

**GIST OF THE LESSON: CONTINENTAL DRIFT, EVIDENCES TO SUPPORT CONTINENTAL DRIFT, FORCES OF DRIFTING, POST DRIFT STUDIES, OCEAN FLOOR CONFIGURATION, DISTRIBUTION OF VOLCANOES AND EARTHQUAKES, CONCEPT OF SEA FLOOR SPREADING, PLATE TECTONICS, MAJOR AND MINOR PLATES, TYPES OF PATE BOUNDARIES RATES OF PLATE MOVEMENT, FORCES OF PLATE MOVEMENT& MOVEMENT OF THE INDIAN PLATE.**

**CONTINENTAL DRIFT: ABRAHAM ORTELIUS** a Duchy map maker 1596 first proposed the possibility of joining the continents such as America with Europe and Africa  
**ANTONIO PELLEGRINI** drew the map showing the three continents together.  
**ALFRED WEGENER** a German meteorologist put forth THE CONTINENTAL DRIFT THEORY. According to him,

All continents formed a single continental mass called PANGAEA

All oceans formed a single universal ocean called PANTHALASSA

AROUND 200 mya THE PANGAEA BEGAN TO SPLIT INTO TWO LARGE MASSES CALLED LAURASIA and GONDWANA LAND

By further splitting Laurasia formed northern continents and Gondwana land formed southern continents.

### EVIDENCES TO SUPPORT THE CONTINENTAL DRIFT

#### 1. The matching of continents (jig-saw fit)

- A. the shorelines of S. America and Africa have remarkable match
- B. a map was produced by Bullard in 1964 to show the jigsaw fit of these two continents.
- C. it was fit around 1000 fathom line of the shoreline

#### 2. ROCKS OF SAME AGE ACROSS THE OCEANS

- A. the belt of ancient rocks of 2000 my from Brazil coast matches with those of Western Africa
- B. Marine deposits of South America and Africa belong to Jurassic age.

#### 3. TILLITE

- A. sedimentary rock formed out of glacial deposits
- B. sediments from India have similar counter parts at different continents of south.
- C. tillite indicates prolonged glaciations
- D. The same glaciations is found in Africa, Falklands, Madagascar, Antarctica and Australia
- E. the glacial tillite indicates that unambiguous evidence of palaeo climates and drifting of continents.

#### 4. PLACER DEPOSITS

- a. Formation of placer deposits of gold in Ghana coast has no source rock.
- a. The gold bearing veins of rocks are found in Brazil

#### 5. DISTRIBUTION OF FOSSILS

- Identical species of animals and plants are found along the coastal regions of the different continents.
  - lemurs occurs in India , Madagascar and Africa.
  - The contiguous land mass was called LEMURIA
  - the fossils of mesosaurus were found in only South Africa and Brazil.

