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GEOLOGY OF GIBRALTAR MINES LTD.  
(A SUMMARY)

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GIBRALTAR MINES LTD.

LOCATION

The Gibraltar-Pollyanna copper-molybdenum deposits are situated in the Cariboo District of British Columbia, some 225 air miles due north of Vancouver. They lie on the western slope of Granite Mountain, 27 air miles north of Williams Lake, B.C. Latitude and longitude are 52° 30' N and 122° 16' W respectively (see Location Map, Figure 1). Topographic relief is moderate as elevations range from 3300 to 4100 feet.

HISTORY

The adjacent Gibraltar and Pollyanna properties have been developed independently since their discovery around 1920. Since 1969, the two properties received combined exploration programs which lead to the recognition of a major porphyry copper deposit. On November 6, 1970, Placer Development Limited announced its intention to place the co-mingled properties into production at 30,000 tons per day. Target date for production is scheduled for June 1972. Current ore reserves are 206.5 million tons of 0.39% Cu and 0.016% MoS<sub>2</sub> at a 0.25% Cu cut-off grade.

REGIONAL GEOLOGY

Geology of the Quesnel-Williams Lake area can be separated by the north-south trending Fraser River fault system. To the east of the fault, broad bands of Triassic and Permian rocks outcrop while to the west, Tertiary volcanic rocks are abundant. The northwest trending geosynclinal rocks of the eastern side appear to be uplifted relative to the western side.

An intermittent north-south trending line of batholithic rocks outcrop along the eastern side of the Fraser River fault system. In the immediate vicinity of Granite Mountain, a regionally foliated and metamorphosed quartz diorite (the Granite Mountain pluton) has intruded Cache Creek Group rocks of Permian age.

GEOLOGY OF GIBRALTAR MINES LTD.

The copper-molybdenum deposits of the Gibraltar East zone, the Pollyanna zone and the Granite Lake zone are entirely within the foliated and regionally metamorphosed Granite Mountain quartz diorite.

Regional Metamorphism of the Granite Mountain Pluton

The quartz diorite host is extremely uniform in its mineral assemblage. The rock is composed of quartz (25 - 30%), "plagioclase" which is presently a mixture of albite-epidote-zoisite-muscovite (50 - 55%, chlorite (20%) which originally was biotite with minor hornblende and disseminated magnetite (1% or less). Grain size is generally 1 - 2 mm. This rock may be classified as a saussuritized quartz diorite. The present silicate assemblage is compatible with those of the greenschist facies of regional metamorphism.

The only rocks encountered in the Granite Mountain pluton which were not regionally metamorphosed are a quartz-feldspar porphyry and an aplite. These rocks are both dykes and are intrusive into the saussuritized quartz diorite.

Regional Foliation

The major structural feature associated with the metamorphism is the foliation which strikes about  $110^{\circ}$  and dips  $20 - 30^{\circ}$  southerly. Foliation is a result of cataclastic deformation within the Granite Mountain pluton. Locally, within shear zones, the foliation becomes extremely contorted and at times completely obliterated.

Mineralization

The following mineralized veins cross-cut or locally parallel the foliation and are listed in chronological sequence (i.e., the first listed is cross-cut by the next listed feature or older features are cut by younger).

Stage 1. a) quartz-pyrite  $\pm$  chalcopyrite WITH a sericitic envelope.

(Sericite envelope assemblage is quartz, sericite, pyrite ± chalcopyrite with all saussuritized feldspar being made over to sericite-clay (?) mixture);

- b) quartz-chlorite-pyrite-chalcopyrite-magnetite ± carbonate WITH a chloritic envelope.

(Chlorite envelope assemblage is quartz, chlorite, pyrite ± chalcopyrite with a pronounced absence of epidote in the saussuritized feldspar);

- Stage 2. a) quartz-chlorite-pyrite ± magnetite;  
b) quartz-chlorite-pyrite-chalcopyrite-epidote ± magnetite;  
c) quartz-chlorite-pyrite-epidote ± magnetite;  
d) quartz-chlorite-pyrite-chalcopyrite ± magnetite;  
e) quartz-chalcopyrite-bornite ± pyrite (restricted to porphyry area between Pollyanna and Granite Lake zone) (all with ± carbonate).

Stage 3. quartz-molybdenite-chalcopyrite-pyrite ± magnetite ± carbonate;

Stage 4. bull quartz-fine grained chlorite blebs-chalcopyrite blebs.

#### Hydrothermal Alteration associated with Mineralization

Sericitic and chloritic envelopes which are associated with Stage 1 veins are definitely of hydrothermal origin.

