OPEN PIT MINING AT GRANISLE COPPER

BY:

R.R. MONTIGNY

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Ronald R. Montigny was born in Quebec. He received his early schooling in Schumacher, Ontario and graduated from Queen's University in mining engineering in 1949.

After graduation he spent eight years with Lamaque Gold Mines Limited in various capacities including miner, shift boss, mine captain, production engineer and chief engineer. He left Lamaque in 1957 to become Underground Superintendent at Merrill Island Copper Limited. From Merrill Island he went to Gunnar Uranium Limited until 1963 when he joined Canadian Johns-Manville at the Munro then at the Reeves mine. In 1969 he joined Granisle Copper Limited as Mine Superintendent.

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INTRODUCTION

The Granisle property is located on Copper Island in Babine Lake in central British Columbia at approximately 54° 57' N Latitude, and 126° 10' W Longitude. The closest town is Topley which is on the Canadian National Railway and Highway 16 and is 166 miles West of Prince George.

The main access is by 34 miles of gravel road from Topley to the Granisle townsite, by ferry to Sterrett Island and then by a system of roads and causeways to the mine plant. The ferry crossing is 11,000 feet long and is kept open during winter months with a compressed air "bubbler" system.

HISTORY

Prior to acquisition of the property by Granby in 1955 development work completed consisted of diamond drilling, tunnelling, trenching and shaft sinking; some of this work dating back to the early 1900. Granby continued development of the orebody by diamond drilling until 1964 when the decision to bring the property to production was made.

Construction started in May of 1965 and production officially commenced December 1, 1966 at 5,000 tons per day. This was subsequently increased to 6,000 tons per day then to 6,500 tons on April 1, 1969.

GEOLOGY

Rocks of Copper Island are considered to be part of the Takla Group which is a series of rocks of Triassic age comprised mainly of volcanic flow material. Sedimentary interbeds of argillite limestone and tuff are common. The Takla rocks have been cut by a series of andesine biotite porphyry intrusions. Copper mineralization occurs with quartz veining at one contact of the main porphyry mass. Since this dyke has a North-Easterly trend the mineralized zone has a definite elongation in that direction. The dip of the porphyry intrusion appears to be close to vertical. The mineralized zone follows the contact downward.

The country rock, through much of the mineralized zone, is a dark gray medium grained material which has resulted from the metamorphism of the volcanics at the porphyry contact. Remnant fragmental texture from the original flow breccia can be detected. This rock has been termed diorite in drill core logs.

In detail the mineralized zone is composed of a closely spaced series of quartz veinlets, with random orientations which occur in the porphyry as well as in the metamorphosed and unaltered volcanics. No veinlets occur where the porphyry contacts an amygdular flow to the north-east or where the porphyry contacts a felsitic flow to the south-east. The main part of the mineralized zone within the above limits has a width of about 500 feet and a length of about 1,500 feet. Boundaries and gradational over 100 feet or more so that a wide marginal zone surrounds the ore section now being mined.

Copper occurs in the mineralized zone principally as chalcopyrite but important amounts of bornite also occur. Minor amounts of gold and silver are associated with the copper minerals. Molybdenum occurs as the mineral molybdenite but in quantities too low for economic recovery.

Open pit ore reserves as at February of 1970 are 25,732,000 tons of ore grading 0.46% copper with a waste to ore ratio of 0.67 to 1.00. A programme of diamond drilling presently in effect is expected to add to these reserves.

PIT DESIGN

The present pit as designed by computer will be 1,200 feet wide and 2,400 feet long and extend to a depth of 410 feet. Mining is carried out on 35 foot benches. Pit walls are sloped at an angle of 60° and a 30 foot berm is left every second bench to give an average overall wall slope of 45°.

All haul roads are designed on a 10 percent grade in a clockwise spiral. Road width is 60 feet. There are two North trending faults, one on the East side and one on the West side of the pit which may affect the final location of the haul road.

PLANNING

Mining schedules are determined on a 5 year, 1 year, quarterly and monthly basis. The long range and 5 year schedules are based on computer determined ore grades and outlines. Short term schedules are based on milling results and blast hole sampling. Isopleths are made using blast hole assays for each bench and these are projected down one bench only as a check against computer grades. Present waste to ore ratio is 0.71 to 1.00. This will increase to 1.10 to 1.0 for the next 5 year schedule.

DRILLING

One Bucyrus - Erie model 40-R rotary drill is used for primary drilling on a two shift per day five days per week basis. A 9" hole is drilled on a standard ore pattern of 15 feet by 30 feet with all holes staggered. Waste is drilled with a 16 feet by 30 feet staggered pattern. Sub. drilling is 5 feet to give a total hole depth of 40 feet for a bench height of 35 feet. The drill is operated at approximately 45rpm, 800psi and 60amps power to give an average of 267 feet per drill shift.

