AGU Press Conference

Spring at the South Pole of Mars

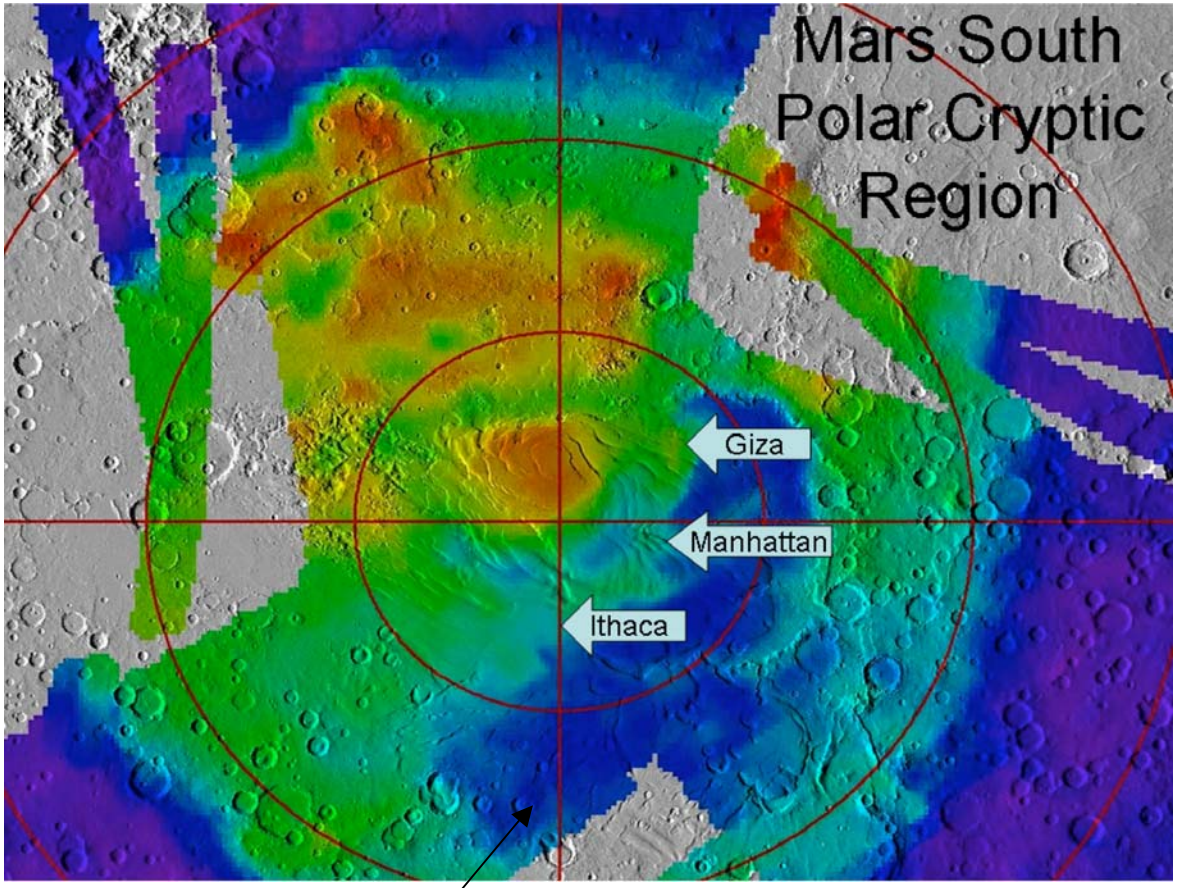
C. J. Hansen, A. McEwen
and the HiRISE Team

December 2007

PSP_003179_0945

Setting the Stage…

- Mars, like earth, experiences seasons
- In the winter a seasonal polar cap of carbon dioxide (CO_2) ice covers latitudes up to ~55^0
- MRO has just completed a campaign to observe the spring sublimation (evaporation) of the CO_2 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*



Map is courtesy of Mars Global Surveyor Thermal Emission Spectrometer and Mars Orbiter Laser Altimeter

