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# **OIL SHALE OCCURRENCES IN UPPER ASSAM BASIN, INDIA : AN OVERVIEW**

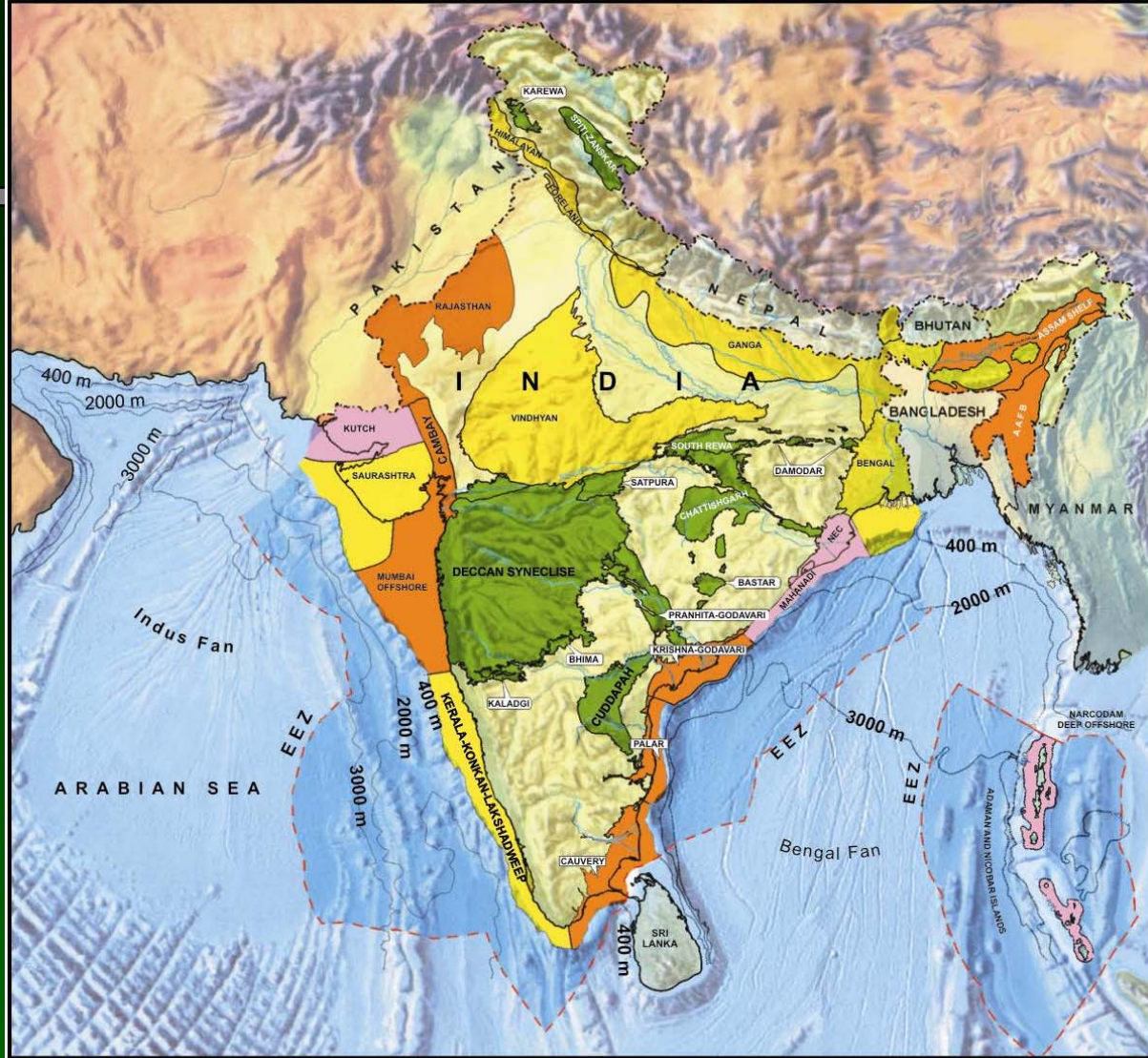
**V.K.Sibal**

**Srinivasan V.Raju**

**DGH**

**Directorate General of Hydrocarbons  
New Delhi**

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# SEDIMENTARY BASIN MAP OF INDIA

## LEGEND

- |  |   |   |  |
|--|---|---|--|
|  | <b>CATEGORY-I BASIN</b><br>(Proven commercial productivity) |  | <b>CATEGORY-IV BASIN</b><br>(Potentially Prospective)  |
|  | <b>CATEGORY-II BASIN</b><br>(Identified prospectivity)      |  | <b>PRE-CAMBRIAN BASEMENT/<br/>TECTONISED SEDIMENTS</b> |
|  | <b>CATEGORY-III BASIN</b><br>(Prospective Basins)           |  | <b>DEEP WATER AREAS<br/>WITHIN EEZ</b>                 |

# HYDROCARBON RESOURCE BASE

- ✦ **Sedimentary Area** : 3.14 Million Sq. Km.  
( >4% of the world's sedimentary area )
- ✦ **Sedimentary Basins** : 26 ( Exploration initiated in 15 )
- ✦ **Prognosticated Resources** : 205 Billion Barrels  
( For 15 Sedimentary Basins only; needs up-gradation )
- ✦ **Established reserves** : 60 Billion Barrels  
( As on 01.04.2005 )

