GEOLOGY OF -30247, -35247 AND -40247 QUADRANGLES, SOUTHERN HESPERIA PLANUM, MARS.
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Introduction: Geologic mapping of MTM -30247, -35247, and -40247 quadrangles is being used to characterize Reull Vallis (RV) and examine the roles and timing of volatile-driven erosional and depositional processes. This study complements earlier investigations of the eastern Hellas region, including regional analyses [1-6], mapping studies of circum-Hellas canyons [7-10], and volcanic studies of Hadriaca and Tyrrhena Paterae [11-13]. Key scientific objectives include 1) characterizing RV in its "fluvial zone," and evaluating its history of formation, 2) analyzing channels in the surrounding plains and potential connections to RV, and 3) examining young, possibly sedimentary plains along RV.

Methodology: This analysis includes preparation of a geologic map of MTM -30247, -35247, and -40247 quadrangles compiled on a single 1:1M-scale base. Crater size-frequency distributions compiled for regional analyses [5,6] will be used in conjunction with newly generated statistics for units mapped in the current study using new datasets (e.g., MOC, THEMIS, CTX and HiRISE).

Mapping Results: This section describes observations from geologic mapping and integrates new results with previous mapping of this area [e.g., 5,6] to complete MTM-scale mapping of the entire RV system.

Fluvial Modification: Fluvial processes have modified much of the map area. Most "highland" channels (<1 km wide; 10s of kilometers long) are incised within ejecta deposits associated with several large (D>35 km) impact craters. They consist of single channels to small networks, and some channels are braided. Several steep-walled, theater-headed channels are found within the plains adjacent to RV. Most of these channels are only a few tens of kilometers long, but some extend for hundreds of kilometers. Lastly, many highland massifs and the interior walls of many craters are incised with gullies that generally extend from the topographic peak to the base of the feature.

Reull Vallis System: Segment 1 (S1) and the upper part of Segment 2 (S2) of RV are found within the map area. S1 (~240 km long, 8–47 km wide, 110–600 m deep) displays erosional scarps, scarp-bounded troughs, and scour marks on the canyon floor. S1 consists of a series of irregular basins that contain remnant islands of ridged plains material. The morphology of S1 suggests formation by combined surface flow and collapse of ridged plains. S1 is the source area for at least some of the fluids that carved S2 [5,6,14].

S1 and S2 are not connected directly, but are separated by the edge of a large depression referred to as the "Morpheos" basin. It has been suggested that during the early stages of RV's formation water released from S1 accumulated in this basin and was later released to carve S2 [15,16].

S2 consists of morphologically distinct upper (S2-U) and lower (S2-L) parts. S2-U (6 to 13 km wide, 110-650 m deep) is sinuous and extends for ~240 km through degraded highlands. Layers or terraces exposed along its walls and braided channels incised in its floor suggest that at least this part of RV was formed and/or modified by surface flow [5,6]. Part of S2-L (6 km wide, 140–350 m deep) occurs in the southwest part of the map area and begins where a narrow (1–2 km wide), shallow (~100 m deep) canyon downcuts into the main canyon floor [5,6]. S2-L displays steep walls and a relatively flat floor suggesting formation by fluvial processes and subsequent modification by collapse and mass wasting [7,8].

Regional Stratigraphy: Materials forming highland terrains - *mountainous material* and *highland plateau material* (previously mapped as the basin rim unit) - are found primarily in the southern part of the map area [5,6,17]. *Mountainous material* (unit Nm) is the most rugged and tends to form isolated to clustered knobs and massifs. *Highland plateau material* (unit Nhp) is less rugged and forms more continuous expanses. These units are interpreted to consist of large blocks/ejecta resulting from the Hellas impact event [3-6,17,18]. In THEMIS day IR images both units appear very rugged; however, in high-res images, the peaks are rounded and appear mantled by a fairly continuous deposit [19,20]. At the peaks of some of the steepest highland massifs this mantling unit is being removed downslope via mass wasting.

