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	Module: Classification of Indian basins and petroleum geology of Assam, Bengal and Cauvery basins

1. Learning outcomes

After studying this module, you shall be able to:

- Know about the four categories of petroliferous basins of India.
- Know about the petroleum system which includes Source rock, Reservoir rock, Oil migration and Oil traps.
- Know about the Geology and Petroleum geology of the three main basins such as Assam basin, Bengal basin and Cauvery basin.

2. Introduction

Indian sedimentary basins cover an aerial extent of about 1.79 million sq. Km, both on land and offshore up to 200m isobaths. However, the sedimentary area in deep water beyond the 200m isobaths has been estimated to be about 1.35 million sq. km. This makes the total sedimentary basinal area as 3.14 million sq. Km. At present, India has 26 sedimentary basins which based on the occurrence of hydrocarbon; exploration and the status of knowledge have been divided into 4 categories.

Category-I

The petroliferous basins with proved hydrocarbon reserves and where commercial production has already been started comes under this category. It mainly includes basins like –

- Assam shelf
- Bombay offshore
- Cambay
- Krishna
- Godavari
- Rajasthan
- Cauvery

Category-II

Sedimentary basin with proved occurrence of hydrocarbons but from which no commercial production has been obtained yet comes under this category. The basins mainly include -

- Andaman Nicobar
- Bengal
- Himalayan foothills
- Jaisalmer
- Kutch
- Mahanadi

Category-III

In this category, sedimentary basins have no significant oil & gas shows but are considered as prospective on Geological considerations. It includes following basins -

- Bikaner- Nagaur
- Kerala- Lakshadweep
- Saurashtra

Category-IV

This is the category, where petroliferous basins with uncertain prospects require basic data for prognosis. It includes the basins, which bear an analogy with similar hydrocarbon producing basins in the world and may be prospective. It includes basins like

- Arunachal Pradesh
- Deccan syncline
- Ganga valley
- Gondwana
- Mizoram
- Manipur
- Narmada
- Vindhyan

Basins Estimated Reserves

BASIN	ONLAND (MMT)	OFFSHORE (MMT)	TOTAL (MMT)
Bombay	9190	-	9190
Assam	-	3180	3180
Cambay	-	2050	2050
Upper Assam	-	1860	1860
Krishna- Godavari	555	575	1130
Cauvery	270	430	300
Rajasthan		380	380
Kutch	550	210	760

3. Petroleum System

3.1. Source Rock: The fine grained, clay rich siliclastic rocks (mudstone shales) or dark coloured carbonate rocks (limestones, marlstones) which have generated and effectively expelled hydrocarbons are known as the source rock. The source rock mainly for petroleum accumulation and generation are shales, silts, and limestones. For the characterization of source rock, there are three essential conditions, which are given as follows:

a) It must consist sufficient content of organic matter of biological origin.

b) The organic matter that occurs in the source rock must have hydrogen- rich composition.

c) The source rock must be buried at certain depth where it is subjected to proper temperature to initiate the process of petroleum generation by thermal degradation of kerogen.

In the source rock of siliclastic and carbonate, minimum concentration levels of 1.5% and 0.5% total organic carbon (TOC) respectively have been established on the basis of empirical evidence.

3.2. Reservoir Rocks: After the generation of petroleum, it migrates from source rocks to the adjacent porous and permeable rocks and accumulates there to form a pool. Such permeable rocks are called “Reservoir Rocks”. They contain interconnected passageways of microscopic pores or holes that occupy the areas between the mineral grains of the rock. Seals are

very fine-grained rock, which have negligible amount of pore spaces, and they do not permits the entry of fluids or blocks the further migration of oil.

The two important properties of reservoir rock are –

Porosity is the volume of void spaces as percentage of a given total volume of rock. The pore size depends on the rock volume and also on the movement of oil. The variety of pore sizes can be measured and expressed as pore-size distribution. There are mainly two types of porosity, primary and secondary (inherited from deposition of sediment or generated by mineral dissolution reactions in the subsurface respectively) and a third type of porosity is fracture porosity caused by tectonic processes.

Permeability is the property of rock, which permits the flow of a fluid through the interconnected pores without any change in the structure of the rock, or displacement of its grains is known as permeability or absolute permeability. The common reservoir rocks are sandstones, conglomerates, porous limestones, fractured shales, and jointed igneous and metamorphic rocks.

3.3. Oil Migration: The movement of oil from source rock to adjacent porous and permeable reservoir rock is known as the migration of oil. Migration of petroleum from its place of origin (source rock) to its place of accumulation (reservoir trap) is controlled by the physical and physico-chemical conditions of the sedimentary strata from which the oil is moving through. The weight of the fluid column corresponding to the interconnected network of water-filled pore spaces from a given depth up to the sediment surface is known as the hydrostatic pressure.

The causes for the migration of petroleum are-

- Compaction of the source rock
- Buoyancy effect
- Capillary effect and
- Water Flushing

Types of Migration

There are mainly two types of migration-

- ***Primary Migration-*** In primary migration the movement of oil takes place from source rock to adjacent porous and permeable rocks which are known as the store house of oil (Reservoir rocks). In good-quality source rocks, oil is transported as a separate phase.
- ***Secondary Migration-*** The secondary migration is the movement of oil from first reservoir to the second reservoir (as shown in the Fig. 1) or on the surface of the earth. The movement of a discrete oil phase is controlled by the interplay of driving and counteracting resisting-forces.

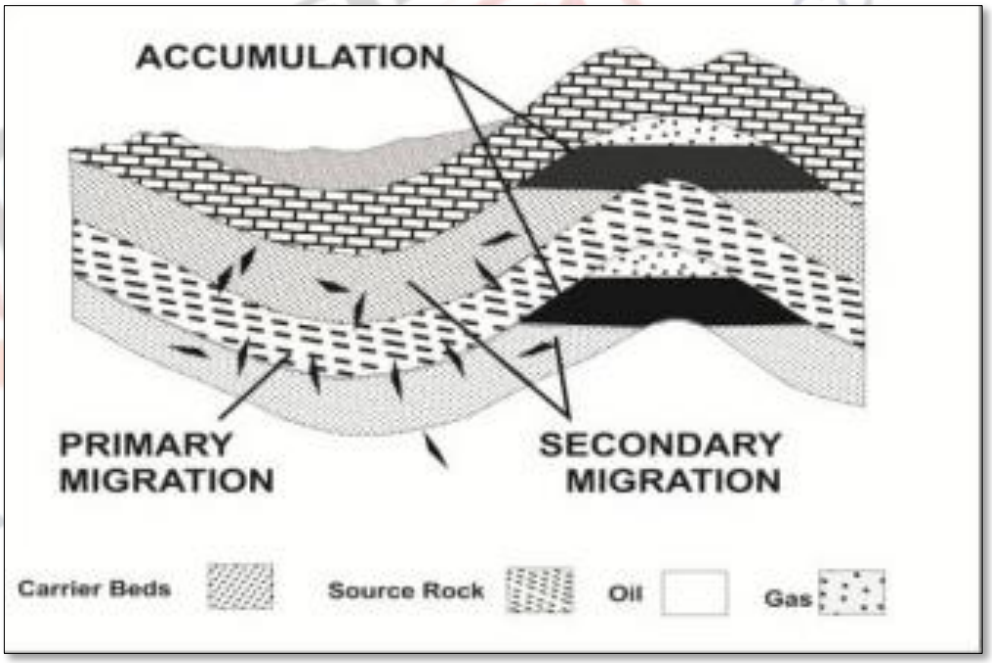

Fig. 1 Migration Types.

