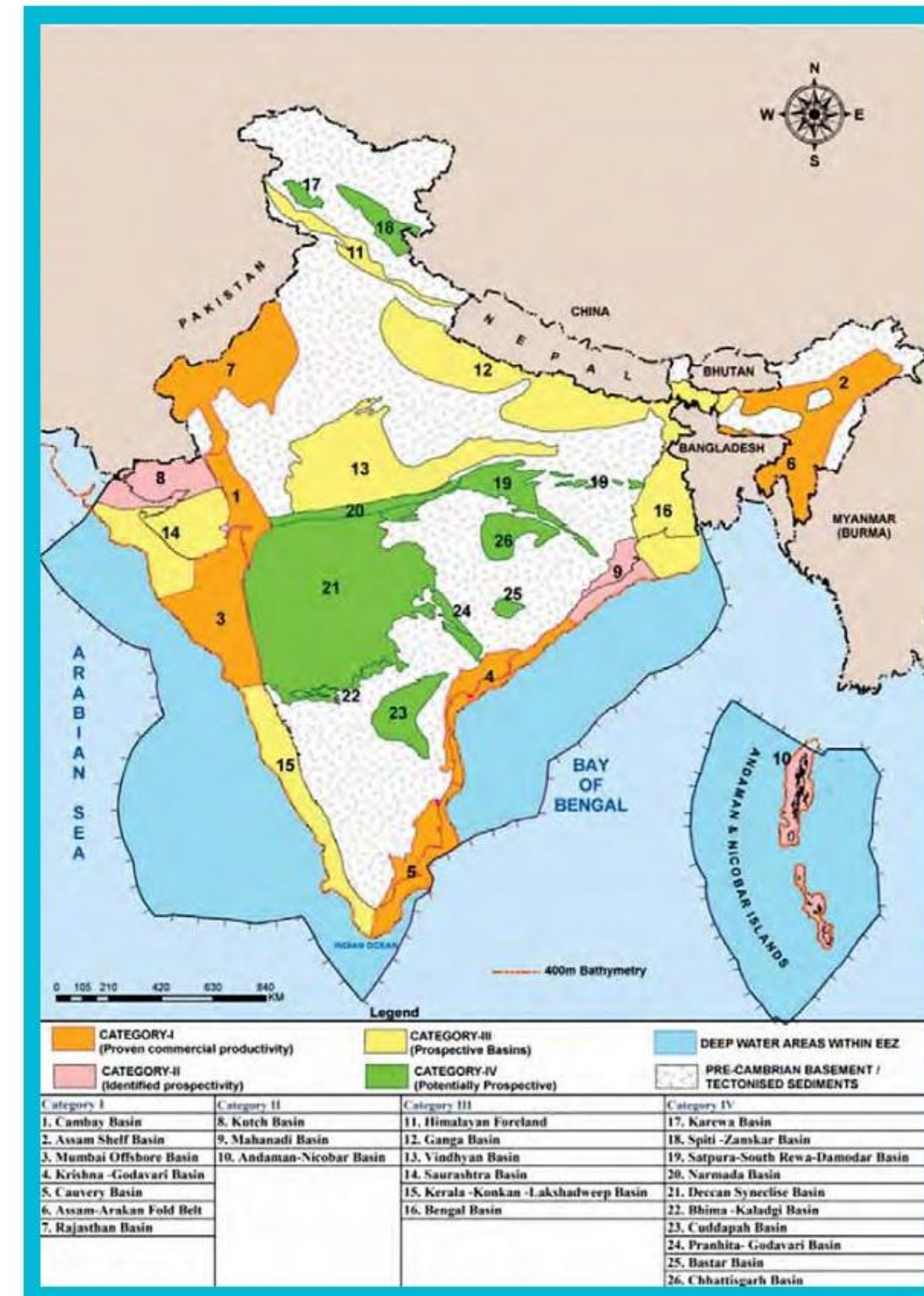


Petroliferous Basins of India

Subject- Geology
 Course- M.Sc. Geology
 Semester- IV
 Paper Code- MGELEC-1
 Paper Name- Fuel Geology (Elective)

Prepared by,
 Mrityunjay Kumar Jha
 Assistant professor (Guest faculty)
 PG Department of Geology,
 Patna University, Patna, Bihar
 Mobile no.- 7004813935
 Email- mkjtunna@gmail.com



Lesson overview

In this lesson, students will learn about classification of the petroliferous basins, different petroliferous basins of India, and petroleum system of Category-I basins of India.

Learning objectives

- What are the petroliferous basins, why they are important and how can we classify them?
- The distribution of petroliferous basins in India

Contents

- Introduction
- Resource/Reserve Classification
- Distribution of Petroliferous basins in India
- Overview of Category-I basins
- References

