

PHELPS DODGE CORPORATION OF CANADA LTD

Preliminary Geological Report on

PROJECT 101 - WATSON RIVER

CLAIMS WAT, SON AND RIV

CLAIM SHEET 105D6

Whitehorse M.D.

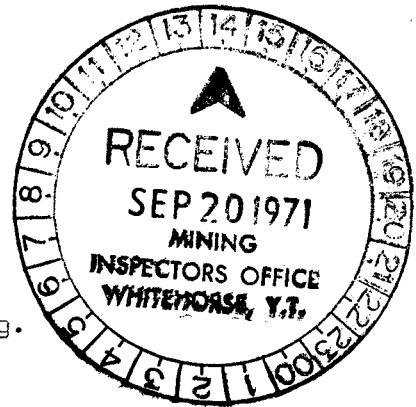
60°20'N, 135°20'W

N.T.S. 105-D/6

Preliminary Report

By

Dr. R.R. Culbert P. Eng.



Work Done June 1 to June 22

1971

This report has been examined by the Geological Evaluation Unit and is recommended to the Commission to be considered as representing work done in the amount of

\$8944.23

*J.B. Craig*  
 \_\_\_\_\_  
 Inspector

June, 1971

Considered as remuneration work under Section 53 (4) Yukon Quartz Mining Act.

*[Signature]*  
 \_\_\_\_\_  
 Commissioner of Yukon Territory

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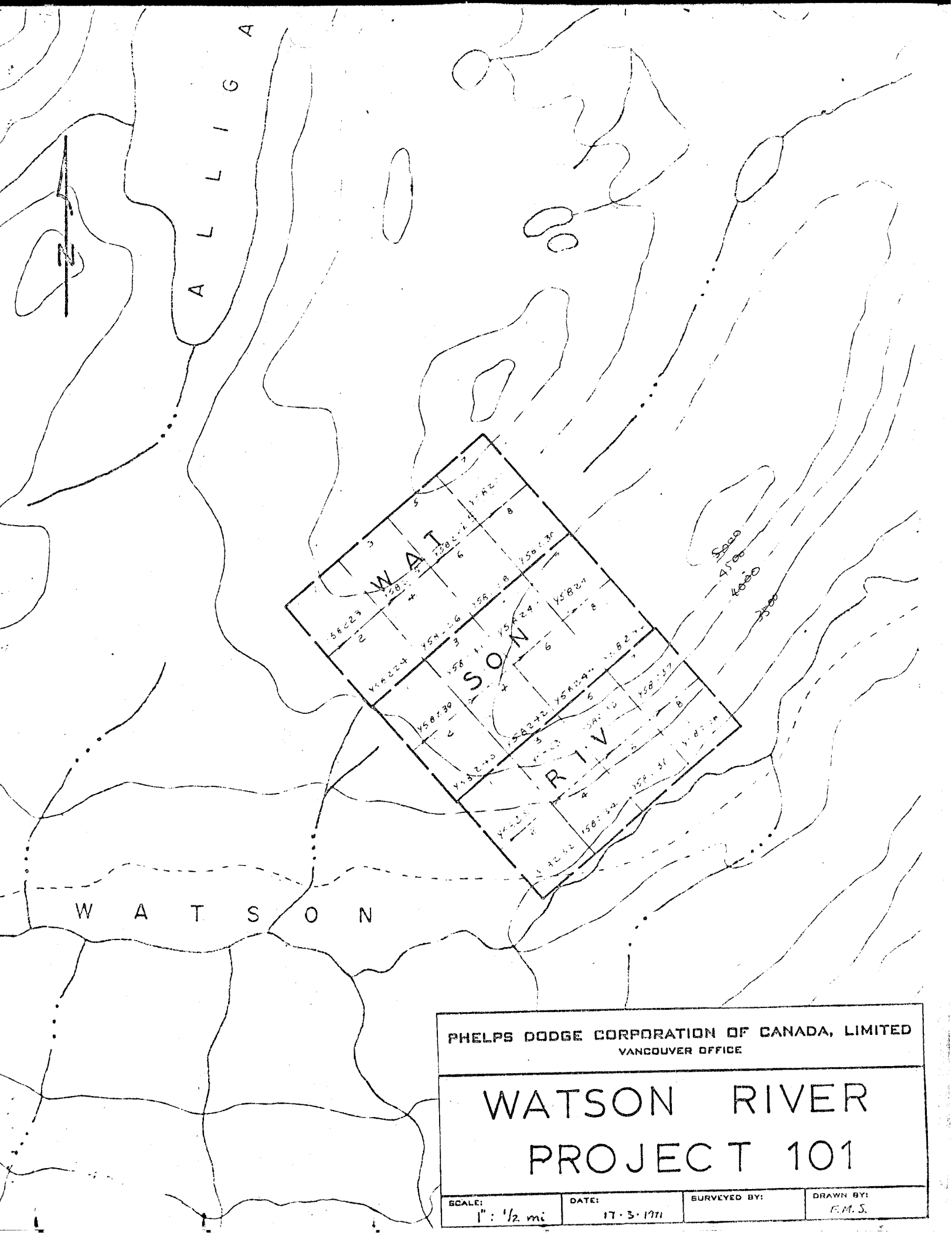
## WATSON

