

SOME MINOR ELEMENTS IN PYRITE FROM
THE SUMMIT CAMP

600125

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SUMMARY

Pyrite separated from 15 samples were analysed for cobalt, nickel, copper, zinc and lead by atomic absorption spectrophotometry. The samples consist of chalcopyrite, magnetite, pyrite, pyrrhotite and sphalerite but only pyrite is common to all of the samples.

The cobalt-nickel content indicates a hydrothermal environment of deposition. The Coryell and Nelson intrusives were the sources of the mineralizing fluids.

There seems to be no causative relationship between the amount of cobalt and the amount of copper, zinc, and lead.

There is no apparent correlation of minor element content and mineralogy except between extremely high cobalt values and pyrrhotite. This may be a result of the small number of samples analysed.

INTRODUCTION

The problem is to determine the concentrations of some minor elements in the pyrite of the Summit mining camp and to draw conclusions as to the environment of deposition and relationships between the minor element content and ore mineralization.

The pyrite was first separated from the parent rock, then analysed. The pyrite was separated by crushing, obtaining a sulphide concentrate with the Superpanner, then separating the pyrite with the Frantz magnetic separator. The analysis was done by atomic absorption spectrophotometry.

The Summit camp is located approximately 6 miles north of Grand Forks, B.C. and between Highway no.3 and the Grandby River (see Fig.1).

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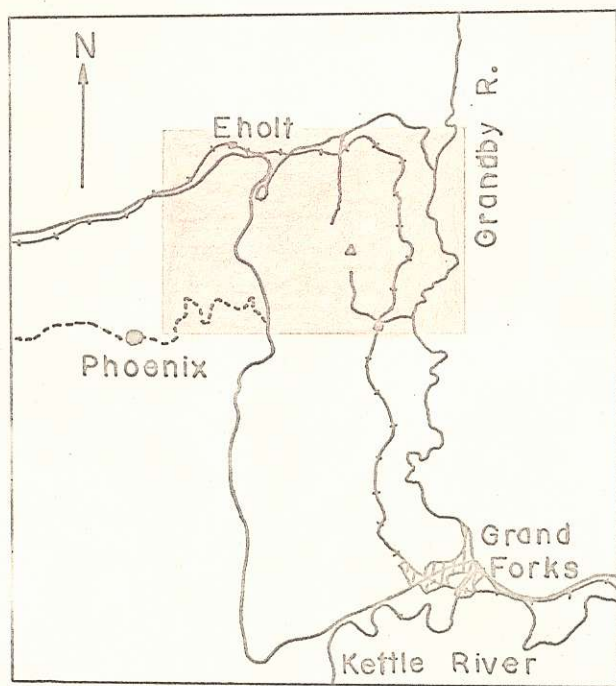


Fig.1 Location of the Summit Camp

HISTORY

Seraphim (1956) described the geology and copper deposits in the Boundary District. Seraphim listed the previous work on the economic geology of the area: Brock (1905): "Boundary Creek Mining District", LeRoy (1911) on the Phoenix camp, LeRoy (1913) on the Motherlode and Sunset Mines and McNaughton (1945) on the Greenwood-Phoenix area.

The early Tertiary rocks in the Greenwood map area (82 E/2) were mapped by Monger (1967). Monger listed the previous work done on the Tertiary rocks.

The latest work (unpublished) was done during the summer of 1969 by Mr. Arne Reinsbakken. The area mapped is bound on the North by Eholt, on the south by Grand Forks, on the east by the Grandby River, and on the west by Phoenix. This mapping was done on a scale of 1 inch to 1000 feet.

GEOLOGY

The area of interest consists of a sequence of folded sedimentary and volcanic rocks ranging from a Permian? to Jurassic age which have been intruded by a large body of Nelson Granodiorite and later Eocene-Oligocene igneous bodies. A large portion of the area is covered by Tertiary sediments and volcanics (see Fig. 2).

The Summit camp is a group of showings and small mines

located mainly in the calc-silicate skarn zones in the Brooklyn Limestone. The Brooklyn Limestone consists mainly of massive argillaceous limestone and skarn formed by thermal metamorphism.

