

Characterization of three mineralization styles of the Revenue Au occurrence, Dawson Range, Yukon Territory, Canada: implications for a large-scale, intrusion-related system

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The Freegold Mountain Project in the Dawson Range of the Tintina Gold Belt hosts multiple gold showings, including the poorly characterized Revenue Au occurrence. At Revenue, three different mineralization styles are hosted in the Cretaceous (ca. 105 Ma) Revenue Granite: (i) early, Cu-Au quartz stockwork, named the Blue Sky Porphyry (BSP), locally overprinted by (ii) the polymetallic (Cu-Mo-W-Au-Pb-Zn) W-Au (WAu - wow) Breccia, which is crosscut by (iii) a diatreme Cu-W hydrothermal breccia. The ore and alteration mineral assemblages have been characterized with respect to paragenesis and mineral chemistry (including major, minor, and trace elements) in order to discriminate the different mineralizing events, fingerprint their chemical signatures, and interpret the processes that led to their formation. The BSP is characterized by early quartz-pyrrhotite-chalcopyrite-pyrite±gold veins with trace sphalerite and potassically altered (biotite, K-feldspar) margins, and late stage quartz-chalcopyrite-molybdenite±carbonate veins. The WAu breccia consists of clasts of phyllic altered Revenue Granite and coeval quartz-feldspar porphyry (QFP) dykes hosted in a sulfide-quartz matrix. The sulfide matrix contains massive pyrite-chalcopyrite with late pervasive molybdenite and local occurrences of Bi-rich galena, sphalerite, and pyrrhotite, and trace glaucodot and ferberite-scheelite. The diatreme-hosted hydrothermal breccia consists of a fine-grained chalcopyrite-pyrite ± scheelite matrix interstitial to weakly phyllic-altered diatreme clasts with diffuse boundaries. Trace element compositions of chalcopyrite, pyrite and pyrrhotite from the early and late Blue Sky Porphyry and WAu Breccia indicate that the sulfides from each location show unique chemical signatures, with respect to relative Co + Ni, Ag + Au + Te, and W + Sn abundances. Major elements of sulfides and sulfarsenides provided a basis to calculate crystallization temperatures: (i) sphalerite with pyrite and pyrrhotite from late stage BSP and WAu Breccia yielded high temperatures of 601°C to 613°C and 610°C to 647°C, respectively, (ii) glaucodot from the WAu Breccia gave temperatures of 300°C to 465°C, and (iii) arsenopyrite in equilibrium with pyrite gave temperatures from 363°C to 491°C for mineralized QFP dykes. The overprinting mineralization styles of the Revenue occurrence were likely the result of an overpressured system due to the emplacement of granitic intrusions at depth. Similar intrusion-related mineralization styles in the Freegold Mountain area suggest that the granitic intrusions were part of a large cooling magmatic system at depth.