# EXPLORATION STATUS



Only 19% of the total 3.14 million sq. km.  
has been extensively explored



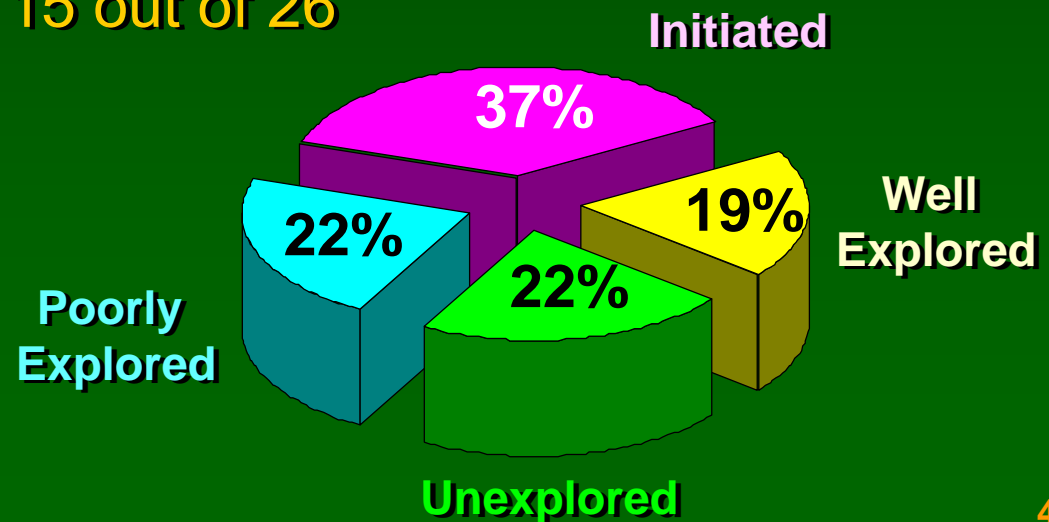
< 30% of total prognosticated resources  
established



Reserves estimated in only 15 out of 26  
basins

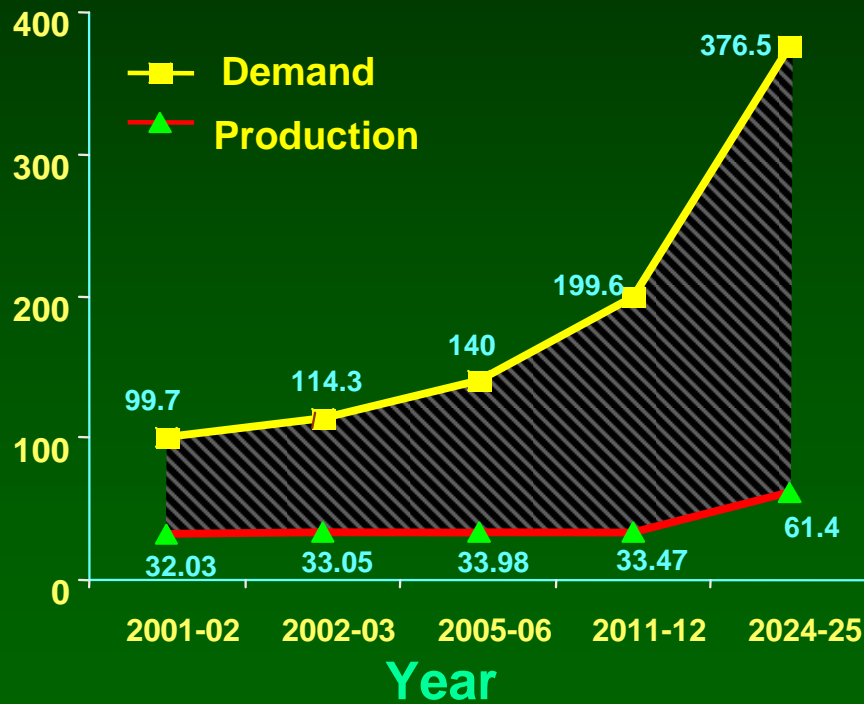


Very low drilling density



# CONTINUOUS EXPANDING ENERGY MARKET

## CRUDE OIL (MMT)



## NATURAL GAS (MMSCMD)



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**EXPLORATION FOR  
NON-CONVENTIONAL FOSSIL FUEL  
RESOURCES IN INDIA**

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# GAS HYDRATES

- The Gas Hydrate exploration and development in India is governed by the National Gas Hydrate Program (NGHP)
- DGH is the technical coordinator for the program
- Investigations for gas hydrates commenced in 1985
- BSR and other indicators found in four offshore basins
- Drilling and coring of sea-bed sediments carried out by R&D vessel JOIDES Resolution at 10 sites in April / May 2006
- High quality gas hydrate samples were recovered at several sites
- Further studies are in progress

