

SYNCHROTRON-BASED THREE-DIMENSIONAL FTIR SPECTRO-MICROTOMOGRAPHY OF MURCHISON.

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Introduction: Carbonaceous chondrites are highly heterogeneous extraterrestrial samples. Their chemical composition contains variety of organics and minerals of different origin and history. Study of composition of carbonaceous chondrites *in situ* can reveal complex parent body processes and origin of constituents of meteorites. Infrared spectroscopy has been the most widely employed technique for the investigation of the chemical composition of extraterrestrial samples. Study of organic matter and its distribution in meteorites is especially of interest [1, 2]. Some organic matter of nebular origin may have formed on mineral grain surfaces, so that a genetic link between the host mineral species and the produced organic matter is highly possible. However, these relations remain poorly understood due to limitations in analytical instrumentation. Here we present, for the first time, application of a non-destructive analytical technique to meteoritics for the study of organic-mineral relations as well as their spatial distributions *in situ* within the meteorite grain.

Methods: FTIR spectro-microtomography experiments were performed at IRENI beamline at the Synchrotron Radiation Center, University of Wisconsin in Madison. A single ~40 μm diameter sized Murchison grain was mounted on a sample holder [e.g., 3], which was rotated after each two-dimensional infrared dataset was collected. A total of 224 two-dimensional transmission spectral images were collected, each 128 X 128 pixels spanning the field of view and giving 1.1 μm X 1.1 μm spatial resolution and 8 cm^{-1} spectral resolution. Datasets were reconstructed using commercial software packages to obtain three-dimensional spatial distributions of specific molecular functional groups [e.g., 3].

Results: We obtained infrared signatures of silicates, sulfates, aliphatic hydrocarbons, carbonates, water, and carbonyls in the investigated grain. Three-dimensional distributions of each component were generated. Silicates were distributed mainly in one half of the grain, while sulfates were mainly in the opposite half. Aliphatic hydrocarbons were found in localized islands. Carbonates and water distributions were roughly homogeneous. From absorbance band areas, carbonates distributions were found positively correlated with those of silicates and sulfates.

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References:

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