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# DISK RESOLVED STUDIES OF THE OPTICAL PROPERTIES AND PHYSICAL NATURE OF THE SURFACES OF THE OUTER PLANET SATELLITES

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The spatially resolved albedo, color, compaction state, roughness, and constituent particle sizes of the surfaces of the satellites of Jupiter, Saturn, and Uranus provide important constraints in understanding the geologic evolution and relevant exogenic processes operating in these satellite systems.

## A. Saturnian System

Color and albedo maps based on Voyager images show that the optical properties of the major airless Saturnian satellites are almost totally unrelated to geologic features and terrains, except for Rhea (Buratti et al., 1990). The influence of exogenic processes, including micrometeoritic and magnetospheric bombardment and the influence of the E-ring, have been investigated. Albedo maps (Figure 1) show that the leading sides of these objects are brighter than the trailing sides, and that the extent of this bright region increases towards Saturn. These observations are in qualitative agreement with the expected effects of cometary and meteoritic bombardment (Shoemaker and Wolfe, 1982).

## B. Uranian System

Color and albedo maps based on Voyager images for these satellites show good correlation with geologic features. However, we find evidence that the leading sides of the satellites are preferentially reddened, and that this effect becomes more pronounced as the distance from Uranus increases (Buratti and Mosher, 1991; see Figure 2). We attribute this observation to the accretion of low albedo, reddish meteoritic dust which originates on undiscovered retrograde (captured) satellites located outside the orbit of Oberon. The spectrum of this material is similar to that of D-type objects, including primitive asteroids, comets, Hyperion, and the dark side of Iapetus. Alternatively, the satellites could have accreted the dust during formation of the Uranian system. In this case, our measurements give a rough indication of the dust gradient in the circum-Uranian primordial cloud.

## C. Jovian System

An analysis of ground-based and Voyager images of Callisto shows that the leading side of this satellite is composed of less compacted, more backscattering particles than the trailing side (Buratti, 1991). Based on laboratory goniometric measurements, we attribute the backscattering properties to a decreased particle size on the leading side (Figure 3), due to preferential micrometeoritic gardening. Previous work has shown the opposite hemispheric dichotomy for Europa, due to magnetospheric bombardment. For Ganymede, no hemispheric dichotomies exist

because the two effects balance.
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## REFERENCES

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**Figure 1.** Maps in Mercator coordinates of the normal reflectances in the Voyager clear filter (0.47 microns) of five Saturnian satellites. From top to bottom: Mimas, Enceladus, Tethys, Dione, and Rhea.

