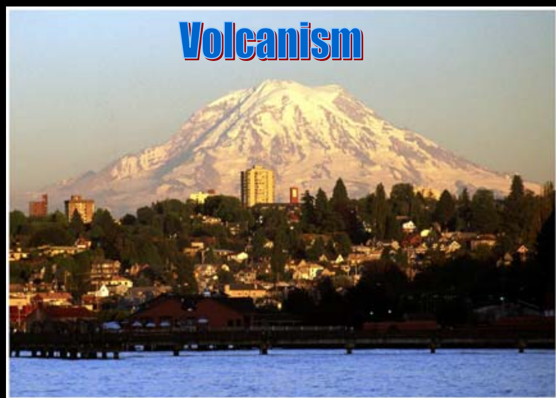
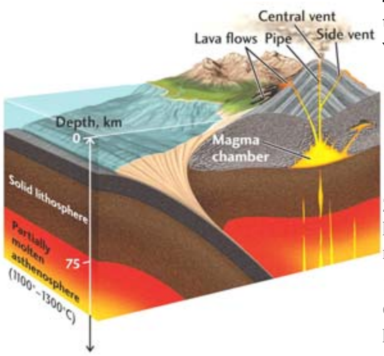




4. …accumulating on the surface to form a volcano.

3. Lavas erupt from the magma chamber through central and side vents…

2. …rises through the lithosphere to form a magma chamber

1. Magma, which originates in the partially melted asthenosphere…

Types of Lavas

- **Basaltic lavas**: low-viscosity mafic lavas, typically erupted at 1000º to 1200º C; cool to form basalt.
- **Rhyolitic lavas**: high-viscosity felsic lavas, typically erupted at 800º to 1200º C; cool to form rhyolite.
- **Andesitic lavas**: intermediate in composition and viscosity between mafic and felsic magmas; cool to form andesite.

Fig. 12.16

Flood Basalts of the Columbia Plateau


Fig. 12.16

Fig. 12.3

Vesicular Basalt:

trapped gases form bubbles (vesicles)

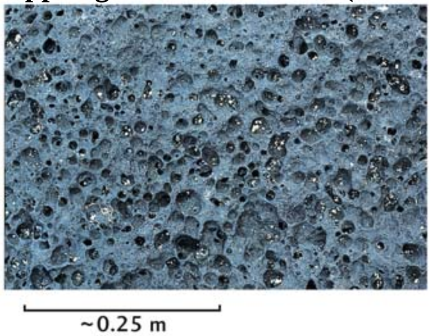


Fig. 12.6

Fig. 12.7

Pyroclastic Material:

