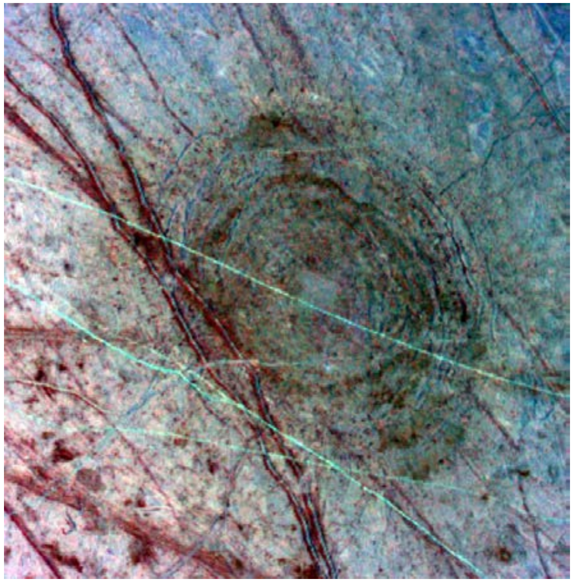
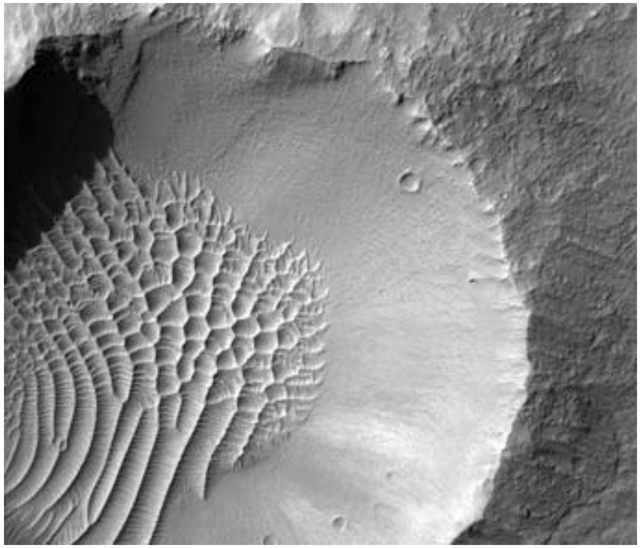
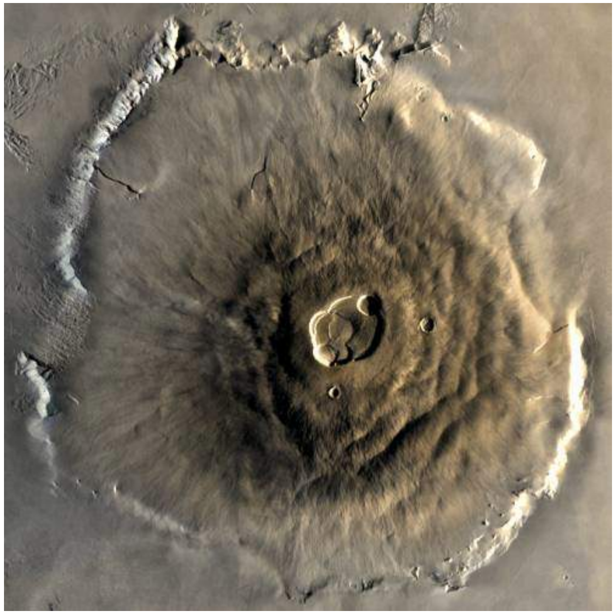
Planetary Surface Processes

Cratering
Gravity
Tectonics
Volcanism
Winds
Fluvial
Glacial
Chemical
weathering

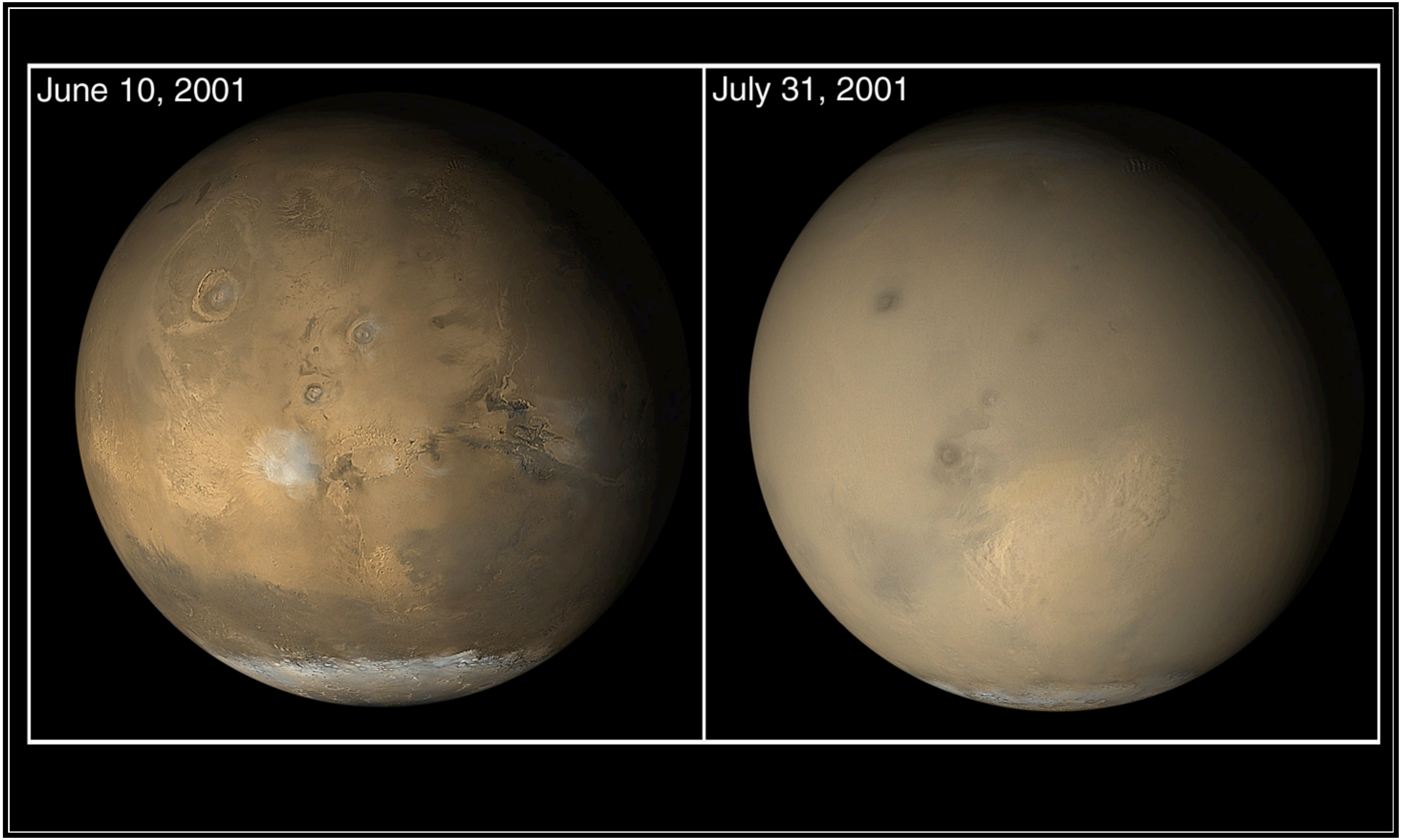






Aeolian Processes

Mars: Global dust storms

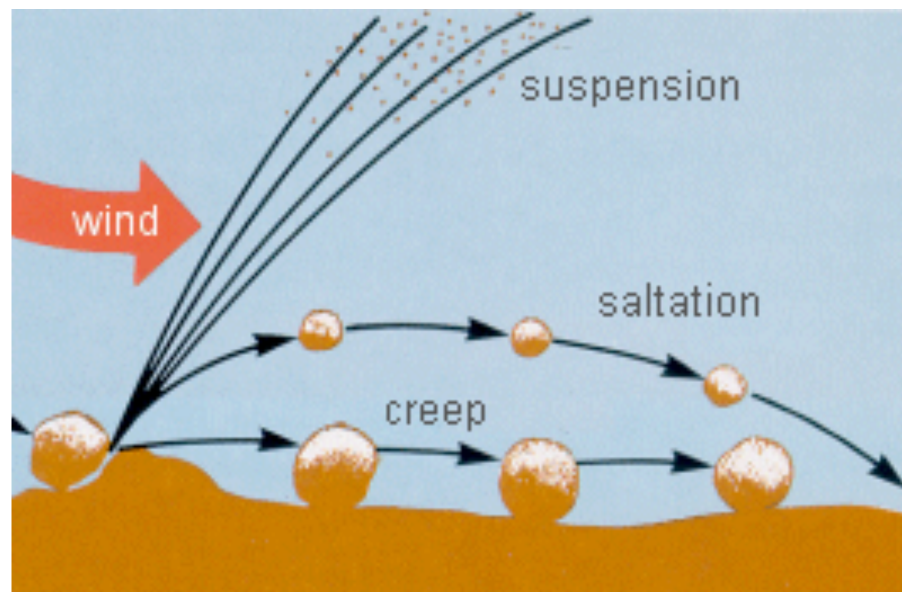


Mars: dust storm viewed from the surface

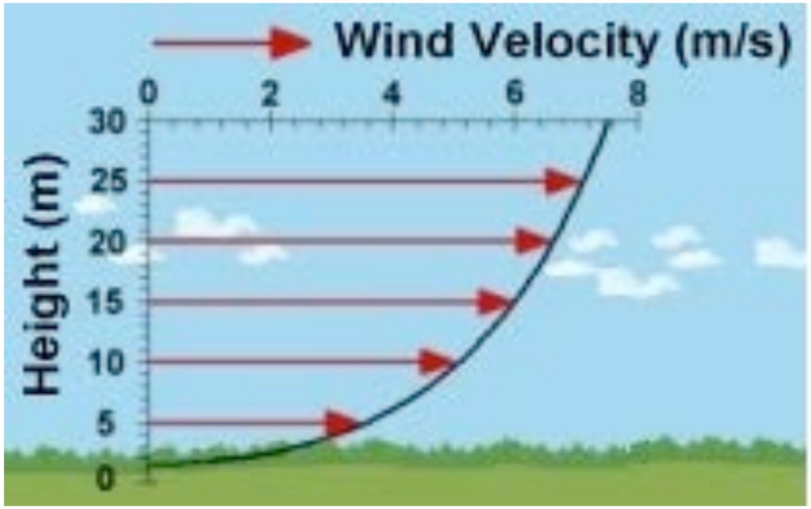
Aeolian Processes: Size-dependent

Size	Wentworth Size Class	Sediment /Rock Name
256 mm	Boulders	Sediment: GRAVEL Rock RUDITES: (conglomerates, breccias)
64 mm	Cobbles	
4 mm	Pebbles	
2 mm	Granules	
1 mm	Very Coarse Sand	Sediment: SAND Rocks: SANDSTONES (arenites, wackes)
1/2 mm	Coarse Sand	
1/4 mm	Medium Sand	
1/8 mm	Fine Sand	
1/16 mm	Very Fine Sand	
1/256 mm	Silt	Sediment: MUD Rocks: LUTITES (mudrocks)
	Clay	

- Dust grains via suspension
- Gravel via creep
- Sand grains via *saltation*



Threshold wind speeds



- Wind varies with height:

$$u \approx 2.5\, u_* \ln(z/z_0)$$

u_* wind friction speed, z_0 aerodynamic roughness (~mm for sand)

