Stable Nickel Isotope Fractionation in Planetary Materials

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Nickel isotopic compositions have been used for almost 40 years to study meteoritic materials both for nucleosynthetic anomalies and radiogenic effects from decay of 60Fe. A recent stable Ni isotope study of high temperature terrestrial systems provided early indications of Ni isotopic fractionation in the Earth's mantle (1), as well as similar isotopic compositions for chondrites, iron meterorites and terrestrial ultramafic rocks.

We present new data for Ni isotope fractionation in high temperature terrestrial and lunar mafic and terrestrial ultramafic rocks, measured using double spiking (2). Data from mineral separates demonstrate that isotopic fractionation during melting and differentiation is unlikely. This is endorsed by data for Cameroon Line nephelinites, basanites and alkali olivine basalts that are approximately uniform with no evidence of isotopic fractionation in Ni poor liquids. Despite this, there are small but significant global variations in the Ni isotopic compostion of basalts and peridotites (1, 3) that remain to be fully understood but might, in principle, trace the effects of recycling.

Preliminary lunar basalt data display a range of Ni isotopic compositions that exceed those of terrestrial samples. This diversity cannot be explained by recycling but may relate to the very different partitioning behaviour of Ni under more reducing conditions, as characterises lunar melting.

References: 1. Gall L, et al. Geochim Cosmochim Acta. 2017; 199:196–209. 2. Gall L, et al. J Anal At Spectrom. 2012; 27(1):137. 3. Saunders et al. Goldschmidt abstracts, 2017