Melt Inclusion Constraints on the Initial Metal Budget of Suspected Causative Magmas in the Au-Rich Doyon-Bousquet-LaRonde Mining District, Abitibi Greenstone Belt, Québec

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The synvolcanic Mooshla Intrusive Complex (MIC) in the Doyon-Bousquet-LaRonde mining camp, Abitibi greenstone belt, Canada, may be genetically associated with numerous Au-rich VMS, epizonal intrusion-related Au ± Cu, and shear zone-hosted orogenic Au and/or remobilized VMS deposits. To understand the magmatic evolution of the MIC and its relationship to these Au-rich deposits, analysis of silicate melt inclusions (SMIs) preserved in zircon and quartz provides a means to determine the original major- and trace-element composition and metal tenor of the magmatic system. The use of SMIs is preferred for quantification of the pre-emplacement melt chemistry (in particular, ore metals) compared to bulk-rock compositions commonly modified by magmatic (e.g., degassing) and post-solidus processes. Characterization of SMI chemistry from different lithologies of the MIC (gabbro, quartz diorites, tonalites, and trondhjemites) was done by integrating petrography with SEM-EDS, EMPA, and LA-ICP-MS analyses. Data presented constitute the first SMI study in Archean-age rocks within Canada.

Melt inclusions, trapped at depths of ~18.5 to 40 km (based on thermobarometry in a parallel study) are sub-alkaline to alkaline and rhyolitic in composition from all lithologies. Importantly, within individual lithologies, SMIs span from sub-alkaline to alkaline compositions, indicating melt entrapment at various stages of magmatic evolution, requiring contamination and/or magma mixing. Present in both zircon- and quartz-hosted SMIs are accidentally trapped sulphide phases (enriched in Au, Ag, Cu, Bi), indicating the melts were sulphide-saturated at the time of SMI entrapment. In quartz-hosted SMIs with no accidentally trapped sulphide, Au concentrations range from 10 to 120 ppb (70 ± 50 ppb; n = 6). Enrichment of SMIs in Au and other metals (e.g., Ag, Cu, Sb, Bi) typical of porphyry-epithermal environments in arc settings reinforces that consideration must be made for the direct involvement of magmatically sourced metals transferred into shallow ore-forming hydrothermal systems through deep magmatic devolatilization.