

UNIT:IV Ocean water circulation & Resources

3.1-Surface configuration of the Ocean floor

The floor of the oceans is highly uneven and varies having longest mountain ranges, deepest trenches and extensive plains. The sonic depth recorder made it possible to measure the variations in the relief of the ocean water topography. the marine relief variations are the outcome of the interaction among the following processes.

1. Tectonic movements
2. Volcanic activities
3. Erosion
4. Deposition

The major events of the ocean bottom topography are four as follows

1. The continental shelf
2. The continental slope
3. The continental rise
4. the Abyssal Plains

More over the minor relief features are also associated with the major events

1. Submarine ridges
2. Abyssal hills
3. sea mounts, Guyots
4. submarine canyons
5. Trenches
6. Banks
7. Shore

8. Island archs

9. Atolls

10. Coral reefs

Major relief features

1. Continental shelf:- it is a gentle seaward sloping surface linking coasts with the continental slopes. They are the out come of the following major processes.

a. submerging of the coastal areas due to rise in the sea level caused due to mainly climatic changes recently due to green house effect and Global warming.

b. Deposition of the materials brought by the rivers from land area and sea waves.

c. submarine erosion.

d. subsidence of the coastal areas covered by the tectonic movements.

The depth of water on the seaward side of the shelf varies from 150 to 200mts. the average width of contenental shelf is 75 and the slope is generally less than one degree.The shelves are generally covered by land driven materials\sediemnts and underlaid by sedimentary rocks or by ignious and metamorphioc rocks. A number of cold beaches and moranes may be identified along the shelves.Contenental shelves are of the great economic significance to man because

1. Marine food comes almost entierly from them. The major fishing grounds of the marine fishries are found on the contenental shelves (a) North west pacific fishing ground (b) North west Atlantic fishing region (c) North east pacific fishing ground (d) Northeast atlantic region

2. They are the important source of precious minerals e.g. 20% petrolium and gas is derived from the contenental shelf

3. They are the major source of sand and gravel which are used for building

construction

4. All the ports and harbours are located along the continental shelves

5. They are centres of the attractions of the millions of tourists per day all around the world. Due to the attractive beaches along them, the tourists enjoy here to see the glimpse of sunrise and sun set, swimming fishing and rowing in shallow water of the shelves.

2. Continental slopes:-

At the outward margins of the shelves the seaward surfacing slopes become very steep ranging from 2' to 5'. The continental slope connects the continental shelves with the continental rise. The average depth of water over the slope is upto 2000mts but at some places it has been measured upto 3660mts. Generally the slopes are dissected by deep trenches and canyons. Very few land derived materials are found on slope.

3. The continental rise:-

At the end of continental slope the gently sloping continental rise begins linking the slope with the Abyssal plains. The angle of the slope of continental rise varies from 0.5' to 1' and generally it has very low relief. With the increasing depth the continental rise becomes nearly flat and merges with the abyssal plains.

4. Abyssal plains:-

Beyond the continental rise lie the deep sea plains known as Abyssal plains or deep sea floors. The Abyssal plains are the deeper parts of the oceans and the depth of water here varies from 3000mts to 6000mts. They are found in all the oceans and also in some seas, covering nearly 40% of the area of ocean bottom. A number of submarine ridges rise above them and on the margins of the Abyssal plains are found deep sea trenches. The deep sea plains are uniquely flat having a gradient of 1:100. They are usually covered of the sediments derived from remains of the organisms and fine dust.

Associated submarine features

Submarine ridges:-These are the mountain ranges forming the longest mountain system on the earth. They generally bisect the deep sea plains into number of oceans basins. Their total length is 7500Km they are flat like plateaus or may be of very steep slopes. At some place their peaks have reached above the surface water forming the islands. They are found along the margins of the converging plate boundaries and are related with the earth quake and volcanic activities.

Abyssal hills, sea mounts , Guyots:- there are found thousands of Abyssal hills, sae mounts and Guyots are found on the ocean floors. The Abyssal hills having the height of more than one thousand above the surroundings are called sea mounts. the flat top sea mounts are known as Guyots. these features are the outcome of volcanic activity. They are found in all the oceans, but their maximum number has been observed on the pacific ocean. The oceanographers believe that there are more than 10'000 sea mounts and Guyots in the pacific ocean alone.

The submarine trenches of ocean deeps:- the long narrow and steep sided depressions on the Abyssal plains are known as trenches. They are the deepest part on the ocean floors, the average depth of water over the trenches is 5505 mts. They are the result of down folding and down faulting, means having tectonic origin. Deep sea trenches are the specific characteristics of the pacific ocean found on the both eastern and western parts of pacific ocean along the island chains. the deepest trench is Mariana trench (11022m) located on the north western parts of pacific oceans of the Guam island.

