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Cominco

EXPLORATION

WESTERN DISTRICT

JEAN PROPERTY
N.B.C. SYNDICATE
TERMINATION REPORT, 1975
N.T.S. 93N

R.U. Bruaset

January 26, 1976

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1. INTRODUCTION

The Jean Property is a porphyry copper-molybdenum prospect located in the Omineca Mining Division about 120 air miles northwesterly of Prince George, B.C. The property is owned jointly by a group of prospectors and senior mining companies under the terms of the N.B.C. Syndicate agreement.

2. SUMMARY

This is a report of the program of geophysical surveying and diamond drilling conducted in 1975 under the direction of Cominco Ltd. and financed jointly by Cominco Ltd., Granby Mining Corporation, Duval International Corporation and Standard Oil Company of British Columbia. Scant reference is made in this report to the history of the property and the previous work. Readers unfamiliar with the history and previous work will find these discussed in reports by Bruaset, 1973 and 1974.

A) The 1975 exploration work is concerned with the south western part of the property where two copper-molybdenum deposits (A and B Zones) totalling 30 million tons grading 0.41% copper equivalent had been indicated in a percussion drilling program in 1974.

B) The 1975 program had two main purposes:-

1) To yield a preliminary assessment of the southern and western extensions of the A and B Zones and to evaluate the remaining southwest corner of the property by I.P., ground magnetics and geological mapping. Limited follow up work by diamond drilling was included.

2) The program sought to verify copper-molybdenum grades within the two mineralized zones and between them. This work was successful in confirming the tenor and thickness of mineralization as well as providing some insight into the possible controls of the mineralization.

C) It appears that the contact fault was an all important structure in guiding ascending hydrothermal solutions. Deposition occurred in a structural environment alongside the fault with both volcanics and intrusives acting as hosts. Zonation may have been temperature dependent. Gustafson et al (1975) suggest possible processes of mineral concentration applicable to the Jean.

D) For the next program I.P., ground magnetics, geological mapping and prospecting is recommended. This includes extending the I.P. coverage to the north of the A and B Zones. The proposed prospecting would cover the projections of the favourable fault into the eastern part of the JEAN claims. Additional claims should be located to protect the favourable possible extension.

2. SUMMARY (Cont.)

E) It appears that much improved road access to the Jean Property from the south could be provided by logging interests as early as three to four years hence. Accordingly, continued small scale testing in areas of potential should be carried out where warranted so that drill targets may be defined by the time the new road is available. The due dates on certain claims do not permit deferment of all work until the projected availability of the road from the south.

3. OWNERSHIP AND AGREEMENT

a) Through an Agreement (Ag/346) dated February 15, 1968, the N.B.C. Syndicate comprised of Cominco, Conwest Exploration Co. Ltd., Granby Mining Corporation, Duval International Corp. and Messrs. W. Bacon and J. Crowhurst, carried out exploration activity in various parts of B.C. during the period 1968-1970.

b) As per agreement terms, a Manager could designate any particular property as a "specific project" when at least $10,000 had been spent on it. Each of the four companies was entitled to maintain a 20% equity in the property by contributing equally to subsequent expenditures, or withdraw totally at any time and accept a lesser equity based on its pro rata contributions to total expenditures on the property.

c) The Jean Group became a "specific project" in 1970, and each company contributed equally to expenditures that year. Conwest withdrew totally from further expenditure contributions on the Jean in early 1971, and Duval assigned 1/2 of its interest to Standard Oil of British Columbia in 1972.

d) Cominco became Manager of the Jean Group "specific project" in 1972.

e) Company formation is presently underway.

f) The vendor interest to be distributed to the various partners on new company formation, by mutual agreement, will be based on expenditures to Dec. 31, 1974. The first 750,000 shares in a new company (the proposed capitalization is 5,000,000 shares) would be distributed as follows:-

Messrs. Bacon and Crowhurst (representing the prospectors)	20.000%
Cominco Ltd.	22.094%
Standard Oil of B.C.	11.047%
Granby Mining Corporation	22.094%
Conwest Exploration	13.716%
Duval	11.047%
	100%

g) The remaining shares would be reserved for financing further development. The new company agreement is in draft form and should be completed in 1976.

4. LOCATION AND ACCESS

A locational insert in included with plate JP 75-1. The property covers a broad east-west trending valley located about 2 miles south of Mt. Alexander in the Nation Lakes area, Omineca Mining Division. The summit of Mt. Alexander is located 120 air miles northwesterly of Prince George. Access in

4. LOCATION AND ACCESS (Cont.)

1975 was by a combined raft and road route established from the east end of Chuchi Lake in 1974. The cost of establishing this route was high and the cost of moving equipment and material along it is also costly. However, the route was the only feasible way of getting heavy equipment to the Jean. The raft built by the Syndicate in 1974, and the key to the surface route, has been turned over to B.C. Forest Service of Fort St. James. This was done in view of the fact that the raft would not be needed by the Syndicate in 1976 and after that, could not be expected to possess adequate buoyancy for further use. The Forestry has agreen in writing, to take over full responsibility for the raft, including its eventual disposal. This has freed the Syndicate from the eventual disposal of the raft. The Syndicate however, retains the right to use the raft at the discretion of the Forestry. Such a disposition of the raft was approved by the Syndicate in the fall of 1975.