Seraphim (1956) describes the skarn at the Oro Denoro mine. He suggested that the diorite stock provided the mineralizing fluids. His evidence is 1) the garnet-epidote skarn grading into the diorite; 2) pockets of skarn with chalcopyrite mineralization found several hundreds of feet within the diorite; 3) ore grade increases with proximity to the diorite contact. Seraphim states "Since the other ore bodies in the Boundary area are similar in mineralization it is probable that they are formed at the same time, and that the Jura-Cretaceous stocks were the source of the ore-forming fluids."

Also Seraphim reports that with one or two exceptions, no noticeable increase in chalcopyrite mineralization was found near faults.

METHODOLOGY

The separation of pyrite was done by crushing obtaining a sulphide concentrate with the Superpanner, then separating the pyrite with the Frantz magnetic separator. Pyrite rich portions of the rock were crushed in a percussion mortar and pestle, then sieved to obtain the -100 mesh fraction.

Crushing to a powder yields approximately a 50% -100 mesh sample. Panning an approximately 5 gram sample yielded 1-2 grams consisting of 90% sulphides. The samples were 75% pyrite. The samples were then washed on a 200 mesh screen with acetone to remove the dust. The pyrite was then separated from the other sulphides with the magnetic separator. The separator was operated at 1.0 amps with the long axis at 25° and the short axis at 20°.

The analyses for the minor elements were done by atomic absorption spectrophotometry. The pyrite samples were weighed into 0.2500 gram portions. Three samples were weighed into two portions each for the purpose of control. The samples were then heated in 5 ml. of concentrated nitric acid, then cooled. An additional 5 ml. of concentrated nitric acid was added, then heated to dryness. Then 2-3 ml. of distilled water was added to the samples, then 3 ml. of concentrated hydrochloric acid added. The solutions were diluted to 25 ml. with distilled water, then analysed.

The samples were analysed in the order: 1, 2, 3, 4, 5, 6, 1(R), 7, 5(R), 8, 9, 10, 11, 12, 13, 14, 15, 9(R).

RESULTS

The data obtained by atomic absorption ^{are} is shown in Fig. 3. The uncertainty is large, but within that required for interpretation. There were three repeat samples for each of

the five elements for which the samples were analysed.

FIGURE 3

SAMPLE NO.	ppm Co	ppm Ni	ppm Cu	ppm Zn	ppm Pb
1	176.7	326.7	377.1	74.0	113.6
1(R)	183.7	355.6	337.0	125.5	11.8
2	4761.0	256.8	305.6	20.3	30.5
3	1610.0	514.4	514.9	46.3	11.8
4	204.7	155.2	201.7	68.0	0.0
5	192.5	167.9	764.2	29.1	0.0
5(R)	194.2	86.6	726.6	35.1	0.0
6	89.2	59.6	776.7	51.6	0.0
7	4831.0	303.2	745.9	8737.0	925.1
8	87.5	514.4	1252.7	276.5	3.9
9	1400.0	420.5	156.6	29.1	0.0
9(R)	1400.0	404.3	154.1	27.6	0.0
10	656.1	274.3	234.3	373.6	0.0
11	826.3	305.1	507.5	91.9	0.0
12	481.1	211.2	114.0	18.7	78.3
13	137.1	116.5	99.0	280.1	2057.2
14	50.7	157.0	55.1	120.3	0.0
15	572.1	328.5	43.8	17.9	0.0

Polished sections of the rock samples were made and the mineralogy of each was noted. The following is a list of the samples and the ore minerals present with the pyrite:

- Sample 1. ("Pyrrhotite" showing)
Chalcopyrite, magnetite, sphalerite.
- Sample 2. (Sailor Boy)
Magnetite, pyrrhotite.
- Sample 3. (Oro Denoro)
Magnetite, sphalerite.
- Sample 4. (Mt. Rose)
Chalcopyrite, magnetite.
- Sample 5. (Pack Rat)
Magnetite, sphalerite.
- Sample 6. (R. Bell Mine)
Chalcopyrite, minor magnetite.
- Sample 7. (Shick Shock)
Magnetite, pyrrhotite.
- Sample 8. (Emma)
Chalcopyrite, magnetite.
- Sample 9. Minor chalcopyrite, magnetite.
- Sample 10. None.
- Sample 11. Magnetite .
- Sample 12. Magnetite .
- Sample 13. Minor magnetite .
- Sample 14. Minor magnetite.
- Sample 15. (Phoenix)
Minor magnetite.