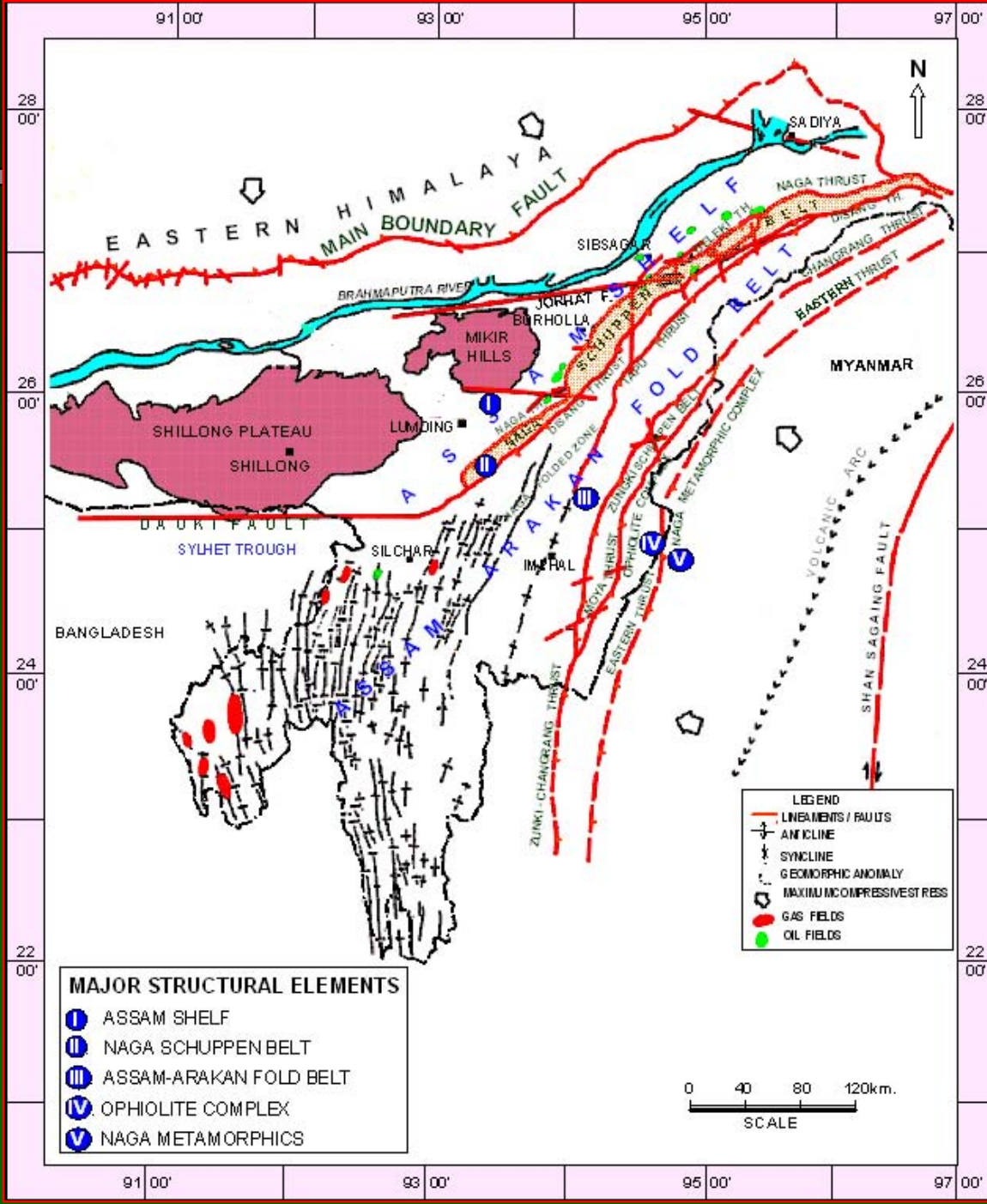
# COAL BED METHANE

- India has the 4<sup>th</sup> largest proven coal resources in the world
- India is the 3<sup>rd</sup> largest producer of coal in the world
- A policy on the development of CBM resources was formulated in 1997 by the Government of India
- ❖ Area opened up for CBM exploration : 13600 sq.km
- ❖ Number of CBM blocks awarded : 26
- ❖ CBM resources in awarded blocks : 48 TCF
- ❖ Production potential in awarded blocks : 1.34 BCFD
- ❖ In CBM-III round, there were 54 bids for 10 blocks
- ❖ Commercial CBM production expected from 2007



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# **OIL SHALE : THE INDIAN SCENARIO**



