Hydrosphere -The hydrosphere is the total amount of water on a planet, including water that is on the surface, underground, and in the air. It can be liquid, vapor, or solid (ice). On Earth, liquid water exists on the surface in the form of oceans, lakes, and rivers. It also exists below ground—as groundwater, in wells and aquifers. Water vapor is most visible as clouds and fog. The frozen part of Earth's hydrosphere is made of ice: glaciers, ice caps and icebergs. The frozen part of the hydrosphere is named as the **cryosphere**.

Water is the most abundant substance at the surface of Earth. About 1.4 billion km3 of water in liquid and frozen form make up the oceans, lakes, streams, glaciers, and groundwaters found there. hydrosphere, extending upward to about 15 km (9 miles) in Earth's atmosphere and downward to depths on the order of 5 km (3 miles) in its crust.

Water masses at Earth's surface

reservoir	volume (in cubic kilometres)	percent of total
oceans	1,338,000,000	96.5
ice caps, glaciers, and permanent snow	24,064,000	1.74
ground ice and permafrost	300,000	0.22
groundwater (total)	23,400,000	1.69
groundwater (fresh)	10,530,000	0.76
groundwater (saline)	12,870,000	0.93
lakes (total)	176,400	0.013
lakes (fresh)	91,000	0.007
lakes (saline)	85,400	0.006
soil moisture	16,500	0.001
atmosphere*	12,900	0.001
swamp water	11,470	0.0008
rivers	2,120	0.0002
biota	1,120	0.0001
total**	1,409,560,910	101.67

*As liquid equivalent of water vapour.

**Total surpasses 100 percent because of upward rounding of individual reservoir volumes.

Source: Adapted from Igor Shiklomanov's chapter "World Fresh Water Resources" in Peter H. Gleick (ed.), Water in Crisis: A Guide to the World's Fresh Water Resources, copyright 1993, Oxford University Press, New York, N.Y. Table made available by the United States Geological Survey.

Oceans - are the body of salt water that covers ~70.8% of the Earth. Five different oceans - Pacific, Atlantic, Indian, Antarctic/Southern, and Arctic. The ocean contains 97% of Earth's water. The ocean produces more than 50 percent of the air we breathe (Oxygen).

Average depth 3.688 km

Max. depth 11.034 km (Challenger Deep)

Pacific Ocean (50.1%)

Atlantic Ocean (23.3%)

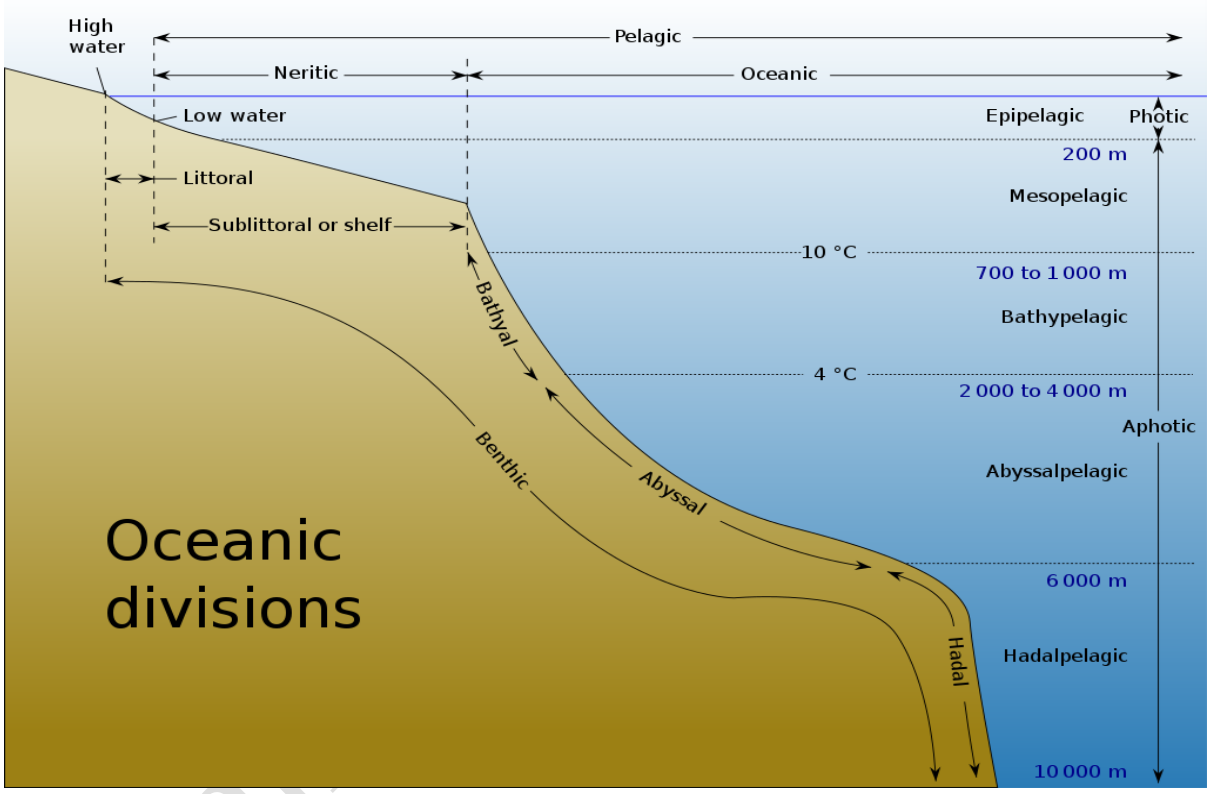
Indian Ocean (19.8%)

