

Banded Iron Formation as Seawater Proxies

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Banded iron formations (BIF) are iron rich (~20-40% Fe) and siliceous (~40-50% SiO₂) marine sedimentary deposits that precipitated throughout much of the Precambrian. Recently, their trace element compositions have been used to determine paleo-seawater chemistry, with the ultimate goal being to better understand nutrient availability (e.g., P, Ni, Zn) for the ancient marine biosphere [1-3]. Using BIF as ancient seawater proxies requires an understanding of the initial mineral precipitates, the adsorption/co-precipitation reactions that took place in the ocean water column, and the potential for post-depositional changes in sediment nutrient content. It has generally been accepted that ferric hydroxide, Fe(OH)₃, particles were the precursor sediment, and that mineral precipitation was intimately linked to the metabolism of planktonic bacteria. The nutrients that later became incorporated into BIF were either supplied as sorbates of the iron hydroxide particles or were components of the cellular biomass [4]. Subsequent deposition and burial of the mineral-cell aggregates then provided an abundant supply of electron donors and acceptors to the seafloor, which fueled sediment diagenesis and metamorphism. Preliminary work on the experimental transformations of ferric hydroxide-biomass composites at elevated temperatures and pressures has demonstrated that all of the ferrous iron minerals in BIF can be formed during late-stage diagenesis. Current experiments are being directed at understanding whether post-depositional alteration may have affected nutrient mobility, and thus, whether BIF composition can indeed be used as an ancient seawater proxy.

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Mineralogical control of Se and Te signatures in peridotites: implications for the primitive mantle

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Selenium and tellurium belong to the group of highly siderophile elements (HSE) that are believed to constitute key tracers for planetary processes such as formation of the Earth's core and the Late Veneer composition. Constraints on HSE systematics on the planetary scale require, however, a previous understanding regarding the behaviour of these elements during petrogenetic processes and their abundances in the primitive upper mantle (PUM). Recent studies have shown systematic differences in Se/Te between fertile lherzolites and depleted harzburgites. In contrast to fertile lherzolites which remain at broadly chondritic values [1], depleted peridotites are highly fractionated with up to suprachondritic Se/Te (up to 35), where high Se/Te correlates with decreasing Te concentrations [2]. Fractionation is also observed at the scale of a single sample and results from the heterogeneous distribution of micrometer sized Te-bearing host phases in residual peridotites. On the whole rock scale this effect results in a more incompatible behaviour of Te compared to Se, once base metal sulfides are highly depleted and in some cases entirely consumed by partial melting. The marked differences in Se-Te systematics observed between fertile lherzolites and depleted harzburgites can be explained by the combined effect of i) different abundances and proportions of residual and metasomatic base metal sulfides and ii) discrete micrometric to nanometric platinum-group minerals. Hence, it is critical to fully understand Se-Te systematics in harzburgites if we are to provide new insights into the behaviour of Se and Te during mantle depletion. This knowledge is a prerequisite to further constrain the Se and Te abundances of the primitive upper mantle.

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