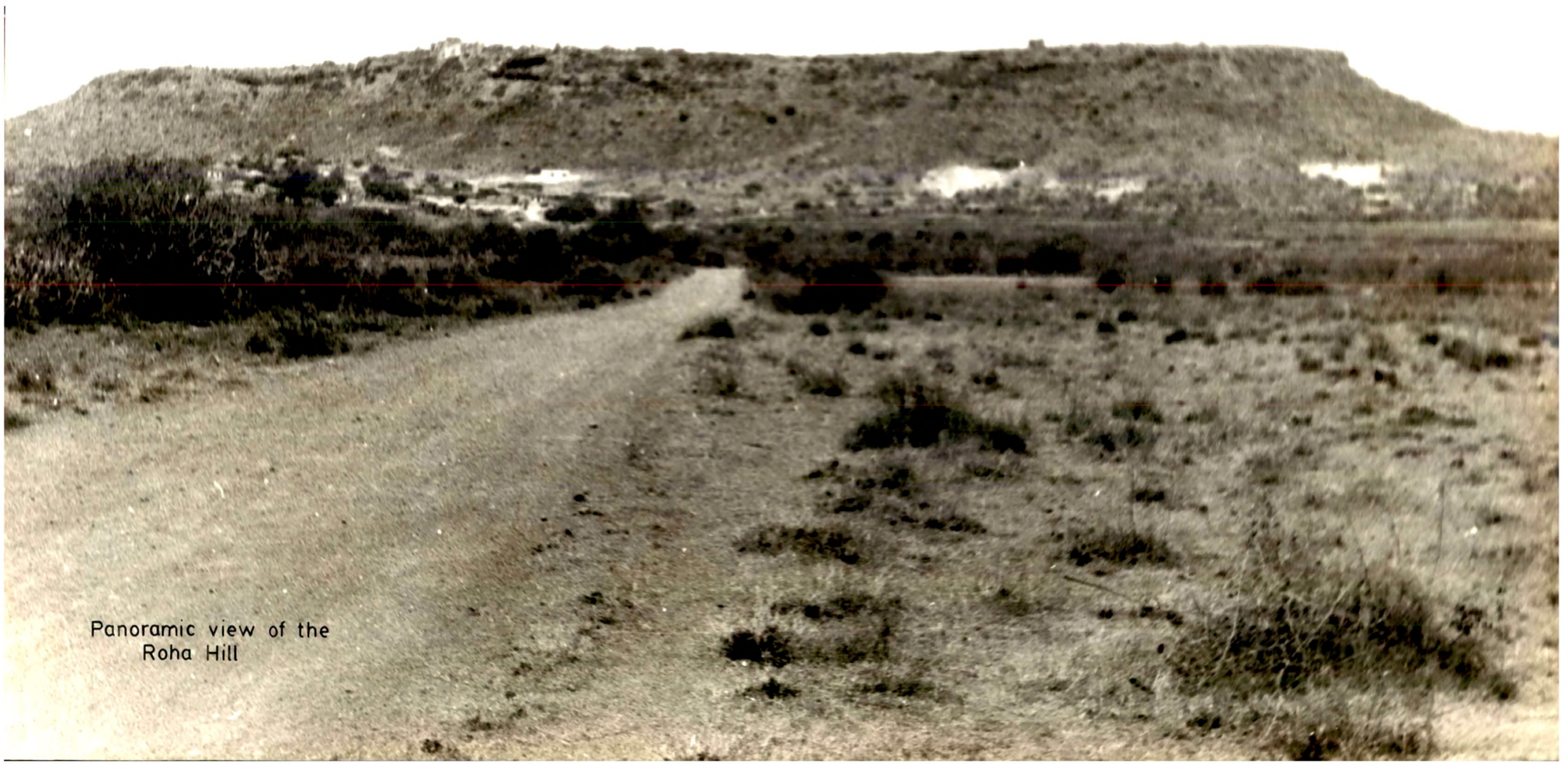
A panoramic view of the
Roha Hill



Panoramic view of the
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CHAPTER - I

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

PURPOSE AND SCOPE OF STUDY

The present study has aimed at understanding the true nature of the Kutch miliolites, giving all information in detail pertaining to their composition and mode of origin. Miliolite occurrences in Kutch are spread sporadically all over the central and eastern parts of the rocky Mainland. This rock, a bioclastic calcarenite, resembles in many ways to the miliolite rocks of Saurashtra, but unlike the Saurashtra occurrences, the miliolites of Kutch have remained practically univestigated. Barring a

few preliminary and regional studies, none in the past have ever attempted to describe the geology of these rocks in detail. The miliolite rocks of Kutch are somewhat different from their counterparts in Saurashtra. They provide a number of vital clues towards many problems of Quaternary geology. Essentially comprising accumulations of biogenic sand grains of marine origin, the miliolite deposits of Kutch reveal an interesting depositional history wherein fluctuating sea levels and strong aeolian actions have combined to generate these deposits.