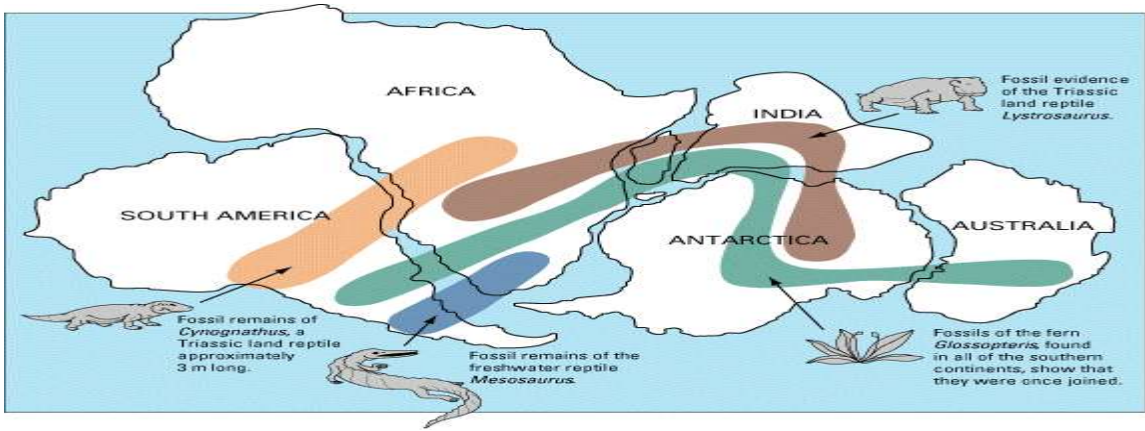


LEMURIA

MESOSAURUS



DISTRIBUTION OF FOSSILS



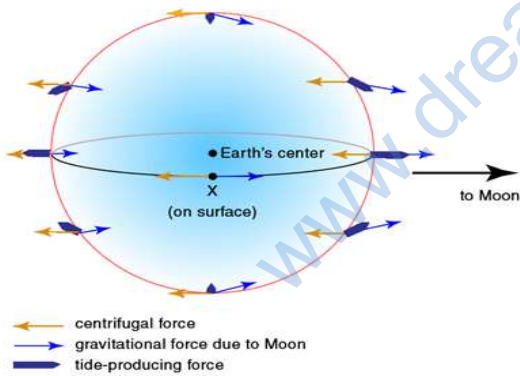
**FORCES FOR DRIFTING THE CONTINENTS**

1. **Wegner suggested that the movement responsible for the drifting of the continents was caused by**

- A. POLAR FLEEING FORCE
- B. TIDAL FORCE

**Possible driving forces for plate tectonics:**

2. bottom lithosphere tractions by convection currents.
3. trench pull (covered earlier).
4. ridge push (sliding off a high, crust in compression).
5. trench suck (rollback).
6. global expanding or contracting forces.
7. membrane forces on spinning ellipsoid (e.g. variants of polar fleeing forces).



**TIDAL FORCE**

Wegener suggested that these two forces are responsible for the movement of plates.

Most of the scholars consider that these forces are not sufficient to move the plates.

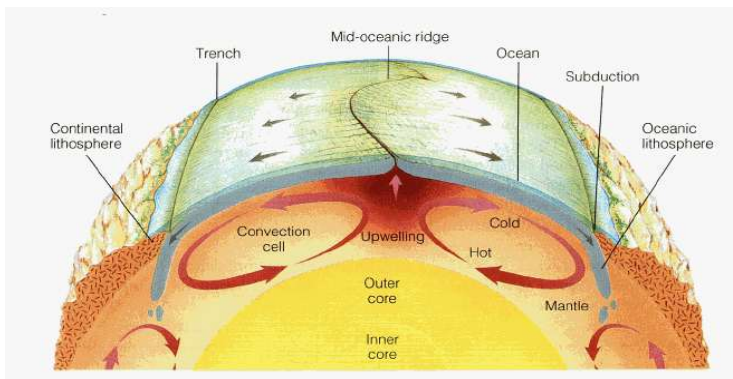
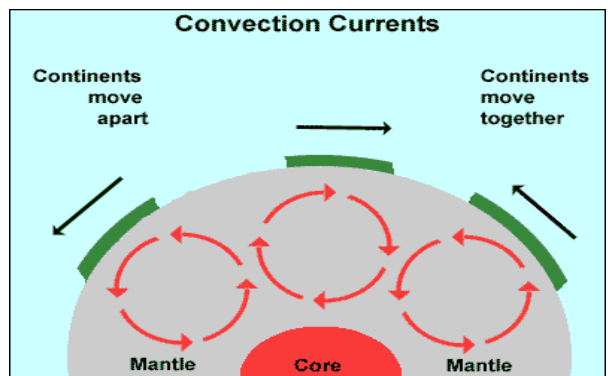
**POST DRIFT STUDIES**

Information collected from the ocean mapping is more useful to study the continental drift

