

# AGU Press Conference

## Spring at the South Pole of Mars

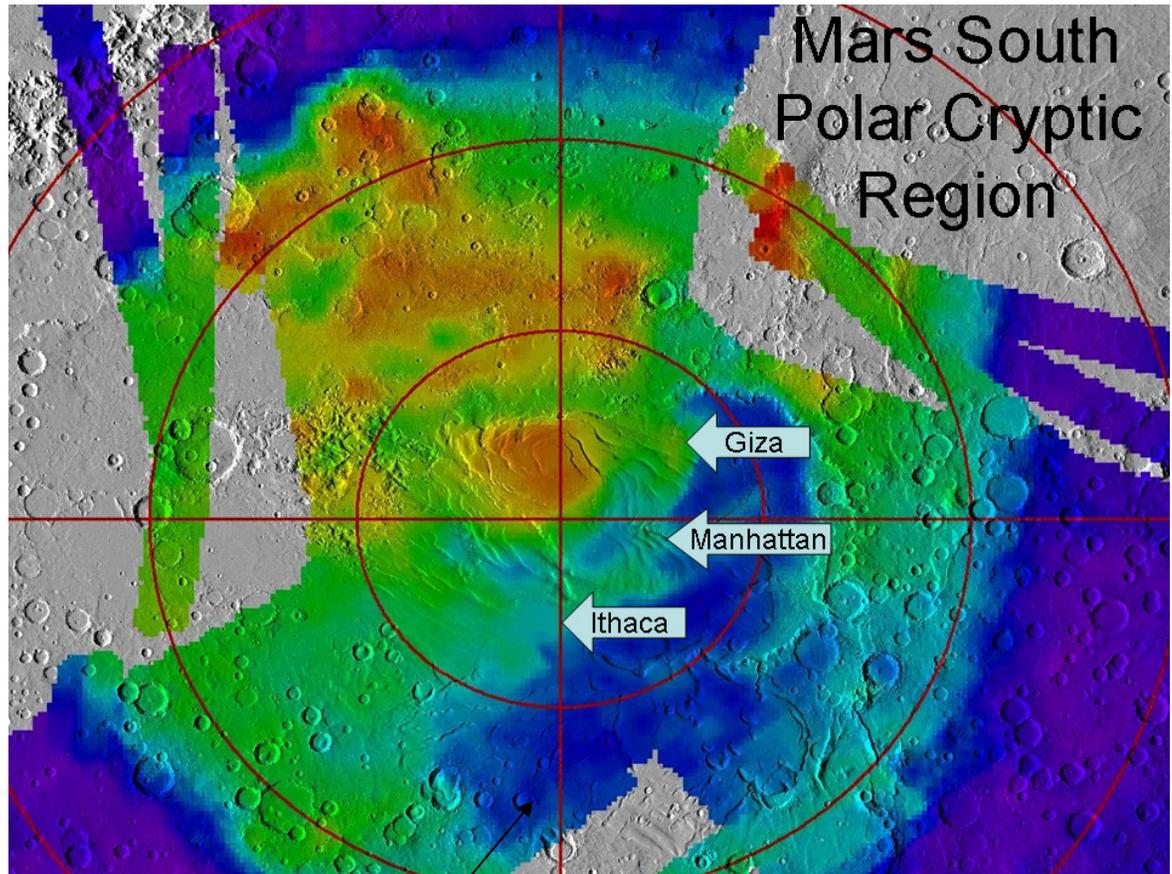


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and the HiRISE Team  
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# Setting the Stage...

- Mars, like earth, experiences seasons
- In the winter a **seasonal polar cap of carbon dioxide** (CO<sub>2</sub>) ice covers latitudes up to ~55°
- MRO has just completed a campaign to observe the spring sublimation (evaporation) of the CO<sub>2</sub> 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<sub>2</sub> 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)

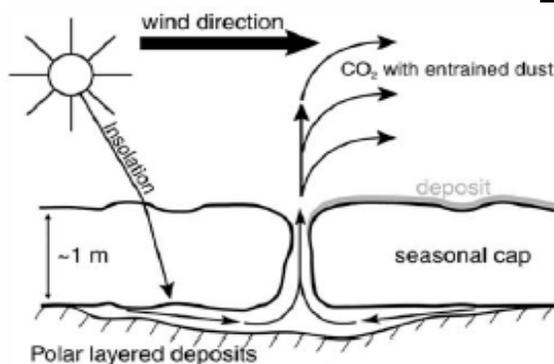
# Four Components of Surface, Apparent in Color

