

671306

SUMMARY REPORT ON THE
JEAN COPPER-MOLYBDENUM PORPHYRY DEPOSITS

N.T.S. 92N/2

Latitude 55°06'N Longitude 124°57'W

by

J.C. Stephen

J.C. STEPHEN EXPLORATIONS LTD.

October, 1991

INTRODUCTION

The JEAN copper-molybdenum mineral occurrences are located along the south margin of the Jean Marie granodiorite stock situated about 25 kilometres south of Tchentlo Lake and about 80 kilometres north northwest of Fort St. James in central British Columbia.

These deposits are 50 kilometres west southwest of the Mt. Milligan copper-gold deposits and are hosted by intrusives of a somewhat different character. Mineralization and extensive geochemical anomalies were discovered in 1969 by the NBC Syndicate. Subsequent exploration has outlined several separate zones over a distance of approximately 10 kilometres.

Ownership of the area is broken up by claim staking on behalf of several organizations. The ALEX-MARION property, the subject of this report, is outlined on Figure 2, Claim Map, and more fully on Map I, JEAN PROPERTY, ALEX-MARION CLAIM GROUP. This property plus the JW 91 1-10; WJ91 1-8; JW 134-143, 131Fr., 132Fr. and JW 221,222 cover the equivalent of about 55 full size claim units. Of this area about 35 full claim units comprise the ALEX-MARION property. It is likely that development of any of the mineralized zones within this area will require the eventual cooperation of the various land holders.

Data for this report has been gathered primarily from this writer's files as a result of his participation in the NBC Syndicate operation. The data is, however, incomplete and efforts should be made to gather additional technical data prior to conducting detailed exploration. This report indicates certain target areas which warrant further exploration.

PROPERTY STATUS

Subsequent to the staking programs of June 24 to about July 7, 1991 the following claims are registered as follows:

<u>CLAIM NAME</u>	<u>NUMBER OF UNITS</u>	<u>RECORD NUMBER</u>	<u>RECORDING DATE</u>	<u>OWNER</u>
ALEX 1-20	20	301725-744	July 15, 1991	J.C. Stephen
ALEX 1 (4 post)	16	301703	"	"
ALEX 2 (4 post)	20	301704	"	"
ALEX 3 (4 post)	12	301705	"	"
ALEX 21-38	18	301745-762	"	"
MARION	20	12381	Aug.10, 1991	
JW 131Fr, 132Fr	2	89064, 065	June 26,1970	Chevron Minerals
JW 134 - 143	10	89068- 077	June 26,1970	"
JW 221,222	2	131830, 831	Aug 19	"
JW91-1 -91-10	10	301229-238	July 2, 1991	D.L. Cooke
WJ91-1 - 91-8	8	301239-246	July 2, 1991	"
WJ91-13 - 91-18	6	301247-252	July 2, 1991	"
JW 100 (4 post)	12	303956		"
JEAN 1	15	10861		Imperial Metals
JEAN 2	20	10862		"
JEAN 3	20	10863		"
JEAN 4	20	10864		"
JEAN 5	20	10865		"
JEAN 6 - 9	80	10866-869		"
JEAN 13	6			"
JEAN 14	20	301504		"
JEAN 15	18	301502		"

REGIONAL GEOLOGY

Information concerning regional geology in the area of the JEAN mineral deposits is documented in the following publications:- GSC Memoir 252, Fort St. James Map Area; GSC Map 971A Smithers-Fort St. James; B.C. Ministry of Mines Bulletin 70 Geology and Mineral Occurrences of the Southern Hogen Batholith 1978; Open File 1991-7 Surficial Geology of the Mt. Milligan Area; and GSC Geological Fieldwork Paper 1991-1.

In general the area of interest is bounded by the N20°W trending Pinchi Fault and is "predominantly underlain by Early Mesozoic Takla Group rocks of island-arc affinity" lying to the east of that fault.

The Takla Group consists of a late Triassic sedimentary unit which interfingers with and is overlain by volcanic and pyroclastic rocks. The Triassic sequence is intruded "by coeval plutons which range up to Early Jurassic in age." (JoAnne Nelson et al, Paper 1991-1)

Garnett (Bulletin 70) documents Hogen Batholith dates to indicate late Triassic to Early Jurassic ages. These rocks are intruded by Early Cretaceous age granites. The Jean Marie stock is dated at 136± ma, or Lower Cretaceous, and is compared to the age of the intrusives in the Endako area.

The aeromagnetic pattern of the region outlines the various intrusive phases with strongly positive magnetic anomalies over the older dioritic phases and later syenitic intrusions with which significant copper gold mineral deposits are associated. Molybdenum mineralization occurs south of Kwanika Creek in the area of younger granitic intrusions which are represented by magnetic lows.

