MERCURY ANALOGUE MATERIALS: REFLECTANCE SPECTROSCOPY AND SPACE WEATHERING SIMULATIONS. L. V. Moroz[1,2], U. Schade[3], J. Helbert[2], A. Maturilli[2], S. S. Rout[1], D. Baither[4], S. Sasaki[5] A. Bischoff[1] [1]Institute of Planetology, WWU, Wilhelm-Klemm Str. 10, 48149 Münster, Germany, [2]Institute of Planetary Research, DLR, Rutherfordstr. 2, 12489 Berlin, Germany; Ljuba.Moroz@dlr.de; [3] Helmholtz Centre Berlin for Materials and Energy, Wilhelm-Conrad-Röntgen-Campus, Albert-Einstein-Str.15, 12489 Berlin, Germany, [4]Institute of Materials' Physics, WWU, Wilhelm-Klemm Str. 10, 48149 Münster, Germany, [5]Nat. Astron. Observatory of Japan, Mizugawa, Oshu, Japan.

Introduction: MERTIS (Mercury Thermal Infrared Imaging Spectrometer) is a part of ESA's BepiColombo mission payload [1] and will map Mercury's surface from 7 to 14 µm with high spatial resolution. To support MERTIS and for cross-calibration with other instruments onboard BepiColombo (SYMBIOSYS) and MESSENGER (MASCS) a list of Mercury analogue materials has been compiled [2]. Here we will report the results of spectral reflectance measurements of these analogues from 0.5 to 18 µm. To evaluate possible deviations of emissivity (E) from 1-R for biconical reflectance, we will compare the TIR reflectance spectra of the samples to their emissivity spectra acquired at PEL by A. Maturilli and J. Helbert (Helbert et al., this meeting) We will also present reflectance spectra of additional analogue materials (synthetic Fe-free silicates) potentially relevant to Mercury.

In addition, we report on a space weathering simulation experiment on plagioclase and discuss future space weathering simulation experiments relevant to Mercury and other solar system bodies with FeO-poor surfaces.

Samples and Experimental Procedures: The selected Mercury analogue materials [2] include: plagioclases (albite, oligoclase, andesine-labradorite, anorthite), orthoclase, enstatite, diopside, forsterite, elemental S and the Apollo 16 lunar highland soil 62231. For the spectral studies we prepared size fractions of <25, 25-63, 63-125, and 125-250 µm (except for the lunar soil). Separates >25 µm were wet-sieved. The samples were characterized in terms of chemical composition, mineralogy, and grain size distribution.

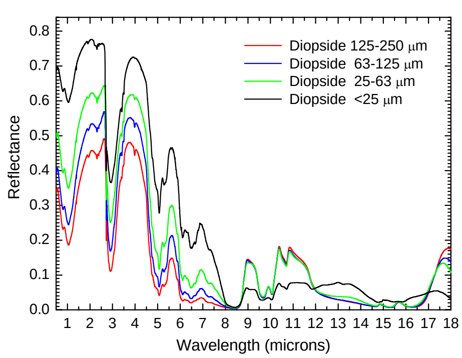

Fig. 1. Biconical reflectance spectra of diopside separates between 0.5 and 18 µm.

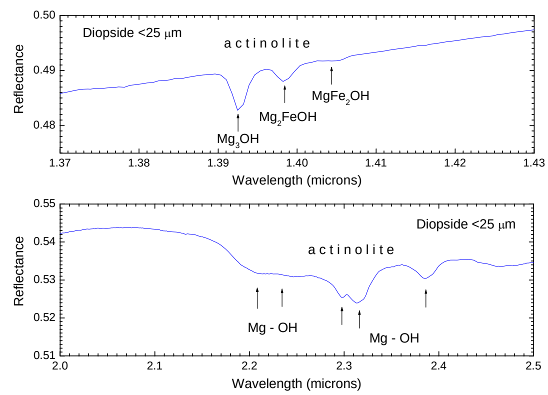

Fig. 2. Identification of weak actinolite absorption bands (Metal-OH overtones) in NIR reflectance spectra of a diopside powder.

Biconical reflectance spectra were acquired from 0.5 to 18 µm at the DLR Institute of Planetary Research using a Bruker IFS88 FTIR-spectrometer equipped with a "Seagull™" reflectance accessory. Reflectance spectra of synthetic Fe-free silicates were measured using Bruker VERTEX 80v FTIR- and Ocean Optics S-2000 spectrometers at the Helmholtz Centre Berlin for Materials and Energy.

To simulate micrometeorite bombardment on an FeO-poor target appropriate to Mercury, pressed pellets of powdered andesine were irradiated with a nanosecond pulsed laser at the National Astronomical Observatory of Japan (see [3] for details); their reflectance spectra were measured with the Bruker IFS88 FTIR-spectrometer.

