Planetary and Space Science 121 (2016) 115–120

Contents lists available at ScienceDirect

Planetary and Space Science

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

Ceres Survey Atlas derived from Dawn Framing Camera images

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ARTICLE INFO

Article history:
Received 10 November 2015
Received in revised form
26 November 2015
Accepted 16 December 2015
Available online 24 December 2015

Keywords:
Dawn
Ceres
Dwarf planets
Planetary mapping

ABSTRACT

The Dawn Framing Camera (FC) acquired almost 900 clear filter images of Ceres with a resolution of about 400 m/pixels during the seven cycles in the Survey orbit in June 2015. We ortho-rectified 42 images from the third cycle and produced a global, high-resolution, controlled mosaic of Ceres. This global mosaic is the basis for a high-resolution Ceres atlas that consists of 3 tiles mapped at a scale of 1:2,000,000. 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 mapped Ceres during the Survey orbit phase from an altitude of 4424 km (Russell and Raymond, 2011) in seven different cycles. The Dawn spacecraft is equipped with a framing camera [FC (Sierks et al., 2011)] which has one clear filter and seven band pass filters. About 900 clear filter images were taken during Survey, which resulted in a multiple global coverage. We selected 42 images from the third cycle with similar illumination conditions to produce a global mosaic of the illuminated part of Ceres with a resolution of 400 m/pixel, along with a 3-tile atlas at a scale of 1:2,000,000. We describe the different processing steps towards the Ceres Survey atlas, i.e. the image processing steps (Section 2), the Ceres longitude system (Section 3), and finally the cartographic processing aspects (Section 4). We also show the map tiles of the atlas.

2. Data processing

The image data returned from the spacecraft are distributed inside the Dawn team in Planetary Data System (PDS) format [http:/pds.jpl.nasa.gov]. The first step of the image processing pipeline is the conversion to Video Image Communication and Retrieval (VICAR) format [http://rushmore.jpl.nasa.gov/vicar.html] followed by the radiometric calibration of the images (Schröder et al., 2013,2014).

The next step towards the cartographic products is to ortho-rectify the images to the proper scale and map projection type. This process requires detailed information of the Dawn orbit and attitude data and of the topography of the targets. Both improved orientation and a high-resolution shape model are provided by stereo processing (bundle block adjustment) of the Survey stereo image dataset (Preusker et al., 2015), Ceres's shape model is used for the calculation of the ray intersection points, while the map projection itself is placed onto a reference sphere of Ceres with a mean radius of 470 km. The final step is the mosaicking of all images to a global mosaic of Ceres, the so-called basemap.

The Dawn team proposed 61 names for geological features. By international agreement, craters must be named after gods and goddesses of agriculture and vegetation from world mythology, whereas other geological features must be named after agricultural festivals of the world. The nomenclature proposed by the Dawn team was approved by the IAU [http://planetarynames.wr.usgs.gov/] and is shown in Fig. 1.

3. Longitude system

The Ceres longitude system was defined by Feature #1 from the Hubble Space Telescope (HST) mosaic in Li et al. (2006). This feature defined the zero-longitude meridian (Archinal et al., 2011). We could not clearly define this feature in our data but found good agreement for other features, e.g., Feature #2 is close to crater Dantu within the errors

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http://dx.doi.org/10.1016/j.pss.2015.12.005
0032-0633/

