

## OIL EXPLORATION IN THE OFF-SHORE AREAS IN INDIA\*

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### ABSTRACT

The paper gives in brief, the history of exploration for oil in the off-shore areas of India. The first off-shore surveys were commenced in early January, 1963. This was a logical step following discovery of oil in the Cambay basin of Gujarat in western India. To start with, the exploration in the off-shore regions was confined to the northern part of the Gulf of Cambay which adjoins the land areas of the Cambay basin. This work was commenced by a group of Indian geophysicists and technicians and was entirely conducted by them. At a later stage, to have a quick appraisal of the full off-shore regions of India, an off-shore seismic crew with ship and equipment was hired from U. S. S. R. This crew covered the southern part of the Gulf of Cambay and northern part of the Arabian Sea, Gulf of Cutch, areas off the coast of Kerala, Gulf of Mannar, Palk Strait, Coromandel Coast, shelf areas adjoining the coasts of Andhra Pradesh, Orissa and West Bengal. The work in the areas off Kerala, in Gulf of Mannar, off coastal areas of Andhra Pradesh, Orissa and West Bengal were covered by broad reconnaissance profiles only. The surveys indicated presence of a number of interesting structures. Some of them have been delineated in detail. Drilling of an exploratory well on one of the structures has been taken up.

### INTRODUCTION

UNTIL about 20 years ago oil exploration in India was confined practically to Assam in the Northeast India. The only oil field that was known to exist in India was at Digboi in Upper Assam and it was generally expressed that India did not have any possibility of having accumulation of oil or gas in any area outside Assam. However, in November, 1948, some of the geophysicists of the Geological Survey of India took a keen interest in the alluvial tracts of Gujarat and took up geophysical surveys with the help of a ground magnetometer in this region. The surveys continued till about the middle of 1949 and the results indicated that there is a deep sedimentary basin under the alluvium of Gujarat. This work was subsequently followed by Geological Survey of India by gravity surveys and to a limited extent, by seismic surveys. The gravity and seismic surveys indicated presence of certain structural anomalies near Cambay town. The Oil and Natural Gas Directorate which was later on converted to Oil and Natural Gas Commission, was formed at the end of 1955. With its formation, the geophysical surveys were taken up more intensively. As a result of this work and subsequent drilling in 1959, oil was discovered in the Cambay basin. In the following year, the oil field at Ankleshwar, the largest in India, was discovered. With the discovery of oil in Ankleshwar, the Oil and Natural Gas Commission took a decision to extend geophysical exploration into the Gulf of Cambay.

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## GEOLOGICAL CONSIDERATION

Two large bays of the Indian Ocean, viz., the Arabian Sea and the Bay of Bengal skirt a large part of the Indian Peninsula. The width of the continental shelf in these bays varies widely. It is widest in the area off Bombay. The shelf is also fairly wide in the area south of the Gangetic delta. The width of the shelf in other parts of the off-shore areas although not so wide, is considerable and the total area in the continental shelf is of the order of 300,000 sq. km. Exploration in the Cambay basin in Gujarat, at the head of the Gulf of Cambay and further north, has brought out the existence of a thick succession of Tertiary sediments overlying the Deccan Trap which comprises of lava flows of the late Cretaceous to Lower Tertiary age. Oil has been found in sands in the Eocene, and in certain parts of the basin, Miocene and Oligocene contains gas bearing sand. From the information obtained from the geophysical surveys on land as well as the data obtained from drilling, it is logical to conclude that the Cambay basin continues into the Gulf of Cambay and perhaps into the adjoining area of the Arabian Sea. In the Gulf of Cutch, existence of a thick succession of Tertiary sediments is envisaged. Below the Tertiary sediments, Mesozoic formations are likely to occur. Deccan Trap may exist between the Tertiary and Mesozoic sediments.

In certain parts of the coastal areas of Kerala, sedimentary rocks of Miocene age are observed. These sediments seem to dip towards the adjoining sea, hence it is reasonable to assume that these sediments and perhaps other older and younger formations exist in the adjoining off-shore areas.

In Cauvery basin of Tamil Nadu, existence of Mesozoic sediments are known from surface out crops, geophysical data as well as information obtained from drilling. The adjoining off-shore area, particularly the area of Palk Strait, appears prospective. The continental shelf area off the coasts of Andhra and Orissa are not very wide. Nevertheless, from general geological considerations, it is reasonable to envisage continuation of the sedimentary basin on land into the adjoining land part into the sea.

The Indo-Stanvac Petroleum Project's work which involved extensive geophysical surveys followed by drilling a number of exploratory wells, proved that a deep sedimentary basin exists under the alluvium of West Bengal. This basin continues into the Bay of Bengal over a long distance. Mesozoic and Tertiary sediments occur in this basin.

## BEGINNING OF OFF-SHORE EXPLORATION

As Already stated, the off-shore exploration was taken up first in the northern part of the Gulf of Cambay. Extremely unfavourable operational conditions exist in this Gulf, particularly in its northern part; the tides may reach a height of as much as 11 metres. Strong tidal currents create serious navigational difficulties. Besides, navigation is made hazardous by the presence of a large number of sand bars which get exposed during low tides. In consideration of these conditions, the seismic surveys in this area, were to be carried out with the help of a flat bottom vessel. A vessel of this type was hired from Bombay and converted to suit the requirements of a seismic vessel.

With this vessel, a group of Indian geophysicists and technicians surveyed the entire northern part of the Gulf of Cambay. Their work, and subsequent exploration carried out by the off-shore seismic crew from U. S. S. R. proved

beyond doubt that the Cambay basin in Gujarat extends into the Gulf of Cambay and the adjoining Arabian Sea. It also showed that basin is much wider in the Arabian Sea. The geophysical surveys brought out the major structural elements of the Gulf of Cambay and the adjoining Arabian Sea. They have also brought out the existence of a number of structures which may be oil or gas bearing. One of these structures is very large and compares favourably with the largest structures known in the World. However, mere existence of structures do not establish the presence of hydrocarbon. Therefore, it would be rather premature to speak about the potentialities of these structures.

Surveys elsewhere of the off-shore regions of India, have not brought out the presence of many interesting structures. Therefore, at present the other off-shore regions of India do not appear very interesting. However, it may be mentioned that the seismic coverage in the coastal areas off West Bengal, Orissa and Andhra Pradesh had been on broad reconnaissance basis only. Further work may bring out presence of interesting structures although the possibility is not too great.

#### OFF-SHORE DRILLING

At present exploratory drilling can be envisaged only in the Gulf of Cambay and the adjoining Arabian Sea where interesting structures have been found. Drilling in this part of the off-shore areas of India is beset with a number of serious difficulties. Some of the structures are located in areas where the water depth is small or very small. In fact, during low tide certain areas get completely exposed. On the other extreme, in the structural areas falling in the Arabian Sea the water depth varies from 40 to 80 metres or more.

The entire Gulf of Cambay and the Arabian Sea are exposed to serious weather conditions during monsoon. Tidal currents are very strong in the Gulf area and tides may be as high as 11 metres.

The Oil and Natural Gas Commission have taken up drilling in shallow waters near the head of the Gulf of Cambay. A well is being drilled a little west of Aliabet Island, at the mouth of the Narmada river. Drilling is being carried out from a fixed platform which has been constructed in India. The Commission have plans for drilling one or two more structures from fixed platforms. For drilling in deeper waters, it will be necessary to use a mobile off-shore vessel. The matter is under active consideration.