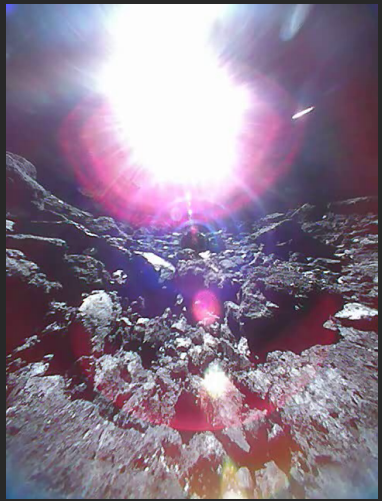
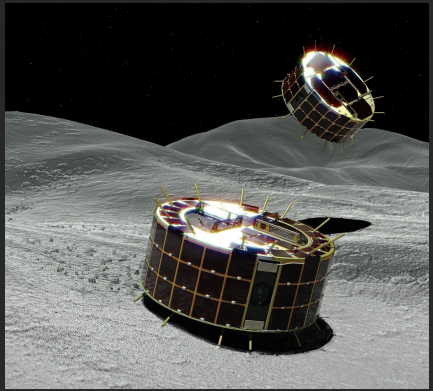
Announcements

- I'm aiming be able to hand back and talk about the test hopefully on Wednesday, definitely by Friday
- WebWorK due on Wednesday!
- Lab this week: Group A
- Polling: `rembold-class.ddns.net`

More on the Minerva rovers!





Review Question

All of the following statements characterize the 4 planets closest to the Sun *except* which one?

A. They are all fairly small
B. They are all rocky
C. They all have largely circular orbits
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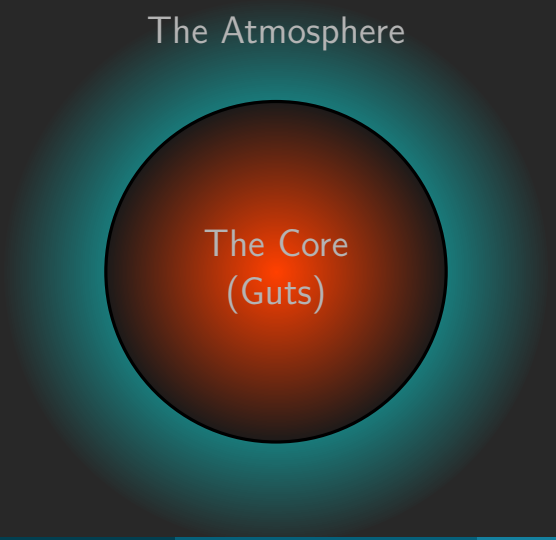
The Parts of Earth



The Core: Earth

- Undoubtably the core we know the most about
- Largely determined by testing with seismic waves
  - Density alters wavespeed
- Consists of a:
  - Metal Core: part solid, part molten
  - The Mantle: mostly solid rock
    - Undergoes convection
  - The Lithosphere: Crust + top of mantle

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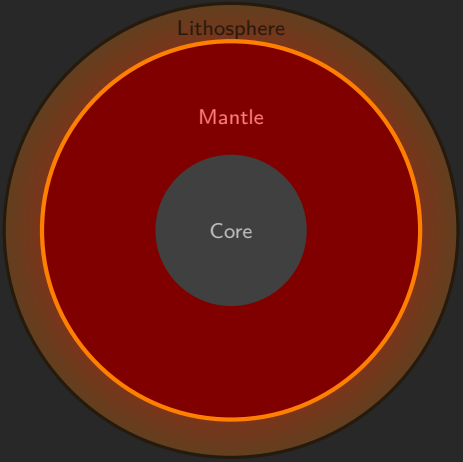
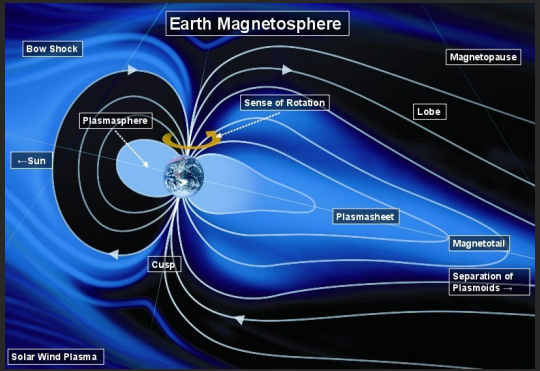


Lava lives here!

