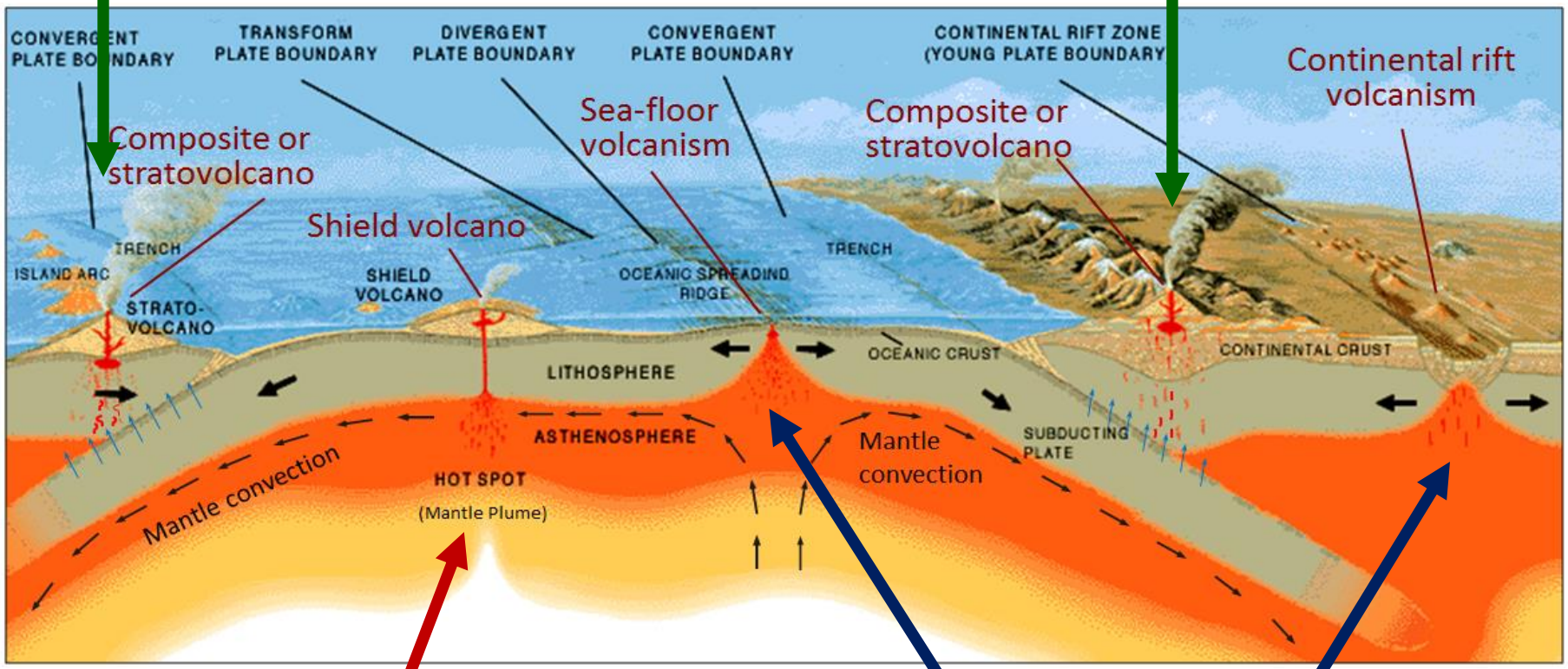
Types of Volcanism

Subduction zone volcanism (most common)



