

CHEMICAL HETEROGENEITY OF ORGANIC MATTER IN MINIMALLY-HEATED CO CHONDRITES.

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Introduction: The CO parent body experienced significant thermal metamorphism, but not pervasive aqueous alteration. As a result, CO meteorites exhibit a range of petrologic types >3.0. Insoluble organic matter (IOM) in these chondrites was not homogenized by aqueous processing and may better preserve signatures of pre-accretionary organic precursor material, if robust to thermal metamorphism.

Methods: IOM from five CO chondrites (DOM 08006, ALHA 77307, DOM 03238, MIL 05013, DOM 10104, and MIL 090010) with petrologic types between 3.00 and 3.2 [1] were embedded in S and microtomed. XANES characterization of 80 nm thick samples was performed at beamline 5.3.2.2 at the Advanced Light Source (ALS), while 30 nm thick samples were characterized with an aberration-corrected Nion UltraSTEM 200 operated at 60 keV, equipped with a Gatan Enfium ER EELS spectrometer and a Bruker windowless SDD X-ray spectrometer.

Results: XANES spectra from bulk IOM show increasing proportion of aromatic C=C bonding with increasing petrologic type, and a corresponding decrease of C=O functional groups [2]. For all samples, an excitonic peak at 291.6 eV is absent, which indicates that pervasive graphitization did not occur.

Sulfur-rich IOM. All samples contained large (1-5 μm) fragments of IOM with a dense, compact texture, in addition to the typical "fluffy" texture of bulk IOM. Both XANES and EELS of the compact IOM reveal a distinct functional group chemistry from that of the fluffy IOM, with a lower proportion of aromatic C=C bonding and a greater abundance of C=O functionality. EDS mapping reveals S contents in the compact IOM up to 10 at. %. S-EELS analyses of this material suggest that the S atoms are bound in aromatic ring structures. However, comparison with S-bearing organic standards indicates that the major peaks in C-EELS and C-XANES spectra are still characteristic of C=O bonding rather than C-S bonding. The large size of the compact, S-rich IOM fragments suggests that they formed on the CO parent body, perhaps through interaction of IOM precursor material with sulfides.

Nanoglobules. The majority of nanoglobules previously measured in CO chondrites have a more aromatic organic chemistry than bulk IOM [2,3]. New data from an additional 22 out of 24 nanoglobules also show enhanced aromatic C=C. Some unusual nanoglobule chemistries were revealed by aberration-corrected STEM, including 5-15 nm N-rich rims in DOM 08006 (previously observed in a primitive CR chondrite [4]) and an unusual S-rich nanoglobule in DOM 03238.

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References: [1] Davidson J. et al. 2014. Abstract #1384. 45th Lunar & Planetary Science Conference. [2] De Gregorio B. T. et al. 2015. Abstract #1384. 45th Lunar & Planetary Science Conference. [3] De Gregorio B. T. et al. 2013. *Meteoritics & Planetary Science* 48:904-928. [4] Vollmer C. et al. 2014. *Proceedings of the National Academy of Sciences* 43:15338-15343.