THE ESKAY CREEK MINE: A PRECIOUS METAL RICH, CLASTIC SULPHIDE-SULPHOSALT DEPOSIT

Tina Roth, Mineral Deposit Research Unit - The University of British Columbia, and Homestake Canada Inc.

The Eskay Creek Mine is a high-grade precious and base metal-rich sulphide and sulphosalt deposit located 80 km northwest of Stewart, British Columbia. A number of mineralized zones identified on the property can be distinguished by varying mineralogy, textures and grade. Economic concentrations of precious and base metals are contained in the 21 zone, which contains a number of distinct sub-zones. The bulk of the ore is hosted in the stratiform 21B zone. Production from the 21B zone commenced in January 1995 with a proven and probable mining reserve of 1.08 million tonnes grading 65.5 grams/tonne Au and 2,931 grams/tonne Ag.

Stratiform mineralization is hosted in marine mudstone at the contact between underlying rhyolite and overlying basalt packages. This succession forms the upper part of the Lower to Middle Jurassic Hazelton Group. At the same stratigraphic horizon as the 21B zone are the 21A zone, characterized by As-Sb-Hg sulphides, and the barite-rich 21C zone. Stratigraphically above the 21B zone, mudstones host a localized body of base-metal-rich, relatively precious metal-poor, massive sulphide (the "hanging wall" zone). Stockwork vein mineralization is hosted in the rhyolite footwall in the Pumphouse, Pathfinder and 109 zones. The Pumphouse and Pathfinder zones are characterized by pyrite, sphalerite, galena and chalcopyrite rich veins and veinlets hosted in strongly sericitized and chloritized rhyolite. The 109 zone comprises gold-rich quartz veins with sphalerite, galena, pyrite, and chalcopyrite associated with abundant carbonaceous material hosted mainly in siliceous rhyolite.

The 21B zone consists of stratiform clastic sulphide-sulphosalt beds. The ore minerals are dominantly sphalerite, tetrahedrite and Pb-sulphosalts with lesser freibergite, galena, pyrite, electrum, amalgam and minor arsenopyrite. Sphalerite in the 21B zone is typically Fe-poor. Stibnite occurs locally in late veins and as a replacement of clastic sulphides. Rare cinnabar is associated with the most abundant accumulations of stibnite. Barite occurs as isolated clasts and in the matrix of bedded sulphides and sulphosalts, or as rare clastic or massive accumulations, mainly in the northern portion of the deposit and in the 21C zone.

The clastic ore beds in the 21B zone show rapid lateral facies variations. Individual beds range from <1 mm to 1 m thick. The thickest beds occur at the core of the deposit and comprise sulphide cobbles and pebbles in a matrix of fine-grained sulphides. These beds have an elongate trend which approximately defines the long axis of the deposit and which probably were deposited in a channel-like depression. Lithic clasts within the beds are mainly chloritized rhyolite and black mudstone. Angular, laminated mudstone rip-up clasts have locally been entrained within the clastic sulphide-sulphosalt beds. Both laterally and vertically, the ore beds become progressively thinner, finer grained and interbedded with increasing proportions of intervening black mudstone. Vertically successive clastic beds, either graded or ungraded, vary from well to poorly sorted. Bedded ore grades outwards from the core of the deposit into areas of very fine grained, disseminated sulphide mineralization.

The 21B zone exhibits many characteristics analagous to Kuroko-type volcanogenic massive sulphide deposits, but is associated with an epithermal element suite and high precious metal content. These features may be explained if the deposit formed in a relatively shallow water environment and significant boiling of the hydrothermal fluids occurred. The variability in textural characteristics of the clastic ore may reflect a variety of mechanisms related to explosive hydrothermal and/or sedimentary processes.

