Tertiary (Caenozoic) Stratigraphy of Rajasthan

Presentation By

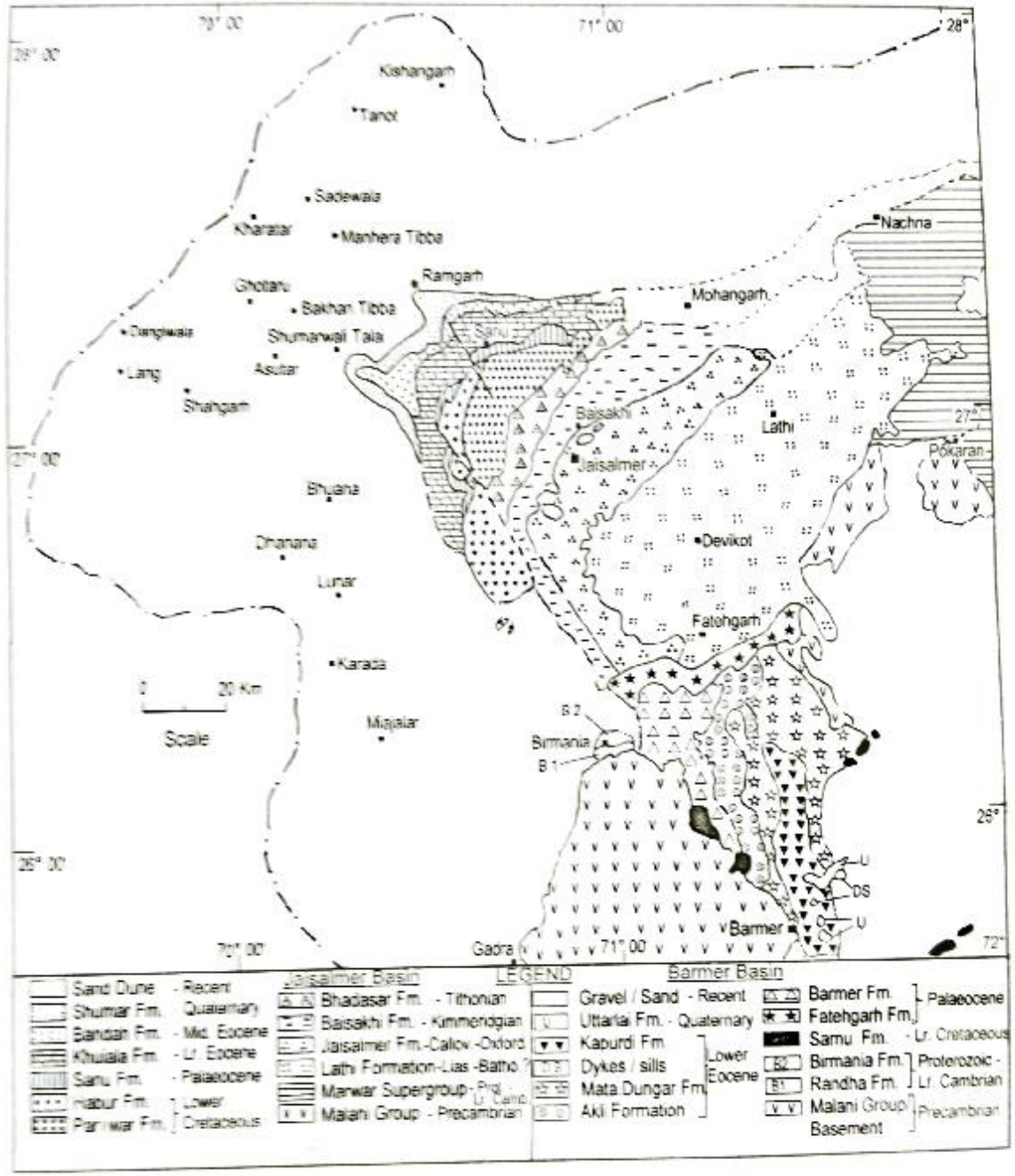
Ritesh Purohit

