Today’s Topics

Completion of subject matter on Mars

Review, as time permits

Quiz 4, covering October 8 and 10 (chapters 6 and 7)

- Chapter 6: origin of Moon, age of solar system, other planetary systems
- Chapter 7, through Mars (not Venus)

Monday: chapters 8, 9

Homework assignment 5 is available, due Wednesday, October 24
Brooks Observatory session 2 next week

Oct. 22–25, Monday through Thursday, 8:30 PM, or after class

Weather-related cancellations will be announced by signs on the doors of this building, in class (if possible), and on the class web site.

Bring your blue ticket.

A short, journal-type report on your experience will be due in class Wednesday, October 31.

If you attended the September session at Brooks and turned in a report, you have already satisfied this requirement and do not need to attend any more sessions.
Mars, continued

**Polar caps**

**Composition**

- Contain water (always frozen) and carbon dioxide snow and ice
- Seasonal vaporization & freezing of carbon dioxide component

Act as cold storage for water and carbon dioxide
Other surface features

Impact craters & basins

Canyons

(See image labeled, "Valles Marineris")

Shield volcanoes

- Large volcanoes with gentle slopes, formed by highly fluid lava. On Earth, the lava tends to originate at great depth, and they are not typically found at plate boundaries.
- Typical in shape for shield volcanoes, but very large
- Likely age (rough estimate!) 2 billion years from number of impact craters on slopes
Permafrost, a permanent layer of subsurface ice

Evidence: peculiar craters with flow patterns around them probably result from impact in frozen soil

**Dry river beds or channels or arroyos**

- Generally quite old; craters on top of them
- “Outflow channels” are the result of flash flooding — wider at beginning, narrower at end.
- Detailed examination by *Mars Reconnaissance Orbiter* shows they are typically filled with lava, although originally carved by flowing water.
Some *gullies* have been found by *Mars Global Surveyor* and confirmed by *Mars Reconnaissance Orbiter*.

- Locations have very few impact craters, hence recently formed
- Appear to be fed by melting subsurface ice
Evidence for long-term climate change on Mars: the channels.

- Water could not flow extensively today
- Higher atmospheric pressure in past (2 billion years ago?)
- More greenhouse warming as a result, warmer also
- Or perhaps Mars is now in an ice age
- Recent MRO results indicate the warm period was less extensive than previously thought. They cast doubt on claims of possible early rainfall, for example.
- Flash flooding could have been caused by an impact melting subsurface ice.
What happened to Mars’ atmosphere?

- Escape: because of its relatively weak gravitational pull, Mars may have lost a significant part of its atmosphere over time.

- Freezeout: a lot of water and carbon dioxide could be stored in permafrost and the polar caps.

Cessation of volcanic activity around 2 billion years ago

- Planet’s interior cooled due to small size

- Then atmosphere no longer replenished by gases emerging from volcanoes
• Fits in with pattern: small size goes with less surface modification
  – Mercury, Moon: smallest, most craters, least modified surface
  – Mars: intermediate in all respects
  – Venus, Earth: largest, fewest craters, most surface modification