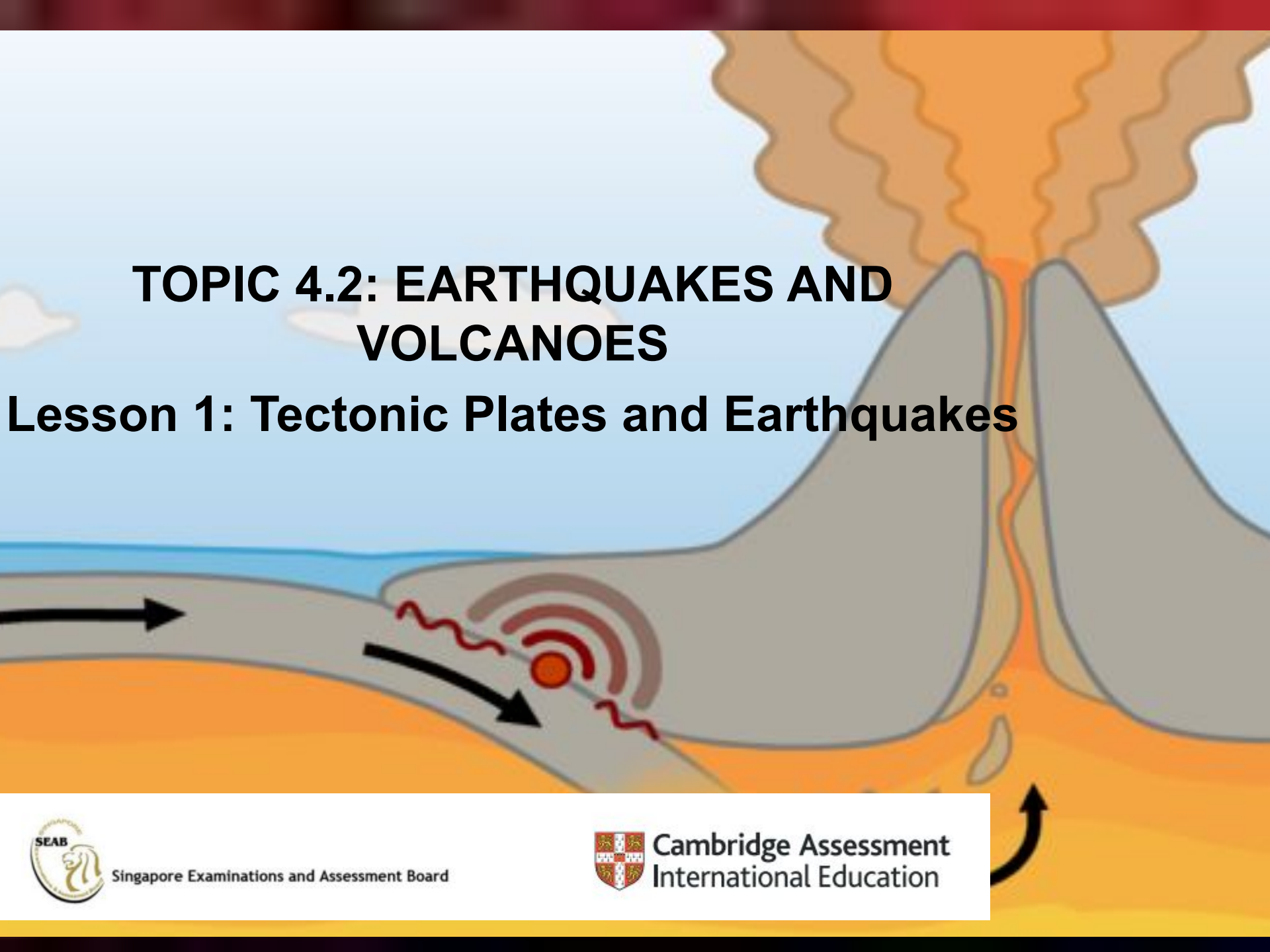


# TOPIC 4.2: EARTHQUAKES AND VOLCANOES

## Lesson 1: Tectonic Plates and Earthquakes



Singapore Examinations and Assessment Board



Cambridge Assessment  
International Education

# Lesson Objectives:

## 1. How do tectonic processes affect the magnitude of earthquakes?

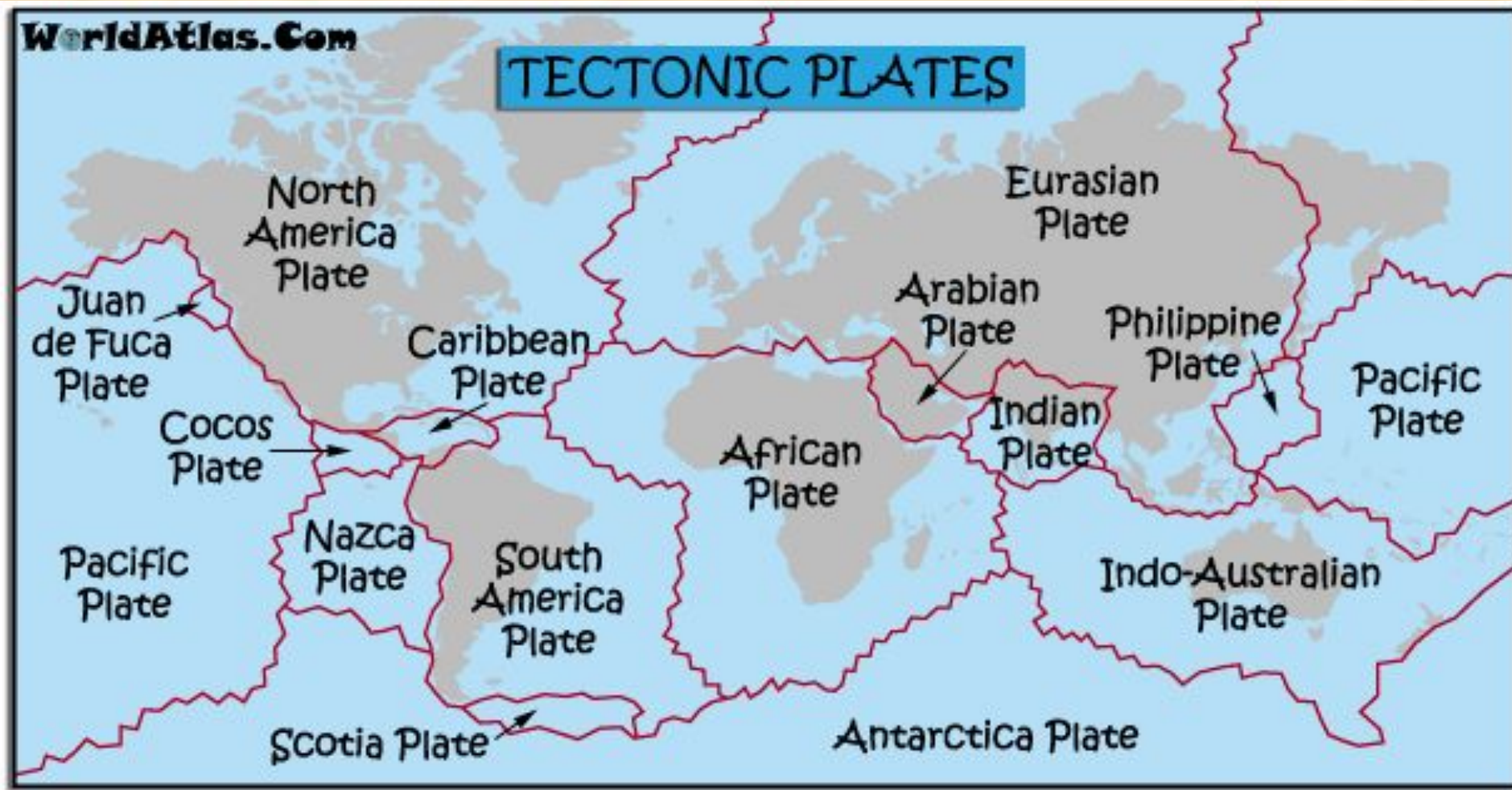
### TOPIC 4.2: EARTHQUAKES AND VOLCANOES

#### About this Topic

Plate movements resulting from Earth's internal processes explain why some locations in the world are prone to experiencing earthquakes and volcanic eruptions. Large-scale tectonic hazards could pose considerable danger to people living in hazard-prone areas, causing widespread destruction that results in the loss of lives and massive damage to property. Tectonic hazards can also affect the natural environment, destroying ecosystems, killing plants and animals. However, there are many advantages to living near volcanoes, which resilient communities can benefit from.

