphyritic hornblende andesite (unit Tau) range between 37 and 25 m.y. (Wilson, 1982). Igneous activity resumed in the late Miocene with emplacement of quartz diorite (unit Tqd) composing the Agripina Bay batholith, small dacite plugs (unit Tid), an associated extrusive andesite and basalt (unit Tab). The latter unit probably includes rocks of other compositions as well as andesite and basalt and is dated by the K-Ar method at 9.25 m.y. (Wilson and others, 1981).

Minor sedimentary rocks of late Tertiary (Miocene) age are exposed aong faults in the Ugashik Lakes area. These surface exposures of the Bear Lake Formation are remnants of more extensive deposits present in the subsurface of the Bristol Bay coastal plain (Brockway and others, 1975).

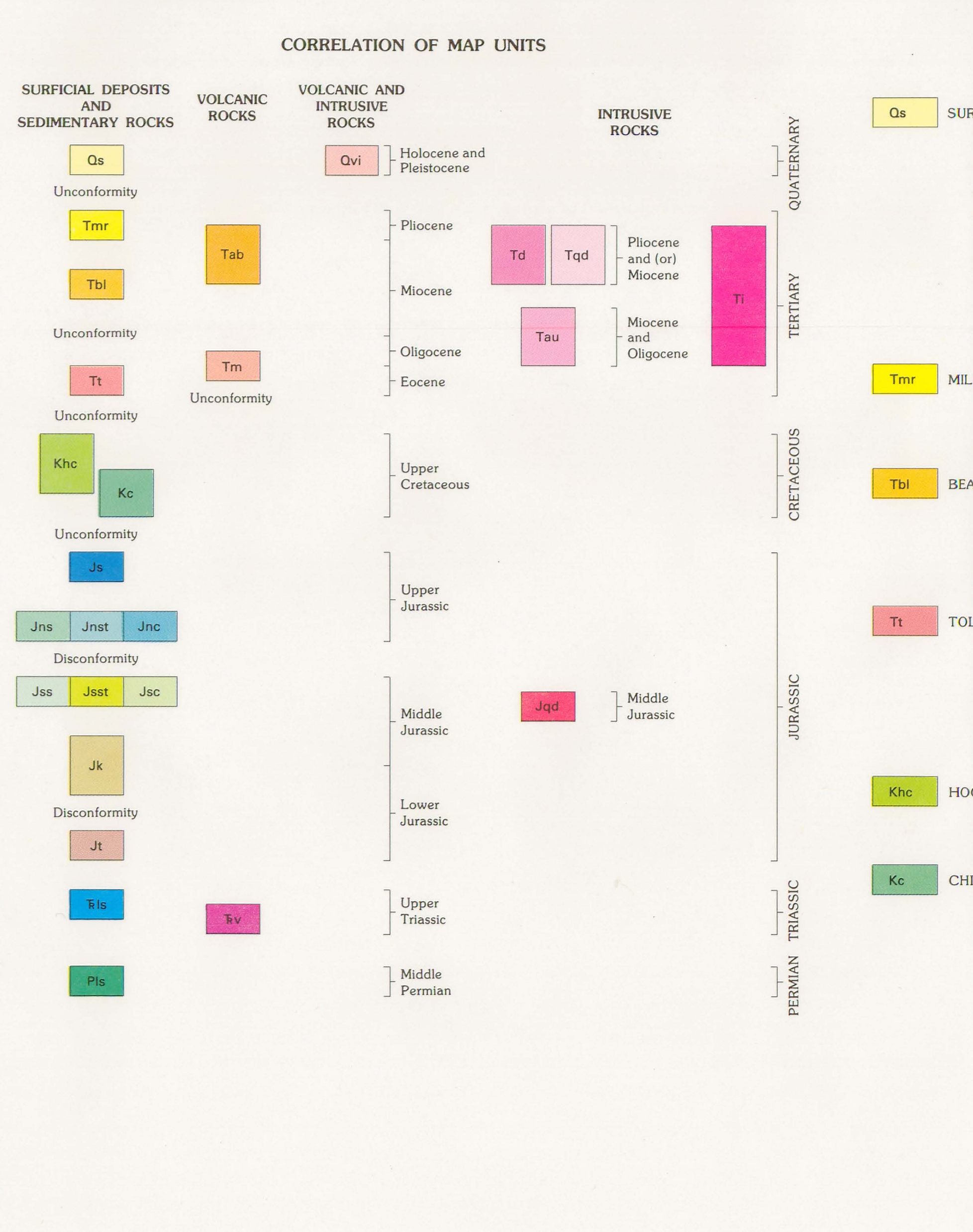
Quaternary volcanism along the Aleutian volcanic arc is particularly evident in the Ugashik-Karluk area with deposits from Aniakchak Crater, Yantarni Volcano, Mount Chiginagak, Mount Kialagvik, Ugashik crater, Mount Peulik, and an unnamed volcanic center north of Becharof Lake covering a large part of the study area. In addition, the eroded cores of two Pleistocene centers are found at Blue Mountain and The Gas Rocks. Porphyritic hornblende andesite at Blue Mountain yields a discordant K-Ar age of 1.66 and 0.55 m.y., and a pyroxene andesite flow from Mount Kialagvik yields a 0.90 m.y. age (Wilson, 1982). A biotite-hornblende dacite from The Gas Rocks is tentatively dated at 0.13 and 0.61 m.y., and and andesite from Yantarni at 0.55 and 0.68 m.y. Major caldera-forming eruptions have occurred at Ugashik and Aniakchak volcanoes. The caldera-forming eruption at Aniakchak occurred about 3,300 years B.P. (Miller and Smith, 1977), and the volcano has erupted numerous times since. Volcanism at Ugashik crater is undated. The most recent volcanic activity was the formation of the Ukinrek Maars in 1977. Other evidence for continued volcanism is the constant plume of steam from Mount Chiginagak.

