

The link between gold mineralization and fluid evolution in epithermal systems: A case study of the Dongyang gold deposit, China

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ABSTRACT

The formation of epithermal gold deposits is closely linked to the evolution of hydrothermal fluids, but the factors controlling the partitioning of gold and arsenic into sulfide minerals within the evolutionary framework remain poorly understood. Here, we interpret the spatial zoning of mineral assemblages, trace elements, and sulfur isotopic fractionation at the Dongyang epithermal gold deposit in southeastern China. The vertical zonation is defined by a distinct transition from an upper (surface to ~100 m) sulfide assemblage with negative $\delta^{34}\text{S}$ values to a lower zone (below ~100 m) where sulfides with near-zero $\delta^{34}\text{S}$ coexist with ferric iron oxides and sulfosalts, indicative of an increase in the oxygen fugacity of the hydrothermal fluids with depth. The distribution of arsenian sulfides exhibits an opposite trend relative to the variation in oxygen fugacity, indicating that low oxygen fugacity facilitates arsenic partitioning into sulfides, which is consistent with the reduction of As(III) aqueous complexes to As⁻ in the structures of pyrite and arsenopyrite. The increased arsenic partitioning into sulfides also enhances mineralization of “invisible” gold in the upper part of the deposit. The vertical zonation, mineralogical, textural, and sulfur isotopic signatures at Dongyang are consistent with a model involving boiling at depth and rapid upward migration of reducing (H₂) and H₂S-rich vapors.

Keywords: Oxygen fugacity, “invisible” gold, arsenic, fluid evolution, epithermal gold deposit