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The History of Oil Exploration in the Union of Myanmar

Scott E. Thornton*

https://doi.org/10.1190/ice2015-2210594

Pages: 1–1

Preview Abstract

The Union of Myanmar (nee Burma) has had oil exploration since the first hand-dug wells were drilled in the Central Burma basin around 900 BC. In 1755, when Myanmar was part of the British colonial empire of India, early British soldier-diplomats visited ...

PERMISSIONS

South East Asia (excluding PNG)

Multiple Stratigraphic Reservoirs Related With Weathered Granite Buried-Hill in Betara Uplift, South Sumatra Basin, Indonesia

Ximin Lyu*, Li Yang, Weihua Guo, Ronghua Wang, and Qianfeng Han

https://doi.org/10.1190/ice2015-2204584

Pages: 116–116

Preview Abstract

Betara uplift is located at the northern margin of South Sumatra back-arc rift basin in Indonesia, which is a secondary unit of Jambi depression. The area covers more than one thousand square kilometers. The basemant of Betara uplift is made up of granite,...

PERMISSIONS

Opportunities in Frontier North Papua Basin, Indonesia: Constraints From Oil Seep of the Teer River and Its Expected Petroleum System

Junita T. Musu, Himawan Sutanto*, David V. Mamengko, Anggi Yusriani, Andi Mannappiang, and Awang H. Satyana

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PERMISSIONS

Large-Scale Retreat and Advance of Shallow Seas in Southeast Asia Driven by Mantle Flow

Sabin Zahirovic*, Nicolas Flament, Dietmar Muller, Maria Seton, and Michael Gurnis

https://doi.org/10.1190/ice2015-2211482

You have access | International Conference and Exhibition, Melbourne, Australia 13-16 September 2015

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Keywords: sediment, geochemical, seepage

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Copyright: 2015

Pages: 564

PUBLICATION DATA

Publisher:Society of Exploration Geophysicists

History

Published: 16 Sep 2015

CITATION INFORMATION

Junita T. Musu, Himawan Sutanto*, David V. Mamengko, Anggi Yusriani, Andi Mannappiang, and Awang H. Satyana, (2015), "Opportunities in Frontier North Papua Basin, Indonesia: Constraints From Oil Seep of the Teer River and Its Expected Petroleum System," *SEG Global Meeting Abstracts* : 117-117.

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PLAIN-LANGUAGE SUMMARY

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Junita T. Musu*, Himawan Sutanto*, David V. Mamengko, Anggi Yusriani*, Andi Mannappiang *, Awang H. Satyana*****

*Research and Development Center for Oil and Gas Technology "LEMIGAS"
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** State University of Papua
Jl. Gunung Salju, AmbanManokwari 98314 Papua Indonesia
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WismaMulia , Jl. Jendral Gatoto Subroto Kav. 42, 12710 Jakarta Indonesia

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***Keywords** : North Papua Basin, Makats and Memberamo "B" Formations, Teer River oil seep, geochemical analysis and petroleum system evaluation.*

Introduction

North Papua Basin is a fore arc basin located on the north coast of Papua, where the exploration activity is still insignificant. However, the presence of hydrocarbons is characterized by the presence of oil seeps of the River Teer (Mamengko *et al.*, 2014). The occurrence of hydrocarbons (**Figure 1**) is evidence of interest for further investigation of the petroleum system in the fore arc basin which is expected can provide indications for exploration within this area.