- Threshold speed for saltation:

$$u_{*t} \approx \{.0123(\rho_p g d/\rho + 3\text{x}10^{-4}/[\rho d])\}^{0.5}$$

ρ_p particle density, d diameter, ρ atm. density

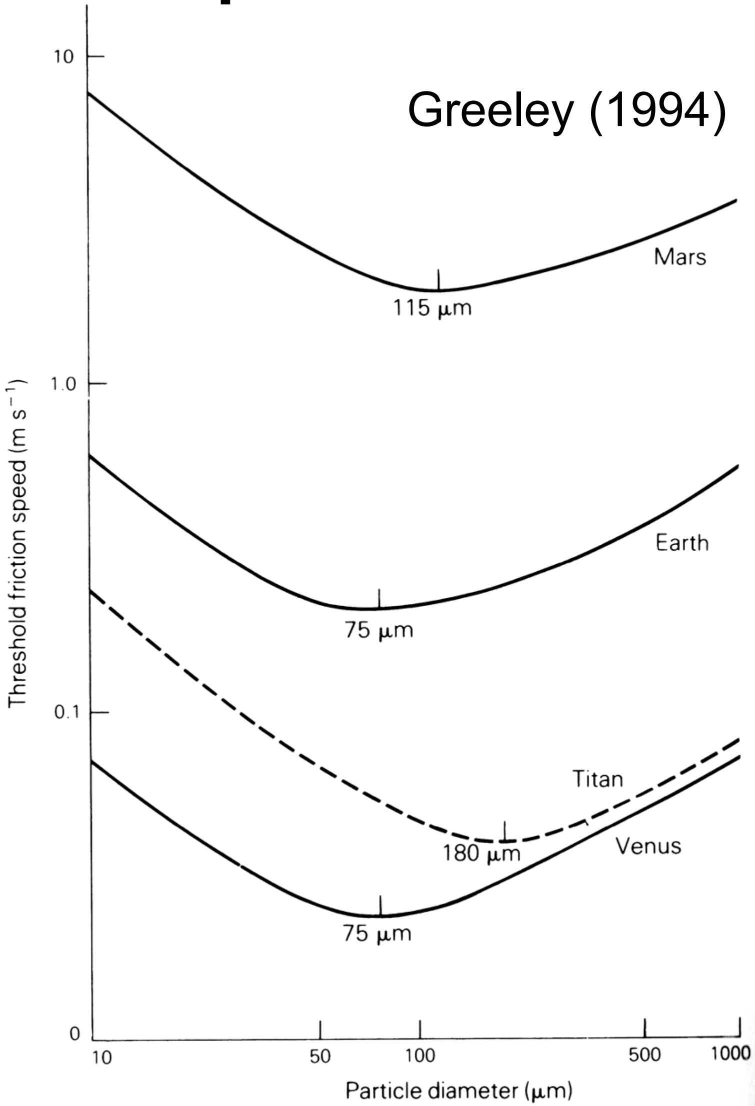
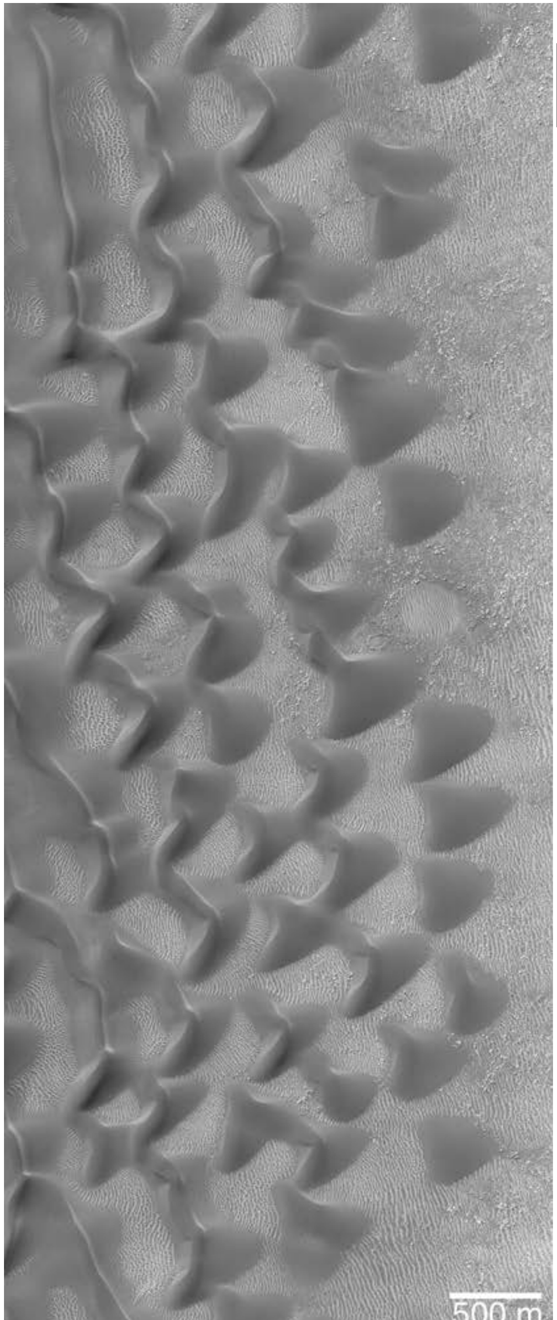
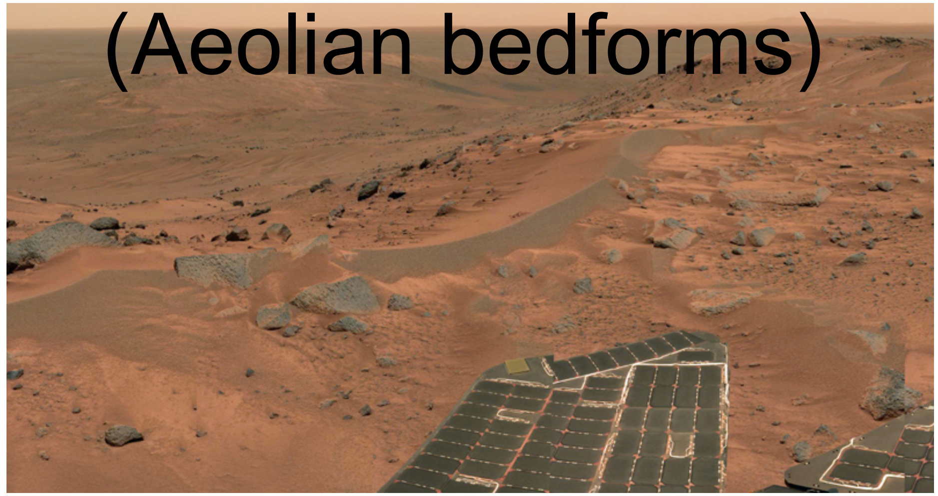


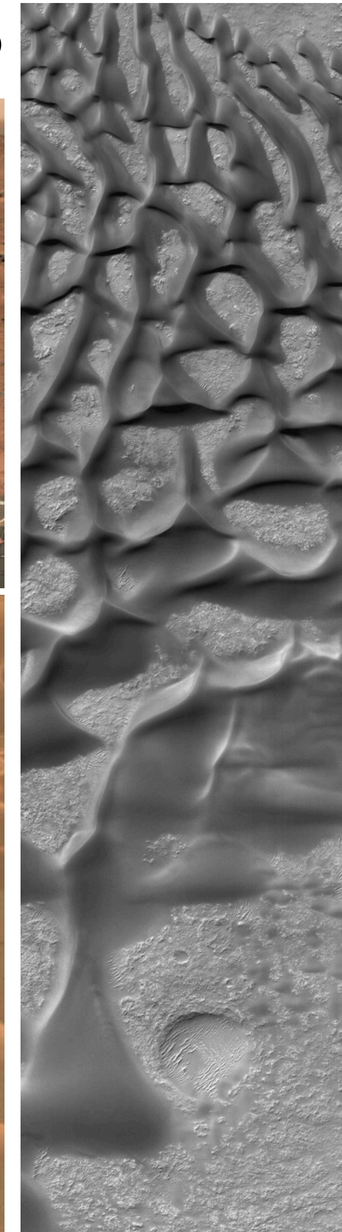
Figure 3.36 Diagram showing the minimum threshold friction speed (a function of wind speed) required to move particles of different sizes on Mars, Earth, Titan and Venus; note that as the atmospheric density decreases from Venus to Mars, minimum winds needed to set particles into motion increases.

Dunes and ripples

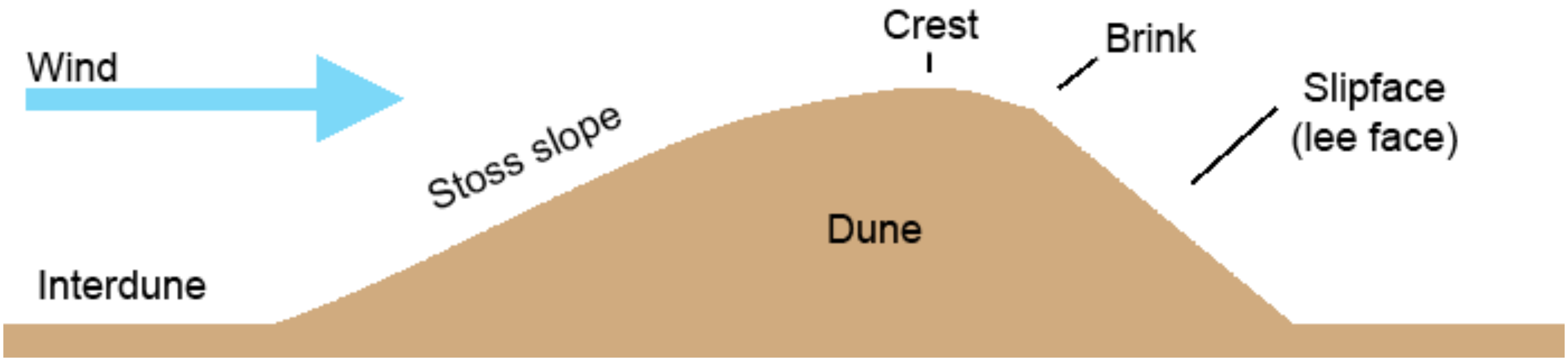
(Aeolian bedforms)

