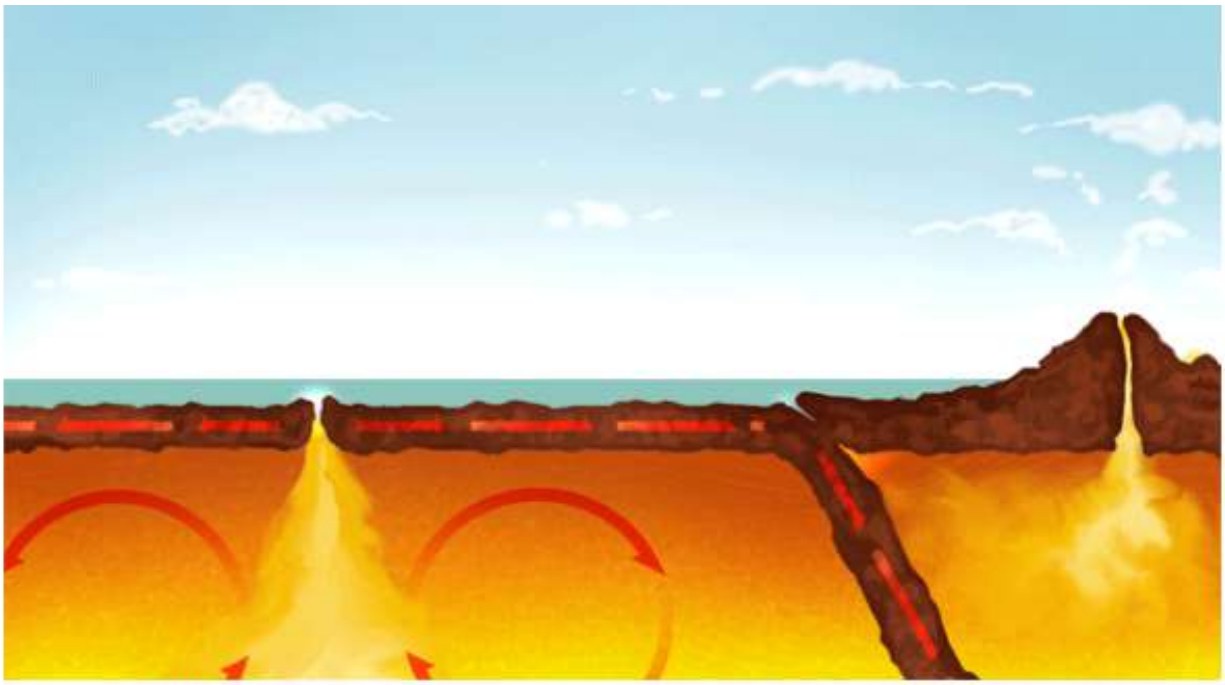
Geography Class 14

REVISION OF THE PREVIOUS CLASS (9:08 AM):

- The Plate tectonic theory was first proposed by Mckenzie, Parker & Morgan in 1967.
- Plates are the broad and rigid segments of the lithosphere which include the rigid upper part of the upper mantle and crust.
- The term "Plate" was coined by **J.T. Wilson.**
- The plates are in motion on the underlying asthenosphere and undergo continuous deformation in the process.
- There can be three types of plate boundaries: Divergent, Convergent, and Transform.
- Plate interactions give us various landforms such as ridges, island arcs, etc.
- In the cases of convergence, it is always the heavier plate that gets subducted below.
- As the oceanic plate subducts, it creates trenches, earthquakes are generated at shallow intermediate and deep locations, Benioff zones are formed, etc.
- As the oceanic plate plunges deeper, it melts and starts to rise.
- This rising magma will accumulate within the continental crust, and eventually move to the surface leading to the formation of volcanoes.

- 
- **Geosyncline** is the basin of sediments that will be made at the junction of continent-continent convergence.
- Continent-Continent convergence sees no subduction, so no melting of rocks due to friction to form magma, volcanoes are absent in the region.
- At transform boundaries, plates slide past each other without the construction of a new plate or the destruction of the new plate.
- **Causes of the plate motion:** Convection Currents, Mantle Plumes, Ridge Push, Gravity sliding, and Slab pull.
- **Slab pull's** main cause is not gravity but the faster movement of the plates near the trenches, due to melting.
- The magma convection currents as they rise from below, diverge and spread laterally.
- This causes the lithosphere to split, resulting in the formation of cracks.
- It is a type of mantle convection that involve jetlike plumes of low-density material from the core-mantle boundary.
- That particular spot on the lithosphere where the mantle plumes are rising is called a **hotspot,** like the Hawaiian islands.

at central pacific ocean

- **Some limitations of the plate-tectonics theory are:**
- It cannot fully explain the formation of old fold mountains (older than 200 million years). like Ural, Aravallis, and Appalachians.
- It cannot fully explain the older movement of different plates.
- What are the future of this process and both plates?
- When will the process stop?

Mains PYQ analysis:

- **Q.1 Why are the world's fold mountain systems located along the margins of continents? Bring out the association between the global distribution of fold mountains and earthquakes and volcanoes(10 marks, 2014).**
- A similar question came in 2021 for 15 marks.
- **Brief approach:**
- Apart from the mechanism of folding mountains, we must also cover how it relates to earthquakes and volcanoes.

Q 2. Explain the formation of thousands of islands in the Indonesian and Philippines archipelagos. (10 marks 2014).

- **Brief approach:**
- We need to use diagrams to show the associated plates.

VOLCANISM/VULCANISM: (9:30 AM):

- Common understanding restricts volcanism to only the release of lava from a conical opening.
- Volcanism includes all the phenomena associated with the movement of molten material from the interior of the earth to the surface.
- Volcanism involves **three processes:**

1. Generation of magma.
2. The intrusion of magma.
3. Extrusion of magma.

in the earth's interior due to increase in temperature and decrease in pressure and increase in water content which lowers the melting point of rocks causing it to generate magma.

when sufficient pressure builds up in the lithospheric chamber, magma erupts onto the surface.

it involves the movement of magma to lower layers to upper lithospheric layers and accumulation within the lithospheric layers.

Generation of magma-

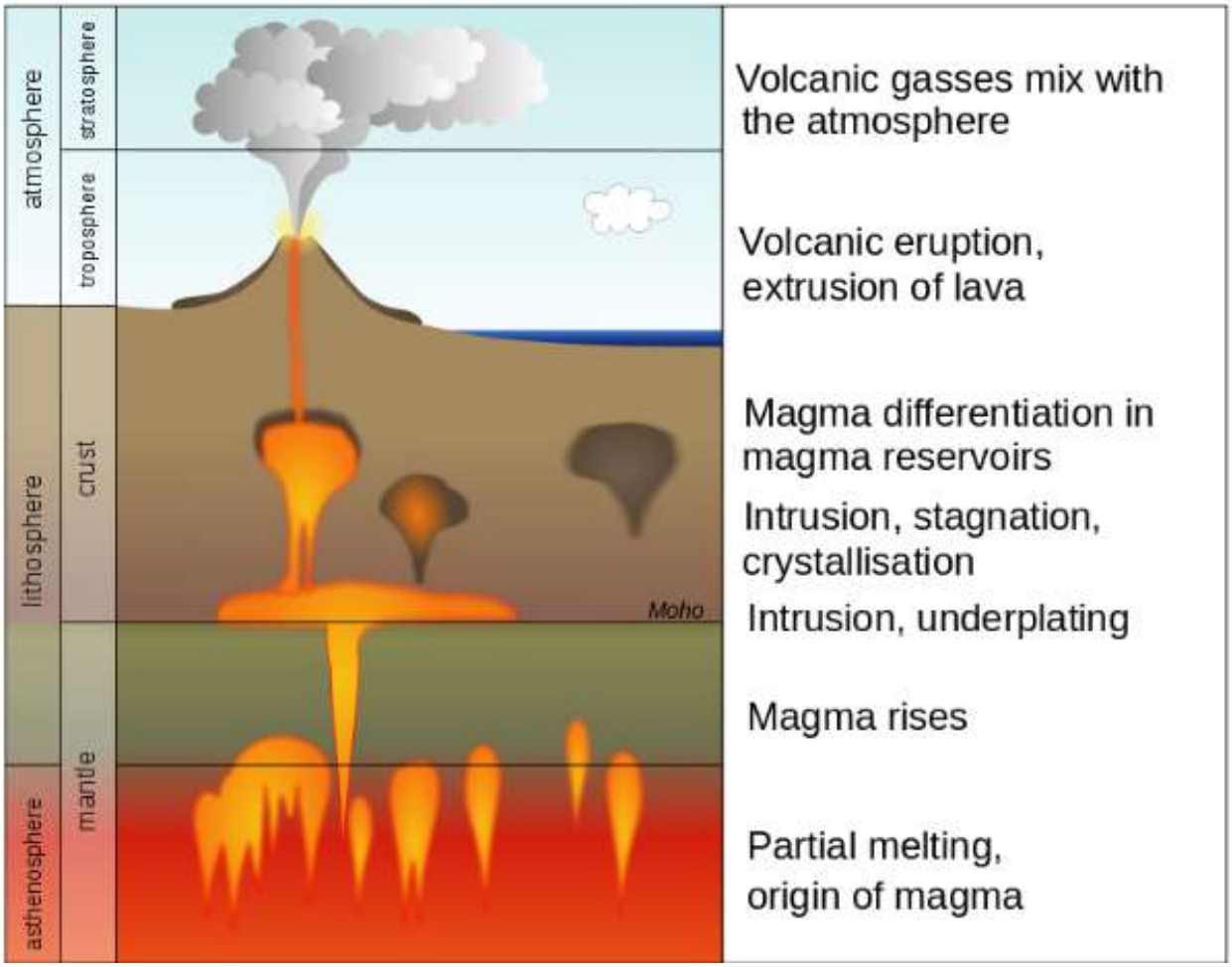
- It includes processes like-
- Increase in heat.
- Decrease in pressure.
- It is facilitated by the presence of water which lowers the temperature.
- Rocks with higher water content will melt faster.
-

