PLATINIFEROUS COPPER, NICKEL AND COBALT OCCURRENCES AND INVESTIGATIONS NEAR RAINBOW MOUNTAIN, CENTRAL ALASKA RANGE

By James C. Barker

Critical and Strategic Minerals in Alaska --

Alaska Range Mafic/Ultramafic Complexes

* Field Report - February, 1983
(revised 6-13-83)

UNITED STATES DEPARTMENT OF THE INTERIOR

James G. Watt, Secretary

BUREAU OF MINES

Robert C. Horton, Director

Standard footnote ??

Samples suffixed with AK were analyzed by atomic absorption methods by TSL Laboratories, Spokane, Washington.

Au and PGE were analyzed by fire-assay preconcentrations followed by ICP technique, Reno Research Center, Reno, Nevada.

Blank assays indicate no analysis was done.

To be used on Au tables ??

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PLATINIFEROUS COPPER, NICKEL AND COBALT OCCURRENCES AND INVESTIGATIONS NEAR RAINBOW MOUNTAIN, CENTRAL ALASKA RANGE

By James C. Barker[1]

ABSTRACT

[1] Supervisory Physical Scientist, AFOC, Fairbanks, Alaska.

INTRODUCTION

The objectives of the investigation of the Rainbow Mountain area were as follows:

(1) Examination of known mineral occurrences and resampling to determine Co and PGM values.

(2) Reconnaissance of the various geologic terranes to determine the potential for, and possible deposition types of yet to be discovered deposits.

(3) Sampling of the Phelan Creek placer gravels to substantiate or disprove the undocumented report of placer platinum.

(4) Bulk sampling to determine feasibility of metallurgical recovery of metals from deposits approaching economic or sub-economic size and grade.

(5) Preliminary examination of mafic/ultramafic units with respect to origin, mineralogy and trace element background (e.g. Cu, Ni, PGM).

ACKNOWLEDGEMENTS

The Bureau of Mines first examined the Rainbow Mountain area in 1959 and then again in 1961 and 1962. Work those years was primarily concentrated in the vicinity of the Emerick and Glacier Lake prospects. This previous unpublished work by Bureau investigators B. Thomas, A. Kimball and W. Gnagy contributed greatly to this report. Data and observations from their investigation are footnoted where included in this manuscript.

Sjoberg - Reno

BUREAU OF MINES RECONNAISSANCE

EMERICK PROSPECT - MAP LOCALITY 1

Location

The Emerick prospect (location 1, figure 2) consists of a series of at least 9 lenses of massive sulfide mineralization and a mineralized dike which outcrop intermittently along a terrace slope for approximately 0.3 miles. The site is approximately one mile east of the Richardson Highway. The prospect is located along the northwest side of an ancient alluvial channelway, formerly of the Delta River or one of its tributaries. Access to the site is possible by light truck via an unimproved trail which departs the Richardson Highway near Mile 213.

Previous Work and Ownership

The Emerick prospect (figure 1-1) was originally owned and explored by Rollie Emerick and Erwin Brakefield who were partners in the Red Rock Mining Co., Box 951, Delta Junction, Alaska. They owned 18 lode claims and 6 placer claims in the area.

In 1962 Newmont Mining Company undertook trenching, mapping and sampling of the prospect.

In 1968 the claims apparently lapsed and in 1970 the prospect was relocated by Joe Taylor and Rick McMullen. The claims lapsed again and were subsequently included in the lands withdrawn from mineral entry for the Delta Wild and Scenic River. This classification was included in the Alaska Lands legislation of 1980, by PL_____.

Geologic mapping was originally compiled in the Rainbow Mountain area by Hanson, 1963 (1)[2/] and further detailed and discussed by Rose, 1965 (5), (see figure 1-2).

2/. Underlined numbers in parentheses refer to items in the reference list at the end of this report.

1 : 1,000,000

Location Map

Fig 1 Location of the Rainbow Mountain area, Central Alaska Range

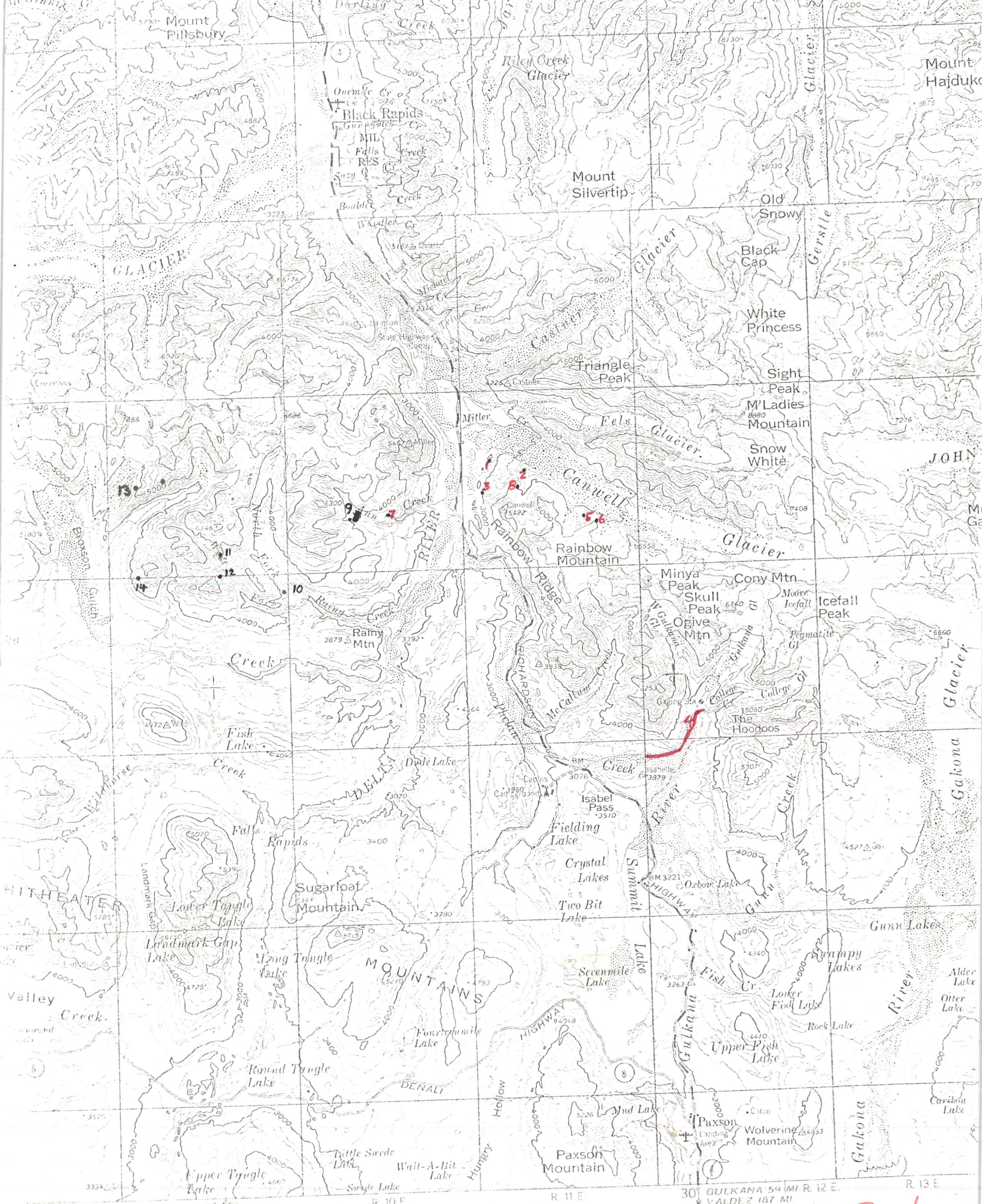

FIGURE 2 - Mineral Occurrences in the Rainbow Mountain Area

FIGURE 14. - Terrace slope exposing the serpentinized pyroxenite body and sulfide deposits of the Emerick Prospect

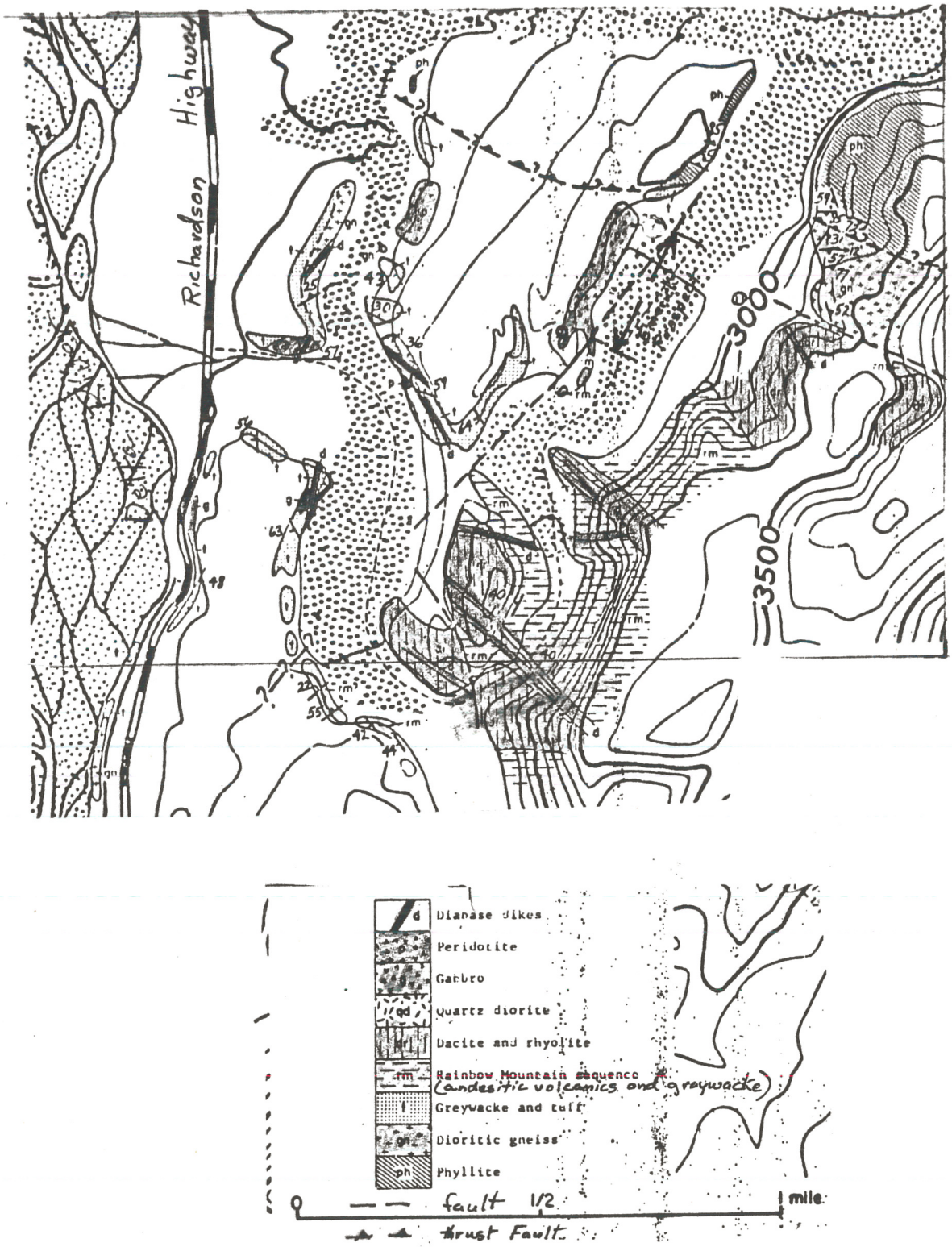

FIGURE 1. Geologic Map of the ~~Rainbow Mountain~~ Emerick prospect and vicinity. Geology by Hanson (1964) and Rose. (-) 1965 (-)

Mineral Investigation

Copper and nickel with accessory amounts of cobalt, gold, silver and platinum group elements are assoicated with an altered (serpentinized) pyroxenite and peridotite. The mineralization occurs as small lenses of massive sulfide and as a dissemination in a gabbroic dike.

Petrographic examination of the ultramafic intrusion indicates the principal minerals are serpentine (composed of antigorite) with chlorite, actinolite and lesser amounts to traces of augite, chromite, chrysotile asbestos, and calcite. Amphibolite lenses/segregations appear to be common. Oxidation products of limonite, malachite, chrysocolla and nickel bloom were observed.

The lenses which were not found to exceed 2.5 feet in width, nor confusing 30 feet in strike length, appear to be associated with northwest trending shear zones. Lenses are steeply dipping to the northeast. The mineralized material is characterized by the deep chocolate-colored limonite staining. Exposure is poor owing to the loose talus on slopes above the outcrops.

An oxidized zone of granulated limonite at sample location 33-(15) (see figure 1-3 back pocket) contained a weighted average grade of 0.82% Ni and 0.16% Cu across 5.5 feet. Original rock composition was completely altered. The zone aligned with the sulfide lenses, striking 300, 75° N.

Polished sections of mineralized samples from massive sulfide lenses were found to contain sulfides of pentlandite, chalcopyrite and pyrrhotite. The pentlandite occurs as compact, rounded to rectangular, subhedral grains embedded in the other sulfides or silicate minerals.

The pyrrotite and chalcopyrite are completely anhedral and poikilablastic to a considerable extent. Pyrrotite is altering to goethite.

Nickel predominates over copper with metal grades of 0.74 to 11.41% Ni to 0.43 to 1.20% Cu. Co values range up to 0.145 percent and up to ___ oz/ton of PGE were found. An analysis of a beneficiation concentrate indicated 65% pyrrhotite, 30% pentlandite, 4% chalcopyrite and 1% goethite.

A gabbroic dike intrudes the northern area of the serpentinized body with an approximate west to northwest strike (figure 1-4). Width of the dike was found to be 12 feet during test pitting in 1962 when channel samples 13a, b, c (table 1-1) were collected.[3]

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[3] Data from mapping and sampling by B. Thomas, Mining Engineer, USBM, 1962.

Due to the presence of slickenside it appears that the dike was emplaced along a fault zone. Mylonite was observed adjacent to the contact.

FIGURE 1-4. - Location of mineralized gabbro dike at the Emerik prospect. The dike is indicated by 'g' and the host serpentized pyroxenite by 's'. Above the outcrop is a mantel of glacial till (Qt).

