

CADMIUM ISOTOPE FRACTIONATION IN ENSTATITE AND CARBONACEOUS CHONDRITES.

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Introduction: Large inorganic mass-dependent Cd isotope fractionations appear to result from evaporation/condensation processes only [1]. Cadmium isotope fractionations in unequilibrated ordinary chondrites [1, 2, 3] probably resulted from evaporation and condensation of Cd on the parent bodies, likely due to thermal metamorphism [1]. Here we report Cd isotope fractionations in enstatite and carbonaceous chondrites and in refractory materials from Allende.

Methods: A NuPlasma MC-ICPMS in Zürich was used for the analyses. The external reproducibility is $\pm 1.1 \text{ } \epsilon\text{Cd/amu}$ (2 s.d.; [1]). The ϵ -notation denotes the deviation of the sample Cd isotope composition from the in-house standard in parts per 10,000 per atomic mass unit (amu). Positive values denote heavy isotope compositions.

Results and discussion: Two unequilibrated EH3 and two strongly metamorphosed enstatite chondrites (EL6 and E7) display heavy Cd isotope compositions (+8.4 to +39.2 $\epsilon\text{Cd/amu}$) with respect to the standard and the Earth ($\epsilon\text{Cd/amu} \approx 0 \pm 1$). However, isotope fractionations are not observed in the volatile element rich EH4 chondrites. Aqueously altered carbonaceous chondrites (CI, CM2, CR2, C2 ungr.) and the Allende CV3 chondrite show no Cd isotope fractionations. One CV3 (Leoville) and two CO3 chondrites, however, display $\epsilon\text{Cd/amu}$ values between +3.1 and +11.1. Three CK chondrites of type 3 to 5 show small, but resolvable variations from -2.4 to +1.1 $\epsilon\text{Cd/amu}$.

It is likely that the part of the solar nebula from which bodies in the inner solar system accreted initially had a homogeneous Cd isotope composition, because most carbonaceous chondrites, EH4 chondrites and the Earth display identical Cd isotope compositions within uncertainty. The heavy Cd isotope compositions of most enstatite and some carbonaceous chondrites suggests later local Cd volatilization. The Cd isotope fractionations in CO3 chondrites may be due to their mild thermal metamorphism. The CK chondrites form a metamorphic series, but the depletion of Cd and Cd isotope fractionation is less obvious than for CO3 chondrites. The depletion and redistribution due to volatilization of Cd varies between carbonaceous and enstatite chondrite classes and ordinary chondrites. This could be due to physical and mineralogical differences in the parent bodies (e.g. porosity and host mineralogy).

Separated Allende matrix shows no Cd isotope fractionations, but two chondrule separates and a refractory inclusion show light isotope compositions with up to -9.6 $\epsilon\text{Cd/amu}$. This result is consistent with the light Zn isotope compositions reported for an Allende CAI [4]. The light Cd isotope composition of the refractory inclusion probably resulted from its preaccretionary evaporation/condensation history (see e.g. [5]). This suggests that the refractory inclusion is an evaporation residue from a volatile-rich precursor material. Cadmium may have survived the evaporation process, because it was locked up in refractory phases (possibly spinel).

References: [1] Wombacher F. et al. (in press) *GCA*. [2] Rosman K. J. R. and De Laeter J. R. (1976) *Nature*, 261, 216-218. [3] Rosman K. J. R. and De Laeter J. R. (1988) *EPSL*, 89, 163-169. [4] Luck J. M. et al. (2003) *Geophys. Res. Abstr.*, 5, EAE03-A-09726. [5] Clayton R. N. et al. (1988) *Phil. Trans. R. Soc. A*, 325, 483-501.