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PROPERTY FILE

GIBRALTAR 93B012 -07

93B012 (9W)

Gibraltar Mines Ltd. (N.P.L.)

McLeese Lake, British Columbia, Canada

c. 1974?

"Exploration of Gibraltar"
by
D.C. Rotherham

Western Miner
Feb 1972

CIM Bulletin
"The Interrelationships of Regional Metamorphism . . .

CIM . 74th Ann. Mtg
Ottawa
April 1972

Jim Wright - mine Mgr.

Mine Engineer (2 I.C.)	Bill Trythall
Mine Supt.	Doug Bailey
Mill Supt.	Anand Inamdar
Mech Supt.	Ernie Brisbane
Mine Geologist	Ted Carpenter
Safety Supervisor	Mel Dodds
Geol. Engineer	Peter

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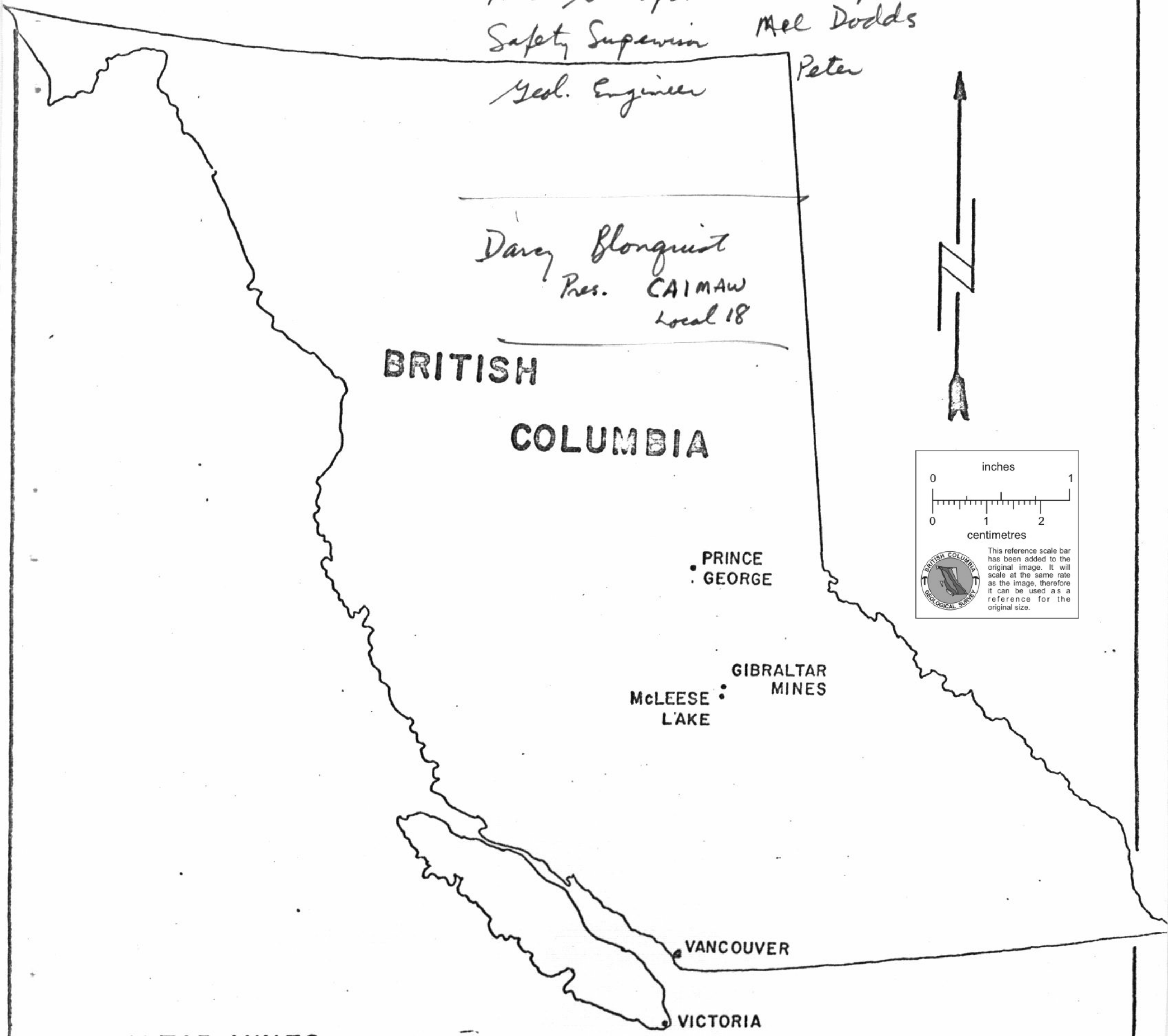
Local 18



GIBRALTAR MINES

LOCATION MAP

SCALE: approx. 1 in. to 100 miles

FIGURE 1

GIBRALTAR MINES LTD. (N.P.L.)

(Latitude 52^{o} 31'N., Longitude 122^{o} 17'W., Elevation 3690 feet at office site)

LOCATION, ACCESS AND CLIMATE

The Gibraltar Mine is located approximately 100 miles south of Prince George, B.C. on the westerly slope of Granite Mountain and near McLeese Lake. (See Figure 1 - Gibraltar Mines - Location Map).

Access is by way of a 10 mile long paved highway that joins Highway 97 near the north end of McLeese Lake.

The ambient air temperature ranges from a winter minimum of minus 30^{o} Fahrenheit to a summer maximum of 95^{o} Fahrenheit.

The annual precipitation at the minesite is approximately 20 inches of which approximately 6.6 inches falls as snow. The maximum snow cover of approximately 3 feet occurs in late February.

HISTORY AND OWNERSHIP

The Gibraltar and Pollyanna properties were for the most part, explored separately until 1969, at which time they received a combined exploration program.

Gibraltar Property

The Gibraltar property was discovered in 1927 and was known as the Hill property. (B.C.M.M. Report 1928). In 1957 Kimaclo Mines Ltd. (N.P.L.) drove a 110 foot adit into a mineralized "shear" that was to be known later as the Gibraltar West but which at that time was called the "Sunset Showings". During 1958 the property was sold to Major Mines Ltd. (N.P.L.) who allowed the property to lapse. The property was restaked by J. Hilton on January 1, 1962 who optioned it to Keevil Mines, who allowed their option to lapse in 1964. Gibraltar Mines Ltd. (N.P.L.) then acquired the property from Hilton. Cominco then optioned the property from Gibraltar and in partnership with Mitsubishi outlined the Gibraltar West zone. They terminated their option in 1967. The property was then optioned to Canex-Duval who were exploring the adjacent Pollyanna property.

Pollyanna

The Pollyanna was discovered in 1910 and at that time, was known as the Rainbow group. After minor work the property was allowed to lapse. It has been known as the Pollyanna since 1925 when, again, minor work was done. In 1949 the showings were staked as the Copper King and a shipment of 1,000 lbs at 10.5 percent copper was made.

Kimaclo Mines restaked the showing in 1954 and allowed it to lapse in 1956. Mr. Robert Glen staked this property in 1963 and optioned it to Keevil Mining Co. who dropped the option in 1964. Duval Corporation Ltd. then optioned the property. In 1967 Canex-Aerial Exploration participated with Duval on an equal basis to explore the claims.

Later, Canex bought Duval's interest and by 1970 held more than 70% of the issued shares of Gibraltar Mines Ltd. (N.P.L.).

GEOLOGY

1. Regional Geology

Please refer to the accompanying sketch of the regional geology - (Figure 2 - Generalized Regional Geology).

In the vicinity of Granite Mountain, the oldest rocks are regionally metamorphosed sedimentary and volcanic rocks of the Cache Creek group of Permian age (Tipper, 1959).

Batholithic intrusives of Jurassic-Cretaceous age intrude the Cache Creek group in the Granite Mountain area. An intermittent north-south trending line of batholithic rocks outcrop from Prince George on the north to as far south as McLeese Lake. These rocks occur along the east side of the Fraser River fault system. The batholiths are composed of granodiorite, quartz diorite, diorite and gniessic varieties of the above rocks. In the immediate vicinity of Granite Mountain, a regionally foliated and metamorphosed quartz diorite occurs which has a chlorite rich diorite margin against rocks of the Cache Creek group. Calcareous members of the latter show, locally, some skarn development adjacent to the diorite contact. It is within the regionally metamorphosed and foliated quartz diorite that the Gibraltar-Pollyanna copper-molybdenum deposits occur.

2. Geology of the Gibraltar Copper Deposits

Please refer to the accompanying sketch of the Granite Mountain Geology (Figure 3 - Generalized Geology Gibraltar Area).

The four copper/molybdenum orebodies of Gibraltar Mines are known as Gibraltar East, Gibraltar West, Pollyanna and Granite Lake. Their locations are shown on Figure 3. The distance between the west end of the Gibraltar East pit and the east end of the Granite Lake pit is about 2 1/2 miles. The distance from the north side of the Pollyanna zone to the south side of the Granite Lake pit is about 1 mile. These four pits lie entirely within the quartz diorite of the Granite Mountain pluton (Figure 3).

Rocks of the Granite Mountain pluton in the vicinity of the Gibraltar copper deposit.

Quartz Diorite

The quartz diorite of the Granite Mountain pluton is extremely uniform in its mineral assemblage, but shows a variable degree of cataclastic deformation and alteration.

