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# Determining the source of mass-independent potassium isotope variations in meteorites

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Identifying the building blocks of planets using nucleosynthetic compositions is a powerful way to constrain the building blocks of planets as well as the timing and delivery of volatile elements that are key to habitability. The recent discovery of nucleosynthetic variations of the moderately volatile elements K and Zn in meteorites [e.g. 1-2] brings new constraints to accretion models that so far have been mostly based on refractory elements. However, the K isotope compositions of meteorites shows substantial variations within individual meteorite groups, impeding their use in producing comprehensive planetary accretion models. To resolve this issue, we investigate the source of the mass-independent variations of K.

We provide new data on 12 chondrites from different groups and leachates of the CI chondrite Orgueil. The K isotopes were measured on a Triton TIMS using the method of [3]. Repeated measurements of the SRM 3141a standard yield an external reproducibility of 34 ppm (2 SD, n= 22). The K isotope composition of BHVO-2 and a synthetic K standard, normalised to SRM 3141a, are undistinguishable within error (2 SD) with $\varepsilon^{40}K$ of 0.07±0.15 and 0.31±0.41, respectively. The bulk chondrite samples are in agreement with the literature data [1,4] but with increased precision due to a higher number of repeat measurements. The K isotope composition of leachates of Orgueil, already measured for Nd and Sm [5], reveals at least two components with one being significantly enriched in $\varepsilon^{40}K$. We will discuss the nature of these components, their likely stellar production sites and implications for the heterogeneous distribution of K nucleosynthetic compositions in the Solar System's materials.

[1] Nie et al. (2023), Science 379, 372-376.
[2] Martins et al. (2023), Science 379, 369-372.
[3] Wielandt et al. (2011), JAAS 26, 366-377.
[4] Zhang et al. (2025), EPSL 674, 119738.
[5] Frossard et al. (2022), Science 377, 1529-1532.