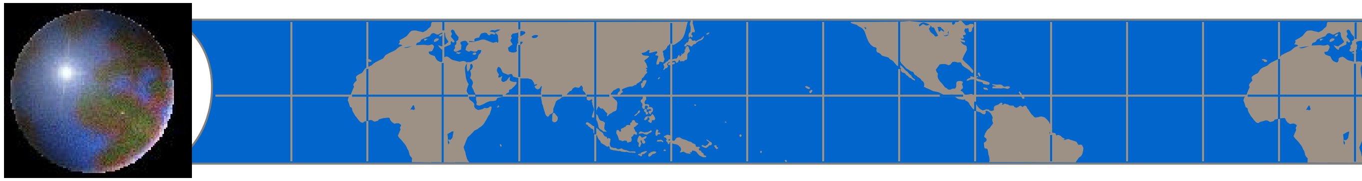
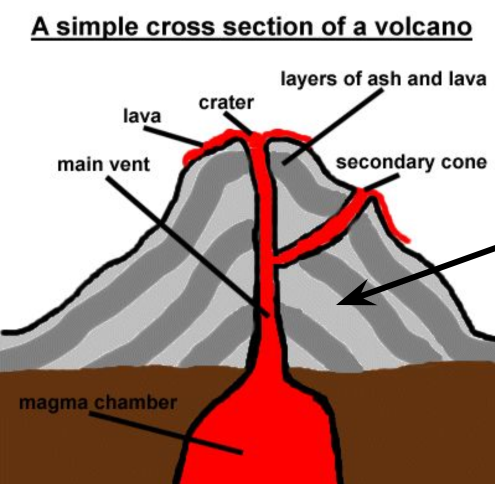


Volcano

Volcanoes are conical or dome-shaped landforms built by the emission of **lava** and its contained gasses (or **pyroclastics**) from a constricted vent onto Earth's surface. Lava rises in a narrow, pipe-like conduit (**vent**) from a **magma chamber** beneath



Composite Volcano!

Volcanism

Factors affecting the nature of volcanic eruptions:

- Magma Temperature "***hotter magma* → *less viscous***"

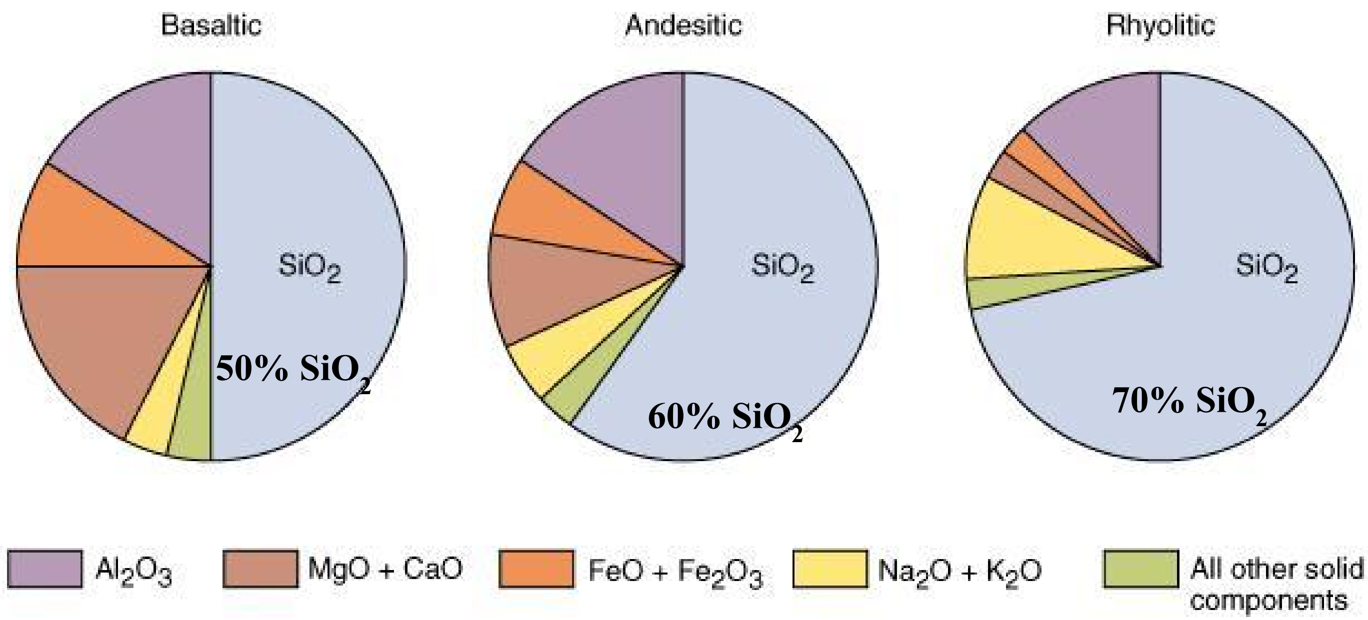
- Magma Composition "***more silica* → *more viscous***"

Felsic = More Silica = More Viscous
Mafic = Less Silica = Less Viscous

Viscosity is the resistance of a liquid to flow.

