### 4.1.3 Iani Chaos

Iani Chaos (Fig. 28; centred 2°S /342.3°E) is a large depression representing the source region of the Ares Vallis outflow channel that extends to the northwest and drains into the Chryse Planitia (Fig. 2). Iani Chaos exhibits three ILDs (Iani 1-3; Fig. 39) aligned along an axis within 260 km in depressions measuring up to -4500 m in depth (e.g. Fig. 41A).

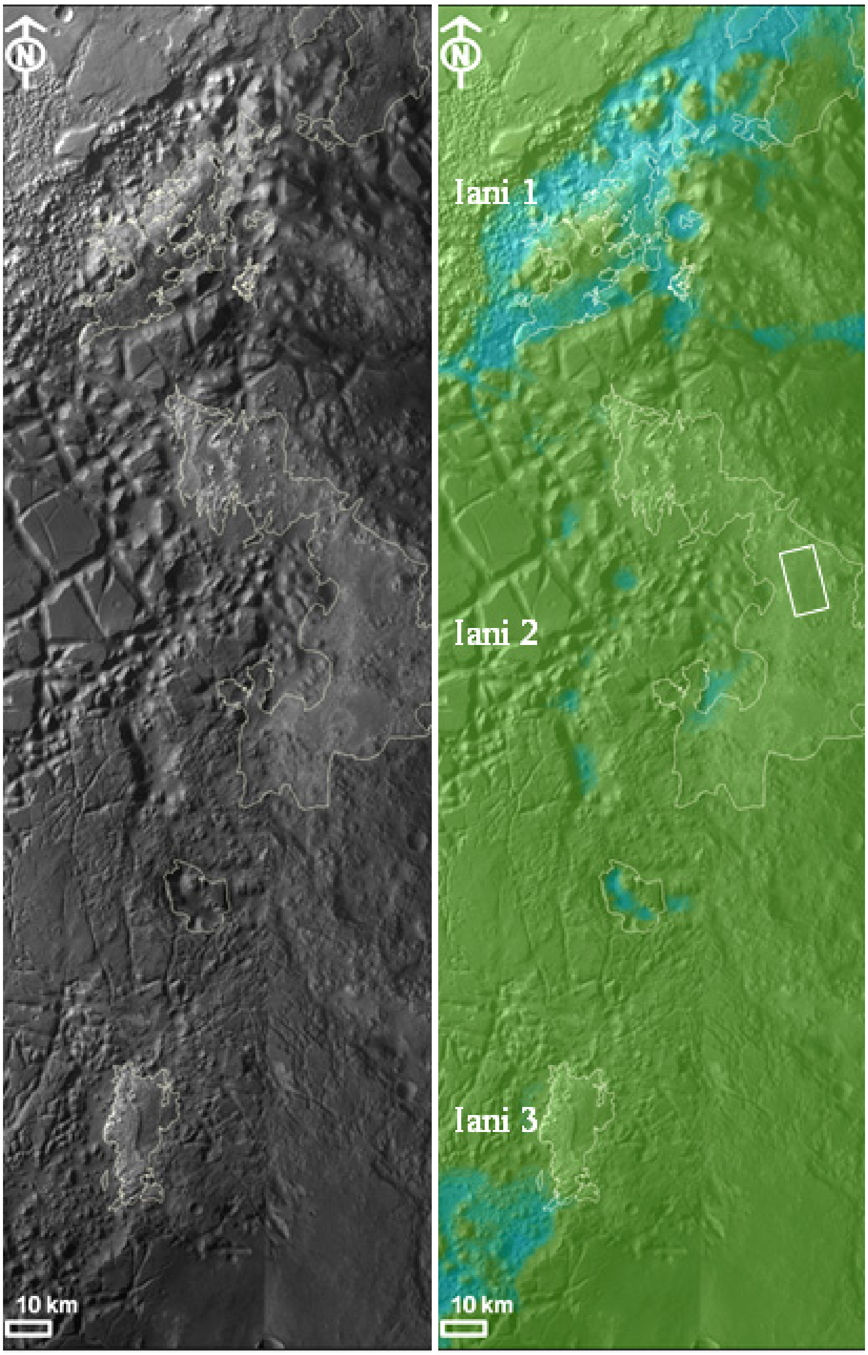



**Figure 39:** Location of ILDs in Iani Chaos. ILDs are found within a distance of 260 km in isolated depressions (not in the deepest area of ~-4500 m marked in blue) surrounded by chaotic terrain *(left)*. HRSC orthoimage orbit h0934_0000; *(right)* same orthoimage overlaid by MOLA DEM (centred at 2.4°S/342.1°E). Box indicates the location of Fig. 43E, 43F.

## Iani 1:

Striking NE-SW, the ILD (0.7°S/341.4°E, Fig. 40) features a dome-like cross-section (Fig. 41A). It measures 66 by 20 km and is exposed at an elevation between -4500 m and -3400 m (Fig. 41D, Table 12). Iani 1 is located along a depression but below the surrounding plateau (Fig. 41A). Unlike Aram (Sect. 4.1.1) and Aureum (Sect. 4.1.2), it has no mesa morphology (Fig. 41C). Irregular in shape (Fig. 40), this ILD is dissected by low-albedo mounds (Fig. 40, 41E). Linear structures running NW-SE are present on the surface (Fig. 40, 41E), highlighted by settled dark aeolian material that is located in depressions (Fig. 41E, 41F). Unidirectional wind may have caused this lineation. The overall albedo is high (Table 12; Sect. 3.2.1). The southern part of the ILD features a sharp contact zone in the form of a steep scarp is present (Fig. 41C). Erosion, possibly by water, may have been very intense in the southern part where there is a steep scarp. This is conceivable as the ILD is situated near Ares Vallis – a huge outflow channel (Fig. 28, 2). In the Late Hesperian when the chaotic terrains formed (Table 3, 4) floods emptied in the Ares Vallis and deposited and eroded material. Apart from that, the ILD looks friable (Fig. 40). Hence, the whole surface of Iani 1 appears rough, grooved, heavily fractured (Fig. 41E, 41F) and more disrupted than elsewhere (Sect. 4.1.1, 4.1.2).