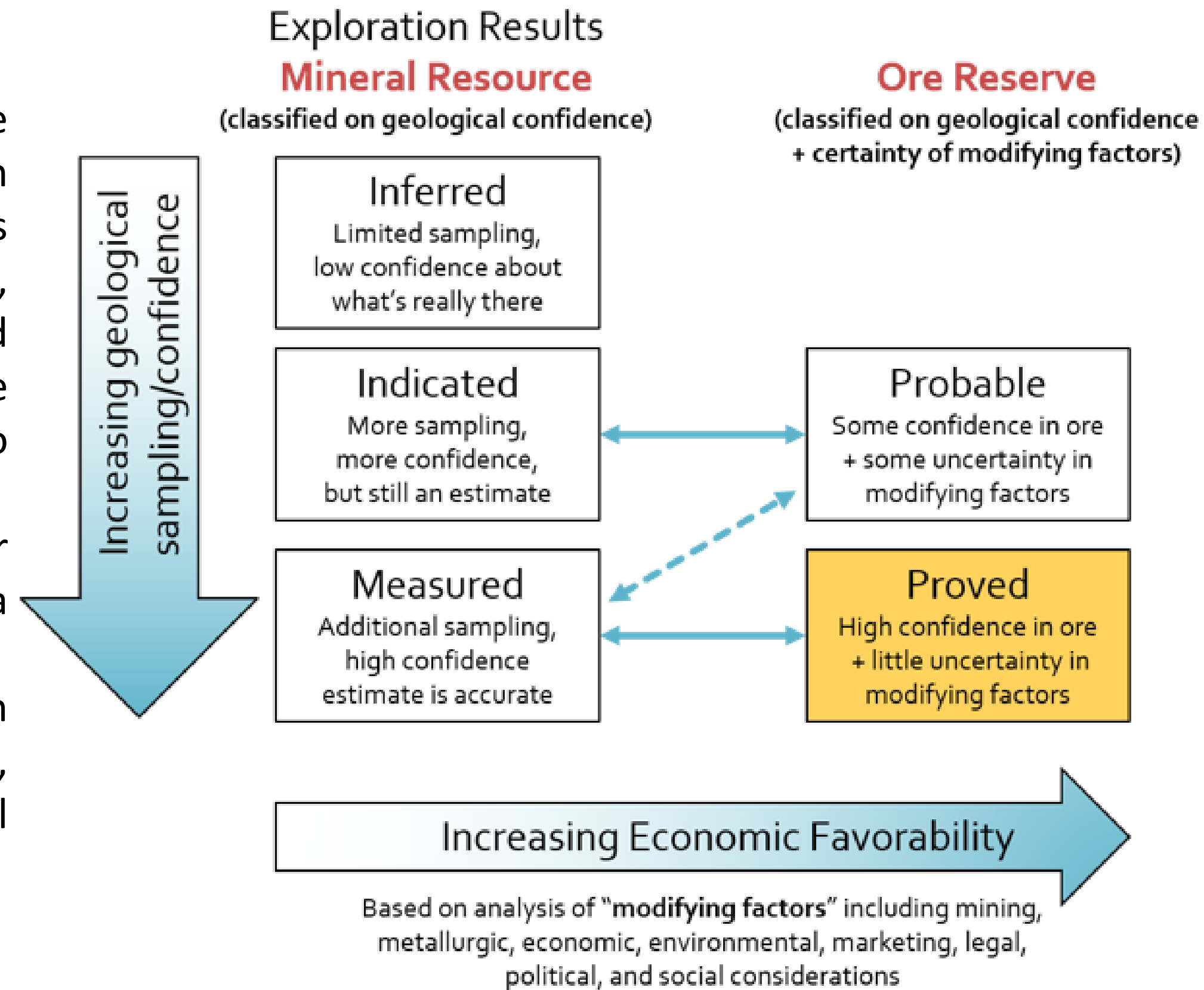
Introduction

- A sedimentary basin having prospect of petroleum exploration or production is called as petroliferous basin.
- India has 26 petroliferous basins.
- The existing 26 Sedimentary Basins have an area of approximately 3.14 million Sq. Kms.
- Based on the occurrence of hydrocarbon; exploration and the status of knowledge these basins have been divided into four categories.

Category I	Category II	Category III	Category IV
1. Cambay basin	8. Kutch Basin	11. Himalayan Foreland	17. Karewa Basin
2. Assam Shelf Basin	9. Mahanadi Basin	12. Ganga Basin	18. Spiti-Zaskar Basin
3. Mumbai Offshore Basin	10. Andaman-Nicobar Basin	13. Vindhyan Basin	19. Satpura-South Rewa-Damodar Basin
4. Krishna-Godavari Basin		14. Saurashtra Basin	20. Narmada Basin
5. Cauvery Basin		15. Kerala-Konkan-Lakshadweep Basin	21. Deccan Syncline Basin
6. Assam-Arakan Fold Belt		16. Bengal Basin	22. Bhima-Kaladgi Basin
7. Rajasthan Basin			23. Cuddapah Basin
			24. Pranhita-Godavari Basin
			25. Bastar Basin
			26. Chattisgarh Basin

Resource/Reserve classification

- A **resource** is a concentration of potentially valuable material that naturally occurs in the earth that can potentially be mined for economic profit. Whether it is worth extracting now or later may depend on the amount, form, location, and quality of the material, a concept called geological confidence, whereas a **reserve** is the part of the mineral resource that can be economically profitable to exploitation (mine).
- A deposit is first identified as an inferred, indicated, or measured mineral resource, it is next labeled as a “probable” or “proved” ore reserve.
- This classification is based on sampling, combined with consideration such as mining, metallurgic, economic, environmental, marketing, legal, political, and social factors.
- Likewise petroliferous basins can also be classified.



Distribution of Petroliferous basins in India

Category-I

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

Category-II

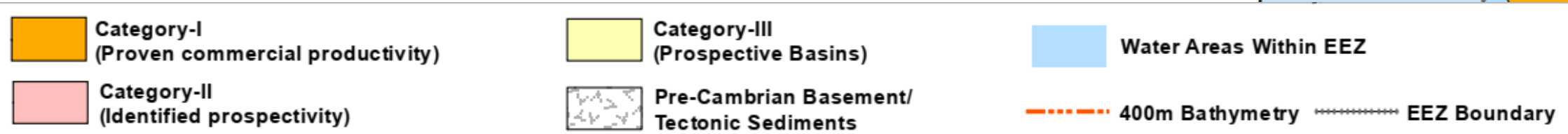
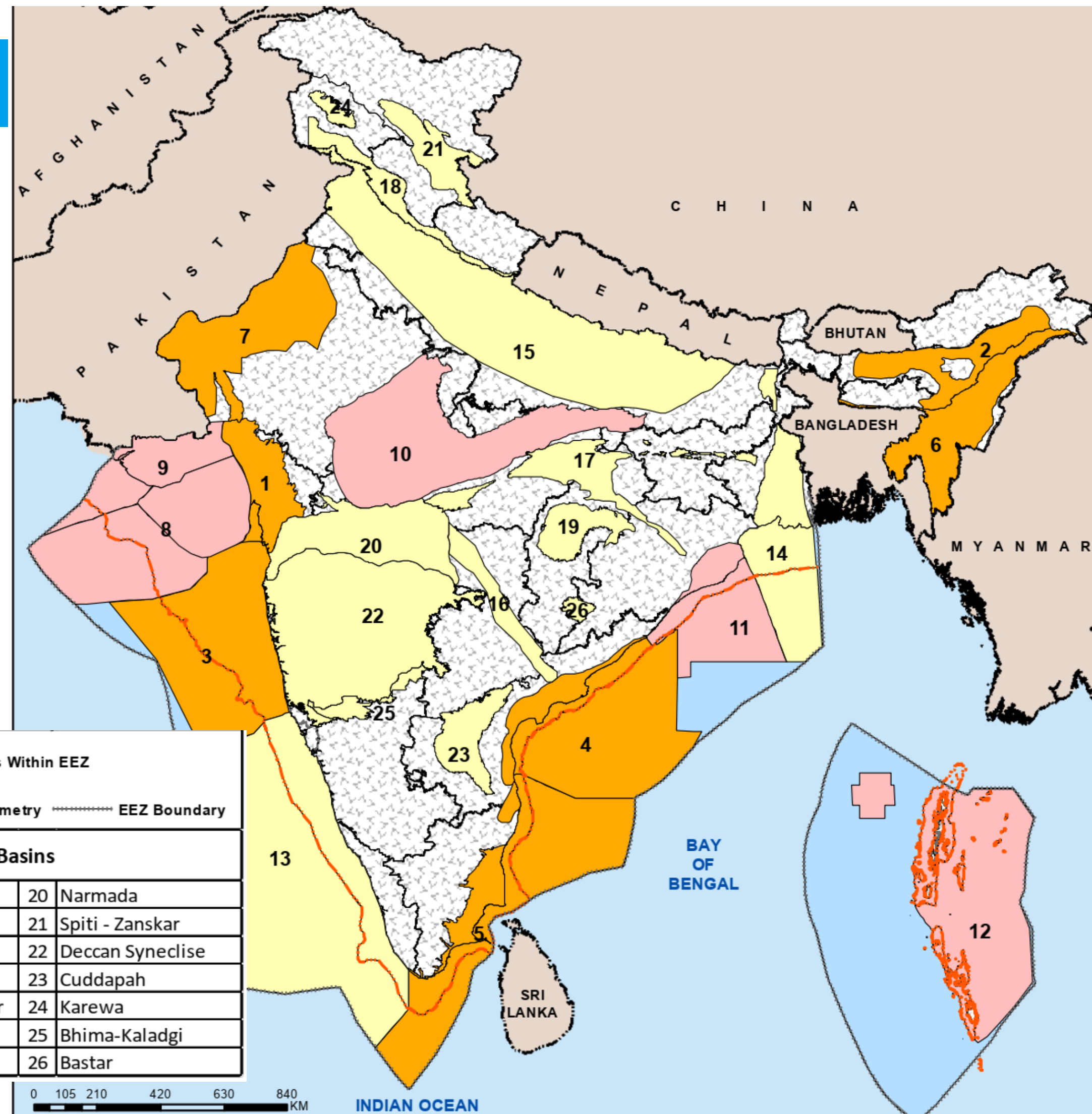
Sedimentary basin with proved occurrence of hydrocarbons but from which no commercial production has been obtained yet comes under this category.

