

## ***Features of Ocean Relief***

By

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**Water** is essential for all the living things and creatures on the earth. They need water for their different uses and continuation of life. In our solar system at present only earth is fortunate to have abundance of water. As you all know; no other planets of the solar system have sign of water except Mars. It is the only resource which is found in all the three stages (i.e. solid, liquid & gas) of matter.

Geographically  $3/4^{\text{th}}$  (i.e. 71%) of the earth surface is covered with water. Out of which 97.3% is salty and 2.7% is fresh water. The large water bodies (remains of Panthalasa) are called oceans. All oceans are connected to each other. The total volume of the world ocean is approximately 1.3 billion cubic kms and the average depth of ocean is 4000 meter. All oceans have salt water. In Pacific Ocean 49.9%, in Atlantic Ocean 25.7%, in Indian Ocean 20.5% and in

Arctic Ocean 3.9% of all oceanic water is found. 75% of the fresh water is found in the glaciers and ice-sheets(2%) of Antarctica, Greenland and in mountainous regions whereas 25% of the fresh water is found in rivers , lakes , ponds ,streams, wells and in underground level(less than 1%). On the globe, Southern Hemisphere has more water; hence is called **watery hemisphere**. Earth is also called **Blue Planet** and **Water Planet** due to huge occurrence of water. Due to Raleigh scattering the propensity is for shorter wavelength at blue end light to be scattered more than longer wavelength red end. The water molecules during daytime absorb blue light as it has short wavelengths. That's why ocean appears blue. The sources of water are- Rivers (surface water), underground water, atmospheric water and ocean water.



*It is impossible to see relief of oceans through necked eye .Challenger expedition has given tremendous and revolutionary information regarding ocean relief. The expedition has broken some earlier myth and gave the new facts based on scientific study/techniques. Challenger expedition concluded that the deepest part is near the coast not in the central/middle part of the oceans.*

### **DISTRIBUTION OF RELIEF**

<b>Class interval of relief</b>	<b>% of oceanic area</b>
0-200	7.6%
200-1000	4.3%
1000-2000	4.2%
2000-3000	6.8%
3000-4000	19.6%
4000-5000	33.0%
5000-6000	23.3%
Above 6000	1.2%
<b>Total</b>	<b>100.0%</b>

### **OCEANS WITH RELIEFS (in %)**

<b>Class interval of relief (in m.)</b>	<b>Atlantic ocean</b>	<b>Pacific ocean</b>	<b>Indian ocean</b>
0-200	3.8	5.7	4.2
200-1000	7.1	3.1	3.1
1000-3000	14.1	9.1	10.8
3000-4000	18.5	18.5	24.0
4000-6000	55.9	61.8	57.5
Above 6000	0.6	1.8	0.4
<i>total</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>

<b>OCEAN</b>	<b>BASE</b>	<b>APEX</b>
ATLANTIC OCEAN	CAPE HORN- CAPE OF GOOD HOPE	EAST OF GREENLAND
INDIAN OCEAN	IN SOUTH	BAY OF BENGAL AND ARABIAN SEA
PACIFIC OCEAN	IN SOUTH	NEAR ALEUTIAN ISLAND

Another fact came out that the central part of the oceans has longest mountain ranges in the form of **Mid Oceanic Ridge**. The relief of ocean is more varied than continents. The average depth of ocean is nearly 3800-4000 meters whereas; it is only 840 meters for continents. Hypsographic or Hypsometric curve is suitable for showing the (depth and height) relief of oceans and continents. The line on the map joining the places or points of equal depth on the sea floor is known as **Isobaths**. From continent to the deep of the ocean; six major reliefs are found successively.

### **Six major divisions of ocean reliefs:**

**1. Continental shelf-** Continental shelf is a granitic structure found up to 200 m. of depth and considered as the part of continent. Average slope of the relief is 17 feet per mile ( $1^{\circ}$  to  $3^{\circ}$ ). The width of continental shelf can be about 5 kms to 1500 kms. Continental shelves are narrower where mountains are present near the coast and much wider where deltas are found near the coast. Eastern coast of India and eastern coast of China have wider shelves. The wider continental shelves are very gentle. Continental shelf on the eastern coast of U.S.A. is 120 kms wide while it is 1200 kms wide along Arctic Ocean. Maximum extension of continental shelf is in Atlantic Ocean. It is extended from Hudson Bay to North Sea and up to Norway Sea continuously. Continental shelves are formed due to (1) rise in the height of sea level, and (2) increase of deposits in ocean water.

- Due to coastal mountains continental shelves become narrower.
- Narrower continental shelf is on the coast of Namibia and Angola.

