

The National Institute of Oceanography (NIO), Goa is trying to map the entire Exclusive Economic Zone (EEZ) of the country, which will be a boon for defense, communication, navigation, and oceanographic research

# Mapping the EEZ

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**O**CEANOGRAPHY - the scientific study of the ocean - presents a view of the earth that is relatively new and useful to us. We have traditionally viewed the earth from the land and from a human frame of reference. But study of the ocean, the earth's most distinctive feature, shows us that continents are only large islands surrounded by a single body of water - well constrained by the fact that almost two-third of the earth's surface (362 million square km) is covered by the oceans.

Climate and weather, even quality of the air people breathe, depend to a large extent on the interplay between the ocean and the atmosphere. In addition, oceans are considered as storehouse of several living and non-living resources. The resources are varied and in plenty. Hence, a complete understanding of the ocean and its resources is required for the benefit of mankind.

The Indian Ocean, the Arabian Sea, and the Bay of Bengal have washed

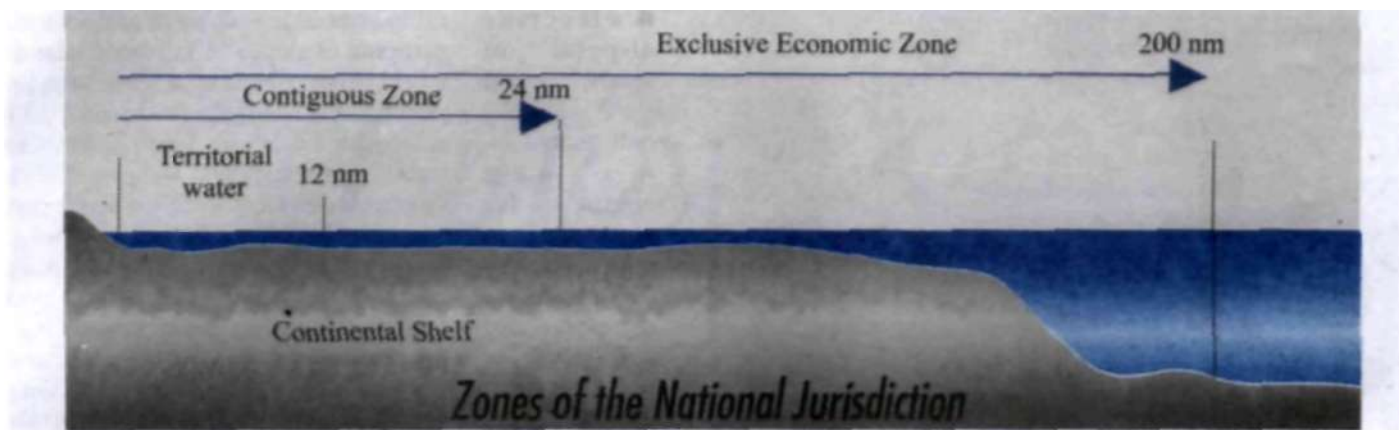
our shores since millions of years and have provided opportunities, which need to be utilized. Though our ancients had a great maritime tradition, our fundamental understanding of these oceans is relatively recent. This has become better known only after the International Indian Ocean Expedition (HOE) between 1962 and 1966.

During the HOE, several ships participated and characterized these water bodies up to a certain extent. With the commissioning of research vessels 'Gaveshani' and 'Sagar Kanya' by the

Department of Ocean Development, the National Institute of Oceanography (NIO) has been executing several systematic surveys in these water bodies for better understanding of their physical, chemical, biological and geological characteristics. Later, the Geological Survey of India and several universities located in the coastal areas initiated studies of the seas around India.

## EEZ and its Resources

The United Nations Convention on the Law of the Sea (UNCLOS) that came into effect on 16 November 1994, provided



for the first time a universal legal framework for the rational management of marine resources and their conservation. According to UNCLOS, oceans are divided into four domains:

1) *Territorial Sea* (coast to 12 nautical miles), where a country has exclusive right to exercise full sovereignty.

2) *Contiguous zone* (coast to 24 nautical miles), where a country can exercise regulations relating to immigration, customs, fiscal, sanitation.

3) *Exclusive Economic Zone* (coast to 200 nautical miles), where a country has the right to use both the living and nonliving resources in the water column, sea surface, and subsurface.