Jaislamer Basin

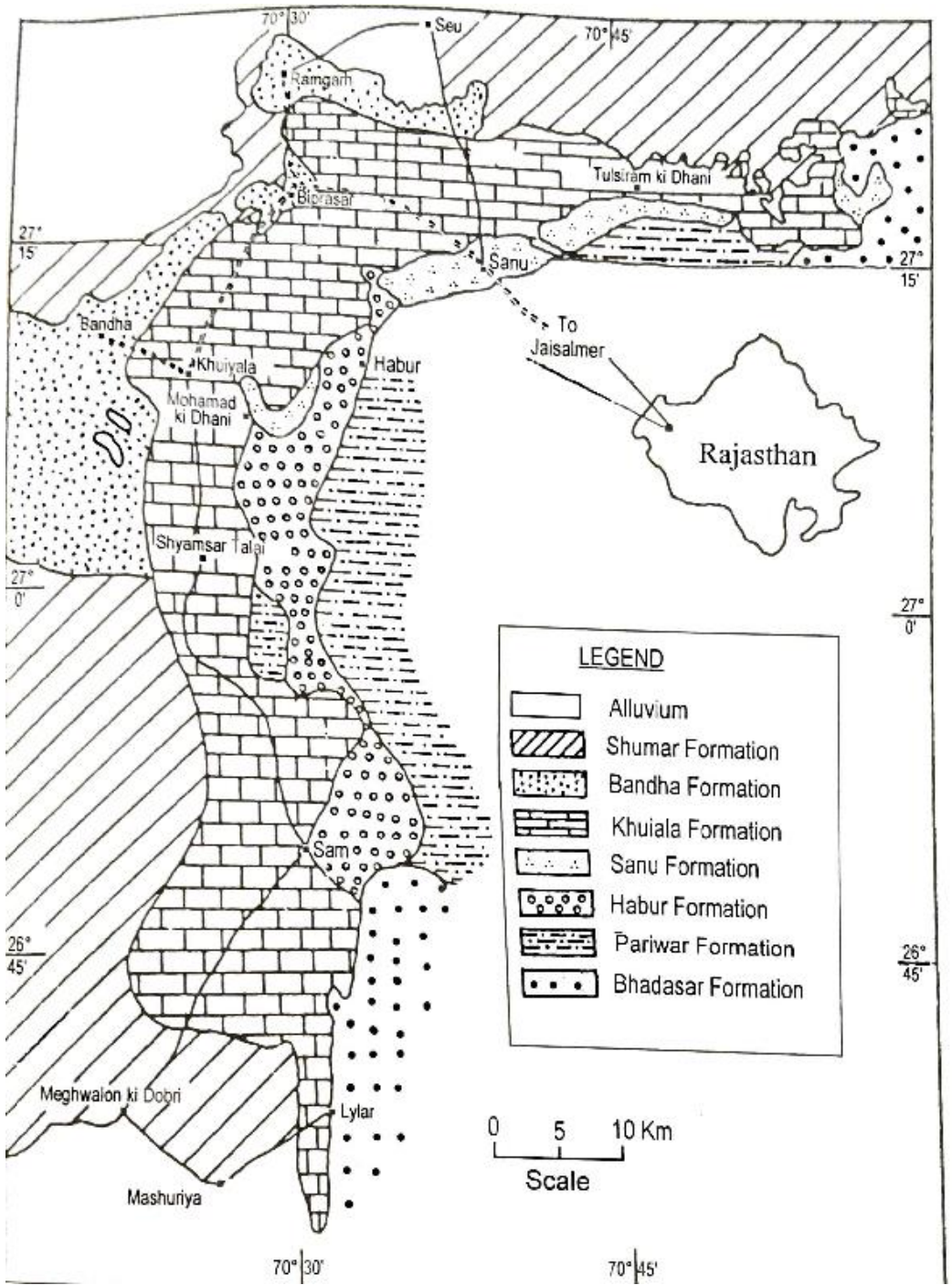
- Three Formations: Sanu Formation, Khuiala Formation, Bandah Formation