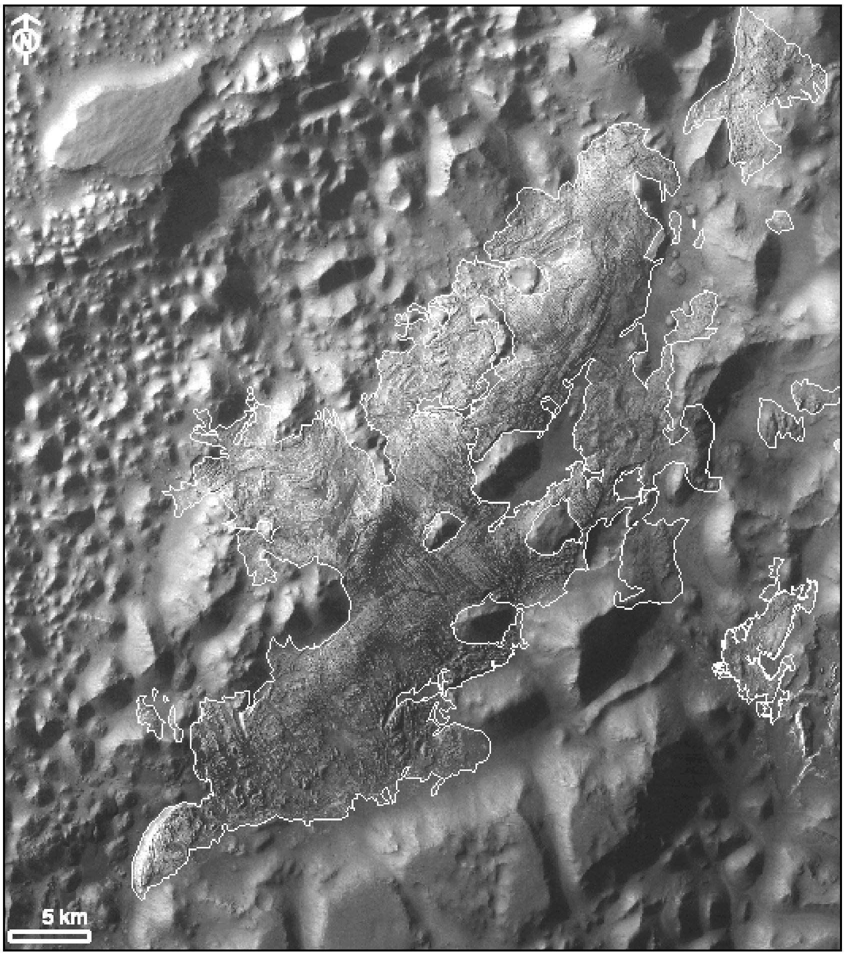



**Figure 40:** Iani 1 featuring a irregular shape and a NW-SE trending surface structure. For context, see Fig. 39 It is heavily fractured and exhibits yardangs as well as dark aeolian material. It is surrounded and dissected by heavily eroded, low-albedo chaotic terrain material and plateau remnants (HRSC orbit h0934_0000; 0.7°S/341.5°E). Nearby ILD, remnants are found in depressions indicating material once filled a larger area and has been eroded.

The ILD is characterised by the parameters shown in Table 12.
Overall, the albedo is high (Table 12). Here, just one morphological unit has been identified. Its surface is marked by a NW-SE trending lineation (Fig. 40, 41E). Along this lineation, yardangs indicate erosion by wind (deflation, corrosion) and water (Sect. 2.3.1). Erosion is also confirmed by flutes and grooves. .A stair-stepped morphology indicates material discrepancies (Fig. 41F). A HiRISE image (Sect. 3.1), for instance, shows ~8 layers in a stair-stepped sequence with an elevation difference of 20 m and an average thickness of ~2-3 m per sequence (Fig. 41F, 41D). For accuracy, HRSC DTM were used (Table 12, cf. Sect. 3.2.3).
Overall, layering is undulated and hardly traceable on the surface that is highly eroded, heavily fractured and convoluted in parts like the top of Aureum 2 (Sect. 4.1.2). The thickness of the whole ILD derived from elevation is 1100 m (Table 12).
Likewise other ILDs, dark talus and light-toned meter-sized (< 5 m) boulders are visible at the base of steep scarps, indicating weathering (Fig. 41F). High albedo talus and low albedo finer material collects at their base indicating differences in the consolidation of material that weathers out. Advanced break-up has produced meter-sized boulders. The TI of the ILD is overall high (Table 12), indicating highly consolidated material (Sect. 3.2.2).
ILD material surrounds and covers low-albedo mounds (Fig. 41A). In some places, these mounds overtop the ILD by a few hundred meters (cf. Fig. 41E, 41A). In contrast to ILDs, they are much steeper and appear more resistant as they are hardly affected by erosion. These mounds are ascribed to chaotic terrain remnants that predate the formation of the ILD and once were covered by the same but now are re-exposed due erosion of ILD material. Aeolian material later on draped over these mounds, was eroded to expose light-toned patches (Fig. 41E). This indicates that the ILD once had a much greater extent than today and has been eroded that is indicated by fragments of ILD material in craters and on nearby mounds (Fig. 40). Breakage structures are especially visible at scarps with a higher albedo than the smooth-appearing flatter regions (Fig. 41F, 41C). Surface depressions frequently exhibit bulks of dark aeolian material trapped in patches.
False colour images (Fig. 41F) reveal different materials. ILD material shows beige to white, differing from chaotic terrain mounds and bluish mafic sand (Sect. 3.2.2). Beige to brownish colour on ripples and the ILD features a dust cover.
No mineral detections were reported by OMEGA or CRISM. ILDs nearby (Iani 2+3) feature PHS and haematite (Sect. 4.1.3; Sect. 3.2.2).
Convoluted layering is visible in fragments. Overall layering is not traceable all around the ILD, so that strike and dip was not measured (Sect. 3.2.3).