TABLE 1-1. - Emerick Prospect Rock Analyses

Map no.	Sample no.	Geochemical Analyses[2] (ppm) Ag	As	Co	Cu	Ni	Pb	Zn	Fire Assay Analyses[1] (oz/ton) Au	Ir	Pd	Pt	Os	Rd	Ru	Description
	33-A		5	1450	4000	79,900			0.00150		0.049	0.021				Massive sulfide lens in serpentinite.
	33-1		5	226	1500	14,400			0.00300							Oxidized zone 5.35 ft wide channel sample No. 1 is 0.65 ft.
	33-2		2	151	1300	7,500			0.00015							Oxidized zone 5.35 ft wide channel sample No. 2 is 0.9 ft.
	33-3		5	98	1300	6,600			0.00075							Oxidized zone 5.35 ft wide channel sample No. 3 is 2.1 ft.
	33-4		5	47	1200	3,500			0.00180							Oxidized zone 5.35 ft wide channel sample No. 4 is 0.6 ft.
	33-5		5	320	2500	11,800			0.00100							Oxidized zone 5.35 ft wide channel sample No. 5 is 1.1 ft.
	1-59			52	<100	600					0.0004	<0.0015				Talus - fragments of partially silicified ultramafic rock composed of serpentinite, antigarite(?), magnetite, chlorite and a trace of augite. Chromite occurs in grain size of 250 mesh and coarser.
	2-59			114	500	3,300					0.0020	0.0020				Intensely fractured serpentinite composed of antigorite, chlorite and a trace of augite. Chromite occurs in grain size of 250 mesh and coarser.
	3-59			900	3,900	59,500			0.00170							Massive sulfide lens.
	4-59			40	200	800					0.0050	<0.0015				Ultramafic rock, slightly magnetic.
	5-59			123	200	3,300			0.00020		0.0050	<0.0015				Talus - fragments of serpentinite composed of antigorite with traces of chlorite and chromite.
	6-59			119	200	3,300			0.00020							Talus - loose fragments of ultramafic rock containing minute grain size sulfides with magnetite.
	7-59			119	100	3,300										Do
	8-59			116	100	3,200					0.0020	0.0020				Intensely fractured serpentinite composed of antigorite. Small amounts of chlorite and chromite detected.
	9-59			204	400	5,600					0.0030	0.0021				Talus - altered ultramafic rock breccia. Individual fragments show hydrothermal alteration.
	10-59			116	200	2,900					0.0008	0.0015				Intensely fractured fine-grained ultramafic rock with minute grain size sulfides. Rock is magnetic.
	AK17933	<3							0.00400†		<0.0100†	0.0290†				Pyrrhotite-pentlandite-chalcopyrite lens 2 ft wide in serpentinite.
	AK17934	0.005							0.00800†		0.0100†	0.0300†				200 lb channel sample of gabbro dike 12 ft wide.
	11-A		5	816	40,000	70,200			See AK 18701							Pyrrhotite-pentlandite lens 1 ft wide in serpentinite.
	11-B		5	32	300	500										Antigorite.
	13-A		6	179	8,000	14,600										4 ft channel sample of gabbro dike with pyrrhotite, chalcopyrite and pentlandite taken from south contact.
	13-B		5	162	9,700	14,500										4 ft channel sample of gabbro dike with pyrrhotite, chalcopyrite and pentlandite. Represents middle 4 ft.
	13-C				10,000	14,000										4 ft channel sample of gabbro dike with pyrrhotite, chalcopyrite and pentlandite taken from north contact.
	14			159	4,800	6,300										Pyrrhotite float.
	19	21		1180	12,000	114,100			0.009							Pyrrhotite lens 0.25 ft wide in serpentinite.
	27			109	<200	2,900					0.009	<0.0015				Serpentinite.
	29			111	<200	2,800	4	31								Vein of quartz, limonite, chlorite and pyrite, 20 ft wide.
	30			101	800	3,800					0.0013	<0.0015				Limonite-stained serpentinite.
	31-A			116	700	3,800			0.00015		0.0012	<0.0015				Intensly fracture serpentinite hanging wall of 31-B.
	31-B		2	186	4,300	7,400			0.0015		0.0155	0.015				Pyrrhotite-limonite lens 0.2 ft wide.

Emerick prospect rock analyses - Continued

Map no.	Sample no.	Geochemical Analyses[2] (ppm) Ag	As	Co	Cu	Ni	Pb	Zn	Fire Assay Analyses[1] (oz/ton) Au	Ir	Pd	Pt	Os	Rd	Ru	Description
	31-C			208	16,300	12,300			0.0045		0.036	0.02		—		Intensely fractured serpentinite footwall to pyrrhotite-limonite lens, 0.2 ft wide.
	32			1180	22,000	64,700			0.001		0.037	0.015		—		Intensely fractured serpentinite footwall to pyrrhotite-limonite lens, 0.6 ft wide.
	11-59			120	100	2,900					0.0017	0.0021		—		Intensely fractured fine-grained magnetic ultramafic rock.
	12-59			131	200	3,000					0.0014	0.002		—		Talus - fine grained magnetic ultrabasic rock fragments embedded in sandy fines. Rock fragments contain minute grain-size sulfides.
	13-59			136	200	3,100					0.001	0.0015		—		Do
	14-59			125	200	4,400					0.002	0.002		—		Talus - weathered fragments of ultramafic rock embedded in fines. Coarse and fine material are both magnetic.
	15-59			118	<100	3,700					0.0159	0.006		—		Serpentinite.
	16-59			103	100	3,900										Talus of ultramafic rock.
	17-59			104	100	2,000										Intensely fractured magnetic ultramafic rock.
	18-59			105	100	2,800										Talus of ultramafic rock.
	19-59			91	100	1,700										Serpentinite.
	20-59			107	<100	3,000										Small fragments of ultramafic rock with calcium carbonate coatings.
	21-59			105	<100	2,700										Partially serpentinized ultramafic rock breccia, with high fracture count.
	22-59			98	100	2,600					0.0006	0.0017		—		Intensely fractured magnetic ultramafic rock.
	23-59			112	100	2,700										Intensely fractured and weathered serpentinite.
	24-59			105	100	3,700										Intensely fractured serpentinite with garnierite coating some fractured planes.
	25-59			102	<100	2,300					0.004	0.004		—		Slightly magnetic fragments of serpentinite.
	26-59			127	<100	2,600					0.0014	0.002				
	27-59			94	<100	3,400										Intensely fractured talc - serpentinite.
	28-59			20	51	129										Blocky iron-stained, altered volcanic rock partly silicified with cryptocrystalline quartz. Chlorite and hydromussorite with traces of albite, oligolase, orthoclase and pyrite present. Provisionally identified as greenstone.
	29-59			11	46	54										Blocky iron-stained altered volcanic rock composed of hydromussorite, chlorite and some cryptocrystalline quartz. Traces of fine cubes of pyrite disseminated throughout the rock. Provisionally identified as greenstone.
	AK10645a								0.020		0.004	0.01				Grab sample from mineralized gabbro dike.
	AK10645b								0.01†		0.032†	0.03†				
	9A-59				700	1,300										Weathered chrysotile asbestos with seams 0.2 ft in serpentinite containing traces of chlorite and chromite.
	22A-59				100	2,700										Intensely fractured magnetic serpentinite with chromite and trace pyrite.

[1] PGE and Au were analyzed by Bondar-Clegg Laboratory, Denver, Colorado, using atomic absorption, except (†) were analyzed by USBM Reno Research Center, using ICP.
[2] Samples prefixed with 'AK' were analyzed by atomic absorption methods at TSL, all other geochemical analyses by assay methods, U.S. BuMines.

NOTE. - Blank assays indicate no analysis was done.

TABLE 1-1. - Emerick Prospect Rock Analyses

Map no.	Sample no.	Geochemical Analyses 2/ Ag	As	Co	Cu	Ni	Pb	Zn	Fire Assay Analyses 1/ Au	Ir	Pd	Pt	Rd	Ru	Description
	33-A		5 %	1450	4000	79,900			0.0015		0.050 .049	0.022 .021			Massive sulfide lens in serpentinite.
	33-1		5	226	1500	14,400			0.003						Oxidized zone 5.35 ft wide. Channel sample No. 1 is .65 ft
	33-2		2	151	1300	7,500			0.00015						" 2 .9
	33-3		5	98	1300	6,600			0.00075						" 3 2.1
	33-4		5	47	1200	3,500			0.0018						" 4 .6
	33-5		5	320	2500	11,800			0.001						" 5 1.1
	1-59			52	<100	600					0.0004	<0.0015			Talus - fragments of partially siliceous ultramafic rock composed of serpentinite, probably antigarite and chlorite and a trace of augite. Chromite occurs in grain size of 250 mesh and coarser.
	2-59			114	500	3,300					0.002	0.002			Intensely fractured serpentinite composed of antigorite, chlorite and a trace of augite. Chromite occurs in grain size of 250 mesh and coarser.
	3-59			900	3,900	59,500			0.0017						Massive sulfide lens.
	4-59			40	200	800					0.005	<0.0015			Ultramafic rock, slightly magnetic.
	5-59			123	200	3,300			0.00015		.005	<0.0015			Talus - fragments of serpentinite composed of antigorite with traces of chlorite and chromite.
	6-59			119	200	3,300			0.00015						Talus - loose fragments of ultramafic rock containing minute grain size sulfides with magnetite.
	7-59			119	100	3,300									Do
	8-59			116	100	3,200					0.002	0.002			Intensely fractured serpentinite composed of antigorite. Small amounts of chlorite and chromite detected.
	9-59			204	400	5,600					0.003	0.0021			Talus - altered ultramafic rock consisting of some coarse fragments embedded in fines. Individual fragments show hydrothermal alteration.
	10-59	<3		116	200	2,900					0.0008	0.0015			Intensely fractured fine-grained ultramafic rock with minute grain-size sulfides. Rock is magnetic.
	AK17933	<0.1 oz							0.004 oz T		<0.01 oz T	0.029 oz T			Pyrrhotite - pentlandite - chalcopyrite lens 2 ft wide in serpentinite
	AK17934	0.148 oz							0.008 oz T		0.016 oz T	0.030 oz T			200 pound channel sample of gabbro dike 12 ft wide
	11-A	5		5	816	40,000	70,200								Pyrrhotite - pentlandite lens 1 ft wide in serpentinite
	11-B			5	32	300	500								antigorite
	13-A			6	179	8,000	14,600								4 ft. Channel sample of gabbro dike with pyrrhotite, chalcopyrite and pentlandite.
	13-B			5	162	9,700	14,500								4A. Do
	13-C					10,000	14,000								4B. Do
	14				159	4,800	6,300								Pyrrhotite float
	19	21			1180	12,000	114,100		0.009						Pyrrhotite lens .25 ft wide in serpentinite
	26				<200	100									
	27				109	<200	2,900				0.009	<0.0015			Serpentinite
	29				111	<200	2,800	4	31						Vein of quartz, limonite, chlorite and pyrite, 20 ft wide.
	30				101	800	3,800					0.0013	<0.0015		Limonite-stained serpentinite
	31-A				116	700	3,800			0.00015		0.0012	<0.0015		Intensly fracture serpentinite hanging wall of 31-B
	31-B			2	186	4,300	7,400			0.0015		0.0155	0.015		Pyrrhotite-limonite lens .2 ft wide

Indicate — parts per million

oz per ton

? All Pd Pt should show 4 places (.000X) follow convention

(?) ified ^ magnetite,

breccia.

Taken from south contact
Represents middle 4 ft
taken from north contact

Emerick prospect rock analyses - Continued

Map no	Sample no.	Geochemical Analyses 2/ Ag	As	Co	Cu	Ni	Pb	Zn	Fire Assay Analyses 1/ Au	Ir	Pd	Pt	Os	Rd	Ru	Description
	31-C			208	16,300	12,300			0.0045		0.036	0.02				Pyrrhotite - limonite lens, .2' wide / Intensely fractured serpentinite footwall to
	32			1180	22,000	64,700			0.001		0.037	0.015				Pyrrhotite - limonite lens .6' wide / " " "
	11-59			120	100	2,900					0.0017	0.0021				Intensely fractured fine-grained magnetic ultramafic rock.
	12-59			131	200	3,000					0.0014	0.002				Talus - fine grained magnetic ultrabasic rock fragments embedded in sandy fines. Rock fragments contain minute grain-size sulfides.
	13-59			136	200	3,100					0.001	0.0015				Do
	14-59			125	200	4,400					0.002	0.002				Talus - weathered fragments of ultramafic rock embedded in fines. Coarse and fine material are both magnetic
	15-59			118	<100	3,700					0.0159	0.006				Serpentinite.
	16-59			103	100	3,900										Talus - small fragments of ultramafic rock.
	17-59			104	100	2,000										Intensely fractured magnetic ultramafic rock.
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	21-59			105	<100	2,700										Partially serpentinized ultramafic rock breccia, with high fracture count.
	22-59			98	100	2,600					0.0006	0.0017				Intensely fractured magnetic ultramafic rock.
	23-59			112	100	2,700										Intensely fractured and weathered serpentinite.
	24-59			105	100	3,700										Intensely fractured serpentinite with garnierite coating some fractured planes.
	25-59			102	<100	2,300					0.004	0.004				Slightly magnetic fragments of serpentinite.
	26-59			127	<100	2,600					0.0014	0.002				Refer to original copy please.
	27-59			94	<100	3,400										Intensely fractured talc - serpentinite.
	28-59			20	51	129										Blocky iron-stained, altered volcanic rock partly silicified with cryptocrystalline quartz. Chlorite and hydromussorite with traces of albite, oligolase, orthoclase and pyrite present. Provisionally identified as greenstone.
29	29-59			11	46	54			.022		.004	.01	2nd Run			Blocky iron-stained altered volcanic rock composed of hydromussorite, chlorite and some cryptocrystalline quartz Traces of fine cubes of pyrite disseminated throughout the rock. Provisionally identified as greenstone.
	AKRB10645								0.01†		0.032†	0.03†				Grab sample from mineralized gabbro dike.
	9A-59				700	1,300										Weathered chrysotile asbestos with seams 0.2 ft wide enveloped in serpentinite containing traces of chlorite and chromite.
	22A-59				100	2,700										Refer to original please. Intensely fractured magnetic serpentinite with chromite and trace pyrite.

1/ PGE and Au were analyzed by Bondar-Clegg Laboratory, Denver, Colo. using atomic absorption, except (†) where analyzed by USBM Reno Research Ctr. using ICP.

2/ Samples prefixed with 'AK' were analyzed by atomic absorption methods at BTSL, all other Geochemical analyses by assay methods, U.S. Bureau of Mines.

Std F.N.

blank assays indicate no analysis was done

The dike is composed of an olivine gabbro containing pyrrotite, pentlandite, chalcopyrite and rare bornite. Nickel predominates over copper, but unlike the massive sulfide occurrences (7:1) the ratio is only approximately 1.3:1.

Several lines of soil samples were collected on the west side of the terrace to determine if the dike persisted over the intervening covered 2500 ft (fig. 1-5). Analyses for Cu and Ni presented on table 1-2 indicate slightly anomalous soils near sample AK 17944, however, this may be due to nearby serpentinite outcrops. No conclusions could be drawn regarding possible westward extension of the dike.

During the Bureau's investigation in 1963, a ground magnetometer survey was performed over the vicinity of the Emerick prospect.[4]

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[4] Magnetometer survey by B. Thomas, 1963.

A contoured interpretation is displayed on figure 1-5 (back pocket). Of particular interest is the prominent 6000 gamma dipole located several hundred feet west of, and on approximate strike with, the mineralized dike outcrop.

Nickel content of the typical samples of the serpentinized pyroxenite body grades 0.1 to 0.4%. Assays of this rock have been of interest to previous prospectors, however, there is no petrographic evidence that the Ni occurs as discrete sulfide or oxide minerals, but rather is locked up as a silicate compound and consequently of little economic value. Magnetic and floatation concentration tests on metallurgical bulk samples were found to not enhance the nickel content.[5] Nor was

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[5] Written communication, W. R. Lessick, Supervising Chemist, Albany Research Center, USBM, 1958, on file with USBM, Fairbanks, Alaska.

