HIGH RESOLUTION CONFOCAL RAMAN IMAGING OF AN IDP. M. Fries, L. Nittler, A. Steele, and Jan Toporski, Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Road, Washington, D.C. 20015. 1Author email: m. fries@gl.ciw.edu

Introduction: Interplanetary dust particles (IDPs) and their included carbon constitute some of the most primitive solar system materials available. Identifying and characterizing the composition of IDP carbon phases is a task well suited to Raman spectroscopy, but resolution of sub-micron detail in IDP carbon has until recently been beyond the capability of available spectrometers. A confocal Raman imager capable of producing ca. 300 nm-resolution spectral maps is used here to examine the carbon phase distribution in an IDP.

Experiment: IDP L2036-V11 Cluster 21 A was examined by confocal Raman imaging spectrometry. The instrument utilized is a Witec GmbH Alpha-SNOM using a 543 nm excitation laser and backscatter geometry.

Results: Previous studies of IDPs using micro-Raman spectroscopy [1,2] have noted heterogeneity in IDP Raman signatures. Raman imagery of this IDP likewise reveals D- and G-band intensity heterogeneity overall, although without obvious correlation to structure seen in SEM imagery (Figure 1). No olivines or other minerals are detected. These observations combined with the general appearance of the IDP in SEM imagery leads to the conclusion that this IDP is composed entirely of carbonaceous material with some long- and short-range order and only minor thermal processing.

Future work will include a more detailed analysis of carbon spectral features, including FWHM comparison, and analysis of a range of IDPs using this confocal technique. Scanning near-field optical microscopy (SNOM) techniques will also be employed to improve Raman spectral resolution further.


Figure 1: SEM image of IDP L2036-V11 Cluster 21 A.

Figure 2: Raman imagery of IDP L2036-V11 Cluster 21 A (left image) showing background-subtracted map of the 1580 cm⁻¹ carbon peak, as collected within a single focal plane. The spectrum on the right is taken from the single pixel indicated (approximately) on the image, with “D” (disorder) and “O” (ordered, or “G” for graphitic) carbon peaks labeled.