For the first time, the miliolite occurrences spread over the length and breadth of the Kutch penisula, have been mapped, and their modes of occurrences and field characters have been recorded. The author, in this thesis, has endeavoured to give a critical account of various aspects of these consolidated foraminiferal carbonate sand deposits, which represent an important product of the Quaternary period in Western India. The author's observations and conclusions on these calcareous rocks are significant from the point of view of following considerations:

i) the work represents the first ever account of systematic investigations of the miliolite rocks of Kutch,

ii) this provides adequate data to obtain a

comparative study between the miliolite of Kutch and Saurashtra,

iii) the present work when considered in conjunction with the available information on similar rocks from Saurashtra, throws much light on the sea level and palaeo-climatic conditions prevailing in Gujarat coast during the Quaternary times.

The author spent an aggregate period of 24 weeks in the field during the summer and winter months of the years 1982, 1983 and 1984. The mapping was carried out on 1:50,000 Survey of India Toposheets, Nos. 41 E/3,4,7,8,11,12,15 & 16; 41 F/5; 41 I/4, 7 & 8. Almost all the miliolite exposures were visited, and data pertaining to their modes of occurrence, distribution, lithology, thickness, depositional structures and underlying rocks were critically observed in field and recorded. The extent of miliolite deposition in each outcrop was marked directly on the map during the field studies and photographs of most of the exposures were taken to support the field observations. In order to study the relative variation in the size and amount of the constituents, a number of samples from vertical and lateral sections of the same outcrop were collected and studied in the laboratory.

About 250 hand specimens were collected, out of which thin sections of 150 samples were prepared and critically examined under the microscope.

