# 9th Social Science Lesson 19 Notes in English

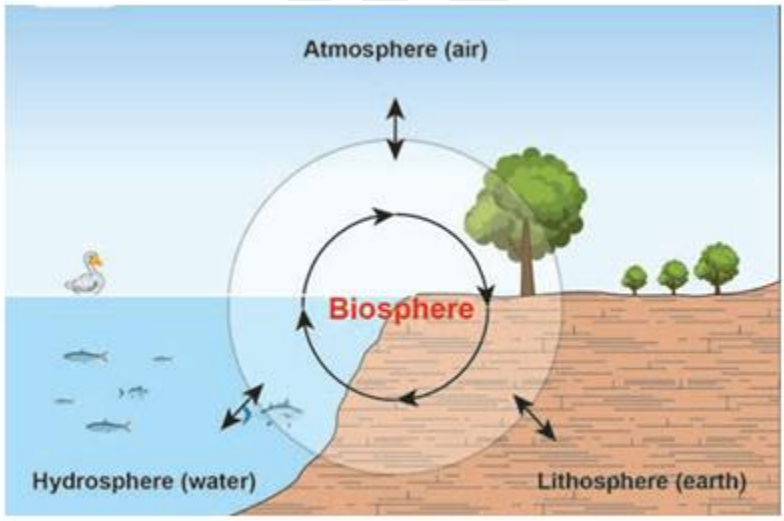
## 19] Lithosphere – I Endogenetic Processes

### Introduction

- The Earth is a unique planet of **the Solar family**.
- The Earth is composed of four spheres namely, the lithosphere, the atmosphere, the hydrosphere and the biosphere.
- This lesson focuses on the internal processes of the Earth.
- The sequence of lessons generally follows the spheres of the Earth system in a comprehensive manner.
- Have you ever wondered what our Earth is made up of? Or what lies underneath the Earth's surface?

### Spheres of the Earth

- Earth's surface is a vast area of 510 million sq.km, where four spheres of the Earth interact.
- The abiotic spheres are the lithosphere, atmosphere and hydrosphere.
- The biotic sphere is the biosphere. Together, these spheres constitute the planet, Earth.