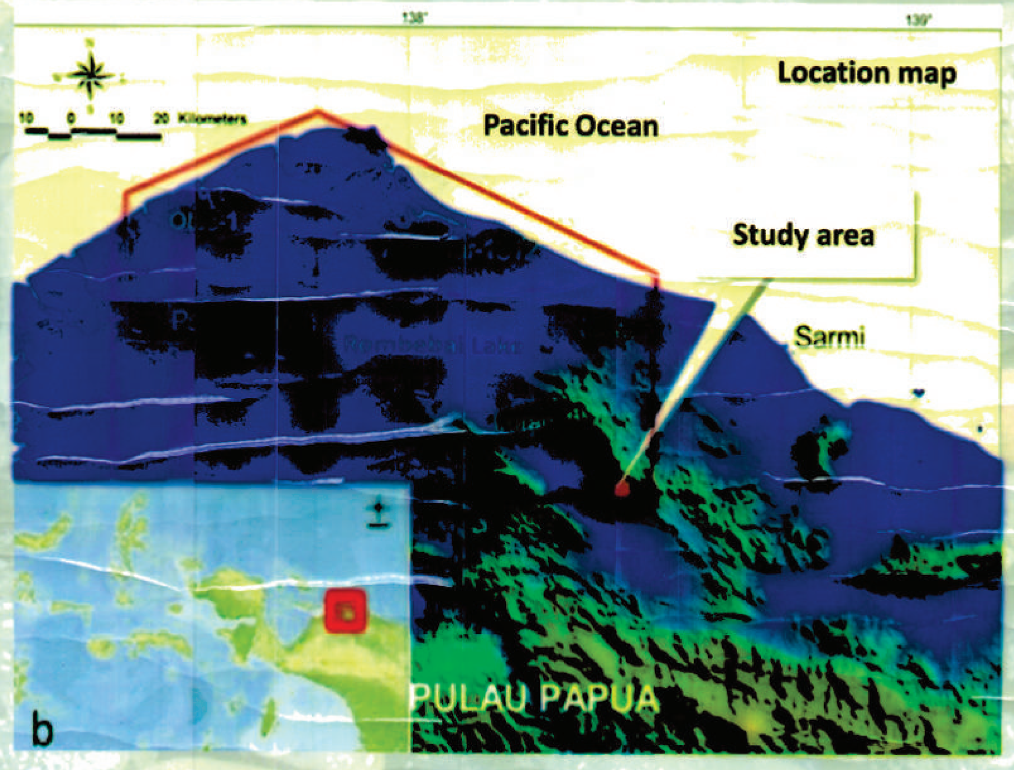
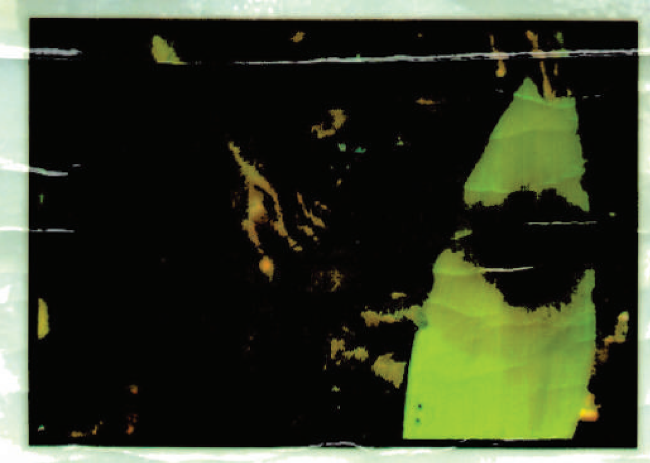
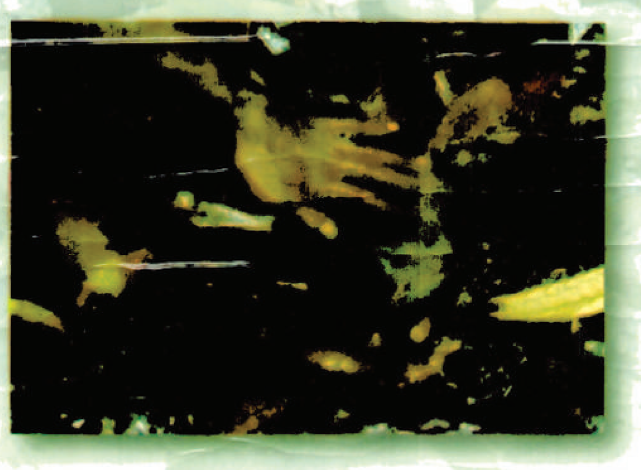


Figure 1. Oil seepage at Teer River





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North Papua Basin is a deep structural depression (**Figure 2**) filled by thick Neogene and Quaternary depositional sequences (**Figure 3**). Tectonically, it is a forearc basin which was resulted from convergent movement of the Australian continental plate and the Pacific Plate or Carolina Micro Plate. Throughout the Pliocene until now, the center of the basin has been passed by a large fault (major left-lateral strike slip fault), known as Yapen Fault Zone (Mamengko *et al.*, 2012).

