



**Essentials of Geology,
9th Edition**

An Introduction to Geology
Chapter 1
Lancaster High School
Mr. Hayhurst




What is Geology?

- Geology is the science that pursues an understanding of planet Earth
 - **Physical geology** - examines the materials composing Earth and seeks to understand the many processes that operate beneath and upon its surface
 - **Historical geology** - seeks an understanding of the origin of Earth and its development through time




What is Geology?

- Geology, people, and the environment
 - There are many important relationships between people and the natural environment
 - Some of the problems and issues addressed by geology involve natural hazards, resources, world population growth, and environmental issues




History of Geology

- Some historical notes about geology
 - The nature of Earth has been a focus of study for centuries
 - **Catastrophism**—The idea that Earth formed in a short period from forces that are no longer active from catastrophic events.
 - **Uniformitarianism**—The forces at work today have been at work throughout the Earth's history in a uniform manner.
 - and the birth of modern geology




Geologic Time

- Geologists are now able to assign fairly accurate dates to events in Earth history
- Relative dating and the geologic time scale
 - Relative dating means that dates are placed in their proper sequence or order without knowing their age in years



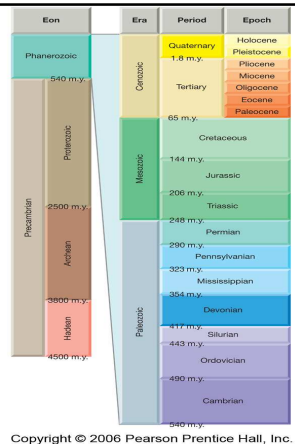
Geologic Time

- The magnitude of geologic time
 - Involves vast times – millions or billions of years
 - An appreciation for the magnitude of geologic time is important because many processes are very gradual



The Geologic Time Scale

- Divides geologic history into units
- Originally created using relative dates
- See handout (Figure 1.4 from text)



Copyright © 2006 Pearson Prentice Hall, Inc.

The Scientific Method

- 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 Scientific Method

- 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 Scientific Method

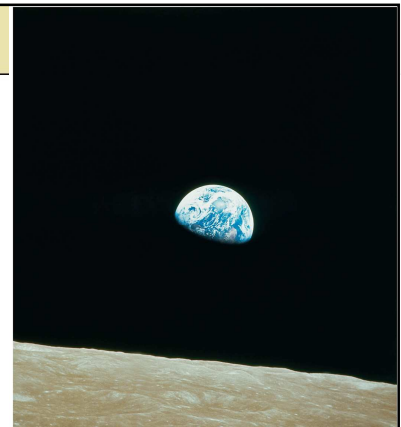
- Scientific methods
 - **Scientific method** involves gathering facts through observations and formulation of hypotheses and theories
- There is no fixed path that scientists follow that leads to scientific knowledge

Earth as a System

- Earth is a planet that is small and self-contained
- Earth's four spheres
 - **Hydrosphere**
 - **Atmosphere**
 - **Biosphere**
 - **Solid Earth (AKA Geosphere)**
 - Lithosphere
 - Asthenosphere

A View of Earth

- (from the Moon)
- Figure 1.6 A



Copyright © 2006 Pearson Prentice Hall, Inc.

Earth as a System



- Earth is a dynamic planet with many interacting parts or spheres
- Parts of the Earth system are linked
- Characterized by processes that
 - Vary on spatial scales from fractions of millimeter to thousands of kilometers
 - Have time scales that range from milliseconds to billions of years

Earth as a System



- The Earth system is powered by the Sun that drives external processes in the
 - Atmosphere
 - Hydrosphere
 - At Earth's surface

Earth as a System



- The Earth system is also powered from Earth's interior
 - Heat remaining from the formation and heat that is continuously generated by radioactive decay powers the internal processes that produce volcanoes, earthquakes, and mountains

