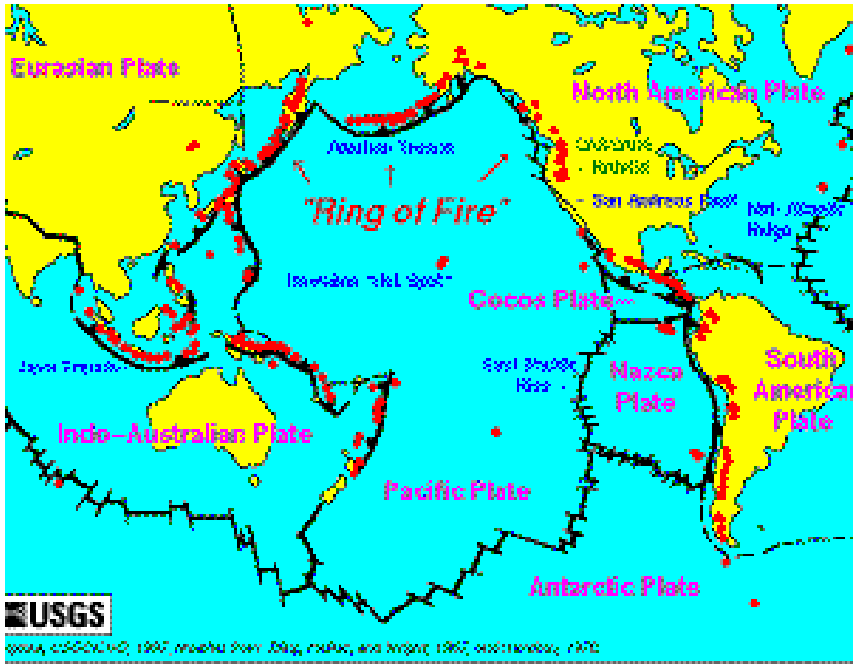
Table of Contents

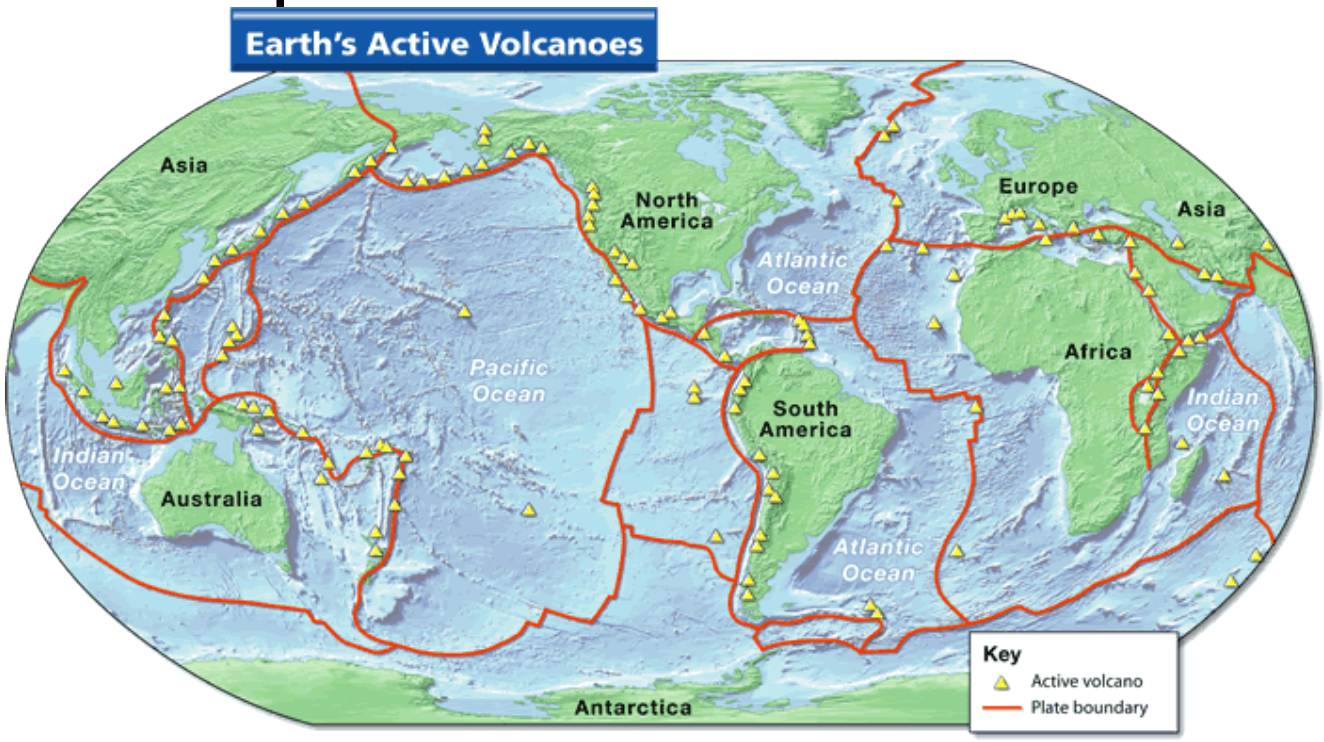
Volcanoes and Plate Boundaries

- There are about 600 active volcanoes on land.
  - Most are found along plate boundaries
  - Fractures at the boundaries allow magma to squeeze up through from the mantle
- **Ring of Fire** – major belt of volcanoes that rims the Pacific Ocean.



