NORTH SUMATRA – MERGUI BASIN
CROSS BORDER CASE STUDY
EPPM-CCOP

PROGRESS REVIEW

INDONESIAN TEAM STUDY

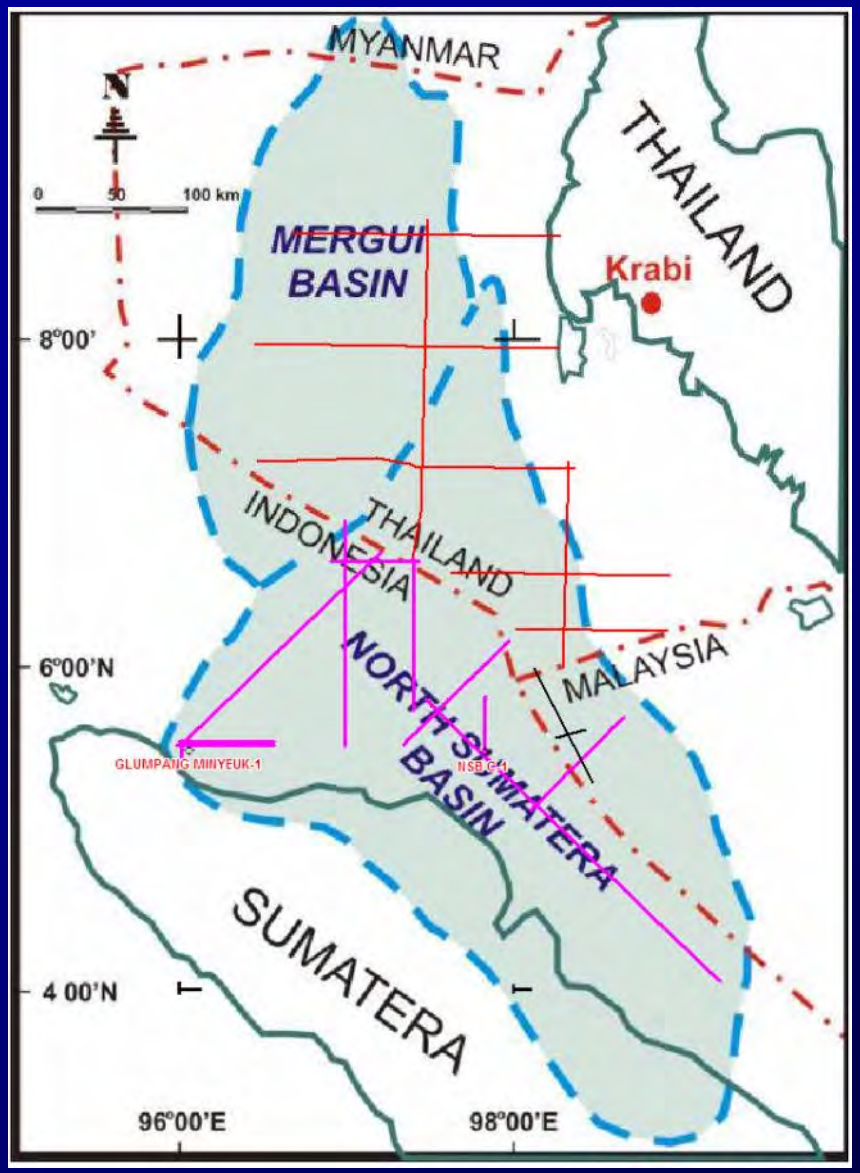
P1W3
2-5 AUGUST
LANGKAWI, MALAYSIA

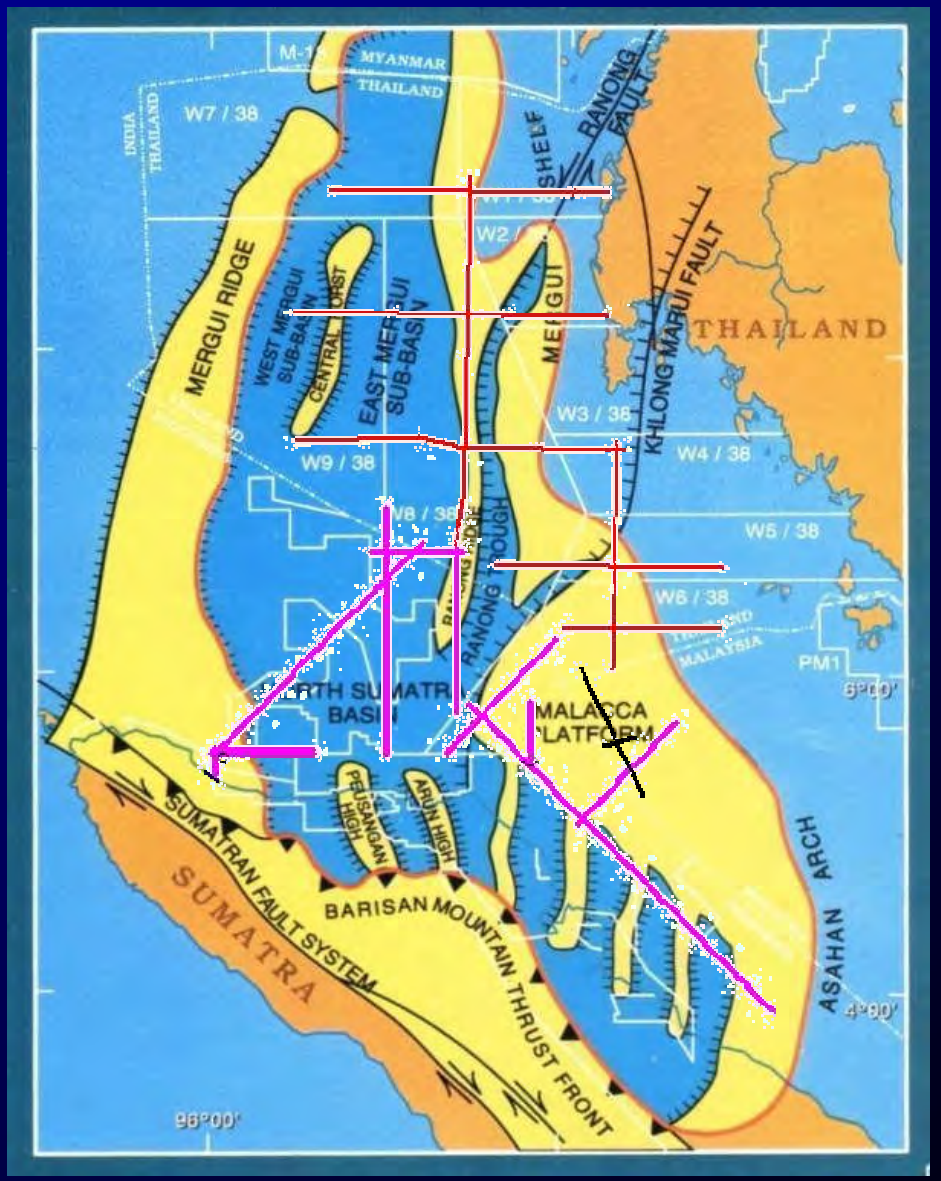
LEMIGAS

PROGRESS REVIEW

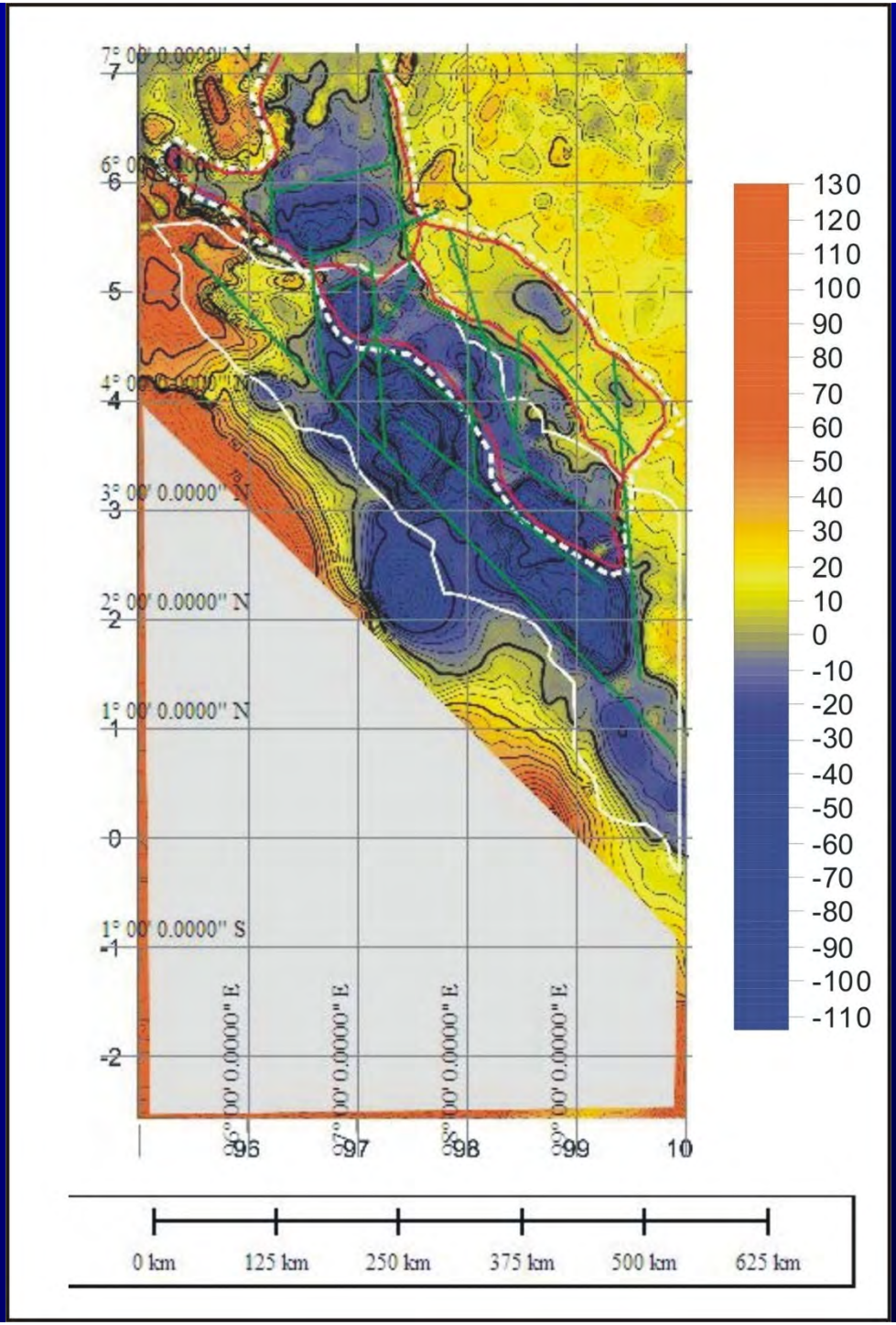
- GRAVITY MAP OF NORTH SUMATRA BASIN
- INDONESIAN SEISMIC INTERPRETATION
- INDONESIAN WELLS DATA ANALYSIS
- SEISMIC & MAP INTEGRATION
- PRELIMINARY BASIN MODELING
- SOME IDEA FOR THE NEXT

GENERAL BASIN OUTLINE & PHYSIOGRAPHY





GRAVITY MAP OF NORTH SUMATRA BASIN



Basin Dimension :

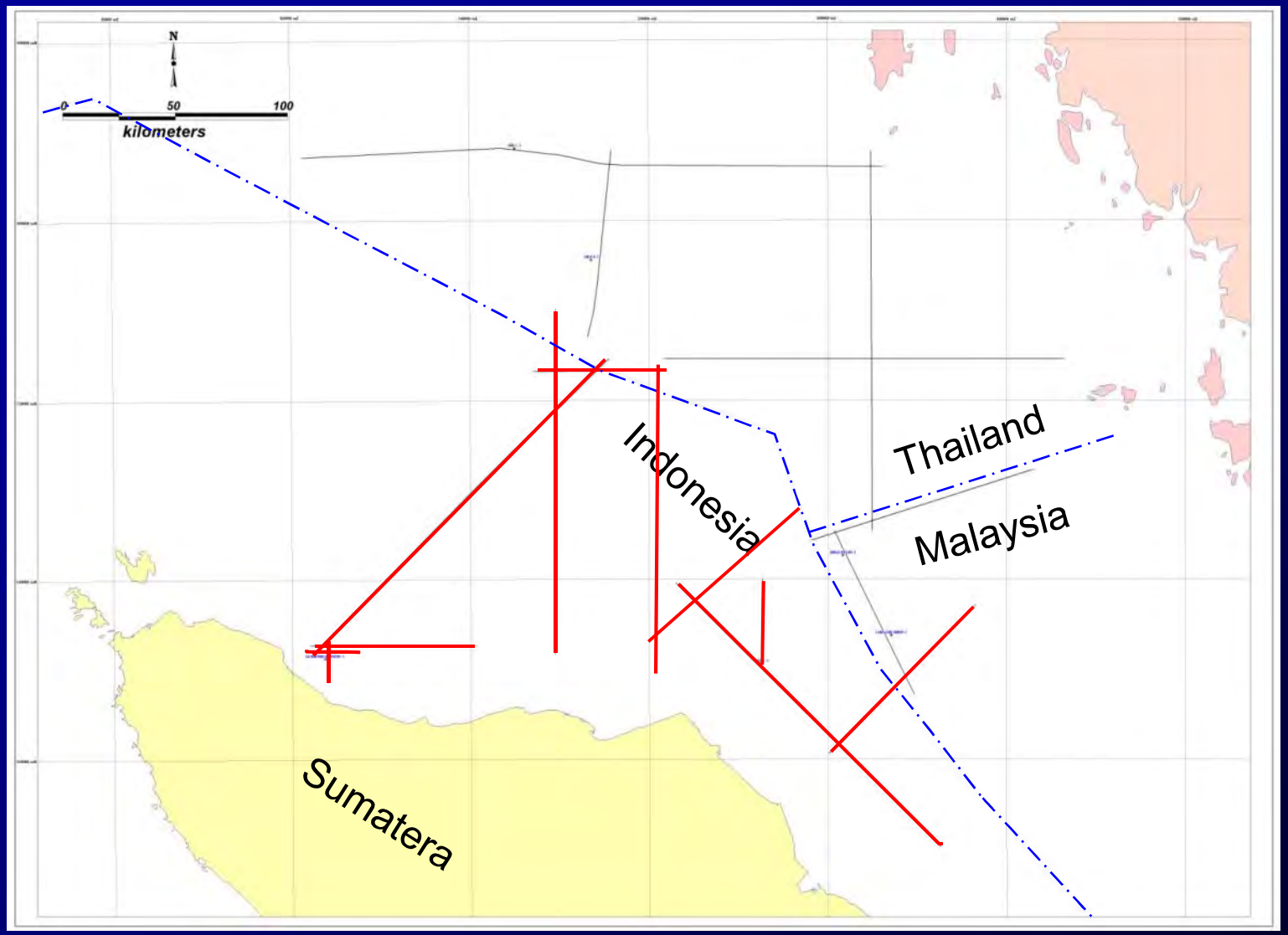
3 Main Depocenter (Graben/Sub Graben)

