

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

Petroleum is essentially a mixture of gaseous, liquid, and solid hydrocarbon-type chemical compounds that occur in sedimentary rock deposits throughout the world (Speight, 1980). In the crude state petroleum has mineral value but when refined it provides high-value liquid fuels, solvents, lubricants, and many other products (Purdy, 1957).

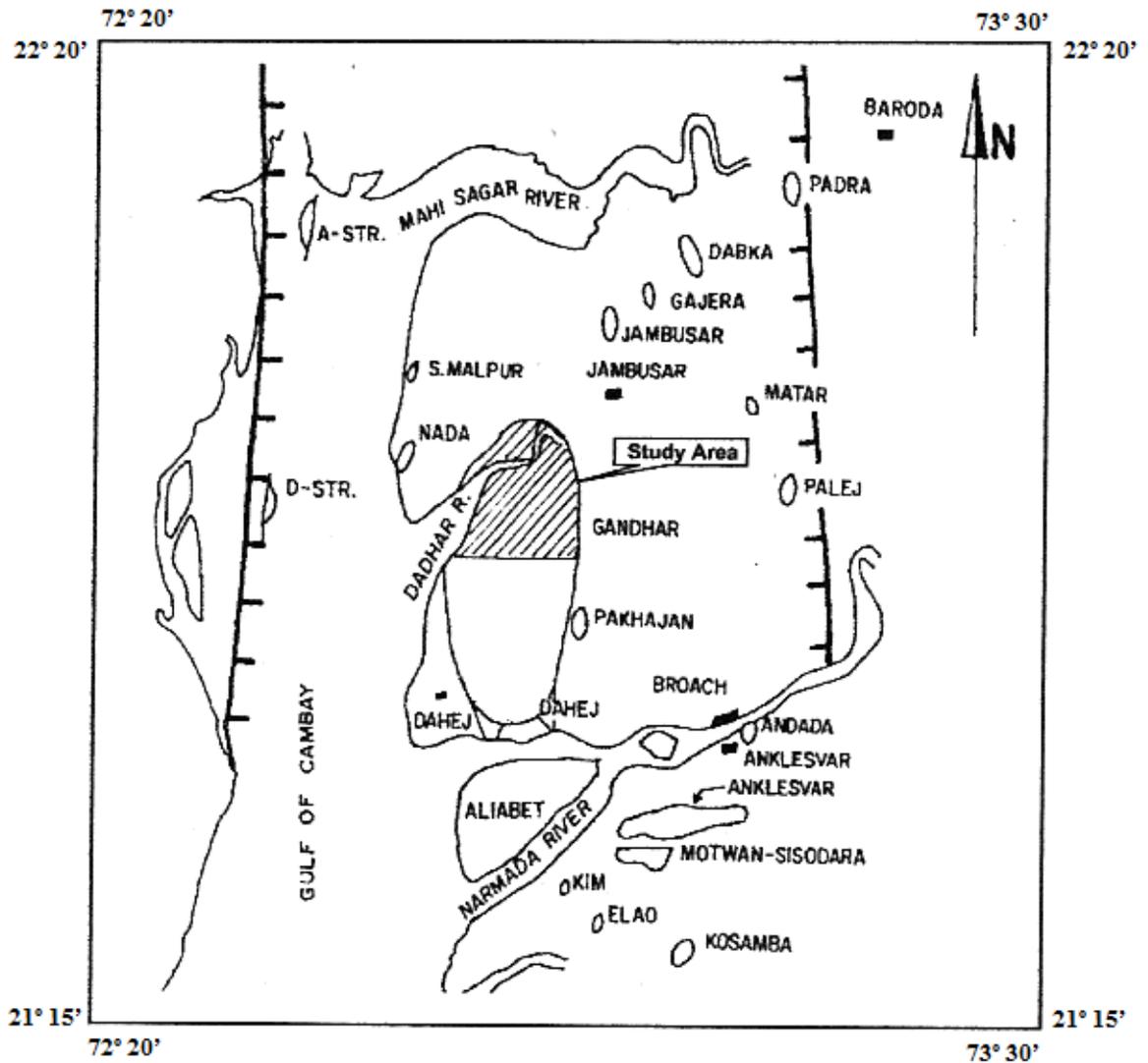
India is one of most important oil producing country in the world having several oil fields on offshore and onshore. There are 26 sedimentary basins in India stretching over an area of 1.39 Million Sq. Km. on land and 1.7445 Million. Sq. Km. on offshore, including the vast stretch of sediment laden area measuring 1.35 Million Sq. Km. in deep water areas (upto 200 Metric Isobaths).