The intrusion of magma:

- The magma proceeds into the lithospheric layers.
- The magma then gets accumulated within the lithospheric layers.

Extrusion of magma:

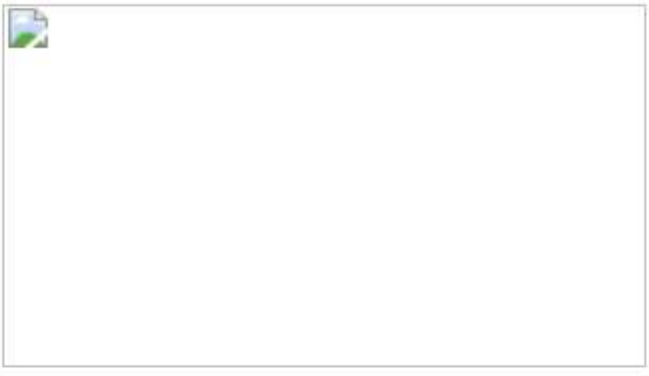
- When sufficient pressure builds up in the lithospheric chamber, the magma erupts onto the surface.
- The conical buildup is a result of the repeated buildup of magma.



Magma:

- Magma is a hot, mobile, molten silicate material.
- Silica materials melt faster.
- It is made up of solids, liquids, and gases and is not entirely liquid.
- When magma reaches the surface, it erupts as **lava**.
- Lava is more volatile and hotter than the magma which is cooling down below the surface.

TYPES OF MAGMA (9:30 AM):

Granitic magma	Basaltic magma
Acidic in nature- more than 66% silica content.	Basic in nature- less than 52% silica content.
It is usually lighter in density.	It is usually heavier in density.
It causes the formation of continental crust	It causes the formation of oceanic crust
It is brighter in color	It is darker in color.
It has low fluidity, this is a reason why continental crust is thicker.	It has a higher fluidity, this is a reason why the oceanic crust is thinner.
It has a lower temperature.	It has a higher temperature.
It is rich in Silica, Aluminium, Sodium, etc.	It is rich in Magnesium, Iron, Calcium, etc.
Violent eruption because as this is less fluid, magma will accumulate at the vent. For the eruption, sufficient pressure needs to be built to blast off the accumulated magma.	less viscous ↓ or highly viscous Eruption nature(Fissure eruption) is smooth and non-violent due to its fluidity.
	

Traps more gases

Traps less gases

- The above classification is general and the actual nature of the magma always depends upon the local conditions.
- Magma will be granitic or basaltic as per the origin, and not during cooling down.
- The generation of granitic magma is very less.
- Granitic magma in most cases gets cooled down in the earth's interior.
- Almost all the magma generated deep in the earth's interiors is basaltic magma.
- When the basaltic magma interacts with the lithospheric rocks, they melt to form granitic magma.
- Mantle plume brings basaltic magma.

Plate tectonics and magma generation:

Parameter	Ocean-Ocean Divergence	Continent-Continent Divergence	Ocean-Ocean convergence	Ocean-Continent convergence	Hotspots
Location	Mid-Oceanic ridge (MOR)	Rift Valley	Near to Trench Volcanic island and volcanic mts.	Trench on the fold mountain	Intra-plate
Type of magma	Basaltic	Basaltic and Granitic	Andesitic	Andesitic	Basaltic
Reason for generation	Convection Currents	Convectional Currents	Subduction and partial melting	Subduction and partial melting	Mantle plume
Nature of eruption	Fissure eruption-non-violent	Slightly violent volcanoes	Very violent eruptions along volcanic islands	Very violent eruptions	Fissure eruption-non-violent Shield Volcano

Fissure eruption means it comes out slowly from gaps between MOR.

Andesitic magma have silica content of more than 52 percent and and less than 66 percent.

Only Andesitic magma and Basaltic magma comes out, Granitic magma will not come out.

Magma comes out from interior of earth is Basaltic only.

ANDESITIC MAGMA (10:00 AM):

- It is that kind of not completely acidic nor completely basic.
- Due to partial melting, the lighter elements are melted more.
- This is named after the **Andes mountains.**
- Sediments of continental crust are spread all over the ocean floor.
- Geomorphological processes over time lead to the formation of this kind of magma.
- The basaltic magma at the oceanic ridge is less viscous and does not accumulate.
- Andesitic magma is viscous, accumulates, and blocks further release of magma.
- Pressure gets built up eventually and causes explosions.

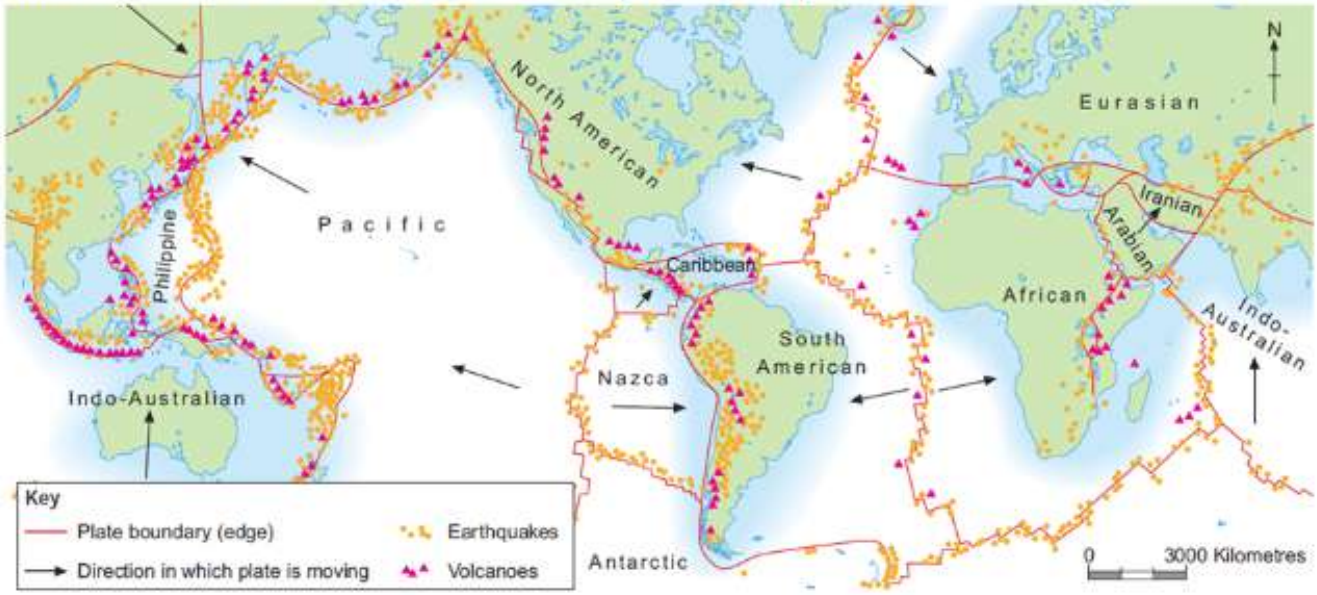
Composite/ stratovolcanoes:

- They are too steep.
- They are mainly due to andesitic magma, hence very violent.