A5

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The Eskay Creek Mine is a high-grade precious and base metal-rich sulphide and sulphosalt deposit located about 80 km northwest of Stewart, British Columbia (Figure 1). A number of mineralized zones have been identified on the property; distinguished by varying mineralogy, textures and grade. Economic concentrations of precious and base metals are contained in the 21 zone, which contains a number of distinct sub-zones (Table 1; Figure 2). The bulk of the ore is hosted in the stratiform 21B zone. Production from the 21B zone commenced in January 1995 with a proven and probable mining reserve of 1.08 million tonnes grading 65.5 grams/tonne Au, 2,931 grams/tonne Ag, 5.6% Zn and 0.77% Cu.

The deposit is hosted in volcanic and sedimentary rocks of the Lower to Middle Jurassic Hazelton Group. The mine sequence comprises an upright stratigraphic succession of andesite, marine sediments, intermediate to felsic volcaniclastic rocks, rhyolite, mudstone which hosts stratiform 21 zone mineralization, and basaltic sills and flows. The lower part of the sequence is intruded by porphyritic monzodiorite to diorite and by younger felsic dikes and stocks which are feeders to the rhyolite package. Basaltic dikes and sills crosscut all strata. These rocks are folded into a gently northeast plunging anticline (Figure 3). Stratiform 21 zone mineralization occurs near the fold closure, dipping at about 40° on the west limb.

Four zones of stratiform mineralization have been identified (Table 1). The 21A, 21B and 21C zones occur at the same stratigraphic horizon, within carbonaceous mudstone above the upper contact of the rhyolite sequence (Figures 2 and 4). The 21A zone comprises a small lens of precious metal rich, massive to semi-massive stibnite-realgar-cinnabar and disseminated stibnite-arsenopyrite-tetrahedrite in the immediate footwall rhyolite. This zone is located about 200 metres from the south end of the 21B zone. The 21C zone is a small zone of barite-rich mineralization approximately 100 metres down-dip of the western margin of the 21B zone, and is also underlain by minor cryptic disseminated mineralization within the footwall rhyolite. The Hanging Wall (HW) zone occurs stratigraphically above the 21B zone, also within mudstone, and is locally cut by unmineralized basaltic dikes and sills. The HW zone is characterized by massive fine-grained pyrite, sphalerite, galena and tetrahedrite.

Discordant vein mineralization is present in the rhyolite footwall in the Pumphouse, Pathfinder and 109 zones (Figures 2 and 4) . The Pumphouse and Pathfinder zones are characterized by veins and veinlets of pyrite, sphalerite, galena and chalcopyrite. The 109 zone comprises quartz veins with lesser sphalerite, galena, pyrite, chalcopyrite and electrum associated with abundant carbonaceous material.

The 21B zone contains the bulk of the ore reserves and consists of stratiform clastic sulphide-sulphosalt beds. The 21B zone has a strike length of about 800 metres and a maximum thickness of about 10 metres. This zone spatially overlies an accumulation of fragmental rhyolite which is commonly altered pervasively to clinochlore and sericite. Massive to flow banded rhyolite below the fragmental interval is strongly altered to quartz - sericite - pyrite ± clinochlore ± K-feldspar.

The ore minerals in the 21B zone are dominantly sphalerite, tetrahedrite and Pb-sulphosalts with lesser freibergite, galena, pyrite, electrum, amalgam and minor arsenopyrite. Sphalerite in the 21B zone is typically Fe-poor. Stibnite occurs in late veins and as replacement of clastic sulphides, and is locally associated with cinnabar. Barite occurs as clasts in the ore beds or as localized clastic or massive accumulations, mainly in the northern portion of the deposit. Gypsum is rare and occurs with barite in hydrothermal alteration zones near the top of the rhyolite underlying the ore.

The clastic ore beds in the 21B zone have well preserved sedimentary features. Bed thicknesses range from less than 1 mm to about 1 m. Unmineralized lithic fragments in the ore beds include angular, laminated mudstone rip-up clasts and intensely chlorite-altered rhyolite fragments. The beds may be alternately graded or ungraded, and poorly to well sorted. Load and flame structures occur at the base of some beds. These sedimentary features are often well preserved, but are locally obscured by penetrative cleavage associated with folding of the Eskay Anticline.