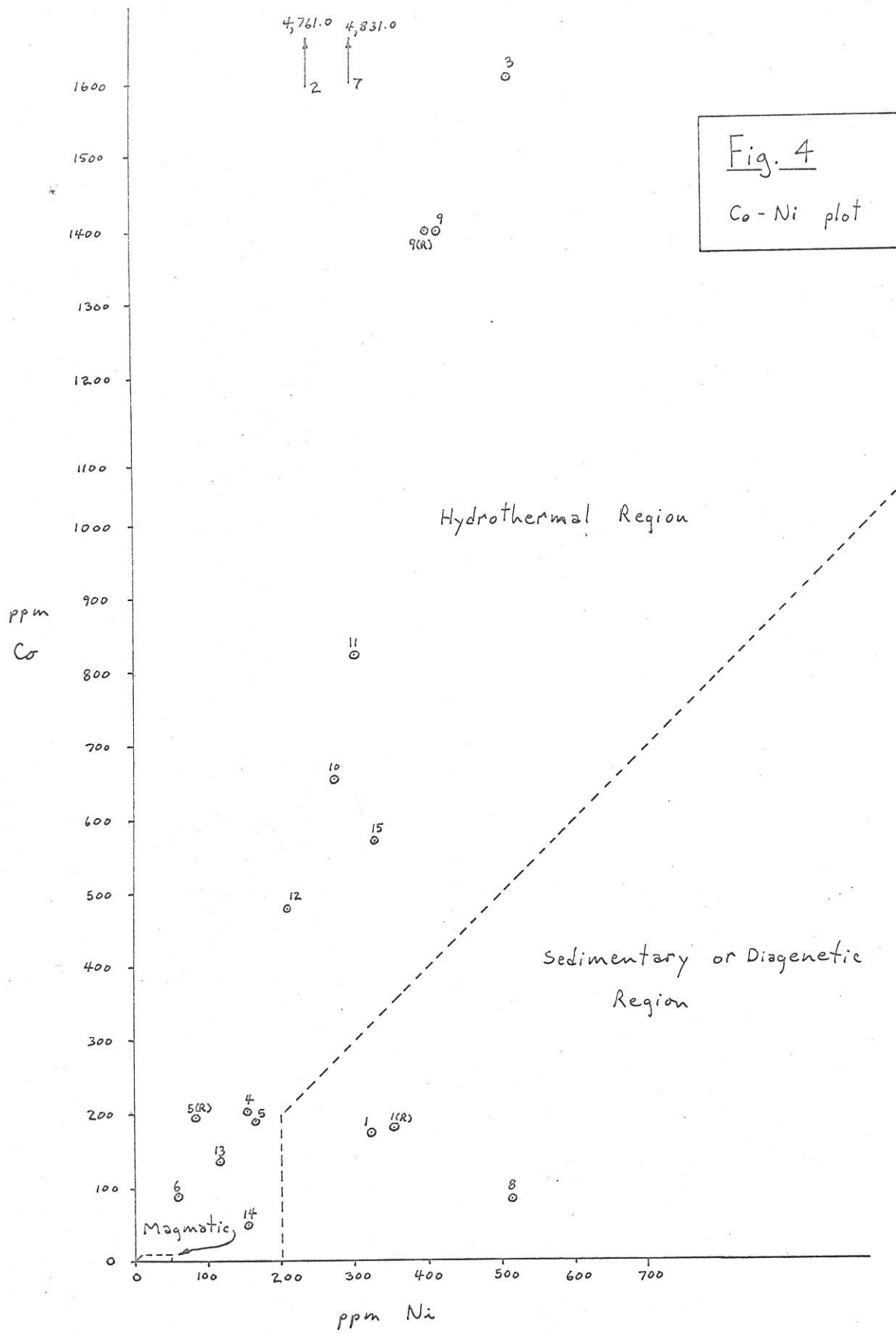
