Genetic relationships of solar system materials based on Ti isotope compositions

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Nucleosynthetic isotope variations in bulk rock samples from different inner solar system materials are now well established for many elements including Ti [e.g. 1]. They were inherited from the precursor materials in the region of the solar nebula from which the planets and asteroids accreted. This led to distinct and unique isotope compositions for each body. For this reason, nucleosynthetic isotope variations enable the investigation of genetic relationships among inner solar system bodies. Titanium is a powerful element for these studies because it is a refractory lithophile element and relatively abundant in silicates. Recent studies documented well resolved nucleosynthetic variations in ^{46}Ti and ^{50}Ti for different solar system materials highlighting the isotopic heterogeneity present in the solar nebula [1, 2, 3]. However, the dataset of nucleosynthetic Ti isotope compositions of Martian meteorites and mesosiderites is very limited. Here we present new high-precision Ti isotope data for Martian meteorites, eucrites and rutiles from mesosiderites to evaluate their possible genetic relationships to other solar system materials, e.g., the proposed connection between mesosiderites and eucrites.

Titanium was purified in a three-stage ion exchange procedure after [2]. The isotope analyses were performed on a Neptune Plus multi-collector ICP-MS at ETH Zurich. To assess accuracy and reproducibility, terrestrial basalts (BCR-2 and BHVO-2) were analysed yielding an external reproducibility (2SD) of ~20 ppm, ~10 ppm and ~20 ppm for ^{46}Ti/^{47}Ti, ^{48}Ti/^{47}Ti, and ^{50}Ti/^{47}Ti, respectively.

Titanium isotope data of three Martian meteorites and two eucrites were obtained so far and more analyses are underway. The data show that variations between Martian meteorites, eucrites and terrestrial basalts are well resolved and most prominent in the ^{50}Ti isotope. The variations suggest that these bodies formed in isotopically diverse regions in the solar nebula.

[1] Trinquier A. *et al.* (2009) *Science* 324, 374-376. [2] Williams N. H. *et al.* (2014) *LPSC XLV*, Abstract #2183. [3] Zhang J. *et al.* (2012) *Nat. Geosci.* 6, 251-255.