**Table 12:** Parameters of Iani 1.

| Morphology | Relative Albedo | Elevation [m] | Thickness [m] | Consolidation of Materials | Mineralogy | Layer Geometry |
|---|---|---|---|---|---|---|
| Complex, dome-like profile | High | -4500±12.5 to -3400±12.5 | 1100±12.5 1 unit identified | High TI TI Ø: 482 SI±77 (surrounding: Ø 344 SI±30) BT: 203-208 K (surrounding: 191-205 K) boulders and talus present | No data | - |

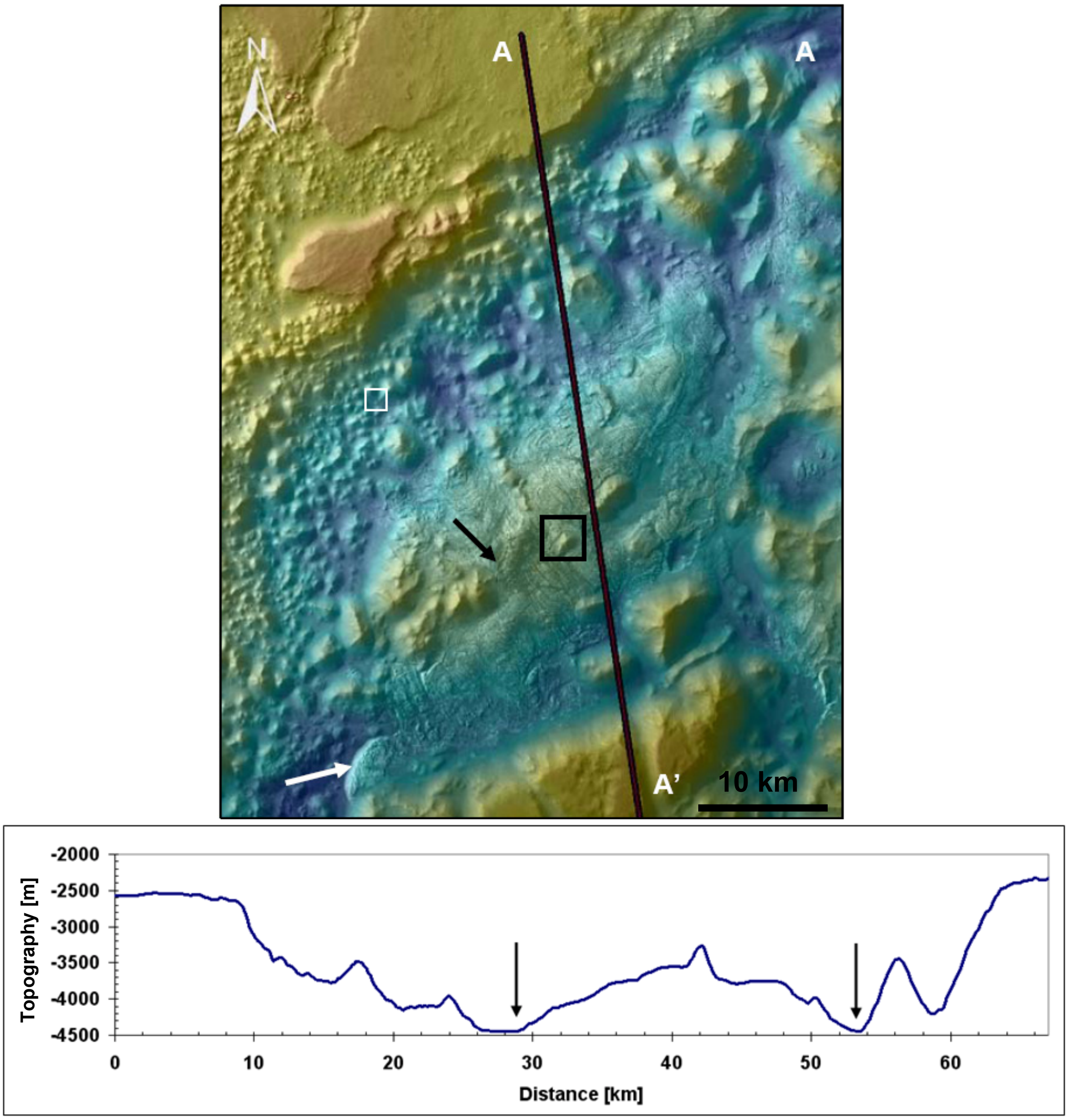
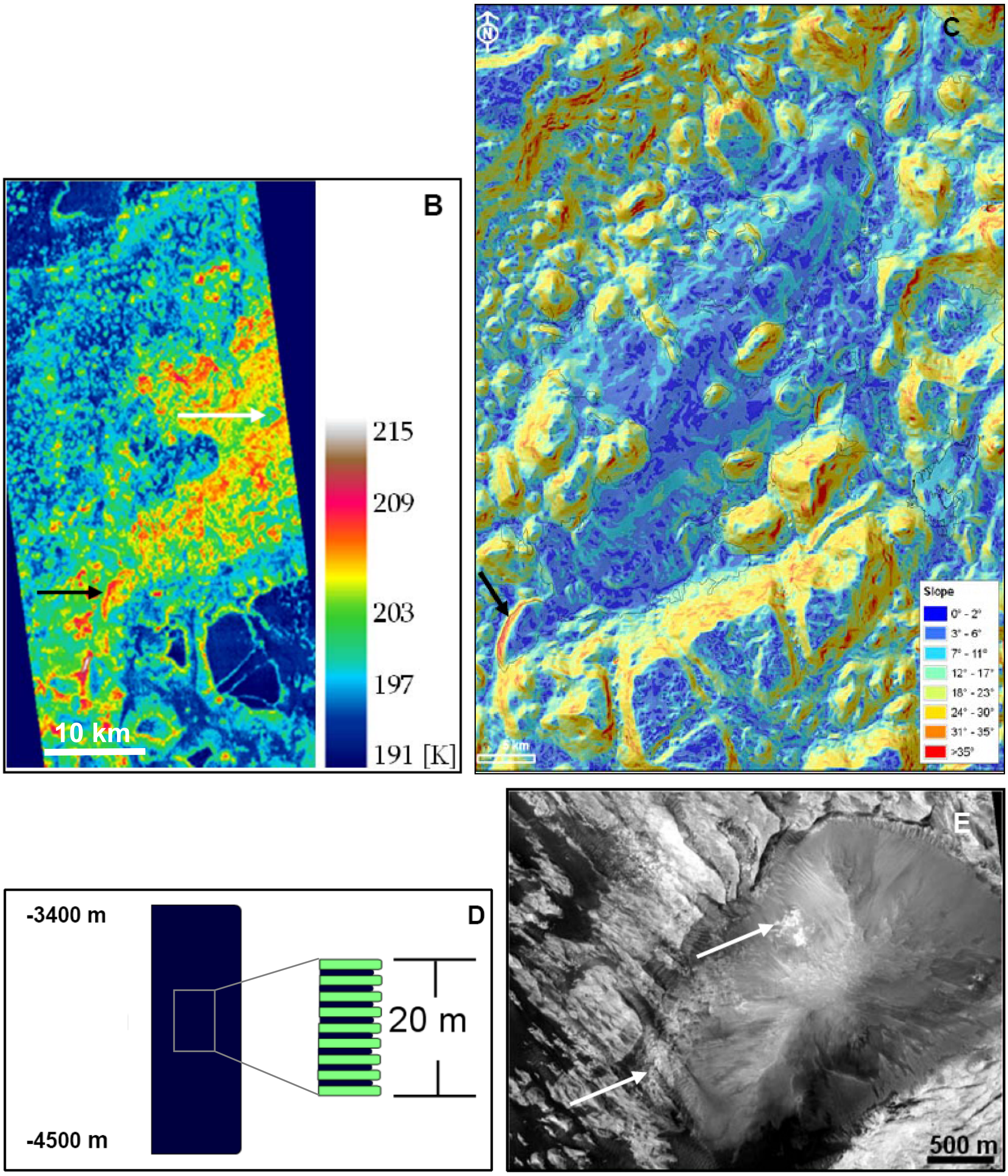
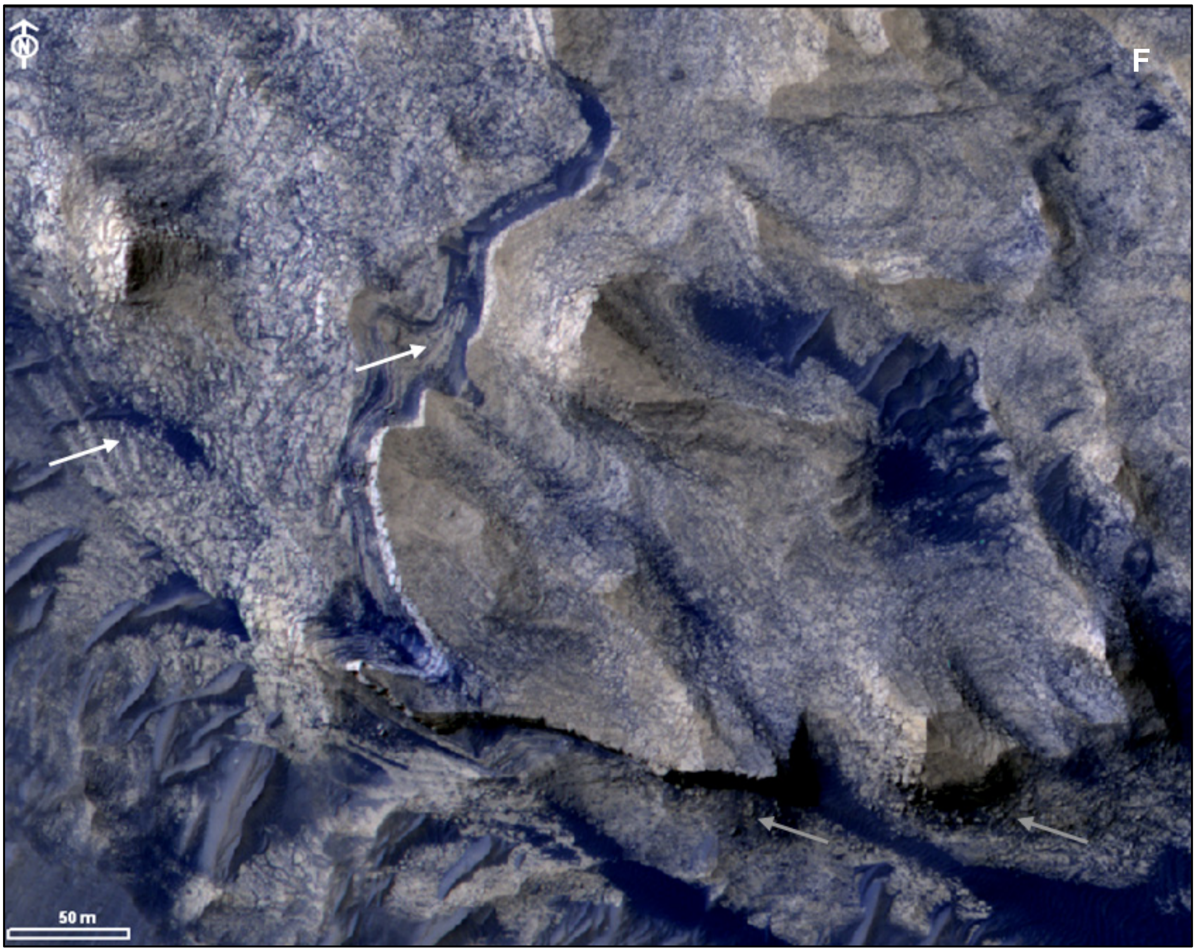



