**VNIR AND TIR SPECTRA OF TERRESTRIAL KOMATIITES POSSIBLY ANALOGUES OF SOME HERMEAN TERRAIN COMPOSITIONS.**

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**Introduction:** Up to date ultramafic and mafic rocks has been recognized in all the planetary surfaces of the Inner Solar System. The new MESSENGER data highlight regions proposed as possibly komatiitic lava flows in the hermean surface [1]. The GammaRay and XRay spectrometers data (onboard MESSENGER mission) provide elemental abundances and show some regional variations (e.g. northern smooth plains vs. older surrounding terrain) [2,3]. On the other hand, VNIR spectroscopy from the MASCS data [4] and Earth-based measurements [5] still highlighting some surface variations, have not shown any $Fe^{2+}$ characteristic absorbtion features.

Comparison of Mg/Si, Ca/Si, Al/Si ratio (derived from GammaRay and XRay spectrometers) with terrestrial rocks shows a quite good fit with the composition of terrestrial komatiite and basalts [2]. In particular, komatiite has been proposed because several surface's features were interpreated to have formed emplacement in a flood-effusive style coupled with thermal erosion [1]. This type of rocks are defined not only for the typical composition but even for the presence of a particular texture, defined, by plate-like crystals of olivine (spinifex texture) [e.g. 6].

Considering the ratios used by [2] and all the komatiite composition dataset from Geochemical Rock Database, we chose samples with ratios closer to the Mercury's norther plains compositions. These samples were collected in the Carribean plateau at Gorgona's island, which is widley known for its upper Cretaceous ultramafic rocks sequence, (~90Ma in age) [see 7 and reference therein].

In this work we present spectra of komatiite and komatiitic basalt from Gorgona in both VNIR (reflectance) and TIR (emissivity) wavelength range. These are the spectral ranges that will be investigated by two different instrument (SIMBIO-SYS and MERTIS) on the joint ESA JAXA BepiColombo mission to Mercury [8].

**Samples and Measurements:** Three different samples were selected from the Gorgona rocks. i) komatiite with a fine grain size (Gor16), ii) komatiite with an higher grain size (Gor22), iii) a basalt with a composition close to the komatiite one but no spinifex texture (Gor20). The petrography and mineralogy of these rocks were characterized by [9].

These samples were selected to investigate which compositional information can be derived from almost fresh komatiitic rocks, and which spectral characteristics can be related to spinifex textures.

The samples were prepared as slab of rock and as powder at two different grain sizes (<125 and <250 μm). On the slab samples, the measured surface was slightly polished using a silicon carbide abrasive to remove the asperities left by the saw, thus avoiding a mirror-like surface. Moreover two orthogonal surfaces were exposed on komatitic samples to investigate how the spinifex texture influences the VNIR spectra data.

We measured both reflectance in VNIR and emissivity in the TIR, the spectral ranges where the BepiColombo mission will investigate the mineralogy of the hermean surface with VIHI (Visible Infrared Hyperspectral Imager Channel of SIMBIO-SYS) and MERTIS (MErcury Radiometer and Thermal Infrared Spectrometer) [10,11].

The bidirectional reflectance spectra were measured with a Fieldspec-Pro spectrophotometer mounted on a goniometer in use at the Institute of Space Astrophysics and Planetology, INAF, under standard laboratory conditions. The spectra were acquired with 1 nm spectral sampling between 0.35 and 2.50 μm, and with i=30° and e=0°. The source used was a QTH lamp. The calibration was performed with Spectralon optical standard (registered trademark of Labsphere, Inc.). The illuminated spot was ~ 0.5 $cm^2$.

The emissivity spectra were measured at the Planetary Emissivity Laboratory, DLR using a Bruker VERTEX 80V Fourier Transform Infrared, operating under vacuum to remove atmospheric features. The Bruker is coupled to a planetary simulation vacuum chamber that allows measurements at different temperatures. In our experiments we measured each sample at low T (~70°C), intermediate T (~250°C) and high T (~450°C).

**Data-set:** Figure 1 show the VNIR spectra of the three slab samples. The spectra are dominated by a negative slope typical of rocks signatures with a clear indication of mafic mineralogy with a wide 1 μm absorption band. It is quite clear that few differences can be addressed to the different spectra. The basalt sample have a slight better defined minimum that can be addressed to a possibly higher amount of clinopyroxene with respect to olivine.

