GEOLOGIC MAPPING OF MTM -30247, -35247 AND -40247 QUADRANGLES, REULL VALLIS REGION OF MARS. S.C. Mest[1,2] and D.A. Crown[1], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719-2395, mest@psi.edu; [2]Planetary Geodynamics Lab, NASA GSFC, Greenbelt, MD 20771.

Introduction: Geologic mapping and stratigraphic analyses of MTM -30247, -35247, and -40247 quadrangles are being used to characterize the Reull Vallis (RV) system and to determine the history of the eastern Hellas region of Mars. Studies of RV examine the roles and timing of volatile-driven erosional and depositional processes and provide constraints on potential associated climatic changes. 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 for these quadrangles include 1) characterization of RV in its "fluvial zone," 2) analysis of channels in the surrounding plains and potential connections to and interactions with RV, 3) examination of young (?), presumably sedimentary plains along RV that embay the surrounding highlands, and 4) determination of the nature of the connection between segments 1 and 2 of RV.

Project Status: This analysis of RV includes preparation of the geologic map of MTM quadrangles -30247, -35247, and -40247 (compiled on a single 1:1M-scale base). The current map area is included in previous Viking-based mapping efforts at regional [5,6] and local (1:500K; MTM -30247) scales. Crater size frequency distributions compiled for the regional analysis of RV [5,6] will be used in conjunction with newly generated crater statistics for units mapped in the current study using the new datasets (e.g., MOC, THEMIS, CTX and HiRISE). This mapping effort will synthesize past results and new analyses, completing MTM-scale mapping of the entire RV system.

Mapping Results: This section describes results derived from mapping of MTMs -30247, -35247, and -40247 combined with results from previous regional [5,6] and local mapping efforts of this area.

Highland degradation: Small valley networks and channels dissect highland terrains in this area. Most fluvial features are found in low-lying areas and appear to erode a sedimentary unit that fills intermontane areas [5-8]. These networks consist of narrow (<1 km) valleys up to several tens of kilometers in length and exhibit rectilinear patterns. Valley and network morphologies suggest they could have formed by combinations of runoff and sapping processes.

Several large craters in the map area exhibit degraded rims, parallel interior gullies, and eroded ejecta blankets. Several craters also contain debris aprons that extend from the craters' interior walls onto their floors. Most craters in the map area are partially filled by smooth or hummocky deposits. The range of crater preservation and the presence of gullies and debris aprons suggest that a combination of fluvial processes and mass wasting is responsible for erosion and degradation of highland craters [2,5-8,14-18].

Tectonism: Wrinkle ridges and ridge rings are the most prominent tectonic features, found predominantly in the northern part of the map area within ridged plains. Two dominant trends are observed—NE–SW (Hellas radial) and NW–SE (Hellas concentric)—indicating either multiple stress regimes were active concurrently or the stress regime shifted over time [19-21]. Crosscutting relationships suggest that ridge formation occurred after plains emplacement (Early Hesperian) and prior to collapse events and fluvial dissection associated with the formation of upper RV (mid-Hesperian?) [5,6].

Reull Vallis System: Segment 1 (S1) and 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) is found in the eastern part of the map area within MTMs -30247 and -35247 and displays erosional scarps, scarp-bounded troughs, small theater-headed channels that converge at a large (~50 km across) depression, streamlined inliers of ridged plains material, and scour marks on the canyon floor. To the south, RV narrows then opens into a series of irregular scarp-bounded basins that also contain blocks of ridged plains material on their floors. Floor materials are generally smooth within S1 and likely include fluvial deposits, as well as debris contributed by collapse of the vallis walls. The overall morphology of S1 suggests formation by a combination of subsurface and surface flow and collapse of ridged plains material; this segment is believed to be the source area for at least some of the fluids that carved RV downstream [5,6,22].

An obvious surface connection between S1 and S2 is not apparent. Recent work using HRSC data suggests that the intersection of S1 and S2 marks the site of the Morpheos basin that formed in an early stage of RV's evolution [23,24]. It is believed that water flowing south from S1 accumulated in the Morpheos basin and was released to carve S2.