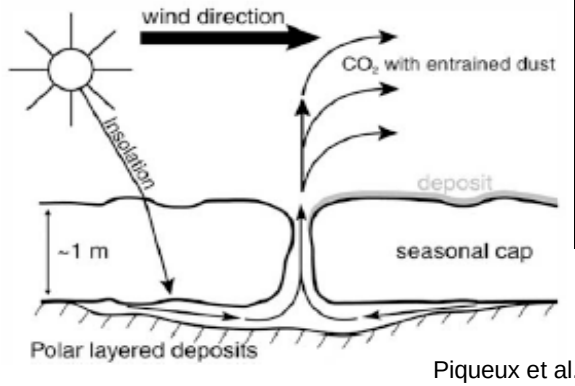
This blue region is the cryptic terrain

Hypothesis: The CO_2 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

False Color PSP_002942_0935



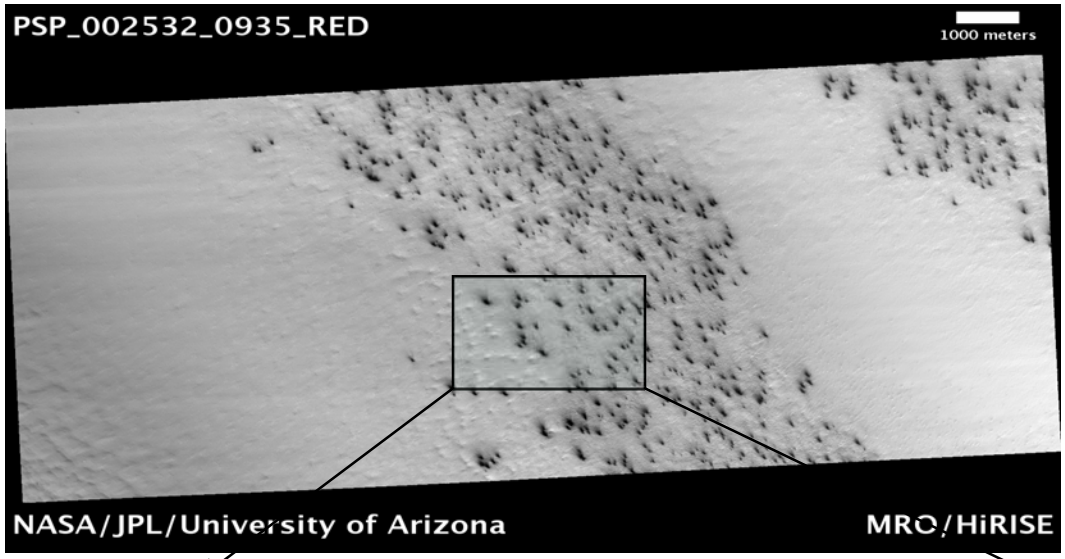
Piqueux et al., JGR 2003

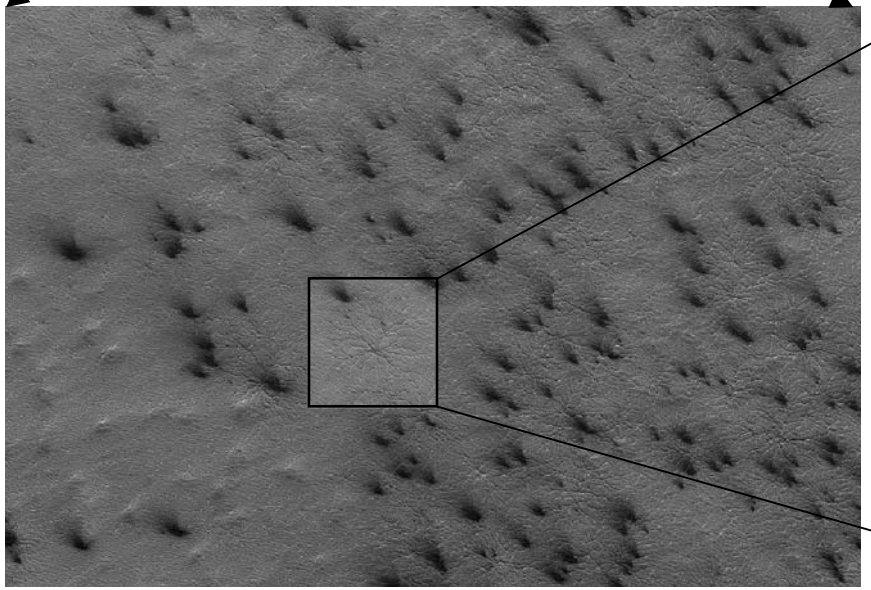
The surface beneath the seasonal ice is water-ice cemented dirt covered by a ~ 5 cm layer of dust (silt-sized particles)

