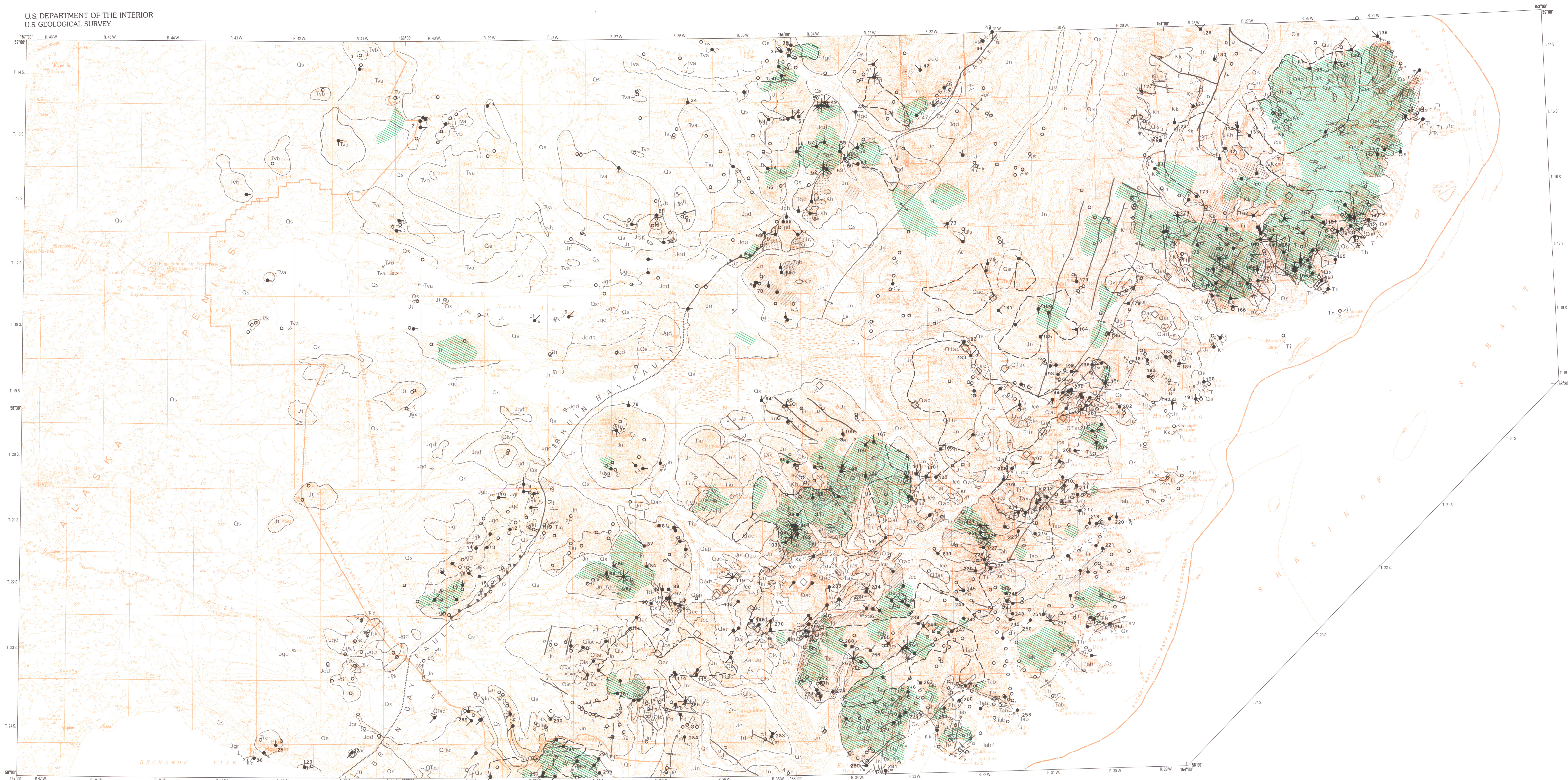
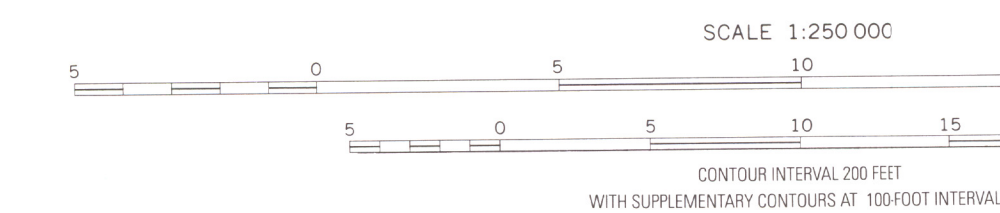


