DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT
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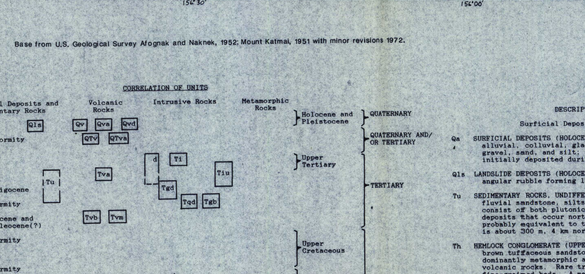
Base from U.S. Geological Survey Afognak and Naknek, 1952; Mount Katmai, 1951 with minor revisions 1972.

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

CORRELATION OF UNITS



GEOLOGIC MAP SYMBOLS

- Contact: dashed where inferred or approximately located
- Fault: dashed where inferred or approximately located, dotted where concealed; Ursthrown side, D-downthrown side
- Thrust or reverse fault: sawteeth on upper plate; bar with number indicates dip of fault plane
- Anticlinal axis: single arrow indicates direction of plunge; dashed where approximately located, dotted where concealed
- Synclinal axis: single arrow indicates plunge direction; dashed where approximately located, dotted where concealed
- Attitude of bedding, measured
- Attitude of bedding, approximate
- Horizontal bedding
- Dike
- Quaternary volcanic vent
- Area of hornfels
- Area of alteration

Geology mapped by: Marin Albert (1983), Peter Burrell (1983), Robert Detterman (1983, 1984, 1985, 1986), Terry Keith (1984), Eric Martin (1984), Jack Miller (1983, 1984, 1985, 1986), Bruce Reed (1983, 1984), Jim Riehle (1983, 1984, 1985, 1986), and Elizabeth Yount (1983, 1984, 1985, 1986)

DESCRIPTION OF MAP UNITS

Surficial Deposits and Sedimentary Rocks

Qs SURFICIAL DEPOSITS (HOLOCENE AND PLEISTOCENE) - Unconsolidated to poorly consolidated alluvial, colluvial, glacial, marine, lacustrine, and eolian deposits. Mainly gravel, sand, and silt; locally includes extensively redeposited pumice and ash initially deposited during the 1912 Katmai eruption.

Qls LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE) - Nonsorted, nonstratified coarse angular rubble forming lobate masses. Larger blocks resemble undisturbed bedrock.

Tu SEDIMENTARY ROCKS, UNDIFFERENTIATED (TERTIARY) - Poorly to moderately well indurated fluvial sandstone, siltstone, and conglomerate of uncertain age; larger clasts consist of both plutonic and volcanic rocks of local derivation. Comprises local deposits that occur northwest of the Aleutian Range crest and at least in part is probably equivalent to the Copper Lake Formation (unit Tc). Maximum known thickness is about 300 m. 4 km north of the west end of Kaguyak crater.

Tb HEMLOCK CONGLOMERATE (UPPER OLIGOCENE) - Poorly indurated fluvial conglomerate, pale brown tuffaceous sandstone, siltstone, shale, coal, and tuff. Conglomerate contains dominantly metamorphic and plutonic clasts and less abundant clasts of silicified volcanic rocks. Rare tree stumps in growth position; abundant megaflora in the fine-grained beds. A measured thickness of 558 m at Cape Nukshak is probably the maximum in the map area.

Tc COPPER LAKE FORMATION (EOCENE AND PALEOCENE?) - Massive, well indurated polymictic conglomerate, sandstone, and siltstone. Clasts are subequally plutonic, metamorphic, and volcanic rocks. Carbonaceous detritus occurs locally in the finer sedimentary rocks. A measured thickness of 1,025 m at Spurred Glacier northwest of Cape Douglas is probably the maximum in the map area.

Kk KAGUYAK FORMATION (UPPER CRETACEOUS) - Upper part consists of interbedded siltstone and graded greywacke sandstone which represent the upper and middle regimes of a submarine fan. Lower part consists of thinly bedded siltstone and some thin limestone beds and includes abundant ammonites, pelecypods, and limestone concretions. The type locality is seacliff exposures between the Swikshak and Big Rivers (Keller and Reiser, 1959; Detterman and Miller, 1985), where the measured thickness of 897 m is close to the maximum in the map area of about 1,050 m.