Shield volcano:

- They are flatter and of much lesser height.
- They are mainly formed by basaltic magma, hence they are non-violent.
-

DISTRIBUTION OF VOLCANOES (10:30 AM):



Ridge volcanism:

- It can be seen along the oceanic floor.
- **For example-** The mid-oceanic ridge, Carlsberg ridge(in the Indian Ocean), etc.

Volcanic arcs:

- It can be seen along the Ocean-Ocean convergent plate boundaries.
- **For example-** Japan, Aleutian, etc.

Volcanic chains:

Indonesia

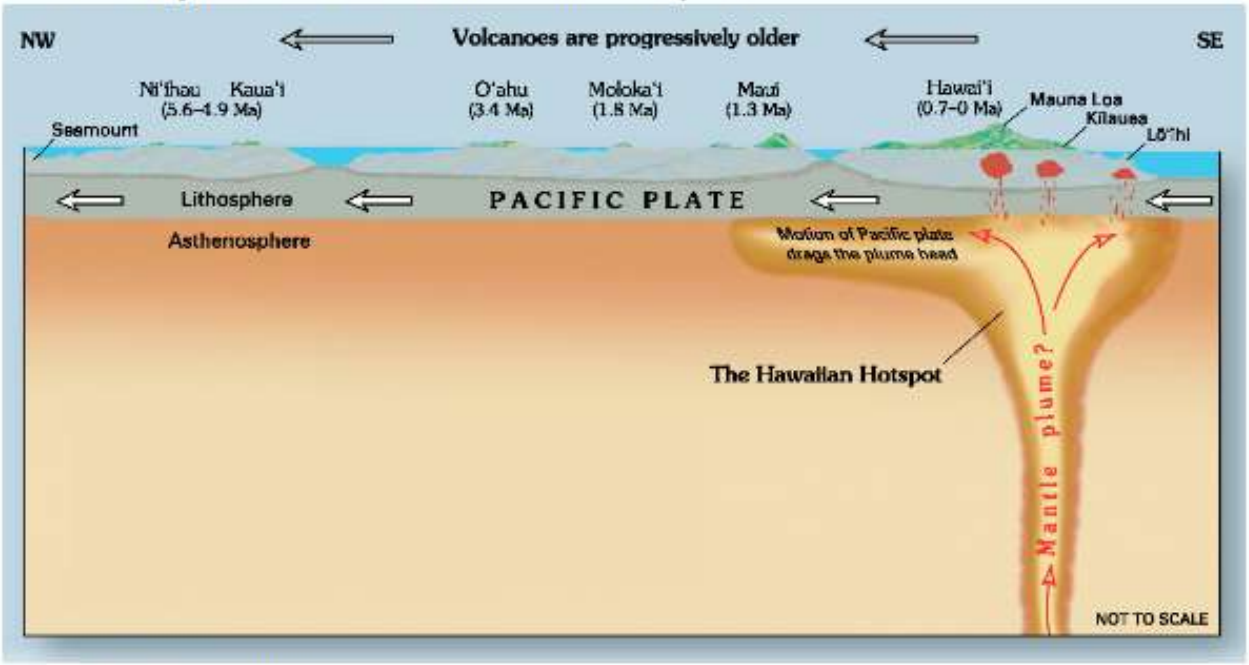
- They are found along ocean-continent convergence plate boundaries.
- **For example-** the Andes, Rockies, etc.

Volcanic clusters:

- They are formed along continent-continent divergence zones.
- For example- the East African Rift Valley.

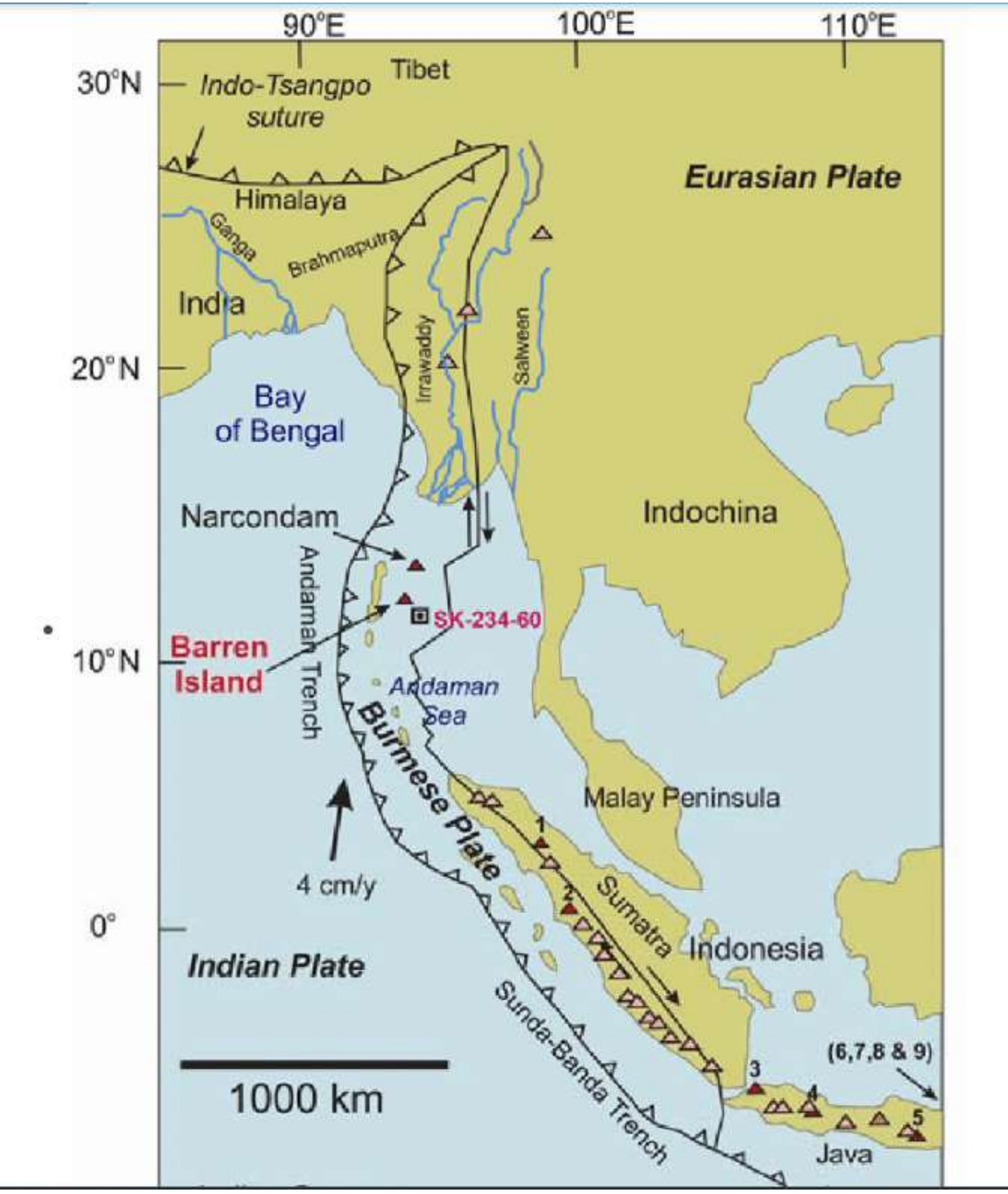
Divergence will be along greater width so clusters of volcanoes will form.

