GEOLOGIC MAPPING OF THE AC-H-4 EZINU QUADRANGLE OF CERES FROM NASA'S DAWN MISSION.

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Introduction and previous work: NASA's Dawn spacecraft is currently orbiting Ceres, a dwarf planet that is the largest object in the asteroid belt (mean diameter of ~940 km). On March 6th 2015, Dawn became the first spacecraft to visit Ceres, which was previously studied by telescopic observations and thermal evolution modeling [e.g. 1, 2, 3, 4]. Ceres science data are primarily acquired during three orbital phases of decreasing altitude: Survey, High Altitude Mapping Orbit (HAMO) and Low Altitude Mapping Orbit (LAMO).

The Dawn Science Team has studied Ceres' physical properties, geology and composition, and is conducting a geologic mapping campaign for Ceres similar to that undertaken at Vesta [5, 6]. Thus, Ceres' surface is divided into fifteen quadrangles to facilitate systematic geological mapping. This mapping effort includes the production of two hemispheric Survey-based global maps and fifteen quadrangle maps based on HAMO and LAMO data. In this abstract we present the LAMO-based geologic map of the Ac-H-4 Ezinu quadrangle (21-66 °N and 180-270 °E) and discuss its geologic evolution.

Methods and mapping data: The acquisition of Survey and HAMO data was completed by the submission of this abstract, along with the collection of initial LAMO data. Thus, the geologic map presented in this abstract is based on HAMO (~140 m/pixel) and Survey (~400 m/pixel) mosaics of clear filter Dawn Framing Camera images [7]. Framing Camera color data and topography data, derived from the Framing Camera images via stereophotoclinometry (JPL) and stereophotogrammetry (DLR), are also used to inform the geologic mapping. Updated mapping will be undertaken before LPSC, using the ~35 m/pixel LAMO Framing Camera clear filter images.

Results: key geologic features:

Linear features. There are three different types of linear features in Ezinu quadrangle: (1) grooves, (2) chains of pits/craters and (3) intra-crater grooves. Some of these grooves and chains of pits/craters form sets that are radial to a central impact crater. We propose these radial linear features are ejecta ray systems, which commonly form as secondary material is ejected during impact crater formation and bounces and scours across the surface. Thus, in this case, the chains are chains of secondary craters, and not chains of pits.

Ezinu quadrangle also contains a prominent set of grooves and chains of pits/craters, which is centered near Erntedank Planum. In agreement with [8], we interpret these grooves and chains of pits/craters as the surface expression of sub-surface fractures. Thus, in this case, the chains are chains of pits, and not chains of secondary craters. These grooves and pit chains are partially buried/cross-cut by ejecta, grooves and secondary crater chains from Occator crater. Thus, Occator crater likely formed after the grooves and pit chains.

We map distinctive sets of linear features inside and in association with Occator and Ezinu craters, which we provisionally name intra-crater grooves. However, in initial LAMO data, some intra-crater grooves appear to be chains of pits rather than grooves. All these linear features are discussed in further detail in [9].

Occator crater. The northern portion of Occator crater is located within Ezinu quadrangle. However, for geologic consistency we mapped the entire interior and ejecta of Occator crater. Occator is a geologically fresh impact crater, and contains the brightest bright spots on Ceres in its floor [10]. In addition to the bright spots, we have mapped the following geologic units within the interior: bright lobate material, undivided lobate material, hummocky crater floor material, smooth material and smooth crater wall material. We map the ejecta of Occator crater as undivided crater material.

Ezinu crater. Ezinu crater is degraded in comparison to Occator crater, is superposed by clusters of craters and does not have impact ejecta that is identifiable in the clear filter HAMO images. However, Ezinu crater does contain the following distinct geologic units: hummocky crater floor material, smooth material, smooth crater wall material and cratered terrain.

Datan and Geshtin craters. Datan crater cross cuts, and is more geologically fresh than, Geshtin crater. Datan crater contains an irregularly shaped central peak (mapped as crater central peak material) and smooth crater wall material. In addition, Datan crater is almost entirely filled by hummocky crater floor material, which we interpret as a mass wasting deposit, and is the source of a flow, mapped as undivided lobate material. The ejecta of Datan crater is mapped as undivided crater material and almost entirely covers Geshtin crater. In addition, numerous bright spots are visible on the floor of Geshtin crater.

