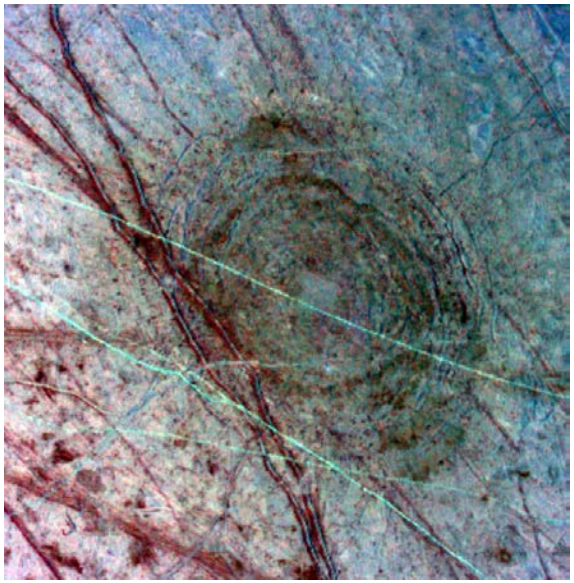
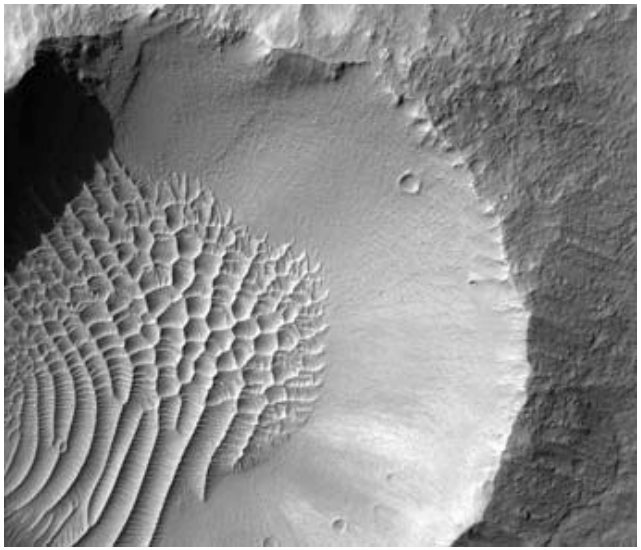
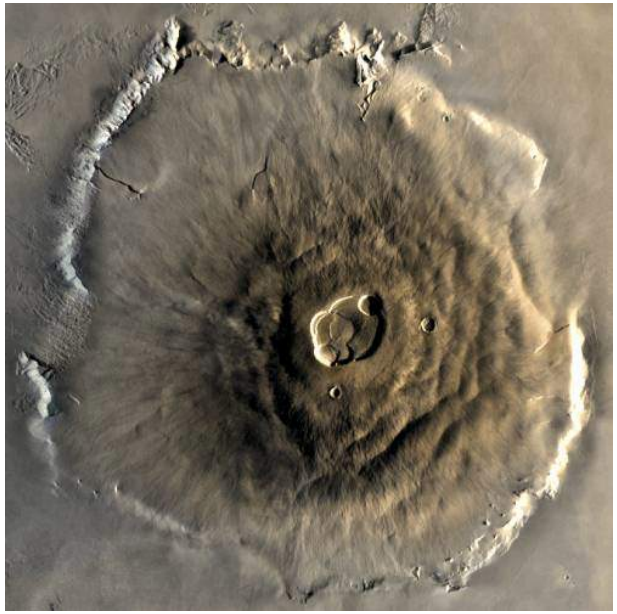
Planetary Surface Processes

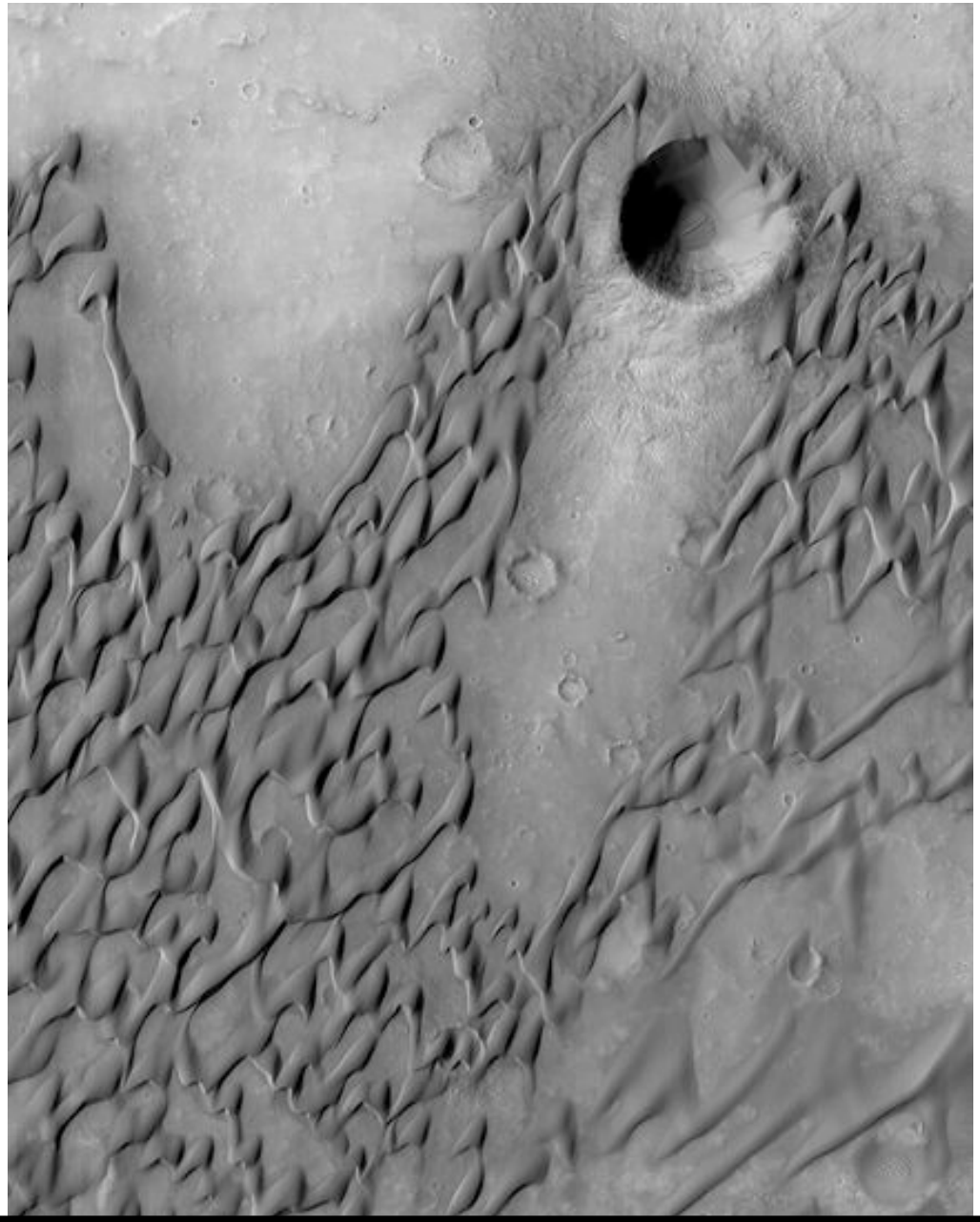
Cratering
Gravity
Tectonics
Volcanism
Winds
Fluvial
Glacial
Chemical weathering



