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YREE determination in seawater. Standardization and validation of a new method based on preconcentration techniques

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The most interesting attraction of using rare-earth elements and yttrium (YREE) to address geochemical and marine chemical problems consists of their chemical coherence as group of trace elements. These characters allow YREE compositions of rocks and minerals to be extensively used in studies of provenance, petrogenesis and chemical evolution of the geological materials (1). Similarly, YREE compositions in the hydrosphere were used in studies of coagulation, particle-solution reactions and oceanic circulation of water masses (2-4).
Unfortunately, very low concentrations of YREE (ng l-1 or sub-ng l-1) associated to high ionic strength of seawater always represented the main difficulty to analyse dissolved YREE in marine environment. The first geochemical investigations of YREE contents in seawater were carried out using neutron activation and isotope dilution mass spectrometry that were almost entirely replaced by inductively coupled plasma supplemented by mass spectrometry (ICP-MS) in recent years. This technique offers many advantages including simultaneous analysis of all the elements of series and their quantitative determination with detection limits of the order of ng l-1 if associated to preconcentration techniques (5).
To perform ultra-trace YREE analyses in seawater, we developed a preconcentration method based on CHELEX-100 iminodiacetate resin followed by ICP-MS determination (Ref). In this study the YREE behaviour was quantitatively investigated during interactions with ion chelating resin and estimation of composed measurement uncertainty associated to measurements was evaluated with a rigorous metrological approach based on method validation and quality control of YREE data. These goals were achieved using synthetic seawater where YREE had concentrations as occurring in natural seawater samples. Under these conditions good recovery were obtained along the YREE series, ranging from 75%-85% and 90%-100% for heavy REE and Y and light REE, respectively. Composed measurement uncertainty was expressed in terms of precision, recovery uncertainties, reference material uncertainty and instrumental calibration uncertainty. The obtained results were critically discussed on the basis of the different contributions and confirm the quadrupole ICP-MS technique as highly sensitive to determine very low YREE concentrations.

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