Geography Optional - 2024

MARITIME ZONES AND MARINE RESOURCES

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Oceans and the Law of the Sea

Life itself arose from the oceans. The ocean is vast, covering 140 million square miles, some 72 per cent of the earth's surface. Not only has the oceans always been a prime source of nourishment for the life it helped generate, but from earliest recorded history it has served for trade and commerce, adventure and discovery. It has kept people apart and brought them together.

Even now, when the continents have been mapped and their interiors made accessible by road, river and air, most of the world's people live no more than 200 miles from the sea and relate closely to it.

Freedom of the Seas The oceans had long been subject to the freedom of-the-seas doctrine - a principle put forth in the 17th century, essentially limiting national rights and jurisdiction over the oceans to a narrow belt of sea surrounding a nation's coastline. The remainder of the seas was proclaimed to be free to all and belonging to none. While this situation prevailed into the twentieth century, by mid-century there was an impetus to extend national claims over offshore resources.

There was growing concern over the toll taken on coastal fish stocks by long-distance fishing fleets and over the threat of pollution and wastes from transport ships and oil tankers carrying noxious cargoes that plied sea routes across the globe. The hazard of pollution was ever present, threatening coastal resorts and all forms of ocean life. The navies of the maritime powers were competing to maintain a presence across the globe on the surface waters and even under the sea.

United Nations Law of the Sea Convention (UNCLOS)

The United Nations has long been at the forefront of efforts to ensure the peaceful, cooperative, legally defined uses of the seas and oceans for the individual and common benefit of humankind. Urgent calls for an effective international regime over the seabed and the ocean floor beyond a clearly defined national jurisdiction set in motion a process that spanned 15 years and saw the creation of the United Nations Seabed Committee, the signing of a treaty banning nuclear weapons on the seabed, the adoption of the declaration by the General Assembly that all resources of the seabed beyond the limits of national jurisdiction are the common heritage of mankind and the convening of the Stockholm Conference on the Human Environment.

The UN's groundbreaking work in adopting the 1982 Law of the Sea Convention stands as a defining moment in the extension of international law to the vast, shared water resources of our planet. The convention has resolved a number of important issues related to ocean usage and sovereignty, such as:

- Established freedom-of-navigation rights
- Set territorial sea boundaries 12 miles offshore
- Set exclusive economic zones up to 200 miles offshore
- Set rules for extending continental shelf rights up to 350 miles offshore
- Created the International Seabed Authority
- Created other conflict-resolution mechanisms (e.g., the UN Commission on the Limits of the Continental Shelf)
- Protection of marine environment and biodiversity

The United Nations Environment Programme (UN Environment), particularly through its Regional Seas Programme, acts to protect oceans and seas and promote the environmentally sound use of marine resources. The Regional Seas Conventions and Action Plans is the world's only legal framework for protecting the oceans and seas at the regional level. UNEP also created The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. It is the only global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems.

The United Nations Educational, Scientific and Cultural Organization (UNESCO), through its Intergovernmental Oceanographic Commission, coordinates programmes in marine research, observation systems, hazard mitigation and better managing ocean and coastal areas.

The International Maritime Organization (IMO) is the key United Nations institution for the development of international maritime law. Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented.

Marine shipping and pollution To ensure that shipping is cleaner and greener, IMO has adopted regulations to address the emission of air pollutants from ships and has adopted mandatory energy-efficiency measures to reduce emissions of greenhouse gases from international shipping. These include the landmark International Convention for the Prevention of Pollution from Ships of 1973, as modified by a 1978 Protocol (MARPOL), and the 1954 International Convention for the Prevention of Pollution of the Sea by Oil.

Polar Code In 2014, important regulatory developments in the field of transport and trade facilitation included the adoption of the International Code for Ships Operating in Polar Waters (Polar Code), as well as a range of regulatory developments relating to maritime and supply chain security and environmental issues.

Piracy In recent years there has been asurge in the piracy off the coast of Somalia and in the Gulf of Guinea. Acts of piracy threaten maritime security by endangering, in particular, the welfare of seafarers and the security of navigation and commerce. These criminal acts may result in the loss of life, physical harm or hostage-taking of seafarers, significant disruptions to commerce and navigation, financial losses to shipowners, increased insurance premiums and security costs, increased costs to consumers and producers, and damage to the marine environment.

Pirate attacks can have widespread ramifications, including preventing humanitarian assistance and increasing the costs of future shipments to the affected areas. The IMO and UN have adopted additional resolutions to complement the rules in the Law of the Sea Convention for dealing with piracy.

