

Preliminary geologic analysis of sedimentary deposits exposed in chaotic terrains within the Chryse region on Mars

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Introduction

Chaotic terrains on Mars are mainly located in the source regions of the outflow channels East of Valles Marineris. They are supposed to be formed by fluidisation of an incompetent layer underlying material that is more competent. Various states of disruption are observed especially in chasmata where some knobs are present. The High Resolution Stereo Camera (HRSC) on ESA's Mars Express mission (MEX) provides 3D-images of the Martian surface in high resolution, while the spectrometer Observatoire pour la Minéralogie, l'Eau, les Glaces, et l'Activité (OMEGA/ MEX) produces data characterising the mineralogical composition of the surface. Very high-resolution Mars Orbiter Camera (MOC) images reveal the texture of the layers, whereas some physical properties of the surface layer can be derived from Thermal Infrared Imaging Spectrometer (THEMIS) night time-infrared data. We just started a project to use HRSC-, MOC-, OMEGA-, THEMIS- and Mars Orbiter Laser Altimeter (MOLA)-data in order to analyse the stratigraphy of Interior Layered Deposits (ILDs) in the chaotic terrains, from Eos Chasma in the west to Aram Chaos in the east. The layers will be characterised by the following parameters: stratigraphic position and elevation, thickness, layer geometry, albedo, colour, physical properties, and chemical composition.

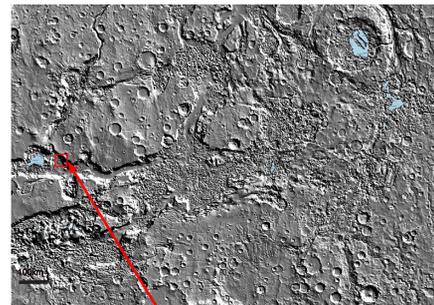


Fig. 1: Shaded mola image of the research area. ILDs occurring in the research area are coloured red. ILDs that are situated in the chasmata mostly are better exposed and of greater extent than those in the chaotic terrains.



Fig. 2a: Anaglyph of small ILDs in Ganges Chasma (N towards right). The segmented ILD on the left shows debris fans on each southern side. In both ILDs joints are visible in high resolution MOC images. Slumping is also observed (Fig. 2b). The left ILD more or less symmetric while the right one has a slope that is flat in the north and steep in the east and south part. The right block shows a sharp margin on the eastern side, the western margin is frayed. On the eastern margin undulated to fold-like structures may be assumed (cryo-turbation?). The absolute elevation of the ILDs is from -4700 m to -3900 m.

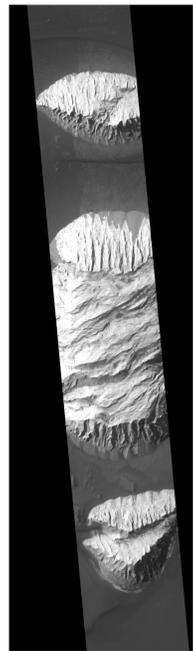


Fig. 2b: This MOC image indicates the differences between lower line layered material and upper parts that are massive (view Fig. 2a for context).

