

### **Ore-Forming Fluid Characteristics and P–T Condition of Gold Mineralization at Paramanahalli, Chitradurga Greenstone Belt, Karnataka, India**

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Paramanahalli gold deposit, Karnataka, India, is hosted by volcano-sedimentary rocks of the Hiriya Formation within splays of the Chitradurga Shear Zone (CSZ). Gold/sulfide mineralization is predominantly confined to N-S-oriented veins and adjacent altered rocks. Mineralized veins are characterized by a hydrothermal assemblage of chlorite (Fe-rich), ankerite, quartz, pyrite, chalcopyrite, pyrrhotite, gold, and silver, whereas non-mineralized veins consist mainly of quartz and carbonate minerals (ankerite and calcite). Fluid inclusion studies on mineralized quartz veins indicate three primary inclusion types: aqueous biphasic (Type Ia), carbonic monophasic (Type Ib), and aqueous-carbonic (Type Ic). The homogenization temperatures ( $T_h$  °C) range from 216°C to 332°C, and salinity from 1.07 to 16.05 wt% NaCl eq. Fluid inclusion studies reveal low to medium salinity (12 wt% NaCl eq.) aqueous-carbonic fluids ( $H_2O-NaCl-CO_2 \pm CH_4$ ) in mineralized veins, and lesser saline inclusions (1.56–6.44 wt% NaCl eq.) in non-mineralized veins. Microthermometric analyses indicate boiling, fluid mixing and fluid-rock interaction played an important role to the destabilization of gold-bearing sulfide complexes and subsequent gold precipitation with sulfides. The mineralizing fluids, near-neutral to slightly alkaline, transported gold as  $Au(HS)_2^-$  complexes. Estimated pressure-temperature conditions for gold mineralization are ~2.2 kbar and 310 °C, while non-mineralized veins formed at ~1.2 kbar and 260 °C. Quartz and calcite from mineralized veins display microstructures indicative of dynamic recrystallization and intracrystalline deformation, suggesting ductile deformation followed by brittle brecciation. Litho-structural controls strongly influenced gold precipitation, extending mineralization into adjacent altered rocks. This study highlights the significance of fluid evolution, deformation processes, and structural controls in the Paramanahalli gold mineralization system, providing insights applicable to orogenic lode gold deposits worldwide.