3.2-Relief of the pacific ocean

the Pacific ocean is the largest and deepest of all the water bodies in the world. Together with its associated seas it covers about $\frac{1}{3}$ rd of the earth's surface and exceeds the total land area of the world in size. Its average depth is around 7300m. Its shape is roughly triangular with its base in south and apex in north at the bering strait. Nearly 20000 islands dot the surface of this vast ocean. Those in mid ocean are coral and volcanic in origion and the rest are

continental

1. North Pacific

This part of the Pacific Ocean is characterised by maximum depth and large number of deeps, trenches and islands. Some well known trenches of this part are Aleutian, Kuril, Japan and Bonin which have depths ranging from 7000 to 10000m. There are also large number of sea mounts and guyots and island chains in the central part of the North Pacific Ocean.

2. South West Pacific

The average depth of this part of the Pacific Ocean is about 4000m and this part is marked by a variety of islands, marginal seas, continental shelves and submarine trenches, Mariana (above 11km) and the Mindanao trench (above 10000m) fall within this part of the Pacific Ocean.

3. South East Pacific

This part of the Pacific Ocean is conspicuous for the absence of marginal seas and has submarine ridges and plateaus. The Tonga and the Atacama are prominent trenches of this part.

Relief of Atlantic Ocean

The Atlantic Ocean is roughly the half of the size of the Pacific Ocean and its shape resembles the letter 'S'. It has a prominent continental shelf with varying width - the largest width occurring off the north east America and north west Europe. The Atlantic Ocean has numerous marginal seas occurring in shelves like the Hudson Bay, the Baltic Sea and the North Sea.

The most striking feature of the Atlantic Ocean is the presence of the mid Atlantic ridge which runs from the north to the south, dividing the Atlantic Ocean into two deeper basins on either side. The ridge is about 14000km long and about 4000m high. Several peaks of this ridge project out of the oceanic water surface to form islands of the mid Atlantic e.g. Pico Islands and Azores and Cape Verde Islands. There are coral islands also such as Bermuda and volcanic islands like Ascension, Tristanda-cunha, St. Helena and Gough. By and large the Atlantic Ocean lacks in troughs and trenches. North Cayman and Puerto Rico

are the two troughs and Romancha and south sandwich are the two Trenches in the Atlantic ocean.

3.3-Distribution of ocean temprature

Temprature of the oceans:- the distribution of temprature in the ocean is controlled by following factors.

1. The average daily duration of insolation and its intensity.
2. The depletion of energy by insolation, scattering and absorption.
3. The albedo of the sea surface and its varying nature depends upon the angle of sun rays.
4. The physical characteristics of the sea surface.
5. Transfer of heat due to evaporation and condensation.
6. Prevalent winds.
7. local weather conditions.
8. The presence of sub marine ridge- temprature is affected due to less mixing of water on the either sides of ridge.
9. The shape of ocean- the latitudinally extensive seas in low latitude regions are warmer than those which are longitudinally extensive.

Vertical distribution of ocean temprature:-There is gradual decrease in temperature with increasing depth. Normally , 90% of the solar energy is absorbed in the top most 15.6m (60 inches) of water. The sea water temprature corresponds to the surface temprature only upto a depth of about 100m and with further descent temprature generally decreases. In tropical oceans and seas three thermal layers can be recognized from surface to bottom. The first layer is about 500m thick with temprature varying between 20-25'C. In mid latitude region this top layer is found only during summer. The thermocline layer is found just below the first layer. It is chacterized by rapid decrease of temprature with increasing depth. The third layer is very cold and extends upto the ocean floor. In contrast to the tropical

oceans, in polar regions only one layer of cold water is identified which extends from surface to bottom. oceans are sometimes divided into two broad zones.

1. Photic or euphotic zone- which extends from the upper surface to 200m. this zone receives adequate solar radiation and
2. aphotic zone- extends from 200m to ocean bottom . This zone does not receive adequate solar radiations.

Following are the trends of the vertical distribution of temperature of oceans and seas.

1. Although temperature decreases with increasing depth upto about 200m, below this depth temperature becomes almost stagnant. This temperature decreases from 17°C to 0°C at about 4267m.
2. The rate of decrease of temperature with increasing depth is greater at the equator than at poles.
3. The surface temperature and its downward decrease are influenced by the upwelling of bottom water. Such conditions are experienced on the African and Californian coasts.
4. In some cases cold surface of water sinks and moves along bottom towards low latitudes. In cold Arctic and Antarctic regions, sinking of cold water and its movements towards lower latitudes is observed.
5. In equatorial regions the surface water sometimes exhibits lower temperature and salinity due to higher rainfall whereas the layers below it have higher temperature.
6. The enclosed seas in both higher and lower latitudes record higher temperature at the bottom.
7. The presence of sub marine barrier may lead to different temperature conditions on the two sides of the barrier.

