EPSC Abstracts
Vol. 7 EPSC2012-**PREVIEW** 2012
European Planetary Science Congress 2012

Unusual bimodal craters on slopes, Vesta

K. Krohn (1), R. Jaumann (1,2), K. Stephan (1), D. Elbeshausen (3), F. Preusker (1), T. Roatsch (1), K. Otto (1), K.D. Matz (1), C.A. Raymond (4) and C. T. Russell (5)
(1) Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany, (2) Freie Universität Berlin, Inst. of Geosciences, Planetology and Remote Sensing, (3) Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany (4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, (5) UCLA, Institute of Geophysics, Los Angeles, USA (Katrin.Krohn@dlr.de)

1. Introduction

NASA's *Dawn* spacecraft entered orbit of the inner main belt asteroid 4 Vesta on July 16, 2011, and is spending about one year in orbit to characterize the geology, elemental and mineralogical composition, topography, shape, and internal structure of Vesta before departing to asteroid 1 Ceres in late 2012 [1]. Detailed studies of the geological characteristics of Vesta's surface exhibits a complex morphology of impact crater: Numerous impact craters are characterized by unusual distribution of ejecta and/or shape of the crater rim indicating peculiar conditions during the impact process [2, 3].

2. Unusual craters

Vesta exhibits extreme topographic variations, causing many craters to be formed on slopes. The asymmetrical shape of these craters shows one sharp and one smooth rim [4]. DTMs and profiles of these unusual craters normally reveal a steep slope uphill and a shallower one downhill, like the crater Helena (Fig.1) [4]. Another expression of this phenomenon is craters with a wider crater floor, which passes into the downhill slope with a reduced crater rim (Fig.2) [4]. The formation of these unusual craters is controlled by the topographic conditions, and thus by the steepness of the slopes [2].

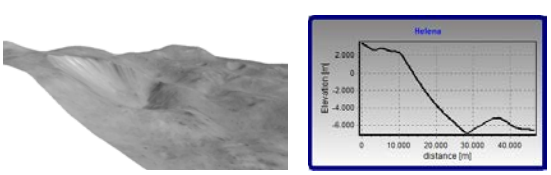

Fig.1: Helena crater, formed on a slope, shows a smooth downhill and a sharp uphill rim, a narrow crater floor, and a prominent unit boundary between the uphill and downhill crater regions.

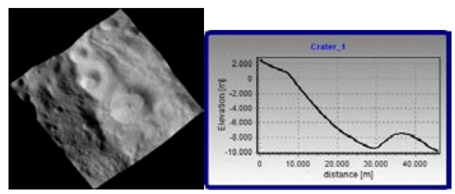

Fig.2: This crater, also formed on a slope, has smooth and a sharp rim expression as well. The crater floor is very flat and the downhill rim passes into the overall slope [2].

3. Investigations

For our investigations we record the unusual craters and measure the size and the ejecta direction. Correlating the craters according to the slope angles (Fig. 3) of Vesta we obtain the following crater size distribution:
On slopes between 10° and 40° we mostly find crater sizes from 0.2 to 15 km, with a maximum between 0.2 and 7 km, and only a few bigger craters up. On slopes > 40° we observe craters from 0.7 to 37 km, with a maximum between 5 and 20 km.

4. Future work

Upcoming higher-resolution images and DTMs will allow us to quantify the angle of repose, ejecta thickness and distribution. Additional spectral information will allow us to estimate the composition of the crater rim and ejecta material. This information will enable us to understand the mechanical process of mass wasting on Vesta, and its different stages [4].

Three-dimensional hydrocode simulations with iSALE-3D [5,6] of the cratering process help to quantify the effect of topography on crater shape and ejecta distribution. Some preliminary results illustrating the formation of a crater similar to Helena are shown in Figure 4.

References

[1] Russell, C.T. et al.: Dawn at Vesta: Accomplishments and Plans, LPSC, 19-23 March 2012, The Woodlands, Texas, 2012.

[2] Jaumann, R. et al.: Vesta's Shape and Morphology, Science, Vol. 336, pp. 687, 2012.

[3] Schenk, P.: Mega-Impacts into Planetary Bodies: Global effects of the Giant Rheasilvia Impact Basin on Vesta, LPSC, 19-23 March 2012, The Woodlands, Texas, 2012.

[4] Krohn, K. et al.: Scarps and unusual craters in the Sextilia Region on Vesta, ACM, 16-20 May 2012, Niigata, Japan, 2012.

[5] Elbeshausen D., Wünnemann K. and Collins G.S. (2009) Scaling of Oblique Impacts in Frictional Targets: Implications for Crater Size and Formation Mechanisms. Icarus 204, 716-731,

[6] Elbeshausen D. and Wünnemann K. (2011). iSALE-3D: A three-dimensional, multi-material, multi-rheology hydrocode and its applications to large-scale geodynamic processes. In: Proceedings of 11th Hypervelocity Impact Symposium (HVIS), Fraunhofer Verlag.

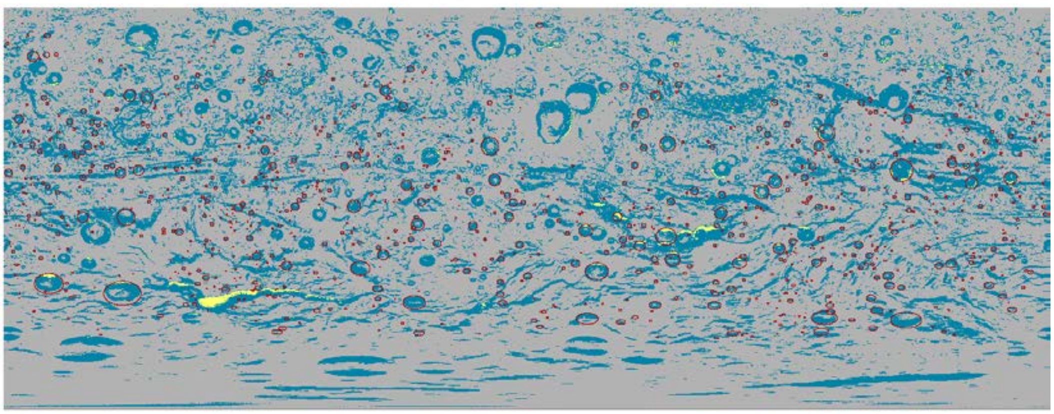

Fig. 3: Slopemap of Vesta with the unusual crater distribution (grey: slopes 0-20°, blue: slopes 20-40°, Yellow: slopes > 40°)

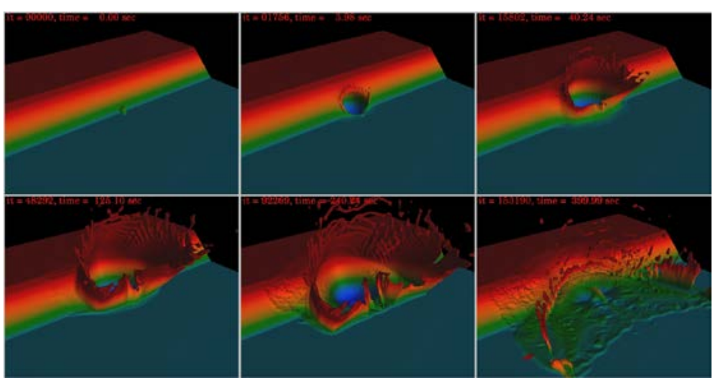

Fig. 4: Numerical simulation of crater formation (similar to Helena) after an impact into a tilted target.