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Towards an improved traceability of W-isotope variations in oceanic basalts: a Nu analytical approach using N-TIMS

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Earth's interior is strewn with conduits of hot mantle material of 100s of km in diameter which rise from the deep mantle towards the surface where they culminate in extensive volcanism. Some of the resulting volcanic rocks have uncommon isotope compositions linked to primordial differentiation of the planet over 4 Gyr ago[1]. One such tracer is the variation of $^{182}W/^{184}W$ due to radioactive decay of ^{182}Hf into ^{182}W ($T_{1/2} \approx 9$ Myr). The magnitude of this isotope anomaly varies geographically and it is unclear whether it traces Hadean material present in the mantle or interactions with the Earth's outer core[2,3]. To test these hypotheses, the occurrence and magnitude of this phenomenon need to be better constrained.

A three-step anion-exchange chromatographic protocol was used for chemical separation and purification of W[4]. For the determination of $^{182}W/^{184}W$ isotope ratios we established a new 7-cycle multi-dynamic analytical protocol via N-TIMS (Nu-Instruments). During each measurement cycle, a time-drift correction was applied by which signal intensities of all cycles were extrapolated to that of the first cycle. After interference corrections following previous protocols[5,6], multi-dynamic $^{182}W/^{184}W$ isotope ratios were calculated using signal intensities obtained in the same Faraday cup across different cycles. Finally, mass discrimination corrections were carried out using a multi-static $^{186}W/^{184}W$. A single average multi-dynamic $^{182}W/^{184}W$ value was reported at the end of each cycle. Multi-static ratios were also obtained.

Analyses of variable filament loads (1000, 800, 500 ng) of the Alfa Aesar W standard solution yield similar internal precision of about 2 ppm (2 SE). Multi-dynamic $^{182}W/^{184}W$ values average at 0.864905 ±7 ppm (2 SD) and $^{183}W/^{184}W$ at 0.467155 ±3.8 ppm (2 SD) while multi-static ratios reproduce at ±3 ppm (2 SD). Analyses of chemically purified geological reference materials are required to validate the entire chemical and analytical protocol.

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