THE GEOLOGY, LITHOGEOCHEMISTRY AND PETROGENESIS OF INTRUSIONS ASSOCIATED WITH GOLD MINERALIZATION IN THE PORCUPINE GOLD CAMP, TIMMINS, CANADA

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Abstract

Most gold deposits within the Porcupine Gold Camp of the Abitibi greenstone belt are spatially associated with porphyry intrusions. These intrusions, however, are present beyond the immediate gold-hosting environment, extending over 80 kilometers along the Porcupine-Destor deformation zone (PDDZ). While petrographically similar, the intermediate to felsic intrusions along the PDDZ represent at least four distinct geochemically defined magmatic suites that span the deformation history of the Porcupine gold camp. The Timmins porphyry intrusive suite (TIS) intrusions are related to magma generated D1-related crustal thickening related to uplift and extension as a result of flat subduction-related underplating of mafic crust, and resultant delamination and partial melting ca. 2690 Ma during D1 deformation at depths <40 kilometers. These TIS magmas were emplaced near surface and represent subvolcanic intrusions to coeval eruptive equivalents such as the Krist Formation pyroclastic volcanic rocks. Two additional suites of lower crustal sourced magmas, the Carr Township porphyry intrusive suite (CIS) and the granodiorite intrusive suite (GIS) were generated from mafic source rocks 10-15 m.y. later. The CIS was generated by lower crustal melting at shallower depths than the TIS, whereas the GIS was generated at greater depths than the TIS indicating that, in the immediate vicinity of Timmins, D2-related magmatism and thrust stacking significantly thickened the crust to in excess of 40 kilometers. The Holmer intrusive suite (HIS) is a late- to post-tectonic suite formed via the partial melting and fractionation of magma sourced from slab-melt altered mantle at depths >40 kilometers.

Gold mineralization has long been recognized to be spatially associated with intrusions proximal to the PDDZ. Although there is no genetic link between spatially related porphyries and mineralization, gold mineralization is associated with sulphidized, sericite ± carbonate altered TIS intrusions emplaced during D1 and to a lesser extent with the late- to post-tectonic HIS and GIS intrusions. The spatial association of gold with the TIS intrusions is related to the intrusions and gold utilizing the same emplacement conduits, presumably reactivated regional faults, as well as the formation of dilation zones surrounding the intrusions during deformation. Similar to gold mineralization, copper mineralization is spatially associated to the Porcupine intrusive suites but does not have a genetic association.