Garnet as a Tracer for the Mineralization in an Orogenic Gold Deposit: Evidence from the Musselwhite deposit, North Caribou Greenstone Belt, Western Superior Province

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Abstract

Schistose, garentiferous rock samples for this study were collected from auriferous zones at the multi-million ounce Musselwhite Au deposit, hosted within the North Caribou greenstone belt of the Western Superior Province. Along with these samples, one Au barren, garnetiferous schist was collected from a banded iron-formation horizon, from outcrop, outside the mine area. Intragranular variations in major (e.g., CaO, MgO) and trace elements in porphyroblastic garnets from Musselwhite are observed here. These variations are demonstrated in the rims of crystals from mineralized rocks that show a pronounced increase in X_{grs} without variation to other major components. Likewise, these rims show the lowest Ni, and highest Mg concentrations, relative to the respective cores. Compare to the Au barren schist, samples from Musselwhite record significantly high positive Eu [$(Eu/Eu^*)_{CN}$] anomalies and orders of magnitude greater variation in HREE (+Y) and LREE concentrations. Several conclusions can be drawn from these data. Firstly, the intragranular variation in major and trace elements suggest Au mineralization occurred during at least two events; a pre to syn-garnet nucleation and post-nucleation. In addition, the earlier Au mineralization event(s) where sulfide is low, as demonstrated by the high Ni concentrations in the cores, compared to post nucleation event(s), recorded by low Ni concentrations in the rims. Secondly, the pronounced difference between in rare-earth and trace element abundances in the mineralized samples, relative to the Au barren schist, suggest the composition of mineralizing fluid(s) were modified throughout Au precipitation. These data may indicate that fluids responsible for Au transportation were, in part, derived from metamorphic sources.