Stratigraphy, depositional environment and hydrocarbon prospects in Moran Oilfield, Upper Assam

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The Moran oilfield is one of the oldest oilfields in the alluvium covered foreland shelf zone of Upper Assam basin. The various lithotypes encountered in the subsurface range in age from Late Eocene to Holocene. The Neogene and Holocene sediments correlate well with their counterparts of Nagaland and Arunachal Pradesh. The area was subjected to marine, brackish water and continental conditions. The marine influence came to an end after the deposition of Kopili Formation in Late Eocene. The remaining formations were deposited under brackish water to continental conditions. The climate that prevailed during the entire span of deposition was humid tropical. Moran Oilfield presently produces oil and gas from Barail Group of Eocene-Oligocene age only. No well has been drilled so far down to basement in Moran Oilfield. Source rocks for hydrocarbon generation could be both argillaceous sediments of Barail and Langpar Shale (Danian). Moran main fault separating the Moran structure into different fault blocks played a vital role in migration as well as in accumulation of oil and gas in the structure. In addition to hydrocarbons present in the Barail reservoirs, there is every possibility of presence of hydrocarbons in Pre-Barail sandstone reservoirs.

Key-words—Stratigraphy, palaeoenvironment, hydrocarbon, Upper Eocene–Holocene, Moran Oilfield, Assam.

INTRODUCTION

BASED on geophysical surveys, Moran oilfield was discovered in 1956 and so far 99 wells have been drilled in this field. Most of these wells in this field have been drilled down to Barail Group of Late Eocene-Oligocene age as hydrocarbons occur in the sandstones of this group, while a few other wells have penetrated the Kopili Formation of Eocene age. This paper presents the results of a study on stratigraphy, depositional environment and hydrocarbon prospects in Moran oilfield based mainly on well evidence.

STARTIGRAPHY

The Tertiary sedimentary sequence of the foreland shelf zone of Upper Assam basin is covered by a thick layer of alluvium and overlies the Precambrian granitic basement as Mesozoic sediments are nearly absent in this area. Generally accepted stratigraphic succession of the shelf region is given in Table 1. On account of facies variations, some of the geological divisions are time-transgressive lithostratigraphic units. As such, these corresponding litho-units get younger in age when traced southwards.

Except for a few limestone beds within the Palaeogene, the area consists of clastic sediments. The post Barail unconformity is a major feature in this region; it distinctly separates Neogene from Palaeogene.

A study of the regional lithological pattern shows that (i) the Alluvium/Dekiajuli thickness decreases gradually towards south-east, (ii) the Namsang Beds are absent in the Nahorkatiya and adjoining areas while these beds are clearly recognised in the Moran area and further west and in the eastern part of the basin, (iii) the Girujan Clay Formation which is practically absent north of Tengakhat, Dikhowmukh, Disangmukh attains a thickness of about 2300 m in Arunachal Pradesh to the east, (iv) there is an increase in the thickness of Surma Group and Tipam Sandstone Formation from north-west to south-east and (v) the thickness of Palaeogene also increases from north-west to south-east.

DEPOSITIONAL ENVIRONMENT

The depositional environment of the pertoliferous basins of Assam shelf was confined to two distinct successive phases. The first was a marine transgressive phase ending after the late Eocene, followed by a regressive phase resulting in deltaic to continental deposits. In Moran Oilfield, only a few wells have penetrated the stratigraphic section down to Kopili Formation. Hence the study on depositional environment is restricted down to Kopili Formation of Eocene age.

Kopili Formation—Kopili Formation consists primarily of siltstone/splintery shale with thick fine grained sandstone beds. The sandstone is typically light to medium grey, locally reddish grey, slightly calcareous, fossiliferous and carbonaceous.

Table 1. Stratigraphic succession of Upper Assam Shelf Region (After Mathur & Evans, 1964)

Epoch	Group	Formation	Thickness (m)	Major lithologic types
Recent Pleistocene Pliocene	Dihing	Alluvium Dhekiajuli	1300–2000	Unconsolidated sands with thin clay bands.
		Unconformity		
Pliocene–Miocene	Dupitila	Namsang Beds	01000	Poorly consolidated sandstone with clay and lignitic bands.
		Unconformity		
		Girujan Clay	100–2300	Mottled clay with sandstone lenses
Miocene	Tipam	Tipam Sandstone	500–900	Sandstone with shale bands
	? Surma	Not subdivided	30–100	Sandstone with shale and grit bands
		Unconformity		
Late Eocene–Oligocene	Barail	Not subdivided	500–1200	Upper part : mudstone/shale with sandstone beds and coal bands. Lower part : sandstone with shale bands
	Jaintia	Kopili Alternation	280–500	Splintery shale and fine grained sandstone with coal bands
Palaeocene–Eocene		Sylhet Limestone	350–450	Splintery shale with sandstone and limestone bands
		Therria	60–170	Sandstone, calcareous sandstone and limestone
		Unconformity		
Precambrian grantic basement				

The foraminiferal assemblage present in the Kopili Formation suggests shallow open marine conditions of deposition. The occurrence of high percentage of palynomorphs of the family Arecaceae, viz., *Palmaepollenites eocenicus, P. communis, Couperipollis rarispinosus* etc. indicates coastal and near shore conditions. Therefore, it is apparent that the sedimentation took place under shallow marine to coastal conditions possibly near the tidal zone. The presence of high salinity in the sediments is also suggestive of marine environment. The presence of fungal spore like *Phragmothrites eocenica* together with pteridophytic palynomorphs indicates prevalence of humid tropical climate at the time of deposition.

The Eocene sea shallowed down after the deposition of the Kopili Formation either due to upliftment of the

Himalaya and consequent movements thereof or due to an upward movement of the Assam-Arakan Yama Ridge, the distinction between shelf and geosynclinal facies disappeared. The marked change from rich larger foraminiferal assemblage to smaller benthonic also shows the regressive conditions in the marine region.

Barail Group—Lithologically, the Barail Group can be divided into two parts - a dominantly arenaceous lower part composed of sandstones with intervening mudstone beds and another dominantly argillaceous upper part with mudstone and few sandstone units. The sands of the arenaceous part are fine to coarse grained, moderately to well rounded, locally carbonaceous and light grey in colour while the mudstones of the argillaceous part are moderately hard, blocky to subfissile, slightly silty and bluish grey in colour. The mudstones contain scattered woody and vitreous carbonaceous debris and coal.

The greater part of the Upper Assam shelf was subjected to various environmental conditions during post Eocene period ranging from brackish water to fluviatile. Azad *et al.* (1971) are of the view that the oil-bearing Barail Group of sediments in Nahorkatiya oilfield were laid down in river channels in flood plains forming shoe string deposits. Lower Barails in the Sibsagar district on the other hand have been considered by ONGC to be the brackish water delta front deposits containing abundant arenaceous foraminiferas. Ray *et al.* (1973) similarly believe that the Upper coal shale alternations were laid in tropical, brackish water, back lagoon swampy environment as supported by the arenaceous forams along with palynomorphs like *Deltoidiaspora* sp., *Palmaepollenites* sp., *Disulcites* sp. etc.

