CARBONS IN ACAPULCO AND LODRAN AT THE NANOSCALE: COMPARISON WITH EXPERIMENTAL ANALOGS.

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Introduction: Acapulcoites and Lodranites (A-L) are very primitive partially differentiated objects and can bring essential insights on planetesimal accretion and differentiation within the first 1-2 Myr of the solar system [1]. Here, we study the origin and evolution of carbons in A-L as tracers of early differentiation stages. The study is focused on the relationship between carbons and Fe-based metal. We coupled, on the same micrometer-sized grains, structural characterization by Raman µspectrometry and mapping and High Resolution TEM on Focused Ion Beam (FIB) sections. The carbon phases of A-L are systematically associated with metal and are partially graphitized [2]. In order to show the possible catalytic role of iron on the graphitization, experimental analogs have been produced using blends of 10% saccharose-based chars analogous to the insoluble organic matter (IOM) of chondrites and 90% iron powder, heated between 650 and 1600°C and compared to carbons in Acapulco and Lodran.

Results: Raman spectra corrected from polishing effects reveal as strong structural heterogeneity at the micrometer scale (defect bands of various intensities). Raman mapping shows that carbons in contact with metal are more graphitized, suggesting a catalytic effect of metal on the graphitization of organic matter, thus allowing formation of graphite at temperature < 1200°C. Experimental analogues completely reproduce the range of structural heterogeneity and relationships with metal observed in Acapulco and Lodran.

HRTEM results specify iron-carbon interactions from the micrometer to the nanometer scales. Again micro- and nano-structures observed in Acapulco and Lodran are correctly reproduced in our pyrolysis experiments. Furthermore, the degree of order of carbons and the morphology of metal nano-inclusions in carbons suggest different mechanisms of graphitization as a function of temperature. At low temperature (650°C), iron diffusion is limited (solid-solid interactions) and mesoporous turbostratic carbons and carbides can be formed. At higher temperature, iron becomes liquid and its diffusion is favored. In both cases ‘catalytic’ graphitization is favored by the presence of iron and *sensu stricto* graphite can be obtained at temperatures as low as 1200°C.

Conclusion: Our experimental study shows that carbon structural heterogeneities in Acapulco and Lodran meteorites result from the catalytic graphitization by Fe-Ni metal of an organic precursor having the typical structure of chondritic IOM and probably not from the preservation of preaccretionnal heterogeneities [3].

References: [1] Touboul et al. 2009, *EPSL*, Vol. 284, pp 168-178. [2] Charon et al. 2009, *Meteorit. Planet. Sci.* Vol.44, pp.A48. [3] El Goresy A. et al. 2005. *GCA* Vol.69. No18. pp. 4535-4556.