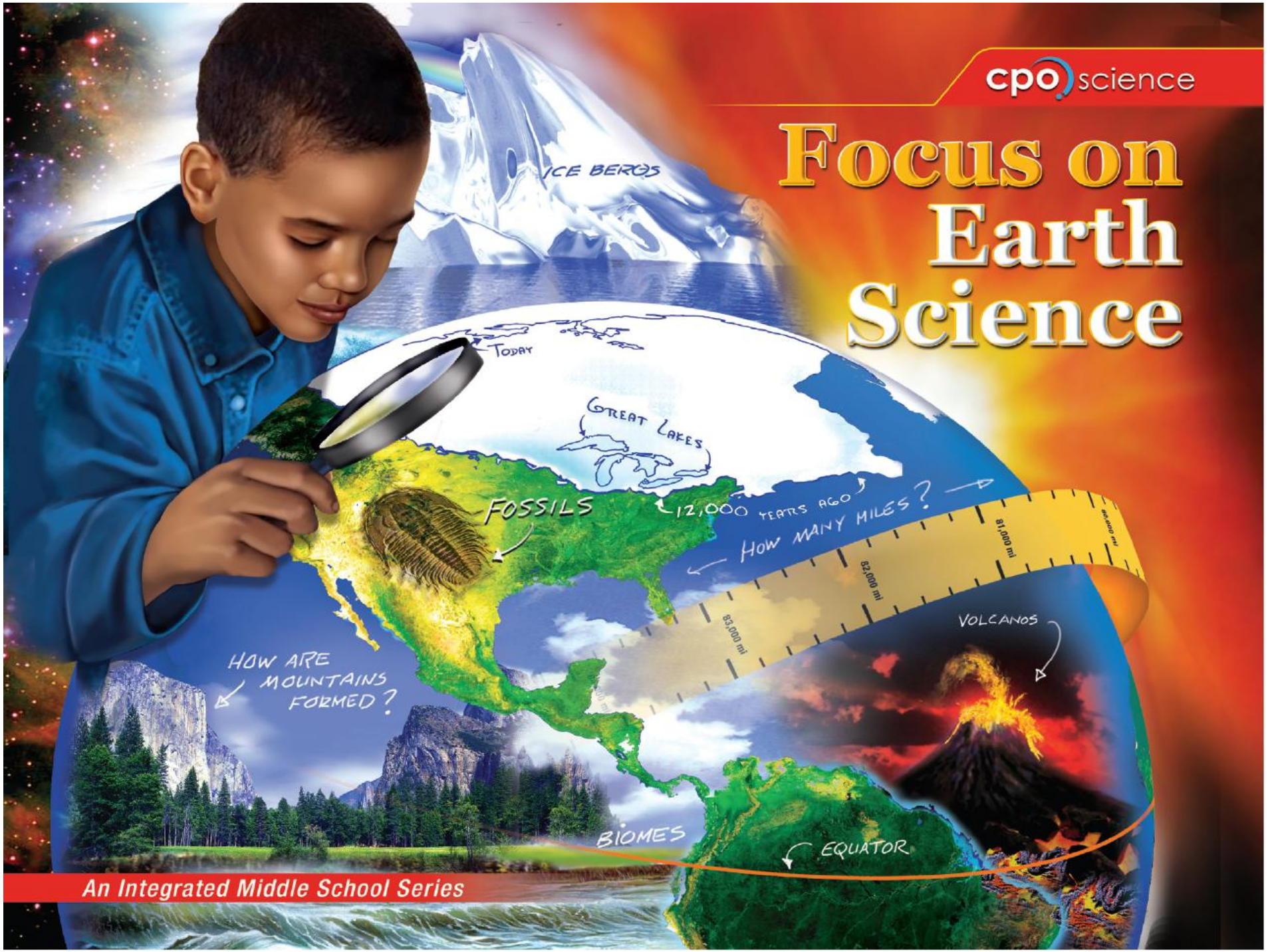

cpo science
Focus on Earth Science
ICE BERGS
TODAY
GREAT LAKES
FOSSILS
12,000 YEARS AGO
HOW MANY MILES?
81,000 mi
82,000 mi
83,000 mi
VOLCANOS
HOW ARE MOUNTAINS FORMED?
BIOMES
EQUATOR
An Integrated Middle School Series

Chapter Ten: Volcanoes

- 10.1 What is a Volcano?
- 10.2 Where do you find Volcanoes?
- 10.3 Types of Volcanoes
- 10.4 Igneous Rocks

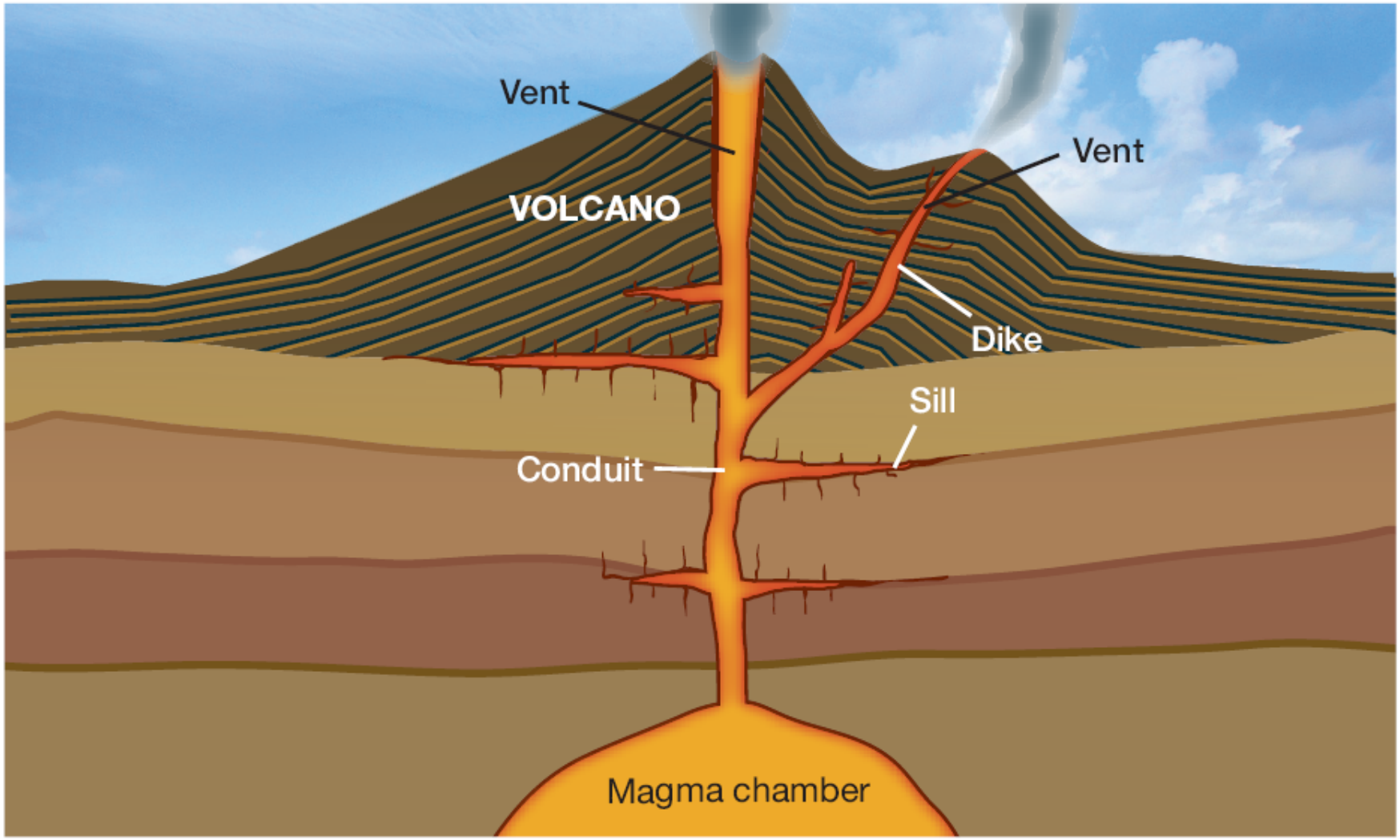
10.1 What is a volcano?

- A **volcano** is a site where melted rock and other materials from Earth's mantle are released.
- Mount St. Helens is a type of volcano called a composite volcano (also known as a stratovolcano).

10.1 What is a volcano?

- During an eruption, melted rock called **magma** leaves the **magma chamber** and moves up the *conduit*. The magma leaves the conduit at the *vent*.
- Magma is called **lava** after it leaves the vent.

Parts of a Volcano



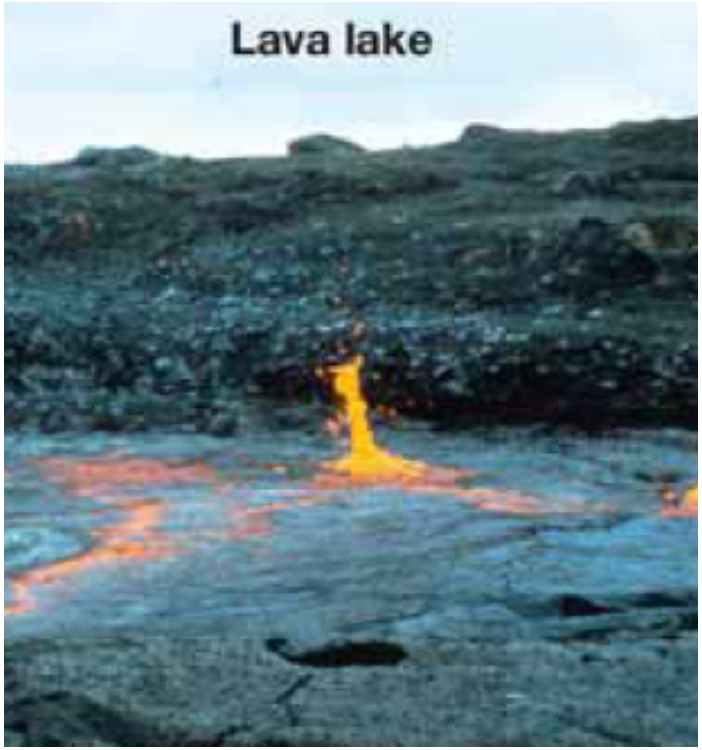
10.1 After the volcano erupts

- Eventually the eruption ends and the volcano vent becomes a bowl-like **caldera**.

