STRUCTURAL GEOLOGY AND MINERALIZATION OF THE WHITE DEVIL MINE, TENNANT CREEK, NORTHERN TERRITORY.

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ABSTRACT

The White Devil gold mine located about 40km northwest of Tennant Creek , Northern Territory, is currently being developed by Australian Development Limited following a successful exploration program in an area of former mining.

The well-bedded siliciclastic sedimentary rocks of the Lower Proterozoic Warramunga Group, which host the White Devil mineralization, have undergone two main deformations. The early ductile deformation (D_1) was a moderate deformation, which produced upright east-west trending open-close folds, with a regular plunge 40-50° toward 245°. The late semi-ductile to brittle deformation (D_2) was a continous deformation, which was associated with at least three closely spaced events. These were the intrusion of a set of semi-concordant porphyries, an early east-west upright shearing associated with the emplacement of hydrothermal quartz-magnetite bodies (ironstone) and a progressive shearing associated with the mineralization. The shearing produced a slickenside/fibre lineation, that suggests a vertical-oblique displacement with the south block eastwardly uplifted and the north block westwardly downthrown.

The gold-bismuth-copper mineralization in the White Devil deposit was formed during the progressive deformation (D_2) and was mainly associated with the long thin magnetite-rich bodies and extended in varying degrees into the associated chloritized sediments, especially within the shear zone.

Studies of mineral textures, fluid inclusions, chlorite compositions and sulphur isotopes have provided information for a preliminary interpretation of ore-forming conditions and some indications of evolution of the hydrothermal fluid. Textural relationships and fluid inclusion data demontrate that there were two distinct phases of the hydrothermal fluid. The magnetite was formed from a fluid of relatively high temperature(~400°C) and high salinity (probably $CaCl_2$-NaCl). The gold-bismuth-copper mineralization was formed from a fluid of lower temperature (~300°C) and moderate salinity (probably NaCl-rich). Analyses of chlorite associated with the ore confirm the fluid inclusion temperatures and indicate log fO_2 and logfS_2 conditions of approximately -31.6 to -35.0 and -9.8 to -11.6, respectively. A magmatic component to the fluid is suggested from preliminary sulphur isotope data.

Under the proposed T-fO_2-pH conditions of the fluid, gold transport would be predominantly by means of the $AuCl_2^-$ complex. Deposition of gold was probably controlled by decrease of fluid temperature and/or increase in pH. The close association of the orebody and the magnetite suggests that the magnetite may also be an important factor, in that in some way, it could have acted as a chemical trap for the ore deposition.

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