1-5

Figure ~~E-6~~

0' 1000'

Scale 1" = 1000'

Overlay Emeric Copper-Nickel Prospect

~~1981 Soil Samples.~~

~~Rainbow Mtn.~~

TABLE 1-2. - Soil sample analyses from the Emerick Prospect (1981)[1]

Map No.	Sample No.	Cu	Ni	Description
	AK 17959	24	110	Wet tundra soil.
	AK 17960	26	86	Light brown sandy clay soil.
	AK 17961	29	87	Rust colored silt and till.
	AK 17962	33	89	Wet sandy soil and glacial till.
	AK 17963	20	33	Gritty clay soil, iron-colored.
	AK 17964	23	37	Moist brown sandy soil.
	AK 17965	19	44	Crumbly, brown sandy soil.
	AK 17966	41	130	Moist sandy soil, somewhat rocky.
	AK 17967	41	51	Sandy moist soil - green to tan - near creek mouth.
	AK 17968	105	320	Sandy soil with some pebbles.
	AK 17969	110	365	Rocky soil.
	AK 17970	67	105	Soil and till, serpentinite bedrock, some quartz veins with trace chalcopyrite.
	AK 17971	46	83	Sandy organic soil - bedrock serpentinized andesite.
	AK 17972	110	290	Silt, sand, till.
	AK 17973	135	490	Dark sandy soil, serpentinite rock chips.
	AK 17974	515	2900	Dark sandy soil, serpentinite chips.
	AK 17975	77	565	Do
	AK 17976	58	610	Rocky serpentinite soil.
	AK 17977	82	115	Soil, bedrock serpentinized gabbro, andesite porphry.
	AK 20361	120	1350	Black soil with serpentine rock chips.
	AK 20362	265	2300	Red-brown soil and serpentine with quartz veinlets.
	AK 20363	89	690	Weathering serpentinite.
	AK 20364	285	1750	Iron-stained soil.
	AK 20365	37	46	Brown soil.
	AK 20366	62	135	Do

[1] Analyses by atomic absorptions methods at TSL Laboratories, Spokane, Wa.

TABLE 1-2. - Soil sample analyses from the Emerick Prospect (1981)[1]

Map No.	Sample No.	Cu	Ni	Description
	AK 17959	24	110	Wet tundra soil.
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	AK 17965	19	44	Crumbly, brown sandy soil.
	AK 17966	41	130	Moist sandy soil, somewhat rocky.
	AK 17967	41	51	Sandy moist soil - green to tan - near creek mouth.
	AK 17968	105	320	Sandy soil with some pebbles.
	AK 17969	110	365	Rocky soil.
	AK 17970	67	105	Soil and till, serpentinite bedrock, some quartz veins with chalcopyrite.
	AK 17971	46	83	Sandy organic soil - bedrock serpentinized "andesite".
	AK 17972	110	290	Silt, sand, till.
	AK 17973	135	490	Dark sandy soil, serpentinite rock chips.
	AK 17974	515	2900	Dark sandy soil, serpentinite chips.
	AK 17975	77	565	Do
	AK 17976	58	610	Rocky serpentinite soil.
	AK 17977	82	115	Soil, bedrock serpentinized gabbro, andsite porphry.
	AK 20361	120	1350	Black soil with serpentine rock chips.
	AK 20362	265	2300	Red-brown soil and serpentine with quartz veinlets.
	AK 20363	89	690	Weathering serpentinite.
	AK 20364	285	1750	Iron-stained soil.
	AK 20365	37	46	brown soil
	AK 20366	62	135	" "

1 Analyses by atomic absorptions methods at TSL Laboratories, Spokane, Wash.

concentration of the nickel content upgraded by screen sizing. Copper content of the serpentinites is typically only several hundred parts per million. Analysis indicates a low level but persistent presence of platinum and paladium.

GLACIER LAKE PROSPECT - MAP LOCALITY 2

See AK 18660

Previous Work and Location

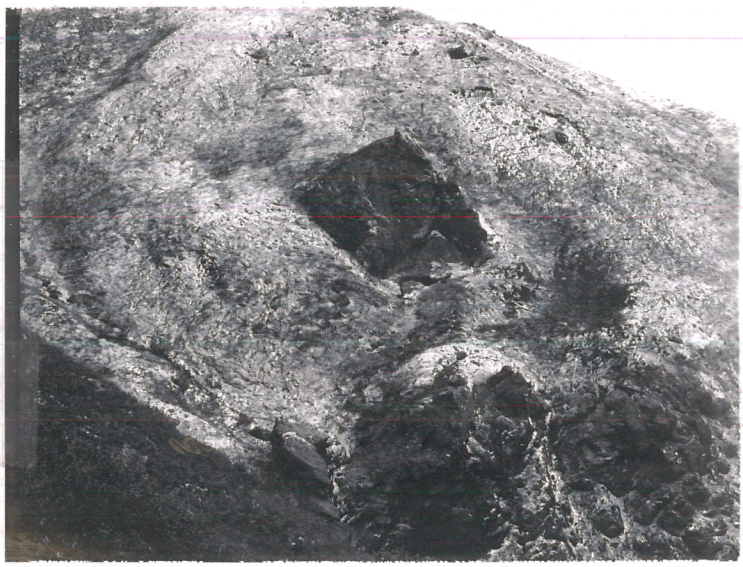
A large slump block of hornblende quartz diorite (figure 2-1) contains a two to three foot thick zone that is mineralized with nickel and copper sulfides. Mineralization as massive sulfide lenses also occurs in underlying serpentinized peridotite. The prospect (location 2) was found by University of Alaska personnel in 1963 while conducting a mapping project in the area, (Hanson, (1), p. 71) and is located at an elevation of approximately 3700 ft. Hanson reported values up to 6% Cu, 1.5% Ni and 0.4 oz Au in samples from the quartz diorite occurrence, and 1.1% Cu, 6.6% Ni, and 0.04 oz Au in a single sample from the massive sulfide lens. Cobalt and PGE values were not determined.

In 1962, claims were staked by Emerick to cover the newly discovered occurrence which is about 1.5 miles east of the principle Emerick prospect. There was no evidence found that indicated the claims to be currently active. The occurrence is referred to herein as the Glacier Lake prospect after the name given to it by Hanson (1963), Rose (1965).

Mineral Investigation

The exposed mineralization (figure 2-2) is approximately 25 feet in strike length and two to three feet thick along the north face of a small knob. Serpentinized basalt rubble in the area suggests the mineralized zone was formerally in contact with the serpentinite. Sample AK 17913 was a chip sample of the sulfide zone and contained 1.35 percent Cu,

A



B

A & B

FIGURE 2-1 — Glacier Lake Prospect. Mineralization occurrs along the left face of the triangular-shaped ~~outcrop~~ block of quartz diorite. ~~M-1~~ Photos by B. Thomas, 1962

2.20 percent Ni, 0.067 percent Co (see table 2-1). Gold and platinum group elements totaled ____ oz/ton. Both the mineralization and the host quartz diorite contain abundant quartz veining. Gypsum is found on the weathering surface. Feldspar has partially altered to epidote.

Prospect pits approximately 75 feet uphill of the quartz diorite outcrop have exposed a lens of massive pyrrhotite, chalcopyrite, and pentlandite cubanite[3/] at the contact of the serpentinite and quartz diorite. Disseminated mineralization extends several feet into the wall rock. Channel samples and assays are shown on table 2-1. Wisps and grains of sulfides occur locally in the serpentinite elsewhere such as at sample location AK 17914.

Very little, in-place bedrock is exposed in the vicinity of the Glacier Lake Prospect. Figure 2-2 is compiled principally from rubble and skree mapping. It is likely that the mineralized quartz diorite outcrop is a gravity displaced body from the serpentinite-quartz diorite south contact further up-slope. This would account for the apparent lack of geologic continuity and suggests that the exposed mineralization was formerly continuous with that observed in the prospect pit to the south. The mineralized contact could not be followed further in either direction due to thicker skree on the slopes.

Approximately 800 ft northeast of the prospect there is abundant rubble of hornblende gabbro containing disseminated sulfides with some boulders containing up to 10 percent pyrrhotite + pentlandite + chalcopyrite (see sample 20327, table 2-1). These boulders occur along a lateral moraine and, while probable, it could not be determined if the source was local.

3/. Identified by W. Gnagy, 1962, USBM, Juneau, Alaska

TABLE 2-1. - Sample analyses from the Glacier Lake Prospect

Map No.	Sample No.†	Geochemical Analyses (ppm) Ag	Co	Cu	Ni	Pb	Zn	Fire Assay Analyses* (oz/ton) Au	Pd	Pt	Os	Ir	Ru	Rh	Description
	56-RM-64			2,800	6,900										Fragmented serpentinite with pyrrhotite and minor Cu stain.
	57-RM-64			9,200	1,700										Earthy yellow-brown serpentinite with dense masses containing pyrrhotite.
	58-RM-64		100	10,600	3,800										Fragmented serpentinite with minor pyrrhotite, iron-staining and dense sulfide masses.
	59-RM-64			2,800	4,800										Fractured quartz diorite with green stain.
	62-RM-64			13,800	13,400										Segregated collection of dense masses from sample No. 58-RM-64.
	63x-RM-64			1,500	5,000										Blocky serpentinite, selected pieces for lower degree of alteration and weathering.
	65-RM-64			1,400	6,300										Serpentinite (dike?).
	66-RM-64			700	2,400										Serpentinite.
	AK 17913	4.90	580	13,500	22,000	41	74	<0.0004	0.0290	0.0210	N	N	N	N	Chip sample across mineralized zone in quartz diorite. No Ir, Os, Ru or Rh.
	AK 17914		195					<0.0002	0.0013	<0.0010	N	N	N	N	Chips of serpentinite with wisps of pyrrhotite. No Ir, Os, Ru, Rh.
	AK 17915		100	96	2,400			<0.0002	<0.0003	<0.0003					Dense partially serpentinized peridotite (dike?).
	BIT-1-64			6,800	26,000										10 ft chip sample across face.
	BIT-2-64			12,300	10,000										Do
	BIT-3-64			10,700	14,000										Do
	BIT-4-64			7,500	20,000										13 ft chip sample across face.
	AK 20325		58	240	530										Green clay-rich soil.
	AK 20327			1,900	1,950			0.0010	<0.0003	<0.0003	N	N	N	N	Partially serpentinized olivine hornblendite to hornblende gabbro, some alteration to epidote; 10 percent pyrrhotite + pentlandite + chalcopyrite. Site is located approximately 800 ft NE of the prospect. Not shown on figure 2-2.

† Samples suffixed with 64 were collected by U.S.BuMines personnel in 1964; those analyses were by chemical assay by USBM. Samples prefixed with 'AK' were analyzed by atomic absorption, TSL Laboratories, Spokane, Washington.

* Au and PGE were analyzed by fire assay preconcentrations followed by ICP technique, Reno Research Center, Reno, Nevada.

RED ROCK CANYON - MAP LOCALITY 3

Location

A narrow steep-walled canyon (location 3), located approximately two-thirds of a mile south of the Emerick prospect, has apparently formed as a result of erosion by an ancient channel or tributary of the Delta River (fig. 3-1). Presently there is no water course through the canyon. Several excellent and fresh exposures of bedrock could be examined where the Alaska Highway Department has recently excavated rip-rap material.

Previous Work

Bedrock geology and mineral reconnaissance of the Red Rock Canyon area was first formerly reported on by Hanson, 1963 (1), who grouped the volcano-sediments into the Rainbow Mountain Sequence.

Hanson noted "several 2-3 inch veins striking 355°, 45° E, in a small swarm" which contained chalcopyrite and galena, site A, figure 3-2. He reported an assay of 1.6% Cu, 2.0% Pb, 2.4 oz Ag and trace gold. At site B a "1.5 foot replacement zone bordered a vein" had an attitude of 270°, 65° S, with an assay of 0.2% Cu, 0.4% Pb and trace Ag and Au. Site X is reportedly a mineralized conglomerate containing unspecified amounts of pyrite and chalcopyrite. The area, which was found to be several hundred square feet in size assayed 0.12 oz of gold.

Mineral Investigation

The canyon has been cut into bedrock of the Rainbow Mountain Sequence (figure 3-2). Rocks are light green in color and consist of graywacke, and volcano-clastics. The rock has been extensively silicified and chloritized. The sequence has also been intruded by a series of north-

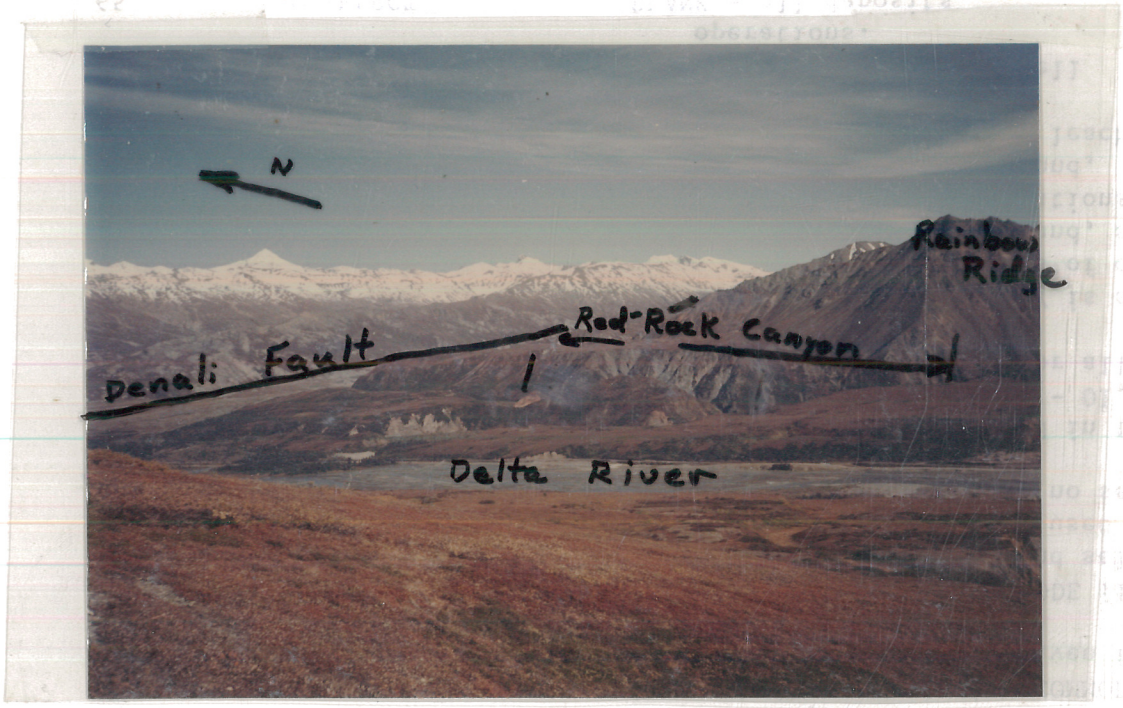


FIGURE 3-1 - Red Rock Canyon - View from the west in the vicinity of Ann Creek.

22 FIGURE 3-2- Mineral Occurrences in the Red Rock Canyon area.

west trending diabase to gabbroic dikes, and large sill-like porphyritic andesite bodies.

The volcano-clastic rocks and andesitic sills of the canyon have been cut by numerous narrow quartz veinlets with a predominating northward orientation. The veinlets were usually 1/8 to 1/4 of an inch thick, although they occasionally were found up to 3/4 of an inch. Typically two or three such veinlets occurred in any square foot of bedrock exposure. Grains of pyrite, chalcopyrite and rare bornite occur along the veinlets. Epidote is also a common accessary mineral. Pyrite and occasional chalcopyrite can also be found as discrete grains in the wall rock for several inches to either side of the more mineralized veins. The mineralized veinlets appear to account for large, impresssive areas of malachite staining that can be seen on the overhanging cliffs. Measurements of the prevailing attitude of the veinlets agreed with Hanson's observation of northerly to northwest strike.

