ISM OBSERVATIONS OF THE SPECTRAL CHARACTERISTICS OF PHOBOS IN THE NEAR INFRARED. Y. Langevin, J-P. Bibring, B. Gondet, *I.A.S., 91406 Orsay, France,* and D. Cruikshank, *Ames Research Center, Moutain View; Ca.*

The ISM experiment on board the "PHOBOS" soviet spacecraft (1) performed two observations of the satellite Phobos on the 25th of March 1989, from a distance of 200 km (2). An equatorial track, 200 pixels long, and a spectral image constituted by 24 x 25 spectra were obtained. The projected size of the pixel is .7 x .7 km^2. The major problem in interpreting the ISM image was the determination of the position of each measured spectrum in terms of phobocentric latitude and longitude. The ISM images are constituted by combining the drift motion of the spacecraft and the motion of a scanning mirror. For Phobos, the observations were performed with a tilt of the x axis of the spacecraft by ~ 30° from the nominal anti-sunward direction (hence a phase angle of ~ 30°), and the drift motion varied rapidly during data acquisition. It was however possible (2) to obtain a reliable positioning of pixels on Phobos, by combining navigational data with correlations with simultaneous VSK observations (3) and Duxbury's geometrical model of Phobos (4). An updated projection of our image in phobocentric coordinates is presented in Fig.4. An additional problem stems from the distribution of the 128 spectral elements of ISM along 4 distinct rows of detectors, which have different looking directions. Therefore, in order to work with full resolution spectra, we had first to completely resample the data according to the predicted looking directions of each of the 4 rows for each of the 24 x 25 observations.

Reconstructed spectra have a spectral resolution of 80 spectral elements / µm in the 2nd order, and 40 spectral elements / µm in the first order (1.61 to 3.15 µm). Residual registration errors may lead to a slight mismatch between the alternating rows of spectral elements. The signal / noise ratio for individual spectral channels range from 150 near 1 µm and 2 µm to less than 15 above 3 µm. The uncertainty on absolute photometry is < 15% overall and a few % between two spectral channels. Three complete reflectance spectra are shown in Fig. 1. Most of the observed jitter stems from registration uncertainties, except above 2.8 µm; where the S/N is low. These spectra do not exhibit strong spectral absorption bands. In particular, the hydration feature observed for many carbonaceous asteroids above 2.7 µm is weak. The major variations are linked to the thermal component which represents up to 25% of the flux near the center of the image, and becomes much smaller near the terminator. This is consistent with a simple model with a surface in radiative equilibrium. Significant changes in continuum slope are observed, which may be related either to changes in grain size or to a small solar incidence effect. Overall, the region of Phobos observed by ISM appears spectrally relatively homogenous, most variations in spectral slopes lying in the range of a few %.

There is however a conspicuous exception : in Fig. 2, the lower part of the spectrum is shown for two typical regions, together with a spectrum from the bottom of a large fresh crater at 247° longitude, 23°N latitude. This spectrum (D) is markedly different from the others in showing a broad absorption feature around 1 µm, which does not appear in other spectra with similar luminances (e.g. spectrum C of Fig. 1). So as to minimize instrumental effects, we present in Fig. 3 the ratio of spectrum D o that of a spectrum near the center of the disk (E), which confirms the presence of an absorption feature around 1 µm, with a center band absorption of ~ 10%. The sharp rise around 1.2 µm suggests that this feature may be linked to an admixture of a pyroxene rich component. A map of this absorption feature (Fig. 4), defined as the ratio of 4 spectral elements near 1 µm to the continuum at .8 µm and 1.2 µm, shows that the two pixels at the bottom of the crater exhibit indeed a much stronger absorption in this region than any other pixel on Phobos. This tentative identification of a 1 µm feature in a sharp crater on Phobos indincates that Phobos may not be entirely constituted of carbonaceous chondritic material, but also exhibits material similar to other types of chondrites.

(1) Bibring et al. (1989) Nature, 341, p. 591. (2) Langevin et al. (1990) Lun. Plan. Sci. XXI, p. 682 (3) Avanesov et al. (1989) Nature, 341, p. 582. (4) Bibring et al. (1990) Proc. 20th Lun. Plan. Sci. Conf., p. 461 (5) T. Duxbury (1991) Planetary and Space Sciences (in press)

