DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-407

Base by U.S. Geological Survey, 1924-49

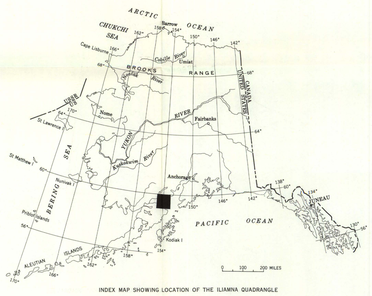
SCALE 1:250 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

CONTOUR INTERVAL 200 AND 1000 FEET
DATUM IS MEAN SEA LEVEL

Geology by J. K. Hartsock and Arthur Grantz 1951–54,
R. L. Detterman and D. W. Hinckley, 1958, R. L. Detterman and
Roger Hope, 1961 and by R. L. Reed and S. D. McDowell, 1962
Geology of Iniskin and Chinitna Bays area by C. L. Kirschner and
D. L. Minard (1949, U.S. Geol. Survey Oil and Gas Inv. Map OM-95),
J. K. Hartsock (1954, U.S. Geol. Survey open-file map)



INDEX MAP SHOWING LOCATION OF THE ILIAMNA QUADRANGLE

RESULTS OF SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS OF MINERAL-BEARING SAMPLES COLLECTED 1961 AND 1962

(Specimens represent grab samples except for 62M-110, 111, 112, and 113, which are stream sediment concentrates)

Sample No.	Si	Al	Fe	Mg	Ca	Na	K	Ti	Mn	Ba	Cd	Co	Cr	Cu	Ga	Mo	Ni	Pb	Sc	Sn	Sr	V	Y	Yb	Zn	Zr
110	M	M	5.0	1.0	2.0	2.0	1.5	0.5	0.15	0.07	0	0.001	0.003	0.002	0.0015	0	0.001	0	0.0015	0	0.1	0.015	0.002	0.0002	0	0.01
111	M	M	5.0	2.0	2.0	2.0	1.5	.7	.15	.07	0	.0015	.005	.003	.002	0	.002	.001	.002	0	.1	.015	.002	.0003	0	.007
112	M	M	7.0	3.0	2.0	1.0	1.0	.02	.15	.05	0	.002	.007	.002	.002	0	.003	.0015	.003	0	.07	.02	.003	.0003	0	.015
113	M	M	7.0	5.0	3.0	2.0	0	1.0	.15	.03	0	.0015	.002	.002	.002	0	.0015	0	.002	0	.07	.015	.003	.0003	0	.01
114	M	5.0	M	3.0	M	.1	0	.7	.2	.005	0	.01	.005	.07	.0015	0	.007	0	.002	.0015	.02	.015	.003	.0005	0	.005
115	M	M	M	5.0	3.0	1.5	0	1.0	.2	.02	0	.002	.0007	.007	.002	0	.0008	0	.005	.0007	.02	.05	.003	.0005	0	.007
116	M	M	7.0	3.0	1.0	5.0	1.0	1.5	.15	.02	0	0	.0003	.01	.002	0	0	0	.003	0	.03	.02	.005	.0005	0	.02
117	M	7.0	7.0	.5	1.5	2.0	1.5	.5	.05	.02	0	0	.0015	.01	.0015	0	.001	0	.0007	0	.03	.005	.001	.0002	0	.005
118	M	7.0	3.0	.2	.03	.5	3.0	.07	.005	.05	0	0	.0015	.01	.0015	0	.0007	0	0	.0015	0	.002	.001	.0003	0	.01
119	M	M	5.0	.3	.5	5.0	0	.3	.05	.01	0	0	.0007	.005	.001	.0007	.0007	0	.001	0	.007	.002	.003	.0003	0	.01
120	M	3.0	M	2.0	M	.7	1.0	.15	1.0	.005	.05	.007	.005	.05	.001	0	.003	.01	.001	.01	.015	.02	.003	.0007	0.0	0
121	M	M	M	M	.15	2.0	3.0	1.0	.5	.015	.03	0	.002	.002	.015	.0015	0	.002	0	.001	0	.03	.003	.007	.001	0	.02
122	M	M	3.0	3.0	1.0	1.5	3.0	1.5	.7	.15	.03	0	.0007	.0015	.015	.0015	0	.0007	0	.002	0	.02	.01	.003	.0005	0	.01
123	M	M	2.0	.7	1.0	2.0	3.0	.3	.015	.02	0	.0002	.0015	.015	.0015	0	.0007	0	.0007	.002	.015	.007	.0015	.0003	0	.02

Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc.; which represent approximate midpoints of group data on a geometric scale. The assigned group for semiquantitative results will include the quantitative value about 30 percent of the time. M, major constituent-greater than 10 percent.

EXPLANATION

Each map unit may include areas of other units too small to be differentiated at scale of map

SURFICIAL DEPOSITS

Qal Alluvium
Stratified silt, sand, and gravel forming flood-plain deposits; commonly terraced at several levels. Includes alluvial fans, talus cones, salt marsh, and lake deposits; may include some glacial outwash and small colluvial and beach deposits

Qb Beach deposits
Elevated beach ridges of several levels; well-sorted, well-drained sand and gravel. May include some terrace deposits and minor alluvium

Qt Terrace deposits
Moderately well-sorted sand and gravel of several terrace levels. May include some beach, outwash, and glacial deposits. At least four terrace levels along the shores of Iliamna Lake

Qc Colluvium
Colluvial and landslide deposits of unsorted fine to coarse rubble; only larger deposits shown

Qg Glacial deposits
Unsorted silt, sand, gravel, and boulders in poorly defined deposits of several glacial advances; may include small areas of outwash, terrace, and alluvial deposits. Thickness ranges from a thin veneer of boulders to more than 100 feet. Deposits at a considerable distance from source and all highly modified. Probably of pre-Wisconsin to early Wisconsin age

Qm Morainal deposits
Well defined terminal, lateral, and recessional moraines consisting of unsorted to poorly stratified sand, gravel, and boulders. At least three advances recognized along Cook Inlet that probably correlate with the Naptowne Glaciation of Wisconsin age, and the Tustumena and Tunnel Stades of the Alaskan Glaciation, of Recent age; two advances recognized near Iliamna Lake

Qo Outwash deposits
Stratified silt, sand, and gravel forming glacial outwash fan plains; may include some terrace deposits and alluvium. Thickness ranges from a few feet to more than 100 feet. Deposits contemporaneous with morainal fronts

UNCONFORMITY

SEDIMENTARY AND VOLCANIC ROCKS

Qvp Volcanic sand and pumice
Chiefly light-colored volcanic sand and andesitic pumice lapilli; includes some ash and volcanic bombs. Deposits may have formed as part of a glowing avalanche. Mapped only on Augustine Island; small deposits elsewhere in quadrangle, but too small to show at scale of map

Qvf Volcanic mud flows
Unsorted volcanic mud flows with large rock fragments resulting from repeated small eruptions. Mapped only on Augustine Island

Qa Andesite
Light-gray hypersthene-augite andesite with phenocrysts of zoned plagioclase, hypersthene, and augite in a pilotaxitic groundmass of andesine; contains minor amounts of hematite and varying amounts of glass. Flows mapped only on Iliamna and Augustine Volcanos

Qd Dacite
Dark-gray to black and dark-reddish gray porphyritic flows containing phenocrysts of orthoclase, plagioclase, quartz, biotite, and hornblende in a glassy matrix. Mapped only on upper slopes and plug-dome summit of Augustine Volcano

UNCONFORMITY

Tba Tuff and flow breccia
Light- to dark-gray, green, and purple lithic tuff, vitric tuff, and flow breccia; includes welded and water-laid tuff and locally tuffaceous sandstone and mudstone. Flow breccia usually dark gray. Tuff and flow breccia at Intricate Bay probably of same age as unit Tba, but considered to be older than upper flows on Lookout Mountain Peninsula

