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# High thermal inertia areas on Ceres

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## Abstract

We compare theoretical and measured surface temperatures on Ceres. We model surface temperatures with a termophysical code that provides the temperature value as a function of thermal conductivity and roughness (i.e., a measure of topography on the sub-pixel scale). The results suggest high values of thermal inertia in the Haulani crater, and possibly in crater Occator's faculae.

## 1. Introduction

Thermal inertia is a fundamental parameter that controls surface temperature variations of airless body. Its value is sensitive to the presence of dust, regolith or rock, so this is an indicator of the history and type of the surface material. Ceres and Vesta, the two largest bodies of the main asteroid belt, are important to understand the early stages of solar system and the formation of terrestrial planets. The Visible and InfraRed mapping spectrometer (VIR) [1] onboard the NASA Dawn mission enabled the measurement of surface temperatures of these bodies on their dayside (the instrument is sensitive to daytime temperatures higher than 180 K [2]), and a thermal analysis was performed Vesta's surface, obtaining a broadly regional map of thermal inertia [3]. We have recently carried out a similar analysis for Ceres [4] to determine its average value of thermal inertia. Here, we show the results of the analysis performed on two local-scale areas: the bright faculae found in the floor of crater Occator, and crater Haulani.

## 2. The method

We derive thermal inertia by comparing VIR-retrieved surface temperatures with theoretical temperatures calculated with a thermophysical model. Local illumination and observing geometry have been derived from a detailed shape model of Ceres. The surface temperature strongly depends on the thermal conductivity of the uppermost surface layer as thick as few cms; the code can simulate different types of material from moondust to bedrock, in ascending order of thermal conductivity. Crater Occator's bright faculae and crater Haulani have been analyzed in this way and for each of them we calculated theoretical daytime temperature profiles, varying the parameters of thermal conductivity and roughness until the measured temperature values were reproduced to within the associated uncertainties.

## 3. Summary and Conclusions

We find that the thermal inertia in crater Haulani's central mountainous ridge and floor is substantially higher than the average value of Ceres. It should be noted that Haulani is one of the youngest impact craters on Ceres (< 6 Myr, [5,6]) both from a geologic and mineralogical perspective [7]. Its central mountainous ridge and parts of its floor may be substantially compact compared to surrounding terrains, even though it remains unclear why the same behavior is not observed in other comparably young surface features. Although to a lesser extent compared to crater Haulani, the bright faculae found in the floor of crater Occator may also be showing higher-than-average thermal inertia, probably due to locally coarse grain size or roughness; this point is still unclear.

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