The composition of the lunar core through zinc and copper isotopes

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The Earth and the Moon share a genetic link, as evidenced by their near identical composition across a number of stable isotopic systems, such as Ni, Ti, Cr, W and O and in their elemental Hf/W contents [1, 2]. Unlike the refractory lithophile elements, however, the isotopic fractionation of more volatile elements, such as Cu, Ga and Zn, show significant variability across the two bodies.

In this study we combine experimental results with high-precision isotopic measurements of Zn and Cu isotope fractionation factors between metallic, sulphide, and silicate melts at conditions relevant to the formation of a sulfur-rich lunar core. We utilise a "sample-sample bracketing" approach which allows us to improve the analytycal precision, and hence resolve a small Zn isotopic fractionation.

Previous work has revealed no discernable Zn isotope fractionation between neither metallic nor sulphide and silicate phases. However, our results suggest that for both Zn and Cu the metallic liquid is slightly enriched in heavier isotopes relative to both the silicate melts and sulphide melt. In contrast, the sulphide melt is isotopically the lightest of the three phases. In all experiments Zn isotopes display a smaller degree of fractionation than Cu isotopes. Overall, the isotope fractionation of both elements slightly decreases with temperature, consistent with the theory of equilibrium mass-dependent isotope fractionation.

Our results on Cu isotope fractionation are consistent with previously reported studies on iron meteorites [3] and experimentally determined Cu-isotope fractionation for metal/silicate and sulphide/silicate liquids [4]. These data suggest the Bulk Silicate Moon exhibits isotopic fractionation resulting from both element volatility and lunar core formation.

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