VOLUMETRIC ANALYSIS OF THE REULL VALLIS FLUVIAL SYSTEM IN THE EASTERN HELLAS REGION OF MARS: INVESTIGATION INTO THE CONTRIBUTIONS OF WATER. Eileen J. Capitoli[1] and Scott C. Mest[2], [1]Department of Earth and Environmental Science, University of Pennsylvania, 240 South 33rd Steet, Phildelaphia, PA 19104-6316, ecap@sas.upenn.edu [2]PSI, Planetary Geodynamics Laboratory, Code 698, NASA Goddard Space Flight Center, Bldg. 34, Rm. G288, Greenbelt, MD 20771, mest@psi.edu.

Introduction: This study evaluates the fluvial and erosional history of the eastern Hellas region of Mars by investigating the sources of water that carved the Reull Vallis (RV) outflow system**.** RV is located east of Hellas Basin in the Hesperia Planum and Promethei Terra regions of Mars (Figure 1). We estimate the volumes of the morphologically distinct segments of the RV system in order to determine the contributions of water to the system. Its source area (segment 1; S1) is believed to have provided the water for the main canyon (segments 2 and 3; S2 and S3) [4]. A large topographic depression, the Morpheos Basin (MB), separates S1 and S2, and is believed to have stored the effluents of S1 plus water from adjacent highland terrains until its divide was breached, thus carving S2 and S3 [1,3]. Teviot Vallis (TV) is identified as an additional source area that is believed to have enlarged S3 downstream [4].

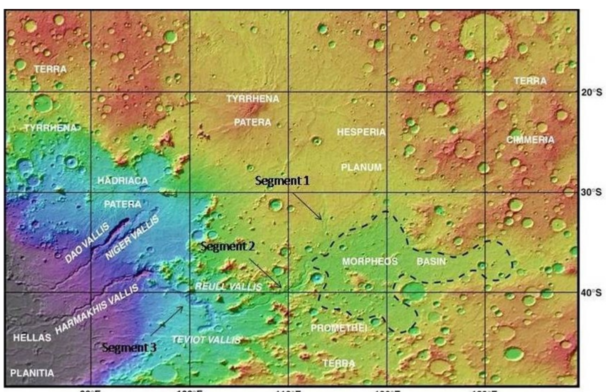

Figure 1. MOLA topographic map of the eastern Hellas region. Segments 1-3 of Reull Vallis are shown along with its side canyon - Teviot Vallis. The Morpheos Basin, as defined by [2, 3] is outlined by the black dotted line.

Method: Volumes were estimated using the MOLA 64 pixels/degree DEM with the IDL-based module GRIDVIEW [5]. In order to obtain the most accurate volumes, we divided each segment of RV into subsegments, such as subsegment 2I of S2. For each subsegment, the contour where the slope of the plains intersects the slope of the canyon wall is used to define the canyon rim. In this example, we use the 250 m contour as the topographic rim of this subsegment. Subsegment volumes were then added together to provide the total cavity volume for each segment. For MB, we measured its volume using different contour levels (650, 600, 550, 500, and 450 m) as its extent,

Results:. We estimate the volumes of S1 and S2 to be roughly equivalent, 2,377.2 km^3 and 2,320.5 km^3, respectively. The volumes of TV and S3 were estimated to be 3,917.8 km^3 and 8,159.4 km^3, respectively. Lastly, the volume of MB at the 650 m contour was found to be 17,138 km^3.

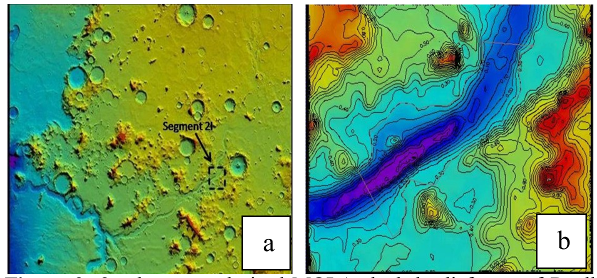

Figure 2. 2a shows a colorized MOLA shaded relief map of Reull Vallis, and the location of subsegment 2I (black dashed box). 2b shows a close-up MOLA contour map of subsegment 2I.

Discussion: Our estimates of S1 and MB suggest that water expelled from S1 could not have filled the basin to the 650 m contour. If MB was filled to the 650 m level, its release would have formed a much larger S2 than is currently observed. Our results show that S1 was likely the sole source for the water that carved S2, suggesting only the western side of the basin may have contained water, possibly to either the 450 m (160.5 km^3) or 500 m (983.5 km^3) contour levels, assuming that there was only one pulse of water released from S1. However, it is possible that more than one pulse of water was released from S1 based on the much greater combined volume of S2 and S3 (10,479.9 km^3) compared with that of S1 and TV (6,295.0 km^3), leaving 4,184.9 km^3 worth of water missing. If S1 and TV were the sole sources of water for S2 and S3 combined, than those volumes should be equivalent. Since the volume of the canyon is much greater than that of its sources, it is possible that there were multiple pulses of water released from S1 which may have filled the MB to the 550 m level (4,142.5 km^3) instead, which could account for the missing water since it is equivalent in volume. It is also possible that a second pulse of water was released from TV which could account for the missing water. This may explain why S3 is significantly greater than its source areas - S2 and TV - combined (6,238.3 km^3). This additional pulse of water may have contributed to the enlargement of S3. Some other possible factors include; 1) the presence of a pre-existing aquifer in the area around S3; 2) the drastic slope increase in the lower part of S2 may have increased eroding power of the water as it approached S3; 3) sediment buildup on the floors of the source channels could be underestimating their volumes; and/or 4) a blocked connection between the terminus of RV and the head of Harmakhis Vallis may have resulted in backcutting of S3.

References: [1] V.P. Kostama., et al., (2004) Vernadsky-Brown XL. [2] Kostama., et al., (2006) Proc. Lunar Planet. Sci. Conf., XXXVII, 381. [3] Kostama, et al., (2007) JGR, 112, E1100. [4] S.C. Mest and D.A. Crown, (2001) Icarus, 153, 89–110. [5] Roark et al., (2000), Lunar Planet. Sci. Conf., XXXI, 2026.