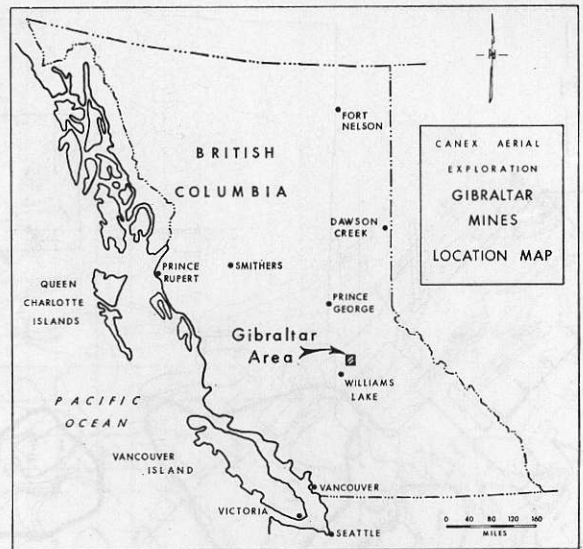


# I. P. and Resistivity Prove Invaluable in Finding Gibraltar Ore

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The orebodies of Gibraltar Mines Ltd. (N.P.L.) are located on the western slope of Granite Mountain, central British Columbia. The area in and around Gibraltar Mines has a moderate topographic relief with elevations between 3500 and 4100 ft. The property is 95% covered by overburden which varies in depth from a few feet to 230 ft.

## Early History and Geology

The present Gibraltar Mines property before amalgamation consisted of the Pollyanna property (Duval-Canex) and the Gibraltar property (original Gibraltar Mines) as well as some Coast Silver and McLeese Lake Copper claims.

The Pollyanna property was first described in the 1917 B.C. Minister of Mines Report which referred to it as the "Rainbow Group". The development at that time consisted of several open-cuts on copper bearing quartz veins. By 1925 the Rainbow Group came to be known as the Pollyanna property and was described in the B.C. Minister of Mines Report as "a wide zone of shearing in granodiorite at least 60 ft in width and possibly wider". Copper mineralization on the Pollyanna and the adjoining Copper Queen group to the south had been found by 1929 in scattered outcrops over a distance of 2000 ft along a northwest-

southeast trend. This mineralization was always found within the sheared granodiorite. Limited work was carried out on the property until Keevil Mining came on the scene in 1963-64.

The Gibraltar property was discovered around 1927 and was mentioned in the 1928 B.C. Minister of Mines Report as the Hill property. The only significant copper showing was exposed along the side of Granite Creek about 6000 ft west of the Pollyanna showing. Very little work was carried out on the property until 1957 when Kimacllo Mines drove an adit for 110 ft along the mineralized shear zone. Subsequent drilling showed the mineralized zone at the adit was over 100 ft wide and extended along both a localized shear at the adit and the regional foliation for an undetermined distance. In 1962, Keevil Mining carried out the first geophysical program on the property in conjunction with a geochemical soil sampling survey.

