

PERIGLACIAL EVIDENCE (USING HiRISE, MOC AND THEMIS IMAGERY) IN UTOPIA AND WESTERN ELYSIUM PLANTIA, FOR A RECENT WET AND WARM MARS. R. J. Soare^{1,2} and G. R. Osinski³, ¹Dept. of Geography, Planning and Environment, Concordia University, 1455 de Maisonneuve Blvd. W., Montreal, QC H3G 1M8, Canada (rsoare@colba.net), ²Dept of Geography, Dawson College, 3040 Sherbrooke St. W., Montreal, QC H3Z 1A4, Canada, ³Canadian Space Agency, 6767 Route de l'Aéroport, St-Hubert, QC J3Y 8Y9, Canada.

Introduction: Understanding the origin of Martian surface features and their possible relationship to sub-surface geological structures provides important constraints on the paleoclimate of the Red Planet. Here, we identify and discuss an assemblage of landforms in Utopia and western Elysium Planitia that is consistent with past and perhaps recent periglacial activity.

If our hypothesis is correct, it points to two things 1. the late Amazonian occurrence of ice-rich regolith throughout this region; and, more importantly, 2. a northern paleoclimate, conducive to water-ice emplacement and near-surface ground-ice formation, that could have been wetter and warmer than was previously thought.

A periglacial landscape in the northern plains

a. Small-sized polygonal patterned ground (~10-250m in diameter) is ubiquitous in the region. In terrestrial cold-climate landscapes, these features form when sub-zero temperatures fall sharply, creating cracks that eventually consolidate into polygons and polygon networks [1]. The cracks themselves are the result of thermal contraction stresses and occur only in ice-cemented sediments. Diurnally or seasonally, sand or water fills the cracks, creating near-surface veins or wedges that freeze when temperatures fall again. A number of researchers have suggested that the small-sized polygons in the northern plains are, or were, underlain by ice wedges. Importantly, the freeze-thaw temperature regime and atmospheric boundary conditions required by thermal contraction cracking and ice-wedge formation could have occurred here at recent high obliquities [2–4].

b. Scalloped depressions ranging in diameter from a few hundred metres to 1–2 kms are widespread in the landscape where the polygons occur and throughout the target region (Fig. 1). From the zero datum of the surrounding plains, MOLA tracks show that these depressions are tens of metres deep. [5]. The depressions lack raised rims and are flat-floored. Some of them are isolated, others appear to have coalesced. Step-like features, suggestive of multiple growth cycles, occur in the depressions (arrows in Fig. 1). The morphology and general characteristics of these depressions are very similar to drained thermokarst-lakes (alases) in terrestrial periglacial environments, where ice-rich sediments dominate the landscape [6][7].

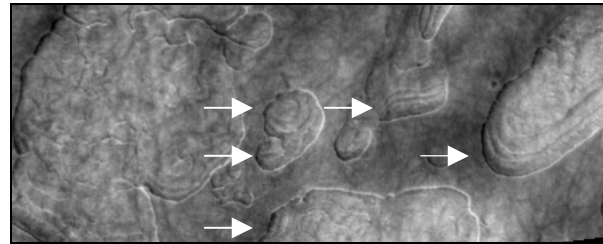


Fig. 1. Scalloped depressions, Utopia Planitia; note the step-like features within them (HiRise TRA-00856-2265, 46°N, 268°W). Image is ~13 km across and illuminated from the west. North is up.

c. Small, roughly-circular pingo-like mounds occur on the floor of a few impact craters in NW Utopia Planitia (Fig. 2) [8]. Some of the mounds display central depressions, giving them a doughnut-like appearance. In some instances, the mounds are crossed by the arms of small-sized polygons. On occasion, the crater-floor polygons and those on the crater walls have an orthogonal orientation.

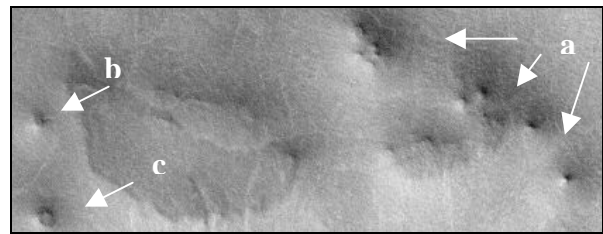


Fig. 2. Crater-floor landscape, nw Utopia Planitia. (a). mounds; (b) mounds crossed by polygons; (c) rimmed mounds; and, (d) orthogonal polygons (MOC-E0500113, res. 6.04m/pixel). Image is 3.3km across and illuminated from the southwest. North is up.

The mounds tend to be located near but not at the centre of the craters in topographic lows where water emplaced atmospherically could have ponded at recent obliquities. Frozen water-ice sitting on crater floors (a product of seasonal atmospheric deposition) is not unusual in this region, even under contemporary boundary conditions that are very cold, dry and absent of high atmospheric pressure.

On Earth, the orthogonal orientation of small-sized polygons occurs when water is slowly lost from a lake or pond (by drainage or evaporation) in an ice-rich landscape. This exposes the embankment sediments to freezing temperatures and to thermal contraction cracking that gains this peculiar orientation [9]. In some instances, the loss of lake water and the subse-