It is understood that Apollo Forest Products of Fort St. James is interested in the timber rights in the area between Kuzkwa River, which is the present end of the Tezzeron Lake road, and the Jean. Kuzkwa River drains Tezzeron Lake to the north. They are known to have made aerial reconnaissance during the spring of 1975 (Plate JP75-1). Portions of the first four miles along the route from Kloch Lake to the Jean is swampy and best crossed by winter roads. The rest of the route to the Jean is not expected to present any serious road building problems. Because this route would not involve the difficulties of raft transportation, it is seen as the most promising access for future programs.

5. HISTORY

The sequence of events that lead the N.B.C. Syndicate to acquire ground in the area, and the exploration work that followed, is covered in the 1973 and 1974 Termination Reports. The Syndicate has worked the area continuously at various levels since the first reconnaissance survey in 1968, at which time, C.J. Stephen, prospector, working on behalf of the Syndicate, obtained anomalous silt samples while searching for an old tungsten prospect (Plate JP-75-2). Until 1972, when Cominco Ltd. assumed field management of the development, the exploration work was carried out by Bacon and Crowhurst Ltd. on a management fee basis. Many years of persistent effort westward along the southern contact of the Jean stock, frequently frustrated by discouraging results, culminated in 1974 with the discovery of 30 million tons of copper-molybdenum mineralization grading 0.41% copper equivalents.

6. SUMMARY OF 1975 DEVELOPMENT

Road Improvements	20 miles
I.P. and ground magnetics	11 miles
Diamond Drilling	2499 feet

7. REGIONAL GEOLOGY

The Jean property lies in the Omineca Mountains within a composite outlier of the Hogem Batholith. The batholithic rocks lie within the regional tectonic feature called the Quesnel Trough (Campbell, 1970). This structure is believed to be a graben underlain largely by Mesozoic volcanic and clastic sedimentary rocks, much of which is Upper Triassic. The trough is bounded by regional faults. The productive areas in the trough appear to be those in which granitic, alkaline or intermediate stocks and batholiths of zoned character intrude the Upper Triassic island arc volcanics of the Takla and Nicola Groups of north-central and south-central B.C., respectively. In some important instances, it has been impossible to distinguish any age difference between the intruded volcanics and the intrusive rocks which leads one to believe that the two are coevel.

In 1975, Jack Garnett of the B.C. Department of Mines, obtained K-Ar dates of 131 ± 4 m.y. and 136 ± 4 m.y., respectively on a hornblende-biotite pair of a fresh unmineralized granodiorite speciman from the Jean stock. This is

7. REGIONAL GEOLOGY (Cont.)

an early Lower Cretaceous age. For comparative purposes, the "ore ages" at Endako range from 136 to 146 m.y. The age of the Topley intrusive, the host rock of Endako, is 148 to 196 m.y. At Brenda, intrusive and "ore ages" are the same at 146 to 155 m.y. No "ore age" is presently available for the Jean. K-Ar dates from the Hogem Batholith indicate an early Jurassic emplacement (Garnett, 1974). Dates are 181 and 189 m.y. Lower Jurassic syenite was emplaced about 170 to 177 m.y. ago. A date on granodiorite from the Kwanika Creek area, 35 miles north west of the Jean, is 121 m.u. A K-Ar date indicates the length of time since intrusive cooled to 200° C. Subsequent thermal events may reset the clock.

8. TREATMENT OF DATA

Graphic presentation of data in this report includes a diamond drilling-geophysics compilation map at a scale of 1"=400'. A summary of pertinent information at a scale of 1"=1600' is presented for the entire property. The purpose of this map is to show areas that should receive further attention prior to any decision being made on ground abandonment. Drilling results are summarized in tabular form and a general diamond drill review containing such information as coordinates and hole attitudes is included, as well as a summary of assay information. A map showing the extent of claim holdings is included at a scale of 1"=1600', as is a compilation of the soil geochemical work to date. Diamond drill logs are summarized in graphic form by the use of strip logs. This is seen as a particularly useful way of presenting a large set of data. Incremental data is shown in a total of 22 vertical columns. The normal sampling interval for the data is commonly the ten foot assay interval. The types of data shown on the strip logs include alteration assemblages, lithologies, grain size distribution, total sulphide contents, sulphide ratios, bornite and molybdenite distributions, core angles and mineralized structures (fractures, veins and seams), presence and absence of leaching, copper and molybdenum assays. Miscellaneous other data, such as distribution and classification of dykes, is also included, as well as reference to paragenetic relationships through specific references to the drill logs.

The nature of the copper and molybdenum distribution, alteration, thickness of the mineralization, chalcopyrite/pyrite and bornite distribution in the A and B Zones is summarized individually for each zone. The isometric presentations shows the "average" data from each of three levels corresponding to the hangingwall; the principal mineralized zones (shortened to "mineralized zone") and the footwall. This data was initially compiled from the 1974 percussion drilling logs of Chuck Fipkie. The data is now revised to include the most recent diamond drilling information. It is significant that minor revisions only, were necessary in order to incorporate the diamond drilling information. The ease with which the two sets of data can be combined on the isometric sections is significant in that it demonstrates a certain sense of continuity and predictability to the A and B Zone, a characteristic that should have considerable bearing on the selection of the drill hole spacing for any subsequent development drilling. The isometric presentations further suggest, quite convincingly, the possible genetic implications of the two mineralized zones astride the faulted volcanic-granodiorite contact. The fault in question is herein called the contact fault. The zoning of metals and sulphides relating to this contact is particularly striking and is suggestive of a genetic relationship between mineralization and the contact fault.

