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Studying basalts spectra in the VNIR and MidIR: what we could learn integrating data from VIHI and MERTIS the spectrometers onboard BepiColombo

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The first orbit data of the MESSENGER (NASA) mission revealed several volcanic features, confirming that volcanism was important in shaping the surface of Mercury. Some northern plains show characteristics typical of a flood-basalt style (Head et al.,2011), also consistent with x-ray spectrometer data that suggest possibly surface compositions between basalts and komatiites with high Mg/Si ratio and possibly low-iron content (Nittler et al.,2011). Multispectral images and VNIR spectroscopy indicate differences in albedo and spectral slopes, but no iron-bearing silicate absorptions, suggesting also a low-iron surface composition with lateral and vertical heterogeneities (Izenberg et al.,2009; Denevi et al.,2009).
The surface composition of Mercury is still an open issue. In particular the large range in diurnal temperatures from -173 to 430°C is expected to affect the physical processes responsible for the spectral features of minerals and rocks.
Helbert and Maturilli (2009) highlighted that the spectra of a labradorite sample show significant changes in spectral features in the mid-infrared with changing temperature. This result suggests that the surface temperature and the thermal history of an observed area must be taken into account in the interpretation of the spectra from an extreme planet such as Mercury.
The following BepiColombo mission (ESA and JAXA joint project) will analyze the surface's reflectance in the range from 0.4 to 2.0 μm (VIHI) and the emissivity from 7 to 14 μm (MERTIS) (Helbert et al.,2005; Flamini et al.,2010).
Here we describe an integrated approach aimed at the spectral characterization of basalts in VNIR reflectance and in the MidIR emissivity, trough accurately inter-calibrated data from different laboratories.
We report the preliminary results of a study focused on two basaltic samples from an Etna lava flow with similar compositions and mineral phases associations, but different textures, with different degrees of crystallinity, due to the different conditions of crystallization from the inner portion of the lava flow (slower cooling) to the surface (faster cooling). Mineral composition has been analyzed by microprobe in order to relate the compositional characteristics to the absorption band parameters.
The samples were spectrally characterized at different grain-sizes and the emissivity measured at three "hot" temperatures.
The VNIR spectra of fine powders reveal a clear absorption band at 1 μm compatible with the presence of pyroxene and olivine (Burns,1993) for the holocrystalline sample, on the contrary the hyalopilitic sample shows a lower albedo and almost featureless spectra. The MidIR emissivity of fine powders show always a Christiansen Feature position at 7.7 μm, and a similar absorption structure between the 7.7μm and 12μm can be observed for both samples. These preliminary results indicate that an integrated approach can provide a better quantitative determination of the minerals and of their abundances, and will be extremely beneficial to the interpretation of our remote sensing data. The two instruments provide complementary information on composition and texture, which will allow, for instance, to separate different portions of a volcanic lava field with different rock texture improving the interpretation of the surface composition.