Category-III

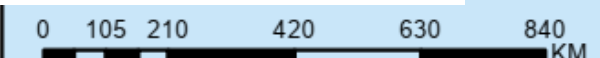
In this category, sedimentary basins have no significant oil & gas shows but are considered as prospective on Geological considerations.

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.



Category - I Basins		Category - II Basins		Category - III Basins	
1	Cambay	8	Saurashtra	13	Kerala-Konkan
2	Assam-Shelf	9	Kutch	14	Bengal - Purnea
3	Mumbai Offshore	10	Vindhyan	15	Ganga - Punjab
4	Krishna-Godavari	11	Mahanadi	16	Pranhita - Godavari
5	Cauvery	12	Andaman	17	Satpura - South Rewa - Damodar
6	Assam-Arakan Fold Belt			18	Himalyan Foreland
7	Rajasthan			19	Chhattisgarh
				20	Narmada
				21	Spiti - Zanskar
				22	Deccan Syneclise
				23	Cuddapah
				24	Karewa
				25	Bhima-Kaladgi
				26	Bastar



INDIAN OCEAN

Overview of Category-I basins

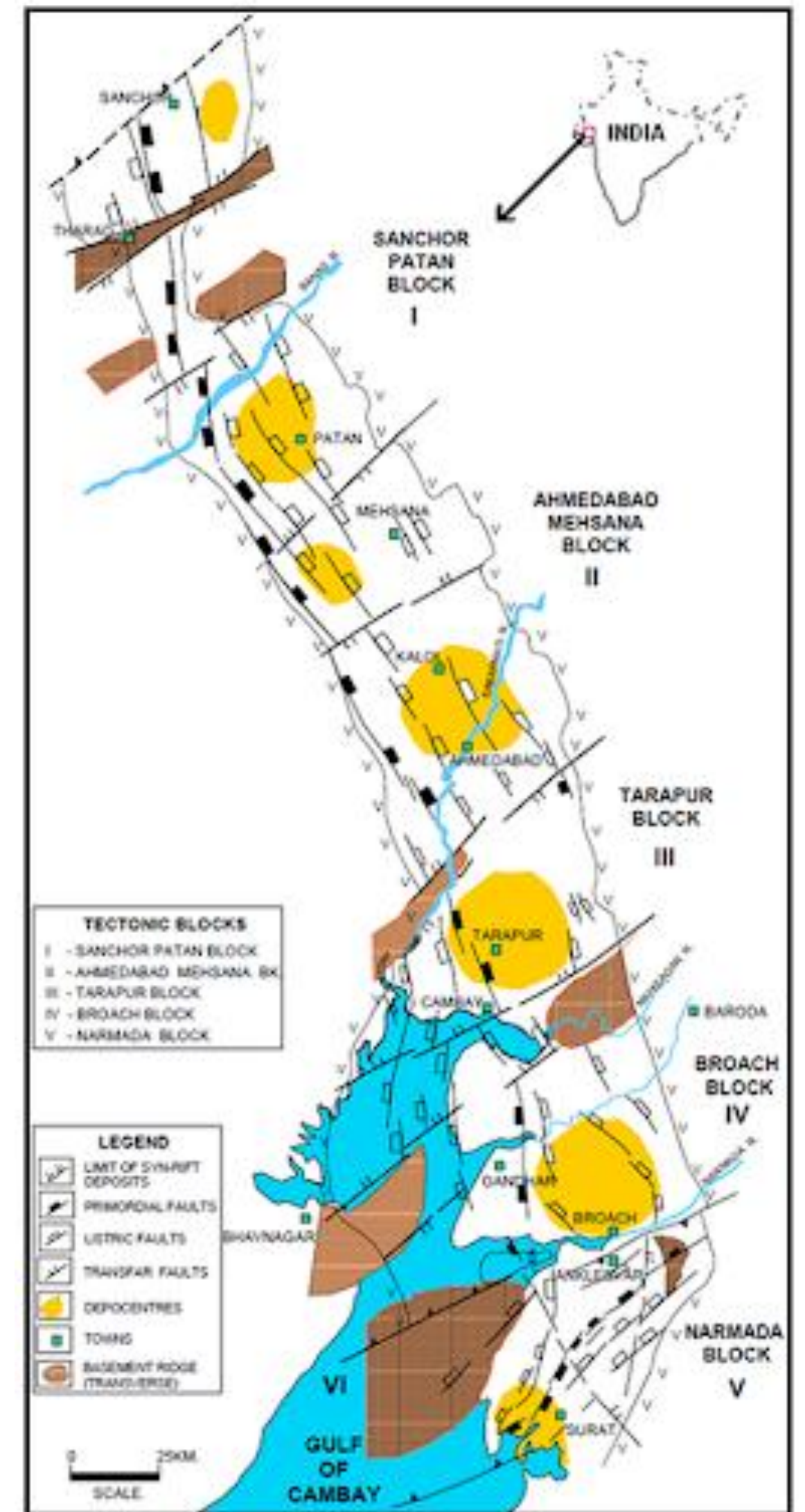
- **India has an estimated sedimentary area of 3.36 million sq. km. comprising of 26 sedimentary basins.**
- **Out of the total area, 1.63 million sq. km. area is in onland, shallow offshore up to 400m isobaths have an areal extent of 0.41 million sq. km. and deep-water beyond 400m isobaths having sedimentary area of 1.32 million sq. km.**

