CLUES TO THE COMPOSITION OF THE IAPETUS DARK MATERIAL: A 0.67-\mu m ABSORPTION FEATURE; Karen R. Stockstill, Lunar and Planetary Institute, 3600 Bay Area Blvd. Houston, TX 77058; Stephen M. Larson, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721; Faith Vilas, NASA Johnson Space Center/SN3, Houston, TX 77058; and Michael J. Gaffey, Dept. of Earth and Environmental Sciences, Rensselaer Polytechnic Institute, Troy, NY 12181.

The composition and origin of the dark material on the leading hemisphere of Iapetus remains a mystery. The dichotomy between materials is striking, the dark material differing in albedo by a factor of ten from the trailing icy hemisphere. Both endogenic and exogenic sources for the material have been proposed, but a lack of detailed spectral data has prevented planetary scientists from making a definitive conclusion about the composition. Evidence for phyllosilicates (clay silicates produced as a result of the action of aqueous alteration on mafic silicate material) exists in the form of a 3.0-\mu m water of hydration absorption [1] also found in the photometry of many C-class asteroids. The association of Iapetus with Phoebe which has C-class asteroid photometry [2] and the suggestion of a 0.7-\mu m absorption feature attributed to iron oxides in phyllosilicates [3] supports the speculation that one component of the Iapetus dark material consists of clay silicates. The steep spectral slope, however, suggests that organics are present in the dark Iapetus material [4,5]. The spectrum has been simulated in the laboratory as a combination of organics, clay silicates and opaque materials [5]. Alternatively, extensive computer modeling suggests that organics could have been produced in the surface ice [6].

Reflectance spectra covering the wavelength interval of 0.38 to 0.88 \mu m were obtained of the trailing (bright) hemisphere of Iapetus on 9/22/93 (~3.9 days from W elongation)(Fig. 1) and of the leading (dark) hemisphere on 10/25/93 (~1.6 days from E elongation) (Fig. 2) using the University of Arizona 1.54-m telescope with a narrowband CCD spectrograph having a dispersion of 11 A/pixel. The solar analog star 16 Cyg B was also observed. Object and comparison star observations were made at similar airmasses. Relative reflectance data were made by scaling the spectra to 1.0 around 0.7 \mu m. The checkerboard linear mixing model defined and used to remove the effects of the bright icy material from photometry of the dark material [5] was applied to these spectra to remove the spectral effects of the bright polar caps on Iapetus from the spectrum of the dark material. The 0.467 factor derived by Bell et al [5] was applied as part of this algorithm. A steeply-sloped spectrum consistent with the photometry previously derived [5] with an absorption feature centered at 0.67 \mu m was produced (Fig. 3). The presence of this feature was suggested by a drop in the 0.65-\mu m filter in the leading edge spectrum of Cruikshank et al. [4].

This feature does not match absorption features found in spectra of low-albedo (C, P, G, F class) asteroids and could be a blended feature. The origin of the feature is under investigation, and could provide a significant new piece to the puzzle of the origin of the Iapetus dark material.

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Fig. 1. Relative reflectance spectrum of trailing (bright) hemisphere of Lapetus (9/22/93).

Fig. 2. Relative reflectance spectrum of leading (dark) hemisphere of Lapetus (10/25/93).

Fig. 3. Relative reflectance spectrum of Lapetus dark material (smoothed with 300Å running box average).