ULTRAVIOLET-VISIBLE AND VISIBLE-NEAR-INFRARED SPECTROSCOPY OF HED METEORITES

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Introduction: Spectroscopic analyses are a powerful method to gather information of planetary surfaces. By comparing spectra measured in laboratories with data gathered by spacecrafts and telescopes it is, for example, possible to identify surface compositions or investigate effects of space weathering or the extreme conditions present in space. To enhance these possibilities, we are currently investigating powdered fractions of 12 HED meteorites, which we measure in the ultraviolet (UV) and visible (VIS) to near-infrared (NIR) spectral range. Because only a few studies have yet analyzed the UV spectra of meteorites (e.g. [1]), it is one of our main goals to gather a dataset of UV spectra of the meteorites. In a second step, we are trying to find correlations between spectral properties, measurement geometries, and sample fractions of the meteorite samples, as well as between different meteorite groups. The VIS to NIR data are furthermore gathered as a benchmark that we can compare with other studies and to investigate the influence of different observation angles and sample fraction sizes on the spectral properties of HED meteorites.

Samples and methods: The samples include four howardites (NWA 1942, NWA 1943, NWA 5748, and NWA 5751), five eucrites (JAH626, Talampaya, NWA 1836, Millibillillie, and NWA 6477), and three diogenites (NWA 2968, NWA 6013, and Tatahouine). A detailed description of the meteorites can be found in [2], who investigated the meteorites in comparison to carbonaceous chondrites. We measure our samples with a Bruker Vertex80v Fourier transform infrared (FTIR) spectrometer at the IRIS laboratory of the Institut für Planetologie in Münster, Germany. The measurements are taken at room temperature (22-25°C) and pressures of ~1.0 hPa. We used the Bruker A513 accessory to mount the samples, because it has a variable mirror stage and hereby allows analyses with varying incidence (i) and emergence (e) angles. The angles used in our analyses are i:13°,e:13°; i:20°, e:30°; and i:30°, e30°. We received from [3], who purchased and prepared the samples but we sieved them again to the sample fractions desired for our study. The fractions were defined as 0-25 µm, 25-63 µm, 63-125 µm, 125-250 µm, and 250-500 µm.

First results: We created a first dataset of UV-VIS and VIS-NIR spectra for the different HED samples. The data are currently analyzed and first plots have been created but are yet to be interpreted and discussed in detail (Fig. 1&2). Hence, we present only preliminary data and interpretations that still await more detailed analyses. A first look at the VIS-NIR data shows that higher incidence and emergence angles appear to lower the band strengths of the HED meteorites (Fig. 1), which is consistent with previous studies on the effects of measurement geometry (e.g., [3], [4]). The effect appears to be stronger at smaller grain size fractions. The UV-VIS data does not show the same effect. Here, band strengths appear to increase at higher incidence and emergence angles (Fig. 2), indicating an opposite effect. Due to the lack of strong absorption bands or spectral features at UV-VIS wavelengths, we used lines of best fit to determine possible effects of the measurement geometry or grain sizes on the UV-VIS slopes of the spectra (Fig. 3). While different grain size fractions seem to influence the UV-VIS slopes of the fitted lines, the measurement geometry appears to have no significant effect.