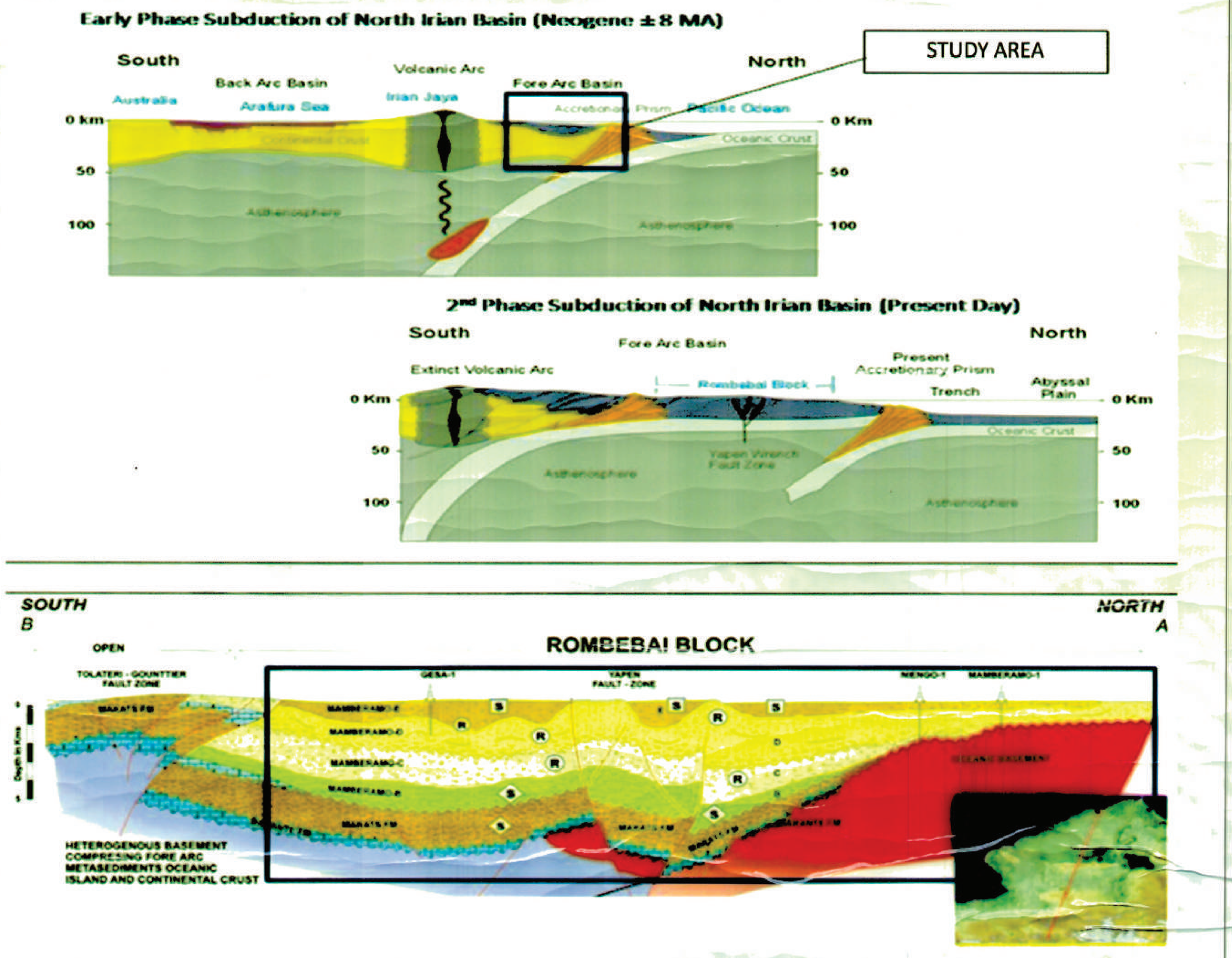

Figure 2. Papua Basin sub-surface configuration.

AGE	FORMATION NAME (PRIOR DUTCH NAME)		LITHOLOGY & FACIES VARIATIONS	TECTONISM & COMMENTS
HOLOCENE TO RECENT	KOEKOENDOERI FORMATION OR ADJA FORMATION			Largely undifferentiated clastics of thed Mamberamo delta delta system. Locally referred to as Koekendoieri and Adja Formations. REGION UPLIFT & FAULTING BANDA ARC FORMED
PLIOCENE - PLEISTOCENE	MAMBERAMO FORMATION (SARMI FM.) WHEN CLASTICS FACIES OR HOLLANDIA FORMATION WHEN DOMENANTLY LIMESTONE FACIES	MAMBERAMO "E" Member 1.300 m Thick	S, R, S	Basin sedimentation consists of widespread turbidites shoaling upwards to deltaic systems. Widespread reeal carbonate deposition in sediment starved marginal areas particularly to the eastern portion of the North Irian Basin.
		MAMBERAMO "D" Member 1.500 m Thick	S, R, S	LOCALIZED UNCONFORMITIES OBSERVED
		MAMBERAMO "C" Member 3.000 m Thick	S, R, S	Widespread reeal carbonate deposition in sediment starved marginal areas particularly to the eastern portion of the North Irian Basin. LOCALIZED UNCONFORMITIES OBSERVED
		MAMBERAMO "B" Member 900 m Thick	S, R	Basin sedimentation consist of widespread turbidites shoaling upwards to deltaic systems. REGIONAL HIATUS
MID TO LATE MIOCENE	MAKATS FORMATION (FOEII Fm.) 1.550 m Thick		S, R, S	MAJOR UNCONFORMITY BASIN WIDE, ONSET OF RAPID SUBSIDENCE. Basin sedimentation consist of widespread turbidites shoaling upwards to deltaic systems. High organic content, good oil source rock.
LATE OLIGOCENE MID MIOCENE	DARANTE FORMATION 850 m Thick		S	Coralline reefal limestone. Locally mixed with minor volcanics. REGIONAL HIATUS
PALEOCENE EARLY OLIGOCENE	AUWEWA FORMATION (BIRI FM.) 3.150 m Thick	Auwewa Volcanics Member / Biri Limestone Member	R, S	COMPRESSIONAL TECTONIC EVENT, FOLDING AND METAMORPHISM. MARK COLUSION OF INDO-AUSSIE PLATE WITH CAROLINE-PACIFIC. Diorite Intrusives, abyssal plain shales, deep water limestones.
PRE-TERTIARY	UNDIFFERENTIATED OCEANIC CRUST CRYSTALLINE BASEMENT COMPLEX			Ophiolites, Basalt Volcanics Diorite Intrusives.

S Source S Seal R Reservoar

Figure 3. Stratigraphy of North Papua Basin consists of several form[illegible] Haebig, 1999; and Lemigas, 2005) .

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Methodology

Geochemistry: This study uses oil samples from the Teer River and are analyzed using gas chromatography (GC), gas chromatography mass spectrometry (GC-MS). The samples were prepared for hydrocarbon GC analysis, and prepared to column DB-1 (J&W) GS with a size of 10 mx 0:21 mm inner diameter by using split-less injection. The MS conditions is ionized mode (electron impact - EI, EM voltage was 1980 volts; electron energy was 70 eV and source temperature of 250 ° C). Oil seeps are tested based on the occurrences of normal alkanes, including isoprenoid, triterpane, sterane, and carbon isotopes. Biomarker data used in this study is limited only on common mass ion, namely triterpane (m/ z 191) and sterane (m / z 217). The later stage is analyzed to determine source rocks, depositional environments of source rocks, and thermal maturity level of oil seeps using methyl phenanthrene aromatic hydrocarbon based distribution (m/ z 178 and 192).

Basin Modeling: Basin modeling was conducted to determine the potential kitchen.

