CHAPTER -1

INTRODUCTION

PURPOSE AND SCOPE

Studies on long term landscape development provide vital data in respect of tectonic activity and behaviour of the sedimentary basin. Reactivated sedimentary basins exhibit a dominating influence of tectonics in the syn-depositional as well as post-depositional geomorphological evolution. Sedimentary basins that have undergone tectonic inversion show marked influences of variations in tectonic activity on the landscape by controlling the erosional and depositional phases. Such studies are extremely important in the cratonic areas of the Indian plate which are of considerable geological importance. These studies have so far been given less attention though these have the potential of throwing light on the long term tectonogeomorphic evolution which have great significance in understanding the changing stress conditions, tectonic phase and the past and present seismicity. The present study aims to address these issues in the

Kim river basin of western India, which lies at the intersection of the N-S trending Cambay rift graben and the seismically active ENE-WSW trending Narmada-Son Fault. This zone at the present time is also tectonically active and characterized by high thermal regime. Intensive geophysical exploration for petroleum reserves has led to generation of a wealth of data on subsurface geology and faults. Precise information on tectonic and structural set up is extremely important in any study on long term morphotectonic evolution.

The Kim river basin is sandwiched between the two major drainage basins of western India- the Narmada basin to the north and Tapti basin to the south. The area falls within the western extremity of SONATA zone, a well known E-W trending zone of crustal instability since the Archaean times. The Kim river basin is unique in several respects. One crucial aspect is its capability to reconstruct an independent drainage basin in an area where all the other rivers join either the Narmada or Tapti rivers. The second is the diverse nature of the landscape configuration and tectonic pattern it traverses before meeting the Gulf of Cambay. The third aspect is its conspicuous meandering course which appears to be structurally controlled. The fourth one is that it exposes a full sequence of sedimentary rocks deposited during the Cenozoic.

In view of the above mentioned unique features, the present study was taken up to understand the Late Cenozoic geomorphic evolution of the Kim River basin. Previous researches in the area have been carried out mainly on sedimentary and stratigraphic aspects of the Tertiary sequences, which constitutes a part of sedimentation in the N-S trending Cambay rift graben. As a consequence, the geomorphic evolution of the Kim river basin in Late Cenozoic is not yet known. As the area falls within the tectonically

and seismically active region, the role of neotectonism in geomorphic evolution has been emphasized. The main objectives of the study has been to characterize the varied landscape of the Kim river basin and to delineate the timing and style of Quaternary deformation leading to the evolution of the present landscape. The present study reveals that the geomorphological history of the Kim river basin has been controlled by well marked episodes of erosion and deposition in response to various phases of sedimentary basin inversion. The study includes a detailed documentation of these phases. An integrated model of landscape evolution in relation to Late Cenozoic inversion tectonics has also been evolved.

STUDY AREA

Location

The study area falls in the southern part of the Mainland Gujarat (Fig. 1.1). The Kim

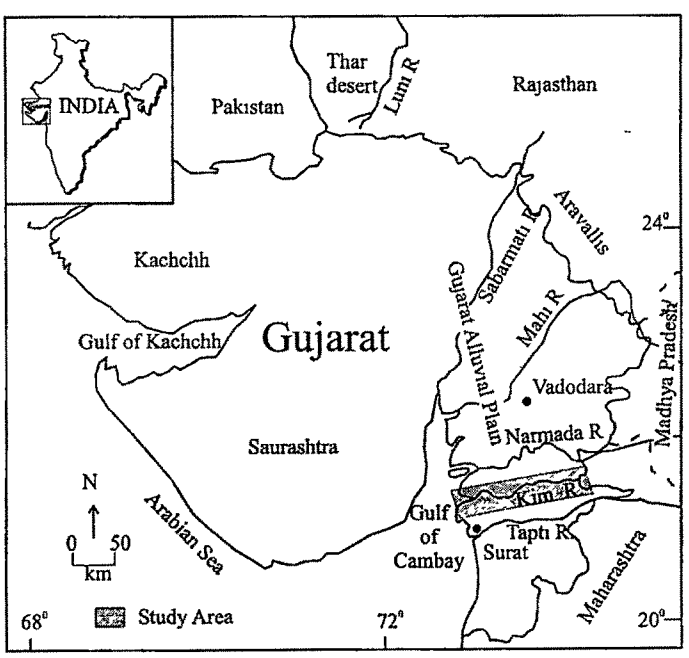

Fig. 1.1 Map of Gujarat state showing the location of Kim River Basin.

