

## THEME 2 : PHYSICAL GEOGRAPHY

- Geology deals with physical formation of the Earth
- Continental Drift:
  - 200 million years ago, Pangea was the super-continent which drifted apart & we see these parts as continents now.
  - The first person who noticed that all continents were once a Pangea was Wagner. But, he wasn't able to explain why or how it broke apart.
  - This is explained in the Sea Floor spreading Theory by Hess.
- Sea Floor Spreading Theory states that constant eruption of volcanoes & cooling of lava forms new crust, <sup>that pushes</sup> pushing the old one apart.
- The Plate Tectonic Theory:
  - It is a combination of both the theories
  - 4.5 billion years ago, Earth was a hot ball in molten state with a temperature of  $2000^{\circ}\text{C}$ . The temperature of the outer atmosphere was  $0^{\circ}\text{C}$ .

- The heavier part/material started sinking & formed the core.

- Lighter material rose to the surface & became the outermost lithosphere/crust.

#### → The Tectonic Plates:

- The hot air/gases try to come out from the mantle & hit the weak parts of the crust, causing the formation of fragments of the crust.

- The volcanoes do the same.

- These fragments of the crust are known as plates.

- These plates move as the hot gases with high kinetic energy try to come up but eventually fail to escape into atmosphere because of the crust.

- Hence, they occupy the area/space just beneath the crust causing its lower part to partially melt.

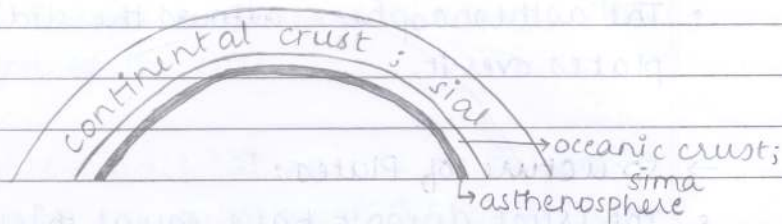
- As a result, a thin plastic-like layer is formed there, called the asthenosphere.

- The asthenosphere allows the sliding of plates over it.

→ structure of Plates:

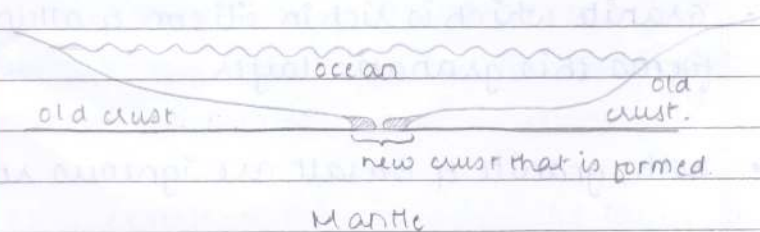
- The crust doesn't have equal thickness throughout. However, its average thickness is 60 km.
- The lower part of the crust is the oceanic crust whose thickness is 10-20 km. It is rich in silicon & magnesium & hence is also known as 'sima'.
- Basalt which is rich in silicon & magnesium, forms this basaltic layer.
- The continental crust forms the upper part of the crust whose thickness is 70-80 km. It is thicker than the oceanic crust. It is rich in silicon & aluminium & hence is known as 'sial'.
- Granite which is rich in silicon & aluminium forms this granitic layer.
- Both, granite & Basalt are igneous rocks.





### → Mid Oceanic Ridge

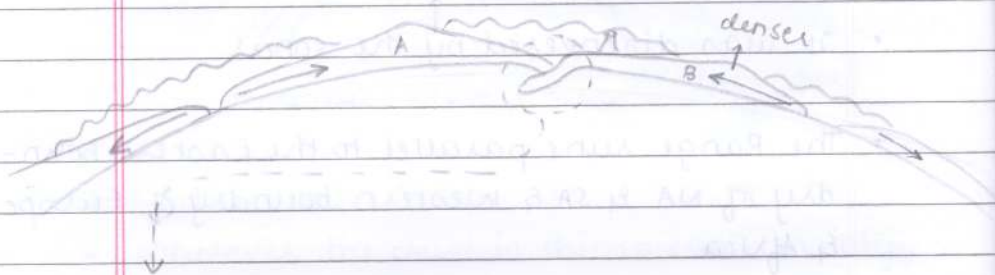
- Whenever, the crust is thin (oceanic mainly), the hot air & magma from the mantle ooze out.
- The magma comes in contact with water & cools down rapidly to form a rock (a piece of crust).
- Simultaneously, the other adjacent plates push apart & make place for this new crust<sup>rock</sup>.
- A new crust is formed there pushing the older one apart.



