CHAPTER - III

GEOMORPHIC SET-UP AND MORPHOGENESIS

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CHAPTER - III

GEOMORPHIC SETUP AND MORPHOGENESIS

INTRODUCTION

The Mahi-Narmada interstream alluvial terrain has long history of geomorphic evolution. The present day physiographic configuration is the manifestation of the regional tectonic framework and local endogenic and exogenic processes during the Quaternary period. The boundaries of the study area, Mahi-Narmada rivers, sea coast and foot hill zone marking the major physiographic features exhibit the tectonic control. The large variety of small scale landforms within the study area represent the complex processes of erosion and deposition under the influence of fluctuating sea levels and neotectonism during late Quaternary. The present landscape scenario of the area represents a case of a terrain development under Quaternary dynamics, confined within a well defined tectonic block. A scenario of geomorphic setting of the study area as seen from the satellite imagery, is given in Plate III.1. It gives an idea of landform features in relation to major tectonic features.

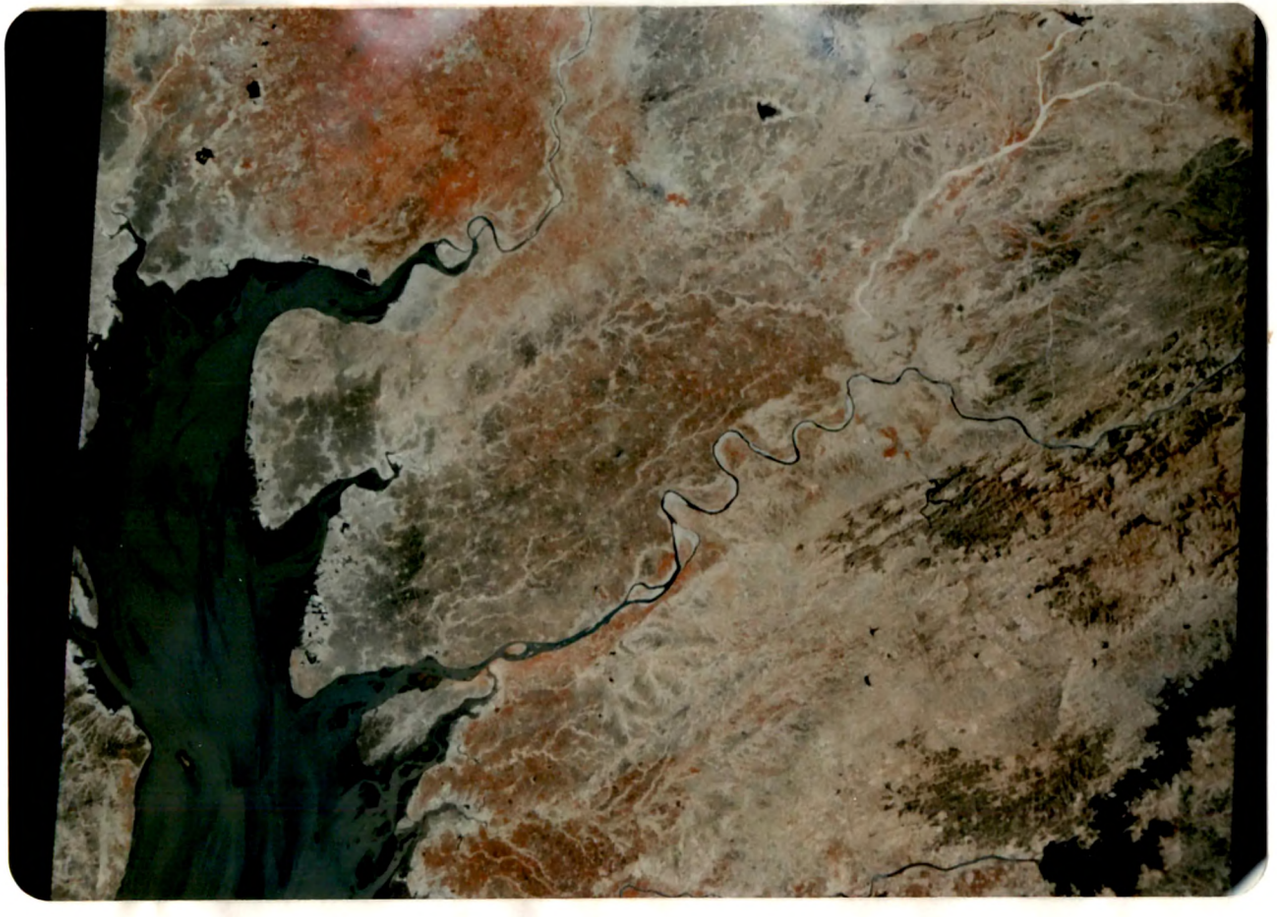


PLATE III.1 A view of the study area and adjoning region as seen in LANDSAT - 5 (TM band 2,3 and 4; Resoultion 30m) showing geomorphic setup, features of structural controls and terrain characteristics

Study of the various geomorphic features not only help in unfolding the intricacies of Quaternary process but also indicate the future trend of terrain behaviour.

In the present chapter detailed description of topography and drainage has been given and based on that the area has been divided into three distinct physiographic units. Unit wise development of different landforms are identified and described. On the basis of critical analysis of the various landforms, a morphogenic evolutionary pattern of the terrain has been discussed.

TOPOGRAPHY

Physiographically, the area is bounded between two major rivers of Mahi and Narmada in the North and South respectively.. The Gulf of Khambhat marks the western border and the line of rocky exposures define its eastern limits. The study area can broadly be divided into three major physiographic units, as

