TRAPPED XENON IN INTERPLANETARY DUST PARTICLES AND ANTARCTIC MICROMETEORITES.

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Introduction: Interplanetary dust particles (IDPs) and Antarctic Micrometeorites (AMMs) constitute most of the extraterrestrial material delivered to Earth. IDPs have some unique characteristics compared to chondrites, and therefore many are assumed to represent cometary materials [1]. AMMs may also sample cometary material, with some fine-grained AMMs resembling CM and CR chondrites [2-3]. Other 'fluffy,' and ultra-carbonaceous types (UCAMMs) are similar to IDPs [4]. Comet Wild 2 dust shares similarities with IDPs, AMMs and chondrites, supporting the concept of a continuum between asteroidal and cometary material [5-6]. With sizes typically 5-200 µm, studies of trace elements such as noble gases are challenging. Here we report the first Xe measurements above-blank in individually measured IDPs, which provide further indication of mixing of precursor materials in the early solar system.

Experimental: 12 IDPs were initially examined by electron microscopy, Raman spectroscopy and NanoSIMS isotope mapping to search for pristine, possibly cometary characteristics (disordered and isotopically anomalous organic matter, abundant presolar grains and GEMS [7-9]). 14 small fragments of new and previously studied AMMs [10] were only briefly optically examined. Xenon was measured using the resonance-ionization mass spectrometer RELAX by laser step-heating.

Results and Discussion: In spite of their small mass (0.4 - 8.0 ng), three IDPs showed ^{132}Xe above the detection limit in the order of several 1000 atoms. One IDP is “ultra-carbonaceous”, (~50 wt% C), another chondritic-porous (12 wt% C) and both contain H and N isotope anomalies. The isotopic composition is consistent with trapped Q, air or solar wind Xe, but there is not sufficient precision to discuss the origin of the Xe. The Xe concentrations in the IDPs are extremely varied; from 1.7×10^{-8} to 2.5×10^{-7} cm^3/g. In view of the short lifetime of IDPs, their limited residence in the inner solar system and shielding effects within cluster particles, the results are inconsistent with solar wind exposure. Moreover, if we infer the ultra-carbonaceous IDP is composed of ~40 % insoluble organic matter (IOM), which contains all Xe, the Xe per g IOM in the IDP is comparable to that found in residues of CM2 Cold Bokkeveld or LL3 Semarkona [11-12].

The most gas-rich IDP reveals a factor of two higher Xe concentration than expected, possibly representing some heterogeneity among IDPs, similar to those found in meteorites. Our results provide further indication that although chondrites contain lower concentrations of IOM than IDPs and most AMMs, the Xe-Q carrier is uniformly distributed amongst organic material.

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