- The Mountain Range <sup>in</sup> ~~under~~ the Atlantic Ocean is known as Mid Atlantic Ridge.
- It was discovered by the sonar.
- The Range runs parallel to the Eastern boundary of NA & SA & western boundary of Europe & Africa.
- This is a striking thing & yet no co-incidence.
- This range is a chain of active volcanoes. ~~They~~ This states that these volcanoes have pushed apart its adjacent plates.



- Rocks of:
  - A & B are same in age (200 m yrs)
  - C & D are same in age (<200 m yrs)
  - E & F are same in age. (recent)

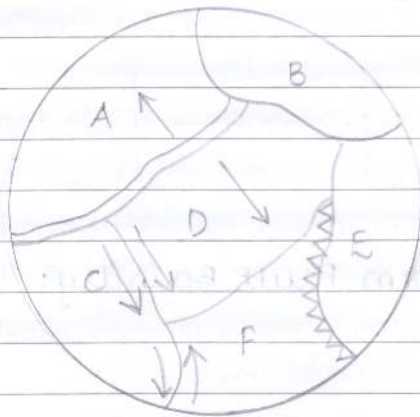


### Subduction Zone:

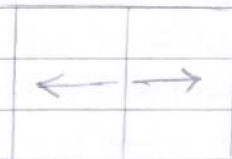
- When 2 pairs of plates move apart together, simultaneous 2 plates come towards each other.
- When such a thing happens, the denser & heavier slides down/subducts under the lighter one.
- Due to friction, a lot of heat is produced which melts the subsiding plate to form magma.
- The place / area where this activity takes place is called Subduction Zone.
- At the subduction zone, the ocean floor lies the deepest. This is known as trench.

→ The Plate Tectonic Theory: (summarizing)

- (1) The Earth's crust is broken up into fragments called plates.
- (2) Continuous eruption of magma at mid-oceanic ridge forms new crust. This causes plates to push apart.
- (3) At subduction zone, one plate thrusts itself beneath other. This causes friction & results in melting of the crust. Hence volcanoes occur at subduction zone.



→ Divergent Boundaries:



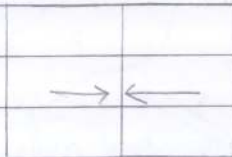


Identification:

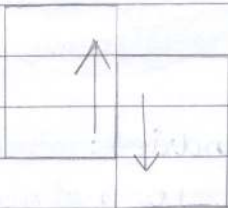
- Located underwater at mid oceanic ridge.
- There is presence from of active volcanoes from which <sup>basaltic</sup> magma is oozing out. Hence, new crust is formed all the time.

→ Convergent Boundary:

- Identification: presence of trenches & volcanoes.
- The magma that oozes out here is granitic magma.
- The <sup>sudden</sup> movements of plates due to stress causes sudden friction which causes sudden eruption.