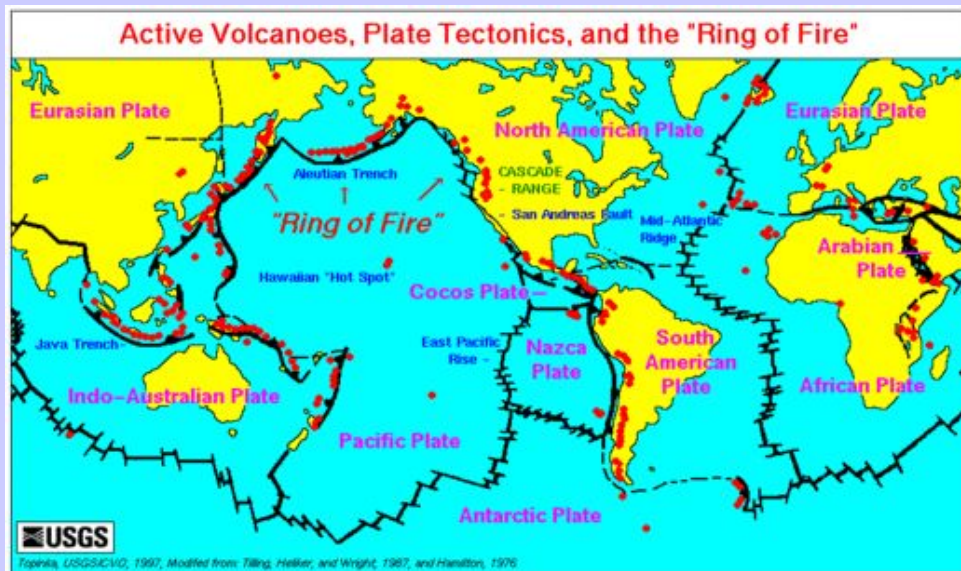
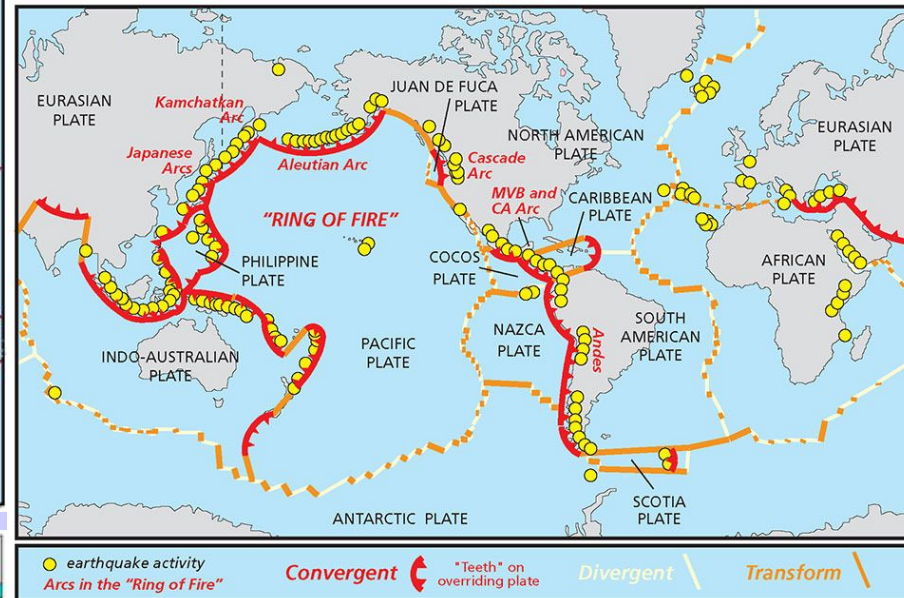
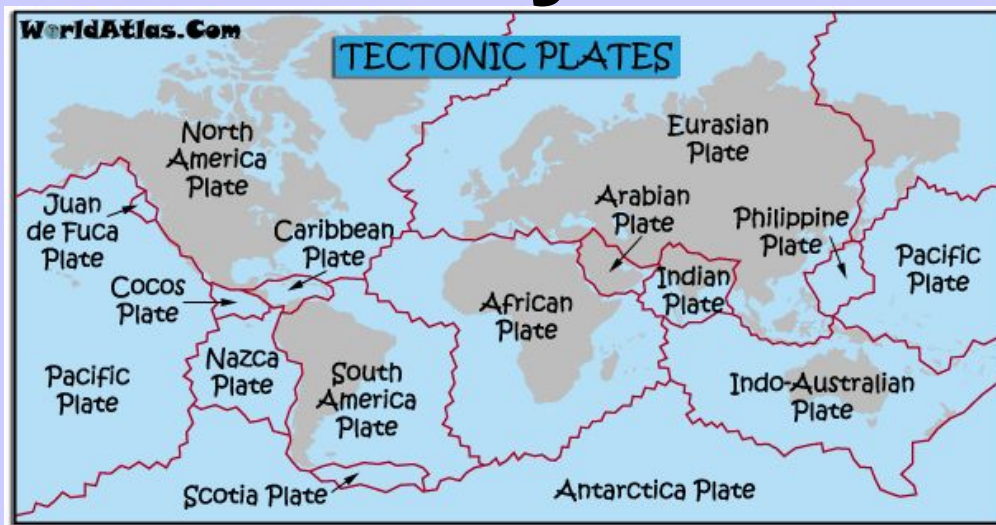
Key questions	Content
1 How do tectonic processes affect the magnitude of earthquakes?	<ol style="list-style-type: none"><li>1 Tectonic processes of earthquakes<ol style="list-style-type: none"><li>(a) stress builds up and exceeds strength of the fault</li><li>(b) sudden release of seismic waves, radiating energy from the focus</li></ol></li><li>2 Magnitude of earthquakes<ol style="list-style-type: none"><li>(a) affected by amount of energy released through ground movement</li><li>(b) recorded using seismometers</li></ol></li><li>3 Measuring earthquakes<ol style="list-style-type: none"><li>(a) Richter scale measures local magnitude of earthquakes</li><li>(b) Moment Magnitude scale measures larger earthquakes more reliably</li></ol></li></ol>