The aeromagnetic pattern over Triassic volcanics and sediments is generally low but may be complex in some areas where magnetic highs may be caused by basic volcanic phases.

The Jean Marie stock is represented by a relatively distinct positive aeromagnetic anomaly of about 100 to 200 gammas. During early exploration the outer line of highest magnetic gradient was used successfully to outline the intrusive contact as guidance for prospecting.

PROPERTY GEOLOGY AND MINERALIZATION

The following description of property geology is quoted from the Cominco Ltd. Termination Report 1973 by R.U. Bruaset.

"REGIONAL GEOLOGY

The JEAN property is situated within the Quesnel Trough of Campbell and Tipper (Campbell et al 1970). This fault bounded trench is traceable for much of the length of B.C. and contains a number of porphyry copper mines and interesting prospects.

INTRUSIVE AND VOLCANIC ROCKS

A differentiated stock of granitic to intermediate composition including minor syenite and monzonite intrudes andesitic flows and pyroclastics of the Takla Group. No distinctive mappable unit that can be termed a marker has been encountered to date in the Takla rocks on the property. Thus it has not been possible to determine the attitude of the Takla Group. In view of the poor exposure, the attitude of the main intrusive contact is unknown. It appears probable, however, that this contact dips steeply since it appears to be quite straight over long distances through areas of appreciable elevation range. The southern border phase of the intrusive is a medium grained (average 3-4mm) porphyritic granodiorite. This phase pinches and swells in width and grades northward into porphyritic diorite of the same grain size. Diorite specimens from the property are leucocratic having colour indices rarely above ten. K-spar and quartz typically occur interstitially to plagioclase, hornblende and biotite in both of the main intrusive units. Quartz diorite of the same grain size and texture as the aforementioned intrusive rocks is present and is presumed to grade into them.

Porphyritic dykes of composition syenite are noted in the 1971 drill core. Aplitic dykes of unknown composition are also present. The apparent importance of the syenite dykes in the mineralization of the JEAN is discussed under a subsequent heading. To date no area of high dyke density has been encountered although the possibility of such should not be discounted in the A, B, C, Zone areas.

The Takla volcanics consist of massive volcanic flows and pyroclastics (agglomerate and breccias). They are typically dark grey and greenish and frequently exhibit augite phenocrysts characteristic of the Nicola-Takla Groups elsewhere. Epidote veinlets and K-spar bearing fractures such as are common associates of mineralization in other parts of the Omenica, notable Duckling Creek area, are not present. The Takla rocks of the area do not appear to have been altered but rather the greenstone like appearance of the rock is presumably the result of low-grade regional metamorphism which appears to have affected most of the Upper Triassic volcanic rocks in B.C.

ALTERATION

Argillic, potassic and phyllic assemblages are noted although rarely can they be classified as intense. Classical alteration patterns such as in the southwestern U.S. have not been recognized to date. The potassic and phyllic assemblages - represented by K-spar and quartz respectively are the types most closely related to the mineralization. Within the area drilled in 1971 there is a definite trend of increasing alteration, particularly potassic, toward the C-Zone.

MINERALIZATION

Sulphides noted in the intrusive consist of chalcopyrite, molybdenite, pyrite and bornite in decreasing order of abundance. All intrusive rock types on the property, with the possible exception of monzonite, are mineralized. The granitic to intermediate intrusives appear to be equally favourable as hosts for sulphide mineralization, the intensity of fracturing being one of the main controls of sulphide distribution and alteration within the rock type. Syenite typically occurs as dykes and dykelets intruding the above units in the area drilled in 1971. However, syenite dykes are not always mineralized in this area but rather the incidence of mineralized dykes of this composition increases towards the C-Zone. A 20 foot intersection of 0.43% copper near the bottom of DDH #71-10 consisted in part of a syenite dyke with higher than average copper content. A second control in this section consists of 1/8" wide quartz stringers (vertically dipping) which cut the syenite. Disseminated chalcopyrite is also present between the individual stringers. Copper mineralization is also present in the wall rock of the syenite. It is significant that mineralized syenite float of this kind is occasionally encountered along the main creek in the A-Zone area. Sulphide zonation is recognized in the A and C-Zone areas. In the A-Zone area sulphides grade from essentially chalcopyrite only at the Apple Cot showing through chalcopyrite and molybdenite at the Orange Cot showing to molybdenite and pyrite with traces of chalcopyrite at the Low water showing. This zonation points to the A-Zone as an area in which better than average copper content can be expected. Sulphide zonation in this A-Zone area is manifested by the distribution of total sulphides as well as that of pyrite and chalcopyrite individually. The most northerly of the holes contain very little sulphide and generally the main sulphide is pyrite. Progressively increasing total sulphide content is indicated in the southerly and westerly direction away from holes such as DDH 71-1, 4, 6. The chalcopyrite plus molybdenite to pyrite ratio increases in the same direction. A detailed description of mineralization at a few of the main showings on the JEAN is given in a subsequent section.