2D modeling uses the software (s/w) Temis 2D version 4.0.2.

__Parameters:__

Surface Temperature	*: 28°C*
Geothermal Gradient	*: 0.04°C/m*
Bottom Temperature	*: 180°C*
Bottom Heatflow	*: 0.065 W/m²*

__Capillary pressure:__

Source rock	*: $\delta\pi$ 10.00 Mpa, π (min) 5.00 Mpa*
Seal	*: $\delta\pi$ 20.00 Mpa, π (min) 8.00 Mpa*
Reservoir rock/ carrier	*: $\delta\pi$ 20.00 Mpa, π (min) 0.04 Mpa*

__Permeability:__

Reservoir rock	*: 5.00E+07 (Kozeny-Carman Law)*
Seal	*: 5.00E+07 (Kozeny-Carman Law)*
Reservoir rock/ carrier	*: 1.50E+07 (Kozeny-Carman Law)*

__Kerogen type__

Source rock of Makats Formation	*: TOC 3.5%, Type III*
Source rock of Silat Formation	*: TOC 4.5%, Type III*

Results and Discussion

Hydrocarbons with a predominance odd carbon number (**Figure 4**) generally indicates terrestrial depositional environment. Moreover, the ratio Pristane/phytane greater than 3 can be interpreted as a hydrocarbon source rocks deposited in oxidizing conditions with the type of coals or silty coals (ten Haven *et al.*, 1988; Peters et al., 2005).

Analysis of GC/ MS is focused on sterane (m/ z 217) and triterpane (m/ z 191). Triterpane and sterane biomarkers can show the organic matters forming hydrocarbons and their depositional environments. Results of the analysis of GC/ MS on samples of hydrocarbon from River Teer (**Figures 5 and 6**) show the abundance bicadinane (m/ z 217) and oleanane (m/ z 191) which indicates the source rock-forming hydrocarbons is Tertiary with terrestrial organic material especially flowering plants or Angiosperm (Van Aarssen *et al.*, 1992; Peters *et al.*, 2005). Triangular diagram C27, C28 and C29 (**Figure 7**) shows that the hydrocarbons derived from source rock containing organic material or estuarine bay.

Hydrocarbon samples also showed maturity (Rc) of the source rock is 0.9 based on the calculation of aromatic methyl phenanthrene m/ z 178 and 192 (**Figure 8**).
Basin modeling (**Figure 9**) shows early oil window occurs at a depth of approximately 3000 meters.

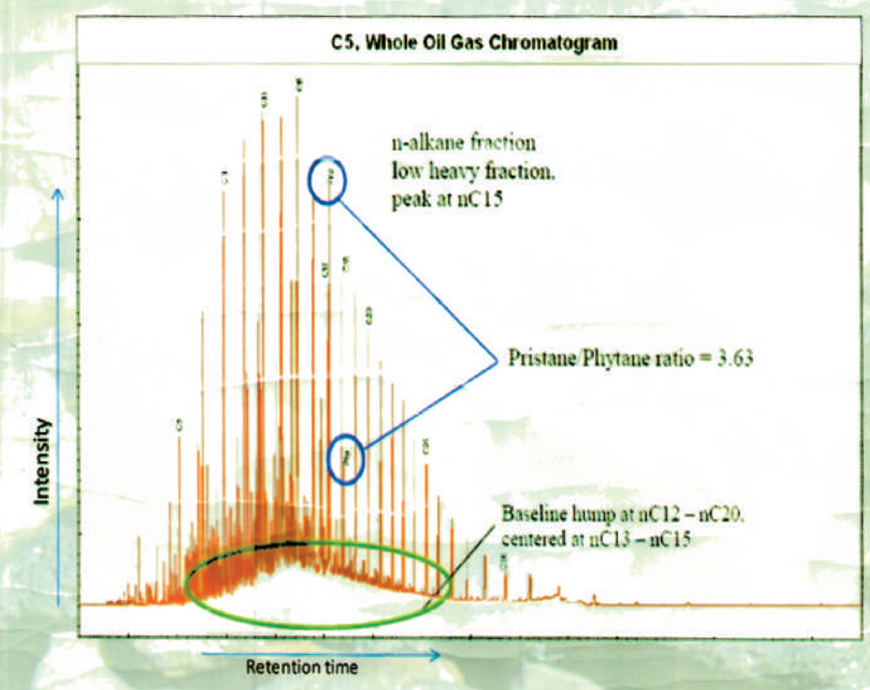


Figure 4. Gas Chromatography of hydrocarbon sample from Teer River shows the ratio of Pr/Ph (Darman and Mamengko, 2007).

