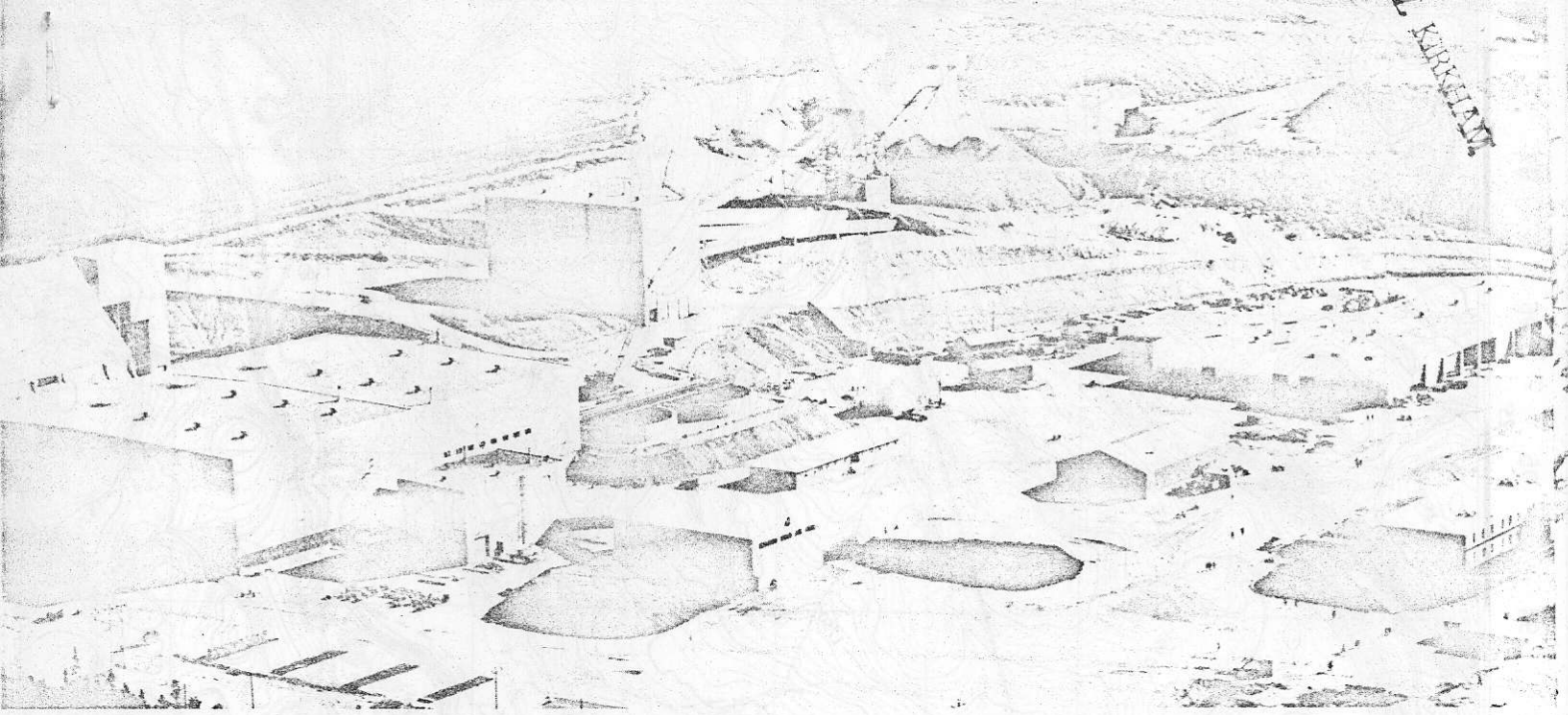


Gibraltar

The Gibraltar Mines operation in central British Columbia includes four copper-molybdenum orebodies from which copper concentrates are produced in a planned sequence. The mill is one of the largest of its kind in Canada

The Gibraltar mine is about 100 miles south of Prince George, central British Columbia, on the westerly slope of Granite Mountain and near McLeese Lake. Air temperatures range from −35C in winter to 35C maximum in summer; annual precipitation is about 20 inches, of which about a third is snow.

