

Preliminary Geologic Mapping of the Ac-S-2 Hemisphere of Ceres from NASA's Dawn Mission

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Abstract

NASA's Dawn spacecraft [1] was captured into orbit by the dwarf planet (1) Ceres on March 6, 2015. During the Approach phase capture was preceded and followed by a series of optical navigation and rotation characterization observations by Dawn's Framing Camera [FC, 2], which provided the first images of Ceres' surface. As was done at Vesta [3,4], the Dawn Science Team will conduct a geological mapping campaign at Ceres during the Nominal Mission, including iterative mapping using data obtained during each orbital phase. In this presentation we will describe the approach of the Ceres Mapping Campaign and discuss the preliminary geological mapping of the Ac-S-2 (0-180°E) hemisphere of Ceres.

Ceres Geologic Mapping Campaign

1. Geologic mapping is an investigative process that goes beyond photogeologic analysis by organizing planetary features into discrete process-related map units. These units are defined and characterized based on specific physical attributes (albedo, morphology, structure, color, topography) related to the putative geologic processes that produced them (volcanism, tectonism, impact cratering, weathering-erosion-deposition). Application of stratigraphic principles (superposition, lateral continuity, cross-cutting, embayment, intrusion, etc.) are used to determine the chronologic order of emplacement of the map units. The map units can then be grouped into geologic formations, from which a geologic timescale and geologic history is determined. Thus, geologic maps are *tools* to help interpret the geologic history of a planetary surface.

2. Following on from our successful campaign to

map the surface of asteroid Vesta [3,4], the Dawn Science Team will conduct a geologic mapping campaign for dwarf planet Ceres during the Nominal Mission. The goals of this campaign are two-fold: 1) to provide geologic context to the full science team of our ever-improving knowledge of the geology of Ceres with increasing FC spatial resolution during discrete orbital phases of the mission; and 2) to provide geologic context to the Visible and Infrared Spectrometer (VIR) and the Gamma-Ray and Neutron Detector (GRaND) teams to aid in interpreting their compositional information.

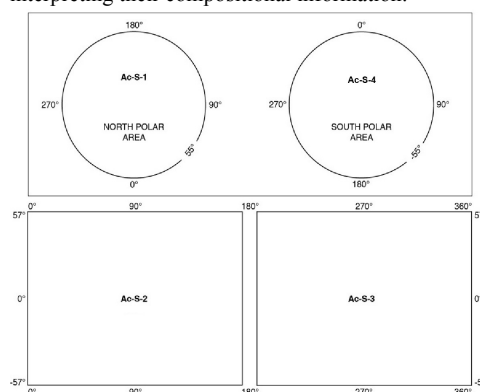


Fig 1: Hemispheric geologic mapping quadrangles for dwarf planet Ceres during the Approach and Survey orbital phases.

3. The first step of the Ceres mapping campaign is to construct a preliminary geologic map using images obtained during the Approach and Survey orbital phases. The purpose of this map is to assess the geology of Ceres at the global scale, to identify global map units and structural features, and determine the geologic processes that have affected

Ceres globally. To accomplish this we will map Ceres using a hemispheric 4-quadrangle system (Fig. 1). In this presentation we will present an overview of the geology of the Ac-S-2 (0-180°E) hemisphere of Ceres.

First Geological Results

4. The Ac-S-2 (0-180°E) hemisphere of Ceres shows a surface heavily modified by impact cratering, and is dominated by impact craters, including craters with central peaks at least ≥ 28 km diameter (Fig. 2). We see fresh, bright-rayed craters and older degraded craters at a variety of size scales. There are variations in crater abundance in different parts of this hemisphere, suggestive of some type of resurfacing process. In particular, a 280-km diameter basin centered near $\sim 10^\circ\text{S}$, $\sim 123^\circ\text{E}$, the largest impact crater positively identified at the time of this writing, contains smooth-textured (4 km/px resolution), lobate deposits on its floor. Smooth terrain also extends outside the crater to the west, perhaps indicative of a regionally extensive resurfacing process. Domatic, positive relief features may also be present in this crater, but require higher resolution imaging before they can be confirmed. Putative mass wasting features have tentatively been identified, but also require confirmation with higher-resolution imaging.

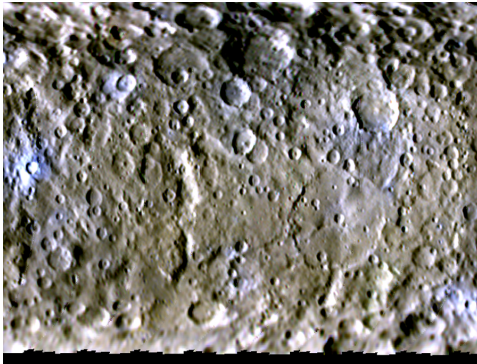


Fig 2: Dawn FC color composite image of the Ac-S-2 (0-180°) quadrangle of Ceres. Obtained during Approach phase, Rotation Characterization 2 observation, ~ 4 km/pixel spatial resolution. Color composite RGB is 0.96-0.75-0.44 μm . Image processing by the MPI for Solar System Research, Germany.

5. Preliminary global map units may include Cratered Plains material, Smooth Plains material, Lobate

material, Bright-rayed crater material, Crater floor material, and Central Peak material. At present spatial resolution is too low to actually map out contacts and structural features, but we expect to be able to begin constructing the maps using Rotation Characterization #3 and Survey mosaics, to be acquired in May and June 2015.

References:

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- [3] Williams, D.A., et al., 2014, Icarus, 244, 1-12.
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