Southern Ocean (5.4%)

Arctic Ocean (1.4%)

Volume of total Oceanic Water

Total 100 %



The ocean is divided into **five** zones:

Epipelagic zone, or upper open ocean (surface to 200 m deep)

Mesopelagic zone, or middle open ocean (200 to 1000 m deep)

Bathypelagic zone, or lower open ocean (1000 to 3000 m deep)

Abyssopelagic zone, or abyss (3000 to 6000 m deep)

Hadopelagic zone, or deep ocean trenches (6000 m and deeper)

Zone based on Sunlight Penetration

Photic Zone - Vertical zone of the ocean that receives sunlight (upto 200 m)

Dysphotic Zone - Twilight Zone (200 to 1000 m)

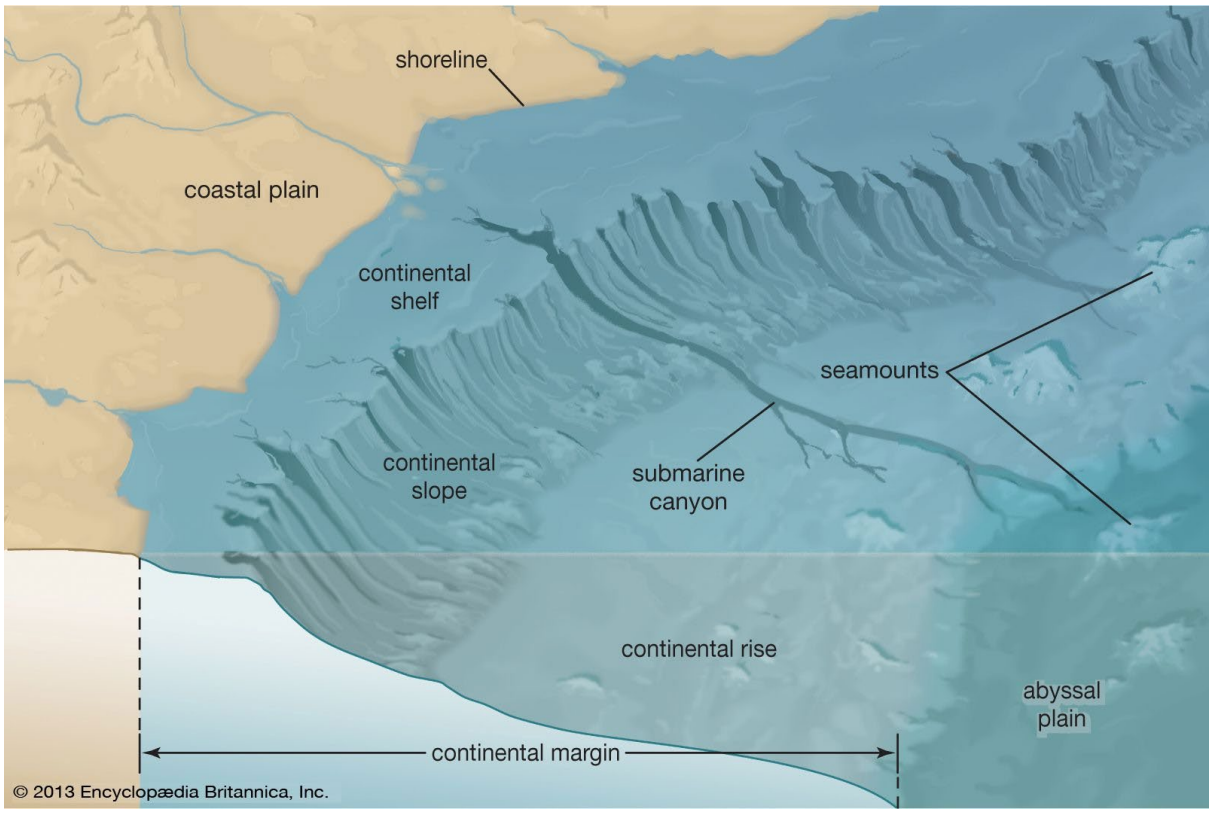
Aphotic Zone - darkness that lies beneath the photic zone (below 1000 m)

