Essentials of Geology

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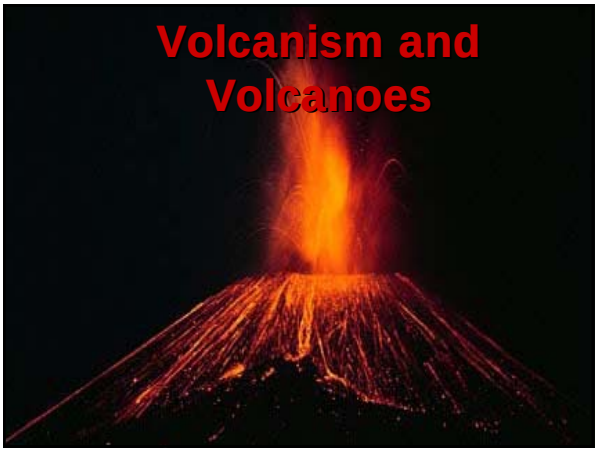
Chapter 4

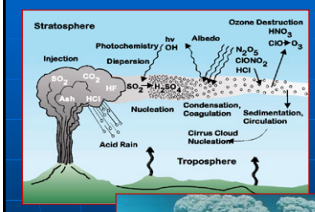
Volcanism and Volcanoes

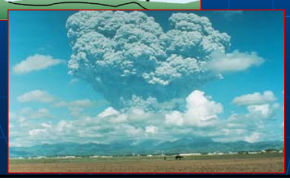


Volcanism

- 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

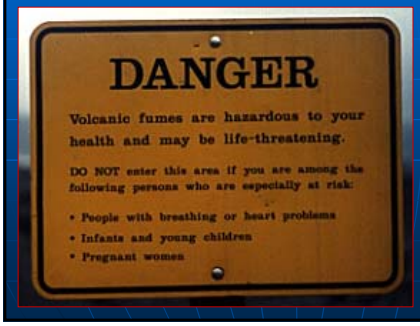
Volcanism





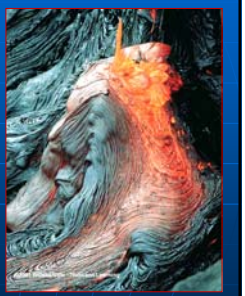
- Volcanic Gases
  - 50 to 80% is water vapor, also carbon dioxide, nitrogen, sulfur dioxide, hydrogen sulfide, carbon monoxide
  - Gases contained in rising magma expand and can contribute to violent explosions

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

- Lava Flows
  - Columnar joints occur in cooling lavas
  - Pillow lava forms during sub-sea eruptions

Volcanism

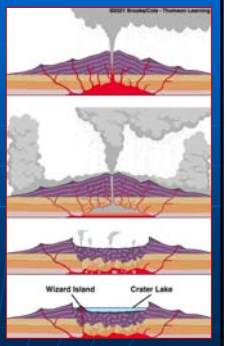
- Pyroclastic materials are deposited as solid fragments of explosive volcanism
  - Ash
  - Lapilli
  - Bomb, block

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

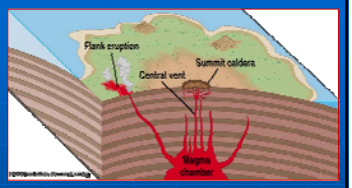
What are Volcanoes?

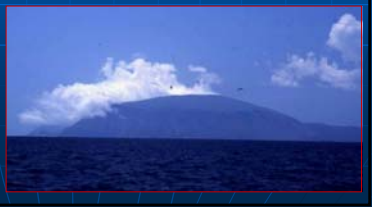
- Calderas form when an emptied magma chamber collapses



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



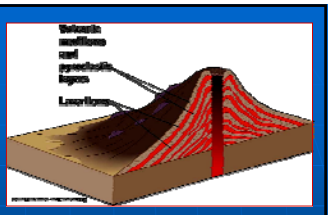


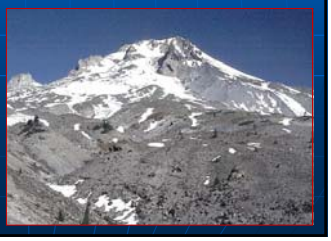
What are Volcanoes?

- 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?

