Spectroscopy of Planetary Analogs for MERTIS on the BepiColombo Mission. Andreas Morlok[1], Bernard Charlier[2], Stephan Klemme[3], Olivier Namur[4], Martin Sohn[5], Iris Weber[1], Aleksandra Stojic[1], Harald Hiesinger[1], Joern Helbert[6] [1]Institut für Planetologie, Wilhelm-Klemm Strasse 10, 48149, Germany [2]University of Liege, Department of Geology, 4000 Sart-Tilman, Belgium [3]Institut für Mineralogie, Corrensstrasse 24, 48149 Münster [4]Department of Earth and Environmental Sciences, KU Leuven, 3001 Leuven, Belgium [5]Hochschule Emden/Leer, Constantiaplatz 4, 26723 Emden, Germany [6]Institute for Planetary Research, DLR, Rutherfordstrasse 2, 12489 Berlin, Germany.

Introduction: The IRIS (Infrared and Raman for Interplanetary Spectroscopy) laboratory generates spectra for a database [1] for the ESA/JAXA BepiColombo mission to Mercury. Onboard is a mid-infrared spectrometer (MERTIS-Mercury Radiometer and Thermal Infrared Spectrometer). This unique device allows to map spectral features in the 7-14 µm range, with a spatial resolution of about 500 meters [2-5]. With these infrared spectra the mineralogical compositions of the planetary surface can be determined via remote sensing

Heavy impact cratering played an important part in the formation of the surface regolith of Mercury [5]. Glass, which can arise through such impacts and in volcanic processes, lacks an ordered microstructure and represents the most amorphous phase of a material, typical for events involving high shock pressures and temperatures [6,7]. Using synthetic materials allows us to produce infrared spectra of analogue materials based on the observed chemical composition of planetary bodies, from which no material in form of meteorites is available so far [8]. Here, we present synthetic analogue materials for surface regions of Mercury based on results of the MESSENGER mission [9], and petrological experiments and modelling [10-12].

Samples and Techniques:

Sample Production: Bulk glasses were synthesized based on the chemical composition for surface areas on Mercury, based on MESSENGER X-ray spectrometer data [9], following a procedure described in [8].

Further glassy and crystalline analogue material was produced in petrological experiments simulating the petrologic evolution of early Mercurian magmas under controlled temperatures, pressures and oxidation states [10-12].

In order to illustrate the range of results, we selected spectra from two analogue samples: the high-Mg NVP (Northern Volcanic Plains) region (Fig.1a), produced at 0.1 GPa and 1210°C, and material based on the composition of the Inter Crater Plains (ICP; Fig.1b), which were equilibrated at 0.1 GPa and 1320°C) [10-12].

Infrared Spectroscopy: For the FTIR diffuse reflectance analyses, powder size fractions 0-25 µm, 25-63 µm, 63-125 µm, and 125-250 µm were measured.

For mid-infrared analyses from 2-20 µm, we used a Bruker Vertex 70 infrared system with a MCT detector at the IRIS laboratories at the Institut für Planetologie in Münster analyses were conducted under low pressure to reduce atmospheric bands.

Additional FTIR microscope analyses of polished thick sections were conducted on the experimental runs using a Bruker Hyperion 1000/2000 System at the Hochschule Emden/Leer. We used a 250×250µm sized aperture.

Results: The spectra of the surface regolith exhibit a strong, dominating feature at 9.8 µm, typical for glassy material (Fig.2) [8]. Two important additional characteristic bands for remote sensing, the Christiansen feature (CF; the position of lowest reflectance), and the Transparency Feature (TF; characteristic of the finest grain size fraction) are located at 8.0 µm and at 11.9 µm, respectively.

The micro-FTIR analyses of the experimental sample analogs for the high-Mg NVP (Fig.3a) show strong crystalline features at 9.3 µm, 9.9 µm, 10.4 µm and 11.6 µm, with minor features at 13.8 µm and 14.7 µm. The CF is at 8.1 µm, enstatite features mixed with diopside bands [13]. The spectra of glassy material is similar to the glass with the regolith composition, with a single strong band at 9.7 µm and a CF at 7.9 µm.

The analyses of the ICP analog material (Fig.3b) show crystalline bands at 9.6 µm, 10.2 µm, 10.7 µm and 11.9 µm; typical olivine bands [14]. The spectra of a glassy spot on the same sample is also similar to the regolith-analog (Fig.2), with a strong band at 9.8 µm and a CF at 8.0 µm.

Discussion & Conclusions: Results of our ongoing study of analogue materials for the surface of Mercury show consistent spectral features for the glass and the crystalline components in relation to its chemical composition. First in-situ micro-FTIR studies of crystalline phases show a variety of olivine and pyroxene bands. These confirm earlier micro analytical studies of the samples [10]. Future analyses will cover a wider range of bulk samples for the surface of the planet, as well as more detailed in situ studies of the phases formed in the petrological experiments under various temperature and pressure regimes.