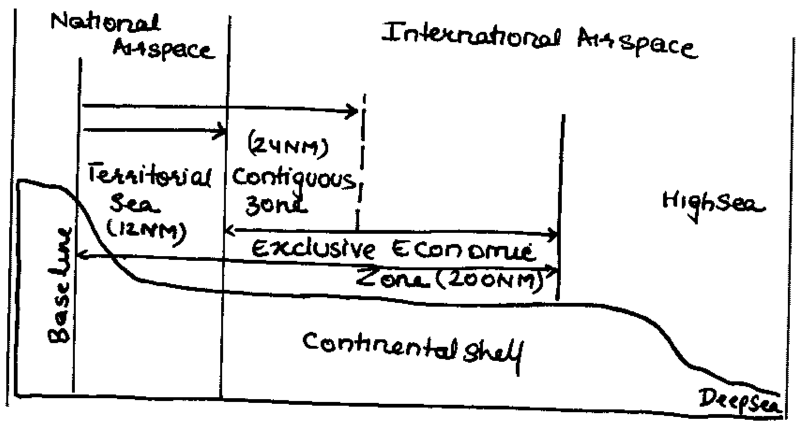
Maritime delimitation is a very complex and multiform subject. The international community and the Courts, in spite of their endeavors, find it difficult to produce a general principle applicable to all maritime delimitation processes. The 1982 LOS Convention sets forth only the goal to achieve maritime delimitation, and says nothing about the principles and methods for the achievement of equitable result. Customary law, which plays an important role in the delimitation process, also establishes that delimitation must be in accordance with equitable principles, taking into account the relevant circumstances. Equitable principles do not lay down obligations, but simply clarifies the guidelines for achieving an equitable result in the delimitation and the relevant circumstances are relevant only for particular cases. At the same time, case law and especially State practice, supports the use of equidistance/relevant circumstances rule and shows that primacy must be accorded to the geographical factors in delimiting maritime boundaries .A single rule or method may not be applicable in all circumstances, irrespective of geographical and other facts. A maritime boundary, to be durable, must be fair and equitable and take into account the special circumstances in the area relevant to delimitation. The primary rule for maritime delimitation accepted both by conventional law and customary law is that the delimitation must be effected by agreement. Maritime boundaries between States, to be secure and stable, have to be settled by agreement between them. The negotiation process between States is very important for the achievement of positive results. The subject of maritime boundary, like the subject of land boundary, is a sensitive one and should be handled carefully and with understanding of the opposite viewpoints. Despite serious and meaningful negotiations if difficulties and disputes arise, the parties may resort to the third-party settlement procedures.

Principles and methods of delimitation

1. **Equidistance** The 1958 Territorial Sea Convention defines equidistance as "the line every point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial sea of each of the two States is measured The emergence of the principle of distance gives pertinence in normal situations to the equitable method of the equidistance/median line. However, notwithstanding there cognition of the principle of distance as the basis of entitlement to both the EEZ and the CS within 200 nautical miles.
2. **Equity and the equitable principle** The notion of equity is at the heart of the delimitation of the CS and entered into the delimitation process with the 1945 proclamation of US President Truman, concerning the delimitation of the CS between the Unites States and adjacent States
3. **Single maritime boundary** Following the emergence of the doctrine of the EEZ, there has been an increasing trend among States to adopt, in the interest of simplicity, certainty and convenience, a single maritime boundary to divide their maritime zones beyond the territorial sea. In the case of adjacent coasts, a line drawn seaward from the coast will usually separate only the territorial waters of the two States for the first twelve nautical miles. Beyond that, if States agree, the same may separate the two maritime zones between them.

4. Proportionality Some rules of international law leave judgment on the legality of an act to the consideration of the specific situation of the case, and offer only a general notion of the criteria for evaluation. One of these rules is the concept of proportionality. The concept of proportionality plays an important role in various domains of international law and the law of the sea, and in particular maritime delimitation. The concept of proportionality has been taken into account in every judgment relating to maritime delimitation.

5. Other methods The perpendicular line to the general direction of the coast is also one of the methods used for drawing the maritime boundary between adjacent coasts. This method was used by the ICJ in some cases and has also found its place in State practice. The use of the perpendicular line is more frequent in the case of adjacent States which present coasts that are more or less straight. A lateral delimitation based on a perpendicular line, however, will only lead to a mutually acceptable result when the coast at the point of termination of the land frontier is relatively straight and the general direction of the coastline rather easy to determine. For such delimitation, the locations of the baselines are important in determining the general direction.



6 *Geographical circumstances*

(a) Configuration of coasts It is necessary to examine closely the geographical configuration of the coastline of the countries since the land is the legal source of power which may exercise over territorial extensions to seaward, it must first be clearly established what features do in fact constitute such extension. Geographical circumstances, and especially coastal configuration, play an important role in State practice as well.

(b) Islands An island is a naturally formed area of land, surrounded by water, which is above water at high tide [and it enjoys its territorial sea, EEZ and continental shelf]. Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf It is necessary to note that the present paper only addresses dependent islands, i.e. islands under sovereignty of one or the other States. The problem is fundamentally different in the case of island States. In such a situation, the delimitation process will be held between opposite States and whether it is a large continental State or a small independent island, in every case its Statehood gives it the same potential for generating maritime projection under the condition laid down by international law.

