

Morphology and Topographic Profiles of Lobate Flow on Mars

How convincing is the Water Ice Hypothesis?

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ABSTRACT

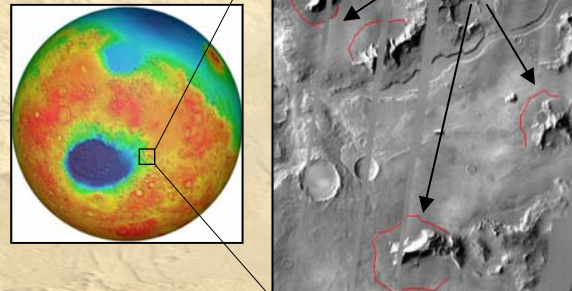
- Surface features observed East of the Hellas impact basin on Mars are indicative of viscous flow, and resemble Earth glaciers.
- This research compares the topographic profiles of the Martian flows to Terrestrial ice analogues.
- Terrestrial profiles are modeled using the equation of Glen's Flow Law.
- We seek to test whether ice is really the correct analogue as presumed by previous works.

METHODOLOGY

- Martian topographic profiles are measured using the digital elevation model (DEM) obtained by the Mars Orbiter Laser Altimeter (MOLA).
- Terrestrial equilibrium profiles are obtained by Glen's Flow Law.

$$\left(\frac{h}{H}\right)^{2+2/n} + \left(\frac{x}{L}\right)^{1+1/n} = 1$$

- This equation expresses topographical elevation as a function of distance to some power n (where $n = 3$ for water-ice glaciers).
- This n exponent controls the plasticity of the material and is governed by stress and strain rate (Paterson 1994).
- An n value for mars different than 3 will suggest that ice is not a straightforward analogue.



GEOLOGIC SETTING

- Debris aprons are located mainly in the mountainous terrain on the eastern side of the Hellas basin.
- High-resolution images clearly indicate a material which has undergone viscous creep.

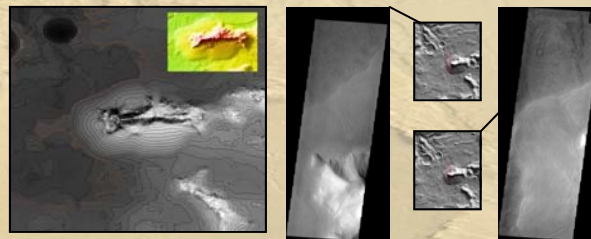


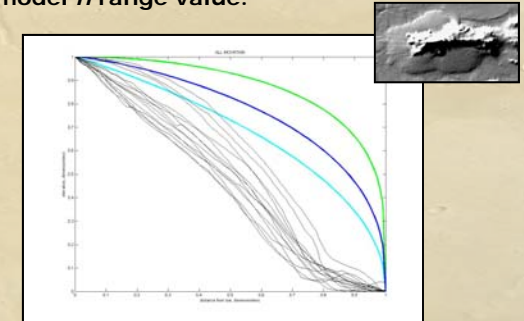
Image Credit: themis.asu.edu and <http://cseilgman.com>

REFERENCES

- Peterson, W.S.B. The Physics of Glaciers, 3rd ed. 1994.
- Li, H. et al. Maritan Southern Hemisphere Debris Aprons. Lunar and Planetary Science. 2006.
- Head, J.W. et al. Tropical to mid-latitude snow and ice accumulation, flow, and glaciation on mars. Nature. 2005.

RESULTS

- Below: Fourteen Martian topological profiles overlapped by the Glen's Flow Law, with n value plotted at $n = 1$ (green), $n = 3$ (blue), and $n = 20$ (cyan). Image also shown of approximate transect lines.
- Profiles clearly do not correlate with any model n range value.



CONCLUSIONS AND IMPLICATIONS

- These finding indicate the material flowing is either not ice or is not dictated by the properties of Glen's Flow Law.
- Re- examination of the many assumptions within the Glen's Flow Law equation. What are some contributing feedback processes such as sublimation, bedrock topography, temperature effects, etc.
- Other potential analogues? Previous published work suggests the Martian flows are water-ice glaciers. Recent discovery of abundant salts on Mars invite this hypothesis to be reconsidered. Another possible terrestrial analogue may be the salt glaciers of Iran.