Table. Category I basin area and resources as on 01 Apr, 2013 : (Basins with reserves being produced and potential to be exploited at increased recovery)

Basin Name	Area Onland (sq. km.)	Area Shallow-water (sq. km.)	Area Deep-water (sq. km.)	Area Total (sq. km.)	Offshore resource (MMT)	Onland resource (MMT)	Total resource (MMT)
Krishna-Godawari	31,456	25,649	1,72,895	2,30,000	555	575	1130
Mumbai Offshore	–	1,18,389	93,611	2,12,000	9190	--	9190
Assam Shelf	56,000	–	–	56,000	--	3180	3180
Rajasthan	1,26,000	–	–	1,26,000	--	380	380
Cauvery	37,825	43,723	1,58,452	2,40,000	270	430	700
Assam-Arakan Fold Belt	80,825	–	–	80,825	--	1860	1860
Cambay	48,882	4,618	–	53,500	--	2050	2050

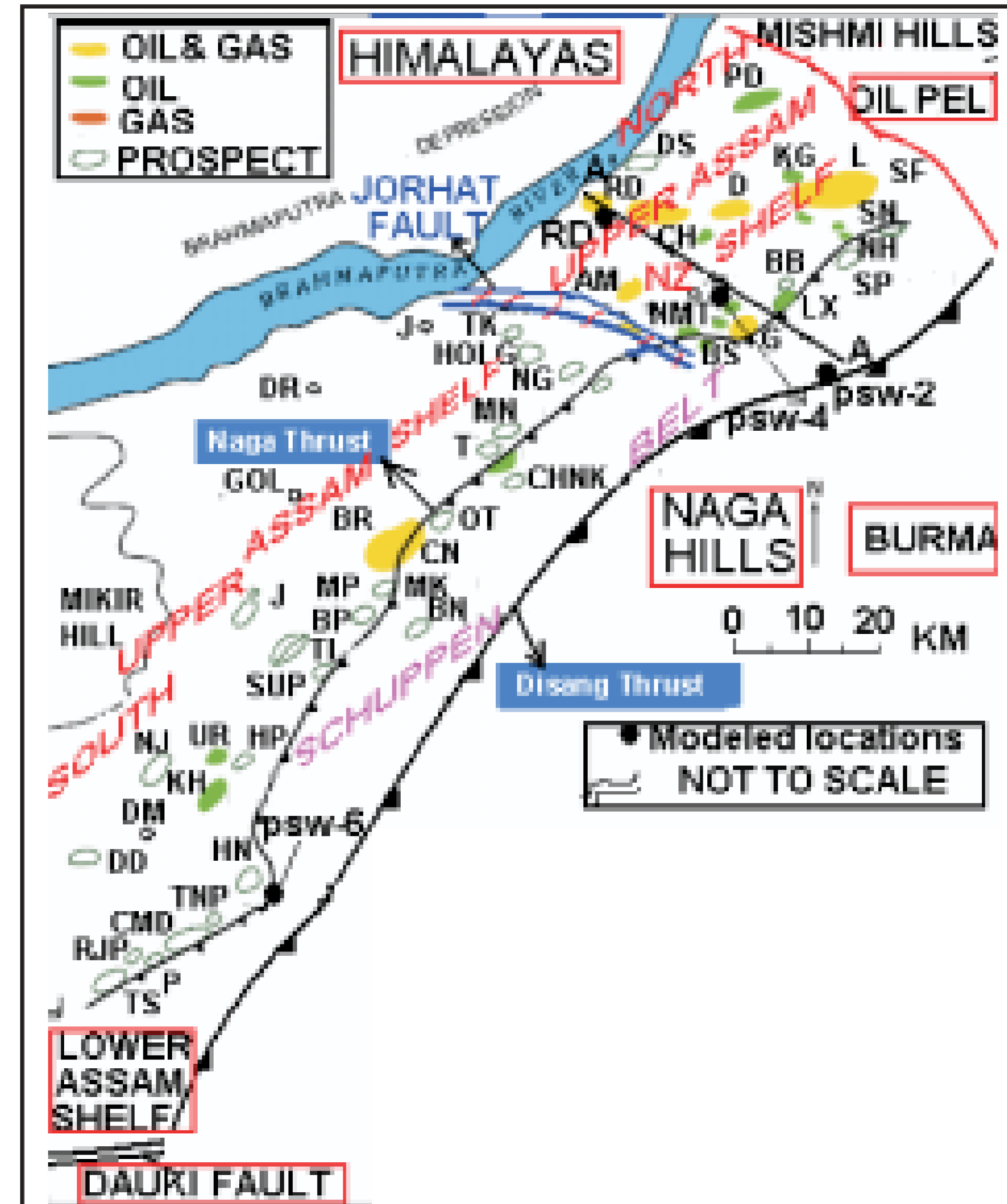
Overview of Category-I basin- 1. Cambay Basin

1. Cambay basin- It is a narrow, elongated rift graben, extending from Surat in the south to Sanchor in the north. In the north, the basin narrows, but tectonically continues beyond Sanchor to pass into the Barmer Basin of Rajasthan. On the southern side, the basin merges with the Bombay Offshore Basin in the Arabian Sea. In this basin eight km of Tertiary sediment rest over the Deccan volcanics. It is an Intracratonic rift graben basin. Thick Cambay Shale has been the main hydrocarbon source rock in the Cambay Basin. In the northern part of the Ahmedabad-Mehsana Block, coal, which is well developed within the deltaic sequence in Kalol, Sobhasan and Mehsana fields, is also inferred to be an important hydrocarbon source rock. There are a number of the reservoirs within the trapwacke sequence of the Olpad Formation. These consist of sand size basalt fragments. Besides this, localized sandstone reservoirs within the Cambay Shale as in the Unawa, Linch, Mandhali, Mehsana, Sobhasan, fields, etc are also present. Structural Highs and fault closures & Stratigraphic traps (pinchouts / wedgeouts, lenticular sands, oolitic sands, weathered trap) in Paleocene to Miocene sequences have been proved as important plays of Cambay Basin. Cambay basin holds 1227 MMT (million metric tonnes) of in-place oil reserves. These established reserves form 56.28% of the total estimated resources of 2180 MMT in Cambay basin.



