

3D MAPPING OF ARAM CHAOS: A RECORD OF FRACTURING AND FLUID ACTIVITY. J.H.P. Oosthoek^{1,2}, T.E. Zegers^{1,2}, A. Rossi², B. Foing², G. Neukum³, and the HRSC Co-Investigator Team,

¹Utrecht University, Faculty of Geosciences, Postbus 80021, 3508 TA Utrecht, The Netherlands, j.h.p.oosthoek@students.uu.nl, ²ESA/ESTEC, Research and Scientific Support Department, Keplerlaan 1, 2200 AG, Noordwijk, The Netherlands, tzegers@rssd.esa.int, ³Remote Sensing of the Earth and Planets, Freie Universität, Berlin, Germany

Introduction: The chaotic terrain Aram Chaos (2.5°N and 338.5°E) was mapped using MOLA, THEMIS, MOC and in particular Mars Express HRSC data. 3D mapping was performed using HRSC analogs and MOLA data. Special attention was given to geometry.

Aram Chaos is located in the Xanthe and Margaritifer Terrae (XMT) region. In the Hesperian and into the Amazonian the XMT region has been dissected by six outflow channels: Shalbatana, Simud, Tiu, Ares and Mawrth Valles [1].

Mapping of Aram Chaos based on spectral information (TES, THEMIS) was performed by Glotch and Christenson [2], who detected hematite. Hyperspectral information from OMEGA [3] showed the presence of sulphates and other hydrated minerals.

Results: Figure 1 shows the resulting map and a cross section. Seven units were distinguished in Aram Chaos, with in some cases sub-units:

Highland Terrain (HT) is the main unit surrounding Aram Chaos. Fractured HT occurs upon approaching and into the Aram Chaos depression. The fractures are 10-100 km with fracture valley depths around 250 - 750m.

Chaotic Terrain (CT) is a lateral unit of HT. It consists of either sharp or rounded km-scale hills and shows the gradual loss of coherence of HT material due to fine scale fracturing, collapse and erosion. Although not visible in detail, the unit most likely consists of a breccia.

Rounded Highland and Chaotic Terrain (RHCT) is a morphological unit. It consists of rounded hills and mesas and occurs near the Aram Chaos channel linking Aram Chaos with Ares Vallis.

The Lower Aram Chaos Formation (LACF) is deposited on top of the HT and consists of three lateral units (fractured, broken and smooth). The *fractured* LACF exhibits a distinct 'glossy' morphology visible on THEMIS VIS. It is cross-cut by, compared to the HT fractures, relatively small-scale fractures (1-2 km scale). Some fractures have raised rims and some show small thrusts at the base of the rim. The *broken* LACF is highly fractured, forming ~1 km sized irregular mesas. It always occurs at the boundary of the LACF and the Fractured Highland Terrain. The *smooth* LACF is

non-fractured and may in fact be a relatively thin unit covering the fractured LACF.

The Intermediate Aram Chaos Formation (IACF) has a rugged morphology and is at maximum ~250 m thick. It is stratigraphically situated between LACF and UACF.

The Upper Aram Chaos Formation (UACF) consists of a ~10-100 m light toned cap material, which is relatively strong, with dark, less strong material underneath. The cap material exhibits a specific 'icing' texture and forms sharp arcuate 'razor blade-like' escarpments. The dark, softer material of the UACF thickens towards the NW. The unit is at maximum around ~300 m thick.

The Aram Ares Channel Deposits has a distinct morphology of lineations and small elongated hills. The Aram Chaos channel incised the AACD and 100 meter scale layering can be observed in the channel wall.

Discussion & Conclusion: Geological mapping using HRSC stereo image capabilities is particularly useful to unravel the geometry of the various units and structures in Aram Chaos as well as their cross-cutting and depositional relationships. In combination with spectral information from TES/THEMIS [2] and OMEGA [3], this can be used to derive the geological evolution of the area.

The Intermediate Aram Chaos Formation mapped here corresponds to a large extent with areas containing hematite [2] and kieserite [3]. Concentrations of unknown hydrated minerals [3] were found in what is mapped here as smooth LACF. These units, as well as the overlying UACF (Cap Unit [2]) were all deposited after fracturing and collapse forming the chaotic terrain in Aram Chaos. This suggests that activity of fluids, resulting in formation of hydrated minerals in these units, post-dated the actual chaotization process. One of the possible mechanisms by which these deposits could have formed is spring deposits [4].

