CHEMICAL CONTENT AND MOLECULAR VARIATIONS IN THE DIDIM (H3-5) METEORITE REVEALED BY MICRORAMAN AND NANOFTIR SPECTROSCOPY. M. Yesiltas[1], M. Kaya[2], T. D. Glotch[3], R. Brunetto[4], A. Maturilli[5], J. Helbert[5], and M. E. Ozel[6] [1]Faculty of Aeronautics and Space Sciences, Kirklareli University, Kirklareli, Turkey, [2]Institute of Acceleration Technologies, Ankara University, Ankara, Turkey, [3]Department of Geosciences, Stony Brook University, Stony Brook, New York, USA, [4]Université Paris-Saclay, CNRS, Institut d'Astrophysique Spatiale, 91405 Orsay, France, [5]DLR, Berlin, Germany, [6]Space Sciences and Solar Energy Research and Application Center, University of Cukurova, Adana, Turkey. (myesiltas@knights.ucf.edu).

Introduction: The Didim meteorite contains multiple lithologies and clasts of different petrologic types in a single stone. A mixture of H5 clasts in an unequilibrated H3 host was previously observed in Didim, according to the initial characterization reported in the Meteoritical Bulletin Database, providing an opportunity to investigate molecular composition that contains varying degree of equilibrium with varying mineralogy. We have taken "from large scale to small scale" approach to spectroscopically investigate the chemical content of Didim.

Bi-directional reflectance spectroscopy: We used two FTIR instruments (Bruker Vertex 80V) available in the Planetary Spectroscopy Laboratory (PSL) at DLR in Berlin to measure bidirectional reflectance spectra of the thick Didim sample at variable incidence and emission angles. Centimeter-scale bidirectional reflectance spectra show that Didim contains abundant olivine and very little pyroxene, evident from a strong Band I and a very weak Band II.

MicroRaman spectroscopy: We conducted our microRaman spectroscopy analysis at the Science and Technology Application and Research Center of Canakkale Onsekiz Mart University, Turkey (COBILTUM). The setup consists of a WiTec alpha300R confocal Raman imaging system equipped with a 532 nm Nd:YAG laser and a 50× objective (NA = 0.8). For the 3D tomography dataset, we measured a particular carbon-rich region (40×40 μm^2 area) for a depth of 15 µm with 1 µm depth resolution, resulting in 15 two dimensional datacubes. Micrometer-scale Raman spectroscopic investigations reveal the presence of both highly ordered and graphitic carbonaceous material, in addition to forsteritic olivine (Fo=90), pyroxene (augite and enstatite), labradorite, and opaque phases such as chromite and hematite. Additionally, our 3D Raman tomographic measurement shows that carbonaceous material in a vein-like structure extends underneath olivine grains, going further down towards the interior, indicating that the observed carbonaceous matter is likely indigenous.

NanoFTIR spectroscopy: Our nanoFTIR experiments were conducted on a commercial s-SNOM system (neaspec GmbH) equipped with a broadband DFG laser at the Institute of Accelerator Technologies of Ankara University, Turkey. We collected the nanoFTIR spectra with 20 nm spatial and 4 cm^{-1} spectral resolution from selected areas at the surface of Didim within the 850-1,600 cm^{-1} spectral range to investigate the peaks in the molecular fingerprint region and detect various functional groups. Nano-scale infrared measurements reveal that the observed chemical materials in Didim contain spectral, and, therefore, molecular variations at the ~20 nm spatial scale. These chemical variations are normally not accessible via conventional infrared techniques, and indicate presence of different anions in the molecular composition of observed minerals. By taking the "large scale to small scale" approach, we show that these compositional variations can be captured and investigated nondestructively in meteorites to understand formation/evolution of chemical components in the parent body.

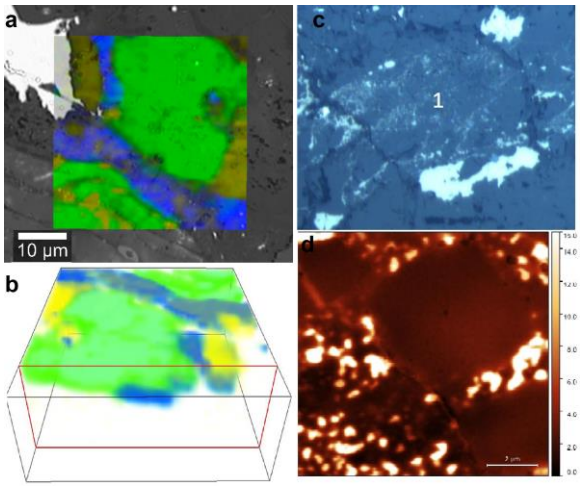

Figure 1. Raman molecular distribution image (a), carbon distribution in 3D Raman tomography (b), nanoFTIR optical microscope image of another region (d), corresponding nanoFTIR AFM image with 20 nm spatial resolution (e).