Determination of Ce isotope ratios on the Nu Plasma II MC-ICP-MS using a high-gain detection system

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Radiogenic $^{138}Ce/^{136}Ce$ ratios help to constrain the ancient history of light REE enrichment and depletion in Earth and planetary materials, and may also be used for geochronology as ^{138}Ce is the daughter product of ^{138}La. However, measurements of $^{138}Ce/^{136}Ce$ ratios are challenging because (1) the small variations in nature require high precision measurements, (2) the relative abundances of ^{136}Ce and ^{138}Ce are low (<0.25%), and (3) both isotopes are plagued by isobaric interferences (e.g., Ba).

Isotopic measurement of Ce as an oxide species by thermal ionization mass spectrometry (TIMS) yields precise and accurate $^{138}Ce/^{136}Ce$ ratios [1]. MC-ICP-MS also holds considerable promise due to the higher ionization efficiency for Ce in the ICP source and the potential for higher sample throughput (compared to TIMS). To date, however, the difficulty of correcting for (1) the larger interferences on the Ce isotopes using MC-ICP-MS (due to its high ionization efficiency for all elements, and the additional presence of interfering ^{136}Xe in the Ar plasma gas) and (2) tailing of the large ^{140}Ce beam under ^{138}Ce (due to relatively poor abundance sensitivity compared to TIMS) has prevented this technique from achieving a level of accuracy and precision that is similar to TIMS [1].

Here we evaluate the ability of the Nu Plasma II MC-ICP-MS equipped with a high-gain detection system (10^{12} ohm resistors) to measure $^{138}Ce/^{136}Ce$ ratios. Preliminary experiments were conducted using (1) both "wet" and "dry" plasma modes to reduce the level of interfering elements in the sample introduction system and (2) high-gain detectors to reduce the uncertainties of the corrections for the most significant interferences (i.e., ^{136}Xe and ^{136}Ba on ^{136}Ce, and ^{138}Ba on ^{138}Ce). In addition, we tested the importance of measuring the isotopic composition of Xe in the Ar plasma gas because an incorrect estimate of the ^{136}Xe interference on ^{136}Ce (inferred from a non-interfering Xe isotope) can lead to inaccurate $^{138}Ce/^{136}Ce$ ratios (depending on the level of Xe). Additional experiments are in progress to demonstrate the capability of the Nu Plasma II MC-ICP-MS for precise and accurate Ce isotopic measurements.

[1] Willbold (2007) *J. Anal. At. Spectrom.* **22**, 1364-1372.