Enter Magneto

- Molten metal in core swirls, creating magnetic field
- Field interacts with solar wind
- Flow around into poles or entirely miss Earth
  - Aurora!
- Side furthest gets stretched out due to solar wind



Earthbending 101

- On the surface, we generally have 4 different ways to shape the Earth:
  - Cratering

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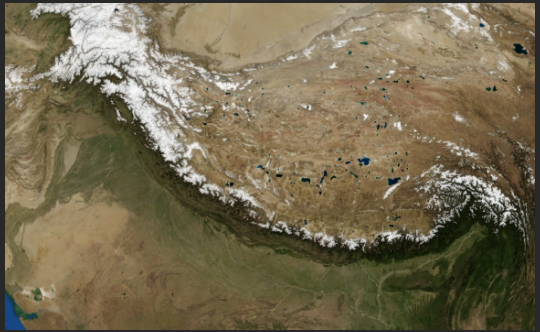

Earthbending 101

- On the surface, we generally have 4 different ways to shape the Earth:
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  - Volcanos
  - Tectonics
  - Erosion

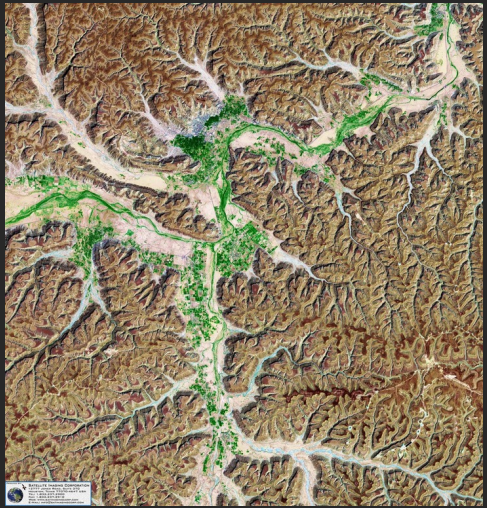
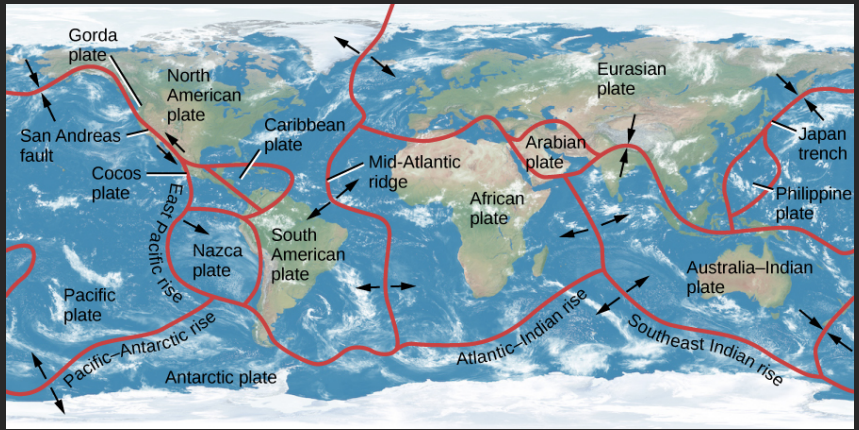


Plate Tectonics

- Create long mountain ranges
- Can also create volcanic mountain chains



Volcanos

- Forms singular peaks
- Can form chains if tectonics present
- Can occasionally also form lava plains

Seeing > Believing

What we see on the surface can give us information about parts of the planet that we can't see!

- Craters
  - Give us information on the presence or thickness of an atmosphere
- Volcanos/Tectonics
  - Give us information about the activity of the mantle/core and its temperature
- Erosion
  - Gives us information about the weather conditions and presence of liquids

Though the Ages

The ordering or layering of all these features can give us a timeline of the planet's past!

Understanding Check

Suppose you observe a planet or moon that seems to have no evidence of extended mountain ranges. You might conclude any of the following except what?

A. The planet has no hot interior on which plates could float
B. The planet has a very thick or strong crust that has not broken into plates
C. The planet is so heavily bombarded or volcanically active that mountain ranges have been erased
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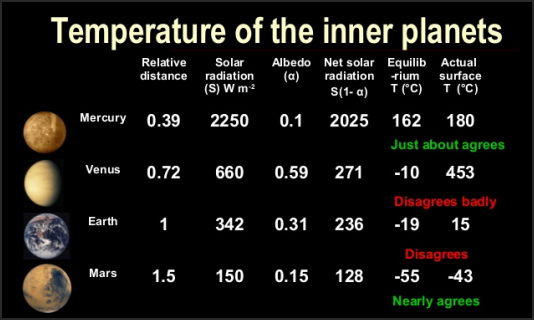
Atmospheres: What are they good for?

