Volcanism

- Essential Questions:
- What is a volcano exactly?
- What are the three main types of volcanoes and in what manner do they erupt?

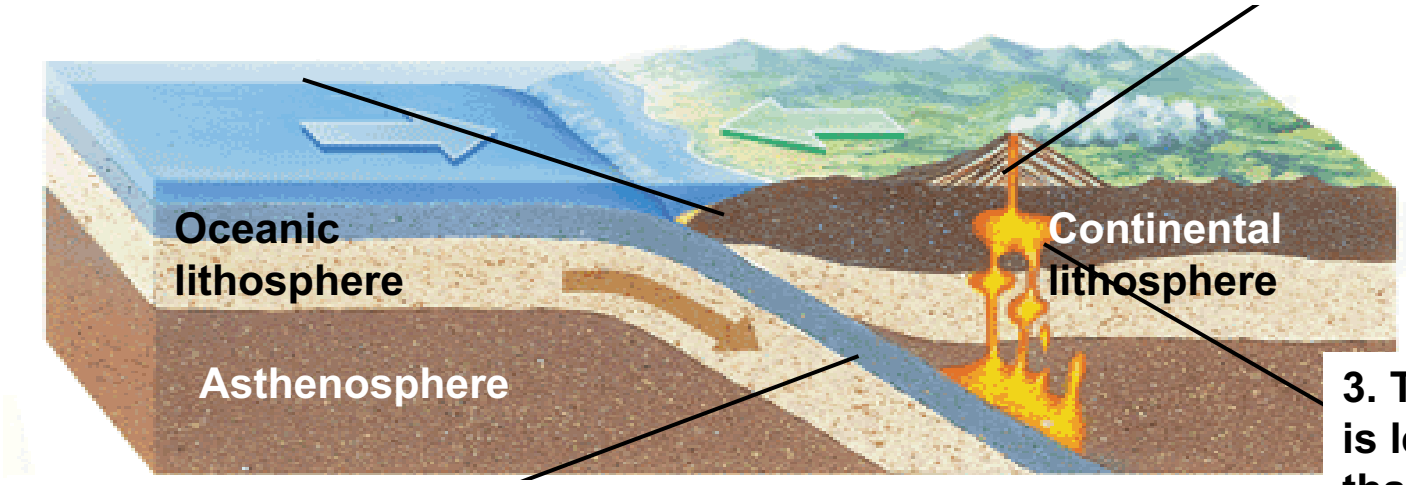
Volcanoes

How and Where Volcanoes Form

Volcanic activity takes place primarily at subduction boundaries,

1. Water in the subducted rock is released into the asthenosphere.

4. Some of the magma reaches Earth's surface, and volcanoes form on the overriding continental plate.



2. The water lowers the melting temperatures of materials in the asthenosphere, leading to magma formation.

3. The magma is less dense than its surroundings, so it rises.

Volcanoes

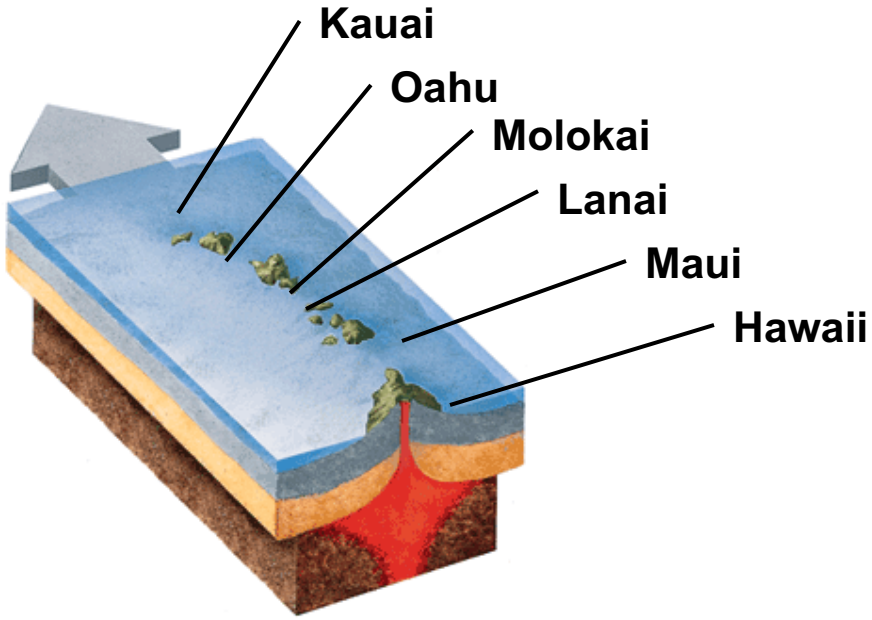
VOCABULARY

volcano

hot spot

How and Where Volcanoes Form

Magma and volcanoes also form at hot spots.



The Hawaiian Islands formed over a hot spot.

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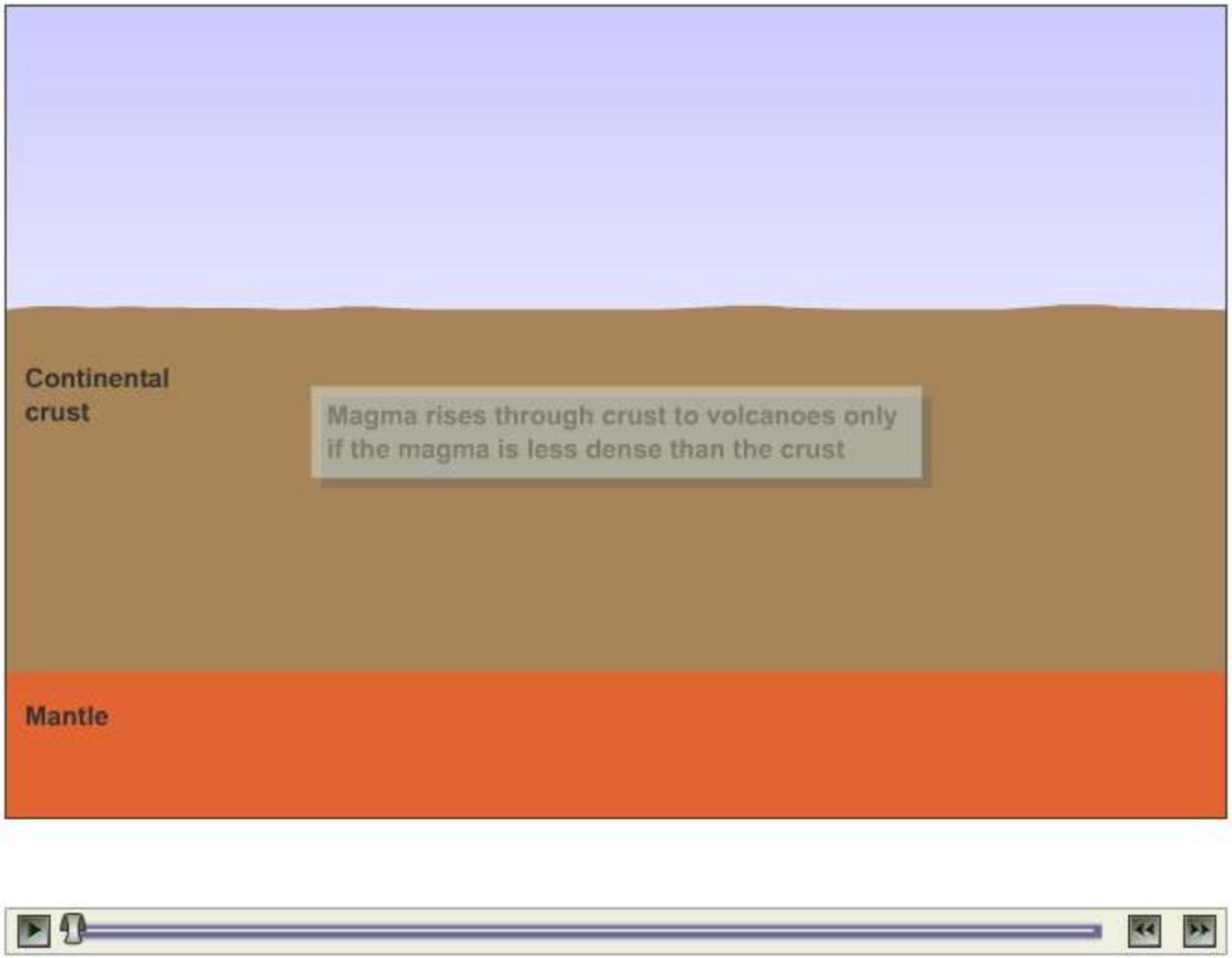
How magma rises