The **more viscous** the molten, the **more explosive the eruption** will be since the molten can trap more gases.

Molten Types Based on Chemistry



gabbro/basalt

Brian J. Skinner.

diorite/andesite

Brian J. Skinner.

granite/rhyolite

Brian J. Skinner.

Volcanoes

Three types of volcanoes are:

Shield Cones
Composite Cones
Ash and Cinder Cones

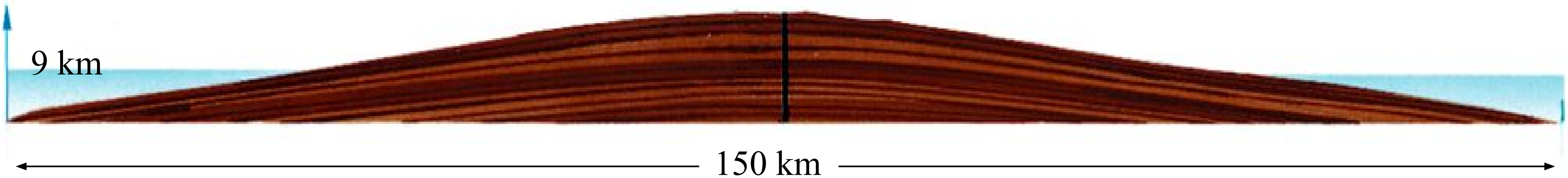
Volcanoes

	Base	Slope	Type of Material	Rock Types	Example
Shield	wide	< 5 degrees	lava flows (< 1% pyroclastic)	basalt	Mauna Loa, USA
Ash and Cinder	narrow	30 - 40 degrees	ejected lava and fragments (pyroclastic)	scoria basalt	Paricutin, Mexico
Composite	intermediate	> 40 degrees	both lava and pyroclastic	basalt andersite rhyolite	Mount St. Helens, USA

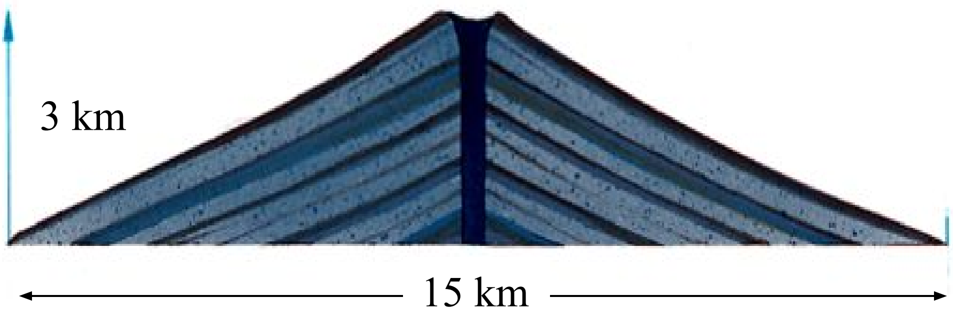
Volcano Types

Shield volcano (e.g. Mauna Loa, Hawaii)

All Lava!

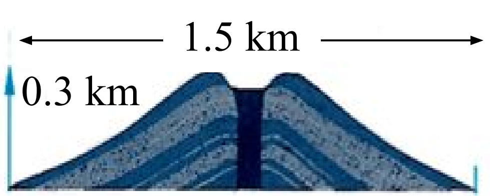


Composite or (stratovolcano) volcano (e.g. Mt. St. Helens, Washington)

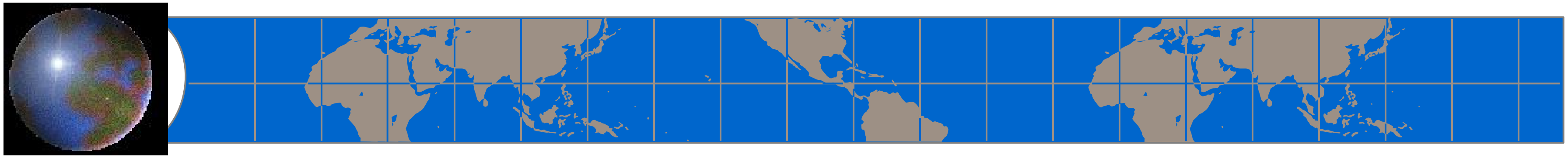


Alternating Lava And Pyroclastics!

Cinder volcano (e.g. Sunset Crater, Arizona)

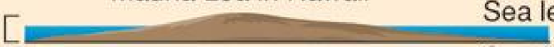


All Pyroclastics!