# Look at the tectonic plates





# After looking at those maps what can you conclude?



Earthquakes and volcanoes are found where plates interact, and occur due to plate movement.

# Earthquakes

1. Convection currents in the mantle move tectonic plates in the crust.
2. Plates (blocks of rock) slide past each other along fault lines.
  - a. Fault: a break in the Earth's crust.
3. Sometimes the plates get stuck, rocks under stress build up pressure and snap.
  - a. The ground vibrates.
    - i. These vibrations are known as Earthquakes.
    - ii. Earthquakes are occurring all the time.

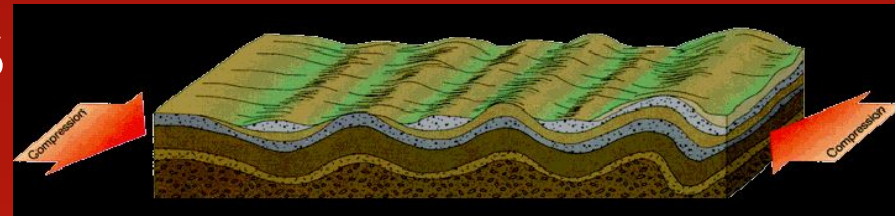


# ★ 3 Types of Stress

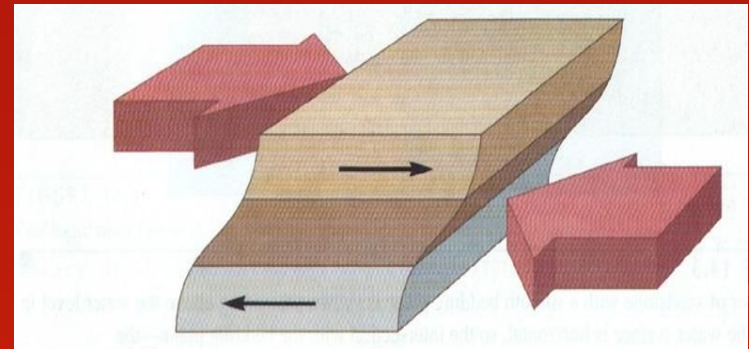
1. **Tension:** stretches rock, makes it thinner in the middle and breaks



2. **Compression:** squeezes rock together until it folds and breaks



3. **Shearing:** pushes rock in two different directions until it breaks



★ And what happens after the stress?

# A fault is produced

Faults are cracks or fractures in the Earth's crust along which movement has occurred.