In India, the well known oil and gas producing state is Gujarat stands third. The Cambay-Hazad petroleum system in South Cambay basin, Gujarat has original in-place oil reserves of 395 Million Tones. The system covers 9320 Sq. Km. encompassing 20 different oil and gas accumulations. Sedimentary rocks in this petroleum province range in age from Paleocene to Recent and were deposited in Tertiary rift basin.

The largest oil and gas field in the Cambay-Hazad petroleum system is Gandhar oil field with in-place oil reserves of 210 Million Tones. The Gandhar oil accumulation occurs in multiple pay sands in a combination trap. The field has a net pay thickness of 57 meters.

## 1.2 LOCATION

The Gandhar is a major oilfield spreading over 800 Sq. Km. in the Jambusar-Broach block of Cambay basin and is located in Gujarat State. Gandhar oil field falls in the Survey of India Toposheet No. 46 C/9 in between 20°51' and 21°55'N latitude and 72°35' and 72° 40' E longitudes in Wagra taluka, Broach district, Gujarat (Fig. No.1).



**Figure 1: Location Map of Gandhar Oilfield, Cambay Basin.**

*(After Kumar et al, 2004)*

### **1.3 ACCESSIBILITY**

Gandhar Oilfield is served by all weather black topped road of State and National Highways and is approachable from Ankleshwar through Wagra, which joins at Ankleshwar to the Ahemdabad–Bombay National Highway No. 8. Gandhar is also connected by Bombay railway line passing through Ankleshwar railway station.

### **1.4 PHYSIOGRAPHIC FEATURES**

Physiographically, the state of Gujarat comprises the three distinct zones: Mainland Gujarat, Saurashtra and Kachchh. Gandhar area is a part of Mainland Gujarat. Gandhar area in general has a flat topography with an average height of about 50m above mean sea level (MSL). Mostly, it is covered by alluvial plains comprises of thick pile of unconsolidated sediments deposited by a combination of fluvial and aeolian agencies mainly during the Quaternary period.

### **1.5 DRAINAGE PATTERN**

On the north, the river Dadhar and on the south river Narmada flows from east to west. These rivers ultimately fall in Arabian Sea in the western side of the oilfield. These rivers are perennial and spate during monsoon. Most of the small nallas, tributaries etc. join both the rivers. The other source of water supply for the drinking purposes is wells and rivers. The water level in the area is roughly 7-10m from the ground level.

### **1.6 SOIL AND VEGETATION**

Soil is generally yellowish in colour. The vegetation of study area only comprises of Acacia shrubs. 90% part of the area is covered by salt pan and has no crops and vegetables grown in the area. Human habitant is only in Gandhar village and rest of the area is open land.

## **1.7 CLIMATE**

The area is warm and humid and having subtropical climate. The monsoon is generally heavy compared to other parts of Gujarat, which starts in late June and continues up to middle of September. The average rainfall is about 980mm (information based on district gazette). The winter months are pleasant with a minimum temperature of 10°C, while the temperature during summer months goes even above 45°C.

## **1.8 PREVIOUS WORK**

The quest for hydrocarbon by the Oil and Natural Gas Corporation Limited (O.N.G.C. Ltd.) has significantly contributed to geologic studies of the Cambay basin. Geological and geophysical surveys carried out in the late 1950's led to the identification of the Ankleshwar structure and the well drilled in 1960 resulted in the first oil discovery in the South Cambay basin. The work started in 1957-58 when Roy and others started mapping the areas east of Broach and recognized a numbers of formations. Simultaneously, with the drilling of Cambay Well No. 1 in 1958, a team of palaeontologists and geologists tried to establish a stratigraphic succession overlying the Deccan Trap. Upto 1990, a total of 20 oil and gas fields had been discovered in the South Cambay basin, and all of them are included in the Cambay-Hazad petroleum system.

Blanford (1872) first studied the geology of the area, followed by Bose (1909) who divided the area into two: Deccan Traps and Tertiaries. The history of petroleum exploration, geology, tectonics and stratigraphy of the Cambay rift has been done by several workers. Some of the important workers are- Sudhakar & Roy (1959), Mathur et al., (1968), Raju (1968), Chandra & Chowdhary (1969), Rao (1969), Sudhakar et al., (1970), Desikachar (1971), Gaur (1971), Krishnamachary (1972), Raju, Chaube & Chowdhary (1972), Sudhakar & Basu (1973), Biswas (1974, 82, 82a & 87), Gambhir (1974), Bhandari & Choudhary (1975), Choudhary (1975), Gadekar (1977), Awasthi

et al., (1979), Ramanathan (1981), Bhasin et al., (1982), Raju & Srinivasan (1983), Badola et al., (1984), Ahuja, et al., (1985), Agarwal (1986), Islam (1986), Dhar et al., (1987), Islam & Tiwari (1988), Ahuja et al., (1990, 1993), Alavi & Merh (1991& 91a), Bhandari et al., (1991), Dhar & Bhattacharya (1991), Sundaram, Rai & Pal (1991), Chandra et al., (1992), Dutt et al., (1993), Dutt & Bhan (1993), Banik & De (1995), Bhuin (1995), Bharkatya et al., (1997), Duggal & Chakravarty (1998), Mahadevan et al., (1998), Singh et al., (1999), Chakraborty et al., (2000), Maurya, Raj & Chamyal (2000) etc.