Width : 10 - 200 Km
Length : 30 – 400 Km

Several faults are a sub basin boundary
Within the main basin

INDONESIAN SEISMIC INTERPRETATION

SEISMIC LINES & WELLS LOCATION MAP



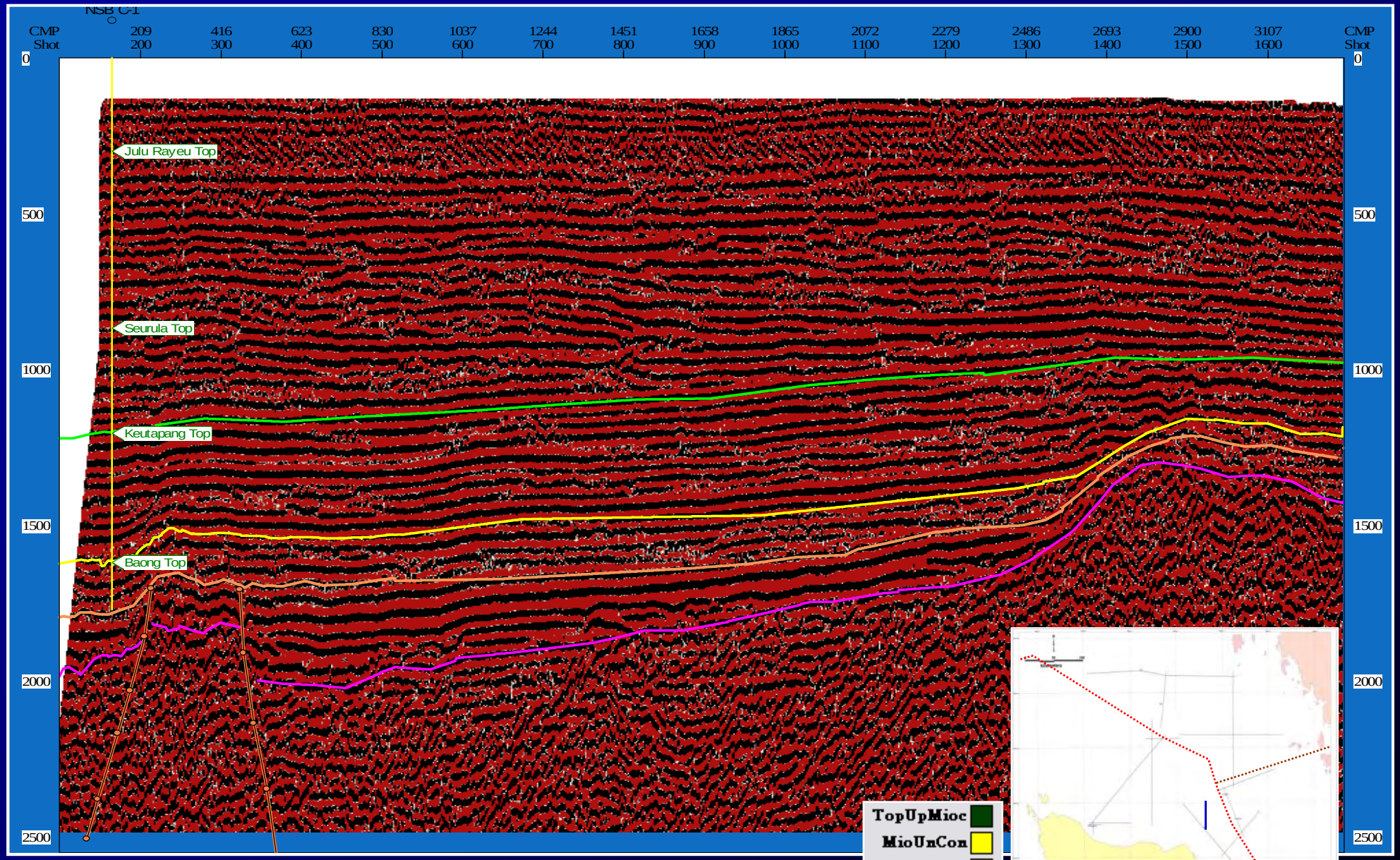
12 Seismic Lines

2 Wells

SEISMIC LINES SUMMARIES

NO.	LINE	SP INTERVAL (m)	SP POSITION RANGE	Total SP	LENGTH (m)
1	123A	25	4437 - 54	4383	109575
2	123B	25	6251 - 4325	1926	48150
3	132/EXT	25	6122 - 53	6069	151725
4	209C	25	5766 - 4797	969	24225
5	210	25	53 - 3040	2987	74675
6	259	25	52 - 2481	2429	60725
7	463+463A-85	26.66	40 - 7102	7080	188752.8
8	506-85	25	713 - 40	673	16825
9	NSO69-25	150	703-118	585	87750
10	NSO69-46	130	(-11) - 1931	1941	252330
11	NSO80-503	25	43 - 1694	1651	41275
12	NSO81-13	25	148 - 4160	4012	100300
TOTAL					1,156,307.8

Line NSO80-503 & Well NSB C-1



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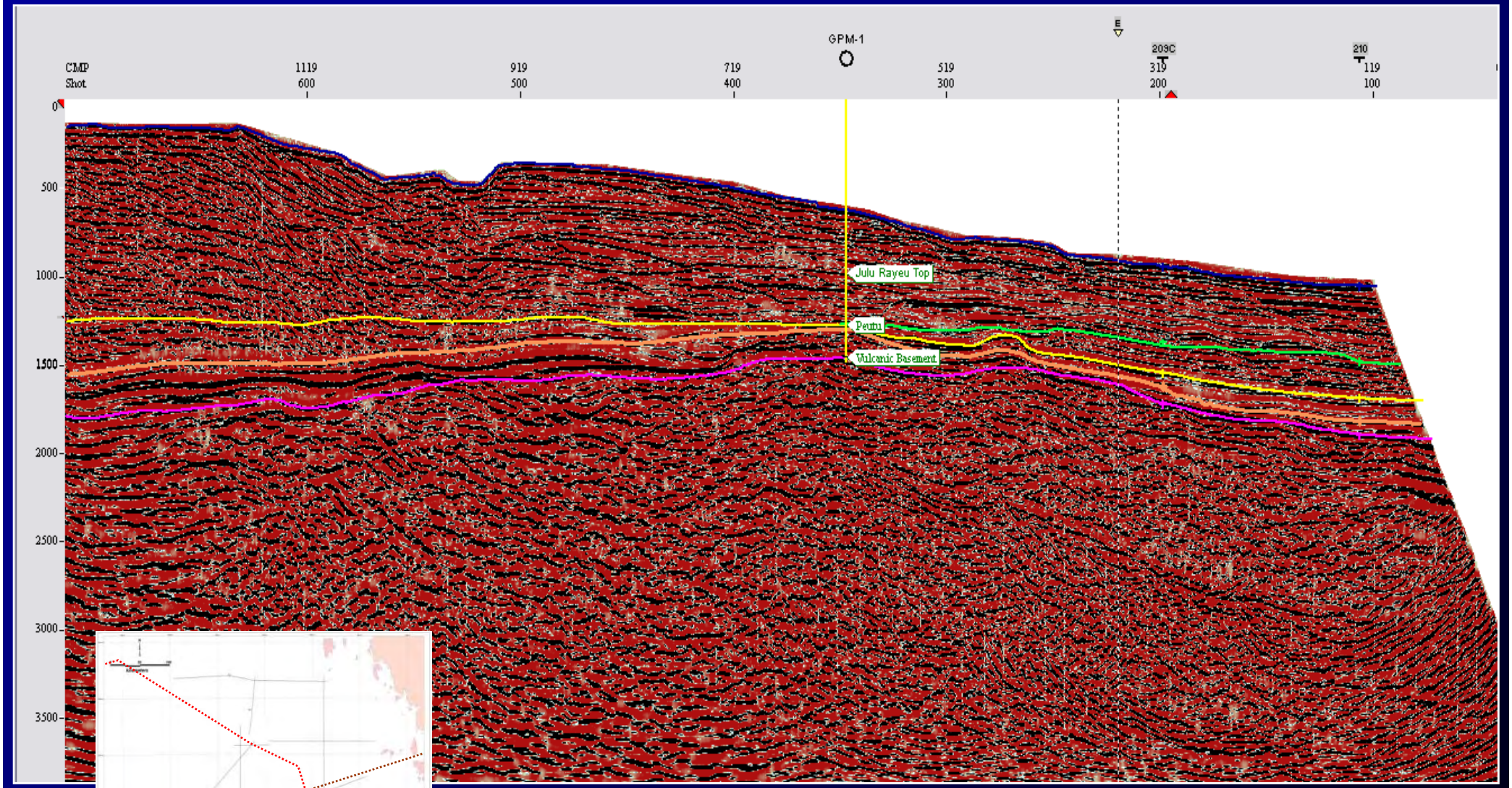
Line 506-85 & Well GPM-1



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INDONESIAN WELLS DATA ANALYSIS

Wells :

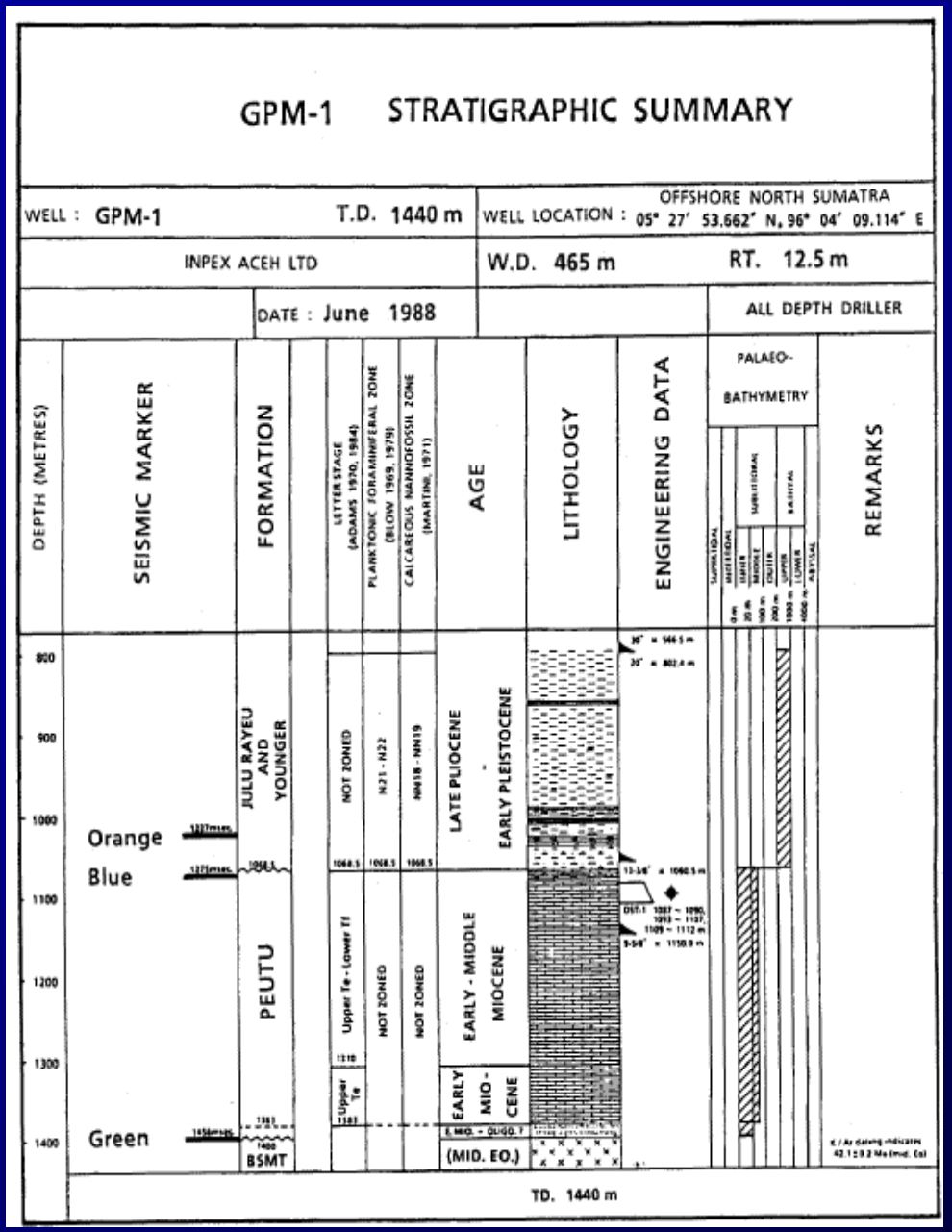
1.Gleumpang Minyeuk-1

2.NSB-C1

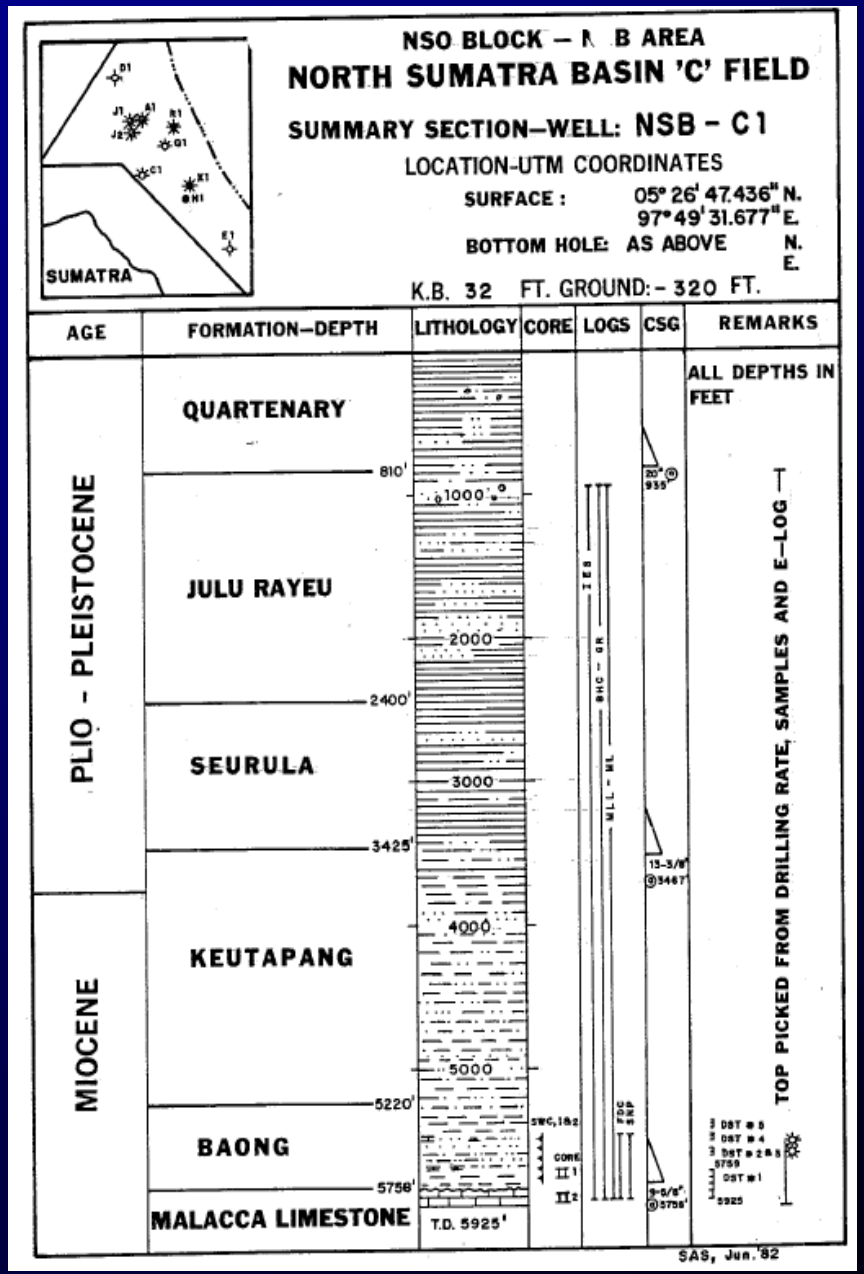
	Well Name	
	Gleumpang Minyeuk-1	NSB C-1
Company/Operator	Inpex Aceh, Ltd.	Mobil Oil Ind.
Year	1987	1974
Well Status	P & A as dry well	P & A
HC Show	Gas (not significant)	Gas & Condensate
Location :	North Aceh Offshore	North Sumatera Offshore
Longitude	96° 04' 09.114" E	97° 49' 31.667" E
Latitude	05° 27' 53.662" N	03° 26' 47.436" N
RKB (above MSL)	12.5 m	32 feet
Water Depth	465 m	320 feet
Total Depth	1438 m	5925 feet
Formation on TD	Basement (volvanic breccia)	Basement (Pre-Tertiary Limestone)