R6

Rapid lateral facies variations occur within the 21B zone ore horizon. Facies are defined within the ore based on variations in bed thickness, clast size, and composition. The thickest beds occur at the core of the orebody and comprise sulphide cobbles and pebbles in a matrix of fine-grained sulphides. The distribution of thick, coarser beds outline a linear trend approximating the long axis of the deposit, suggesting deposition in a channel-like depression (Figure 5). Thick ore beds near the base of the sequence generally lack intervening mudstones and may represent an agglomerated sequence of debris flows. Clast size and bed thickness typically decrease stratigraphically upwards, progressively thinning to fine laminations and disseminated sulphides and sulphosalts in mudstone. Thin beds of intercalated black mudstone generally increase proportionally towards the top of the mineralized zone as sulphide beds become thinner and clast size decreases. Laterally away from the thickly bedded core of the 21B zone, the size of the sulphide-sulphosalt clasts rapidly decreases to less than 5mm, and to less than 1mm. Laterally, the ore beds also generally become progressively thinner and the proportion of intercalated black mudstone inereases. At the distal margins of these beds, sulphide-sulphosalt clasts become very fine grained and disseminated in the black mudstone. This relationship is shown schematically in Figure 5.

The clastic sedimentary nature of the ore, the geometry of the zone, and the spatial association with an accumulation of volcaniclastic rocks suggest that the deposit may have formed by the collapse or breakup of a sulphide mound on the flank of an elongate depression, possibly controlled by synvolcanic fault activity. The epithermal element suite associated with the 21 zone and the high precious-metal content of the ore may be explained if the deposit formed in a relatively shallow water environment where significant boiling of the hydrothermal fluids occurred. The variability in textural characteristics of the clastic ore may reflect a variety of depositional mechanisms related to sedimentary and/or hydrothermal eruptive processes.

ACKNOWLEDGEMENTS:

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Figure 1: Location of the Eskay Creek Mine.

Figure 2: Spatial distribution of mineralized zones within the Eskay Creek 21 Zone.

Figure 3: Geology of the Eskay Creek area. Compiled from mapping by F.C. Edmunds & D.L. Kuran (1991), R.D. Bartsch (1993), P.D. Lewis (1993), T. Roth (1993), and H. Marsden & A. Kaip (1993).

Figure 4: Schematic cross-section through the Eskay Creek 21 Zone showing the relative spatial relationship of the subzones of mineralization. The orientation of this diagram is representative of a section looking west approximately parallel to the Pumphouse Fault Zone shown in Figure 2. The position of the 21C zone is schematic and indicates only its stratigraphic level within the deposit.

Figure 5: Schematic representation of facies variations within the 21B zone clastic ore. The thickest beds and coarsest clasts appear to form a generally northward trending channel. The arrows indicate the direction of generally decreasing clast size and bedding thickness. The clast size generally decreases along this channel to the north. Bedding thickness and grain size typically decreases laterally away from this central channel. The margins of mineralization are typically fine-grained disseminated sulphides in mudstone.