Volcanic lines:

- They are formed by Mantle plumes.
- The direction of the plume is fixed vertically, but the plate is moving continuously.
- Only the volcanoes over the plumes remain active.
- **For example-** Reunion & Hawaiin hotspots.
- 

Volcanism in India:

- The **Barren island** of Andaman is the only active volcano in the entire South Asia.
- The **Narcondum** of Andaman is another dormant volcano.


90°E
100°E
110°E
30°N
20°N
10°N
0°
Tibet
Indo-Tsangpo suture
Himalaya
Eurasian Plate
Ganga
Brahmaputra
India
Irrawaddy
Salween
Bay of Bengal
Narcondam
Indochina
Andaman Trench
SK-234-60
Barren Island
Andaman Sea
Burmese Plate
Malay Peninsula
4 cm/y
Sumatra
Indonesia
Indian Plate
Sunda-Banda Trench
(6,7,8 & 9)
1000 km
Java

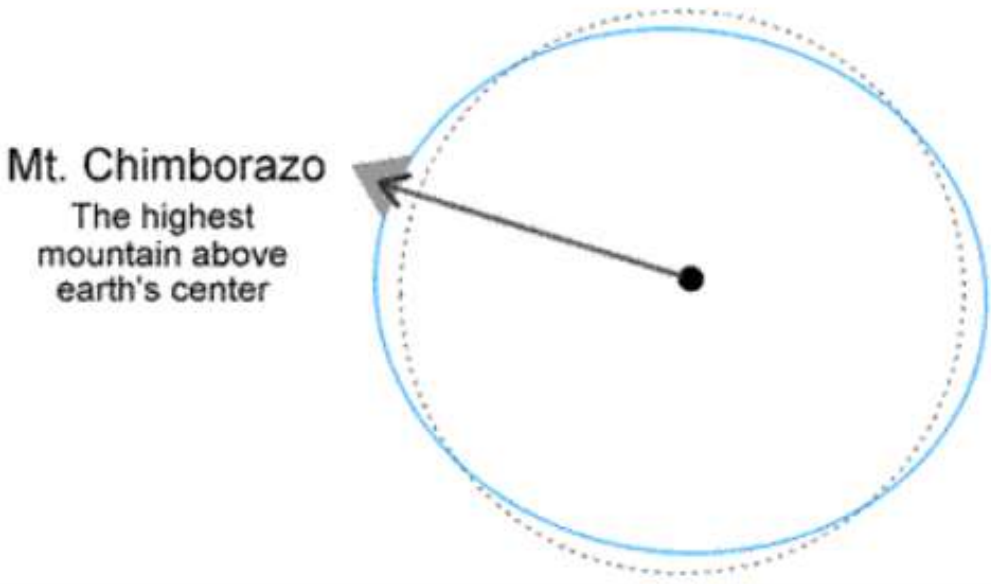
Classification of volcanoes as per their frequency of eruption:

Active:

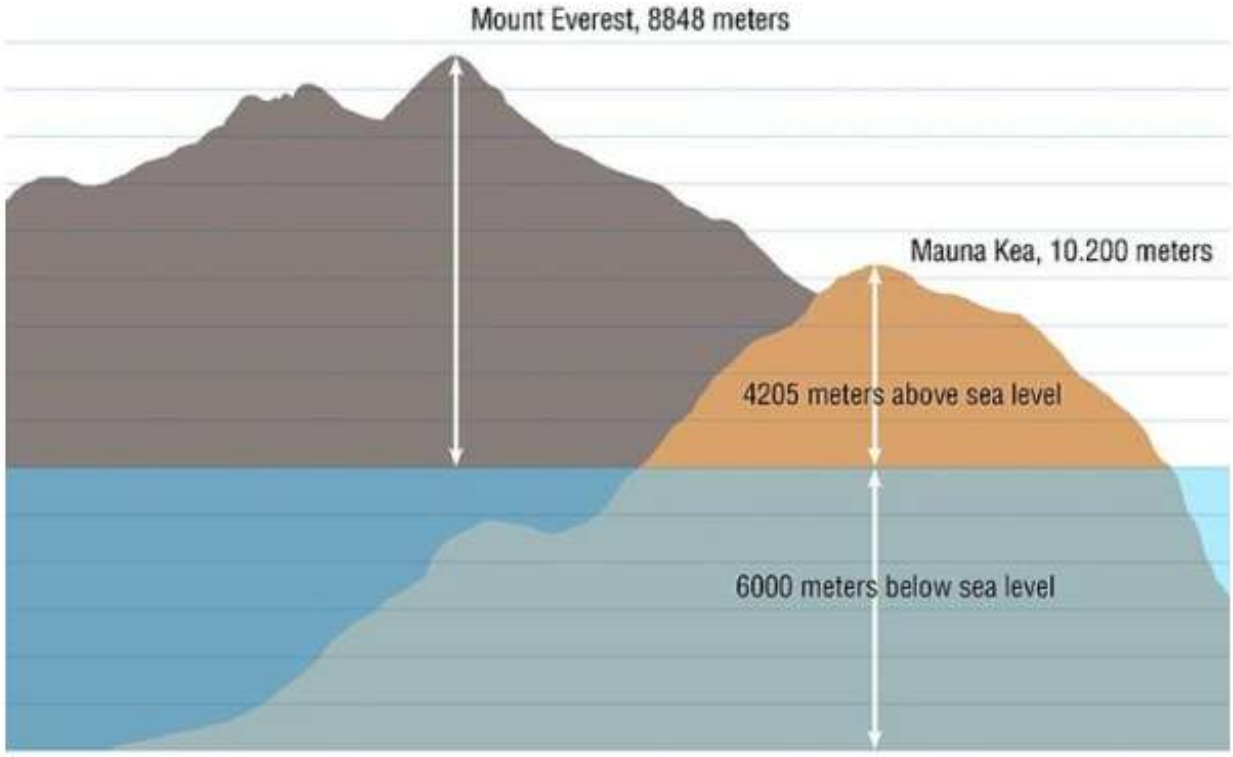
- When the volcano has erupted in recorded history.
- The eruption can continue for months
- **For example-** Mauna Loa, Mauna Kea, Cotopaxi, Chimborazo, St Helens in the Rockies, etc.

Mount Chimborazo, which is very near the equator is the closest point on the Earth to the moon, due to the equatorial bulge.

in Andes



- Mauna Loa is the largest volcano by size because it is a shield volcano.
- Mauna Kea is the tallest mountain on the earth from its height to its tip.

- 

- The St Helens eruption in 1980 is the most disastrous eruption in American history.
- There were signs of eruptions, but the volcano erupted laterally and covered a very large area.
- The whole mountain got collapsed.

- 
1980

1982

- **Krakatoa** volcano in Indonesia is an underwater volcano.
- When it erupted in 1883, the sound of eruption reached Australia, and tsunami waves reached India and even Africa.
- It is the most violent eruption in recent times.
-

Dormant volcano:

- They have erupted in the past and there is a chance of eruption in the future.
- **For example-** Mount Vesuvius. (In Italy)

Extinct Volcano:

