CHAPTER - IV

GEOLOGICAL SETTINGS

BASIN CONFIGURATION

The Jaisalmer Basin is pericratonic basin, representing mainly the western dipping eastern flank of the Indus shelf, characterised by several second and third order structures (Fig.IV.1) Tectonically, the Jaisalmer basin is divisible into three zones viz.,

a) the raised Mari-Jaisalmer Arch extending through the central part of the basin with a NW-SW trend and flanked by,

b) the synclinal Shahgarh basin to south and southwest, and by the

c) monoclinal Kishangarh sub-basin to the north and northeast.

Along the south-eastern part of the Mari-Jaisalmer Arch, a number of sedimentary formations, from Lias to Lutetian age have been exposed on the truncated, peneplained Precambrian basement. In the present investigation, Jurassic sediments have been studied in detail.

STRATIGRAPHY

As has been mentioned in the introductory chapter, the review of previous work has revealed that the Jurassic sediments are characterised by varied lithological associations, sedimentary structures, a diverse and rich occurence of fauna. The area is limited up

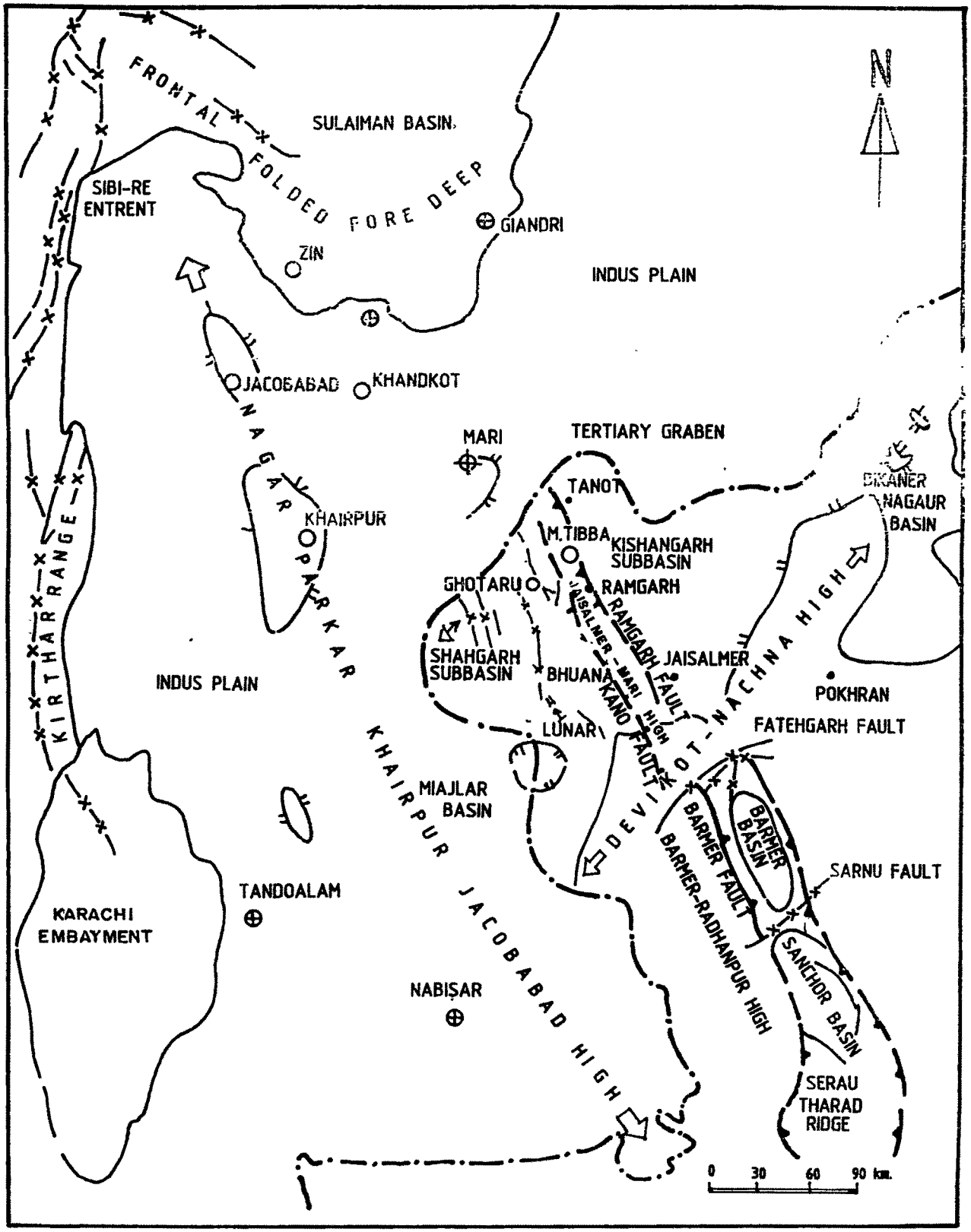


FIG.IV.1 REGIONAL TECTONIC PATTERN, NORTH WESTERN INDIA

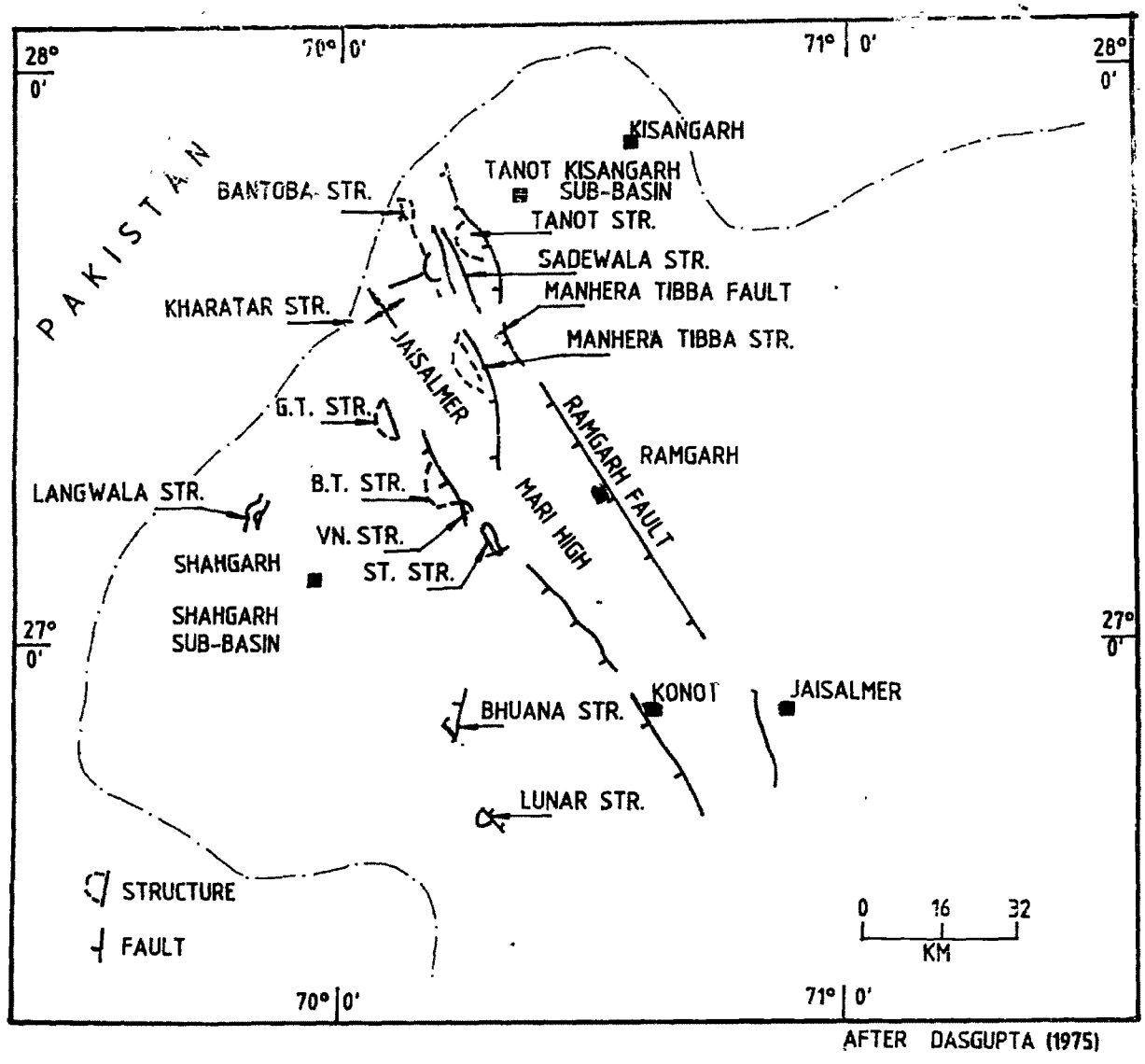


FIG.IV2 TECTONIC MAP OF RAJASTHAN BASIN