In the Moran Oilfield, the base of the Barail Group consists mainly of arenaceous sediments with arenaceous forams, while the upper part is argillaceous. No marine element has so far been found from the Barail or in younger formations. Therefore, it is apparent that the sea regressed from the Upper Assam shelf with the deposition of sediments of Barail Group. The basal part with the arenaceous forams along with the palynomorphs like *Palmaepollenites communis*, *Couperipollis rarispinosus*, *C. brevispinosus* etc. suggest only a brackish water conditions due to back waters. This view is supported by the low salinity (3200-4500 ppm) in the sediments. The Upper Barail with coal-shale association contains rarely arenaceous forms and was deposited under continental conditions. The sediments contain only terrestrial palynomorphs, viz., *Polypodiisporites oligocenicus*, *P. speciosus*, *Nyssapollenites borooahii* etc.

The presence of high wax oils with high pour points and low sulphur content indicates a special case of non-marine crude oil (Tissot & Welte, 1978). Hebderg (1968) observed that such oils are mainly found in sandstone-shale sequences in association with coal and were deposited in continental, paralic or near shore conditions. The crude oil of Moran contains high wax.

The Moran Oilfield as stated earlier has oil reserves in the sediments laid in near-shore conditions. The presence of thick coal-carbonaceous shale sequence in the adjacent area, viz., Makum Coalfield together with the palynomorphs suggests swampy and lagoonic conditions. From the above discussion, it is evident that the Barail sediments of the Moran area were deposited in sea shore with fluvial domination.

The lithological models supported by electrologs show some important characteristics which are usually observed in a deltaic environment. The sand bodies within the arenaceous section throughout the areas under study show flat SP both towards the top and bottom of the sand. Such type of sand bodies called as distributory mouth bar is a characteristic of deposition of subaqueous topsheet of a delta and the whole section can be described as delta front sheet sand as described by Reineck and Singh (1975). The humid tropical climate prevailed during Barail sedimentation as is evidenced by palynomorphs.

Surma Group and Tipam Formation—In Assam shelf zone, a thin bed of gritty sandstone with occasional bluish grey shale bands are considered to represent the Surma Group of rocks. The Tipam Formation is characterized by its typically arenaceous character with thick shale beds in the lower part. The sands are fine to coarse grained, moderately to poorly sorted, subangular to angular and light grey in colour while the shales are firm, locally silty and carbonaceous and light grey in colour.

The Surma Group and Tipam Formation are terrestrial in nature and could only be distinguished lithologically; palynologically they cannot be differentiated. The formational salinity is estimated to be 1500-3000 ppm. The SP log shape against Surma and Tipam sandstone represents deposition by braided rivers. The palynofossils recorded from Surma and Tipam sediments are *Striatriletes sussane*, *Cyathidites australis*, *Nyssapollenites borooahii*, *Bombacacidites assamicus*, *Malvaceacreemopolis miocenicus* etc. together with some reworked Permian palynofossils.

In the equivalent beds in Arunachal Pradesh, Assam and Nagaland many recycled palynomorphs of Permian, Eocene together with indigenous Miocene have been found. Based on palynofossils together with lithological characters the Neogene sediments of these areas could be well correlated (Chart I). The heavy mineral in sediments suggest provenance from crystalline rocks of the north, viz., eastern Himalaya. There is also a good representation of fungal spores such as *Phragmothyrites* cf. *P. paddakarisen*, *Phragmothyrites* cf. *P. ecocenica*

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Table 1. Correlation of Neogene rocks of Sibsagar Oilfield, Moran Oilfield in Assam and Kameng, Subansiri and Siang districts of Arunachal Pradesh

Dutta & Singh, 1980 Tezpur–Bomdila Road, Kameng District			Ranga Rao & Babu, 1974 Burai River Section, Subansiri			Jain *et al.*, 1974 Lakabali–Along Road Siang District		Moran Oilfield, Dibrugarh District, Assam				Sibsagar Oilfield, Assam		
Stratigraphic Unit	Lithology	Probable age	Formation	Lithology	Thickness (m)	Stratigraphic Unit	Lithology	Age	Group	Formation	Lithology	Age	Formation	Lithology
Unit–A	Soft massive sandstone, grey green laminated siltstone clay and pebble bands	Pleistocene	Kimin	Alternations of soft massive sandstone, siltyclays and gravel beds	3000	Unit–C	Grey, massively to bedded siltstone, nodular silty shale, pebbly sandstone and congolomerate stringes and lenses	Pleistocene to Pliocene	Dihing	Dhekiajuli	Fine to coarse-grained sandstone with bands of dark grey clays		Dihing	Unconsolidated coarse sand along with minor clays, sands more consolidated and clayey towards bottom
				Unconformity						Unconformity				
Unit–B	Massive, soft, coarse grained dirty white to blue grey sandstone with silty clay bands	Pliocene	Upper Subansiri	Predominantly soft sandstone alternating with silty clay bands	800	Unit–B	Conglomerate with sandstone interbeds, roller and blade-shaped clasts of quartzite	Mio-Pliocene	Dupitila	Namsang	Fine to medium-grained and occasionally coarse-grained sandstone with thin bands of clay.		Namsang	Argillaceous sandstone with subordinate clays and silts
				Unconformity						Unconformity				
Unit–C	Soft medium to coarse-grained poorly bedded sandstone with lenses and stringes of coal	Upper Miocene	Lower Subansiri	Monotonous sandstone, soft and massive	1830			Miocene	Tipam	Girujan	Mottled clay with intercalations of sands and occasional bands of lignite		Girujan	Mainly mottled clays with occasional thin bands of sand and grit
										Tipam Sandstone	Mainly light grey, fine to medium-grained moderately to poorly sorted sandstone with intervening clay band		Tipam Sandstone + Surma (?)	Mainly sands and soft sandstone with thin clay and claystone bands
Unit–D	Micaceous sandstone, hard, poorly bedded ferruginous sandstone with bluish grey clay	Miocene	Dafla	Alterations of hard sandstone and shale	2400	Unit-A	Grey hard micaceous sandstone, 2500 m siltstone and shale		Surma(?)		Mainly light grey, fine to medium moderately hard sandstone with thin laminated bluish grey shales and clay			
				Main Boundary Fault						Unconformity			Unconformity	
			Permian – LOWER GONDWANA					Late Eocene-Oligocene	BARAIL GROUP					

with *Striatriletes* possibly due to some swampy, humid and warm conditions during deposition. The coniferous pollen *Podocarpidites* from Surma and Tipam sediments in the Moran and Nahorkatiya oilfields (Sah & Dutta, 1967; Handique & Dutta, 1981) also points to source of the sediments from the high altitudes.

