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SIMILKAMEEN MINING COMPANY LIMITED

Princeton, British Columbia.

HISTORY

Early copper showings have been known on what is now company property since before the turn of the century. Various amounts of unsuccessful development work were done before 1923, when the Copper Mountain area west of the Similkameen River was acquired by the Granby Consolidated Mining, Smelting and Power Company Limited.

During the periods 1926-1930 and 1937-1957 Granby successfully produced copper from the area, with approximately 34 million tons of ore, grading about 1% copper, being mined and concentrated. For the most part, mining was carried out by underground methods although during the last seven years of operation two small open pits were developed.

In December 1967 Newmont Mining Corporation purchased all of the Granby holdings in the area.

The main claims on the Ingerbelle area west of the river were controlled by a Princeton group and were acquired by Newmont in 1968.

Both properties were concurrently explored after acquisition with approximately 470,000 feet of diamond drilling and one mile of underground workings.

In July 1970 a go-ahead decision was made by Newmont to put the property into production.

GEOLOGY OF THE INGERBELLE
AND
COPPER MOUNTAIN DEPOSITS

The Ingerbelle and Copper Mountain orebodies lie within a 14,000 by 3,500 foot belt of Nicola rocks. These rocks are composed of andesitic tuffs and agglomerates, lesser amounts of flows, and some lensy siltstone layers. The west end of this belt is in fault contact with other Nicola rocks including flows, agglomerates, and agillites. The volcanic belt is bounded on the south by the concentrically zoned Copper Mountain stock consisting of diorite, monzonite and pegmatitic syenite and on the north by the complex Lost Horse Intrusive. Small masses of this intrusive also occur in the volcanics.

The Ingerbelle mineralized zone is crudely L-shaped. The southwest arm is about 1,000 feet wide and tails off to a narrow erratic zone of low-grade mineralization. Narrowing as it wraps around the point of the L, the zone broadens to a width of 1,500 feet as it trends southeast to the Similkameen River. A 900-foot width of Nicola volcanics lying between the orebody and the Copper Mountain stock is practically devoid of copper. On the northwest side mineralization terminates abruptly against highly altered volcanics, but small patches of it are scattered through the less altered volcanics further to the north and east.

Chalcopyrite mineralization at Ingerbelle occurs as disseminations, discontinuous fracture-fillings and coarse blebs. Sulphide veins up to several inches thick are rare. The host rocks are mainly altered tuffs and agglomerates. Massive andesite, although mineralized, is less favourable for ore-grade material. Less than 10% of the ore is in small masses of monzonite or diorite.

At Ingerbelle the most prominent alteration associated with copper mineralization is a pale greenish bleaching of the dark volcanics. This alteration involves a conversion of andesine plagioclase to albite, together with the formation of considerable epidote and lesser amounts of chlorite, scapolite, calcite, and occasionally hornblende. The recrystallization has converted the host into a hard, tough rock with many of the original fractures healed together.

Ore reserves recoverable by open pit mining at Ingerbelle are estimated at 45 million tons of 0.53% Cu. The stripping ratio at Ingerbelle is 2.6 tons of waste to one ton of ore.

OPEN PIT OPERATION

Original reserves of approximately 75,000,000 tons of ore grading 0.52% Cu are contained in three pits. The largest of these, the Ingerbelle on the west side of the river, is presently being mined. In order to start mining operations in the Ingerbelle pit, approximately 4.2 miles of highway had to be relocated.

Two smaller pits, the Similkameen Pits 1 and 2, are located on the east side of the valley in the vicinity of old Copper Mountain mine.

Mining is generally carried out on a 3-shift five-day per week schedule at a mining rate of about 90,000 tons of ore and waste per day. Weekend mining is occasionally scheduled and weekend mine maintenance is scheduled as required.

A working-stripping ratio of 2.3 to 3:1 is maintained. Bench heights are designed at 40 feet and the overall final wall slope varies between 45° and 50°.