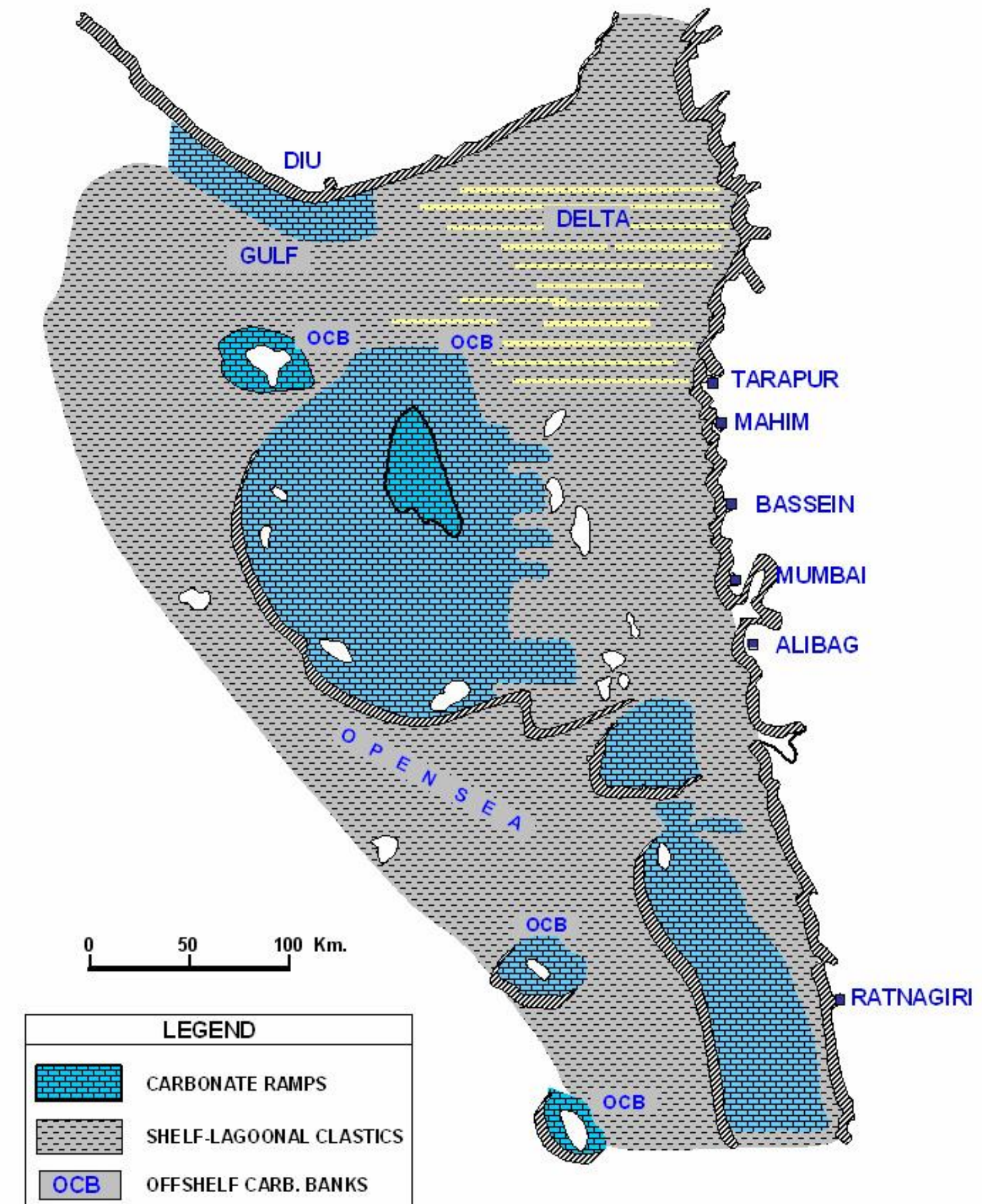
Overview of Category-I basin- 2. Assam Shelf Basin

2. Assam Shelf Basin- The upper Assam shelf, a southeast dipping shelf is the foreland part of Assam-Arakan Basin. It is bounded by the shield of Mikir hills towards its west and Mishmi hills along its northeastern boundary. The upper Assam shelf contains about 7000m thick sediments of mostly Tertiary and Quaternary age. Source rocks are mainly, Barail, Kopili and Sylhet/Tura formations of the Schuppen belt. Excellent reservoir rocks include the Barail main pay sands and the Tipam Group massive sandstones beside the Sylhet limestones, Kopili interbedded sandstones, Tura and Langpar (basal) marine sandstones are also acting as reservoir rocks. Effective seals include interbedded Oligocene and Miocene shales and clays, and the thick clays of the Pliocene Gurjan Group. Anticlines and faulted anticlinal structures subparallel to and associated with the northeast trending Naga thrust fault, are the primary traps.



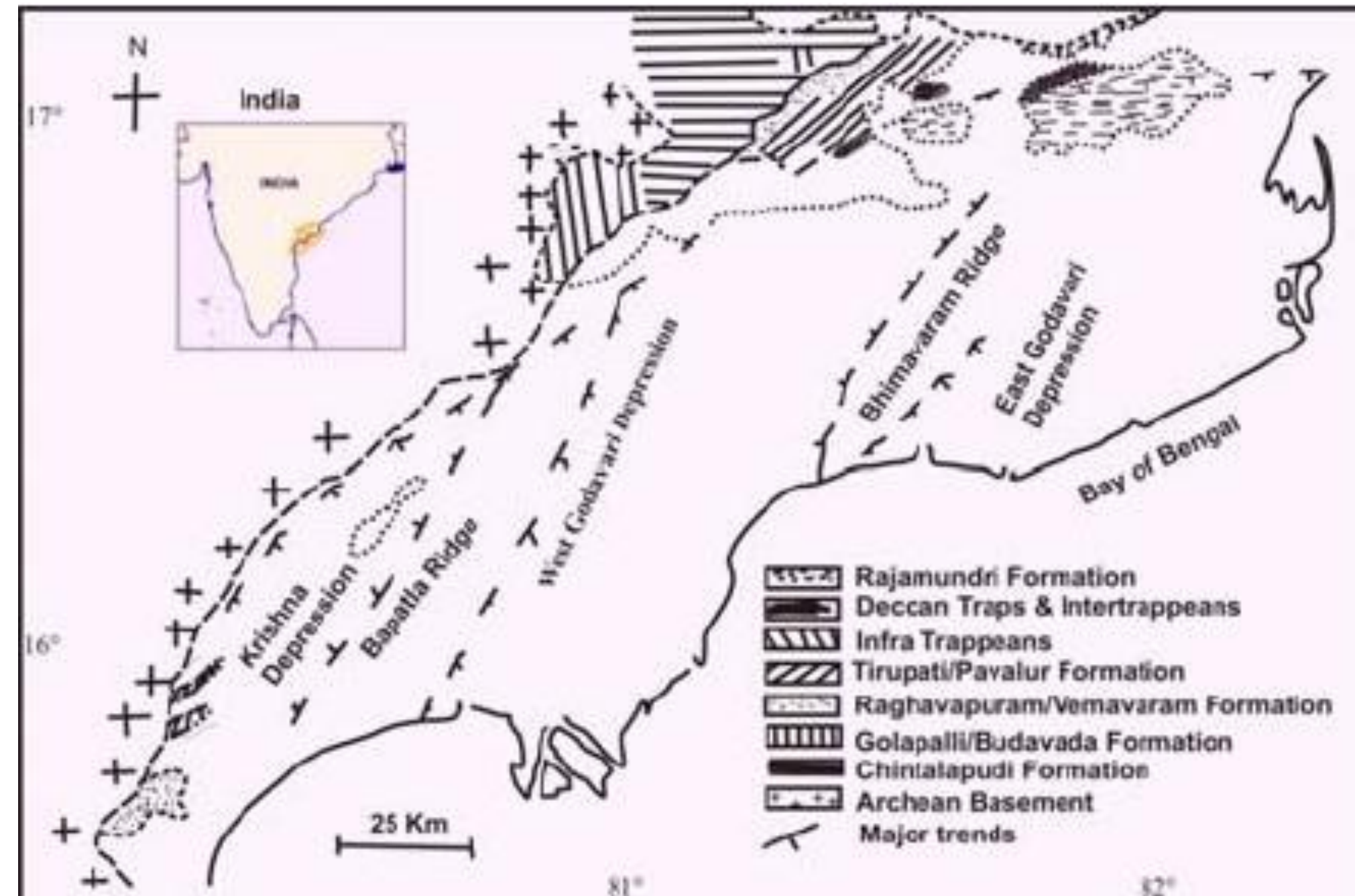
Overview of Category-I basin- 3. Mumbai Offshore Basin

