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Geochemical and micro-texture of pyrite: evidence of gold remobilization and enrichment for the Tudui-Shawang gold deposit, Jiaodong Peninsula, China

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The Jiaodong gold province is renowned as China's most prolific gold-producing region, with reserves exceeding 5000 tons. Extensive study and discussion have focused on the genesis of high-grade gold ore zones. Given gold's low solubility in hydrothermal fluids, its remobilization during subsequent alteration and deformation is believed to be crucial for gold enrichment. In the Jiaodong gold province, pyrite is a key gold-bearing mineral. Its morphology and geochemical composition help differentiate between initial crystallization and post-deposition events. This investigation centers on the pyrite in the Tudui-Shawang gold deposit to unveil the gold enrichment process. We have identified four mineralization stages: (I) quartz-pyrite, (II) quartz-pyrite-Au, (III) pyrite-pyrrhotite-magnetite-Au, and (Ⅳ) calcite. Stage I features pyrite (Py1) as euhedral to subhedral grains, exhibiting wild Co, Ni, and As contents, alongside moderate Au content (bdl-2.13 ppm). Pyrite in Stage II is bifurcated into two generations (Py2-1 and Py2-2). Py2-1 is marked by corrosion-texture regions (Py2-1a) and homogenous regions (Py2-2b), whereas Py2-2 is characterized by complex zoning: (1) homogenous cores (Py2-2a), (2) mantles with alternating bright (Py2-2b) and dark (Py2-2c) bands featuring a corrosion texture, and (3) outermost rims (Py2-2d). The corrosion texture and abundant inclusions in Py2-1a, Py2-2b, and Py2-2c indicate that gold remobilization has occurred, likely governed by coupled dissolution-reprecipitation (CDR) processes. Py2-1a shows elevated Au (0.22-27.3 ppm) and other trace elements compared to Py2-1b. Py2-2a is enriched in Co and Ni but deficient in As and Au, indicative of high-temperature equilibrium precipitation. Py2-2b forms during boiling, accompanied by cooling and an increase in fO_2, while Py2-2c precipitates during the intermission of fluid boiling. The residual fluid not only forms the gold-poor rim (Py2-2d) but also modifies the original textures of primary pyrite, fostering gold enrichment in Py2-2b (Au = bdl-53.1 ppm) and Py2-2c (Au = bdl-1.10 ppm) via CDR reactions. Visible gold is intergrown with Py2-1, and high-content invisible Au exists in Py2-1a and Py2-2b, highlighting that the CDR process promotes Au enrichment and transforms invisible Au into visible forms. This study emphasizes the pivotal role of the CDR in the remobilization and subsequent enrichment of gold within the Jiaodong gold deposit.