DIVERSITY IN C-XANES SPECTRA OBTAINED FROM CARBONACEOUS SOLID INCLUSIONS FROM MONAHANS HALITE.

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Introduction: Monahans meteorite (H5) contains fluid inclusion-bearing halite (NaCl) crystals [1]. Microthermometry and Raman spectroscopy showed that the fluid in the inclusions is an aqueous brine and they were trapped near 25°C [1]. Their continued presence in the halite grains requires that their incorporation into the H chondrite asteroid was post metamorphism [2]. Abundant solid inclusions are also present in the halites. The solid inclusions include abundant and widely variable organics [2]. Analyses by Raman microprobe, SEM/EDX, synchrotron X-ray diffraction and TEM reveal that these grains include macromolecular carbon similar in structure to CV3 chondrite matrix carbon, aliphatic carbon compounds, olivine ($Fo_{99–59}$), high- and low-Ca pyroxene, feldspars, magnetite, sulfides, lepidocrocite, carbonates, diamond, apatite and possibly the zeolite phillipsite [3]. Here we report organic analyses of these carbonaceous residues in Monahans halite using C-, N-, and O- X-ray absorption near edge structure (XANES).

Samples and Methods: Approximately 100 nm-thick sections were extracted with a focused ion beam (FIB) at JSC from solid inclusions from Monahans halite. The sections were analyzed using the scanning transmission X-ray microscope (STXM) on beamline 5.3.2.2 at the Advanced Light Source, Lawrence Berkeley National Laboratory for XANES spectroscopy.

Results and Discussion: C-XANES spectra of the solid inclusions show micrometer-scale heterogeneity, indicating that the macromolecular carbon in the inclusions have complex chemical variations. C-XANES features include 284.7 eV assigned to aromatic C=C, 288.4-288.8 eV assigned to carboxyl, and 290.6 eV assigned to carbonate. The carbonyl features obtained by C-XANES might have been caused by the FIB used in sample preparation. No specific N-XANES features are observed. The C-XANES spectra obtained from several areas in the FIB sections include type 1&2 chondritic IOM like, type 3 chondritic IOM like, and none of the above. The natures of the macromolecular carbon in the solid inclusions observed by C-XANES are consistent with the previous studies showing that the carbonaceous solid inclusions have not originated from Monahans parent body [1-3], and have various origins, including various chondritic meteorite parent bodies as well as other unknown source(s).

References: [1] Zolensky M. E. et al. 1999. *Science* 285: 1377–1379. [2] Fries M. et al. 2011. Abstract #5390. 74th MetSoc. [3] Zolensky M. E. et al. 2013. Abstract #5200. 76th MetSoc.