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Mapping of 1 µm band on Mars

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Abstract

Aim of this paper is mapping the 1 µm from the OMEGA spectra in order to study the Martian iron mineralogy. Due to the misalignment of the OMEGA VNIR and IR-C channels, spectral indexes related to the 1 µm absorption have been usually computed considering the left or right edges of the absorption [1,2], without taking the band as a whole. In this work we report a method to co-register the VNIR and IR-C channels of the OMEGA instrument to compute the 1 µm band integral, search new spectral indices and possible correlations between them.

1. Introduction

OMEGA [3] is the imaging spectrometer on board of Mars Express probe. It consists of three spectral channels: the VNIR channel working in the visible-near infrared wavelengths (0.35-1.05 µm), the SWIR channel operating in the 0.92-2.7 µm range and the LWIR channel covering the 2.7-5.1 µm one. In this work we implement a method to co-register the VNIR and SWIR channels to recover the whole spectral region where they overlap, thus allowing the study of the 1 µm band.

2. Method

Due to a slight misalignment and different IFOV of the VNIR and SWIR channels they do not observe exactly the same areas in the same instant. As a result the VNIR and SWIR footprints corresponding to the same pixel are not geographically coincident and a spatial co-registration is needed. For this purpose we search the best overlapping between the OMEGA averaged images around 1 µm from the VNIR and SWIR channels respectively by shifting one image with respect to other. The new OMEGA cube is built on the basis of the resulting new alignment.
After the spatial co-registration a residual difference in the I/F at 1 µm between the two spectral channels can still remain. To avoid this problem each visible spectrum is rescaled to the value of the I/F at 1 µm of the corresponding near infrared spectrum (spectral co-registration). The spectral shift at 1 µm is usually of the order of 1-2% and only the 1.6% of the considered data show a shift >10%.

3. Preliminary results

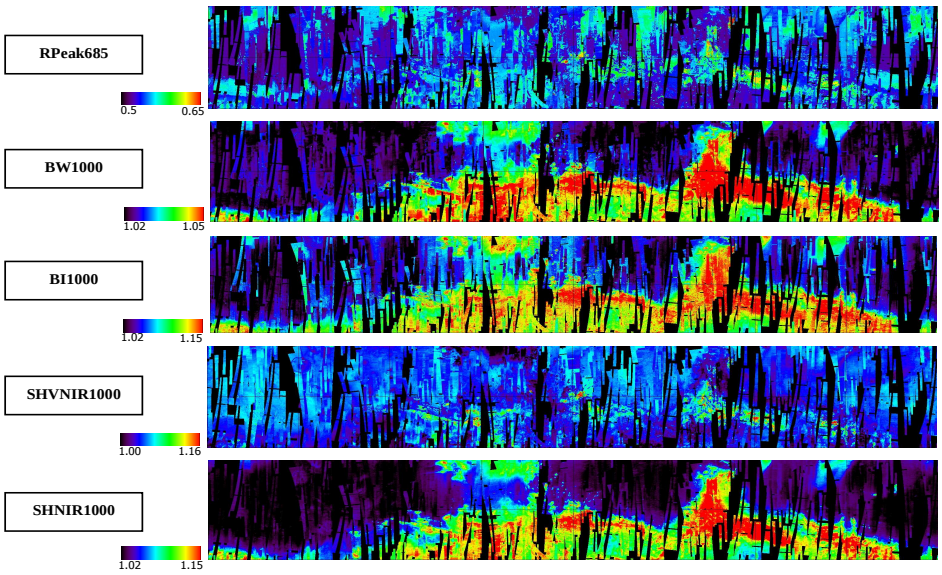
At the moment, 5 spectral indices are defined: the 1 µm band integral, the 1 µm band width, the shoulders height along the 1 µm band and the peak at 0.685. The corresponding maps are showed in fig. 1, while a summary of the parameters is reported in table 1.

Table 1. 1 µm spectral parameters:

Name	Parameter	Formulation
RPeak685	0.685 µm reflectance	R685/(0.5*R633+0.5*R782)
BW1000	1 µm band width	λ(IRpeak) - λ(VNIRpeak)
BI1000	1 µm band integral	$\frac{1}{\Delta\lambda}\cdot\sum_{ch(VNIR_{peak},IR_{peak})} R_{ch}\cdot\delta\lambda_{ch}$
SHVNIR1000	1 µm shoulder height in the VNIR channel	R(VNIRpeak)/R(937)
SHNIR1000	1 µm shoulder height in the NIR channel	R(IRpeak)/R(1124)

Some of these parameters are not sufficient alone to locate a specific mineral. For this reason it is necessary to put them in correlation through scatter plots to get information on the mineralogy. Here we report as an example the case of BI1000 and SHNIR1000 (fig.2). Red points, which form a cluster for BI1000<0.045 and SHVNIR1000>1.1, are localized in *Terra Meridiani* and in some areas of *Valles Marineris* where the hydrated oxides are found; blue points, characterized by 0.05<BI1000<0.075

Figure 1. Maps of spectral parameters between 30°S and 30°N.



and SHVNIR1000>1.16, are localized in *Aram Chaos* where sulfates are found; the yellow points, with 0.08<BI1000<0.95, identify pyroxenes localized in many dark areas on Mars; and finally the green points, with the most extreme values of the BI1000 (>0.95), identify the *Nili Fossae* region where the olivine is observed.

References:

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Figure 2. Scatter plot of BI1000 as a function of SHNIR1000.