CHAPTER - I

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

GENERAL

Laterites are interesting rocks. Not only they are of great economic value, providing an important source of aluminium, nickel and titanium, but they have intrigued geologists world over in respect of their precise mechanism of genesis. In India, these rocks occur extensively along the west and east coasts. In Gujarat too, laterites comprise an important horizon in the Cenozoic sequence. They are recorded in many areas of the state. They overlie the Deccan Trap, from which they have obviously derived, and are in turn, underlain by Tertiary rocks at many places. Stratigraphically, they have been considered to be of Palaeocene age. As compared to Mainland Gujarat, laterite and bauxite are better developed in Kutch and Saurashtra, and they have received considerable attention in the past on account of their economic value. On the Mainland Gujarat, the lateritic rocks, though comparatively less developed, provide a greater variety in terms of modes of occurrence, profiles and mineralogy. Very little information is available on these Mainland laterites,

and in this thesis, an attempt has been made to provide a detailed account of these rocks.

On Mainland Gujarat, laterite and bauxite occurrences are recorded from a number of localities in North Gujarat and South Gujarat, and as such, they comprise two distinct areal groups, separated by the wide stretch of the Central Gujarat alluvial fields.

The present investigation has aimed at collecting all available information on the laterites of Mainland Gujarat and provide a comprehensive account of the various occurrences, their mineralogy and chemistry. The purpose of the study has been mainly to obtain relevant data and analyse, and present them with a view to highlight some of the less understood features of laterite formation. The author has also endeavoured to give his own perceptions towards the genesis of the Mainland laterites.

LIMITS OF THE STUDY AREA AND LOCATIONS OF LATERITE OCCURRENCES

Laterites on Mainland Gujarat extend in a linear belt, that falls within N.latitudes 20°45' TO 24°0' and E. longitudes 72°45' to 73°15', and they comprise two groups of exposures, one each in North Gujarat (N.latitudes 22°30' to 24°0' E.longitudes 73° 0' to 73° 15') and in South Gujarat (N.latitudes 20°45' to 21° 45' E.longitdes 72°45' to 73°15') falling within the limits of Kheda and Sabarkantha districts and Valsad, Surat and Bharuch districts respectively (Fig. I.1). The study area is included in the

