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Geochemisty, depositional environment and tectonic setting of Neoarchaean banded iron formations: Evidence from western Bastar craton, central India

Malpe, D.B. [1] and Khandare, H.W. [1]

[1]Department of Geology, R.T.M. Nagpur University, Nagpur-440 001, India, e-mail: dbmalpe@yahoo.com

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In Dewalgaon area (79°59'38": 20°22'50") of western Bastar craton, TTG Amgaon Gneissic Complex (AGC) from Amgaon Greenstone belt encloses rafts and enclaves of mafic volcanics (metabasalts). Neoarchaean supracrustal belt of Baildila occurs as ridges and knolls interstratified within AGC. Bailadila Group rocks are represented by quartzo-feldspathic-schist, quartzite and banded iron formations (BIF) associated with ultramafic volcanics having komatiitic affinity, now represented by amphibole and talc schist.

Similar to most of the Archaean iron-formations, BIF of Dewalgaon area is well banded with variable thickness and is cherty facies type. Bands of hematite and silica (Quartz) in various mineralogical forms are present in BIF, with minor amount of magnetite, apatite, monazite and xenotime. The contacts between hematite and chert bands are sharp on mesoscopic level and sharp to diffuse at microscopic level.

Major, trace and REE data of Dewalgaon BIF does not match either with Algoma or Superior type. But, features like size, extent and association with volcanic rocks matches with the Algoma type BIF. Low concentration of Al_2O_3, TiO_2, Zr, REE as well as lack of aluminosilicate phases and trilinear relationship of various oxides suggest very little or no clastic input, but some mafic input in the BIF. There is a large variation in the concentration of various elements in the BIFs of the present area including Fe_2O_3* (45.57 to 98.45%, avg. 54.19%), SiO_2 (0.26 to 53.08%, avg. 44.89%), Cr (10 to 280ppm, avg. 103ppm), Co (32 to 73, avg. 54ppm) and Ni (4 to 166, avg. 35ppm). The Co/Ni ratio varies between 0.37 to 28.5 and most of the samples have Co/Ni value higher than 1, suggesting derivation of iron from high temperature igneous source such as high-temperature metalliferous hydrothermal brine. Low concentration of Zr (<10ppm) and trace elements like Cu (avg. 17ppm), Mn (avg. 355ppm), Pb (avg. 8ppm) and Y (avg. 13ppm) suggest volcanogenic source for BIF. This is also supported by plot of (Co+Cu+Ni) / ΣREE, where present BIF samples plot within or close to the hydrothermal field suggesting that major part of the metals in the BIF are added to the bottom sea water by hydrothermal solutions [1]. The NASC and PAAS normalized REE patterns of Dewalgaon BIF shows a distinct LREE depletion with weak to no Ce and strong positive Eu anomaly and comparatively enriched flat HREE pattern. Positive Eu anomalies (Eu/Eu^*_N = 1.12 – 2.74) observed in BIFs suggest that there is a large contributions of hydrothermal fluids to the seawater involved in BIF precipitation and also signifying that the solutions which brought FeO and SiO_2 to the ambient ocean were derived from a reducing environment. The variation in Eu anomalies in BIF further indicates mixing of hydrothermal fluids of different temperature with the bottom sea water [2]. Average REY concentrations (REE and Y) for the Dewalgaon BIF (22.09ppm) is considerably below PAAS abundance (211.77ppm) and it shows positive $(Eu/Eu^*)_N$ anomalies which is typical of high temperature hydrothermal fluids. The average REY-pattern show strong positive Y_N-anomaly indicating fairly rapid precipitation of BIF. Depleted ΣREE, positive Eu anomalies, positive correlation between Eu_N-anomalies and Fe_2O_3 and flat HREE-enriched pattern of Dewalgaon BIF indicates that iron and silica for these BIFs were mainly added to ambient ocean water by hydrothermal

solutions emplaced at the vent sites situated at the Archaean Mid-Oceanic Ridges (AMOR) [1, 3], which is supported by presence of Amgaon metabasalts of MORB affinity in the vicinity [4].

References:

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