Several barren quartz veins, two to three feet thick were observed in the canyon, as well as at least two breccia/fault zones. Only traces of copper mineralization were identified in the breccia (AK 17928, table 3-1) material, although considerable pyrite and iron-staining were present. At sample location no. AK 20293, chalcopyrite and pyrite occur throughout a quartz vein 2 to 4 ft wide. The vein strikes 115° and is exposed for at least 40 ft.

The copper showings occur randomly for 1/3 mi along the east side of the canyon. This quartz-veinlet mineralization could possibly constitute a large tonnage copper-silver-gold resource but with grades well below economic levels (AK 17927). Further investigation, however, would appear warranted to determine if areas of more intense quartz

TABLE 3-1. - Sample analyses from the Red Rock Canyon area

Sample No.†	Ag	Au	Co	Cu	Ni	Pb	Zn	Description
59-30	<0.1	<0.001		400				Chip sample from 1.5 ft wide copper-stained zone in greenstone which is composed of chlorite, epidote, cryptocrystalline quartz, quartz, calcite, pyrite and hydromuscovite. Zone strikes 337°, dipping 50° SW.
59-31	<0.1	<0.001		85,700				Sample of a chalcopyrite vein 0.25 ft wide hosted in greenstone.
59-32	<0.1	<0.001		600				Pyrite vein, 0.3 ft wide, along hanging wall of minor fault in greenstone, striking 253°, dipping 70° SW.
59-33	<0.1	<0.001		14,300				Chalcopyrite, pyrite, malachite veinlet, 0.25 ft wide, in greenstone, striking 018°, dipping 86° SE.
59-34	<0.1	<0.001		200				Greenstone chip sample composed of hydromuscovite, chlorite, calcite, and quartz.
59-35	0.1oz	0.01oz						Altered volcanic rock composed of hydromuscovite with chlorite, oligoclase, cryptocrystalline quartz. Traces of limonite, pyrite, and quartz are present.
59-37	20	0.045	33	22,000	34			A 2 ft wide pyritic quartz vein cutting greenstone, striking north and dipping 77° W.
59-38	32	0.055	9	6,300	41			Chip sample composed partly of vein quartz and barite with limonite and partly of altered volcanic rock containing hydromuscovite, chlorite and pyrite.
	0.18oz	0.001oz						
59-39	1.10	0.020	8	11,000				Chip sample of quartz vein with pyrite cutting greenstone, vein is 2.5 ft wide and strikes west.
AK17927	0.40		26	600		28	790	Chip samples across andesite rubble slope with more abundant quartz veinlets and copper minerals.
AK17928	13		17	21,000	11	40	165	Breccia zone in altered graywacke(?), 4 ft thick with abundant pyrite and iron staining.
AK17929	11.20		28	18,000	58	230	12	Chips from typical float of pyrite-rich zone(s) of unknown width.
AK17930	0.93		19	1,700	11	30		Chips from andesite rubble with copper-bearing quartz veinlets.
AK17931								Float rock from vuggy, leached, silicified breccia zone of unknown width (exceeding 1 ft) in canyon wall; contains angular clasts of graywacke, interstitual pyrite and chalcopyrite.
AK20293		<0.0002	13	6,800				Chip sample across chalcopyrite vein 2 to 4 ft thick in andesite.
AK20367		0.001	10	25,000				Sulfide lense (2 by 6 ft) within above quartz vein.

† Samples prefixed by 59 were collected by USBM personnel of 1959; analyses are by chemical assay, USBM. All other analyses by atomic absorption, TSL Laboratories, Spokane, Washington.

TABLE 3-1. - Sample analyses from the Red Rock Canyon area

Sample No.	Ag	Au	Co	Cu	Ni	Pb	Zn	Description
59-30	<.1	<.001		400				Chip sample from 1.5 ft wide copper-stained zone in greenstone which is composed of chlorite, epidote, cryptocrystalline quartz, quartz, calcite, pyrite, and hydromuscovite. Zone strikes 337°, dipping 50° SW.
59-31	<.1	<.001		85,700				Sample of a chalcopyrite vein 0.25 ft wide hosted in greenstone.
59-32	<.1	<.001		600				Pyrite vein, 0.3 ft wide, along hanging wall of minor fault in greenstone, striking 253°, 70° SW.
59-33	<.1	<.001		14,300				Chalcopyrite, pyrite, malachite veinlet, 0.25 ft wide, in greenstone, striking 018°, 86° SE.
59-34	<.1	<.001		200				Greenstone chip sample composed of hydromuscovite, chlorite, calcite, and quartz.
59-35	0.10 oz	0.01 oz						Altered volcanic rock composed of hydromuscovite with chlorite, oligoclase, cryptocrystalline quartz. Traces of limonite, pyrite, and quartz are present.
59-37	20.00	0.045	33	22,000	34			A 2 ft wide pyritic quartz vein cutting greenstone, striking north and dipping 77° W.
59-38	32.00	0.055	9	6,300	41			Chip sample composed partly of vein quartz and barite with limonite and partly of altered volcanic rock composed of hydromuscovite, with chlorite and pyrite.
59-39	.18 oz	.001 oz						
	1.10	0.020	8	11,000				Chip sample of quartz vein with pyrite cutting greenstone, vein is 2.5 ft wide and strikes west.
AK17927	0.40		26	600		28	790	Chip samples across andesite rubble slope with more abundant quartz veinlets and copper minerals.
AK17928	13.00		17	21,000	11	40	165	Breccia zone in altered graywacke(?), 4 ft thick with abundant pyrite and iron staining.
AK17929	11.20		28	18,000	58	230	12	Chips from typical float of pyrite-rich zone(s) of unknown width.
AK17930	0.93		19	1,700	11	30		Chips from andesite rubble with copper-bearing quartz veinlets.
AK17931								Float rock from vuggy, leached, silicified breccia zone of unknown width (exceeding 1 ft) in canyon wall; contains angular clasts of graywacke, interstitual pyrite and chalcopyrite.
AK20293		<0.0002	13	6,800				Chip sample across chalcopyrite vein 2 to 4 ft thick in andesite.
AK20367		0.001	10	25,000				Sulfide lense (2 by 6 ft) within above quartz vein.

+ Samples prefixed by 59- were collected by USBM personnel of that year; analyses are by wet chemical, USBM. assay. All other analyses by atomic absorption, TSL Laboratories, Spokane, Wash.

Floodplain gravels are composed predominently of diorites, cherts, quartz with lesser amounts of tan sandy limestone cobbles, schist, and mafic/untramafic material.

A lode gold prospect was reported by the present owner, to occur on the West Fork of Phelan Creek. A short adit is supposed to have been driven on the showing, however, no evidence was found during this investigation.

The extensive moraines of the Gulkana and College Glaciers offered an excellent opportunity to examine a variety of bedrock materials derived from the ice-covered region to the north which borders the Denali Fault. Samples were collected from 6 various mafic/ultramafic lithologies as described in table 4-2 (fig. 4-1). All contained trace to subordinate sulfides, predominently as pyrrhotite. Trace level PGE was detected in half of the samples indicating source rocks are available to provide PGE to placer formation.

CANWELL ASBESTOS - MAP LOCALITY 5

A partially serpentinized dunite body contained abundant parallel asbestos veinlets. The asbestos occurred as rubble only so orientation of mineralizations could not be determined. This is the vicinity of an observation by Hanson (1, p. 73) of "small veinlets of cross-fiber chrysotile along the northern margin" of the dunite body. No further details were given.

The abestos is cross-fiber (figure 5-1) and confirmed as serpentine asbestos by x-ray diffraction. Fiber length was quite short, ranging from 1/32 to 3/32 in. in length. Nowhere was the length found to exceed 1/4 in.

FIGURE 5-1 Asbestos bearing serpentinized dunite, Cresswell #5

The dunite is bordered on the north (figure 5-2) by a narrow-zone of serpentinized (olivine hornblendite [AK 17888]) with a possible intrusive contact. This in turn is bordered by pyroxene gabbro.

To the south is a limonitic sulfide zone approximately 4 to 8 feet wide and exposed along strike for several hundred feet. Only pyrrhotite was recognized in the green silicious groundmass. The sulfide zone is hosted by the quartz diorite, but lies close to and nearly parallel of the dunite contact.

Similar chrysotile asbestos-bearing serpentinite was occasionally observed as float rock in Ann Creek 2 to 3 mi above the mouth. In one sample, asbestos cross-fiber up to 1/4 in was found.

A stream sediment sample (AK 17889) contained slightly anomalous Co, Cu and Ni values, but this is probably due to the serpentinization of ultramafic bedrock.

In 1966, Rose (6), reported occasional small veins of chrysotile asbestos up to 1/4 inch wide to be present in dunite outcrops of the Broxson Gulch area. While some prospecting appeared to have been attempted there was no evidence that significant mineralization was discovered.

CANWELL PROSPECT - MAP LOCALITY 6

A quartz diorite to granodiorite intrusion south of the Canwell Glacier (figure 6-1) hosts a copper, nickel, and cobalt-bearing zone (location 6). The mineralization consists of frost fractured rubble and several poorly exposed outcrops in a gulch. Width of the zone exceeds several feet and occurs near the peridotite (dunite) contact. No estimate of strike length was possible due to accumulation of skree

TABLE 5-1. - Analyses of samples from the Canwell Asbestos area

Sample No.	Ag	Co	Cu	Ni	Pb	Zn	Au	Pt	Pd	Type	Description
								(ppm)		(oz/ton)	
AK17888										Rock Speciman	Fine grain mafic hornblende gabbro grading to hornblende pyroxenite.
AK17889	3.5	76	103	980	27	58				Stream Sediment	
AK17891	1.4	34	25	13	19	115		<0.001	<0.001	Rock	Sulfide and gosson zone, 4 to 8 ft wide in quartz diorite near dunite contact.
AK17892										Rock Speciman	Serpentine asbestos in abundant parallel veinlets up to 1/8 in wide. Cutting dunite.

Samples suffixed with AK were analyzed by atomic absorption methods by TSL Laboratories, Spokane, Washington.

Au and PGE were analyzed by fire-assay preconcentrations followed by ICP technique, Reno Research Center, Reno, Nevada.

TABLE 5-1. - Analyses of samples from the Canwell Asbestos area

Sample No.	Ag	Co	Cu	Ni	Pb	Zn	Au	Pt	Pd	Type	Description
AK17888										Rock Speciman	Fine grain mafic hornblende gabbro grading to hornblende pyroxenite.
AK17889	3.5	76	103	980	27	58				Stream Sediment	
AK17891	1.4	34	25	13	19	115		<0.001	<0.001	Rock	Sulfide and gosson zone, 4 to 8 ft wide in quartz diorite near dunite contact.
AK17892										Rock Speciman	Serpentine asbestos in abundant parallel veinlets up to 1/8 in wide. Cutting dunite.

