Preliminary evaluation of the use of bulk fluid inclusion volatile signatures for exploration of argillite-hosted disseminated gold deposits: a case study in the Meguma terrane, Nova Scotia, Canada*

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Contemporary exploration programs focused on gold mineralization rely on detailed lithogeochemical and structural data coupled with assaying of host rocks and vein material to define mineralized domains, with no emphasis on ore fluid chemistry. Predictive models for hydrothermal ore deposit formation should also consider how ore-bearing fluids are modified at a "deposit-scale" level, producing systematic variations in fluid chemistry potentially discernable at strategic distances from mineralization. This is especially relevant in the exploration for disseminated gold deposits since gold in these settings is not hosted in obvious quartz-carbonate veins, and is often unidentifiable during routine core logging.

We evaluate whether the bulk volatile chemistry (speciation and abundances of volatile species) of argillite-hosted fluids can be used to identify proximity to mineralization or differentiate ore-bearing vs. barren parcels of metasedimentary rock at a strategic level, and whether a gas chromatographic-related (GC) exploration tool may be effectively integrated into exploration protocols. To evaluate these questions, the metasedimentary rock-hosted disseminated gold deposits associated with the Moose River Anticline (MRA; e.g., Touquoy), and the "barren" parcels of metasedimentary rock along the MRA (e.g., Otter Lake) have been sampled.

Samples of metamudstone (meta-argillite, slate) and of crosscutting quartz-carbonate veins (<5 cm) from along the MRA have been investigated in order to evaluate the occurrence and composition of fluid types that may constitute a "bulk fluid". In quartz veins from Touquoy, clusters of 2-phase aqueous-carbonic fluid inclusions (type 1) of indeterminate origin, and secondary inclusion trails that extend away from vein margins into the argillite host rock, have variable abundances of CO_2 (0.12–0.95 mol%), CH_4 (0.08–0.80 mol%), and N_2 (0–0.84 mol%) in the vapour phase. Conversely, 2-phase inclusions hosted in quartz within arsenopyrite pressure shadows in argillite, are vapour-rich and dominated by CH_4 (0–0.82 mol%) and N_2 (0.18–1 mol%). Vapour-only inclusions (type 2) in quartz veins are variable CO_2-CH_4-N_2-bearing, while type 2 inclusions in pressure shadows are dominated by CH_4 and N_2 only. Preliminary bulk volatile GC analysis of argillite/slate samples from mineralized (>0.1 g/t) and barren parcels (<0.1 g/t) has been performed. Understanding the differences in fluid chemistry in barren vs. mineralized regions of the Meguma may help improve gold models by determining if (i) pulses of auriferous fluids locally infiltrated regions of the Meguma and precipitated gold, or if (ii) a gold-bearing fluid broadly infiltrated the Meguma but only precipitated gold as a result of favorable mechanistic factors (e.g., host rocks, dilational settings, etc.).

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