OXYGEN ISOTOPE VARIATION IN FINE-GRAINED CAIs IN ALHA 77307: MIXING AND TRANSPORT IN DIVERSE NEBULAR ENVIRONMENTS.

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Introduction: Varying oxygen isotopic compositions in CAI minerals are thought to reflect exposure of CAIs to different solar nebular environments. Models [1,2] show that particles within the protoplanetary disk will have complicated trajectories, traveling inwards and outwards, leading to formation of CAIs with complex temperature histories. Large systematic variations in $\Delta^{17}O$ (≥25‰) in the Wark-Lovering (WL) rim and margin of an Allende CAI suggest interaction of CAIs with ^{16}O-rich and ^{16}O-poor solar reservoirs by transfer among different environments within the protoplanetary disk [3]. However, interpretation of O-isotopes in Allende CAIs is difficult, as the Allende parent body has experienced extensive thermal and aqueous alteration [4].

The characteristics of fine-grained CAIs in ALHA 77307 suggest transport of early-condensed solids and back-reaction with a nebular gas [5]. The CAIs show evidence of disequilibrium reactions; each inclusion appears to have experienced unique formation and thermal histories. The microstructures of these inclusions, as well as the pristine nature of the chondrite indicate the inclusions have not undergone post-accretion alteration. To investigate if the complex thermal history in fine-grained CAIs in ALHA 77307 reflects transport through ^{16}O-rich and ^{16}O-poor nebular regions, we analyzed the oxygen isotope compositions in four fine-grained CAIs (one of which had been re-melted).

Results: Due to the fine-grained nature of the CAIs, O-isotope measurements were performed using the LLNL NanoSIMS 50. Oxygen isotope data were collected for different mineral phases across four CAIs. The CAIs are uniformly ^{16}O-rich ($\Delta^{17}O \approx -22$‰); no systematic discernable differences in oxygen isotope abundances, outside uncertainty, between the distinctive mineral phases are observed. In contrast, data for a chondrules in the same thin section show a distinctly ^{16}O-poor composition with $\Delta^{17}O \sim -5$‰. Unlike the rims surrounding igneous CAIs in CV chondrites and despite convincing petrographic evidence for complex formation and thermal histories, CAIs in ALHA 77307 did not re-equilibrate with an ^{16}O-poor gas subsequent to formation. We reported similar behavior for rims surrounding melilite-rich inclusions from Murchison [6]. Our data are consistent with data for unmelted, fine-grained CAIs in Yamato-81020 (CO3.0) with uniform $\mathbf{\Delta}^{17}O$ of ≈ −22 ‰ [7] and support a scenario in which mineralogical and chemical alteration of CAIs in the least metamorphosed CO chondrites is decoupled from O-isotope exchange.

References: [1] Ciesla F. J. 2010. *ApJ* 723:514–529. [2] Ciesla F. J. 2010. *ApJ* 740:1–12. [3] Simon J. I. et al. 2011. *Science* 331:1175–1178. . [4] Brearley A. J. and Krot A. N. 2012 *In Metasomatism and the Chemical Transformation of Rock – Lecture Notes in Earth System Sciences*, 659–789. [5] Han, J. M. and Brearley, A. J. 2012. A1324. 43rd LPSC. [6] Matzel, J. E. P. et al. 2013. A2632. 44th LPSC. [7] Itoh, S. et al. 2004 *GCA* 68:183–194.