3.4. Oil Traps: When oil migrates from source rock to adjacent porous and permeable reservoir rock it accumulates to form an oil pool covered by an impervious surface, which blocks the further migration of oil. There are two conditions necessary for the Formation of oil traps-

- There should be a suitable structure like fold and faults for oil accumulation.
- There should be an impervious cap rock, which blocks the vertical and horizontal migration of the oil.

Once in the reservoir rock, the oil and natural gas continue to migrate through the pore spaces of the reservoir rock until all further movement of the oil and gas are blocked by physical arrangement of the reservoir rock and one or more seals. This arrangement of the reservoir and seals is called a trap. There are mainly two types of traps- structural trap and stratigraphic trap.

Structural Traps- The structural oil traps are formed as a result of folding, faulting and igneous intrusions. Some of the main types of traps are- Anticlines and domes, Faults, Salt domes and igneous intrusions (as shown in Fig. 2a).

Stratigraphic Traps- The stratigraphic oil traps are formed as a result of lateral and vertical changes in the permeability of the reservoir rocks (Fig. 2b).These changes are caused by variations in the conditions during the deposition of rocks. Some of the important stratigraphic oil traps are Unconformity traps, sand lenses, wedge outs, etc.

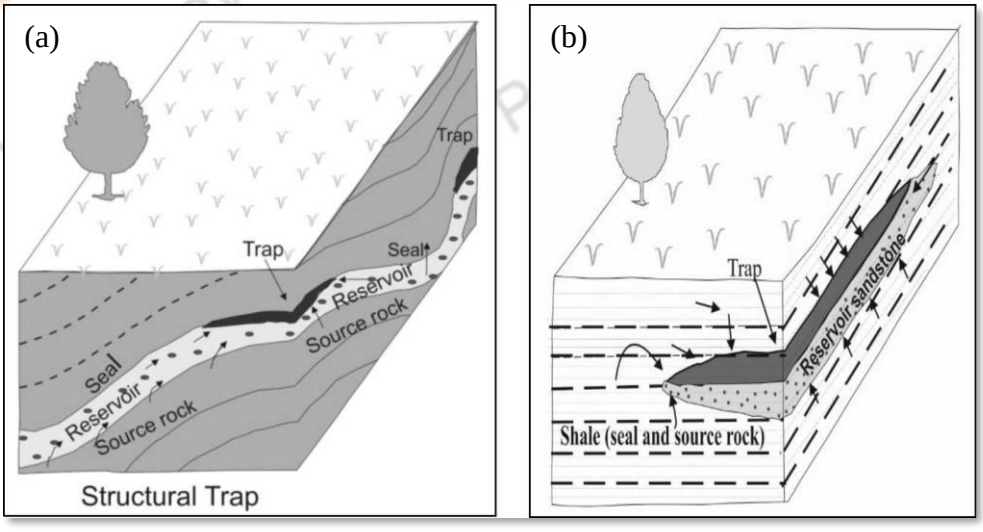

Fig. 2 (a) Folded strata which form a structural; (b) A discontinuous layer of sandstone that forms a Stratigraphic trap.

4. Basin Description

4.1. Assam Basin

4.1.1. Introduction: The Assam basin is situated in the NE part of India categorized as category-I basin. The basin covers an area of 11, 6000 sq. km. Major tectonic elements of basin are: Assam Shelf, Naga Schuppen belt, Assam-Arakan fold belt. The oil exploration in India commenced with the discovery of Digboi oil field of Assam. The chief oil fields of Assam are Digboi, Nahorkathiya, Moran, Rudrasagar and Lakwa (Fig. 3).

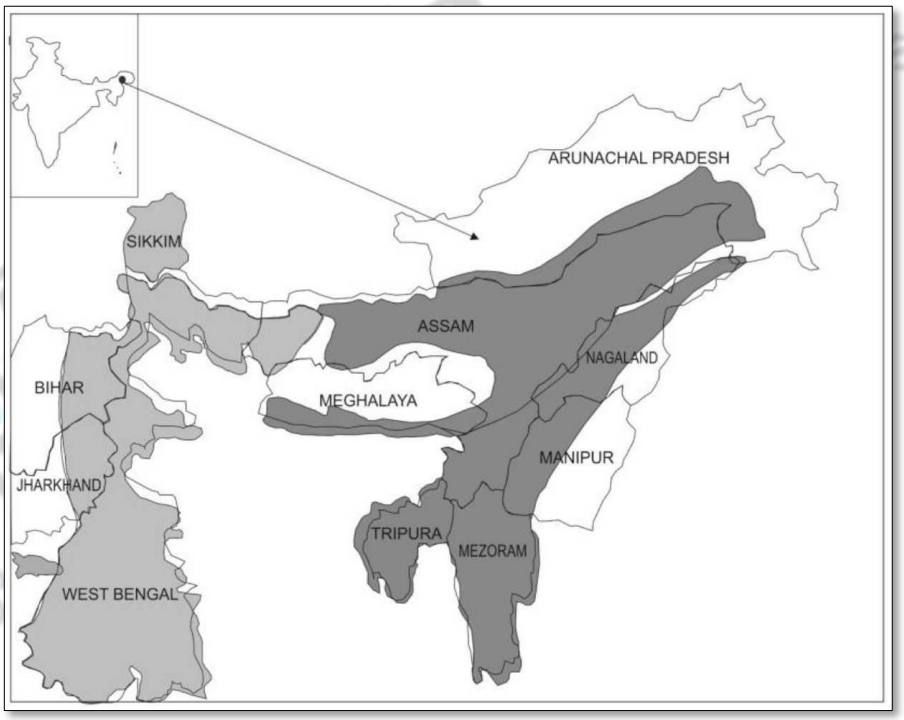

Fig. 3 Map of Assam- Arakan Basin.

4.1.2. Geology

- The basin covers the states of Meghalaya and Assam. The upper Assam basin consists of northern Himalayan foreland basin (HFB) and the southeastern Assam Arakan foreland bas in (AAFB). The AAFB consist thick wedge of pre- orogenic passive margin Cretaceous-Eocene (Khasi-Jaintia groups) and deep marine Oligocene (Barail

group) flysch sediment overlain by post- Orogenic Neogene molasses (Tipam group). The basement of HFB is covered by the Neogene (Tipam group) and Quaternary.