9. THE GEOLOGY OF THE A AND B ZONES

9a) Lithology

Plates JP-75-2 and 4 show the distribution of the various lithologic units. Granodiorite is thought to represent the acid core of the Jean Stock. It appears to grade into quartz diorite and diorite to the north. The principal intrusive phases are texturally alike, all being massive, medium grained hypidromorphic. They may be the product of diferention of an intermediate or basic magma.

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9a) Lithology (Cont.)

Dykes are not abundant. Dyke rocks are of monzonite, quartz diorite and diorite composition. A single simple pegmatite dyke was encountered in the 1975 diamond drilling. This dyke occurs at 362 feet in DDH 75-4. It is mineralized with chalcopyrite occurring as disseminations and fracture fillings. Feldspar porphyry dykes of unknown composition are common in the eastern part of the property.

The intrusive rocks on the Jean have been classified by etching and staining techniques. Monzonites occurring as dykes and sills are known in a few location. The principal occurrence is at the Apple Cot showing. Here a monzonite body, presumed to be a sill, is closely associated with a strong, but narrow mineralized zone with a generally gentle dip to the south. Very heavy disseminated and fracture controlled chalcopyrite and pyrite, with traces of bornite, occur in the monzonite. Disseminated chalcopyrite occurs in the chilled border of the monzonite and fracture controlled mineralization, and disseminations occur throughout the rest, and extends up to a few feet into its footwall and hangingwall. A similar monzonite body was encountered at 154 ft. in DDH 75-1. In this case, the monzonite contains pyrite as the principle sulphide. At the C-Zone, a small but well mineralized zone, is poorly exposed in a trench near P-74-15. The host of copper mineralization here is a monzonite dyke. The dyke intrudes the granodiorite and both rocks have been affected by post-dyke faulting. Chalcopyrite occurs as disseminations, as quartz vein fillings and as hairline fracture fillings. Copper mineralization shows a strong affinity for monzonite dykes or sills. The association between strong silicification, ie. quartz veins, and copper mineralization in a monzonite host is puzzling. The monzonite dyke near P-74-15 grades about 0.5% copper across the five foot width of the dyke. The dyke is obviously "juicier" than the adjacent granodiorite suggesting it could be a "mineralizer". A porphyritic quartz diorite body, likely a dyke, is exposed in a road cut between the camp and Jean Creet, just east of the A Zone. Chilling is not noted in either the dyke or the granodiorite, with which it is in contact. The contact with the granodiorite is poorly exposed, but appears to be marked by shearing. Whether this is pre or post dyke is not known. This is at odds with textural data which suggests quartz diorite of the Jean stock grades into a slightly younger granodiorite.

Dykes of diorite composition are occassionally intersected in the diamond drilling, notably in hole 75-4 where they intrude Takla volcanics. The dykes are clearly premineral since the mineralized fractures cut both the diorite and the intruded volcanic rocks. A small outcrop of porphyritic diorite, also apparently a dyke, located just west and possibly on strike of the porphyritic quartz diorite dyke just discussed, is texturally similar, suggesting the two are genetically related. Dioritic dykelets cut the Takla volcanics on the northern fringe of the Jean stock near the north end of line 104W.

In view of the textural similarities between the three main intrusive units of the Jean stock, and the general lack of pink primary feldspars in the rocks, etching and staining techniques should be utilized when attempting to classify the intrusives on the Jean property.

To date no granodiorite dyke material has been identified in the western part of the Jean. This point is considered significant in terms of configuration of the principal intrusive phases on the property. The apparent lack of granodiorite dykes cutting the Takla volcanics in the A and B Zones supports the concept that the granodiorite is the acid core of the Jean stock. If this contact were intrusive, one might reasonably expect to find granodiorite dykes cutting the volcanics. This is apparently not the case, although dykes of diorite composition are encountered in the volcanics. It is suggested that the distribution of diorite dykes and the absence of granodiorite dykes in the volcanics may be explained in terms of a probable fault along the granodiorite-volcanic contact. It is proposed that magmatic material of diorite composition fairly readily escaped into the volcanics country rock of the Jean stock to form dykes, whereas magmatic material of granodiorite composition did not. The relationship of a small "outcrop" of granodiorite located on the Jean Creek, near its confluence with Andesite Creek, is not known. Possibly this is a large dyke or a separate intrusive. It could also be a very large boulder.

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9a) Lithology (Cont.)

Volcanic rocks on the Jean consist mainly of a monotonous series of massive basic flows of Upper Triassic age and minor interlayered pyroclastics. Sedimentary rocks are reported to partly underlie the eastern part of the JEAN claims. These rocks have not been seen by the present writer. It is believed that these are mainly argillite. The strip logs contain information on the distribution of "augite porphyry", a very common textural variety of the Upper Triassic marine volcanics of B.C. On the Jean, no sedimentary interbeds are noted, where the present writer has mapped. The indicated calcsilicate zone on the south east edge of the B Zone suggests the possible existance of carbonate interbeds. No outcrop of carbonate is noted in that area, but fairly angular carbonate float up to half a foot in diameter can occassionally be found on the hill to the south and east of hole P-74-14. This could, however, be Permian Cache Creek type float transported by the glacier. However, the presence of carbonate units on the Jean cannot be ruled out at this time.

In the absence of sedimentary markers, it has been impossible to determine the altitude of the volcanic rocks. In DDH 75-4 at 241', bedding appears to dip 20°. This marks the contact between fine grained and aphanitic flows. Flows on the property are variously aphanitic to medium grained. Intersections of a few inches of fragmental Takla were encountered in DDH 75-3 and 4.

