

Volcanism



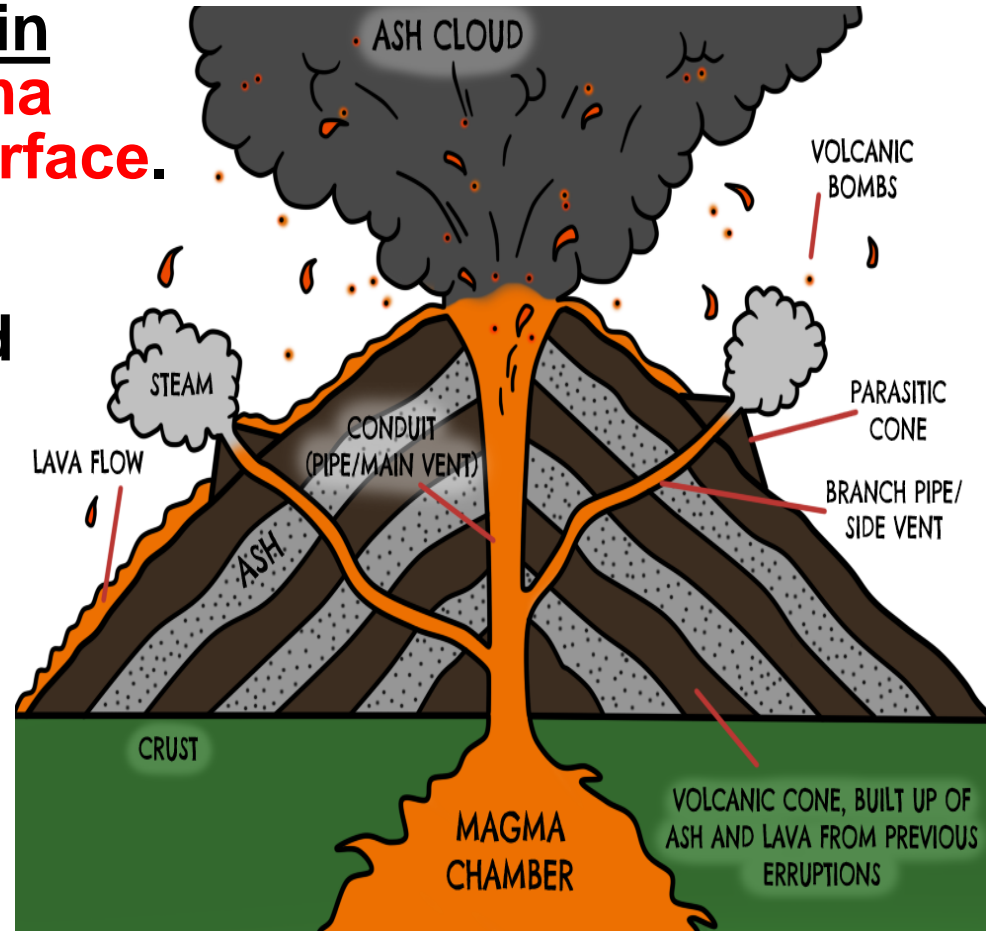
What is Volcanism?

- A volcano is a mountain that forms when **magma reaches the Earth's surface**.

- Magma develops and collects in areas called **magma chambers**.

- Magma is less dense than the solid rock around it.

