Reading for next week: Chap. 9, Sect. 9.4-9.5, Chap. 10, Sect. 10.1-10.2, 10.4-10.5
Homework 5: Due in recitation Friday/Monday Oct. 11, 14
Homework 6: Available on website, due Friday/Monday, Oct. 18, 21
Public Lecture (extra LC credit) : Tuesday, Oct. 15, 8:15pm - MU Great Hall:
Dr. Chris Lintott: *"How to Find a Planet Without Leaving Your Couch*

Last time: **Planet interiors and surfaces**

- Planetary interiors: hot and stratified
- Processes affecting planetary surfaces
  - Impact cratering
  - Volcanism and melting
  - Weathering, erosion

Today: **Planet surface processes, cont'd., ages**

- (plate) tectonics
- Relative Ages via Crater Density
  - more craters, worn-down craters = older surface

Dust devils on Mars

More Mars Weathering: Wind Streaks

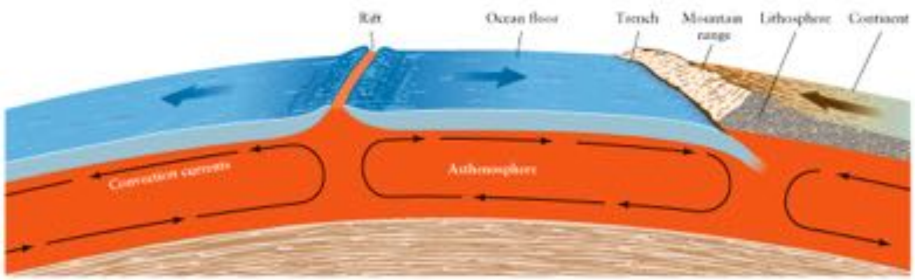
Tectonic Changes

Mercury, Venus, Earth, Mars

- Definition: large-scale changes as a planet's crust responds to stress
- Earthquakes:
  sliding and cracking of crust
- Mountain Building:
  buckling and folding of crust
- Subduction:
  forcing down of crust into interior

