Iron and silicon isotope evolution across Palaeoproterozoic BIF of the Transvaal Supergroup, South Africa

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Silicon (Si) and iron (Fe) dominate the composition of banded iron formations (BIF) by mass. They occur mainly in quartz and magnetite, and are strongly decoupled due to the conspicuous Fe-rich and Fe-poor banding that typifies BIF. Fe silicate and Fe carbonate-rich sub-facies also host an appreciable proportion of the bulk Fe and Si in some BIF. Fe is redox-sensitive and provides useful insights into processes of biological or inorganic iron cycling during deposition and diagenesis. By contrast, Si bears no obvious value as a redox tracer, but has potential in constraining sources of Si (e.g. terrigenous versus hydrothermal) in the marine realm of BIF formation. Stable isotope ratios of both elements have thus been used, either independently or in combination, in studies aiming at elucidating the origin of BIF and the processes involved in their deposition and diagenetic modification.

We carried out combined Fe and Si isotope analyses of bulk BIF samples from the Palaeoproterozoic Transvaal Supergroup, South Africa. The samples span the entire ~400m BIF stratigraphy, which comprises a microbanded, deeper-water BIF facies (*Kuruman*), followed upwards by a granular, shallower-water BIF facies (*Griquatown*). Low-resolution stratigraphic records for both isotope ratios reveal a reproducible pattern of higher δ values in the Kuruman BIF (δ^{57}Fe: -1.0 to 0.5‰; δ^{30}Si: -1.5 to -1.0‰), followed by a decline across the transition to lower δ values in the Griquatown BIF (δ^{57}Fe: -2.5 to -0.5‰; δ^{30}Si: -2.5 to -1.5 ‰). On average, the δ values for both Fe and Si are lower than those postulated for their corresponding primary aqueous inventories. Given strong variations in modal mineralogy and thus Fe and Si speciation across the examined BIF sequence, and the expectedly dissimilar cycles of the two elements in the primary depositional environment, we intepret the above isotopic records as containing a strong primary marine signal, that would reflect depth-gradients in the isotopic composition of aqueous Fe and Si in the ambient water-column.