i) Coastal Lowland
ii) Central Alluvial Plain
iii) Eastern Piedmont Zone

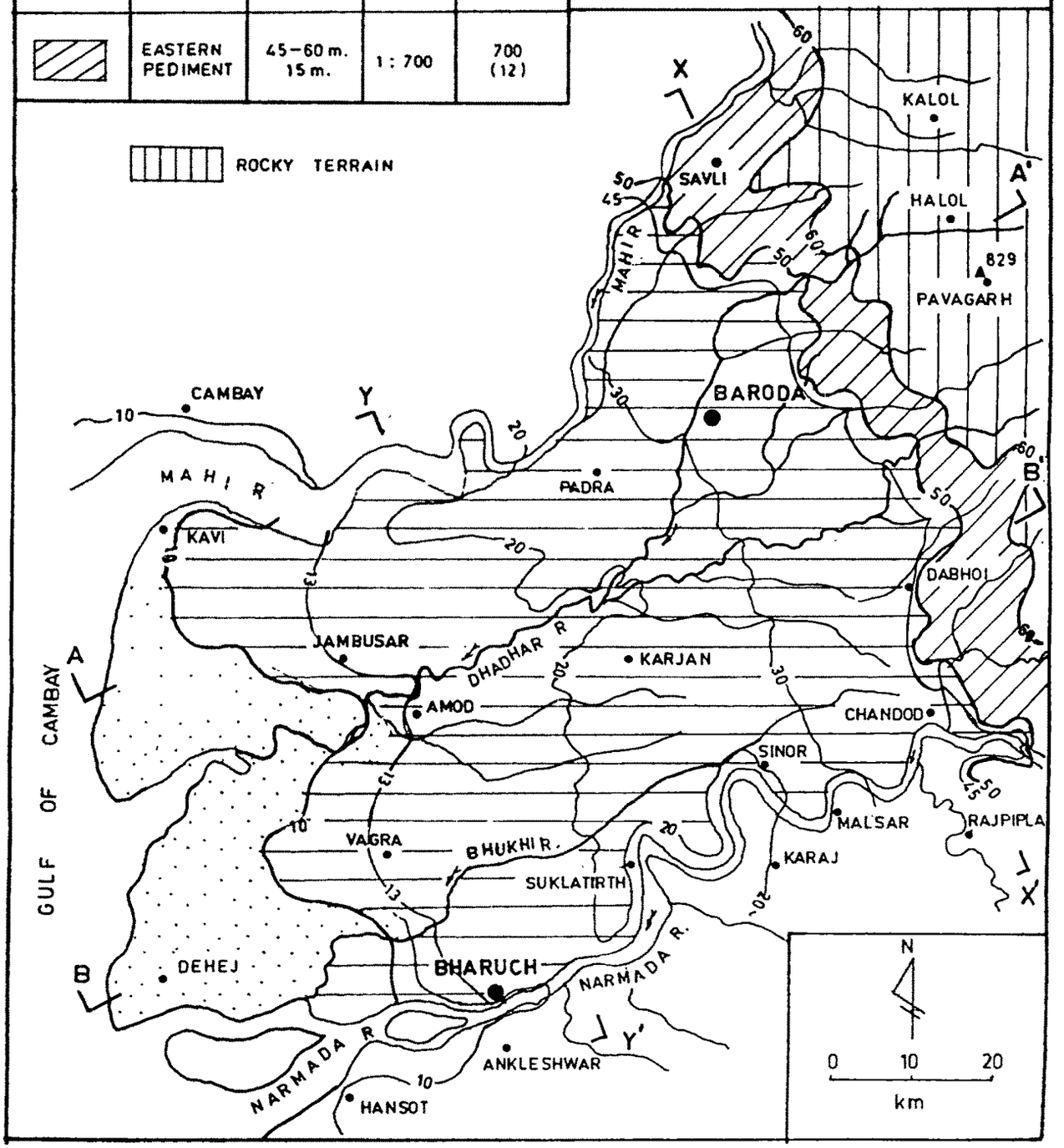
A physiographic map showing the distribution of these units is shown in Fig. III.1. The Coastal Lowland lies below 13m elevation covering about 1500 km^2 i.e. 25% of the total study area. From the coast line to hinterland this zone extends for 20 km to about 30 km. The central plains lie in the elevation range

FIG - III - 1

PHYSIOGRAPHIC MAP OF STUDY AREA

SYMBOL	PHYSIO. UNIT	ELEVATION (diff.)	GROUND SLOPE	AREA km^2(%)
	COASTAL LOW LAND	0 – 13 m. (13 m.)	1 : 2500	1500 (25)
	CENTRAL PLAINS	13 – 45 m. (32 m.)	1 : 2800	3800 (63)
	EASTERN PEDIMENT	45 – 60 m. 15 m.	1 : 700	700 (12)

A – A'
B – B'
X – X'
Y – Y'
} PROFILE LINES (REF. FIG. III.2)



of 13m to 45m. It covers about 3800 km^2 sharing 67% of the study area. Its E-W length and N-S width are about 75 km and 40 km respectively. The Eastern piedmont forms a narrow bordering at the foot hills of the scattered rocky exposures on one side and perceptibly merges into the central plains on the other side. It covers about 700 km^2. This area lies in the elevation range of 45m to 60m. Its N-S length is about 85 km and E-W width is about 10 km to 15 km. This unit forms a lower most part of extensive piedmont zone of eastern hilly tract.

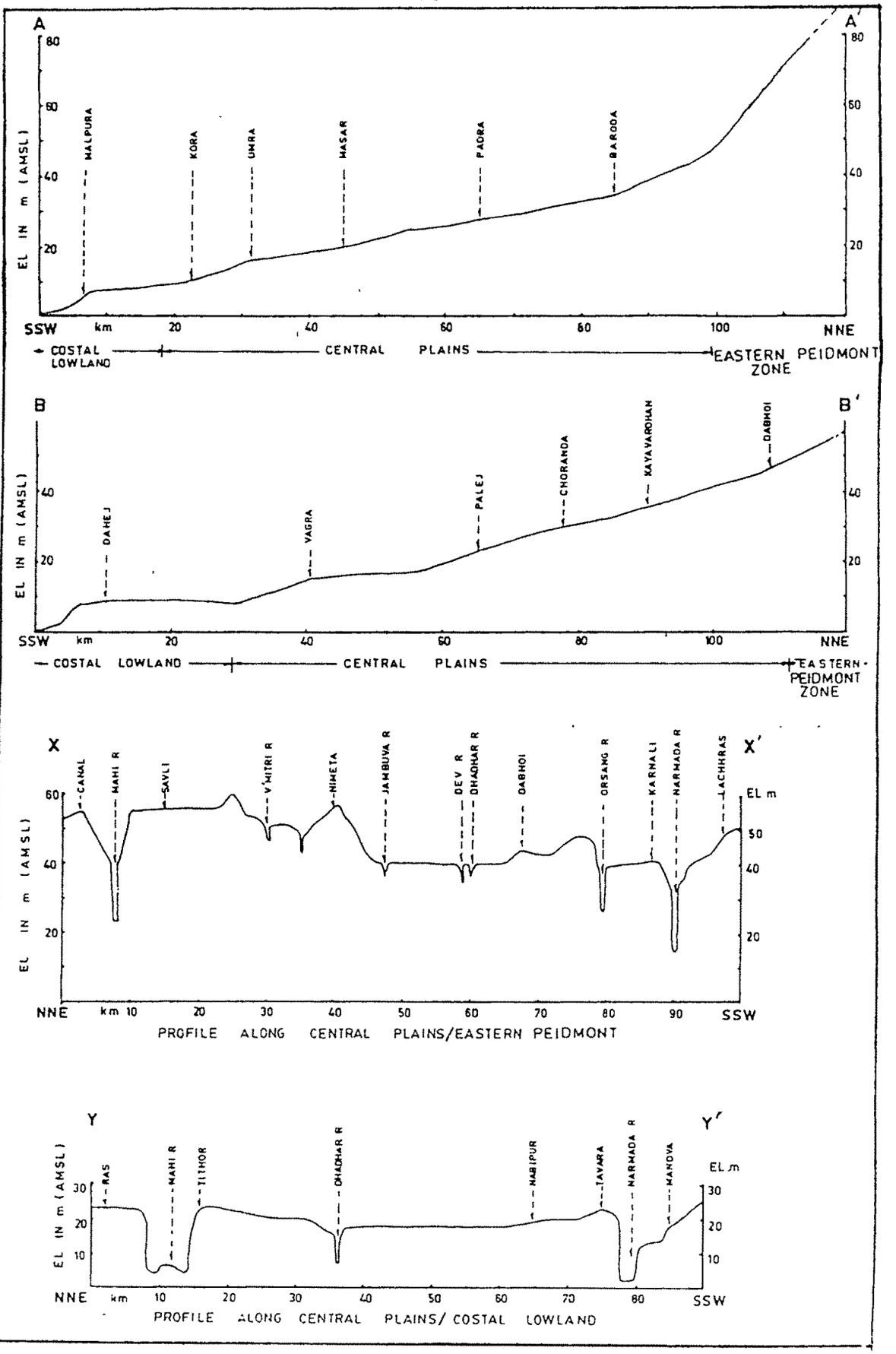
The area in general slopes due WSW. Two topographic profiles (A-A', B-B') along the slope direction are shown in (Fig. III.2). It is seen that along the slope direction the ground has smoothly falling surface. The average ground slope is of the order of 1:1500. However, it is observed that the different physiographic units show significant variations of ground slopes. The ground when traced across the general slope direction i.e. NNW-SSE it shows relatively higher order undulations. The two topographic profiles (X-X' and Y-Y') along NNW-SSE direction showing the ground undulations are given in Fig. III.2. Higher order undulations are observed towards eastern upland compared to that towards the coastal lowland.

