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R. V. KIRKHAM

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Report

on an

ORIENTATION GEOCHEMICAL SURVEY

for

GRANDUC MINES LIMITED
SKEENA MINING DIVISION
BRITISH COLUMBIA

by

July, 1968

F. D. Forgeron, Ph. D.
Bondar-Clegg & Company Ltd.
Vancouver, B. C.

TABLE OF CONTENTS

RECOMMENDATIONS

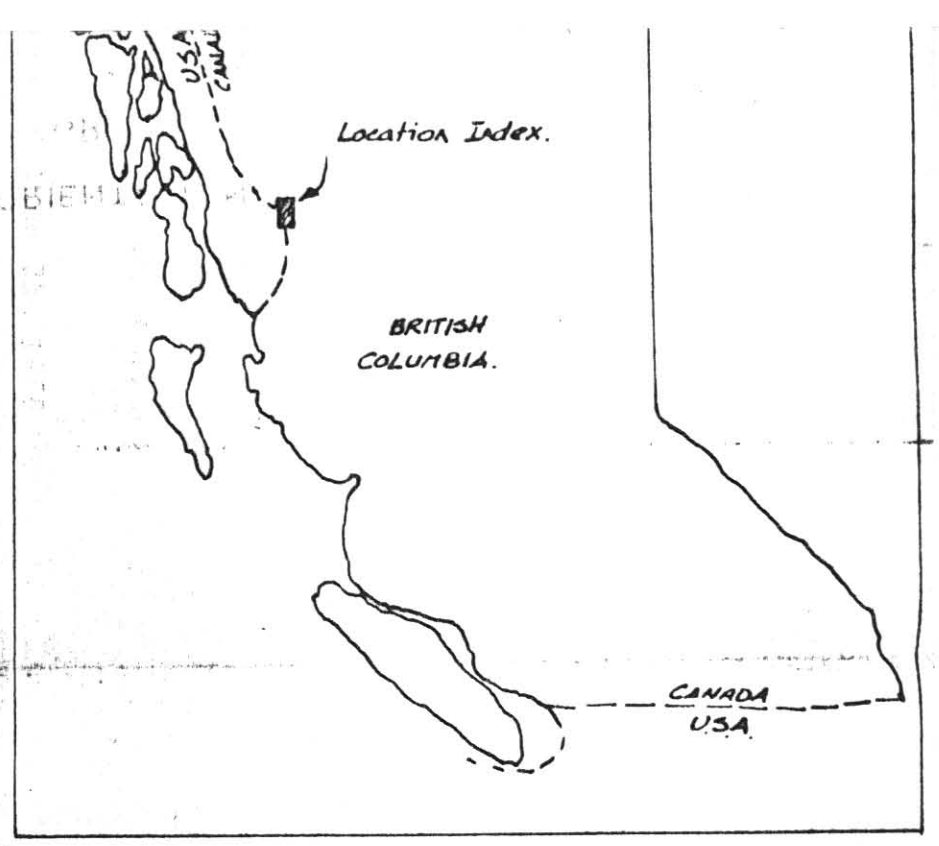
1. All streams and seeps should be sampled at 500' intervals.

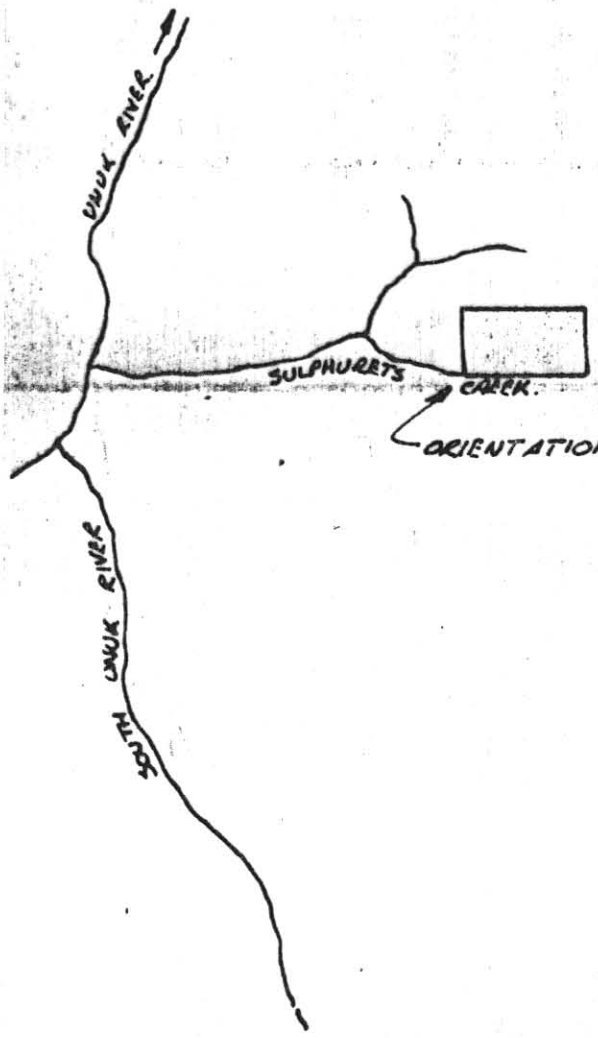
2. The samples should be analyzed on location for cold extractable copper.

