

EXPOSED ICE IN THE NORTHERN MID-LATITUDES OF MARS

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Ice-Rich Layer: Polygonal features with dimensions of approximately 100 meters, bounded by cracks, are commonly observed on the martian northern plains. These features are generally attributed to thermal cracking of ice-rich sediments, in direct analogy to polygons in terrestrial polar regions [1,2]. We mapped polygons in the northern mid-latitudes (30 to 65 N) using MOC and HiRISE images [3]. Polygons are scattered across the northern plains, with a particular concentration in western Utopia Planitia. This region largely overlaps the Late Amazonian Astapus Colles unit, characterized by polygonal terrain and nested pits consistent with periglacial and thermokarst origins [4].

Bright and Dark Polygonal Cracks: An examination of all MOC images (1997 through 2003) covering the study area demonstrated that, at latitudes of 55 to 65 N, most of the imaged polygons show bright bounding cracks. We interpret these bright cracks as exposed ice. Between 40 and 55 N, most of the imaged polygons show dark bounding cracks [5]. These are interpreted as polygons from which the exposed ice has been removed by sublimation. The long-term stability limit for exposed ice, even in deep cracks, apparently lies near 55 N.

Bright and Dark Spots: Many HiRISE and MOC frames showing polygons in the northern plains also show small numbers of bright and dark spots, particularly in western Utopia Planitia. Many of the spots are closely associated with collapse features suggestive of thermokarst. The spots range from tens to approximately 100 meters in diameter.

The bright spots are interpreted as exposed ice, due to their prevalence on terrain mapped as ice rich. The dark spots are interpreted as former bright spots, which have darkened as the exposed ice is lost by sublimation. The bright spots may be the martian equivalents of pingos, ice-cored mounds found in periglacial regions on Earth [6,7,8,9, 10]. Terrestrial pingos from which the ice core has melted often collapse to form depressions similar to the martian dark spots.

Future Observations: The SHARAD radar should be able to confirm the presence and measure the depth of the interpreted ice-rich layer that forms the Astapus Colles unit. If this layer is confirmed it will strengthen the interpretation of bright polygon cracks and bright spots as exposed ice. HiRISE images of the northern plains are showing unprecedented details of the polygonal cracks. Future HiRISE images that include bright spots, compared to MOC images taken years earlier, will illustrate the temporal stability of the spots. The CRISM spectrometer, with multiple spectral bands and a spatial resolution around 20 meters, should allow mineralogical identification of the material exposed in the polygonal bounding cracks and in the bright spots.

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