- *Average width of continental shelf is nearly 30 miles.*
- *8.6 % area of the total ocean comes under continental shelf.*
- *Out of the total area of the Atlantic Ocean, Pacific Ocean and Indian Ocean; continental shelf is extended over 13.3%, 5.7% and 4.2% respectively.*
- *Northern hemisphere is more continental shelf than southern hemisphere.*
- *Sunlight is present on shelves as it is the shallow part of ocean. Therefore, sea foods are available here.*
- *Fishes is found here as algae are abundantly found.*
- *Mineral oil and natural gas are also extracting from shelves region.*

**2. Continental slope-** *Continental slope is also a part of continent made up of granite. Beyond continental shelf steep slope starts known as continental slope. The average slope of this relief is 68 feet per mile ( $2^{\circ}$  -  $5^{\circ}$ ). Actually; it is the submerged part of continent and is the end part of continent .Beyond this, ocean starts. No sea weeds/ plants grow here.*

- *.average slope of continental slope along St. Helena is  $40^{\circ}$ . It is  $30^{\circ}$  along Spain,  $15^{\circ}$  along St. Paul and  $5^{\circ}$  -  $15^{\circ}$  along Calicut of India.*
- *. average depth of continental slope is 200-3000 m.*
- *.depth of continental slope near Peru and Chili coast is 3700m.*

- *.continental slope is extended over 8.5 % area of the total ocean.*
- *.continental slope is extended nearly 12.4 %, 7% and 6.5 % over Atlantic Ocean, Pacific Ocean and Indian Ocean respectively.*
- *.continental slope is generally devoid of marine deposits or have little layer of materials due to slope.*
- *Sea canyons are found here. Somewhere it starts from shelves or somewhere it starts from slope and reached up to ocean floor/ deep sea plain.*
- *The continental slope in Atlantic Ocean, east of U.S.A. starts from 80 kms from the coast and extended up to 383 kms.*
- *There are five types of continental slope. They are- gentle slope, steep slope, fault slope, cascade / staircase slope and the slope on which sea mountains are found.*

**3. Mid oceanic ridge-** *Mid oceanic ridges are formed by the (magma coming out at this point) diversion of plate. Ridges are found in all the three oceans namely East Pacific ridge, Mid-Atlantic ridge and Karl burg ridge. It makes world's longest mountain system.Karl burg ridge is in Y whereas Atlantic ridge is in S shape. The ridges are fracture zone through which plate slides. The ridge of Pacific ocean is like plateau rise.*

- *. Average depth of **M.O.R.** is 2000-4000m.*
- *. Due to diversion of plate, magma comes out and solidifies*

*quickly and forms the ridge like structure along the plate.*

- *. Longest ridge is 14000 kms long found in Atlantic Ocean. It starts from Iceland in the north to Bonnet island in the south in 'S' shape.*
- *.The ridge is known as Dolphin Ridge in the north and Challenger Ridge in the south.*
- *.Indian ocean ridge is 9000 kms long from Lakshadweep to Antarctica with an average depth of 2000m.*
- *Hawaii and Honolulu Island is on the peak of the ridge.*
- *The extension of the ridge is near about on the 31% of the total oceanic area.*
- *. **Different name of Indian Ocean ridge-***

*North of equator =Lakshadweep-Chagos ridge*

*0<sup>0</sup>-30<sup>0</sup> S. = Chagos-St. Paul ridge*

*30<sup>0</sup>-50<sup>0</sup> S. = St. Paul- Amsterdam ridge*

*South of 50<sup>0</sup>= Kargulen-Gausberg ridge*

***Deep sea plain/Basins-*** *Deep Sea plain is basaltic structure formed by plate tectonic activity. According to Harry-Hess it is the result of sea floor spreading (1 fathom=6feet).Deep sea plain starts after continental slope and is the extensive part of the ocean.*

- . Average depth of Deep Sea plain is 3000 - 6000m.
- .More than 80% of oceanic area comes under this relief.
- . Deep sea plain have very gentle slope. Some volcanic deposits are found here.

### Atlantic Ocean

#### **Western part**

1. Labrador basin-4000m.
2. N. America basin- 5000m.
3. Brazilian basin- 4000m.
4. Argentinian basin-5000.

#### **Eastern part**

1. Spanish basin-5000m.
2. Canary basin-4000m.
3. Cape Bherde basin - 5000m
4. Gini basin-5000m.
5. Angola basin-5000m.
6. Cape basin-4000m.
7. Aghulhas basin-4000m.