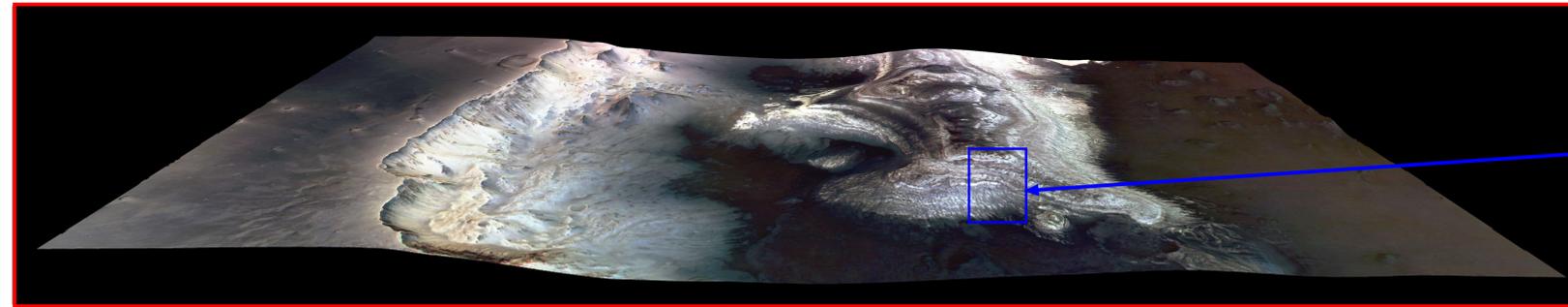


Fig. 3a: 3D-image of a big ILD in Ganges Chasma. The NS-extend is about 60 km. In the profile below the high elevation and steepness is shown. The elevation of this ILD nearly reaches the elevation of the channel margins (view towards E).

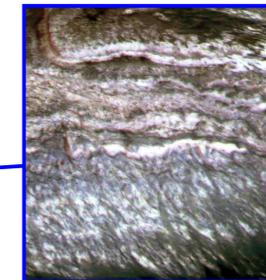


Fig. 3b: This is a subset of Fig. 3a which displays the layering in this big ILD.

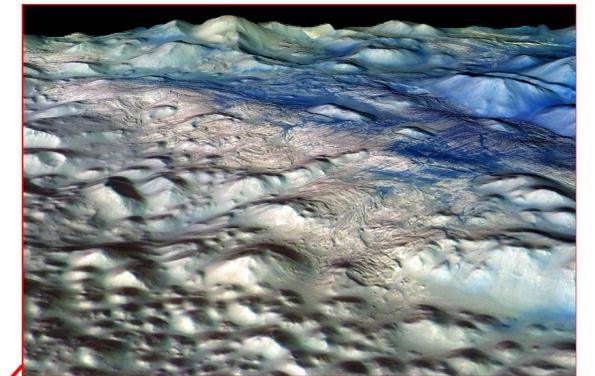


Fig. 6: 3D perspective view of an ILD in Iani Chaos. This image shows that the ILDs are superposed on the chaotic terrain.

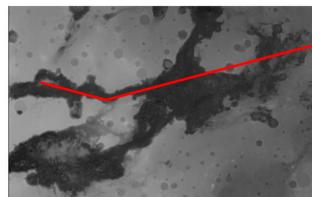


Fig. 4a: Profile section from Ganges Chasma to Aram Chaos displayed in mola.

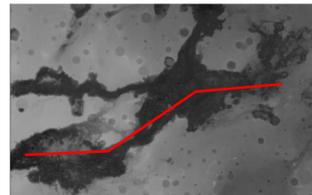
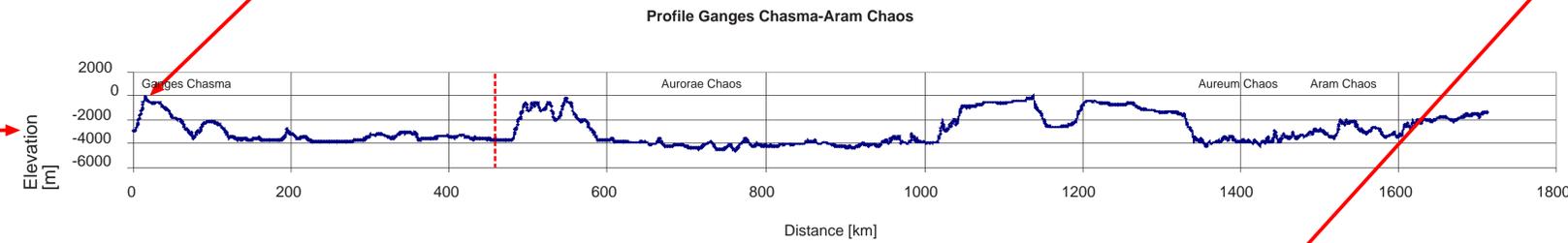


Fig. 4b: Profile section from Eos/ Capri Chasma to Iani Chaos displayed in mola.