LEGEND

9 & 8 PLEISTOCENE and RECENT

Till, gravel, sand, and clay

7 MIOCENE + PLIOCENE

Basalt

6 & 5 EOCENE and/or OLIGOCENE

Basalt, tuff, breccia, conglomerate, shale, and sandstone

4 PALEOCENE and/or EOCENE

Rhyolite, dacite, tuff, and breccia

1 PERMIAN

CACHE CREEK GROUP

Chert, argillite, limestone, and greywacke

INTRUSIONS

A JURASSIC-CRETACEOUS

Granodiorite, diorite, quartz diorite and related gneisses

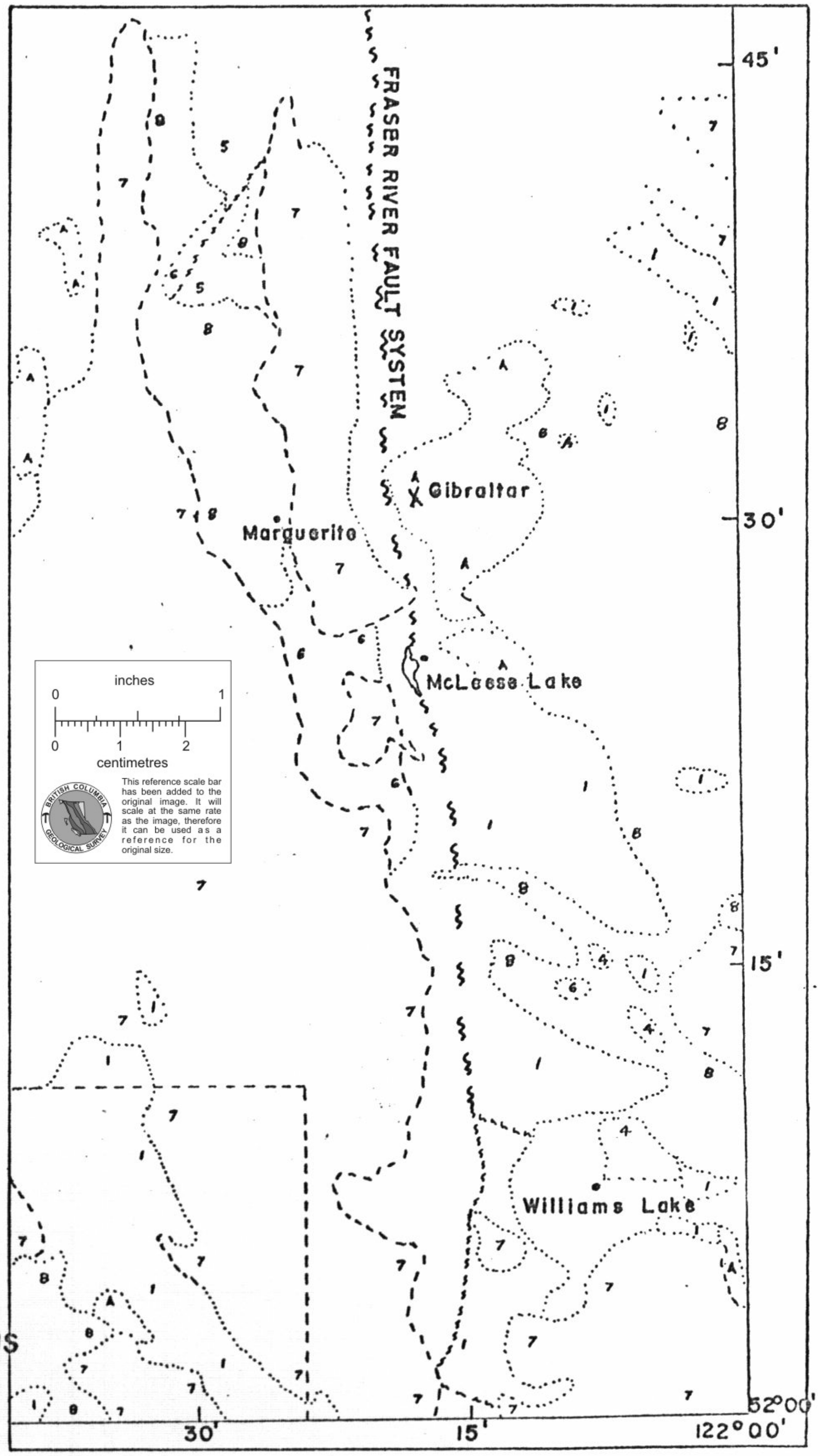


FIGURE 2

GENERALIZED REGIONAL GEOLOGY

SCALE: 1" = 4.8 miles (approx.)

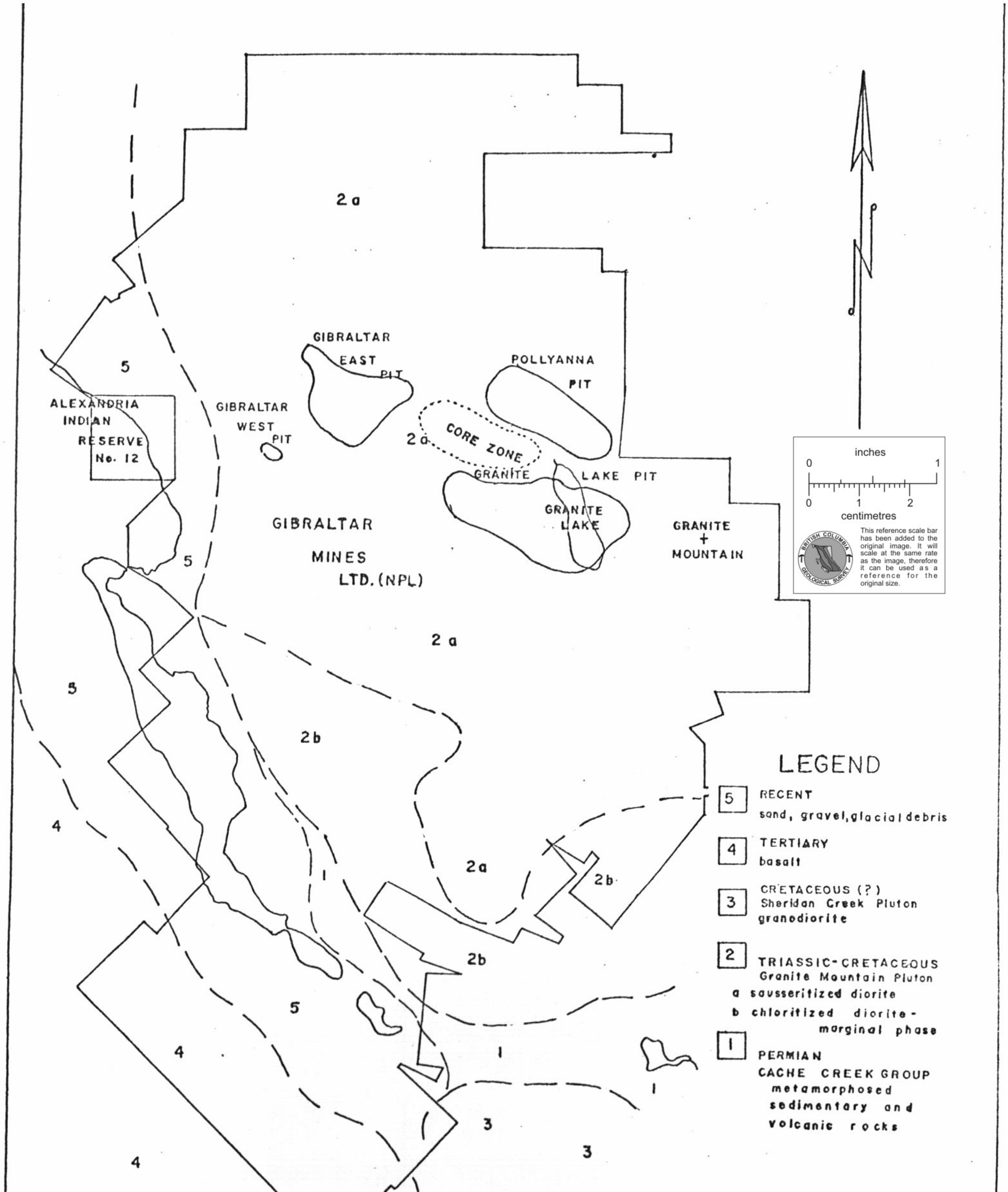


FIGURE 3

GENERALIZED GEOLOGY
GIBRALTAR AREA

This rock is composed of quartz (25-30%), "plagioclase" which is presently a mixture of albite-epidote-ziosite-muscovite (50-55%), chlorite (20%) which originally was biotite with minor hornblende and disseminated magnetite (1% or less). The rock is equigranular and generally has a grain size of 2-4 m.m. The grain size varies and to the north in the vicinity of the tailing pond, may be as much as 10 m.m.

Throughout the Granite Mountain pluton the quartz diorite has been regionally foliated and altered. Mineralogical and textural changes according to the degree of cataclastic deformation were developed. When the foliation is weakly developed the mineral association is quartz-albite-muscovite-chlorite, epidote, zoisite-magnetite. As the intensity of foliation increases the quartz diorite eventually becomes schist like. The mineral assemblage is quartz-oligoclase-chlorite-muscovite ± magnetite. Epidote content decreases as the intensity of the foliation increases.

Locally,"shear zones" within the above rock contain an assemblage of quartz-feldspar-(oligoclase?) - garnet-chlorite.

Rocks Intrusive into the Quartz Diorite

Within the saussuritized and foliated quartz diorite of the Granite Mountain pluton, there are three pre-mineral and one post-mineral intrusive rocks. These are:

1. White Quartz Diorite

A rock which exhibits both a sharp and a gradational contact against the saussuritized quartz diorite is a leucocratic porphyritic quartz diorite. This rock is composed of quartz (30%) and saussuritized plagioclase with albitic rims (45%) in grains which range from 1 to 5 m.m. The remaining 25% of the rock is a fine grained mosiac of quartz and albitic plagioclase with about 1-2% chlorite. This rock is nondirectional to moderately well foliated and is saussuritized.

