Planetary Geology

- 10-24-2005

Opening Discussion

- Have you seen anything interesting in the news?
- http://www.space.com/scienceastronomy/051018_science_
- http://news.yahoo.com/s/space/20051021/sc_space/whens
- Drake equation estimating the probability of life.
- Pragmatic vs. philosophical implications of planets being common.
- Religion and science. An omnipotent being makes anything explainable.
- Flipping of the Earth's magnetic field.
- Planet orbits in binary star systems. Figure 8s would not be stable.

More Minute Essays

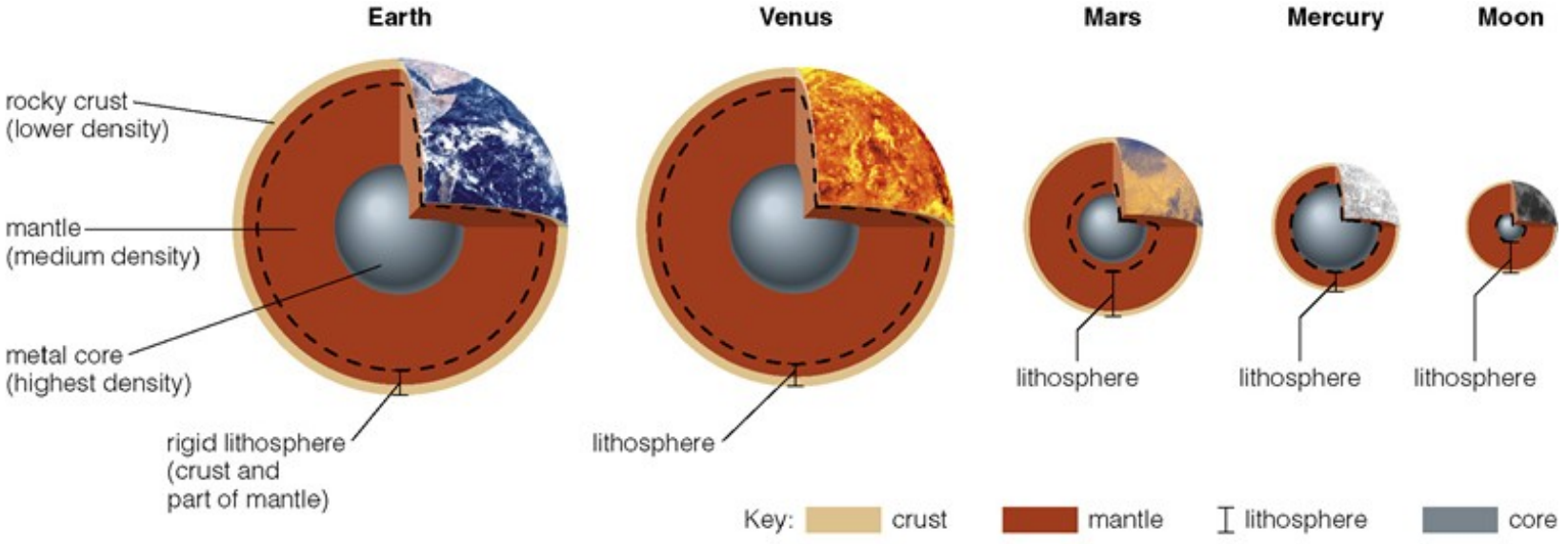
- Terraforming planets in a solar system formed from a massive disk.
- What would Earth be like if it were the size of Jupiter?