Segment 2 consists of morphologically distinct upper (S2-U) and lower (S2-L) parts. Contained within MTM -40247, S2-U displays sinuous morphology and extends for ~240 km through degraded highlands. S2-U (6 to 13 km wide, 110 to 650 m deep) exhibits features indicative of surface flow including layering or terracing along canyon walls, and braided gullies incised in floor material [5,6].

A portion of S2-L occurs in the southwest part of the map area, and begins where a narrow (1–2 km wide), shallow (~100 m deep) gully downcuts into the canyon floor [5,6]. This part of S2-L extends for ~70 km before opening into a large basin west of the map area [7,8]. Here, S2-L displays steep walls and a relatively flat floor, and is narrower (6 km) and shallower (140–350 m) than the remainder of S2-L to the west [7,8]. Unlike S2-U, S2-L does not display features on its floor indicative of fluvial erosion, though the canyon contains small-scale layering or terracing (tens to hundreds of meters thick) along its walls near the transition. Floor material consists of debris infilling the canyon from fluvial deposition and wall collapse, and exhibits pits and lineations that parallel the vallis walls similar to lineated valley fill in fretted terrain.

The morphology of S2 suggests initial formation by fluvial processes and subsequent modification by collapse and mass wasting. Several narrow, steep walled and flat-floored channels enter S2-U suggesting fluvial contributions to RV. These tributaries begin within and cut through various units including the basin–rim unit and smooth plains [5,6].

Regional Stratigraphy: The northern part of the map area is composed primarily of ridged plains material, initially believed to have been emplaced as flood lavas [25-27], although no obvious flow fronts are visible. Subsequent fluvial activity and deposition of sediments have significantly modified portions of the ridged plains in this area. Inter-ridge areas display relatively smooth and featureless surfaces except for the presence of low-relief scarps and small sinuous channels, interpreted to be fluvial in origin. MOC images show that inter-ridge areas contain dune features indicating eolian redistribution of sediments [5,6].

Analyses of the map area to date indicate that highland materials are surrounded and embayed by at least two plains units identified in previous mapping studies: dissected and smooth plains [5,6]. Dissected plains material, previously mapped as ridged plains [27], is found in MTM -35247 along the western edge of the map and between S1 and S2, and in the southeast part of the map area. This unit is characterized by a smooth surface dissected by narrow sinuous channels and low-relief scarps, and displays a few eroded wrinkle ridges. The contact between the ridged plains and dissected plains is gradational in most places, but the lack of high concentrations of pristine wrinkle ridges in dissected plains material allows it to be distinguished from ridged plains material [5-8]. Dissected plains material is interpreted to consist of volcanic and/or sedimentary materials eroded by fluvial processes.

Smooth plains material, originally mapped as part of the smooth plateau unit [27], is found adjacent to S2 of RV, embays highland units where they are in contact, and exhibits lobate terminations in some locations [5-8]. In high-resolution images, smooth plains display low-relief scarps, small channels, pits and small-scale undulations suggesting sublimation and collapse of volatile-rich material, as well as modification by fluvial and eolian processes. Along S2-U of RV, smooth plains material shows a fluted scarp boundary, whereas along most of S2-L, smooth plains material extends to the canyon wall [7,8]. Smooth plains are interpreted to be a mixture of sediments deposited from overflow of RV and at the termini of valley networks, and may also include materials deposited via mass wasting [5-8].

Mass wasting formed some of the youngest deposits in the map area. Debris aprons [1,5-8,16-18] and other viscous flow features [28,29] are found along highland massifs and crater walls, and are interpreted to consist of debris mass-wasted from steep slopes. Massif-associated features typically have uniform or mottled albedo, lobate frontal morphologies, and appear to be composed of multiple coalescing flows. Crater-associated features are relatively small and display mottled albedo, relatively featureless surfaces, and arcuate to lobate fronts. Some crater floor deposits contain rings concentric to the crater walls, similar to concentric crater fill [30,31].

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