

**COMPLETE GLOBAL GEOLOGIC MAP OF VESTA FROM DAWN AND MAPPING PLANS FOR CERES.** D.A. Williams<sup>1</sup>, D.T. Blewett<sup>2</sup>, D.L. Buczkowski<sup>2</sup>, W.B. Garry<sup>3</sup>, T. Kneissl<sup>4</sup>, K. Krohn<sup>5</sup>, S.C. Mest<sup>6</sup>, O. Ruesch<sup>3</sup>, M. Schaefer<sup>7</sup>, J.E.C. Scully<sup>8</sup>, R.A. Yingst<sup>6</sup>, C.M. Pieters<sup>9</sup>, R. Jaumann<sup>5</sup>, C.A. Raymond<sup>10</sup>, H.Y. McSween<sup>11</sup>, S. Marchi<sup>12</sup>, N. Schmedemann<sup>4</sup>, C.T. Russell<sup>8</sup>. <sup>1</sup>School of Earth and Space Exploration, Arizona State University, Box 871404, Tempe, AZ 85287 ([David.Williams@asu.edu](mailto:David.Williams@asu.edu)); <sup>2</sup>Johns Hopkins University Applied Physics Laboratory, Laurel, MD; <sup>3</sup>NASA Goddard Spaceflight Center, Greenbelt, MD; <sup>4</sup>Freie Universität, Berlin, Germany; <sup>5</sup>German Aerospace Center (DLR), Berlin, Germany; <sup>6</sup>Planetary Science Institute, Tucson, AZ; <sup>7</sup>MPI for Solar System Research, Goettingen, Germany; <sup>8</sup>UCLA, Los Angeles, CA; <sup>9</sup>Brown University, Providence, RI; <sup>10</sup>NASA JPL, California Institute of Technology, Pasadena, CA; <sup>11</sup>University of Tennessee, Knoxville, TN; <sup>12</sup>Southwest Research Institute, Boulder, CO.

**Introduction:** The science team from NASA's Dawn mission has completed a geologic mapping campaign for asteroid (4) Vesta. The purpose of this abstract is to serve as a citable source for our Low Altitude Mapping Orbit (LAMO)-derived global geologic map of Vesta (**Figure 1**, also press released by NASA in November 2014) until a USGS-publishable global map can be completed. We also discuss our geologic mapping plans for dwarf planet (1) Ceres.

**Vesta Mapping Campaign:** The process to produce a global geologic map of Vesta using Dawn Framing Camera images is described in [1, 2]. Briefly, we conducted an iterative mapping campaign using images with increasing spatial resolution from Dawn's Survey orbit, High Altitude Mapping Orbit (HAMO), and LAMO. The first Survey map was published in *Science* [3]. The HAMO map was published in *Planetary and Space Science* [1], and the Survey and HAMO maps along with other studies led to the determination of a chronostratigraphy and geologic time-scale for Vesta (**Figure 2**), also published in *Icarus* [4].