### Introduction

The Watson Project claims were staked to cover a reconnaissance soil geochemistry anomaly <sup>found</sup> located during July of 1970. There was no previous claim staking known in the area of the north side of the Watson River near Alligator Lake; although, some claims have been staked south and east of this locality.

### Property

The WAT (Y58223 - Y58230), SON (Y58239 - Y50246) and RIV (Y58231 - Y58238) claims were staked in mid August 1970 recorded September 1, 1970 and transferred to the ownership of Phelps Dodge Corporation of Canada, Limited, 404-1112 West Pender, Vancouver 1, B.C.



PHELPS DODGE CORPORATION OF CANADA, LIMITED  
VANCOUVER OFFICE

# WATSON RIVER PROJECT 101

SCALE: 1" = 1/2 mi	DATE: 17.3.1971	SURVEYED BY:	DRAWN BY: G.M.S.
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TABLE OF FORMATIONS (REGIONAL)

Project 101 - Watson River

Quaternary - Miles Canyon Basalt (12)

Cretaceous or possibly Tertiary or Earlier

- Coast Intrusives - granodiorite, granite, (8)
- quartz monzonite, quartz diorite
  - 8 (a) - hornblende - biotite - oligoclase granodiorite
  - 8 (b) - leucocratic granite, biotite granite
  - 8 (c) - biotite - hornblende quartz diorite
  - 8 (d) - hornblende diorite
  - 8 (e) - gneissic porphyritic granodiorite
  - 8 (f) - shattered granodiorite and granite breccia
  - 8 (g) - pegmatitic syenite

Triassic

Lewes River Group

- 3 (d) - metamorphic rocks probably belonging to  
Lewes River Group

Precambrian or later

Yukon Group

- 1 (b) - metamorphosed sediments, feldspathic gneiss,  
gneissic granitic rocks.

PHELPS DODGE CORPORATION  
OF CANADA LIMITED

WATSON RIVER PROPERTY  
YUKON TERRITORY  
INTERIM REPORT

1. INTERIM CONCLUSIONS

Indications of copper and molybdenum on the Watson River property, are confined to scattered occurrences, mostly of secondary minerals along widely spaced shear zones. The possibility of copper mineralization being occluded in chlorite and mafic fracture of fillings or below the weathering zone in places of severe crushing cannot be entirely discarded until soil and samples analyses are complete. The possibility of significant mineralization occurring in this form is, however, slim.

A minor aeromagnetic anomaly over the zone of shearing and multiple intrusion suggests that the complex trends in a northwesterly arc towards Alligator Lake. This axis cuts across the northern portions of the property, which are till covered. It is hence quite likely that scattered geochemical anomalies will be picked up there. As will be discussed, copper and molybdenum mineralization is not directly associated with the regions of intense pyritization. This limits the usefulness of I.P., and the form of occurrence is likely to exclude other geophysical techniques. Only minor magnetite has been observed in a few quartz veins.

The next obvious step for anomalies beneath the till is hence the rather destructive and expensive one of bulldozer stripping or trenching. If the geochemical anomalies in the area of geological mapping are satisfactorily explained by the non-economic showings, and if geochemical anomalies beneath the till are indeed only scattered, no further work is recommended.

## 2. LOCATION AND TERRAIN

The WAT - SON - RIV claim group consists of 24 claims north of Watson River and southeast of Alligator Lake. A cliff and talus hillside of about 2500 feet differential elevation stands above Watson River in the southern portion of the property. The river here is at an altitude of 3000 feet. This steep section of hillside exhibits a large gossan, and represents most of the outcrop on the claim group. A band of glacial lake terraces flanks the Watson River, and the balance of the property is almost entirely covered by till or swamp with only a few outcrops or felsenmeer patches from which to deduce geology.

## 3. PROGRAM

A four man SEMCO crew, consisting of two soil samplers and two geologists spent three weeks examining the property.

Soil samples were taken on a 100 foot grid over the gossan and adjacent slope, and at 400 foot intervals on lines of 800 foot spacing over the balance of the property. Results have not been received at time of writing.

Mapping of lithology, structure, alteration and mineralization was carried out over those parts of the property where outcrop occurred, with greatest attention being paid to the mineralized area of the steep hillside.