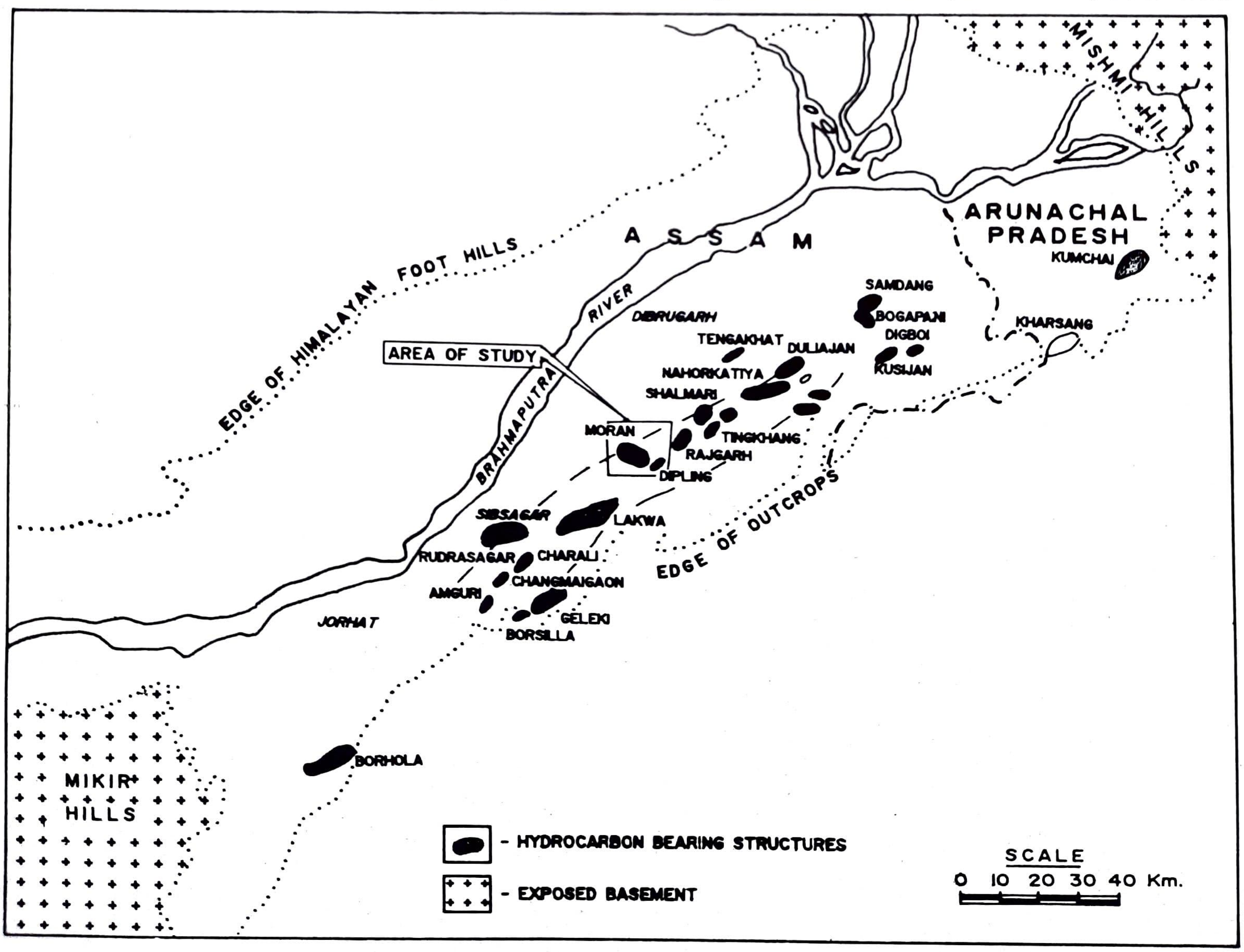
During Palaeogene, the Assam valley was the platform shelf of the Naga-Lushai belt which was converted into an intermontane continental basin in Neogene times as the East Himalayan geotectonic cycle was superposed on the Naga-Lushai geotectonic cycle. The Palaeogene platform deposits thus are succeeded by intermontane Neogene molasse. In Upper Assam, the Surma period is marked by regional uplift of both geosynclinal and platform areas whereby part of the Barail was eroded. The Surmas were deposited in some structural lows on the pericraton attaining a thickness of upto 600 m while the thickness in the local depressions is upto 200 m (Raju, 1968).

Girujan Clay Formation—The Girujan Clay Formation is typically characterized by the presence of mottled and reddish brown, soft to moderately hard clay. Lenses of sandstone, which are light grey, fine to medium grained and subangular to subrounded are relatively more abundant in the lower part.

The Tipam Sandstone is succeeded by Girujan Clay and contains palynomorphs supporting fluviatile conditions of deposition. The heavy mineral suite suggests that the provenance from the north through the south flowing drainage. The climate, as elucidated by palynofossils, has been humid tropical.

Namsang Formation—The Namsang Formation consists of interbedded sandstone and clay with minor lignite beds. The sands are fine to medium grained and light grey to brown in colour while the clays are predominantly bluish grey and carbonaceous.

The Girujan Clay is unconformably overlain by the Namsang Formation of the Dupi Tila Group. In the present study no palynofossil has been recorded from Namsang Formation. Banerjee *et al.* (1973) have



Text-figure 1. Map showing localities of hydrocarbon bearing structures in upper Assam valley.

reported swampy elements from the sub-surface of Sibsagar District. The heavy minerals recorded are from the crystalline rocks of north-east. The regional thickening out of the sediments strengthen this view.

Dhekiajuli Formation—The Dhekiajuli Formation consists primarily of unconsolidated to semiconsolidated sands with minor clay bands.