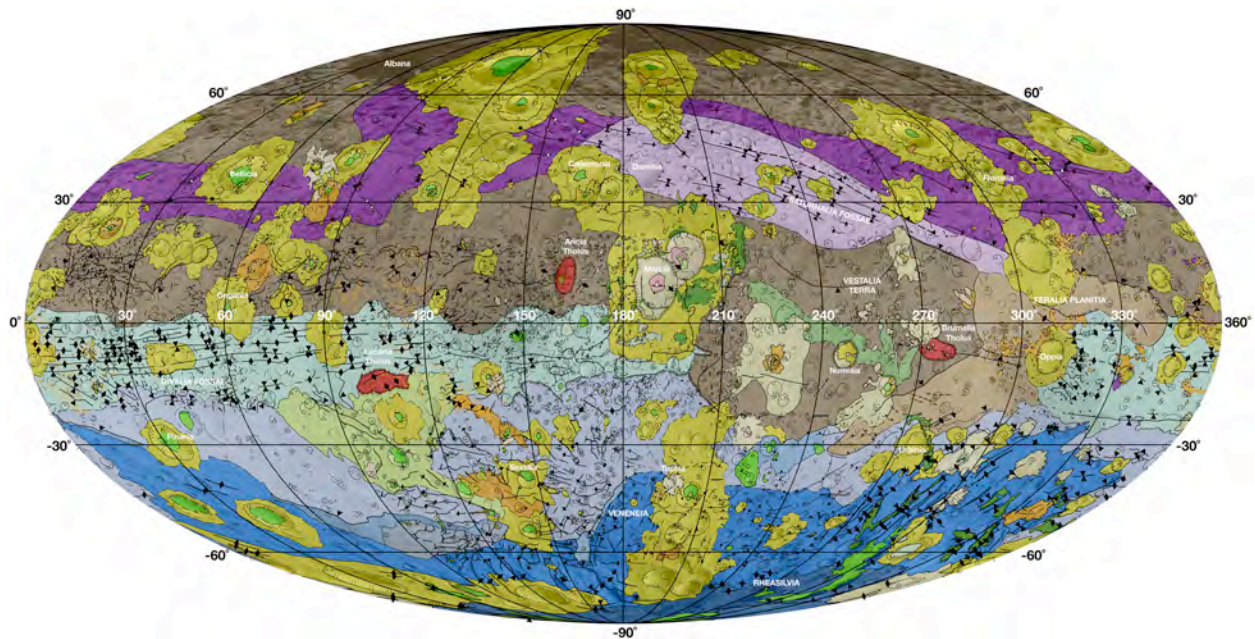
LAMO images were used to produce a series of 15 quadrangle geologic maps, whose goals were to investigate geologic features/topics identified from the global mapping in more detail. As discussed in [2], there were challenges with this approach, most significantly coordination of 14 individual mappers and their mapping styles and objectives relative to efforts by other Dawn Science Team members. In the end, for the final published maps and mapping papers, individual quadrangles had to be combined based on the distributions and extents of geologic units and features on the vestan surface. For example, the five quadrangles covering the vestan northern hemisphere above 22°N were combined into one geologic map [5], and two additional special topics maps were made focusing on putative antipodal features (relative to the south polar basins) at the north pole [6] and structural features of the Saturnalia Fossae Formation [7]. In all, nine papers were published that discuss important vestan geologic features or processes, including the equatorial Divalia Fossae [8], young, large equatorial craters such as Marcia [9], the Vestalia Terra plateau (remnant of Ves-

ta's original crust: [10]), the unusually-colored ejecta around Oppia crater [11], and Vesta's gradational features including landslides, asymmetric craters [12] and mid-sized craters superposed on the Rheasilvia basin [13]. These nine papers along with an introductory paper discussing the Vesta mapping campaign and the chronostratigraphy paper [4] were published in the December 2014 issue of *Icarus*.