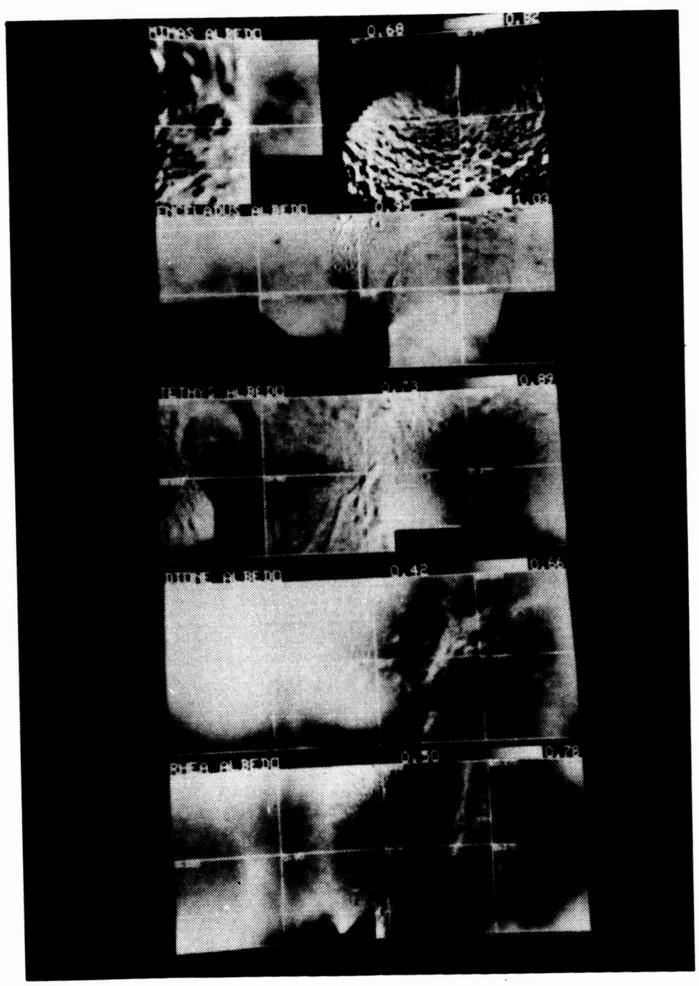

**Figure 2.** The scans on the left show the longitudinal distribution of normal reflectance for the five major Uranian satellites. On the right, the longitudinal distribution of the ratio of the Voyager green and violet filters is shown.

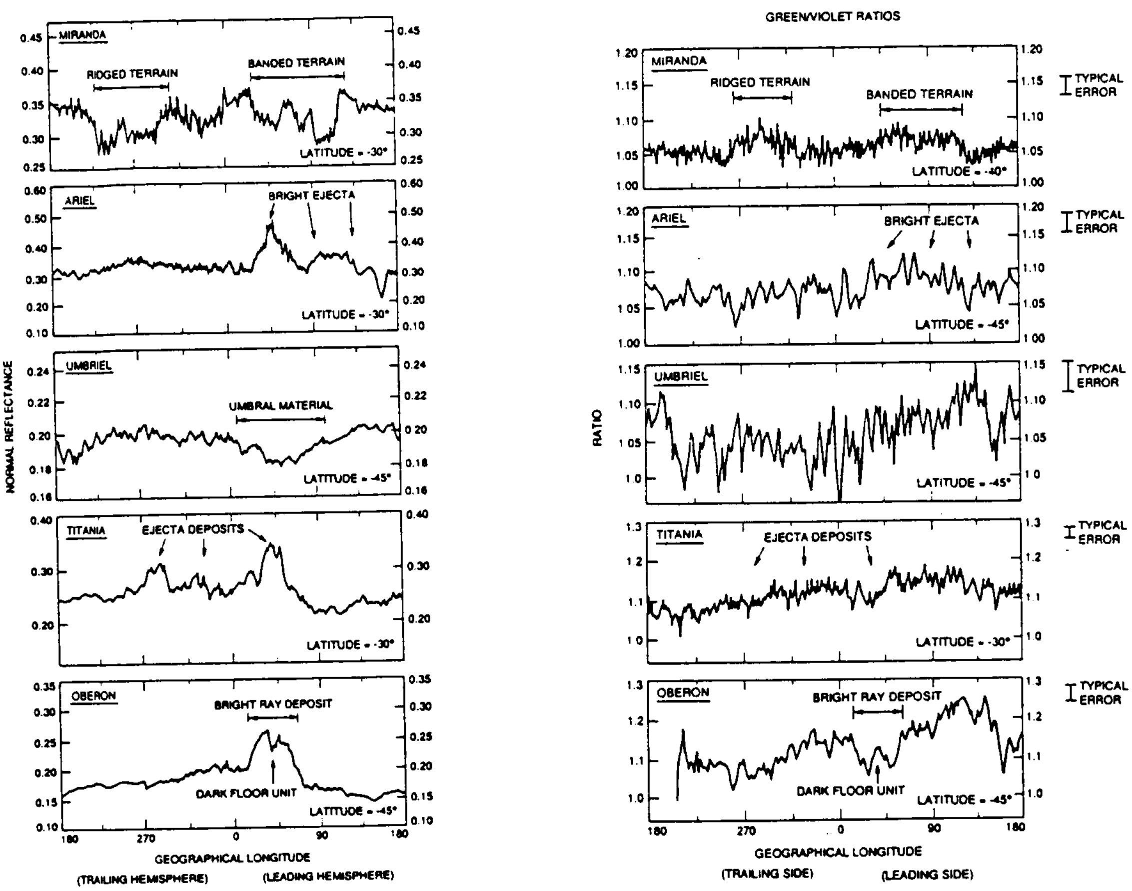


**Figure 3.** Laboratory measurements of the effect of compaction state and particle size on the phase curve of photometric analogues of Callisto's surface (Rn is the normal reflectance).