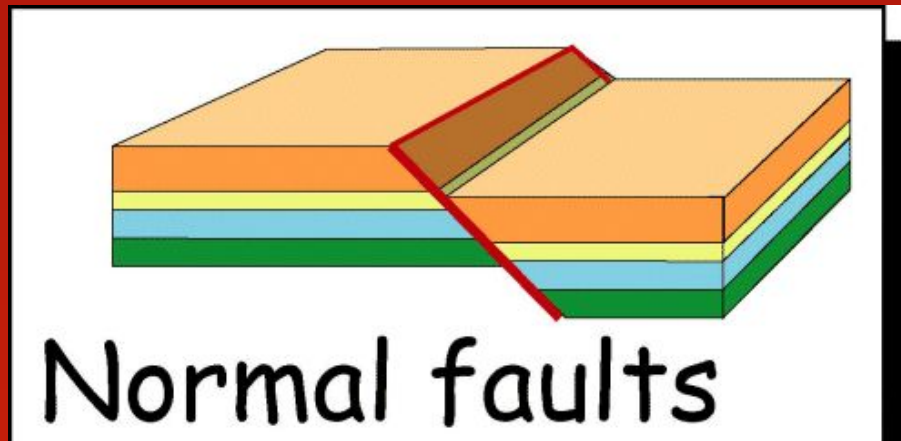
Three types of faults:

- Normal Faults
- Reverse Faults
- Strike-Slip Faults

# ★ Kinds of Faults

## 1. Normal faults

- fault at an angle
- walls move away from each other
  - rock above: footwall
  - rock moving down: hanging wall

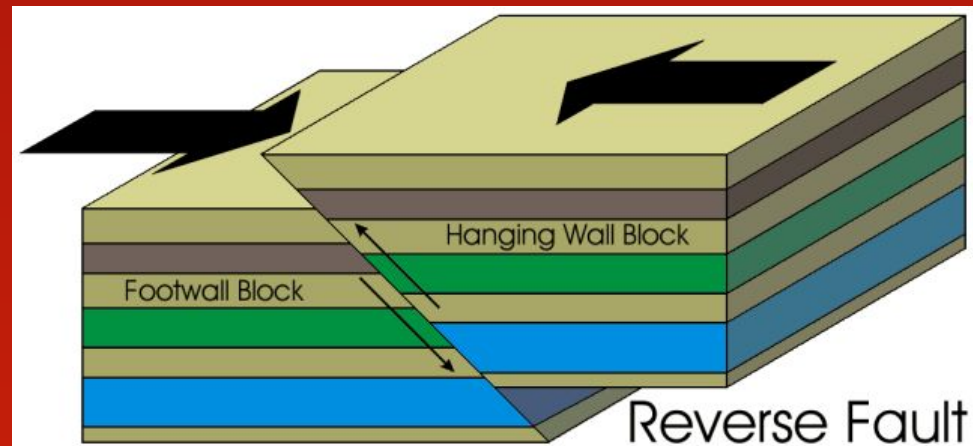




# ★ Kinds of Faults

## 2. Reverse Faults

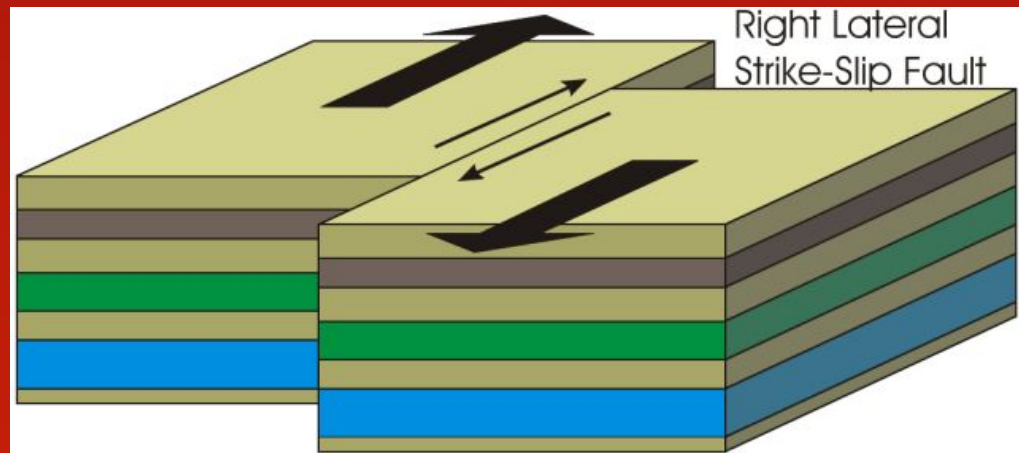
- fault at an angle
- walls move towards each other
  - rock moving above: hanging wall
  - rock below: footwall