Tba Basalt and andesite
Dark-greenish gray basalt and gray to dark-gray andesite; locally includes minor siliceous flows, tuffaceous sandstone, and breccia flows. Some flows over 75 feet thick with well developed regolith between flows on Lookout Mountain Peninsula. Good columnar jointing in the nearly flat lying flows on Lookout Mountain Peninsula and islands to northwest

Tu Volcanic rocks, undifferentiated
Includes various types of volcanic flow rock, tuff, and breccia with small areas of nearly flat lying tuffaceous sedimentary rock. Intruded by Late Tertiary dikes. In general considered to be older than units Tba and Tt, but probably in part equivalent.
Iliamna and Kakhonak Lakes: mostly dark colored flows and breccia of various composition with gray, yellowish-gray, and green vitric and lithic tuff; includes a few tuffaceous sandstone beds.
Battle Lake: essentially flat lying basalt and andesite; may include some unmetamorphosed flow rock of the Talkeetna Formation. Contact with the Talkeetna Formation poorly exposed or undefinite.
Gibraltar Lake: north and west side of lake essentially flat lying rhyolite flows overlying basalt; some coarse-grained greenish-gray sandstone midway along western shore. East and south side of lake; medium- to dark-gray basalt flows, at least 600 feet thick, which dip gently westward and overlie acidic flows and tuff at south end of lake; includes small area of boulder conglomerate and agglomerate along east side of lake, south of Jurassic intrusive

Tg Granodiorite
Light-gray, fine-grained hornblende granodiorite. Of known late Tertiary age only on Flat Island. Similar small, medium- to fine-grained quartz diorite to diorite intrusives at Kakhonak Bay and Gibraltar Lake of questionable Tertiary age

Ts Sandstone and siltstone
Predominantly yellow to olive-gray sandstone, tuffaceous sandstone, and siltstone; local conglomeratic sandstone lenses. On south shore of Iliamna Lake, fine to coarse grained, thin to thick bedded in lenticular units cut by basaltic dikes and containing carbonized wood fragments. Rocks considered to be of nonmarine origin

Tr Siliceous and intermediate flows
Light-colored siliceous flows predominantly rhyolite, but including trachite, latite, quartz latite, and possibly some dacite; local areas of flow breccia and lithic tuff shown by symbol. Dikes of a composition similar to the flows intrude the rocks on Flat and Porcupine Islands

UNCONFORMITY

Kc Conglomerate
Well rounded pebble- to cobble-conglomerate; constituents are predominantly dark-gray, green, and red volcanic rocks probably derived from the Talkeetna Formation; with few granitic clasts. Local lenses of coarse-grained sandstone. North of Kakhonak Lake the conglomerate is locally ferruginous. May be equivalent, in part, to Chisik Member of Naknek Formation

Jn Naknek Formation
Upper part; massive light-gray arkose and arkosic conglomerate.
Middle part; thin-bedded to massive brownish-gray siltstone, laminated near base.
Chisik Conglomerate Member at base; cobble-boulder conglomerate, constituents well-rounded, approximately 40 percent granitic rocks, 40 percent volcanic rocks from Talkeetna Formation, and 20 percent intraformational sedimentary rocks.
Fine-grained rocks contain fauna of Late Jurassic (Oxfordian and Kimmeridgian) age

LOCAL UNCONFORMITY

Jc Chinitna Formation
Massive to thin-bedded grey to brownish-gray arenaceous siltstone; weathers reddish brown in lower part and gray in upper part. Small limestone concretions in parallel bands in lower part and large, randomly spaced limestone concretions in upper part. Sandstone interval between upper and lower parts. Abundant ammonite fauna of Late Jurassic (Callovian) age