The fracturing, brecciation, and subsidence associated with the chaotization process are best explained by the sudden withdrawal of water stored in the Aram impact crater. The Aram Ares Channel Deposit may be interpreted as the remnant of a fan deposit formed during original flow of water into the Aram crater. The current, eroded and channeled, morphology of the

Aram Chaos channel is compatible with channel erosion by flow out of the crater, probably associated with collapse and fracturing of the overburden. Part of the trapped fluids may have escaped by local vents around the rim of the crater. Rapid depressurization may locally have caused hydraulic fracturing and brecciation resulting in the CT unit.

References: [1] Tanaka K. L. et al. (2005) *Scientific Investigations Map*, 2888, USGS. [2] Glotch T.D. and Christensen P.R. (2005) *JGR*, 110, E09006. [3] Gendrin A. et al. (2005) *Science*, 307, 1587-1591. [4] Rossi et al., (2007), this LPSC

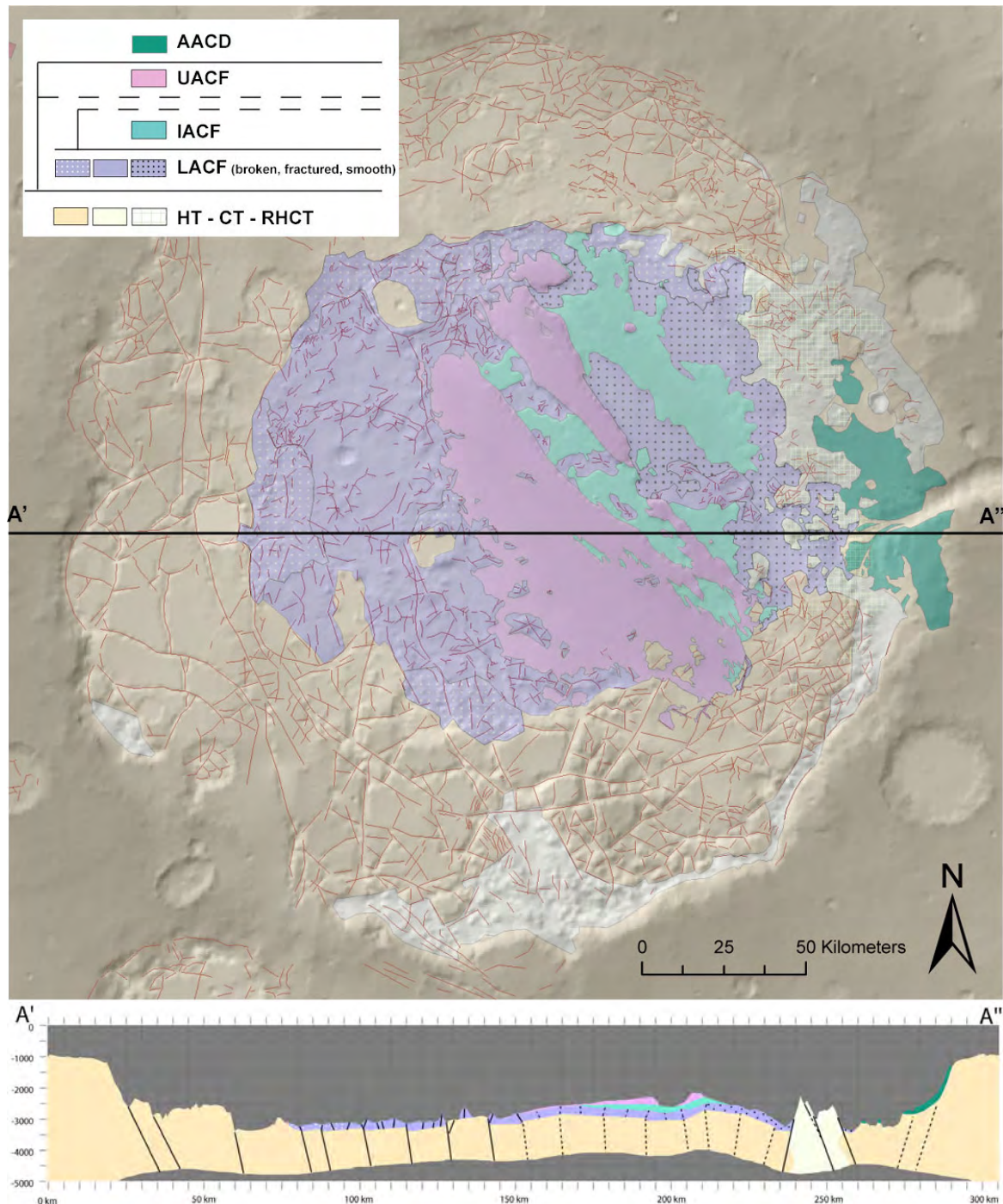


Figure 1. Map of Aram Chaos and cross section. For explanation of the geological units, see text