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Distribution, origin and evolution of hypothesized mud volcanoes, thumbprint terrain, small mounds and giant polygons: Implications for sedimentary processes in the northern lowlands of Mars: Case study from the Acidalia Planitia.

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This study is part of the activities of an ISSI International Team, which intends to produce new geomorphological maps of the northern lowlands of Mars along three long traverses across Acidalia, Utopia, and Arcadia Planitiae [1]. This specific study focuses on mounds of different sizes: Large Pitted Mounds (LPM), Thumbprint Terrain (TPT), Small Mounds (SM) as well as km-sized, giant polygons (GP) [2,3]. These landforms were formed on the Vastitas Borealis Formation (VBF) Marginal and Interior Units, which are interpreted as outflow channel deposits or sediments of a hypothesized ocean. The aim of our study is to map the above mentioned features in the northern lowlands and establish a formational history and stratigraphy of landforms using morphological observations and geostatistics in Acidalia Planitia.
Our study is based on CTX mosaics (6 m/pixel) and we also used data from HiRISE (0.25 m/px), HRSC (images >10 m/px, HRSC- derived Digital Elevation Models [DEM], grid size 50-200 m), MOLA DEM (∼460 m/px), and THEMIS Nighttime IR (∼100 m/px).
The TPT appears north of about 30°N in the termination zones of the Chryse outflow channels and shows a transition zone with the LPMs at around 36°N in Acidalia Planitia. North of 39°N, only LPM can be observed. LPM are typically surrounded by topographic moats. Sometimes more than 75% of a mound can be covered or embayed by „plain filling material" of varying thickness. The LPM are observed in the same area as large-scale polygon troughs (buried and fresh) associated with circular-shaped small mounds (SM). The SM are located from 34°N to 48°N, completely overlapping the area of LPM and partly the TPT. These features are randomly distributed, but commonly arranged in clusters. Their domical shape with the central pit shows morphological resemblance with the LPM. These features characterize the area from 35 N° to 61 N° and completely disappear in the Acidalia Colles region.
The mapping results show a morphological transition zone of the TPT into the LPM in the Acidalia Planitia. It varies by latitude and may be related to the distance from the circum-Chryse outflow channel and the thickening of sediments towards Acidalia Planitia. We find observational evidence for complete or partial sedimentary burial of LPM as well as polygon troughs by a viscous flow material. This material shows flow fronts, suggesting an emplacement by multiple viscous processes [4,5]. We established a new approach of the detailed sequence of the origin of the main four landforms (LPM, TPT, SM, GP) using morphological analysis and geostatistics in combining the results of the previous studies [4,5].

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