Volcanic Settings

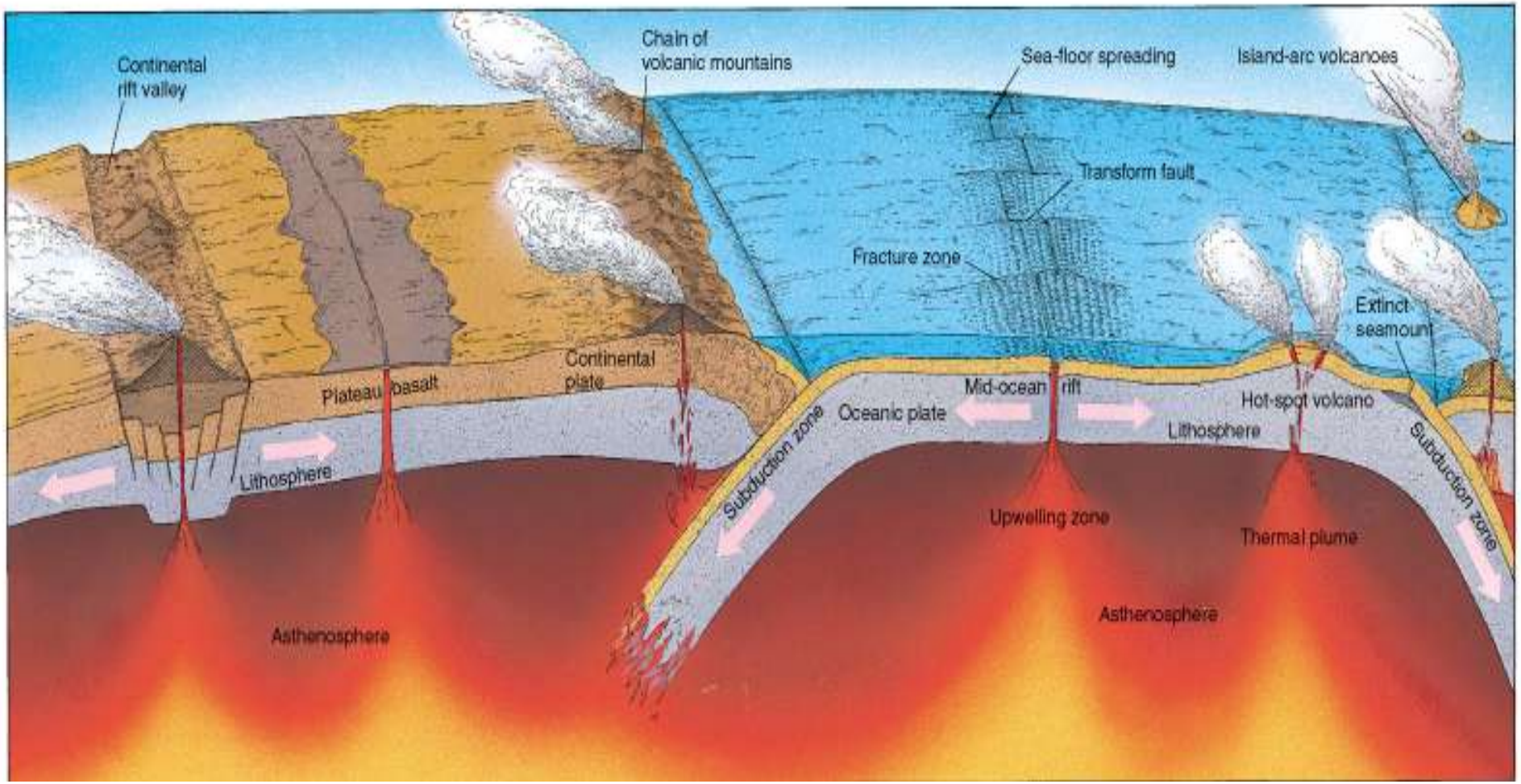


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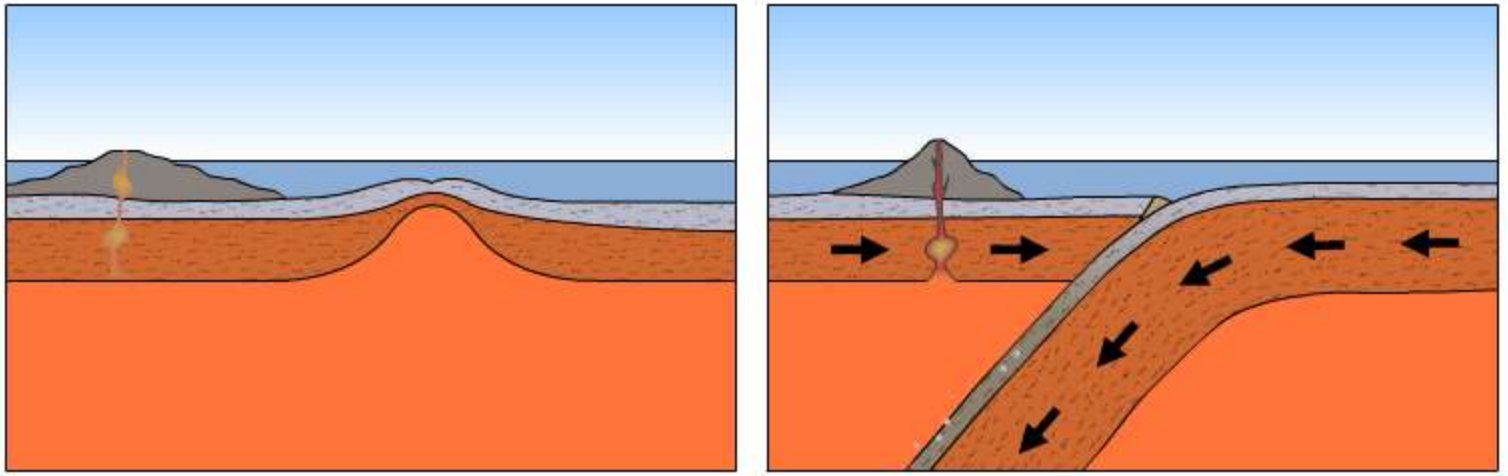
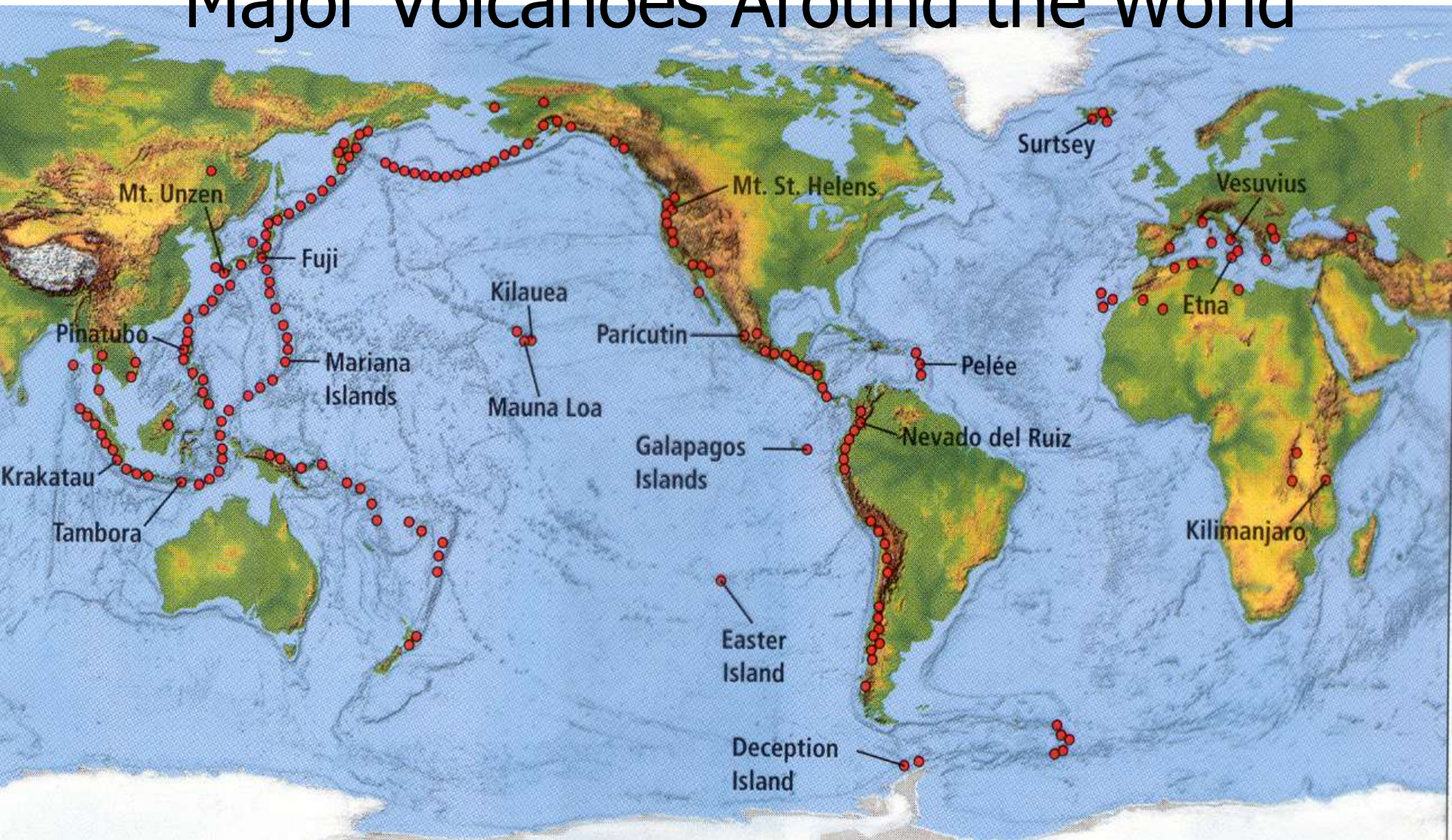
Plate Tectonics and mantle melting



Decompression melting

Wet melting

Major Volcanoes Around the World



Magma and Erupted Materials

Gases escape easily from basaltic magma, generating relatively quiet eruptions. Hardened