**Convictional current theory**

It was proposed by ARTHUR HOLMES IN 1930

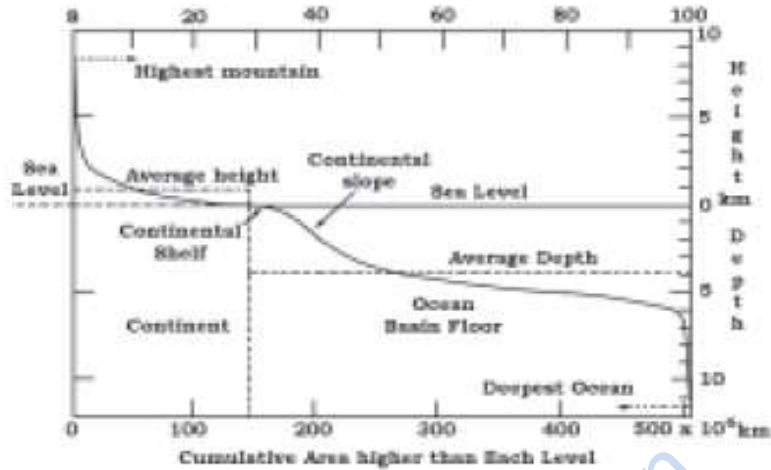
Due to difference in the temperature currents are formed due to disintegration of radioactive materials inside the earth. These currents are found entire mantle portion



## MAPPING OCEAN FLOOR

1. Existence of ridges and deep trenches nearby continental margins
2. Mid oceanic ridge is the most active for volcanic eruptions
3. The ocean floor is much younger than the continents
4. Rocks of equal distance of the ridge have similar chemical composition and age

## OCEAN FLOOR CONFIGURATION



## OCEAN FLOOR CONFIGURATION

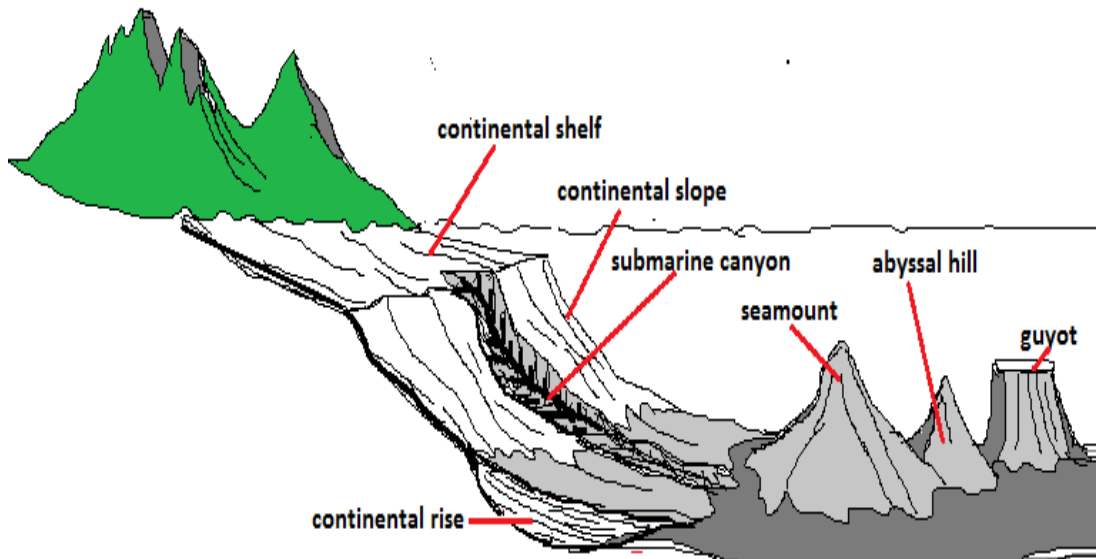
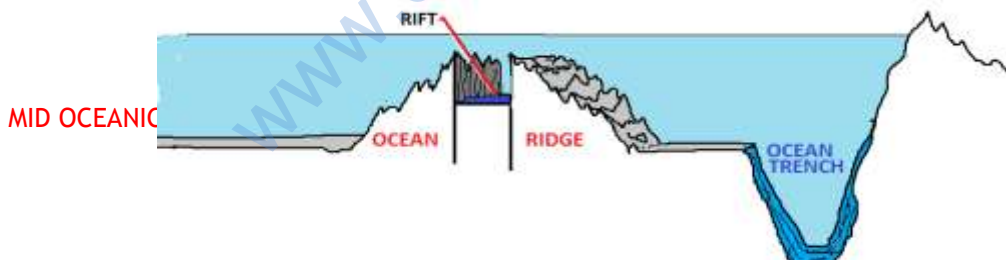
The ocean floor is segmented into three major divisions  
Based on depth and configuration