Summary of Volcano Types

Table 4.2 Comparison of the Three Types of Volcanoes

Profile of Volcano	Description	Composition
Mauna Loa in Hawaii  10 km; Sea level; Sea floor; Shield volcano	**Shield Volcano** Gentle slopes—between 2 and 10 degrees. The Hawaiian example rises 10 km from the sea floor.	Basalt. Layers of solidified lava flows.
 < 300 meters; 33°; Cinder cone	**Cinder Cone** Steep slopes—33 degrees. Smallest of the 3 types.	Pyroclastic fragments of any composition. Basalt is most common.
 Typically 1000 to 4000 meters; Composite volcano	**Composite Volcano** Slopes less than 33 degrees. Considerably larger than cinder cones	Layers of pyroclastic fragments and lava flows. Mostly andesite.

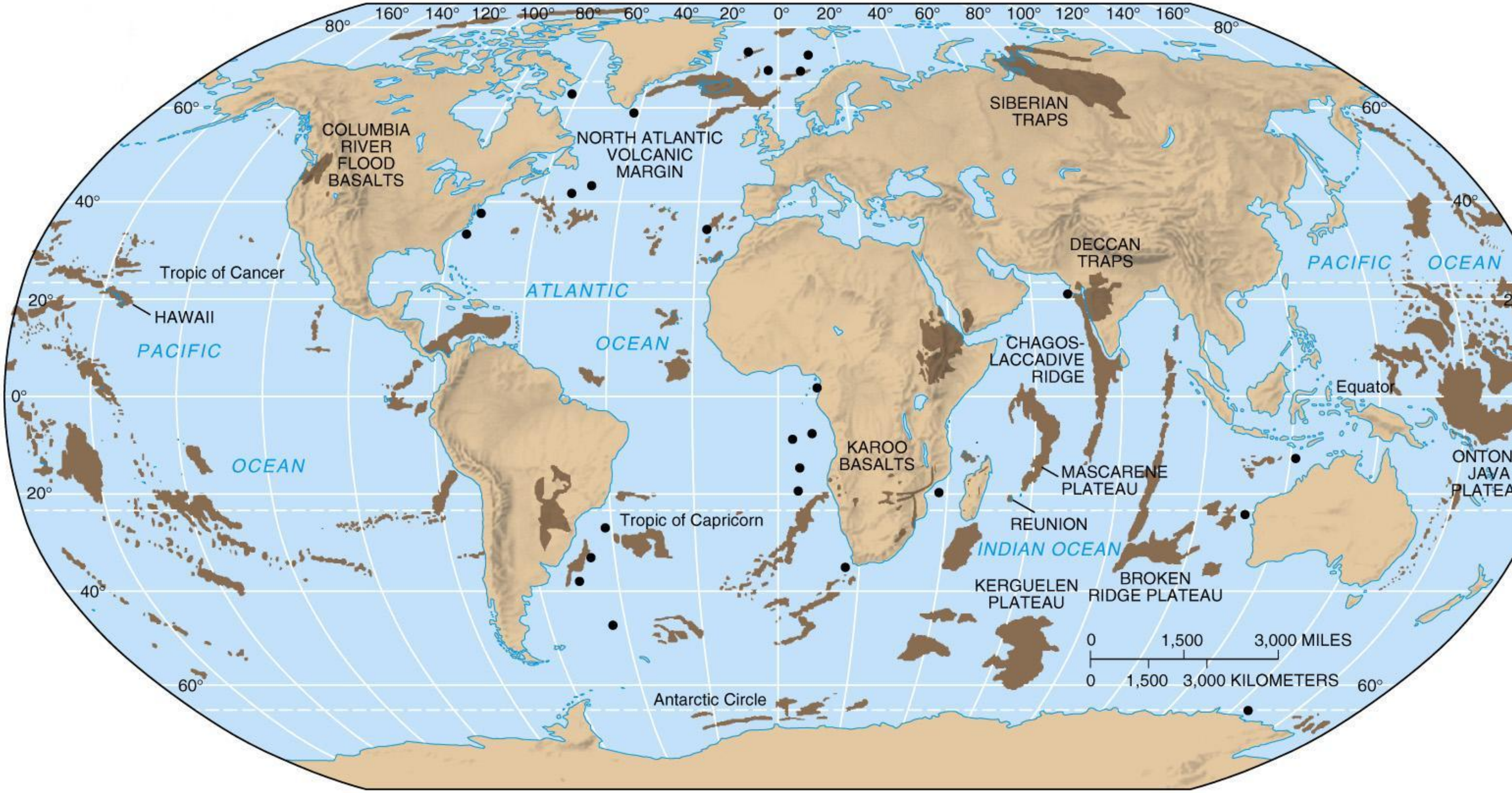
GENTLE ERUPTIONS!

