Analysis of Processes of Iapetus' Terrain Darkening

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One of the most profound features of the surface of Iapetus is its global black-and-white dichotomy. While a large part of the leading side, which is called *Cassini Regio*, is covered by very dark material, the poles and trailing side are relatively bright.
In images of the trailing side, dark crater bottoms and troughs with dark floors are common at low latitudes. The boundaries of these smaller-scaled dark areas are very sharp. Even at the highest resolution in images from the Cassini imaging experiment (ISS), the typical length of a drop-off in albedo is captured within one camera pixel [1].

A thermal feedback process has been proposed as the cause for the global dichotomy [2]. To understand that process better we complemented the data of global thermal pattern with data from small scale patterns. This approach is valid when the local darkening is triggered 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. To understand the exact nature of the threshold necessary for the darkening process, we simulated different crater characteristics.

Also, in some models we added strongly localized effects, which do not affect the global segregation like thermal conduction. Due to the repetitive nature of the processes needed for the growth of darkened terrain within craters, the significant processes should not be as long-ranged as ballistic mass (and latent heat) transfer of ice that is important for large scale segregation [2] and [3].

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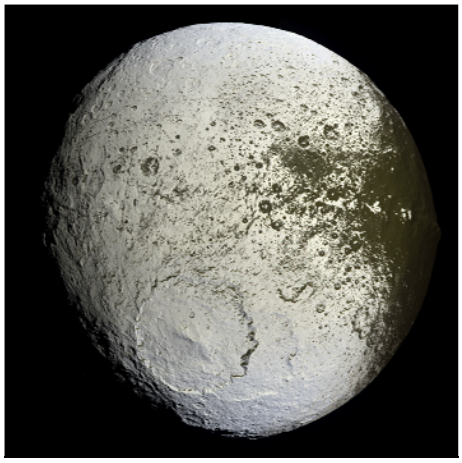
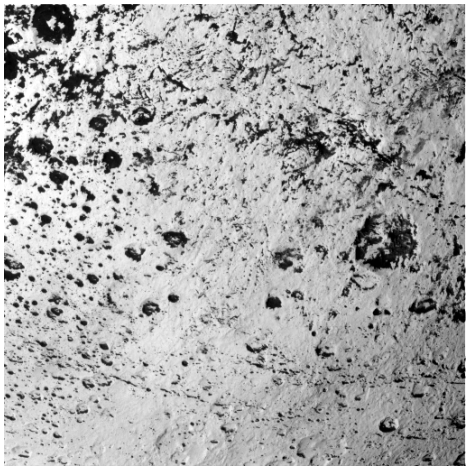


Cassini ISS image of Iapetus, showing the trailing side after the targeted flyby in September 2007. The diameter of Iapetus is 1470 km.



Dark-floor craters on the trailing side of Iapetus. The dark crater on the right, named Hamon, has a diameter of 96 km.

References:

[1] Denk, T. *et al.* (2010), Science 327, 435 - 439
[2] Spencer, J. R. and Denk, T. (2010), Science 327, 432 – 435
[3] Palmer, E. E. and Brown, R. H. (2008), Icarus 195, 434 – 446