Planetary Surface Processes

- Cratering
- Gravity
- Tectonics
- Volcanism
- Winds
- Fluvial
- Glacial
- Chemical weathering
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
Planetary Surface Processes

Cratering
Gravity
Tectonics
Volcanism
Winds
Fluvial
Glacial
Chemical weathering
Mars is the outermost terrestrial planet.
Where is Mars’s water now?

• Lost to space
• In atmosphere
• Trapped in
  – Polar caps (at surface)
  – Ground ice
  – Mineral structures in rocks
Ground Ice (and hydrated minerals): Evidence from Neutron Spectroscopy

Lower-Limit of Water Mass Fraction on Mars

Data from Mars Odyssey Gamma Ray Spectrometer; see for example Feldman et al. 2002
Ice revealed by impacts

Observed to fade over time

Byrne et al. (2009)
Phoenix observed ice directly
Polygonal patterned ground - Phoenix
Polygonal patterned ground - HiRISE
Contraction crack formation

(a) Winter cold snap
   tension
   zero
   frozen active layer
   permafrost

(b) Late summer
   “thawed”
   permafrost

(c) Winter again
   frozen
   permafrost

(d) Summer
    Many years later
    thawed
    permafrost

Melosh (2011)
Glaciers on Mars

Fastook et al. 2008

Neukum, Mars Express HRSC

Dickson et al. 2008
A glacier at equilibrium

Melosh (2011)
Flow velocity is not uniform

Side view:

Overhead view:
Glacial creep

Melosh (2011)
Cold vs. warm-based glaciers

Melosh (2011)