A second hydrothermal feature is only observed microscopically. Under regional metamorphism of the greenschist facies, plagioclase in the original quartz diorite has been reconstituted to a mixture of albite-epidote-zoisite-sericite (minor). A suite of rock samples across the Pollyanna and Gibraltar East zones indicated that the sericite-epidote ratio in the saussuritized feldspar increased directly with copper values across the mineralized zones.

### Relationship of Mineralization to Regional Foliation

Veins outlined above are superimposed on each other as well as on the regional foliation. The above indicates the complete separation of the two geological events, that is, the foliation preceded the mineralization.

### Supergene Zone

Throughout the entire mineralized area, there is a leached zone above the supergene copper zone but it is irregular in development and thickness. A weak to strong development of limonite is characteristic of this zone.

Supergene copper minerals include chalcocite with minor amounts of native copper, azurite, malachite, cuprite and traces of covellite and occur throughout the zone to some degree.

### STRUCTURE WITHIN THE GRANITE MOUNTAIN PLUTON

The structure history of Gibraltar Mines must relate the superposition of the mineralized stockwork on the pre-mineral foliation developed in the saussuritized quartz diorite. A weakly mineralized or barren core in and around which the porphyry is found, is aligned more or less parallel to the regional foliation. Mineralization and fracture intensity increase outwards from this core area in such a manner that the overall size of the elliptical shaped area of stockwork development is 4 - 5 miles by 1 - 2 miles.

### Relationship of I.P. Response, Mineral Zoning and Structure

The Gibraltar East zone, Pollyanna zone and Granite Lake zone are situated along the inner side of a band of higher I.P. response. Mineral sequence outward from a porphyry-bearing barren core is as follows:

- 1) minor chalcopyrite, minor bornite, ± minor pyrite (low sulphide area);

- 2) pyrite-chalcopyrite or chalcopyrite-pyrite;
- 3) pyrite-minor chalcopyrite. The latter is generally associated with numerous sericite envelopes such that the outer zone may equally well be termed a pyrite sericite zone. Molybdenite-bearing veins are scattered throughout the zones, but locally may show an increase with an increase in copper values.

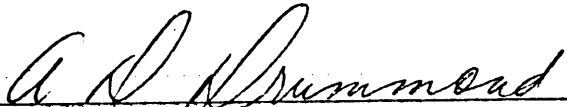
#### GEOLOGICAL SUMMARY

The following geological events are chronologically outlined below:

