Geology 100

Professors:

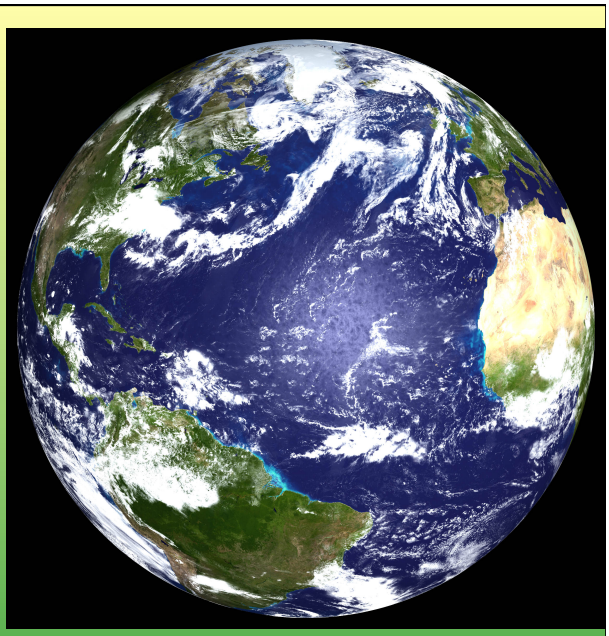
C. DeMets

B. Singer

TAs:

E. Heckler

S. Johnson



www.geology.wisc.edu/~chuck/Classes/Geo100

"*Our physical environment is fundamentally interesting. To know it is a pleasure, to understand it is a joy…*" J. H. Bretz, originator of controversial, but now accepted hypothesis for the channeled scablands landscape of the Pacific Northwest and winner of Geol. Soc. of America's highest award.

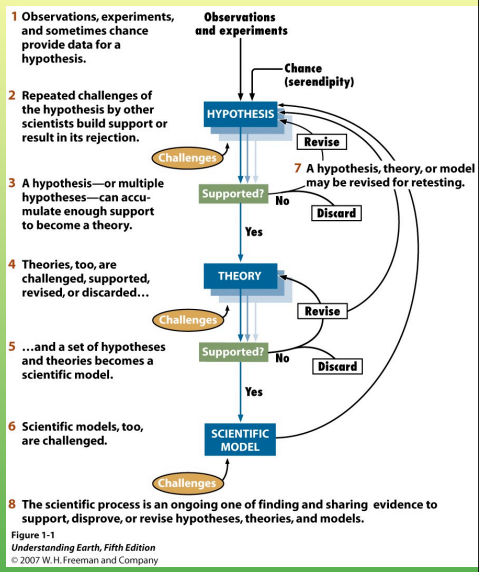
You are only 1000 miles from some of the most amazing geology on Earth. Drive west into ANY national or state park. Turn off the car ignition. Turn off your iPod and cell phone. Get out and walk… You will see why geology is relevant and fun

- Course information
- Scientific method
- Shape and surface of Earth
- Geologic record
- Earth's interior
- Earth systems
- Geologic time

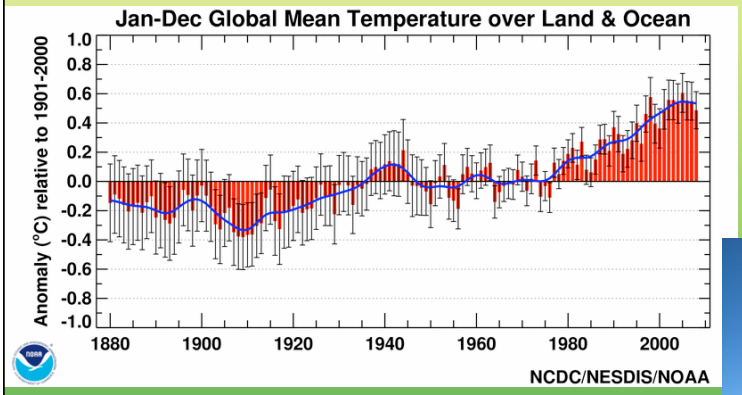
***The scientific method*:**

Make reasonable guesses at explanations for observed phenomena based on **evidence** that can be **reproduced** by others. Hypotheses are tested against more evidence and discarded or modified if wrong.