Horizontal distribution of temperature :- The horizontal temperature distribution is shown by isothermal lines, i.e, lines joining the places of equal

temperatures. The sea surface isotherms in february, for the Atlantic ocean, reveal that the isothermal lines are closely spaced in the south of Newfoundland, near the west coast of Europe and north sea and then isotherms widen out to make a bulge towards north near the coast of Norway. the cause of this phenomenon lies in the cold Labrador current flowing southward along the North American coast which reduces the temprature of the region more sharply than in other places in the same latitude, at the same time the warm Gulf stream proceeds towards the western coast of europe. In the south western parts of the Atlantic , isotherms bulge towards south-west due to warm brazil current but in the eastern part of south Atlantic isotherms bend towards north- west due to cold Benguela current. Further south , isotherms are parallel owing to constant prevailing west wind drift.

The distribution of temperature in the north and the south Atlantic is not symmetrical. For example , in north Atlantic, 5'C isotherm touches 70'N latitude whereas in the southern half of the Atlantic is never crosses 50'S latitude because the warm Gulf stream is more powerful and it reaches to much higher latitude than the cold Brazil current. Moreover there is considerable difference between the eastern and western parts of the Atlantic. In the western part near Labrador coast, 0'C temprature is recorded but 9' to 13'C temprature is found on the west coast of Europe.

In the marginal seas, temperature varies due to latitude and location, e.g., the Mediterranean records higher temprature than the neighbouring Atlantic Ocean but the Baltic and the Hudson bay are colder than the Atlantic. In the northern half of the pacific, isotherms and latitudes are almost parallel, but on the coast of North America isotherms bend slightly Northward under the influence of the warm Kuroshio current and along the coast of japan isotherms are closely spaced due to the cold Oyashio current. In the equatorial region of the western part of the pacific, high tempratures are recorded as the warm equatorial current flows towards south. In the eastern part of the pacific, low temprature prevail due to the influence of Cold Peru current. In the south pacific, isotherms makes minor loops due to warm peru of Humboldt current.

In the Indian ocean, the isotherms of 25'C,27'C, and 28'C occupy the central location of the ocean. Towards south no difference is observed with the pacific as the isotherms roughly follow the parallels except a minor loop near the Cape

of Good hope due to the cold Agulhas current. The isotherms bend southward near the coast of North Africa due to a cold current which flows south-westward from cape Guardafui.

The same isotherm bends northward in the Arabian sea when it enters the Indian peninsula, but in the Bay of Bengal it bends towards south due to the effect of monsoon drift. The enclosed water bodies like the red sea have higher temperature towards south due to the mixture of open sea water. The Persian Gulf records lower temperature than the Indian ocean under the influence of cold land area.

The August condition is markedly different from that of February isothermal conditions. In the Atlantic the ice in the arctic melts away resulting in northward loop of all the isotherms in the Davis Strait. The sharp northward bends of isotherms on the Norwegian coast are absent in August. On an average the isotherms in the north Atlantic shift northwards in August. The Southern Pacific shows isothermal lines and latitudes placed parallel. Towards west the adjacent ocean of Australia-Asia region witnesses temperature as high as 28°C as the westerly flowing equatorial current draws warm water towards west Pacific.

3.4-Coral reef

Coral reefs chiefly are made of skeletons of minute sea organism called polyps. There are about 2500 species of coral reefs. These tiny organisms extract calcium from water to build hard skeletons to protect their soft bodies. They live in colonies which remain fastened to rocky seafloor. When one generation of polyps dies, fresh structures are built upon the old skeleton by a new generation, in due course of time a great mass of coral reef is formed. Besides coral reef millions of small plants (Algae) deposit calcium carbonate and thus contribute to the building coral rock.

Favorable conditions for coral growth

1. corals are generally found in tropical seas between 30°N and 30°S.
2. coral polyps need for their growth a temperature of 20°C.

3. they live at depths of almost 45 to 55m where sun light is abundance.
4. polypes thrive well in clear salt water, both fresh and highly saline water are harmful to the growth of polyyps.
5. they avoid delta region because for their growth the water should be free from sediments.
6. An adequate supply of oxygen and microscopic marine food is essential for the existence and growth as the food supply more plentiful or in the seaward side of a growing reef. coral grow on the seaward side more rapidly.

