ANALYSIS OF IMAGES OBTAINED BY THE PHOBOS 2 SPACECRAFT

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The reflection spectrum and density of the Martian satellite Phobos suggest that it may be a captured C-type asteroid and hence may contain relatively unaltered organic material from the early history of the solar system. Since there is evidence from the isotopic anomalies that meteorites presumably derived from such asteroids contain preserved interstellar material, it is conceivable that evidence for interstellar matter might also be present on Phobos. The present research concerns interpretation of the chemical composition of Phobos' surface and analysis of images of Phobos taken by the FREGAT camera equipment aboard the Phobos 2 spacecraft, including both disk-integrated and disk-resolved photometry. Because the surface of Phobos is a regolith (a pulverized surface layer of irregular texture), spectral information on the surface composition will be convolved with information on the surface texture. A primary goal of the present research has been to untangle these effects.

Unfortunately, the spacecraft Phobos 1 lost contact with Earth during its transit to Mars, and Phobos 2 likewise lost contact after two months in orbit around Mars. Thus, the "hovering" phase of very close approach and the landing of instruments on the surface of Phobos did not take place, so that no data on the elemental composition of the surface is available. However, thirty-seven images were obtained of the satellite. The results include the first such observations at near infrared wavelengths, for which disk-integrated results show that the corresponding geometric albedo is quite small and very similar to the value in the blue. The resolved surface photometry has been analyzed by developing new methods of radiative transfer in rough surface layers and a procedure referred to as "statistical photoclinometry". The results provide rms surface slopes on scales from the order of 1 millimeter to 250 meters, albedo fluctuations, and corresponding correlation lengths.