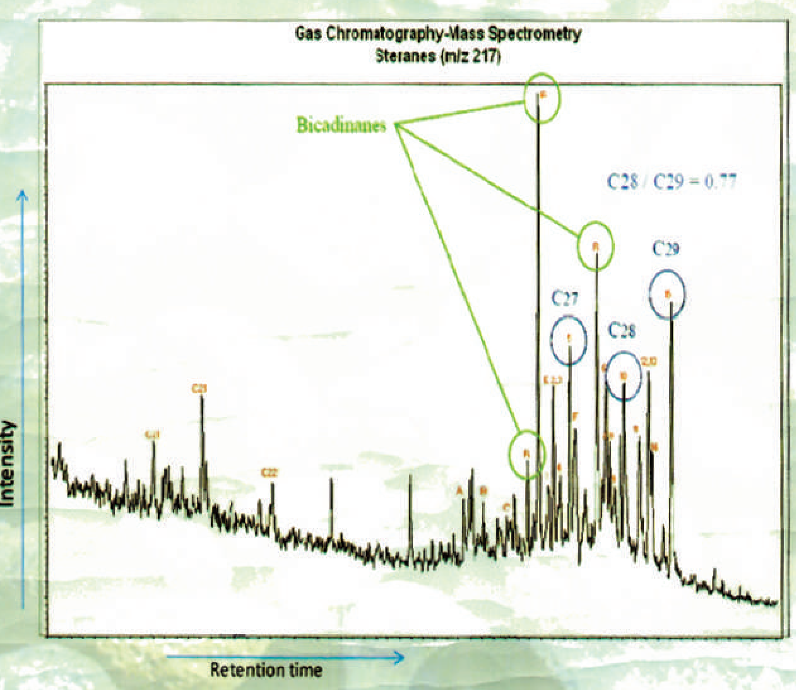


Figure 5. Gas Chromatography Mass Spectrometry (m/z 217) of hydrocarbon sample of Teer River shows the occurence of bicadinane as an indication of higher plant of Tetiary.

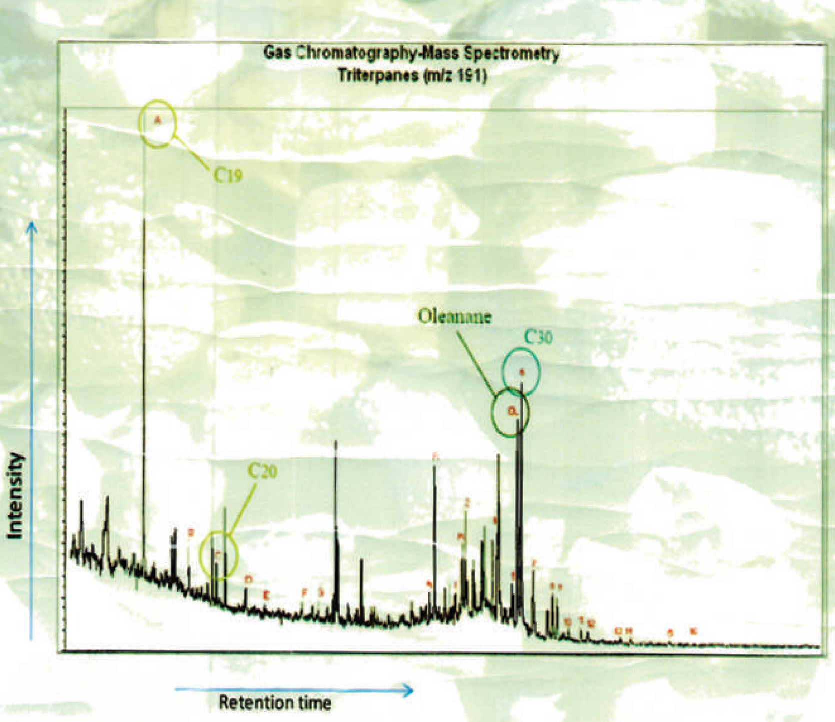


Figure 6. Gas Chromatography Mass Spectrometry (m/z 191) of hydrocarbon sample of Teer River shows the domination of Oleanane peak of higher plant as an indication of terrestrial organic material.

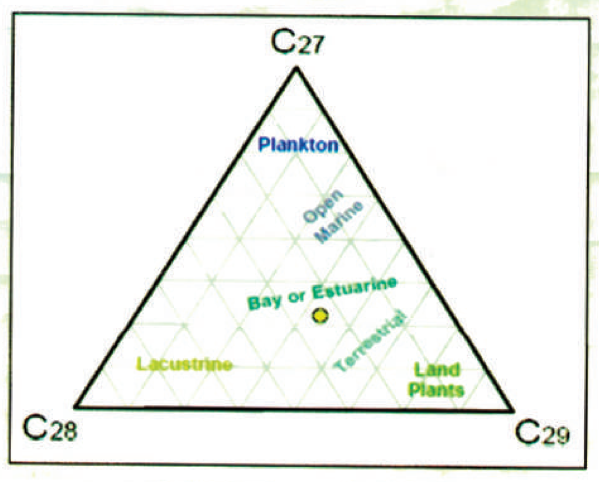
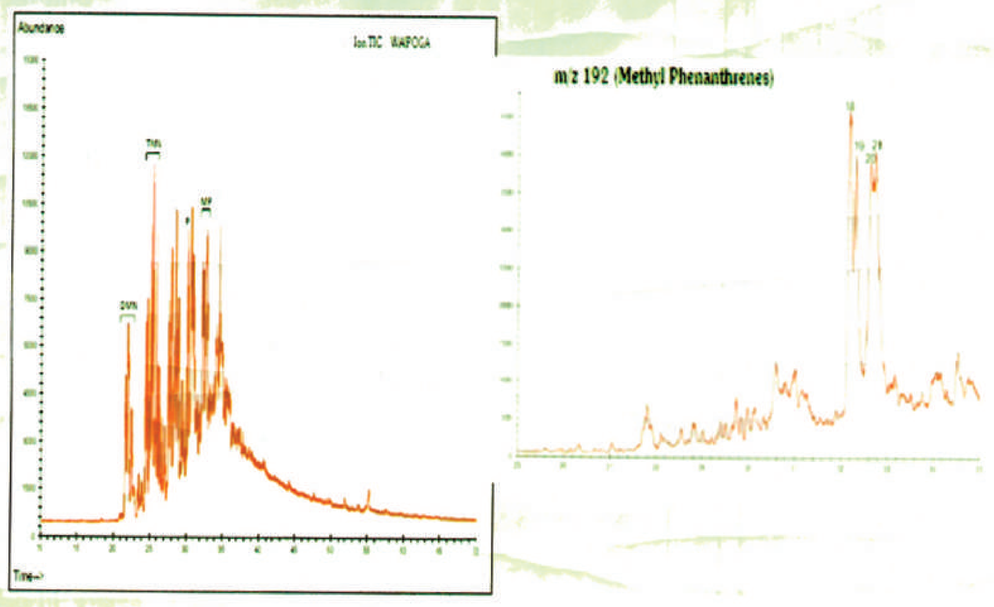