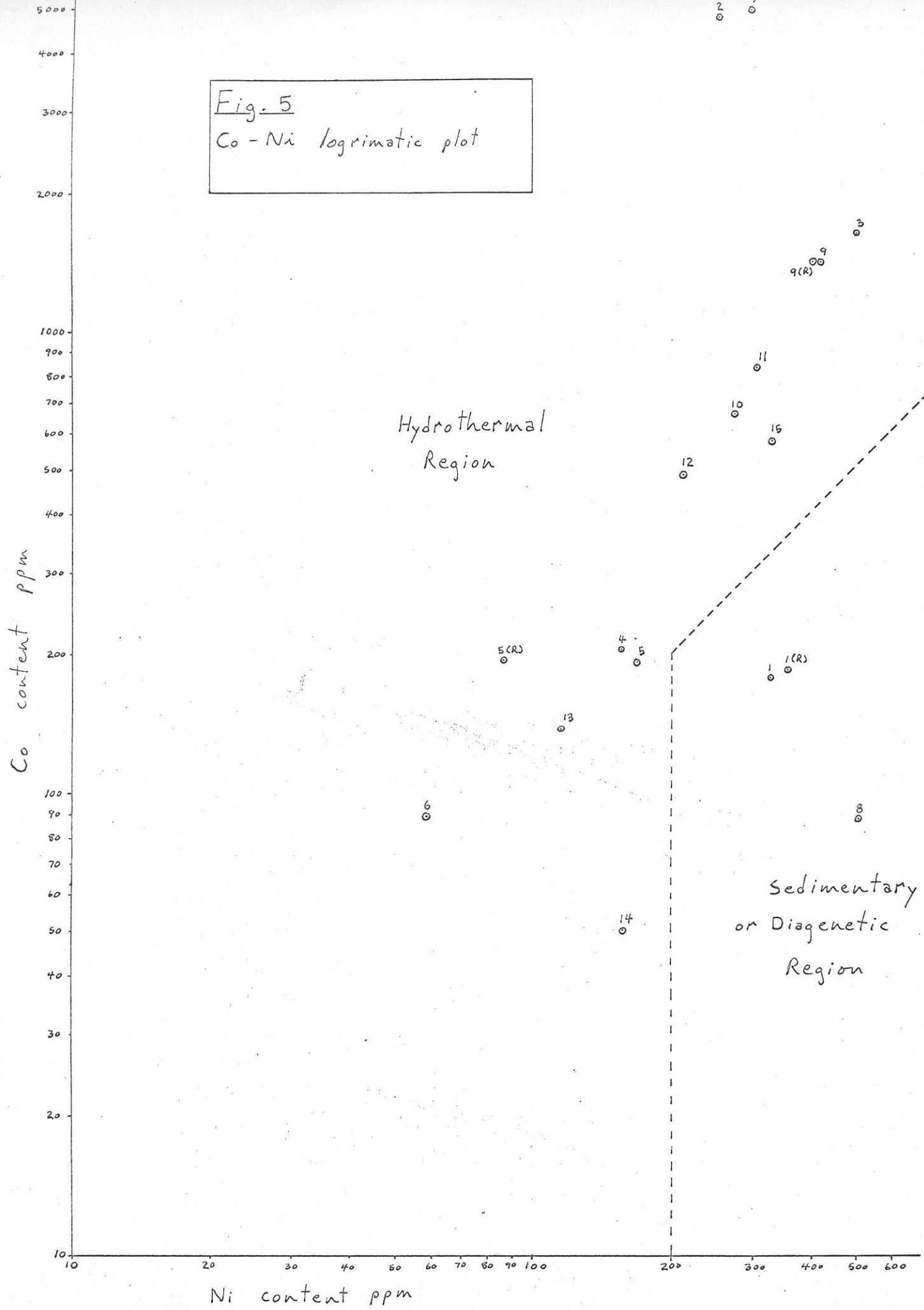