Types of corals

Three types of corals have been recognised on the basis of their characteristics & mode of occurrence.

1. Fringing reef
2. Barrier reef
3. Atoll reef

Fringing reef

it is a coral platform attached to the coast of the continent or an Island. Some times there is lagoon or a shallow channel between the edge of the reef and the land. Fringing reef is a narrow belt & its width varies between 0.5 to 2.5Km. The fringing reefs are found in the Gulf of mannar near Rameshwaram in south India & of the south coast of Florida.

Barrier reef

it is the largest of the three types. it may be several Km wide and several 100Km long. The essential characteristic of this kind of reef is its distant location from the coast on the Island. It is seperated from the land by a comparatively broader and deeper lagoon. small channels usually out the barieer reefs connecting lagoon with the open sea. The barrier reefs are formed by the accumulation of corals of various shapes and sizes through the edges. Their surface is covered with boulders, corals debris and sand. Generally

barrier reefs are in circle Islands in an irregular and broken ring. the great barrier reef of the north east coast of Australia is the largest in the world. it is more than 1900Km long and 160Km wide. A vast complex of 100's of seperated reefs and Islands. The great barrier reef of Australia is cosidered as a marine paradise. It attracts thousands of tourists every year from all over the world.

The Atoll

Atoll is ring like reef which partly or sometimes completely encloses shallow lagoon.it has a depth of 80 to 150mts having an island or a submerged plateau in it. Generally a large number of channels cutting across the atoll reef from the lagoon with the open sea.

Origin of coral reefs

The problem of the origion of coral reefs in general and Atoll in particular is highly complex. The following theories havebeen put forward regarding the origin of barrier reefs and Atolls

- I. Subsidence theory of Charles Darwin
- II. Non subsidence or standstill theory of Murray
- III. Glacial controll theory of Daly

Importance of coral reefs

- * Corals reefs proviode a source of food and shelter for a large variety of species including fish, shellfish, fungi, sponges, sea anemones, sea urchins, sea snakes, sea stars, worms, jelly fish, turtles and snails.
- * living coral reefs are the foundation for many marine species, and thus a crucial support for human life.
- * coral reefs are the homes of many species including crabs, shrimp, oysters and clams.
- * Coral reefs protects lines from ocean storms and floods.
- * coral reefs are environmental indicators of water quality because they can tolerate narrow ranges of temprature, salinity, water clarity and other water

conditions.

* Coral reefs make important contributions to local economies because they attract millions of tourists every year to enjoy beaches, water sports and other activities.

* Coral reefs are important source of new medicines that can be used to treat diseases and other health problems.

3.5-SALINITY

Salinity of the ocean water simply means the presence of dissolved salts in the sea water. Salinity is defined as the ratio between the weight of dissolved solid materials and the weight of sample sea water. Generally, salinity is defined as the total amount of solid material in grams contained in one kilogram of seawater and is expressed as part per thousand (‰) e.g. 30‰. (means 30 grams of salt in 1000 grams of seawater). The average salinity of seawater is 3.5‰(parts per hundred) but is always mentioned as 35‰. (parts per thousand) in order to avoid decimals.

CONTROLLING FACTORS OF SALINITY :- there is wide range of variation in the spatial distribution of salinity within the oceans and the seas. the factors affecting the amount of salt in different oceans and seas are called as controlling factors of oceanic salinity, which are as follows

- a. Evaporation
- b. Precipitation
- c. Influx of river water
- d. Prevailing winds
- e. Ocean currents and sea waves
- f. Freezing and melting of ice

Distribution of Seawater salinity :- the areas of higher salinity are found near the tropics, from where the salinity decreases towards the equator and the poles. This is because at the tropics there is active evaporation owing to

clear skies, high temperature and steady trade winds. In the Atlantic ocean salinity near tropics is about 37%. . On the other hand near the equator there is heavy rainfall, high humidity, cloudiness and calm air. The equatorial region of Atlantic ocean has a salinity 35%. . The polar areas experience little evaporation and large amount of fresh water from melting of ice. This leads to low levels of salinity ranging from 20-30%. . The maximum salinity occurs between 20 degree to 40 degree north and 10 degree to 30 degree south latitudes.

In the open seas the variation in salinity is less pronounced compared to partly or wholly closed seas e.g. in Baltic seas salinity increases from 11%. near south west coast to 20%. near the head of gulf of Boyhnia. Black sea receives many rivers and thus its salinity is 18%. only . The red sea on the other hand experiences high evaporation and there are no rivers falling into it, therefore it has a salinity of 40%. and above .

