Polymetallic Co-Ni-As-Bi-Sb-Ag veins in the southern Slave Province, Northwest Territories

HALEY LEBLANC[1]*, JACOB HANLEY[1], AND HENDRIK FALCK[2] - *1. Department of Geology, Saint Mary's University, Halifax, Nova Scotia, B3H 3C3 ¶ 2. Northwest Territories Geoscience Office, Yellowknife, Northwest Territories, X1A 2L9*

Polymetallic ("five metals association") veins containing Co-Ni-As-Bi-Sb-Ag mineralization in the area of Caribou Lake in the Southern Slave Province, Northwest Territories, Canada, exhibit various stages of mineralization consisting of an early barren (quartz ± ankerite) stage, an intermediate (A) nickel-cobaltarsenide (nickeline ± bismuthinite ± sulfarsenide solid solution [SSS] ± ankerite± quartz) stage, an intermediate (B) sulphide (pyrite ± galena ± chalcopyrite±sphalerite ± ankerite ± quartz) stage and a late (ankerite) stage. The mineralized veins show open-space filling textures containing nickeline rimmed with SSS. This suggests nickeline formed early followed by SSS as S fugacity in the mineralizing solutions increased. Compared to other mineralization sites of this type in the Slave Province (Great Bear magmatic zone) and in other areas (e.g., Cobalt, Ontario) the veins are devoid of native silver and uranium minerals indicating the inability of the hydrothermal fluid to transport these elements, or a lack of these elements in the original source rocks that the fluids obtained their metal endowment from. Stable carbon and oxygen isotope analyses of calcite and quartz in the veins show ^{13}CVPDB ranging from -0.3–3.3‰ and ^{18}OVMSOW from 12.4–18.1‰, broadly consistent with data from the deposit at Echo Bay, Great Bear Lake but with 13C values in the upper (most ^{13}C-enriched) range reported for all deposits of the Great Bear magmatic zone. Fluid inclusion data from quartz and calcite suggest a NaCl + $CaCl_2$ hydrothermal fluid responsible for metal transport and deposition with salinities ranging between 25.4–36.6 wt%eq. NaCl (absolute: 10.0–19.5 wt% NaCl and 5.8–18.7 wt % $CaCl_2$). LA-ICPMS analyses of single fluid inclusions confirms this and indicates Na:Ca ratios varying widely from one inclusion assemblage to another, ranging from 1.5 to 5.4. The homogenization temperatures for late quartz-hosted inclusions range from 143–196°C and in early calcite-hosted inclusions range from190–256°C. The similar phase ratios in inclusions suggests there was no boiling during ore deposition although the varying salinities, homogenization temperatures, and Na:Ca ratios from one assemblage to another could indicate mixing of two fluid end-members (e.g., magmatic and meteoric water). Where the polymetallic veins cross-cut the Caribou Lake gabbro, constraints on fluid composition, temperature-pressure of entrapment, and timing are provided. First, a comparison of the chemical composition of fresh and altered gabbros shows that fluid influx caused enrichments in Li-Rb-Cs-Tl-Pb-U-Cu-Ni-Bi-Co-Mo-Ag-Sb, but removed Ba, Sr, Zn and V through the breakdown of feldspars and oxides. LA- ICPMS analyses confirm that the latest stage fluids in the polymetallic veins were highly enriched in K and Ba. Second, primary magnetite-ilmenite intergrowths have been altered to rutile+ankerite in the alteration selvages of the veins. The relative stability of rutile vs. titanite depends on XCO_2. Once this is constrained, an accurate P-T window for an alteration stage involving rutile formation can be determined. A preliminary U-Pb age was obtained from hydrothermal rutile of 1320 ± 80 Ma (discordant). This age has a large error because of Pb contamination from the surrounding country rock but overlaps with the age of the Mackenzie and Berthoud orogenies, suggesting that resetting of U-Pb isotopes occurred during these orogenic periods, or that the mineralized veins themselves formed during these events and are much younger than comparable mineralization styles in the Great Bear magmatic zone.

***Winner of the Imperial Oil Award for the best poster presentation**

doi: 10.4138/atlgeol.2014016