ppm / TSL / Reno / oz/t

Std FN

AA @ TSL

Fire Assay ICP Reno

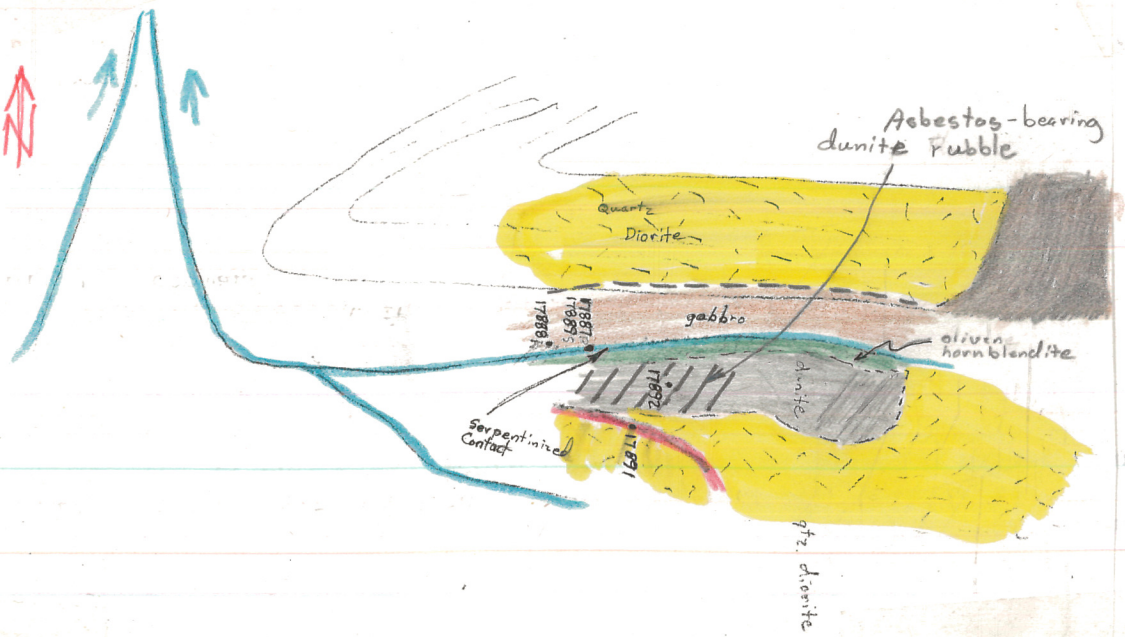


FIGURE ~~B~~ 5-2 - Canwell Asbestos Prospect

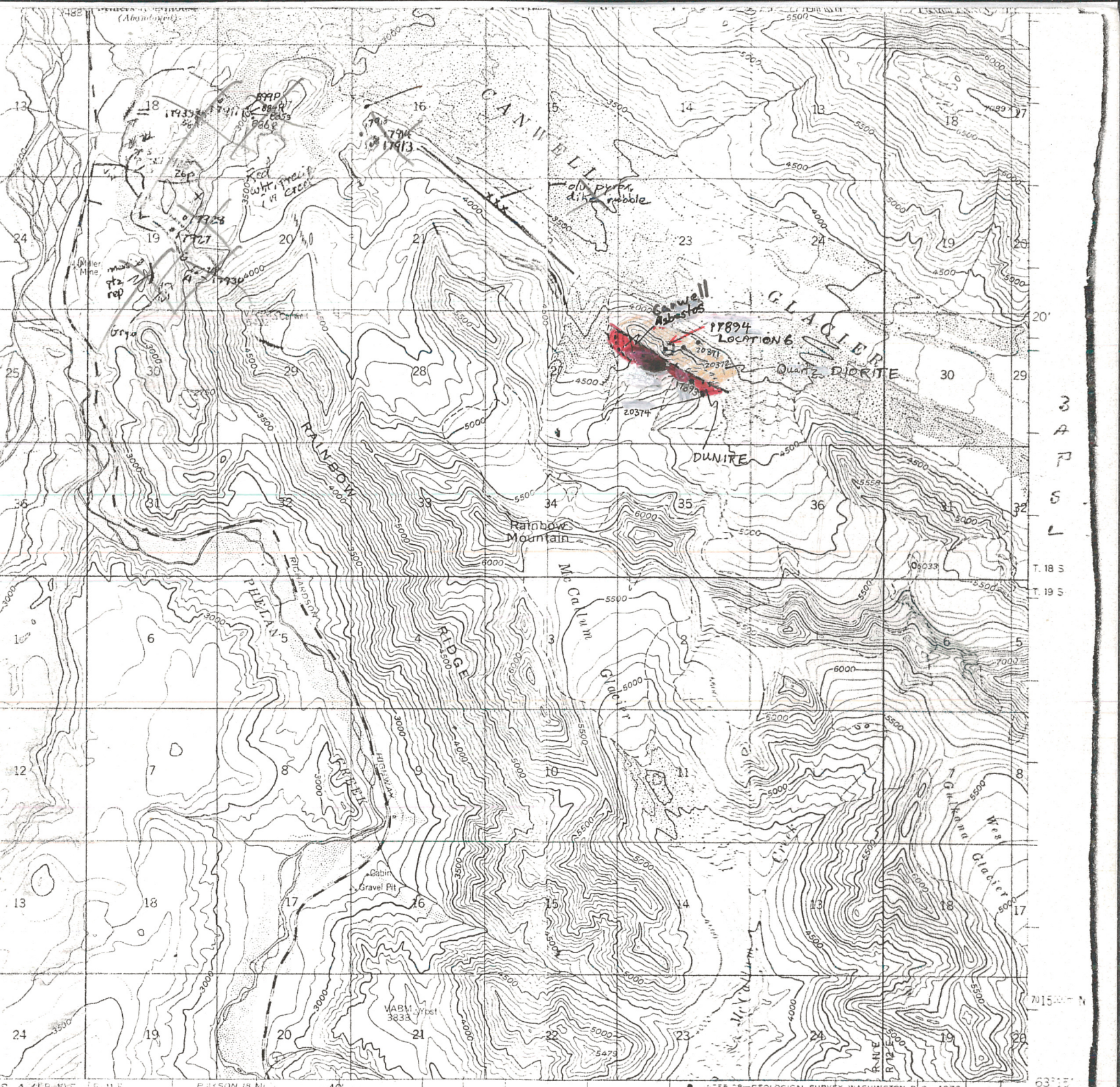


FIGURE 6-1 — Location of the Canwell Prospect

TABLE 6-1. - Sample analyses from the Canwell prospect

Sample no.	Sample type	ppm Ag	Co	Cu	Ni	Pb	Zn	oz/T Au	Pt	Pd	Os	Ir	Ru	Rh	Description
AK17893	rock			140	2,100			<.001	<0.001	0.0094	N	N	N	N	Dunite with chromite spinel (<1%) and traces of malachite.
AK17894	rock	11.2	340	15,500	26,500	32	45	<.001	400 ppb 0.012	600 0.017	100 0.0030	N	75 0.0022	45 0.0013	Sulfide zone >2 ft thick in altered quartz ~~chl~~di orite.
AK20371	rock	<1	10	610				<.001							Silicified zone about 10 ft thick with pyrite and chalcopyrite.
AK20372	rock	3	34	400				<.001							Silicified zone about 2 ft thick with pyrite and malachite.
AK20374	rock							0.001	<0.0003	0.0026					Dunite boulder with 1/4 in vein of chalcopyrite.

Samples suffixed with AK were analyzed by atomic absorption methods by TSL Laboratories, Spokane, Washington.

Au and PGE were analyzed by fire-assay preconcentrations followed by ICP technique, Reno Research Center, Reno, Nevada.

Blank assays indicate no analysis was done.

TABLE 6-1. - Sample analyses from the Canwell prospect

Sample no.	Sample type	Ag	Co	Cu	Ni	Pb	Au	Pt	Pd	Zn	Os	Ir	Ru	Rh	Description
AK17893	rock	<1		140	2,100		<.001	<0.001	0.0094		N	N	N	N	Dunite with chromite spinel (<1%) and traces of malachite. No Ir, Ru, Os, Rd.
AK17894	rock	11.2	340	15,500	26,500	32	<.001	0.012	0.017	45	0.0030	N	0.0022	0.0013	Sulfide zone >2 ft thick in altered quartz chlorite.
AK20371	rock	<.1	10	610			<.001								Silicified zone about 10 ft thick with pyrite and chalcopyrite.
AK20372	rock	3	34	400			<.001								Silicified zone about 2 ft thick with pyrite and malachite.
AK20374	rock						0.001	<0.0003	0.0026		N	N	N	N	Dunite boulder with 1/4 in vein of chalcopyrite. No Ir, Os, Ru, Rh detected.

Std Fn's PGE by Fire assay ICP Rand

others - TSL

blank assay - - -

to either side of the gulch. Test pits will be necessary for further evaluation.

Analyses of a mineralized random chip sample (AK 17894) indicated metal values similar to the gabbro dike at the Emerick Prospect. Total platinum group metal content is 0.0355 oz/ton.

Pervasive chloritic-hematitic alteration occurs in the quartz diorite of this area. Irregular pyritic zones associated with silicification (e.g. AK 20371) are common as well and were found with malochite and traces of chalcopyrite. Dacite dikes also occur in the area but carry no mineralization.

The quartz diorite body did not appear to be in fault contact with the dunite to the south but is bounded by Denali Fault to the north. The quartz diorite/granodiorite is believed to be intruded by the dunite [Kleist, 1972, (3)]. Kleist reported a K-Ar date for granodiorite to yield 83 m.y. (1971).

Several very small occurrences of copper mineralization were observed in the dunite. Samples AK 17893 and 20394 both contained traces of palladium.

ANN CREEK - MAP LOCALITY 7

Previous Work

Claims in the area of a Cu-Ni prospect were staked in _____ by R. Emerick and his associates but now appear to be inactive. The last know assessment work on these claims was in ____. Rose (5, p. 25) examined the prospect and described the local geology consisting of a east-west zone of ultramafic and gabbroic rocks bordered to the south by andesitic and dactic volcanics. He suggested that the ultramafic rocks of dunite and peridotite, and mafic gabbro are a sequence which had been

intruded along a fault.

A sample of a massive sulfide lens reportedly contained 2.01 per cent Ni and 0.61 percent Cu. Other assays of mafic gabbro with disseminated sulfides contained 0.17 to 0.57 percent Ni and 0.11 to 0.32 percent Cu with traces of Au and Ag.

Mineral Investigation

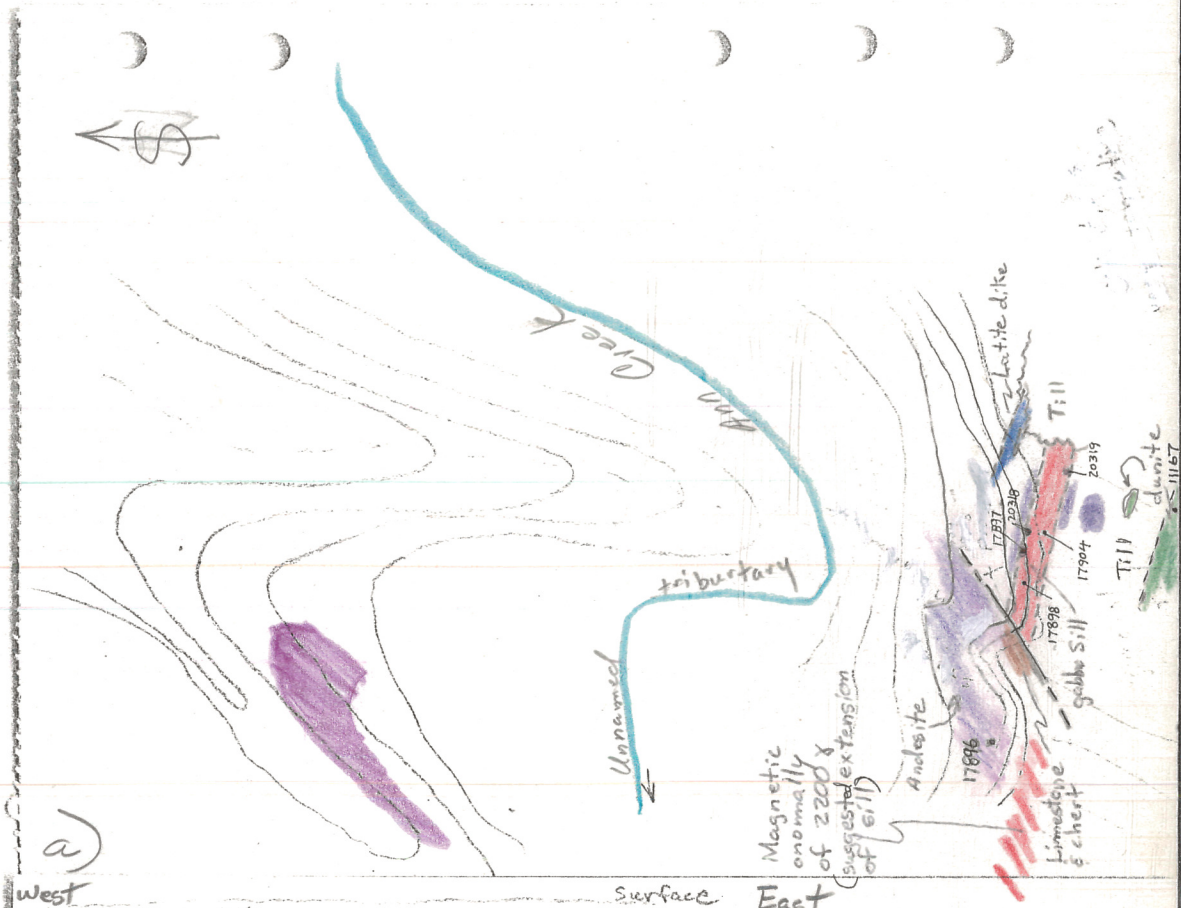
A partially serpentinized, fine grain maafic gabbro sill-like body is hosted by meta-volcanics, limestone-chert and andesite (fig. 7-1). The body is exposed along a strike of 110° for approximately 250 ft and contains disseminated sulfides of pyrrhotite, chalcopyrite and entlandite (location 7).

Width of the structure appears to be about 35 ft with a s ip but this observation was tentative due to poor outcrop. astern end the gabbro is terminated in fault contact with owever, major displacement is not indicated. The western end overed by high-level till deposits.

Interstitual sulfide grains, generally less than 2 mm, occur in variable concentrations in an apparent layered structure with some zones being nearly barren.

Pyrrhotite-pentlandite and chalcopyrite constitute 5-7 percent of the rock below a white band (magnesite ?) and a somewhat smaller percentage above it except for a 4 ft thick horizon near the top (AK 20319). Magnetite is variably present throughout the sill. Sample AK 17898, which consisted of random chips taken from below the white band, contained 0.037 percent Cu, 0.125 percent Ni and 0.009 percent Co. Assays indicated ____ oz/ton Pt and ____ oz/ton Pd. A similar

Paul - you may want to enlarge figure 7-1



North profile of cliff face

± 50'

W

add 2 more layers spaced 5' apart

FIGURE 7-1 : Ann Creek Prospect

TABLE 7-1. - Sample analyses from Lower Ann Creek prospect

Sample no.	ppm Ag	Co	Cu	Ni	Zn	oz/T Au	Pt	Pd	Ir	Rh	Ru	Os	Description
AK11167						<0.0002	<0.0003	<0.011	N	0.0026	N	N	Serpentinized magnetic dunite
AK17896	2.1	1280	290	13	110	<0.001	<0.001	<0.001	0.0026	N	N	N	Altered (andesite?) with quartz veinlets.
AK17897	15.0	285	25,000	1,000		<0.001	0.009	0.015	N	0.0016	N	N	Pods or lenses of massive sulfide and gossan.
AK17898	2.7	89	365	1,250		<0.0002	0.001	0.001	N	N	N	N	Random chips of mafic gabbro with disseminated sulfides and minor serpentinization.
AK17904	2.9	125	920	2,200		<0.001	0.004	0.0024	N	N	N	N	Mafic pyroxene olivine gabbro with + 5% disseminated sulfide.
AK20319	9.4	340	35,000	19,000		<0.0002	0.01	0.016	0.0026	0.0014	N	N	Chips of massive sulfide and gossan at base of gabbro sill.
AK20319	1.9	81	2,300	3,000		<0.0002	0.003	0.008	N	N	N	N	Chip sample across a more distinctly mineralized horizon approximately 4 ft thick in gabbro sill.

Samples suffixed with AK were analyzed by atomic absorption methods by TSL Laboratories, Spokane, Washington.

Au and PGE were analyzed by fire-assay preconcentrations followed by ICP technique, Reno Research Center, Reno, Nevada.

Blank assays indicate no analysis was done.

TABLE 7-1. - Sample analyses from Lower Ann Creek prospect

PPm — oz/to

Sample no.	Ag	Au	Co	Cu	Ni	Zn	Pt	Pd	Ir	Rh	Ru	Os	Description
AK11167		<0.0002		270			<0.0003	<0.0003	N	.00026	N	N	Serpentinized ~~and~~ magnetic dunite
AK17896	2.1	<.001	1280	~~390~~	13	110	<0.001	<0.001	0.0026	N	N	N	Altered (andesite?) with quartz veinlets.
AK17897	15.0	<.001	285	25,000	1,000		0.009	0.015	N	0.0016	N	N	Pods or lenses of massive sulfide and gossan.
AK17898	2.7	<.0002	89	365	1,250		.001*	0.001	N	N	N	N	Random chips of mafic gabbro with disseminated sulfides and minor serpentinization.
AK17904	2.9	<.001	125	920	2,200		0.004	0.0024	N	N	N	N	Mafic pyroxene olivine gabbro with + 5% disseminated sulfide.
AK20319	9.4	<0.0002	340	35,000	19,000		0.01	0.016	0.0026	0.0014	N	N	Chips of massive sulfide and gossan at base of gabbro sill.
AK20319	1.9	<0.0002	81	2,300	3,000		0.003	0.008	N	N	N	N	Chip sample across a more distinctly mineralized horizon approximately 4 ft thick in gabbro sill.

Std Fn's to Reno TSL

blank assay . . .

sample, AK 17904, taken above the white band contained 0.092 percent Cu, 0.22 percent Ni, and 0.013 percent Co. While a more consistently mineralized 4 ft thick section contained 0.23 percent Cu and 0.30 percent Ni.

Pods and small lenses of massive sulfides (AK 17897 and 20318) occur along at least two narrow stratified intervals and contain pyrrhotite-pentlandite and minor chalcopyrite. Rose, in 1965 (5, pp. 25-26) reported the massive sulfides in a single continuous lens approximately 18 in thick. Due to recent rubble cover, this could not be confirmed. Bureau samples indicate several percent each of Ni and Cu with approximately 0.03 oz total PGE. Underlying andesites contain quartz stringers and veinlets with pyrite and occasional chalcopyrite. A serpentinized shear (?) zone at sample location AK 17896 was found to bear pyrite and chalcopyrite also.

Several magnetometer profiles were run in the area of the gabbro sill. While solar activity at the time of the survey precluded a detailed analysis, the data did reveal a magnetic body to the east of the sill which is presumed to be the faulted extension of at least comparable strike length.

A larger body of dunite occurs approximately 0.5 mi east of the prospect. It was not apparent whether this ultramafic correlates with the mafic/ultramafic sequence, however a stream sediment sample from a small creek draining the northern contact contained 1100 ppm Cu.

Recommendations

The preliminary magnetometer data indicates that inferred mineralized tonnages on the order of 500,000 tons may occur, however sample analyses

indicate overall grade will probably not exceed 0.5 percent Cu + Ni + Co with minor silver (0.1 to 0.2 oz/ton) and 0.01 to 0.02 oz/ton total PGE values. Further magnetometer surveys and soil sampling appear warranted to determine if additional tonnage and higher grade zones may exist elsewhere along a projected trend of the sill.