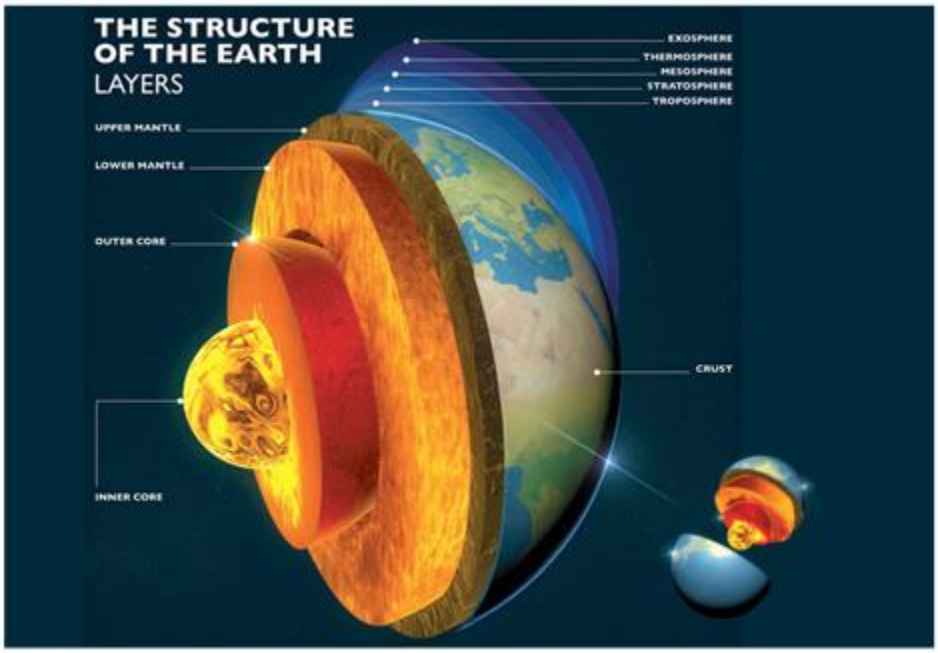



Spheres of the Earth

### Structure of the Earth

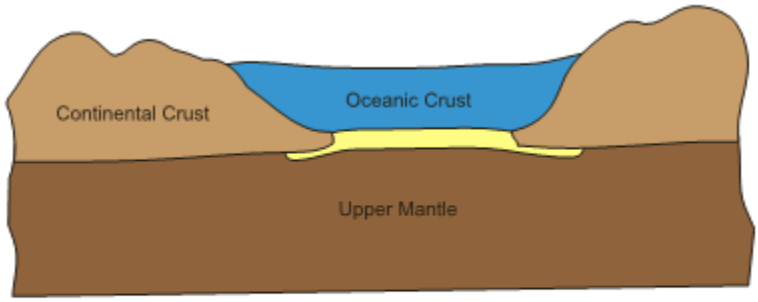
- The outer surface and inner core of the Earth are totally different in their nature and structure.
- The structure of the Earth's interior is divided into three layers namely **the crust, the mantle** and **the core.**
- "The Earth can physically be described as a ball of rock (the lithosphere), partly covered by water (the hydrosphere) and wrapped in an envelope of air (the atmosphere).

- To these three physical zones it is convenient to add a biological zone which includes all the living organisms (the biosphere)." **Arthur Holmes**
- The lithosphere is the solid outer part of the Earth.
- The atmosphere is a thin layer of gases that surrounds the Earth.
- The hydrosphere is the watery part of the Earth's surface including oceans, rivers, lakes and water vapour
- The biosphere is the layer of Earth where life exists.
- The terms **'lithosphere'** and **'crust'** are not the same.
- The lithosphere includes the crust and **the uppermost part of the mantle**.
- All terrestrial planets have lithosphere.
- The lithospheres of Mercury, Venus, and Mars are much thicker and more rigid than that of the Earth.




**Crust**

- Crust is the outer layer of the Earth, where we live. It is the skin of our Earth, which ranges between 5 to 30 km.
- It is the solid and rigid layer of the Earth.
- The thickness of the crust is greater below the continents than the ocean floor.
- The crust is classified as **continental crust** and **oceanic crust.**
- The major elements of crust **SIAL** are Silica (Si) and Aluminium (Al) and SIMA (Si - Silica and MA - Magnesium)




Continental Crust is made up of SIAL and Oceanic Crust is made up of SIMA

**Mantle**

- The interior part beneath the crust is called **mantle**, which is about 2,900 km thick.
- In the upper part of the mantle, the rock remains solid, whereas in the lower part of the mantle, **rocks are in molten form.**
- This molten rock inside the Earth is called **'magma'**.

**Core**

- The core is **the innermost** and **hottest layer of the Earth** which lies below the mantle. It is composed mainly of **Nickel (Ni) and Iron (Fe).**
- Hence it is called **NIFE**. The core is divided into Solid inner core and Liquid outer core.
- The presence of large quantities of iron in the core is responsible for the Earth's gravitational force.
- As the Earth rotates on its axis, the liquid outer core spins over the solid inner core and generates **the Earth's magnetic field.**
- This is responsible for the functioning of the magnetic compass.
- Due to high pressure, the materials in the inner core are unable to move and hence remain solid.

**Rocks**

- **The crust** is a storehouse of rocks.
- An aggregate of minerals on **the Earth's crust** is called **'rock'**.
- It may be hard and compact like **'granite'** or soft as **'clay'** or loose as **'sand'**.

**Types of Rock**

- Based on formation, rocks are classified as:
- **Igneous**,
- **Sedimentary and**
- **Metamorphic**.

