THE EVOLUTION OF THE REULL VALLIS FLUVIAL SYSTEM, MARS. V.-P. Kostama[1], M. Ivanov[1,2], J. Korteniemi[1] and J. Raitala[1]. [1]Planetology group, PO box 3000, FIN-90014 University of Oulu, Finland; [2]Vernadsky Institute, Moscow, Russia; <petri.kostama@oulu.fi>.

Introduction: The region between Hesperia Planum and Hellas basin is one of the main areas on Mars where large outflow channels occur [1-7]. One of these, Reull Vallis, begins in Hesperia Planum and runs from east to west across the northern portion of Promethei Terra. Here we present a new hypothesis for the evolution of Reull and its fluvial system. We suggest that the fluvial system of Reull Vallis consists of several parts that were formed during several distinct phases.

Data and methods: We defined and analyzed the different parts of the fluvial system and correlated temporally the processes that led to their formation using available images and topography data (MDIMs, MOC, THEMIS (IR and VIS), HRSC, and MOLA-gridded topography (128 px/deg)). Crater counting served to derive relative and model absolute ages of different portions of the Reull Vallis system; measurements from MDIM and MOLA were used to estimate volumes and their balances for different parts of the system.

Parts of the Reull Vallis fluvial system: The Reull Vallis fluvial system consists of five parts (Fig. 1). The first, northernmost part (depression with provisional name "Morpheos Trough"), begins within the southeastern portion of Hesperia Planum at ~31°S, 246.5°W. At ~32.5°S, 246°W, it is transformed into a morphologically distinct channel, "Morpheos Vallis" (segment 1 of Reull of [8]), which represent the second part of the system. This channel runs southward, and disappears at the northern edge of "Morpheos basin" at about 35°S, 246°W. The Morpheos Basin is the third part of the system; it represents a closed topographic depression elongated in W-E direction in the SE portion of Hesperia Planum, which received and stored water from Morpheos Vallis. Morphology of Morpheos Vallis suggests a catastrophic outflow through it. If we assume velocity of the flow to be 60-70 km/h, it would take ~5-8.5 days to fill the basin up to 650 m contour (~200 m deep); the volume of stored water is ~11-17 x 10^3 km^3. Morpheos basin appears to be the source area of Reull Vallis (segment 2 of Reull of [8]). The fourth part of the fluvial system is the upper Reull Vallis (Fig. 1). It begins as a full-sized topographic and morphologic feature at the western edge of the Morpheos Basin (~37.5°S, 247°W). For the largest portion, the channel of Reull Vallis is on a very shallow slope (Fig. 2). At ~42°S, 254°W, slope of the channel increases, whereas the regional slopes on both sides of it remain to be the same (Fig. 2). Volume of the upper Reull is ~1700 km^3. The fifth part of the system is the lower Reull Vallis (Fig. 1). It starts at ~42.5°S, 257°W as a broad and deep canyon and runs to the west along a shallow slope, which is similar to the regional slope outside of the channel and to the slope of the upper Reull (Fig. 2). Volume of the upper Reull is ~8300 km^3. The longitudinal profile (Fig. 2) shows that Teviot Vallis, an apparent tributary to Reull Vallis (its volume is ~3100 km^3), continues topographic trend of the lower Reull.

Apparent sequence of events: Morphologic characteristics and topographic configuration of different parts of the Reull Vallis fluvial system (especially a major break in slope separating the upper and lower Reull) suggest the following sequence of major events during formation of the system. The oldest parts of the system appear to be the Teviot-lower Reull Vallis and the sub-system of Morpheos Trough-Vallis-Basin. Probably, these two oldest parts formed independently; relative ages between them cannot be established. Within the Morpheos sub-system, a flow below the lava plateau removed supporting material and resulted in formation of the trough due to subsidence of the lava plains. When the flow broke through to the surface, it carved the Morpheos Vallis, filled a part of the Morpheos basin, and formed there a standing body of water. The last episode of the evolution of the Reull Vallis fluvial system was formation of the upper Reull due to discharge of the Morpheos basin. Topography along the upper Reull and secondary channels near its end suggest that water was pounded during formation of the upper Reull. Such a pounding may have resulted in erosion, deposition, and resurfacing of an area around both the upper and lower Reull. Note that the volume of water that potentially may be stored within the Morpheos basin is about an order of magnitude larger than the volume of material removed from the upper Reull.

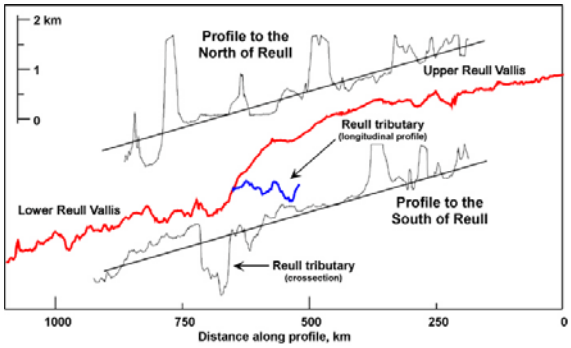

Figure 2. The longitudinal topographic profile of Reull Vallis consists of two distinct parts, the upper and lower Reull separated by a major break in slope. A "tributary" to Reull (Teviot Vallis) continues the topographic trend of the lower Reull.

