Dual source of constituents in Banded Iron Formation, O'Toole Nickel Sulfide Deposit, Minas Gerais, Brazil: Rare Earth Elements evidence

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The O'Toole nickel sulfide deposit is located in the Morro do Ferro Greenstone Belt, M.G., Brazil. The deposit is hosted by the third of four volcanic cycles, each comprised of komatiitic metaperidotite/dunite - metapyroxenite - metabasalt (amphibolite) sequences. The cycles are separated by banded iron-formations (BIF).

Rare earth elements (REE) study on mineral separates from the silicate facies ! carbonate ! magnetite BIF indicates the presence of two distinct sources for elements, continental crust erosion and hydrothermal activity. Two mineral separates (amphibole and carbonate) have chondrite-normalized REE patterns (pattern I) typical of continental erosion derived sources, i.e., LREE-enriched and fractionated, exhibit no Eu anomaly, have flat HREE, and are comparable to Archean shales. Six mineral separates (three amphibole, one carbonate, one quartz, one magnetite) have chondrite-normalized REE patterns (pattern II) typical of hydrothermal-related sources, i.e., have a very prominent positive Eu anomaly and low LREE and HREE abundances. The widespread preservation of positive Eu anomalies in Archean metasediments as compared to a much more restricted preservation of this feature in modern sediments indicates that oceanic conditions during Earth's early history were more reducing.

The REE study of mineral separates representing BIF microbands is very informative of the rapid changes that might occur during the deposition of the iron formations. Changes from patterns typical of continental to those representing hydrothermal sources appear to take place on a centimeter scale, emphasizing the dynamic nature of hydrothermal processes. The REE pattern II can be reproduced by a mixture of MORB-type hydrothermal fluids and seawater in 1:40 ratio.