

201 GPH

Unit 4 (Review)

Q. How old is Earth?

A. Based on the radiometric age dating, Earth is 4.6 billion years old.

Q. How much is Earth's radius?

A. Earth radius is the distance from the Earth's center to its surface which is about 6371 km (3953 miles).

Q. What are the divisions of internal Earth?

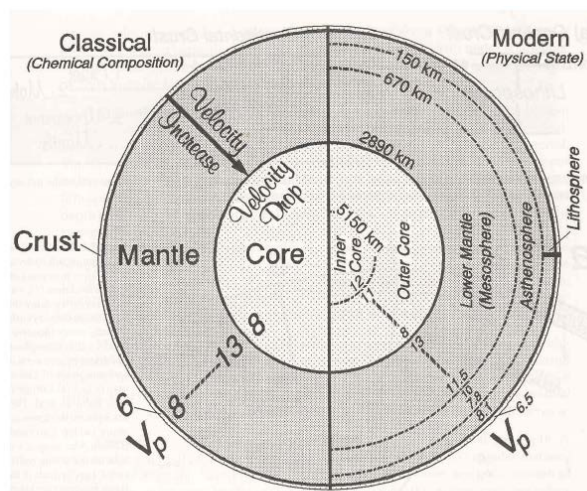
A. Earth inner structure can be subdivided according to:

1. Chemical composition: the chemical composition of earth materials.

1. Crust
2. Mantle
3. Core

2. Physical properties: how the rocks respond to increase temperature and pressure with depth.

1. Lithosphere
2. Asthenosphere
3. Mesosphere
4. Outer core
5. Inner core



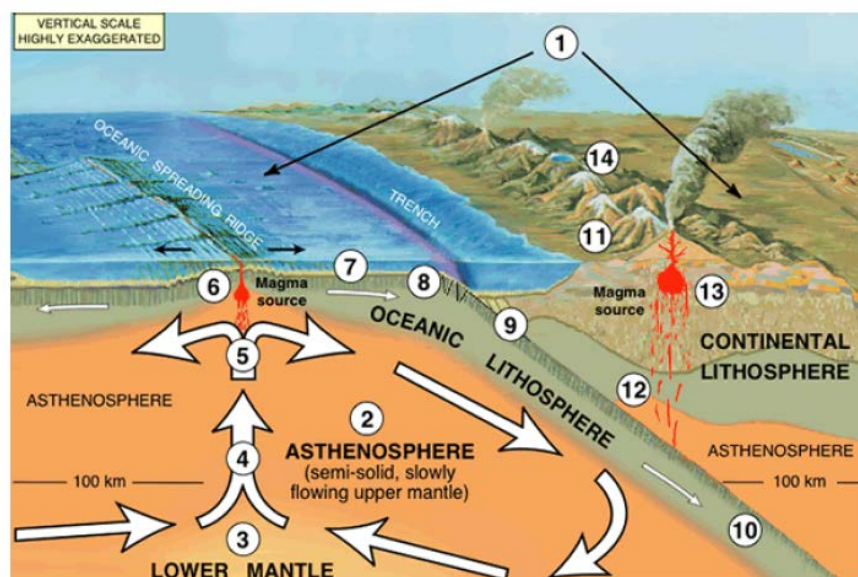
Q. What are the differences between continental crust and oceanic crust?

Continental Crust	Oceanic Crust
Thick crust (average 35-40 km)	Thin crust (roughly 7 km thick)
Less dense (2.7 g/cm ³)	More dense (3.0 g/cm ³)
Old (4 Ga years old)	Young (180 Ma years old)
Composed of granitic rocks	Composed of igneous rocks

Q. What is plate tectonics?

A. Plate tectonics is a theory that explains the following features on earth:

1. Formation of mountain belts, volcanoes, and ocean basins.
2. Locations of volcanoes, faults, earthquakes, and mountain building.
3. Ocean floor features.
4. The continuing development of Earth's surface.
5. The distribution of past and present life on earth.



Q. What is the concept of plate tectonics?

A. The outer core of the earth is made up of about 20 distinct plates (~ 100 km thick) which move relative to each other. This motion is what causes earthquakes and makes mountain ranges.