# ★ Kinds of Faults

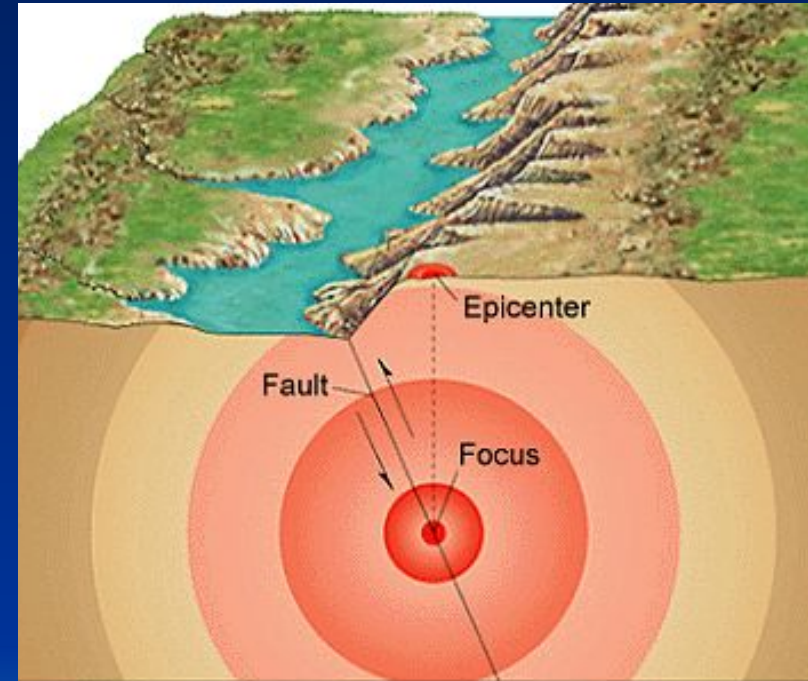
## 3. Strike-slip Faults

- plates moving past each other - Transform boundary
- little up or down motion



# Earthquake's Focus & Epicenter

- **Focus.** The focus is the underground origin of an earthquake.
  - Spot where rocks first break (fault)
- **Epicenter.** Ground directly above the focus, on the Earth's surface.
  - Earthquake waves reach the epicenter first.
  - During an earthquake, the most violent shaking is found at the epicenter.
- **Seismic waves** Vibrations in the ground
  - Carry energy from an earthquake away from the focus, through Earth's interior, and across the surface



# ★ Types of Seismic Waves

## **P Waves - Primary Waves**

- compress and expand the ground like an accordion
- damage buildings
- travels through both liquids and solids

## **S Waves - Secondary Waves**

- vibrate from side to side as well as up and down
- shake ground back and forth
- cannot travel through liquids





Seismic stations sense earthquakes, instantly gather and process data and, as part of a network, can relay warnings to the public.