A final report, including geochemical interpretation, geological details, photographs, etc. will be submitted at end of the field season.

## 4. PARAMETERS INFLUENCING GEOCHEMISTRY

A coded set of parameters is submitted for each soil or silt sample taken. This includes observable factors likely to influence interpretation of results, and is outlined on Table 1. A pH meter was not available but silt samples were not numerous, and for the most part, may be assumed washed by surficial melt water at this time of year. As both copper and molybdenum mineralization are present, pH should not be a critical detection parameter for mineralized areas.

Parameters (Cont'd)

Most of the coded data requires no discussion, an exception being terrain classification. Proceeding back from Watson River, the following terrains are encountered:

- (a) Valley Floor. -- There are no indications that bedrock approaches the flood plain of the Watson River, or that any anomaly found here could be directly interpreted.
- (b) Lacustrine Terraces. -- Terraces involving 125 foot cross section of silts and gravel lenses comprise most of the area between the river and steep hillside. The Terraces exhibit silt bluffs and flat or back-draining tops with swampland. The gravel lenses are not generally aquifers, and where river meanders have cut deeply into the terraces they expose no bedrock. Soil samples from this terrain are hence of limited value. Where the base of the silt bluffs expose the water table, samples have been taken, but even these are likely to prove of limited use.
- (c) Stable Talus. -- Rising abruptly from the terraces are steep soil and talus slopes partially stabilized by scrub aspen and lower vegetation. The soil has been derived from rockslide and avalanche debris and wind-blown detritus -- both originating from the slopes above. Further mixing by solifluction is evident. Benches high on this terrain are marked as proglacial lake margins by the GSC but appear to be Kame Terraces, so that glacial debris may be mixed with the more local material. Drainage does not collect on surface on these slopes.
- (d) Loose Talus. -- Most of the mountainside is either rock face or loose talus. Much of the latter contains sufficient fine material for soil sampling. It should be noted, however, that gravity distribution of the fine fraction does not appear to be as major a factor as wind distribution. Upward movement of dust was commonly observed in the prevailing wind.

## Parameters (Cont'd)

- (e) Till. -- Most of the property features till spread over a broad, swampy valley. In places this is obviously thin, and reveals angular felsenmeer where angular lithic fragments suggest bedrock nearby, this has been noted in the coding. It seems likely that geochemical sampling will detect anything major beneath the till.
- (f) Swamp. -- Drainage appears to overlie permafrost, and organic material goes deep. Interpretation of anomalies will be correspondingly doubtful.

## 5. LITHOLOGY

Overall geology features a very complex migmatite in the classic pattern of Coast Mountain batholith, multi-component, intrusive migmatites. Fifteen intrusive components were classified and will be briefly mentioned -- briefly because they did not prove important in control of mineralization. Only a few of the rock types could be mapped as continuous lithologies in the field. Identification was partly based on appearance of hand specimens and partly on quartz and potassium content as revealed by etching the rocks and staining with cobaltinitrite. A table of boundary and time relations will be prepared for the final report.

- (a) Granodiorite. The dominant and likely oldest rock is a biotite granodiorite, averaging 12% mafics, 15% quartz, and 10% K feldspar (dominantly interstitial). In unaltered assemblages mineral percentages remain within  $\pm 50\%$ . Quartz diorite gradations were observed, but are mainly peripheral to the property.
- (b) Chlorite Quartz Diorite. This was found to be a stress-alteration form of the granodiorite as will be discussed later. It grades into phyllitic mylonite.
- (c) P<sup>+</sup> Grey Porphyry. A wide variety of porphyries appear on the property. These usually display plagioclase, quartz and biotite phenocrysts, and commonly have factions sufficiently coarse to be confused with

Lithology (Cont'd)

fully developed intrusive rocks. Upon etching, however, quartz eyes are observable even in coarse assemblage and potassium is in a groundmass instead of K feldspar. P<sup>+</sup> phases differ widely in appearance and are differentiated by a potassium-rich matrix.

- (d) P<sup>-</sup> Grey Porphyry. This is similar to P<sup>+</sup> porphyries but with little potassium in the groundmass and is likely earlier. The two cannot be distinguished in badly altered specimens.
- (e) Dark Matrix Porphyry. This is distinguished by a black groundmass, grading to interstitial mafics in coarser phases while the P<sup>-</sup> porphyries tend to have synplutonic boundary relationships with the granodiorite, this rock appears to have arrived later and caused spectacular intrusive brecciation.
- (f) Fine-grain Granodiorite. A grey, nondescript granodiorite occurs in the western portion of the property and occasionally elsewhere. It has proved remarkably resistant to regional stresses.
- (g) Dolerite. A few large dolerite dykes represent comparatively late arrivals in the region. They postdate most of the tectonic dislocations and hence may be followed for considerable distances.
- (h) Greenstone and Trap dykes. A variety of badly sheared, contacted, and dissected dykes may be seen in outcrops throughout the property. They appear to represent at least two stages of activity. Lamprophyre was observed at the northeastern corner of the property.
- (i) Biotite Granite. A medium to fine grained granite appears in a few localities as small bodies or dykes. If a parent body exists it is likely lower than the levels exposed.

