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Mapping the northern plains of Mars: origins, evolution and response to climate change – a new overview of the recent ice-related landforms in Utopia Planitia

Francois COSTARD, Antoine SEJOURNE, Ania LOSIAK, Zusanna SWIRAD, MattHew BALM, Susan CONWAY, Colman GALLAGHER, Stephan VAN-GASSEL, Ernst HAUBER, Andreas JOHNSSON, Akos KERESZTURI, Thomas PLATZ, Jason RAMSDALE, Dennis REISS, and James SKINNER

GEOPS CNRS/P-Sud, UMR 8148 IDES, bat. 509, Orsay Cedex, France (francois.costard@u-psud.fr)

An ISSI (International Space Science Institute) international team has been convened to study the Northern Plain of Mars. The northern plains of Mars are extensive, geologically young, low-lying areas that contrast in age and relief to Mars' older, heavily cratered, southern highlands. Mars' northern plains are characterised by a wealth of landforms and landscapes that have been inferred to be related to the presence of ice or ice-rich material. Such landforms include 'scalloped' pits and depressions, polygonally-patterned grounds, and viscous flow features similar in form to terrestrial glacial or ice-sheet landforms. Furthermore, new (within the last few years) impact craters have exposed ice in the northern plains, and spectral data from orbiting instruments have revealed the presence of tens of percent by weight of water within the upper most ∼50 cm of the martian surface at high latitudes.

The western Utopia Planitia contains numerous relatively young ice-related landforms (< 10 Ma). Among them, there are scalloped depressions, spatially-associated polygons and polygon-junction pits. There is an agreement within the community that they are periglacial in origin and, derivatively, indicate the presence of an ice-rich permafrost. However, these landforms were studied individually and, many questions remain about their formation-evolution and climatic significance.

In contrast, we conducted a geomorphological study of all landforms in Utopia Planitia along a long strip from ∼30N to ∼80N latitude and about 250km wide. The goals are to: (i) map the geographical distribution of the ice-related landforms; (ii) identify their association with subtly-expressed geological units and; (iii) discuss the climatic modifications of the ice-rich permafrost in UP. Our work combines a study with CTX (5-6 m/pixel) and HRSC (∼12.5-50 m/pixel) images, supported by higher resolution HiRISE (25 cm/pixel) and MOC (∼2 m/pixel) and a comparison with analogous landforms on Earth.