CHAPTER II

GENERAL REVIEW OF KUTCH

HISTORY:

Kutch is a land of great antiquity that has reference in the old stone inscriptions, copper plates, old writtings, manuscripts and even in the notes of foreign travellers. The name "Kutch" by which it is referred in the modern time has a mention in Mallinath's (14-15th century) "Sanjivani" (Sanskrit commentary on Amarkosh) as a marshy region or waste land. Prior to the dawn of Christianity this region lying between Sindh and Saurashtra was known as "Abhir" from its original inhabitants - a name that also appears for this region in the great Hindu epic "Mahabharata".

GEOGRAPHY:

The crescent shaped region called "Kutch" forms the northwestern portion of the state of Gujarat and roughly covers an area of about 44,203 squares kilometers lying between 22°-44' - 11" to 24°-54'-47" north latitudes and 68°-09'-46" to 71°-54'-47" east longitudes. The region of Kutch has strategic importance being on the inter-continental border in the north and northwest with Pakistan. It is bounded by the Arabian Sea to its west, Saurashtra to its south and east and by parts of Rajasthan to its northeast. It is cut off from

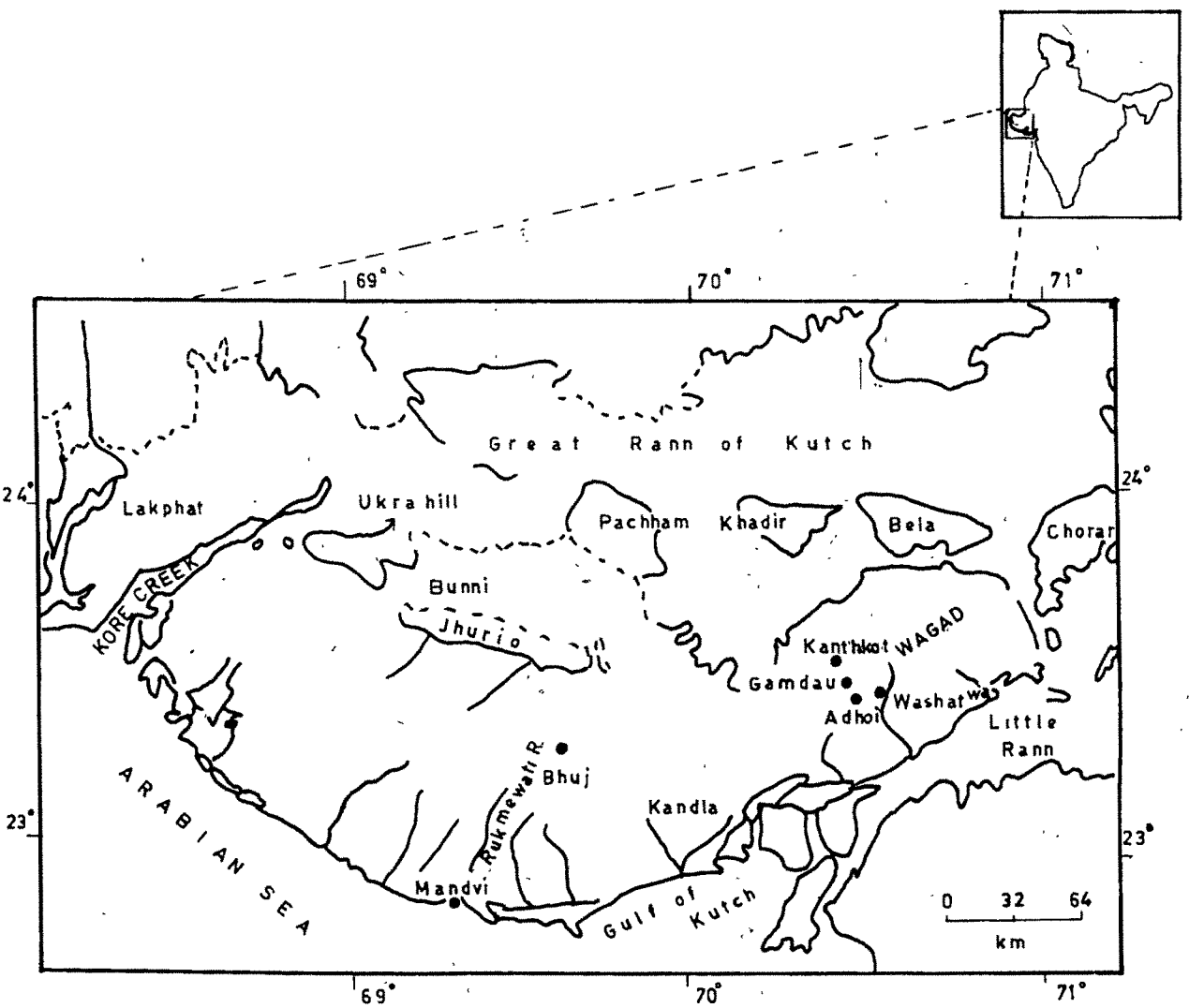


FIG. 1. Location and Index map of Kutch.

