Origins of mass-dependent and mass-independent Ca isotope variations in meteoritic components

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Mass-dependent and -independent Ca isotope variations are observed in meteoritic components, and can be used to investigate early Solar System processes and the origins of genetic diversity in the nebula [1-5].

Mass-dependent Ca isotope variations ($\delta^{44/40}$Ca) in calcium aluminium inclusions (CAIs) likely developed via a series of thermal processing events in the nebula [1,2]. The extent and cause of $\delta^{44/40}$Ca variability in other meteoritic components, however, is unclear. We determined the $\delta^{44/40}$Ca compositions of 16 CAIs, chondrules, amoeboid olivine aggregates (AOAs), dark fragments, and a dark inclusion from Allende (CV3) and NWA 753 (R3.9)[6]. Combined REE and $\delta^{44/40}$Ca data indicate that some samples had Ca isotope compositions set via kinetic isotope fractionation during condensation/evaporation, whereas other samples had more complex thermal processing histories.

Mass-independent Ca isotope anomalies ($\varepsilon^{48/44}$Ca) have been identified in meteoritic components [1,2,5] and may reflect the selective unmixing of different presolar grain dust generations [5]. This interpretation is examined by exploring the relationship between $\varepsilon^{48/44}$Ca *vs.* $\delta^{44/40}$Ca compositions in different meteoritic components. No strong correlation is identified using the present dataset, implying that the thermal processing event which caused a heterogeneous distribution of $\varepsilon^{48/44}$Ca in the solar nebula is unlikely to be directly related to the thermal processing event that caused Ca mass-dependent isotopic fractionation in meteoritic components.

[1] Niederer and Papanastassiou (1984) *GCA* **48**, 1279-1293. [2] Huang et al. (2012) *GCA* **77**, 252-265. [3] Simon et al. (2017) *EPSL* **472**, 277-288. [4] Amsellem et al., (2017) *EPSL* **469**, 75-83. [5] Schiller et al. (2015) *GCA* **149**, 88-102. [6] Bermingham et al. (2018) *GCA* **226**, 206-223.