Earth's building materials from mass-dependent Ca isotopic compositions

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Nucleosynthetic isotopic anomalies of planetary objects suggest that accretion reservoirs were separated into two major reservoirs (carbonaceous and non-carbonaceous), both showing mixing trends [1]. It has been suggested that these two reservoirs may have been isolated by the formation of Jupiter [2]. Alternatively, ^{48}Ca anomalies were interpreted as the consequence of accretion timescales of planets [3], but EC and aubrites are identical in ^{48}Ca to Earth [4, 5]. The ^{48}Ca are notably correlated with mass-dependent variations in bulk meteorites, but not in CAIs [6, 7], nor in chondrules [3]. This may suggest mixing of reservoirs, and/or thermal processing of precursors. To better constrain the Bulk Earth composition, we have measured by MC-ICPMS the mass-dependent isotopic variations of Ca (expressed as $\delta^{44/40}Ca$ relative to SRM915a) of various meteorites and their components. $\delta^{44/40}Ca$ of individual L3 and LL3 chondrules have a range similar to those found for CV3, CR2 and L3 [3, 7, 8]. NWA 8486 $\delta^{44/40}Ca$ is within those of eucrites. A EL3 clast of Almahata Sitta (fall) has a composition of 1.24‰, and with another EL3 [9], are both heavier compared to EL6 or EH3-6 [5, 8-10]. Our data thus support that EL3 chondrites may originate from different bodies than other EC [11]. The EL3 (1.34‰) and other EC (1.05‰) are on average isotopically heavier than the Bulk Earth as constrained from mantle peridotites (0.94‰) [12]. Isotopic similarities for ^{48}Ca between EC, and EL3 in particular, with Bulk Earth [4] and other isotopic systematics [11] would thus imply that either the $\delta^{44/40}Ca$ of EC have been modified by nebular proceses [4] and/or that the accessible parts of the mantle and their melting products were fractionated by mantle processes.

[1] Warren (2011) *EPSL* **311**, 93. [2] Budde et al. (2016) *EPSL* **454**, 293. [3] Schiller et al. (2018) *Nature* **555**, 507. [4] Dauphas et al. (2014) *EPSL* **407**, 96. [5] Huang et al. (2017) *GCA* **201**, 364. [6] Kööp et al. (2018) *EPSL* **489**, 179. [7] Bermingham et al. (2018) *GCA* **226**, 206. [8] Amsellem et al. (2017) *EPSL* **469**, 75. [9] Simon et al. (2010) *EPSL* **289**, 457. [10] Valdes et al. (2014) *EPSL* **394**, 135. [11] Boyet et al. (2018) *EPSL* **488**, 68. [12] Kang et al. (2017) *EPSL* **474**, 128.