GEOLOGIC ANALYSIS OF HRSC IMAGES OF THE AREA EAST OF THE MANGALA VALLES HEAD GRABEN, MARS. A. T. Basilevsky[1,2], G. Neukum[2], T. Kneissl[2] and A. Dumke[2], [1] Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow 119991 Russia (atbas@geokhi.ru), [2] Institute for Geosciences, Freie Universitaet Berlin, Germany.

Introduction: This study is mostly based on the analysis of the MEX HRSC images taken in orbit 2271. The area of this study (13.5°-19.3°S, 146.1°-147.8°W) is located east of the Mangala Valles head graben. The latter was the major source of the water for several episodes of flooding which carved the valley system [e.g., 1-3]. Within the study area, there are observed several relatively large lava flows which seem to be associated with a graben being an obvious continuation of the Mangala head graben. We have made crater counts to determine ages of the lava flows and adjacent terrains aiming at understanding if the lava eruption episodes correlate with episodes of the Mangala Valles floods. The latter could have been initiated by dyke intrusions. A surface expression of this is the valley head graben [4]. Besides, several of the observed lava flows and other geologic units show an obvious time sequence of their emplacements. So it was possible to check how the ages determined through crater counts correlate with the morphologically deduced sequence of emplacements.

Observations and analysis: As a result of the geological analysis of the HRSC images, several geologic units have been identified (from older to younger): 1) large highly cratered mountain ridge, 2) knobby plains, 3) smooth plains (locally with small channels on them), 4) etched plains, 5) lava flows, 6) relatively young impact craters, and 7) fields of wind streaks (Figure 1). Major emphasis of our study was on lava flows, the larger of which is ~90 km x 200 km, the smallest, 10 km x 25 km. Using the Digital Terrain Model produced form the HRSC images and MOLA data we have found that the lava flow termination "scarps" are 30 to 70 m high and 700 to 2000 m long; so their steepness varies from 1.3° to 3.1° (mean value 2.2°). Thus what is seen on the images as scarps are actually very gentle slopes. Above them within the 1 km to 7 km wide zone the lava flow surface is usually also inclined towards the flow terminations but with significantly smaller angles: 0.1° to 0.7° (mean value 0.4°). Further away from the "scarps" the surface is even more gently sloped. The gentle slopes typical of the lava flows of the study area suggest low viscosity of lavas that, in turn, implies their basaltic composition.

The HRSC images have been used to count craters aiming at determining absolute ages of lava flows and non-lava geologic units of the study area [5-8]. In this study we have found several cases when on the crater count size-frequency distributions there were "kinks" and the younger age (usually called resurfacing age) is the basic age of the lava flow emplacement while the older age is a signature of the crater population superposed on the underlying precursor terrain and protruding through the lava (Figure 2).

Figure 3 presents a histogram showing absolute ages of the elements of the Mangala Valles valley system [3] and ages of lava flows and non-lava geologic units of the study area. It is seen from the histogram that the studied lavas were emplaced around 0.5 Ga ago, thus correlating with the 0.5 Ga episode of the Mangala valley-carving floods. The 0.2 Ga resurfacing signatures for the lavas correspond to the strong 0.2 Ga peak of activity in the Mangala Valles evolution. The four signatures of resurfacing for the non-lava units of the study area seem also to correlate with the same peak. As it was suggested by [3] the Mangala fluvial activity around 0.2 Ga ago (when meandering channels have been formed) could happen in the environment of a short-time period of a thicker atmosphere and thus warmer climate.

Figure 4 shows how the morphologically established time sequences of lava flows and non-lava geologic units correlate with absolute ages determined by crater counts. Good correlation is obvious although error bars for the units are often overlapping.

Conclusions: This study shows that the lava fields associated with a graben being the continuation to the east of the head graben of the Mangala valles have morphologic characteristics suggesting their basaltic composition. The studied lava flows mainly formed around ~0.5 Ga ago, thus correlating with one of the episodes of the Mangala Valles flood activity [3]. This supports the hypothesis [4] that the formation of the graben and the Mangala-carving water release was due to emplacement of a magmatic dike(s). The study area has signatures of resurfacing around ~0.2 Ga ago supporting the hypothesis [3] that then could have been a short-time period of a thicker atmosphere and thus warmer climate.

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References: [1] Tanaka K. L. and Chapman M. G. (1990) *JGR*, 95, 14,315-14,323. [2] Ghatan G. J. (2005) *EMP*, 96, 1-57. [3] Basilevsky A. T. et al. (2009) *PSS*, (in press). [4] Wilson L. and Head J. W. (2002) JGR, 107(E8), 5057, doi:10.1029/2001JE 001593. [5] Neukum G. and Hiller K. (1981) *JGR*, 86, 3097-3121. [6] Hartmann W. K. and Neukum G. (2001) *Space Sci. Rev.* 96, 165-194. [7] Werner S.C. (2005) ***http://www. diss.fu-berlin. de/2006/33/indexe. html.*** [8] Michael G. and Neukum (2007) *LPSC XXXVIII*, Abstract #1825.