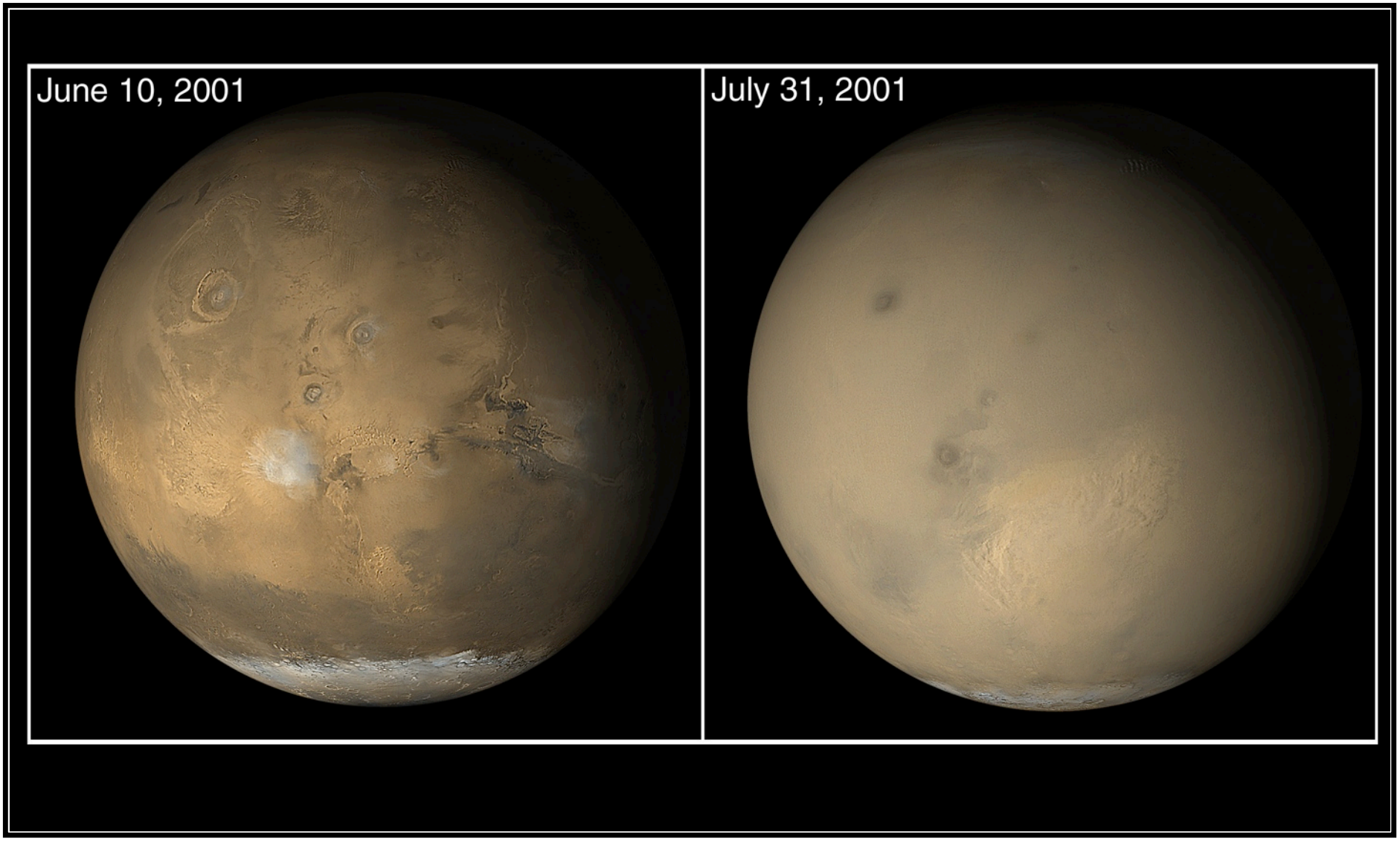




Aeolian Processes



Mars: Global dust storms

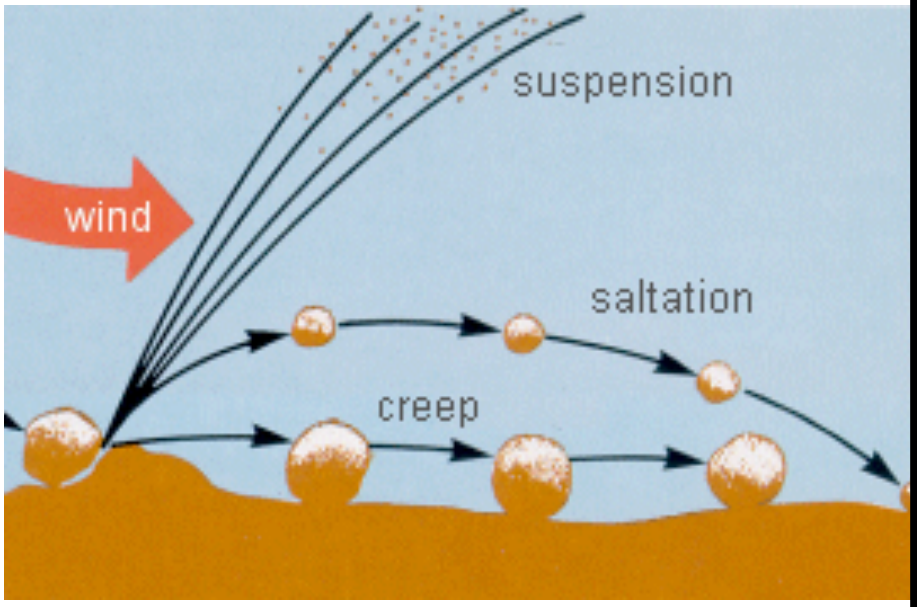


Mars: dust storm viewed from the surface

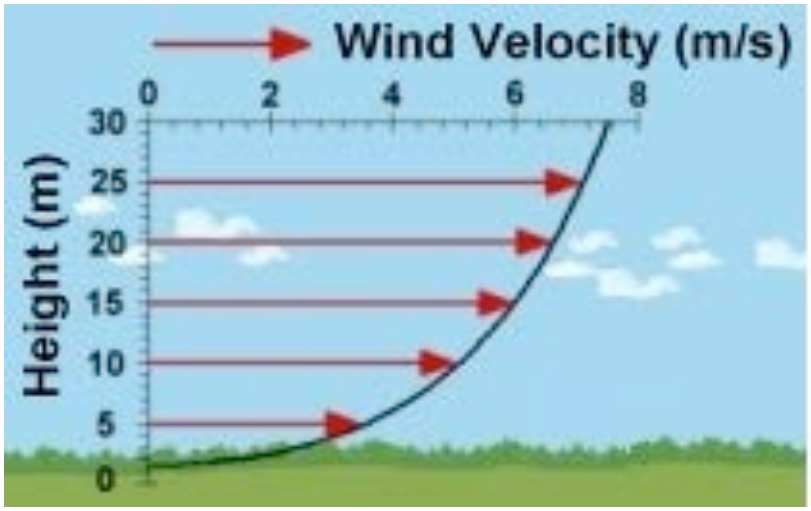
Aeolian Processes: Size-dependent