Fig. 5
Co - Ni logrimatic plot

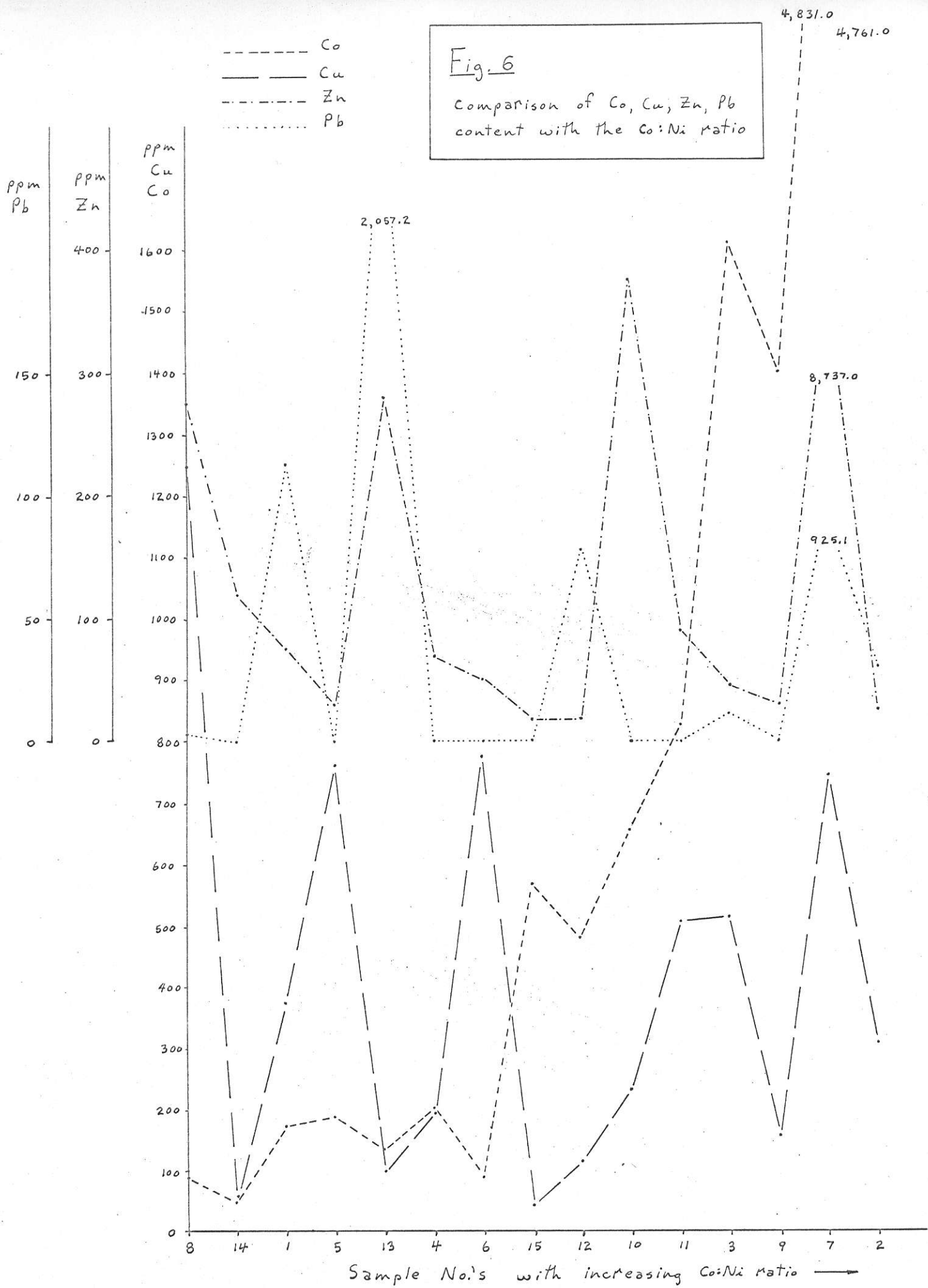


The cobalt and nickel values are plotted on Fig. 4 and Fig. 5. These two figures show that in the repeated samples, essentially all of the uncertainty is in the nickel values. It was found that the hydrochloric acid solution was corroding a metal portion of the spectrophotometer and the samples were being contaminated with nickel. However it appears that only analyses 4, 5, 6, 13, and 14 could be significantly affected as they have relatively low nickel content. This is taking into consideration the order of analysis (1, 21, 3, 4, 5, 6, 1(R), 7, 8, 5(R), 9, 10, 11, 12, 13, 14, 15, 9(R)), and the fact that analysis 5 is the only one significantly different than its repeat. Since with contamination the nickel value could only be greater than the true value, analysis 5(R) is probably close to the true value and analysis 5 is definitely contaminated. Analyses 4, 6, 13, and 14 are possibly significantly contaminated.

CONCLUSIONS

In Fig. 4 and Fig. 5 the hydrothermal, sedimentary or diagenetic and magmatic fields were obtained from some of the published literature on the subject. The references consulted were: Fleischer(1955), Hawley and Nicols (1961), Loftus-Hills and Solomon (1967), and Mitchell(1968).

The author concludes that the cobalt-nickel content in the pyrite indicates a hydrothermal environment of deposition



for most of the occurrences of sulphite mineralization in the Summit camp. This conclusion supports the hydrothermal origin suggested by Seraphim (1956). The Coryell intrusives as well as the Nelson intrusives were the sources of the mineralizing fluids. *wow!*

Samples 1 and 8 indicate a sedimentary or diagenetic environment of deposition. The similarities of samples 1 and 8, in field relations and mineralogy to the other samples suggests to the author that samples 1 and 8 are actually hydrothermal. For some reason the analyses are anomalous and do not reflect the true environment of deposition.