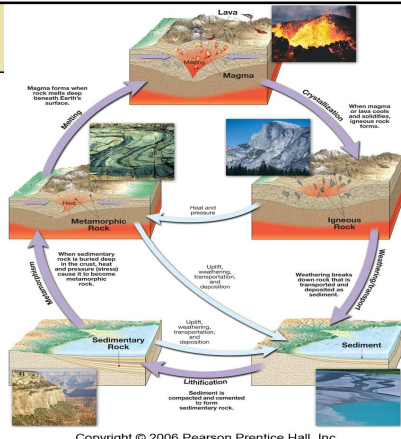
The Rock Cycle: Part of the Earth system



- The loop that involves the processes by which one rock changes to another
- Illustrates the various processes and paths as Earth materials change both on the surface and inside Earth

The Rock Cycle

- See Handout
- Figure 1.11 from text book



Early Evolution of Earth



- Origin of Earth
 - Most researchers believe that Earth and the other planets formed at essentially the same time
 - Nebular hypothesis
 - Solar system evolved from an enormous rotating cloud called the solar nebula
 - Nebula was composed mostly of hydrogen and helium

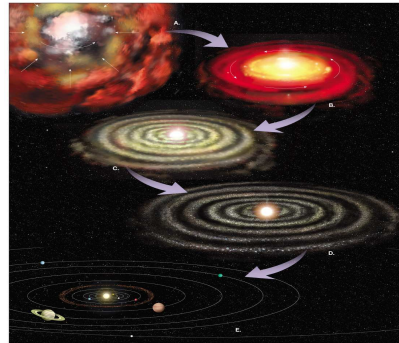
Early Evolution of Earth

- Origin of Earth

- Nebular hypothesis *continued*

- About 5 billion years ago the nebula began to contract
 - Assumes a flat, disk shape with the protosun (pre-Sun) at the center
 - Inner planets begin to form from metallic and rocky clumps
 - Larger outer planets began forming from fragments with a high percentage of ices

The Nebular Hypothesis



Earth's Internal Structure

- Earth's internal layers can be defined by
 - Chemical composition
 - Physical properties
- Layers defined by composition
 - Crust
 - Mantle
 - Core

Earth's Internal Structure

- Four main layers of Earth are based on physical properties and hence mechanical strength

- Lithosphere (the crust and the upper mantle)
 - Asthenosphere (all in the upper mantle)
 - Mesosphere (the lower mantle)
 - Core (inner core and outer core)

Earth's Internal Structure

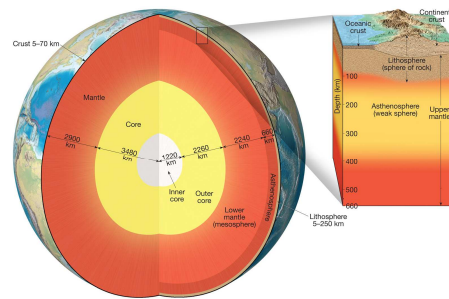
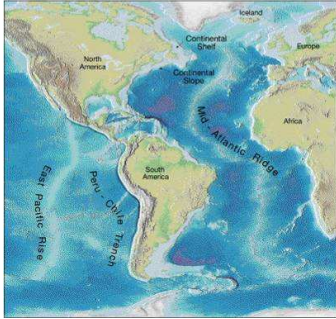


Figure 1.13

The Face of Earth

- Earth's surface

- Continents
- Oceans



The Face of Earth

- Continents

- Mountain belts

- Most prominent feature of continents
- Mountains provide visual evidence of enormous compressional forces that have deformed large sections of the crust



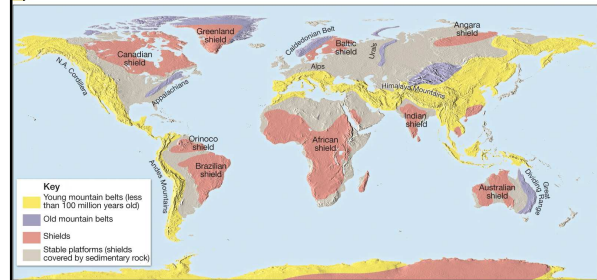
The Face of Earth

- Continents

- The stable interior

- Shields and stable platforms
 - Shields are large, relatively flat expanses of ancient metamorphic rock within the continental interior
 - The stable continental platforms consist of thick sequences of sedimentary strata that overlay thick sections of stable continental crust