GLACIER LAKE CONTACT PROSPECT - MAP LOCALITY 8

A body of dacite to dacite porphry has intruded meta-sediments of the Rainbow Mountain Sequence at location 8, figure 8-1. The dacite is pyritic resulting in strong limonitic staining of the hillside. At the top of the limonite slope a five foot-wide zone of calcareous, thermally altered meta-sediments contained pyrite, chalcopyrite, arsenopyrite(?) and minor bornite. The zone is exposed along strike for approximately 20 feet before being covered by vegetation. Grab sample AK 17955 was typical of the more consistently mineralized portions of the zone and contained 1.62 oz/ton Ag and 12.5 percent Cu. Only background levels (1.5 2nd run)
of Co, Mo and Zn were detected.

UPPER ANN CREEK - MAP LOCALITY 9

A brief reconnaissance was made of the upper Ann Creek area (fig. 9-1) where the USGS (_) has previously reported anomalous levels of Co in stream sediments. Bedrock in the are is comprized of volcano-clastics, sedimentary rock and andesites which border a large mass of peridotite to the west (fig. 9-1). Geologic mapping at 1:63,360 scale has been published by Stout, 1976. Extensive occurrences of ferricreted volcano-clastic of probable sedimentary deposition along a former alluvial surface are found lying horizonally up to 100 ft above the

Figure 8-1 Glacier Lake Contact Prospect

TABLE 9-1. - Sample analyses from Upper Ann Creek

Sample no.	Sample type	Ag	Au	Co	Cu	Ni	Pb	Zn	Pt	Pd	Ir	Os	Rh	Ru
AK20287	rock		<0.0002	<10	80	20	<10	170	0.001	0.0036	N	0.0013	N	N
AK20289	pan										N	N	N	N
AK20290	sed	0.1		31	120	350								
AK20291	pan										N	N	N	N
AK20292	sed	<0.1		62	175	900								
AK20296	sed	<0.1		58	66	780								
AK20297	sed	<0.1		35	76	510								
AK20313	rock	13.8	0.036	270	32,400	670		1150	<0.001	0.002	N	N	N	N
AK20314	rock		0.008	235	2,500	9000			0.022	0.037	0.0088	N	0.0020	0.0076

Pls check changes
no comprehende

TABLE 9-1. - Sample analyses from Upper Ann Creek

Sample no.	Sample type	Ag	Au	Co	Cu	Ni	Pb	Zn	Pt	Pd	Ir	Os	Rh	R	
AK20287	rock		<0.0002	<10	80	20		170	0.001	0.0036	N	0.0013	N	N	Random chips ferricrete breccia composed of silicious (tuffaceous?) fragments.
AK20289	pan										N	N	N	N	
AK20290	sed	0.1		31	120	350									
AK20291	pan										N	N	N	N	
AK20292	sed	<0.1		62	175	900									
AK20296	sed	<0.1		58	66	780									
AK20297	sed	<0.1		35	76	510									
AK20313	rock	13.8	0.036	270	32,400	670		1150	<0.001	0.002	N	N	N	N	Chips from several massive sulfide cobbles composed of pyrite, chalcopyrite, and trace bornite, in a 20%± silicious ground mass.
AK20314	rock		0.008	235	2,500	9000			0.022	0.037	0.0088	N	0.0020	0.0	Chips from 1 ft boulder in hillside rubble, no other mineralized rubble seen on hill but several pieces seen in creek bed below. Snow cover obscurred higher slopes at the time of the examination. Rock is a fine-grain, hornblende gabbro with pyrrhotite-pentlandite and chalcopyrite.

<250 ppb
10
725 ppb
1070

HH

Don't understand changes on this one —

present creek. Till commonly mantles areas of higher slopes.

Several types of mineralized rock as listed in table 9-1 were found occasinally in the alluvial and sidehill rubble.

Original sources of the mineralized material were not found. Further investigation for potential mineralized deposits would appear warranted, particularly in the area of sample location AK 20314 which contained 0.077 oz/ton total PGE plus values in Au, Co, Cu, and Ni.

NORTH FORK OF RAINY CREEK - MAP LOCALITY 10

Previous Work

In the early 1960's a Co and Cu prospect was discovered on the edge of an alluvial fan along the right limit of the North Fork of Rainy Creek and approximately 20 ft above the creek bed.[7] Mineralized boulders

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7 D. Stevens, Geologist, Stevens Exploration, written communication.

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with cobalt-bloom (erythrite), reportedly occur over an area several hundred feet square. Prospect pits, however, were unsuccessful in locating bedrock sources. The prospecting and excavations wee undertaken in 1964 and no evidence of the site could be found during this investigation.

Geology of vicinity of Locality 10 as mapped by Stout, 1976 (7) is composed of rocks of the Permian Upper Tetelna complex. These consist of interbedded green to light green pyroclastics, volcaniclastic sediments, and bioclastic limestone interlayered with andesitic to basaltic flows. The Tetelna complex has been intruded by sill-like bodies of hornblende gabbro. To the north the complex is in contact with a large body (1.5 x 5 mi) of dunite.

Recently, the USGS has reported (_) several tributaries to the North Fork to contain anomalous concentrations of Co in stream sediments (fig. 10-1).

Mineral Investigations

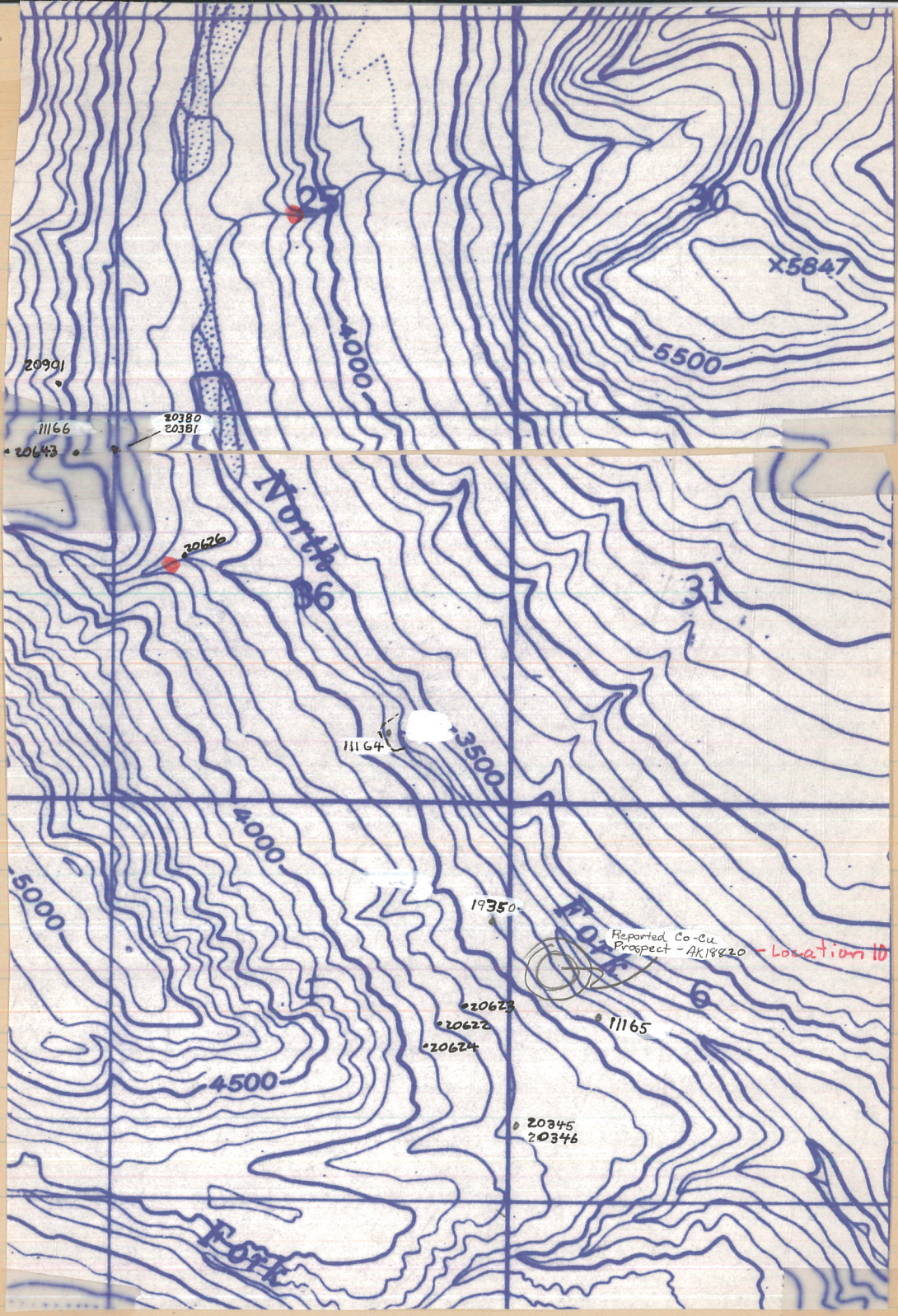
Diffraction analysis on a sample (AK 18820) from the Co-Cu prospect provided to the Bureau, indicated the presence of cobaltite (Co, Fe, Ni) AsS and a tentative determination of safflorite (Co, Fe) As_2.

Sulfide-bearing float was found in a small gulch further to the north (sample AK 11166 - fig. 10-1) which consisted of massive pyrrhotite, minor chalcopyrite. Analyses (table 10-1) indicated 0.92 percent Co and 0.41 percent Cu. No further investigation of bedrock sources was possible.

Rubble occurring near sample location AK 11165 consisted of a very fine intermediate volcaniclastic with abundant sulfide (20-30 percent) containing concentrations of Co and Cu. Bedrock sources were not found. A nearby aphanitic dike (AK 19350) also contained anomalous levels of cobalt. Further work to assess potential Co-bearing volcaniclastic deposits in this area is recommended.

LOCATION 11 - PIONEER CLAIMS

Copper, with associated gold and silver mineralization occurs in a small Tertiary stock of gabbro which locally intrudes the Upper Tetelna complex of basaltic volcanics and volcaniclastic sediments (7). Local outcrop mapping is shown in figure 11-1.



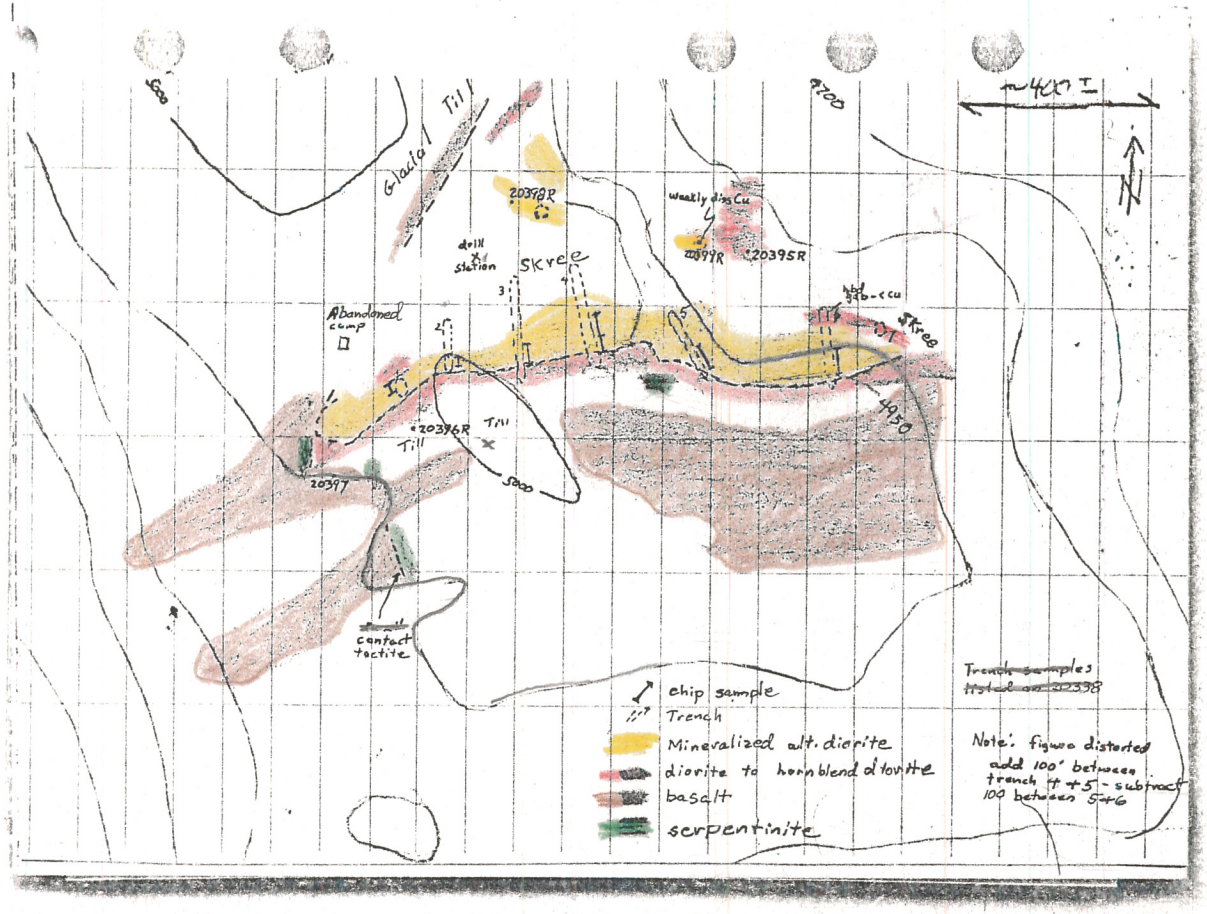
● USGS (-) Co anomaly in stream sediment

FIGURE ~~X~~ 10-1 - North Fork Rainy Creek - Location 10

TABLE 10-1. - Sample analyses from the North Fork Rainy Creek - Location 10

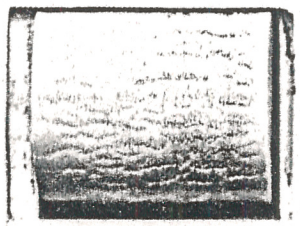
Sample no.	Sample type	Ag	Au	Co	Cu	Ni	Zn	Pt	Pd	Ir	Os	Rh	Ru	
AK11164	~~rock~~ soil	0.2		79	135	295								Deeply leached iron-stained serpentinite and hematitic soil.
AK11165	rock	2.3	<0.0002	600	4300	310	22	<0.0003	~~<0.0003~~ .0022					Very fine-grain volcanic(?) with abundant disseminated pyrrhotite and minor chalcopyrite. Secondary quartz veinlets are common.
AK11166	rock	4.5	<0.0002	920	4100	815	80	<0.0003	~~<0.0003~~ .019					Random chips from occasional massive sulfide float occurring in gulch. Rock is moderately magnetic.
AK19350	rock	0.2	<0.0002	85	240	2440	19	<0.0003	<0.0003					Fine-grain to aphanic sub-volcanic dike with disseminated pyrite and trace chalcopyrite.
AK20345	pan													
AK20346	sed	<0.1		26	69	190								
AK20380	pan		0.004					<0.001	<0.001					
AK20381	sed	<0.1		38	105	270								

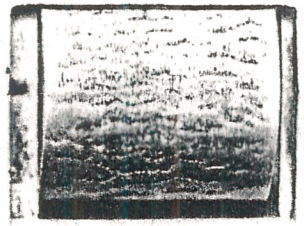
AK18820 .018 18600 <.0003 <.0003 Siliceous matrix with pyrite, cobaltite,



11-1

FIG 11 - Pioneer Claims copper prospect at Location 11.