To control dust while drilling, water with 3 percent of water miscible oil added is injected into the air stream at approximately 10 gallons of mixture per hour. Secondary drilling is done with a jackleg or with a Gardner Denver ATD 3100 Airtrac.

BLASTING

Dry holes are toe loaded with M-8 hydromex slurry and column loaded with AN/FO. Wet holes are loaded with M-8 and Nitrex II slurries. Explosives types and column loads are varied to give 0.78 energy units per ton blasted for normally breaking areas and 0.83 energy units per ton for hard breaking areas. The energy units are based on 1 pound of AN/FO being equal to 1.0 energy units and the quantities required were determined through experience and experiment.

All holes are primed with three Pentomex II on a downline of Scuf-Flex primacord. Holes are tied together with re-inforced primacord and delayed between rows with 40 ms. delays. Delays are kept to a minimum of 2½ms per foot of burden whenever possible. Safety fuse with a No.6 blasting cap is used to initiate the primacord.

Blasting patterns are directed to N25°E whenever possible to take advantage of geological structure to improve fragmentation. Some experimental work was done with pre-shearing and cushion blasting of perimeter holes in preparation for the future blasting on the ultimate pit perimeter.

BLASTING: cont'd.

Sinking cuts to new benches are drilled in their entirety if time permits otherwise a division is made into two parts of equal footage each with its own initial cut. The initial cut is located at the deep end of the ramp and is loaded to twice the energy units per ton as a normal blast. The holes in the vicinity of the initial cut are loaded to 1.75 times the energy units and the remaining holes are loaded to 1.5 times the energy units.

EXCAVATING AND HAULAGE

The broken muck is loaded by two P & H model 1400 electric shovels each equipped with a 5 cu.yd. dipper. The haulage fleet consists of eight Terex 50 ton trucks of which six are used each shift. Loading and hauling is also on a two shift five day week basis.

A Caterpillar model 988 front end loader equipped with a 5 cu.yd. rock bucket and two-way radio is used to clean up in the shovel areas and as a supplementary loader in case of a shovel break down. If required for high bottom a Caterpillar D-8 tractor equipped with a ripper is available.

ROADS

Roads are top dressed with pit waste crushed to 3/4" and maintained with a Caterpillar No.12 grader. If excess spillage occurs on the road the front end loader can be quickly called in to assist in clean-up. A Euclid model F-91 truck converted into a tanker is used to water the roads during dry periods. In winter the tank is replaced by a sanding unit.

GRADE CONTROL

All blast hole cuttings are assayed and each blast is split into mill feed, stockpile material or waste, depending upon the results of the assays. Assay sheets are made for each blast and in addition the assay contacts are marked in the field to assist the pit foreman in selective mining. Digging limits are spray painted on the broken muck by the geologists in accordance with a standard colour code. Cut-off grade for mill feed is 0.30 percent copper. Material grading between 0.25 percent and 0.30 percent copper is stockpiled for possible future use as mill feed. Any material grading below 0.25 percent copper is disposed of as waste.

REPAIRS AND MAINTENANCE

Service and repair crews work around the clock with major repairs and overhauls confined to the day shift or on weekends.

All equipment is regularly serviced and thoroughly checked by mechanical crews according to a preventative maintenance schedule.

REPAIRS AND MAINTENANCE: cont'd.

The truck fleet is only 4 months old and to date very little repair work has been required. Tires are approximately 40% worn at 1,000 hours. A life of 8,000 hours is expected for both the engines and the transmissions.

The shovels average 1 hoisting cable and 20 bucket teeth per month. Buckets are removed approximately every 6 months for a major overhaul.

The Caterpillar 988 loader averages 1 tire recap per month. In 6 months the cutting edge of the loader bucket wore back 14" and it was necessary to install an Esco zipper lip complete with replaceable teeth.

The present heavy equipment maintenance shop is being superseded by a new and larger building now under construction. This building was designed with a view to possible future expansion and will be capable of servicing 100 ton trucks.