## Lithology (Cont'd)

- (j) F<sup>+</sup> Felsites. These are light colored dyke rocks with a glassy fracture and high potassium content. They are often sheared and may show mylonitic banding when stained.
- (k) F<sup>-</sup> Felsites. Similar to F<sup>+</sup> variety except with low potassium content and likely earlier.
- (l) Vesicular Basalt. Small stringers of fresh vesicular basalt, in places with obsidian, were found following certain shears. This cuts the dolerites and is evidently quite young.
- (m) Quartz Porphyry. A large quartz porphyry band cuts through the southwestern portion of the corner of the property. It is leucocratic and displays large, high-temperature quartz crystals. It is low in potassium content, however, and carries negligible metallic mineralization. The groundmass is very feldspathic and the rock is typical of quartz porphyries not associated with porphyry deposit style of alteration.
- (n) Greisen. Quartz, chlorite, muscovite ± calcite veins and fracture fillings are general through the property.
- (o) Quartz-calcite veining. At least two periods of quartz veining occurred, and likely more. This accompanies copper and molybdenum mineralization and will be discussed later.

Some evidence might be cited for correspondence between the occurrences of copper or molybdenum indications on the property and greenstone dykes and/or felsites. For the most part, however, lithological control of mineralization is the result only of physical properties of the units in response to deformation. Mineralization is controlled by structure and associated alteration.

## 6. STRUCTURE

Shearing and fracture zones are common through much of the property,

### Structure (Cont'd)

especially in the vicinity of the gossan. Almost without exception, indications of copper or molybdenum on the property were found to be controlled by fracture zones, generally accompanied by quartz veining. Drag folding is intense in many cases. Because of complex dissection, and lack of initially parallel layers in the intrusive complex, regional scale folding could not be proved, but there are compelling reasons to believe that folding controls the structure. Signs include different directions of offset on parallel shears, crushed margins along the boundaries of competent dykes etc., and reasonably close clustering of drag fold axes as compared to poles of movement on corresponding shear planes. Stereonet plots will be submitted with the final report.

The area of gossan displays the strongest shearing. A significant number of major planes of failure here, including most of those with indications of copper or molybdenum mineralization, have orientations plotting about a pole plunging steeply to the WNW. This is most easily explained by fractures following the boundaries between rocks of differing competency around folds. Orientation of drag folds suggests a somewhat more northwesterly plunge of the folding axis, and the overall indications are that the central structure of the gossan zone is a dissected anticline leaning northeast.

Highly sheared dykes and quartz veins on fractures testify to more than one stage of tectonic activity. Most drag fold axes are somewhat curved and east of the gossan area there are strong indications of fractures being distributed about a vertical axis of deformation.

Under stress, the regional granodiorite in some zone underwent conversion to chlorite quartz diorite with partial recrystallization and removal of volatiles as will be discussed later. Intense crinkling and productions of open fissures accompanied the event, which either accompanied or preceded the folding. In any case, the resulting quartz diorite proved a more competent rock in folding, generally bending without failure, and is now a prominent cliff former. For the most part, grey porphyry dykes also underwent dynamic metamorphism, or retained structural unity, suffering only folding and jointing. The unaltered granodiorite, however, has tended to crush - especially along its boundaries with other rock types. This is analogous to folding of sedimentary layers of different competency. The resulting lines of failure host most of the copper and molybdenum occurrences, and this is most obvious for those in the area of the gossan.

## 7. ALTERATION AND MINERALIZATION

Although widespread, occurrences of copper mineralization are not of economic form. Chalcopyrite was observed in a few quartz or quartz chlorite veins, typically where these cut greenstone dykes or felsite stringers. It forms veinlets or isolated pods and does not appear to be associated with the widespread pyritization of the gossan zone. Malachite is abundant, and the most commonly met indicator of copper; azurite was also observed. Sooty wisps of chalcocite were occasionally found, as a few minor films of a grey copper mineral, likely one of the sulphosalts.

Molybdenite was not observed on the property, but minor amounts of ferromolybdate are associated with certain quartz shears and with some zones of crushing. Its identification on this property is made difficult by mixtures of jarositic limonite with calcite on some fractures. In only a few cases were indications of molybdenum and copper found on the same shears.