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

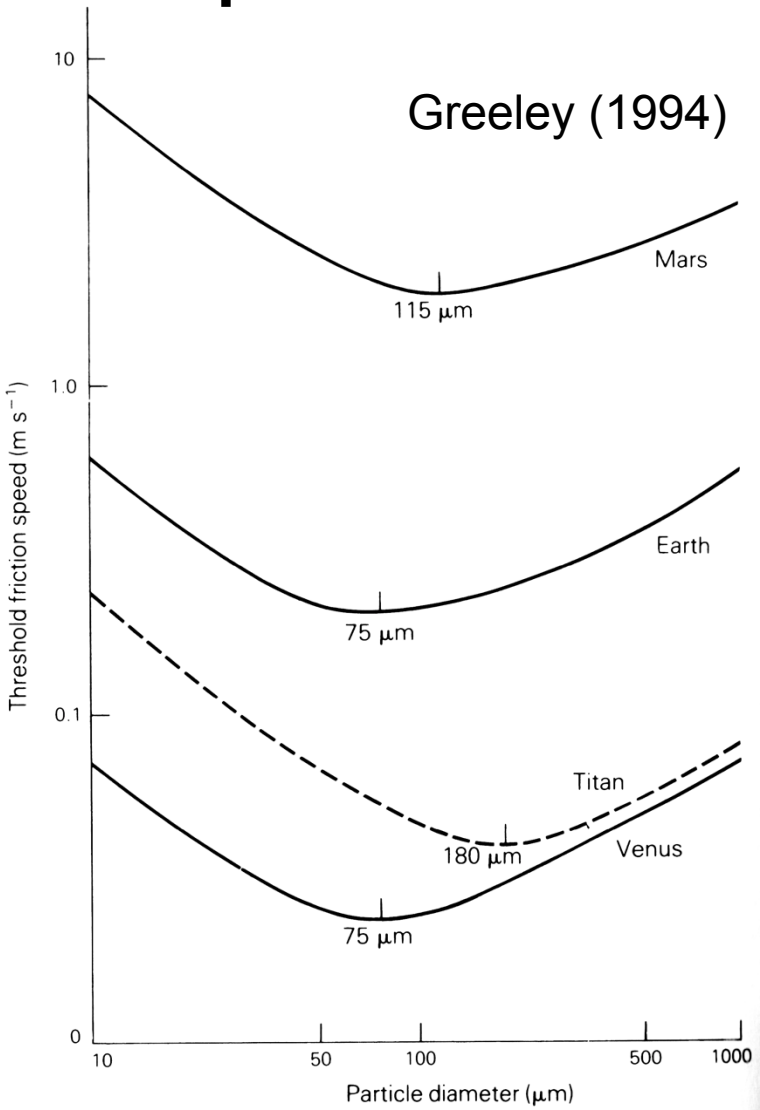
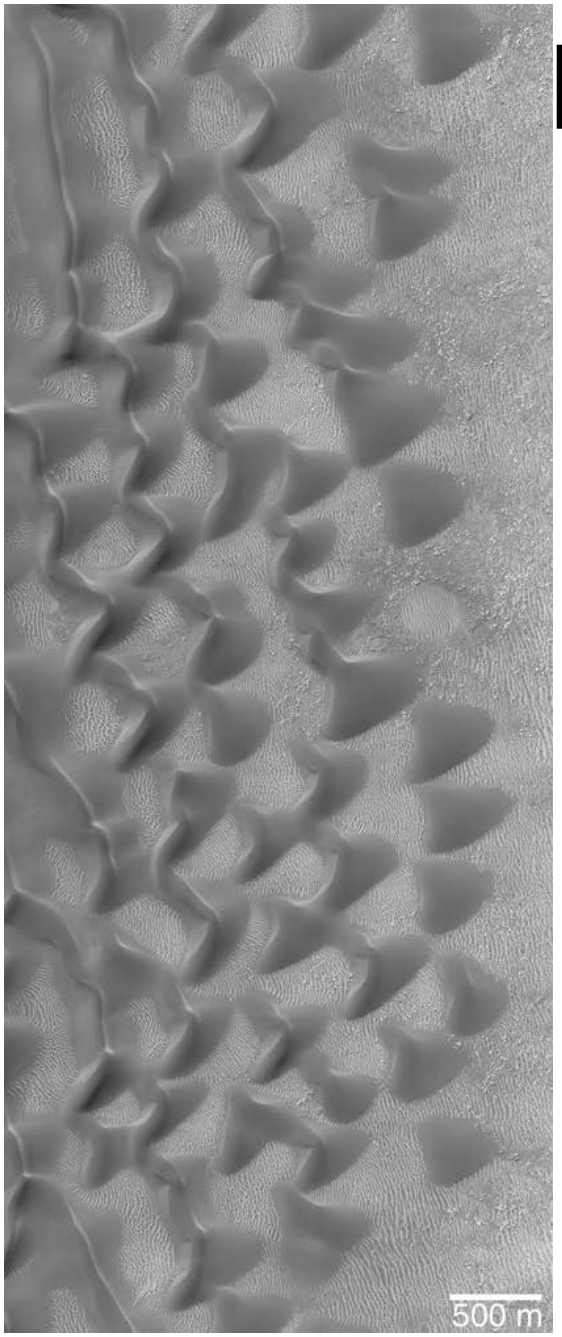
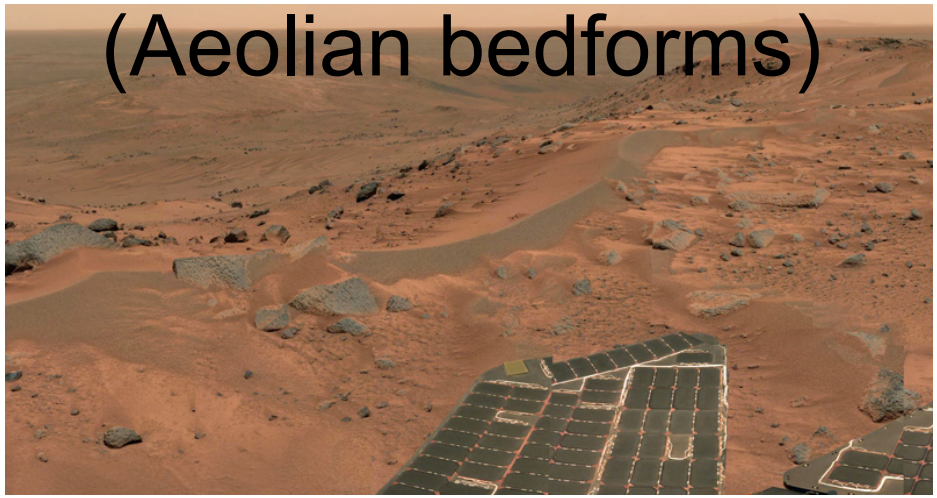


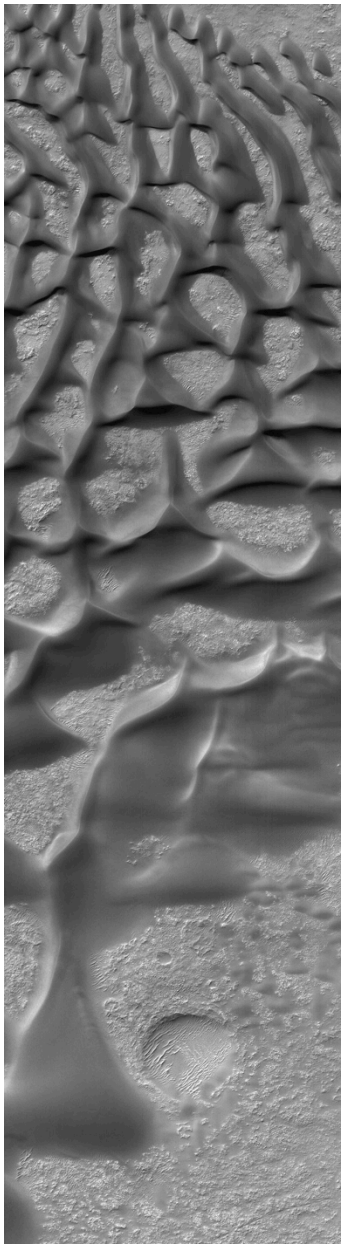
Figure 3.36 Diagram showing the minimum threshold friction speed (a function of wind speed) required to move particles of different sizes on Mars, Earth, Titan and Venus; note that as the atmospheric density decreases from Venus to Mars, minimum winds needed to set particles into motion increases.

