Origin of epithermal-style gold mineralization in the eastern Cobequid Highlands, Nova Scotia, Canada: constraints from S isotopes and pyrite trace element chemistry

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In the eastern Cobequid Highlands, Nova Scotia, recent bedrock mapping, bulk rock geochemistry, and prospecting have identified a potential low-sulphidation epithermal Au system in Late Devonian to Early Carboniferous bimodal, rift-related felsic (Byers Brook Formation) and mafic (Diamond Brook Formation) volcanic and volcaniclastic rocks. The Warwick Mountain area located in the northwest portion of the Diamond Brook Formation shows the most potential for gold mineralization, with two zones of intensely silicified and sulphidized basalt present. Assays show anomalous Au concentrations up to ~660 ppb, as well as anomalous As, Sb, Cd, W, and Hg.

This research aims to (i) characterize the ore mineralogy of the Au occurrences; (ii) determine what generation of pyrite is associated with the Au mineralization, and (iii) utilize the trace element and S isotope chemistry of pyrite to establish key events in the paragenesis of the mineralization. Petrographic and scanning electron microscopy (SEM) results document the mineralogy and textural characteristics of pyrite and representative grains of pyrite were investigated further by secondary ion mass spectrometry (SIMS), electron microprobe (EMP), and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). SIMS data for Nuttby Mountain showed distinct differences from rim to core with arsenic-poor pyrite cores having a δ34S ranging from -1.8 ‰ to -0.6 ‰ and As-rich rims having a δ34S between -3.0 ‰ and -6.8 ‰. SIMS data from Warwick Mountain showed indistinct differences with arsenic-rich cores having a δ34S ranging from -1.5 ‰ to 0.7 ‰ and As-poor rims had δ34S between -1.9 ‰ and 0.6 ‰. Pyrite from Nuttby Mountain is oscillatory zoned with respect to As, with the highest concentrations of As occurring on the rims of pyrite. Oscillatory zoning is also present in the Warwick Mountain pyrites. Gold maps show some elevated concentrations near and along the rims of pyrite from Nuttby, which together with the S isotope data, suggests that fluid boiling was a key mechanism for gold precipitation. Further additions to this study will include the use of similar methods and techniques to analyze drill core and an additional surface sample from other areas in the Cobequid Highlands.

*Winner of the Frank S. Shea Memorial Award for best economic geology presentation

Atlantic Geology, 2018, Volume 54
Atlantic Universities Geoscience Conference 2018 – 68th Annual Conference, November 1-3, 2018
doi:10.4138/atlgeol.2018.015