

REE in 3.2 Ga BIF from Barberton, South Africa : An interplay of Fe oxidation and hydrothermal activity

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Banded iron formations (BIFs) have been believed to have deposited by oxidation of dissolved Fe^{2+} emanated from submarine hydrothermal activity. During precipitation of Fe oxyhydroxide, rare earth elements (REEs) coprecipitated by adsorption onto their reactive surface. Such adsorbed REEs inherit crucial information on the ocean chemistry, such as the redox state of seawater and the extent of hydrothermal activity that affected BIF deposition. Here we present REE compositions of 3.2 Ga old BIFs from South Africa in order to constrain the marine environment at the time of BIF formation,

Samples used in this study belong to the lowermost unit of the Fig Tree Group of the Swaziland Supergroup in the northeastern part of the Barberton Greenstone Belt, South Africa. Powdered samples were measured for major element compositions by XRF and REE compositions by ICP-MS ($n = 37$). Most of the samples have a relationship $\text{SiO}_2 + \text{total Fe}_2\text{O}_3 = \text{about } 100\%$. Sample with Al_2O_3 contents less than 1.0 wt.% are considered to be chemical precipitates, essentially free from continentally-derived detritus and thus used for further discussion.

The most important finding is systematic covariations among total Fe_2O_3 , Eu anomaly, Ce anomaly, and Y/Ho ratios. The higher the total Fe_2O_3 content, the more positive Eu anomalies are, and the higher the Y/Ho ratios. Although only weak negative Ce anomalies were found in the samples, they are associated with the higher Y/Ho ratios. Here is a simple scenario for BIF deposition that may explain every observation. Submarine hydrothermal activity discharged dissolved Fe^{2+} (with more positive Eu anomalies) into seawater, then the Fe was oxidized to Fe^{3+} to precipitate as Fe oxides, to which REEs were absorbed inheriting seawater chemistry, i.e., generally negative, but variable degrees of Ce anomalies and Y/Ho ratios.

Keywords: REE, BIF