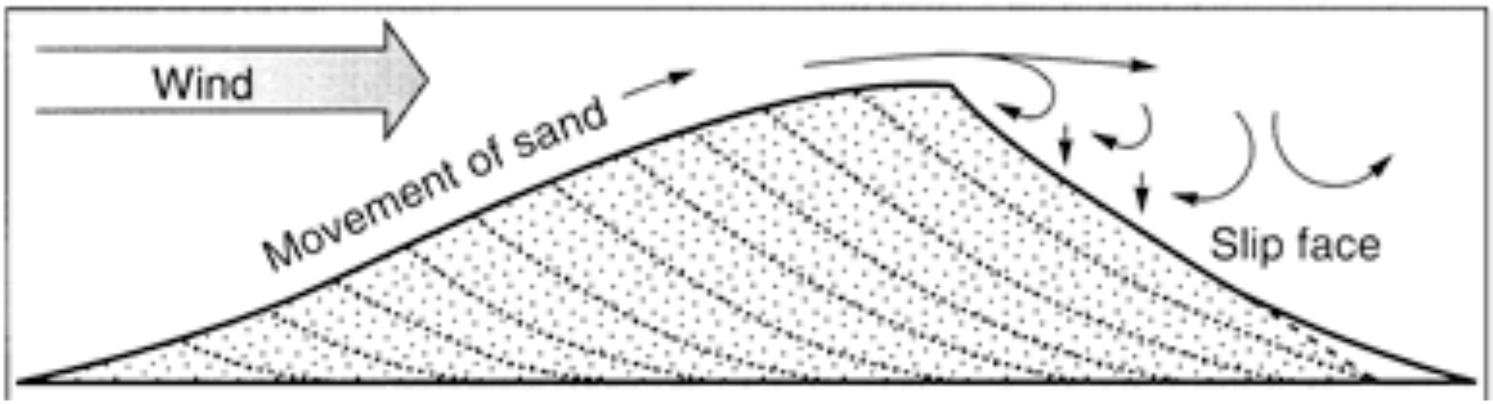




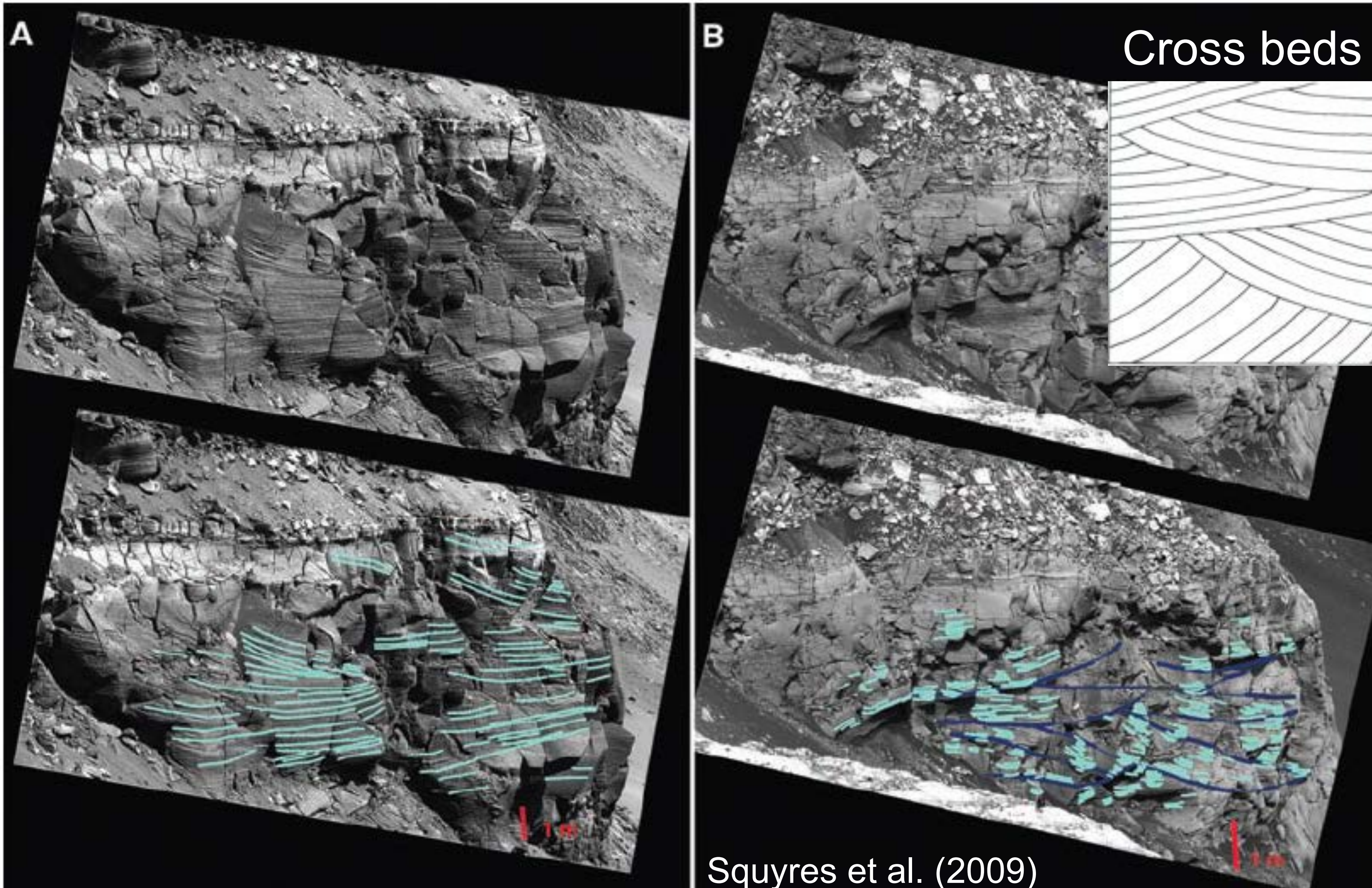


Anatomy of a dune

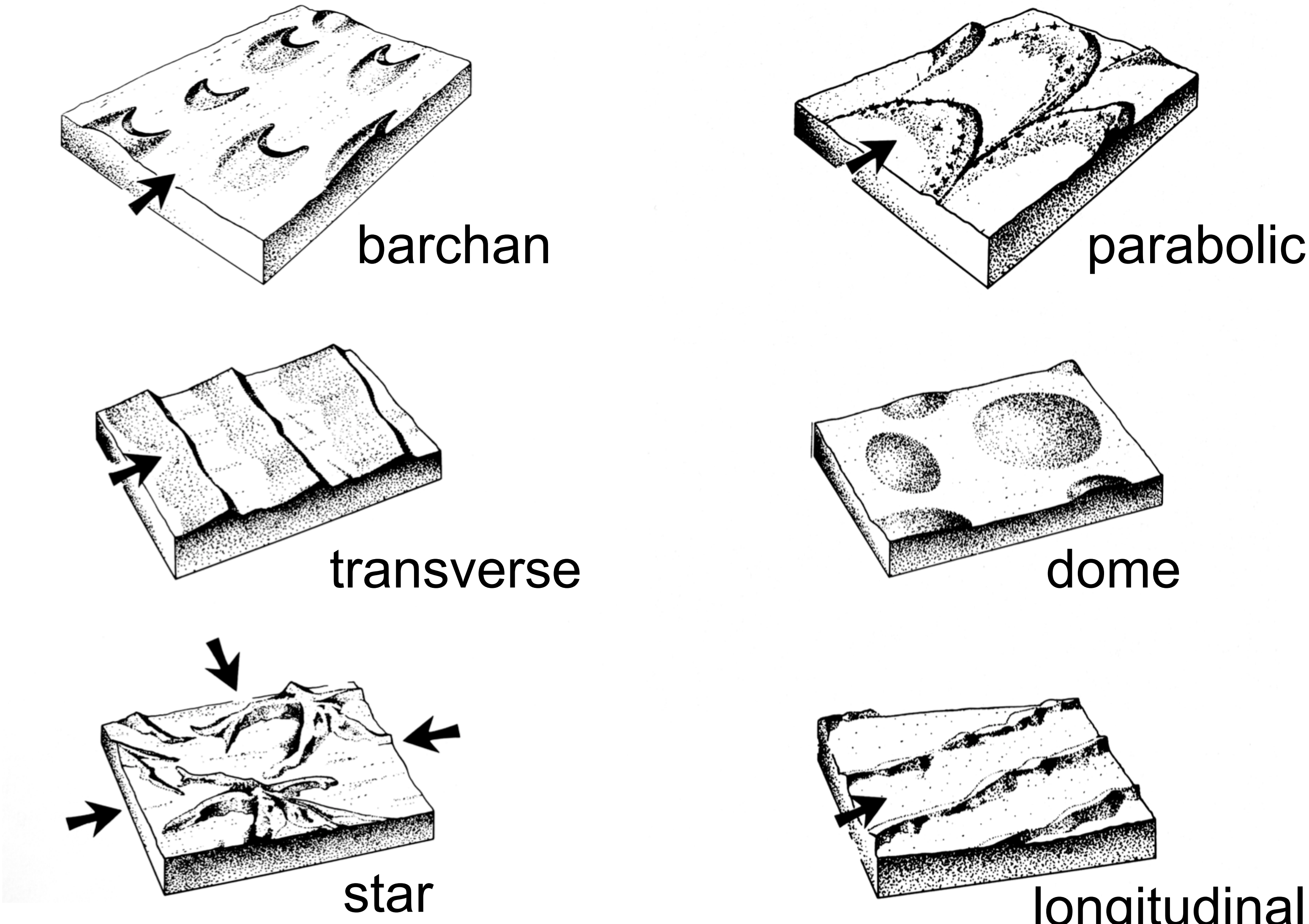




Ancient dunes on Mars

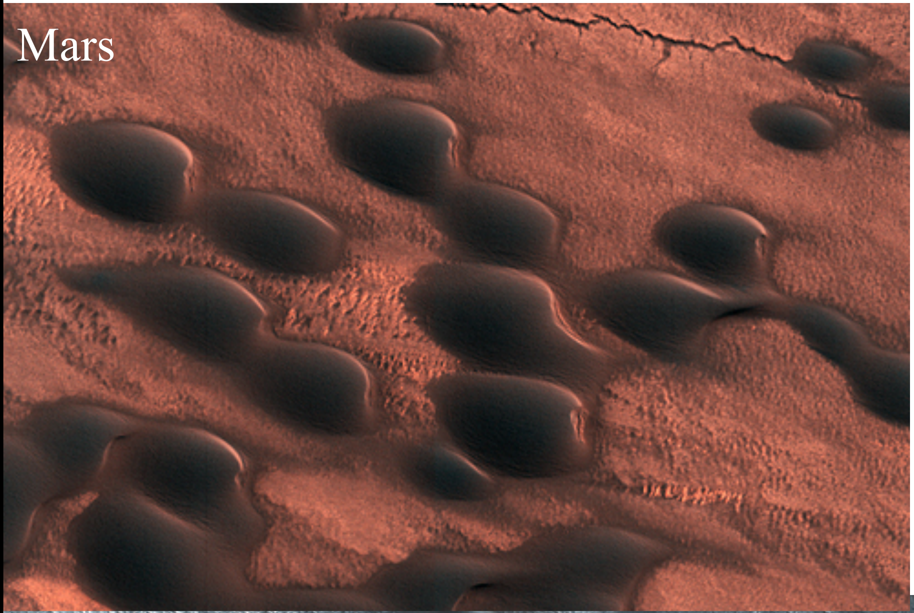


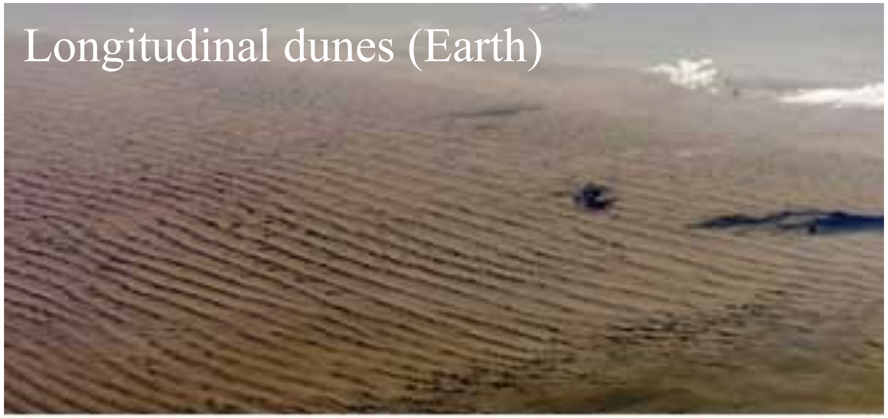
Dunes take many forms

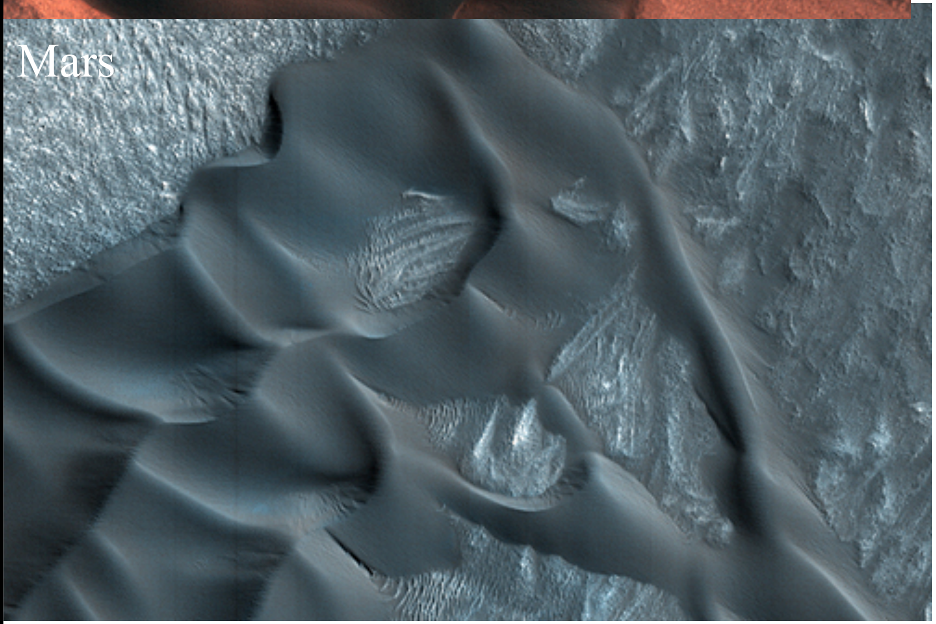


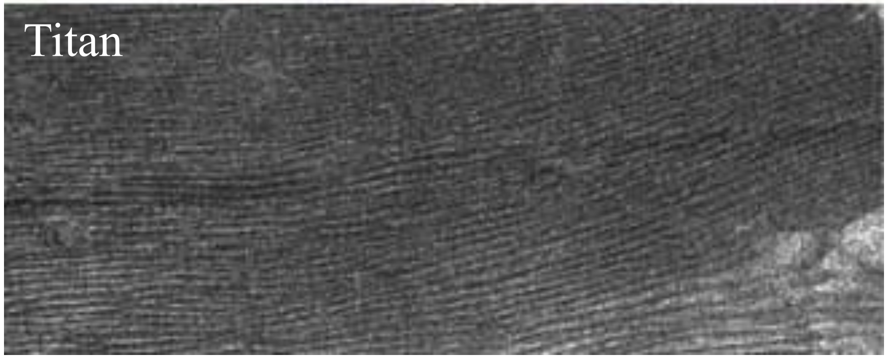
Greeley (1994)

