EXTRUSIVE IGNEOUS ROCKS

Volcanoes and Volcanic Rocks

What's your favorite volcano?

Famous Volcanoes

- Basalts
  - Dotsero, CO
  - Kilauea
  - Mauna Loa
  - Haleakala
  - Hekla

- Andesites
  - Fuji
  - St. Helens
  - Ranier
  - Shasta
  - Stromboli
  - Vesuvius
  - Popocatépetl
  - Orizaba
  - Pélée

- Rhyolites
  - Yellowstone
  - Valles
  - Long Valley
  - Crater Lake
  - Pinatubo
  - Krakatoa
  - Santorini
  - Campi Phlegri (Naples)

Do you clean your volcanoes regularly?

Where do volcanoes occur?

- Plate Boundaries (98%)
  - Divergent
  - Ocean-ocean convergent
  - Ocean-continent Convergent
- Hot (wet) Spots
*Where do volcanoes not occur?*

- Cratons
- Passive continental margins
- Oceanic abyssal plains
- Continent – continent convergent boundaries

*Most Volcanoes are at Plate Boundaries*

*Igneous Rock Names and Compositions*

- **Composition Name**
  - Ultramafic
  - Mafic
  - Intermediate
  - Silicic (felsic)

- **Intrusive Rock Name**
  - Peridotite
  - Gabbro
  - Diorite
  - Granite

- **Volcanic Rock Name**
  - (Komatiite)
  - Basalt
  - Andesite
  - Rhyolite

*Most Volcanoes are at Plate Boundaries*

*Magma and Lava*

- **Magma** is the term for any molten silicate material, whether below the surface or on top.
- **Volcanic rocks** are erupted on the surface.
  - Volcanic rocks are fine-grained (<1 mm)
- **Lava** is the term for a magma on the surface.

*Geologic Settings*
**Basaltic Eruptions**

- Low Viscosity
- High Temperature (1000 - 1200°C)
- Normally Quiescent Lava Flows
  - Aa - early, low temperature, blocky flow
  - Pahoehoe - later high temperature, ropy flow
  - Pillow Lavas - underwater flow
- Edifice
  - Shields
  - Cinder cones

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**Aa, Hawaii (Basalt)**

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**Pahoehoe, Hawaii (Basalt)**

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**Pillow Lava, Kauai (Basalt)**

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**Cinder Cone, Pu’u’o’o, Hawaii (Basalt)**

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**Most Volcanoes are at Plate Boundaries**
Cinder Cone + Caldera, (Basalt)

Skjaldbreidur Shield, (Basalt)

Caldera, (Basalt) Halemaumau

Basalt Flow Grand Canyon < 1 My old

Columnar Basalt

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- Kilauea
- Mauna Loa
- Haleakala
- Hekla
- Vulcan’s Throne

- Andesites
- Fuji
- St. Helens
- Ranier
- Shasta
- Stromboli
- Vesuvius
- Popocatepetl
- Orizaba
- Pelee
- Etna

- Rhyolites
- Yellowstone
- Valles/Jemez
- Long Valley
- Crater Lake
- Pinatubo
- Krakatoo
- Santorini
- Campi Phlegri (Naples)

Andesite Eruptions

- Higher viscosity (higher polymerization)
- Lower temperature
- More water, more explosive
- Subduction zone volcanism
- Flows
  - Viscous lava flows
  - Pyroclastic flows
- Edifice
  - Composite Cones

Geologic Settings

Which volcanic environment will, on average, produce the most felsic (silicic) lavas?

A. Mid-ocean ridge
B. Island arc
C. Continental arc
D. Oceanic hotspot

Clicker Question

Plate tectonics explains the global pattern of volcanism.

Which volcanic environment will, on average, produce the most felsic (silicic) lavas?

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Clicker Question

Plate tectonics explains the global pattern of volcanism.

What composition volcanic rocks characterize magmatism at mid-ocean ridges?

A. Carbonatite
B. Basalt
C. Andesite
D. Rhyolite

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What composition volcanic rocks characterize magmatism at mid-ocean ridges?

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Andesite Flow, Mt Shasta

Composite Cone, Mt. Fuji, Japan

Composite Cone, Mt. Daisen

Composite Cone, Llaima Volcano, Chile
Andesite Eruptions
- Higher viscosity (higher polymerization)
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  - Viscous lava flows
  - Pyroclastic flows (Nuée Ardente)
- Edifice
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Clicker Question
- Which of the following is an example of a basalt volcano?
  - A. Mt St. Helens
  - B. Yellowstone
  - C. Mauna Loa
  - D. Mt Pinatubo
  - E. Mt. Fuji

Clicker Question
- Which of the following is an example of an andesite volcano?
  - A. Kilauea
  - B. Yellowstone
  - C. Mauna Loa
  - D. Mt Pinatubo
  - E. Mt. Fuji
Clicker Question

Which of the following is an example of an andesite volcano?

- A. Kilauea
- B. Yellowstone
- C. Mauna Loa
- D. Mt Pinatubo
- E. Mt. Fuji

Rhyolite Eruptions

- Very high viscosity
- Low temperature (600 - 800°C)
- Massive Pyroclastic eruptions
  - Air fall (pumice)
  - Ash Flow (Nuée Ardente) Tuff
  - Obsidian Flows
- Edifice
  - Caldera (5 - 25 km)
  - Resurgent dome

Rhyolite Eruptions

- Associated Phenomena
  - Hot Springs
  - Geysers
  - Fumaroles
- Geologic Setting
  - Continental Margins and Interiors
  - Subduction Zones

Pumice = Glass foam

Geologic Settings

Ash-Flow Tuff

with Air-Fall Units (pumice)
As-Flow Tuff Unit

Silicic Tuff Units (Jemez, NM)

Caldera with Cinder Cone
Crater Lake, OR

Sulfur Fumarole, Nysseros

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**Geyser**
*Old Faithful (Yellowstone)*

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**Crater Lake, OR**
A. Basalt
B. Andesite
C. Rhyolite
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B. Andesite
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Geologic Settings

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Volcanic Terms

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- Mafic
- Intermediate
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- Basalt
- Andesite
- Magma
- Lava
- Aa
- Pahoehoe
- Pillow Lava
- Shield
- Composite Cone
- Cinder Cone
- Caldera
- Pyroclastic
- Nuée Ardente
- Air Fall
- Ash Flow
- Tuff
- Obsidian
- Vitrophyre
- Pumice
- Resurgent dome
- Hot Spring
- Geyser
- Rhyolite

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Clicker Not Registered

- McClelland, A
- Keegan, R.
- Moten, J.
- Runyon, K.
- Scott, G.
- Shepley, J.
- Wheeler, S.