MAPPING MARS` NORTHERN PLAINS: ORIGINS, EVOLUTION AND RESPONSE TO CLIMATE CHANGE – A NEW OVERVIEW OF RECENT ICE-RELATED LANDFORMS IN ACIDALIA PLANITIA.

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Introduction: Many young landforms in mid- and high-latitudes on Mars are thought to be related to ice [1], but their exact distribution and origin are still poorly understood. In an attempt to determine their extent and identify possible spatial relationships and genetic links between them, we mapped their distribution across a N-S traverse across Acidalia Planitia (Fig. 1), following the method described by [2]. The general characteristics of Acidalia are similar to that of Utopia Planitia described in the companion abstract by [3]. Here we report preliminary results from our mapping.

Map products: We employed a grid mapping approach based on CTX images [2], which enables mapping large areas at small scales. Our resulting maps show a binary ("yes" or "no") distribution of specific landforms in each grid cell (~20 × 20 km), but allows for some ambiguity (another class is "possible", where no unambiguous decision was possible). We also document where no data were available ("NULL") and where a landform is dominant. Examples of resulting maps are shown in Fig. 2.

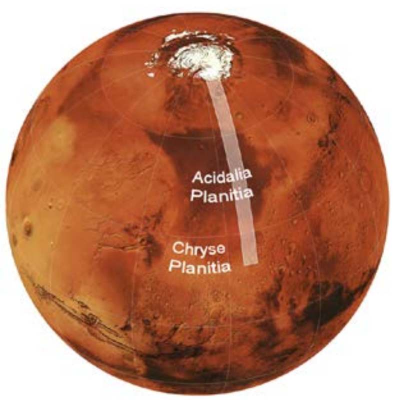

Figure 1. Location of traverse across Acidalia Planitia (from 20°N to the margin of the north polar cap). Width of traverse is 300 km.

Observations: We mapped individual landforms that may have been formed in association with ice or water, including polygonal terrain, gullies, and mantling material (the full list of landforms is provided by [2]). The following paragraphs give a short overview on the distribution of selected landforms.

Mantling deposits. Mantling deposits are ubiquitous and occur basically everywhere between ~43°N and almost the margin of the north polar cap. As their surface may appear smooth if undegraded, and their texture (if degraded) can be difficult to detect at CTX scale, unambiguous detection of mantling deposits is often complicated. Moreover, the quality of CTX images in the northern lowlands is not always perfect. Therefore, we classified the occurrence of mantling deposits in the majority of grids as "possible". (Fig. 2a).

Gullies. Gullies were observed within a limited latitude range between ~32°N and ~54°N (Fig. 2b). They predominantly occur in Acidalia Mensae (outcrops of highland material [4]) and Acidalia Colles (knobs that can be several hundred meters high [4]). Although gullies were found in several impact craters, their clustering in Acidalia Mensa and Colles is likely due to the high relief compared to the northern lowlands in general. First gully orientation analyses in the Acidalia Mensa/Colles region between ~44-54°N show a strong equatorward orientation, in agreement with results of previous studies in this latitude region [5,6].

Small-scale polygons. Due to limitations of CTX resolution we focused on first-order polygon networks that are tens to approximately hundred meters in size. Small-scale polygons are observed between ~60°N to ~70°N in agreement with previous studies [7,8] (Fig. 2c). They occur predominantly as oriented orthogonal networks in crater interiors and depressions and as random orthogonal patterns on plains.

Viscous Flow Features (VFF). The VFF as originally coined by [9] here embraces all meso-scale landforms indicative of creep of ice and debris, either confined as valley fill or inside impact craters as concentric crater fill or as lobate aprons that are commonly distributed within a well-defined latitude belt between 45°-60° [e.g., 10]. As VFF movement is predominantly controlled by slopes (rather than internal deformation), these features are observed only in higher-relief areas of the Acidalia Mensae and Colles. Their morphology is not well pronounced, partially subdued and covered, and most features are restricted to debris aprons distributed circumferentially around small knobs.