## MAJOR STRUCTURAL ELEMENTS, ASSAM-ARAKAN BASIN

# OIL SHALE OCCURENCE

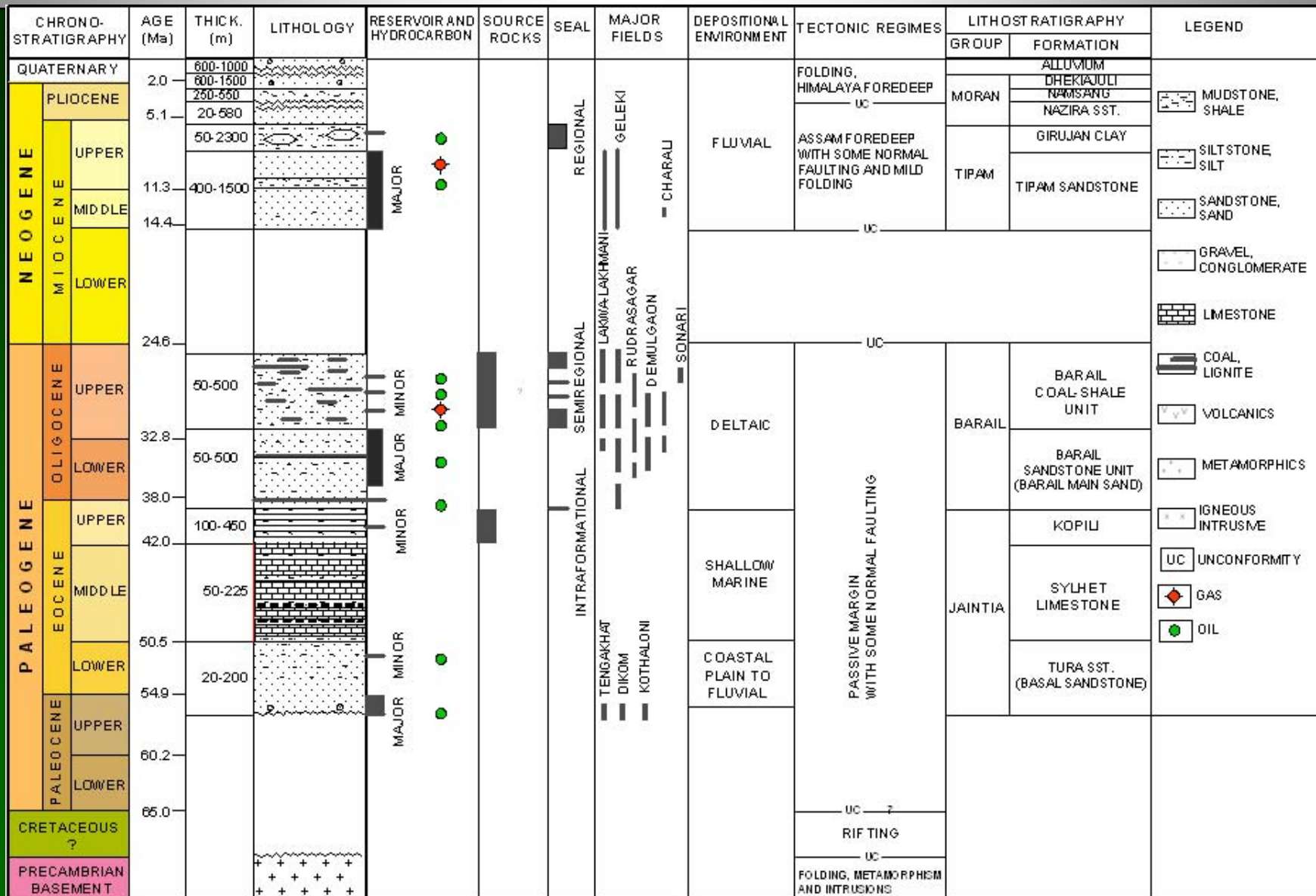
- Carbonaceous shale of Oligocene age occurs in association with Tertiary Coal in Assam and neighboring areas of Arunachal Pradesh
- The coal-shale unit occurs as outcrops towards south of the oilfields in a region called the *Belt of Schuppen*
- The presence of coal and organic rich shale has been recorded in the subsurface from wells drilled for oil
- The coal-shale unit was probably deposited in a regressive phase in backwater lagoons or brackish water swamps on a prograding delta complex

# ABOUT THE AREA

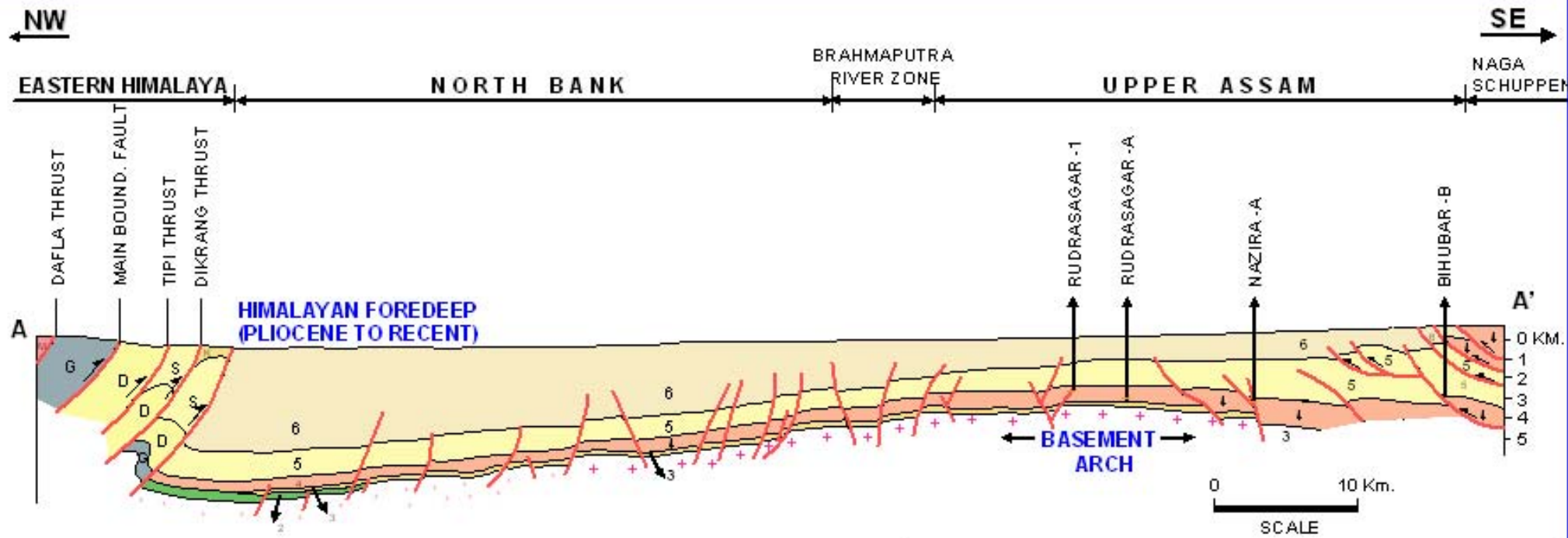
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- THE AREA IS THICKLY FORESTED AND LOGISTICALLY DIFFICULT
- THE WELL KNOWN DIGBOI OIL FIELD IS LOCATED IN THE VICINITY
- MORE THAN A CENTURY OF OIL PRODUCTION FROM THE DIGBOI FIELD (SINCE 1889)