- The Paleocene to Eocene continental shelf of the Indian plate which became emergent and which is being over-thrust by the Himalayas on the north-northwest and by the Naga hills on the southeast comes under the upper Assam shelf.
- The present-day Assam Basin, a cratonic margin, reflects three distinct tectonic phases. The earliest was Late Cretaceous to Eocene block faulting and development of a southeasterly dipping shelf. Duringthe second phase, in Oligocene time, uplift and erosion occurred north of the many basement faults were reactivated; and many basement-controlled structures became prominent.
- In eastern Manipur, thin cretaceous limestones to the south are the oldest rocks reported near the Assam geologic province. The Assam geologic province consist the oldest sedimentary rocks. It is comprised of continental to lagoon sandstones and interbedded shales of Upper Cretaceous and Paleocene Dergaon and Disang Formations. The Manipur and Mizoram areas consist more than 5,300m of shales & sandstones and Assam shelf consist more than 500m of sandstones and shales, of the upper Cretaceous and Paleocene Disang Formation.
- The top of the Dergaon and Disang is overlain by the medium-grained massive sandstones of the Paleocene and Eocene Jaintia Group Tura and Langpar Formations and is also marked by an unconformity. In a fluvial to marginal marine environment, more than 250m of the Tura and Langpur were deposited.
- The Eocene Sylhet Formation was deposited in a range of environments and was subdivided into the members which generally represents these different depositional environments. The lower

Lakadong member was deposited in a lagoonal environment consists of more than 350m of thin sandstones and interbedded shales and coals in it basal parts (Fig. 4 showing the development of Assam Shelf). The environment of the Lakadong member typically consists of the thick sands of barrier- bar. The members of upper part of the Lakadong Formation are calcareous sandstone of a restricted shallow water platform.

- The overlying Narputh member consists of claystones and siltstones of a shelf environment. The upper member of the Sylhet, the Prang member, is a shelf carbonate with interbedded siltstones and clay. Due to contemporaneous platform tilting and basement sourced block faulting the Sylhet Formation is depositionally thicker from northwest to southeast in the Assam geological province. A 500m of shallow marine to lagoonal shales and interbedded limestones of Eocene Kopili Formation are accumulated over a regional unconformity marked on top of Sylhet Formation (as shown in Fig. 5).

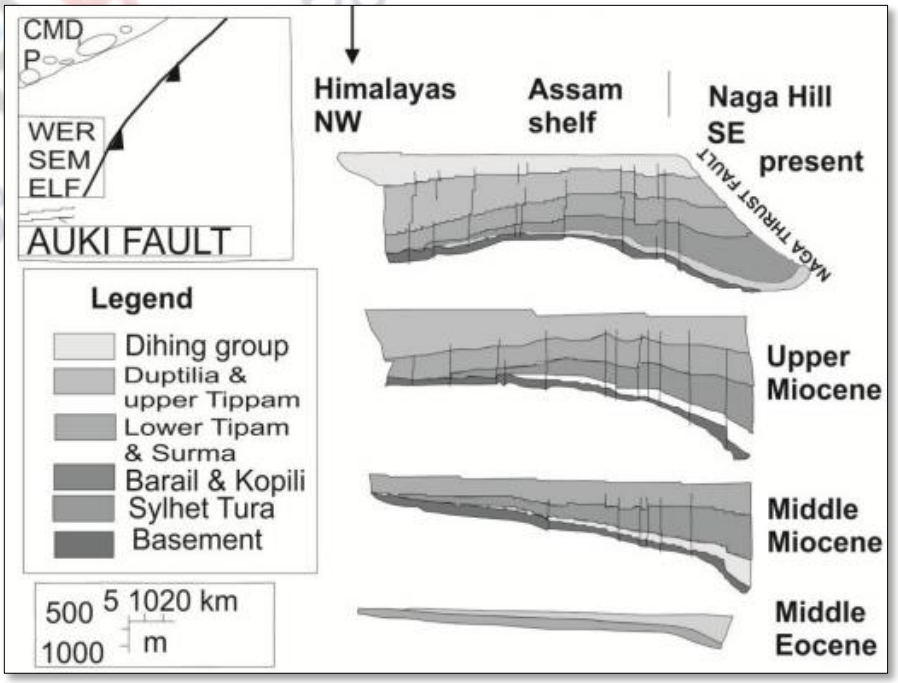

Fig. 4 Development of Assam Shelf.

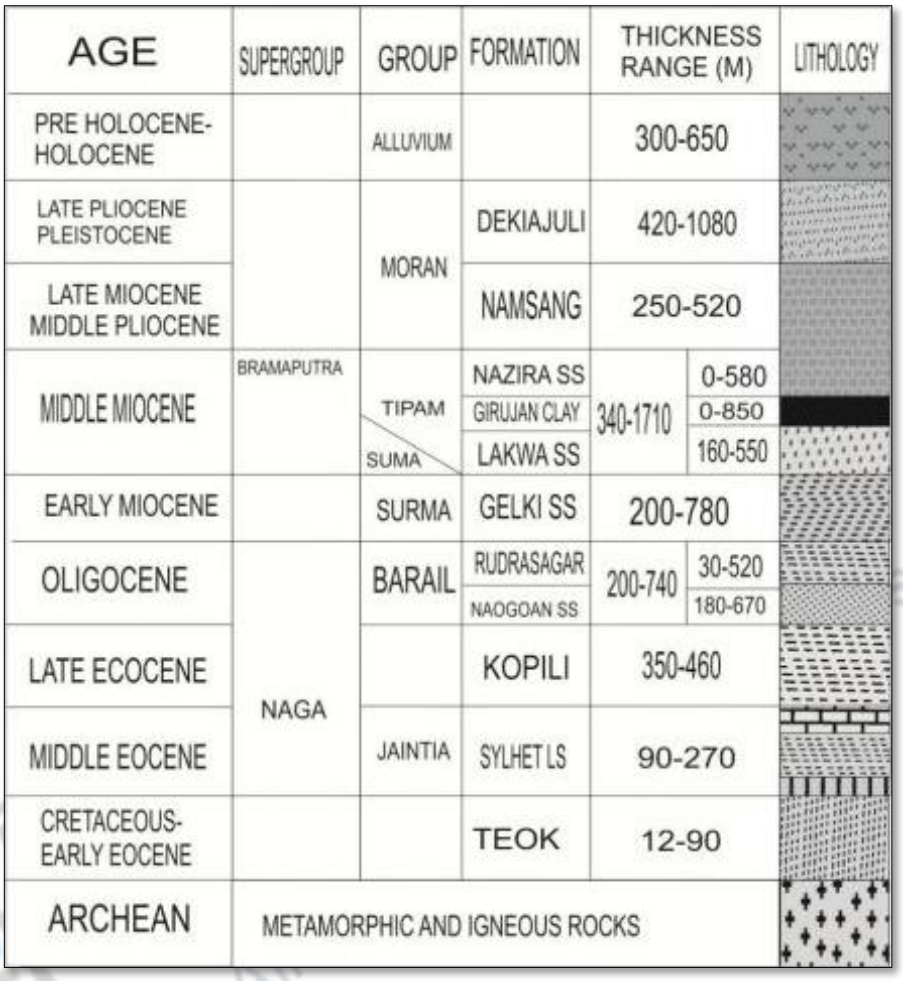

Fig. 5 Stratigraphy of Assam Basin.

4.1.3. Petroleum Geology

- **Source Rock:** Several petroleum systems are present within the Assam Basin geologic province. They have combined the composite petroleum system Sylhet- Kopili/ Barail- Tipam for the assessment purposes. For few correlations of source to reservoir where hydrocarbons were available to the time of assessment, a composite Total Petroleum System was used. The Total Petroleum System of Sylhet- Kopili/Barail-Tipam are composed of the rocks of the Eocene-Oligocene Jaintia Group Sylhet and Kopili Formations, the Oligocene Barail Group, and the Oligocene-Miocene Surma and Tipam Groups. These rocks consist of platform carbonates, shallow marine shales

and sandstone, and the sandstone, siltstones, shales and cols of deltaic, alluvial and lagoonal facies.