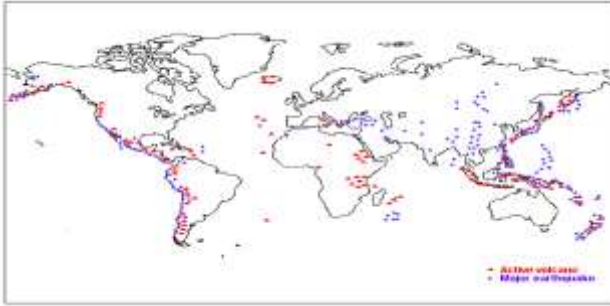
### 1. Continental margins

- a. Form transitional zone between continental shore and deep sea basins
- b. They include continental slope, shelf, continental rise and deep oceanic trenches

### ABYSSAL PLAINS

1. EXTENSIVE PLAINS
2. FOUND BETWEEN CONTINENTAL MARGIN AND MID OCEANIC RIDGE
3. CONTINENTAL SEDIMENTS GET DEPOSITED





### DISTRIBUTION OF VOLCANOES AND EARTHQUAKES

1. all volcanoes and earthquakes are parallel to the coast
  2. this line also coincides with mid- atlantic ridge
  3. alpine himalayan system
  4. around the pacific ocean it is called **ring of fire**
- Mid oceanic ridges**

1. Interconnected mountain system within the ocean
2. Longest mountain chain in the ocean floor
3. Consist of central rift system at the crust
4. Intense volcanic activity is found

### CONCEPT OF SEA FLOOR SPREADING

1. it was proposed by **Hess** in 1961
2. he believed that new lava pushes out the plates from the mid oceanic ridge
3. palaeo magnetic studies of the ocean floor reveals that
  - A. along the mid oceanic ridge there is intense volcanic eruption
  - B. huge amount of lava comes out along the mid atlantic ridges
  - C. the equidistant rock formations have similar age and chemical compositions & magnetic properties
7. rocks closer to the mid oceanic ridges are young and normal polarity
8. The age of rocks increases as the distance increases from the mid oceanic ridge
9. Oceanic crust is much younger (**200my**) than continental crust (**3200my**)
10. The sediments of ocean floor is very thin
11. earth quakes are common along the deep sea trenches

Positions of continents through geological past

### PLATE TECTONICS

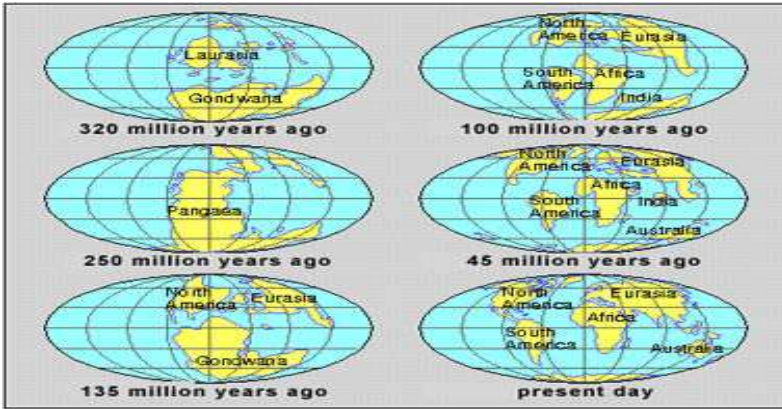
1. The theory of plate tectonics was introduced by McKenzie, parker and Morgan in 1967
2. A tectonic plate is also called as lithosphere plate
3. It is a massive irregularly shaped slab of solid rock
4. Consists of oceanic and continental sphere
5. Plates move horizontally over the Asthenosphere
6. Average thickness is 100 km of oceanic part and 200 km continental part
7. It may be oceanic or continental
8. Pacific plate is largest oceanic plate where as Eurasian plate is the largest continental plate

### MAJOR PLATES OF THE EARTH CRUST



**MAJOR PLATES**

## MAJOR PLATES



1. Antarctica And Surrounding Oceanic Plate
2. North American Plate
3. South American Plate
4. Pacific Plate
5. India-Australia-New Zealand PLATE
6. African Plate
7. Eurasian Plate

