

Essentials of Geology

Chapter 1



An Introduction To Geology



What is Geology?

Specialties of Geology related to the subsystems of Earth include:

Geochronology
Geochemistry
Mineralogy
Planetary Geology
Environmental Geology
Hydrogeology
Geophysics
Structural geology
Stratigraphy
Seismology
Oceanography
Paleontology

How Does Geology Affect our Everyday Lives?

- Natural Events
- Economics and Politics
- Our role as Decision-makers
- Consumers and Citizens
- Sustainable Development

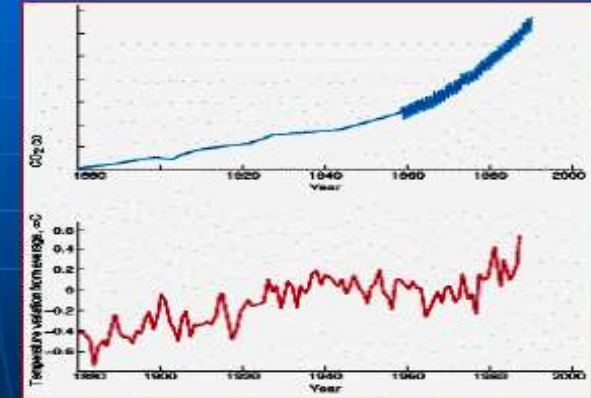
Global Geologic and Environmental Issues Facing Humankind



From a population of one billion at the beginning of the 19th century, our species now numbers more than six billion people.

Overpopulation ?

Global Geologic and Environmental Issues Facing Humankind

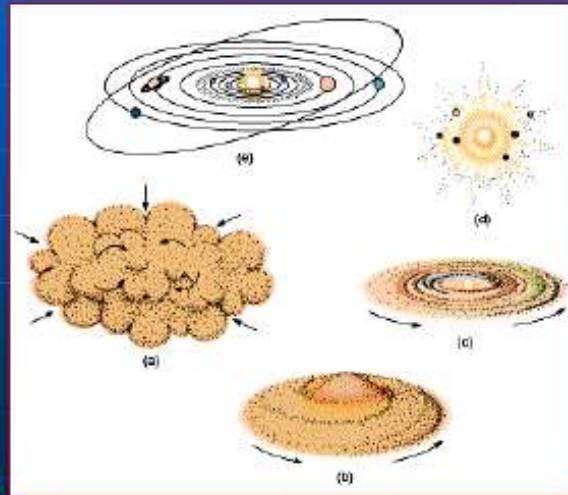


Global warming ?

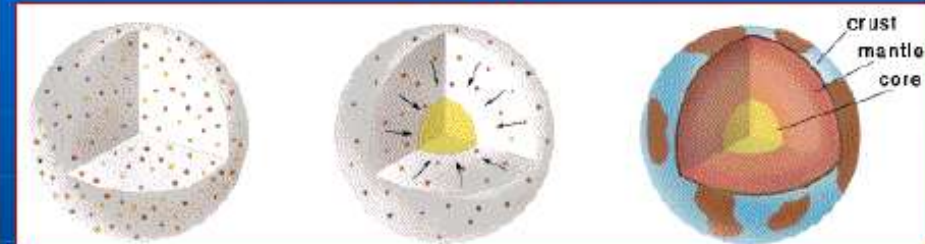
The Origin of the Solar System

Solar Nebula Hypothesis

- Condensation and collapse of interstellar material
- Flattening and rotation of cloud
- Accretion of planetesimals
- Birth of Sun



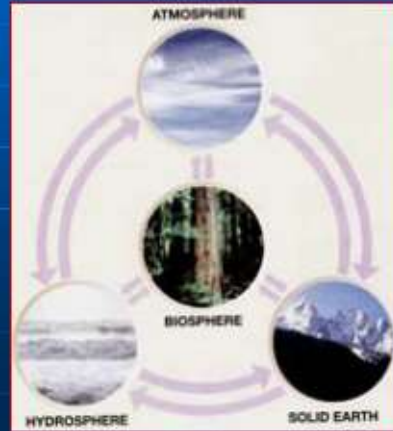
The Differentiation of Early Earth



Perhaps the most significant event in Earth history, the 'settling' of material according to density resulted in a layered Earth. This concentric arrangement of material led to the formation of continents, oceans, and the atmosphere.

A View of Earth

- Earth is a planet that is small and self-contained
- Earth's four spheres
 - Hydrosphere
 - Atmosphere
 - Biosphere
 - Solid Earth



The Core

- solid inner
- liquid outer
- density of 10-13 gm/cm³

The Mantle

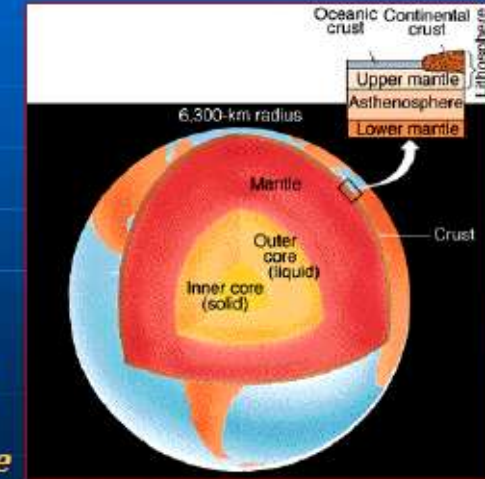
- surrounds the core
- density of 3.3-5.7 gm/cm³
- three distinct zones

The Crust

- oceanic - 3 gm/cm³
- continental - 2.7 gm/cm³

Plate Tectonic Theory explains the interactions of these zones

Why is Earth a Dynamic Planet?