Preliminary Results: Examples of biconical reflectance spectra are shown in Fig. 1 for diopside separates. Note the significant variations in reflectance values and absorption band contrasts with grain size. Many terrestrial mineral samples from [2] contain impurities, weathering products or fluid inclusions, which Detailed analysis of weak absorption features in high-resolution NIR reflectance spectra enabled the identification of OH and/or H_2O-bearing weathering products in the samples (see, e.g., Fig 2).

Fig. 3 shows reflectance spectra of two andesine-labradorite ($An_{47.5}$) pellets, non-irradiated and irradiated once (20 mJ x 1) or twice (20 mJ x 2) with a nanosecond pulsed laser to simulate micrometeorite bombardment on a very FeO-poor (0.77 wt.% FeO) target. No darkening is evident even after the highest irradiation dose. A mild VNIR reddening (Fig. 3a) and decrease in the TIR spectral contrast (Fig. 3b) are observed. The latter effects are probably caused by the changes of the surface roughness, produced by the laser, though further analysis is needed for confirmation. Our result – weak reddening and no darkening – differs from those of previous nanosecond pulse laser irradiation experiments [e.g., 3] and indicates that the presence of Fe in the target minerals is crucial to produce darkening and reddening of space-weathered planetary regoliths, induced by micrometeorite bombardment. HRTEM studies of the laser-irradiated plagioclase sample are currently underway. Our recent HRTEM study of other laser-irradiated samples [4] demonstrates that we can successfully detect and analyze nano-phase Fe^0 inclusions, when present.

We plan new space-weathering simulation experiments (e.g., irradiation of Fe-free and targets with low-energy ions) to investigate how Fe-poor silicate materials would respond to irradiation with solar wind plasma and micrometeorite bombardment in space. We will characterize the irradiated samples by HRTEM and EELS techniques at the Institute of Materials' Physics in Münster. The results of such experiments should provide crucial information not only on space weathering effects on Mercury, but also regarding space weathering on certain asteroids, such as, for example, a ROSETTA mission target 2867 Steins.

Acknowledgments: We thank I. Büttner, K. Schmale, T. Grund, M. Ahmedi, U. Heitmann, T. Jording, K., Prof. H. Palme, Dr. R. Wäsch for assistance in sample preparation and analyses. We thank Prof. R. M. Housley for synthetic mineral samples. This work is supported by DLR MERTIS project.

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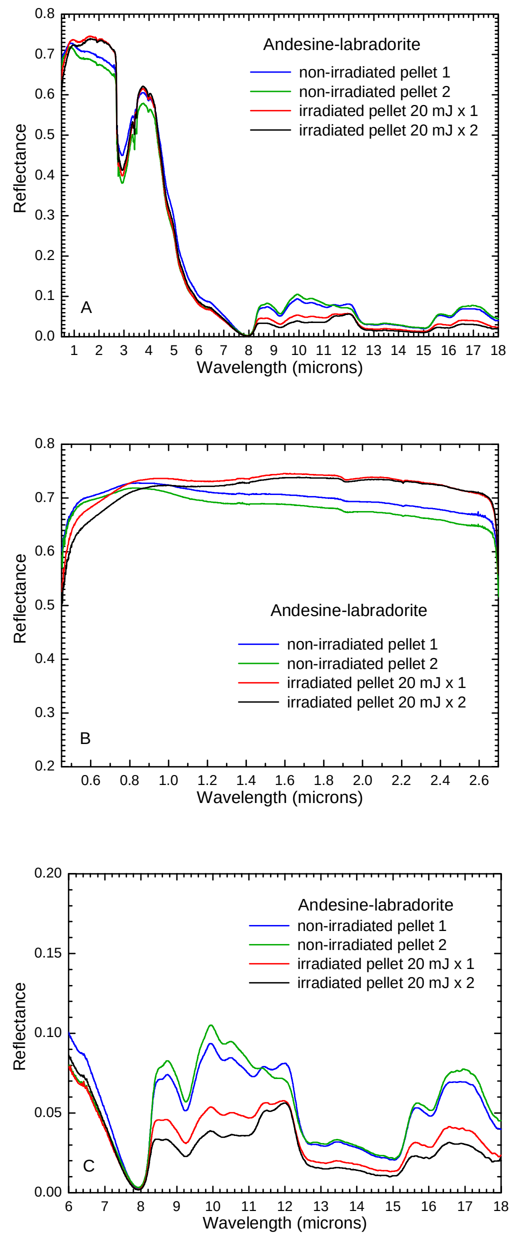

Fig. 3. Biconical reflectance spectra (0.45-18 µm) of non-irradiated and laser-irradiated plagioclase pellets.