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Diagenetic cycling of barium isotopes in anoxic sediments

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Barium (Ba) isotopes are a novel tracer with the potential to provide information on past marine biological productivity (Bridgestock et al., 2019). The application of this tracer is however compromised by diagenetic Ba cycling in anoxic sediments – in particular below and at the sulfate-methane transition (SMT; e.g. Riedinger et al., 2006). This study aims to understand (1) how Ba isotopes are fractionated during the formation of diagenetic barite fronts in anoxic sediments, and (2) the impact of enhanced benthic Ba fluxes from sulfidic surface sediments on marine Ba isotope inventories. To this end, Ba concentration and isotope data is presented for the sediment and porewaters of two sediment cores (GeoB8455-2 and 23010), and overlying seawater depth profiles located along the Namibian continental shelf and slope.

Both of the sediment cores feature diagenetic barite fronts, formed due to the dissolution/re-precipitation of barite below/at the SMT. These fronts feature $\delta^{138/134}$Ba 0.10 to 0.15 ‰ lower that the background values. Steady-state 1D diffusion-reaction modelling will be used to determine the cause of this observation. These insights will be useful for interpreting Ba enrichments in terms of productivity vs diagenesis in ancient sediments with poorly known redox histories.

The Ba concentration of seawater increases by 15.9% as it circulates over the Namibian shelf attributed to benthic inputs. Isotopic data for these samples can be feasibly explained by the input of Ba with $\delta^{138/134}$Ba ≈ 0.3 ‰, consistent with measured pore water values from underlying sulfidic sediments. These results provide insights into how the global seawater Ba isotope inventory could be impacted by global changes in ocean redox, which should be considered when interpreting Ba isotope records in sediments from a variety of anoxic environments, including oxic settings.

References:

Luke Bridgestock, Yu Te Hsieh, Donald Porcelli, and Gideon M. Henderson (2019), Increased export production during recovery from the Paleocene–Eocene thermal maximum constrained by sedimentary Ba isotopes. Earth and Planetary Science Letters.

Riedinger, S. Kasten, J. Gröger, C. Franke, K. Pfeifer (2006). Active and buried authigenic barite fronts in sediments from the Eastern Cape Basin. Earth and Planetary Science Letters, 241: 876–887.