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Hydrocarbon Source Rock Analysis of Barail & Disang group

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Abstract: ***Petroleum source rocks are those which has sufficient amount of organic matter to generate and expel hydrocarbons to form a commercial accumulation of oil or gas. The objective of this project is to analyze the principal learning on the application of the formation of petroleum source rocks and hydrocarbon generation to exploration activities along with evaluation of petroleum source rocks and hydrocarbon generation. In this project, samples of Barail Group and Disang Group of rocks of Naga-Schuppen Belt were analyzed to determine their source rock characteristics and petroleum generative potentials***

Keywords: source rock, van Krevelen, Rock Eval pyrolysis, Hydrogen Index, Total organic Carbon content

I. INTRODUCTION

To be a source rock, a rock must have three features:

1) Quantity of organic matter
2) Quality capable of yielding moveable hydrocarbons
3) Thermal maturity

The first two components are products of the depositional setting. The third is a function of the structural and tectonic history of the province.

Among the various techniques available, “van Krevelen” diagram and rock-eval pyrolysis are regularly being used in hydrocarbon exploration. They provide information on the kerogen type, sedimentary environment, effective source rock identification and its thermal maturity.

II. SAMPLES

The Disang Group and Barail Group of rocks occupies a vast region in Fold Belt of Assam-Arakan Basin. Data for source rock analysis are obtained from Disang Group and Barail group.

III.DATA ANALYSIS AND INTERPRETATION

TABLE: 1

Litho-unit	Field ID	HI mg HC/g TOC	T max (°C)
Barail Group	1	33	434
	2	33	497
	3	98	431
	4	43	433
	5	135	427
	6	25	497
	7	10	497
	8	39	487

Litho-unit	Field ID	HI mg HC/g TOC	T max (°C)
Disang Group	A	680	476
	B	140	496
	C	0	496
	D	110	417
	E	28	440
	F	37	459
	G	36	514
	H	29	443
	I	5	497
	J	35	459
	K	27	497
	L	57	497

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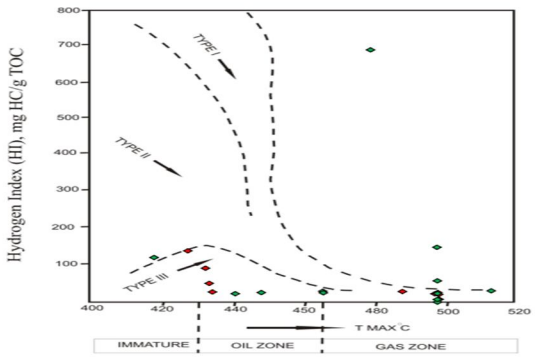


Fig 1: Hydrogen Index (HI), mg HC/g TOC vs. Tmax°C

--- *Barail group* --- *Disang Group*

- *Interpretation:* Hydrogen Index (HI), mg HC/g TOC vs. Tmax°C (Fig.1) is ploted from the data obtained from Barail and Disang group.

✓ *Hydrogen Index*

The hydrogen index represents the amount of hydrogen relative to the amount of organic carbon present in a sample.

✓ T_{max}

We can use the general guidelines for maturation levels given below for Rock-Eval pyrolysis T_{max} for types II and III kerogens. Different pyrolysis techniques have different cutoffs for pyrolysis oil and gas generation zone boundaries. Pyrolysis T_{max} can be significantly different for type I kerogen or kerogen containing high sulfur concentration and is not a reliable indicator of maturity for these kerogen types. From the graph it can be interpreted that hydrocarbon generation zone of Barail group falls into type II and type III kerogen and most of the field of Disang group falls into oil and gas zone.

TABLE: 2

Litho-unit	Field ID	HI mg HC/g TOC	OI mg CO2/g TOC
Barail Group	1	2	81
	2	0	7
	3	33	67
	4	125	275
	5	98	14
	6	43	36
	7	135	18
	8	19	77
	9	12	25
	10	13	53
	11	10	42
	12	39	12
	13	28	28
	14	25	240

Litho-unit	Field ID	HI mg HC/g TOC	OI mg CO2/g TOC
Disang Group	A	140	240
	B	0	21
	C	110	225
	D	28	50
	E	37	7
	F	36	21
	G	10	59
	H	5	20
	I	3	16
	J	9	9
	K	10	4
	L	4	5
	M	6	12
	N	15	18
	O	6	5
	P	35	174
	Q	9	19
	R	6	6
	S	10	23
	T	57	286
	U	4	41
	V	8	50
	W	4	3