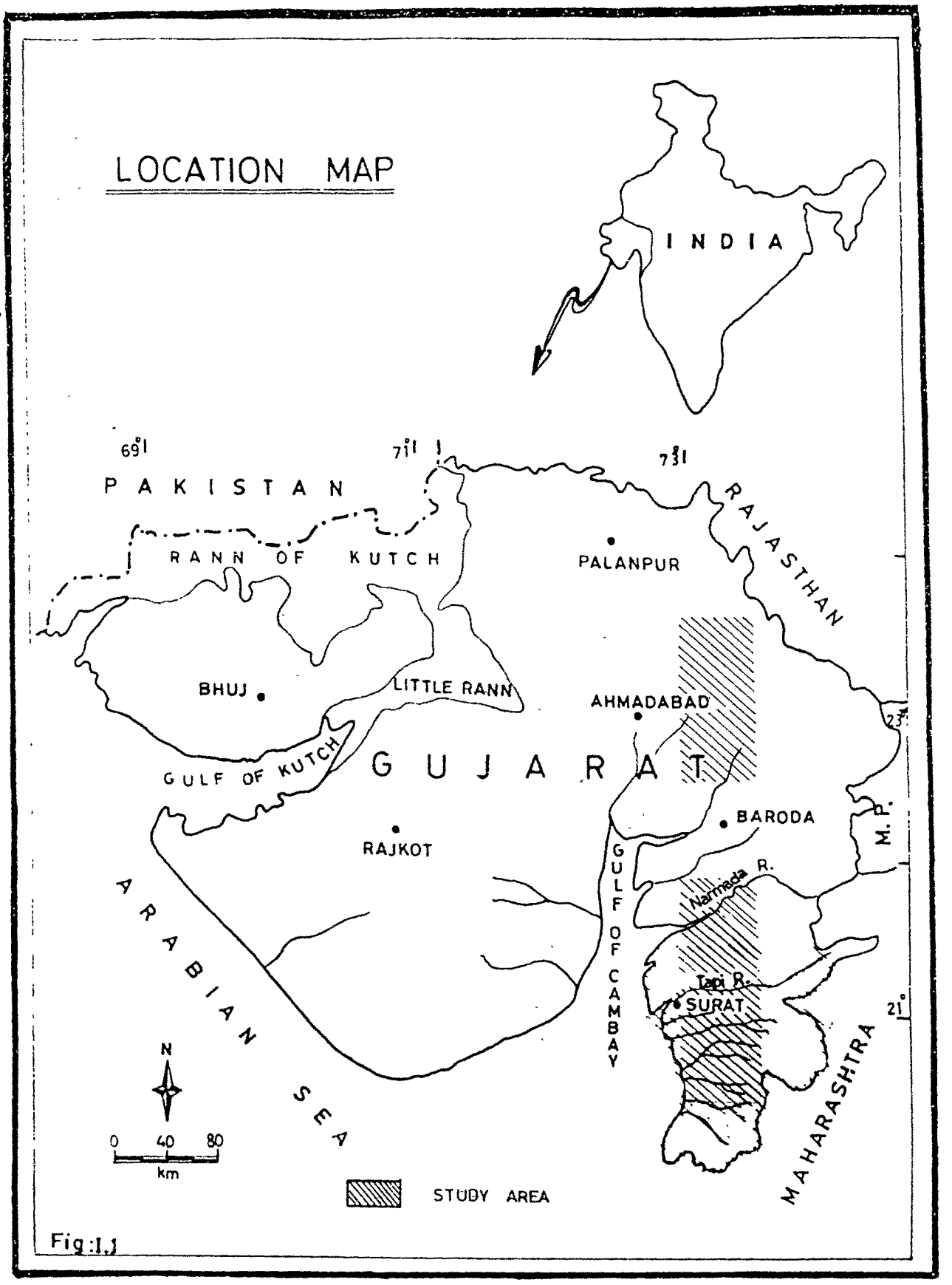
LOCATION MAP
INDIA
69°
71°
73°
PAKISTAN
RANN OF KUTCH
PALANPUR
RAJASTHAN
BHUJ
LITTLE RANN
AHMADABAD
23°
GULF OF KUTCH
GUJARAT
BARODA
M.P.
RAJKOT
GULF OF CAMBAY
Narmada R.
Tapi R.
SURAT
21°
ARABIAN SEA
MAHARASHTRA
N
0 40 80
km
STUDY AREA

Fig:1.1

Survey of India 1 : 50,000 Toposheet No. 46D/9,13; 46E/2,3,4; 46F/1,2 46G/2,3,4; and 46H/1.

PHYSIOGRAPHY

From the topographic point of view, the two areas, North and South Gujarat, are quite distinct. The North Gujarat surface is relatively more undulating as compared to that of South Gujarat, and it can be categorised as plain to undulating, broad and smooth mounds rising above the plain ground. The altitude of high ground varies from 90-115 m, while the low plains are 60-80m above the MSL. The area is bound by two major rivers; viz. Vatrak and Mazam, the latter being a tributary of the former. These two rivers are the main source of drainage in this area as they are perennial. The other tributaries are torrential during monsoon but otherwise dry. The channels of these rivers and their tributaries are broad and U-shaped. River Mazam confluences Vatrak near Moti Pawthi. In the vicinity of river banks of both Mazam and Vatrak 'badland' topography has developed; deep incision of tributary channels is typically observed in this area and the drainage density is also quite high.

South Gujarat terrain is flat except for a few isolated ridges and low flat-topped mounds, located at Pathri, Khergam, Valia, Tarbhon, Chikhli, Munjlau; the heights of these range between 40-60 m above MSL. The mounds located at rest of the places, seldom attain heights more than 5-20 m above MSL. In

all 6 major streams viz., Narmada, Kim, Tapi, Mindhola, Purna and Ambica drain the area. Of these, Narmada and Tapi are the major rivers which originate further east beyond the limit of Gujarat and cut across the Trappean hills. Rest of the rivers originate along the eastern limit of the state starting from the high scarpland that rises abruptly above 600 m. The main drainage courses as well as those of quite a few low order streams follow the fracture pattern. Narmada and Tapi are perennial rivers, with a lot of water flowing year round, whereas other rivers tend to have decreased quantities of water in the months other than monsoon. Small nallas and streams having north-south trend drain into the various perennial rivers (Fig. I.2).