- **Reservoir Rocks:** In Assam geologic province the reservoir rocks are present throughout the stratigraphic province. Reservoir rock consist of the Eocene-Oligocene Jaintia Group Sylhet Formation limestones and Kopili Formation interbedded sandstones; Tura and Langpar (basal) marine sandstones also have reservoir potential, and Surma Group alluvial sandstone reservoirs are productive in the south -western part of the Assam geologic province. The Barail main pay sands and the Tipam group massive sandstones are the most productive reservoirs. Permeability ranges from less than 8 millidarcies to as much as 800 millidarcies in the Tipam Group sandstones with porosities ranging from less than 7 to 30 percent.

- **Migration:** Below the Naga thrust fault, the generation of oil begins by the early to middle Miocene for the Sylhet and Kopili Formations. According to Mathur and others (2001), the onset generation is about 1,750 million years ago for Langpar and Lakadong members of the Sylhet, and today the generation is continuing in the deeper portions of the Assam geologic Province. Primarily the migration is up dip, along the northeast- trending slope of the Assam shelf. The paths of migration may extend to adjacent reservoirs but more often as far as 15 km. the significant volumes of oil found must have migrated from deeper areas along the Naga thrust fault because the source rocks reported in many fields are marginally mature. Along the leading edge of the thrust sheet the oil generated beneath the thrust sheet has probably migrated to the leading edge of the thrust sheet and contributes materially to the total oil volume in reservoirs. Through reactivated basement-rooted faults associated with plate collision may predominate the vertical migration in some areas, particularly near the edge of Naga thrust fault.

- **Seal and Traps:** The primary traps of area are the anticlines and faulted anticlinal structures, sub-parallel to and associated with the northeast- trending Naga thrust fault. Below the Naga thrust sheet, probably the sub thrust traps are present. There have also been stratigraphic trap discoveries, such as Dholiya gas field, described as an Oligocene Barail clastic depositional lenses, and Hapjan and Sarojani oil fields identified as Barail depositional sandstone lenses. The seals of the areas are the interbedded Oligocene and Miocene shales and clays, and the thick clays of the Pliocene Gurjan Group. In the southwestern part of the Assam geologic province, the upper marine shale at the top of the Tipam Sandstone is a regional seal that extends into and throughout much of Bangladesh.

4.2. Bengal Basin

4.2.1. Introduction: Bengal is situated towards northeastern part of Indian peninsula in the state of West Bengal. It lies between 25^0- $20^0$30' and longitude $87^0$30'- 90^0 30' and falls in west Bengal state of India and Bangladesh. Basin is categorized under category-III as it has shown hydrocarbon in some of the wells that are considered geologically prospective. It occupies an area of 89,000 sq. km. in total about which 57,000 sq. km. is onland and 32,000 sq.km. offshore up to 200m bathymetry the prognosticated hydrocarbon resources in Bengal basin are placed at 190MMt of oil and gas equivalent (Fig. 6).

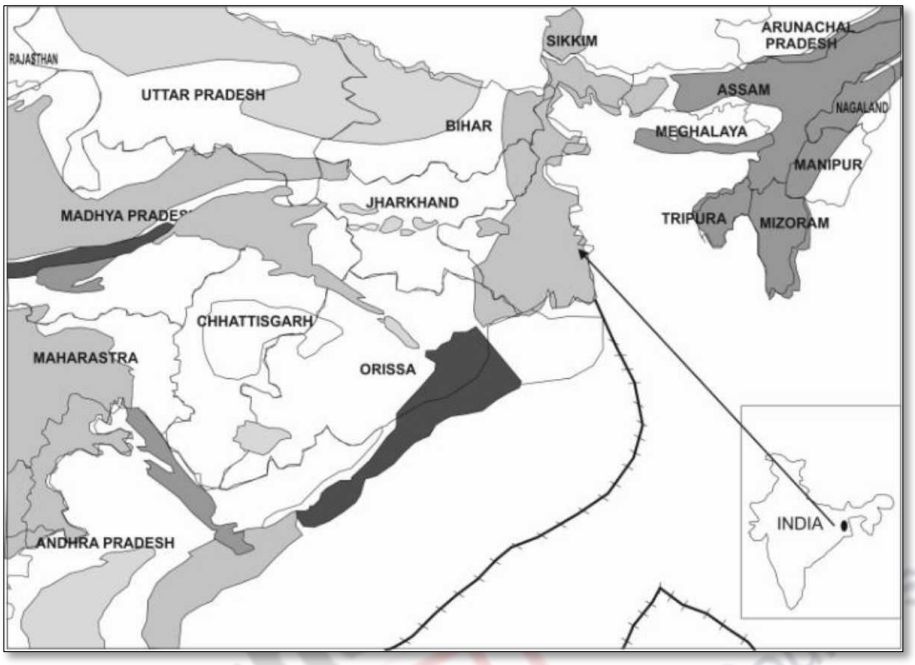

Fig. 6 Location of Bengal Basin.

4.2.2. Geology

- The geologically young and tectonically active region of the Ganges-Brahmaputra- Meghna river basin is Bengal Basin. The Bengal basin is bordered on the west by the Indian Shield, on the north by the Shillong Shield, on the east by Naga-Lusai orogenic belt and is open to the Bay of Bengal at the south. The major tectonic features of the Bengal basin are shown in the Fig. 8- Sub Himalayan fore-deep, Rangpur platform, Bogra Shelf, Calcutta- Mymensingh Hinge Zone, Bengal fore-deep, Tripura Chittagong folded bed. The Formation of the Bengal basin was initiated during Middle upper Cretaceous time with differential subsidence (as shown in Fig. 7). The episode corresponds with the deposition of subaerial fluvial clastics of Bolpur Formation. The Indo- Burman uplift has built a thick sequence of approximately 20km of deposits in the Bengal basin.

- The rock beds of Bengal basin are grouped into the Neogene and Palaeogene rock units. The rock units of Neogene are composed of

clastic sediments derived from the Himalaya, Shillong Plateau and the Arakan- Yoma Mountain ranges and they are exposed in mainly in hilly regions of Chittgong, Chittgong hill tracts, Sylhet and Mymensingh. The Neogene sequence consists of unfossiliferous alternating sandstone and shale deposits at its lower successions and massive pebbly sandstone to clay at its upper part. The Paleogene sequences are exposed mainly on northern part of Sylhet district and composed of alternating sandstone, siltstone and shale at its upper part and limestone and sandstone at its lower part. The limestone bed is fossiliferous and shows a clear water shallow marine deposit.

