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STUDY OF SPECTRAL PROPERTIES OF 1 μm BAND TO CHARACTERIZE THE MARTIAN MINERALOGY

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Abstract

In this work we show the results obtained with the new VNIR transfer function of a previous study [1]. Moreover, the results regard also the Polar regions. Goal of this paper is mapping the 1 μm from the OMEGA spectra in order to study the Martian mineralogy. In particular we search new spectral indexes around the 1 μm absorption and the correlations between them.
Due to the misalignment of the OMEGA VNIR and SWIR channels, spectral indexes related to the 1 μm absorption have been usually computed considering the left or right edges of the absorption [2,3], without taking the band as a whole. In this work we report a method to co-register the VNIR and SWIR channels of the OMEGA instrument to compute the 1 μm band integral, search new spectral indices and possible correlations between them.

1. Introduction

OMEGA [4] 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. 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).

3. Results

We have defined 6 spectral indices: the 1 μm band integral, the 1 μm band width, the shoulders height along the 1 μm band, the peak at 0.685 μm and a spectral ratio in the SWIR channel. 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
HRP685	height reflectance peak at 0.685 μm	R685/(0.5*R633+0.5*R782)
BW1000	1 μm band width	λ(SWIRpeak) – 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)/R937
SHSWIR1000	1 μm shoulder height in the SWIR channel	R(SWIRpeak)/R1124
SROLV	Spectral ratio in the SWIR channel	R1729/R1300

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 example the case of SHVNIR1000 and SHSWIR1000 (Fig. 2). Red points, which form a cluster for SHVNIR1000<1.03 and SHSWIR1000>1.11, are localized in *Terra Meridiani* and in some areas of *Valles Marineris* where hydrated minerals are found; blue points, characterized by 1.05< SHVNIR1000<1.12 and SHSWIR1000>1.16, are localized in *Aram Chaos* where sulfates are found; and finally the green points, with the most extreme values of the SHVNIR1000 (>1.13) and SHSWIR1000 (>1.15), identify the olivine in the *Nili Fossae* region.

Figure 1. Global maps of spectral parameters.

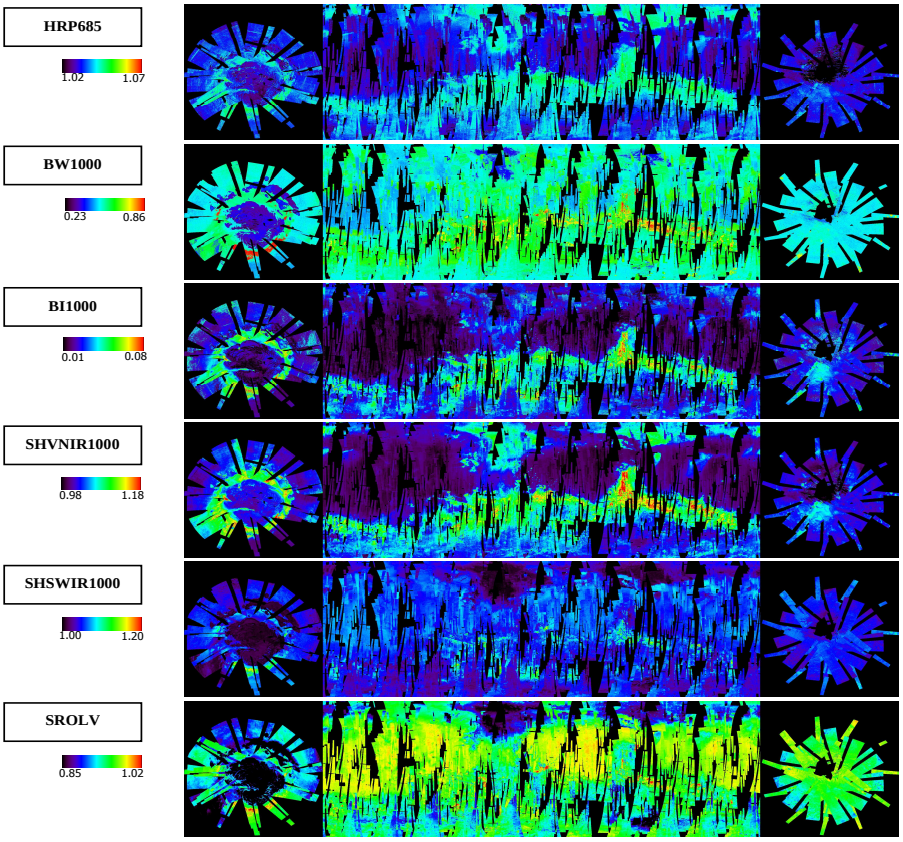

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Figure 2. Scatter plot of SHVNIR1000 as a function of SHSWIR1000. Spectra with ice are not present. Regard to the method of selection of these spectra see reference 3 and 5.