- Generally at **hotspots** & **spreading centers (ridges)**.
- Magma comes directly to surface and turns into **lava flows**.
- ***Hot lava; low viscosity, very mafic (i.e. low silica); flows easily; gases escape easily.***
- Forms **shield volcanoes** and **flood basalts**.

(c)

(a)

(b)



A MAP OF FLOOD BASALTS IN THE WORLD

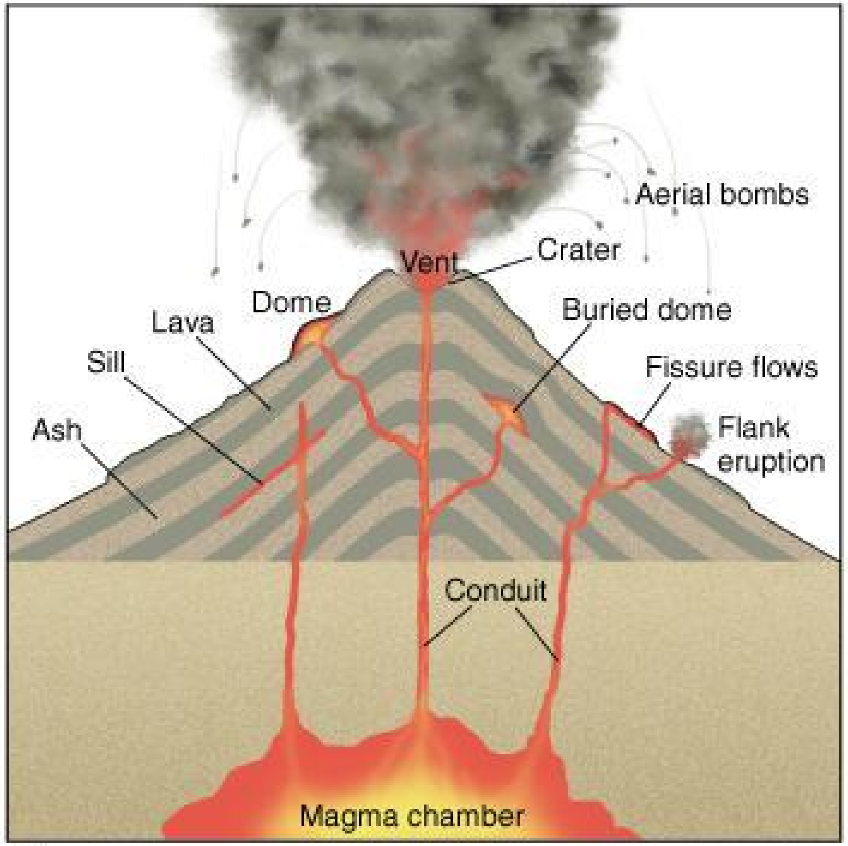
EXPLOSIVE ERUPTIONS!

- Found at **subduction zones**. Convergent plate boundary!
- ***Magma is relatively lower temperature (800 degrees Celsius); high viscosity; does not flow easily; more felsic composition; gases become trapped; hard to predict explosions.***
- Forms **composite volcanoes and cinder volcanoes**; very destructive.


Composite Volcano
Columbia River Basalt Flow

Pyroclastic Explosion!

Composite Volcanoes



(a)

(b)

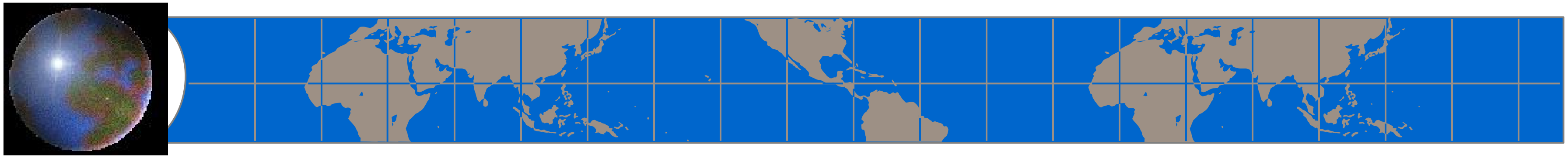
Alternating Pyroclastics and Lava Flows

Figure 12.34

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.



Volcanic Settings - Consider Volcano Types at the Different Plate Boundaries – Let's Talk!