WELL SUMMARY

Gleumpang Minyeuk-1



NSB-C1



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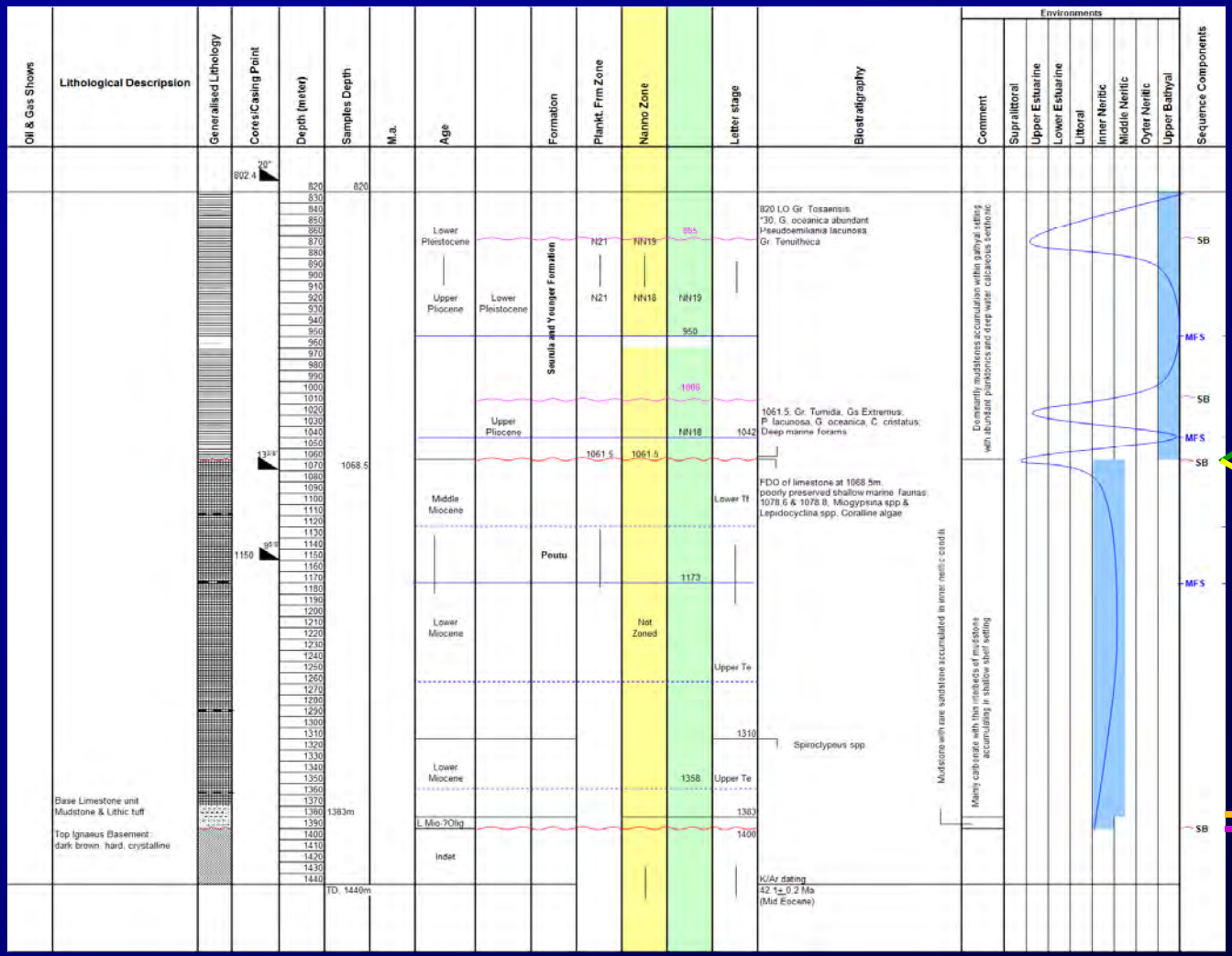
Gleumpang Minyeuk-1

BIOSTRATIGRAPHIC ANALYSIS



Sequence Boundary Candidate :

1. Top Basement
2. Upper Middle Miocene
3. Mid Upper Pliocene
4. Plio-Pleistocene
5. Mid Lower Pleistocene

Top Upper Miocene Horizon

Miocene Unconformity Horizon

Top Syn Rift Horizon

Basement Horizon

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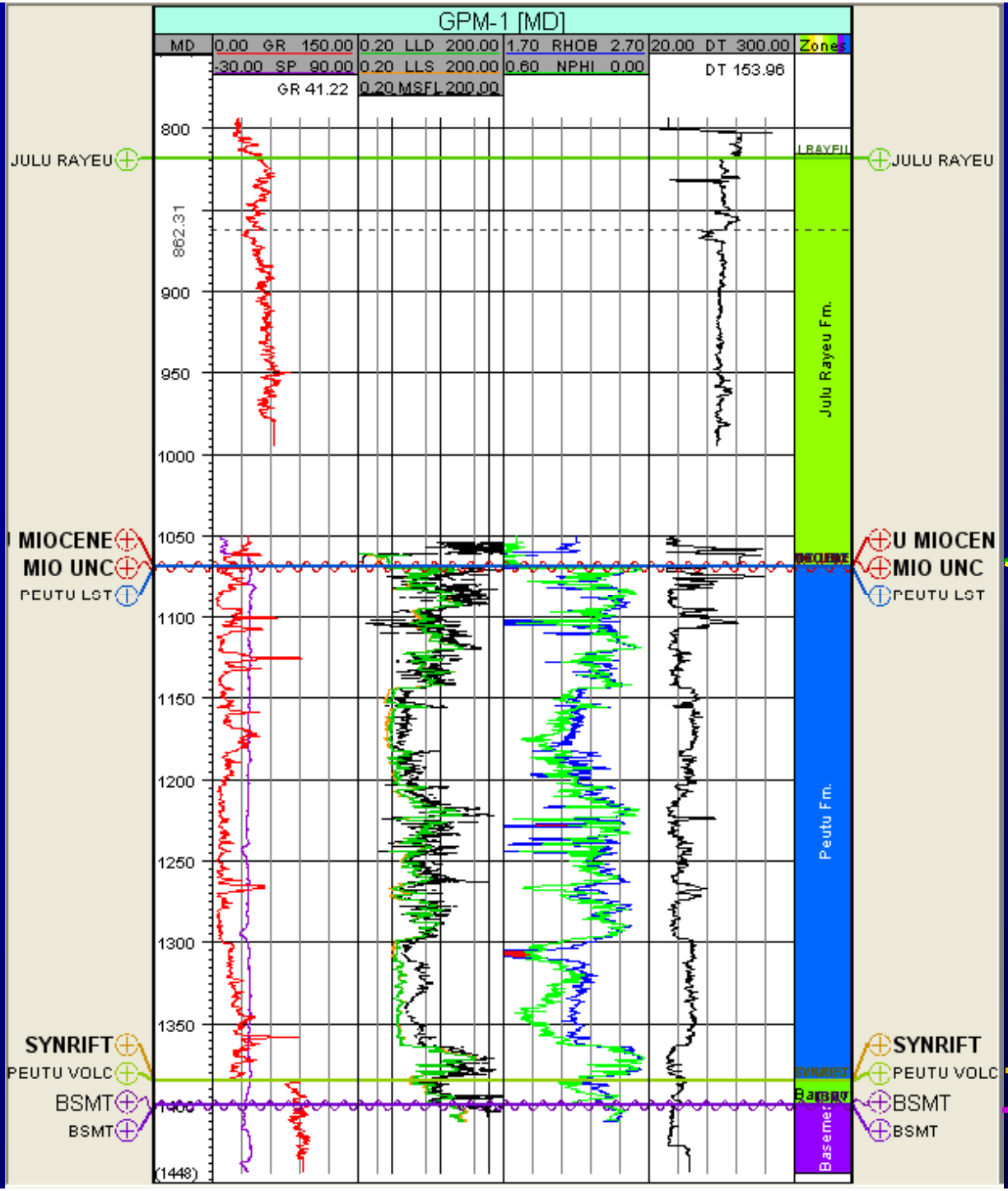

Gleumpang Minyeuk-1

Quick Look on Wireline Log

Top Upper Miocene Horizon

Miocene Unconformity Horizon

Top Syn Rift Horizon

Basement Horizon

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Gleumpang Minyeuk-1

VITRINITE REFLECTANCE RESULTS

Range : 0.21 % - 3.37 %

No.	Sample Depth (m)	Plug type	Mean Ro (%)	No. of readings	Minimum Ref. %	Maximum Ref. %	Sd
1	820-840	WR&C	0.25	18	0.21	0.29	0.023
2	840-860	WR&C	0.27	15	0.23	0.3	0.023
3	860-880	WR&C	0.28	18	0.23	0.32	0.023
4	880-900	WR&C	0.28	5	0.25	0.3	0.022
5	900-920	WR&C	0.3	23	0.24	0.35	0.034
6	920-940	WR&C	0.35	20	0.30	0.4	0.031
7	940-960	WR&C	0.37	5	0.32	0.4	0.034
8	960-980	WR&C	0.39	23	0.31	0.44	0.042
9	980-1000	WR&C	0.37	18	0.31	0.45	0.047
10	1000-1020	WR&C	0.41	4	0.37	0.44	0.033
11	1020-1040	WR&C	0.39	13	0.34	0.43	0.032
12	1040-1060	WR&C	0.4	5	0.38	0.43	0.019
13	1060-1080	WR&C	0.44	9	0.38	0.55	0.061
14	1076.34 - 1076.51	WR	0.53	35	0.46	0.64	0.05
15	1078.27- 1078.36	WR	0.59	16	0.52	0.67	0.046
16	1080-1100	WR&C	0.43	2	0.41	0.45	0.028
17	1100-1120	WR&C	0.32	2	0.3	0.33	0.021
18	1120-1140	WR&C	BARREN				
19	1140-1160	WR&C	0.76	7	0.69	0.81	0.04
20	1160-1180	WR&C	BARREN				
21	1180-1200	WR&C	1.03	2	1.02	1.05	0.021
22	1200-1220	WR&C	1.57	2	1.56	1.58	0.014
23	1220-1240	WR&C	0.77	3	0.71	0.81	0.049
24	1240,-1260	WR&C	0.79	1	0.79	0.79	
25	1260-1280	WR&C	0.98	2	0.92	1.05	0.092
26	1280-1300	WR&C	1.01	8	0.91	1.1	0.063
27	1300-1320	WR&C	0.32	8	0.25	0.37	0.041
28	1320-1340	WR&C	1.05	2	0.94	1.16	0.016
29	1340-1360	WR&C	0.47	6	0.21	0.64	0.18
30	1360-1380	WR&C	0.55	11	0.48	0.65	0.074
31	1380-1400	WR&C	2.09	6	1.78	2.46	0.02
32	1400-1416	WR&C	4.06	4	3.37	5.17	0.85

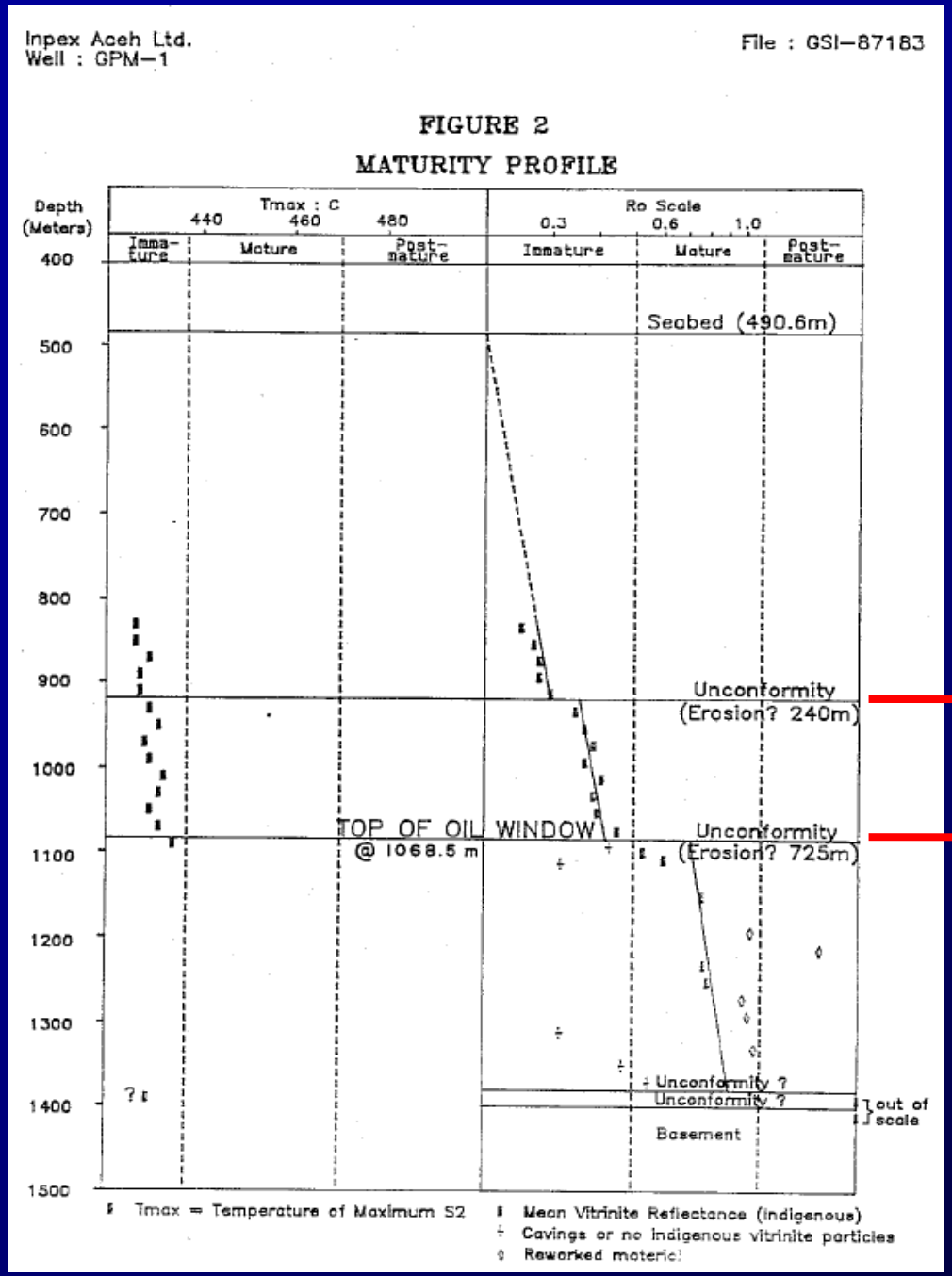
Sea Bottom Temperature : 50°F (10 °C) at 456 SS

BHT : 138°F (58.9 C) at 1436 m (1065.58 m)

Avg Geothermal gradient : 2.76°F/100ft or 5.172 °C/100 m

Gleumpang Minyeuk-1

VITRINITE REFLECTANCE PROFILE

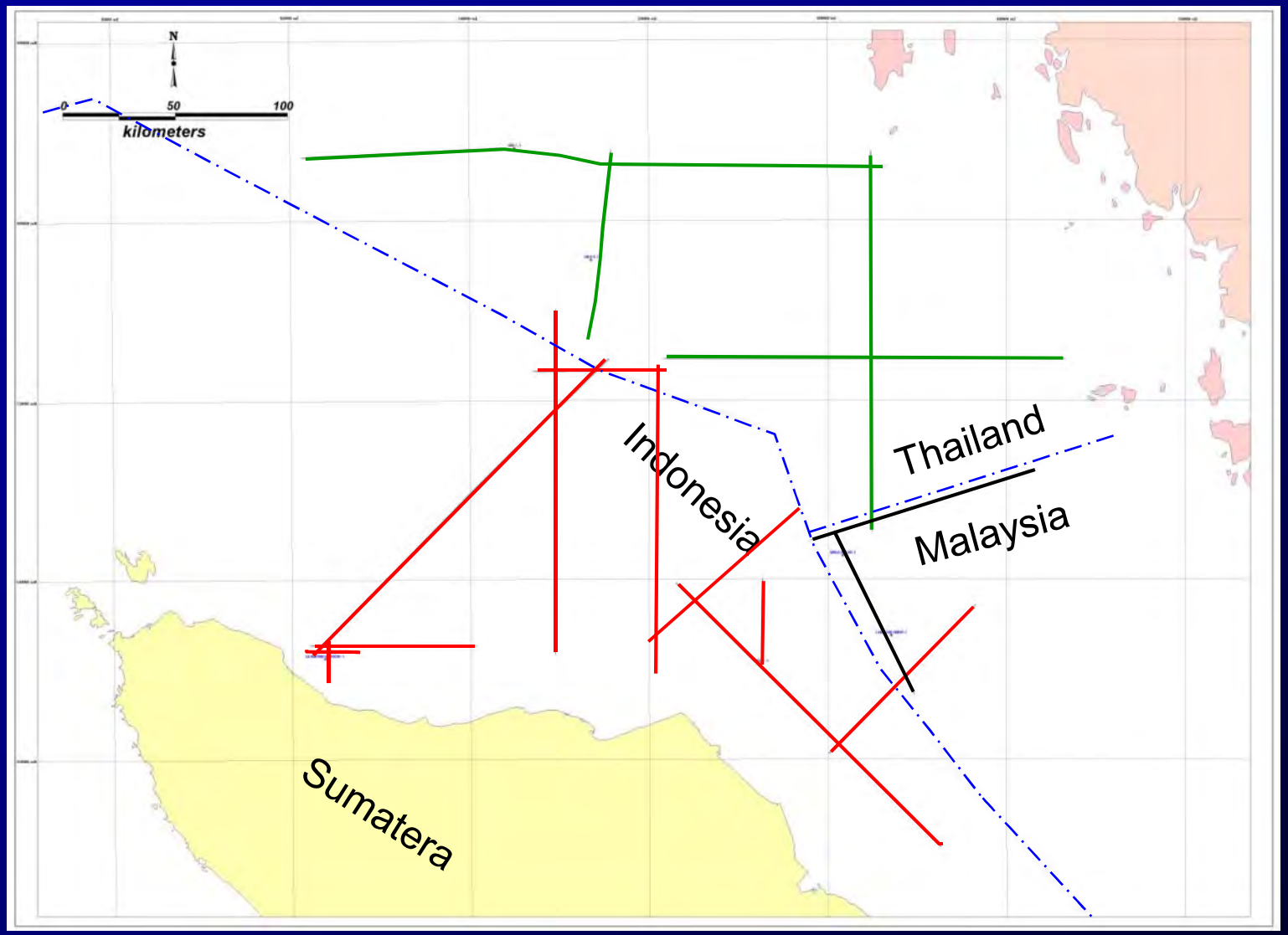


SEQUENCE BOUNDARY ?