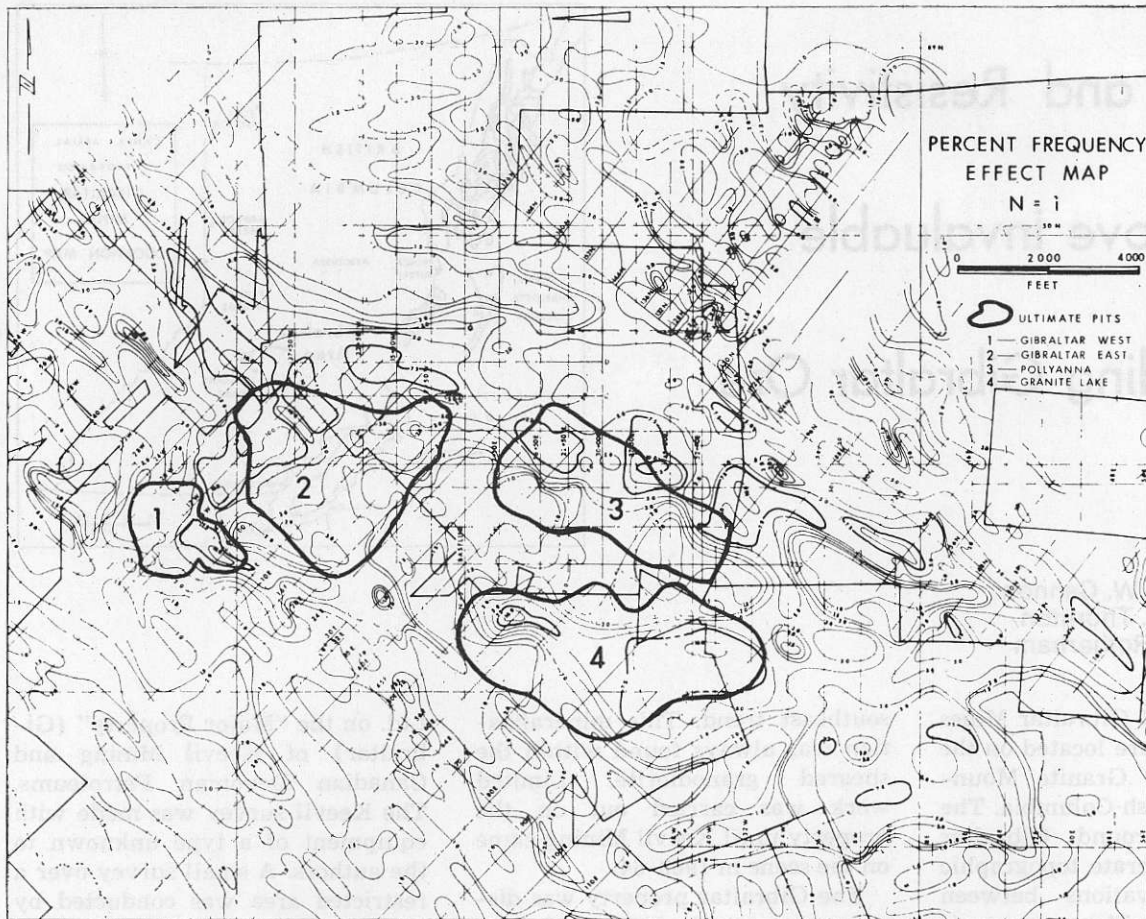
## The Induced Polarization and Resistivity Surveys

No induced polarization and resistivity surveys were conducted on the properties until the early 1960's when the first survey was conducted on behalf of the Keevil Mining Group Ltd. This survey was carried out in 1962 by Geophysical Engineering and Surveys

Ltd. on the "Major Property" (Gibraltar) of Keevil Mining and Canadian Devonian Petroleum. The Keevil survey was made with equipment of a type unknown to the authors. A small survey over a restricted area was conducted by Hunting surveys in 1963 near the Sunset adit. This survey tested part of the area which had been covered by the earlier Keevil survey.

In 1964 Duval Corp. of Canada optioned the Pollyanna property and the following year McPhar Geophysics conducted a limited I.P. survey from the zone of known mineralization to the eastern boundary of the property. At this time, a Duval geologist, recognized the occurrence of limonite after chalcopryrite as a typical porphyry environment which could have contained a zone of supergene enrichment. The McPhar survey was extended in 1966 by Heinrichs Geoexploration Co. to further delineate the Pollyanna zone. Also in 1966, Cominco, using McPhar frequency effect equipment, re-surveyed the area covered by Keevil Mining. In 1967, Canex Aerial Exploration joined Duval on an equal participation basis. At this time the surveys on

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The I.P. halo grades outward from 1.0% frequency effect at the center to 10.0-0.5% at the rim.

both Pollyanna and Gibraltar were extended by Canex and McPhar respectively to cover both properties in their entirety except along the property boundaries. The remaining Keevil property to the east of Pollyanna was also covered by a McPhar I.P. survey in 1967. The property owned by Gunn Mines was optioned in 1968 by Canex-Duval and the portion bordering on Pollyanna-Gibraltar was covered by an I.P. survey.

In 1969 Canex-Duval optioned the Gibraltar Mines property and the I.P. surveys were tied in along the mutual borders with Pollyanna. This data enabled a complete picture of the I.P. surveys to be assembled. By this time a total of 165 line mi of I.P. had been carried out in and around the area of the four orebodies over a span of eight years. The I.P. survey coverage was subsequently extended to cover the region of the proposed tailings impoundment area to the north of the orebodies. This brought the total mileage of

I.P. coverage in the area to 260 line mi.

