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Magnetite in Banded Magnetite Quartzite from Turamdih and Mohuldih, Singhbhum Shear Zone, eastern India: disparity between texture and geochemistry

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In Turamdih and Mohuldih, Singhbhum Shear Zone, India, magnetite ± apatite ± ilmenite ± rutile occurs in banded magnetite quartzite with alternating quartz-rich and Fe-oxide-rich bands that texturally resembles "*sensu lato"* the Banded Iron Formation (BIF) formed by syn-sedimentary processes. In Turamdih, magnetite is locally interwoven with ilmenite whereas in Mohuldih, abundance of magnetite and apatite in the bands varies significantly and both these minerals share sharp mutual grain boundaries with rutile.

We report the trace element composition of magnetite hosted in the banded units from Turamdih-Mohuldih. Temperature-sensitive elements like Ti, V and Ga are anomalously enriched in magnetite compared to typical BIF-magnetite. The magnetites are also enriched in Al, Mg, Cr, Mn, Co, Ni, Zn, and Sn contrary to the known upper threshold concentrations of these elements in typical BIF-magnetite. Positive La, Eu and Y anomaly, commonly accepted as an evidence of precipitation from seawater modified by moderate T (<250°C) hydrothermal fluids are absent in the studied magnetites. In most of the well-known process/deposit-type discriminators such as Ti vs. Ni/Cr, (Ti + V) vs. (Al + Mn), (Ti + V) vs. Ni/ (Cr + Mn), and Mn vs. Ti/V, the Mohuldih-Turamdih magnetites plotted away from the assigned field for BIF. In empirical (Ti+V) vs. (Al + Mn) temperature-discriminator diagram, they plot near the high-T domain (≤ 500°C) consistent with the results of Mg-based magnetite thermometry (≈ 400°C).

Although the present state of the work is not conclusive about the origin of the banded rock, the concentrations of elements like V, Ni and Ga which remains relatively unaffected during post-depositional changes, bear no resemblance with BIF-magnetites. Probably the magnetite-rich bands formed in localized environment with significant input from hot hydrothermal vents, the metals being derived from mafic protolith by hydrothermal fluid. Alternatively, they could have formed from hydrothermal fluid ingress after the formation of the sedimentary unit. Thus the present study highlights the illusive nature of textural criterions and adds caveats to consider alternating Si-rich and Fe-rich bands as the *prima facie* evidence for chemical/biochemical sedimentation and the subsequent use of extracting information about the chemistry of primordial ocean.