The areal extent of the aeromagnetic high within which the Jean stock lies, is suggestive of a probable extension of the stock well to the south of its present drill indicated limits. Systematic checking of rock specimen and drill core from the Jean, indicates that the volcanics have generally somewhat lower susceptibility than the quartz diorite and diorite (see Column #13 of Strip Logs). A possible interpretation of the aeromagnetics in the area south of the drill confirmed intrusive is that a thin roof of Upper Triassic volcanics, of somewhat lower magnetic susceptibility than typical intermediate intrusives. (quartz diorite and diorite) is partly masking the underlying intrusives of quartz diorite and diorite composition. The occurrence of intrusives of granodiorite and monzonite composition in the A Zone area, lying to the south of the projected contact fault, suggest an unroofed intrusive mass in that area. Plate JP 75-2 shows the outline of the 3900 gamma aeromagnetic contour. This contour appears to coincide approximately with the western and northwestern extent of the border phase of the Jean stock.

9b) Mineralization and metal zoning

Isometric plates A-1, 2 and B-1, 2 show the distribution of copper and molybdenum in the A and B Zones, as well as the respective hangingwalls and footwalls. Specific zonation of the metals is indicated. In the case of molybdenum, for instance, a very strong preference for intrusive as host is indicated. Another interesting feature, is than in the case of the hangingwall and footwall of the B Zone, and the A and B Zones themselves, the intrusive portions carry about half of the copper values of the corresponding volcanic portions. However, the lower copper grade in the intrusive is more than made up for by the effect of molybdenum which is usually higher in the intrusive. A possible clue to the origin of the zonation lies in the general paragenesis of hydrothermal ores. According to Edwards, 1965, the same paragenesis appears to be present in all hydrothermal ores regardless of whether they are pyrometasmatic, hypothermal, mesothermal or epithermal. Of the sulphides present on the Jean, according to Edwards, molydenite would form first, then pyrite followed by chalcopyrite and bornite. The above sequence of deposition, is in order of decreasing temperature. According to other information provided by Edwards, one would regard molybdenite, and possibly pyrite, as crystallizing at higher temperatures than chalcopyrite and bornite. This suggests the zonation between copper and molybdenum could have been the result of termperature differences between the intrusive and the volcanic portions of the mineralized zone which were simultaneously subjected to hydrothermal solutions of the same composition. It is proposed that the higher temperature molybdenite deposited in the hottest part of the zone together with lesser copper sulphide, but the principal portion of the copper sulphide deposited in the somewhat cooler volcanic portion. One would, of course, expect

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9b) Mineralization and metal zoning (Cont.)

the intrusive portion, being the source of the heat, to be the hotter of the two host rocks. A higher degree of fracturing in the volcanics would favour more rapid dissipation of heat, ie.: quicker cooling of the mineralized solutions as well as provide more reactive surfaces upon which, a greater volume of total sulphide was deposited. Column 7 of the strip logs gives semi-quantitative estimates of the metal contents of the various host rocks.

While the volcanic portion of the A and B Zones contain generally only trace molybdenum, the respective intrusive portions have means of 0.04% and 0.06% respectively. Calculated copper equivalent means for intrusive portions of the A and B Zones are 0.46% and 0.52%, respectively. The corresponding equivalents for volcanic portions are 0.39% and 0.35% If adequate reserves of the grade occurring in the intrusive could be demonstrated, clearly the potential of the Jean would be significantly improved. The extensions of the copper-molybdenum mineralization in the A and B Zones are open to the north. Another interesting feature indicated by the isometric drawings is that copper grade of the footwall for any one zone tends to be somewhat higher than the respective hanging wall. The molybdenum trends are somewhat similar. Molybdenum is more abundant in the granodiorite footwall than the granodiorite hangingwall. The respective volcanic portions generally do not contain more than trace molybdenum.

The overall zonation of metals in the A and B Zone areas support the concept that hydrothermal solutions were channelled upward into the A and B Zones via the contact fault.

9c) A and B Zone Isopachs

Plates A-3 and B-3 are isopach isometrics. The A Zone is funnel-like in cross section. The funnel-spout is centred over the granodiorite-volcanic contact and appears to plunge to the south east. This relationship to the contact fault has been suggested by drilling. However, percussion data only is available in the area of the probable fault suggesting that core drilling is necessary for fault confirmation. The deepest hole in the "spout" of the A Zone is 252 feet and was stopped in potentially significant mineralization. The "core zone" of the A Zone is also a relatively low grade area with copper equivalents of 0.25% or less. Low grade core zones are common in porphyry systems. The B Zone appears to thicken over the granodiorite-volcanic contact, although this appears to take place in the south-eastern part of the zone where thicknesses in the order of 100 feet prevail. Additional drilling between lines 32W and 24W could return significant thicknesses of the mineralization, but any extensions east of line 24W seem unlikely, in view of the lack of a significant I.P. response. However, this does not rule out the possibility of significant molydenite occurring in the area to the east of 24W. Certainly, the drilling to date indicates potential for molybdenum mineralization to the north of the B Zone.

9d) Leaching, supergene enrichment and oxidation

No significant supergene enrichment or oxidation is noted in surface outcrops or in the drilling. Traces of cuprite, chalcocite and malachite were occassionally noted during the course of the binocular microscope examination of percussion cuttings. Assaying for soluble copper (Reference: 1974 Termination Report) showed no significant values. In the course of the 1975 diamond drill core logging, no secondary copper or molydenum minerals were observed. A little leaching is indicated in DDH 75-6 where relict chalcopyrite and/or bornite occassionally occur on limonitic fractures. Specific data on such occurrences is given in the strip logs in column 20. Reference to limonitic fractrues in column 10 for some holes, may or may not indicate leaching. In any case, no relict copper or molybdenum ore minerals were noted. A significant metal loss through leaching is nowhere indicated in the A or B Zones.

