STARDUST ABUNDANCE VARIATIONS AMONG INTERPLANETARY DUST PARTICLES.

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Introduction: Presolar grain abundances reflect the degree of processing primitive materials have experienced. This is evidenced by the wide range of silicate stardust abundances among primitive meteorites (~10 to 300 ppm) [1], attributable to parent body hydrothermal processing. Stardust abundance variations are also pronounced in anhydrous interplanetary dust particles (CP-IDPs), that have not experienced parent body processing (300 to > 10,000 ppm) [2-4]. The large range in stardust abundances among CP IDPs thus reflect nebular processing. Here we present results of a systematic search for stardust among cluster CP IDPs. Our goals are to establish mineralogical trends among IDPs with different stardust abundances. This may shed light into the nature of isotopically normal presolar grains (GEMS grains?; 5) if their abundances vary similarly to that of isotopically exotic stardust grains.

Sample and Methods: 10 µm fragments of two cluster IDPs were selected for this study: L2036 AA4 cluster #4, and L2005 AL5 cluster #13. The samples were each embedded in elemental S, and 70-nm thick sections were deposited onto Cu TEM grids. Many of the sections were first fully characterized by transmission electron microscopy (TEM) with a JEOL 2500 FESTEM, including quantitative chemical imaging (EDX) and mineralogy. 17 of these sections were then subjected to O and N isotopic imaging with the JSC NanoSIMS 50L ion microprobe. In total we obtained O isotopic images from 152 μm^2 of L2005AL5 and 29 μm^2 of L2036AA4.

Results and Discussion: We identified 3 presolar silicates in L2005AL5 and 2 presolar silicates in L2036AA4. The AL5 grains were identified as GEMS grains by prior TEM study [7]. 3 grains have $\delta^{17}O$ enrichments (300–1000‰) and normal/slightly depleted $\delta^{18}O$ typical of Group 1 grains from AGB stars [6]. The other presolar silicates have $\delta^{17,18}O$ ~ 200‰ and $\delta^{17}O$=0, $\delta^{18}O$=150‰ and their origins are likely high metallicity stars or supernovae. Based on the areas of the presolar grains relative to the search areas, we estimate the silicate stardust abundances of these two IDPs to be 1,300ppm (L2005AL5) and 6,900ppm (L2036AA4). Both IDPs contain typical IDP components: enstatite, forsterite, amorphous silicates (GEMS grains), equilibrated aggregates, Fe-Ni sulfides, and carbonaceous material. Interestingly, the stardust-rich IDP (L2036AA4) is particularly fine-grained, whereas the other IDP contains larger crystalline silicates and thermally modified grains (equilibrated aggregates).

Some interstellar dust models predict that isotopically homogenized (perhaps GEMS) grains are much more abundant than stardust [6]. While the most stardust-rich IDPs may thus contain abundant interstellar materials, IDPs deficient in stardust (<1000 ppm) should have far less of this material assuming equivalent destruction rates. The nature of this material is unknown, but a leading candidate may be a subset of the ubiquitous GEMS grains in IDPs.

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