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Thermokarst degradation of polygons inside scalloped depressions in Utopia Planitia as a benchmark for the presence of ice-wedges polygons on Mars

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In the northern lowlands of Mars, the western Utopia Planitia (UP) is dotted with an assemblage of possible young periglacial landforms (< 10 Ma): small-sized polygons (∼100 m in diam.), polygon-junction pits (∼10 m in diam.) and scalloped depressions (∼100-1000 m in diam.). Several studies show that they are similar with the landform assemblage of the periglacial region of the Central Yakutia (Siberia), the Tuktoyaktuk Peninsula (Canada) where an ice-rich permafrost is present. Based on their similar shape and scale to the thermal contraction polygons on Earth, the polygons in UP are interpreted to be due to thermal contraction process. However, the nature of the polygons (nature of material filling the cracks forming the wedges) is uncertain. On Earth, thermal-contraction polygons are underlain by ice-wedges or sand-wedges or a combination of both depending on the environmental conditions during their formation. Assess the nature of the polygons in UP could give clue about the recent atmospheric conditions on Mars that might be slightly different than today's dry and cold conditions.
Here we describe new features resulting from the degradation of polygons inside scalloped depressions in Utopia Planitia using images from the High Resolution Imaging Science Experiment (HiRISE, 25 cm/pixel) and a HiRISE stereo Digital Elevation Model (DEM, vertical precision of 50 cm and horizontal precision of 1-2 m). In order to understand the degradation and the nature of the polygons inside the scalloped depressions, we compare these landforms with our study of active degradation of polygons in Central Yakutia (Siberia).
Our study shows that the pole-facing slopes of scalloped depressions show degraded polygons that are reminiscent of highly degraded ice-wedge polygons in Central Yakutia. The degradation of polygons is due to thermokarst but occurred by sublimation of ground-ice instead of melting. We propose that the degradation of permafrost was initiated by an enhanced insolation during high-obliquity periods of Mars between 5 and 9 Ma. Also by using the pattern of degradation, we show that the polygons have composite-wedges or even ice-wedges. The formation of these polygons could give an insight of the recent climate that could have been relatively slightly wetter than the current climate on Mars.