### Fact

- The ancient city of Petra in **Jordan** is an example of an entire city carved out of rocks.
- There are many specimens of magnificent rock-cut architecture in India, like the Ajanta and Ellora caves in Maharashtra, the Aihole and Badami temples in Karnataka, the Konark temple in Odisha and Mamallapuram in **Tamil Nadu.**

### Igneous Rocks

- The word **'igneous'** is derived from the Latin word Ignis meaning **'Fire'**.
- The interior of the Earth contains very hot molten material called **'Magma'**.
- When the magma reaches the Earth's surface, it is referred to as **'Lava'**.
- The lava on the surface cools down and gets solidified as rocks called **igneous rocks.**
- Granite and basalt are examples of such rocks.
- Igneous rocks are also called **Primary** or **Mother rocks** because all other rocks are directly or indirectly formed from them.

### Sedimentary Rocks

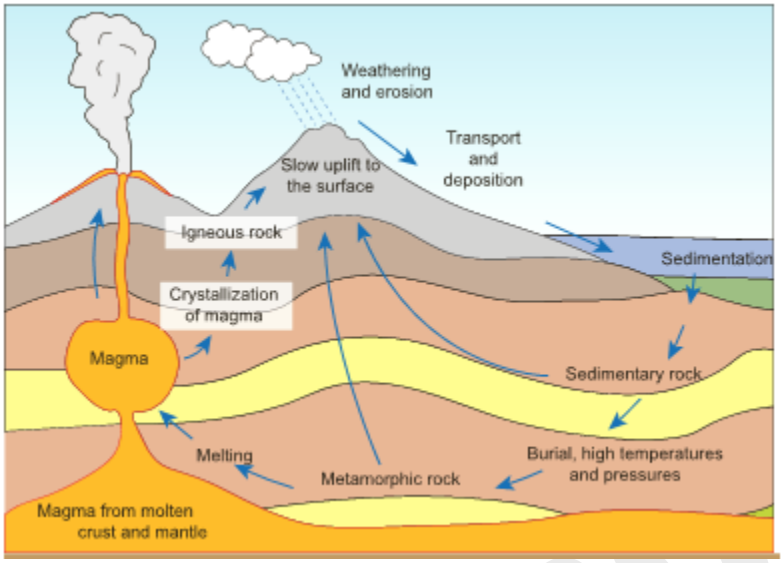
- These sedimentary rocks are named after the latin word **'sediment'** meaning ' **settle**.
- Rivers, glaciers and winds carry bits of rock and soil and deposit them in layers.
- After a few million years, these deposits harden into **compact rocks** and are called **Sedimentary rocks.**
- The bodies of plants and animals that fall on the deposits get embedded in the layers and form **Fossils**.
- Sandstone, limestone, chalk, gypsum, coal and conglomerate are examples of sedimentary rocks.

### Metamorphic Rocks

- The term **'metamorphic'** is derived from the word **'metamorphosis'**, which means, **'change of form'**.
- When igneous or sedimentary rocks are subjected to extreme heat and pressure, they undergo a complete change in their form and character .i.e., in course of time, granite may get transformed to gneiss, basalt to schist, limestone to marble and sandstone to quartzite.

### Rock Cycle

- The Rock cycle is a continuous process through which **igneous, sedimentary** and **metamorphic rocks** are transformed from one form to another.




**Geomorphic Processes**

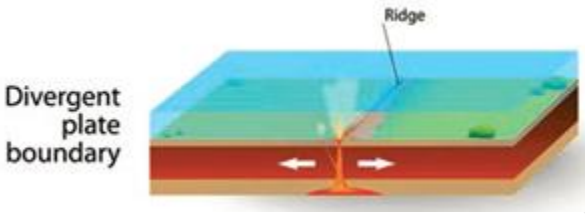
- The forces that act from the Earth's interior towards the Earth's surface are called **Internal processess** or **Endogenetic processes**.
- These forces build **the landscape** and create **topographic relief.**
- The forces that act on the surface of the Earth due to natural agents like running water, glacier, wind, waves etc. are called **External processes** or **Exogenetic processes**.
- These external processes tear the landscape down into relatively low elevated plains and shapes the landform created by Endogenetic process.