10.1 After the volcano erupts

- If magma flows back up the conduit, a mound called a **resurgent dome** may form on the caldera floor.

10.1 After the volcano erupts



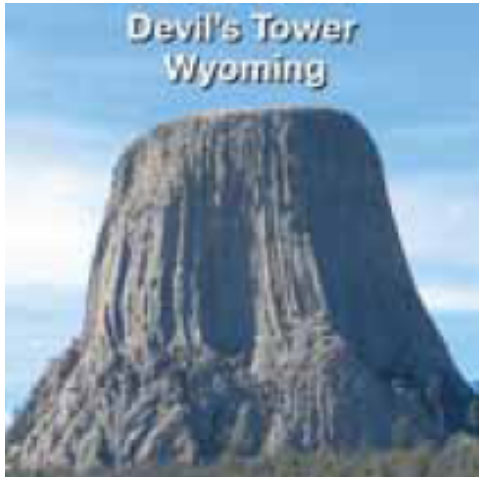
- If water fills the caldera, or magma doesn't drain completely, a **lava lake** remains.

10.1 The life of a volcano

- An **active volcano** is the most vigorous kind of volcano.
- Active volcanoes are erupting or have erupted recently, and are expected to erupt again in the near future.
- A **dormant volcano** is a quiet volcano.
- Dormant volcanoes are not active now, but may become active again in the future.

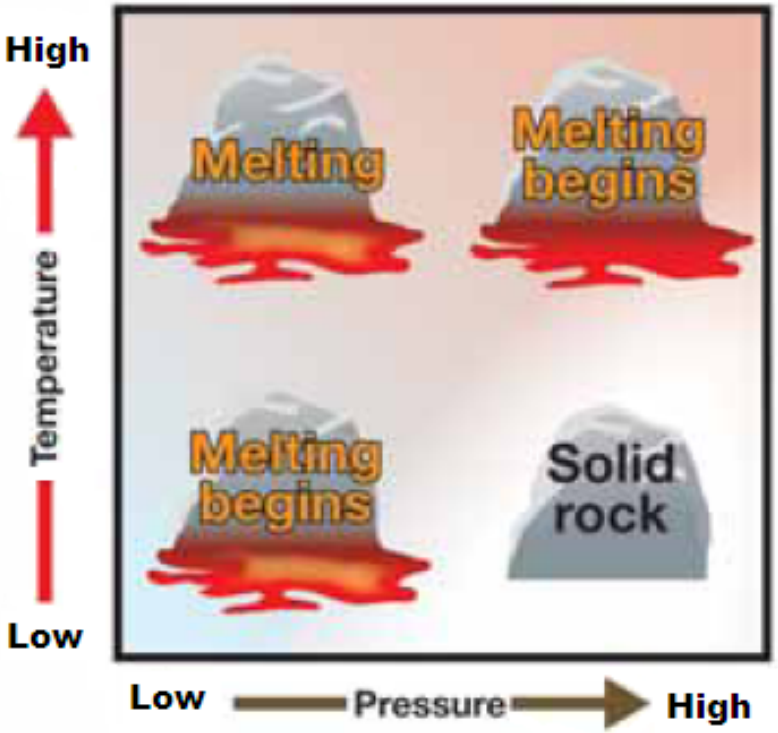
10.1 The life of a volcano

- Devil's Tower and Ship Rock are examples of extinct volcanic "necks".



As the volcano erodes, a core of solid magma gets exposed.

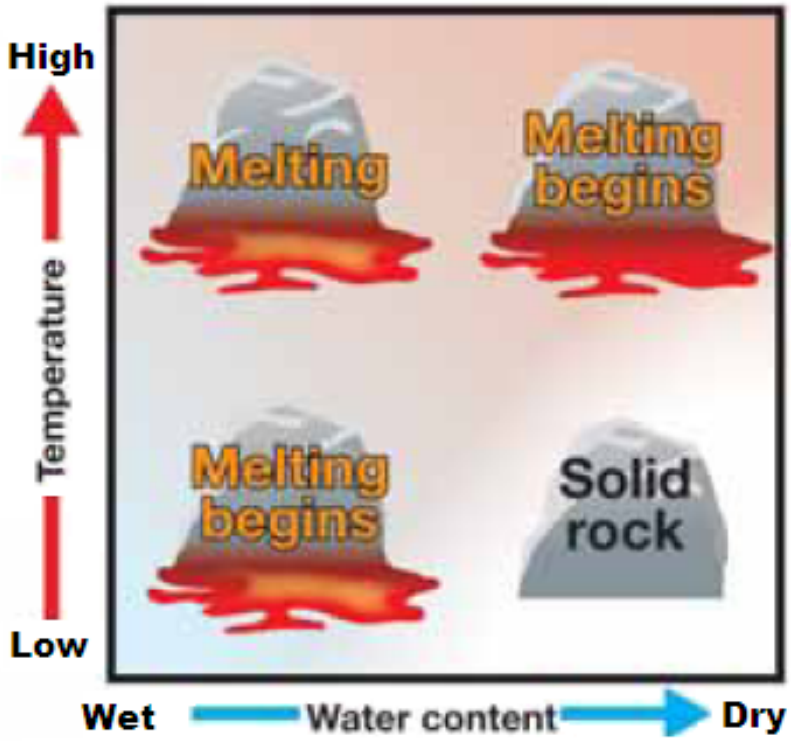
10.1 Making magma



- There are two other ways to make rock melt.
- One way is to reduce the pressure.

10.1 Making Magma

- The other way is to mix water with the hot rock.
- The conditions needed to melt rock are very special and exist inside our planet.



Investigation 10A

Volcanoes

- *How are volcanoes and plate boundaries related?*

Table I: Examples of volcanoes and VEI ratings

VEI	Plume height	Volume (m^3)	Average time interval between eruptions	Example
0	<100 m	≥ 1000	one day	Kilauea
1	100-1000 m	≥ 10,000	one day	Stromboli
2	1-5 km	≥ 1,000,000	one week	Galeras, 1992
3	3-15 km	≥ 10,000,000	one year	Ruiz, 1985
4	10-25 km	≥ 100,000,000	≥ 10 years	Galunggung, 1982
5	> 25 km	≥ 1,000,000,000	≥ 100 years	Mount St. Helens, 1981
6	> 25 km	≥ 10,000,000,000	≥ 100 years	Krakatoa, 1883
7	> 25 km	≥ 100,000,000,000	≥ 1,000 years	Tambora, 1815
8	> 25 km	≥ 1,000,000,000,000	≥ 10,000 years	Toba, 71,000 years ago

Geology Connection

Western Region Volcanoes

- There are many volcanoes on the mainland of the United States.
- In the recorded history of Earth, more than 500 volcanoes have erupted.

10.2 Where do you find volcanoes?

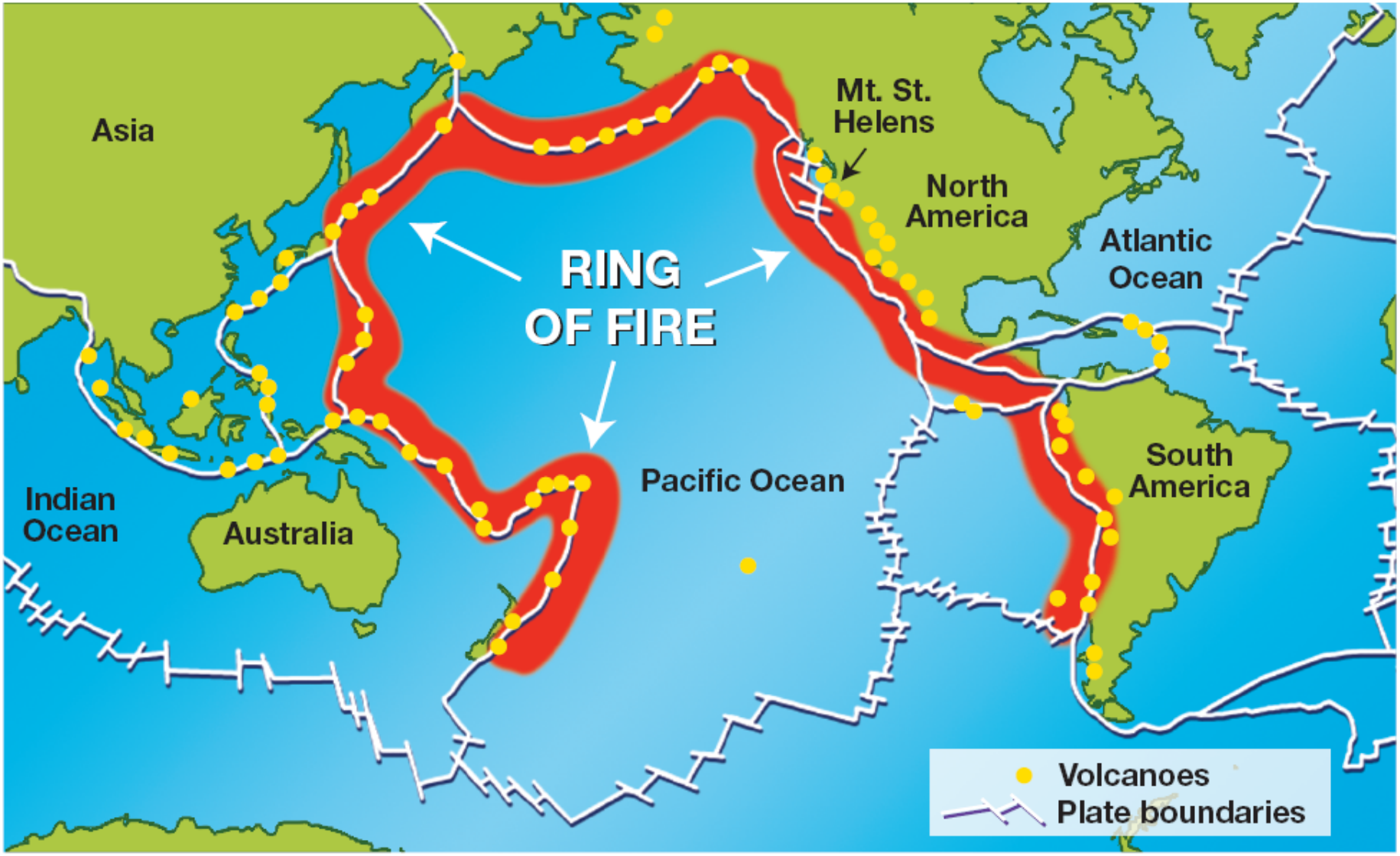
- About half of the active surface volcanoes on Earth occur along the shores of the Pacific Ocean.
- This region is called the Ring of Fire.

