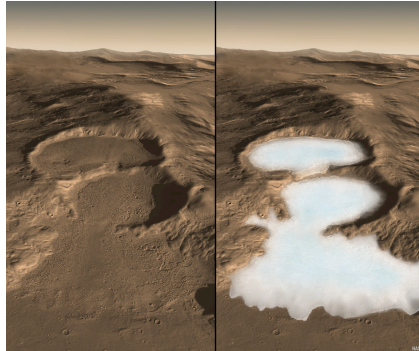


## Buried Glaciers at Mars

- Radar observations made from orbit reveal that nearly pure ice “glaciers” covered by rock are common at mid-latitudes on Mars
- Previous spacecraft images indicated glacier-like features next to steep slopes and filling some craters, but could not see through the overlying rock to confirm their presence
- The layer of rock protects the ice from subliming (evaporating) in Mars’ cold dry climate



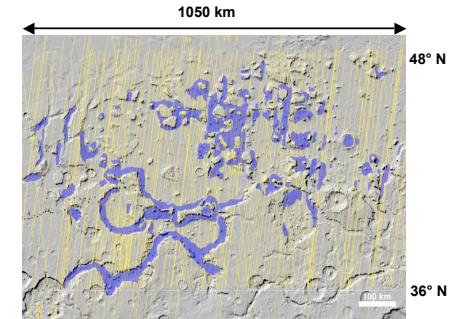
(Left) Perspective image of craters in the southern hemisphere of Mars, created using NASA Mars Reconnaissance Orbiter images; (Right) Artist conception of ice underlying a surface layer, based on radar observations.

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## Forming Protected Ice Reservoirs

- The tilt of Mars’ rotation axis was likely much greater (~45°) millions of years ago
- During that epoch glaciers could form more easily at mid-latitudes on Mars
- Overlying debris transported from nearby steep slopes would prevent some glaciers from subliming, even after Mars’ tilt changed



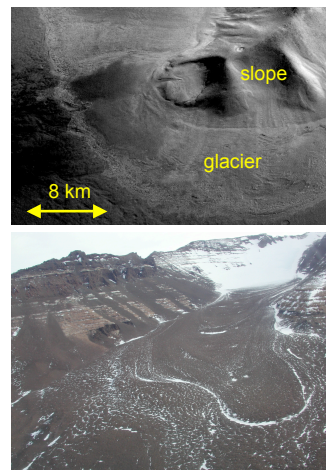
Topography map from Mars Global Surveyor showing the locations of buried glaciers (blue) in a northern hemisphere region of Mars, inferred from many radar observations obtained by Mars Reconnaissance Orbiter (yellow). Buried glaciers are always found near steep slopes.

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## The Big Picture

- Debris-covered glaciers at mid-latitudes on Mars may contain enough ice to cover the entire planet in 20 cm of water
- These ice reservoirs are covered by only a few meters of material - easily accessible for future human and scientific exploration
- Buried ice may record the history of Mars’ climate, as ice cores from Earth’s glaciers do



Debris covered glaciers on Mars (top, imaged by the Mars Express spacecraft) and in Beacon Valley, Antarctica (bottom, photo courtesy Jack Holt)

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## For More Information...

### Press

- Space.com - 03/04/10 - “Hidden Glaciers are Common on Mars”  
<http://www.space.com/scienceastronomy/mars-ice-glaciers-100304.html>
- National Geographic News - 11/20/08 - “Buried Mars Glaciers May Be Remnants of Past Ice Age”  
<http://news.nationalgeographic.com/news/2008/11/081120-buried-mars-glaciers.html>

### Images

- Slide 1 image courtesy NASA / Caltech / JPL / UTA / UA / MSSS / ESA / DLR  
[http://www.jsg.utexas.edu/galleries/mars\\_glaciers112008/](http://www.jsg.utexas.edu/galleries/mars_glaciers112008/)
- Slide 2 image courtesy NASA / JPL / ASI / U. Rome / SwRI  
<http://photojournal.jpl.nasa.gov/catalog?IDNumber=PIA12861>
- Slide 3 Antarctica image courtesy Dr. Jack Holt (U. Texas)
- Slide 3 Mars image courtesy ESA / DLR / FU Berlin  
[http://www.jsg.utexas.edu/galleries/mars\\_glaciers112008/](http://www.jsg.utexas.edu/galleries/mars_glaciers112008/)

### Source Articles (on-campus login may be required to access journals)

- Holt et al., “Radar Sounding Evidence for Buried Glaciers in the Southern Mid-Latitudes of Mars”, *Science*, 322, doi:10.1126/science.1164246, 2008.  
<http://www.sciencemag.org/cgi/content/full/322/5905/1235>

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