Extrasolar Planet Comments

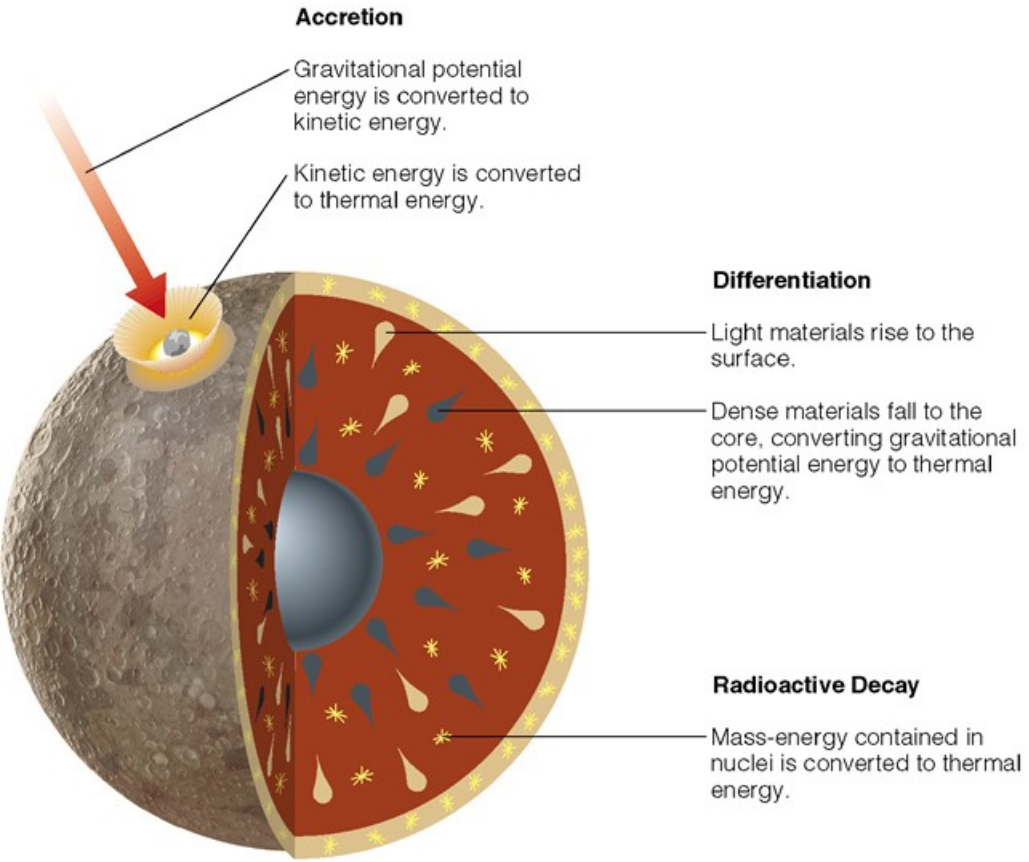
- Nebular drag and waves migrating planets.
- Extrasolar systems. We have found a few stars with more than one planet around them. These are some of the more interesting cases and give us significantly more information about formation models.
- Direct detection: transits and imaging.
- Detecting life: direct imaging goes with spectra and that could detect molecules that aren't stable through geological processes.

Planetary Interiors

- Terrestrial planets have crust, mantle, and core (sorted by density). We know about interior structure of Earth and Moon from quake data. Orbiters give us distribution information for other planets.