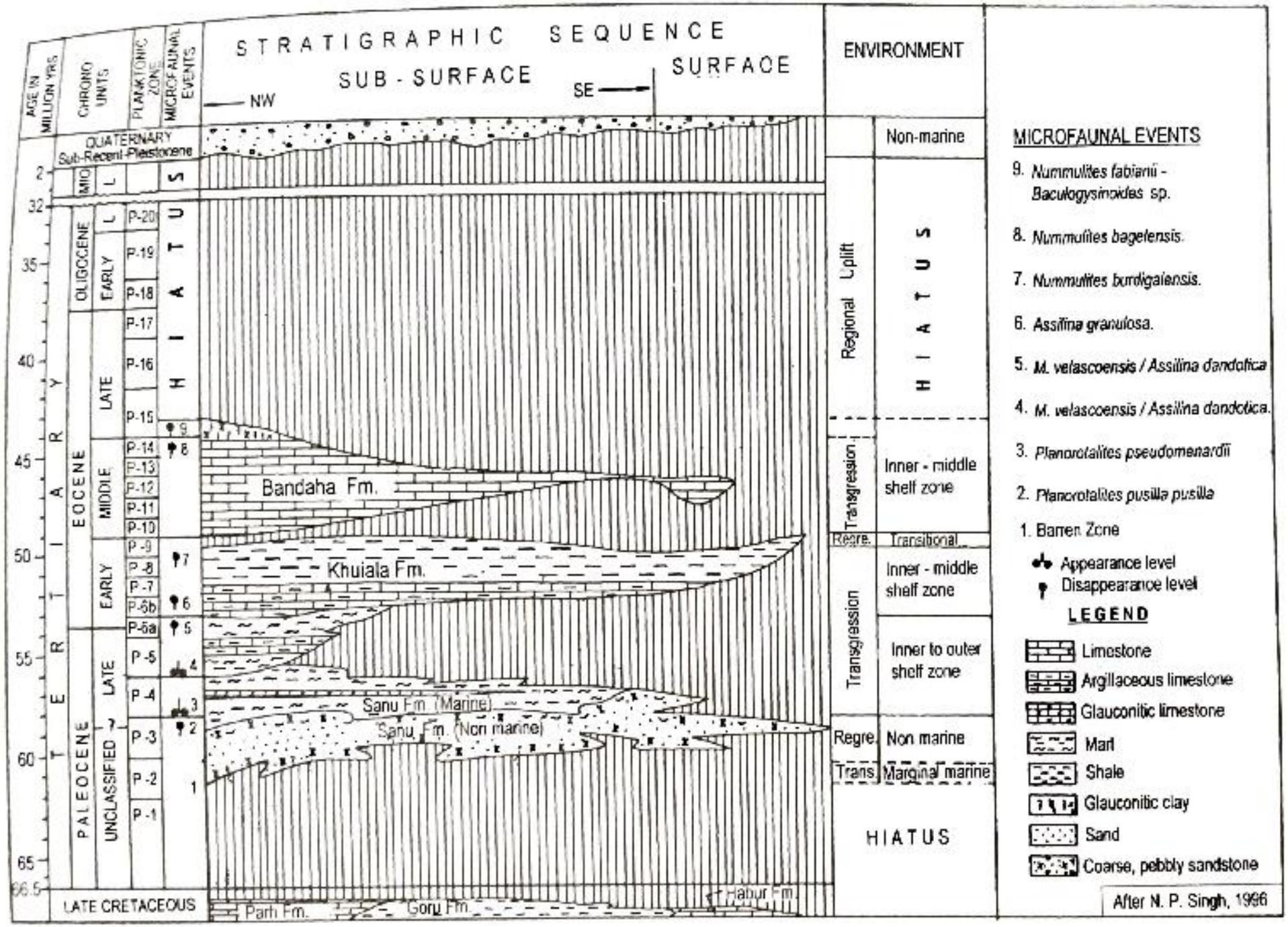
- Early Eocene age is claimed on the basis of Foraminifers: Assilina and Nummulites

- Exposures of Tertiaries in Jaisalmer basin and chronostratigraphy of the formations is shown in successive slides