2. Quartz-Felspar Porphyry

A more definite pophyry occurs in the same areas as the leucocratic phase. The quartz-fedspar porphyry crosscuts the saussuritized quartz diorite and apparently crosscuts the leucocratic phase. This latter relationship has not been conclusively demonstrated. The porphyrh is composed of 3-5 m.m. phenocrysts of quartz, (30%) and albitic plagioclase (10%) in a white aphanitic matrix which is composed of quartz, albitic plagioclase and some carbonate, muscovite and zoisite. This rock is not altered.

3. Alpite

Another intrusive phase is aplite which, typically, is very fine grained and has a sugary texture. This rock is not altered.

4. Hornblende Dacite

There has been only one post mineralization rock encountered to date and that rock is a very fine grained chloritized hornblende dacite which is known only in the Gibraltar East zone.

STRUCTURAL ELEMENTS OF THE GRANITE MOUNTAIN PLUTON IN THE VICINITY AT THE GIBRALTAR COPPER DEPOSIT.

The recognized elements of structure in order of their age is indicated by the field relationships. Starting with the apparent oldest they are:

(1) S1: Primary Igneous Flow Foliation. This is not recognized in the mine area except at Granite Lake. Where seen strike is 90-100 Az with dips from 25° south to 80° south.

(2) S2: Penetrative Secondary Foliation with related biotite (=chlorite) and hornblende foliation in its weakest expression. This foliation averages approximately 110° Az in strike with an average dip of approximately 30° southerly. In the Gibraltar East pit it has averaged 135° Az in strike and 40° to 45° southwesterly in dip. (This is the foliation referred to in the section on regional geology and in general when referring to foliation).

(3) White quartz diorite intrusive. This is largely confined to be the area central to the mineralized zones. It has both gradational and sharp contacts against the saussuritized quartz diorite. Size, shapes and attitude of the individual bodies of this rock are as yet unknown.

(4) Quartz, felspar porphyry intrusive into the area central to the mineral deposits. Again size, shapes and attitude of the individual occurrences is unknown. As seen in diamond drill core it appears to cut the leucocratic quartz diorite.

(5) Aplite intrusion which occurs as rare, scattered very small dykes. These are seldom more than 2 inches in thickness or 15 feet long. Attitudes are irregular. They appear to be randomly distributed.

(6) K_1: Major Fracture Stockwork. This stockwork is very extensively developed. The fractures are generally parallel to S_2, above, but in some instances may be observed to cut across S_2 at angles up to 45°. This stockwork is now occupied by mineralized vein stages V_1 and V_2 (see below).

(7) Mineralized Vein Systems V_1 occupying for the most part K_1. This is basically a fracture filling.

(8) Mineralized Vein Systems V_2 occupying for the most part K_1. Again this is basically a fracture filling. It has been observed to cut V_1 in core and in hand specimens but not vice versa.

(9) Vein Systems V_{3a} and V_{3b}. These are major vein systems parallel to the average orientation of S_2. They range up to 1 foot or more in thickness and, commonly, can be traced along strike for 500 feet or more. They are observed to cut S_2, K_1, V_1 and V_2.

(10) A fold system involving S_1, K_1, V_1, V_2, V_{3a} and V_{3b}. Individual folds range from a fraction of one inch to as much as 150 feet or better in width. Intensity at individual members ranges from tight crumples in small members to gentle open structures in the larger individuals. Fold axes in the Gibraltar East pit strike at approximately 135° and plunge at an average of 20° to the southeast.

(11) S_3: Foliation imposed on S_2 commonly related to slip surfaces and/or kink bands but also present as weak mineral orientation of new chlorite. They may be contemporaneous with the folding above.

(12) V_4: This is a vein and veinlet system. Individuals are irregular in shape and have limited continuity despite widths of 1 to 2 feet or more. They are oriented in axes of the above folds and in gash veins related to V_1, V_2 and V_3 (a and b). They may be seen to cut these vein systems or, conversely, grade into them.

(13) A dyke system (hornblende dacite). Only a few individuals have been seen and then only in the Gibraltar East pit. They are up to 18 inches in width and appear to be lensoid with about 50 feet being the maximum dimension noted to date. Strike is irregular but dips are all close to vertical.

(14) Joints. There a number of joint sets present. The most persistent of these as shown by mapping the Gibraltar East pit is one that strikes 20° Az to 40° Az and dips 65° to 80° to the northwest.

(15) Faults. A number of fault systems exist in the mine area. Mapping and photo-interpretation indicate the attitudes of the main fault systems to be: 30° Az to 40° Az dip 70° to 80° westerly; 340° Az to 350° Az dip steep; 300° Az to 320° Az, dip steep; 0° Az to 20° Az, dip steep. Red hematite is frequently, though not necessarily always, present in and adjacent to fault and shear zones.

MINERALIZATION AND HYDROTHERMAL ALTERATION

As outlined in the section on structure:

There are at least four stages of veining recognized within the Gibraltar deposits. The division of veins into stages is dependent on their relative age relations which means that the first listed in crosscut by the next listed feature. The four stages are summarized below.

V_1 - i - Quartz-pyrite ± chalcopyrite WITH a sericitic envelope. (Sericite envelope assemblage is quartz, sericite, pyrite ± chalcopyrite with all saussuritized feldspar being made over to sericite-clay (?) mixture):

ii - 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).

V_2 - i - Quartz-chlorite-pyrite $\pm$ magnetite

ii - Quartz-chlorite-pyrite-chalcopyrite=epidote $\pm$ magnetite

iii - Quartz-chlorite-pyrite-epidote $\pm$ magnetite

iv - Quartz-chlorite-bornite $\pm$ pyrite (restricted to porphyry area between Pollyanna and Granite Lake zone. (all with $\pm$ carbonate).

V_3 - a - Quartz pyrite chalcopyrite $\pm$ magnetite $\pm$ carbonate

- b - Quartz pyrite-chalcopyrite-molybdenite $\pm$ magnetite $\pm$ carbonate

V_4 - Quartz-fine grained-chlorite particles - pyrite $\pm$ chalcopyrite.

Veins with sericitic and chloritic envelopes are definitely crosscut by V_2 veins which do not have envelopes. To date, a vein with a sericitic envelope has not been found to crosscut a vein with a chloritic envelope. Consequently, those veins with either type of envelope are considered to be in Stage 1.

Veining can be parallel to the foliation in the host quartz diorite or it can crosscut the foliation.

Hydrothermal alteration in the form of the sericitic and chloritic envelopes is similarly seen to be parallel to, as well as crosscutting the foliation in the host quartz diorite.

A second hydrothermal alteration feature was observed in a petrographic study (Simpson, 1970) of the saussuritized plagioclase across the Pollyanna and Gibraltar East zones. It was noted that the amount of sericite relative to epidote in the saussuritized plagioclase could be correlated reasonably well to the copper grade.

MINERAL ZONING

An obvious gross zoning of mineralization exists as far as economic copper mineralization is concerned.

There is little mineralization of any kind in the core zone. Immediately outside of and for some distance copper minerals chiefly chalcopyrite in the primary zone, are present in economic amounts. It is within this portion of the mineralized zone that the orebodies occur. Beyond that, mineralization is chiefly pyrite although, generally, minor to trace amounts of copper mineralization are present.

SUPERGENE ZONE

The supergene zone consists of the following 2 divisions.

Leached zone

Over almost all of the mineralized zones there exists a zone that is wholly or in part, leached of primary sulfide mineralization. It is characterized by abundant limonite and the absence of economic copper mineralization. It is irregular in development and thickness. In the Gibraltar East pit where it can readily be seen it averages somewhat less that 100 feet.

Enrichment Zone

Supergene copper minerals occur to depths of a least 600 feet to 700 feet in local, isolated instances, but the vast bulk of supergene copper mineralization occurs from the bottom of the leached zone to a depth of from 200 feet to 400 feet.

This supergene mineralization has created a blanket of secondary enrichment over the copper bearing portion of the mineralized zone. The degree of enrichment has not been closely ascertained. The major effect is that it has added to the tonnage available for milling.

Chalcocite forms at least 85% at the secondary copper mineralization and is present mainly as coatings on the primary sulfides pyrite and chalcopyrite. Cuprite makes up 10% plus of the remainder of the secondary mineralization. This is followed by a small amount of malachite, minor amounts of azurite and native plus trace amounts of covellite and chrysocolla.

The above 2 zones are illustrated on Figure 4. (Geology Cross Section 46415 E) which accompanies this report.

