ISOTOPE STUDY OF INTERPLANETARY DUST PARTICLES FROM FIVE DUST COLLECTIONS

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Introduction: Knowing the distribution of volatiles and noble gases is important to understand origin, accretion and transport of early solar system matter. Comets may have delivered noble gases to the terrestrial planets [1], but the cometary inventory is only rarely examined [2,3]. Cometary IDPs may offer additional insights. However, their origin can be inferred only indirectly [4,5]. IDP collection during Earth's passage through a cometary dust stream increases the probability to examine dust of a known source [4]. In our previous study, Xe was detected exclusively in IDPs collected during encounters with the comet Grigg-Skjellerup dust stream ("GSC", collectors L2054) [6].

Here we present new textural and isotope observations of 13 IDPs from encounters with the GS and Schwassmann-Wachmann 3 (L2009/11 [7]) dust streams and non-specific collections (L2008/36). This will allow us to link the potential detection of Xe to specific dust streams, degree of primitiveness of IDPs and ultimately to carriers and origin of trapped cometary noble gases.

Experimental: The IDPs were examined with ESEM/EDX for rough elemental and textural classification. H, C, N and O isotopic compositions were mapped (NanoSIMS, Carnegie Institution) at a spatial resolution of ~150-300 nm [8]. Xenon is currently being measured with high-sensitivity resonance mass spectrometry ("RELAX", Manchester [6,9]).

Results and discussion: The IDPs cover a wide range of textures from chondritic porous (large bulk and hotspot δD, $\delta^{15}N$ and C/H values, indicating abundant, possibly protosolar organic matter (OM)) to chondritic smooth and FeNiS-rich compositions (no D and ^{15}N enrichments). Two GSC-IDPs from L2054 Cl(uster) 4 and 5 are Al-rich and have low δD values. They are not spherical and similar to the potentially Xe-bearing GSC-IDPs [6]. High Fe-Ni and detection of some Si suggest that these IDPs are unlikely to be rocket fuel contaminants.

An L2036 Cl20 IDP shows the highest bulk δD (3100‰) and $\delta^{15}N$ values (630‰). However, a GSC-IDP shows the highest $\delta^{15}N$ hotspot (1800‰), illustrating that ^{15}N and D enrichments can be decoupled. The most extreme D-rich hotspot (20000‰) is in an individual L2008 IDP. Several presolar grains were found based on their anomalous O isotopic composition. An L2009 Cl5 IDP shows magnetite and isotopically normal OM, but also a group 2 presolar grain, suggesting that pristine OM might have been altered by heating during atmospheric entry.

We do not find discrepancies between chondritic porous GSC-IDPs and other IDPs [8]. Candidate IDPs for the detection of Xe are those with the highest abundances of D, ^{15}N and presolar grains (L2036 Cl9/20, L2008 L7, L2054 Cl5) but also the Al-rich GSC-IDPs (L2054 Cl4/5) that resemble the IDPs found to contain Ne (R. Palma, personal. comm.), and possibly Xe [6].

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