Can you predict the location of volcanoes?

“A volcano is any landform from which lava, gas, or ashes, escape from underground or have done so in the past.”

What is causing this eruption? What factors influence its character?

We learned from Chapter 5 that magma (and lava) can be felsic, intermediate, or mafic. How does magma chemistry influence the nature of volcanic eruptions?

There are three common types of magma:

**BASALTIC**
Basaltic lava flows easily because of its low viscosity (low gas content). The low viscosity is due to low silica content.

**ANDESITIC**
Andesitic magma erupts explosively because it tends to have high gas content. It is viscous and therefore traps gas, builds pressure and explosively erupts. High viscosity is related to high silica content.

**RHYOLITIC**
Rhyolitic magma erupts catastrophically because it has high gas content. It is viscous and therefore traps gas, builds pressure and explosively erupts. High viscosity is related to high silica content – an abundance of silica polymers (chains etc.) leads to the high viscosity.
Comparison of common magma types

**EXPLOSIVE ERUPTIONS** are fueled by violent releases of volcanic gas.

<table>
<thead>
<tr>
<th>Magma Type</th>
<th>Composition</th>
<th>SiO₂ Content and Viscosity</th>
<th>Gas Content</th>
<th>Explosivity</th>
<th>Temperature</th>
<th>Examples of Volcanoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basalt</td>
<td>Mafic</td>
<td>Low, &lt;15% (40%, 10%)</td>
<td>5-10%</td>
<td>Low</td>
<td>900-1100°C</td>
<td>Mount St. Helens, Mount Rainier, Mount Fuji</td>
</tr>
<tr>
<td>Andesite</td>
<td>Intermediate</td>
<td>Moderate, &lt;15% (40%, 10%)</td>
<td>5-10%</td>
<td>Intermediate</td>
<td>800-1000°C</td>
<td>Kilauea, Taranaki, Fuji</td>
</tr>
<tr>
<td>Rhyolite</td>
<td>Felsic</td>
<td>High, &gt;70% (40%, 10%)</td>
<td>5-10%</td>
<td>High</td>
<td>800-1000°C</td>
<td>Tavurvur, Pinatubo, Yellowstone</td>
</tr>
</tbody>
</table>

**EFFUSIVE ERUPTIONS** are relatively fluid lava flow.

**DETERMINED BY:**
- viscosity (low)
- temperature (high)
- gas content of magma (low)

---


http://www.youtube.com/watch?v=xjLTJjjgUai
TYPES OF VOLCANIC DEBRIS

- Ash
- Pumice
- Volcanic bombs
- Volcanic block
- Welded tuff

Volcanic products?

Lava, gas, pyroclastic debris

Gases released from a volcano can be as deadly as the hot, fiery lava.

Volcanoes can be classified into 6 major types based on their size, shape, and origin.

<table>
<thead>
<tr>
<th>TYPES OF VOLCANOES</th>
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<tr>
<td><strong>COMPARISON OF SIX TYPES OF VOLCANOES</strong></td>
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</table>

**TABLE 6.1 Types of Volcanoes**

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<tr>
<th>Type</th>
<th>Shape</th>
<th>Magma Type</th>
<th>Tectonic Setting</th>
<th>Example</th>
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<tbody>
<tr>
<td>Composite volcano</td>
<td>Large volume, gently sloping</td>
<td>Basaltic, low silica</td>
<td>Mid plate setting (trend of small</td>
<td>Mauna Loa Volcano, Hawaii</td>
</tr>
<tr>
<td></td>
<td>dome-shaped</td>
<td></td>
<td>shield) or variable setting</td>
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<tr>
<td>Lava dome</td>
<td>Large volume, steep</td>
<td>Basaltic, high silica</td>
<td>Mid plate setting (near</td>
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<td></td>
<td>cone-shaped</td>
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<tr>
<td>Central vent</td>
<td>Large volume, steep</td>
<td>Basaltic, high silica</td>
<td>Mid plate setting (near</td>
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Mauna Kea

Shield Volcano
- Low silica, low gas magma originates in the mantle.
- Fluid, basaltic lava results in "Aa" and "Pahoehoe".
- Low viscosity creates broad, gentle slopes.
- Sometimes, Phreatomagmatic eruptions (rapid expansion of steam) occur when lava contacts water.