CLIMATE

The two groups of exposuures, fall into two climatically distinct zones, viz. (i) semi-arid and (ii) sub-tropical. The climate of North Gujarat in general is dry except for monsoon season. The winter starts from December and ends in February. It is followed by summer that continues upto middle of June, while the monsoonal rain is confined mainly between middle of June and September retreating in October and November. During summer, the mean daily temperature is around 40°C; the mean daily minimum temperature being 25°C. In summer the temperature occasionally rises beyond 43° C. In winter season, daily temperature is around 15°C and only occasionally it goes below 4° C. The area falls under the semi-arid zone; the average rainfall in the area varies between 800 mm and 900 mm.. The South

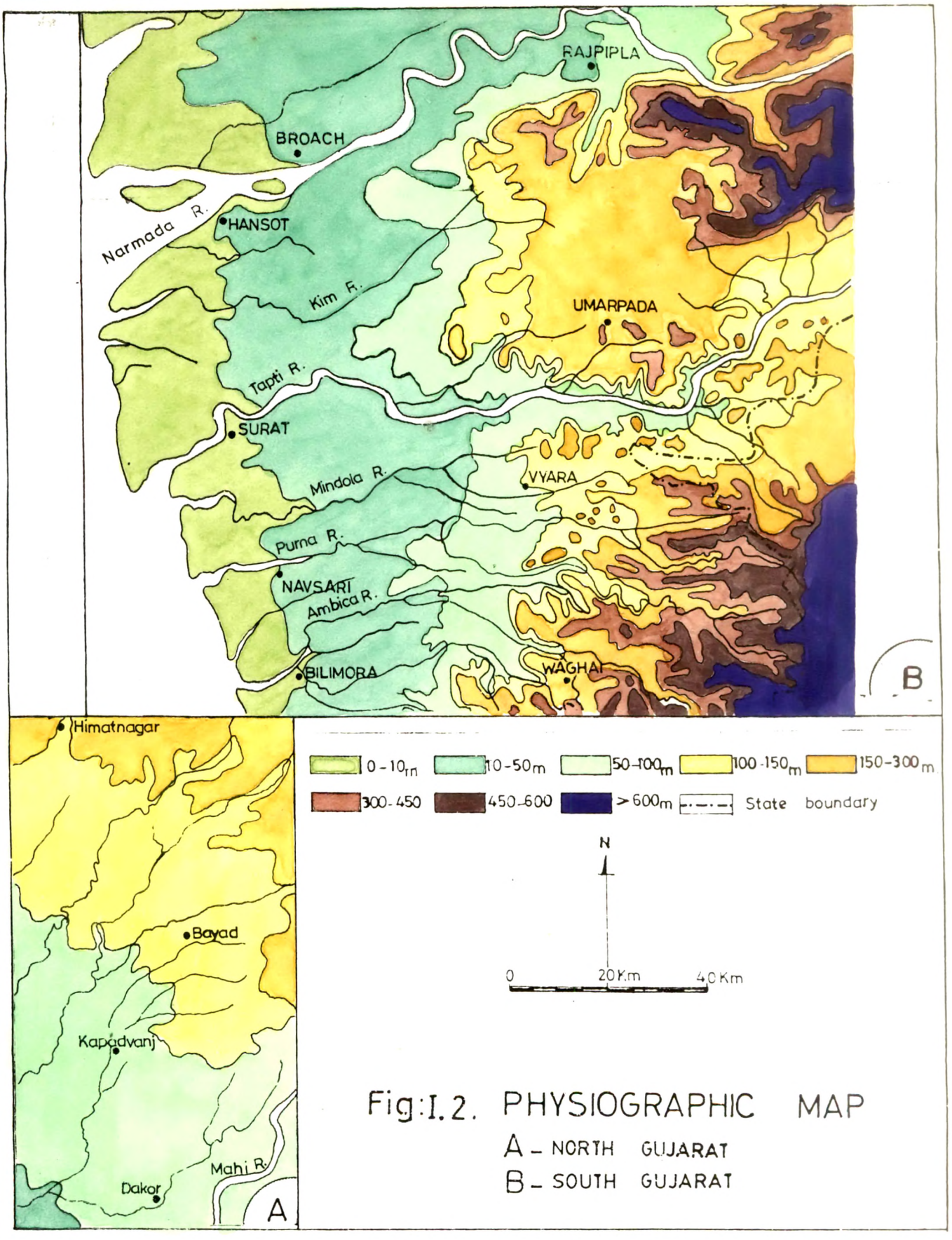

Fig: I. 2. PHYSIOGRAPHIC MAP

A – NORTH GUJARAT

B – SOUTH GUJARAT

Gujarat, on the other hand, is almost sub-tropical, moderately hot and humid. During summer, the days remain quite hot but nights become cool. The winter season is pleasant, extending from December to March, the average minimum temperature during the winter being about 18°C. The summer months are April, May and June. With the advent of summer by the end of March, the temperature rises, the mean maximum temperature during summer being around 38°C. By the middle of June, the area receives south-west monsoon rains, which continue till the end of September. The average annual rainfall during the monsoon is around 2000 mm or even more.

FLORA AND FAUNA