river flows mainly through Narmada, Broach and Surat districts and is located between 72° 35' N to 73° 27' N longitudes and 21° 20' E to 21° 40'E latitudes. In the lower reaches, the river forms southern limit of the Bharuch district and northern limit of the Surat district. The Kim river rises in the trappean hills near Phulwadi located to the east of Netrang town and follows a general ENE-WSW trending course. It joins the Gulf of Cambay, forming a large estuarine mouth, which is located about twenty miles to the north of the estuary of the Tapti river.

Communication and transport

The study area lies within the well known industrial corridor of Mainland Gujarat (Fig.1.2), which extends from Ahmedabad in the north to Vapi in the south. Due to this reason, the study area has a well developed communication and transport system. Its different parts and the major towns are linked with other parts of the country by rail and road. Almost all villages are connected by metalled roads. The National Highway No.8 and the Delhi-Mumbai broad gauge mainline of the railways pass through the area. Ankleshwar, Bharuch, Surat and Kim are the important railway stations. The National

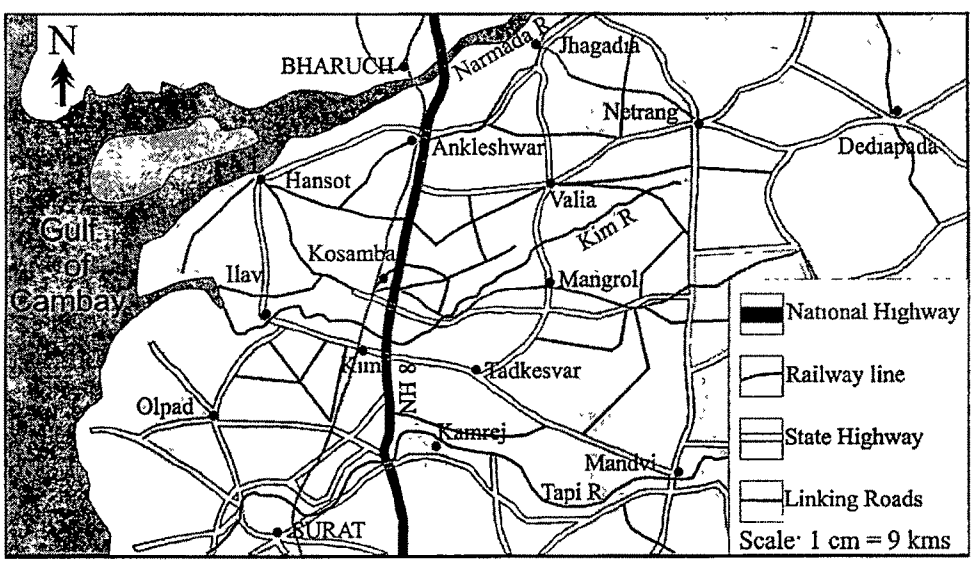

Fig. 1.2 Communication Map of the study area

highway running parallel to the broad guage mainline, meets numerous state highways and district roads; thus in totality almost all parts of the study area are well connected with roads, except the eastern hilly terrain. In addition to the, dense network of good motorable roads, narrow gauge railways are also present in the study area. The nearest airport is located at Vadodara about 100 km north of the study area.

Climate

The climate of the area is characterized by four seasons the winter (November-February), the summer (March-May), the south-west monsoon (June-September) and the transitional month of October. The winter season is characterised by clear skies and is cooled by northerly winds. Morning are chilly and occasionally the cold is severe. The minimum temperature on individual days may be 40^0 F or lower. The wind direction is mainly between North and East for the greater part of the day except in the afternoon. In the hot season, which begins towards the close of February, temperatures goes up and maximum temperatures of the order of 110^0 F are not uncommon, even in the month of March. It goes on steadily increasing and temperatures of the order of 115^0 F or higher are recorded sometimes during the period, April to June. The hot season practically continues till about the middle of June when the onset of monsoon takes place. The westerly winds dominated from April and last till the end of September. The rainy season is from June to September. July is the rainiest month getting nearly double the rainfall in June and August months.

