

INTRODUCTION

Interior Layered Deposits (ILDs) are light-toned layered deposits that occur in the Valles Marineris and Chaotic Terrains on Mars. They have been known and analysed for more than 30 years but their origin is still uncertain. ILDs are supposed to be aeolian [1], lacustrine [2] or volcanic [e.g. 3, 4] assuming they are younger than the troughs in which they formed or ILDs are ancient deposits that are exposed due to erosion [e.g. 5].

Our studies concentrate on ILDs in the Eastern Valles Marineris and adjacent Chaotic Terrains. We use high-resolution image and elevation data to get information about their formation processes.

RESEARCH AREA

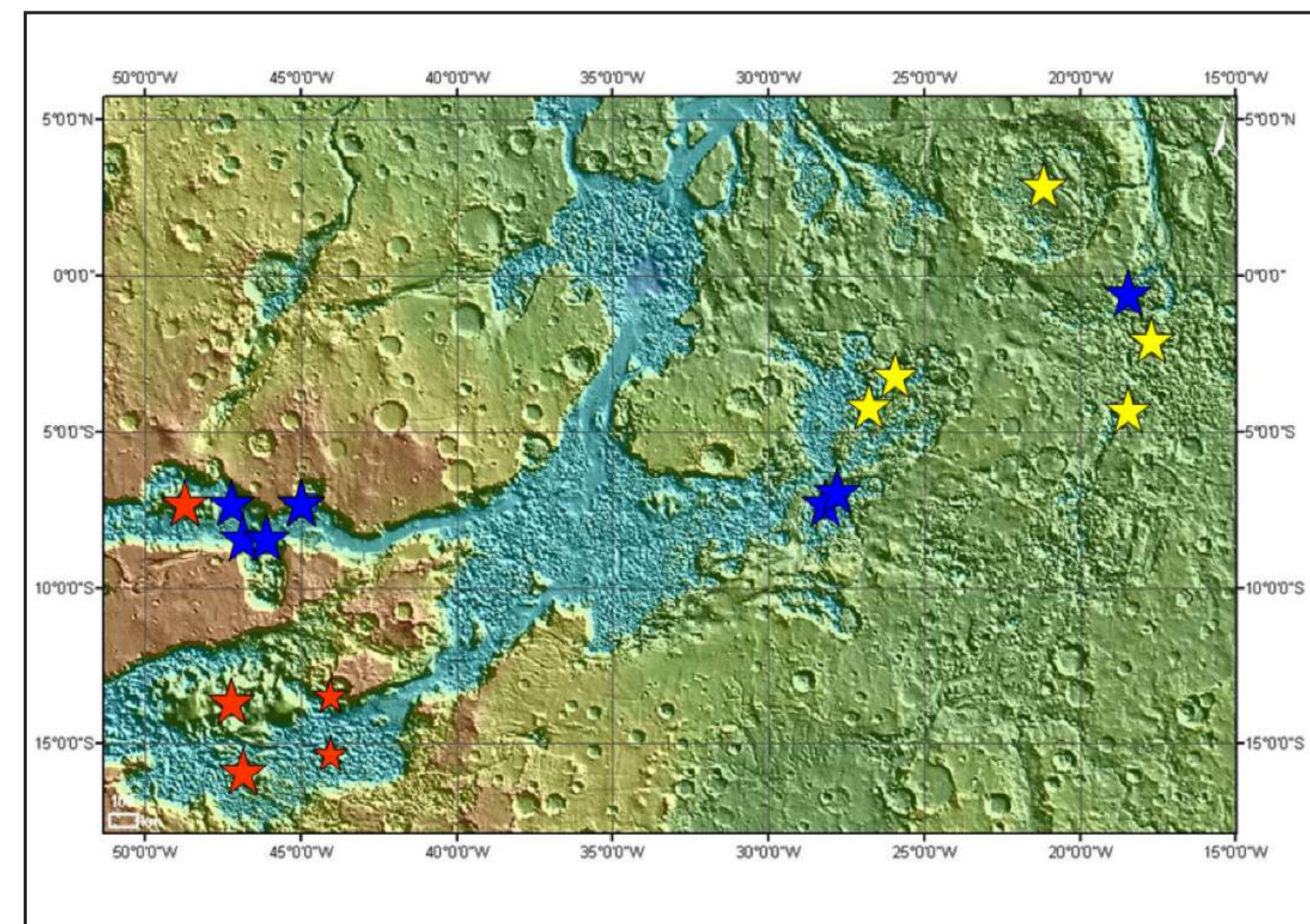


Fig. 1: MOLA-map of the research area including ILDs in Gangis, Eos/ Capri Chasmata, Aureum, Arsinoe, Aram, and Iani Chaos.

