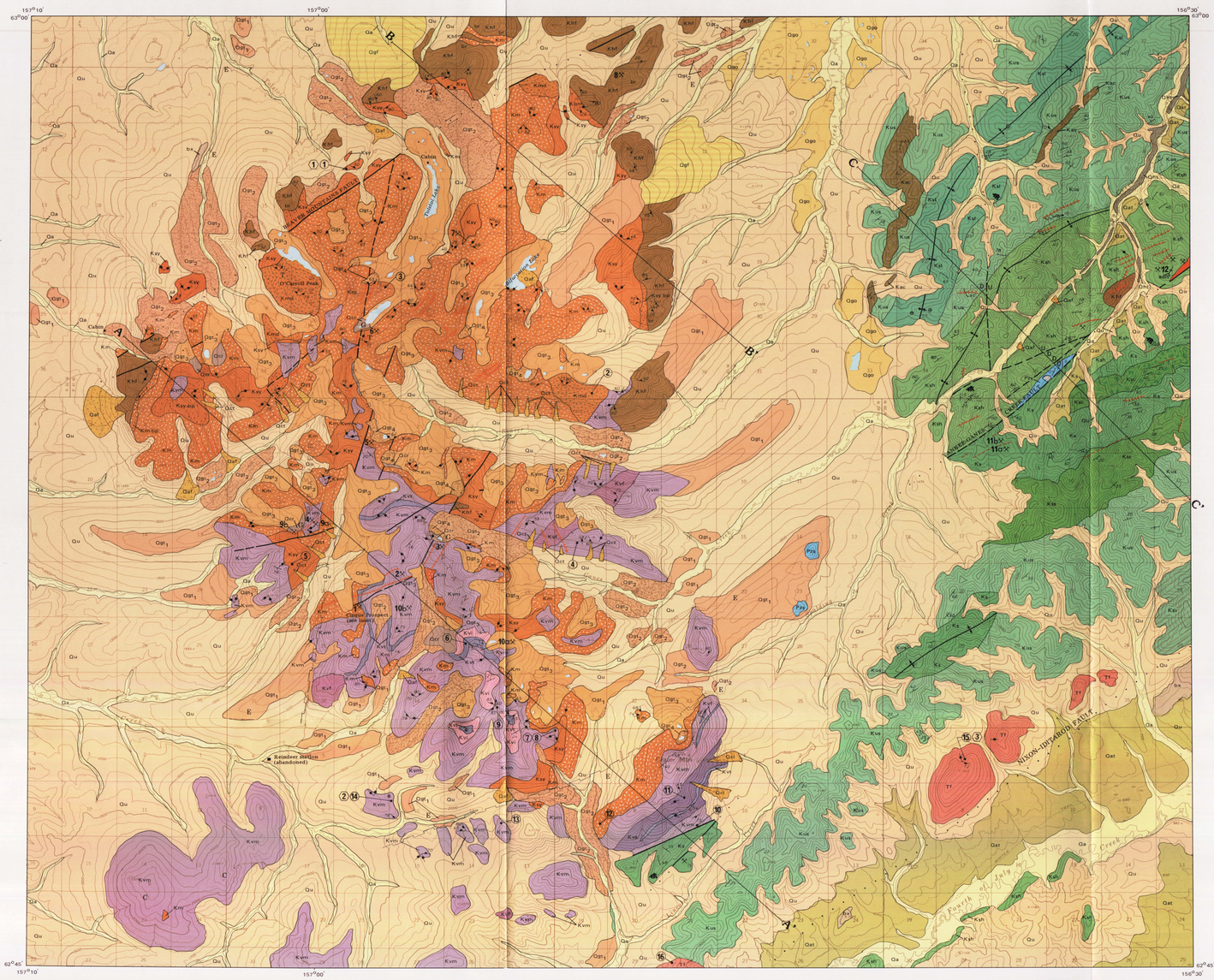
GR72-SH1
GEOLOGIC REPORT 72



Base by U.S. Geological Survey, 1954.
Universal Transverse Mercator projection, 1927.