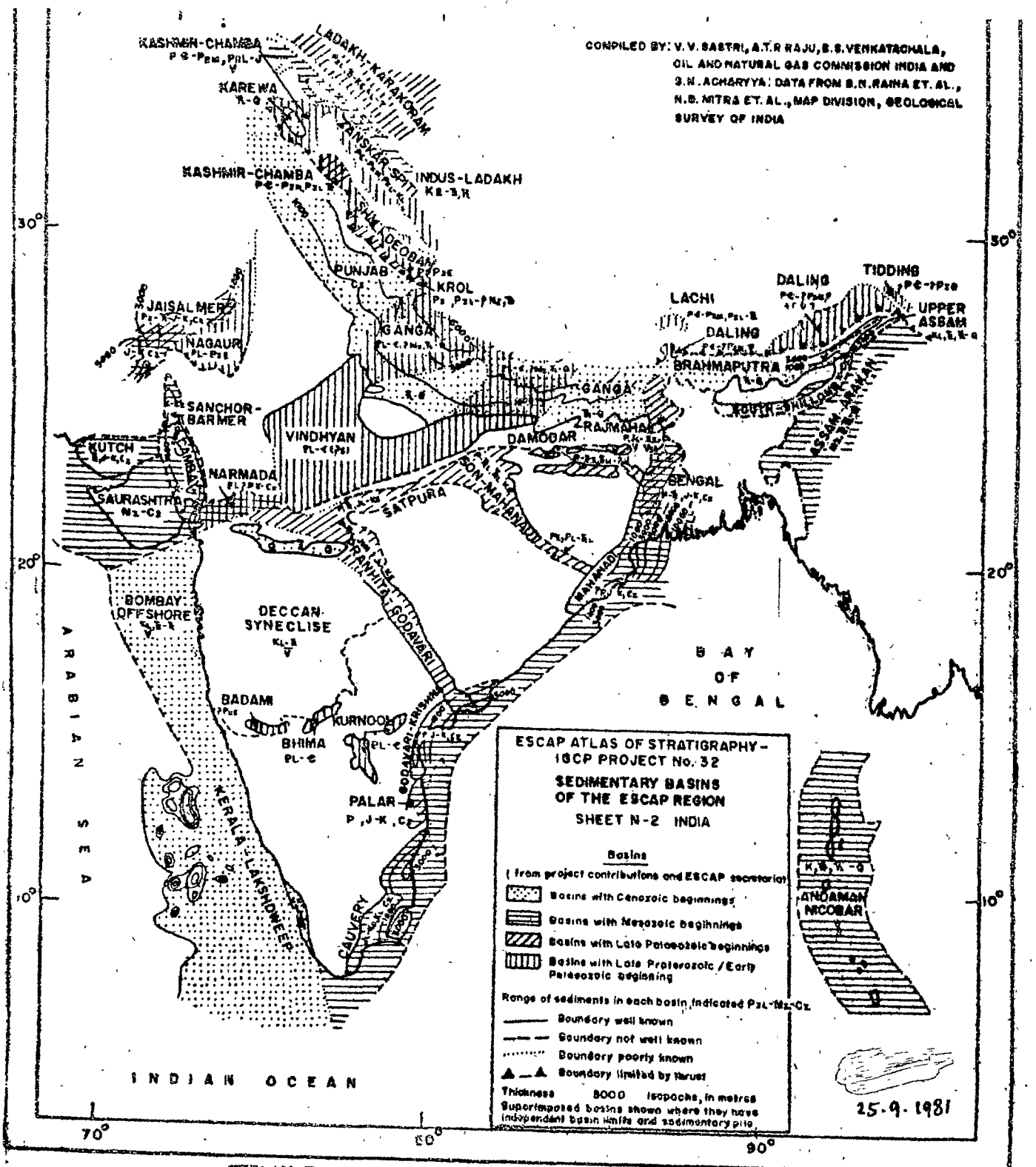
the mainland of Gujarat by the greater and little Ranns of Kutch in the north and northeast respectively (Fig. 1). The entire region of Kutch lies near the eastern limits of the great arid belt of southwest Asia and has a hot dry climate. The average rainfall is about 13.5 inches, most of which falls from June to September during the southwest monsoon.