INTERPRETATIVE SUMMARY OF THE GEOLOGY OF THE GIBRALTAR COPPER DEPOSIT

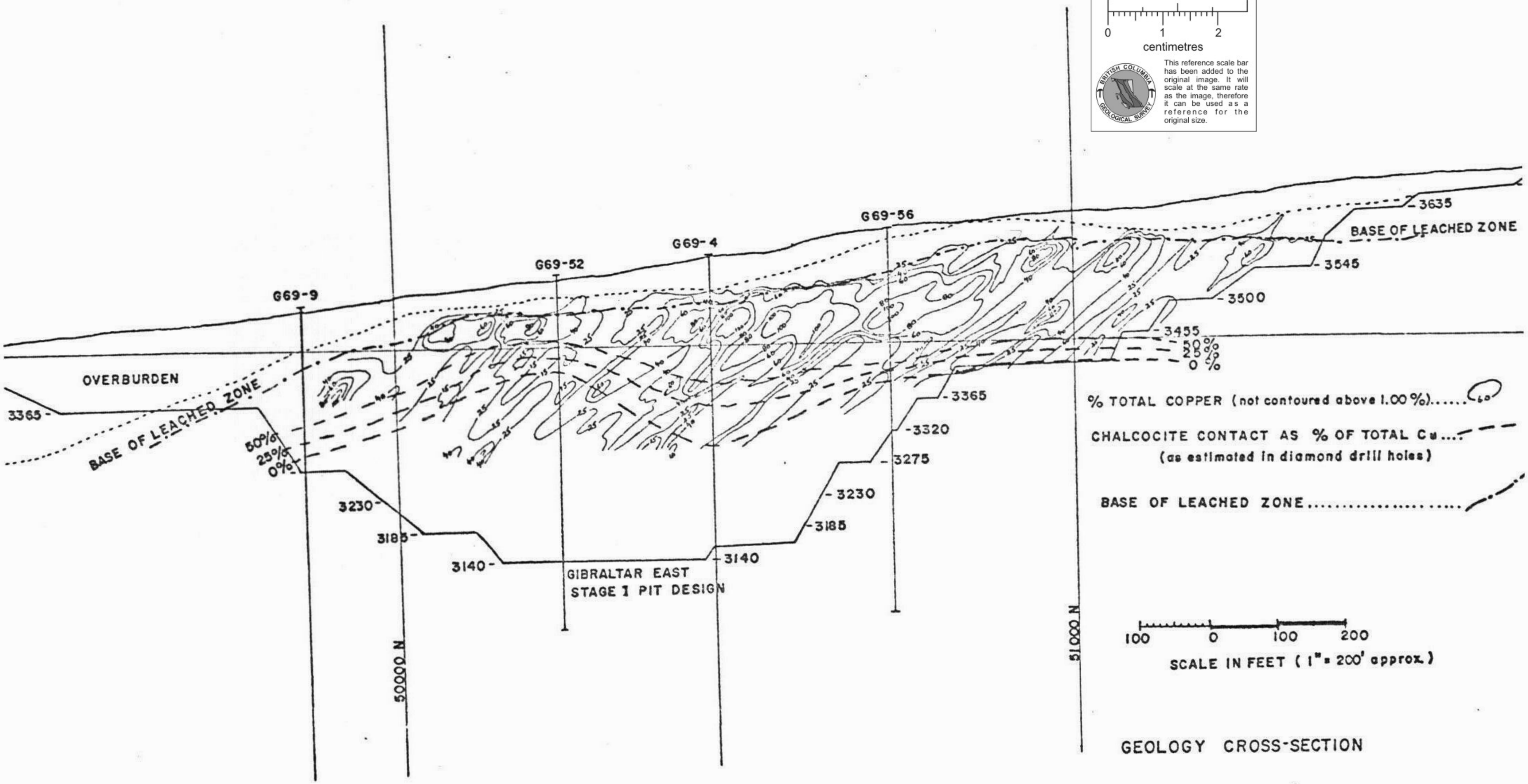
The following is an abbreviated interpretation of the foregoing. It explains one hypothsis regarding the development at the deposits. The various geological events, according to this interpretation are:

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 prophyry 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.



GEOLOGY CROSS-SECTION

46415 E

FIGURE NO. 4

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 deposits.

ORE RESERVES

The total ore reserve for the four pits at the commencement of milling in March 1972 were 358 million tons grading .367 percent copper and .016 percent molybdenite.

REFERENCES

1. CANEX PLACER LTD. STAFF., Geology and Ore Reserves of the Gibraltar Pollyanna Copper Molybdenum Deposits. Vol 1 May, 1970. Unpublished

2. SIMPSON, Y.R., Geology of the Gibraltar Pollyanna Copper Deposits. April 1970. Batchelor's Thesis - University of British Columbia.

3. DRUMMOND, A.D., TENNANT, S.J., and YOUNG, R.J. The Interrelationship of Regional Metamorphism, Hydrothermal Alteration and Mineralization at the Gibraltar Mines Copper Deposit in B.C. - 1973. Can. Min. Metall. Bull., Vol. 66, No. 730; p.p. 48-55.

4. A. SUTHERLAND BROWN., letter summarizing findings of field work at Gibraltar in August 1973, and personal communication while at the property.

PROPERTY OPERATION

The surface layout of the Gibraltar Mines operation is shown in Figure 5 (minesite). Under the direction of a Mine Manager and an Assistant Mine Manager, the operating crew is classified into six departments with personnel distribution as outlined below in Table No. I.

TABLE NO. I

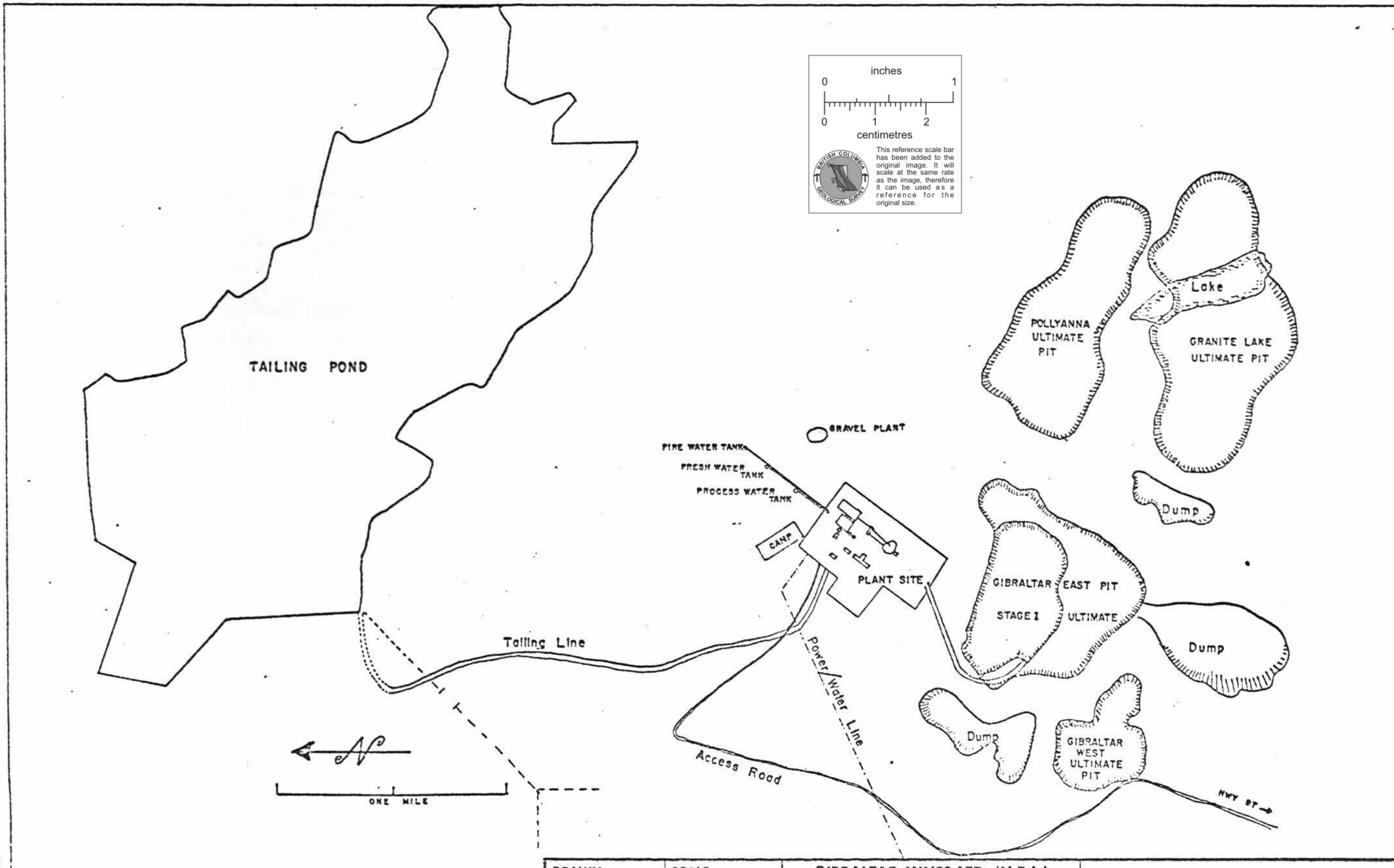
DEPARTMENT	STAFF	HOURLY	TOTAL
Administration	3		3
Accounting	26	14	40
Employee Relations	10	1	11
Engineering & Geology	23		23
Mine	13	165	178
Mill	26	62	88
Plant:			
Crusher Maintenance		12	
Electrical Maintenance		22	
Machine Shop Maintenance		35	
Mill Maintenance		19	
Pit Shop Maintenance		52	
Plant Maintenance		19	
Surface Maintenance		38	
Total Plant	26	197	223
TOTAL	127	439	566

MINING OPERATION

The total area encompassing orebodies, dumps and plantsite on the Gibraltar Mines Ltd. (N.P.L.) property covers approximately 4300 acres.

As mentioned under the section on Geology, the copper deposit comprises four separate and distinct orebodies. Each orebody is to be mined sequentially, from Stage I through to the ultimate Stage III. This sequence has been based on computerized pit designs and schedules thus allowing maximization of the discounted cash flow.

The computerized pit designs were smoothed, allowing for the incorporation of haulage ramps, power supply and pumping equipment, etc.



DRAWN	SCALE	GIBRALTAR MINES LTD. (N.P.L.)	
TRACED	DATE	Fig. 5 MINE SITE	
APPROVED	CHECKED		FILE No.

The following design parameters were used:

Copper Price	- 50¢ N.S.R.
High-grade cutoff	- 0.25% Cu
Minimum size pit design	- 30 mill. tons (High grade ore)
Overburden bank slope	- 45°
Safety berm at base of overbuden	- up to 100 feet depending on overburden thickness
Working face slope	- 67°
Bench interval height	- 45 feet
Safety berms in rock	- 45 feet wide every other bench
Haulage roads widths (2-lane)	- 80 feet to 100 feet
Haulage roads gradients	- up to 10%
Minimum pit wall curvature	- radius not less than 60 feet

Pit Production

As of the 1st January, 1974, the Gibraltar East pit Stage I, was nearing completion, having only four more benches to be mined (making a total of 13 benches in all). The Granite Lake pit Stage I was initiated in the latter part of 1973 and at present stripping is proceeding prior to full ore production in the middle of 1974, when Gibraltar East will be phased out.