Dunes and ripples

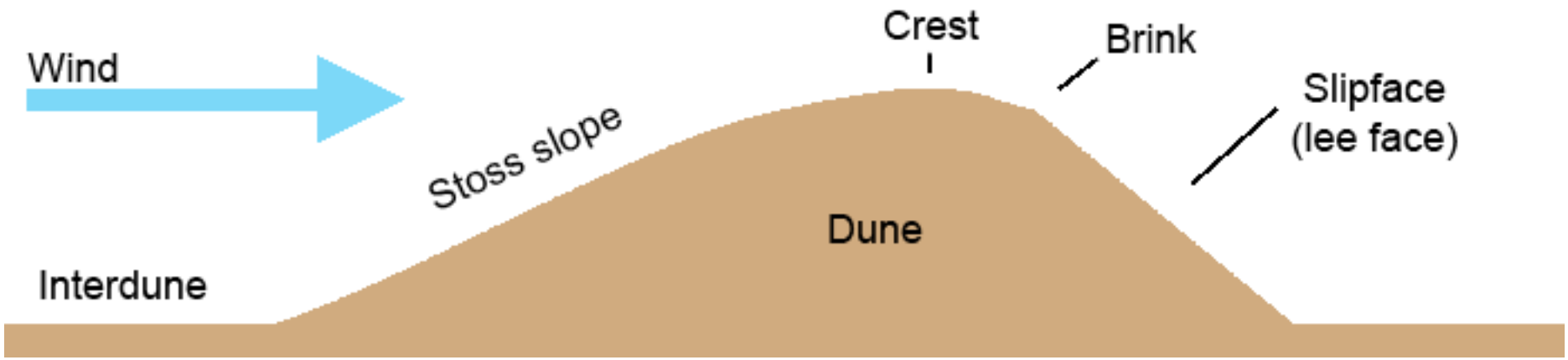
(Aeolian bedforms)

