

BOTTOM RELIEF OF THE PACIFIC OCEANS

Shape and Size

The Pacific Ocean covering one-third of the area of the earth, extends from the coast of Asia in the west to America in the east (16093 km) and from Bering Strait in the north to the Cape Adare (Antarctica Continent) in the South (14966 km). The average depth of the Pacific is about 5000 m. Only 3.9 % of its area is less than 1000 m. deep whereas major portion (30.9 %) lies below 5000 m. excluding adjacent seas. The descent from the coast to the sea plain is very much steeper. The oceanic surface in general is uniform, with broad gentle swells and depressions. Maximum area of 37.7 % lies within 4000-5000 m. depth.

It is the most unique ocean in many respects. It has a broad triangular shape. All along the coast for nearly 17700 km, the folded mountains are found parallel to it. In the north, it is completely blocked excepting a narrow Bering Sea passage into the Arctic Ocean.

Continental Shelf

The continental shelf surrounding the margin of the Pacific Ocean is controlled by the shape and structure of its coastline. On the eastern margin of this ocean the width of the shelf is rather narrow. Due to the presence of the Rockies and the Andes Mountains parallel to the west coasts of North and South Americas respectively the continental shelves have become very narrow. Their width is limited to only 80 km.

However, on the western margin of this ocean, due to the absence of mountain chains or plateaus, the continental shelf is broad. The continental shelves adjoining the coasts of Australia, East Indies and East Asia are relatively much broader. Along these coasts the width of the shelves varies from 160 to 1600 km with their average depth hardly exceeding 1000 m. On these shelves are situated most of the islands and marginal seas.

Ridges

Pacific Ocean is different from the other oceans in the respect that it has no central ridge. Only a few submarine ridges can be located here and there, mostly on the eastern margin of the ocean, and the submarine swells are found in the middle of the Pacific. One of the most important ridges known as the East Pacific ridge or Albatross Plateau (3000-4000 m. deep) is quite extensive. The north-east projection of the plateau is known as Cocos ridge and extends from the coast of Central America towards south-west. It is about 1600 km broad and

bifurcates into two near 2° S lat. The eastern part is a narrow ridge named San Felix-Juan Fernandez ridge, less than 2000 m. deep and runs parallel to the Chilean coast. The western ridge moves to the south and forms a wide plateau between 20°-40°S lat., known as South-Eastern Pacific plateau. The depth here is between 2000-4000m. Further south the same plateau narrows down in the form of a curved Pacific-Antarctic ridge where the depth is about 3500 m.

Basins

Many depressions and basins, separated by numerous swells, are also found in the Pacific Ocean.

1. Aleutian basin – north of the Aleutian island, this basin is 4000 m. deep.
2. Philippine basin – situated east of Philippine Islands, this basin extends up to 5° N. Its depth varies between 5000-6000 m. The western part of the basin is comparatively deeper than 6000m.
3. West Caroline basin. It is a 4000-5000 m. deep circular basin east of Philippine basin.
4. East Caroline basin – this basin is also 5000 m. deep.
5. Fiji basin – south of Fiji Island, Fiji basin is more than 4000 m.
6. East Australian basin – a 4000 m. deep basin, compact and circular in form, extends east of Australia with areas deeper than 5000 m. found in the north.
7. South Australian or Jeffrey's basin – it is a 5000 m. longitudinal basin extending south of Australia.
8. South-western Pacific basin – it is a wide 6000 m. deep basin.
9. South-eastern Pacific basin – this 5000 m. deep and broad basin extends west of Peru and Chile with Baver deep of 5266 m. depth.
10. Pacific Antarctic basin. It extends south-west of Chile.