7 ***Non geographical circumstances***

(a) Geology and geomorphology Geological and geomorphologic factors may constitute relevant circumstance in CS delimitation. These factors are closely related to the concept of natural prolongation, which played an important role in the 1969 North Sea case as the basis for the entitlement for CS. It is also necessary to note that, during this time, the notion of the EEZ had not emerged. The Court stated that one of the factors needed to be taken into account by States in their negotiation process is the "physical and geological structure of the continental shelf areas involved." But, at the same time, the other two factors noted by the Court were the geographical factors, such as costal configuration and "the element of a reasonable degree of proportionality

(b) Socio-economic circumstances Economic and social factors may play an important role in maritime negotiation process between States, but these factors are considered by the Court as largely irrelevant to delimitation due to the fact that equity does not operate in this case as distributive justice. In all cases brought to the ICJ and arbitral tribunals, the Court was asked to draw maritime boundary lines applying the principles and rules of international law. The Court did not regard as relevant the existence, importance or location of natural resources. In most cases, there was no reason for adjusting the delimitation line simply because an oil deposit or a fishery resource straddled the line, or because all the resources were to be found on one side. If the provisional line cuts across a resource, dividing it in two, this is not the circumstance which reasonable to take into consideration.

Law of the Sea, branch of international law concerned with public order at sea. Much of this law is codified in the United Nations Convention on the Law of the Sea, signed Dec. 10, 1982. The convention, described as a "constitution for the oceans," represents an attempt to codify international law regarding territorial waters, sea-lanes, and ocean resources. It came into force in 1994 after it had been ratified by the requisite 60 countries; by the early 21st century the convention had been ratified by more than 150 countries.

According to the 1982 convention, **each country's sovereign territorial waters** extend to a maximum of 12 nautical miles (22 km) beyond its coast, but foreign vessels are granted the right of innocent passage through this zone. Passage is innocent as long as a ship refrains from engaging in certain prohibited activities, including weapons testing, spying, smuggling, serious pollution, fishing, or scientific research. Where territorial waters comprise straits used for international navigation (e.g., the straits of Gibraltar, Mandeb, Hormuz, and Malacca), the navigational rights of foreign shipping are strengthened by the replacement of the regime of innocent passage by one of transit passage, which places fewer restrictions on foreign ships. A similar regime exists in major sea-lanes through the waters of archipelagos (e.g., Indonesia).

Beyond its territorial waters, every coastal country may establish an **exclusive economic zone (EEZ)** extending 200 nautical miles (370 km) from shore. Within the EEZ the coastal state has the right to exploit and regulate fisheries, construct artificial islands and installations, use the zone for other economic purposes (e.g., the generation of energy from waves), and regulate scientific research by foreign vessels. Otherwise, foreign vessels (and aircraft) are entitled to move freely through (and over) the zone.

With regard to the seabed beyond territorial waters, every coastal country has exclusive rights to the oil, gas, and other resources in the seabed up to 200 nautical miles from shore or to the outer edge of the continental margin, whichever is the further, subject to an overall limit of 350 nautical miles (650 km) from the coast or 100 nautical miles (185 km) beyond the 2,500-metre isobath (a line connnecting equal points of water depth). Legally, this area is known as the continental shelf, though it differs considerably from the geological definition of the continental shelf. Where the territorial waters, EEZs, or continental shelves of neighbouring countries overlap, a boundary line must be drawn by agreement to achieve an equitable solution. Many such boundaries have been agreed upon, but in some cases when the countries have been unable to reach agreement the boundary has been determined by the International Court of Justice (ICJ; e.g., the boundary between Bahrain and Qatar) or by an arbitration tribunal (e.g., the boundary between France and the United Kingdom). The most common form of boundary is an equidistance line (sometimes modified to take account of special circumstances) between the coasts concerned.

The high seas lie beyond the zones described above. The waters and airspace of this area are open to use by all countries, except for those activities prohibited by international law (e.g., the testing of nuclear weapons). The bed of the high seas is known as the International Seabed Area (also known as "the Area"), for which the 1982 convention established a separate and detailed legal regime. In its original form this regime was unacceptable to developed countries, principally because of the degree of regulation involved, and was subsequently modified extensively by a supplementary treaty (1994) to meet their concerns. Under the modified regime the minerals on the ocean floor beneath the high seas are deemed "the common heritage of mankind," and their exploitation is administered by the International Seabed Authority (ISA). Any commercial exploration or mining of the seabed is carried out by private or state concerns regulated and licensed by the ISA, though thus far only exploration has been carried out. If or when commercial mining begins, a global mining enterprise would be established and afforded sites equal in size or value to those mined by private or state companies. Fees and royalties from private and state mining concerns and any profits made by the global enterprise would be distributed to developing countries. Private mining companies are encouraged to sell their technology and technical expertise to the global enterprise and to developing countries.