Figure 7. Triangular plot shows source rock of hydrocarbon were from bay or estuarine.



Aromatic Ratio								
Napthalene Ratio			**Phenanthrene Ratio**					
DNR-1	:	2.74	MPI-1 :	0.85	Rc1 :	0.91		
DNR-6	:	2.43	MPI-2 :	0.74	Rc2 :	0.95		
TNR-1	:	1.12	MPR-1 :	2.28	Ro1 :	1.04		
TNR-3	:	0.34	MPR-2 :	1.04	Ro2 :	0.76		
TNR-4	:	037	F1 :	0.54	C_{20}TA (%)/C_{20}TA + C_{20}TA		:	51.05
			F2 :	0.23	C_{28}TA (%)/C_{29}MA + C_{28}TA		:	-

Figure 8. Gas Chromatography Mass Spectrometry of aromatic fraction (m/z 178 dan 192) shows thermal maturity of Teer River.

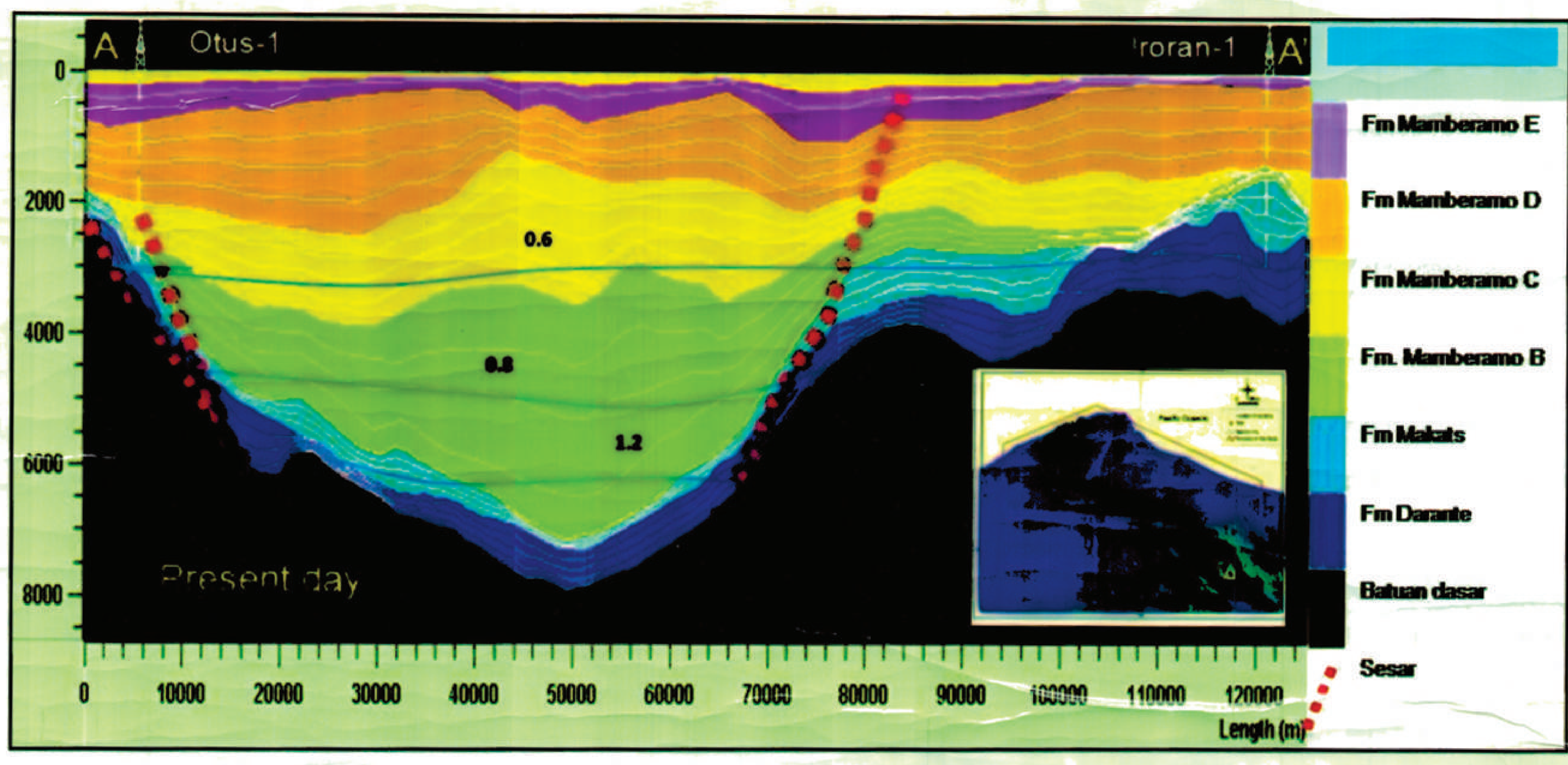


Figure 9. 2D modeling of key seismic lines showing oil and gas window in studied area.