Erntedank Planum. Ezinu quadrangle contains a portion of a topographically high region, called Erntedank Planum. Currently, this is the only planum defined on Ceres.

Discussion, geologic history and future work:

Based on our current geologic mapping, we have developed the following preliminary geologic history for Ezinu quadrangle:

1. The cratered terrain, grooves and pit chains, and Ezinu and Geshtin craters are some of the earliest geologic features to form in this quadrangle.
2. More recently, the undivided crater material, ejecta ray system radial to Occator crater, and Occator and Datan craters form.

Before LPSC, we will refine and expand upon this geologic history, and also conduct continued research into:

1. The possibility that subsurface fractures related to the grooves and pit chains may be conduits that enable the upward flow of the material that forms the Occator bright spots.
2. The formation mechanism of the intra-crater grooves.
3. The types of mass wasting that occur in Ezinu quadrangle, for example dry landsliding versus ice-cored/ice-cemented flows. Additionally, we will investigate whether fluidized ejecta occurs within the quadrangle.
4. The possibility that the Occator bright spots are related to bright spots found elsewhere in the quadrangle, for example in Geshtin crater.

References:

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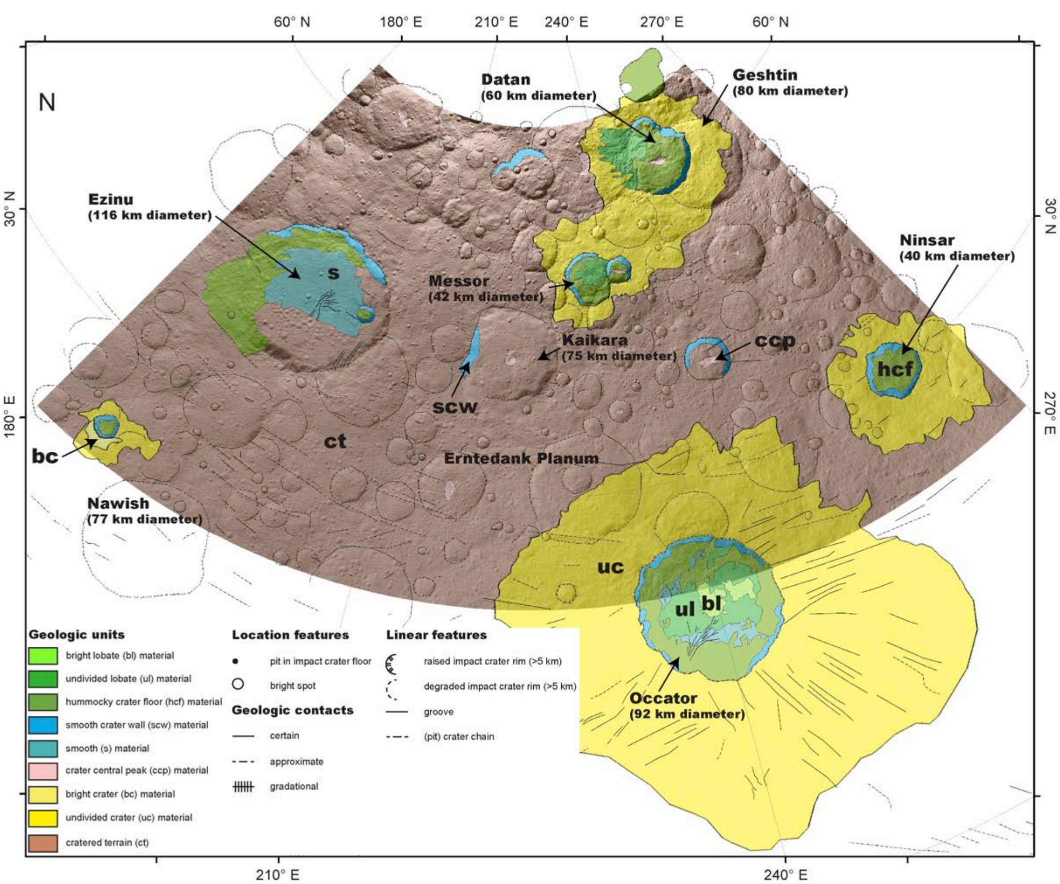

Figure 1. Geologic map of the Ac-H-4 Ezinu quadrangle of dwarf planet Ceres. The base map is a Dawn Framing Camera HAMO mosaic (~140 m/pixel; courtesy of DLR).