GEOMORPHOLOGIC SETTING OF PITTED TERRAINS ON VESTA AND IMPLICATIONS FOR THEIR FORMATION. T. Michalik[1], K. Otto[1], R. Jaumann[1,2] [1] German Aerospace Center (DLR e.V.), Rutherfordstr. 2, 12489 Berlin, Germany (tanja.michalik@dlr.de), [2] Freie Universität Berlin, Malteserstr. 74-100, 12249 Berlin, Germany.

Introduction: On asteroid Vesta, the crater Marcia and its vicinity host > 99% of the existing pitted terrains on the whole body. This crater is also the youngest large crater on Vesta (Ø ~ 63 km) with very peculiar properties regarding its shape, ejecta patterns, spectral characteristics and thermal properties. Denevi et al. [1] stated that the pitted terrains formed, likewise as on Mars, by explosive volatile outgassing from volatiles in the pre-existing regolith. However, some observations challenge aspects of this view.

Pitted terrains locally exhibit more pronounced pyroxene absorptions and higher reflectance than their immediate surrounding [2]. Furthermore, as shown in this study, several pitted terrains are associated with a positive local topography as well as accumulation of material on slopes, linking them to the emplacement of ejecta. Here we describe six pitted terrains that are located within the ejecta blanket of Marcia in geomorphologic detail and discuss implications arising from these observations.

Data: The data used for this study was obtained by Dawn's Framing Camera that generated images in the VIS and NIR wavelengths with a spatial resolution of up to 16 m/px and digital terrain models with a lateral and vertical resolution of about 90 and 6 m/px, respectively [3,4].

Description of the six pitted terrains of interest: All six pitted terrains are located ~ 10 to 25 km off the SW rim of Marcia and are situated relatively close to each other (Fig. 1). Four of the six pitted terrains are located in craters that existed prior to the Marcia impact. For another pitted terrain (Fig. 1, box 2f), the existence of a previous crater cannot be determined for sure as its rim appears to be subdued by ejecta. The last pitted terrain does not seem to be linked to a pre-existing crater (Fig. 1, box 2c).

The pitted terrains are not located at the lowest elevation of the craters but rather near the walls facing the excavation direction towards Marcia (Fig. 1a). The overall topographic slopes of these pitted terrains do not exceed 13° and never level out to 0°. For some of the pitted terrains, their distinct spectral characteristics extend to the near vicinity (labelled as 'spectral "halo"' in Fig. 2, see [2] for more details on the spectral characteristics of the pitted terrains) and moreover, some are slightly depleted in OH [2]. The approximate thickness of the pitted terrains' material was derived from the hypothetical topography shown in Fig. 2 as dashed lines and constitutes about 20 to 200 m.

For context: Pitted terrains are scattered around Marcia in all directions. Other pitted terrains in the vicinity of Marcia do not exhibit this clear evidence of accumulation due to downslope movement. Their formation might therefore not necessarily be caused by the same process. Nevertheless, many of the pitted terrains are likewise situated on Marcia facing slopes.

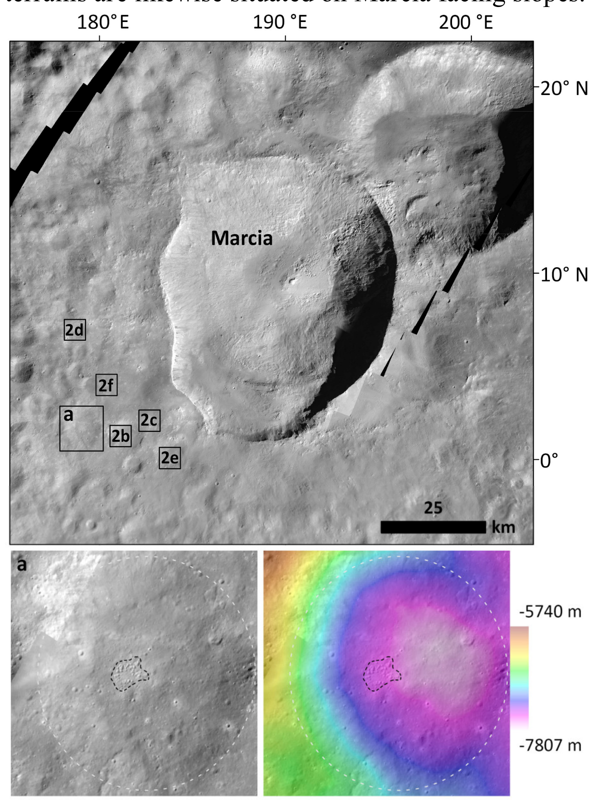

Figure 1: Crater Marcia and the locations of the six pitted terrains of this study. a) closer view of one pitted terrain (left panel) with DTM data (right panel). Dashed lines denote the pitted terrain (black) and the approximate crater rim (white). The topographic profile of this crater is shown in Fig. 2a.