In 1969 a combined exploration program was launched on what had been two separate properties: the Polyanna, discovered in 1910, and the Gibraltar, discovered in 1927. After various stages of ownership and interest, Gibraltar Mines Ltd acquired the Gibraltar property after a Keevil Mines option lapsed in 1964: Cominco and Mitsubishi outlined the Gibraltar West zone under option (ended in 1967), and the property was optioned to Canex-Duval who were exploring the adjacent Polyanna property. The Duval interest was later bought by Canex, which now holds some 71.9% of Gibraltar.

The four copper-molybdenum orebodies of Gibraltar Mines are: Gibraltar West, Gibraltar East, Polyanna, Granite Lake; they lie within an area about 2.5 miles long and 1 mile wide, and are entirely within the quartz diorite of the Granite Mountain pluton.

Estimated mineable ore reserves at 31 December 1975 were 308-million tons at cut-off grade of 0.25% and average grade of 0.35% copper.

The molybdenite circuit in the mill was shut down in April 1975 because of the increased cost of reagents.

PROPERTY OPERATION

Under the direction of the mine manager there are six departments: administration (2 people); accounting (37); employee relations (11); engineering and geology (23); mine (138); mill (81); plant (231); for a total of 523 personnel (130 staff, 393 hourly rated).

MINING

The orebodies, dumps, and plant site cover about 4300 acres. Each of the four distinct orebodies is mined sequentially, based on computer-calculated pit designs and schedules, which allow for incorporation of haulage ramps, power supply, pumping equipment, etc.

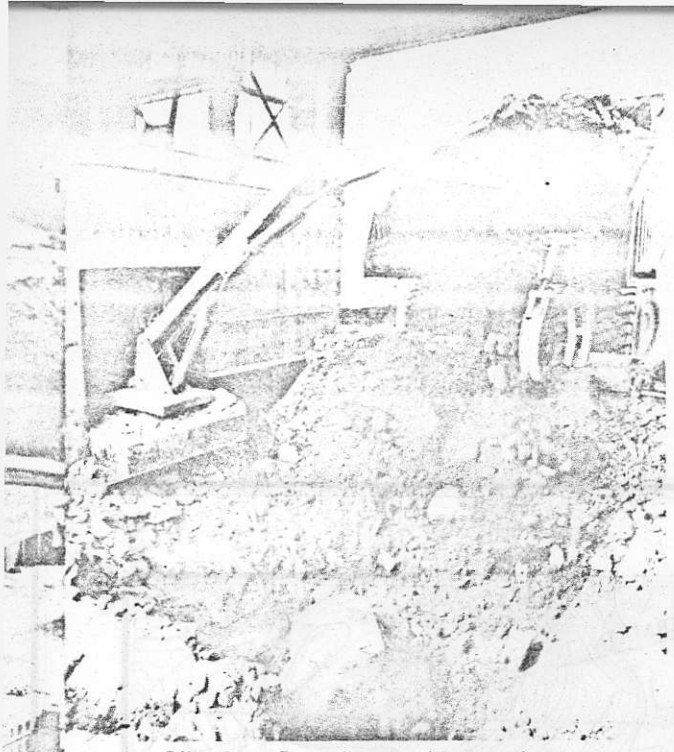
Design parameters: Copper price 50¢ nsr; high-grade cutoff 0.25% copper. Minimum size pit design 30-million tons (high grade ore). Overburden bank slope 45°; safety berm at base of overburden up to 100ft, depending on overburden thickness; working face slope 67°; bench interval height 45ft; safety berms in rock 45ft wide every other bench. Haulage roads (2-lane) 80-100ft with gradients up to 10%. Minimum pit wall curvature not less than 60ft radius.

