Volcanoes
Right now, volcanoes are active on every continent—even Antarctica—and on the floor of every major ocean. At spreading centers deep beneath the waves, volcanoes erupt 24 hours a day, and their lava continually adds to Earth’s seafloor.

Major eruptions have killed or disrupted the lives of millions over the history of human civilization.

500-plus volcanoes are currently active on the continents.

6 types of volcanoes
Monogenetic fields

- Rhyolite caldera complex
- Stratovolcanoes
- Shield Volcanoes
- Mid-Ocean Ridges

Flood basalts

- Low silica content
- Low explosivity

- High silica content
- High explosivity

Explosivity
Shield Volcano

- Mid-plate setting
- Basalt, silica depleted, lower mantle source
- Large volume, low angle slopes
- Fluid, low viscosity lava, flows easily
- Non-violent eruptions (phreatic eruptions)

Mauna Kea
Shield Volcano
Phreatic eruption as rising tide encounters new magma body within beach.
Lava types:
1. Aa
2. Pahoehoe
Lava tubes form when flowing pahoehoe roofs over...lava flow rate drops and a hollow tube forms.
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 25 different landslides have been identified

Koolau reconstructed

Will the south shore of the Big Island slide?...it already is!
Perhaps the Pali’s are a product of the detachment headwalls where the landslides originated – and have evolved as landscapes…

We might expect giant tsunami’s as a result of massive landslides
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.
OLYMPUS MONS

MAUNA LOA

VE=5x

100 km
Composite Volcano or Stratovolcano

Layered with lava Flows and ashfall Deposits – massive explosions
Mt. Fuji
- Steep slopes
- Explosive
- Irregular outline from past explosions
- Andesite magma
- Relatively high silica content
What happens when the plug is blown?

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

Pressure builds behind the plug until it blows...

Major atmospheric impacts
Volcano is blasted to pieces

Sticky silica-rich magma controls volcano shape, explosivity, and behavior
Pyroclastic flow
Mt. Unzen, Japan
Stratovolcano

- Layered lava and explosive debris flows
Volcanic Products

• Lava

<table>
<thead>
<tr>
<th>Lava Type</th>
<th>Composition</th>
<th>Silica Content and Viscosity</th>
<th>Gas Content</th>
<th>Explosivity</th>
<th>Examples of Volcanoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basaltic</td>
<td>Mafic</td>
<td>Least, ~50% (thin, runny)</td>
<td>0.5–2%</td>
<td>Least</td>
<td>Mid-ocean ridges, Hawaiian Islands</td>
</tr>
<tr>
<td>Andesitic</td>
<td>Intermediate</td>
<td>Intermediate, ~60%</td>
<td>3–4%</td>
<td>Intermediate</td>
<td>Many volcanoes in Pacific northwest region</td>
</tr>
<tr>
<td>Rhyolitic</td>
<td>Felsic</td>
<td>Greatest, &gt;70% (thick, stiff)</td>
<td>4–6%</td>
<td>Greatest</td>
<td>Yellowstone volcano</td>
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</tbody>
</table>
Volcanic Products

• Pyroclastic Debris (tephra)

Volcanic Ash
Mt. St. Helens Pumice
Volcanic Lapilli
Welded Tuff
Volcanic Bomb
### Volcanic Products

#### Gas

Percent Volcanic Gas Content at Three Volcanoes

<table>
<thead>
<tr>
<th>Gas</th>
<th>Kilauea, Hawaii (basaltic magma, 1170°C, hotspot, shield volcano)</th>
<th>Erta` Ale, Ethiopia (basaltic magma, 1130°C, divergent margin, shield volcano)</th>
<th>Momotombo, Nicaragua (andesitic magma, 820°C, convergent margin, stratovolcano)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O</td>
<td>37.1</td>
<td>77.2</td>
<td>97.1</td>
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<tr>
<td>CO₂</td>
<td>48.9</td>
<td>11.3</td>
<td>1.44</td>
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<tr>
<td>SO₂</td>
<td>11.8</td>
<td>8.34</td>
<td>0.50</td>
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<tr>
<td>H₂</td>
<td>0.49</td>
<td>1.39</td>
<td>0.70</td>
</tr>
<tr>
<td>CO</td>
<td>1.51</td>
<td>0.44</td>
<td>0.01</td>
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<tr>
<td>H₂S</td>
<td>0.04</td>
<td>0.68</td>
<td>0.23</td>
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<tr>
<td>HCl</td>
<td>0.08</td>
<td>0.42</td>
<td>2.89</td>
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<tr>
<td>HF</td>
<td>---</td>
<td>---</td>
<td>0.26</td>
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</tbody>
</table>
What is the effect of a rhyolite magma?
Monogenetic Fields – single magma system, “horizontal volcano”..
spread across region

Mystery – single magma source with multiple eruptions across thousands of years..
How does same magma find same vent when it solidifies between eruptions?
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?
Spreading Center Volcanism
The Spreading Center
Nevado Huascaran, Peru - 1970

**Lahar** – 23,000 buried in 14 minutes

Yungay before     Yungay now
Monogenetic fields

Rhyolite caldera complex

Stratovolcanoes

Shield Volcanoes

Mid-Ocean Ridges

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Explosivity

Silica content

low

high

Monogenetic fields

Explosivity

Silica content