The salinity of in lands seas and lakes is very high e.g. salinity of Grand lakes (USA) is 220%. , Dead sea 240%. and lake Van in turkey 330%.

Salinity distribution also varies vertically and is again Subjected to Latitudinal differences. The decrease is also influenced by cold and warm currents. In high latitudes salinity increases with depth, in mid latitudes it increases upto 35m and then decreases. At the equator, surface salinity is lower and increase downwards.

Seas having salinity above normal

- * Red sea (34-41%.)
- * Persian gulf(37-38%.)
- * Mediterranean sea(37-39%.)

Seas having normal salinity

- * Carribean sea and Gulf of Mexcio(30-36%.)
- * Bass strait (35%.)
- * Gulf of california(25-35%.)

Seas having salinity between normal

- * Arctic ocean (20-35%.)
- * North Australian sea(33-34%.)
- * Berring sea (28-33%.)
- * Okhotsk sea (30-32%.)

the upper zone of maximum salinity is separated from the lower zone of minimum salinity by transitional zone called 'halocline zone'.

Books consulted

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3. Geography by Rajiv Ahir
4. Physical Geography by Majid Hussain.
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Tides: - Origin and Types

Tides refer to the regular rise and fall of water level in the world's oceans resulting from gravitational attraction that is exerted upon the Earth by the **Sun** and the **Moon**. They are the longest wave known. The nature and magnitude of tides vary from place to place.

Factors Controlling The Nature And Magnitude Of Tides

1. The movement of the **moon** in relation to the **earth**.
2. Changes in positions of the **sun** and the **moon** in relation to the **earth**.
3. Uneven distribution of the water over the globe.
4. Irregularities in the configuration of the oceans.

❖ The Mechanism Of Tide Formation

The gravitational interaction of the **moon**, the **sun** and the **earth** is responsible for the occurrence of tides. The sun by virtue of its bigger size should attract more, but owing to its greater distance from the earth is unable to exert much influence. The moon on the other hand, though much smaller in size than the sun, is relatively close to the earth and is thus able to attract more than sun. Hence, the moon exerts strongest influence on tides. The tide producing force of the moon is twice as strong as that of the sun.

The position of the moon in relation to the earth determines the magnitude of the tide. Thus on full moon and new moon, the moon and the sun are almost in a line with the earth. Hence, they exert their combined pull on the earth. Therefore, on these two days the tides are the highest and are known as the **Spring Tides**. Similarly, when the moon is at first and last quarter, the sun and the moon are at right angles to the earth's centre. The attraction of the sun and the moon tend to balance each other. As a result tides with the lowest amplitude occur. These are known as **Neap Tides**.

Although tides occur twice a day, their interval is not exactly 12 hours. Instead, they occur at regular intervals of 12 hours and 26 minutes. This is because the moon revolves around the earth from west to east, and each day it moves a bit to the east if observed from the same place on the earth at the same time on two

consecutive days. This time lag explains the tide interval of 12 hours and 26 minutes, as tides occur twice a day.

➤ **Types of tides**

As mentioned earlier, oceanic tides are produced due to tide producing forces of the sun and the moon. There is lot of temporal and spatial variation in the tide producing forces because of different positions of the sun and the moon with the earth. Because of variations in the intensity of tide producing forces several types of tides are caused. A few important types of tides are as follows:-

1. Spring Tides

Very high tide is caused when the **sun**, the **moon** and the **earth** are almost in the same line. Such high tides are called **Spring Tides**. The position of the sun, the moon and the earth in a straight line is called **syzygy**. When the sun and the moon are in one side of the earth, the position is called **conjunction**. When the position of the earth is in between the sun and the moon the position is called **opposition**. The positions of **conjunction** and **opposition** take place during **new moon** and **full moon** respectively. In these situations the gravitational forces of the sun and the moon work together with combined force and thus high tide is caused. The height of such tide spring tides is 20 percent more than the normal tides. Such tides occur twice every month (during full moon and new moon) and their timing is fixed.

2. Neap Tides

The sun, the earth and the moon come in the position of quadrature (i.e. from right angles) on seventh or eighth day of every fortnight of a month and thus the tide producing forces of the sun and the moon work in opposite direction, with the result low tide is caused. Such tide, which is lower in height than the normal tide, is called **neap tide**. The height of neap tides is generally 20 percent lower than normal tides.

3. Daily and Semi – diurnal Tides

The tides recurring at the interval of 24 hours 52 minutes daily are called **diurnal** or **daily tides** while the tides recurring at the interval of 12 hours and 26 minutes are called **semi – diurnal tides**.