On many issues the 1982 convention contains precise and detailed regulations (e.g., on innocent passage through territorial waters and the definition of the continental shelf), but on other matters (e.g., safety of shipping, pollution prevention, and fisheries conservation and management) it merely provides a framework, laying down broad principles but leaving the elaboration of rules to other treaties. Regarding the safety of shipping, detailed provisions on the safety and seaworthiness of ships, collision avoidance, and the qualification of crews are contained in several treaties adopted under the auspices of the International Maritime Organization (IMO), a specialized agency of the United Nations (UN). The IMO also has adopted strict antipollution standards for ships. Pollution of the sea from other sources is regulated by several regional treaties, most of which have been adopted under the aegis of the United Nations Environment Programme. The broad standards for fisheries conservation in and management of the EEZ (where most fishing takes place) laid out in the 1982 convention have been supplemented by nonbinding guidelines contained in the Code of Conduct for Responsible Fisheries adopted in 1995 by the UN Food and Agriculture Organization. Principles of management for high seas fishers are laid down in the UN fish stocks treaty (1995), which manages straddling and highly migratory fish stocks, and in detailed measures adopted by several regional fisheries commissions.

Countries first attempt to settle any disputes stemming from the 1982 convention and its provisions through negotiations or other agreed-upon means of their choice (e.g., arbitration). If such efforts prove unsuccessful, a country may, subject to some exceptions, refer the dispute for compulsory settlement by the UN International Tribunal for the Law of the Sea (located in Hamburg, Ger.), by arbitration, or by the ICJ. Resort to these compulsory procedures has been quite limited.

MARINE RESOURCE

Physical resources result from the deposition, precipitation, or accumulation of useful substances in the ocean or seabed. Most physical resources are mineral deposits, but petroleum and natural gas, mostly remnants of once-living organisms, are included in this category. Fresh water obtained from the ocean is also a physical resource.

Marine energy resources result from the extraction of energy directly from the heat or motion of ocean water.

Biological resources are living animals and plants collected for human use.

Non-extractive resources are uses of the ocean in place: transportation of people and commodities by sea, recreation, and waste disposal are examples.

1. Physical resources

Petroleum and Natural Gas About 32% of the crude oil and 24% of the natural gas produced came from the seabed. About a third of known world reserves of oil and natural gas lie along the continental margins. Oil is a complex chemical soup containing perhaps a thousand compounds, mostly hydrocarbons. Petroleum is almost always associated with marine sediments, suggesting that the organic substances from which it was formed were once marine. Planktonic organisms or soft-bodied benthic marine animals are the most likely candidates. Their bodies apparently accumulated in quiet basins where the supply of oxygen was low and there were few bottom scavengers. The action of anaerobic bacteria converted the original tissues into simpler, relatively insoluble organic compounds that were probably buried – possibly first by turbidity currents, then later by the continuous fall of sediments from the ocean above.Oil is less dense than the surrounding sediments, so it can migrate from its source rock through porous overlying formations. It collects in the pre spaces of reservoir rocks when an impermeable overlying layer prevents further upward migration of the oil. Drilling for oil offshore is far more costly than drilling on land because special drilling equipment and transport systems are required. Most marine oil deposits are trapped from offshore platforms resting in water less than 100 meters.

Methane Hydrate The largest known reservoir of hydrocarbons on Earth is not coal or oil, but methane-laced ice crystals – methane hydrate – in the sediments of some continental slopes. Little is known about their formation, but methane hydrates exist in thin layers 200 to 500 meters below the seafloor, where they are stable and long-lived. Sediment rich in methane hydrate looks like green Play-Doh. When brought to the warm, low-pressure conditions at the ocean surface, the sediment fizzes vigorously as the methane escapes. It burns vigorously if ignited.

Though abundant, exploitation of this resource would be very costly and dangerous. Even if engineers could bring the sediment to the surface before the methane disappeared, extracting the methane from the sediment and liquefying it for efficient use would be prohibitively expensive.

Sand and Gravel Sand and gravel are not very glamorous marine resources, but they are second in dollar value only to oil and natural gas. Only about 1% of the world's total sand and gravel production is scraped and dredged from continental shelves each year, but the seafloor supplies about 20% of the sand and gravel used in the island nations of Japan and the United Kingdom. The world's largest single mining operation is the extraction of aragonite sand at Ocean Cay in the Bahamas. Sand is suction-dredged onto an artificial island and then shipped on specially designed vessels. This sand, about 97% calcium carbonate, is used in Portland cement, glass, and animal feed supplements and in the reduction of soil acidity.

Magnesium and Magnesium Compounds

Magnesium, the third most abundant dissolved element, precipitates from seawater, mainly in the form of magnesium chloride ($MgCl_2$) and magnesium sulfate ($MgSO_4$) salts. Magnesium metal (a strong, lightweight material used in aircraft and structural applications) can be extracted by chemical and electrical means from a concentrated brine of these salts. Worldwide, about half the production of metallic magnesium is derived from seawater.

Magnesium compounds are also valuable. Magnesium salts are used in chemical processes, in foods and medicines, as soil conditioners, and in the lining of high-temperature furnaces.

