LAYERED DEPOSITS OF IANI CHAOS ON MARS

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INTRODUCTION

Layered and light-toned deposits (LDs) are present in many locations on Mars, preferred in depressions (craters, chaotic terrains, chasmata). There are different hypotheses supposing LDs are of sedimentary [e.g. 1,2] or volcanic origin [3,4]. In this study, we concentrate on Iani Chaos (Fig. 1) layered deposits and look at their morphology, elevation, thickness, and layer geometry.
Iani Chaos (0.7°S/ 340.6°E) is a large depression (180 km * 200 km) characterised by heavily eroded randomly distributed blocks forming a disrupted terrain. These knobs are several hundreds of meters high and may be remnants of a pre-existing landscape that collapsed due to subsurface ice or water release. Erosive power of large amounts of water is supposed to have carved the outflow channel Ares Vallis, which originates in Iani Chaos and drains into Chryse Planitia.

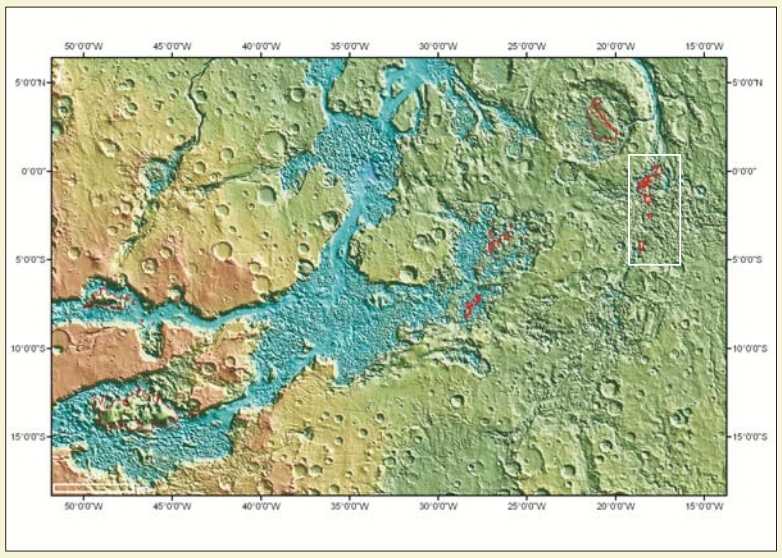
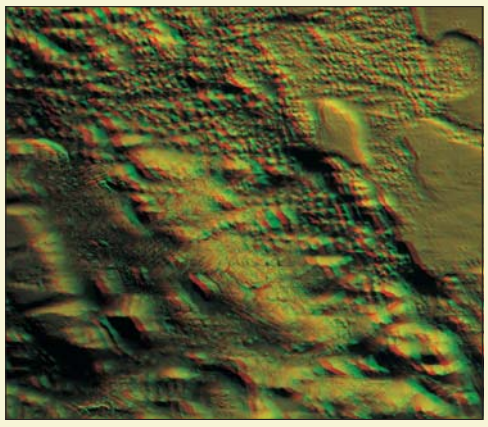


Fig. 1: MOLA map showing the eastern Valles Marineris and adjacent chaotic terrains were layered deposits occur (marked red). The white box corresponds to the research area.

MORPHOLOGY

LDs have different morphologies. Most of the light-toned material has domal cross-sections (Fig. 9, 10). Furthermore, there are flow-like structures where light-toned material flows around mounds of chaotic terrain (Fig. 2-4) as well as terrace-like structures and razorblade-shaped morphologies that show massive cap rocks. All these morphologies feature Iani Chaos.



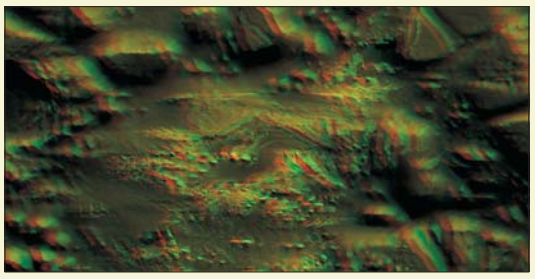
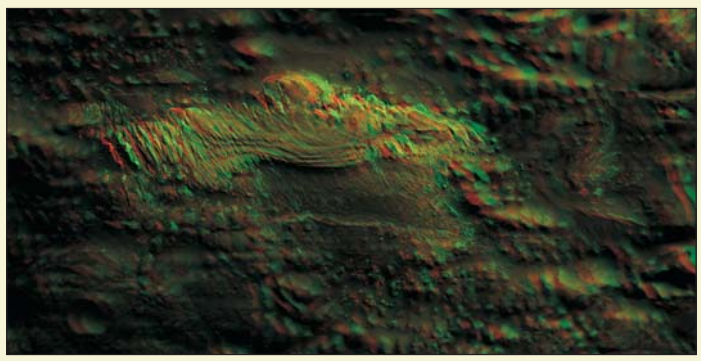


Fig. 2-4: Anaglyphs showing the domal shape of LDs dissected by blocks of chaotic terrain. They are characterised by their higher albedo than surrounding areas and their position below surrounding plateau rims (north to the right).



