RECENT ADVANCEMENTS IN CALCIUM ISOTOPE GEOCHEMISTRY AND COSMOCHEMISTRY.

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Introduction: Here we present an overview of recent advancements made with regards to the Ca isotopic system in the terrestrial planets.

Ca isotopic composition of the Earth: A range of terrestrial basalts and mantle rocks were analyzed to estimate the Ca isotopic composition of the terrestrial mantle. No systematic variations were observed between different basalt types (δ^{44}Ca average = 0.90 ± 0.04‰, 2sd). Mantle xenoliths show larger variation ranging from basalt-like to heavier compositions in the most refractory lithologies (δ^{44}Ca = 0.81 to 1.25 ± 0.10‰). Analyses of mineral separates show that olivine and orthopyroxene are isotopically heavier than co-existing clinopyroxene [1, 2]. Therefore, variation in xenoliths is likely due to different degrees of melt depletion. Given that the Ca isotope composition of fertile peridotites is indistiguishable from basalts, we take the basalt average to represent BSE [1, 3].

Ca isotopic composition of meteoritic materials: O- chondrites (0.96 ± 0.01‰) and E-chondrites (0.97 ± 0.04‰) have Ca isotope compositions that are indistiguishable from terrestrial. The carbonaceous (CI, CV, CM and CR) chondrites are much more variable, and are typically enriched in light Ca (0.27‰ – 0.79‰) compared to Earth. Unique among the C-chondrites, we find that CO chondrites exhibit a similar Ca isotopic composition to terrestrial samples [3].

Enstatite chondrites: Whether Ca isotopes exhibits significant mass-dependent variation between Earth and E-chondrites has been contentious [4]. We show that E-chondrites have similar isotopic compositions to terrestrial igneous rocks and cannot therefore be ruled out as being representative of the fraction of condensable material that accreted to form the Earth [3].

Variations among carbonaceous chondrites: The origin of the isotopic variation within the carbonaceous group remains puzzling. The variations in Ca isotopes do not correlate with any other isotopic system, the volatility trend, or with the abundance of isotopically light calcium-aluminum rich inclusions (CAIs). It is possible that kinetic isotopic fractionation produced isotopically distinct Ca reservoirs, which may be testable by analyzing Ti stable isotopes; isotopic variations among chondrule pools might also carry part of the isotopic variation observed among some C-chondrites.

Inter-mineral Ca isotopic fractionation: application to lunar data: Although most cluster around the BSE value, analysis of lunar samples reveals significant Ca isotope variability in such samples [3]. Specifically, olivine basalts are slightly enriched in the heavier isotopes of Ca compared to ilmenite basalts and glasses. This supports the idea that olivine can be significantly enriched in heavier Ca isotopes during magmatic processes [1].

References: [1] Chen et al. 2014. Abstract #3940. Goldschmidt 2014 Meeting; [2] Huang et al., 2010, *Earth and Planetary Science Letters* 292:337-344; [3] Valdes M.C. et al. 2014. *Earth and Planetary Science Letters* 394:135-145; [4] Simon J.I. and DePaolo, D.J. 2010. *Earth and Planetary Science Letters* 289:457-466.