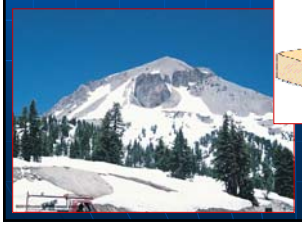
- Composite Volcanoes
  - Also called stratovolcanoes, are composed of alternating layers of pyroclastics and lava flows
  - Composition is intermediate, with andesite common
  - Eruptions are infrequent, violent, and may involve lahars

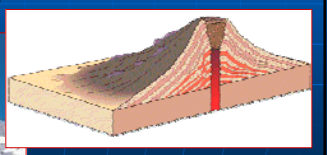




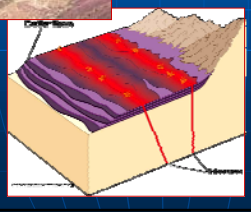
What are Volcanoes?

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





Do all Eruptions Build Up Volcanoes?



- Fissure Eruptions and Basalt Plateaus
  - Columbia River basalts flowed from fissures to cover large areas in WA and OR
  - Low viscosity, mafic lavas spread out and built up a basalt plateau

Do all Eruptions Build up Volcanoes?

- Pyroclastic Sheet Deposits
  - Cover large areas with felsic ash and welded tuff
  - Appear to issue from fissures associated with caldera formation

How Large is an Eruption and How Long Does it Last?

- Eruptions are ranked by the volcanic explosivity index or VEI
  - Ranges from 0 (unexplosive) to 8 (megacolossal)
  - Based on volume of material explosively ejected, height of eruption plume
  - Volume of lava, human and property damage are not considered
  - Duration is widely variable, from days to years

Is it Possible to Predict Eruptions?

- Volcano monitoring
  - Physical and chemical changes
    - Tiltmeters, seismic activity, past history
    - Changes in magnetic and electrical fields
    - Gas emissions, groundwater level and temp
  - While timely warnings have been issued in the past, volcanoes remain unpredictable and only a few are regularly monitored

Distribution of Volcanoes

- Most are at or near plate boundaries
  - Circum-Pacific, Mediterranean and mid-oceanic linear trends are recognized

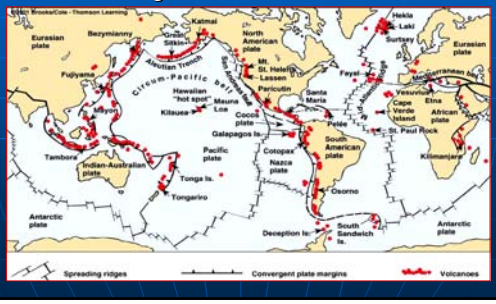


Plate Tectonics, Volcanoes, and Plutons

- Divergent Plate Boundaries and Igneous Activity
  - Ocean crust is primarily basalt and gabbro
  - Emplaced as vertical dikes, gabbro plutons, and pillow lava
  - Mid-Atlantic Ridge, East Pacific Rise, Indian Ridge are examples

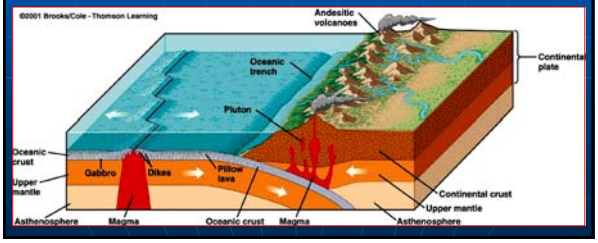


Plate Tectonics, Volcanoes, and Plutons

- Igneous Activity at Convergent Plate Boundaries
  - Composite volcanoes found in the circum-Pacific and Mediterranean belts where partial melting produces intermediate/felsic magmas, lava domes, and violent eruptions

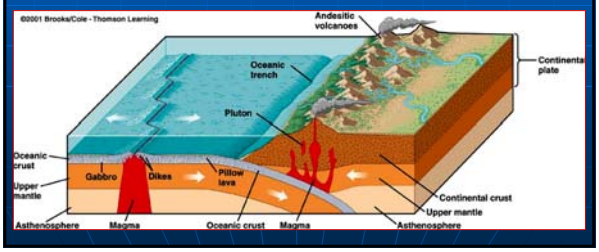


Plate Tectonics, Volcanoes, and Plutons

- Intraplate Volcanism
  - Occurs as a plate moves over a stationary 'hot spot' in the upper mantle