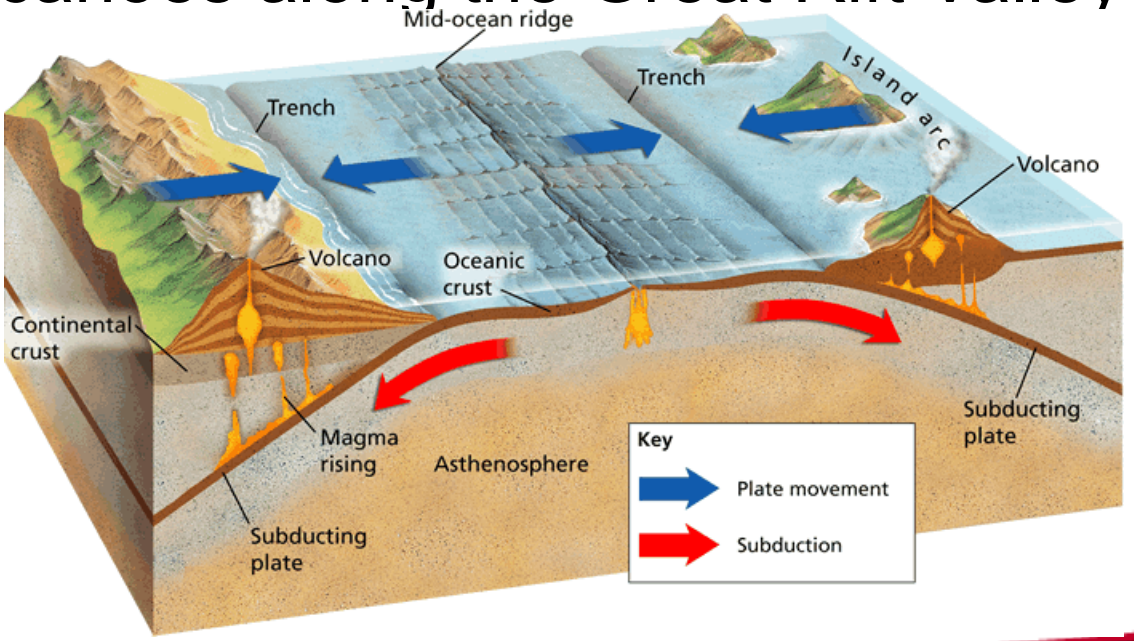
Volcanoes and Plate Boundaries

- Volcanic belts form along the boundaries of Earth's plates.



Volcanoes and Plate Boundaries

- **Divergent boundaries** – create volcanoes along mid-ocean ridges where the two plates are pulling apart
  - Ex: Volcanoes along the Great Rift Valley in Africa

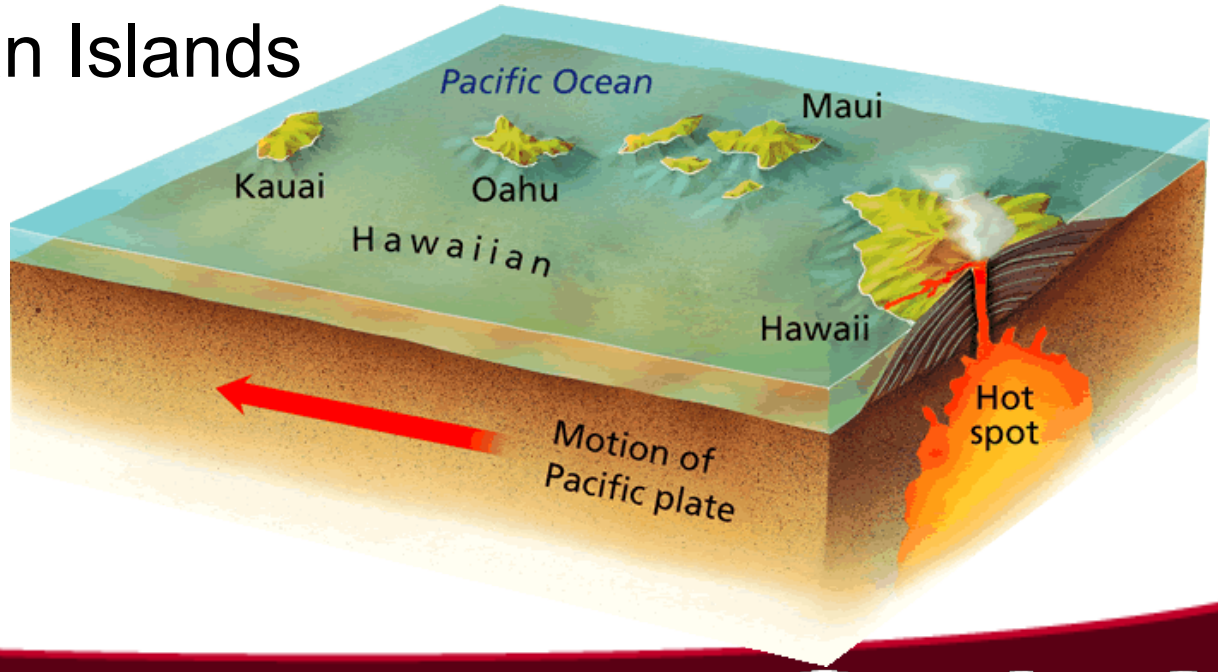


Volcanoes and Plate Boundaries

- **Convergent boundaries** – create volcanoes on land when an oceanic plate is subducted under a continental plate.
  - Ex: Volcanoes of the Andes Mountains in South America
  - **Island arc** – string of islands formed by volcanoes along a deep-ocean trench where two oceanic plates converge
    - Ex: Japan, New Zealand, Caribbean Islands, Philippines

Hot Spot Volcanoes

- Some volcanoes result from “hot spots” in Earth’s mantle.
- **Hot spot** - area where magma from deep within the mantle melts through the crust above it.
  - Ex: Hawaiian Islands

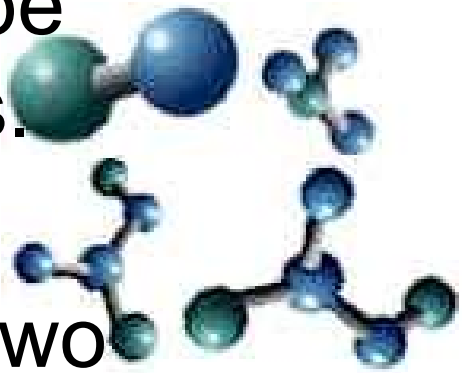


More on Volcanoes

- Click the PHSchool.com button for an activity about volcanoes.

Physical and Chemical Properties

- Magma/lava are made up of many elements and compounds.
- **Element** – substance that cannot be broken down into other substances.
  - Ex: carbon, hydrogen, and oxygen
- **Compound** – substance made of two or more elements that have been chemically combined.
  - Ex: Water, carbon dioxide, and table salt



