COORDINATED CHEMICAL AND ISOTOPIC IMAGING OF THE BELLS (CM2) METEORITE.

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Introduction: Organic matter in carbonaceous meteorites preserves complex records of interstellar, nebular, and asteroidal chemistry [1]. Traditional geochemical methods have yielded detailed information on chemical properties of bulk samples. However, observations of large *H*, *C* and *N* isotopic anomalies in μm-scale organic nanoglobules suggest that organics from nebular/interstellar environments co-exist with organics formed or altered within the meteorite parent body [4]. To decode this record requires high spatial resolution chemical and isotopic analysis. We are performing *in situ* correlated chemical and isotopic mapping of the matrix of the Bells (CM2) meteorite. This meteorite was chosen because it contains abundant ^{15}N- and *D*-rich organic nanoglobules [2-4].

Methods: Bells (CM2) matrix grains were pressed into *Au* foil and imaged by optical and low-dose ultraviolet (UV) fluorescence microscopy. UV fluorescence reveals the distribution of aromatic and conjugated organic moieties and organic nanoglobules [5]. Organic chemical mapping of a 50×100 μm region was performed at a spatial resolution of ~ 5-7 μm using the JSC two-step laser mass spectrometer (μ–L^2MS). We used a vacuum UV (118 nm) laser ionization source to enable detection of virtually all classes of organics. SEM-EDX was used to establish the mineral composition of the mapped matrix fragments.

Results & Discussion: The matrix showed heterogeneous fluorescence emission from clusters and/or veins of sub-μm globular features interpreted as organic nanoglobules. Organic maps of nanoglobule-poor and nanoglobule-rich matrix were dramatically distinct. In nanoglobule-rich regions the overall abundance of organic species was several fold higher than the surrounding matrix and was dominated by low weight *O*, *N* & *S* containing molecular species. The most prominent species include NH_3, H_2S, CH_3SH, CH_2O, CH_3CHO & CH_3COCH_3, and CH_3CH_2CHO. In contrast, nanoglobule-poor regions were an order of magnitude depleted in these hetero-organics, being composed of minimally alkylated 3- to 5-ring aromatics and higher molecular weight C_{12}-C_{28} hydrocarbons with variable degrees of unsaturation. The strong microscale chemical dichotomy provides evidence for preservation of pre-accretional chemical processes. The high abundance of NH_3 in concert with simple aldehydes and ketones also supports the hypothesis that nanoglobules formed through formose-type condensation reactions [6]. Previously observed isotopic anomalies in organic nanoglobules suggests that this occurred by radiation processing of organic grains in nebular or interstellar environments [4].

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