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Province of British Columbia

Ministry of Energy, Mines and Petroleum Resources
GEOLOGICAL SURVEY BRANCH

MEMORANDUM

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VB → Vancouver Island

Memo To:

From: Robert Pinsent

Date: September 14th, 1992

Subject: MEMPR MPB MINE TOUR; V.I.: Sept. 15-18th, 1992:

ISLAND COPPER (p. 6, 7, 8)

ISLAND COPPER: BHP-UTAH MINES LIMITED

The Island Copper "porphyry copper" deposit is at the head of Holberg Inlet, approximately 15 kilometres due south of the community of Port Hardy (MAPSHEET 92L 11/W; MINFILE NUMBER 92L 158). It is an "open pit" operation that has been in continuous production since 1971. In an average year it produces approximately 175,000 tonnes of copper concentrate, 4,600 tonnes of molybdenum concentrate and some 40,000 to 60,000 ounces of gold (GCNL Sept. 29th, 1990). It currently processes approximately 50,000 tonnes of ore per day at an average grade of approximately 0.35% Cu and 0.2g/t Au. + rhenium

The mine is reaching the end of it's life and it is planning for the decommissioning process. The pit went through a major, and probably final, "push-back" that involved the construction of a retaining wall in 1990. As of September, 1991 it had mineable reserves of 130 million tonnes of ore grading approximately 0.35% Cu. By the end of it's active life, it will likely have produced approximately 400 million tonnes of ore at an average grade of 0.45% Cu, 0.017% Mo and 0.0064 o/t Au at cut-off figure of 0.2% Cu.

The Island Copper deposit was formed during the development of the Jurassic-age "Bonanza Group" volcanic arc (see attachment). The deposit formed from hydrothermal fluid that was focused by a complex mineralizing "dyke" or pluton as it was emplaced into pre-existing volcanic rock late in the development of the volcanic arc.

The mineralizing dyke at Island Copper is a tabular body that intruded along an extensional structure in the volcanic arc and introduced fluid into the surrounding rock. This caused the alteration and mineralization.

"Porphyry copper" deposits are commonly formed from plutons emplaced beneath volcanic vents. The plutons are magmatic on emplacement and contain a small percentage of fluid within their make-up. The fluid builds up near the apical tip of the pluton and eventually creates a pressure that can only be released by explosive activity. Once this occurs, the rock surrounding the apical tip will be shattered and permeable. Fluid will migrate into the open space, alter the rock and deposit both sulphide and, commonly, quartz. The spaces will seal and the pressure will build again until there is another pressure relieving volcanic explosion. Deposits are commonly made up of mineralized veins formed by several explosive events.

The fluid released from the pluton will react with plutonic rock as well as "country rock". The affect that the alteration process has will be governed by the nature of the fluid, the composition of the rock and physio-chemical conditions such as temperature, pressure and level of oxygen in the fluid. The fluid will change as it reacts, migrates and cools. This creates alteration "shells" around a central core. The fluid tends to dump potassium, creating biotite and feldspar, where it is hottest (near the core) and sericite furthur out. The best copper and molybdenum values commonly occur at the transition from feldspar to sericite. Cool fluids, that have deposited their copper and molybdenum commonly migrate outward and create an outer shell of chlorite, carbonate and pyrite alteration. Note that the mineralizing process waxes and wanes. The process will colapse inward as the pluton cools off and ground water starts to interact with the system.

At Island Copper, there is a large amount of breccia and the process has created shells of both alteration and mineralization peripheral to, and above the main feeder dyke. Note that alteration zones above a "porphyry copper" deposit are commonly removed by erosion and thus not available for study. At Island Copper one can see a small amount of "pyrophyllite breccia" - a clay rich alteration product formed as a result of upward streaming of spent fluids that was involved in the creation of the underlying deposit.

"Porphyry Copper" deposits tend to be large in volume and low in grade and thus unit value. The operations are highly susceptible to minor fluctuations in metal price and they require economies of scale to be cost effective. "Porphyry copper" mines process anywhere between 40,000 and 120,000 tonnes of ore a day. In addition, the operator may have to remove two or three times as much waste rock in order to obtain the depth necessary to extract the ore.

Pushing back the walls of a deposit can create problems as the operator is required to strip and store material from the "pyritic halo" that forms around the main deposit. It is possible for the pyrite to oxidise and create acid but this need not be a problem as the same fluids that deposited the pyrite may have deposited calcite, a mineral that neutralizes acid. The amount of acid produced will reflect the relative proportions of the two minerals.

Exploration geologists looking for "porphyry copper" deposits have a reasonably large target to aim for. They are usualy looking for the apical tip of a pluton. They may concentrate on exploring eroded volcanic centres and small stocks peripheral to major batholiths. It is less common to explore large plutons but they can be mineralized (It would be a pity to miss Highland Valley).

Deposits eroded to the right level will usualy provide a large geochemical anomaly on surface. This may show up in stream sediment sample surveys and should show up in grid soil geochemical surveys.

Geophysical methods can be useful in defining the shape of a deposit. Induced Polarization surveys respond to disseminated pyrite in the "pyritic halo" around the main zone of mineralization. If you find the halo and move inside you may find the deposit.

Once a deposit has been identified, the critical question, as with all deposits, is one of tonnage and grade and mineability. The former comes from diamond drilling and a careful study of the geology of the deposit and the latter comes from detailed engineering studies and an understanding of economic considerations.

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- submarine tailings deposition
- custom milling potential
+ increased expl'n eg. Expo, Red Dog