3. All samples should be sent to a central laboratory for copper, molybdenum and silver analyses.

4. The whole survey area should be covered with the stream sediment survey before follow-up surveys be attempted.

5. Upon completion of the survey and receipt of all analytical data, the results of the survey should be evaluated by a geochemist to assign priorities for follow-up exploration.





Location Index.

ORIENTATION GEOCHEMICAL SURVEY
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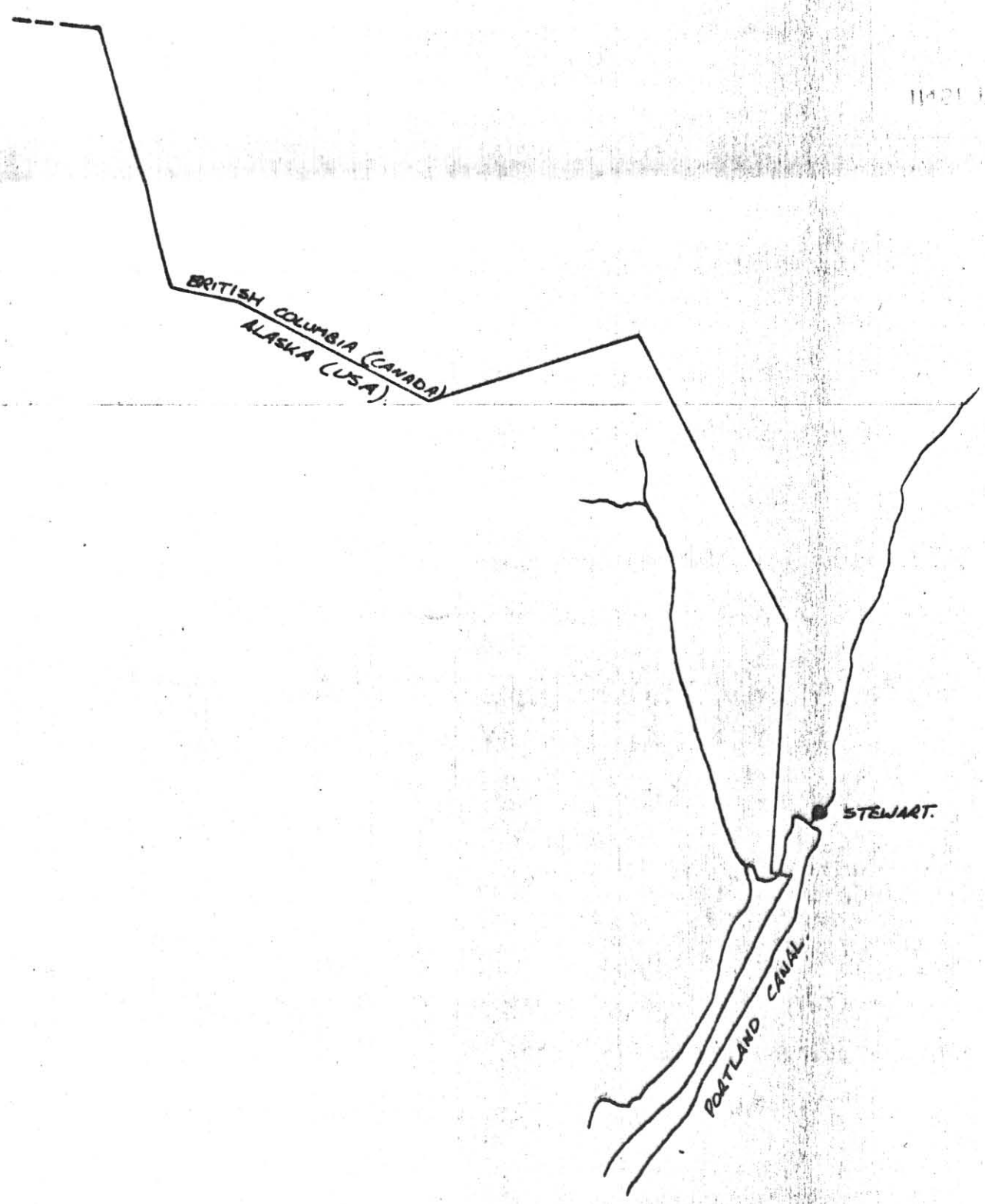

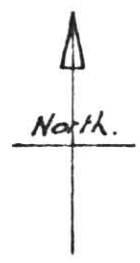

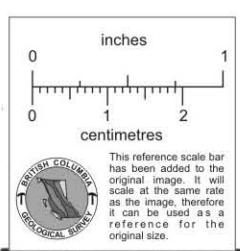

SURVEY by F. D. Ferguson Ph.D.
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VANCOUVER B.C. July 1968.

INTRODUCTION

General

The writer was commissioned by Mr. E. Ostensoe of Granduc Mines Limited to carry out an orientation geochemical survey in the Stewart Region of northern British Columbia. The writer visited the area and carried out the investigation during the period of June 25, 1968 to June 29, 1968. The results of the survey are recorded in this report.

Location and Access

The proposed geochemical exploration is to be carried out in the Mitchell Creek - Sulphurets Creek area. This area is located some forty-two miles north-northwest of Stewart, British Columbia. There are no roads in the area and access is entirely by helicopter.

