

**TOPIC: -**

**OCEAN FLOOR TOPOGRAPHY.**

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## **OCEAN FLOOR TOPOGRAPHY.**

### **INTRODUCTION: -**

Seas and Oceans are blue beauties of the planet earth. Oceans are vast body of saline water occupying the great depressions on the earth. They belong to the hydrosphere and cover almost 97% of it. Oceans cover 361 million Sq.km of the earth's surface. The volume of water is 1.37 billion cubic km. They are extensive, exhaustive and exploitable marine ecosystems. Very huge masses of water with varied dimension exist as oceans. On-shore and off-shore marine ecosystems are characterized by very distinct features with unique fauna and flora. They hold many marine habitat and contain a lot of natural resources.

When we move towards the seashore, we may see the beaches with splashing tides and dancing waves. There is a bluish water body seen as a straight flat plane denoting the sea-level. Waves coming towards the land break while nearing towards the coast and subsides while touching the beach. The coastline is the boundary between land and ocean. The surface beneath the oceanic waters is characterized by a lot of relief features. The structure, configuration and relief features of the oceans also vary from each other.

All major oceans and seas vary in their sizes, shape, depth, areal extension and in all other aspects like temperature, density, salinity and chemical composition. The marine geological, chemical and biological information and data are very vast and useful for studying and analyzing the oceans.

On the basis of Bathymetry and other studies, the morphology of Ocean basins includes:

- 1) Continental margins encompassing Continental shelf & Continental slope,
- 2) Deep ocean basins encompassing the Abyssal plains, abyssal hills, ocean trenches, Mid- oceanic ridges and deep ocean floor.

## OCEAN BASINS: -

Our earth is the only planet in the solar system which has water in abundance, hence, it is often called a 'watery Planet'. About 71 % of the earth's surface is covered by water. Oceans form a single, large, continuous body of water encircling all the landmass of the earth. They account for four- fifth of the Southern Hemisphere and three fifth of the Northern Hemisphere. They contain 97.2 percent of the world's total water.

There are four principal oceans in the world which are separated largely on the basis of their geographical locations. These are the Pacific Ocean, the Indian ocean, the Atlantic Ocean and the Arctic Ocean. All the other seas, inland seas or the arms of the oceans, are counted within these four main oceans.

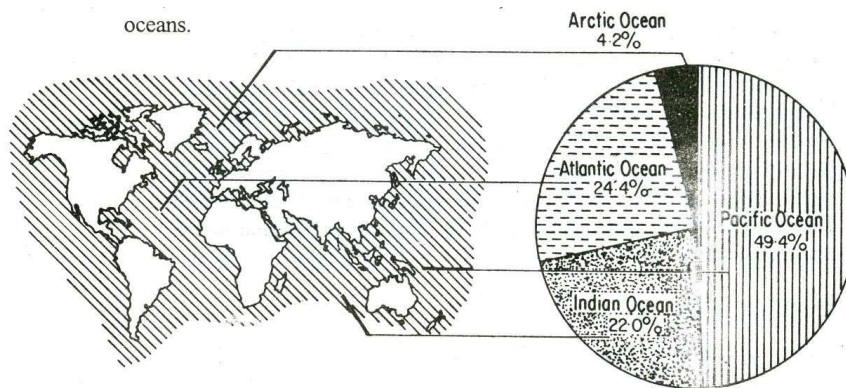


Fig.1: The Oceans and their Percentage Share of the Planet's total Ocean Area.

## THE RELIEF OF THE OCEAN BASINS: -

The ocean water conceals a considerable variety of landscape very similar to its counterpart on the continents. There are mountains, basins, plateaus, ridges, canyons and trenches beneath the ocean water too. These relief features found on the ocean floor are called submarine relief. The Ocean basins are broadly divided into four major sub-divisions. They are:

- A. Continental shelf;
- B. Continental slope;
- C. Abyssal plains and

#### D. The ocean deeps.

- (a) Continental shelf;
- (b) Continental slope;
- (c) Abyssal plains and
- (d) The ocean deeps.