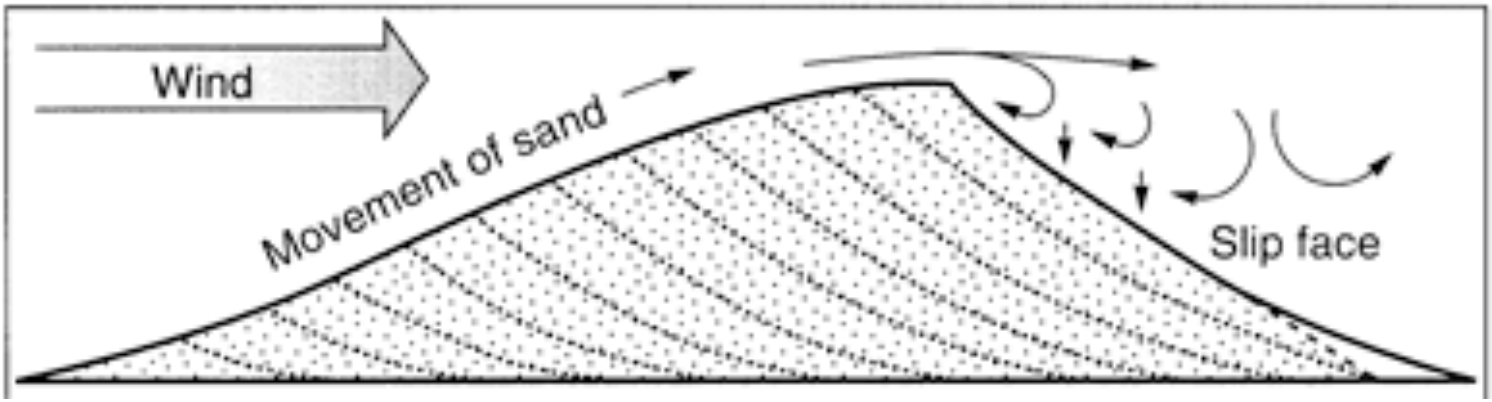




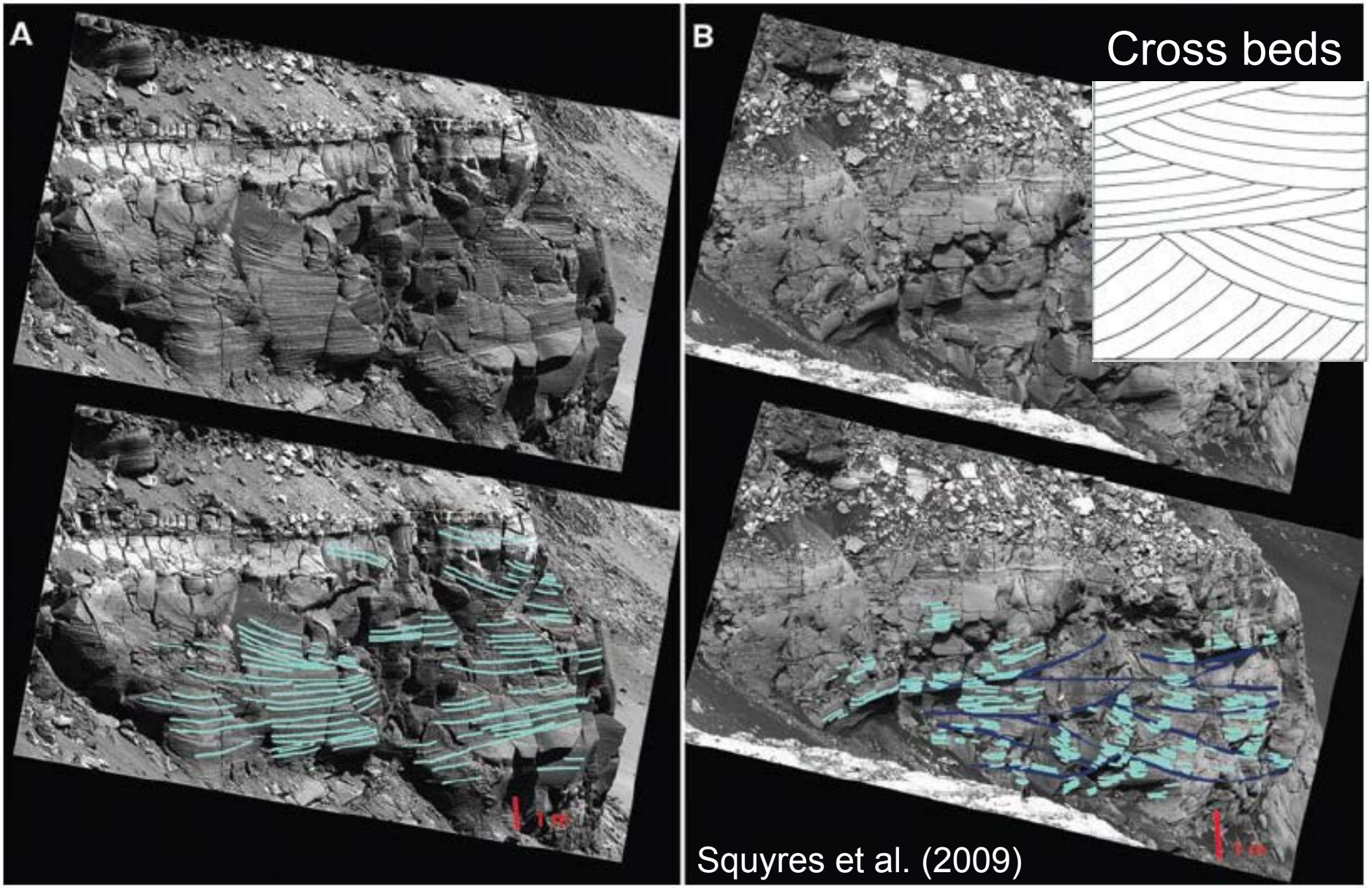


Anatomy of a dune

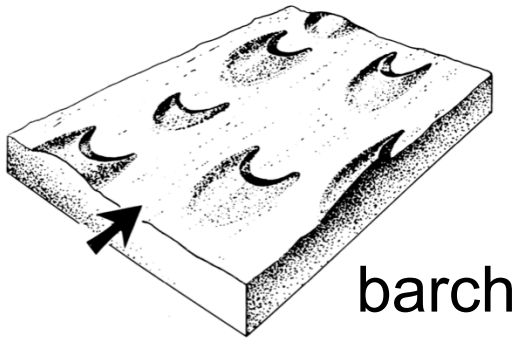




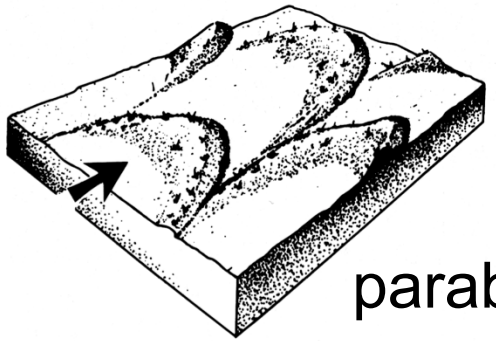
Ancient dunes on Mars



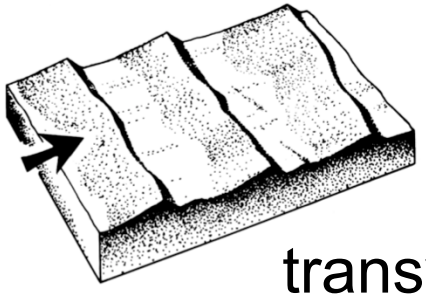
Dunes take many forms



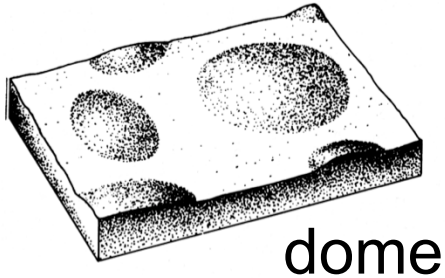