**Internal Processes**

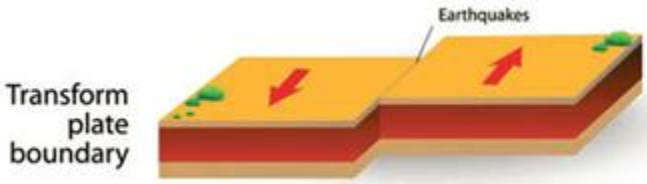
- The internal processes **generate heat** and **eject materials** from deep below the Earth's crust.
- **Internal radioactivity** is the principal source of power for this process.

**Plate Tectonics**

- The lithosphere is divided into a number of huge slabs of rocks called **'Tectonic plates.'**
- These tectonic plates are divided into **major** and **minor plates.**
- These plates float independently over the mantle.
- **Collisions of these plates** produce mountain ranges and other irregular surface features, both on land and the ocean floor.
- This phenomenon is called **'plate tectonics'**.
- The movement of tectonic plates is due to thermal energy from the mantle.
- Now we have a better understanding about the plate movements and its relation to Earthquake and volcanic activities.
- Types of **Plate Boundaries Convergent Boundary** - Here the plate moves toward each other and sometimes, a plate sinks under another.


- The location where the sinking of a plate occurs is called a **subduction zone** (eg) **Fold Mountain-Himalayas.**
- **Divergent Boundary** – Here the plates pull away from each other as magma pushes up from the mantle (eg) Mid Atlantic Ridge
- **Conservative/Transform Boundary** – Here the plates slide horizontally past each other. (eg) San Andres Fault.




**Movements of Continental Plates**

- Due to lateral compressional forces, the plates are forced to move upwards and downwards. This is called **'Folding'**.
- Mountains formed by folding are called **fold mountains**.
- The process of folding creates lofty mountain ranges such as **the Himalayas** and **the Alps** According to plate tectonics, the plates are in constant motion with an average rate of few centimetres per year.
- The movement might seem slow, but over millions of years, the plates and the continents riding on them move a long way.
- For example, about 250 million years ago, the Indian Plate was a part of **the Gondwana land**, which comprised of modern Africa, Australia, Antarctica, and South America.
- Approximately 140 million years ago, the Indian plate broke away from the ancient super continent **'Gondwana'** and began moving north and collided with Asia.
- The collision with **the Eurasian Plate** along the boundary between India and Nepal formed **the Orogenic belt** that created **the Tibetan Plateau** and the mighty Himalayan Mountains.

