

An overview of petroleum potential and investment opportunities in Southeast Asia

Minh Hoang Cu^{1*}, Khac Hoan Phung¹, Hai An Le²

¹PVEP Overseas Co., Ltd

²Hanoi University of Mining and Geology

Received 2 June 2017; accepted 1 September 2017

Abstract:

Southeast Asia has 11 countries: Brunei, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Southeast Asia is considered one of the most active economic development regions in the world, with high demand for energy development, cultural diversity, and language. These countries and Vietnam have good relationships in diplomacy and cooperation and in other fields; therefore, it is very convenient for Vietnam to invest in oil and gas exploration and exploitation in the region. On the basis of evaluating the criteria of natural conditions, geological features, sedimentary basins, exploration and exploitation status as well as investment environment of each country in Southeast Asia, this article will introduce the most comprehensive information about the potential and the overall picture of the oil and gas industry in Southeast Asia and in individual countries, thereby providing information and orientation for investment opportunities of each country in the region.

Keywords: hydrocarbon reserves, investment opportunities, petroleum potential, Southeast Asia.

Classification number: 4.2

Southeast Asia Petroleum Potential Overview

There are 11 countries in the Southeast Asia, including Philippines, Malaysia, Brunei, Indonesia, East Timor, Singapore, Myanmar, Thailand, Laos, Cambodia, and Vietnam. The rapid economic growth is being recorded in some countries such as Indonesia, Malaysia, Thailand, Singapore, and Vietnam.

The proven oil reserves of Southeast Asia are around 16 billion barrels, approximately 1% of the world reserves and 39% of the Asia-Pacific reserves (Fig. 1) [1]. In which, Malaysia has the largest amount of the proven reserves of around 5.9 billion barrels, approximately 36% reserves of the region. The follow-up proven reserves belong to Vietnam, Indonesia, and Brunei, respectively, in which Indonesia owns ~ 4 billion barrels, and Brunei owns ~ 1.1 billion barrels, (Fig. 2).

The proven gas reserves of Southeast Asia are around 6.8 Tcm (trillion cubic meter), approximately 3% of the world reserves and 40% of the Asia-Pacific reserves (USGS, 2012 - Fig. 3). In which, Indonesia has the greatest amount of the proven reserves of around 3 Tcm. Malaysia takes the second

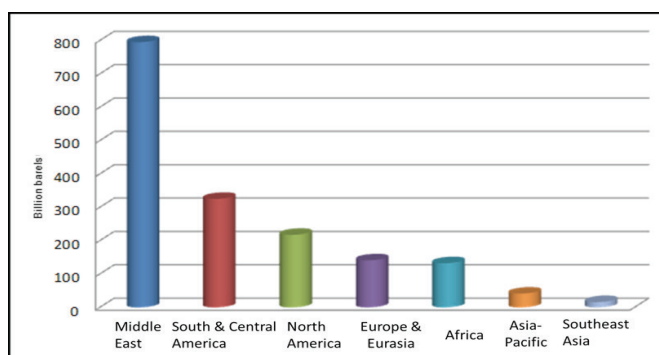


Fig. 1. Worldwide oil reserves distribution (USGS, 2012).

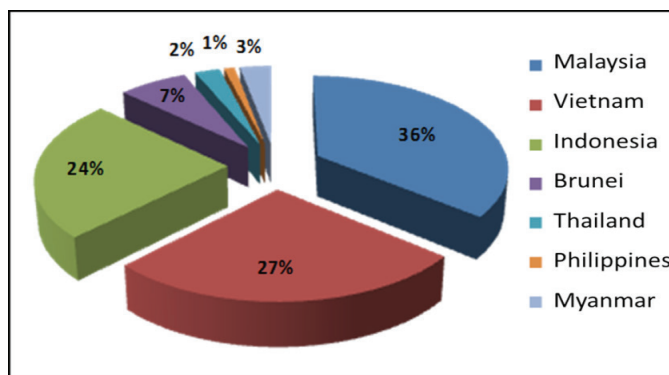


Fig. 2. Oil reserves distribution of Southeast Asia (USGS, 2012).

*Corresponding author: hoangcm@pvep.com.vn

position with 2.4 Tcm and is followed by Vietnam. The gas reserves of remaining countries in the region are very small or limited (Laos, Cambodia...) (Fig. 4).

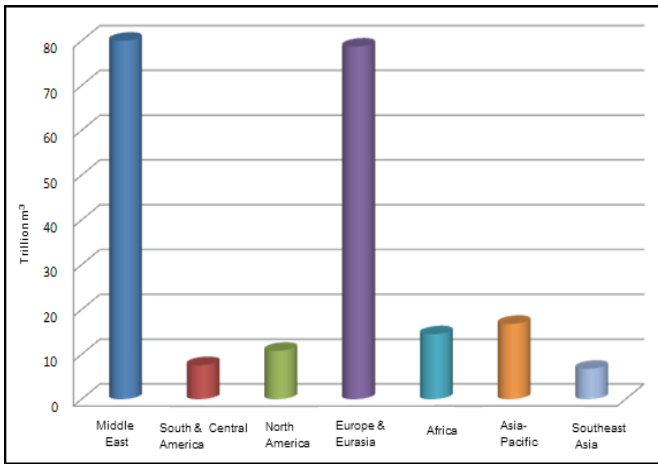


Fig. 3. Worldwide gas reserves distribution (USGS, 2012).