STRUCTURE

The Wide Bay-Bear Creek anticline is the major anticlinal structure in the study area. Southwest of Mount Chiginagak the anticline is a thrust fault that continues southwest toward Aniakchak Crater (Detterman and others, 1981a). Subsidiary anticlines and synclines north of the fault zone, near the south boundary of the map, bend sharply toward the thrust fault, indicating a northeast right-lateral strike-slip component. The anticline is also thrust faulted northeast of Puale Bay.

The Bruin Bay fault, a major structural feature in southwestern Alaska, can be mapped for 530 km from Mount Susitna, near Anchorage, to the south shore of Becharof Lake. Quaternary volcanic rocks and glacial deposits mantle the fault trace south of Becharof Lake. However, an aeromagnetic survey (U.S. Geological Survey, unpub. data, 1984) suggests that the fault continues southwest in the subsurface toward Aniakchak Crater. Along much of its length, the fault juxtaposes Jurassic granitic rocks of the Alaska-Aleutian Range batholith against upper Mesozoic sedimentary rocks. The batholith was the source provenance for many of these upper Mesozoic sedimentary rocks. Granitic clasts, some as much as 2.5 m in diameter, are found in the Naknek Formation south of Lower Ugashik Lake. These clasts yield K-Ar ages of 152 to 161 m.y. (Wilson, 1982) and their size indicates a nearby source terrain in the batholith. The batholithic source terrain is now buried below upper Tertiary sedimentary rocks on the coastal plain, suggesting a change in movement along the fault; the west side of the fault north of Becharof Lake is upthrown, whereas south of the lake it is downdropped.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS

Qs SURFICIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)—Unconsolidated, poorly to well-sorted, poorly to moderately well stratified deposits; consists predominantly of alluvial, colluvial, glacial, marine, lacustrine, eolian, and swamp deposits. Also, locally includes reworked volcanic debris, as well as block and ash flows. Alluvial deposits range from coarse subangular rock fragments to fine sand and silt. Colluvial deposits consist of landslides and talus cones composed of coarse angular rubble and solifluction deposits of weakly stratified silty rock debris and stony organic silt. Glacial deposits are poorly sorted nonstratified drift, forming terminal, lateral, and ground moraines; moderately well sorted stratified ice-contact and outwash deposits. Marine deposits consist of moderately stratified, sorted sand and gravel on beaches and on wave-cut scarps at several elevations; mud and silt in estuaries. Lacustrine deposits are mainly fine sand and silt. Eolian deposits form dunes of sand and pumice as high as 10 m. Swamp deposits consist mainly of organic silt, clay, and peat

Tmr MILKY RIVER FORMATION (PLIOCENE)—Present only in surbsurface (sections *B–B′, C–C′*) in study area (Brockway and others, 1975). Mainly volcaniclastic sandstone with volcanic-pebble conglomerate in upper and lower parts; minor tuffaceous siltstone and ash beds. Mainly of marine origin with mollusks locally abundant; approximately 790 m thick in Great Basins #1 Ugashik well