In Fig. 6 the amounts of cobalt, copper, zinc and lead are compared to the Co:Ni ratio. The variation in the Co:Ni ratio is mainly due to the variation of the cobalt content. There seems to be no causative relationship between the amount of cobalt and the amounts of copper, zinc and lead.

In a comparison of the minor element content and the mineralogy of the rocks, there is very little correlation. Samples 2 and 7 are the only rocks containing pyrrhotite and these two analyses show anomalously high cobalt content. This is quite likely due to small inclusions of pyrrhotite in the pyrite. The other samples show no apparent correlation of minor element content and mineralogy. However this may be a result of the small number of samples analysed. A correlation may appear if several samples from different parts of a single deposit are analysed.

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Carswell

Lithologic Legend for Fig. 2

Oligocene?

Coryell Intrusives



Biotite syenite, K-spar rhomb porphyry



Syenodiorite, monzonite and trachyte porphyries

Eocene-Oligocene?



Marron Formation (Midway and Phoenix volcanic groups)

Andesite, trachyte, quartz latite, rhyodacite, interbedded pyroclastics

Eocene



Kettle River Formation

Arkosic sandstones, local conglomerate, shale and coal

Cretaceous?



Valhalla Intrusives

Granite, quartz monzonite



Nelson Intrusives

Granodiorite, hornblende granodiorite, quartz mononite, minor granite and diorite

Triassic-Jurassic?



Diorite, gabbro and related dykes



Serpentinite and minor pyroxenite related to large fault zones

Lithologic Legend (cont'd)

Jurassic



Eholt Formation

Massive andesitic flows and pyroclastic equivalent

Triassic



Brooklyn Formation

Massive argillaceous limestone, banded limestone, breccias, chert pebble limy sandstone and thermally metamorphosed equivalents



Puddingstone

Equivalent to sharpstone Conglomerate except the matrix is maroon coloured



Sharpstone Conglomerate

Chert breccia, interbedded with argillite, siltstone and mudstone. Includes the local Rawhide Shale