What is the Ring of Fire?

10.2 Where do you find volcanoes?

- The **Ring of Fire** is found where the oceanic crust of the Pacific Plate is subducting under nearby plates.
- Most volcanoes are located along plate boundaries.

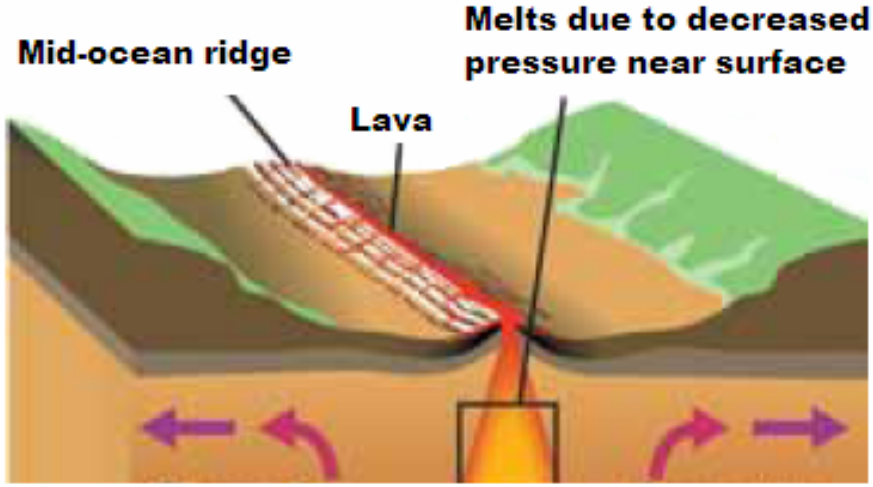
Ring of Fire


Asia
Mt. St. Helens
North America
Atlantic Ocean
RING OF FIRE
Pacific Ocean
South America
Indian Ocean
Australia
Volcanoes
Plate boundaries

10.2 Where do you find volcanoes?

- Mount St. Helens is one of the volcanoes within the Ring of Fire.
- This volcano formed when the small Juan de Fuca Plate subducted under the North American Plate.

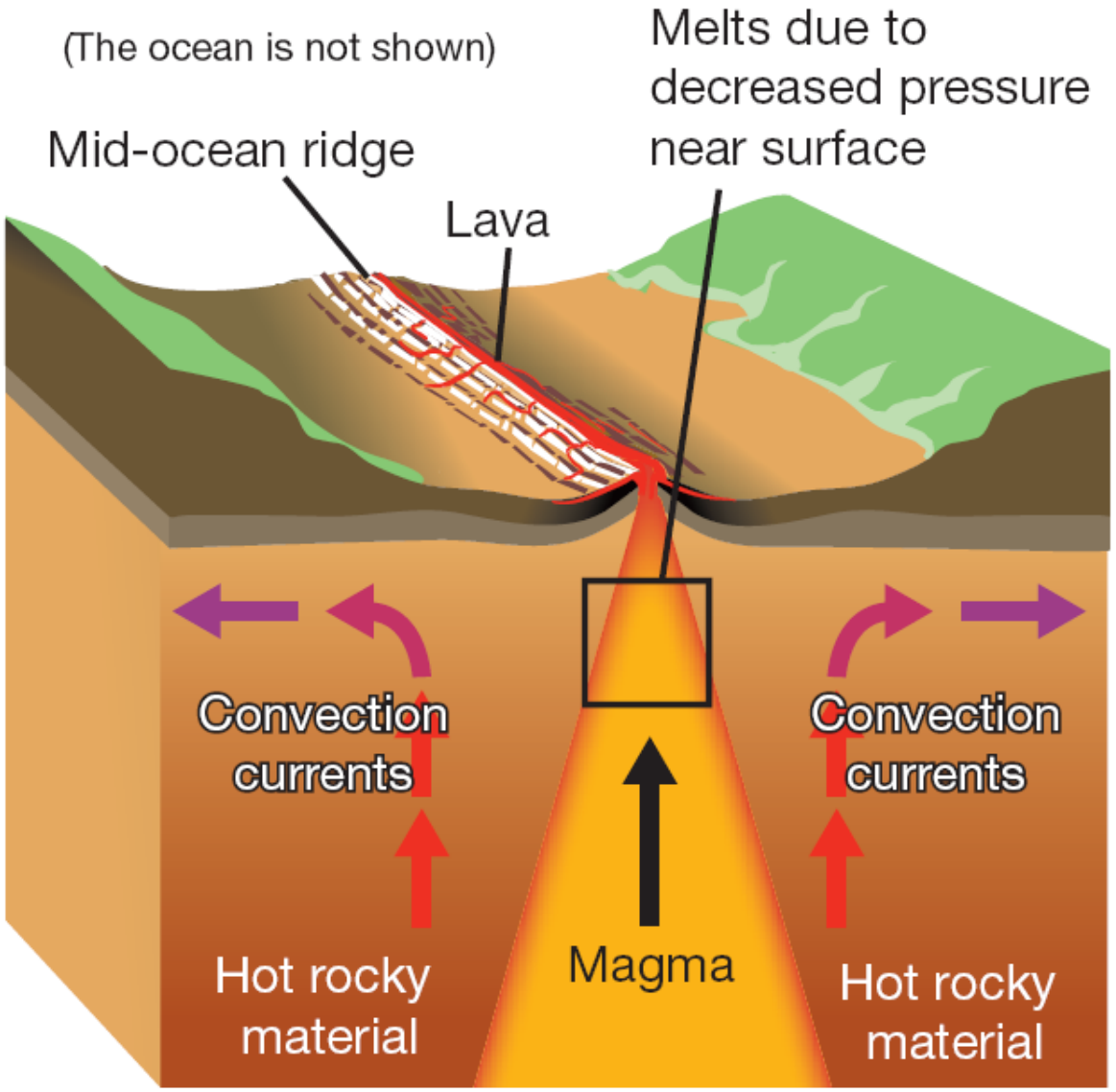
10.2 Volcanoes at mid-ocean ridges



What causes lava to melt?

- Mid-ocean ridges occur at diverging plate boundaries.
- When lava oozes out at a mid-ocean ridge, it immediately hits cold seawater, forming a crust.

