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Intrusion-Associated Au Mineralization in the Archean Mooshla Intrusive Complex, Doyon-Bousquet-LaRonde Mining Camp, Abitibi Greenstone Belt, Québec, Canada

Kevin Neyedley[1], Jacob J. Hanley[1], Patrick Mercier-Langevin[2, 3], Richard A. Stern[4]
1. Department of Geology, Saint Mary's University, Halifax, NS, Canada, 2. Geological Survey of Canada, Quebec, QC, Canada, 3. Agnico Eagle Mines Limited, Toronto, ON, Canada, 4. Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada

The Mooshla Intrusive Complex (MIC) is an Archean polyphase magmatic body located in the Doyon-Bousquet-LaRonde mining camp of the Abitibi greenstone belt, Québec, Canada, that is spatially associated with numerous Au-rich VMS, epizonal ‘intrusion-related’ (or porphyry-epithermal-*style*) Au(-Cu) vein systems, and shear zone-hosted Au deposits. To elucidate any genetic links between deposits and the MIC, mineralized samples from two epizonal ‘intrusion-related’ Au-Cu vein deposits (Doyon and Grand Duc Au(-Cu)) have been characterized using a combination of detailed petrography and trace element and sulfur isotope analyses of sulfide phases.

Based on a wide variety of geochemical data, it is clear that numerous processes were occurring to produce the different ore assemblages at Doyon and Grand Duc. However, the main gold precipitation mechanism is interpreted to be a reduction in the fluid composition that was influenced by wall-rock sulfidation for both the Doyon high-grade and Grand Duc lower-grade vein systems.

Multiple fluid processes were operating in the mineralization at Grand Duc as the texture, trace element signatures, and $\delta^{34}S$ composition of pyrite all are indicative of fluid boiling leading to an increase in fO_2 of the hydrothermal fluid and gold mineralization is late-pyrite to syn-pyrrhotite + chalcopyrite + sphalerite. The common occurrence of tellurobismuthite in the high-grade veins suggests that gold precipitation may be related to a reduced fluid event as Te is more soluble in oxidized fluids and precipitates as fluid conditions become more reducing.

Importantly, the $\Delta^{33}S$ composition of pyrite and pyrrhotite is similar in both deposits and does not vary within individual pyrite grains, implying the source of sulfur was from a uniform reservoir. Additionally, there is no evidence of a sedimentary $\Delta^{33}S$ signal for a source of sulfur, and therefore it is likely to be magmatic, indicating the MIC could have supplied volatiles to these Au-rich deposits.