

MINERALOGY AND OXYGEN ISOTOPE COMPOSITIONS OF AN UNUSUAL HIBONITE-PEROVSKITE REFRACTORY INCLUSION FROM ALLENDE. L. P. Keller¹, C. Snead², Z. Rahman¹ and K. D. McKeegan². ¹Robert M. Walker Laboratory for Space Science, Code KR, ARES, NASA/JSC, Houston, TX 77058 ²IGPP, Dept. of Earth and Space Sciences, UCLA, Los Angeles, CA 90095 (Lindsay.P.Keller@nasa.gov).

Introduction: Hibonite-rich Ca- and Al-rich inclusions (CAIs) are among the earliest formed solids that condensed in the early nebula [e.g. 1]. We discovered an unusual refractory inclusion from the Allende CV3 chondrite (SHAL) containing an ~500 μm long single crystal of hibonite and co-existing coarse-grained perovskite. The mineralogy and petrography of SHAL show strong similarities to some FUN inclusions, especially HAL [2]. Here we report on the mineralogy, petrography, mineral chemistry and oxygen isotopic compositions in SHAL.

Results and Discussion: Electron microprobe analyses of the hibonite core show it is nearly pure $\text{CaAl}_{12}\text{O}_{19}$, with ~1 wt.% TiO_2 and trace MgO and FeO that increase at the rim. The core of the hibonite contains numerous <10 μm -sized perovskite platelets. We extracted a section through several of the perovskite grains using focused ion beam techniques followed by transmission electron microscopy. The perovskite exsolutions are crystallographically oriented such that $[100]_{\text{pv}} \parallel [100]_{\text{hb}}$ and $[011]_{\text{pv}} \parallel [0001]_{\text{hb}}$. A partial Wark-Lovering rim is present on the hibonite, but terminates at the contact with the coarse perovskite. The coarse-grained perovskite crystals are refractory and contain ~0.2 wt.% ZrO_2 , 0.1 wt.% Y_2O_3 and up to 2 wt.% Al_2O_3 . The coarse-grained perovskite contains thin veins of ilmenite along cracks and grain boundaries although it is not clear if the alteration occurred in a nebular or parent body location.

Oxygen isotopes were measured on the UCLA Cameca ims-1270 ion microprobe using a primary Cs^+ beam and negative secondary ions and Faraday cups for all three O isotopes. Instrumental mass fractionation was determined from San Carlos olivine, Burma spinel, Madagascar hibonite and LP204 magnetite standards. With these conditions, the precision on an individual measurement was in the range 0.2-0.5‰ and the reproducibility on $\delta^{18}\text{O}$ and $\delta^{17}\text{O}$ was ~1.3‰ and 1.5‰ (at 1σ), respectively. The hibonite is ^{16}O -rich and shows evidence for mass dependent fractionation whereas the coarse perovskite is uniformly ^{16}O -poor (avg. $\delta^{17}\text{O} = -7\text{‰}$, $\delta^{18}\text{O} = -7\text{‰}$). The coarse perovskite has likely undergone oxygen exchange owing to the rapidity of oxygen diffusion in perovskite compared to other CAI phases [3]. Additional isotopic measurements are planned to determine whether the mass dependent fractionation in O extends to other isotopic systems (e.g. Mg).

References: [1] Simon, S. B. et al. (1997) *MAPS* 32, 259. [2] Allen, J. M. et al. (1980) *GCA* 44, 685. *Meteoritics & Planetary Science* 32:A74. [3] Sakaguchi, I. and Haneda, H. (1996) *J. Solid State Chem.* 124, 195.