ELEVATION

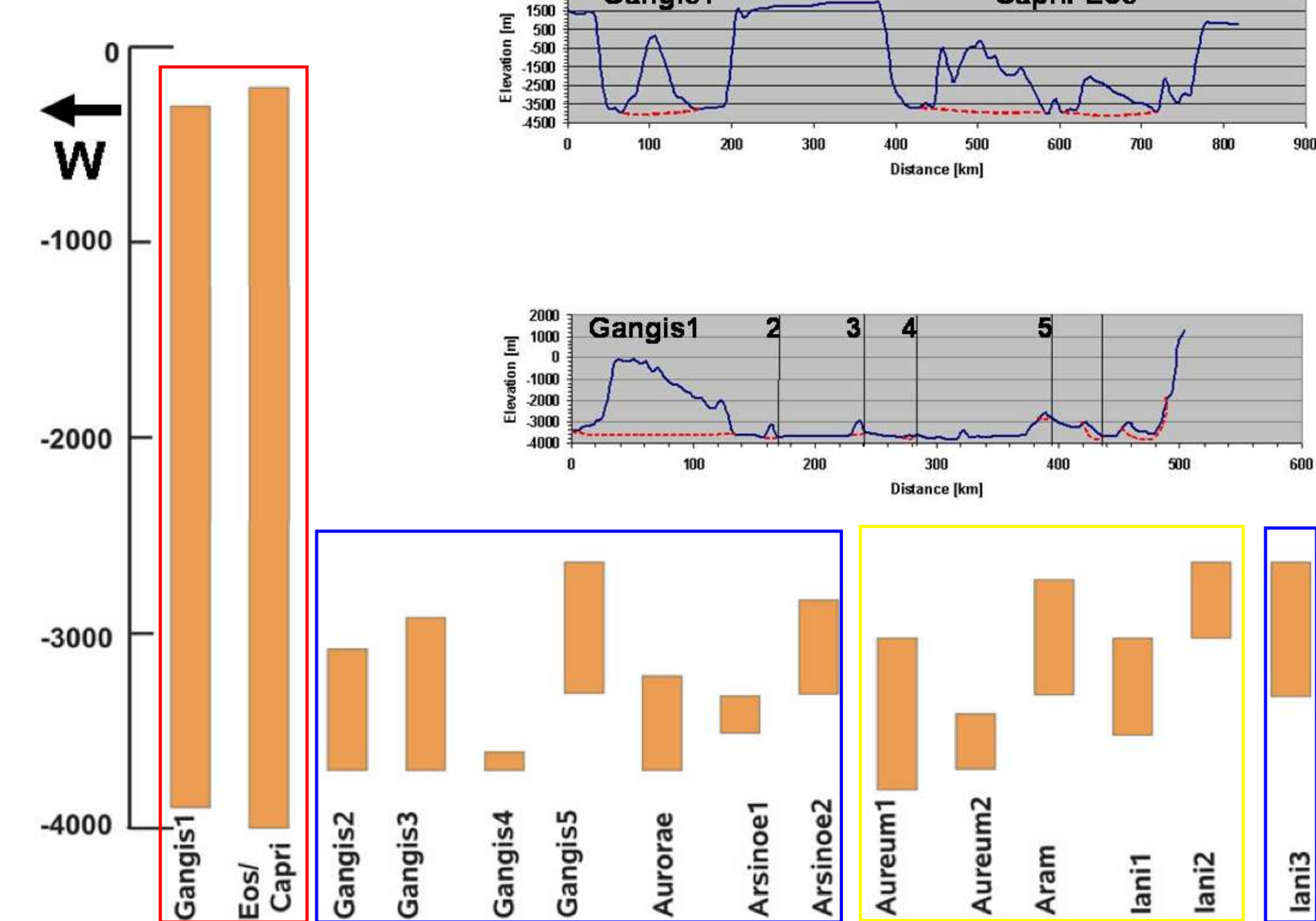
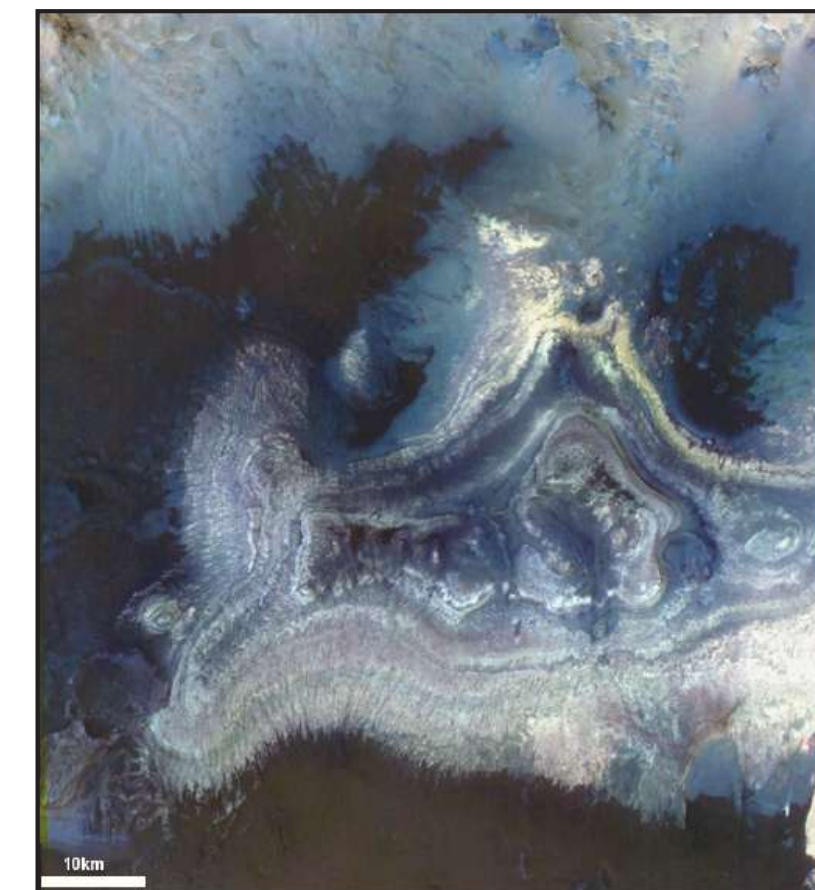


Fig. 2: Min-Max elevation of ILDs inferred from MOLA. Cross-sections: NS-trending covering Gangis 1 and Eos/ Capri and WE-trending from Gangis1 to Gangis 5 show that all ILDs are situated below the rim of the surrounding plateau.