N. Latitudes 26° 30' to 27° 12' and E. Longitude 70° 44' to 71° 30' and occupying effective exposed area of about 3870 sq km. (Fig. IV.2&3). The Lathi Formation, the lowermost unit of the Jurassic sequence is seen resting on the older formation, (Dangri Village). However, the lower contact of this formation with the Tertiary sediments of the Barmer basin is faulted and designated as Fatehgarh fault. The sediments are dipping gently (at very low angles up to a max. of 5°) towards the north-west to north-north-west following NE-SW trends. Though the area is fairly large, the exposures are comparatively few on account of the thick cover of recent sand dunes. There are hardly any well defined river cuttings across the area. However, an attempt has been made to cover most of the cuestas and available road and river sections in order to do sampling, and record the sedimentary structures and other field evidences. The nomenclature and classification of the stratigraphic succession as worked out by Das Gupta (1974) have been recognised by the author in the field and are systematically worked out and described in detail. Fig.III.2 shows the stratigraphic succession of Jurassic sediments of the area along with the thickness, as computed on the basis of the present work.

LITHOFACIES AND SEDIMENTARY STRUCTURES

The lithostratigraphic units of member status, belonging to the exposed Jurassic sediments, which constitute Lathi, Jaisalmer, Baisakhi and Bhadasar formations in ascending order, originally identified by Das Gupta (1974), have been recognised by the author in the field, and have