Fragmentary volcanic rocks ejected into the air

Fig. 12.7

Volcanic Bomb

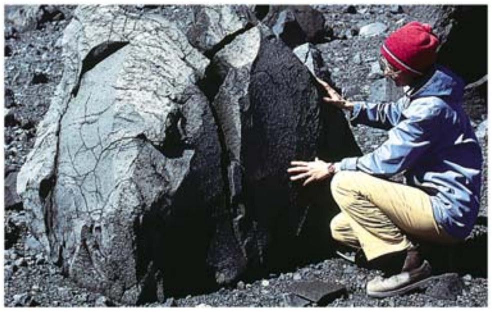


Fig. 12.8

Volcanic Breccia

Fig. 12.9

Welded Tuff Formed from Pyroclastic-Flow Deposit

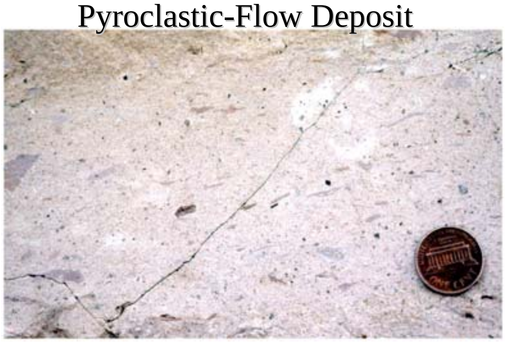


Fig. 12.9

Eruptive Styles and Landforms

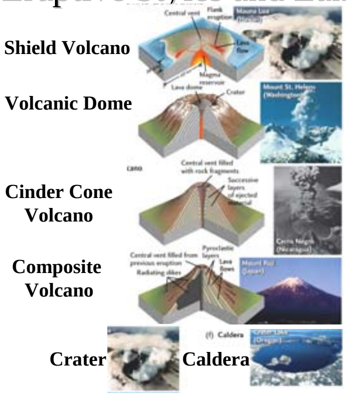


Fig. 12.11

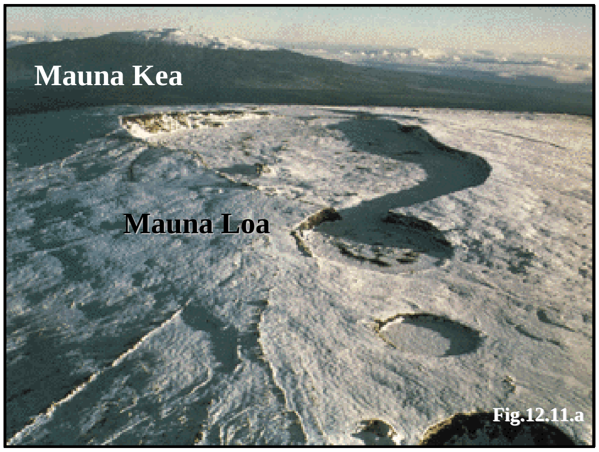


Fig.12.11.a

Shield Volcano

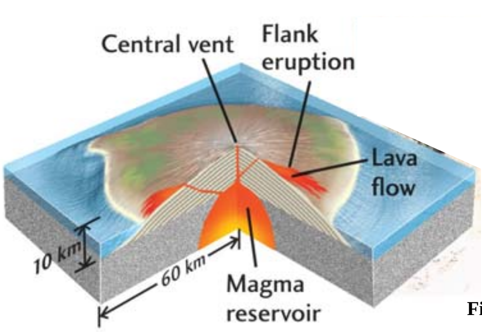
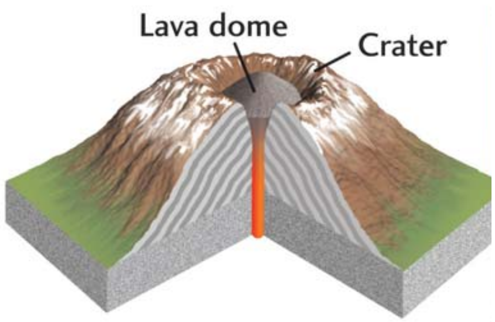


Fig.12.11.a

Shield Volcanoes

- Formed mainly of basaltic lavas
- Gentle sides: ~2-10 degrees
- Can be huge: up to 120 km wide!
- Long duration of activity:10,000’s yrs
- Eruptions usually non-violent

Volcanic Dome



12.11b

Volcanic Domes

- Form of viscous felsic lavas
- Steep-sided and small:~100's m wide
- Grow slowly

Paricutin Volcano, Mexico (1943-1952)

Cerro Negro Cinder Cone, near Managua, Nicaragua in 1968

Fig. 12.11c

Cinder Cone

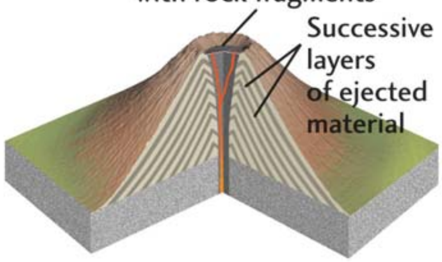


Fig. 12.11c

Cinder Cones

- Formed mainly of basaltic pyroclastic material
- Steep sides: ~30 degrees
- Relatively small: ~ 1 km wide
- Short-lived: typically a single event

Mt Fujiyama, Japan

Fig. 12.11d

Composite Volcano

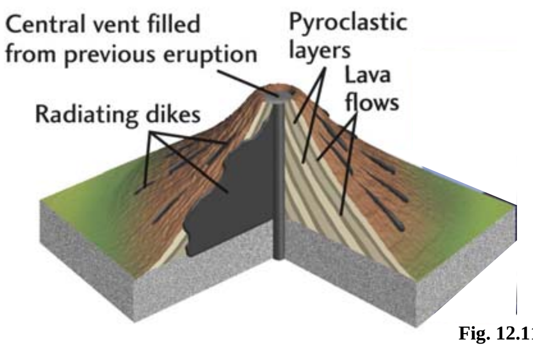


Fig. 12.11d

Composite Volcano

- Mainly alternating pyroclastic deposits and andesitic lava flows
- Slopes are intermediate in steepness
- Relatively large: ~10-15 km wide
- Intermittent eruptions over long time span: 1,000's of yrs
- Eruptions often highly explosive

Caldera

Fig. 12.11e

Caldera

- A large depression (typically several km wide) formed by collapse of a volcano into a partially drained magma chamber
- May have younger domes within it

STAGE 1
Fresh magma fills a magma chamber and triggers a volcanic eruption of lava and columns of incandescent ash.

