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High-Grade Gold Mineralization at the Fenelon Deposit: Going Undercover to Study a Major Discovery in the Abitibi Greenstone Belt

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The Fenelon gold system is one of the most important mineral discoveries made in recent years in the Abitibi greenstone belt and this has re-ignited exploration in the northwestern Abitibi. The deposit lies north of the Sunday Lake Deformation Zone, a major east-west structure that controlled the emplacement of the world-class Detour Lake deposit (~25 Moz Au) ~70 km to the west. The belt and deposit area are covered extensively by till and, thus, continued exploration success hinges on understanding the controls on mineralization at this recently discovered deposit. Preliminary geologic and genetic models for Fenelon are presented here based on structural analysis and sampling of oriented drill core integrated with airborne geophysical data.

The deposit consists of three main ore zones that occur in shear corridors and narrow veins hosted in different types of host rocks. The Tabasco-Cayenne zone (e.g., 22.73 g/t over 48.01 m), hosted mainly within argillite and its contact with the 2697 Ma Jeremie diorite, defines the core of the known deposit. It consists of ESE-striking and steeply dipping, shear-hosted, sulfide-rich mineralization associated with silica flooding and intense sericite alteration. The Gabbro zones (e.g., 260.44 g/t over 7.02 m) have similar orientations but are restricted to a polyphase mafic sill of calc-alkaline affinity. The Area 51 zone is hosted within the Jeremie diorite, in which early centimetric auriferous quartz veins with local sulfides including rare molybdenite are overprinted by a second gold event consisting of chlorite and sulfides closely associated with shearing.

Oriented drill core show two foliations with different orientations. S_1 strikes ESE and is parallel to parts of the Tabasco-Cayenne and Gabbro zones, suggesting it was an important pre-existing control on shearing and fluid flow. S_2 strikes ENE and is parallel to gold-hosting shear zones within Area 51, suggesting it was also an important control on mineralization, at least for its chlorite and sulfide-rich stage. In the Tabasco-Cayenne zones, D_2 deformation appears to have overprinted and locally remobilized the S_1 -parallel mineralization into high-grade ore shoots along the intersection of S_1 and S_2 . Bedding orientations derived from airborne magnetic data and oriented drill core suggest two folding events which may have been responsible for the two foliations.

The gold mineralization is enriched in As, Ag, Cu, and Zn with chalcopyrite being the sulfide mineral correlating best with gold grade. Petrographic examination shows that native gold co-precipitated with pyrrhotite, chalcopyrite, arsenopyrite, and sphalerite, which speaks to the elevated base metal content of the ore fluid(s). Preliminary results suggest that Fenelon is a polyphase gold deposit with elevated base metals, which deposited in various types of host rocks over two main structurally controlled ore stages that may correlate temporally with multiple deformation events.