MORPHOLOGY



Most ILDs appear as light-toned layered outcrops but they show various morphologies. ILDs have heavily fractured and rugged surfaces and are often eroded into yardangs resulting from wind action. They are hardly cratered due to a young erosional age.

Fig. 3: ILDs show interbedded strata like this ILD in Gangis Chasma (HRSC false-colour) which is characterised by light and dark layering, a flat top and steep slopes. It comprises a volume of about 4141 km³ and covers an area of ~3335 km² (inferred from HRSC-DTM, res. 75 m/ px).

STRATIGRAPHIC POSITION

ILDs (A) superpose the chaotic terrain (B).

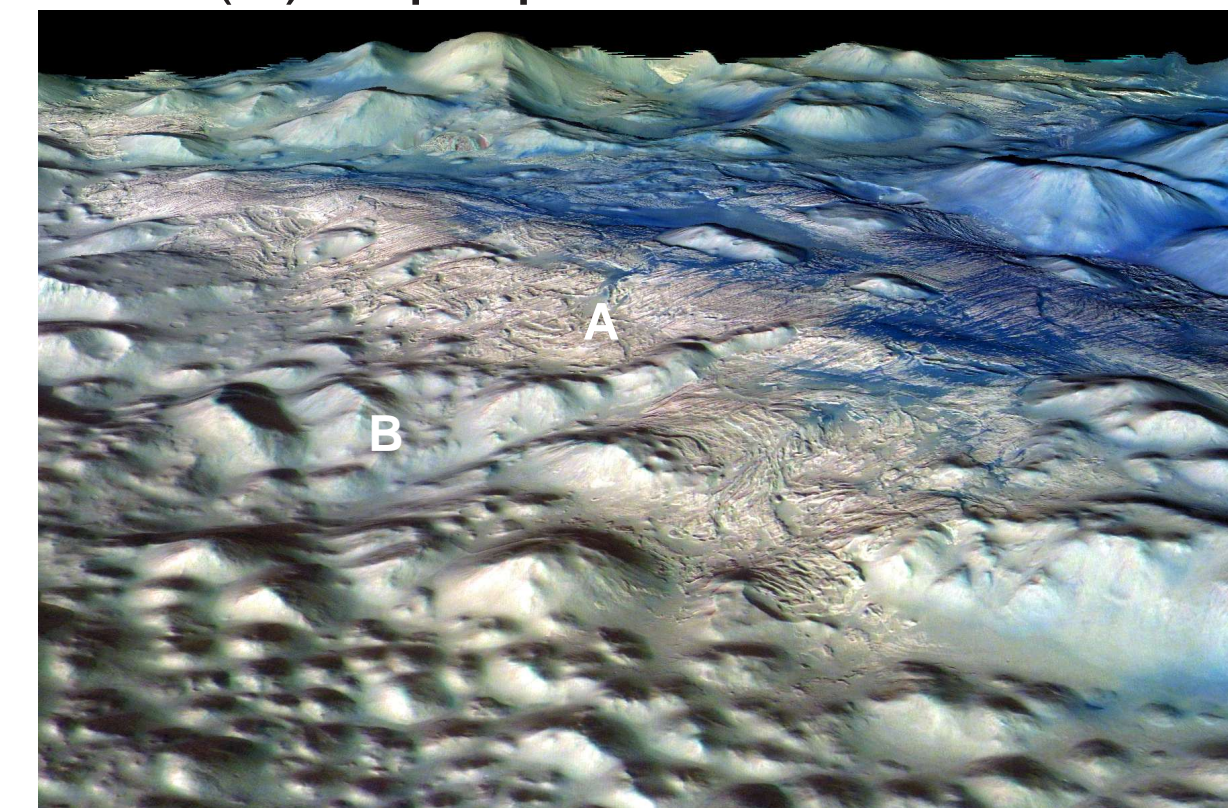


Fig. 4: Iani Chaos. HRSC false-colour perspective.

