

REE ABUNDANCES IN INDIVIDUAL OLDHAMITE, NININGERITE AND ENSTATITE IN SEVERAL EH3 CHONDRITES: GENETIC IMPLICATIONS

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Introduction: Results obtained using the ¹⁴⁶Sm-¹⁴²Nd short-lived radioactivity reveal that REE fractionation occurred very early in Earth's history [1]. The EH-chondrites originated in a highly reduced region. Accordingly, REE are mainly chalcophile, and concentrated in oldhamite (CaS) [2]. REE inventory of individual minerals in the primitive EH-3 chondrites, Sahara97072 and ALHA77295 were investigated to elucidate their condensation and accretionary mechanisms.

Results: Our investigations are based on crystal habit of CaS and its host assemblages. Detailed petrologic study indicates the presence of several CaS-bearing assemblages: (A) idiomorphic or anhedral in metal-sulfide clasts, (B) various habits around kamacite-FeS clasts, and (C) various habits among silicates in matrix. A-C probably reflects sequential condensation and accretionary events of either pristine (euhedral), recycled (anhedral) or grains originated from different nebular regions. REE concentrations were measured by SIMS and LA-ICPMS. CaS depicts REE enrichments (10-100×C1). Four REE patterns are encountered in CaS in 77295: **1.** Flat REE pattern with minor deficit in Eu in idiomorphic grains in fluffy metal clasts and in matrix. **2.** Flat patterns with both minor deficit in Eu and excess in Yb in idiomorphic grains in matrix. **3.** Flat patterns with small deficit in Yb in matrix and clasts. **4.** Grains with flat patterns and slight to large anomalies in both Yb and Eu. In comparison, 96% of CaS in Sahara97072 depict REE of category 4 and enrichment in LREE relative to HREE, suggesting a different source region in the EH-3 parent body or a different EH asteroid. REE concentrations in enstatites (MgSiO₃) range between 0.2 to 8×C1. The modal abundance of MgSiO₃ ranges from 60 to 70% in bulk meteorites, it is an important REE host next to oldhamite. Most patterns are characterized by negative Eu and Yb anomalies. Niningerites are negligible contributors to bulk EH-3 REE inventory.

Discussion: CaS and MgSiO₃ are the phases that control the REE budget in EH chondrites. Positive Eu and Yb anomalies observed in most in 97072 CaS are complimentary to the negative ones in enstatite thus explaining the flat patterns of the bulk meteorites. [3] Predict that the first CaS condensates should have flat REE patterns with Eu and Yb depletions since EuS and YbS condense at lower temperature than other REE. This pattern is however, seen in MgSiO₃. Although CaS are all enriched in LREE relative to HREE, they have super-chondritic Sm/Nd ratios because like Yb, Sm is slightly enriched relative to neighboring REE. Our results in EC tend to rule out the scenario proposed by [4] in which they evoke the incorporation of REE in the core to explain ¹⁴²Nd excess in terrestrial samples relative to chondrites.

References: [1] Boyet M. and R. W. Carlson, 2005, *Science*, **309**, 576-580. [2] Larimer J. M. and Bartholomay M., 1979, *GCA*, **43**, 1455-1466. [3] Lodders K. and Fegley, 1993, *EPSL*, **117**, 125-145. [4] Andreasen R. et al. 2008. *EPSL*, 266, 14-28. **309**, 576-580.