The whole of Kutch is undulating and hilly with altitudes ranging from sea-level upto 510 meters above it. The important streams of the region are Rukhmawati, Kankawati, Naiera, Miti and Khari Rivers, which flow to the south and ultimately empty into Gulf of Kutch or the Arabian Sea. Important streams flowing to the north are Pur, Bhuvral, Bhuki and Chawad rivers which in drain into the Rann of Kutch. The streams are all of ephemeral in character i.e. they carry water only in direct response to monsoon rains but are dry during most of the year.

PALAEOGEOGRAPHY:

The palaeogeography of the region of Kutch is closely connected with that of the Gondwanaland and its foundering during the Tethyan time (Poddar, 1959). It is interesting to note that the faunal elements of Kutch show unmistakable affinities with those of Madagascar and that of the Mediterranean and Alps. On the basis of these affinities it has been postulated that the Tethyan Sea of Jurassic and later

FIG. 2. SEDIMENTARY BASIN MAP OF INDIA



EXPLANATION TO THE LETTER SYMBOLS USED IN THE MAP

P	=	Proterozoic	Tr	=	Triassic	Mz	=	Mesozoic	V	=	Volcanic
A	=	Precambrian	J	=	Jurassic	Pz	=	Palaeozoic	E	=	Early
C	=	Cambrian	K	=	Cretaceous	Te	=	Palaeogene	M	=	Middle
S	=	Silurian	T	=	Tertiary	N	=	Neogene	L	=	Late
P	=	Permian	Cz	=	Cainozoic	Q	=	Quaternary			

times extended beyond the main Himalayan axis into the region of lesser Himalayas, and that a channel of the same extended into Baluchistan and the salt range and further south through portions of Rajasthan into the region of Kutch peninsula and then south-westward as far as Madagascar.

GEOLOGY:

Geologically the region of Kutch occupies an important position amongst the sedimentary basins of India (Fig. 2). A variety of rocks ranging in age from Jurassic to Recent and formed under the varying environmental conditions of marine and non-marine origin are known to occur in this region. The estimated thickness of the Mesozoic sediments in Kutch is of the order of 2400 meters or even more. The occurrence of basal granite conglomerate beds in the Khadir Island and the syenite rocks in the Meruda hills of Kutch indicate that the sedimentary sequence of the northeastern part of the Kutch basin is quite thin and that the oldest exposed Mesozoic sediments (Bathonian in age) directly overlie the Precambrian basement rocks (Biswas and Deshpande, 1968). Numerous basic dykes, sills and plugs are known to have intruded the Mesozoic rocks of Kutch at various localities.

Good exposures of Mesozoic rocks can be located in the following six disconnected areas in Kutch. According to Biswas (1977) these represent the major uplift zones forming