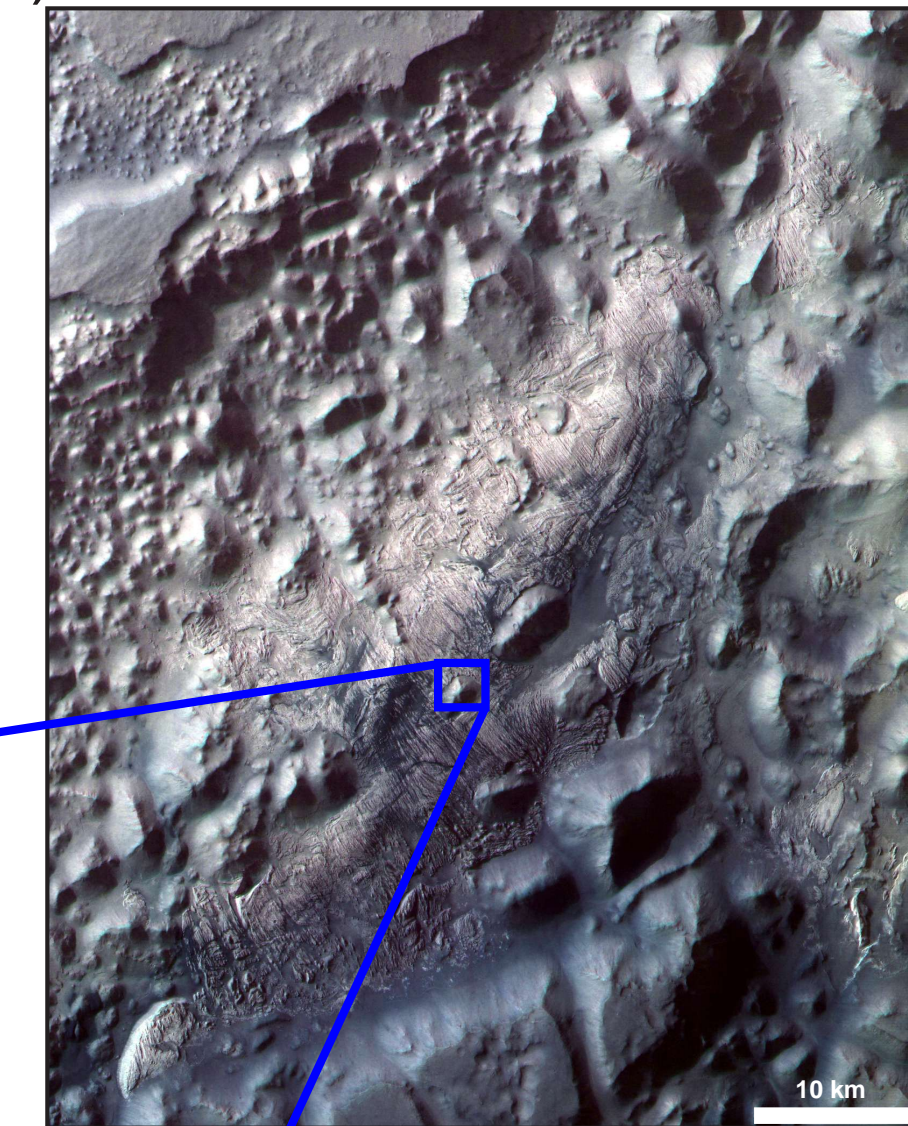
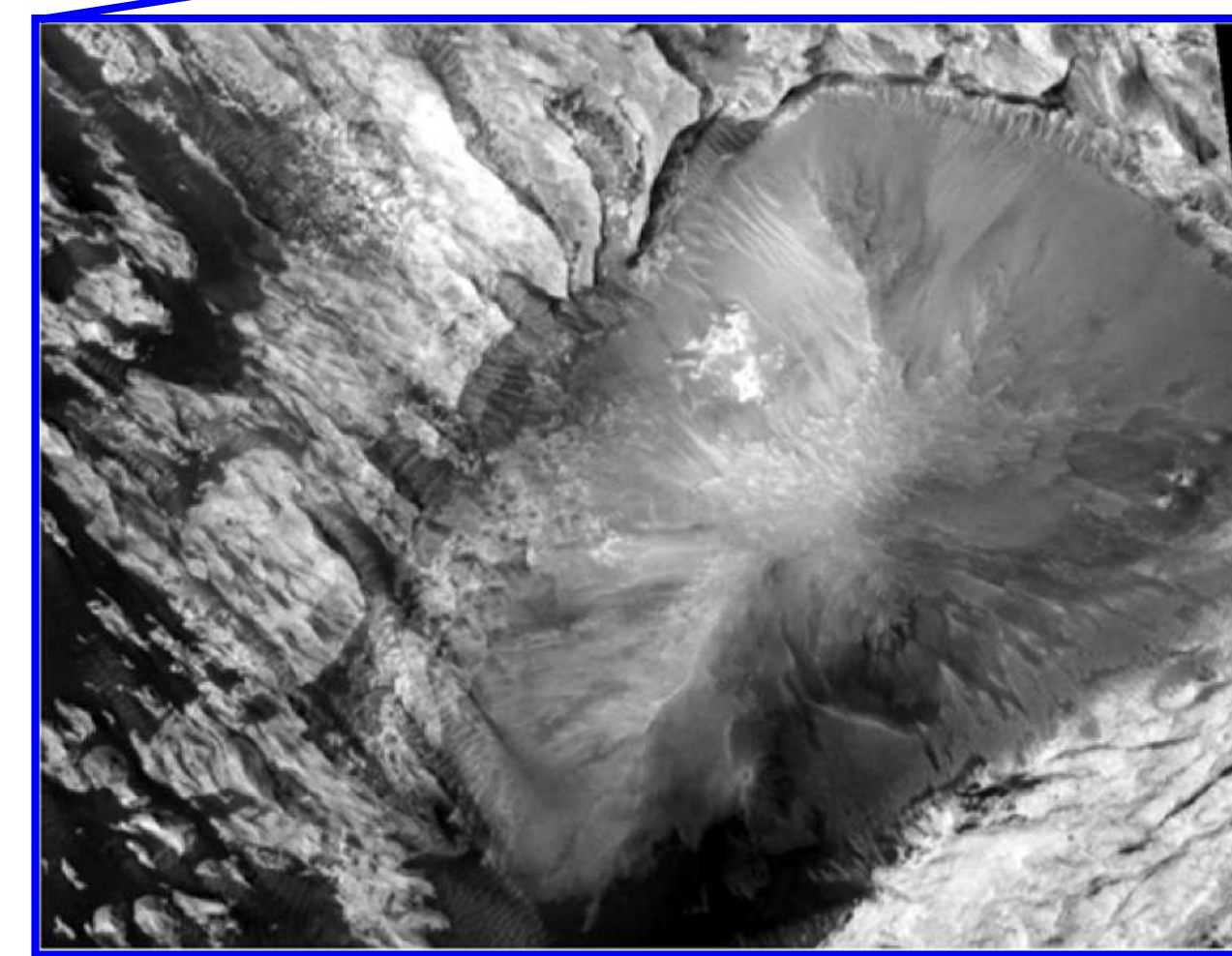


