Molecular Composition of Carbonaceous Globules in the Bells (CM2) Chondrite.

S. J. Clemett[1*], K. Nakamura-Messenger[2], S. Messenger, K. L. Thomas-Keprta[3], G.-A. Robinson[4] and D. S. McKay[5].
[1-4]ESCG / [5]NASA Johnson Space Center, Houston, TX77058, USA. * E-mail: simon.j.clemett@nasa.gov

Introduction: Some meteorites and IDPs contain μm-size carbonaceous globules (e.g., [1,2]) that are associated with significant H and/or N isotopic anomalies [3,4]. This has been interpreted as indicating that such globules may contain at least partial preserved organic species formed in the outer reaches of the proto-solar disk or the presolar cold molecular cloud. Owing to their small sizes, relatively little is known about their chemical compositions. Here we present *in situ* measurements of aromatic molecular species in organic globules from the Bells (CM2) chondrite by microprobe two-step laser mass spectrometry (μL^{2}MS) [5]. This meteorite was chosen for study because we have previously found this meteorite to contain high abundances of globules that often occur in clusters. The Bells (CM2) globules are also noteworthy for having particularly high enrichments in ^{2}H and ^{15}N. In this study, we identified individual globules and clusters of globules using native UV fluorescence.

Methods: Low-dose UV fluorescence offers both a convenient and non-destructive method to identify the *in situ* spatial distribution organic globules within a host chondrite matrix. A small chip of the Bells (CM2) chondrite, ~ 500 μm in diameter, was embedded in epoxy on a potted stub and cross-sectioned using a diamond knife ultramicrotome to expose an interior surface. After sectioning the freshly cut epoxy surface was imaged with a fluorescence microscope. Using a 330–385 nm UV excitation filter in combination with a 420 nm long-pass emission filter, both individual globules and clusters showed well defined native fluorescence signatures allowing their exact spatial locations to be determined. After correlation the positions of individual globules with subsequent optical imaging the epoxy surface was transferred to μL^{2}MS instrument for molecular analysis. The organic composition of individual globule and/or clusters was measured with a spatial probe resolution of ~ 7 μm. After μL^{2}MS analysis the epoxy section was finally C coated and re-imaged using field-emission SEM.

Results and Discussion: While the elemental and isotope compositions of organic globules from a range of meteorites and IDP have been well documented there is a paucity of information on their molecular composition. Our results indicate that while both globules and the average organic composition of the bulk Bells (CM2) matrix share a similar distribution of multiply alkylated 3-4 ring polycyclic aromatic hydrocarbons (PAHs) there is a distinct difference in their distributions of lower molecular weight (< 178 amu) species. Although significant variations exist between globules all show complex distributions of 1-2 ring aromatic species containing a variety of O and S containing function groups such as phenol (C_6H_5OH; 94 amu) and benzothiophene (C_8H_6S; 134 amu).

References: [1] Nakamura K. et al. 2002. *International Journal of Astrobiology* 1:179-189. [2] Garvie L.A.J. and Buseck P.R. 2006. Meteoritics & Planetary Science 41:633-641. [3] Nakamura-Messenger K. et al. 2006. *Science* 314: 1439-1442. [4] Busemann H. et al. 2006. *Science* 312: 727-730. [5] Clemett S.J. and Zare R.N. 1996. *IAU symposium* 178: 306.