Physiography

The area lies within the eastern Coast Mountains; a young mountain belt which is actively undergoing erosion, both from streams and from ice. Locally, the relief is approximately 3500 feet with the valley floors having an elevation of 2500 feet and the mountain tops 6000 feet. The tree line occurs at an elevation of about 4500 feet.

The local drainage characteristics are recorded on Map 1. Drainages into Sulphurets Valley are typical of the area and are in general, poorly developed probably due to recent retreat of the glacier; so, the stream beds in many instances are intermittent and the origin of the streams appears to have been land or ice slides. At the time of the writer's visit to the area, many of the stream beds were still covered with snow; thereby making sampling difficult.

MAP 1.

Drainage Characteristics, Topography, and Sample Locations.

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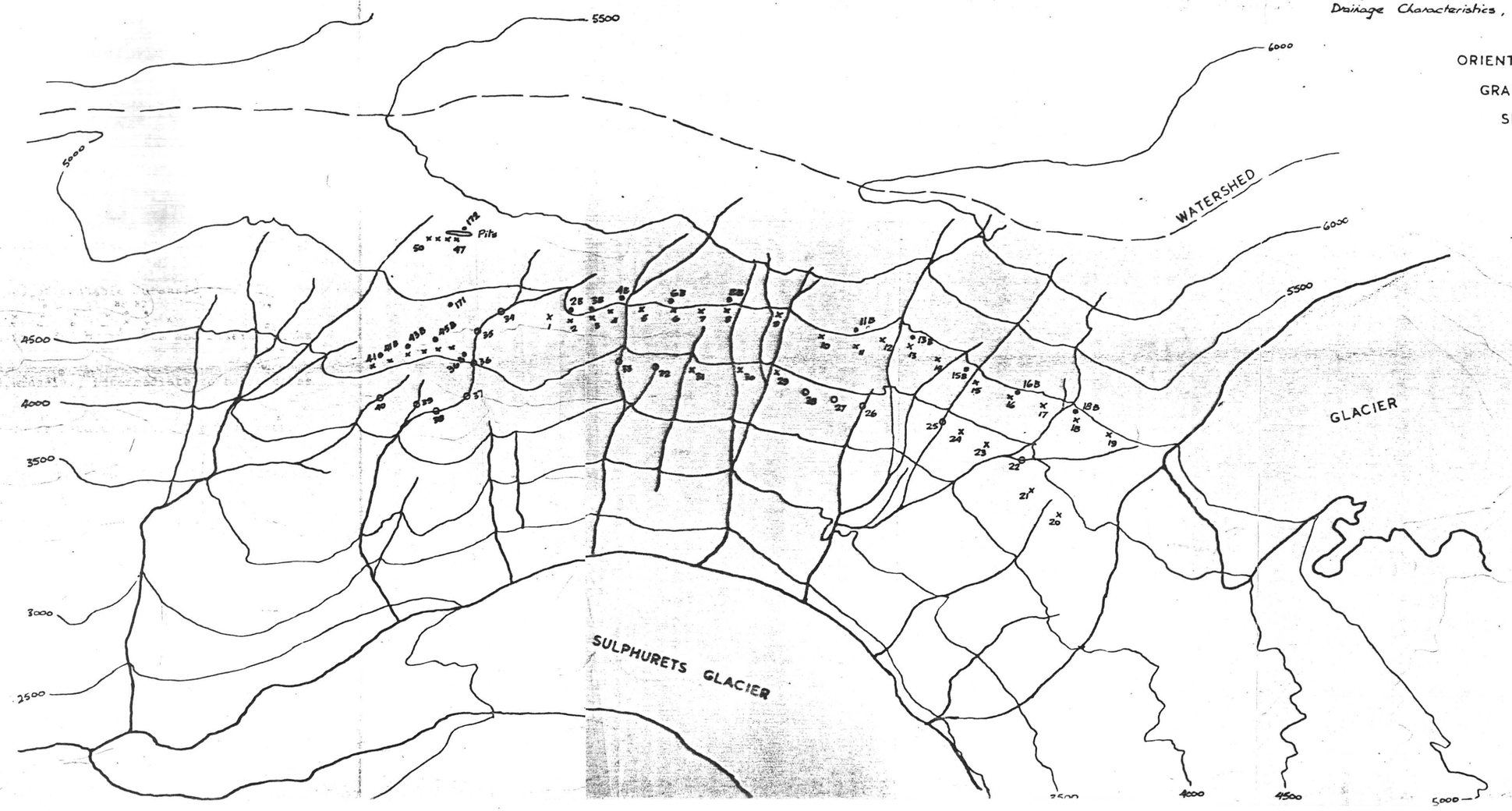
Scale : 1" = 1000'



LEGEND

- × Talus fines sample.
- o Stream sediment sample
- ● Bedrock sample.
- Stream.
- 3000 Contour
- Glacier

North.

inches 0 1 0 1 2 centimetres

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VANCOUVER, B.C., July 19

Geology

The geology of the area is complex and not well understood. During the writer's visit, detailed plain-table mapping was being carried out. Briefly, the area is underlain by intermediate to basic volcanic rocks with minor sedimentary rocks (eugeosynclinal type) of probable Jurassic Age. The volcanic rocks have been intruded by syenite and related rocks, and by some fine grained, massive, intermediate to basic dikes which have been referred to as keratophyres. The host rocks in the area have been subject to intense hydrothermal alteration consisting of quartz sericite, carbonate, pyrite, chlorite, albite, etc. The intensity of any given variety of alteration varies areally, permitting rough definition of several zones of alteration.