The major gossan zone marked on the alteration overlay is the result of pyrite in all rock types through an area of considerable shearing and crushing. Weathering of the crushed granodiorite has also contributed to this coloration. Pyrite occurs in disseminated forms; (typically by alterations of mafic minerals) and on joint or fracture surfaces. Outside of the gossan area, pyrite occurs mainly in conjunction with major shears, and is not particularly related to copper or molybdenum.

Disseminated pyrite in the competent rock was found to be associated with negligible chalcopyrite, but in the crushed and deeply weathered granodiorite some jarositic cavities suggest conditions of leaching sufficiently acid to have removed the copper. Hand trenching was carried out as deeply as possible into one of these crushed zones, and fresher samples revealed no chalcopyrite with the disseminated sulphides. Rusty fracture surfaces and quartz stringers, however, were totally vacated and the shapes of their boxworks of no value.

Certain observations suggest that hydrothermal leaching of some sort has converted most of the copper and molybdenum which may have been present to secondary minerals. These signs include formations of fairly thick "veins" of malachite and azurite, the occurrence of malachite was a permeation texture, the depth of removal of molybdate from quartz veins, the remarkably thorough leaching on a slope where mechanical wastage limits weathering

### Alteration and Mineralization (Cont'd)

time, and the appearance of calcite (and siderite) in veins which only secondary copper minerals remain. Chalcopyrite, where found, was typically in sheared quartz, and may have originated with an earlier stage of activity.

Most copper occurrences are in the area east of the gossan and were associated with little or no pyrite. In some cases, copper appears to be in the form of sooty grey material associated with mafic veining or chloritic fractures. In this style it is extremely unapparent unless marked by secondary minerals. Samples of mafic veining from near some of the forementioned sites have been collected for analysis. This mafic veining is fairly widespread in the eastern and northern part of the property, and chloritic fractures are a feature of the stressed quartz diorite. The "veining" tends to be very fine. In some places it involves epidote, in other locations chlorite or chloritoid, and in still others is fine line of some trap work, possibly associated with the dark matrix porphyries. These phases do not carry pyrite, are not usually accompanied by potassic alteration, and their association with copper mineralization near shears may be spurious.

Considerable effort was directed to unravelling the history of volatile phases and their alteration styles, notably by tracing removal and influx of quartz and potassium.

The forementioned stress-alteration which produced the chlorite quartz diorites was basically a process of volatile removal (see fig. 1) in which first potassium and then quartz was lost. The crushed portions of the granodiorite provide an obvious receptable, and this appears to have been at least part of the story. Staining reveals lines of potassic alteration and K-Qtz veining throughout the gossan areas and in certain zones beyond.

It is also associated with major shear zones and hence usually with the copper and molybdenum mineralization. In the gossan zones, potassic and pyrite alterations appear to be directly associated. It is of considerable importance, however, that potassic alteration is almost entirely directive in style on this property. With the exception of a few specimens in which there was wide potassic banding or initial attack on plagioclase crystals, alteration was on discrete lines and did not have the permissive or permeation style of the potassic alteration directly associated with porphyry deposits.

There remains the important question as to whether the mineralization and alteration observed might not be peripheral to a porphyry copper occurrence. The epidote, chlorite, calcite sort of alteration of the eastern and northern region, and the more potassic and pyritic alteration of the gossan area might be compared to the outer alteration zones of such a deposit in the classical cases. The deposit would presumably be located below the gossan and hence under the Watson River valley on the west side of the claims. Appearance of quartz porphyry felsite; an aplitic granite; and potassium rich, quartz-eye, grey porphyry in the closest outcrops might also be noted with some interest. In view of the obvious structural control, however, this trend does not warrant excitement. It is unlikely that even if a deposit did exist beneath the silt deposits of the Watson valley, sufficient indications could be found to warrant drilling.

#### Addendum

A somewhat circular feature is outlined by lineations on aerial photographs about 4 miles west of the claims. This was investigated because of the association of porphyry deposits with such patterns. The area was mainly till covered, and the outcrop dominantly of intrusive groups similar to those of the property. (It is of interest that the GSC report maps this region as a migmatite while the claim area is denoted by granitic rock). A few new felsite porphyrites were observed, however, and minor pyritization. Soil and silt samples were collected.

Respectfully submitted:

R.R.Culbert, P. Eng.  
Senior Geologist  
STOKES EXPLORATION  
MANAGEMENT CO. LTD.

June 22 , 1971.