Criticism abounds – goals are rarely achieved – difficult to get funding for research – years to decades may be required to complete single project



Geoscientific research provides factual information essential for vital policy and environmental decisions



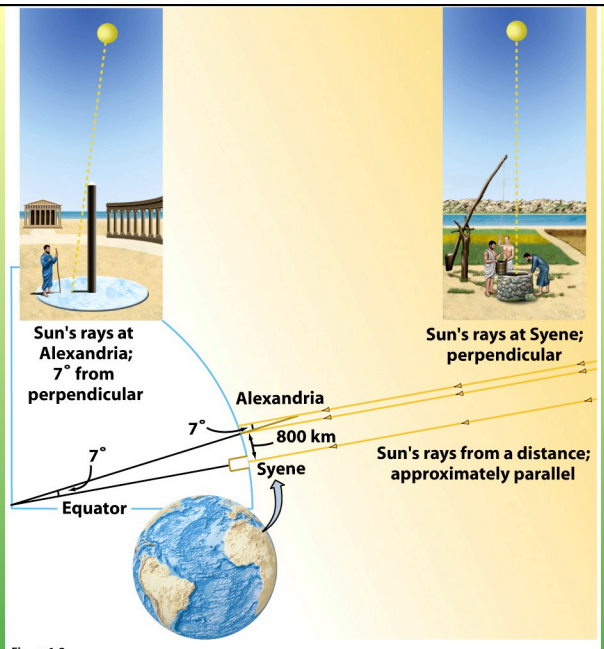
1875 to 1/1/2009 global mean temperature (above)

Oil derrick (right)

"Earth" science has a long history…

Shape of Earth

The Greeks first showed that Earth is spherical and estimated its circumference to be 40,000 km. Based on shadows and angles…. Eratosthenes – 250 B.C. – see text.



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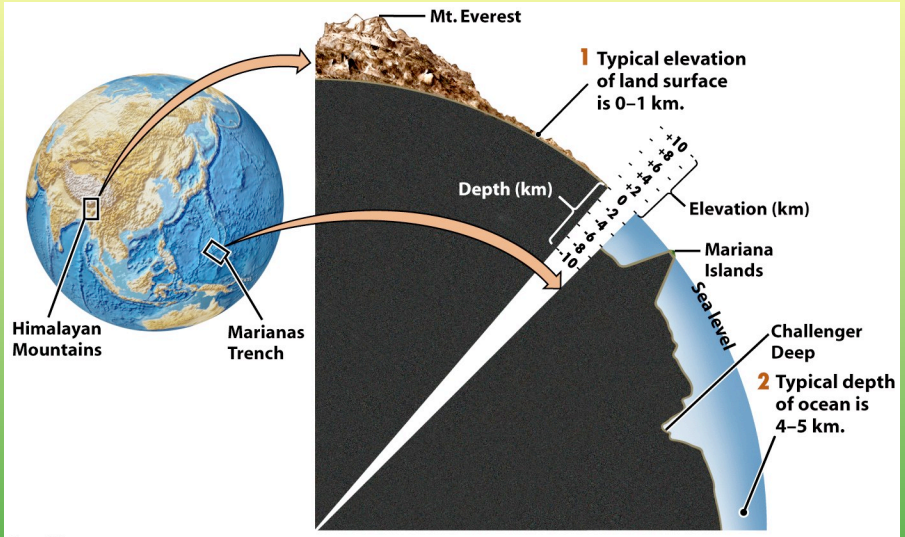

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Uniformitarianism

James Hutton

Principle that processes we see today have been much the same in the geologic past. Geologic record is product of uniform processes through time.

