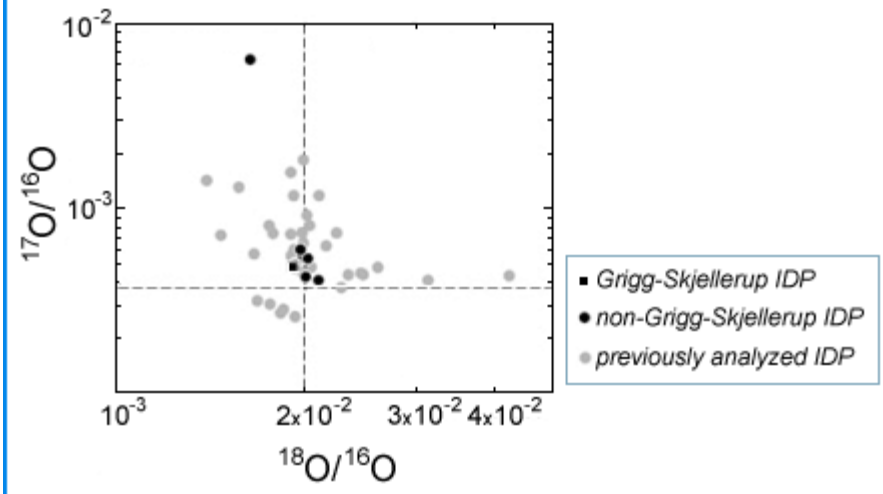
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks
Quick Views of Big Advances

Studying the Most Primitive Extraterrestrial Dust

Interplanetary dust particles (***IDPs***), while tiny, are big, premier-league players when it comes to revealing information about the starting materials of our Solar System. These 5–25 micrometer-sized particles, likely from comets, are considered chemically "primitive" in the sense that they were subjected to minimal secondary processing (likely altered by water but not by heat) and contain isotopic anomalies.

Collected in the stratosphere by specially-designed collectors on NASA aircraft (see PSRD article ***A New Type of Stardust***), most IDP collections are made at random times, yet one flight in the spring of 2003 was dedicated to collecting IDPs specifically from the dust stream of comet 26P/Grigg-Skjellerup. A study comparing IDPs from the Grigg-Skjellerup collection and IDPs from untargeted collections is reported by Jemma Davidson (formerly at The Open University, UK and now at the University of Hawai‘i) and colleagues from the Open University and University of Manchester. Their painstaking work using the high-tech instruments capable of analyzing µm-sized grains reveals details of the isotopic compositions (such as oxygen, nitrogen, carbon, hydrogen), elemental compositions, presolar grain abundances, and organic matter in this remarkable dust.

Oxygen Isotopic Compositions of Presolar Silicates in Interplanetary Dust Particles



(From Davidson, *et al.*, 2012, *Meteoritics & Planetary Science*, v. 47(11), p. 1748-1771, doi: 10.1111/maps.12010.)

Ratios of oxygen-17 and oxygen-18 to oxygen-16 allow presolar grains to be distinguished from typical solar system materials (solar values are indicated by the dashed lines). The black data points are presolar silicate grains from the IDPs analyzed by Davidson and colleagues; they are within the ranges previously reported—the grey points are data from previous work by other researchers. 1σ errors are smaller than the symbols. One silicate (uppermost data point) appears to be the most oxygen-17-rich silicate reported in an IDP to date and one of the most oxygen-17-rich silicates reported in any extraterrestrial material.

Davidson and colleagues used MicroRaman spectroscopy and the NanoSIMS ion microprobe during their analysis of 10 fragments from cluster IDPs; three from the Grigg-Skjellerup collection and seven that are not associated with any known extraterrestrial dust stream. They determined the spatial distributions of the H, C, N, O, and Si isotopes and assessed the presolar grain inventory (SiC, graphite, silicates, oxides) in the IDPs. They found one silicate grain to be the most ^{17}O-rich silicate ever reported in an IDP and one of the most ^{17}O-rich silicates reported in *any* extraterrestrial material to date (see graph). It has been identified as a possible ***GEMS***. The organic matter in this collection of IDPs is disordered, meaning there are structural defects in the mineral lattice, suggesting it is primitive insofar as not heated significantly on the parent bodies or during entry in Earth's atmosphere. Davidson and coauthors give evidence for the primitive nature of the IDPs citing the anomalous bulk and

hotspot/coldspot isotopic compositions, disordered character of organic matter, presolar grain abundances and distribution, and the textures of the IDPs. Ultimately, they did not find differences to distinguish IDPs from the Grigg-Skjellerup collection and IDPs from untargeted collections; yet it was a small sample set of even smaller particles. Their work on these IDPs—some of the most pristine Solar System components available for scrutiny in the laboratory— moves forward the science of cosmochemistry and the exciting work on the very building blocks of our Solar System.

See:

· Davidson, J., Busemann, H., and Franchi, I. A. (2012) A NanoSIMS and Raman Spectroscopic Comparison of Interplanetary Dust Particles from Comet Grigg-Skjellerup and non-Grigg Skjellerup Collections, *Meteoritics & Planetary Science,* v. 47(11), p. 1748-1771, doi: 10.1111/maps.12010. [***abstract***]

Also:

· ***NASA Curation Site***: Targeted sample collections during the 2003 crossing of Comet Grigg-Skjellerup.
· **PSRD** article ***A New Type of Stardust***.

Written by Linda M. V. Martel, Hawai‘i Institute of Geophysics and Planetology, for ***PSRD***.

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http://www.psrd.hawaii.edu

psrd@higp.hawaii.edu