



# Earthquakes

Ms Toal EAMS 2019

# Earth is Stressed!

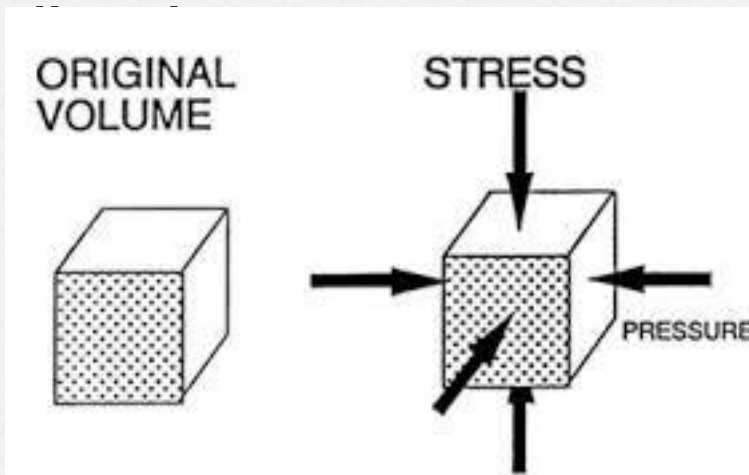
- o The movement of plates create stress
- o **STRESS** – is a force that acts on an area of rock to change its shape or volume.
- o Because stress is a force, it adds energy to the rock.
- o **Energy is stored** in rocks until it is released.





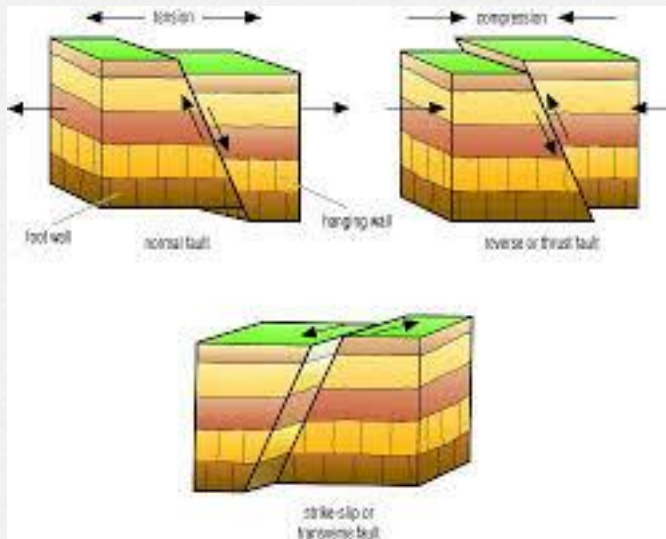
# 3 Types of Stress

- 1) **Tension** – pulls on the crust. **Stretches** rock to be thinner in the middle.  
(divergence)
- 2) **Compression** – **squeezes** rock until it folds or breaks (pushing together)
- 3) **Shearing** – rocks pushed in **opposite** directions (slip)

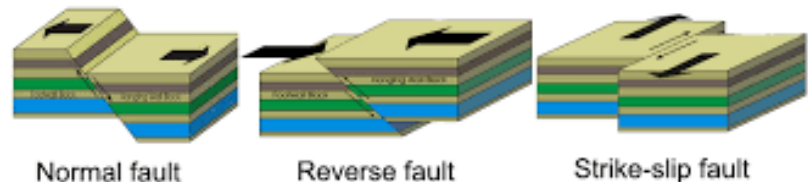


# Types of Faults

- Normal Faults – caused by tension.
- Reverse Faults – caused by compression
- Strike Slip Faults – caused by shearing.



What are the three main types of faults?

