FLUID COMPOSITION AND FLUID/ROCK INTERACTION AT THE HUTTI GOLD MINE, INDIA

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The Hutti Gold Mine is located in the Archean Hutti-Maski greenstone belt in the Dharwar Craton, India. Gold mineralisation is synchronous with two stages of deformation (D2 and D3) and retrograde metamorphism. The second deformation event (D2) formed shear zones which are characterised by an alteration zonation. The distal alteration is dominated by chlorite, sericite, arsenopyrite and pyrite which correlates with an enrichment in Mg, Fe, As, and S. The proximal alteration is dominated by biotite, plagioclase, arsenopyrite, and pyrite which correlates with an enrichment in K, Rb, Ba, As, and S. Fluid inclusions within sporadic quartz veins are primarily CO$_2$-rich (0–0.2 XCH$_4$), with rare low salinity (0–5 wt% NaCl equiv.) aqueous inclusions. The fluid associated with the distal and proximal alteration, calculated at 530$^\circ$C, has a $\delta^{18}O_{H_2O}$ of 7.5 ppm and $\delta D_{H_2O}$ of $-23$ ppm with $\delta^{18}O_{H_2O}$ of 7.8 ppm and $\delta D_{H_2O}$ of $-26$ ppm, respectively. In contrast, the alteration associated with reactivation of the shear zones (D3) is dominated by chlorite, K-feldspar, scheelite, and pyrrhotite. The most significant element enrichments are W and Au. Fluid inclusions in the laminated quartz veins formed during D3 are CO$_2$-rich (0–0.2 XCH$_4$), with rare low salinity (1–5 wt% NaCl equiv.) aqueous inclusions. This later fluid, calculated at 350$^\circ$C, has a $\delta^{18}O_{H_2O}$ of 5.0 ppm and $\delta D_{H_2O}$ of $-23$ ppm.

The similarity in the composition of fluid inclusions from the D2 and D3 veins indicates: (1) that the initial fluid information was lost by the overprinting of the second mineralising event; or (2) a similar fluid type for both stages of mineralisation. The removal of K and As correlates with the replacement of biotite by chlorite and arsenopyrite by pyrrhotite during reactivation of the shear zones (D3). In addition W
and Au where transported into the shear zones. The isotopic composition of the D2 fluid varies slightly between the alteration zones, the distal alteration is isotopically lighter indicating elevated fluid/rock interaction. The isotopic composition of the D3 fluid indicates negligible meteoric/seawater influence, neighbouring granitoids may have contributed to the fluid although fluid inclusion salinity remains low. Two differing fluids are responsible for these two stages of gold mineralisation whereby the overprinting relationships have enhanced the gold grade, creating one of the largest gold deposits in India.