CHAPTER - I

INTRODUCTION

GEOGRAPHIC LIMITS

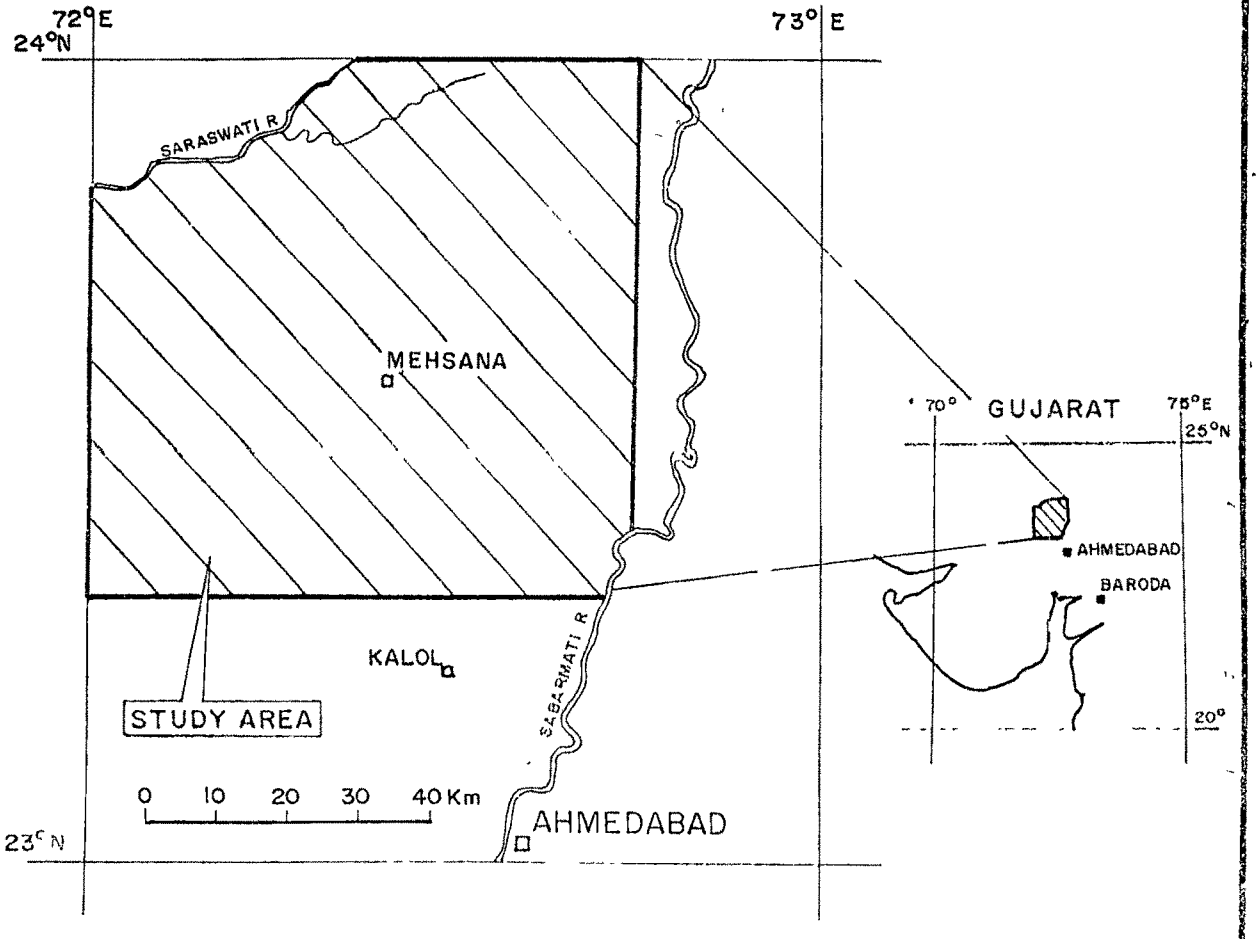
The area under study is bounded to the north by Saraswati river, to the south by latitude 23°20'N, to the east by longitude 72°45' and to the west by longitude 72°0' (fig. I.1).

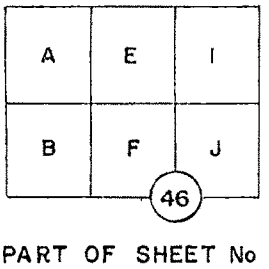
Mehsana, the principal town of the area is located in the central part. The other towns are Patan in the northern part, Visnagar in the eastern part, and Becharaji in the western part. The study area measures 62.50 km in the north south and 76.25 km in east west directions, encompassing an area of 4765 km^2.

