OMEGA OBSERVATIONS OF MARS ANALOGUE ROCKS. G. Bonello[1], J.P. Bibring[2], R.V. Morris[3] and J.F. Mustard[4], [1]IASF, CNR di Tor Vergata, via del fosso del cavaliere,100, 00133 Roma, ITALY, guillaume.bonello@rm.iasf.cnr.it, [2]IAS, Université Paris-Sud, Bat. 121, 91405 Orsay CEDEX, FRANCE, [3]NASA Johnson Space Center, Houston, TX 77058, [4]Department of Geological Science, Box 1846, Brown University, Providence RI, 02912.

Introduction: In the last 20 years, imaging spectrometry in the visible and near infrared onboard spacecraft has become an essential technique to study surfaces and atmospheres of planetary objects, prior and in addition to in-situ analyses. Remote sensing experiments analyzing the sunlight reflected by planetary surfaces can be used to derive the mineralogical composition [1] and physical properties [2] of the natural surfaces and atmospheres observed. This technique was successfully used on Mars with ISM instrument [3,4]. As an improvement of ISM, OMEGA onboard MARS-EXPRESS will play a key role in the mineralogical mapping of the Martian surface. We present the reflectance measurements made with OMEGA during on ground calibration sessions on natural slabs of rocks and minerals part of a database which will be used on similar future American instruments (as CRISM onboard MRO). We discuss the implication on the scientific capabilities of OMEGA instrument.

OMEGA instrument: OMEGA experiment is the visible and near infrared mapping spectrometer of the MARS-EXPRESS mission [5]. It will be launched in June 2003 and will map the surface of Mars in 2004-2005 (possibly extended to 2007). The instrument can provide spatially sampled spectra of the surface and atmosphere from 0.35 to 5.2 µm with a spatial sampling of 1.2 mrad, leading to surface sampling of 300 m at pericenter up to 5 km from 4000 km altitude. The spectral resolution (7.5 to 20 nm) is high enough to study also atmospheric characteristics (abundance and variability of major and minor components and aerosols).

Rock samples: The rock samples were kindly provided by R.V. Morris and are part of a Mars Analogue Sample Repository located at the NASA Johnson Space Center. There are presented as rectangular slabs with variable dimensions and their surfaces have been polished with 600 grit paper on one side and 60 grit paper on the other. Some samples have cleaved or natural surfaces.

Measurements and data reduction: The ground calibration of this experiment has been done in January and February 2002 at IAS/Orsay. This final development phase is critical for the scientific reduction of the data that will be down-linked from the spacecraft. The experimental set-up has been designed to allow the observation of rocks or powders mixtures with OMEGA in reflectance conditions. We have used a biconal reflectance toolkit originally developed for an Brucker IFS66 FTIR spectrometer present at the IAS/Orsay laboratory (see [6,7] for details). We can thus compare the measurements made by OMEGA with a laboratory spectrometer in the same lighting conditions. We only made the measurements for the infrared part of OMEGA. table 1 summarized the measurements made.

Table 1. Measurements list: observed with OMEGA (Ω) or with an Brucker IFS66 FTIR spectrometer (IFS66).

Sample ID	**Type**	**Measure**
AREF001	Andesite Breccia	Ω
AREF011	Siderite	Ω - IFS66
AREF014	Hematite	Ω - IFS66
AREF015	Pyroxene	Ω - IFS66
AREF019	Basalt	Ω - IFS66
AREF022	Gypsum	Ω
AREF023	Silicrete	Ω - IFS66
AREF029	Gabbro, Xenolith	Ω - IFS66
AREF032	Hematite	Ω - IFS66
AREF044	Andesite	Ω - IFS66
AREF050	Andesite	Ω - IFS66
AREF066	Gabbro	Ω - IFS66
AREF089	Dolomite	Ω - IFS66
AREF118	Basalt	Ω - IFS66
AREF133	Basalt	Ω - IFS66
AREF148	Basalt	Ω - IFS66
AREF160	Olivine+Chromite	Ω
AREF164	Brucite	Ω - IFS66
AREF169	Calcite	Ω - IFS66
AREF179	Gabbro	Ω - IFS66
AREF186	Gabbro	Ω - IFS66
AREF193	Alunite	Ω - IFS66
AREF195	Breccia, Hydrothermal	Ω - IFS66
AREF213	Tremolite	Ω
AREF217	Dolerite	Ω - IFS66

The reflectances are obtained by comparing the signal acquired with the sample to the signal acquired with a reference standard. For the OMEGA measurements, łLabsphere absolute calibrated reflectivity standards were used. The absolute calibration only exists for wavelengths shorter than 2.5 µm. To extend the use of these standards to the full spectral range, we combine the Labsphere reflectance with CSi powder measurements using IFS66 spectrometer. Although acquisitions were made under dry nitrogen atmosphere conditions, the CO_2 4.2-4.3 µm signature remain uncorrected in some calculated reflectances.

Results: Only partial results are presented here.

Carbonates. Three samples are part of the carbonates group: AREF011 is a slab of Siderite, AREF089 a slab of Dolomite and AREF189 one of Calcite. The reflectances deduced from OMEGA are shown in the Figure 1 and are compared to the reflectance measured with the IFS66 FTIR spectrometer (resolution x10 higher). In general, we observe good agreement between OMEGA and IFS66 reflectance, except for artifacts observed below 1.9 µm for the AREF189 sample. We can also see that the contrast of carbonates features around 3.5 and 4.0 µm is emphasized with Ca contents.