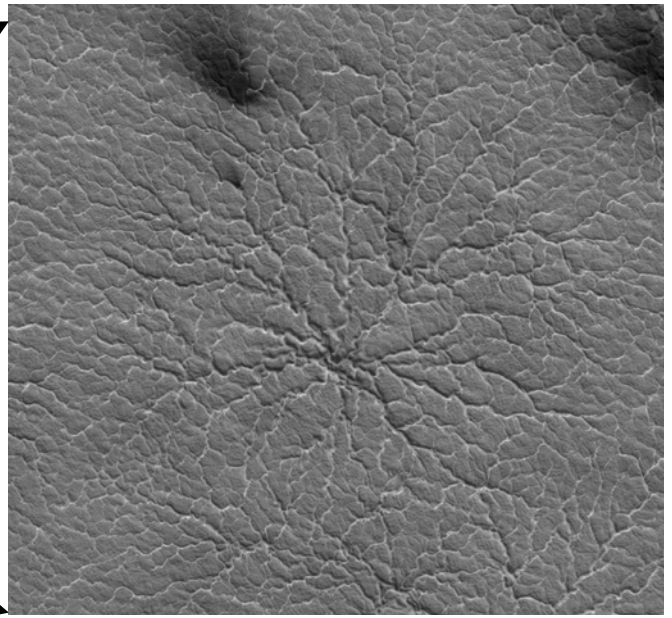
Anatomy of a “Spider”

