**GEOLOGIC MAPPING OF VESTA: EARLY RESULTS.** R. A. Yingst, S. C. Mest, D. A. Williams, W. B. Garry, and D.C. Berman; 1Planetary Science Institute (1700 E. Fort Lowell, Suite 106, Tucson, AZ 85719; yingst@psi.edu); 2Arizona State University; 3NASA Goddard Space Flight Center.

**Introduction:** The most recent maps of Vesta were created during the active phase of the Dawn Vesta mission, to inform the immediate needs of the Dawn team [e.g., 1-3]. Such mapping represents a first, rapid assessment of gross geology, providing geologic context within a timeframe that allows a map to inform data analysis on a mission timeline. However, revealing the interrelationships of geologic characteristics requires a more comprehensive integration of multiple processes, unit boundaries, information from disparate regions, structures, features and characteristics to be adequately addressed. We are constructing a global geologic map of Vesta at 1:300,000-scale for mapping and digital publication, and 1:1,500,000-scale for the print version. Compared to previous maps, this map will incorporate available, calibrated elemental and mineralogical data.

**Geologic Setting:** Vesta is an ellipsoidal asteroid of approximately 286 km long axis [4]. Earth-based and Hubble Space Telescope data suggested it had sustained large impacts, including one that produced a large crater at the south pole. Measured and inferred mineralogy results indicated that Vesta has an old, differentiated surface, with spectrally-distinct regions that can be geochemically tied to the HED meteorites [5-7]. Dawn data confirmed that Vesta has a heavily-cratered surface, with large craters evident in numerous locations. The two largest impact structures resolved are the degraded Veneneia crater, and the younger, larger Rheasilvia crater, both located near the south pole. Vesta’s surface is also characterized by a system of deep troughs and ridges. Notwithstanding previous spectroscopic observations, no volcanic features have been unequivocally identified.

**Data:** The Dawn Framing Camera (FC) Low-Altitude Mapping Orbit (LAMO) images constitute the basemap. The Digital Terrain Model (DTM), derived from High-Altitude Mapping Orbit (HAMO) FC stereo data of 93 m/pxl horizontal resolution [8], provides topography, while DTM-derived slope and contour maps yield the shape of the surface and assist in evaluating the extent of geologic materials and features. High-resolution, calibrated spectroscopic data obtained by the Dawn VIR and Dawn Gamma Ray-Neutron Detector Spectrometer (GRaND) allow compositional and elemental information about Vesta’s surface materials to be evaluated. VIR provides spectral data in the visible and near infrared wavelengths. GRaND yields abundances for rock-forming elements (O, Si, Fe, Ti, Mg, Al and Ca), radioactive elements (K, U and Th), trace elements (Gd and Sm), and H, C and N (major constituents of ices).

**Mapping Procedure:** We began by following the methods developed and described by [10-13]. Units were initially defined and characterized based on morphology, surface textures, and albedo. We are using color data from the FC (and later VIR) to refine unit boundaries where the morphologic characteristics provide more than one possible interpretation, or the interpretation of the unit type is ambiguous. Where unit boundaries are obscured by subsequent geologic activity (typically through emplacement of impact ejecta, or through vertical or lateral mixing of the surface regolith), ejecta from craters that post-date the activity may be used as a proxy for the unmodified composition of the unit (e.g., lunar dark halo and other craters). Craters down to 2 km diameter are also being mapped and classified based on preservation state and the presence and distribution of ejecta, rim, and floor units.

**Progress:** The initial mapping linework (Figure 1), shows a variety of structures, gecontacts, and crater locations. Important potential units outlined by this linework include heavily-cratered, presumably ancient terrain, and hummocky and curvilinear trough terrain associated with the Rheasilvia impact structure. Heavily-cratered surfaces contain a range of crater morphologies. Small fresh craters, are characterized by sharp-crested, narrow rims and bowl shapes; larger fresh craters have flat floors and may display slumping of rim walls, some finer-textured floor fill, or visible ejecta material. Degraded craters have subdued but distinct continuous rims and varying internal shapes. A large percentage of the heavily-cratered terrain is intersected by two series of ridges and troughs (near the equator and to the north); further mapping and data analysis will determine whether this dissected terrain should be mapped as a standalone unit or not.

The Rheasilvia formation is characterized by (a) bounding arcuate scarps; (b) a central mound with smoother, less cratered regions; (c) a linear set of ridges and troughs running through either side of the central mound; and (d) a more arcuate set swirling out from and around the central mound.

**Unit Definition:** Defining the boundary criteria for rock units on a small, airless, rocky body has its own particular challenges. Where the primary geologic process for the bulk of a body’s history is impact cratering, traditional approaches to mapping can be inadequate, because the difference in morphological characteristics among the various cratered surfaces can be
Figure 1. Preliminary linework for global map of Vesta.