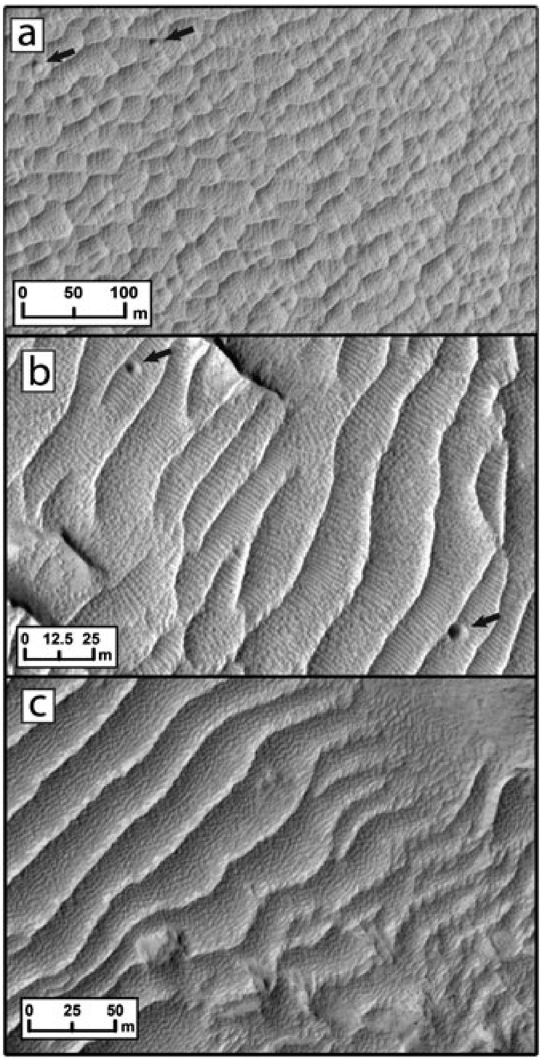

Figure 8. Indurated TARs. (a) Networked TARs of Southern Lucus Planum with subdued crests, degraded, knobby secondary bedforms, and small craters (arrows) (portion of HiRISE image PSP_008844_1730). (b) Linear TARs with flattened, crenulated crests and degraded, knobby secondary bedforms, also lightly cratered (arrows) (portion of HiRISE image PSP_006273_1715). (c) Linear TARs in a more advanced state of erosion with rounded crests, grading into complex terrain where TAR crests are flattened and interrupted (portion of HiRISE image PSP_009399_1760).

distinct ridges. This progression suggests that TARs made of similar material can experience different levels of induration or erosion based on local topographic microenvironments.

Based on the above progression, it is clear that TARs can become indurated over time, at which point they are susceptible to erosion rather than continued lateral migration as bedforms. The morphologies that result, however, can change depending on the original morphologies of the TARs, and on how exposed the indurated TARs are to the wind. For example, exposed ridges with an originally tranverse orientation can develop yardangs parallel to the dominant wind direction as they are eroded.

In Figure 11, a patch of relatively fresh network TARs (black arrow) can be seen near a small, exposed yardang which we interpret to be its source. However, this patch of network TARs sits on a rough, polygonal terrain (white arrow) with features of the same wavelength and similar morphology as the fresh network TARs, suggesting that these too were once active network TARs before becoming indurated. The superposition of fresh TARs upon indurated TARs (regardless of their source) demonstrates the evolving nature of the surface, and suggests that the landscape could, in places, be composed of layers of TARs that have undergone varying degrees of induration.

Figure 12(a) shows linear and network TARs adjacent to and continuous with the faceted terrain described above, a texture seen on and between many yardangs throughout the MFF. The close, gradational relationship between the network TARs and the faceted terrain and the identical wavelength of the polygonal patterning shared by the two feature types suggests that the polygonal ‘faceting’ may actually represent an indurated form of network TARs that have been subsequently dulled and modified by erosion. The origin of this faceted terrain as network and linear TARs would explain why some yardangs have smooth, flat tops, but faceted troughs and flanks: TARs preferentially accumulate in low-lying areas (Figure 12(a)). In Figure 12(b), somewhat complex, blunt, linear TARs (similar to those seen in Figure 4(c)) are clearly resolved towards the northwest part of the frame, but towards the southeast they become indistinguishable from what might be called ‘complex’, ‘faceted’ or even ‘bidirectional yardang’ terrain, the morphology of which might at first be assumed to be dominated by erosion. In this way, the process of TAR induration and erosion may provide an explanation for why bidirectional yardangs are so different from other Martian yardang types, as described above and shown in Figure 6. Like accumulations of TARs, bidirectional yardangs curve around topography, they usually appear to be deposited on top of the terrain instead of carved into it, and they are found in patches and topographic lows. These observations are more consistent with descriptions of TARs than with descriptions of yardangs. An origin of bidirectional yardangs from TARs would explain these similarities, and would also explain why these yardangs are different from other MFF yardangs in size and morphology. This formation mechanism would make pervasive jointing of the formation unnecessary (Bradley *et al.*, 2002), although it would not preclude the existence of joints.

Possible end-members of this induration process for both network and linear TARs are shown in Figure 13. The different starting morphologies of TARs can explain why the faceted terrain observed in different areas would show linear or polygonal patterns. Changes in TAR wavelength, as would be expected in topographic hollows, would be mirrored in the final faceted surface, as seen in Figure 13(a). This state would not be the end-state for these features, however. Instead, as wind passed over the complex features, etching and winnowing would begin to dominate, with the locations of resultant notches and flutes controlled by the repeating topography of the indurated TARs. An intermediate terrain can be seen in Figure 13(c). This image shows a field of features interpreted to be heavily indurated network TARs with notches and grooves eroded into their former crests. Eventually the original TARs will become difficult to recognize, leaving only a highly grooved and notched terrain that resembles a jointed surface. In this manner, terrain dominated by indurated bedforms of one orientation can be eroded into yardangs of a different orientation, or in the case of network TARs, bidirectional yardangs (Figure 14(a)).

The induration of bedforms and the deposition of new bedforms on top of indurated forms could eventually lead to the formation of a type of aeolianite (a rock formed from sediment that was deposited by the wind and subsequently lithfied; Sayles, 1931). We use the term ‘aeolianite’ as an alternative to ‘sandstone’ in order to focus on the mode of deposition (by the wind) rather than the grain size; however aeolianites have the same broad-scale morphological characteristics as sandstones (Sayles, 1931). Swirling, discontinous layers are commonly found in terrestrial aeolianites as a result of the deposition of successive layers and the subsequent planing of their complex surface morphologies (Kocurek, 1991).