The laterite areas both in North and South Gujarat are on the whole devoid of any forest growth. The vegetation is poor and shruby. The common flora in the areas, comprises a variety of trees and bushes of various genera, viz. *Garuga pinnata*, *Acacia arabica*, *Pongamia pinnata*, *Embilica officinalis*, *Aegle marmolos*, etc. The agricultural crops (rice, wheat, maize, barley, millet, cotton etc.) and these are the main source of income for local inhabitants. These are mainly dependent upon rain. Besides, people grow a variety of vegetables and fruits in their farms or on the river banks.

The fauna in general comprises both wild beasts as well as domestic quadrupeds and numerous species of birds. In the recent past, wild animals like leopards, panthers, black bears, tigers,

wolves, hyaenas, jackals, fox, stags, spotted deer, antelopes, Indian gazelles, blue bulls, wild cat, hares and monkeys abounded in the hilly terrain and forested areas. Of course, now the wild life is almost depleted and these animals are encountered only occasionally. Various types of birds, lizards and snakes are also common. The domestic animals are mainly horses, cows, bullocks, buffaloes, camels, sheep, goats, ponies and these are confined to inhabitated areas.

COMMUNICATION

All the localities of laterite occurrences are by and large, easily accessible and well connected by a network of good roads and tracts. The North Gujarat is favourably located so far as communication is concerned. Himatnagar town, the headquater of Sabarkantha district falls on the Ahmedabad-Delhi National Highway No. 8. The State Highway No. 69 connects Bayad and Dehgam. A district road runs between Dakor and Kapadvanj. Himatnagar and Dehgam rail stations are on the metre gauge section of Western Railway connecting Ahmedabad and Udaipur. Kapadvanj station is on the narrow-gauge Nadiad-Kapadvanj section of Western Railway. The interior villages are connected with a number of all-season tar roads and fair-weather jeepable roads. State Transport and private vehicles ply regularly to most of the villages of the area (Fig. I.3).

