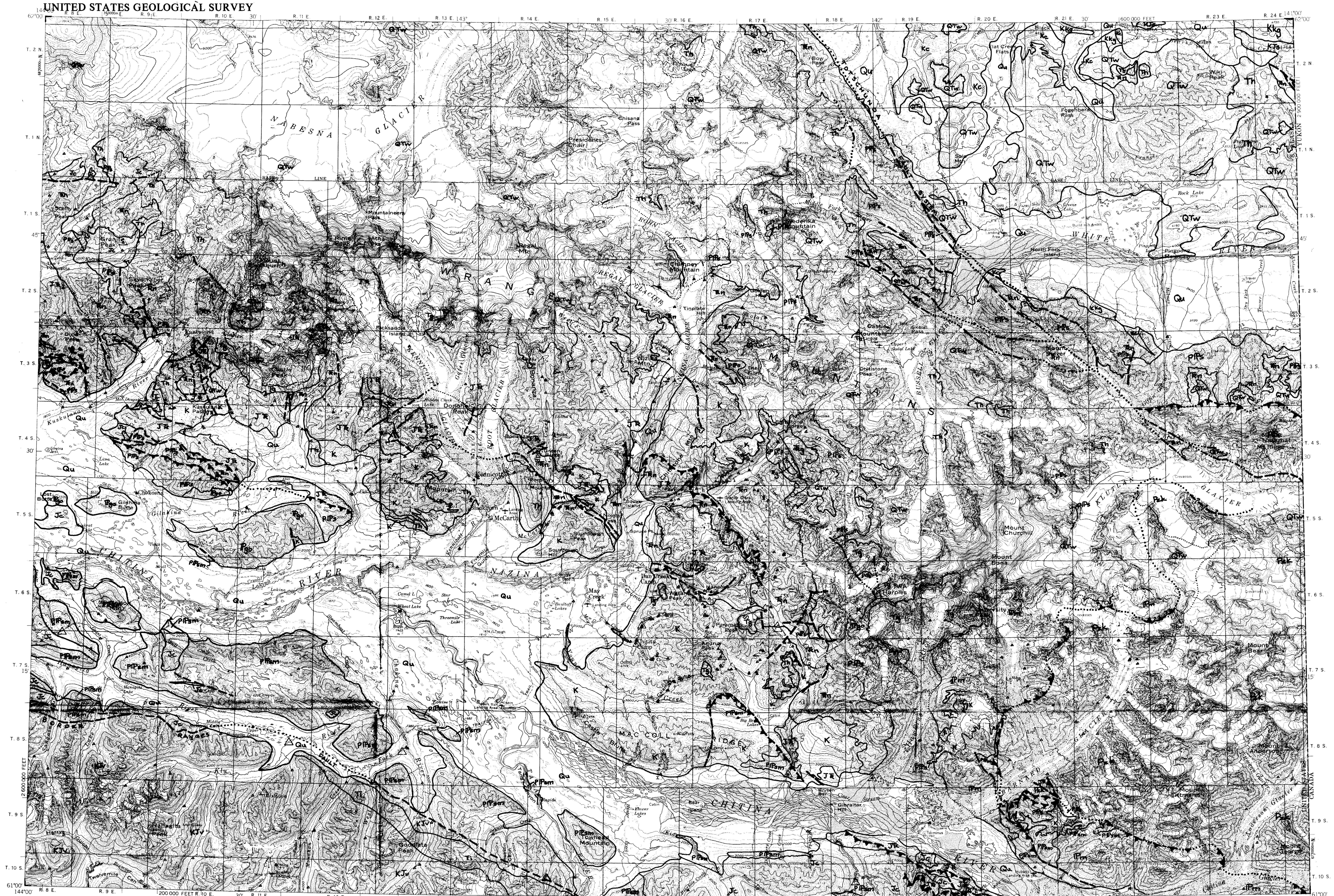

Base from U.S. Geological Survey, 1965
Geology generalized by MacKevett, 1976

Background information for this folio is published as U.S. Geological Survey Circular 739, available free of charge from the U.S. Geological Survey, Reston, Va. 22092.