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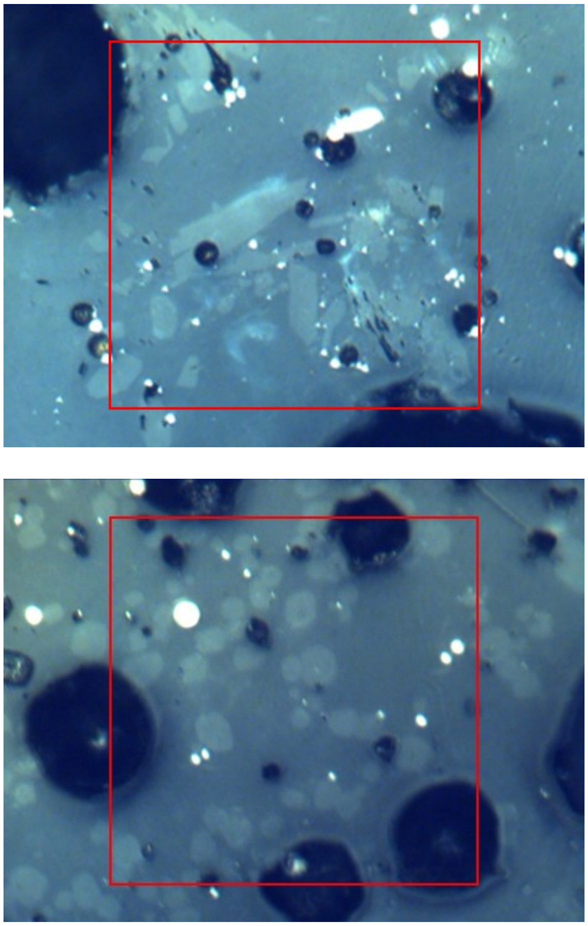

Fig.1. Optical images of the areas analyzed using micro FTIR. The red box is the 250×250µm analyzed area. **a (top):** Experimental high-Mg sample with the composition of the Northern Volcanic Plains area. The bright parts are crystalline phases, the darker parts are glass. **b (bottom):** Experimental run with the composition of the Inter Crater Plains. The bright parts are crystalline phases, olivine. The darker parts are glass.

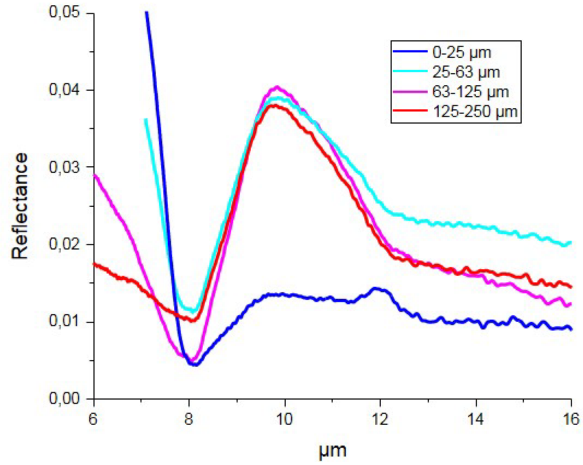

Fig.2: Mid-infrared reflectance spectra of powdered bulk glass with a composition analogue to surface regolith from Mercury [9]. The features are typical for amorphous materials, showing a featureless strong band in this region [8].

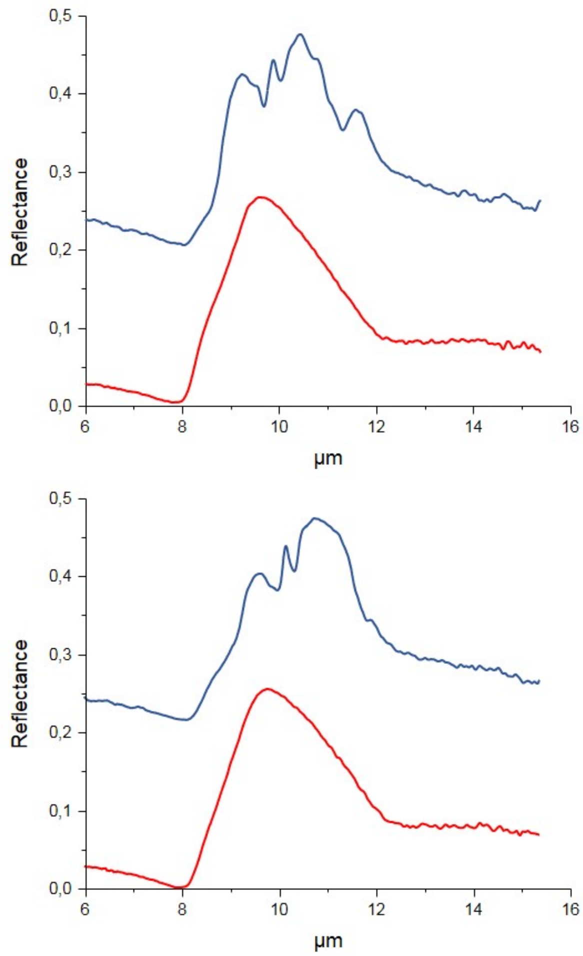

Fig.3. Micro-FTIR analyses of crystalline (blue) and glassy phases (red) from Fig.1.**a (top):** High-Mg Northern Volcanic Plains region **b (bottom):** Inter Crater Plains

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