basaltic lava flows on land are characterized as pahoehoe or aa; if the lava cools underwater, it is characterized as pillow lava.

Parameters of volcanism:

- Viscosity
- Chemistry of Magma
- Gases within the magma
- Water content of magma

Magma and Erupted Materials

Lava Flow - A 'stream' of molten rock

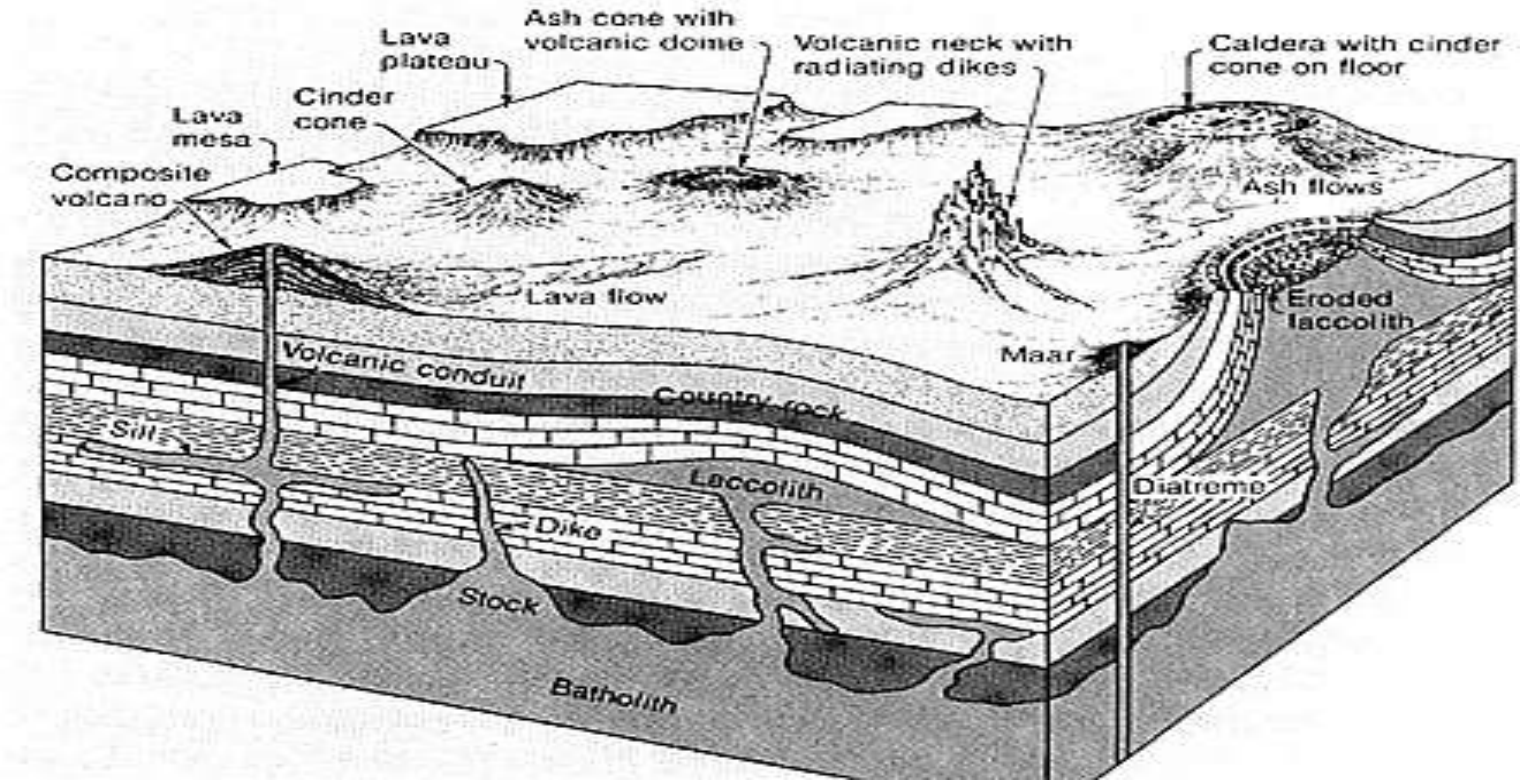
Viscosity: Viscosity is a measure of how thick (viscous) and sticky a liquid is.

