TOPOGRAPHY OF VESTA FROM DAWN FC STEREO IMAGES. Frank Preusker[1], Frank Scholten[1], Klaus-Dieter Matz[1], Ralf Jaumann[1], Thomas Roatsch[1], Carol A. Raymond[2], Christopher T. Russell[3], [1]German Aerospace Center, Institute of Planetary Research, D-12489 Berlin, Germany (Frank.Preusker@dlr.de), [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109-8099, USA, [3]UCLA, Institute of Geophysics, Los Angeles, CA 90095-1567, USA

Introduction: The Dawn mission has completed its Survey and High Altitude Mapping Orbit (HAMO) phases at Vesta and is currently in its Low Altitude Mapping Orbit (LAMO) [1]. From the Survey orbit (altitude ~2,700 km) the Dawn Framing Camera (FC) [2] acquired 1,179 clear filter images with a mean image resolution of 256 m/pxl whereas from the HAMO orbit (~700 km altitude) there are 2,674 clear filter images with a mean resolution of 63 m/pxl. In both mapping phases the surface was imaged several times under similar illumination conditions (Sun elevation and azimuth), but different viewing conditions (by tilting the spacecraft). This allows to analyze the images stereoscopically and to construct stereo topographic maps. The topography is particularly important, because it is essential for:

- derivation of physical properties of Vesta
- precise ortho-image registration, mosaicking, and map generation of monochrome/color FC images and VIR images
- quantitative geomorphologic analysis and
- precise photometric analysis (from detailed local surface inclination).

Methods: The stereo-photogrammetric processing for Vesta is based on a software suite that has been developed within the last decade. It has been applied successfully to several planetary image data sets [3-9] and covers the entire workflow from photogrammetric block adjustment to digital terrain model (DTM) and map generation.

Differences in illumination	<5°
Stereo angle	15-55°
Incidence angle	0-85°
Emission angle	0-60°
Phase angle	5-160°

Table 1. Requirements for stereo processing.

Results: We constrained all Survey clear filter images with our stereo requirements (Table 1) and achieved at least triple stereo image coverage for the entire illuminated surface. In total, about 3,500 independent multi-stereo image combinations were used to determine selected image tie points by multi-image matching for the set-up of a 3D control network of ~7,000 surface points. The control point network defines the input for the photogrammetric least squares adjustment where corrections for the nominal navigation data (pointing and position) are derived. The three-dimensional (3D) point accuracy of the resulting ground points have been improved from ±360 m to ±34 m (0.15 pxl). We have also refined Vesta's spin axis orientation, formerly determined from Earth-based observations [10, 11], to: right ascension = 309.031° ± 0.01°, declination = 42.235° ± 0.01°). Finally, 3,500 individual multi-image matching processes at full image resolution were carried out to yield ~750 million object points. The achieved mean forward ray intersection accuracy of the ground points is ±35 m, which is comparable to absolute 3D point accuracy [12]. Finally, we have generated a DTM with a lateral spacing of 450 m/pxl (10 pxl/degree) and a vertical accuracy of about 30 m (Fig. 2). The Survey DTM covers approximately 78% of Vesta's surface. Radii vary by about 80.5 km (from 212.1 to 292.6 km). The most dominant topographic feature is the large (~500 km diameter) South Pole basin Rheasilvia (Fig 1).

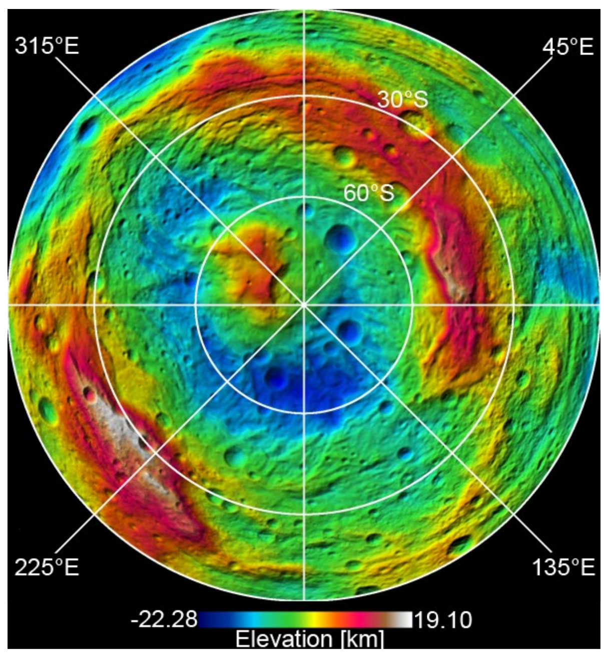

Figure 1. Survey DTM of the southern hemisphere of Vesta with a lateral spacing of 450 m (hill-shaded color-coded heights) in Lambert azimuthal projection (equal-area). Heights refer to a 2-axial ellipsoid (285x229 km).