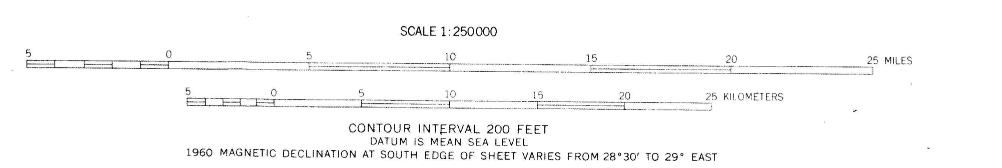

Table showing linear correlation coefficients between logarithmic values of the concentration of selected elements versus gold, McCarthy quadrangle, Alaska. [Leaders (---)indicate insufficient data.]

Analytical method	Six-step semiquantitive spectrographic analyses																						Atomic absorption and colorimetric 1/					
Element	Fe	Mg	Ca	Ti	Mn	Ag	B	Ba	Be	Co	Cr	Cu	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr	Au	Cu	Pb	Zn	Hg	As
Correlation Coefficient(X100)	-3	-6	8	-7	-8	--	-8	-11	-59	-7	10	-20	85	-19	-25	-8	-11	13	-15	13	--	13		-26	-18	-4	-23	-32
Number of pairs	54	54	53	49	54	--	50	54	12	52	51	54	5	17	53	33	53	54	54	50	--	51		17	18	18	15	12

1/ Au, Cu, Pb and Zn by atomic absorption analysis
Hg by flameless atomic absorption analysis
As by colorimetric analysis

DISTRIBUTION AND ABUNDANCE OF GOLD IN STREAM SEDIMENTS AND MORAINE DEBRIS, McCARTHY QUADRANGLE, ALASKA

By

Keith Robinson, R. M. O'Leary, C. M. McDougal, and Theodore Billings

1976

DISCUSSION

A geochemical survey was conducted in the McCarthy quadrangle Alaska, to identify areas containing anomalous concentrations of various metallic and nonmetallic elements. This study incorporates the results of analyses for gold from 764 stream sediment and glacial moraine debris samples collected in the quadrangle, and analyzed by the U.S. Geological Survey between 1961 and 1976 using atomic absorption spectrophotometry. No analytical results for gold are available for stream sediment samples from the White River area, located in the northeastern part of the quadrangle.

The accompanying map shows the distribution and relative abundance of gold in stream sediment and glacial moraine debris samples. Geochemical analyses have been grouped and are represented by symbols on a base map, which includes topography and generalized geology. The range of analytical values and the symbol that represents it are shown on the histogram. Graphical representation of analytical values on the map permits easy observation of any large variation resulting from separate or duplicate samples collected at the same or nearby localities.

In general, the stream sediment samples were obtained from active streams as close to the channel center as was practical, however in some cases, only dry stream beds could be sampled. The glacial debris was collected from medial and lateral moraines on active glaciers. Samples of both stream sediments and glacial moraine debris were air dried and sieved to obtain material that would pass through a 180 micron opening sieve, and this fraction was used for analysis. When a fine sediment sample could not be obtained, a representative fraction of the smallest available rock fragments in the streams or on the glacial moraines was collected and ground so that it would pass through the same sieve opening for analysis.

The geographic distribution of samples analyzed for gold in the McCarthy quadrangle is large but irregular. However, the gold analyses may help to locate potential occurrences of concealed mineral deposits, particularly large buried porphyry copper and molybedenum deposits.

The geographic distribution of samples analyzed for gold in the McCarthy quadrangle is large but irregular. However, the gold analyses may help to locate potential occurrences of concealed mineral deposits, particularly larged buried porphy copper and molybdenum deposits.

The arithmetic and geometric mean values of gold in stream sediments and glacial debris from the McCarthy quadrangle are 0.31 and 0.08 ppm, respectively. Based on an evaluation of the statistical data given in the accompanying histogram, gold values ranging from N(0.02) to 0.03 ppm are classified as background values. Those values between 0.05 and 0.5 ppm are classified as threshold to weakly anomalous, and values greater than 0.5 ppm gold are considered to be significantly anomalous.

