

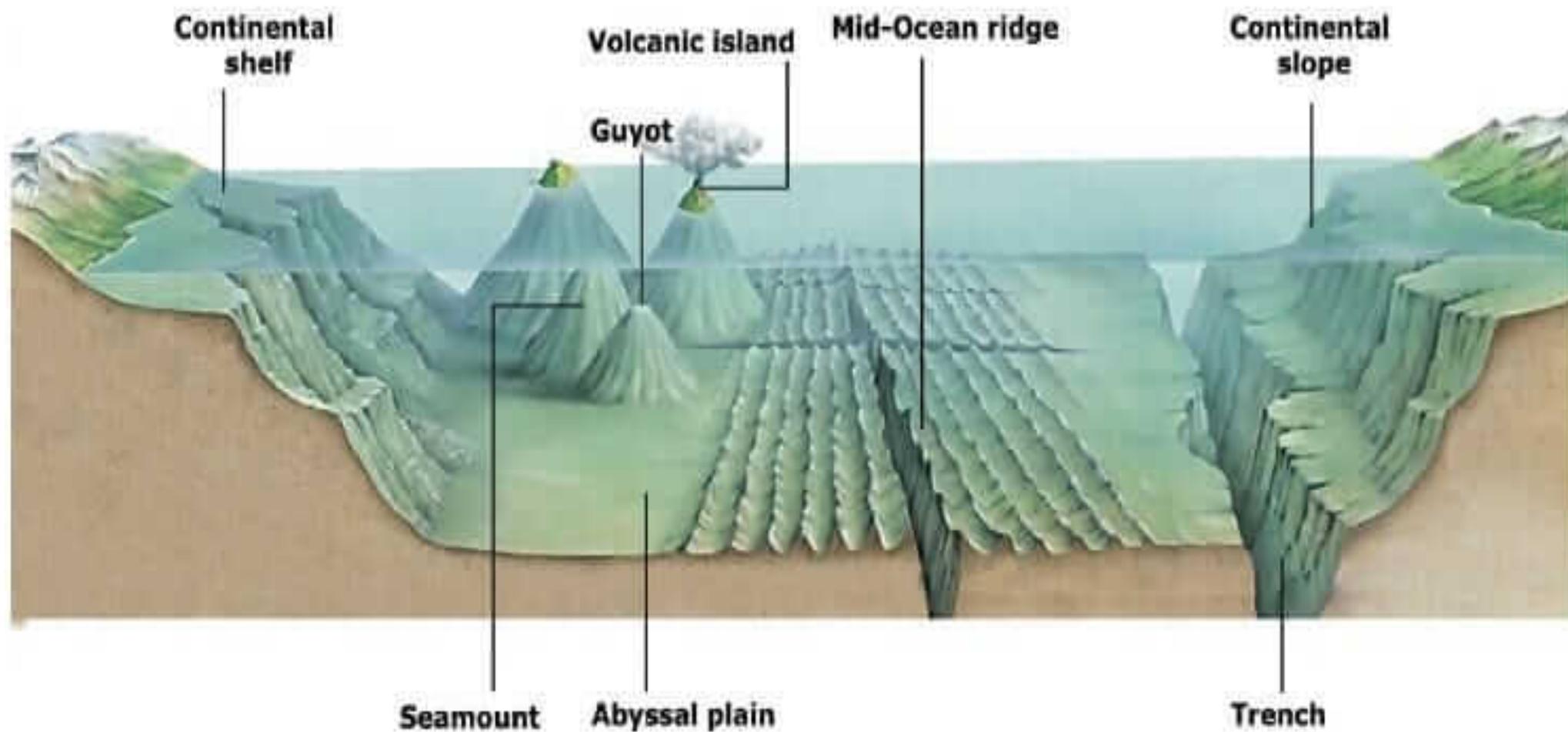
# Ocean

While there is only one global ocean, the vast body of water that covers 71 percent of the Earth is geographically divided into distinct named regions. The boundaries between these regions have evolved over time for a variety of historical, cultural, geographical, and scientific reasons.

**Historically, there are four named oceans: the Atlantic, Pacific, Indian, and Arctic.**

However, a new ocean has now been recognized as the Southern (Antarctic) ocean as the fifth ocean. The Pacific, Atlantic, and Indian are known as the three major oceans.

- They are the **source of food**— fish, mammals, reptiles, salt, and other marine foodstuffs.
- The **tides can be harnessed to provide power.**
- Oceanography is the branch of science that deals with the physical and biological properties and phenomena of the sea.
- Earlier **echo-sounding techniques were used**, now **radar soundings and electrical Echo devices are used to find the precise depths of ocean floors and map the relief of oceans.**



# Ocean Relief Features

The oceans, unlike the continents, merge so naturally into one another that it is hard to demarcate them.

The geographers have divided the oceanic part of the earth into **five oceans, namely the Pacific, the Atlantic, the Indian, Southern, and the Arctic**. The **various seas, bays, gulfs, and other inlets are parts of these four large oceans**.