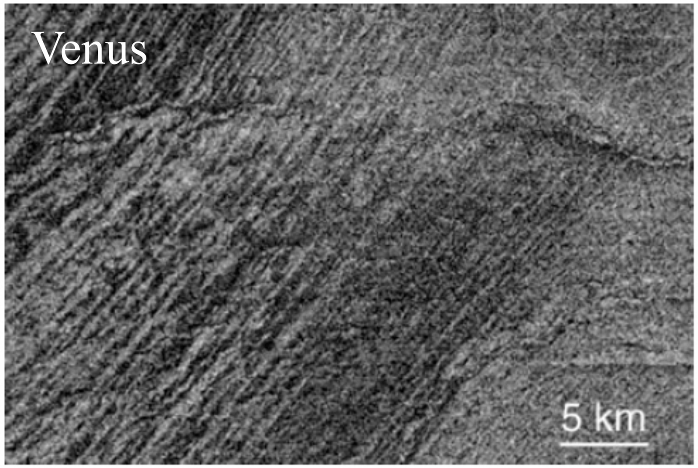
Planetary dunes





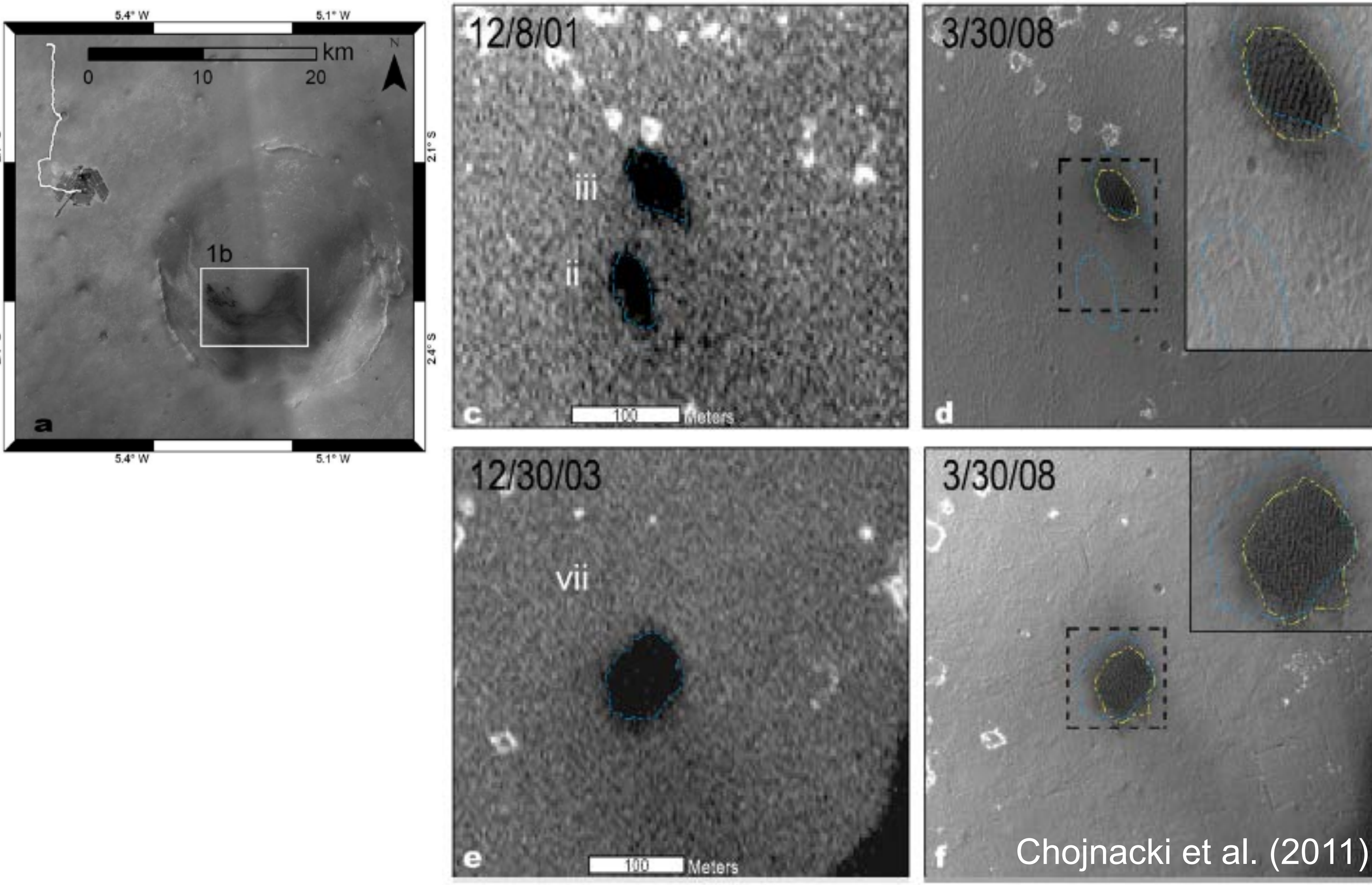






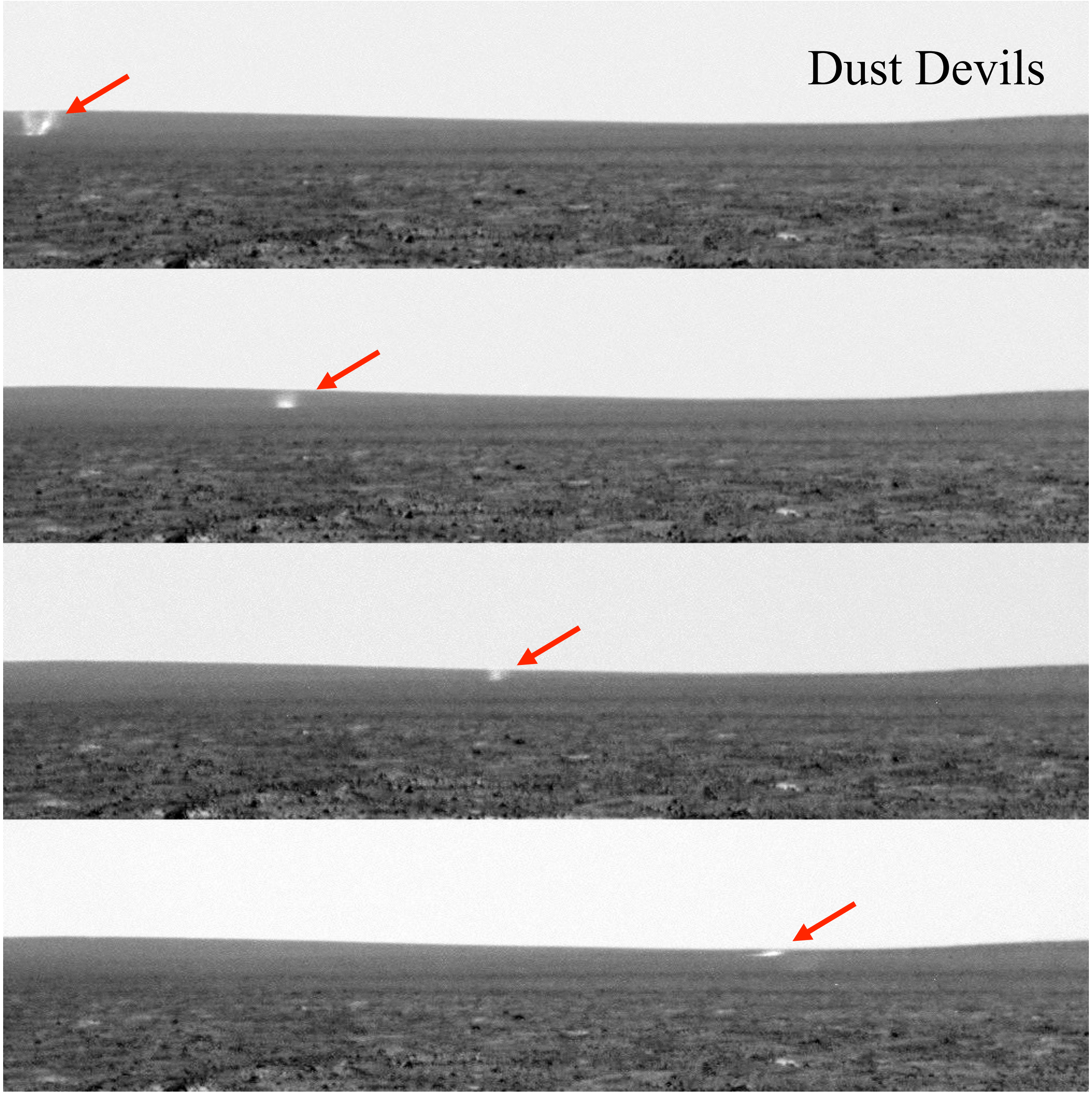
Sand movement on Mars

Sand movement at Endeavour crater



Mars Dust Devils

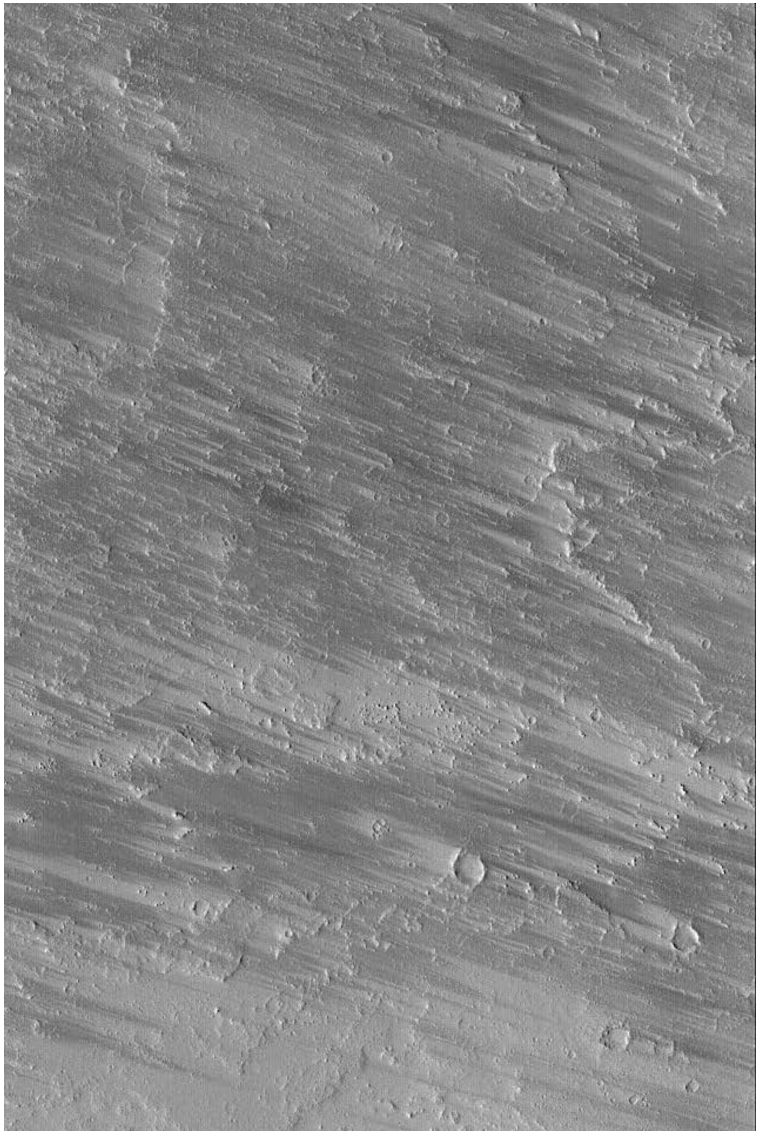
Dust Devils