Conclusion

- Results of analysis of oil seeps at Teer River have characteristics of Tertiary source rock with terrestrial to bay/ estuarine environment with organic material derived from higher plants or Angiosperm with oxidizing conditions. Type of source rocks are considered as shales, carbonaceous shales or coals. Based on these results, the source rocks are mostlikely Makats or Memberamo "B" Formations.
- The presence of source rocks generating oils as shown by the oil seep of the Teer River shows the presence of active petroleum system within the study area. Further study is worth to do to examine kitchen distribution and identifying traps.

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Acknowledgement

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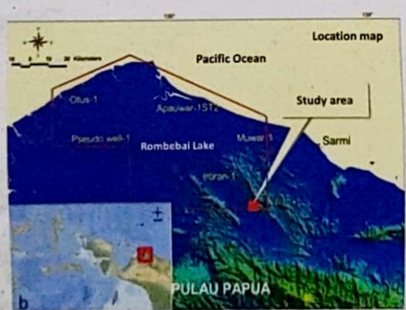

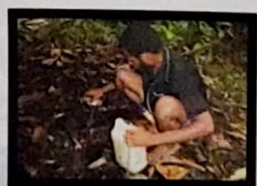

Figure 1. Oil seepage at Teer River

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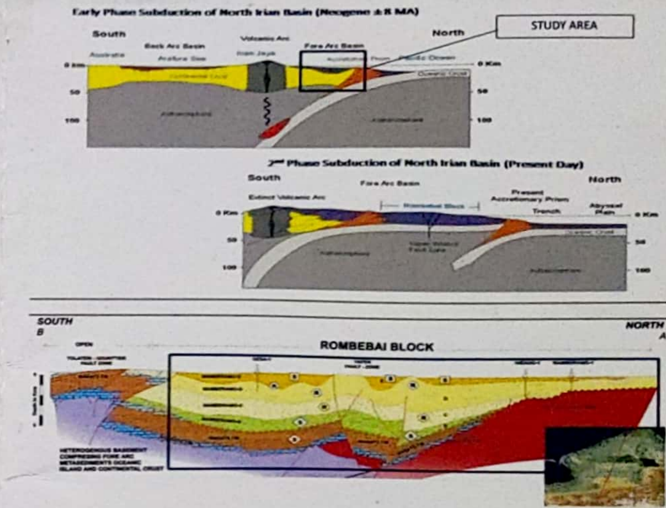

Figure 2. Papua Basin sub-surface configuration.

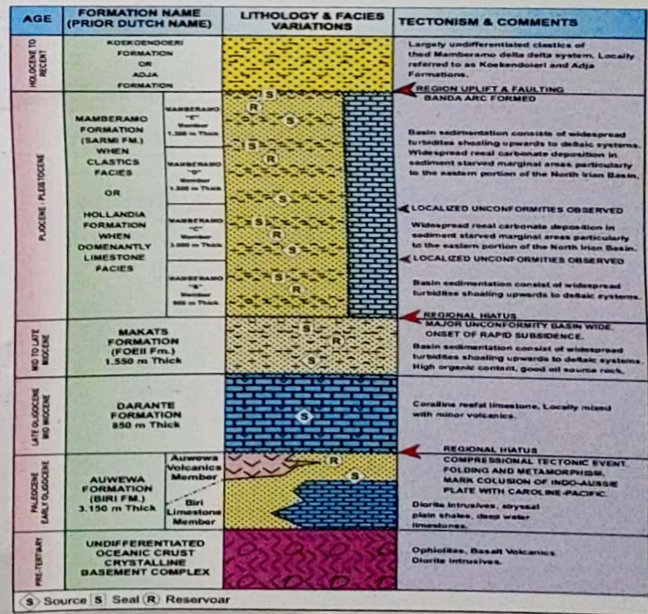

Figure 3. Stratigraphy of North Papua Basin consists of several formations (Kunst, 1986; McAdoo & Haebig, 1999; and Lemigas, 2005).

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Seal	*: δⵋ 20.00 Mpa, ⵋ(min) 8.00 Mpa*
Reservoir rock/ carrier	*: δⵋ 20.00 Mpa, ⵋ(min) 0.04 Mpa*

Permeability:

Reservoir rock	*: 5.00E+07 (Kozeny-Carman Law)*
Seal	*: 5.00E+07 (Kozeny-Carman Law)*
Reservoir rock/ carrier	*: 1.50E+07 (Kozeny-Carman Law)*

Kerogen type

Source rock of Makats Formation	*: TOC 3.5%, Type III*
Source rock of Silat Formation	*: TOC 4.5%, Type III*

Results and Discussion

Hydrocarbons with a predominance odd carbon number (**Figure 4**) generally indicates terrestrial depositional environment. Moreover, the ratio Pristane/phytane greater than 3 can be interpreted as a hydrocarbon source rocks deposited in oxidizing conditions with the type of coals or silty coals (ten Haven *et al.*, 1988; Peters et al., 2005).

