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High-Precision Sn isotope analysis using MC-ICP-MS/MS with Double Spike technique

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Tin (Sn) has ten naturally occurring stable isotopes, the highest number among the elements. This abundance provides significant advantages for research into cosmochemical processes (e.g., nucleosynthetic sources, accretion of volatiles to planetary) and geological processes (e.g., magmatic-hydrothermal transitions, ore deposit formation), as well as the study of archaeological artifacts. Although accurate Sn isotope measurements have been reported over the past decade due to advancements in MC-ICP-MS techniques, greater precision, and accuracy in isotope ratio measurements are still needed to resolve the small variations due to fractionation effects and also correct for isotopic shifts caused by Sn loss during sample preparation. In this study, we set up double-spike Sn isotopic measurements using a Neoma MS/MS, equipped with a pre-cell mass filter (set with Wien B-field = 10 %, E-field = 46 V, Pre-filter slit = 100%) and collision cell (operated without reaction gas), and coupled with an Apex Omega desolvating system (Ar flow rate: ~2.2 L/min, without N_2 gas).

The double spike (^{117}Sn-^{122}Sn) was added before dissolution at an optimal spike-to-sample ratio of 40:60 [1] to correct for Sn isotope fractionation during sample preparation and analysis. Tin was purified using 1.5mL TRU resin columns, effectively reducing isobaric interferences and matrix effects to negligible levels in ~0.4 to 0.7g granitic to mafic whole-rocks. A long-term precision of 0.013 ‰ on $\delta^{122/118}$Sn (2SD, n = 34 over 4 months) was obtained for NIST SRM 3161a analyzed at 50 ng.g^{-1} with ^{120}Sn beam intensity > 14 V. The average $\delta^{122/118}$Sn of BCR-2, BHVO-2, JA-2, and AGV-2 geological reference materials are 0.315 ± 0.017 (2SD, n = 8), 0.353 ± 0.011 (2SD, n = 11), 0.169 ± 0.016 (2SD, n = 2), and 0.288 ± 0.023 (2SD, n = 3), respectively (all expressed in ‰ deviation from the measured NIST 3161a standard composition), which are consistent with values reported in previous studies [2, 3].

[1] Creech et al. (2017) *Chemical Geology* 457, 61–67.
[2] She et al. (2023) *J. Anal. At. Spectrom.* 38, 142–155.
[3] Wang et al. (2022) *Geostandard Geoanalytical Res.*, ggr. 12443.