Lecture 9:

The Earth We Stand On

Astronomy 141 – Winter 2012

This lecture describes the interior structure of the Earth and its crust.

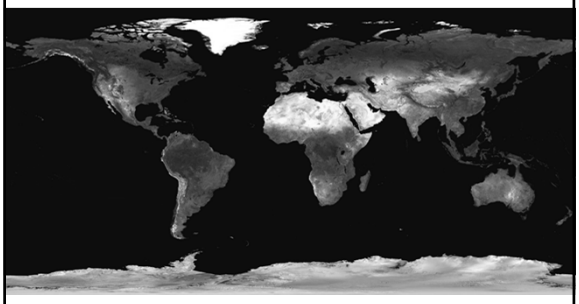
The Earth's interior is strongly differentiated into a solid iron inner core & molten iron outer core, and a Thick, rocky mantle & thin, rocky crust

The Earth's Magnetic Field is generated by convection currents in the molten outer core.

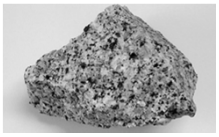
The Earth's crust is broken into 16 rigid tectonic plates.

The plate boundaries are the locations of earthquakes, volcanoes, and the recycling of crustal rocks.

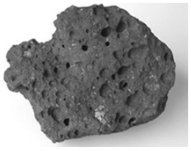
The Earth's surface is mostly oceans (~71%) with 29% land surface.



The surface composition of the Earth is mostly silicates, iron-rich basalts, and carbonaceous rocks.



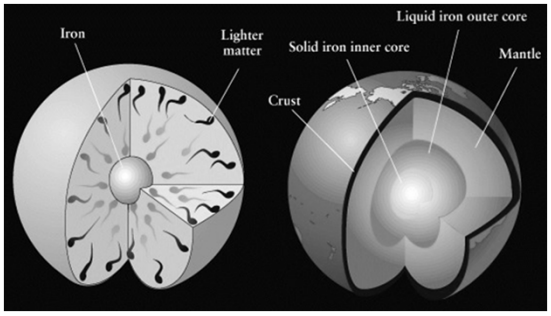
Silicate Rocks (granite, quartz)



Iron-rich Rocks (basalts)

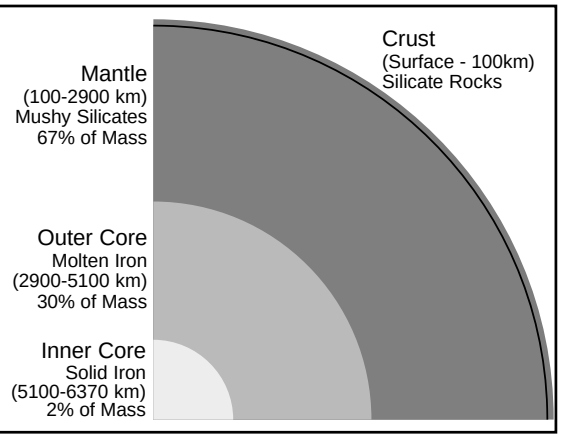
Carbonaceous Rocks (limestone)

The inside of the Earth is hot, dense, and strongly differentiated into light silicates and heavy metals.



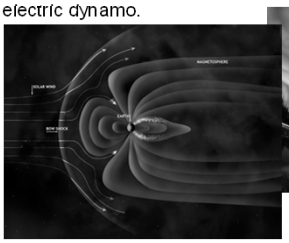
Original Mix

Current Differentiated State



The Earth's magnetic field is generated by convection currents in the molten outer core.

The flowing electrically conducting iron fluid sets up an electric dynamo.

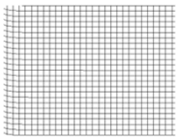


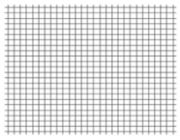
Aurora borealis

This generates a strong magnetic field that extends out into interplanetary space.

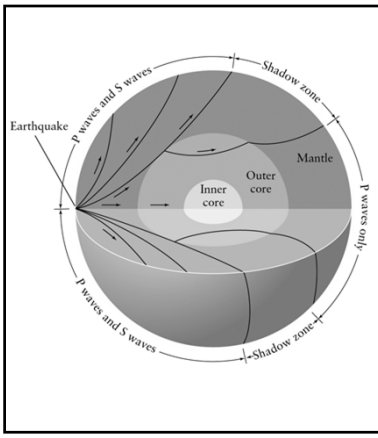
Earthquakes create Seismic Waves that pass through the Earth.

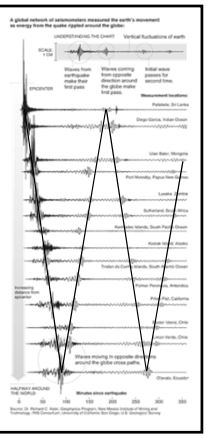
S-waves are Shear waves that pass through solids, but are reflected/absorbed by liquid (molten) regions.





P-waves are Pressure waves that pass through both solid & molten regions.

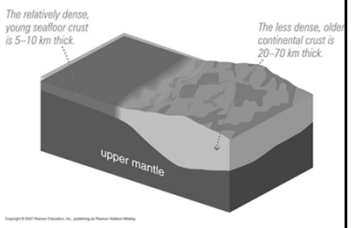




The Crust of the Earth is broken into 16 rigid plates that float on top of the Mantle.

