Planetary and Space Science 73 (2012) 283–286

Contents lists available at SciVerse ScienceDirect

Planetary and Space Science

journal homepage: www.elsevier.com/locate/pss

High resolution Vesta High Altitude Mapping Orbit (HAMO) Atlas derived from Dawn framing camera images

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ARTICLE INFO

Article history:
Received 30 May 2012
Received in revised form
1 August 2012
Accepted 21 August 2012
Available online 29 August 2012

Keywords:
Dawn
Vesta
Asteroids
Planetary mapping

ABSTRACT

The Dawn framing camera (FC) acquired about 2500 clear filter images of Vesta with a resolution of about 70 m/pixels during the High Altitude Mapping Orbit (HAMO) in fall 2011. We ortho-rectified these images and produced a global high resolution controlled mosaic of Vesta. This global mosaic is the baseline for a high resolution Vesta atlas that consists of 15 tiles mapped at a scale of 1:500,000. The nomenclature used in this atlas was proposed by the Dawn team and was approved by the International Astronomical Union (IAU). The whole atlas is available to the public through the Dawn GIS web page [http://dawn_gis.dlr.de/atlas].

1. Introduction

The Dawn mission has been mapping Vesta from three different orbital heights during Survey orbit (2700 km altitude), HAMO (High Altitude Mapping Orbit, 700 km altitude), and LAMO (Low Altitude Mapping Orbit, 210 km altitude) (Russell and Raymond, 2011). The Dawn mission is equipped with a framing camera [FC (Sierks et al., 2011)], which was the prime instrument during the HAMO phase. Dawn orbited Vesta during HAMO in 6 cycles between the end of September and early November 2011. The framing camera took about 2500 clear filter images with a resolution of about 70 m/pixel during these cycles. The images were taken with different viewing angles and different illumination conditions. Images from one cycle (cycle #3, image numbers 9899–10429) were selected for the mosaicking process to have similar viewing and illumination conditions. Cycle #3 with 518 images was selected since it was the first cycle with almost complete global coverage. Very minor gaps in the coverage were filled with three images from cycle #4 (image numbers 10559, 10632, and 10741).

Details of the image processing will be described in Section 2. Section 3 summarizes the high-level cartographic work that produced our high resolution atlas, which consists of 15 map tiles of the different regions of Vesta. Two examples of these map tiles are shown. A brief overview of future work is given in Section 4.

2. Data processing

The image data returned from the spacecraft are distributed inside the Dawn team in PDS (Planetary Data System) format [http://pds.jpl.nasa.gov]. The first step of the image processing pipeline is the conversion to VICAR (Video Image Communication and Retrieval) format [http://rushmore.jpl.nasa.gov/vicar.html] followed by the radiometric calibration of the images.

The next step of the processing chain deals with the ortho-rectification of the images into a cartographic map projection at a specified scale. This process requires detailed information with regard to Vesta's global shape. Vesta is best described by a global digital terrain model as derived from FC images by Preusker et al. (2012) and Jaumann et al. (2012). However, to facilitate comparison and interpretation of the maps, the DTM was used only for the calculation of the surface intersection points of the line of sight vectors, while the map projection itself was done onto a sphere with the mean radius (255 km). The Dawn orbit and attitude data used for the calculation of the surface intersection points are provided as SPICE kernels [http://naïf.jpl.nasa.gov] and were improved using a bundle-adjustment technique (Preusker et al., 2012). A cylindrical equidistant map projection was chosen

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http://dx.doi.org/10.1016/j.pss.2012.08.021

for the global mosaic. The coordinate system adopted by the Dawn mission for satellite mapping is the IAU "planetographic" system, consisting of planetographic latitude and positive east longitude. But because a spherical reference surface is used for map projections of the satellites, planetographic and planetocentric latitudes are numerically equal. The longitude system of Vesta is defined by the tiny crater Claudia which is located at 356° east (Russell et al., 2012). Mosaicking of the single images was the final step of the image processing.

The Dawn team proposed 50 names for geological features. By international agreement, the features must be named after Roman Vestals, famous Roman women, cities in which the cult of Vesta is known, or festivals in which the Vestals participated. The nomenclature proposed by the Dawn team was approved by the IAU [http://planetarynames.wr.usgs.gov/] and is shown in Fig. 1.

