THERMOPHYSICAL ANALYSIS OF PITTED TERRAINS ON VESTA. M. T. Capria[1], F. Tosi[1], M. C. De Sanctis[1], E. Ammannito[1], F. Capaccioni[1], S. Fonte[1] , A. Frigeri[1], A. Longobardo[1], E. Palomba[1] , F. Zambon[1], S. Schroëder[2] , B. Denevi[3], D. A. Williams[4], T. A. Titus[5], D. Blewett[6], C. T. Russell[7] and C. A. Raymond[8].

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Introduction: Pitted terrains are known on Mars [1, 2] and have recently been discovered on Vesta [3] by the Dawn spacecraft during its year-long orbital mission [4]. These terrains, always associated with impact craters, occur as thin, heavily pitted deposits. The formation of such terrain on Mars is attributed to the rapid degassing of volatiles in the target material as a consequence of an impact. For this reason, the origin of pitted terrain has interesting implications for the volatile content of the target and the impactor. On Vesta, a similar formation mechanism, involving devolatilization of hydrated minerals has been proposed [3], but the details of the process and the implications for the structural characteristics of the surface are still uncertain.

Pitted terrains on Vesta: Pitted terrains have been found on the floors of Vesta's Marcia and Calpurnia craters [0°-20°N, 180°E-220°E (in the Claudia system)], and within Cornelia crater [10°S-0°, 220°E-230°E (in the Claudia system)]. These regions are all characterized by the presence of a hydroxyl (OH) absorption, mainly in the ejecta [5, 6]. From the initial analysis of Approach data [7] (pixel resolution 1.3 km), it appears that these areas are characterized by a thermal inertia higher than Vesta's average of 30 ± 10 Jm^{-2} $s^{-0.5}$ K^{-1}. In particular, part of Marcia crater exhibits the highest thermal inertia value yet found on Vesta, 50 ± 5 Jm^{-2} $s^{-0.5}$ K^{-1}. These higher than average values can be attributed to structural properties of the surface layer, related to a higher degree of compactness or a higher proportion of exposed bare rock.

Results on high resolution data: We are in the process of refining the analysis of the pitted terrain areas by using the higher-resolution data acquired during the Survey and HAMO phases of the Dawn mission. The technique is similar to the one used to analyze the Approach data. A thermophysical model, giving as a result thermal inertia as a function of thermal conductivity, is used. The initial results from the analysis of Survey and HAMO observations confirm and extend the earlier findings obtained with lower resolution data. Higher than average thermal inertia prevails on and around areas in which pitted terrain have been found; in addition, a few more small regions with a thermal inertia of 50 ± 5 Jm^{-2} $s^{-0.5}$ K^{-1} have also been identified (see fig. 1).

Future work and conclusion: Our thermophysical model strives to provide the best possible simulation of the characteristics of the materials that may be present on the surface of Vesta. We are in the process of improving the expressions for thermal conductivity and density used in the code, and are updating the simulations to better model the structural effects that rapid devolatilization could have on surface material. To this end, we are planning to adapt results on the effect of similar phenomena on Earth and Mars, taking into account the lack of atmosphere and the lower gravity of Vesta.

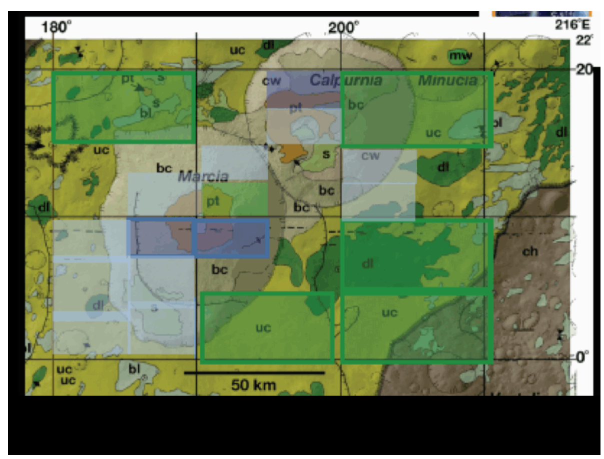

Figure 1: Thermal inertia map of the Marcia and Calpurnia craters superimposed on a geological map (in the Claudia system) [8]. Color code is the following: green, thermal inertia of 30± 10 Jm^{-2} $s^{-0.5}$ K^{-1} + average sub-pixel roughness; light blue, thermal inertia of 40± 10 Jm^{-2} $s^{-0.5}$ K^{-1} + low sub-pixel roughness; blue, thermal inertia of 50± 5 Jm^{-2} $s^{-0.5}$ K^{-1} + low sub-pixel roughness.

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