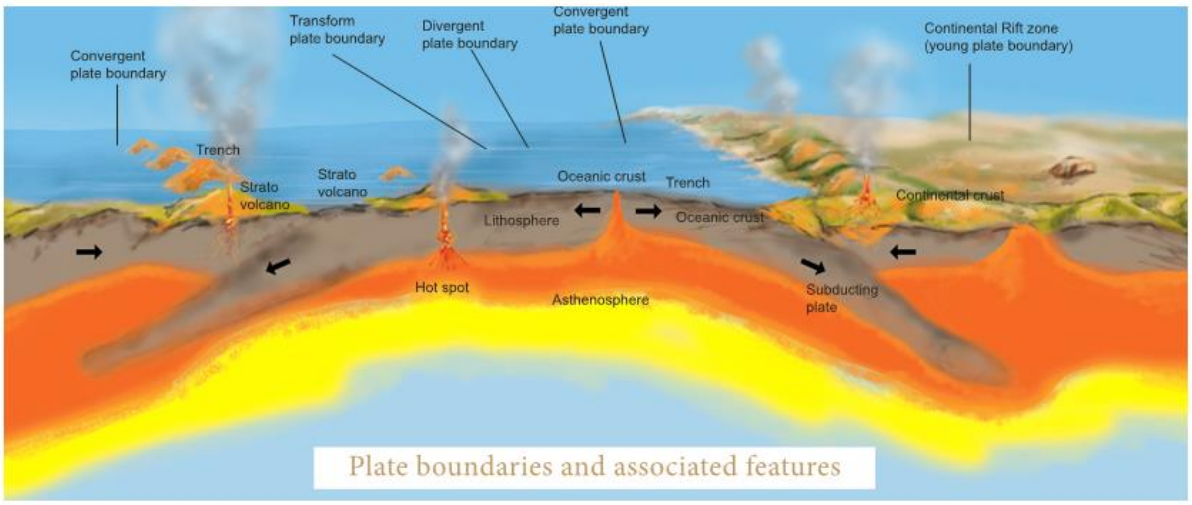
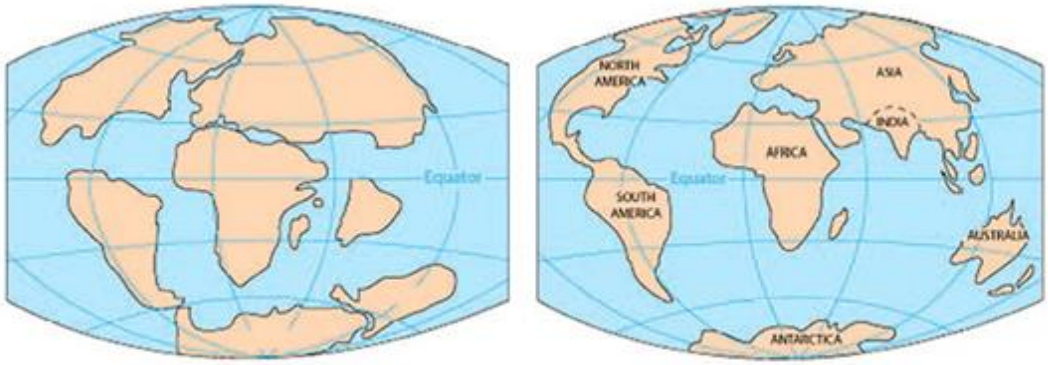
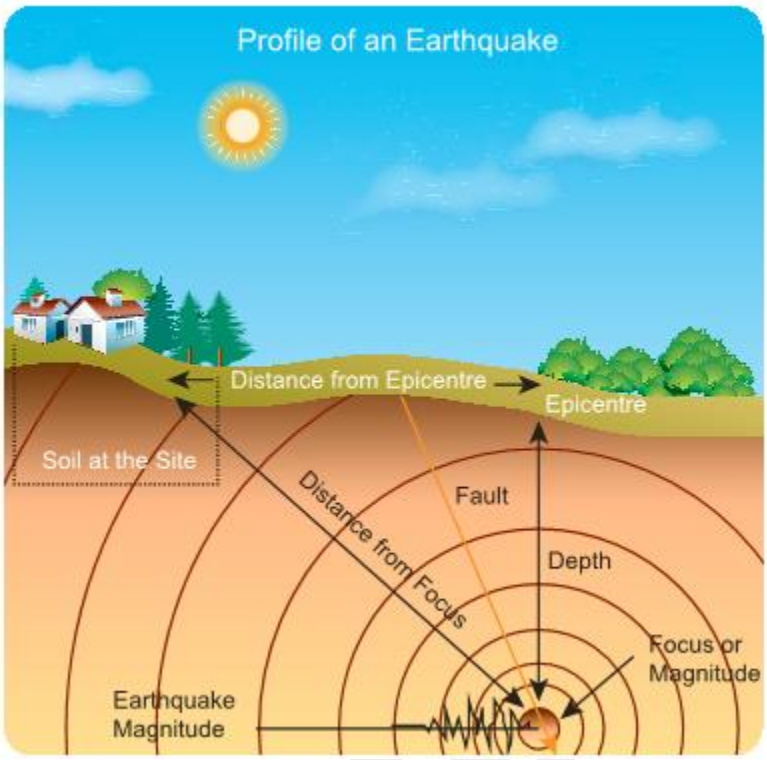


Plate boundaries and associated features


## Earthquake

- Earthquakes are generally caused by **the sudden vibrations in the Earth's crust,** which spreads outward in all directions as waves from the source of disturbance.
- The point of origin of an Earthquake is called **'Focus'** (Hypocenter) which generates a series of elastic waves.
- **'Epicentre'** is a point on the Earth's surface that lies directly above the focus.
- The impact of the Earthquake is felt the most at the epicentre.