RIVERS

The study area lying between the lower reaches of two major rivers of Mahi and Narmada is also referred as 'Doab' meaning the land intercepted between two rivers. Mahi and Narmada are two

FIG III-2 TOPOGRAPHIC PROFILES

(Ref Fig III-1)



westerly flowing major rivers in the Peninsular India. Regional set-up of the Mahi-Narmada drainage system is shown in Fig. III.3 Dhadhar is centrally flowing river, draining major part of the doab.

In order to have relative idea about the magnitude of the rivers related to the study area, the general characters about catchment, length, and discharge for the three rivers are given in the Table III.1.

Table : III.1 River Basin Data of Mahi, Dhadhar and Narmada

River Basin	Catchment area km^2	River length km	Annual Discharge Mm^3
Mahi	34,842	533	8500
Dhadhar	4,250	160	690
Narmada	98,796	1322	40,705
Total	137,888	2,015	49,825

Data Source : Rao, (1979).

It is interesting to observe that most of the sediments of the study area have been derived by the two major rivers of Mahi and Narmada. However, at the present the predominant drainage is formed by the medium size river of Dhadhar.

Channels and Terraces

Sinuous winding courses of Mahi and Narmada are quite conspicous. The Mahi course shows regular meandering pattern

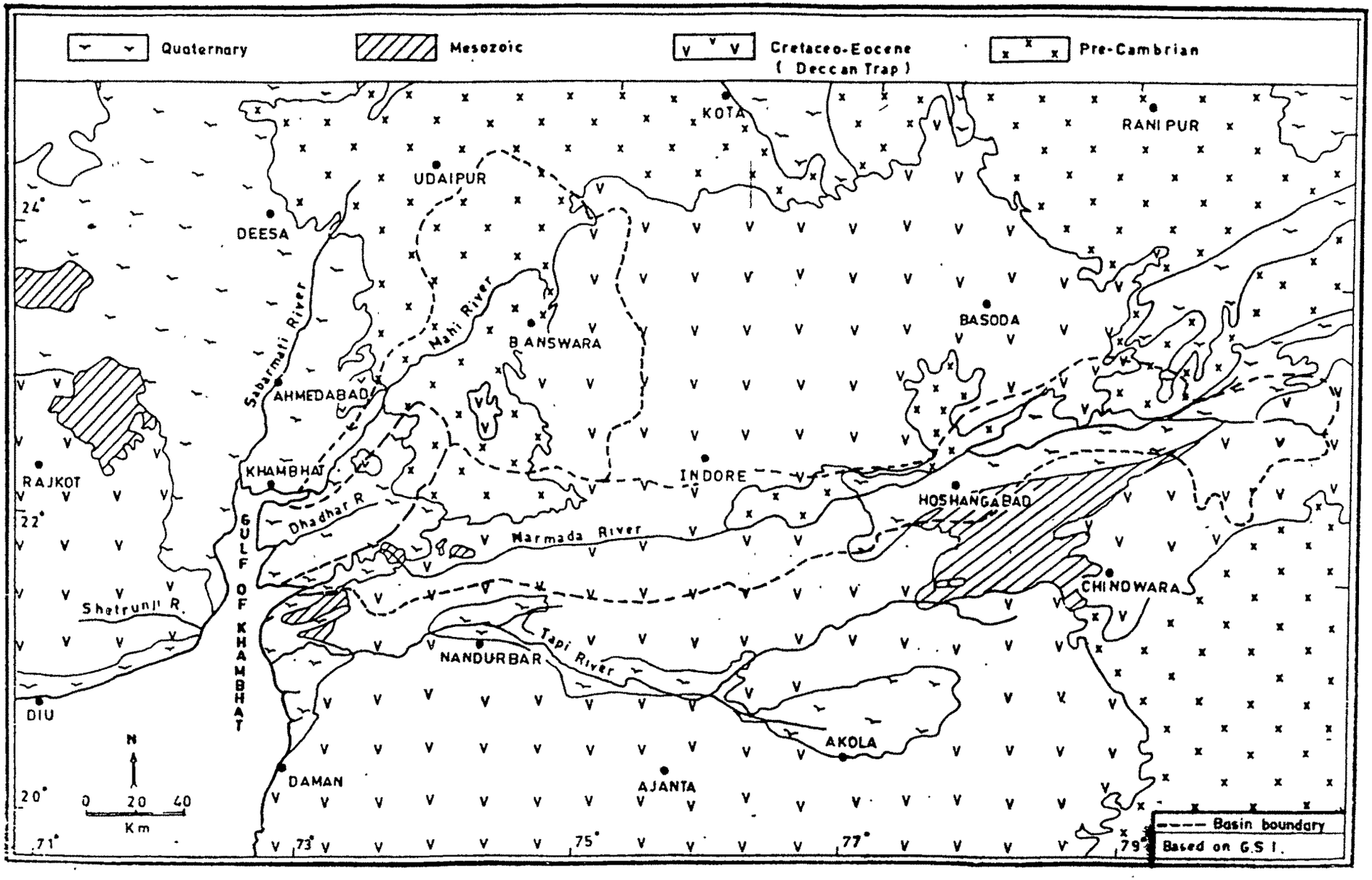


FIG-III-3 DRAINAGE BASINS OF MAHI, DHADHAR AND NARMADA RIVERS IN THE REGIONAL GEOLOGICAL SETTING

between Tithor and Singhrot. The channel downstream of Tithor and upstream of Singhrot is almost straight. A typical meander near Dabka shows radius of curvature as 2.5 km, amptitude of 5 km and wave length of 12 km. up to Mujpur, the river channel has estuarine character, and dowstream of Dabka it shows braided nature. In the braided section the straight valley length is 45 km, channel length of 70 km having sinuosity of 1.6 and channel width varies from 1.5 km to 3.5 km.

Narmada course shows more prominent series of sinuous meandering from Tilakwada to Shuklatirth. The meanders in the upper reaches betwen Tilakwada and Sinor are rather moderate having radius of curvature 2.5 km to 3.5 km, amptitude 2.5 km to 5 km and wave length 10 km to 15 km. while the meandering pattern down stream of Sinor becomes rather close upto Shuklatirtha. Here the radius of curvature is 3 km to 45 km. Amptitude 8 km to 10 km and wave length 20 km to 25 km. The river channel down to Shuklatirtha has straight course showing estuarine nature. Several point bar islands on these reaches have been developed. The development of prominent estuarine mouth bar of Aliabet measuring 25 km x 10 km is very remarkable and significant feature.

Segmentwise details of the Narmada river channel as worked out by Bedi and Vaidyanathan (1982) are given in Table III.2

Table III.2 Narmada Channel types and then Parameters

Channel segment	Channel type	Straight valley length km	Channel length km	Sinuosity	Average channel width m	Straight stretch channel with ratio
Gora to Chanod	Straight or sinuous	28.0	33.0	1.20	830	6
Chanod to Shukla-tirth	Meande-ring	30.0	68.0	2.26	700 to 1000	-
Suklatirth	Braided	33	40.5	1.23	-	-

The centrally flowing Dhadhar is a seasonal river, drains about 63% of the total study area which accounts for 80% of its total catchment. It has not developed striking landform features, but its coastal zone landforms are relatively more pronounced including large scale development of estuarine mouth bar. Micro level course winding and meandering channel in the central part are very significant features. Its major tributaries are Vishwamitri, Sunva Jhabua, and Deo. The upper part of the basin shows typical dendritic pattern with rather high density, and the stream channels have steeper gradient. The lower part of the basin, is characterised by the density of drainage and very gentle channel gradient. In comparison to the small catchment and discharge, it has got very wide open estuarine mouth. The high tide waters in the esturine creek reaches in landwards almost upto Karjan i.e. a length of about 50 km.