barchan



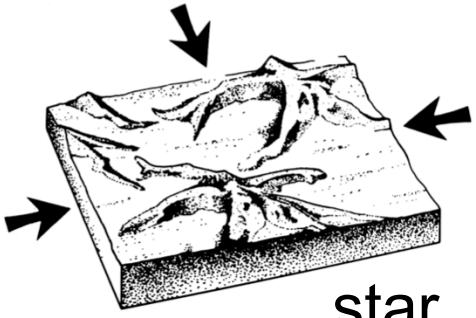
parabolic



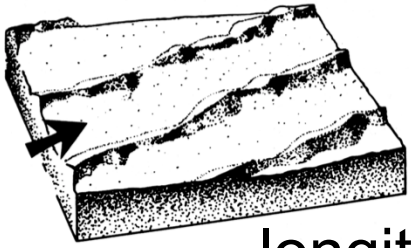
transverse



dome



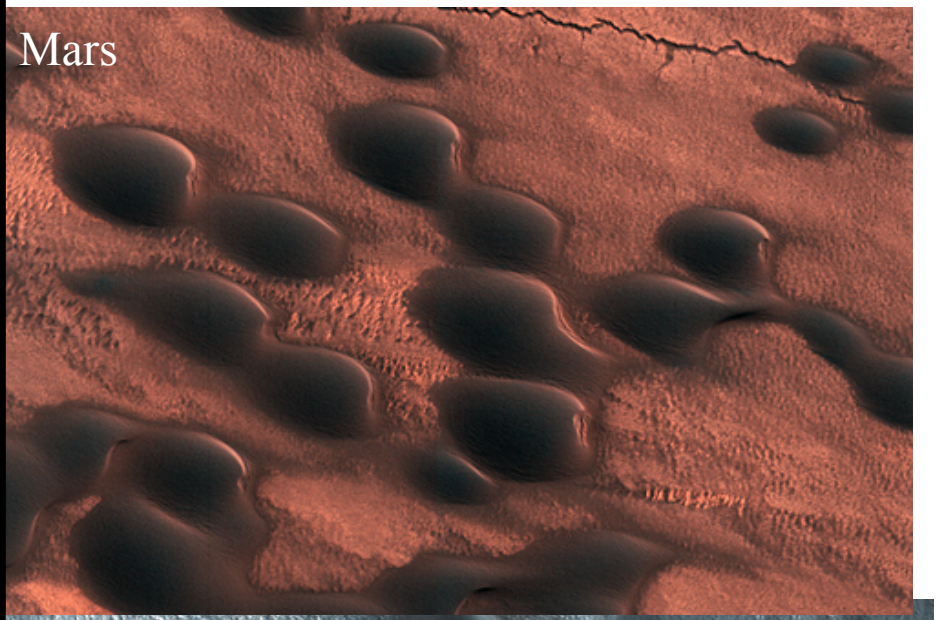
star

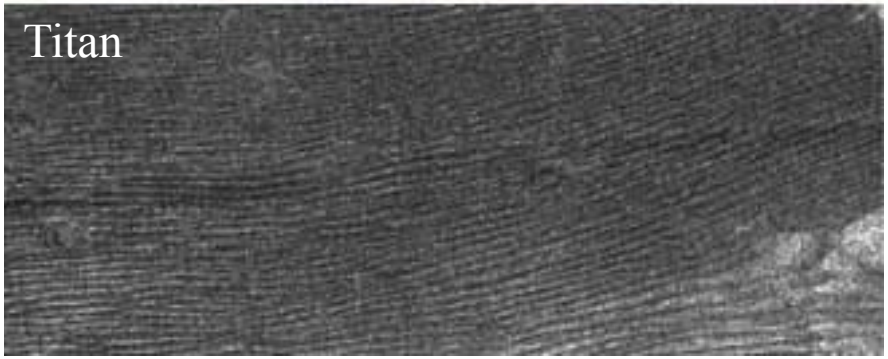


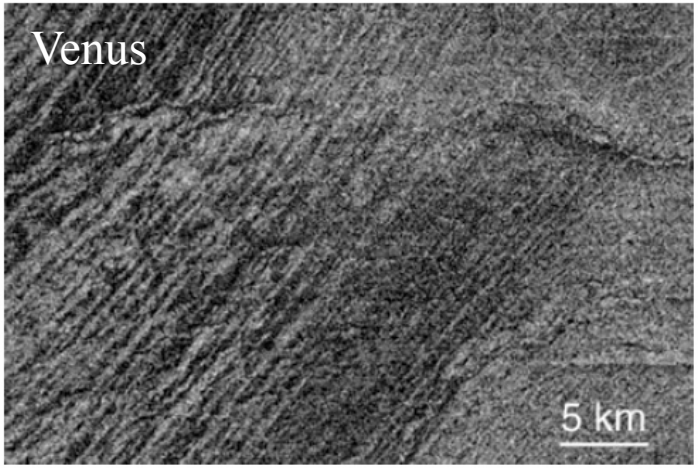
longitudinal

Greeley (1994)