**Seismic Waves**

- Earthquakes generate **seismic waves.**
- The nature, force and speed of these seismic waves depend on the nature of the medium through which it passes.
- Accordingly, there are three major types of waves.
- **Primary or P-waves** are the fastest of all the Earthquake waves and the first to reach the epicentre.
- These waves pass through solids, liquids and gases, either through push or pull with an average velocity of 5.3km per second to 10.6 km per second.
- **Secondary or S-waves** travel only through solids.
- These transverse waves shake the ground perpendicular to the direction in which
- they propagate.
- The average velocity of these waves is 1Km per second to 8 km per second.
- **Surface Waves (or) L-waves** are similar to **P-waves** but they travel primarily along the ground surface.
- These waves travel comparatively slower and are the most destructive waves.
- The average velocity of these waves are 1 km per second to 5 km per second.

**Tsunami**

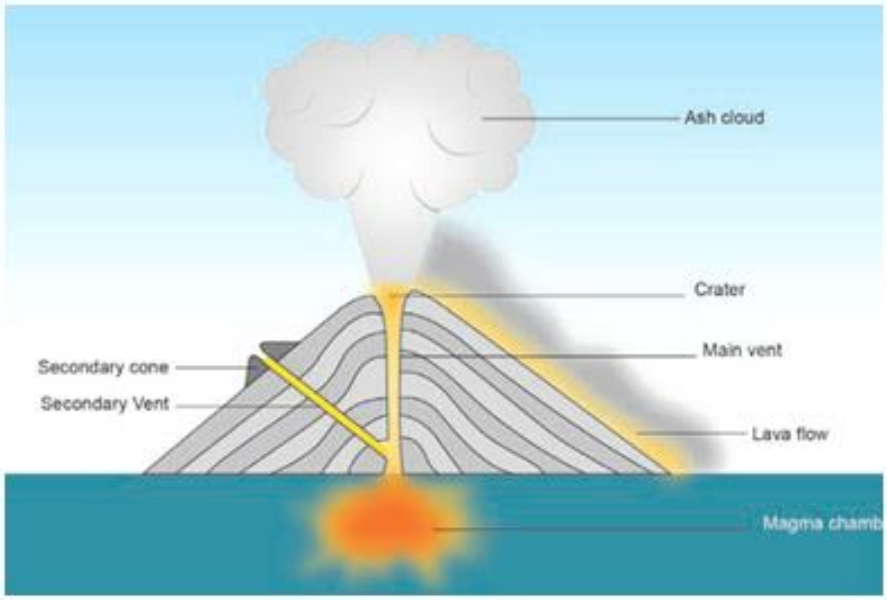
- The word **'Tsunami'** is a Japanese term, meaning harbour waves.

- It is adopted to describe large seismically generated sea waves caused by **Earthquakes, submarine explosions** and **landslides**.
- These waves travel at a great speed (more than 500 km per hour) and the length of the waves exceeds 600 km.
- These waves reach to a height of more than 15 m near the sea shore and are capable of causing destruction along the coastal area.
- **The 2004 Indian Ocean Earthquake** that caused tsunami is the sixth-deadliest natural disaster which travelled at a speed of 600 km per hour with an estimated death toll of 2,80,000.
- The Earthquake which occurred near Indonesia at 00.58 hours took nearly 7 hours to reach Chennai.

**Volcanoes**

- A volcano is a vent or an opening on the surface of the Earth crust, through which hot solid, liquid and gaseous materials (**Magma**) erupt out to the surface from the Earth's interior.
- **Magma** rises up and ejects on the surface as **Lava**.
- Volcanoes are also formed when **plates move apart**.
- Volcanoes generally have the following major components.
- They are: i. **Magma chamber** - a large pool of liquid rock found beneath the surface of the Earth
- ii. **Vents** - an opening serving as an outlet for air, smoke, fumes, magma etc
- iii. **Volcanic cone** - a landform built by the magma ejected from the vent in the shape of a cone.
- iv. **Crater** - a bowl shaped depression found at the top of the volcano through which the magma flows out.
- Based on the periodicity of eruptions, volcanoes are classified into

I. **Active volcano,**
II. **Dormant volcano,**
III. **Extinct volcano.**




**a. Active Volcano**

- **Active volcanoes** are those which constantly eject volcanic lava, gases and fragmented materials. (eg.) **Mount St. Helens** in the United States.

