Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29568

Automated purification of Ce for repeatable and precise stable isotope measurements

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Cerium (Ce) anomalies have long been used as redox proxies in geochemistry due to cerium's unique ability amongst the rare earth elements (REE) to change valence states under terrestrial conditions. However, these anomalies are primarily qualitative as their magnitude does not directly derive from the redox conditions of the environment. Recent studies have, therefore, paired such anomalies with Ce stable isotope analyses for a more quantitative approach [1-3]. Unfortunately, current analytical precision for Ce isotopes is insufficient to fully resolve the subtle fractionations, particularly at high temperature [4-5]. This limitation stems largely from the challenging requirement for high-purity, high-yield separation of Ce from complex geological matrices and other REEs.

To address this, we developed an automated column chromatography setup for repeatable and quantitative purification of Ce from geologic samples. The automated separation is achieved through a custom designed machine that allows for sample loading, elution, and eluent collection, which can be conveniently placed within a laminar hood. This system significantly enhances repeatability and sample throughput by running unattended, paving the way for higher precision Ce isotope analyses. Further details of the analytical setup will be presented at the conference.

[1] Nakada et al. (2016), *GCA,* 181, 89-100; [2] Hu et al. (2023), *ACS Earth and Planetary Sci.*, 7, 2222-2238 ; [3] Bonnand et al. (2023), *Geochem. Persp. Lett.,* 28, 27-30; [4] Schauble (2024), *Geochem. J.*, 58, 227-245; [5] Nestmeyer & McCoy-West (2025), *GCA*, 388, 236-252