Physical and Chemical Properties

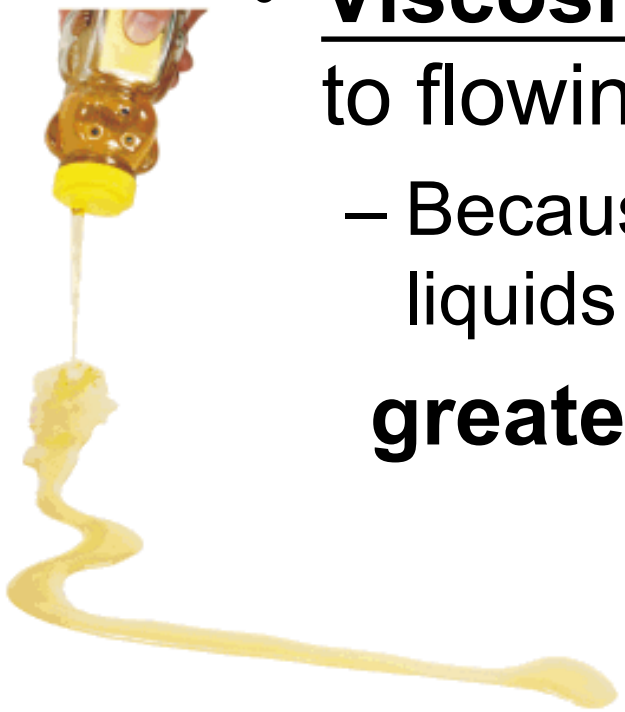
- Each substance has a particular set of physical and chemical properties.
- These properties can be used to identify a substance or to predict how it will behave
- **Physical property** – any characteristic of a substance that can be observed or measured without changing the composition of the substance.
  - Ex: density, hardness, melting point, boiling point, and magnetism

Physical and Chemical Properties

- **Chemical property** is any property that produces a change in the composition of matter.
  - Ex: ability to burn and its ability to combine, or react, with other substances

What Is Viscosity?

- A liquid can flow because particles in it are not bound tightly together
- **Viscosity** – the resistance of a liquid to flowing.
  - Because liquids differ in viscosity, some liquids flow more easily than others.



greater viscosity = slower flow

Ex: Honey

Viscosity is due to more friction between molecules of the liquid

Viscosity of Magma

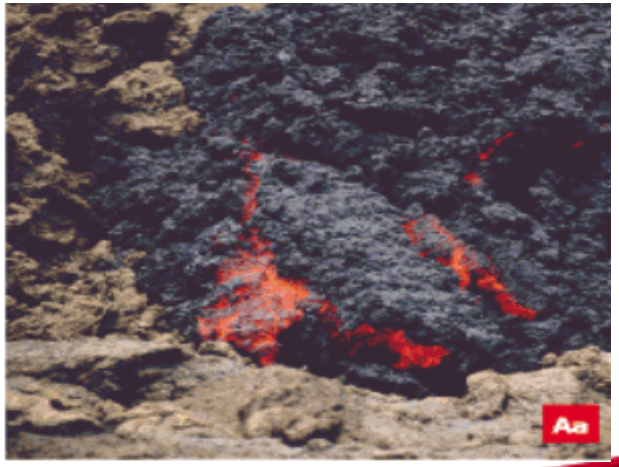
- The viscosity of magma depends upon its silica content and temperature.
- **Silica** – material found in magma that is formed from the elements oxygen and silicon.
  - Silica content of magma ranges from 50-70%
  - The more silica magma contains, the higher its viscosity
  - Cooled high-viscosity magma forms granite rock
  - Cooled low-viscosity magma forms basalt rock

Viscosity of Magma

- Viscosity of fluids tends to increase as temperatures decrease.
  - Heated honey pours much easier than honey that has been in the refrigerator.

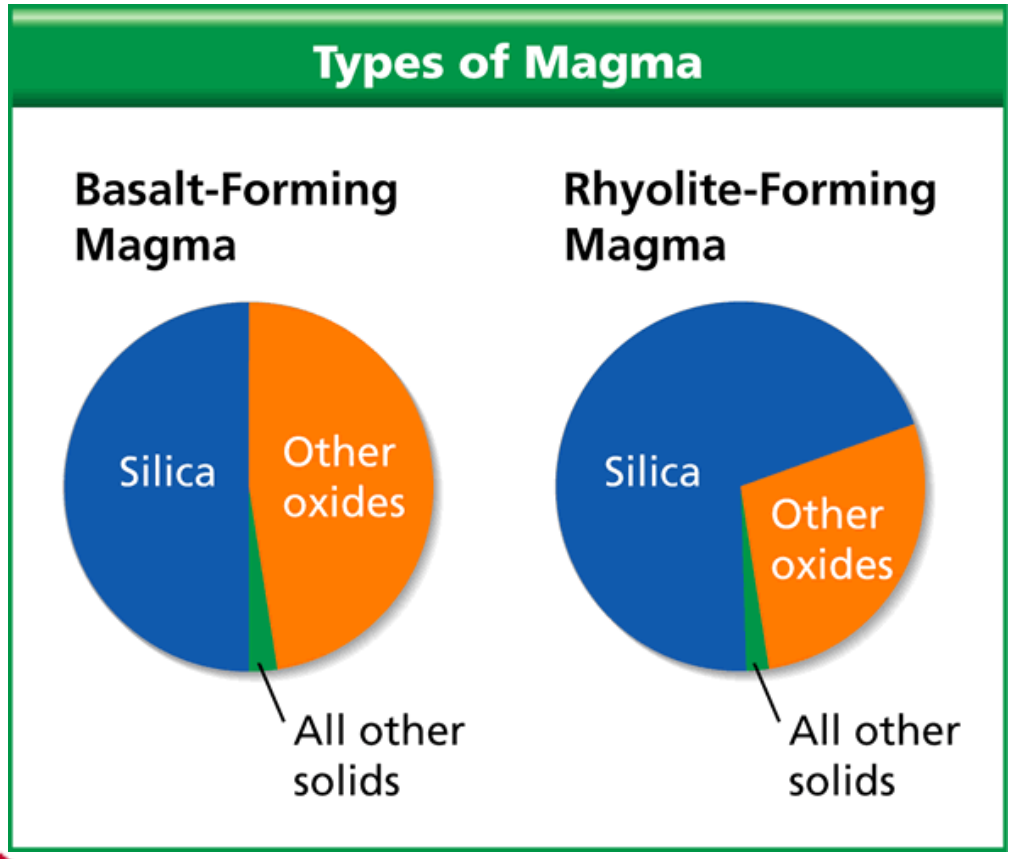
Viscosity of Magma

- Temperature also affects lava
  - **Pahoehoe** - a hot, fast-moving type of lava that hardens to form smooth, ropelike coils.
  - **Aa** – a slow-moving type of lava that hardens to form rough chunks; cooler than pahoehoe.