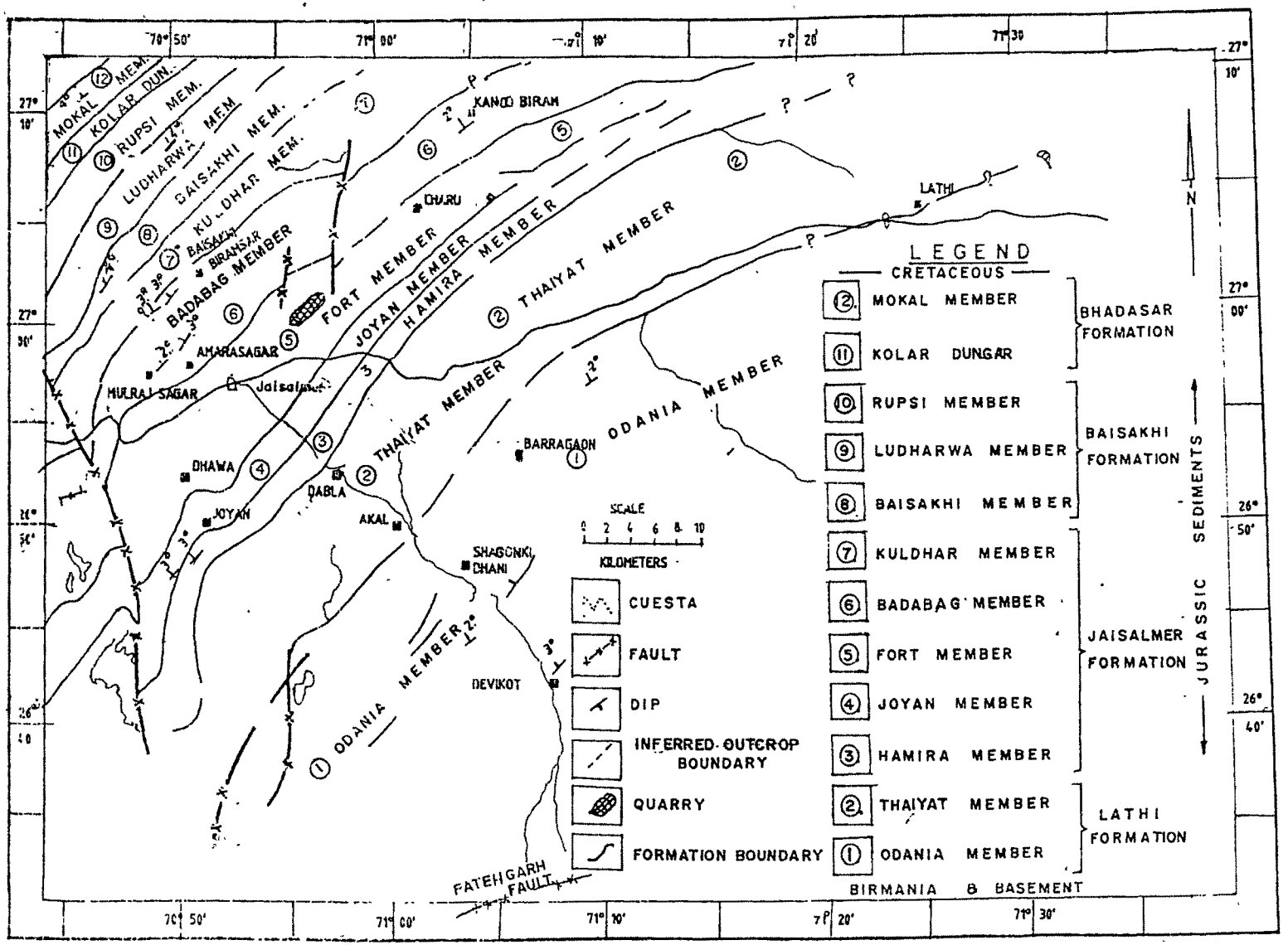


FIG IV.3 GEOLOGICAL MAP OF JAISALMER AREA, WESTERN RAJASTHAN, SHOWING JURASSIC OUTCROPS.