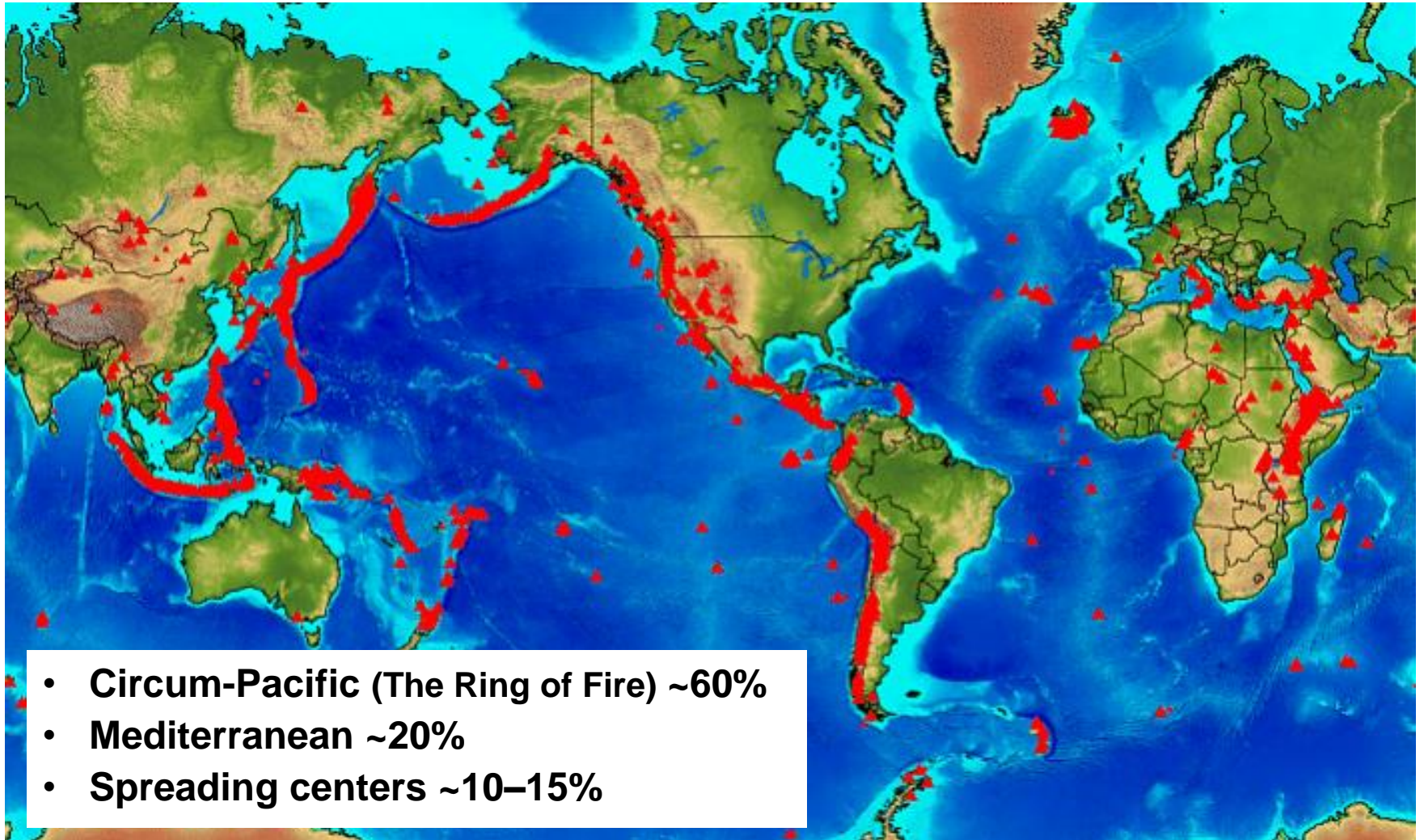
- Magma can also easily migrate (flow) if a structural zone allows movement.



- When a **rupture on the crust** is present, magma rises to the surface and escapes, resulting in **volcanism**.

Volcano Distribution

On Earth, volcanoes are generally found where tectonic plates are diverging or converging.



Volcanic Activity

- **Active** - activity present in the last few centuries:
 - Mauna Loa, HI (current)
 - Mt. St. Helens, WA (1980)
- **Dormant** - “quiet” for the last hundreds to thousands of years, but still have potential to erupt:
 - Mt. Elbrus, Russia (~2000 years ago)
- **Extinct** - no eruption in historical times, unlikely to erupt again, no longer have a magma supply:
 - Castle Rock, Edinburgh, Scotland (~350 million years ago)



Non-explosive Eruption

- Most volcanoes erupt basalt, a fluid **low viscosity lava** that erupts *effusively* (quietly) and forms *flows* with occasional *fountains*.



- **Higher viscosity lava** with low gas content produces bulging lava *domes*.