- 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







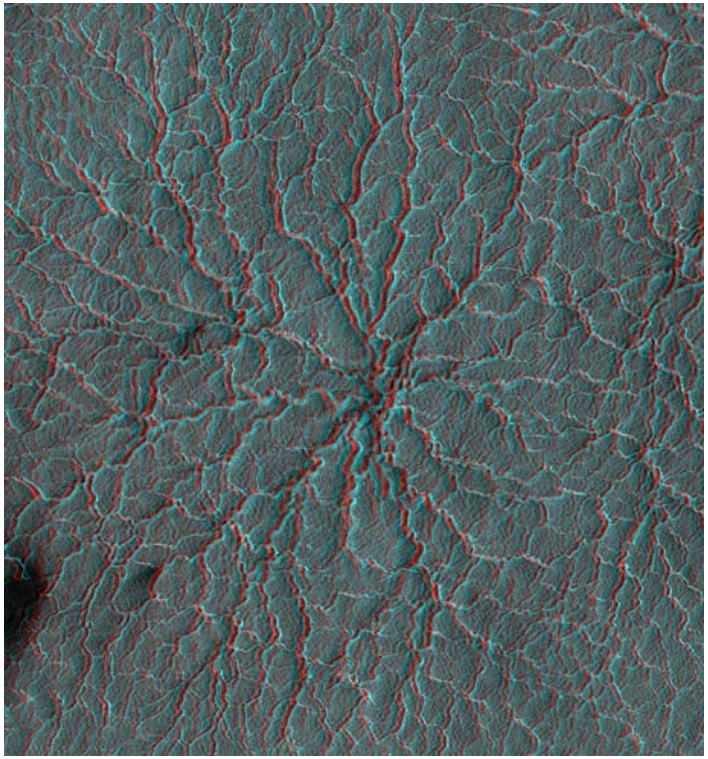
Spider is ~0.55 km in diameter

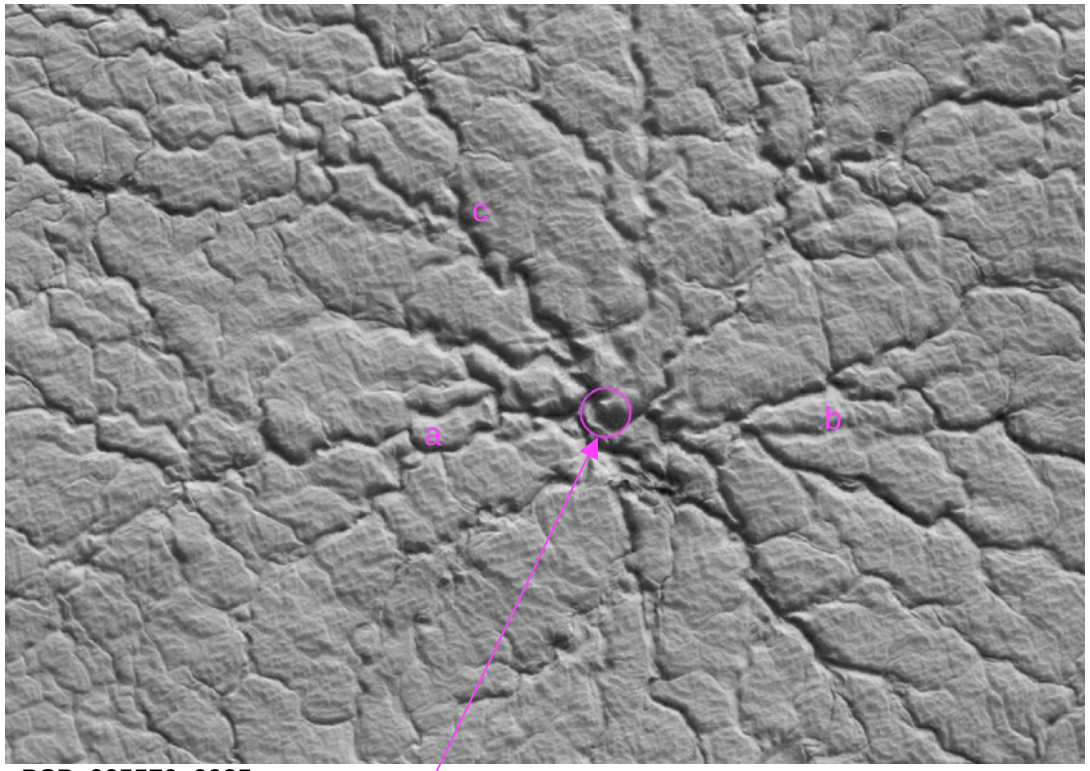
Spider Size

Spider dimensions

- from shadow measurements after seasonal ice was gone
- incidence angle = 74.88^0