SEQUENCE BOUNDARY ?

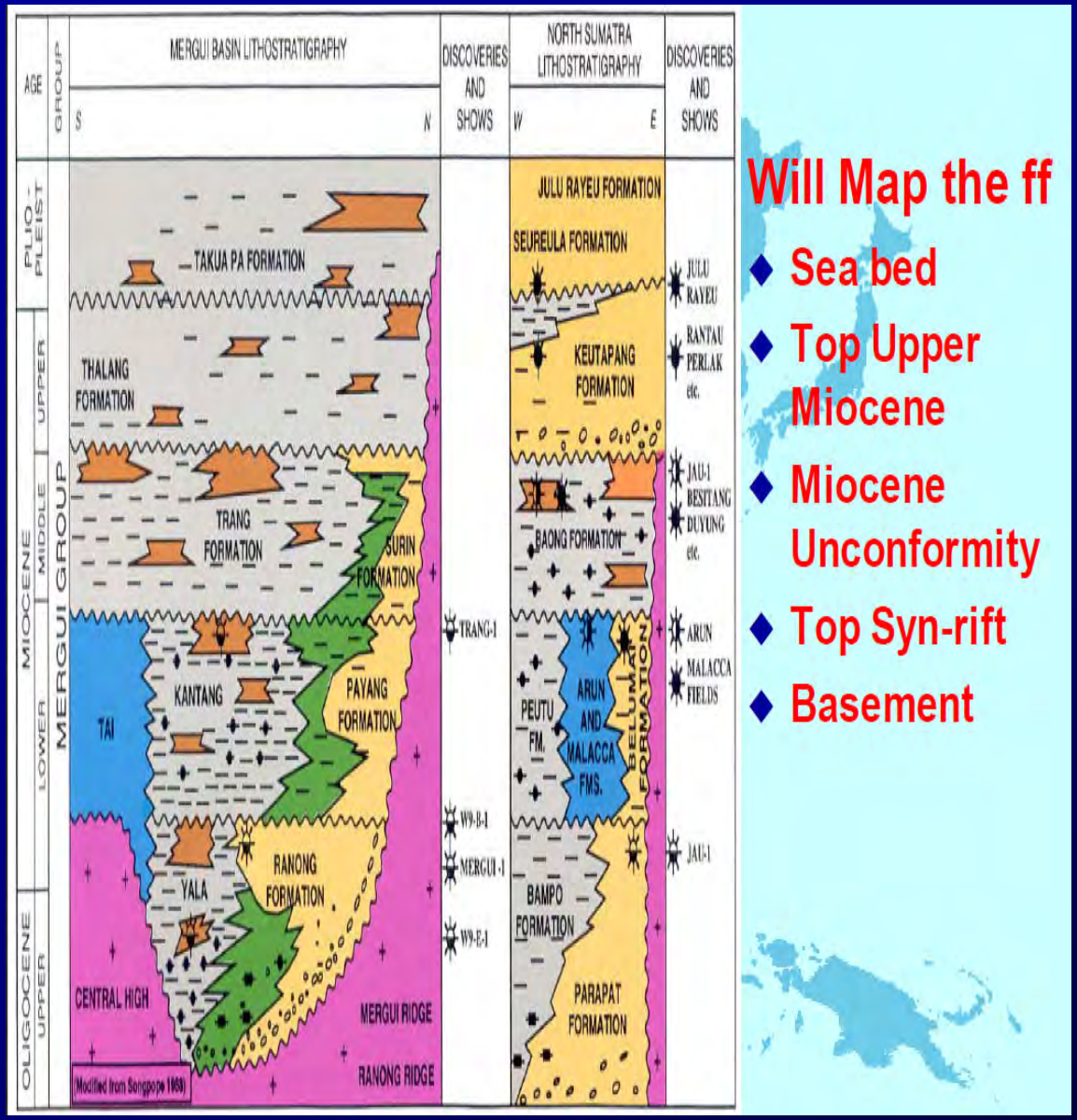
SEISMIC SECTIONS & MAP INTEGRATION

SEISMIC LINES BASE MAP



DATUM : WGS 1984

AGREEMENTS



a. Sea bed – blue
b. Top Upper Miocene – Green
c. Miocene Unconformity – Yellow
d. Top Syn-rift – Orange
e. Basement – red/purple

a. Maps – 1: 500,000
b. Seismic sect ions – 5cm/sec, vertical up to 6 sec.

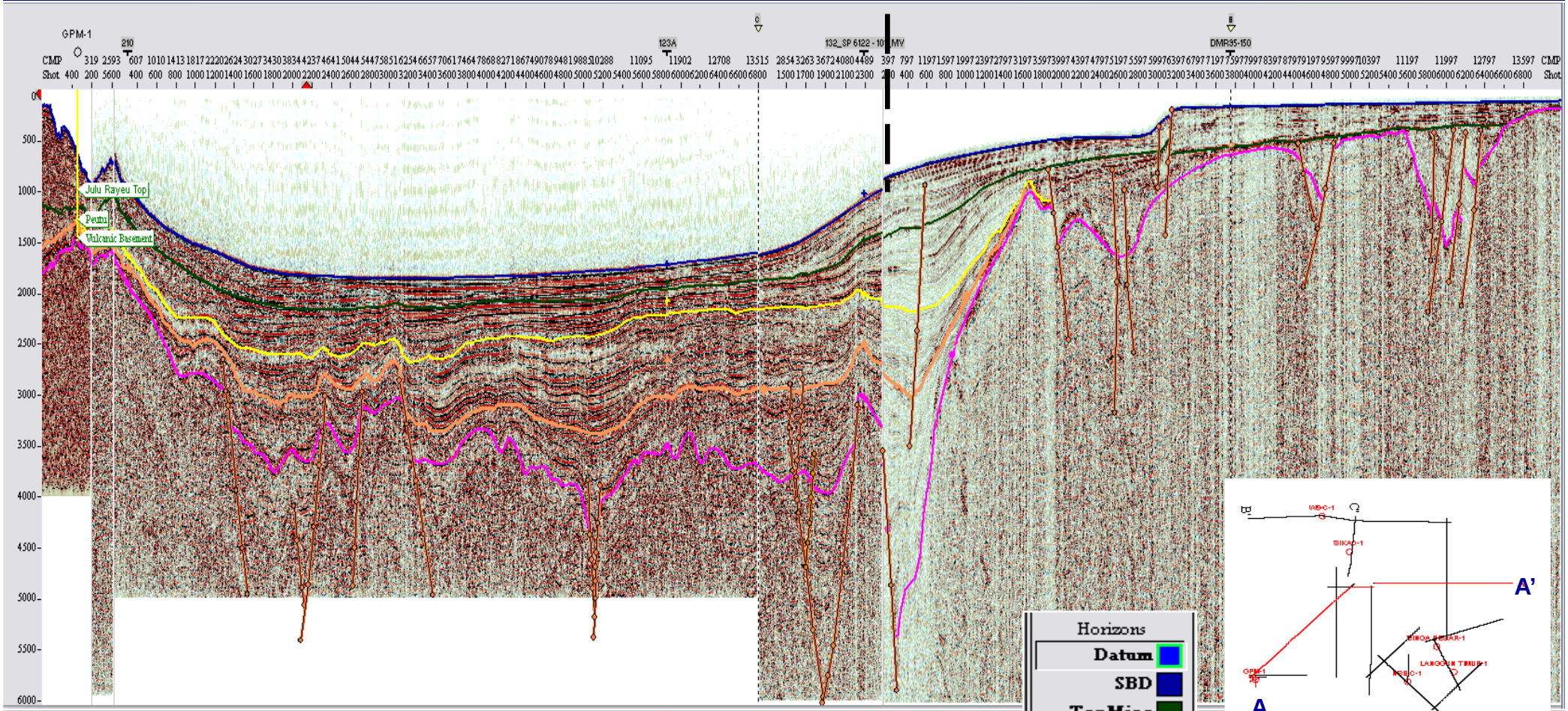
COMPOSITE LINE

INDONESIA

THAILAND

A

A’



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COMPOSITE LINE

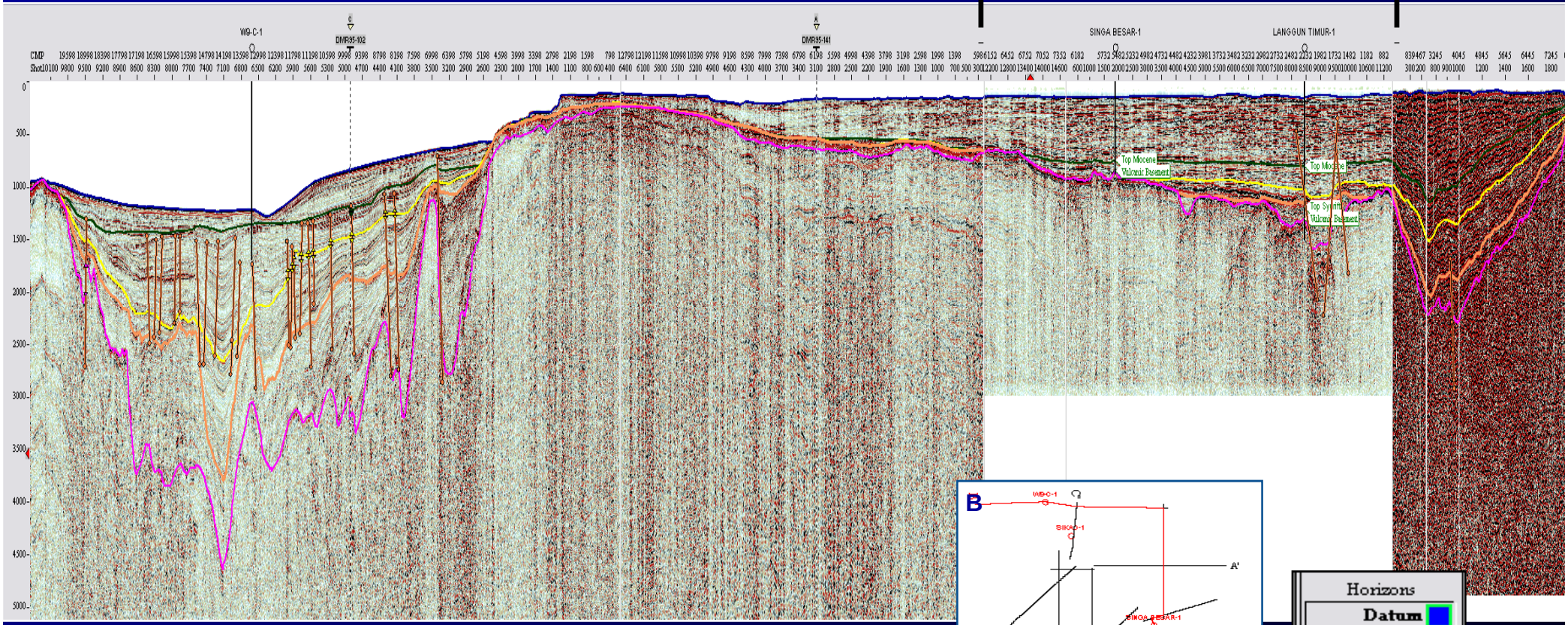
THAILAND

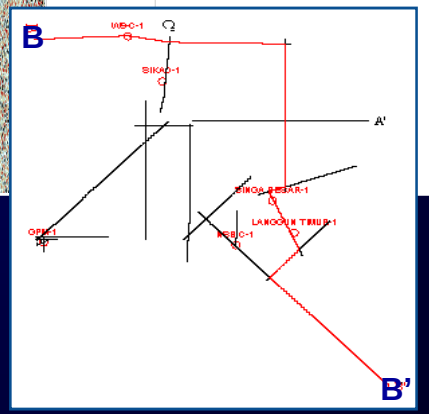
MALAYSIA

IND

B

B’





Horizons

- Datum
- SBD
- TopMioc
- UCMioc
- TopSynrift
- BSMNT

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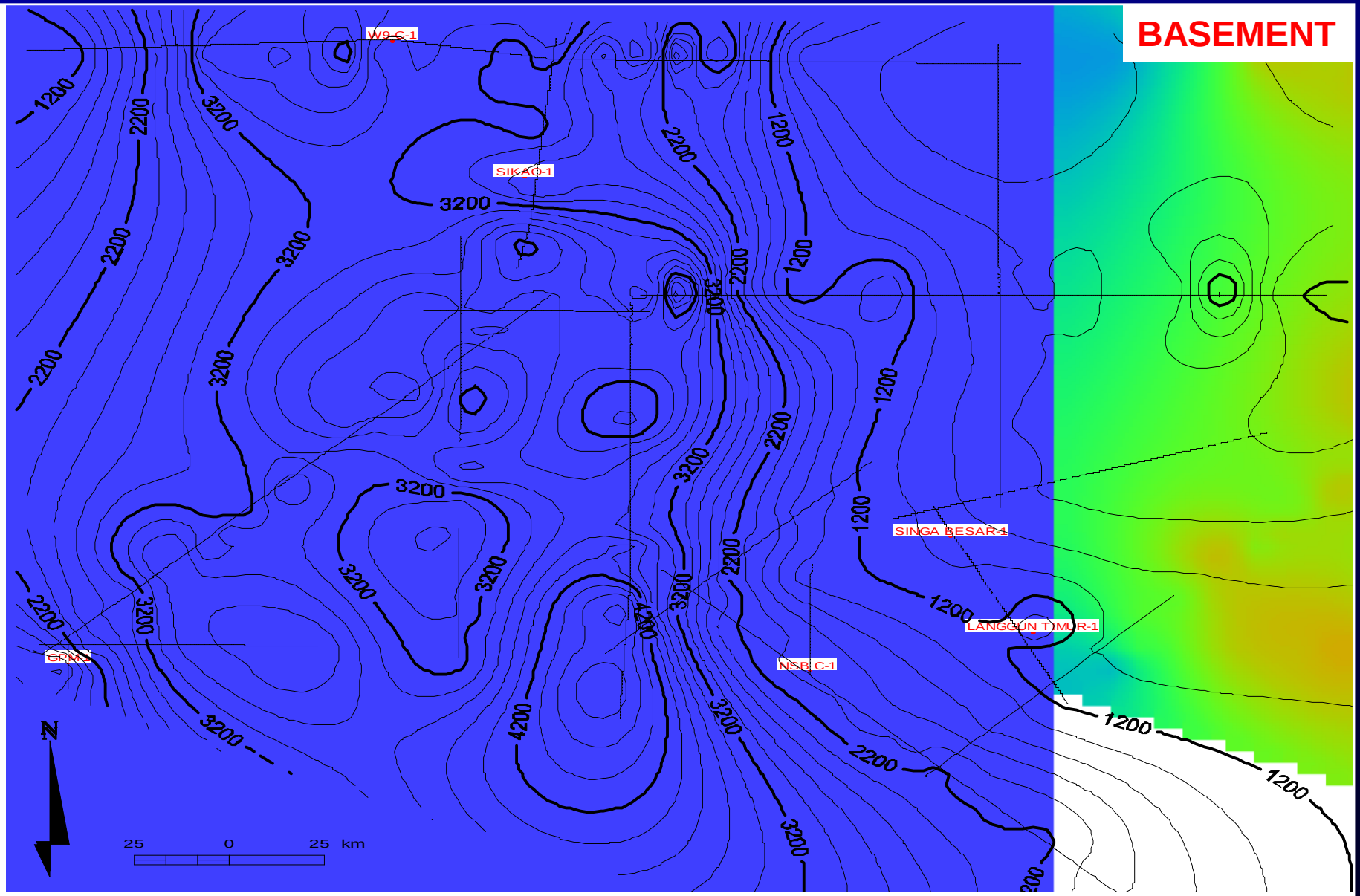
BASEMENT



BASEMENT, Time Structure Map

(ms)

