PROTON INDUCED X-RAY EMISSION (PIXE) ANALYSIS OF METEORITIC MICROSAMPLES

R. Wallenwein, H. Blank, E.K. Jessberger, K. Traxel
Max-Planck-Institut für Kernphysik
Postfach 10 39 80
6900 Heidelberg
W. Germany

ABSTRACT. Interplanetary dust particles (IDPs) collected in the stratosphere are thought to be mostly of cometary origin. They survived heating during their deceleration in the earth's atmosphere (1). Because of their small size (< 50 μm) and mass (< 10^{-7}g) they are difficult to analyse. Special preparation and examination methods have been developed for their investigations (2). We set out to study the trace-element-composition of these particles using the Heidelberg proton microprobe.

At Heidelberg a proton microprobe has been constructed with a beam spot of $\geq$ 2 μm x 3 μm and has been successfully used for the quantitative analysis of trace elements in minute (10 μm^3) inclusions in lunar materials and meteorites (3). We reported on exploratory studies of the applicability of this microprobe for the trace element analysis of IDPs. First test measurements were made on thick meteoritic samples. These samples consist of material from the meteorites Hallingeberg and Allegan, which was ground to nominally less than 1 μm grain size and subsequently compacted with high pressure. The reason for choosing that material was that we expected chemical uniformity on a very small scale. We took as standard Lunar Analog Glas, containing 13 elements of different concentrations. The agreement between the PIXE results and the bulk analysis of the meteorites is quite satisfactory within an error rate of 10%.

For further comparing tests we used individual particles of the carbonaceous chondrite Murchison. The particles were mounted on a thin (200-300 Å) carbon foil held by a nickel grid. We analysed a total of ten particles with a typical diameter of about 20 μm and determined their elemental composition. We found discrepancies to the values from bulk Murchison. However, we want to mention that the bulk analysis done by Jarosewich was performed with 40g of the Murchison meteorite.

The next step will be to use PIXE for minor element analysis and also to analyse real IDPs. We set out to produce some thin standards with our ion implantation equipment for further measurements.

ACKNOWLEDGEMENTS: We thank K. Fredriksson for the Hallingeberg and

R. H. Giese and P. Lamy (eds.), Properties and Interactions of Interplanetary Dust, 157–158.

Allegan pellets, E. Zinner for the preparation of the Murchison samples, G. Lange and D. Maas for advice and help.

REFERENCES

(1) - F.L. Whipple, Proc.Nat.Acad.Sci. USA 37, 19, 1951.
(2) - D.E. Brownlee, Microparticle studies by sampling techniques, Cosmic Dust, p. 295-336, Wiley, New York, 1978.
- G.J. Flynn, P. Fraundorf et al., Chemical and structural studies of "Brownlee" particles, Proc.Lunar Planet.Sci.Conf. 9th, p. 1187-1208, 1978.
- P. Fraundorf, Microcharacterization of interplanetary dust collected in the earth's stratosphere, Dissertation Washington University, St. Louis, Missouri, 1980.
- P. Fraundorf, Interplanetary dust in the TEM, Geochimica et Cosmochimica Acta, Vol. 45, p. 915-943, 1981.
(3) - The Heidelberg Proton Microprobe, Nucl.Sci.Appl., Vol. 1, p. 33-55, 1980.
- H. Blank, Spurenelemente in koexistierenden opaken Oxyden lunarer Gesteine gemessen mit einer Protonenmikrosonde, Dissertation University of Heidelberg, 1982.