- 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: CO<sub>2</sub> gas re-condensed on top of the ice as fine-grained bright frost



False Color

PSP\_002942\_0935



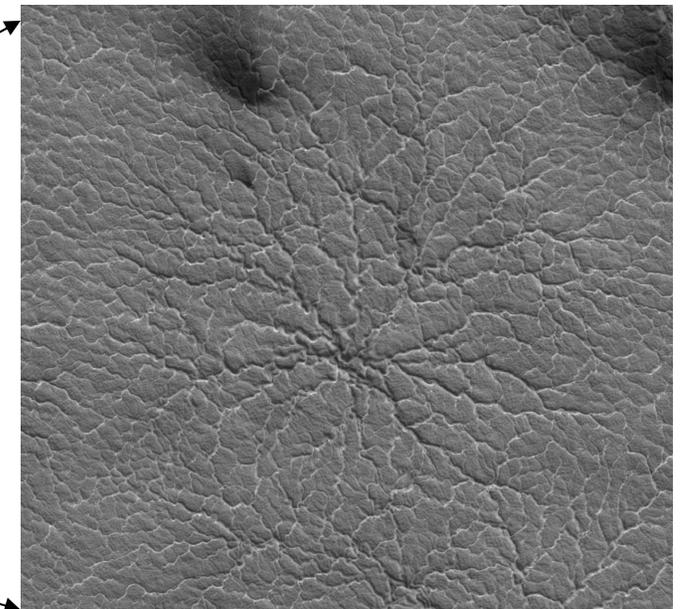
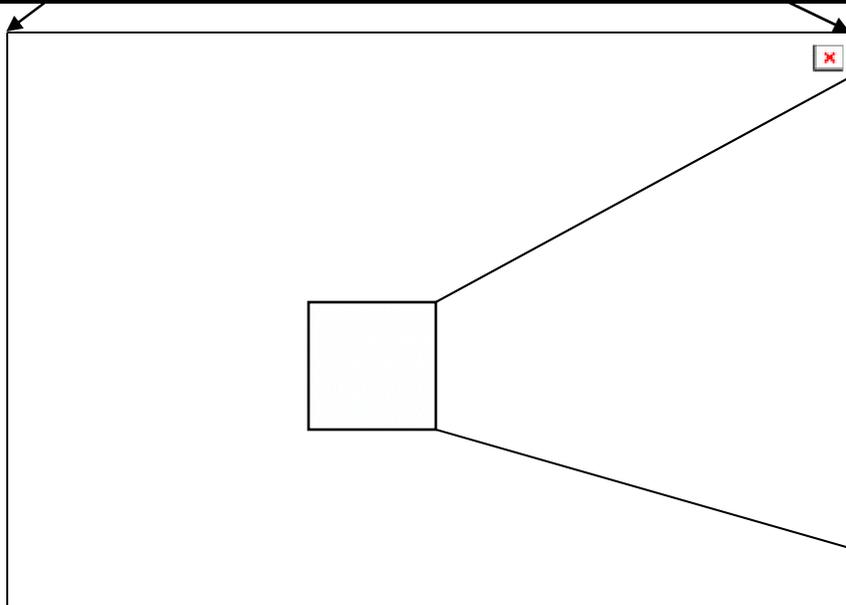
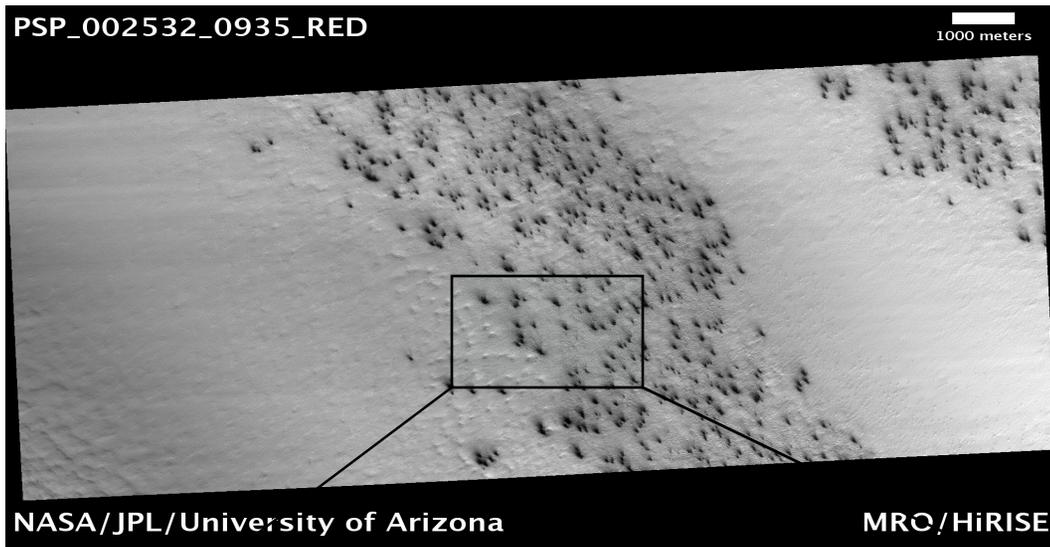
Piqueux et al., JGR 2003

