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A Proposed Time-Stratigraphic System for Protoplanet Vesta

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The Dawn Science Team completed a geologic mapping campaign during its nominal mission at Vesta, including production of a 1:500,000 global geologic map derived from High-Altitude Mapping Orbit (HAMO) images (70 m/pixel) [1] and 15 1:250,000 quadrangle maps derived from Low-Altitude Mapping Orbit (LAMO) images (20-25 m/pixel) [2]. In this abstract we propose a time-stratigraphic system and geologic time scale for the protoplanet Vesta, based on global geologic mapping and other analyses of NASA Dawn spacecraft data, supplemented with insights gained from laboratory studies of howardite-eucrite-diogenite (HED) meteorites and geophysical modeling. Our time-stratigraphic system for Vesta relates the geologic map (rock) units identified from geologic mapping to a series of time-rock units and corresponding time units that define a geologic time scale for Vesta. During the Dawn nominal mission it became clear that the south pole of Vesta hosts two large impact basins, the older Veneneia superposed by the younger Rheasilvia [3,4]. Two separate sets of large ridges and troughs were identified, one set encircling much of Vesta equatorial region (Divalia Fossae), and the other preserved in the heavily cratered northern terrain (Saturnalia Fossae). Structural analysis of these ridge-and-trough systems demonstrated that they are likely a tectonic response to the formation of the south polar basins: the Rheasilvia impact led to the formation of the Divalia Fossae, the Veneneia impact led to the Saturnalia Fossae [3,5]. Crater counts provide cratering model ages for the Rheasilvia impact of $\sim$3.6 Ga and $\sim$1 Ga, and ages for the Veneneia impact of $\sim$3.8 Ga and >2.1 Ga using the lunar-derived and asteroid flux-derived chronologies, respectively. Despite the differences in absolute ages, it is clear that these two large impact events had global effects, and thus delineate the major periods of Vesta's geologic history. Zones of heavily cratered terrain (HCT: [6,7]) in the northern hemisphere adjacent to the Saturnalia Fossae Formation [1] likely are heavily modified portions of Vesta's ancient crust. The geologic units in and around the 68 x 58 km Marcia crater appear to delineate the most recent large impact event on Vesta. Crater counts of areas of the Marcia ejecta blanket give cratering model ages of $\sim$120-150 Ma and $\sim$220-390 Ma using the lunar-derived and asteroid flux-derived chronologies, respectively [6-8].

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