Magma and Erupted Materials

	Basaltic Magma	AndesiticMagma	Rhyolitic Magma
Silica Content	Least (~50%)	Intermediate (~60%)	Most (~70%)
Gas Content	Least	Intermediate	Most
Viscosity	Least viscous	Intermediate	Most viscous
Type of Eruption	Rarely explosive	Sometimes explosive	Usually explosive
Melting Temp.	Highest	Intermediate	Lowest
Location	Rifts, oceanic hot spots 	Subduction boundaries 	Continental hot spots 

Volcanic Landforms

A volcano's shape and structure depend on how it erupts and what materials are released. Shield volcanoes are formed by basaltic lava that flows long distances before hardening.



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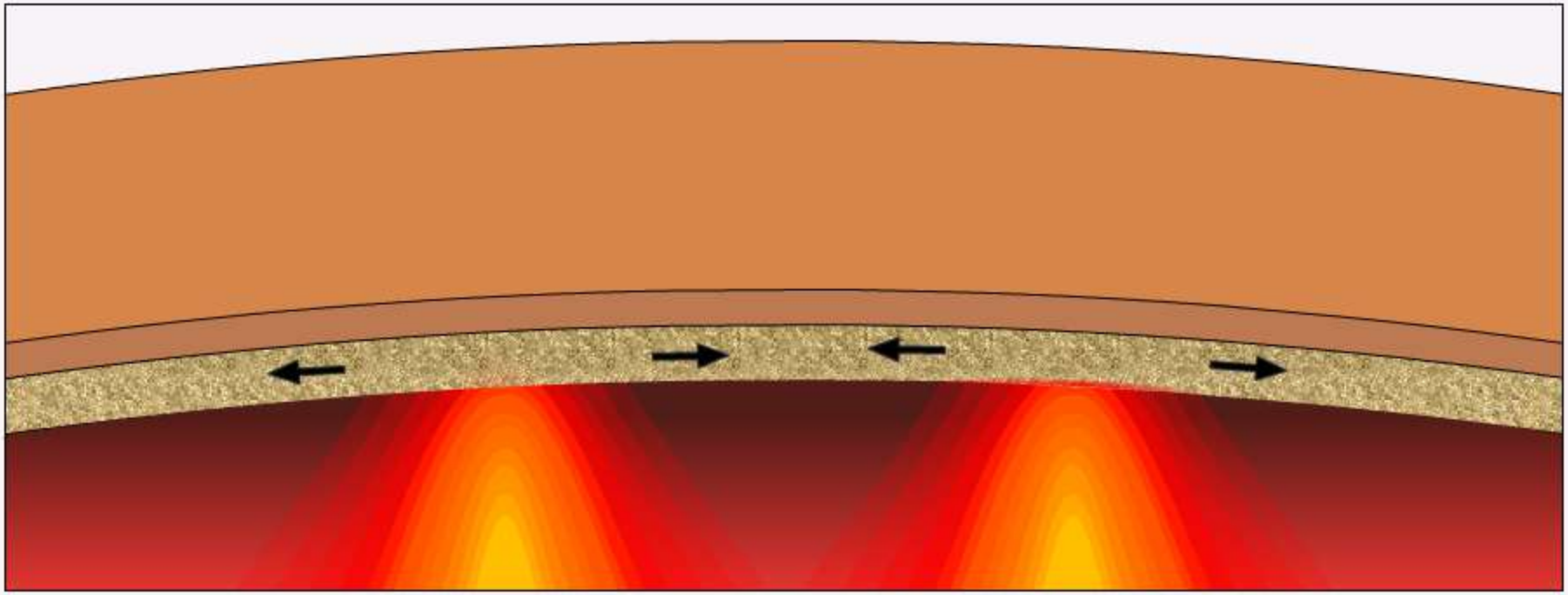
Tectonic Settings of Volcanic Activity

Continental rift volcanism | Continental volcanic arc | Hot-spot volcanoes | Volcanic-island-arc