### Indian Ocean

#### **Western Part**

1. Oman basin-6000m.
2. Arabian basin-6000m.
3. Somali basin-6000m.
4. Mauritius basin-4000m.
5. Netal basin-4000m.
6. Aghulhas basin-6000m.

#### **Eastern Part**

1. Andaman Basin: 600-2000m. (North of 10°)
2. Cocos-kiling Basin: 2000-4000m. (10°N.-50°S)
3. Indian Ocean- Antarctica Basin- 4000-6000m(South of 50°)

### **Pacific Ocean**

1. California basin- N.E.Pacific
2. Japanese basin- N.W. Pacific

3. Peru-Chili basin- S.E.Pacific
4. Australian basin- S.W.Pacific



## **5. Specialized features-**

**Specialized features** include coral reefs, sea- caves Guyots and sea-mount like structures. Coral reef is a depositional features found on continental shelf. Generally, **coral reefs** are found on the eastern coast of islands or continents between 30°North latitude to 30°South latitude. **Sea -caves** are V shaped valley developed in continental shelf. It is found normally on the mouth of large rivers. According to some scientists sea- caves are submerged valley and were the part of landmass during Pleistocene age. Narrow deep V shaped valley cut deep into the continental shelf and slope are also called **Submarine Canyons**. The longest sea canyon is found in Bering Sea, west of Alaska. One is 400 kms long and other is 2600 kms long. There are 102 submarine canyons in the world which are of three types-

**a-** Small gorges found on the shelf and slope. e.g-Oceanographer canyon in New England Region.

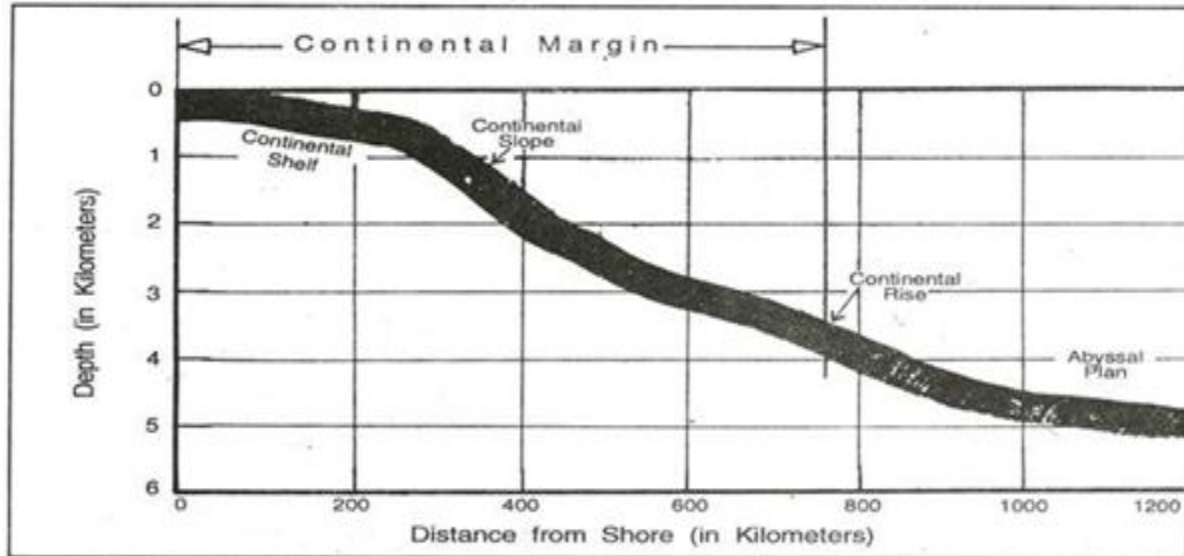
**b-** Canyons which begins at the mouth of the river and extended over the shelf. e.g- Mississippi River Canyon.

**c-** Deep dissected canyons -along the coast of California. According to Shepherd most of the canyons are found in the bay of California.

**Guyots** and **sea-mounts** are hill-like structures found on oceans basins. These are residual hills of basalt in which Guyots are flat topped hills and sea-mounts are pointed topped hills.