Drilling patterns vary according to rock type, geological structure and drill hole diameter, but can be summarized as follows:

Hole Diameter (inches)	Burden (feet)	Spacing (feet)
9 7/8	19	21
12 1/4	23	25

The following figures summarize pit production statistics from start-up (April 1971) until December 1973.

1. Pre-Production Phase (April 1971 - March 1972)

Overburden	- 3,225,000 tons (removed by contractors)
Overburden	- 1,408,000 tons (removed by Gibraltar)
Waste Rock	- 4,156,000 tons
Stockpiled High Grade	- 328,000 tons @ 0.41% Cu
Stockpiled Low Grade	- 1,115,000 tons

2. Production Phase (March 1972 through December 1973)

Overburden	- 2,881,000 tons	(removed by contractors)
Overburden	- 4,179,000 tons	(removed by Gibraltar)
Waste Rock	- 12,634,000 tons	
Stockpiled High Grade	- 635,000 tons	@ 0.49% Cu
Stockpiled Low Grade	- 8,356,000 tons	
Mill Feed	- 26,800,000 tons	@ 0.47% Cu
Total Mined	52,604,000 tons	

3. Production for Year ending 31st December 1973

Overburden	- 21,181,000 tons	
Waste Rock	- 8,013,000 tons	
Stockpiled Low Grade	- 3,908,000 tons	
Mill Feed	- 15,225,000 tons	@ 0.48% Cu
Total Mined	29,327,000 tons	

Pit Equipment:-

Current pit equipment and respective performances appear in Table No. II. (Pit Production Equipment).

Maintenance Facilities:-

The maintenance shop is housed in a totally enclosed structure covering some 51,500 square feet and is located on the main plant site, some 1000 yards from the entrance to the Gibraltar East pit. The shop includes facilities for the complete range of repair and maintenance of the pit production equipment, surface equipment and the fleet of mine service vehicles. The building includes a machine shop, three welding bays, ten maintenance bays, seven gas service bays, two tire bays, one steam bay, an electrical shop and tool crib.

Warehouse Facilities:-

The mine warehouse is immediately adjacent to the maintenance shop and covers an area of approximately 14,000 square feet.

Table No. II

Pit Production Equipment

Function	Type of Unit	No. of Units	Scheduled per shift	Shifts per operating day	Unit performance
Blast hole drilling	Rotary drills				
	Electric 45R Bucyrus-Erie	2	2	3	721 feet of 9 7/8 in. diameter holes
	Electric 4M Marion	1	1	3	701 feet of 12 1/4 in. diameter holes
Loading	14 cubic yard shovels				
	Electric 2100B P&H	3	2	3	12,200 tons per shift
	Electric 191-M Marion	1	1	3	12,300 tons per shift
Haulage	Diesel-electric trucks				
	100T Unit Rig	23	18	3	2,050 tons per shift
Dump Maintenance Shovel Clean-up	Track Dozers				
	D-9 Caterpillar	1	1	3	
	D-8 Caterpillar	4	4	3	
	Tired Dozers				
	824 Caterpillar	1	1	3	
Road Maintenance	Road grader				
	16E Caterpillar	1	1	3	
	14E Caterpillar	1	1	3	
	Watering truck	1	1	When required	
	Sanding truck	1	1	When required	

GIBRALTAR MILLING OPERATIONS

SUMMARY

The Gibraltar concentrator commenced operation in March 1972. The mill was designed for 30,000 tons per day but within a short period was continually exceeding 40,000 tons per day. The crushing, milling, and tailing disposal operations are conventional but with some notable exceptions:

1. Only two stages of crushing are being used. Three stages are common for many large tonnage operations.

2. The Work Index varies between 8.5 and 10.0 which permits a coarse mill feed of 40% + 3/4 inch to be acceptable.

3. A coarse flotation feed of 30% + 65 mesh can be used while still obtaining good recovery.

4. The center-line method of tailing dam construction is used such that anticipated seismic loading in this area will not cause a dam failure.

Mill heads are .37% copper, concentrate grade 28% copper, and total copper recovery is above 85% on the clean ores. The crushing and milling operates are seven days per week on a three shift basis.

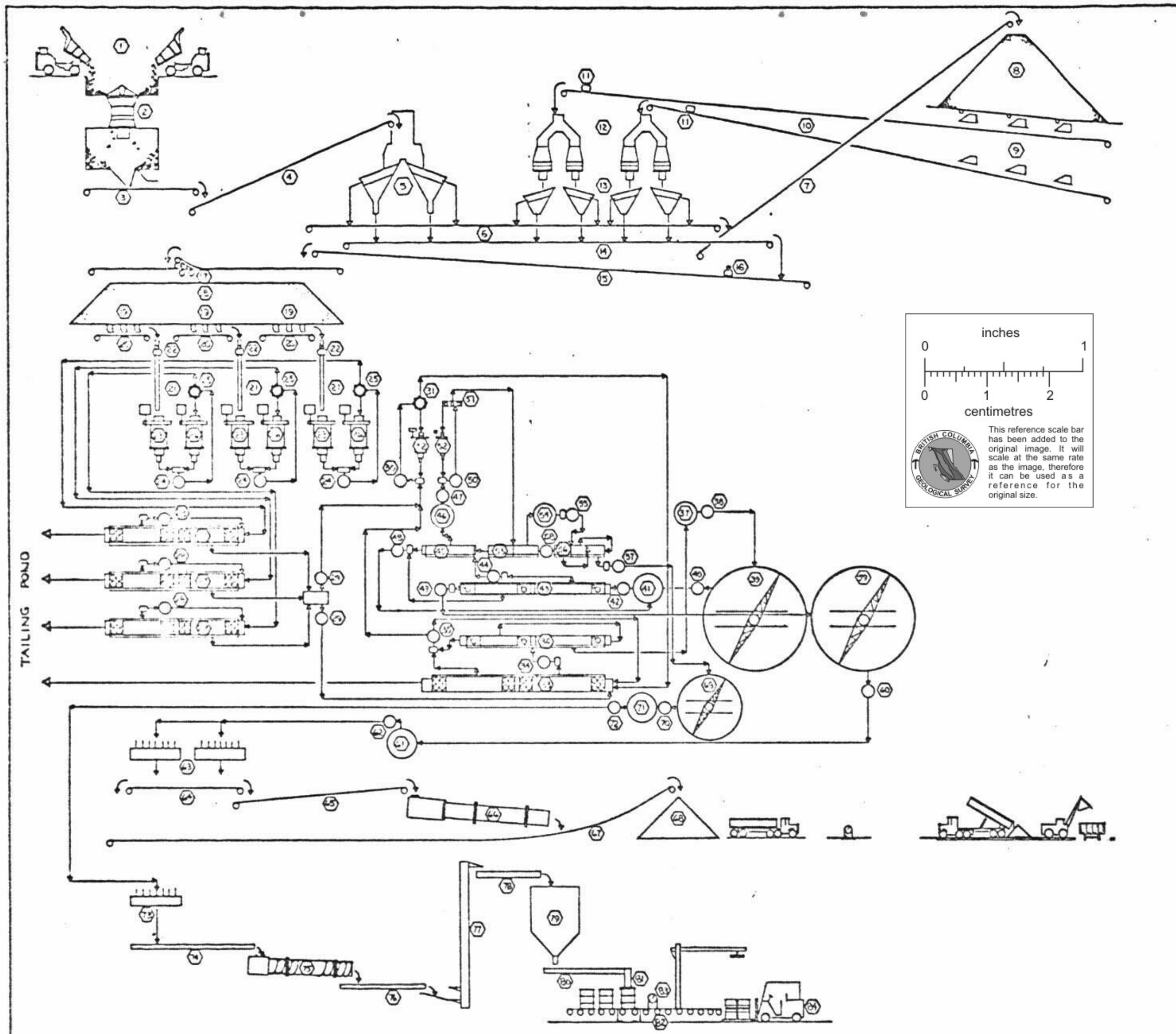
PRIMARY CRUSHING

A 54 inch by 74 inch Allis Chalmers crusher is used to crush the mine run ore to minus 7 inches. Ore is hauled from the various pit locations on a 7 day, 3 shift basis. Dump points are provided on either side of the crusher such that one truck can be dumping while another is backing into position.

The primary crusher operator is located in a control room overlooking the dump pocket. He controls the dumping of the trucks through a system of traffic and signal lights. The operator area has radio and telephone communication with the pit and secondary crushing plant.

A 600 H.P. electric motor running at 1180 R.P.M. is connected via V belt drive to the crusher drive shaft. A Wichita air clutch is mounted on the crusher drive shaft to permit the motor to run continuously while the crusher is disengaged.

The crusher discharge drops onto a short 84 inch wide variable speed belt conveyor and then onto a 72 inch conveyor which feeds two 8 feet by 20 feet primary screens. These screens make a 1 1/2 inch split with the oversize going to a 36,000 ton live storage stockpile and the undersize to a 20,000 ton live storage fine ore stockpile. Dozers can be used on both stockpiles such that total coarse and fine ore storage is approximately 150,000 tons.