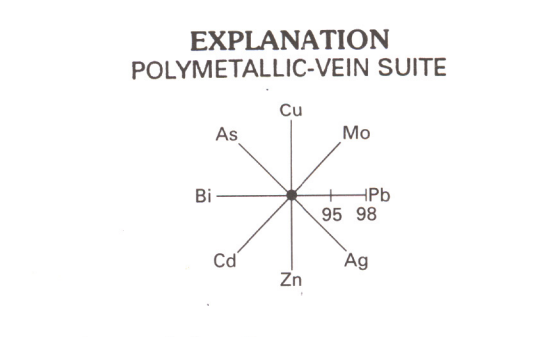
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



Base from U.S. Geological Survey
Map series, 182 (revised 1975)
Afognak, 182 (revised 1982)
Nakek, 182 (revised 1982)
Various Tertiary Member Projection



Geologic base simplified from
Harris and others (in press)



EXPLANATION
POLYMETALLIC-VEIN SUITE
Sample contained anomalous concentrations of elements in the base-metal polymetallic-vein suite at the 95th or 98th percentile (see star diagram above). Numbered localities correspond to entries in tables 11-18.
Sample from outcrop
Sample from stream float
Sample did not contain anomalous concentrations of elements in the base-metal polymetallic-vein suite
Sample from outcrop
Drainage basin containing anomalous concentrations of Cu, Mo, Pb, Ag, Zn, Cd, Bi, and (or) As as determined in both stream sediments and nonmetamorphic-heavy-mineral concentrates
Drainage basin containing more than 25 percent sulfide minerals in the nonmetamorphic-heavy-mineral separate from panned concentrate

DESCRIPTION OF MAP UNITS
SURFICIAL DEPOSITS AND SEDIMENTARY ROCKS
Surficial deposits (Holocene and Pleistocene)—Unconsolidated to poorly consolidated alluvial, colluvial, glacial, marine, lacustrine, and eolian deposits. Locally includes extensive redeposited pumice and ash from the Novarupta eruption.
Landslide deposits (Holocene and Pleistocene)—Nonsorted, nonstratified, coarse, angular rubble forming lobate masses.
Sedimentary rocks (Tertiary)—Poorly to moderately well indurated fluvial sandstone, siltstone, tuff, and conglomerate. Larger clasts consist of locally derived plutonic and volcanic rocks.
Hemlock Conglomerate (Oligocene)—Poorly indurated fluvial conglomerate, pale-brown tuffaceous sandstone, siltstone, shale, coal, and tuff. Age is late Oligocene.
Copper Lake Formation (Eocene and Paleocene)—Well-indurated polymictic conglomerate, sandstone, and siltstone.
Kaguyak Formation (Late Cretaceous)—Upper part consists of interbedded siltstone and graded graywacke sandstone that represent the upper and middle regions of a submarine fan. Lower part consists of thinly bedded siltstone and some thin limestone beds and includes abundant ammonites, pelecypods, and limestone concretions.
Pedmar Formation (Early Cretaceous)—Thick-bedded, gray sandstone and minor amounts of siltstone and shale that contain amounts of Albian age.