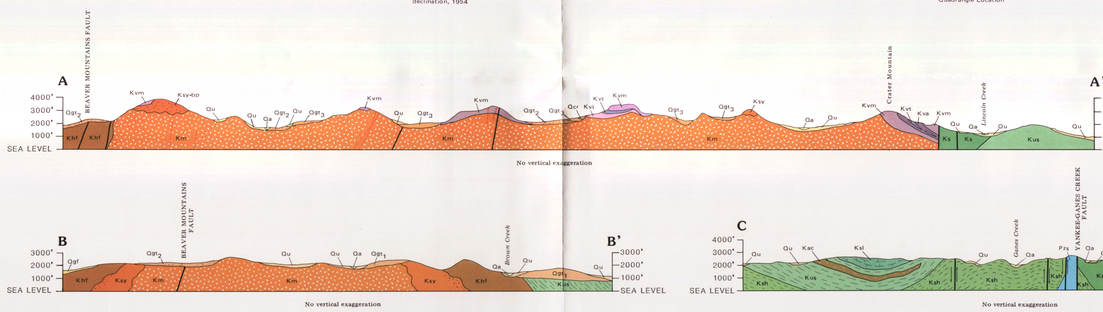
SCALE 1:63,360

CONTOUR INTERVAL 100 FEET

DATUM IS MEAN SEA LEVEL

Approximate mean declination, 1954

Geology by T.K. Bundtzen and G.M. Laird, 1979 and 1981.
Reviewed by M.S. Robinson and R.D. Reger. Cartography by G.M. Laird.



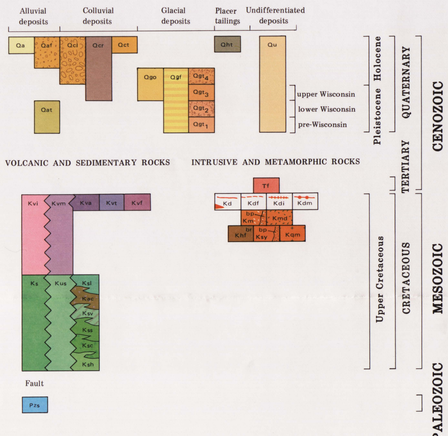
GEOLOGIC MAP OF THE IDITAROD D-2 AND EASTERN D-3 QUADRANGLES, ALASKA

By

T. K. Bundtzen and G. M. Laird

1982

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qa — STREAM ALLUVIUM — Unconsolidated silt, sand, and gravel deposited by modern streams on flood plains; commonly covered by pioneer flora.

Qaf — ALLUVIAL-FAN DEPOSITS — Poorly sorted, partially stratified silt, sand, and coarse gravel in alluvial fans.

Qat — TERRACE ALLUVIUM — Poorly to moderately stratified gravel and sand, locally cemented by iron oxides; may include alluvial aprons and strath terraces. Vegetated surface dissected by modern streams and mantled by eolian silt.

Qcl — LANDSLIDE DEPOSITS — Heterogeneous mixture of poorly sorted soil and rock material containing large, angular bedrock blocks; formed by mass failure along south flank of Crater Mountain.

Qcr — ROCK-GLACIER AND PROTALUS-RAMPART DEPOSITS — Lobate- to spatulate-shaped masses of poorly sorted, angular bedrock rubble often covered by lichens and weakly developed soils; A_1 active.

Qct — TALUS-CONE DEPOSITS — Unsorted, cone-shaped deposits of angular rock rubble.

Qgf — OUTWASH-FAN DEPOSITS — Unsorted to moderately sorted sand, gravel, and mixed debris deposited proximal to ice-marginal meltwater streams in Wisconsin time.

Qgo — OUTWASH DEPOSITS — Moderately well-stratified, poorly consolidated sand and gravel deposited beyond terminal positions of Pleistocene glaciers; outwash deposits 150-300 ft above modern flood plains may include till. Surface mantled by eolian deposits and modified by thermokarst processes.