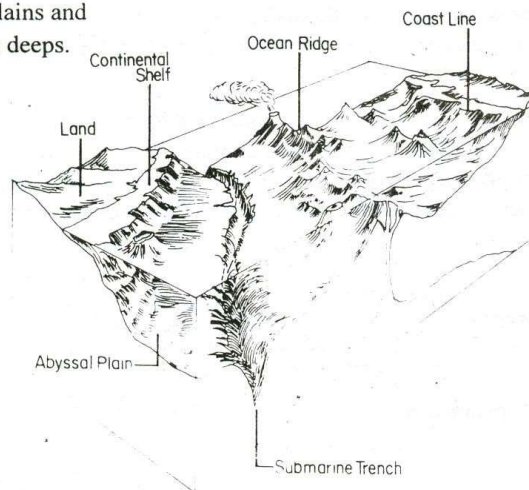


Fig. 2: The Relief of the Ocean Basins

#### **CONTINENTAL SHELF: -**

There is no clear or well-defined line separating oceans from continents. In fact, continents do not end abruptly at shoreline. They slope seaward from the coast to a point where the slope becomes very steep. The shallow submerged extension of continent is called the continental shelf. The depth of this shallow sea water over the continental shelf ranges between 120 to 370 metres. The width of the continental shelf varies greatly ranging between a few kilometres to more than 100 kilometres. This variation can be seen even in the context of Indian peninsula. The continental shelf off the eastern coast of India is much wider than that of the western coast. Similar variations are seen all over the world. Off the coast of West Europe, it extends to 320 kilometres from the Cape of Land's End. Off the coast of Florida, the shelf is 240 kilometres wide. They are much narrower or absent in some continents, particularly where fold mountains run parallel or close to the coast as along the eastern Pacific Ocean. Most of the continental shelves represent land which has been inundated by a rise in sea level. Many regard their formation due to the erosional work of waves or due to the extension of land by the deposition of river borne material on the off-shore terraces. Off the coast regions which were once covered by ice sheets, they may have developed due to glacial deposits. The continental shelves are of great importance to man. The shallow water over the shelf enables sunlight to penetrate through the water to the bottom and encourages growth of microscopic plants and animals called planktons. These planktons are the food for fishes. Continental shelves are the source of fishes, mineral including sand and gravel. A large quantity of the world's petroleum and natural gas is obtained from these shelves. The Bombay High and the recent discovery of petroleum in the Godavari basin are examples of on shore drilling on the continental shelf. Coral reefs and lipoclastic materials are also common on continental shelves. One of the striking features of the continental shelf is the presence of submarine canyons which extend to the continental slope. These canyons are 'steepsided valleys' cut into the floor of the seas. They are very similar to the gorges found on the continents. Godavari Canyon in front of the Godavari river mouth is 502 metres deep.

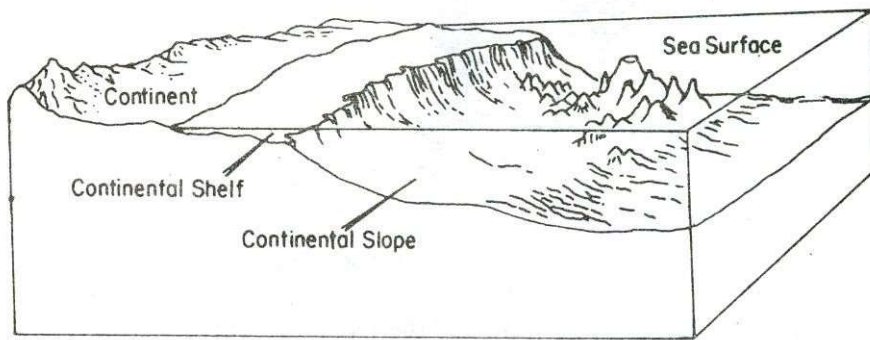


Fig.3: Submarine Canyon

One of the reasons for the formation of submarine canyon is underwater landslide. The sediments collected on the continental shelves get dislodged by a storm or an earthquake. The force of these moving sediments erode the slopes as they come down and as a result submarine canyons are carved out. The continental shelf is generally considered to be territorial water extent of the nations to which it adjoins.

#### CONTINENTAL SLOPE: -

The continuously sloping portion of the continental margin, seaward of the continental shelf and extending down to the deep sea floor of the abyssal plain, is known as continental slope. It is characterized by gradients of 2.5 degrees. It extends between the depth of 180 to 3600 meters. In some places, for example, off the shore of Philippines, the continental slope extends to a great depth. Continental slopes, mainly due to their steepness and increasing distance from the land have very little deposits of sediments on them. Sea life is also far less here than on the shelf.