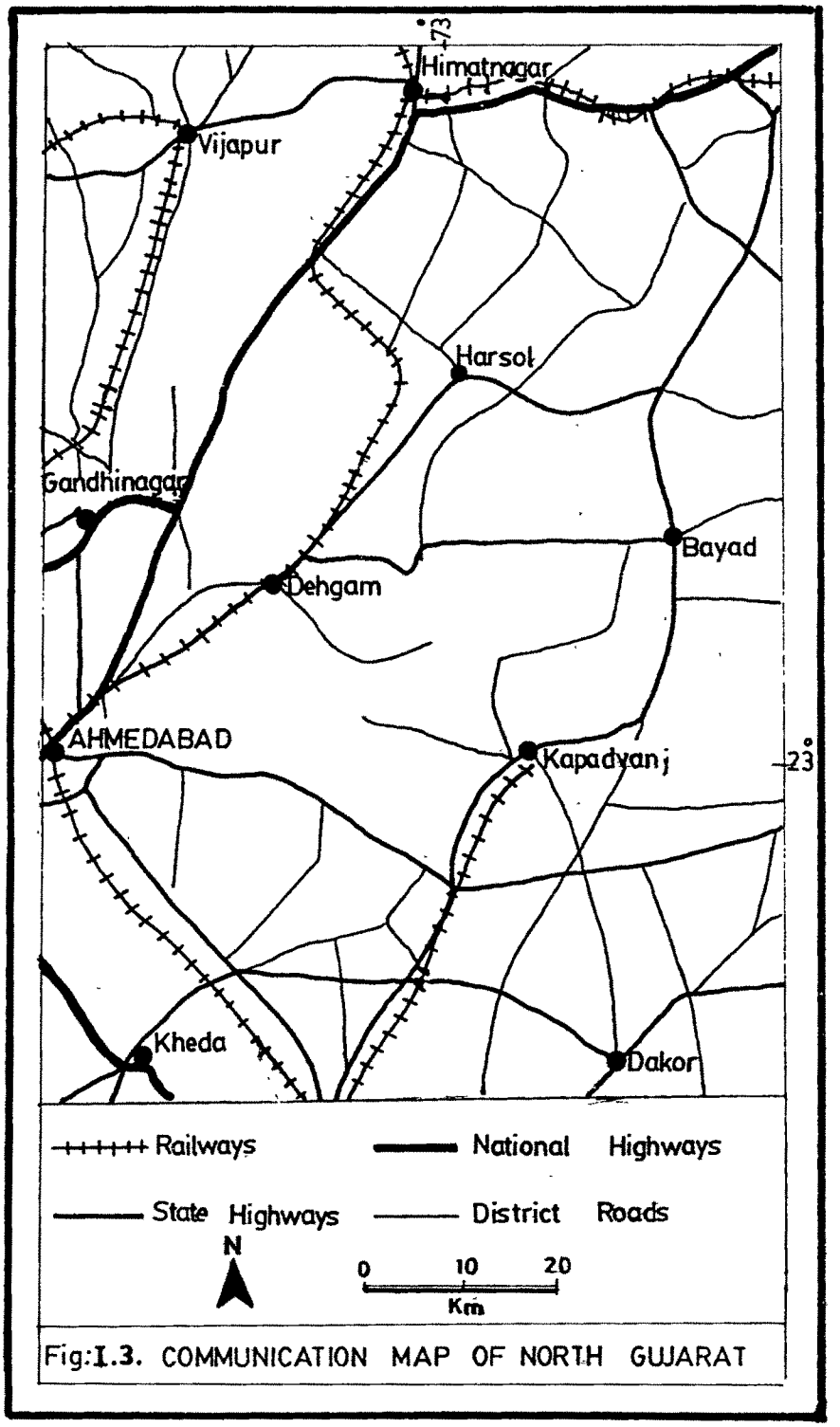

Fig:I.3. COMMUNICATION MAP OF NORTH GUJARAT

South Gujarat localities too are well connected. The National Highway No. 8 passes through Bharuch, Surat, Billimora and Valsad towns. The various interior villages are linked 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 metre-gauge railway line (Fig.I.4).

SCOPE OF INVESTIGATION

The main purpose of the present study has been to provide a detailed account of the various laterite profiles of Mainland Gujarat. Previous workers have no doubt, given some useful information on these lateritic occurrences, but as yet no attempt has been made to provide a coherent description of all the known localities. In this thesis, the author has not only attempted to provide all possible information collected by him in the field and in the laboratory, but has also ventured to put forth a genetic model for these controversial rocks of Mainland Gujarat. The scope of his investigations comprised :

1. 'On-the-spot' visit to the various laterite exposures in North and South Gujarat with a view to collect information on their mode of occurrence,extent of the deposit, nature of the vertical profiles, etc.

