

CHAPTER - I

I N T R O D U C T I O N

PURPOSE AND SCOPE

GEOGRAPHIC LOCATION

OVERALL PHYSIOGRAPHY

DRAINAGE

CUMMUNICATION AND TRANSPORT

ENVIRONMENT AND HABITATION

SALIENT FEATURES OF THE STUDY

## INTRODUCTION

### PURPOSE AND SCOPE

Geomorphically, the South Gujarat landscape provides a unique example of the dominant role played by tectonic features. Not only the coastline, but the Trappean Highlands also provide a wide variety of terrain features which point to a strong tectonic control. The hilly area comprising the southeastern part of the Gujarat state, in fact, represents the fringe of the Deccan basaltic plateau such that further southeast, the hills are higher and the topography more rugged. In this thesis, the author has carried out detailed geomorphic studies on the South Gujarat, emphasizing on the Trappean highlands.

Significantly, the basaltic hills falling within the limit of Gujarat reveal many landforms and drainage features which furnish evidences of post Mesozoic tectonism. This tectonism manifested in the form of several sets of fractures at all scales, has played a dominant role in sculpturing the landscape. Thus the South Gujarat highlands comprises a terrain wherein morphotectonics have played quite a significant role. The landscape evolution has, no doubt, depended on the factors of geology and processes of subaerial erosion but what is so striking about the study area is that the shapes and the sizes of the hills, the slope diversity and above all, the drainage pattern have been essentially controlled by tectonic elements.

The South Gujarat highlands with their step-like topography to some extent, can be taken as one more example of a Deccan Trap landscape. But in its evolution linear structural elements have contributed significantly. The flat top hills, ridges and plateaus at differing altitudes as seen today are indicative of subaerial erosion and weathering of a basaltic terrain comprising bedded lava flows. Tectonic features have played an important role by facilitating the agencies of denudation. The author has attempted to evaluate the role played by the structural elements. According to him, the study area affords an ideal example of morphotectonic landscape evolution. Whereas the area on a cursory look, appears to comprise successive lava flows, eroded to progressively decreasing levels, detailed studies reveal a more complicated picture, the altitude variations from south to north and east to west suggestive of successive down-faultings.

Further, the entire area, being criss-crossed by several sets of fractures, sometimes closely spaced and sometimes wide apart, is seen to be made up of hills and valleys, shapes and sizes of which are relatable to the various Post-Mesozoic bounding fractures. The drainage of the area and the pattern shown by the different order streams, also point to a significant lineament control. The investigations by the author have aimed at highlighting this morphotectonic aspect. It is not to say that rock types and their disposition and intensity of fluvial and related weathering processes did not play their due roles but what the present author intends to highlight, is the unique