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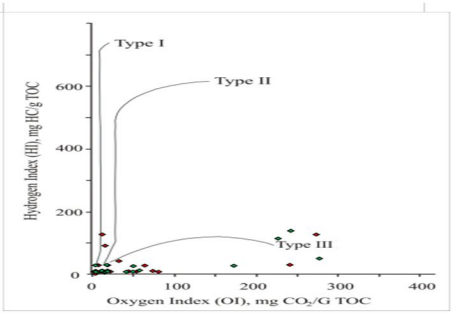


Fig 2: Hydrogen Index (HI), mg HC/g TOC vs. Oxygen Index (OI),mg CO_2/G TOC

- *Interpretation:* Fig.2 shows the Hydrogen Index (HI), mg HC/g TOC vs. Oxygen Index (OI),mg CO_2/G TOC.

oxygen index (OI) : Oxygen index (OI) measured by Rock-Eval analysis provides reliable information about the early evolution stages of coals and type III kerogens. OI appeared to be a sensitive indicator during both simulated diagenesis and the entire oil window for gas-prone coal having a substantial humic contribution to its precursor material. The OI of oil-prone coal and coal with mixed oil and gas potential proved to be a valuable rank parameter only up to the beginning of the oil window. It could be utilized successfully for describing depth profiles in organic-rich intervals of early maturity in wells.
The oxygen index (OI) represents the amount of oxygen relative to the amount of organic carbon present in a sample.The HI vs. OI technique is used to determine source rock quality (kerogen type) of immature rocks. HI and OI change as a source rock matures (the amount of hydrogen and oxygen relative to carbon decreases and the HI/OI ratios converge toward the origin of the plot, leading one to a more gas-prone type III interpretation)

TABLE: 3

Litho-unit	Field ID	PI	T max (°C)
Disang Group	A	0.28	476
	B	0.17	496
	C	1	496
	D	0.34	417
	E	0.07	440
	F	0.08	459
	G	0.21	443
	H	0.17	497
	I	0.13	459
	J	0.18	497

Litho-unit	Field ID	PI	T max (°C)
Barail Group	1	0.14	434
	2	0.18	497
	3	0.05	431
	4	0.11	433
	5	0.04	427
	6	0.45	497
	7	0.18	497
	8	0.12	487
	9	0.21	496

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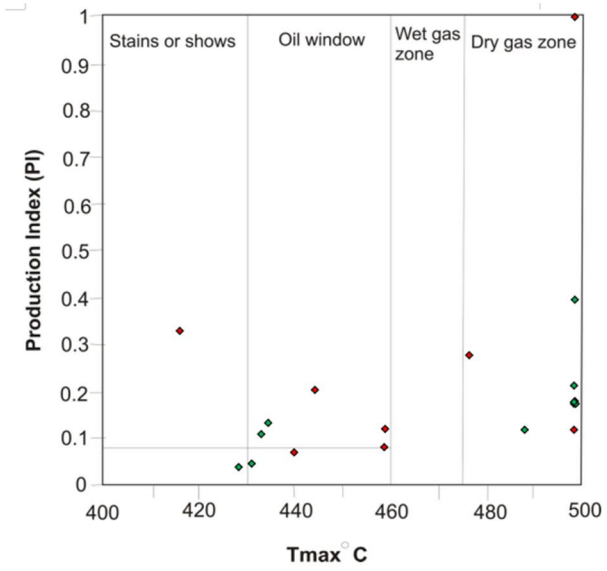


Fig 3: Production Index (PI) vs. Tmax°C

- *Interpretation:* Production Index (PI) vs. Tmax°C is shown in Fig.3. From the graph it can be seen that samples from Barail group enters into oil zone and samples from Disang group falls into oil zone and dry gas zone.