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Uniformitarianism describes only some of the processes that yield the geologic "record".

Catatastrophic events also play a major role

Meteorites, tsunamis, earthquakes, hurricanes – major effects over short time scales.

Figure 1-4 right
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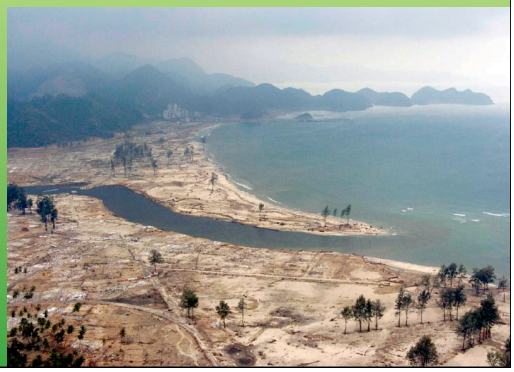
Sumatra tsunami – 12/26/04 - 300,000 dead – profound impact on coastal geologic record

***Left** – Before and after tsunami spawned by M=9.2 Dec. 26, 2004 Sumatra earthquake, Banda Aceh, Indonesia.*

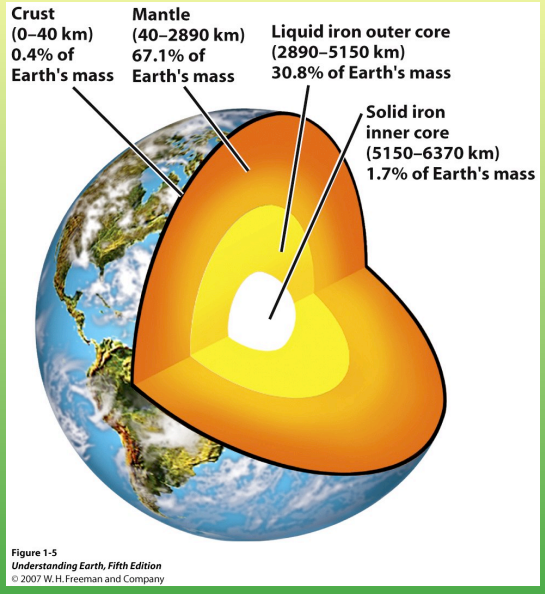
***Below** – After 12/26/04 tsunami, Aceh province, Indonesia*



What's inside the spherical shell ?

Crust, mantle, core (inner and outer)

Gravity too strong on surface to be caused entirely by "light" continental or oceanic rocks. Need denser interior.



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Hints about composition of interior from distinct types of meteorites that fall to Earth

Stony (at right)

Iron-nickel (beneath)

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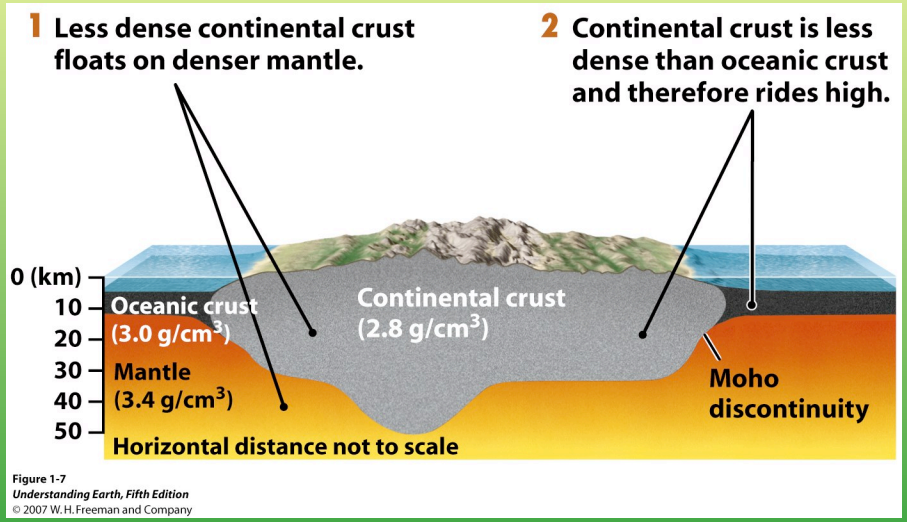
The outer 0.1%-1% of Earth consists of continental and oceanic crust that float on the denser mantle beneath