The Face of Earth

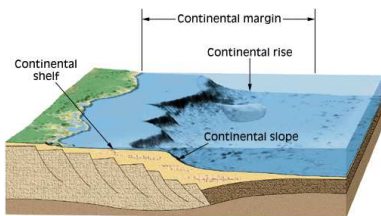


The Face of Earth

- Ocean basins

- Continental margins

- Includes the continental shelf, continental slope, and the continental rise

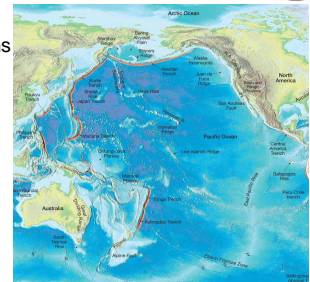


The Face of Earth

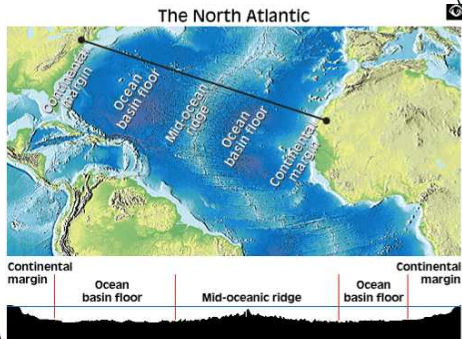
- Ocean basins

- Deep-ocean basins

- Abyssal plains
- Oceanic trenches
- Seamounts

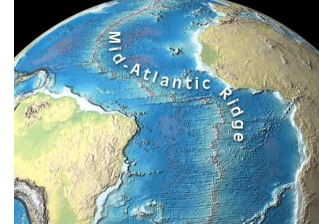


The Face of Earth



The Face of Earth

- Ocean basins
 - Oceanic ridge system
 - Most prominent topographic feature on Earth
 - Composed of igneous rock that has been fractured and uplifted

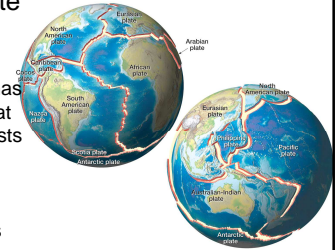


Dynamic Earth

- The theory of plate tectonics
 - Involves understanding the workings of our dynamic planet
 - Began in the early part of the twentieth century with a proposal called continental drift – the idea that continents moved about the face of the planet

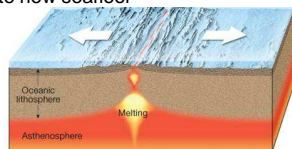
Dynamic Earth

- The theory of plate tectonics
 - A theory, called plate tectonics, has now emerged that provides geologists with the first comprehensive model of Earth's internal workings



Dynamic Earth

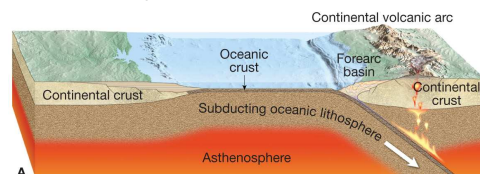
- Plate boundaries
 - All major interactions among individual plates occurs along their boundaries
 - Divergent boundary – two plates move apart, resulting in upwelling of material from the mantle to create new seafloor



A. Divergent boundary

Dynamic Earth

- Plate boundaries
 - Convergent boundary – two plates move together with subduction of oceanic plates or collision of two continental plates

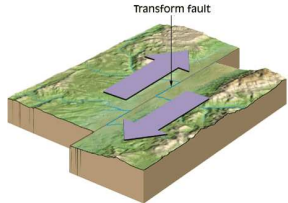


A.

Dynamic Earth



- Plate boundaries
 - Transform boundaries - located where plates grind past each other without either generating new lithosphere or consuming old lithosphere



End of Chapter 1

