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Teia crater ejecta mineralogy: sample a possible dike on Vesta

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Abstract

Data from the Dawn VIR (Visible InfraRed mapping Spectrometer) instrument [1,2] have been used to characterize and map the distribution of minerals on Vesta. Basaltic meteorites derived from Vesta indicate that volcanic and/or magmatic activity would have been present on Vesta. A specific search for signature of past volcanism has been made without unambiguous results [e.g. 3] The mineralogy of Teia, a small crater that impacted Brumalia Tholus, when interpreted in the context of the local geology and topography [4,5,6] could suggest the presence of a " dike" (magmatic intrusion) on Vesta.

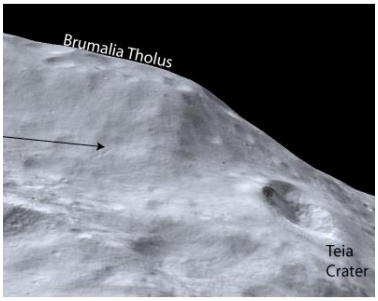
1. Introduction

The presence of basaltic compositions and textures in HED meteorites indicates that magmatic activity occurred on Vesta and could have included volcanism [3,7,8]. Given these studies, we expected that some volcanic features might be present on the surface, although they probably would have been heavily modified by impacts and thus are not easy to recognize. The search for lobate, flow-like features on the surface did not yield unequivocal morphologic evidence of ancient volcanic features [9].

Nevertheless, there are a few specific regions that could indicate ancient volcanism and magmatism, such as the "tholi" identified on Vesta [4]. We have analysed the mineralogic composition of one of these hills, Brumalia Tholus, seeking "special features" that could be indicative of volcanic/magmatic activity.

2. Brumalia tholus and Teia crater

Brumalia Tholus is an elongate hill on Vestalia Terra characterized by merged pits westward of the hill and steep slopes (fig.1a,b). Several morphological properties of Brumalia Tholus suggest that this topographic high would most likely have been formed as some type of magmatic intrusion [5].



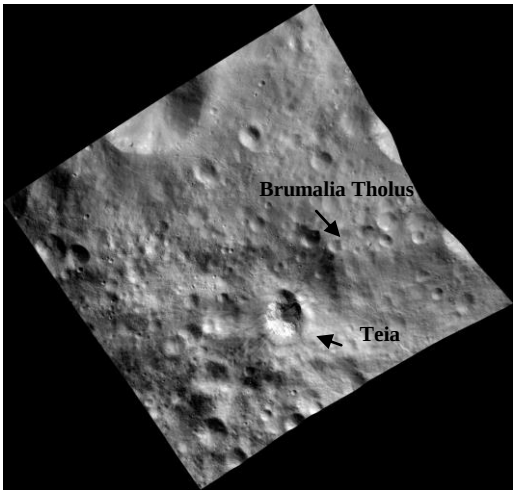


Fig.1 FC clear filter data of Brumalia tholus and Teia crater.

A relatively small and fresh crater, Teia (preservation state 1 of [10]), formed near the top of

the hill. VIR spectral data Comparing the observed spectra with the HED band centers [10,11] as plotted in the false color image in Figure 2, indicates that the Teia ejecta include flow-like material made by howardite enriched in diogenite.indicates that ejecta from Teia have distinct characteristics (Fig. 2) with respect the rest of the Brumalia Tholus terrains. Asymmetric ejecta with a smeared and flow-like texture are observed in the VIR false color image.

The overall mineralogy of this area resembles that of howardite, but deviations in band centres and depths are seen in the spectra of ejecta. Comparing the observed spectra with the HED band centers [11, 12] as plotted in the false color image in Figure 2, indicates that the Teia ejecta include flow-like material made by howardite enriched in diogenite. This distinct material is enclosed in a larger ejecta flow that is slightly enriched in eucrite. Diogenites are deep materials formed in the lower crust/upper mantle, thus can be exposed on the surface by large and deep impacts. Teia is a small, ~7 km diameter, and thus shallow crater that could not have sampled lower crust/upper mantle material unless it is anomalously close to the surface.

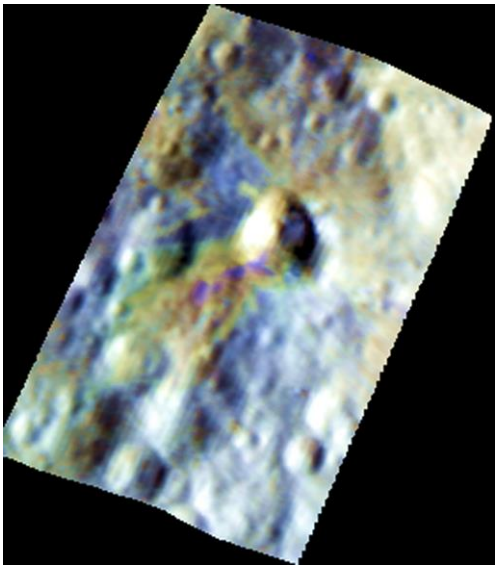


Fig.2 : False color composite of Teia crater ejecta derived from VIR data. Violet tones indicates howardite enriched in diogenite while green/yellow tones indicates howardite enriched in eucrite.

The identification of howardite with a larger amount of diogenite with respect the surrounding material in the ejecta of Teia is consistent with the presence of a subsurface magmatic intrusion. In this scenario, the Teia impact occurred on this magmatic intrusion, incorporating eucritic material from the top of the dike and diogenitic dike material from deeper down in the dike into its ejecta.

References

[1] De Sanctis M.C. et al., Space Sci. Rev., DOI 10.1007/s11214-010-9668-5 , 2010.

[2] Russell C.T et al., Science, 336, 684, 2012.

[3] McSween, H.Y., Jr. et al., Space Sci. Rev. 163, 141-174, 2011.

[4] Jaumann et al., Science 336, 687-690, 2012,

[5] Buczkowski et al., LPSC 2013.

[6] Raymond et al, 2013, LPSC 2013.

[7] Wilson and Keil, J. Geophys. Res., 101, 18, 927-18, 940, 1996

[8]Wilson L. and Keil K., Chemie der Erde Geochemistry, 72, 289-321, 2012.

[9] Williams et al., PSS, 2013.

[10]Crater paper describing the classification into types 1 to 4 from fresh to ruined craters.

[11] De Sanctis M.C. et al., Science, 336, 697, 2012

[12] De Sanctis M.C. et al., MAPS, 2013

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