A fluid inclusion study of volcano-sedimentary - hosted quartz-carbonate-copper sulfide-gold veins at the Mile Brook occurrence, Broad River Group, New Brunswick

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Outcrops of quartz-carbonate-copper sulphide-gold bearing veins cutting Neoproterozoic Broad River Group (BRG) metavolcanic (felsic lithic tuffs, interbedded felsic/mafic flows) and metasedimentary rocks occur along the Bay of Fundy coast, ~75 km northeast of Saint John, New Brunswick. The mineralized veins at Mile Brook are characterized by chalcocite-bornite infilling vuggy quartz-carbonate with abundant inclusions of electrum and bismuthinite.

Only two-phase liquid-vapour fluid inclusions were observed in the host quartz. The origin of the inclusions cannot be discerned based on petrographic criteria (i.e., not hosted in growth zones, healed fractures). However, microthermometric data were obtained on ~85 inclusions grouped into multiple assemblages (small groups of adjacent inclusions in patches of optically continuous quartz). Homogenization occurs by vapour bubble disappearance between 150-270°C for all assemblages; individual assemblages show relatively narrow ranges (e.g., assemblage 5A, 173–191°C, n = 22). Bulk salinities from final ice melting range from 4 to 13 wt% NaCl eq. (compared to individual assemblages; e.g., assemblage 5B, 7 to 11 wt% NaCl eq.). No correlation between salinity and Th is observed. Stable isotopes (qtz-carb) constrain the crystallization/final equilibration T of the host quartz to between ~250–270°C; if inclusions are primary, then a maximum Ptrapping = ~1.5 kbar, based on the lowest T assemblages, is estimated. Stable isotope data for the host quartz and carbonate ($\delta^{18}O$ = 13.7–15.1‰; $\delta^{13}C$ = -4.4 to -4.6‰) and estimated fluid from which the quartz precipitated ($\delta^{18}O$ = 6.1‰) combined with the microthermometric data rule out unmodified, heated seawater and meteoric water as fluid sources, and suggest either a magmatic source, or more likely, formation water modified through fluid-rock interaction with the host metavolcanic rocks. The data share some similarities to other Cu-Au quartz-carbonate vein systems hosted in volcano-sedimentary sequences (e.g., Keewenawan Penninsula and Mamainse Point, Michigan and Ontario; Lisbon Valley, Utah; SW Scottish Highlands).

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