RIFTING IN ACHERON FOSSAE, MARS, OBSERVED BY THE HIGH RESOLUTION STEREO CAMERA (HRSC). P. Kronberg[1], E. Hauber[2], T. Schäfer[1], M. Grott[2], K. Gwinner[2], B. Giese[2], Ph. Masson[3], G. Neukum[4], and the HRSC Co-Investigator Team, [1]TU Clausthal, Leibnizstr. 10, D-03678 Clausthal-Zellerfeld, Germany; peter.kronberg@tu-clausthal.de; [2]German Aerospace Center (DLR), Berlin, Germany, [3]Univ. Paris-Sud, Orsay, France; [4]FU Berlin, Germany.

Introduction: We describe the morphotectonic features of the Acheron Fossae (AF) graben system (NW Tharsis). The AF were early recognized as a heavily fratured region [1,2,3,4], and Viking-based geologic mapping summarized the major geologic surface units of the region [5], but no detailed tectonic investigation has been performed yet. An ESE- to E-W-trending topographic high of Noachian age, standing up to ~2000 m above its srroundings, is cut by a complex system of extensional tectonic features. About 275 km wide, the well-developed horst and graben system extends along its trend over 775 km. Its overall elevation decreases westwards before extensional structures disappear under lowland deposits. We use HRSC-imagery as well as HRSC- and MOLA-derived topographical data for detailed photogeological mapping and structural evaluation of extensional structures, following earlier studies of the Tempe Fossae [6] and the Claritas Fossae region [7].

Geographic and Structural Overview: Fig.1 provides a synoptical view of the Noachian topographic high and its predominant E-W trending horst and graben structures, which we refer to as Acheron Fossae 1 (AF1) (Fig. 2). An along-strike change in width and architecture of extensional deformation allows to differentiate Acheron Fossae I. An eastern segment (~155 km long and up to 150 km wide) is characterized by steep normal faults (30-130 km long), outlining complex horst and graben structures with large observable throw (up to 2050 m). A topographic rise, here informally termed Acheron Montes, with elevations up to 3000 m is associated with the eastern grabens and crossed by extensional faults. We interpret it as a center of early- to syn-rift volcanism. Towards the west, the eastern segment narrows into a 55 km wide central segment (about 220 km long). Its deep axial graben (around 25 km wide) is bordered by step faults (1000-1225 m throw). Two HRSC-based topographic profiles illustrate the change in rift architecture (Fig.1 and 3). Values of crustal extension across profiles A and B change from 8.7 km to 3.7 km, decreasing westwards. A western segment is characterized by a 50-60 km-wide series of multiple horsts and grabens (only 2-3 km wide and 30-50 km long). Crustal extension decreases further to 1.7 km. Western structures of AF1 are superposed and vertically displaced (800-1225 m) by a discrete NW-SE trending double graben. This feature is part of a second regional graben system, Acheron Fossae 2 (AF2). The sinuous shape of the double graben and its intermediate structural high indicates a reactivation of the pre-existing AF1 structures. Towards the southeast, the double graben developes into an asymmetric graben (130 km long and 10-25 km wide) with the largest throw on S-dipping master faults (300-700 m).

Interpretation: According to the results from our detailed photogeological mapping, we see the AF1 graben system as a possible rift structure associated with crustal upwarping. The rift-related volcanic center of the Acheron Montes should indicate local magmatic uprise and involvement of lithosphere. The observed change in topography, fault geometry and crustal extension would favour the westward propagation of rifting. The AF1 are expected to continue eastward under a cover of Hesperian-aged lava flows from Alba Patera. The dimensions and width of the AF1 fall well into the size of rifts on Earth. The AF1 rift developed under NNE-SSW oriented extensional stress and does not seem to be part of a Tharsis-related radial fault pattern. Morphotectonic features indicate that crustal extension along the AF2 graben is related to tensile stress associated with late-stage crustal uplift along the central and western AF 2 rift.

References:: [1] Carr, M. and Scott, D. (1978) Geol. Map Mars, USGS Map I-1083. [2] Scott, D. et al. (1981) USGS Maps I-1266 – I-1280. [3] Tanaka, K. L. (1986), *J. Geophys. Res.*, *91(B13)*, E139-E158. [4] Scott, D. H. (1982) *J. Geophys. Res.*, *87(B12)*, 9839-9851. [5] Morris, E. C. and Tanaka, K. L. (1994) *Geologic maps of the Olympus Mons region of Mars*, USGS Map I-2397. [6] Hauber, E. and Kronberg, P. (2001) *J. Geophys. Res.*, *106(E9)*, 20,587-20,602. [7] Hauber, E. and Kronberg, P. (2005) *J. Geophys. Res.*, *110(E7)*, E07003, doi: 10.1029/2005JE002407.