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centimetres

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BRITISH COLUMBIA GEOLOGICAL SURVEY

CRUSHING

(1) 100 TON LECTRA HAUL TRUCKS.
(2) 54" x 74" A.C.C. GYRATORY PRIMARY CRUSHER 7" O/S SETTING, 500 H.P.
(3) CONVEYOR NO. 1, 84" WIDE x 95' @ 250-50 FPM VARIABLE, 50 H.P., HORIZONTAL.
(4) CONVEYOR NO. 2, 72" WIDE x 1575' @ 400 FPM, 600 H.P., 6° - 12'.
(5) TWO DOUBLE DECK PRIMARY SCREENS, 8' x 20', 3" GRIZZLY UPPER x 1 1/2" LOWER.
(6) CONVEYOR NO. 3, 72" WIDE x 350' @ 350 FPM, 100 H.P., HORIZONTAL.
(7) CONVEYOR NO. 4, 72" WIDE x 1365' @ 400 FPM, 650 H.P., 14° - 36'.
(8) COARSE ORE STOCKPILE, 20,000 TONS LIVE CAPACITY, 150,000 TONS TOTAL.
(9) SIX HYDRASTROKE FEEDERS, 48" x 10', NICO MODEL 550 B, 30 H.P.
(10) CONVEYOR NOS. 5 AND 6, 48" WIDE x 1355' @ 450 FPM, 350 H.P., 7° - 25'.
(11) TWO FRIEZ METAL DETECTORS.
(12) FOUR SECONDARY CRUSHERS, 13" x 84" A.C.C. HYDROCONES 7/8" CLOSED SIDE SETTING, 350 H.P. WITH 1 1/4" THROW.
(13) FOUR SECONDARY A.C.C. RIPL-FLO SCREENS, 8' x 16', 1 1/2" OPENINGS, SINGLE DECK.
(14) CONVEYOR NO. 7, 72" WIDE x 375' @ 350 FPM, 100 H.P., HORIZONTAL.
(15) CONVEYOR NO. 8, 60" WIDE x 1030' @ 450 FPM, 600 H.P., 13° - 12'.
(16) CONTIDYNE CONVEYOR SCALE.
(17) CONVEYOR NO. 9, 60" WIDE x 632' @ 450 FPM, 150 H.P., HORIZONTAL TRIPPER.
(18) COVERED FINE ORE STOCKPILE, 36,000 TONS LIVE CAPACITY.
(19) MEXICAN TUBE FEEDERS.
(20) CONVEYOR NOS. 10 - 18, 36" WIDE x 133' @ 135 FPM (60) VARIABLE, 10 H.P., HORIZONTAL.
(21) CONVEYOR NOS. 19, 20, 21, 36" WIDE x 340' @ 350 FPM, 40 H.P., 2° - 23' TO 10° - 93'.
(22) THREE - CONTIDYNE CONVEYOR SCALES.

CONCENTRATOR

(23) ROD MILLS, 13'6" x 20'0", A.C.C., 2500 H.P.
(24) TWO CYCLONE FEED PUMPS, SRL-C 16 x 14, A.C.C., 350 H.P.
(25) SIX 30" KREBS CYCLONES IN CYCLOPAK.
(26) BALL MILLS, 13'6" x 20'0", A.C.C., 2500 H.P.
(27) BULK ROUGHER SCAVENGER FLOTATION CELLS, 14 CELLS/TANK, 3 BANKS DENVER "DR" NO. 600H, 50 H.P.
(28) TWO PUMPS, SRL-C, 10" x 8", ROUGHER CONCENTRATE, A.C.C., 40 H.P.
(29) TWO PUMPS, SRL, 10" x 8", BULK ROUGHER TO 1ST CLEANERS & TO R.GRIND.
(30) TWO PUMPS, SRL C, 12" x 10", BULK REGRIND DISCHARGE, A.C.C., 150 H.P.
(31) EIGHT 15" KREBS CYCLOPAK BULK REGRIND CYCLONES.
(32) BULK ROUGHER CONCENTRATE REGRIND MILL, 9'6" x 14'0", A.C.C., 600 H.P.
(33) COPPER 1ST CLEANER FLOTATION CELLS, 16 CELLS, DENVER "DR" NO. 300, 50 H.P.
(34) TWO PUMPS, SRL-C, 10" x 8", BULK 2ND CLEANER FEED, A.C.C., 30 H.P.
(35) TWO PUMPS, SRL-C, 10" x 8", BULK 1ST CLEANER SCAVENGER CON AND 2ND CLEANER TAILS, A.C.C., 30 H.P.
(36) COPPER 2ND AND 3RD CLEANER FLOTATION CELLS, 16 CELLS, DENVER "DR" NO. 30, 100 CU. FT., 25 H.P.
(37) BULK CONCENTRATE CONDITIONER TANK, DENVER SPINDLE BEARING AGITATOR MECH., 15 H.P.
(38) TWO PUMPS, SRL-C, 10" x 8", BULK THICKENER FEED, A.C.C., 30 H.P.
(39) BULK CONCENTRATE THICKENER, 80" x 16", DORR OLIVER, 5 H.P.
(40) TWO PUMPS, SRL-C, 3" x 3", BULK THICKENER UNDERFLOW, A.C.C., 30 H.P.
(41) MOLY ROUGHER FEED CONDITIONER, 12" x 12", DENVER SPINDLE BEARING AGITATOR, 15 H.P.
(42) TWO PUMPS, SRL-C, 6" x 6", MOLY ROUGHER FEED, A.C.C., 15 H.P.
(43) MOLY ROUGHER SCAVENGER FLOTATION CELLS, 16 CELLS, DENVER "DR" NO. 30, 100 CU. FT., 25 H.P.
(44) TWO PUMPS, SRL C 5" x 5", MOLY ROUGHER CON, A.C.C., 15 H.P.
(45) MOLY 1ST CLEANER CELLS, 8 CELLS, #24 OR 50 CU. FT., 15 H.P.
(46) MOLY 1ST CLEANER CON. CONDITIONER, 6" x 6', DENVER SPINDLE BEARING AGITATOR, 7.5 H.P.
(47) TWO PUMPS, SRL C 2" x 2", MOLY 1ST CLEANER CON., A.C.C., 3 H.P.
(48) TWO PUMPS, SRL-C, 5" x 5", MOLY 1ST CLEANER TAIL, A.C.C., 5 H.P.
(49) TWO PUMPS, SRL-C, 6" x 6", COPPER THICKENER FEED, A.C.C., 30 H.P.
(50) TWO PUMPS, SRL C, 5" x 5", MOLY REGRIND DISCHARGE, A.C.C., 15 H.P.
(51) THREE 6" KREBS MOLY REGRIND CYCLONES.
(52) MOLY REGRIND MILL, 6' x 12', A.C.C., 200 H.P.
(53) MOLY 2ND AND 3RD CLEANER FLOTATION CELLS, 10 CELLS, 24 CU. FT. DENVER, 7.5 H.P.
(54) MOLY 3RD CLEANER CON. CONDITIONER, 6' x 6', DENVER SPINDLE BEARING AGITATOR, 7.5 H.P.
(55) TWO PUMPS, SRL-C, 2" x 2", FOURTH CLEANER FEED PUMPS, A.C.C. 3 H.P.
(56) MOLY 4TH, 5TH AND 6TH CLEANERS, 10 CELLS, 24 CU. FT. DENVER, 7.5 H.P.
(57) TWO PUMPS, SRL-C, 2" x 2", MOLY THICKENER FEED, A.C.C., 3 H.P.
(58) TWO PUMPS, SRL-C, 2" x 2", MOLY 4TH CLEANER TAIL, A.C.C., 3 H.P.

CONCENTRATE HANDLING

(59) COPPER THICKENER, 80' x 16', DORR-OLIVER, 5 H.P.
(60) TWO PUMPS, SRL-C, 3" x 3", COPPER THICKENER UNDERFLOW, A.C.C., 30 H.P.
(61) COPPER CONCENTRATE STOCK TANK, 16' x 16', DENVER PADDLE TYPE AGITATOR MECHANISM, 30 H.P.
(62) TWO PUMPS, SRL-C, 3" x 3", COPPER FILTER FEED, A.C.C., 30 H.P.
(63) TWO DORR OLIVER COPPER FILTERS, 10 DISCS, 8'6" DIAMETER.
(64) CONVEYOR NO. 22, 36" WIDE x 125' @ 96 FPM REVERSIBLE, 5 H.P., HORIZONTAL.
(65) CONVEYOR NO. 23, 24" WIDE x 175' @ 150 FPM, 10 H.P., HORIZONTAL.
(66) COPPER CONCENTRATE DRYER, LOWHEAD HAGGERTY, 40 H.P.
(67) CONVEYOR NO. 24, 24" WIDE x 490' @ 150 FPM, 10 H.P., HORIZONTAL TO 17° - 53 - 46".
(68) COPPER CONCENTRATE STORAGE BUILDING.
(69) MOLY THICKENER, 12' x 6', DORR OLIVER, 1 H.P.
(70) TWO PUMPS, SRL C, 2" x 2", MOLY THICKENER UNDERFLOW, A.C.C., 7.5 H.P.
(71) MOLY STOCK TANK, 9' x 9'.
(72) TWO PUMPS, SRL C, 2" x 2", MOLY FILTER FEED, A.C.C., 7.5 H.P.
(73) MOLY FILTER DORR-OLIVER, 4 DISCS, 4' DIAMETER.
(74) CONVEYOR NO. 25, 12" STRONG SCOTT SCREW CONVEYOR TO MOLY DRYER, 1 H.P.
(75) MOLY DRYER, HOLO-FLITE TYPE, JOY MFG., 1/2 H.P.
(76) CONVEYOR NO. 26, 6" STRONG SCOTT SCREW CONVEYOR TO BUCKET ELEVATOR, 1/2 H.P.
(77) BUCKET ELEVATOR, STRONG SCOTT, 1/2 H.P.
(78) CONVEYOR NO. 27, 6" STRONG SCOTT SCREW CONVEYOR TO MOLY STORAGE BIN, 1/2 H.P.
(79) MOLY STORAGE BIN, 10'11" I.D. x 17'5" HT. GYRATORY BIN DISCHARGE.
(80) CONVEYOR NO. 28, 9" STRONG SCOTT SCREW CONVEYOR TO MOLY PACKER.
(81) MOLY DRUM VIBRATOR AND FILLER.
(82) ROLLER CONVEYOR.
(83) SCALE.
(84) FORK LIFT.