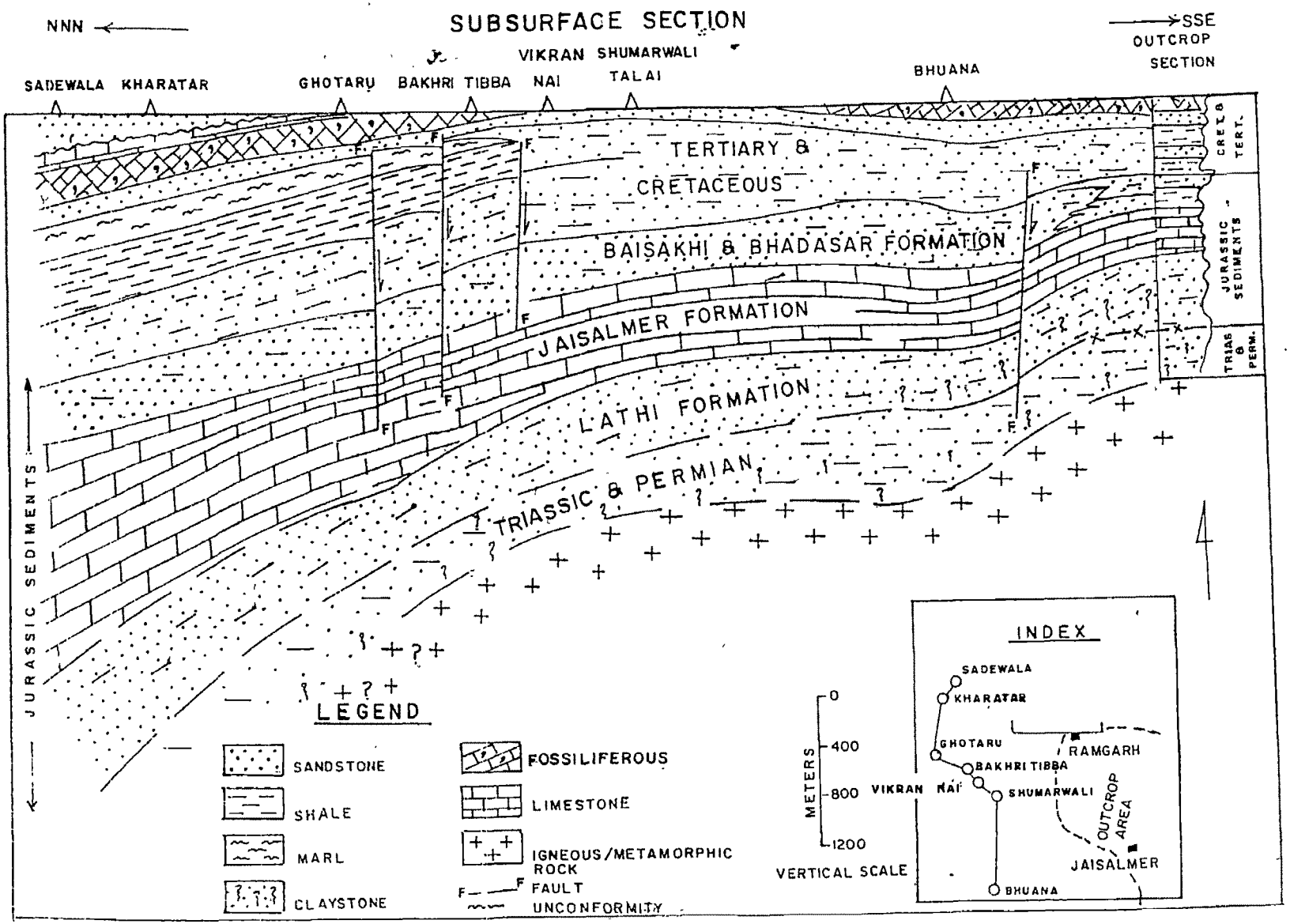


FIG.IV,4: SCHEMATIC GEOLOGICAL SECTION ACROSS- JAISALMER BASIN

been systematically studied and described in detail.

Lathi Formation

This is the lower most formation of Jurassic sediments named by Oldham (1886) after the village Lathi on the Pokran-Jaisalmer road. One of the most important unconformities, at the base of the Lathi is found in this region. This formation rests at various places on the Permian Bedhaura, the supposedly lower Palaeozoic Birmania or its equivalents, as well as Precambrian acid volcanic or granitic rocks.

The Lathis comprise a sequence of conglomerate, poorly sorted coarse grained sandstone and siltstone with abundant fossil wood, mostly ferruginised and occasionally solely silicified. On the basis of lithological details it has been divided into two members, namely Odania Member and Thaiyat Member.

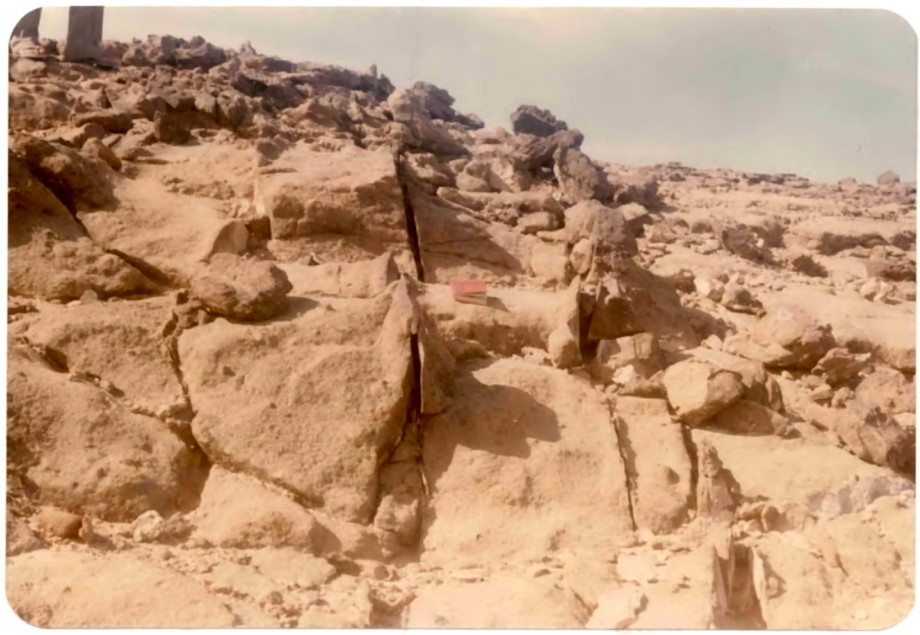
Lithofacies and outcrop characters

Odania Member

The lower most member is typically exposed in Lathi Odania section and is characterised by a conglomerate bed over the Proterozoic Billara Limestone as seen to the north and south east of Odania village. This is followed by a sequence of white to maroon siltstone, coarse to medium-grained, illsorted, gritty sandstone (Plate IV 1A) grading upwards to siltstone with numerous impressions of wood fossils. Fine grained, ferruginous sandstone showing NNE-SSW trends of joints

PLATE-IV.1

A. Ferruginous, gritty, poorly sorted sandstone with silicified fossilwood (not seen in photograph). Odania Member, Lathi Formation; Locality: Fossilwood park, Akal.



B. Fine grained, ferruginous, well sorted sandstone showing NNE-SSW trend of joints, Odania Member, Lathi Formation; Locality: Fossil-Wood park Akal.

have been also observed in the upper part of the Odania Member in Akal area (Plate IV 1B). This sequence is overlain by a conglomerate bed with fossil tree trunks in coarse grained sandstone bands, in the scarps south of Bhojaka. The conglomerates are made up of rounded pebbles, mainly of quartz, chert, and jaspar with minor amount of sandy matrix. The sandstone are soft, medium to coarse grained, moderately compacted, occasionally well bedded, light grey to grey in colour; at places stained with shades of purple yellow, brown colour, ripple marks and current bedding (tabular and lenticular type) and cross-bedded features are commonly observed in a exposed fine grained sandstone section along the road cutting 1 Km NE of Akal village (Plate IV. 2A). The beds have a NNE-SSW strike with horizontal or gentle undulating dips. (Plate IV. 2B).

Thaiyat Member

This member is best exposed in the scarp to the west and northwest of Thaiyat village (Plate IV. 3A). Very good sections of the upper part of Lathi are also seen around Moklat, Dabhla, devikot, Chor, etc. Except along the scarps, the Lathi beds are generally poorly exposed, being covered by windblown sand spreads; Because of its predominantly arenaceous facies, the Lathi topography is generally featureless. Besides a few scarp section and isolated hillocks exposing Lathi sediments, the area is a vast flat land covered by a thick layer of sand and sandy soil. It is characterised by a sequence of thin interbeds of fine grained, calcareous, yellow to buff coloured sandstone,

PLATE-IV.2

A. Cross bedded, fine grained sandstone with thin intercalation of marl and hard siltstone, Odania Member, Lathi Formation; Locality: 1 km NE of Akal, Road section.

