AST 105
Intro Astronomy
The Solar System
Continuing:
Planetary Geology
Earth and the Other Terrestrial Worlds
Terrestrial Worlds - Interiors & Surfaces
Anatomy of a Planet

If defined by **DENSITY**

- **Core**
  - *Metals* *(Iron, Nickel)*

- **Mantle**
  - *Medium-density Rocks* *(Silicates: quartz, olivine)*

- **Crust**
  - *Low-density rocks* *(Granite, Basalt)*
Anatomy of a Planet

If defined by **STRENGTH**

- **Lithosphere**
  - Outer layer of cool, rigid rock
- **Everything else**
  - The warmer, softer rock that lies beneath
Processes that HEAT planets

- Accretion
- Differentiation
- Radioactive Decay
Transporting **HEAT away** (i.e. **COOLING**)

1. **Convection**
   Transportation of thermal energy as hot material rises and cold material falls (in the mantle)

2. **Conduction**
   Transportation of thermal energy from hot material touching cold material (in the lithosphere)

3. **Radiation**
   Transportation of thermal energy as light (at the surface)
Lithosphere: The outer, cool, hard layer of a planet. Which planet should have the thickest lithosphere (in terms of percent of the planet’s overall radius)?

A. A large planet
B. A small planet
C. The lithosphere should always be the same percentage of a planet’s radius
D. Lithosphere thickness does not depend on size
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Role of Size

- Smaller worlds cool off faster and harden earlier
- Larger worlds hotter, thinner lithosphere
- Moon and Mercury are cold and “geologically dead”
Planets Have Three Basic ‘Fundamental Properties’

• Size (mass & radius)
• Distance from Sun
• Rotation rate

If you know these properties of a planet, you can predict nearly all other characteristics
4 Processes that Shape Surfaces

- **Volcanism**
  - Eruption of molten rock onto surface

- **Impact cratering**

- **Tectonics**

- **Erosion**
• Convection heats upper mantle
  - Raising magma towards the surface
Runny Lava

*floods areas to make mostly flat surfaces*

Lava plains (maria) on the Moon

Lunar “Maria”
What happens when the lava is not so runny?
Shield Volcanoes around the Solar System

Sapas Mons (Venus)  Hawaii (Earth)  Olympus Mons (Mars)
Volcanism also releases gases from planetary interiors into (creating) the atmosphere.
Which planet(s) should have the most volcanism? (be prepared to say why!)

A. Mercury
B. Venus
C. Earth
D. Moon
E. Mars
4 Processes that Shape Surfaces

• **Volcanism**
  - Eruption of molten rock onto surface

• **Impact cratering**
  - Impacts by asteroids or comets

• **Tectonics**

• **Erosion**
Impact Cratering

- Most impacts happened soon after solar system formed
  - Period of heavy bombardment

- Small craters greatly outnumber large ones
Impactors hit Earth at high speeds

~30 km/s
~70,000 mph

HUGE Kinetic Energy!!

• Produces Heat
• Excavation

Craters are typically about 10 times wider than object that made them, and about 10-20% as deep as they are wide.
Earth (Arizona)
Meteor (Barringer) Crater
50,000 years old
Impact Craters on the Moon

Tycho Crater

85 km
Manicouagan Crater
214 million years old
180 km in diameter!
What do craters tell us about surface ages?
Compare numbers of lunar impact craters on maria (dark) vs highlands (light). Which **surface** is younger?

A. The highlands  
B. The maria  
C. We can’t tell  
D. They both are the same age (4.5 billion years old)
Less craters means **younger surface**

- Means the surface has been ‘repaved’ since the period of heavy bombardment
- *Not a younger planet!!*
Impact Craters on Mars

“standard” crater  impact into icy ground  eroded crater

Crater shapes can reveal surface conditions
Mercury and the Moon are considered geologically "dead" because geological processes have virtually stopped.