Kp UNNAMED FORMATION (LOWER CRETACEOUS) - Thick-bedded grey sandstone and minor amounts of siltstone and shale that contain ammonites of Albian age. Occurs at the coast between Katmai and Dakavak Bays and at the head of the landslide-dammed valley about 12 km north-northeast of Mt. Katmai (dominantly siltstone at the second occurence). The maximum known thickness of 82 m is at the seacoast exposure, but the distribution of these rocks is poorly known.

Khl HERENDEEN LIMESTONE (LOWER CRETACEOUS) - Calcareous sandstone and siltstone, thinly bedded, light to dark olive grey. Contains abundant Inoceramus prisms and, locally, complete Inoceramus ovatoides. The maximum thickness is about 250 m, 12 km north-northeast of Mt. Katmai, but the average thickness throughout the map area is probably about 25 m.

Ks STANISHKOVICH FORMATION (LOWER CRETACEOUS) - Siltstone, shale, and thinly bedded, fine-grained, feldspathic and laumontitic brown sandstone. Known exposures are confined to the region centered about 12 km north-northeast of Mt. Katmai, where the thickness probably ranges from 0 to 100 m; however, the distribution of this unit is poorly known.

Jn NAKNEK FORMATION, UNDIVIDED (UPPER JURASSIC) - The main sedimentary rock unit of the map area, consisting of sandstone, conglomerate, siltstone, and dark shale. The formation comprises five members, from oldest to youngest: massive conglomerate and thinly bedded sandstone; thick bedded to massive sandstone; thinly bedded, dark grey siltstone with limestone concretions; thinly bedded sandstone and siltstone; massive conglomerate. Clasts in both the oldest and youngest conglomerate members are dominantly metamorphic, volcanic, and sedimentary rocks with subordinate granitic rocks. Fossils in the fine-grained rocks are locally abundant and are chiefly several species of the pelecypod Buchia. The lowermost conglomerate is well exposed in the vicinity of the unnamed lake near the center of the north margin of the map, but the base of the formation is nowhere exposed in the map area. The thickness probably ranges between 2,000 m and 9,000 m in the map area.

Jt TALKEETNA FORMATION (LOWER JURASSIC) - Lava flows, breccias, and lahars locally interbedded with volcaniclastic sandstones, conglomerates, and shales. Includes sills of uncertain ages. Metamorphosed to non-schistose epidote-albite-calcite assemblages suggestive of lower greenschist facies. Conglomerates fracture across the clasts and secondary quartz, calcite, or zeolite minerals are common. The maximum exposed thickness in the map area is about 1200 m at Oakley Peak on the south shore of Kolik Lake.

TRk KAMISHAK FORMATION (UPPER TRIASSIC) - Slightly to moderately recrystallized, non-fossiliferous limestone. Exposed only along the King Salmon River (Takayoto Creek) in the southwest part of the map area, where the thickness is about 200 m. Intruded by dikes and sills.

Volcanic Deposits and Rocks

YOUNGER DEPOSITS AND ROCKS OF THE ALEUTIAN VOLCANIC ARC (QUATERNARY AND UPPER TERTIARY) -

Qva Pyroclastic-flow deposits (Holocene). Poorly sorted, variably indurated deposits of ash, vitrophyric blocks, and/or pumiceous lapilli. Comprises the 1912 ash flow of Katmai (Novarupta) and the Holocene block-and-ash flows of Kaguyak caldera. Individual pumiceous clasts are andesitic (some Novarupta), dacitic (Kaguyak), or rhyolitic (most Novarupta). None of the deposits have been glaciated or eroded. Maximum thickness of the Novarupta deposit away from the caldera around Novarupta dome is possibly 250 m (Hildreth, 1983), and that of the Kaguyak deposit is probably about 125 m.

Qvd Domes (Holocene). Domes of dacitic or rhyolitic composition. A dacitic dome at Snowy Volcano occupies the central vent of an older composite cone, whereas dacitic domes within Kaguyak volcano and the rhyolitic dome of Novarupta are both intra-caldera domes. Cerberus, Falling Mountain, and unnamed domes on Maple Creek and outside Kaguyak caldera are all of dacitic composition.

