DETERMINATION OF SPECTRAL UNITS IN THE SYRTIS MAJOR-ISIDIS PLANITIA REGION FROM PHOBOS/ISM OBSERVATIONS; S. Erard, J-P. Bibring, Y. Langevin, Institut d'Astrophysique Spatial, Orsay, 91406, France; M. Combes, Departement de recherches spatiales, Observatoire de Meudon, France; S. Hurtrez, C. Sotin, Laboratoire de Géophysique, Université de Paris-Sud, Orsay, 91405, France; J.W. Head, J. F. Mustard, Department of Geological Science, Brown University, Providence, R.I.

Introduction: On March 1st 1989, the ISM spectrometer on the Phobos 2 probe observed the Syrtis-Isidis domain. This window contains very different units including Isidis Planitia, its heavily cratered rim, and the dark Syrtis Major shield. It provides an opportunity to observe the crustal dichotomy in the eastern hemisphere. The domain lies between longitudes 240°W and 310°W, and latitudes 2°N and 9°N (Fig. 1). The image is made of 25 x 120 pixels (3000 x 450 km^2), each one (20 x 20 km^2) being a set of 128 spectral measurements ranging from 0.76 to 3.16 μm (1).
Data correction process is the following : 1) Dark current substraction, 2) Detector temperature correction, 3) Gain correction, 4) Spectral orders overlap removal, 5) Division by the transfert function (DN to physical units), and 6) Division by a solar spectrum, taking into account the Sun-Mars distance at this date. Edge effects due to individal detectors locations in the focal plane are not corrected. This results in ghost features along the strong albedo boundaries (2).

First results : Three simple criteria were used for quick-look analysis (3). Brightness (Fig. 2) accounts for more than 80% of the spectral variance, the instrument having observed two very different types of terrains. In particular, Syrtis Major is known to be one of the darker parts of Mars. Brightness (computed as a geometrical mean of intensities at 0.99, 1.07, 1.10 μm) ranges from 0.1 to 0.35, varying by a factor of three between Isidis and Syrtis. In this case, the brightness is very close to albedo, slopes being relatively weak. The highest albedo material is probably a dust component. Hydration measured as the depth of the 2.9 μm H_2O absorption band, is also an important parameter in terms of variance. The spatial distribution is close to that of the brightness, opposing mainly a very dry Syrtis (25% absorption) to a very hydrated Isidis (40% absorption). Redenning (ratio of intensities at 2.39 μm and 1.79 μm) has a similar spatial distribution. It also exhibits a second order discrepancy within Syrtis. The general slope in the spectra is partly due to atmospheric dust.

Methods used to determine the spectral units : In order to use the total spectral information, four principal component analysis (PCA) have ben carried out, one for each quarter-spectra window (odd and even, first and second orders). This allows us to avoid major discrepancies in viewing directions. Rough atmospheric corrections are performed with a simple atmospheric spectrum from the Pavonis high resolution track combined with a linear model and based on the strengh of the CO_2 2 μm absorption band (4). Since brightness variation is the major information, each quarter-spectrum has been divided by its own mean value in order to see second order features that define five different units (Fig. 3). Another method has been used to define the different spectral units. Two reference spectra are chosen respectively in the darkest area (Syrtis) and in the brightest area (Isidis). The location of the reference spectra is taken in a homogeneous domain. For each pixel, the spectrum is fit as a linear combination of the two reference spectra. This way, we get rid of the brigthness that represents the largest part of the total variance on the window. For each pixel, the variance between the theoretical spectrum and the observed spectrum is determined. The spatial distribution of these two informations (brigthness and variance) allows the definition of five units as those defined with the previously described method.

Results: Results obtained with the odd and even channels are very consistent : a strong opposition between hydration and a broad absorption band centered at 2.3 μm, possibly due to high Ca pyroxenes; another strong opposition in the second order between two silicate bands centered around 0.9 and 1.1 μm. Five domains can be defined, which are spatially consistent with observation of images of the surface of Mars. Isidis Planitia (domain 1) seems to be covered with bright and very hydrated dust, with poor mineralogic features, except an absorption band at 0.9 μm.

A smooth plain in the SE, crossing the heavily cratered rim in a NW-SE direction, exhibits similar features. The cratered rim of Isidis in the South (domain 2) and Arabia (domain 3) in the NW corner are a little drier, and exhibits an absorption band at 2.3 μm. The Syrtis Major region seems to be free from dust, much darker and drier, with strong absorption features corresponding to maffic minerals, in particular at 1.1 μm. The Eastern part of Syrtis Major (domain 4) is bluer and drier than the Western part (domain 5). Also, the shape and position of the 1.1 μm band are different between these two domains within Syrtis. Differences in slopes may be due to surface materials, since albedo is about the same. In Syrtis Major, several smaller spatial features of particularly interest are observed near the region's topographic crest. Further interpretation of ISM spectra in terms of mineralogy within each of the previously defined units is done in the companion paper (5).

References : (1)Bibring et al., *Nature 341, 6242,591-592*, 1989 (2)Bibring et al., *Lunar Planet. XXI*, this volume,1990 (3)Erard et al., *DPS*,1989 (4)Bibring et al., *Proceedings of Lunar Planet. XX*,1990 (5)Mustard et al., *Lunar Planet. XXI*, this volume, 1990.

Figure 1. Map of depth of CO_2 2 μm absoption band correlated with topography, and location of the window.
Figure 2. Brightness map in near-IR.
Figure 3. First factor of PCA from 1.66 to 3.16 μm, corresponding to the opposition between hydration and possible Ca-pyroxenes feature. The five units determined appear on this map.