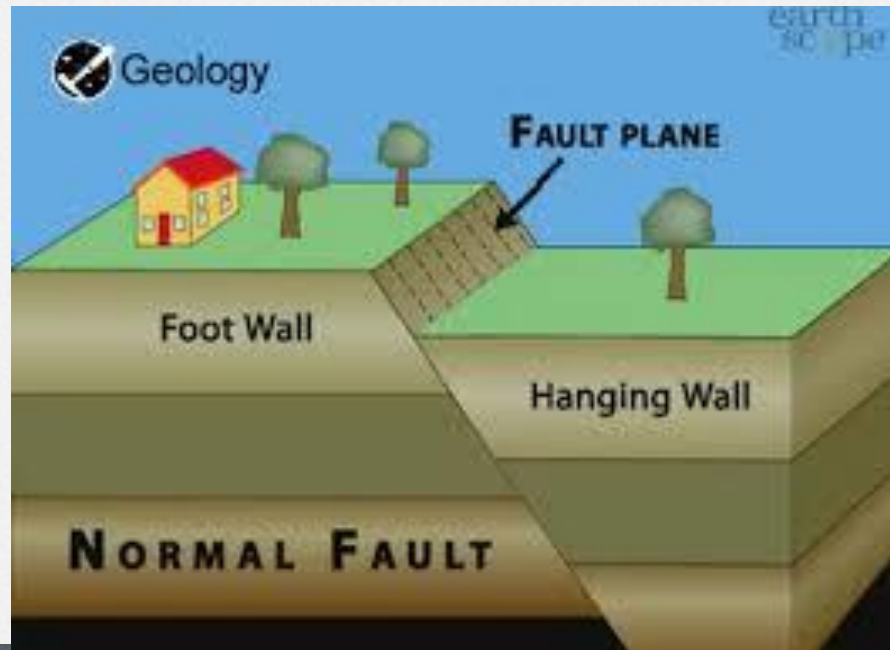


[www.GeologyPage.com](http://www.GeologyPage.com)



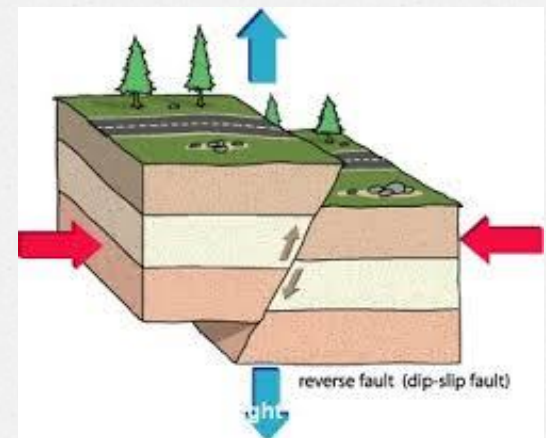
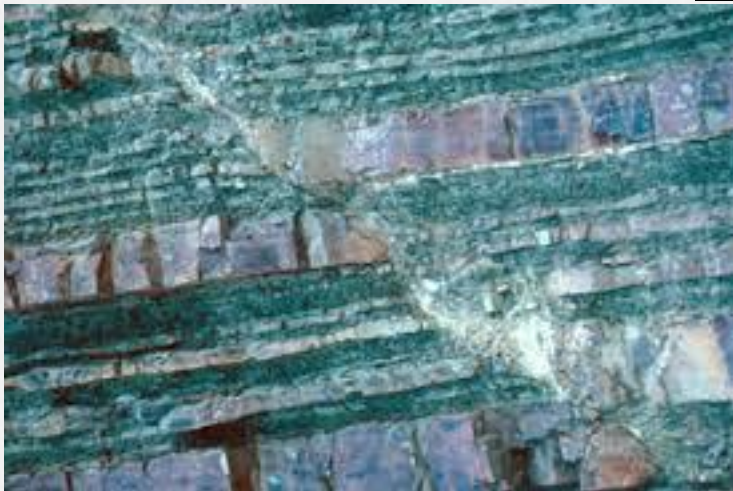
# Normal Faults

- Fault is at an angle, tension pulls blocks apart.
- The block that lies above is called the hanging wall
- The block that lies below is called the footwall.
- When there is movement on this fault, the hanging wall slips downward



