MERTIS/IRIS: A MID-INFRARED STUDY OF RED SUEVITE IMPACT ROCKS FOR PLANETARY APPLICATIONS.

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Introduction: Infrared spectroscopy provides the only mean to determine directly the structural and thus mineralogical compositions of planetary surfaces via remote sensing. In order to interpret the remote sensing data, laboratory spectra of analog materials are necessary for comparison.

Our work at the IRIS (**I**nfra**R**ed spectroscopy for **I**nterplanetary **S**tudies) laboratory is focused on building a database of mid-infrared spectra for comparison to expected data from BepiColombo, Europe's first mission to Mercury, anticipated to be launched in 2016 and arriving in 2024. Onboard is a mid-infrared spectrometer (MERTIS-Mercury Radiometer and Thermal Infrared Spectrometer). This unique device allows us to map spectral features in the 7-14 µm range, with a spatial resolution of ~500 m [1-4].

As part of our ongoing study of analog materials for the surface of Mercury, we present first mid-infrared spectra of red suevite. This impact melt rock from the Nördlinger Ries impact crater in Southern Germany (25 km in diameter) contains material in all stages of shock metamorphism [5]

Such material is of interest since the surface of Mercury was exposed to heavy impact cratering in its history. Therefore, understanding the effects of impact shock and heat on the mineral structure and thus spectral properties is of high interest for the MERTIS project. A 'normal' suevite consists of a porous matrix of fine-grained rock and melt glass particles (Flädle) and crystalline basement rocks in all stages of shock metamorphism [5].

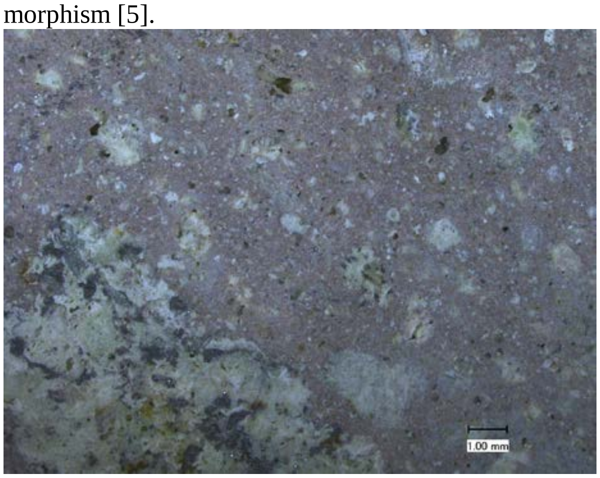

Figure 1: Optical image of red suevite from Polsingen. This sample consists of a red groundmass of melt glass, in which are embedded larger clasts of rock clasts in all stages of shock metamorphism [5].

The spectra presented here are of a red suevite sample from the Polsingen quarry at the eastern rim of the Ries crater. Samples from this location are characterized by their red color due to a high hematite content. The materials resembles a coherent, dense melt rock. The formation was possibly related to ejection of melt in the direction of the impacting body [5]. In contrast, the conventional suevite shows melt clasts and the fine-grained matrix as separate components, while in the red suevite, differences between these components are not visible. Also, there are differences in bulk chemistry (alkalis and SiO_2) between the suevites [5,6,7] (Figure 1).

Techniques: We powdered a bulk sample of the red suevite from Polsingen. The rock powder was dry sieved into seven size fractions from 0 to 1000 µm. For the mid-infrared analyses we used a Bruker Vertex 70 infrared system with a MCT detector for a spectral range from 2 to 20 µm at the IRIS laboratory at the Institut für Planetologie at the WWU Münster. Analyses were conducted under high vacuum (3 mbar) to avoid atmospheric bands. For reflectance measurements, a Bruker 513 variable geometry stage allowed us to measure samples with independent incidence and emergence angles. Some of the results are presented in Figure 2.

Results:

In the spectral range of interest for MERTIS (7 – 14 µm), we see the Christiansen Feature (CF) between 7.7 and 7.9 µm for the size fractions of 0 – 500 µm. For the largest size fraction (500-1000 µm), the feature ist at 8.1 µm. The CF reflects the felsic composition of the basement rocks in the area of the impact, mainly granite and gneiss [8]. Melt glass from 'normal' suevite has the CF at 7.8 µm, while the CF of the fine-grained matrix is at 7.3 µm. This indicates a similarity between the two materials and would confirm the nature of the red suevite as a coherent melt rock [5,6,7]

The strongest Reststrahlen (RS) feature for red suevite in this range is at 9.5 µm, similar to the melt glass and matrix in the conventional suevite, while a weak RS band or shoulder at about 8.7 µm in the red suevite is not visible in the normal suevite. This also points towards a similarity between the red suevite and the melt glass component in normal suevite. However, the 8.7 µm could also be due to variations in the crystalline clasts in the sample. The melt rocks from Polsingen contain higher abundances of gneiss/granite, while 'normal' suevite also contains mafic rocks [5].