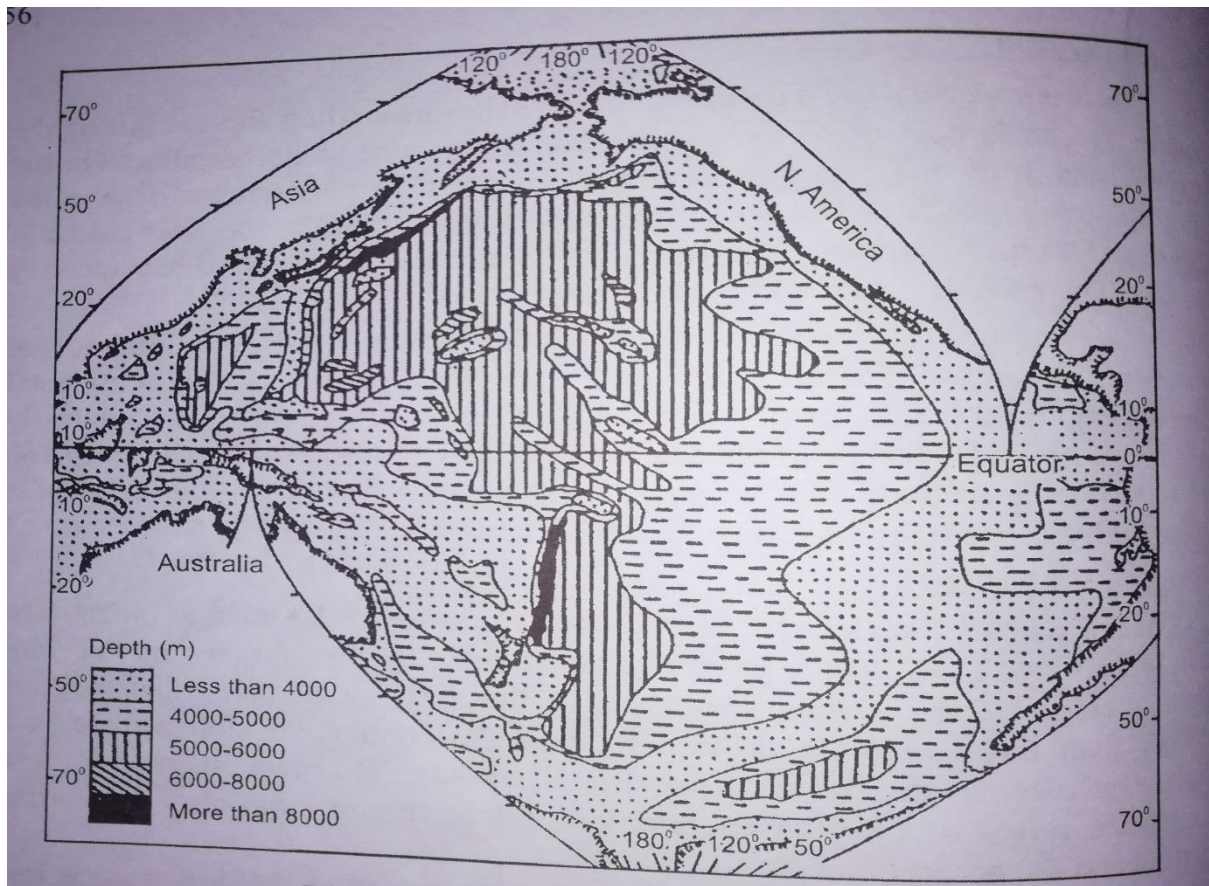


Fig. 1. Bottom relief of the Pacific Ocean

Depths

Total 32 deeps are recorded in the Pacific, out of which most of them are in the trenches (longitudinal deep areas), parallel to the island arc or the mountain chain. These deeps are located mostly in the western part of the ocean. The following are some of the important deeps and trenches:

1. Aleutian trench – it is an arc like depression bordering Aleutian Islands; the average depth is about 6000 m. and the maximum recorded depth is 7679 m.
2. Kurile trench and Japan trench – lying parallel to the Japanese Islands, the 8000 m. deep trench extends for 2700 km, and seldom more than 160 km away from the land. In it are situated Vityez deep (10377 m) and Ramapo deep (10374 m).
3. Philippine trench. Extending 64 km along the eastern coast of Philippine Islands, this trench records the greatest depth (10497 m) off the island of Mindanao, known as Cape Johnson deep.
4. Mariana trench – the Challenger Deep, in the South Pacific's Marianas Trench, is the deepest known part of the Ocean. Its bottom lies 10,900 m below the sea level.

