GEOLOGIC MAPPING OF THE AV-2 BELLICIA QUADRANGLE OF ASTEROID 4 VESTA. O. Ruesch[1], H. Hiesinger[1], N. Schmedemann[2], T. Kneissl[2], D.T. Blewett[3], D.A. Williams[4], C.T. Russell[5], C. A. Raymond[6], [1]Institut für Planetologie, Westfälische Wilhelms-Univerität Münster, Münster, Germany (ottaviano.ruesch@uni-muenster.de), [2]Institute of Geosciences, Freie Universität Berlin, Berlin, Germany, [3]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA, [4]Arizona State University, Tempe, AZ, United States, [5]University of California, Los Angeles, Institute of geophysics, Earth and Space Science, Los Angeles, CA 90095-1567,United States, [6]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, United States.

Introduction: The Dawn spacecraft entered its orbit around the asteroid Vesta on July 16, 2011. By March 2012 Vesta will have been observed from three different orbits of decreasing altitude (2420 km, 670 km and 180 km) and by three instruments: a framing camera (FC), a visible and infrared mapping spectrometer (VIR) and a gamma-ray and neutron spectrometer (GRaND). The large size of Vesta and its particular basaltic surface imply that the asteroid has experienced a planetary scale differentiation with extensive melting and formation of a basaltic crust [1]. Thus, studying Vesta could be equivalent to studying an intact protoplanet, i.e., a survivor of the very early Solar System.

Here we focus on Dawn Framing Camera images to investigate the geology of the surface of the Bellicia (Av-2) quadrangle, located at 21° N-60° N and 0° E-90° E. Our mapping effort will allow us to establish the geologic context for the compositional investigations by VIR and GRaND data.

Methods: The first step in our analyses is the geologic mapping of Vesta within the Dawn Mapping Working Group. Unfortunately, illumination conditions of our quadrangle limit the observation from 21° N to 45° N. Our map is primarily based on morphologic observations in clear filter FC images and derived Digital Terrain Models (DTMs) [2]. Images with 70-m pixel scale acquired from the high altitude mapping orbit (HAMO) were used. In addition, we employ ~30 m/pixel images obtained from the low altitude mapping orbit (LAMO) to refine our map. Compositionally similar units are mapped on the basis of false-color images from FC multispectral data (430-1000 nm).

Impact craters are the dominant features on planetary bodies and by means of crater size-frequency distribution (CSFD) measurements the surface evolution can be inferred. If the impactor flux is known, absolute model ages can be calculated. For our study we use a lunar-like production function and chronology function [3]. However, several poorly constrained parameters [4] result in non-negligible uncertainties in absolute model ages. Using a lunar-like production function, crater counts can still be used to derive relative ages of geologic units on Vesta. For comparison, we performed crater counts of a region with a different morphology from the “Bellicia” quadrangle. The region is located in the “Rheasilvia” quadrangle and broadly corresponds to the central peak of the great south pole impact crater.

Results: Our preliminary map of the Av-2 “Bellicia” quadrangle is presented in Figure 1. The quadrangle is dominated by a heavily cratered unit with impact craters in a wide variety of degradation states. A second unit is defined by relatively flat, homogeneously smooth and less-heavily cratered areas. This unit corresponds to ejecta blankets of >5 km large, fresh appearing impact craters. A third unit is characterized by a smooth, inclined surface. We also observed features (<20 km), which we interpret as slump material on crater walls and lobate material on intracrater plains. Crater chains are present, but lack a clear impact crater source, thus most likely originate from several impact craters. Similar to some impact craters in the equatorial region, a dark rayed impact crater ejecta has been observed at 39° N, 71° E.

At LAMO resolution, smooth areas are observed to be related to crater ejecta. These areas may occur in topographic lows and smaller examples (<5 km) are also found on topographic highs. Dark-ray albedo features were observed on smooth ejecta deposits of impact craters with fuzzy boundary, probably indicating very fine material.

Impact crater CSFDs broadly agree with the lunar-like production function at large diameters (Figure 2). For diameters <~10km the Bellicia and Rheasilvia quadrangles' CSFD behave differently. The Rheasilvia distribution generally follows the isochrone, whereas the Bellicia CSFD is too steep.

Discussion: The Av-2 “Bellicia” quadrangle shares the high density of impact craters with other northern quadrangles. However, the Bellicia quadrangle is unique among the northern hemisphere quadrangles because it lacks troughs or ridges. This makes the Bellicia quadrangle one of the oldest areas of Vesta not affected by tectonism. The ejecta of fresh impact craters is homogeneous in color and albedo, indicating that the impacts excavated material from a relatively homogeneous crust. In one case, however, dark-rayed ejecta may express differences in the excavated material with depth. However, at least for some dark rays we can not exclude the possibility that they were formed by down-slope movements, i.e., mass wasting. Alternatively, dark material could come from the impactor itself (e.g., residual carbonaceous material). Smooth areas found on crater ejecta can be plausibly interpreted as impact-melt pools. Smooth areas not in topographic lows, however, might have other origins.