**Figure 41:** Properties of Iani 1. (A) *(top)* HRSC-nadir image overlain by DTM showing NNW-SSE-trending profile-section of Iani 1 (0.7°S/341.5°E). The ILD is located in depressions and/or elevations within disrupted terrain and surrounded by higher plateau. Note the heavily eroded and disrupted surface. White arrow

indicates steep, well-eroded, high-albedo scarp (cf. Fig. 41B, 41C). Black arrow shows location of Fig. 41F. Box demonstrates Fig. 41E. *(bottom)* Profile showing the ILD located in a depression overtopped by plateau material and some chaotic blocks. It is identified by arrows. The ILD displays an irregular shape (Fig. 41A *above*) and a dome-like cross-section. Its elevation ranges from -4500 m to -3400 m (Table 12). Accuracy: Distance ±0.050 km, topography ±12.5 m (HRSC DTM orbit h0934_0000).




(B) THEMIS BT map (I00931002RDR; 0.7°S/341.5°E) indicating regions of high BT (black arrow; 205-207 K) corresponding to areas that are steep and/or show a high albedo in contrast to low-albedo, flatter regions (cf. Fig. 41A, 41B). The ILD surroundings also display lower BT (191-205 K; Table 10). White arrow indicates the mound in Fig. 41E. (C) HRSC slope map (orbit h0934_0000) showing that the entire ILD (outlined in grey) has few steep areas, except where it is dissected or dominated by chaotic terrain or plateau remnants. Mounds dissected the mostly uncovered ILD are steep-sided. The slope-forming character of the ILD could be an indication of its location near Ares Vallis experiencing frequent erosion and resurfacing. (D) Estimated thickness of the ILD is 1100 m. Only one unit was identified in the ILD. This unit is heavily affected by erosion (yardangs, NW-SE surface lineation, grooves) and fractured, which complicates the observation of surface morphology. In parts, convolute-like bedding as seen on the top of Aureum (Sect. 4.1.2). Note the dimension: within 20 m ~9 stair-stepped sequences were estimated. (E) MOC-image (orbit R1600246; (0.7°S/341.6°E) showing high-albedo ILD material superimposed on low-albedo chaotic terrain mound, suggesting that the ILD formed later. For context, see Fig. 41A. The mound exhibits spots of light-toned material and ILD material weathering out indicating the ILD extended much farther than what is seen here. Note the NW SE-trending surface structure possibly caused by wind erosion. Along surface depressions, dark windblown material is exposed (north toward the top).




(F) HiRISE false colour image (orbit PSP_008100_1790; 0.8°S/341.5°E) demonstrating ILD break-up. For context, see Fig. 41A. Break-up of materials is best observed at the scarps that exhibit talus at their base (grey arrows). ILD material shows beige to white. Mafic sands (e.g. in ripples) are bluish and located in depressions on the ILD. Brownish-beige dusty material is present on most parts of the ILD and on some ripples. The ILD surface appears bouldered, possibly because of weathering. Layering is undulated and indicated by white arrows. Surface depressions act as traps for windblown dark material (bluish) that is partially rippled. Monadnocks indicate materials that differ in their resistance to erosion and weathering.

## Iani 2:

Iani 2 (1.6°S/342.4°E) has a terrace-like morphology with knobs (Fig. 42, 43A). The ILD measures 22 by 33 km; it is situated at an elevation of -3800 m to -3000 m. It is surrounded by blocks of chaotic terrain. Erosion must have come form north/northwest, as there is a sharp boundary there, whereas the southern and eastern parts are frayed. The knobs (30-50 m high) are aligned along a NS axis in the deepest part of the ILD (Fig. 43A). Their streamlined island-like morphology could be an indication for erosion by water.

