TRACE ELEMENT COMPOSITIONS OF INTERPLANETARY DUST AND TERRESTRIAL PARTICLES COLLECTED FROM THE STRATOSPHERE;

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INTRODUCTION: Trace element compositions have been previously determined for a small set of interplanetary dust particles (IDPs) [1,2,3]. The first order conclusion is that IDPs are similar chemically to CI or CM carbonaceous meteorites, the volatile elements being the notable exceptions. Enrichments relative to CI composition have been observed for Ga, Ge, Zn, Se and Br. Perhaps most significant are the generally large enrichments in Br which have been observed up to about a factor of 40. The origins of these volatile enrichments remain to be demonstrated. Inherent cosmochemical signatures, stratospheric contamination and collection/handling contamination are among the possible interpretations.

We have performed additional measurements on a variety of stratospheric particles using synchrotron fluorescence analysis (SXRFA). Additional analyses of cosmic class particles are being pursued to obtain a more representative database and to extend the capabilities to other elements. The question of terrestrial contamination is being addressed with measurements on *terrestrial* particles collected from the stratosphere- particles classified as TCA (artificial) or TCN (natural) plus aluminum oxide spheres (AOS). An absence of volatile enrichments in these particles would favor a cosmochemical interpretation of the enrichments observed in cosmic particles.

EXPERIMENTAL TECHNIQUES: The x-ray microprobe (XRM) at the National Synchrotron Light Source, Brookhaven National Laboratory, uses synchrotron radiation as the excitation source for x-ray fluorescence analyses of trace elements with high spatial resolution [4]. A tungsten, double-pinhole collimator [5] was used to produce an x-ray beam 40x18 micrometers in size. The beam could be reduced in size down to about 15x15 micrometers by rotating the collimator thereby adjusting its apparent aperture. A Klinger translation and rotation stage allowed 1 micrometer specimen movements. Samples were analyzed in air with a Si(Li) energy dispersive detector at 90 degrees to the incident beam. A 170 micrometer Al filter was used on the detector for Fe-rich particles to suppress the intense K fluorescence. A major improvement was the incorporation of a Nikon Optiphot petrographic microscope with transmitted and reflected light capabilities which allowed easy positioning of the 10 micrometer particles in the synchrotron beam. The XRM has now been installed on beamline X26A, a recently completed beamline whose experimental area is twice as close to the source as that of the previous beamline used (X26C). The resulting increase in flux improved elemental sensitivities by about a factor of 2. Acquisition times were typically 20-30 minutes. Using a combination of filtered and unfiltered detection systems, SXRFA is now capable of providing concentrations in 20 micrometer IDPs for virtually all elements between S and Mo (Z= 16 to 42).

Analytical procedures were similar to those used previously for stratospheric particles [1]. Particles were transferred with silicone oil from the JSC shipping slides onto 7 micrometer thick Kapton ($C_{22}H_{10}N_2O_5$) within a Class 100 clean room. The Kapton and silicone oil yield negligible fluorescence signals during the analyses. X-ray spectra were reduced using STRIP. Elemental concentrations for "chondritic" particles were calculated using the NRLXRF routine modified to perform standard-less analyses based on the known concentration of a major element [6]. Concentrations for the other particles used the chondritic particle spectra as standards with matrix corrections obtained from the prediction mode of NRLXRF.

RESULTS:Chondritic Particles: Four cosmic class particles were analyzed: W7013-A11 (20 μm) and H17 (15 μm), W7027-C5 (30 μm) and U2022-G17 (12 μm). CI-normalized abundances are shown in the figure. The enhanced sensitivity has allowed us for the first time to determine the concentrations of Rb, Sr, Y, Zr, Nb and Mo in an IDP. The Br enrichments in these four particles ranged from 1.3 to 38, consistent with the range previously observed. **Aluminum Oxide Spheres (AOS):** Two AOS kindly supplied by D. Brownlee (AOS 87, B1 and B2) were analyzed. These spheres were mounted by Brownlee on carbon film suspended over a Be grid and the synchrotron measurements were done in this configuration. No Br was detected in these spheres. The analyses were somewhat complicated by the trace levels of some elements in the carbon itself, notably Fe, Ni, Cu, and Zn (Fe/Ni=2.2). A first order correction for the carbon component was made by subtracting a carbon spectrum taken under identical conditions to the sphere spectra. Ni fluorescence in the sphere spectra were essentially equivalent to that detected from the carbon film so that only lower limits of 200 for the Fe/Ni ratio in the spheres were obtained. **Other Terrestrial Particles:** Three particles classified as TCN were analyzed: W7013-A1, B1 and B11. Such particles are valuable in constraining contamination by stratospheric aerosols and the collection process. The first two of these particles are aluminosilicates while B11 gave comparable levels of Na, Si, S and K in the JSC spectrum. The Br contents were 10, 50, and <10 ppm, respectively.

DISCUSSION: The composition of the most precise analysis for a cosmic class particle (W7027-C5) is consistent with our previous result for U2022-G1. Elements from Cr to Se have abundances within a factor of 1.7 of CI whereas Br is enriched (a factor of 4 in this case). The contents of Rb, Sr, Y, and Zr in W2027-C5 are within about a factor of 2 of CI. Nb and Mo are greater than CI by factors of 27 and 7, respectively. Br enrichments range from 1.3 to 38 for the four C class particles, again consistent with previous observations. Significant is the fact that the IDP with the highest Br is also the most enriched in Mn, Cu and Zn (U2022-G17). Yet, no strict correlation exists between Br content and the contents of other volatiles such as Zn.

The absence of Br in the AOS suggests that the element is not strongly adsorbed in the stratosphere. Chlorine and sulfur in three stratospheric particles (2 terrestrial and 1 cosmic) were observed using a Scanning Auger Microprobe (SAM) within a 100 Angstrom thick surface layer [7]. Thus, Br is apparently not strongly concentrated relative to chlorine in this way. Yet, it can be argued that the surfaces of AOS are unlike those of IDPs. The TCN particles are better analogies and high Br was observed in one of the three analyzed here. Volcanic effluents can be halogen-rich so that volcanic TCNs may be naturally enriched. Mineralogic data on the Br carrier in these particles would be useful in understanding the origin of Br in the IDPs.

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