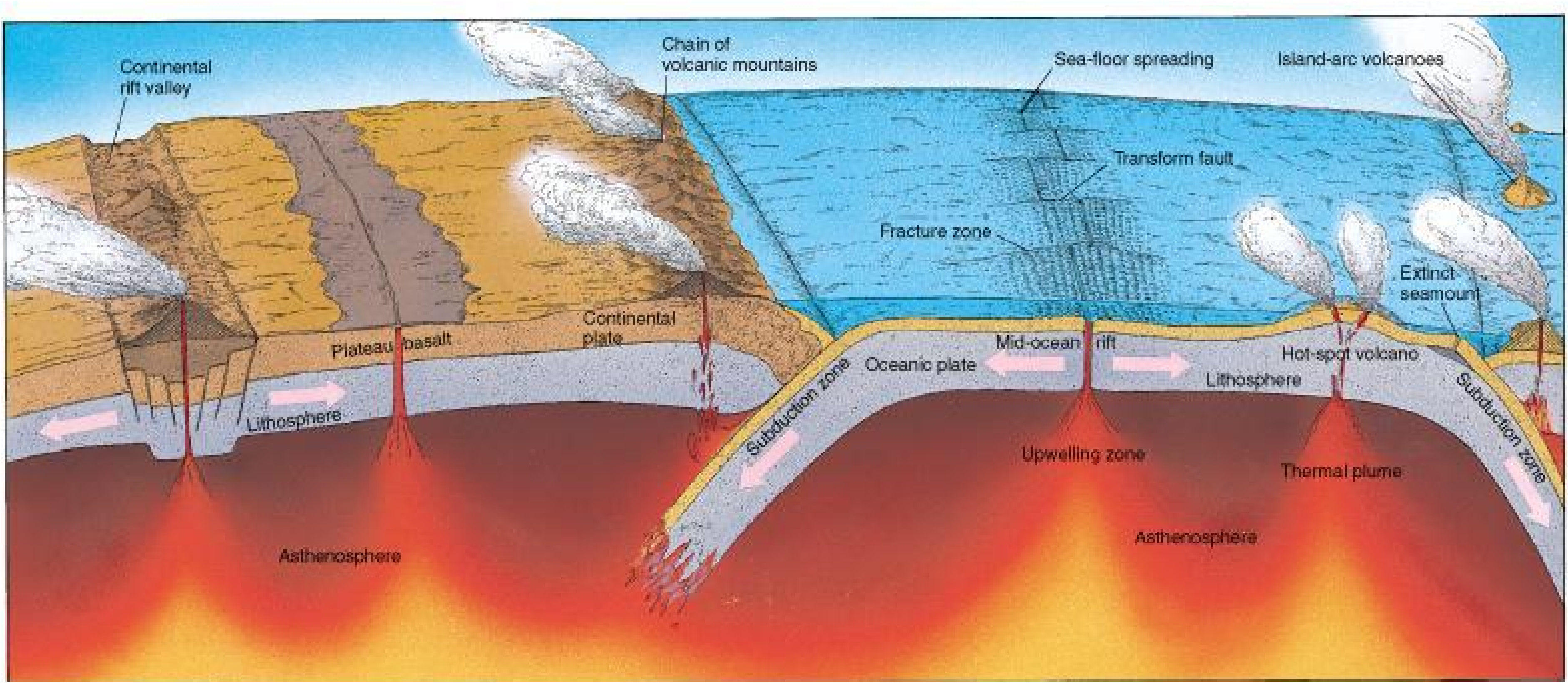
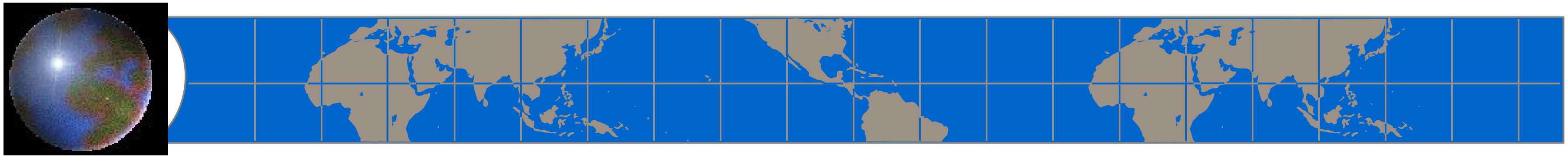


Figure 12.24



Volcano Types and Plate Boundaries:

