**TRACE ELEMENT ABUNDANCES IN AN UNUSUAL HIBONITE-PEROVSKITE REFRACTORY INCLUSION FROM ALLENDE**

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**Introduction:** Calcium-aluminum-rich refractory inclusions (CAIs) are thought to be the first-formed solids in the Solar protoplanetary disk and can provide information about the earliest Solar System processes (e.g., [1]). A hibonite-perovskite-bearing CAI from the Allende CV3 chondrite (SHAL, [2]) contains a single ~500 μm hibonite grain and coarse-grained perovskite. The mineralogy and oxygen isotopic composition of this CAI shows similarities with FUN inclusions, especially HAL [2]. Here we present trace element abundances in SHAL.

**Results and Discussions:** Rare earth element (REE) abundances were obtained using a CAMECA IMS 6f secondary ionization mass spectrometer (SIMS) at ASU, using an $O^-$ primary beam. NIST 610, 612 and 614 glasses were used for calibration standards. We performed 8 spot analyses on the hibonite grain and 5 analyses on the perovskite aggregates.

The hibonite grain shows significant variation in REE concentrations (La ~2 to 100 × CI; Lu ~1 to 19 × CI). There are two distinct REE patterns observed in this hibonite. Five of the hibonite analyses show enrichment in the LREEs compared to HREEs ($[La/Sm]_{CI}$ ~1.1-2) and a moderate negative Eu anomaly (Eu/Eu* ~0.5-0.9). The remaining three hibonite analyses have a concave upwards pattern, with a small positive Eu anomaly (1.2-1.3). All hibonite analyses show varying degrees of negative Yb anomalies (Yb/Yb* ~0.01-0.8). These patterns show similarities to the BAG-type hibonites of [3,4], but are distinct from the PLAC and SHIB varieties.

The perovskite analyses all show similar REE patterns, with a limited range of concentrations (La ~10 to 25 × CI; Lu ~ 420 to 670 × CI). They are depleted in LREEs compared to HREEs ($[La/Sm]_{CI}$ ~0.04), show a strong negative Eu anomaly (Eu/Eu* ~0.09) and a moderate negative Yb anomaly (Yb/Yb* ~0.7).

**Conclusions:** The hibonite grain shows significant variations in its REE pattern and abundances. While five of the analyses show LREE-enriched pattern, three show concave-downward REE patterns (similar to Allende ultra-refractory inclusions [5]).

Cerium behaves as a volatile element only under oxidizing conditions, whereas Eu and Yb require reducing conditions to be volatile. The existence of anomalies in all these elements in the Allende HAL inclusion has been explained by varying redox conditions in the solar nebula [6]. The absence of Ce anomalies, but presence of Eu and Yb anomalies in SHAL hibonite and perovskite are indicative of reducing conditions during its formation.

**References:** [1] MacPherson G. 2003. Treatise on Geochemistry 1: 201-246 Ed.: Davis A. M. (Elsevier Ltd.) [2] Keller L. P. et al. 2012. *MAPS* 32: A74. [3] Ireland, T. 1988. *GCA* 52: 2827-2839. [4] Liu M-C. et al. 2009. *GCA* 73: 5051-5079. [5] Fahey A. J. et al. 1994. *GCA* 58: 4779-4793. [6] C. Floss et al. 1996. *GCA* 60: 1975-1997.