Figure 39 shows that the plateau surface is more eroded and smoothened south of the ILD than in the north, where there are plateau remnants that less affected. This may be explained by erosion by water. Here, the western part of the ILD (Fig. 39 cf. 42A) was studied because of appropriate HRSC data.
The ILD is characterised by the parameters shown in Table 13.
The overall albedo is intermediate (Table 13). It is higher at eroded steep scarps than in flat regions where aeolian material is trapped (Fig. 42, 43C).
Just one unit has been identified in Iani 2 (Fig. 43D). In parts, shows undulating structures (Fig. 43G, 43H). Its stair-stepped morphology indicates material of varying consolidation. Cliff-forming material is observed in parts with steep scarps (Fig. 43C). HiRISE-images (Fig. 43F) show bouldered material pointing to weathering (e.g. frost weathering). A thickness of 800 m could be established (Table 13).
HiRISE images (Fig. 43E, 43F) give notice to advanced weathering causing an angular surface pattern and the formation of meter-sized boulders that are deposited along scarps and accumulate at their base (Fig. 43E). The edges are visibly frayed, another indication that the ILD surface was broken up (Fig. 43F). Dark talus is also present at the base, and windblown material in the flatter regions (Fig. 43C, 43G, 43H), occasionally rippled. Light-toned steeper regions, which are few in number, show higher BT (cf. Fig. 43C, 43B) and TI than their surroundings (Table 13).
On false colour images (Fig. 43E), ILD material appears yellow to brownish. Aeolian material accumulated in ripples is bluish. Brownish dusty material covers both the ILD and the ripples. Haematite was also detected within the ILD [*Glotch and Rogers*, 2007]. PHS[1] was identified by OMEGA [*NoeDobrea et al.*, 2008]. These mineral detections correlate with layered terrain.
Layering geometry measurements were not performed

**Table 13:** Parameters of Iani 2.

| Morphology | Relative Albedo | Elevation [m] | Thickness [m] | Consolidation of Materials | Mineralogy | Layer Geometry |
|---|---|---|---|---|---|---|
| Terrace-like, mesa profile | Intermediate[2] | -3800±12.5 to -3000±12.5 | 800±12.5 1 unit identified | Low TI[3] TI Ø: 342 SI±52 (surrounding: Ø 297 SI±28) BT: 195-203 K (surrounding: 187-195 K); boulders and talus observed | PHS + haematite within | - |

[1] Previous mineral detection pointed to gypsum [*Gendrin et al.*, 2005].
[2] section 3.2.1
[3] section 3.2.2