Thumbprint terrain (TPT). TPT is characterized by curvilinear arrangements of pitted cones [11]. It is wide-spread in the northern lowlands and especially in Isidis Planitia. In our study region, TPT appears north of about 30°N in the most distal parts of the Chryse outflow channels and shows a transition zone with the LPMs (see below) at around 36°N. It is not observed north of ~39N° [12]. TPT is arranged in clusters and linear or arc-shaped chains. TPT cones have smaller basal diameter then the LPMs.

Giant Polygons. Giant polygons with an average spacing of 5 to 10 km were already detected in Mariner 9 images [13]. The delineating troughs have average depths of ~30 m [14]. Together with the LPM (see below), the giant polygons have been considered analogous to fluid expulsion features in terrestrial sedimentary basins [15]. They characterize the study area from to 35 N° until 61 N° and completely disappear in the Acidalia Colles region [12]. Their spatial distribution overlaps with that of the LPM.

Large Pitted Mounds (LPM). These are dome-like features, commonly with a summital pit or crater, which have a greater basal diameter then the TPT cones. LPM are located in the northern part of Acidalia Planitia, arranged in clusters and associated with the giant polygons [12,16]. Their morphology is changing from domical to pancake-like shapes around 48 N°. LPM completely disappear at ~63N°. North of 39°N, only LPMs without TPT can be observed.

Summary: Gid mapping proved to be an efficient way to map small-scale landforms over wide areas. The distribution of possible ice- and water-related features in Acidalia is clearly latitude- and topography-dependent. For some features (e.g., TPT, giant polygons), it is very similar to that in Utopia [3]. Next steps will include the comparison of our results with those obtained for Utopia [3] and Arcadia [17] Planitiae, and with a morphologic inventory of impact craters in the three study areas [18], compiled in the same project.

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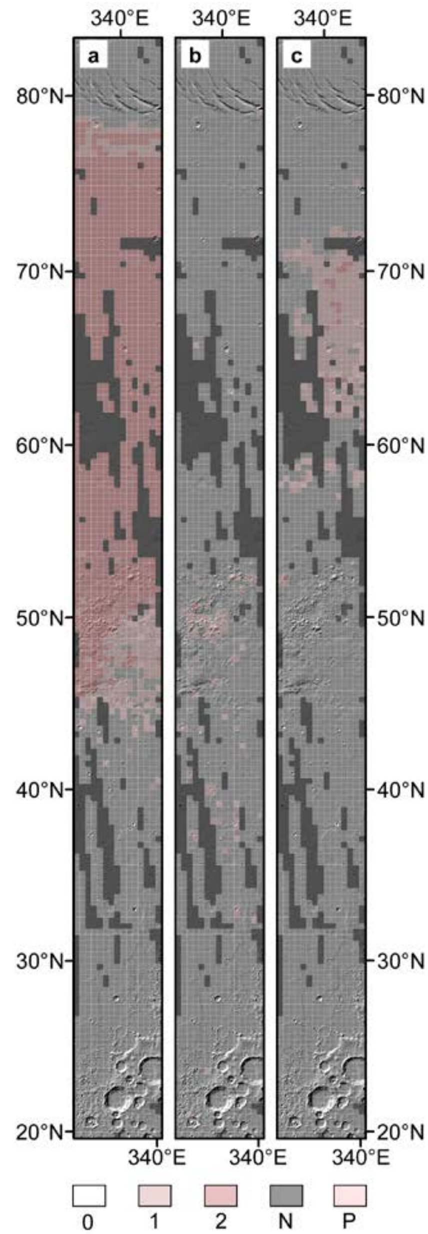

Figure 2. Selected grid maps with individual landforms. Colors indicate classification of grid cells (0=no color, just MOLA hillshade background: landform not present, 1: present, 2: dominant, N: no data, P: landform possibly present. (a) Mantling deposits. (b) Gullies. (c) Small-scale polygons.