Previous Work

Rose, 1965, (5, p.27) reported claim staking of copper occurrences on a small ridge shown on figure 11-1. Rose described a barren dark, fine-grained gabbro bordering a lighter-colored gabbro containing disseminated chalcopyrite. The mineralized showings occurred across several hundred feet of the ridge. A copper grade of 1 percent with 0.01 oz/ton Au and 0.22 oz/ton Ag was reported. No appreciable Ni, Pb or Zn was detected. Cobalt was not analyzed for.

In the early 1970's an exploration firm undertook mapping and trenching of the deposit and put down 2 drill holes (written communication, Anthony). Reportedly, one of the holes encountered mineralization at depth. Mining claims over the property are still active.

Mineral Investigations

Examination of the workings in 1982 indicated copper mineralization to be continuous for approximately 1200 ft along the contact between

Total width and dip of the zone could not be determined but trenches perpendicular to the strike exposed continuous mineralization for up to 100 ft (fig. 11-2). To the east, the copper grade appeared to decline where the zone became covered by hillside skree. A possible northeast

Figure 11-2 — Trench No. 3 Bronco claim
A chip sample from the trench contained 1.23% Cu with traces of Au and Ag.

Pioneer Claims (Cont)

trending fault appeared to terminate the zone on the west where outcropping of serpentinite was observed. Parallel zones to the north are indicated by occasional float and prospect pits (see fig. 11-1).

Sample analyses shown on table 11-1 indicate only Cu, Ag, and Au are present in significant concentrations. The lack of Ni, Pt, Pd or Co may indicate the mineralization is due to secondary mobilization of metals followed by deposition along the alteration interface. While this prospect may serve as a model for other yet to-be-discovered deposits in the region, no further investigation of this location for Co or PGE appears warranted.

more info/notes on sample cards

WEST FORK SKARN PROSPECTS - MAP LOCALITY 12

Pyroxene-sulfide-magnetite skarns occur concordently in cherty marbles and garnet-diopside tactites along the valley of the West Fork of Rainy Creek. These mineralized skarns contain concentrations of Cu, Au, with lesser values of Ag and Co. As would be expected for skarn deposits there were no assiciated PGE values detected. The carbonate sequence has been intruded by quartz diorite plugs and peridotite, basalt and gabbro dikes. The skarns have formed in favorable carbonate horizons, and not adjacent to intrusive contacts. East, northeast striking skarn occurrences at sample locations AK 20405 and 20406 (fig. 12-1) have been briefly described by Rose, 1965 (5, p. 28). Evidence of much older prospecting and trenching was seen at AK 20405. As previously described these occurrences do not appear to exceed approximately 2 ft in width, although at least three parallel bodies were obseved during this investigation.

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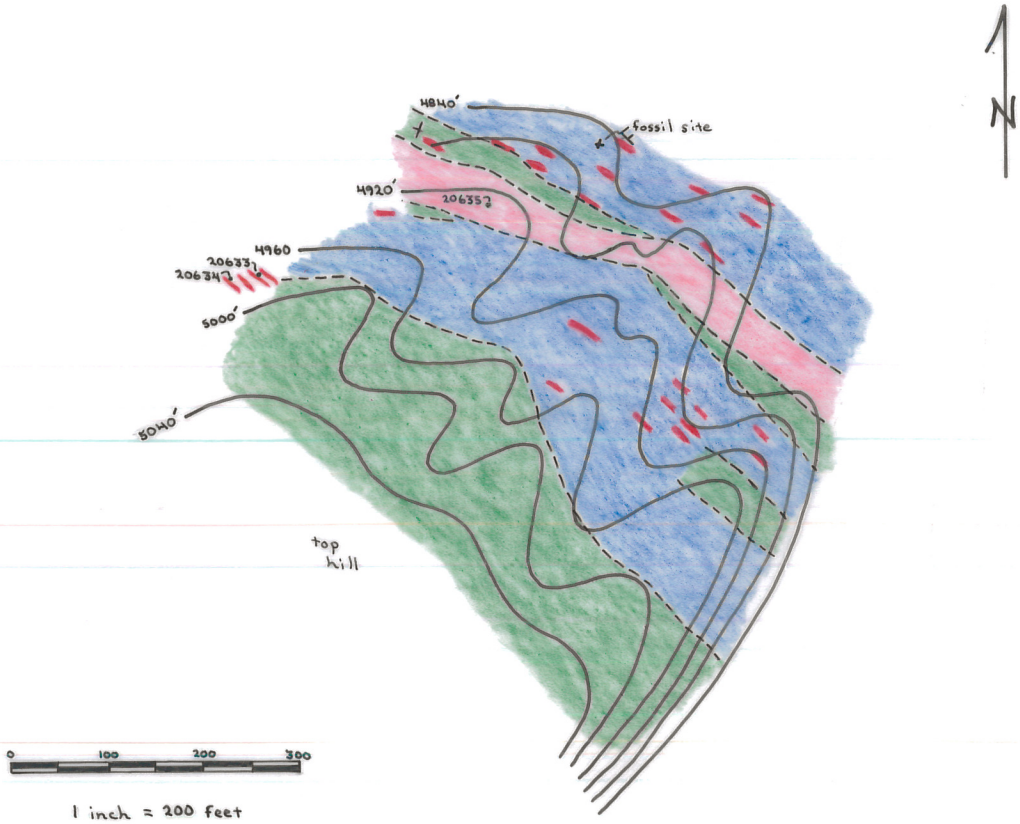
Sample analyses shown on table 11-1 indicate only Cu, Ag, and Au are present in significant concentrations. The lack of Ni, Pt, Pd or Co may indicate the mineralization is due to secondary mobilization of metals followed by deposition along the alteration interface. While this prospect may serve as a model for other yet to-be-discovered deposits in the region, no further investigation of this location for Co or PGE appears warranted.

more info / notes on sample cards

WEST FORK SKARN PROSPECTS - MAP LOCALITY 12

Pyroxene-sulfide-magnetite skarns occur concordently in cherty marbles and garnet-diopside tactites along the valley of the West Fork of Rainy Creek. These mineralized skarns contain concentrations of Cu, Au, with lesser values of Ag and Co. As would be expected for skarn deposits there were no assiciated PGE values detected. The carbonate sequence has been intruded by quartz diorite plugs and peridotite, basalt and gabbro dikes. The skarns have formed in favorable carbonate horizons, and not adjacent to intrusive contacts. East, northeast striking skarn occurrences at sample locations AK 20405 and 20406 (fig. 12-1) have been briefly described by Rose, 1965 (5, p. 28). Evidence of much older prospecting and trenching was seen at AK 20405. As previously described these occurrences do not appear to exceed approximately 2 ft in width, although at least three parallel bodies were obseved during this investigation.



LEGEND

- Diorite dike
- Volcanics
- Marbles, silicified carbonates
- Sulfide skarns

Figure — West Fork Skarn Prospect.

EH 9-20-83

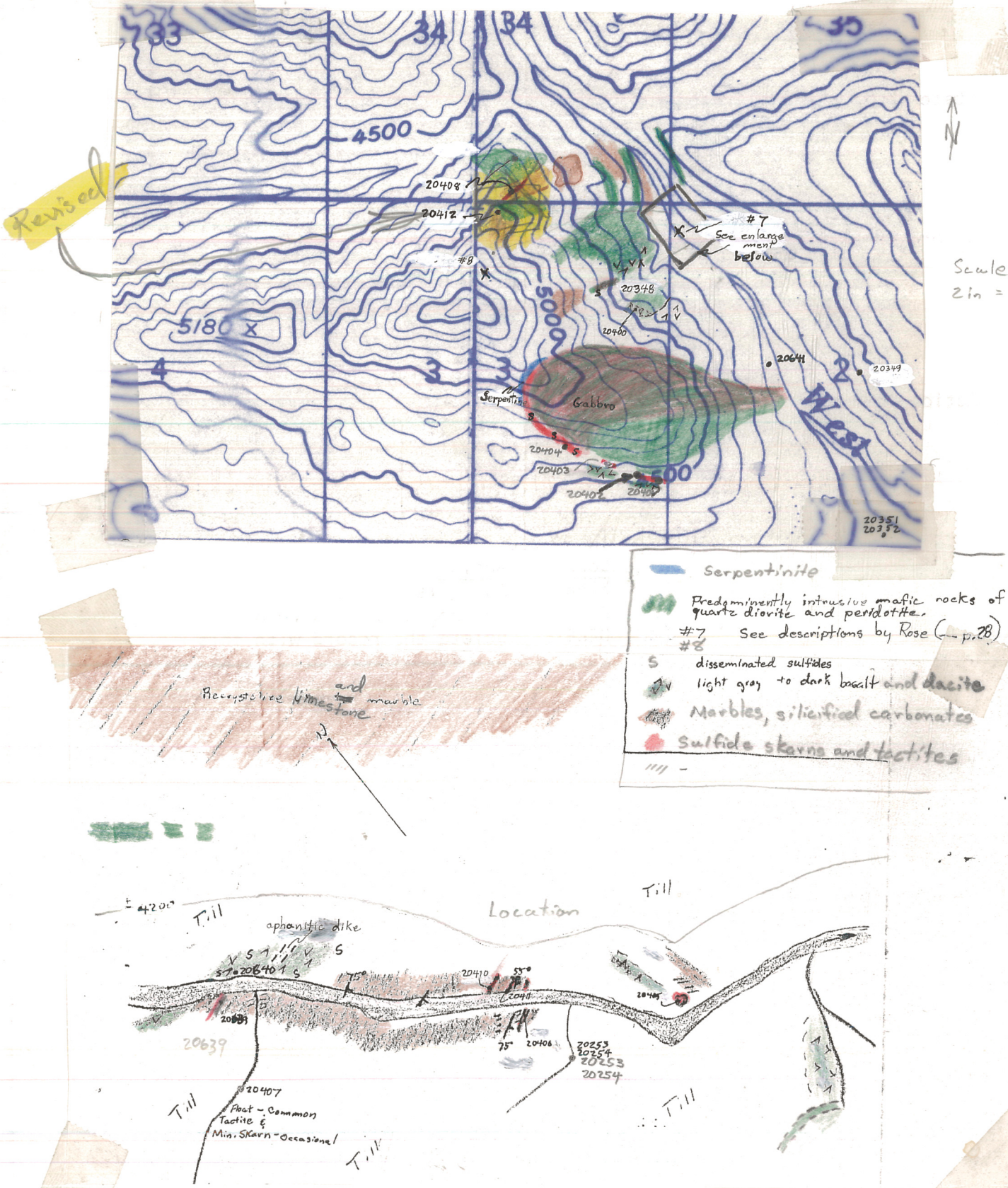


FIG. 12-1 West Fork Skarn Prospects

TABLE 12-1. - Analyses from the West Fork Skarn prospects - location 12

Sample no.	Sample type	Ag	Au	Co	Cu	Ni	Zn	Pt	Pd	Os	Ir	Ru	Rh	Description
AK20348	rock	0.2	0.001	24	93	27		<0.002	0.002	N	N	N	N	3 ft wide pyrrhotite zone in gabbro dike
AK20349		1.5	0.001	52	1900	105								High graded sample from a small area of gray aphanitic dike rock with pyrite and chalcopyrite.
AK20351	pan		0.002					<0.001	<0.001					
AK20352	sed	0.9		24	58	165								
AK20353	pan		<0.0001					<0.001	<0.001					
AK20354	sed			28	96	295								
AK20400	rock		0.001	86	78	960		<0.0003	<0.0003	N	N	N	N	Basalt with narrow zone of pyrrhotite.
AK20401	rock	0.5	0.001	16	90	8	54	<0.0003	<0.0003					Gossan, ferricrete rock chips and traces of marcasite in silicious zone greater than 10 ft thick. Occurs along contact of gabbro and basaltic volcanics.
AK20402	rock	0.1	0.001	17	46	26		<0.0003	<0.0003					Do
AK20403	soil	<0.1		44	160	350								Limonitic soil along the ferricrete zone described above.
AK20404	rock	0.2		43	99	460								Same as 20401. Zone is 60 ft wide here.
AK20405	rock	0.5	0.024	520	9600	28	58	<0.002	<0.002	N	N	N	N	Random chips from pyroxene-sulfide-magnitite skarn rubble in creek bank.
AK20406	rock	1.2	0.001	61	2600	78	40	<0.0003	<0.0003					Skarn and gossan in marble horizons. Mineralized zone is at least 2 ft thick.
AK20407	rock	3.1	0.001	175	3000	410		<0.002	<0.002	N	N	N	N	Chips from 1.5 ft boulder of skarn mineralization. Others in creek bed.
AK20408	rock	6.2	<0.001	73	760	88								Skarn and gossan/boxworks, all sulfides are leached. Zone is 10+ ft thick and poorly exposed for 250 ft.
AK20410	rock	0.4	<0.001	27	850	11								Tactite with pyrite across a 3 ft zone with diopside, garnet, and some malachite.
AK20411	soil	<0.1		25	530	19								Limonitic soil with boxwork fragments.
AK20412	soil	<0.1		36	200	74								Brown soil and rock skree.

West Fork Skarns (Cont)

A gossan zone exceeding 10 ft in width and exposed for 250 ft along strike occurs at AK 20408. The deeply leached gossan strikes N 30° E and is covered by talus at both ends. A second similar zone occurs approximately 40 ft up slope. The gossans are situated near, but not at, a poorly exposed contact with a stock of porphyritic biotite-hornblende quartz diorite with magnetite. The mostly leached gossan material was anomalous in copper and silver and weakly so in cobalt. Trenching will be required for further evaluation.

Approximately 150 ft south of sample AK 20408 is a small lens of sulfide described by Rose (5, p. 28, #8)as hosted by a zone of garnet, olivine and pyroxene rock in contact with serpentinite country rock. An assay indicated 0.37 percent Cu, 0.50 percent Ni, 0.03 oz/ton Au and 0.33 oz/ton Ag.

A gabbro stock occurring approximately 0.5 mi south of Location 7 (???) is in intrusive contact with basaltic volcanics. A persistent silicious and limonite gossan zone was observed along the west and south margins of the stock. Samples AK 20401-04 were collected from the zone which is partially to entirely leached of sulfides. Exposed width ranges from 10 to 60 ft. Only traces of marcasite and rare pyrite were found. No significant economic metal grades were detected along the contact zone.

BROXSON GULCH - MAP LOCALITY 13

Rose in 1965 (5, pp. 30-31) reported massive sulfide boulders being eroded from a zone 20 ft wide located east of the headwaters of Broxson Gulch (fig. 2). Assays of 0.9 percent Cu, 0.1 percent Ni and trace zinc were given. No analyses for Co or PGE were included.

Examination of this site in 1982 revealed a persistently mineralized sulfide zone adjacent to the contact of hornblende gabbro with thermally metamorphosed limestone. The mineralization has a width of up to 15 to 20 ft and was traced intermittently along strike for approximately 600 ft. Further extensions of the zone are likely but covered by skree.

Near sample location AK 20394 (fig. 13-1) at least 2 poorly exposed parallel zones were observed. Sulfides of pyrite, pyrrhotite and chalcopyrite were identified. TS 20391---... No magnetite was detected in hand samples.

Copper content was estimated to range from 0.1 to in excess of 1 percent in high grade zones. Analyses indicated Co grade of 0.2 to 0.4 percent (see AL 20391, 20393, 20394, 20415 - table 13-1). Values for Ni and Ag were negligible.

The hornblende gabbro is a perifyerial zone to a dunite intrusive stock. The gabbro is characterized TS 20393.