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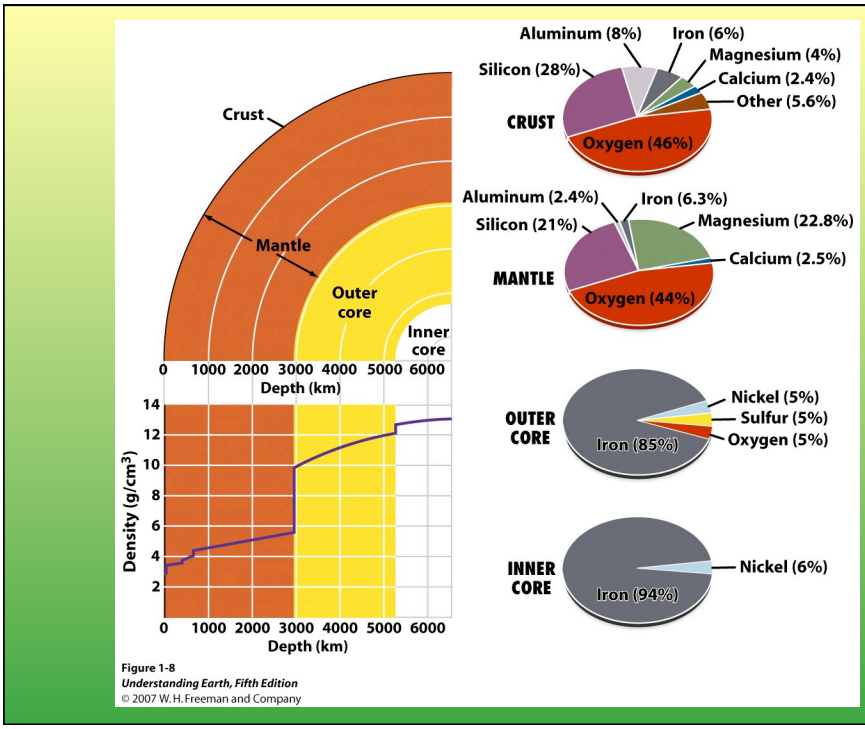

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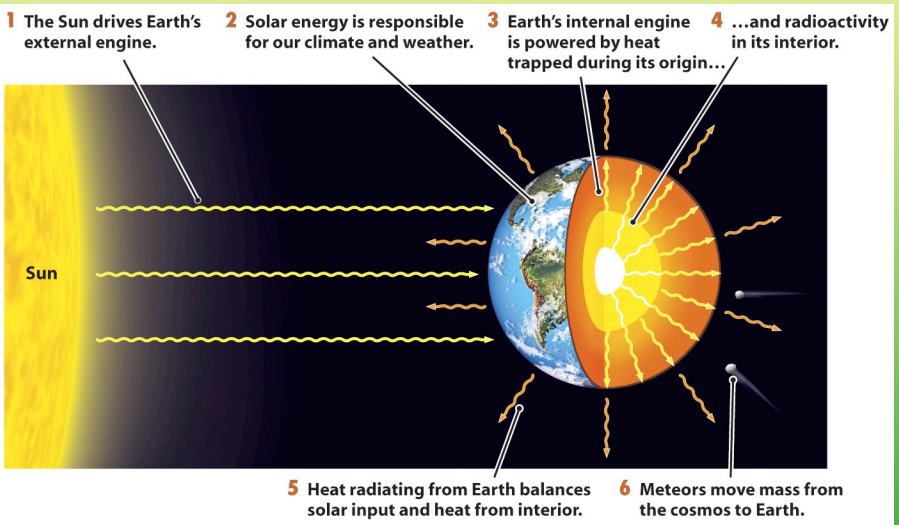
Heat - the key component that drives the dynamics of Earth's interior and exterior. Three primary sources – the sun, radioactive decay, primordial from birth of Earth