R8

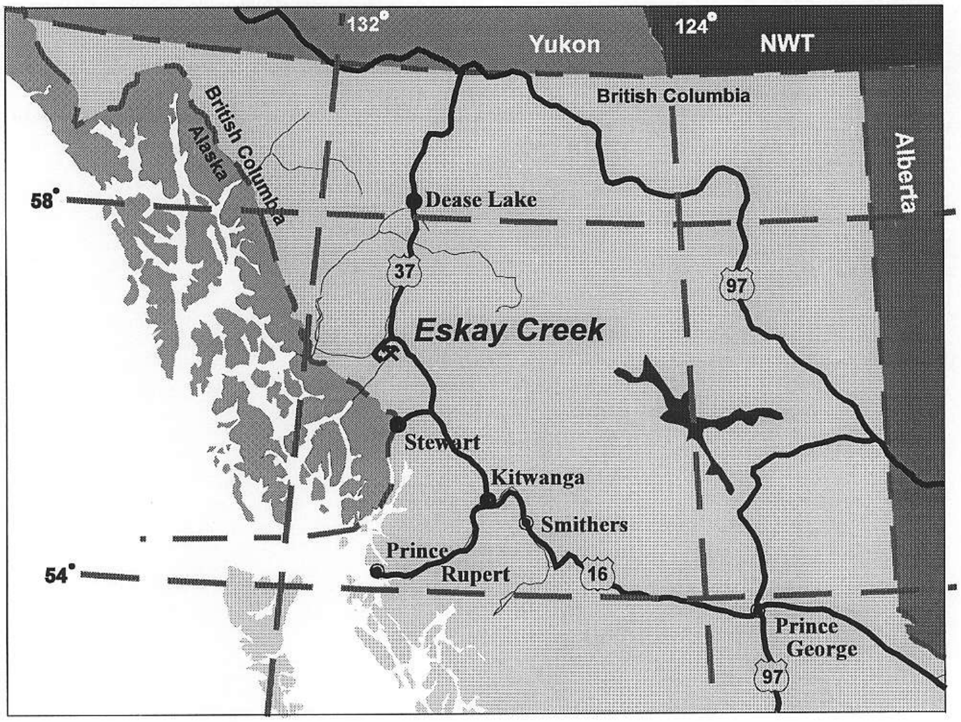

132°
124°
Yukon
NWT
British Columbia
British Columbia
Alaska
Alberta
58°
54°
Dease Lake
37
97
Eskay Creek
Stewart
Kitwanga
Smithers
Prince
Rupert
16
Prince
George
97

