

DISTRIBUTION OF ORGANIC MATTER AT THE NANOSCALE IN THE MATRIX OF MET 00426 (CR 3.0) AND ITS RELATIONSHIP WITH OXYSULFIDES

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Introduction: Organic matter (OM) in chondritic meteorites provides important insights into the complex processes that occurred in the interstellar medium and solar nebula prior to accretion as well as postaccretionary parent body processes such as aqueous alteration and thermal metamorphism. However, the origin of OM remains unclear and interstellar [1], as well as nebular [2] and parent body formation mechanisms [3] are all plausible. To better understand the role of parent body processes to the formation of OM, we have conducted a FIB-TEM study, focused on the distribution and phase relationship of OM in the matrix of the CR chondrite MET00426. [4] showed that its matrix consists of amorphous Fe-rich silicate and sulfides, with a small amount of phyllosilicates. It is currently the least altered CR described (CR 3.0) and thus represents a unique opportunity to observe *in situ* OM in a matrix that has been affected by minimal aqueous alteration or thermal metamorphism.

Results and Discussion: We extracted 10 FIB sections from several different regions of MET00426 matrix, to address the heterogeneity of OM distribution. The largest OM grains are about 500 nm in size, and HRTEM shows randomly oriented lattice fringes shorter than one nanometer. To a first order, all the FIB sections are similar in terms of OM distribution and carbon content, which is estimated to be about 0.4 ± 0.1 wt. % in agreement with bulk values [5]. These observations suggest that OM is homogeneously distributed at the micron scale in this meteorite.

The FIB sections reveal a broad diversity of organic grain morphologies. In addition to carbonaceous nanoglobules, we observe porous aggregates with rounded shapes that can be connected to cracks, and much finer-grained material distributed around sulfide grains, all occurring together in the same section.

Remarkably, in most sections, the main mass of the organic grains is in close contact with an irregularly-shaped oxysulfide phase containing Fe, Ni, S, O, probably tochilinite (< 500 nm). HRTEM indicates that this phase is formed by hydration/oxidation of sulfides, a chemical pathway never described before which may release H₂S and favor sulfur mobility.

The systematic association of hydrated oxysulfides and organic grains either implies that: (i) water was accreted as composite H₂O ice/organic grains, which melted. Liquid water then reacted with sulfides to form tochilinite on a localized scale. This would support the origin of some organics by preaccretionary UV photolysis on water ice grains. Or; (ii) insoluble organic matter (IOM) was transported by, if not formed in water, during the first stages of aqueous alteration and concentrated next to the alteration products. This would support the parent body *in situ* formation of IOM proposed by [3]. However, none of these mechanisms is exclusive, but the diversity of morphologies tends to favor mixing of OMs from different origin.

References: [1] Floss C. and Stadermann F. 2009. *Aph. J.* 697:1242-1255. [2] Remusat et al. 2010. *Aph J.* 713: 1048-1058. [3] Cody G. 2009. #2325. 40th Lunar & Planetary Science Conference. [4] Abreu N. M. and Brearley A. J. 2010. *GCA* 74:1146-1171. [5] Alexander C. M. O'D et al. 2007. *GCA* 71:4380-4403.