The Sn isotope composition of chondrites, the Earth and the Moon

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Tin is a moderately volatile element with a 50% condensation temperature of 704 K [1]. Mass-dependent Sn isotope data of chondrites, terrestrial and lunar rocks can thus provide valuable constraints on how volatiles were delivered to the Earth, and in particular, whether the volatile element budget of Earth was provided by a late veneer of chondritic material. Moreover, lunar data can constrain the physico-chemical conditions during and after the moon-forming giant impact. Recent lunar Zn and K data [2,3] show enrichments in heavy isotopes compared to the Earth. They were interpreted to record e.g. (i) vapor loss during formation of the Moon [2] or (ii) that the Moon reflects a partial condensate of bulk silicate Earth vapor [3]. Here, we report new Sn isotope data for carbonaceous and enstatite chondrites as well as terrestrial and lunar magmatic rocks.

Tin isotope measurements were performed on a MC-ICPMS (NU Plasma II) using a ^{117}Sn–^{122}Sn double spike. Our average reproducibility is 8 ppm/amu (2SD, n=8) for the bracketing NIST 3161a standard solution. The SPEX CLSN-2Y Sn standard yielded a difference relative to the NIST 3161a standard of 0.078 ± 0.010 for $\delta^{122/118}$Sn/amu (2SD, n =20). This is in excellent agreement with data from [4,5].

When expressed relative to BHVO-2, our data for the USGS standards AGV-2 and BCR-2 agree well with those of [6,7]. The new obtained Sn isotope data for magmatic rocks correlate with their MgO contents and indicate Sn isotope fractionation during partial melting and differentiation, in agreement with previous work [7,8]. Our data for terrestrial basalts span over a limited range of 0.020 ‰/amu, which overlaps with that of carbonaceous chondrites and in particular with CM chondrites. This supports the idea that the late veneer was dominated by CM-like materials [9]. The CR chondrites, however, show larger variations and this implies an additional process leading to Sn isotope fractionation in these meteorites.

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