

The Distribution of Diogenitic Material on Vesta in Comparison with Rheasilvia Ejecta. N. Schmedemann^{1,2}, A. Neesemann², F. Schulzeck³, K. Krohn³, I. von der Gathen³, K. A. Otto³, R. Jaumann^{2,3}, G. Michael², A. Nathues¹, G. Thangjam¹, T. Platz¹, M. Hoffmann¹, C. A. Raymond⁴, C. T. Russell⁵, ¹Max Planck Institute for Solar System Research, Justus-von-Liebig-Weg 3, 37077, Göttingen, Germany, ²Institute of Geological Sciences, Freie Universität Berlin, Berlin, Germany; ³German Aerospace Center, Institute of Planetary Research, Berlin, Germany; ⁴JPL, Caltech, Pasadena, CA, USA, ⁵University of California, Los Angeles, CA, USA. (nico.schmedemann@fu-berlin.de)

Introduction: The ~500 km Rheasilvia impact on Vesta is the most recent basin-forming event on Vesta as indicated by the basin morphology that is not superimposed by any other basin [1,2]. Rheasilvia itself superimposes the older ~370 km diameter Veneneia basin, including its central peak area. Hydrocode impact modelling [3] indicated that the combined effect of both impacts likely excavated material not only from the basaltic crust but also from the mantle of Vesta. Observations by the Dawn spacecraft did not reveal large amounts of olivine, indicative of mantle material on the surface of Vesta [4]. Olivine that was identified on the surface of Vesta, appears not to be related to the Rheasilvia impact and has been linked to a likely exogenic origin [5], leaving the question for the missing Rheasilvia – excavated olivine unanswered. Color ratio data does show diogenitic material that stretches out from inside the Rheasilvia basin into the northern hemisphere. Here we investigate whether the observed distribution of diogenitic material is consistent with Rheasilvia ejecta.

Methods: For the identification of diogenitic material on the surface of Vesta we use the F3(749 nm)/F4(917 nm) color filter ratio of the Dawn Framing Camera [6]. This ratio is usually used for the green color channel in Dawn - “Clementine” color ratios e.g. [7].

We developed an ejecta model based on the ejecta scaling by [8] and crater scaling by [9]] to calculate the trajectories and distribution of excavated material. The ejecta tracer particles do not interact with each other but are simulated interacting with the gravity field of Vesta. The gravitational disturbances of the major planets as well as the Vestan gravity anomalies are taken into account up to degree 20 [10]. For simplicity, we further use the current state of rotation and topography of Vesta in our simulation, although both likely changed during the formation of the Rheasilvia basin. In order to simplify the calculations, the Vestan topography and gravity field were generalized to arrays with 1 by 1 degree resolution. We further assume a symmetrical geometry of the particle ejection angles and velocities. All particles are ejected at an angle of 45° with respect to the local surface and at the same velocity, if the distance of their ejection point from the

center of impact is equal. As center coordinates of the Rheasilvia basin we use 310°E longitude and 75°S latitude and a basin diameter of 505 km.

Results: Due to the high rotation rate of only 5.3 hours per revolution crater ejecta on Vesta are subject to strong Coriolis effects. Similar simulations on Ceres [11,12,13] did show a NW-SE oriented arcuated accumulation of reimpacted tracer particles a few degrees east of the source crater for craters in the southern hemisphere. This feature is a result of the change in propagation direction of the backfalling ejecta curtain for eastward ejected material. The change in propagation direction occurs only for very high and far flying particles. The feature is most prominent for craters close to the equator and disappears if the source crater is located at very high latitudes.

In our simulation of Rheasilvia ejecta we find the feature described above in the northern part of Feralia Planitia continuing into NW direction in the northern part of Postumia and further into the North Pol area. It is essentially parallel to but north of Saturnalia Fossae (Fig. 1, center panel).

In the F3/F4 color ratio the region around Feralia Planitia between 210°E and 100°E and from the rim of Rheasilvia to at least 75°N shows relatively high values. With highest values correlated with fresh craters e.g. Fabia and Teia possibly indicating an optical maturation of the surficial material with respect to deeper situated material [14]. The center of this region shows lower values, while the eastern part is more pronounced with high values (Fig. 1, bottom panel).

In general the location of the modelled Coriolis force related ejecta accumulation is in the region of relatively high F3/F4 color ratios. However, correlation in shape and extent of color ratios and modelled ejecta accumulation is much less obvious than found in a similar simulation conducted for the relatively young Urvara crater on Ceres [12,13]. Rheasilvia may not be the one and only source of diogenitic material on Vesta but other large craters may have excavated deep situated material as well. Also, prolonged impact gardening could have diluted the signature of the Rheasilvia related accumulation of impact ejecta. Further, it may be possible that assumptions and simplifications in our model do not reflect the formation conditions of the

Rheasilvia ejecta very well. Although our ejecta model did produce results in very good agreement with observations on Ceres and the mid-sized Saturnian satellites [13], there are questions yet to be answered in the case of Vesta. Solving these issues may improve our understanding in terms of cratering and ejecta distribution on Vesta.

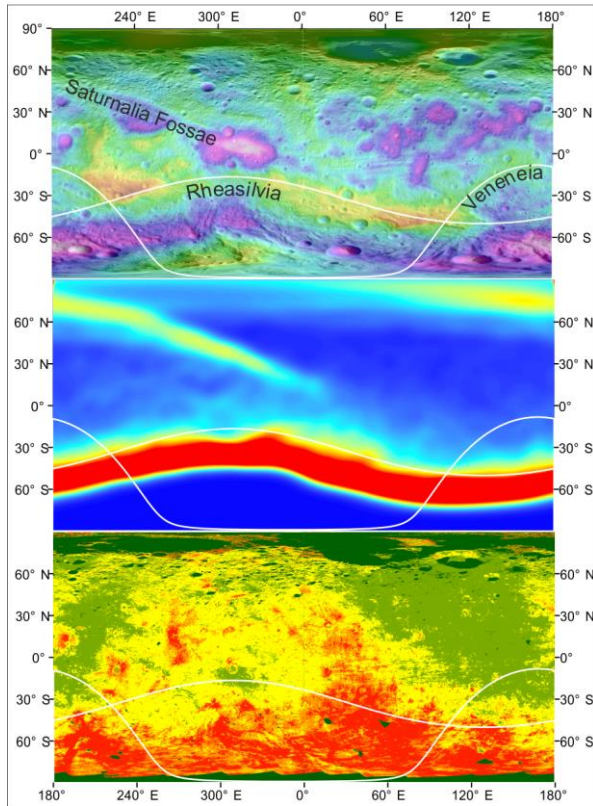


Fig.1: Top Panel: Global clear filter map of Vesta color coded with topographic data. Warmer colors represent higher elevation with respect to a two axial ellipsoid. White outlines indicate the rims of the Rheasilvia and Veneneia basins. Center Panel: Kernel density map of impact positions of Rheasilvia ejecta tracer particles. Warmer colors give higher relative densities. Bottom Panel: F3/F4 color ratio map highlighting diagenitic material on the surface of Vesta. Warmer colors indicate higher ratio values, indicative of higher content of diagenitic material.

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