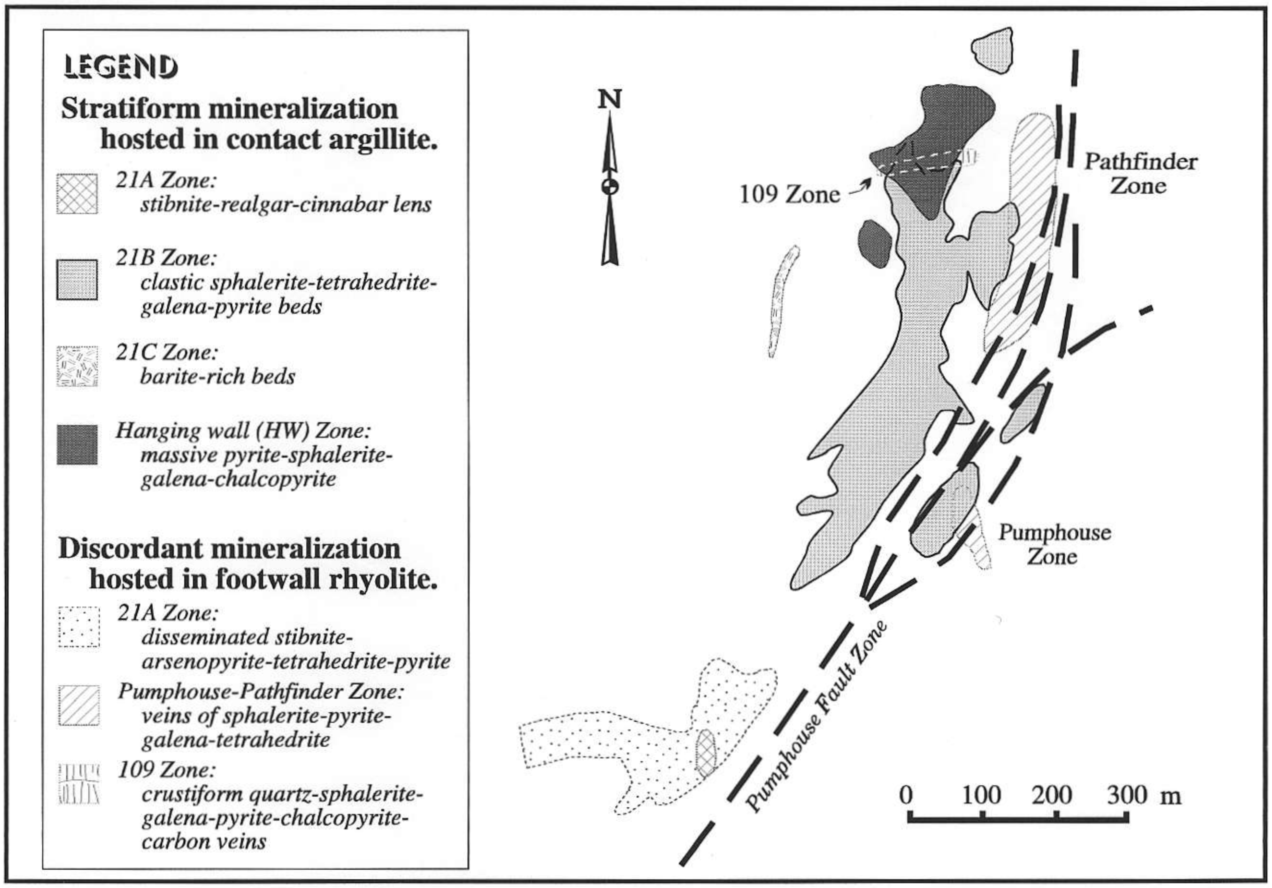
Figure 1

TABLE X. Mineralization in the Eskay Creek 21 Zone

Zone	Associated elements	Characteristics	Stratigraphic Position	Reserves
21A	As-Sb-Hg-Au-Ag	Stratiform lens of massive to semi-massive sulfides underlain by disseminated and veinlet mineralization. Mineralogy of: realgar, stibnite, cinnabar, arsenopyrite, tetrahedrite, pyrite, sphalerite, galena ± chalcopyrite .	base of contact mudstone, overlying discordant mineralization within rhyolite	0.97 million tonnes grading 9.6 g/tonne Au and 127 g/tonne Ag[1]
21B	Au-Ag-Zn-Pb-Cu-Sb	Stratiform, bedded clastic sulfides and sulfosalts including: sphalerite, tetrahedrite - freibergite, Pb-sulfosalts (e.g. boulangerite, bournonite, jamesonite), stibnite, galena, pyrite, electrum, amalgam	base of contact mudstone	1.08 million tonnes grading 65.5 g/tonne Au and 2931.4 g/tonne Ag[2]; 5.7% Zn, 0.77% Cu, and 2.89% Pb[3]; current producer.
21C	Ba	Bedded massive to bladed barite associated with very fine-grained disseminated sulfides including pyrite, tetrahedrite, sphalerite and galena.	base of contact mudstone	*n/a*
Hanging Wall (H.W.)	Pb-Zn-Cu	Massive, fine-grained stratabound sulfide lens dominated by: pyrite, sphalerite, galena, & chalcopyrite (mainly as stringers) This zone has lower gold - silver grades relative to the 21 zones.	within contact mudstone; at a higher stratigraphic level than the 21 zones	*n/a*
Pumphouse & Pathfinder	Fe-Zn-Pb-Cu	Veins of pyrite, sphalerite, galena, and tetrahedrite. Commonly banded; locally with colloform textures.	discordant, within rhyolite; spatially underlying the 21B zone	*n/a*
109	Au-Zn-Pb-Fe	Veins of quartz, sphalerite, galena, pyrite and visible gold associated with silica flooding and fine-grained amorphous carbon alteration.	discordant, within rhyolite	*n/a*

[1] A.H. Ransom, International Corona Corporation, personal communication, 1991; estimated resource.
[2] Prime Resources Group Inc. Annual Report, 1994; proven and probable mining reserves including 27% dilution.
[3] Homestake Canada Ltd., Press Release, June 1993
n/a not available; currently subeconomic.