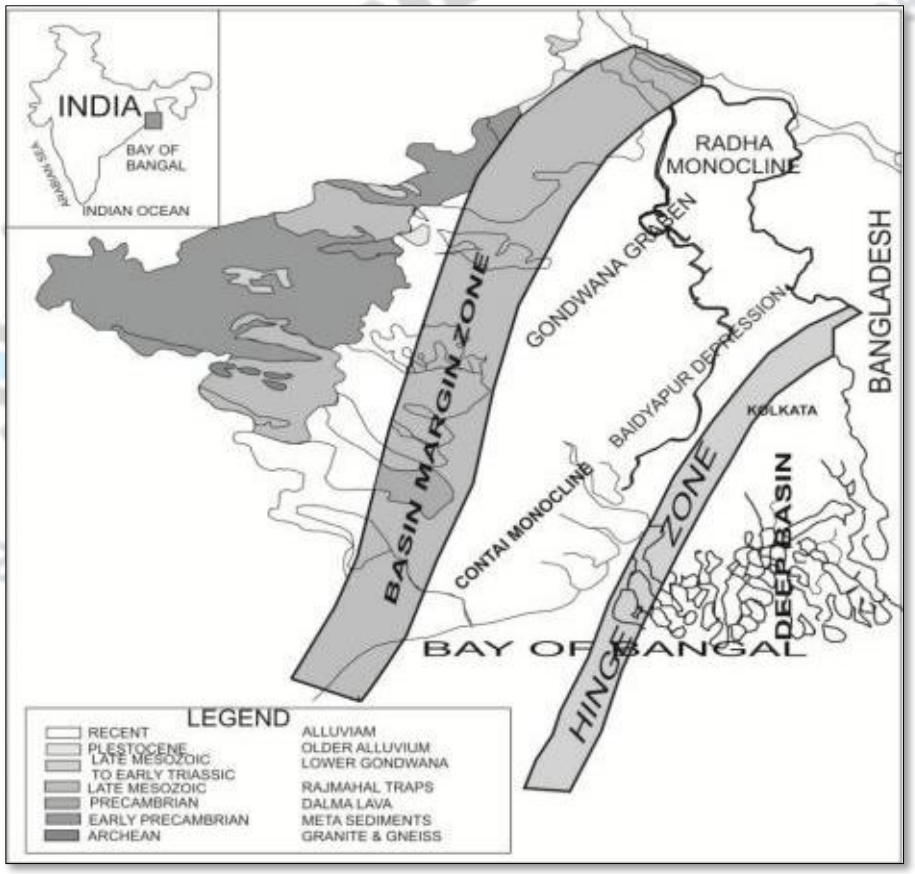

Fig. 7 Tectonic Zones of Bengal Basin.

4.2.3. Petroleum Geology

- **Source Rocks:** Stratigraphy of the Bengal basin has been revealed by drill holes in the shelf, slope, and basin areas (Fig. 8). The potential source rocks of the Bengal basin are Oligocene and Eocene carbonaceous marine shales. The Lower Gondwana sediments contain 4% of organic carbon with type II and III Kerogen, in wells Galsi- I, Maninagar- I, Palasi- I. The vitrinite reflectance values of source material within the Gondwana sequences range between 0.47% and 3.29%.

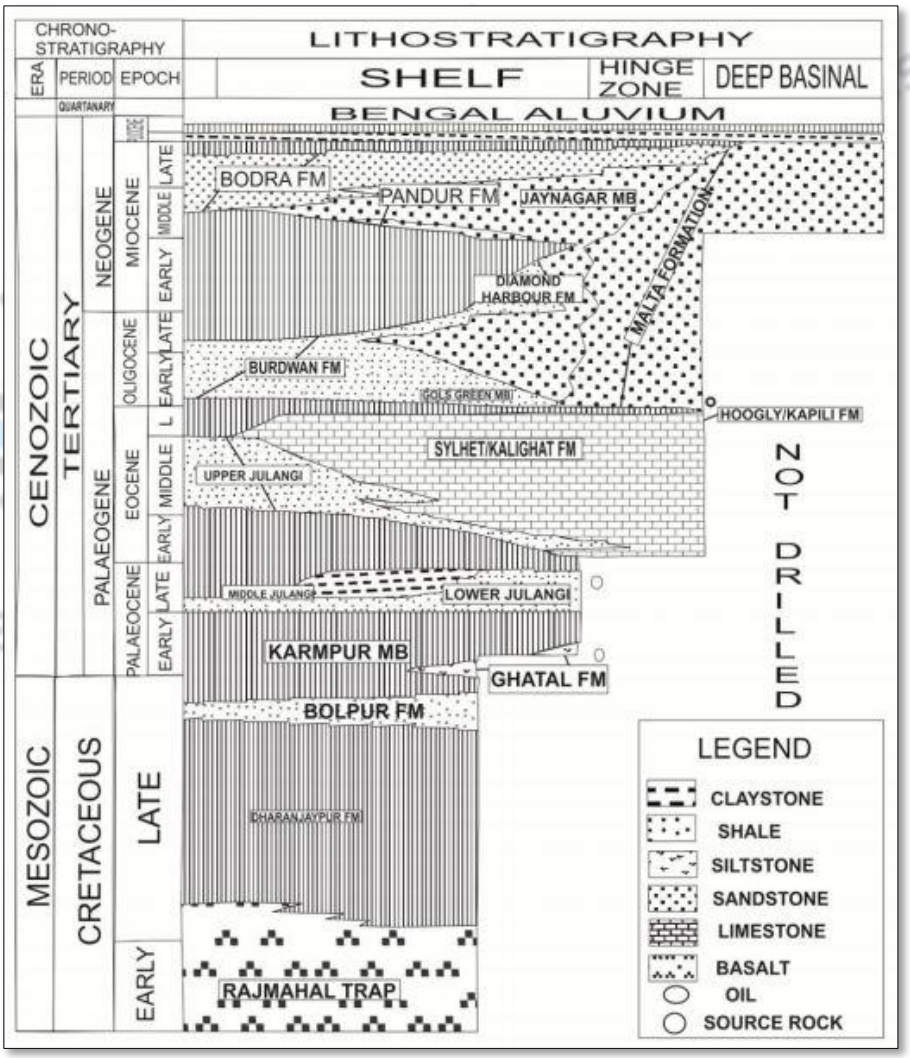

Fig. 8 Stratigraphy of Bengal Basin.

- **Reservoir Rocks:** The potential reservoir rocks of Bengal basin are early to middle Miocene sandstones and siltstones of Surma and Tipam groups. Reservoir rocks in the Surma basin are chiefly Tertiary age sandstones of the Bokabil and Bhuban Formations (Miocene). Porosity ranges generally from 10 to 20 percent. Reservoir sands range from thick channel fill and littoral or marine bar deposits to sandstones thinly interlaminated with shale and siltstone. Structural and combination traps of Miocene age occur along stratigraphic boundaries, in sandstone-filled channel deposits and in sandstone beds sealed laterally by shale-filled channels and these comprise major traps in the eastern part of the basin.
- **Migration:** Both short distance and long distance migration are predominant in Bengal basin.
- **Seals:** Mio-Pliocene shale sequence acts as an effective cap rocks for the hydrocarbon reservoirs of the Bengal basin. Intra Formational shales and clay stones of the Surma group are common seal for the gas fields of Bengal Basin. The Kopili shale may act as a regional seal over the shelf-slope areas. So far, the anticlines are the common type of traps for the accumulations of both oil and gas in Bengal Basin.
- **Traps:** Graben setting, with composite lithology, may provide suitable conditions for hydrocarbon accumulation in structural, stratigraphic and strati-structural traps. In Cretaceous and Paleocene age hydrocarbon got accumulated in stratigraphic and strati structural traps.

