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GEOLOGY OF WESTERN MINES

Western Mines operate a 1,000 ton per day Cu-Pb-Zn mine located on Central Vancouver Island some 125 miles northwest of Victoria, B.C. Mining commenced in 1967 and to date production plus ore reserves total some 4 million tons grading 3.5 oz. silver, 1.6 percent copper, 1.0 percent lead and 7.5 percent zinc.

The ore deposits of Western Mines are located near the north limit of a belt of Permian volcanics which trend northwest from Duncan to Buttle Lake, a distance of 110 miles. The stratigraphy of Western Mines is shown on Plate 1. Permian volcanics are over 6,000 ft. in thickness and have been subdivided locally into three units. The oldest unit is the Vent Formation and contains the diagnostic rock types, rhyolite, andesite flows and breccias and lapilli tuffs of dacitic composition. These rocks form submarine volcanic piles which are overlain and infilled by the Banded Tuff Formation. The Banded Tuff Formation is composed of finer pyroclastic material and contains numerous cherty banded tuff members. The Banded Tuff and Vent Formations are believed to represent a single volcanic cycle.

The Dacitic Tuff Formation is a fairly uniform assemblage of green lithic tuffs some 4,000 to 5,000 ft. in thickness. It contains occasional banded tuff members suggesting at least partial submarine deposition but because of its widespread nature, it covers over 100 square miles of the mine area, a major sub-aerial vent system is suspected. Some support for this suggestion is indicated by a widespread agglomerate which occurs near the top of the unit.

Crinoidal limestones of early Permian age overlie the volcanics and following a period of mild uplift pillow andesites of the Triassic Karmutsen Formation were deposited. Diabase sills and dykes associated with this period have intruded the Permain volcanics. Further intrusive activity occurred in Jurassic time. Numerous dykes and several small stocks of granodiorite intrude the Permian volcanics and the Bedwell batholith lies about one mile west of the mine.

The surface geology of the mine area is shown on Plate 2. Faulting is the most important structural element and three fault systems have been recognized. The ~~oldest~~ FIRST trend to the northeast and serve to subdivide the area into the Lynx, Myra Falls and Price mine area. These faults disrupt but do not cut off a through-going northwest fault system which apparently influences the location of the vent formation. The vent formation dips to the south in the Price mine area and to the northeast in the Lynx mine area. I should also point out that the movement on this fault is 1500 ft. of vertical displacement on the Banded Tuffs and Vent Formation whereas the displacement on the diabase and limestones is in the order of several hundred feet in the opposite direction. This fault was active prior to the final deposition of the Dacitic tuff formation and the Permian limestones which formed on the shallow marine shelf the Dacitic tuffs provided. The youngest fault system trends to the north and these faults likely developed in post Permian time. They offset both the Karmutsen diabase sills as well as the Jurassic feldspar porphyry dykes associated with the Bedwell batholith.

The detailed geology of the Lynx Mine is shown in the next two slides. The first one is a cross section looking to the north. Here rhyolite breccias and tuffs define a volcanic pile dipping 40^{o} northeast which has been drag Folded and truncated by the south wall fault zone. The rhyolites have been down dropped some 1500 feet by this fault. The banded tuffs deposited on the flank of this pile are flat lying and are beleived to thicken to the east and thus in-fill this structure. Strata bound massive sulphide ore occurs 2,000 feet from the intersection of the rhyolite and the south wall fault in a rhyolite tuff-argillite environment and adjacent to the fault in the G zone and G hanging wall rhyolite breccias. Lenses of massive sulphide also occur adjacent to the south wall fault. This ore is believed to be a fault disrupted strata bound zone. The next slide is a longitudinal section of Lynx showing the continuity of the mineralization along strike. The zones on the south wall terminate where a northeast fault disrupts the G zone and a north fault truncates the entire structure at an acute angle. G zone mineralization has been traced more or less continuously to the western limits of the developed part of the mine. In this area we are currently getting encouraging results in both the G zone and the South Wall zone.

The Myra Falls mine is located immediately southeast of the Lynx and a northeast fault separates the two areas. At Myra a 900 foot dip length of the rhyolite occurs between the south wall fault and a second parallel fault not present in the Lynx area. This fault block of rhyolite has been traced 5,000 ft. southeast where a second northeast fault offsets the rhyolite north to the Price Mine area.

