GEOLOGICAL EVOLUTION OF MANGALA VALLES, MARS: ANALYSIS OF THE HRSC IMAGE H0286. A. T. Basilevsky[1,2], G. Neukum[2], S. C. Werner[2*], S. van Gasselt[2], A. Dumke[2], W. Zuschneid[2], M. Chapman[3], R. Greeley[4], [1]Vernadsky Institute, RAS, Moscow, Russia, [2]Institute of Geosciences, Freie Universitaet Berlin, Germany, [3]U.S. Geological Survey, Flagstaff, AZ, USA; [4]U.S. Arizona State University, Tempe, AZ, USA, [*]Now at Geological Survey of Norwey.

Introduction: The Mangala Valles is the N-S trending, 900 km long outflow channel system in the region adjacent to the SE flank of the Tharsis bulge. Previous studies were mostly based on Viking orbiter photogeological mapping and general studies [1-8]. Crater counts for a few of the primary map units, led to the conclusion on two episodes of channel formation. Some studies suggested the possibility of more than one source for the water carved the channel system[1, 6, 7]. Recent analysis of THEMIS and MOLA data suggests on a single period of catastrophic flooding consisting of two phases from one source [9]. Their work question the validity of crater counts used by previous researchers to support multiple periods of flooding because of the poor crater statistics. Our work is based on photogeologic mapping of HRSC image H0286 and the derived DTM (Figure 1). The MOC and THEMIS (daytime, 18 m/px) images have been also studied.

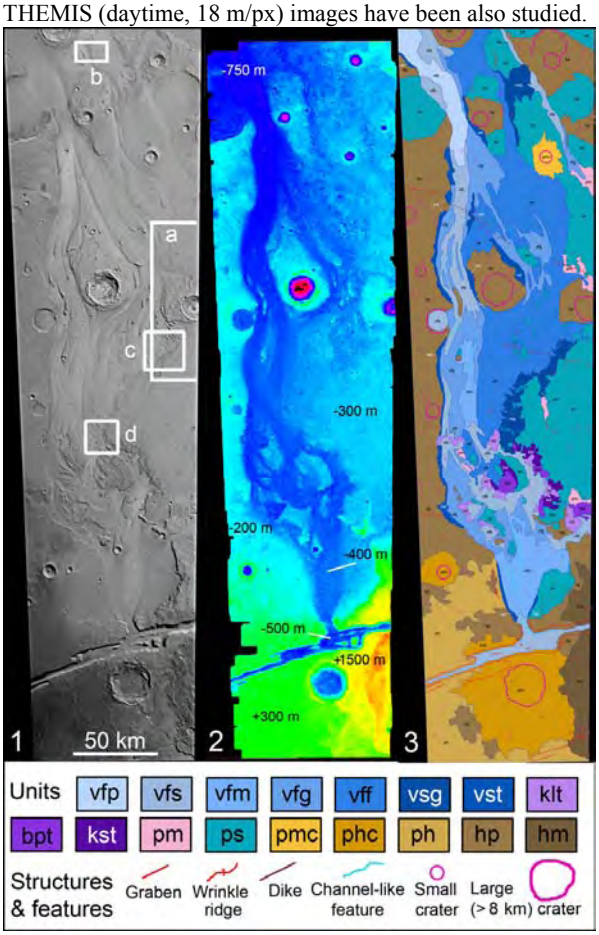

Figure 1. Left, southern part of HRSC image 0286, white boxes outline areas shown in figures 2 a,b,c,d; center, the HRSC-based digital elevation model; right, geological sketch map with all units identified.

Mapping results: Figure 1 right shows our map of the study area. The units are based on surface characteristics seen in the images, and include both three-dimensional rock units (i.e., inferred to be "formations" in the traditional geological sense) and terrains with characteristic surface textures, such as grooves. The map shows that the highland plateau material (hm) and hummocky plains units (ph) are cut by the fractures of Memnonia Fossae, forming grabens. One of the grabens centered at 18S, 149W is the water source suggested in previous studies. The earliest Mangala Valles flood event is represented by smooth plains materials (ps) found in the eastern part of the valley system and bearing evidence of the surface flow from the up-valley source to the NNW direction (Figures 2a and b).

