

### **The Archean Troilus Au-Cu-Ag Deposit: An Atypical Syn-Volcanic World-Class Deposit Reworked During Amphibolite-Grade Metamorphism and Deformation (Quebec, Canada)**

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The world-class Troilus Au-Cu-Ag deposit (13.01 Moz Au equivalent) is located in the underexplored Frotet-Evans greenstone belt (Quebec, Canada). Though it was historically mined as an open pit operation from 1996 to 2010, producing more than 2Moz Au and 70kt Cu, the nature of the deposit remains a controversy. It was originally described as a volcanic-hosted Archean porphyry deposit, primarily due to its base metal content, the bulk nature of mineralization and an association with felsic porphyritic dykes. Subsequent work described the deposit as the result of overprinting orogenic events. The dispute over Troilus' origins is the consequence of it displaying features characteristic of a wide range of deposit types (VMS, porphyry/intrusion-related, skarn/contact metasomatism and orogenic). After extensive exploration efforts and ~350,000m of drilling since 2018, a deposit reclassification seems warranted; a polyphased atypical Archean Au-Cu-Ag deposit is proposed.

New field and core observations, combined with comprehensive deposit-scale 3D modelling, point to an early mineralizing event (~2.79 Ga) during the emplacement of the polyphased gabbro-diorite-tonalite syn-volcanic Troilus intrusion into a submarine caldera containing a complex mafic to felsic tholeiitic-transitional-calc-alkalic volcanic sequence intruded by a swarm of felsic dykes. Au-Cu-Ag mineralized zones are dominantly disseminated in nature or as a stockwork and hosted within specific stratigraphic horizons/units, including brecciated volcanic rocks and tuffs, high Fe-Ti basalts, near felsic dykes and within a tonalitic phase of the Troilus intrusion. The deposit has been deformed and metamorphosed under amphibolite facies conditions, resulting in a high-degree of remobilization and a strong structural control within a dextral transpressional shear system. Ore is associated with the presence of biotite, sericite, albite, quartz, carbonate, magnetite, chlorite and locally with alumino-silicates and fuchsite. A retrograde greenschist event has also been recognized, which is interpreted as an orogenic Au overprint and presents as discordant quartz-tourmaline-chlorite veins.