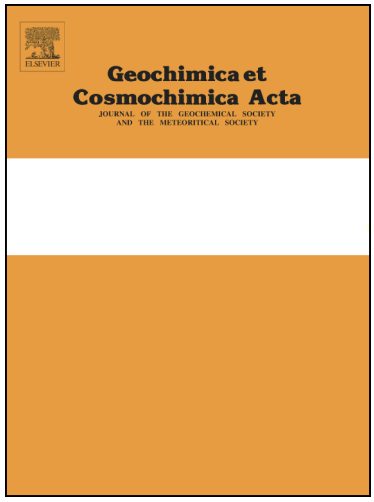

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Barium isotopes reveal role of ocean circulation on barium cycling in the Atlantic

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Abstract

We diagnose the relative influences of local-scale biogeochemical cycling and regional-scale ocean circulation on Atlantic barium cycling by analyzing four new depth profiles of dissolved Ba concentrations and isotope compositions from the South and tropical North Atlantic. These new profiles exhibit systematic vertical, zonal, and meridional variations that reflect the influence of both local-scale barite cycling and large-scale ocean circulation. Previously reported epipelagic decoupling of Ba and Si in the tropics is also found to be associated with significant Ba isotope heterogeneity. We contend that this decoupling originates from the depth segregation of opal & barite formation but is exacerbated by weak vertical mixing, as in the tropics. Zonal influence from isotopically-'heavy' water masses in the western North Atlantic evidence the advective inflow of Ba-depleted Upper Labrador Sea Water, which is not seen in the eastern basin or the South Atlantic. Meridional variations in Atlantic Ba isotope systematics below 2,000 m appear entirely controlled by conservative mixing. Using an inverse isotopic mixing model, we calculate the Ba isotope composition of the Ba-poor northern end member as +0.45 ‰ and the Ba-rich southern end member +0.26 ‰, relative to NIST SRM 3104a. The near-conservative behaviour of Ba in the deep ocean indicates that Ba isotopes may serve as an independent tracer of the provenance of advected water masses in the Atlantic Ocean. The clearly resolved Ba-isotope signatures of northern- and southern-sourced waters may also prove useful in paleoceanographic studies, should appropriate sedimentary archives be identified. Overall, our results offer new insights into the controls on Ba cycling in seawater and thus the mechanisms that underpin the utility of Ba-based proxies in paleoceanography.