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High precision ^{142}Nd isotope measurements using a Nu TIMS

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The ^{146}Sm-^{142}Nd isotopic system ($T_{1/2}$=103 Ma) is a powerful tracer of the formation and evolution of continents and mantle reservoirs formed during the first 500 Ma of Earth's history. Hadean material is very rare at the surface of the Earth but some might still be preserved in the mantle and be sampled by recent volcanism. However, the expected range of ^{142}Nd/^{144}Nd variations in modern volcanic rocks is very small. To detect minute anomalies requires measurements with a routine precision better than 5 ppm (2sd).

The Nu TIMS is equipped with a zoom optics system and 16 fixed Faraday detectors with 10^{11} Ω amplifier resistors. We benefit from its flexibility to perform 5-line multi-dynamic analyses of Nd isotopes [1]. For 800 ng of Nd loaded on double Re filaments, a typical analysis is composed of 800 cycles and measures a 7 V-signal of ^{142}Nd^{+} for 18 hours. It produces five static and three dynamic ratios per cycle for each Nd isotope. Combined with an extended statistical counting, such analyses reach a standard error on ^{142}Nd/^{144}Nd ratios as low as 1 ppm (2se) and a steady reproducibility of 3.4 ppm (2sd, n=30), for the Nd standard solution Rennes-Ames, over 15 months. The reproducibility is also improved relative to previous studies on TIMS [e.g., 2] for the other Nd isotopes with 5.9, 3.9, 4.2 and 8.5 ppm for ^{143}Nd/^{144}Nd, ^{145}Nd/^{144}Nd, ^{148}Nd/^{144}Nd and ^{150}Nd/^{144}Nd ratios, respectively. Similar results are obtained for the JNDi-1 reference standard, usually used as a reference for the terrestrial composition for ^{142,145,148,150}Nd/^{144}Nd ratios. We also analysed rock standards (BCR-2, BHVO-2, BE-N, RGM-1, BIR-1) and we obtain the same reproducibility as for the synthetic standards and ^{142}Nd isotopic values within error of the terrestrial reference.

Our results demonstrate that a precision better than 4 ppm can be routinely obtained on a Nu TIMS. This opens the possibility to trace very small variations in ^{142}Nd/^{144}Nd and detect minor traces of Hadean material in the present-day Earth mantle.

[1] Luu et al. (Chemical Geology, 2022), [2] Garçon et al. (Chemical Geology, 2018)