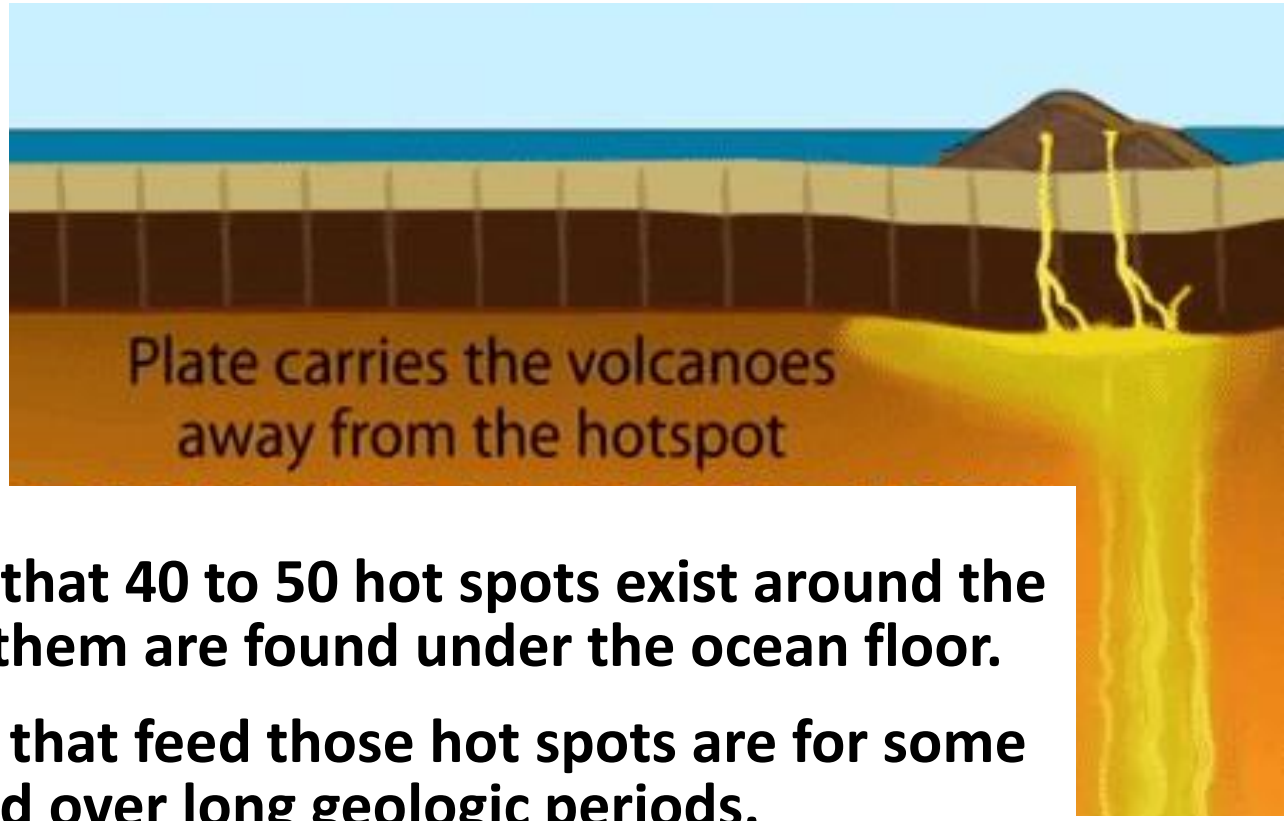
Hot spot volcanism (rare)

