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SUB LEVEL OPEN STOPING WITH LONG HOLES AT REEVES MACDONALD MINES, LTD.

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The Reeves MacDonald property is located one-half mile north of the International Boundary, 4½ miles west of the border station of Nelway, B. C.

Production of 500 tons per day was started in December of 1949, and this was increased to 1,000 tons per day in June of 1950.

The Reeves orebody is a replacement in the limestone. The limestone beds strike E.-W. and dip to the south at 57 degrees. The ore zone follows the same strike and dip as the beds and in plan has the shape of a lens. The main ore section is approximately 400 feet long with a maximum width of 80 feet. At the west end this main lens splits into two sections, each section approximately 500 feet long with an average width of 15 feet. The ore in the split area is more erratic and lower grade than the main ore body. The 1900 foot level and 2650 levels are connected by a service raise and ore pass approximately 30 feet in the footwall. Levels have been established at 50 foot vertical intervals.

To obtain tonnage for the first mill unit while development of levels at 50 foot intervals was progressing, levels below the 2650 level were slashed the full width of the orebody and broken muck slushed to main ore pass. After the orebody was slashed full width and to limits of slushing, breasting down was started by taking 10 feet out of back and then a 10 foot bench was started. In both cases the muck had to be slushed to the main ore pass. This type of mining produced large boulders that required an excessive amount of secondary blasting.

Early in 1950 it was decided to change the stoping system from horizontal breasting and benching to vertical slicing by sub level long hole benching.

The following conditions incluenced this choice:

1. The firmness of ore and country rock.
2. The remarkable continuity of the ore over its vertical range.
3. The system would permit the breaking in excess of drawing, thus allowing large storage of broken muck.
4. The only slushing necessary would be in removal of broken ore from the sub level drift.

5. Larger tonnage broken per foot of drill holes.

The development necessary prior to long hole stoping consists of a slusher or scram level, sub level drifts at 50 foot vertical intervals, and slot raises connecting sub levels for initial break between pillar sections.

Two main scram levels have been established at the 1950 and 2350 levels and scram drifts are driven 8 x 8 feet with draw points cut at 25 foot centers. The sub level drifts are driven 5 x 7 feet and approximately through the center of the orebody.

In order to provide ore passes from upper scram and to facilitata driving sub levels, 30 foot vertical pillars are left from hangingwall to the footwall at the 140 foot centers. A raise is driven along the footwall in each pillar section and connected to the sub levels by a short raise out of hangingwall of pillar raise.

A typical stope section is 110 feet long, 50 to 80 feet wide and 50 feet thick. Stoping on each level starts at either end of the orebody and retreats towards the shaft X-cut. A stope section is opened by slashing a 10 foot wide bench around the top of the slot raise. This bench is then drilled with down holes paralleling the raise, and spaced approximately 2 to 2½ feet apart. In this way the slot is enlarged until the hanging and footwalls are reached. The stope then retreats towards the shaft in 10 foot slices the width of the orebody. Each slice consists of a slash 10 feet wide and 9 feet high from the drift to the hangingwall and footwall, and the resulting bench is drilled off with two parallel rows of down holes spaced 7 feet apart with a 5 foot burden on the rows. All holes are drilled at the prevailing dip of the walls, and in most cases are drilled through from 55 to 60 feet.

After the long hole bench round has been blasted, a new 10 foot slash is drilled and blasted from hanging to footwall. Then long holes are again drilled. This procedure is repeated until mining has retreated to next pillar. Holes are loaded to within 3 feet of the collar with 1-3/4 x 16" - 40% Forcite and blasted with millisecond delays.

The ore rock is not too abrasive and very little gage loss has been encountered on the carbide bit. The holes being drilled parallel puts an even distribution of burden on the holes resulting in better fragmentation and less powder per ton than by fanning holes from the sub level drift.

The machines used in long hole drilling are 3½" Denver Automatic Leyners mounted on 7 foot aluminum shells. Two bars, with a 14 foot arm between them are mounted parallel to the edge of the bench, and a row of holes drilled on each side, using a 3 foot cross arm. Holes are drilled with 2" Timken or Carset bits. The rods are made up in 5 foot lengths from 1" quarter octogen carbon steel, threaded for Type 1 C.I.R. couplings. Lugged shanks are made up from 2 foot lengths of 1¼" round drill steel with the holes in the shank end plugged. A hole is drilled in from the side for use with a water swivel. The average bit life is from 350 to 400 feet and bits are sharpened after each hole. The average rod life is 75 feet of hole, and coupling life is 100 feet of hole. Rods and couplings are reversed in consecutive holes in order to keep thread wear even.

Tonnage including opening up the initial slot averages 2.5 tons per foot of hole drilled. Thus a 2-man crew averages 400 tons per machine shift. Slush tonnage averages 40 to 50 tons per machine shift thus reducing the overall average to approximately 170 tons per machine shift.

30 horsepower electric slushers with 42 inch scrapers and 50 horsepower electric slushers with 60 inch scrapers are used in the scram drifts for scraping broken ore from draw points to ore pass. The 30 horsepower slusher has an approximate average of 90 tons per man shift, and the 50 horsepower slusher has an approximate average of 400 tons per man shift moving muck an average distance of 100 feet in each case.

An International TD 14 diesel powered bull dozer has been used on the 2650 level instead of a slusher for moving rock from draw points to ore pass. The average distance is 150 feet and has averaged approximately 425 tons per

man shift. This same dozer was used in an open pit instead of a slusher for moving muck from a bench to ore pass, a distance of 200 feet, at approximately 420 tons per man shift. Counting miners and dozer operator, an average of 140 tons per man was made.

Slushers and track mounted equipment are adaptable under certain conditions, but are limited to distances that ore or waste can be moved economically.

The cost of a long hole drilling averages 43¢ per foot, made up as follows:

Drilling labor	-	30¢
Rods & Couplings	-	8¢
Bits	-	5¢
Total		43¢

This gives us a total cost for benching of approximately 31¢ per ton.

Slashing the benches prior to long holing averages $1.10 per ton. As the ratio of slash muck to long hole is approximately 1 ÷ 4.5, the overall stoping cost is approximately 45.5¢ per ton.

Some experimental work was done with diamond drill blast holes as ring drilling from sub level drifts and from benches, but this compared unfavorably with the tungsten carbide bit and percussion drills.

This type of mining method has decreased costs and made it possible to mine the low grade Reeves orebody.

L. M. KINNEY
General Superintendent

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