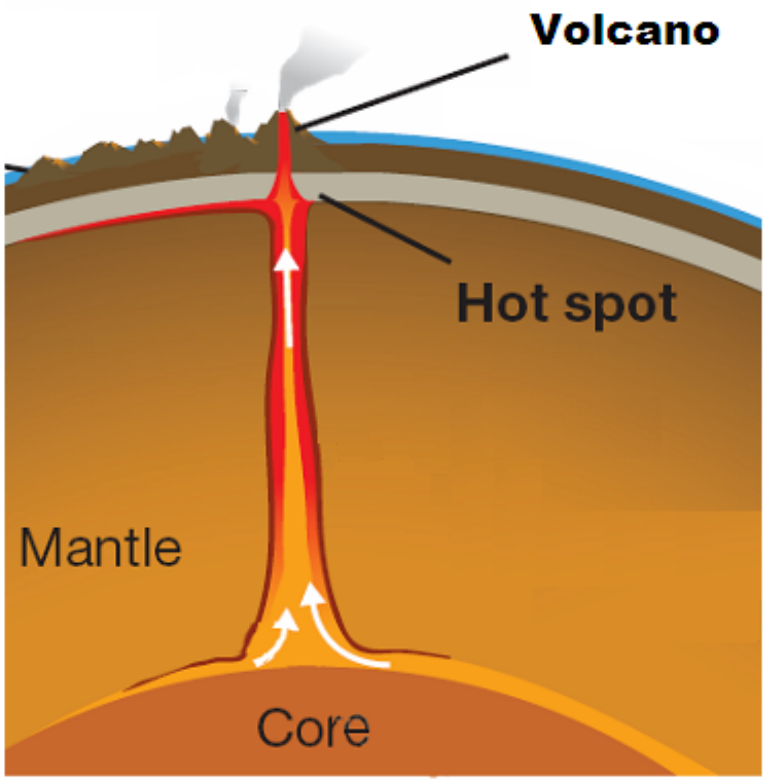
Volcanoes at Mid-Ocean Ridges



10.2 Volcanoes at mid-ocean ridges

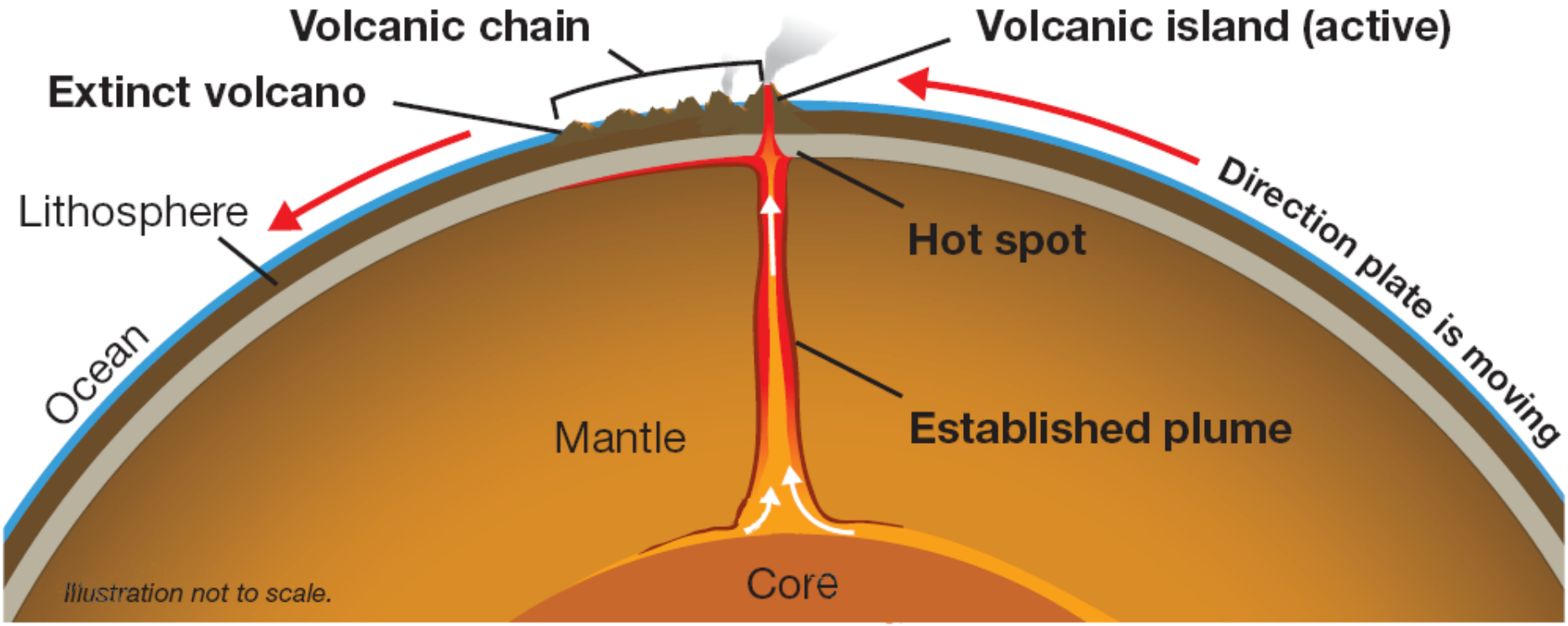
- **Silica** makes magma thick and sticky.
- **Quartz** is mineral made of silica.
- **Basalt** magma is runny because of its low silica content.

10.2 Volcanic chains



- A **volcanic island** is not formed at a plate boundary.
- It forms when **mantle plumes** bring material from deep within the lower mantle under an ocean.
- The top of an active mantle plume is called a **hot spot**.

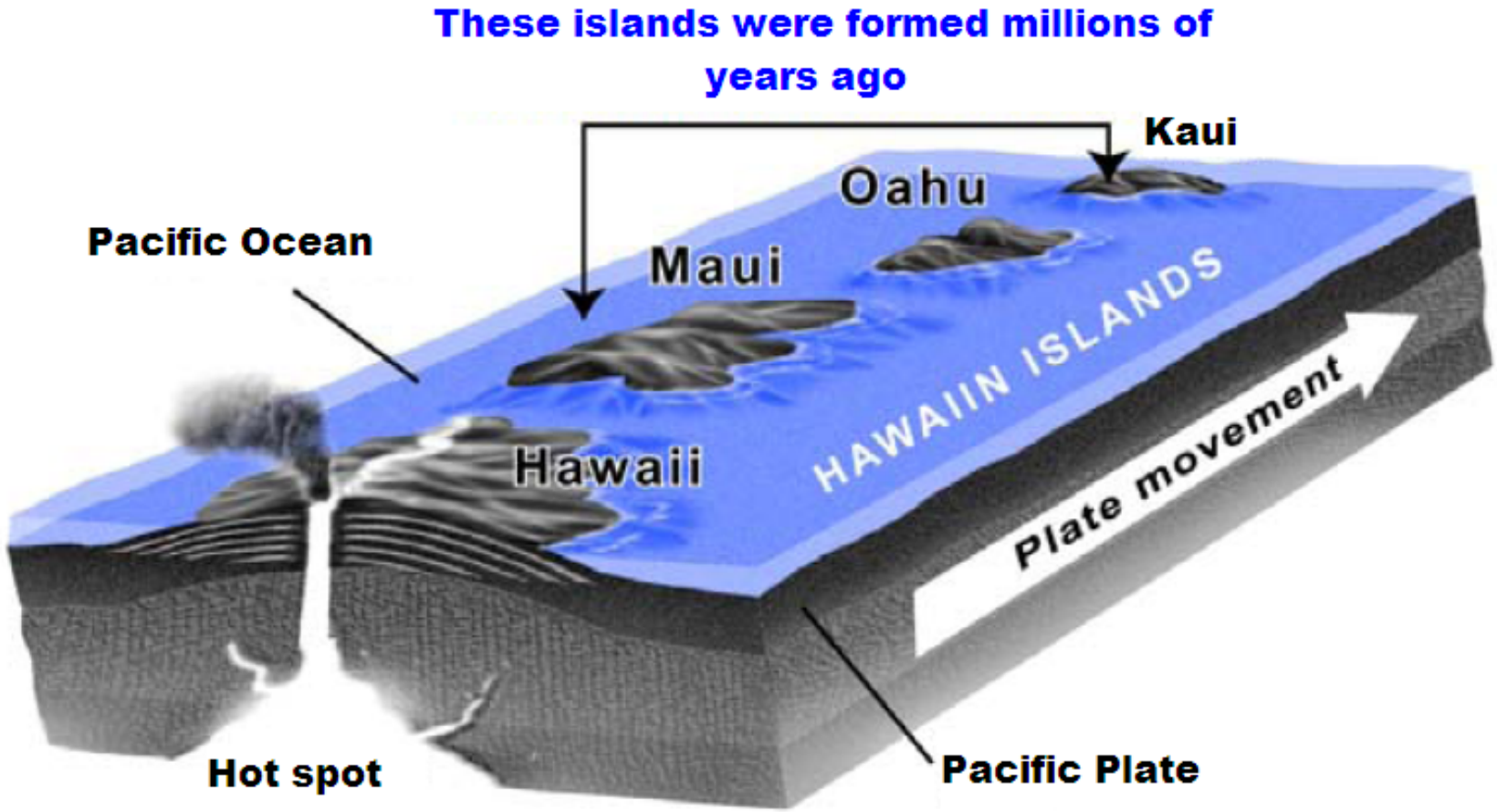
Volcanic Islands



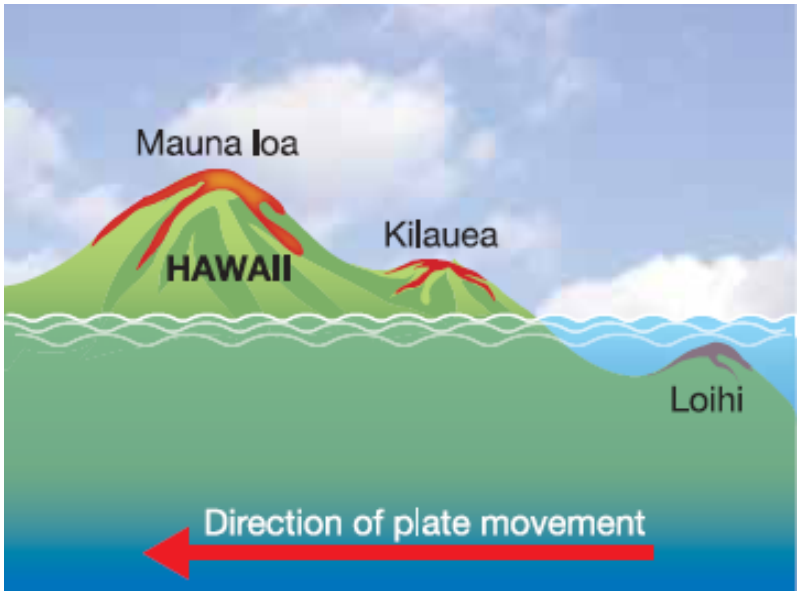
10.2 Volcanic chains

1. As the plate moves, it carries the volcanic island away from the active hot spot.
2. Without the hot spot to supply magma, the volcano becomes extinct.
3. The hot spot begins to form a new volcano beside the old one.
4. The result is a **volcanic island chain.**