Spreading ridge/rift volcanism

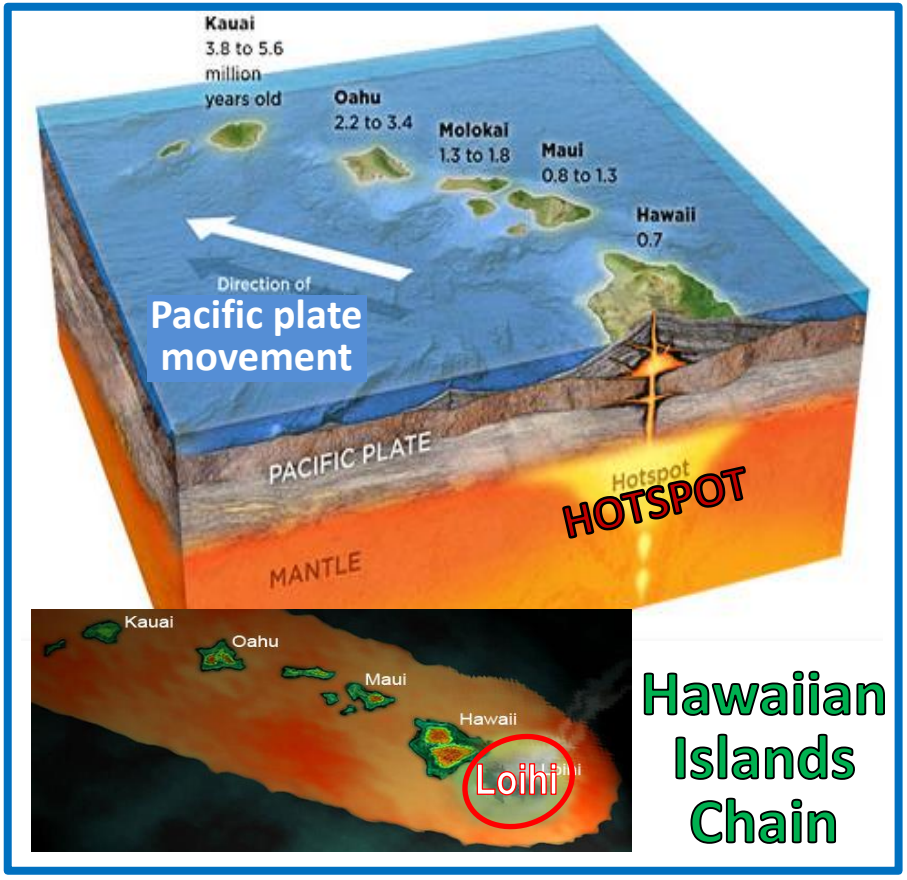
Hot Spot Volcanism

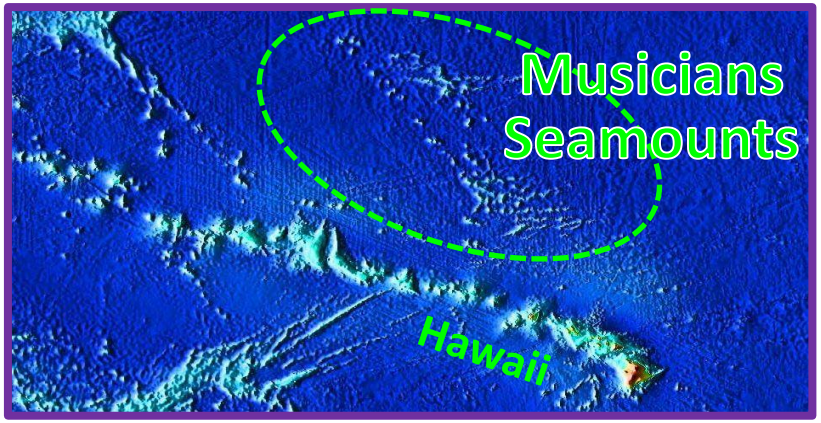
Hot spots are due to a plume of hot magma flowing up to the crust from the core-mantle boundary.

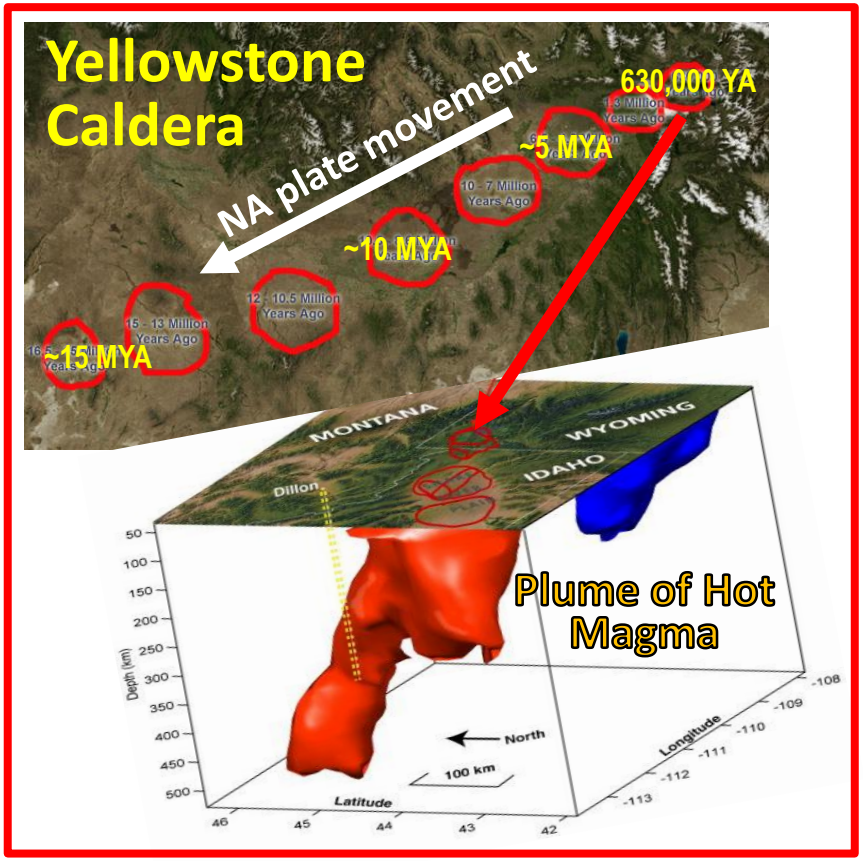
- **Over time, the tectonic plates of the Earth move over the hot spots leaving a trail of volcanoes.**



