

COORDINATED CHEMICAL AND ISOTOPIC STUDIES OF IDPS: COMPARISON OF CIRCUMSTELLAR AND SOLAR GEMS GRAINS. L. P. Keller and S. Messenger. Robert M Walker Laboratory for Space Science, ARES, NASA Johnson Space Center, Houston, TX 77058. Lindsay.P.Keller@nasa.gov.

Introduction: Silicate stardust in IDPs and meteorites include forsterite, amorphous silicates, and GEMS grains [1]. Amorphous presolar silicates are much less abundant than expected based on astronomical models [2], possibly destroyed by parent body alteration. A more accurate accounting of presolar silicate mineralogy may be preserved in anhydrous IDPs. Here we present results of coordinated TEM and isotopic analyses of an anhydrous IDP (L2005AL5) that is comprised of crystalline silicates and sulfides, GEMS grains, and equilibrated aggregates embedded in a carbonaceous matrix. Nanometer-scale quantitative compositional maps of all grains in two microtome thin sections were obtained with a JEOL 2500SE. These sections were then subjected to O and N isotopic imaging with the JSC NanoSIMS 50L. Coordinated high resolution chemical maps and O isotopic compositions were obtained on 11 GEMS grains, 8 crystalline grains, and 6 equilibrated aggregates.

Results: Two GEMS grains had anomalous O isotopic compositions and all of the remaining grains were indistinguishable ($\pm 50\%$) from solar. The IDP had a bulk $\delta^{15}\text{N}$ of $+150\%$ with hotspots up to $+500\%$. **Grain 1** had a pronounced O isotopic anomaly ($\delta^{17}\text{O} = +523 \pm 85\%$; $\delta^{18}\text{O} = -100 \pm 37\%$), consistent with this GEMS grain originating from a red giant or AGB star. It is an elongated ($0.3 \times 0.5 \mu\text{m}$) aggregate that is chemically heterogeneous on a 100 nm scale and subgrain element/Si ratios vary by factors of 2 to 3. The bulk composition is sub-solar as is typical for most GEMS grains (Mg/Si=0.72, Fe/Si =0.48, S/Si=0.19, Al/Si=0.08, Ca/Si=0.04). The O abundance is stoichiometric, assuming that all Fe is present as metal or sulfide. The grain shows no evidence for zoning or element depletions at the grain rim relative to the core. No relict grains are observed. **Grain 2** is a $0.5 \mu\text{m}$ GEMS grain aggregate of at least 4 morphologically distinct subgrains. It is moderately ^{18}O enriched ($\delta^{18}\text{O} = +80 \pm 20\%$), but a sub-region reaches $\delta^{18}\text{O} = +145 \pm 30\%$, possibly due to one of the subgrains. The subgrains are compositionally similar but differ in their abundance of metal and sulfide inclusions. The bulk composition is sub-solar except for Mg (Mg/Si=1.20, Fe/Si = 0.43, S/Si=0.19, Al/Si=0.19, Ca/Si=0.06). No zoning profiles across the aggregate are observed and the O abundance is stoichiometric.

Discussion: The isotopically anomalous GEMS grains bear remarkable resemblance to isotopically solar GEMS grains. Isotopically solar GEMS grains may have formed in the nebula under similar conditions to those that condensed in circumstellar outflows. Alternatively, they may have been isotopically homogenized by extensive irradiation/cycling of material in the ISM [3]. However, the chemical compositions of GEMS grains do not easily fit in with this scenario [4]. The preserved microstructure of the presolar GEMS grains suggests that they were not extensively affected by irradiation or thermal processes.

References [1] Messenger, S. *et al.* (2007) *Science* 309, 737 [2] Kemper, F. *et al.* (2004) *ApJ*. 609, 826 [3] Bradley JP (1999) *Science* 285, 1716 [4] Keller, L. P. *et al.* (2005) *LPS* 36, #2088