Dark Terrains on Iapetus: From the Local to the Global Perspective and Back. G. G. Galuba[1], T. Denk[1] and G. Neukum[1], [1]Freie Universität Berlin, Geosciences, Planetary Sciences and Remote Sensing

Introduction: The surface of Iapetus is famous for its global albedo dichotomy. On the leading side of Iapetus, the region called *Cassini Regio* is covered by very dark material. The poles and trailing side are relatively bright.

At low latitudes on the trailing side, dark floors inside craters and troughs are common. These smaller-scaled dark areas have very sharp edges. Even in the images with the highest resolution from the Cassini imaging experiment (ISS), the typical length of a drop-off in albedo is below the resolution limit ([1]). Yet the shape of the local features differs strongly with latitude: At low-latitudes, the whole floor of a crater is usually darkened, leaving only the central peaks bright. At mid-latitudes, merely walls facing the equator are darkened (Fig. 1). At high-latitudes we do not see darkened craters at all [1].

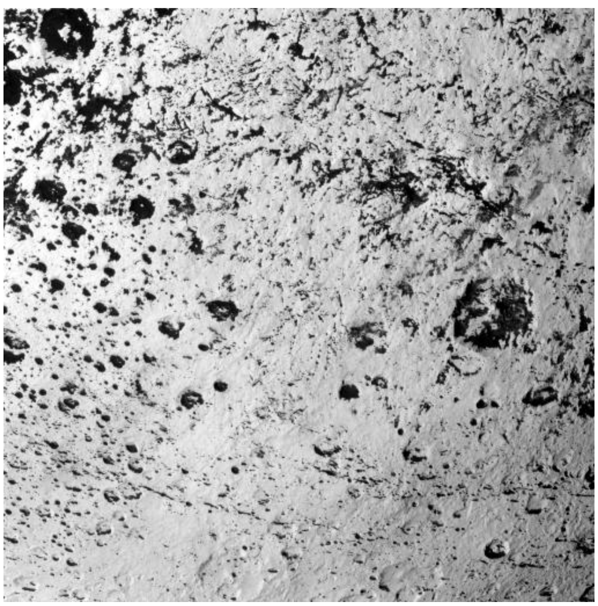

Figure 1: Some typical dark crater floors. Crater Hamon (center right; 11°N, 270°W) has a diameter of 96 km. Near the upper left corner is crater Garlon.

Denk *et al.* [1] and Spencer and Denk [2] have proposed a thermal feedback process as the cause of the *global* albedo dichotomy. In this feedback process, the intimately mixed dark material forms the lag deposit that remains after the water ice sublimed. At any location where an enrichment of the lag deposit has occured, the albedo decreases significantly due to the enhanced amount of dark lag. As a result of this decrease in albedo, more sunlight is absorbed and the sublimation becomes more efficient. This leads to a positive feedback process or *runaway effect*.

The aforementioned papers explain the global albedo dichotomy, but do not go into details regarding the comparatively small dark patches on the trailing side. These give us a high amount of additional information that complements the data of the global dichotomy pattern with regard to the threshold that determines whether a specific location gets darkened by the process or not. This approach is valid under the assumption that the local darkening is caused by the same runaway feedback-process as the global dichotomy. The difference in the global instance of this effect and the local one is that the triggering mechanism must differ in its characteristic length.

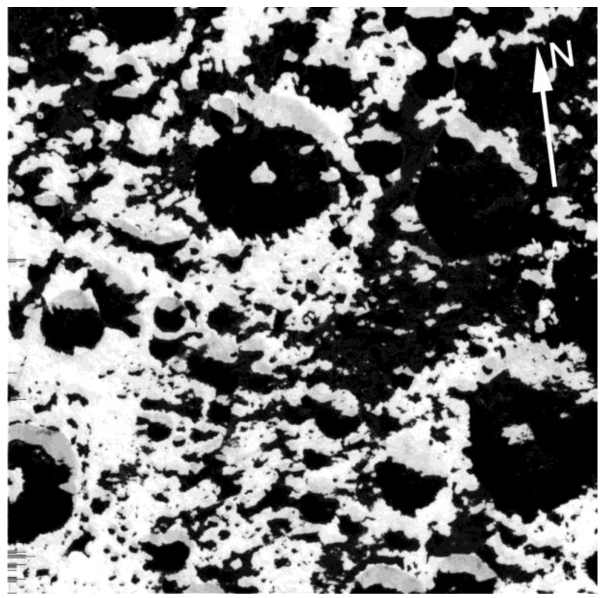

Figure 2: Three unnamed craters with diameters 20km - 25km around 17°S, 218°W. The westernmost edge of crater Timozel is visible at the very right.

An a-priori difference between the leading and the trailing side due to in-fall of exogenic material on the leading side only was proposed as the crucial difference in the boundary conditions ([2]) between the two hemispheres. As the trigger mechanism acting locally within the craters on Iapetus' trailing side, we propose an explanation derived from the geometry of the crater topography: An increased amount of sunlight irradiated onto crater walls facing the equator is reflected by the concave curvature of these features and thus enhanced. In order to get more quantative information, we studied the insolation geometry using different models for the reflection. First, we derived a model from [3] with a linear interpolation between lunar and Lambert-like scattering. It reproduced the dark patterns relatively well (Fig. 2, Fig. 3), but did not allow for a quantitative interpretation by itself. To understand the more exact and quantitative nature of the threshold necessary for the darkening process, we simulated different crater characteristics such as wall slopes and central peak variations. Taking the latitude of the craters into account, we get an averaged energy flux.

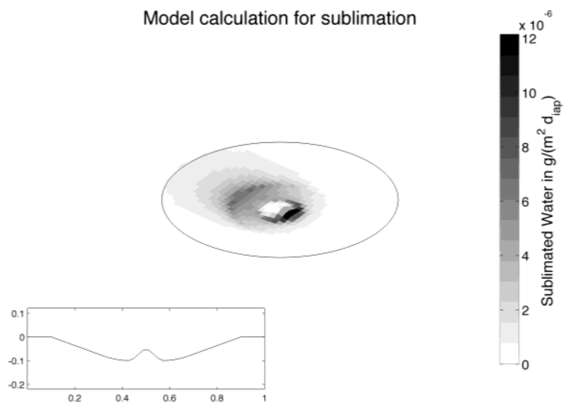

Figure 3: Model calculation with a 50x50 facet grid for a crater at 20° latitude

With the knowledge of the temperature-dependence of the sublimation (compare [4]), we can estimate the sublimation rate needed to trigger the feedback and compare it with estimates for the global process.

Globally we determine the net mass flux with a network of nearly congruent areas on the surface of Iapetus. We therefore get a difference between global net mass flux and local mass flux within craters. This gives a better understanding of the feedback-process and its constraints.

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