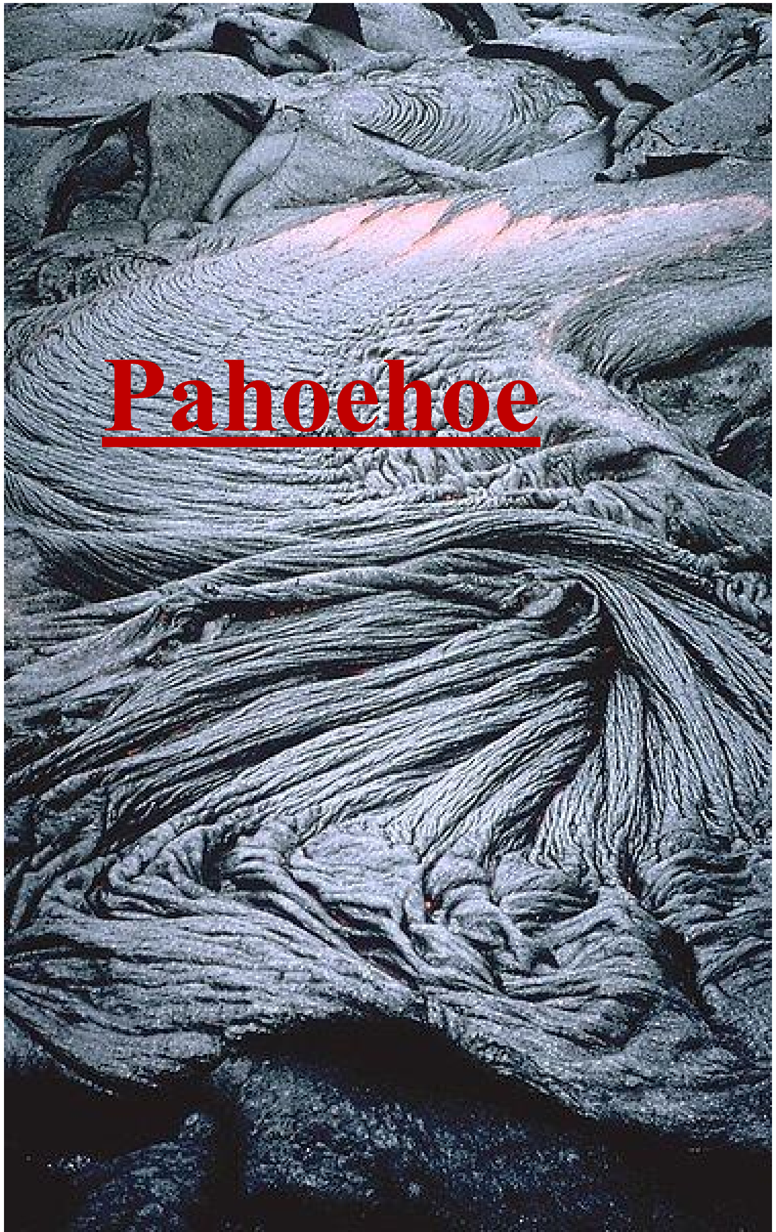
Volcano Type	Silica Content	Viscosity	Gas Content	Eruption Style	Plate Boundary
Shield	least (~50%)	flows least	least (1-2%)	quiet, free-flowing lava	divergent
Ash and Cinder	greatest (~70%)	explodes greatest	greatest (4-6%)	violent and explosive, pyroclastic	convergent and divergent
Composite	intermediate (~60%)	flows and explodes intermediate	intermediate (3-4%)	alternating quiet, free-flowing lava and violent and explosive, pyroclastic	convergent

Volcanoes and Rock Types:

- (i) Shield – Basalt
- (ii) Ash and Cinder – Basalt and Scoria
- (iii) Composite – Andesite, Basalt, Rhyolite

Lava Types:

- **Pahoehoe (i.e. ropy)**: Basaltic lava that has a smooth, billowy, undulating, or ropy surface.
- **Aa (i.e. jagged, angular):** Basaltic lava characterized by a rough or rubbly surface composed of broken lava blocks called clinker.


Pahoehoe


Aa

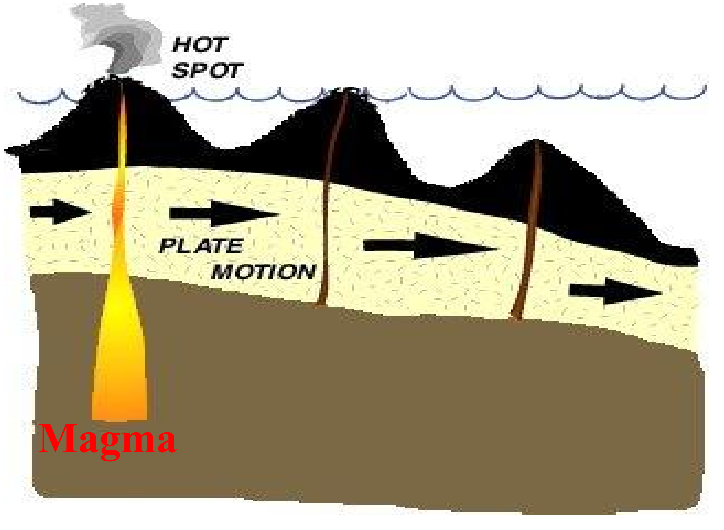
Intraplate Volcanism

- **Hotspots** - are stationary plumes of rising magma.

- **Plates above hotspots move** and the result, are chains of volcanoes on either the land (e.g. **Yellowstone National Park**) or ocean floor (e.g. **Hawaiian Island Chain**).

1) Beneath Oceans:

- Hotspots within the mantle cause magma to move upward and flow onto the ocean floor (becoming lava) forming shield volcanoes and therefore, volcanic islands.