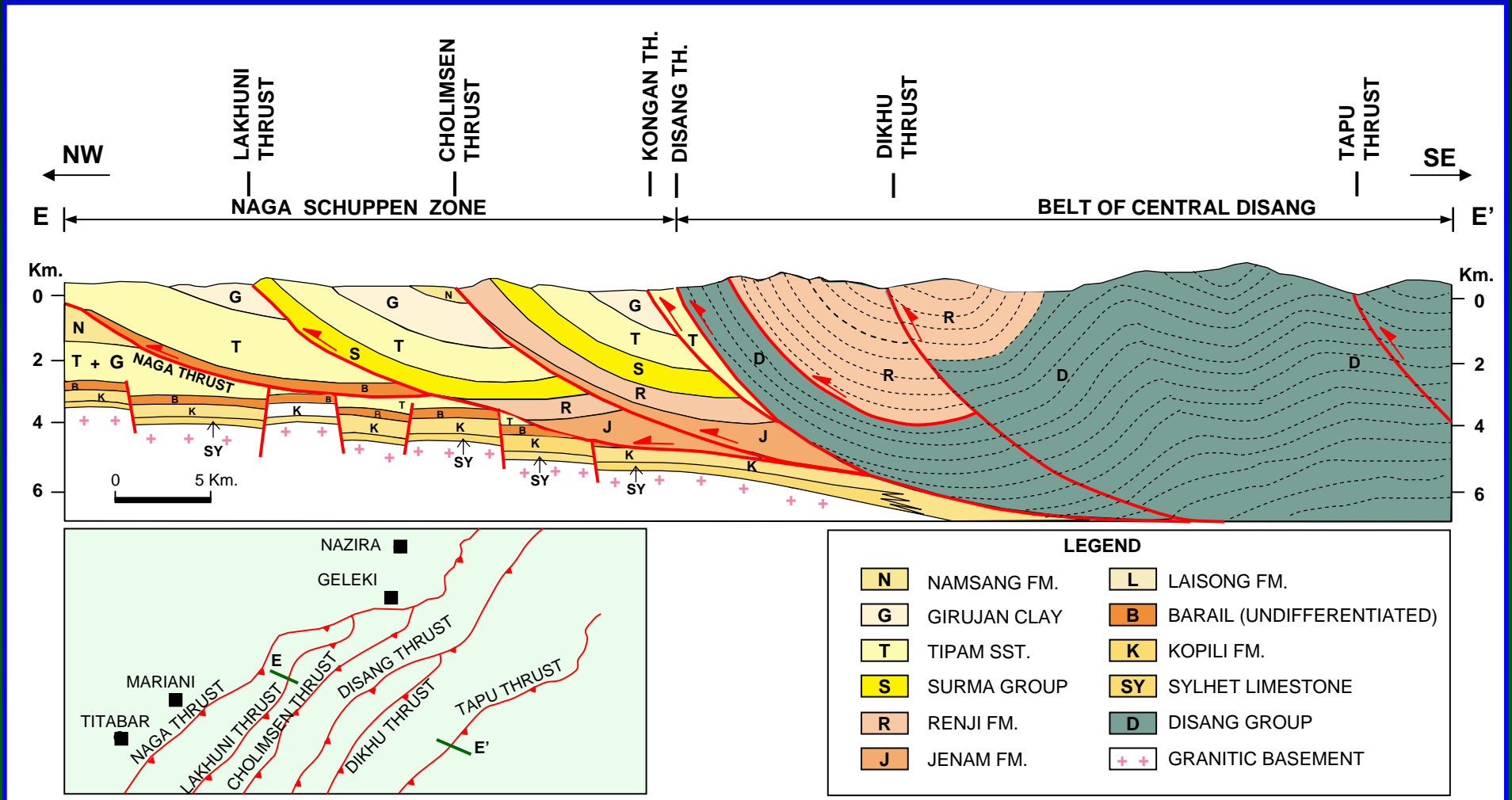
# STRATIGRAPHY OF THE UPPER ASSAM SHELF (BRAHMAPUTRA VALLEY)