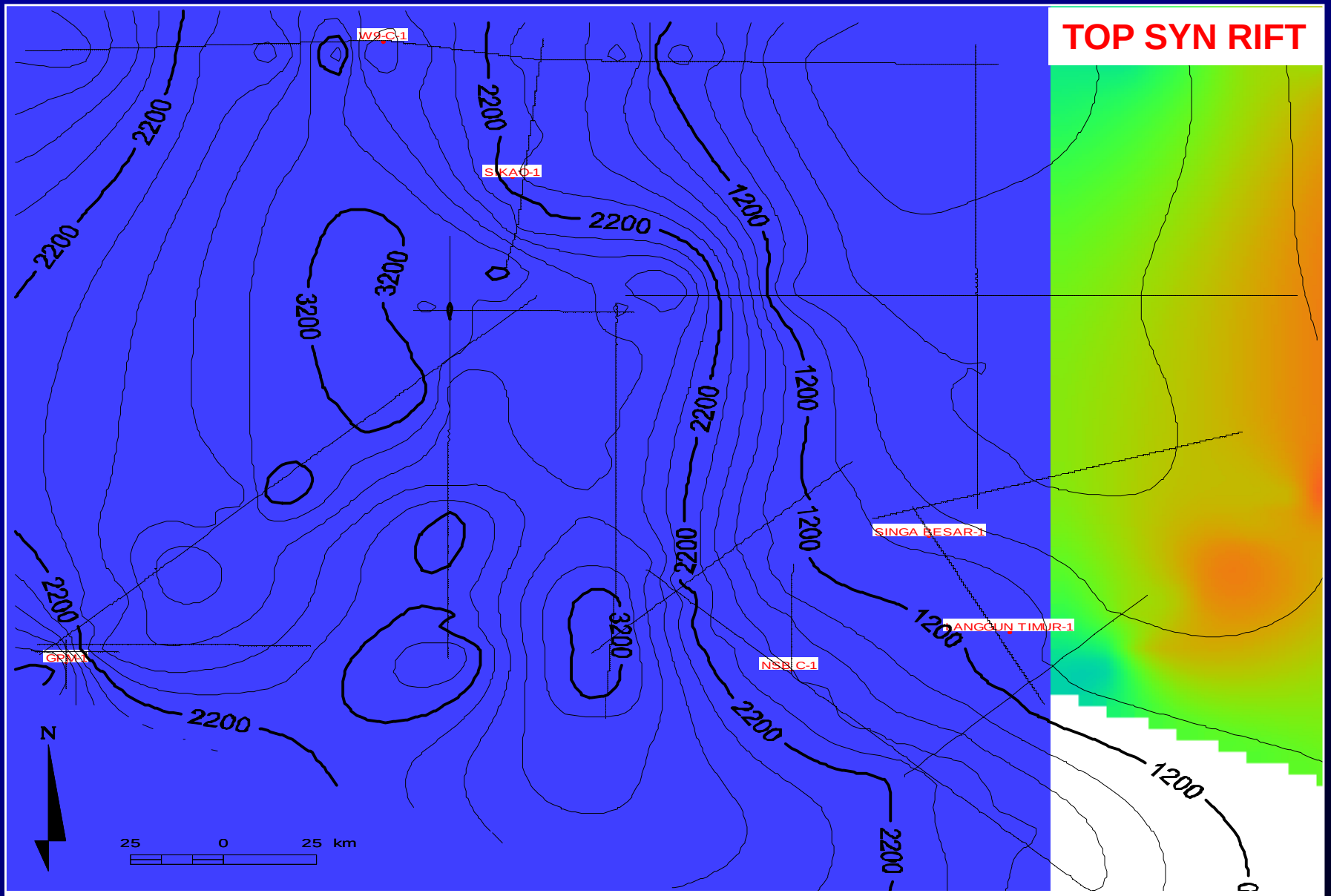
179 1380 2570 3760 4969

CCOP

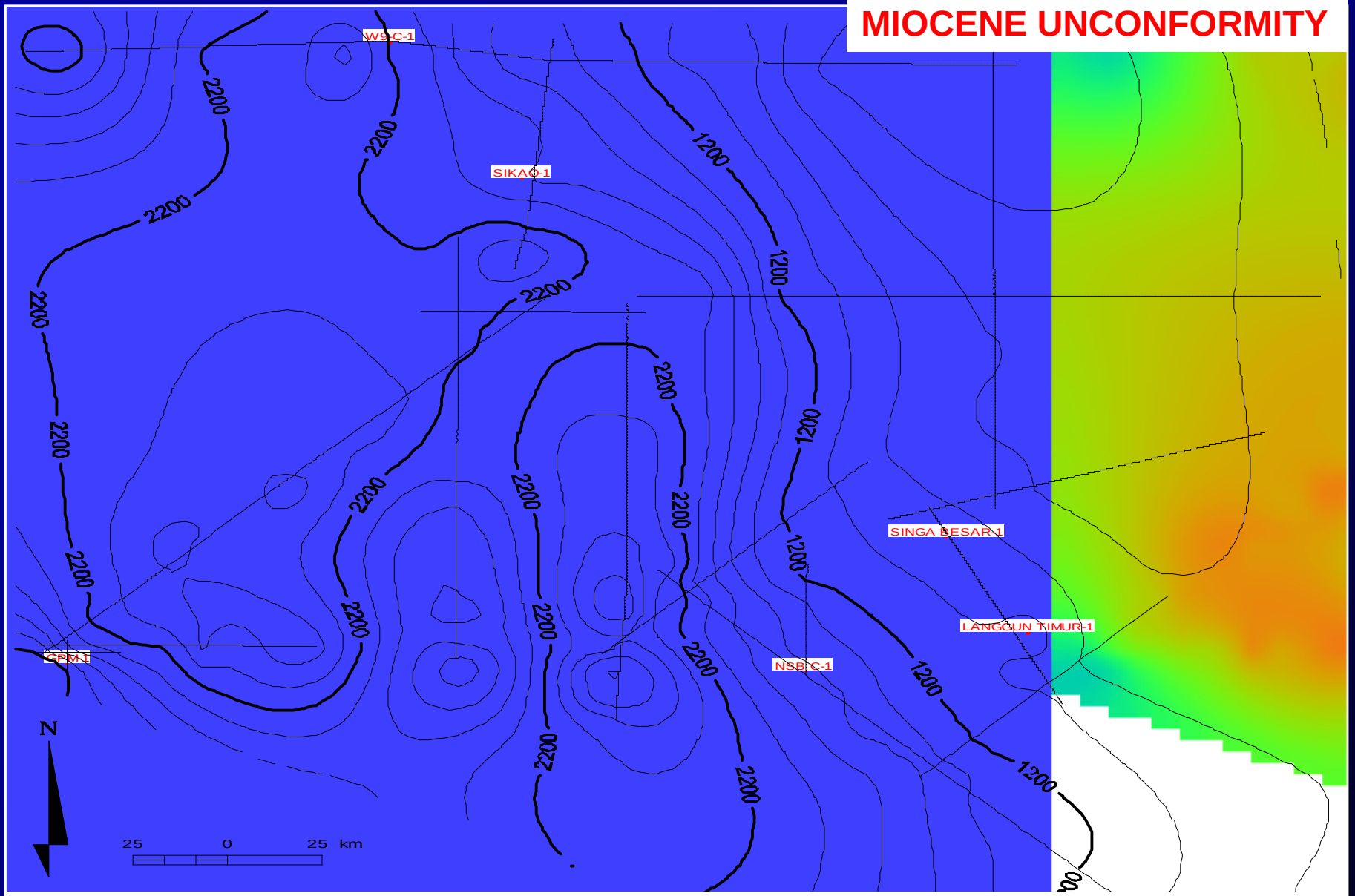
MERGUI BASIN
EPPM **P1W3**: Basin Analysis (cross border CS)

Indonesia | Malaysia | Thailand

LEMIGAS


TOP SYN RIFT
JW9-C-1
SUKAO-1
SINGA BESAR-1
PANGGUN TIMUR-1
NSB-C-1
GRM-1
2200
1200
3200
0
N
25 0 25 km
Top Synrift, Time Structure Map
(ms)
204
1030
1840
2650
3478
CCOP
MERGUI BASIN
EPPM P1W3: Basin Analysis (cross border CS)
Indonesia
Malaysia
Thailand

MIOCENE UNCONFORMITY



Miocene Unconformity, Time Structure Map

(ms)

203 910 1610 2310 3015

CCOP

MERGUI BASIN

EPPM **P1W3**: Basin Analysis (cross border CS)

Indonesia | Malaysia | Thailand

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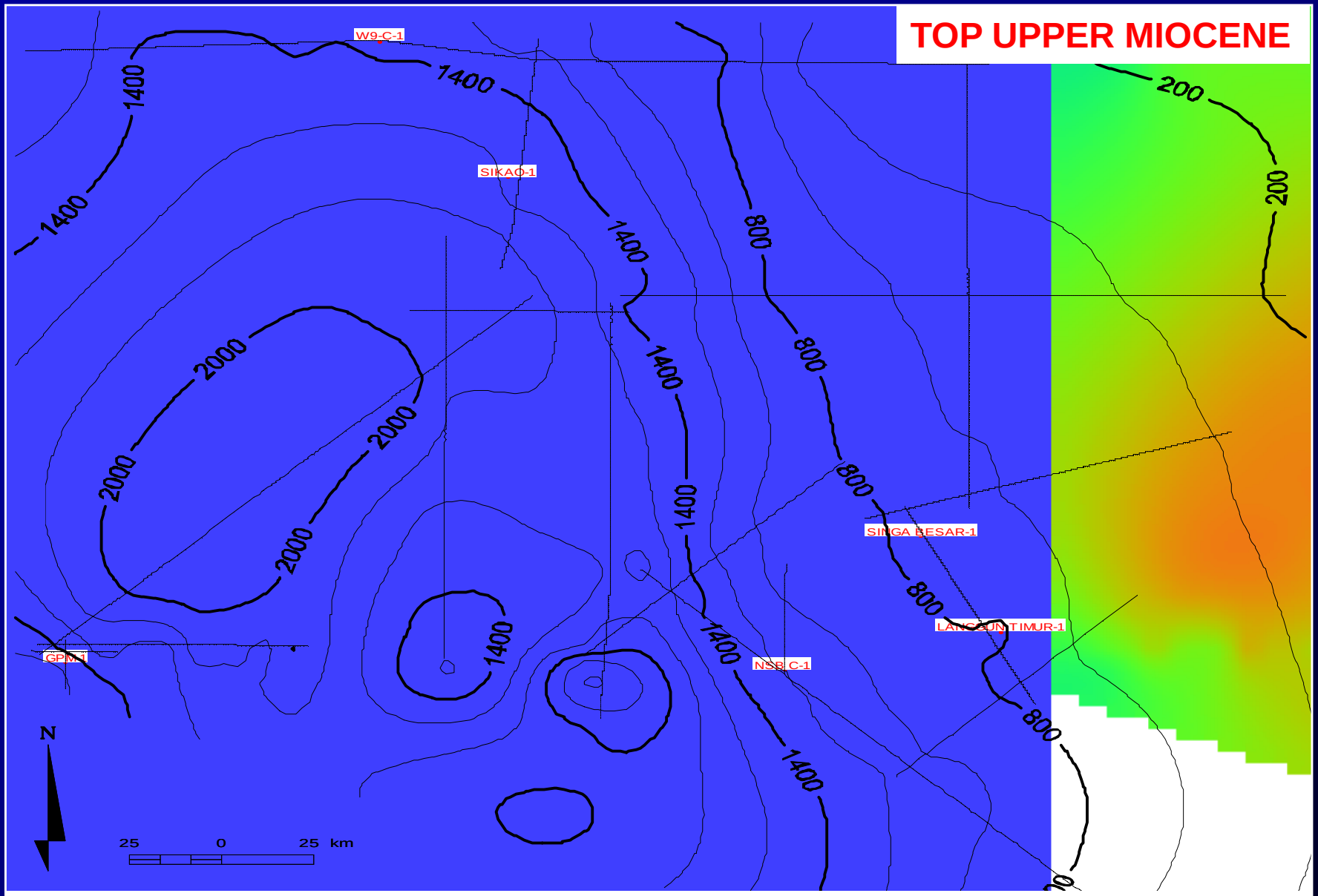
TOP UPPER MIOCENE



Top Upper Miocene,Time Structure Map

(ms)

145 720 1280 1840 2417

CCOP

MERGUI BASIN

EPPM **P1W3**: Basin Analysis (cross border CS)

Indonesia	Malaysia	Thailand

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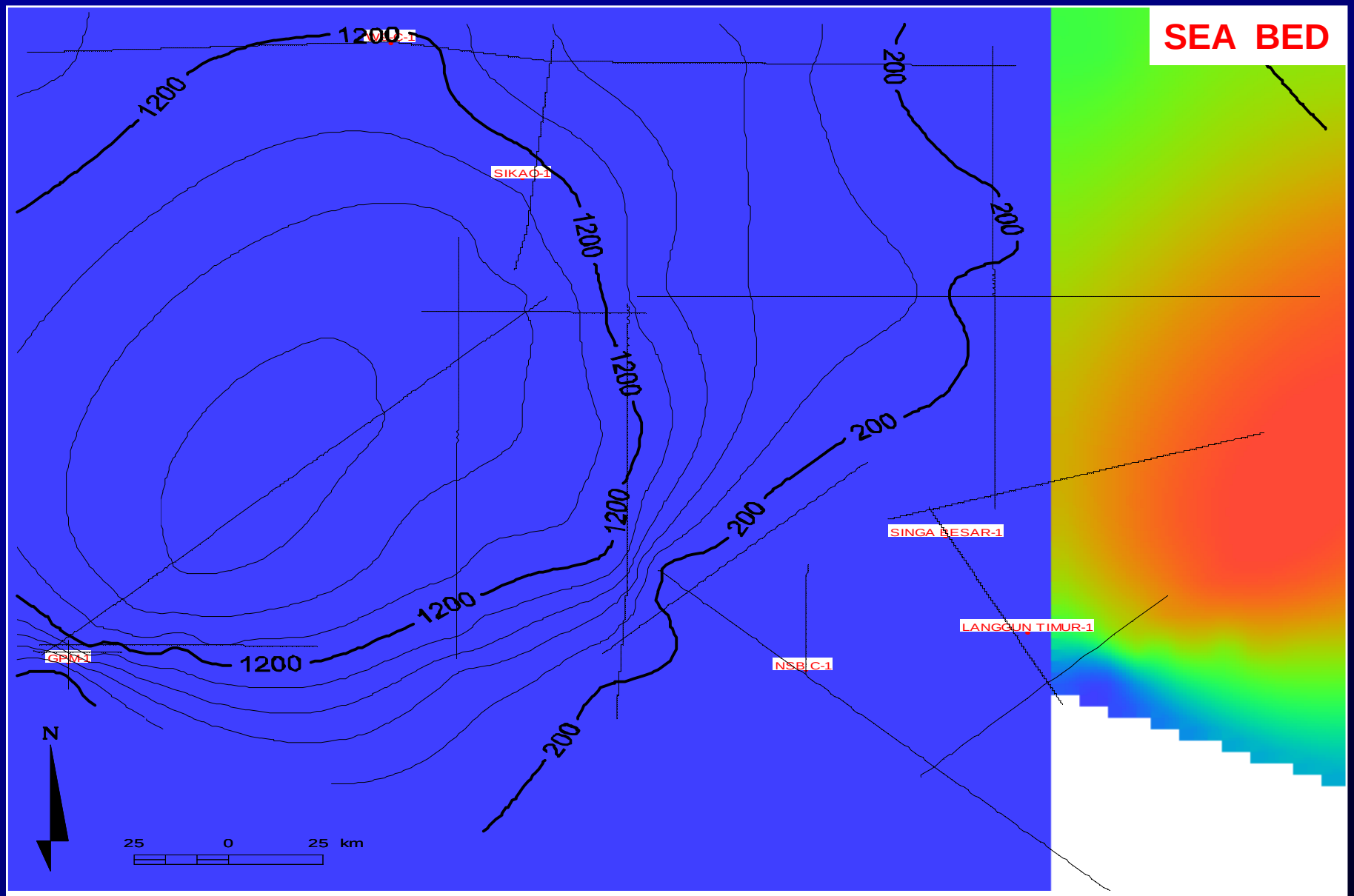

SEABED, Time Structure Map

(ms)

33 490 940 1390 1857

CCOP

MERGUI BASIN

EPPM **P1W3**: Basin Analysis (cross border CS)

Indonesia | Malaysia | Thailand

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PRELIMINARY BASIN MODELING
USING "TEMIS" 2D

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MODELING PARAMETER
(Derived from GM-1 Well)

STRATIGRAPHIC FRAMEWORK		Average TEMPERATURE GRADIENT	Sea Bottom TEMPERATURE HISTORY
HORIZON	AGE		
	(MYA)	(°C /m)	(°C)
Sea bottom	0	0.051	10
Top Upper Miocene	5.3		
Top Miocene Unconformity	13.8	0.7	20
Top Syn Rift	20.4		
Top Basement	65		

ROCKS PROPERTIES FOR MODELING INPUT

(Average Thermal conductivity of Principal Rock from Sumatera)

Litology	Thermal Conductivity (K) mCal/cm˚C sec			
Shale	4.31	± 0.53		
Sandstone	7.25	± 1.07		
Limestone	6.3	± 1.06	W/m/C	= 2.39 mCal/cm˚C sec

(**Vacquier, Victor**, 1981, Calculation of Thermal Conductivity from Lithology and Laboratory Measurement on Oil Well Cores, "Joint ASCOPE/ CCOP Workshop on Heatflow"