Fig. 1 *(next page)* Topographic map of the Acheron Fossae derived from HRSC-imagery and MOLA-data.

Fig. 2 *(next page)* Structural Map of the Acheron Fossae graben system.

Fig. 3 *(next page)* HRSC-profiles and interpreted structural context across a) eastern and b) central AF1 segments.

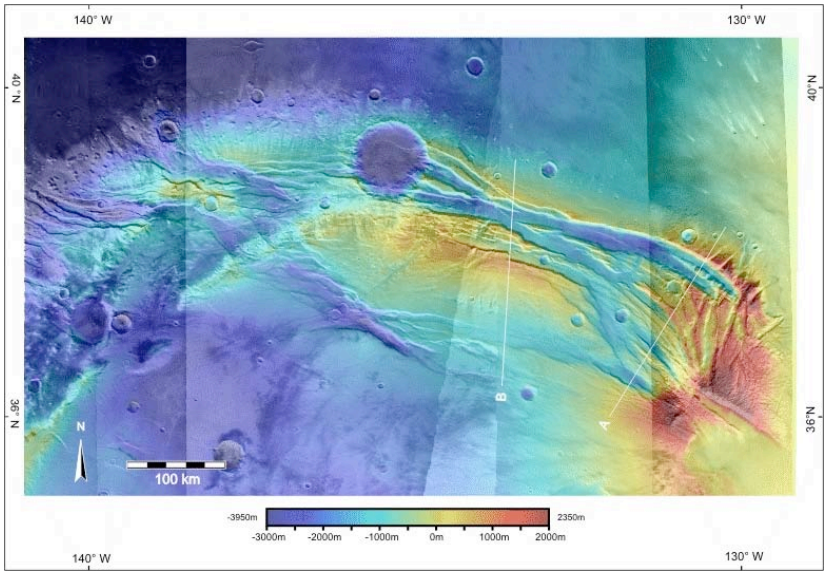

Figure 1.

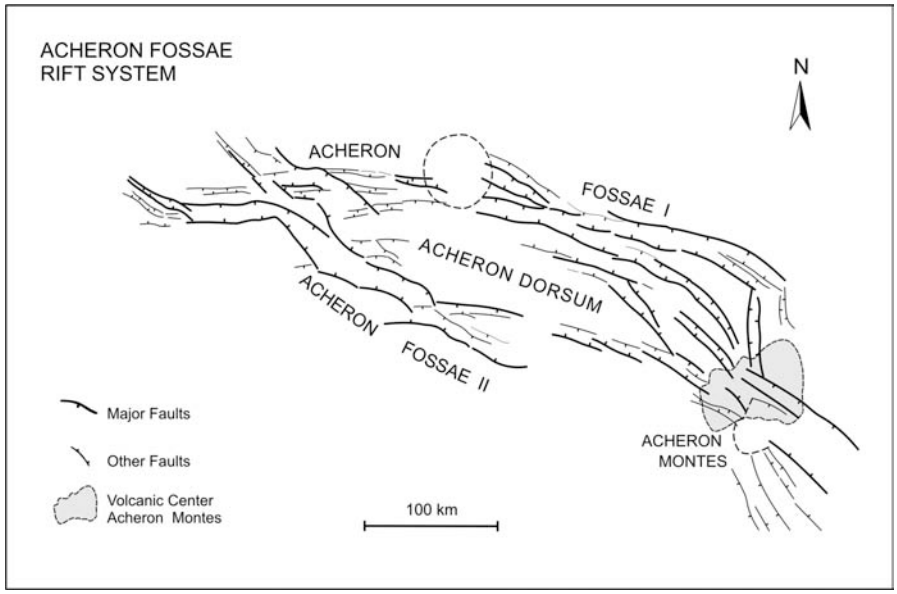

Figure 2 (naming is informal).

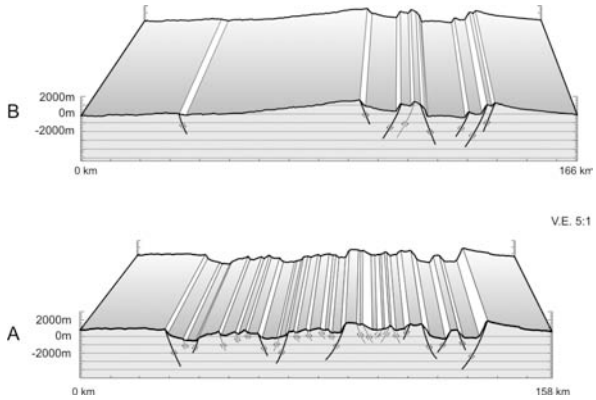

Figure 3.