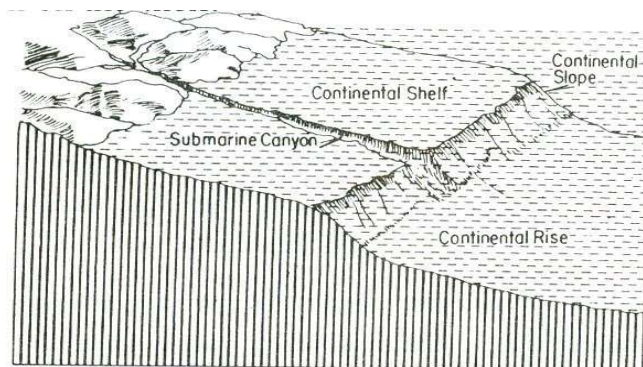


Fig. 4: The Continental Shelf and Slope

Along the base of the continental slope is a deposit of sediments. This belt of sedimentary deposits forms the continental rise. In some regions the rise is very narrow but in others it may extend up to 600 km in width.

#### ABYSSAL PLAIN: -

Abyssal plains are extremely flat and featureless plains of the deep- ocean floor. In fact, the abyssal plains are likely the most level areas on the earth. Abyssal plains covering a major portion

of ocean floor between the depth of 3000m to 6000m. They were once regarded as featureless plains but modern devices have shown that they are as irregular as the continental plain or surface. They have extensive submarine plateaus, hills, guyots and seamounts. The floor of the abyssal plain is covered by sediments. The plains close to the continents are covered mostly by sediments brought down from the land. But those seas which favour, an abundant growth of organisms have a thick layer of sediments, formed from the remains of living things. These sediments are called oozes. Some of the open seas do not support enough life to produce ooze on the floor. They are covered with a type of sediment called red clay which is of volcanic origin or made up of tiny particles brought by wind and rivers.

### **SUBMARINE RIDGES: -**

The lofty mountain systems which exist on the continents is also represented beneath the ocean waters. These oceanic mountains are known as submarine ridges. They are linear belts occurring near the middle of the oceans and are also called mid-oceanic ridges. All the mid oceanic ridges constitute a world-wide system which is interconnected from ocean to ocean. These ridges are intersected by faults. The oceanic ridge is the site of frequent earthquakes. Volcanism is common in ocean ridges and it produces many relief features. The Mid-Atlantic Ridge is the largest continuous submerged mountain ridge which runs from north to south in the Atlantic-Ocean. It is in the shape of S. At some places, the peaks, rise above the surface of water in the form of islands. Many of the islands are volcanic in origin. The East Pacific Ridge and Carlsberg Ridge are some of the important submarine ridges.

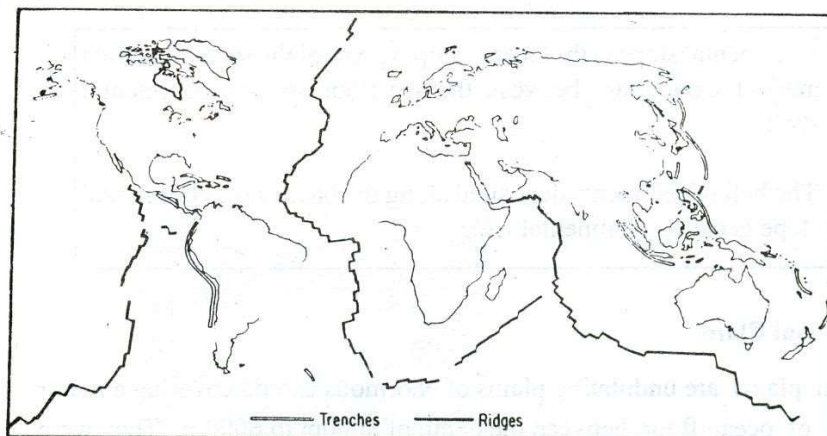


Fig .5: The World Wide System of Submarine Ridges and Trenches.

