CHAPTER VIII

RESUME'

The northern Cambay basin, totally covered by alluvium, is a part of the hydrocarbon bearing Cambay Tertiary basin that has been studied in detail in some parts of the basin and in the Paleogene part of its sedimentary sequence.

The Cambay basin is an intracratonic basin bounded on the east by the Precambrian shield of the Aravalli orogenic complex and by the Kahiawar uplift and Kutch embayment on the west, extending into Bombay offshore basin through the gulf of Cambay. Three orogenic lineaments are prominently noticed in the basin. These are the Aravalli (northeast-southwest), the Dharwarian (northwest-southeast) and the Satpura (east north east-west southwest) trends, the last one is confined

to south of Narmada river. The northeast southwest trend is clearly seen in Bouger gravity map cut across by the northwest-southeast trend, the later one parallel to the grain of the Deccan Trap basement of Cenozoic sediments.

The genesis of Cambay Tertiary basin is related to the plate tectonics in which the Indian shield moved towards north rapidly in Cretaceous-Eocene and then slowly after Oligocene. During this movement, the shield rotated anticlock-wise and reached the present position. In this plate movement, intense volcanic activity took place from centres along the present west coast of India, where the Moho is at a shallow depth. The Cambay Tertiary basin is subsequently formed as a half graben caused by down faulting to the west along the same crustal weak zone from which sub aerial volcanic activity took place.

The basin is divided into four tectonic blocks based on the structural and sedimentary characteristics of each of these blocks. The study area is in the Mehsana block. The sedimentary fill of the basin can be visualised in four stages. The first stage was the formative stage in which the sedimentation was controlled by faulting in Deccan Trap and limited to the base of the fault scarps and slopes. The second stage was a uniform sedimentation in the entire basin due to a wide-spread transgression. The third stage was marked by regression and deposition of thick prisms of coarse clastics during delta development; at the end of this stage, a minor transgression is noted. The final

stage was marked by a fill up of the basin, with the deposition of greyish green claystone and gritty sandstone.

The structural features of the study area have been brought out by seismic and subsurface geological methods. The main faults in the sedimentary section are basement faults in Deccan Trap that extend into the sediments. Others are adjustment faults in the sediments resulting from these main faults. Similarly, the main anticlines and synclines are also due to basement tectonics and the minor anticlines are due to the adjustment faults within the sediments.

The prominent structural features of the basin are the Mehsana horst and the overlying Mehsana anticline, Kadi anticline, formed on an extension of the Mehsana horst, Sobhasan anticline formed by the adjustment faults in the Paleogene sediments and Becharaji anticline formed in the Paleogene sedimentary section due to faulting in Deccan Trap. Mehsana depression is the main sedimentary sink of the area, east of Mehsana horst where a maximum thickness of about 4500 m of sediments are deposited. This sink has probably generated the hydrocarbons which migrated into the adjacent anticlines and other petroleum traps. The other two main but smaller depressions are the west Mehsana depression and the Patan depression, west of Mehsana horst and north of Saraswathi river respectively.

The other structural features are the marginal faults at the basement level on the margins of the basin, limiting the early Paleogene sediments, the faults on the flanks of Mehsana horst at

basement level and many other small faults both at Deccan Trap level and in the Paleogene sediments.

Geomorphological studies of the quarternary land forms on aerial photos are made in order to identify the land forms related to the neotectonic movements which in turn can be related to the tectonic movements of Paleogene period. The different landforms namely structural plateau, denudational bad lands, pedimented landscapes, levees, terraces, flood plains, channel sands, etc. have been mapped; the processes through which these have been created, their sequential development, their age relationship and the degree of influence of neotectonics on these landforms are interpreted.

The cases where the neotectonic movements and the subsurface structural feature are relatable, are described. The two lineaments in the northeast southwest and northwest southeast directions, noted on the recent landforms are related to the tectonic lineaments of the Paleogene sedimentary section. The Bouger anomaly trends and the Paleogene structural trends from seismic data are correlated with morphostructures in a few cases. The relationship of the gravity trends with the morphostructures has been analysed. An attempt is also made to compare the morphological features with Miocene sedimentary structural features.

The stratigraphy of the Cenozoic sedimentary section is worked out with wireline logs recorded in the exploratory wells drilled for hydrocarbons. These log data are used with the lithological,

sedimentological and faunal data. The unconformities are identified mainly by faunal evidences supported by stratigraphic relationships. Nine formations are identified in the Cenozoic sequence of which five are in Paleogene section, three in Miocene and the youngest undifferentiated unit in Plio-Pleistocene section. The lithology of each formation is described from the cores cut and drill cuttings collected. The oldest formation is the product of weathering of Deccan Trap terrain, fast transportation of the detritus of weathering and quick deposition in the nearby sites. The formation is usually a conglomerate or wacke with angular fragments and grains of Decen Trap. Then, widespread transgression resulted in the deposition of a thick shale of uniform lithology over the conglomerate. Into this marine environment, delta building rivers carried coarse clastics and thick prisms of sandstones are formed in some parts of the basin. This sedimentary section containing coarse clastics is divided into two formations. At the end of this delta building activity, spread in most of the study area, a minor transgression took place resulting in the deposition of a widespread thin shale, above whichs an unconformity is noted. The overlying three Miocene formations have sandstone with minor claystone beds in the basal part and thick arenaceous beds in the upper part with thinly bedded claystone in the middle part. Overlying the Miocene formations is a thick arenaceous unit.

The two arenaceous Paleogene formatioins are studied by sedimentological methods for interpreting their depositional environment. Besides studying the lithological association of these sand bodies,

univariate analysis which provides individual parameter (mean size, standard deviation, skewness and kurtosis) variation as a measure of environmental index and bivariate analysis for comparison with modern sediments, are made. These indicate that the sands of the lower part of the arenaceous units are deposited in marginally marine conditions whereas the middle and upper part of the sand units are formed in the lower delta plain environment where fluvial processes have been largely operative. Studies on C-M patterns have also indicated the same environmental picture as of the earlier methods. The heavy mineral studies of the samples showed the provenance for sands as acid igneous rocks with minor association of metamorphic rocks.

A second approach to the sedimentary environmental interpretation of these sands is the use of electrolog patterns which are an established technique in the petroleum industry. These studies have also shown that the Mandhali member sands have features of distributary mouth bar whereas the sands of Mehsana member and of Kalol formation have typical channel sand features. Due to non-availability of fossil evidence in the shales intervening the sands, no specific environmental study for these sands by fauna could be carried out. The broad marine environment of the area in three stages of the Paleogene period is worked out which shows that sediments are deposited in inner to middle shelf. By the same study, the environment of deposition of the overlying Miocene formations separated from the Paleogene formations by an unconformity is interpreted to be a delta plain.

The evolution of the basin through the several stages from its formation to the present is analysed. The number of transgressions, their age, extent, direction of sand entry and influence in the different parts of the study area are identified. The tectonics experienced by the different parts of the study area of the basin in the different stages is analysed and then correlated with the sedimentation in the same stages. The reasons for the deposition of coarse clastics and other lithological suites are analysed. An evolutionary model of the basin is developed.