Interior Structure of the Earth

Structure of the Earth

Crust

- The crust is the outermost brittle solid part of Earth ranging from 5 – 70 km.
- The Crust can be divided into:

1. Continental Crust: Mean thickness is around 30 km, made of SIAL (Silica and Aluminium) and is thicker than oceanic crust. Its density is around at 2.7 g/cm^3
2. Oceanic Crust: Mean thickness is around 5 km made of SIMA (Silica and Magnesium). Oceanic crust is *basaltic* in origin and relatively of a *younger age* than the continental crust. The basaltic crust is denser at 3.0 g/cm^3

Mantle

- They extend up to 2890 km.
- **Asthenosphere:** The upper portion of the mantle which extends up to around 400 km and the main source of Magma.
- The density of mantle is 3.4 g/cm^3
- The lower mantle is in solid-state which extends up to the Core-Mantle boundary. This layer is called as the D″ (pronounced dee-double-prime) layer.

Note:

- The Crust and Upper part of Mantle combined called as Lithosphere.

Core

- The Core extends to 2870 – 6370 km.
  It is divided into
  0. Liquid Outer Core
  1. Solid Inner Core: Made of NIFE – Nickel and Ferrous.

Note: Inner core rotates slightly faster than the rest of the planet.

- The density at the outer core is at 5.5 g/cm^3 which increase to 13 g/cm^3 in the inner core.

Note:

Dynamo theory: It suggests that convection in the outer core, combined with the Coriolis effect, gives rise to Earth's magnetic field.

Schematic sections through the Earth:

- Continental crust
- Oceanic crust
- Upper mantle
- Lower mantle
- Outer core
- Inner core

Boundaries in the Earth's interior

Conrad Discontinuity: Between Upper and Lower Continental Crust.

Mohorovičić discontinuity, "Moho": Crust-Mantle boundary

Gutenberg discontinuity: Core-Mantle boundary

Lehmann discontinuity: Boundary between Outer and Inner Core By Kelvinsong - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=23966175

Important Facts

- Earth's radius: 6370 km.
- Earth diameter: about 12756 km at equator &
  about 12715 km at the poles.
- Crust: 0.5 % of the volume of the Earth
  Mantle: 83 % of the volume of the Earth
  Core: 16 % of the volume of the Earth
- Temperature, Pressure and Density increases with the increasing distance from the surface to the interior in deeper depths
- Gravitation force is greater near the poles and lesser near the equator
- Gravity anomaly is the difference in gravity value according to the mass of the material