Fig. 12.12

STAGE 2
Eruption of lava and pyroclastic flows continue, and the magma chamber becomes partly depleted.

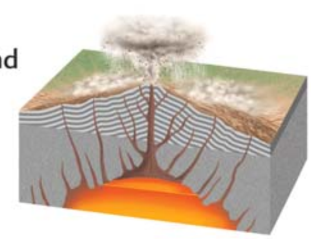


Fig. 12.12

STAGE 3
A caldera results when the mountain summit collapses into the empty chamber. Large pyroclastic flows accompany the collapse, blanketing the caldera and a surrounding area of hundreds of square kilometers.

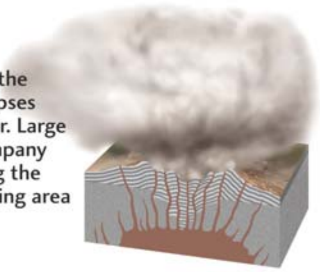


Fig. 12.12

STAGE 4
A lake forms in the caldera. As the residual magma in the chamber cools, minor eruptive activity continues in the form of hot springs and gas emissions. A small volcanic cone forms in the caldera.

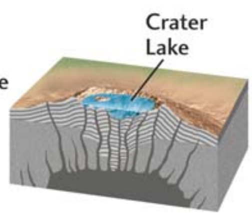


Fig. 12.12

Phreatic Explosion:
caused by magma mixing with water

Fig. 12.5

Formation of a Diatreme

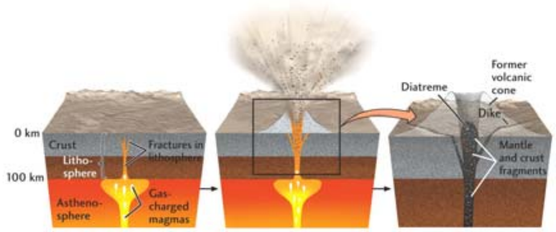


Fig. 12.13

Almost 5 carat yellow diamond found in Crater of Diamonds, AK last year

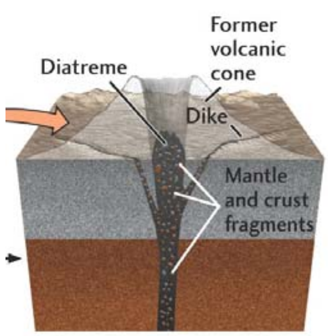


Fig. 12.13

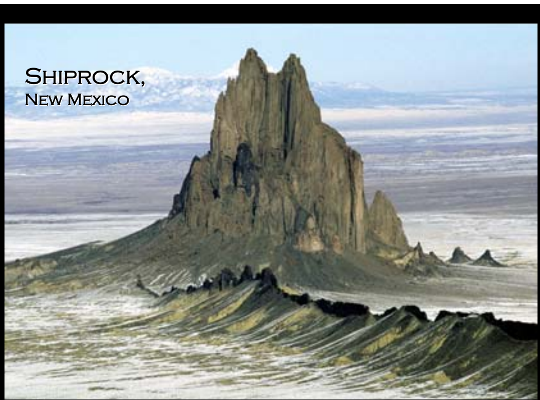


Fig. 12.13

Fissure Eruptions

A volcanic eruption originating along an elongate fissure rather than a central vent.

Volcanoes along the Laki Fissure (Iceland) formed in 1783, resulting in the largest lava flow in recorded history