Fig. 5a: Iani Chaos. HRSC false-colour and corresponding MOC-image (Fig. 5b) demonstrating heavily eroded mounds of chaotic terrain surrounded by ILD material that exhibits dark dunes in its depressions (North towards top).

MINERALOGY

From TES [6] we know that there is hematite on ILD surfaces in Aram, Aureum and Iani Chaos, and OMEGA [7] detected monohydrated sulfates in Aram (kieserite) and Iani Chaos (gypsum) as well as polyhydrated sulfates in Capri Chasma.

→ sulfates may point on aquatic conditions since they form by hydrothermal alteration of volcanic material or evaporation under decreasing water availability

SURFACE MORPHOLOGY

The surface of ILDs looks different. At least three surface types are distinguished.

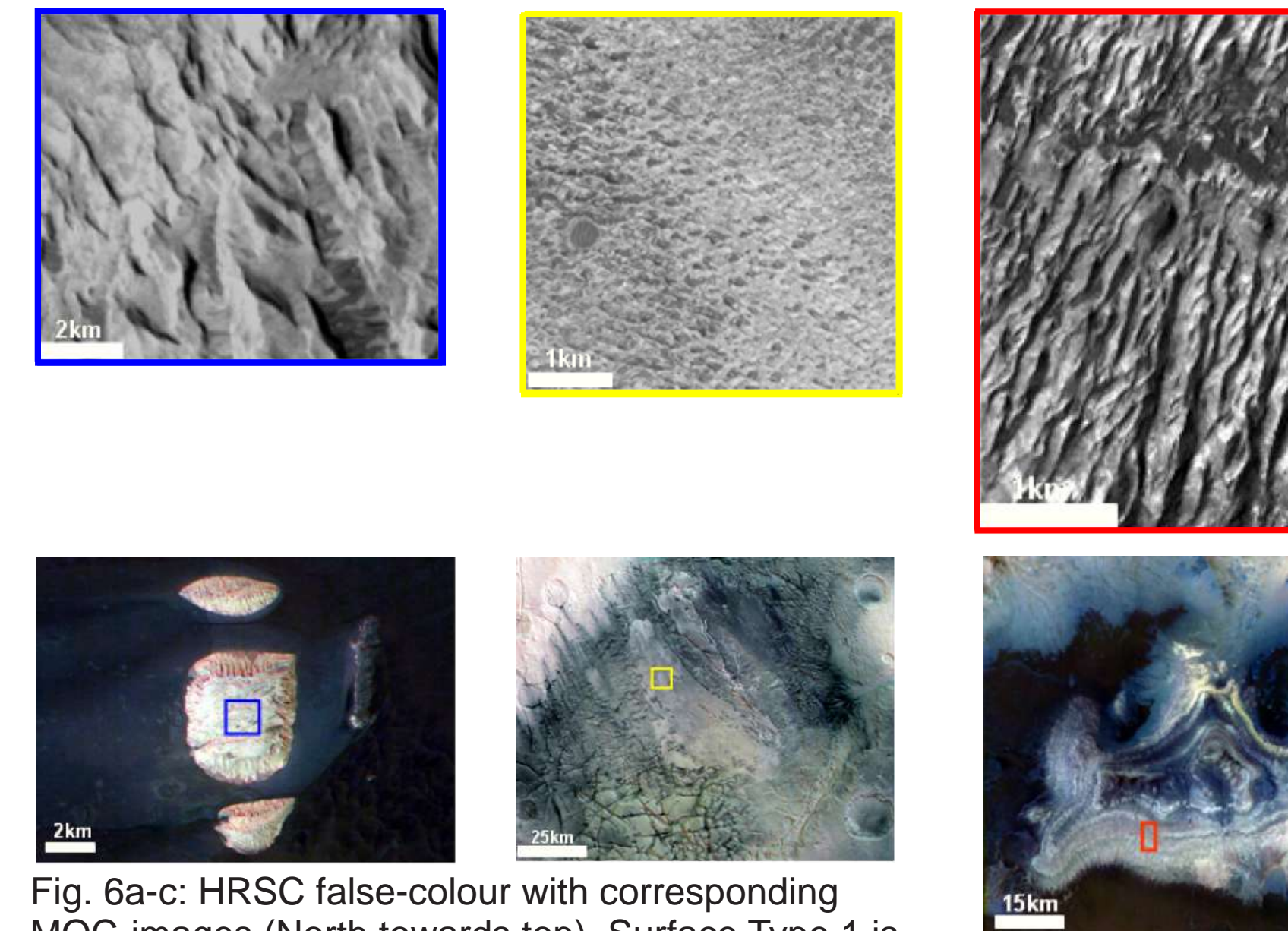


Fig. 6a-c: HRSC false-colour with corresponding MOC-images (North towards top). Surface Type 1 is mostly associated with dissected blocks (Gangis Chasma, Iani, Arsinoe Chaos), Type 2 with caprock units (Aureum, Aram, Iani Chaos), and Type 3 with layered mounds (Gangis, Eos/ Capri Chasmata). Regarding the surface types plotted on MOLA-topography (Fig.1) there is a topographic trend as Type 3 (red stars) is only exposed in the Valles Marineris, in the west part of the research area and Type 2 (yellow) only in chaotic terrains in the eastern part. Type 1 (blue) is more distributed and occurs in chasmata as in chaotic terrains.

When we look at the elevation (Fig. 2) there is also a height trend: Type 3 is exposed from about -4000 m up to 100 m while Type 1 and 2 occur at elevation from -3700 m up to -2700 m.

