

### What are Earthquakes?

- The shaking or trembling caused by the sudden release of energy
- Usually associated with faulting or breaking of rocks
- Continuing adjustment of position results in aftershocks

### What is the Elastic Rebound Theory?

- Explains how energy is stored in rocks
  - Rocks bend until the strength of the rock is exceeded
  - Rupture occurs and the rocks quickly rebound to an undeformed shape
  - Energy is released in waves that radiate outward from the fault

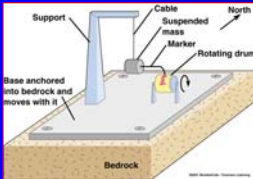
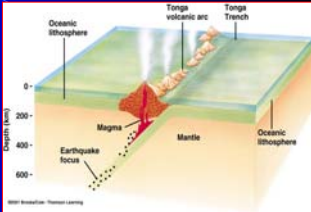
### What is Seismology?

The point within Earth where faulting begins is the focus, or hypocenter. The point directly above the focus on the surface is the epicenter.

- The Focus and Epicenter of an Earthquake

## What is Seismology?

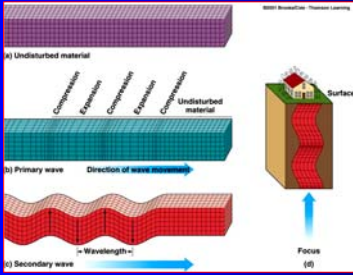
- Seismographs record earthquake events

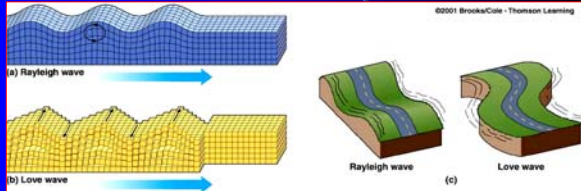
At convergent boundaries, focal depth increases along a dipping seismic zone called a Benioff zone

## What are Seismic Waves?

- Body waves
  - P or primary waves
    - fastest waves
    - travel through solids, liquids, or gases
    - compressional wave, material movement is in the same direction as wave movement
  - S or secondary waves
    - slower than P waves
    - travel through solids only
    - shear waves - move material perpendicular to wave movement



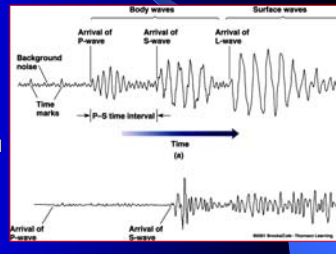
## What are Seismic Waves?



- Surface Waves
  - Travel just below or along the ground's surface
  - Slower than body waves; rolling and side-to-side movement
  - Especially damaging to buildings


## How is an Earthquake's Epicenter Located?

- Seismic wave behavior
  - P waves arrive first, then S waves, then L and R
  - Average speeds for all these waves is known
  - After an earthquake, the difference in arrival times at a seismograph station can be used to calculate the distance from the seismograph to the epicenter.



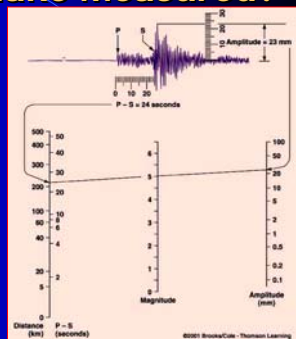
## How is an Earthquake's Epicenter Located?

- Three seismograph stations are needed to locate the epicenter of an earthquake
- A circle where the radius equals the distance to the epicenter is drawn
- The intersection of the circles locates the epicenter



## How is the Size and Strength of an Earthquake Measured?

- Magnitude
  - Richter scale measures total amount of energy released by an earthquake; independent of intensity
  - Amplitude of the largest wave produced by an event is corrected for distance and assigned a value on an open-ended logarithmic scale





## What are the Destructive Effects of Earthquakes?

- Building collapse
- Fire
- Tsunami
- Ground failure

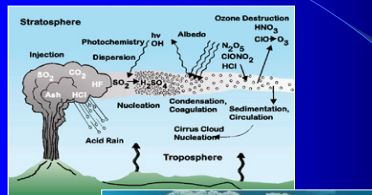


## Volcanism

- Processes which lead to the extrusion of lava, gases, and pyroclastic materials onto the surface and into the atmosphere
- Active volcanoes
- Dormant volcanoes
- Extinct volcanoes



## Volcanism



- Volcanic Gases
  - 50 to 80% is water vapor, also carbon dioxide, nitrogen, sulfur dioxide, hydrogen sulfide, carbon monoxide
  - Gases contained in rising magma expand and can contribute to violent explosions

## Volcanism

- Volcanic Gases
  - Many fatalities have resulted from exposure to toxic gases, or suffocation from the displacement of oxygen by denser volcanic gases



## Volcanism



- Lava Flows
  - Paths are predictable
  - Rarely a danger to human life
  - Two types are recognized from Hawaiian flows: pahoehoe and aa

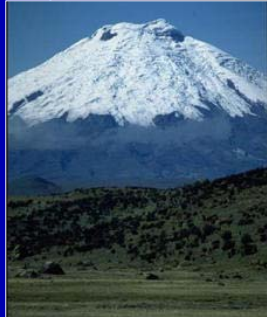
## Volcanism

- Pyroclastic materials are deposited as solid fragments of explosive volcanism
  - Ash
  - Lapilli
  - Bomb, block



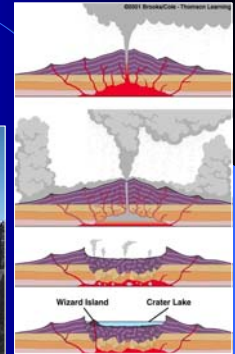
## What are Volcanoes?

- Conical mountains formed around a vent where lava, gases, and pyroclastic materials are erupted
  - Variations in lava composition and other factors distinguish three types
  - Most have a central crater, while calderas and fissures are also common



## What are Volcanoes?

- Calderas form when an emptied magma chamber collapses



## What are Volcanoes?

- Shield Volcanoes
  - Low, rounded profiles; slope angles 2-10°; composed of numerous flows of mafic composition and little explosive activity
  - Largest of all volcanoes



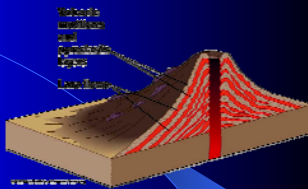
## What are Volcanoes?

- Cinder Cones
  - Composed of pyroclastic materials that accumulate around the vent; steep slopes (33°)
  - Usually short-lived and may represent final eruptive stages



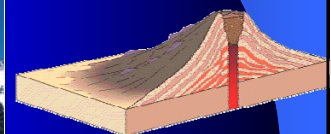
## What are Volcanoes?

- Composite Volcanoes
  - Also called stratovolcanoes, are composed of alternating layers of pyroclastics and lava flows
  - Composition is intermediate, with andesite common
  - Eruptions are infrequent, violent, and may involve lahars



## What are Volcanoes?

- Lava Domes
  - High-viscosity, felsic magmas move slowly upward to form steep-sided lava domes
  - Sudden collapse or explosive eruption may cause a nuée ardente to move rapidly downslope, incinerating everything in its path



# Hot Spot Tracks