Qtl_4, Qtl_3, Qtl_2, Qtl_1 — TILL — Unsorted boulders, gravel, sand, and silt deposited by glacial ice; Qtl_4 - Holocene; Qtl_3 - Late Wisconsin; Qtl_2 - Early Wisconsin; Qtl_1 - pre-Wisconsin. Morphology of till deposits progressively modified through time (Bundtzen, 1981).

Qmt — PLACER-MINE TAILINGS — Symmetrical to irregular stacked piles of sorted gravels; fine fractions artificially removed or diluted during placer-mining process.

Qu — QUATERNARY DEPOSITS, UNDIFFERENTIATED — Unconsolidated alluvial, colluvial, and eolian deposits; includes reworked drift and talus cones in Beaver Mountains; eolian deposits locally ice rich in valley fill.

VOLCANIC AND SEDIMENTARY ROCKS

Kvt — AIR-FALL TUFF — Light- to medium-greenish-gray, fine- to coarse-grained crystal and lithic tuff; grades from coarse sand to fine, silt-sized clasts from base to top. Crystal tuff composed of resistant, euhedral clinopyroxene and olivine grains to 5 mm in diameter. Thickness of individual sequences generally unknown, but ranges from 3 cm to 2 m on Crater Mountain.

Kva — VOLCANIC AGGLOMERATE — Medium- to dark-green lapilli tuff, volcaniclastic sandstone, and agglomerate containing elliptical bombs and fragments of basalt and coarse sandstone up to 3 m in diameter. Forms knobs on dip slopes.

Kvm — MAFIC VOLCANIC ROCKS — Dark-greenish-gray, aphanitic to fine-grained olivine-pyroxene basalt and basaltic andesite, locally porphyritic with plagioclase, clinopyroxene, and olivine grains to 5 mm in diameter. Locally hornfelsed; contains tourmaline-andalusite porphyroblasts and amygdules (a).

Kvi — INTERMEDIATE VOLCANIC ROCKS — Light- to medium-greenish-gray, aphanitic to porphyritic, propylitized andesite to dacite flows. Contains air-fall tuff locally indistinguishable from Kvt.

Kvf — FELSIC VOLCANIC ROCKS — Light-greenish-gray, aphanitic felsite and minor, medium- to coarse-grained, felsic lithic tuff; locally welded and extensively chloritized.

Ksl — LIMY VOLCANICLASTIC SANDSTONE — Light-gray, tan-weathering, medium-grained, fissile sandstone and minor micaceous siltstone; locally contains calcareous matrix and abundant wood chips, plant stems, and dicotyledon leaf fragments. Moderately resistant in outcrop.

Ksp — AGGLOMERATE, CHERT, TUFF, AND SANDSTONE — Medium- to dark-green agglomerate, green chert, lapilli tuff, and volcaniclastic sandstone similar to Kva, but with much higher chert and sandstone content. Forms hogbacks and ridges.

Ksv — SILICEOUS VOLCANICLASTIC SANDSTONE — Fine- to coarse-grained, indurated, gray volcaniclastic sandstone with distinctive green tinge. Locally siliceous and composed of up to 40 percent volcanic clasts. May be lateral facies equivalent of Kac. Very resistant in outcrop.

Kss — LITHIC SANDSTONE — Light-gray, tan-weathering, fine-grained lithic sandstone with 25 percent siltstone interbeds. Moderately resistant in outcrop.

Ks — SANDSTONE — Light- to medium-gray, fine- to coarse-grained lithic sandstone exhibiting graded bedding, flute casts, ripple marks, and cross-bedding; contains 15-40 percent shale and silt horizons; wood chips and *Inoceramus* prisms locally abundant. ABCD and BCDE Bouma sequence present. Resistant in outcrop.

Ksh — SHALE AND SILTSTONE — Medium- to dark-gray, finely laminated, locally graded siltstone and shale with up to 15 percent fine-grained lithic wacke. Flysch trace fossil *Protopaleodictyon* locally abundant. Nonresistant in outcrop.

