AGU Press Conference

Spring at the South Pole of Mars

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December 2007
Setting the Stage...

- Mars, like earth, experiences seasons
- In the winter a seasonal polar cap of carbon dioxide (CO₂) ice covers latitudes up to ~55°
- MRO has just completed a campaign to observe the spring sublimation (evaporation) of the CO₂ ice
- Focus has been on 3 sites in the “cryptic terrain”, a region that stays cold even as it gradually darkens
- *This region is home to topography unlike anything on planet earth*

Hypothesis: The CO₂ seasonal ice in the cryptic terrain is translucent, allowing sunlight to penetrate through the ice to the surface below. The ice then sublimates from the bottom of the slab, eroding channels in the surface below. (H. Kieffer, 2000)
Four Components of Surface, Apparent in Color

- Muted red: dark surface, appearance muted by translucent ice
- Dark fans: dust brought up from surface, laying on top of translucent ice
- Translucent ice: “visible” by effect it has on surface tone
- Bright bluish: gas re-condensed on top of the ice as fine-grained bright frost

The surface beneath the seasonal ice is water-ice cemented dirt covered by a ~ 5 cm layer of dust (silt-sized particles)
Anatomy of a “Spider”

- Associated with more fans early in the season
- Radially organized channels which deepen and widen as they come to the center
- Spiders often drape over the local topography
- Channels often widen and deepen as they go uphill

Consistent with gas as the erosive agent

Spider is ~0.55 km in diameter
Spider Size

Spider dimensions

- from shadow measurements after seasonal ice was gone
- incidence angle = 74.88°

Overall Spider size:
~550 m diameter

Center Depth: 1.8 m

Channel Widths, Depths
a  5 m wide, 1 m deep
b  3.4 m wide, 0.7 m deep
c  5 m wide, 0.6 m deep
Spider Time Lapse Series

PSP_002532_0935 \hspace{1em} Ls = 181.1

PSP_002850_0935 \hspace{1em} Ls = 195.4

PSP_002942_0935 \hspace{1em} Ls = 199.6

PSP_003496_0935 \hspace{1em} Ls = 226.0

PSP_003641_0935 \hspace{1em} Ls = 233.1

PSP_005579_0935 \hspace{1em} Ls = 325.4
A New Vocabulary is Required (1)

“Araneiform” (spider-like)

**Isolated araneiform topography**
- Radially organized channels, not connected to other spiders

**Circular araneiform topography**
- Roughly circular expanse, channels do not connect to neighboring spiders

**Etched araneiform topography**
- Very shallow channels, wider than they are deep

**Connected araneiform topography**
- Radially organized channels branch dendritically, connect to other spiders' channels

Spider is 190 x 210 m

PSP_003087_0930

Image is ~1 km wide

PSP_003443_0980

PSP_003364_0945

Image is ~1 km wide

PSP_002651_0930

Image is ~1 km wide
A New Vocabulary is Required (2)

“Lace” - Dense tangle of channels, no radial organization, fewer fans

Organized Lace

Channels are tortuous, some strands are more pronounced than others

Un-organized Lace

Channel segments are straighter, more uniform in size

“Lacertilian” (lizard-like) Surface Texture

Surface texture reminiscent of lizard skin, no deep channels - just grooves

Cryptic terrain morphology may evolve from lacertilian to araneiform as channels erode and deepen

Longest fan is 140 m
Active Processes: Bright Streaks and Dark Fans

These images were acquired with time separation of just 106 hours.

Fans show significant changes.

For more great images go to http://hirise.lpl.arizona.edu
New Findings from HiRISE

- We have just completed our campaign to image selected locations throughout spring in the southern hemisphere to watch the seasonal processes in action
  - New products: high resolution color images, anaglyphs

- Surface morphology is so un-earthly that a new taxonomy is required to describe the features we see

- Earlier hypotheses about sub-ice sublimation are substantiated by HiRISE images

- We now have data with resolution that is good enough to study the erosion of the surface by gas evaporating from dry ice - a new geological theme

- Possible now to make measurements of channels, dust volume, fans, tortuosity, etc. to derive erosion rates, study the role of underlying structure vs. solar energy

- Comparison of terrains shows how one may evolve into another as CO₂ gas erodes the surface beneath the seasonal ice

- This is just the beginning!