Tbl BEAR LAKE FORMATION (MIOCENE)—Mainly nonmarine poorly consolidated sandstone, siltstone, conglomerate, and lignite. Rocks weather pale yellowish brown. Well-rounded conglomerate clasts consist of chert, quartz, volcanic, and sedimentary rocks. Unit is less than 100 m thick where exposed along faults near Upper and Lower Ugashik Lakes, but more than 1,250 m thick in surbsurface. Unconformably overlies the Meshik and Tolstoi Formations. Unit is considered middle(?) and late Miocene in the report area

Tt TOLSTOI FORMATION (EOCENE)—Unit exposed only in the southern part of the mapped area and is at least 1,000 m thick; consists of nonmarine sandstone, siltstone, conglomerate, mudstone, coal, tuff, and lapilli tuff. Well-rounded conglomerate clasts consist mainly of volcanic rock with about 25 percent chert and quartz; a "blue-pebble" conglomerate near top composed of pebbles as large as 2 cm in diameter. Coal and carbonaceous shale mainly in upper part contains abundant plant megafossils and petrified logs. Plant fossils indicate an early Eocene age for the unit in mapped area (J. A. Wolfe, written commun., 1982). Unconformably overlies the Chignik Formation with orange-colored erosion surface

Khc HOODOO AND CHIGNIK FORMATIONS, UNDIVIDED (UPPER CRETACEOUS)—Poorly exposed dark siltstone and sandstone mapped near Imuya Bay. Contains sparse marine megafauna (*Inoceramus* and ammonites). Rocks silicified and hornfelsed by intrusion of the Agripina Bay batholith

Kc CHIGNIK FORMATION (UPPER CRETACEOUS)—Dark-yellowish-brown siltstone, shale, mudstone, and thin sandstone with abundant limestone concretions in upper part. Marine deltaic to lagoonal sequence 55 to 100 m thick. Abundantly fossiliferous, mainly ammonites and *Inoceramus* indicating a Campanian to early Maestrichtian (Late Cretaceous) age (J. W. Miller, written commun., 1982). Correlative, in part, with the Kaguyak Formation (Keller and Reiser, 1959) in the adjoining Mount Katmai area. Unconformably overlies the Staniukovich and Naknek Formations with orange-weathered erosion surface

Js STANIUKOVICH FORMATION (UPPER JURASSIC)—Thin-bedded, fine-grained, light- to medium-brown feldspathic sandstone, as much as 165 m thick. Minor tuffaceous material in upper part. Exposed mainly in southern part of study area, locally along syncline east of Becharof Lake; elsewhere removed by erosion prior to deposition of the Chignik Formation. Contains abundant *Buchia blandfordiana* indicative of a Tithonian (Late Jurassic) age (J. W. Miller, written commun., 1982). Gradationally overlies the Naknek Formation. Age of unit in study area is Late Jurassic

NAKNEK FORMATION (UPPER JURASSIC)—In this study area, divided into:

Jns Sandstone member—Upper part mainly thin-bedded, fine-grained, olive-brown, shelf- to inner-neritic sandstone as much as 759 m thick. Lower part mainly massive to thick-bedded medium- to coarse-grained arkosic nonmarine fluvial sandstone, commonly laminated with magnetite grains; as much as 1,000 m thick. Abundant *Buchia mosquensis* and *B. rugosa* in upper part indicative of a late Oxfordian to Kimmeridgian (Late Jurassic) age (J. W. Miller, written commun., 1982); plant debris present in lower part. Contains a few ammonites. Locally, includes thin siltstone and conglomerate beds

Jnst Siltstone member—Medium- to dark-olive-gray, slightly calcareous to siliceous and micaceous siltstone with nodules, concretions, and thin lenticular limestone beds; thin bedded to fissile. Forms middle to locally upper parts of formation. Commonly 300 to 700 m thick; contains a few ammonites and *Buchia concentrica* indicative of an Oxfordian (Late Jurassic) age (J. W. Miller, written commun., 1982)

Jnc Conglomerate member—Mainly massive to thick-bedded cobble-boulder conglomerate with clasts as large as 2 m in diameter; clasts mostly well rounded, mainly composed of granitic rocks; locally includes as much as 20 percent metamorphic and volcanic rocks. Commonly includes thick units of coarse arkosic sandstone, rarely intercalated with thin beds of siltstone; deposited primarily in a fluvial environment. Locally forms base of formation and disconformably overlies the Shelikof Formation; elsewhere overlies sandstone at base of formation

SHELIKOF FORMATION (MIDDLE JURASSIC)—In this study area, divided into:

