Mineralogical controls on the cycling of trace metals in marine sediments

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Mineralogical processes in marine sediments provide an important control on trace metal fluxes at the sediment seawater interface, and can ultimately govern whether marine sediments act as a sink or a source of trace metals to seawater. Despite their relatively low abundance in marine sediments, iron and manganese minerals in particular, through coupled sorption and redox reactions, can provide a first order control on trace metal cycling, strongly influencing metal speciation, isotopic composition, concentration and distribution between sediment minerals, sediment porewaters and the overlying water column.

Here we use a combination of advanced, high resolution analytical techniques, including X-ray absorption spectroscopy and microscopy, coupled with laboratory sorption and isotope fractionation experiments, to investigate the reactivity and cycling of trace metals in the marine environment, focusing on the mineralogical processes that control metal cycling between marine sediments and seawater. We are applying these techniques to understand the cycling of micronutrient trace metals, and in this talk we will highlight the power of these microanalytical approaches to shed light on trace metal behaviour, exemplified with case studies including nickel and copper in marine sediments.

We will focus on the processes that control the initial drawdown of trace elements from seawater into their host mineral phases and the subsequent alteration of the primary host phases during sediment diagenesis.

We will show that a combination of molecular level mineralogical processes occurring during metal drawdown and sedimentary diagenesis provide a first order control on the global cycling of trace metals in the marine environment.