REFERENCE	N°	DWG. NO.	ISSUED FOR	DRWN	CHECK	APPR	DATE	REV	DESCRIPTION	DRAWN D.G.V. / TRACED / APPROVED	SCALE NONE / DATE / CHECKED N.H.	GIBRALTAR MINES LTD. (N.P.L.)	DESIGN AND RESEARCH	GENERAL PROCESS FLOWSHEET / FILE No. D-0-33-285

Table I

Primary Crusher

Operating Personnel	- 1 man per shift/7 days per week
Crushing capacity	- 3000 tons per hour
Mantle Life	- 3.0 million tons
Concave Life	- 5.5 million tons

SECONDARY CRUSHING

Ore is drawn from the coarse ore stockpile by six Nico hydrastroke feeders and fed to four 13 inch by 84 inch Allis Chalmers crushers. Two 48 inch conveyors are side by side but in separate tunnels underneath the coarse ore stockpile. Each conveyor feeds two crushers but either crusher can be closed off such that crusher maintenance can be done independently.

Each of the secondary crushers is driven by a 350 H.P. motor via V belt drive but with no clutch. Metal detectors on the crusher feed belts provide protection from tramp steel.

The crushers each have a 6 foot by 14 foot screen under them to make a 1 1/2 inch separation. The plus 1 1/2 inch product recycles back to the coarse ore stockpile such as to enable closed circuit crushing. The minus 1 1/2 inch product joins the primary screen undersize and is conveyed to the fine ore stockpile.

The 60 inch belt feeding the fine ore bin is equipped with a Compudyne belt scale which records total tonnage and hourly rate. The secondary crushers are capable of producing 450 tons per hour each. Combined with the 1,000 tons per hour of primary screen undersize the total crushing capacity is approximately 2800 tons per hour.

The secondary crushing plant and all associated conveyors and equipment are controlled from a central control room in the secondary crushing building. The crushing rate is limited by the amperage draw on the secondary crusher motors. The feeders under the coarse ore stockpile are adjustable in their feed rate such that the crusher motor amperage can be kept at a maximum.

Dust collection systems are located at the primary crusher area, secondary crushing plant, and fine ore storage area. The dust collection slurry water is pumped to the concentrator to permit recovery of any copper minerals.

Table II

Secondary Crushing

Operating personnel	- 2 men per shift/7 days per week
Secondary Crushing setting	- 3/4 inch close side
Mantle Life	- 1.5 million tons
Concave Life	- 3.0 million tons

GRINDING CIRCUITS

Three primary grinding circuits are used for preparing the crushed rock for rougher flotation. Each circuit has a 13.5 foot by 20 foot rod mill and a 13.5 foot by 20 foot ball mill. The rod mills receive their ore from a belt conveyor system located under the fine ore stockpile. The Allis Chalmers grinding mills are equipped with 2500 H.P. motors coupled through Wichita air clutches.

The ball mills each operate in closed circuit with six 30 inch Krebs cyclones. Two sizes of cyclone pumps are used - Allis Chalmers 20 x 18 SRL and 16 x 14 SRL.

Dry ore feed rate can be controlled automatically to vary the feed rate as the grinding characteristics change. The system utilizes an Autometrics particle size analyzer and other related equipment to maintain the desired grind while varying tonnage accordingly. If the operator wishes to maintain a constant tonnage this can also be done. A Compudyne belt scale is used on each rod mill feed belt to measure tonnage. The cross conveyors under the fine ore bin are variable speed to permit controlled tonnage variations.

The average mill throughput is 41,500 tons per day at a Bond Work Index of 9.3. Cyclone overflow sizing is 30% + 65 mesh at 52% solids.

Increasing the rod mill speed from 69 to 73% critical has shown a tonnage increase. An increase from 78 to 81% critical is being evaluated on a ball mill.

Table III

Rod and Ball Mill Statistics

		Rod Mills	Ball Mills
Size	-	13.5 feet x 20 feet	13.5 feet x 20 feet
Horsepower Installed	-	2500	2500
Horsepower Drawn	-	1900 & 2100	2350
Speed % Critical	-	69 & 73	78
Grinding Media	-	4 inch Rods	2 inch Balls
Grinding Media Consumption	-	.52 lb/T	.53 lb/T
Liners	-	Mn Lifter & Ni Hard Shell Plate, Cr-Mo Ends	Ni Hard Double Wave Shell Ni Hard Ends

COPPER FLOTATION

The cyclone overflow from each grinding circuit flows by gravity to a single bank of sixteen Denver 600 H. flotation machines. The first eight cells produce the rougher concentrate and the last eight the scavenger concentrate. The scavenger concentrate recycles to the head of the roughers for additional flotation. The rougher concentrate is reground to 75% - 325 mesh in a 9 1/2 foot by 14 foot Allis Chalmers ball mill powered by a 600 H.P. motor. A Krebs cyclopak consisting of eight 15 inch cyclones is used to permit closed circuit grinding at the regrind mill.

The reground product flows by gravity to 16 Denver 300V flotation machines for the first stage of cleaning. The first cleaner tail at 15% solids joins the rougher scavenger tail and flows to the tailing pond. The first cleaner concentrate is pumped to the second and third cleaners each having eight No. 30 Denver flotation machines.

MIBC and A.F. 65 are used jointly as the frothing agent in the roughers while sodium isopropyl xanthate is the collector. Frother and collector are added at the grinding circuit and stage added in the roughers. Lime is used to give a primary float pH of 10.0.

Additional A.F. 65 and zanthate are used in the copper cleaners as required. The pH in the cleaner float is increased to 11.5.

Head grade average .40% Cu with a .04% oxide copper content. Copper recovery is quite variable depending upon the oxide copper content. The cleaner ores permit recoveries of 88% total copper but increasing oxide content will lower the recovery to 80% total copper. A rougher concentrate of 12 to 15% is normal and is upgraded to 28% Cu after three stages of cleaning.

MOLYBDENITE RECOVERY

The copper third cleaner concentrate is pumped to an 80 foot thickener. Ammonium sulfide is added to the thickener feed to strip the reagent coating off the copper minerals. The thickener underflow is pumped to a conditioner tank where sodium hydrosulfide and additional ammonium sulfide are added. Fuel oil is added at this point to act as the moly collector.

This slurry is pumped to the moly roughers where the initial copper - moly separation occurs. The reagents added in the thickener and conditioner have effectively depressed the copper and promoted the moly. Ten stages of cleaning are used to upgrade the molybdenite with stage adding of sodium hydrosulfide, cyanide, fuel oil, and sodium silicate. A regrind is used between the first and second cleaners to liberate gangue minerals.

Table IV

Assays			Reagents		
MoS_2 mill feed	-	.016%	$(NH_4)_2S$	-	9 lb. per ton of copper con
MoS_2 copper con	-	.75%	NaHS	-	18 lb. per ton of copper con
MoS_2 moly tail	-	.08%	Fuel oil	-	3 lb. per ton of copper con
MoS_2 Moly con	-	.88% MoS_2	NaCN	-	2.5 lb. per ton of copper con
Cu in moly con	-	.7%	Na_2SiO_3	-	less than 1 lb. per ton

FILTERING AND DRYING

The moly circuit tails is now the final copper con and is pumped to an 80 feet thickener. Thickener underflow at 65% solids is pumped to a 16 foot by 16 foot stock tank and then to one or both of two 8 foot 6 inches DOL 10 disc filters. Filter cake at 10% moisture is conveyed to a LH rotary dryer where it is reduced to an 8% moisture content.

After leaving the concentrate dryer the concentrate is conveyed to a storage shed with a 3000 ton capacity.

The moly concentrate is thickened to 40% solids and filtered by a 4 foot DOL filter. The filter cake is then sent to a Joy Holo Flite dryer where the moisture is reduced to 5%. The dried concentrate is stored in a 75 ton capacity silo. The moly concentrate is then put into 33 gallon drums and shipped.