4.3. Cauvery Basin

4.3.1. Introduction: It extends along East coast of India bounded by 8^0 to $12^0$5' N latitude and 78^0- 80^0 E longitude. Hydrogen exploration is happening from late fifties. The first deep well was drilled in 1964. The onland extent of Cauvery basin is 25,000 sq. km. and shallow offshore area comprises of 30,000 sq. km. In addition, there is

about 95,000 sq. km. of deep-water offshore area. Cauvery basin is a pericratonic rift basin and comes under category-I. Some of the important the important oil fields are Ariyalur-Pondicherry, Tranqquebar, Nagapattinam, Tanjor and Ramnad (as shown in Fig. 9a & 9b).

Fig. 9(a) Location of Cauvery basin in India.

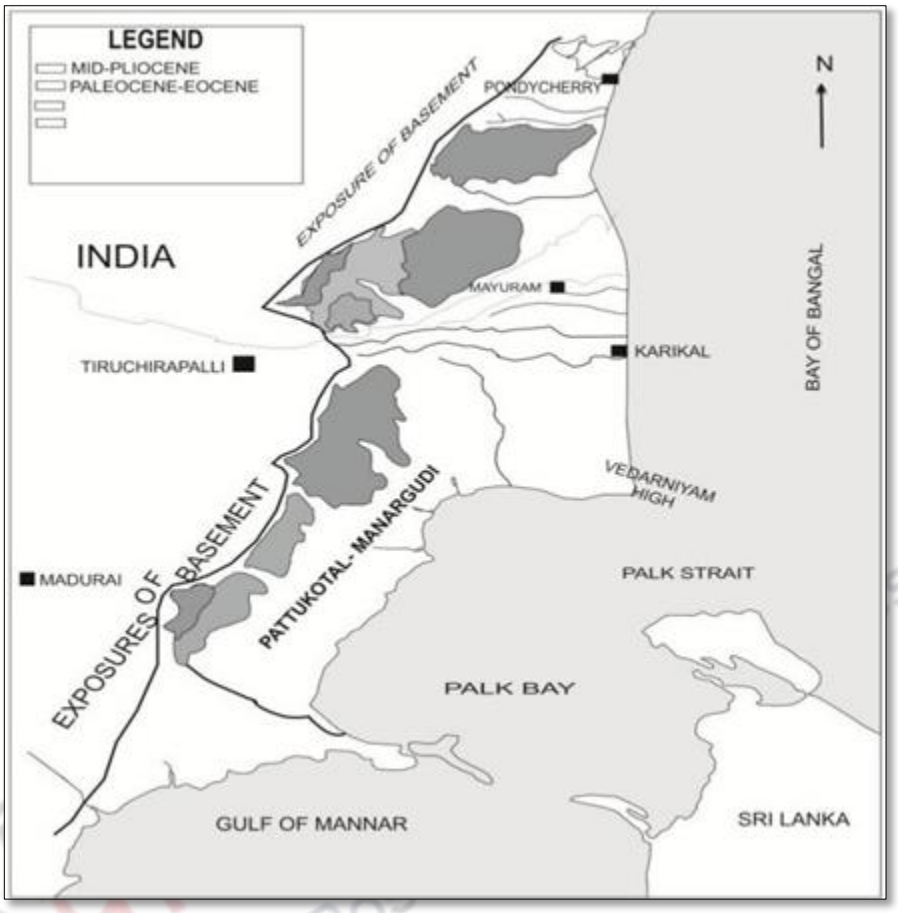

Fig. 9(b) Geological map of Cauvery Basin.

4.3.2. Geology: In Cauvery basin, the horst graben trend is oblique to the N-S trending coastlines and shelf (Fig. 10). The boundary between KG and Cauvery basin is physically defined by sharp bend of eastern seaboard from NE-SW to N-S although the Eastern Ghat tectonic trend influenced the structural fabric of the southern basin also the N-S orientation of the coastal plain here is due to the North ward extension of the Indrani Transform Fault (as shown in Fig. 11).

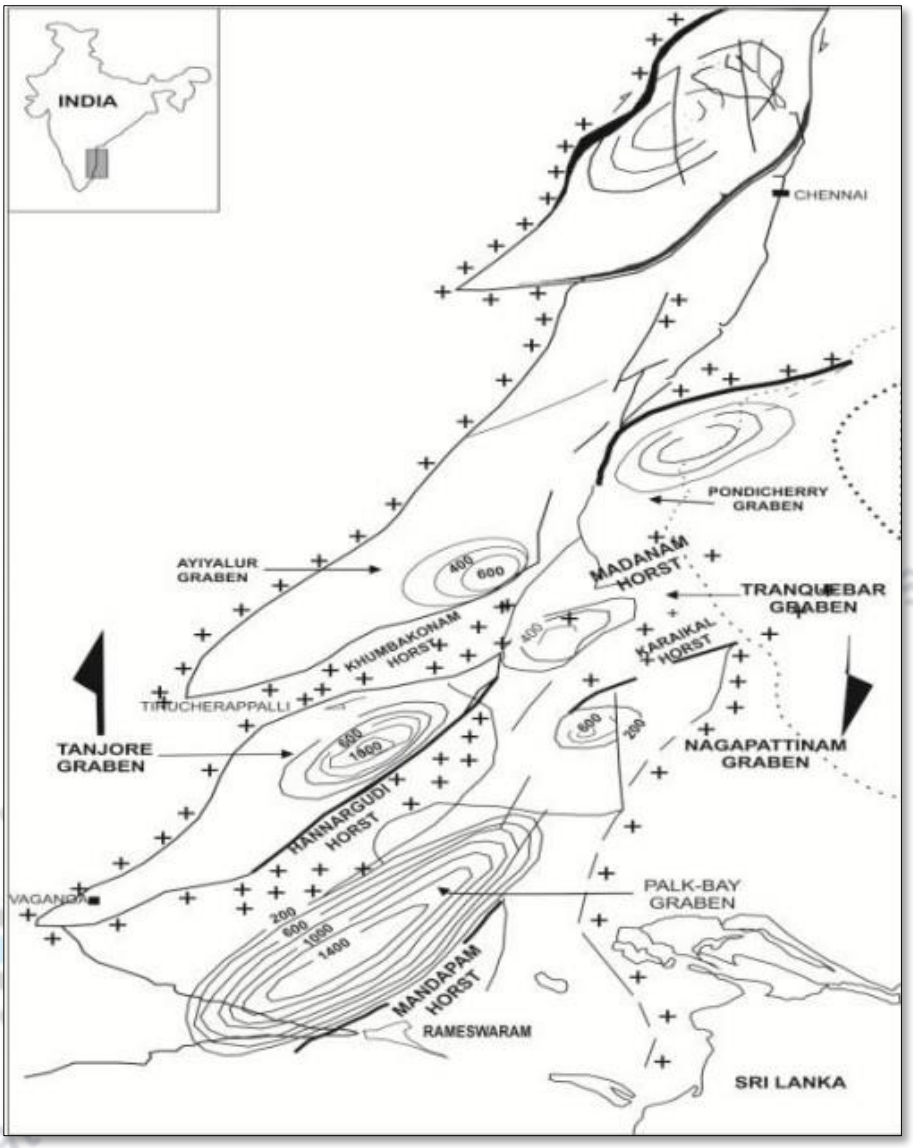

Fig. 10 Tectonic map of Cauvery Basin.

