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Global stratigraphy of the dwarf planet Ceres from RC2 imaging data of the Dawn FC camera

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Abstract

On March 6, 2015, the Dawn spacecraft was captured into orbit around Ceres. During its approach phase since Dec. 1, 2014, imaging data returned by the framing camera (FC) have increased in spatial resolution exceeding that of the Hubble Space Telescope. In this paper, we use these first images to identify and map global geologic units and to establish a stratigraphic sequence.

1. Introduction

Since Dec. 1, 2014, the FC framing camera aboard the Dawn spacecraft [1][2] has taken several hundred images of the dwarf planet (1) Ceres with increasing spatial resolution. These images comprise optical navigation (OpNav #2 to #7) as well as rotational characterization (RC #1 & #2) sequences. For this work, images from sequence RC2 with a spatial resolution exceeding that of Hubble Space Telescope by about a factor of 7 are primarily used.

2. Methodology

Individual images as well as a global mosaic derived from the RC2 images were used for geologic mapping and crater counts. The images were processed according to the procedure described in [3]. Geologic units are identified with respect to morphology and superimposed crater frequency. In addition, topography was taken into account as a mapping criterion. The topographic information was taken from a digital terrain model (DTM) derived by [4]. Cratering model ages were obtained from crater counts in the mapped units using the cratering chronology model by Schmedemann et al. [5][6].

3. Geologic units and ages

Broadly, five units can be distinguished in terms of morphology, superimposed crater frequency and topography: (1) two generally densely cratered plains units found in a number of locations and topographic levels, designated as *cpdh* (high terrain) or *cpdl* (low terrain); (2) two sparsely cratered plains units, either topographically high (*cpsh*) or low (*cpsl*); and (3) the topographically low smooth floor of a large impact crater or basin, ~ 280 km in diameter (*bfs*). Three examples for crater counts on these units are shown in Fig. 1.

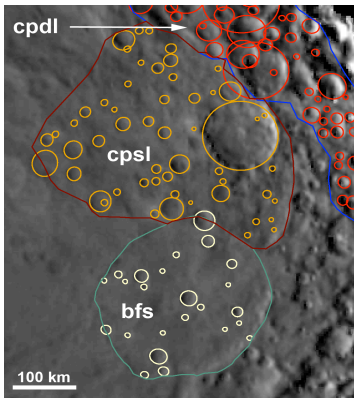

Figure 1: Detail of a geologic map with crater counts. The center of the large crater/basin (unit *bfs*) is located at lat. 11° S, long. 124° E.

Figure 2 shows the stratigraphic relationship of these units from measured crater frequencies. A sequence of geologic events forming these units can clearly be

derived from the data. Oldest units are the densely cratered plains, showing cratering model ages [6] on the order of 3.7 – 3.8 Ga. Between the higher (*cpdh*) and lower (*cpdl*) variety no clear separation in model age can be made. The sparsely cratered plains are in general younger than the densely cratered plains and seem to have a wider span in cratering model age. A topographically low area of this unit (*cpsl*), located adjacent to the north of the 280-km crater/basin, has a model age of 3.4±0.2 Ga. From the crater frequency measured on the floor of this large crater/basin (unit *bfs*), a model age of 1.8±0.6 Ga could be determined. A topographically higher area of unit *cpsh* shows a comparable model age of 2.0±0.3 Ga. These two units are the youngest found so far on Ceres.

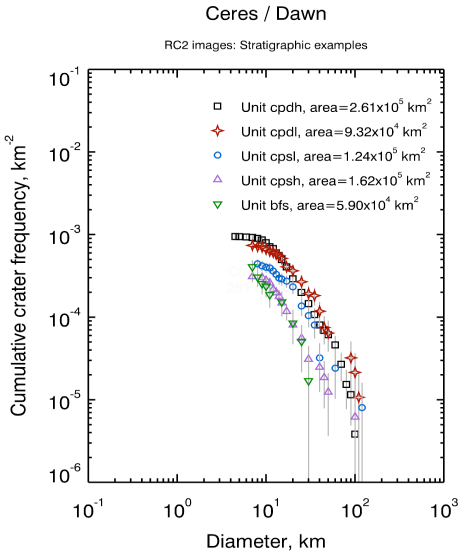

Figure 2: Cumulative crater frequency diagram of five geologic units, mapped and measured in RC2 images of the Dawn FC camera. The units are separable by their superimposed crater frequency.

4. Summary

The geologic units mapped in the RC2 images, supported by using a DTM [4], can be separated by their superimposed crater frequencies and show a clear stratigraphic sequence. Oldest units are the densely cratered plains (*cpdh*, *cpdl*), more or less independent of their topographic level. Youngest unit mapped is the smooth floor of a 280-km large crater/basin (*bfs*). The cratering model age derived on the areas of sparsely cratered plains (*cpsh*, *cpsl*) lie in between the impact feature (*bfs*) and the densely cratered plains.

The crater frequencies superposed on some of the measurement areas imply possible resurfacing processes. Slopes of the cumulative distributions become flatter below a given crater diameter on the order of ~ 30-60 km but are steeper again at craters smaller this size. This feature has to be investigated further in high-resolution data.

Further work using higher-resolution images involves the identification of stratigraphic key horizons in order to subdivide the geologic record of Ceres into a sequence of time-stratigraphic systems and, based on a cratering chronology model, into chronologic periods. The prerequisite to do this is the confirmation of suggested feature names by IAU.

References

[1] Russell, C. T., and Raymond, C. A.: The Dawn Mission to Vesta and Ceres. Space Sci. Rev. 163, 3-23, 2011.

[2] Sierks, H., et al. : The Dawn Framing Camera. Space Sci. Rev. 163, 263-327, 2011.

[3] Roatsch, T.: High-resolution Ceres Survey atlas derived from Dawn FC images. This volume, 2015.

[4] Preusker, F., et al.: Shape model and rotational state of dwarf planet (1) Ceres from Dawn FC stereo images. This volume, 2015.

[5] Schmedemann, N. et al.: The cratering record, chronology and surface ages of (4) Vesta in comparison to smaller asteroids and the ages of HED meteorites. Planet. Space Sci. 103, 104-130, 2014.

[6] Schmedemann, N. et al.: A preliminary chronology for Ceres. Lunar Planet. Sci. Conf. XLVI, abstr. #1418, 2015.