Palaeo-environmental studies of Cambay basin has been done by Lal & Singh (1984), Lal (1985) and Raju & Hardas (1985).

Different important works especially geochemical characteristics & reservoir management on Cambay basin oils has been done by Zubov et al., 1966), Rao & Rao (1970), Prasad et al., (1975), Mehrotra & Bhasin (1979), Jain et al., (1982), Malhotra et al., (1982), Raju et al., (1982), Bhattacharya & Kale (1983), Mehrotra (1983), Gupta et al., (1984), Kumar et al., (1984), Sastry et al., (1984), Goyal et al., (1989), Hardas et al., (1989), Verma & Santhan (1989), Banerjee et al., (1991), Mehrotra et al., (1991), Nanavati et al., (1991), Narendra et al., (1991), Niranjana & Mehrotra (1991), Pandey et al., (1991), Singh et al., (1991), Shanmukhapa (1991), Sharma (1991), Pandey & Minz (1993), Pandey et al., (1993), Senapati et al., (1993), Pandey et al., (1995), Anand et al., (1995), Kohli et al., (1995), Pandey & Upadhyay (1995), Pathak et al., (1995), Raman et al., (1995), Singh et al., (1995), Singh et al., (1995), Singh et al., (1995), , Gupta et al., (1997), Lohia & Kumar (1997), Mandal et al., (1997), Mandal & Bhattacharya (1997), Bhattacharya et al., (1999), Singh (2000) and Kumar et al., (2004).

## **1.9 SCOPE OF PRESENT WORK**

The Gandhar oilfields is an integral part of Ankleshwar project, Cambay basin, Gujarat and have been studied in detail to know their geological, structural and stratigraphical set-up; the physical and chemical characteristics of oil and their occurrences along with origin of oil in the basin. Exploration and Exploitation techniques used in oilfield are taken with a view to contribute the existing geoscientific knowledge regarding oilfield. The introductory geological works such as mapping, lithology and stratigraphy have been completed to a definite extent as regimed by the oil industries in the later part of the nineteenth century. The main emphasis on the work has been given to the detailed geological mapping, correlation of borehole logs / data, exploration and exploitation techniques and physical and chemical characters of the oil samples collected from the field / different bore holes. The due care has been taken while studying the environmental issues of the oilfield.

## **1.10 RESEARCH AND METHODOLOGY**

The present work began with preliminary literature consultation followed by field survey, sampling of oils for physical and chemical studies and collection of water samples, noise level and air pollution data for environmental discussion. For present investigation sampling of crude oils from self flowing wells had been done and many samples were collected from different sands or pay horizon and labelled according to their well numbers. Thus out of whole 13 groups of oils samples from Gandhar Oilfield were subjected to physical and chemical studies. Borehole data of each well had been used to know the position of pay horizon and their correlation with other wells.

Physico-chemical studies include physical, chemical and gas chromatography analysis. colour, odour, API gravity, density, viscosity, optical activity, boiling point, cloud point and pour point was determined in the light of physical analysis where as it's chemical composition (carbon, hydrogen, oxygen, nitrogen, sulphur and metal

contents) was determined under chemical analysis. Gas Chromatography analysis gives information about amount of wax in oils and also shows the types of hydrocarbons present.

The borehole data of each well as provided by O.N.G.C. Ltd. were used to know the actual position of pay sands of each well in the basin. After these, all the borehole data was correlated by modeling.

Exploration and Exploitation studies deal with all the steps or procedures, which were started with the demarcation of position of reservoir rocks upto supply of oils to the refinery. Exploration was started with various surveys, exploratory well drilling, land acquisition, reserve calculation of oil and total expenditure of project. Exploration was followed by exploitation of well for oil production upto its supply for separation and refining in refinery.

Environmental pollution is vital issues of today and mining industry is one of the point source. The oil / petroleum industry is one of them which are likely to sensitive to the environment. The situation in Gandhar Oilfield is not different. The study on the adoptability of suitable techniques for well drilling and suggestion for delimiting the main pollutants in the area has been prepared. The results obtained from the above procedures have been critically analysed for the validation for the present study.

The entire work has been arranged in 6 separate chapters and a comprehensive discussion of outcome of the problem taken up for the study has been presented in easily understandable manner. Finally, the physical and chemical properties, position of reservoir rocks in the basin and environmental impacts have been visualized in the last chapter of summary and conclusion.