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

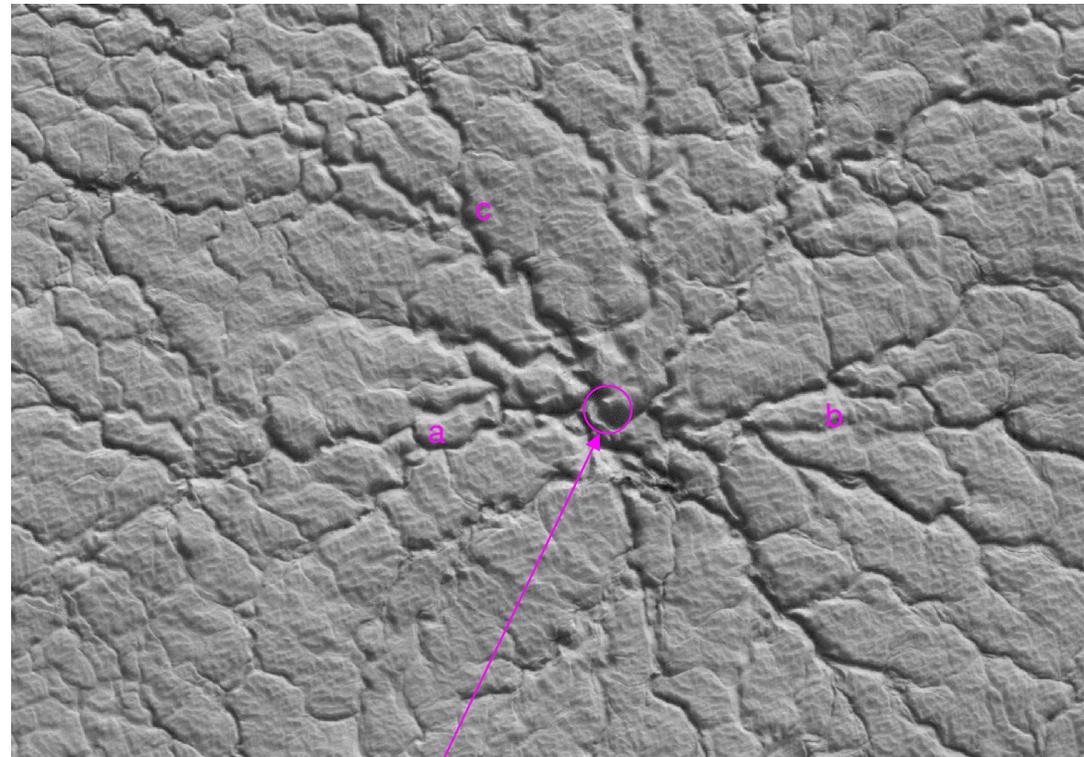
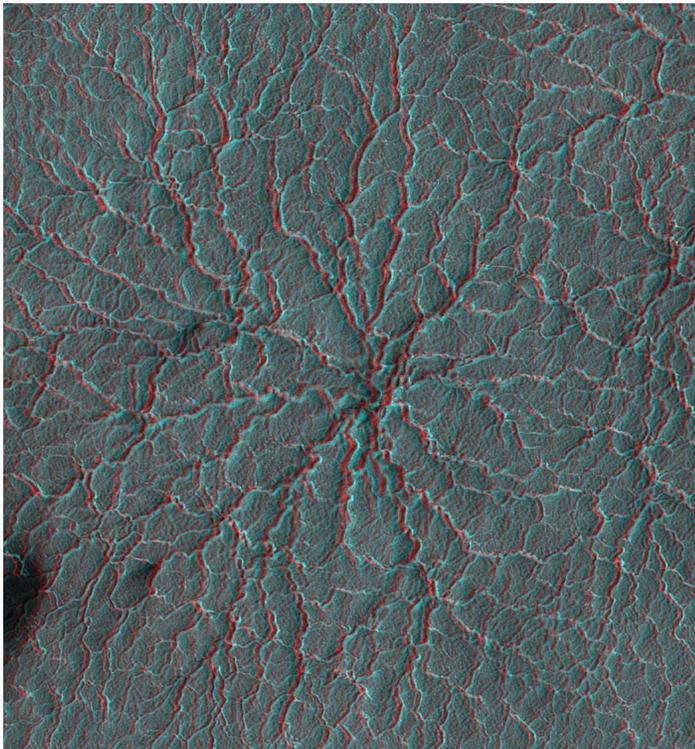