A **major portion of the ocean floor is found between 3-6 km below the sea level**. The 'land' under the waters of the oceans, that is, the ocean floor exhibits complex and varied features as those observed over the land.

The **floors of the oceans are rugged with the world's largest mountain ranges, deepest trenches, and the largest plains**. These features are formed, like those of the continents, by the factors of tectonic, volcanic, and depositional processes.

## Major Ocean Relief Features

The ocean floors can be divided into **four major divisions**:

- the Continental Shelf
- the Continental Slope
- the Deep Sea Plain
- the Oceanic Deeps

## Continental Shelf

The **continental shelf** is the **extended margin of each continent occupied by relatively shallow seas and gulfs**. It is the **shallowest part of the ocean showing an average gradient of 1° or even less**.

- The shelf typically ends at a **very steep slope, called the shelf break**.
- The width of the continental shelves varies from one ocean to another. The average width of continental shelves is about 80 km.
- The shelves are almost absent or very narrow along some of the margins like the coasts of Chile, the west coast of Sumatra, etc. On the contrary, the Siberian shelf in the Arctic Ocean, the largest in the world, stretches to 1,500 km in width.
- 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.
- The **continental shelves are covered with variable thicknesses of sediments brought down by rivers, glaciers, wind, from the land, and distributed by waves and currents**. Massive sedimentary deposits received over a long time by the continent shelves become the source of fossil fuels.

- There are **3 views on the continental shelf** –
  - They can be part of the continent **submerged due to the rise in sea level.**
  - Some smaller continental shelves could have been **caused by wave erosion.**
  - They may have been **formed by the deposition of lands-derived or river-borne materials on the off-shore terrace.**

### Continental shelf geographical significance

Their **shallowness enables sunlight to penetrate through the water, which encourages the growth of plants and organisms → now rich in plankton → fishes thrive on them → so continental shelves are the richest fishing grounds.**

- E.g. – Grand banks off Newfoundland, the North Sea, and the Sunda shelf.
- Their limited depth and gentle slope keep out cold under-currents and increase the height of the tide. This sometimes hinders shipping and other marine activities since ships can only enter and leave port on the tide.
- Ports like Southampton, London, Hamburg, Rotterdam, Hong Kong, and Singapore are located on continental shelves.

- ***Marine food comes almost entirely from continental shelves;***
- ***They provide the richest fishing grounds;***
- ***They are potential sites for economic minerals*** [20% of the world production of **petroleum** and gas comes from shelves. **Polymetallic nodules (manganese nodules; concentric layers of iron and manganese hydroxides)** etc. are good sources of various mineral ores like manganese, iron copper, gold, etc.]

### **Continental Slope**

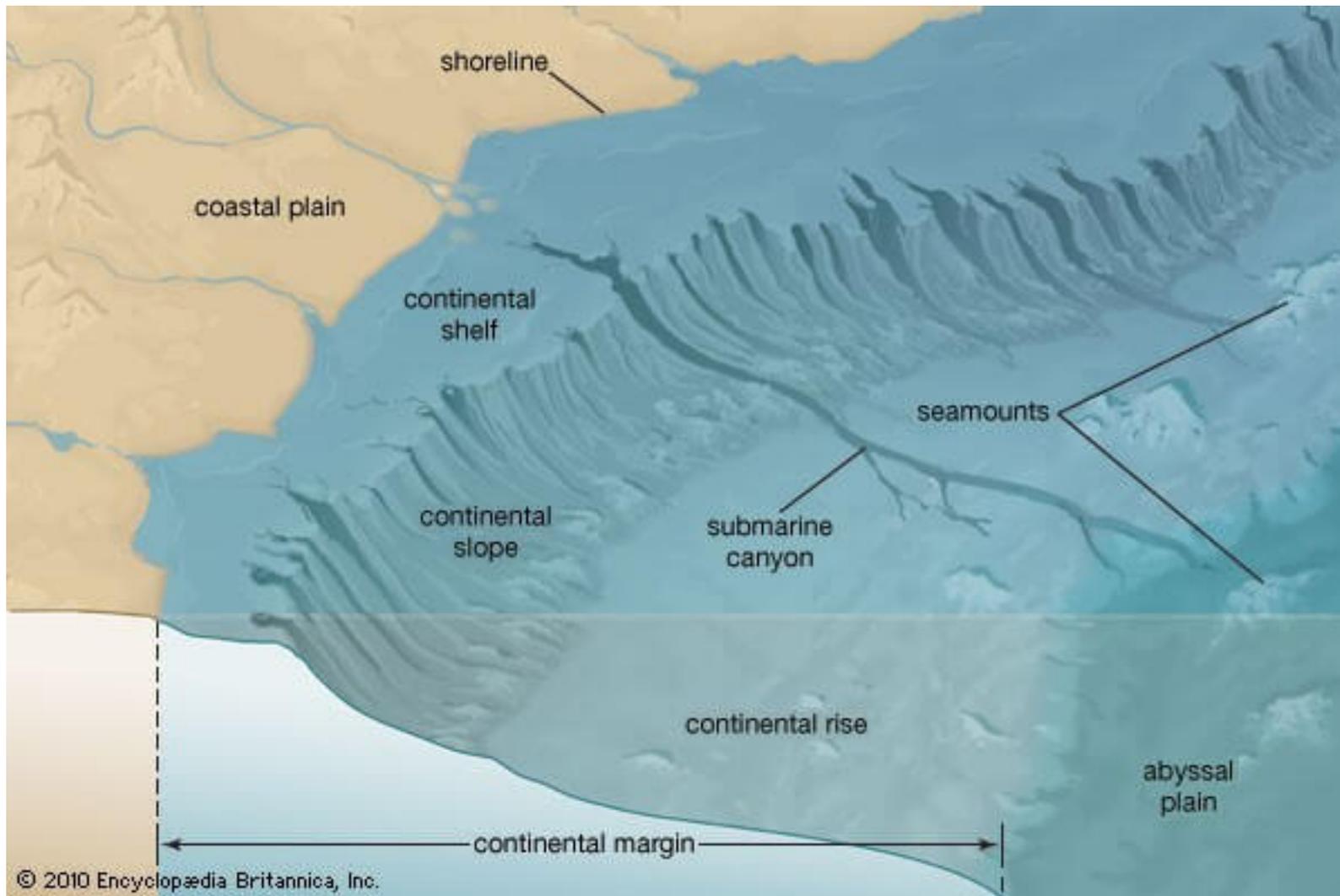
- **The continental slope connects the continental shelf and the ocean basins. It begins where the bottom of the continental shelf sharply drops off into a steep slope.**
- **The gradient of the slope region varies between 2-5°.**
- **The depth of the slope region varies between 200 and 3,000 m.**
- **The slope boundary indicates the end of the continents.**
- **Canyons and trenches are observed in this region.**

