

Cerium isotope measurements by MC-ICPMS

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The ¹³⁸La-¹³⁸Ce system (half-life 1.05x10¹¹ years) is a potentially highly useful tool to unravel information about the timing of geological processes and about the interaction of geological reservoirs on Earth, complementing information from the more popular ¹⁴⁷Sm-¹⁴³Nd and ¹⁷⁶Lu-¹⁷⁶Hf systems. However, Ce isotope measurements are analytically challenging: first, there are strong isobaric interferences from ¹³⁸Ba on ¹³⁸Ce and from ¹⁴²Nd on ¹⁴²Ce; secondly, static measurements of all Ce isotopes are difficult due to the high abundance of ¹⁴⁰Ce (88.45%) relative to the small ¹³⁶Ce (0.185%) and ¹³⁸Ce (0.251%).

To perform Ce measurements by MC-ICPMS, Ce was separated from matrix elements and in particular from interfering Ba, La, and Nd by a substantially optimized ion exchange protocol employing cation and LnSpec resins. The external reproducibility achieved for ¹³⁸Ce measurements is significantly better, once ¹³⁶Ce/¹⁴⁰Ce is used for mass bias correction (± 25 ppm), rather than ¹³⁶Ce/¹⁴²Ce (± 40 ppm, all 2 σ r.s.d.). Because the JMC 304 reference material is not commercially available anymore, a new reference material was prepared from AMES Laboratory Ce metal (Cologne-AMES). Relative to JMC 304, an $\epsilon^{138}\text{Ce}$ value of $+0.67 \pm 10$ ppm (2 σ r.s.e.) was determined for Cologne-AMES. In a first test, we performed simultaneous measurements of all Ce isotopes by MC-ICPMS on the two standard basalts BCR-2 and BHVO-2. Assuming an $\epsilon^{138}\text{Ce}$ (CHUR) of +1.46 ppm for JMC 304 [1] [2], our measured $\epsilon^{138}\text{Ce}$ (CHUR) for BCR-2 and BHVO-2 are -0.14 ± 30 ppm and -1.44 ± 30 ppm, respectively. These results are in good agreement to those of older TIMS studies [1] [2], and the relative difference between the standard basalts is also in good agreement with a more recent TIMS study [3]. However, there are systematic differences relative to the AMES standard values used in our study and in [3] [4], calling for a better characterization of standard materials used in different laboratories.

[1] Makishima, A., & Nakamura, E. (1991). *Chem. Geol.*, **94**, 1–11 [2] Makishima, & Masuda, (1993) *Chem. Geol.*, **106**, 197–205 [3] Doucelance et al. (2014). *Earth Planet. Sci. Lett.*, **407**, 175–186 [4] Willbold, M. (2007) *J. Anal. At. Spectrom.*, **22**, 1364–1372