Characterization of auriferous quartz veins of the Ptarmigan and Tom gold deposits, Yellowknife, Northwest Territories

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The Yellowknife greenstone belt in the Northwest Territories, Canada hosts numerous orogenic gold deposits that formed in a range of structural and lithological settings during late Archean metamorphism. However, the ability to establish absolute ages for gold deposition has remained elusive. The Ptarmigan and Tom gold deposits comprise a series of *en echelon* vein-type gold deposits hosted by amphibolite-grade deformed turbiditic rocks of the Archean Burwash Formation of the Slave Structural Province. The deposits are located within a 4 km-wide metamorphic aureole of the Prosperous Granite to the east. The host rocks contain cordierite porphyroblasts and several pegmatite dykes. The proximity of the Ptarmigan mine to the Prosperous Granite intrusion and the numerous related pegmatite dykes presents a unique opportunity to evaluate what role magmatic fluids may have played in the formation of mesothermal gold deposits.

Groundwork assessment of structural controls on gold-bearing quartz veins of the Ptarmigan and Tom deposits was completed in the summer of 2018. Three generations of structures were identified: (D_1), a bedding-parallel, weakly spaced cleavage interpreted as S_1; (D_2), a dominant foliation with variable intensity that ranges from spaced cleavage in greywacke to a schistosity within slate horizons; and (D_3), a crenulation cleavage. In addition to the recognized structural generations, a sequence in the style of quartz veins was observed. Structural interpretation displays progressive deformation as follows: (a), bedding-parallel veins, ptygmatically folded and overprinted by porphyroblasts, and refolded by outcrop-scale asymmetric folding; (b), stratabound, *en echelon* veins folded by asymmetric F_2 folds; (c), Ptarmigan-style veins, sub-parallel to cleavage, locally cross-cutting bedding, locally boudinaged, asymmetrically folded, and crosscut by straight shear veins; (C*), flat veins (extensional veins) that locally occur on both sides of the Ptarmigan and Tom veins; (D), cleavage-parallel straight shear veins.

The Ptarmigan vein exhibits pervasive muscovite and chlorite wall-rock alteration. Sulphide mineralization within the wall-rock is comprised of arsenopyrite, fine-grained pyrite, and pyrrhotite. Vein mineralization includes globular arsenopyrite (locally 5%), brown sphalerite (locally 5% in veinlets), pyrrhotite (locally 3%), chalcopyrite (locally 3%), tourmaline (locally 4%), galena (locally 3%), and rare muscovite. Additionally, millimetre-scale fractures are filled with dark green tabular epidote and massive globular arsenopyrite, brown sphalerite, pyrrhotite, and pyrite. Several polished thin sections have revealed the presence of hydrothermal apatite and monazite in gold-bearing quartz veins from the Ptarmigan mine. Next steps will include direct U–Pb dating using these gold-bearing veins.

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