- **Scientists think that 40 to 50 hot spots exist around the world; most of them are found under the ocean floor.**
- **Magma plumes that feed those hot spots are for some reason sustained over long geologic periods.**
- **Volcanoes carried far away from the hot spot become extinct.**


Kauai
3.8 to 5.6 million years old
Oahu
2.2 to 3.4
Molokai
1.3 to 1.8
Maui
0.8 to 1.3
Hawaii
0.7
Direction of
Pacific plate movement
PACIFIC PLATE
Hotspot
HOTSPOT
MANTLE
Kauai
Oahu
Maui
Hawaii
Loihi
Hawaiian Islands Chain


Musicians Seamounts
Hawaii


Yellowstone Caldera
NA plate movement
630,000 YA
~5 MYA
~10 MYA
~15 MYA
MONTANA
WYOMING
IDAHO
Dillon
Plume of Hot Magma
Depth (km)
Latitude
Longitude
North
100 km


Kermadec Trench
Louisville Seamount Chain
New Zealand

Volcanic Caldera *(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.

Dangerous volcanoes are constantly being monitored by volcanologists using the following methods:

- **Measuring slope**
  - bulges may form with magma pushing up.
- **Measuring volcanic gases**
  - outflow of volcanic gases (*sulfur dioxide, carbon dioxide*) may precede eruption.
- **Measuring temperature from orbit**
  - monitoring changes in temperature over time.
- **Measuring small quakes**
  - increase in number & intensity before eruption.