3. Mumbai Offshore Basin- Bombay Offshore Basin is producing nearly 70% oil and gas of India's total hydrocarbon production. The Bombay High is the only giant oil field so far discovered in Bombay offshore Basin as well as in India. The medium sized Oil field are Panna, Neelam, Heera and Ratnagiri. The Bassein, Daman, Mid Tapti and south Tapti are the major gas fields in this basin. The major Producing horizons are Miocene limestone(Bombay High), Middle Eocene(Ratnagiri, Panna, Mukta, Neelam, Bassein, Heera), Oligocene (Tapti- Daman) and other sequences. The main source rock of Hydrocarbon generation is the pre-Middle Miocene shales in the Surat Depression and Shelf Margin area. The Shales alternate with the limestone, deposited in local depression of the above age, also act as source rock. The limestone of early Miocene-Eocene sequence also contributed for hydrocarbon generation. The main reservoir rock in this basin is limestone sequence of different ages. In addition to it, sandstone and siltstone sequence also occur as reservoir rocks (Daman, Tapti and Basal Clastics etc.) . the post middle Miocene Shales mainly act as a cap rock in the basin.



Overview of Category-I basin- 4. Krishna- Godavari Basin

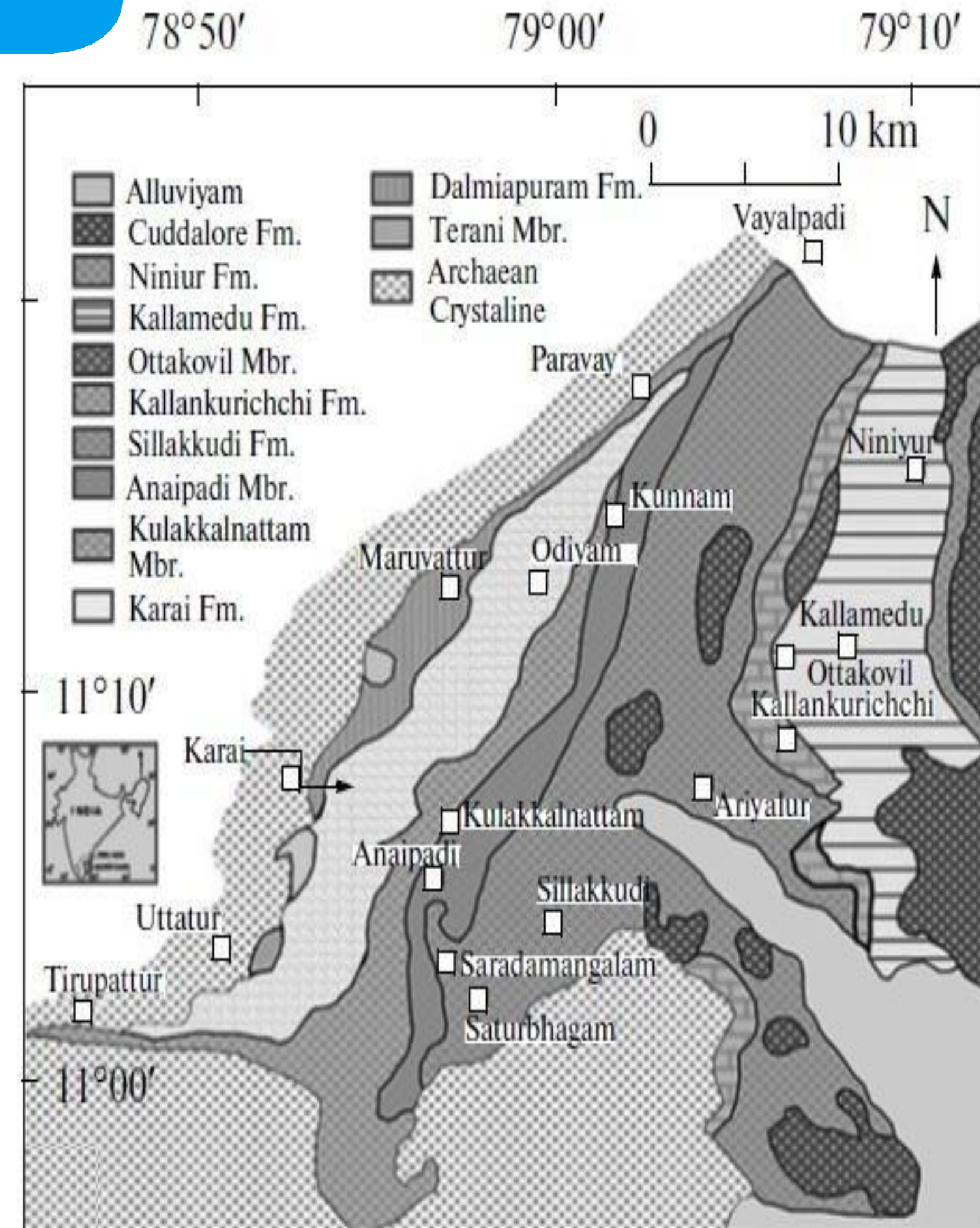
4. Krishna-Godavari Basin- Extensive deltaic plain formed by two large east coast rivers, Krishna and Godavari in the state of Andhra Pradesh and the 16 adjoining areas of Bay of Bengal in which these rivers discharge their water is known as Krishna Godavari Basin. The basin contains about 5 km thick sediments with several cycles of deposition, ranging in age from Late Carboniferous to Pleistocene. ONGC has carried out detailed geological mapping in the area covering 4220 sq. km since 1959. Krishna Godavari Basin is a Continental passive margin pericratonic basin. The five major tectonic elements of the basin are- Krishna Graben, Bapatla Horst, West Godavari Sub basin, Tanuku Horst and East Godavari sub basin. In this basin the hydrocarbon accumulations are in the oldest Permo-Triassic Mandapeta Sandstone onland to the youngest Pleistocene channel levee complexes in deep water offshore. The basin has been endowed with four petroleum systems, which can be classified broadly into two categories viz. Pre-Trappean and Post-Trappean in view of their distinct tectonic and sedimentary characteristics.