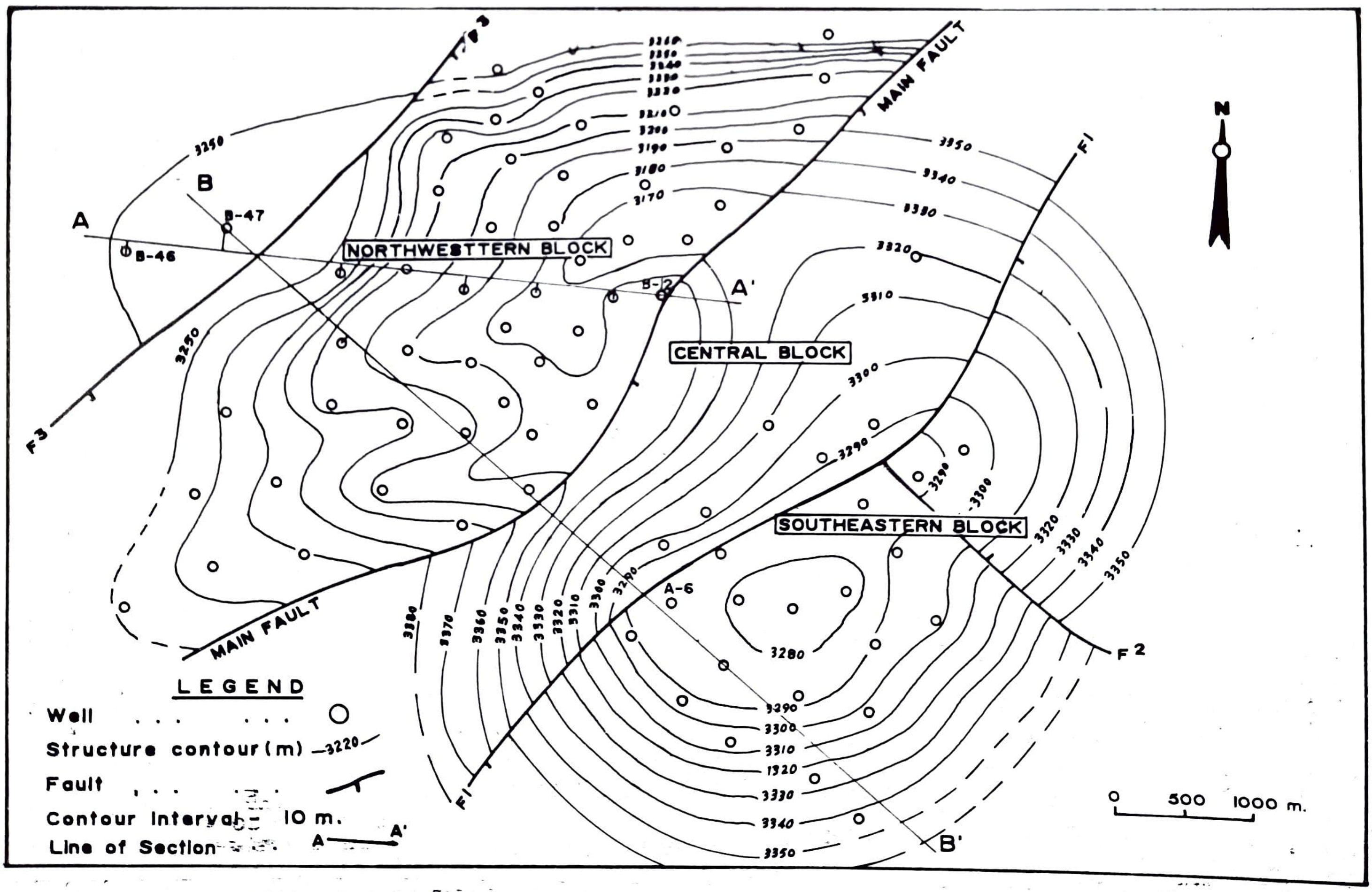
The Dhekiajuli Formation of the Dihing Group which forms the top of the Tertiary sequence unconformably overlying the Namsang Formation consists mainly of thick pebble beds. In comparison with other formations palynofossils are scanty. A good number of fungal spores with pteridophytic spores *Polypdiisporites*, *Polypodeaceaesporites* have been found suggesting prevalence of humid tropical climate.

STRUCTURE AND PALEOTECTONIC EVOLUTION

Available geophysical data (gravity, aeromagnetic & seismic) and evidence obtained from drilled wells in the shelf zone indicate that Moran Oilfield is situated on the southeastern flank of the regional hidden basement ridge which is the north–eastern extension of the Precambrian basement exposed in the Karbi Anglong (Mikir Hills) in the west. The axis of the ridge passes through Tengakhat high in north-east direction almost parallel to Brahmaputra and swings towards NNE beyond Tengakhat high (Handique *et al.*, 1989). Moran structure is one of the localised highs present in the Assam shelf zone. Lack of drilling evidence below the Kopili Formation does not permit to study the pre-Kopilis and to have the clear picture of the basement configuration in Moran Oilfield.

The size of the NE-SW trending Moran anticlinal structure would be approximately 50 sq. km. The structure is bisected by the major Moran fault running in NNE-SSW direction and heading towards SE with a throw of about 160 m within Barails which has resulted in, the formation of two main blocks, viz., north-western and south-eastern blocks. Another minor normal fault running almost parallel to Moran fault and heading in the same direction forms a narrow central fault block in between north-western and south-eastern main blocks. Presence of a few more minor normal longitudinal and transverse faults (with throw of about 15 m) makes the structure more complicated by forming separate fault blocks (Text-fig. 2).

The Moran main fault and few minor faults could be indentified on seismic reflectors which is confirmed by drilling evidence, while a number of minor faults have



Text-figure 2. Structure contour Map on a Marker Horizon -1 within Barail Argillaceous Group in Moran Oilfield.

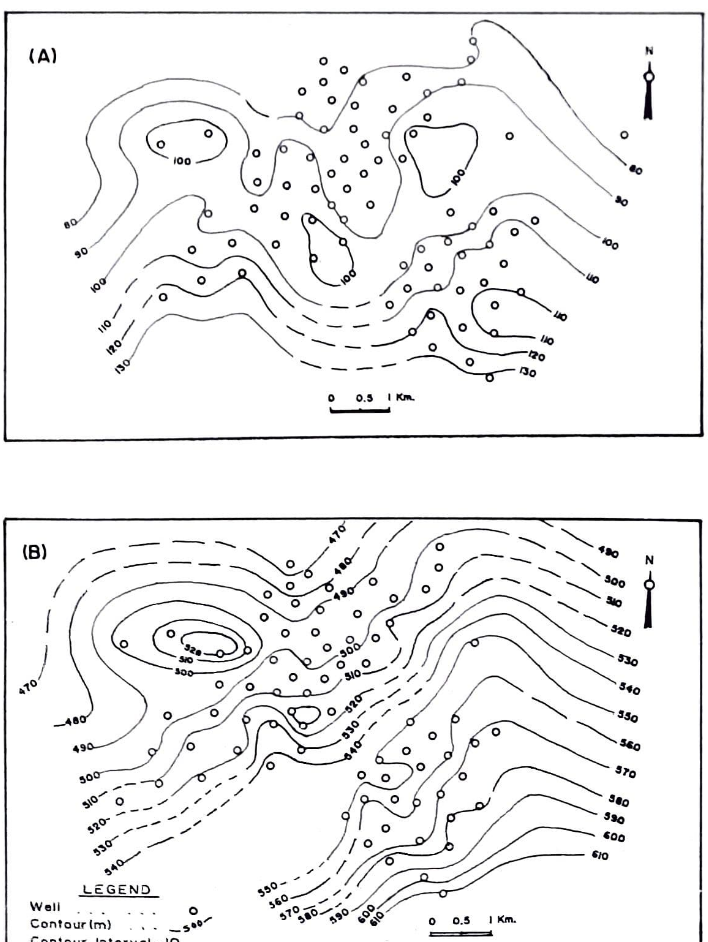
been identified on the basis of anomalous fluid distribution only.

