

# 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