10.2 Volcanic chains



10.2 Volcanic chains

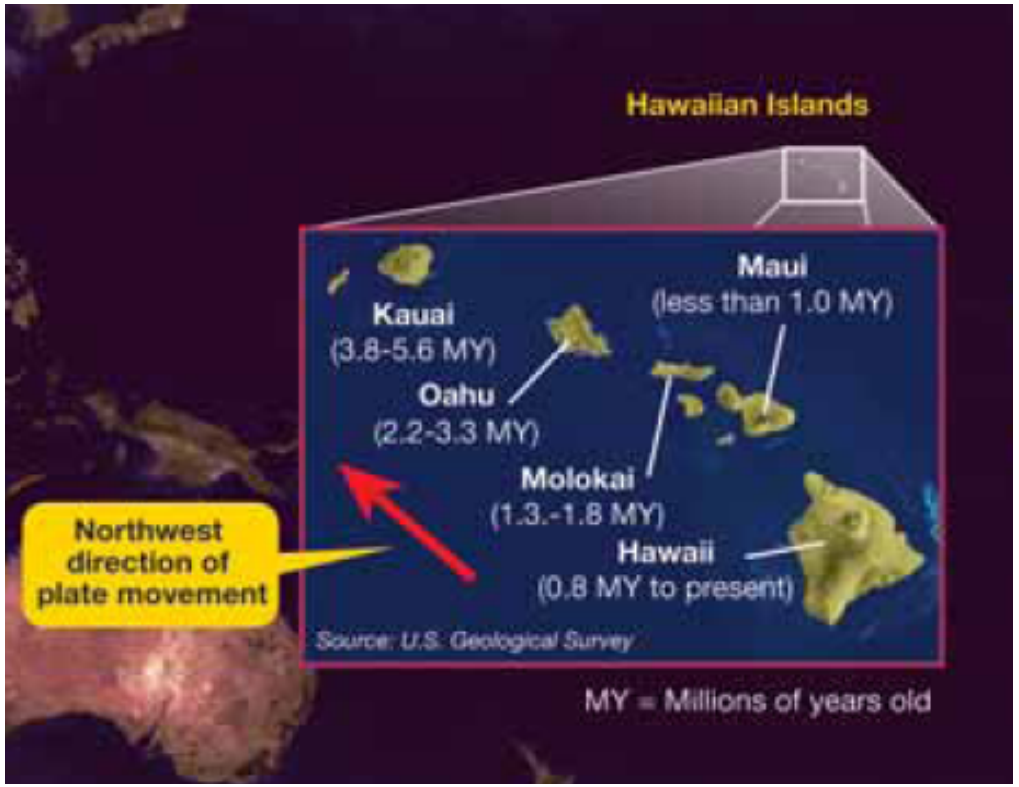


A hot spot is making Loihi bigger, so Hawaii is growing.

- The island of Hawaii sits on top of a hot spot.
- The hot spot has formed the Mauna Loa and Kilauea volcanoes on the island.
- Currently, the hot spot is making the undersea volcano Loihi to the southeast of the island.

10.2 Measuring motion of a plate

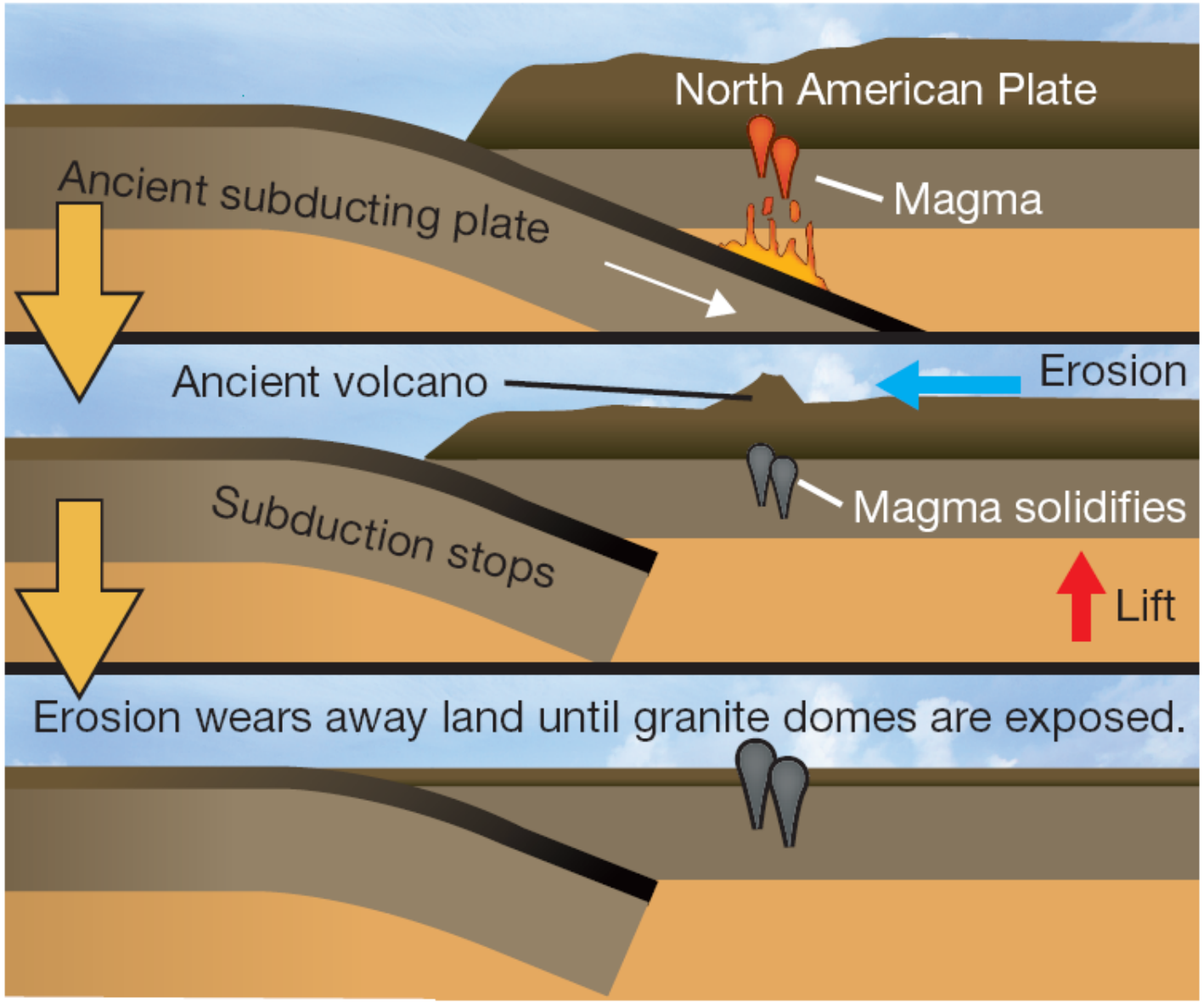
- By studying a volcanic chain, scientists can determine the direction and speed that a plate is moving.



10.2 Volcanoes and subduction

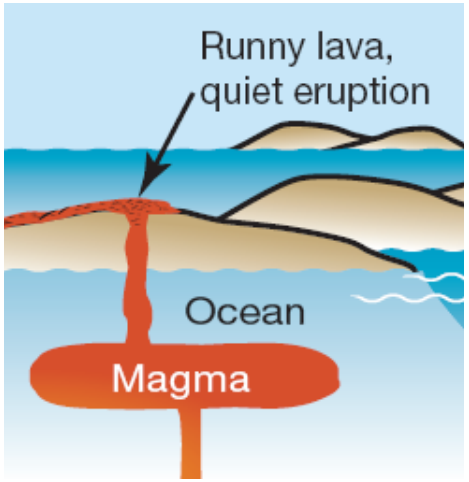
- The famous granite domes of Yosemite National Park in California were formed as silica-rich magma rose through the edge of the North American Plate.
- The surrounding land later eroded away, exposing granite domes.