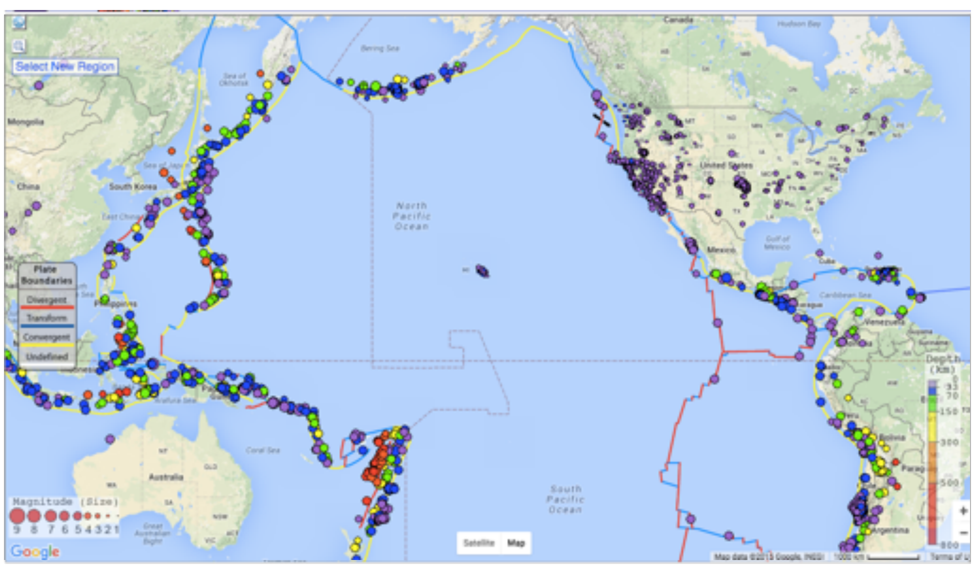
Plate Tectonics on the Earth

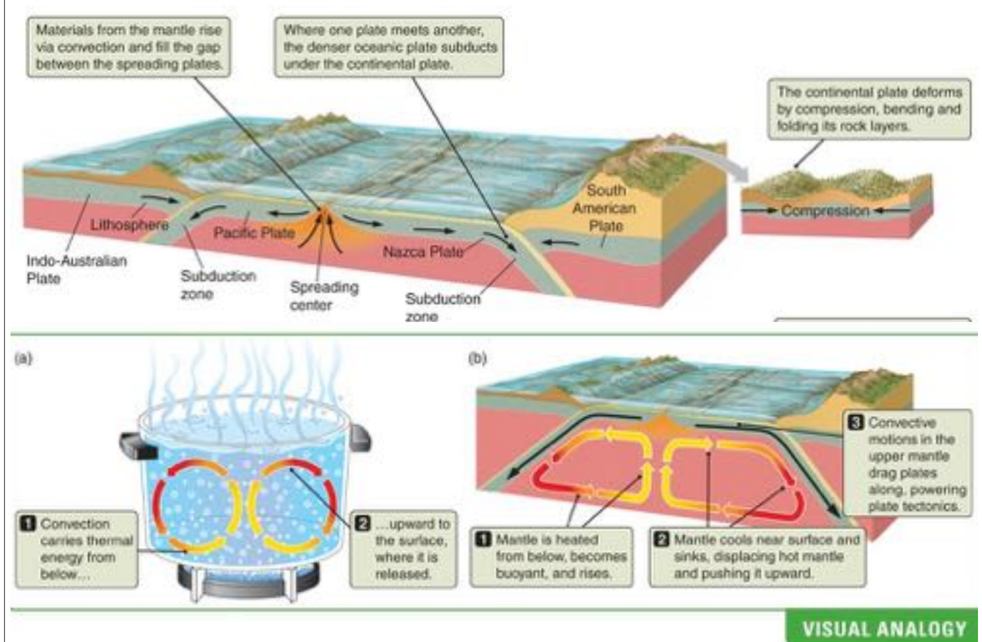
- partially molten asthenosphere (upper mantle)
- crustal plates “float” atop asthenosphere
- subduction zones: where plates overlap
- faults: where plates slide past



