

## Surface Relief of the earth

### MAJOR GEOLOGIC FEATURES OF THE EARTH'S EXTERIOR

Lithosphere is divided into two main groups of first order relief features:

1. Continental Masses (between sea level and 1 km elevation)
  2. Oceans Basins (3 to 6 km or 10-20,000 ft below sea level)
- Scattered across parts of both are various volcanic edifices.

### Continental Mass

The major land areas of the world constitute about 29.2 % of the earth's surface.

If we take 100 fathom (or 180 m or 600 feet) below sea level as the continental boundary (continental shelf), this value will change to 35 %. Average altitude about 800 m.

In a general way the continents are broad, table like areas.

Continents can be best analyzed by organizing them into large natural regions called physiographic provinces where surface morphology and kinds of rocks form consistent association. They include:

- Mountains
- Plains
- Plateaus
- Shields

### MOUNTAINS

A mountain is considered to be any land mass that stands around 400 m or more higher than its surroundings. The great mountain belts of the earth have been named cordilleras (Spanish = strings). Individual parts of cordillera based on morphology include:

- Mountain ranges
- Mountain systems
- Mountain chains

### PLAINS

Features known as plains typically show small variations between the lowest and the highest parts or relief.

Commonly plains are underlain by sediments, and the surface of the plains has grown upward by addition of new layers of sediments at the top. Plains characterizes many:

- Coastal areas
- Interiors of continents
- Smaller tracks within mountain belts

### PLATEAUS

A plateau is a high standing area within which the rocks strata are generally horizontal. They may be also volcanic.

## SHIELDS

Areas referred to as shields or continental shields are generally low lying regions whose rocks have formed by the joining together of numerous ancient mountain belts.

They are usually thick and rigid. They have undergone erosion for long span of time, so have low relief.

They are composed of truly ancient rocks. Rocks as old as 3.8 billion years have been found in these areas.

## OCEANS AND OCEAN BASINS

### ***Ocean water and the hydrosphere***

The Hydrosphere is the collective name of the water on and near the surface of the earth in a liquid or solid (frozen) state. They occur in the oceans and seas, lakes, rivers, and occupy pore spaces beneath the earth (groundwater).

Solid water, in the form of ice is found in ice sheets, icebergs and glaciers.

## **Importance of water**

1. As transporter of regolith and as shaper of Earth's surface
2. Oceans act as a collection reservoir for nearly all substances
3. An essential ingredient for all forms of life.

## Sea Water

Sea water covers about 71 % of the earth's surface. But the aggregate area of the ocean basin is only 60 %. The ocean basin is thus more than full, and the overflow of sea water inundates nearly 26 million sq km of continental shelf. The North Sea, the Baltic and Hudson Bay are examples.

During the ice age much of the continental shelf was land. Mean water depth is about 4 km.

If water is uniformly distributed over the surface of the earth, it would form an ocean of 2750 m deep.

## OCEAN BASINS

### **Topography of the ocean basin floor**

Continuously recording echo-sounding apparatus (precision depth recorder) was used after world war II. It makes use of sound emitting device at the bottom of the ship.

The reflected sound is picked up by the microphone. Automatic recording device indicate the time. Reflections are plotted continuously by a writing instrument and gives the profile of the ocean bottom.

According to system of submarine landform classification by Bruce C. Heezen, Ocean basins fall into three major divisions:

- a. The continental margins
- b. The ocean basin floors with the trenches, and
- c. The Mid oceanic ridges

### a. Continental margins

**It includes:**

- Continental shelves
- Continental slopes
- Continental rise
- Submarine canyons

**Continental shelves:** They fringe the continents in width from a few km to more than 300km. Generally having very smooth and gently sloping floors, Mostly they are less than 600ft (180m) deep. Eastern coast of USA is the example.

**Continental slopes:**

**Along the sea-ward margins the continental shelves give away to the continental slopes. The actual inclination with horizontal is only 3-6°, but compared to submarine relief, it is high. The continental slope drops from the sharply defined brink of the shelf to depths of 1370-3200m (4,500-10,500ft)**

**Continental rise:**

**The continental slope lessens in steepness and is replaced by continental rise. A surface of much gentler slope, decreasing in steepness towards the ocean basin floor. Ranging in width from hundred to several hundred km, they have moderate to low relief. It reaches up to the depth of 5 km at its outer margin.**

### Submarine canyons:

**Notching the continental slope visualized as resembling gullies cut by water erosion in the side of a hill, but on a huge scale. They are scored by currents of muddy water (Turbidity flows)**

### B. The ocean basin floors:

**Second of the major topographic divisions of the ocean basins is the extensive region of basin floor-generally lying in the depth range of 4600-5500 m (15,000-18,000 ft). It is divided into three categories of forms:**

1. Abyssal plains and hills
2. Oceanic rises
3. Sea mounts.

### 1. Abyssal plains and hills

1. It is an area of the deep ocean floor having a flat bottom with very faint slope. Characteristically situated at the foot of the continental rise. It is found due to the deposition of sediments brought by the turbidity currents and all the irregularities are buried.
  - a. Mid oceanic canyons: They are found in abyssal planes also. It is due to branching turbidity channels like the river system on the land.
  - b. Abyssal hills: It is an area of hundreds of miles in breadth over which the surface rises several hundred feet above the surrounding abyssal plains. For example Bermuda Rise.

### MID OCEANIC RIDGES

**It is 64,000km in length. The ridge runs down the middle of the North and South Atlantic oceans, into the Indian ocean basin, then passes between Australia and Antarctica to enter the South Pacific basin.**

**Turning north along the eastern side of the Pacific (East Pacific Rise), the ridge contacts the North American Continent along the coast of Mexico. The Mid-Oceanic Ridge also extends across the Arctic Ocean basin.**

## Mid-Atlantic Ridge

It is a belt of 2000 to 2400 km wide, in which the surface rises through a series of steps from abyssal plains on both sides toward the central, or median, line, where the ridge assumes mountainous proportions. Since the higher points lie at depth of 1800 to 2700 m, the mid Atlantic ridge has a height of roughly 3700 m.

## Trenches

Ocean floor contains extremely deep grooves that are occasionally more than 11,000 m (36,000 ft) deep. Although these deep-ocean trenches are relatively narrow and represent only a small fraction of the ocean floor, they are nevertheless very significant features.

Some trenches are located adjacent to young mountains that flank the continents, e. g. the Peru-Chile trench off the west coast of S. America parallels the Andes Mountains. Other trenches parallel linear island chains called volcanic island arcs.