

# Exploration of Gibraltar

A review of the development of another

B.C. copper mine due for start-up soon

By

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Gibraltar is one of the newest and lowest grades of the British Columbia porphyry deposits. It is located in the Cariboo district of central British Columbia on the western slope of Granite Mountain. The property is 38 miles north of Williams Lake and approximately 230 miles north of Vancouver. The area surrounding the property is one of moderate relief with elevations between 3,500 feet and 4,100 feet. It is an area of good access with the P.G.E. railway siding at Marguerite, Highway No. 97, and the Fraser River all within eight miles of the property. The main Peace River powerline and a major gas pipeline strike in a north-south direction between Marguerite and the property.

The first record of claims staked in the area goes back to 1917 when open cuts were made on quartz veins in what is known as the Pollyanna group. Little work was carried out in the area until an adit was driven in 1957 on what is now considered as an extension of the Gibraltar West zone. It should be pointed out that very little natural exposure of rock occurs in the areas of the Gibraltar ore zones. Of the four orebodies, one is completely covered; the smallest one, the Gibraltar West, has minor exposure; and the other two have minor exposures of leached capping. Rock exposure is confined to less than 5% in the area of mineralization.

The claims covering the adit zone were allowed to lapse and were re-staked by Mr. J. Hilton in January 1962. He in turn optioned them to Gibraltar Mines in 1964. The claims covering the Pollyanna zone were staked by Mr. R. Glen in 1963. They were examined by Mr. Bill Kerns for Duval who recognized limonite that indicated a chalcocite zone at depth. On his recommendation, Duval optioned the

Pollyanna property and did an I.P. survey which was followed by diamond drilling. This program indicated a size-

able body of low-grade mineralization. Canex was later invited by Duval to joint-venture the property with them. At this time, we would like to acknowledge the many contributions to the knowledge of the area made by Duval geologists, especially Dr. Bob Gale. Special credit should also be given to Mr. Pat Bowes, past-president of Gibraltar. Other early ground holders in the area were Keevil Mines, Gunn Mines and Coast Silver.

I.P. surveys and diamond drilling were carried out on the Gibraltar pro-



View of Gibraltar plant site, looking S.S.E. Concentrator is visible in centre with A-frame fine-ore storage bin taking shape to left. Gibraltar East pit is visible as cleared area at extreme right, beyond trees.

A paper presented by D. C. Rotherham at the 77th Annual Convention of the Northwest Mining Association, Spokane, Washington, December 3, 1971.

## THE AUTHORS

Donald Charles Rotherham was born in Alberta where he received his early education. He attended the University of Saskatchewan from which he graduated with a master's degree in geology.

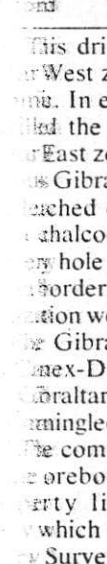
His early professional career was in exploration in the Canadian Shield. The next three years were spent in the Cordilleran largely as a mine geologist. He then returned to the exploration field and in 1962 commenced his association with Placer Development Limited as a geologist working on the exploration phase of Endako. Mr. Rotherham's present position is manager of exploration, Western Division, and as such he has supervised the Gibraltar exploration programme.

Stuart John Tennant, originally from South Africa, graduated in 1959 from the University of British Columbia with a B.Sc. in honours geology. For four years following graduation he was an exploration geologist for Anglo American Corporation of South Africa in Zambia. Returning to Canada in 1963, he worked for V. Zay Smith and Associates, a consulting petroleum-engineering firm in Calgary. In 1964 Mr. Tennant joined the Placer Development organization as an exploration geologist for Canex Aerial Exploration Ltd. In 1969, he became field supervisor for the Gibraltar project.

Arthur Drummond, Ph.D., P.Eng., received his primary and secondary education in Vancouver and graduated in geological engineering from the University of British Columbia from which he gained a B.A.Sc. in 1959 and an M.A.Sc. in 1961. He took his Ph.D. degree at the University of California in 1966.

From 1958 to 1961, he was employed by Kennco Explorations (Western) Limited on the Lime Creek molybdenum deposit of British Columbia Molybdenum Limited. He has been associated with the Placer Development group of companies since 1963, first with Craigmont, then with Endako, and since 1967 at head office as research geologist for Canex Aerial Exploration Ltd. He has been closely associated with the Gibraltar project since 1969.