# Reverse Fault

- Crust/rocks are pushed together.
- Same structure as a normal fault except the movement is opposite of the normal fault.
- Hanging wall slides up over the footwall.
- Reverse faults produce Rocky Mountains, and also Klamath Mountains in California





# Strike – Slip Faults

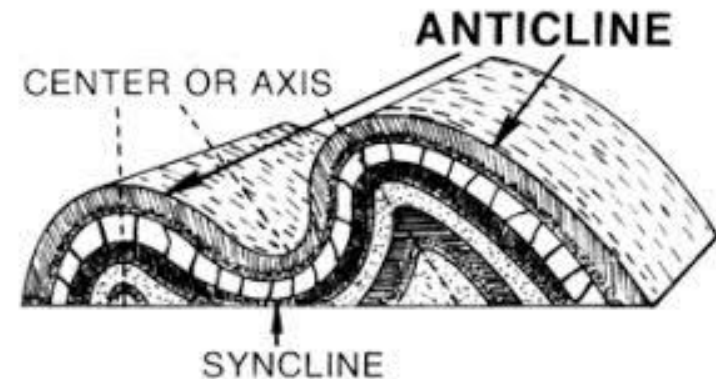
- The rocks on either side of the fault slip past each other side-ways.
- A strike-slip fault that forms between two plate boundaries is called a sliding boundary.
- The San Andreas fault is a Strike-Slip fault. (2 inches per year)



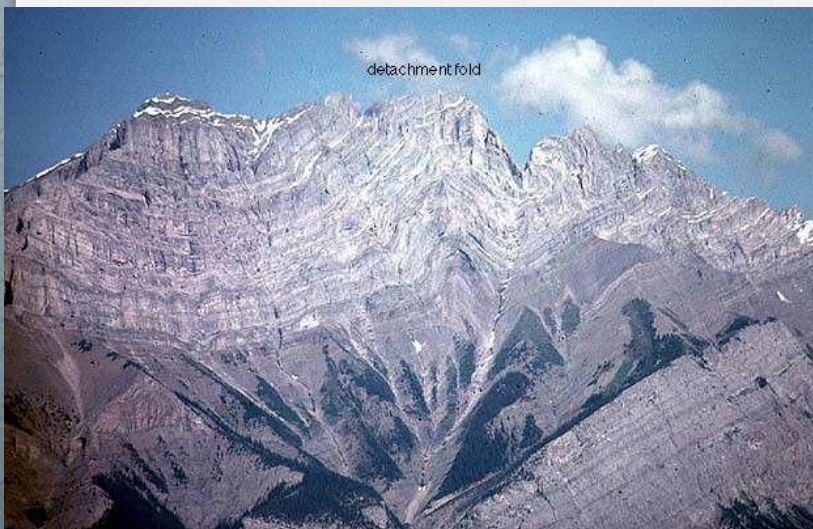
# Changing Earth's Surface

- o **Folding** – (like skidding into a rug on a wooden floor) caused by **compression forces**.
- o Forces that fold earth to bend **upwards** is an **anticline**
- o Forces that fold earth to bend **downwards** is a **syncline**.
- o Largest mountains produced **Himalayas, Alps, California Coast Range**.

Chevron Folds









# Changing Earth's surface

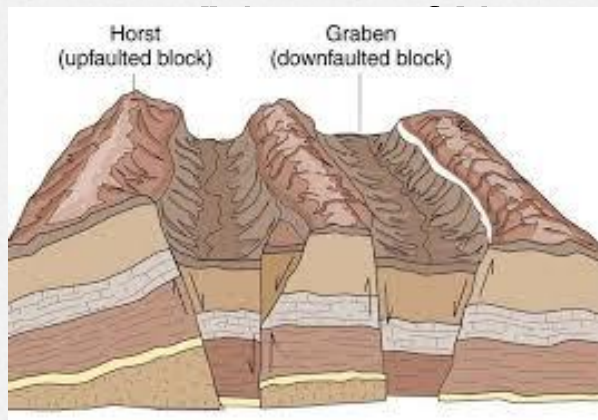
o Stretching crust – when two normal faults cut parallel through a block of rock, a fault-block mountain forms.

o Pulling apart creates normal faults.