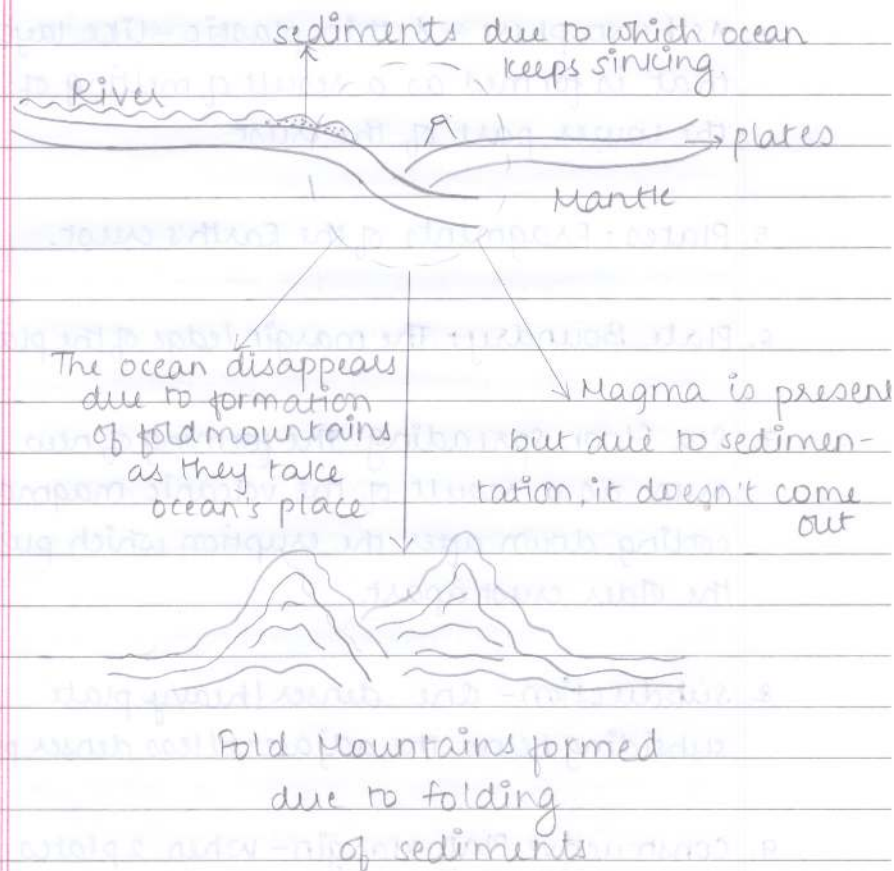


→ Transform Fault Boundary:





- Plates get locked due to friction.
- The movement isn't sudden & spontaneous.
- Presence Volcanoes aren't present by earthquakes do occur.



→ Summarizing / Revision:

1. Tectonic Activity - Movement of tectonic plates
2. Crust - The outermost layer of the Earth that is solid & its <sup>avg.</sup> thickness is 60 km.
3. Mantle - The <sup>layer that is in</sup> semi-solid/molten state & lies below the crust & contains magma.
4. Asthenosphere - A thin plastic-like layer that is formed as a result of melting of the lower part of the crust.
5. Plates: Fragments of the Earth's crust.
6. Plate Boundary: The margin/edge of the plate.
7. Sea Floor spreading: The forming of new crust as a result of the volcanic magma cooling down after the eruption which pushes the older crust apart.
8. Subduction - One denser/heavy plate subsiding below the adjacent/less denser plate.
9. Constructive Plate Margin - When 2 plates move <sup>apart from</sup> ~~towards~~ each other & new crust is formed.

10. Destructive Plate Boundary - When one plate subsides & melts under another lighter plate.
11. Conservative Plate Boundary - When 2 plates rub against each other.
12. Collisional Plate Boundary - When 2 plates collide.
13. Trench - The deepest point of ocean at the subduction zone.

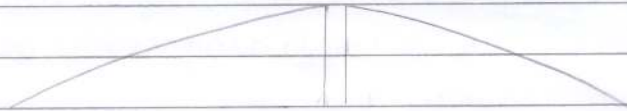
→ Volcanoes.

(1) Divergent Plate Boundaries.

- Magma erupts from mantle

- Magma is Basaltic Magma which has uniform thickness/consistency; & is relatively dense.

Because of its viscosity (resistance to flow), it spreads very quickly which gives the volcano a shape/form like a shield.



- These volcanoes are active meaning that they are in a constant state of eruption. There is hardly a month or two when they don't erupt.

- It is safer to live near these volcanoes because its eruption is already expected.

Examples:

- ~~Mt. Ki~~ Mt. Kilimanjaro located at East African Ridge

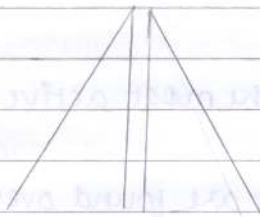
Loki, Keafra, Hekla & Katta located at Iceland present in Mid Atlantic Ridge.