#### Equipment Used

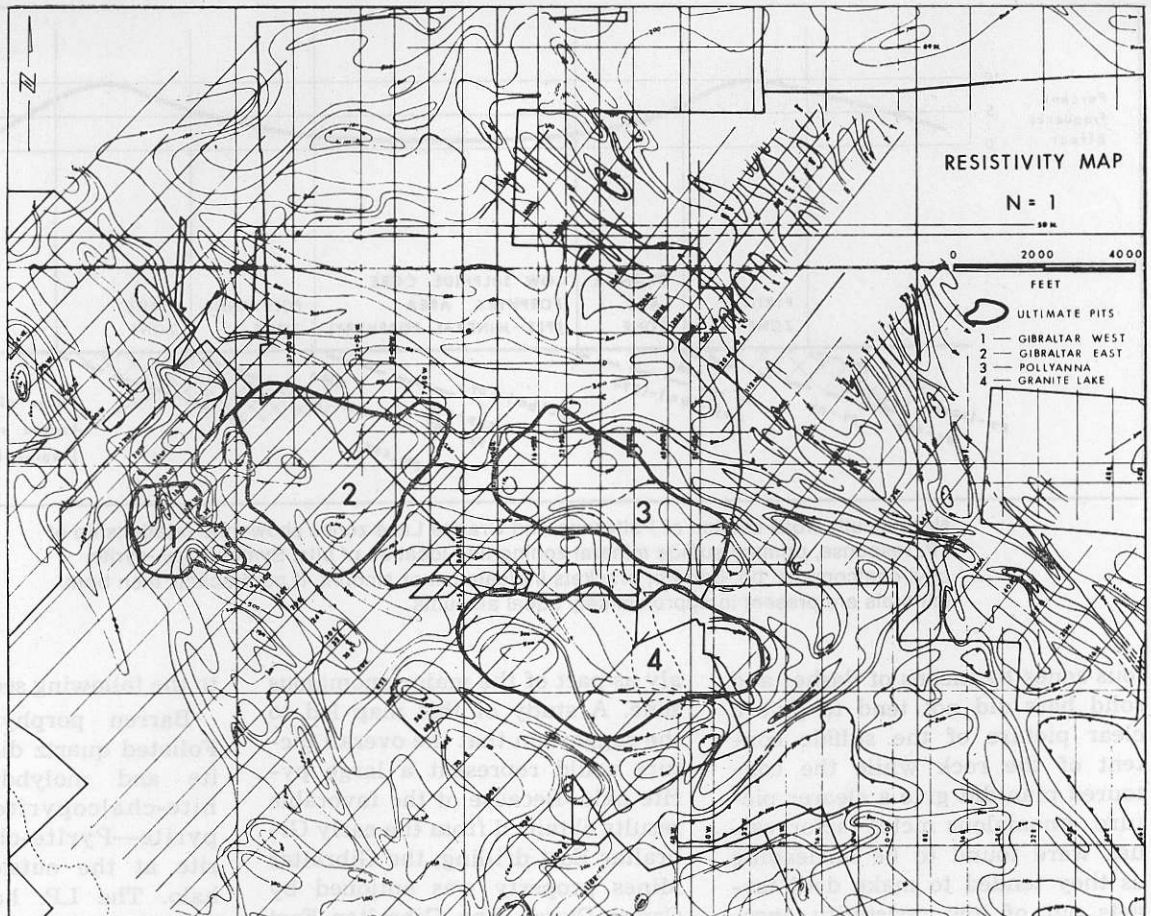
The majority of the equipment used was frequency type equipment with the exception of that used by Hunting. The McPhar, Cominco and Canex surveys all used McPhar equipment and employed frequencies of 0.31 and 5.0 Hertz. The dipole-dipole method was employed for all the frequency type surveys with 300-ft dipole lengths and separations of  $N = 1, 2$  and  $3$ . The Heinrichs survey used frequencies of 0.05 and 3.0 Hertz and a 400-ft dipole length. Their results were modified to fit the other frequency effect data. The use of similar frequencies and dipole lengths proved to be very important in the combining of the survey data.

An instrument of unknown characteristics was used on the early survey on the Gibraltar

property for Keevil Mining. The results of this survey were very erratic and little meaningful interpretation could be made of the data obtained. However, the survey did outline a rather large resistivity low which corresponds roughly to the areas of the Gibraltar East and West orebodies. The Hunting survey during the following year was conducted only over the Gibraltar West zone near the Sunset adit. This survey outlined the higher grade Gibraltar west zone quite well.