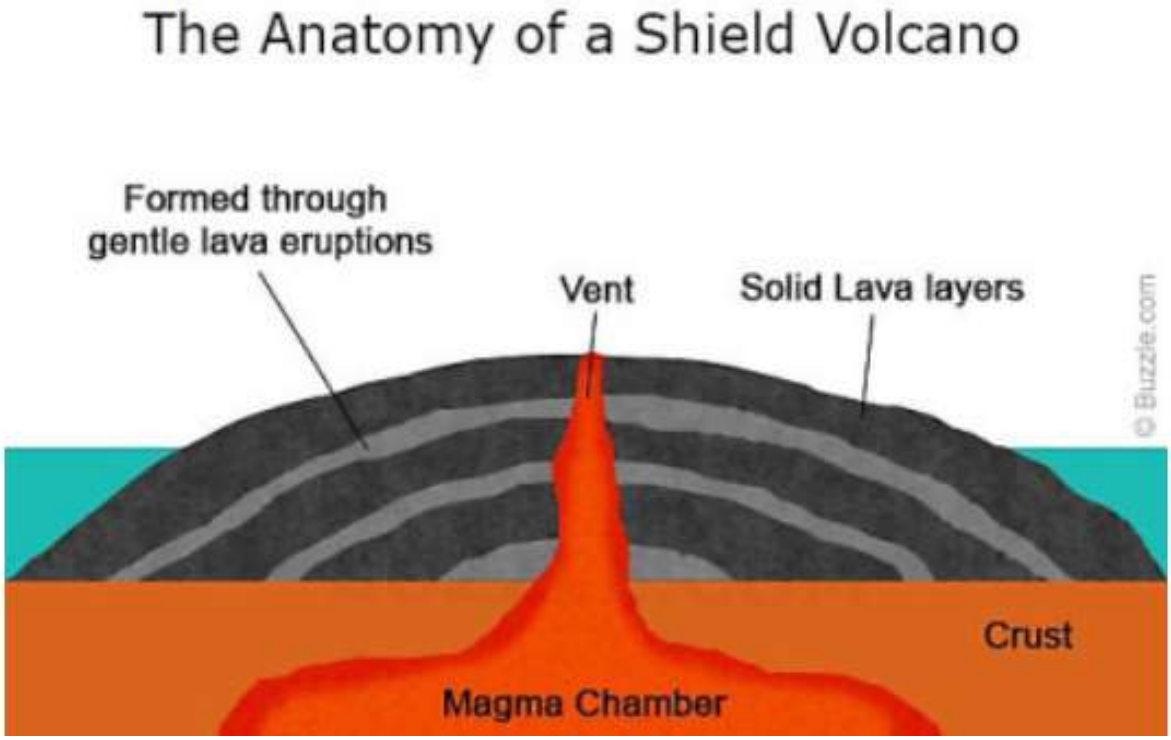
- They have no future chance of an eruption.
- The formation of the crater lake is a sign of an extinct volcano.
- Their lava vent is broken and has no connectivity with the magma chamber.
- For example- Mount Kilimanjaro, Tanzania


ZANZIBAR
ARCHIPELAGO
Kenya
N
Tanga
Pangani River
Pangani
Tumbatu Island
Kendwa
Tanzania
Zanzibar
Sadani
Zanzibar Town
Wami River
Zanzibar Channel
Paje
Mtende
Bagomoyo
Dar es Salaam
40m
40 km
Mchungo
Fundo Island
Wete
Pemba Island
Pemba Channel
Chake Chake
Indian Ocean
Mafia Island
Kilindoni
© WorldAtlas.com

VOLCANIC LANDFORMS (11:10 AM):

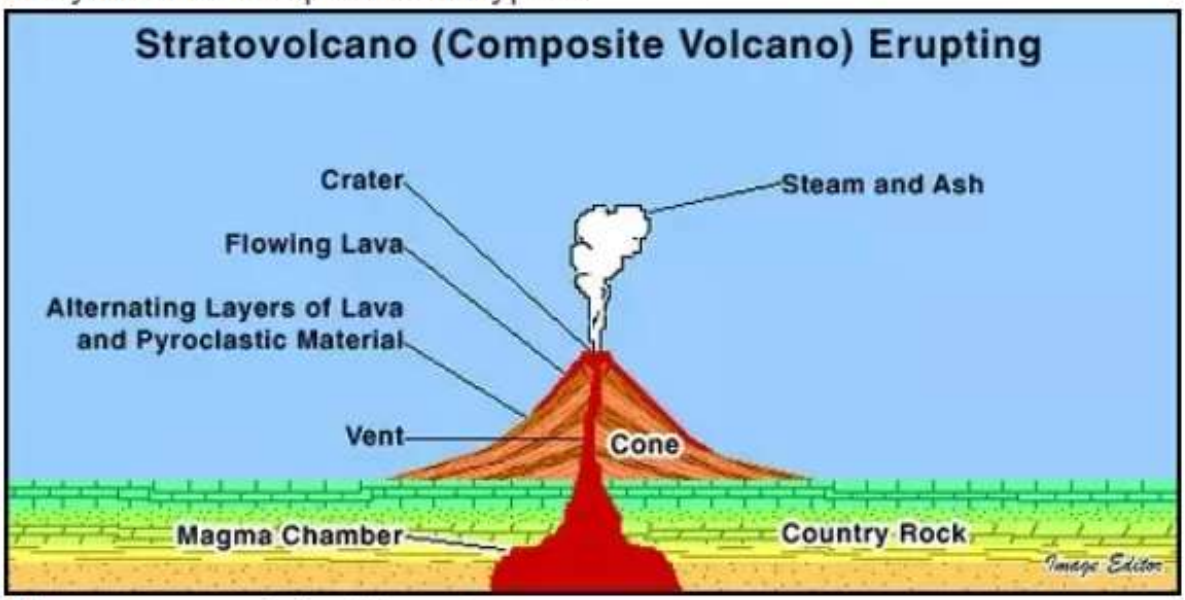
Extrusive Features:

- **Shield Volcanoes:**
- They are formed by basaltic magma.
- They are found near hotspots.
- They are the largest of all volcanoes.
- They are not very steep and they appear in a dome shape.
- **For example-** Mauna Loa, Mauna Kea, etc. (Mauna Loa in Hawaii island USA)



A composite structure is a system or material made by combining two or more different components or materials with distinct properties to create a stronger, more efficient, or functional whole. The individual components work together to leverage their unique strengths while offsetting their weaknesses.

Composite/Stratovolcano:

- They are formed due to the accumulation of viscous andesitic magma.
- The alternate layers of lava and ash provide a composite structure.
- They are the steepest of all types.
- 

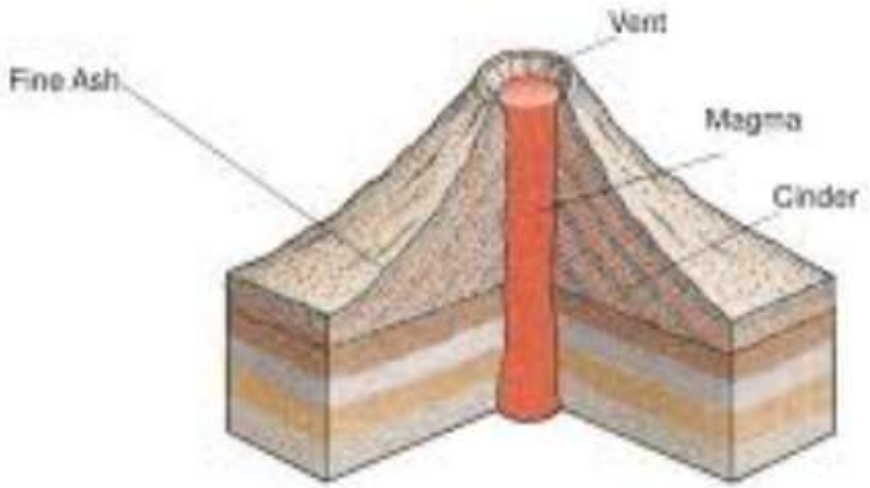
- They are very violent in nature.
- **For example-** Mount Fuji in Japan.

Ash Cinder Volcano:

- They are formed by the accumulation of loose sediments and particles from the eruption.
- They are dominated by ash, debris, and other volcanic material with less lava.
- **For example- the** Taal Volcano of the Philippines.

(Cinder refers to a small, porous fragment of volcanic rock, ash, or material that is partially burned and left as residue. It is commonly associated with volcanic activity or combustion processes. Cinders are often lightweight and dark in color due to their high carbon or iron content.)