Forming Granite Domes

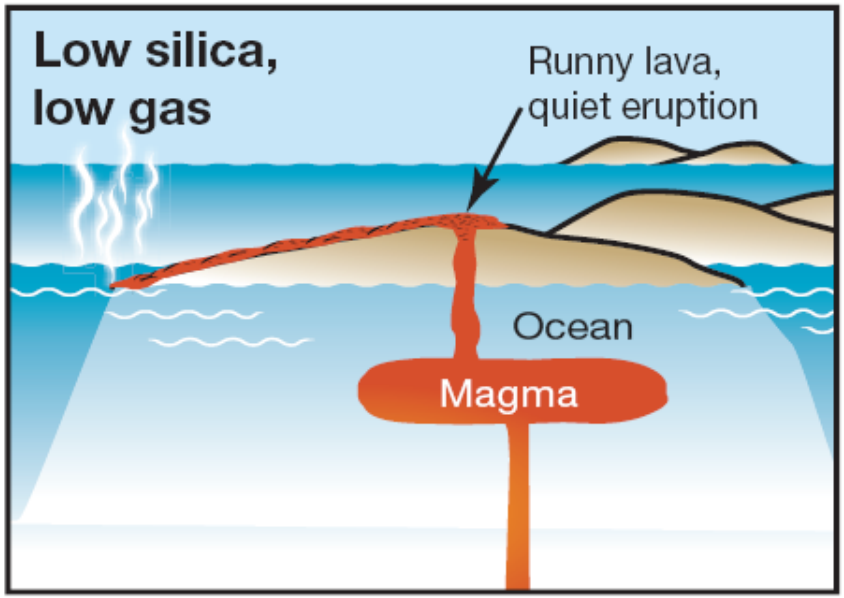


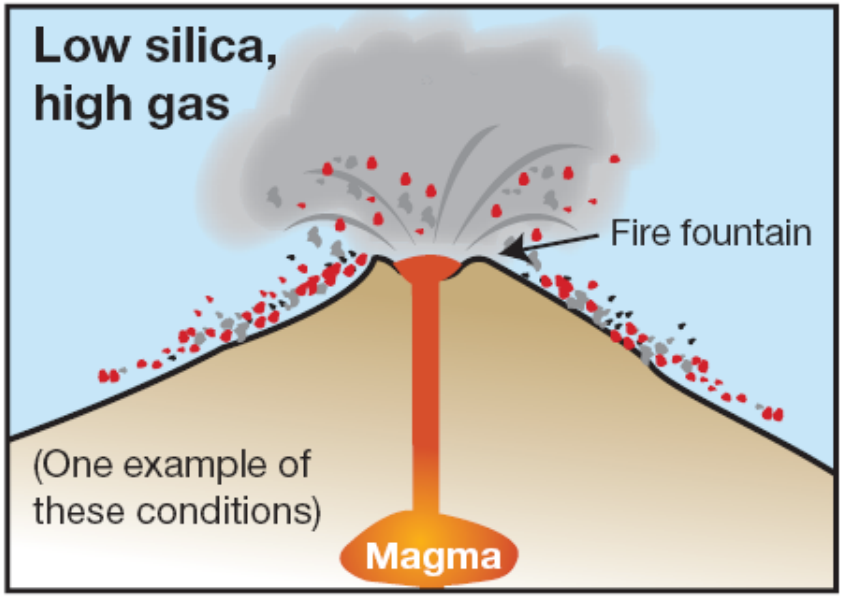
10.3 Types of magma

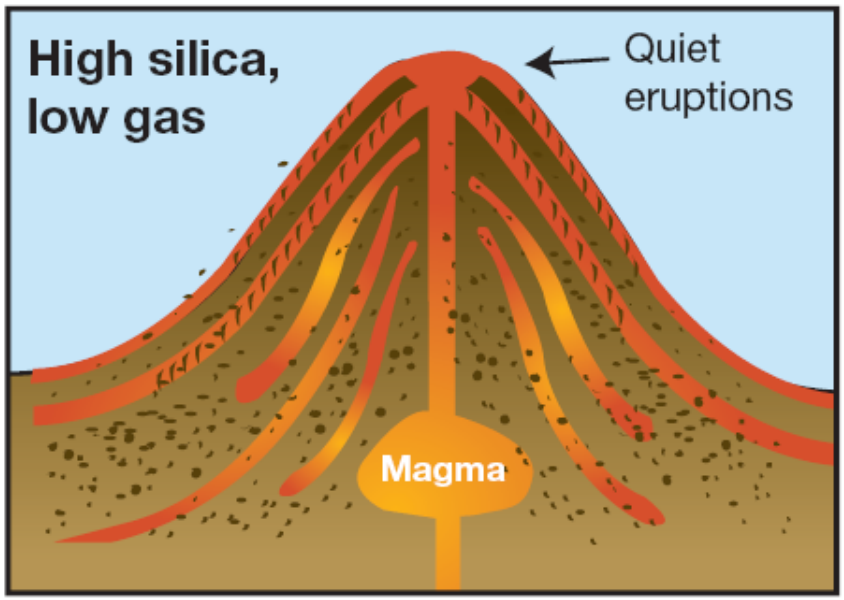
- An important property of magma is how much silica it has.
- Magma with little silica makes runny magma.
- Magma with a lot of silica makes thick, sticky magma.

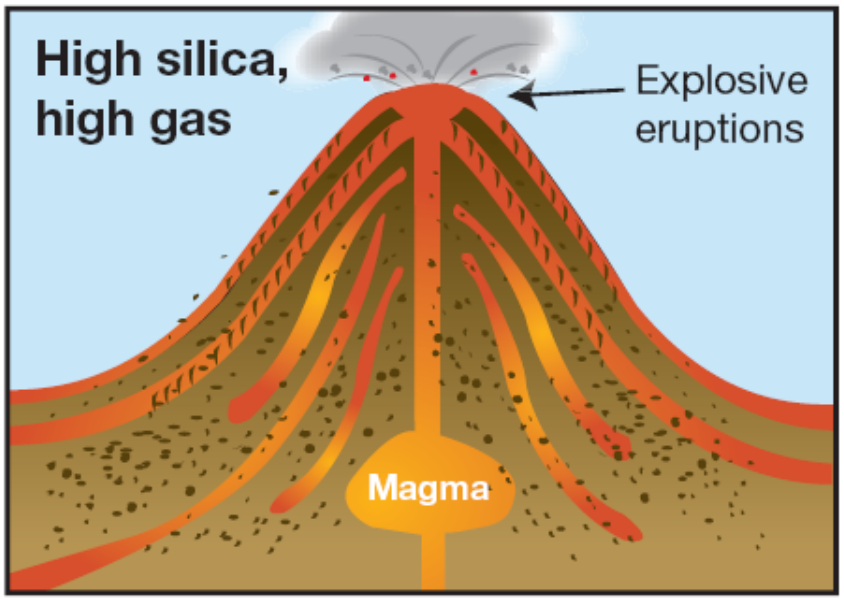


Types of Volcanoes









10.3 Types of magma

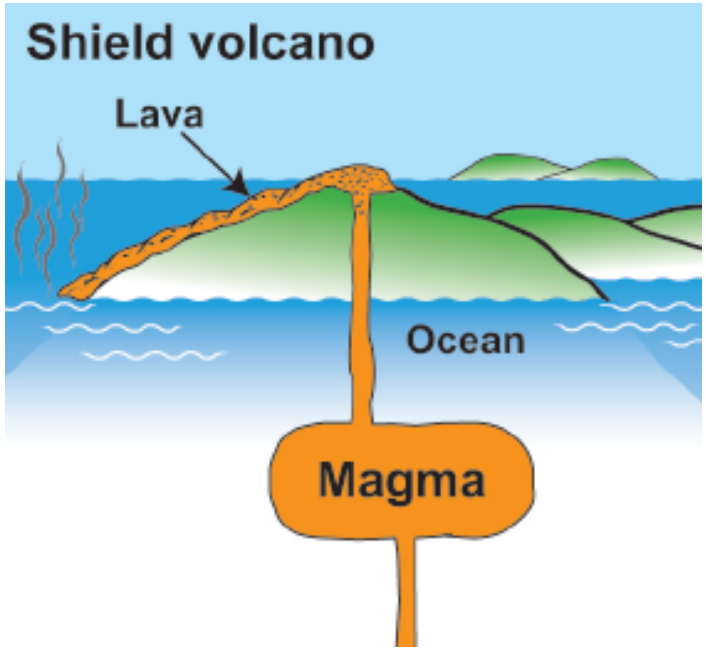
- Another important property of magma is how much gas is dissolved in it.

	Low gas content	High gas content
Low silica content	• Runny magma, like syrup	• Runny magma, bubbly
	• Quiet eruption, lava flows easily	• Fire fountain, lava flows easily
High silica content	• Thick, sticky magma	• Thick, sticky magma
	• Quiet eruption	• Explosive eruption

10.3 Volcanoes with low silica magma

- Low silica magma produces a **shield volcano**.
- Because low silica magma is runny, it can't build up a tall volcano.

10.3 Volcanoes with high silica magma



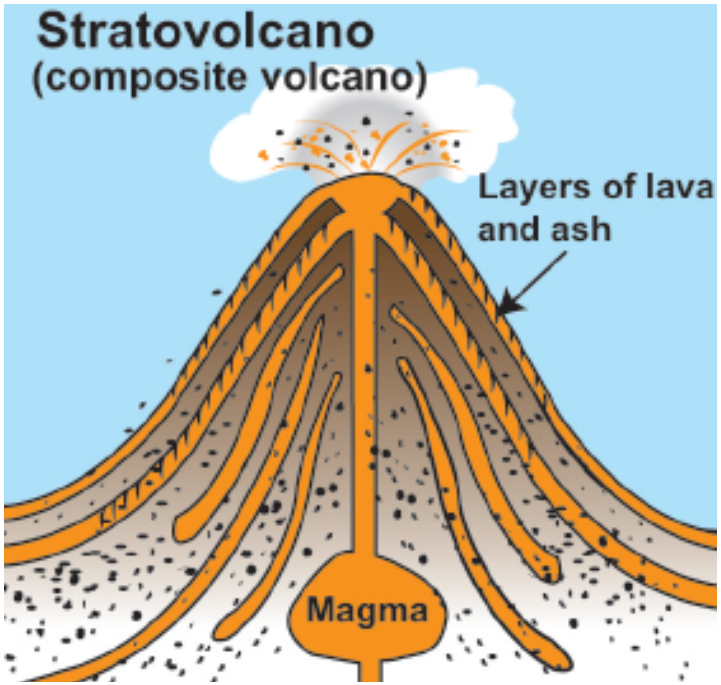
- A tall cone, or **composite volcano** forms from thick, sticky magma because it is silica-rich.