Kus — UNDIFFERENTIATED SEDIMENTARY ROCKS — Predominantly a heterogeneous package of medium-grained lithic sandstone and siltstone. Also contains shale, siltstone, conglomerate, and sandstone of previously listed sedimentary rock units.

Ksc — SANDSTONE AND CONGLOMERATE — Generally light-gray, coarse-grained lithic sandstone and pebble conglomerate containing chert, quartz, phyllite, and mafic volcanic clasts; *Inoceramus* prisms locally abundant. Graded bedding with ABC Bouma sequences. Resistant in outcrop.

Pzs — CHERT, TUFF, ORTHOQUARTZITE, ARGILLITE, AND LIMESTONE — Medium-gray to green, radiolarian chert; light-green, aphanitic siliceous tuff; very minor medium-grained, indurated orthoquartzite; dark-gray argillite; lenses of medium-gray, fossiliferous limestone.

INTRUSIVE AND METAMORPHIC ROCKS

Tf — RHYOLITE — Light-gray, bleached, aphanitic to very fine grained biotite-quartz rhyolite; biotite usually altered.

Khf — HORNFELS OR METASOMATITE — Brown to gray, massive to porphyroblastic, chlorite + cordierite hornfels, locally tourmaline rich. Massive dark-gray varieties sometimes difficult to distinguish from aphanitic basalt. Shatter zone peripheral to Beaver Mountains stock, bx; consists of tourmaline-manganese breccia.

Ksy, bp — SYENITE — Light-gray, bleached, fine- to medium-grained, usually porphyritic biotite syenite + augite; generally less altered than monzonite or monzodiorite phases. Color Index (CI) = 15. Probably early phase of stock. Fine-grained border phase, bp.

Km, bp — MONZONITE — Medium- to coarse-grained, light- to medium-greenish-gray, porphyritic to locally equigranular, tourmaline-bearing biotite-augite monzonite. Feldspar phenocrysts commonly zoned within altered, finer grained groundmass; CI = 15-35. Fine-grained border phase, bp.

Kmd — MONZODIORITE — Medium- to dark-greenish-gray, coarse-grained, usually porphyritic tourmaline-augite-biotite monzodiorite; potassium-feldspar phenocrysts usually zoned with potassic rims and sodic cores; secondary biotite common; groundmass commonly altered; CI = 40.

Kqm — QUARTZ MONZONITE — Medium-gray, medium-grained, equigranular biotite-quartz monzonite. Probably early-stage phase.

Kdf, Kdm, Kdi, Kd — DIKES AND SUBVOLCANIC ROCKS — Aphanitic to very fine grained dikes of variable composition; usually altered. Kdf, porphyritic felsite dike; Kdm, olivine-bearing mafic dike; Kdi, intermediate dike; Kd, altered dike or silica-carbonate rock. Thickness of dikes schematic.

bx — UNDIFFERENTIATED BEDROCK — No age inferred.

MAP SYMBOLS

Contact; dashed where approximately located, queried where questionable.

High-angle fault — Dashed where approximately located, queried where questionable. U, upthrown side; D, downthrown side; arrows show direction of relative movement.

Photogeologic lineament.

Anticline, showing trace of axial plane and direction of plunge.

Syncline, showing trace of axial plane and direction of plunge.

Strike and dip of beds: Inclined; Vertical; Horizontal

Strike and dip of foliation: Inclined; Vertical; Horizontal

Strike and dip of cleavage: Inclined; Vertical

Strike and dip of joints: Inclined; Vertical

Flow lineation in igneous rock

Slate pencil

Overturned isoclinal fold

1 — Major oxide analysis (table 1)

1 — Mineral prospect, mine (table 3)

E — Glacial erratic

G — Gossan

T — Tourmaline-greisen fracture filling

1 — K-Ar age-date locality (table 2)

Fossil locality (Bundtzen and Laird, 1980, p. 14-15)

C — Geode

REFERENCES

Bundtzen, T.K., 1981, Multiple glaciation in the Beaver Mountains, western interior Alaska, in Short notes on Alaskan geology - 1979-80: Alaska Division of Geological and Geophysical Surveys Geologic Report 63, p. 11-18.