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9e) Alteration

The reader is referred to isometric plates A-6 and B-6 for a three-dimensional view on alteration. Mineral assemblages, indicative of the classical alteration facies of Lowell and Guilbert, are recognized on the property. Potassic alteration associated with mineralization, is indicated by the occurrence of K-feldspar selvages in borders of veins, principally in intrusive host rocks. Secondary biotite of either contact metamorphic or hydrothermal origin is pervasive in the Takla volcanics in the mineralized zones, and in the foot walls and hangin walls as well. Petrographic work is needed to determine the origin of this biotite. Its restriction to the volcanics suggests it may be of thermal metamorphic origin. The secondary biotite exhibits no apparent relationship to the mineralization. Such biotite is practically ubiquitous in the volcanic portion of each zone as well as the respective hanging walls and foot walls. By comparison to the other holes drilling in the volcanics, the area of DDH 75-3 is relatively low in secondary biotite. This raises the possibility that the mineralization was deposited within the biotite isograd for thermal metamorphism. The occasional habit of K-spar to pervasively flood volcanic rocks locally, giving the latter the appearance of a dyke, is termed metasomatic dyke. An example is 310-314 in DDH 75-3. Typically, such dykes grade into volcanics. Presence of augite phenocrysts suggest that they are recrystallized volcanics. Limited thin section work on sample material, apparently rich in fine grained biotite, confirm the existence of secondary biotite. A detailed petrographic study of the biotite and other possible metamorphic minerals may enhance our understanding of the metamorphic history of the area, and also shed some light on the probable environment, temperature and pressure conditions at the time of mineral deposition. Column number 1 of the Strip Log gives the distribution of K-feldspathization. Column 4 gives the distribution of secondary biotite.

Argillic alteration is expressed by softening of and/or discolouration of plagioclase crystals. In very intensely "kaolinized" sections, the plagioclase becomes soft to the finger nail. In less intensely altered areas, the plagioclase assumes various shades of green. Argillic alteration is generally only megascopically observed in the intrusives owing to the coarser grain of the rock. No doubt thin section work on volcanic samples would indicate argillic alteration as well. Sections of particularly intense plagioclase softening are often associated with faults. This type of effect might be explained in terms of fualts acting as conduits for hydrothermal solutions. Alteration assemblages indicative of the propylitic zone are not widely indicated at the Jean. Epidote is rarely noted. Noteable exceptions are DDH 75-1 and 75-3 where epidote occurs in fair amounts. Chlorite is occasionally noted, but as for epidote, lacks any apparent association with mineralization. In some specimens, chloritized biotite and fresh biotite are occasionally found to coexist. The chlorite may, in part, be of deuteric origin. In the 1975 drilling, sericite is noted in the bottom of DDH 75-5. Systematic binocular microscope logging in 1974 indicated considerable sericite development in the A and B mineralized zone and the respective footwalls (Plate A-6, B-6). Considerable recrystallization or possible silica introduction is noted in the volcanics of the mineralized zones. This is indicated by widespread silica and/or silicates of probable premineral age. This type of alteration or metasomatic effect is limited to the volcanics. Column 3 of the Strip Logs shows the distribution of such silica metasomatism or recrystallization. It appears, from cross cutting relationships, that this silica introduction of the volcanics is premineral and most probably of thermal metamorphic origin.

Silicification related to mineralization is widespread. This alteration assumes the form of quartz veins cutting the volcanics and the granodiorite. Column 15 of the strip logs shows the distribution of quartz veins. The veins are typically more common in the intrusive than in the volcanics. In the latter, thin fractures referred to as "hairline fracture" often contain minor quartz gangue.

Post mineral alteration takes the form of widespread hairline fractures filled with calcite. This material clearly cuts mineralized veins and fractures in the volcanic and granodiorite alike. A possible source of calcite is plagioclase destruction in the argillic facies of alteration. Barren quartz veins of post mineral age occur in holes 75-5 and 75-6.

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9e) Alteration (Cont.)

These veins cut mineralized veins containing various combinations chalcopyrite, molybdenite, pyrite and bornite. While typically the mineralized quartz veins exhibit K-spar selvages on their borders, the barren variety typically lack such borders. The alteration pattern shown on plates A-6 and B-6 have only a slight resemblance to the classical patterns. A slight similarity to the model of Lowell and Guilbert is indicated by the general dominance of plagioclase destructive alteration facies in the core of each deposit. Also, there is an enrichment of potash expressed by introduced K-spar.

The alteration pattern that can be inferred is very much dependent on whether the secondary biotite development in the volcanics is of hydrothermal or of metamorphic origin. In the case of the A Zone, a strong sericitic-potassic overlap is indicated with a possible sericite overprinting. A minor degree of symmetry with respect to the contact fault in the case of alteration in the A Zone and its footwall is suggested. The apparent prevalence of the more intense alteration facies close to the contact fault suggest the fault acted as a channel way for ascending mineralized solutions.

