Barium-isotopic cycling in Southern Ocean particulate matter

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The mass accumulation rate of barite on the seafloor is a powerful tracer of export productivity in the modern and paleo-oceans. However, the formation mechanism of marine barite is still uncertain, as are possible dynamical transformations that may occur in the water column between barite formation and deposition on the seafloor. Since stable-isotopic measurements can provide insight into mineral—fluid reactions, analysis of the stable isotopic composition of Ba in barite should help address these uncertainties.

We examined the Ba-isotopic composition of marine particulate matter from the upper 600 m of the water column of the Ross Sea, collected via *in situ* seawater filtration. The lack of significant $CaCO_3$ production in this region facilitates interpretation of our suspended particulate profiles in terms of Ba associated with $C_{org.}$ and barite. A selective leaching procedure was used to avoid lithogenic Ba contributions, with data obtained for four profiles that define an offshore transect spanning 500 km.

We find highly systematic patterns of particulate Ba abundance and Ba-isotopic compositions in all four profiles. Across the transect, particulate Ba and P concentrations show monotonic increases and decreases with depth, respectively, in accord with an organic matter remineralization-mediated mechanism for barite precipitation. In contrast, particulate Ba-isotopic compositions are not monotonic with depth, and show similar patterns at all four stations. The heaviest Ba-isotopic values are observed at the very surface, with a distinct minimum between 100-200 m, before increasing again to values approaching those seen at the very surface by 600 m. This profile shape may reflect the changing relative influence of multiple Ba sources with distinct Ba-isotopic compositions (e.g. $C_{org.}$, barite), or it may indicate additional processes taking place within the water column, such as selective phase dissolution.

Regardless, the similarity amongst the particulate profiles across the transect suggests that vertical cycling dominates the particulate Ba flux in the Ross Sea. Elucidating the mechanisms driving these dynamical transformations will be aided by analysis of Ba-isotopic compositions in associated seawater samples and sinking particles.