Planetary and Space Science 85 (2013) 293–298

Contents lists available at ScienceDirect

Planetary and Space Science

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

High-resolution Vesta Low Altitude Mapping Orbit Atlas derived from Dawn Framing Camera images

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ARTICLE INFO

Article history:
Received 25 April 2013
Received in revised form
7 June 2013
Accepted 25 June 2013
Available online 1 July 2013

Keywords:
Dawn
Vesta
Asteroids
Planetary mapping

ABSTRACT

The Dawn Framing Camera (FC) acquired close to 10,000 clear filter images of Vesta with a resolution of about 20 m/pixel during the Low Altitude Mapping Orbit (LAMO) between December 2011 and April 2012. We ortho-rectified these images and produced a global high-resolution uncontrolled mosaic of Vesta. This global mosaic is the baseline for a high-resolution Vesta atlas that consists of 30 tiles mapped at a scale between 1:200,000 and 1:225,180. 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 mapped 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 has one clear filter and seven band pass filters. Clear filter images which were taken during HAMO were used to produce a global mosaic of the illuminated part of Vesta with a resolution of 70 m/pixel and a 15-tile atlas at a scale of 1:500,000 (Roatsch et al., 2012). The FC took about 10,000 clear filter images at low altitudes in LAMO which allowed us to produce a global mosaic of Vesta with a resolution of 20 m/pixel and a 30-tile atlas. This LAMO atlas is a higher-resolution supplementary atlas to the known HAMO atlas (Roatsch et al., 2012), the 15-tile atlas will still be used for geological and mineralogical mapping (e.g. Blewett et al., 2012, Williams et al., 2012). The LAMO mission phase occurred during Northern winter which kept the north pole region in darkness; only 84% of the surface was illuminated, as shown in Figs. 1 and 2. The color codes represent the best geometric resolution of the acquired images at the respective surface position. This includes images which were taken with high incidence angles (between 70° and 90°); good illumination (incidence angle < 70°) was only available for 66.8% of the surface.

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 30 map tiles of different regions of Vesta. Three examples of these map tiles are shown.

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 photogrammetric image processing towards a global orthoimage mosaic. LAMO images were acquired in nadir-viewing mode and therefore do not permit stereo reconstruction. In contrast to stereo-processing of Dawn HAMO data (Preusker et al., 2012), the original Dawn orbit and altitude data, provided as SPICE kernels [http://naïf.jpl.nasa.gov], were therefore used without further block adjustment. For the detection of surface intersection points within the derivation of LAMO FC orthoimages, a global digital terrain model (DTM) derived from images taken in HAMO-1 and HAMO-2 phases (Preusker et al., 2012, Jaumann et al.,

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http://dx.doi.org/10.1016/j.pss.2013.06.024

