ELEMENT ABUNDANCES IN SEVEN PARTICLES FROM THE LARGE AREA COLLECTORS G. J. Flynn¹ and S. R. Sutton²,³; ¹Department of Physics, SUNY-Plattsburgh, Plattsburgh, NY 12901; ²Department of the Geophysical Sciences, The University of Chicago, Chicago, IL 60637; ³Department of Applied Science, Brookhaven National Laboratory, Upton, NY 11973.

The Johnson Space Center (JSC) cosmic dust collection effort has been expanded to include Large Area Collectors (LAC) providing greater numbers and larger sizes of cosmic dust particles. At present, LAC particles are allocated to investigators without prior characterization at JSC, so their compositions (and possible origins) are unknown. We have determined elemental abundances for seven LAC particles - L2001*C, L2001*D, L2001*E, L2001*G, L2002*C, L2003*D, and L2003*E - by Synchrotron X-ray Fluorescence (SXRF). Since there is much interest in the analysis of chondritic particles, generally thought to be interplanetary, we have attempted to define criteria to maximize the likelihood of selection/allocation of chondritic particles.

Analytical Techniques: The particles were first analyzed in the same manner we have previously employed for minor and trace element determinations on stratospheric cosmic dust (1). These analyses were performed with a 75 micrometer thick Al filter over the X-ray detector to reduce sum peaks and maximize the sensitivity for trace elements from Ni to Mo. Since no major element data were available for the LAC particles, we performed a second SXRF analysis with the Al filter removed, allowing detection of lighter elements including S and Ca. We have not previously reported unfiltered light element data since X-ray absorption for these low energy peaks limits our analysis to a fraction of each particle, the amount depending on particle size, composition, and density. Si abundances were not determined since the analyses were performed in silicone oil, as supplied by JSC, to minimize trace element contamination from handling.

Chondritic Particles: Three particles, L2001*D, L2003*D, and L2003*E, exhibited generally chondritic element abundance patterns. One of these chondritic particles, L2003*E, was provided to us in 3 fragments which we elected to analyze individually to provide the first significant test of element homogeneity within a single chondritic particle. To compare L2003*E to the other two particles we have weighted the element abundances in proportion to our best estimate of the relative masses of the three fragments (Bulk L2003*E = 3x(frag. A) + 1x(frag. B) + 1x(frag. C)).

CI normalized element abundances for the three chondritic particles are shown in Figure 1. The patterns observed in L2001*D and L2003*D are quite similar to each other, including a large enrichment in Mn over the CI value (by factors of 3.9 and 3.2 respectively). L2003*E is distinctly different from the other two, showing a dramatic depletion in Ca (0.05 x CI). All three particles show the Br enrichment previously seen in almost all other chondritic particles analyzed (2).

The results of the individual fragment analyses on L2003*E are given in Table I. Most elements are within a factor of two of the particle mean in all three fragments, and they exhibit either consistent enrichment or depletion. Zn is the exception, being depleted to 0.5xCI in fragment A and enriched in the other two fragments. The Ca depletion is consistent among the three fragments. Br is relatively uniform among the three fragments.

Chondritic particles appear to be easily recognized by their Fe to Ni abundance ratios, which are generally within a factor of 3 of the CI value of 17. This single measurement provides an efficient screen to select particles which are likely to exhibit chondritic major, minor and trace element abundance patterns, though it will also include a few Al-rich non-chondritic particles (2, 3). This screening procedure would miss low-Ni particles exhibiting chondritic major element abundance patterns but non-chondritic trace element patterns.
Compositions of Large Area Collector Particles

Flynn, G. J. and Sutton, S. R.

similar to igneous material (2).

**Non-chondritic Particles:** Three other particles, L2001*E, L2001*G, and L2002*C, were observed to be opaque in transmitted light but highly reflective in coaxial reflected light. These particles were dominated by Fe and Zn among our detectable elements. Br was observed in only one of these (L2002*C) which also was the only one to contain other volatiles such as S, K and Pb. If the objective is to pick chondritic particles, particles of this type can be discriminated against by examining the collector surface in coaxial reflected light. L2001*C contained mainly Cu and Cr with minor amounts of Fe, Zn.

Thus, 40% of the particles studied here appear to be “chondritic”. Since the total number of particles was small, it is difficult to use these initial results to infer the true overall proportion of such particles in the large area collection.

**References:**

Table I

**Element Abundance/CI Element Abundance in 3 Fragments of L2003*E**

(data are normalized to CI Fe)

<table>
<thead>
<tr>
<th>Fragment</th>
<th>S</th>
<th>Ca</th>
<th>Ti</th>
<th>Cr</th>
<th>Mn</th>
<th>Fe*</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
<th>Ga</th>
<th>Ge</th>
<th>Se</th>
<th>Br</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.32</td>
<td>.03</td>
<td>1.5</td>
<td>1.7</td>
<td>.67</td>
<td>1.0</td>
<td>.94</td>
<td>0.50</td>
<td>1.3</td>
<td>.87</td>
<td>1.0</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>.91</td>
<td>.11</td>
<td>1.3</td>
<td>1.8</td>
<td>.52</td>
<td>1.5</td>
<td>.65</td>
<td>1.5</td>
<td>0.3</td>
<td>.47</td>
<td>.17</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>.49</td>
<td>.03</td>
<td>1.4</td>
<td>4.5</td>
<td>.50</td>
<td>1.9</td>
<td>.58</td>
<td>2.3</td>
<td>1.0</td>
<td>.41</td>
<td>.67</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1:** CI-normalized element abundances for three chondritic LAC particles. The data for L2003*E are weighted-averages of the results for its three fragments based on optical estimates of their relative volumes.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System