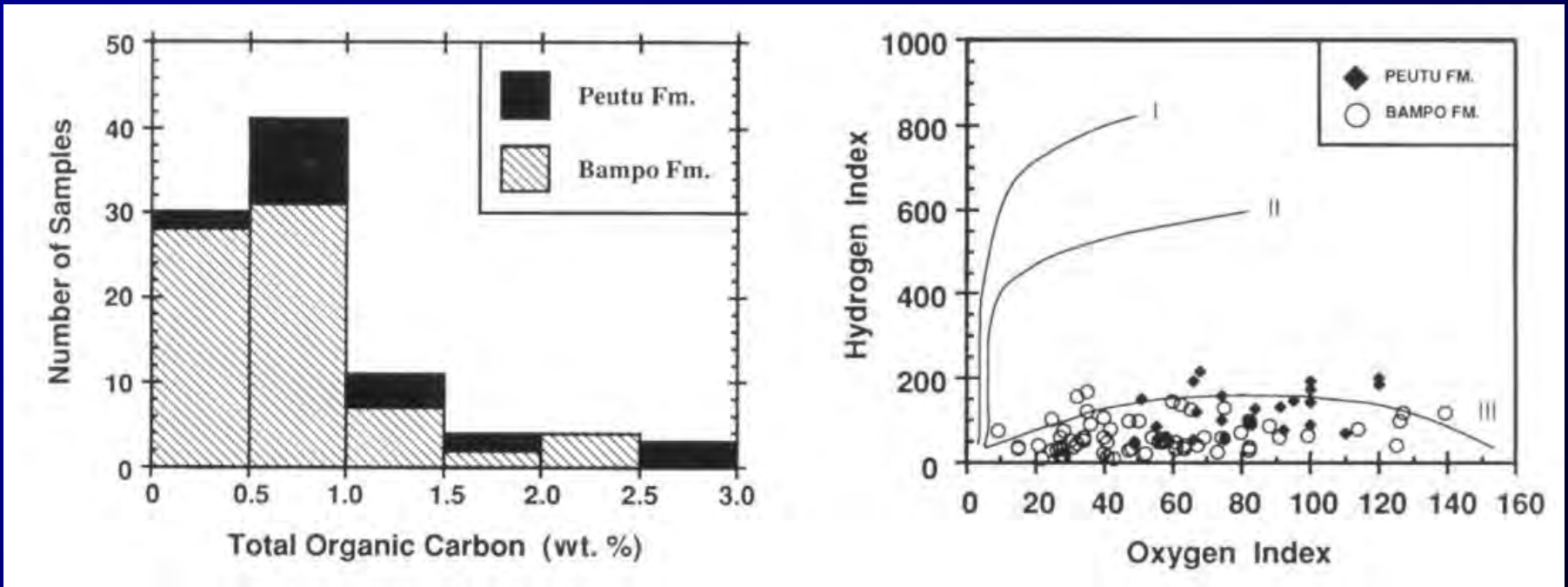
No.	FORMATION/HORIZON	DEPTH (m)	AGE (Ma)	LITHOLOGY COMPOSITION	Solid Density (Kg/m3)	Thermal Conductivity (K) W/m/C
1	**Sea Bottom**	**465**	0	Sandstone (15%), Shale (85%)	2649.5	1.99
2	**Top Upper Miocene**	**1068.5**	5.3	ERODED		
3	**Miocene Unconformity**	**1068.5**	13.8	Sandstone (1%), Shale (4%), Limestone (95%)	2707.05	2.63
4	**Top Syn-rift**	**1384.919582**	20.4	Sandstone (10%), Shale (76%), silt (14%)	2650.1	2.01
10	**Basement**	**1400**	65	Volcanic breccia & lava		

silt = 50% sand, 50% shale

marl = 50% limestone, 50% shale

TYPYCAL SOURCE ROCK FOR MODELING INPUT

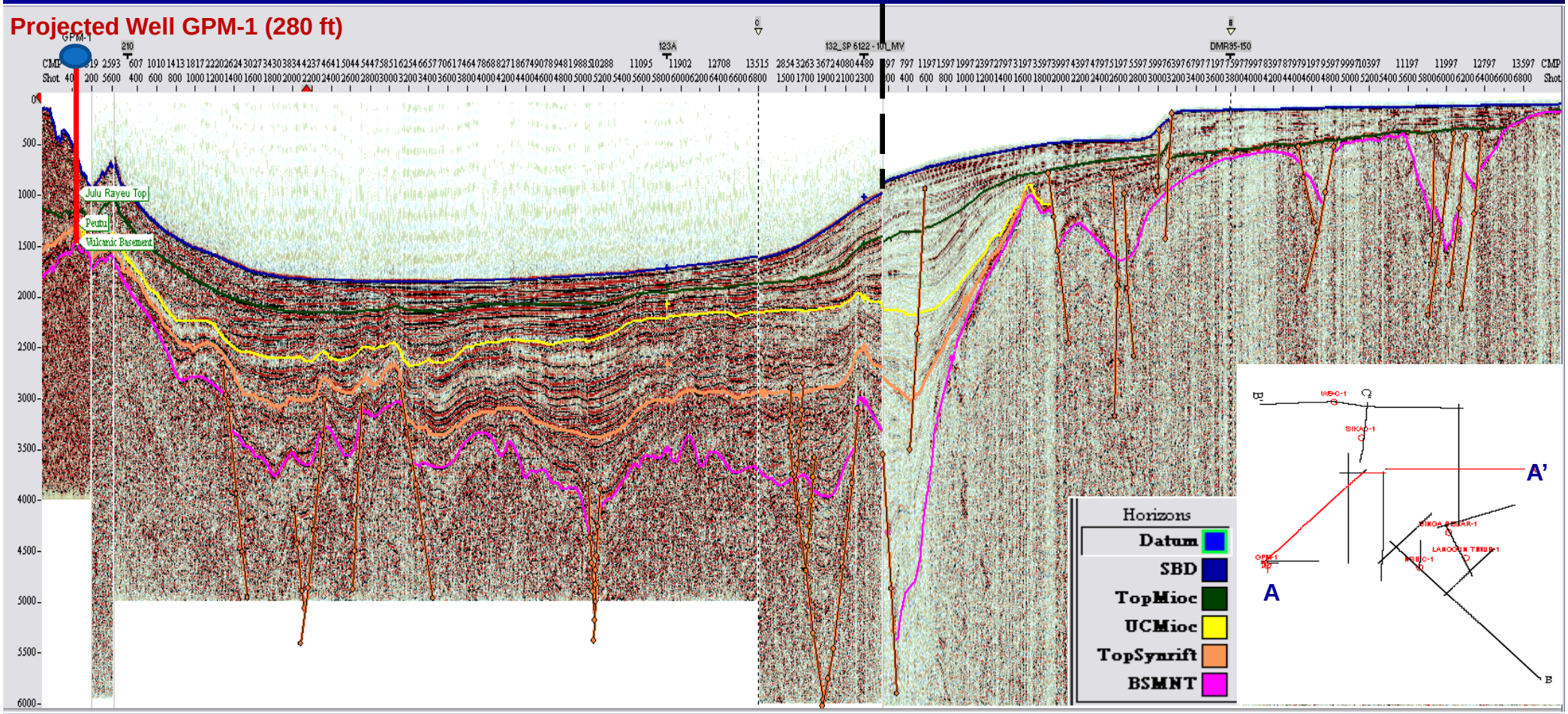
- **Shales & mudstones of Bampo & Peutu Formation were dominantly tipe III kerogen with TOC range from 0.5 % to 3 %.**

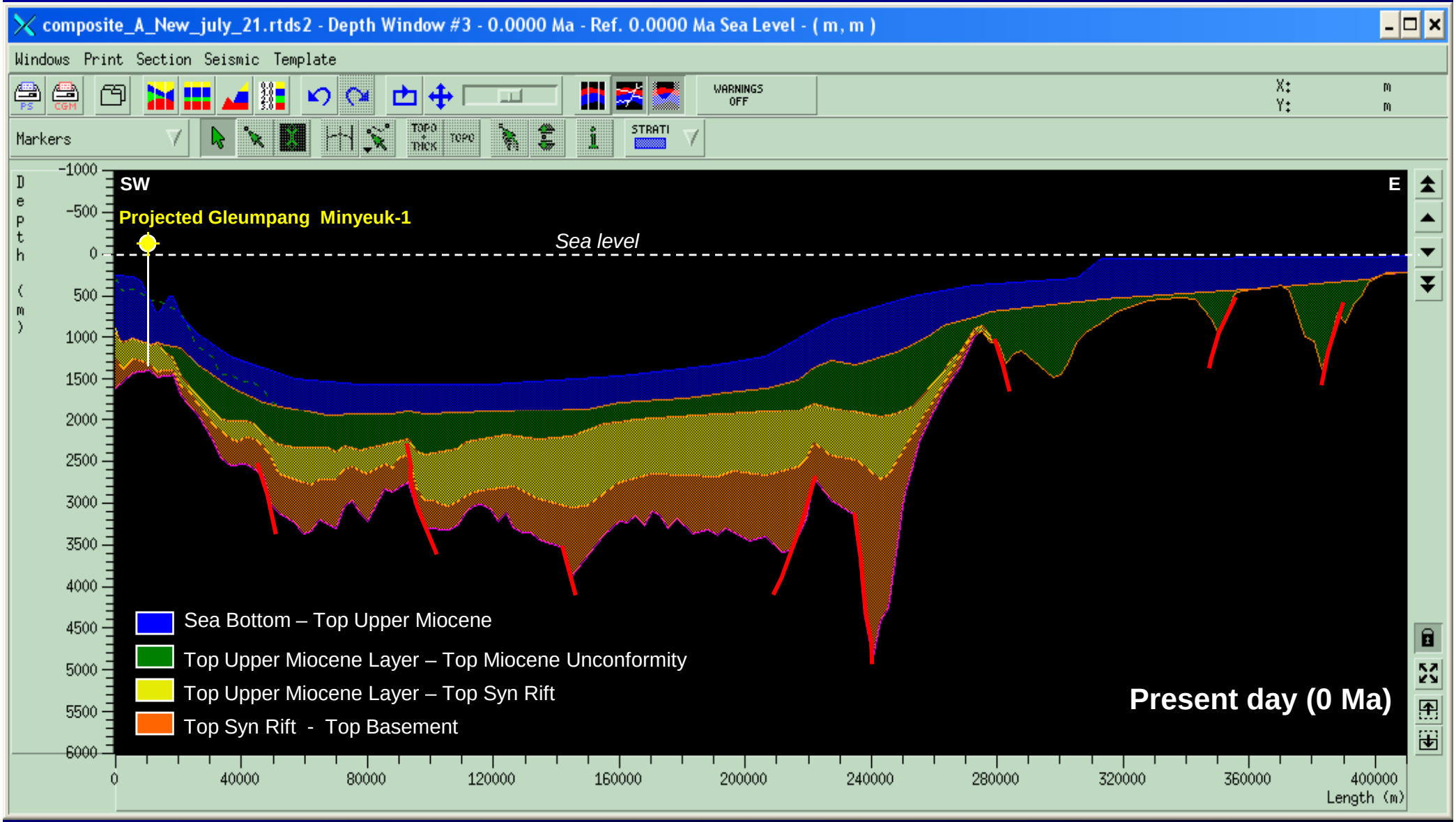


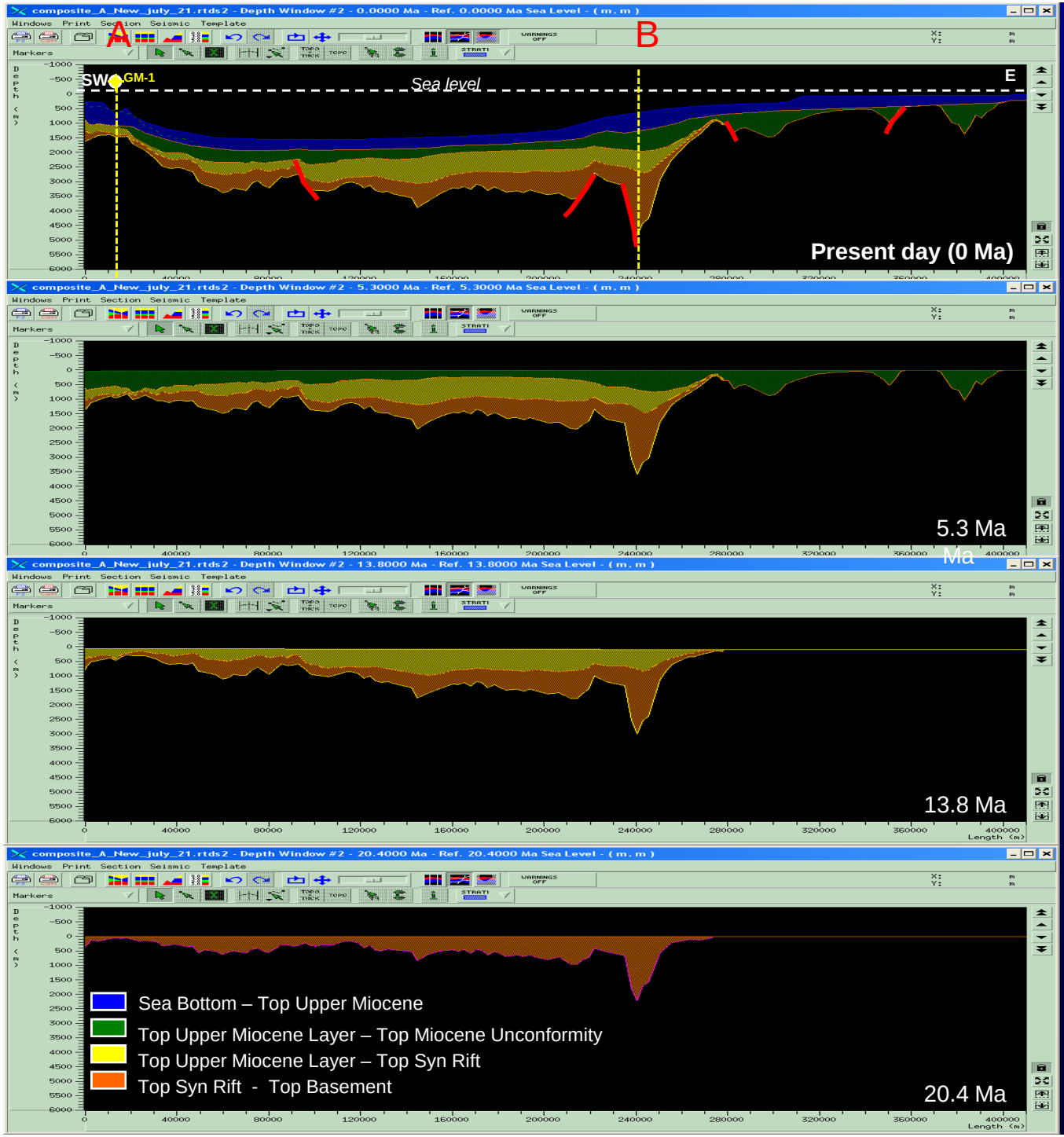
Buck & Mc. Culloh (1994)

2D PRELIMINARY BASIN MODELING FROM COMPOSITE LINE INDONESIA & THAILAND

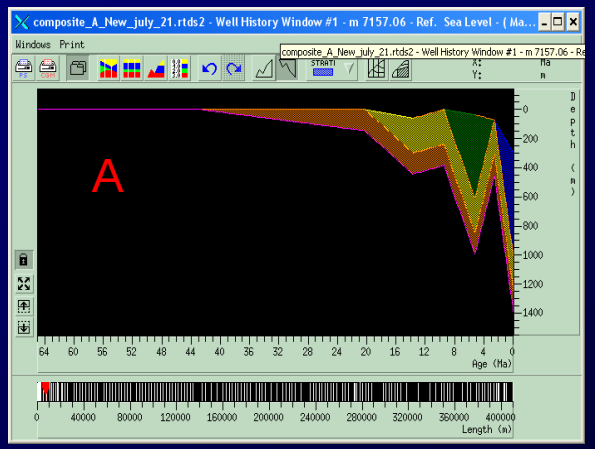
A INDONESIA THAILAND A’

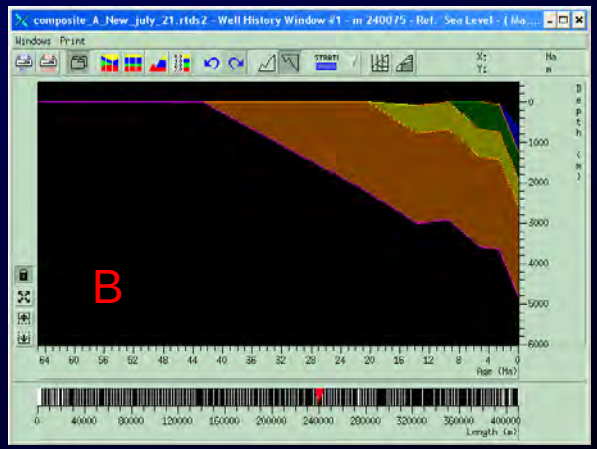



composite_A_New_july_21.rtds2 - Depth Window #3 - 0.0000 Ma - Ref. 0.0000 Ma Sea Level - (m, m)
Windows Print Section Seismic Template
WARNINGS OFF
Markers
STRATI
SW
E
Projected Gleumpang Minyeuk-1
Sea level
Depth (m)
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
0
40000
80000
120000
160000
200000
240000
280000
320000
360000
400000
Length (m)
Sea Bottom – Top Upper Miocene
Top Upper Miocene Layer – Top Miocene Unconformity
Top Upper Miocene Layer – Top Syn Rift
Top Syn Rift - Top Basement
Present day (0 Ma)