9f) Zoning of Sulphides

Chalcopyrite, bornite, pyrite and molybdenite are zoned vertically relative to the mineralized zones and laterally relative to the contact fault. Zoning was discussed under the heading of Mineralization and metal zoning. Zoning of chalcopyrite and pyrite expressed as chalcopyrite to pyrite ratios are plotted on isometric sections A-4 and B-4. The chalcopyrite to pyrite ratio in the A Zone are generally highest in the mineralized zones and almost invariably greater than one. In the hanging and footwall of the zone, values are variable. The pattern in the B Zone is quite different. There, the hanging wall and foot wall have chalcopyrite to pyrite ratios generally less than one. In the mineralized zone itself, the ratio is generally greater than one. A remarkable reversal in the chalcopyrite to pyrite ratio is noted in DDH 75-1 upon entering the mineralized zone. The ratio changes abruptly from about 1:3 in the hanging wall to about 3:1 in the mineralized zone. The sharp reversal in chalcopyrite to pyrite ratios is reflected in a grade change from 0.10 in the hanging wall to 0.68% in the mineralized zone. An even more sudden reversal in the chalcopyrite to pyrite ratio is noted at first entry of the foot wall of the B Zone. It is interesting to note that the top and bottom of the B Zone appear within a few feet of the straight line projections of the upper and lower limits of the zone as inferred by percussion intersepts in JPH 74-6 and 7. This is quite remarkable in view of the fact that these holes are 400 feet apart. This is taken as an indication of a probably high degree of continuity in the mineralized zone. This feature has direct application when considering drill hole spacing, since it appears that the mineralized zone may be projected accurately for some considerable distance with a surprising uniformity in thickness.

The distribution of bornite on plates A-5 and B-5 is a further indication that the contact fault area may be the centre from which sulphides became progressively less cupriferous and increasingly pyritic.

9g) Structural Control

Chalcopyrite, bornite, molybdenite and pyrite occur variously in the two deposits, principally as fracture controlled sulphides with relatively minor amounts occurring as disseminations. Fracture controlled material occurs as hairline fracture filling, quartz veins and seams.

Column 15 of the strip logs provides a detailed classification of the control of mineralization. Of the four categrories considered, hairline fractures, quartz veins, disseminations and seams, the most common in the volcanic portions of the deposits are hairline fractures, while quartz veins are dominant in the intrusive portions. The volcanics exhibit generally a much higher fracture frequency and more varied attitudes than the intrusives.

9. THE GEOLOGY OF THE A AND B ZONES (Cont.)

9g) Structural Geology (Cont.)

Post mineral faulting is evident at all of the known showings on the property. This takes the form of gouge and crushed sulphides.

Mapping along Jean Creek indicates that copper mineralization occurs in fractures and quartz veins dipping southerly. At least three structural directions are noted, namely 060° to 070° (dip 40° southerly); 090° (dip 20°-35° southerly); and 120° (dip 25° northerly). Other structural directions are 015° (with dip to the east) and 360° (with dip 19° to the west). Similar fracture attitudes and several others, are noted at the Blueberry showing on the southern edge of the B Zone. Many of the fractures are no doubt due to cooling of the intrusive and volcanic rocks. Conjugate sets are most probably present as well. The scarcity of outcrop has made it impossible to interpret the faulting on the property. It seems likely that faulting played an important part in developing fractures and "plumbing" systems. Faulting is widespread along Jean Creek from the Apple Cot showing to a point on the creek about 1/2 mile above the Lowwater showing, where outcrops end. There is little doubt that a major fault marks the contact between the granodiorite and the volcanics in the B Zone area. Although no such fault has actually been intersected in any of the two diamond drill holes in the A Zone, the relationship of the A Zone to the volcanic-intrusive contact leaves little doubt that such a fault is probably also present here. Both holes in the A Zone, namely DDH 75-5 and 6, were drilled well to the north of the projected fault.

Column 10 of the strip logs provides information on dips of faults (true or apparent) and their thicknesses. Attention is drawn to the nature of faulting in DDH 75-1. Major faulting is first noted at 370' and continues to the end of the hole at 635'. This hole ended well within the intrusive. The faults are defined as zones of gouge, mylonite or intense fracturing. This data appears to indicate that the contact fault represents a wide zone of weakness, which cuts volcanics and granodiorites alike. The diamond drilling in the B Zone area suggests convincingly, that the intensity of faulting is the strongest in the holes closest to the volcanic granodiorite contact.

Dips of mineralized structures can be inferred from the tabulations of core angles in column 12 of the strip logs for vertical drill holes.

Sulphide controlling structures appear to have about the same order of dips as those indicated along Jean Creek, ie. mainly in the 20-40° range. The wide distribution of these comparatively gentle dipping fractures is suggestive of a fairly uniform stress field in the area. Possibly a major fault such as the contact fault, could have produced gently southerly dipping fractures and ore controls. There is however, insufficient outcrop in the area to provide the detailed structural picture needed.

10. GEOPHYSICS

The I.P. survey carried out was a continuation of the 1973 survey. The area surveyed is defined approximately as the southwest corner of the J.W. claims lying generally to the south of Baseline 28N, to the west of line 32W. Adequate overlap for correlating the present survey with the previous surveys in the A and B Zones was allowed. In all, eleven miles were done on 11 parallel lines spaced at 800 feet. A magnetic survey covered the same grid.

The survey was carried out by Phoenix Geophysics Ltd. (ex. McPhar Geophysics). The I.P. - resistivity survey was carried out with a McPhar Model P660 frequency domain I.P. unit employing frequencies of 0.3 and 5.0 cps. The transmitter used was a standard McPhar 2.5 Kw unit. The input impedence of the receiver is 2 megohms. The I.P. effect is read directly as percent frequency effect. Resistivities are calculated from the values of the current applied to the ground, the primary voltage measured at the receiver and a factor dependent on the electrode configuration. The dipole-dipole array using 200 foot dipoles and four separations was employed.

