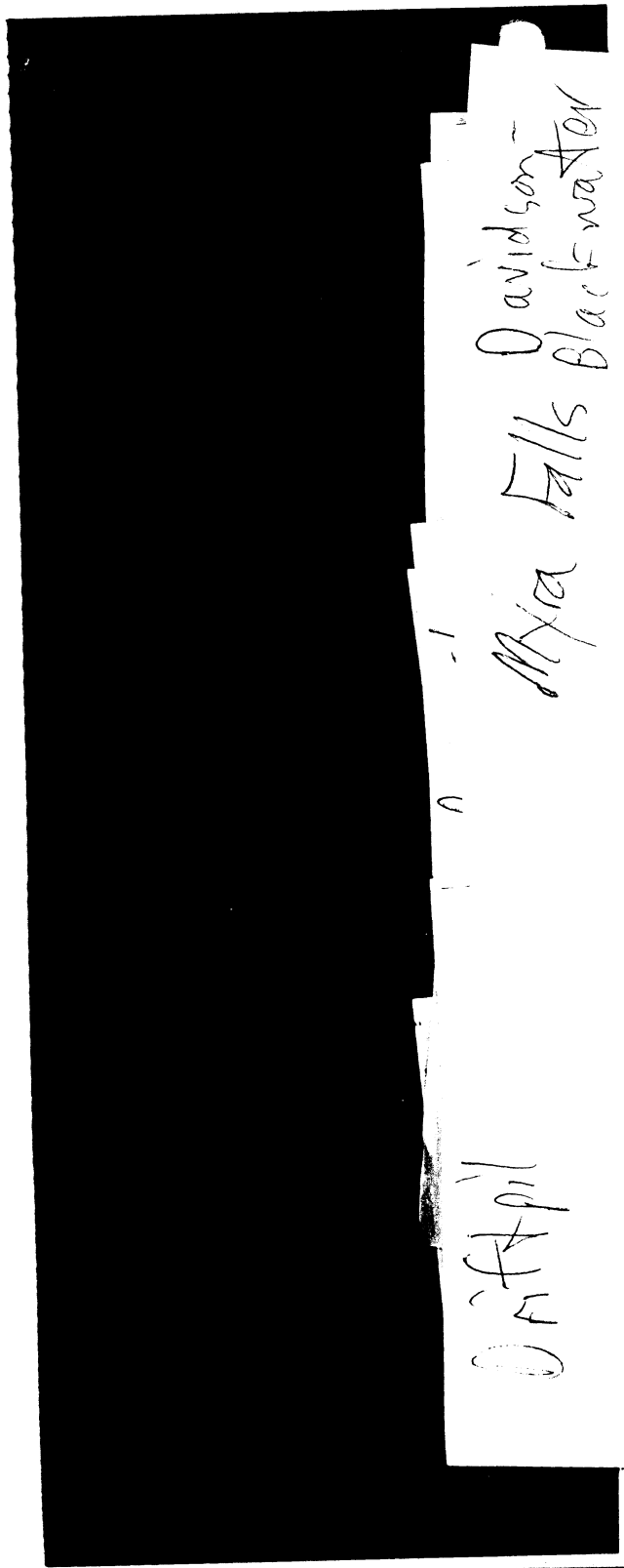

characterized by quartz-sericite-dolomite-pyrite with pyrite-quartz veins common in the footwall.

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Volcanic Setting of the H-W Massive Sulfide Deposit, Myra Falls, Southern British Columbia

Timothy J. Barrett, and Ross L. Sherlock, Mineral Deposit Research Unit, Department of Geological Sciences, University of British Columbia

The Myra Falls deposits occur on Vancouver Island, in Paleozoic Sicker Group rocks of the Wrangellia terrane. The H-W orebody has total past production and current reserves of 13.7 million tonnes grading 1.9% copper, 0.35% lead, 4.0% zinc, 1.9 g/t gold, and 30.9 g/t silver (Pearson, 1993). The stratigraphic footwall to the orebody consists of >300 metres of mainly massive to pillowed mafic flows of basaltic andesite composition and island-arc tholeitic affinity. Directly under the orebody, a strong sericite-quartz-pyrite alteration zone interpreted as the main feeder zone extends 25-50 metres into the footwall. Calculated mass changes in this zone reveal very large additions of K, near total loss of Ca and Na, and variable changes in Si. Whole rock $\delta^{18}O$ values and fluid inclusion data indicate data indicate that temperatures in the feeder pipe were ~150-250°C.