SIMPLIFIED BURIAL HISTORY MODEL





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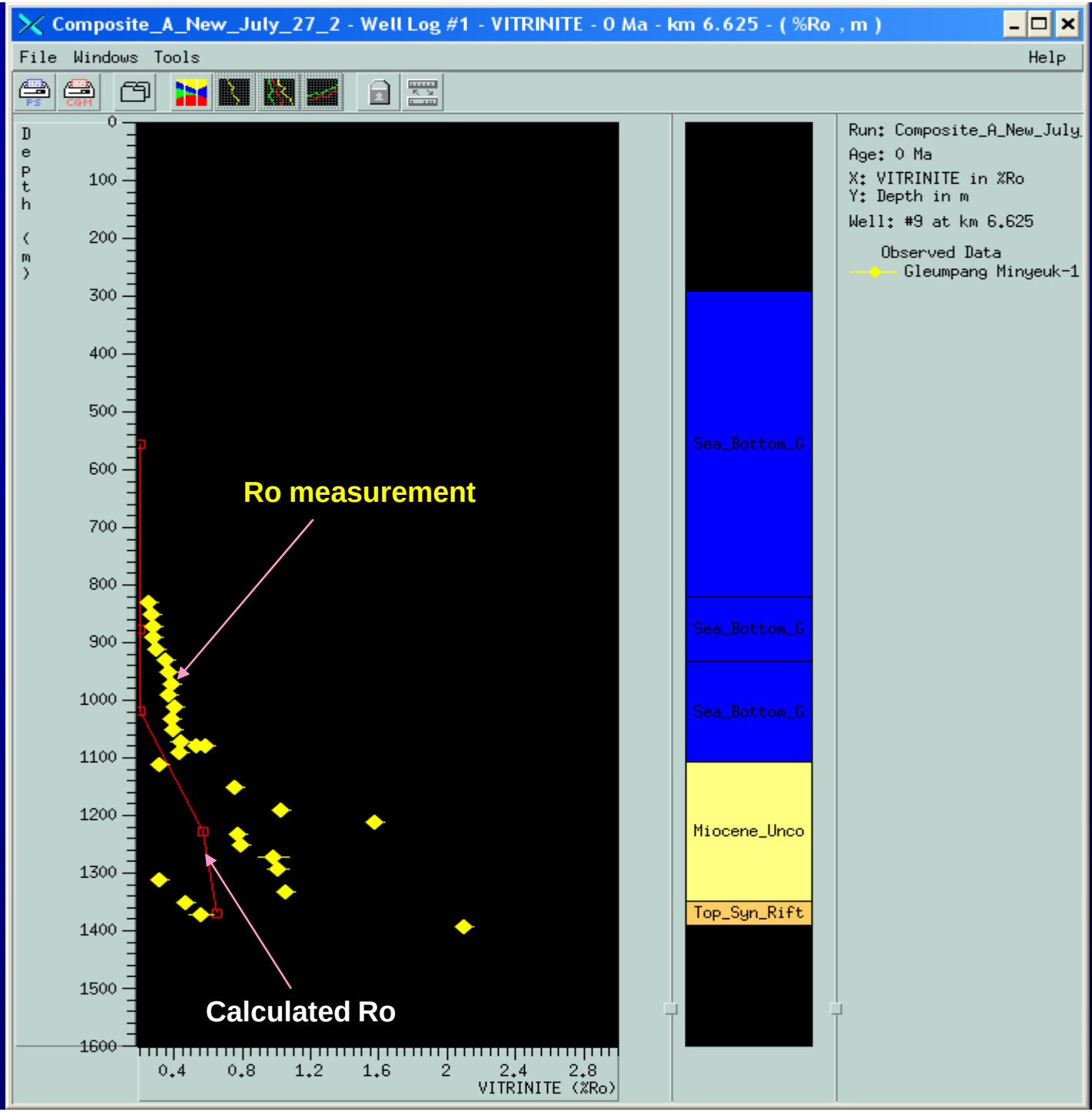

Modeling Verification

Not fit yet

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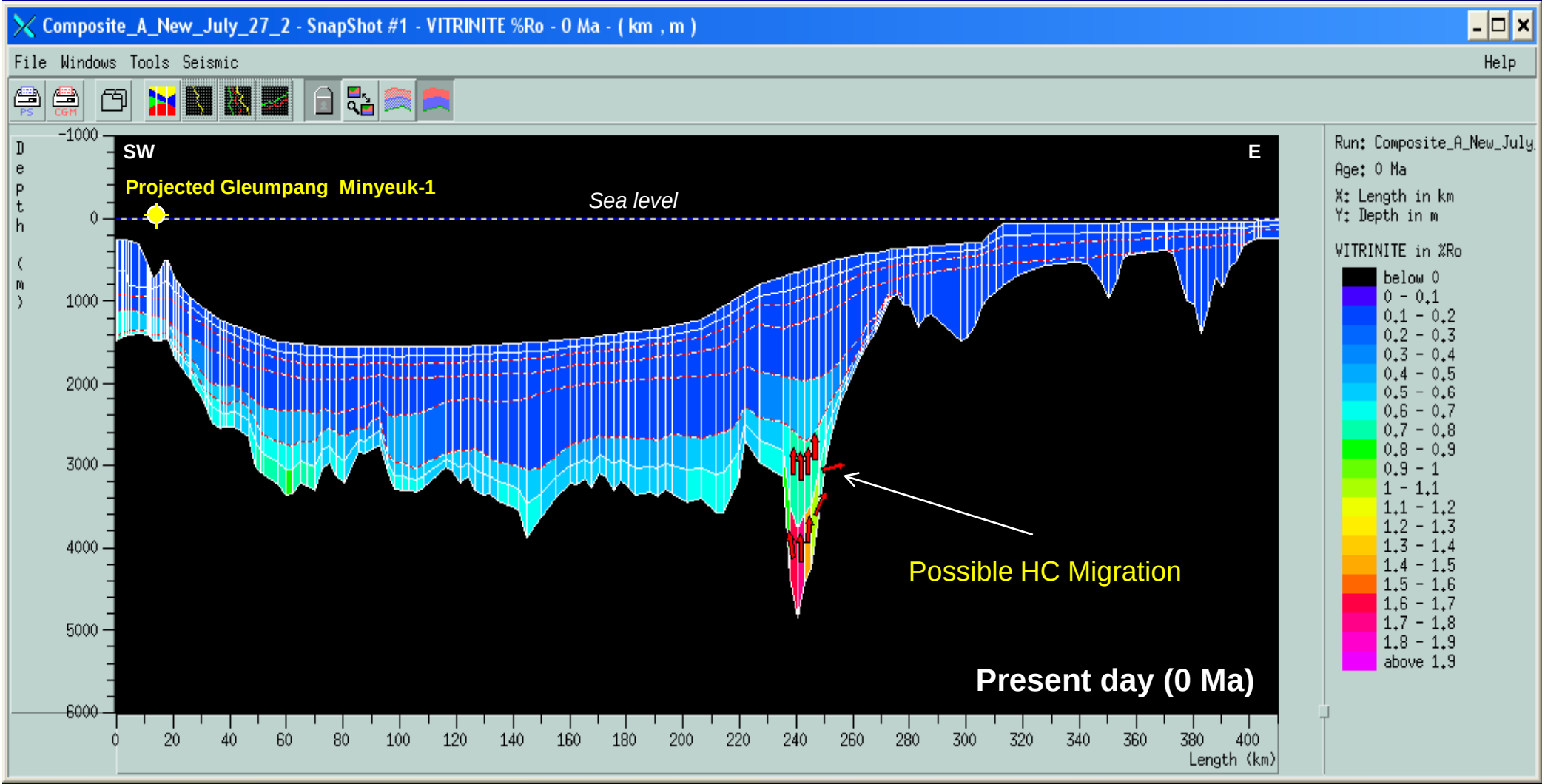
MATURATION MODEL



RECOMMENDATION FOR THE NEXT MODELING

Need more data/info to complete

- Need more Facies/lithology distribution/interpretation along seismic section
- Need more layer/horizon to define
- Need Well data/information from another country (VR, TOC, HI, BHT, TG, HF)

SOME IDEA FOR THE NEXT

EXAMPLE FROM SIMEULUE

WHY WE NEED GRAVITY MODEL/MAP

⇩

TO DELINIATE BASIN BOUNDARY & KITCHEN AREA (Sediment Thickness)

⇩

COMBINE WITH BASIN MODELING

⇩

ROUGHLY ESTIMATED HYDROCARBON GENERATED FROM KITCHEN AREA

SIMEULUE AREA MAP

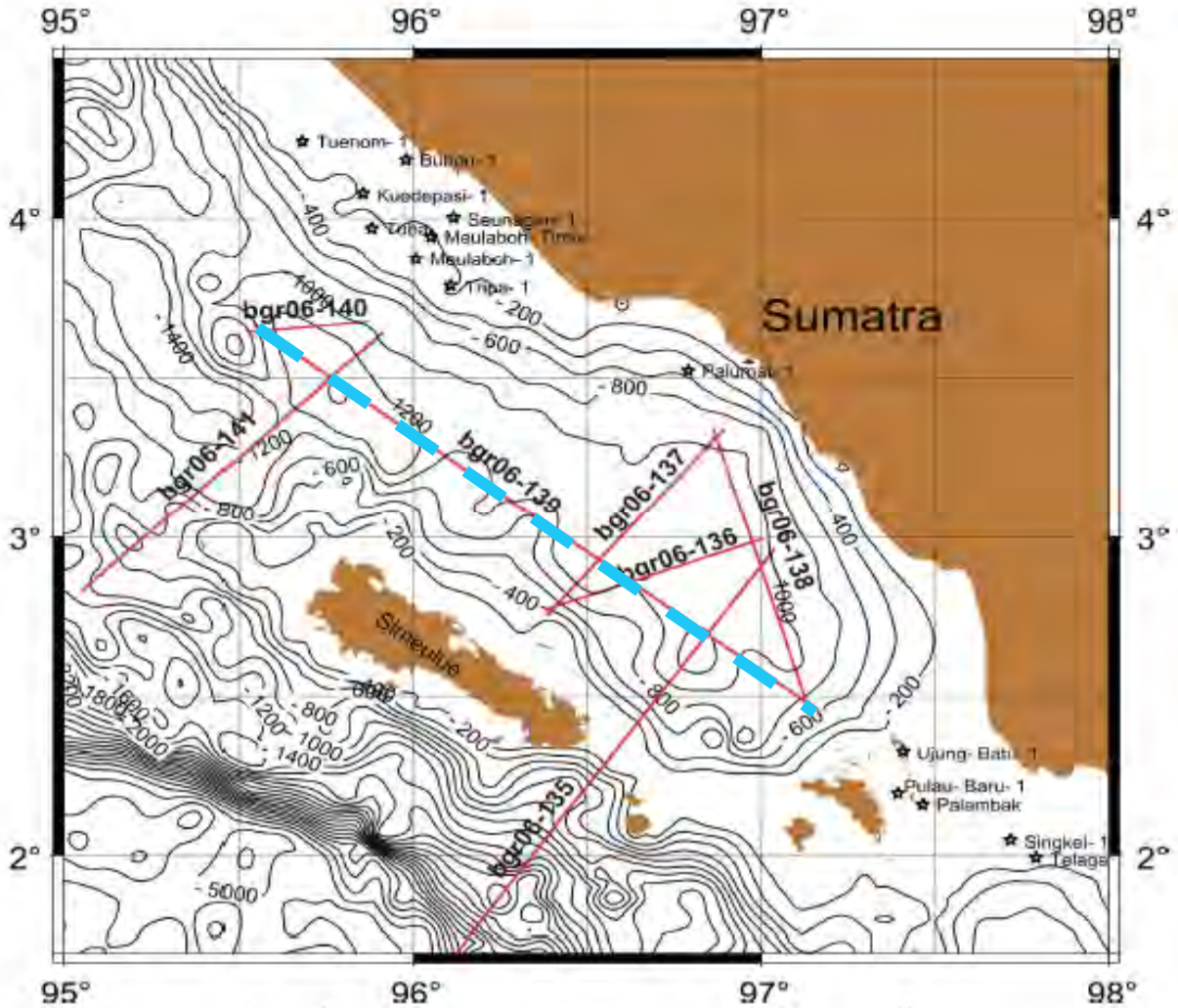
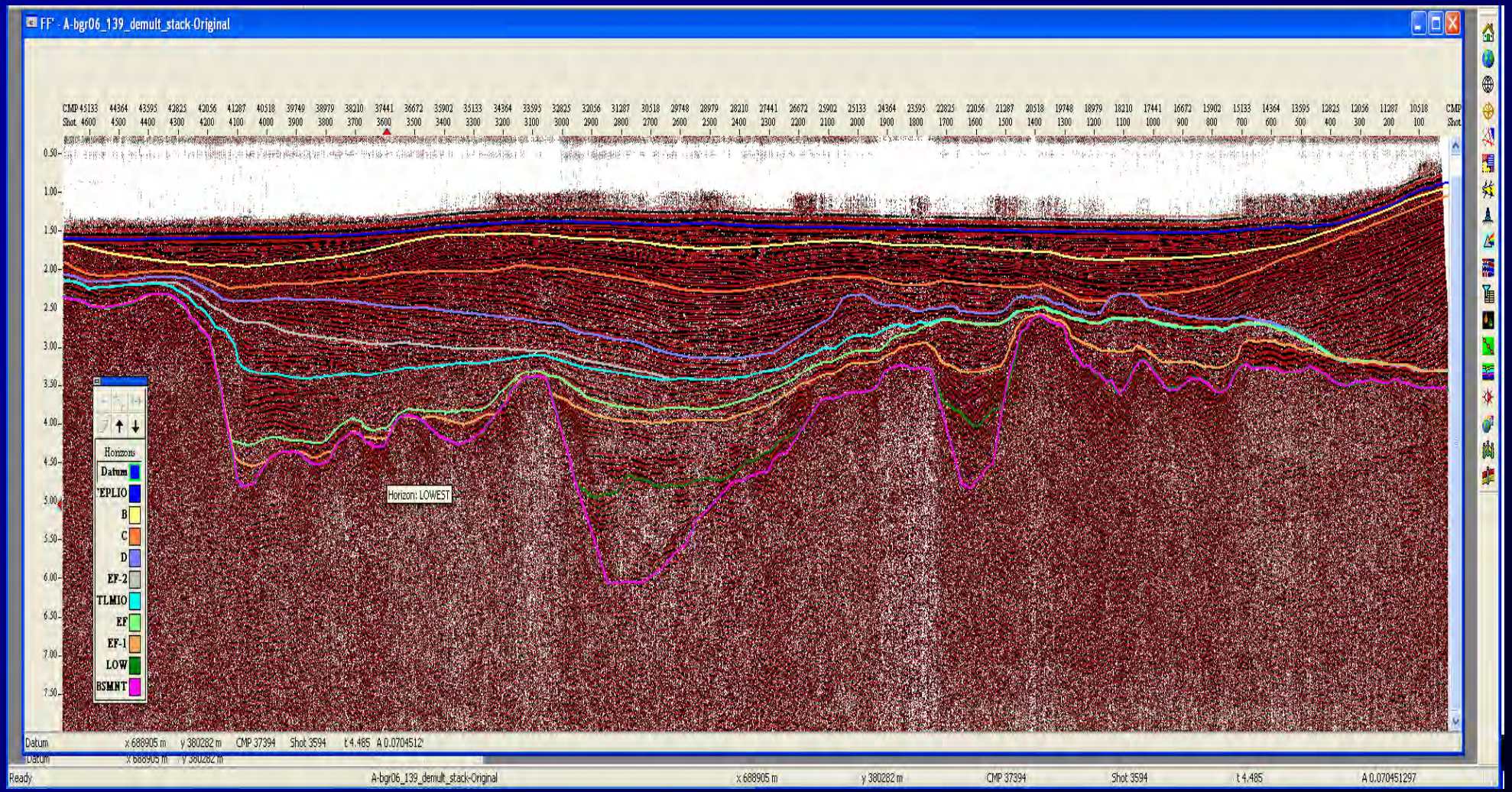