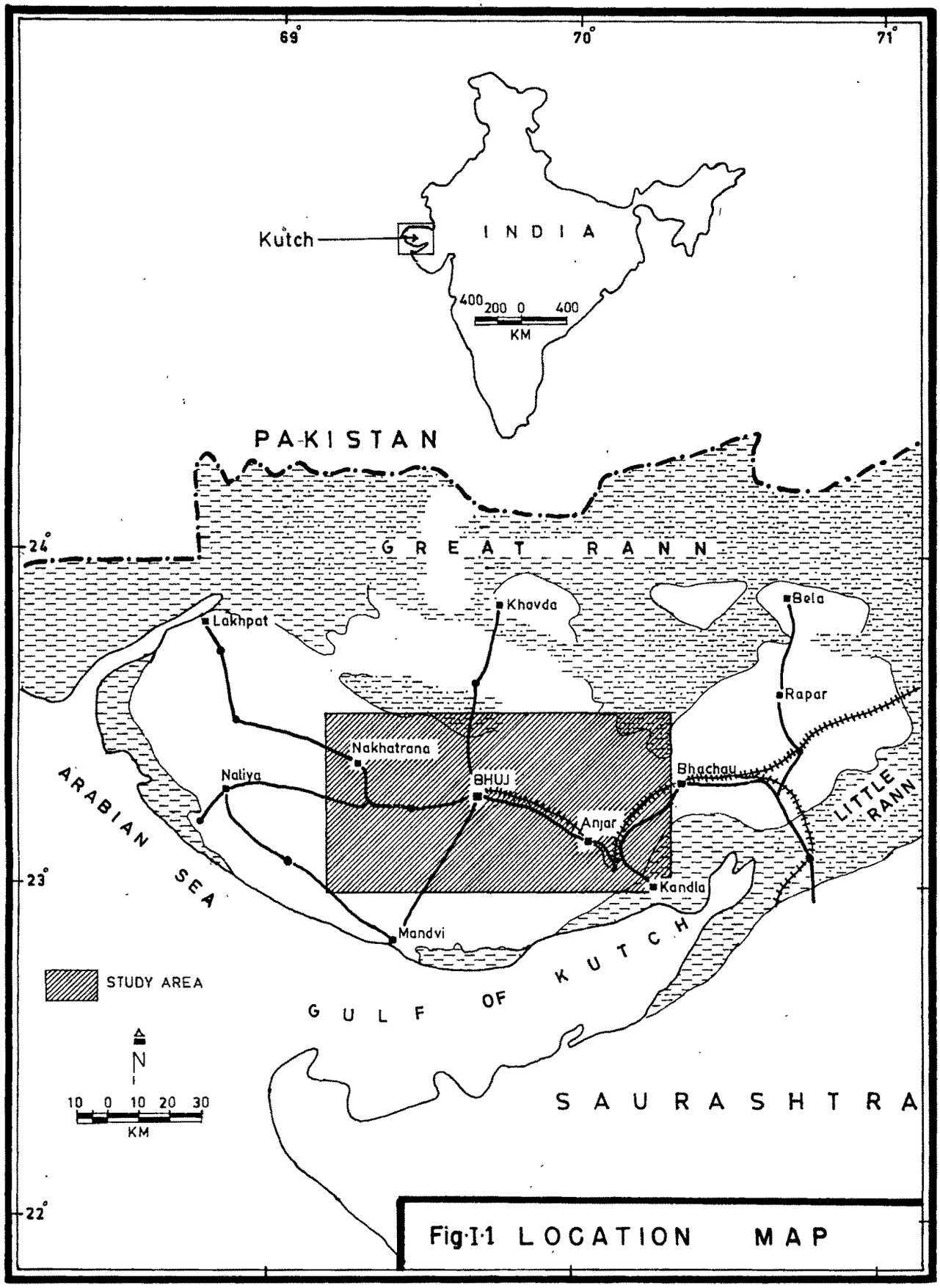
formation of unconsolidated

The author has applied the concept 'present is the key to the past' to understand the nature, mode of formation and origin of these miliolite rocks, which comprise an important member of the Quaternary sediments in Kutch. Hence, a comparative study between the composition of the present day beach and coastal dune sands along the south-west coast of Kutch and the miliolite rocks of inland Kutch was carried out by the author. It was observed that there is much similarity between these two, especially in the microfaunal and peloid content, and the nature of abrasion and micritisation.

LOCATION, LIMIT AND EXTENT OF THE STUDY AREA

complicated sentences should have been avoided

The Kutch region forms a part of Gujarat State and is located in the westernmost part of India. The miliolite occurrences, spread sporadically over an area of 6000 sq.km. form a SW-NE zone and are restricted to the central and eastern parts of the rocky Mainland, that lie between Bhachau in the east and Nakhatrana in the west. The northern limit of miliolite zone is marked by their occurrences along the northern fringe of the E-W Jurassic hills, while the southern fringe of the trappean hills parallel to the present day sandy coast of south Kutch, marks the southern limit (Fig.I.1). The geographic limits of the zone of these occurrences are marked by



Fig·I·1 LOCATION MAP

N. Latitudes 22° 59' & 23° 3 and E. Longitudes 69° 5' & 70° 21'.

GEOGRAPHIC SETTING

Topographically, the Kutch penisula is divisible longitudinally into following four zones from north to south, viz (1) the Ranns, (2) the low lying Banni Plains, (3) the Rocky Mainland and (4) the Southern Coastal Plain. The miliolite occurrences are restricted to the northern, central and eastern parts of the rocky Mainland.

As the area experiences arid climate, its drainage comprises mostly surface-fed small rivers and shallow intermittent streams which carry small quantity of water and sediments to the sea. Most of them receive water during monsoon and cause occasional flash flooding. During summer and winter seasons they generally remain dry. The overall drainage pattern is radial, with numerous streams flowing down from the Central Hilly ridges of the Mainland Kutch in various directions. These streams discharge their waters into Arabian sea in west, Gulf of Kutch in south and Rann of Kutch in the north.

Kutch has a typical desertic (arid to semi-arid) climate, with the Tropic of Cancer passing through it.

The winter season is comparatively cold, extending from December to February, with average temperatures being about 3° to 4°C. The winter season is followed by summer which extends from March to about middle of June. The maximum temperature during summer is as high as 48°C in the month of May. Quite often violent dust storms of short duration caused by strong cyclonic winds (whirlwind type) spread over a large area restricting the visibility. The area experiences strong southwesterly winds during pre-monsoon and monsoon periods and weaker northerly and northeasterly winds during winter (Fig.I.2). The period between the middle of June to middle of September is that of the south-west monsoon with a very erratic rainfall. Almost the whole of Kutch peninsula receives relatively low rainfall, the average rainfall being about 300 to 400 mm. A progressive increase in rainfall is observed from Kutch towards south (Fig.I.3).

FLORA

The Kutch peninsula as a whole is devoid of forest growth, but is characterised by sparse thorny bushes which are characteristic of desertic terrains. The vegetation can be classified into two main types:

a) Low thorny shrubs of xerophytic flora typical of dry sandy and rocky terrains.

b) Halophytic vegetation which grows near the sea.