**b. Dormant Volcano (or) Sleeping Volcano**

- Volcanoes that do not show any sign of volcanic activity for a long period of time are known as **dormant volcanoes.**
- Sometimes there may be a sudden explosion which may cause unimaginable loss to life and property (e.g.) **Mt. Fuji** , Japan

**c. Extinct or Dead Volcano**

- When a **volcano permanently stops** its volcanic activity, then it is called as **extinct** or **dead volcano** (e.g.) **Mt. Kilimanjaro**, Tanzania.
- Volcanoes can also be classified based on their structure and composition as **composite volcano, shield volcano** and **dome volcano**

**d. Composite Volcano**

- Composite volcano, also known as **strata volcano**, is a conical volcano built by many layers of hardened lava, pumice and volcanic ash.
- These are commonly found in the Pacific Ocean Eg. **Mt. Fuji**, Japan

**e. Volcanic Dome**

- A lava dome or volcanic dome is roughly a circular mound formed due to **the slow ejection of viscous lava** from a volcano.
- As the lava is rich in **silica** with intense viscosity, it is prevented from flowing far from its vent. e.g. **Parícutin**, Mexico

**f. Shield Volcano**

- Shield volcanoes are formed by **intense viscous lava**.
- These are shallow depositions with gently sloping sides.
- Hence the lava flows out in all directions to create a shield. **E.g., Mauna Loa**, Hawaii

**Distribution of Earthquakes and Volcanoes**

- Most **Earthquakes** and **volcanic eruptions** do not strike randomly, but occur along the plate boundaries.
- One such area is **the Circum-Pacific Ring of Fire**, where the Pacific Plate meets many surrounding plates.
- **The Ring of Fire** is the most seismically and volcanically active zone in the world.
- The other distinctive major belts are **Mid- Oceanic Ridges ,Mid-Continental Belts** and **Alpine - Himalayan belt**.

**Effect of Volcanoes Constructive Effects**

- Volcanic materials enrich **the soil fertility** that promotes **agricultural activities.**
- The hot volcanic region helps in generating **geothermal energy.**
- Many dormant and active volcanoes are the most attractive **tourist spots** of the world.
- Most of the volcanic materials are used as **building materials.**
- **Destructive Effects Volcanic** eruption causes Earthquakes, flash floods, mud slide and rock fall.
- Lava can travel very far and burn, bury, or damage anything in its path.
- The large amount of dust and ash makes breathing hard and irritable.
- Volcanic eruptions can alter the weather conditions and disrupt transport (**Iceland volcanic eruption**) in and around the volcanic region.

**MORE TO KNOW:**

- **The Deepest Place** ever reached by human technology vary from time to time.
- Till 2011 **Kola Super Hole** (12,262m) in **Murmansk, Russia** was the deepest place.
- But in 2012, Z-44 **Chavyo Well** (12,376m) broke the record, and is supposed to be 15 times the height of **Burj Khalifa** in Dubai.
- The exploration of Earth's interior continues.

**'seismology'**

- The instrument which records the Earthquake waves is called **'seismograph'** or **'seismometer'**.
- The science that deals with Earthquakes is called **'seismology'**.

**Tsunami**

- On 26 December 2004 a tsunami occurred in **the Indian Ocean**.
- It was the result of **the Indio-Australian Plate subducting** below the Eurasian Plate.
- It was caused by an **Earthquake** measuring a magnitude of above **9 in the Richter scale.**
- The Earthquake caused the seafloor to uplift, displacing the seawater above.

**"God of Fire"**

- The term **'volcano'** is derived from the Latin term **VULCAN**, which is the name of Roman "**God of Fire**".

**Fact**

- **C.F. Richter** devised a scale to measure **the magnitude of Earthquakes**.
- This scale relates to the energy released at **the epicentre** and provides an estimation of **the severity of an Earthquake**.
- It is an open ended scale.
- **The highest magnitude** ever recorded is **9.5** on Richter scale (Bio-Bio, Chile in 1960).