TABLE: 4

Litho-unit	HI mg HC/g TOC	TOC (Wt %)
Disang group	110	1.44
Barail group	135	5.92

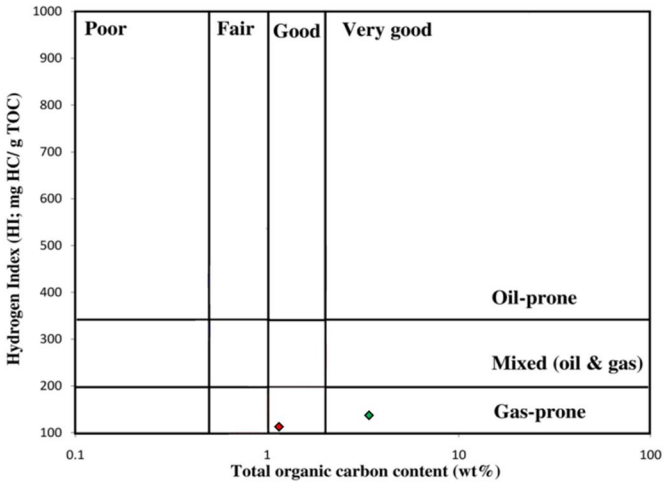


Fig 4 : Hydrogen Index (HI), mg HC/g TOC vs. Total organic Carbon content (wt%)

- *Interpretation:* Fig 4 shows Hydrogen Index (HI), mg HC/g TOC vs. Total organic Carbon content (wt%). Both the samples from barail and disang groups falls unger gas prone zone where sample from barail group indicates good quality and Disang group indicates very good quality.

TABLE: 5

The table below lists the Rock-Eval pyrolysis peaks

Peak	Is a measurement of	represents
S1 mg Hc/g rock	The free hydrocarbons present in the sample before the analysis	-residual hydrocarbon phase. When S1 is large relative to S2, an alternative source such as migrated hydrocarbons or contamination should be suspected
S2 mg Hc/g rock	The volume of hydrocarbons that formed during thermal pyrolysis of the sample	- Used to estimate the remaining hydrocarbon generating potential of the sample

TABLE: 6

Litho-unit	S1	S2	S1+S2	TOC
	mg HC/g rock	mg HC/g rock	mg HC/g rock	(Wt %)
Disang group	0.13	0.34	0.47	0.05
Disang group	0.11	0.2	0.31	1.44
Barail group	0.15	2.82	2.97	2.89
Barail group	0.3	8.02	8.32	5.92

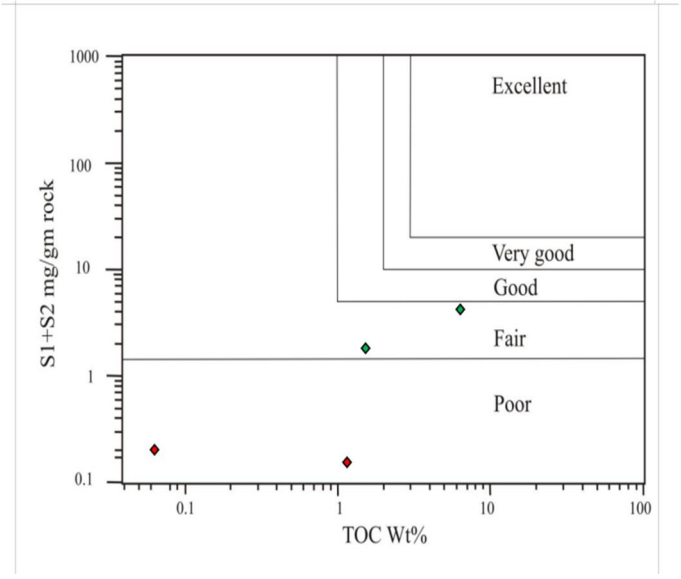


Fig 5 : S1+S2 mg/gm rock vs. TOC Wt%

- *Interpretation:* S1+S2 mg/gm rock vs. TOC Wt% is shown in fig.5. here, samples from barail group indicates poor quality and Disang group indicates fair quality.

TABLE: 7

Litho-unit	Field ID	S1 mg HC/g rock	TOC (Wt %)
Disang Group	A	0.11	1.44
	B	0.01	0.27
	C	0.04	2.87
	D	0.01	0.61
	E	0.01	0.91
	F	0.01	0.44
	G	0.01	0.52
	H	0.01	1.61
	I	0.01	0.68
	J	0.01	0.33
	K	0.01	0.66
	L	0.01	0.23
	M	0.01	0.15
	N	0.01	0.54
	O	0.01	1.03
	P	0.01	0.82
	Q	0.01	0.46
	R	0.01	0.4

Litho-unit	Field ID	S1 mg HC/g rock	TOC (Wt %)
Barail Group	1	0.01	0.12
	2	0.15	2.89
	3	0.04	0.69
	4	0.3	5.92
	5	0.01	0.47
	6	0.01	0.48
	7	0.01	0.47
	8	0.01	0.31
	9	0.05	0.88
	10	0.01	0.5
	11	0.01	0.2