#### Results of the I.P. Surveys

The survey by Cominco in 1966 was, as stated in a report by G. Tikkanen, designed to cover areas of known mineralization and to cover some of the interesting parts of the property away from the known mineralization. This survey revealed a distinct anomaly over the known mineralization at the adit (Gibraltar West) and a some-



The four orebodies found along the inside of the I.P. halo lie in the 2.5-7.5 P.F.E. zone.

what stronger anomaly to the north of the adit anomaly. This stronger zone (Gibraltar East) was only partially drilled at this time and discouraging results were obtained.

In 1967, McPhar Geophysics carried out an I.P. survey for Cominco over the remainder of the Gibraltar property. Several anomalous zones were detected in this survey. The largest of these zones corresponded to the present Granite Lake orebody and was stated to be a possible extension of the northern zone (Gibraltar East) detected in the earlier Cominco survey.

The McPhar survey conducted over the Duval ground in 1965 discovered an anomalous zone to the east of the known mineralized area. This zone was not completely outlined as the I.P. lines were not of sufficient length to get off the anomalous zone (Pollyanna). This survey also detected an anomalous zone (Gibraltar East) to the west of the Pollyanna

zone. Drilling of the main Pollyanna zone was started early in 1965 and a major area of copper mineralization was discovered. At this time, the coverage of the Pollyanna zone was extended by Heinrichs Geoexploration. This work, combined with that of the previous year, outlined a "northwest-southeast trending anomalous zone approximately 2000 ft wide and 10,000 ft or more in length". In 1967, Canex acquired a 50% interest in the Pollyanna property and the rest of the property was covered by I.P. This survey extended the anomalous zone from the east boundary of the property to the west boundary but did not reveal any additional anomalous zones.

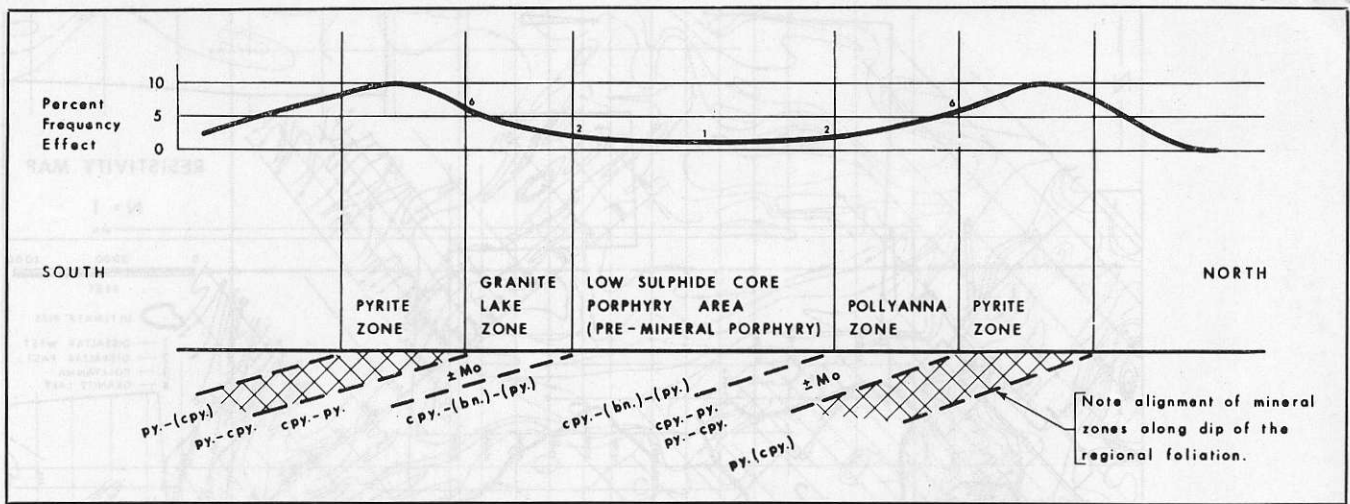
The 1968 survey, on the west half of the Gunn ground, by Canex-Duval outlined two anomalous zones. One zone corresponded to an area of known mineralization on the Gunn property while the other zone was detected on the Gunn-Pollyanna-Gibraltar

boundary near Granite Lake (Granite Lake Zone).

In 1969, Canex-Duval optioned the Gibraltar ground and tied in the various I.P. surveys across the mutual boundaries. The survey results were combined and a contoured plan map was drawn up of first separation frequency effect.