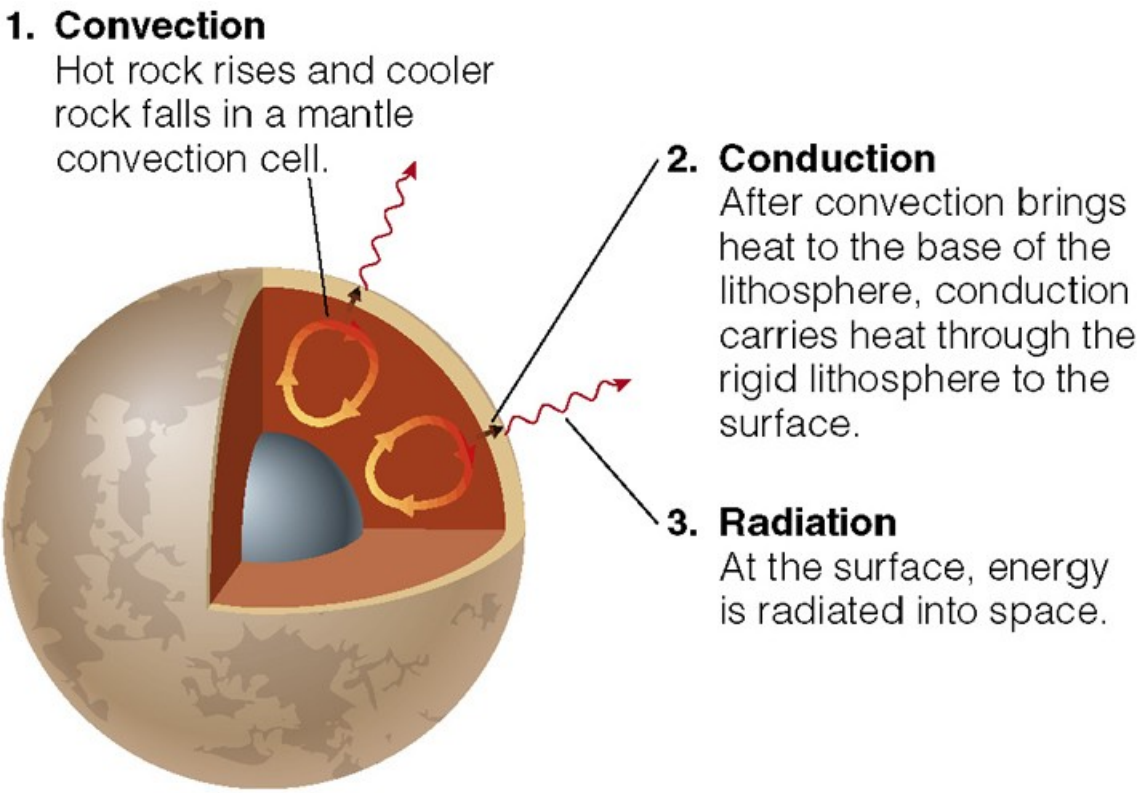


Sources of Heat



- Geology is driven by internal heat. This heat comes from accretion, differentiation, and radioactive decay.
- The first two are basically converting gravitational potential energy to thermal energy. The third converts mass energy to thermal energy.
- All three of these are greater for bigger planets.

Dissipating Heat

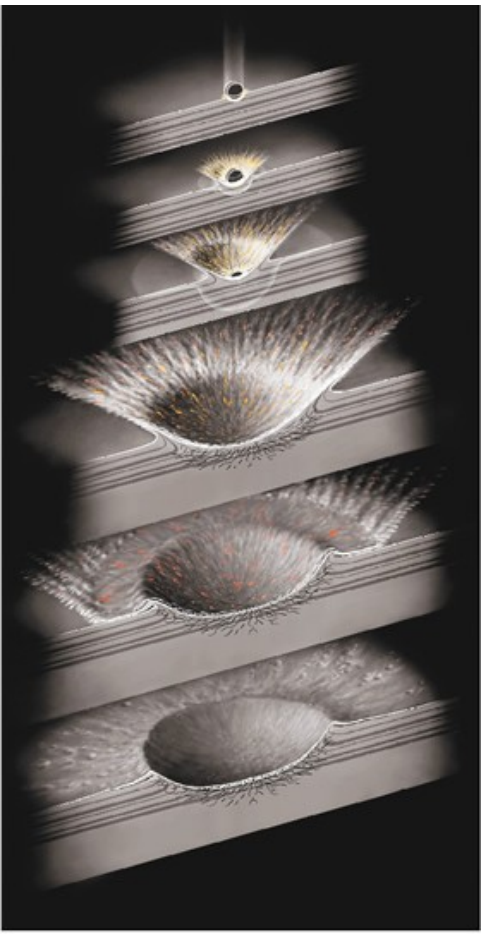


- Energy is constantly escaping from the surface of the planet through thermal emission. This keeps the surface layers cooler and heat moves outward over time.
- I fluid material convection does th moving of heat. In solid material it moves through conduction. Dissipating heat drives a lot of geology. Big planets cool more slowly.