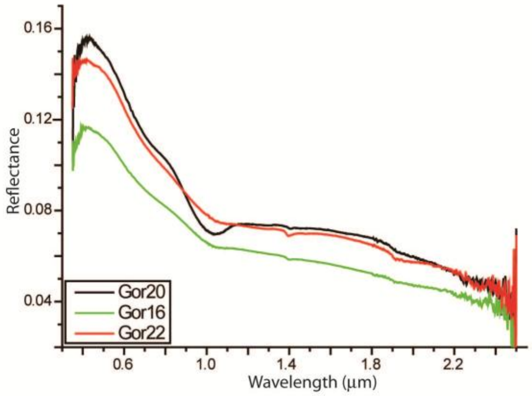


**Figure 1** – Reflectance spectra of the three slabs of the samples.

In figure 2 the spectra of the powders show more clearly the same indications we had from the slab spectra. All the samples are characterized by the same absorption band at 0.75 μm and 1.00 μm, a band at 2.00 μm indicating the presence of clinopyroxene it is more evident in the Gor20, where the alteration of the sample is almost absent. The other two samples show vibrational bands at circa 1.4, 1.9, 2.3 μm, suggesting the presence of few amount of olivine alteration. From the powders spectra we can see also that the three samples are characterized by a similar mafic composition. Only the basalt can be slightly differentiated thanks to the different characteristics of the 1 μm band, which is centered at a lower wavelength, indicating an higher relative clinopyroxene amount.

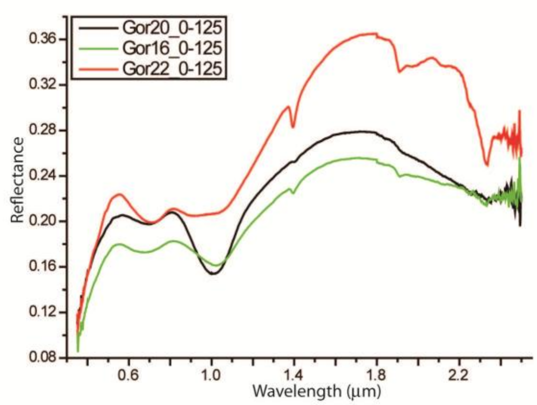


**Figure 2** - Reflectance spectra of the three powders of the samples. We consider a 0-125 μm as grain size range.

Figure 3 show the emissivity spectra of the slabs at high temperature. All the spectra have a Christiansen features at a similar position, at ca. 8.07 μm, indicating a similar basic composition. Also the restrahlen band shows similar minima position for all the samples, with very small variations.

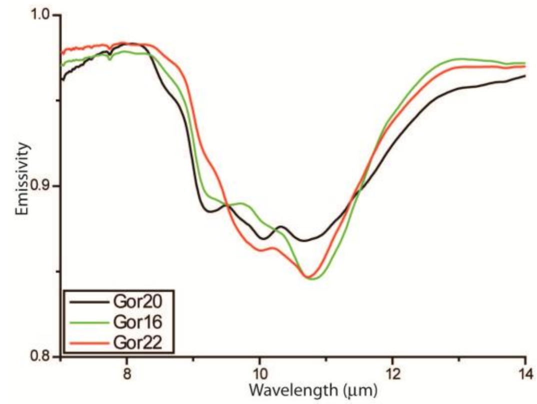


**Figure 3** – Emissivity spectra of the three slabs of the samples at ca. 450°C.

**Preliminary results:** Terrestrial komatiitic samples that have Mg/Si, Ca/Si, Al/Si ratio comparable to some hermean terrains show clear information of their mafic mineralogy. However from our preliminary work it is clear that komatiite and basalt with similar composition can not easily be differentiated from VNIR and TIR spectroscopy, although some indications could help to potentially separate areas with those characteristics.

**Future works:** Quantitative analisys of the VNIR and TIR spectra of this samples will be performed to compare with their actual mineralogy and petrography. Moreover spectra in the VNIR of the orthogonal surfaces, parallel and perpendicular to the spinifex orientation, can provide information to relate to mineral iso-orientation in komatiitic samples. The emissivity of these rocks acquired at different temperatures will be used to highlight potential variations in the position of spectral minima as already shown for olivine by [12].

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