

FTIR, XANES SPECTROSCOPY AND ELECTRON MICROSCOPIC ANALYSIS OF HYDRATED IDPs.
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Introduction: Chondritic hydrated interplanetary dust particles (IDPs) comprise up to 50% of all IDPs collected in the stratosphere. Although much is known about the mineralogy, chemistry and carbon abundance of hydrated IDPs controversies still exist regarding their formation, history, and relationship to other primitive solar system materials. Hydrated IDPs are probably derived from asteroidal sources that have experienced aqueous alteration. However, the high C contents of hydrated IDPs (2 to 6X CI [2,3]) indicate that they are not derived from the parent bodies of chondritic meteorites. This study presents our recent progress in understanding the relationship between the organic content and mineralogy of hydrated IDPs.

Methods: We studied four 15-30 μ m hydrated IDPs by transmission electron microscopy (TEM), and Fourier-transform infrared spectroscopy (FTIR) and x-ray absorption near-edge spectroscopy (XANES) for C distribution and bonding states. The TEM analyses were performed at JSC, and the XANES and FTIR measurements were performed on beamlines X1A and U10B at the National Synchrotron Light Source at Brookhaven National Laboratory. The particles were embedded in elemental S and 70 nm-thick sections were obtained by ultramicrotomy. Sections were transferred to C-coated grids for TEM and SiO grids for XANES and FTIR analyses.

Results and Discussion: Our TEM observations are consistent with previous mineralogical studies of hydrated IDPs. Although distinct magnetite rims are observed on the IDPs (formed during atmospheric entry heating), the interior clay minerals are intact. The IR spectra show absorption features from phyllosilicates (Si-O) lattice vibration at 750 ~ 1110 cm^{-1} , interlayer water around 3400 cm^{-1} and the structural hydroxyl at 3650 cm^{-1} . The spectra also show CH_2+CH_3 stretching vibrations due to aliphatic hydrocarbon at 2860 ~ 2950 cm^{-1} . More detailed information on the nature of the organic matter is offered by the XANES spectra. C-XANES spectra of IDP and meteorite organic matter are characterized by three main absorption peaks: one at ~285 eV from C=C, one at 286.5 eV from C=O or C-N, and one at ~288.5 eV from a mixture of functional groups. While one of the IDPs studied here (L2011S4) has a typical IDPs XANES spectrum, the C-XANES spectra from IDPs L2047D26 and L2011Q9 are different from other anhydrous and hydrated IDPs [4,5]. L2047D26 has an unusually weak absorption at ~285 eV, its 288 peak is slightly shifted at ~288.7 eV, and it has a broad absorption feature at ~289.8 eV which is consistent with aliphatic hydrocarbons. These data suggest L2047D26 has much more aliphatic and less aromatic carbon than other hydrated IDPs [4]. L2011Q9 also exhibits unusual spectra. A strong 288.2 eV π^* peak suggests simple aliphatic single C bond chain, similar to PMMA but with more carbon, and less C=O [6]. Interestingly, a small (~800 nm) area in L2011Q9 has a 289.5 eV peak that does not match any literature standards.

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