Bundtzen, T.K., and Laird, G.M., 1980, Preliminary geology of the McGrath-upper Innoko River area, western interior Alaska: Alaska Division of Geological and Geophysical Surveys Open-file Report 134, 36 p., 3 pl.

CIRQUE PROSPECT, BEAVER MOUNTAINS

(See map 1✕ and table 3)

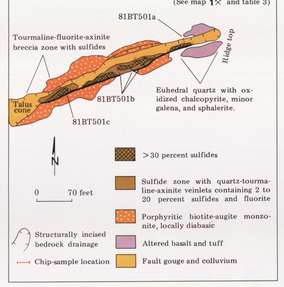


Table 1. *Major-oxide analyses and CIPW norms of igneous rocks*

Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Field no.	79BT436	79BT457	79BT439	79BT486b	81BT510	79BT501	79BT503.1	81BT503.2	79BT506	79BT511	81BT514	79BT508.2	81BT521	81BT524	81BT495	81BT528
Rock type	Syenite	Monzonite	Monzonite	Andesite	Syenite	Mafic tuff	Basalt	Syenite	Basalt	Basalt	Andesite	Syenite	Andesite	Andesite	Rhyolite	Rhyolite
SiO_2	60.70	57.80	60.20	55.30	60.14	47.40	55.80	59.40	55.60	53.30	55.90	60.80	56.97	57.96	72.90	71.21
Al_2O_3	19.30	15.70	15.50	16.80	14.96	11.90	16.30	15.60	16.30	13.70	17.70	14.80	16.74	17.67	14.04	15.17
Fe_2O_3	0.33	1.53	0.77	0.66	1.15	1.55	0.87	0.96	1.28	2.02	0.95	0.64	1.28	2.27	0.31	0.47
FeO	2.38	4.23	4.41	4.77	3.68	7.78	4.77	3.60	3.90	5.59	4.35	4.18	3.32	2.34	0.54	0.21
MnO	0.05	0.12	0.12	0.12	0.12	0.20	0.11	0.10	0.14	0.17	0.10	0.08	0.09	0.06	0.02	0.01
MgO	1.80	3.66	3.37	2.95	3.17	12.50	4.61	3.23	3.43	8.75	3.02	3.29	2.48	2.39	0.07	0.18
CaO	4.84	3.89	3.18	5.98	3.37	9.62	6.48	3.65	7.09	8.12	7.69	4.37	5.12	4.44	0.82	1.89
Na_2O	3.71	2.78	2.75	3.00	2.52	1.29	2.96	3.07	2.13	2.29	3.20	2.94	2.67	2.77	3.97	3.37
K_2O	4.99	4.78	4.70	5.24	4.66	2.93	4.58	5.02	7.48	1.70	3.17	5.03	4.71	4.39	4.58	4.05
TiO_2	0.49	0.81	0.68	0.97	0.72	0.84	1.97	0.66	1.15	0.67	1.04	0.77	1.07	1.17	0.06	0.11
H_2O	0.17	0.45	0.24	0.25	0.09	0.45	0.20	0.35	0.20	0.06	0.27	0.60	0.13	0.17	0.00	0.27
LOI*	0.09	1.59	1.40	1.63	2.36	1.50	0.19	1.30	1.82	0.33	0.22	0.95	2.83	2.15	0.80	1.91
Total	98.85	97.34	97.32	97.67	96.94	97.96	97.94	96.94	100.52	97.24	97.61	98.45	97.41	97.78	98.11	98.85
*Loss on ignition																
Norms																
Quartz	6.02	7.75	11.39	0.23	14.29	0.00	0.48	8.35	0.00	3.41	4.52	9.46	9.16	13.00	30.34	32.07
Orthoclase	29.46	28.25	27.77	30.96	27.54	17.31	27.08	29.66	44.20	10.05	18.73	29.72	27.83	25.94	27.06	23.93
Albite	31.39	23.52	23.27	25.39	21.32	9.23	25.05	25.98	14.17	19.38	27.08	24.88	22.59	23.44	33.59	28.52
Anorthite	21.27	16.24	15.78	16.90	14.89	18.03	17.66	13.96	12.82	22.08	24.57	12.33	19.78	19.02	3.55	8.72
Nepheline	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00	2.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diopside	2.25	2.49	0.00	10.54	0.00	23.88	11.77	3.38	18.12	14.61	11.13	7.66	1.70	0.00	0.00	0.00
Hypersthene	6.76	13.29	8.39	8.98	12.74	0.00	12.24	11.31	0.00	22.59	7.73	10.48	8.79	6.55	0.85	0.45
Olivine	0.00	0.00	0.00	0.00	0.00	22.80	0.00	0.00	3.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magnetite	0.48	2.22	1.12	0.96	1.67	2.25	1.26	1.39	1.86	2.93	1.38	0.93	1.86	3.29	0.45	0.58
Ilmenite	0.93	1.54	1.29	1.84	1.37	1.60	2.03	1.25	2.18	1.27	1.98	1.48	2.03	2.22	0.11	0.21
Differentiation index	66.90	59.43	58.00	56.58	63.10	27.46	52.59	64.00	60.46	32.83	50.33	64.05	59.58	62.38	91.00	84.52