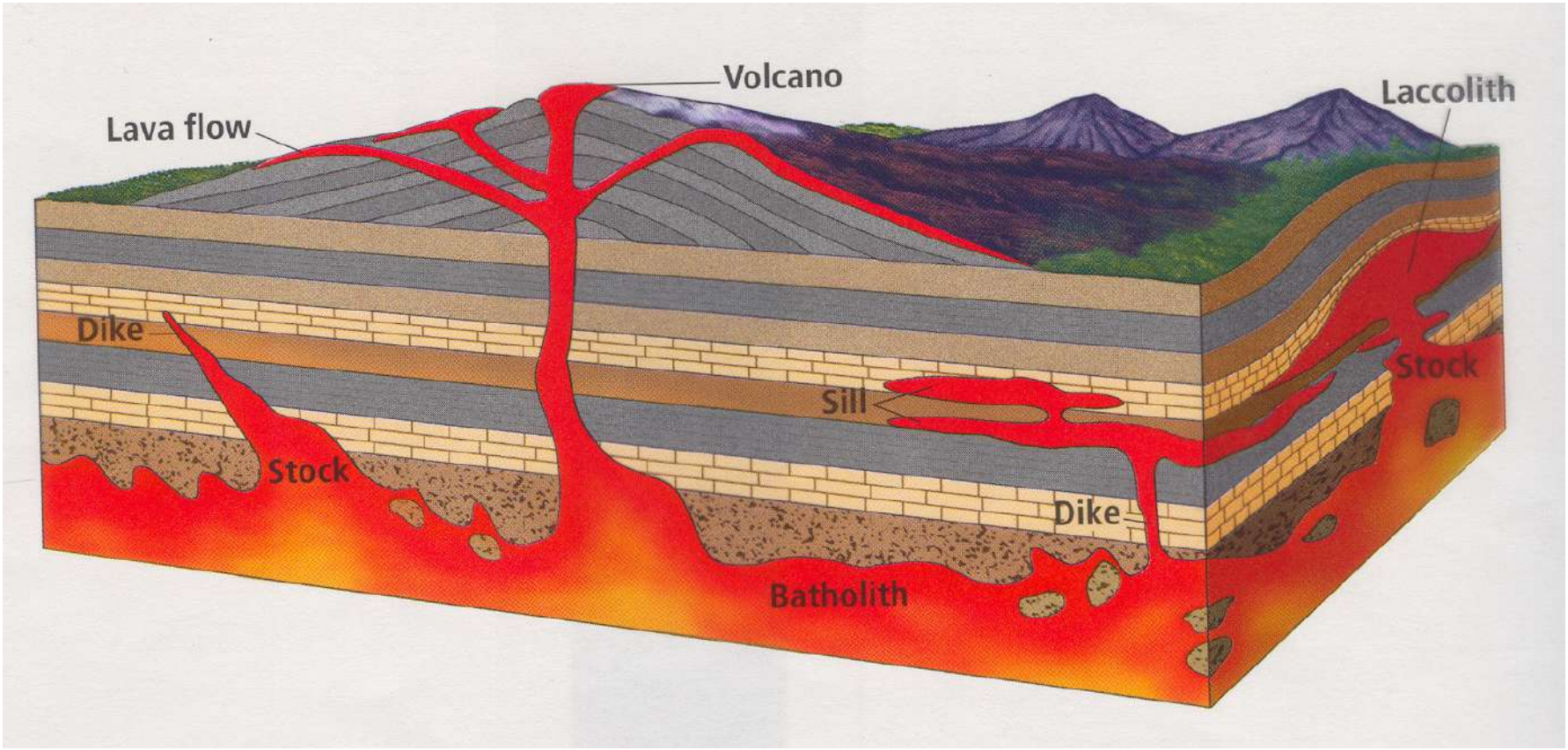


0 5 10 15 20 25 30 35 40 45 50

Millions of years

Labels Off Main page

Igneous ~~Intrusions~~ - classified by shape, size, and orientation



There are three types of volcanic cones:

- Cinder – explosive eruptions, small but steep slopes, pyroclastics.
- Shield – non-explosive eruptions, fluid basaltic lava, gentle broad slopes.
- Composite – alternating between lava and pyroclastics, explosive and non-explosive eruptions, steep and tall.

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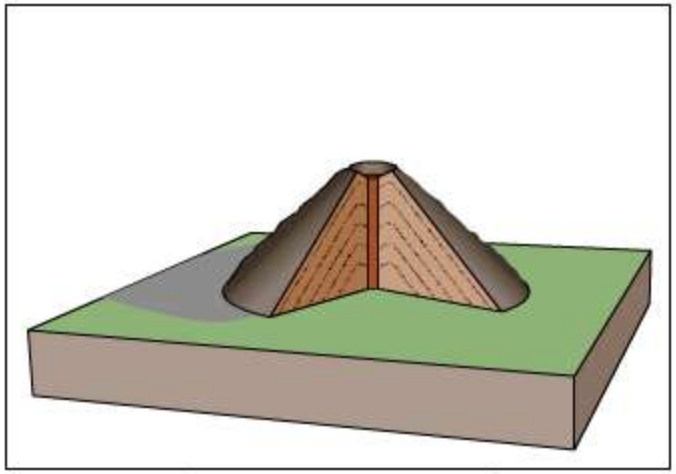
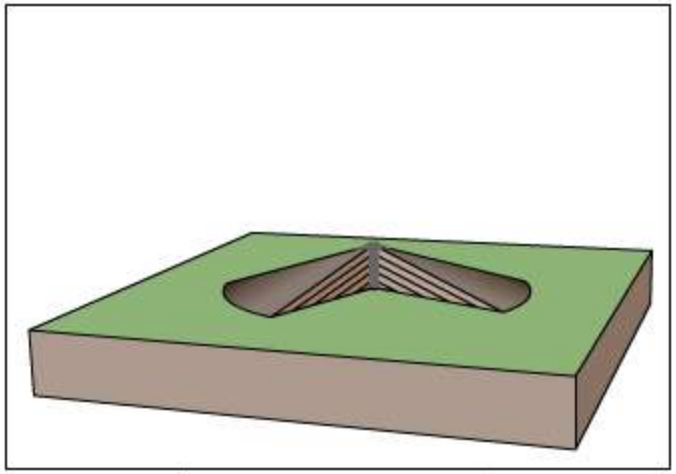
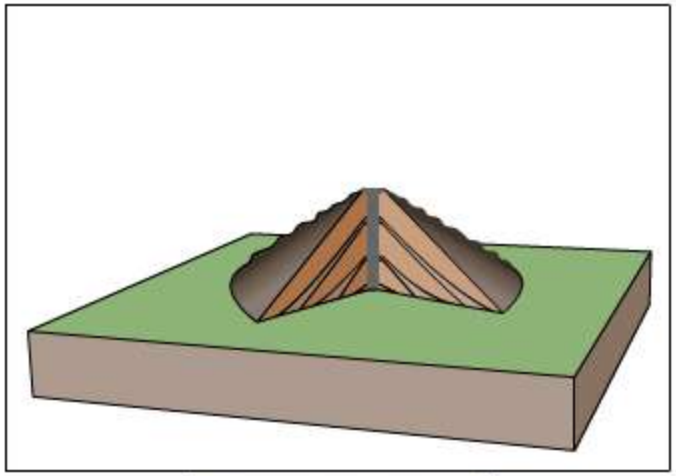
Types of Volcanoes