Overall Spider size:
~550 m diameter





PSP_005579_0935

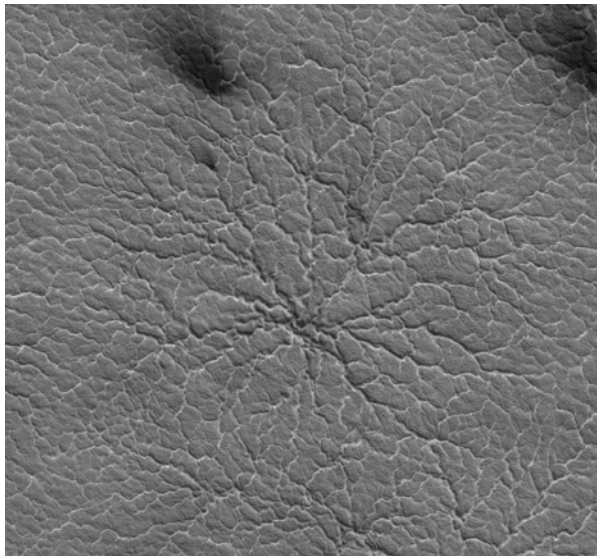
Center Depth: 1.8 m

Stereo pair from
PSP_002532_0935 and
PSP_002533_0935

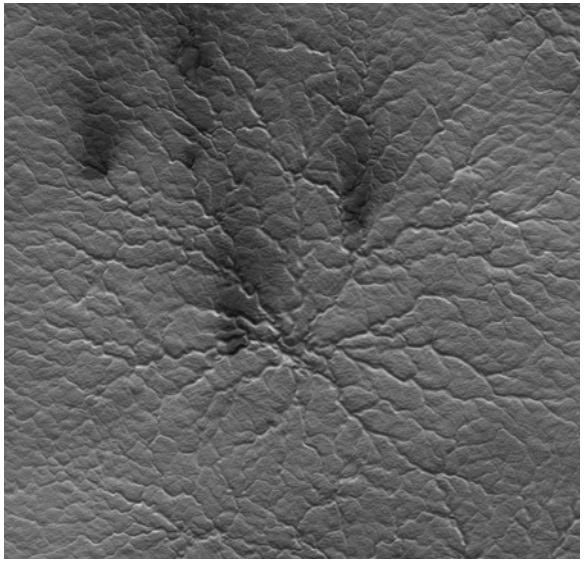
Channel Widths, Depths

a 5 m wide, 1 m deep
b 3.4 m wide, 0.7 m deep
c 5 m wide, 0.6 m deep

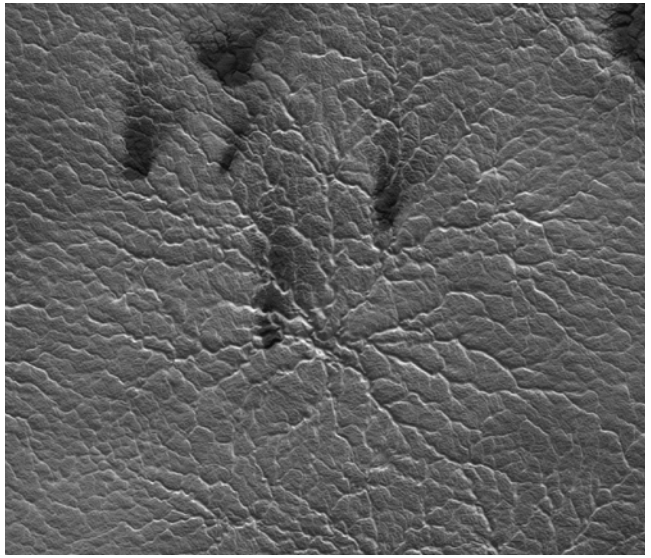
Spider Time Lapse Series



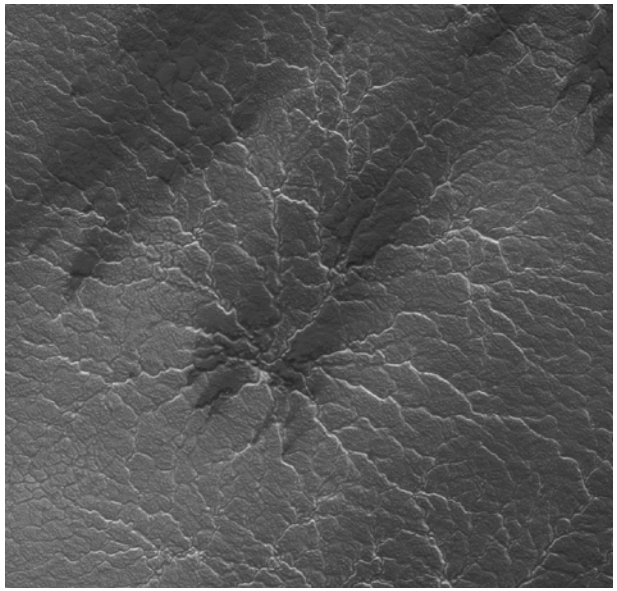
PSP_002532_0935 Ls = 181.1



