

MINERALS

from the Sea

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TEN years ago, very few persons would have realised that some of the largest treasures of the world lie hidden under the sea and that the oceans will be put to such an extensive use for obtaining minerals.

The recent energy crisis in the world has accelerated the pace of sea exploration, and in recognition of the need for obtaining more and more minerals from the sea, many countries are launching programmes to probe into the mysteries of the sea bottom and to develop new resources of materials and fossil fuel.

The oceans contain almost all known minerals which are found on land; but at present only a few can be obtained economically. The minerals of the sea can broadly be divided into two groups. Hydrocarbon minerals and non-hydrocarbon minerals. Under the hydrocarbon minerals we include petroleum consisting of both oil and gas. Under the non-hydrocarbon minerals, there are a variety of minerals such as sand and gravel, shell, lime, iron, tin, zinc, aluminium etc.

Hydrocarbon minerals: The question which is often asked is, how did the petroleum go under the sea? As probably you are aware, petroleum, whether found on land, or in the sea is of organic origin. Its formation in the earth-crust involves a complicated process of geological change, beginning with the accumulation of large quantities of organic matter, that is, plants and animals deposited in layers within the earth-crust. With the increasing depth, the organic material gets transformed by chemical processes into hydrocarbons in the form of oil and gas. You may ask another question, how can we know where oil and gas occur in the sea? The answer to this question is simple. Whether on land or under the seabed, hydrocarbons are discovered by geophysical surveys and subsequently by drilling techniques. By geophysical surveys we are able to know about the sedimentary strata upto a great depth, and depending upon the thickness of the earth-crust, it is possible to mark the areas where conditions for oil and gas entrapment are favourable (see Figs. 1 and 2).

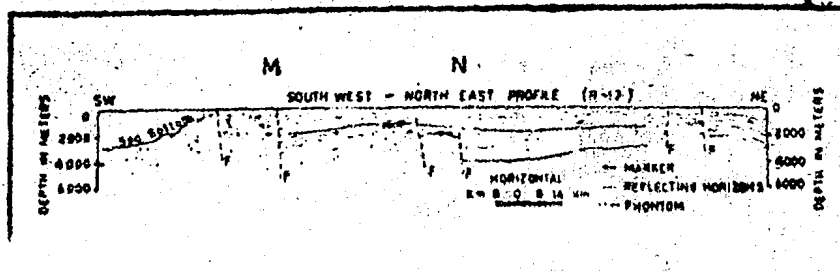


Fig. 1. Depth section obtained from seismic profiler in the Gulf of Cambay. The Bombay High area where oil has been struck is shown between M and N.

Although the first discovery of petroleum in the sea was made about 75 years ago in very shallow waters of the California Coast, it was only from 1946 that systematic exploration

continental shelf and it is about 150 kilometres away from the coast.

At present, more than 80 countries are engaged in the exploration of oil from the sea.

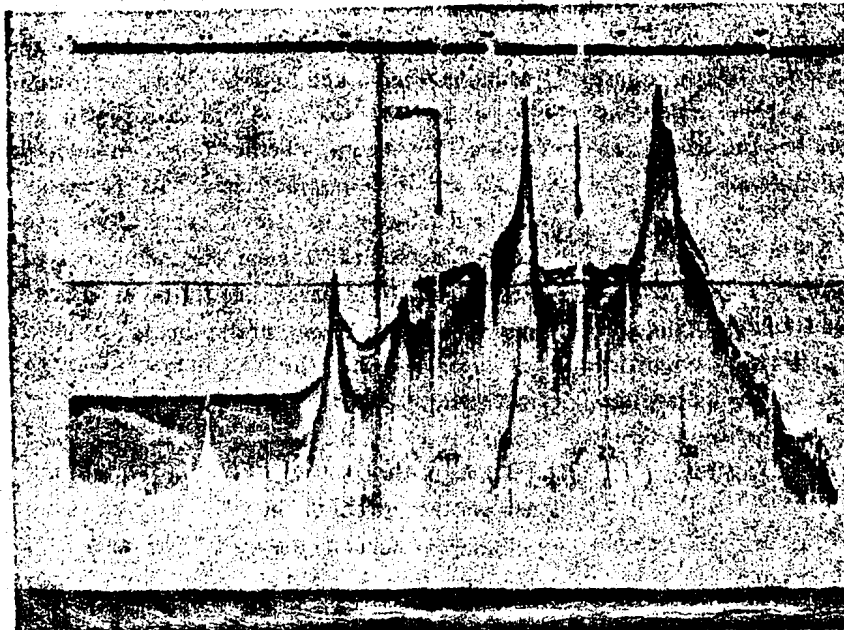


Fig. 2. Records of continuous seismic profile from the Indian Ocean showing a series of ridges.

of offshore oil began, and within 27 years or so, more than 16,000 wells have been drilled in the continental shelf at ever-increasing depths and progressively at a greater distance from the shore.

is expected to provide $\frac{1}{3}$ of the world's projected daily requirements of petroleum. Although the continental shelves are expected to meet a significant need for the future petroleum requirements, the oil industry is already

Today oil is being produced in waters at depths of 400 to 500 metres and about 200 kilometres away from the coast. In India, the well known Bombay High, where oil has recently been struck, lies within the

Of these, 28 are producing or are about to produce oil and gas from the sea. Offshore production of oil in the world is now 17 per cent of the total world's daily output of 5.5 million tonnes.