A geochemical interpretation of the distribution and abundance of gold in samples of stream sediment and glacial moraine debris collected in the McCarthy quadrangle is not complicated or unduly influenced by metals derived from the Middle and (or) Upper Triassic Nikolai Greenstone as are some other elements because the greenstone in the McCarthy quadrangle has a regional average value of less than 0.02 ppm gold. An initial study of the geographical distribution of gold anomalies suggests that most of the gold is related to Tertiary felsic hypabyssal and granodioritic intrusive rocks, in dikes associated with Pennsylvanian monzonitic-granitic complexes, and in rocks of the Jurassic(?) and Cretaceous Valdez Group. With the exception of molybdenum, no statistically significant positive correlation coefficients occur between gold and any other element. This lack of correlation may be expected in view of the occurrence of native gold as discrete particles in placer mined deposits. Unpanned stream sediments are not likely to detect particulate gold unless it is abundantly present.

Because erratic, biased, and in many cases widely separated sample localities were used in this project, undue emphasis may be placed on anomalous gold values occurring in only one or two samples in a given area. In all cases, geochemical interpretation has been made utilizing associated elements in combination with geological, structural, and geophysical data. More detailed geological, analytical, and statistical data for geochemical studies of specific areas in the McCarthy quadrangle can be found in reports by MacKevett and Smith (1968), Winkler and MacKevett (1970), Knaebel (1970), and Winkler, MacKevett, and Smith (1971).

In addition to being a commodity of considerable economic value, gold is an important pathfinder element that can be used in the search for porphyry-type deposits. Gold often forms halos around zoned porphyry copper deposits. The distributions of gold, molybdenum, silver, and arsenic in rocks, together with the distributions of copper, gold, lead, arsenic, and mercury in stream sediments and glacial debris, may reveal zoning patterns that are related to undiscovered mineral deposits.

Analyses of stream sediment samples collected in the McCarthy quadrangle south of the Chitina River yield anomalous gold concentrations which suggest extensive gold occurrences associated with rocks of the Valdez Group. These anomalies are substantiated by mines and prospects in the Golconda Creek area. Some gold may be associated with rocks of Tertiary granodiorite and tonalite that intrude the Valdez Group in juxtaposition with the Border Ranges fault which traverses the southwest corner of the quadrangle. Two anomalous gold samples were taken from Goat Creek (T. 10 S., R. 19 E.), which originates in the Bering Glacier quadrangle to the south. The occurrence of scattered gold, silver, arsenic, and mercury anomalies suggest more detailed geochemical studies should be conducted in this whole general area.

No positive gold anomalies were detected in stream sediments collected in the area around the Kennecott group of mines, despite the fact that several strongly anomalous gold values were detected in rocks from this general locality.

No gold anomalies were detected in samples of stream sediment collected adjacent to the Totschunda fault system (T. 3 S., R. 21 E.) or to the northeast in the White River area. Only one anomalous gold value was detected in rocks adjacent to the Totschunda fault. However, few samples from this area have been analyzed for gold.

East of the University Peak (T. 6 S., R. 20 E.), weak gold anomalies were detected in samples collected from two areas of glacial moraine debris in the upper reaches of the Barnard Glacier (T. 7 S., R. 22 E.). These gold anomalies are associated with copper, arsenic, and minor concentrations of mercury in samples of sediment from the same general area. Outcrops covering several square kilometers show evidence of strong hydrothermal alteration and positive aeromagnetic anomalies occur locally (Case and MacKevett, 1976). Strong gold anomalies were also detected in rocks associated with a monzonitic-granitic complex of Pennsylvanian age located to the immediate south. Anomalous amounts of copper, silver, arsenic, mercury, and lead were detected in samples of stream sediment and rock collected from this area. The intrusive complex also contains anomalous amounts of molybdenum in several places and tin in two places. The presence of anomalous amounts of all these elements suggests that this area might contain undiscovered porphyry-type copper and molybdenum deposits related to the intrusive complex.

Several gold anomalies were detected in samples of glacial debris collected in an area of Tertiary granodiorite and tonalite intrusions located in the vicinity of The TWA Harpies (T. 6 S., R. 19 E.). Two anomalous gold values in samples of stream sediment and glacial debris from the TWA Harpies Glacier valley (T. 5 S., R. 18 E.), may also reflect mineralization related to the exposed Tertiary granodiorite and tonalite. Zones of intense hydrothermal alteration are visible in the outcrop. The intrusive may be inferred to extend northwest under the central part of the University Range (T. 5 S., R. 18 E.). This inference is also supported by aeromagnetic data (Case and MacKevett, 1976). Anomalous concentrations of copper, arsenic, mercury, silver, and molybdenum are also present in samples of rocks and stream sediments collected in the same general area. While the possibility of contamination from metals eroded from the Nikolai Greenstone cannot be discounted, especially in Toby Creek and the TWA Harpies Glacier valley (T. 5 S., R. 17 E.), the TWA Harpies area is considered promising for the discovery of porphyry-type copper or possibly molybdenum deposits.

