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Asteroid 4Vesta's surface composition and geology

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HED meteorites (which consist of *h*owardites, *e*ucrites and *d*iogenites) are supposed to originate from asteroid 4Vesta [1] and possibly had been excavated in a huge impact event that formed the Rheasilvia impact basin located on Vesta's South Pole. Excavated material reach down to Vesta's lower crust/mantle and thus the *HED*s could provide a view into the composition of Vesta's interior. This could be verified due to the results achieved by NASA's Dawn mission, which enabled to investigate Vesta's geology and surface composition [1,2]. Especially, small impact craters (<10 km in diameter) on Vesta's surface with a photometrically distinct ejecta blanket provide the opportunity to study the composition of the un-weathered surface enabling a stratigraphical investigation [3].

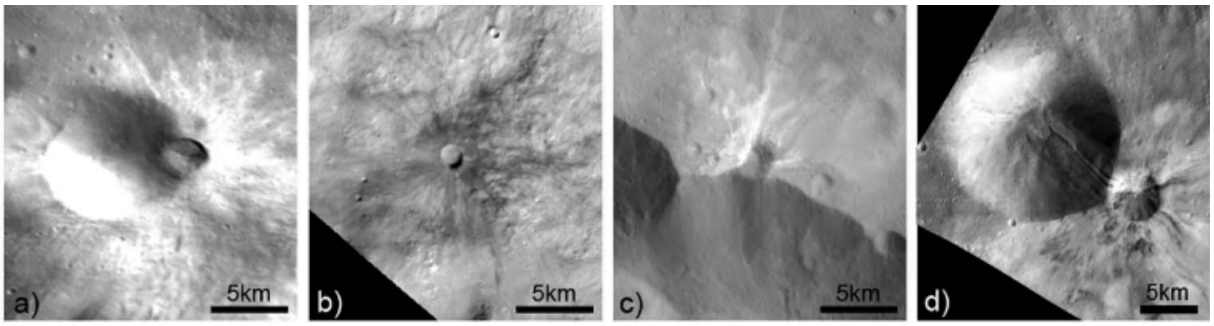

Figure 1: Type examples of small fresh impact craters on Vesta's surface: a) bright crater and ejecta; b) dark crater and ejecta; c) darker crater with bright ejecta; d) craters with bright/dark ejecta.

Dawn data reveal impact craters that differ from their surroundings in the visible albedo and the composition (Fig. 1). Bright ejecta, only seen in the equatorial portion of Vesta's southern hemisphere, are dominated by howardite/eucrite-like material as expected for Vesta's crust [2]. Dark ejecta associated with dark impact craters are dominated by a strongly absorbing, spectrally neutral compound, supporting an origin from carbon-rich impactors [4]. Few impact craters of intermediate albedo in Vesta's southern hemisphere contain material resembling diogenites, which are expected to exist in the deeper parts of Vesta's interior [2]. The results show a transition from eucritic dominated equatorial region into a diogenitic dominated composition of the Rheasilvia basin, which supports the magma-ocean model as the most plausible formation model for Vesta's interior [1]. Especially, Matronalia Rupes, the huge scarp that defines the uplifted rim of the Rheasilvia basin is dominated by diogenite [5]. The geological settings support that the eucrite-like and diogenite-like ejecta represents material excavated and re-deposited by the Rheasilvia impact event and became re-excavated by more recent impacts. Whereas, the eucrite-like material became excavated during the early stage of the excavation period, the diogenitic ejecta represent material excavated from a greater depth of Vesta's crust during the latest stage of the impact event. On the contrary, the asymmetry in the distribution of

diogenite-rich outcrops in the northern parts, i.e. the depletion of these deposits in the Veneneia region, is at odds with the equally distributed plutonic intrusions of diogenitic-rich material as proposed in the serial magmatism model but could be explained by an uneven distribution of its ejecta on Vesta due to an oblique Rheasilvia impact.

References:

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