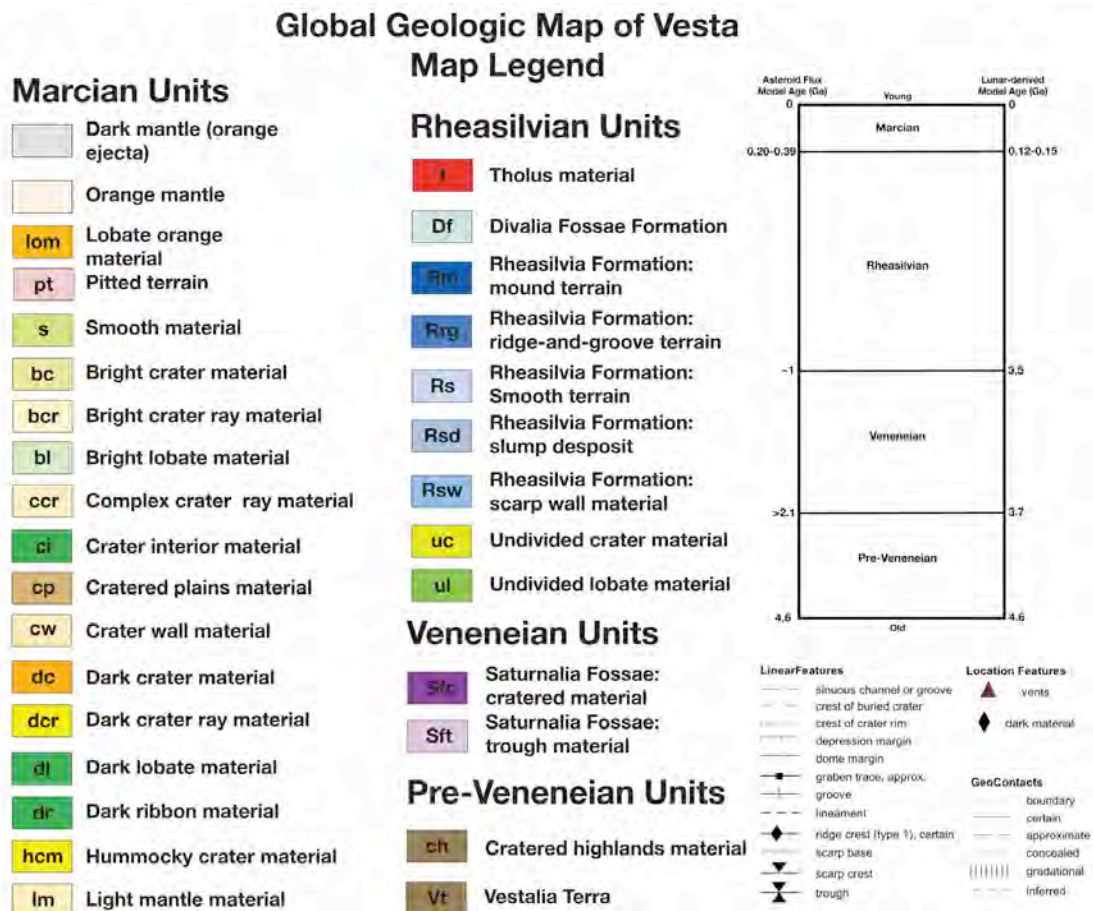
**Mapping Plans for Ceres:** NASA's Dawn spacecraft will arrive at dwarf planet (1) Ceres in early March 2015, and attain orbit by ~April 15. We plan to conduct a mapping campaign at Ceres similar to that at Vesta, although the timeline will be compressed depending on the availability of hydrazine fuel and the length of the Dawn Ceres Nominal Mission. Fortunately, we now have a group of experienced mappers to investigate the geology of Ceres. Key aspects of the Ceres mapping campaign will include:

- Four experienced mappers will begin mapping Ceres using Survey and HAMO images, covering four regions (N pole, S pole, E and W hemispheres)
- Engage the crater counters early as we define map units to determine the chronostratigraphy of Ceres and obtain useful model age dates of the surface
- Use a series of geologic sketch maps in conference posters to introduce the geologic complexity of Ceres
- Let the geology of Ceres define the LAMO map regions for the final publications
- Minimize the number of different mappers

**References:** [1] Yingst R.A. et al. (2014) *PSS*, 103, 2-23. [2] Williams D.A. et al. (2014) *Icarus*, 244, 1-12. [3] Jaumann R. et al. (2012) *Science*, 336, 687-690. [4] Williams D.A. et al. (2014) *Icarus*, 244, 158-165. [5] Ruesch O. et al. (2014) *Icarus*, 244, 41-59. [6] Blewett D.T. et al. (2014) *Icarus*, 244, 13-22. [7] Scully J.E.C. et al. (2014) *Icarus*, 244, 23-40. [8] Schaefer M. et al. (2014) *Icarus*, 244, 60-73. [9] Williams D.A. et al. (2014) *Icarus*, 244, 74-88. [10] Buczkowski D.L. et al. (2014) *Icarus*, 244, 89-103. [11] Garry W.B. et al. (2014) *Icarus*, 244, 104-119. [12] Krohn K. et al. (2014) *Icarus*, 244, 120-132. [13] Kneissl T. et al. (2014) *Icarus*, 244, 133-157.



**Figure 1.** LAMO-derived global geologic map of asteroid (4) Vesta (Mollweide projection, center long. = 180°, Dawn Claudia coord. system). This map was produced using ArcGIS™ software through integration of 15 individual quadrangle maps produced by the coauthors. NASA Planetary Photojournal PIA18788. For citation of this map, please use this abstract. Download at: [http://rpif.asu.edu/downloads/VESTA\\_Mapping\\_Poster\\_Dec2014.pdf](http://rpif.asu.edu/downloads/VESTA_Mapping_Poster_Dec2014.pdf)



**Figure 2.** Legend for map in Figure 1, including Vesta geologic timescale (from [4]).