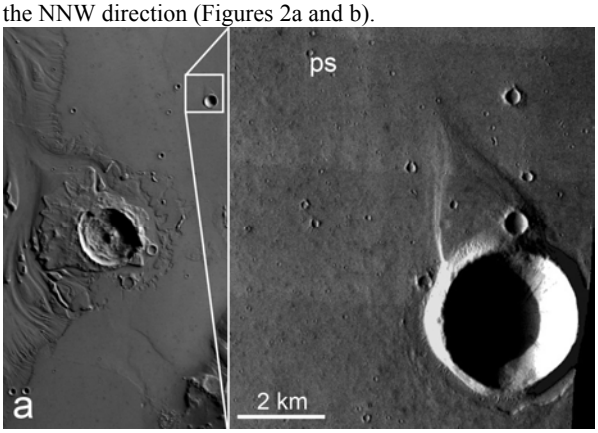

Figure 2a. The 3-km impact crater east of the mapped area, the tear-drop feature suggests a surface sheet flow to NNW direction, THEMIS image V06235005 (17 m/px, daytime).

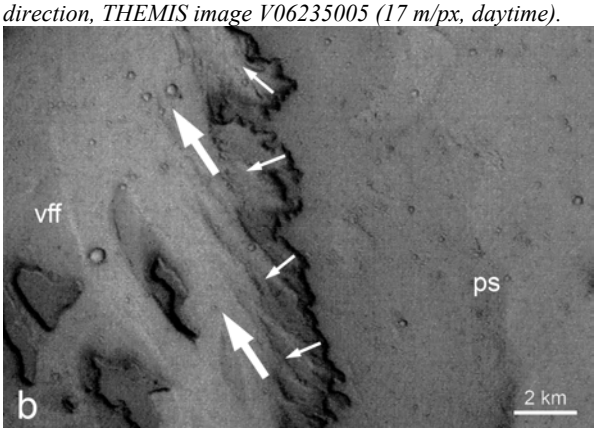

Figure 2b. The high-standing valley floor (unit ps) and the deep-incised channel floor with flutes (unit vff), whose orientation suggests flow from the up-valley source, HRSC image.

In other places however one can see that the erosional flutes on unit vff and grooves on the channel slope (unit vsg) are strongly controlled by the geometry of the channel edge (Figure 2c). This suggests significant water release from beneath the ps unit. There are also three other lines of evi-

dence suggesting release of subsurface fluids from beneath or within the smooth plains: 1) as shown in Figures 1 and 2d, the smooth plains and valley floor flutes have been broken into units characterized by knobs (klt and kst), the outcrops which form amphitheater-like patches suggestive of collapse, as it might have occured from the release of subsurface water, 2) polygonal blocks form zones of chaos (unit bpt), which is generally attributed to the release of subsurface water as observed elsewhere on Mars [10], and 3) within parts of unit vsg, small braided channels are found (arrow in Figure 2d), the heads of which end abruptly and give the appearance of sapping from ground water sources.

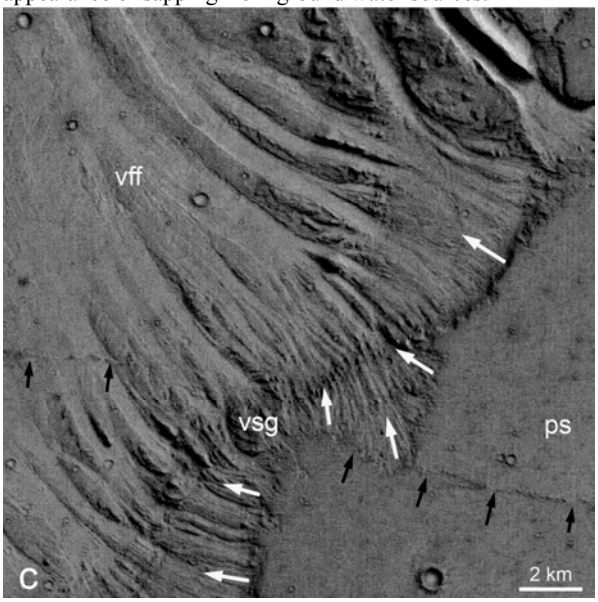

Figure 2c. The high-standing valley floor (unit ps), valley grooved slope (vsg) and the deep-incised channel floor with flutes (vff), orientation of flutes (white arrows) suggests fluid release from underground beneath the ps unit at the eastern slope of the channel, black arrows show possible dike, HRSC image.