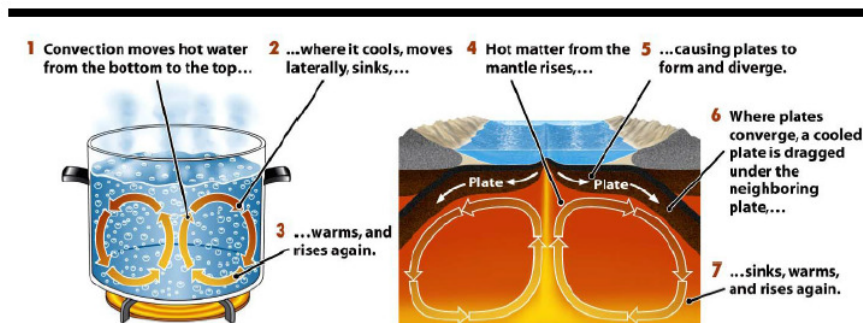
Q. What are the processes of plate tectonics?

A. Convection currents coming from the upper mantle.

Convection

On the stove

In the mantle

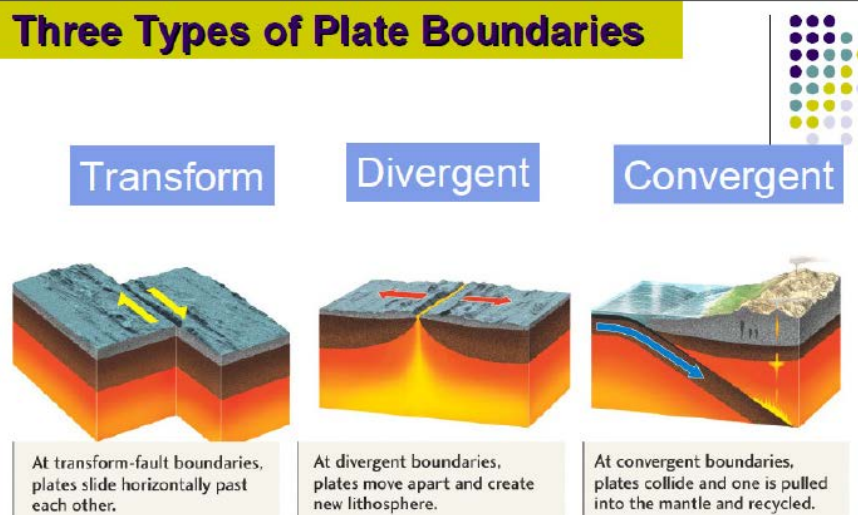


Q. What are the types of plate boundaries? Give examples?

A. There are three types of plate boundaries:

1. Divergent: Mid-Atlantic Ridge and East African Rift Valley.
2. Convergent:
 1. Ocean-ocean: Marianas Trench and Mariana Islands.
 2. Ocean-continent: Peru-Chile Trench.
 3. Continent-continent: Himalaya
3. Transform: San Andreas fault.

Three Types of Plate Boundaries



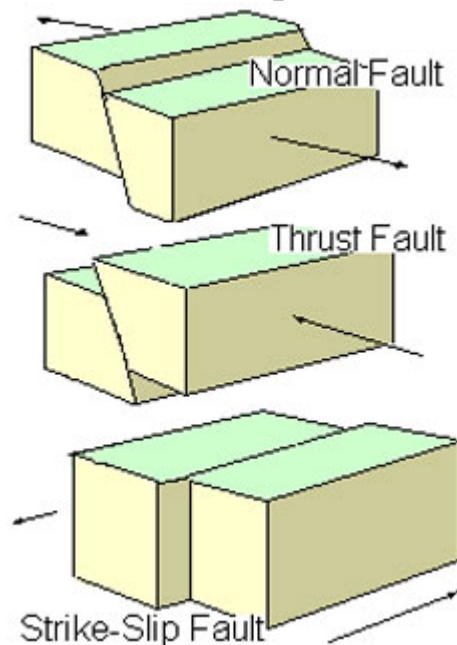
Q. What is a fault?

A. A fault is a fracture or zone of fractures between two blocks of rock. Faults may range in length from a few millimeters to thousands of kilometers. The fault surface can be horizontal or vertical or in between.