Geology (Cont'd)

The Sulphurets fault, a gently eastward dipping thrust, appears to be the control of most copper mineralization found to date in the area. Molybdenum mineralization has been found in the northeastern part of the proposed survey area; also, minor lead, zinc, silver and gold have been found in the southeastern part of the area.

GEOCHEMISTRY

Sampling and Analytical

A total of 67 samples were collected from the area consisting of 17 bedrock samples, 14 stream sediment samples and 36 talus fines samples. Two of the bedrock samples were taken near ore grade mineralization (samples M-1, M-2) and can be regarded as specimens. The other 14 samples have been taken on a random basis throughout the traverses.

The talus fines and stream sediment samples have been dried and sifted to -80 mesh. The -80 fraction of each stream sediment and talus fine sample was analyzed as follows:

(a) cold citrate extractable copper, (atomic absorption determination)

(b) hot acid extractable copper, lead, zinc, and silver, (atomic absorption determination)

(c) pyrosulphate fusion and thiocyanate colorimetric determination of molybdenum.

Sampling and Analytical (Cont'd)

The bedrock samples were crushed to -100 mesh and analyzed for copper, lead, zinc, silver and molybdenum in the manner of the talus fines and stream sediment samples. In addition, all samples have been submitted for gold determination using a cold aqua regia extraction and atomic absorption determination. At the time of writing the gold analysis were not available; however, the results found to date suggest that the purpose of the orientation survey, that is, to determine whether geochemical techniques can be used to indicate the presence of ore grade mineralization, has been fulfilled. The gold analysis will be submitted when they become available.

Geochemical Environment

The dominant aspect of the geochemical environment of the area is the ubiquitous gossan. The gossan results from dissolution of pyrite which is disseminated throughout the volcanic and sedimentary rocks. Geochemically, gossans are scavengers of trace amounts of metals by sorption or co-precipitation with the hydrated ferric oxides, giving anomalous metal values which may mask the true bedrock contents. Fortunately, as will be discussed below, economic grade copper mineralization has been defined by sampling of regoliths and stream sediments.

Stream Sediments

The 14 stream sediment samples are plotted on Map 2 with the concentrations of hot acid extractable copper and molybdenum. The complete list of analytical data is given on Table I.

Hot Acid Extractable Copper: The stream located south of the copper deposit shows a good dispersion of copper, i.e. 1850 ppm at the head of the stream to 520 ppm at a distance of 2000 feet downstream. The background of copper in the stream sediment samples cannot be determined because of incomplete information; however, it would appear from the existing data that the copper background will be between 100 and 200 ppm. The concentrations in the mineralized area, then are approximately an order of magnitude higher than background, which is easily discernable from background concentrations.

TABLE I

STREAM SEDIMENT ANALYSES

	REMARKS	Cx. Cu	Cu	Pb	Zn	Mo	Ag	Au
T-22		175	870	52	2500	16	3.0	
T-25		6	98	140	600	8	2.8	
T-26		ND	99	125	460	8	2.0	
T-27		14	195	390	650	6	4.0	
T-28		105	360	570	1000	8	8.0	
T-32	Some Malachite up slope	73	470	460	340	18	7.0	
T-33	Some Malachite up slope	63	410	160	225	9	4.8	
T-34	Drainage from known Cu mineralization	550	1850	102	123	70	4.8	
T-35	" " " "	500	1400	105	116	50	2.2	
T-36	" " " "	400	1800	130	122	60	2.1	
T-37	" " " "	500	1250	107	152	40	2.3	
T-38	" " " "	73	520	100	118	48	1.7	
T-39	" " " "	41	280	90	119	60	1.9	
T-40	" " " "	500	4800	75	158	48	2.5	