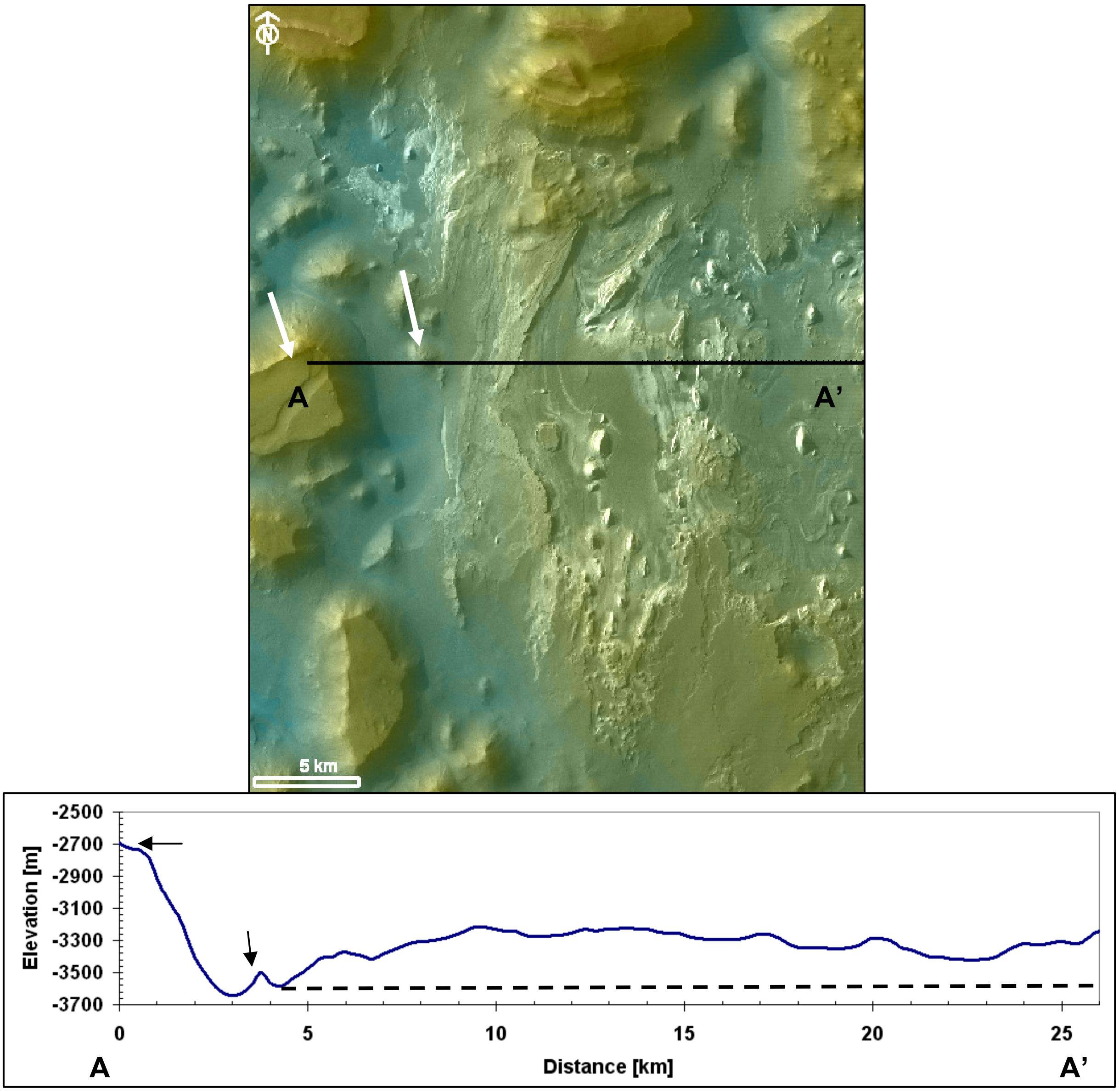



**Figure 42:** Profile of Iani 2. *(top)* Course of the WE-trending profile covering plateau remnants (arrows), heavily eroded chaotic terrain remnants and ILD material (cf. Fig. *below*). For context, see Fig. 39 (HRSC-nadir overlaid by DTM; 1.7°S/342.3°E). *(bottom)* Profile section (cf. Fig. *above*) showing