Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4084

High-precision Sr and Nd isotope measurements using a Nu TIMS

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A Nu TIMS was installed at IPGP early 2020 to perform high-precision Sr and Nd isotope measurements. The instrument is equipped with 16 Faraday detectors, that can be dynamically connected to different resistors (10^{11}, 10^{12} and 10^{13} Ω). This configuration allows to set up multidynamic measurements with multiple lines. The benefit is a better correction for cup efficiences compared to static measurements and a better external reproducibility.

More specifically, we use a Nd method based on a 5 lines acquisition routine, returning 3 dynamic and 5 static $^{143}Nd/^{144}Nd$ and $^{142}Nd/^{144}Nd$ for each cycle. A single analysis typically lasts 300 cycles when looking at $^{143}Nd/^{144}Nd$ and 800 cycles when interested in $^{142}Nd/^{144}Nd$ (with 3 min baseline and 80 s acquisition time per cycle), with 800 ng Nd loaded on Re double filaments. This method allows precisions of ~ 3 ppm and ~ 7 ppm (2rsd, n=16) to be reached on $^{143}Nd/^{144}Nd$ and $^{142}Nd/^{144}Nd$, respectively, for the Nd standard solution Rennes-Ames.

Similarly, we developped a 5 lines acquisition routine for Sr isotopes, returning 4 multidynamic and 5 static $^{87}Sr/^{86}Sr$. A single analysis typically lasts 200 cycles (with 3 min baseline and 50 s acquisition time per cycle), with 300 ng Sr loaded on Re single filaments. This method provides a precision of ~ 6 ppm (2rsd, n=30) on $^{87}Sr/^{86}Sr$ for the NBS 987 standard solution. This is at least twice better than the most precise Sr isotopic ratios reported in the literature so far.

Being able to reach such precisions opens new perspectives in the field of Earth Sciences. Tiny anomalies in $^{142}Nd/^{144}Nd$ should be detectable and the presence of early Earth material in any rock should be visible. It also opens new perspectives in geochronology: we should be able to obtain Rb-Sr or Sm-Nd isochrons for much younger rocks, and we should be able to obtain isochrons for phases with lower Rb/Sr or Sm/Nd. Finally, fine structures, such as those discovered when Pb isotopes started being measured with high precision, might be discovered for volcanic rocks in both Sr and Nd isotopic spaces.