HEREDEN Formation (Early Cretaceous)—Calcareous sandstone and interbedded siltstone, thinly bedded, light to dark olive gray.
Staniukovich Formation (Early Cretaceous)—Siltstone, shale, and thinly bedded, fine-grained, brown to reddish sandstone.
Nakek Formation (Late Jurassic)—Main sedimentary rock unit of the map area, consisting of sandstone, conglomerate, siltstone, and dark shale. Divided into five members (not mapped separately here), from oldest to youngest: massive nonmetamorphic conglomerate and thinly bedded sandstone member; thick-bedded to massive sandstone member; thinly bedded, dark-gray matrix siltstone member containing limestone concretions; thinly bedded matrix sandstone and siltstone member; massive conglomerate member. Conglomerate in both the oldest and youngest members are metamorphic, volcanic, and sedimentary rocks with subordinate plutonic rocks.
Talkeetna Formation (Early Jurassic)—Lava flows, breccia, and tuff locally interbedded with volcanoclastic sandstone, conglomerate, and shale. Includes sills of uncertain age. Locally metamorphosed to nonschistose epidote-alkali-calcic assemblages suggestive of lower greenschist facies.
Kamihak Formation (Late Triassic)—Slightly recrystallized, nonfoliated limestone and interbedded basalt flows and breccia.
DEPOSITS AND ROCKS OF ALEUTIAN VOLCANIC ARC
Pyroclastic-flow deposits (Holocene)—Poorly sorted, variably indurated deposits of ash, vitrophyric blocks, and (or) pumiceous lapilli of the 1912 ash flow of Novarupta and the Holocene block-and-ash flows of Kaguyak caldera.
Domes (Holocene)—Domes of dacitic or rhyolitic composition.
Younger central-vent deposits and rocks (Holocene and Pleistocene)—Lava flows, tuffs, and breccias predominantly of andesitic composition but locally including lava flows of low-alkali dacitic composition, aerial deposits of andesite to rhyolitic composition on Baker Mountain and Broken Mountain.
Pyroclastic-flow deposits (Pleistocene and late Tertiary)—Poorly sorted, variably indurated deposits of ash, vitrophyric blocks, and (or) pumiceous lapilli. Primary compositions are uncertain because of alteration but probably range from andesite to dacite.
Older central-vent deposits and rocks (Pleistocene and late Tertiary)—Lava flows, breccias, and domes of andesitic and dacitic composition. Locally moderately to extensively altered where associated with fossil fumaroles (bleaching to light-red or yellow shades).
Volcanic rocks of Barrier Range (late Tertiary)—Breccias, lava flows, sills, and local pyroclastic and epiclastic tuffs of late Tertiary volcanic field located southeast of the Aleutian Range crest and extending from the lava flows of Kukak Bay. Predominantly of andesitic and dacitic composition. Pyroclitic alteration is extensive and argillaceous; possible alteration is locally intensive, such as near contacts with hypabyssal intrusive rocks (Ti).

INTRUSIVE ROCKS
Dikes (Tertiary)—Dikes from 1 to 20 m wide that occur mainly southeast of the Bruin Bay fault and have a northwest trend. Many are members of the Hemlock Conglomerate (Th), suggesting that most dikes are related to late Tertiary magmatism.
Hypabyssal intrusive rocks near Shikof Strait (late Tertiary)—Sill-like or cross-cutting subvolcanic intrusive bodies generally less than 10 km² in outcrop area, as well as larger plutonic bodies such as those beneath Fourpeaked Volcano or along the Aleutian Range crest east of Seppent Tongue Glacier. Fine-grained, porphyritic to equigranular rocks that consist predominantly of granodiorite or tonalite and minor quartz diorite.
Hypabyssal intrusive rocks, undivided (Tertiary)—Intrusive bodies ranging from small plugs and sills to plutons exposed over as much as 30 km². Rocks are fine to medium grained, are commonly porphyritic, and consist chiefly of quartz diorite or tonalite.
Granodiorite (middle Tertiary)—Medium-grained equigranular to magnesian porphyritic rocks in which modal quartz rarely exceeds 25 percent; unit includes rocks that are mineralogically classified as quartz monodiorite or quartz diorite.
Quartz diorite (middle Tertiary)—Medium-grained equigranular rocks in which accessory hornblende exceeds biotite; also occurs as zones within intrusions of granodiorite (Tpd).
Gabbro and diorite (middle Tertiary)—Medium-grained rocks having gabbroic or dioritic textures.
Granite (Jurassic)—Medium-grained equigranular or fine-grained porphyritic rocks in which biotite exceeds hornblende.
Granodiorite (Jurassic)—Medium-grained equigranular to fine-grained porphyritic rocks. Also includes isolated outcrops of tonalite and quartz diorite. Modal quartz is 22-44 percent of rock.
Quartz diorite and tonalite (Jurassic)—Medium-grained equigranular rocks containing accessory biotite; unit includes some granodiorite and gabbro (Jurassic).
Diorite and gabbro (Jurassic)—Dark, diabiastic and gabbro-textured rocks.
METAMORPHIC ROCKS
Kakhonak Complex (Jurassic, Triassic, and Paleocene?)—Locally foliated or banded quartzite, schist, amphibolite, and garnet-bearing gneiss indicative of amphibolite-facies metamorphism. Probable protolith consists of Talkeetna Formation (Tl), Kamihak Formation (Kk), Cottonwood Bay Greenstone (Bk), and unnamed sandstone and argillite.