2. Systematic sampling of the material from various horizons.

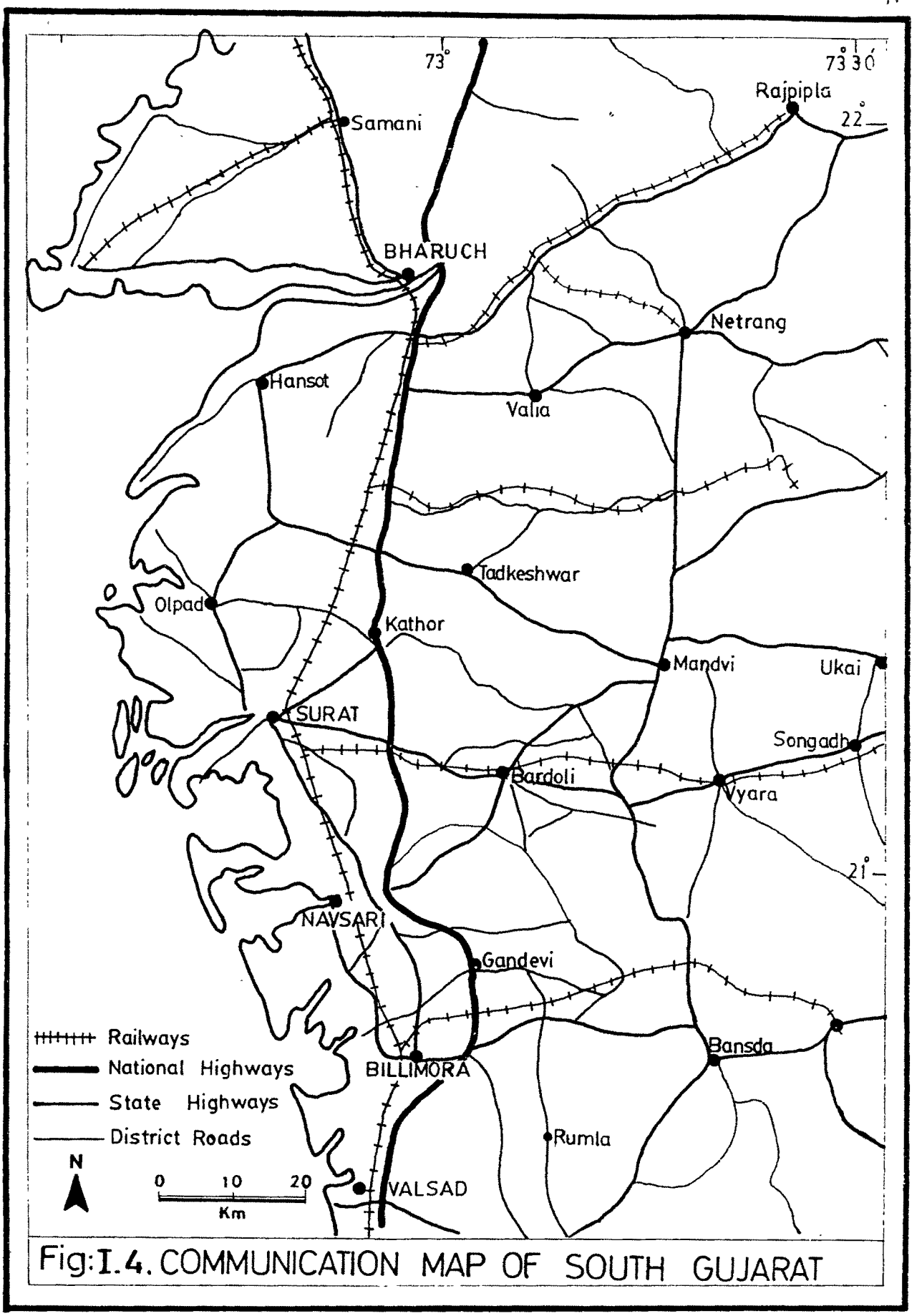

Fig:I.4. COMMUNICATION MAP OF SOUTH GUJARAT

3. A critical scrutiny of the available bore-hole data and their comparison with exposed sections.
4. Identification of minerals with the help of XRD. Powder X-ray diffractogrammes were obtained on samples ground to less than 200 mesh size employing a powder diffraction unit (Type PW 1729, No. DY 841, Japan). The setting in all cases comprised of 35 KV and 15 MA current, CuKα , Ni filter and scanning speed of 1.2° per minute. The 'd' spacings given for all samples were obtained with attached computer to the unit, by referring the measured 2θ values.
5. A thorough appraisal of the structural features at mega and microscopic scales.
6. Chemical analyses for major and trace elements of representative samples with the help of routine analytical methods and AAS. These studies were aimed at understanding the pattern of distribution of elements in different profiles. The various major constuents, viz. SiO_2 , Al_2O_3 , Fe_2O_3, FeO, TiO_2, CaO, Na_2O, K_2O and Loss On Ignition were determined by routine wet chemical analytical method. While the trace elements were analysed with the help of AAS instrument (GBC Model 901, Japan) using accetylene flame/air.
7. Comparative study of the North and South Gujarat occurrences bringing out the similarity and differences between the two.
8. Synthesizing the observations to present a likely genetic model for the laterite and bauxite rocks.