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Paper No. 59 — 2:45

The Eskay Creek 21B Au-Ag-Cu-Zn-Pb Sulphide-Sulphosalt Deposit, Northern British Columbia

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The Eskay Creek 21 Zone, located in the Iskut River area 80 kilometres northwest of Stewart, is a precious metal-rich, base metal deposit (1.09Mt grading 65.5g/t gold, 2,909g/t silver, 5.6% zinc and 0.77% copper), hosted by bimodal volcanic rocks of the Jurassic Hazelton Group. The 21B deposit occurs mainly as stratiform mineralization in a mudstone-siltstone sequence underlain by rhyolites and intermediate volcanic rocks, and overlain by basalts. Discordant mineralization is also present in the rhyolitic footwall. The upper footwall includes sericitized-chloritized subconcordant alteration and areas of silicification beneath the ores.

Stratiform mineralization is dominated by detrital sulphide-sulphosalt beds (1 millimetre to 1 metre thick) composed of clastic sphalerite, tetrahedrite, freibergite, galena, pyrite, boulangerite, bournonite and electrum, with variable amounts of argillite, chloritized rhyolite and barite clasts. Honey-coloured sphalerite grains are generally coarser than surrounding sulphides-sulphosalts. Near the core of the deposit, some basal detrital beds up to 50 centimetres thick are rich in sulphide-sulphosalt cobbles and pebbles, and pass upwards and laterally into argillite containing rhythmically bedded and graded sand-sized clastic ore beds of centimetre-scale thickness. Clastic ore beds show rapid lateral facies variations suggesting rapid deposition, perhaps from chaotic proximal mass flows that infilled local seafloor depressions. Thinner sheets of more distal mineralized debris may have been transported parallel to the long dimension of the 21B Zone. Discordant mineralization occurs in the rhyolite-hosted 109 Zone, which plunges at a high angle to the sediment-volcanic contact, and comprises crustiform quartz veins with coarse-grained sphalerite, galena, pyrite, chalcopyrite and electrum, with abundant carbonaceous material.

Fluid inclusion homogenization temperatures on discordant footwall quartz veins, and sphalerite from the overlying clastic sulphide-sulphosalt beds, are low, ranging from 120° to 210°C. Fluid inclusion gas ratios and homogenization temperatures suggest that phase separation likely occurred at water depths of about 160 metres. Fluid salinities vary from 2.6 to 10.5 equiv. weight per cent sodium chloride. Anion-cation ratios suggest that the lower-salinity fluids are typical seawater-dominated hydrothermal vent fluids. However, the higher-salinity fluids have lower bromium/chlorine and sodium/chlorine ratios and higher potassium/chlorine ratios than typical seawater-dominated vent fluids. These ionic ratios suggest that original seawater-dominated hydrothermal fluids were modified by the addition of salts in proportions consistent with magmatic ratios, which may have occurred by direct magmatic input or leaching of the underlying volcanic rocks.

Paper No. 60 — 3:15

The Turner-Albright Ophiolite-hosted Cu-Zn Massive Sulphide Deposit, Southwestern Oregon

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The Turner-Albright massive sulphide deposit occurs in olivine basalt hyaloclastite at the base of the pillow lava sequence of the Late Jurassic Josephine ophiolite in the Klamath Mountains of southwestern Oregon. Published reserves total 2.9Mt of ore averaging 1.6% copper, 3.7% zinc, 3.7g/t gold and 19.8g/t silver. Cobalt averages 0.1% in parts of the deposit. Mineralization includes massive and banded pyrite-rich sulphide interpreted to have formed on the seafloor at hydrothermal vent sites similar to "black smokers" on modern spreading centres. The exhalative portion of the ore is separated from overlying basalt flows by a thin unit of hemipelagic mudstone indicating a brief hiatus in constructive volcanism following sulphide deposition. The bulk of the sulphide was deposited below the seafloor within hyaloclastite breccia. Hydrothermal metamorphism related to circulation of heated seawater through the upper oceanic crust resulted in regionally pervasive metamorphism of the upper part of the Josephine ophiolite to prehnite-pumpellyite facies. Hydrothermal alteration related to sulphide mineralization at Turner-Albright is characterized by the presence of abundant iron-rich chlorite. In contrast, chlorite formed by sub-seafloor metamorphism has intermediate magnesium-iron compositions. An increase in alteration toward massive sulphide is indicated by the replacement of chlorite by quartz and the local development of the assemblage quartz-chlorite-sericite. Semi-massive to massive sulphide mineralization is associated with intense silicification of basalt and near complete leaching of even sparingly soluble cations such as titanium and aluminum. Oxygen isotope ratios of hydrothermally altered basalt indicate seawater-rock interaction at 250° to 350°C as compared to sub-seafloor hydrothermal metamorphism that produced ^{18}O-enriched metabasalt at 140° to 200°C. Sulphur isotope ratios indicate a predominantly basaltic sulphur source with significant contributions of reduced seawater sulphate.