CONTACTS—Dashed where inferred or approximately located; dotted where concealed; queried where uncertain. U, upthrown side, D, downthrown side, query next to U or D indicates direction of movement uncertain; arrows indicate direction of relative movement.
Thrust or reverse fault—Showing dip of fault plane; southwest on upper plate.
Antiformal axis—Showing direction of plunge; dashed where approximately located; dotted where concealed; queried where existence uncertain.
Synclinal axis—Showing direction of plunge; dashed where approximately located; dotted where concealed; queried where existence uncertain.
Measured strike and dip of beds inclined
Horizontal
Approximate strike and dip of beds
Strike and dip of foliation
Quaternary volcanic vent
Area of altered rock
Area of hornfels
Area covered by glacier

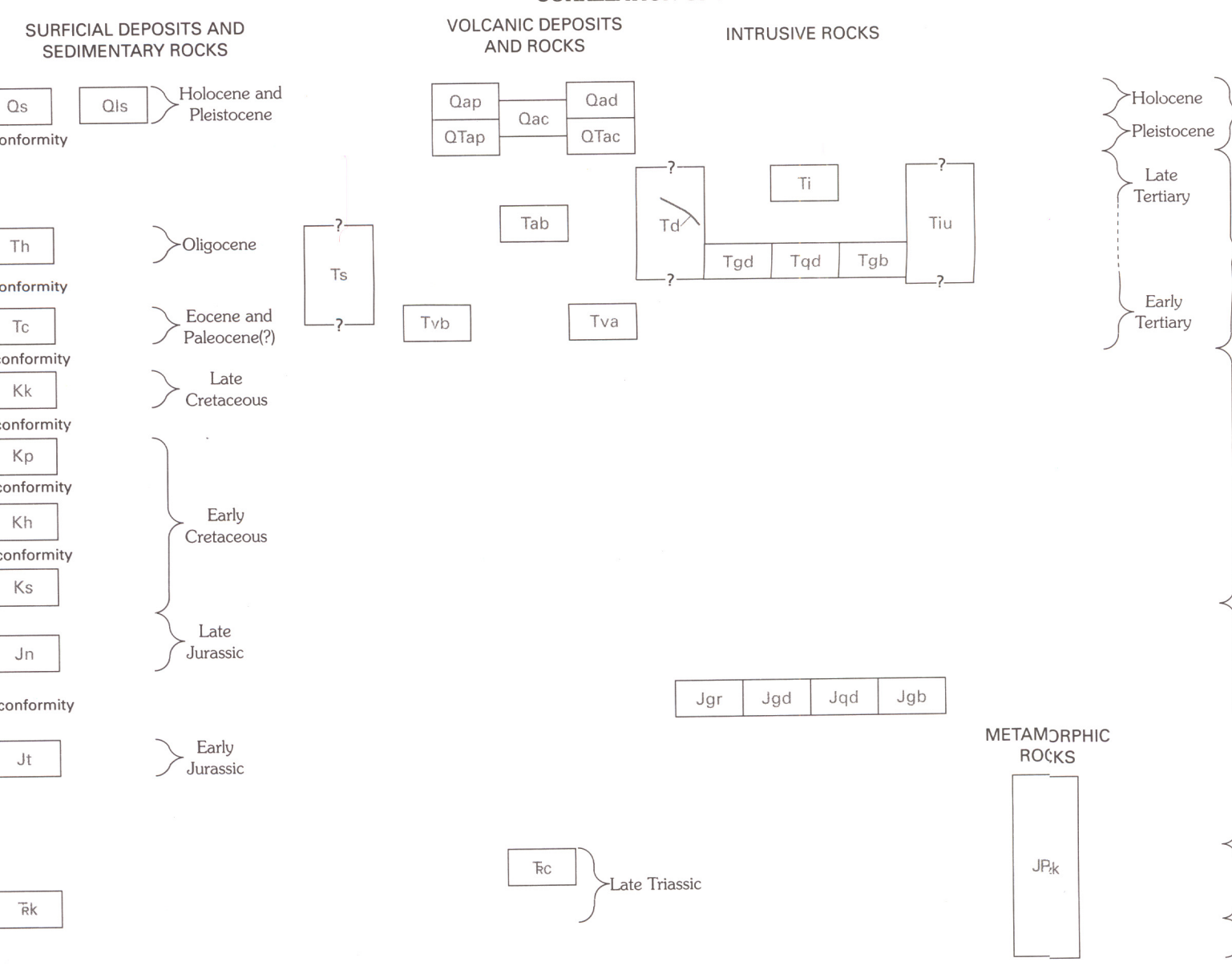
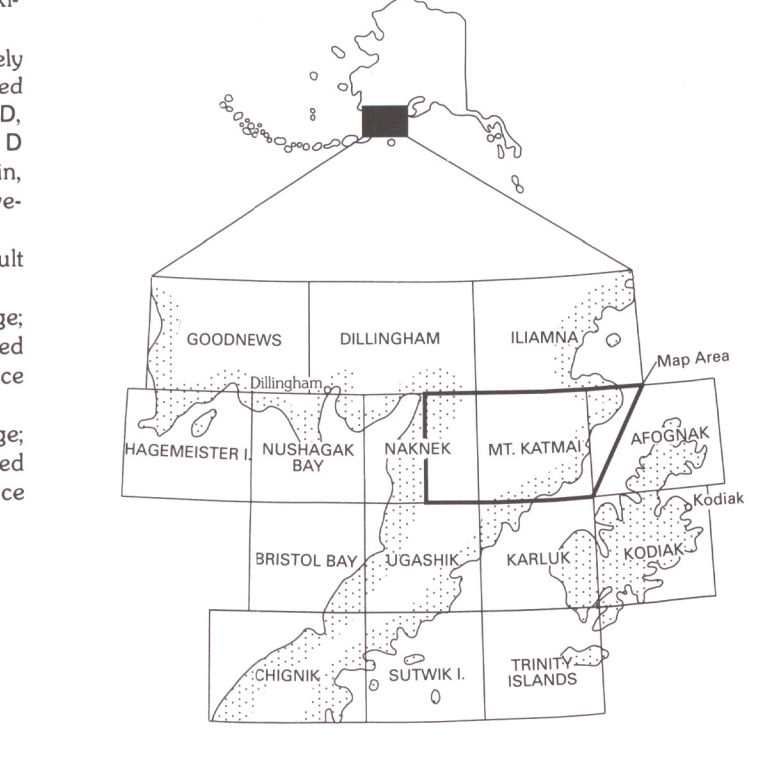