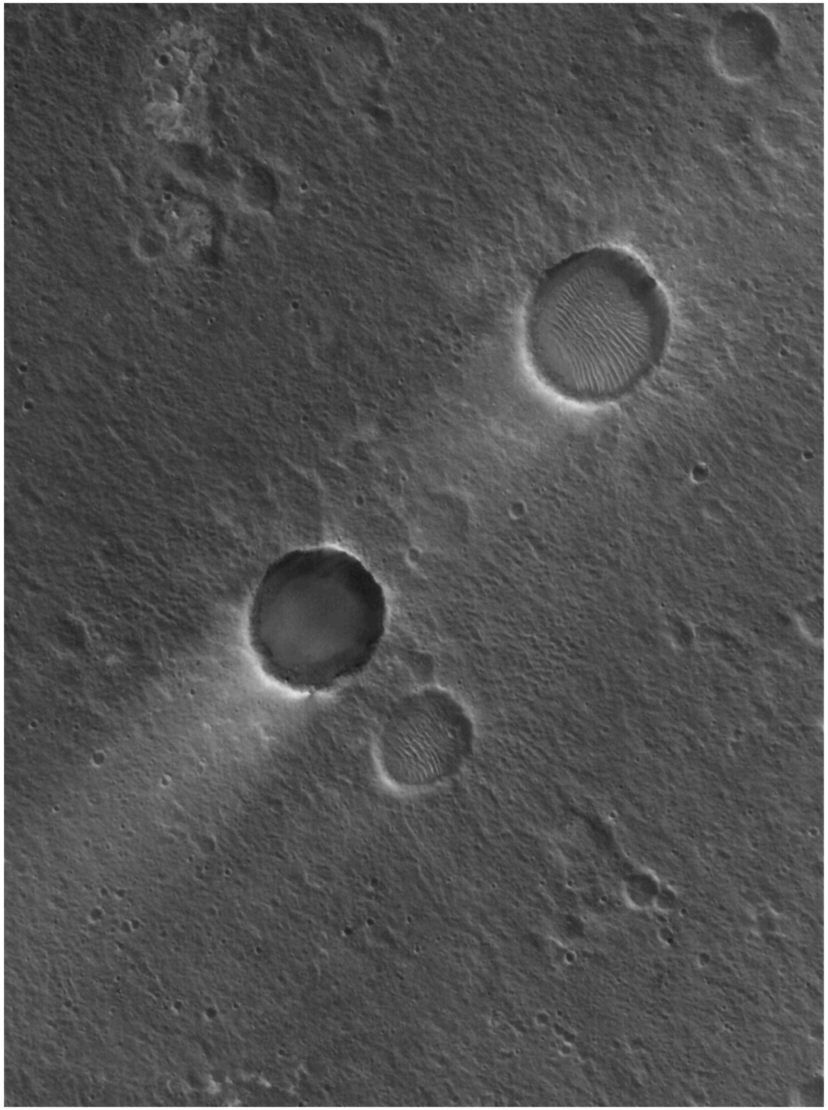


Phoenix Public Release Image

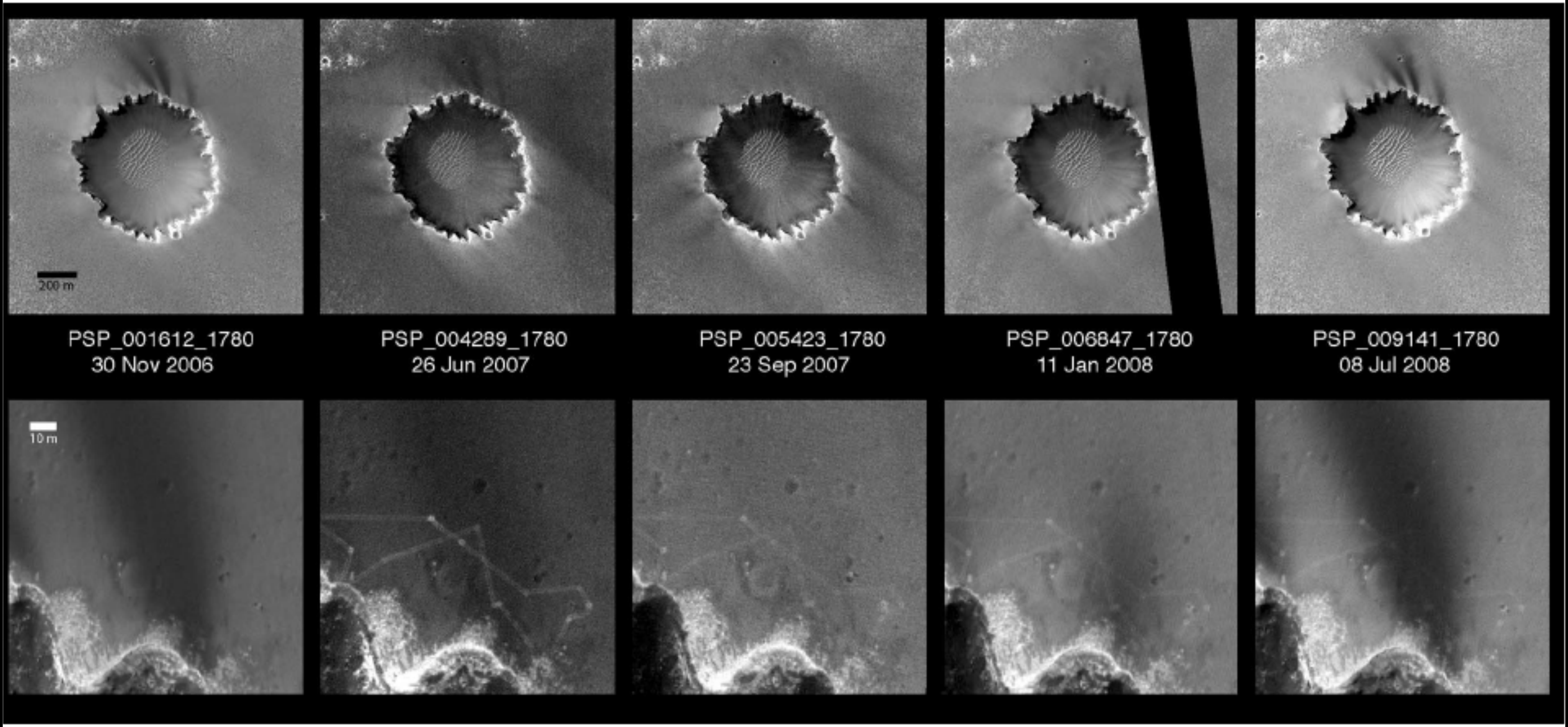
Mars dust devil tracks

Wind streaks



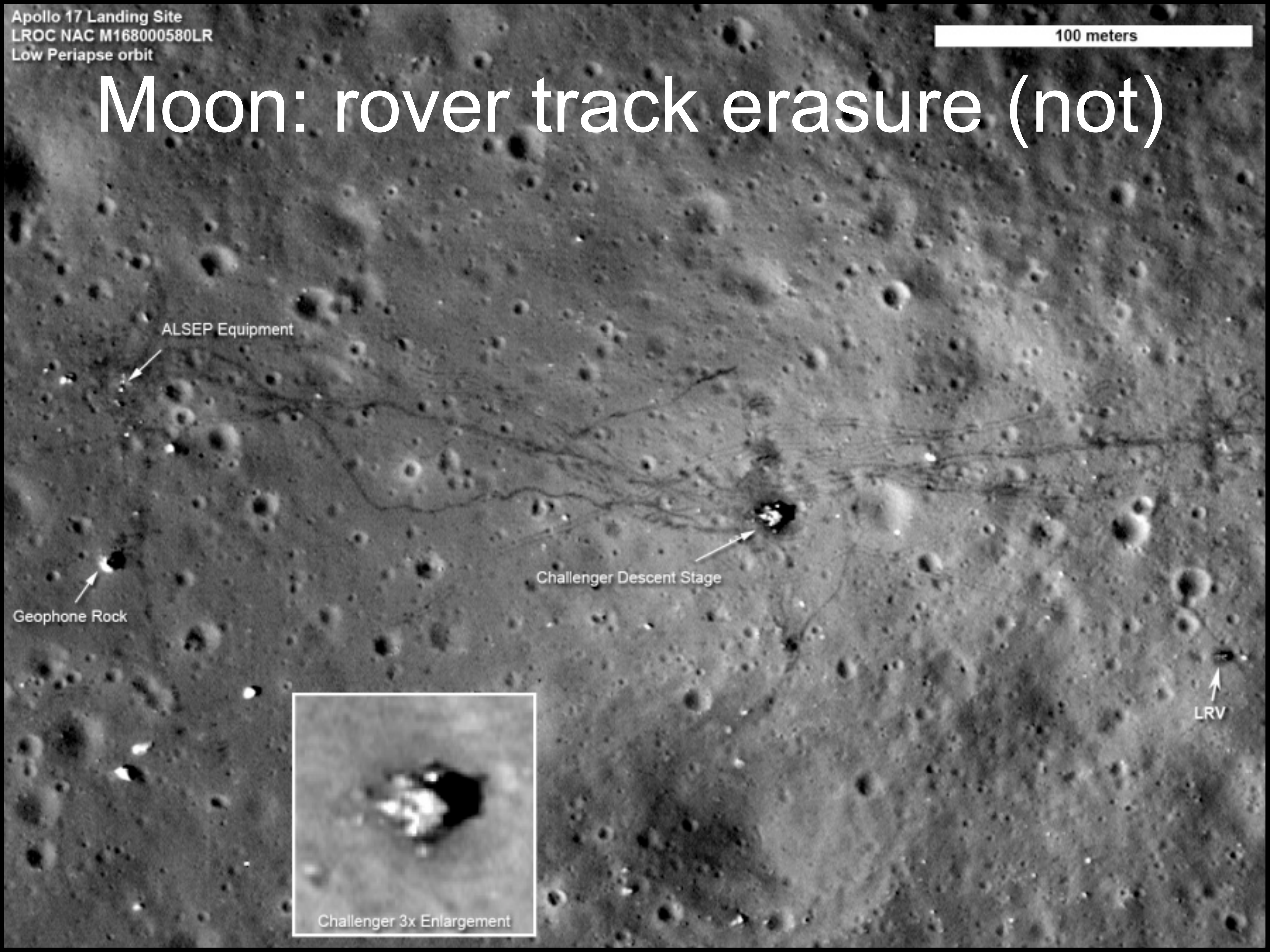


Mars: rover track erasure

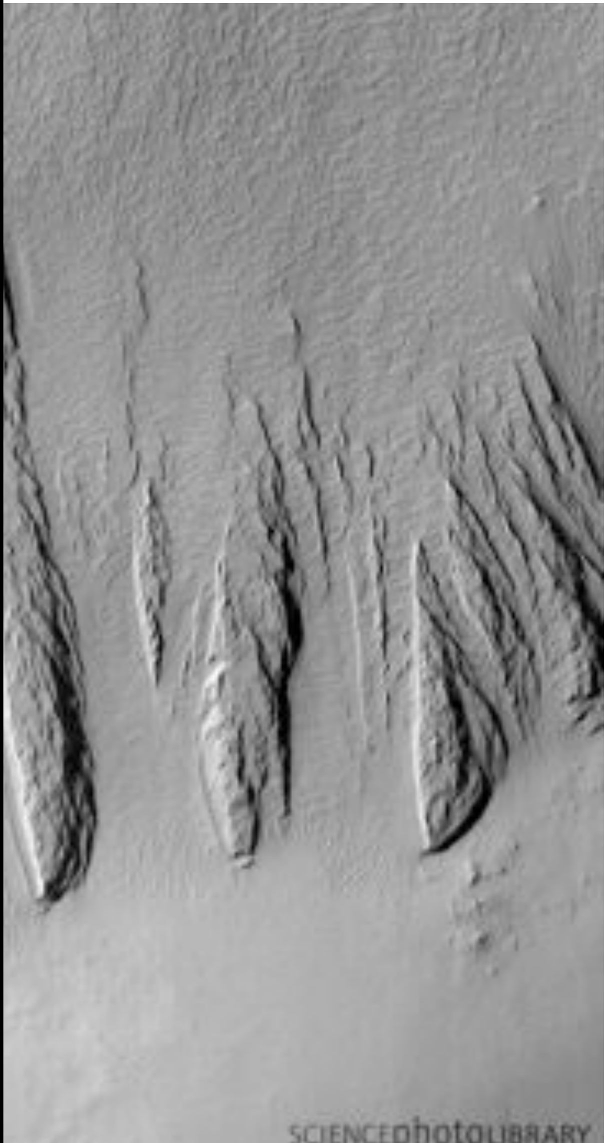


Geissler et al. (2010)

Moon: rover track erasure (not)