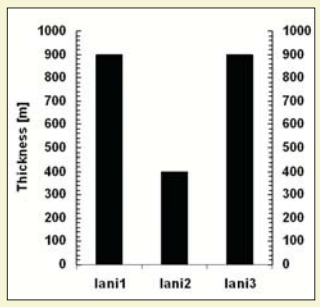
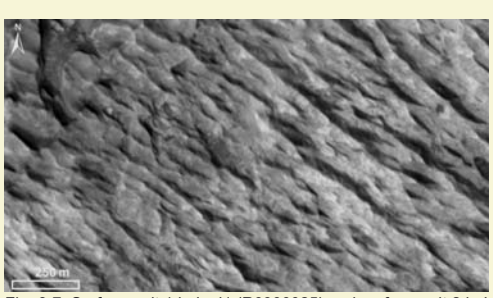


Fig. 5: LD thicknesses vary in the range of 400-900 m, assuming horizontal to sub-horizontal stratification.

Two surface units are distinguishable (Fig. 6-7) based on MOC-images, thermophysical, and morphological characteristics.
Unit 1 is characterised by rough surfaces and many fractures and is exposed in Iani1. Its thermal inertia (TI: 460-510 SI) is a little higher than that of unit 2 (TI: 410-440 SI) indicating more consolidated rock material [5]. Unit 2 has a surface that looks grooved and is characterised by ventifacts. This type appears as terrace-like structured and razorblade-shaped LD often association with cap rock in Iani2 and Iani3.
Varying surface textures may be due to different consolidation and/or wind erosion; the mineralogical composition is however comparable. LDs are closely connected to sulphate- [6] and hematite rich materials [7].



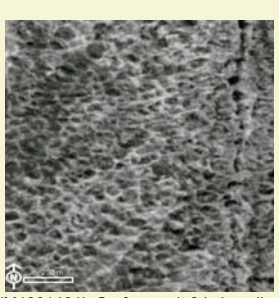


Fig. 6-7: Surface unit 1 in Iani1 (R0900025) and surface unit 2 in Iani3 (M1301484). Surface unit 2 is heavily fluted and pitted and looks like dilution disrupted it. The contact between LD and chaotic terrain often is diffuse due to dust coverage.

References

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ELEVATION

Elevation data show that LDs are located in depressions at different elevations but far beneath the surrounding plateau rims. Iani Chaos LDs are exposed at elevations of 200 m up to 1000 m below the surrounding plateau (Fig. 8-10). The highest elevation is accomplished in Iani2, the lowest in

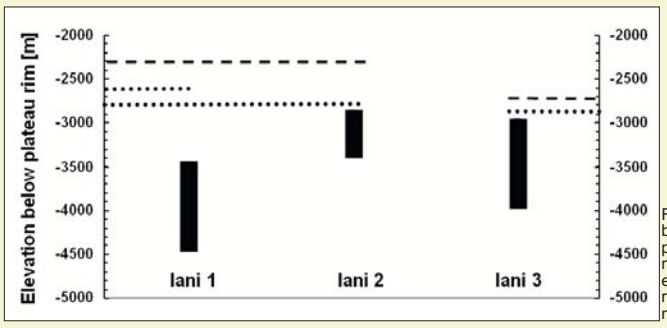


Fig. 8: LDs are located beneath the respective plateau rim. Dashed lines mark the maximum elevation of the plateau rim, dotted lines its minimum elevation.

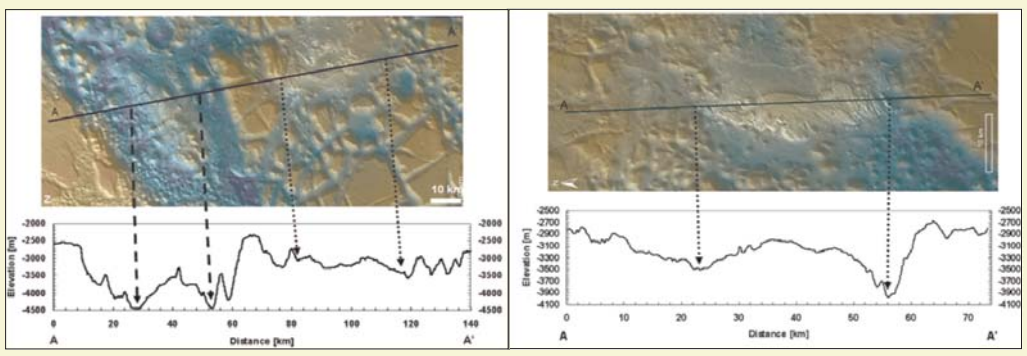
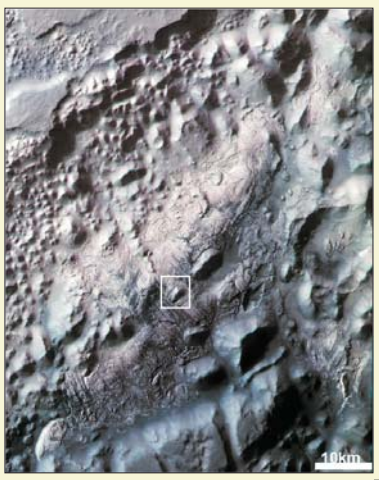


Fig. 9, 10: Profiles showing LD material situated at different elevations within disrupted terrain. On the left Iani1 (marked by dashed lines) and Iani2 (dotted lines) are shown, on the right dotted lines mark the area of Iani3.