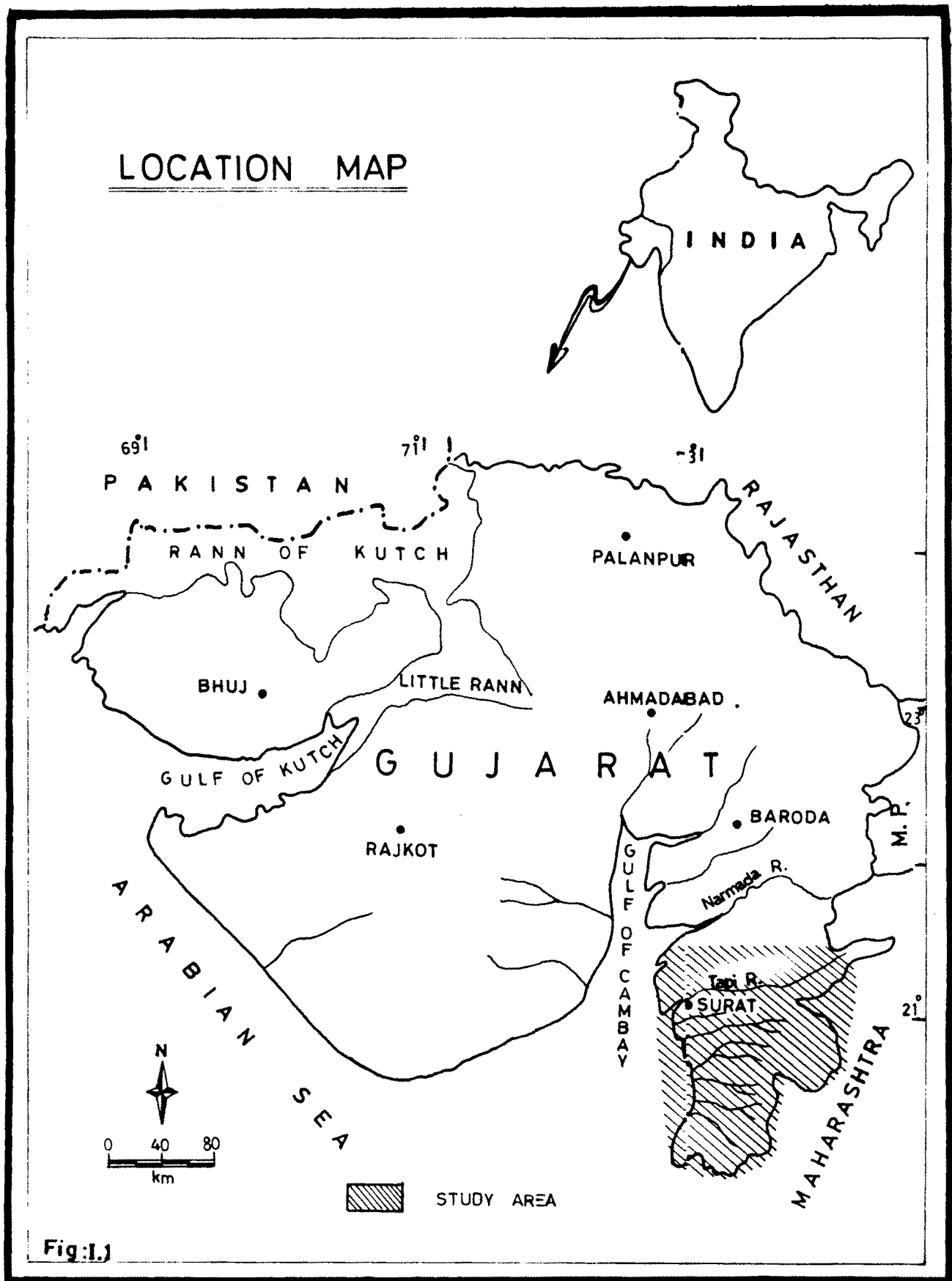
combination that existed between these processes and the tectonic features. In the following pages of this thesis an attempt has been made to present an integrated picture of the South Gujarat landscape, highlighting the control exercised by the tectonic events during the Tertiary and the Quaternary periods.

The morphotectonic investigations have to be viewed in the larger context of the regional tectonism, namely the NNEward drift of the Indian landmass and the formation of the Tertiary Cambay basin and Narmada-Tapi basin to the west and north respectively. The tectonic elements of the study area have been interpreted keeping these two factors in mind.

#### GEOGRAPHIC LOCATION

The study area lies between North latitudes 20.15' to 21.30', and East longitudes 72.30' to 74.0' and falls within the Survey of India Toposheet Nos. 46 C,D,G and H.

The area includes the districts of Valsad, Dangs and part of Surat, and comprises approximately 12,000 sq.km. It is bounded to the north by the entire catchment of the Tapi drainage, to the south and east by the Maharashtra State and to the west by the Gulf of Cambay (Fig.I.1).