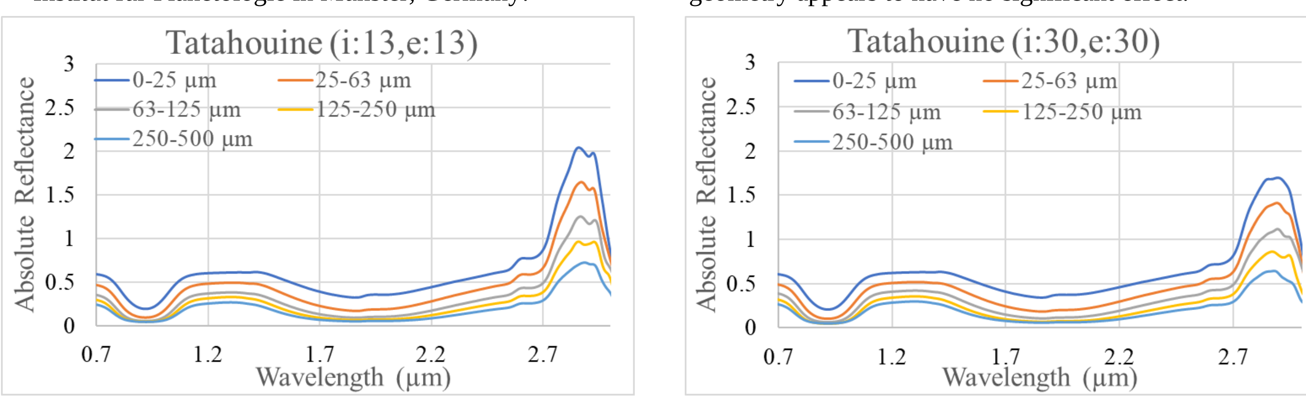

Figure 1: A first comparison of the VIS-NIR spectra of different grain size fractions of the diogenite Tatahouine at incidence and emergence angles of 13, 13 (left) and 30, 30 (right). The band strengths appear to be higher at lower incidence and emergence angles. The effect also appears to be stronger for smaller grain size fractions.

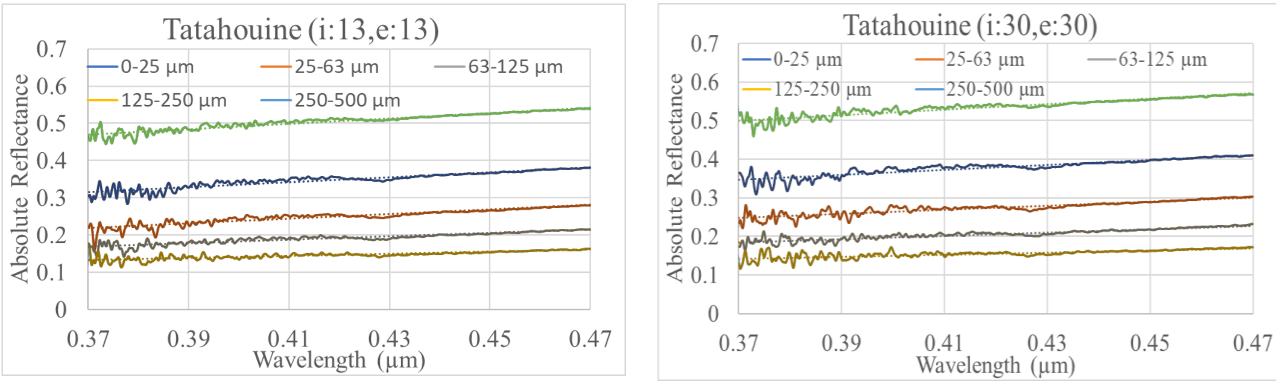

Figure 2: A first comparison of the UV-VIS spectra of different grain size fractions of diogenite Tatahouine at incidence and emergence angles of 13, 13 (left) and 30, 30 (right). Opposite to the VIS-NIR spectra, the absolute reflectances appear to increase at higher angles.

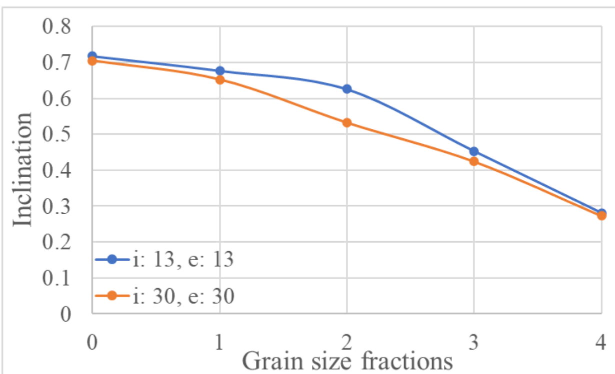

Figure 3: Plot of the UV-VIS slopes for different grain sizes and for different measurement geometries. The UV-VIS slopes were calculated using lines of best fit to the spectra shown in Figure 2. The grain size fractions are defined as 0: 0-25 µm, 1: 25-63 µm, 2: 63-125 µm, 3: 125-250 µm, 4: 250-500 µm.. It appears that the UV-VIS slopes decrease with increasing grainsizes. The incidence and emergence angles appear to have no significant effect on the UV-VIS slopes .

References: [1] D. M. Applin et al. (2018) *Icarus 307*, pp. 40-82. [2] E. A. Cloutis et al. (2013) *Icarus 223*, pp. 850-877. [3] O. Ruesch et al. (2015) *Icarus 258*, pp. 384-401 [4] A. Pommerol and B. Schmitt (2008) *J. Geophys. Res. 113*, E12008. [5] A. Maturilli et al. (2016) *Earth, Planets and Space 68*, 84.