PIT PRODUCTION

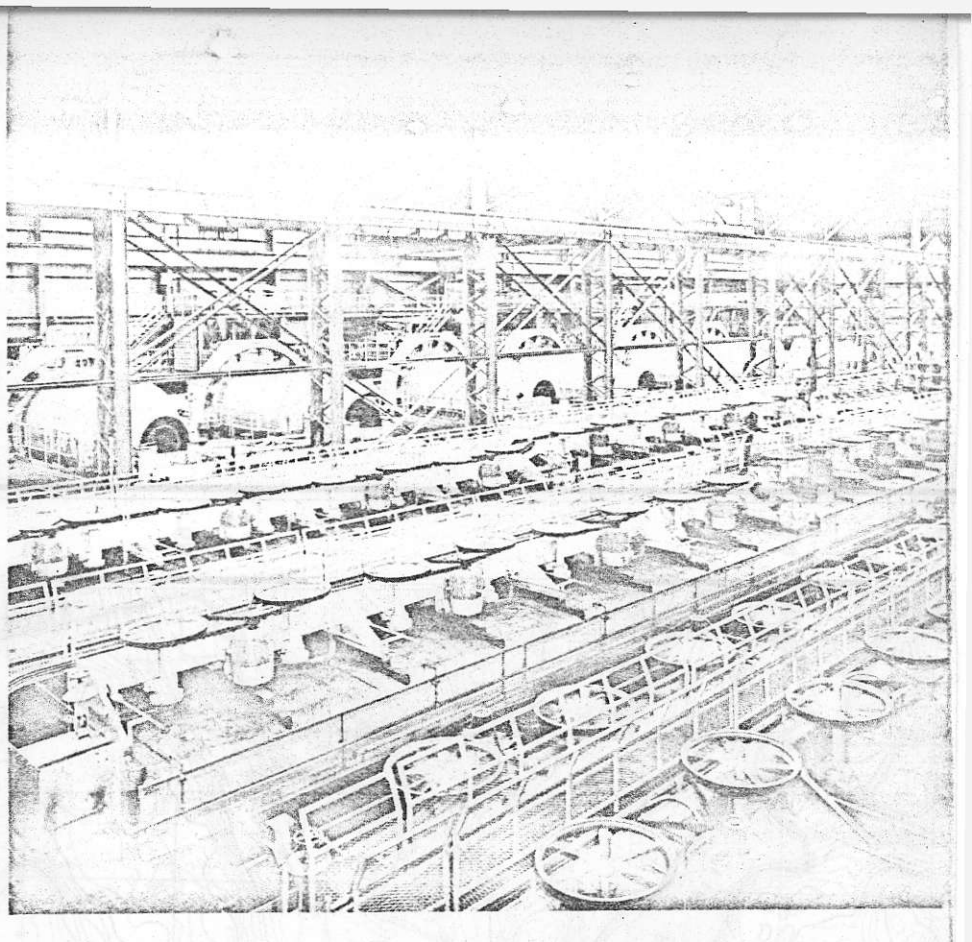
At 1 January 1976, the Granite Lake Stage 1 Pit was nearing completion having only four more benches to be mined (making a total of 10 benches in all). The Pollyanna Pit Stage 1 was initiated in the latter part of 1975 and stripping has been proceeding prior to full ore production in the middle of 1977 when Granite Lake will be phased out.

Drilling patterns vary according to rock type, geological structure and drill hole diameter.

The following figures summarize pit production statistics from start-up until



Gibraltar: Dumping ore into crusher



Gibraltar: Flotation area and mills in the concentrator building

December 1975. Ore mined 50,791,000 tons at 0.445% Cu; waste mined 76,145,000 tons; for a total mined 126,936,000 tons.

Maintenance: The maintenance shop is 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.

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

Pit equipment: Rotary drills are used for blasthole drilling; two Bucyrus-Erie 45R electric (9⅞in) and one Marion 4M electric (12¼in). These operate on three shifts a day.