5. Tonga-Kermadec trench – it is trough like depression extending from north-east to south-west along the Tonga and Kermadec Islands. They are measured to be 8000 m. deep with 9428 m. Aldrich deep.
6. Peru-Chile trench – it is situated along the Andean coast in the form of broken trenches. Batholomew deep 7973 m. located near Antafogsta city.

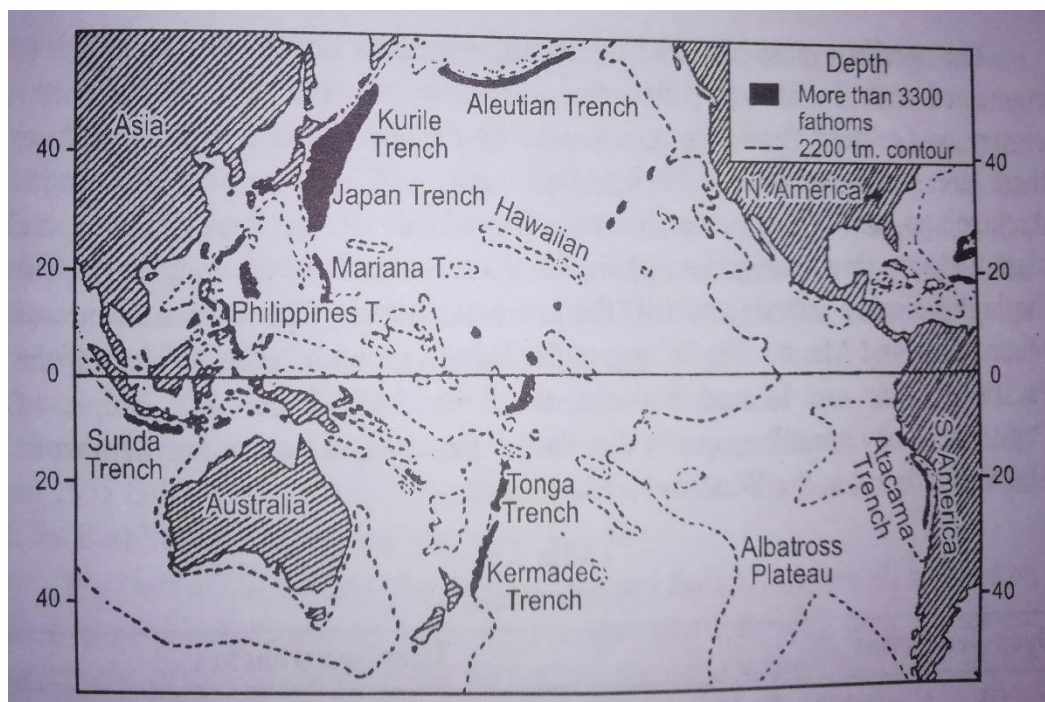


Fig. 2. Pacific Ocean: Ridges and Trenches

BOTTOM RELIEFS OF THE ATLANTIC OCEAN

- (1) Oman basin faces the Gulf of Oman and is spread over the extensive continental shelf with average depth of 3,658 m.
- (2) Arabian basin is located in almost circular shape between Laccadive-Chagos ridge and Socotra – Chagos Ridge with the depth of 3,600m – 5,486m.
- (3) Somali basin is bordered by Socotra – Chagos ridge in the north-west. Central Ridge in the east, Seychelles – Mauritius Ridge in the south-west and African coast in the west. The average depth is 3,600m.