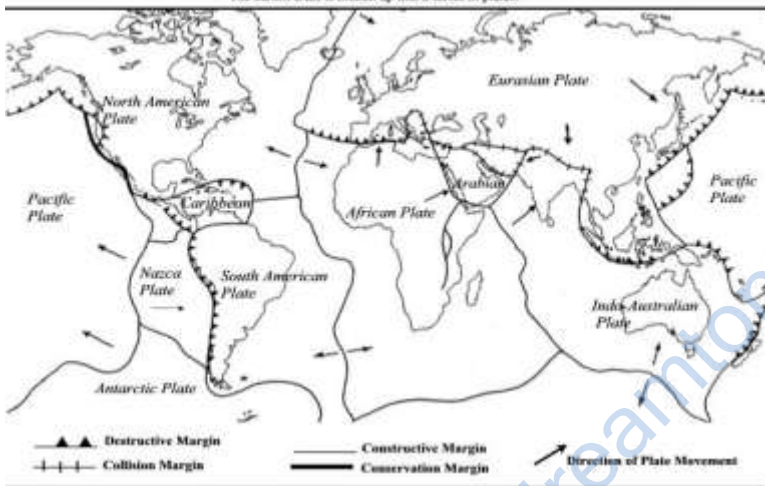
## MINOR PLATES

1. Cocos Plate
2. Nazca Plate
3. Arabian Plate
4. Philippine Plate
5. Caroline Plate
6. Fuji Plate

These plates are moving constantly throughout geological time not the continent believed by Wegener. Pangaea was the convergent of all the plates. Position of Indian subcontinent is traced with the help of rocks analyzed from Nagpur area.

### Major Plate Boundaries

The earth's crust is broken up into a series of plates.



## TYPES OF PLATE BOUNDARIES

### I. DIVERGENT BOUNDARIES

1. New crust is generated
2. plates move away from each other
3. These are called spreading sites
4. Ex. Mid Atlantic ridge

### II. CONVERGENT BOUNDARY

1. Crust is destroyed
2. sinking of plate is called 'subduction zone'
3. There are three ways in which subduction occurs
  - i. Ocean and continent
  - ii. Ocean and ocean
  - iii. continent and continent plates

Type of Margin	Divergent	Convergent	Transform
Motion	Spreading	Subduction	Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Topography	Ridge/Rift	Trench	No major effect
Volcanic activity?	Yes	Yes	No

(a)

(b)

(c)

### III TRANSFORM BOUNDARIES

1. Crust is neither produced nor destroyed
2. Plates slide horizontally
3. Perpendicular to the mid oceanic ridges
4. Differential movement of a plate at the same time
5. Rotation of the earth has its effect on this movement

### RATES OF PLATE MOVEMENT

1. The strips of normal and reverse magnetic field helped the scientists to study the rate of plate movement
2. Arctic ridge has the slowest rate less than 2.5 cm /year east pacific rise has more than
3. 15 cm/year

### FORCES OF THE PLATE MOVEMENT

1. Surface of the earth is dynamic
2. Interior is always mobile
3. Beneath the lithosphere there is always movement of magma horizontally
4. Heated material rises to the top and cooled material sinks down
5. This cycle is repeated over the time and form convection cells

### SOURCES OF HEAT

- A. Residual heat
  - b. Radioactive decay
6. It was first considered by Arthur Holmes in 1930
  7. Later it also influenced **Harry Hess**

### MOVEMENT OF INDIAN PLATE

1. Indian plate includes India and Australia
2. Northern boundary is along the Himalayas
3. It is the place of continental convergence
4. In the east it extends up to Rakinyoma mountains of Myanmar
5. Eastern margin is spreading site
6. Western margin extends along Kirthar mountains, Makran coast red sea rift .
7. The boundary between India and Antarctica is called divergent boundary
8. Till 225 m y a India was separated by **Tethys sea**
9. About 200 m y a India started its journey towards north
10. India collided with Asia about 40-50 m y a and caused the upliftment of Himalayas
11. About 140 m y a the position of Indian plate is at 50°s latitude
12. During the movement of Indian plate two events occurred in India
  - A. out pouring of lava and formation of Deccan plateau
  - B. Subsidence of west coast
14. The Himalayas started rising about 40 m y a



STAGES OF MOVEMENT OF INDIAN PLATE TO WARDS ASIAN PLATE AT DIFFERENT AGES