R 10



LEGEND
Stratiform mineralization hosted in contact argillite.
21A Zone: stibnite-realgar-cinnabar lens
21B Zone: clastic sphalerite-tetrahedrite-galena-pyrite beds
21C Zone: barite-rich beds
Hanging wall (HW) Zone: massive pyrite-sphalerite-galena-chalcopyrite
Discordant mineralization hosted in footwall rhyolite.
21A Zone: disseminated stibnite-arsenopyrite-tetrahedrite-pyrite
Pumphouse-Pathfinder Zone: veins of sphalerite-pyrite-galena-tetrahedrite
109 Zone: crustiform quartz-sphalerite-galena-pyrite-chalcopyrite-carbon veins
N
109 Zone
Pathfinder Zone
Pumphouse Zone
Pumphouse Fault Zone
0 100 200 300 m

Figure 2

R11

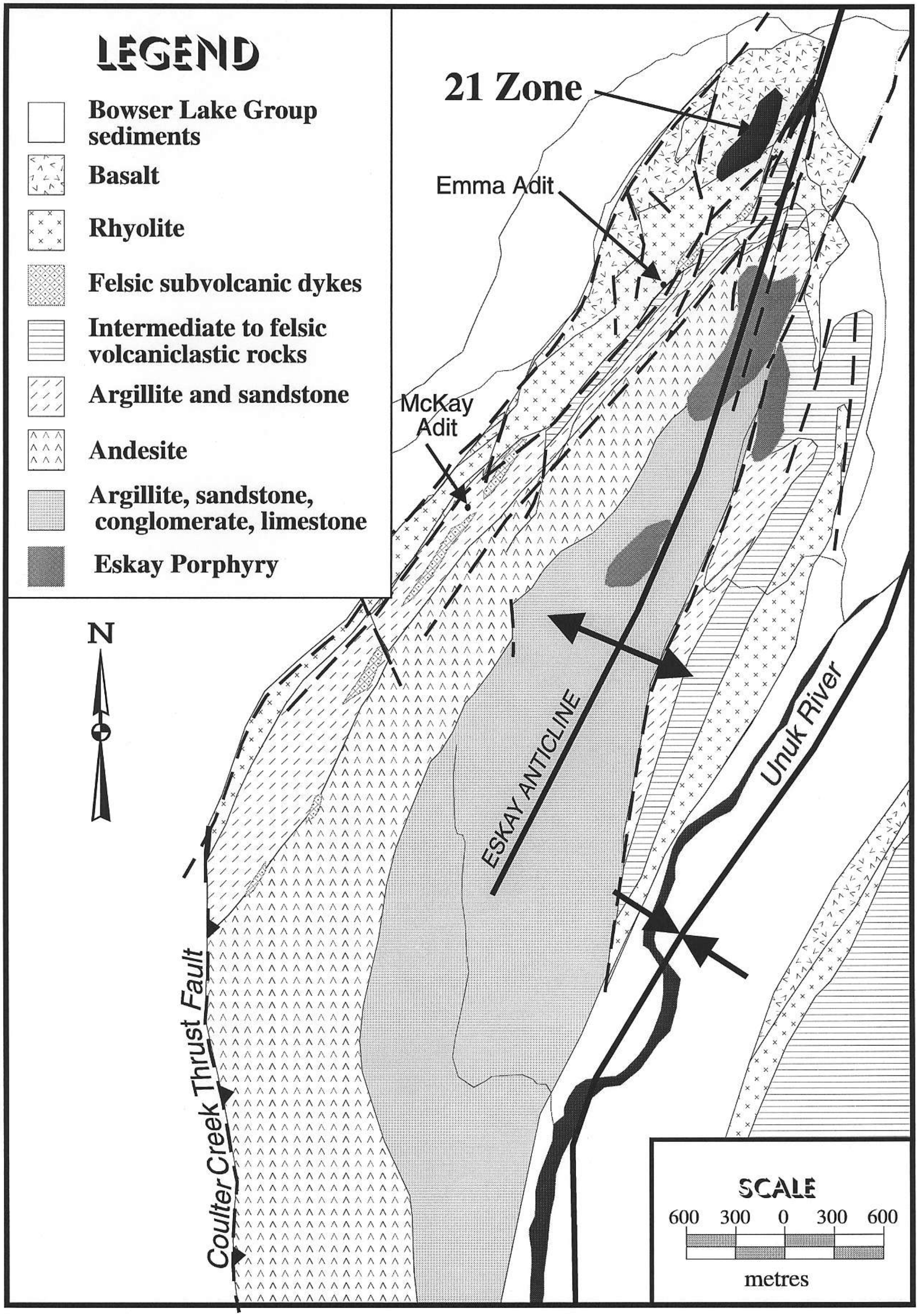

LEGEND
Bowser Lake Group sediments
Basalt
Rhyolite
Felsic subvolcanic dykes
Intermediate to felsic volcaniclastic rocks
Argillite and sandstone
Andesite
Argillite, sandstone, conglomerate, limestone
Eskay Porphyry
N
21 Zone
Emma Adit
McKay Adit
ESKAY ANTICLINE
Unuk River
Coulter Creek Thrust Fault
SCALE
600 300 0 300 600
metres