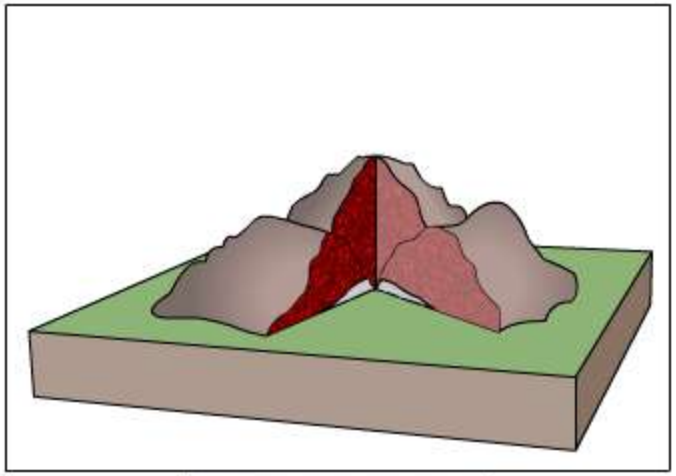
Cinder cone



Shield volcano



Composite volcano



Dome complexes

Volcanic Landforms

VOCABULARY

shield volcano

cinder cone

composite volcano

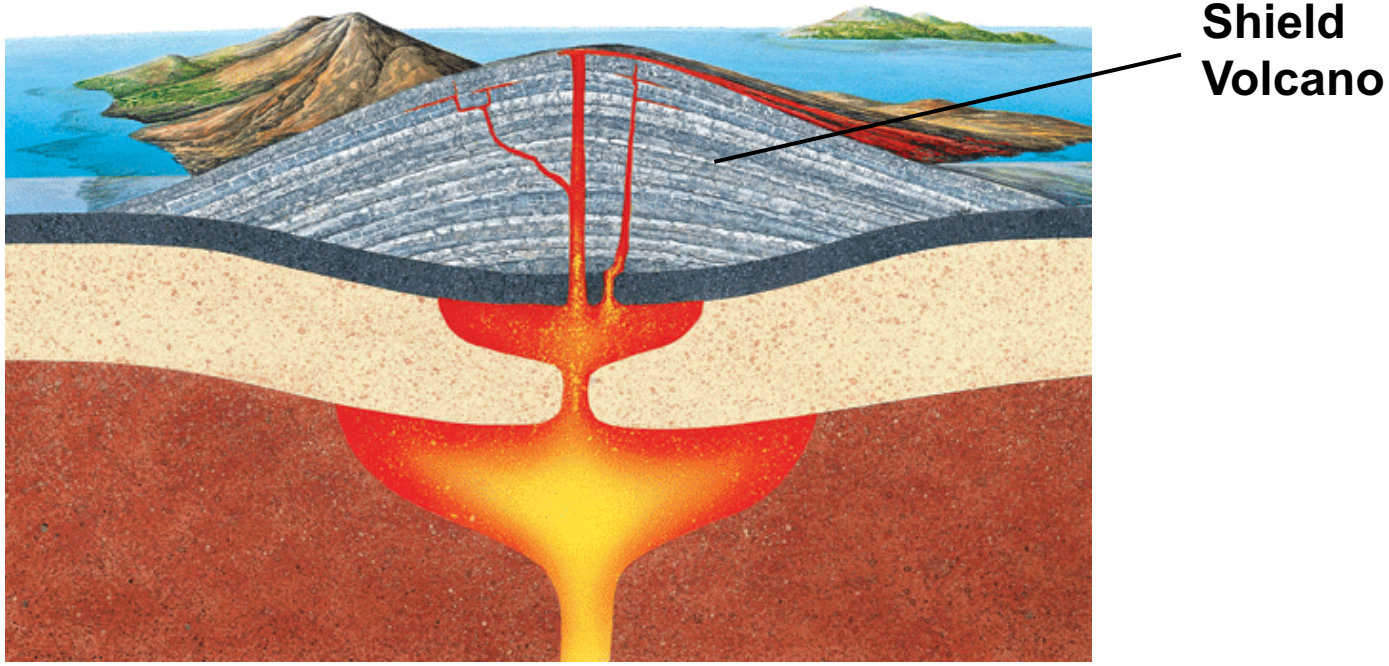
lahar

caldera

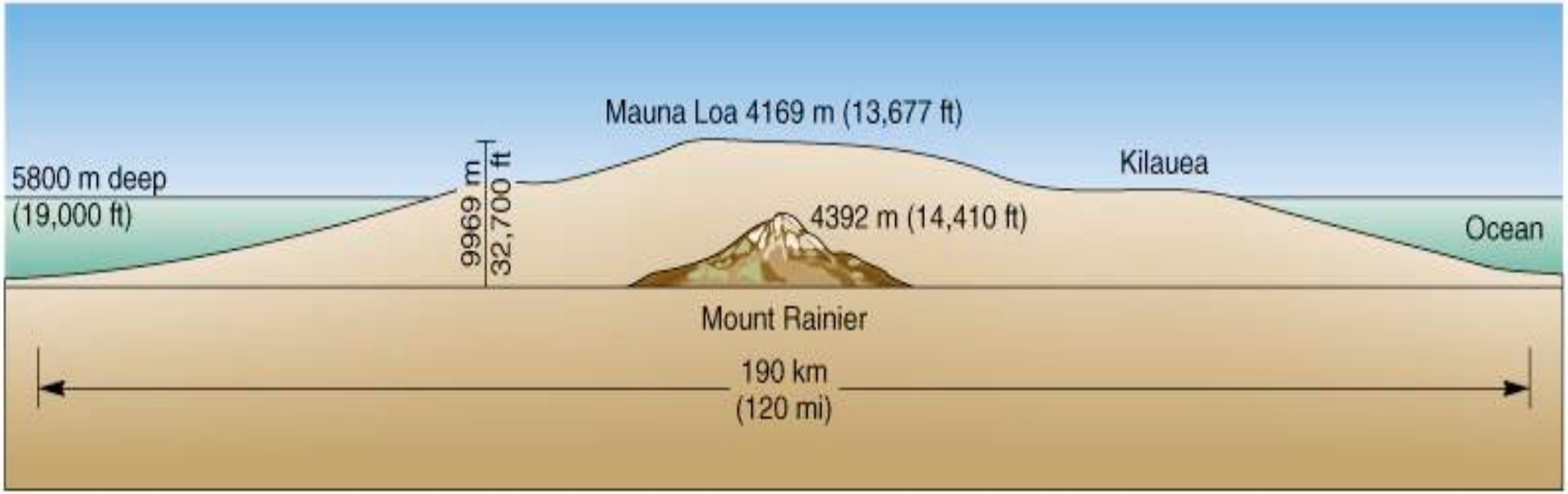
lava plateau

A volcano's shape and structure depend on how it erupts and what materials are released.

Shield volcanoes are formed by basaltic lava that flows long distances before hardening.

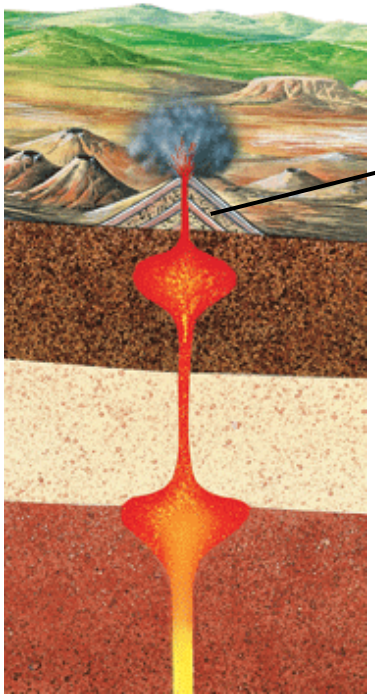


Shield and Composite Volcanoes



Volcanic Landforms

Cinder cones are formed when molten lava is thrown into the air from a vent and breaks into drops. These drops harden into cinders that form a steep cone around the vent.