Fig. 12.15

Fissure Eruptions and associated Flood Basalts

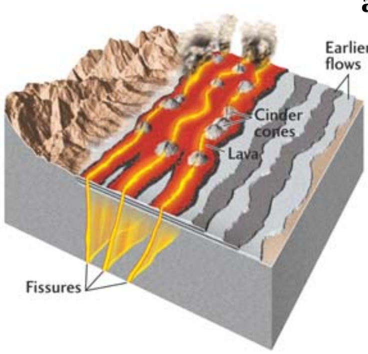
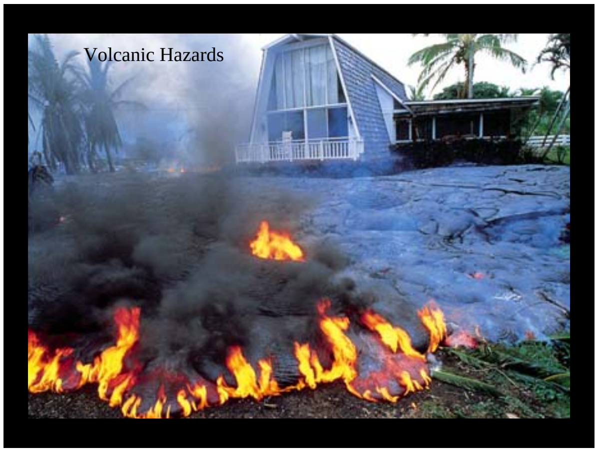
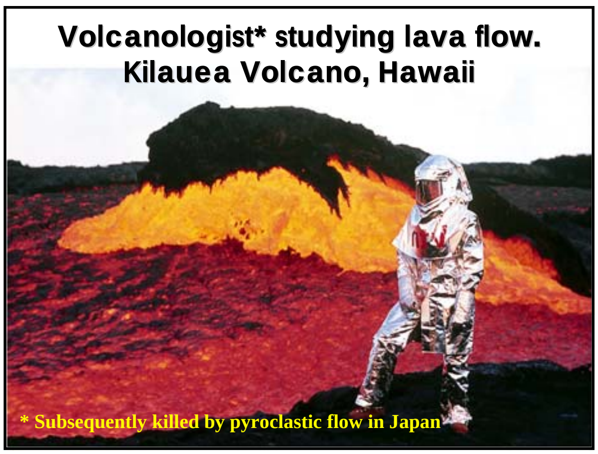
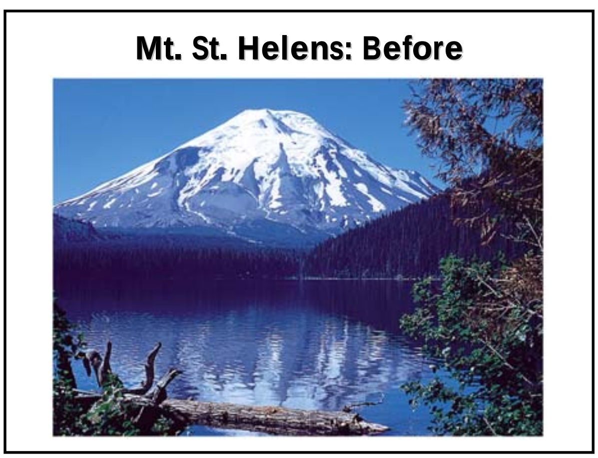


Fig. 12.15


Volcanic Hazards


Volcanologist* studying lava flow.
Kilauea Volcano, Hawaii
* Subsequently killed by pyroclastic flow in Japan


Mt. St. Helens: Before

Mt. St. Helens: During

Mt. St. Helens: After

Active Subaerial Volcanoes of the World
(80% at convergent plate boundaries)