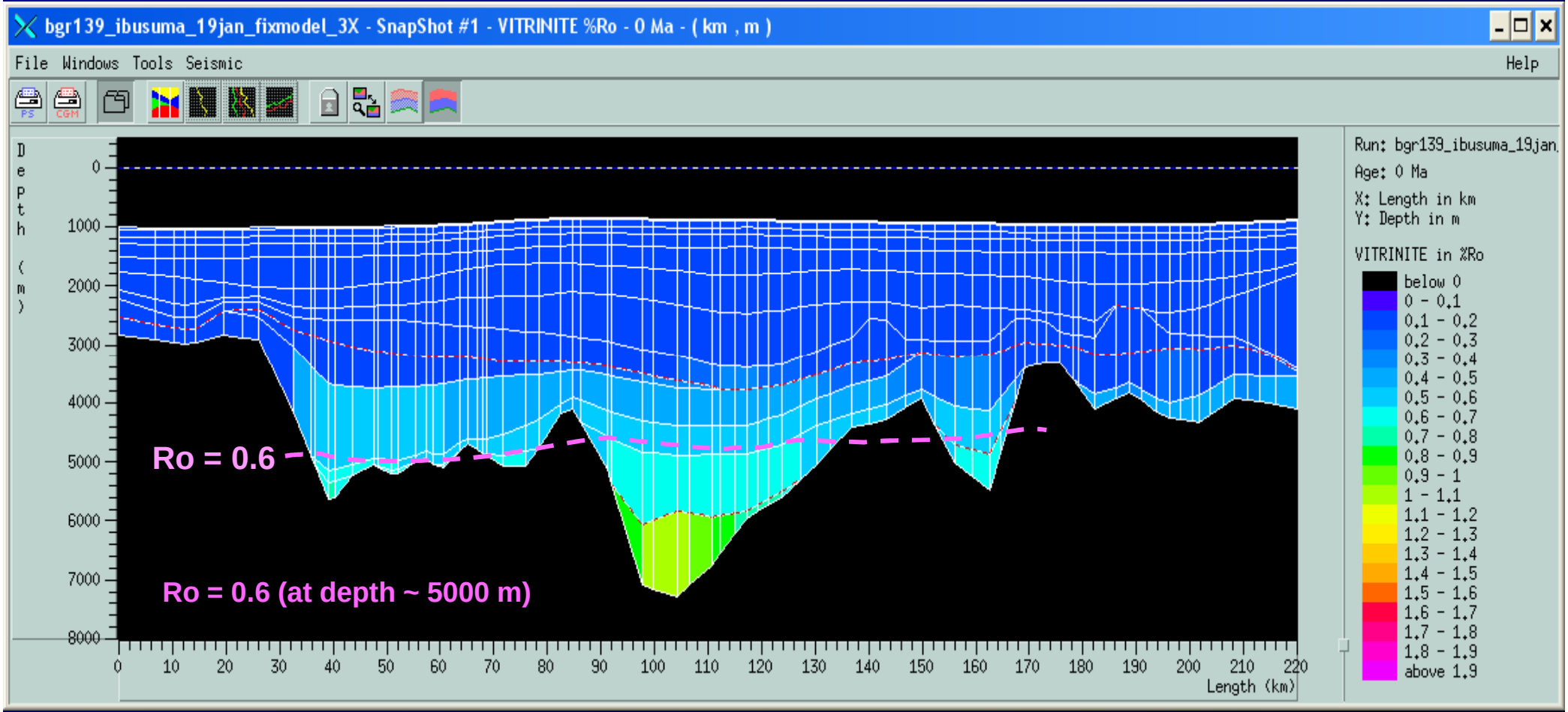
Figure 1: Location of study area (red=MCS lines of BGR, bgr06-135-141, stars=wells drilled by Union Oil; Beaudry & Moore, 1985; Karig et al., 1979). Bathmetry from (Smith and Sandwell, 1997)

SEISMIC LINE USED FOR BASIN MODELING



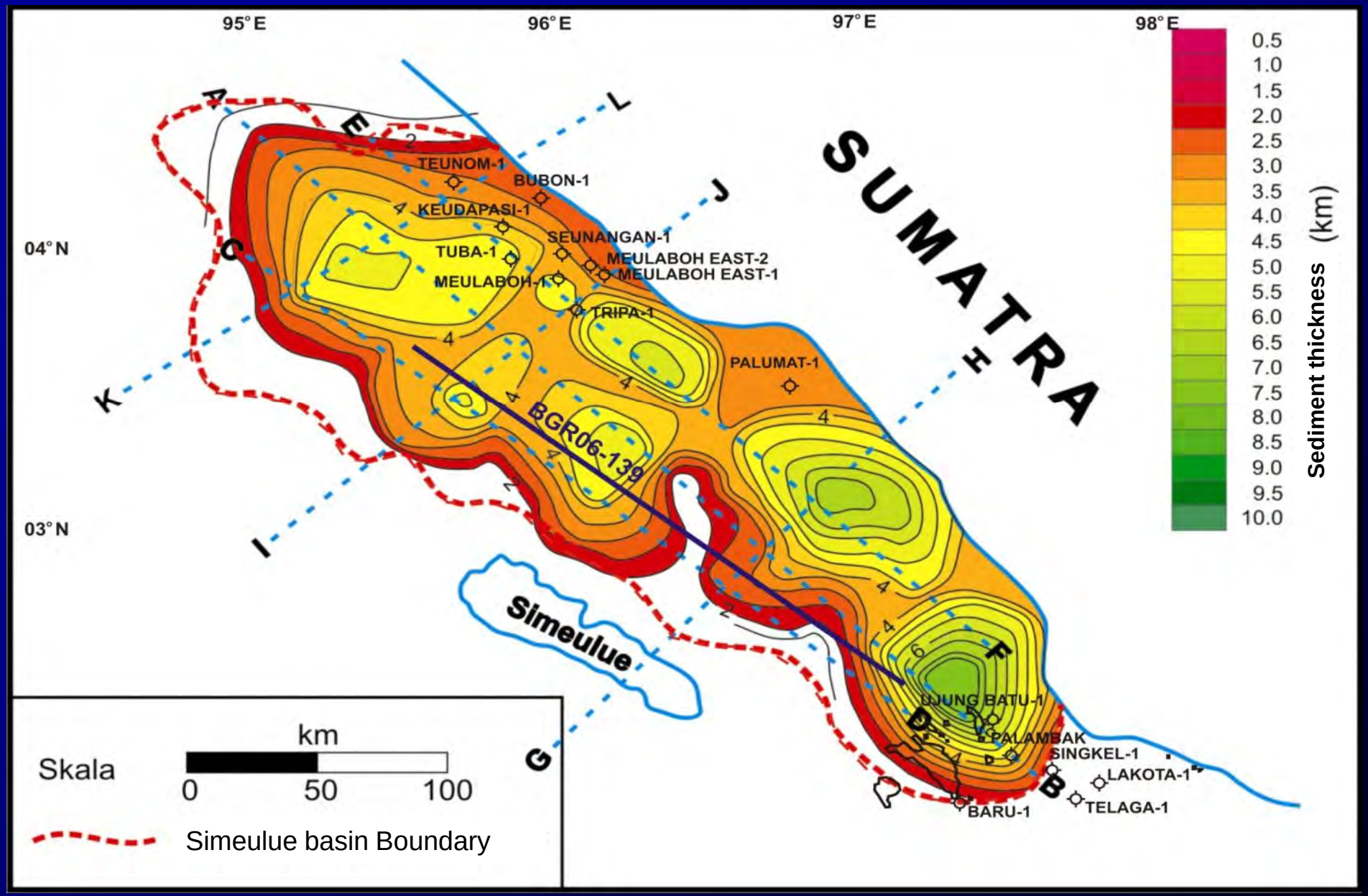
Speculative Modeling Line BGR06_139

Vitrinite Reflectance (Ro) Model

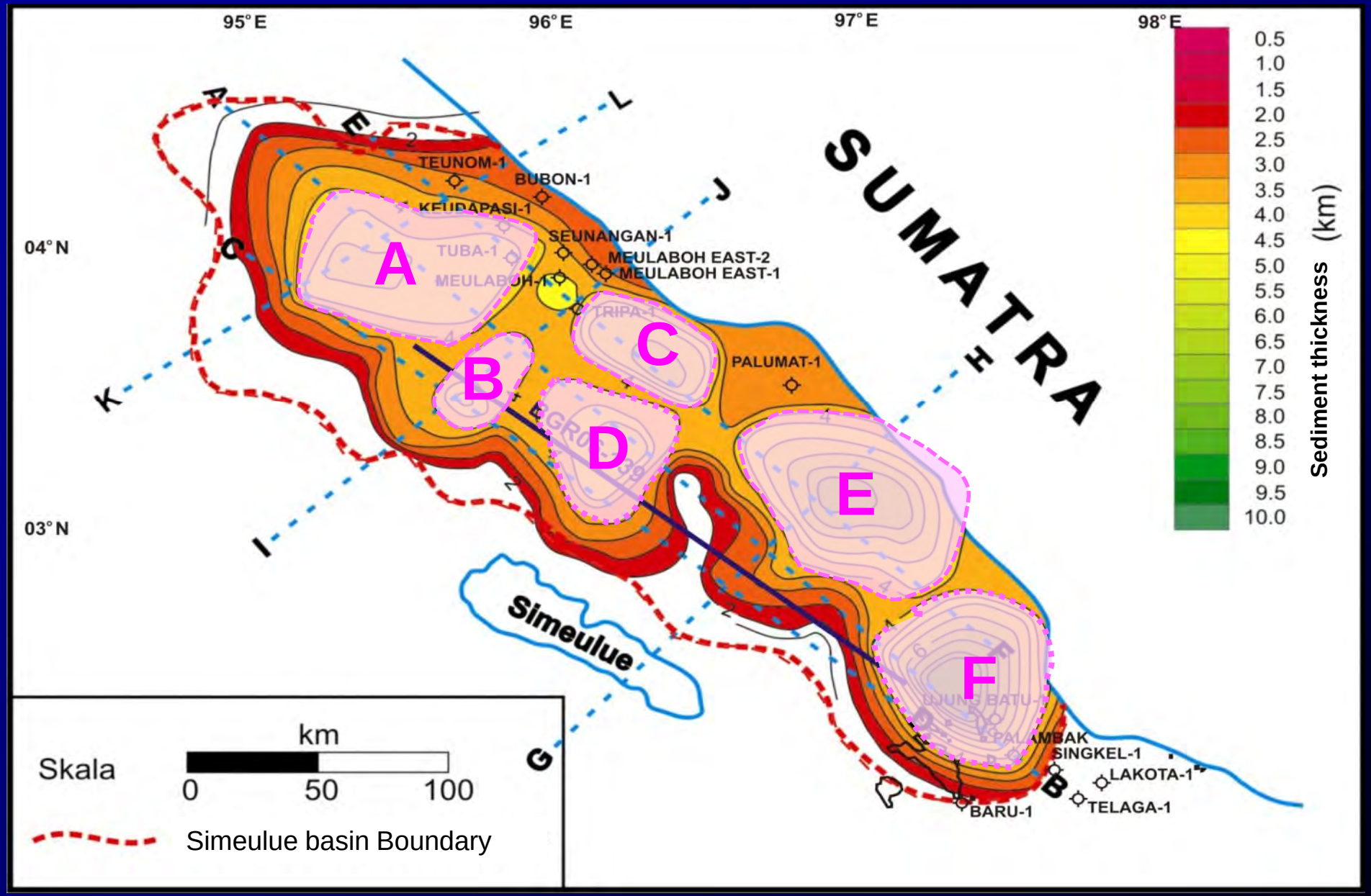


Ro = 0.6 (at depth ~ 5000 m), top of EF_1 Sediment (24 Ma/ Late Oligocene)

Sediment Thickness Map derived from Gravity Model

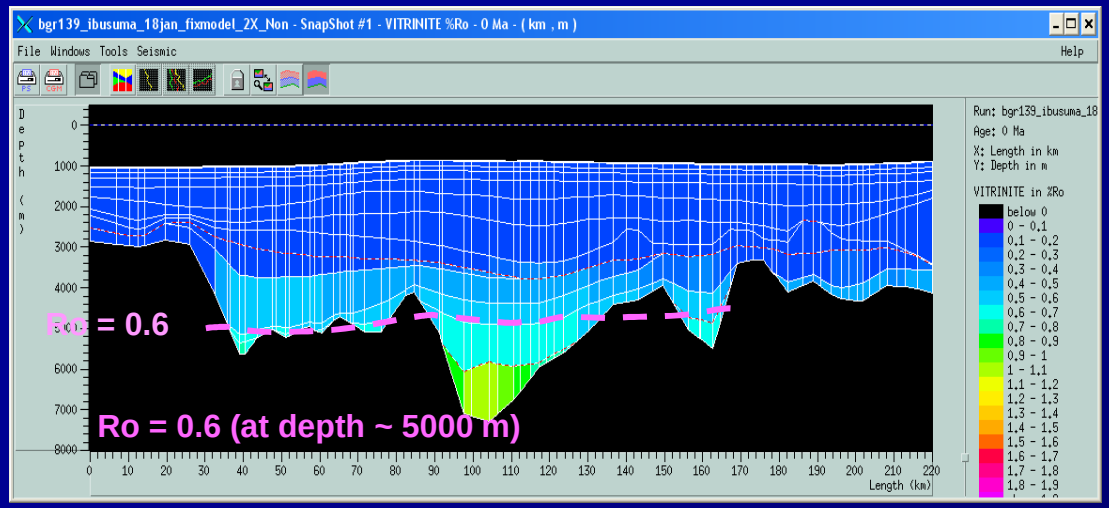


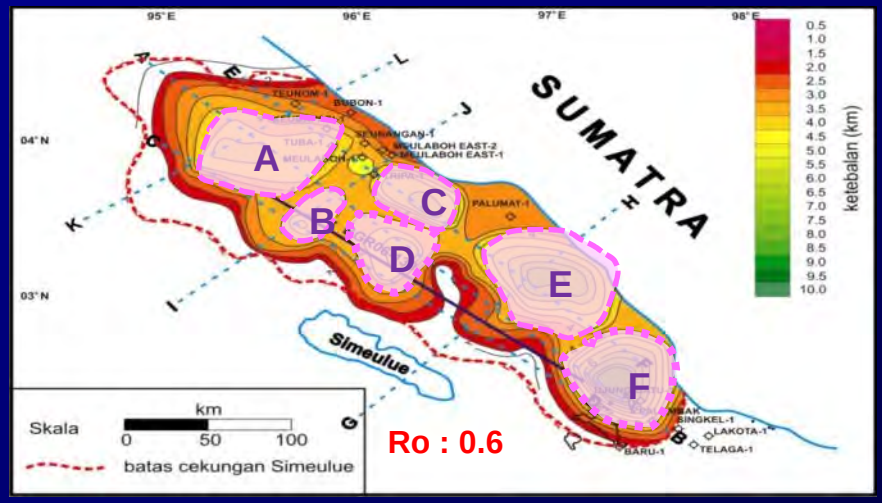
LEMIGAS


95° E
96° E
97° E
98° E
04° N
03° N
SUMATRA
A
B
C
D
E
F
TEUNOM-1
BUBON-1
KEUDAPASI-1
SEUNANGAN-1
MEULABOH EAST-2
MEULABOH EAST-1
TUBA-1
MEULABOH-1
TRIPA-1
PALUMAT-1
EGRU-39
Simeulue
UJUNG BATU-1
MBAK
SINGKEL-1
LAKOTA-1
TELAGA-1
BARU-1
Sediment thickness (km)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
Skala
km
0
50
100
Simeulue basin Boundary

LEMIGAS

SPECULATIVE AMOUNT OF HYDROCARBON GENERATED





Scenario 1

KITCHEN	KITCHEN AREA (Km2)	Max. SEDIMENT THICKNESS (m)	GEOMETRIC FACTOR	BULK SEDIMENT VOLUME (m3)	percent shale (%)	SHALE VOLUME (m3)	SHALE DENSITY (kg/m3)	Shale Weigt (ton)	Initial TOC (%)	Organic Carbon WEIGHT (ton)	Avg. TOTAL GENERATED HC from model (kg/ton)	TOTAL GENERATED HC t.o.e	TOTAL GENERATED HC (BBOE)	HC Type 16.3 % oil; 83.7 % gas Oil BBO	HC Type 16.3 % oil; 83.7 % gas Gas TCF	POSSIBLE TRAPPED HC 20% Oil BBO	POSSIBLE TRAPPED HC 20% Gas TCF
A	3850	1000	0.4	1.54E+12	60	9.24E+11	2600	2.4E+12	1.5	36,036,000,000	0.0749	2,699,096	0.02	0.003	0.013	0.0007	0.0001
B																	
C																	
D																	
E																	
F																	
1 t.o.e (tons of oil equivalent) = 7.4 BOE (bbl of oil equivalent)											Total						

1 m^3 o.e = 6.29 BOE

1 m^3 o.e = 1000 m^3 gas

1 BOE = 158.98 m3 gas = 5612.08 cf gas

(CCOP, 2000, The CCOP Guidelines for Risk Assessment of Petroleum Prospect)

THANK YOU