Overview of Category-I basin- 5. Cauvery Basin

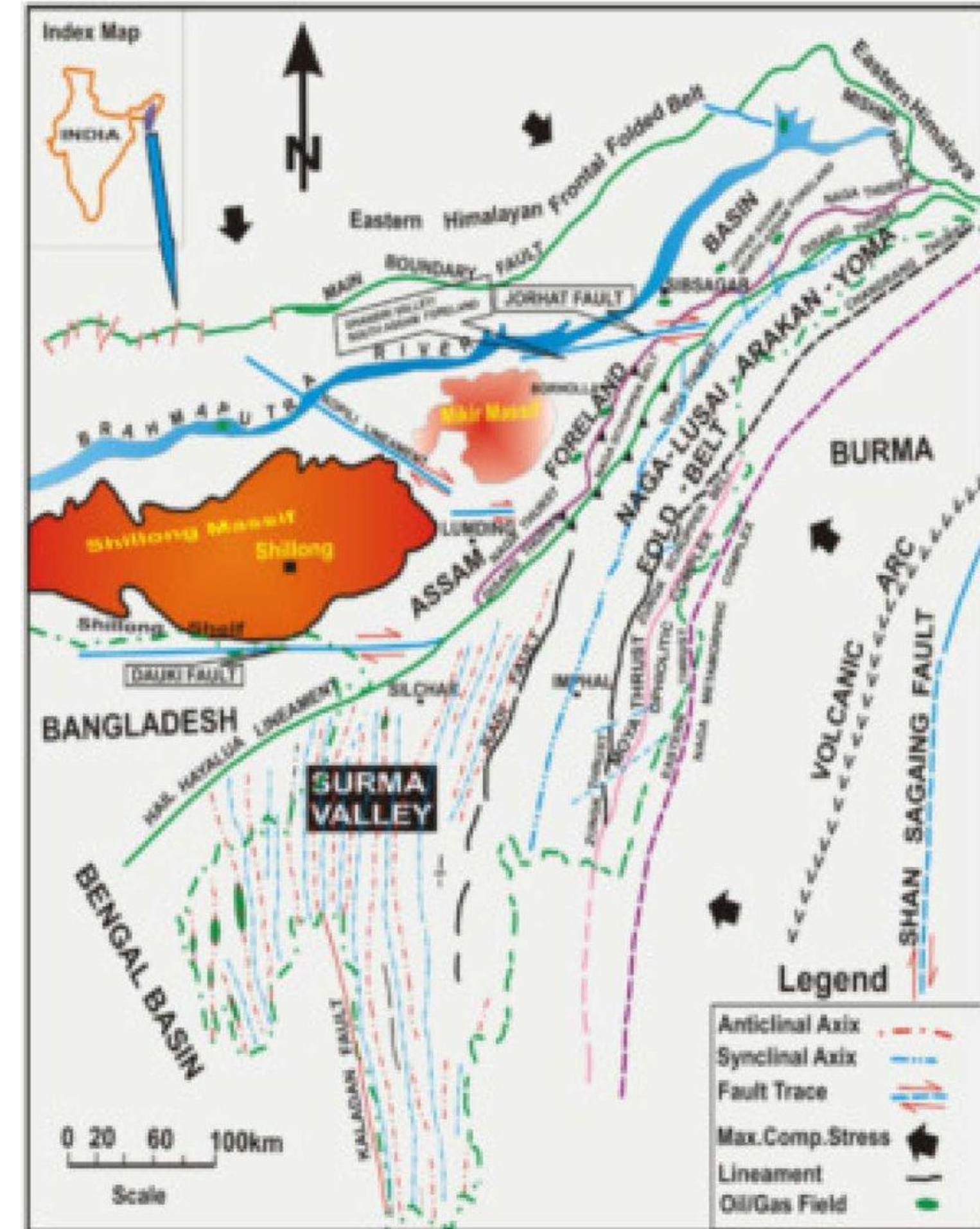
5. Cauvery Basin- Extends along the East Coast of India, it has been under hydrocarbon exploration since late nineteen fifties. The Cauvery Basin covers an area of 1.5 lakh sq.km comprising onland (25,000 sq.km) and shallow offshore areas (30,000 sq km). Cauvery basin is a pericratonic rift basin. The source rocks are Sattapadi shale within Cretaceous– main source Kudavasal Shale within Cretaceous Basal part of Kamalapuram Fm (Paleocene).

The reservoir rocks are Andimadam, Bhuvanagiri & Nannilam Formations within Cretaceous Kamlapuram and Niravi Formations within Paleocene Precambrian Fractured Basement. Cap Rocks are Sattapadi shale within Cretaceous and Post unconformity shales like Kudavasal and Kamlapuram. The type of entrapment are structural/ stratigraphic, combination traps. The Cauvery Basin has an established hydrocarbon province with a resource base of 700 MMT out of which 430 MMT for onland areas and 270 MMT in the offshore.



