Unit 7: Dynamic Planet: Earthquakes & Volcanoes

Lecture 2 Objectives:

E3.4B - Describe how the sizes of earthquakes and volcanoes are measured or characterized.

E3.4d - Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes.

Earthquakes*

Earthquake intensity and magnitude

- Intensity
 - A measure of the degree of earthquake shaking at a given locale based on the amount of damage
 - Most often measured by the Modified Mercalli Intensity Scale
- Magnitude
 - Concept introduced by Charles Richter in 1935

Earthquakes *

Earthquake intensity and magnitude

- Magnitude
 - Often measured using the Richter scale
 - Based on the amplitude of the largest seismic wave
 - Each unit of Richter magnitude equates to roughly a 32-fold energy increase
 - Does not estimate adequately the size of very large earthquakes

Earthquakes

Earthquake intensity and magnitude

- Magnitude
 - Moment magnitude scale
 - Measures very large earthquakes
 - Derived from the amount of displacement that occurs along a fault zone

Volcanic eruptions *

 Factors that determine the violence of an eruption

- Composition of the magma
- Temperature of the magma
- Dissolved gases in the magma
- Viscosity of magma
 - Viscosity is a measure of a material's resistance to flow

Volcanic eruptions *

Viscosity of magma

- Factors affecting viscosity
 - Temperature (hotter magmas are less viscous)
 - Composition (silica content)
 - High silica high viscosity (e.g., rhyolitic lava)
 - Low silica more fluid (e.g., basaltic lava)
 - Dissolved gases (volatiles)
 - Mainly water vapor and carbon dioxide
 - Gases expand near the surface

Volcanic eruptions

Viscosity of magma

- Factors affecting viscosity
 - Dissolved gases (volatiles)
 - Provide the force to extrude lava
 - Violence of an eruption is related to how easily gases escape from magma
 - Easy escape from fluid magma
 - Viscous magma produces a more violent eruption

Materials associated with volcanic eruptions

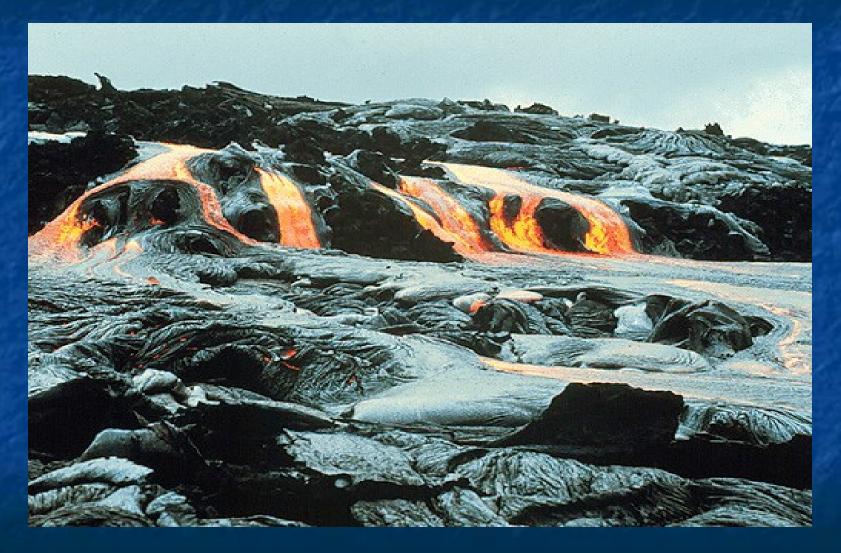
* Lava flows

- Basaltic lavas are more fluid
- Types of lava
 - Pahoehoe lava (resembles braids in ropes)
 - Aa lava (rough, jagged blocks)

* Gases

- One to five percent of magma by weight
- Mainly water vapor and carbon dioxide

A Pahoehoe lava flow



A typical aa flow



Origin of magma

 Factors that influence the generation of magma from solid rock

- Role of pressure
 - Increase in confining pressure causes an increase in melting temperature
 - Drop in confining pressure can cause decompression melting
 - Lowers the melting temperature
 - Occurs when rock ascends

Origin of magma

 Factors that influence the generation of magma from solid rock

- Role of volatiles
 - Primarily water
 - Cause rock to melt at a lower temperature
 - Play an important role in subducting ocean plates

Origin of magma

 Factors that influence the generation of magma from solid rock

- Partial melting
 - Igneous rocks are mixtures of minerals
 - Melting occurs over a range of temperatures
 - Produces a magma with a higher silica content than the original rock