Paper No. 61 — 3:45

The Goldstream Besshi-type Cu-Zn Massive Sulphide Deposit, Southeastern British Columbia

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The Goldstream copper-zinc deposit (1.43Mt at 4.48% copper, 3.03% zinc; reserves, May 1993) is a Besshi-type volcanogenic massive sulphide occurrence of probable Early-mid Palaeozoic age. It is hosted in a structurally complicated, inverted package of fine-grained calcareous and carbonaceous clastic rocks and mafic volcanic rocks of the Index Formation (Lardeau Group) which has been intruded and contact metamorphosed by the post-tectonic Early Cretaceous (114Ma, Ar-Ar, Hb) Goldstream Pluton.

Polyphase deformation (four phases) has transposed and attenuated the massive sulphide layer into a shallow northeast-plunging ruler-shaped body, approximately 350 metres long and 2 to 3 metres thick with a down plunge extension exceeding 1,800 metres.

Sulphides consist of intermixed pyrrhotite, chalcopyrite and sphalerite and numerous rounded inclusions of quartz and chloritic and calcareous wall-rock (*durchbewegung texture*). Sulphides within the massive sulphide layer are coarse-grained recrystallized gneissic layers often folded, or show fracture-filling remobilized textures; disseminated sulphides extend out into the hanging wall and less often the footwall rocks. Sulphide textures, metal zonation and morphology of the orebody reflect pre-Middle Jurassic phase 2 deformation and accompanying metamorphism. Its northeast plunging elongation parallels phase 2 stretching lineations and the pronounced lateral Zn/Zn+Cu zoning is probably a preferential remobilization of copper towards the west edge of the orebody.

Phase 3 deformation folded the strata about gently east-plunging structures. Younger, high angle north-trending faults and upright folds define east and western boundaries of the orebody. Imbricate stacking of isoclinal fold hinges along low angle faults produces a relative thickening in the western and central portions of the orebody.

Iron-manganese- and boron-rich sediments are present both regionally and associated with the massive sulphide layer in the Mine Stratigraphy, where they are interpreted to represent submarine hydrothermal exhalations. These distinctive units extend laterally beyond the sulphide horizon and provide better exploration targets than the smaller alteration envelope of chlorite-biotite-sericite schists that enclose the massive sulphide layer at the mine.

Paper No. 62 — 4:15

The High Lake Cu-Zn-Ag Massive Sulphide Deposits, Slave Province, Northwest Territories

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The High Lake copper-zinc-silver volcanogenic massive sulphide deposits are located 40 kilometres south of Coronation Gulf within Archean age (2.69 to 2.60Ga) falsic and mafic volcanic and sedimentary rocks of the High Lake greenstone belt, northern Slave Province, Northwest Territories.

A steeply west dipping, volcano-sedimentary sequence hosts the High Lake deposit. Volcanic-hosted massive sulphides consisting of pyrite, chalcopyrite and sphalerite occur in the AB, D, E, H and Lake zones in the centre of the property. Copper-zinc mineralization coincides with, and overlies, footwall alteration zones depleted in sodium and calcium and enriched in magnesium, silicon and iron. Footwall alteration mineralogy consists of pervasive chlorite, and less common anthophyllite, talc and