70° 00'
71° 00'
28°
28° 00'
Kishangarh
Tanot
Sadewala
Kharatar
Manhera Tibba
Nachna
Ghotaru
Ramgarh
Mohangarh
Sakhan Tibba
Dangiwala
Shumarwali Tala
Asutar
Lang
Shahgarh
Sanu
Baisakhi
Lathi
Jaisalmer
27°
Pokaran
27° 00'
Bhuana
Devikot
Dhanana
Lunar
Fatehgarh
Karada
0
20 Km
Scale
Mujalar
B 2
Birmania
B 1
26°
26° 30'
U
DS
U
Barmer
Gadra
71° 00'
72°
LEGEND
Jaisalmer Basin
Sand Dune - Recent
Shumar Fm. - Quaternary
Bandar Fm. - Mid. Eocene
Khuiala Fm. - Lr. Eocene
Sanu Fm. - Palaeocene
Habur Fm. - Lower Cretaceous
Parihar Fm.
Bhadasar Fm. - Tithonian
Baisakhi Fm. - Kimmeridgian
Jaisalmer Fm.-Callov -Oxford
Lathi Formation-Lias -Batho ?
Marwar Supergroup - Prob. Lr. Camb.
Malani Group - Precambrian
Gravel / Sand - Recent
Uttarlai Fm. - Quaternary
Kaburdi Fm.
Dykes / sills
Mata Dungar Fm.
Akli Formation
Lower Eocene
Barmer Basin
Barmer Fm.
Fatehgarh Fm.
Palaeocene
Sanu Fm. - Lr. Cretaceous
Birmania Fm.
Randha Fm.
Proterozoic - Lr. Cambrian
Malani Group
Basement
Precambrian

Geological map of Tertiary formations of the Jaisalmer Basin




STRATIGRAPHIC SEQUENCE
SUB - SURFACE
SURFACE
NW
SE
AGE IN MILLION YRS.
CHRONO UNITS
PLANKTONIC ZONE
MICROFAUNAL EVENTS
ENVIRONMENT
QUATERNARY
Sub-Recent-Pleistocene
PLIO
MIO
L
S
2
32
35
40
45
50
55
60
65
66.5
TERTIARY
OLIGOCENE
EOCENE
PALEOCENE
EARLY
LATE
MIDDLE
UNCLASSIFIED
P-20
P-19
P-18
P-17
P-16
P-15
P-14
P-13
P-12
P-11
P-10
P-9
P-8
P-7
P-6b
P-6a
P-5
P-4
P-3
P-2
P-1
HIATUS
Bandaha Fm.
Khuiala Fm.
Sanu Fm. (Marine)
Sanu Fm. (Non marine)
Habur Fm.
Parh Fm.
Goru Fm.
LATE CRETACEOUS
Regional Uplift
Transgression
Regre.
Transgression
Regre.
Trans.
HIATUS
Non-marine
HIATUS
Inner - middle shelf zone
Transitional
Inner - middle shelf zone
Inner to outer shelf zone
Non marine
Marginal marine
MICROFAUNAL EVENTS
9. Nummulites fabianii - Baculogysinoides sp.
8. Nummulites bageiensis.
7. Nummulites burdigaiensis.
6. Assilina granulosa.
5. M. velascoensis / Assilina dandotica
4. M. velascoensis / Assilina dandotica.
3. Planorotalites pseudomenardii
2. Planorotalites pusilla pusilla
1. Barren Zone
Appearance level
Disappearance level
LEGEND
Limestone
Argillaceous limestone
Glauconitic limestone
Marl
Shale
Glauconitic clay
Sand
Coarse, pebbly sandstone
After N. P. Singh, 1996

Sanu Formation

- Named after village Sanu, represents lowermost Tertiary formation in Jaisalmer basin. Palaeocene age (Singh 1999).
- Comprises poorly consolidated, cross-bedded, reddish glauconitic sandstone and silty sandstone, overlying the Pariwar Formation of Jurassic period.
- Divided into two members: Mohammed Dhani Member and Kharatar Member. The latter member has rare surface exposures.
- Mohammed Dhani Member is denoted by moderately hard and friable, medium to coarse grained, reddish yellow cross-bedded sandstone with clay and shale bands.
- Kharatar Member is of calcareous sandstone, coquinoidal and glauconitic limestone and Marl.
- Maximum thickness is 670m, continental environment of deposition in lower beds and upper beds represent marine influence.

