GEOLOGIC MAPPING OF THE Ac-H-12 TOHARU QUADRANGLE OF CERES FROM NASA's DAWN MISSION. S. C. Mest[1], D. A. Williams[2], D. A. Crown[1], R. A. Yingst[1], Debra L. Buczkowski[3], Jennifer E. C. Scully[4], R. Jaumann[5], T. Roatsch[5], F. Preusker[5], A. Nathues[6], M. Hoffmann[6], M. Schäfer[6], C. A. Raymond[5], C. T. Russell[7], and the Dawn Science Team, [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719 (mest@psi.edu); [2]School of Earth & Space Exploration, Arizona State University, Tempe, AZ; [3]JHU-APL, Laurel, MD; [4]NASA JPL, California Institute of Technology, Pasadena, CA; [5]DLR, Berlin, Germany; [6]MPI for Solar System Research, Göttingen, Germany; [7]UCLA, Los Angeles, CA, USA.

Introduction: NASA's Dawn spacecraft arrived at Ceres on March 5, 2015, and has been studying the dwarf planet through a series of successively lower orbits, obtaining morphological, topographical, mineralogical, elemental, and gravity data. The Dawn Science Team is conducting a geologic mapping campaign for Ceres similar to that done for Vesta [1,2], including production of a Survey- and High Altitude Mapping Orbit (HAMO)-based global map and a series of 15 Low Altitude Mapping Orbit (LAMO)-based quadrangle maps. In this abstract we discuss the surface geology and geologic evolution of the Ac-H-12 Toharu Quadrangle (21-66°S, 90-180°E).

Mapping Data: At the time of this writing LAMO images (35 m/pixel) are just becoming available. The current geologic map of Ac-H-12 was produced using ArcGIS software, and is based on HAMO images (140 m/pixel) and Survey (415 m/pixel) digital terrain models (for topographic information). Dawn Framing Camera (FC) color images were also used to provide context for map unit identification. The map (to be presented as a poster) will be updated from analyses of LAMO (~35 m/pixel) images.

Mapping Results: The Toharu Quadrangle is named after crater Toharu (86 km diameter; 48.3°S, 156°E), and is dominated by smooth terrain in the north and more heavily cratered terrain in the south. The quadrangle exhibits ~9 km of relief, with the highest elevations (~3.5-4.6 km) found among the western plateau and eastern crater rims, and the lowest elevation found on the floor of crater Chaminuka.

Preliminary geologic mapping has defined three regional units (*smooth material*, *smooth Kerwan floor material*, and *cratered terrain*) that dominate the quadrangle, as well as a series of impact crater material units (Figure 1) [3,4]. Smooth material forms nearly flat-lying plains in the northwest part of the quadrangle, and overlies hummocky materials in some areas. Smooth material extends over a much broader area outside of the quadrangle, and appears to contain some of the lowest crater densities on Ceres. Cratered terrain forms much of the map area and contains rugged surfaces formed largely by the structures and deposits of impact features. In addition to geologic units, a number of geologic features – including crater rims, furrows, scarps, troughs, and impact crater chains – have been mapped.

The Toharu Quadrangle contains impact craters that exhibit a range of sizes – from the limits of resolution to part of the Kerwan basin (280 km diameter) – and preservation styles. The quadrangle also contains a number of large (>20 km across) depressions that are only observable in the topographic data. Smaller craters (<40 km) generally appear morphologically "fresh", and their rims are nearly circular and raised above the surrounding terrain. Larger craters, such as Toharu, appear more degraded, exhibiting irregularly shaped, sometimes scalloped, rim structures, and debris lobes on their floors. Numerous craters (> 20 km) contain central mounds; at current FC resolution, it is difficult to discern if these are primary structures (i.e., central peaks) or secondary features.

Crater Toharu exhibits relatively typical morphology relative to other craters of this size on Ceres, including a rim slightly raised above its surroundings, smooth interior walls along parts of the rim, terraces within collapsed materials along the western to northeastern walls, and a central peak. The collapsed materials do not display lobate margins similar to other mass wasting deposits on Ceres, and may have resulted from slumping of wall materials rather than flow.

Crater Chaminuka (122 km diameter; 58.8°S, 131.7°E) appears more degraded, shallower, and contains more superposed craters than Toharu, indicating it is likely older. Portions of Chaminuka's rim are nearly removed, and the remnants of mass wasting materials are evident, although more subdued than in Toharu, along the southwest and northeast walls. Larger craters have impacted Chaminuka's rim and their ejecta is emplaced on its floor.

Craters Juling (19 km diameter; 36°S, 168.3°E) and Kupalo (27 km diameter; 39.6°S, 173°E), in the eastern part of the quadrangle, display relatively pristine (sharp rims, well-preserved ejecta) morphologies. Their ejecta and floor materials display distinctly unique properties in Ceres Color Composite (CCC) data derived from ratios of FC color images. The ejecta from both craters and material on the floor

of Kupalo are "blue", which is generally a measure of freshness. However, the material on the floor of Juling is distinctly "redder", which suggests this material is compositionally different from the crater materials, and may have been emplaced after crater formation.