Math Analyzing Data

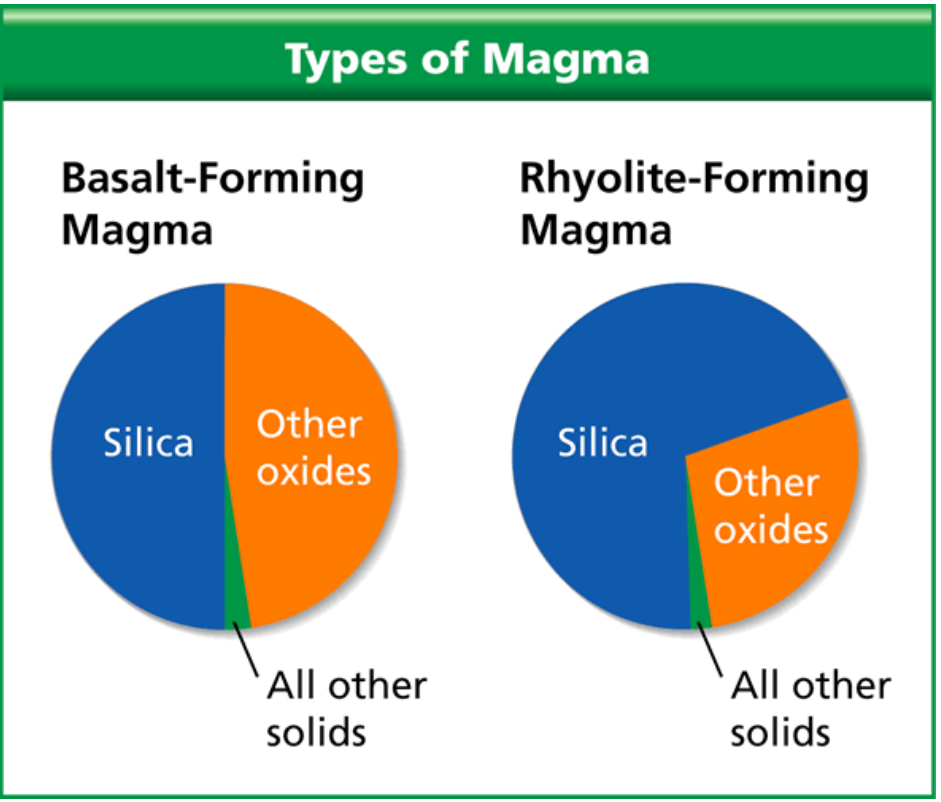
Magma Composition



Magma varies in composition and is classified according to the amount of silica it contains. The graphs show the average composition of the two types of magma. Use the graphs to answer the questions.