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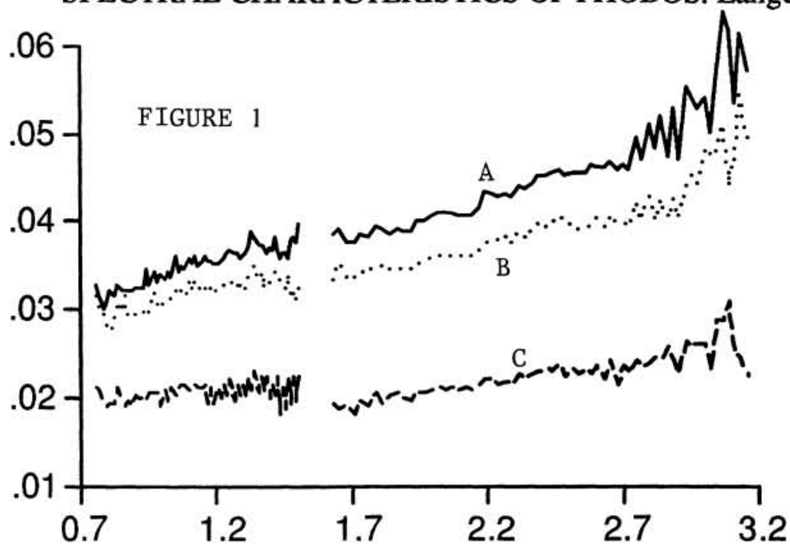
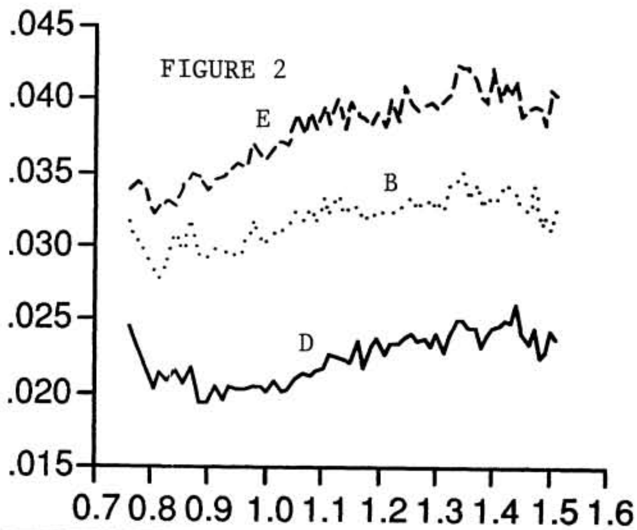
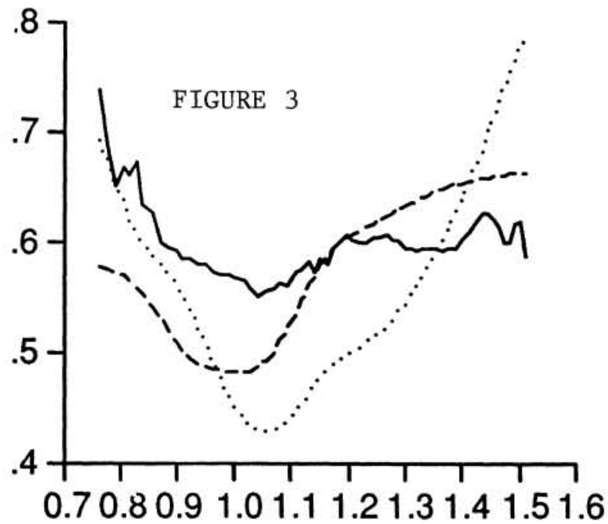


Fig. 1: Spectral reflectances of 3 regions on Phobos, near the center of the disk (A), near the crater at 247°, 23°N (B) and near the terminator (C). The thermal contribution above 2.7 µm is smallest near the terminator. see Fig. 4 for locations on Phobos

Fig. 2: The spectral characteristics inside the crater (full line, D) are markedly different from that of other regions of Phobos (B and E) in showing an absorption feature around 1 µm





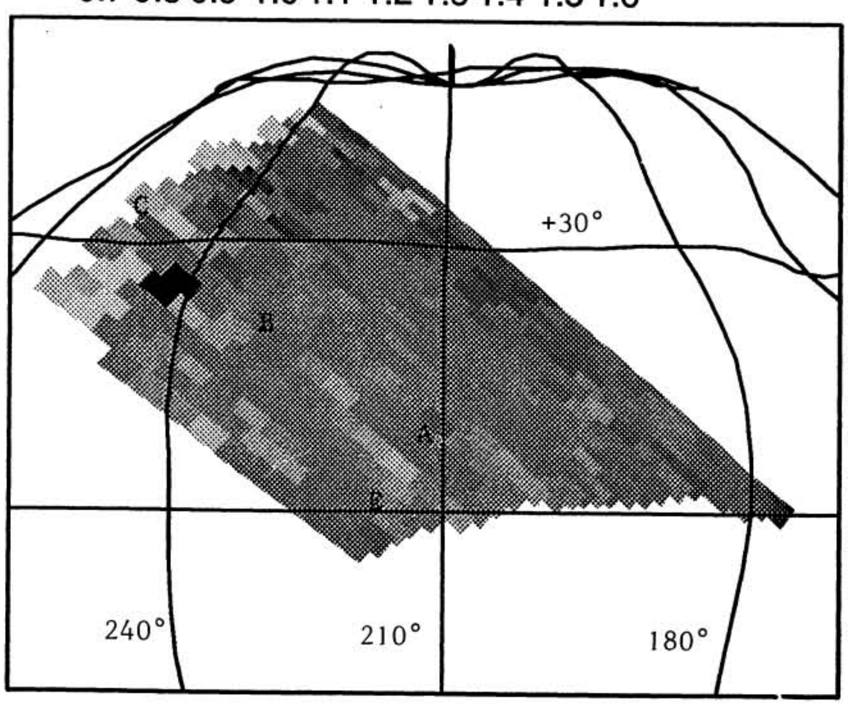


Fig. 3: The full line corresponds to the ratio of spectra D and E of Fig. 2. The position and width of the band fits better with pyroxene (dashed line) than with olivine (dotted line).

Fig. 4: distribution of the depth of the 1 µm absorption feature. The continuum is derived from the fluxes at .8 and 1.2 µm. The dark to white scale ranges from .94 to 1. The two pixels at the bottom of the crater show the strongest absorption. other minor variations are observed, which may be linked to grain size, or compositional variations.