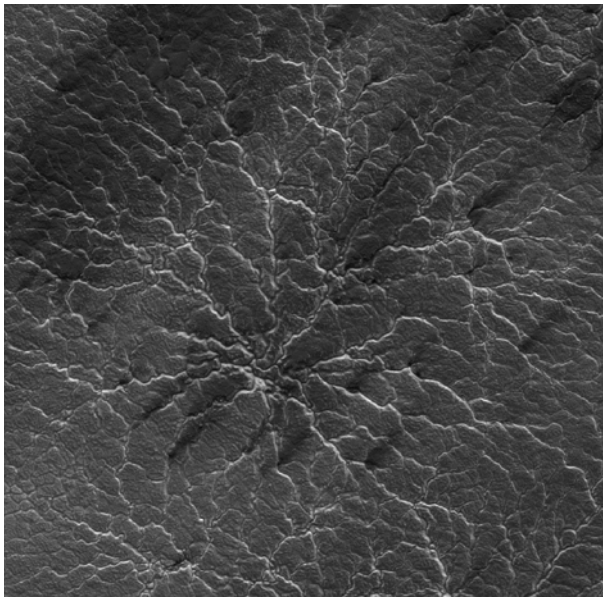
PSP_002850_0935 Ls = 195.4



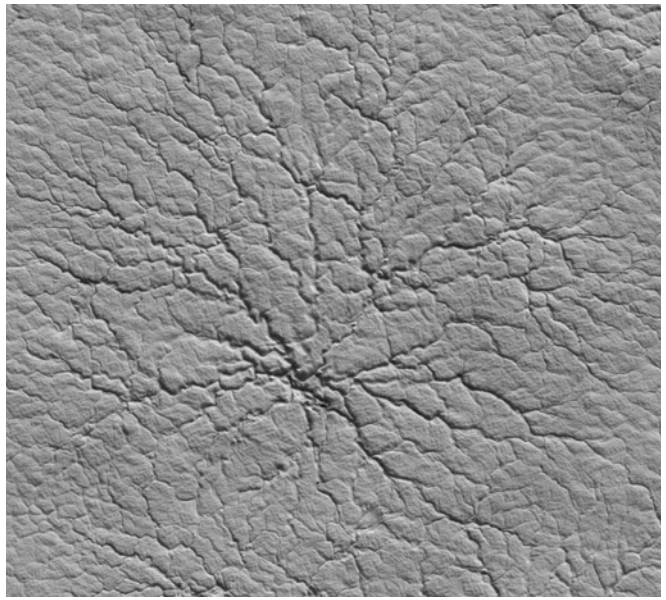
PSP_002942_0935 Ls = 199.6



PSP_003496_0935 Ls = 226.0



PSP_003641_0935 Ls = 233.1



PSP_005579_0935 Ls = 325.4

A New Vocabulary is Required (1)

“Araneiform” (spider-like)

Isolated araneiform topography

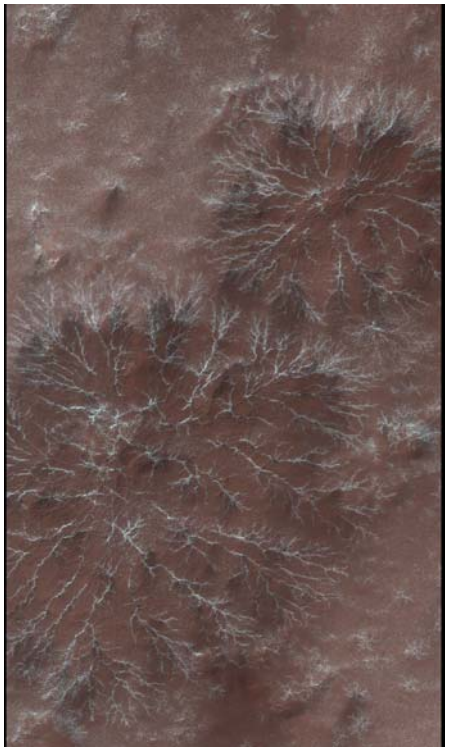
Radially organized channels, not connected to other spiders