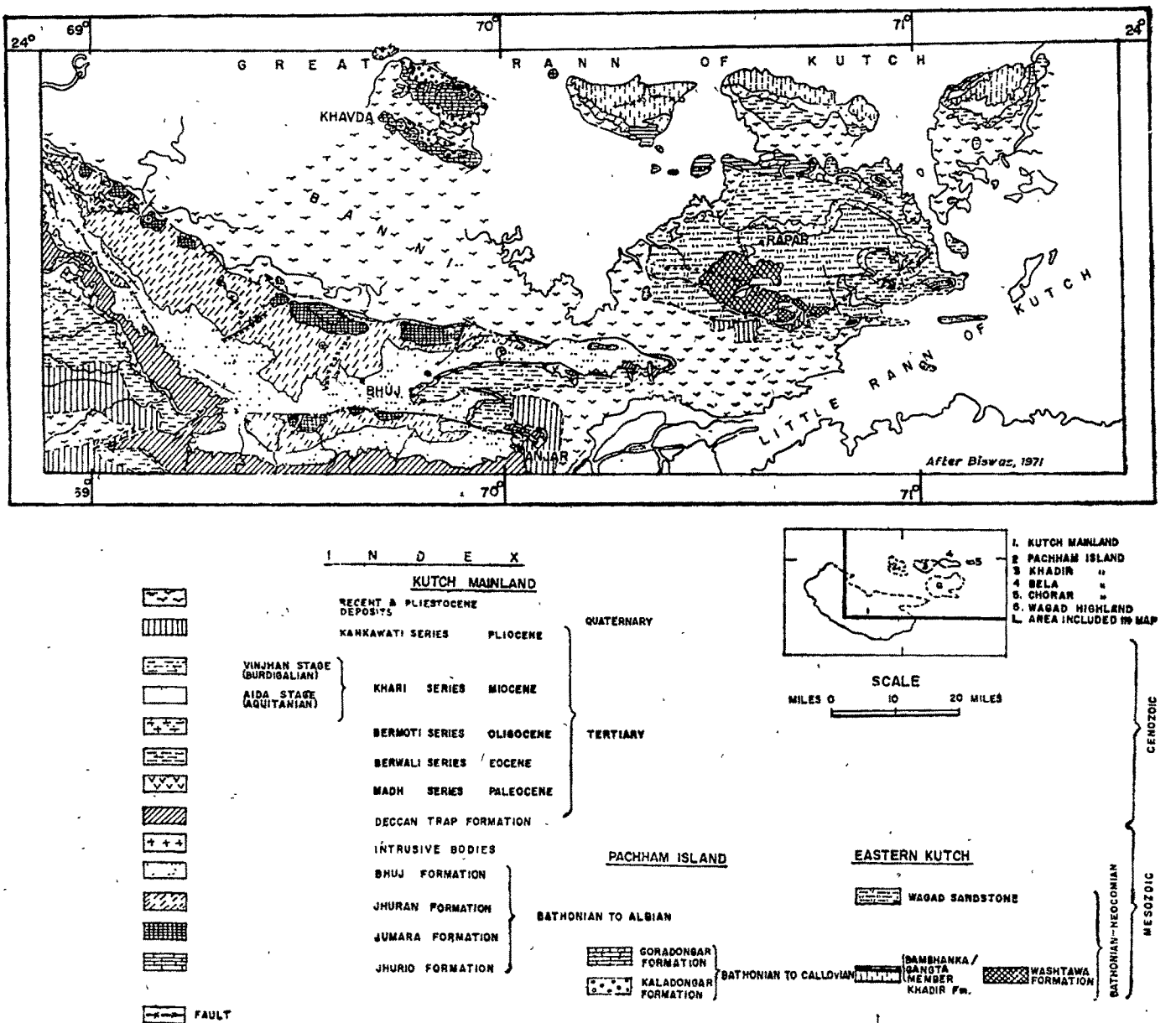


Fig. 3. Geological map of a part of Kutch Basin showing distribution of Mesozoic formations.

highlands admist extensive plainland areas of Kutch. These are: (a) "Kutch Mainland", (b) "Pacham Island", (c) "Khadir Island", (d) "Bela Island", (e) "Chorer Hills", and (f) the "Wagad Region" (Fig. 3). All these highland areas generally show an E-W regional strike. Lately, Biswas (1971), has called Kutch as a pericratonic embayment with its sedimentary column ranging in age from Bathonian to Holocene and forming a wedge shape body with thinner ends towards north and east.

STRUCTURE AND TECTONICS:

The Kutch basin as mentioned earlier includes six major uplifts giving rise to highland areas. The sub-basins between these are the parts of "residual depressions" in which the Tertiary and younger sediments are deposited (Biswas, 1981). These structural lows also form the great plains of the Ranns of Kutch and Banni covered by the Recent marine sediments. The uplifts have been produced by a sediments. The uplifts have been produced by a series of parallel east to west, quasivertical, marginal faults which follow the major tectonic trends of the precambrian basement (Deshpande, 1972). The basinal framework of Kutch according to Biswas (1981), consist of an embayment closed by Radhanpur-Barmer Arch in the east, a sloping platform featured by parallel east-west fault ridges, and median high across them (Fig. 4). The

the Nagar Parker fault. The structural axis of the basin plunges southwest, trending parallel and close to the south-eastern margin.

REVIEW OF THE PREVIOUS WORK AND HISTORY OF STRATIGRAPHICAL NOMENCLATURE:

The earliest reference to the geology of Kutch was made by Grant (1837), but the details of this work are not available. The most important and pioneering work on the geology of Kutch is that by Wynne (1872). Wynne was the first to publish a detailed account of the geology of Kutch along with a map in 1 inch = 4 miles scale. The map is quite accurate and has been providing the basis of reference to all subsequent geological work. The lithostratigraphic classification as suggested by Wynne is shown in Table 1.

