The Origin of Banding in BIFs: II. Cr isotopes and Th/U in the Neoarchean Temagami IF, Canada

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The similar Y/Ho and the systematic variation of Ge/Si between alternating magnetite and metachert bands in the Temagami IF suggest that the former formed during times when seawater composition was dominated by hydrothermal input, while the latter formed during times when continental runoff was dominant. Hence, geochemical signals from the terrestrial surface environment may be oberved in the metachert bands, rather than in the magnetite bands. This allows to test the reliability of geochemical redox proxies and may provide additonal clues to answer the question whether the banding in BIFs is of depositional or diagenetic origin.

We report on the Cr isotopic composition and on Th/U in alternating ultrapure magnetite and metachert bands of the 2.7 Ga old Temagami IF, Ontario, Canada. While the magnetite bands are characterized by unfractionated Cr isotope ratios and unfractionated Th/U similar to those of igneous and clastic rocks, the metachert bands show positive $\delta^{53}Cr$ and low (i.e. fractionated) Th/U. Hence, both redox proxies indicate oxygenated conditions in the source area of Cr and U present in seawater when the Si-dominated bands formed, but hint at reducing conditions in the source area of Cr and U in seawater when the magnetite bands were deposited. While this is in agreement with the generally reducing conditions in the Neoarchean deep ocean and in marine hydrothermal systems, it reveals the contemporaneous existence of a transient oxygen oasis on the landmass adjacent to the "Temagami Sea". This further reveals that the precursor minerals of the alternating magnetite and metachert bands precipitated at different times from seawater of different composition, demonstrating that the prominent banding of BIFs is a primary depositional and not a secondary diagenetic feature.