Cinder Cone Volcano Diagram



Crater Volcano:

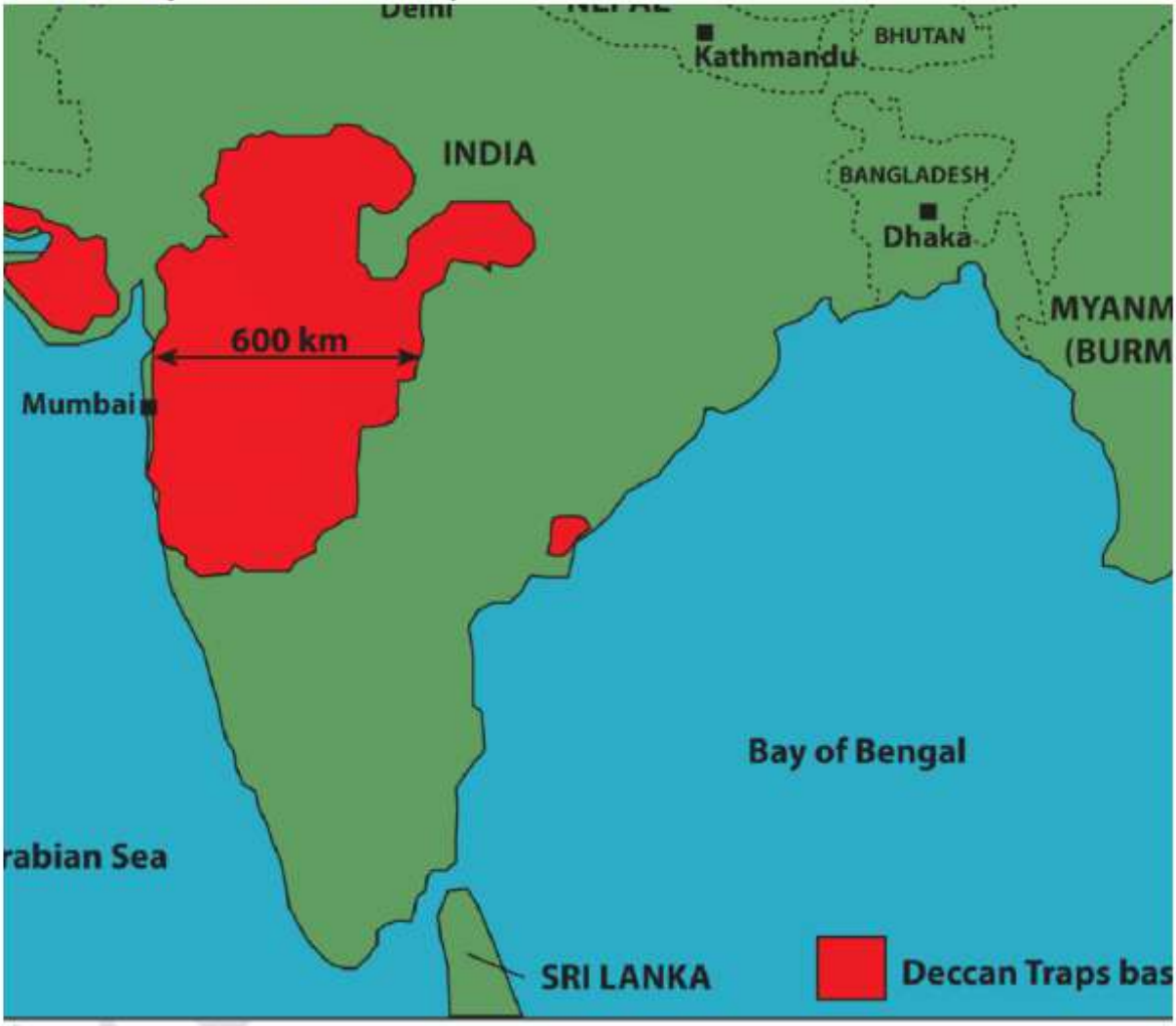
- It is a funnel-shaped depression at the mouth of the volcano.
- When it is filled with water, we get a **Crater Lake.**
- 

Caldera:

- It is a greatly enlarged depression formed due to the violent eruption of the volcano resulting in the subsidence of a large portion of the volcano.
- Like the Mount Tambora of Indonesia.
- 
- It results in **Caldera Lake** like Lake Toba in Indonesia.

Flood Basalt Province:

- When the highly fluid basaltic maga erupts over a plateau region, it flows for a long distance and covers a large area.
- The flood basalt province is created in this manner
- **For example-** The Deccan plateau.



- The Deccan plateau was much older and the Decan traps came later after the Indian plate passed over the Reunion hotspot and lava got spread over the plateau.

Other Volcanic landforms:

- When the water sinks deep enough beneath the surface to be heated by a hotspot or a magma chamber or a geothermal belt.
- The folding process is so intense that heat is generated due to the friction and compression in between the rock layers.
- Such layers are called **geothermal belts.**
- This is the region for some volcanic landforms(hot springs) in the Himalayas and even in Bihar.
- Such heated water rises to the surface without any explosion.
- This results in **Hot Springs. Thermal Springs.**
- The water contains dissolved minerals and is of medicinal value.
- USA, India (Manikaran, Manikaran, Tatapani, Rajgir, Tatapani, Rajgir, Ladakh, etc.
- This can also be used to produce **Geothermal energy.**

Geyser:

- These are fountains of hot water and superheated steam which is ejected intermittently at regular intervals with an explosion.
- **For example-** Geysers of New Zealand, and the USA (Old Faithful Geyser of Yellowstone National Park, the world's first national park).
- The Old Faithful remains silent for 62 minutes, then pumps for 1 minute.

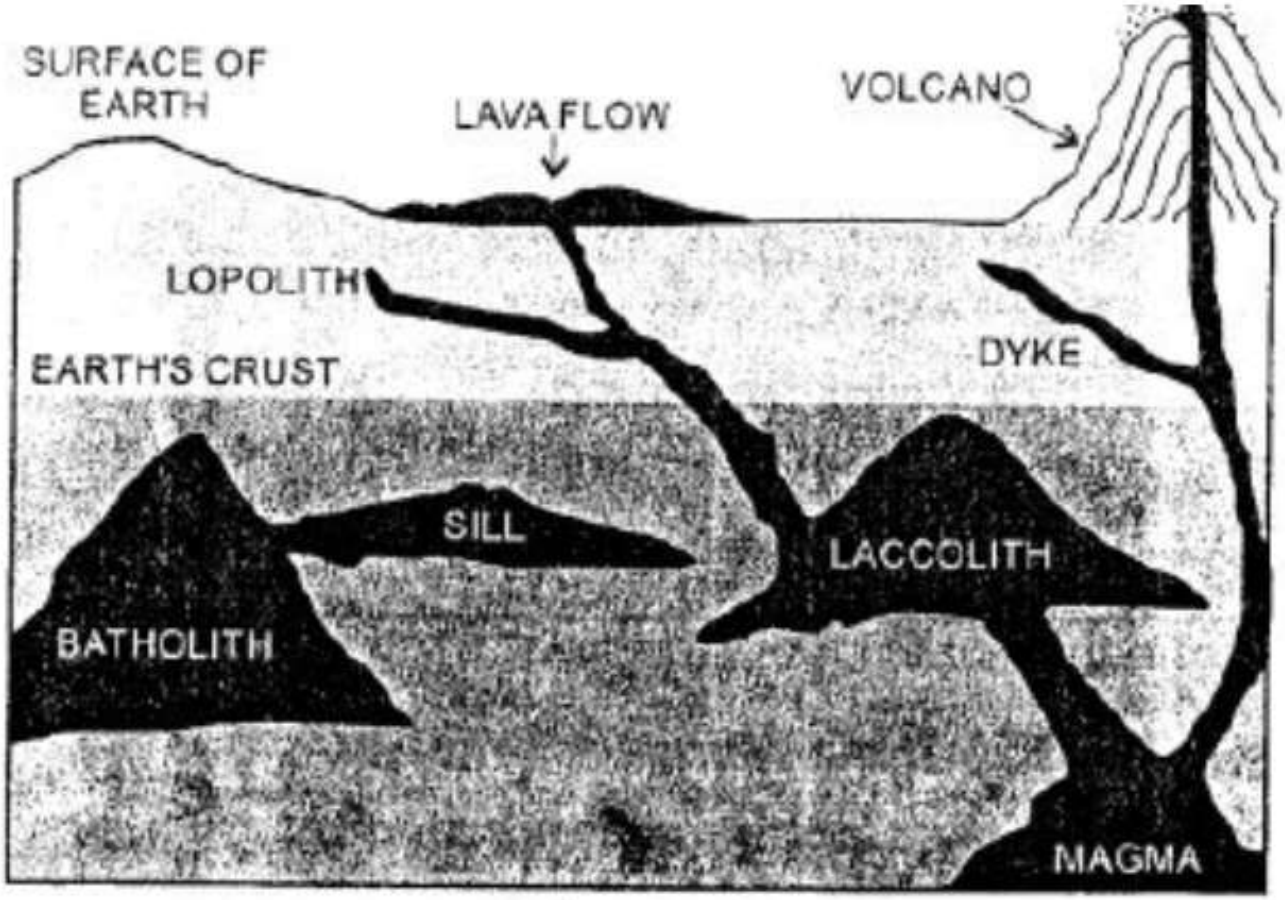
Fumaroles:

- It involves continuous jet-like emissions of steam and other gases.
- 

Mud Volcanoes:

- It involves the eruption of mud, mixed with water and gases and it may not have magma.
- It is associated with subduction zones.
- **For example-** Baratan Island in Andaman.

