

Standardless determination of Nd isotope ratios in glasses and minerals using LA-MC-ICP-MS

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We investigated an appropriate instrumental setup for a laser-ablation multiple-collector inductively coupled plasma mass spectrometer (LA-MC-ICP-MS) and found that a reduced oxide setting allowed accurate and precise analysis of Nd isotope ratios in samples with or without concomitant interfering elements. We used an Aridus II solution/excimer laser dual-intake system. The ICP interface used normal sample and skimmer cones with torch shield switched off and an additional large interface rotary pump. The setting accomplished reduced oxide levels $\text{NdO}^+/\text{Nd}^+ 0.01\text{--}0.05\%$, without significant sacrifice of the instrumental sensitivity ($\sim 70\%$). Oxide molecular ions for the lighter elements were negligible and accurate internal mass bias corrections were achieved for both Sm and Nd using isotopic ratios derived from thermal ionization mass spectrometry measurements. This report reveals a novel setup that requires no external mass bias corrections (standardless analysis) for Sm and Nd isotope analyses by both solution- and LA-MC-ICP-MS methods. Solution analysis of La Jolla Nd standard gave a $^{143}\text{Nd}/^{144}\text{Nd}$ ratio of 0.511860 ± 0.000026 , which is in excellent agreement with the reference value (relative deviation (RD) = +6 ppm). JMC Nd standard solution yielded a $^{143}\text{Nd}/^{144}\text{Nd}$ ratio of 0.512216 ± 0.000044 (RD = -14 ppm) while a Sm-doped JMC solution showed 0.512211 ± 0.000030 (RD = -23 ppm). For LA analyses, the observed ratios and RDs were $^{143}\text{Nd}/^{144}\text{Nd} = 0.511921 \pm 0.000013$ (RD = -12 ppm) for NIST SRM 610 glass standard (430 ppm Nd/453 ppm Sm); 0.512490 ± 0.000018 (RD = +14 ppm) for Durango apatite (1121 ppm Nd/147 ppm Sm); 0.512200 ± 0.000009 (RD = -26 ppm) for Fish Canyon Tuff sphene; 0.512232 ± 0.000003 (RD = +65 ppm) for EDR monazite; and 0.512890 ± 0.000147 (RD = +34 ppm) for groundmass of a St. Helena lava (22.7 ppm Nd/ ~ 5.01 ppm Sm). All measurements were in good agreement with the reference values. Examinations on Sm/Nd elemental fractionation have also been made and we confirmed that this was originated from the ICP interface region rather than at laser ablation site.

Keywords: LA-MC-ICP-MS, Nd isotope, glasses, minerals