ISOTOPIC AND RAMAN ANALYSES OF LOW-DENSITY ORGUEIL CARBON GRAINS.

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Introduction: We present isotopic and Raman-spectroscopic data for 20 low-density presolar grains from the OR1d (size>1μm, ρ=1.75-1.92 g cm^{-3}) size/density separate of the Orgueil CI chondrite [1]. OR1d contains substantial insoluble organic material (IOM) of solar composition, from which the grains must be physically separated via micromanipulation prior to analysis. Some IOM coating may remain on a grain's surface, yielding isotopic compositions that are less anomalous than the true values. Correlated SEM and isotope images allow us to locate uncoated areas on the grains from which we may infer their true isotopic compositions.

Results: We measured $^{12,13}C$, $^{14,15}N$, $^{16,18}O$, $^{28,29,30}Si$, $^{24,25,26}Mg$, and ^{27}Al isotopes with the NanoSIMS. Inferred $^{26}Al/^{27}Al$ ratios in 10 grains are between 0.012 and 0.45, in the range of SiC X grains [2]; additional ^{18}O excesses in these grains confirm their supernova origin. 18 grains have ^{15}N excesses. $^{12}C/^{13}C$ ranges from 7 to 306, with 9 grains being isotopically heavy, 5 isotopically light, and 6 of solar composition.

N and O isotope images of 6 grains reveal regions of large isotopic anomalies amidst regions of roughly solar composition. From SEM images we may verify the presence of IOM adhered to the grains' surfaces. Four grains with $^{16}O/^{18}O$ ratios of 162, 169, 304, and 139, all highly enriched in ^{18}O with respect to solar, showed regions of much more extreme ^{18}O enrichment with $^{16}O/^{18}O$ of 6, 14.4, 40, and 9, respectively, in the ion images. The whole-grain $^{16}O/^{18}O$ ratios differ by 1-2 orders of magnitude from the ratios in uncoated areas of the grains. ^{16}O and ^{18}O concentrations are spatially anti-correlated in one grain, implying that low $^{16}O/^{18}O$ regions are representative of the uncoated grain, while solar-valued regions must be IOM on the surface. $^{14}N/^{15}N$ values also correlate with the presence of IOM (whole grain:uncoated area): (141:20), (256:27), (209:30), (261:111) in the same four grains.

There exists a correlation between Raman and isotopic data. Based on 1st and 2nd order Raman spectra [3], 11 grains are Allende-type (i.e., glassy carbon), 3 are graphitic, and 6 are kerogen-type [4]. All grains with unambigous SN signatures were found to have Allende- or graphitic Raman spectra. Kerogen-type grains all have isotopically normal C and O, but generally have excesses in ^{15}N.

Discussion: Whole-grain isotope ratios of OR1d carbon grains represent lower limits of isotopic anomalies due to the presence of solar-composition IOM on the grains' surfaces. Isotope images allow us to distinguish between regions covered with IOM and those of the true grain, helping us determine the isotopic composition without sputtering too much of the grain away. These grains will be ultramicrotomed for subsequent Raman, TEM, XANES and NanoSIMS analyses of their interiors, therefore preserving as much of the grain is of utmost importance.

References: [1] Jadhav M. et. al. 2006. *New Astronomy Reviews* 50:591-595. [2] Zinner E. et al. 2010. *Proceedings of Science* (NIC XI) 148. [3] Wopenka B. et al. This conference. [4] Wopenka B. et al. 2011. *Lunar and Planetary Science Conference XLII*. Abs. # 1162.