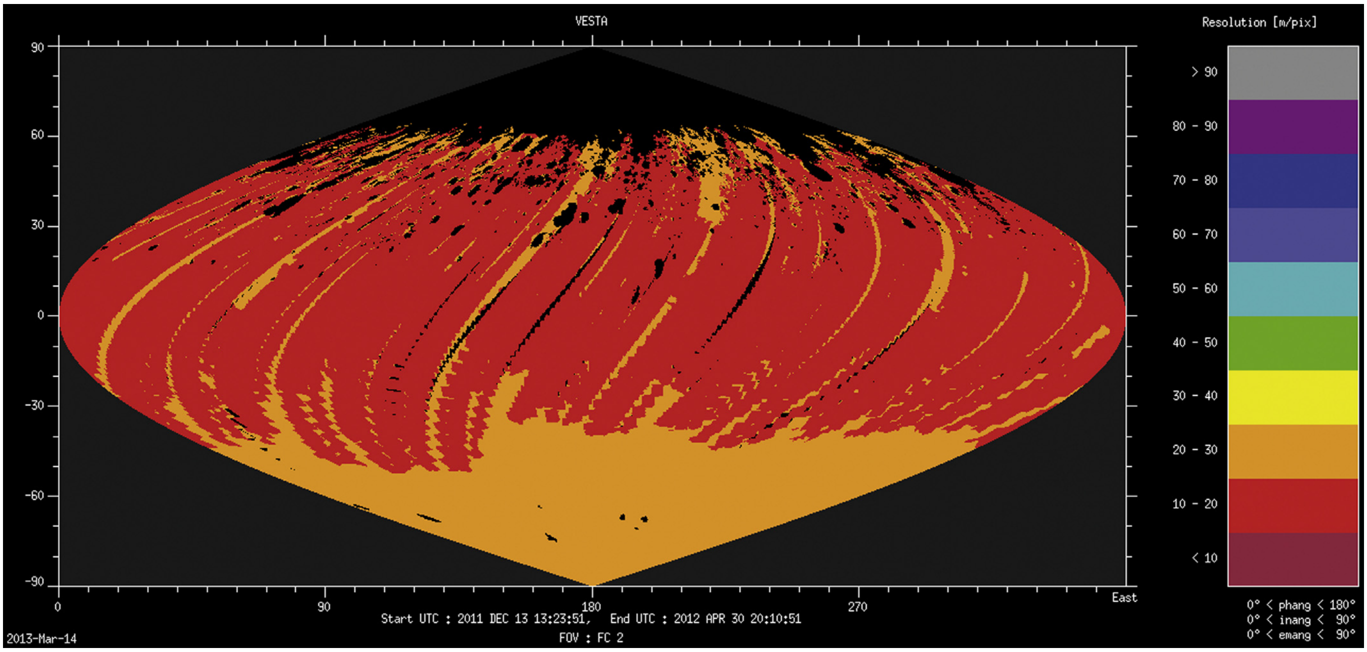

Fig. 1. Global LAMO coverage in sinusoidal projection.

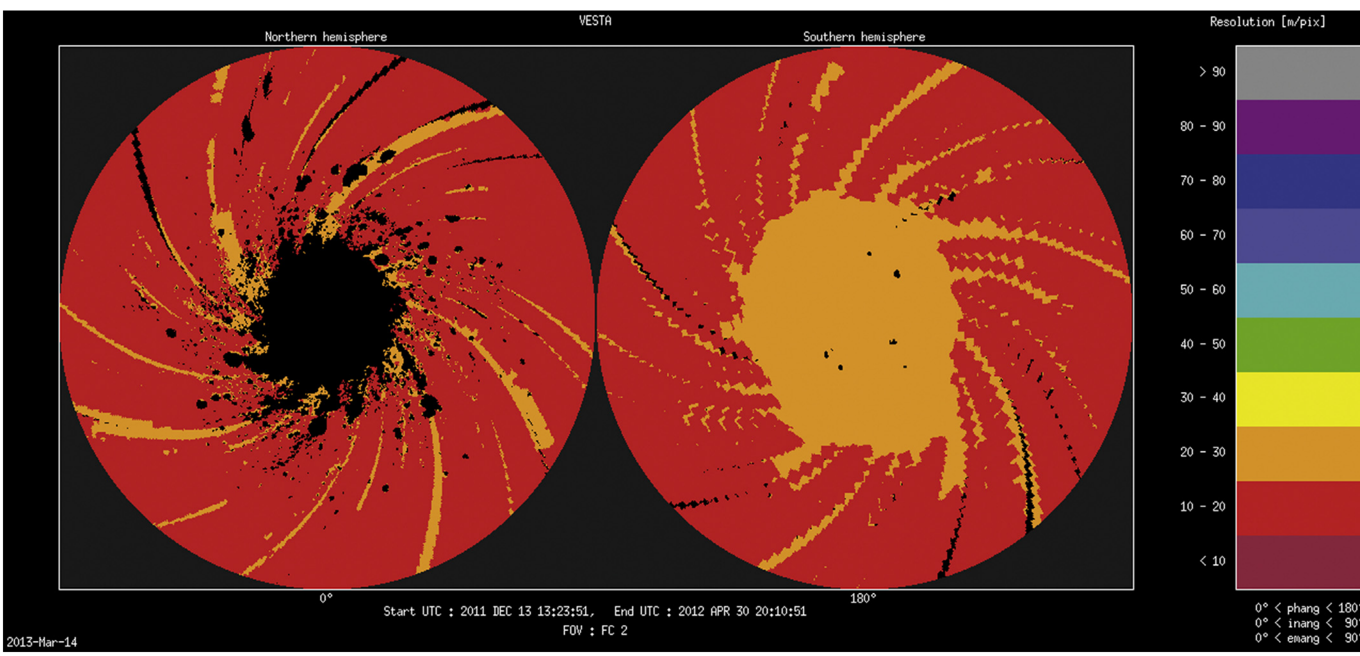

Fig. 2. LAMO coverage of both hemispheres in stereographic projection. The color codes represent the best geometric resolution of the acquired images at the respective surface position.

2012) was used as the topographic reference body while a sphere with a radius of 255 km was chosen as the reference body for the map projection. This approach (topographic reference body and map projection sphere) was also used for the generation of other planetary data products (e.g. Gwinner et al., 2010) and simplifies the interpretation of the map projected products. Finally, automated seam lines at the center of orthoimage overlaps and weighted averaging within these overlaps were applied within the generation of the final uncontrolled mosaic. Coverage gaps as can be seen in Figs. 1 and 2 were filled with lower resolution HAMO images.

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°E (Russell et al., 2012). Mosaicking of the single images was the final step of the image processing. A cylindrical equidistant map projection was chosen for the global mosaic.

The Dawn team proposed 65 names for geological features. By the 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