Two of five 14yd³ shovels operate each of three daily shifts, loading 13,000 tons per shift; the units, all electric, include three P&H 2100B, one 2100BL, and one Marion 191-M.

Hauling is done by 25 Unit Rig diesel electric trucks, of which 14 units move 2050 tons per shift.

Dump maintenance, shovel clean-up, and road maintenance are handled by five D-8 Caterpillar tracked dozers, three 824 Caterpillar tired dozers, road graders, water and sanding trucks.

MILLING OPERATIONS

The Gibraltar concentrator started 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 14.0 which permits a coarse mill feed of 40% +¾ inch to be acceptable.

(3) A coarse flotation feed of 40% +65 mesh can be used while still obtaining good recovery.

(4) The centre 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 0.44% copper, concentrate grade 28% copper, and total copper recovery is about 85% on the clean ores. The crushing and milling operates seven days per week on a three shift basis.

Primary crushing: A 54x75in 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 seven day, three shift basis.

The primary crusher operator is located in a control room over-looking 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.

The crusher discharge drops onto a short 84in wide variable speed belt conveyor and then onto a 72in conveyor which feeds two 8x20ft primary screens. These screens make a 1.5in split; oversize going to a 36,000-ton live storage stockpile and undersize to a 20,000-ton live storage fine ore stockpile. Dozers can be used on both stockpiles; total coarse and fine ore storage is approximately 150,000 tons.

Secondary crushing: Ore is drawn from the coarse ore stockpile by six Nico hydrastroke feeders and fed to four 13x84in 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 the crusher maintenance can be done independently.

Below each crusher is a 6x14ft screen to make a 1.5in separation: oversize goes to the coarse ore stockpile; minus 1.5in joins the primary screen undersize and is conveyed to the fine ore stockpile.

A 60in 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/hour each. Combined with 1000 tons/hour of primary screen undersize, the total crushing capacity is approximately 2800 tons/hour.

The secondary crushing plant and all associated conveyors and equipment are controlled from a central control room in the secondary crushing building.

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.

Grinding circuits: Three primary grinding circuits are used for preparing the crushed rock for rougher flotation. Each circuit has a 13.5x20ft rod mill and a 13.5x20ft ball mill.

The ball mills each operate in closed circuit with six 30in Krebs cyclones.

Dry ore feed rate can be controlled automatically 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 40,000 tons per day at a Bond Work Index of 12.5. Cyclone overflow sizing is 39% +65 mesh at 50% solids.

Increasing the rod mill speed from 67% to 74% critical has shown a tonnage increase. An increase from 78% to 81% critical is being evaluated on a ball mill.

Copper flotation: The cyclone overflow from each grinding circuit flows by gravity to a single bank of sixteen Denver 600H 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 70% −325 mesh in a 9.5x14ft Allis Chalmers ball mill (600hp 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 300H 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.

Head grade averages 0.44% copper with a 0.02% 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 8% to 10% is normal and is upgraded to 26.5% copper after three stages of cleaning.

Filtering and drying: The final copper concentrate is pumped to an 80-ft thickener. Thickener underflow at 65% solids is pumped to a 16x16ft stock tank and then to one or both of two 8.5ft DOL 10 disc filters. Filter cake at 12% moisture is conveyed to a LH rotary dryer where it is reduced to an average 8% moisture content.

After leaving the concentrate dryer, the concentrate is conveyed to a storage shed (3000 ton capacity).

TAILING DISPOSAL

The final tailing consisting of rougher and first cleaner tail flows by gravity through a 36 inch steel line to the tailing impoundment area. The line is sloped at 0.5% to prevent standing 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; dam height can be increased by using the tailing sand.

The reclaim barge is about 8000ft upstream from the main dam and recycles the tailing water back to the concentrator. Adequate room is provided in the tailing disposal area to store the spring runoff. This water is then used in the mill, minimizing the amount of fresh water 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.