Determination of trace elements in seawater by ICP-SFMS after Tm addition and co-precipitation

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We report on two novel procedures for the determination of several trace elements in seawater, including elements characterized by very low abundance (sub-0.1 to 1 ng l-1) in the ocean, such as REEs, Hf, and Th. Our methods are based on the procedure developed recently by Bayon et al. [1], and applied successfully to a wide range of geological samples. It involves addition of a Tm spike and pre-concentration using co-precipitation, prior to analysis by inductively coupled plasma-sector field mass spectrometry (ICP-SFMS). The addition of a small amount of Tm to the sample produces a positive Tm anomaly in the resulting REE pattern, which allows calculation of precise trace element concentrations. Two different procedures were investigated during the course of this study: 1) co-precipitation onto iron hydroxides (after addition of a Fe-spike); and 2) magnesium co-precipitation (no spike required). The validity of the procedures was assessed through a series of co-precipitation experiments, using ultra-diluted solutions of a certified rock standard (BIR-1), and analyses of natural water certified reference materials (CRMs). Results obtained for NASS-5, CASS-4, and SLEW-3 are in agreement with published working values for REEs. A set of proposed values for these CRMs, with uncertainties typically better than 8% (RSD), is also proposed for Hf, Zr, and Th. The advantages and disadvantages of using the iron vs magnesium co-precipitation procedure for determining trace element concentrations in seawater will be compared and discussed.