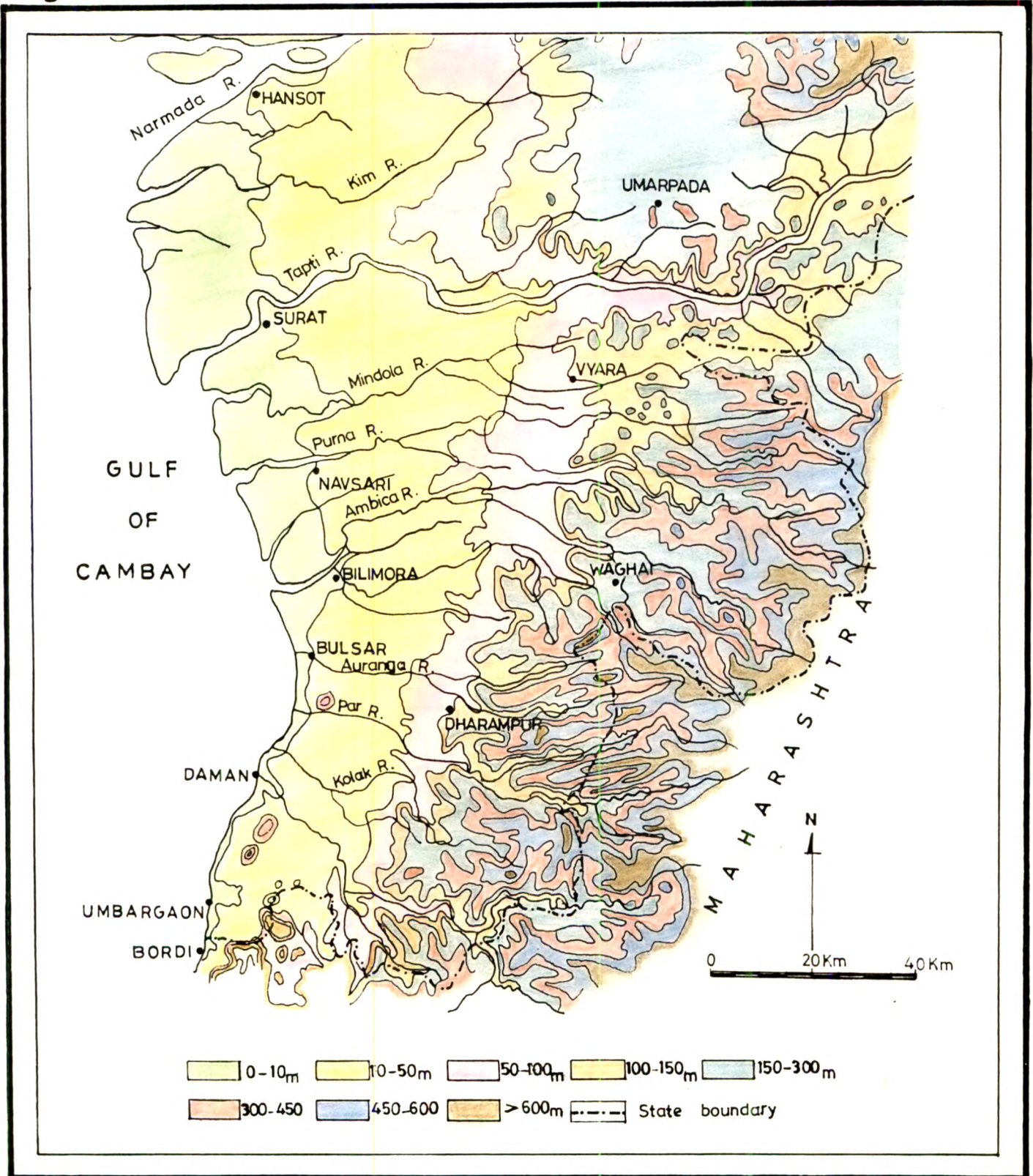


### OVERALL PHYSIOGRAPHY

The South Gujarat terrain to the south of Tapi river forms a 60 km wide hilly zone, merging into higher hills of Maharashtra to the east and south; westward through a narrow strip of transitional zone, it merges into the coastal alluvial plains. Essentially made up of Deccan basalt flows, the highlands provide an example of considerable ruggedness. Altitudewise, the southeastern extremity is the highest, and relatively the northern half of the study area between Tapi and Ambica river is physiographically less rugged as compared to the Southern half bounded by the rivers Ambica and Damanganga. A number of west flowing rivers namely Mindola, Purna, Ambica, Auranga, Par, Kolak, and Damanganga originate along the eastern fringe and broadly flow westward into the Arabian Sea. The southern half of the highlands is dominated by east-west trending flat-topped ridges as high as 600 m, or more. In contrast, the hills of the northern half show lesser heights, never exceeding 600 m; the topography is also less well defined, hills and plateaus do not show any clear-cut orientation and comprise uneven elevated areas of various altitudes (Fig. I.2.).

