Isotopic constraints on the biogeochemical cycle of Ba in the South Atlantic

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The cycling of Ba in the ocean is dominated by removal through barite ($BaSO_4$) precipitation, with $BaSO_4$ accumilation rates in sediments commonly applied as a paleo-proxy for export production [1]. Isotope composition variations are a promising new tool for studying the marine biogeochemical cycle of Ba [2,3,4]. Here we present Ba isotope composition data for marine sediments, in addition to data for the overlying water column from samples collected in the South Atlantic (GEOTRACES GA10W cruise, December, 2011 – January, 2012).

Dissolved Ba concentrations and isotope compositions in the water column display a strong co-variance. Barium concentrations and isotope compositions range from 40 nmol kg^{-1} and $\delta^{138/134}Ba_{NIST3104a} \approx 0.5‰$ in surface waters, to 100 nmol kg^{-1} and $\delta^{138/134}Ba_{NIST3104a} \approx 0.2‰$ at depth. This relationship is consistent with Ba removal following closed system Rayleigh fractionation models, using fractionation factors (seawater-$BaSO_4$) of 1.0003 to 1.0004.

Underlying sediments display lighter isotope compositions than the dissolved seawater, of $\delta^{138/134}Ba_{NIST3104a}$ = -0.12 – 0.05‰. These compositions are consistent with those predicted by the aforementioned Rayleigh fractionation models. Ba isotope compositions of marine sediments may therefore record useful information on Ba removal from the ocean. However, Ba/Al ratios indicate the sediments feature a range of Ba contributions from authigenic and detrital sources. Similar isotope compositions are observed for samples featuring high and low Ba/Al ratios, making it difficult to deconvolve the composition of authigenic Ba, particularly for sediments close to the continental shelf. Isolation of $BaSO_4$ from the sediment may circumvent this issue [1]. We will also gain further insights into marine Ba cycling through aquistition of data for suspended particulate material in the water column.

[1] Paytan & Griffith (2007), *Deep Sea Research II*, **54**, 687-705 [2] Hsieh & Henderson (2015), *Goldschmidt Abstracts*, 1326 [3] Horner *et al*. (2015), *EPSL*, **430**, 511-522 [4] Cao *et al*. (2016), *EPSL*, **434**, 1-9