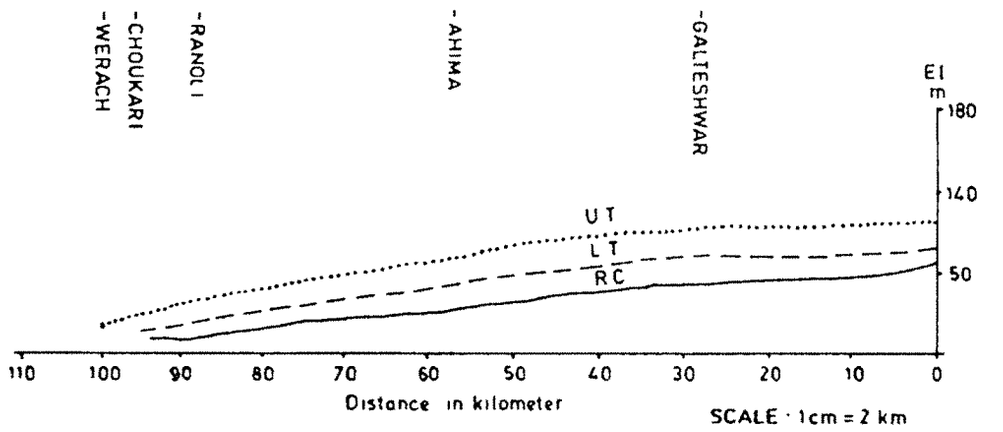
River profiles along the channel bed and terrace levels for Mahi and Narmada are shown in Fig. III.4. According to Bedi and Vaidyanathan (1982) the upper terraces are non-cyclic paired types while the lower terraces are cyclic and up-paired types. Alchin et al. (1971) studied the terraces from archeological point of view to indicate climatic fluctuations while Bedi and Vaidyanathan (1982) studied from the view of tectonism and morphogenesis.

DRAINAGE SYSTEM

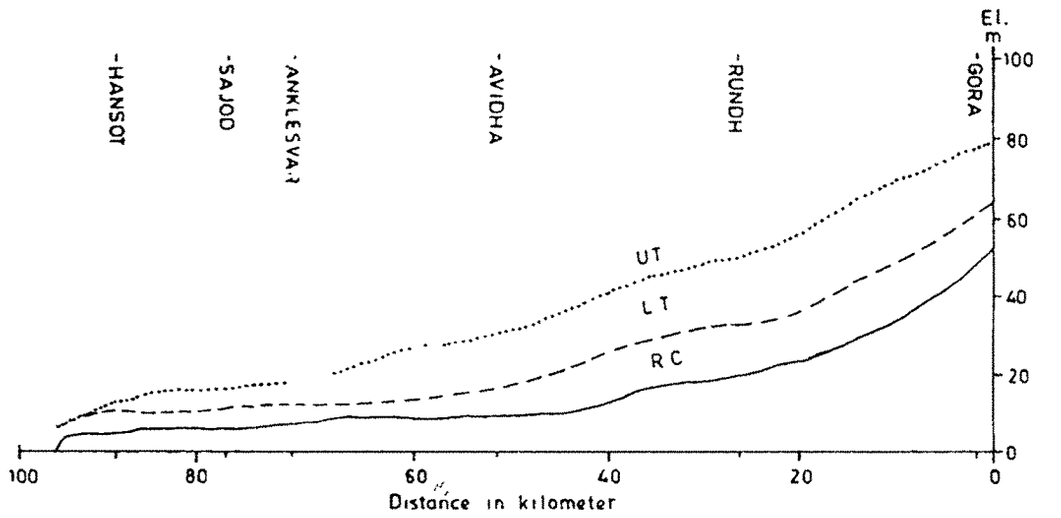
The drainage of study area shows a combination of several patterns (Fig. III.5). The author has identified fine distinct drainage patterns as per their development in the different parts of the study area. The different patterns have been classified and thier details are given in Table III.3.

FIG III - 4

LONGITUDINAL PROFILES OF TERRACES AND RIVER CHANNELS OF MAHI AND NARMADA



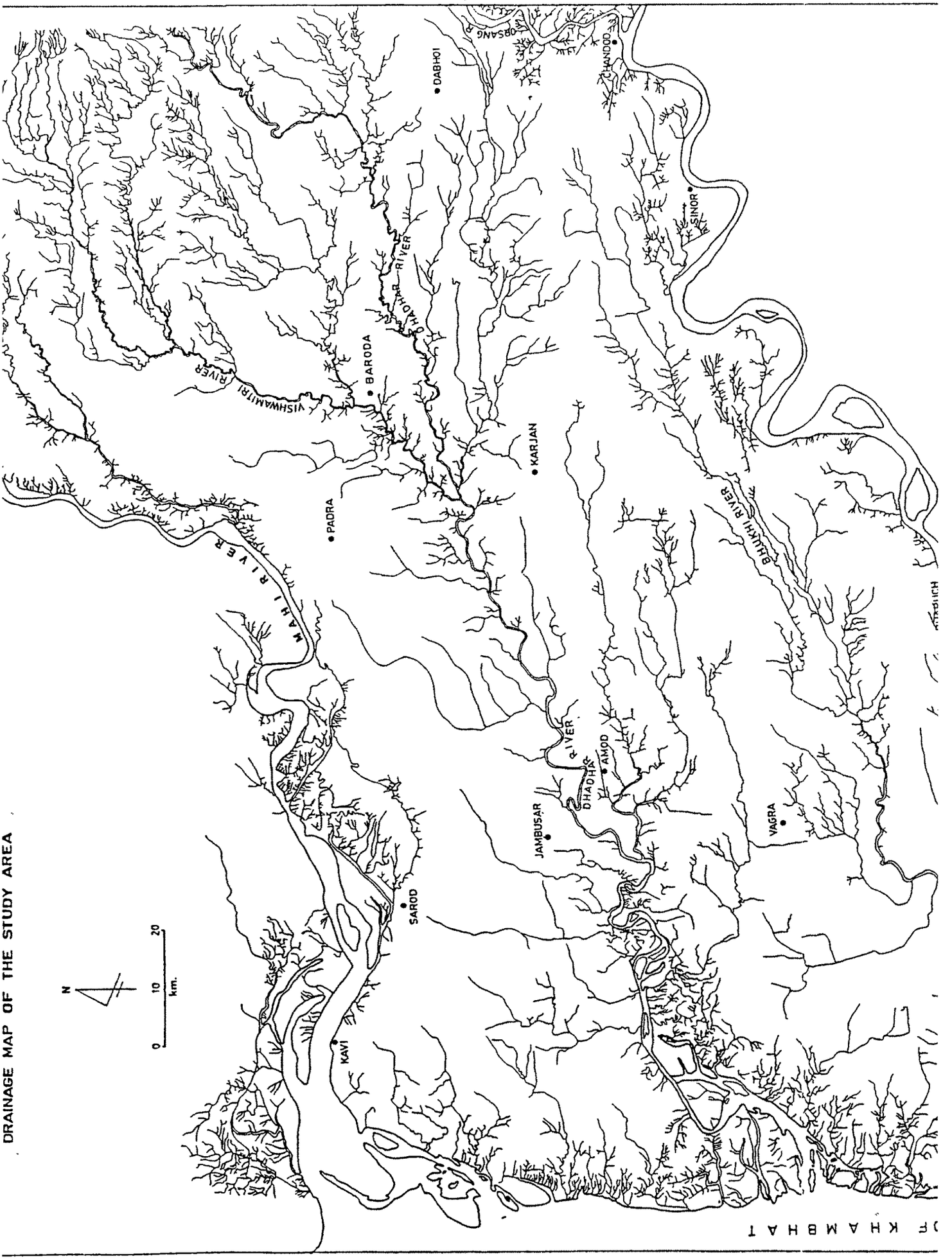
(A) PROFILES ALONG MAHI [After Allchin, B. at.el. (1971)]