Oceanic Plates are young & thin (5-10km)

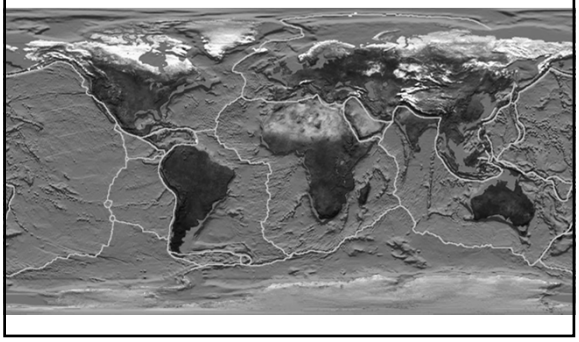
Continental Plates are old & thick (20-70km)



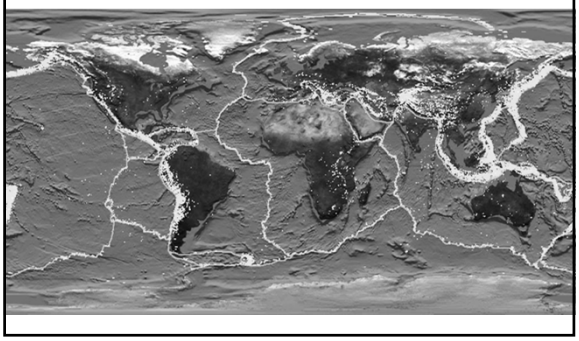
Plates float on a complex transition zone where basaltic lavas form.

Lubricates the bottoms of the plates, allowing them to slide around…

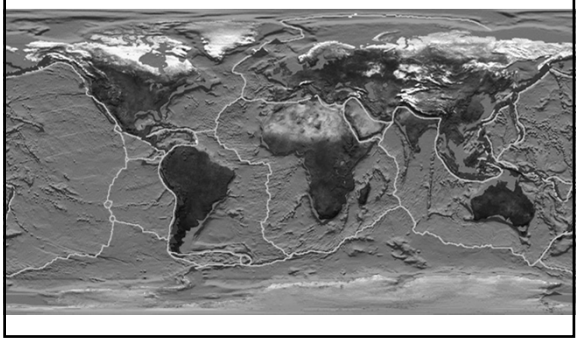
The Earth's Tectonic Plates



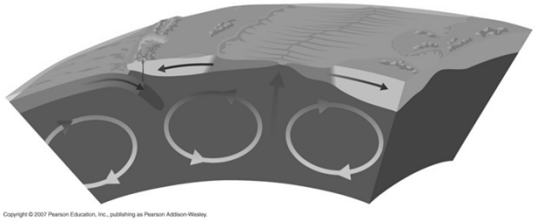
Earthquakes occur mostly along plate boundaries (but not always).



Most the Earth's active volcanoes are located near plate boundaries.



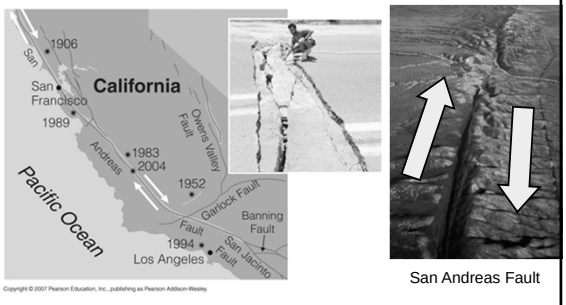
Tectonic plates slide around over the Mantle, driven by convection currents in the Mantle.



Speeds are a few centimeters per year.

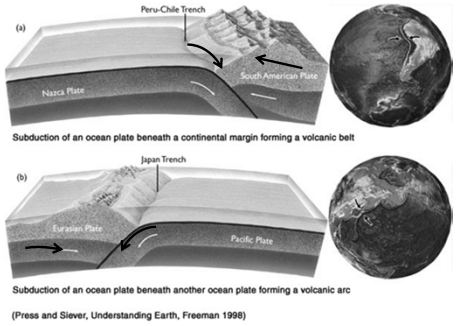
Plates can slide laterally past each other, collide, or diverge.

Transform Boundaries are where two plates slide laterally past each other.



San Andreas Fault

Convergent Boundaries are where two plates collide, with one plate *subducting* under the other.

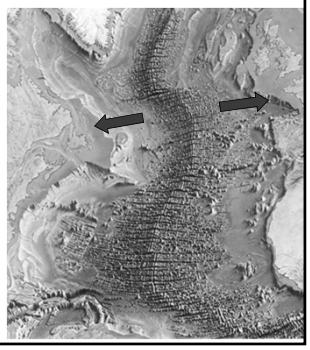


Divergent Boundaries are where two plates are moving away from each other.

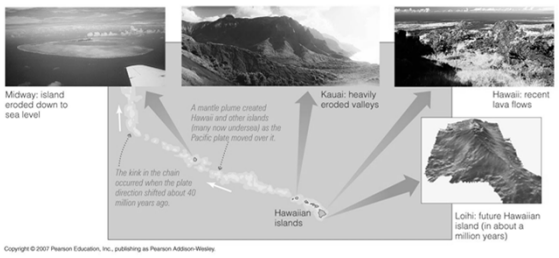
New crustal rock is created at the junction.

Within continents, they form *Rift Valleys*.

Between oceanic plates,they form *Mid-Ocean Ridges*.



Hot spots can form in the middle of a plate, building chains of shield volcanoes as the plate slides over it.



Hawaiian Island Chain

The Earth is a dynamic, evolving planet.

The Earth's surface has been reshaped by tectonic & weather forces acting over billions of years.

Most of the surface is relatively young (few 10s to 100s of Million years old).

It is still active today because its interior is still hot, most (80%) of the heating coming from radioactive decay.

The Earth's tectonic activity may be an important factor in its habitability…