Figure 3

R12

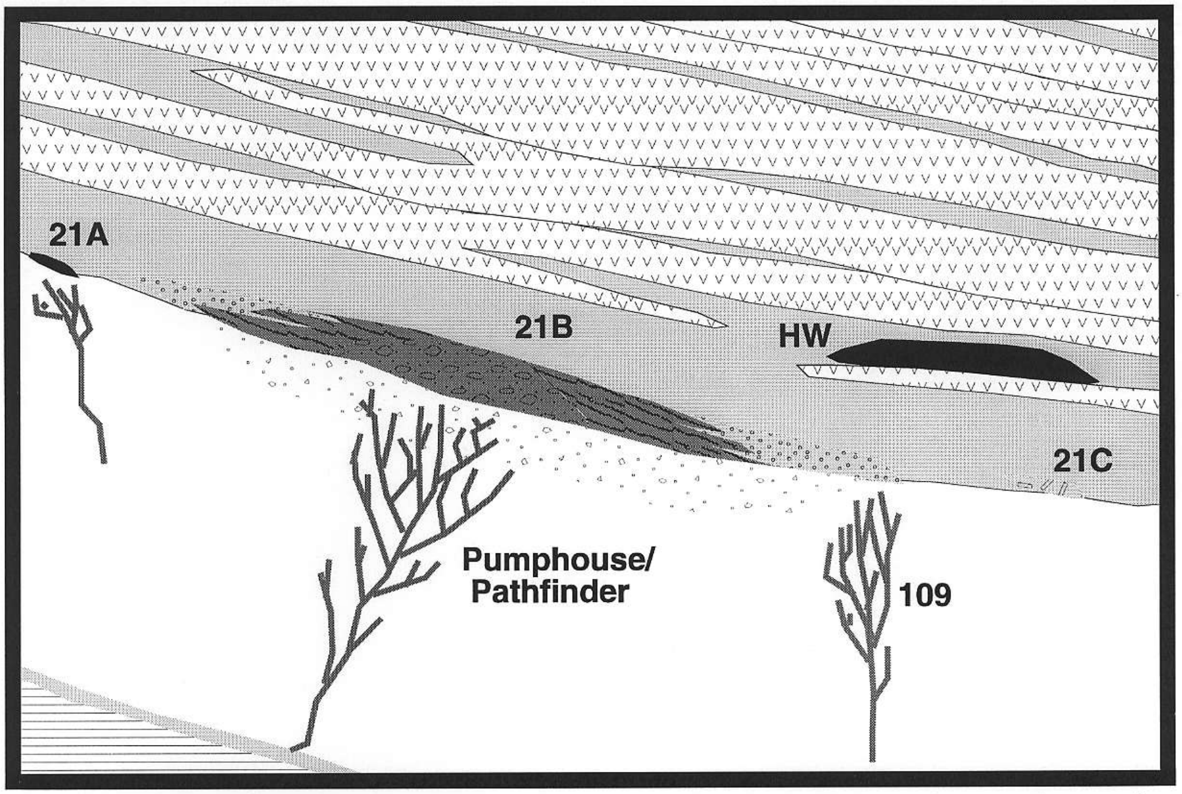


Figure 4

Basalt: massive to pillow flows and sills

Argillite

Rhyolite: volcaniclastic rocks

Rhyolite: massive, flow banded, brecciated

Intermediate to felsic volcaniclastic rocks

Mineralization

Massive to semi-massive