10. GEOPHYSICS (Cont.)

The magnetic survey over the above grid employed a McPhar M700 fluxgate vertical field magnetometer. Readings were taken at 100' intervals and base station checks were made. The I.P. results show large areas of less than 1.5% frequency effect. Such values are considered normal for unmineralized Takla volcanics. Other areas with values of 2.5% frequency effect or greater, appear to correlate with areas of significant polarizable minerals such as sulphides and magnetite. Initial percussion drilling in 1974 was done within the 3% frequency effect contour for the second separation. This criteria was found to correlate quite well within the outlines of the A and B Zones, as indicated by the percussion drilling that year, and more recently confirmed by the diamond drilling in 1975. It appears that on the northern fringes of the two zones, significant copper-molybdenum mineralization can be expected from areas of 2.5% frequency effect for the second separation. The last I.P. survey has defined the southern extensions of the I.P. anomalies within which the A and B Zones occur. In the case of the B Zone anomaly, the favourable I.P. responses extend considerably to the south and west of the area drilled and known to contain significant copper mineralization. DDH 75-2 and 3 appear to indicate pyrite as the principal chargeable mineral on the southern fringe of the B Zone. This appears to severely restrict the southward extensions of the B Zone. However, in view of the size of the anomaly still untested by drilling, additional drilling would have to be done to rule out the possibility that a commercial body of mineralization does not exist in the anomalous area.

11. POTENTIAL IN THE A AND B ZONES

Appendix 1 is based on the results of the 1974 percussion drilling. No significant revision of the data is made on the basis of the 1975 diamond drilling. The diamond drilling confirms the flat tabular configuration of the A and B Zones, as well as the grades in a general way. It is noteable that the intersection of the B Zone in hole 75-1 is much higher than that indicated by the adjacent holes JPH 74-6 (0.46% Cu) and JPH 74-7 (0.38% Cu). This is due to the inclusion of a five foot sample of 3.37% copper occurring as quartz veins in DDH 75-1. The weighted average for the hundred foot intersection is 0.68% copper. Further drilling would have to be done to ascertain the confidence with which such a high grade zone (3.37%) may be projected. On the other hand, it would be unwise to cut the value at this stage.

The copper grade in DDH 75-5 is much less than predicted from the closest percussion holes, namely JPH 74-29, 30 and 33. It appears that the diamond drill hole encountered the extension of a lenticular low grade core zone, intersected by JPH 74-29. The molydenum grade in this zone, on the other hand, is about that encountered in JPH 74-29.

The diamond drilling program severely restricts the potential of the A and B Zones along several of the extensions opened by the 1974 percussion drilling. The main extensions possible now are to the north in the case of both the A and B Zones, and to the southeast in the case of the B Zone. A westerly extension of the B Zone on line 64 between DDH's 75-3 and 4 should receive further attention. The general I.P. response to the south and west of DDH 75-3 requires further drilling. The extensions to the north into the area underlain by the intrusive are favourable since the mean grade of the intrusive portions are indicated to be significantly higher than the volcanic porion, namely about 0.48% copper equivalent. However, the extent of such material is probably governed by the 2.5% frequency effect contour suggesting the extensions are unlikely to produce more than a few tens of millions of tons. The structural-plutonic setting suggests proximity to the granodiorite-volcanic contact is a principal control of mineral deposition. From the drilling on lines 48W, 58W, it appears that the southern limits of favourability have been determined. Deeper drilling on line 32W to the south of JPH 74-11, would most likely indicate further mineralization. However, the sudden raise in the topography to the north in this area would necessitate moving considerable tonnages of hanging wall rocks before reaching the mineralized zone in the case of a mining operation.

The easterly and northerly extensions are quite favourable in terms of stripping ratio.

12. MISCELLANEOUS POTENTIAL (Ref. Plate JP 75-2)

Several I.P. anomalies, still untested by drilling, lie along the apparently all important granodiorite-volcanic fault contact. These are generally small targets, and drill testing of these should not be done until the remainder of the volcanic-granodiorite contact has been tested by I.P., ground magnetics and mapped in detail.

The available data suggest a fault may run the length of the contact, a distance of at least 5 miles. While most of this contact has been covered by I.P. already, the eastern mile or more has not. Further mapping is also needed in this area to locate the favourable contact fault more accurately. Of the I.P. anomalies indicated along this contact, and untested by drilling to date, the H Zone remains most interesting. This zone remains incompletely defined by I.P. Indications are that the zone is at least 3500 - 4000 feet in length and at least 1300 feet in width. Pyritic basic volcanics are widespread in the anomalous area. This could indicate that the anomaly is caused by pyrite only. However, a mineralized zone such as the B Zone, or hopefully one of better grade, could equally well be the cause. Certainly, the B Zone is characteristically high in pyrite in its hanging wall. Therefore, every I.P. anomaly of adequate size potential occurring along the contact, must be drill tested for lack of a better way of discriminating pyrite and copper-pyrite anomalies. Another potential along the contact is the occurrence for monzonite dyke swarms. These are expected to exhibit ground magnetic highs. This type of occurrence offers considerable potential in view of the fact that practically every showing involving such a dyke contains copper mineralization grading 0.5% copper or better, in the dykes. Mineralization in a single dyke association typically extends, at the most, a few feet into the intruded rocks and then only when the intruded rock is volcanic. However, if a large number of such dykes were encountered, the picture would change drastically. Two such showings are known, namely the Apple Cot in the A Zone and an unnamed showing near JPH 75-15 at the C Zone. The apparently greater preponderance of dykes in the eastern part of the property, as indicated by the mapping of Bacon and Crowhurst, may be significant and warrants further attention in the field. Additional ground acquisition should be done on the south side of Jean 21, 23, 25, 27 and 29 to protect the favourable extension of the contact fault, before this work is carried out.