CERTIFICATION

I, Richard R. Culbert, of 1709 Haywood Ave, West Vancouver, in the Province of British Columbia:-

DO HEREBY CERTIFY:

1. That I am a Consulting Geologist, working with the firm of Stokes Exploration Management Co. Ltd., of Professional Engineers of British Columbia (No 7343).
2. That I am a registered member in good standing of the Association.
3. That I am a graduate of the University of British Columbia with a degree of PhD in Geophysics.
4. That I have practised my profession as an Engineer or Geologist for the past 12 field seasons.
5. That I have personally supervised the geological and geochemical investigations conducted on the WAT, the SON and the RIV claims, claim sheet 105D6 from the field camp and prepared the interim report contained in this assessment report.
6. Work conducted on this property and report preparation is here by acknowledged to Mr. John Ricker, Geologist, Mr. F.M. Smith - Geologist and the SEMCO crew.
7. That I have no direct or indirect interests in any of the mineral claims, or in any of the securities held by Phelps Dodge Corporation of Canada Ltd., nor do I expect to receive any.

Dated this first day of September, 1971.

*Dick Culbert*  
R.D. Culbert. P. Eng.

Dr. R. (Dick) Culbert, Geologist

1709 Haywood Avenue,  
West Vancouver, B.C.

John Ricker, Geologist

R.R. #1, Wellington, B.C.

Fred D. Carney, Sampler

2 - 818, 19th Avenue S.W.  
Calgary, Alta

R. (Bob) Gallagher, Sampler

4615 Woodburn Road,  
West Vancouver, B.C.

September 1st, 1971.

**Certificate of Expenditure  
for Assessment Purposes  
for the period May 1st, 1971 to August 31st, 1971**

**on  
Project 101 - Watson River  
Whitehorse Mining Division  
Yukon Territory**

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Labour - Geological & Engineering	\$5,782.48
Camps & Cookery	1,049.61
Transportation - Airborne	1,132.00
Field Tools, Hardware, etc.	500.99
Travelling Expense	<u>479.15</u>
	<b>\$8,944.23</b>

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**AFFIDAVIT**

I, George W. Stanley - Accountant  
residing at Apt. 201 - 100 Cee Hill  
Dr., Toronto, Ontario do solemnly  
declare the above to be true and  
correct. DECLARED before me at  
Toronto, Ontario in the County of  
York this 1st day of September  
1971.

Certified Correct



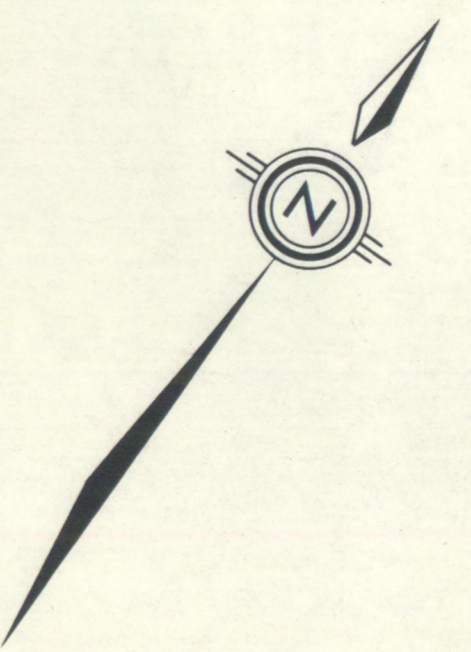
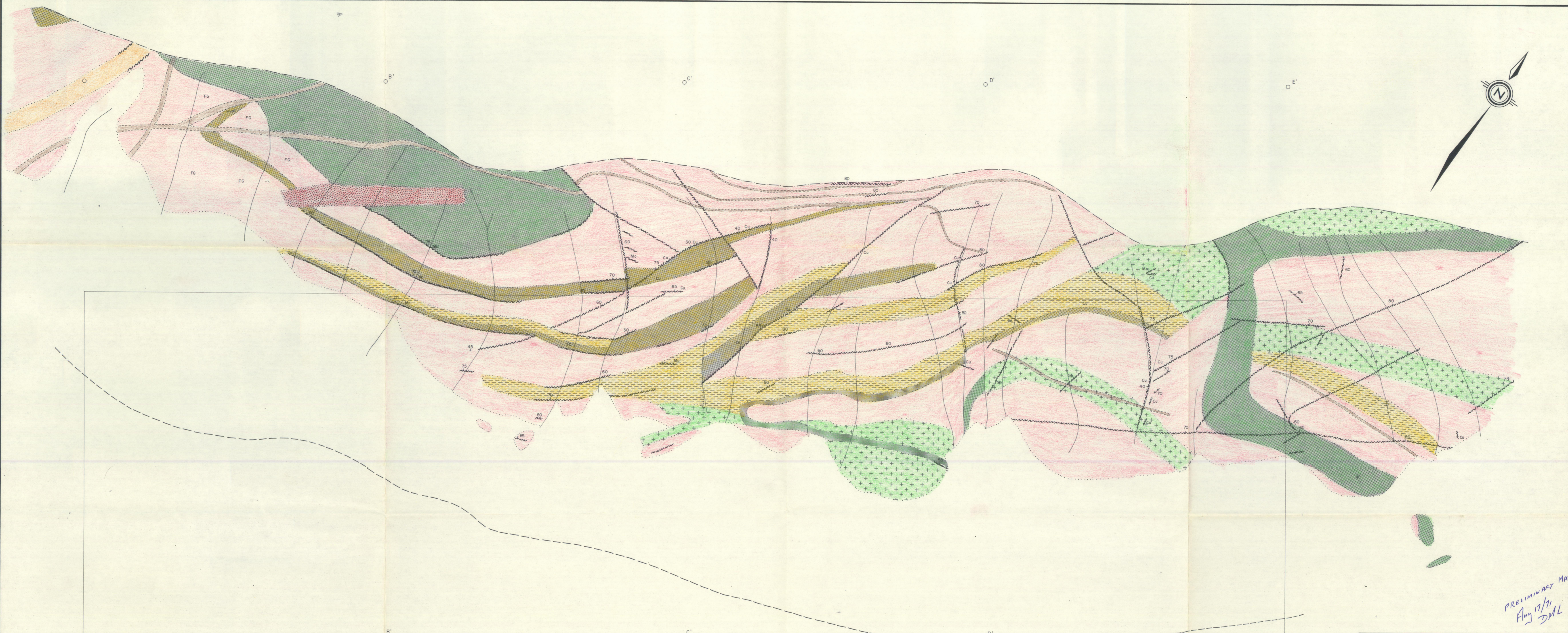
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