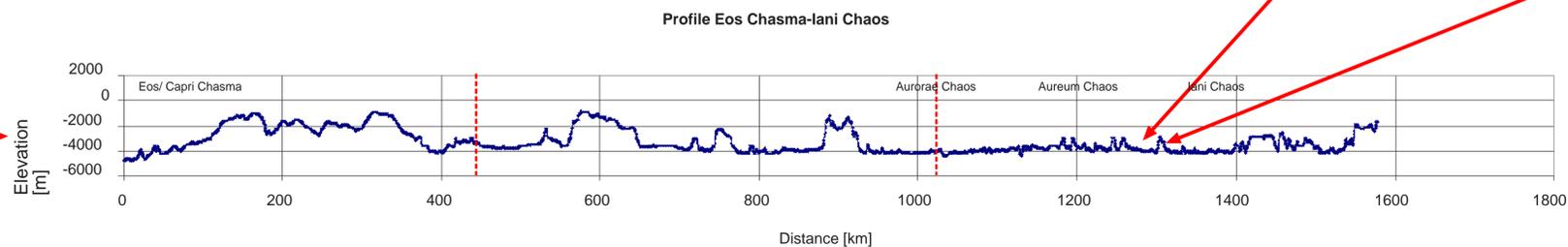


Fig. 5a, b: The profiles from Ganges Chasma in the west to Aram Chaos in the east and from Eos /Capri Chasma to Iani Chaos show the high elevation of the ILDs in chasmata and the lower elevation in the chaotic terrains. The elevation of the plateau is nearly reached by ILDs in Ganges Chasma while ILDs within chaotic terrains mostly have lower elevations.

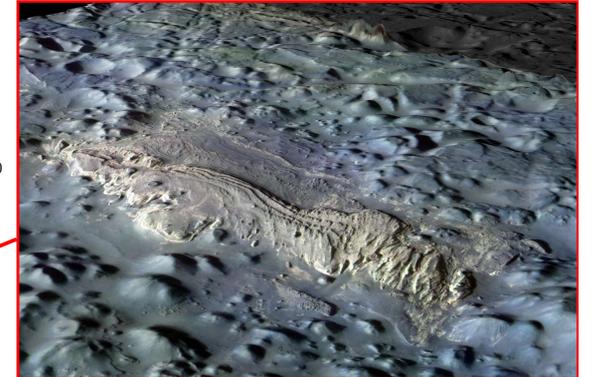


Fig. 7: 3D perspective view of an ILD occurring within the chaotic terrain in Iani Chaos (length: 34 km, width: 14 km; view towards NE). The elevation reaches from -4000 m up to -3000 m. The profile announces a flat northeastern part and a steep southwestern slope.

Discussion

The ILDs occur in various extent in the chasmata and chaotic terrains as isolated blocks with varying flank slopes. In the chasmata (e.g., Ganges Chasma) they are often better exposed than in the chaotic terrains. It seems that at least some ILDs are superposed on the chaotic blocks covering the floors of the chaotic terrains. Finely layered material is observed at their lower parts, while in the upper parts the material is more massive (e.g. Fig. 2b).

As the high resolution data base is very new, the final evaluation of the observation request detailed analysis that will focus on:

- What is the detailed stratigraphy of the ILDs?
- Do different ILDs show the same stratigraphic pattern?
- What is the layer geometry (strike and dip)?
- What is the current (and past) thickness of ILDs?
- What is the elevation of the ILDs in the chaotic terrains?
- What is their composition?
- Are the ILDs younger than the chaotic blocks, or are the very ancient and exhumed layers?
- Were they originally continuous from Valles Marineris to Aram Chaos?

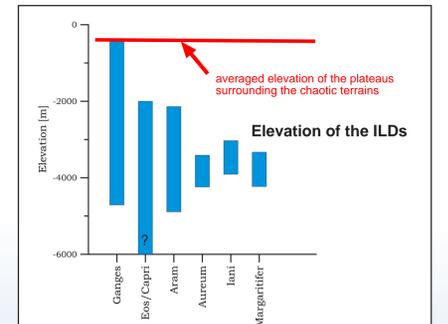


Fig. 8: Range of absolute elevation of the ILDs. The "thickness" of the ILDs (as compared to the canyon depth) in the chaotic terrains is often smaller than that of the ILDs in the chasmata. All ILDs are beneath the surrounding level of the canyon rims.