Barium isotope variations across the Paleocene-Eocene Thermal Maximum

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Elevated accumulation rates of Ba in open ocean sediments during recovery from the Paleocene-Eocene thermal maximum (PETM) have been used to provide evidence for the role of export production in the sequestration of carbon from the ocean-atmosphere system [1]. Alternatively, the high Ba accumulation may reflect addition of large quantities of Ba to the ocean during release of methane hydrates at the onset of the climate perturbation [2]. In either case, globally increased Ba burial occurs over timescales exceeding the oceanic Ba residence time, representing a significant pertubation to the marine Ba cycle. In this study, we measure Ba isotopes across the PETM to assess changes in the Ba cycle across this period.

Initial results from ODP site 1263 (South Atlantic; Walvis Ridge) show a decrease in $\delta^{138/134}$Ba values from 0.1‰ to 0.0‰ after the negative carbon isotope excursion [3]. Minimum $\delta^{138/134}$Ba values occur slightly later than those of δ^{13}C, coinciding with the onset of increased Ba burial. Subsequently, $\delta^{138/134}$Ba values recover to 0.14‰ over this period of elevated sedimentary Ba burial.

We propose that increased biological productivity, marked by higher Ba burial rates, caused euxinia in marginal sediments. This allowed the diffusion of Ba from sulfate-depeleted pore waters into the water column from marginal sediments, a process thought to fractionate Ba isotopes to 'lighter' compositions [4], decreasing the $\delta^{138/134}$Ba values of seawater and consequently open ocean sediments. This additional marine Ba source may have balanced increased output, allowing elevated Ba removal rates to occur over timescales exceeding the oceanic Ba residence time [5]. Barium isotope records from other ODP sites will be produced to investigate the consistency of these variations at a global scale. These novel results highlight the potential use of Ba isotope variations for paleo-oceanographic applications.

[1] Ma et al., 2014, *Nat. Geosci.*, doi:10.1038/NGEO2139, [2] Dickens et al., 2003, *Geol. Soc. of Amer. Sp. Paper*, 369, 11-23, [3] Zachos et al., 2005, *Science*, 208, 1611-1615, [4] van Zuilen et al., 2016, *GCA*, 186, 226-241, [5] Paytan et al., 2007, *Geology*, 35, 1139-1142