AN AUTOMATED NANOSIMS SEARCH FOR PRESOLAR OXIDE GRAINS.

Ming-Chang Liu[1], Larry R. Nittler[1], Conel. M. Alexander[1] and Frank Gyngard[2]. [1]Dept. of Terrestrial Magnetism, Carnegie Institution of Washington (mliu@dtm.ciw.edu). [2]Laboratory for Space Sciences and Dept. of Physics, Washington University, St. Louis, MO 63130.

Introduction: Presolar grains are condensates from the outflows or envelopes of evolved stars and thus preserve records of nuclear processes insides their parent stars [1]. However, some presolar grain isotope signatures are also believed to reflect chemical evolution in the Galaxy (GCE), such as the Si and Ti isotopes in mainstream SiC [2]. A majority of presolar oxides and silicates (Groups 1+3, [3]) is believed to have originated in low-mass asymptotic giant branch stars. However, their $^{18}O/^{16}O$ ratios are affected by both GCE and mixing processes in the parent stars themselves. Disentangling these effects is not straightforward and requires analysis of multiple elements. Inferred ^{26}Al contents and Ti isotopes are of particular importance in this regard, as the former provides information on nuclear and mixing processes in the stars, and the latter provides a bridge between the presolar oxide and SiC data. However, the data sets for Al-Mg and, especially, Ti in presolar oxides are still limited, relative to O isotopes. We are thus using a new automated analysis system to search for additional presolar oxide grains and subsequently to obtain high-quality multi-element isotope data on them.

Experimental: The automated system, developed in collaboration with Cameca Instruments, has been described previously [4]. Briefly, image processing algorithms identify grains in 25μm × 25μm isotopic images of a sample mount. The primary beam is then deflected to each grain in turn and an isotopic measurement performed. Once all grains in an image are analyzed, the sample stage is moved and the process repeated. As an initial test of the system on the Carnegie NanoSIMS 50L, we surveyed an acid-resistant residue of the Tieschitz ordinary chondrite. Grains were identified in ^{16}O images and measured for their $^{17}O/^{16}O$, $^{18}O/^{16}O$ and $^{27}AlO/O$ ratios. Identified presolar grains were subsequently analyzed for their Al-Mg compositions.

Results and Discussion: Through the method described above, seven presolar grains were identified. SEM-EDX analysis indicated all are Al_2O_3 and range in size from 0.2 to 1 μm. Five grains are typical ^{17}O-enriched Group 1 oxides, one is a moderately ^{17}O- and ^{18}O-rich Group 4 grain ($\delta^{17}O$~120‰, $\delta^{18}O$~180‰), and the last is a highly ^{18}O-depleted Group 2 grain. Five grains show ^{26}Mg excesses, with a very wide range of inferred $^{26}Al/^{27}Al$, from 10^{-6} to ~10^{-2}. Note that the origin of presolar oxides with very high $^{17}O/^{16}O$ ratios (> ~0.003–0.005) is not well understood, but previous measurements of three such grains revealed no evidence for ^{26}Al [5,6]. Interestingly, the two Group 1 grains found here with the highest $^{17}O/^{16}O$ ratios (≥0.003) also show very low ^{26}Al. Unfortunately, the presolar grains found here lacked measurable amounts of Ti for meaningful isotopic analyses. Searches for more Ti-rich oxide grains are underway.

References: [1] Clayton D. D. and Nittler L. R. 2004. *ARA&A* 42:39–78. [2] Alexander C. M. O'D. and Nittler L. R. 1999 *ApJ* 519:222–235. [3] Nittler L. R. et al. 1997. *Nucl. Phys.* A 621:113–116. [4] Gyngard, F. et al. 2009. *40th LPSC*. #1386 (abstract). [5] Choi et al. 1999. *ApJL* 522:133–136. [6] Nittler et al. 2008. *ApJ* 682:1450–1478.