The Mesozoic rocks of Kutch in fact attracted the attention of the earlier workers for the wealth of fossils contained in them. The fossils of ammonites from these rocks were studied in great details by Waagen (1871, 1873-1876). Stolickzka (after Waagen, 1975) suggested the welknown four fold Mesozoic stratigraphical classification of Kutch. This includes Patcham, Chari, Katrol and Umia Groups in ascending order. Waagen defined units by "ammonite assemblage zones". This classification has been followed till now with various

modifications by later workers mostly on the basis of their palaeontological observations. Gregory (1893, 1900), on the basis of his studies of fossil corals, and Kitchin (1900, 1903) on the basis of brachiopod genera and species assigned Patcham series to the European Bathonian and Chari to Lower Callovian. Spath (1924, 1927, 1933) subdivided the Mesozoic sequence of Kutch into Bathonian; Callovian, Oxfordian, Kimmeridgian, Tithonian, and Neocomian stages in ascending order. Rajnath (1932) suggested the extension of the upper age limit of the Jurassic of Kutch. Cox (1940, 1952) recorded species of Trigonia which he claimed were similar to those found in Europe, Somalia, South Africa and Tanganyika. Tiwari (1948) assigned Bathonian to Argovian age to the Jurassic sequence of Habo hills on gastropod and lamellibranch evidence. Agarwal (1956), however favoured callovian age to the middle Chari series on the basis of his Macrocephalites charienis and other megafossil finds. Poddar, (1959) considered Patcham series to be Bathonian or slightly older; Chari series to be Callovian-Oxfordian; Katrol series to be Kimmeridgian - Tithonian; and Umia series to be Neocomian-Aptian in age. According to Mathur and Evans (1964) the oldest Jurassic outcrop in Kutch is of Bathonian age and these are sediments ranging from Middle Jurassic to Recent. Rao (1964) pointed that the faunal evidences suggests a Bathonian or Lowest Callovian to post-Aptian age for the Mesozoic sequence of Kutch.

TABLE - 1

LITHOSTRATIGRAPHIC CLASSIFICATION OF WYNNE, 1837.

Recent	Alluvial, blown sand and Sub-Recent deposits	Pleistocene
	Upper Tertiary	Pliocene
	unconformity	
Tertiary	Argillaceous Group Nummulitic Group Gypseous Shales	Miocene to Upper Eocene
	Arenaceous Group Nummulitic Group Gypseous Shales	Eocene
Volcanic	Sub-Nummulitic stratified traps and intratrappean beds	
Tertiary	Infra-trappean beds	
	unconformity	
Jurassic	Upper Jurassic Group Lower Jurassic Group	Oolitic
Metamorphic Crystalline	Syonite	