The study area comprises successive lava flows of varying texture, composition and hardness, and these have given rise to a rugged landscape which has got quite a few interesting topographic features. The area is marked by wide flat areas, at different heights, flanked by steep slopes at their ends, either

Fig:I.2 PHYSIOGRAPHIC MAP OF THE STUDY AREA



a rise or a fall, and abounds in sudden breaks in topography, flat-topped hills and ridges characterized by steep slopes and scarps. In carving out such a physiography, tectonic features have played an important role.

Broadly speaking the northern half dominates in coastal alluvial plains as compared to the southern half; these plains are almost 50 km wide at Tapi, gradually narrowing down to almost 20 km at the Auranga river. The alluvial thickness is of the order of 100 m. Eastward, it merges into the colluvium, while to the west it goes beneath the tidal muds.

The various west-flowing rivers have their own tributaries and smaller order streams, their channels and courses are considerably influenced by the fracture patterns. As the area receives a reasonably heavy rainfall during the monsoon months the various streams in their upper courses bring about significant erosion. An interesting feature of the fluvial regime of this part of Gujarat is that these streams give rise to accumulation of fluvial sediments at varying altitudes. At all such spots wherever they emerge on a flat ground, such alluvial accumulations (right within the hills), have provided sites for the location of the villages.

#### DRAINAGE

Broadly speaking the drainage of the study area is westerly and most of the major streams originate from the hills in the



east, and flow westward to meet the Arabian Sea. In all 7 major streams viz., Tapi, Mindola, Purna, Ambica, Auranga, Par and Kolak drain the area. Of these, Tapi is a major river which originates further east beyond the limit of Gujarat and cuts across the Trappean hills. In fact, it follows a regional fracture trend. Rest of the rivers originate along the eastern limit of the state starting from the high scarplands that rises above 600 m. The main drainage courses as well as those of quite a few number of low order streams follow the fracture pattern. The various river basins are rather narrow and linear, roughly E-W and point to a strong influence of E-W, fractures. Tapi is a perennial river, with a lot of water flowing year round, whereas other rivers tend to have decreased quantities of water in the months other than monsoon. ✓

#### COMMUNICATION AND TRANSPORT

The National Highway No. 8 passes through Surat, Billimora, Valsad and Vapi towns. The various villages are interlinked by metalled as well as unmetalled roads, and these join to the State Highways No. 5 and 15. Several cart-tracks in the area are motorable in dry season. The State Transport buses ply on most of these roads. The Delhi-Bombay (W.R.) B.G. rail line also passes through the area. The towns of Waghai and Billimora are connected by a M.G. railway line (Fig. I.3).



FIG:1.3 COMMUNICATION MAP OF THE STUDY AREA

### ENVIRONMENT AND HABITATION

✓Based on geological factors and physiography as already stated the study area is broadly divisible into two main categories. The southeastern part is hilly and rocky whereas the western and northwestern part is seen to comprise mostly of residual and transported soils and alluvium.

Annual rainfall is fairly high, about 2000 mm or even more. During monsoon the streams carry large volume of water, bringing about significant erosion. Wherever such streams emerge in the intermontane valleys or over flat plateau tops of lesser heights, they deposit their sediment load, and such local alluvial patches of various altitudes provide sites for agriculture and village locations. During summer months, landscape becomes desolate as most of the streams and vegetation dry up. Groundwater occurrence is erratic, and is confined to fracture zones in the basalts or occurs in the locally accumulated alluvial patches in the intermontane valleys or channel meanders over flat tops. Wherever available, groundwater occurs at shallow depths of a few meters only. The valleys and gentler hill slopes are thickly forested.

