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Isotopic composition of barium in seawater around the Kerguelen Plateau (Southern Ocean)

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The Kerguelen plateau is distinguished from the HNLC Southern Ocean by a natural Fe fertilisation. This fertilisation comes from sedimentary inputs as well as river and glacier runoff, but their respective contributions are still poorly constrained. In order to better understand these various sources of fertilisation, the use of Ba isotopes can be helpful. Indeed, in the ocean, dissolved Ba (DBa) shows a nutrient-like behaviour due to its oceanic cycle that is mainly controlled by barite precipitation ($BaSO_4$) in the mesopelagic zone and its dissolution at depth. When organic matter falls through the water column, anoxic microenvironments form and promote the precipitation of $BaSO_4$ crystals. This cycle is linked to organic matter remineralization [1]. Isotopic Ba provides new insights into the Ba cycle in the ocean and understudied processes such as barite formation or Ba release driven by resuspension.

Samples were collected during the SWINGS cruise (GS02, 13 January - 8 March 2021, Marion Dufresne) and Ba isotopes in seawater were measured by thermo-ionization mass spectrometry (TI-MS). This method includes two principal stages: pre-concentration and purification of Ba by coprecipitation and cation exchange chromatography [2], followed by isotopic analysis by TI-MS. Isotopic analysis shows a precision of ± 0.03 ‰ (1 SD) for δ^{138}DBa in seawater samples.

On the Kerguelen Plateau, DBa exhibits significant spatial variations in both concentration and isotopic composition, reflecting diverse non-conservative processes. In the mesopelagic zone, barite precipitation seems to strongly influence the isotopic distribution, enriching the upper part in heavy isotopes through the preferential incorporation of lighter isotopes into barite, while its decomposition at depth releases light isotopes without fractionation. Near the sediments, resuspension leads to an input of lighter DBa into the water column, originating from accumulated barite at the seafloor. Thanks to these unique imprint of Ba isotopes, we will show how we can decipher the glaciers from the sedimentary sources in the water masses surrounding the Kerguelen plateau.

[1] Dehairs et al. (1997) Deep Sea Research Part II: Topical Studies in Oceanography, 44(1), 497–516.

[2] Horner et al. (2015) Earth and Planetary Science Letters, 430, 511–522.