The southern rim of Kerwan basin, visible along the northern edge of the quad, is here preserved as a low-relief scarp. Kerwan's floor is covered by smooth Kerwan floor material, which is fairly flat and featureless at Survey and HAMO scales, but appears to contain more smaller diameter craters than smooth materials to the west of Kerwan.

Summary: Preliminary geologic mapping of the Ac-H-12 Toharu Quadrangle of Ceres using recent Dawn Mission data shows morphologically distinct terrains that have been modified by different amounts of impact cratering. Cratered terrains contain a higher density of impact craters that vary in size and morphology, whereas smooth materials in and around Kerwan basin contain fewer craters of smaller sizes and more pristine morphology. Impact craters in the map area display a range of sizes and morphologies (degraded to well-preserved). Larger craters, such as Toharu and Chaminuka, display moderately to highly degraded morphologies with scalloped rims and mass wasting deposits on their floors. The apparent higher density of craters on the floor of Kerwan suggests it predates the smooth materials, but postdates much of the cratered terrain.

References: [1] Williams D.A. et al. (2014) *Icarus, 244,* 1-12. [2] Yingst R.A. et al. (2014) *PSS, 103,* 2-23. [3] Mest, S.C. et al. (2015) *GSA Abstracts with Program*, Abstract 308-12. [4] Mest, S.C. et al. (2015) *Fall Meeting AGU*, Abstract P53E-2179.

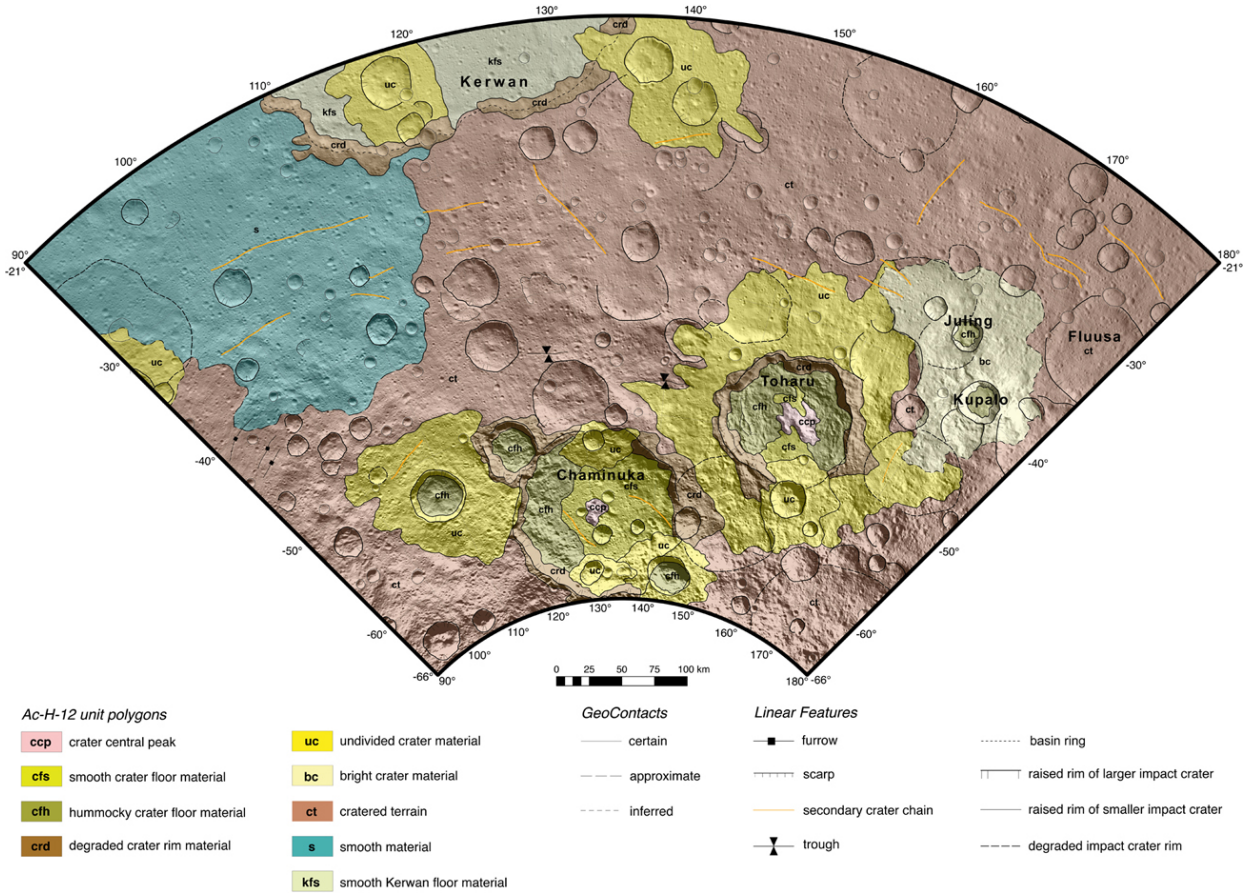

Figure 1: Geologic map of the Ac-H-12 Toharu Quadrangle of dwarf planet Ceres. Mapping base is Dawn FC HAMO mosaic (courtesy DLR).