In 1970, Dr. Drummond and E. T. Kimura were recipients of the 1969 Barlow Memorial Medal of the Canadian Institute of Mining and Metallurgy for their papers on the geology and hydrothermal alteration of the Endako molybdenum deposit.



## INDUCED POLARIZATION

The lack of outcrop caused geological frustrations in that it seemed impossible to come up with a geological model that would explain mineralization and the relationships between areas of mineralization. Geophysical I.P. surveys were carried out with varying success on the Gibraltar, Pollyanna, Keevil, and Gunn properties. The Pollyanna ore zone was completely covered and should be considered an I.P. discovery. I.P. had been done on Gibraltar, Keevil, and Gunn properties but follow-up drilling had produced little more than pyrite in abundance. In early 1969, Canex geophysical personnel combined all the known I.P. in the area into a one large-scale map (see Figure 1). It became apparent that if one took the regional foliation of the intrusive into account, one could come up with a pattern that resembled a distorted pyrite halo. The Gibraltar East zone fitted into the inner side of the halo and suggested that low to moderate I.P. response coincided with copper mineralization. A geological model was suggested which indicated that a drift-covered "core" existed in the center of the distorted halo. Further drilling on the Pollyanna zone strengthened the model picture in that it showed the Pollyanna zone to exist on the inner side of the halo. A decision was made to do step-out drilling on 800 ft. centers to the south of the Pollyanna. This resulted in the finding of a barren quartz porphyry "core" and on its south side, the Granite Lake zone of mineralization which became the second largest orebody in the area.

It is apparent that a problem was pre-

sent in the I.P. interpretation in that any single property only gave you part of the picture and was in many ways analogous to the old fable of the blind men describing the elephant.

## GEOLOGY

The main feature of the regional geology is a north-south trending line of batholiths which occur along the eastern side of the Fraser River fault system. The Gibraltar deposits occur in one of these, the Granite Mountain pluton. This pluton intrudes volcanics and metasediments of the Cache Creek group. It has been regionally metamorphosed and contains a uniform foliation at 110 degrees dipping 20-30 degrees south. It is predominantly a quartz-diorite which is extremely uniform in its mineral assemblage, quartz 25-30%, "plagioclase" now a mixture of albite-epidote-zoisite-muscovite, 50-55%, chlorite 20%. Grain size is generally 1-2 mm. The rock may best be described as a saussuritized quartz diorite with its present silicate assemblage comparable to the green schist facies of regional metamorphism. The area surrounding the pluton is in part underlain by late Tertiary basalts which allow limited knowledge of the earlier geology.

The main structural feature is the regional foliation. In the large picture, this foliation is uniform and through-going but locally is deformed and at times is extremely contorted. Often adjacent to shear zones it is completely obliterated. Observations suggest that the contorted areas are the most favourable for mineralization. Dikes of aplite and quartz feldspar porphyry cut the