STRUCTURAL CONTROL

Within the volcanics sulphide mineralization occurs principally along hairline fractures of nearly random attitudes. Within the intrusives however, northerly to easterly trends are predominant. Again the sulphides occur along narrow fractures but dips are generally gentle - frequently less than twenty-five degrees. Gentle dips are indicated in the 1971 drilling as well. Generally, more than one mineralized attitude is present whenever mineralization is encountered. Shearing

or other manifestations of faulting is generally poorly developed on the property. The A-Zone area is the most highly fractured and faulted part of the property.

DESCRIPTION OF SHOWINGS

The Apple Cot, the Orange Cot, the Low Water and the Blueberry are four areas sufficiently well mineralized to warrant being called showings. These are shown on the accompanying map.

THE APPLE COT (Location: near 16N, 88W)

Chalcopyrite as fracture fillings and seams outcrops over a strike length of 8 feet in a flat lying horizon in a fine grained massive Takla andesite. The footwall of the zone and $2\frac{1}{2}$ to $3\frac{1}{2}$ foot thick sections of the mineralization are exposed. The vertical and the lateral extensions of the mineralization are covered with overburden and vegetation. The host rock of the mineralized zone appear to be texturally and compositionally identical to the footwall locally well exposed and containing only minor copper. The basic control is not clear, it could be that the mineralized portion of the volcanics were originally more highly fractured than the footwall and so more receptive to mineral deposition. There is no indication of a shear zone or a flat dipping fault structure that could have acted as a control. Two chip samples have been taken across the mineralized zone. They have a weighted average of 2.45% copper and 0.03% Mo across a mean thickness of three feet. Some malachite is present in the samples, and minor pyrite is present. The volcanics are unaltered. Large blocks of angular mineralized float estimated to contain up to 8% copper in quartz stockworks cutting Takla volcanics are occasionally found in the creek just upstream from the Apple Cot exposure. This material occasionally contains bleached angular fragments of andesite. Except for the silicification and bleaching, the host rock is unaltered. The source of the float has not been found. This float is different from the Apple Cot in that at the latter showing there are no quartz veins.

THE ORANGE COT (Location: near 24N, 72W)

Chalcopyrite and subordinate amounts of molybdenite occur in generally gently dipping fractures in weakly altered granodiorite on the south side of the main creek. The material is locally quite impressive - specimens of fist size occasionally containing up to 0.75% copper in the form of closely spaced mineralized fractures and quartz veinlets. Here, as elsewhere on the property, the best looking mineralization is partly obscured by overburden and vegetation. This is particularly true at the west end of the outcrop area where considerable digging had to be done to expose a few square feet of bedrock. Alteration noted here, apart from phyllic, is potassic expressed by well developed K-spar envelopes adjacent to fractures. Because of the small size of the individual exposures at the west end of this showing no sampling has been done. The southern half of the showing forms a steep cliff on which the mineralization, alteration type and structural control, are well exposed. An average grade of above 0.10% copper is not likely to pertain over widths much in excess of a few tens of feet in the eastern half of the showing. It appears that the western part of this showing

is more highly mineralized than the eastern part because the fractures controlling mineralization are more closely spaced. Mineralization at the Orange Cot has been traced through scattered outcrop a distance of 300 feet.

LOWWATER SHOWING (Location: near 32N, 64W)

Heavier molybdenum mineralization than has been noted anywhere else on the JEAN property is associated with pyrite and chalcopyrite in gently dipping hairline fractures and quartz veins. The mineralization is expressed in the south and north banks as well as in the creek which at the time of mapping was relatively low. The mineralization is open in all directions. The fracture frequency for the main control varies from 1 to 2 / foot to as high as 12 / foot in the eastern part of the showing. A post-mineral fault contains considerable moly gouge. The bed rock is highly oxidized in the faulted area. The exposed length of mineralization is about 150 feet. Phyllic and potassic alteration are again very closely related to the mineralization. The exposed thickness of mineralization as inferred from the attitude of the main fracture set is about 1-12 feet. The mineralogy here is strikingly different from that of the Orange Cot downstream. The essential difference is the relative abundance of chalcopyrite, pyrite and molybdenite. At the Lowwater the order of decreasing sulphide abundance is molybdenite-pyrite-chalcopyrite. The relative abundance of molybdenite and pyrite over chalcopyrite in mineralized float along the creek above the Orange Cot was noted by the writer before encountering an area of molybdenum mineralization discovered by J.C. Stephen at the time the initial map of the property was being prepared. The sulphide distribution at the Orange Cot and Lowwater raises the question of mineral zoning. The classic porphyry copper model of Lowell and Guilbert places molybdenite with bornite in the central mineralized zone rather than in a peripheral zone with pyrite. However, peripheral molybdenite zones are known in the porphyry copper environment, Valley Copper (Allen et al 1970) being a good example. The mean metal content of the Lowwater showing is 0.022% Mo, 0.2% Cu as based on three chips taken across the mineralized structure at 50 foot intervals along the strike. A chip sample taken from a 12 foot long outcrop at the northwest corner of the showing returned appreciably higher values but the sample, because of the thinness of the exposed mineralization, was taken along the strike of the main fracture direction. In this area the frequency of the main mineralized fractures is high.