**P** waves are the first to emanate from the source of an earthquake and are far less destructive than S-waves.

**S** waves the deadly, high-energy waves of an earthquake, travel at half the speed of P-waves.

Quake focus

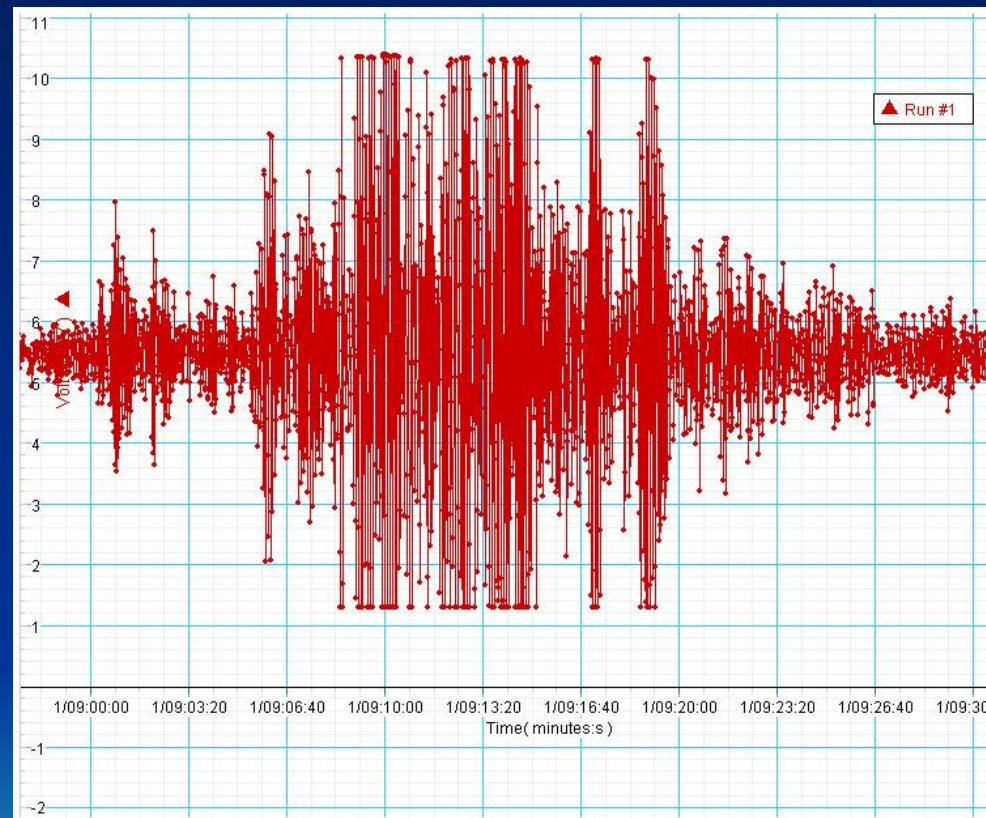
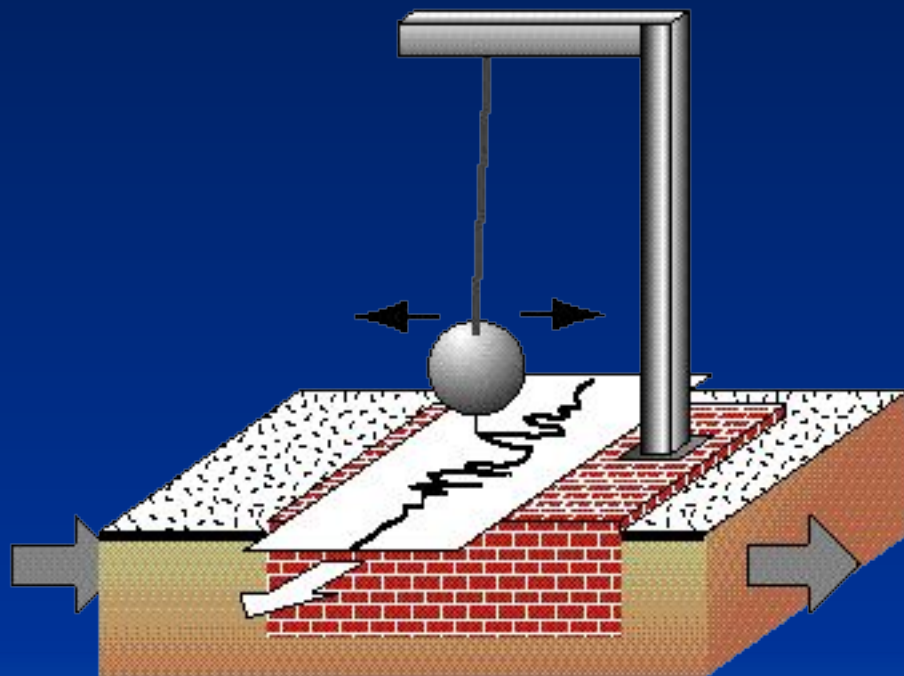