B. Horizontal, thinly bedded, ferruginous siltstone and light brown, hard, compact, fine grained sandstone. At places sandstone shows lensoid nature. Odania Member, Lathi Formation; Locality: 1km NE of Akal, Road section.

variegated siltstone with thin layers of red siltstone at the top (Plate IV. 3A). The calcareous sandstone sequence shows Karbub structure, a sort of tubercle like concretionary structure caused by the aeolian erosion in sandstone. The upper contact of the member shows an intertonguing relationship with the overlying Jaisalmer Formation (Plate IV. 4A).

Thickness

Though the Lathi Formation is poorly exposed, a few water wells have been drilled though the whole thickness of the formation and general lithological characters have been recorded. On account of the fact that the rock exposures are poor and scanty over long stretches of the area traversed, estimation of exact thickness is very difficult. The problem is aggravated by the near horizontal to very low ($1° - 4°$) dipping nature of the Lathi beds. However, with all these constraints and with a fair amount of generation and correlation with the subsurface data available from exploratory tube wells, the thickness computed comes to 700m, The thickness of Lathi Formation in subsurface section, drilled by ONGC in Sumarwali Talai and Bhuvana structures have been recorded as 790 m and 533 m respectively. A considerable thickening of the formation towards the Shahgarh basin is expected, based on seismic stratigraphy.

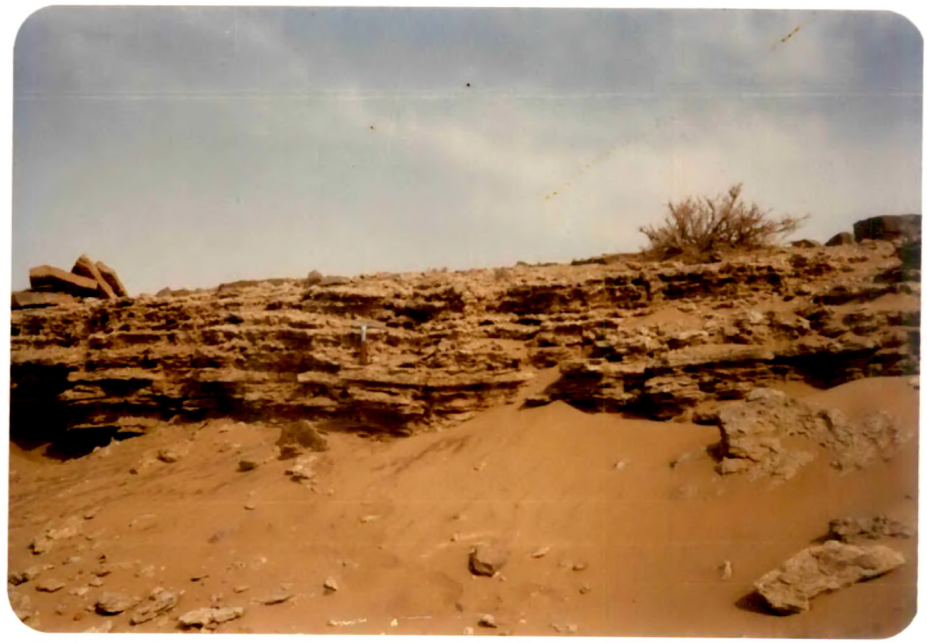
The general coarser nature of sediments, along with sedimentary feature like ripple marks, current bedding and the presence of plant impressions and fossil wood are indicative of a deltaic environment for

A. Ferruginous marl bed on the top of Lathi Formation mark the gradational contact between overlying Hamira Member (Jaisalmer Formation, lower most part) and underlying Lathi Formation; Locality: North of Thaiyat village.

B. Yellowish brown calcareous claystone showing ptygmatic and micro folds within the ferruginous claystone near Fatehgarh fault at the base of Lathi Formation; Locality: NW of Fatehgarh village.

PLATE-IV.4

A. Lower contact of Jaisalmer Formation with underlying Lathi Formation, marked by reddish brown marl Bed. Locality: near Thaiyat.



B. Thinly bedded, light yellow calcareous sandstone and marl, Hamira Member, Jaisalmer Formation; Locality : Near Thaiyat, road section.

Lathi sediments. Lathi sediments show a gradual transition from deltaic to marine environment towards the top as indicated by the gradational (intertonguing) contact with the overlying Jaisalmer Formation (Plates IV-3A and 4A).

Stratigraphic relationship

The lower contact of this formation with the Tertiary sediments of Barmer basin is faulted and designated as the Fategrah fault (Saproo et.al., 1981 not covered in the study area). Similarly, in the Jaisalmer Basin, adjacent to the Fatehgarh fault and to the north west of Fatehgarh village, the yellowish brown, calcareous claystone found at the base of Lathi Formation, exhibits ptygmatic and micro-folds, indicating a faulted contact, (Plate IV 3B). However, at Dangri, Lathi beds are seen resting directly over the basement, conformably overlain by the Jaisalmer Formation with which it has as intertonguing contact (Plate IV 4A).

Palaeontological evidence for age and correlation

Except for dicotyledonous wood fragments and fossil tree trunks, no diagnostic fossils have been found in the Lathi Formation. Silicified gastropod referred by Narayanan (1964), belong to the Fatehgrah Formation of the Balmer basin (Das Gupta 1975). The core and cuttings of the tubewell section at Chore have shown a sporomorph assemblage indicative of a Liassic age for the lower parts of the section (Lukose, 1972).