The area is covered by alluvium and residual soils.

Fig 1.1

LOCATION MAP AND INDEX MAP OF TOPOSHEETS OF STUDY AREA





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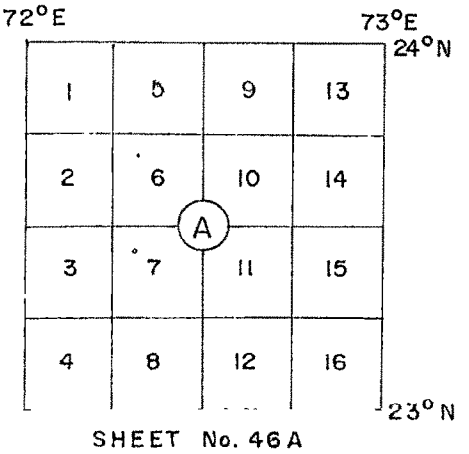


SHEET No. 46 A

PHYSIOGRAPHY AND DRAINAGE

The area has a flat terrain covered by alluvium and soil showing gently rolling topography. A general rise towards north eastern direction is noticed. The ground elevation varies from 35 m to 150m above mean sea level. No marked hilly features are present.

A number of streams traverse the area flowing west. The main streams are Saraswati river, Pushpawati river and its tributary Khari river, Rupen river and Sabarmati river. The direction of flow of the rivers is controlled by the slope of the ground.

Saraswati river is in a mature stage and is flowing towards west southwest to the gulf of Kutch. A tributary, Amardasi river joins Saraswati river near Hisor village. The widest part of the river is here and then the river narrows down near Khalipur village down stream. In the wider parts of the river, sand bed is exposed. At places, the river banks are steep.

Sabarmati river passes through the south-eastern corner of the area. It is flowing in a south southwestern direction to Gulf of Cambay. The river bed has sand banks at places.

A prominent lake Shree Chimnabai Sarovar is present in the northeastern part of the area which supplies water to the nearby villages through canals.

COMMUNICATION

A good network of metalled and unmettalled roads criss

cross the area connecting various towns and villages. Several cart-tracks in the area are motorable in dry season. A number of state highways (Nos. 7,10,19,55 and 56) connect the main towns in the area and nearby areas.

Mehsana is the main meter gauge railway junction in the area. The Ahmedabad-Dehli meter gauge railway line passes through Mehsana and Mehsana is connected with main towns of Saurashtra by meter gauge railway line.

The main meter gauge lines of the area are Mehsana-Patan, Mehsana-Visnagar-Vadnagar-Taranga hill, Mehsana-Viramgam, mehsana-Kalol-Kadi-Becharaji (fig I. 2)

CLIMATE

The area experiences a dry hot climate in general and some rains from June to September during the monsoon season. The average annual rainfall is 53 cms but a maximum rainfall of 99 cms is experienced in some parts of the area. Mild winter is experienced after the rainy season till the month of March followed by a rise in atmospheric temperature resulting in an uncomfortable weather due to hot winds and low humidity. The maximum temperature experienced is 114°F and minimum is 40°F in the months of may and january, respectively.

