Zinc isotope anomalies in bulk chondrites

PAUL S. SAVAGE[123], FRÉDÉRIC MOYNIER[2] AND MAUD BOYET[4]

[1]Department of Earth Sciences, University of Durham, UK Email: p.s.savage@dur.ac.uk
[2]Institut de Physique du Globe de Paris, France
[3]Department of Earth and Environmental Science, University of St. Andrews, UK
[4]Laboratoire Magma et Volcans CNRS, Clermont-Ferrand, France

The measurement of mass-independent isotope anomalies in primitive meteorites provides important information concerning the nucleosynthetic history and chemical evolution of the early solar nebula. Of particular interest are the iron peak elements, the products of fusion reactions in the cores of massive stars [1]. Early studies found significant ^{48}Ca, ^{50}Ti, ^{54}Cr, ^{64}Ni and ^{66}Zn isotope anomalies in refractory inclusions, interpreted to reflect incomplete mixing of a neutron-enriched nucleosynthetic source [2 and refs therein]. More recently, however, the detection of correlated isotope anomalies from distinct stellar progenitors, on the bulk meteorite scale, has been taken as evidence for 'unmixing' of an isotopically distinct phase from an initially homogeneous protosolar molecular cloud [3] [4]. Here we extend these observations to include the Zn isotope system.

With improved analytical precision, we show that carbonaceous chondrites have resolvable ^{66}Zn and ^{68}Zn excesses compared to terrestrial. We also find that enstatite chondrites have small ^{66}Zn deficits, which is consistent with the small ^{48}Ca and ^{50}Ti deficits observed in such samples [5]. Furthermore, sequential leaching experiments show that the Zn anomalies are not limited to one phase.

This study is the first to demonstrate that Zn isotope anomalies are present in bulk primitive meteorites. The complimentary excesses and deficits exhibited by the carbonaceous and enstatite chondrites, the more volatile nature of Zn, and the linear relationships seen between Zn and other iron-peak anomalies seems to further confirm the 'unmixing' hypothesis. That the anomalies are not limited to one phase indicates that, in terms of Zn, large-scale isotope heterogeneity existed in the early solar nebula.

[1] Wallerstein et al (1997) *Rev. Modern Phys.* **69**:995-1084; [2] Birck (2004) *Rev. Min Geochem.* **55**:25-64; [3] Trinquier et al (2009) *Science.* **324**:374-376; [4] Schiller et al. (2015) *GCA* **149**:88-102; [5] Dauphas et al. (2014) *EPSL* **407**:96-108.