Jaisalmer formation

The original Jaisalmer Limestone of Oldham, (1926), has been redesignated as the Jaisalmer Formation by Swaminathan et. al., (1959). Later workers (Narayanan et al, 1960, 1961) retained the classification proposed the Swaminathan; Das gupta (1974) further subdivided the Jaisalmer Formation into five member viz. Hamira, Joyan, Fort, Badabag and Kuldhar members in ascending order. These have been studied in detail by the author and summarised below.

Gross Lithology

The Jaisalmer Formation is characterised by alternations of sandstone, calcareous sandstone, limestone, bioclastic limestone, with thin interbeds of oolitic limestone and shale at the top. Limestones are invariably oolitic and sandy in nature and show a continuous gradation from sandy limestone to calcareous sandstone. They are generally hard, massive to flaggy and orange to yellow brown in colour. The dolomitized portions of the limestone are generally greyish in colour and are seen mainly in the lower and partly in the upper parts of the formation. Sandstones are generally soft, fine to medium grained, whitish grey, buff to yellowish brown in colour, current bedded with occasional thin bands of ferruginous compact sandstone found in the basal part of the formation. Clays are dirty grey to pale yellow, at places containing abundant gypsumcrystals in the form of thin sheets, which occur mainly parallel to the bedding and also sometimes in perpendicular cracks.

Structure and attitude of beds

The lower contact of the Jaisalmer Formation with the underlying Lathi is both gradational and intertonguing, while the overlying Baisakhi Formation has an unconfromable contact. The sediments follow a NE - SW trend, dipping towards the northwest and north-north west at a very low angle upto a maximum of 5°. Some erratic dips of about 15° are noted and are largely due to local slumping of the beds. One major fault has beed marked in the western part of the study area which trends in a NNW-SSE direction. The sudden disappearance of beds in the western part and the presence of younger beds in contact with the older beds to the east, is indicative of a fault, with the eastern side as the downthrown block of the fault.

Sedimentary structure

The sedimentary structure such as crossbedding (planar as well as trough) are noticed in the sandstone and limestone scarp sections of the Fort and Joyan members. Ripple marks and burrowing structures are also observed in the road and river sections in the area.

Characteristic features of member of Jaisalmer Formation

The Jaisalmer Formation has been divided into five member in an ascending order on the basis of lithological characters. The main characteristic features are summerised below :-

a) Hamira Member

It is the lower most member of the Jaisalmer Formation, typically exposed at the top of Thaiyat scarp and characterised by a yellow arenaceous limestone with thin beds of medium - to coarse - grained sandstone with fragmentary bivalve shells and having an intertonguing relationship with the underlying Lathi formation (Plate IV. 4A). The limestone consists of sandsized grains and shows some degree of dolomitization. The upper beds are blocky, with a somewhat coquinoidal appearance. A thin whitish to dirty brown coloured mari band, has been observed within the limestone (Plate IV 4B and IV 5A). The thickness of this member varies between 70-90m.

b) Joyan Member

This member is exposed near Joyan and comprises of greyish white to buff coloured, fine to mediumgrained fossiliferous sandstone, showing crossbedded features (planar as well as trough), (Plate IV 5B). These sandstones are composed of subangular to subrounded grains of quartz, moderately compacted at the base, overlain by ferruginous, gritty sandstone, and are capped by a thin bed of fossiliferous limestone.

c) Fort Member

This member is best exposed on the Jaisalmer Fort escarpment

PLATE-IV.5

A. Yellowish brown, moderately hard, marl and light brown, cross-laminated, fine grained, sandstone, Hamira Member, Jaisalmer Formation; Locality: 7 km SE of Jaisalmer town.

B. Cross bedded, fine grained, fossiliferous, sandstone, Joyan Member, Jaisalmer Formation; Locality: 7 km SE of Jaisalmer town.

situated to the northwest of Jaisalmer town. It is also developed between Jesurana and Ghauri Dungar area. It is characterised by a basal feldspathic sandstone followed by limestone and an occasional shale bed at the top. The sandstone are buff to dirty white in colour, fine to medium grained,moderately compacted, feldspathic, having subangular to subrounded grains of quartz, feldspar and mica flakes and show cross-bedded features (Plate IV 6A). The limestone is golden yellow to yellowish brown, hard and compact, fossiliferous and oolitic, generally horizontally bedded,at places,showing herring bone cross-lamination (Plate IV 6B). The limestone, at places is marly in nature and contains many small brachiopods, echinoid and molluscan shell fragments.

d) Badabag Member

It is well exposed in the scarp sections of Badabag area. The basal part of the member is characterised by a yellowish brown, oolitic, massive limestone containing brachiopod and echinoid shells. It is overlain by sandy limestone having thin marl bands, followed by intraformational conglomerate (Plate IV 7A), and sandy limestone which contains pebbles of jasper and chert. The sequence is capped by cross-bedded, coarse grained calcareous, greyish brown to buff coloured sandstone (Plate IV & B & 8A). The thickness of this member ranges from 50-120m.

e) Kuldhar Member

The top most member of the Jaisalmer Formation is well exposed

PLATE-IV.6

A. Light yellow, fine grained, sandstone (Basal part of Fort Member) showing faint cross lamination, Fort Member, Jaisalmer Formation.

B. Light yellow, hard, sandy, oolitic limestone showing herring bone cross lamination, indicating tidal effect during deposition, Fort Member, Jaisalmer Formation; Locality : Fort Escarpment around Jaisalmer.