Jt Tuxedni Group
Massive to thin-bedded feldspathic graywacke, lithic graywacke, pebble-cobble conglomerate, siltstone, and shale. Units of dominantly coarse clastics alternate with siltstone and shale. Sandstone and graywacke dark greenish gray in lower part, mottled green and white in middle (Cynthia Falls Sandstone), and light gray to gray in upper part. Conglomerate constituents well-rounded and nearly all volcanic rocks from the Talkeetna Formation (less than 5 percent granitic rocks). Abundant limestone concretions and volcanic ash beds in siltstone and shale units.
Unconformities present at contact with Talkeetna Formation and near the top (at base of Bowser Formation); local unconformities present between thick units of coarse and fine clastics. The rocks are abundantly fossiliferous with an ammonite and pelecypod fauna of Middle and Late Jurassic (Bajocian and Callovian) age

Identified only in areas east of Bruin Bay fault

UNCONFORMITY

JTk Talkeetna Formation
Upper part; mainly white, tan, red, green, purple, and mottled tuff interbedded with tuffaceous sandstone.
Middle part; mostly pink agglomerate, lapilli tuff, and porphyritic andesite flows with minor volcanic breccia, tuffaceous sandstone, and argillite.
Lower part; massive green to dark-green volcanic breccia, bedded lithic tuff and vitric tuff, massive agglomerate, and thick aphanitic lava flows that are locally porphyritic.
Low- to high-grade metamorphism near contact with Aleutian Range batholith; rocks locally altered to greenstone, argillite, quartzite, and schist near Marsh Creek

UNCONFORMITY(?)

Rk Kamishak Formation
White to dark-gray and black limestone, dark-gray to black calcareous shale, and black, green, and white chert. Limestone locally altered to white pyritiferous marble, and chert to greenish-gray metachert near contact with pluton; some mineralized rock present near contact with intrusive. Rocks locally fossiliferous containing an Upper Triassic fauna; echinoid- and coral-reef limestone present at Bruin Bay.
Ursus Cove; mainly dark-gray to black calcareous shale with interbeds of black limestone and chert.
Bruin Bay; black, green, and white chert thin-bedded and highly folded at entrance to bay; dark-gray limestone at southeast end of bay, and black shale and limestone on north side.
Kakhonak Bay; highly folded green and white chert

INTRUSIVE ROCKS

Jgd Granodiorite
Chiefly medium- to coarse-grained biotite-hornblende granodiorite, hornblende-biotite granodiorite, and hornblende granodiorite; includes some quartz diorite, quartz monzonite, granite, and dikes of aplite and monzonite. Locally foliated near intrusive contact with older rocks, xenoliths common near contacts; highly fractured on Porcupine and Flat Islands and recemented by Tertiary volcanic rocks; cut by numerous Tertiary dikes.
A potassium-argon date of 156 million years on biotite from Pile Bay, Iliamna Lake and of 159 million years at Iliamna Bay is not inconsistent with stratigraphic evidence which indicates an early Middle Jurassic age for the intrusion

Jqd Quartz diorite
Chiefly medium- to coarse-grained biotite-hornblende quartz diorite and hornblende quartz diorite; includes some granodiorite and granite. Locally well foliated near intrusive contacts, especially near Kakhonak Lake. Cut by dikes of Tertiary age

METAMORPHIC ROCKS

Mg Greenstone
Dark-green, massive with local schistose and hornfelsic texture; irregular fractures commonly filled with epidote. Consists mainly of amphibole and chlorite with minor amounts of quartz and feldspar. Considered to have been originally both mafic flows and intrusive

Ma Amphibolite
Dark-gray to black hornblende crystals up to 10 inches long; minor amounts of plagioclase and some magnetite. Believed to be a recrystallized greenstone. Mapped only at Pile Bay and Iliamna Lake, where it is confined to contact between Aleutian Range batholith and greenstone

