Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
GEOLOGICAL SURVEY BRANCH

MEMORANDUM

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VOS → Vancouver Island
Myra Falls
885845

Memo To:

From: Robert Pinsent

Date: September 14th, 1992

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

The three operational mines on Vancouver Island are excellent representatives of three of the most important classes of mine found in the Province of British Columbia. The H-W occurrence is a classic example of a selectively mined "high-grade", "low-tonnage", "massive sulphide" deposit exploited by underground extraction methods. The Quinsam mine is a typical example of a combined strip and underground coal mine and Island Copper provides an excellent example of a bulk tonnage open-pit "porphyry copper" operation. Each gives considerable insight into a fundamentaly important type of mineral deposit and the most appropriate method of mineral extraction.

The following notes will provide (1) an overview of each operation, (2) a discussion on the factors controlling the location of the deposit type and (3) some of the factors considered by geologists and engineers in attempting to locate and develop each type of deposit. Note that the descriptions are simplified and somewhat generic. They are more concerned with process and concept than specific local detail.

MYRA FALLS: WESTMIN RESOURCES LIMITED

MYRA FALLS (p.1,2,3,4)

The Myra Falls Operation of Westmin Resouces Limited (MAPSHEET 92F/12E; MINFILE NUMBER 92F 330), 90 Km south west of Campbell River, started production in 1966. It produces approximately 3,650 tonnes of ore daily from the H-W and Lynx underground mines. The Company mined 1,081,400 tonnes of ore grading 3.29% Zn, 1.71% Cu, 0.19% Pb, 26.2 g/t Ag and 2.09 g/t Au in 1991.

The Operation had mineable reserves of 9,975,000 tonnes grading 3.7% Zn, 1.8% Cu, 0.3% Pb, 32.0 g/t Ag and 2.1 g/t Au as of 1st January, 1992 (Annual Report; 1991). The Company recently announced the presence of a substantial new mineable reserve in it's Gap and Battle Zones 1.7 million tonnes grading 10.9% Zn, 2.2% Cu "with significant precious metal credits" (Northern Miner, August 17th, 1992).

MYRA FALLS

The Operation exploits a cluster of "Kuroko-type massive sulphide" lenses within "island arc" volcanic rocks of the Paleozoic Sicker Group (see attachments). The deposits are formed in a zone of tectonic instability established on the flanks of a large felsic (quartz-rich and therefore explosive) submarine volcano.

The deposits are largely comprised of sulphide lenses formed in sea floor depressions that form as a result of differential movement on faults defining the long axis of the zone of instability. Their shape is controlled by several factors including (1) the topography of the floor of the depression, (2) the size of the feeder stockwork underlying the mound, (3) the rate of growth of the sulphide mound, (4) the time available before the depression is choked with extraneous material such as volcanic flows, airborne tuff, breccia or sediment or (5) the time available before tectonic activity cuts off, or re-routes, the flow of the hydrothermal fluid feeding the mound.

Most of the lenses are approximately ten to twenty metres thick, fifty metres wide and several hundred metres in length. They commonly contain between 200,000 and 2,000,000 tonnes of sulphide. The H-W and Battle Zones are unusual in that they are appreciably larger. The H-W lens contained approximately 15,000,000 tonnes of relatively low-grade ore prior to production. The dimensions of the Battle Zone have yet to be defined.

The composition of a given lens is governed by the temperature and composition of the final fluid passing through the underlying stockwork. The process of mound formation is not well documented. It appears that mineralized fluids discharge their sulphide into sea water until such time as it's interaction with sea water creates a sulphate crust over the vent. The crust inhibits the release of the hydrothermal fluid and allows it to cool and precipitate copper and zinc sulphide prior to mixing with sea water. The mound grows from below.

Note that changes in fluid temperature will affect the composition of the mound. Copper sulphide is generally precipitated from hotter fluid than lead, zinc or iron sulphide. Stockworks feeder systems below mounds are commonly formed from hotter fluids that also alter the rock and deposit quartz. They tend to be richer in copper sulphide than the tops and outer fringe lenses.

The grade of a "massive sulphide" lens is governed by the proportions of the various sulphide minerals present and the amount of extraneous material. The low grade of the H-W lens is a function of it's high content of (worthless) pyrite.

MYRA FALLS

The zone of tectonic instability that hosts the mineralization is defined by a 500 metre thick stratigraphic package "Mine Series" that has been traced for a strike length of 12 kilometres. The package is complex as rock deposition was affected by the presence of contemporary faults that also had a profound affect on the flow of hydrothermal fluid. It is not uncommon to find stacked sulphide lenses formed through repeated reestablishment of a structurally controlled plumbing system. The package is covered by massive volcanic rock that shows no sign of mineralization.

The "Mine Series" has been deformed about a anticlinal fold axis that more or less parallels the strike of the northwesterly trending zone of instability. This has caused some flattening and disruption of the sulphide lenses. Those on the steep southwesterly limb have been rotated into a vertical aspect (G-Zone). Those on the flatlying northeasterly limb (H-W, Battle) are close to flat lying. This has implications for mining as the vertical lenses are easier to handle.