Above the H-W orebody are 50-100 metres of subaqueous felsic volcaniclastic mass flows and pyroclastic beds, and intercalated black mudstones, collectively known as the H-W interval. Felsic rocks in this interval are of transitional to mildly calc-alkaline affinity. Tholeiitic mafic sills commonly intrude the H-W interval, producing widespread peperitic textures and disruption of bedding, indicating intrusion into unconsolidated sediments.

Directly above the H-W deposit, a thick sequence of black mudstone accumulated with episodic introduction of felsic mass flows. However, in the direction of the North Lens, a small deposit located several hundred metres laterally away from the H-W orebody, the proportion of felsic mass flows increases until massive rhyolites are encountered. These relations suggest that the H-W deposit may have attained its large size in part because only mudstones were accumulating in this area of the basin. By contrast, deposition of the North Lens orebody was arrested by the extrusion of massive rhyolites and associated flanking felsic debris.

The Tulsequah Chief and Big Bull Volcanogenic Massive Sulphide Deposits, Northern British Columbia

Chris F.B. Sebert, Timothy J. Barrett, and Ross L. Sherlock, Mineral Deposit Research Unit, Department of Geological Sciences, University of British Columbia,

The Devono-Mississippian Tulsequah Chief and associated nearby Big Bull volcanogenic massive sulphide deposits are in the Stikine Terrane about 100 kilometers southwest of Atlin, BC. At the Tulsequah Chief deposit, the stratigraphically lowest unit is composed of basalts and basaltic andesites rocks which form

lators want about risk. They can only help shape professional judgment and common sense.

SESSION 12 - PLAZA EAST
Geology III — Massive Sulphide Deposits of Western North America
TIM BARRETT, The University of British Columbia, Chairperson

Paper No. 57 — 1:45
The Myra Falls Kuroko-type Cu-Zn-Pb-Au-Ag Massive Sulphide Deposits, Vancouver Island, Southern British Columbia
TIMOTHY J. BARRETT and the MDRU-VMS Project, The University of British Columbia and STEPHEN J. JURAS, Westmin Resources Limited

The Myra Falls deposits occur 90 kilometres from Campbell River, in Palaeozoic Sicker Group rocks of the Wrangellia allochthonous terrane. The H-W orebody and adjacent North Lens have geological reserves of 12.5Mt grading 1.9% copper, 0.5% lead, 6.3% zinc, 2.1g/t gold and 45.6g/t silver. The Price andesite forms the footwall and consists of at least 300 metres of massive to pillowed flows and flow breccias. This unit is overlain by the H-W horizon, which comprises 50 to 100 metres of felsic subaqueous volcaniclastic and pyroclastic beds, lesser interbedded black mudstones, and, near the North Lens, a quartz-feldspar-porphyritic rhyolite unit up to 50 metres thick. Zircon U-Pb dating of H-W rhyolite yielded an age of 370±6Ma.

The massive sulphide lenses are underlain by a strongly altered and pyritized feeder zone that extends 25 to 50 metres into the footwall. Above the feeder zone, massive pyrite grades stratigraphically up into massive pyrite with several per cent disseminated chalcopyrite. This is typically overlain by an interval of semi-massive to disseminated polymetallic sulphides alternating with mass flow units of felsic debris. This upper interval of mineralization tends to be dominated by sphalerite, galena, tennantite and barite.

The mafic footwall has low incompatible trace element contents (with Zr/Y = 3-5), low TiO_2 (0.8-0.9%), and slightly evolved REE signatures ($[La/Yb]_n$ = 2-4)), all indicative of an island-arc tholeiitic series. By contrast, the felsic hanging wall rocks have a more evolved mildly calc-alkaline affinity (Zr/Y = 5-7, $[La/Yb]_n$ = 4-8). Two main alteration trends in Al_2O_3 vs. TiO_2 and Al_2O_3 vs. Zr space result from alteration of rhyolite and mafic precursors with limited compositional ranges in their immobile element ratios. Calculated mass changes for the upper mafic footwall and lower hanging wall at both deposits reveal large additions of potassium, and near-total loss of calcium and sodium, but only minor magnesium addition.

The geological evolution of the host stratigraphy at the H-W deposit involves: (a) formation of a widespread mafic volcanic basement; (b) massive to semi-massive sulphide mineralization of various styles, with local

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baritic to cherty intervals; (c) emplacement of massive felsic domes and shallow sills, with lateral accumulation of felsic volcaniclastic mass flow deposits in local mudstone basins; and (d) synsedimentary emplacement of mafic sills and flows of tholeiitic affinity into the felsic hanging wall sequence.