Math Analyzing Data

Magma Composition



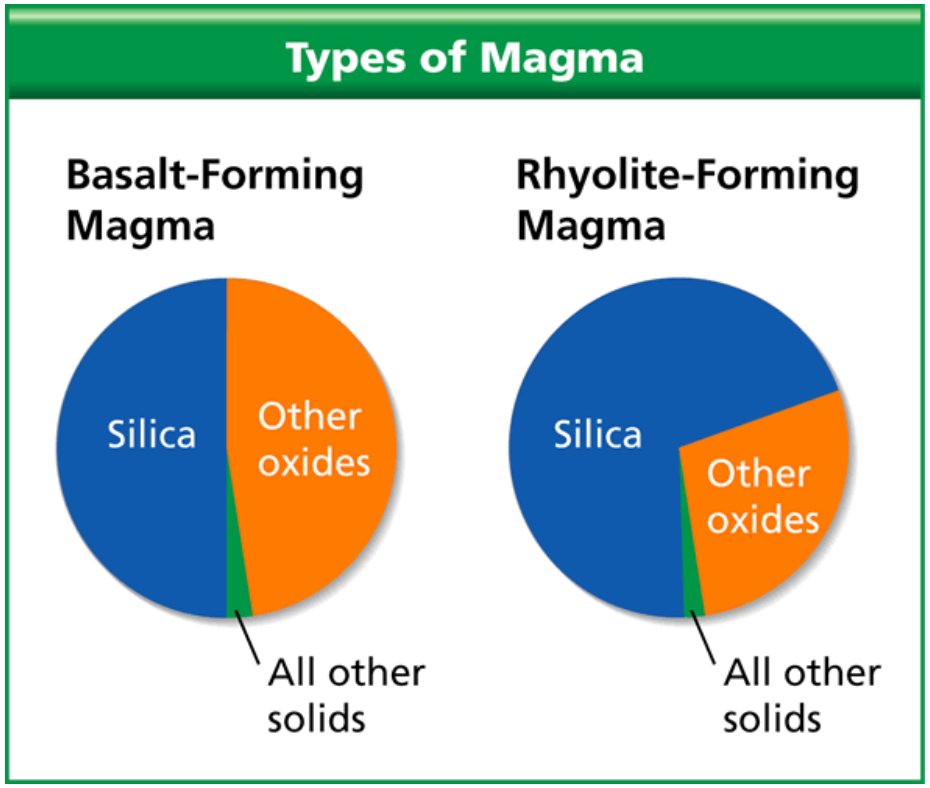
- **Reading Graphs:**

Q. Study both graphs. What materials make up both types of magma?

A. ilica, other oxides, and other solids.

Math Analyzing Data

Magma Composition



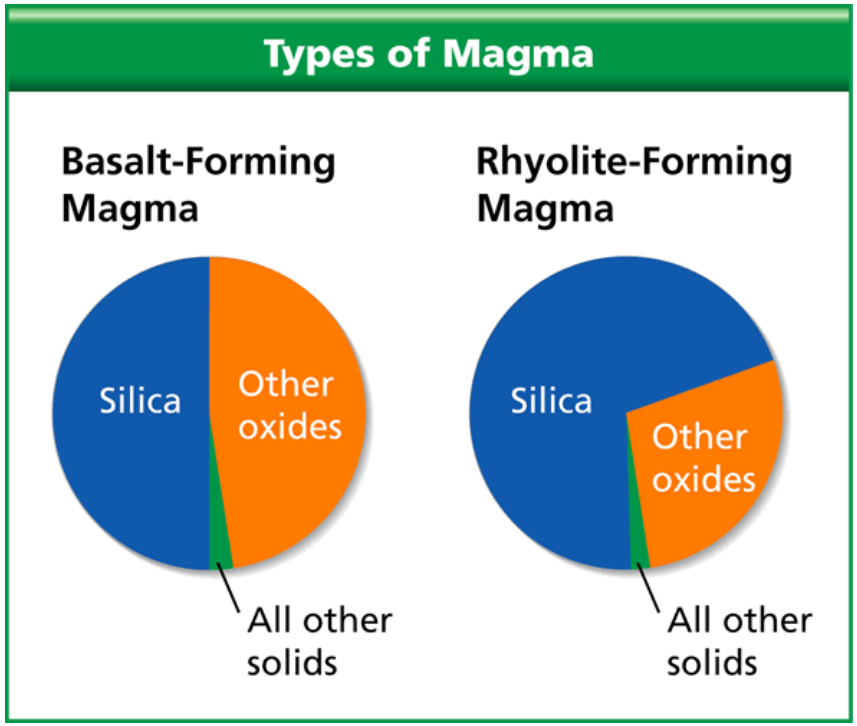
- **Reading Graphs:**

Q. Which type of magma has more silica? About how much silica does this type of magma contain?

A. Rhyolite-forming magma; about 70 percent.

Math Analyzing Data

Magma Composition



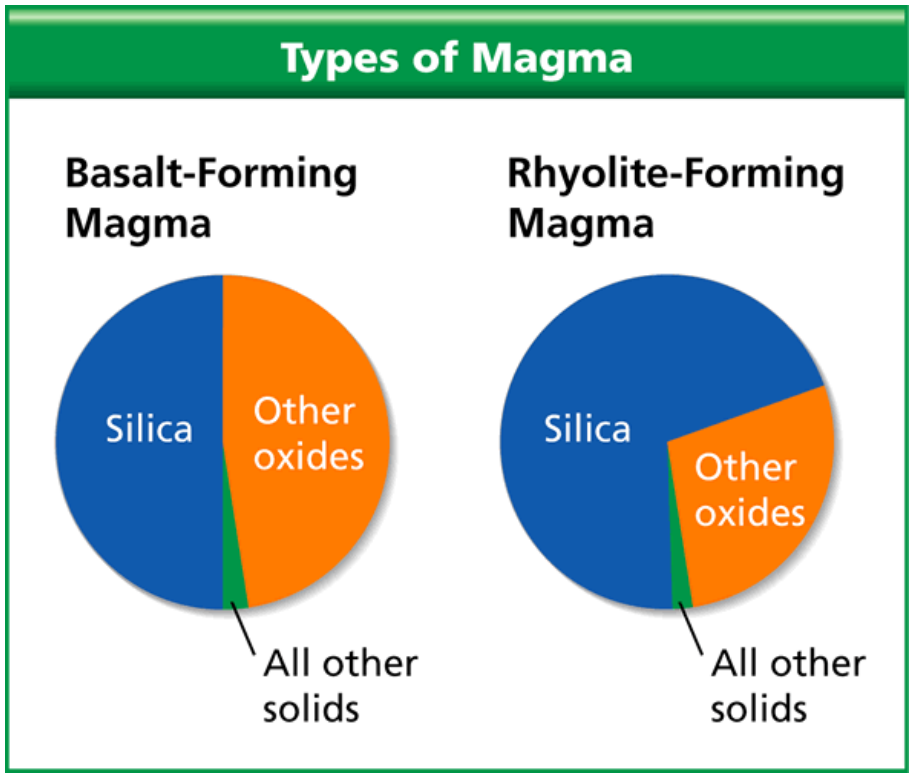
- **Estimating:**

Q. A third type of magma has a silica content that is halfway between that of the other two types. About how much silica does this type of magma contain?

A. About 60 percent

Math Analyzing Data

Magma Composition



- **Predicting:**

Q. What type of magma would have a higher viscosity? Explain.

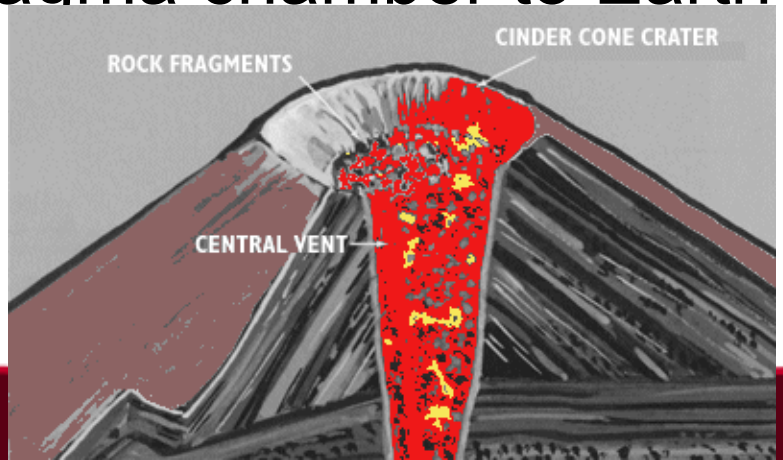
A. Rhyolite-forming magma would have higher viscosity because it is higher in silica.

Links on the Properties of Magma

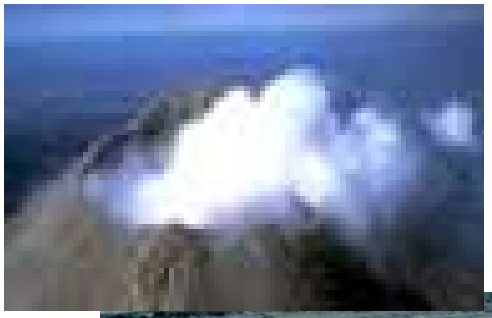
- Click the SciLinks button for links on the properties of magma.

Magma Reaches Earth's Surface

- All volcanoes have a pockets of magma beneath the surface and cracks through which the magma forces its way up.
- **Magma chamber** – pocket beneath a volcano where magma collects.
- **Pipe** – long tube through which magma moves from the magma chamber to Earth's surface.



