Mapping Evidence of Glaciation Around Olympus Mons, Mars

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Background

• Rock facies indicate glacial formations on Mars
• Some speculate the obligatory patterns of the orbit
• Uneven orbit causes the glaciers to advance and recede
Hypothesis

How is the evidence of glaciers distributed around Olympus Mons?
Lobes

- Ice and debris features
- Distinctive ‘tongue’ shape
- Distinguishable from lava flows, etc. by shape, features, dimensions.

Aerial photo of Canadian protalus lobes from a rock glacier.
Lobes, contd.

Map of Martian lobate deposits, likely the remnants of a Piedmont glacier.
Glacial Ridges on Mars

- Large deposits of sediment and glacial till, scraped up by forceful movement of glaciers
- Similar to Terrestrial moraines
Alcoves

• Theater shaped
• Found on basal escarpment
• Lobes found below formation
• Large moraines and scarps
Cones

• Talus Cone – a sloping apron of rocks along the base of a cliff

1. 

2. 

Glacier National Park in Canada

Olympus Mons, Mars
Mound-and-Tail Terrain:

- Break-up of terrain into closely-spaced and elongated mounds.
- Typically 30-50m long.
- Steep up-glacier facing core and a shallow elongated tail.
- Hellas Planitia Mounds.
- Found in the glacier-like-form basin.
- Similar in look to Drumlins on Earth.
Lineated Valley Fills

• Distinguished by a continuation of ridges in the topography that have a single direction of flow

• “Found in Constrained Valleys” (Dickson, Head, and Fasset, 2012)

(Farien et al, 2012)
Troughs (U-Shaped Valleys)

- Identifying features of glaciation appear to be located within troughs.
- Troughs are located down from cirques.
- Troughs can only be created by glaciers.
Knobby Facies

• Caused by Sublimation tills
• Located before ridged facies
• Are a sign of cold based glaciers
• Similar to the Antarctic cold based glaciers

A) Geologic sketch of Arisa Mons. Knobby facies indicated by letter K and ridged facies by letter R. B) Ridged facies seen on Mars. Photos from Cold-based mountain glaciers on Mars: Western Arisa Mons by James Head & David Marchant
Formation of Knobby Facies

1. accumulation of ice and debris
   - basal escarpment
   - ice and debris

2. formation of glaciers
   - debris-covered
   - arcuate drift ridges on glacial surface
   - less debris in accumulation zones than in glaciers

3. localized ice-lava interactions
   - local lava flows

4. sublimation of unprotected ice
   - chaotic
   - arcuate ridged
   - marginal
   - blocky facies

Photo credit: www.sciencedirect.com
Scaly Terrain

• Land has a “scale” like pattern. The scales are 5-6 sided and are 10-20 meters across.

• The scales have 1-3 upslope facing edges that are raised and a body that dips down slope. This creates cracks between the adjacent scales.
Scaly Terrain Continued:

- Similar to thermally cracked periglacial surfaces found on Earth and other areas on Mars.
- Periglacial terrain originally referred to land that lies around an ice sheet. Now it is land that is or has been affected by intense frost or permafrost.
- Permafrost is known to make polygons.
Impact Craters (IC’s)

- Examined in order to gain a concept of time scale by observing the total quantity of IC’s present in a defined area in comparison to another
- Process called “Crater Counting”
Methods:

• Base map from JMARS.
• Our class is focusing on the area beyond the escarpment of Olympus Mons.
• Each student becomes a specialist on a specific glacial feature.
Methods, contd.

• Each student will add manually marks to the base map as features of interest are found in THEMIS images

• Finally, findings will be transcribed on a new map created in Adobe Illustrator
Base Map

Image captured from JMARS
Base Map

http://marsprogram.jpl.nasa.gov/gallery/atlas/images/3dom.jpg
Disseminating our Research:

• Accessible through our school website for other students.
• Presentation at CNY Earth Science Student Symposium-April 12, 2013.
• Large presentation of research displayed in the Hobart and William Smith Geoscience Department.
References


Dickson, J, Head, J & Fassett, C. I. 2012, *Patterns of accumulation and flow of ice in the mid-latitudes of Mars during the Amazonian.* *Icarus.*


[http://capone.mtsu.edu/cdharris/GEOL100/erosion/talus-creep.htm](http://capone.mtsu.edu/cdharris/GEOL100/erosion/talus-creep.htm)


Nature Geoscience. *Figure 2: Glaciers on Early Mars*. Retrieved from http://www.nature.com/ngeo/journal/v4/n10/fig_tab/ngeo1243_F2.html