Several weakly anomalous gold values were detected in samples of stream sediment from the Dan Creek, Nikolai Butte, Williams Peak, Pyramid Peak, Andrus Peak, and Mount Holmes area (T. 6 S., R. 16 E.), and in the upper reaches of Canyon Creek, all located in the south-central part of the quadrangle. Highly anomalous gold values were also detected in samples of rock and this general area has been extensively placer mined. The anomalies are considered to be extremely significant. An intrusion of Tertiary granodiorite and tonalite, which forms small outcropping plutons, is inferred to inderlie much of the area. These intrusives are probably related to the Tertiary intrusive complex exposed in the University Range (T. 5 S., R. 18 E.) to the northeast. Anomalous concentrations of copper, silver, arsenic, mercury, antimony, lead, and molybdenum detected in samples of rock and stream sediments suggest that relatively intense mineralization probably occurs in this area. Strong positive magnetic anomalies are present (Case and MacKevett, 1976) and hydrothermally altered rocks are visible in outcrops. The area is known to contain veins of gold-arsenic-antimony, and gold-copper-molybdenum. These element associations suggest a strong possibility for concealed porphyry-type copper, molybdenum or other types of deposits.

Two weak gold anomalies were detected in samples of stream sediment and several highly anomalous gold values in rocks collected from the general area of the Kuskulana River south of Skyscraper Peak (T. 2 S., R. 9 E.). The anomalies may be related to veins of sulfides in the Nikolai Greenstone. However, the close proximity of monzodiorite, granodiorite, and tonalite intrusives of the Jurassic Chitina Valley batholith suggest that the mineralized rocks may be related to the intrusives in the area (Moffit and Mertie, 1923). The gold anomalies are associated with copper, arsenic, silver, and molybdenum anomalies A few weak gold anomalies were detected in samples of stream sediment collected from creeks west of Granite Peak (T. 1 S., R. 9 E.). Anomalous concentrations of molybdenum, copper, arsenic, and mercury were also detected in some samples of stream sediment and rock collected in the same general locality. The Jurassic Chitina Valley batholith of monzodiorite, granodiorite and tonalite underlies much of Granite Peak and intrudes the Nikolai Greenstone. Positive aeromagnetic highs occur locally (Case and MacKevett, 1976) and strongly altered rocks are visible in the area. Some geochemical anomalies may be related to veins of sulfide in the Nikolai Greenstone, however many of the anomalous samples may be related to undiscovered porphyry-type copper and possibly molybdenum deposits.

A complete set of coordinates for sample sites, as well as statistical and analytical data, obtained 1974-1976 for gold in stream sediments and glacial moraine debris collected in the McCarthy quadrangle is available, together with details of sample collection, preparation, analysis, data storage and retrieval, in U.S. Geological Survey Open-File Report 76-824 (O'Leary and others, 1976) and on a computer tape (VanTrump and others, 1977)