# Spider Size

## Spider dimensions

- from shadow measurements after seasonal ice was gone
- incidence angle =  $74.88^\circ$

Overall Spider size:  
~550 m diameter



PSP\_005579\_0935

Center Depth: 1.8 m

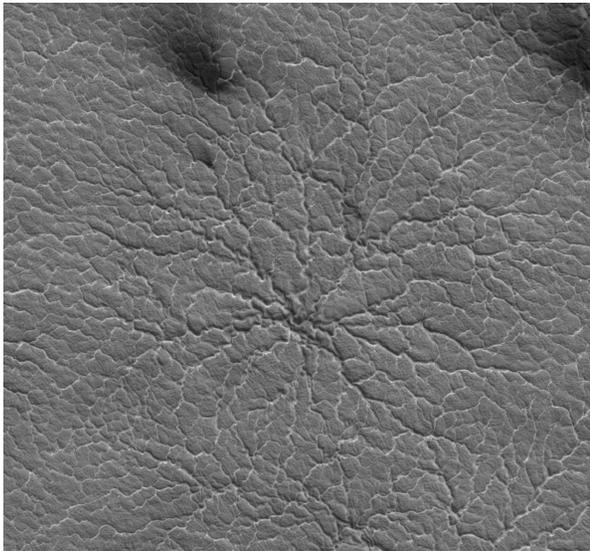
## Channel Widths, Depths

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

Stereo pair from  
PSP\_002532\_0935 and  
PSP\_002533\_0935

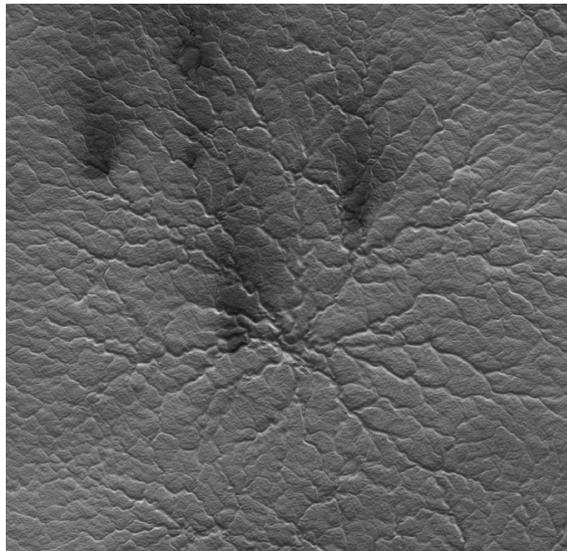