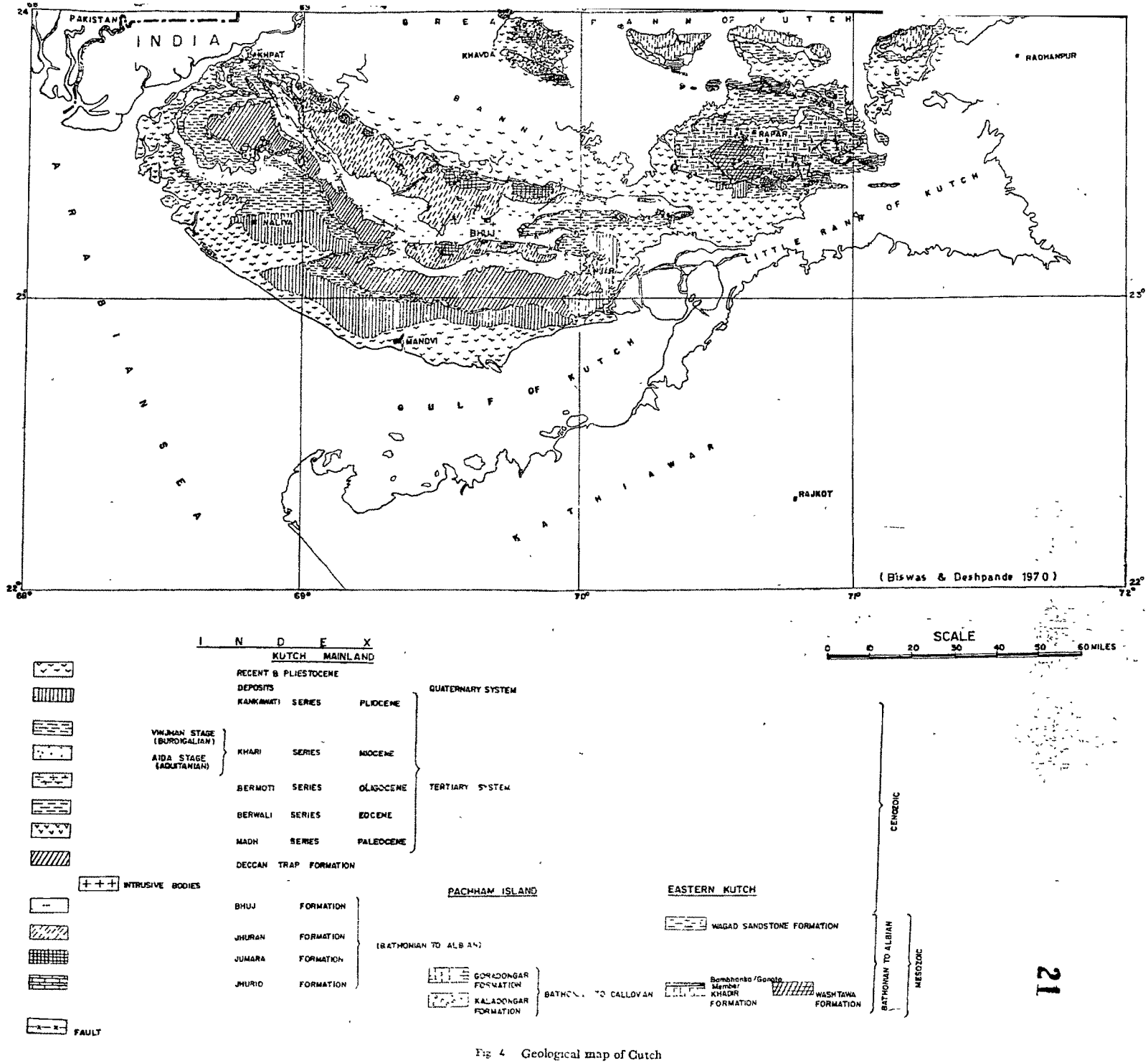


Fig 4 Geological map of Cutch

According to Ghosh (1969, a) the megafossil assemblage of Kutch shows more affinity with the east and south Africa assemblage than those of Himalayas or European Jurassic and ranges in age from Middle Bathonian to Argovian (Ghosh, 1969b).

A concise version of the above work and their European equivalents can be summarised in the following Table 2. (after Bhalla and Abbas, 1980).

TABLE - 2

MESOZOIC SUCCESSION IN KUTCH

Series	Thickness (in meters)	European stratigraphic Equivalents
Bhuj	450	Post-Aptian
Umia	900	Upper Tithonian to Aptian
Katrol	300	Upper Oxfordian to Middle Tithonian
Chari	366	Lower Callovian to Lower-Upper Oxfordian (part)
Patcham	300	Upper Bathonian to - Lower Callovian (part)

Archean Granites and Gneisses:

Lately Biswas (1971-1972) for the first time proposed a rock-stratigraphic classification for the Mesozoic rocks of Kutch following the recommendations of the International Subcommission on Stratigraphical Classification. He has proposed

TABLE 3: ROCK STRATIGRAPHIC CLASSIFICATION AS COMPARED TO EARLIAR CLASSIFICATIONS

AGE	BISWAS, 1971			PASCOE, 1959 (MAINLY AFTER SPATH, 1933).		KRISHNAN, 1968 (MODIFIED FROM RAJNATH, 1932, & ARKELL, 1956).	
	E. KUTCH	PACHHAM	MAINLAND				
ALBIAN TO ? SANTONIAN			BHUJ FORMATION			BHUJ STAGE : PALMOXYLON BEDS PTYLOPHYLLUM BEDS ZAMIA BEDS.	
APTIAN			UKRA MEMBER	UKRA BEDS		UKRA STAGE : MARINE CALCAREOUS SHALE	
BERRIASIAN TO BARREMIAN	NOT EXPOSED			UMIA SERIES	SANDSTONE AND SHALE WITH PLANT REMAINS, UNFOSSILIFEROUS SHALE TRIGONIA SANDSTONE. OOLITIC BANDS WITH MARINE FOSSILS.	UMIA SERIES	UMA STAGE : BARREN SANDSTONE TRIGONIA BEDS BARREN SANDSTONE UMIA AMMONITE BEDS BARREN SANDSTONE
TITHONIAN TO KIMMERIDGIAN	WAGED SANDSTONE		JHURAN FORMATION	KATROL SERIES	KATROL SANDSTONE (UNFOSSILIFEROUS) GUDJINSAR BED (MARINE FOSSILS) ZAMIA SHALES BROWN AND RED IRONSTONES BASAL AMMONITE BED. JURAN BELEMNITE MARLS KANTHKOT SANDSTONE	KATROL SERIES	UPPER KATROL SHALES GAJANSAR BEDS UPPER KATROL MIDDLE KATROL LOWER KATROL KANTKOTE SANDSTONE
OXFORDIAN TO CALLOVIAN	KANTHKOT MEMBER WASHTAWA FORMATION KHADIR FORMATION	NOT EXPOSED GORADONGAR FORMATION	(DHOSA OOLITE MEMBER) JUMARA FORMATION	CHARI SERIES	DHOSA OOLITE ATHLETA STAGE ANCEPS STAGE REHMANI STAGE SOLDEN OOLITE STAGE	CHARI SERIES	DHOSA OOLITE ATHLETA BEDS ANCEPS BEDS REHMANI BEDS MACROCEPHALUS BEDS
BATHONIAN	KALADONGAR FORMATION	KALADONGAR FORMATION	JHURIO FORMATION	PATCHAM SERIES	UPPER STAGE LOWER STAGE	PATCHAM SERIES	PATCHAM CORAL BED PATCHAM SHELL LIMESTONE PATCHAM BASAL BEDS (KUAR BET BEDS)
	PRECAMBRIAN BASEMENT EXPOSED AT MERUDA HILL.	NOT EXPOSED	NOT EXPOSED				

