Gold in the Cantung W-skarn deposit, Northwest Territories: distribution, mineralogy, and petrogenesis

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Cantung is a world-class W-Cu-(Au-Bi) skarn deposit located in the Northwest Territories close to the Yukon border. It is within the polymetallic W-Au Tintina Belt of the northern Canadian Cordillera and is currently operated by North American Tungsten Corporation Ltd. Despite multiple mine closures since opening in 1962, Cantung had an estimated 6.21 Mt with an average recovered grade of 1.56 % WO_3 extracted as of the end of 2009. The most recent estimate of the indicated mineral resources is 2.06 Mt grading 1.04 % WO_3 with probable mineral reserves of 1.34 Mt grading 1.05 % WO_3 as of October 2011. The deposit is located in both an underground mine, termed the "E Zone", and an Open Pit resource near the surface. Extensive magmatic systems formed the W skarns that were later altered by magmatic-hydrothermal events.

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Previous research indicates that the hydrothermal fluids were predominately supercritical, hot magmatic brines with homogenization temperatures that ranged from 270 to 500 °C. Mineralization at the Cantung mine comprises calc-silicate skarn replacements within the Ore Limestone, a clean limestone receptive to skarn development, and lower grade replacements in the Swiss Cheese Limestone, a calc-silicate/chert unit. Pyrrhotite is abundant in all skarn facies and is positively correlated with the W mineralization. Scheelite and chalcopyrite are dominant, although locally abundant sphalerite and anomalous Bi and Au concentrations were also significant. The purpose of this study is to characterize the distribution, mineralogy, and petrogenesis of Au in this deposit. From the E Zone, five samples with bulk rock Au assay values greater than 0.5 ppm were examined petrographically. Using the bulk assay data (n = 48), Au correlates positively (Spearman's Rank, r') with Bi (0.76), Ag (0.70), Fe (64), Cu (0.64), and Mo (0.60). No free Au (electrum) has been identified optically or by SEM and FEG-SEM in analyses thus far. The hypothesis is that the Au is present as nano-inclusions within chalcopyrite or is lattice bound within Bi-minerals or related tellurides and selenides that occur in the interstices of calc-silicate minerals that have been identified. The liquid bismuth collector model is tested using LA-ICP-MS analysis to determine the extent of lattice bound Au. This model involves Au scavenging from magmatic hydrothermal fluid by complex liquid Bi-sulphide phases saturating during W-Cu mineralization.