

A novel method for high-precision tungsten isotope measurements on small-size samples

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The application of $^{182}\text{Hf} - ^{182}\text{W}$ system for accurate dating and tracing of planetary events relies on highly accurate and precise tungsten isotope measurements. However, high-precision measurement of W isotopes usually requires a large size of samples, which greatly hampers the study of low-content and/or small-size samples. In this study, a two-column W purification procedure was developed for small-size samples (< 400 mg), using a 2.5 mL AG1X8 and a 0.5 mL TEVA resin column to separate W from matrix and interference elements, respectively. The whole procedure blank of W is less than 40 pg and the recovery of W is greater than 97%. Meanwhile, a high-precision W isotopes measurement method was developed for amount W larger than 30 ng using static Faraday cups with 10^{13} , 10^{12} , and $10^{11} \Omega$ amplifiers by negative thermal ionization mass spectrometry (NTIMS). Another novelty of the present study is the measurement of O isotope compositions with high precision and accuracy in the form of ReO_4^- prior to W isotope analysis for each sample. This approach eliminates the residual correlation between instrument-mass-fractionation-corrected $^{182}\text{W}/^{184}\text{W}$ and $^{183}\text{W}/^{184}\text{W}$ ratios from different analyses, which is often found in previous studies. By analyzing the SRM 3163 calibration solution, the long-term repeatability of the $^{182}\text{W}/^{184}\text{W}$ ratio was 0.864868 ± 6 ppm (2 RSD, $n = 29$, $t = 12$ months) when the W amount was greater than 30 ng. Four international geological reference materials, and one ordinary chondrite were also measured, and their $\mu^{182}\text{W}$ values were consistent with published data, with a precision of less than 5 ppm (2 RSD). The $\mu^{182}\text{W}$ values for one iron meteorite are slightly higher than the published data, probably due to sample inhomogeneity. The chemical procedures and mass spectrometric analyses described above are applicable to silicate rocks and iron meteorites with sample sizes of 20–400 mg.