Seismic evidence and correlation of electric logs of wells in the Moran oilfield indicate that the Moran main fault extends from basement upto the basal part of the Girujan Clay Formation. The value of throws is about 160 m and about 90 m on Barail Marker horizon 1 (Text-fig 2) and top of Tipams respectively. The minor faults with about 15 m throw seem to be extended upto the the Tipam+Surma-Barail unconformity.

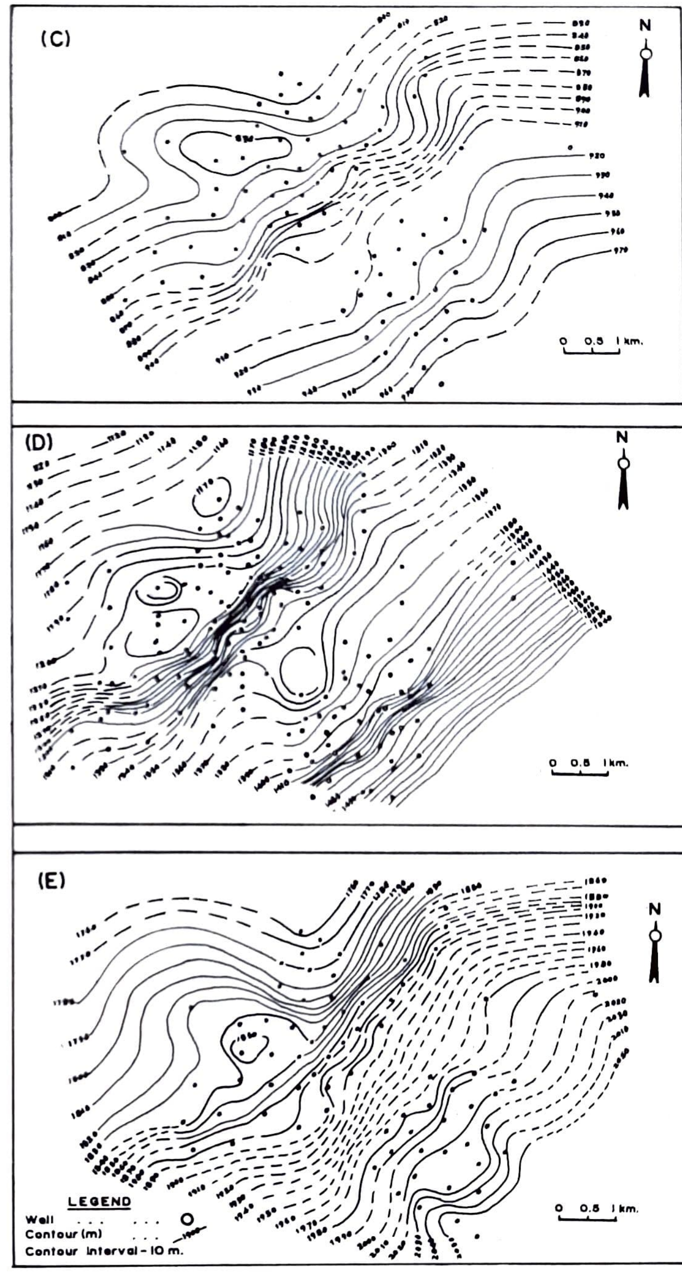
From the study of the isopach maps (Text-figs 3, 4) and paleostructural reconstruction (Text-fig. 5), the following observations can be made :

(i) The movement along the Moran main fault was contemporaneous with deposition of sediments upto basal Girujan Clay Formation. The thickness of sediments in the down thrown side was always higher than the upthrown side. From this point of view the nature of the fault was of growth type. A very important criterion for growth fault is that there exists differential throw for different horizons and usually the displacement increases downward which is evident in case of Moran main fault. The minor faults might have come into existence at the beginning of deposition of Namsang sediments.

(ii) In the south-eastern area the anticlinal structure started forming right from the time represented by the beginning of deposition of Surma and Lower Tipams. These structures come into existence upto present time with minor modification and readjustment during geologic time. In the north-western area the anticlinal structure along the main fault appeared at the time of deposition of Upper Tipam sequence and Girujan Clay Fromation but at the beginning of deposition of Namsangs the structure



Text-figure 3. Isopach Map between (A) Barail Marker Horizon-1 and Barail Top. (B) Barail Marker Horizon-1 and Tipam Shale Band Top.



Text-figure 4. Isopach Map between (C) Barail Marker Horion -1 and Tipam Top (TS-1). (D) Barail Marker Horizon -1 and Girujan Clay Top. (E) Barail Marker Horizon - 1 and Namsang Top in Moral Oilfield.

had undergone some changes. During deposition of Dhekiajuli/Alluvium Formation the structure reappeared as prominent one in that area (Text-figs 3. 4). This modification and readjustment might be due to later tectonic forces in post Namsang time.

(iii) Overall thickness of older formations of Jaintia. Barail and Tipam Groups are increasing towards south/south-east, whereas post Girujan depositional phase depicts reversal of basinal dip from south-east to north-west and north-east towards Himalayan foot hills.

(iv) Moran structure is. in general. keeping with the regional trend of the structural evolution of the Shelf zone in Upper Assam Valley.

HYDROCARBON PROSPECT OF MORAN OILFIELD

On the basis of distribution pattern of hydrocarbon accumulations in the known fields in the shelf zone. south of Brahmaputra river. three distinct belts of structures (Text-fig. 1) can be identified as follows :