**How do we  
measure the  
intensity of an  
earthquake?**

Using a Seismograph  
which measures

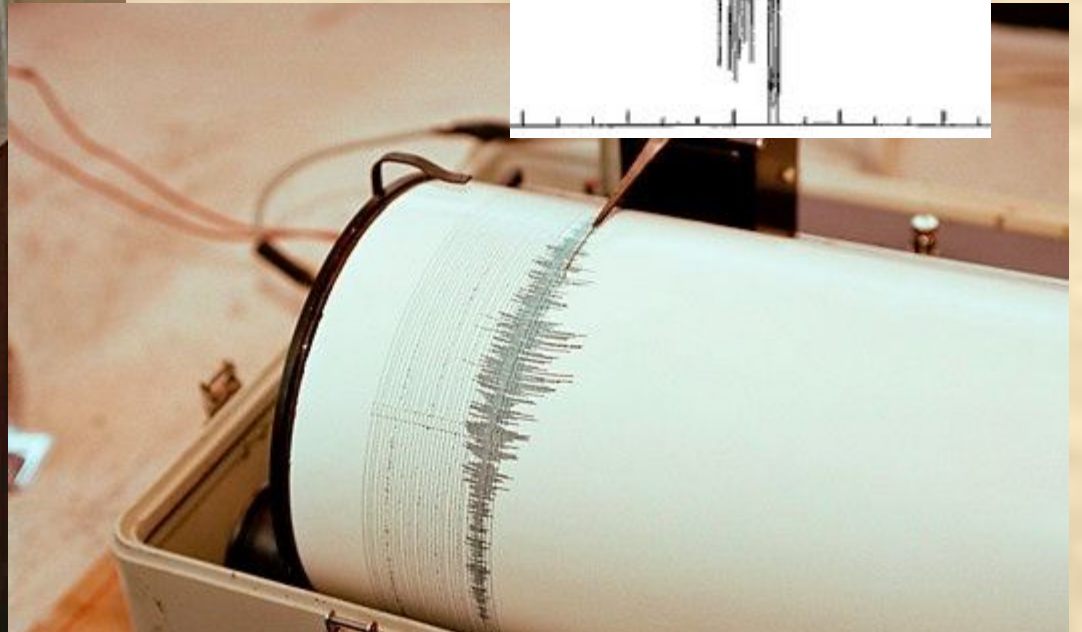
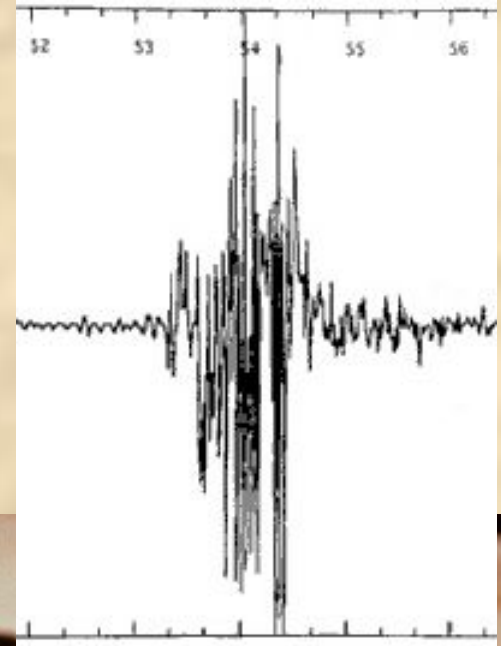
# Magnitude

or the strength of an  
earthquake





**Seismograph records “energy” waves called seismic waves of the earth**



# Seismologists

- Seismologists study earthquakes.
- They can determine the strength of an earthquake by the length of the wavy line recorded on paper.
- The record of waves that the seismograph makes is called a seismogram.
- 3 scales are used to calculate the strength (magnitude) of an earthquake.



# The Richter Scale

- Measures the energy released by an earthquake.
  - Magnitude: The measure of the energy released by an earthquake.
- The scale goes from 1.0 to 10.0.
- Each increase of magnitude by one whole number is ten times greater
  - Releasing 32 times more energy than the whole number below it.



# The Richter scale

Measures energy waves emitted by earthquake

0 - 1.9

Can be detected only by seismograph

2 - 2.9

Hanging objects may swing



3 - 3.9

Comparable to the vibrations of a passing truck



4 - 4.9

May break windows, cause small or unstable objects to fall

5 - 5.9

Furniture moves, chunks of plaster may fall from walls

6 - 6.9



Damage to well-built structures, severe damage to poorly built ones

7 - 7.9



Buildings displaced from foundations; cracks in the earth; underground pipes broken

8 - 8.9

Bridges destroyed, Few structures left standing

9 and over



Near-total destruction, waves moving through the earth visible with naked eye

260302

AFP



# How many earthquakes of each magnitude per year?

<b>Richter Magnitude</b>	<b>Number of Earthquakes per year</b>
<b>1.0 to 3.9</b>	<b>900,000 +</b>
<b>4.0-4.9</b>	<b>6200</b>
<b>5.0-5.9</b>	<b>800</b>
<b>6.0-6.9</b>	<b>226</b>
<b>7.0-7.9</b>	<b>18</b>
<b>8.0-8.9</b>	<b>Less than 2</b>



Alaska Earthquake 1964









