Barium isotopes reveal role of ocean mixing on Ba cycling in the Atlantic

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Microbial oxidation of organic matter in the water column is associated with the precipitation of particulate barite, which subsequently dissolves in barite-undersaturated seawater. Dissolved Ba distributions in seawater are thus a function of barite cycling superimposed atop ocean circulation. However, disentangling the relative proportions of either process is challenging using existing methods. Stable Ba isotopes in seawater hold the potential to shed light on the importance of these two processes and their spatial variations. We present multiple new depth profiles of dissolved Ba concentrations and Ba isotopes from the tropical North Atlantic obtained using double spike MC-ICP-MS. We observe Ba isotope heterogeneity in water masses from the twilight zone, in contrast to the homogeneity observed at similar depths in the South Atlantic. We hypothesize that this Ba isotope heterogeneity results from insufficient penetration of the mixer layer to the probable depths of barite formation (100-200 m), such that barite precipitation is able to impart significant Ba isotope variation to water masses in the immediate subsurface. This heterogeneity is not communicated to deeper waters, whose Ba isotope systematics are consistent with existing profiles suggesting that Ba isotope variations are inherited only during ventilation. Our results highlight the potential of Ba isotopes to understand Ba cycling in seawater, particularly for quantifying the interplay between large-scale ocean circulation and local scale processes in setting zonal and meridional gradients in Ba distributions across the Atlantic Ocean.