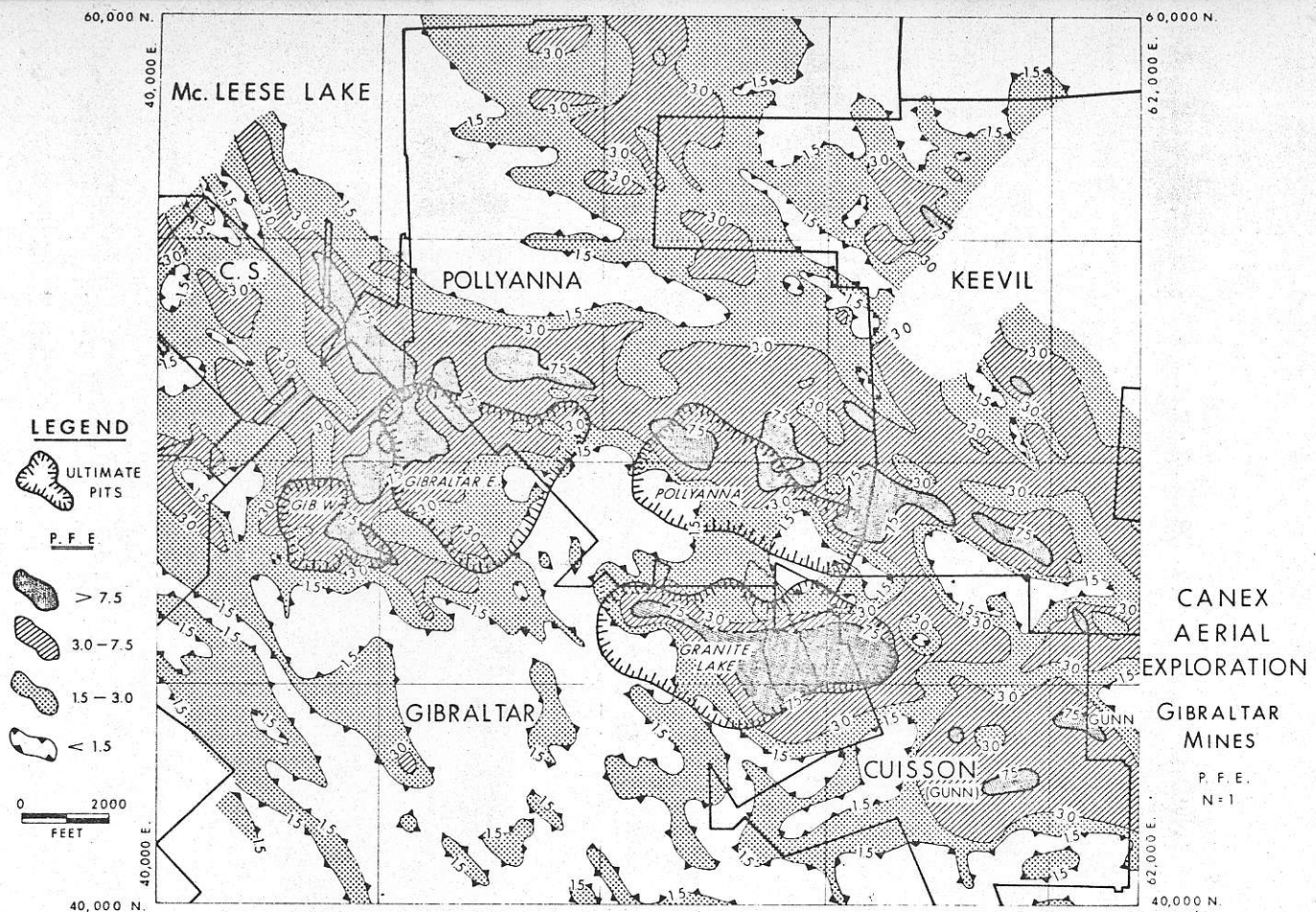


Figure 1 I.P. Compilation

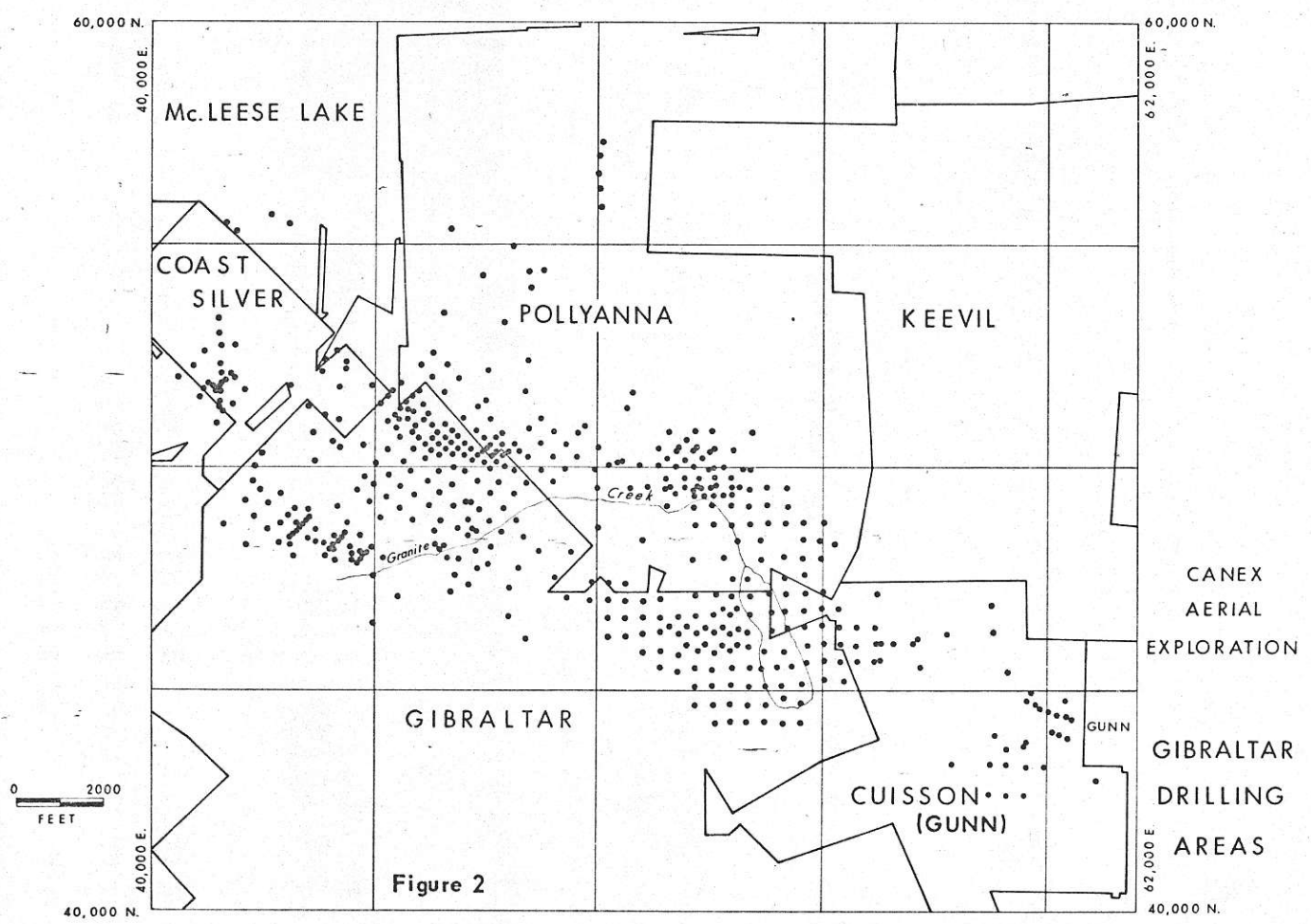


Figure 2

saussuritized quartz-diorite. The quartz feldspar porphyry is most common in the central core area.

The area of mineralization appears relatively undisturbed by faulting. However, strong zones of faulting occur to the East of Granite Lake.

### MINERALIZATION

The Gibraltar East and the Pollyanna orebodies both have well-developed leached zones above a supergene zone. This supergene zone is irregular in development and thickness. The main supergene mineral is chalcocite with minor amounts of covellite. Chalcopyrite is the main primary-copper mineral with primary bornite being restricted to areas near the core porphyry. Present in minor amounts are cuprite, native copper, malachite, and zurite. The oxide mineralization is most prevalent near the interface of the leached and the supergene zones. Gibraltar will be the first of the British Columbia porphyries to have the majority of its initial production from a supergene zone. Other porphyries in British Columbia are known that have supergene zones. However, none are in production to date.

In the Pollyanna, Granite Lake, and to a lesser extent, the Gibraltar East zones, a definite relationship exists between structure, mineral zoning, and the I.P. response. The three main orebodies are situated along the inner side of an induced-polarization high. The mineral sequence outward from the

quartz feldspar porphyry core is as follows:—

1. minor bornite, minor chalcopyrite, pyrite often absent.
2. chalcopyrite-pyrite.
3. pyrite with minor chalcopyrite.

Zone 3 is much thicker than zones 1 and 2. The pyrite zone is generally associated with numerous sericite envelopes so that at times in some areas, it may be equally well termed a pyrite-sericite zone. Molybdenite-bearing veins occur throughout but seem commonest with the better copper grades.

### ORE RESERVES

The total ore reserves using a 0.25% Cu cut-off are 358 million tons at 0.37% Cu and 0.016% MoS<sub>2</sub>. This tonnage includes four separate pits. Profit optimization in pit planning is such that the first 55 million tons will grade 0.44% Cu and will be available for mining in the early years.

