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Physico-Chemical Conditions of Pahardiha- Rungikocha Gold Deposit, North Singhbhum Mobile Belt, Eastern India

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The Pahardiha-Rungikocha gold deposit is located south of the Dalma volcano-sedimentary belt within the North Singhbhum Mobile Belt (NSMB), in the eastern part of India. Gold occurs in the quartz \pm carbonate veins within the sheared quartz-chlorite schists. Field observations coupled with previous studies show 3 phases of deformation (D1, D2, D3) within the Pahardiha-Rungikocha gold deposit. The D1 and D2 deformation phases are progressive metamorphism. The late deformational phase, D3, is responsible for the gold mineralization. The total gold ore reserve reported from the deposit is 0.487 million tonnes with an average grade of 3.43 ppm. Gold within the deposit occurs as native particles or specks of visible gold along the cracks/margins of euhedral pyrite. The gold-bearing pyrite is coeval with a generation of chromite-cored magnetite where euhedral magnetite rims show epitaxial overgrowth over the relict chromite cores. In this work, we use chromite-cored magnetite chemistry and bulk rock chemistry to determine the physico-chemical conditions of gold mineralization. The final phase of deformation is responsible for the formation of the chromite-cored magnetite rims, which is coeval with the gold mineralizing event. These magnetite rims formed as a result of the metasomatic process brought about by the interaction of hydrothermal fluids with the wall rock. The chromite-cored magnetite trace element signatures resemble the high-temperature Ca-Fe alteration and high-temperature K-Fe alteration facies reported from various IOCG and IOA type deposits. The host rock chemistry is a consequence of a mixed provenance of felsic and mafic/ultramafic source rocks of the mineralized quartz-chlorite-schists. These fluids were relatively rich in mafic components such as Ni, Mg, Cr, and V, as evident in the chromite-cored magnetite chemistry. A comparative study of bulk rock chemistry of the quartz-chlorite schists and chromite-cored magnetite chemistry reveals that the chemical composition of this gold mineralizing metasomatic fluid was controlled by the ambient wall rock chemistry. The final stage of the deformation event allowed metasomatic Au-enriched fluids and precipitation in quartz \pm carbonate veins.

Fig: A) BSE image of chromite-cored magnetite and X-ray elemental map shows the Chromite-rich zone at the core. B) Comparison of trace elements of average magnetite and bulk rock chemistry.