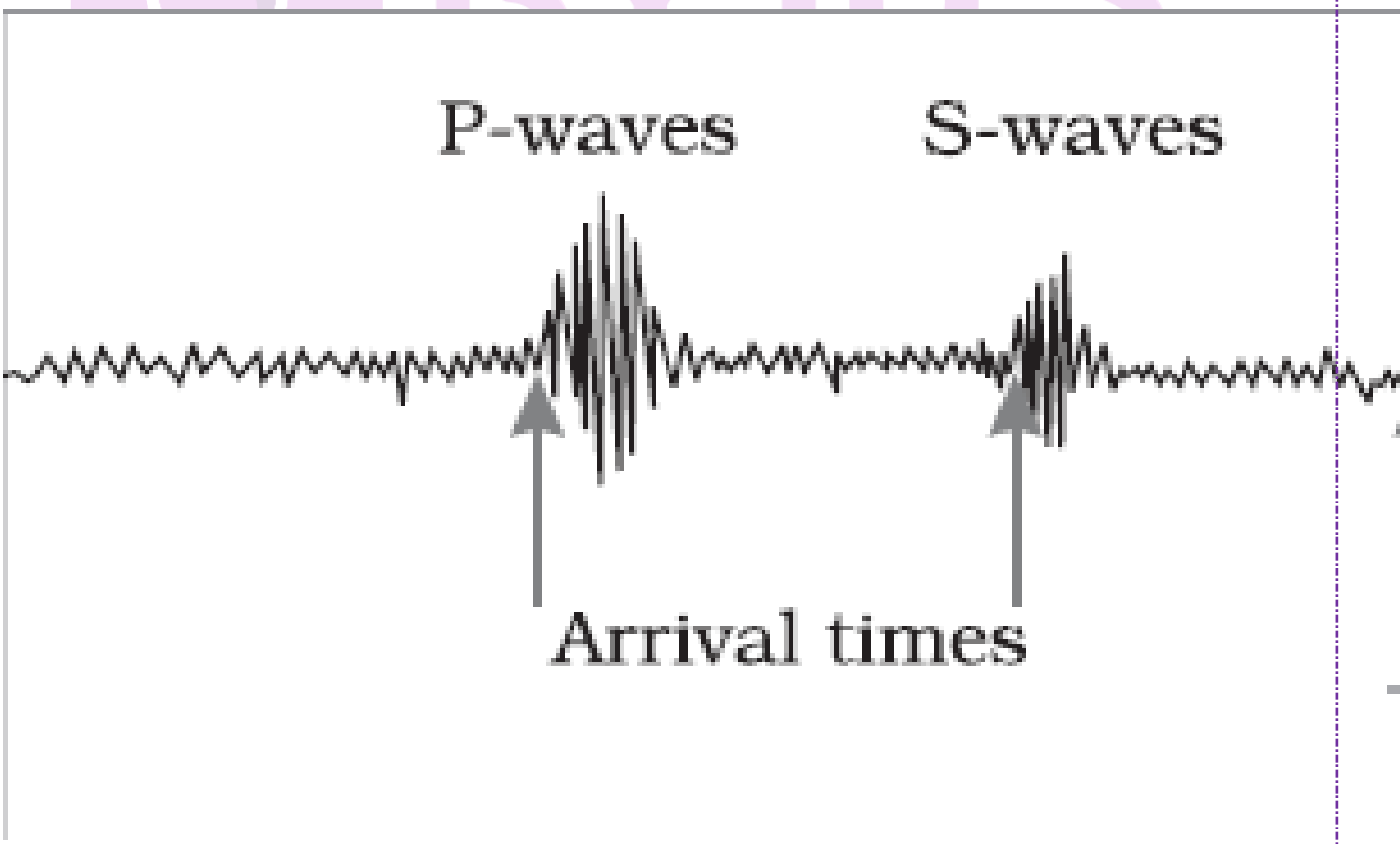
Earthquake

- It is a shaking of the Earth which is caused due to the release of energy along a fault line.

- ***Hypocentre or Focus:*** The point where the energy of an earthquake is released
- ***Epicentre:*** It is the point on the surface, directly above the focus, the first one to experience the waves.

Earthquake waves are divided into

- Body waves: created due to the release of energy at the Hypocentre (focus). These waves travel in all directions through the body of the earth. It can be divided into:
    0. P-waves: They are called Primary waves. They move faster and are first to arrive at the surface. They are similar to sound waves and can travel through Solid, Liquid and Gaseous materials. P waves vibrate *parallel* to the direction of the wave which causes stretching and squeezing of the material
    1. S-waves: They are called Secondary waves which arrive at a time lag with Primary waves. They can travel *only* through solid materials. S-waves vibrate in *perpendicular* to the wave direction which creates crests and troughs.



- Surface waves: the body waves interact with the surface rocks and generate surface waves which move along the surface rocks. They are the *last* to report on the Seismograph and are the most *destructive* They cause displacement of rocks and structural collapse. Surface waves vibrate *perpendicular* to the wave direction.

The velocity of the waves is directly proportional to the density of the material through which they travel. Differing density leads to reflection or refraction of the seismic waves.

Shadow Zone

Shadow zones are those specific areas where seismic waves are not reported. These zones are distinct for P and S-waves.

- Within the distance, up to 105° from epicentre has recorded the arrival of both waves.
- The zone between 105° - 145° from the epicentre is identified as a shadow zone for both types of waves (P & S).
- Beyond 105° Zone does not receive S-waves. **Thus the shadow zone of S-wave is much larger than P-wave.**
- P-wave appears after 145° from the epicentre.

Types of Earthquake

- **Tectonic**: They are caused due to the sliding of rocks along a fault plane.
- **Volcanic:** they are confined to areas of active volcanoes. They are caused due to the explosion of volcanos and the corresponding tectonic disturbances.
- **Collapse**: they are caused in areas of intense mining activities where the roofs of underground mines collapse causing minor tremors
- **Explosion:** they are caused due to the explosion of chemical or nuclear devices.

Important facts

- A seismograph is an instrument that records the waves reaching the surface.
- Richter Scale: it is known as *Magnitude* scale as it measures the energy released during the quake. It is expressed in absolute numbers 0-10.
- Mercalli Scale: it is called an *Intensity* scale as it measures the visible damage caused by the earthquake. The range is from 1 – 12.

Tsunami

- These are long-wavelength, long-period sea waves or tidal waves produced by the sudden or abrupt displacement of large volumes of water (including when an earthquake occurs at sea.)
- The effect of Tsunami would occur only if the epicentre of the tremor is below oceanic waters and the magnitude is sufficiently high.

Effects of Earthquakes

- Ground Shaking
- Differential ground settlement
- Land and mudslides
- Soil liquefaction
- Ground lurching
- Avalanches
- Ground displacement
- Floods from the dam and levee failures
- Fires
- Structural collapse
- Falling objects
- Tsunami

Global warming and Earthquakes

- In recent research, geologists claim that global warming is one of the reasons for increased seismic activity.
- Reason: Melting glaciers and rising sea levels disturb the balance of pressure on Earth's tectonic plates which causes an increase in the frequency and intensity of earthquakes.