Paragenesis and Trace Element Signatures of Pyrite from Paramanahalli Gold Deposit, Chitradurga Greenstone Belt, Karnataka, India: Implications for Ore Genesis

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Gold mineralization at the Paramanahalli, within the Chitradurga Greenstone Belt (CGB), of Western Dharwar Craton (WDC) India, is confined to altered metabasalt and Banded Iron Formation (BIF). Chlorite (Fe-rich)-quartz-biotite-ankerite-rutile-magnetite-pyrite chalcopyrite-pyrrhotite ± gold is the mineral assemblage found in mineralized zones. Pyrite is the dominant sulfide mineral and occurs in both altered rocks and in quartz veins, classified as altered zone hosted and vein-hosted pyrites, respectively. Three distinct generations of pyrite were identified based on textural and geochemical analyses including X-ray element imaging, electron probe microanalysis (EPMA), and LA-ICP-MS: (1) early stage pyrite-I, euhedral grains with silicate and oxide inclusions, (2) main ore stage pyrite-II, subhedral-anhedral grains, closely associated with visible gold and subdivided into Ni-rich (pyrite-IIa) and Co-rich (pyrite-IIb) types, and (3) late stage pyrite-III as anhedral grains and free from mineral inclusions. Trace element variations across pyrite generations reveal decreasing concentrations of As, Ni, Au, Se, Mo, and Te from pyrite-I to pyrite-III. Native gold grain is found to be associated only with altered zone-hosted pyrites (Pyrite-II) from the main ore stage. The inferred paragenetic sequence indicates formation of early pyrite-I, followed by main-stage pyrite-II, and culminates with late-stage pyrite-III. Gold probably occurs as lattice-bound within pyrite-I, and visible gold in pyrite-II formed later during the fluid induced dissolution-reprecipitation processes. Sulfidation, chloritization, and ankeritization are the major wall rock alterations responsible for the formation of sulfides and gold during the main ore stage. These findings emphasize the role of fluids to form visible gold within Pyrite-II and their significance to understand the ore-forming processes in greenstone-hosted gold deposits in CGB, of WDC, India.