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G. W. Stanley - Accountant

A NOTARY PUBLIC IN AND FOR  
THE PROVINCE OF ONTARIO.

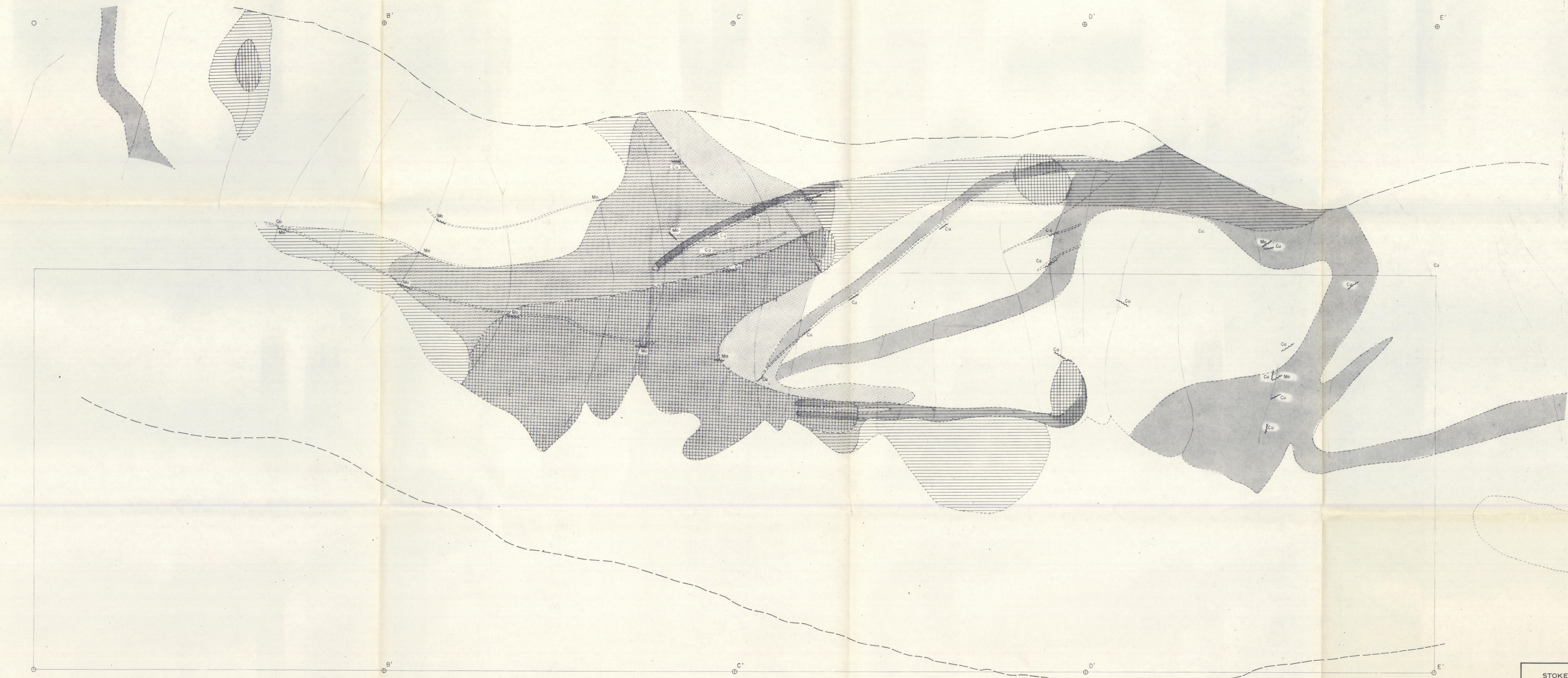
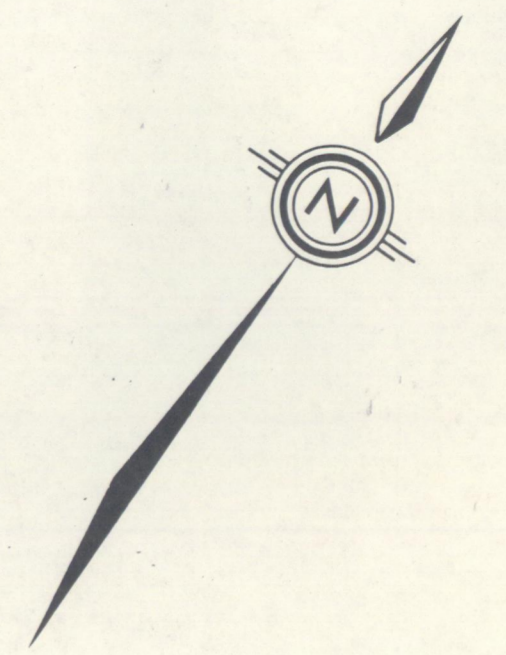