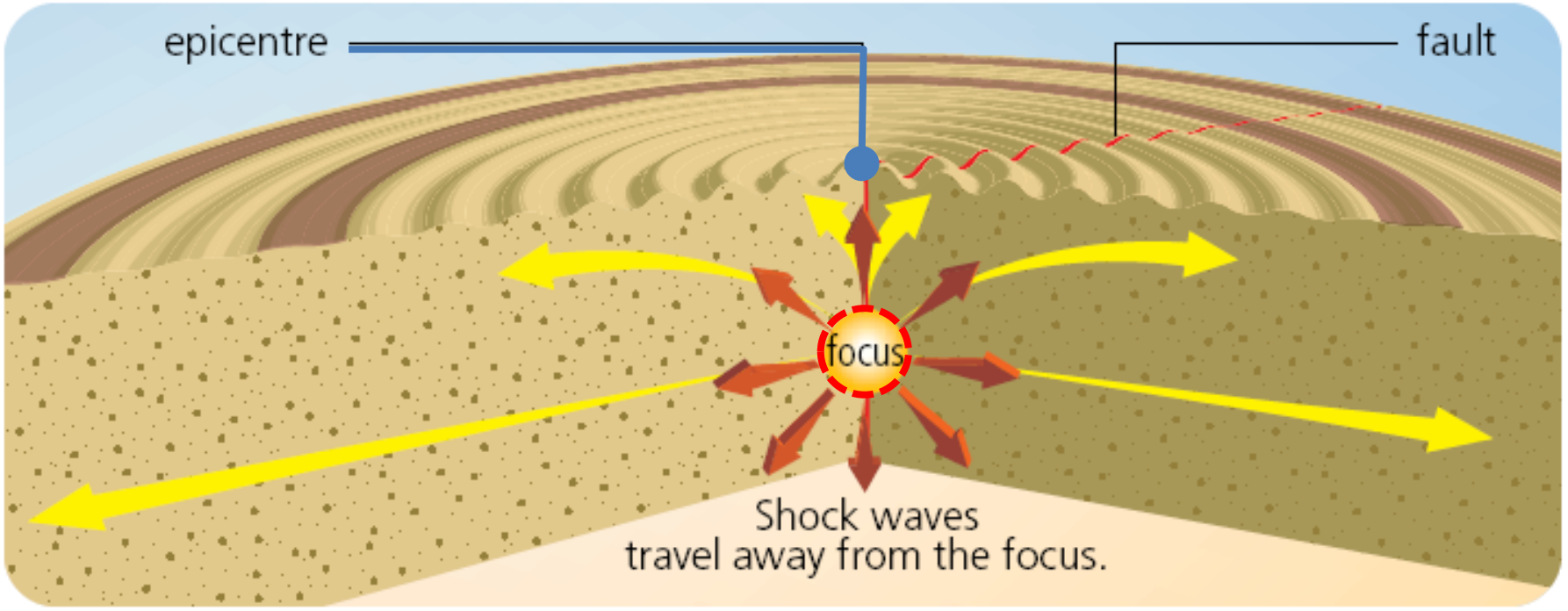
Earthquakes

What is an earthquake?

Earthquake is the vibration (shaking) and/or displacement of the ground produced by the sudden release of energy.

- **Rocks under *stress* accumulate *strain energy* over time.**
- **Stress results from tectonic plate movement, magmatic or volcanic activity.**
- **When stress exceeds strength of rocks, rock breaks and slips.**
- **Rock slippage/rupture occurs at the weakest point *(fault)*.**
- **Strain energy is released as seismic waves.**

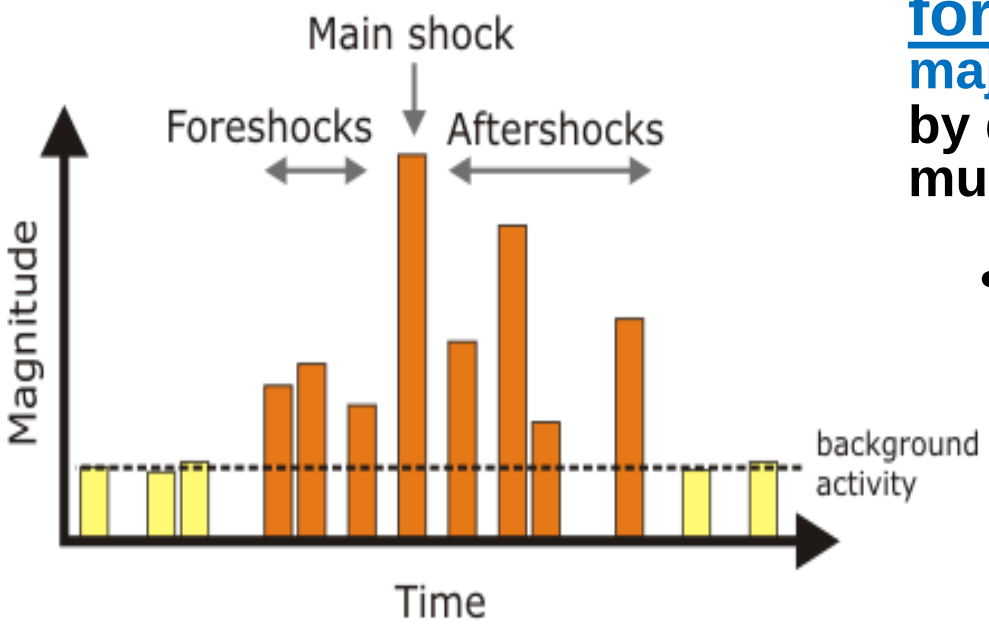
Focus and Epicenter



- **Focus – point inside the Earth where an earthquake begins (*point of initial rupture*). The majority of tectonic earthquakes originate in depths not exceeding tens of kilometers.**
- **Epicenter – point on the surface of the Earth directly above the focus where the shaking is usually felt most strongly.**