PLATE-IV.7

A. Intraformational conglomerate bed exposed in Badabag section; Locality : Badabag.

B. Cross bedded, calcareous sandstone, exposed in type section of Badabag Member; Locality : Badabag Village.

in a river cut section near Kuldhar village. The basal part of the member is an argillaceous sandstone which is sometimes ferruginous and is overlain by argillaceous limestone with abundant species of Turritella and Belemnites. The sequence is followed by alternations of fossiliferous limestone, siltstone and shale. The limestone sequence above the basal beds also contains many large ammonites, crinoid-stems, pelecypods and echinoid spines and plates. The limestone and claystone are oolitic in nature (Plate IV 8B). The oolites are golden brown in colour when fresh, but get tarnished on the weathered surface. The limestone at places are highly argillaceous with thin bands of shale (Plate IV 9A). In the Kuldhar Nala section, the upper most unit of this member is represented by gypsiferous shale (Plate IV 9B) suggesting a shallowing of the sea during the deposition of the unit. In the Biramsar area, thinly bedded calcareous sandstone represents the basal part of Kuldhar Member (Plate IV 10A). Presence of a poorly compacted conglomerate bed, marks the unconformable contact of Jaisalmer Formation with the Baisakhi Formation. (Plate IV 10B).

Thickness

The thickness of the exposed section of Jaisalmer Formation varies from 490m, recorded along Thaiyat-Kanod traverse, to 700 in the Thaiyat-Biramsar traverse. In Ghotaru structure drilled by ONGC a maximum thickness of 1138 m, has been recorded (Pandey A.N., et. al. 1987, 88).

Palaeontological evidence and geological age

The Jaisalmer Formation has a rich variety of fossils. A large

A. Light yellow, fine grained moderately sorted cross-bedded,sandstone (lower) overlain by flaggy oolitic limestone, Badabag Member, Jaisalmer Formation.

B. Ferruginous fossiliferous oolitic claystone, overlying hard, compact micritic limestone, suggesting unstable shelf condition of deposition, Kuldhar Member, Jaisalmer Formation; Locality : Kuldhar Nala section Near Kuldhar.

PLATE-IV.9

A. Ferruginous, argillaceous, limestone with band of shale exposed in Kuldhar nala section near Kuldhar village.

B. Gypsiferous shale representing topmost unit of Kuldhar Member, exposed in Kuldhar Nala section, suggesting shallowing of sea during deposition of upper part of Jaisalmer Formation; Locality : Near Kuldhar Village.

PLATE-IV.10

A. Light brown, thinly bedded, very fine grained, sandstone, Kuldhar Member, Jaisalmer Formation; Locality Near Biramsar River section.

B. Conglomerate bed overlying highly calcareous light brown, sandstone; upper part of Jaisalmer Formation (Kuldhar Member), making unconformable contact between Jaisalmer and Baisakhi Formation; Locality : 1/2 KM NW of Biramsar village in Biramsar river section.

number of species belonging to diverse groups such as gastropods pelecypods, echinoderms, brachiopods, echinoides, corals, algae have been reported by earlier workers (Spath 1933, Lubimova et. al., 1960 Subbotina et. al., Singh et. al., 1969, Das gupta 1975, Kachhara et. a., 1981, and Kalia et. al., 1983).

Dinosaurian bones from the sandstone sequence of the middle member of Jaisalmer Formation 2 km NNE of Jaisalmer city, have been recorded (Mathur U.B, et. al., 1985).

Kachhara and Jodhawat (1981) have studied the megafossiles of Jaisalmer Formation in detail. The important fauna recorded by them are: Lissoceratoides, Dhosaites, Mayaites, Reineckeia, Sivajeeras etc. in Kuldhar Member ; Trigonia brevicostata kitchin, Dactyomya I acryma J. dec. Sowerby in Badabag Member ; Carbula Iyarata J. dec Sowerby C. daghaniensis cox, Eomiadon indicus cox etc. in Fort Member; Rhactovicula, Isognomon, Kaoraensis com, P. stolickai cox in Hamira Member, The microfossils like foraminifers and ostracods from Jaisalmer Formation have also been reported.

The fossil assemblage indicates a Callovian-Oxfordian age for the formation (kachhara & Jodhawat, 1981). The bioclastic and arenaceous nature of limestone having the above faunal assemblage, suggests a shallow marine environment of deposition. The presence of evaporite

minerals in association with dolomite and the lithoassociation of oolitic beds in the Kuldhar Member, suggests a more restricted lagoonal environment, with moderate to high energy conditions at the end of Jaisalmer sedimentation.

Correlation

On the basis of similarity in lithological association and fossil assemblages the Jaisalmer Formation is considered to be correlatable with the Jumara Formation of Kutch (Pareck 1981). However, lack of prolific ammonite fauna of Kutch, indicates that the Callovian sequence is not perhaps well preserved in the Jaisalmer area. The lower part of the Jaisalmer Formation in a well-section, is clastic dominated, represented by sandstone and limestone which are oolitic at times, and are well correlatable with the Hamira and Joyan members of the exposed Jaisalmer Formation. The subsurface equivalent of exposed Fort, Badabag and Kuldhar members which consist of clastic-carbonates, is a dominantly carbonate sequence with thin intercalations of shale (Fig. IV.4).

Baisakhi Formation

Swaminathan et. al., (1959) defined this Formation by grouping together the shale and sandstone beds lying above the Kuldhar Member of Jaisalmer Formation, but below the gritty sandstone beds of the Bhadasar (originally spelt as Bedesir) Formation above. The Formation is named after village Baisakhi about 12 km, north of Jaisalmer. The

Baisakhi Formation comprises essentially of alternations of soft sandstone and silty shale with occasional gritty sandstone layers (Fig. IV.4). The sandstones are white to grey, occasionally pale yellow and brown, thinly bedded and moderately compacted with occassional encrustations of ferruginous concretions and nodules. Clay are variegated with shades of grey, pale yellow, purple colour and gypseous in nature.