Wind also erodes: Martian yardangs



Wind also erodes: ventifacts

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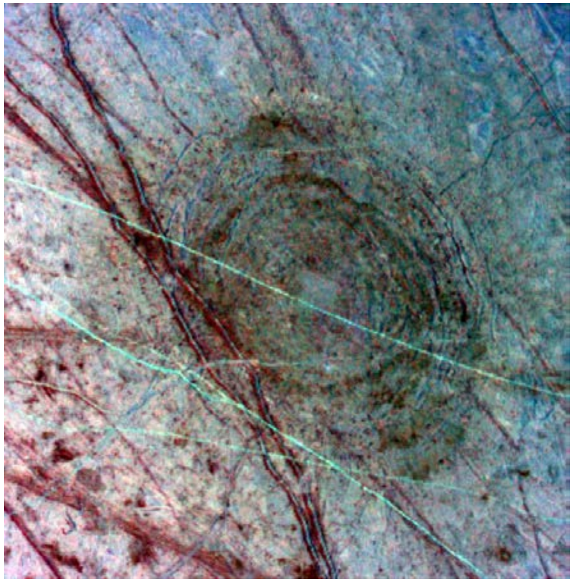
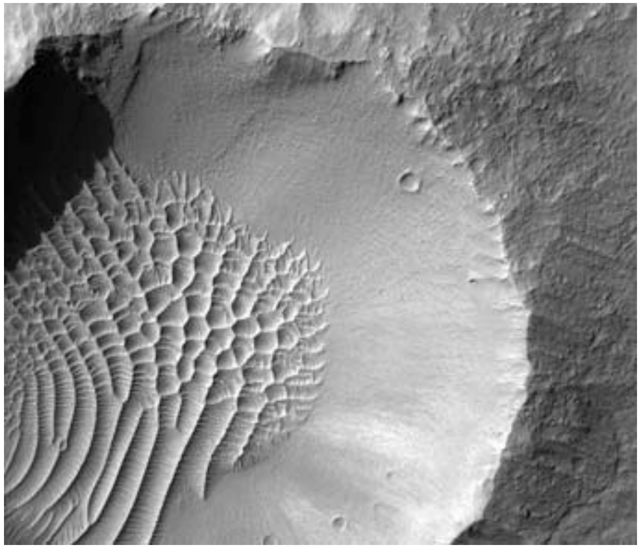
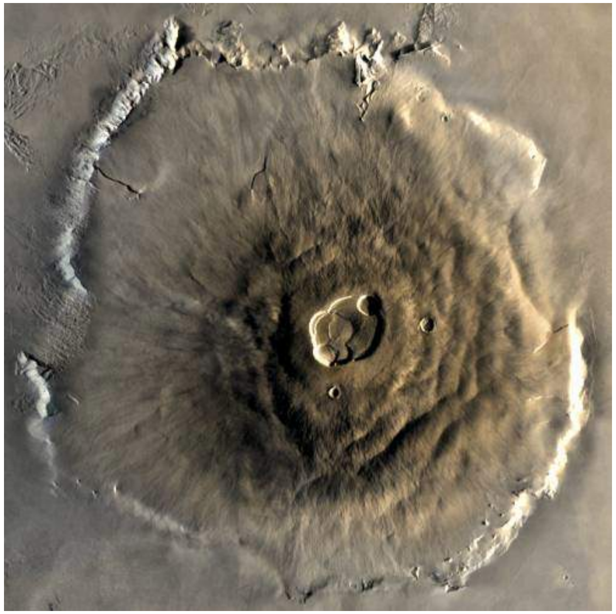
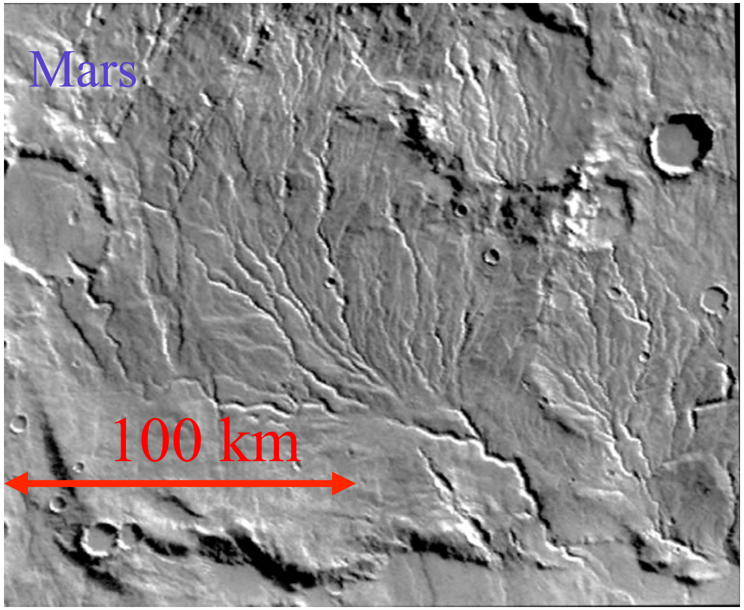