Q. How many types of faults there are?

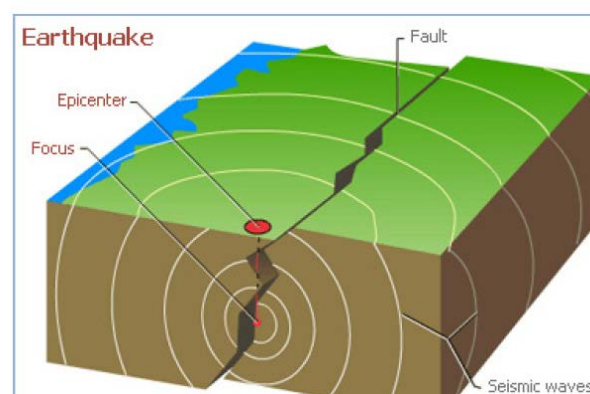
A. There are three types of faults:

1. Normal: The hanging wall moves downward relative to the footwall.
2. Thrust: The hanging wall moves upward relative to the footwall.
3. Strike-slip: the two blocks slide past one another.



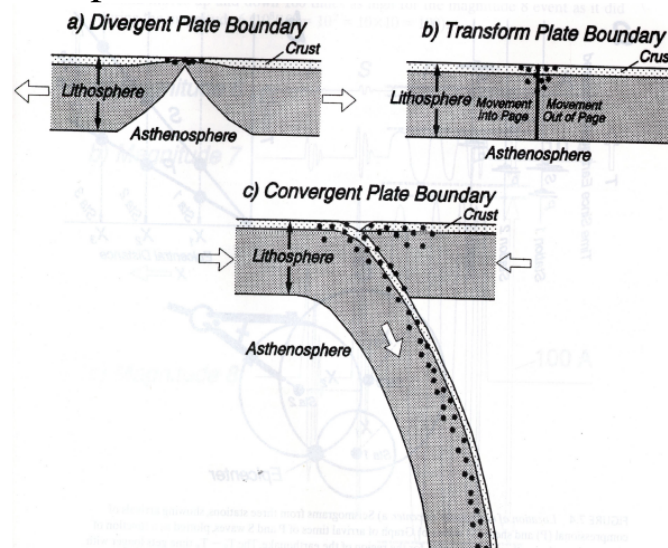
Q. Why do earthquakes occur?

A. Earthquakes are usually caused when rock underground suddenly breaks along a fault. This sudden release of energy causes the seismic waves that make the ground shake



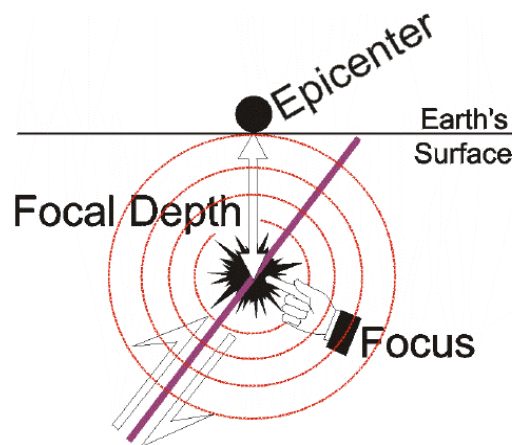
Q. Where do earthquakes occur?

A. At all types of plate boundaries.



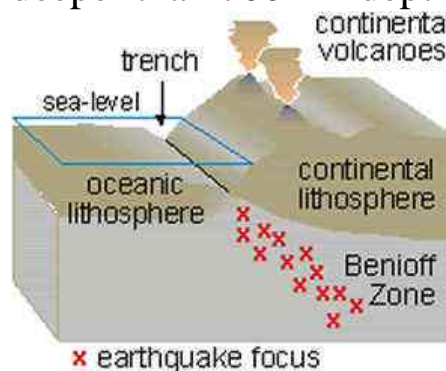
Q. What are the differences between focus and epicenter?

A. Focus: is the actual point of rupture within the earth.
Epicenter: is the point on Earth's surface directly above the focus.