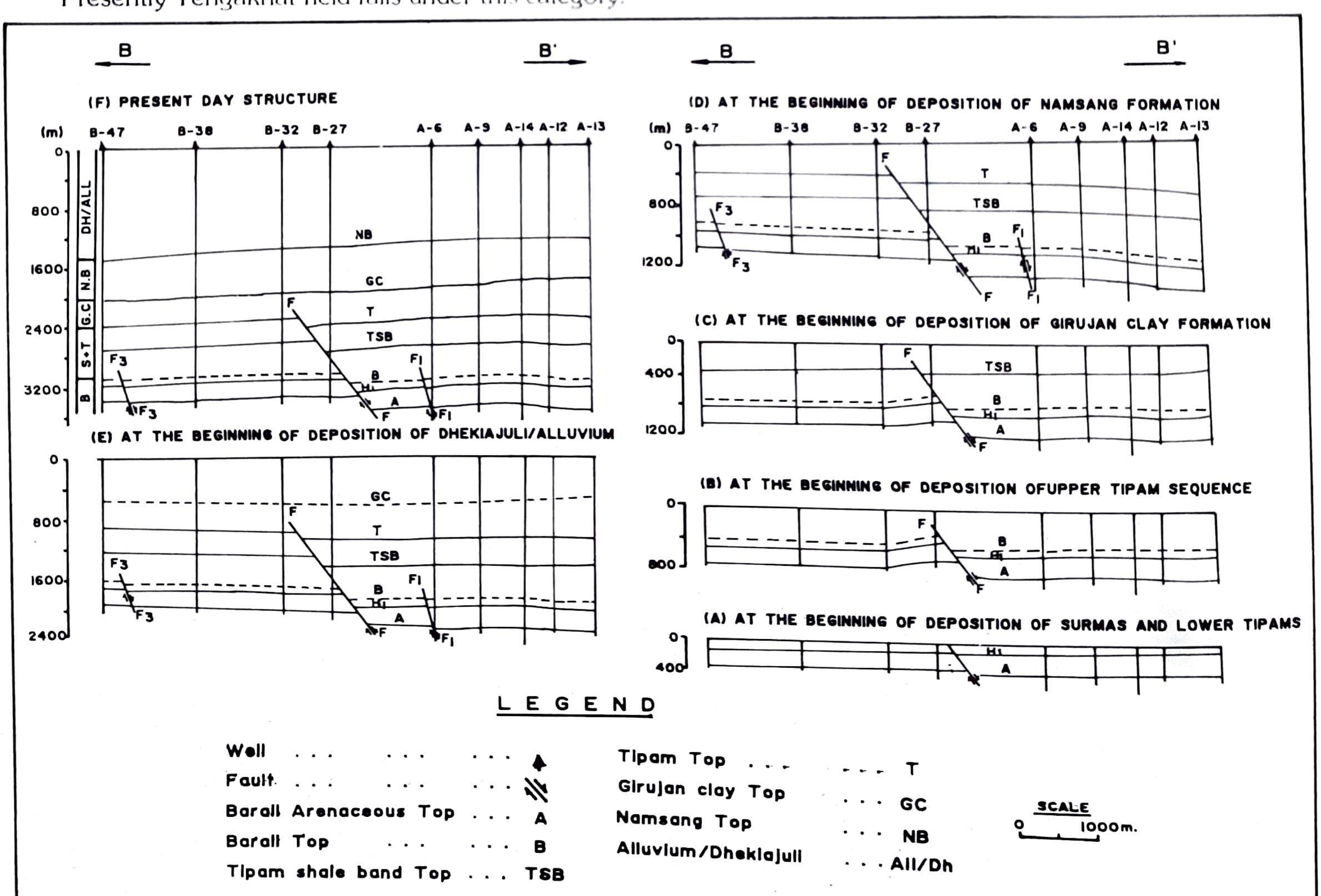
(i) Belt of Paleocene-Eocene prospects for mainly gas with oil along the axis of the hidden basement ridge. Presently Tengakhat field falls under this category.

(ii) Belt consisting of Rudrasagar. Moran. Tinali. Nahorkatiya and northern part of Jorajan oilfield having oil accumulations mainly in the Barail Group. This belt follows the general trend of the hidden basement ridge and lies south it.

(iii) There lies another belt comprising Geleki. Lakwa. southern part of Jorajan oilfield and Kusijan structures lying towards the shelf/geosynclinal margin close to Naga-thrust. Hydrocarbons occur mainly in Tipam and Barail Formations in this belt.

As seen from above. Moran oilfield belongs to the second belt of structures comprising Rudrasagar. Nahorkatiya. Tinali etc. in the shelf zone where hydrocarbon accumulations are confined mainly to Barail Group. The overlying formations have not indicated presence of hydrocarbons in this field. Hydrocarbon prospects in the Palaeocene-Eocene rocks are yet to be known as no well has so far penetrated entire stratigraphic sequence in Moran area.

Hydrocarbon resources in the Barail sediments occur mainly in two major sandstone reservoirs : sand bodies-I within the alternation section. other sand bodies-II within arenaceous section (Text-figs 6. 7). Besides. these two major reservoirs. oil and gas accumulations are also found



Text-figure 5. Profile showing structural evolution along B-B' direction in Moran Oilfield.

in some small extra sand bodies within Barail alternation and argillaceous section which are referred to as extra sand-E (Text-fig 6). These small pools are mainly present in north-western block.

Thick mudstone bands above the oil reservoirs act as the cap rock in the area. The thickness of the mudstone varies in different wells. The sand bodies particularly the extra thin sand bodies are not always continuous throughout the field. They pinch out within a short distance, hence hydrocarbon accumulations in such sand bodies within Barail alternation and argillaceous sections are mainly in lithostratigraphic traps (Tex-figs 6, 8). Due to produced lateral variation of the sand bodies, any prediction of sand development and oil accumulations in the neighbouring area is rather difficult. Since the sand bodies-II are in the thick and persistent arenaceous section of the Barail Group, hydrocarbon accumulations might be controlled mainly by the anticlinal structure/fault closures. It is, therefore, evident that combination type of traps, i.e. lithostratigraphic and structural might have helped in accumulation of oil and gas in the Moran oilfield.

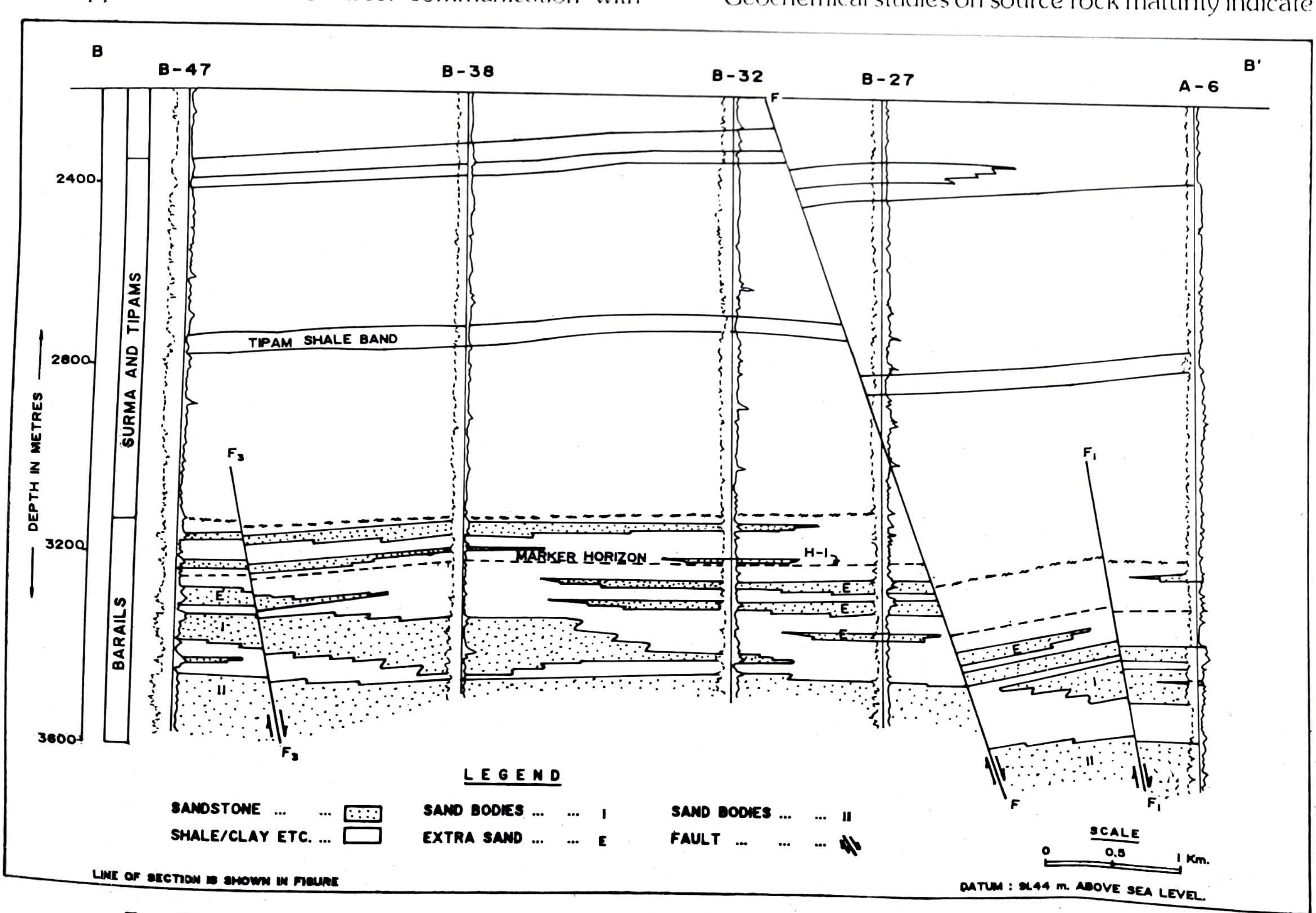
In case of expulsion of oil to the producing well, the water drive is supposed to be effective except in the extra sand bodies-E as the sand bodies are not continuous and are supposed to have no direct communication with surrouding water body. The other expulsion mechanisms like solution gas drive, gravity drive are supposed to act in the field.