Khuiala Formation

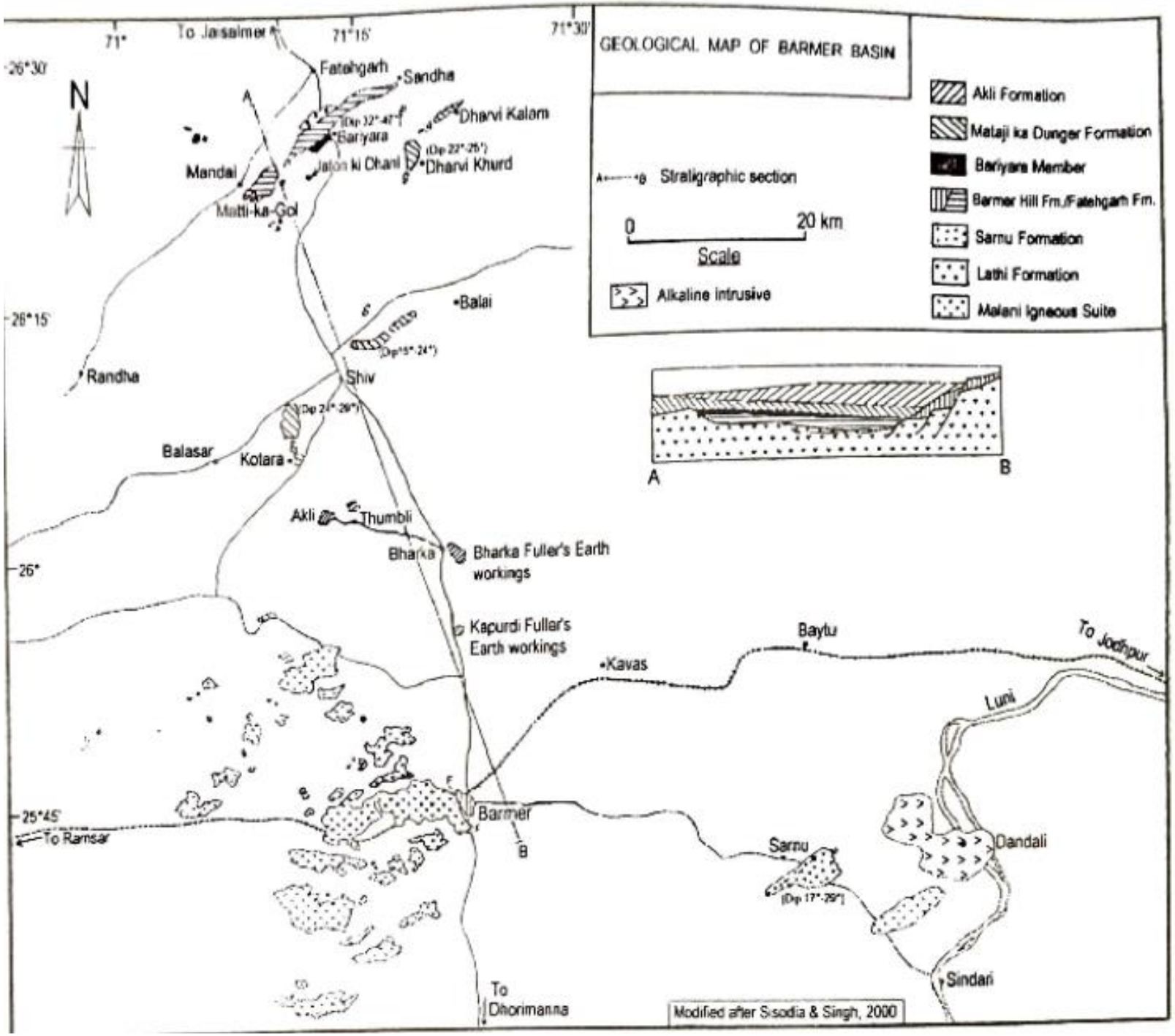
- Named after Khuiala village and also exposed in Te-Takkar and Khinsar villages, underlying Bandah Formation with unconformable contact
- Maximum thickness is of 400m, virtually horizontal beds
- Divided into four members: Hingola, Te-Takkar, Sirhera, Khuiala Scarp
- Comprises argillaceous limestone, foraminiferal beds, shales and clay beds
- Fossil assemblages include: *Nummulites, Assilina, Orbitolites, Alveolina, Lockhartia* indicating Late Palaeocene to Lower Eocene age.