(B) PROFILES OF NARMADA [After Badi, N. at.el. (1982)]

INDEX

.....	UPPER TERRACE	UT
- - - -	LOWER TERRACE	LT
———	RIVER CHANNEL	RC



DRAINAGE MAP OF THE STUDY AREA

Table : III.3 Classification of Drainage pattern

Drainage Pattern	Areas of Occurrence	Geomorphic Significance
Dendritic and sub dendritic	Upper reaches of Dhadhar basin and it tributaries of Vishwamitri, Jhabua Sunva and Deo.	Primary control by basement topography and secondary control by Quaternary sedimentation and neotectonism.
Parallel and sub-parallel	Bhukhi Basin, Lower Dhadhar basin, Mahi-Mini system between Bhadarwa and Singhrot.	Parallel and elongate land forms with moderate to gentle ground slopes. Predominently controlled by Quaternary neotectonic activities.
Pinnate	Immediate banks of Mahi, Narmada and middle reaches of Dhadhar.	Rapid erosion of soft and fine textured deposits of natural levee, fossil dunes and other fluvial deposits, coupled with neotectonic control.
Anastomatic and Braided	River mouth areas of Mahi, Dhadhar and Narmada.	Estuarine deltaic deposition under eustatic sea level changes.
Multibasinal	Inter-mouth flats of Mahi-Dhadhar and Dhadhar - Narmada.	Random small scale erosional streams in older alluvium, represent relict distributaies.

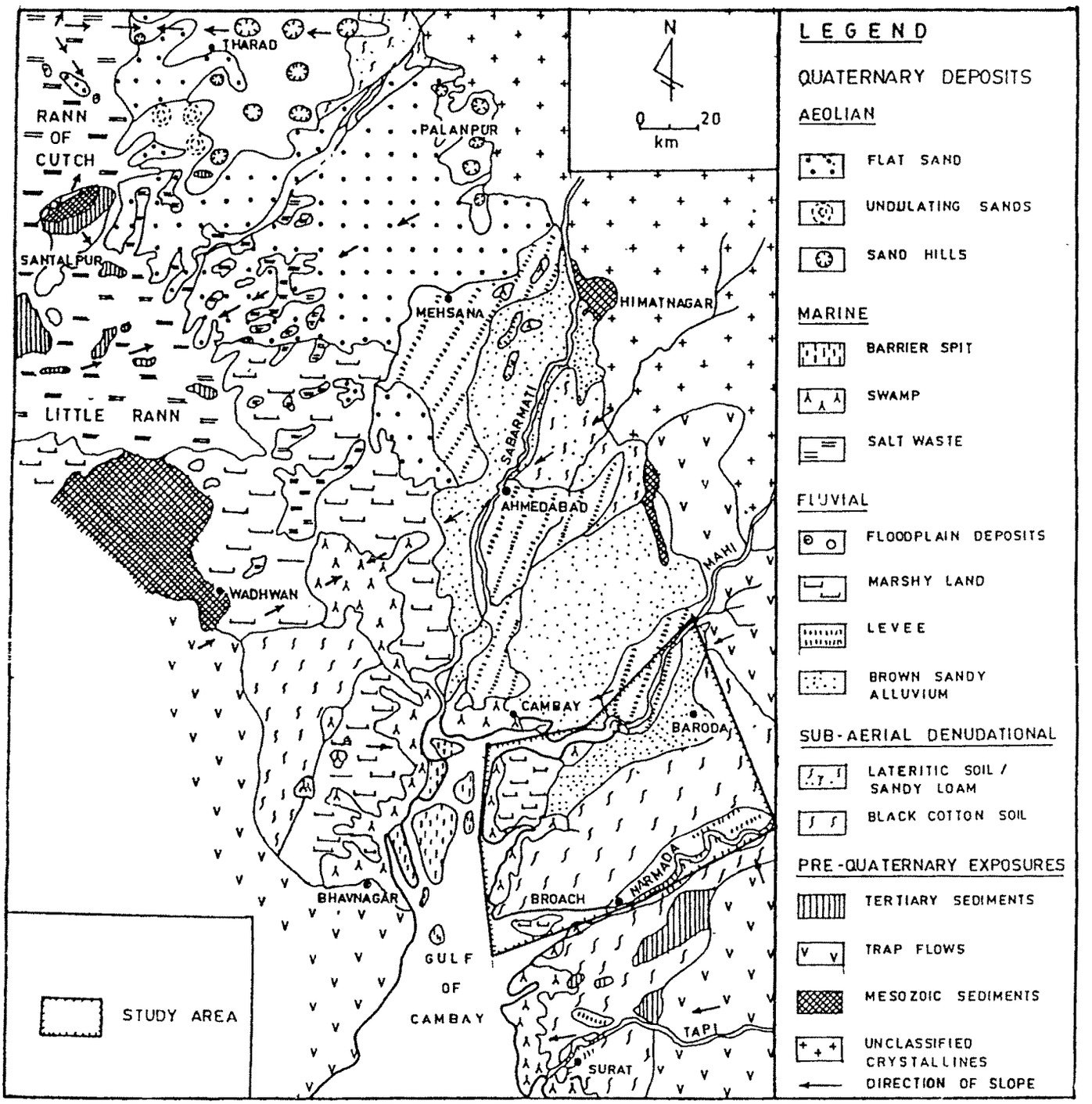
It is seen that drainage of the area has got a long history of development and varied control of tectonism and Quaternary exogenic processes, and under neotectonic activities. The major high order river channels have tectonic controls while the lower order stream have developed during the Quaternary period under local condition of dynamic processes.

LANDFORMS

The landscape of the Gujarat Mainland of which the study area forms an important part has preserved within it an admirable and rather well defined imprints of various landforms of Quaternary origin. Babu (1977) studied Quaternary geology of Cambay basin and compiled a geomorphic map (Fig. III.6). Babu has classified the Quaternary landforms into four different groups based on the depositional process as aeolion, marine, fluvial and sub-aerial denudation. . Bedi (1978), Bedi and Vaidynathan (1982) studied morphology of lower Narmada and Mahi rivers.

