

Veiki-moraine-like landforms in Nereidum Montes on Mars: Insights from analogues in northern Sweden.

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Mars is a cold hyper-arid planet where liquid water is extremely rare [1]. The observable water budget is instead found in a number of frozen reservoirs such as the polar caps, near surface ground ice and as glacier ice. Previously, numerous studies reported on glacier landforms such as viscous flow features and lobate debris aprons where water-ice is believed to be present under insulating debris cover [2]. This notion was confirmed by SHARAD measurements [3]. However, very little is known about glacial landforms in which water is an important factor. Most studies have focused on moraine-like ridges that are associated to gully systems [4], glacial landforms at the equatorial volcanic province [5] and possible drop-moraines from CO₂ glaciers [6]. Here we report on an unusual lobate assemblage of irregular ring-shaped landforms within a mountain complex in Nereidum Montes, Mars. These landforms are well-preserved and may suggest recent ablation of a debris-covered glacier. These martian ring-shaped landforms show a striking morphological resemblance to the Veiki moraine in northern Sweden. Veiki moraines are believed to have formed at the lobate margins of a stagnant ice-sheet during the first Weichselian glaciation [7]. As it sharply ends to the east it may represent the maximum extent of this former ice sheet. The Veiki moraine is characterized by ridged plateaus that are more or less circular and surrounded by a rim ridge. The newly acquired national LiDAR data over Sweden enable us studying these landforms in unprecedented detail. They also enable us exploring geomorphological similarities between Earth and Mars in large spatial contexts. This study aims to increase our understanding of glacial landforms on Mars by comparison to terrestrial analogues. Questions addressed are: (1) How morphological similar are the Martian landforms to the Veiki moraine of Sweden? (2) How does the ring-shaped landforms relate to other possible glacial landforms within the mountain complex? (3) Do the ring-shaped landforms indicate the maximum extent of former ice sheets on Mars? (4) Was any meltwater involved?

References: [1] McEwen et al. 2011, (5) 333. [2] Milliken et al., 2003. *JGR-Planets* (E6) 108. [3] Holt et al., 2008. *Science* (21) 322. [4] Arfstrom et al., 2005. *Icarus* (2) 174. [5] Scanlon et al., 2015. *PSS*. [6] Head et al. 2006. *Met & Plan Science* (10) 41. [7] Lagerbäck, 1988. *Boreas* 17.