# Spider Time Lapse Series



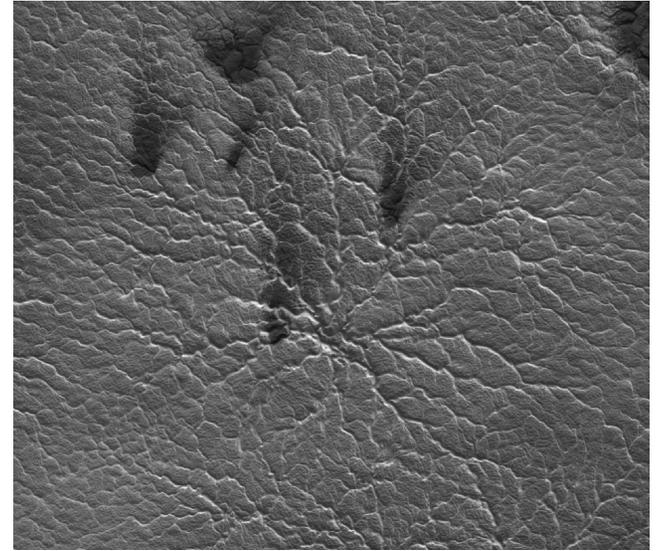
PSP\_002532\_0935

Ls = 181.1



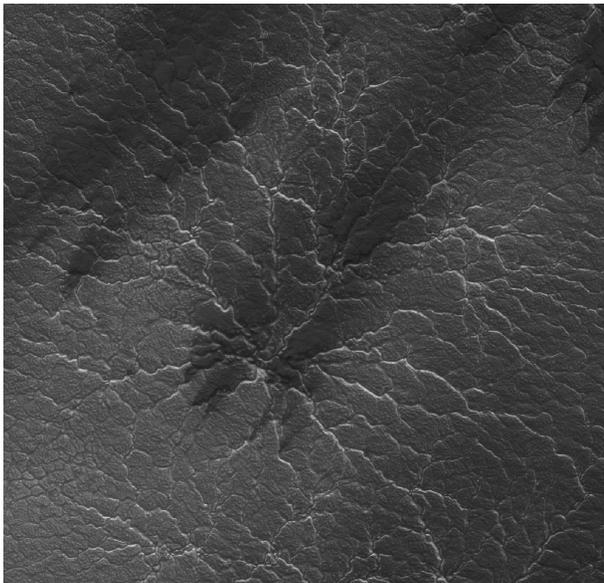
PSP\_002850\_0935

Ls = 195.4



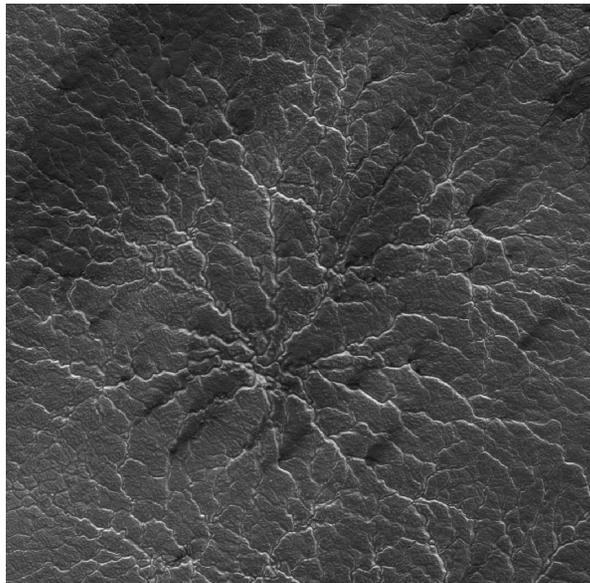
PSP\_002942\_0935

Ls = 199.6



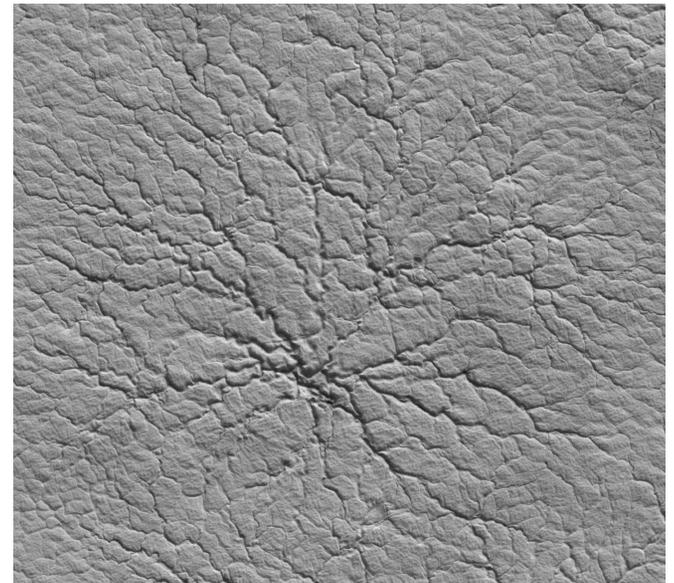
PSP\_003496\_0935

Ls = 226.0



PSP\_003641\_0935

Ls = 233.1



PSP\_005579\_0935

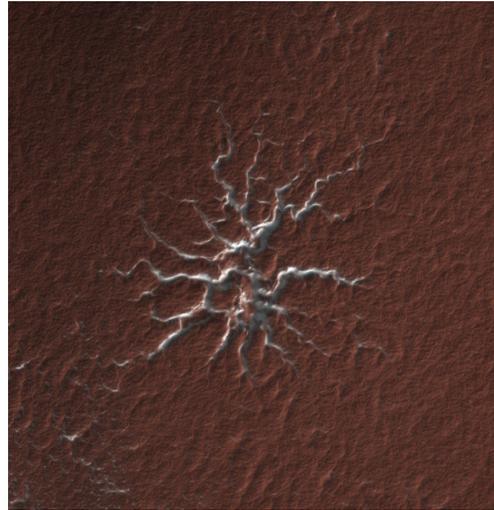
Ls = 325.4

# A New Vocabulary is Required (1)

“Araneiform” (spider-like)