Bandah Formation

- Named after Bandah village in Jaisalmer district. Two sections represent total exposures at: Batewala Tibba and Shumarwali Talai
- Comprising Clay, argillaceous and chalky limestone. Unconformably overlain by Quaternary Shumar Formation. Max. thickness 200m
- Two members: Bakhri Tibba Member and Habib Rahi Member.
- Comprises hard foraminiferal limestone with intercalations of marl and brown clay. Fossils include *Nummulites, Assilina, Alveolina* and *Discocyclina*. Besides this Lamellibranchs and echinoides are also present

Barmer Basin

- Six Formations: Sarnu Formation, Fathegarh Formation, Barmer Formation, Akli formation, Mataji-Ka Dungar Formation, Kapurdi Formation.
- Barmer basin is narrow, elongated and roughly N-S trending linear Graben. Northern limit is marked by arcuate Fatehgarh Fault and southern limit is Barmer hill representing a fault
- Inverted Barmer basin has a maximum length of about 100km and width of about 50km. Conceived as an extension of Cambay Basin connected through Sanchor basin south.
- Basin developed due to tensional faults along margins accompanied by volcanic activity.


GEOLOGICAL MAP OF BARMER BASIN
Akli Formation
Mataji ka Dunger Formation
Bariyara Member
Barmer Hill Fm./Fatehgarh Fm.
Sarnu Formation
Lathi Formation
Malani Igneous Suite
Stratigraphic section
0
20 km
Scale
Alkaline intrusive
To Jaisalmer
71°
71°15'
71°30'
26°30'
26°15'
26°
25°45'
N
Fatehgarh
Sandha
Dharvi Kalam
Bariyara
Jalon ki Dhani
Dharvi Khurd
Mandal
Matti-ka-Gol
Balai
Randha
Shiv
Balasar
Kotara
Akli
Thumbli
Bharka
Bharka Fuller's Earth workings
Kapurdi Fuller's Earth workings
Kavas
Baytu
To Jodhpur
Luni
Barmer
To Ramsar
Sarnu
Dandali
Sindari
To Dhorimanna
A
B
Modified after Sisodia & Singh, 2000

Sarnu Formation

- Basement for the Barmer basin and underlained by Malani magmatic rocks. Best outcrops close to Sarnu hill and Lunnu hills NW of Barmer
- Lithologically of red siltstone, fine to pebbly feldspathic sandstone and grit containing plant fossils. Devoid of fauna
- Maximum thickness is about 60m and dip is 27 to 29 degrees SE.
- Continental depositional environment.
- Cross bedding present indicating SW direction of palaeocurrent.
- Floral assemblage indicates Lower Cretaceous age.

Fatehgarh Formation

- Exposed in the fault scarp at Bariyara south of Fatehgarh
- Consists of Conglomerate, ferruginous sandstone and phosphatic mudstone. Bentonite and clay are also present.
- Maximum thickness is about 40m and general strikes is NE-SW and dip varies from $35\text{-}47^0$
- Divided into two members: Lower Vinjori Member of silty sandstone and orthoquartzite bands and Upper Sajit Scarp Member of Coquina band with abundant gastropods and bivalves
- Palaeocene age

Barmer Formation

- Underlie Akli formation and overlies Fatehgarh Formation with NNW-SSE strike and 20-25^0 easterly dip. 70 m thick
- Two members: Mandai Scarp member with cross bedded pink silty sandstone and Barmer Hill Member: Sandy siltstone with bedded chert, conglomerate and siltstone with leaf impressions.
- Rapid alluvial fan environment. Devoid of fauna fossils. Angiosperms fossil leaves are present
- Palaeocene age

Akli Formation

- Named after Akli village with maximum thickness of 280m
- Formation is carbonaceous, gypsiferous and pyritous in lower parts having foraminiferal fossils. Lignite is also associated
- Upper part has ferruginous sandstone, bentonite-clays and siliceous earth, shales and sandstone with or without phosphate.
- Lower member is called as Thumbli Member and Upper member is called as Akli member/Kapurdi's Fuller Earth Member
- Rich store of Bentonite and siliceous earth, montmorillionite, cristobalite silica and other similar set of minerals
- Age Palaeocene to early Eocene

Mataji-ka Dungar Formation

- Also called as Mandia Sandstone Formation (Pareek, 1984).
- Composed of coarse grained, ferruginous sandstone with clay and bentonitic clay bed at base.
- Maximum thickness is of about 180m and indicates continental palaenvironment.
- Poor presence of fossils, except in lower part where angiosperm leaf impressions are seen
- Eocene and Lower Palaeocene age has been assigned by different authors

Kapurdi Formation

- Youngest Tertiary formation of Barmer basin, overlain by Quaternary Uttarlai Formation. Maximum thickness is of about 12-15m.
- Lithologically comprises of Fuller's earth with carbonaceous streaks and gypsaceous clay in the lower part whereas with dull argillaceous limestone and bioclastic marl in upper part.
- Common fossil recorded in the formation include foraminifera, ostracoda, echinoids and lamellibranchs. Fossils of plants, crabs, turtles, gastropods and fish are also reported.
- Early Eocene age is the most accepted age.