4. Apogean and Perigean Tides

The nearest position of the moon with the earth is called **perigee** when the distance between them is **3, 56,000 km**. The tidal force of the moon is most powerful during this position and hence high tides are caused. Such tides are called **Perigean tides**. The height of these tides is generally 15 to 20 percent higher than normal tides. On the other hand, the tidal force of the moon is **minimum** during the position of **apogee** when the moon is at the farthest distance (**4, 07,000km**) from the earth and hence low tides are caused. Such low tides are called as **Apogean tides**, and are 20 percent lower than normal tides.

Currents: - Origin and Type

❖ Oceanic Currents:

1 Ocean currents are narrow and shallow (up to 500 meter deep), stream of water circulating along the ocean margins.

❖ The main aim of the oceanic currents is heat distribution- from poles to equator or vice versa.

❖ Warm water from equator to cold water from poles.

2 Factors responsible for oceanic currents:

❖ **Wind:** Most dominant force is wind, most of the currents follow the direction of the trade winds, Westerlies & polar easterlies

❖ **Insolation:** Sunlight plays important role on two factors i.e. temperature gradient & Salinity. Water lighter near equator, than at the equator. Cold water being denser sinks downward. Salinity also increases density of water.

❖ **Coriolis force:** Factors modifying the ocean currents: a) factor deflect the path of the currents, b) coastlines also modify the path of the currents.

❖ **Gravity.**

3 **Ocean currents of the world:**

❖ Two types of currents mainly influenced by temperature differences Warm & cold currents mainly blow in their opposite direction to exchange their characteristic in their exotic positions.

❖ Presently three important navigable oceans occupying huge portion of earth's surface i.e. Pacific ocean, Atlantic Ocean & Indian Ocean.

Origin of Currents

The currents in the oceans are originated due to the combined effect of several factors acting internally as well as externally. The factors, in fact, controlling the origin and other characteristics of ocean currents are related to different characteristics of ocean waters, rotational mechanism of the earth, external factors or atmospheric factors, topographical characteristics of the coasts and ocean basins. Besides, there are some factors which modify ocean currents.

1. The factors relating the earth's nature and its rotation include

(i) **Gravitational force**

- (ii) **Deflective force by the earth's rotation**
2. Oceanic factors include
 - (i) **Temperature variations**
 - (ii) **Pressure gradient**
 - (iii) **Salinity differences**
 3. Ex - Oceanic factors include
 - (i) **Atmospheric pressure and winds**
 - (ii) **Evaporation**
 - (iii) **Precipitation**
 4. Currents modify factors are
 - (i) **Direction and shape of coastlines**
 - (ii) **Bottom reliefs of ocean basins**
 - (iii) **Seasonal variations**
 - (iv) **Rotation of the earth**

There are two types of oceanic currents

1. Warm Current

2. Cold Current

Warm Current

Warm currents are those which flow from the low latitudes in tropical zones towards the high latitudes in the temperate and sub – polar zones.

Cold Current

Cold currents are those which flow from high latitudes towards the low ones.

Currents of Atlantic Ocean:

1 Northern hemisphere

a) **North Equatorial current (warm current):** North Equatorial current is formed between the equator and 10°N latitude. This current is generated because of upwelling of cold water near west coast of Africa and is also pushed westward by canary current. The current is deflected into two branches after being obstructed by the east coast of Brazil i.e. Antilles current & Caribbean current.

b) **Counter equatorial current (warm current)** flows west to east in between the westward flowing strong north & south equatorial currents.

c) **Gulf Current (Warm current):** Is a system of several currents moving in north easterly direction. This system originates in the Gulf of Mexico around 20°N latitude and moves in north easterly direction along the eastern coast of North America & reaches western coasts of Europe near 70°N latitude. This is named Gulf Stream after its origin in the Mexican Gulf.

d) **Florida Current (Warm current):** in fact, the northward extension of the north equatorial current. This current flows through Yucatan channel into the Gulf of

Mexico, there after current moves forward through Florida Strait & reaches 30°N latitude.

e) **Labrador Current (Cold current):** an example of cold current, originates in the Baffin Bay & Davis Strait and after flowing through the coastal waters of Newfoundland and Grand Bank merges with the Gulf Stream around 50° W longitude

f) **Canary current (Cold current):** Flows along the western coast of North Africa between Madeira & Cape Verde. In fact this current is the continuation of north Atlantic drift which turns south wards near the Spanish coast and flows to the south along the Coast of Canaries Island.

The anticyclone circulation of ocean currents comprising the north equatorial current, The Gulf Stream and the Canary current in the North Atlantic Ocean forms a motionless gyral is called Sargasso sea, sea without coast.