Isolated  
araneiform  
topography

*Radially organized  
channels, not  
connected to other  
spiders*

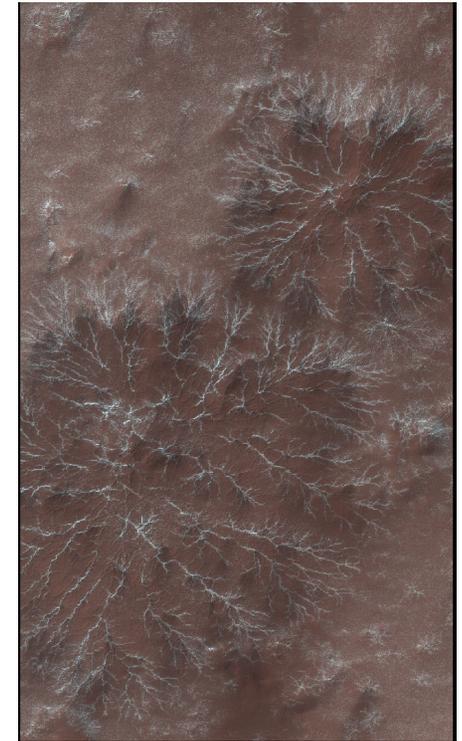


PSP\_003087\_0930

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*

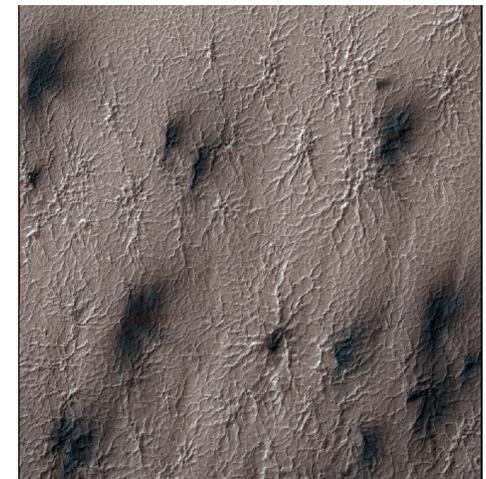


PSP\_003364\_0945

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*

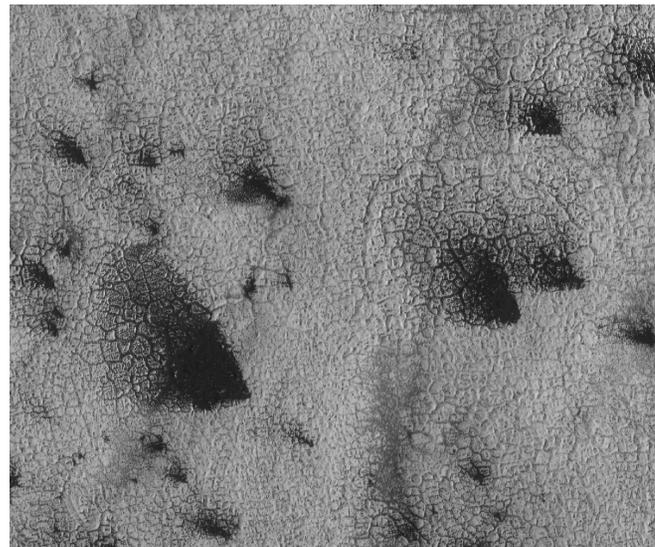


PSP\_002532\_0930

Channels are ~1 m wide

“Lacertilian” (lizard-like)  