### **SEAMOUNTS AND GUYOTS: -**

Scattered over the entire sea floor are thousands of submerged volcanoes with sharp tops called seamounts. Sometimes they rise above the sea as isolated Islands. Hawaii and Tahiti Islands are the exposed tops of volcanoes. Volcano rising above the ocean floor whose top has been flattened by erosion and is covered by water is called guyot.

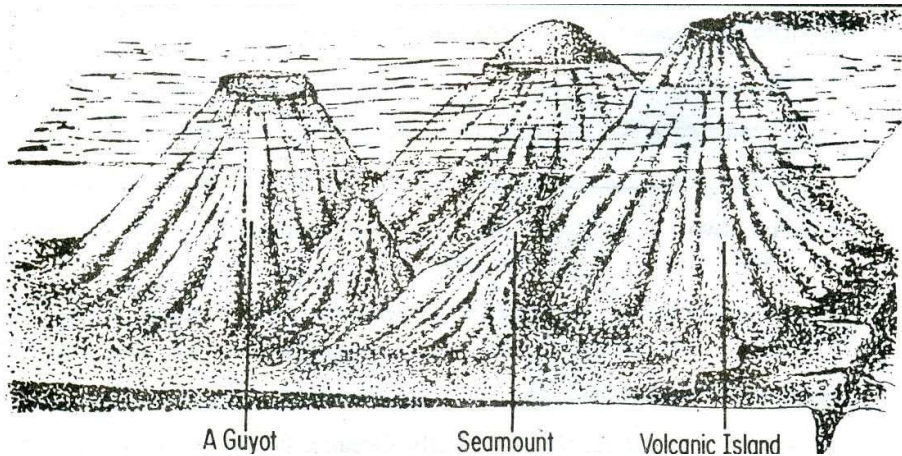


Fig. 6: Seamounts and Guyots.

### **THE OCEAN DEEPS: -**

The ocean deeps are the deepest part of the ocean. They are long, narrow, steep sided and flat-floored depressions on the ocean floor. They are generally called submarine trenches. These trenches are not always located in the middle of the ocean basins, as may be generally expected but are situated very close or parallel to the continents bordered by fold mountains. They are usually found adjacent to the areas of volcanic and earthquake activity. Great earthquakes and tsunamis are born in them. They occur in all the major oceans. The Pacific Ocean has the largest number of trenches. The Mariana Trench in 'the Pacific Ocean is the deepest known part of the oceans. This trench is so deep that if we place the highest mountain of the world - the Mt. Everest in it, even this shall have a few kilometers of water above its summit.

**MINOR RELIEF FEATURES: -** Apart from the above four major relief features of the ocean floor. Some minor but significant features are predominating in different parts of the oceans. These are as follows: -

#### **1. MIDOCENIC/ SUBMARINE RIDGE: -**

Mid-ocean ridges are created by the upwelling of basaltic lava and lateral rifting of ocean crust . They form a rift valley system that encircles the Earth along a total length of over 75,000 km . The mid-ocean spreading ridge covers the largest fraction of abyssal zone in the Arctic Ocean, where it characterizes 4.76% of the area of abyssal zone, and it is absent from the Mediterranean and Black Sea. The greatest area of mid-ocean ridges occurs in the South Pacific Ocean where this feature type covers an area of 1,868,490 km<sup>2</sup>.The mid-ocean ridges are the Earth's largest volcanic system, accounting for more than 75% of all volcanic activity on the planet. The heat from this volcanism is dispersed by hydrothermal circulation of seawater. Hot seawater venting from the seafloor supports exotic benthic communities that have evolved to survive by using the hydrogen sulphide dissolved in the hot fluid (discussed further below). The mid-ocean ridges are flanked on either side by abyssal hills and hilly abyssal plains .

