

THE EARTH'S DYNAMIC CRUST

- I. Earth's interior is layered** (see Ref. Tables ... p. 10)
- A. Gravity caused layering according to **density differences** in early earth materials.
1. These layers differ in composition and states of matter.
- B. The characteristics of the earth's interior are inferred through the study of the behavior of earthquake waves passing through it, and also by analyzing meteorites. (Meteorites suggest the earth's core consists of iron and nickel, and also the approximate age of the earth as 4.6 billion years.)
- II. Earth's crust** - outer zone of solid rock (**lithosphere**)
- A. Are two types:
1. **continent crust** - is thicker, less dense, and felsic . . . granite rock
 2. **ocean crust** - is thinner, more dense, and mafic . . . basalt rock
- The continent crust "floats" on the more dense ocean crust, which is "floating" on the more dense asthenosphere (plastic mantle) beneath.
- B. The crust is constantly changing. Evidence includes:
1. **deformed strata** (layers) from the original horizontal arrangement
 - a) folded (bent)
 - b) tilted (slanted)
 - c) faulted (cracked, with movement along the crack)
 - d) down-warping (sinking of crust where rivers dump sediments into an ocean causing major depositional basins, like at the Gulf of Mexico)
- III. Earthquakes**
- A. Shaking of the earth's crust produces seismic waves (earthquake waves) that are measured with a seismograph.
- 1.) **Focus** - underground source of seismic waves
 - 2.) **Epicenter** - point on earth's surface directly above the focus
- B. **Two basic types of earthquake (seismic) waves:**
- 1.) **P-waves** - Primary waves (arrive first)
 - compression waves
 - **faster**
 - travel through **anything** (solid, liquid, or gas)
 - 2.) **S-waves** - Secondary waves (arrive second)
 - Shear waves
 - **Slower**
 - only travel through **SOLIDS**

- C. The *denser* the medium through which these waves travel, the ***FASTER*** these waves will move. (see Ref. Tables ... p. 10 for densities)
- D. **Magnitude** - strength of the earthquake, as determined by a seismograph
 - 1. Richter scale - open-ended logarithmic scale of earthquake strength
 - 2. Mercalli intensity scale - based on damage done to property
- E. **Emergency preparedness**
 - 1. Earthquakes and volcanoes present geologic hazards to humans
 - a) loss of property
 - b) personal injury
 - c) loss of life
 - 2. Tsunamis - “tidal waves” created from earthquakes under an ocean
 - 3. Safety measures:
 - a) avoid earthquake/volcano zones when building
 - b) construct stronger buildings
 - c) no decorative overhangs
 - d) be aware of earthquake/volcano emergency procedures

IV. Using the P and S wave chart (see Ref. Tables... p. 11)

- A. Using **lag time** (time between arrival of first P-wave and first S-wave of an earthquake), the chart can be used to calculate the distance from the station to the epicenter, and also the time that the actual earthquake took place.
- B. **Shadow zones** - caused by these seismic waves being bent or absorbed as they pass through layers of the earth’s interior with different characteristics (like density and state of matter)
 - 1) **P-waves** are *refracted* when they enter the earth’s outer core (a liquid).
 - 2) **S-waves** are *absorbed* when they enter the earth’s outer core.

V. Locating an epicenter

- A. Three seismograph stations are needed. (Draw 3 circles on the same map...epicenter is where all three circles touch.)

VI. Plate Tectonics (see Ref. tables ... p. 5)

- A. The lithosphere consists of separate plates that are moving.
 - 1. Is why many continents appear to “match-up”, like S. America and Africa. (see Ref. Tables ... p 5 **AND** p. 9 to note past & predict future continent movement)
 - 2. These plates ride on the more fluid asthenosphere and move slowly
 - 3. Outward transfer of earth’s internal heat drives convection circulation in the mantle that moves these plates. (see Ref. Tables ... p. 10)
- A) THESE PLATE BOUNDARIES ARE THE SITES OF MOST EARTHQUAKES, VOLCANOES, AND YOUNG MOUNTAIN RANGES ON EARTH!!!**

- B. Types of plate boundaries (see Ref. Tables ... p. 5)
1. **Convergent** - two plates coming together (convection current is sinking)
 - a) Two continent crust plates form young mountains. (India and Asia)
 - b) An overriding plate (continent plate) and a subducting plate (ocean plate) form a **subduction zone** ... results in a **trench**.
 2. **Divergent** - two plates moving apart from each other (convection current is rising)
 - a) These are found along mid-ocean ridges, and form **rifts** (splits).
 - b) New (young) crustal material is forming along these.
 - c) These are usually broken by transform faults.
 3. **Transform** - two plates sliding past each other
 - a) The San Andreas Fault in California.

VII. Earth features resulting from plate tectonics

- A. **Mid-ocean ridges** - rock age and magnetism patterns along these are consequences of plate tectonics.
1. Youngest rock is *closest* to the ridge...older to either side of it.
 2. Magnetic field reversals match to either side of the ridge.
- B. **Rifts and trenches**
- C. **Island arcs** - form as an ocean plate moves over a **hot spot** (plume of magma piercing the earth's crust), like the Hawaiian Islands
- D. **Mountain ranges** - can be:
1. Folded - plate collisions cause buckling of rock
 2. Faulted - blocks of earth's crust forced upward
 3. Volcanic

VIII. The rock cycle and plate collisions

- A. Magma is produced at both subducting and rifting regions. Results in:
1. Igneous rock formation
 2. Contact metamorphism
- B. Regional metamorphism occurs within subduction zones

IX. Global Effects of plate tectonic

- A. Plate motions have resulted in global changes in geography, climate and the patterns of organic evolution (like in Australia).