Analyses by X-ray fluorescence, DGGS Minerals Laboratory.

Table 2. *Analytical data for ^{40}K-^{40}Ar age determinations*

Sample	1[a] (79BT436)	2[b] (81BT523)	3[b] (81BT494)
Rock type	Biotite syenite	Basalt	Rhyolite porphyry
Mineral dated	Biotite	Whole rock	Biotite
K_2O (wt%)	8.75	4.24	7.02
Sample wt(g)	0.1073	0.6295	0.1725
$^{40}Ar(rad)$ (moles/g) x 10^{-11}	90.309	61.262	81.542
$^{40}Ar(rad)/^{40}K$ x 10^{-3}	4.17	2.18	3.89
$^{40}Ar(rad)/^{40}Ar$ (total)	0.731	0.661	0.300
Age (m.y.) ± 1σ	70.3 ± 2.1	35.1 ± 1.1 (minium age due to alteration)	65.8 ± 3.9

Constants used in age calculations
[a] $\lambda_e = 0.585 \times 10^{-10}\ yr^{-1}$ $\lambda_\beta = 4.72 \times 10^{-10}\ yr^{-1}$ (D.L. Turner and B.J. Spell, Geophysical Institute University of Alaska, Fairbanks)
[b] $\lambda_e = 0.581 \times 10^{-10}\ yr^{-1}$ $\lambda_\beta = 4.962 \times 10^{-10}\ yr^{-1}$ (Daniel Krummenacher and Donna Martin, San Diego State University, San Diego, California).

Table 3. *Analytical results of mineral prospects in Iditarod D-2 and eastern D-3 Quadrangles*