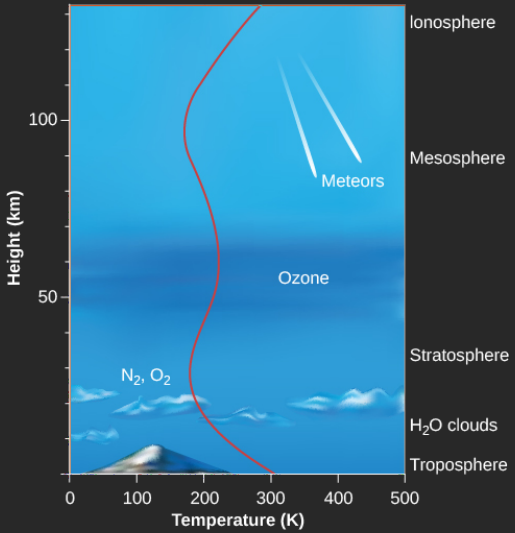
- What has your atmosphere ever done for you?
  - Protects from harmful solar radiation (UV and X-rays)
    - X Rays due to any atom
    - UV due to Ozone
  - Protects from harmful space debris (asteroids)
  - Greenhouse gases (Earth would be frigid without!)



Temperature of the inner planets

	Relative distance	Solar radiation (S) W m^{-2}	Albedo (α)	Net solar radiation S(1- α)	Equilib -rium T (°C)	Actual surface T (°C)	
Mercury	0.39	2250	0.1	2025	162	180	Just about agrees
Venus	0.72	660	0.59	271	-10	453	Disagrees badly
Earth	1	342	0.31	236	-19	15	Disagrees
Mars	1.5	150	0.15	128	-55	-43	Nearly agrees

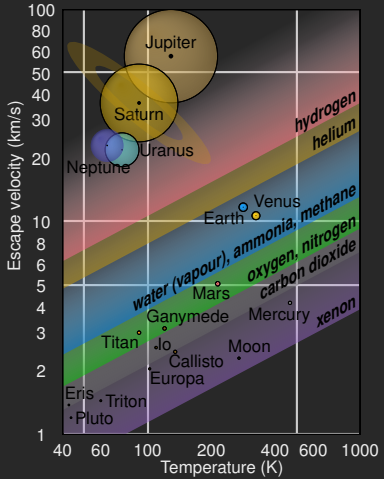
Properties of our Atmosphere



- Comprised of several layers
- Density decreases quickly as you go up
- Flights operate in Troposphere
- "Edge of Space" considered at 100 km
- Ozone heats because of absorbing Sun's UV radiation

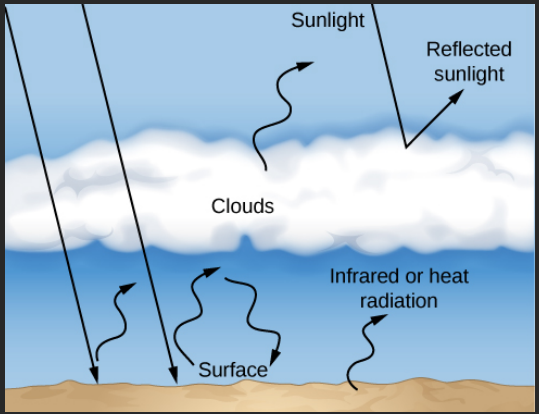
Too Hot to Handle: Atmospheric Leakage

- As gases get warm, they move faster
- Lighter gases speed up quicker
- If they move too fast, they escape the planets gravity and leave!
  - Large, cold planets can keep their gases
  - Small, hot planets slowly lose their gases!



Greenhouse Effects

- Certain gases reflect energy and heat back to Earth, trapping it
- Results in a higher temperature than would be predicted from equilibrium
- Water vapor and CO_2 the largest contributors



Where are the Craters?

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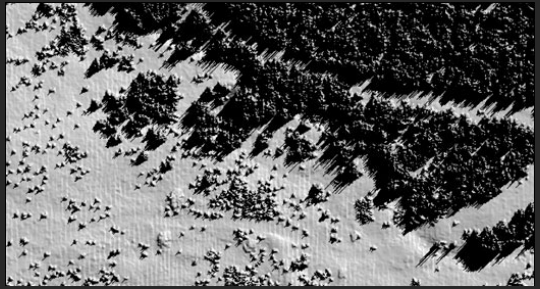
- But not nearly so many as the Moon
- Atmosphere not thick enough to protect us from the big ones



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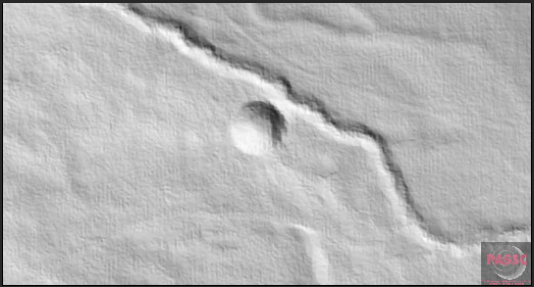

Lots Hidden from View

“Recent” Events

- Tunguska Explosion (1908)
  - Exploded in air
  - Shockwave flattened a thousand square kilometers of forest
- Chelyabinsk Explosion (2015)
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  - Threatened an attack

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