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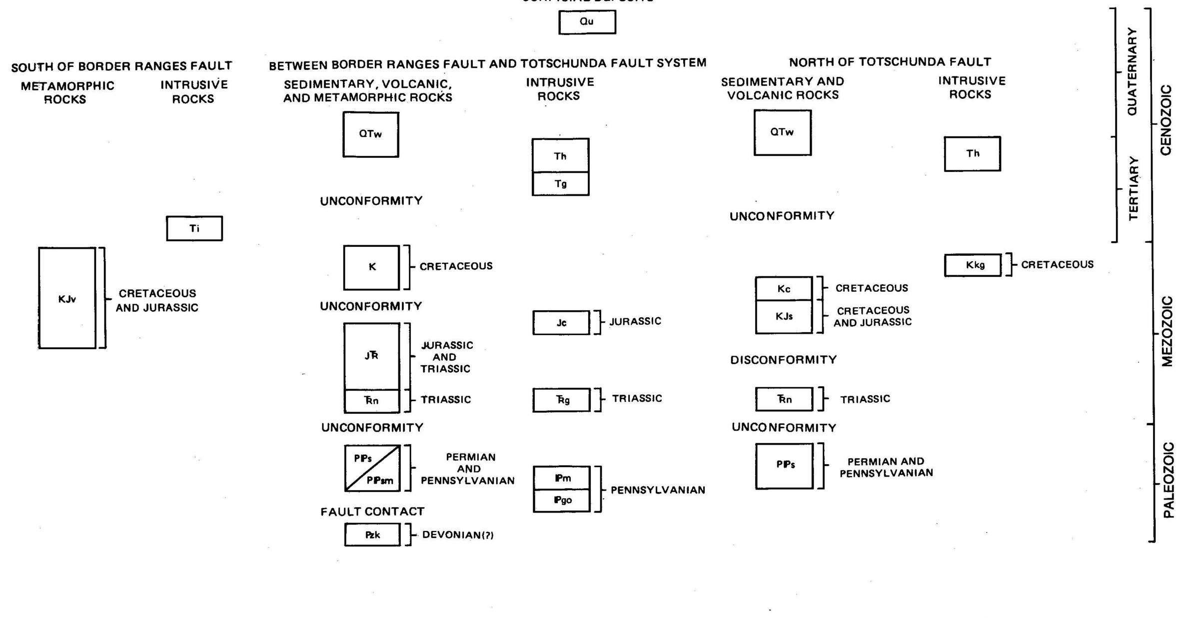
EXPLANATION FOR GENERALIZED GEOLOGIC MAP
(GEOLOGY GENERALIZED BY MacKEVETT, 1976)

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

- Qu — UNCONSOLIDATED SEDIMENTARY DEPOSITS (Quaternary)

SOUTH OF BORDER RANGES FAULT

METAMORPHIC ROCKS

- KJv — VALDEZ GROUP (Cretaceous and Jurassic?)

INTRUSIVE ROCKS

- Ti — INTRUSIVE ROCKS (Eocene?) Typically, foliated granodiorite and tonalite

BETWEEN BORDER RANGES FAULT AND TOTSCHUNDA FAULT SYSTEM

SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS

- QTw — WRANGELL LAVA (Quaternary and Tertiary) Chiefly subaerial andesitic lava flows and tephra; includes local subaerial sedimentary rocks of the Frederika Formation
- K — MARINE SEDIMENTARY ROCKS (Upper and Lower Cretaceous) Includes MacColl Ridge, Chititu, Moonshine Creek, Schulze, and Kennicott Formations, and unnamed Lower Cretaceous rocks
- JŦR — MARINE SEDIMENTARY ROCKS (Jurassic and Triassic) Includes Root Glacier, Nizina Mountain, Lubbe Creek, and McCarthy Formations, Kotsina Conglomerate, and Nizina and Chitistone Limestones
- Ŧn — NIKOLAI GREENSTONE (Upper and (or) Middle Triassic) Mainly subaerial tholeiitic basalt; includes subordinate Chitistone Limestone north of Totschunda fault system
- PPs — SKOLAI GROUP (Permian and Pennsylvanian) As mapped includes a few scattered remnants of Middle Triassic sedimentary rocks in northeastern part of quadrangle
- PPsm — METAMORPHOSED SKOLAI GROUP (Permian and Pennsylvanian) Includes a few small outcrops of serpentinized ultramafic rocks near Border Ranges fault
- Pzk — KASKAWULSH GROUP OF KINDLE (1953) (Devonian?)

INTRUSIVE ROCKS

- Th — FELSIC HYPABYSSAL ROCKS (Pliocene) Mainly porphyritic dacite
- Tg — GRANODIORITE (Pliocene) Unfoliated granodiorite with local mafic border facies
- Jc — CHITINA VALLEY BATHOLITH (Jurassic) Mainly foliated quartz monzodiorite, granodiorite, and tonalite
- Ŧg — GABBRO
- Pm — MONZONITIC-GRANITIC COMPLEX (Pennsylvanian) Mainly nonfoliated quartz monzonite and granite, local mafic border facies
- Pgo — GABBRO AND ORTHOGNEISS (Pennsylvanian)