PSP_003087_0930

Spider is 190 x 210 m

Circular araneiform topography

Roughly circular expanse, channels do not connect to neighboring spiders



PSP_003443_0980

Image is ~1 km wide

Etched araneiform topography

Very shallow channels, wider than they are deep

PSP_003364_0945

Image is ~1 km wide

Connected araneiform topography

Radially organized channels branch dendritically, connect to other spiders’ channels

PSP_002651_0930

Image is ~1 km wide

A New Vocabulary is Required (2)

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

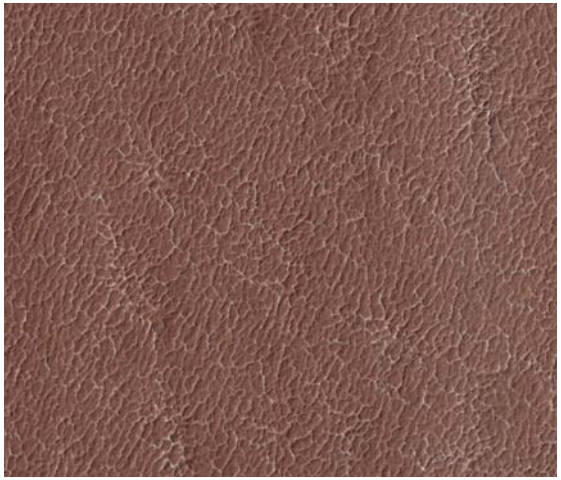
Organized Lace

Channels are tortuous, some strands are more pronounced than others

PSP_002651_0930

Un-organized Lace