The mineralization at Myra differs somewhat from that at the Lynx in that the pyrite and chalcopyrite content decreases while there are significant increased in the silver and galena content. In the eastern portion of the mine mineralization occurs primarily as massive strata bound ore overlain by an andesite flow. Disseminated zones in a possible fumarole structure and disseminated zones in fractures parallel to the bedding panes also occur. As the strata bound zone is traced ~~east~~ WEST it plunges into the structurally disturbed area associated with the northwest trending fault system. The dip length of the strata bound ore is shortened in this area and the ore is clearly drag-folded in places. Disconnected lenses of mineralization adjacent to the fault are found only in this western area and it is assumed they are down faulted portions of the strata bound zone.

The next slide shows the geology at the Price mine. Here there has been a major modification to the northwest fault system. The apparent vertical movement is reversed with the south block now uplifted relative to the north block. This results in the exposure of the southern flank of the vent formation pile. The stratigraphy at the Price Mine is not unlike the Lynx or Myra Falls mine. It is shown here in slightly more detail and you can see that there is a basal rhyolite tuff member overlain by a sequence of alternating breccias and lithic tuffs. The Banded tuff formation overlying the pile again shows angles which are not conformable to the pile. No commercial mineralization has been discovered at the Price mine to date. Two small streta bound ore shoots occur in lenses of altered rhyolite tuff high in the vent formation sequence and the main rhyolite member is currently being explored by an exploration heading which will connect with the Myra Falls development.

At this time I would like to summarize the main points of the Western Mines deposit. These features are:

(1) The volcanic pile is symetrical about a northwest trending fault system and a breccia to tuff facies change occur downdip of this fault system.

(2) All of the mineralization found to date occurs in rhyolite adjacent to and downdip of the fault system.

(3) Most of the mineralization is at or near the top of the rhyolite members. No significant mineralization is in the hanging wall, andesite and rhyo-dacite breccia units.

(4) Fragments of ore and altered rhyolite occur in hanging wall breccias and tuffs.

(5) The orebodies have relatively small cross-sectional areas but are remarkably persistent along a horizontal plunge.

These features indicate centres of submarine volcanic activity were localized along a pre-existing northwest break. Hydro-thermal mineralization is closely associated with the rhyolite phase of volcanic activity and most probably limited to this phase. It is suggested that massive sulphides were deposited primarily at the rhyolite-marine interface and concentrated downdip of vents and fumerals controlled and inter-connected by the northwest break. At the close of the Vent-Banded Tuff volcanic cycle movement along this break occurred and dragged a considerable portion of the ore deposits to their present position.

The next group of slides are intended to illustrate the rock types found in the Western Mines area within the Permian volcanics and as well show some of the alterations associated with the ore:

Slide 1 - is a rhyolite lapilli tuff showing very minor alteration.

Slide 2 - this rhyolite shows typical alteration associated with the ore zones. Wisps of sericite impart a schistose fabric to the rock and disseminated pyrite occurs in both the matrix and fragments.

Slide 3 - This slide is of silver rich ore from the Myra mine. Massive weakly banded galena-sphalerite mineralization occurs with a silicous gangue. Chalcopyrite is disseminated sparsely throughout and occurs as a very thin band.

Slide 4 - Andesite flows commonly overlie the rhyolites and this slide illustrates the typical andesite containing quartz amygdules.

Slide 5 - This is an unaltered dacite breccia from well up in the hanging wall and contains an altered pyrite bearing rhyolite fragment. Ore fragments in the hanging wall breccias are not uncommon.

Slide 6 & 7 show some typical hematite alteration. Hematite alteration of the volcanics is common and may take two forms. The first slide shows hematite veinlets in an altered dacitic tuff. Slide 7 shows Jasper fragments developed probably by replacement of silecous fragments.

Slide 8 - is a rhyo-dacite tuff breccia containing sparse pyrite.

Slide 9 - this is a dacite breccia and the following slide is a close up of the lapilli tuff.

Slide 10 - This is a member from the sharp band tuff formation which contains these tuffs inter-bedded with finer lithic tuffs. The sharp banded tuff formation is assigned to a unit containing a significant number of these sharp banded tuffs. Each banded tuff however may only be several feet in thickness.

Slide 11 - The dacitic tuff formation is illustrated by this slide, however it is generally finer grained and more uniform in texture.