Ocean Relief -

Ocean relief is largely due to tectonic, volcanic, erosional and depositional processes and their interactions.

Four major divisions in the ocean relief are:

1) **Continental Shelf:** A continental shelf is the edge of a continent that lies under the ocean. Continents are the seven main divisions of land on Earth. A continental shelf extends from the coastline of a continent to a drop-off point called the shelf break.

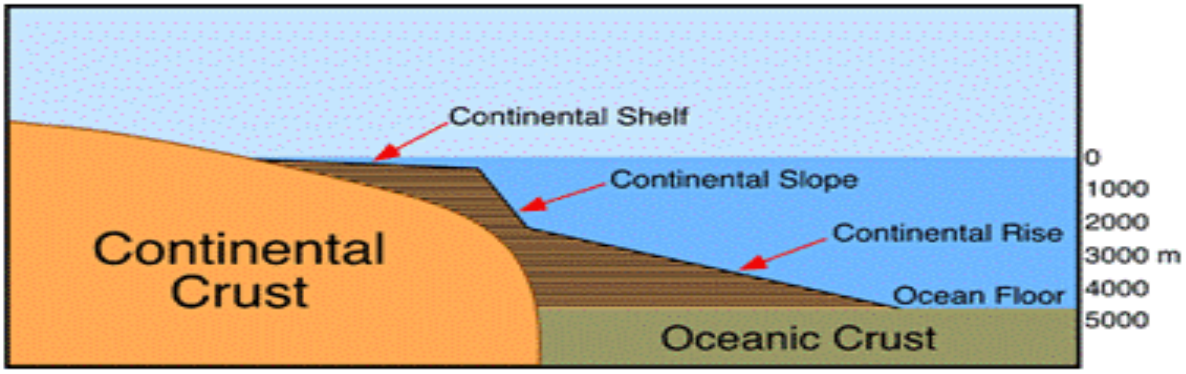


- Continental Shelf of all oceans together cover 7.5% of the total area of the oceans.
- Gradient of continental is of 1° or even less.
- The average width of continental shelves is between 70 – 80 km.
- The depth of the shelves also varies. It may be as shallow as 30 m in some areas while in some areas it is as deep as 600 m.

2) **Continental Slope:** The continental slope is a steep slope that starts at the edge of the continental shelf and gradually levels out into the continental rise. The continental rise marks the edge of the continental margin where it meets the oceanic crust.