Discussion: Our observations indicate that the formation of at least these six pitted terrains is not only linked to material loss due to explosive volatile degassing but also to the accumulation of ejected material on previously existing slopes. It is therefore unlikely that the pitted terrains are associated to the

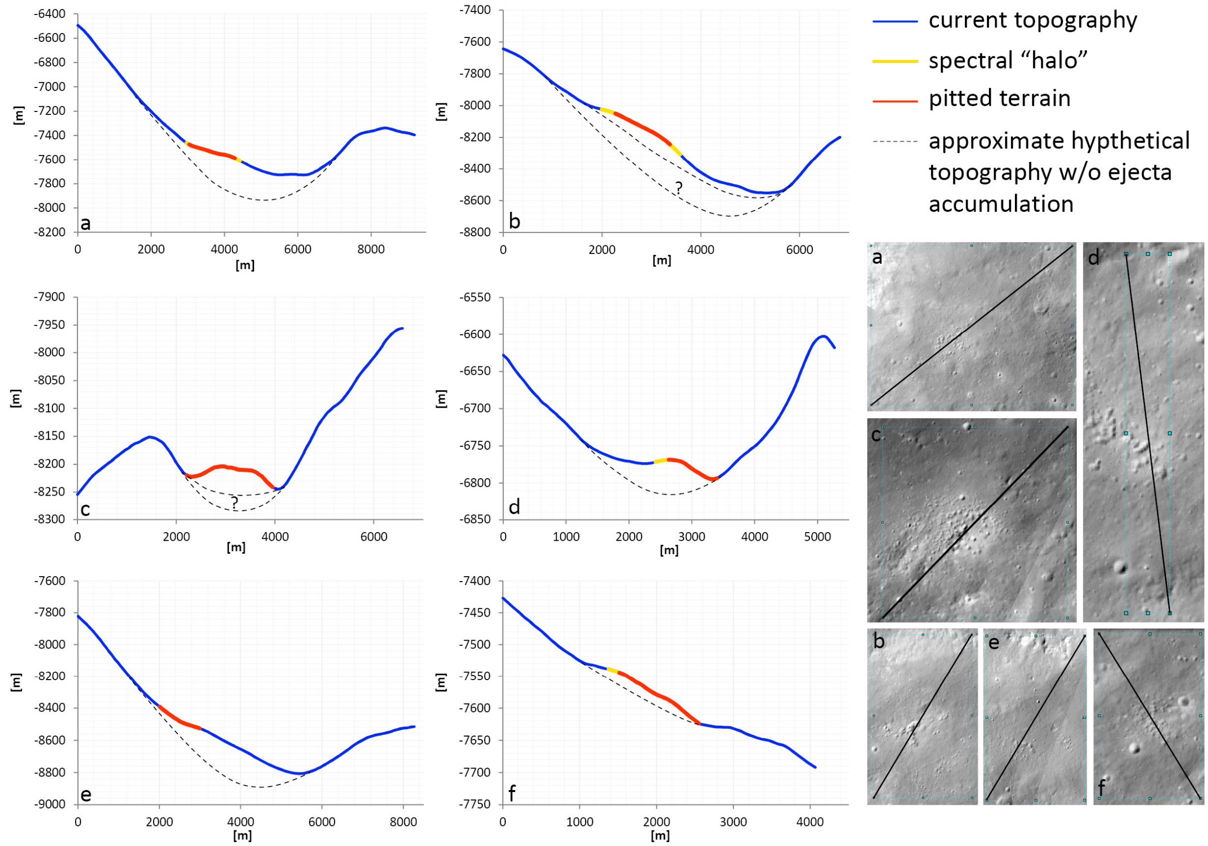

Figure 2: Topographic profiles of the six pitted terrains at the locations shown in Fig. 1.

loss of water ice that was pre-existing in the regolith and then heated by overlying ejecta.

It appears more likely that entrained volatiles in the ejecta were trapped due to the downslope movement of other ejecta on the walls and subsequently built up enough pressure to overcome the overburden by eventually forming escape vents.

This approach does not explain the pronounced pyroxene-dominated spectral characteristics of the pitted terrains. However, the accumulation of material might also play a role for this spectral phenomenon as the heat that might accompany proximal ejecta would also be trapped, not being able to radiate freely into space. As a result, the heat could be used to liberate OH groups from OH-bearing minerals and thus changing the materials’ spectral properties.

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