# SCHEMATIC GEOLOGICAL SECTION ACROSS BRAHMAPUTRA VALLEY



# SCHEMATIC GEOLOGICAL SECTION ACROSS THE NAGA SCHUPPEN ZONE AND THE ASSAM – ARAKAN FOLD BELT (AAFB)



# CURRENT UNDERSTANDING

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- **Currently, coal mining is actively pursued in this area**
- **The associated organic rich shale is dumped as waste material**
- **Oil India Limited, a public sector undertaking has set up a pilot plant for production of syncrude from coal**



# CURRENT UNDERSTANDING

- Although presence of oil shale is known, exact stratigraphic position, thickness and extent of the horizons are not known
- **Systematic exploration, sampling and analysis in potential areas is required**
- The potential areas are located in the northern part of the *Belt of Schuppen*

# CURRENT UNDERSTANDING

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- **The favorable characteristics of Tertiary coal in north eastern part of India has been known for a long time**
- **In the late 80's the coal and associated shale were re-examined for their potential as oil shale**
- **Rock-Eval yields proved to be quite encouraging**

# CHARACTERISTICS OF OLIGOCENE COAL

- The Oligocene coal are soft and friable in nature
- **Moisture content** : **1-3%**
- **Low ash content** : **2-10%**
- **High volatile content** : **40-48%**
- **High Sulfur content** : **1.5 to 5%**
- **Carbon content** : **78 to 82%**
- **Nitrogen content** : **1.2 to 1.6%**
- **Oxygen content** : **7.6 to 11%**
- **High vitrinite content** : **80 to 90%**
- **Low exinite content** : **5 to 10%**
- **Inertinite content** : **5 to 10%**

# CHARACTERISTICS OF BARAIL

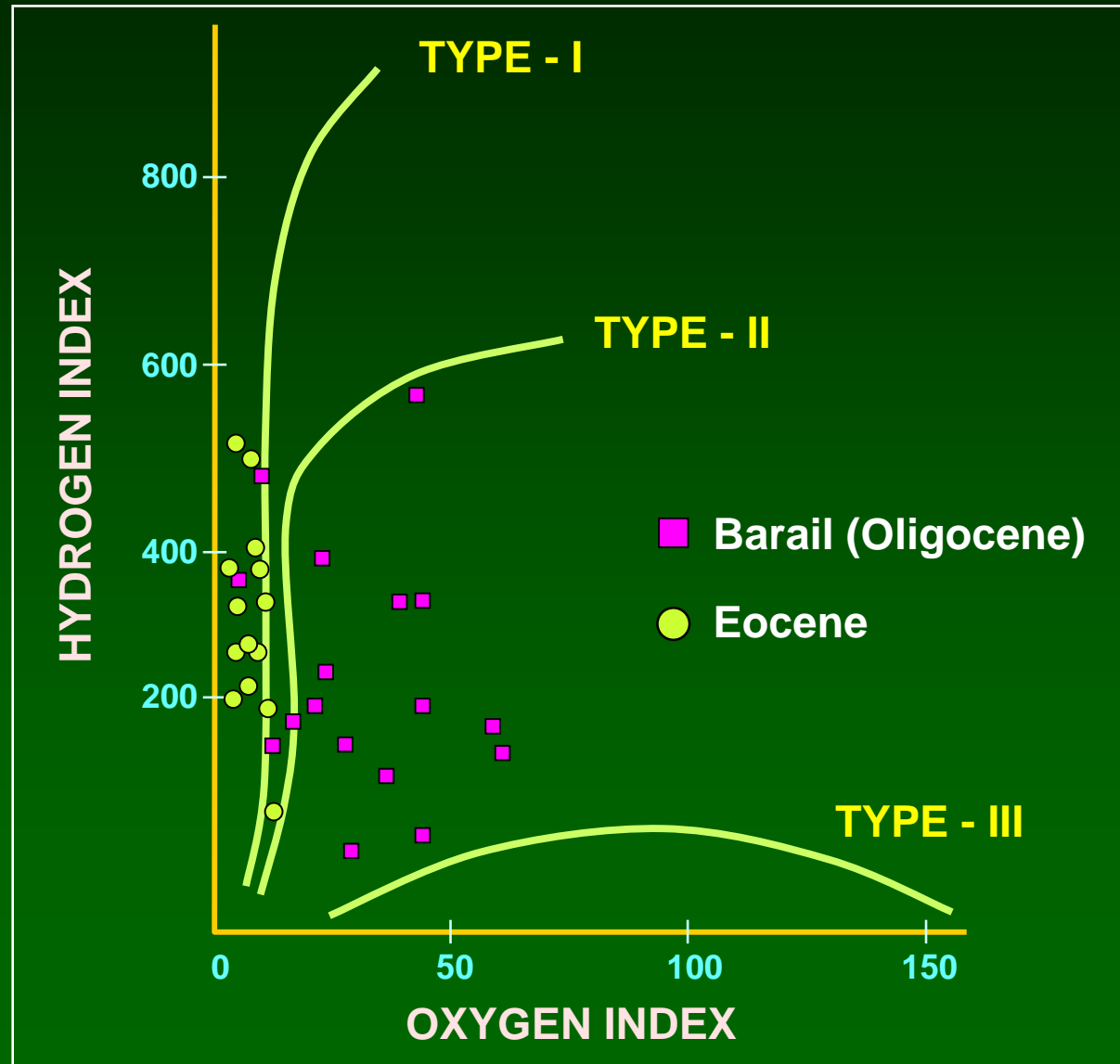
- AVERAGE VITRINITE REFLECTANCE IN OIL RANGES FROM 0.5 TO 0.7%.
- ROCK-EVAL T<sub>max</sub> VALUES ARE LESS THAN 435°C INDICATING LOW THERMAL MATURITY
- THE ORGANIC MATTER IS PREDOMINANTLY TYPE-II +TYPE-III
- BIOMARKER RATIOS INDICATE A DOMINANCE OF LAND PLANT DERIVED KEROGEN : preponderance of C<sub>29</sub> ααα 20R steranes and high hopane/sterane ratio
- SULFUR CONTENT IS HIGH : 1.5 to 5%