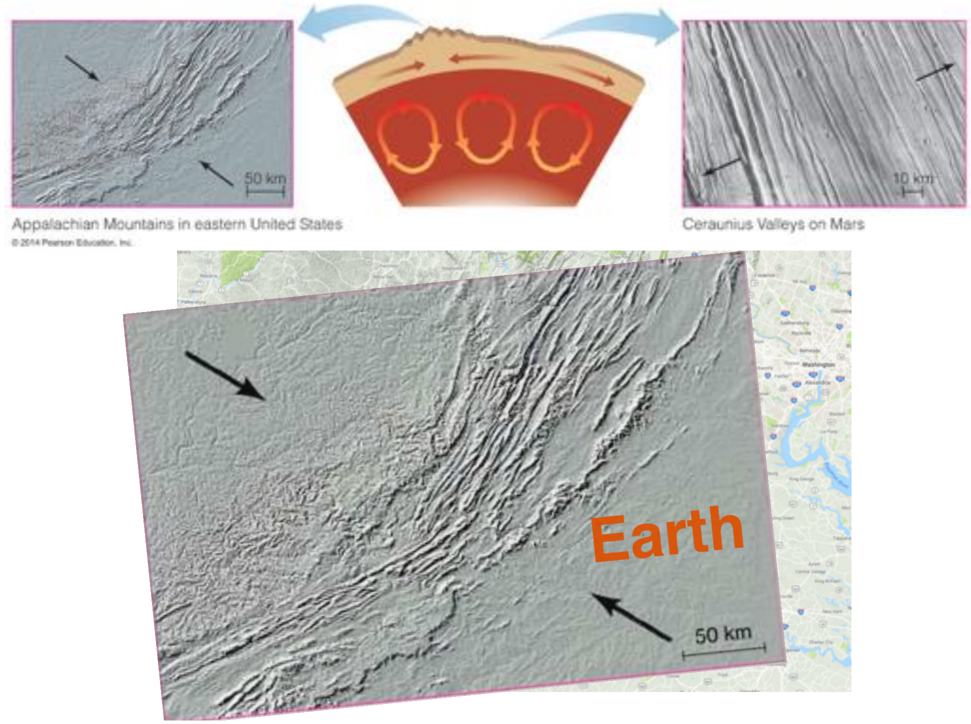
the San Andreas fault

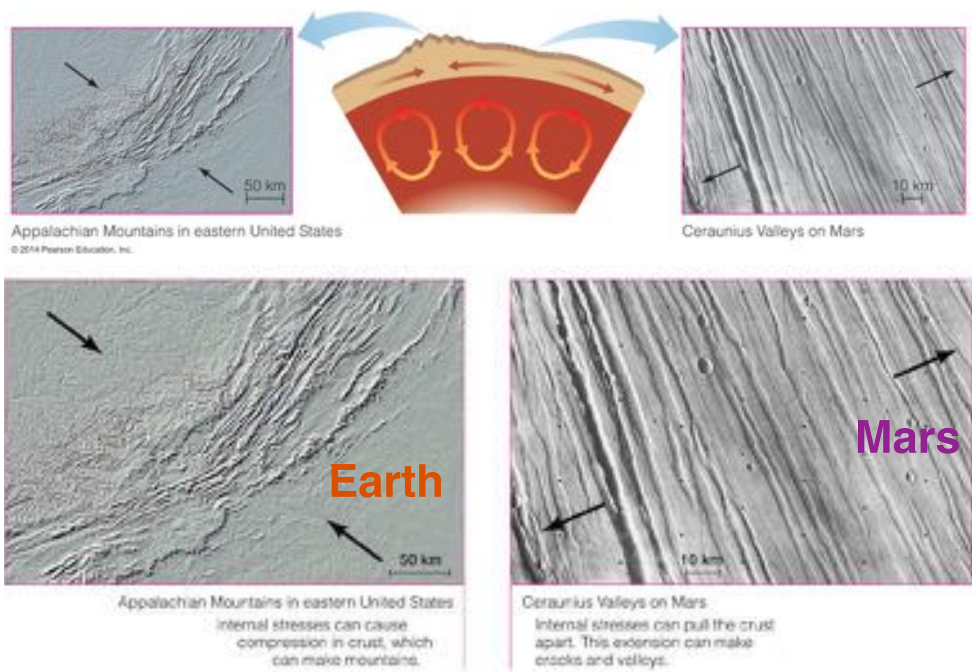
Earth’s continental plates - Pacific region

