PLATE TECTONICS

The concept of plate tectonics has evolved from the hypothesis of ocean-floor spreading and transform faults. The overall concept was proposed almost simultaneously by **Mc. KENZI & PARKAR (1967) and MORGAN (1968)**. The basic idea is that the surface of the earth is covered by a small number of relatively thin shell like plates of rigid rocks, which are in motion relative to each other. The term plate was first used by **TUZO WILSON** when he defined transformed faults. Most of the earth's tectonic activities i.e. earthquakes, volcanism etc. are concentrated at boundaries between adjacent plates.

The velocity at which plates move varies from place to place and within the portions of the same plate ranging between 2 to 20 Cms./year. Although the rate is very slow, but the total movement with time is truly significant.

LE PICHON (1968) divided the earth's crust into following six major plates: -

1) Pacific Plate **2) American Plate** **3) African Plate**
4) Eurasian Plate **5) Indian Plate** **6) Antarctic Plate**

All plates include both continental and oceanic crust, except the Pacific Plate, which includes only the oceanic crust. Boundaries or margins of plates can, but need not coincide with the continental and oceanic crust.

TYPES OF PLATE MARGINS

Geological observations, geophysical data and theoretical considerations support the existence of three distinct types of plate margins, which are classified on the basis of relative movement of adjacent plates.

1) Divergent Plate Margin:

A divergent plate margin is a line along which two adjacent plates move apart from each other and along which new lithosphere is made. Along the axis of the mid-oceanic ridges (Mid-Atlantic ridge, east Pacific Rise) the plates move apart from each other and new material (volcanic) welling up into the void forms a ribbon of new material. Each of the separating plate creates half a ribbon of new lithosphere and thus new surface areas are added to the plates.

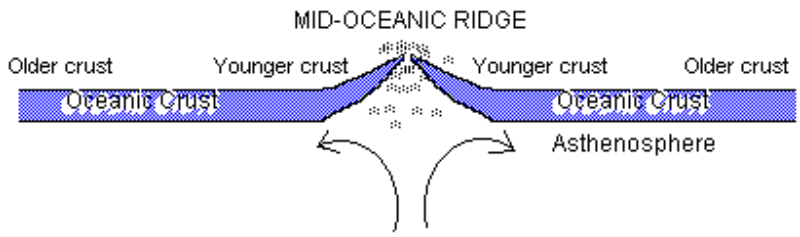

Fig 1- Mid-Oceanic ridge

Along the divergent plate margin capped on both sides by oceanic crust, Mid-oceanic ridges are found e.g. Mid Atlantic ridge (Atlantic Ocean) and along the divergent margin capped on both sides by continental crust rift valleys are found e.g. African rift valley.

Volcanic and seismic activities occur along divergent margins. The along mid-oceanic ridges basaltic lava and along the rift valleys carbonatitic lava is found. Shallow focus earthquakes occur along the mid-oceanic ridges.

2) Convergent Plate Margin:

A convergent plate margin is a line along which two plates move towards each other and along which lithosphere is destroyed. As we know that the earth is neither expanding nor contracting, the increase in lithosphere created along divergent boundary must be consumed/compensated by the destruction. Compensatory destruction of lithosphere occurs along the convergent margins and accompanied by subduction and continental collision. In subduction the heavier plate (i.e. oceanic plate) plunges beneath the another plate and gets destroyed.

Along convergent margin capped on both sides by the oceanic crust one plate (the heavier one) is subducted into the asthenosphere and continues to move down as a result of this ocean trench is formed e.g. Tonga Karmadec trench, Aleutian trench etc. The subducting plate is heated by friction with the surrounding material and gets melted. The magma produced in this way moves up and extrudes in the form of lava on the ocean floor and builds a series of volcanoes (Fig 2) parallel to the ocean trench e.g. Japanese Island.