SURFACE TEMPERATURE

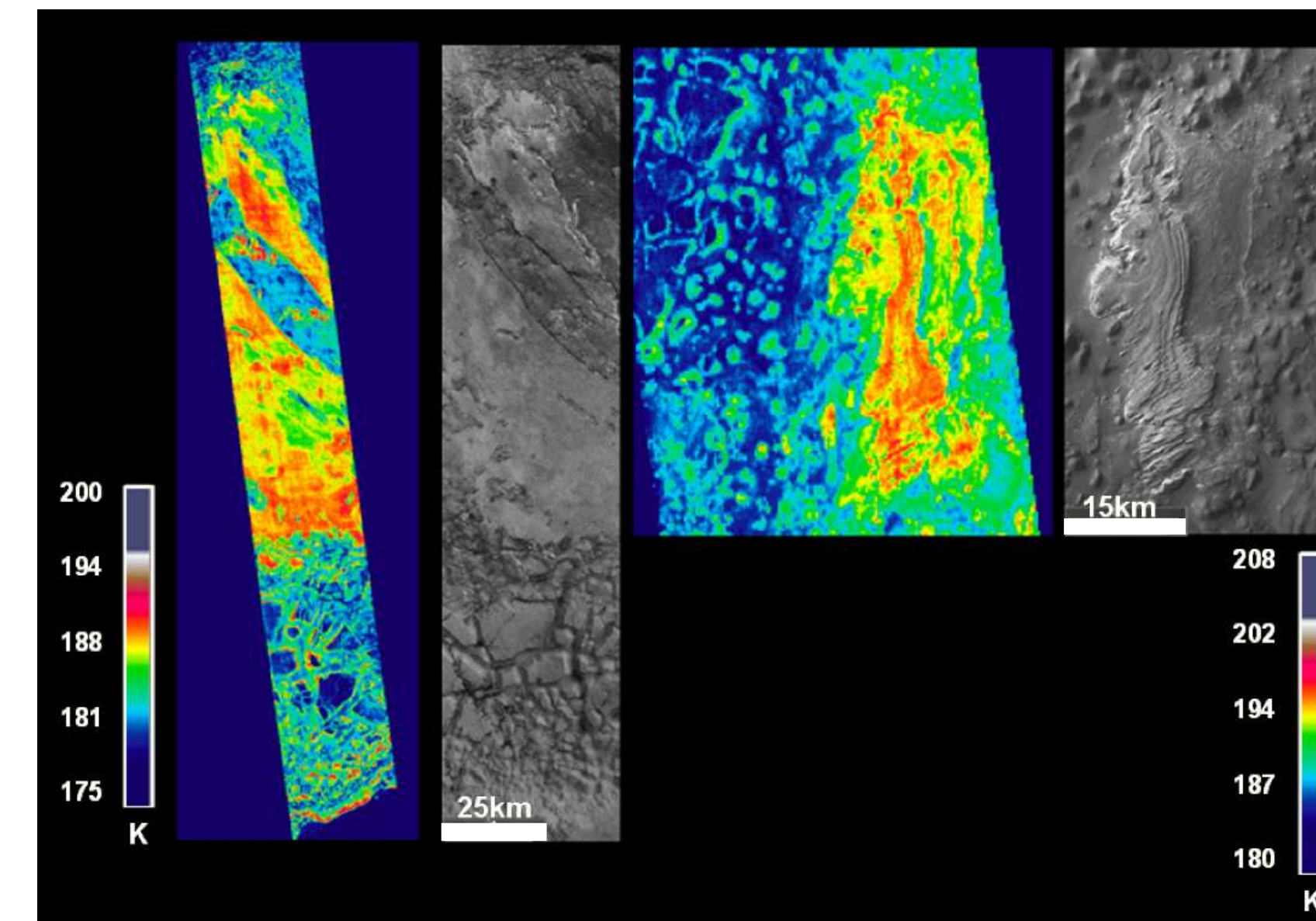


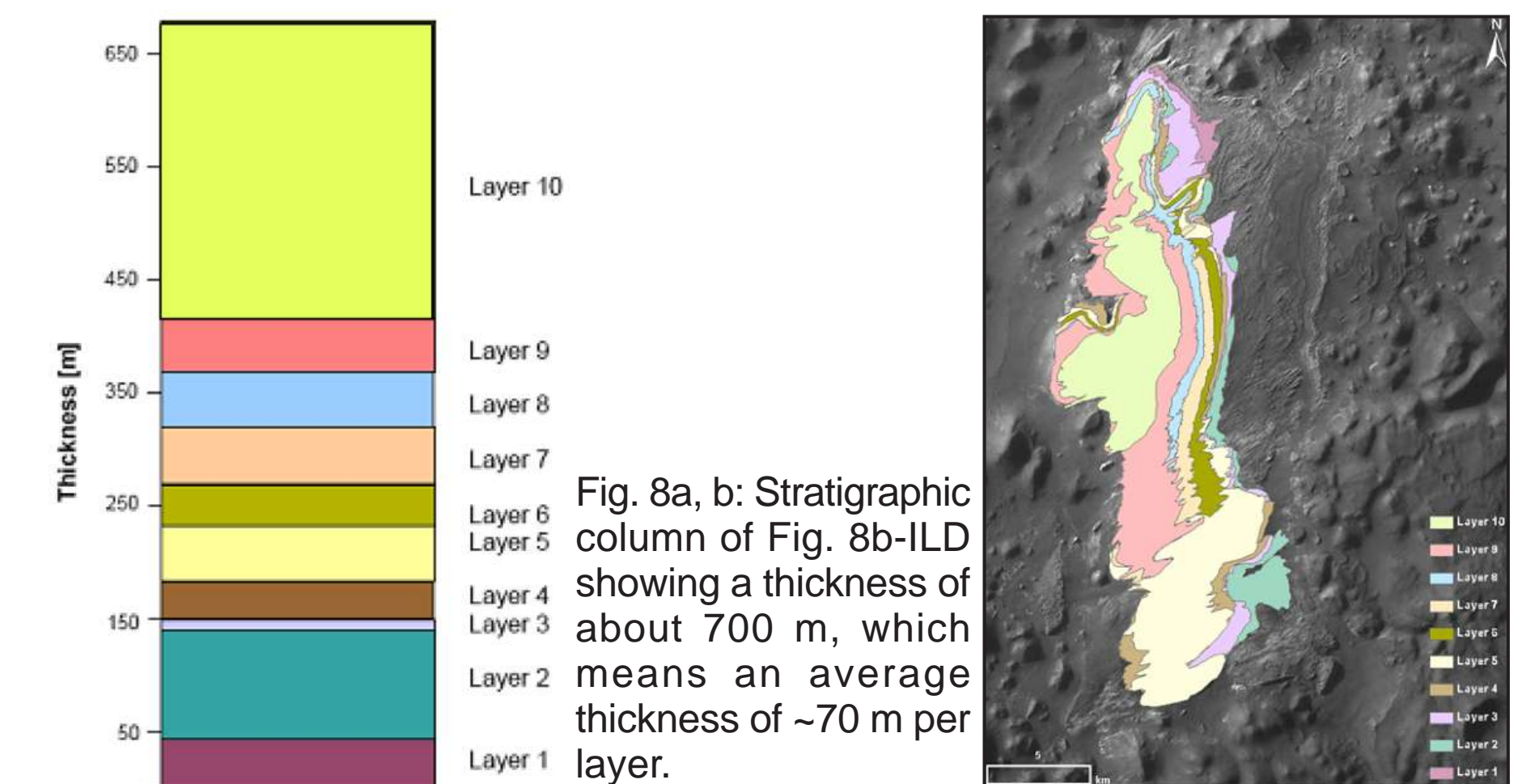
Fig. 7: THEMIS Brightness-Temperature of Aram and Iani Chaos ILDs (North towards top). ILDs have higher surface temperatures than their surroundings which indicates more consolidated material.

REFERENCES

- [1] Peterson, C. (1981) Proc. Lunar Planet. Sci. Conf., 11th, 1459-1471
- [2] Nedell et al. (1987) Icarus, 70, 409-441
- [3] Hynek B. M. et al. (1987) JGR, 108 (E9), 5111
- [4] Chapman, M. G., and K. L. Tanaka (2002), Icarus, 155, 324-339
- [5] Malin, M. C., and K. S. Edgett (2000), JGR, 290, 1927-1937
- [6] Glotch, T. D., and P. R. Christensen (2005), JGR, 110
- [7] Gendrin et al. (2005), Science, 307, 1584-1586

LAYER THICKNESS

We measured the thickness of an Iani Chaos ILD using a high-resolution DTM (res. 50 m/ px). The ILD shows distinct layering and we could distinguish ten layers.