### DRILLING

At that time of signing the Canex option, one diamond drill was working on Gibraltar and a second on Pollyanna. The number was rapidly increased to an average of 4. The majority of the drilling was done by Candian Longyear with a lesser part by Shepherd Enterprises and earlier drilling by Trolenberg. All drilling in the Canex program was NQ wireline. A drilling

record was set for NQ by Canadian Longyear when one of their crews drilled 2,010 feet in a one-week period. Five moves were included that week. The total for the four drills for the same week was 5,184 feet. With this kind of performance, core logging, splitting, and sample handling became a problem. In total over 150,000 feet of diamond drilling was carried out in approximately one year (see Figure 2).

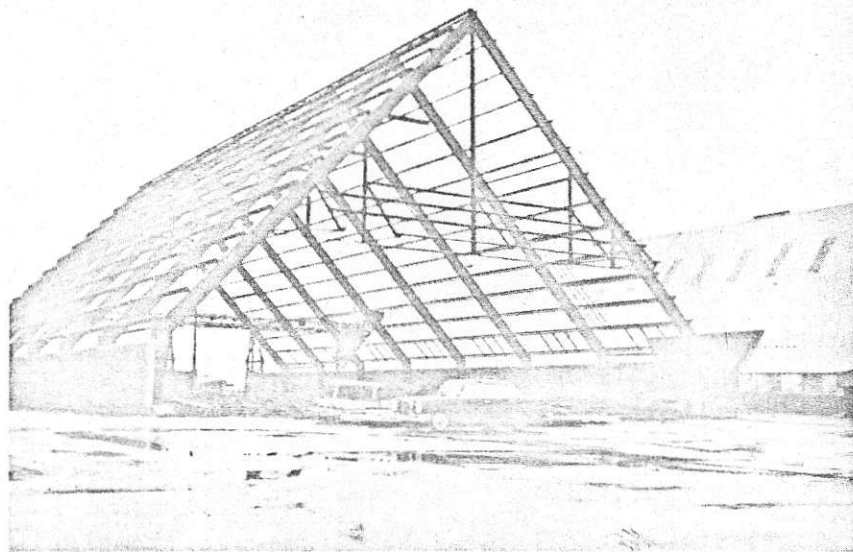
### BULK SAMPLING

A decision was made for a bulk sampling program in order to confirm grades and provide material to determine the milling characteristics of the ore. Plans were drawn up for a conventional underground program with the sinking of shafts, cross-cutting, and raising on drill holes with all the material produced going through a sampling plant. Tenders were let and bids received. The bids were in the order of twice our estimated costs. In shock we decided to look at alternatives and were attracted to the idea of drilling large enough holes to give a check on grades and sufficient sample for metallurgical testing. Thirteen 5 $\frac{7}{8}$ -in. holes totalling 3,404 feet were drilled by Becker Drilling of Calgary using their reverse circulation equipment. In this system, all the cuttings are blown up the drill stem. The cuttings were then collected in a 45-gallon drum lined with a polyethylene bag. Each drum ideally represented 10 feet of hole. Considerable water was encountered in some holes and at times it was necessary to use up to 10 drums to collect 10 feet. In such cases, the drums were set aside to permit settling of the fines and then the water was decanted. The drums of cuttings were then shipped to Placer's research lab in Vancouver for assaying and testing. The assay samples were obtained by first augering the drums and secondly coning and quartering the dried samples. The use of the rotary drill saved over one million dollars and over six months in time when compared with the underground program.

In conclusion, I would like to remind you that the exploration phase has been past for over a year. Duval's position in Gibraltar has been obtained by Placer and on November 6, 1970, an announcement was made of a production decision. Construction on a 30,000-ton per day plant is well advanced and nearing completion.

Pre-production stripping has now reached a stage where over 80,000 tons of rock are being mined per day. Construction appears ahead of schedule and the mill is expected to be turning over early in the second quarter of 1972. Yesterday's Jackpine stands are rapidly becoming B. C.'s newest open-pit copper mine.

## Gibraltar Storage Sheds



A familiar sight on Vancouver waterfront is the A-frame silhouette of storage sheds for metal concentrates from British Columbia mines. Shown is newest of the large structures at Vancouver Wharves. It will be used by Gibraltar Mines when it begins shipping copper concentrate to Japanese smelters in the early part of the second quarter. A 30,000-ton shed measures 175 feet by 114 feet, and is being equipped with an overhead conveyor for concentrate input. Transfer to ships will be by front-end loader to hopper-fed conveyor system.