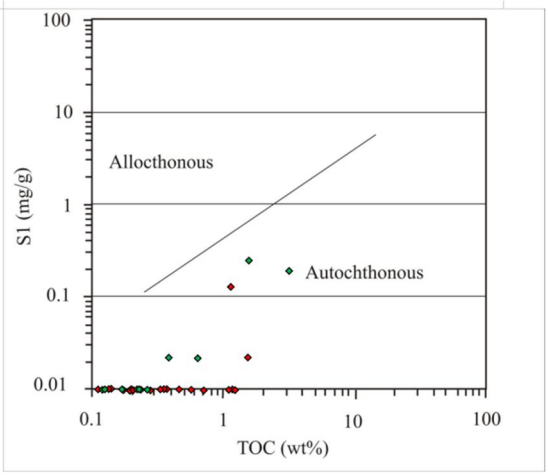


Fig 6 : S1 (mg/g) rock vs. TOC Wt%

- *Interpretation:* Fig.6. shows S1 (mg/g) rock vs. TOC Wt%, where both the samples from barail and disang falls into Autochchthnous group. It refers to sediments that are native to its location.

TABLE: 8

Litho-unit	S2 mg HC/g rock	TOC (Wt %)
Disang group	0.2	1.44
Disang group	0.1	0.27
Disang group	1.02	2.87
Barail group	2.82	2.89
Barail group	0.3	0.69
Barail group	8.02	5.92
Barail group	0.34	0.88
Barail group	0.14	0.5

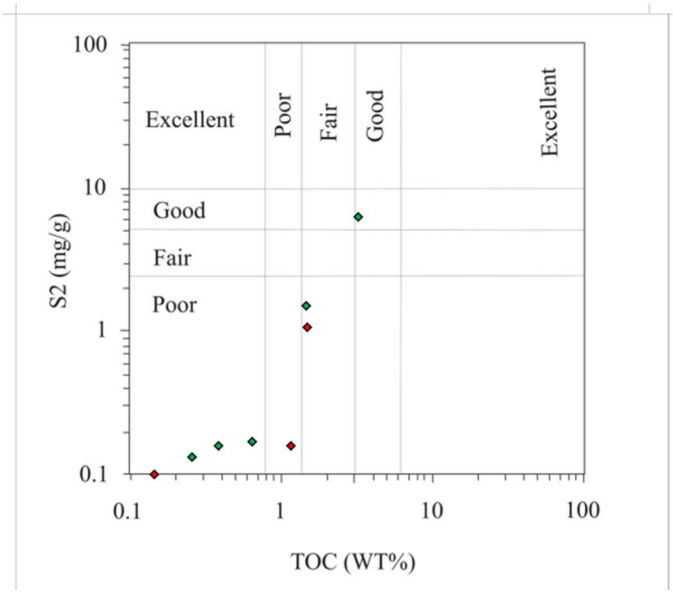


Fig 7 : S2 (mg/g) rock vs. TOC(Wt%)

Interpretation: S2 (mg/g) rock vs. TOC Wt% is shown in the fig.7. where most of the samples from Barail and Disang group falls into poor category.

IV. CONCLUSION

The Rock Eval pyrolysis for samples from Barail Group and Disang Group of rocks of Naga Schuppen Belt have been analysed here. Various graphs are plotted which includes Hydrogen Index vs. $T_{max,}$ HI vs OI, Production index vs t_{max}, HI vs. TOC(wt%), S1+S2 vs TOC(wt%), S1 vs TOC(wt%), S2 vs TOC(wt%) and graphs are interpreted which indicates type of maturity, quality of hydrocarbon etc. Thermal maturity of organic matter in the analyzed samples is also evaluated based on the T_{max} and production index "PI" value.

From the Fig 1, which indicates Hydrogen Index (HI), mg HC/g TOC vs. Tmax°C of the barail and disang group, it can be interpreted that hydrocarbon generation zone of Barail group falls into type II and type III kerogen and most of the field of Disang group falls into oil and gas zone.

After plotting the data obtained from both of the groups,Fig 2 (Hydrogen Index vs. Oxygen Index) indicates to more gas-prone type III kerogen.

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Production Index (PI) vs. Tmax°C (Fig.3.) shows that samples from Barail group enters into oil zone and samples from Disang group falls into oil zone and dry gas zone.

