Secrets of the deep – shining light on bio-essential element cycling at the sediment-seawater interface

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Trace metals are essential for life and the concentration of trace metals in the surface oceans regulates photosynthetic primary productivity, which in turn regulates the drawdown of atmospheric carbon dioxide and ultimately climate. The processes governing the concentration of trace metals in the oceans are complex but in most cases the ocean sediments provide an important sink for these bio-essential elements, locking up trace metals with sediment minerals. The iron and manganese (hydr)oxide minerals are particularly reactive towards trace metals and can exert a primary control on trace metal concentrations in the sediments and overlying water column. Understanding the processes by which trace metals become locked into these minerals, and whether trace metals are retained or released as these minerals change with time, is critical to evaluating the role of marine sediments at the global scale, yet requires investigation of the mechanisms and processes responsible for metal retention and release at the nano scale. This talk will highlight the power of combined high-resolution electron and X-ray techniques, to investigate natural and experimental samples that shed light on bio-essential trace element cycling in marine sediments. Work will show that the nano scale mechanisms responsible for mineral formation and transformation during sedimentary diagenesis have a primary role in governing the long-term cycling of bio-essential trace metals between marine sediments and seawater, and thus an important role in the global scale cycling of these micronutrients.