CHEMICAL AND PETROGRAPHIC STUDIES OF MOLECULAR CLOUD MATERIALS PRESERVED IN INTERPLANETARY DUST. L. P. Keller[1], S. Messenger[2], G. J. Flynn[3], C. Jacobsen[4], and S. Wirick[4]. [1]MVA, Inc. 5500 Oakbrook Pkwy, Norcross, GA 30093, lkeller@mvainc.com, [2] Physics Department, Washington University, St. Louis, MO 63130, [3] Dept. Physics, SUNY-Plattsburgh, Plattsburgh, NY 12901, [4] Dept. Physics, SUNY-Stony Brook, Stony Brook, NY 11794.

Introduction. Some interplanetary dust particles (IDPs) exhibit substantially elevated D/H relative to terrestrial materials. These isotopic anomalies are thought to reflect the partial preservation of presolar molecular cloud material. Recent studies have shown that the fragile 'cluster' IDPs have more common, larger and more variable H and N isotopic anomalies than other IDPs or meteorites, reaching the values of some interstellar molecules [1]. Earlier studies of a D-rich IDP [2] have implicated organic matter as the main carrier of the anomaly. We have begun a transmission electron microscope (TEM), X-ray absorption near-edge structure (XANES) spectroscopy, and infrared spectroscopy study of IDPs with extremely large D/H ratios, reaching 50 times the terrestrial value.

Methods. To succeed with this research, ion probe measurements and TEM observations have to be made on the same parts of each IDP. Our earlier approach was to embed IDPs in sulfur, cut thin sections of the IDP for TEM, FTIR, XANES etc. and then extract the remainder of the IDP, place it on an ion probe mount, and measure the isotopic compositions [3]. However, we have yet to study an extremely D-rich particle (the particles we had selected have simply not been that D-rich – the highest to date has been ~400 ‰, see [2]). We are now obtaining measurements on particles that are demonstrably D-rich. We have modified our sample preparation technique so that we prepare microtome thin sections of IDPs that have been pressed into gold and previously analyzed in the ion probe. Following the ion probe measurement, we extract the IDP undisturbed along with a portion of the Au substrate and then embed the Au+IDP in sulfur for microtomy. This procedure allows for a direct one-to-one comparison of features in ion images to TEM images, XANES maps, and FTIR maps.

Results and Discussion. The IDP we studied is L2005, #4, a fragment from a cluster IDP (cluster nickname "Dragonfly") with a measured δD of 24,800 ‰ and a δ15N of 340 ‰ [1]. TEM measurements show that Dragonfly is dominated by carbonaceous material, Mg-rich silicates (mostly enstatite), GEMS (glass with embedded metal and sulfides), and low-Ni Fe-sulfides (i.e. the common assemblage observed in primitive chondritic porous IDPs). Minor phases include kamacite, magnetite, and a spinel grain embedded in Ca-aluminosilicate glass. Some of the petrographic context was lost when the IDP was crushed into the gold, and sputter-deposited Au complicates the analysis. Nitrogen was detected in the carbonaceous material using electron energy-loss spectroscopy, but the concentration was too low to determine the N speciation. The distribution of carbon in a thin section of Dragonfly was mapped using the scanning transmission X-ray microscope (STXM) and XANES spectra were obtained at the carbon k-edge. The carbonaceous material is abundant and is relatively uniformly distributed throughout the thin section. The XANES data from points within the Dragonfly thin section are, in general, similar to other carbon-rich IDPs we have measured in that prominent C-C, C-H, and C-O absorptions are observed. However, it is noteworthy that one carbon-rich region near the center of the thin section gives different XANES spectra with a pronounced 286.5 eV absorption.

Summary. We conclude from these preliminary analyses that the abundant organic matter in this IDP is responsible for the extremely high D excess. Additional analyses (e.g. FTIR, PAHs analysis) should help to further the D-rich phases. Future work will include chemical and petrographic studies of IDPs with pronounced "hotspots".

References. [1] Messenger, S. (2000) *Nature* **404**, 968. [2] Keller, L. P. *et al.* (2000) *JGR-Space Physics*, **105**, 10397. [3] Keller, L. P. *et al*. (1996) *LPSC XXVII*, 659.