TAILING DISPOSAL

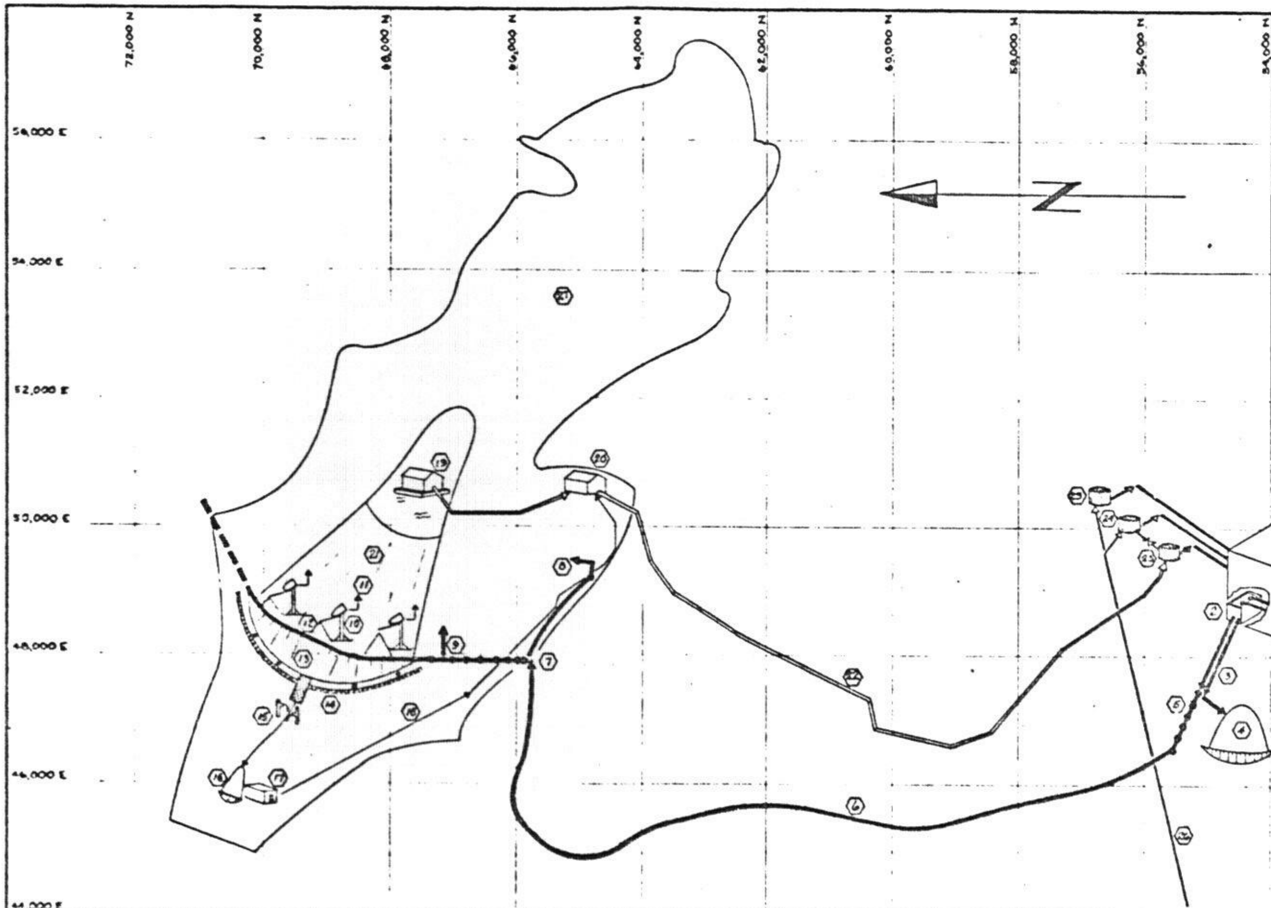
The final tailing consisting of rougher and first cleaner tail flow by gravity through a 36 inch steel line to the tailing impoundment area. The line is sloped at .5% to prevent sanding but not so steep as to cause wear problems. A series of droptanks are used to compensate for vertical drop.

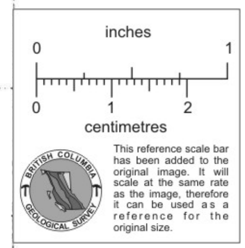
The pipeline extends for approximately 4 miles to the disposal area which has been cleared and grubbed. A glacial till starter dam was constructed prior to mill startup and has served as the foundation for the sand dam which has been constructed on top of it. The +200 mesh fraction of the tailings is recovered via 30 inch Krebs cyclones such that dam height can be increased by using the tailing sand. The center-line method of dam construction is being used and is designed and built to withstand any seismic loading which might occur in the area. Finger drains are constructed under the sand portion of the dam to aid in drainage and maintain a suitable phreatic line.

The cyclones are mounted on steel towers with skids on the bottom which allows a bulldozer to drag them to the necessary locations.

The reclaim barge is located approximately 8000 feet upstream from the main dam and recycles the tailing water back to the concentrator. Adequate room is provided for in the tailing disposal area to store the spring runoff. This water is then used in the mill and permits a minimum amount of fresh water to be required.

A seepage dam and pumphouse are located below the main dam to collect any seepage or spills. This dam and automatic pumping system ensure that the disposal area is a closed system.

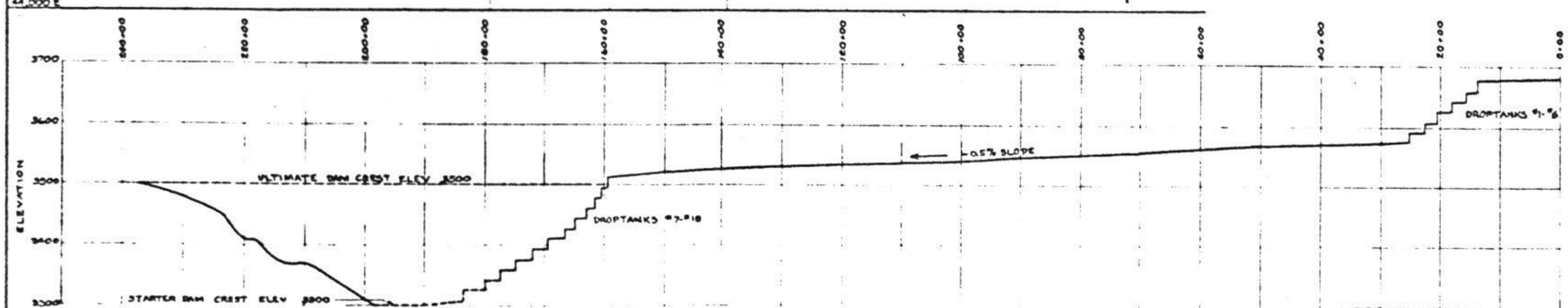




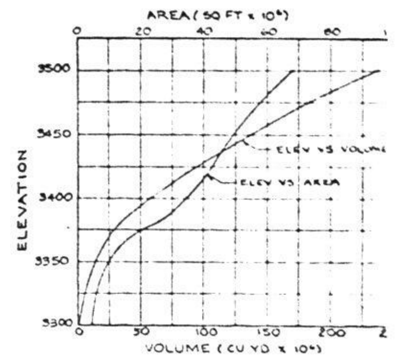
LEGEND

1. CONCENTRATOR. 42,000 SDTPD @ 47% SOLIDS.
2. TAILING SUMP.
3. 36" DIA. EMERGENCY TAILING LINE. TOTAL LENGTH TO DISCHARGE PT = 1300'
4. EMERGENCY TAILING POND. CAPACITY 70,000 CU. YD. OR 40 HRS. PRODUCTION
5. DROPTANKS 1 TO 6. 16' HIGH, 6' DIA, RUBBER-LINED INLET AND OUTLET
6. TAILING LINE. 36" DIA 0.375" THICK STEEL. 0.5% SLOPE
7. 7A. TWO 36" HYDRAULICALLY OPERATED LETSON AND BURPEE BUTTERFLY VALVES
8. WINTER TAILING DISCHARGE
9. 7B. TWO 36" HYDRAULICALLY OPERATED VALVES BYPASS FOR CYCLONE MOVES
10. 30-INCH KREBS CYCLONES ON PORTABLE STEEL CYCLONE TOWERS
11. CYCLONE OVERFLOW TO POND
12. CYCLONE UNDERFLOW DEPOSITED ON DAM. SAND RECOVERY 40% OF TOTAL TAILING @ 12% - 200 MESH
13. CYCLONED SAND DAM BUILT BY CENTERLINE METHOD
14. FINGERDRAINS TO CONTROL PHREATIC WATER LEVEL IN DAM
15. ARTESIAN PRESSURE RELIEF WELLS. 75' DEEP, 4" DIA PERFORATED PVC WITH GRAVEL FILTER
16. SEEPAGE RECOVERY DAM AND POND
17. SEEPAGE RECOVERY PUMPHOUSE. 3 PEERLESS 1100 GPM VERTICAL TURBINE PUMPS WITH G.E. 200 H.P. MOTORS. 3 STAGE PUMPS.
18. 14-INCH DIA SEEPAGE RECOVERY LINE DISCHARGING INTO SUMP OF RECLAIM BOOSTER PUMPHOUSE
19. FLOATING BARGE RECLAIM PUMPHOUSE WITH 6 3000 GPM VERTICAL TURBINE PUMPS AND 600 H.P. MOTORS. 4160 VOLTS, 3 STAGE PUMPS
20. RECLAIM BOOSTER PUMPHOUSE. SAME PUMPING UNITS AS BARGE PUMPHOUSE EXCEPT 4 STAGE PUMPS
21. SLIMES BEACH
22. 34" DIA RETURN WATER LINE, WRAPPED AND BURIED. TOTAL LENGTH 12,360'
23. 200,000 IMP GAL FIRE WATER TANK. 90 PSI IN CONCENTRATOR
24. 200,000 IMP GAL FRESH WATER TANK. 60 PSI IN CONCENTRATOR
25. 200,000 IMP GAL PROCESS WATER TANK. 40 PSI IN CONCENTRATOR
26. 20-INCH DIA FRESH WATER LINE FROM FRASER RIVER. CAPACITY 3000 GPM. 3 PUMPING STATIONS.
27. TAILING IMPOUNDMENT AREA

    INITIAL CLEARING TO ELEV 3400 - 898 ACRES
    ULTIMATE CLEARING TO ELEV 3500-1682 ACRES



PROFILE OF TAILING LINE
SCALE: 1" = 100' VERT
1" = 1000' HOR.



ELEVATION VS VOLUME & AREA

DWN	CHECK	APPR	ISSUED FOR	DATE	REV	DESCRIPTION	DWN	CHECK	APPR	ISSUED FOR	DATE	REV	DESCRIPTION	REFERENCE	No	DWG No.
							PCL				22/3/73					

GIBRALTAR MINES LTD. (N.P.L.)
TAILING DISPOSAL

SCHEMATIC FLOWSHEET
PROFILE OF TAILING LINE

SCALE PLAN 1" = 1000' PROFILE AS SHOWN

Endako

Mine Mgr. John Dodge
Mill Supt George Sutherland
Mine Geol. Ed Kimura
Mill