the terrace-like appearance of the ILD. Dashed line marks the WE extent of the ILD. The ILD lies below the surrounding plateau rim and is covered in parts by dark material (dust, dark sand). Accuracy: Distance ±0.050 km, topography ±12.5 m (HRSC DTM orbit h0934_0000).

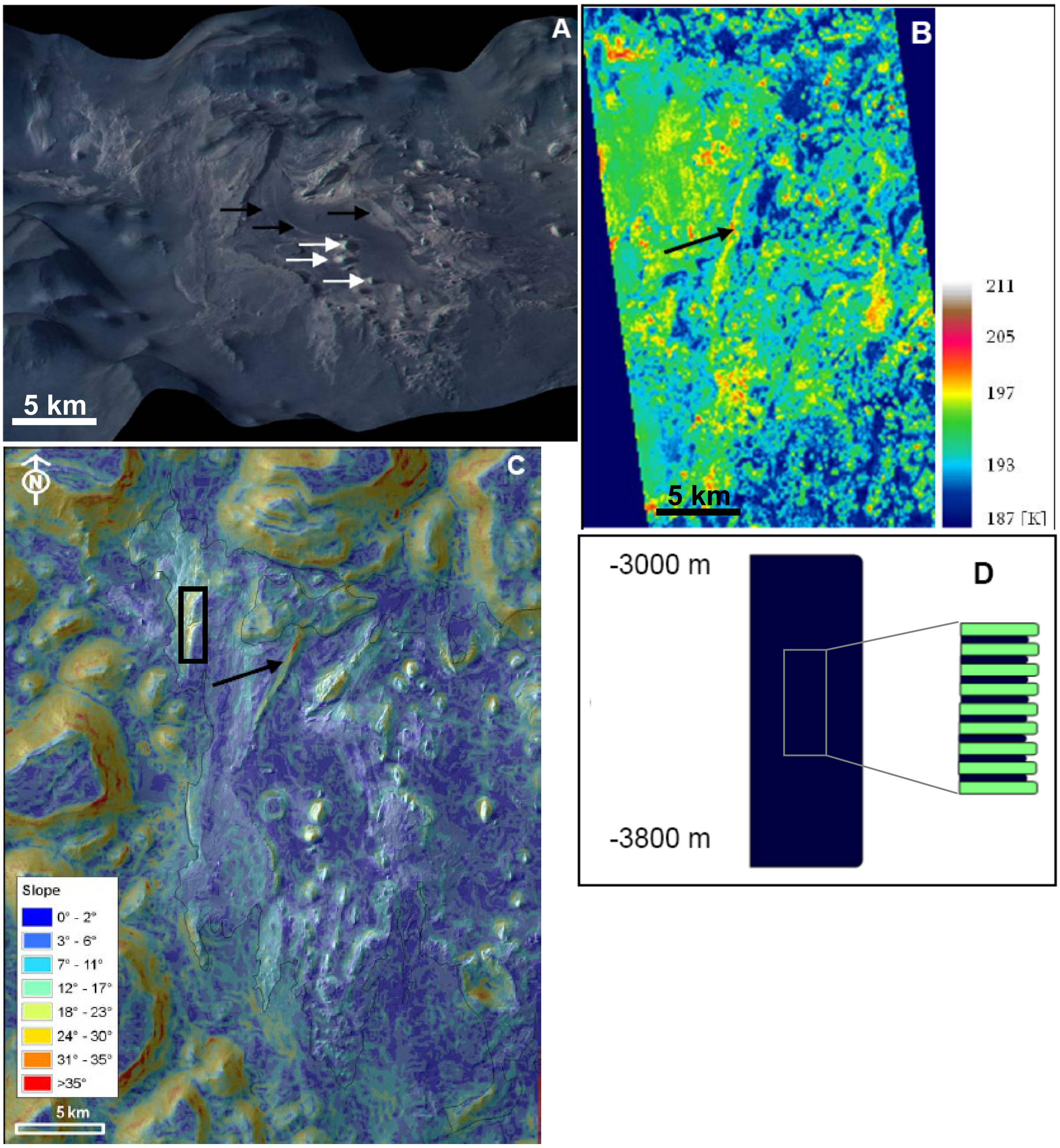
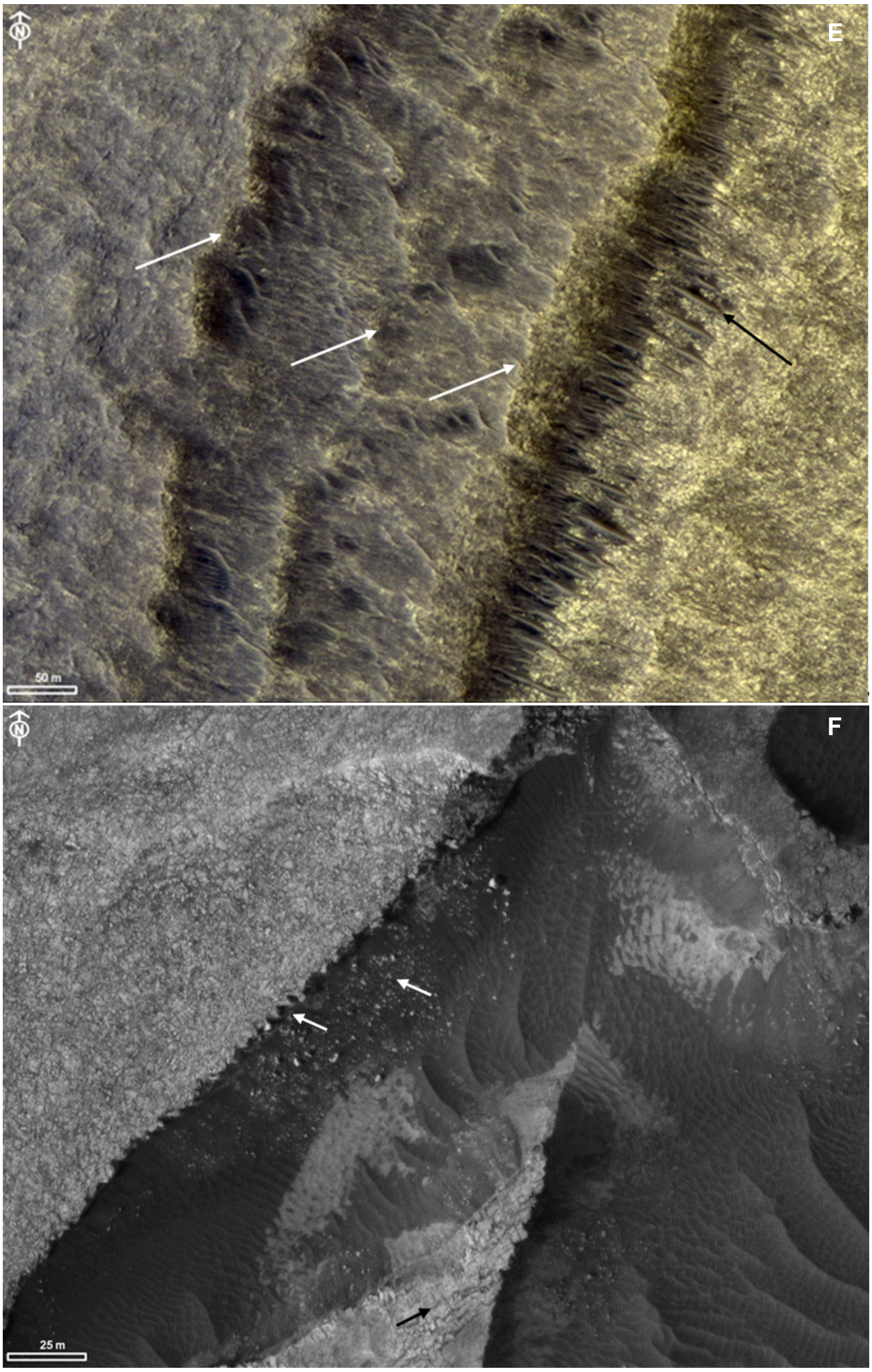