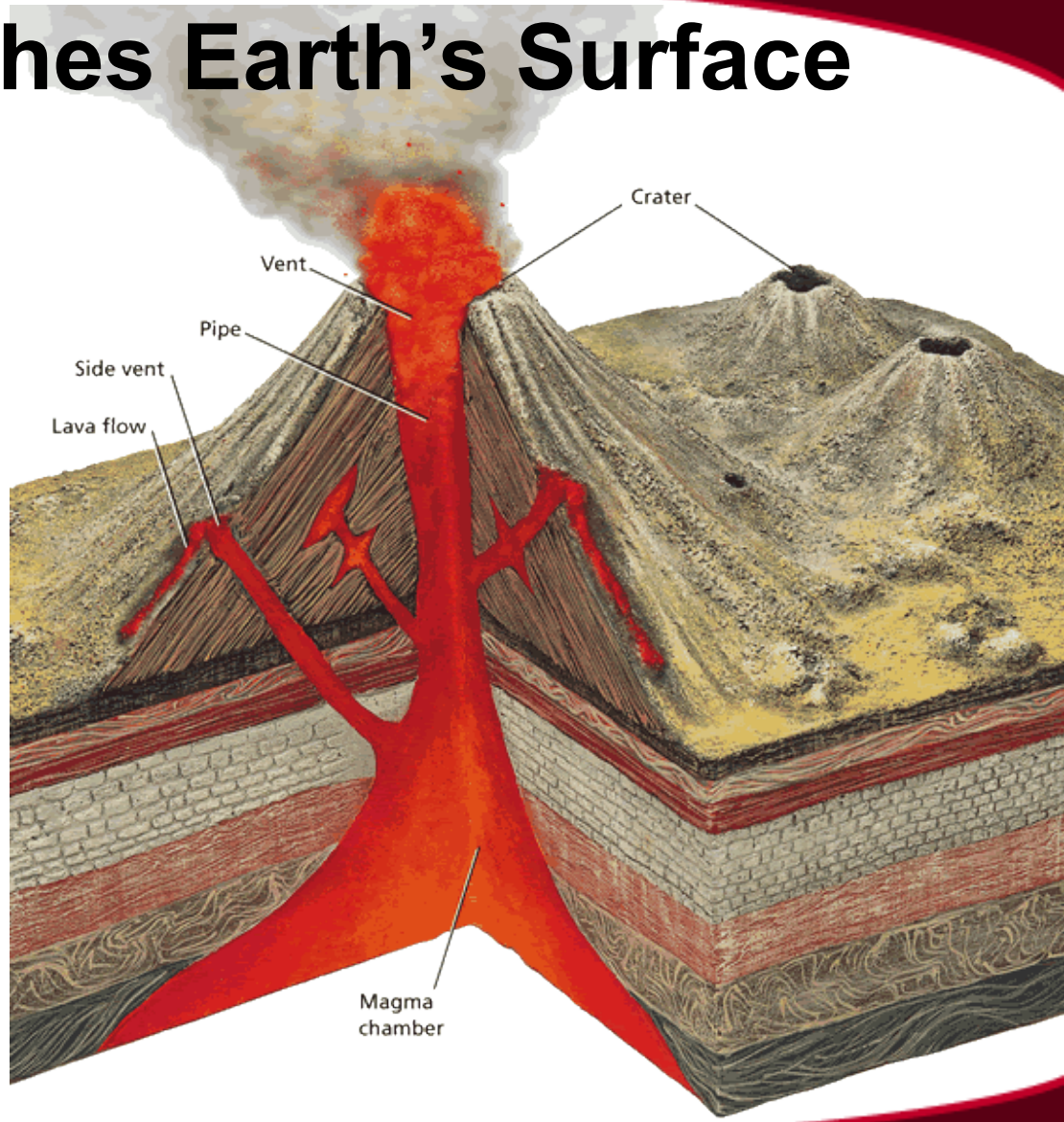
Magma Reaches Earth's Surface



- **Vent** – opening through which molten rock and gas leave a volcano.
- **Lava flow** – area covered by lava as it pours out of a volcano's vent.
- **Crater** – bowl-shaped area that forms around a volcano's central opening.

Magma Reaches Earth's Surface

- When a volcano erupts, the force of the expanding gases pushes magma from the magma chamber through the pipe until it flows or explodes out of the vent.

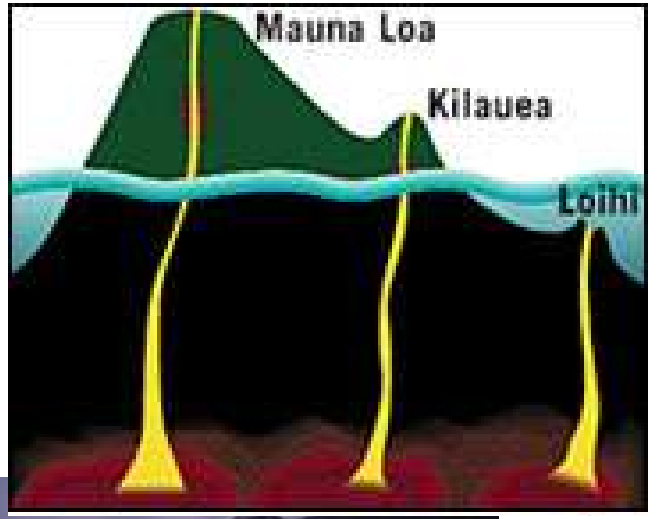


Composite Volcano Eruption Activity

- Click the Active Art button to open a browser window and access Active Art about composite volcano eruption.

Kinds of Volcanic Eruptions

- **Geologists classify volcanic eruptions as quiet or explosive.**
  - Quiet eruptions are the result of very hot magma with a low-viscosity, low-silica content
    - There are minimal gases associated with quiet eruptions.
    - Ex: Hawaiian Islands

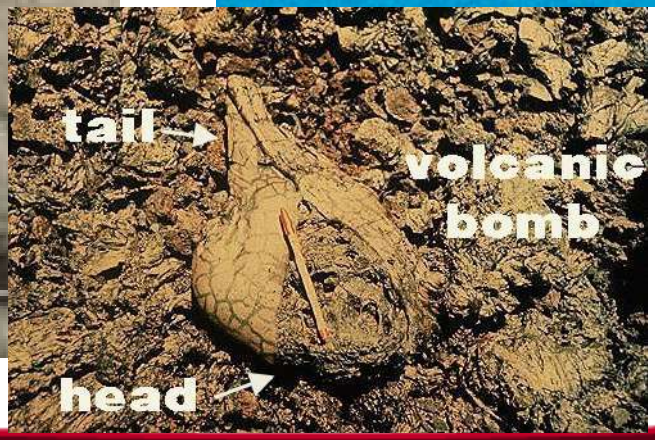


Kinds of Volcanic Eruptions

- Explosive eruptions are the result of cooler, thicker magma with a high viscosity and a high silica content.
  - Enormous amounts of gases become trapped inside the magma creating lots of pressure
  - Ex: Mount. St. Helens

Kinds of Volcanic Eruptions

Pyroclastic flow – expulsion of ash, cinders, bombs, and gases during an explosive volcanic eruption.(write down-not on notes!)



- Within the last 150 years, major volcanic eruptions have greatly affected the land and people around them.

1980 Mount St. Helens
When Mount St. Helens in Washington exploded, it blasted one cubic kilometer of volcanic material skyward.

1991 Mount Pinatubo
Pinatubo in the Philippines spewed out huge quantities of ash that rose high into the atmosphere and buried nearby areas.

2002 Mount Etna
Bulldozers constructed a wall against a scalding river of lava creeping down the slopes of Mount Etna in Sicily.