Paper No. 58 — 2:15
The Tulsequah Chief Kuroko-type Cu-Zn-Pb-Au-Ag Massive Sulphide Deposit, Vancouver Island, Northern British Columbia
ROSS L. SHERLOCK and the MDRU-VMS Project, The University of British Columbia, TERRY CHANDLER, Redfern Resources Ltd. and GARNET DAWSON, Cambria Geological Ltd.

The Tulsequah Chief volcanogenic massive sulphide deposit is located on the Tulsequah River 100 kilometres south of Atlin. Reserve estimates for all classes are 9.34Mt grading 1.41% copper, 1.23% lead, 6.65% zinc, 2.54g/t gold and 105.6g/t silver.

Mineralization occurs primarily as a series of closely spaced lenses within felsic volcaniclastic mass flows of the lower hanging wall. Several facies of mineralization are present, although the spatial relationships are partly obscured by folding. The pyrite facies consists mainly of massive pyrite with a low base metal content. The zinc facies is composed of semi-massive pale yellow sphalerite, pyrite, galena, chalcopyrite and tetrahedrite, with barite, quartz and sericite-altered lithic fragments. The copper facies is mainly composed of massive pyrite with up to several per cent disseminated chalcopyrite. Baritic and cherty facies also occur. The felsic host rocks are dominantly altered to sericite-silica-pyrite. Stringer mineralization in the mafic footwall is common and comprises thin, anastomosing, quartz veins with dark red sphalerite and chalcopyrite. The uppermost footwall mafic flows are commonly strongly amygdaloidal with an alteration assemblage of sericitic, biotite, quartz, cordierite and pyrite.

The mafic footwall has low incompatible trace element contents (Zr/Y = 3-5), low TiO_2 (0.8-0.9%), and transitional REE signatures ($[La/Yb]_n$ = 2-4) indicative of an island arc tholeiitic series. By contrast the hanging wall felsic rocks have a mildly calc-alkaline affinity (Zr/Y=5-7, $[La/Yb]_n$ = 4-8). Two main alteration trends in both Al_2O_3-TiO_2 and Al_2O_3-Zr space are the result of alteration of mafic and felsic rocks with limited initial composition ranges. Mass change calculations for both the upper footwall and lower hanging wall indicate large additions of potassium, and near total loss of calcium and sodium with only minor magnesium additions. The overall stratigraphic setting of the mineralization, the average metal grades and the sericite-rich alteration are all similar to those of the H-W and Battle orebodies of the Myra Falls camp on Vancouver Island.

Paper 23 — 9:30 a.m.

Westmin Resources Ltd. Massive Sulphide Deposits, Buttle Lake, Vancouver Island, B.C.

RICHARD WALKER, Westmin Resources Ltd., Campbell River, B.C.

Westmin Resources Ltd. (formerly Western Mines Ltd.) currently produce 965 short tons of ore per day from Myra and Lynx mines, located at the south end of Buttle Lake in central Vancouver Island. Two new mines, the Price and the H-W, were discovered in the latter part of 1979 and are currently under development. All production since start-up in 1967 has been from the Myra and Lynx mines. Ore produced to the end of 1980 totalled 4,616,000 short tons averaging 0.06 ounce Au/ton, 2.8 ounces Ag/ton, 1.6% Cu, 1.0% Pb and 7.6% Zn with by-product cadmium. Proven reserves in Myra and Lynx mines at the end of 1980 were 1,092,000 tons grading 0.07 ounce Au/ton, 3.3 ounces Ag/ton, 1.1% Cu, 1.0% Pb and 7.7% Zn.

Sinking of a 2500-ft shaft is in progress to gain access to the H-W deposit, which was first intersected by a surface drill hole at a depth of 1400 ft below the floor of Myra valley. Based on surface holes drilled in 1980, an independent consulting firm estimated a reserve in the H-W deposit of 5,314,400 tons "drill indicated" and 2,714,600 tons "possible" with an average grade of 0.07 ounce Au/ton, 1.0 ounce Ag/ton, 2.1% Cu, 0.3% Pb and 4.9% Zn. Continuing exploration has expanded the known dimensions of the deposit, which is still open.