Qvy Younger central-vent deposits and rocks (Quaternary). Lava flows, tuffs, and breccias dominantly of andesitic composition (55-61% SiO2) but locally including lava flows of low-silica dacitic composition (61-66% SiO2), alfafai deposits of andesitic to rhyolitic composition on Baked Mountain and Broken Mountain, and scoria cones of basaltic composition (<51% SiO2). May include some unidentified domes. Mainly unaltered and only slightly to moderately dissected by glacial erosion. Rocks of this unit comprise part or all of the following volcanoes: Mt. Douglas, Fourpeaked Mountain, Kaguyak crater, Devil's Desk, Kukak, Mt. Stellar, Mt. Denison, Snowy Mountain, an unnamed peak 5 km southwest of Snowy Mountain, Griggs Volcano (formerly Knife Peak), Mt. Katmai, The Trident, Mt. Magnik, Martin Mountain, and three unnamed basaltic scoria cones: 24 km west of Kaguyak crater (VAHM "Iron"), 19 km north of Snowy Mountain on the northeast side of the Naknek River, and 11 km east of Blue Mountain (Whale Mountain) on the north side of Becharof Lake.

Qvs Pyroclastic-flow deposits, undifferentiated (Pleistocene and upper Tertiary) - Poorly sorted, variably indurated deposits of ash, vitrophyric blocks, and/or pumiceous lapilli. Primary compositions are uncertain owing to alteration but probably range from andesitic to dacitic. Known occurrences are 5 km northeast of Devil's Desk, 4 km east of Griggs Volcano (Knife Peak), and at the south margin of the map area 22 km east of Blue Mountain (Whale Mountain). Maximum preserved thickness at each occurrence is about 200 m.

QTv Central-vent deposits and rocks, undifferentiated (Pleistocene and upper Tertiary) - Lava flows, breccias, and domes of andesitic and dacitic composition. Locally moderate to extensive alteration associated with fossil fumaroles (e.g., bleaching to light red or yellow shades). Moderately to extensively dissected by glacial erosion. Thickness at the following vents or volcanic centers exceeds 300 m: Kaiyuh Mountains (south margin of the map area), Alautian Range crest between Mt. Katmai and Snowy Mountain, and the ridge between Devil's Desk and the Riniagak River. Other, smaller centers or vents marked by plugs are along the Savonoski River northwest of Hook Glacier, a ridge 8 km northwest of Kiukpalik Island, and small flows or domes capping ridges up to 10 km west of Martin Mountain.

Tva OLDER VOLCANIC ROCKS OF THE ALEUTIAN VOLCANIC ARC (UPPER TERTIARY) - Breccias, lava flows, sills, and local pyroclastic and epiclastic tuffs that comprise a late Tertiary volcanic field located southeast of the Aleutian Range crest and extending from the Katmai River to Kukak Bay. Dominantly of andesitic and dacitic composition. Propylitic alteration is extensive and argillic or potassic alteration is locally intensive, such as near contacts with hypabyssal intrusives of unit Ti. The maximum known thickness of about 800 m occurs along the axis of an open syncline which trends through Kukak Bay.

VOLCANIC ROCKS OF THE MESHIK VOLCANIC ARC (LOWER TERTIARY) -

Tvb Basaltic lavas. Plugs, dikes, and flows of basaltic composition (<51% SiO2) which intrude or overlie rocks of unit Tvm. Maximum thickness of lava flows is probably about 200 m.

Tvm Andesitic and dacitic lava flows and breccias. Includes local domes or tuffs of rhyolitic (?) composition, now altered to quartz and sericite or kaolinite. Maximum thickness is probably 800 m northeast of Ikavain Lake.

Intrusive Rocks

d DIKES (TERTIARY) - Dikes from 1 m to 20 m wide and which occur southeast of the Bruin Bay fault, that is, in rocks no older than the Naknek Formation (unit Jn). Many are in rocks as young as the Hemlock Conglomerate (unit Tb), however, suggesting that most are probably middle to late Tertiary in age. Two are porphyritic and have quartz and potassium feldspar in the groundmass; the remainder have partially altered phenocrysts of plagioclase and either or both of pyroxene and hornblende in a chloritized groundmass. Chemical analyses are not available because of the common occurrence of propylitic alteration and inclusions of sedimentary rocks.