## (2) Convergent Plate Boundary.

- Magma is produced due to rubbing of plates. Most of the times, it is a continental plate & rubbing against an oceanic plate rubbing against each other.

- The Magma is granatic Magma which is uneven in consistency. (It is thick at some places & thin at the others)  
Its thicker / denser part is viscos where as the thinner part is not. Due to this the shape of the volcano is in the form of a cone.



- These volcanoes can be active but most of them are dormant. (which haven't erupted recently but can erupt any time)
- It is dangerous to live near them because:
  - (a) they can erupt any time; there is no predictability.
  - (b) there could be a sudden <sup>burst</sup> outlet of lava due to accumulated stress which is caused by sudden subsiding movement of tectonic plates.

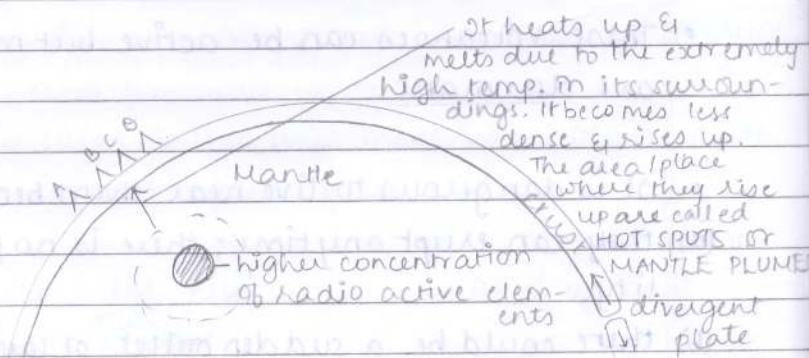
(3) Heading:

A  
B  
C  
D

NA

SA

- A, B, C & D are volcanoes
- A - oldest & extinct
- B -
- C -
- D - youngest & the most active.
- These volcanoes are found over HOT SPOTS or MANTLE PLUMES.



- Increase in formation of these volcanoes can make that zone weaker.

⇒ Destructive / Negative Effects of Volcanoes:

→ Occurrence of Earthquakes before volcanic eruption.

→ Toxic Gases such as  $\text{CO}$  +  $\text{SO}_2$  that come out first as the volcano erupts.

→ Ash Cloud containing dust particles & gases, which if inhaled, can cause death. It also causes loss of visibility.

→ Pyroclastic Cloud is a mixture of <sup>gases</sup> clouds. Pyro comes from the word pressure & clastic means piece of rock. Because of pressure inside the volcano, rocks break into pieces & explode from the volcano along with gases. They have got a very high speed & are destructive.

→ Volcanic bombs are lumps of semi molten rocks with high temperature that are thrown out due to eruption of volcano. They can cause fire.

→ Lava is viscous & hence it moves very slowly. This makes it the least destructive result of an volcanic eruption.



- Lahar is a mixture of snow, lava, soil & pyroclastic material. It occurs in glacier regions like a kind of mudflow.
- \* Landslide - sliding of soil.  
Mudflow - when a large mass of soil comes down a steep slope, it behaves like liquid. Its qualified speed is 200 km/hr & it is the most dangerous & destructive of natural disasters.
- Adds carbon dioxide to atmosphere.
- Constructive / Positive Effects :
  - New crust is formed due to the eruption.
  - Formation of New soil. Volcanic eruptions lead to formation Black soil which is very fertile because it consists of LIMCAP (Lime, Ironoxide, Magnesium,  $\text{CaCO}_3$ , Alumina & Potash). Potash is very important for plants.
  - \* Weathered Particles + humus = Soil.
  - The place becomes a tourist attraction.
  - Geo Thermal Energy is the heat energy of Earth. The <sup>hot</sup> gases from volcano with pressure are used to rotate turbines.
  - Hot Springs: Medical & Therapeutic Value.