. Continental slope range in steepness from 1 to 25 degrees,
. Average is 4 degrees.
• Pacific (active margin) average >5 degrees.
• Atlantic (passive margin) average about 3 degrees
. About 8.5 percent of the ocean floor is covered by the continental slope-rise system.
Depth -> 100 – 3200 m

3) **Continental Rise:** A continental rise is a gradual slope that extends from the deep ocean plain to the continental slope. It's a low-relief zone that's made up of silts, mud, and sand that's been deposited by turbidity flows. The continental rise is a major part of the continental margin, covering around 10% of the ocean floor.
Slope: 0.5 to 1 degree



4) Deep-Sea Plain or the Abyssal plain:
Deep sea planes are gently sloping areas of the ocean basins. These are the flattest and smoothest regions of the world because of terrigenous [marine sediment eroded from the continents] and shallow water sediments that buries the irregular topography.

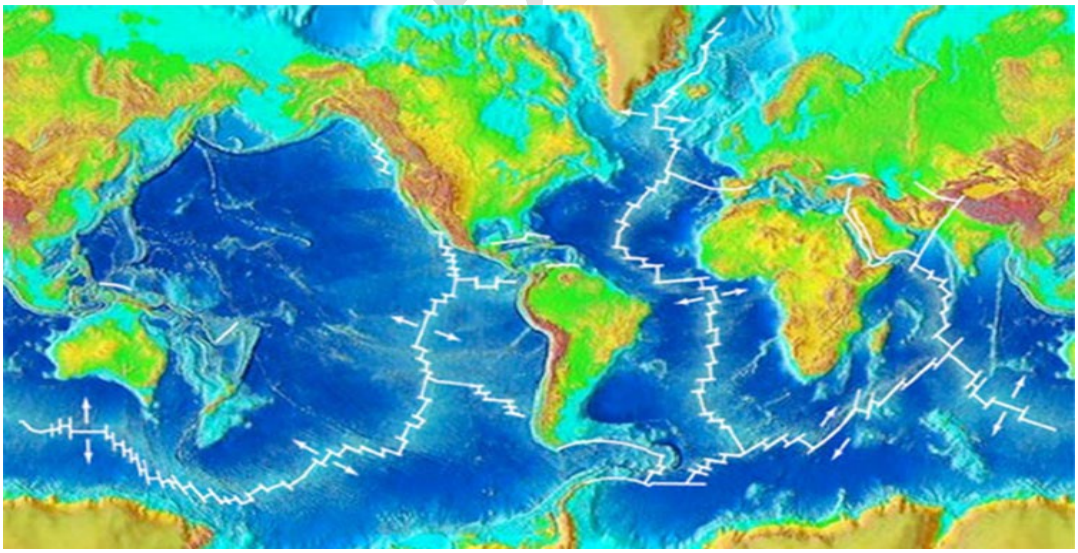
It covers nearly 40% of the ocean floor. The depths vary between 3,000 and 6,000 m. These plains are covered with fine-grained sediments like clay and silt.

Oceanic Deeps or Trenches: The trenches are relatively steep-sided, narrow basins (Depressions). These areas are the deepest parts of the oceans. They are of tectonic origin and are formed during ocean – ocean convergence and ocean-continent convergence. They are some 3-5 km deeper than the surrounding ocean floor.

The trenches lie along the fringes of the deep-sea plain at the bases of continental slopes and along island arcs. The trenches run parallel to the bordering-fold mountains or the island chains. The trenches are very common in the Pacific Ocean and form an almost continuous ring along the western and eastern margins of the Pacific. The Mariana Trench off the Guam Islands in the Pacific Ocean is the deepest trench with, a depth of more than 11 km. They are associated with active volcanoes and strong earthquakes. As many as 57 deeps have been explored so far; of which 32 are in the Pacific Ocean; 19 in the Atlantic Ocean and 6 in the Indian Ocean.