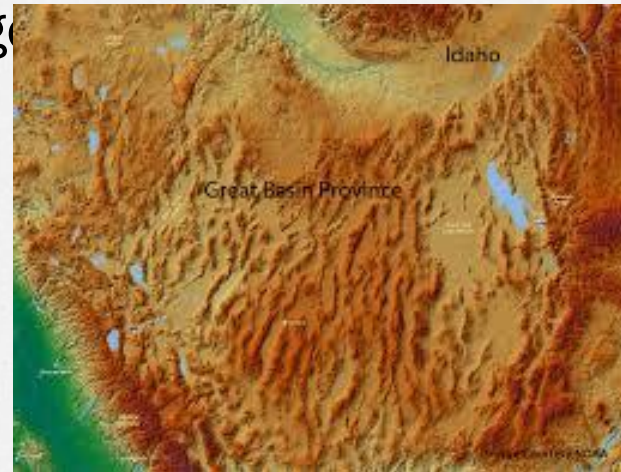
o Ex:

o Panamint Range in Death Valley

o From Salt Lake City to Los Ang



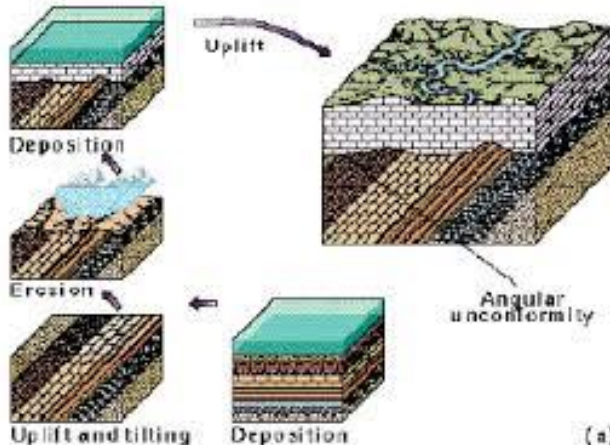
a)





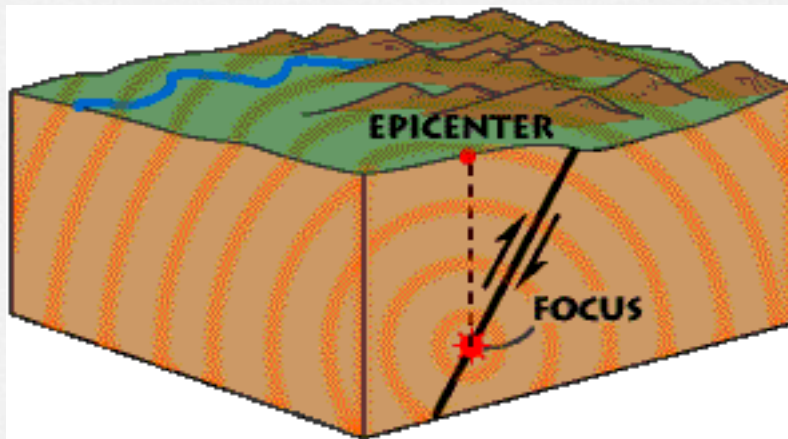
# Uplifting

- If a large level block is uplifted, this creates a plateau.
- Ex: Colorado Plateau (1500 m above sea level)
- It is made of lots of flat layers and is much wider than it