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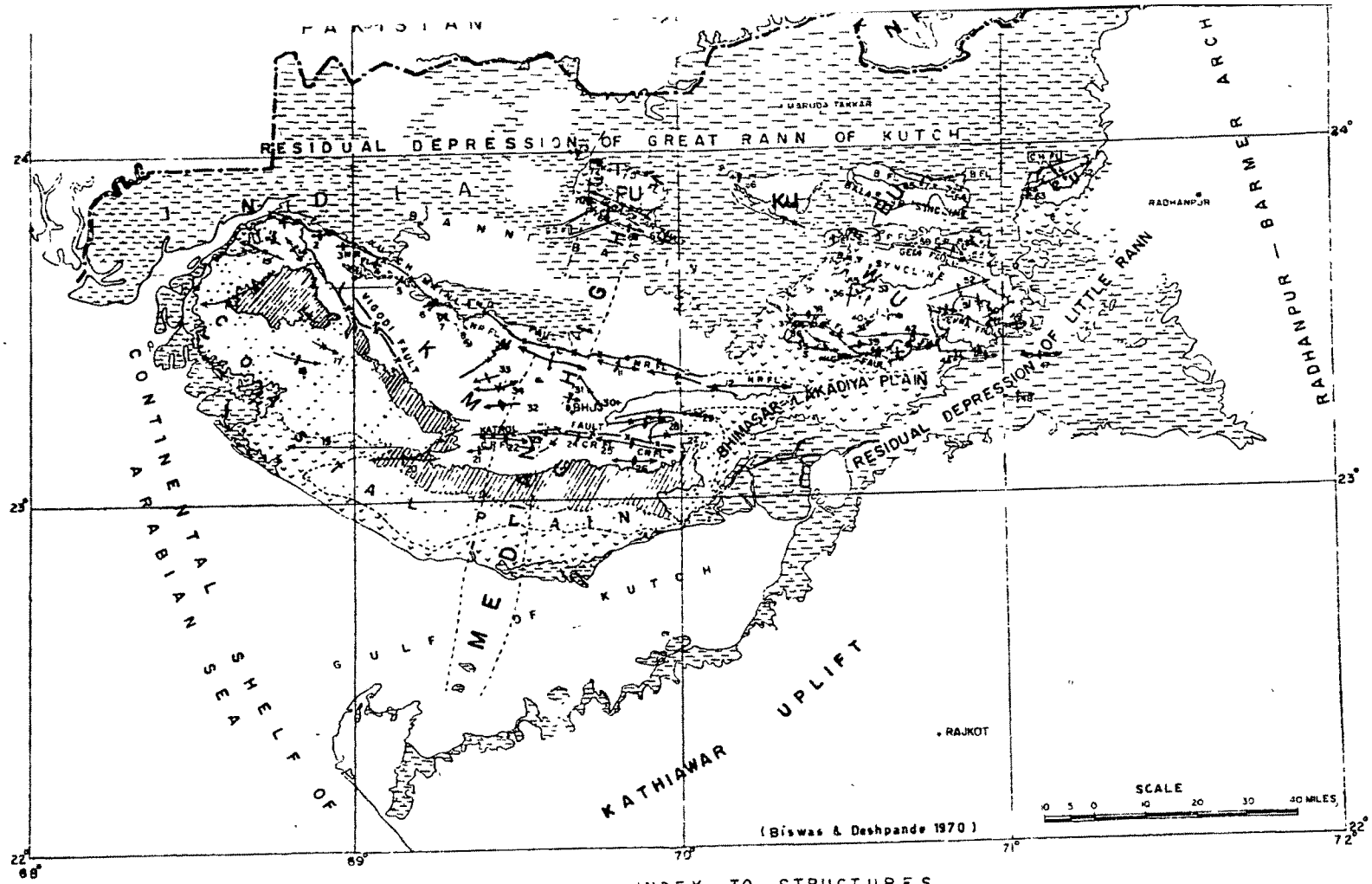
stratotypes together with brief description of the units. The following Table - 3 summarises his work.

