**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 of MTM -30247, -35247, and -40247 quadrangles characterizes the upper reaches of Reull Vallis (RV) and illustrates its context in the history of the eastern Hellas region of Mars. Studies of RV provide constraints on the roles and timing of volatile-driven erosional and depositional processes and 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 study includes preparation of a geologic map of MTM quadrangles -30247, -35247, and -40247 compiled on a 1:1M-scale THEMIS day IR base. Crater size-frequency distributions will be generated for all mapped units in this area using new high-resolution datasets (e.g., MOC, THEMIS, CTX and HiRISE). This mapping effort will synthesize past results [5,6] and new analyses, completing MTM-scale mapping of the entire RV system.

**Mapping Results:** This section describes results derived from new mapping of MTMs -30247, -35247, and -40247 combined with results from previous regional [5,6] and local mapping efforts of this area. The northern extent of the map area is located in southern Hesperia Planum (27.5°-42.5°S lat., 245°-250°W lon.) and encompasses the upper reaches of Reull Vallis located within ridged plains and other plains materials and remnants of ancient highland terrians found within Premethei Terra.

*Highland degradation:* Small valley networks and channels dissect highland terrains in the map 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.

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 their erosion and degradation [2,5-8,14-16].

*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 multiple stress regimes were active concurrently or the stress regime shifted over time [17-19]. Crosscutting relationships suggest that ridge formation occurred after plains emplacement (Early Hesperian) and prior to 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 within MTMs -30247 and -35247 and displays erosional scarps, scarp-bounded troughs, small theater-headed channels, 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 [5,6,20].

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 [21,22]. 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 its floor [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, believed to consist of flood lavas [23-25], although no obvious flow fronts are visible. Subsequent fluvial activity, including formation of S1 via collapse and erosion of plains materials, and deposition of sediments significantly modified portions of the ridged plains in this area. At THEMIS IR scales, 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]. CTX images show that most surfaces, including ridged plains material and vallis floor material in the vicinity of S1 are overprinted with a knobby texture that may be indicative of a regional mantling unit.

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 is found along the western edge of the map, between S1 and S2 (occupying the floor of the Morpheos Basin), and in the southeast part of the map area. The western exposure is characterized by a smooth surface overprinted with a knobby texture similar to that observed in the nearby ridged plains, and is dissected by narrow sinuous channels and displays a few low-relief scarps and eroded wrinkle ridges. Here the contact between the ridged and dissected plains is gradational, 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].

The southeast exposure appears mottled in THEMIS images and displays knobs that are more scattered; this texture extends farther to the east within southern Hesperia Planum. The similarity of these knobby materials, as well as the presence of exhumed craters within this material suggests deposition and removal of a regional mantling unit. The underlying plains material is interpreted to consist of volcanic and/or sedimentary materials.

Smooth plains material is found adjacent to S2, 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, 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 consist of sediments deposited from overflow of RV, materials eroded from highland terrains by valley networks, and materials deposited via mass wasting [5-8].

Mass wasting formed some of the youngest deposits in the map area. Debris aprons [1,5-8,14-16] and other viscous flow features [26,27] are found along highland massifs and crater walls, and are interpreted to consist of debris shed from steep slopes. Debris aprons typically have uniform or mottled albedo, lobate frontal morphologies, and appear to be composed of multiple coalescing flows. Some crater floor-related debris display rings concentric to the crater walls [28,29].

**Ongoing Work:** Mapping is nearing completion for this 3-quadrangle area and geologic unit names and description will be finalized upon completion of the mapping. Craters greater than 1 km in diameter will be identified and measured, and crater size-frequency distribution statistics will be calculated. From these statistics, as well as superposition and cross-cutting relations, a correlation chart will be developed and unit ages will be determined.

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