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Validating the high-precision measurement of Mo isotopes at the 5 ng level using double spike MC-ICP-MS

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With recent advancements in analytical methods of Mo isotopes, the $\delta^{98/95}$Mo ratios of most geological and environmental samples can be determined. Still, it remains a challenge to obtain high-precision Mo isotope data for low-Mo samples with complex matrices such as igneous and plant samples. Here, we present an improved Mo purification and cleaning resin scheme for reducing the total procedure blank to ≤ 0.16ng using common MuromacÂ®1X8(AG1-X8) anion and AG50-X8 cation resins. By an improved Aridus II with ice chamber in sample introduction system (SIS) and adding nitrogen(N_2), high sensitivity measurement (^{95}Mo signal intensity: 200~330V ppm^{-1}) of Mo isotopes was achieved on Neptune Plus MC-ICP-MS. Thus, the sample size containing 30~60 ng Mo is sufficient to be purified for isotope measurement with high-precision (≤ 0.06‰, 2SD) can be determined at a concentration of 3~ 10 ng level using a ^{97}Mo-^{100}Mo double spike. The NIST 3134(0.00±0.05‰), SGR-1b(0.41±0.05‰), NOD-P-1(0.87±0.02‰) and other international reference materials (RMs) were analyzed at 3, 5, 10, and 20 ng mL^{-1} levels to be in excellent agreement with the published $\delta^{98/95}$Mo values, demonstrating that good accuracy and precision of Mo isotope analysis can be achieved with an injecting sample size as small as 5 ng Mo.

Our improved method can be applied to various geological and environmental samples. The $\delta^{98/95}$Mo of CLB-1(1.25±0.03‰), JDO-1(0.50±0.02‰), GSV-2(0.47±0.02‰), and other 38 RMs with relatively higher and lower Mo concentrations are reported for the first time. The total average $\delta^{98/95}$Mo ratio of 8 soils and 18 sediments is 0.003+0.277‰ (1SD, n=26), slightly lighter than that upper continent crust (0.05‰~0.15‰). The $\delta^{98/95}$Mo ratios (0.23~0.79‰, n=8) of plant and animal organs from the land show they are enriched in heavy isotopes relative to the bulk silicate earth (BSE). The $\delta^{98/95}$Mo ratios of carbonate are much lower than that in seawater.

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