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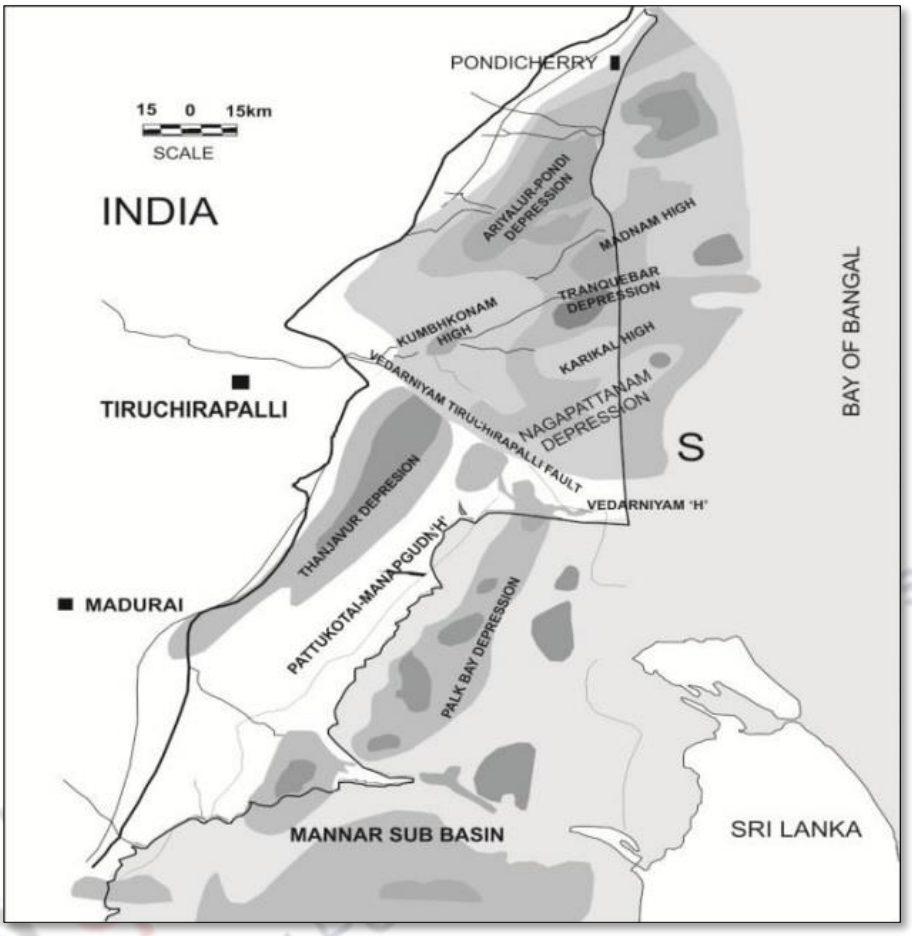

Fig. 11 Cauvery basin with the rejuvenation of rifting.

The evolution of Cauvery basin is understood to have taken place through three distinct stages namely:- (1) Late Jurassic-Early Cretaceous rift stage, (2) Late Cretaceous and post Cretaceous. The stratigraphy of Cauvery basin is shown in Fig. 12.

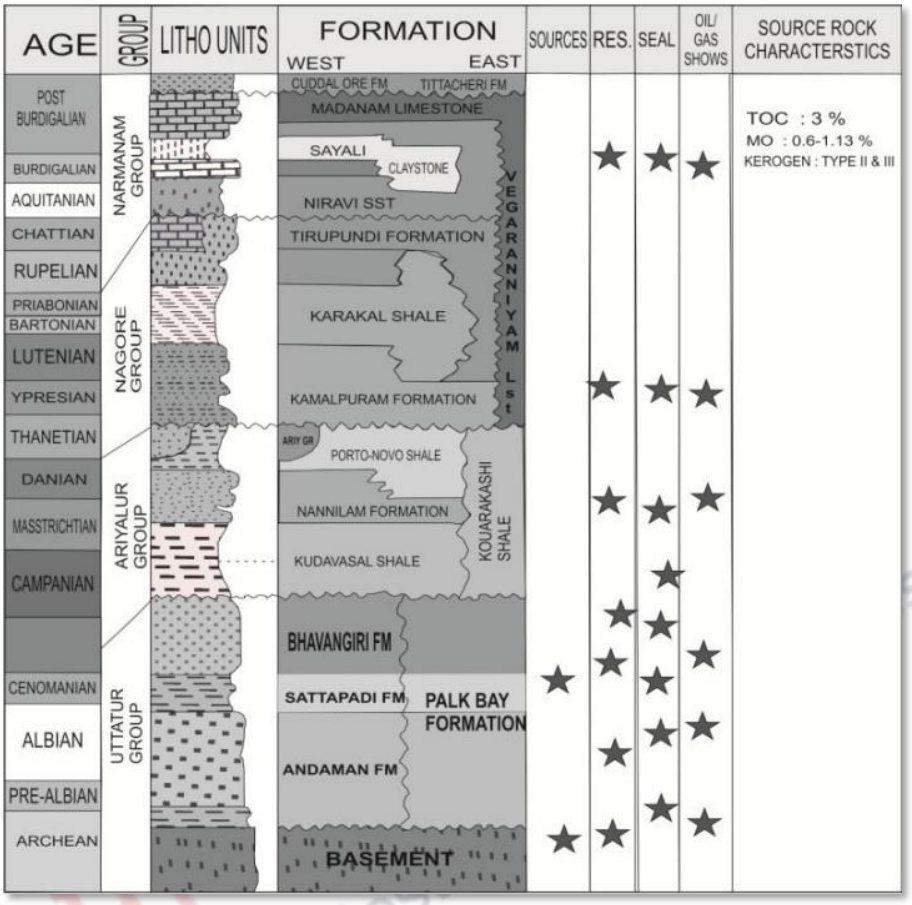

Fig. 12 Stratigraphy of Cauvery Basin.

4.3.3. Petroleum Geology

- **Source Rock:** Hydrocarbon potential of this basin is not as high as KG basin. Detailed geochemical studies conclusively established that the bulk of Tertiary sediments are inadequately matured for hydrocarbon generation. Only the Synrift and postrift Cretaceous shale sequences are matured source rock. It is important to note that adequately source rocks occur within and in vicinity of the medium wrenched corridor. The occurrence of the matured source rocks within the wrenched corridor indicates a locally enhanced geothermal gradient that favored maturation. The known source facies are established in the lower Cretaceous Andimadam Formation. Alternate streaks of shale sequences in deeper parts

are known to have good source rock potential. These shales are typically the main source rock encountered in the study area. The source rocks are typically a mixture of type II-III facies.

- **Reservoir Rocks:** Extensive sandstone deposition took place in all the grabens/half grabens during synrift phase of the Cauvery basin evolution. Besides sandstone and allodepic carbonate, siltstone deposits also locally form reservoirs. In the Cauvery basin, fractured gneissic basement is the reservoir indicating basement as a potential target. Known reservoirs in the area are the middle Cretaceous Bhuvnagiri sandstones, upper Cretaceous Nannilam sandstones and Kamlapuram sands of Paleocene age. The synrift sequences of the Andimadam Formation are still not well understood in terms of source and reservoir distribution. With the majority of production coming from the Nannilam reservoirs, deeper reservoir Formations of Andimadam sequence are likely to be a next potential target for hydrocarbon exploration.