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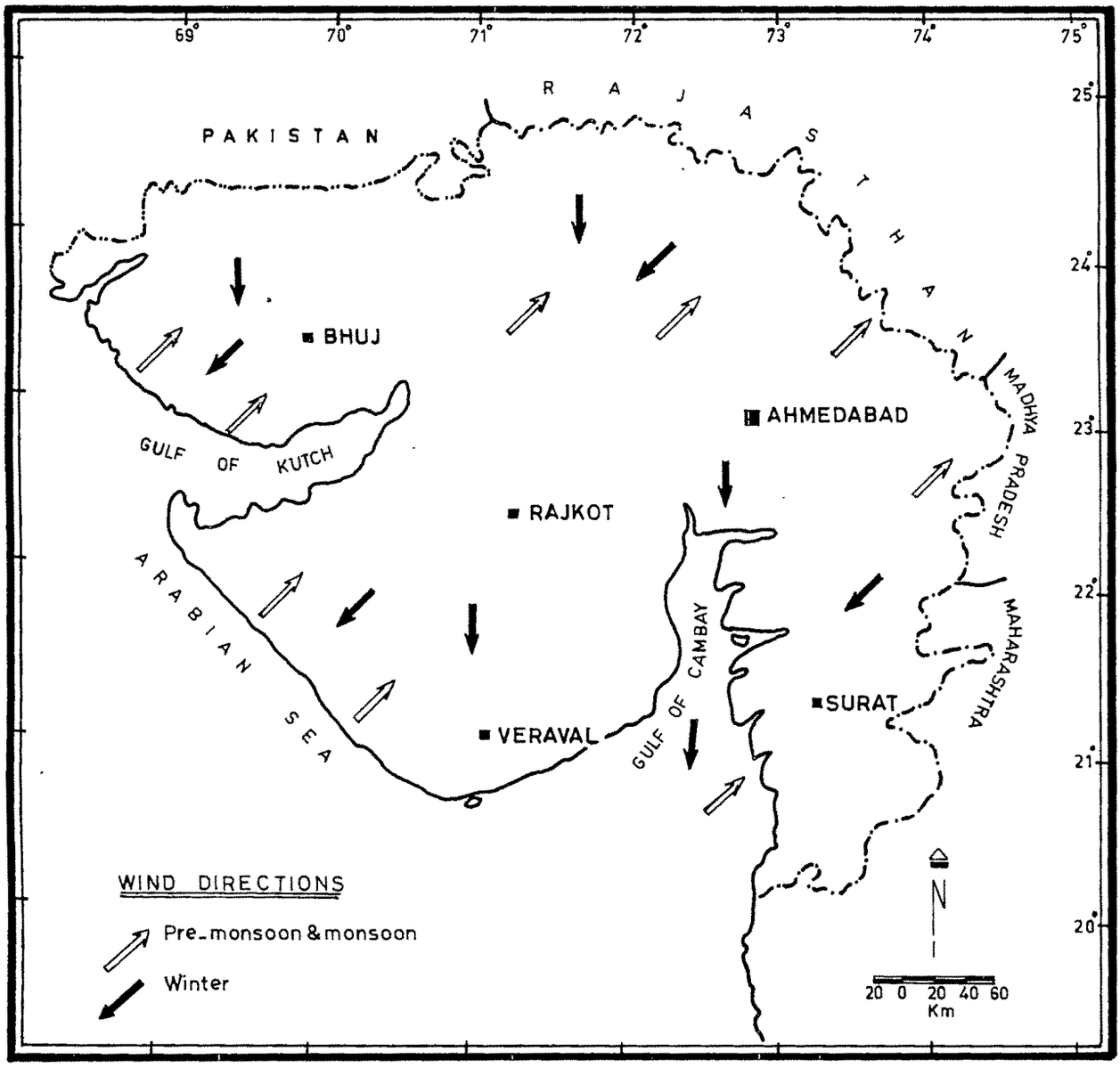
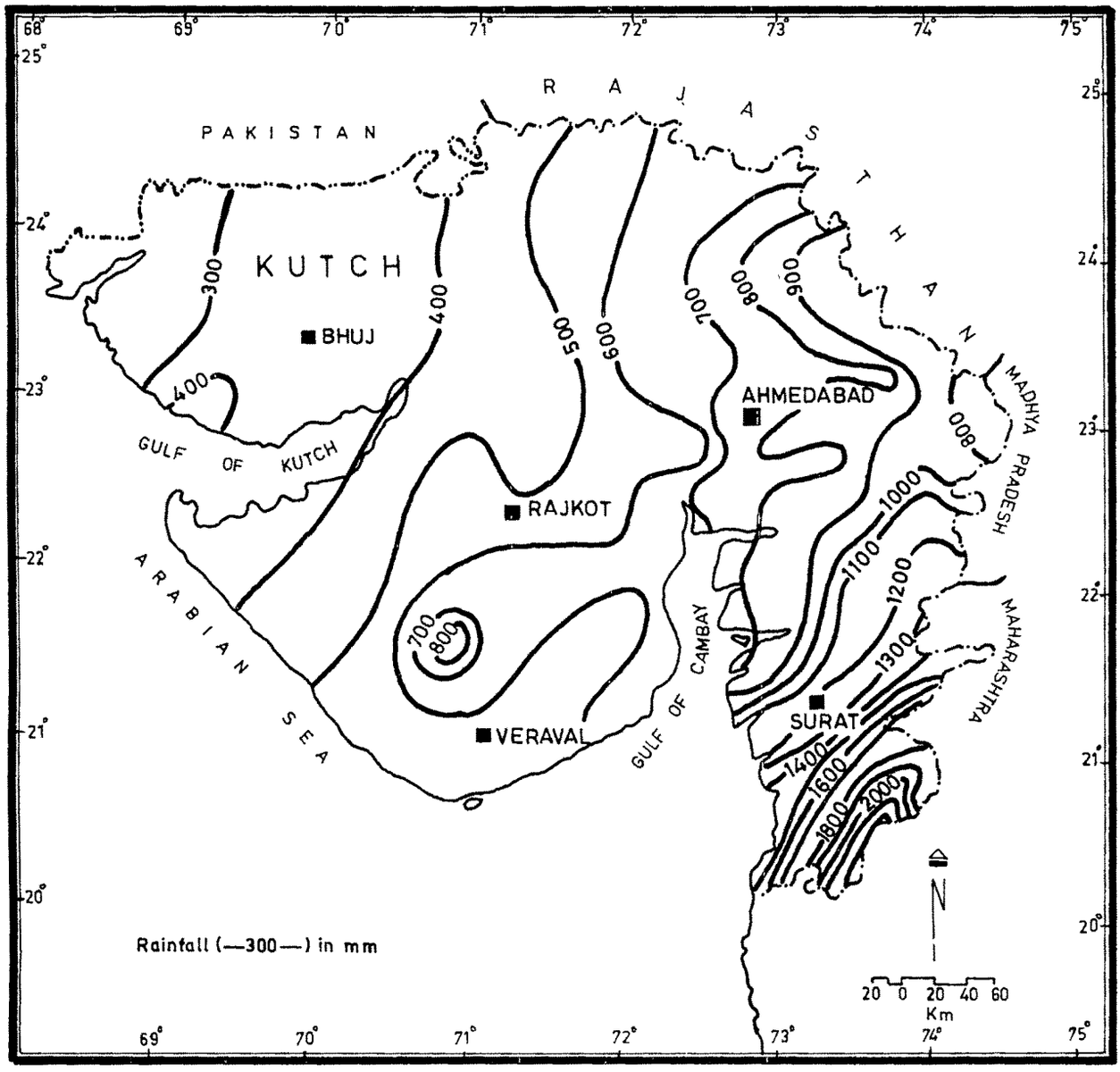