Rainfall

The rainfall of the study area averages about 999 mm but, it varies very much from year to year, the lowest recorded being 228 mm for Rajpipla, 685 mm for Dediapada and

715 mm for Valia and the highest 2183 mm for Rajpipla, 2403 mm for Dediapada and 2288 mm for Valia. Rainfall increases from west to east. About 95% of the rainfall is received in monsoon. The study area lies between an average annual rainfall isohyte of 1200 mm (Fig. 1.3). The Kim river is in general located in a dry subhumid climatic zone.

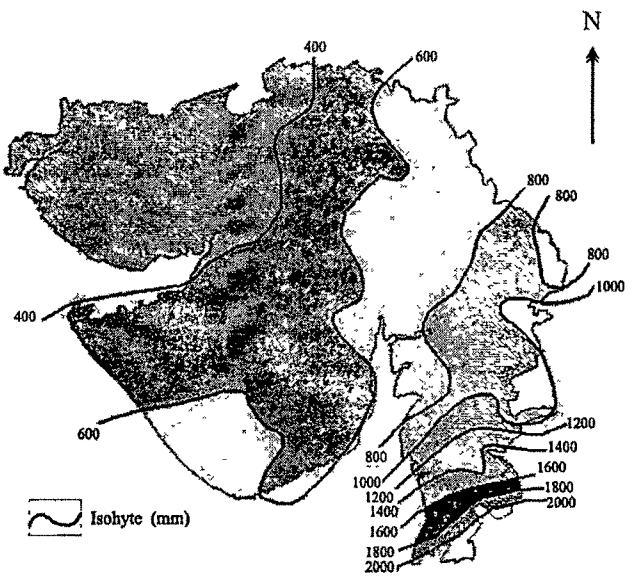

Fig. 1.3 Ishohyte Map of Gujarat. (after GEC, Vadodara)

Physiography

The Mainland Gujarat is mainly covered by the Quaternary sediments of the Gujarat alluvial plain confined to the north of Narmada River. The study area falls under the southern part of the Mainland Gujarat. The northern and eastern portion around Rajpipla, Netrang and Dediapada talukas comprises a hilly terrain covered by forests and intercepted by alluvial valleys. The western part mainly comprises alluvial plain, which rises gradually to the east in step like topography. The alluvial plain is a product of the processes of erosion and deposition carried out by the Kim river flowing from trappean hills to the Gulf of Cambay. There appear to be well-marked phases in the evolution of

these alluvial plains and its present topographical settings. These hills form the northwestern extremity of the Deccan upland region of Peninsular India. The trappean highlands typically point to a strong structural control and the entire topography is characterized by E-W and NNE-SSW trending ridges and intramontane valleys. The trappean highlands show an altitude variation from 150 to 300 m. River valleys with steep sidewalls are the major features. The hilly terrain consists of successive lava flows of varying texture, composition, which belong to the Deccan Trap Formation.

Drainage

The drainage is mainly controlled by physiography and tectonic framework of the area. As the overall physiography of the study area is moderately rugged, the surface of the area is undulating, broken by many watercourses and by a recession of low, abrupt and rugged weathered ridges. The drainage network in the present study area is formed by rivers such as the Kim River and its tributaries the Tokri, Bhaga and Gondhawa nadi which traverses through Rajpipla and Valia, talukas of Broach and Surat districts. In addition the groundwater occurs in both confined and semiconfined condition, groundwater level in all formation varies between 6-30 m below ground. The area is situated between two major rivers such as the Narmada and the Tapti. Many tributaries of both the major rivers are flowing very near to the study area which show striking diversity of the drainage pattern. The Kim river basin forms the only independent drainage which flows between the Narmada and Tapti rivers.