ND - Not Detected

MAP 2

Copper - Molybdenum in Stream Sediments

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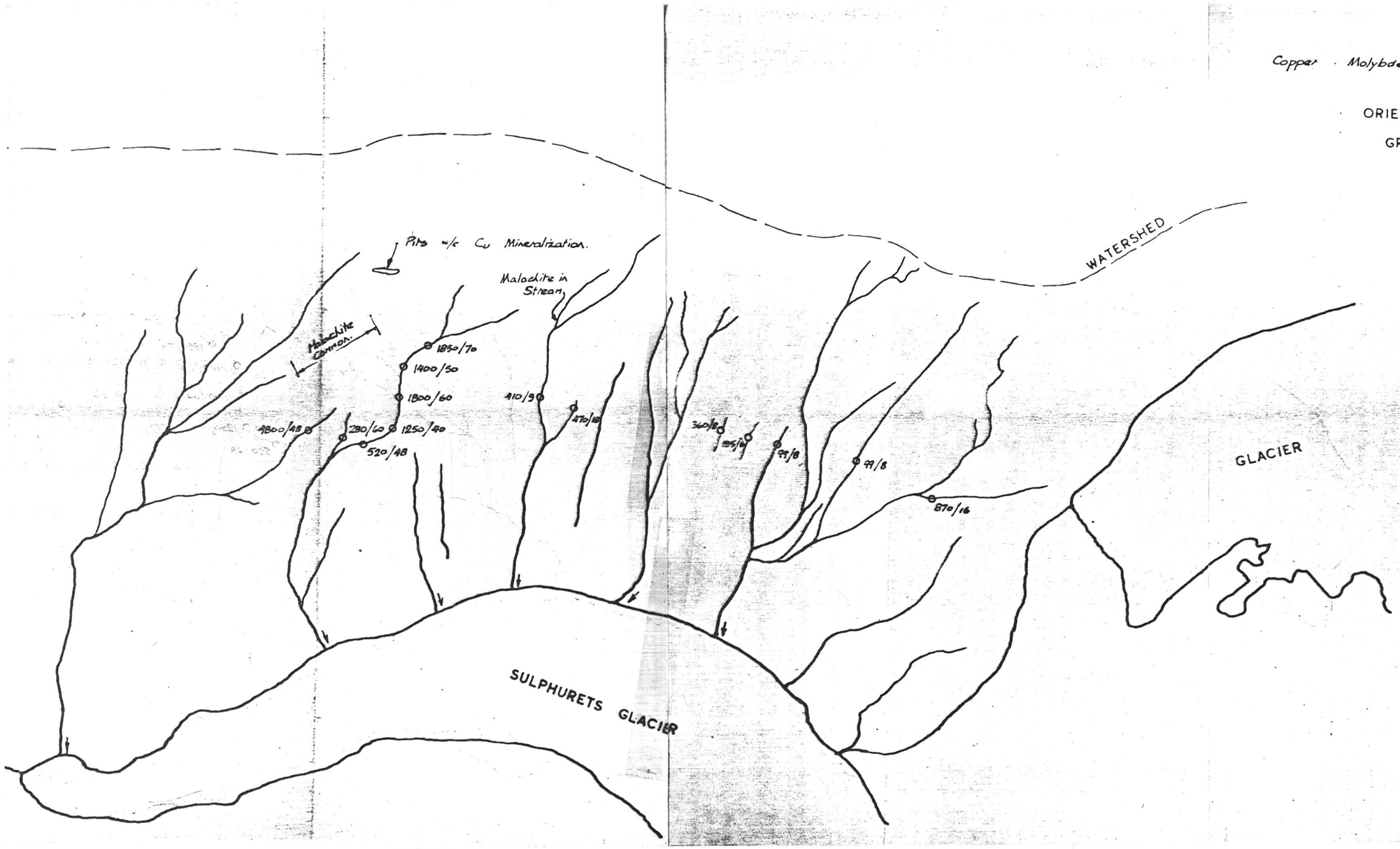
Scale : 1" = 1000'



LEGEND

150/20
Molybdenum (ppm).
Hot acid extractable copper. (ppm)
Sample Location.

North.

inches
0 1
0 1 2
centimetres

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Cold Citrate Extractable Copper: Citrate extractable copper was determined in the field and in the laboratory. In both cases excellent correlation with the hot extractable results were found in the area of known copper mineralization, suggesting it's effective use elsewhere. Effective cold citrate extractable tests provide information at sample location and thereby more efficient reconnaissance survey coverage.

Molybdenum: Molybdenum appears to display a response similar to that of copper in the stream sediment samples. The background although not determined may be between 10 and 20 ppm with the molybdenum concentrations in the area of copper mineralization reaching 70 ppm.

Lead, Zinc and Silver: Lead, zinc and silver have been analyzed on all stream sediment samples and the analytical data are recorded on Table I. Neither of the above mentioned metals appear to be significant in the definition of copper mineralization in the area. However, the relationship between lead, zinc and silver is apparent on comparing results of samples 27, 28 and 32 with the rest of the stream sediments. Such a relationship is common in nature and since some silver has been found in the area, it would appear that further investigation of this relationship is warranted.

Talus Fines Sampling

The locations and distribution of copper and molybdenum concentrations are recorded on Map 3. All analytical data for the talus fines samples are recorded on Table II.

TABLE II

TALUS FINES ANALYSES

	REMARKS	Cx. Cu	Cu	Pb	Zn	Mo	Ag	Au
T-1	Sample traverse at elevation of 4700' T-1 to T-19	9	150	100	80	8	1.9	
T-2		15	195	240	109	12	2.0	
T-3		43	350	240	176	48	3.4	
T-4		53	770	200	82	36	2.5	
T-5		34	365	110	66	8	1.5	
T-6		47	580	240	74	36	2.4	
T-7		250	370	130	100	14	1.1	
T-8		30	310	175	160	8	2.7	
T-9		11	170	240	150	12	3.7	
T-10		64	350	240	121	12	8.0	
T-11		10	170	160	159	7	3.0	
T-12		73	420	420	380	28	6.0	
T-13		1	130	280	134	6	1.0	
T-14		ND	31	680	430	8	2.8	
T-15		18	118	135	170	7	2.6	
T-16		ND	110	370	116	20	3.8	
T-17		7	160	250	109	12	2.1	
T-18		14	310	70	110	10	1.5	
T-19		3	230	150	93	8	1.5	