Surface Texture

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



PSP\_003730\_0945

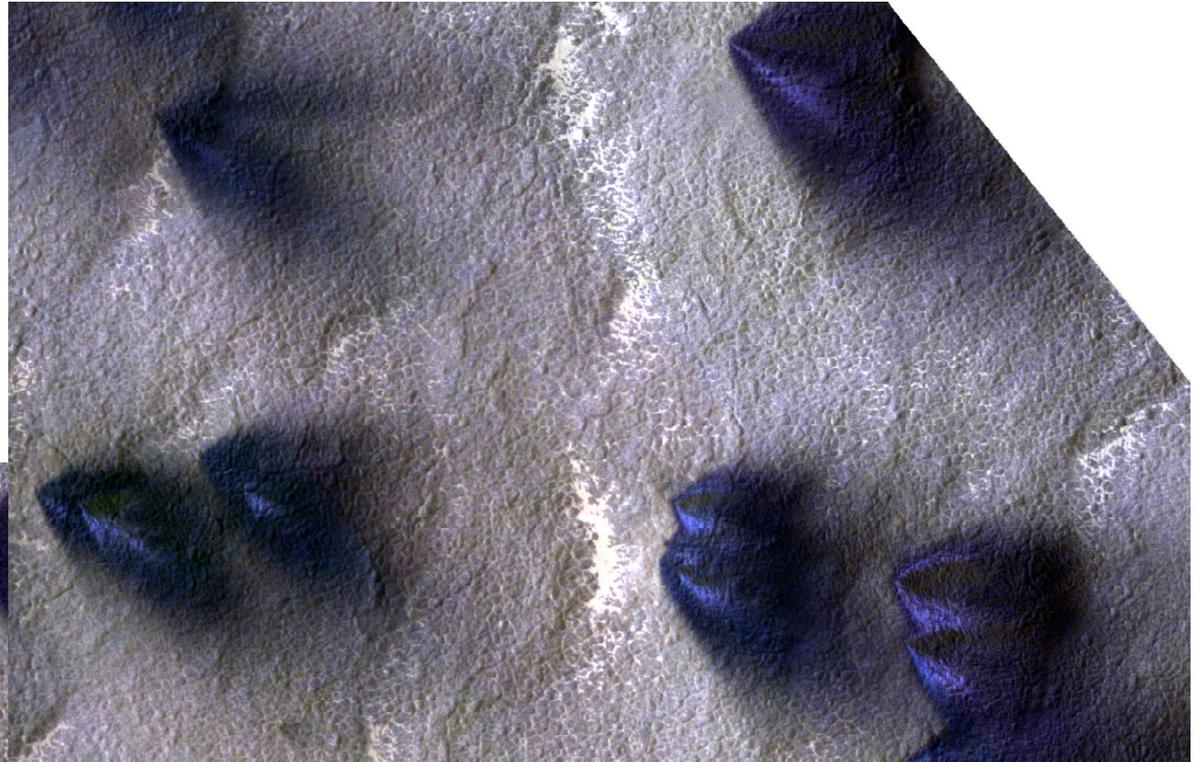
Longest fan is 140 m

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



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

**HIRISE**

PSP\_002622\_0945



## 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<sub>2</sub> gas erodes the surface beneath the seasonal ice
- This is just the beginning!