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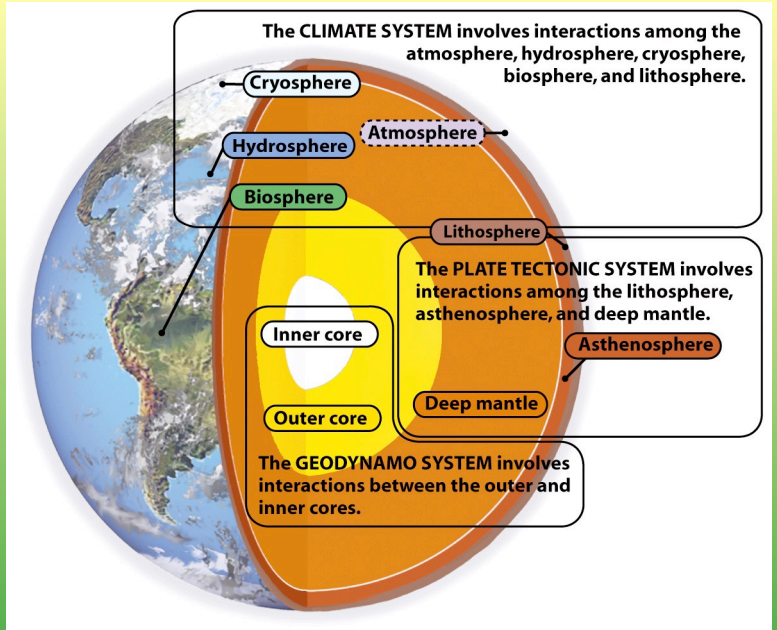

Figure 1-10 part 1
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Solar Radiation Energizes These Components	
Atmosphere	Gaseous envelope extending from Earth's surface to an altitude of about 100 km
Hydrosphere	Surface waters comprising all oceans, lakes, rivers, and groundwaters
Cryosphere	Polar ice caps, glaciers, and other surface ice and snow
Biosphere	All organic matter related to life near Earth's surface
Earth's Internal Heat Energizes These Components	
Lithosphere	Strong, rocky outer shell of the solid Earth that comprises the crust and uppermost mantle down to an average depth of about 100 km; forms the tectonic plates
Asthenosphere	Weak, ductile layer of mantle beneath the lithosphere that deforms to accommodate the horizontal and vertical motions of plate tectonics
Deep mantle	Mantle beneath the asthenosphere, extending from about 400 km deep to the core-mantle boundary (about 2900 km deep)
Outer core	Liquid shell composed primarily of molten iron, extending from about 2900 km to 5150 km in depth
Inner core	Inner sphere composed primarily of solid iron, extending from about 5150 km deep to Earth's center at 6370 km

Figure 1-10 part 2
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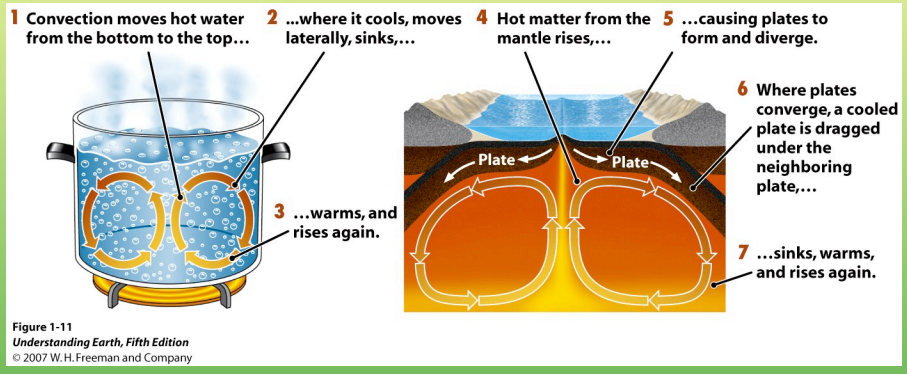
Heat flow from hot core to Earth's surface mostly occurs by convection – drives plate tectonics