**LEGEND**

- |  |  |   |                              |
|--|--|---|------------------------------|
|  | GRANDIORITE  |  | INDICATION OF MINERALIZATION |
|  | MAJOR LITHOLOGY } P+ POTASSIUM RICH GREY PORPHYRY<br>SCATTERED DYKES (BIO, QTZ, PLAGIO PHENOCRYST) |  | GULLY                        |
|  | MAJOR LITHOLOGY } P- LIKE P+ BUT POTASSIUM POOR<br>SCATTERED DYKES                                 |  | FINE GRAIN                   |
|  | INTRUSIVE BRECCIA  |  | MAJOR SHEAR                  |
|  | DOLERITE DYKE  |   |                              |
|  | QUARTZ PORPHYRY  |   |                              |

PRELIMINARY MAP  
Aug 17/71  
DML

STOKES EXPLORATION MANAGEMENT CO. LTD.			
SOUTH CLIFF WATSON RIV CLAIMS GROUP			
<b>GEOLOGICAL MAP</b>			
GOSSAN AREA			
PROJECT :	PROJ. No.	DATE	SCALE
WATSON	153	JULY 1971	1" = 200 FT.



- LEGEND**
-  PYRITIZATION COMMON  
THE GOSSAN ZONE
  -  POTASSIC ALTERATION AS VEINS OF FRACTURE  
FILLINGS COMMONLY WITH PYRITE, QUARTZ
  -  POTASSIC ALTERATION ALONG OTHERWISE INDISTINCT  
LINES COMMONLY WITH PYRITE
  -  ZONES OF STRESS METAMORPHISM AND VOLATILE  
LOSS
  -  COPPER MOLY INDICATIONS  
OBSERVED
  -  OBVIOUS SHEAR ZONES CONTROLLING  
MINERALIZATION

STOKES EXPLORATION MANAGEMENT CO. LTD.			
SOUTH CLIFF WAT-SON-RIV CLAIMS GROUP			
<b>ALTERATION OVERLAY</b>			
GOSSAN AREA			
PROJECT	PROJ. No.	DATE	SCALE
WATSON	153	JULY 1971	1" = 200 FT.

I&E KUSAWA

<u>Claim Name</u>	<u>Grant Number</u>	<u>Recording Date</u>	<u>Expiry Date</u>
KUS 1	Y58199	Sept. 1/70	Sept. 1/71
KUS 2	Y58200	"	"
KUS 3	Y58201	"	"
KUS 4	Y58202	"	"
KUS 5	Y58203	"	"
KUS 6	Y58204	"	"
KUS 7	Y58205	"	"
KUS 8	Y58206	"	"
KUS 9	Y58207	"	"
KUS 10	Y58208	"	"
KUS 11	Y58209	"	"
KUS 12	Y58210	"	"
AWA 1	Y58211	Sept. 1/70	Sept. 1/71
AWA 2	Y58212	"	"
AWA 3	Y58213	"	"
AWA 4	Y58214	"	"
AWA 5	Y58215	"	"
AWA 6	Y58216	"	"
AWA 7	Y58217	"	"
AWA 8	Y58218	"	"
AWA 9	Y58219	"	"
AWA 10	Y58220	"	"
AWA 11	Y58221	"	"
AWA 12	Y58222	"	"

Typed Oct.1/70 vñ