# Earthquakes and Seismic Waves

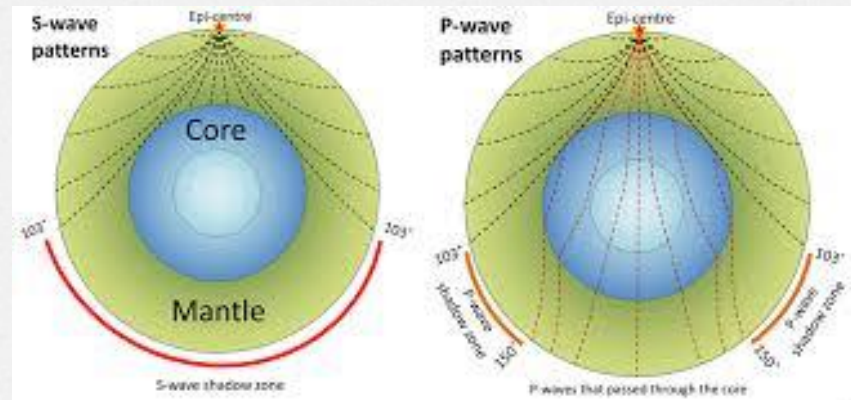
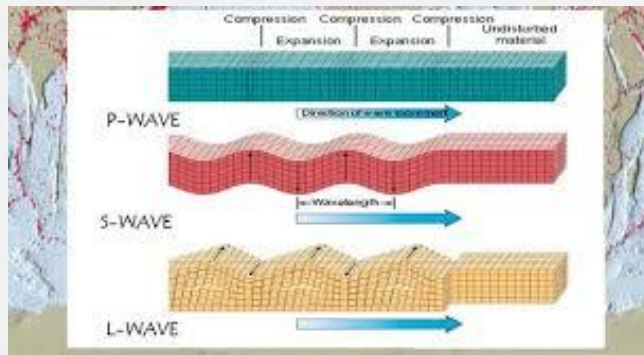
- Forces of plate movement cause quakes.
- Focus – is the area beneath Earth's surface where the rock actually breaks.
- Epicenter – is the point on the surface directly above the focus.





# Seismic Waves

- Energy from the quake is away from the focus, through Earth's interior, and across the surface.
- **P waves** - (primary) are first to arrive. They compress and expand (like a pulse in a slinky). Through **solids and liquids**.
- **S waves** - (secondary) are second, they vibrate side to side. **Not through liquids**.



# Surface Waves

- When P and S waves hit the surface, they become surface waves.
- Sometimes you can feel the ground roll like ocean waves.
- Sometimes it can make the buildings move from side to side.

## Seismic waves

An earthquake produces several types of seismic waves, each causing extensive degrees of damage.

Surface waves, rolling through rocky terrain are usually long and side-rolling waves. If strong enough, they are nearly a threat to larger structures, such as bridges and high-rises. Smaller structures are able to ride out the wave and remain intact.



### "P" waves

The initial jolt comes from the primary or "P" wave. It travels in a fast, longitudinal fashion, alternately compressing and dilating the rock. They are generally felt as a bang or thump.



### "S" waves

The slower and stronger secondary, or shear, wave arrives after the "P" wave, shaking the ground in a transverse and vertical motion. "S" waves cannot travel through the outer core because these waves cannot exist in it; water or molten rock.



### Surface waves

Topped near the Earth's surface, the earthquake's energy travels horizontally. The Rayleigh wave, shown above, has the same uniform properties of an ocean wave and can cause severe damage to larger structures.



# Measuring Quakes (3 ways)

- Mercalli Scale: uses roman numerals (I – XII), based on damage caused.
- Richter Scale: based on size of seismic waves. Size = “magnitude”
  - Each increment represents a power of 10
  - ex: magnitude 2 is 10X more than 1 Magnitude 3 is 100X more than 1



# High Risk Plates/Faults

- o In California, Pacific plate meets with North American plate
- o In Washington, the Juan de Fuca plate is being subducted by North American plate
- o In Alaska, the Pacific Ocean plate is being subducted.





# Risks

- o **Liquefaction** – when the soil beneath building acts like a liquid during an earthquake
- o **Aftershocks** – hours, days or months after a large quake (as opposed to a foreshock)
- o **Tsunami** – quake jolts deep ocean floor. Water displaced by quake can cause waves to form and spread in all directions.



