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Extreme variation in rare earth element accumulation along a continental margin transect

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The abundance of rare earth elements (REE) in marine sediments can be used to reconstruct environmental conditions in ancient sedimentary deposits. Specifically, the chemical signal of cerium (Ce) can be used as an indicator of paleo redox conditions. However, in a dynamic marine system with varying sources of sediment input, high productivity, and gravity and current-driven sediment redeposition, the primary geochemical signal of REE can be strongly impacted. To investigate the influence of depositional processes on the redox-related geochemical signals of REEs we analyzed sediments from three sites along the continental margin off southwest Africa. The study area is characterized by high primary productivity with an extended oxygen minimum zone and low terrestrial sediment input. Another important characteristic of the study area is the lateral transport of material (mainly organic matter) from the shelf to the deeper water depths via particle-rich nepheloid layers [1]. Samples of the upper ~30 cm sediment column were collected at the shelf, shelf break, and upper slope offshore Namibia, where modern bottom water redox conditions are anoxic (sulfidic), suboxic, and oxic, respectively [2]. Our data show that the REE composition in these sediments does not correspond to the different redox conditions in the overlying bottom waters or to the content of organic carbon. In contrast to other trace metals in the investigated area [2], the REE content is strongly increased at the shelf break with up 20-times higher values of all REE elements compared to the anoxic shelf or oxic slope deposits. It appears that the redeposition processes that lead to partial erosion along the shelf break have a far stronger impact on the REE signal in the sediments compared to the local redox conditions, although, the actual process that leads to such high REE accumulation at the shelf break has yet to be determined.

[1] Inthorn et al. (2006) Deep Sea Research Part I: Oceanographic Research Papers 53, 1423-1438.

[2] Abshire et al. (2020) Marine Geology, 429, p.106316.