Fig 4 (Hydrogen Index vs. Total organic Carbon content) indicates that barail group falls under good quality and Disang group falls under very good quality. And both the samples from barail and disang groups indicates gas prone zone.

S1+S2 vs. TOC (Fig.5.) shows that samples from barail group is poor in quality and Disang group is fair in quality.

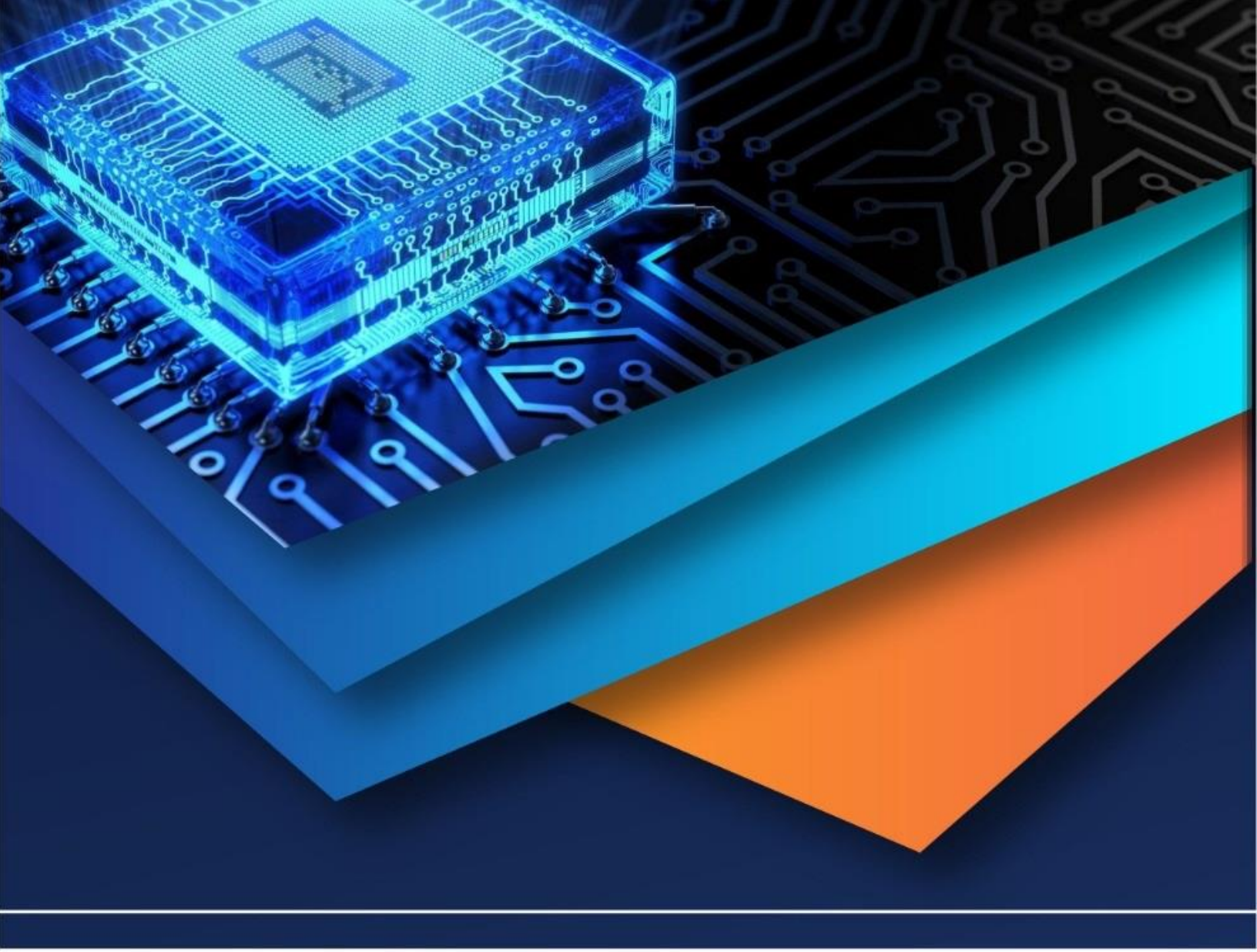
Fig.6. (S1 rock vs. TOC) where both the samples from barail and disang belongs to Autochchthnous group which means the sediments that are native to its location.

S2 rock vs. TOC which is shown in the fig.7, here most of the samples from Barail and Disang groups falls into poor category.

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