(4) Mauritius basin is located between S.W. Indian Ridge and South Madagascar Ridge and extends from 20°S to 40°S latitude. The depth varies between 3,600m and 5,486 m. The deepest part measures 6,391 m depth.

(5) Mascarene basin of oval shape extends between Madagascar and Seychelles – Mauritius Ridge.

(6) Agulhas-Natal basin is an elongated basin which is bordered by Madagascar ridge in the north and north-east, Prince Edward Crozet Ridge in the east and the S.E. African coast in the west and north-west, Average depth is 3,600m.

(7) Atlantic- Indian – Antarctic basin is in fact the eastward continuation of Atlantic – Antarctic Basin. It stretches upto 70°E longitude and is bordered by Prince Edward Crozet Ridge in the north, Antarctica in the south and Kerguelen Gassberg Ridge in the north-east. Average depth is 3,600m.

(8) Eastern Indian-Antarctic basin is located between Amsterdam – St. Paul Plateau and Indian-Antarctic Ridge in the north and north-east and Antarctica in the south. The depth varies from 3,600m to 4,800m. Kerguelen – Gassberg Ridge separates the basin from the Atlantic – Indian-Antarctic Basin.

(9) West Australian basin is the most extensive basin and forms rectangular shape surrounded by S.E. Indian Ridge in the south – west, Ninety East Ridge in the west, continental shelves of Java-Sumatra in the north-east and the continental shelf of west Australia, Average depth varies from 3,600m to 6,100m but the central part of the basin is 6,459 m deep.

(10) Mid-Indian basin is bordered by the central ridge in the west and the south-west, by Ninety East Ridge in the east and by the Bengal plateau in the north. The average depth of outer part ranges from 3,600m to 6,800m while the depth of the central part of the basin ranges between 4,800m and 6,100m.

Deeps and Trenches:

There are very few deeps and trenches in the Indian Ocean. About 60 per cent of the Ocean consists of deep sea plains with depth ranging from 3,600m to 5,487m. Important deep sea plains are Somali Abyssal plain. Ceylon (Sri Lanka) Abyssal plain, Indian Abyssal Plain,

(4,380m) etc. Significant trenches are Java or Sunda Trench (7,450m deep), Ob Trench (6,875m deep), Mauritius Trench, Amirante Trench etc.

BOTTOM RELIEF OF THE INDIAN OCEAN

Shape and Size

The Indian Ocean covers 20 % of the total area of all the oceans of the world. It is a warm ocean blocked on the three sides by the continents of Africa, Asia and Australia. Most of the coast is made up of hard block mountains of Gondwana remnant in Africa, Australia, Deccan Plateau of India and Western Australia, but folded ranges are also found along East Indies.

The shape of the ocean is compact, with bold and regular coastlines. In the south it extends up to the Antarctica continent where it merges into the Atlantic and the Pacific. The average depth of the ocean is 4000 m., which is less varying and comparatively lesser than that of other oceans. Out of the total area, the deep-sea plain with a depth between 4000-6000 m. covers 58.8 % area.

Continental Shelf

The continental shelf surrounding this ocean varies in its width. The continental shelf of this ocean is generally narrow with the average width of about 96 km. However, in the Arabian Sea, the Bay of Bengal and the Andaman Sea the width of the shelf varies from 192 km to 208 km. On the seaward margin of the shelf, the depth of water lies between 50 and 200 meters. Between Australia and New Guinea Island the shelf is 960 km wide. Due to intense glaciation the structure of the shelf adjoining the Antarctica has become very complex. In such areas the landward margins of the shelf are 150-200 m deep, whereas the seaward margins register depth varying from 400 to 500 meters.

In the tropical areas different types of coral reefs such as, fringing reef, barrier reef and atoll are found on the shelf. The continental slopes on the outer margins of the shelf are marked by the extreme steepness, angle of slope varying from 10° to 30°. The continental shelves are characterized by many submarine valleys and canyons. The width of the shelf along the coast of Africa is just normal, but near Madagascar the shelf is relatively broader than elsewhere. The continental shelves of Java and Sumatra Islands are about 160 km. wide.