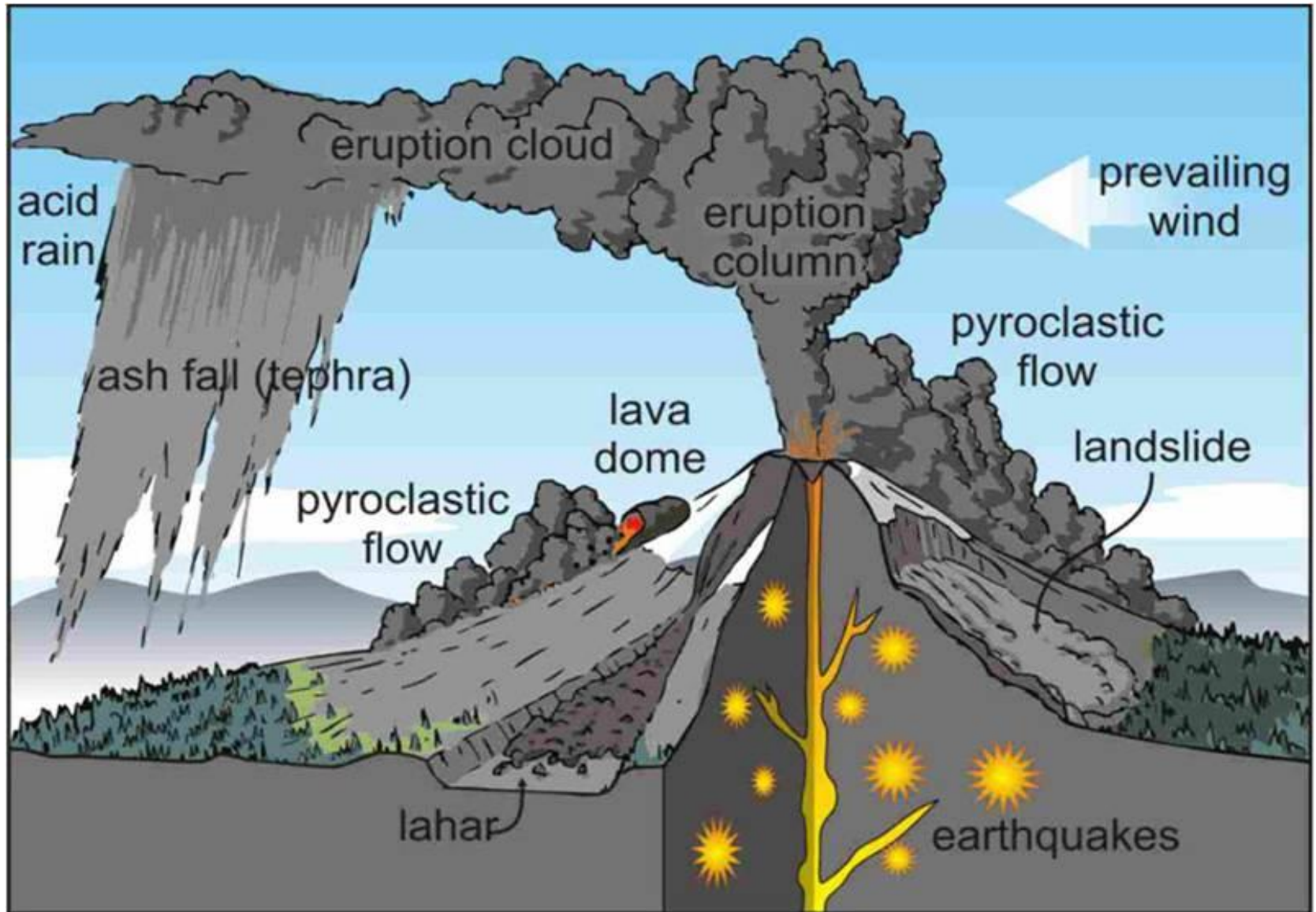
Explosive Eruption

Very high viscosity magma prevents the release of volcanic gases; **gases accumulate** and the **magma pressure builds up**... until it is blasted out in an explosion!



Explosive eruptions can send rocks, dust, gas and pyroclastic material **up to 20 km** into the atmosphere.

Explosive Eruption Diagram



Volcanic Eruption: Primary Effects

- Three types of material expelled from volcanoes:

- Lava (“liquid”)
 - Ash, cinders, bombs (“solid”)
 - Gases
- HOMEWORK**

- An erupting volcano will produce a number of distinct landforms including:
 - Volcanic cones
 - Flood basalts
 - Calderas

Volcanic Landforms: Cones

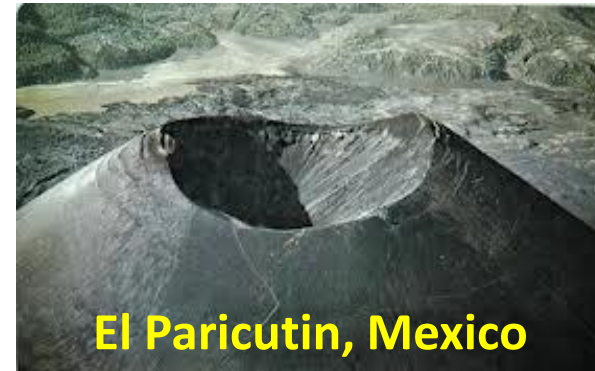
- **Shield volcanoes**

- Multiple layers of basaltic lava
- Shallow sides due to magma's low viscosity
- Multiple "Gentle" eruptions



- **Cinder cones**

- Layered ash and cinders
- Smallest volcanic cone
- Short, narrow cone, steep sides
- Violent eruptions, often *single*