Crater counting: In order to estimate ages in different portions of the Reull Vallis fluvial system relative to Hesperia Planum and to each other, we have counted craters in three large regions: 1) Hesperia Planum (1.50 x 10^6 km^2, 3266 craters, 1.2-49.9 km in diameter), 2) Morpheos Basin (0.24 x 10^6 km^2, 357 craters, 1.2-31.4 km in diameter), and 3) Reull Vallis region (both upper and lower Reull, 0.27 x 10^6 km^2, 261 craters, 1.2-39.7 km in diameter). The crater size-frequency distributions show that the Morpheos and Hesperia curves are practically coincided, while the Reull Vallis curve is distinctly lower (Fig. 3). Thus, the crater retention age of the Morpheos basin is indistinguishable from that of Hesperia Planum and the area around Reull Vallis is younger, which is consistent with apparent sequence of events during formation of the Reull Vallis fluvial system.

Conclusions: Our analysis suggests that the Reull Vallis fluvial system consists of several distinct parts that have different origin and age. The whole evolution of the system appears to be consisted of three major episodes: (1) formation of the lower Reull (apparent beginning of it is the Teviot Vallis in ~44°S, 258°W), (2) formation of the Morpheos fluvial sub-system (these two episodes may or may not be contemporaneous), and 3) formation of the upper Reull that connected the Morpheos sub-system with the lower Reull.

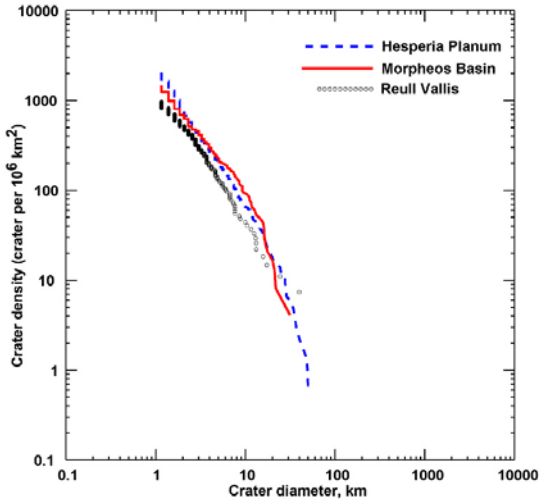

Figure 3. The crater size-frequency distributions for Hesperia Planum, Morpheos basin, and area around the upper and lower Reull.

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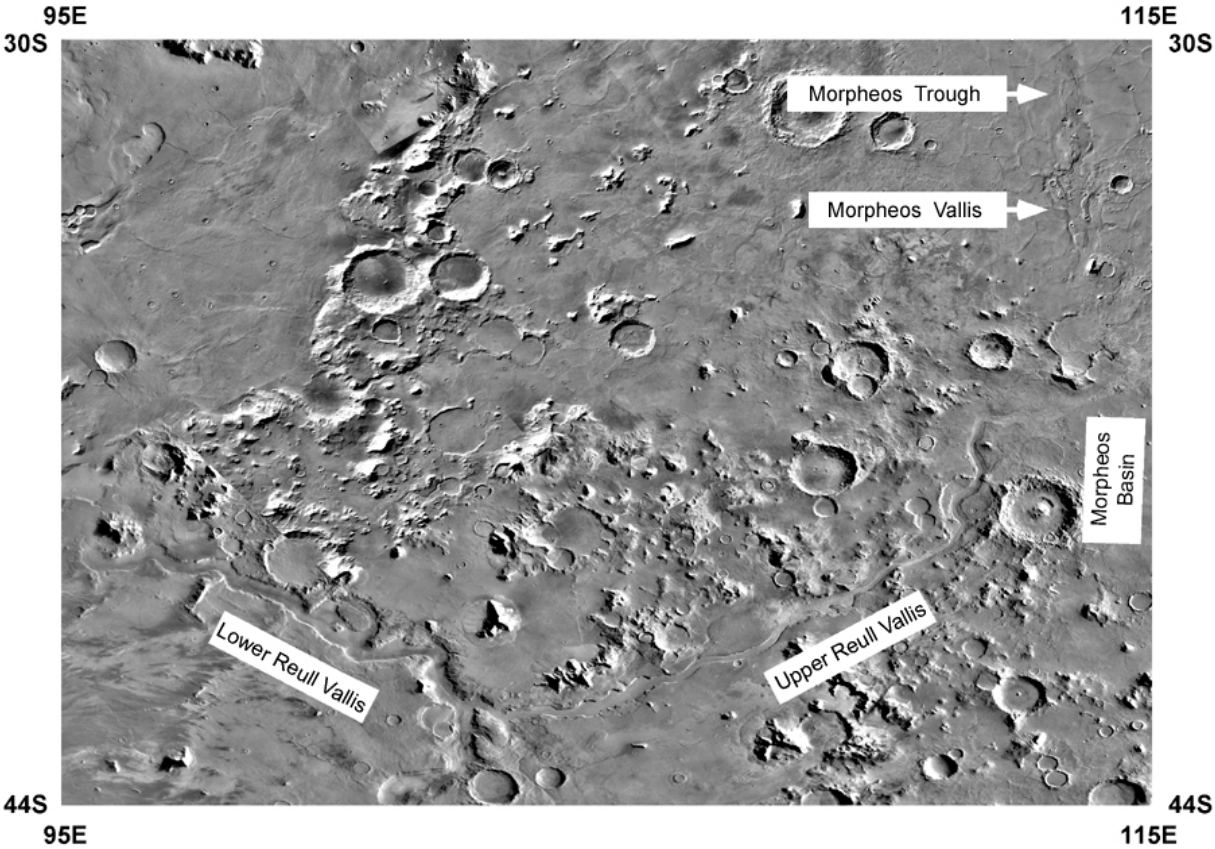

Figure 1. Viking MDIM showing the five parts of the Reull Vallis fluvial system.