The study area shows a wide variety of landforms. In fact, the landscape scenario of the area has been developed under multiple dynamics during Quaternary including sedimentation, tectonics, climatic fluctuations, and sea level changes. This is reflected into the complex landforms pattern of polygenic origin. An attempt has been made here to classify the different landforms based on the controlling environs and present day physiographic distribution. This mode of classification not only facilitates describing present day aggradational and degradational characters but also help in providing proper background of understanding their morphotectonic evolution in space and time. All landform features of the area are broadly classified into two groups as depositional and erosional. The predominant environment characteristics of the different physiographic units have mainly

Fig III-6 REGIONAL GEOMORPHIC MAP



controlled in ultimate shaping the various landforms. Detailed landform classification is given in Table III.4

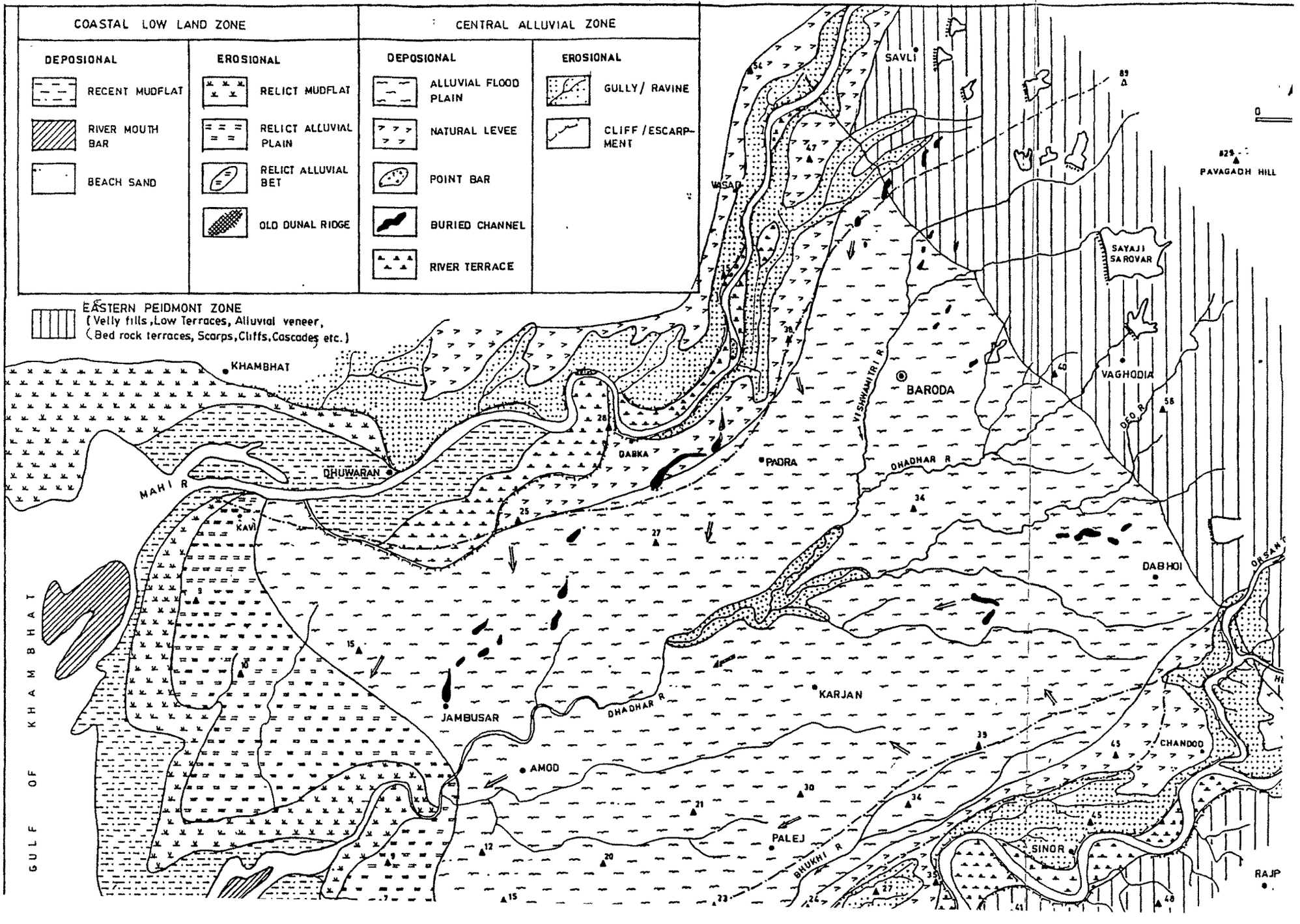
Table : III.4 Landform classification of study area

Physiographic Units		Coastal Lowland	Central Alluvial Plain	Eastern Piedmont Zone
LANDFORM TYPES	Depositional or Aggradational	Recent mudflats River mouth bars Beach sand	Flood Plains Natural levees Point Bars Buried channels	River terraces and channel fills pluvial and colluvial mounds and low ridges.
	Erosional or Degradational	Raised Mudflats Older alluvial plains and bets	Gullies Cliffs and Scarps	Cliffs, Cascades Terraces etc.
	Environments	Marine	Fluvial	Subaerial Denudational

Distribution of various landforms are shown in the geomorphic map of the study area (Fig. III.7). Brief description of the landforms for each physiographic unit is given in the following paragraphs.

COASTAL LOWLAND

The landscape of coastal lowland generally lying below 13m elevation comprise a wide variety of landforms developed under the fluvial marine environmental regime during the fluctuating sea levels of late Quaternary. The depositional landforms like


COASTAL LOW LAND ZONE
DEPOSIONAL
RECENT MUDFLAT
RIVER MOUTH BAR
BEACH SAND
EROSIONAL
RELICT MUDFLAT
RELICT ALLUVIAL PLAIN
RELICT ALLUVIAL BET
OLD DUNAL RIDGE
CENTRAL ALLUVIAL ZONE
DEPOSIONAL
ALLUVIAL FLOOD PLAIN
NATURAL LEVEE
POINT BAR
BURIED CHANNEL
RIVER TERRACE
EROSIONAL
GULLY/ RAVINE
CLIFF / ESCARPMENT
EASTERN PEIDMONT ZONE
(Velly fills, Low Terraces, Alluvial veneer,
(Bed rock terraces, Scarps, Cliffs, Cascades etc.)
GULF OF KHAMBHAT
KHAMBHAT
DHUWARAN
MAHI R
KAVI
DABKA
PADRA
VISHWAMITRI R
BARODA
SAVLI
VASAD
SAYAJI SAROVAR
VAGHODIA
DHADHAR R
DHADHAR R
JAMBUSAR
AMOD
KARJAN
PALEJ
BHUKHI R
DABHOI
CHANDOD
SINOR
RAJP
PAVAGADH HILL

recent mudflats, river mouth bars, beach sand ridges are all located at lower level and show progressively growing trend. The erosional landforms like raised mudflats, older alluvial plains, and bets, etc. are relatively located at higher levels. Descriptions of coastal landform are found in the works of Pandya, (1984), Agrawal (1984), Patel (1985), Islam (1986) etc. A general view of the coastal landscape is shown in plate III.2

Recent Mudflats

The open wide foreshore track is marked by the development of recent mudflats (Plate III>3). The high water line defines its outer limits. The mudflats quite frequently change their shape and size. Their extensive development is seen along the estuarine mouths of the Mahi and Dhadhar. The Narmada mouth is significantly devoid of them. The inter mouth river zones of Mahi-Dhadhar and Dhadhar-Narmada all along the shoreline show regular development of the mudflats within a strip of about 3km. width, mangrove growth is also quite prominent in some places within these mudflats.