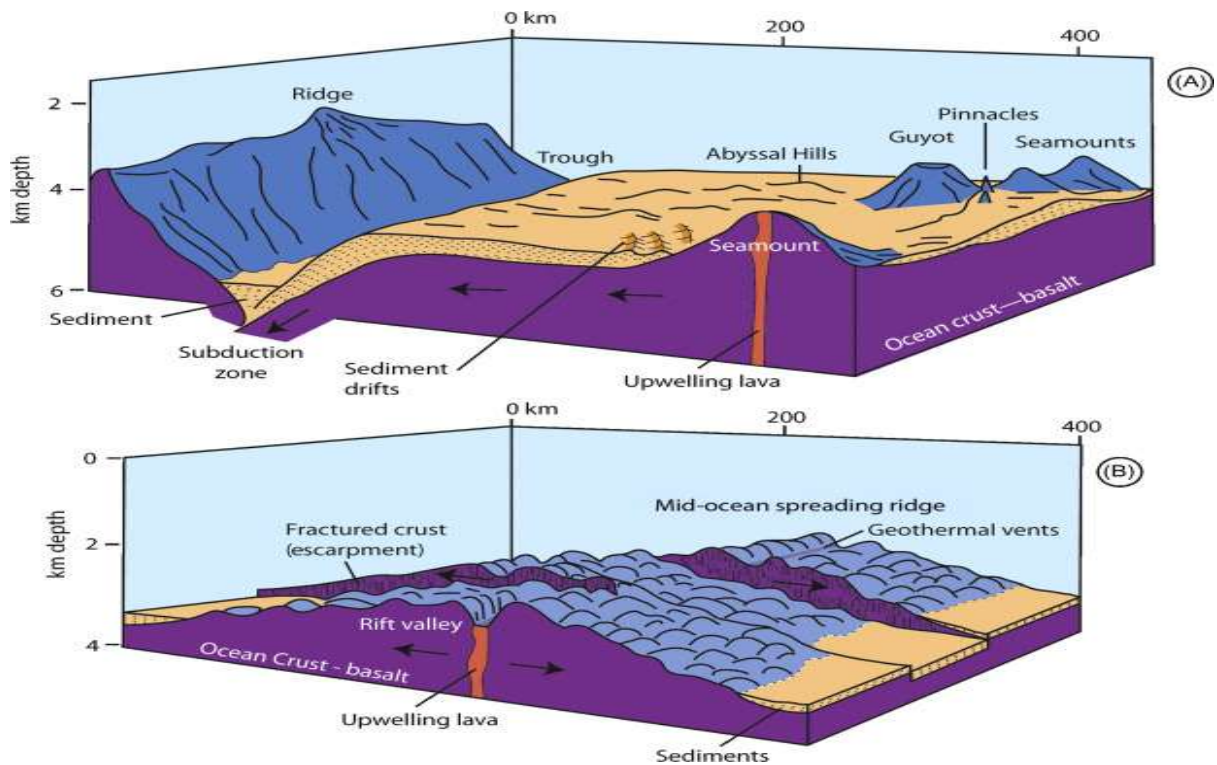


Fig. 7: Mid oceanic Ridge

2. **SUBMARINE CANYONS:** - These are deep valleys, some comparable to the Grand Canyon of the Colorado river. Ex.- Hudson canyon is the best known submarine canyon in the world.
3. **ATTOL:** - Atolls are low islands found in the tropical oceans consisting of coral reefs surrounding a central depression. It may be a part of a sea lagoon or sometimes enclosing a body of fresh, or saline water.
4. **ISLAND ARCS:** -

Island arcs are curved chains of volcanic islands. They are generally convex towards the open sea. Due to this nature, they are called as arcs. They are hundreds and thousands of extinct volcanoes in the ocean floors. These regions are seismically active zones. Island arcs are topographically and structurally continuous features. These are formed when two oceanic plates converge and collide. The melting of the descending plate rises upwards as an extended magma, to form the islands. Most of these eruptions are unnoticed. In some localities, especially in islands, one can see the impacts as mud volcanoes and hot springs. Various features found in the ocean basins are not permanent. Some parts of the ocean may be closing due to plate movements and some part may be expanding. This process of opening and closing of the ocean basin is called as Wilson cycle.



## **CONCLUSION: -**

Water is important for life on the earth. It is required for all life processes, such as, cell growth, protein formation, photosynthesis and, absorption of material by plants and animals. There are some living organisms, which can survive without air but none can survive without water. All the water present on the earth makes up the hydrosphere. The water in its liquid state as in rivers, lakes, wells, springs, seas and oceans; in its solid state, in the form of ice and snow, though in its gaseous state the water vapour is a constituent of atmosphere yet it also forms a part of the hydrosphere. Oceans are the largest water bodies in the hydrosphere. In this lesson we will study about ocean basins, their relief, causes and effects of circulation of ocean waters and importance of oceans for man.