In 1970, Biswas and Deshpande published a comprehensive and detailed geological and tectonic maps of the entire region of Kutch. These are reproduced in figures 4 and 5 respectively.

Deshpande in his 1972 Ph.D. studies investigated the Wagad rocks of eastern Kutch with the objectives of studying the important stratigraphical and sedimentological parameters of the region. He has also worked out the stratigraphical classification of the Wagad rocks of eastern Kutch. Utility of this particular classification is discussed in the following Chapter-III.



LEGEND

- QUATERNARY
- TERTIARY
- DECCAN TRAP
- INTRUSIVE BODIES
- MESOZOIC
- BASEMENT
- FAULT
- ANTICLINAL AXIS WITH PLUNGE DIRECTION
- SYNCLINAL AXIS WITH PLUNGE DIRECTION

KMU KUTCH MAINLAND UPLIFT
PU PACHHAM UPLIFT
KU KHADIR UPLIFT
BU BELA UPLIFT
CU CHORAR UPLIFT
WU WAGAD UPLIFT
NPU NAGARPARKAR UPLIFT
KDFL KALADONGAR FLEXURE ZONE
GDFL GORADONGAR FLEXURE ZONE
BFL BELA FLEXURE ZONE
CNFL CHORAR FLEXURE ZONE
DPFL DESALPUR FLEXURE ZONE
KKFL KANTHKOT FLEXURE ZONE
DFL DEDARWA FLEXURE ZONE

APFL ADHOI FLEXURE ZONE
NRFL NORTHERN RANGE FLEXURE ZONE
CRFL CHARWAR RANGE FLEXURE ZONE

INDEX TO STRUCTURES

1. LAKHPAT ANTICLINE
2. MUNDHAN ANTICLINE
3. JARA DOME
4. JUMARA DOME
5. MANJAL DOME
6. KEERA DOME
7. LYARI DOME
8. CHARI DOME
9. DHAR DONGAR HALF DOME
10. JHUMO BRACHY ANTICLINE
11. HABO BRACHY ANTICLINE
12. KAS HILL ANTICLINE
13. DEDHADI NOSE
14. PRANPUR ANTICLINE
15. BAE A SYNCLINE
16. NARAYAN SAROVAR NOSE
17. SAMDA SYNCLINE
18. BHADRA NOSE
19. NALIYA SYNCLINE
20. VINJHAN NOSE
21. NABHOI BRACHY ANTICLINE
22. GURUMUL DONGAR ANTICLINE
23. WALAKHALAS ANTICLINE
24. AMUNDRA LER ANTICLINE
25. KATROL HILL ANTICLINE
26. NIGAL HAROI BRACHY ANTICLINE
27. RATNAL SYNCLINE
28. KANDERA NOSE
29. KUKMA SYNCLINE
30. PUR RIVER SYNCLINE
31. BHUJ ANTICLINAL NOSE
32. KALYANPUR NOSE
33. KUARTHADA NOSE
34. KUARTHADA SYNCLINE
35. ADHOI ANTICLINE
36. GAMDALI SYNCLINE
37. KANTHKOT ANTICLINE
38. CHHOBARI NOSE
39. WASHTAWA DOME
40. SARASLA DOME
41. DABUNDA DOME
42. BADARGARH SYNCLINE
43. DEDARWA ANTICLINE
44. CHITROD DOME
45. TAGODAR ANTICLINE
46. KANHER GON BRACHY ANTICLINE
47. NARSAKBET ANTICLINE
48. KESMAR BET ANTICLINE
49. JARWU ANTICLINE
50. VEKRA ANTICLINE
51. JUMAPUR ANTICLINE
52. JODESAR NOSE
53. RAPAR SYNCLINE
54. NARADA DOME
55. TRAMAU NOSE
56. RAMWAO SYNCLINE
57. MANJUNWAS BRACHY ANTICLINE
58. FATEHGARH ANTICLINE
59. DESALPUR ANTICLINE
60. MAIYA WANOH DOME
61. GANGTA BET DOME
62. CHORAR ANTICLINE
63. EWIL DOME
64. MOUANA DOME
65. BELA ANTICLINE
66. BHANLADA NOSE
67. POINT 72 DOME
68. GANIAPUR ANTICLINE
69. DHORSAR HALF DOME
70. RAIMALRO ANTICLINE
71. KALADONGAR ANTICLINE
72. DINGY DOME
73. KUAR BET DOME

Fig 5 Tectonic Map of Cutch