Jss Sandstone member—Massive to thick-bedded, medium- to coarse-grained, dark-green to gray volcanogenic sandstone containing abundant magnetite grains; commonly contains beds of grit and small pebbles. Sandstone northwest of Wide Bay deposited in shallow water with abundant plant debris and pelecypod *Corbicula* sp.; southeastward across Wide Bay sandstone was deposited as submarine fans with graded beds, flute and load casts, and flame structures

Jsst Siltstone member—Dark-grayish-olive-green to dusky-yellow-green, thin-bedded siltstone. Numerous 1- to 3-cm-thick beds of limestone and abundant concretions of brown fine-grained limestone in lower part of section. Thin sandstone beds in upper part of section. Siltstone is siliceous with metallic luster on weathered surface. Contains moderately abundant ammonites, mainly *Cadoceras* sp. and *Pseudocadoceras* sp., indicative of a Callovian (Middle Jurassic) age (R. W. Imlay, written commun., 1982)

Jsc Conglomerate member—Mainly massive lenticular submarine channel deposits that are present throughout formation. Clasts primarily well-rounded dark volcanic cobbles; locally polymictic with pebble to boulder sized clasts of limestone, sandstone, and occasional granitic rocks

Jk KIALAGVIK FORMATION (MIDDLE AND LOWER JURASSIC)—Olive-gray to green medium-bedded fine- to medium-grained graywacke, mudstone, siltstone, and shale, approximately 790 m thick; locally contains lenses of volcanic pebble conglomerate; plant debris and carbonaceous material common throughout; abundantly fossiliferous with ammonites and pelecypods indicative of a Toarcian (late Early Jurassic) to middle Bajocian (Middle Jurassic) age (R. W. Imlay, written commun., 1982). Disconformably overlies the Talkeetna Formation. Formation named by Capps (1923, p. 91–94) for exposures at Wide (Kialagvik) Bay

Jt TALKEETNA FORMATION (LOWER JURASSIC)—Lower part mainly thin gray tuffaceous limestone, tuff, and dark siliceous shale approximately 170 m thick; upper part thin to massive tuffaceous gray sandstone with minor siltstone and shale interbeds approximately 240 m thick. Exposed only on peninsula between Puale Bay and Alinchak Bay. Ammonites indicate an early Hettangian (early Early Jurassic) age and late Sinemurian to Toarcian (late Early Jurassic) age (R. W. Imlay, written commun., 1982). Conformably overlies the Upper Triassic limestone unit. Named by Martin (1926, p. 218–219) for exposures in Talkeetna Muntains 645 km to the northwest

Ŧls LIMESTONE (UPPER TRIASSIC)—Medium- to thick-bedded, dark-gray limestone, weathers light gray; thin to shaly bedded light-tan limestone; locally contains massive chert-pebble and limestone-cobble conglomerate cemented by limestone. Interbedded with basalt flows, volcanic rubble flows, and agglomerate of the Upper Triassic volcanic rocks of unit (Ŧv). Unit approximately 795 m thick. Locally abundant pelecypods and ammonites indicate a Norian (Late Triassic) age (N. J. Silberling, written commun., 1981). Contact with the underlying middle Permian limestone unit (Pls) is not exposed. Exposed between Puale Bay and Alinchak Bay

Pls LIMESTONE (MIDDLE PERMIAN)—Massive light-gray crystalline limestone with chert nodules; approximately 40 m thick. Contains middle Permian brachiopods (Hanson, 1957). Exposed only on one island at mouth of Puale Bay

VOLCANIC ROCKS

Tab ANDESITE AND BASALT (PLIOCENE AND MIOCENE)—Exposed on southeast side of Alaska Peninsula around Chiginagak Bay. Dark-greenish-gray to black porphyritic volcanic rocks; composed of clinopyroxene, orthopyroxene, plagioclase, and hornblende phenocrysts in a holocrystalline to hyalophitic groundmass. Individual flow units as much as 15 m thick, locally columnar jointed; interbedded lithic tuff and volcanic breccia. Locally altered and silicified on Ashiilak, David, and Poltava Islands. Associated with volcanic plugs of the undifferentiated andesite unit (Tau), one of which has been dated by K-Ar method at 9.25 m.y. (whole-rock sample 77AWs9 of Wilson and others, 1981)

Tm MESHIK FORMATION (OLIGOCENE AND EOCENE)—Exposed in southwestern part of study area and known in subsurface from drill-hole data. Coarse volcanic-rubble flows, lahars, lithic tuff, lava flows, and minor volcanogenic sedimentary rocks; mainly flow banded basalt and basaltic andesite, commonly porphyritic and amygdaloidal with abundant zeolite minerals; red oxidized zones between individual flow units are common. Whole-rock K-Ar ages of 24.9 to 39 m.y. (Wilson, 1982; Brockway and others, 1975). Unconformably overlies the Tolstoi Formation