The Westmin Resources' ore deposits occur within volcanics, volcaniclastics and sediments of the Myra Formation. The most probable age of the Myra Formation is late Silurian to Devonian. The Myra Formation is underlain by the mafic volcanic Nitinat Formation and overlain by limestone of the Buttle Lake Formation, which is middle Pennsylvanian to Permain in age. The above three formations comprise the Sicker Group. The Sicker Group, along with the overlying Vancouver Group and Bonanza Group, comprise a segment of allochthonous terrane termed Wrangalia which was accreted on the west coast of British Columbia in the Jurassic.

The Myra Formation is composed of volcaniclastic and sedimentary rocks thought to have formed in a submarine island-arc environment. The volcanics include basaltic, andesitic and felsic rocks of predominantly calc-alkaline character. The massive sulphide deposits of Buttle Lake are closely associated with felsic volcanic rocks. All known ore deposits and felsic volcanics are limited to a stratigraphic zone approximately 1200-1500 feet thick which is characterized by massive volcanic rocks, heterolithic volcaniclastics which range from coarse breccias to fine tuffs or greywackes, and subordinate chemical sediments which include massive sulphide, barite, chert, jasper and carbonaceous chert to argillite. Large zones of altered rocks occur principally beneath the ore zones. The altered rocks have been metamorphosed and are recognized as sericitic, siliceous and pyritic. Sulphitic alteration beneath ore includes major zones of stringer and disseminated pyrite and minor base metal sulphides. Only a small amount of pyrite stringer zone material has been mined for its chalcopyrite content.

cf. Greens Ck., Alaska

The Myra Formation in the mine area has been affected by dynamothermal metamorphism of the lower greenschist facies. Deformation has been inhomogeneous and has led to the development of schistose and stretched rock fabrics. Schistosity is localized primarily in sericitic altered rocks associated with the ore zones.

The Lynx, Myra and Price mines are segments of a single elongate zone of rhyolite, altered rocks and ore. This zone is coincident with a large assymetrical anticlinal "shear fold" with a flat plunge, northwest strike, steep northeast-dipping axial plane, axial-plane schistosity and a prominent b-lineation in the rock fragment. Amplitude is at least 1500 feet and the southwest limb is in part overturned. The ore zone and structure have been traced over a strike length of 18,000 feet. The H-W deposit lies at a lower stratigraphic level and occupies a parallel elongate trough or syncline with an axis 2000 feet northeast. There is evidence that both structure and paleotopography may have influenced its present form. Smaller-scale fold structures, including folded schistosity, are present, especially in the strongly schistose incompetent rocks of Lynx mine.

GEOLOGY OF WESTERN MINES

BUTTLE LAKE, VANCOUVER ISLAND

A B S T R A C T

Western Mines Ltd. owns, and produces concentrates from, base metal sulfide orebodies near the center of Vancouver Island at Lat. 49° 35' N and Long. 125° 35' W. The metals in the ore - Zn, Cu, Pb, Ag and Au, the rock alteration - sericite and chlorite, and the gangue minerals - barite and pyrite, are features characteristic of many base metal deposits in volcanic rocks. The Kuroko ores of Japan and the pyritic copper - zinc ores of the Canadian Shield are two commonly cited groups of this widely recognized deposit type. These deposits display a close spatial relationship to centers of subaqueous volcanism which produce acid breccias and tuffs at the end of a period of activity. Commonly, ore deposits develope as a stratiform sheet separating acid rocks from overlying andesitic rocks. At Western Mines' Lynx property a prominent N-W striking fault separates a structurally disturbed southwest side of an acid breccia pile from a relatively undisturbed northeast side of the pile. Reconstruction of the geology at Lynx suggests an early ridge of rhyolitic breccia and massive rhyolite, approximately symmetrical in section, about 2,000 feet wide at its base and with relief of about 1,000 feet. This pile was partly mantled by a sheet of sulfide up to 30 feet thick thinning to zero in a slope distance of 800 to a 1,000 feet down each flank. Following accumulation of overlying tuffs, breccias and andesite flows, a narrow wedge, elongate parallel to the ridge at or near the crest of the pile collapsed carrying an elongate segment of the thickest portion of the sulfide sheet some 500 feet downward from its original position. The presence of both altered and unaltered post-ore units southwest of the fault suggests collapse may have extended over some duration of instability in the pile. The oversteepened southwest flank of the pile has rotated downward at least 30°. Foundering or compression from the southwest (indicated by late thrust faults) or a combination of both may have caused this rotation.

8-10% Zn
2% Cu
1% Pb
2-3oz Ag

T. W. Muraro