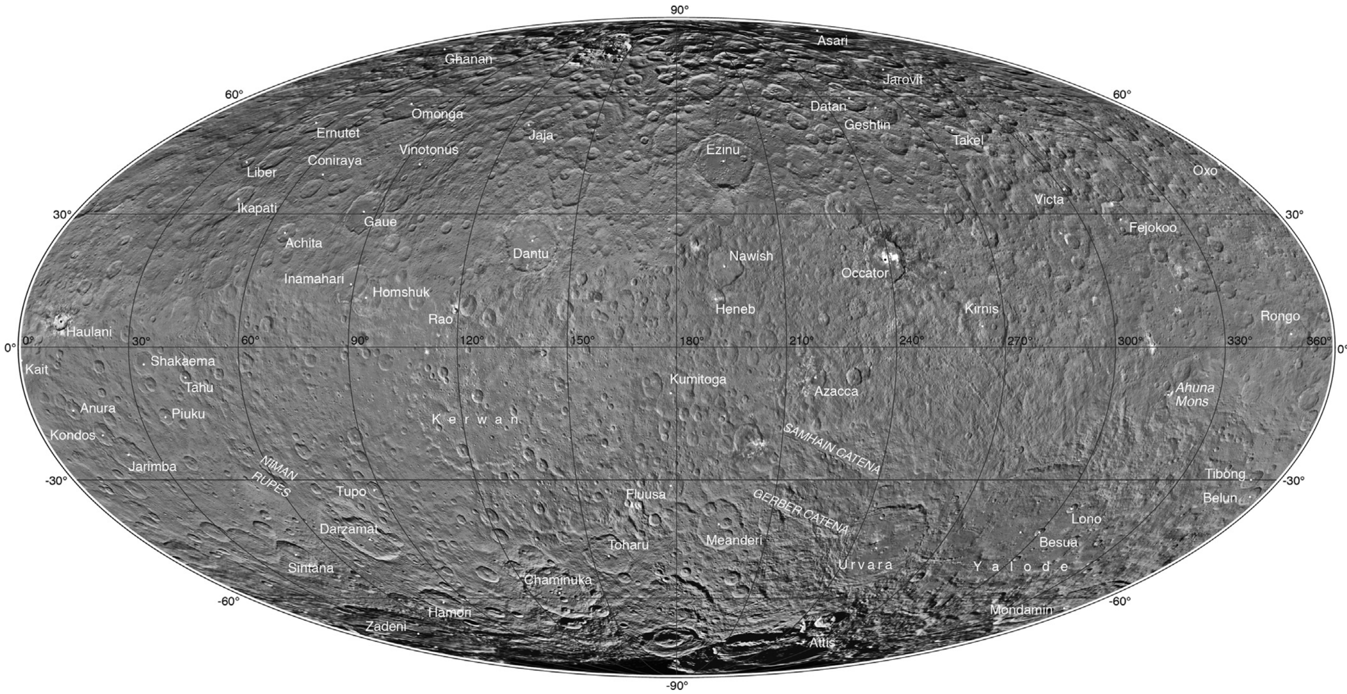

Fig. 1. Global Survey mosaic with nomenclature in Mollweide projection.

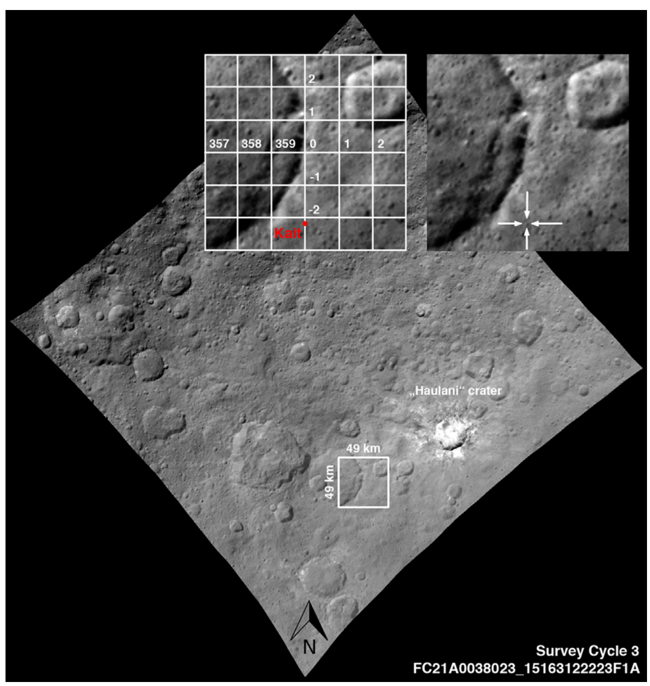

Fig. 2. Crater Kait in Survey image FC21A0038023. The upper left box is overlaid by a grid with one degree intervals in latitude and longitude direction.

of the HST images. Therefore, we proposed to the IAU Working Group on Cartographic Coordinates and Rotational Elements (WGCCRE) to select a tiny crater which is close to the former zero degree longitude as a new reference crater. This proposal was accepted, and we selected crater Kait (Fig. 2) as the new reference crater. This crater is now at zero degrees longitude and will be kept at this longitude also in higher resolution mosaics.

4. Ceres map tiles

The Ceres atlas consists of 3 map tiles in the subdivision of the synoptic format. The tiling scheme conforms to those proposed by Greeley and Batson (1990) and is used e.g., for mapping the Saturnian moons Iapetus and Mimas on a scale of 1:3,000,000 and 1:1,000,000, respectively (Roatsch et al., 2009, 2013). A map scale of about 1:2,000,000 guarantees a mapping at the highest available Dawn FC Survey resolution and results in an acceptable printing scale for the hardcopy map of 5 pixel/mm. The individual map 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 map tiles (from 57°S to 57°N latitude) are in Mercator projection with true scale at 0° latitude, whereas the poles are in stereographic projection with true scale at ±90° latitude (from 90°S to 55°S latitude and from 55°N to 90°N latitude) (Snyder, 1987). Individual tiles have no overlap in the