TRANSMISSION ELECTRON MICROSCOPY OF IN SITU PRESOLAR SILICATES IN ALAN HILLS 77307.

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Introduction: Presolar grains are dust grains that condensed in the outflows from stars that predate the Sun. They exhibit isotopic signatures that deviate so far from solar values that they can only be explained as the results of nucleosynthesis in stars. Silicates are the most abundant unequivocally presolar grain phase, with concentrations exceeding 100 ppm in some anhydrous interplanetary dust particles [1] and primitive meteorites, e.g., ALHA77307 [2,3]. Previous coordinated secondary ion mass spectrometry (SIMS) and scanning Auger electron spectroscopy studies of ALHA77307 have identified over 100 individual presolar silicate grains, with a wide range of compositions, e.g., Fe-rich, Ca-Al-rich, pure SiO_2 [2]. In order to better understand the structure and composition of the silicate grains, and the relationship to the surrounding matrix material, we have begun focused ion beam-enabled in situ transmission electron microscopy studies.

Methods: The presolar silicate grains were identified in a thin section of ALHA77307 using the Carnegie NanoSIMS 50L. Elemental maps of the grains and surrounding areas were obtained with the PHI 700 Auger Spectrometer at Washington University. Details of these measurements were reported previously [2]. Sections of two of the grains were extracted in situ using focused ion beam (FIB) lift-out with the FEI Nova 600 FIB-SEM at the Naval Research Laboratory (NRL). Structural and elemental analysis of the section was performed using the NRL JEOL 2200FS transmission electron microscope (TEM).

Results and Discussion: Grain 166a has an oxygen isotope composition of $\delta^{17}O$ +680‰ and $\delta^{18}O$ -220‰. Auger measurements suggest that it is a ~700 nm silicate with a Ca-Al-rich core and a Mg-rich rim. From cross-sectional scanning TEM-based energy dispersive spectrometry mapping, it is apparent that the Mg-rich material is adjacent to but does not surround the Ca-Al-rich grain. Variation of the Si, Ca and Al intensity inside the grain suggests that it is either an inhomogeneous glass, or a polycrystalline aggregate. The lack of metal and sulfides rules out the possibility of a GEMS identity. Diffraction analysis and high-resolution TEM of the grain is planned, pending further FIB thinning of the section. Grain 65a has an oxygen isotope composition of $\delta^{17}O$ +1225‰ and $\delta^{18}O$ +385‰. The Auger composition measurements show it to be a Ca-rich silicate surrounded by Fe-rich silicates. Cross-sectional STEM analysis revealed that despite the ~ 600 nm grain diameter at the surface, the grain extended only ~ 20 nm below the section surface after SIMS measurements. The TEM data from these two grains underscores the complexity of presolar grain microstructures and the potential pitfalls of extrapolating to 3-D from surface imaging.

References: [1] Floss C. et al. 2006. *GCA* 70: 2371-2399**.** [2] Nguyen A. N. .et al. Abstract #2142. 39th Lunar & Planetary Science Conference. [3] Nguyen A. N. et al. 2007. *ApJ* **656**:1223-1240.