Ridges and Basins

The bottom relief of the Indian Ocean resembles that of the Atlantic Ocean. This ocean has a continuous central ridge, called the Arabic-Indian Ridge, together with its southern extension, the Kerguelen-Gaussberg Ridge, which connects with the Antarctic continent. The central ridge separates the eastern basin from the western basin. Remember that all the oceanic islands in this ocean are situated on the central ridge and on its cross ridges.

The Indian Ocean is characterized by having many broad submarine ridges, separating several individual basins of the abyssal plain. One of its most distinguishing features is the presence of the series of curving ridges in the north-west segment of the ocean.

The above-mentioned ridges divide the Indian Ocean into three distinct parts: 1. African part, 2. Australian part, and 3. the part adjoining the continent of Antarctica. Each one of these parts is further subdivided into several basins by ridges and submarine mountain chains, namely, Comoro and North Australian Basin extending up to 320 km. South Indian Basin and Australian-Antarctic Basin extend up to 9000 km. the Arabian Basin is surrounded by ridges.

The East Indian Ridge, also called the Ninety East Ridge, is 4000 km long and straight. The ridge joins the West Australian Ridge (the Broken Ridge) in the south. It is interesting to note that the central ridge that runs from near the Cape Comorin to Antarctica has been given different names in its different sections. In the south the central ridge becomes wider, and there it is called the Amsterdam – St. Paul Plateau. A transverse branch goes towards the south-east from Cape Guardfui, the ‘Eastern Horn’ of Africa to join the main ridge and is named the Socotra-Chagos Ridge. Another transverse ridge called the Seychelles Ridge runs parallel to the Socotra-Madagascar trends southwards. It is called the South Madagascar Ridge. Farther south it becomes wider and is known as the Prince Edward – Crozet Ridge. Thus, the submarine ridges rising from the coastal areas of Peninsular India, Madagascar and the eastern coast of Africa extend southwards. In the south the extensive plateau of Karguelen extends from north-west to south-east. There are numerous trenches beside the submarine ridges on the ocean floor, among which the East Indian, Chagos and Amerante trenches are very important.