2. Southern Atlantic Currents:

a) **South equatorial (warm current)** current flows from the western coast of Africa to the eastern coast of South America between the equator & 20°S latitude. This current is more constant, stronger and of greater extent than north equatorial current.

b) **Brazil current (warm current)** characterized by high temperature & high salinity. This current is generated because of the bifurcation of the south equatorial current because of obstruction of the Brazilian coast near

Sun Rock. The northern branch flows northward & merges with north equatorial current while southern branch called Brazil current.

c) **Falkland current (cold current):** The cold waters of the Antarctic Seas flows north wards along the eastern coast of South America up to Argentina. This current brings numerous icebergs from the Antarctic area to the South American coast.

d) **Benguela current (cold current):** a cold current, flows from south to north along western coast of South Africa. in fact, the south Atlantic Drift turns North ward due to obstruction caused by the southern tip of Africa. Further north ward, this current merges with the south equatorial current.

- **Currents of Pacific Ocean:**

1 Northern Hemisphere:

a) **North equatorial warm current:** originates along the western coast of Mexico and flows westerly direction & reaches Philippines coast after covering a distance of 7500 nautical miles. This current originates because of the Californian current and north-east monsoon.

b) **Counter equatorial current (warm):** flowing west to east between north & south equatorial current.

c) **Kuroshio Current (warm):** comprised of several currents & drifts is similar to the Gulf Stream system of the Atlantic Ocean. This system runs from Taiwan to the Bering Strait.

d) **Oyashio current (cold)**: is also known as kurile cold current. This current flows through the Bering Strait in southerly direction & thus transports cold water of the Arctic sea into the Pacific Ocean.

e) **California current (cold)**: similar to canary cold current. This is generated because of the movement of oceanic water along the Californian coast from north to south in order to compensate the loss of water due to large scale transport of water off the coast of Mexico under the influence of trade winds in the form of north equatorial current.

2 South Pacific Currents:

a) **South equatorial current (warm)**: Originates due to influences of south east trade winds & flows from west to east. This current is stronger than north equatorial current.

b) **Peru cold current**: flowing along the western coast of South America to north also known as Humboldt Current. This current is known as Peru coastal current near the coast while it is called Peru oceanic current off the coast.

c) **El Nino (warm current)**: A subsurface warm current, known as El Nino current flows from north to south between 30°S & 36°S latitude at a distance of 180km from the Peruvian coast.

d) **East Australia current (warm):** south equatorial current is bifurcated near the Australian coast into northern & southern branches. The southern branch flows as east Australia current from north to south along the western coast of Australia, New Zealand is surrounded by this current.

e) **West wind drift (cold):** flows from west to east under the influence of the Westerlies between Tasmania & South American coast.

Marine Resources: Oceans as a store House.

(Conceptual Background)

A new or reserve supply that is used or drawn upon when needed or any kind of source which fulfills socio-economic needs of humans is called a resource which include both biotic and abiotic.

❖ The resources both biotic and abiotic found in the oceanic water upper surface as well as bottom of the oceans are called **Marine resources**.

❖ The marine resources include marine water, inherent energy (wave energy & tidal energy etc), biotic marine life (plants and animals), abiotic elements (minerals, fossil fuels etc.).

- ❖ The marine resources are unique in the sense that they are renewable as most of the organisms can be regenerated.
- ❖ From the very beginning there is cohesive relationship between man & oceans. Humans have been using oceans in number ways e.g. transport, communication, trade, fishing, defense purpose, mineral extraction, medicines, recreation & waste disposal etc.
- ❖ Presently, the importance of oceans has increased many folds because of increased demand of food & minerals consequent upon ever increasing world population.

1. Classification of Marine Resources:

- ❖ Sea & Oceans are endowed with different varieties of Biotic & Abiotic mainly from two different sources.
- ❖ Firstly, by rivers by carrying different minerals into the sea by draining through different land areas of the lithosphere.
- ❖ Secondly, resources manufactured by plants in shallow water.
- ❖ Oceans are vast reservoirs of biotic resources, nearly 40000 species of mollusks & 25000 species of fishes are found in marine water.
- ❖ Besides minerals, different types of vitamins and medicinal elements are also found in huge number.

Generally, marine resources are divided into three categories:

- a) Biotic Resources
- b) Abiotic Resources and
- c) Commercial Resources (navigation, aviation, trade & transport etc.).

Alternatively, marine resources can also be divided into mineral resources, energy resources and food resources.

1. Marine Biological Resources:

A) Food Resources- i) Animal resources (fishes, crabs, prawns, zoo planktons etc.)

ii) Plant Resources- Phytoplankton's, Sea grass etc.)