River Mouth Bars

The estuarine river mouths of Mahi, Dhadhar and Narmada are wide open and extend for serveral kilometres inland. During high tides, the sea water enters through the river mouths to long distances and as a result extensive accumulations of tidal muds are encountered along the estuary of the these rivers. During the low tides the mud banks and shoals emerge as prominent mud

PLATE III.2 A general landscape view of the coastal lowland. Part of Dhadhar creek is seen in the extreme left, Loc. Near Gandhar

PLATE III.3 A view of recent mudflats, Loc. Lohara

accumulation patches across the mouths, and through which a network of braided channels is formed. The mouth bars of the three rivers are about 5 to 10 km wide and 10 to 20 km long. Dhadhar mouth bar is a good example of chocking the mouth by heavy accumulation of mud. The mouth bars of Mahi and Narmada are predominently sandy while that of Dhadhar are mainly composed of clay and silt. Major part of these mouth bars get submerged during the high tides. These mouth bars are under high influence of the gulf tide and wave dynamics, their configuration gets changed seasonally, depending upon the sediment supply and the pattern of tides.

Beach Sand Ridges

Sand ridges are observed along the beach portion between Dhadhar and Narmada. They extend in the form of a narrow strip stretching between Dahej to Luhara light house for a distance of about 6 km. (Plate III.4). Their width is about half a kilometre they consists of medium to fine sand rising 5m to 8m above the surrounding plains.

Raised Mudflats

The older mud flats are seen to occur just above the present day high water line. These are usually featureless barren areas characterised by salty waste land. Their width is abouth 2 km. to 3 km. and run along the coastline having well defined contacts with the recent mudflats on western side and seen perceptibly

PLATE III.4 A view of beach sand ridge Loc. Near Dahej

merging with the relict alluvium on the other side. In the strip of the mudflats between Gandhar and Dahej inliers of relict alluvium are seen in the form of a series of bets like projections.

Relict Alluvial Plains and Bets

The plain land to the east of the limits of the raised mudflats extends towards east for about 10 km to 15 km reaching upto line joining Kavi-Jumbusar-Amod-Vagra-Bhadbhut. It is a featureless land with shrubby vegetation and a general lack of well developed drainage. Its elevation is within 8 m to 13 m. It is mainly covered with saline soils. The eastern border of the plains perceptibly merge into the central alluvial flood plains.

With raised mudflats, occur numerous 'bets' or 'Islands' of older alluvium projected a few metres above the high water line, irregular in shape and size. These older alluvial patches reveal a sequence of Quaternary sea level change. An early regression followed by a late transgression. The relict patches represents an eroded alluvial topography of the period when the strandline was much lower than the present and was located far away in the west. Subsequent transgression (Flandrian) drowned the river channels and encircled the elevated portion of dissected alluvial coast. The bets in the form of a continuous chain are located between Gandhar and Dahej. On an average, the bets have 2 km

diameter and they rise to a height of about 2m to 3m above the surrounding level of the mudflats.

CENTRAL ALLUVIAL PLAIN

The landscape of the central plains are characterised by typical high energy fluvial processes. The rivers of Mahi and Narmada have heavily drained their vast catchment areas and have deposited by forming a compound deltaic plains under fluctuating strandline. The rivers have shifted their courses almost continuously leaving the sediments on the banks and have build up the alluvial flood deposits. The present day geomorphic scenario exhibits a large variety of landforms. Distribution of various landforms of this unit can be seen in Fig. III.7. Along the river banks a close variation in landforms are observed, while the central part relatively show monotonus features over greater extent.

The important depositional landforms are alluvial flood plains, natural levee, point bars, buried channels etc., while the erosional land forms mainly include gullies and scarps. Figures II.5 to II.8 of geology and cross sections show a mutual relationship of different landforms of the central plains.

Flood Plains

The vast open land between the two main rivers forms the alluvial flood plains (Plate III.5). These are almost flat with

PLATE III.5 A landscape of the central alluvial plains, Loc. South wadhawana lake near Dabhoi

PLATE III.6 A pertial view of point bar in Narmada river, just upstream of Gadeshwar bridge

very gentle slope towards WSW. The top surface is covered by fertile soils of black cotton and sandy loam types. Development of drainage in these plains is very poor. Almost all the precipitation is generally absorbed through the porous soil cover, hardly leaving any excess rain water to form flow in to channels. The monotony of flatness is broken by the centrally flowing Dhadhar river. It is observed that the plains show a general depression along the Dhadhar river. The maximum rise in ground elevation about of 5 to 7 m is observed. On their northern and southern limits along the levee banks of Mahi and Narmada rivers (Fig. III.2).

Natural Levees

The natural levees form striking ridge like elevations all along the river banks of Mahi and Narmada. The outer sides of the levees have very gentle slope and gradually merge into the alluvial flood plains. The levee formation, inhibits the local drainage to meet the main rivers. The drainage generally flow away from these rivers. There appears some mixing of aeolian sandy material along with the levee deposits, especially on the banks of Mahi between Singhrot and Bhadarwa such mixed material of fossil dunal sand and levee silts is clearly observed in the river cut sections and gully erosions.

Point Bars

The point bar development is seen along the meandering courses of Narmada and Mahi. These are most important components

of latter accretion. Bloom (1979) describes the genetic development of point bars. As the meandering channel migrates across the flood plain, the steep bank on the concave side is undercut and eroded. As it collapses, the derived bedload is carried to a short distance down stream and deposited as a submerged bar, usually on the convex side of the stream. The result is across stratified deposit with a subdued relief of low ridges and intervening shoals that may record many episodes of a meandering channel migration. The crests of the point bars approach the level of the former flood plain on the cut bank side unless the stream is actively entrenching or aggrading so the level of the flood plain need not change significantly by lateral accretion. Mahi has one such point bar near Dabka while Narmada has at least four point bars in its meandering segment (Plate III.6).

Buried Channels

Old river courses and cut off parts of meanders oxbow lakes etc. are found associated with the river course migration. A prominent buried channel trace is seen between Vadu and Jaspar along the immediate southern bank of Mahi. It possibly represents the palaeo-course of Mini river which subsequently captured by Mahi. Wadhwana tank near Dabhoi is an example of oxbow lake. There are several natural linear depression in the area which mark the traces of older river channels (Plate III.7).

PLATE III.7 A view of relict channels, Loc. Samalaya

PLATE III.8 Gully erosion on the northern bank of Narmada river. Loc. near Chandod

Gullies

The soft sediment with uniform texture forming the levees along the immediate banks of Mahi and Narmada are subjected to typical gully formation (Plate III.8). The gully formation is characterised by a steep or vertical sided ephemeral stream with a steep head that is actively eroding headward, usually on the water gethering wash slopes (Plate III.9). Compared to the quantity of water flowing through the stream, it erodes very excessively, the material producing a characteristic ravine land. Angular to rectangular patterns suggest neotectonic controls. Gullies grow headward rapidly enough showing tendency to capture adjacent streams and commonly develop a branching network of tributaries. They mark the first step in the landscape dissection of the flood plains and development of pinnate drainage pattern.

Cliffs and Scarps

Cliffs and scarps are the erosional features in the alluvial plains developed along the river courses. These are almost vertical cuts along river banks and are generally related to flood erosion, and generally, found on the concave side of the meandering channel (Plate II.10, and Plate II.1). The confluence of Orsang meeting Narmada near Chanod has developed significant meander with steep scarp (Plate III.11). Neotectonic activities also appears to have significant influence on their development.

