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
Silica content
Explosivity
low
high
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Shield Volcano Mauna Kea

• 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)
Main eight – 0 to 5 myr

NWHI – 4-27 myr

The “bend” – 57 myr

Suiko – 64 myr
Kohala
Hualalai
Mauna Kea
Mauna Loa
Kilauea
Loihi
Haleakala– West Maui 0.4-1.6 myr

E and W Molokai 1.3-1.8 myr

Koolau-Waianae 1.8-3.8 myr

Koloa
Makaweli
Napali 1.4-5.7 myr

Haleakala– West Maui 0.4-1.6 myr
Shield Volcano
Lava types:
1. Aa
2. Pahoehoe
Phreatic eruption as rising tide encounters new magma body within beach.
Lava tubes form when flowing pahoehoe roofs over...lava flow rate drops and a hollow tube forms.
Geologists have known for years that pieces of the two shields that make Oahu have been missing.

Our islands are carved by massive landslides.
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

Mount Mageik, Katmai National Park

Layered with lava Flows and ashfall Deposits – massive explosions
Steep slopes
Explosive
Irregular outline from past explosions
Andesite magma
Relatively high silica content

Lava Dome – a plug that prevents eruption
What happens when the plug is blown?

Pressure builds behind the plug until it blows...

Major atmospheric impacts
Volcano is blasted to pieces

Plinian-style eruption…don’t stick around to watch

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

- Layered lava and explosive debris flows
Mt. Pinatubo - 1991
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>
</tr>
</tbody>
</table>
Volcanic Products

- Pyroclastic Debris (tephra)
  - Volcanic Ash
  - Volcanic Lapilli
  - Volcanic Bomb
  - Mt. St. Helens Pumice
  - Welded Tuff
Volcanic Products

• Gas

Percent Volcanic Gas Content at Three Volcanoes

<table>
<thead>
<tr>
<th></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>
</tr>
<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>
</tr>
<tr>
<td>HF</td>
<td>---</td>
<td>---</td>
<td>0.26</td>
</tr>
</tbody>
</table>
Rhyolite Caldera Complexes

“reverse volcanoes”

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?
Mantle Plumes
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

Silica content

Explosivity

Low

High

Mid-Ocean Ridges

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Shield Volcanoes

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