BLUEBERRY SHOWING (Location: near 14N, 40W)

Chalcopyrite and pyrite (chalcopyrite more abundant than pyrite) occur on a 30 foot cliff face. Two thirty foot chip samples each weighing about 45 pounds have been cut up the cliff. The most northerly of the two samples contains 0.2% Cu, while the second contains in the order of 0.1% Cu. Again the outcrop appears to be quite uniform in composition - being a fine grained greenish grey andesite, yet considerable variation in grade is apparent from the northern to the southern half. It appears that the difference in grade is due to the intensity of the fracturing. The most highly fractured half being most well mineralized. At least four mineralized fracture attitudes are recognized. Typically, the copper mineralization occurs in hairline fractures and as fine grained disséminations between mineralized fractures. The mineralization extends into drift and vegetation covered areas.

CONCLUSIONS

The portions of the JEAN property surveyed by IP and ground magnetics in 1972 and 1973 are now indicated to have considerable potential. Fundamental processes involved in porphyry copper deposition have clearly been active in the area. These are expressed by such features as complex and varied rock types, high level intrusion, alteration, mineral zoning and fracturing. The area has reached the stage where the next logical step is drilling. Although it is difficult to rate areas of principal interest the A-Zone appears to be most attractive. It is felt that this zone has considerable geological advantages over the other two. The suggestion that the Lowwater area containing a mineralogy suggestive of a peripheral zone of a porphyry copper is interesting and adds to the attraction of the A-Zone as a target worthy of drill testing.

The C-Zone, because of its proximity to the large geochemical anomaly, the occurrence of near ore grade material in hole 71-10 on its edge, as well as the indicated grade trend within the 1971 drilling, favour the C-Zone as another target of considerable potential. The definite indications of increasing intensity of potassic alteration towards the C-Zone within the 1971 drilling area adds further to its interest.

There is insufficient geological data available from B-Zone to properly analyze its potential. However, what little is known of it must be considered generally favourable. This includes particularly strong IP responses, occurrence of multi-directional mineralized fractures and occurrence of sub-ore to near-ore grade material within the IP anomaly."

EXPLORATION TARGETS

The data available from Cominco's Termination Report 1975 indicates the following mineral potential for Zones A, B, and C.

ZONE	CUTOFF GRADE	WASTE MATERIAL	POTENTIAL	% Cu	% Mo
	% Cu EQUIV.	(<.1% Cu EQUIV.)	MINING RESERVE		
		x 10 ⁶ tons	x 10 ⁶ tons		
A	0.22	19.6	14.2	0.30	0.015
B	0.31	14.0	15.4	0.31	0.025
C	None	-	33.0	0.11	0.017

An additional 8,000,000 tons grading 0.13% Cu, 0.029% Mo can be inferred in the core of B-Zone below the main zone encompassing the bottoms of holes JPH74-6; 7; 9; 11; 34; 35.

The ALEX-MARION property covers the north tip of the A-Zone as presently indicated. This portion appears to be located at the north limit of the available Cominco IP survey data and the area has not been closed off either by geophysics or by drilling. Further exploration may reveal extension of this mineralization to the north or northwest. Hole DDH 75-6, to the northwest, encountered only low values except for 1.02% Cu over 10 feet at a depth of 90 feet. Other scattered values of 0.10, 0.11, 0.18 and 0.19% Cu were obtained over 10 foot sections. The hole averaged 0.098% Cu over 237 feet from 60 to 297 feet.

The east end of the B-Zone appears to extend into the ALEX claims.

C-Zone lies almost entirely within the ALEX claims and further drilling appears to be warranted within an 800 foot wide portion of the property lying between the previous Cominco drilling and the JW 138-143 claims. Imperial Metals JEAN claims may touch the east end of C-Zone.

Southwest of B-Zone the Cominco IP contours indicate an anomalous area within the ALEX 2 four post claim and possibly extending into the MARION claim. Since grid lines here are 800 feet apart more detailed surveys are warranted to explore the area.