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Zinc Content as an Indicator of the Degree of Entry Heating of Interplanetary Dust Particles

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Beamline(s): X26A

Introduction: Some interplanetary dust particles (IDPs), small fragments of comets and asteroids collected from the Earth's stratosphere by NASA aircraft, may be the most primitive material available for laboratory study. But IDPs are heated, some only moderately but others more extremely, during atmospheric deceleration. Thus, it is necessary that secondary alterations to these particles, such as those caused by entry heating, are well understood so that they can be distinguished from primordial features. In addition, several researchers have pointed out that the connection between the degree of frictional heating and entry velocity may allow identification of IDPs from high speed source objects, particularly comets [e.g. FLYNN, 1989]. Thus, understanding atmospheric entry heating and establishing ways to identify heated particles is a critical problem in IDP research. Heating indicators based on the concentrations of volatile trace elements are particularly attractive because such elements can be measured non-destructively using X-ray fluorescence spectroscopy.

Methods and Materials: Nier and Schlutter [1993] have shown that solar wind He, implanted in IDPs during their time as small particles in space, is removed by atmospheric entry heating. Both the He-content and the He release temperature in an IDP indicate the degree of heating experienced by that IDP. But this He measurement is destructive. We measured the trace element compositions, using the X-Ray Microprobe on Beamline X26A, and the noble gas contents, using a mass-spectrometer at Washington University, of 32 individual IDPs collected from the Earth's stratosphere. The trace element compositions of the IDPs were generally similar to the primitive CI-type meteorites, which are believed to represent the bulk Solar System composition. But some IDPs are significantly depleted in Zn/Fe with respect to CI, which Flynn and Sutton [1992] suggested might serve as an internal heating indiator.

Results: All 32 of the IDPs analyzed had trace element contents similar to the CI-meteorite abundances, but about one-half showed significant underabundances (by an order-of-magnitude or more from the mean IDP abundance) of Zn. Noble gases were detected in all but one of the IDPs. These noble gas elemental compositions were consistent with the presence of fractionated solar wind. We found a rough correlation between surface-normalized He abundances and Zn/Fe ratios: Zn-poor particles generally have lower He content than the other IDPs.

Conclusions: These results indicate that both Zn and He were lost by frictional heating during atmospheric entry and confirms the view that Zn can serve as an entry-heating indicator in IDPs. Because the Zn content of an IDP can be measured non-destructively, using an x-ray microprobe, these measurements provide an important, non-destructive screening technique to separate IDPs that experienced severe atmospheric entry heating from less severely heated IDPs.

References: FLYNN G.J. [1989] Atmospheric entry heating: a criterion to distinguish between asteroidal and cometary sources of interplanetary dust. *Icarus* **77**, 287-310.

FLYNN G.J. AND SUTTON S. R. [1992] Trace elements in chondritic stratospheric particles; zinc depletion as a possible indicator of atmospheric entry heating. *Proc. Lunar Planet. Sci. Conf.* **22nd**, 171-184.

NIER A.O. AND SCHLUTTER D.J. [1993] The thermal history of interplanetary dust particles collected in the Earth's stratosphere. *Meteoritics* **28**, 675-681.

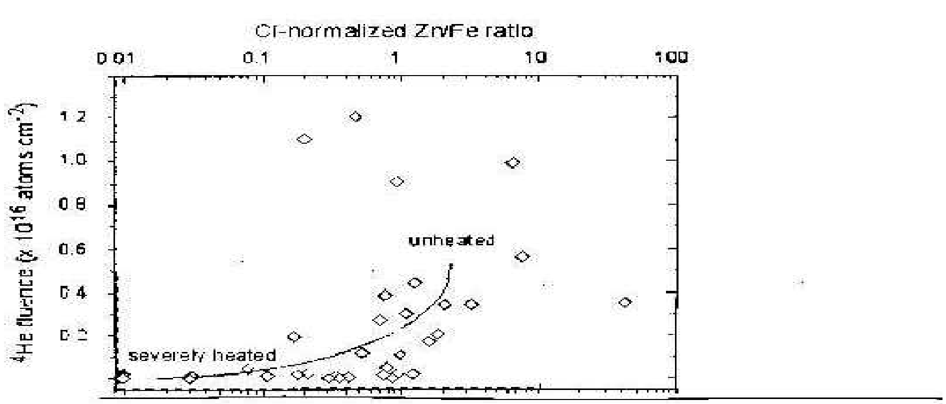

Figure 1: Zn/Fe ratio versus He content for 32 IDPs analyzed by X-ray Microprobe and noble gas mass spectrometry.