4) *Legal Continental Shelf* (coast to a maximum of 350 nautical miles), where country has the right to use only the non-living and sedentary resources (except water column) subject to satisfaction of certain geophysical conditions.

India, traditionally a seafaring country, has a wide EEZ (exclusive economic zone) of about 2 million sq km all along the 7500 km long coastline around her. The living and nonliving resources in this exclusive economic zone of India constitute around two-thirds of the landmass of the country - Additionally, several million people living along the coastline are directly influenced by the oceanography of the EEZ, coastal environmental hazards, and related social issues. Our EEZ also boasts of many economically exploitable mineral and hydrocarbon resources.

Transportation, defense, and fishing are traditional uses of the ocean. But increasing demand for fuels, metals, and construction materials has in many instances outstripped the production

### Resources of Indian EEZ

<p>A. Living Resources and their use</p> <ol style="list-style-type: none"> <li>1. Different type of fishes</li> <li>2. Crustaceans and molluscs</li> <li>3. Resource base for biotechnology (from flora and fauna)</li> <li>4. Drugs from the sea</li> </ol> <p>B. Non-living Resources</p> <ol style="list-style-type: none"> <li>1. Resources from seawater - salt, water, and metals (magnesium, calcium, potassium and bromine)</li> <li>2. Hydrocarbon resources - Petroleum and natural gas</li> <li>3. Mineral resources - Aggregates (sand, gravel, shells and coral debris), heavy minerals (ilmenite, rutile, zircon and sillimanite), hydrothermal minerals (sulphides of metals like zinc, cooper,</li> </ol>	<p>iron, silver, cobalt and gold), phosphorites</p> <ol style="list-style-type: none"> <li>4 Energy resources - Ocean thermal energy conversion (OTEC), wave energy, tidal energy, salinity gradient energy, offshore wind energy, marine current energy, marine bioconversion</li> <li>5 Storage and disposal sites as a resource - Disposal sites of non-toxic, toxic and radionuclide wastes</li> <li>6 Site for man-made structures as a resource - Sites of offshore ports, industries and artificial islands or platforms</li> <li>7 Employment and recreation - Sites of scenic, scientific and historic values</li> </ol>
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capabilities of land resources and increasingly the ocean is being exploited to meet the need. This has been particularly obvious in the case of petroleum and natural gas, for which the EEZ is expected to become a prime source in the next few decades.

Managing sustained use of the resources of such a large area requires detailed knowledge and understanding of the very dynamics of the resource formation. Much of India also has several groups of islands - the Lakshadweep group on the west and the

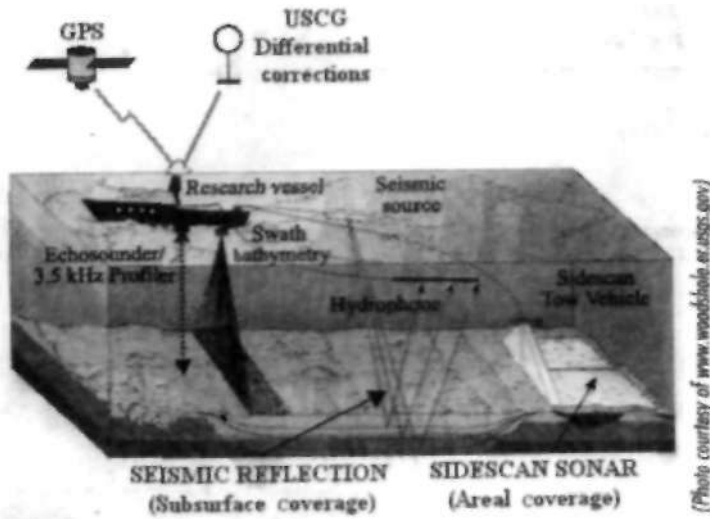
Andaman group on the east. Unfortunately, there is not much data available about these islands.

Encouraged by the bountiful resources that EEZ can generate, several coastal countries have initiated major and dedicated exploration programs during the last decade. USA has a massive mapping and research program for her EEZ, including a Pacific Mapping program for islands like Hawaii, Guam, American Samoa and North Mariana. Countries like Australia, Brazil, Chile, China, Ireland, New Zealand, Pakistan, Sweden and Venezuela are all actively running programs on EEZ surveys.

