Organic matter evolution on asteroids: New clues from Paris

L. REMUSAT*, V. VINOGRADOFF, C. LE GUILLOU AND S. BERNARD

IMPMC, UMR CNRS 7590, Sorbonne Université, UPMC, IRD, MNHN, CP52-57 rue Cuvier, 75005 Paris, France
*email: remusat@mnhn.fr

The Paris meteorite is the least altered CM carbonaceous chondrite, as witnessed by the presence of unaltered metal grains and amorphous silicate, usually absent in CM chondrites [1]. Its O-isotopes are intermediate between altered CM and the thermally metamorphosed CO chondrites. Chondritic organics have most likely a multi-stage history that remains complex to disentangle, but Paris provides a unique opportunity to assess the specific role of parent body processes on their evolution. Therefore, we have studied the insoluble organic matter (IOM) of Paris and compared it to IOM from Murchison and other CMs. By focusing on a single chondrite group, we can rule out possible precursor influence that we encountered in a previous study of IOM in carbonaceous chondrites from different groups [2].

We obtained a "bulk" IOM of Paris by HF/HCl digestion of a large sample (>10g) of matrix isolated by the freeze-thaw method [1]. The bulk C, H and N-isotope compositions of Paris IOM fall among the heaviest CM chondrites. NanoSIMS images of H and N-isotopes reveal numerous hot spots. D-rich hot spots in Paris span the same range as in Murchison, however ^{15}N-rich hot spots are significantly heavier (mean value at 550‰, max at 1000‰), albeit lighter than in Bells [3]. The Raman signature points to a disordered material, similar to type 1 and 2 chondrites [4]. FTIR, XANES and NMR reveal that Paris is intermediate between CR2 and CM2 IOMs. In particular, they show that the aliphatic/aromatic carbon ratio is larger in Paris than in Murchison.

Overall, it appears that during aqueous alteration on the CM parent body, IOM underwent some degree of aromatization in addition to slight D/H decrease and a more significant ^{15}N-rich hot spot depletion. Coupled hydrous and thermal effects could explain this evolution. Paris IOM appears primitive with respects to other CM and could resemble to the organic matter that accreted on the CM parent body.

[1] Hewins *et al* (2014) *GCA* **124**, 190-222. [2] Le Guillou *et al* (2014) *GCA* **131**, 368-392. [3] Busemann *et al* (2006), *Science* **312**, 727-730. [4] Quirico *et al* (2009) *EPSL* **287**, 185-193.