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Evidence for slow periglacial mass wasting in the southern mid-latitudes, Mars.

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Solifluction is a common mass-wasting process in permafrost regions on Earth. The main solifluction processes include frost creep, and/or gelifluction [Matsuoka, 2001]. On Earth solifluction lobes are strong indicators of past or present freeze-thaw activity and represent a potentially useful source of paleoclimatic information [Åkerman, 2005]. Previously, well-preserved small-scale lobes lobes have been reported in the northern mid-and-high latitudes on Mars by several authors [Balme et al., 2013 and references therein]. Based on morphology and integrated landform analysis [Gallagher et al., 2011; Gallagher and Balme, 2011], morphometry and Earth-analogues [Johnsson et al., 2012] the proposed mechanism is by solifluction. By implication, this suggests active-layer formation and consequently transient liquid water close to the surface at repeated times in the recent climate history on Mars, which is contrary to modeling [Kreslavsky et al., 2008].

In this study we extend our search to the latitude band 40°S and 80°S on Mars. Like the northern counterparts, the observed small-scale lobes show striking similarities to solifluction lobes on Earth and they are typically located in a context associated with thermal contraction polygons and gullies. The small-scale lobes are tens to hundreds of meters wide with well-defined lobe fronts (risers). The risers are in the order of decimeters to a few meters (<5m) high. Individual lobes overlap or occur as sheet-like landforms. They are restricted to crater walls and hillslopes and are not confined to valley topography. They lack attributes typically associated with creep/deformation of ice or ice-rich debris such as crevasses, compression ridges and furrows. Hence they are morphologically different from glacial landforms such as Viscous Flow Features [Milliken et al., 2003] and Lobate Debris Aprons [e.g. Mangold 2003].

Previously, small-scale lobes have only been observed at a few sites in the south using Mars Orbiter Camera (MOC) images [Mangold, 2005]. The first question we ask is hence: what is the distribution of small-scale lobes on southern Mars as seen in HiRISE and CTX datasets. Secondly, is there a link to other mass wasting landforms that have been associated with melting of ice/snow such as gullies? And thirdly, how do the southern small-scale lobes compare to the northern counterparts?

Our results show that small-scale lobes are widely distributed across the southern hemisphere of Mars. Particularly well-developed lobes are concentrated in the Charitum Montes region, but well-preserved lobes are also found elsewhere in the mid-latitudes. Their close spatial proximity and superposition relationship to gullies suggests that they may form under similar conditions. Their morphometry and their close proximity to gullies and polygonal terrain are in agreement with terrestrial analogues. Small-scale lobes may therefore be strong indicators of past freeze-thaw activity and be useful sources of paleoclimatic information on Mars.

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