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Enhanced Isotopic Measurements of Sub-Nanogram Nd Standard JNdi-1 by TIMS Using the NdO^+ Technique with Isotopx ATONA® Amplifiers

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The samarium-neodymium (Sm–Nd) isotopic system serves as a fundamental tool for geochronology and geochemical tracing, offering insights into the timing and evolution of geological processes. However, achieving high-precision Nd isotope ratio measurements for ultra-small samples remains a challenge, particularly when using the conventional Nd^+ ionization approach in thermal ionization mass spectrometry (TIMS). Due to its superior ionization efficiency, the NdO^+ technique has emerged as a more effective method for analyzing neodymium isotopic compositions in microscale samples.

This study presents a comprehensive dataset of repeated isotopic measurements for sub-nanogram JNdi-1 standard samples using the NdO^+ method on an Isotopx Phoenix TIMS instrument equipped with Isotopx ATONA® amplifiers. The ATONA® amplification system, which relies on capacitive charge detection instead of conventional high-ohm resistors, enhances measurement precision through improved dynamic range, long-term gain stability, and reduced noise levels. Our dataset includes high-precision measurements of multiple Nd isotopic ratios, achieving an external reproducibility of: $^{142}Nd/^{144}Nd$: 24 ppm (2RSD), $^{143}Nd/^{144}Nd$: 24 ppm (2RSD), $^{145}Nd/^{144}Nd$: 24 ppm (2RSD), $^{148}Nd/^{144}Nd$: 42 ppm (2RSD) and$^{150}Nd/^{144}Nd$: 41 ppm (2RSD).

All measured isotopic ratios exhibit an external reproducibility of ≤42 ppm (2RSD), representing a marked improvement in analytical precision for 200 pg Nd loads. The results highlight the effectiveness of combining NdO^+ ionization with ATONA® amplifiers to achieve high-precision isotopic measurements on significantly smaller sample sizes than were previously possible. This advancement expands the potential for Sm–Nd isotope geochemistry in applications such as high-resolution geochronology, isotope tracing in microscale systems, nuclear forensics, cosmochemistry, and ultra-trace element analysis.