OPEN PIT OPERATION

PIT EQUIPMENT

Shovels	Four P&H Model 1900 10 cu.yd. bucket capacity
Drills	Three Bucyrus-Erie 60R Electric 9 7/8" diameter hole using rotary tri-cone bits
Trucks	Fifteen 100-ton Lectra Haul Tires 2700 X 49 - 42 ply Engines GM12V - 149T Generator and Electric Drive by G.E.
Auxiliary	2 - Cat D-8 bulldozers 2 - Cat Model 14 road graders 3 - Cat 824B rubber-tire dozers 1 - Wabco 32-ton fuel and lube truck 1 - Wabco 32-ton water truck 1 - LeTourneau 15 cu.yd. loader

PERFORMANCE

Shovels	Scheduled 3 shovels out of 4 at 10,000 tons/shovel/shift
Trucks	Scheduled 11 trucks from fleet of 15
Drilling	22' x 22' pattern 9' sub-grade
Blasting	Powder factor .37 ANFO loaded in 96% of drill holes Wet holes are pumped, lined with 10 mil plastic sleeves, and loaded with ANFO

CONCENTRATOR OPERATION

The Similkameen concentrator was designed, after considerable test work, around the principle of autogenous grinding, an operation by which the rock grinds itself. This mode of operation lends itself to lower capital costs and operating costs.

The Concentrator, designed to treat 15,000 tons per day, operates 24 hours per day, 7 days per week. It is fully automated and requires only 4 men to operate per shift.

Ore is dumped from 100-ton rear dump trucks into a 54" x 74" Allis Chalmers gyratory crusher where it is reduced to minus 9". The crushed ore is conveyed to a "boomstacker" where it is spread over a 45,000 live ton storage pile. From the pile hydrostroke feeders draw ore to feed the three large 32' diam. 14' long Hardinge autogenous mills. The mills discharge through grates with 3" ports into a large trommel screen which rotates with the mill. This trommel separates the $-3/4"$ into a classifier, the $-3" + 3/4"$ material discharges to a conveyor to be either crushed or not crushed then returned to the mill for further grinding. The $-3/4"$ material enters the 96" spiral classifier which discharges sands to be conveyed back to the mill. The classifier fines or overflow is pumped to 20" cyclones for further classification. The coarse material or underflow from the cyclone returns to the mill and the fines about 65% -200 mesh is fed to flotation.

The Similkameen orebody is strictly copper which occurs in chalcopyrite mineralization. The flotation process uses collectors such as sodium ethyl xanthate and potassium amyl xanthate with frothers of pine oil and Dowfroth 250. The three similar banks of cells each comprised of 2-400 cu.ft. cells act as first roughers, the tailings are then further treated in a set of 4-400 ft³ cells acting as second roughers. The second rougher tailings feed a bank of 4-400 ft³ cells which function as rougher-scavengers. The rougher-scavenger tailings then become the final tailings. The concentrates from all three banks of cells are pumped to a regrind circuit. From this circuit the material is pumped to 10" regrind cyclones for classification. The coarse underflow from the cyclones returns to the 12' x 18' regrind mill for further grinding. The overflow then feeds the cleaner circuit.

The cleaner cells, 8-100 ft³ cells, act as the first cleaner. The tailings from this first cleaner feeds a bank of 5-400 ft³ cells, the cleaner-scavengers. The cleaner-scavenger concentrates return to the regrind circuit, the tailings are a final tailings. First cleaner concentrates are pumped to the second cleaners, 3-100 ft³ cells. Here the final concentrate grade of 28% Cu is reached. The second cleaner tailings return to the first cleaner cells and the second cleaner concentrates feed the 70' Eimco thickener.

The clean thickener overflow is returned to the plant circuit. The underflow feeds an 8' 10" filter to be filtered to about 15% moisture. From the filter the cake enters a 5' x 50' Lockhead-Haggerty dryer to be dried to about 8% moisture and then fed to a storage shed. From the shed the concentrate is loaded into trucks by a front-end loader and then shipped to Vancouver Wharves to await further shipment to Japan.

The tailings from the plant flows by gravity about 900 feet downhill to a suspension bridge which crosses the Similkameen Canyon. Across this bridge the tailings travel 3,500 feet to a cyclone station. At the cyclone station one of two things happen: the tailings can be directly by-passed into the tailings pond, or the tailings can be classified by 4-30" cyclones. The overflow from the cyclones is sent to the tailings pond and the underflow can go to one of two destinations: to the west dam by gravity, or be pumped to a head station and then flow by gravity to the east dam. The tailings impoundment itself is an old canyon which contains an ecologically dead lake. Two starter dams of graded alluvium and impervious material were constructed to an initial height sufficient for one year's operation and the cycloned sands must build them up as the tailings pond rises.

Water is reclaimed from the tailings pond by two barges which pump the water back to the concentrator. About 75% of the water used in the concentrator is reclaimed from the tailings. The other 25%, used for cooling water and gland water, comes from a pumping station situated at the Similkameen River 700 feet below the concentrator site.

Briefly summarizing, the Similkameen concentrator utilizes the newest and best ideas in mineral processing to recover copper from low grade ores economically and without discharging any waste material or otherwise damaging the ecology.