Channel segments are straighter, more uniform in size



PSP_002532_0930

Channels are ~1 m wide

"Lacertilian" (lizard-like) Surface Texture

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

PSP_003730_0945

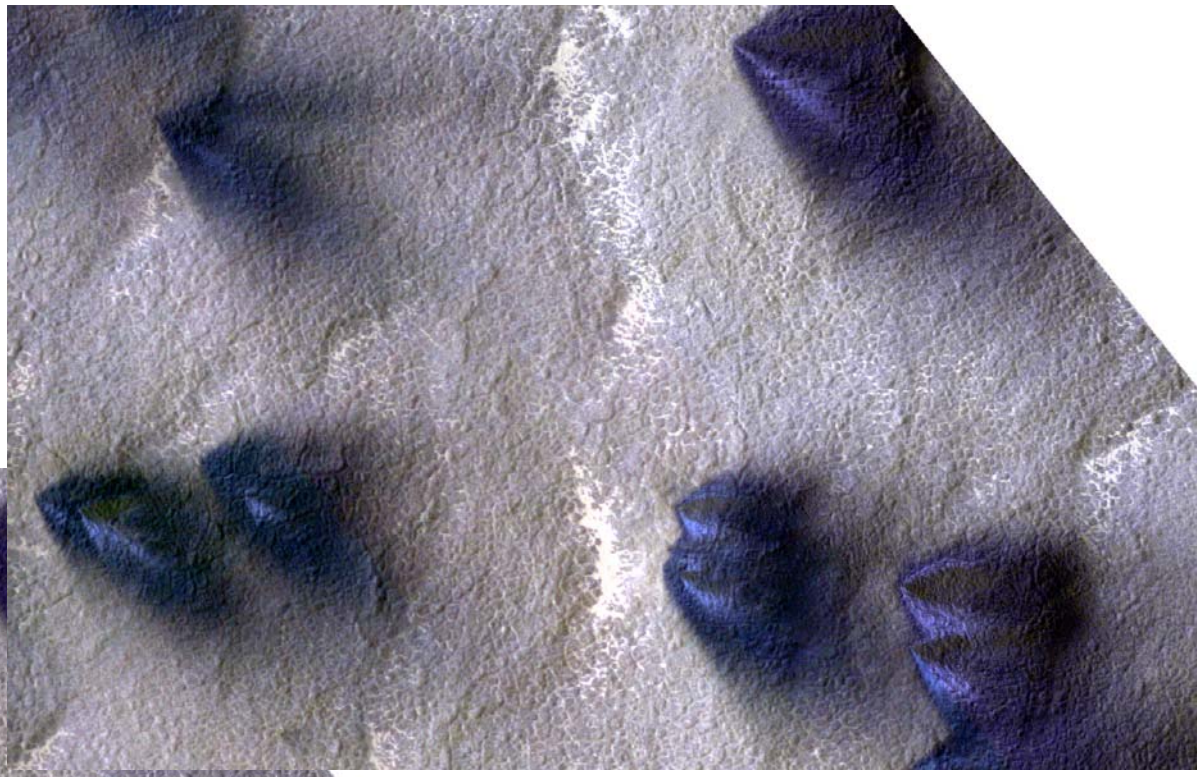
Longest fan is 140 m

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

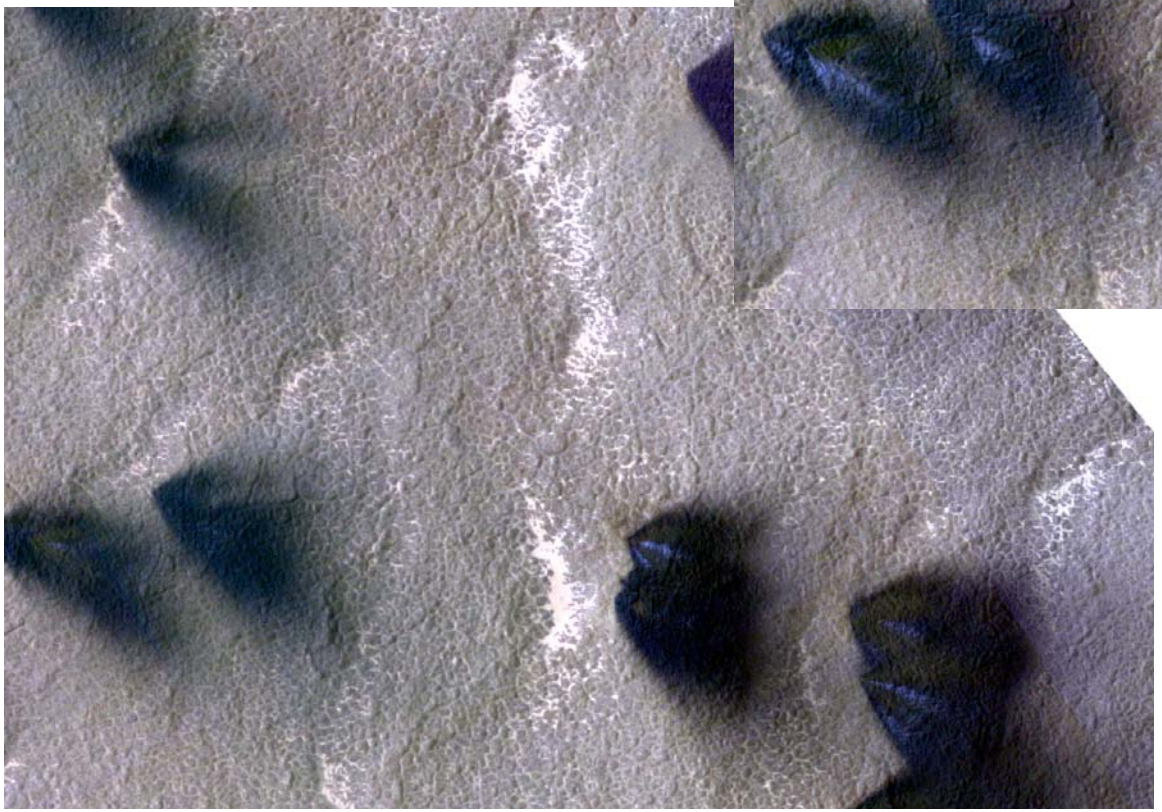
Active Processes: Bright Streaks and Dark Fans

These images were acquired with time separation of just 106 hours

Fans show significant changes



PSP_002675_0945



PSP_002622_0945

For more great images go to
http://hirise.lpl.arizona.edu

HiRISE

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 CO_2 gas erodes the surface beneath the seasonal ice
- This is just the beginning!