Ŧv VOLCANIC ROCKS (UPPER TRIASSIC)—Columnar-jointed basalt flows, volcanic breccia and agglomerate. Basalt yields K-Ar age of 197 m.y. Pillow structures locally in basalt flows. Also includes dikes and sills. Basalt flows are interbedded with the Upper Triassic limestone unit (Ŧls)

VOLCANIC AND INTRUSIVE ROCKS

Qvi VOLCANIC AND SHALLOW INTRUSIVE ROCKS (HOLOCENE AND PLEISTOCENE)—Basaltic andesite to dacite lava flows and volcaniclastic deposits; includes air-flow tuffs, volcanic domes, block and ash-flow deposits, ash-flow tuffs, volcanic-rubble flows, debris flows, and hot-blast avalanche deposits. Clastic units typically unsorted to poorly sorted and poorly stratified

INTRUSIVE ROCKS

Td DACITE (PLIOCENE AND (OR) MIOCENE)—Includes several hypabyssal bodies on the south boundary of the mapped area, a quartz-plagioclase felsite sill near the head of Painter Creek, a quartz-plagioclase felsite body southwest of Mount Chiginagak, and porphyritic biotite-quartz dacite dikes near the Mike prospect. Sericitic alteration is common and especially pronounced in the felsite. A K-Ar age determination on hornblende in a sample of dacite from the Sutwik Island quadrangle immediately south of the mapped area indicates a minimum age of 19.3 m.y. (sample 78AWs11, Wilson and others, 1981). K-Ar ages on biotite and plagioclase from biotite-quartz dacite are 3.48 and 3.42 m.y., respectively (Wilson, 1982)

Tqd QUARTZ DIORITE (PLIOCENE AND (OR) MIOCENE)—Main exposures of the unit are the Agripina Bay batholith and a small stock west of the head of Chiginagak Bay. Rock types composing unit consists of quartz diorite, quartz monzodiorite, granodiorite (low in quartz), and quartz monzonite; fine to medium-grained hypidiomorphic granular; orthopyroxene and clinopyroxene are common, biotite is ubiquitous though minor, hornblende is sparse; chloritization is irregularly developed. A hornfels zone is well developed in the sedimentary and volcanic rocks around the batholith. K-Ar age determinations on rock samples from the Agripina Bay batholith yield a minimum age of 2.5 to 3.2 m.y. Unit also includes several small stocks near Cape Kubugakli and plutons and stocks in the area between Wide Bay and Portage Bay; all these bodies are mostly composed of medium-grained hypidiomorphic granular biotite-bearing hornblende quartz diorite, but also include a dark fine-grained diorite facies. A sample from Mount Becharof near Portage Bay yielded a K-Ar age of 2.3 to 2.88 m.y.

Tau ANDESITE, UNDIVIDED (MIOCENE AND OLIGOCENE)—Hypabyssal hornblende andesite exposed in southern third of study area, mainly as small plugs and stocks. Fine to medium grained; sparse biotite. Porpylitic alteration and disseminated pyrite common. Whole-rock and hornblende K-Ar ages range from 9.25 to 35.2 m.y. (Wilson, 1982; Wilson and others, 1981)

Ti INTRUSIVE ROCKS, UNDIVIDED (TERTIARY)—Small plugs, stocks, dikes, and sills

Jqd GRANODIORITE (MIDDLE JURASSIC)—Medium to coarse grained, hypidiomorphic granular granodiorite. K-Ar determinations on hornblende and biotite give ages of 172 and 176 m.y., respectively (Reed and Lanphere, 1969)

CONTACT—Dotted where concealed

FAULT—Dotted where concealed; queried where probable. U, upthrown side; D, downthrown side. Arrows indicate direction of relative movement

THRUST OR HIGH-ANGLE REVERSE FAULT—Dotted where concealed. Sawteeth on upper plate

FOLDS—Showing trace of axial plane. Dashed where approximately located; dotted where concealed; queried where uncertain. Arrows indicate direction of plunge

Anticline

Syncline

LINEAMENT

STRIKE AND DIP OF BEDS OR FLOWS

Horizontal

26 Inclined

VOLCANIC CRATER

VOLCANIC VENT OR CINDER CONE

EXPLORATORY DRILL HOLE

OIL SEEP

GAS SEEP

HOT SPRING

COLD SPRING

GLACIER

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

By
R. L. Detterman, J. E. Case, F. H. Wilson, and M. E. Yount

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