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Insights into the Metallogenic Evolution of the Timmins Gold Camp Using Quartz-Hosted Melt Inclusions from the Porcupine Intrusive Suite

Sarah Speight[1, 2], Jacob Hanley[1], Stephen Piercey[2], Jim Crowley[3]
1. Saint Mary's University, Halifax, NS, Canada, 2. Memorial University of Newfoundland, St. John's, NL, Canada, 3. Boise State University, Boise, ID, USA

The Abitibi greenstone belt in northeastern Ontario, Canada is home to the Timmins gold camp, a world-class gold district with >60 Moz of high-grade gold (past production and future reserves). Deposits are spatially associated with the synorogenic Porcupine-Destor deformation zone (PDDZ). The formation of these deposits is attributed to a few key processes, including large-scale CO_2-rich fluid flow and clastic sediment deposition along the PDDZ, the presence of ultramafic rocks, and the occurrence of competent intrusions that pre-date metamorphism. These intrusions are believed to have prepared the host rocks for enhanced fluid flow during mineralization. Despite the coincident timing of early magmatism with these events, the contribution of metals from these intrusions is often disregarded.

However, quartz-hosted melt inclusions (MI) from porphyry intrusions within the main Timmins gold camp show evidence of variably elevated, arc-related metals (e.g., Cu, Mo, Bi, W, As, Sb, Ag, Sn). The Paymaster and Crown Lake porphyries, along with the Krist fragmental horizon, also have MI with similar primary bulk compositions. SEM analysis of the MI shows co-precipitation of Cu and Au, suggesting a genetic link and shared metallogenic history. Assessing the compositional evolution of an Archean porphyry system through primary MI, and comparing with modern environments, will help us understand magmatic-hydrothermal processes in the Timmins district. By examining MI from the Porcupine Intrusive Suite and applying time constraints with accompanying U-Pb geochronology, early magmatic degassing events can be evaluated with respect to the overall metal budget of the Timmins gold camp.