Analysis of GC/ MS is focused on sterane (m/ z 217) and triterpane (m/ z 191). Triterpane and sterane biomarkers can show the organic matters forming hydrocarbons and their depositional environments. Results of the analysis of GC/ MS on samples of hydrocarbon from River Teer (**Figures 5 and 6**) show the abundance bicadinane (m/ z 217) and oleanane (m/ z 191) which indicates the source rock-forming hydrocarbons is Tertiary with terrestrial organic material especially flowering plants or Angiosperm (Van Aarssen *et al.*, 1992; Peters *et al.*, 2005). Triangular diagram C27, C28 and C29 (**Figure 7**) shows that the hydrocarbons derived from source rock containing organic material or estuarine bay.

Hydrocarbon samples also showed maturity (Rc) of the source rock is 0.9 based on the calculation of aromatic methyl phenanthrene m/ z 178 and 192 (**Figure 8**).
Basin modeling (**Figure 9**) shows early oil window occurs at a depth of approximately 3000 meters.

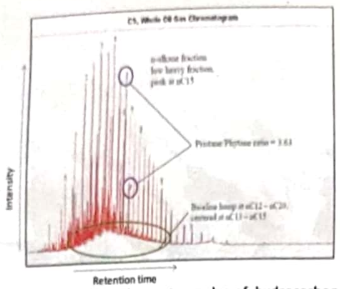


Figure 4. Gas Chromatography of hydrocarbon sample from Teer River shows the ratio of Pr/Ph (Darman and Mamengko, 2007).

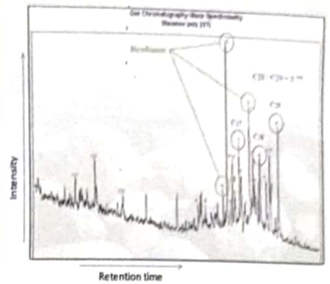


Figure 5. Gas Chromatography Mass Spectrometry (m/z 217) of hydrocarbon sample of Teer River shows the occurence of bicadinane as an indication of higher plant of Tetiary.

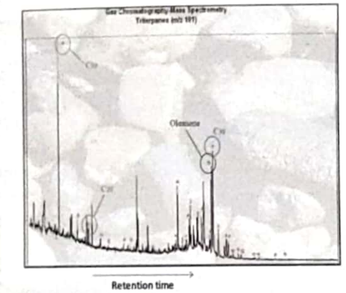


Figure 6. Gas Chromatography Mass Spectrometry (m/z 191) of hydrocarbon sample of Teer River shows the domination of Oleanane peak of higher plant as an indication of terrestrial organic material.

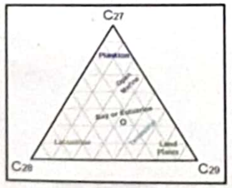
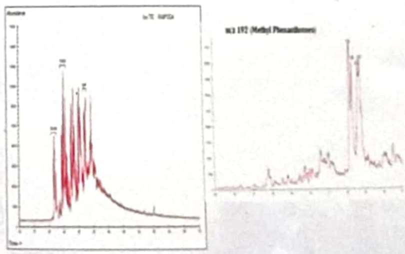


Figure 7. Triangular plot shows source rock of hydrocarbon were from bay or estuarine.



Aromatic Ratio								
Napthalene Ratio			**Phenanthrene Ratio**					
DNR-1	:	2.74	MPI-1	:	0.85	Rc1	:	0.91
DNR-6	:	2.43	MPI-2	:	0.74	Rc2	:	0.95
TNR-1	:	1.12	MPR-1	:	2.28	Ro1	:	1.04
TNR-3	:	0.34	MPR-2	:	1.04	Ro2	:	0.76
TNR-4	:	037	F1	:	0.54	C[illegible]TA (%)/C[illegible]TA + C[illegible]TA	:	51.05
			F2	:	0.23	C[illegible]TA (%)/C[illegible]MA + C[illegible]TA	:	

Figure 8. Gas Chromatography Mass Spectrometry of aromatic fraction (m/z 178 dan 192) shows thermal maturity of Teer River.

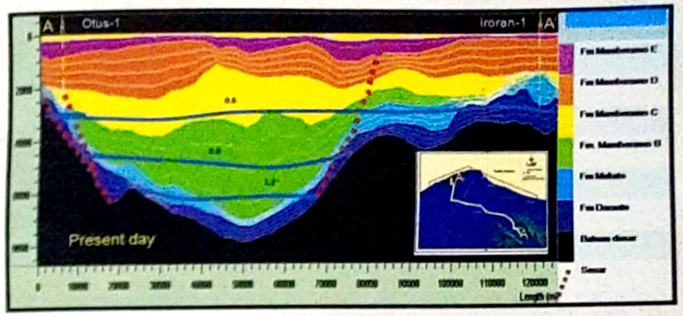


Figure 9. 2D modeling of key seismic lines showing oil and gas window in studied area.

Conclusion

- Results of analysis of oil seeps at Teer River have characteristics of Tertiary source rock with terrestrial to bay/ estuarine environment with organic material derived from higher plants or Angiosperm with oxidizing conditions. Type of source rocks are considered as shales, carbonaceous shales or coals. Based on these results, the source rocks are mostlikely Makats or Memberamo "B" Formations.
- The presence of source rocks generating oils as shown by the oil seep of the Teer River shows the presence of active petroleum system within the study area. Further study is worth to do to examine kitchen distribution and identifying traps.

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Acknowledgement

Our thanks go to PPPTMGB "LEMIGAS" and SKKMIGAS for support and permission to publish this study.

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