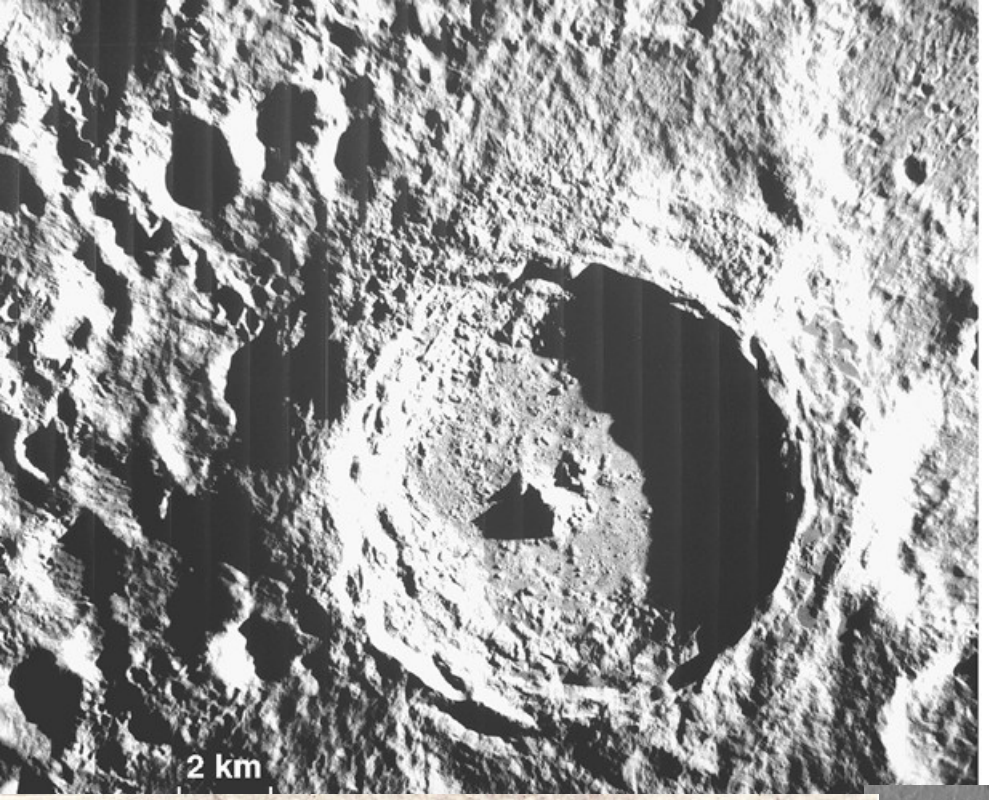
Four Geological Processes

- What we see of planets is just their exteriors. There are a lot of features that can be formed on planetary surfaces, but they all come about because of four basic processes: impact cratering, volcanism, tectonics, and erosion.
- The interaction of these four is what determines the types of features that we see on the surface of a planet.

Impact Cratering

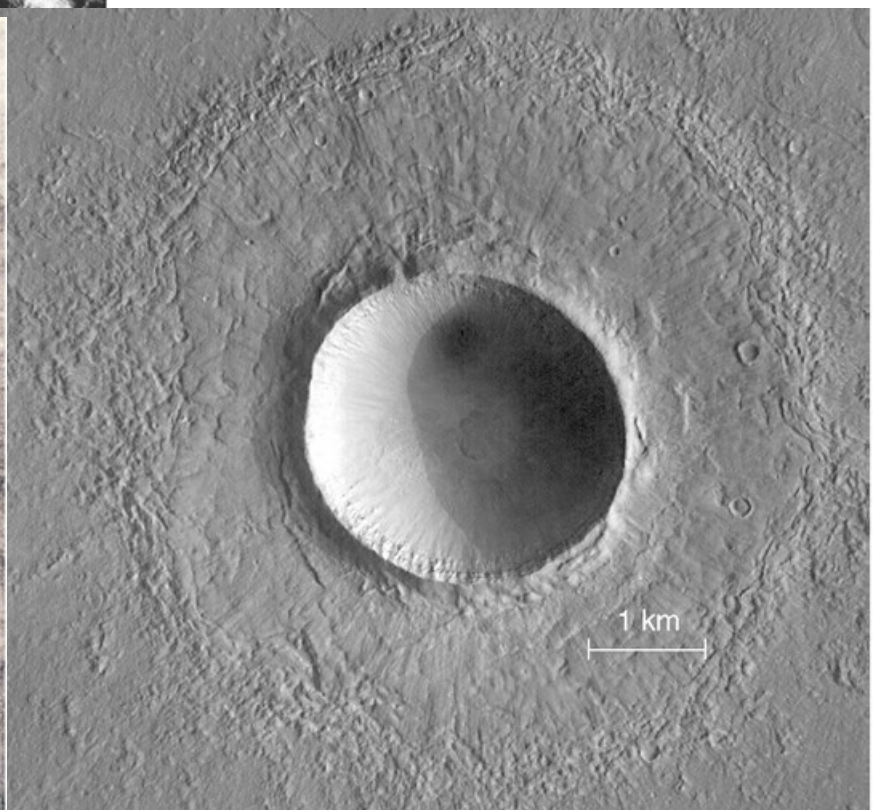


- During the heavy bombardment, the terrestrial bodies were being pelted with debris, large and small, on a regular basis. Since that time the rate of impactor has decreased, but it is not zero.
- Impact speeds are typically in the tens of thousands of km/hr. Impactors typically make craters 10 times larger across than the impactor and 1-2 times as deep.
- The number of craters we see on a surface tells us about the age of the surface. All terrestrial bodies should have undergone the same cratering history. The question is whether that history has been removed.



