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Invisible Gold Mineralization within Korivipalle Dolostone and Dhone Dolerites: Implications from EPMA and LA-ICP-MS Analysis of Pyrite

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The study focuses on auriferous sulfides hosted in the Vempalle dolostone to elucidate the genesis of invisible gold mineralization in the Korivipalle area of the Cuddapah Basin, southern India. Petrographic examination, SEM, and EPMA data reveal various sulfide phases including pyrite, chalcopyrite, and galena. Textural characteristics and Co/Ni values differentiate two pyrite generations: sedimentary pyrite (Py1) and hydrothermal pyrite (Py2). Py1 grains are finer and anhedral, while Py2 grains are coarser and euhedral, associated with quartz calcite veins. The Au vs As diagram obtained from Laser Ablation Inductively Coupled Mass Spectrometry analysis suggests invisible gold occurs both as solid solution and nano inclusions within sulfides. Nano-gold inclusions in pyrite form due to increased solubility during crystallization and exsolution of Au nanoparticles during later mobilization. Py2 exhibits higher gold concentration than Py1 due to dissolution and remobilization by later hydrothermal fluid. Organic activities provided the redox environment for sulfide precipitation, evident by their presence along oolitic boundaries.

In Dhone, a dolerite dyke intrudes the dolostones, rich in pyrite, chalcopyrite, and magnetite, with accessory phases of covellite, galena, and martite. Texture-based classification identifies two pyrite types: coarser, porous Py1 and finer, euhedral Py2. Py1 and chalcopyrite are mainly located along vertical to near-vertical fracture zones, likely formed during the dyke's cooling phase. This is evidenced by crosscutting relationships of Py1 with host silicates minerals. Py2 originates from a higher temperature fluid, inferred from enrichment of high-temperature elements like Bi, Te, Co. Py2 has lower Au content due to gold instability at higher temperatures. All points on the Au vs As diagram lie below the gold solubility curve, indicating solid solution mode of occurrence. In conclusion, gold was initially present within the Py1 phase and later remobilized by a high-temperature fluid, resulting in a lesser concentration in Py2 compared to Py1.