Salts The ocean's salinity varies from about 3.3% to 3.7% by weight. When seawater evaporates, the remaining major constituent ions combine to form various salts, including calcium carbonate ($CaCO_3$), gypsum ($CaSO_4$), table salt ($NaCl$), and a complex mixture of magnesium and potassium salts. Table salt makes up slightly more than 78% of the total salt residue.

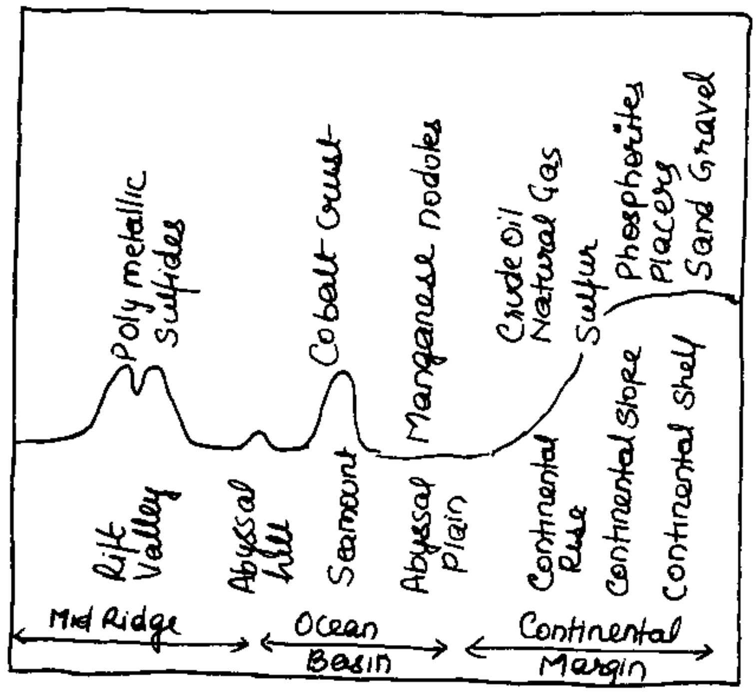
Seawater is evaporated in large salt ponds in arid parts of the world. Operators can segregate the various salts from one another by shifting the residual brine from pond to pond at just the right time during the evaporation process. The magnesium salts are used as a source of magnesium metal and magnesium compounds. The potassium salts are processed into chemicals and fertilizers. Bromine (a useful component of certain medicines, chemical processes, and antiknock gasoline) is also extracted from the residue. Gypsum is an important component of wallboard and other building materials. About a third of the world's table salt is currently produced from seawater by evaporation.

Manganese Nodules Manganese nodules are the rounded black objects that litter the abyssal plants, particularly in the pacific. These slow-growing lumps were first seen in the bottom samples taken by scientists aboard HMS *Challenger* in 1874. The iron, manganese, copper, nickel, and cobalt content of the nodules makes them particularly attractive to industrial nations lacking onshore sources of thee crucial materials.

Manganese nodules have been dredged from the seabed in small-scale trials. Various recovery schemes have been proposed, including a system resembling a vacuum cleaner, but the difficulties of collecting large numbers of nodules from abyssal depths in excess of 4,000 meters have rendered these plans uneconomical – at least until prices for manganese, copper, and nickel rise as the terrestrial sources are consumed.

Phosphorite Deposits Also discovered the *Challenger* Expedition were irregular chunks of phosphorite, first collected from the continental rise off South Africa. Sedimentary phoshorite deposits, from which industrial chemicals and phosphate-rich agricultural fertilizers can be made, formed from the decaying remains of marine organisms that lived in areas of extensive upwelling. The richest deposits occur at depths between 30 and 300 meters. Post-*Challenger* investigations have revealed rich deposits of this important material off the coasts of Florida, California, western South America, and western Africa. Even though phosphorite deposits occur in much shallower water than manganese nodules do, the cost of recovering the resource from the ocean greatly exceeds that of recovery from land.

Metallic Sulfides and Muds The recent discovery of metal-rich sulfides around hydrothermal vents has spurred interest among economists as well as oceanographers. Heated seawater carrying large quantities of metals and sulfur leached from the newly formed crust pours out through vents and fractures. The metals – mainly zinc, iron, copper, lead, silver, and cadmium – combine with the sulfur and precipitate from the cooler surrounding water as mounds, coatings and chimneys. While these deposits are certainly commercial-grade ores, they are neither large nor extensive. Also, they are subject to solution and oxidation on the seafloor and are not likely to be preserved in thick layers for long periods of time.