- **Migration:** Most of the sandstone sequences encountered in Andimadam can serve as a good reservoir, and that hydrocarbons can potentially accumulate. Both structural and stratigraphic traps were in place during the evolution of basin at different times. Migration routes within the area are mostly vertical due to buoyancy. At some places, faults can also be seen acting as a conduit for fluid migration. The model considers the effect of open and close faults for understanding the hydrocarbon migration, which takes place during different time steps of basin evolution. The stratigraphical and structural traps present within the Andimadam Formation can be a good target for deeper exploration in future. The expected play types are structural and combination traps in Early Cretaceous to Paleocene sequences. Stratigraphic traps such as pinch outs/ wedge outs and lenticular sand bodies in Early to Late Cretaceous sequences are favored traps.

- **Seals and Traps:** The area has good seals in place, with shale sequences of Cenomanian, Santonian, and Maastrichtian being the major regional seals. The common hydrocarbon traps are structural, stratigraphic, combination, fault related structures and draped over basement highs. Deep-water exploration in offshore Cauvery is not as successful as in KG offshore.

5. Summary

1. In India there are 26 sedimentary basins covering an area of 3.14 million square kilometer.
2. Indian sedimentary basins have been divided into four categories based on their degree of prospectivity. There are seven basins in category- I, three basins in category-II, six basins in category-III and ten basins in category-IV.
3. Assam and Cauvery basin falls in category-I and Bengal basin in category-III.
4. In all the three basins described in the text, explorationists explore for structural, stratigraphic and combinational traps.
5. Assam geologic province is the first known hydrocarbon province in India. The chief oil fields of Assam are Digboi, Nahorkathiya, Moran, Rudrasagar, Lakwa, etc.
6. Reservoir rocks are present throughout most of the stratigraphic section in the Assam geologic section.
7. Expected play in Cauvery basin is mostly stratigraphic such as pinch outs/ wedge outs and lenticular sand bodies in Early cretaceous sequences.
8. The source is mostly Sattapadi shale within cretaceous; reservoir rock comprises of Andimadam, Bhuvanagiri and Nanilam Formation within Cretaceous Formation.
9. Bengal basin is less explored basin among that described in the text. Entrapment conditions are expected to exists in basement related structures and stratigraphic wedge outs. Eocene shelf edge forms a favorable locale for the development of carbonate reef prospects.

Frequently Asked Questions-

Q1. Categorize sedimentary basins of India according to hydrocarbon prospectively?

Ans: On the basis of hydrocarbon, prospectively the sedimentary basins of India have been categorized into four basins, which are as follows:

Category-I

The petroliferous basins with proved hydrocarbon reserves and where commercial production has already been started comes under this category. It mainly includes basins like –

- Assam shelf
- Bombay offshore
- Cambay
- Krishna
- Godavari
- Rajasthan
- Cauvery

Category-II

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- Bengal
- Himalayan foothills
- Jaisalmer
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Category-III

In this category, sedimentary basins have no significant oil & gas shows but are considered as prospective on Geological considerations. It includes following basins -

- Bikaner- Nagaur
- Kerala- Lakshadweep
- Saurashtra

Category-IV

This is the category, where petroliferous basins with uncertain prospects require basic data for prognosis. It includes the basins, which bear an analogy with similar hydrocarbon producing basins in the world and may be prospective. It includes basins like

- Arunachal Pradesh
- Deccan syncline
- Ganga valley
- Gondwana
- Mizoram
- Manipur
- Narmada
- Vindhyan

Q2. Describe reservoir rocks of Cauvery basin?

Ans: In Cauvery basin the extensive sandstone deposition took place in all the grabens/half grabens during synrift phase of the Cauvery basin evolution. Besides sandstone and allodepic carbonate, deposits also locally from reservoirs. In the Cauvery basin, fractured gneissic basement is the reservoir-indicating basement as a potential target. Known reservoirs in the area are the middle Cretaceous Bhuvnagiri sandstones, upper Cretaceous Nannilam sandstones and Kamlapuram sands of Paleocene age. The synrift sequences of the Andimadam Formation are still not well understood in terms of source and reservoir distribution. With the majority of production coming from the Nannilam reservoirs, deeper reservoir Formations of Andimadam sequence are likely to be a next potential target for hydrocarbon exploration.

Q3. Enumerate the traps encountered in Cauvery basin?

Ans: In this area the common hydrocarbon traps are –

1. Structural and Stratigraphic
2. Combination
3. Fault Related Structures and Draped Over Basement Highs

Q4. Detail out the main tectonic and structural zones identified in Bengal basin?

Ans: The Bengal basin is the geologically and tectonically active region of the Ganges- Brahmaputra- Meghna river basin. The Bengal basin is bordered on the west by the Indian Shield, on the north by the Shillong Shield, on the east

by Naga-Lusai orogenic belt and is open to the Bay of Bengal at the south. The major tectonic features of the Bengal basin are shown in the fig.8- Sub- Himalayan foredeep, Rangpur platform, Bogra Shelf, Calcutta-Mymensingh Hinge Zone, Bengal fore-deep, Tripura- Chittagong folded bed. The Formation of the Bengal basin was initiated during Middle upper cretaceous time with differential subsidence. The episode corresponds with the deposition of sub-aerial fluvial elastics of Bolpur Formation. The Indo- Burman uplift has built a thick sequence of approximately 20km of deposits in the Bengal basin.

Q5. Discuss the source rock characteristics of Bengal basin?

Ans: The potential source rocks of the Bengal basin are Oligocene and Eocene carbonaceous marine shales. The Lower Gondwana sediments contain 4% of organic carbon with type II and III Kerogen. In wells Galsi- I, Maninagar- I, Palasi- I the vitrinite reflectance values of source material within the Gondwana sequences range between 0.47% and 3.29%.

Multiple Choice Questions-

1. Bengal basin comes under _____ category basins

(a) I
(b) II
(c) III
(d) IV

Ans: c

2. Cauvery basin comes under_____category basins

(a) I
(b) II
(c) III
(d) IV

Ans: a

3. The Formation of Bengal basin was initiated during___time with differential subsidence

(a) Miocene
(b) Oligocene
(c) Pliocene
(d) Cretaceous

Ans: d

4. The source material within the Gondwana sequence range between __ % to___ %

(a) 0.5 - 1.0
(b) 7.0 – 8.0
(c) 6.0 – 7.0
(d) 0.5 – 3.0

Ans: d

5. In Borholla and Chmpang oil fields, oil occurs in

(a) Lenticular sands
(b) Wedge outs
(c) Pinch outs
(d) Fractured basements

Ans: d

6. Kerogen type of source in Assam – Arakan basin is

(a) Type-I
(b) Type-II
(c) Type-III
(d) Type-IV

Ans: c

7. Oil exploration in India commenced with the discovery of oil field

(a) Geleki
(b) Charali
(c) Dirok
(d) Digboi

Ans: d

8. Stratigraphic traps in Cauvery basin are

(a) Pinch outs
(b) Wedge outs
(c) Lenticular sand bodies
(d) All of above

Ans: d

9. In Cauvery basin rejuvenation of rifting took place in

(a) Oligocene
(b) Miocene
(c) Pliocene
(d) Jurassic

Ans: d

10. India has _____ number of sedimentary basin

(a) 10
(b) 15
(c) 26
(d) 32

Ans: c

Suggested Readings:

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