Heat Conduction: An Important Process for the Shape of Iapetus's Dark Spots?

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The saturnian moon Iapetus is famous for its global black-and-white dichotomy. While its leading side (Cassini Regio) is covered by very dark material, the poles and trailing side are relatively bright. However, craters and troughs with dark floors are located within the bright area, especially at low latitudes. The boundaries of these smaller-scaled dark areas are very sharp. Even within the best-resolved images from the Cassini imaging experiment (ISS), the typical length of a drop-off in albedo is below the resolution limit.

Thermal segregation, driven by a feedback process, has been proposed as the cause for the global dichotomy (Spencer and Denk 2010; Denk et al. 2010). In addition, for local features like craters and troughs, we explain the local darkening by an increased amount of insolation caused by the concave curvature of these features. We studied the insolation geometry using varying reflectance models. A model of linear interpolation between lunar and Lambert-like scattering reproduces the dark patterns relatively well. However, the increased insolation by itself neither explains the abundance of darkened terrain, nor the temporal behavior of darkening of fresh bright craters from the outside inward within the Cassini Regio area.

A comparison of time scales and spatial scales shows that heat conduction might act as a major contributor to the growth of local dark areas within the bright terrain, despite its short range. Due to the repetitive nature of the processes needed for the growth of darkened terrain, the significant processes should not be as long-ranged as saltation of ice or CO_2.

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