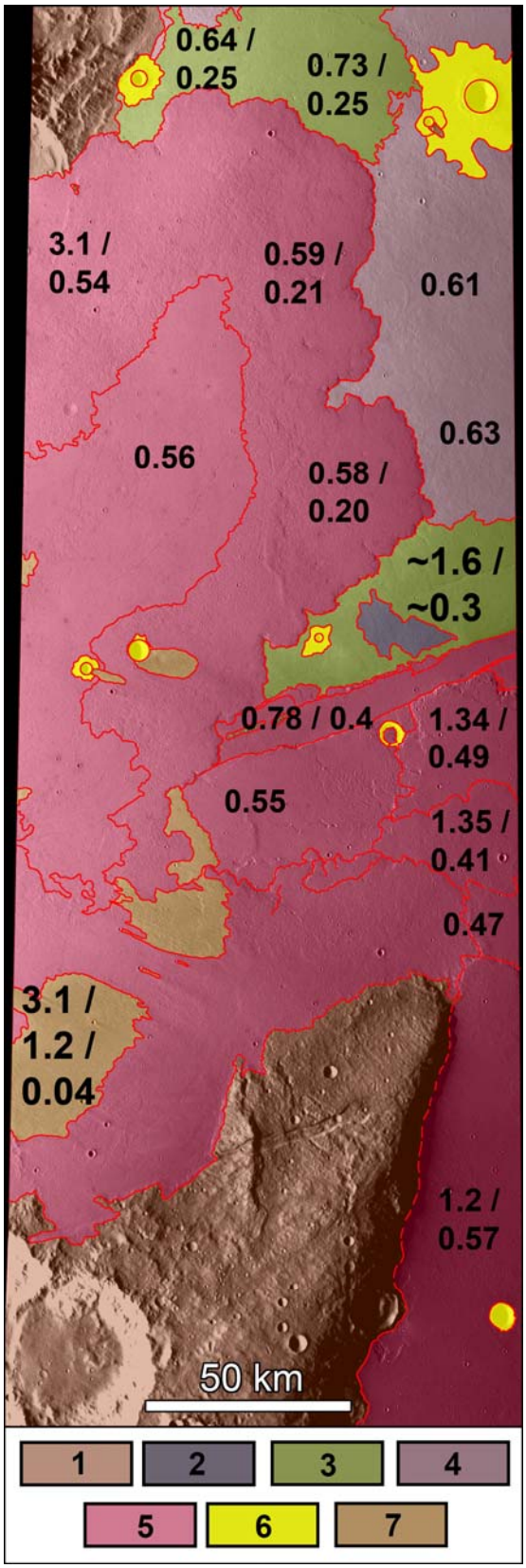

Figure 1. Geomorphic map of the study area with absolute ages determined through crater counts.

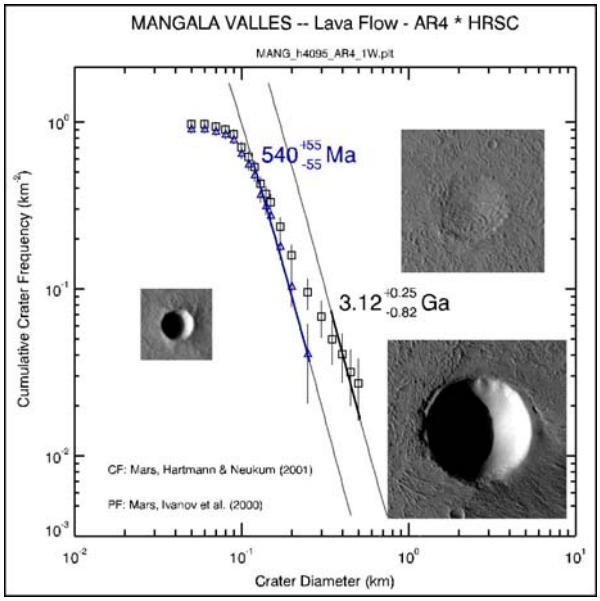

Figure 2. One of the crater count diagrams showing also images of craters superposed on lava flows (one on the left) and protruding through lavas (two on the right).

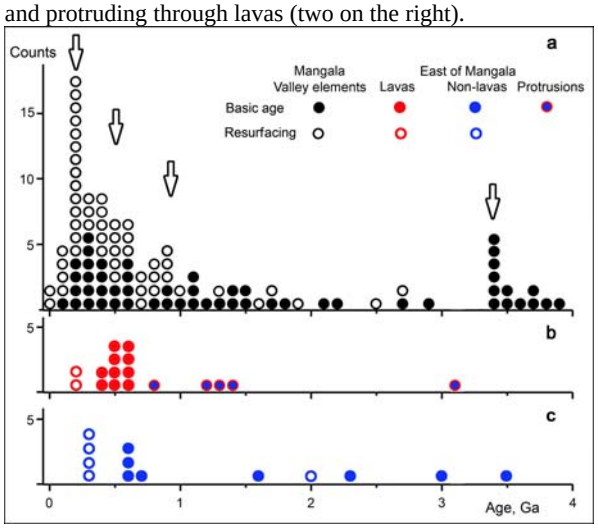

Figure 3. Histogram showing ages of the Mangala Valles elements (a) in comparison with ages of lavas (b) and non-lavas (c) of the study area.

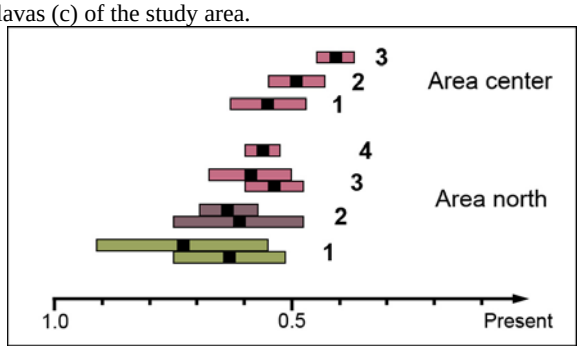

Figure 4. Morphologically determined time sequences of lava flows and non-lava units (1 =>4 and 1 =>3) v.s. absolute ages determined by crater counts. Colors of the error bars correspond to those for the geologic units in Figure 1.