Two-Stage Ore-Forming Process for Bonanza-Grade Gold Veins in the Brucejack Au-Ag Deposit, British Columbia, Canada

Kevin Man Hoi Ng[1], James Clark[1], Anthony Williams-Jones[1], Jacob Hanley[2], Duncan McLeish[1]
[1]McGill University, Montreal, Canada, [2]Saint Mary's University, Halifax, Canada

An integrated petrographic and microthermometry study was carried out on the bonanza grade gold-bearing veins at the Brucejack epithermal gold-silver deposit in British Columbia, Canada to investigate fluid chemistry, fluid source, and physiochemical conditions of the ore-forming processes of (1) primary bonanza grade electrum and (2) subsequent structural modification. SEM-CL textures reveal that Phase 1 epithermal quartz crystals comprise (1) CL-homogenous cores; (2) oscillatory-zoned overgrowths; and (3) microcrystalline quartz associated with primary electrum mineralisation. This quartz was followed by Phase 2 quartz, which is the immediate host to secondary, structurally modified electrum. Fluid inclusion studies reveal that the primary epithermal gold veins were deposited from relatively saline (7 to 12 eq. wt. % NaCl) magmatic fluids with homogenisation temperatures (Th) ranged from 170 to 200 °C. A decrease in salinity (3 to 6 eq. wt. % NaCl) and Th (150 to 170 °C) was recorded in later quartz overgrowth phases. Epithermal calcite crystals were subsequently deposited at low temperature of 120 to 150 °C from low salinity to non-saline fluids (0-1.7 eq. wt. % NaCl). A resurgence in temperatures is recorded during recrystallisation of Phase 2 quartz associated with post-mineral deformation with Th between 165 and 190 °C. The fluid inclusion assemblage with an electrum inclusion bearing fluid inclusion has a salinity of ~12.5 eq. wt. % NaCl and a Th of 170 °C. Laser ablation ICP-MS analyses of secondary fluid inclusions hosted in quartz crystals detected Au, Ag, As, Sb, Sr, Cu and Pb, indicating that electrum grains were remobilised and captured in secondary fluid inclusions trapped during deformation.