Foreshocks and Aftershocks

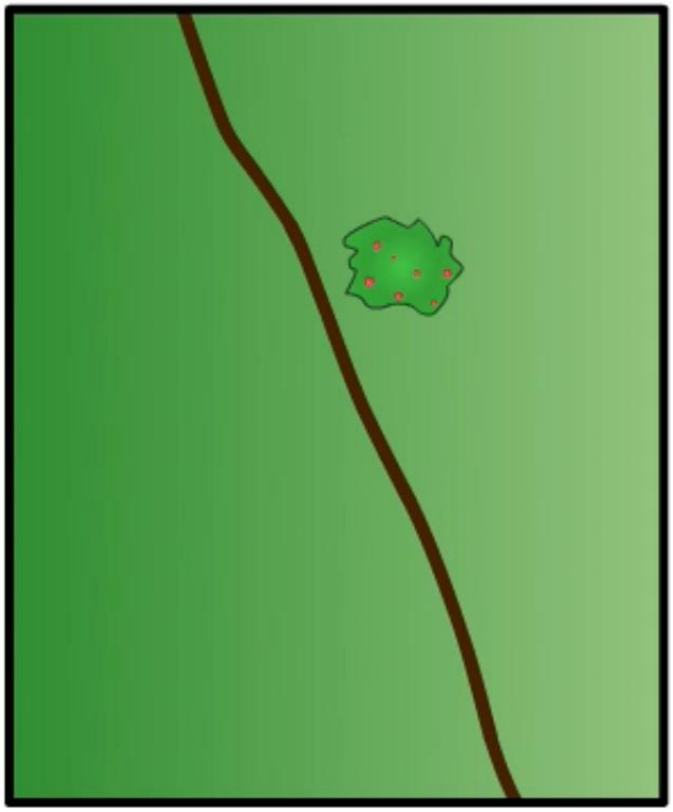
Earthquakes often occur as a sequence rather than individual events:



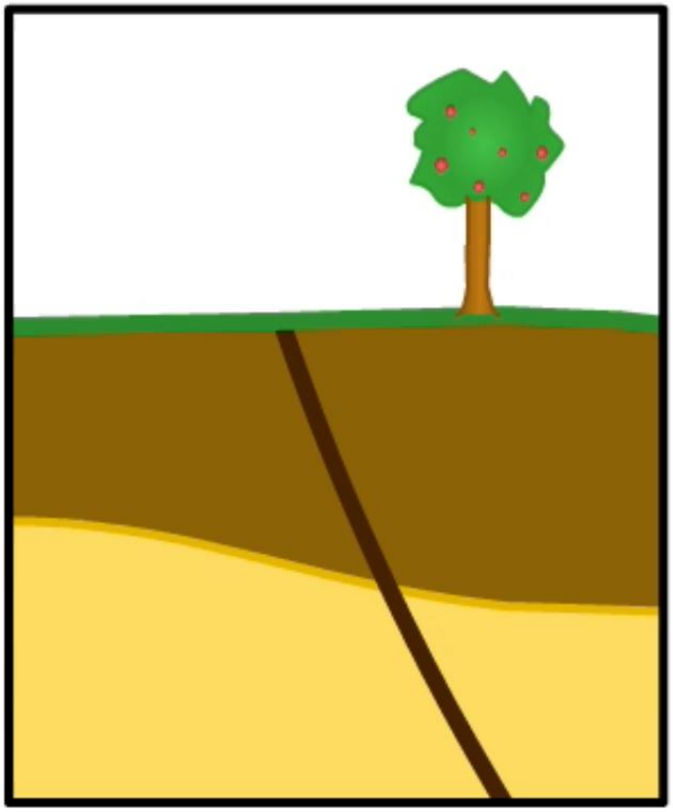
- **Small earthquakes, called foreshocks, often precede a major earthquake (main shock) by days or, in some cases, by as much as several years.**
- **Adjustments of crust (redistribution of stress on the fault) that follow a major earthquake often generate smaller quakes in the same area called aftershocks.**
- ***Bigger* earthquakes often have *more and larger* aftershocks and the sequences can last for years.**
- **Earthquake swarms are sequences of earthquakes striking in a specific area within a short period of time in which no single earthquake has notably higher magnitudes than the other.**

USGS Foreshocks, Mainshocks & Aftershocks

Foreshock Mainshock Aftershock



Map View



Cross-Section View