Repair and Maintenance Cost Per Ton Mined:-

	Shovels	Trucks	Drill	General Services and Supervision
Repair & Maint. Lab.	$ .01	.02	.003	.01
Repair & Maint. Supplies	$ .02	.02	.003	.01
Operating Supplies	$ .01	.03	.02	.01

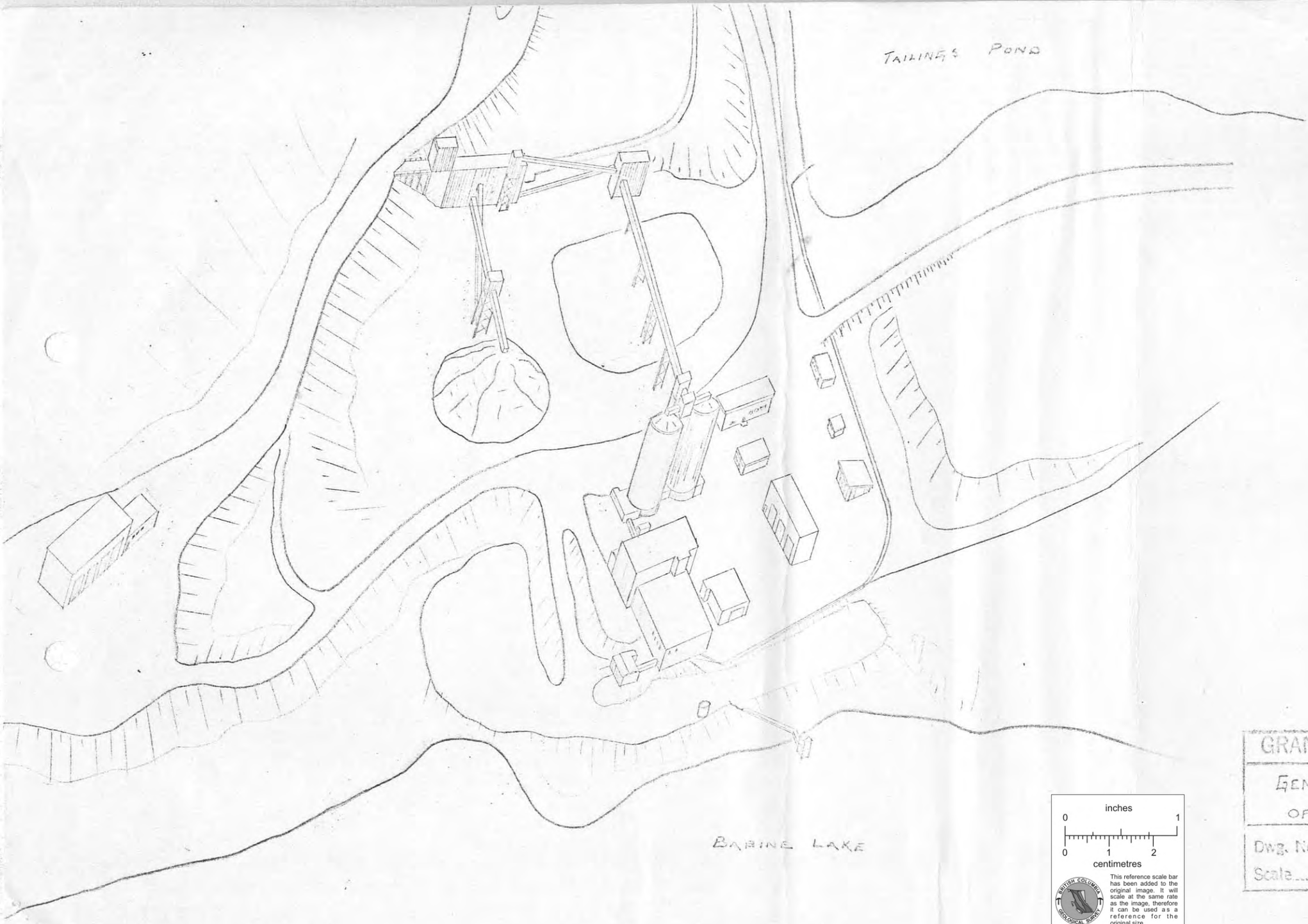
LAND RECLAMATION AND CONSERVATION

Looking ahead to the future when it is planned to reclaim the land presently occupied by the pit, tailings pond, plant site etc. a permanent agriculturist has been added to the staff. A series of test plots with grasses, legumes and trees has been set up and a programme of research has been initiated all directed towards the achievement of the above plant.

MINING COST

Mining costs are controlled through monthly cost statements detailing the cost of each operation and comparing the cost to the budgeted figures.

In addition when it is deemed that equipment is obsolete or uneconomical to operate, Cost Reduction analysis are made and if warranted the equipment is replaced. To this end one Caterpillar model 988 front end loader was purchased to replace two Caterpillar D-7 tractors on shovel clean-up and eight Terex 50 ton trucks were purchased to replace ten Haulpak 35 ton trucks.



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GENERAL SKETCH OF PLANT SITE

Dwg. No. S-6-2-3-3 Date June/71

Scale Nil Drn. by L.L.