Forests and flora

Forests of the area are confined to ridges and hills of Jhagadia, Valia, Nandod, Dediapapda, Sagbara, i.e. south eastern hills consists of one third forest land. These

forests are tropical dry deciduous of two sub-types. (1) Dry teak forests & (2) Dry mixed deciduous forest. But these two are so merged with each other that forests are called as dry deciduous forests. Teak is found growing with the following associated in the top canopy:- Shisham (Dalberyia latifolia), Khair (Acacia catechu), Haldervo (Adinacordifolia), Kalam (Stephegyne parviflora), Simal (Bombox malabarcium), Timbru (Diospyros melanoxylon), Gugal (Boswellia serrata), Kakad (Garuga pinnata), Modal (Linnea grandis), Bondar (Lageerstroemia lanceolata), Karanj (Pongamia glabra), Katas (Bambusa arundinacea), etc.

Low relief, undulating yet relatively flat dissected terrain with different types of soils provides fairly good cultivable land. Gentle hill slopes, foothills, uplands, plateau, flood plains and coastal plains consist of landuse. The crops grown in the area, are paddy, groundnut, bajri, tobacco, maize, vebi, jowar and wheat while with the help of irrigation cotton, paddy and jawar crops are also grown. In the rocky or hilly soils the crops taken are maize, groundnut, cotton, paddy, jawar, wheat and pulses. In loamy alluvium soil the crops cultivated are bajri, wheat, cotton, groundnut and other staple food crops like jowar, banto, banti, long and vegetables. There are many trees growing in the area. Bamboo is sparse and of poor quality.

Fauna

There are several wild animals present in the area, which are confined at the western tail end of the Satpura range. The wild animals are Panther (Felis pardus), Leopard cat (Felis Bengalensis), Jungle cat (Felis chaus), the small Indian Civet (Viverricula malaccensis), the Indian Palm Civet (Paradoxyrus niger), Indian mongoose (Herpestes mungo), Hyaena (Hyaena striata)-called Jarakh, the Indian Wolf (Canis

Lupus), Indian Fox (Vulpus Bangalensis), the Jackal (Canis aureys), etc. There are various wild birds found in the area, more than one third of which are migratory winter visitors.

Occupation

Most of the people residing in the study area are working in agricultural and related sectors. The rest of the non-agricultural people are engaged in various occupations supporting the industrial activity of the area which are mainly mill worker, bakeries, boarding and lodging houses, cold drink houses including preparations of aerated water, flour mills, copper and brass smiths, gold smiths, hair cutting saloons, laundries, mattresses and pillow making, motor building and repairing, pounding and parching of grains and rice, printing and dyeing, restaurants and tea shops and tailoring. Now a days the area is more known for textile and other modern industries.

APPROACH AND METHODOLOGY

The present study has been primarily aimed at delineating the role of tectonic activity during Late Cenozoic in the geomorphic evolution of the Kim River basin. The study has utilized all the standard field techniques known for mapping and analysis of geomorphic landforms. The study has also dwelt on the stratigraphic aspects of the exposed Late Quaternary sediments which had remained uninvestigated so far. The categorization, characterization of the landforms and reconstruction of morphostratigraphy has been done based on well established geomorphic criteria. However, any neotectonic study is to be based on a sound knowledge of the geologic and structural setting of the area. Therefore, a critical evaluation of the existing data on the

surface and subsurface structural aspects of the Tertiary rocks in the Kim basin was also carried out. Following is the methodology in brief adopted for the present study:

1. Collection and critical evaluation of surface and subsurface geology which includes seismic, stratigraphic and structural data of the Kim river basin.
2. Field mapping of the various geomorphic surfaces and landforms was done on 1:50,000 scale using Survey of India Topographic maps as base maps. Satellite images were visually interpreted for identifying the mega-geomorphic sets of the Kim river basin.
3. Vertical and lateral lithofacies mapping of the exposed Quaternary sediment successions from different geomorphic zones were carried out.
4. Vital data on tectonically generated geomorphic features like geomorphic surfaces, terraces, entrenched meanders, steep valley scarps and incision were generated to understand the role of neotectonism.
5. Morphometric analysis of drainage characterstics was carried out to substantiate the field data generated on aspects of neotectonics.
6. The data generated were synthesized to reconstruct the geomorphic evolution in the context of inversion related tectonic activity in the Kim river basin during Late Cenozoic.