Table 9. Summary of threshold values (95th and 98th percentiles) used for the rock and soil samples plotted on plate 2, Katmai study area, Alaska.
[Analysis by semi-quantitative emission spectroscopy except where noted by an asterisk (*), which indicates data determined by atomic absorption. Dashes (—), no data; all concentrations expressed as parts per million. Threshold values determined largely from the data in tables 1 and 4.]

Element	Lithologic unit									
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Cu	150	200	100	200	100	100	150	100	100	100
Mo	5	7	5	7	5	7	10	15	7	7
Pb	50	70	50	70	50	70	50	70	50	70
Ag	0.5	1	0.5	1	0.5	1	0.7	0.5	0.5	0.7
Zn	100	210	100	160	100	140	60	140	90	140
Cd	2	4	2	4	2	4	2	4	2	4
Bi*	25	30	20	30	100	10	15	10	15	10
As*	—	—	—	—	—	—	—	—	—	—

1. Metamorphic rocks southwest of Bruin Bay fault (Kakhonak Complex, Cottonwood Bay Greenstone, Kamihak Formation, Talkeetna Formation) and locally, southwest of Bruin Bay fault, hornfelsed rocks adjacent to plutons. 94 samples were analyzed for most elements.
2. Mesozoic sedimentary rocks (Nakek, Staniukovich, Hereden, Pedmar, and Kaguyak Formations). 157 samples were analyzed for most elements.
3. Tertiary sedimentary rocks (Copper Lake Formation, Hemlock Conglomerate, and undivided Tertiary rocks). 90 samples were analyzed for most elements.
4. Jurassic and Tertiary plutonic rocks of the Alaska-Aleutian Range belt (gabbro, diorite, quartz diorite, tonalite, granitic, granodiorite, and granite) and Tertiary hypabyssal plutons and sills occurring throughout the Katmai study area. 86 samples were analyzed for most elements.
5. Tertiary dikes (primarily middle to late Tertiary). 28 samples were analyzed for most elements.
6. Tertiary volcanic rocks (informally named "volcanic rocks of Barrier Range" and "volcanic rocks north of Nakek Lake"). 474 samples were analyzed for most elements.
7. Quaternary volcanic rocks (chiefly lava flows and domes at or near the crest of the Aleutian Range). 73 samples were analyzed for most elements.
8. Altered rock samples from unspecified formation; threshold values taken from the screen-sediment data set (table 1).

MAP OF THE MOUNT KATMAI QUADRANGLE AND ADJACENT PARTS OF THE AFOGNAK AND NAKNEK QUADRANGLES, ALASKA, SHOWING GEOCHEMICAL DATA INDICATING UNDISCOVERED BASE-METAL-BEARING POLYMETALLIC VEINS

By
S.E. Church, J.R. Riehl, and R.J. Goldfarb
1994