Fig.I.2 PREVAILING WIND DIRECTIONS_GUJARAT



Fig·I·3 ANNUAL AVERAGE RAINFALL MAP_ GUJARAT

The xerophytic flora is dominated by Acacia nilotica, Acacia senegal, Acacia sundra, with associated thorny Mimosae and Ziziphus. Stunted trees of dry deciduous forest occur scattered in varying numbers throughout and comprise Anogeissus laltifolia and Soymiola, Acacia arabica, Prosopis spicigera, Salvadora persica etc. are also commonly seen.

The Halophytes are Suedo nadiflora, Seudo meritima, Aeluropus sp., Avecenia officinalis and Cress cretica. The Cammiphora mukul plant is common and gum of this plant is utilized in the preparation of paints.

Arua and few trees of wild date, mango, neem, pipal, tamarind, banyan etc. are found near villages and on the road sides. The alluvial and soil covered plains and hill slopes have been brought under cultivation, and the crops include Pinicillaria spicata (millet), Sorghum vulgarae (jowar), Triticum sativum (wheat), bajara and other cereals. Plantation of Saccharium officianarism (sugarcane), Ricinus communis (castor seeds) and Mangifera indica (mango) is common.

FAUNA

The wild life in Kutch is scarce. The common animals include deer, fox, nilgais (blue bulls), hyenas, wolves and jackals. The spiny tailed lizards called uromastix are also

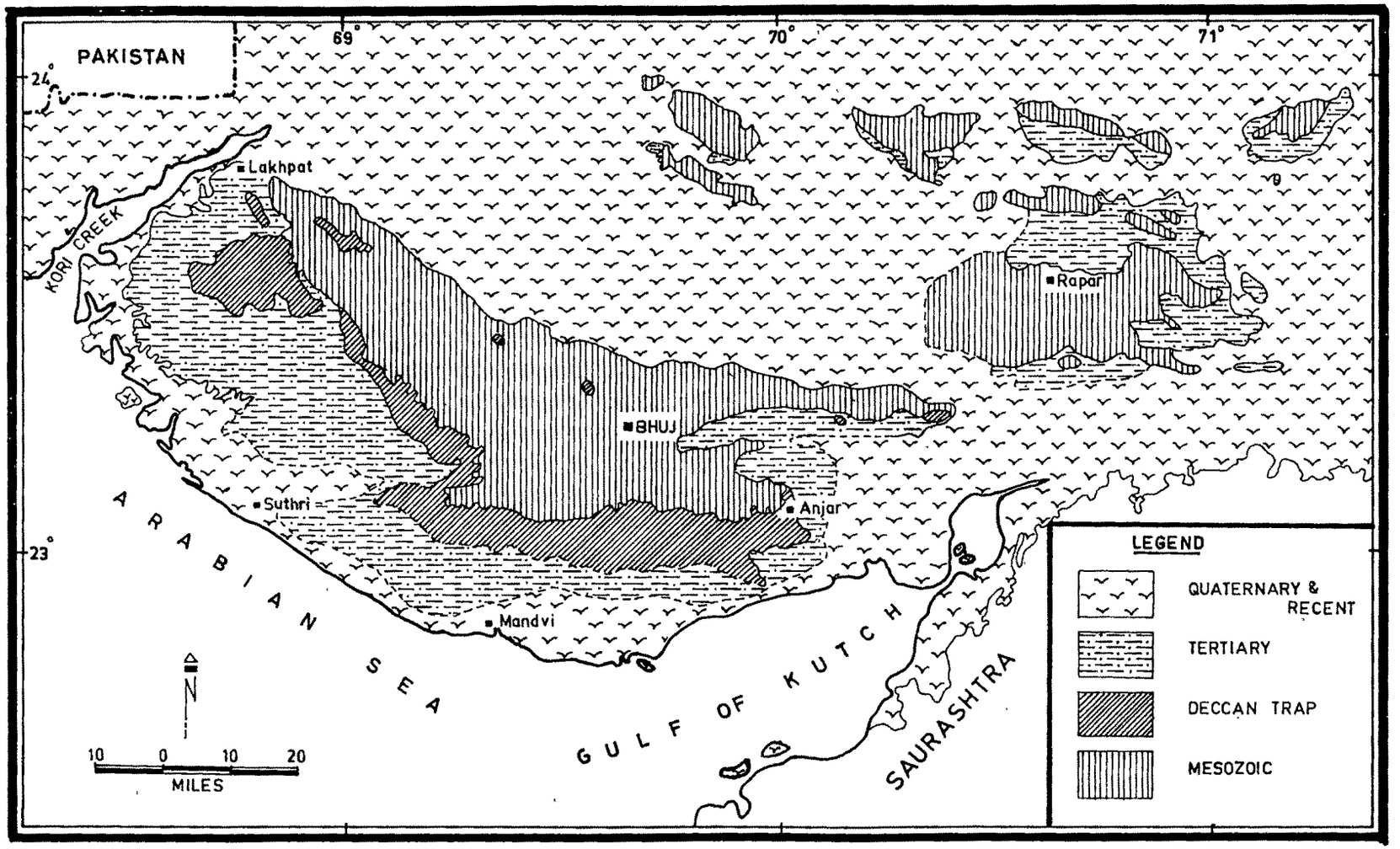
commonly seen and reported from grassy patches. Over and above, varieties of poisonous snakes, including cobras and vipers are occasionally noticed; flamingoes, pelicans and the Great Indian bustard are typical of the Kutch, especially in the Great Rann.

COMMUNICATION AND TRANSPORT

The Bhuj city, a district headquater, is connected by a number of all-weather tar roads with all the important cities and towns of the district, along which the State Transport buses ply regularly. Bhuj is connected to Gandhidham by a Meter Gauge railway line which is further extended to Ahmedabad and Bombay by a Broad Gauge railway track. Bhuj is also linked by Indian Airlines flights with Jamnagar, Rajkot and Bombay. Bhuj as well as Kandla are connected by National Highway No.8 leading to Delhi and Ahmedabad. The interior villages are connected with numerous tar roads, fair-weather jeepable roads, cart tracts and foot tracts. By and large, a majority of workable miliolite deposits are approachable by roads.

BRIEF GEOLOGICAL FRAMEWORK OF KUTCH

Geologically, the Kutch peninsula comprises rocks ranging in age from Jurassic to Recent (Fig.I.4); the main outcrops, however being those of Mesozoics, have attracted



Fig·I·4 GEOLOGICAL MAP OF KUTCH (After Wilson)

number of geologists since last 100 years or more, and are considered to be a store house for the well-recorded and excellently preserved fossiliferous Jurassic sequence of rocks. The accompanying table (Table I.1) gives a detailed stratigraphy of the rocks encountered in the Kutch terrain which furnishes a suitable background of the geology of Kutch.