**Figure 43:** Properties of Iani 2. (A) HRSC false colour image perspective (orbit h0934_0000; 1.7°S/342.3°E). Note the terrace-like appearance (black arrow) indicated by a steeper slope (Fig. 43C) and knobs (white arrow) aligned along the layering as well as the surrounding plateau areas (cf. Fig. 42). (B) BT (orbit I17868017; $L_S$ = 345.6 →S-summer) is < 198 K in steep almost uncovered regions (arrow; cf. Fig. 43C; 1.7°S/342.3°E). (C) HRSC slope map showing that the few steep scarps (~30°) in the ILD correspond to eroded light-toned material with higher BT (arrow, cf. Fig. 43B). Box shows Fig. 43G. (D) Thickness profile showing an overall extent of 800 m for the ILD, which is characterised by undulated layering and dark mantling in parts (Fig. 43G, 43H). This ILD indicates PHS and haematite.




(E) HiRISE false colour image (orbit PSP_003907_1780; 2.1°S/342.4°E) showing material discrepancies observed in Iani 2. The layered ILD material (white arrows) appears yellow unless covered by dark material (bluish) partially accumulated in ripples (black arrow). Few steep slopes are observed (Fig. 43C) but boulders at the base are present as well as indications of material weathering into boulders (more competent) and talus (less competent, Fig. 43F). For context, see Fig. 39 (white box). (F) HiRISE image (orbit PSP_003907_1780; 2.1°S/342.4°E) of a weathering pattern detail. The ILD surface looks grained. Breakage structures are visible throughout the whole ILD surface, forming angular pieces. These pieces are transported downslope as meter-sized (mostly < 5 m) boulders (white arrow). The edges are frayed (arrow) indicating material cohesion has been weakened and break-up takes place starting at the rims. Parts of the surface show a rectangular pattern (joints; black arrow). Dark material (e.g. in ripples) covers wide areas and even settles on ILD material.