Clastic, thick beds

Clastic, thin beds

Disseminated

R 13

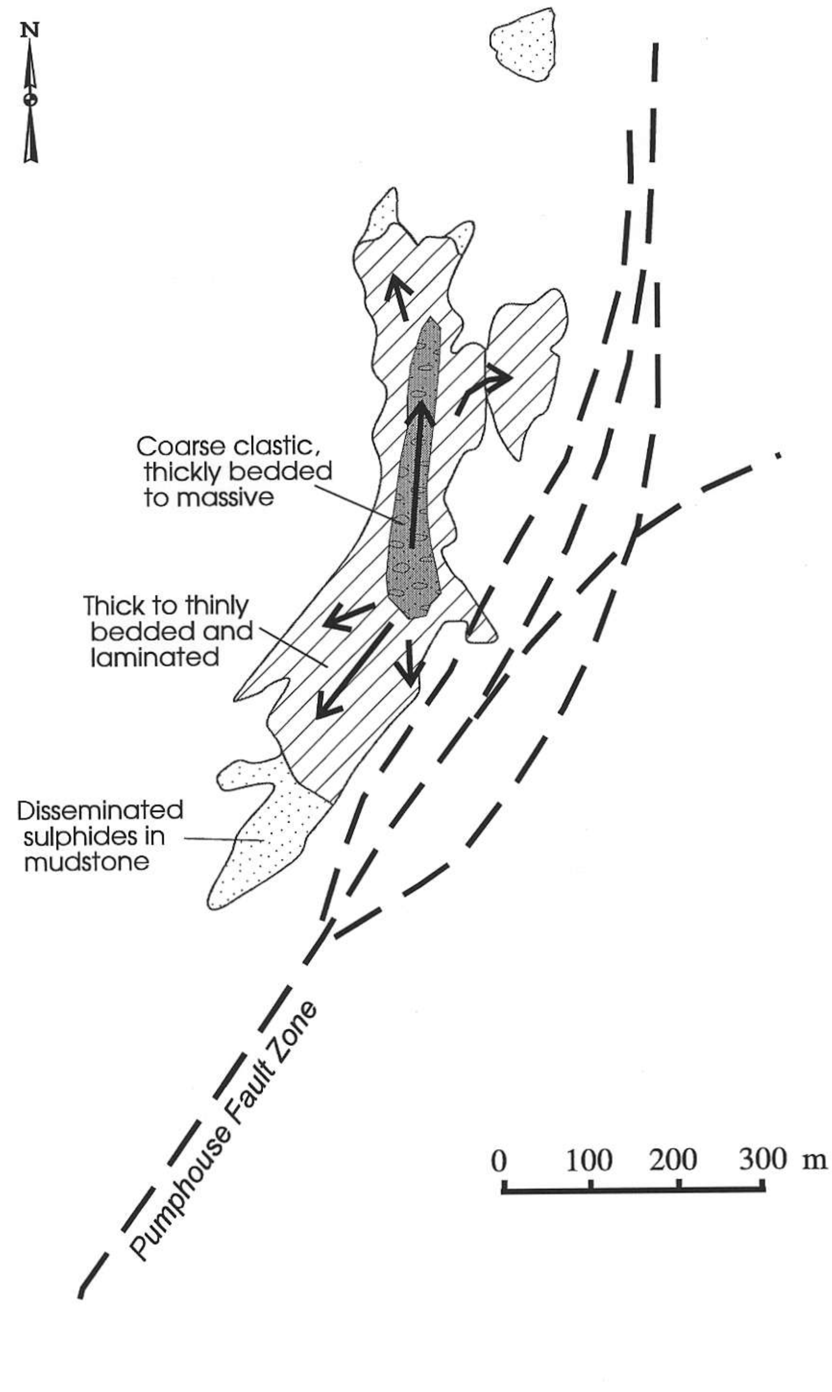

N
Coarse clastic, thickly bedded to massive
Thick to thinly bedded and laminated
Disseminated sulphides in mudstone
Pumphouse Fault Zone
0 100 200 300 m

Figure 5