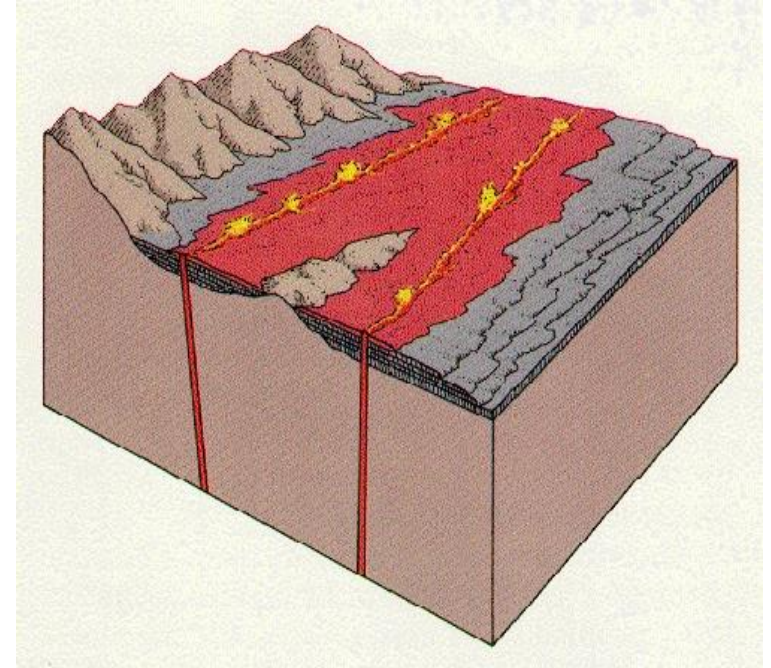
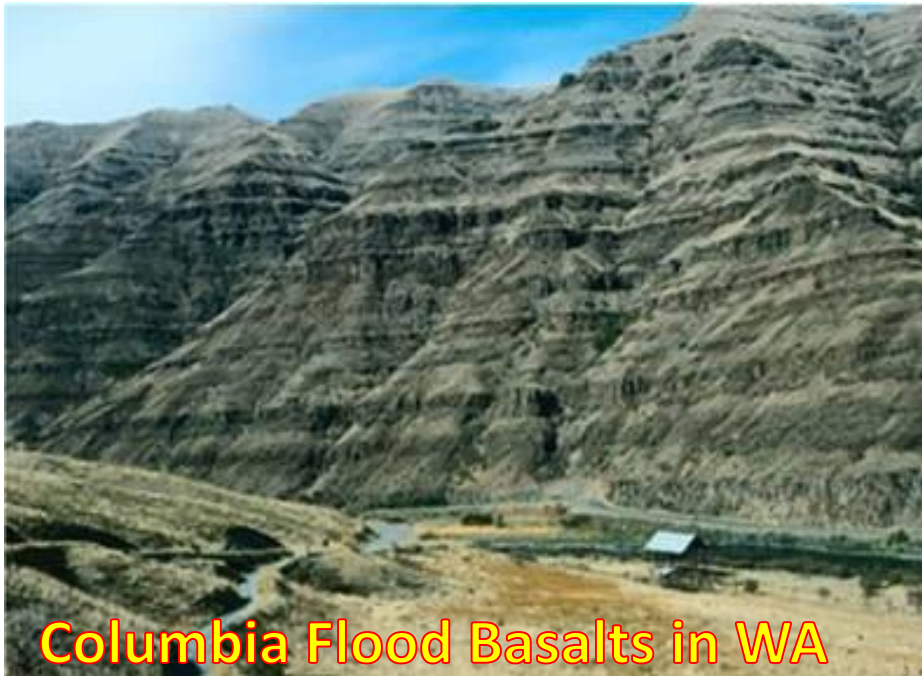
- **Composite cones (stratovolcanoes)**

- Most common type
- Layered ash, lava, and mud
- Steep sides due to magma's high viscosity
- Tall volcanoes – 1 to 2 miles high
- Violent, often *catastrophic*, eruptions



Volcanic Landforms: Flood Basalts

- Large (10-100 square miles) outpourings of very low viscosity basaltic lava
- Multiple, “quiet” eruptions
- Lava plateau forms



Flood basalt volcanism
has been connected to
major mass extinction
events in the past.

Volcanic Landforms: Calderas

(Spanish for “cooking pot”)

Volcano rapidly empties its magma chamber, and support is lost. Overlying material collapses into the magma chamber: a caldera forms.

- **Explosive calderas**

Silica-rich magma feeding these volcanoes has high viscosity; gases tend to become trapped at high pressure within the magma, resulting in explosion.



- **Non-explosive calderas**

Basaltic magma feeding these volcanoes is silica poor and much less viscous; the magma chamber is drained by large lava flows rather than by explosive events.



Hot Spot Volcanism

Hot spots are due to a **plume of hot magma** flowing up to the crust from the core-mantle boundary. This plume is for some reason sustained over long geologic periods.

Over time, the **tectonic plates of the Earth move over** these hot spots leaving a **trail of volcanoes**.