Mid-Oceanic Ridges or Submarine Ridges:

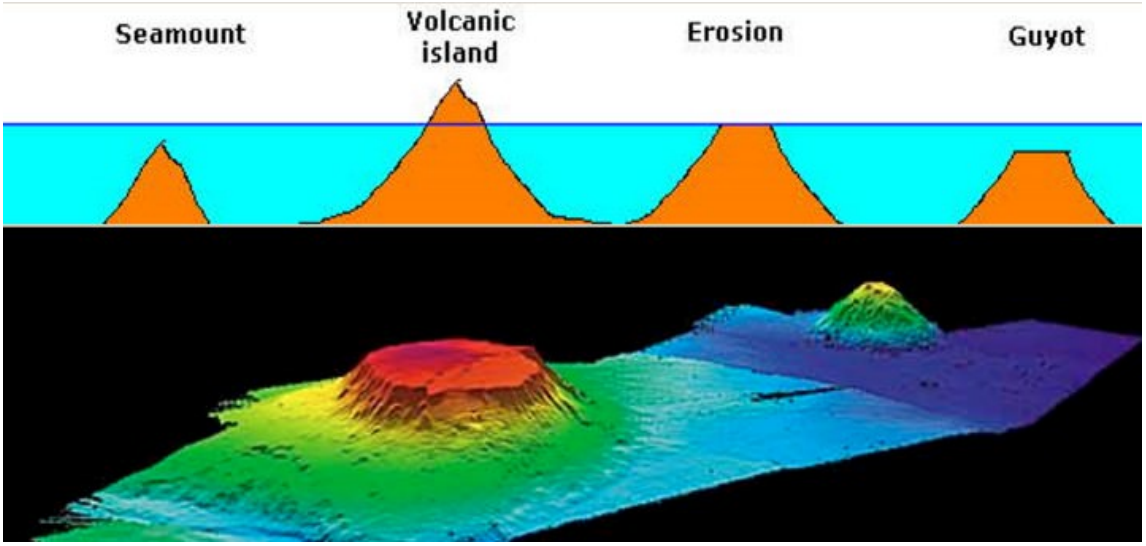
- A mid-oceanic ridge is composed of two chains of mountains separated by a large depression. [Divergent Boundary]
- The mountain ranges can have peaks as high as 2,500 m and some even reach above the ocean's surface.
- Running for a total length of 75,000 km, these ridges form the largest mountain systems on earth.
- These ridges are either broad, like a plateau, gently sloping or in the form of steep-sided narrow mountains.
- These oceanic ridge systems are of tectonic origin and provide evidence in support of the theory of Plate Tectonics.



Abyssal Hills

- Seamount: It is a mountain with pointed summits, rising from the seafloor that does not reach the surface of the ocean. Seamounts are volcanic in origin. These can be 3,000-4,500 m tall.

- The Emperor seamount, an extension of the Hawaiian Islands [Hotspot] in the Pacific Ocean, is a good example.
- Guyots: The flat-topped mountains (seamounts) are known as guyots.
- Seamounts and guyots are very common in the Pacific Ocean where they are estimated to number around 10,000.



Submarine Canyons

CANYON: a deep gorge, especially one with a river flowing through it
GORGE: a steep, narrow valley or ravine
VALLEY: a low area between hills or mountains or a depression, typically with a river or stream flowing through it.

Atoll

These are low islands found in the tropical oceans consisting of coral reefs surrounding a central depression. It may be a part of the sea (lagoon), or sometimes form enclosing a body of fresh, brackish, or highly saline water.

Ie - Maldives

(Atoll)

Reef

A reef is a predominantly organic deposit made by living or dead organisms that forms a mound or rocky elevation like a ridge. Coral reefs are a characteristic feature of the Pacific Ocean where they are associated with seamounts and guyots. The largest reef in the world is found off the Queensland coast of Australia Since the reefs may extend above the surface, they are generally dangerous for navigation. The Coral reefs in India are mainly restricted to the Andaman and Nicobar Islands, Gulf of Mannar, Gulf of Kutch, Palk Strait and the Lakshadweep islands

Coral Bleaching - Coral bleaching is a process that occurs when corals expel the algae (zooxanthellae) that live inside their tissues. This happens when corals are stressed, such as by changes in temperature, light, or nutrients.

Coral reefs are often called the "rainforests of the sea" and support about 25% of all known marine species

(Coral Reef)

Water Budget of Earth –