The earliest I.P. survey on the Gibraltar property gave readings which were of little use in delineating the ore zones (Gibraltar West and East). The later surveys all detected part of the major anomalous zone but the overall significance of the results was not clearly understood.

In 1967, an attempt was made by Canex to combine the early Cominco data from Gibraltar with the McPhar-Heinrichs' data from Pollyanna. Because of insufficient data (i.e. the Granite Lake area had not been covered) only an L-shaped anomaly could be surmised. The method of plotting these earlier I.P. results as definite, probable and possible anomaly



North-south cross section of Pollyanna and Granite Lake zones shows the relationship of I.P. response, primary sulfide mineral zoning and location of pits. Symbols: py.-pyrite, cpy.-chalcopyrite, bn.-bornite; brackets indicate minor amount, if no brackets then both minerals are present in approximately equal amounts.

ous zones by means of dashes and solid bars did not tend to give a clear picture of the sulfide content of the rock while the contoured plan did give a clearer picture. Anomalous metal factor values were found to be misleading as they tended to make drill targets out of low resistivity overburden areas such as swampy areas or areas containing bands of conductive clays.

Late in 1968, Canex Aerial Exploration carried out a study of the total Gibraltar-Pollyanna information. They concluded that the Gibraltar West zone was restricted in further potential and that any further drilling should be carried out along the Gibraltar-Pollyanna boundary. Meanwhile, personnel connected with Gibraltar Mines conducted an independent analysis of the available information and arrived at a similar conclusion. Therefore, drilling to check out the anomalous I.P. zone between the Pollyanna and Gibraltar West orebodies was recommended. Drilling was started on the Gibraltar side by Gibraltar Mines in March 1969, and by Canex-Duval on the Pollyanna side in May 1969.

At the time of these evaluations, the Cominco-McPhar I.P. data was received by Canex and it was combined with all of the previous data of the general area. A first separation, percent frequency effect map of the combined data was drawn up with the resultant map showing the Granite Lake anom-

ally as part of the major anomalous zone. A study of this map led to the suggestion that the overall picture could represent a large pyrite halo. Because of the favorable results obtained from the early Gibraltar East drilling, the Gibraltar Mines property was optioned by Canex-Duval. The Gibraltar East orebody was subsequently outlined and at the same time the Pollyanna orebody was drilled out.

In order to explain the pyrite halo sufficiently, a younger intrusive was postulated to occur in the central core of the anomalous I.P. zone. No geologic information was available to confirm or deny the existence of this intrusive as this area was entirely overburden covered. When the drilling was finished on the Pollyanna orebody, a decision was made to step off drill holes to the south of Pollyanna. This drilling resulted in the subsequent discovery of the Granite Lake orebody and also the confirmation of a barren intrusive occurring in the central core of the pyrite halo.

Four orebodies have been found to occur along the inside of the I.P. halo. The halo grades outward from 1.0% frequency effect at the center to 10.0-15.0% frequency effect at the rim. This high P.F.E. reflects a large pyrite content (5-10% metallic sulfides) with submarginal copper values. The ore zones lie in the 2.5-7.5 P.F.E. zone. A study of the overall drill results shows a zoning of the mineralization which adheres roughly

to the following sequence:

Barren porphyry at center—Foliated quartz diorite with bornite and molybdenite—Molybdenite-chalcopyrite—Chalcopyrite-pyrite—Pyrite-chalcopyrite—Pyrite at the outside edge of the halo. The I.P. halo follows this zoning of the mineralization as closely as can be expected in any given field environment. A complete pseudo-section across the entire halo is unavailable due to the restrictions placed on the I.P. grids by the various property boundaries. The mineralization emplacement was controlled to a large part by the regional foliation of the quartz diorite. The foliation strikes about 110° and dips 20-30° southerly. The foliation thus aided in the mineralization emplacement on the Pollyanna zone and acted as a dam on the Granite Lake zone. The dip of the regional foliation is quite steep at the west end of the Granite Lake zone. This steepness resulted in a narrow mineralized area just west of Granite Lake and thus the I.P. anomaly is quite sharp. The other portions of this ore zone and the other ore zones have broad I.P. anomalies due to the shallow dip of the foliation which allowed a greater dispersion of sulfides. This experience shows that the contouring of the frequency effect and the resistivity results on a plan map gives an excellent insight into the relative shape of the anomalous zone.