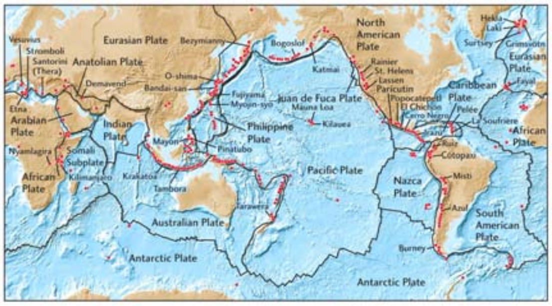


Fig. 12.19

Volcanism Associated with Plate Tectonics

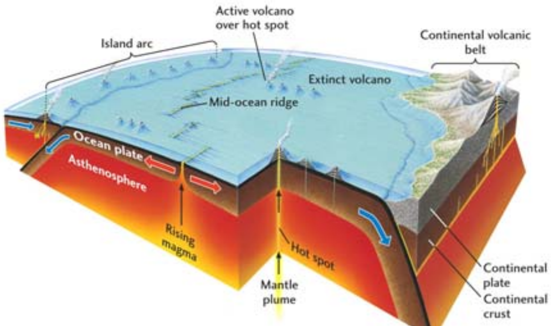


Fig. 12.20

Hot Spot Tracks

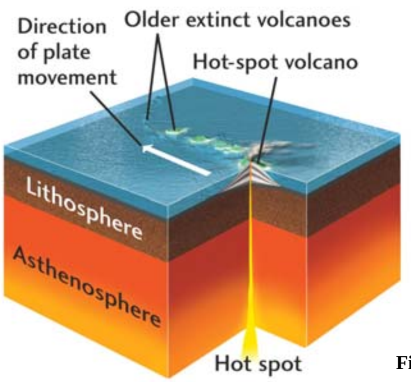


Fig. 12.21

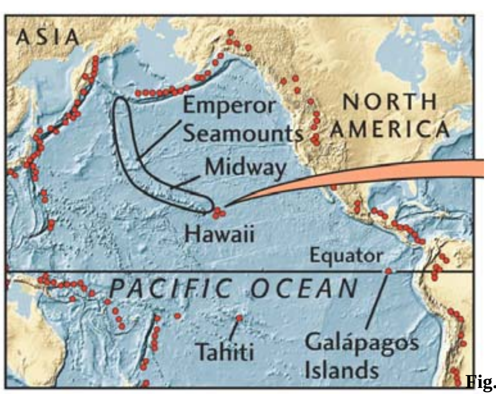


Fig. 12.21

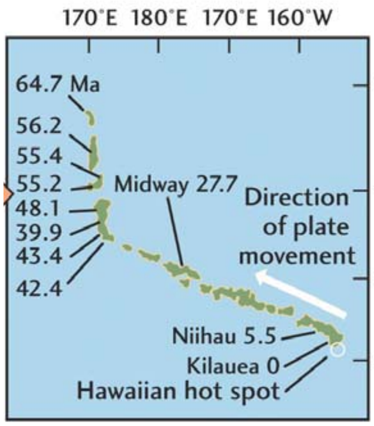


Fig. 12.21

Yellowstone Hot Spot Track Formed as the North American Plate Moved WSW

Fig. 12.21

Age of Yellowstone Calderas Track Movement of Plate Over the Hot Spot

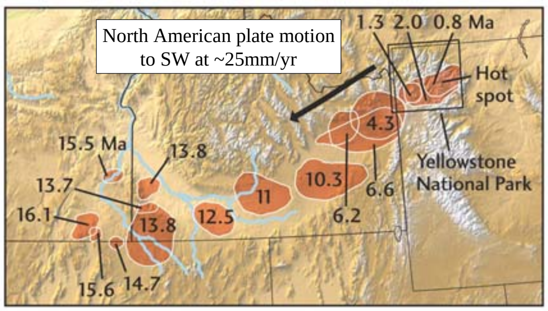


Fig. 12.21

Types of Volcanic Hazards

- **Lava Flows**:
  - e.g. Hawaii, 1998
- **Gas**:
  - e.g. Lake Nyos (Cameroon), 1984 -1700 people killed
- **Ash fall:**
  - e.g. Mt Pinatubo, 1991

Lava Flow, Hawaii

Tree-kill area from Carbon Dioxide

Ash from Mt. Pinatubo

Types of Volcanic Hazards

- **Pyroclastic flows**:
  - e.g. Mt Pelee, 1902 - 28,000 killed
- **Lahars** (mudflows):
  - e.g. Nevado del Ruiz, 1985 - 23,000 killed
- **Tsunami**:
  - e.g. Krakatoa, 1883 - 36,417 killed

Pyroclastic Flows:

A density flow consisting of a hot (up to 800º C), poisonous mixture of gas and pyroclastic material moving downslope at speed in excess of 200 km/hr!

Fig. 12.10

Lahars (Volcanic mudflows)

Formed by the sudden mixing of large volumes of pyroclastic material with water (e.g. heavy rain, draining of crater lake, melting of glacier).

They Move Fast

Lahars can move 100+ km/hr, and can cover large areas (1,000's of km^2), and can kill large numbers of people (~25,000 in one event)