The Red Sea is another area where lithospheric plates are diverging and where molten material is close to the surface. Seawater seeping in through deep faults and fractures comes into contact with fresh, hot basalts and dissolves metals and salts from the rock. The recycled water emerges at temperatures of around 100° C (212° F) and is extremely saline, about 250% to 300% (average seawater is about 34%). Though the solutions are hot, their great density causes them to stay on the floor of the Red Sea in deep, fault-bounded basins. **Fresh Water** Only 0.017% of Earth's water is liquid, fresh, and available at the surface for easy use by humans. Another 0.6% is available as groundwater within half a mile of the surface. Unfortunately, much of this is polluted or otherwise unfit for human consumption. The fact that fresh, pure water often costs more per gallon than gasoline emphasizes its scarcity and importance. More than any other factor in nature, the availability of potable water (water suitable for drinking) determines the number of people who can inhabit any geographic area, their use of other natural resources, and their lifestyle.

Fresh water is becoming an important marine resource. Exploitation of that resource by desalination, the separation of pure water from seawater, is already under way, mainly in the Middle East, West Africa, Peru, Florida, Texas, and California. More than 1,500 desalination plants are currently operating worldwide, producing a total of about 13.3 billion liters (3.5 billion gallons) of fresh water per day. The largest desalination plant, in Saudi Arabia, produces about 114 million liters (30 million gallons) daily.

2. Marine Energy

Waves and Currents Waves are the most obvious manifestation of oceanic energy. Many devices have been proposed to harness this energy: Japan, Norway, Britain, Sweden, the United States, and Russia have built small experimental plants to evaluate their effectiveness. Extensive use of wave power generators along a shore could deprive that shore of its natural wave energy. Changing the wave patterns could alter longshore transport or disrupt the life cycles of marine organisms. Ocean currents might also be harnessed. Huge, slowly turning turbines immersed in the Gulf Stream have been proposed, but their necessary size and complexity make them prohibitively expensive.

Thermal Gradient

The gradient potential for energy generation in the ocean lies in exploiting the thermal gradient between warm surface water and cold, deep water harnessed by device called OTEC plants, for *Ocean Thermal Energy Conversion*.

Mainly because of the low efficiency of the OTEC process, the efficiency of heat-driven power generators depends on the *difference* in temperature between the hottest part of the system and the coldest. A fossil-fueled generating plant can be highly efficient because of the great difference in temperature between the flame and the water (or air) cooling the heat exchanger.

There are other problems. An OTEC plant would need to be sited in the tropics, where warm water is layered over cold. Tropical cyclones common in these areas would wreak havoc with the plant's long pipes and delicate generators. Marine life stimulated by the upwelled, nutrient-rich cold water would grow in the surrounding ocean and foul the heat exchangers. Construction and maintenance costs would be astronomical, and the transmission of power to a distant shore presents special difficulties. Still, as energy becomes more and more costly, the OTEC option may prove practical.

3. Biological Resources

Compared to the production from land-based agriculture, the contribution of marine animals and plants to the human intake of all protein is small, probably around 4%. Although most of that protein comes from fish, marine sources account for only about 18% of the total animal protein consumed by humans. Fish, crustaceans, and mollusks contribute about 14.5% of the total: fish meal and by-products included in the diets of animals raised for food account for another 3.5%. About 85% of the annual catch of fish, crustaceans and mollusks comes from the ocean, and the rest from fresh water.

Fishes, crustaceans and mollusks are the most valuable living marine resources. Of the thousands of species of marine fishes, crustaceans, and mollusks, fewer than 500 species are regularly caught and processed.

The maximum sustainable yield, the maximum amount of each type of fish, crustacean, and mollusk that can be caught without impairing future populations, probably lies between 100 and 135 million metric tons.

Whaling Since the 1880s, whales have been hunted to provide meat for human and animal consumption; oil for lubrication, illumination, industrial products, cosmetics and margarine; bones for fertilizers and food supplements; and baleen for corset stays.

Fur-Bearing Mammals Worldwide, between 400,000 and 500,000 seals and sea lions are killed annually for fur. Eight species of seals and one species of sea lion are of economic importance.

The harp seal, a species found in relatively great abundance on ice floes off the coast of Canada in the Labrador and Barents Seas, has attracted much popular attention in the last decade.

Botanical Resources

Marine plants are also commercially exploited. The most important commercial product is **algin**, made from the mucus that slickens seaweeds. When separated and purified, algin's long, intertwining molecules are used to stiffen fabrics; to form emulsions such as salad dressing, paint, and printer's ink; to prevent the formation of large crystals in ice cream; to clarify beer and wine; and to suspend abrasives.

4. Non-extractive Resources Transportation and recreation are the main non-extractive resources the ocean provides. People have been using the ocean for transportation for thousands of years. Through most of this time the transport of cargo has produced far more revenue than the movement of passengers.

Nearly half of the world's crude oil production is transported to market by ships. Tankers are needed because very few of the major oil-drilling sites are close to areas where the demand for refined oil products is highest. Modern harbors are essential to transportation. Cargoes are no longer loaded and off-loaded piece by piece by teams of longshoremen.