Based on the entire Survey DTM (Fig. 2), we determined a best-fit ellipsoid (286.3/278.6/223.2 km) with its body long axis at 40.6°E w.r.t. the new reference system [1]. Compared to results from Earth-based observations [10], these values are smaller by about 4%. Finally, ortho rectified Survey images and image mosaics have been derived based upon the adjusted orientations and the Survey DTM as the topographic reference [13].

Outlook: We will update and refine the Vesta DTM based upon stereo-images from the HAMO orbit and will present the results at the conference. A final version of the Vesta DTM and an overall re-assessment of Vesta's geophysical properties can be expected from the analysis of the entire DAWN FC image dataset of Vesta (from Survey, HAMO, and LAMO orbit) when the Dawn spacecraft will have left Vesta, heading towards its next target, Ceres, the largest asteroid in the solar system.

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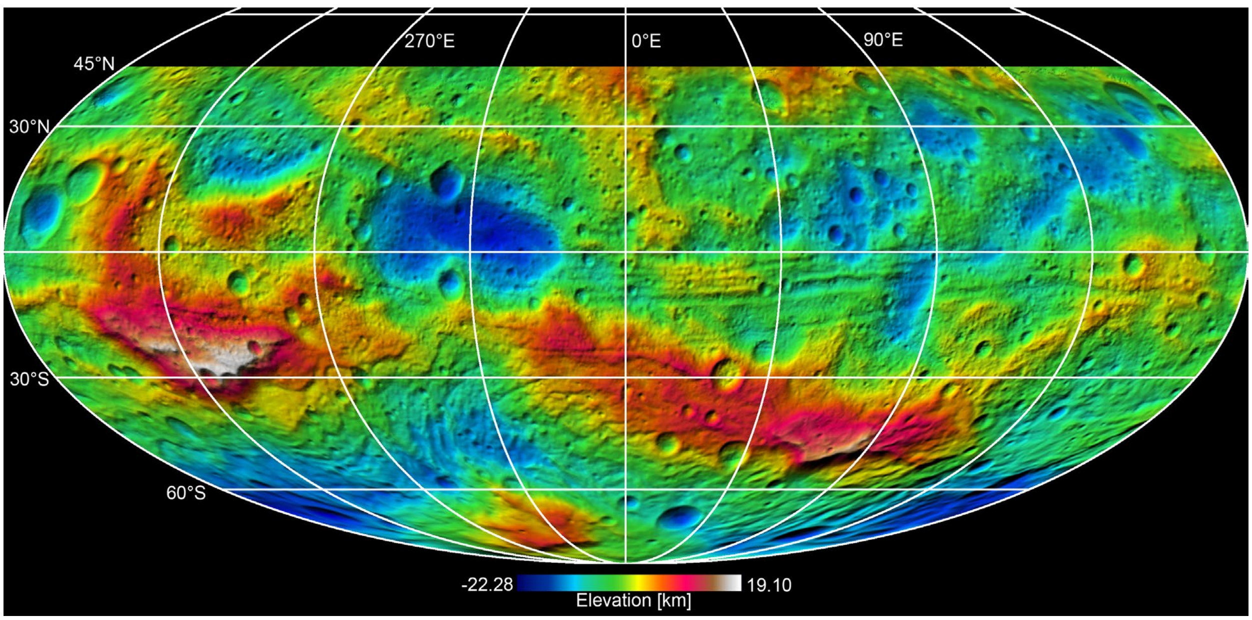

Figure 2. Global Survey DTM of Vesta with a lateral spacing of 450 m (hill-shaded color-coded heights) in Mollweide Projection (equal-area). Heights refer to a 2-axial ellipsoid (285x229 km).