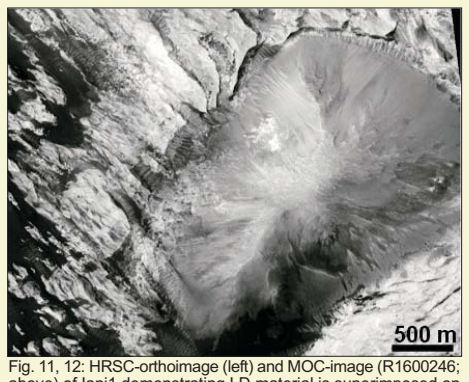
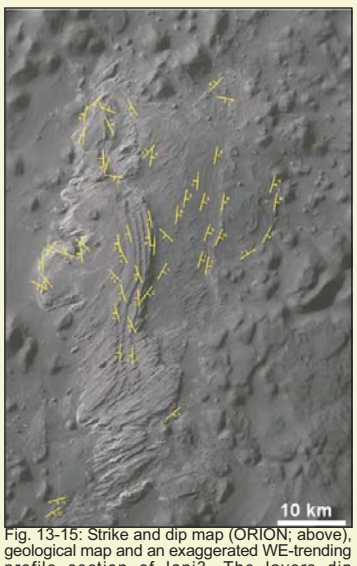


Fig. 11, 12: HRSC-orthoimage (left) and MOC-image (R1600246; above) of Iani1 demonstrating LD material is superimposed on chaotic terrain.



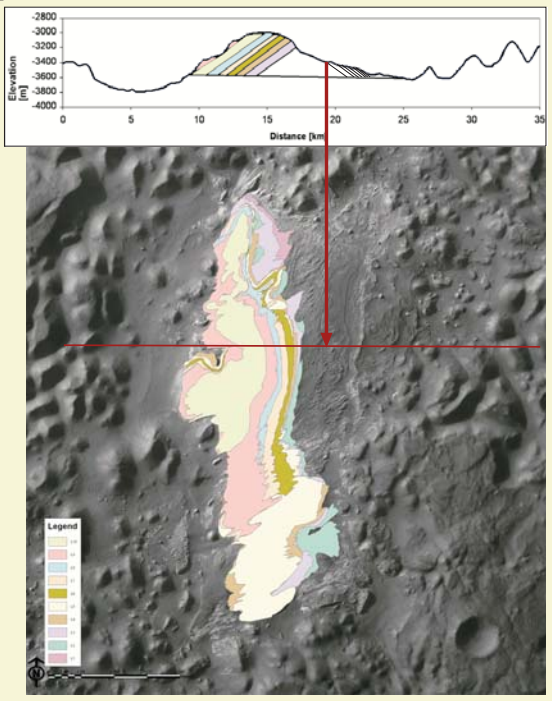


Fig. 13-15: Strike and dip map (ORION; above), geological map and an exaggerated WE-trending profile section of Iani3. The layers dip subhorizontal (5-10°) to the west. The arrow marks the change in the dipping direction to the east.

DISCUSSION

LDs
- occur at different elevations below the surrounding plateau rim
- are younger than the chaotic terrain they superimpose
- have a comparable thickness as well as sub horizontal layering
- show varying morphologies and are of different surface character
- share the same mineralogical composition (connected to sulphate- and hematite-rich materials)

⟶ aquatic environment

Volcanic ash fall or tephra deposits:
-more distributed (e.g. appearing on the plateau)
-tephra and ash fall deposits drape over existing topography
-no evidence for caldera (unless there has been sub ice etc. volcanism under sub aerial conditions) (lava flows may be largely (not entirely) horizontal [8], interbedded lava, tephra and sediments would be)

Aeolian deposits:
-sedimentation on LDs and other aeolian morphologies
-wind-blown sand would have piled up against topographic obstacles (not coincident with LD morphologies)

Lacustrine deposits:
-surrounding plateau rim overlaps the LDs
-high thickness and horizontal to sub horizontal layering (unless layers no tilting)
-debris fans on the slopes ⟶ loose to partly consolidated sedimentary rocks
-TES-TI and THEMIS-BT values confirm consolidated to rock material
-OMEGA and TES-data point on sulfates and hematite, that form under aquatic conditions