- An example is the Hawaiian Islands in the middle of the Pacific Ocean and got this type of volcanism (i.e. hotspot volcanism).

2) <u>Within Continents</u>:

- **Hotspots within the mantle cause magma to move upward and flow onto the continental surface (becoming lava) forming <u>volcanoes</u> and <u>lava plateaus</u>.**

- **Yellowstone National Park has this type of volcanism (i.e. <u>hotspot volcanism</u>). The type of volcanoes is complex due to volume of molten in chamber, volume of molten that erupts, composition of molten, etc.**

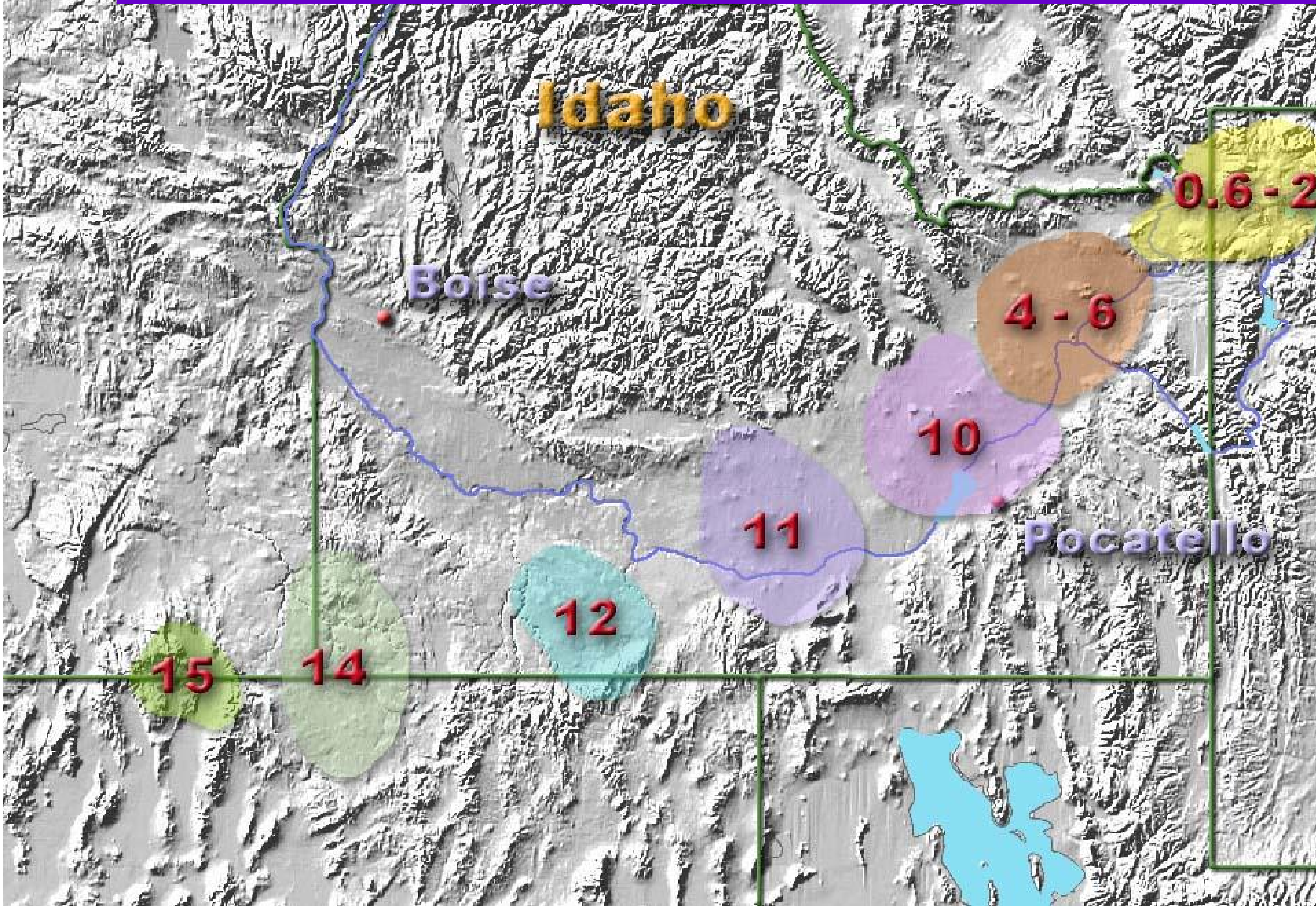
Similarity: Hawaii and Yellowstone

- Both form above a hotspot.