Intrusive Landforms:

- 

Intrusive Landforms

Batholith: Forms in deep inside

- Large, irregular, or dome-shaped features.
- **Laccolith:**
- Mushroom-shaped feature with active connection with the magma chamber.
- **Lopolith:**
- Saucer-shaped depressions occupied by magma.
- **Sil:**
- Cooling of magma parallel to bedding plain of sedimentary rocks.
- **Dykes:**
- Vertical walllike formations.

Significance of Volcanism:

- Building of different types of landforms such as volcanic mountains, flood-basalt provinces, etc.
- Volcanic ash increases the fertility of the soil.
- Direct source of information about the earth's interior.
- It is a source of igneous rocks and important minerals.
- Magma generation provides energy for plate movement.
- Impacts the human settlement patterns.
- It causes landslides, land subsidence, hot springs, geysers, etc.
- Results in tsunami generation, earthquakes.
- Releases greenhouse gases like Carbon dioxide, Sulfur dioxide, Methane, etc. which contribute to global warming.
- Large-scale release of smoke, dust, and particulate matter blocks incoming sunlight and may cause global cooling.

MAPPING EXERCISE (12:05 PM):

- Continents as per size- Asia, Africa, North America, South America, Antarctica, Europe, and Oceania.
- Asia touches the Pacific, Indian, and Arctic Oceans.
- Continents are marked as per our own convenience and they are not geological boundaries for continents.
- The **Ural Mountain range** is the boundary between Asia and Europe.
- Russia lies on both sides of the Ural mountains, hence it is both a European and Asia country.

Block mt.

- 

- The **Caucasus Mountain range** is another boundary between Asia and Europe.
- Ural and Caucasus mountains are the only land boundaries between Asia and Europe.

Fold Mountains

- The **Sinai Peninsula** connects Asia to Africa.

The Washington Post

- **New Guinea** Island is the land boundary between Asia and Oceania.
- 

- Mount Everest is the highest point in Asia and the world; it is exactly located at the boundary between Nepal and China.
- The **Dead Sea** is the lowest point in Asia and the world - 400 meters below sea level.

- 

- The Dead Sea lies in Israel and Jordan.