The offshore reserves of oil amount to 21 per cent of the total world reserves of 60 billion tonnes. The demand of world petroleum is expected to double by 1980 and to triple by 1990. By 1980, the offshore oil

looking towards deeper waters for future petroleum supplies. Technology is already available to investigate not only the continental shelves but also the deep ocean basins.

However, our ability to drill exploratory wells for finding oil is at present very limited. In the development of offshore drilling, floating platforms and ships are conventionally used for drilling exploratory wells. Sagar Samrat, the drilling ship used in India at the Bombay High and at other places, is a good example. The technology for drilling such wells is at present limited to a depth of about 500 metres. Once the oil is properly discovered, the floating vessels and platforms are replaced by large fixed structures and several production-wells are required with elaborate storage facilities for petroleum. The maximum depth where such structures have been installed is only about 100 to 200 metres. Very soon, they will be installed upto 400 to 500 metres depth. During the next 10 years or so, the investment of different countries in the exploration of oil and the development of submarine oil fields would be of the order of Rs. 4,800 crores.

Non-hydrocarbon minerals: The world demand for non-hydrocarbon minerals is expected to double by 1985. These minerals are found at three different places in the sea — at the ocean floor, beneath the seabed and in a dissolved state in sea water. In the first category, are included sand, gravel, shells and lime, which are mined in several countries including India. For the very heavy minerals such as those containing platinum and gold, commercial exploitation in some countries is likely to take place soon. Lesser heavy minerals such as tin, manganese, monazite ilmenite are exploited by India, Thailand,

Indonesia and Malaysia. Iron is being recovered from submerged deposits of Japan. Diamonds are also being recovered from shallow water deposits of South-West Africa. Surface mineral substances are also available in the form of phosphorite and manganese nodules (see Figs. 3 & 4). The manganese



Fig. 3. Phosphorite nodules from the Pacific Ocean.
A. Large nodule weighing 128 kg.
B. & C. Smaller nodules.



Fig. 4. The much publicized manganese nodules which range from 2-8 cm in diameter.

nodules have the shape of potato and are found scattered on the floor of the Atlantic, Pacific and Indian Oceans in deeper areas. These nodules cover millions of kilometres. Very soon, the nodules will be exploited from the sea by the rich countries which have advanced technology. The total estimates of minerals made by marine geologists from the nodules of the oceans are really incredible. These are:

- 45 billion tonnes of aluminium
- 358 billion tonnes of manganese
- 7.9 billion tonnes of copper
- 1.00 billion tonnes of zirconium
- 14.7 billion tonnes of nickel, and
- 5.2 billion tonnes of cobalt.

These resources, according to our present needs, are going to last for thousands of years.

The other types of minerals such as coal, iron and sulphur are found deep in the seabed. Coal from the sea is being mined in Canada, United Kingdom and Japan; and similarly iron ore is being mined in Japan, Finland and Canada. Sulphur is recovered through boreholes and is being mined by America and some other countries.

The third types of non-hydrocarbon minerals are in the form of dissolved substances found in sea water, and it is said that

if dissolved substances could be extracted from the sea water economically, they would provide an inexhaustible resource for our mineral needs. Unfortunately, only three substances are extracted economically today. Common salt is being obtained from sea water since ancient times. Similarly, magnesium and bromine are also recovered from the sea water economically.

In addition to minerals which have been mentioned above, the oceans are more and more becoming a source of world's growing fresh water needs, particularly in desert regions and in highly populated coastal areas which have inadequate fresh water supplies. It has already been estimated that by the middle of this decade i.e. towards the end of 1975, it would be necessary to process 35,000 million tonnes of sea water each year to meet the increasing world demands of fresh water.

In conclusion, I would like to add that oceans have a very great potential, as a source of minerals to meet man's growing needs. But, at present, the potential is not the same for all areas or for all minerals. Some of the potential resources are of no value unless they can be obtained economically. A variety of scientific and engineering skills are required for the recovery of minerals, particularly from the deep sea and we hope to meet this challenge in India by developing a technology which will be used for the benefit of our people as ocean industry.