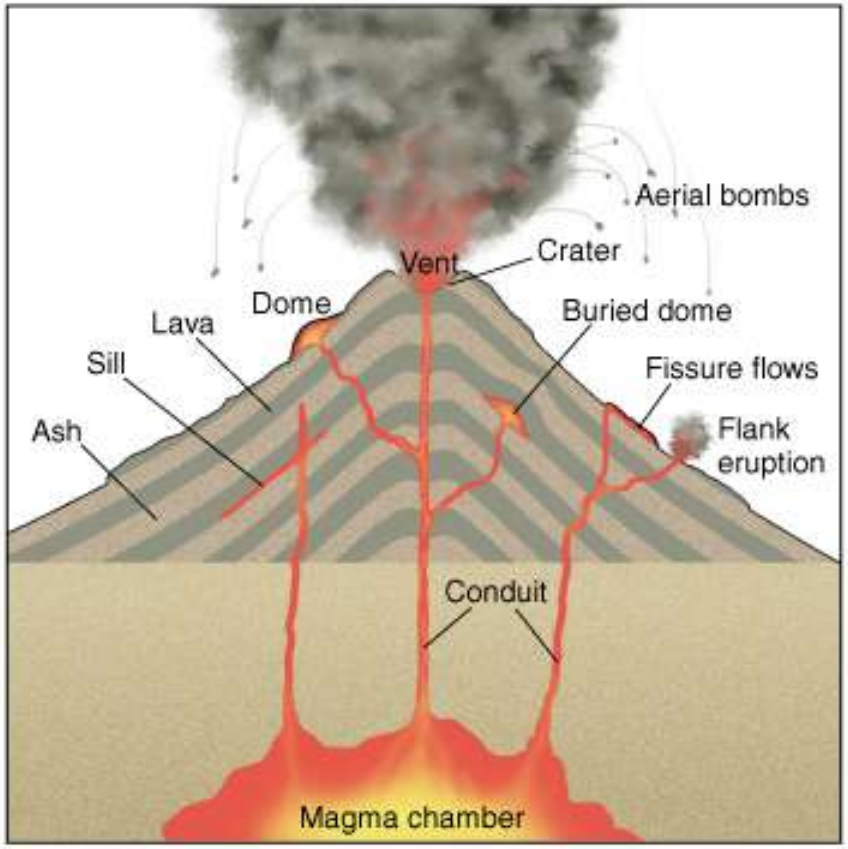


Volcanic Landforms

Composite volcanoes are formed by layers of pyroclastic materials and lava that have erupted in the past.

Composite Volcano

Composite volcanoes



(a)


(b)

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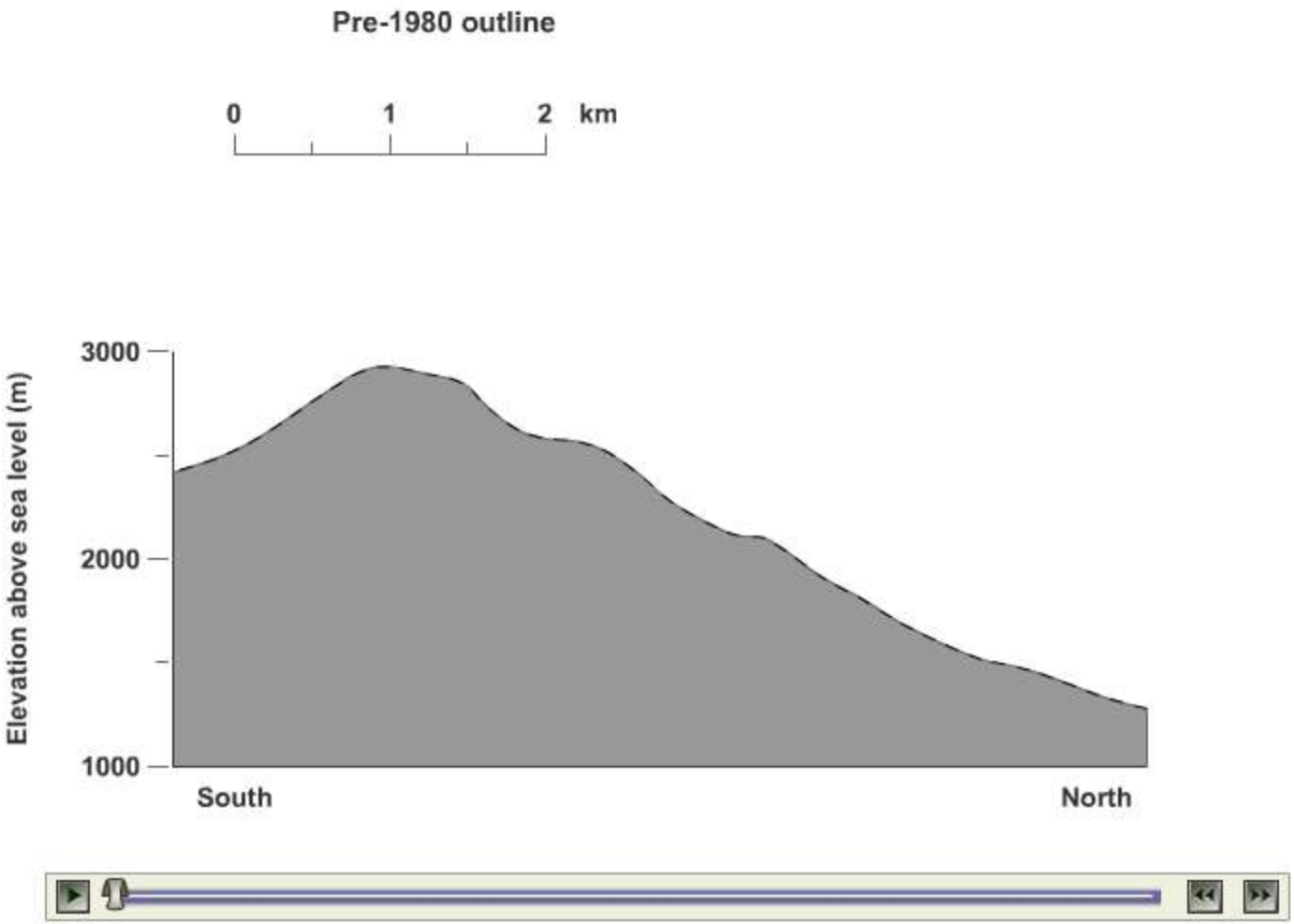
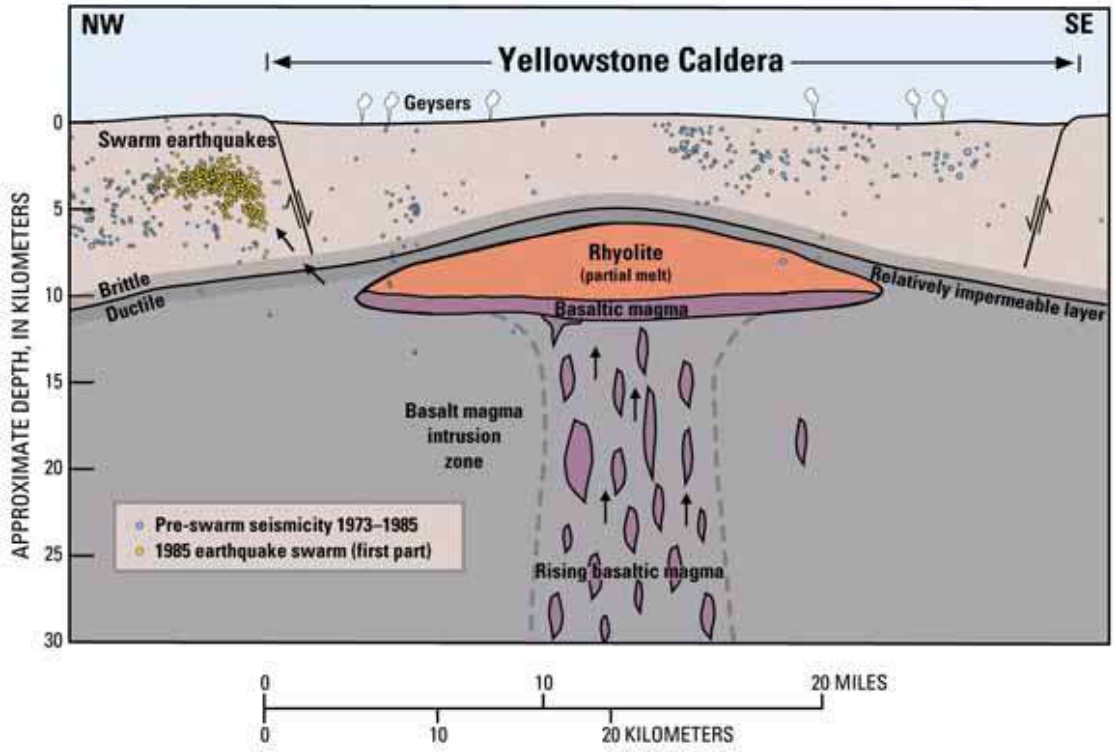
Debris avalanche and eruption of Mt. St. Helens, Washington



