Highly precise Mo isotope analysis by N-TIMS with in-run oxygen isotopic correction

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Mo isotope systematics has been extensively used in geosciences such as paleoceanography and cosmochemistry [1] [2]. Recently Mo isotopes have been commonly measured by MC-ICP-MS with typical analytical uncertainty of 20–30 ppm for ^{95,97}Mo/^{96}Mo ratios. By contrast, thermal ionization mass spectrometry (TIMS) plays an important role for obtaining highly precise isotope compositions for various elements with analytical precision of <10 ppm (e.g., Nd, W). In this study, we developed a new Mo isotope analysis aimed at achieving analytical precision of <10 ppm, specifically for the study of nucleosynthetic isotope anomalies in meteorites.

Mo isotopes (MoO_3^-) were measured by negative-TIMS using TRITON *plus* (Thermo-Fisher Scientific) installed at Tokyo Tech. The instrument was equipped with 9 Faraday cups with 10^{11} Ω amplifiers. Approximately 3 μg of Mo was loaded on a zone-refined Re filament together with $La(NO_3)_3$ as an activator (La/Mo ~5). A Mo standard solution for atomic absorption spectrometry (Kanto Chem.) was used as an in-house standard. The results were obtained by averaging 360 ratios collected in the static multicollection mode.

First, we confirmed that interferences from Zr and Ru were negligible. A notable finding was that the O isotopic composition of MoO_3^- ion varied significantly throughout all isotopic measurements, resulting in poor analytical reproducibility of Mo isotope ratios when a fixed O isotope composition was applied for the oxide correction. By contrast, the reproducibility was improved by 1.0-1.7 times when the O isotopic composition of individual isotopic run was utilized. The reproducibility of the standard was 45 ppm, 13 ppm, 9.7 ppm, 13 ppm, and 32 ppm for ^{92,94,95,97,100}Mo/^{96}Mo ratios, respectively (n = 21). The accuracy of our method was confirmed by analyzing multiple synthetic solutions conditioned by mixing an isotopically normal solution and enriched isotopes (^{92,97,100}Mo) in varying proportions. In addition, we analyzed one IIIAB iron meteorite, Tambo Quemada. The extent of Mo isotope anomaly for this meteorite was identical to the literature data within analytical uncertainties, suggesting that our method is applicable for the study of nucleosynthetic isotope anomalies in meteorites.

[1] Kendall et al. (2011), *EPSL*, **307**, 450. [2] Burkhardt et al. (2011), *EPSL*, **312**, 390.