## → Earthquakes

1. Back & Forth
- $\longleftrightarrow$
- P waves

primary waves - faster

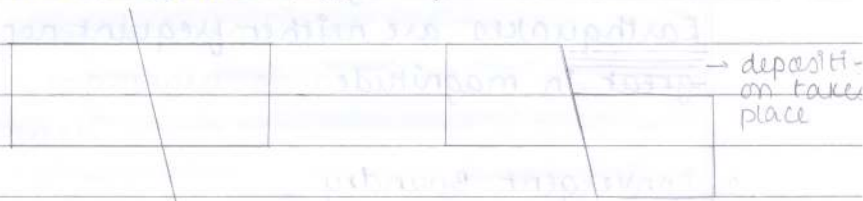
2. Up & Down
- $\updownarrow$
- S waves

secondary waves - slower

wave - series of disturbance in the particles of a medium caused due to the propagation of energy.

When the rocks break the stored energy is released. There will come a point where the rocks lose their elasticity & the break.

This is called FAULTING.



How do stresses accumulate?

deposition of materials

breaking of rocks

magma pushing



Volcanoes can be predicted if there is an earthquake before it.

### Elastic Rebound Theory

S-waves



stored energy released



rocks break/faulting



stresses accumulated

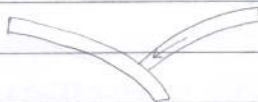
→ Where do earthquakes take place?

#### 1. Divergent Boundary

Earthquakes are neither frequent nor great in magnitude

#### 2. Convergent Boundary

Earthquakes are more frequent & magnitude is also high



## 3. Transform Fault Boundary

Earthquakes are more destructive but not powerful. Cause harm to urban developments & hence are more destructive.

## ★ Measuring Intensity

## Powerful

- Richter Scale

1-9

- measures amount of energy; scientific

## Destructive

- Mercalli Scale

1-12

- measures amount of destruction in terms of lives, property; non scientific

Scientific because energy is measured or expressed on a paper



1 - x      8 -  $10^7$  x — exponential.

2 -  $10$  x      9 -  $10^8$  x

3 -  $100$  x

4 -  $1000$  x

5 -  $10000$  x

6 -  $10^5$  x

7 -  $10^6$  x

Epicentre - place where maximum energy is released

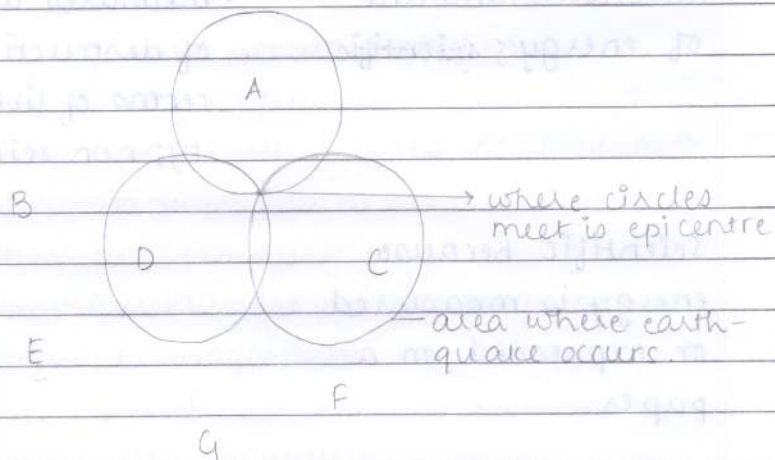
Epicentre

point directly above the focus

focus/hypocentre

↳ amt. of energy released from this point

Arrival of P waves



Speed of P waves in crust is 5 km/s



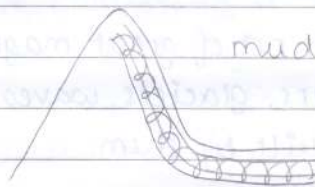
- Effects

Secondary Hazards (things triggered to earthquake)

1. Tsunami

Sea floor vibrating

2. Landslide/Mudflow.



mudflow

- turbulent flow  
get mixed with each other.

3. Liquefaction - when solid behaves like a liquid

4. Fires

5. Floods & Dam wreckage.