Oil accumulations in the north-western block are comparatively more than those in the south-eastern block.

The depths of the reservoirs vary from about 3200 m to 3600 m. Porosities range from 18 to 20% and oil permeability from 15 to 60 md. Connate water saturations are in the range of 25 to 40%. The oil gravity is in the 33.2^0 to 36.8^0 API range with the initial GOR in the 170 to 276 cu m/kl range. The oil viscosity (0.2 to 0.4 cps) is of the same order of magnitude as that of formation water at in-situ conditions; so a favourable mobility ratio for water drive exists.

All the reservoirs were initially at hydrostatic pressure which ranged between 320 and 360 kg/sq cm and the reservoir temperature ranged from 92.2 to 98.1^0 C. A few of the reservoirs have primary gas cap. In the Lower Pool reservoirs a strong bottom water drive is prevalent, whilst the other reservoirs have either a partial edge water drive or a depletion drive both with or without gas cap expansion. The majority of the wells in the field are gas lifted, but some are still on natural flow.

Geochemical studies on source rock maturity indicate

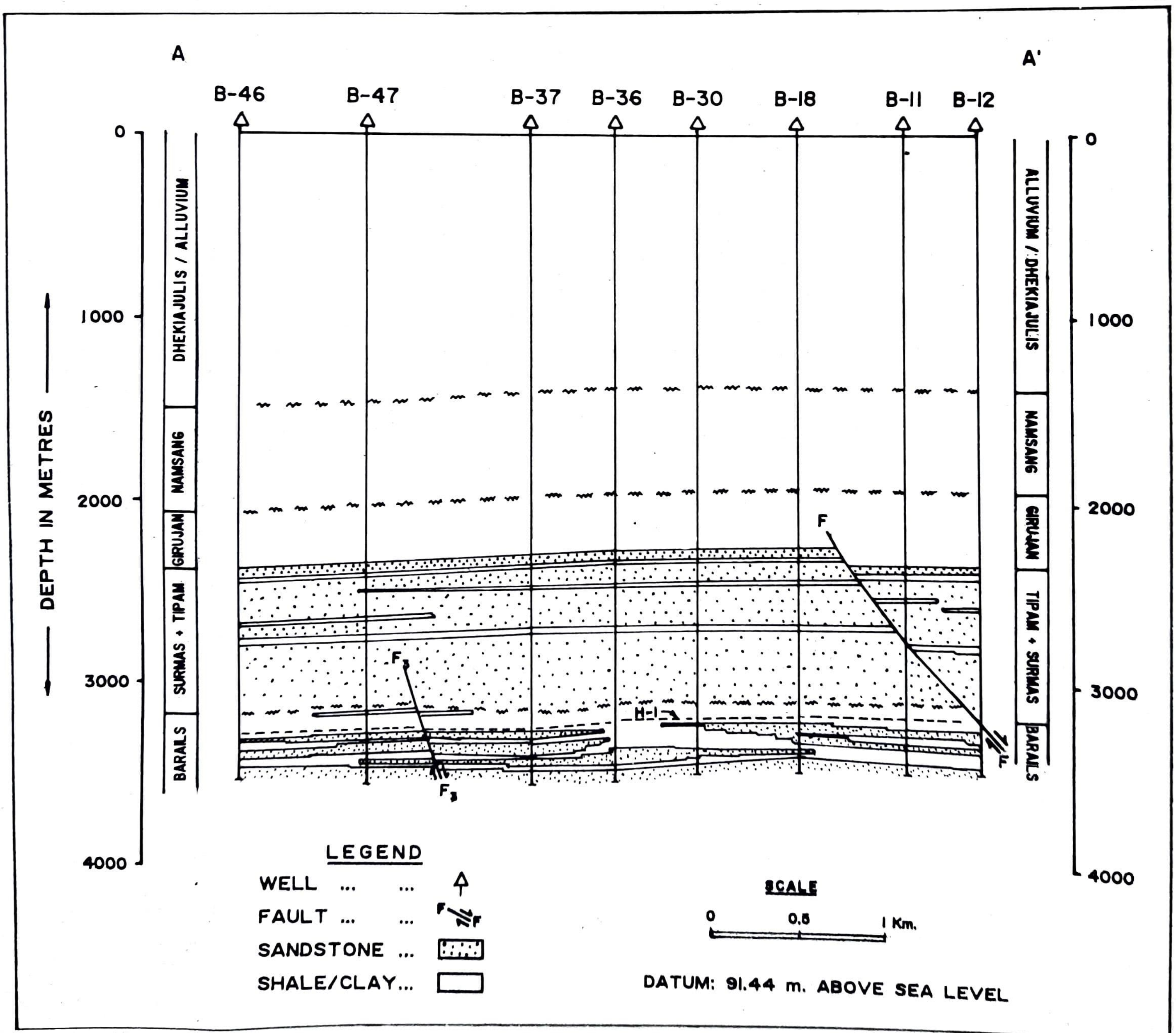


Text-figure 6. Geological section showing hydrocarbon bearing sand bodies within Barail Group in Moran Oilfiled.