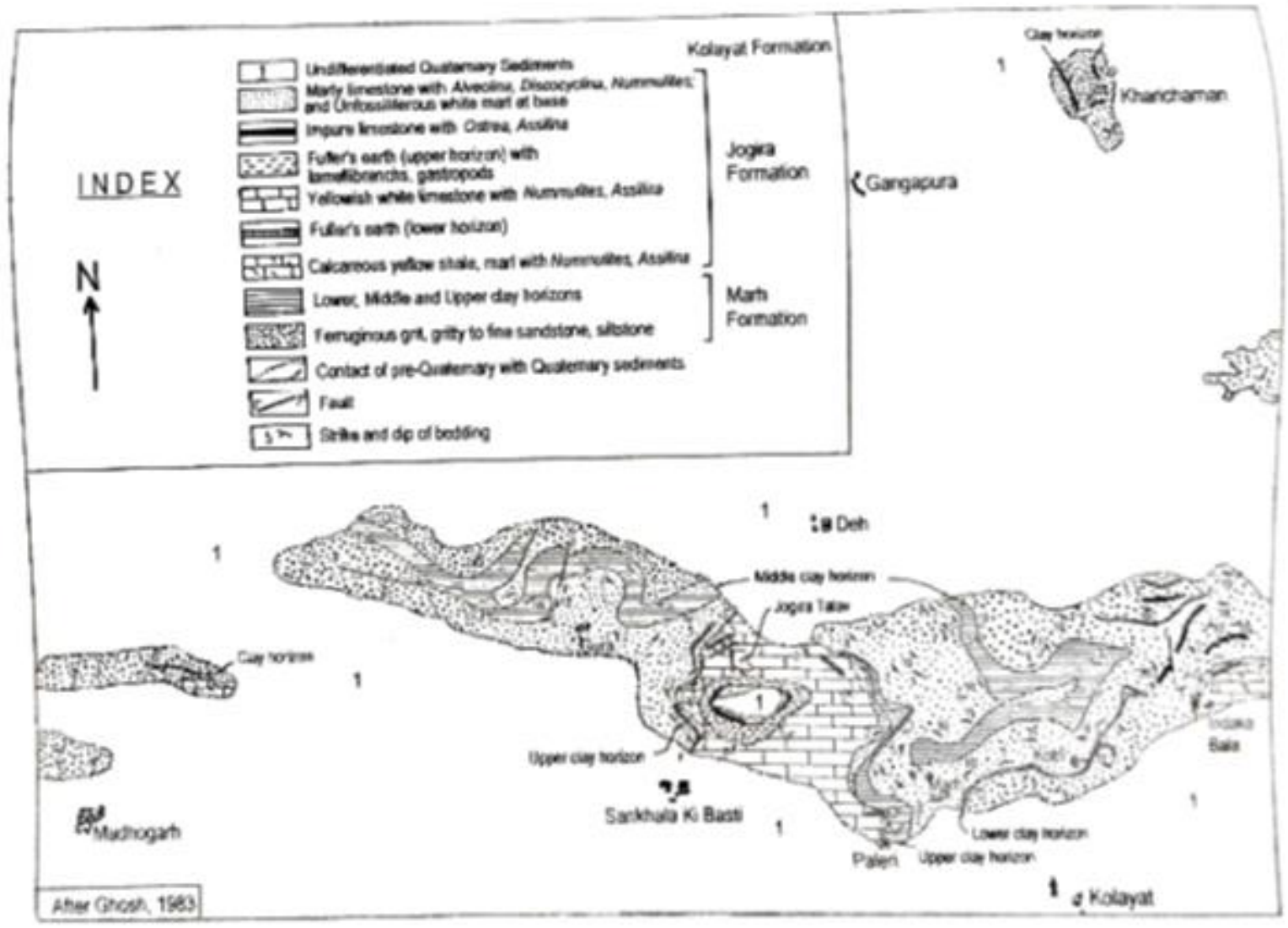


Fig. 9.35. Geological map of Tertiary Formations of Bikaner area, Western Rajasthan (after Ghosh, 1983a)

