

Preconcentration and determination of beryllium and rare earth elements in small volumes of marine pore-water

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Beryllium (Be) and rare earth elements (REEs) in the ocean are useful tracers of weathering input and ocean circulation. Though release from marine sediments is assumed to be a major source of these elements to the oceanic dissolved pool, existing pore water data are scarce, especially for Be. Given that they are similarly particle-reactive, coupled Be and REE analysis can help to better understand boundary exchange processes at the sediment-water interface and their impact on oceanic mass balance. Like REE, pore-water Be measurement is analytically challenging due to its low concentration (picomolar level) and small sample volumes (1~10 ml). To minimize the required sample amount, it is better to perform separation and measurement of Be and REE using the same aliquot.

Here we couple a recently developed REE preconcentration procedure to an additional step for Be preconcentration from the REE-free seawater matrix. The whole procedure involves four steps. 1) REE are collected from 5 ml of pore-water using a Nobias Chelate-PA1 column (R-fraction). 2) REE-free seawater matrix collected from the first step is processed using Fe co-precipitation to separate Be (B-fraction) from the matrix. 3) Fe in the B-fraction is further removed using an AGMP1 anion column. 4) REE and Be in the two fractions are measured using a Thermo Fisher Scientific Element XR ICP-MS coupled to a desolvator (Aridus 1).

The utility of this procedure was assessed using in-house seawater standards and pore-water samples, by adding known amounts of REEs and Be. A preliminary test shows that the proportion of Be in the R-fraction is < 3% of the total or below detection limit, and that the proportion of most REE in the B-fraction is commonly < 1%, indicating near-quantitative separation of Be and REEs. Future tests will focus on processing pore-water samples of diverse matrix compositions and evaluating the consistency in yields of Be and REE. This procedure, obtaining data for Be and REE from the same (small) aliquot of pore water, will make it easier to include the additional oceanic tracer beryllium into the existing toolbox of the GEOTRACES program.