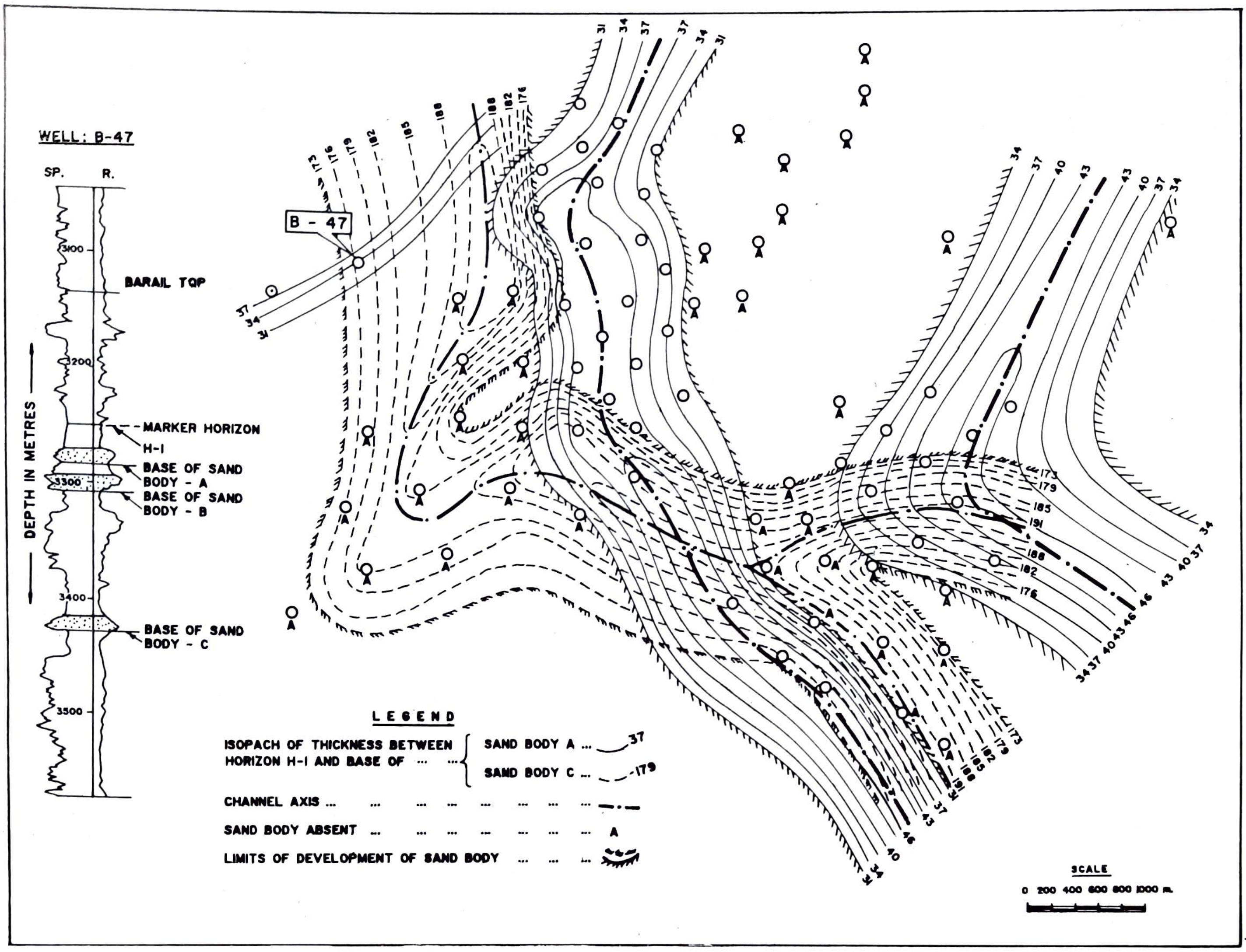
that uppermost Langpar Formation and Lakadong member of Paleocene age and argillaceous group of Barails of Late Eocene-Oligocene age have been subjected to differing maturity histories depending on geological location. These source rocks are immature to early mature for hydrocarbon generation in general in the Assam shelf zone. The attainment of maturity has only taken place in the subthrust of Naga-thrust and in the suprathrust slices of Naga- thrust zone where these sediments are buried deeply. The bulk of the commercial accumulations of hydrocarbons in the shelf zone is considered to be migrated from the direction of south-east, viz., from the area close to/beneath the Naga-thrust where the source rock first entered the oil generation window during and shortly after thrusting.

The north-western and south-eastern blocks of the Moran oilfield are producing oil and gas from the Barail reservoirs as mentioned earlier. The central block in between the above oil producing reservoirs has remained unexplored so far. This block has great potential for hydrocarbons within Barails and needs immediate attention.

The Moran main fault which is of growth fault nature extending upto Girujan Clay Formation has exerted profound influence on accumulations of hydrocarbons in Moran Oilfield. The regional dip of the area towards the south became more prominent during deposition of Girujan sediments. Due to the subsidence of south-eastern part along the fault, it might have acted as a path of migration from south-eastern structure to north-eastern structurally high sandstone reservoirs. As the north-western block was structurally high, the huge amount of



Text-figure 7. Geological section showing sand geometry within Barail and Tipam Groups in Moran Oilfield.



Text-figure 8. Base Profile Map of sand body A and C in Moran Oilfield.

hydrocarbons seemed to be migrated from the south-eastern block to north-western block through the active main fault which sealed during later geological time.

The range 2030-5300 m from Upper Miocene (Tipam Sandstone Formation top) to Upper Eocene rocks (Kopili) in Moran Oilfield falls within the hydrocarbon-liquid-window (Handique *et al.*, 1981). However, drilling in this field, in general, is stopped within Barail Group. Possibility of hydrocarbon accumulations in the deeper sediments of marine to brackish origin (Eocene rocks) in this field cannot be ignored. Hence, the Eocene rocks of this field need to be explored by a few deep wells. Recent discovery of oil prospects within Palaeocene-Eocene rocks in Dikom, Kathaloni etc. in Tengakhat area justifies drilling for such prospects in Moran oilfield.

CONCLUSION

From the foregoing observations and discussions, the salient points may be summarised as follows : (i) The Moran Oilfield area like other areas in the Assam shelf zone was subjected to marine influence upto the deposition of Kopili Formation of Late Eocene, then to deltaic conditions during deposition of Barail Group of Late Eocene-Oligocene age and finally continental conditions during deposition of post Barail sediments, (ii) Source rocks-Langpar and Lakadong members of Palaeocene age and argillaceous unit of Barail Group are immature to early mature for hydrocarbon generation in the oilfield areas in the shelf zone. Migration of hydrocarbons was from the areas close to and beneath the Naga-thrust in the south-east, (iii) Hydrocarbon accumulations are confined mainly to the Barail sandstone reservoirs, (iv) Central block of Moran Oilfield is likely to have Barail prospects, (v) Exploration for Eocene prospects in Moran Oilfield draws attention.

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