Bikaner-Nagaur Basin

- Three Formations: Palana Formation, Marh Formation, Jogira formation exposed in the districts of Bikaner, Churu and Nagaur and subsurface extension upto Ganganagar district.
- Overlain by blown sand, gypsite beds and alluvial sand of recent age
- Exposures are found as detached outcrops and best developed along Bikaner-Kolyat highway for 54km WSW of Bikaner
- Age is of Middle Palaeocene to Middle Eocene
- Continental conditions of deposition after withdrawal of Sea under fluvial and arid to eolian conditions

Pleistocene to Recent	Kolayat Formation	Sand and sandy alluvium	5 to 11 m
		Ironstone nodule, sandy calcareous grit kankar, gypsite	
		Ferruginous band, semi-consolidated conglomerate	1-2 m
		Erratic boulder of quartzite	?
		——————Unconformity——————	
Lower to Middle Eocene	Jogira Formation (Calcareous facies)	Shaly and marly limestone with foraminifers (*Alveolina, Discocyclina, Nummulities*)	5-10 m
		Unfossiliferous, white clayey marl.	1m
		Dirty brown impure limestone with broken shells of *ostrea* and foraminifers (*Assilina*)	1.5 m
		Fuller's earth with shale partings having casts of lamellibranchs and gastropods.	14 m
		Cream and yellowish white limestone full of smaller foraminifers (*Nummulites* and *Assilina*) with a thin band of fuller's earth (1-2 m) near base	75 m
		Yellow shales ochers, marl, etc. with smaller foraminifers (*Nummulites, Assilina*)	20 m
		—————— Angular unconformity ——————	
Upper Paleocene (?)	Marh Formation (Arenaceous facies)	Upper clay horizon with one clay bed	3-10 m
		Ferruginous sandstone, gritty sandstone and sugary sandstone with white glass sand (local)	60 m
		Middle clay horizon with five clay beds and sandstone partings	50 m
		Ferruginous sandstone, gritty sandstone, grit, siltstone	70 m
		Lower clay horizon with one clay bed	1-3 m
		Ferruginous sandstone, gritty sandstone, various siltstone with leaf impressions (Base not exposed)	20 m
		—————— (?) Gradational Contact ——————	
Lower Paleocene (?)	Palana Formation (Carbonaceous facies)	Fine grained sandstone carbonaceous shale and lignite	?
		—————— Base not encountered ——————	

Palana Formation

- Named after Palana village in Bikaner district and consists of grey variegated shales, carbonaceous shales, clay and shaly lignite seams.
- Lignite deposits are abundant and about 120m thick.
- Overlies Badhura Formation with pronounced unconformity and upper boundary is gradational with Marh Formation.
- Lignite beds show subtropical swampy environment conditions
- Occurrences of fresh water fish skulls has also been reported.
- Polospore assemblage indicates Middle Palaeocene to Lower Eocene age

Marh Formation

- Found in Marh and Kolayat villages of the Nagaur and Bikaner district.
- Lower units are rich in Fuller's Earth with intercalated bodies of argillaceous limestone and shale.
- Cross-bedded sandstone with light-dark coloured clays are also seen
- Leaf impressions are seen in sandstone.
- Outcrops are exposed along 35km length with a maximum width of 7km trending E-W, affected by N-S fault
- No faunal fossil has been recorded. An early Eocene age is suggested.
- Fluvial paleoenvironmental conditions of deposition

Jogira Formation

- Exposed near Jogira Talab village in Bikaner district
- Represented by alternations of Marl, yellow shales, siltstone and fullers-earth and foraminiferal limestone
- Topmost *Discocyclina* bed is typically a yellow stone bed.
- Maximum thickness is about 60m forming an oval shaped outcrop pattern of an area about 26 sq km. Number of NNE-SSW faults have affected the outcrop pattern.
- An inner to middle Neritic palaeoenvironment predicted with the help of fossils