Ti HYPABYSSAL INTRUSIVES OF THE ALEUTIAN VOLCANIC ARC (UPPER TERTIARY) - Includes sill-like or cross-cutting subvolcanic intrusive bodies generally less than 50 m in outcrop area, as well as larger plutonic bodies such as those beneath Fourpeaked volcano or along the Aleutian Range crest east of Serpent Tongue Glacier. Fine-grained porphyritic to equigranular rocks which consist dominantly of granodiorite or tonalite and minor quartz diorite. Veins and patches of secondary quartz, epidote, chlorite, and albite typical of deuteric alteration are common.

Tiu HYPABYSSAL INTRUSIVES, UNDIFFERENTIATED (TERTIARY) - Intrusive bodies ranging from small plugs and sills to plutons exposed over as much as 30 square km. Rocks are fine- to medium-grained, commonly porphyritic and consist chiefly of quartz diorite or tonalite. Veins and patches of secondary quartz, epidote, chlorite, and albite typical of deuteric alteration are common. Unit occurs only northwest of the Aleutian Range crest.

Tgd GRANODIORITE (TERTIARY) - Medium-grained equigranular to marginally porphyritic rocks having subhedral plagioclase and/or hornblende phenocrysts. Fracture quartz and proticlastic textures are common but volumetrically minor. Biotite is subequal to clinopyroxene or hornblende; secondary epidote and chlorite are common and one occurrence of tourmaline was noted. Average color index is 18. Rocks are in modal quartz and unit includes tonalite and monzonite. Average color index is 23.

Tgd QUARTZ DIORITE (TERTIARY) - Medium-grained equigranular rocks having accessory hornblende in excess of biotite. Modal quartz ranges widely and rocks comprising the unit include tonalite and monzonite. Average color index is 23.

Tgb GABBRO AND DIORITE (TERTIARY) - Medium-grained gabbroic or diabasic rocks, undifferentiated. The single occurrence in the map area is a sill-like body about 9 km north-northeast of the west end of Lake Grosvenor. Hornblende and clinopyroxene are common and the color index ranges from 30 to about 70.

Jgr GRANITE (JURASSIC) - Medium-grained equigranular or fine-grained porphyritic rocks. Average color index is 8 and biotite equals or exceeds hornblende. Rounded quartz grains weather prominently from the rock and, where elliptical, define a foliation. Antiperthite and protoclastic texture occur but are uncommon.

Jgd GRANODIORITE (JURASSIC) - Medium-grained equigranular or fine-grained porphyritic rocks in which incipient to well developed protoclastic textures are common. Color index averages 15; either hornblende or biotite is the dominant mafic phase. Myrmekite, antiperthite, and tourmaline have all been noted but are uncommon. Isolated samples of tonalite and quartz diorite are included within the unit.

Jqd QUARTZ DIORITE AND TONALITE (JURASSIC) - Medium-grained equigranular rocks. Average color index is 26; either clinopyroxene or hornblende is the dominant mafic and biotite is an accessory. Fine-grained mafic inclusions or inclusions of porphyroaphanitic volcanics are common. Both a foliation and a layering have been observed at several sites. A few isolated samples of granodiorite are included in this unit.

Jgb DIORITE AND GABBRO (JURASSIC) - Dark, diabasic- and gabbroic-textured rocks having either or both of two pyroxenes and hornblende; undifferentiated. Some are hornfels-textured rocks in which biotite and muscovite have partly replaced hornblende and clinopyroxene.

Metamorphic Rocks

TRc COTTONWOOD BAY GREENSTONE (UPPER TRIASSIC) - Basalt flows now metamorphosed to epidote-albite-actinolite assemblages suggestive of greenschist facies; locally includes chert and fine- to medium-grained diabase.

JTk KAHKNHAK COMPLEX (JURASSIC, TRIASSIC, AND OLDER?) - Locally foliated or banded quartzite, schist, amphibolite, and garnet-bearing gneiss indicative of amphibolite-facies metamorphism. Protoliths probably include the Talkeetna Formation (unit Jt), the Kamishak Formation (unit TRk), the Cottonwood Bay Greenstone (unit TRc), and unnamed quartz sandstones and argillites.