10.3 Volcanoes with low silica magma

- When low silica magma has high levels of dissolved gas, gas bubbles out as it reaches the volcano vent.
- Imagine shaking a soda bottle to produce a shower of soda.

High-gas magma produces a spectacular fire fountain.

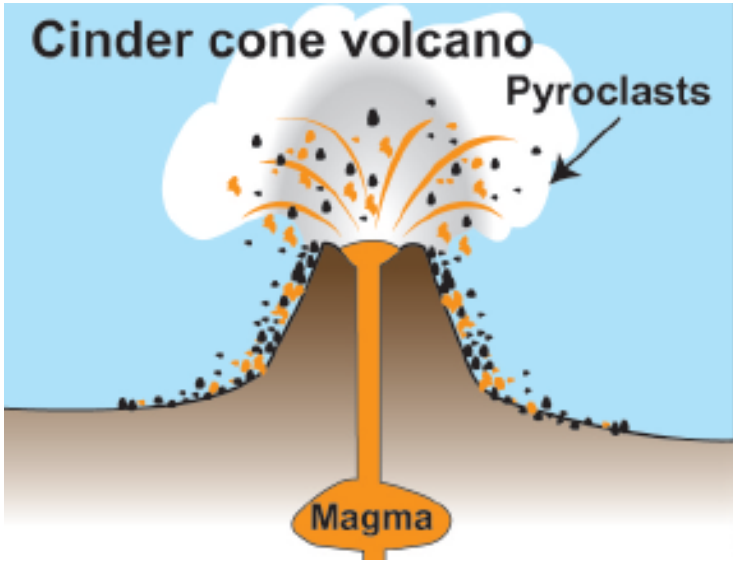
10.3 Volcanoes with high silica magma



- A tall cone, or **composite volcano** forms from thick, sticky magma because it is silica-rich.

10.3 Volcanoes with low silica magma

- The lava cinders form a cone around the vent called a **cinder cone**.
- Cinder cones are a common form of volcano.



Pyroclasts are loose clumps of particles of lava.

10.3 Volcanoes with low silica magma

- Before a composite volcano eruption, the magma may be under so much gas pressure that the composite volcano cone bulges.

10.3 Volcanoes with low silica magma

- The cone may explode near the vent, throwing a column of gas and lava bits high into the atmosphere.
- The lava bits puff up and rip apart as the dissolved gas expands inside each bit.

10.3 Volcanoes with low silica magma

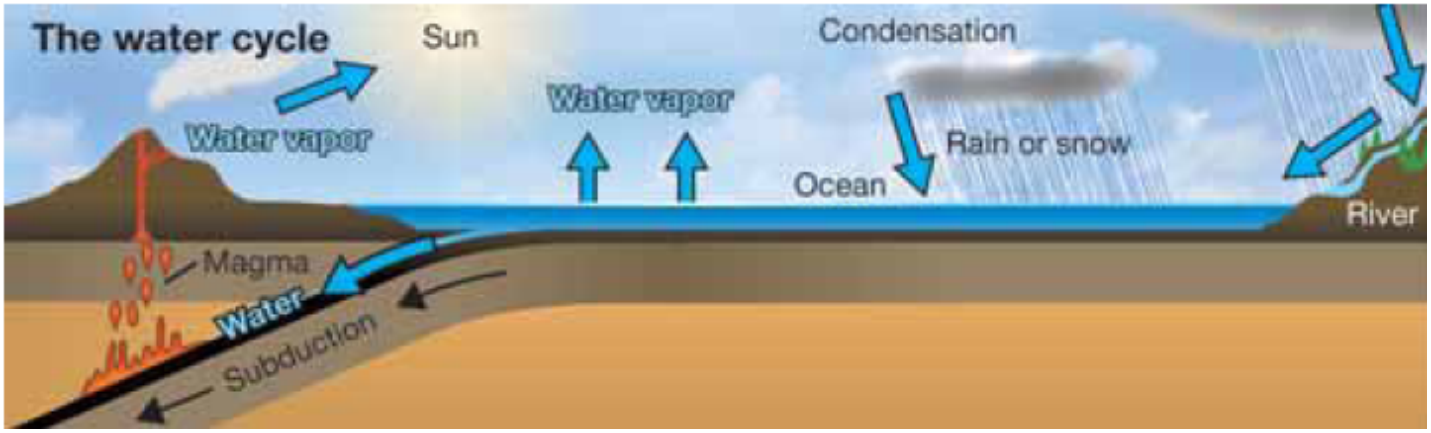
- When a column of exploding material collapses, it races down the side of a composite volcano as a **pyroclastic flow**.
- The speed force, and heat of the flow make it extremely destructive.

10.3 Volcanoes with low silica magma

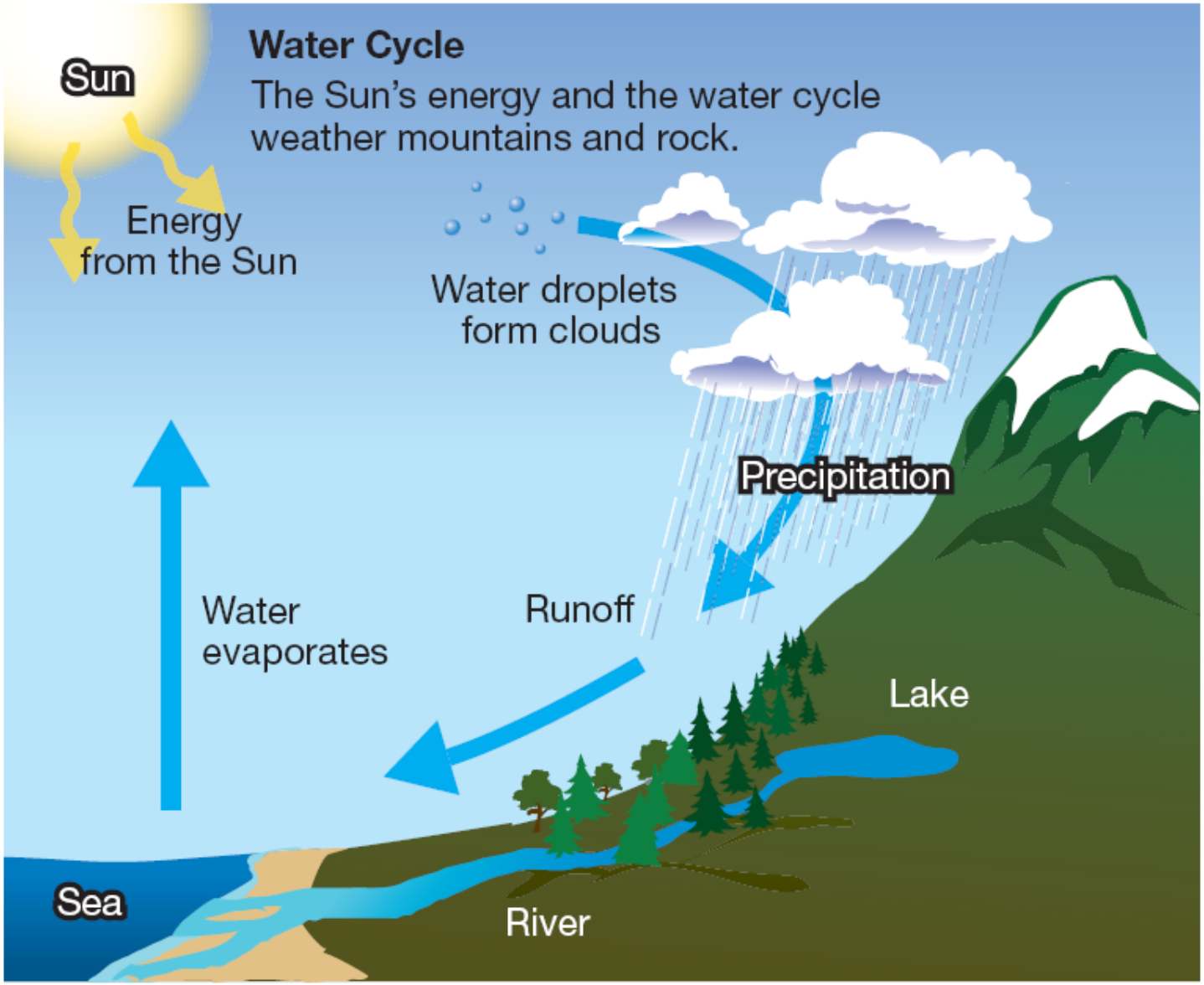
- If water is present in the ground, mudflows may accompany a composite volcano eruption.
- The mudflows, called **lahars** can destroy forests and property and added to the death toll.

10.3 Water and volcanoes

- Volcanoes are part of Earth's water cycle.
- The **water cycle** is a set of processes that keep water moving from place to place.
- When a volcano erupts, water that is in the magma is released as water vapor into the atmosphere.