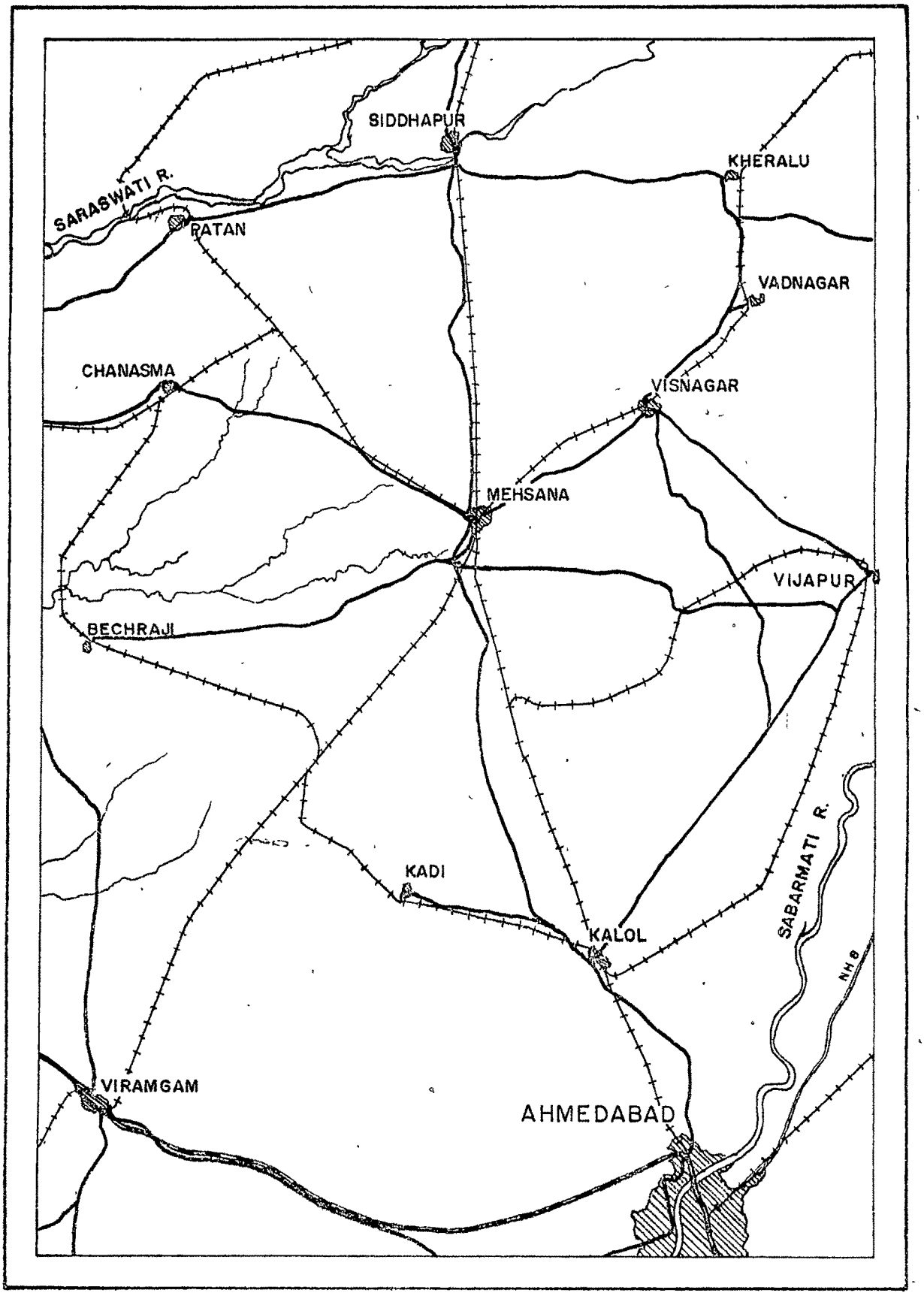
VEGETATION AND CROPS

The main types of trees and plants are teak, timru, baval, amla, mangoes, grapes, papaya, ber, kalam, siswa, baheda, amli and bill.

LOCATION MAP

0 5 10 15 20 25 30 Km

Fig 1.2



The main crops are cotton, jawar, bajri, sarsav, castor seed, wheat, pulses and spices.

The main type of soil present in the area is Goradu soil which is a mixture of sand, clay and kankar. Black soil is present in a few places which is highly retentive of moisture.

OBJECT OF STUDY

The object of the study is to critically examine all geological and geophysical data of North Cambay basin and bring out the tectonics that operated in this part of the basin as a result of the superimposed orogenic activities, to map the structures and fault patterns within the sedimentary sequence and its basement, relate them with the regional tectonics and with each other, to decipher the architecture of the basin, to prepare a stratigraphic column of the sedimentary sequence and the spread of some of its formations, to study the paleo-geography of the basin in the different geological epochs of Cenozoic era and bring out the direction of drainage, the provenance for the sediments, the location of the coarse clastics in relation to fine clastics during the same geological epoch and the reasons for the deposition of the coarse clastics in a place, to analyse by the sedimentological techniques the patterns of grain size distribution of sand bodies and thereby deduce the environment of deposition of the same sands, to collate all the evidences including that of faunal indices for environmental interpretation, to prepare sand geometry maps of some stratigraphic units that are useful for future exploration of hydrocarbons,

to prepare geomorphological maps and relate neotectonics of the area with the Paleogene geological features.