Ss Slate and limestone
Dark-gray to black calcareous rock with slaty cleavage parallel to original bedding; contains elongated limestone concretions and a few beds of dark-gray to white crystalline limestone. Rocks confined to a small area between the heads of Cottonwood and Iliamna Bays

Mgn Migmatite
Intimate admixture of granitic and metamorphic rocks, grading from gneissic and schistose textures to unoriented plutonic rocks. Mapped only at the head of Bruin Bay. Present at Kakhonak Lake and Kukaklek Lake but too small to show at scale of map

Sgn Schist, gneiss, and quartzite
Chlorite schist, mica schist, quartzitic schist, hornblende gneiss, hornblende-garnet gneiss and schist, and quartzite. Generally dark green to dark gray. Foliation usually parallel to bedding; locally well crenulated with irregular segregations of white vein quartz parallel to foliation. Migmatite zones near contact with Aleutian Range batholith at Bruin Bay, Kakhonak Lake, and Kukaklek Lake. Minor sulphides common

Contact
Includes gradational and inferred contacts. Short dashes between surficial deposits of various types and between surficial deposits and bedrock; queried where doubtful, dotted where concealed

Fault, showing movement
Dashed where approximately located, dotted where concealed, queried where doubtful; U, upthrown side, D, downthrown side [not shown where direction of movement unknown]; Bruin Bay fault shown by darker line

Anticlinal structure
Showing crest line and plunge. Dashed where approximately located, queried where doubtful, dotted where concealed

Synclinal structure
Showing position of trough and plunge. Dashed where approximately located, queried where doubtful, dotted where concealed

Anticline
Syncline
Plunge of minor folds

Inclined
Overturned
Vertical
Horizontal
Crumpled
Strike and dip of beds

Strike and dip of beds by distant observation or photo-interpretation

Strike and dip of flow banding in lavas; primarily confined to Quaternary and Tertiary lava flows

Inclined
Vertical
Strike and dip of foliation

Inclined
Overturned
Vertical
Strike and dip of foliation generally parallel to bedding

Strike and dip of cleavage

Inclined
Vertical
Strike and dip of joints

Bearing and plunge of lineation

Strike and dip of foliation and plunge of lineation

Dike
Showing dip, D, on side of direction of dip

Glacial striae
Showing direction of movement of glaciers

Fossil locality
Three or more collections from immediate area

Fossil locality
One or two collections from immediate area

Prospect
Showing location of old prospect pits and location of samples collected for spectrographic analysis; number is spectrographic analysis 62M110-123

Complex association of gold, silver, and copper with other minerals

Copper

Oil well
With show of oil and gas

QUATERNARY
TERTIARY
JURASSIC
CRETACEOUS
TRIASSIC
PERMIAN OR TRIASSIC

AGE	NAME	THICKNESS (in feet)
Quaternary	Surficial deposits	0–400
Late Tertiary	Andesite and dacite	800±
	Basalt and andesite	200–400
	Granodiorite	
Middle(?) and late Tertiary	Sedimentary and volcanic rocks	2000–3000
Jurassic or Cretaceous	Conglomerate	<800
Late Jurassic	Naknek Formation	1800–5200
	Chinitna Formation	1700–2600
Middle Jurassic	Tuxedni Group	5000–6900
	Granodiorite and quartz diorite of Aleutian Range batholith	
Early Jurassic	Talkeetna Formation	5900–9000
Late Triassic	Kamishak Formation	<1000
Triassic	Greenstone and amphibolite	Unknown
Permian or Triassic	Slate and limestone	1000±
	Schist, gneiss, quartzite, and migmatite	Unknown–2000±

CONTACT BETWEEN JURASSIC SEDIMENTARY AND VOLCANIC ROCKS BELIEVED TO BE A NONCONFORMITY

PRELIMINARY MAP OF THE GEOLOGY OF THE ILIAMNA QUADRANGLE, ALASKA

By
Robert L. Detterman and Bruce L. Reed

1964

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1964—O-643419

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-407

For sale by U.S. Geological Survey, price 50 cents