Permian



Knob Hill Formation

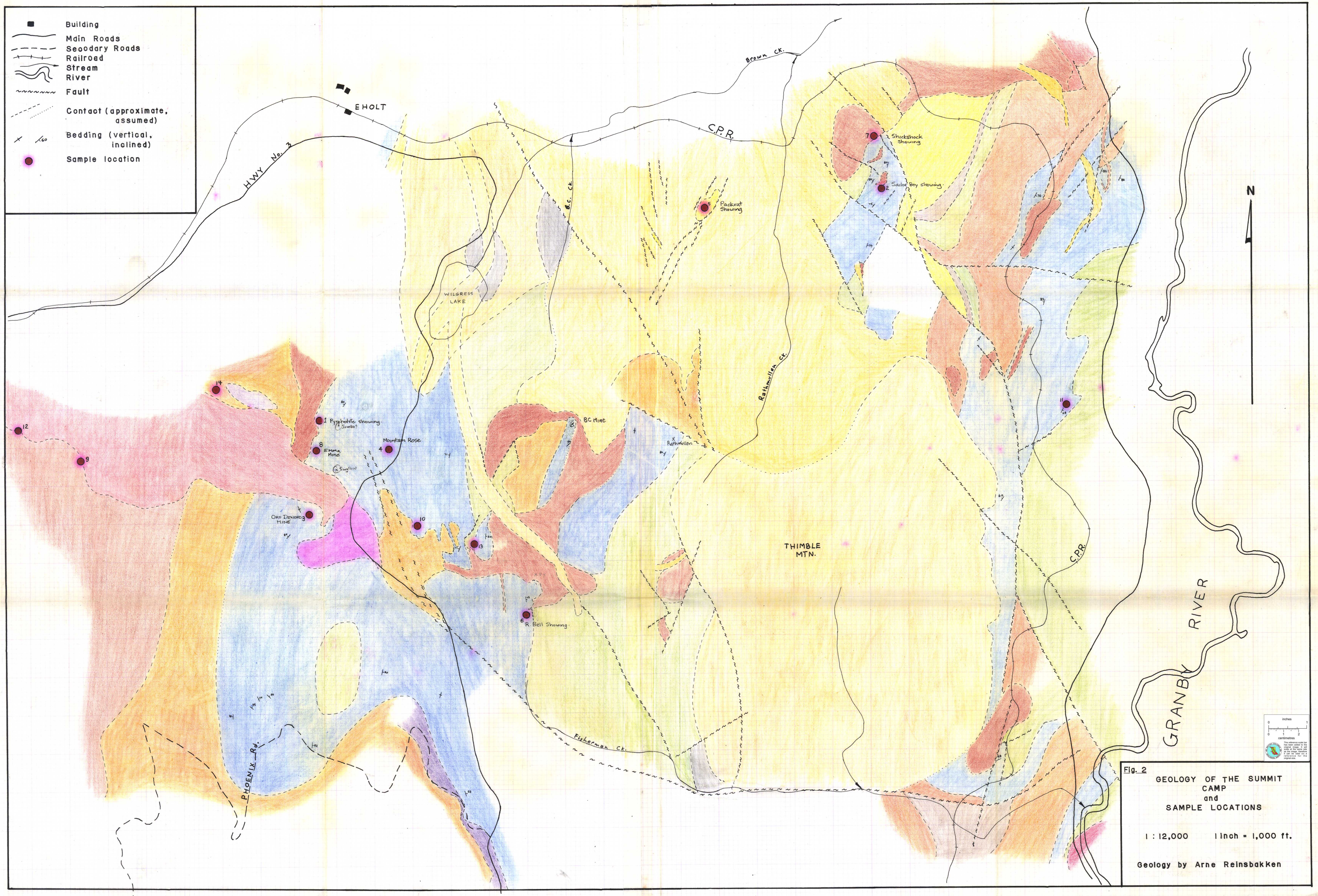
Argillite, cherty argillite, phyllite, hornfels, schists and gneisses



Chert (rhyolite?), quartzite and minor quartz sericite schist



Unidivided argillite and siliceous metasediments



- Building
- Main Roads
- - - Secondary Roads
- +— Railroad
- ~ Stream
- ~ River
- ~~~~ Fault
- - - Contact (approximate, assumed)
- + /60 Bedding (vertical, inclined)
- Sample location

Fig. 2
GEOLOGY OF THE SUMMIT CAMP and SAMPLE LOCATIONS
 1 : 12,000 1 inch = 1,000 ft.
 Geology by Arne Reinsbakken