Using fluid inclusions to characterize gold deposit settings and processes in the gold-rich Abitibi Greenstone Belt, Canada

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The fluids responsible for Archean gold mineralization and related vein formation and alteration in the hydrothermal ore systems of the Abitibi Greenstone Belt (AGB) are preserved within vein minerals as micron-scale vacuoles, otherwise known as fluid inclusions. Numerous studies on many ore systems (e.g., porphyry, epithermal, skarn, orogenic gold) have proven the value of fluid inclusions to decipher the P-T-X conditions attending ore formation, thus contributing greatly to ore deposit models. This study, a GSC TGI-5 funded project (2017-2018), builds on early fluid inclusion work on gold deposits in the AGB, albeit limited, to provide the most comprehensive data set from representative mineralized settings. Results will be used to evaluate current deposit models and the use of fluid inclusions as potential ore vectors. The study integrates the modern protocol of fluid inclusion assemblages during petrographic study with critical application of terms for timing (e.g., primary vs. secondary); this will be supplemented with cathodoluminescence (CL) to best constrain the timing of fluid entrapment. Initial observations reveal that fluid inclusion textures, a feature rarely documented, are important monitors of ΔP during vein formation and likely reflect changing P_{fluid}. In addition to standard microthermometry routinely used in similar studies, the fluid inclusions are being more fully characterized using laser Raman and GC methods to quantify volatile species (e.g., CO_2, CH_4, N_2, H_2S) and evaporate mound as well as LA ICP-MS analysis to quantify cations and anion chemistry. Some observations and results to date will be presented from a variety of deposit settings to illustrate the challenges of getting useable and workable fluid inclusions due to the nature of settings (e.g., extensive recrystallization), the variable chemistry of fluids (i.e., H_2O-CO_2 vs H_2O, differing X_{CO2}, variable salinity), evidence for fluid unmixing, extent of decrepitate textures, and evaporate mound data indicating a range for fluid chemistry (Na, K, Ca, Fe, S, F). Initial results indicate that a singular, homogeneous fluid type, the so-called "global gold fluid" (i.e., H_2O-CO_2 fluid with X_{CO2} = 0.1-0.15 and ca. 5 wt. % eq. NaCl) is not universally applicable to the AGB deposits and instead a variety of fluid types are present. However, whether such fluid variability will be reflective of ore deposit settings remains to be seen and will be a focus of future research.