Mesozoic rocks are exposed mainly in six regions viz., Kutch Mainland, Wagad Highland, "Pachham, Khadir and Bela Islands" and in Chorar Hills. These areas are isolated by vast stretches of low lying plain ground of Rann of Kutch and Banni. These Highlands clearly indicate that tectonically Kutch Peninsula is a very active region and is characterized by numerous major and minor faults which have uplifted the above mentioned Highlands. These Highlands form three anticlinal E-W ridges (domes), decreasing in size from north to south; owing to an E-W fault, the whole sequence is repeated (Fig. I.5). The structure developed in Kutch Mesozoics are pre-Deccan Trap in age (Biswas & Deshpande, 1970).

The northern, highest and biggest ridge is broken up into four islands of Pachham, Khadir, Bela and Chorar in the Rann of Kutch. The another chain of domes (i.e. the middle ridge) borders the Kutch Mainland and flanked by Kutch

Table I.1 Stratigraphic sequence of Kutch (compiled after Krishnan, 1968; Biswas, 1965, 1971).

Era	Period	Epoch	Series	Stage	Lithology
C	QUATERNARY	Holocene	Recent	-	Alluvium, Rann silts and blown sands.
		Pleistocene	Miliolite Formation	-	Oolitic, calcareous sandstones.
E		---------- Unfonformity ----------			
	T	Pliocene	Kankawati series (300 m)	-	Grey sandstones; Pink fossiliferous, calc grits and conglomerates with shales.
		---------- Disconformity ----------			
N	E	Miocene	Khari series (200 m)	Vinjnan stage (135 m)	Grey and Khakhi clay with fossiliferous marls.
				Aida stage (65 m)	Variegated siltstone
	R	---------- Unconformity ----------			
O		Oligocene	Ber Moti series (35 m)	Waior stage (10 m)	Dirty white and yellow banded marl and impure limestone
				Ramania stage (25 m)	
	T	---------- Paraconformity ----------			
Z		Eocene	Berwali series (95 m)	Babia stage (55 m)	Silty limestone, fossiliferous calcareous clays and shells

Table I.1 (contd)

Era	Period	Epoch	Series	Stage	Lithology
	I		----------	Disconformity	----------
C				Kakdi stage (40 m)	Grey shales and red laterites. Brown gypseous shales with thin fossiliferous marls and mud balls. Locally gypseous shales with red ochre and black shales with lignite beds.
	A				
I		----------	Disconformity		----------
	R	Paleocene	Madh series (50 m)	-	Laterites, tuffaceous, clays, bentonitic and ferrugincus clays with volcanic ash.
	Y	----------	Unconformity		----------
C		Upper Cretaceous to Paleocene	Deccan Trap formation (600 m)	-	Dark green basalts, alternating flows of columnar and amygdaloidal basalts.
	J	----------	Disconformity		----------
M		Cretaceous	Umia series (1000 m)	Bhuj beds	Sandstone and shales.
				Ukra beds	Marine calcoreous shales.
	U			Umia beds	Barren sandstone and shales

Table I.1 (contd)

Era	Period	Epoch	Series	Stage	Lithology
E			Katrol series (300 m)	Up. Katrol shales	Red sandstone, shales and marls.
	R			Gajansar beds	
				Upper Katrol	
S				Lower Katrol	
	A			Kantkote sandstone	
O					
	S		Chari series (360 m)	Dhosa oolite	Green and brown oolite.
Z				Athleta beds	Marls and gypseous shales.
	S			Anceps beds	limestone and shale.
O				Rehmani bed	Yellow limestone.
	I			Macrocephalus beds	Shales with calcareous bands with golden oolites
I					
C			Patcham series (300 m)	Patcham coral bed	Clastic sandstones and yellow limestones.
				Patcham shell limestone	
	C			Patcham basal beds	
	Triassic		-	-	-

(Base not exposed)