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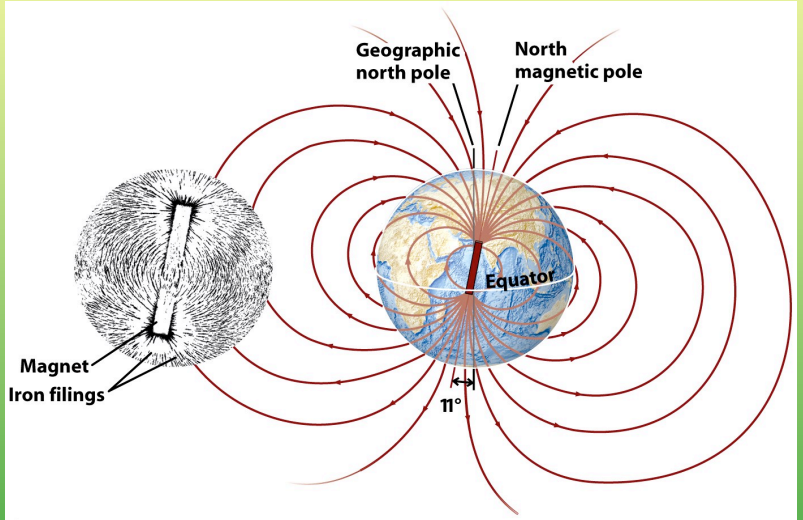
Liquid Fe and Ni circulation in inner core generate Earth's magnetic field – similar to field of a simple dipole (bar) magnet



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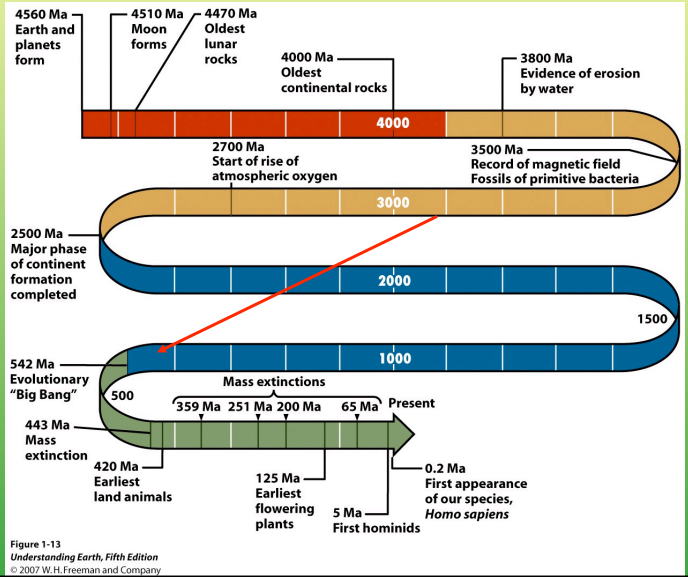
Concept of "deep" time in geology – billions of years for evolution of planet's surface, life, catastrophes and subsequent recoveries – TIME is the 4th dimension in the geological sciences.



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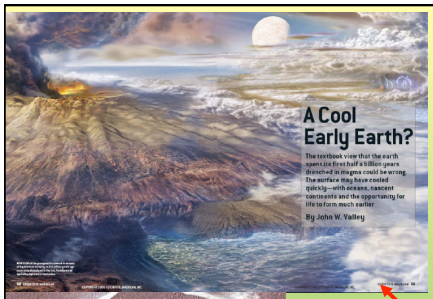

Life on Earth

Emerged when ?

Causes of mass extinctions ?

Interactions with minerals

Bacteria living on hematite mineral