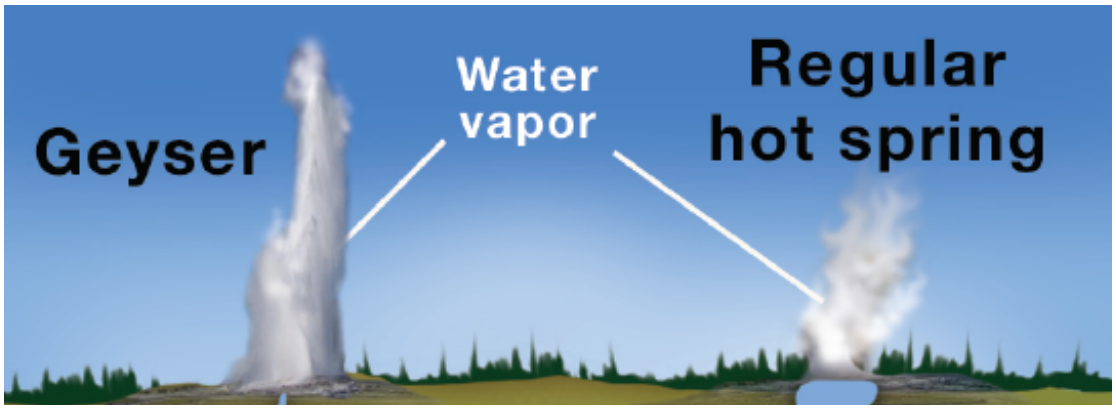


Water Cycle

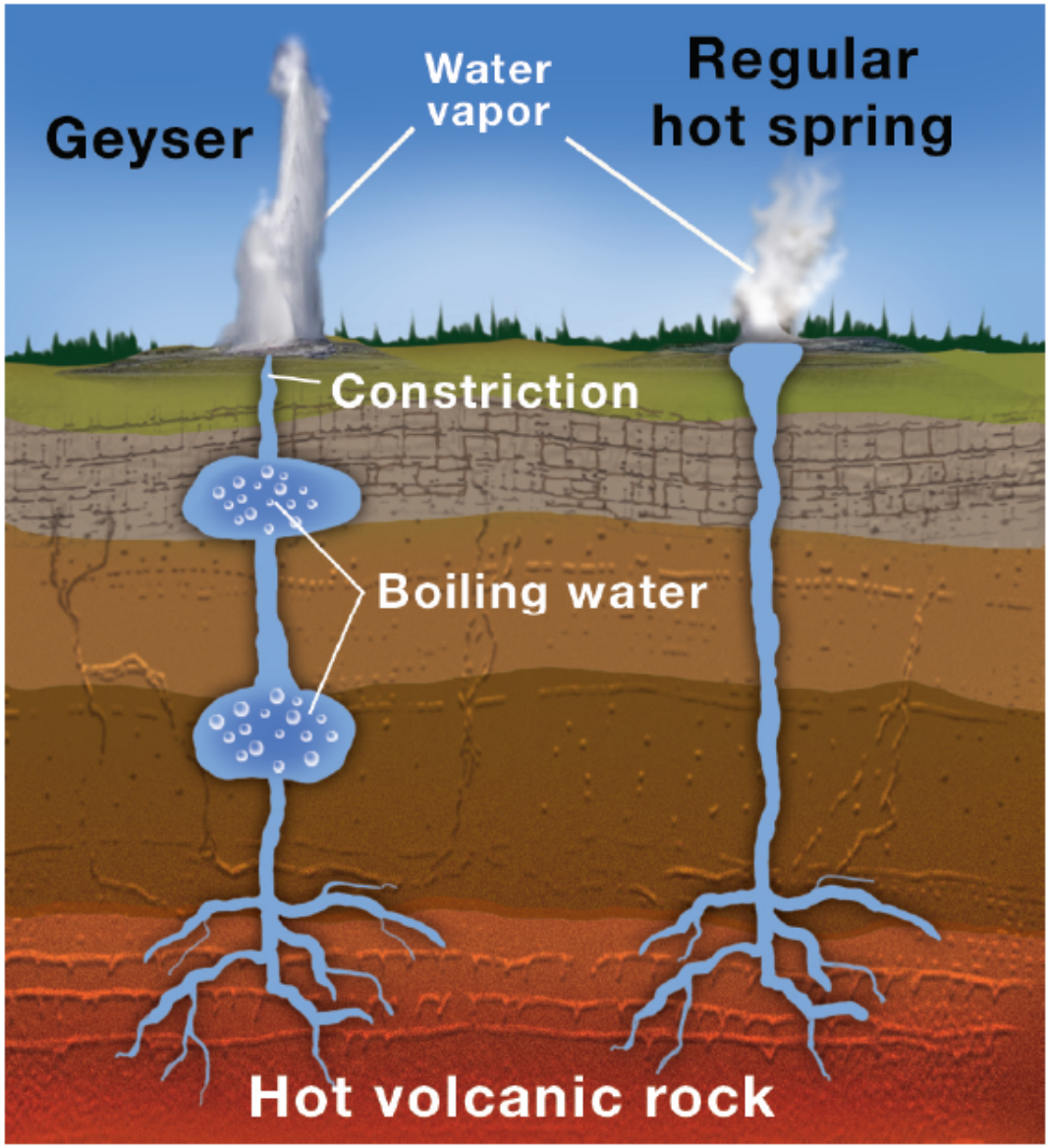

Water Cycle
The Sun's energy and the water cycle weather mountains and rock.
Sun
Energy from the Sun
Water droplets form clouds
Precipitation
Water evaporates
Runoff
Lake
Sea
River

10.3 Water and volcanoes

- Geysers and hot springs are the result of water in the ground coming in contact with magma-heated rock below the surface.



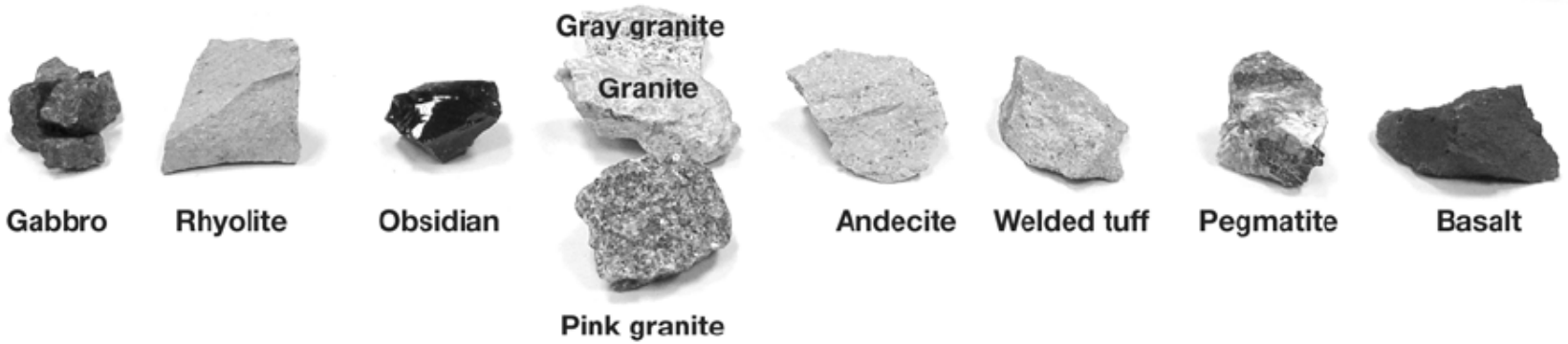
Geysers and Hot Springs



Investigation 10B

Igneous Rocks

- *How are igneous rocks classified?*



10.4 Igneous Rocks

- Rocks formed from magma or lava are called **igneous rocks**.
- Pumice is useful as a commercial abrasive.

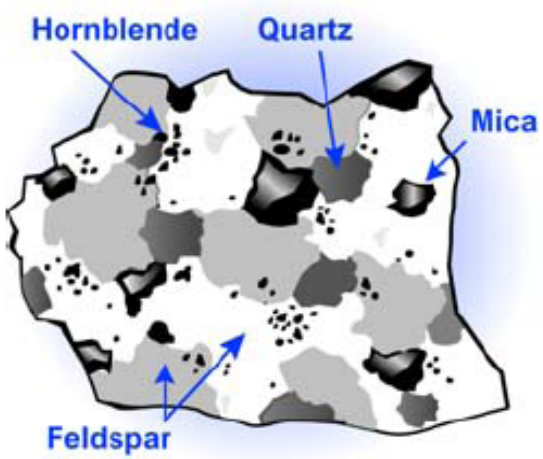
10.4 Types of igneous rocks

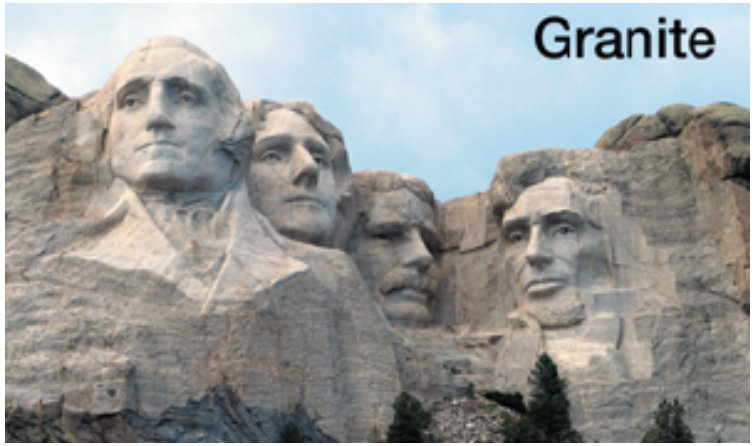
- Crystal size can tell us a lot about how a rock formed.
- *Basalt* and *gabbro* are made from the same low silica magma.
- Basalt has fine crystals, but gabbro has large crystals.

Basalt

Gabbro

10.4 Granite





- **Granite** makes up continental plates.
- It is less dense than basalt, is made of high-silica magma, and has large crystals.
- Mount Rushmore is a famous granite sculptured mountain.

10.4 Types of igneous rocks

- *Granite*, *rhyolite*, and *obsidian* all come from the same silica-rich magma.
- Granite cools underground and has large crystals.
- Rhyolite cools on the surface and has fine crystals.
- Obsidian cools so fast that it has no crystals and is often called volcanic glass.