Example Craters

- Structure of craters can tell us about the local geology.

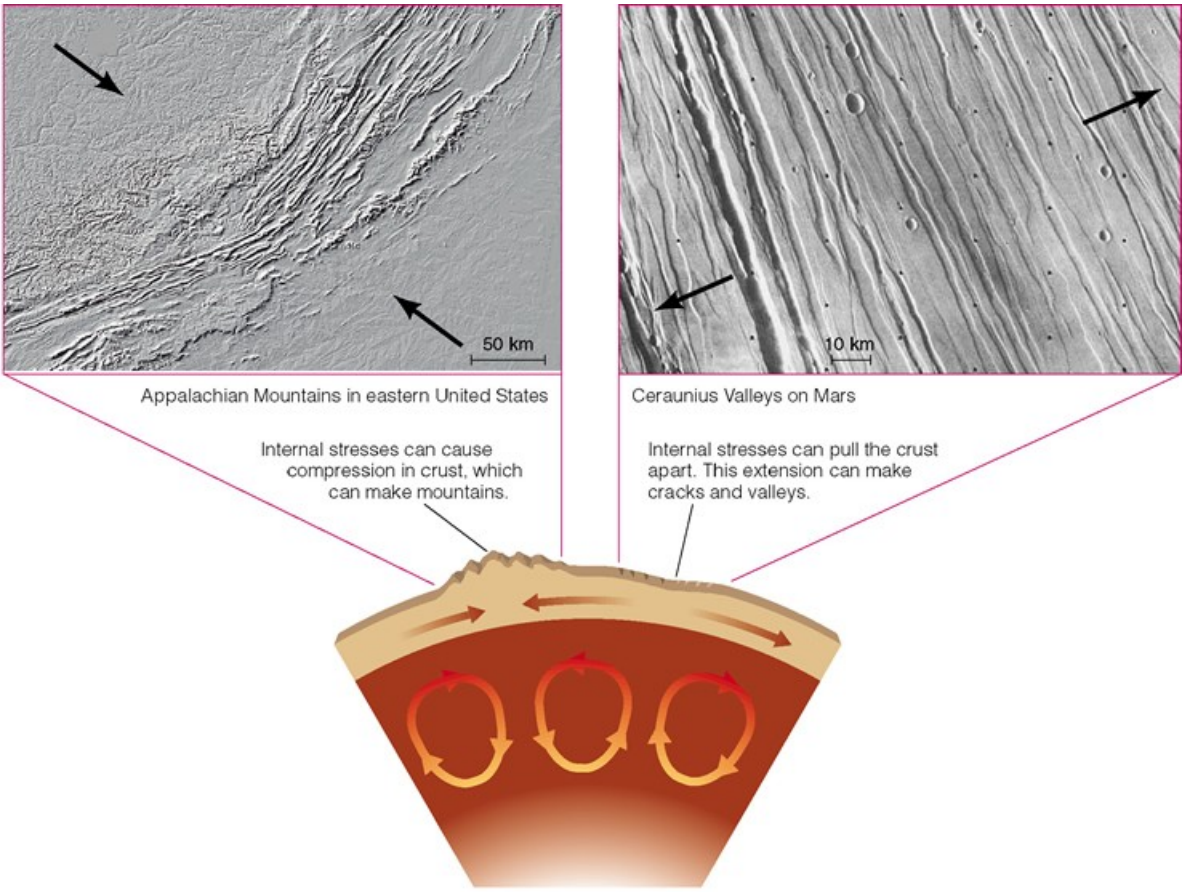


Volcanism

- Volcanism is the process of magma rising to the surface of a planet and flowing out as lava.
- Depending on the viscosity of the material, you get basins, shield volcanoes, or stratovolcanoes.
- Outgassing from eruptions is also significant for planets as it provides volatiles to the surface. These become oceans and atmospheres.

Tectonics

- Mantle convection drives tectonic activity by pushing the lithosphere around.



Minute Essay

- What did we talk about today?
- Callie turns 21 tomorrow. Make sure she celebrates it proper Trinity style.