New insights into ocean circulation and particle interaction from a global dissolved rare earth element dataset

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Rare earth element (REE) distributions and patterns are being used extensively in geology and geochemistry. In this study we highlight their value as tracers for marine biogeochemical dynamics in a changing climate, in particular regarding issues such as acidification, deoxygenation and seawater-sediment interactions. In order to fully exploit REEs as process tracers in the ocean we have extended the original REE dataset of Byrne & Sholkovitz [1] by collating historical measurements with new data measured as part of the GEOTRACES program. We discuss the spatial distribution of the main REE patterns and examine correlations between REEs and traditional hydrographic tracers. Building on this we selected examples illustrating how a growing global REEs dataset can be exploited to investigate and quantify a variety of physical and biogeochemical processes. As a first example [2], we show how the global dataset can be used to define a nearly ubiquitous and statistically significant mid-depth Dy/Er minimum and discuss possible sources of the low Dy/Er signal, leading to a hypothesis about the applicabilityof REEs as specific ocean circulation tracers. We then demonstrate how the global REE dataset can be used to quantify the influence of water mass advection on dissolved REE concentrations [3] and explain how advection needs to be invoked to interpret REE sections while at the same highlighting the role of seawater-sediment interactions and hydrothermal scavenging.

[1] Byrne & Sholkovitz (1996) *Ch. 158: Marine chemistry and geochemistry of the lanthanides*. In *Handbook on the Physics and Chemistry of Rare Earths*, vol. 23, Eds: Gschneider and Eyring. [2] Osborne et al. (2015) Mar Chem 177, 172-183. [3] Zheng et al. (2016) GCA 177, 217-237.