# Rock-Eval Results for Barail

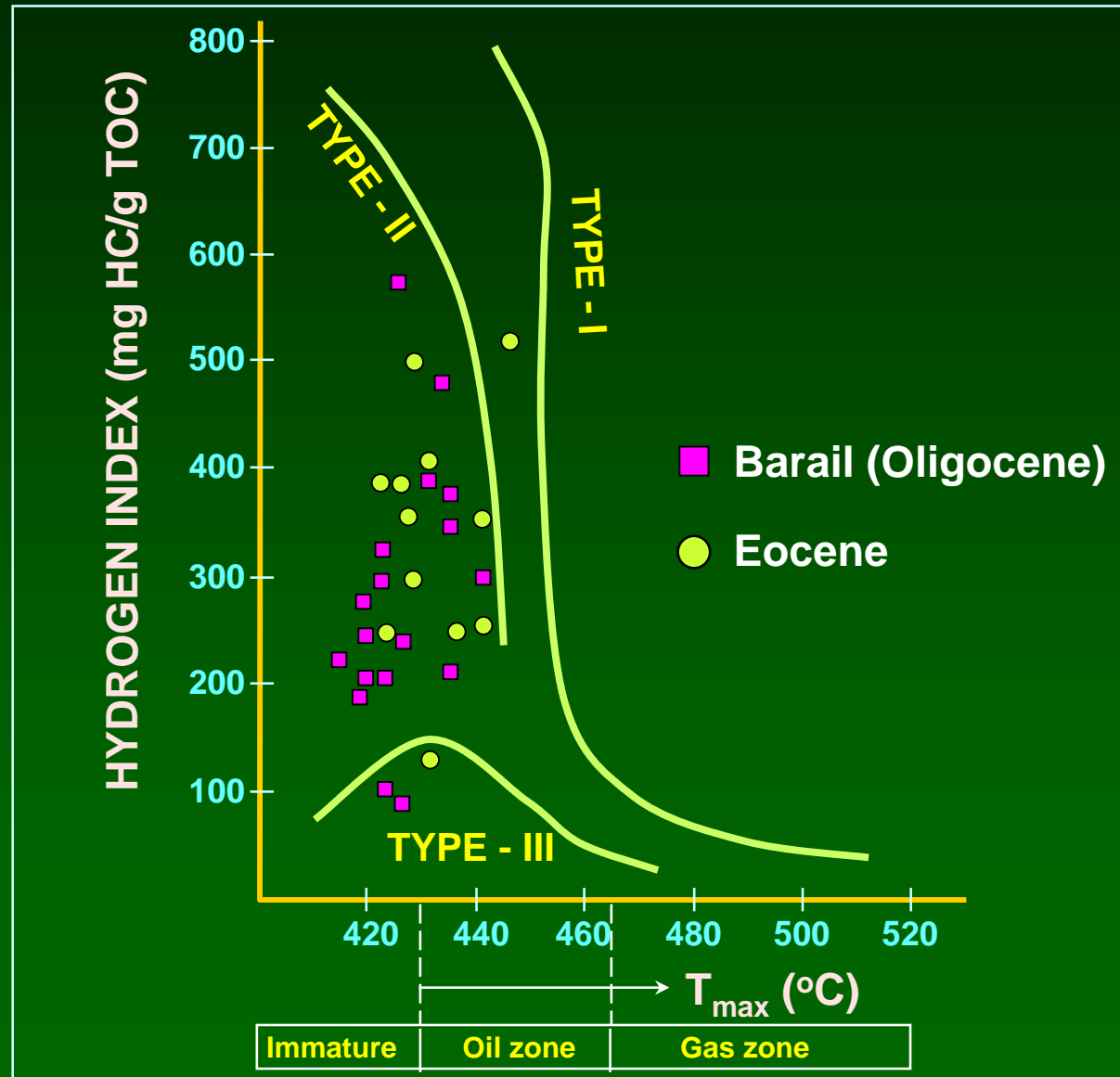
(Surface / near-surface samples)

Sample Code	TOC (%)	S1 (mg/g)	S2 (mg/g)	T <sub>max</sub> (°C)	HI	OI
Mta-1	77.02	8.76	288.38	435	374	5
Mta-2	64.74	8.15	255.24	431	394	22
Mta-3	66.00	7.91	268.03	433	486	12
Mak-1	15.99	1.19	34.37	436	214	59
Dli-1	38.96	6.89	222.43	425	570	43
Trp-1	12.75	2.62	44.73	436	350	43
Trp-2	14.89	2.54	53.75	432	360	-