Deep-sea mining

- Deep-sea mining is the process of retrieving mineral deposits from the deep sea – the area of the ocean below 200 m.
- Depleting terrestrial deposits and rising demand for metals are stimulating interest in the deep sea, with commercial mining imminent.
- The scraping of the sea floor and pollution from mining processes can wipe out entire species – many yet to be discovered.
- Environmental impact assessments, effective regulation and mitigation strategies are needed to limit the impacts of deep-sea mining.
- Comprehensive baseline studies are needed to improve our understanding of the deep sea.

Deep-sea mining is the process of retrieving mineral deposits from the deep sea – the area of the ocean below 200 m which covers about 65% of the Earth's surface. There is growing interest in the mineral deposits of the deep sea. This is largely due to depleting terrestrial deposits for metals such as copper, nickel, aluminium, manganese, zinc, lithium and cobalt, coupled with rising demand for these metals to produce high-tech applications such as smartphones and green technologies such as wind turbines, solar panels and electric storage batteries.

So far, the focus has been on exploring the deep sea – assessing the size and extent of mineral deposits.

The International Seabed Authority (ISA) – which regulates activities in areas beyond national jurisdiction – had issued 29 contracts for the exploration of deep-sea mineral deposits. More than 1.5 million km2 of international seabed – roughly the size of Mongolia – have been set aside for mineral exploration in the Pacific and Indian oceans, and along the Mid-Atlantic Ridge.

But exploration may soon give way to exploitation. Commercial mining in national waters of Papua New Guinea has began. Mining in international waters is expected to commence in 2025.

The seafloor contains an extensive array of geological features. These include abyssal plains 3,500–6,500 m below the sea surface, volcanic underwater mountains known as seamounts, hydrothermal vents with bursting water heated by volcanic activity, and deep trenches such as the Mariana Trench, which at almost 11,000 m is the greatest depth registered in the ocean. These remote areas support species that are uniquely adapted to harsh conditions such as lack of sunlight and high pressure. Many of these species are unknown to science.

As the deep sea remains understudied and poorly understood, there are many gaps in our understanding of its biodiversity and ecosystems. This makes it difficult to thoroughly assess the potential impacts of deep-sea mining and to put in place adequate safeguards to protect the marine environment.

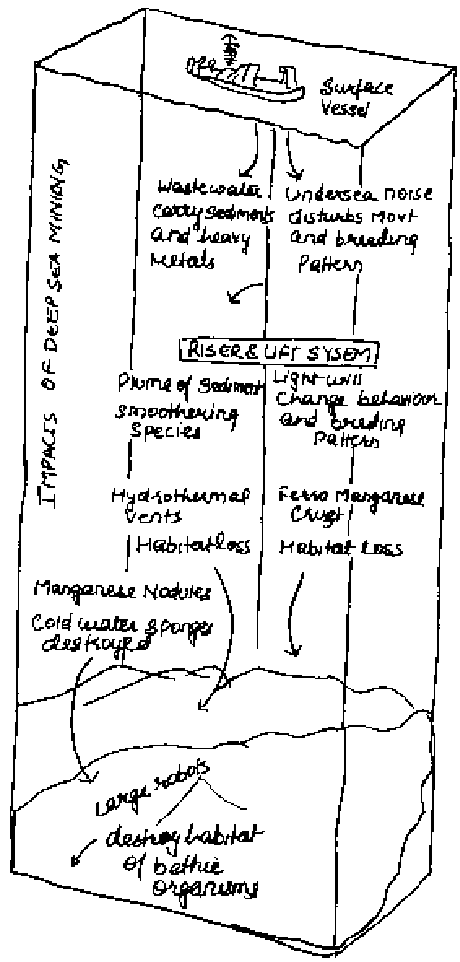
Based on current knowledge of the deep sea, the following impacts of mining activities could affect its biodiversity and ecosystems:

Disturbance of the seafloor The scraping of the ocean floor by machines can alter or destroy deep-sea habitats, leading to the loss of species and fragmentation or loss of ecosystem structure and function. Many species living in the deep sea are endemic – meaning they do not occur anywhere else on the planet – and physical disturbances in just one mining site can possibly wipe out an entire species. This is one of the biggest potential impacts from deep-sea mining.

Sediment plumes Some forms of deep-sea mining will stir up fine sediments on the seafloor consisting of silt, clay and the remains of microorganisms, creating plumes of suspended particles. It is unclear how far these particles may disperse beyond the mining area, how long it would take for them to resettle on the seafloor, and to what extent they may affect ecosystems and species, for instance by smothering animals or harming filter-feeding species that depend on clear, clean water to feed, such as krill and whale sharks.

Pollution Species such as whales, tuna and sharks could be affected by noise, vibrations and light pollution caused by mining equipment and surface vessels, as well as potential leaks and spills of fuel and toxic products.

Potential impacts from deep-sea mining A better understanding of the deep sea is necessary to guide mitigation strategies and proper enforcement of regulations in order to limit the environmental impacts of mining activities.