The topics for the next class are Geomagnetism and Earthquakes

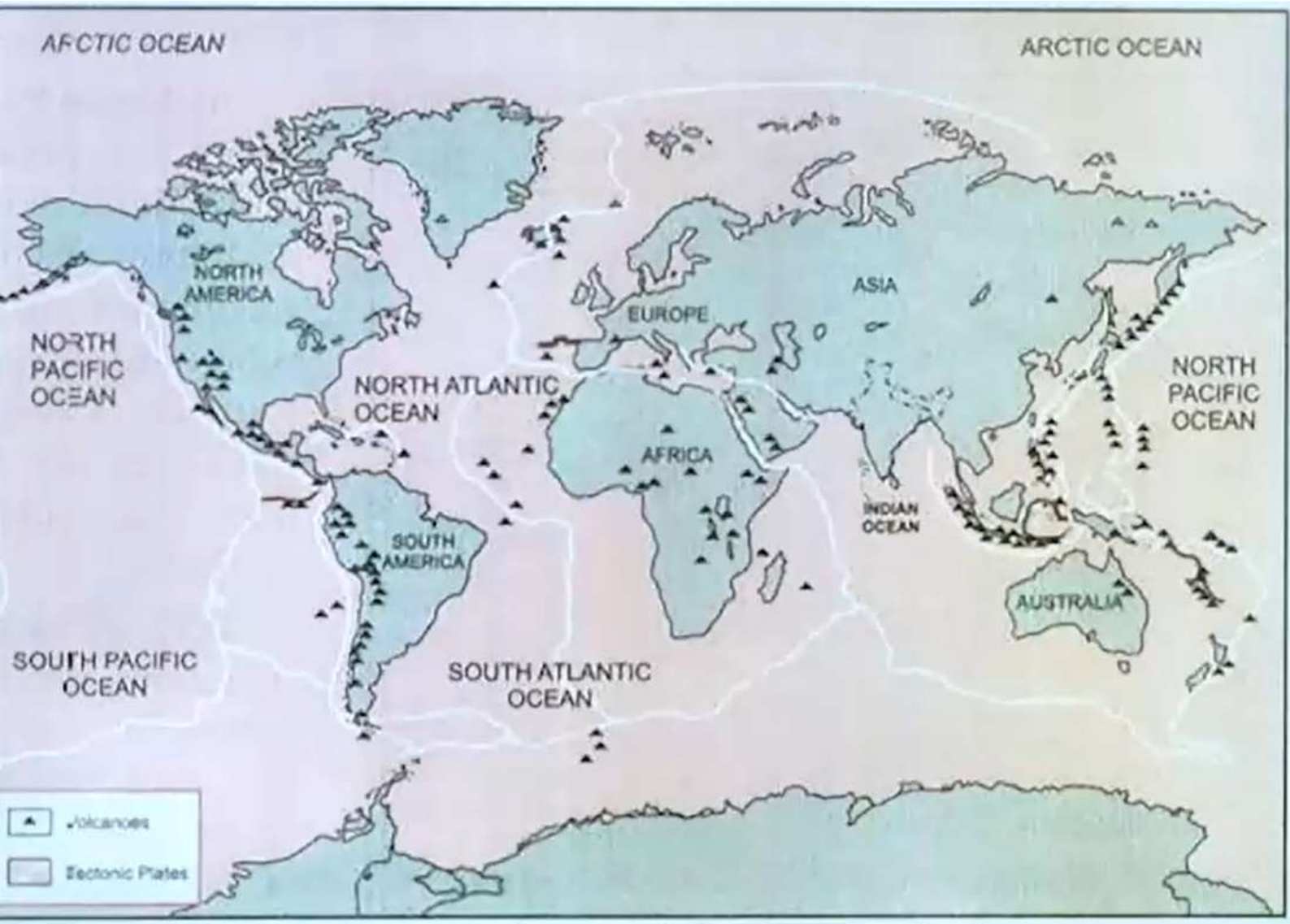
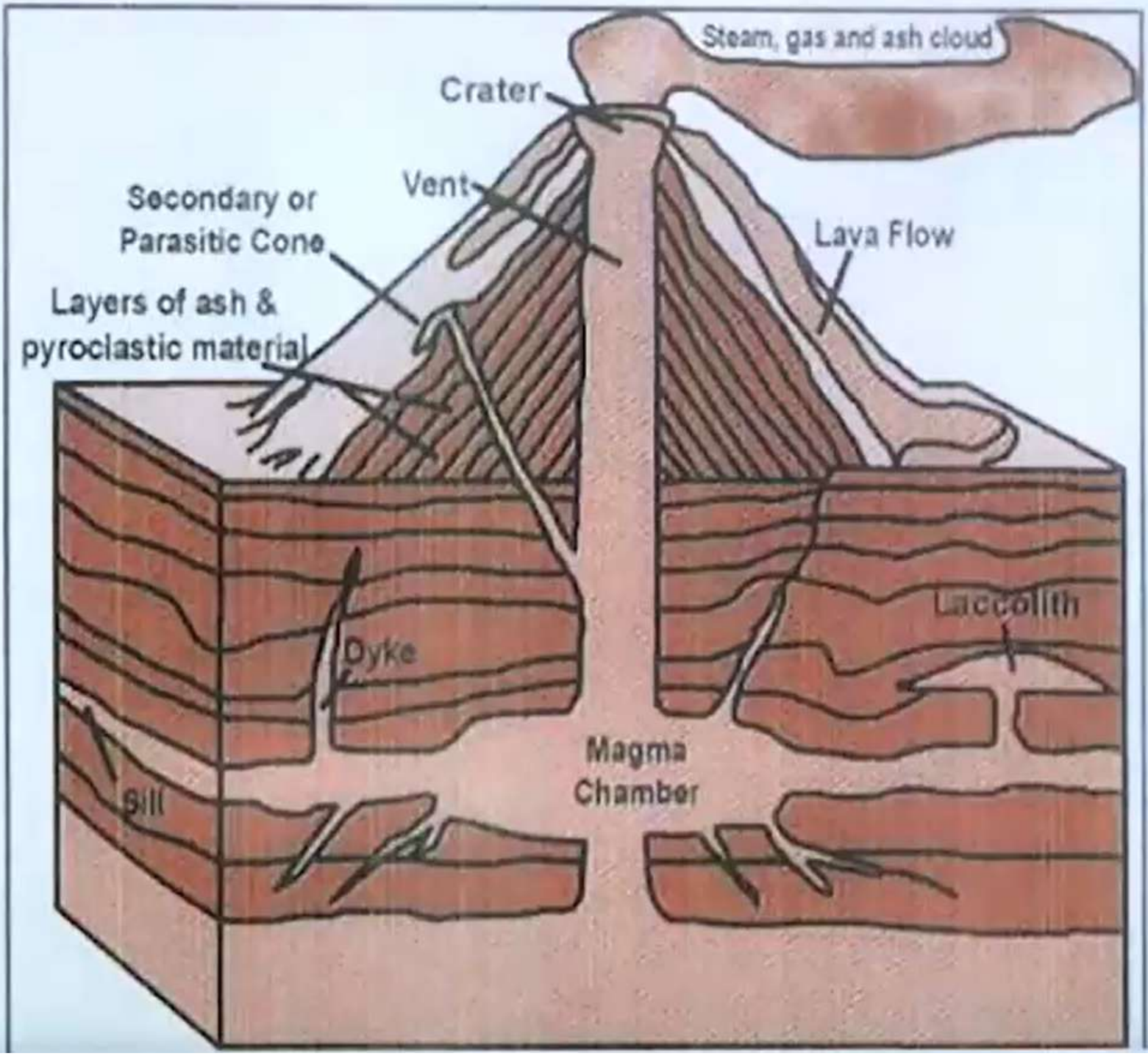
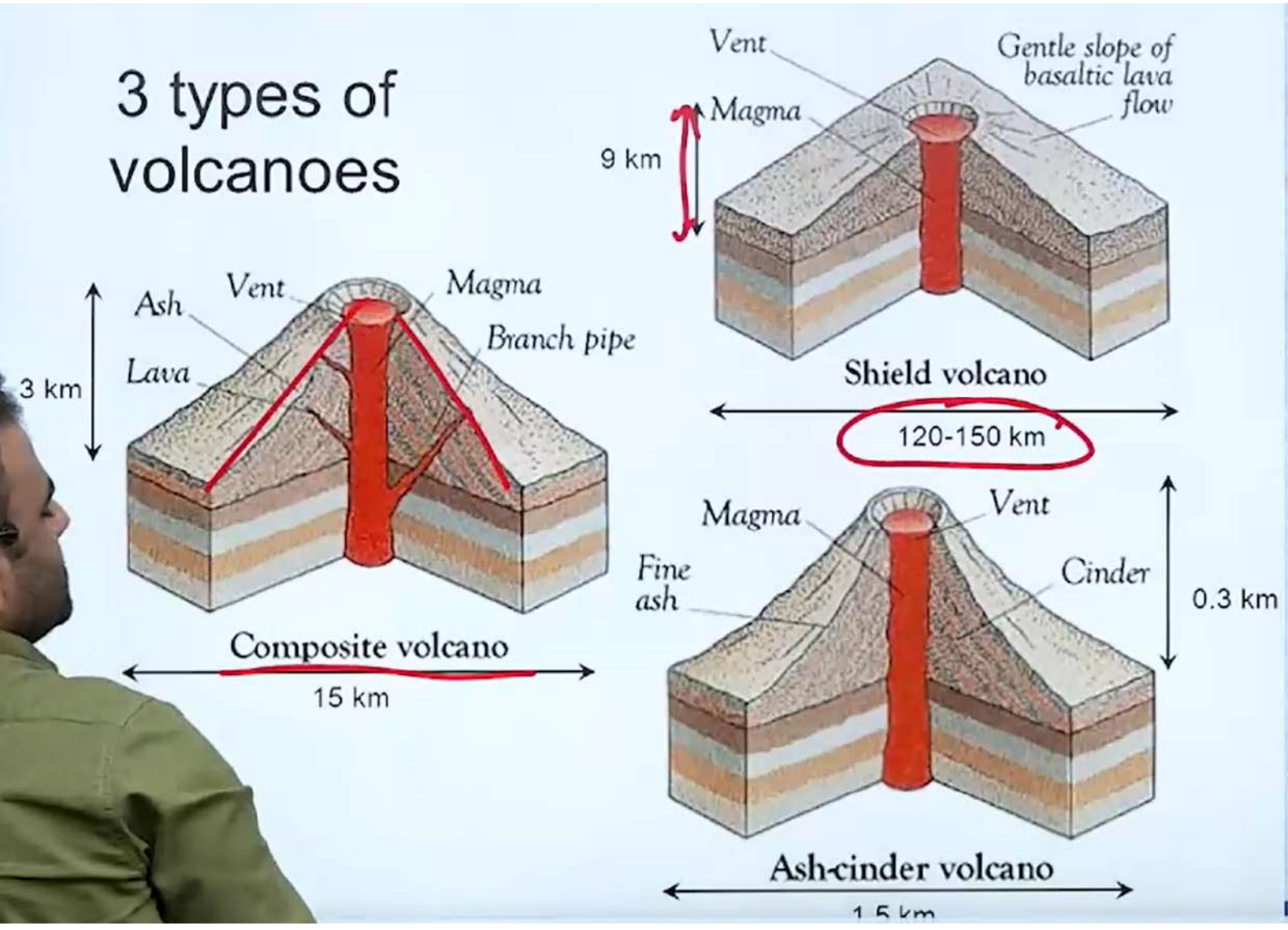


Fig. 8.1. Tectonic plates and distribution of volcanoes


Steam, gas and ash cloud
Crater
Vent
Secondary or
Parasitic Cone
Lava Flow
Layers of ash &
pyroclastic material
Laccolith
Dyke
Magma
Chamber
Sill

3 types of volcanoes



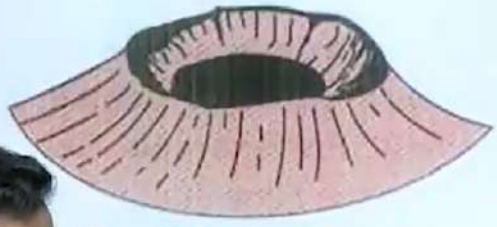


Fig. 8.4. Crater Lake

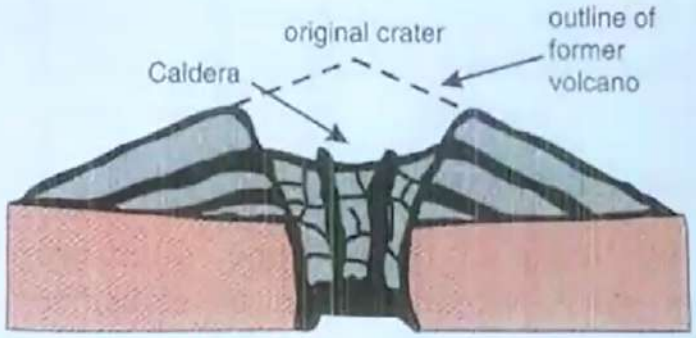


Fig. 8.6. A caldera

Vulcanism

Hot springs

Geyser

Fumaroles