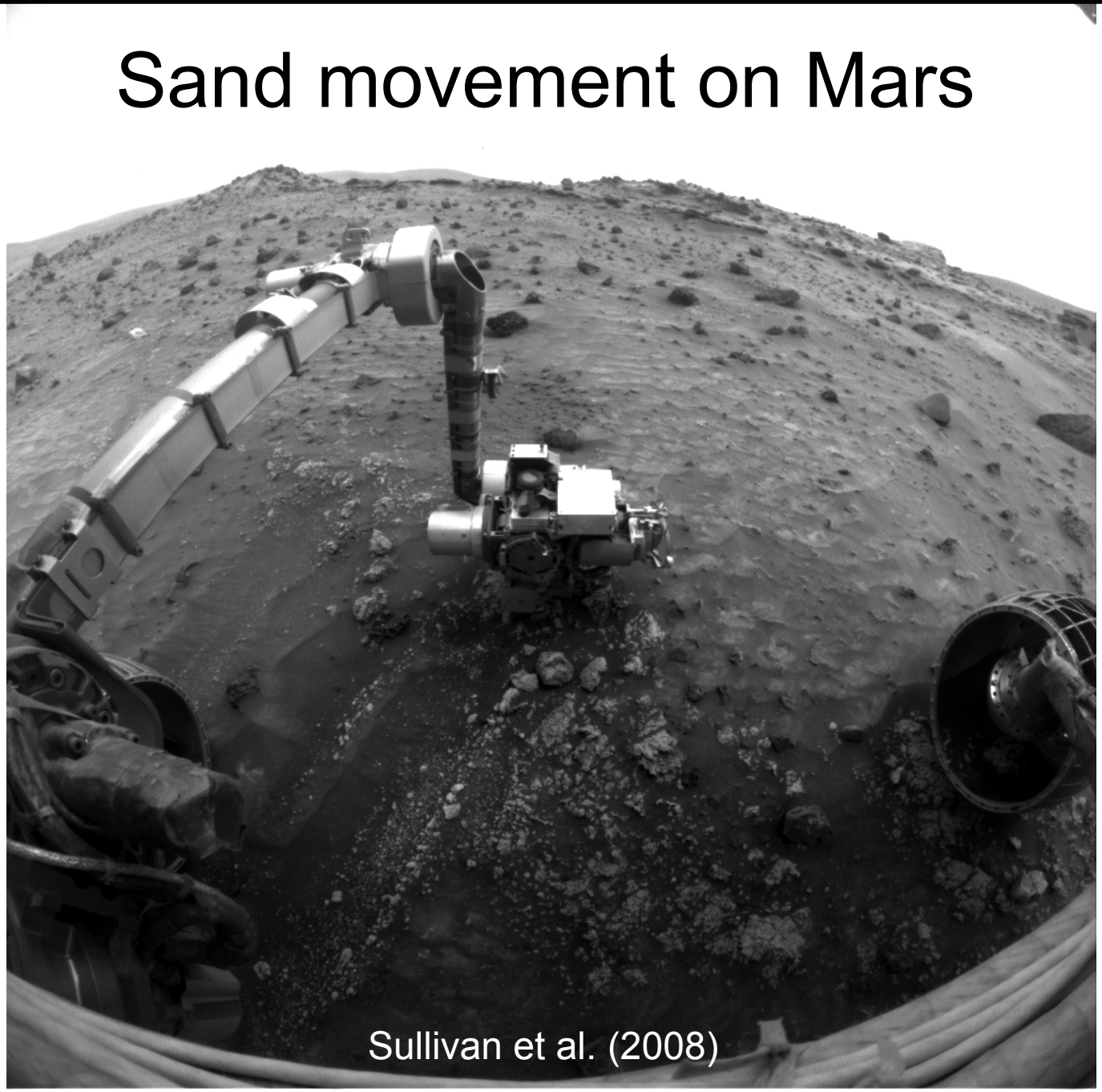
Planetary dunes



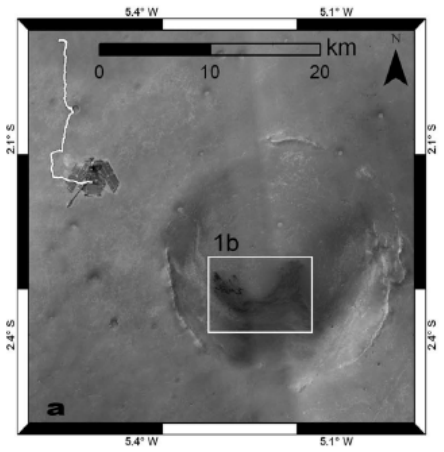


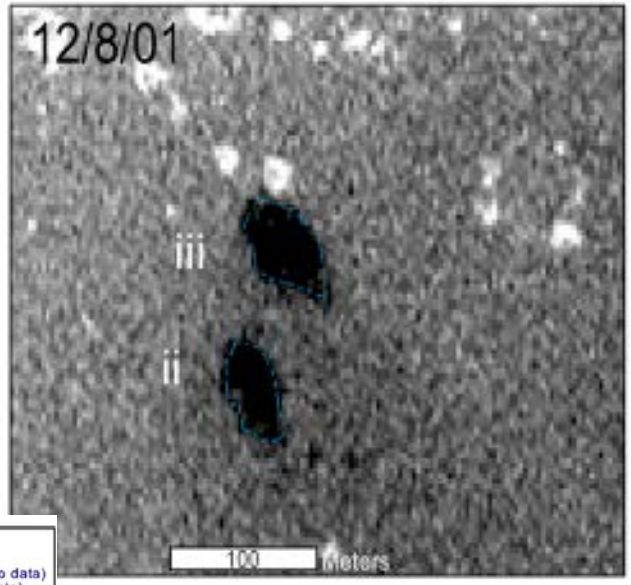


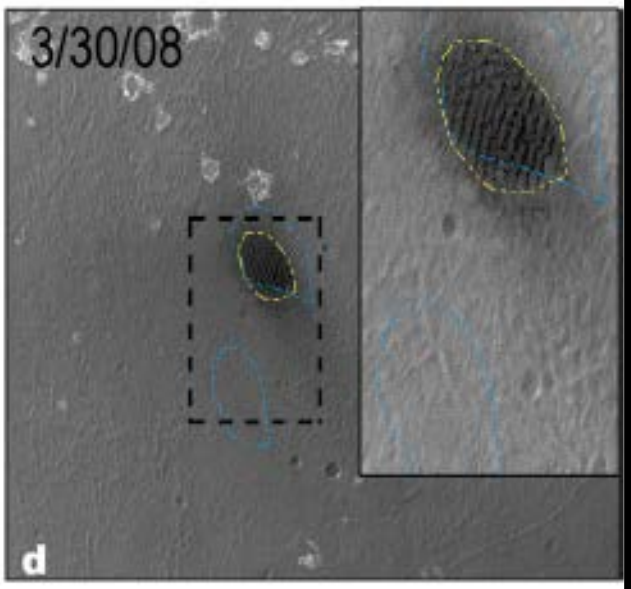
Sand movement on Mars



Sand movement at Endeavour crater







Bridges et al. (2013)