A weakly mineralized zone in the dunite occurs at sample location AK 20355 where discontinuous pods and disseminations of pyrrhotite and chalcopyrite occur over an area 75 ft long and 15 ft wide. Analyses of a high graded sample indicated approximately 0.015 oz/ton of total PGE, however, the mineralization sampled is not of, or near an economic grade. Due to the size of the mineralized zones further work would

Jim,

Compiled Broxson Gulch map from report copy & my survey notes of mineralized locations. Not sure of some of geology (rock type of dike) or contacts

EH

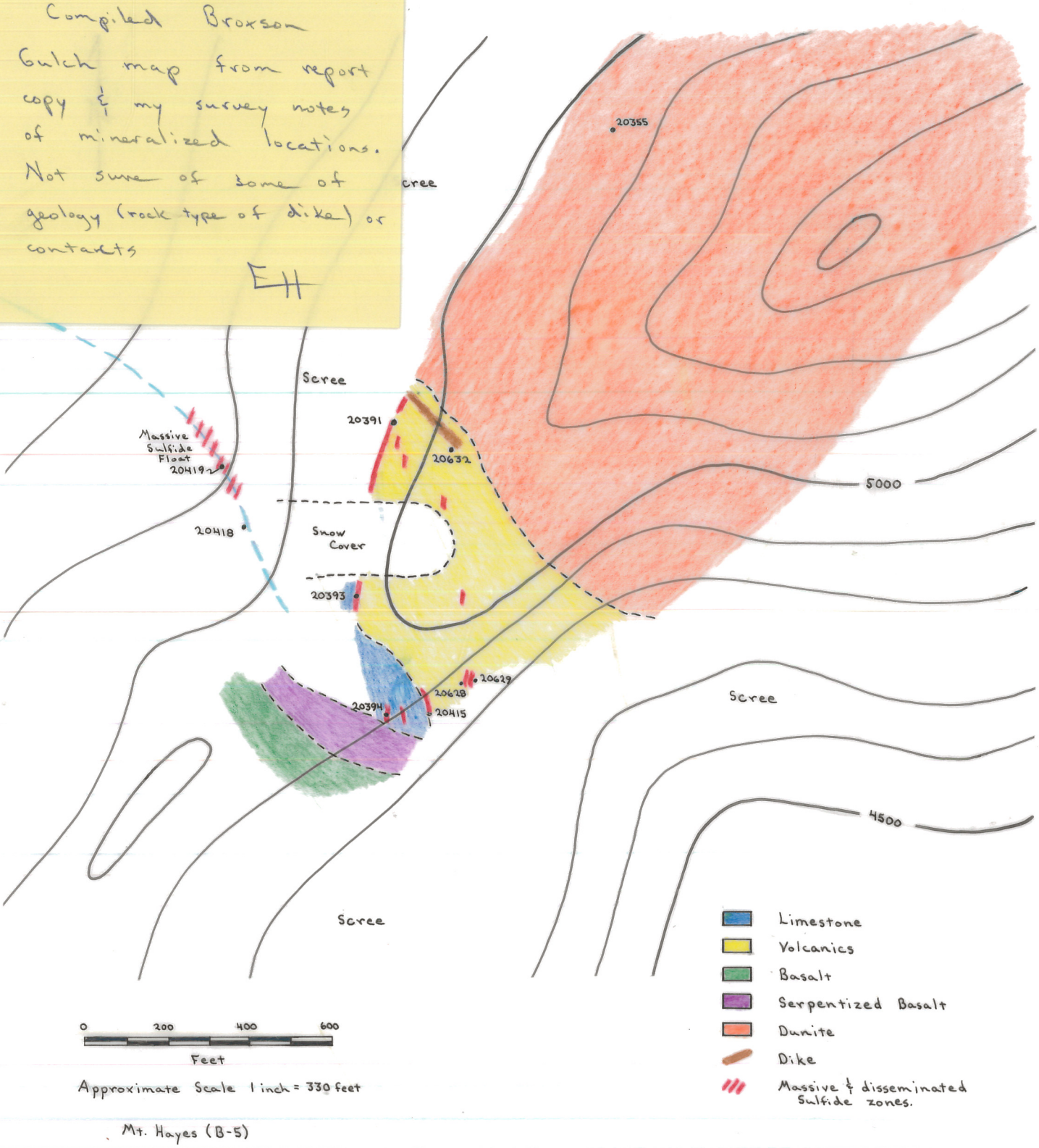


Figure 13-1 – Broxson Gulch Prospect – Location 13

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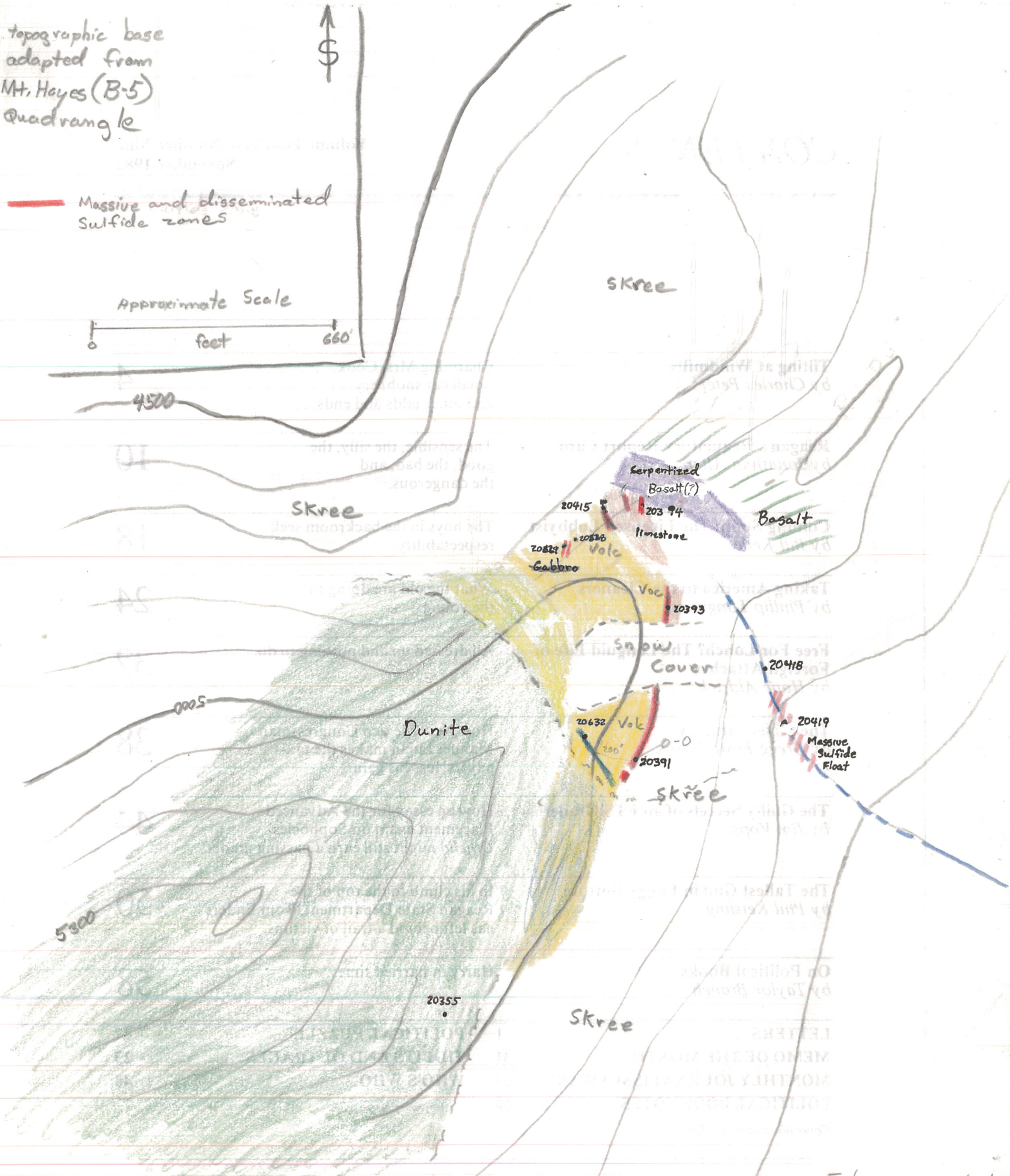
Paul - you can turn this fig. around to ~~the~~ north



Enlargement to of previous

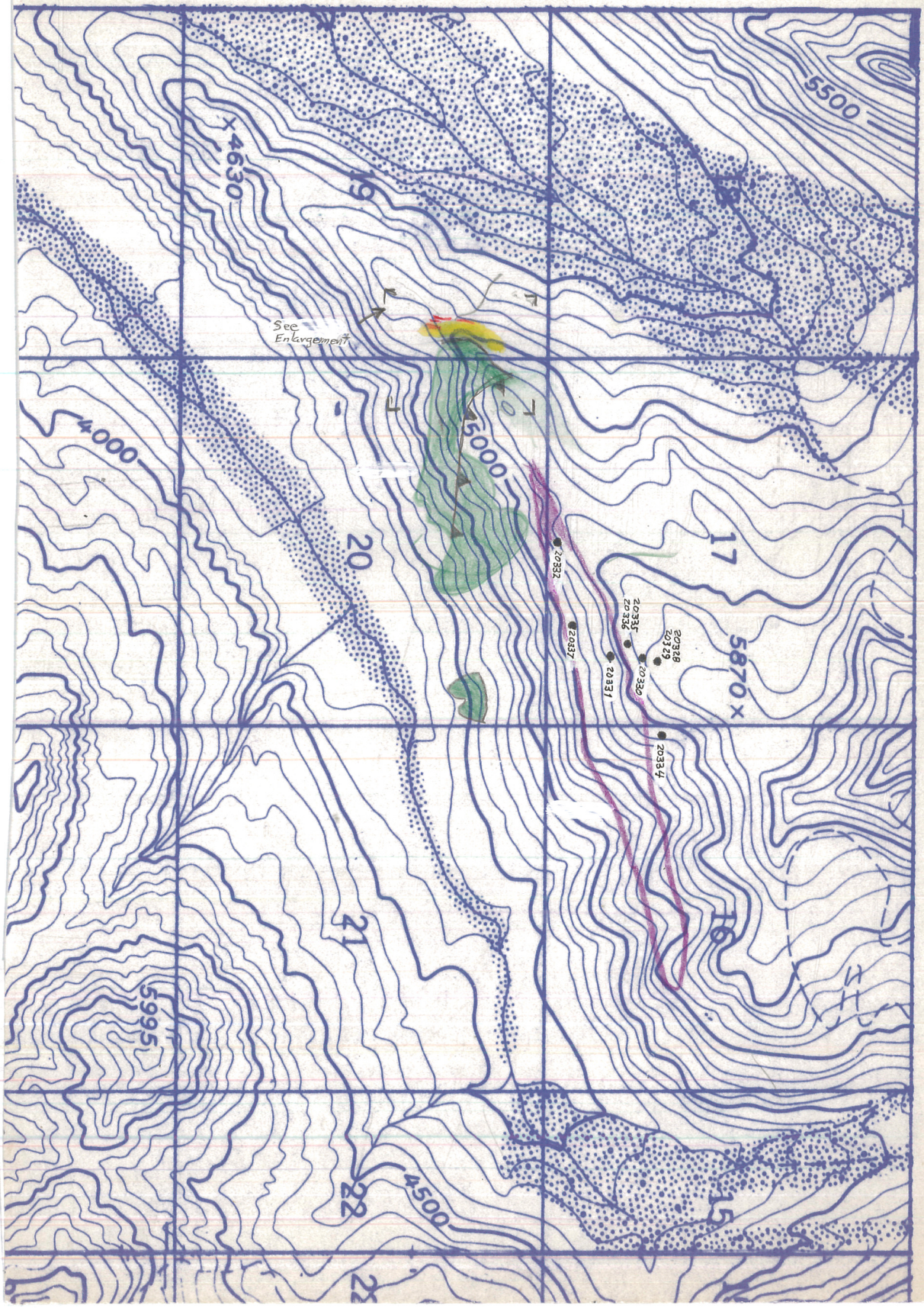
FIGURE 13-1 — Broxson Gulch Prospect - Location 13

TABLE 13-1. - Analyses from Broxson Gulch samples - location 13

Sample no.	Sample type	Ag	Au	Co	Cu	Ni	Zn	Pt	Pd	Os	Ir	Rh	Ru	
AK20328	soil			21	115	58								Limonitic soil at limestone/serpentinite contact.
AK20329	rock	1.3	0.004	67	6,400	470	31	<0.0003	<0.0003	N	N	N	N	Rubble occurrence of magnetic-pyrrhotite-pyrite-calcopyrite proxene skarn with diopside, sericite and garnet.
AK20330	rock		0.002	180	7,400	820		<0.0003	<0.0003	N	N	N	N	Rubble occurrence of fine grain pyroxenite with disseminated chalcopyrite and pyrrhotite.
AK20331	rock	1.3		92	8,150	240								Boulders of gossan and breccia with malachite occurring on basaltic skree slope.
AK20332	rock	1.0	0.005	46	550	160		<0.002	0.0016	N	N	N	N	Lens of disseminated and massive sulfides and magnetite over a width of 15 ft and along strike for 100 ft. Elevation is 5350 ft. Zone is hosted by volcanics.
Ak20334	rock	4.3		18	5,600	79								10 in calcite vein with chalcopyrite exposed for 100 ft cutting serpentized basalt.
AK20335	rock	1.5		13	3,100	34								Dacitic dike cutting basalts with pyrite, and chalcopyrite and malachite. Dacitic dikes are common in this area.
AK20336	rock	1.4	0.001	760	16,600	550	71	<0.002	0.003	N	N	N	N	Massive sulfide lens approximately 4 ft in diameter in fine grain intermediate to felsic volcanics.
AK20337	rock	0.7	0.003	16	1,650	10	13	<0.0003	<0.0003	N	N	N	N	Lens of magnetite pyroxenite approximately 3 ft wide by 20 ft long in contact with clinopyroxenite and secondary quartz.
AK20355	rock		0.001		590	6600		<0.004	0.004	N	0.0054	0.0048	0.0018	High grade from zone of pods and disseminations of sulfides in dunite. Zone is 15 ft wide and exposed along strike for 75 ft.
AK20391	rock	0.4	<0.0004	215	5,500	480	25	<0.0006	<0.0003	N	N	N	N	Chip sample across 15 ft of sulfide zone which is exposed intermittently for 600 ft and open on both ends.
AK20393	rock	0.8	<0.0004	410	1,350	435	82	<0.0006	<0.0003	N	N	N	N	Rubble zone of pyroxene gabbro with pyrrhotite and massive sulfide, 350 ft south of AK20391 along same mineralized zone.
AK20394	rock	1.4	<0.0004	450	960	200	54	<0.0006	<0.0006					Rubble in iron stained, sulfide zone hosted by limestone.
AK20415	rock	0.5	0.001	220	1,550	260		<0.002	<0.002	N	N	N	N	High grade sample of massive sulfide hosted by limestone.
AK20418	sed	<0.1		25	82	125								Sediment from overflow ice.
AK20419	rock	1.2	0.001	190	6,700	355	120	<0.002	<0.002	N	N	N	N	Chips from random cobbles of massive sulfide float and sulfides in limestone tactite grading to pyroxene skarn.

FIGURE 13-1 - Broxen Gulch Prospect - Location 13

combine these 2 pages



be waranted in the vicinity of the gabbro-peridotite complexes particularly where they are intruding limestones.

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