Volcanic Landforms

A **caldera** is a large crater-shaped basin that forms when the top of a volcano collapses.



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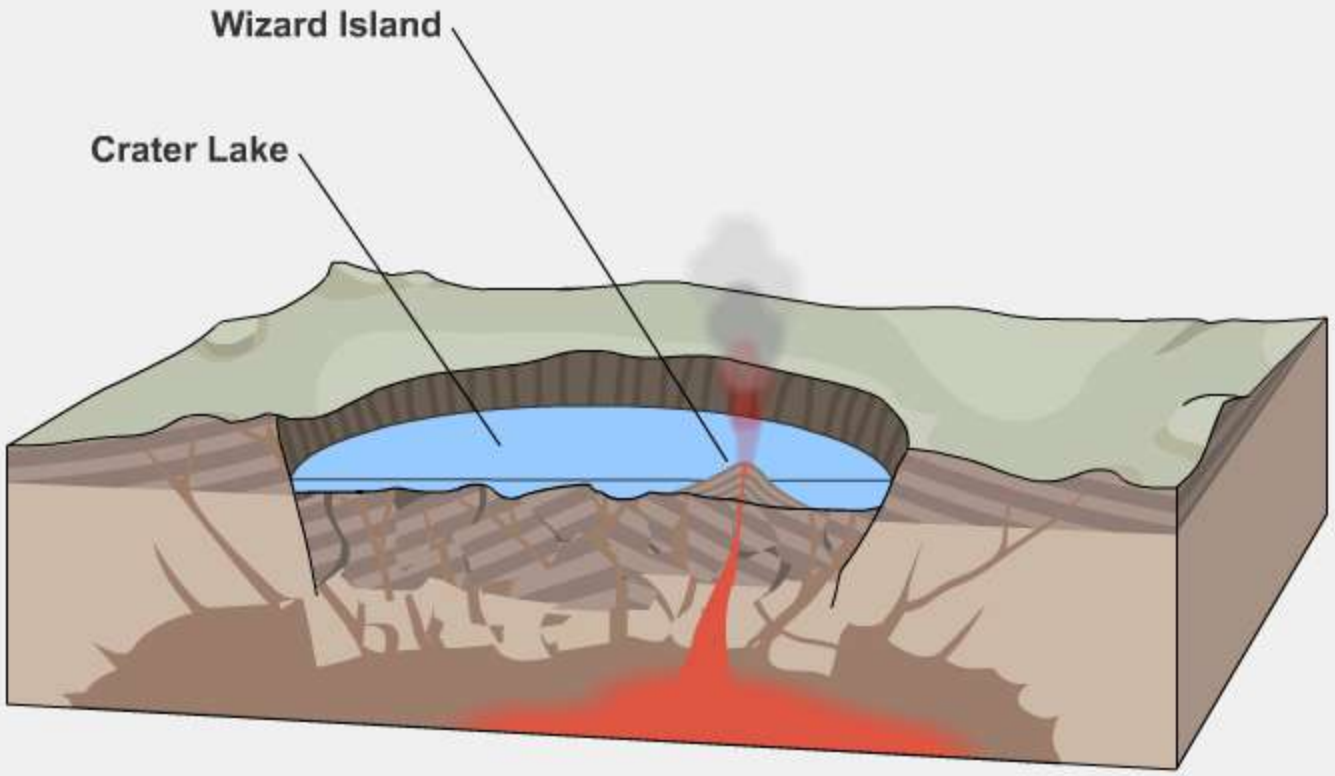

Formation of a Crater Lake--type caldera

Reset

EFFUSIVE ERUPTIONS

- Generally at hots spots, spreading centers
- Mantle comes directly to surface
- Hot lava; low viscosity, very mafic, flows easily, gases escape easily
- Forms shields, flood basalts

EXPLOSIVE ERUPTIONS

- Found at subduction zones
- Magma low temp (800 degrees C), high viscosity, does not flow easilty, more felsic mineralogy, gases trapped, hard to predict explosions
- Forms composite volcanoes, cinder cones, calderas, aerial bombs, nuee ardente gas flows, very destructive

Table 12.3 Notable Composite Volcano Eruptions

Date	Location	Number of Deaths	Amount Extruded (mostly pyroclastics) in km^3 (mi^3)
Prehistoric	Yellowstone, Wyoming	Unknown	2400 (576)
4600 B.C.	Mount Mazama (Crater Lake, Oregon)	Unknown	50–70 (12–17)
1900 B.C.	Mount St. Helens	Unknown	4 (0.95)
A.D. 79	Mount Vesuvius, Italy	20,000	3 (0.7)
1500	Mount St. Helens	Unknown	1 (0.24)
1815	Tambora, Indonesia	66,000	80–100 (19–24)
1883	Krakatau, Indonesia	36,000	18 (4.3)
1902	Mont Pelée, Martinique	29,000	Unknown
1912	Mount Katmai, Alaska	Unknown	12 (2.9)
1943–1952	Paricutín, Mexico	0	1.3 (0.30)
1980	Mount St. Helens	54	4 (0.95)
1985	Nevado del Ruiz, Colombia	23,000	1 (0.24)
1991	Mount Unzen, Japan	10	2 (0.5)
1991	Mount Pinatubo, Philippines	800	12 (3.0)
1992	Mount Spurr/Mount Shishaldin, Alaska	0	1 (0.24)
1993	Galeras Volcano, Colombia	5	1 (0.24)
1993	Mount Mayon, Philippines	0	1 (0.24)
1994	Kliuchevskoi, Russia	0	1 (0.24)

*See opening section under Volcanism for listings of other volcanic activity since 1995.