Trace element and isotopic characterization of Neoarchean - Paleoproterozoic BIFs (Black Hills, South Dakota, USA) straddling the first rise of atmospheric oxygen between 2.4 and 2.0 Ga

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Banded iron formations (BIF) were deposited in the Black Hills, South Dakota, both prior to and after the first main oxygenation of the atmosphere at ~2.4-2.3 Ga. Paleoproterozoic oxide BIFs deposited before this event still indicate prevalence of reducing conditions in the depositional basins, consistent with the occur-rence of stratigraphically associated uranium- and pyrite-rich conglomerates. In contrast, mixed silicate-carbonate-oxide BIFs were formed long after this 2.4-2.3 Ga event, with deposition straddling the end of the ~2.3-2.0 Ga positive $\delta^{13}C$ anomaly. The older, oxide-facies and detritus-free BIFs were depo-sited during rifting at ~2.56-2.48 Ga, associated with initial break-up of the Kenorland supercontinent. These BIFs exhibit REE characteristics typical of ambient seawater signatures (positive La, Eu, Y, and negative Ce, anomalies in PAAS-normalized REE diagrams); Sm-Nd model ages of 3.78-2.56 Ga; a high-μ ($^{238}U/^{204}Pb$) tenor, typical of the Wyoming craton; and low $^{208}Pb/^{204}Pb$ relative $^{206}Pb/^{204}Pb$ ratios, implying pro-nounced fractionation of U relative to Th during source rock weathering processes and (or) during deposition. Deposition of the younger, silicate-carbonate-oxide BIFs appears to have occurred in a rifted continental margin that developed as a con-sequence of final break-up of Kenorland beginning at ~2.1 Ga, during discrete episodes of rifting precisely dated at 2.02-1.98 and 1.89-1.88 Ga. These horizons of younger BIF both reveal significant detrital input. They also exhibit Sm-Nd model ages of 3.83-2.51 Ga, comparable to the older BIFs. However, the younger BIFs differ by their less-fractionated PAAS-normalized REE patterns, lack of La anomalies, only weakly posi-tive Eu anomalies, and positive Ce anomalies. Positive Ce anomalies may reflect more oxidative scavenging of Ce(IV) onto Fe-oxyhydroxides, generally pointing to a more oxidized seawater environment during their deposition.

Earth´s oldest BIFs (Isua, W Greenland) – Constraints from Ge/Si ratios, REE systematics and Sm-Nd and Pb isotopes for different interacting water masses during their formation

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We report trace element, Sm-Nd and Pb isotopic data for individual micro- and mesobands of the Earth's oldest Banded Iron Formation (BIF) from the ~3.7-3.8 Ga Isua Greenstone Belt (IGB, West Greenland) in an attempt to contribute to the characterization of the depositional environment and to the understanding of depositional mechanisms of these earliest chemical sediments. REE-Y patterns of the individual mesobands show features of modern seawater with diagnostic Ce/Ce*, Pr/Pr* and Y/Ho anomalies. Uranogenic Pb isotope data define a correlation line with a slope of 3691 ± 41 Ma, indicating that the U-Pb system remained closed after the formation of this BIF. High $^{207}Pb/^{204}Pb$ relative to $^{206}Pb/^{204}Pb$ ratios compared to average mantle growth evolution models are a feature shared by BIF, penecontemporaneous basalts and clastic volcanogenic metasediments and are indicative of the ultimate high-μ ($^{238}U/^{204}Pb$) character of the source region, an essentially mafic Hadean protocrust. Sm-Nd isotopic relations on a layer-by-layer basis point to two REE sources controlling the arc basin depositional environment of the BIF, one being seafloor-vented hydrothermal fluids (εNd (3.7 Ga) ~+3.1), the other being ambient surface seawater which reached its composition by erosion of parts of the protocrustal landmass (εNd(3.7 Ga) ~+1.6).Systematic trends in Ge/Si ratios support the above theory and suggest that significant amounts of silica were derived from unexposed and/or destroyed mafic Hadean landmass, unlike iron which probably originated from oceanic crust following hydrothermal alteration by deep percolating seawater.