(Lynx)

Kuroko-type "Volcanogenic Massive Suphides" are exceedingly attractive exploration targets as they are generally polymetallic (precious-metal bearing) and relatively high grade. This makes them less sensitive to small fluctuations in metal price than lower-grade operations.

The deposits are generally small tonnage (<10,000 t/d) operations mined by underground methods. The mine plan will call for the removal of the minimum amount of waste rock possible to access ore. The actual extraction methods used ("long-hole stoping", "cut and fill" etc.) will be governed by a trade-off between extraction cost and ore grade. Exceptionaly high-grade material may be worth selective mining, which is exensive. Low-grade material may be worth bulk mining, which is cheaper but less efficient. More waste will be extracted with the ore. Note that the absolute amount of rock extracted is a small fraction of that generated by an open-pit "porphyry" mine.

Modern mine operations try to limit the amount of pyritic (iron-sulphide) waste-rock as it may react with oxygen and rain water in the surficial environment to generate weak sulphuric acid. This creates "acid mine drainage".

Exploration for "massive sulphide" deposits is exceedingly difficult as individual lenses make extremely small targets (see above). Exploration geologists attempt to locate regionally favourable geological environments (felsic centres in "island arc" volcanic belts and sort out the

MYRA FALLS

geology of the area around the volcanic vent. Items of importance are (1) local stratigraphic complexity indicative of tectonic instability and synvolcanic faulting, (2) evidence for time breaks (sediment, chert) in the volcanic stratigraphy, (3) direct evidence of "massive sulphide" mineralization, or (4) indirect evidence of mineralization based on the presence of hydrothermal (foot-wall stockwork) alteration.

Companies will commonly fly airborne and/or conduct ground geophysical surveys over the volcanic centre looking for electrical conductors. The approach is good for near-surface copper or iron sulphide bodies but zinc sulphides are not particularly conductive. A good conductor, like graphite, in sediment adjacent to a sulphide lens will over-power the sulphide signal.

The hydrothermal fluids that create sulphide lenses react with underlying rock in transit to the surface and change it's chemistry. Companies will conduct extensive lithogeochemical sampling surveys designed to locate alteration zones beneath sulphide lenses.

Note that most favourable volcanic packages in the Province are more or less deformed, which means that a stratigraphic surface that contains a sulphide lens may have any orientation with respect to the modern land surface. It may be vertical (as it commonly is in Central Canada) or it may be essentialy horizontal. It may or may not intersect surface. There is very little mineralization on surface at Myra Falls as the "Mine Series" is only breaches surface in the valley of Myra Creek. It is very difficult to locate buried lenses from above. Hence Westmin's requirement for underground development to explore the Battle and Gap lenses.

QUINSAM (p. 4,56)

QUINSAM COAL: HILLSBOROUGH RESOURCES

The Quinsam Coal Mine (MAPSHEET 92F/14; MINFILE NUMBER 92F 319), at Middle Quinsam Lake near Campbell River, is owed by Hillsborough Resources Limited. It has been in production since 1986 and produced approximately 400,000 tonnes of low-sulphur bituminous thermal coal in 1991. The Company expects to increase production to a rate of 500,000 tonnes in 1992 (Annual Report; 1991). It has approximately of 44 million tonnes of accessible reserves.

The Quinsam "coal measures" are Cretaceous in age (see attachments). They are part of the Comox Formation, a sedimentary unit that is part of the more widespread Nanaimo Group.

Province of
British Columbia

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→ Myra Falls

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Province of British Columbia

NEWS RELEASE

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

FOR IMMEDIATE RELEASE

1991:75

December 4, 1991

WESTMIN'S EXPLORATION DRILLING PROGRAM OK'D AFTER PUBLIC INPUT

Victoria - Westmin's Resources has been given approval to drill test-holes at 16 sites on its existing lease within Strathcona Park on Vancouver Island.

Approval follows a detailed review of the company's plans at a public meeting held in Campbell River and includes stringent conditions for the six-to-eight-week program.

Announcement of the permit approval was made jointly today by Energy and Mines Minister Anne Edwards and by Environment, Lands and Parks Minister John Cashore, whose ministries will supervise the program.

"The approval process has given Westmin's and the public the opportunity to participate fully in the review of the program," said Edwards. "There will be regular meetings in future to keep the door open for discussion and comment."

"Environmental protection, a special wildlife program and full reclamation are written into the approval," noted Cashore. "The special character and status of the area have been recognized."

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Colin Gabelmann, local MLA and Attorney General, emphasized: "All mining activities now and in future are limited to Westmin's existing lease. Development of future reserves will be from existing underground workings within the lease borders and will not extend underground into areas below the park."

Westmin's mine employs more than 400 people and is located on a lease within Strathcona Park. The mine has operated for more than 30 years, and its legal right to operate on its existing lease zone has been recognized. The permitted drilling program is aimed at finding a new orebody to extend the estimated 10 years of remaining reserves.

Full details of the program and permit conditions are available.

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For further information contact:

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