Differences: Hawaii and Yellowstone

- Volcano type
- Molten composition
- Eruption style

Chain of Calderas! (i.e. Collapsed Volcanoes)

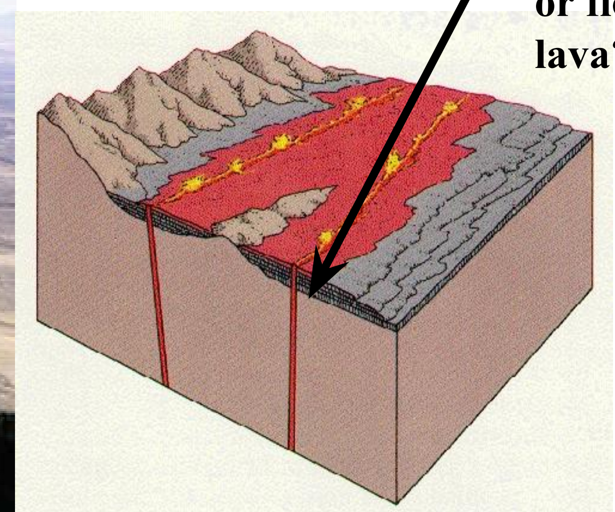


Lava Plateau

← **Flat**
High Elevation

Lava plateaus are formed by highly fluid (i.e. runny) **basaltic lava** during numerous successive eruptions through numerous **linear fissures or rifts.**

See the layers or flows of lava?



Fissures are fractures that extend to the depths of the mantle. Lava plateaus do not form from volcanic craters.

Global Effects of Volcanic Activity

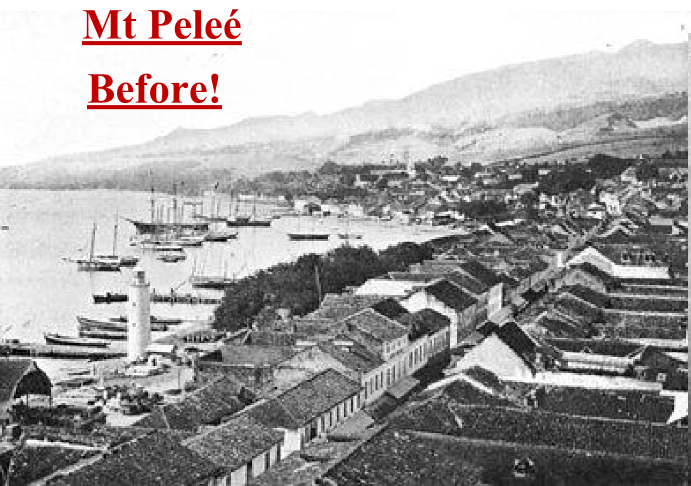
Some effects are short term and some are long term!

Short Term:

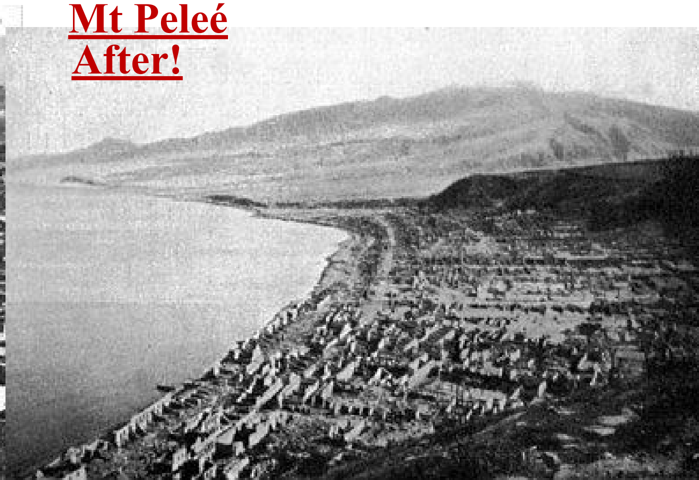
1. Material can block out sunlight causing short-term cooling.
2. Material can disrupt air travel.
3. Material can quickly create new land.
4. Volcanoes and associated material can be destructive (e.g., death to organisms, property damage, road damage).
5. Volcanoes release sulphur dioxides and nitrogen oxides which can mix with water vapour in the atmosphere leading to increased, short-term, acid precipitation.

Mt Peleé

Before!



Mt Peleé
After!



Global Effects of Volcanic Activity

Long Term:

1. Volcanoes release gases like carbon dioxide and water vapour, which in large amounts, could contribute to global warming and climate change.
2. Volcanoes release sulphur dioxides and nitrogen oxides, which can mix with water vapour in the atmosphere leading to increased, long-term, acid precipitation.
3. Volcanoes create fertile soils which enhance agriculture.
4. Volcanoes, depending on number, frequency, and eruption size, could contribute to global cooling and the origin of ice ages, due to the blocking out of the sun. Plants failing to photosynthesize could result in total collapse of food webs and ecosystems.

Scary!!!!!

• Careers related to plate tectonics, earthquakes, and volcanoes include:

(i) structural geologist
(ii) volcanologist
(iii) seismologist
(iv) geomorphologist
(v) geochemist
(vi) geophysicist
(vii) petrologist
(viii) sedimentologist