Q. What is Wadati-Benioff Zone?

A. It is a deep active seismic area in a subduction zone. There are no earthquakes deeper than 700 km depth.



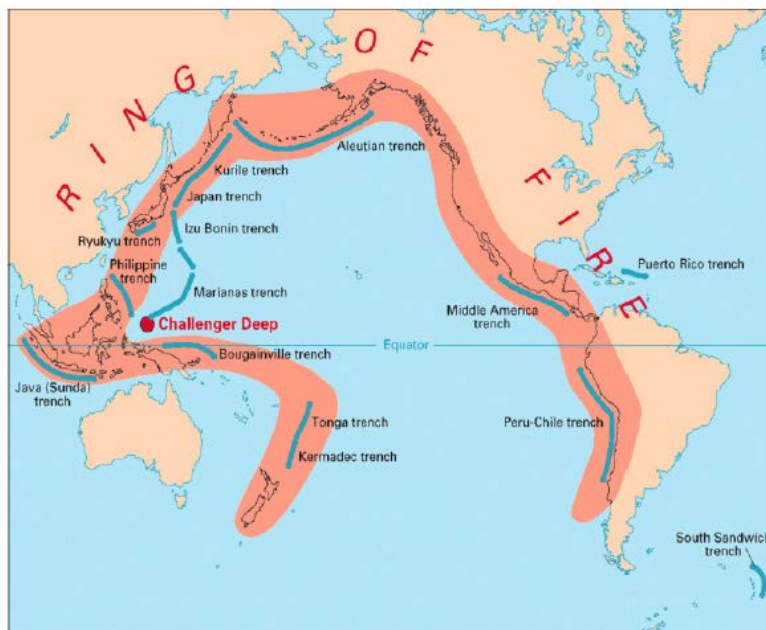
Q. What are the types of earthquakes?

A. There are four types of earthquakes:

1. Tectonic earthquakes.
2. Volcanic earthquakes.
3. Collapse earthquakes.
4. Explosion earthquakes.

Q. What is Ring of Fire?

A. The Ring of Fire is an area where a large number of earthquakes and volcanic eruptions occur in the basin of the Pacific Ocean. About 90% of the world's earthquakes and 81% of the world's largest earthquakes occur along the Ring of Fire.



Q. What are the depths of earthquakes?

A. Depth of earthquakes are three types:

1. Shallow earthquakes (0-70 km).
2. Intermediate earthquakes (70-300 km).
3. Deep earthquakes (300-700 km).

Q. What is earthquake intensity?

A. It represents the degree of shaking at a particular location on the earth's surface.

Q. What is the scale of intensity?

A. Modified Mercalli Scale (12 degrees) ranging from I to XII.

Q. What is earthquake magnitude?

A. It is the amount of energy released by the earthquake.

Q. What is the scale of magnitude?

A. Richter Scale ranging from 1 to 10.

Q. What are types of magnitudes?

A. There are two types of magnitudes:

1. Body wave magnitude (m_b)

Body wave magnitude (m_b) depends on the amplitude of a particular P or S wave :

$$m_b = \log_{10} (A/T) + \alpha$$

where :

m_b - body wave magnitude

A- ground displacement in microns (10-6m)

T-period of selected(P or S) wave in seconds

α -factor correcting the epicentral distance, focal v depth, and type of wave

2. Surface wave magnitude (M_s)

Surface wave magnitude (M_s) is a function of the observed amplitude of Rayleigh waves :

$$M_s = \log_{10} A + 1.656 \log_{10} \Delta + 1.818$$

where :

M_s - surface wave magnitude

A- Amplitude of horizontal component of 20s period Rayleigh wave

Δ - Epicentral distance in degrees period of selected surface wave

Body and surface wave magnitudes are related by the relationship :

$$m_b = 0.56 M_s + 2.9$$

Q. How can we calculate the energy of earthquake (E)?

Energy of earthquakes (E)

The energy released by an earthquake (**E**, in units of Joules) relates to the surface wave magnitude M_s :

$$\log_{10} E = 5.24 + 1.44 M_s$$

or :

$$E = 10^{(5.24 + 1.44 M_s)}$$

Q. How can we calculate moment of magnitude?

Moment magnitude

For very large earthquakes, M_b and M_s saturate: amplitudes cease to increase dramatically with increasing energy. It is more useful to use moment magnitude (M_w)

$$M_w = [(\log_{10} M_o) / 1.5] - 10.73$$

where :

$$M_o = (A)(u)(\mu)$$

represents seismic moment

A -area of fault that ruptures during earthquake

u -average displacement across the fault during earthquake

μ -shear modulus (rigidity) of the rock