Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29279

Calibrating mixed Sm-Nd and Lu-Hf isotope spikes for use in Earth and planetary materials

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A critical requirement for isotope work on planetary and early Earth materials is to use isotopic dilution methods for determining precise and accurate ^{147,146}Sm-^{143,142}Nd and ^{176}Lu-^{176}Hf systematics to deduce isochron ages and initial Nd and Hf isotope ratios. The addition of mixed enriched spikes to rocks, minerals or solutions allows for the precise determination of elemental concentrations and therefore radioactive and radiogenic isotope ratios. We made one mixed ^{149}Sm-^{150}Nd and three separate ^{176}Lu-^{180}Hf spikes with different Lu/Hf ratios to match the variation in natural samples. These spikes were mixed with precise gravimetric standards produced from pure elemental metals of certified weight and processed through column chemistry to separate each element. We calibrated the isotope spikes using a Neoma MC-ICPMS/MS at BGI and Neptune Plus MC-ICPMS at WSU. Calibrating the isotope spikes involves accurately determining the isotope abundance of spikes as well as of the mixtures of standards and spikes used in the calibrations. These measurements are challenging because the isotopes and mixtures do not have natural isotope ratios to correct for instrumental mass bias - something that is used in natural samples for their accurate analysis. To compensate for the non-natural isotope ratios, a highly stable MC-ICPMS is required, which we ensured for every analytical session. A graphical user interface for calculating ^{176}Lu/^{175}Lu using Yb for mass bias corrections [1] was created using Igor Pro software by Wavemetrics.

Our measurements of USGS reference materials BCR-2 and BHVO-2, using our calibrations of the mixed isotope spikes, are consistent with literature reports for elemental abundances, elemental ratios (with 0.2% precision) [2,3], and isotopic compositions [3,4].

With these calibrated spikes, we can accurately analyze the full range of Earth and meteoritic materials for high-precision Sm-Nd and Lu-Hf geochemistry and geochronology. We will also be able to determine high-precision concentrations of chondrites and samples returned from space missions to better constrain the abundance of these elements in the Solar System.

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[4] Weis et al. (2006) *G3*, Q08006.