13. CONCLUSIONS AND RECOMMENDATIONS

The subore grade makes the Jean property a hold situation, but small expenditures would be justified from time to time to protect critical claims, test geologically favourable areas beyond the present claim group and to increase the feel for known reserves.

The available information on the potential of the A and B Zone areas indicates the maximum open pit reserve that can be expected is in the order of 40-50 million tons. The mineralization discovered at the A and B Zones to date has little possibility of becoming profitable in the forseeable future. Discovery of a higher grade deposit nearby could significantly improve the otherwise uncertain future for the A and B Zones and could eventually permit production from them at an earlier date. Technological advancements could alter the present economics for such deposits. However, in the light of vast reserves of 0.3% to 0.4% copper in deposits in other locations, mining the Jean deposits seems to lie well into the future. However, this is a centre of mineralization and copper deposits tend to occur in clusters and exploration should be continued. The likelihood for finding new reserves in the A and B Zones is considered poor. On the otherhand, the detailed testing has been limited to parts of the contact. One area that has received little attention is that to the north of the A and B Zones. This is low wet ground located outside of the present I.P. coverage. Another area is the eastern projection of the contact fault to the east of "K"-Zone plate (JP-75-2) and considerations should be given to expanding the I.P. coverage into it.

Examples of multiple, relatively close spaced porphyry copper ore bodies in B.C. occur at Gibralter, Copper Mtn. and Bethlehem. Variations in grade is present in each area.

13. CONCLUSIONS AND RECOMMENDATIONS (Cont.)

Gibralter ore bodies:-

Gibralter East, Gibralter West, Pollyanna, Granite Lake.

Total reserves at the end of 1973 were 332 M. tons @ 0.366% Cu and 0.016% Mo.

Production from 1972 to 1973 was 22,163,500 tons containing 199,196,380 lbs. Cu and 493,535 lbs MoS_2. The recoverable copper grade is 0.45% (Reference: Mineral Deposit Land Use Map 93B).

Copper Mtn. ore bodies:-

Four ore bodies total reserves mined 34 M. tons grading about 1% Cu.
Reference: Western Miner Dec. 1973.

Bethlehem Copper:-

Four ore bodies; Jersey 50 M. tons @ 0.65% Cu, East Jersey 3.3 M. tons @ 1.2%, Iona 15 M. tons @ 0.43%, Huestis 30 M. tons @ 0.56%.
Source: Personal Communications, Bethlehem Copper

On the Jean two deposits have been found and there are untested areas where others may occur and it is not unreasonable to hope for better grade.

For the next program it is recommended that the following work be done:-

Area I - The Area to the north of the A and B Zones

A program of I.P. and ground magnetics involving about 24 line miles of both surveys commencing at the northern extent of the present coverage and extending from line 96W to line 16E. This will test an area 2 mi. long and 1.4 miles to 2 miles wide. The cost of such a program is estimated at about $30,000.

Area II - The projection of the contact fault to the east of the K Zone

Geological mapping and prospecting is needed in this area in order to detail the projection of the contact fault into this area. The mapping would be at a scale of 1" = 400' with careful attention being paid to mineral, metal zoning alteration and structures. The crew should be equipped with a black light in view of the occurrence of a tungsten showing in the area. This work would allow us to assess the area immediately to the south of the present claim boundaries in the area south of JEAN 21, 23, 25, 27, 29, 31 and 33 M.C. The available data indicates this area to be structurally and lithologically similar to portions of the A and B Zones.

The estimated overall cost of the mapping in Area II is $4,000.

The proposed approach strikes a balance between the desireability of going slowly, and of working systematically towards developing new percussion drill targets available for drilling by the late '70's, when a road from the south can be expected. This approach further enables us to maintain our holdings where warranted and allows us to systematically reduce them as the critical information becomes available. It also further reduces the chances that ground will be abandoned without adequate testing. To protect claims in the areas to be considered, this work should be done in 1977.

The development of the concept that the contact fault is a prime exploration parameter arose out of this years work.

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ENCLOSURES

Plans

Plate JP 75-1	Claim Map	1" = 1600'
JP 75-2	Compilation	1" = 1600'
JP 75-3	Geology Geochemistry	1" = 1600' (November, 1972)
JP 75-4	1975 Diamond Drilling I.P.	1" = 400'

SECTIONS

Plate JEAN 74-10	(Revised)	Sections 56W, 48W	1" = 100'
JEAN 74-11	"	Sections 64W, 68W	1" = 100'
JEAN 74-13	"	Sections 84W, 80W	1" = 100'
JEAN 74-14	"	Sections 96W, 88W	1" = 100'
JEAN 74-15	"	Longitudinal Section	1" = 400'

APPENDIX

No. 1 Tenure List

No. 2 Diamond drilling summary

No. 3 Diamond drilling assay summary

No. 4 Potential reserves

No. 5 Strip Logs DDH 75-1 to 6

No. 6 A and B Zones isometrics

Plates A-1 to 6, B-1 to 6

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