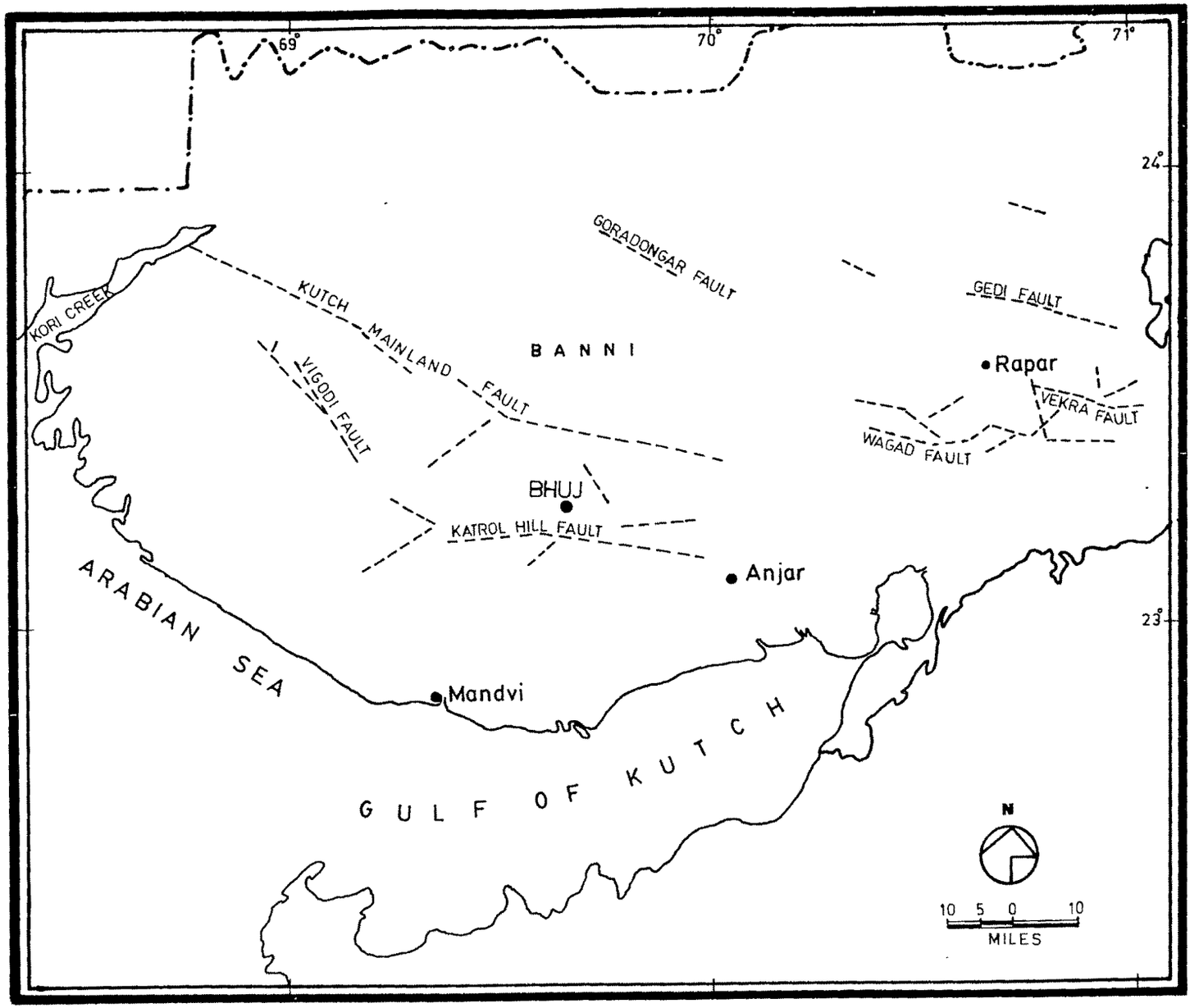


FIG: I.5 TECTONIC MAP OF KUTCH.

(After Biswas & Deshpande , 1970)

Mainland Fault' and marks the hills of Jhura, Jumara and Lodai. The southern ridge, forms the Chaduva hill ranges which is marked by 'Katrol Hill Fault' and 'Wigodi Fault' on its northern flank which has brought younger Cretaceous rocks against the older Jurassics. These domal structures shown by the Jurassic rocks have intrigued many workers.

The Deccan Traps occur along the southern fringes of the Umia beds and Bhuj beds (Cretaceous age) in an E-W narrow belt varying in width, right from Nareda in the west upto Anjar in the east. At many places bentonite, bauxite and laterite are closely associated with these rocks.

Tertiary and Quaternary rocks also have received considerable attention. It was during Cretaceous period that Cenomanian transgression gave rise to Tertiary deposits which was of worldwide scale. The Tertiary Formation of Kutch is of marine shelf facies and overlie Deccan Trap, Cretaceous and Jurassic strata and mark the Kutch coastal plains.

Quaternary miliolite deposits that form the subject matter of this thesis are unique in the sense that they comprise accumulations of bioclastic sands occurring in the sporadic patches over a dominant portion of the Kutch Mainland. These rest on the rocks of all ages right from

Jurassic to Pliocene. Coastal sand dunes, tidal flats and alluvium form the topmost members of the Quaternary Formations in the Kutch region.