For large craters, the Bellicia CSFD may be fitted with two isochrones, indicating resurfacing. The steep slope for diameters <~10km may be explained by the presence of an additional impactor population with limited projectile sizes. The impactors could be secondary craters from a large impact, but the low escape velocity of Vesta seems contradicting this option [5]. A collision in the neighborhood of Vesta could be another source for projectiles. Whatever the origin is, the lack of a steepening in the younger "Rheasilvia" terrain seems to indicate that the event is related to the early history of Vesta.

Conclusions: On the basis of our preliminary investigation, we conclude that (1) in the Av-2 Bellicia quadrangle the dominance of impact craters contrasts with earlier hypotheses of extensive volcanic material on Vesta [6] ; (2) impact craters played a role in excavating possible volcanic material and in covering the surface with impact-derived material; (3) our CSFD measurement of the Bellicia quadrangle shows a steepening for craters smaller than ~10 km. The origin of this distinctive pattern needs further investigation.

References: [1] Pieters, C .M. et al. (2011) *Space Sci. Rev.* [2] Sierks H. et al. (2011) *Space Sci Rev*. [3] Neukum, G. et al. EPSC-DPS2011-501-1. [4] Ivanov B.A. (2001), *Space Sc. Rev.,* 96, No.s 1-4. [5] Bierhaus et al. (2011) *LPS XLII* Abstract #2616 [6] Wilson L. et al. (1996) *JGR* 96JE01390

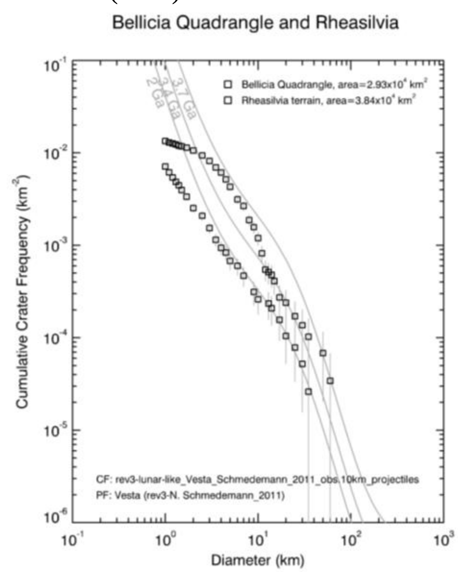

Figure 2. Crater SFD for the Av-2 "Bellicia" quadrangle and Rheasilvia south pole terrain.

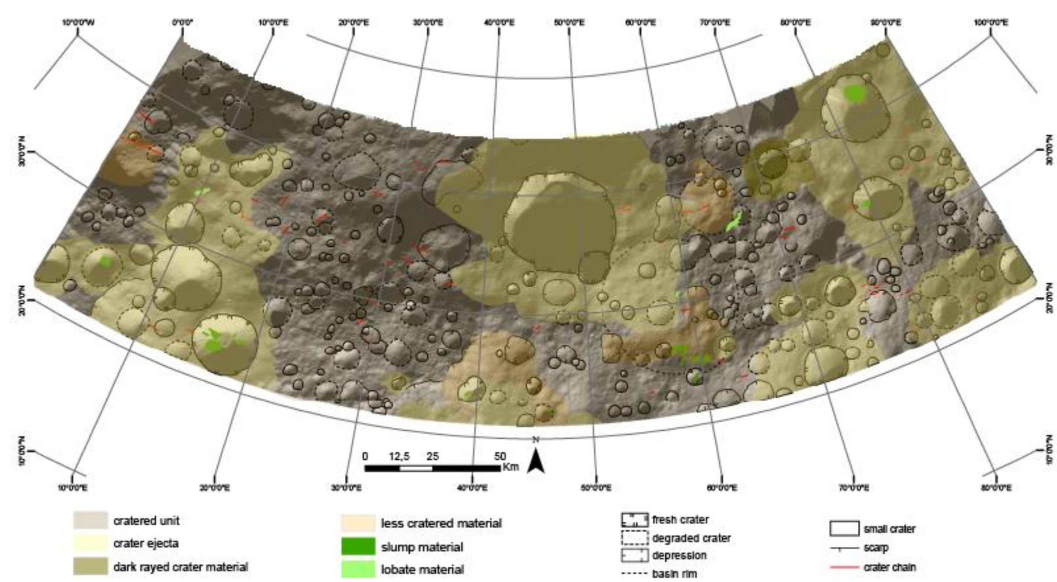

Figure 1. Map of Av-2 "Bellicia" quadrangle. Three units are distinguished: a high cratered unit, a smooth impact crater ejecta unit and a less cratered unit.