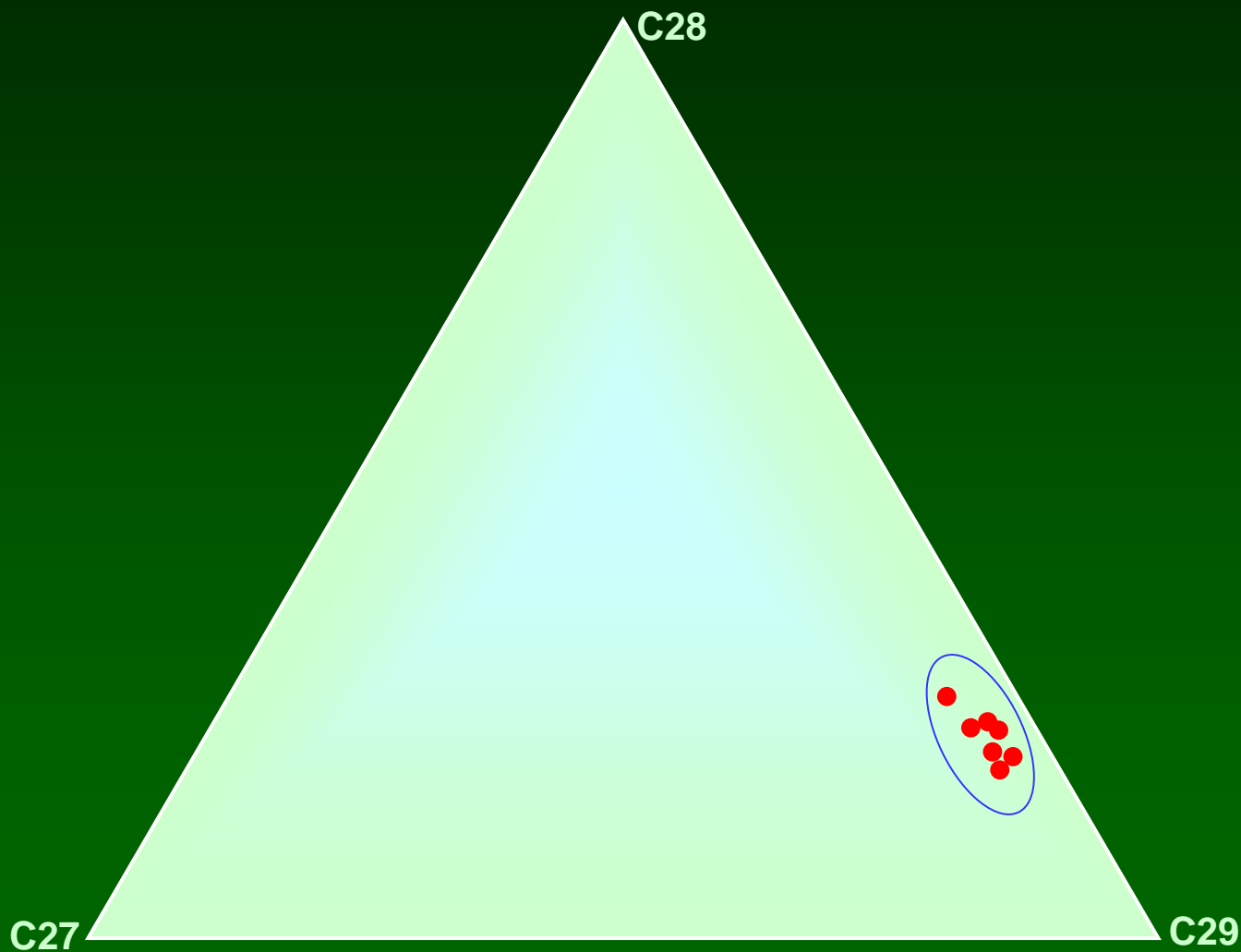
# ROCK-EVAL HI vs OI PLOT SHOWING KEROGEN TYPES



# ROCK-EVAL HI vs T<sub>MAX</sub> PLOT



# STERANE TERNARY PLOT FOR CRUDE OILS





# NORTH EAST COAL / OIL SHALE RESERVES AND SYNCRUDE POTENTIAL

	RESERVES	SYNCRUDE POTENTIAL
	PROVED + INDICATED (MMT)	PROVED + INDICATED MMT (Billion BBIs)
<b>BARAIL SERIES COAL</b>	<b>2250</b>	<b>405 (2.997)</b>
<b>BARAIL SERIES OIL SHALE (Uncertain)</b>	<b>27000</b>	<b>2700 (19.98)</b>
<b>TOTAL</b>	<b>29250</b>	<b>3105 (22.977)</b>

Source : 'Urja'

# CONCLUSIONS

- Although presence of rocks with favorable characteristics of oil shale are known, the reserves are not known at present
- More field and laboratory studies are required for a realistic assessment of the oil shale resources
- Appropriate technology for exploitation of the coal and oil shale needs to be looked into

# CONCLUSIONS

- **DGH has initiated a project for the assessment of the oil shale resources of Assam and neighboring area**
- **For oil shale development in India, interaction with agencies actively engaged in oil shale is required**
- **Since the area is forested and part of a fragile ecosystem, the exploitation of oil shale entails environmental concerns which needs to be addressed**

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**THANK YOU**