MAP 3

Copper - Molybdenum Distribution in talus fines

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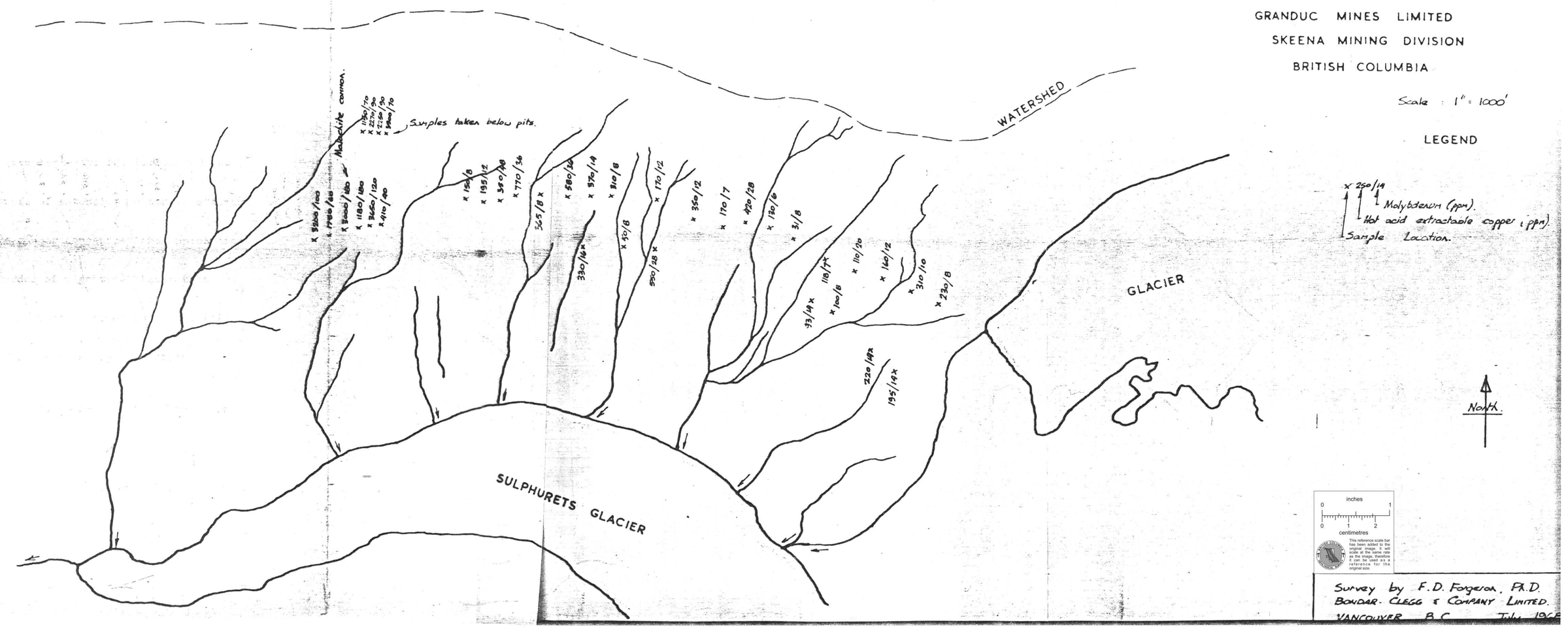
Scale : 1" = 1000'



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Vancouver B.C. July 1968

CONT'D

TABLE II

TALUS FINES ANALYSES

	REMARKS	Cx.Cu	Cu	Pb	Zn	Mo	Ag	Au
T-20	Sample traverse at elevation of 4300' T-20 to T-31	5	195	106	92	14	1.5	
T-21		12	220	70	100	14	1.4	
T-23		3	100	190	200	8	2.4	
T-24		2	93	1400	480	14	1.3	
T-29		130	550	360	1150	28	7.0	
T-30		ND	50	160	135	8	1.0	
T-31		18	330	300	134	16	8.0	
T-41	T-41 to T-46 in area of some malachite staining	500	3200	70	49	100	4.5	
T-42		300	1750	68	119	60	3.0	
T-43		175	3000	88	45	180	7.0	
T-44		120	1180	49	43	180	2.0	
T-45		500	3650	47	53	120	4.0	
T-46		130	410	100	125	40	2.0	
T-47	T-47 to T-50 below pits in mineralized area	500	3900	90	134	70	6.1	
T-48		140	2250	97	73	90	6.1	
T-49		165	2270	80	66	90	9.0	
T-50		190	1150	64	56	70	7.5	

Hot Extractable Copper: The copper concentrations in the talus fines samples varies from 31 ppm to 3900 ppm. The background in copper may be between 100 and 300 ppm. The copper concentrations in the talus fines samples collected below the "pits" overlying the known copper mineralization (samples 47 to 50, inclusive) and the samples taken in areas of extensive malachite staining (samples 41 to 46) have copper concentrations approaching 4000 ppm; or about an order of magnitude higher than background. Such contrast is considered to be sufficient to outline areas containing copper mineralization.

Molybdenum: The molybdenum concentrations in the talus fines varies between 6 and 180 ppm. The background in molybdenum may be between 10 and 30 ppm giving

Molybdenum: (Cont'd)

a contrast of 5 to 10 times background in areas of known copper mineralization. It is concluded from these data that molybdenum may be used an an indicator to define copper mineralization.

