Fe-speciation by sequential extraction and Fe-isotopes as tracers of processes mobilizing Fe in lacustrine sediments

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The redox state of sediments and water bodies helps identifying and characterizing the magnitude of past climate-induced changes in limnological processes. Redox conditions in Lake Towuti (Indonesia) seem to be controlled by climate-induced changes in water column mixing. Iron speciation by sequential extraction and isotope ratios of diverse Fe-phases were performed in order to infer the redox state of both sediments and water column through time. Coupled to the characterization of sedimentary organic matter, this dataset allows the identification of different processes mobilizing Fe.

Sediments are mainly composed of phyllosilicates (serpentine, smectite, kaolinite) and diverse Fe-minerals, alternating between oxic (siderite-rich) and reduced horizons. High amounts of Fe(III)-phases settle during oxic water conditions. In the corresponding sediments, Ti/Fe ratios in magnetite extractions suggest a relatively higher authigenic component. Additionally, their negative δ^{56}Fe values (-0.5 ‰) are in agreement with bacterial reduction processes. On the other hand, the siderite pool records near zero per mil δ^{56}Fe values in the same horizons.

Fe(III)-phases and magnetite are less stable under reducing conditions, enhancing the passage of iron to the aqueous phase. Magnetite extractions in reduced sediments show relatively high Ti/Fe ratios suggesting remnant detrital magnetite, which is supported by near zero per mil δ^{56}Fe values. Conversely, siderite (-0.5‰) incorporates light Fe from the $Fe(II)_{aq}$ pool conforming with siderite formation in equilibrium with water/porewater with crustal signature.