Parts of the valley floor in the mid-to-north region mapped show narrow (<100 m wide), long grooves cut into the surface that are oriented parallel to the inferred flow direction. We suggest that these features could represent scours carved by glaciers, consistent with the interpretation by [6] for similar features seen in the south near the source-graben for Mangala Valles. Possible glacial activity is also suggested by irregular-shaped depressions, or pits, smaller than a few hundred meters across and seen on the valley floor to the north designated vfp in the map [9]. The pits could be "kettles," which represent blocks of ice that were entrained in glacial deposits and which subsequently melted, leaving voids in the deposits.

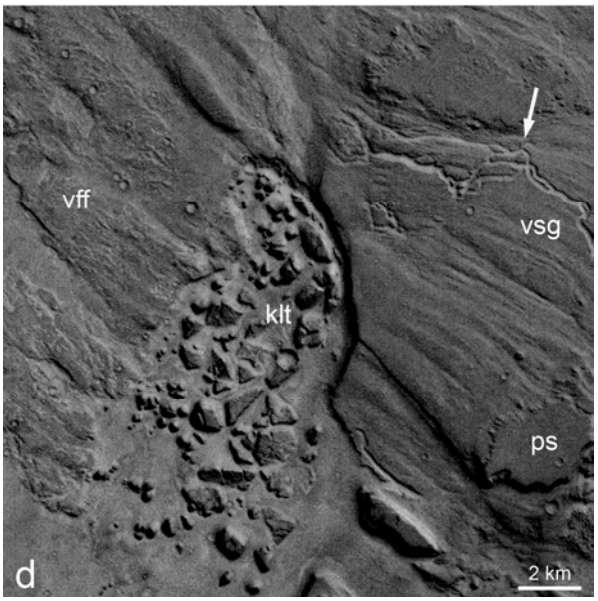

Figure 2d. The large knob terrain unit (klt) suggesting surface collapse due to underground water release, HRSC image.

Conclusions: Our analysis shows that the Mangala Valley flooding(s) had more than one source. One, important and probably dominating, was that described by previous researchers for the graben in the valley head. Another important, source was the release of ground water beneath the smooth plains unit. The observed morphology could be formed in one or in more than one flooding periods; this issue can potentially be solved using crater-based dating on different units [11].

References: [1] Carr M. H. (1979) *JGR, 84*, 2995-3007. [2] Chapman M. G. et al. (1989) Geologic maps of science study site 1A, East Mangala Valles, Mars, *U.S. Geol. Surv. Misc. Invest. Ser. Map, I-1962*. [3] Tanaka K. L. and Chapman M. G. (1990) , *JGR, 95*, 14,315-14,322. [4] Chapman M. G. and Tanaka K. L. (1990) *Proc. Lunar Planet. Sci. Conf., 20th*, 531-539. [5] Chapman M. G. and Tanaka K. L. (1992) *U.S. Geol. Surv. Misc. Invest. Ser. Map, I-2294*. [6] Zimbelman et al. (1992) *JGR., 97,* 18,309-18,317. [7] Zimbelman et al. (1994) Geologic Map of the MTM-15147 Quadrangle, Mangala Valles Region of Mars, *U.S. Geol. Surv. Map I-2402*; [8] Craddock R. A. and Greeley R. (1994) Geologic Map of the MTM-20147 Quadrangle, Mangala Valles Region of Mars, *U.S. Geol. Surv. Map I-2310*. [9] Ghatan et al. (2005) [10] Baker V. et al. (1992) in *Mars*, Kieffer, H.H., B. Jakosky, C.W. Snyder, and M.S. Matthews, eds., University of Arizona Press, p. 493-522. [11] Neukum G. et al. (2007) this volume.