CONCENTRATOR

PRODUCTION

Crude Ore	5,475,000 dst/yr
Copper Conc. (28%)	96,600 dst/yr

OPERATING SCHEDULE

Shifts/Week	21
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FEED RATES (dst)

Per Effective Day	220
Per Scheduled Day	15,000

METAL RECOVERIES

Copper	88%
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MAJOR EQUIPMENT ITEMS

Crusher

-Primary Crusher	54" x 74" Allis Chalmers (600 hp)
-Ore Conveyor	96" x 50' (c-c)
	48" x 220' (c-c)
	48" x 105' (c-c) Boomstacker

Grinding

-3 Mills	32' diam x 14' long
Motors	2 ea. @ 4,000 hp
Ring Gear	38' diam 31" face
Speed	10.4 rpm, 76% critical
-3 Spiral Classifiers	96" diam, 75 hp
-3 Nordberg Cone Crushers	4 1/4' short head, hydraulically adjusted
	200 hp
-3 Cyclone Feed Pumps	14" x 12" rubber-lined Allen Sherman Hoff
	200 hp with fluid drive coupling
-3 Cyclopaks	7 ea. 20" Krebs Cyclones
-3 Feed Belts	42" x 240'
-6 Feeders	48" x 21' variable speed
-3 each	
Cone Crusher Discharge Conv.	36" x 46'
Recycle Transfer Conveyor	30" x 157'
Recycle Conveyor	36" x 31'

Flotation

-3 banks each	10 cells, 360 cu.ft, 40 hp
-Concentrate Transfer Pumps	8" x 6", 20 hp
-Regrind Mill	12' x 18' Allis Chalmers, 900 hp
	16 rpm, 72% critical
-Regrind Mill Discharge Pump	10" x 8" variable speed, 75 hp
-Regrind Cyclones	1 pack of 8 cyclones D-10-B
-First Cleaner Cells	8 cells, 100 cu.ft.
-Cleaner Concentrate Pump	4" vertical pump, 20 hp
-Second Cleaner Cells	3 each, 100 cu.ft.
-Cleaner Scavenger Cells	5 each, 360 cu.ft, 40 hp

Concentrate Handling

-Thickener	70' diam, 12' deep, center drive, 3 hp
-Thickener Underflow Pump	3" x 3" variable speed, 20 hp
-Thickener Overflow Pump	4" x 4", 30 hp
-Filter	8' 10" Eimco Agidisc, 8 rows, 10 discs
-Dryer Feed Conveyor	36" x 31.5'
-Dryer Feed Screw	16" diam, 6' long, 5 hp
-Dryer	5' x 56', 30 hp exhaust fan 25 hp, 24" diam
	scrubber sludge pump 1/3" x 3", 2 hp
-Dryer Discharge Belt	24" x 220' 5 hp

Reagents

-Collectors	Sodium ethyl xanthate-2,000 imp.gal. mixing tanks 7' x 7'
	Potassium amyl xanthate-200 gal.head tank 8' x 6'
-Frothers	Dowfroth 250-360 imp.gal.head tank 4' x 4'
	Pine Oil
-Lime	Feed screw 2 hp
	Lime ball mill 4' x 5', 1" balls 30 hp
	Cyclone feed pump 3" x 3" 5 hp
	Cyclone 10"
	Lime slurry storage tanks-2 ea 16' x 18' 23,000 gal.
	Lime distribution pumps 4" x 4" 10 hp

Tailings Handling

-Gravity flow from mill through 5,900 feet of 20" diam pipe 1,000 feet of rubber-lined, 4,900 feet of steel	
-Sands production for dam building	4-30" cyclones Gravity flow to one dam Pumped to head station by 5-stage pumps, 75 hp
-Sands line to West Dam	900' of 8" plastic pipe
East Dam	12,200' of 8" plastic pipe

Water Supply

-Reclaim water from tailings pond	4-1200 GPM, 7-stage, 300 hp 2-400 GPM, 7-stage, 125 hp 1-200,000 gal. tank 35' x 32'
-Fresh water from Similkameen River	4-850 GPM, 9-stage, 300 hp 1-545,000 gal. tank 47' x 47'
-Reclaim water line	12,350' of 18" spiral welded pipe 1,700' of 12", 2 pipes

Miscellaneous

-Air Supply	2 Atlas Copco, 40 hp, 100 psi, 250 cfm compressors
-Vacuum	1 Roots, 125 hp, 24" hg, 2700 cfm vacuum pump
-Flotation Blowers	3 Buffalo Forge, 100 hp, 7500 cfm @ 1.5 psig

