Calcium isotope heterogeneity in shallow sediment from the Gulf of Aqaba and the Iberian Margin

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Authigenic carbonate precipitation has been suggested as a potentially important sink for carbon from the ocean in the geological past. Quantifying the global rate of formation of authigenic carbonate has used the global Ocean Drilling Program (DSDP/IODP/ODP) database, modelling the rate of change in the pore fluid concentration of calcium beneath the sediment-water interface as a proxy for the rate of formation of calcium carbonate minerals within sediment. However, the global pore fluid database does not include the chemically reactive boundary layer, the uppermost centimeters of sediment where the chemical reactions may be fastest. Here, we investigate the formation of authigenic carbonate using the calcium isotope composition of boundary layer pore fluids; calcium isotope ratios can be used to track the precipitation and recrystallisation of calcium carbonate minerals. We present data from high-resolution profiles from both box and piston cores in the upper meter of the sediment column at sites from both the Gulf of Aqaba and the Iberian Margin to investigate the use of calcium isotope ratios to explore carbonate mineral precipitation and dissolution over small length scales.

In both locations, while calcium concentrations change outside of analytical error, the calcium isotopic composition of the pore fluid varies systematically around seawater values. We suggest that the calcium isotopic composition track small-scale heterogeneity within the pore fluid, that is that within a given volume of pore fluid the calcium isotopic composition of the fluid can vary on very small spatial scales through local chemical reactions. We also note that the calcium isotopes within the porefluid suggests that there isn't a significant amount of net-dissolution of calcium carbonate minerals within the boundary layer where oxic conditions can lead to a decrease in pH of the pore fluid.