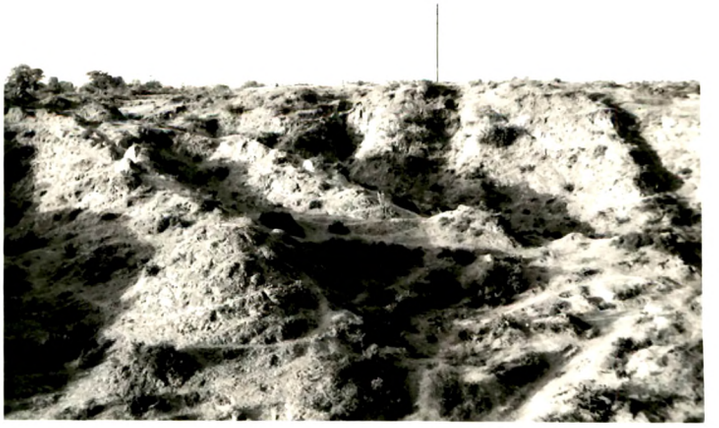


PLATE III.9 Ravine land on Mahi bank Loc. Near Singhrot

PLATE III.10 Dhadhar river meandering and surrounding landscape, Loc. near Por N.H.8

PLATE III.11 Orsang - Narmada confluence meandering coarse of orsang in the central part Loc. Chandod

The cliffs of Mahi are 10 m to 25m while that of Narmada are 10 to 40m high.

EASTERN PIED MONT ZONE

The landscape of the piedmont zone show low relief and subdued topography (Plate III.12). It includes mixed landforms of erosional as well as depositional characters. The landforms are confined in the elevation range of 45m to 60m located in a narrow strip between Savli in the north to Tilakwada in the south. This zone marks a retreating front of hill slopes laying a low velocity transportation at their base. It marks the water spreading wash surfaces. Higher gradient streams meet together and forming well defined river course with reducing bed gradient. River channel of Mahi cutting through the alluvial deposits of about 10m deep have exposed trappean basalt in the bed near Savli (Plate III.13).

The low height contrast exogenic landscape reflects the nature of underlying bedrock configuration. A thin veneer of alluvial deposits in transit from higher to lower levels develops several smaller size aggradational features. The notable depositional features observed are, valley fills, low terraces, alluvial veneer on badland, etc. (Plate III.14). The erosional forms like residual bedrock terraces, scarps, cliffs, cascades, rapids, etc. (Plate III.15). At several places aeolian sandy accumulation of fossil dunes are observe marking the arid phase

PLATE III.12 A view of landscape of eastern peidmont zone, Loc. Near Tilakwada

PLATE III.13 Rocky exposures in Mahi river bed in the eastern Peidmont zone, Loc. near Savli

PLATE III.14 An aerial view of flat topography and cultivated land in the central alluvial plain

PLATE III.15 A view of the eastern Peidmont zone showing undulating ground and land erosion, Loc. Near Jarod

of late Quaternary. Rapid erosion of such dunes have given rise to local formation of gullies. The sediments in the pediment zone are generally assorted coarse grained material of sand and gravel of pluvial and colluvial sediments characterising rather high energy processes indicate the trends of climatic fluctuations during Quaternary.

MORPHOGENESIS

The Geomorphic evolution of the study area reflects the history of the Cambay basin development in the initial phase and the Quaternary dynamics in the later phase. The major framework has been provided by the morphotectonics of the Cambay basin. It has contollred Mahi - Narmada river courses and evnironemnts of deposition. The lower reaches of these rivers comprises the Quaternary alluvial material which concealed the Tertiary sediments which deposited in the Cambay basin. The present day landscape of the terrian has been architectured under the combined influence of late Quaternary processes like eustatic sea level changes, climatic fluctuations, neotectonism and sub-aerial exogenic deposition and erosion related to fluvio-marine energy conditions. Detailed account of the Cambay basin morphotectonics has been given by several workers, mainly among them are Raju (1968), Mathur (1968), Chandra & Chaudhary (1969) and Biswas (1984, 1987).

The present day coastline and the coastal zone landforms have been evolved due to Quaternary tectonism along major

oundary faults and associated fractures of Jambusar-Broach block of Cambay basin, in combinations with eustatic sea level changes. The three major rivers flowing through the plains and discharging to the sea have appropriately contributed towards the nature and amount of coastal sediments. The on-shore terrain characters appears to have been considerably influenced by the offshore processes. The neotectonic subsidence has been responsible for the accumulation of such an anormous thickness of the alluvial material.

The landforms of the central alluvial plains are mainly controlled by the climatic fluctuations, sediment influx, neotectonic movements and sea level changes. The major regressive phase of the sea are responsible for phenomena of rejuvinations of the three major rivers and resultant development of the extensive flood plains of the present day. The sediments of the alluvial flood plains have mixed origin of Pre-cambrian crystallines brought by Mahi, Dhadhar and Panam drainage systems. While that from basaltic lava of Deccan Traps brought by Narmada drainage system. The landforms of the eastern pediment zone show their development under subaerial exogenic processes under the influence of semi-arid to humid climate with modera e to high rainfalls. The deposits of flood plains and levees brought over by the rivers mark the high rainfall phases.

Babu (1979) has described geomorphology of the Cambay basin and discussed its morphotectonics which are produced by the

interaction between endogenic and exogenic processes. The endogenic factors being more prominent in the tectonic movements, the distribution of the various morphostructural elements of the surface relief appear to have been considerably regulated by the lithostructural features of the basement development. The tectonic movemments which developed during the latest geological periods - Neogene and Quaternary are of great impor ance in the formation of recent morphostrucctural set up. The tectonic activities within the platforms are reflected by the relief and are indicated by the structures of various orders like the formation of arches, basins, swells, domes, troughs e c.

Neotectonic activities continued in the platform and thus has been reflected by topography in the form of elevations and depressions in the plain surfaces. Faulting of various kinds also continued as it is most clearly reflected by higher order ream pattern. The geomorphic anomalies represented by the presence of escarpments, linear trends, topographic highs and lows, etc. These anomalies exhibit their long axis in the NE-SW (Mahi-Dhadhar Lineaments) and ENE-WSW (Narmada lineaments), the rend variations indicate different movements in the basin from time to time.

Bedi and Vaidyanathan (1982) studied morphotectonics of Narmada river. The morphogenesis of present landscape commenced sometime in Pleistocene, after folding and faulting of the Plio-Pleistocene sediments. The deposition of vast thickness of alluvium has taken place during the late Quaternary. Due to

climatic oscillations during this period, there were several alternate bio-rhexistatic (Termier and Termier, 1963) phases which affected the rate of erosion. Remnants of planation surfaces and two terrace levels indicate at least three phases of uplift or anagenetic revival, a process suggested by Fairbridge (1968), elsewhere the climatic variations in the past brought in palaeohydrological changes which controlled the river channel dynamics in the form of course migration, buried channels, meandering, entrenchment of modern channel etc.

Available radiocarbon dates for he semi-carbonised wood from the Older Alluvium suggest an age less than 40,000 years (Agrawal et al 1972). Study of stabilised dunes and Kankarised soil profiles developed in the area, north of Narmada, indicate that atleast two major dry phases interspersed with one major wet phase from pre-middle Stone age onwards (Goudie at al 1973). On each rejuvination phase the rivers entrench more and more, various types of deposits now exposed in the river stream sections indicate the palaeohydrological changes, which controlled erosion and deposition. The covered flood plains, varigated stream section deposits and the abundoned meander scrolls in proximity of new braided channels, all together confirm that the rivers of the area have undergone metamorphosis Schumm (1969) from time to time. The frequent modifications in the landform characteristics, especially of the rivers were caused by the combined affects of ectonism and climatic changes.

The polygenic landscape of the terrain has been thus evolved under the intensive interaction of endogenic and exogenic processes being under operation during Quaternary and continuing till the present day. The differential movements and palaeoclimatic variations have affected the hydrodynamics of the rivers and their metamorphosis. The phases of rejuvination of the rivers exhibit strong controls control of eustatic and static dynamics.