Baseline studies Comprehensive baseline studies are needed to understand what species live in the deep sea, how they live, and how they could be affected by mining activities. More funds are needed for training and educational programmes focused on improving our understanding of the deep sea.

Environmental impact assessments High-quality environmental assessments are needed to assess the full range, extent and duration of environmental damage from deep-sea mining operations. These assessments are also needed to ensure that the loss of biodiversity as a result of mining operations is properly accounted for in mining regulations set by authorities, well before any decision to mine is approved. The costs to the marine environment should be included in the financial and economic assessments conducted by mining companies.

Mitigation Current technologies may not be sufficient to avoid serious and lasting harm to the environment, including the loss of biodiversity. Mining operations strategies will need to prioritise the avoidance of environmental impacts. This needs to include establishing protected area networks to keep large parts of the seabed undisturbed as well as stringent and precautionary controls on the permissible extent and duration of mining operations. Minimising impacts should involve, among other things, improving mining equipment to reduce seafloor disturbance. Remedying environmental impacts has not yet been shown to be effective in practice.

Enhanced regulation The ISA is operating with the dual mandate of promoting the development of deep-sea minerals whilst ensuring that this development is not harmful to the environment. This challenging and conflicting mandate will require improved oversight by the international community – including government representatives and the general public – to ensure that marine life is adequately protected.

To avoid possible conflicts of interest due to the dual mandate of ISA, the organisation should consider divesting itself of some of its responsibilities, and placing them on independent entities.

Circular economy The repair, recycling and reuse of products should be encouraged to help reduce the demand for raw materials from the deep sea. Enhancing product design to make use of less or alternative materials can also reduce the demand.

Rare earth effect *Rare earth minerals—-there are 17 of them—are vital for the production of smart phones, cameras, steel and hybrid cars, and hence the world economy. They are present in a significant amount on the sea floor, both in sovereign and international waters. Polymetallic nodules are known to contain rare earth minerals. At present, China contributes 90 per cent of the global production of the minerals. Developments in last five years show that China has been using this monopoly to control the production and price of the minerals. So there have been attempts worldwide to realign strategic relations around exploration of rare earths in seabed. Developed countries are taking the lead. Japan, along with the US and the EU, formed an alliance to challenge China's restrictive policies in the WTO. In April 2014, the WTO ruled against China.*

India has collaborated with Japan since November 2012 to develop rare earth materials. As part of India-Japan strategic collaboration, an agreement was signed for exploration and production of rare earths, following which India is setting up a monazite processing plant in Odisha. In April 2013, Japan disclosed discovery of a bounty of rare earths in the seabed around Minami-

Tori-shima Island. Scientists claim the reserve holds 20 to 30 times more minerals than those being mined in China.

The prospect of a race to the bottom of the ocean has alarmed scientists. The reason is deep seas are not marine deserts as thought. "The deep sea is the largest habitat on earth. It is incredibly important to humans and it is facing a variety of stresses, from increased human exploitation to impacts from climate change," says Andrew Thurber, marine scientist at the Oregon State University, US, who has recently published a review of the services deep seas provide.

But just like the terrestrial environment, oceans are facing the conflicts between development and environment—overfishing, industrial waste and plastic debris are just a few of the factors ailing them. What adds to the conflict is utter lack of knowledge of the deep sea environment.

According to the international conservation association IUCN Oceania, only 0.0001 per cent of the deep sea floor has been investigated for the presence of life. A handful of studies, however, indicate that the resources that will be mined to extract minerals are indeed rich nursery of benthic organisms (microbes and invertebrates). The world is slowly discovering them. About 50 per cent of organisms collected from areas deeper than 3,000 m are new species. In 1977 when scientists discovered the hydrothermal vent, where the temperature remains around 400ºC, the richness of biodiversity around it startled them. The biomass around the vents can be 50 to 100 times higher than in the surrounding areas. A survey shows that 90 per cent of the 500 species identified around the vents were endemic to it. These species have been identified by studying just 100 vents. The cobalt crusts play a critical role in distributing nutrients that help the primary productivity in surface waters. The seamounts are also known to host specific ecosystems.

In fact, the deep sea hosts a much diverse and unique ecosystem than the terrestrial ecology. By volume, 98.5 per cent of the planet that can support life is in the deep sea. Deep seas are 10 times larger than shallow continental shelves in the world's oceans. "A quarter to a half of the carbon dioxide we have put into the atmosphere has been absorbed by deep sea,", underscoring the environmental services of the oceans.

The technology used for deep-seabed mining is different for different resources. But all the technologies follow the standard procedure of violating the sea floor, the water above and a massive reshuffling of habitats.

Mining will introduce light to an environment where life thrives in darkness. This may attract or deter some fish or benthic species and alter their feeding and reproductive behaviours .As the ores mixed with seawater are processed in surface support vehicles for extracting minerals, this will create massive swirls of debris and sediments. The treated seawater, of different salinity and temperature and containing trace amounts of toxic chemicals, will then be dumped in the sea, which will have profound impacts on the ecosystem.