The out crops are better developed in the Masurdi river section, scarps sections near Baisakhi, Ludharwa,, Rupsi, Nidh Dongar and road sections at Damodara and Jaisalmer-Ramgarh. On the basis of lithological association, the formation has been sub divided into three mappable members viz. Baisakhi, Ludharwa and Rupsi, in ascending order. The characteristic features of these litho-units are described below.

Baisakhi Member

The lower most member, typically exposed in the low scarps in the general flat Rann topography west of Baisakhi village, consists of grey to dark grey often shale, ferruginous with thin purple, violet, coloured sandy siltstone and streaks of gypseous clay.

Ludharwa Member

The sequence of the Ludharwa Member is typically exposed in the scarps around Ludharwa village, and consists of argillaceous sandstone (Plate IV 11A) with local slump structures and intraformational conglomerate.

PLATE-IV.11

A. Yellow, fine to very fine grained, mod. hard, well sorted, argillaceous sandstone intercalated with light yellow claystone, Ludharwa Member, Baisakhi Formation; Locality : NW of Ludharwa village.

B. Thinly bedded, light brown, fine grained, compact, sandstone; Rupsi Member, Baisakhi Formation; Locality; North of Baisakhi village.

Rupsi Member

The topmost Rupsi member is typically exposed in the scarp section west of Rupsi village and consists of intercalations of fine grained, light brown to grey, argillaceous sandstone (Plate IV 11B) and grey shales with ammonites. Gypseous clay bands with poorly developed current bedding has been observed at the top of this member.

Thickness

The exposed thickness of this formation as calculated from the field data, is about 166m.

Stratigraphic relationship

The lower contact of Baisakhi Formation with the underlying Kuldhar Member of Jaisalmer Formation is not clear, though Willing (1964) has suggested a time gap (i.e absence of Callovian in the stratigraphic column). The upper boundary with Bhadasar Formation is sharp and unconformable. Narayanan et. al., (1961), is of the opinion that the overlying Bhadasar Formation progressively overlaps this formation to the northeast of Bhadesar.

Palaeontology, Age and Correlation

The formation contains ammonites of smaller size and the species identified by Colignon (1964, IPE unpub. report) from bottom to

top are torquotisphinetes, sp. novd. Tlevuistrialvs spath, etcs, Katroliecsas depressum spath Torpuatisphinetes sp indet aff, alfernephicalus wag. are suggestive of a Kimmeridgian age.

On the basis of lithological similarity and fossil assemblage, the Baisakhi Formation is considered as homotaxial with the Katrol of Kutch (Narayanan et. al., 1960, 1961).

Bhadasar Formation

This formation, the original Bedesir beds of Oldham has been named after the Bhadasar village, exposed in the scarp section along the Bhadasar-Mokal road. The scarp extends to the southwest, with gradual widening of the outcrop.

Lithologically, the Bhadasar Formation is characterised by alternations of ferruginous gritty sandstone and friable red sandstone with intercalation of clay, followed by brown argillaceous sandstone with broken ammonite shells. On the basis of lithological association the formation may be subdivided into two mappable members showing the following characteristic features :

Kolar Dungar Member

The lower member of the formation comprises of ferruginous gritty sandstone alternating with poorly compacted fine to medium - grained sandstone and with calcareous claystone containing broken

PLATE-IV12

A. Contact of thinly laminated very fine sandstone of Baisakhi Formation and gritty ferruginous Sandstone of Bhadasar Formation (Kolar Dungar Member), Locality : Bhadasar Escarpment; NW of Bhadasar village.

B. Alternation of fine grained, light brown, sandstone and siltstone, showing thin lamination of ferruginous clays; Kolar Dungar Member, Bhadasar Formation; Locality : Bhadasar Village, Bhadasar Escarpment.

PLATE-IV.13

A. Light brown, fine grained, hard and compact sandstone showing cross lamination, Mokal Member, Bhadasar Formation; Locality : Near Mokal village.

B. Ferruginous sandstone, hard, compact, highly jointed, showing slump like structure, Mokal Member, Bhadasar Formation; Locality : NNE of Mokal Village.

ammonite shells. The lower gritty sandstone bed in the Bhadasar Scarp begins with the coquina layer containing belemnites, bivalve corals etc. It is overlain by ammonite bands. In the Nimar river section southwest of Bhadasar, giant ammonite fossils are occasionally encountered.

Mokal Member

The member is typically exposed in the scarps near Mokal high, and consists of hard, brown, argillaceous, fine to mediumgrained, current bedded sandstone(Fig. IV.4), which is highly jointed and contains fossil wood and fragments of broken, reworked ammonites, gastropods, bivalves, etc. The absence of an apparent break between the Kolar Dungar and Mokal members, represents a gradual change from a shallow, oscillatory marine to continental environment.

Thickness

On the basis of different traverse sections, an approximate thickness of 65 m has been worked out for Bhadasar Formation.

Stratigraphic Relationship :

The lower contact of this formation is sharp and non-gradational. According to Narayanan et al. (1961), the Bhadasar Formation overlaps the underlying Baisakhi formation, and the basal grit bed of Bhadasar Formation is seen to rest on succesively older beds of Baisakhi. The upper boundary of Bhadasar is not exposed. In south-western part the contact is believed to be uncomfortable, and in the north eastern part the Bhadasar Formation is reported to be overlapped by pariwar formation

(Saproo et al. 1981) Dasgupta et al. (1957), however suspect this contact to be conformable, and even gradational in the northern part.

Age and Correlation :

Megafossils comprising brachiopods, pelecypods, gastropods and cephatopods, collected by ONGC Geologists and identfied in the Commisions laboratories (Singh and Khanna, 1959) suggest an Upper Jurassic age for this formation. Spath (1927-33, 1938) as quoted by Narayanan et al. (1961) assigns port landian to Tithonian age to this formaion.

Narayanan et al. (1961) compare this formation with lower Umia beds of kutch.