**6. Trenches-** Deeps/trenches are the deepest part / depressions found in the ocean floor. Deeps are called Tiefe and Fosse in Germany and France respectively. Altogether 57 deeps are known in which 32 are in Pacific while 19 are in Atlantic and 6 are in Indian Ocean. It is extended over 5% of the oceanic area. It can be compared with the gorge found on landmass. Oceanic deep or trenches are the result of subduction of oceanic plate. Mariana, Port Rico and Sunda trenches are the deepest trenches of Pacific, Atlantic and Indian Ocean respectively. The deepest part of any ocean in the world is the Mariana trench. **SOME POPULAR DEEPS/TRENCHES**

<b>SI.NO.</b>	<b>NAME</b>	<b>DEPTH (in metres)</b>	<b>LOCATION</b>
1	Mariana	10911	North Pacific
2.	Tonga	9185	C.South Pacific
3.	Philippine/Swire	8720	N.W.Pacific
4	Port Rico/Nares	8525	Off W. Indian Islands
5.	Japan/Tuscarora	8515	Off Japan
6.	Romanche /Tizard	7378	S.Atlantic
7.	Sunda/Wharton	7000	E. Indian Ocean
8.	Murray	6475	C.N.Paciic
9.	Bailey	6280	N.W.Pacific
10.	Brooke	6270	N.W. Pacific
11.	Belknap	6105	Central Pacific
12.	Chun	6070	N. Pacific
13.	Moseley	6050	N. Atlantic
14.	Valdivia	5732	S.Atlantic&Indian oceans
15.	Buchanan	5600	Ern.S.Atlantic



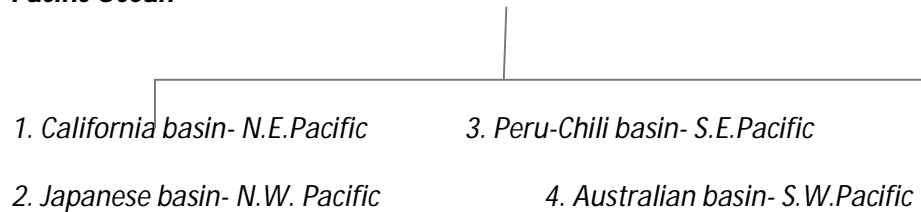
## **Bottom relief of Pacific Ocean:**

Pacific ocean covers 1/3<sup>rd</sup> area of the globe and remains the largest ocean .North America and South America lies in the east of Pacific while Asia, Australia and eastern island groups lies in its west and Bering sea is in its north. Average depth of Pacific is about 4000 different seas like- Java Sea, Japan Sea, Yellow Sea, East and South China Sea, Okhotsk Sea, Celebes Sea, Bering Sea, Alaska Sea, California Sea, Gulf of Panama, Coral Sea and other seas are present in an around Pacific ocean. It is covered by the popular **Ring of Fire** as it is characterized by subduction zones.

If we considered its continental shelf, only 6% area is under this relief. It is found in the eastern island groups / near East Indies and eastern Australia. Near American coast it is 80 kms wide while it is 1500 kms wide near Australian coast. Continental slope is extended over 7% of the Pacific Ocean. Somewhere it is very rugged and somewhere it is like cliff. In Pacific Ocean continental slope are very steep and its slope gradient increases beyond continental shelf.Depth of continental slope

*near Peru and Chili coast is 3700m. Hawaii and Honolulu Island is on the peak of the oceanic ridge/ submarine plateau. 3/4<sup>th</sup> part of Pacific Ocean has oceanic plain.*

**Pacific Ocean**



*Several trenches (32) are found in Pacific Ocean. Some of them are as follows:*

<b>Trenches (Pacific Ocean)</b>	<b>Depth (in m)</b>
1. Mariana Trench	10911
2. Tonga Trench	10882
3. Kuril Trench	10542
4. Philippine Trench	10540
5. Kermadec Trench	10047
6. Izu Bonin Trench	9780
7. Japan Trench	9000
8. Atacama Trench	8065
9. Aleutian Trench	7679
10. Bailey Trench	6280
11. Brooke Trench	6270
12. Belknap Trench	6105
13. Chun Trench	6070
14. Moseley Trench	6050

*In Pacific some islands are in arc shape and are the part of Fold Mountain. Volcanic mountains are also present there. Kurile Japan and Philippine islands are such examples. Hawaii and Funafuti is volcanic mountain and coral island respectively. About 20000 islands (highest) are found in Pacific Ocean. According to Prof. Johnson Pacific Ocean*

have four parts. North Pacific Ocean is the deepest part with average depth of 6000m. Deep trenches and islands are present here. Due to the part of ring of fire the region experiences earthquake frequently. Central Pacific region is characterized by sea mounts, Guyots, volcanic, coral as well as arc islands. It is the widest part of Pacific Ocean. This part has average depth of 4000m. South-west Pacific Ocean has widest continental shelves and islands. This part has again average depth of 4000m. South-eastern part is characterized by submerged plateau.