BACKGROUND

This geologic map is the first in a series of maps dealing with the geology and mineral resources of the Mt. Katmai area, Alaska. The map series is the result of the U. S. Geological Survey's Alaska Mineral Resource Assessment Program (AMRAP). Subsequent maps in the series will treat fossils, geochronology, detailed Quaternary deposits (both unconsolidated and volcanic), and mineral resources. Such a resource-oriented study of an area that is nearly entirely either a national park and preserve or a wildlife refuge is of merit for two reasons. First, the Alaska National Interest Lands Conservation Act (ANILCA; P.L. 96-487) of 1980 requires that such studies be carried out on all Alaska public lands. And second, the Naknek-Mt. Katmai-Afognak quadrangles are the last quadrangles on the Alaska Peninsula to be systematically mapped and evaluated by "modern" techniques; thus, until now there has been a gap in published, geologic data relative to the amount of information available from areas to the north around Cook Inlet and to the south on the Alaska Peninsula.

Fieldwork for the project was carried out in 1983, 1984, 1985, and 1986 and consisted of 130 days of helicopter support of an average of four geologists per day. About 15 days of the 130 were entirely lost to inclement weather and another 15 were partly lost. Five sites served as base camps: Amalik Bay and Kukak Bay harbored the helicopter ship R/V Don J. Miller (1983 and 1984); Naknek Lake (1984); Becharof Lake (1985 and 1986); and a former hunting camp on Battle Lake (1985 and 1986). In addition, commercial facilities in King Salmon were used briefly in 1983 and 1985.

Recent studies in the region that culminated with published maps are few. The most comprehensive is that by Keller and Reiser (1959) and includes a geologic map at 1:250,000 scale, a text briefly describing the map units; several measured sections, and a review of all prior topical and regional studies. Our map differs from the Keller and Reiser (1959) map in the detailed distribution of map units and occasionally in assignment to major units; however, we emphasize the advantages we enjoyed in the superior logistical access afforded by helicopter, in the greater time of the AMRAP project, and in our better understanding of the regional geology as a result of mapping in adjacent quadrangles published after 1959. The northeastern portion of our map was included in a compilation by Magoon, Atkinson, and Egbert (1978) of data which were previously published, such as radiometric ages from the Alaska-Aleutian Range batholith by Reed and Lanphere (1972), as well as previously unpublished. A portion of the compiled map in the Kamishak Hills and Douglas River area was subsequently modified by Magoon, Egbert, and Petering (1978). Lastly, the distribution of the ash-flow tuff in the Valley of Ten Thousand Smokes is essentially that shown by Hildreth (1983). We have benefited from, and attempted to incorporate the results of, all of these prior mapping studies.

Despite the amount of fieldtime invested in the map, in several essential respects it is still a reconnaissance product. The detailed eruptive products of individual vents of the various Quaternary volcanoes cannot be shown at 1:250,000 scale. The assignment of particular volcanic deposits to Quaternary, Quaternary and/or Tertiary, or Tertiary units is locally uncertain; moreover, contacts involving both volcanic rocks and hypabyssal rocks, especially in rugged terrain near the Aleutian Range crest, are commonly only approximately located. Distinction between early Tertiary (unit Tvm) and early Jurassic (unit Jt) volcanic rocks west of the Aleutian Range crest is ambiguous. Contacts between compositional units ("plutons") of the Alaska-Aleutian Ranges batholith are approximate; following Detterman and Reed (1980) in the adjacent Iliamna quadrangle, many of our contacts are only midpoints between locations where different rocks were sampled. Although in some cases pluton-pluton contacts are recognizable by alteration ("gossan") of the older pluton at the margin, the majority are not.

We would like to acknowledge the following organizations and individuals whose assistance or cooperation materially aided the project. The Superintendent and staff of Katmai National Park and Preserve, U. S. Park Service, and the Manager and staff of the Becharof National Wildlife Refuge, U. S. Fish and Wildlife Service, of King Salmon, were helpful in granting Special Use permits. More important, employees of both agencies helped to solve several logistical problems by offering their local expertise.

Land managers of the Alaska Peninsula Corporation and the Paug-Vik Corporation granted access to selected corporation lands. The Board of Directors of the Becharof Bible Camp kindly permitted use of the seasonal camp at Becharof Lake in 1985 and 1986. A special thanks goes to all of the helicopter pilots and mechanics who helped to get the job done safely: Glenn Hill, John Dobson, Jim Johns, Rich LaTour, Landis Lindgren, Ron Meek, Bruce Riecke, Dan Todd, Lew Webb, and Bill Woollen.

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PRELIMINARY GEOLOGIC MAP OF THE MT. KATMAI QUADRANGLE AND PORTIONS OF THE AFOGNAK AND NAKNEK QUADRANGLES, ALASKA

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1987

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