Hawai‘i
- Eight main islands are exposed tips of the Hawaiian Ridge.
- Age range is modern to ~6 million years old.
- Volcanoes develop on the Pacific Plate as it moves across the Hawaiian Hotspot.

Hawai‘i
- As the islands age, they erode and subside, becoming atolls and seamounts.
Our islands are carved by massive landslides.

Geologists have known for years that pieces of the two shields that make Oahu have been missing.

Maps of the seafloor indicate that massive landslides have occurred.

Over 17 different landslides have been identified.

Will the south shore of the Big Island slide...it already is!

Measurements show the south flank of Kilauea is moving 10 cm/yr to the SE.

1975 Kalapana quake shifted the flank 8 m horizontal and 3 m vertical.
Volcanoes can be classified into 6 major types based on their size, shape, and origin.

- Large-scale Volcanic Terrains: no central vent, network of source material generally massive.
- Central Vent Volcanoes: central vent, summit crater, flank eruptions, fissure eruptions.

**Cinder Cones**
- high lava fountains on the vents of shield volcanoes.
- composed of pyroclastic debris.
- caused by high gas content.

**Composite Volcano or Stratovolcano**
- Layers of lava flows and ashfall deposits, massive explosive eruptions.

**FEATURES OF STRATOVOLCANOES (composite volcanoes)**
- Alternating andesitic lava flows and layers of explosively ejected pyroclastics.
- Magma is intermediate, making the lava viscous and difficult to erupt.
- Explosive eruptions due to buildup of gases.
Lava Dome – a plug that prevents eruption

Pressure builds behind the plug until it blows...

Sticky silica-rich magma controls volcano shape, explosivity, and behavior

What happens when the plug is blown?

Plinian-style eruption...don't stick around to watch

Major atmospheric impacts: Volcano is blasted to pieces

Mt. Mayon, Philippines

Pyroclastic flows

Mt. Pinatubo - 1991

Lahar
Rhyolite Caldera Complexes Are Central Vent Volcanoes.

FEATURES OF RHYOLITE CALDERA COMPLEXES

- High-silica, high-gas magmas.
- Massive explosions (most explosive of all types).
- Collapse, producing an “inverse volcano”, or Caldera (Spanish for cauldron).

Large-scale volcanic terrains lack a central vent

San Francisco Volcanic Field

Monogenetic Fields
- Poorly understood.
- Multiple vents and cinder cones.
- Erupt at different times.
- Grow laterally.
- Usually a single magma source.
- Low magma supply.
**Large Igneous Province**

Fed by massive mantle plumes
Caused by flood basalts (especially fluid basaltic lavas)
Discharge over time through long fissures (cracks).
Create large plateaus.

Columbia River Basalts

Flood Basalts – large igneous province
Very fluid lava erupting rapidly and with great volume over thousands of years.
Columbia River basalts, Deccan Traps, Siberian Traps
Do LIP’s mark beginning of hotspots?

**Mid-ocean Ridges**

develop at spreading Center.
Basaltic flow creates global network of interconnected ridges.

**Spreading Center Volcanism**

Fluid basaltic lavas, divergent plate margins, mid-ocean ridges

**Arc Volcanism**

Explosive rhyolitic, andesitic, and basaltic lavas, divergent plate margins, mid-ocean ridges

**Spreading Center Volcanism**

Fluid basaltic lavas, divergent plate margins, mid-ocean ridges

**Intraplate Volcanism**

aka “midplate volcanism”, shield volcanoes, rhyolite caldera complexes, and monogenetic fields

Most volcanoes are associated with spreading center volcanism, arc volcanism, or intraplate volcanism

Plate motion
Rift

Mid-ocean ridge

Continental crust

Mediterranean

Hotspot

Pressure release melting

Lithosphere

Continental crust

Stratovolcanoes

Fracture zone

Trench

Mid-ocean ridge

Island arc

Trench

Hotspot

Hotspot volcanism

Intraplate Volcanism

Rhyolite caldera complex

Shield volcanoes

Monogenetic fields

Lithosphere