Cold Citrate Extractable Copper: Cold citrate extractable copper, as determined in the field, gave largely negative results in the talus fines samples. The same analysis were carried out in the laboratory using an one hour extraction time, which gave more positive results (see Table II), but do not show a good correlation with the hot extractable values. The reason for the lack of correspondence between the cold extractable and hot extractable copper is due to the degree to which copper is bonded

Cold Citrate Extractable Copper: (Cont'd)

to or within the particulate matter. The cold extractable copper is not considered to give supplementary information to the hot acid extractable copper; and, therefore, is not recommended on a routine basis in the talus fines samples.

Lead, Zind and Silver: Lead and zinc do not appear to show significant contrast in the areas of known copper mineralization as compared with other parts of the area. Silver, however, shows a marked increase in concentrations in samples 47 to 50 which were taken immediately below the mineralized pits. The bedrock concentrations of silver in a specimen of the ore grade mineralization was found to be 68 ppm. The silver, when liberated from

Lead, Zinc and Silver: (Cont'd)

the ore minerals, is probably co-precipitated or sorpted with the iron oxide in the nearby regolith and shows an extremely limited mobility. Throughout the remainder of the area, lead, zinc and silver appeared to be related and may reflect a bedrock source.

Bedrock Geochemistry

The location of bed rock samples with the hot extractable copper and molybdenum concentrations is shown on Map 4. The analytical results of the bedrock samples with megascopic descriptions of each sample is recorded on Table III. A fairly complete cross-section of the various types of bedrock of the area have been taken although insufficient sampling of each specific rock unit has been

Bedrock Geochemistry (Cont'd)

carried out to completely elucidate the bedrock geochemistry of the area.

All rock samples were analyzed by hot acid leaching which result in breakdown of sulphides and any hydrous silicate phases present, but which will not attack to any great degree the anhydrous silicate phases. In terms of the economic mineralization potential of the area, this type of analysis is considered to give sufficient information to carry out effective exploration.

TABLE III

BEDROCK ANALYSES

SAMPLE NUMBER	MEGASCOPIC CHARACTERISTICS	Cu	Pb	Zn	Ag	Mo	Au
2B	Fe oxides on sheared andesite	125	56	71	2.0	4	
3B	Malachite staining on siliceous volcanics	5,200	30	36	1.5	90	
4B	Sheared pyroclastics	1,470	120	240	2.0	28	
6B	Qtz-py-sericite alteration on volcanics	71	46	6	ND	3	
8B	Fresh andesite	166	20	85	1.1	2	
11B	Malachite staining on porphyritic andesite	1,600	17	69	ND	3	
13B	Fault zone, sericite chl. alteration sheared andesite	125	88	500	2.3	7	
15B	Fresh andesite	90	20	156	1.5	ND	
16B	Sandstone (pyroclastic?)	26	59	83	1.0	7	
16B2	Fine grained fresh massive basic dike	28	19	275	1.7	ND	
18B	Qtz-sericite-py-alteration aphanitic volcanic?	83	31	31	0.2	7	
36B	Fresh andesite	155	19	74	1.4	3	
41B	Silicified zone, malachite staining, in porphyritic rock	1,670	22	40	2.7	4	

CONT'D

TABLE III

BEDROCK ANALYSES

SAMPLE NUMBER	MEGASCOPIC CHARACTERISTICS	Cu	Pb	Zn	Ag	Mo	Au
43B	Sericite-siliceous alteration fault zone - andesite	1,500	19	36	2.0	7	
45B	Qtz-py-alteration, malachite, andesite	1,670	20	27	2.3	36	
M-1	Malachite staining sheared andesite	16,500	15	48	7.0	125	
M-2	Cpy-py specimen from pits	111,000	39	89	6.8	70	

MAP 4

Copper - Molybdenum Distribution in Bedrock.