NORTH OF TOTSCHUNDA FAULT SYSTEM

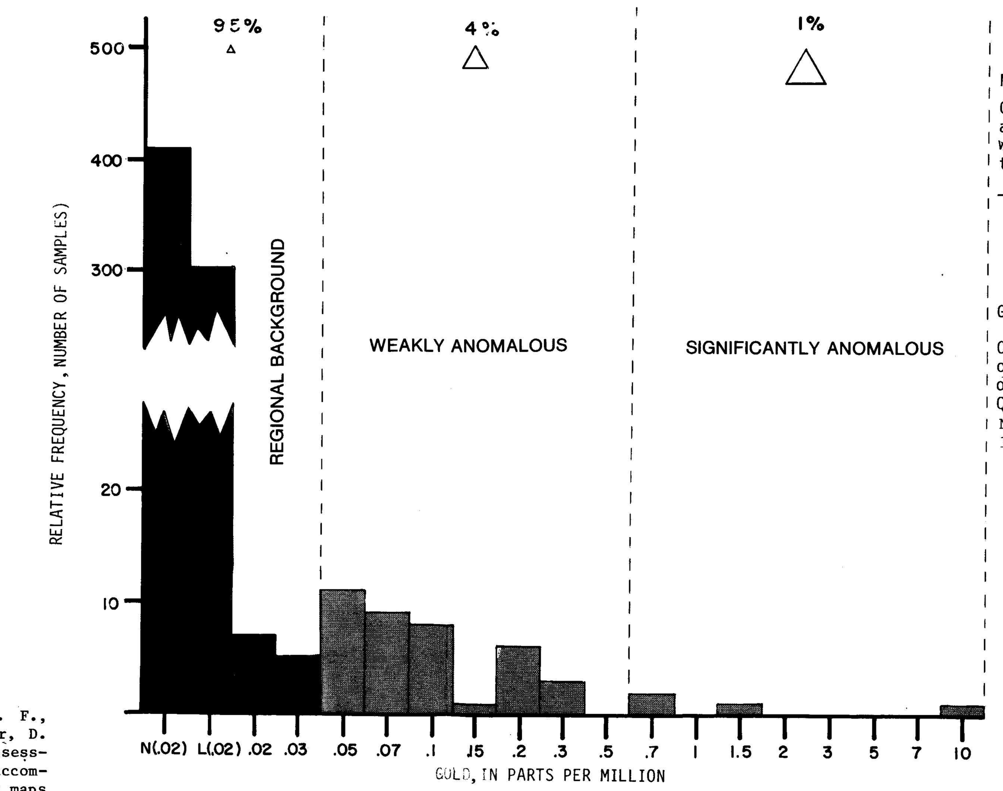
SEDIMENTARY AND VOLCANIC ROCKS

- QTw — WRANGELL LAVA See above
- Kc — CHISANA FORMATION (Lower Cretaceous) Marine and subaerial volcaniclastic and volcanic rocks
- KJs — NUTZOTIN MOUNTAINS SEQUENCE (Lower Cretaceous and Upper Jurassic)
- Ŧn — NIKOLAI GREENSTONE See above
- PPs — SKOLAI GROUP See above

INTRUSIVE ROCKS

- Th — FELSIC HYPABYSSAL ROCKS See above
- Kkg — KLEIN CREEK PLUTON (Cretaceous) Chiefly granodiorite

Contact; dotted where concealed
High-angle fault; dotted where concealed
Thrust fault; sawteeth on upper plate. Dotted where concealed
NOTE: Areas without letter symbols are glaciers and snowfields



MODE = N(.02) ppm
MEDIAN = N(.02) ppm
Calculation based on analysis of 764 samples with concentrations of Au in the range N(.02) through 9.6 ppm

ARITHMETIC MEAN = 0.31 ppm
STANDARD DEVIATION = 1.3
GEOMETRIC MEAN = 0.08 ppm
GEOMETRIC DEVIATION = 3.3

Calculation based on analysis of 54 samples with concentrations of Au in the range 0.02 through 9.6 ppm. Qualified N and L values not included.
N, not detected; L, detected but below limit of determination (0.02).

Histogram showing frequency distribution, analytical range, and map symbols for gold in stream sediments and glacial debris, McCarthy quadrangle, Alaska.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1976

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