COMPOSITION OF THE SURFACE OF PHOBOS: RESULTS FROM THE PHOBOS MISSION

D. P. Cruikshank[1,2], M.J. Bartholomew[2,3], and T. L. Roush[2,4]

[1] Participating Scientist, Phobos Mission,
[2] NASA Ames Research Center, Moffett Field, CA 94035,
[3] Sterling Software, Palo Alto, CA,
[4] San Francisco State University, San Francisco, CA.

We are engaged in an independent analysis of the data on Mars' satellite Phobos acquired by the infrared mapping spectrometer (ISM) on the Phobos 2 spacecraft. The effort has focused on two areas; first, an independent analysis of the relative errors in the data set from the single spectral image of a portion of Phobos, and second, a search for spectral features diagnostic of the composition of the surface of the satellite.

The spectral image was obtained by spatial scanning of the four detector arrays in the ISM focal plane. The total spectral interval covered by the 256 detectors was 0.76-3.14 micrometers (Bibring et al. 1989; Langevin et al. 1990).

In order to establish the reality of such spectral absorption features as may exist in the spectrum of Phobos, it is essential to assess the relative errors at various wavelengths in the spectral image cube. To do this we fit three second-order polynomials to each of the four spectral sub-intervals defined by the four detector arrays, i.e. a total of 12 polynomials. One polynomial was fit to the several wavelength channels at each end of the spectral sub-intervals, and one in the central portion of the spectrum. We chose to evaluate each array in this manner because preliminary analyses indicated a distinct difference between the ends and central portion of each array. We then calculated the differences between the observed spectrum (r_λ) and the fitted curve ($r_{m,\lambda}$) at each wavelength.

$$\Delta_\lambda = r_\lambda - r_{m,\lambda} \tag{1}$$

$$\overline{\Delta}_\lambda = \frac{\sum_{sp=1}^{sp=n} |\Delta_\lambda|}{n} \tag{2}$$

$$\sigma_{\Delta,\lambda}^2 = \frac{\sum_{sp=1}^{sp=n} (\Delta_\lambda - \overline{\Delta}_\lambda)^2}{n-1} \tag{3}$$

This calculation provides a measure the fit of the data to the "model", which merely assumes that no strong absorption features in the Phobos spectrum occur in a given spectral interval and that the continuum is adequately fit by the second-order polynomial. Calculated relative errors at the ends of the four detector arrays are typically 0.03-0.05, while in the other wavelength channels the relative error is usually less than 0.01.

In our study of the spectral features in the ISM image cube, we have given particular attention to spectral features near 1 micrometer, and are assessing their distribution and

PHOBOS SURFACE COMPOSITION: Cruikshank, D. P., et al.

identification. We have also found a weak spectral absorption near 2.2 micrometers appearing in some regions of the satellite's surface. Some phyllosilicates exhibit a feature near this wavelength; although it is typically narrower than the band observed in the ISM data, it is commonly identified with combinations of the OH fundamental stretch with the Al-O-H, Fe-O-H, and/or Mg-O-H fundamental bending modes. If the Phobos feature is such a band, the Mg+-OH stretching fundamental should occur near 2.75 micrometers, although it can range from 2.6 to 3.4 micrometers (Farmer 1974, Russell 1987). An absorption in this spectral region is not evident in the data. Alternative explanations for the 2.2-micrometer feature are being explored, including its similarity in shape and position to an absorption identified with the overtone of the X-CN fundamental in organic solids (Cruikshank et al. 1991).

References:

Bibring, J-P., et al. (1989) Nature 341, 59-1593.
Cruikshank, D. P., et al. (1991) Submitted.
Farmer, V. C. (1987) In *The Infrared Spectra of Minerals*, V. C. Farmer, Ed., Mineralogical Society, London, 539 pp.
Langevin, Y., et al. (1990) Abstracts LPSC XXI, 682-683.
Russell, J. D. (1987) In *A Handbook of Determinative Methods in Clay Mineralogy*, M. J. Wilson, Ed., Blackie, London, 309 pp.