## **Continental Rise**

- The continental slope **gradually** loses its steepness with depth.
- When the slope reaches a level of between 0.5° and 1°, it is referred to as the continental rise.**
- With increasing depth, the rise becomes virtually flat and merges with the abyssal plain.**

## **Deep Sea Plain or Abyssal Plain**

- An **abyssal plain** is an underwater plain on the deep ocean floor
- Found at depths – between **3,000 meters and 6,000 meters.**
- Lying generally between the foot of a continental rise and a mid-ocean ridge, abyssal plains cover more than 50% of the Earth's surface.**
- It has extensive **submarine plateaus, ridges, trenches, beams, and oceanic islands** that rise above sea level in the midst of oceans.
- E.g. the **Azores, Ascension Island***
- These plains are **covered with fine-grained sediments like clay and silt.**



## Oceanic Deeps or Trenches

**Ocean trenches are steep depressions in the deepest parts of the ocean** [where old ocean crust from one tectonic plate is pushed beneath another plate, raising mountains, causing earthquakes, and forming volcanoes on the seafloor and on land].

- **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 kilometers.**

- **Other ocean deeps –**
  - **Mindanao deep** (35000 feet)
  - **Tonga trench** (31000 feet)
  - **Japanese trench** (28000 feet) (all 3 in the Pacific Ocean)
- They are associated with **active volcanoes** and **strong earthquakes** (Deep Focus Earthquakes like in Japan). This makes them very significant in the study of plate movements.
- 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.

## **The Oceanic deposits of the ocean floor**

We have read that rivers erode and deposit some materials in flood plains and drop sediments like sand, silt in the sea. Slow sedimentation – in this process eroded particles are filtered slowly and settled on one another in layers. Oceanic deposits can be classified on a different basis:

## **On the basis of Origin –**

- **Terrigenous deposits:** These are the deposits that **originated on terrestrial surfaces** and were transported to oceans through wind and water. They contain both organic and inorganic matter. The thickness of terrigenous deposits is highest on the continental shelf and slope.
- **Hydrogenous deposits:** They **originate in water**. They include both **organic and inorganic particles**. Most of the organic materials are derived from dead plants and animals. Inorganic particles contain precipitated salts.
- **Cosmic deposits:** They are **extra-terrestrial**. They are **less than 1% of total deposits** and uniformly distributed on the abyssal plain. Some of them are **thin glassy particles called tektites**.

**The oozes- The biological deposits of oceans are called Oozes.**

- **Pelagic deposits** – fine-grained sediment that accumulates as the result of the settling of particles to the floor of the open ocean, far from land.
- Made of – shelly and skeletal remains of marine organism

- They have a very fine, flour-like texture and occur as accumulated deposits or float about in suspension.
- They can be of two types –
  - **Calcareous Oozes** – They have a high quantity of calcium. They are found up to the depth of 2500m.
  - **Silicious Oozes** – They have a high quantity of silicon and found beyond 2500 m.

## Clays

- They are one of the **finest deposits found on the ocean floor.**
  - Occur as red clay in the deep oceanic basin. (abundant in the Pacific Ocean)
  - These are believed as volcanic dust blown out from volcanoes during volcanic eruptions.