PAHs, C clusters and fullerenes in meteorites

H. Sabbah[1, 2*], M. Carlos[1, 2], and C. Joblin[1]

[1] *IRAP, Université de Toulouse, CNRS, CNES, Toulouse, France*
[2] *LCAR/IRSAMC, Université de Toulouse, CNRS, Toulouse, France*

**Corresponding author e-mail address: hassan.sabbah@irap.omp.eu*

Most of our knowledge on the chemical composition and evolution of carbonaceous cosmic matter is based on astronomical observations. Solar System objects such as meteorites, interplanetary dust particles and samples from return missions have the advantage that samples can be measured or analyzed directly. Meteorites are the most available type of extraterrestrial material on Earth and are representative of the early solar system. Analysis of Murchison, the most studied carbonaceous chondrite, shows the extensive varieties of organics [1] (up of tens of thousands of different molecular species) in meteorites . However questions about the origins of these species remain hard to answer. Observing isotopic anomalies could help in the identification of their interstellar or proto-stellar origins.

Advances in the understanding of the meteoritic organic composition are tightly associated with improvements in analytical techniques. In this work, we present a new experimental setup called AROMA [2] (Astrochemistry Research of Organics with Molecular Analyzer). It has been developed in the framework of the Nanocosmos ERC synergy project to characterize the molecular content of cosmic dust analogues and meteorites samples. The experimental set-up consists of a microprobe laser desorption ionization source and a segmented linear quadrupole ion trap connected to an orthogonal time of flight mass spectrometer. The ion source offers the possibility to study large carbonaceous molecules such as polycyclic aromatic hydrocarbons (PAHs) and fullerenes as well as carbon clusters that are embedded in a variety of solid samples by performing Laser Desorption Ionization (LDI) in a single or/and double steps.

We demonstrate the potential of AROMA for the analysis of meteoritic samples. Hundreds of peaks are identified in the mass spectra with notable discrepancies across the different samples. These discrepancies provide clues on the chemical history of each sample and are not a bias of our analysis. A double bound-equivalent (DBE) method is applied to sort the detected carbonaceous molecules into families of compounds. The DBE is representative of the unsaturation level of the molecules and thus corresponds to a direct measure of their aromaticity [3]. It reveals in addition of PAHs, the presence of other populations such as mixed aromatic-aliphatic species, carbon clusters and fullerenes.

Acknowledgments: This work is supported from the European Research Council under the European Union's Seventh Framework Programme ERC-2013-SyG, Grant Agreement n. 610256 NANOCOSMOS.

References

[1] P. Schmitt-Kopplina, Z. Gabelicab, R. D. Gougeonc, A. Feketea , B. Kanawatia, M. Harira, I. Gebefuegia, G. Eckeld, and N. Hertkorn, *PNAS.* 2010, 107, 2763-2768.
[2] H. Sabbah, A. Bonnamy, D. Papanastasiou, J. Cernicharo, J. Martín-Gago, and Christine Joblin, *The Astrophysical Journal* 2017, 843, 34.
[3] A. G. Marshall, and R. P. Rodgers, *PNAS.* 2008, 105, 18090-18095.