### **Bottom relief of Atlantic Ocean:**

Atlantic is the second largest Ocean extended over 1/6<sup>th</sup> part of the globe and is also half of Pacific Ocean. Atlantic Ocean is extended from Arctic Ocean in the north to Antarctic Ocean in the south in S shape. North America and South America lies in its west and Europe and Africa lies in its east. Maximum depth of 8605 m found in Portorico near West Indies but the average depth is 3926m. Several sea and bays are found in this ocean. Some of them are-Hudson Bay, Baffin Bay, Gulf of Mexico, Bay of Biscay, Gulf of Gini, Mediterranean Sea, North Sea, and Baltic Sea. Several islands are found in it in which Greenland is the largest one. British Isles groups, Iceland, West Indies group are famous island among them.

In Atlantic Ocean continental shelf is found over 13% of the total area and is comparatively more than any other oceans. It is highly uneven as it is 1 km to 80 kms wide. The widest part of continental shelf in this ocean is found near north-east America to north-west Europe where it is 240 kms to 400 kms wide. . Maximum extension of continental shelf is in Atlantic Ocean. It is extended from Hudson Bay to North Sea and up to Norway Sea continuously. The continental shelf near Newfoundland to British Isles is full of sea/ marine flora and

fauna. The area is famous for Grand Bank and Dogger Bank, the fishing hot spots in Atlantic. Several drow valleys are found on the shelves of Atlantic. Several sea and islands are situated on the continental shelf of Atlantic Ocean.

Continental slope is extended nearly 12.4 % areas over Atlantic Ocean. The slope is very gentle is its prominent feature.

Mid Atlantic Ridge, nearly 15000 kms long is the popular ridge found in Atlantic Ocean. It is in S shape. The ridge seperates the ocean floor into two parts namely- eastern and western part. Both the part has several sub-basins .The depth of these basins are uneven. Highest depth of 9000m has been found. At some places these ridges are above sea level and forms islands like- Cape Verde and Azores Islands. Some volcanic islands like- St. Helena, Ascension and Coral Island Bermuda Island are found.

### **Atlantic Ocean**

#### **Western part**

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2. N. America basin- 5000m.
3. Brazilian basin- 4000m.
4. Argentinian basin-5000.
5. Guiana basin -

#### **Eastern part**

1. Spanish basin-5000m.
  2. Canary basin-4000m.
  3. Cape Verde basin - 5000m
  4. Gini basin-5000m.
5. Angola basin-5000m.  
6. Cape basin-4000m.  
7. Aghulhas basin-4000m.

Cayman, Puerto Rico, Romanche and South Sandwich trenches are prominent out of 19 trenches found in the Atlantic.

## **Bottom relief of Indian Ocean:**

*Indian Ocean is the third largest ocean on the globe and is the only ocean to have been named after a country- India. The Indian ocean is boarded by Asia in the north, Antarctica in the south, Africa in the west and Australia in the east .It is extended over.....area in M shape. The Peninsular shape of Southern India divides it into two parts namely- Arabian Sea in the west and Bay of Bengal in the east. Indian Ocean linked with Atlantic Ocean in the west while Pacific Ocean in the east. Gulf, bays, seas and islands are present in the ocean. Red sea, Andaman Sea, Gulf of Aden, Malagasy island, Andaman Nicobar island group, East Indies, Zanzibar and Socotra islands are prominent among them. Mauritius and Reunion islands are volcanic island whereas Lakshadweep and Maldweep are coral islands situated in Indian Ocean.*

*Continental shelf of Indian Ocean is comparatively wider in northern region and is 650 kms wide at Bay of Bengal and Arabian Sea. The slope gradient of continental slope is seen near Java – Sumatra Island. Several submerged ridges are found from Kanya Kumari to Antarctica.*

### **Different name of Indian Ocean ridge-**

*North of equator =Lakshadweep-Chagos ridge*

*0<sup>0</sup>-30<sup>0</sup> S. = Chagos-St. Paul ridge*

*30<sup>0</sup>-50<sup>0</sup> S. = St. Paul- Amsterdam ridge*

*South of 50°*

*Kargulen-Gausberg ridge (west) Indian –Antarctica ridge (east)*

*Indian Ocean ridge is 9000 kms long from Lakshadweep to Antarctica with an average depth of 2000m. Indian Ocean have several basins.*

**Indian Ocean**

**Western Part**

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**Eastern Part**

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2. Cocos-kiling Basin: 2000-4000m.
3. Indian Ocean- Antarctica Basin-
4. Western Australian Basin

Relief of oceans is not only physical features but our resources too. Therefore, we should step towards their conservation.