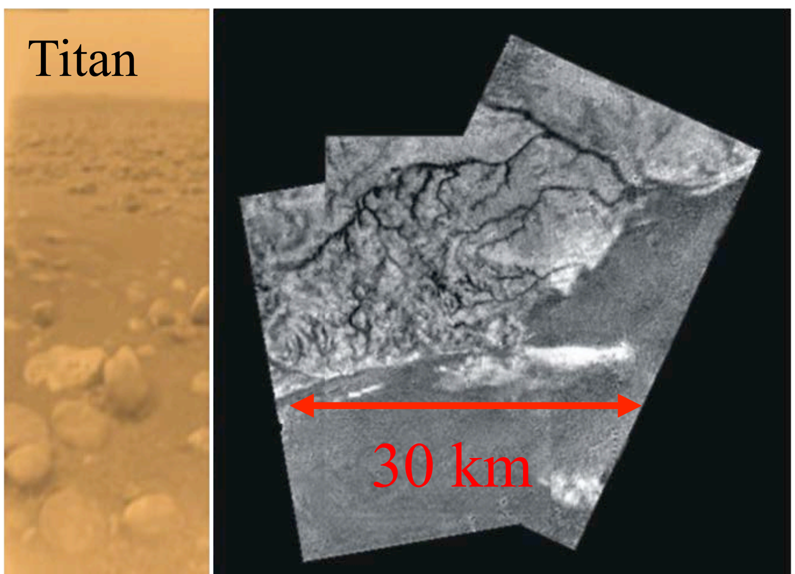


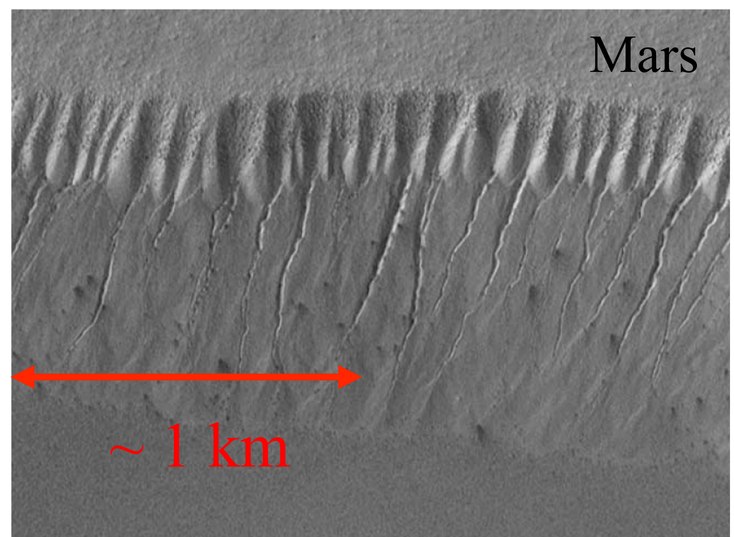


Fluvial Processes

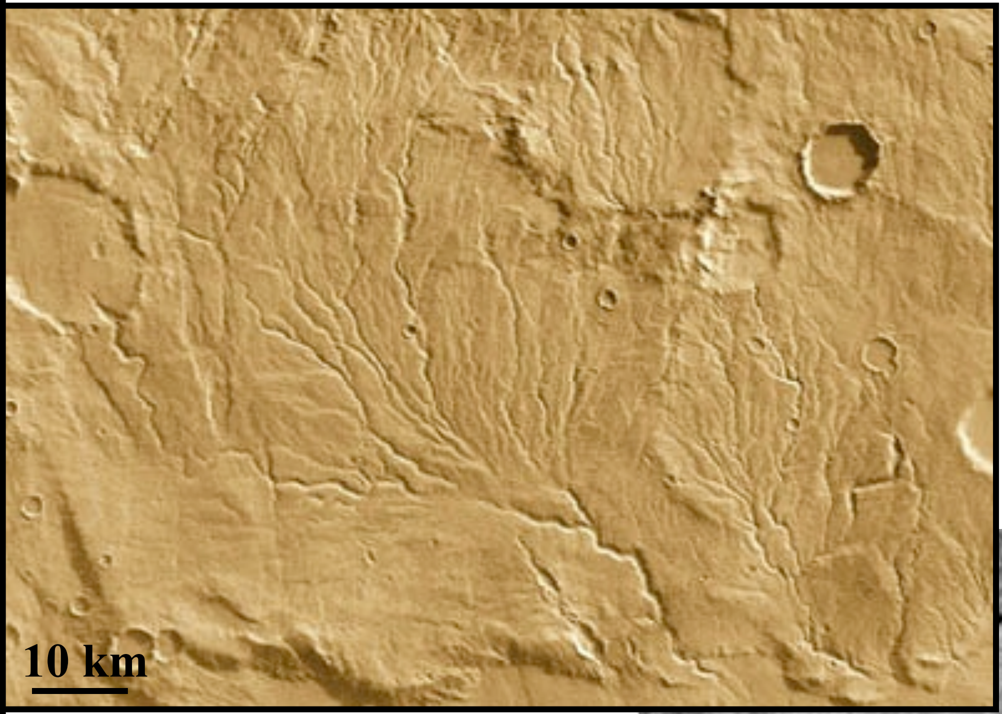


- Erosion, transport, and deposition of material by liquid flowing across a planetary surface

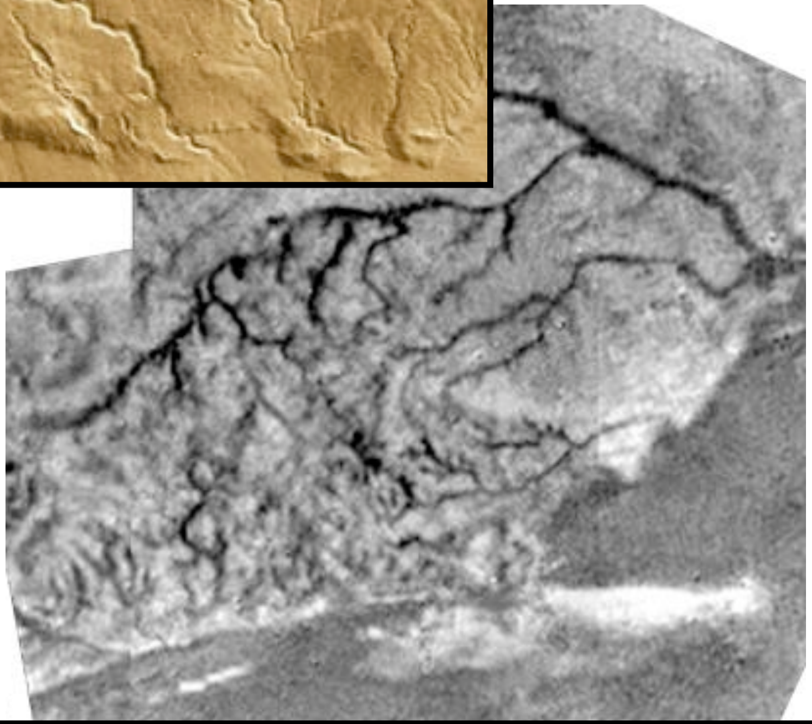




Dendritic Valley Networks



Mars

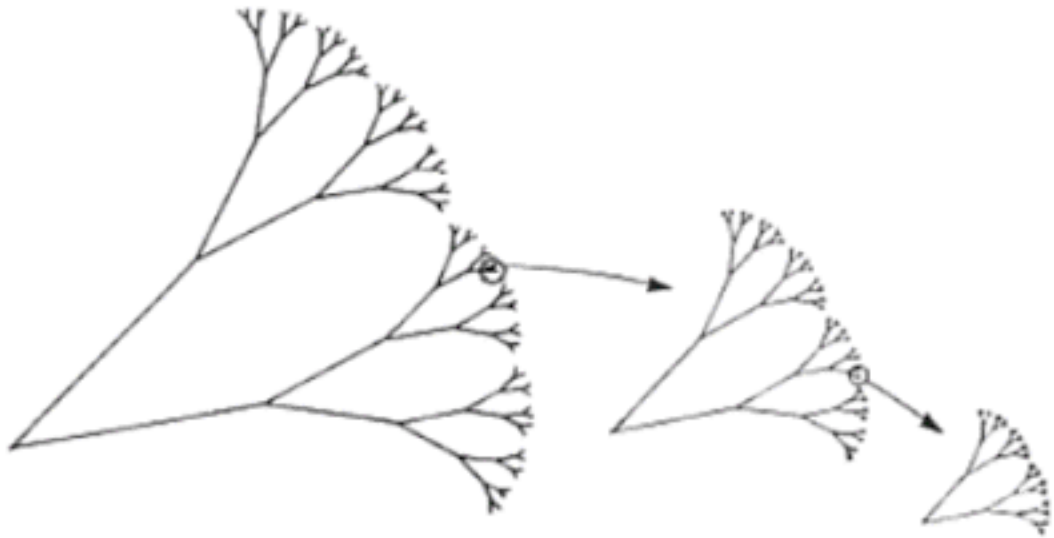


Titan

Yemen

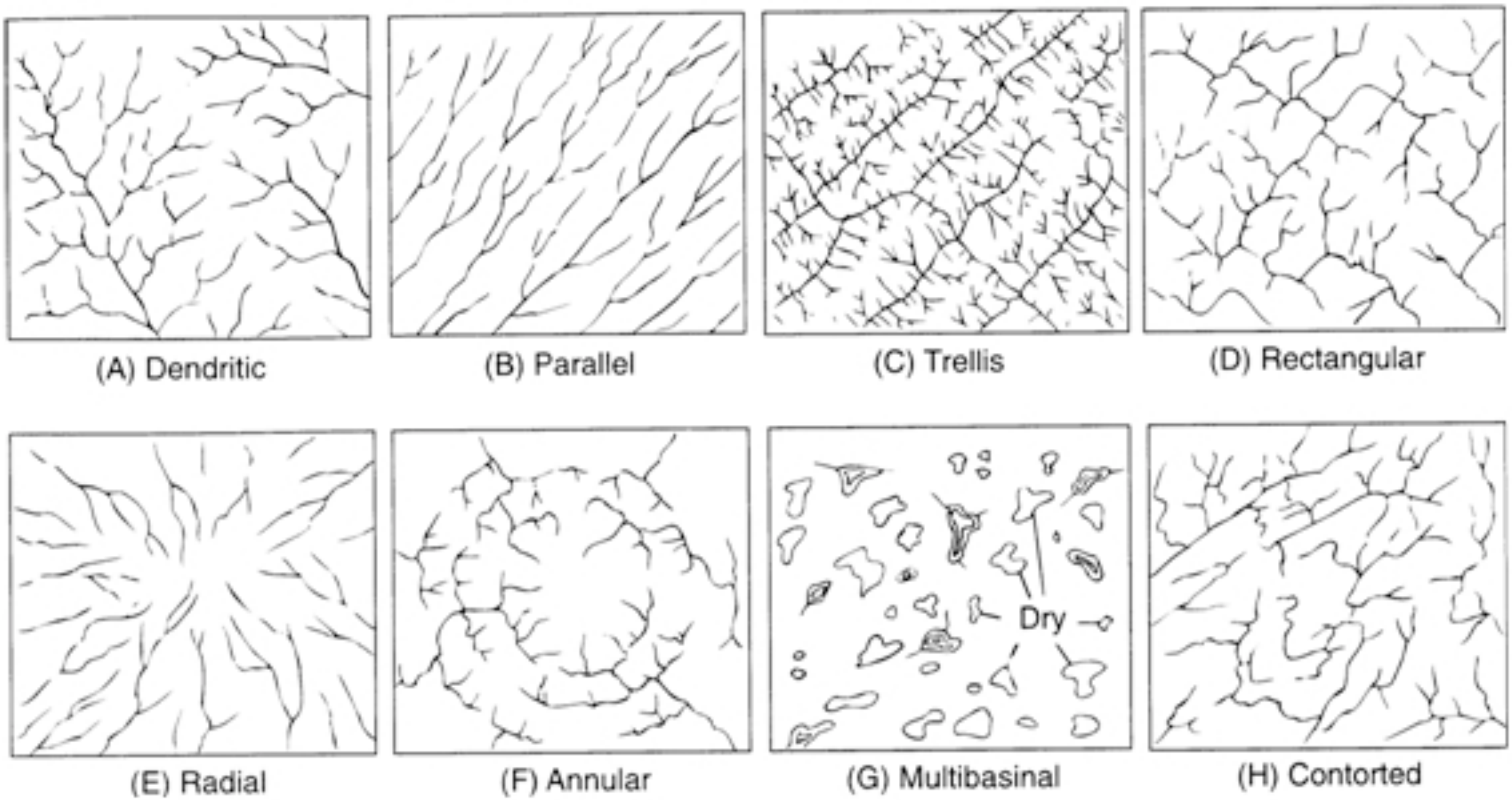
Dendritic Valley Networks

from Greek “dendron” (tree)