1950 1975 2000

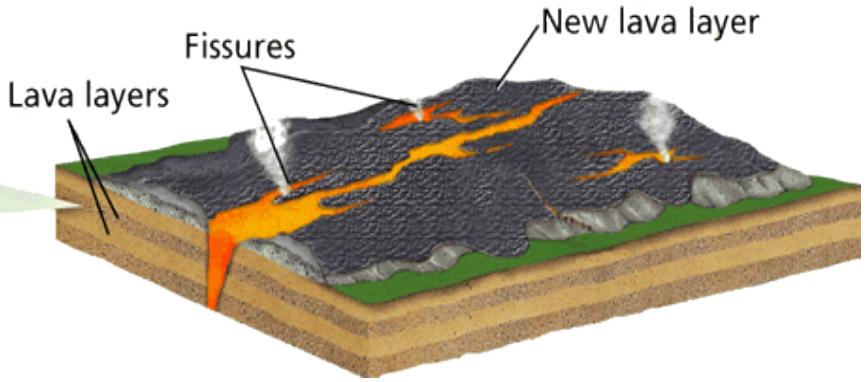
Stages of Volcanic Activity

- Geologists often use the terms ***active,*** ***dormant,*** or ***extinct*** to describe a volcano's stage of activity.
- **Dormant** – volcano that is not currently active, but may become active in the future.
- **Extinct** – volcano that is no longer active and is unlikely to erupt again.

Landforms From Lava and Ash

- Volcanic eruptions create landforms made of lava, ash, and other materials. These landforms include composite volcanoes, shield volcanoes, cinder cone volcanoes, and lava plateaus.

Lava Plateau
A lava plateau is made up of many layers of thin, runny lava that erupt from long cracks in the ground.



Landforms From Lava and Ash

- **Shield volcano** – wide, gently sloping mountain made of layers of lava and formed by quiet eruptions.
  - Ex: Hawaiian Islands

- **Cinder cone** – steep, cone-shaped hill or small mountain made of volcanic ash, cinders, and bombs piled up around a volcano's opening.
  - Ex: Mount Paricutín in Mexico

Landforms From Lava and Ash

- **Composite volcano** – tall cone-shaped mountain in which layers of lava alternate with layers of ash and other volcanic materials.
  - Ex: Mount Fuji in Japan and Mount St. Helens in Washington

It's Your Turn!!

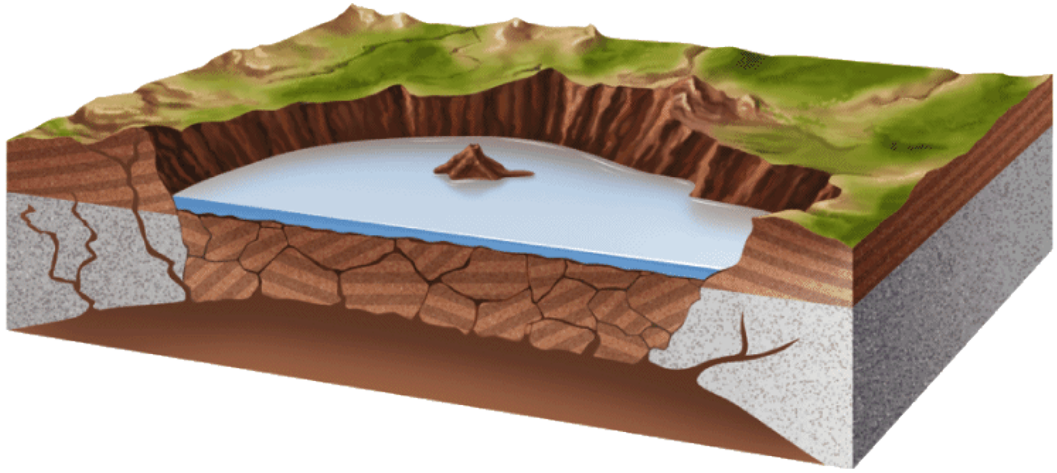
Erupt a Volcano!!

Landforms From Lava and Ash

- **Caldera** – large hole at the top of a volcano formed when the roof of a volcano's magma chamber collapses.

Landforms From Lava and Ash

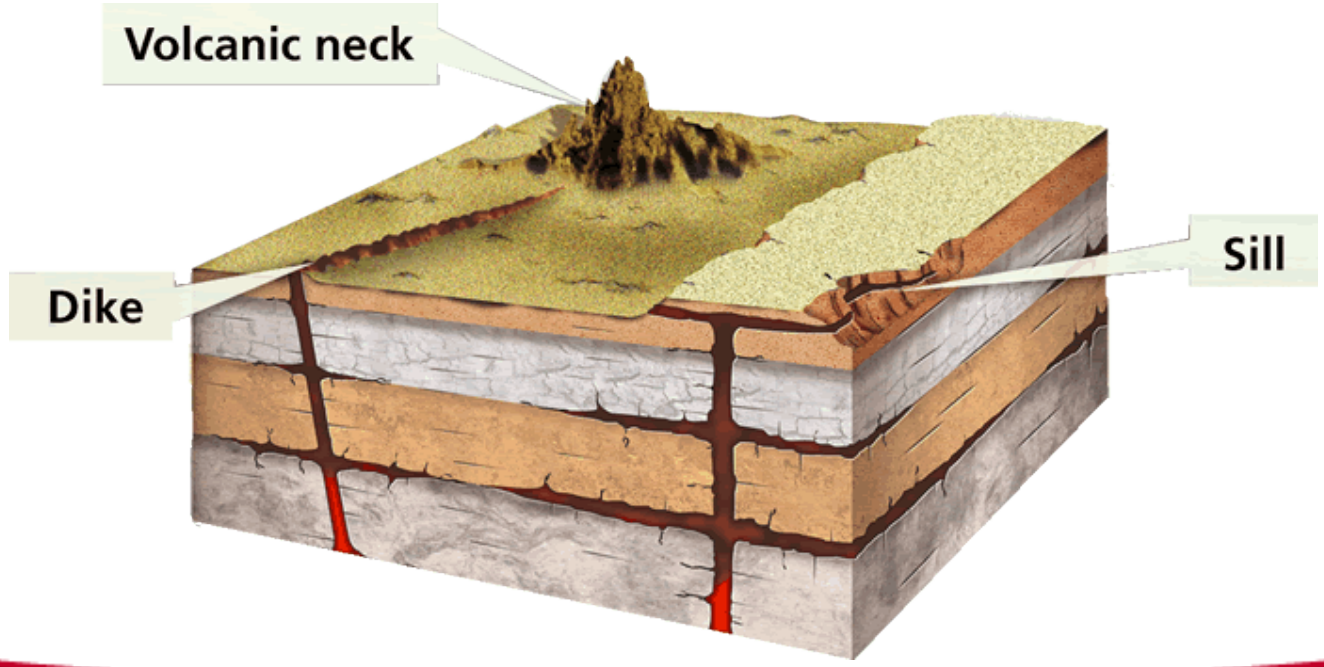
- A caldera forms when an volcano's magma chamber empties and the roof of the chamber collapses. The result is a large, bowl-shaped caldera.



