

Fluid inclusion systematics of the polymetallic (Co-Ni-As-Au) veins of the Nictaux Falls Dam occurrence, Annapolis Valley, Nova Scotia, Canada

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Cobalt-nickel-rich sulfarsenide (cobaltite-gersdorffitearsenopyrite) mineralization (+Au, Ag, Bi) is located in the Nictaux Falls Spillway, Annapolis Valley, Nova Scotia. Mineralization occurs in a zone of fault-bounded quartz veins, breccia and stockwork, which cross-cuts the late Silurian Kentville Formation in the central portion of the spillway. Mineralization is hosted by: (i) early, laminated, quartz-sulfarsenide veins (~1–2 cm wide) characterized by early sulfarsenide crystals, with interstitial wall-rock material (i.e., chlorite, rutile, biotite) and later anhedral (interstitial with respect to sulfarsenide) to euhedral (surrounding sulfarsenide) quartz; and (ii) sulfarsenide-mineralized wall rock clasts (~1 cm in diameter) in quartz breccia veins. Late quartz veins appear barren of mineralization and crosscut mineralization in the fault-bounded mineralized zone. These veins range from <1 cm to 20 cm in diameter, and are characterized by beige-coloured, coxcomb quartz, with miarolitic cavities and wall-rock clasts in the largest veins. Similar barren veins are exposed in the other areas of the spillway, crosscutting the metasedimentary rocks and the nearby Cloud Lake Pluton of the South Mountain Batholith.

Quartz-hosted fluid inclusions in both vein types are similar and classified into two types. Type-1 inclusions contain two phases (L+V), are <5 µm in size, and exhibit rounded to negative crystal shape. Type-2 inclusions contain three phases, are <14 µm in size and exhibit irregular to negative crystal shape. Despite cathodoluminescence imaging of the quartz, the fluid inclusion assemblages are of indeterminate origin as they occur as clusters in the core, or between growth zones, of the individual quartz crystals. The vapour bubbles of the fluid inclusions were analyzed using Raman spectroscopy and are water vapour-dominated (i.e., no CH₄, CO₂, N₂ detected). Homogenization temperatures of type-1 inclusions range from 167.2°C to 181.8°C. Type-2 fluid inclusions homogenize via halite dissolution between 163.2–227.2°C, indicating entrapment at high-pressure (e.g., 2.5 to 4 kbar at 300°C) assuming no post-entrapment modification. Based on microthermometric calculations, the range of salinities for type-2 fluid inclusions is 30.37–33.86 wt.% NaCl equivalent. The salinities of type-1 inclusions could not be determined due to analytical difficulties related to their small size.

Ongoing and future work includes: (i) continued microthermometric analysis of fluid inclusions, (ii) Ti-in-quartz thermometry to provide independent temperature constraints for P-T estimates using microthermometric isochores, (iii) decrepitate mound analysis to determine solute composition of the fluid inclusions, and (iv) determination of ¹⁸O/¹⁶O in mineralized and barren quartz to confirm their genetic relationship and constrain source(s) of fluid.