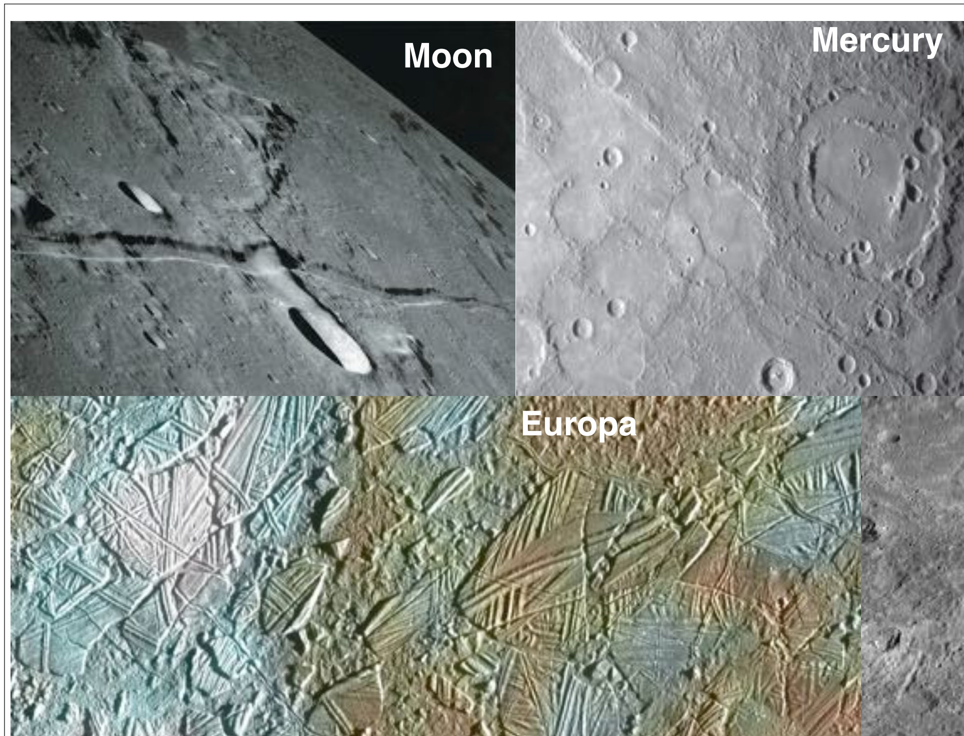


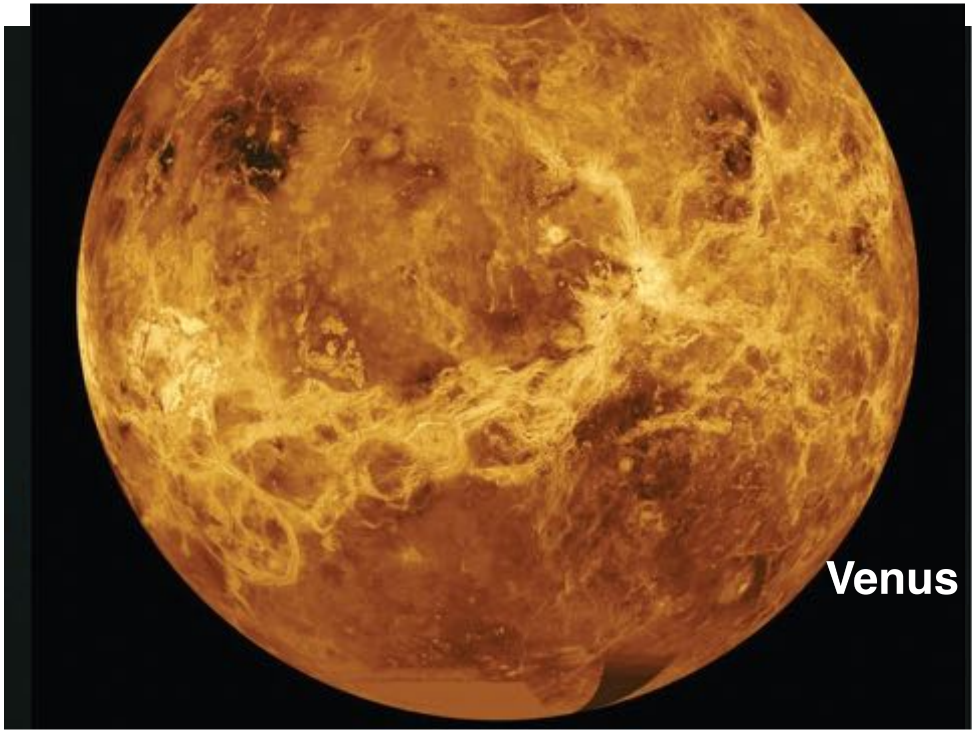


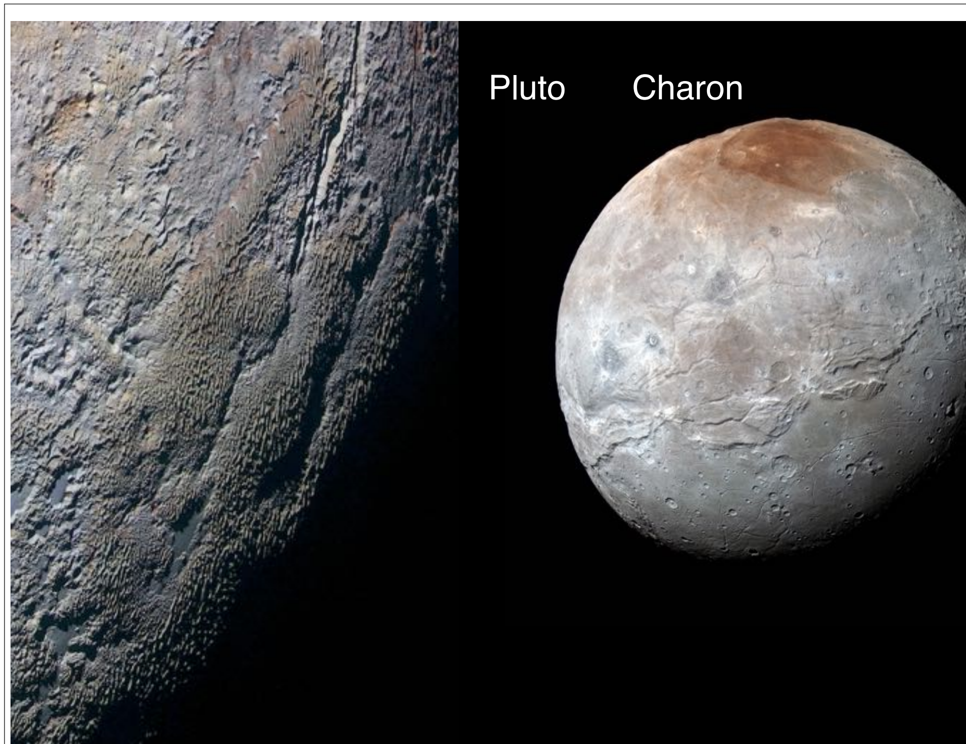
Mid-Atlantic Ridge





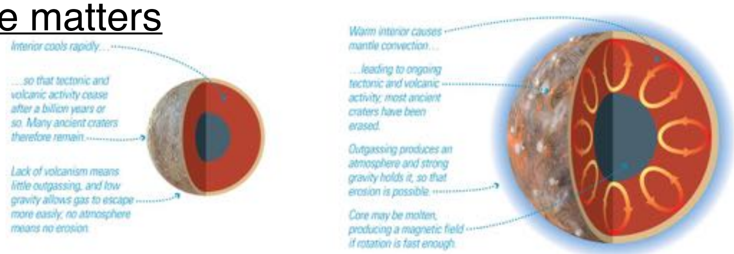




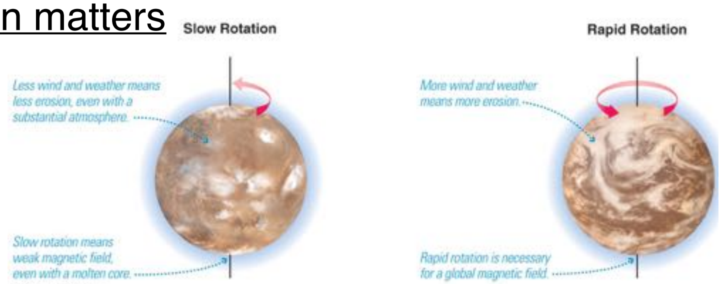


Contrasting the planets

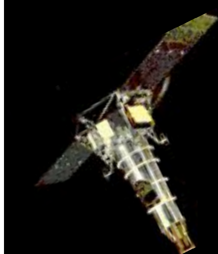
- Size matters



- Rotation matters



Ranger 9 Mission to the Moon
March 24, 1965



Ages: when did the surface solidify after being molten?

Relative Ages from cratering density

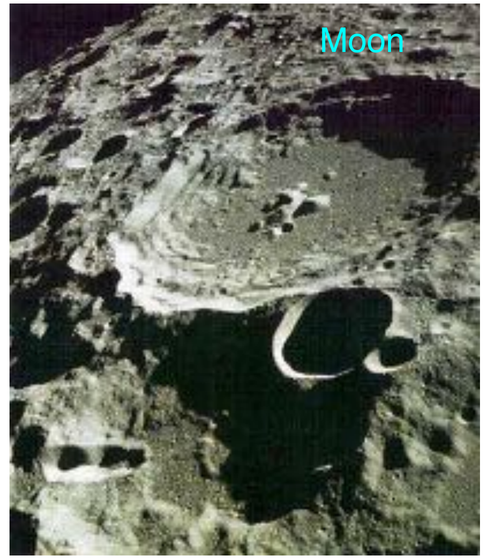
Moon, Mercury, Mars, Venus, outer moons

crater density:

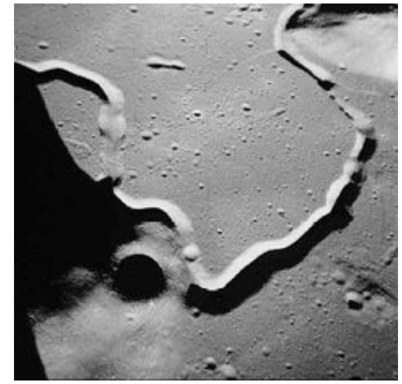
number of craters per unit area on a surface

Younger Surfaces:	Older Surfaces:
• low crater density • fresher looking craters	• more time to collect impacts • higher crater density • older, degraded craters • saturation - new ones cover old

Crater density gives relative ages across a body calibrated for the Moon only via lunar sample dating



An "old" surface on the lunar farside (4.0 billion yrs)



A "new" surface: Hadley Rille (3.2 billion yrs)

Absolute Ages from Radiometric Dating

- *unstable* isotopes
  - an unstable isotope is a form of an element with too many, or too few *neutrons*.
  - example: ^{12}C (6p, 6n) is 'normal' while ^{14}C (6p, 8n) has two extra neutrons, and is *unstable*
- radioactive decay
  - i.e. neutron changes to a proton+electron
  - occurs at random, but with well defined average rate
  - **half life** = time for 1/2 of the unstable isotopes to decay
    - intrinsic property of atomic nuclei
    - unchanged over time
    - specific for a given decay channel
- example: $^{40}K \rightarrow {}^{40}Ar$; half life = 1.25×10^9 yr

		1 half-life	2 half-lives	3 half-lives	4 half-lives
Element	**Start**	**1.25 Gyr**	**2.5 Gyr**	**3.75 Gyr**	**5.0 Gyr**
Potassium 40	1000	500	250	125	62
Argon 40	0	500	750	875	938
Ratio K/Ar	--	1	0.33	0.14	0.067