The RS features are similar to features of experimentally shocked feldspars [9] and glass with granitic compositions [10].

With decreasing grain size, a transparency feature (TF), result of backscattered light due to volume scattering in the porous, fine-grained material, appears at 12 µm, and becomes the strongest band at the smallest size fraction (<38 µm).

Significant features outside of the presented range are strong water bands at 2.8 µm. These point towards weathering of the sample.

Conclusions

The similarities in the positions of the CF and RS in red suevite and melt glass in normal suevite indicate that the red suevite is basically a bulk glass melt rock.

However, bulk chemistries of the materials show differences [6].

Future analyses will cover infrared analyses of more types of impact rocks from the Nördlinger Reis, als well as complementary chemical analyses of the materials.

References:

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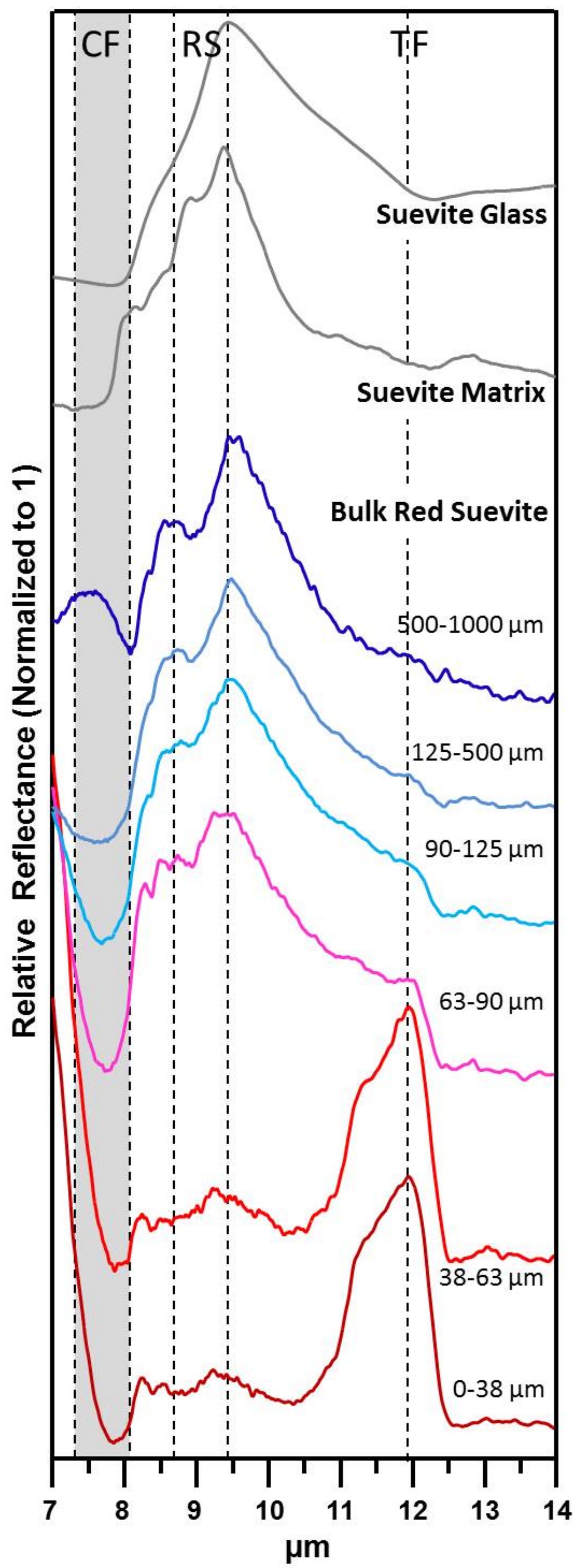

Figure 2: Analysis of red suevite in the 7-14 µm range in various grain sizes from 0 to 1000 µm at 30° incidence and 30° emergence angle in vacuum. The intensities are normalized to unity. For comparision, fine-grained matrix and glass from a polished thin-section of 'normal' suevite' are shown (Top). With decreasing grain size, the transparency feature starts to appear at ~12 µm. CF=Christansen Feature, RS=Reststrahlen, TF=Transparency Feature