3. Vesta map tiles

The Vesta atlas was produced in a scale of 1: 500,000 and consists of 15 map tiles that conform to the quadrangle scheme proposed by Greeley and Batson (1990) for medium-sized planetary bodies (Fig. 2). A map scale of 1: 500,000 guaranteed a mapping at the highest available HAMO resolution and results in an acceptable printing scale for the hardcopy map of 7 pixel/mm. The individual tiles were extracted from the global mosaic and reprojected, coordinate grids were superposed as graphic vectors and the resulting composites were converted to the common PDF-format. The equatorial part of the map (from 22 S to 22 N latitude) is in Mercator projection onto a secant cylinder using standard parallels at 13 S and 13 N latitude. The regions between the equator region and the poles (from 66 S to 21 S and from 21 N to 66 N latitude) are in Lambert's conformal conic projection with

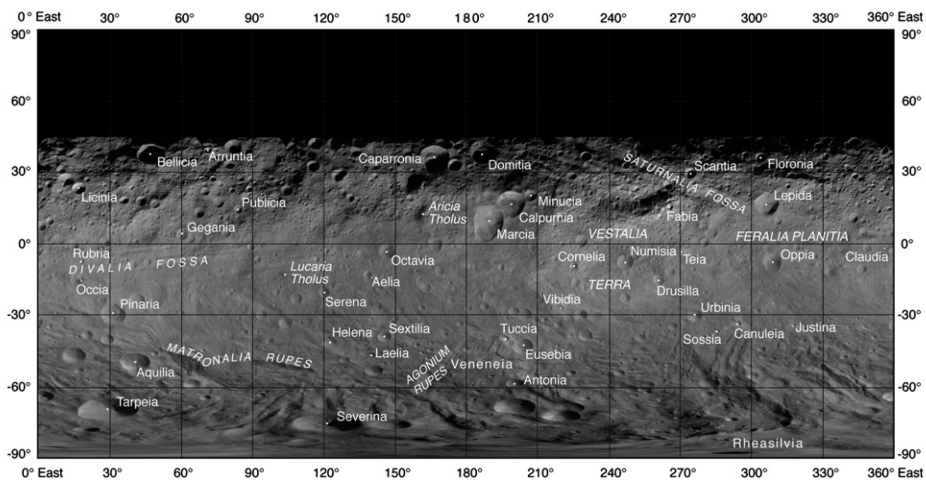

Fig. 1. Global mosaic of Vesta with nomenclature.

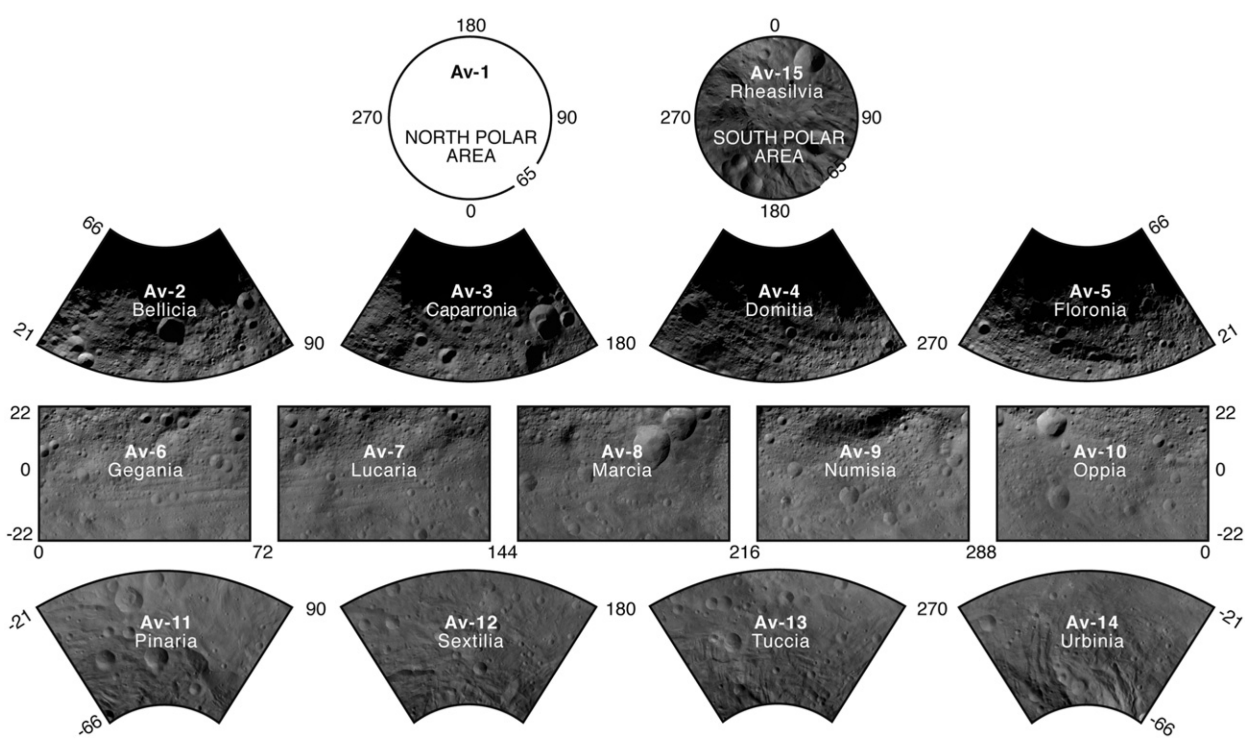

Fig. 2. Quadrangle scheme filled with the 15 Vesta tiles.