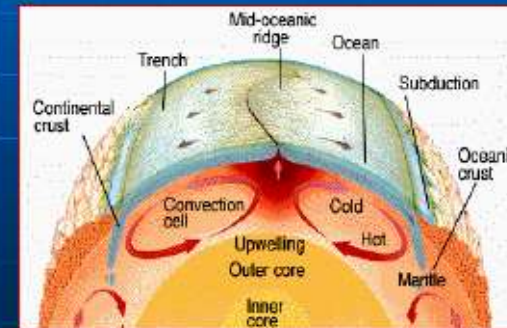


Geology and the Formulation of Theories

- Plate Tectonic Theory
- The Rock Cycle
- Organic Evolution
- Geologic Time and Uniformitarianism

These theories, supported by extensive research, are the cornerstones of the study of geology, and help explain many seemingly unrelated observations.

Plate Tectonic Theory



- The Formulation of Plate Tectonic Theory

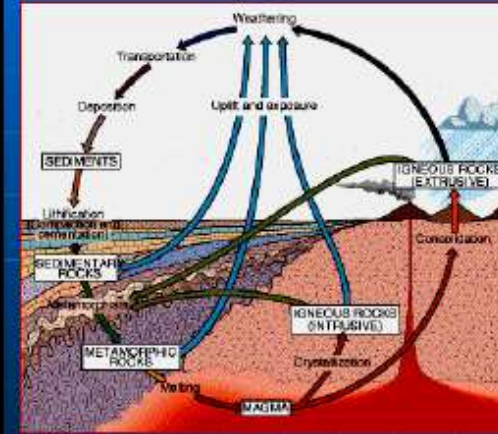
- Divergent boundaries
- Convergent boundaries
- Transform boundaries
- *convection cells*
- *subduction zones*

Plate Tectonic Theory



The Earth's lithosphere is divided into rigid plates of various sizes that move over the asthenosphere.

The Rock Cycle



- Provides a way to examine the relationships between internal and external processes
- Relates Igneous, Metamorphic, and Sedimentary rocks to one another and to the processes which 'recycle' earth materials

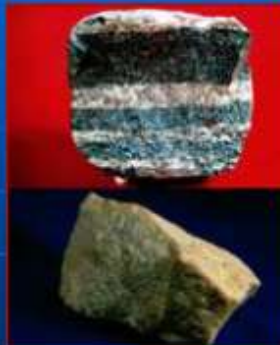
The Rock Cycle



Igneous rocks
basalt, granite



Sedimentary rocks
limestone, conglomerate



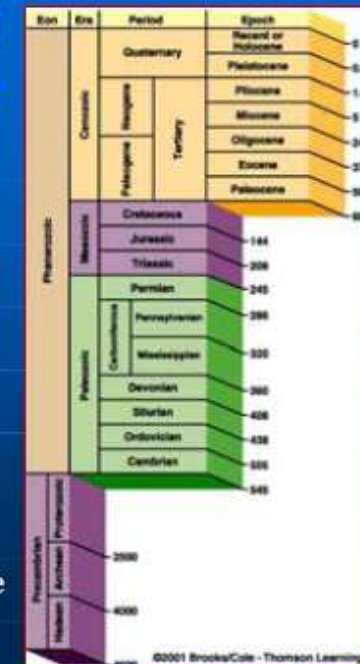
Metamorphic rocks
gneiss, quartzite

Geologic Time and Uniformitarianism

The perspective of geologic time requires a shift in our usual way of thinking.

The geologic time scale is the result of the collaboration of many earth scientists working together to construct a chronology of events on Earth.

The Principle of Uniformity holds that present day processes have operated throughout Earth's history, therefore we can better understand past events by studying modern processes.



How Does the Study of Geology Benefit Us?

An understanding of the dynamic nature of the planet allows us to:

- Appreciate the balance in delicate systems
- Make appropriate choices about our interaction with the environment
- Ensure that a quality future will be left to our children as we make difficult decisions regarding natural resource consumption

Santa Tecla-El Salvador 2000



The nature of scientific inquiry

- Science assumes the natural world is consistent and predictable
- Goal of science is to discover patterns in nature and use the knowledge to make predictions
- Scientists collect "facts" through observation and measurements

The nature of scientific inquiry

- How or why things happen are explained using a
 - Hypothesis – a tentative (or untested) explanation
 - Theory – a well-tested and widely accepted view that the scientific community agrees best explains certain observable facts

The nature of scientific inquiry

- Scientific methods
 - Scientific method involves gathering facts through observations and formulation of hypotheses and theories

• There is no fixed path that scientists follow that leads to scientific knowledge