Cumulative Deaths Due to Volcanic Eruptions Over the Last 2,000 Years

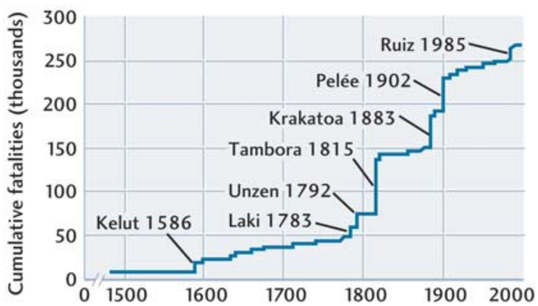
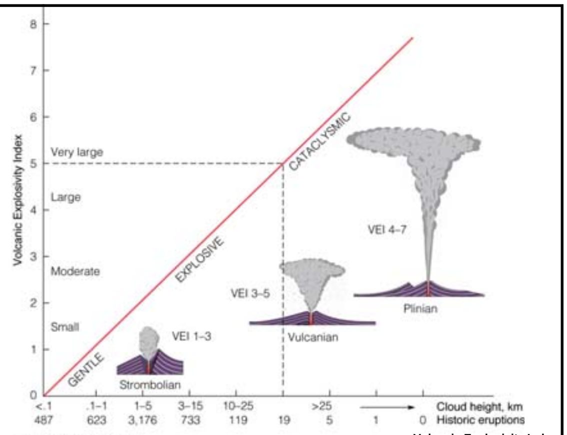
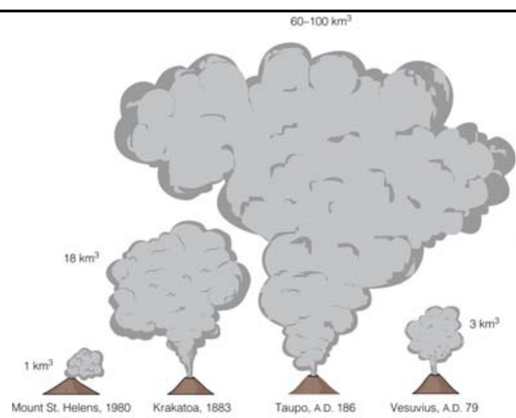


Fig. 12.24



Volcanic Explosivity Index

Plinian ash cloud, Mt. Pinatubo



Relative Sizes of Eruptions

Location of Potentially Hazardous Volcanoes in Alaska

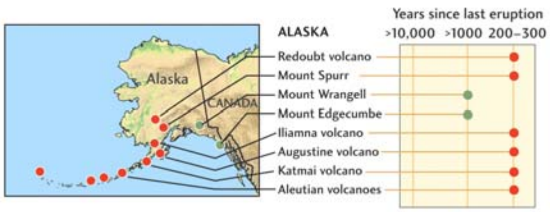


Fig. 12.26

Redoubt Volcano, Alaska 1989

Location of potentially hazardous volcanoes in Hawaii…

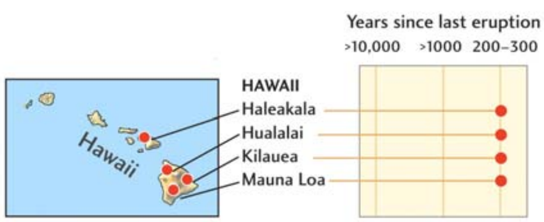


Fig. 12.26

...and in North America!

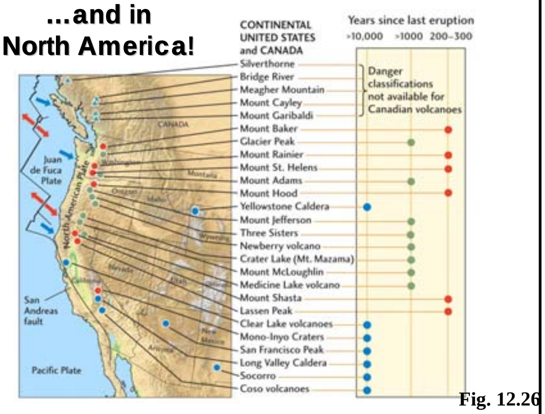
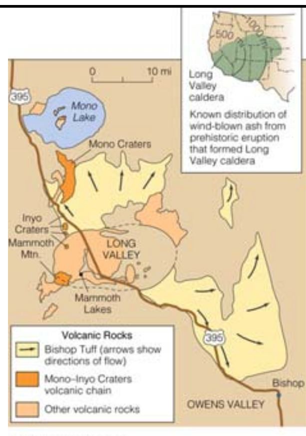
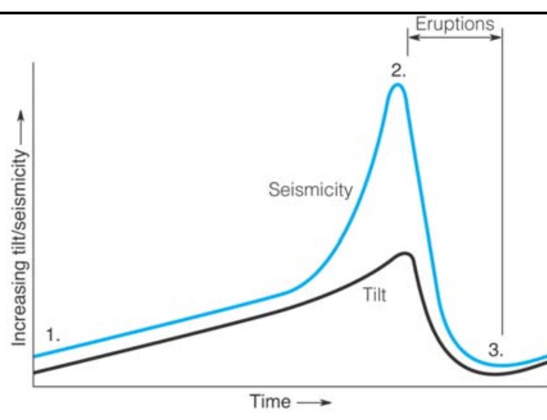


Fig. 12.26



Long Valley Caldera



Hawaii Eruption Cycle