Broadly speaking the area can be divided into forest-land and cultivable-land. The hilly areas are forest dominated whereas the north-western plains are areas of agriculture. Within the hilly terrain, there are numerous pockets of cultivable areas. By and large, the hilly region is forested,

the intensity of which is moderate; very thickly forested patches are only sporadic, though at one time in the past, there were thick forests. The forests can be classed into two as, (a) tropical moist deciduous forest, terrain is hilly and gently slopes, forested with thick vegetation and bamboo plantation and (b) littoral and swamp forest restricted to the coastal plains.

Low relief terrain with different types of soils, provides the cultivable land and consists of gentle hill slopes, foothills, uplands, plateaus, flood plains, and coastal plains. A large part of the cultivable land lies in the northwestern half, the crops grown are paddy, groundnut, bajri, tobacco, maize, jowar, wheat and tur. In the rocky or hilly soils, crops taken are maize, groundnut, cotton, paddy, jowar, wheat and pulses.

The village locations and set-ups are mainly controlled by the terrain conditions. Within the Highlands, the topography being rocky and rugged, the suitable sites for village location are scarce. Small flat patches on hill tops gentler hill slopes, river banks and valley lowlands have provided village sites. Villages comprise clusters of huts within or near the available cultivable land, the population of each village hardly exceed 500; the majority of the inhabitants belong to the Kunkna tribe, but unlike the tribes of surrounding areas, which are still to a considerable extent, hunters and gatherers, this population has settled down to agriculture, though wood-cutting also forms an important source of livelihood. The agricultural activity being

seasonal, employment as casual labourers on various constructional activities also provide alternative occupation. As the Kanknas essentially constitute indigenous inhabitants of the region, this tribe like any other of the neighbourhood has a distinct social structure of its own, somewhat different from those of the traditional Hindu society, especially in respect of the religious belief and caste system.✓

#### SALIENT FEATURES OF THE STUDY

The author has aimed at a total appraisal of the South Gujarat landscape especially the Trappean highlands, and has tried to highlight the morphotectonic aspects. A large part of the study area is made up of a thick pile of basaltic lava flows of varying composition, which have been subsequently affected by the processes of fracturing and jointing. As a result, the erosional and depositional processes operating in such a terrain have given rise to landforms which not only reflect the lithology and disposition of volcanic rocks, but also reveal a strong control exercised by faults, fractures and joints.

The author carried out his investigations with the help of Survey of India Topographical sheets (1:50,000 and 1:250,000), satellite imagery and field work. Almost all parts of the study area were personally visited by the author. This enabled him to fully obtain ground truth regarding the numerous terrain features seen on the map and the satellite imagery. The author has analysed the drainage pattern of the study area mainly on the

toposheets. He has categorized channels of different orders, distinguishing between the fracture controlled and slope controlled streams. Slope categorization of a few representative areas has been carried out with a view to know the controls exercised by lithology, disposition of flow surface and fracturing. Representative samples of different rock types were collected and petrographically studied; this was done mainly for the purpose of recognition and correlation of flows over long distances.

Following important facts have emerged from the present study : 1) The South Gujarat landscape reveals a strong influence of two major fracture directions; viz. ENE-WSW and NNE-SSW, and also the base of the eastern escarpment is a regional fault. 2) The progressive decrease in altitude from south to north and east to west is to a considerable extent controlled by several more or less parallel faults in the two directions, 3) The junction between the coastal plain and the hills marks a fault line, 4) The southern portion of the area to the south of river Damanganga is dominated by numerous ENE-WSW faults which have dissected the area into several horsts and grabens. To the north of the Damanganga the widely spaced fractures in both the directions have given rise to rather expansive plateaus, tablelands and uplands, 5) The NNE-SSW and ENE-WSW faults are the reflections of deep seated fractures in the craton reactivated in post Mesozoic time. Whereas the ENE-WSW fractures are related to the Narmada geofracture, the NNE-SSW fractures are obviously part and parcel of the Cambay Basin tectonics, (parallel to the East

Cambay basin bounding system) which in turn, are manifestation of the rifting of the western continental margin of India, 6) The present day landscape, marked by a variety of flat-topped hills, ridges and table-lands, and exhibiting an overall step-like topography, typically reveals an example of the control exercised by tectonic features on erosional and depositional processes, the area providing an ideal site for the study of morphotectonic evolution of a continental margin escarpment.