Glaciation in the Erebus Montes region of Mars

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Evidence for extensive glaciations in mid-latitudes of Mars became available through analyses of Late Amazonian aged (~1Ga) lobate debris aprons (LDA) and lineated valley fill (LVF) [1-3]. In this study, we carry out detailed analysis of LDA and LVF preserved in the Erebus Montes region (35˚ N, 175˚ W) to show that debris-covered glacial activity on Mars was very extensive and erosive in nature than previously thought. We have used the Mars Reconnaissance Orbiter Context Camera datasets (~6 m/pixel) and High Resolution Imaging Experiment datasets (~0.25 m/pixel) for the morphological analysis. For topography, we used the ~200 m/pixel blended Digital Elevation Model data derived from the Mars Orbiter Laser Altimeter and the Mars Express High-Resolution Stereo Camera. Observations indicate that Erebus Montes stands out as a unique glacial region in comparison to the other glaciated terrains on Mars because (1) it hosts large LDAs associated with small mesa, (2) LDAs are formed in low lying regions for ~1000 km, (3) LDAs are emplaced far away from the dichotomy boundary, and (4) LDAs are commonly closer to some of the largest volcanic constructs. Evidence of relatively small mesa height and extensive LDA cover within this region reveal that it must have experienced significant ice accumulation, erosion and flow in the past. However, evidence of small-scale lobes sourced from mesa alcoves and superposed on the main LDA rather suggest a less extensive glaciation in the later phase. The brain-terrain texture and ring-mold crater morphologies are fairly consistent with the near-surface ice in the region; however, a radar based investigation is warranted in validating the presence of subsurface ice. Crater-size frequency distributions of LDA and LVF corroborate glaciations to be active till the past ~100 Ma. Our study suggests that the region had experienced history of long-lived glacial episodes as extensive epochs during the past ~1 Ga and younger, relatively less extensive, mild glacial epochs during the past ~100 Ma. We propose that this long-lived glacial activity (ice accumulation-flow) resulted in extensive erosion of the mesa flanks and further expediting emplacement of LDA with enhanced flow extent within the Erebus Montes region.

References: [1] Sinha R. K. and Murty S. V. S. (2013) *PSS, 86,10-32*. [2] Sinha R. K. et al. (2017) *Icarus, 297, 217-239*. [3] Sinha R. K. and Vijayan S. (2017) *PSS 144, 32-48*.