**The mapping will be a boon for defense, communication, navigation, oceanographic research etc.**

### Mapping the Oceans

Assessment of EEZ resources requires comprehensive, accurate, and up-to-date bathymetric maps. The maps used for navigation have limited value for exploration of resources because the



Equipment generally used to obtain bathymetric map

fathom-sounding lines are quite apart without sufficient density of data and with artifacts that result from contouring dense data. Thus, a detailed bathymetric mapping of our EEZ is of immediate necessity and with sophisticated state-of-the-art technologies like Multibeam echo sounder, it is possible to obtain a detailed bathymetric map of the EEZ.

Multibeam echo sounder is a relatively recent successor to echo sounding technique. This technology utilizes multiple beams of sound at the same time to cover a large fan-shaped area of the ocean floor. This is in contrast to the technique of echo sounder in which a small patch of seafloor is covered and mapped. Multibeam echo sounder sends out a swath of acoustic beams that covers a distance on either side of the ship. All of the signals that are sent out reach the seafloor and return at slightly different times. These signals are received and continuously converted through software to water depths, and then automatically plotted as bathymetric maps.

A detailed picture of the seafloor of the EEZ is useful to the following:

- the Navy and Coast Guards for strategic purposes,
- fishermen for fishing operations using deep trawl or bottom fishing gear,
- petroleum and natural gas exploration for mineral exploration,
- development and assessment of mineral resources,
- telecommunication industry for laying cables,
- sub-sea pipe lines for geological hazard assessment,

- effective disposal of waste and reducing pollutants,

- ocean engineers for constructing and maintaining structures of port and harbor,

- for deployment of research instrumentation on or near seafloor including submersible operations,

- for fish habitat research and so on

A detailed bathymetry is also essential for understanding physical oceanography, biology, and marine geology. There are numerous interesting geological features one could expect like the canyons, paleochannels, submarine fans, island-ridges, seamounts and coral banks, the study of which will throw more light on the climate and change in sea levels during the past. There are lots of additional benefits that may accrue from these studies

There are several areas that can benefit from detailed bathymetric mapping. For example, the sea floor morphology would contribute to better management of the fisheries resources by increasing precision in relocating fishing sites (preferred fishing zone, PFZ). Similarly, multibeam backscatter data can provide information on seafloor sediment characteristics, and the side scan sonar image can identify pockmarks, which are considered to be the signature of gas-escape, suggesting areas with petroleum potentiality.

Geological assessment of permissive areas for OTEC plant installations can be facilitated by bathymetry information. Topographic precision is again needed for accurate assessment of mining areas for the mining of sand, gravel and shell, heavy minerals, cobalt-crust, phosphorite and other offshore placer deposits. Side-scan sonar images can identify a suitable place for laying submarine pipe- and

cable-lines. Side-scan sonar and acoustic mapping of slopes of inhabited islands could also provide a measure of potential natural hazards like submarine landslides, earthquakes and stability of coastlines, associated with marine development. Submarine canyons, identified from bathymetric maps, can be used for sewage disposal zones for civic bodies. Offshore port facilities for deep-draft vessels e.g., tankers, development of port and harbour, and other civil constructions can be augmented by accurate bathymetry maps.

### Indian Campaign

Appreciating the need to study in detail and understand the EEZ of the country, the National Institute of Oceanography (NIO) is presently carrying out an exploration-cum-research project. The Department of Ocean Development (DOD) funds the ongoing EEZ project. The project envisages a six-year field and laboratory work between 2003 and 2009 to undertake systematic multibeam surveys in 2.172 million sq km in the EEZ. Of these, an area of 1.631 million sq km covers the deeper parts of the EEZ at depths in excess of 500 m, and the rest 0.541 million sq km occurs in the shallow areas.

The main objective of the project is to prepare a comprehensive bathymetric map for the entire EEZ of the country, which will be a boon for defense, communication, navigation, oceanographic research etc. In addition, tectonic study of the east and west coasts, understanding the bathymetry of the Bengal fan, Indus fan and other important geomorphological features on the EEZ, will also be possible. Detailed studies on sediment and rock are proposed to enhance our knowledge on sedimentation, paleoclimate, and petrology, reflecting on the processes leading to the formation of the continental margins of India.

The ongoing EEZ project is a small initiative not only for ocean development but also for the economic and social benefit of the country.

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