Self-similar (“fractal”) geometry

Topography influences valley forms

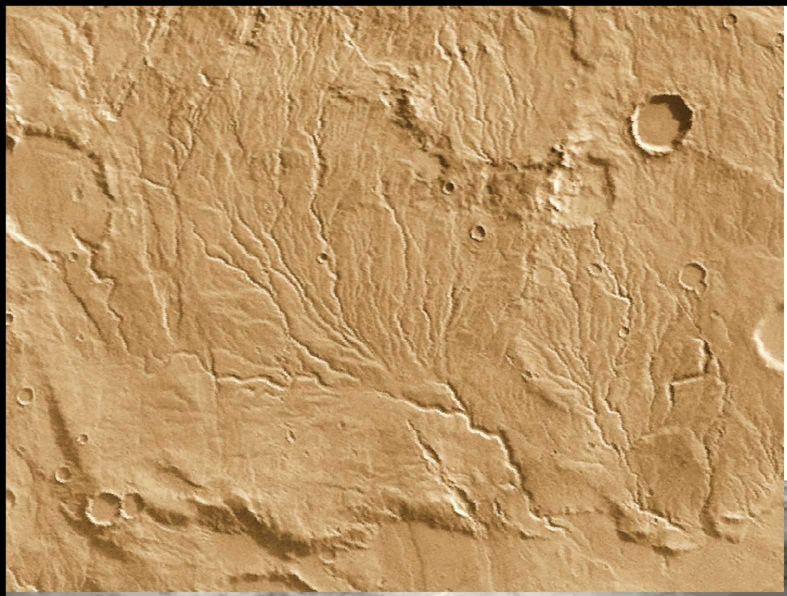


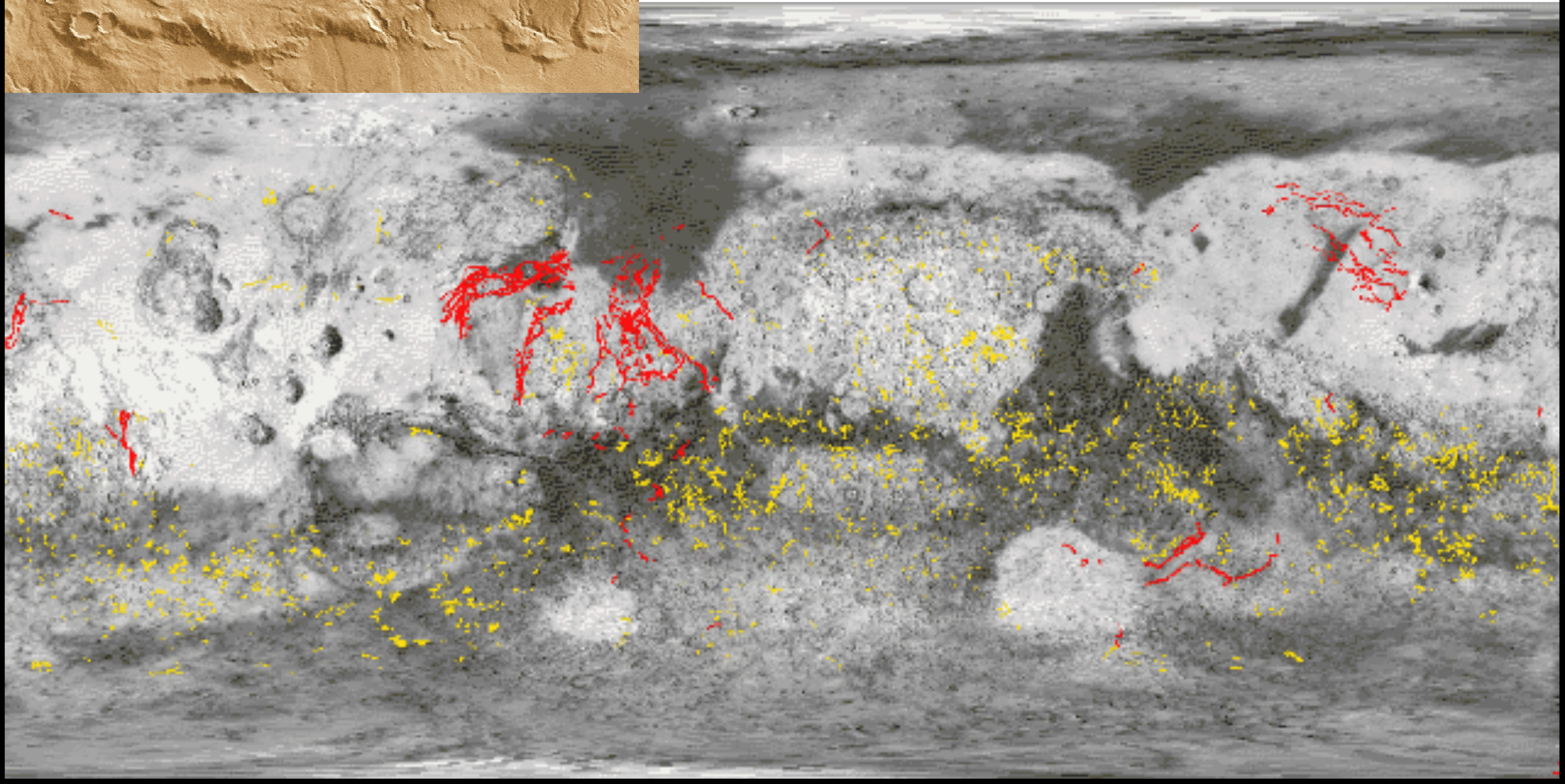
Howard (1967)

Valley networks

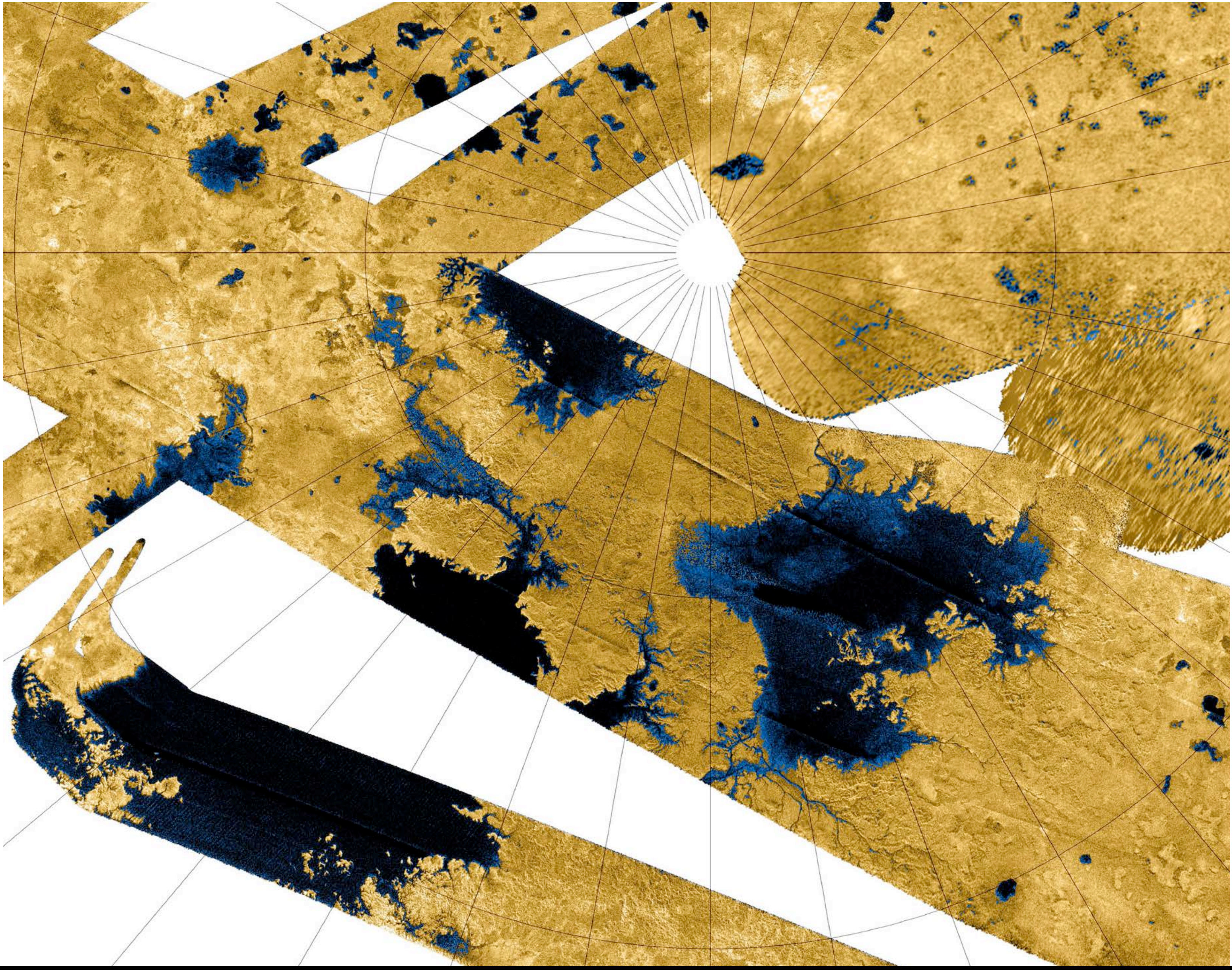
(yellow)

Evidence for ancient precipitation belt?
Some flow into/out of paleolake basins

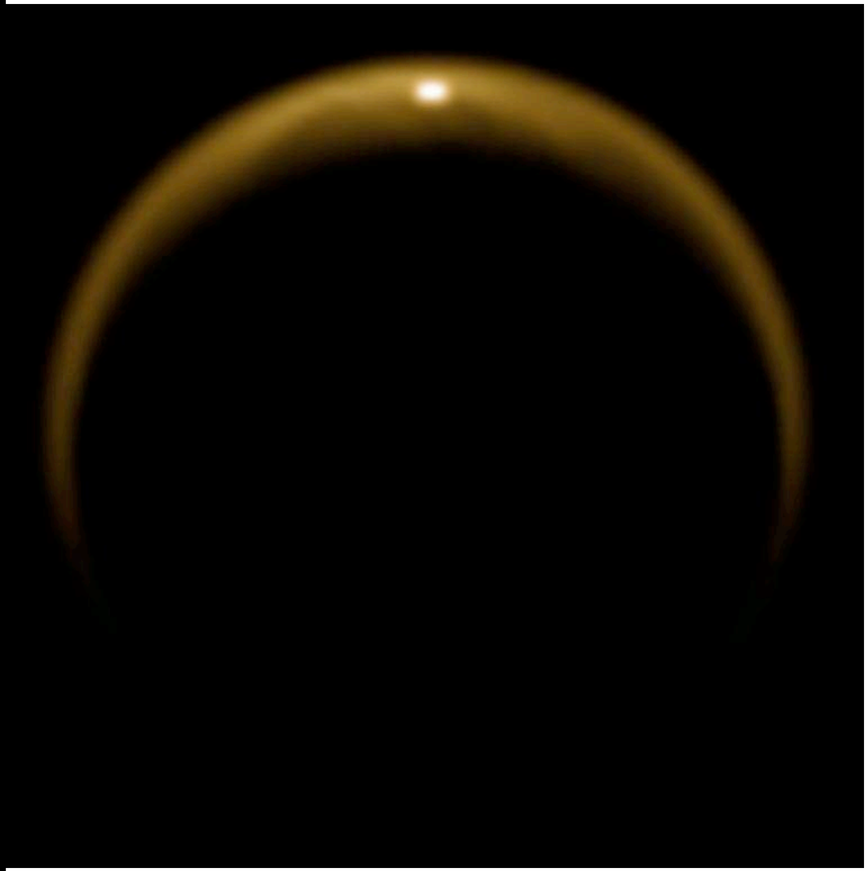




CH_4 Lakes on Titan



Lakes on Titan



- Specular reflection confirms liquid
  - minimal waves
- Some lakes evaporating over time?
- Cobbles rounded by fluvial transport?