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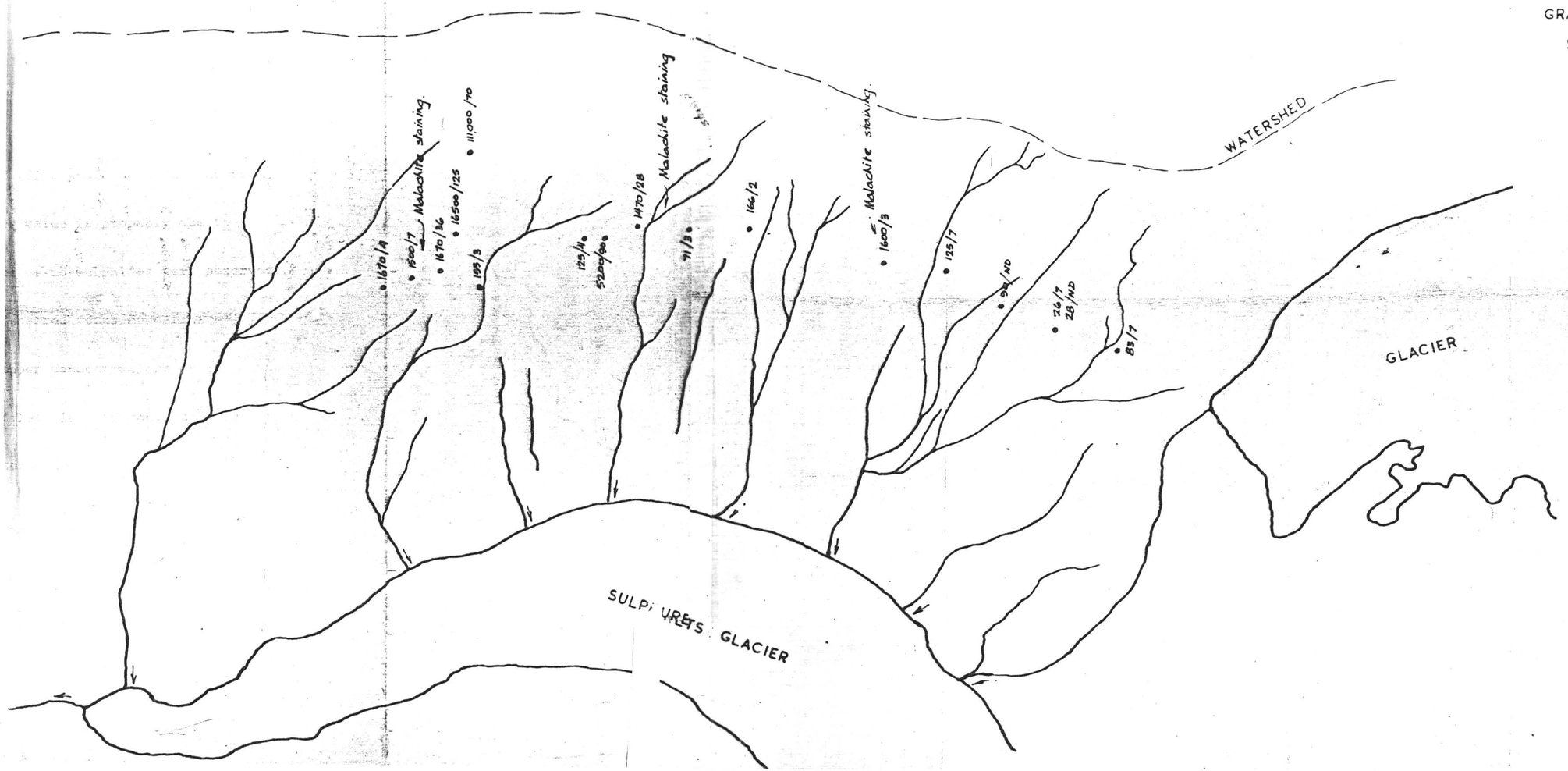
BRITISH COLUMBIA

Scale : 1" = 1000'



LEGEND

125/10
Molybdenum (ppm)
Hot Acid extractable copper (ppm).
Sample Location.

North.

inches
0 1
0 1 2
centimetres

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VANCOUVER B.C. July. 1968

Copper: Where malachite staining has been observed in the field, the copper concentration of all rocks is in excess of 1500 ppm, in the fresh relatively unaltered andesite flow rocks, the copper concentration is between 75 and 150 ppm, sample 16B2 (fine grain massive dyke rock) yielded 28 ppm copper. This value is probably due to leaching of siliceous phases as no sulphides were observed. In the altered, faulted or sheared rocks no definite figure can be put on the copper concentrations as it appears to be a function of leaching and concentrating related to the original alteration.

Molybdenum: The molybdenum concentration does not bear a specific relation to copper in the rocks, possibly because of different mobilities between copper and

Molybdenum: (Cont'd)

molybdenum which results in malachite staining occuring in fractures and on the surface of the bedrock which produces high copper values without a corresponding molybdenum relationship. In the area of known economic grade copper mineralization, the bedrock carries a small but anomalous content of Mo (M-1, M-2) which is less widely dispersed than is copper.

Lead and Zinc: Lead and zinc do not show a marked contrast relative to copper distribution, however, the higher values of lead and zinc appear to be related to shearing and faulting.

Silver: Silver concentrations of all samples other than samples M-1 and M-2 contain 2 ppm or less. No significance can be attached to these values with the amount of data available; however, the concentrations of silver in the area of the copper mineralization (7 ppm and 68 ppm, respectively) for samples M-1 and M-2 suggest that silver accompanies the copper mineralization in small quantities.

SUMMARY AND CONCLUSIONS

The total of 67 samples of bedrock stream sediments and talus fines were collected in the Sulphuretes Creek area of northern British Columbia during the period of June 25 to June 29, 1968. These samples were analyzed for copper, lead, zinc, molybdenum, and silver with the purpose of determining whether geochemical techniques could be used to define ore grade copper mineralization.

Interpretation of analytical and field data have permitted the following conclusions:-

1. Hot acid extractable copper, cold acid extractable copper and molybdenum in stream sediments samples indicate the presence of known copper mineralization.

2. Hot acid extractable copper and molybdenum define the presence of known copper mineralization in talus fines samples.

SUMMARY AND CONCLUSIONS (CONT'D)

3. Anomalous silver concentration occur in talus fines samples within 200 feet of known copper mineralization and may be useful in giving target sites from broadly anomalous copper and molybdenum areas.

4. Lead and zinc do not appear significant in outlining copper deposits either in stream sediments, talus fines, or bedrock.

5. Bedrock analyses indicate that copper gives a broadly anomalous halo around known copper mineralization and that molybdenum and silver give more restricted halos which may be useful in providing target sites over broad bedrock copper anomalous.

6. Lead and zinc in bedrock appear to be most anomalous in sheared or faulted zones.

7. There is a copper-lead-zinc association in the talus fines which may be indicative of bedrock sources of silver.