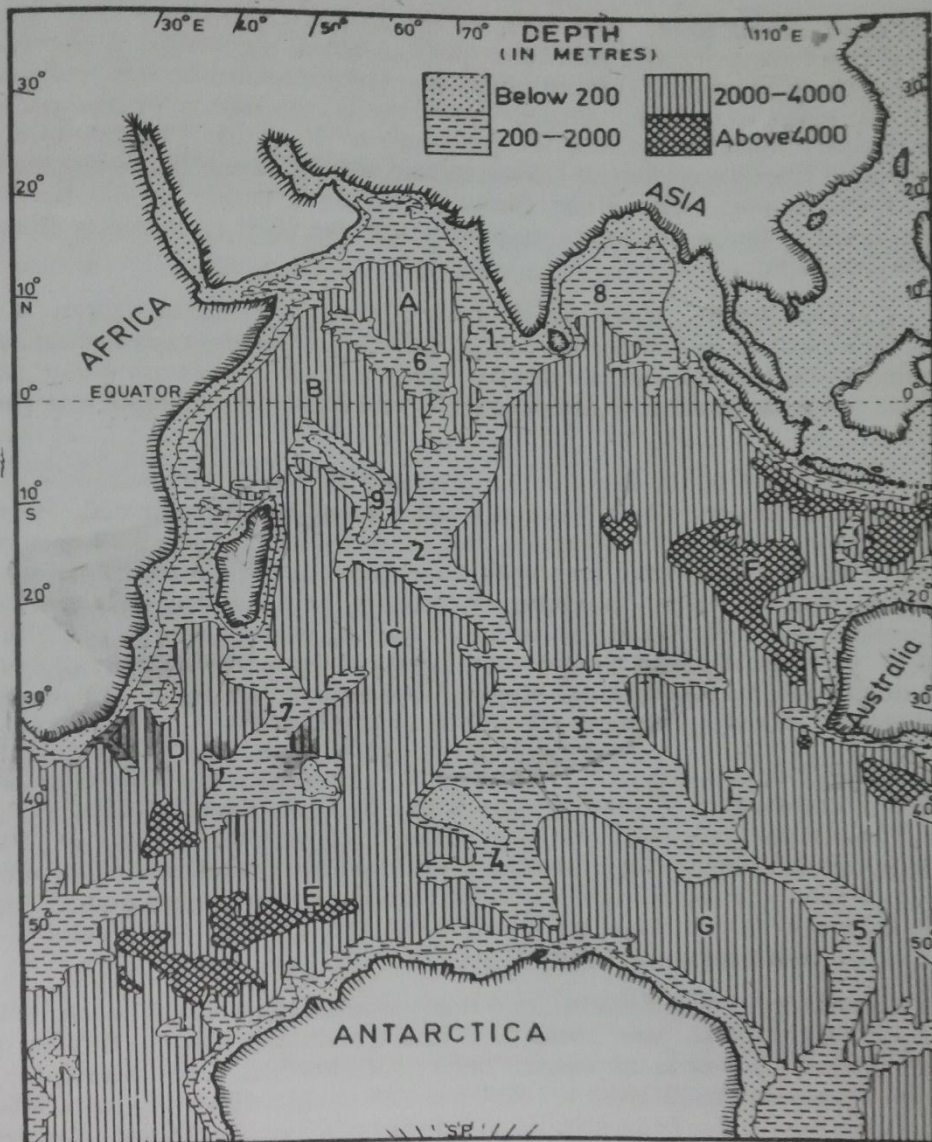


Fig. 5.3 Bottom Relief of Indian Ocean

1-Laccadive-Chagos ridge. 2-Chagos-Saint Paul ridge. 3-Amsterdam-St. Paul plateau. 4-Kergelen-Gaussberg ridge. 5-Indian-Antarctic ridge. 6-Socotra-Chagos ridge. 7-Madagascar ridge. 8-Andaman-Nicobar ridge. 9-Seychelles ridge.

A-Arabian bsin. B-Somali basin. C-Mauritius basin. D-Natal basin. E-Indian-Antarctic basin. F-Cacos-Keeling basin. G-Eastern Indian Antarctica basin.

Fig. 1. Bottom Relief of Indian Ocean (Source: Oceanography for Geographers by R. C. Sharma & M. Vatal)

Oceanic Deeps

Out of the total area of Indian Ocean, about 58.8 % forms deep sea plain between the depth of 4000-6000 m. Unlike the Pacific and Atlantic Oceans, the oceanic deeps with unfathomable depths are lacking. The Sunda Deep near Java is an exception. The depth of this oceanic deep is 7450 metres.

Islands

Relative to the Pacific and Atlantic Ocean, the number of islands in the Indian Ocean is far less. Some of the islands, however, are supposed to be parts of the main land. Out of these islands, Madagascar and Sri Lanka are the most prominent. Some of the smaller islands namely, Socotra, Zanzibar and Comoro situated off the Cape Guardafui fall into this category.

Marginal Seas

Since the coastal areas of the Indian Ocean are generally plateaus, the number of marginal seas is far less. In fact, there are only two real marginal seas in this ocean: the Red Sea and the Persian Gulf. The Red Sea occupies a rift-valley between the continent of Africa and the Arabian Peninsula. The Red Sea is separated from the Indian Ocean by a submerged sill across the Strait of Bab-el-Mandeb. The depth of water over the sill is only 200 fathoms. The Persian Gulf represents a shallow trough. It is practically enclosed and separated from the open ocean by the northward projecting Oman Peninsula. Due to this peninsula, the Strait of Hormuz has become very narrow, its width limited to only 80 km.