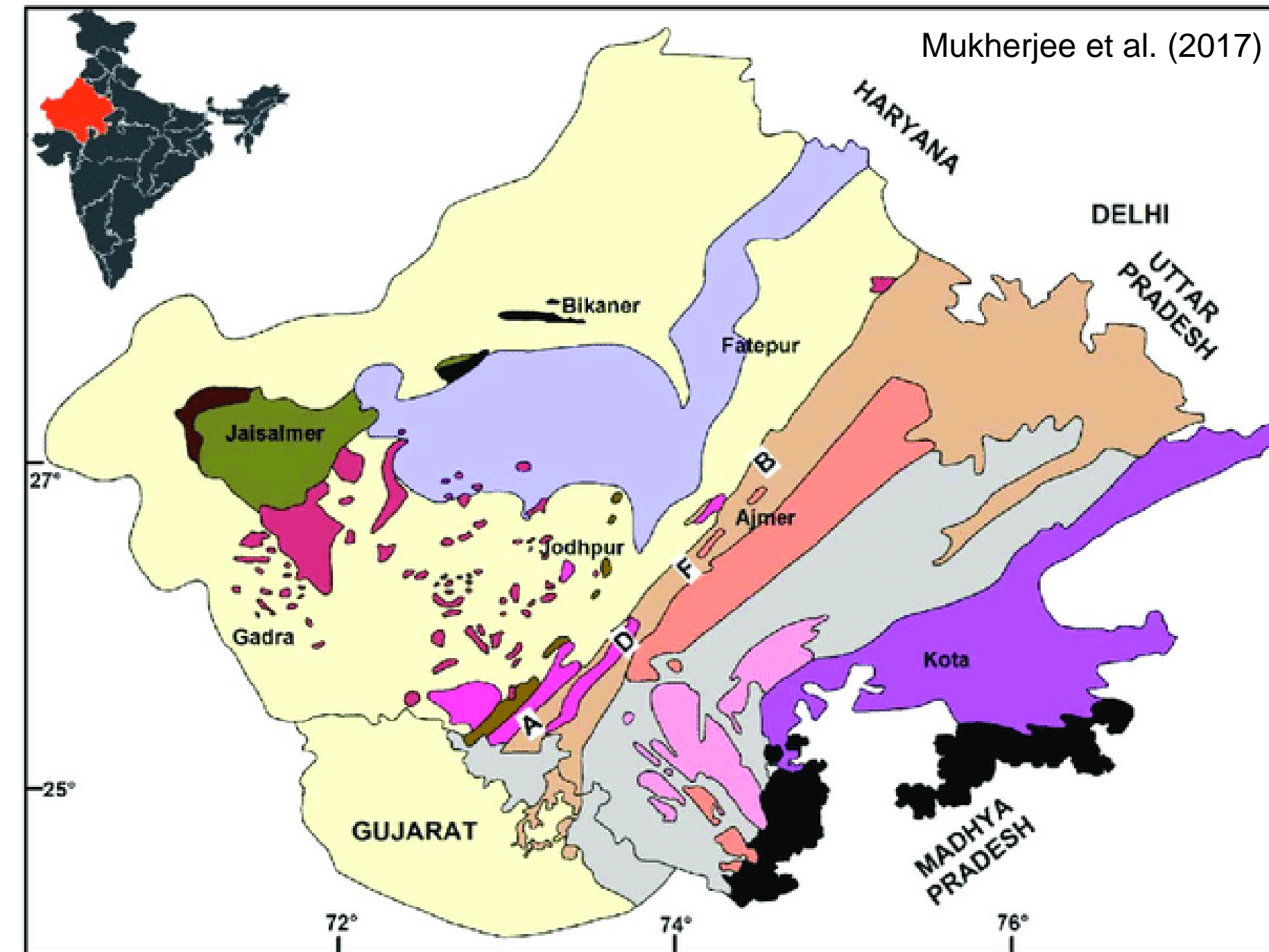
Overview of Category-I basin- 6. Assam-Arakan Fold Belt

6. Assam-Arakan Fold Belt- The Assam-Arakan Basin is situated in the northeastern part of India categorized as category-I basin. The basin covers an area of 116000 Sq. Km. Three major tectonic elements of the basin are Assam Shelf, Naga Schuppen belt, and Assam-Arakan Fold belt. Bulk of the oil and gas, discovered in Upper Assam till late 1980s, has been found in the Barail Group of Upper Eocene to Lower Oligocene age and the Tipam Group of Upper Miocene age. During the last decade, oil and gas accumulations have been discovered within the Langpar and Lakadong formations of Paleocene to Lower Eocene age in several structures like Dikom, Kathaloni, Tengakhat, Tamulikhat, Shalmari, Baghjan, Panidihing, etc. In the Borholla oil field, oil occurs in fractured granitic basement rock of Precambrian age. The Assam-Arakan sedimentary Basin is a shelf–slope–basinal system. There are three well developed regional cap (generally structural fold and fault) rocks within the Tertiary sedimentary succession, the lower one, occurring in the Upper Eocene is the argillaceous Kopili Formation, the middle one is the Barail Coal-Shale Unit and the upper one, overlying the Tipam Sandstone is the Girujan Clay. The prognosticated resource base of the Upper Assam shelf and the Naga schuppen belt is roughly 3180 MMt, of which about 27% has been converted into inplace geological reserves.



Overview of Category-I basin- 7. Rajasthan Basin

7. Rajasthan Basin- Rajasthan Basin forms the eastern flank of Indus geosyncline and comprises the sedimentary tract to the west and northwest of Aravallis upto Indo-Pakistan border. This pericratonic basin also forms a part of the great Thar Desert. Age ranges from Cambrian To Recent. For Barmer-sanchor: Tertiary for Bikaner-Nagaur : Paleozoic and for Jaisalmer : Mesozoic & Cenozoic age. The average thickness of sediments in Rajasthan basin is five km. Jaisalmer sub-basin is a Pericratonic Basin, whereas Bikaner- Nagaur & Barmer-sanchor are Intracratonic Basins. Bilara Shales and Dolomites, Cambay shale, Karampur/Badhaura Shales, Upper Carbonate Dolomites, Tharad shale act as important source rocks. Clastic and Carbonate formation such as, Baisakhi-Bedesir, Pariwar, Goru, Sanu and Khuiala formation sandstones as well as fractured limestones of the Jaisalmer Formation, Lower Bandah Limestones / Khuiala Limestones, Upper Carbonate Dolomites, Nagaur Sandstones, Jodhpur Sandstone and Bilara Dolomites acts as reservoir rocks. Traps are mainly of Anticlinal closures, Fault related closure/traps, Unconformity related traps viz., Wedge outs, Lithostratigraphic traps. This basin has a reserve of 380 MMT.



References and Bibliography

<http://dghindia.gov.in/index.php/page?pagelId=66&name=Indian%20Geology>

<http://dghindia.gov.in/assets/downloads/5e395394c76fddghwebsite5.pdf>

<http://dghindia.gov.in/index.php/page?pagelId=67&name=Indian%20Geology>

http://petroleum.nic.in/sites/default/files/resources_0.pdf

https://www.ndrdgh.gov.in/NDR/?page_id=603

https://www.ndrdgh.gov.in/NDRdghpre/?page_id=647