SCOPE OF WORK

In order to achieve the objectives stated above, the sub-surface data collected from the study area in the course of exploratory drilling for hydrocarbons, gravity surveys, seismic reflection surveys and the computer processed data of these surveys have been fully studied. A part of the data is presented in the plates, but all the scientific data are used in the preparation of the plates, and the interpretation is comprehensive. Since the data are vast in some geographically concentrated areas and sparse in other areas, considerable extrapolation is required in sparse data area. Similarly in some aspects, data availability is rich. In parts of the study area such as the margins of the basin and synclines, the coverage of seismic work is poor and the extent of extrapolation is high. In the stratigraphic sequence, the Paleogene section is intensively studied, particularly the upper part, wherein cores are cut in the coarse clastic section during drilling and the drill cutting samples are collected in the rest of the section, due to the occurrence of hydrocarbons in this part of the sedimentary section. In many cases, samples of drill cuttings are not collected in the Miocene section and not at all in the Post Miocene section. Such data available in a few points are utilised for extrapolation over a large area. Even the seismic data are collected and processed with the object of studying the denoted Paleogene section only. Hence the reason for concentrating the present study of the environment

of deposition on two formations of Paleogene age.

The seismic data are used wherever feasible. In fact the seismic data are the only source of information for extrapolation between subsurface data points. This information includes the faults in the sedimentary sequence, particularly when these are near vertical faults, that cannot be identified from the well data, faults at the top of Deccan Trap particularly on the margins of the basin where the depth to the top of Deccan Trap is shallow (less than 2 km). By comparison with known lithology, the Paleogene sedimentary section's facies is deduced from the seismic sections wherever these sections are prone to such analysis by the data quality.

METHODOLOGY

The methods used in this study are not generally followed in the research work of the academic institutions but only in the international petroleum industry. Besides, as the geology is not exposed, a large amount of work had to be done in order to prove a point which could normally have been done by a few surface observations.

The tectonics of the area has been understood by integrating the regional geology and tectonics with the local data; these local data are obtained by Bouger gravity map which gives structural trends and larger features and residual gravity map which sometimes provides structural information on individual features. In the present study, the major faults at the top of Deccan Trap along the margins of the basin and along the flanks of the prominent horsts are traced from

the residual gravity map. These faults are also confirmed in the seismic lines across the faults. In the deeper parts of the basin where the seismic reflections are scarce, the gravity data are alone used to trace the tectonic elements.

All the folds and their extent are mapped with seismic data, as they are subsurface features. The mapping is not difficult for experienced workers in these data handling by following the markers with seismic signatures. The seismic signatures are extensively used to identify the faults in the sedimentary section. The faults are identified either by diffraction or by an abrupt termination and subsequent commencement of a marker reflection, etc. Although seismic facies maps are not prepared, due to a special computer processing of data needed for the purpose, it is carried out wherever such a study is feasible and its results incorporated in the isopach and sand isolith maps.

The wireline logs are extensively used even for small details, as they are the only basic data for all subsurface geologic analysis. The lithology of the beds and its boundaries, the stratigraphic boundaries checked and correlated with drill cutting samples, the datum planes for tectonic analysis are all made out from these logs. The S.P.-resistivity and gamma ray log are specially used to understand the characteristics of a sand, such as the probable grain size variation and the shale content, and to interpret the environment of deposition of these sands. These are well established techniques that are used in

the study of sediments during exploration for hydrocarbons and that are gaining more currency and validity now.

The environment of deposition of the sand bodies is also studied by the sedimentological analysis of a large number of samples from the hydrocarbon bearing sands, to enable a comparison of these studies with environmental studies from the electrologs. Besides the univariate analysis which provides the individual parameter variation as a measure of the environmental index, the bivariate analysis namely standard deviation against skewness and standard deviation against mean size have also been made and the results compared with those of modern sediments. The results are very consistent and compare well with other environmental indicators.

Faunal studies are made for a few stratigraphic intervals to bring out the paleobathymetry and the environment of deposition of these sedimentary sections. Faunal studies along with lithology of the formations are used to decipher the stratigraphic boundaries and the unconformities in the total Cenozoic sedimentary sequence.

Neotectonic studies are made for comparison with the structural features in the subsurface in order to see any correspondence between them. Even in many alluvial covered areas of some sedimentary basins, the anticlines and faults have found their reflection on the surface by geomorphological features. Accordingly, photogeomorphological studies are made with ground checking. Some geomorphic anomalies are related to the geological structures on which exploratory drilling is carried out for hydrocarbons. Lineaments are marked on

aerial photographs and some of these coincide with the tectonic lineaments of the basin.