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Fluid evolution in shear-hosted Cu-Au mineralisation at Thanewasna, Central India: Constraints from fluid inclusion and stable isotope study.

Dora, M. L.[1], Suresh,G[2]., Mayachar,G[3]., Rao, N.K[1].,Mohapatra, K.C[1]., Nitnaware N,V[1]., Smita,R. S[2] and Randive K, R[4].

[1]Geological Survey of India, Central Region, Nagpur-440006; corresponding author: dorageol@gmail.com

[2]Geological Survey of India, GSITI, Hyderabad-500068

[3]Geological Survey of India, NCEGR, Bangaluru-566070

[4]Department of Geology, RTM University, Nagpur-440001

The Cu-Au mineralization of Ghanpur-Thanewasna-Naidilli, Western Bastar Craton, occurs as fracture-filling quartz-chlorite veins hosted in a granitoid, confined to a 30 km long NW-SE trending brittle-ductile shear zone. Mineralization occurs as dissemination, stringer and massive veins, and consists of chalcopyrite, pyrite and minor amounts of gold. These modes of occurrence indicate that several influxes of mineralized fluid took place. A combined fluid inclusion, XRD, Raman spectroscopy, ore petrography, chlorite chemistry and sulphur stable isotope study based on surface and drill core samples has been undertaken to characterise the ore-forming fluid, the P-T conditions of ore formation, and the depth of mineralized fluids. Three types of primary inclusions (monophase vapour (V), dominant two-phase vapour-liquid rich (V-L) and rare multiphase solid (L-V-S)) were observed. Microthermometric measurements were performed using a Linkam THMS 600 heating – freezing stage with Linksys software version 1.8 [1] and FLUIDS [2]. A wide range in initial melting, final melting and homogenization temperatures were found. The microthermometric and Raman spectroscopy data suggest that the fluids responsible for the main mineralising event were trapped during fluid mixing and phase separation of a H_2O-CO_2 liquid. Gold-barite mineralization is associated with low salinity (2.46-7.00 wt.% NaCl) and copper with medium to high salinity (7-29 wt.% NaCl) fluids. Homogenization temperatures scatter over the range of 150 ºC to 251 ºC. This temperature range is further supported by six empirical and thermodynamic geothermometers based on Al ^{IV}, Al ^{VI} and Fe/Fe+Mg ratio of chlorite, yielding formations temperatures from 187 ºC to 381 ºC [3].

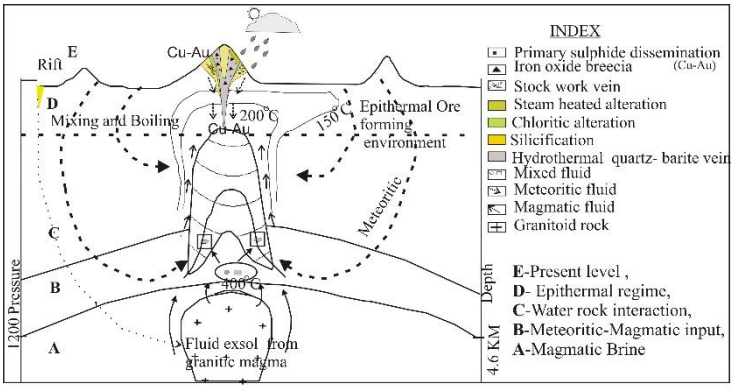

Figure.1 Schematic fluid evolution diagram of Thanewasna copper deposit (ruled area), dotted arrows indicate meteoric water influxes.

Sulphur isotope values of sulfides near 0 per mil suggest a brine of magmatic origin and an igneous source of S. Gel textures from hydrothermal pyrite are due to rapid cooling and precipitation from fluids related to magmatism. Isochore intersections imply that Cu-Au mineralization formed at depths of ~3 to 4.6 km (1200 bar pressure) over a temperature range of 195-251 ºC. Au-Cu mineralization is produced by mixing of volatiles in groundwater with a hot magmatic fluid with higher salinity. The source of the ore-bearing fluids is related to emplacement of the Proterozoic Mul granite (1587 ± 14 Ma) in the vicinity of the shear zone along the northern shoulder of the Godavari rift, which produced a high geothermal gradient for driving hydrothermal fluid circulation, resulting in alteration and remobilised Fe, Cu, Au (Fig.1). Quartz veins show colloform and lattice bladed calcite in outcrop, which indicates boiling. Microthermometric data and mineralogical evidences indicate

that variable amounts of boiling, mixing and cooling may have played an important role in metal (Cu-Au) precipitation, under epithermal conditions in a brittle shear zone, which channelled fluids. Integrating field and laboratory results suggest that the Ghanpur-Thanewasna quartz-chlorite ore system is part of a structurally controlled high sulphidation epithermal type deposit. This characterization helps in the regional exploration for base and precious metals in the Bastar Craton and similar deposits elsewhere.

References

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