LAYER GEOMETRY

Using Orion (Pangaea®) structural analysis software combined with HRSC orthoimage and high-resolution DTM (res. 50 m/ px) we measured the strike and dip of the layers in Iani Chaos.

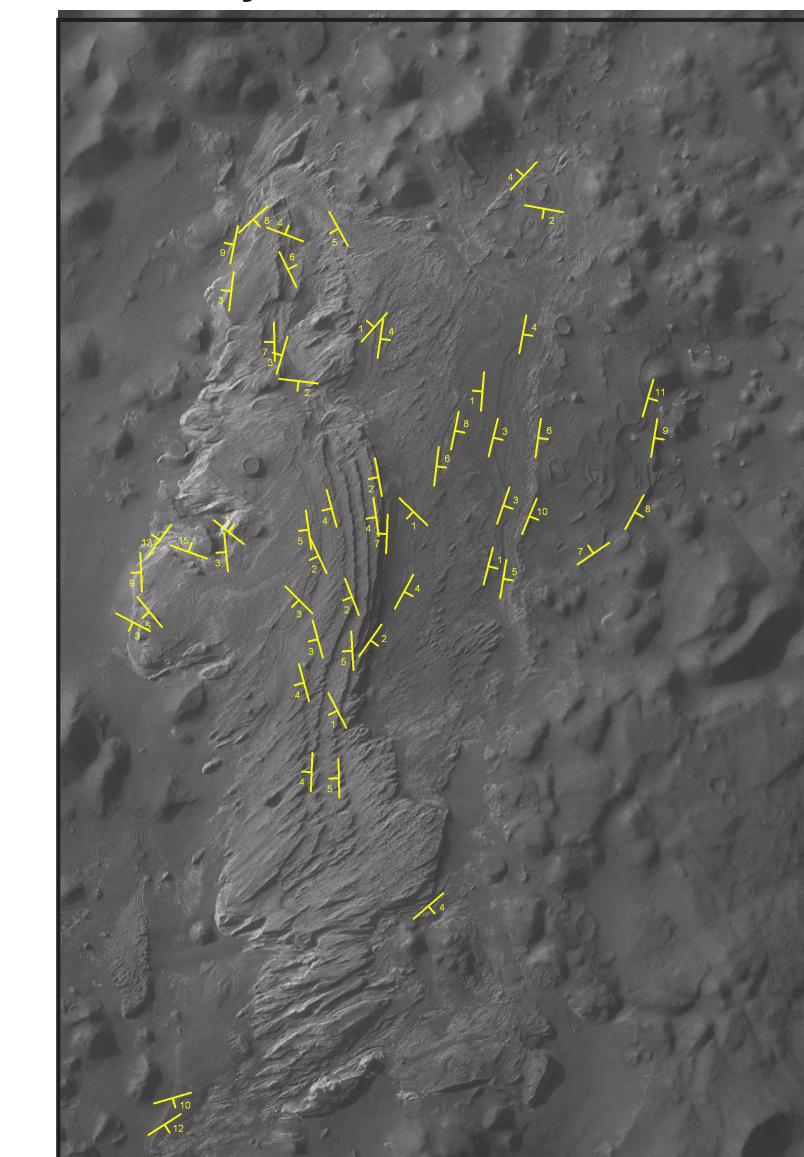


Fig. 9: The layers have a ~NS-strike and dip subhorizontally (~5°) to the West and East, as there is a change in the dipping direction (Fig. 10).

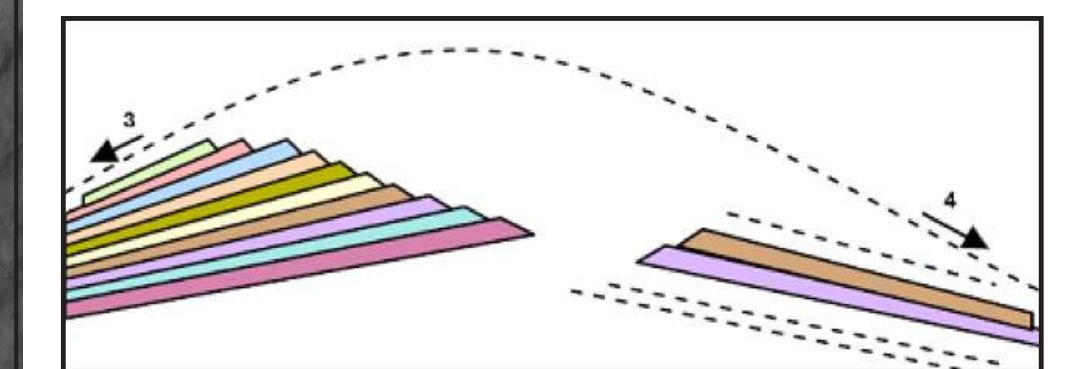


Fig. 10: Exaggerated sketch which shows the change in dipping direction.

CONCLUSIONS

- ILDs are exposed at different elevations in Valles Marineris and chaotic terrains
- situated below the rim of the surrounding plateau
- superpose the chaotic terrain → younger
- interbedded strata and sub horizontal layering
- mineralogy mono- (gypsum and kieserite), polyhydrated sulfates, hematite points to aquatic environment
- different surface appearance, topographic trend, height trend
- probably different weathering intensity
- may have formed in similar, isolated environments under aquatic conditions