Map no.	Field no.	Cu (%)	Pb (%)	Zn (%)	Ag (oz/ton)	Au (oz/ton)	As	Sb	Bi	Sn	W	Cd (ppm)	Se	V	Nb	Cr	Co	Ni	Hg (ppb)	Remarks
1[2]	81BT501a	3.00	3.00	0.40	19.35	--	ND	2000	ND	100	--	ND	ND	--	--	--	--	ND	--	2½-ft channel
	81BT501b	20.00	ND	0.20	32.25	--	ND	200	2000	ND	--	ND	ND	--	--	--	--	ND	--	3-ft channel Tourmaline-axinite-greisen fracture fillings in monzonite and overlying basalt (see Cirque Prospect inset)
	81BT501c	21.05	ND	0.08	25.80	--	ND	35	ND	100	--	ND	600	--	--	--	--	ND	--	1½-ft channel
2[1]	81BT503	8.00	ND	ND	9.67	--	ND	100	ND	100	--	ND	ND	--	--	--	--	ND	--	Grab sample from same fracture system as (1) about 1 mi to the east.
3[2]	79BT495	0.01	ND	0.02	0.22	ND	--	ND	ND	ND	ND	--	--	500	--	20	--	50	--	Pyritiferrous mafic volcanic rocks and pluton in cirque headwall.
4[2]	79GL321	0.50	0.70	0.09	16.12	Tr	ND	200	100	60	ND	ND	ND	300	--	ND	--	20	--	Disseminated copper sulfide in fracture filling near cupola of monzonite; rubble crop only.
5[2]	79GL318	2.00	ND	ND	3.22	0.02	--	ND	ND	ND	300	--	--	150	--	ND	--	20	--	High-grade sulfide mineralization similar to (6).
6[2]	79BT441	10.00	ND	ND	31.00	0.01	10,000	500	ND	ND	ND	ND	300	--	--	ND	--	50	--	Random grab samples of tourmaline breccia-sulfide mineralization
	79BT441c	10.00	ND	ND	32.25	0.01	10,000	400	ND	ND	ND	ND	300	--	--	ND	--	150	--	in greisenized fracture. Similar to (1). Visible chalcopyrite, pyrite,
	79BT441d	0.10	0.80	2.00	1.29	Tr	20,000	200	ND	200	ND	200	ND	200	--	ND	--	50	--	minor galena.
7[2]	79BT403	0.10	0.02	0.04	0.96	Tr	400	400	ND	ND	ND	ND	ND	30	--	ND	--	20	--	Mineralized monzonite.
8[2]	79BT451	0.05	ND	0.10	1.61	Tr	--	100	ND	ND	ND	ND	ND	30	--	ND	--	20	--	Mineralized hornfels.
9a[1]	81BT508	0.02	0.09	0.12	0.03	Tr	--	5	50	--	2	500	--	300	ND	100	20	10	80	Tourmaline-greisen fracture filling in monzonite and overlying meta-
9b[1]	81BT509	0.01	0.24	0.22	0.23	Tr	--	ND	20	--	3	200	--	200	ND	ND	20	5	130	basalt.
10a[1]	81GL131	0.01	0.02	0.01	Tr	ND	--	ND	ND	--	3	500	--	700	1000	500	30	20	70	Greisenized metabasalt with 10 ppm gallium; sulfide-quartz fracture
10b[1]	81GL121	0.05	0.01	0.01	0.12	0.01	--	59	ND	--	3	ND	--	ND	200	20	20	5	50	filling in metabasalt.
11a[1]	79BT285	Tr	ND	ND	0.06	Tr	--	ND	ND	--	ND	ND	--	ND	--	ND	ND	5	--	Rhyolite dike with quartz in prospect pit 81GL121.
	79BT285	Tr	ND	ND	ND	Tr	--	ND	ND	--	ND	ND	--	300	--	ND	ND	20	--	
11b[1]	79BT180	Tr	ND	ND	ND	0.04	--	ND	ND	--	ND	ND	--	300	--	ND	ND	5	--	Quartz-gossan in altered siltstone.
12[1]	79BT127a	Tr	ND	ND	0.06	0.01	--	ND	ND	--	ND	ND	--	300	--	20	ND	10	--	Quartz vein system with ferricrete cement; trenched in several
	79BT127b	Tr	ND	ND	ND	Tr	--	ND	ND	--	ND	ND	--	300	--	ND	ND	10	--	areas.
	79BT127c	Tr	ND	ND	ND	ND	--	ND	ND	--	ND	ND	--	100	--	ND	ND	20	--	

[1] DGGS Minerals Laboratory
[2] U.S. Bureau of Mines
-- = Not analyzed
Tr = Trace
ND = Below limits of detection
Cu, Pb, Zn, Au, Ag, and Sb by atomic-absorption spectrophotometry; As, Bi, Sn, Cd, Se, Hg, and W by X-ray fluorescence; V, Ni, Co, Cr, Nb by emission spectrography; Mo, Be, and Ga looked for but not detected