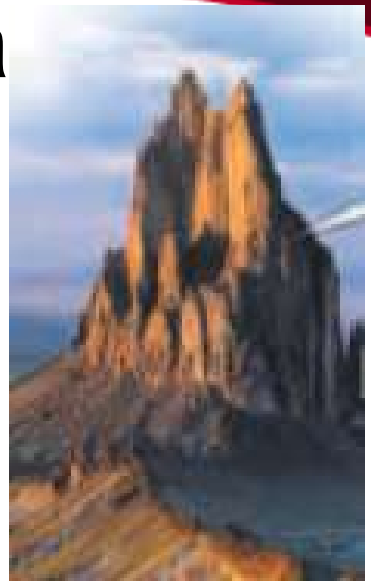
3 Later, a small cinder cone forms in the caldera, which partly fills with water.

Landforms From Magma

- Features formed by magma include volcanic necks, dikes, and sills, as well as batholiths and dome mountains.

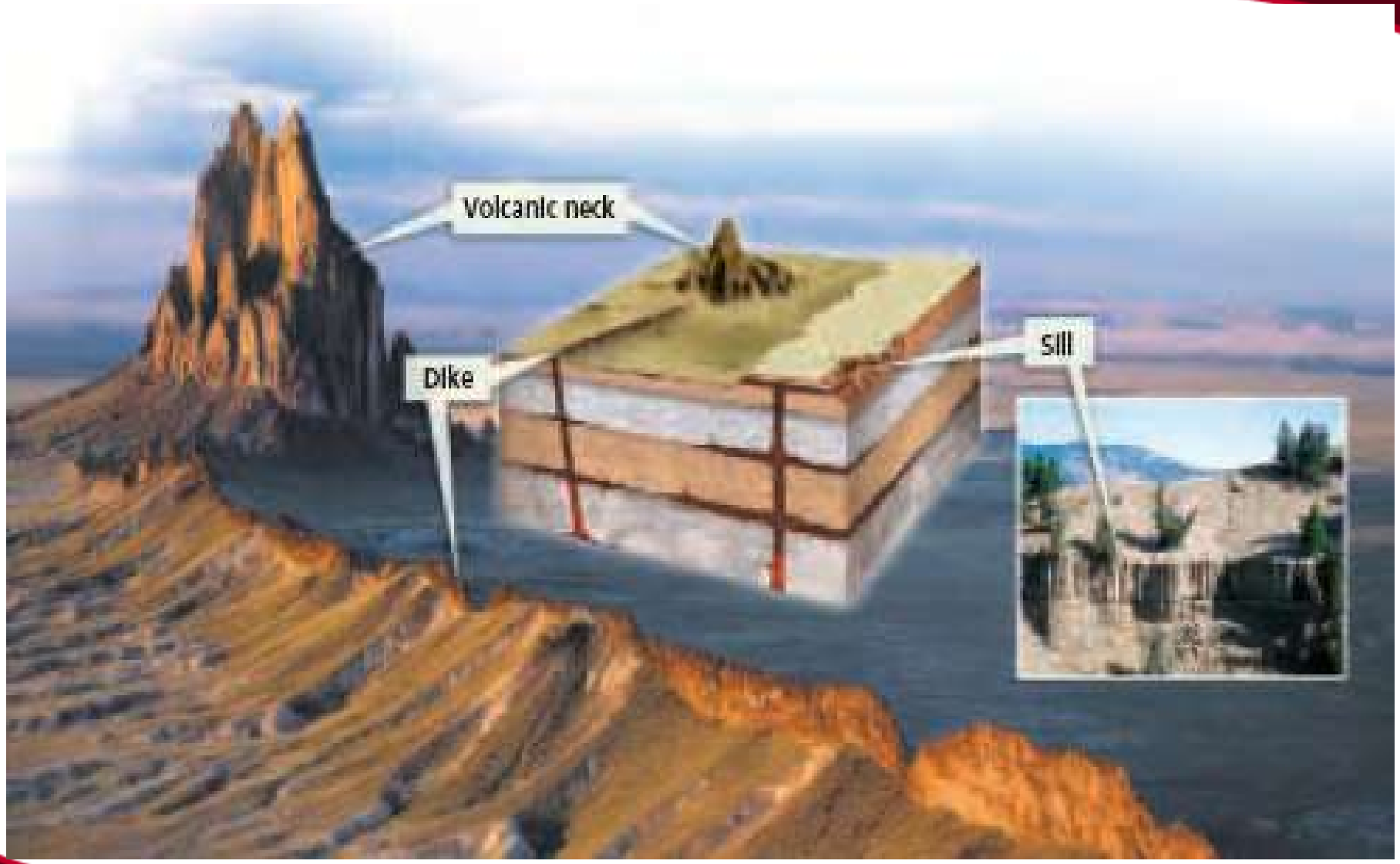


Landforms From Magma



- **Volcanic neck** – deposit of hardened magma in a volcano's pipe.
  - Ex: Ship Rock in New Mexico
- **Dike** – slab of volcanic rock formed when magma forces itself across rock layers. (Vertically)
- **Sill** – slab of volcanic rock formed when magma squeezes between layers of rock. (Horizontally)

Volcanoes - Volcanic Landforms



Landforms From Magma

- **Batholith** – mass of rock formed when a large body of magma cools inside the crust.
  - Several large batholiths form the core of mountain ranges in western North America.
  - Ex: Half Dome in Yosemite National Park, California, is part of the Sierra Nevada batholith.

Links on Volcanic Effects

- Click the SciLinks button for links on volcanic effects.

Geothermal Activity

- **Geothermal activity** – heating of underground water by magma.
- Hot springs and geysers are types of geothermal activity that are often found in areas of present or past volcanic activity.
  - **Geyser** – fountain of water and steam that builds up pressure underground and erupts at regular intervals.
    - Ex: “Old Faithful” Yellowstone National Park, Wyoming

Graphic Organizer