B) Non-food Resources –Corals.

Marine Biological Resources can also be divided into following categories:

A) Plankton Communities- Phytoplanktons, Zoo Planktons.

B) Nekton Communities- Pelagic Fishes, Demersal fishes

C) Benthos Communities- Epibenthic community, Benthic Organisms ,inflora and infauna

2. Marine Mineral Resources-

A) On the basis of location

(i) Minerals of the continental shelf deposits

(ii) Minerals of the continental slope deposits

(iii) Minerals of the deep sea bottom deposits.

- B) On the basis of nature
 - (i) Metallic minerals
 - (ii) Fuel minerals (Petroleum, Natural gas)
 - (iii) Construction materials (Gravels, Sands etc.).

3. Energy Resources

- A) Conventional Energy- Petroleum and Natural gas
- B) Non-Conventional Energy- Tidal energy, Wave Energy and Biomass

4. **Fresh Water Resources:** Manufactured water (Transformation of saline sea water through the process of desalinization into potable water).

- **Oceanic Deposits:**

- ❖ The unconsolidated sediments, derived from various sources during run-off process deposited at the sea floors are included in the ocean deposits.

- ❖ The study of ocean (marine) deposits includes: The types of sediments, their sources, methods of their transportation, Horizontal distribution, lithological succession or vertical variations in their distribution and composition etc.

3.1: Sources and Types of Marine or Oceanic Deposits

- ❖ The Sediments deposited in the oceans and seas are derived from three major sources Viz.

- a) Terrigenous Sources
- b) Volcanic eruptions and
- c) Marine plants & Animals

Based on the composition the sediments derived from these sources are of many types Viz. Organic and inorganic sediments, calcareous sediments, siliceous sediments etc.

On the basis of sources ocean deposits are classified into the following categories:

A) **Terrigenous Deposits:** The continental rocks are disintegrated and decomposed into fine to coarse sediments due to various types of weathering and are deposited at the bottom of seas/oceans. These sediments of continental origin are called terrigenous deposits.

- ❖ Terrigenous deposits includes gravels, sand, silt, clay and mud (blue mud, green mud & red mud).

- ❖ All these are brought to rivers through surface wash, rain wash, rills, gullies & small rivulets and ultimately these sediments are brought by the rivers to the oceans and seas.

- ❖ Over 15000 million to 20000 million tons of sediments per year are discharged through the rivers to the oceans.

B) **Volcanic Deposits:** Volcanic materials deposited in the marine environment mainly by two sources- a) Volcanic eruptions on the land & b) Volcanic eruption in the oceans and small rivulets

- ❖ Volcanic materials resemble blue mud and are grey to black in color.

C) **Organic Materials:** The source of the organic materials is sea itself.

- ❖ They include skeletons of marine organisms and plant remains.

- ❖ These materials are grouped into two categories viz. (i) Neritic matter and Pelagic matter.
- ❖ The neritic matter includes skeletons of marine organisms & plant remains while pelagic matter consists of remains of different types of algae.
- ❖ Neritic matters are deposited mostly on the continental shelves and are generally covered with terrigenous materials. These include shells of molluscs and their fragments, skeletons of radiolaria, calcareous and siliceous plant remains.
- ❖ Pelagic deposits consist of matter derived from algae and are mostly in the form of liquid mud, generally known as ooze.
- ❖ Pelagic materials are oozes which are divided into two groups on the basis of lime & silica content- **Calcareous oozes** contain lime content in abundance and are seldom found in the greater depth because of their high degree of solubility. They are generally found at the sea floor between the depths ranging from 1000 fathoms to 2000 fathoms (1 fathom equals to 6 feet).
- ❖ On the basis of principal organisms calcareous oozes are further divided into (a) Pteropod Ooze, (b) Globigerina Ooze.
- ❖ **Siliceous Ooze**- when silica content dominates, the Ooze becomes siliceous in nature. This Ooze does not dissolve as compared to calcareous Ooze because of less calcium carbonate & dominance of silica, thus such Oozes are found in both cold & warm water at greater depth. This group is further divided into two sub types on the basis of dominance of a particular organism—(a) Radiolarian Ooze and (b) Diatom Ooze.

D) Inorganic materials: Majority of inorganic elements are basically precipitates which fall down from above.

❖ These materials fall down on land as well as in the oceans. some of the inorganic elements are transported from the land to the oceans by various agencies.

❖ The inorganic precipitates include dolomite, amorphous silica, iron, manganese oxide, phosphate etc.

❖ The organic & inorganic materials are so mixed together due to chemical process that it becomes very difficult to isolate them from each other.