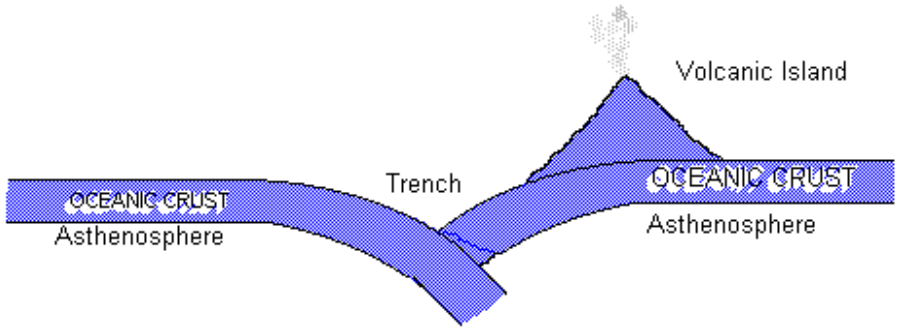

Fig 2 - Convergent margin capped on boath sides by oceanic crust.

A boundary where lithosphere is capped on one side by continental crust and on other by oceanic crust, oceanic plate is subducted beneath the continental plate, because the continental plate is lighter in weight than the oceanic plate. Here also due to friction partial melting takes place and a chain of volcanic mountains (Fig 3) are formed e.g. Andes mountains.

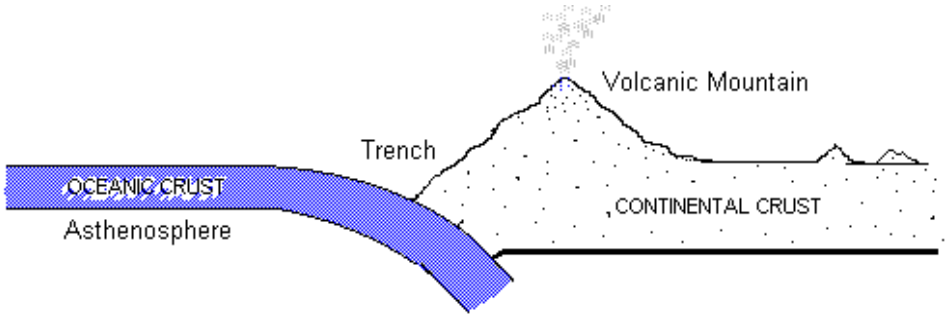

Fig 3 - Convergent margin capped on one side by oceani crust and on the other by continental crust.

If both converging plates consist of continents then instead of subduction, continental collision occurs because lightweight continental crust can not be subducted. Due to continental collision folded mountain (Fig 4) belt is formed. A classic example of continental collision is the formation of Himalayan mountains, produced during the Cenozoic era by the convergence of Indian and Eurasian plate.

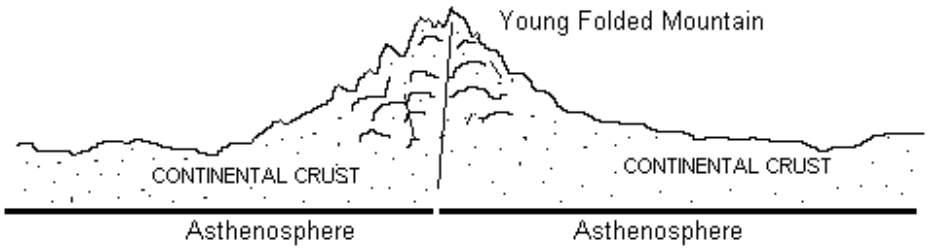

Fig 4 - Convergent margin capped on boath the sides by the continental crust.

Shallow, intermediate and deep focus (i.e. from 70 to 700 Kms. deep) earthquakes occur along the subduction zones. The zone of earthquakes that exists along a subducting plate is known as **Benioff zone**. It is names after H. Benioff, a geophysicist who first noted the existence of the zone. Volcanic activity also occurs along the subduction zones and here andesitic lava is found.

3) Transform Plate Margin:

Such types of plate margins are found along transform faults. Transform faults are always strike slip faults. Here the relative movement is parallel to the boundary that separates the plate. Transform faults are generally oriented perpendicular to the mid-oceanic ridge system.

Earthquake activity occurs along the transform faults because here the plates side past each other.

CAUSES OF PLATE MOVEMENT

Four ideas have been suggested to explain the causes of plate movement, which are as follows:

i) Dragging of plate by convection.
ii) Sliding of plate due to gravity.
iii) Pulling of plate due to sinking.
iv) Pushing of plates by lava pressure.

Only one mechanism can not move huge lithospheric plates hence it is suggested that probably all the mechanisms are simultaneously operating to make the plates move.