Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14996

Ba/Ca of the last millennium North Atlantic deep-sea corals as water mass evolution and ocean circulation variability archive

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The concentration of dissolved barium in seawater, $[Ba]_{sw}$, exhibits a nutrient-like profile. Its shallow distribution is primarily linked with regional primary productivity, while the intermediate-deep $[Ba]_{sw}$ is largely influenced by near-conservative mixing of different water masses [1, 2]. The Ba/Ca ratios of azooxanthellate scleractinian corals are predominantly controlled by $[Ba]_{sw}$ [3], while the Li/Mg ratios are strongly dependent on temperature [4]. Together, these proxies can be used to reconstruct past ocean barium cycling and provide insight into ocean circulation variability beyond modern instrumental observation.

The North Atlantic received both natural and anthropogenic influences over the last millennium, and serves as an important site to examine the relative timing and mechanisms of interplay between climate change, ocean circulation and human impact. In this study, solitary and colonial fossil scleractinian corals collected from intermediate depths in the central (768~2022m) and eastern (842~1173m) subpolar North Atlantic were analysed for Ba/Ca and Li/Mg. The corals were dated using isotopic U-Th series approaches and the ages span the last millennium. The reconstructed $[Ba]_{sw}$ values from the central subpolar North Atlantic corals are mostly within the modern seawater range, while those from the east exhibit large fluctuations, some of which far exceed the modern ocean at equivalent depth. When paired with Li/Mg-derived temperatures, and examined in the context of modern water mass classification regime and $[Ba]_{sw}$ profiles [5, 6], the high Ba/Ca anomalies suggest an enhanced contribution of the Northeast Atlantic Deep Water (NEADW). As NEADW is partially influenced by modified Antarctic Bottom Water, the coral Ba/Ca ratios may therefore serve as an archive of temporal and spatial evolution of northern- and southern-source water mass mixing and ocean circulation variability in the North Atlantic.

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