Ridged plains material (unit Nrp) forms most of the northern part of the map area. This unit contains a high density of NE-SW and NW-SE trending wrinkle ridges and ridge rings. In THEMIS day IR images, inter-ridge areas are relatively featureless except for low-relief scarps and small sinuous channels. High-res images show inter-ridge areas contain dune features, accumulations of smooth materials in low areas, and small knobs [17]. Crosscutting relationships suggest ridge formation occurred after plains emplacement and prior to formation of S1 [5,6]. N(2) and N(5) statistics suggest this unit is Noachian in age. Collapse and erosion of Nrp to form S1 significantly modified portions of the ridged plains resulting in exposure of *modified ridged plains material* (unit Nmrp). The ridged plains sequence is interpreted to be sedimentary and/or volcanic [17,18,21,22] material that was modified by fluvial and eolian erosion, mobilization and deposition of surficial materials.

Plains in the southern part of the map area occupy low-lying regions and embay highland massifs. *Smooth plains material – upper member* (unit Nspu) is found primarily adjacent to S2-U. These deposits display smooth surfaces in THEMIS IR images, but high-res images reveal low-relief scarps, small channels, pits and scattered knobs suggesting sublimation and collapse of volatile-rich material, as well as modification by fluvial and eolian processes. *Smooth plains material – lower member* (unit Nspl) is stratigraphically lower than the upper member and forms the lower wall along S2-U. These materials were likely exposed during formation of S2. The smooth plains sequence is interpreted to be sediments deposited prior to and during the formation of RV by overflow of the canyon and from erosion via valley networks, and may also include materials deposited via mass wasting [5-8,17].

Two distinct plains units occupy the southeast part of the map area. *Etched plains material* (unit Nep) is found in the location corresponding to the "Morpheos" basin. In THEMIS day IR images, etched plains display a mottled appearance, which in high-res images is due to erosion of low albedo material into yardangs and exposure of underlying higher albedo material [17]. M*ottled plains material* (unit Nmp) occupies much of MTM -40247; these plains appear smooth at most scales and fill low-lying areas around highland massifs and degraded craters. The mottling and lack of detail expressed throughout much of these plains suggests these materials may be eolian in nature, similar to the mantled highlands unit mapped by [6]. Knobby textures along the southeastern edge of the map area consist of small knobs surrounded by smooth plains, and may consist of remnants of ejecta from a 50-km-diameter impact crater to the west [17].

The floors of the RV segments are covered with morphologically distinct materials [17]. S1 contains *smooth Reull Vallis floor material* (unit Nrvfs) that is generally smooth to rough (at MOC scale) and likely includes fluvial deposits, as well as collapsed ridged plains. S2-U contains *upper Reull Vallis floor material* (unit Hrvfu), which displays an overall smooth appearance at all image resolutions, and this entire deposit is incised with narrow sinuous channels. S2-L contains *lower Reull Vallis floor material* (unit Hrvfl) and exhibits pits and lineations that parallel the canyon walls. S2 floor materials likely consist of sediments eroded from "Morpheos" basin and adjacent highland and plains units [17].

Debris apron material (unit Ada) forms some of the youngest deposits in the map area [1,5-8,17,23-25] along highland massifs and crater walls. These deposits display uniform or mottled albedo, smooth relatively featureless surfaces to ridge-and-groove morphology, lobate frontal morphologies, and appear to be composed of multiple coalescing flows. Some crater floor deposits contain rings concentric to the crater walls, similar to concentric crater fill, suggesting flow of material downslope [26,27].

Impact-related materials cover a large part of the map area and exhibit a range of preservation states (fresh to highly degraded) and ages (Noachian to Amazonian) [17]. *Crater floor material* (unit AHcf) is found on the floors of most craters in the map area. In THEMIS day IR images, crater floor material appears smooth and featureless; however, in high-resolution images these deposits display a variety of albedos and surface textures, including knobby, pitted, "stucco"-type, "brain"-like, and ridge-and-groove. This unit is interpreted to consist of sediments emplaced via fluvial, eolian and/or mass wasting processes. The differences in albedo and surface textures suggest emplacement by a combination of processes and/or post-emplacement modification of the deposits.

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