Pyroxene rocks. As another example, we plot the reflectance of two rocks samples constituted of pyroxene. The figure 2 shows perfectly the variation of the 2 µm band with the pyroxene type. AREF179 is a Mg rich orthopyroxene whereas AREF015 is a Ca rich clinopyroxene.

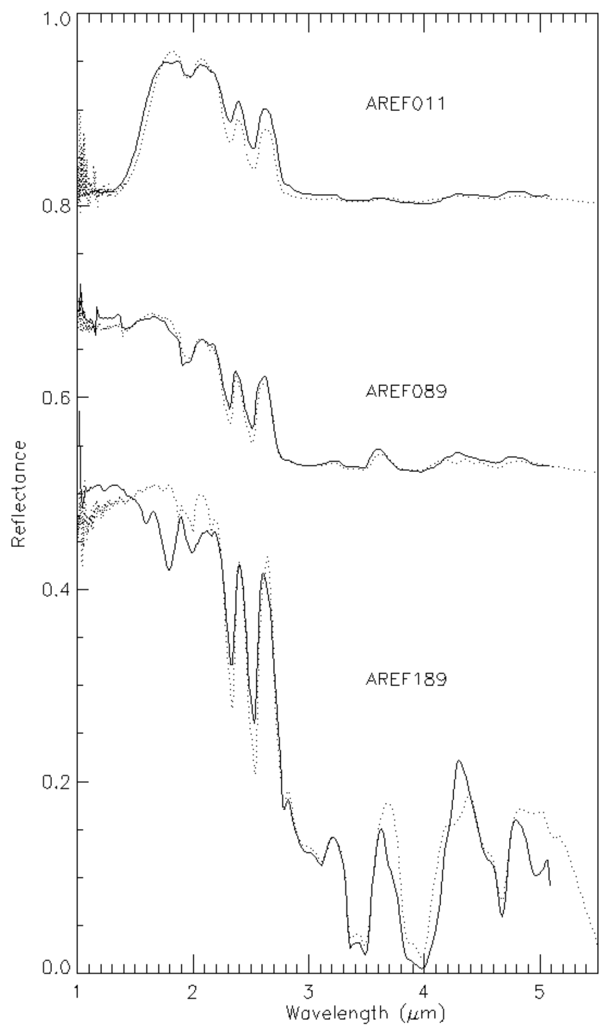

Figure 1. Reflectance of carbonates deduce from OMEGA measurements in solid lines and IFS66 in dot lines.

Conclusions: The results describe here show the sufficient OMEGA spectrometric capability to detect diagnostic features in natural samples of Earth rocks that are reasonable analogs for Mars. It confirms the extended results obtain with powder mixtures [8] showing the particular interest of the 3 to 5 µm region to detect features of minor constituents (as carbonates or sulfates) in the OMEGA IFOV.

References: [1] Burns, R. G., (1993), *Cambridge University Press*. [2] Pieters, C.M. and Englert, P.A.J, (1993), *Cambridge university Press*. [3] Puget, P. et al., (1988), *SPIE 865*, 136-141. [4] Murchie, S. L. et al., (2000), *Icarus, 147*, 441-471. [5] Puget P. et al., (1995), *SPIE, 2583*, 323-330. [6] Le Bras, A. and Erard, S., (2003), *PSS, in press*. [7] Bonello et al., (2003a), *PSS, in press*. [8] Bonello et al., (2003b), PSS*, in press*.

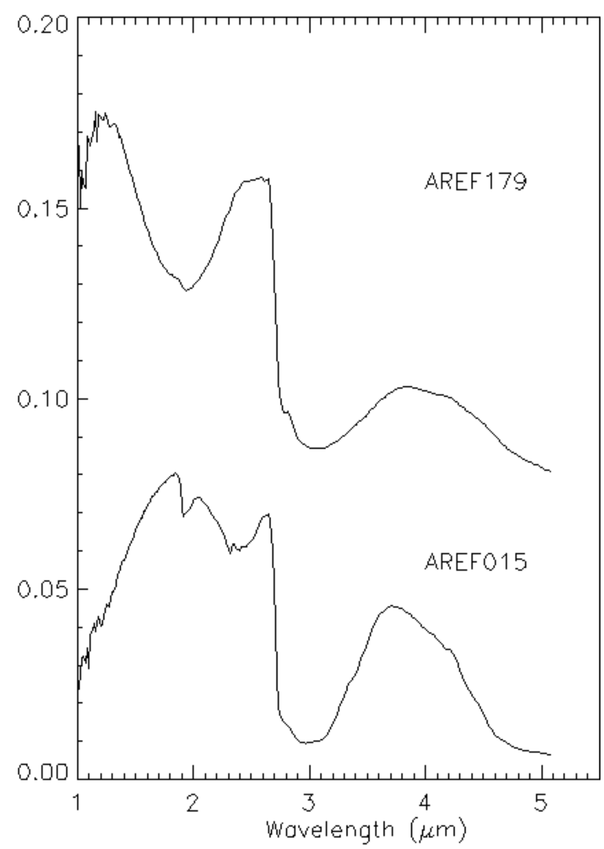

Figure 2. Reflectance of pyroxene rocks deduce from OMEGA measurements.