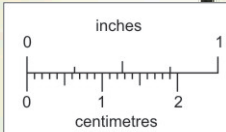
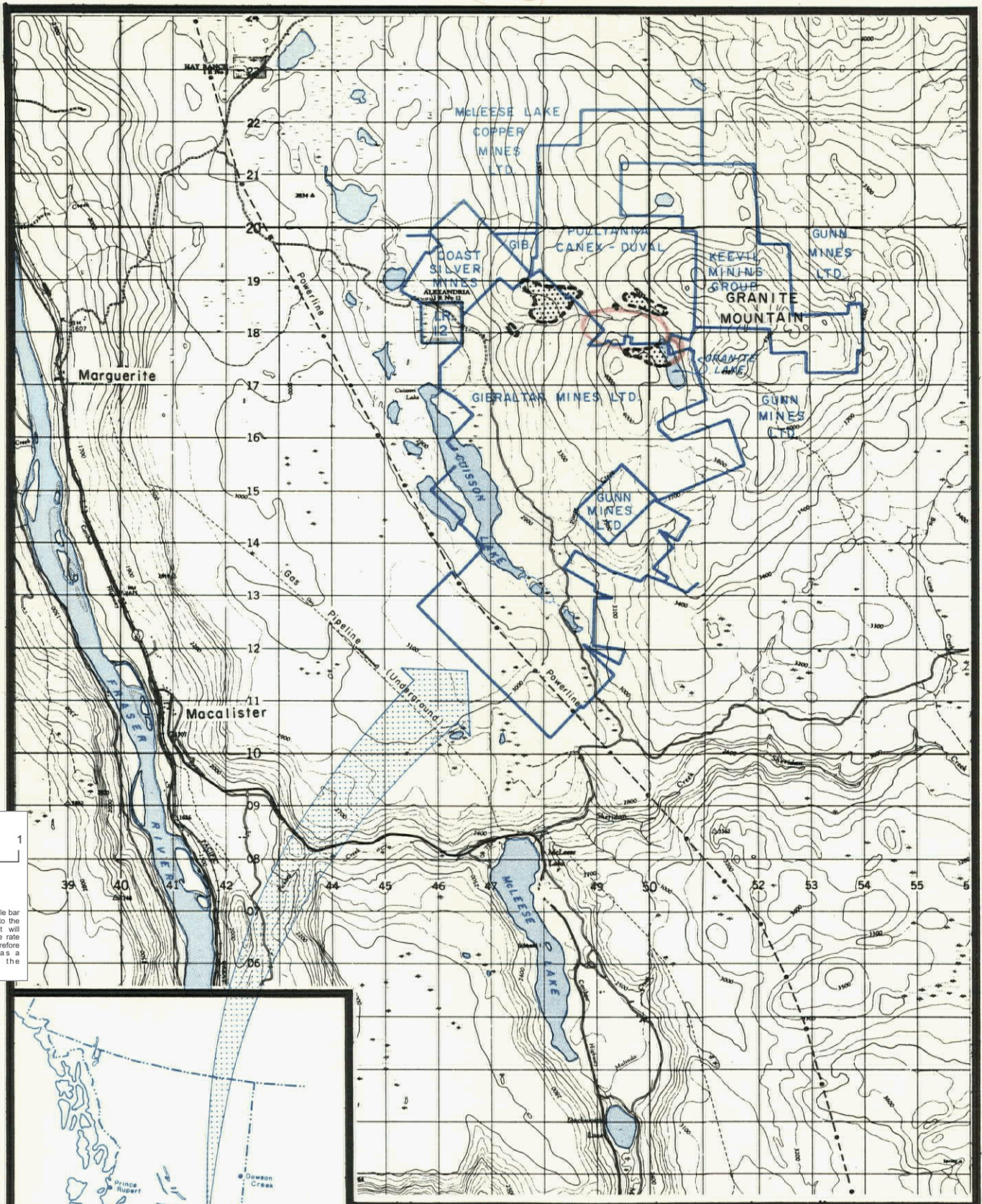
- 1) The Granite Mountain pluton intruded Cache Creek group rocks during Jurassic-Cretaceous time.
- 2) Deformation of the general area has produced simultaneous development of (a) regional foliation, and (b) regional greenschist facies type of metamorphic assemblages within the quartz diorite of the Granite Mountain pluton.
- 3) During continued deformation, quartz-feldspar porphyry intruded the pluton which formed a structurally more competent core.
- 4) During further deformation, a fracture pattern developed around the structurally more competent core. This fracture system which is imposed on, and partly controlled by, the regional foliation contains a wide but regionally restricted sulphide zone. Within the sulphide zone, a chalcopyrite-secondary chalcocite-molybdenite zone occurs between the low sulphide core and a pyritic halo.
- 5) At some later time, movements on the Fraser River fault system have uplifted the Granite Mountain pluton. Relatively down-dropped areas were filled by Tertiary volcanism. Weathering under arid conditions caused a leached zone and an underlying zone of secondary enrichment.

- 6) Recent glacial activity has deposited till and gravel over the entire area of the Gibraltar-Pollyanna copper-molybdenum deposit.

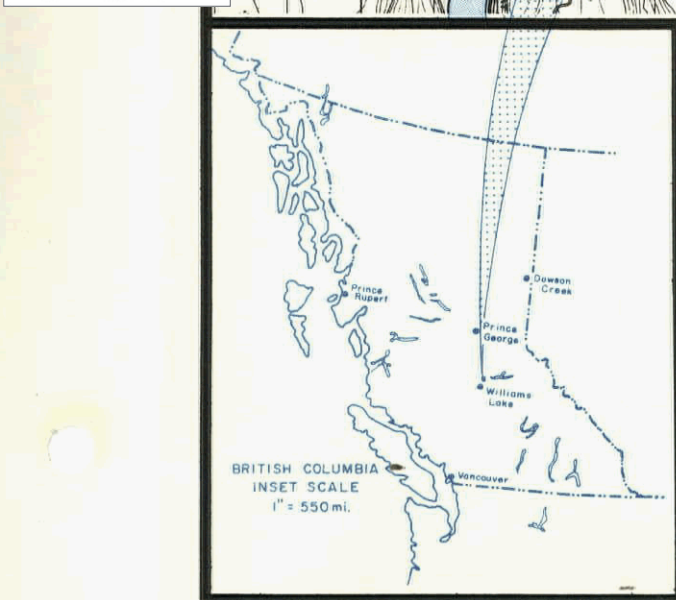
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**FIGURE 1**  
**CANEX AERIAL EXPLORATION LIMITED**  
**LOCATION MAP**

SCALE: 1" = 1.6 miles

15 April 1970