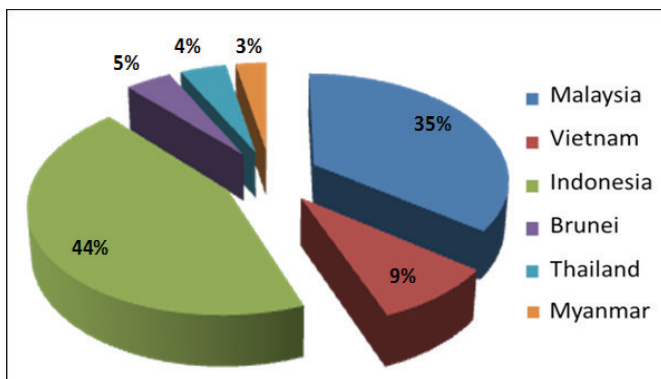


Fig. 4. Gas reserves distribution of Southeast Asia (USGS, 2012).

Referring to the analysis of USGS in the year 2012, the remaining potential of oil and gas in Southeast Asia is around 22 billion barrels (~3.6% of worldwide total reserves - 595 billion barrels) and 8.5 Tcm (~5.3% of worldwide total reserves - 159 Tcm), respectively. Generally, the remaining potential of the region is distributed mainly in Indonesia (41% of oil and 36% of gas potential), Malaysia (25% of oil and 27% of gas potential), and Vietnam (12% of oil and 16% of gas potential). The attractive basins for exploring the remaining oil potential in the Southeast Asia are Baram Delta Basin (Brunei) - Sabah Basin (Malaysia), Kutei and East Java Basins (Indonesia), Cuu Long Basin (Vietnam), offshore basins of Myanmar, and the Gulf of Thailand. The attractive basins for exploring the remaining gas potential are Kutei and East Java Basins (Indonesia); Baram Delta Basin (Brunei), Sarawak and Sabah Basins (Malaysia), and Nam Con Son Basin (Vietnam).

Southeast Asia geological characteristic overview

Southeast Asia recently is a part of the south-eastern Eurasia plate. To the east, it is bounded by the Pacific Plate and Philippines Microplate. To the west, southwest and the south, it is bounded by Indian-Australia Plate. These boundaries are defined by Arakan - Nicoba - Java - Timo subduction zone (1), Sorong strike-slip zone (2) and East Philippines subduction zone (3), (Fig. 5).

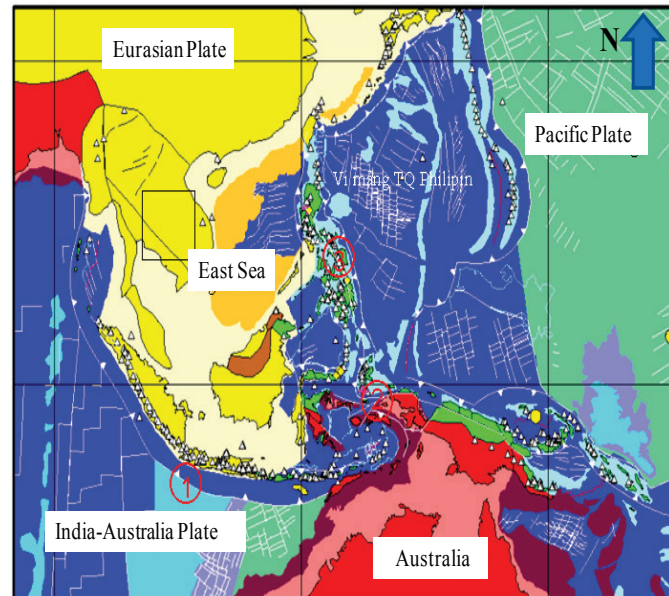


Fig. 5. Southeast Asia tectonic map (Hall, 2004 [2]).

The subduction of India-Australia Plate beneath Eurasia Plate formed the Sunda active margin with five main elements including Java Trench, Nias Accretionary Complex, Northeast Nias fore-arc basin, Sumatra-Java volcanic arc, and Ace back-arc basin. The subduction of the Pacific Plate and the Philippines Microplate beneath the Western Eurasian plate resulted in forming Philippines active continental margin elongating from Taiwan - Philippines to East Hal Mahera.

The crust of Southeast Asia has generally been formed since Cambrian. Only some areas, such as the center of East Sea, Sulu Sea, Sulawesi Sea, Banda Sea, and Andaman Sea, have typical oceanic crust formed by sea spreading during the Cenozoic. Recently, in the Southeast Asia, there are five main geotectonic blocks, namely South China (I), Indonesia (II), Sibumasu (III), West Myanmar (IV), India (V), and Borneo (VI). The suture zones between these geotectonic blocks are: Ma River (1), Utaradi-Bentong-Rup (2), Sittang-Bham (3), East Aracan (4), Kuching-Lupa (5), Sumatra-Java subduction zone (6), Mae Ping-Hau River Fault (7), Three-Pagoda Fault (8) (Fig. 6).



Fig. 6. Main geotectonic blocks of Southeast Asia: I) South China; II) Indosinia; III) Sibumasu; IV) East Myanmar; V) India; VI) Borneo; Suture zones: 1) Ma River 2) Utaradi; 3) Sittang-B.Ham; 4) East Aracan; 5) Kuching-Lupar; 6) Sumatra-Java subduction zone; 7) Mae Ping-Hau River; 8) Three-Pagoda Fault (PVEP Mekong, 2008 [3]).

Petroleum investment opportunities in the Southeast Asia

In the Southeast Asia, hydrocarbon has been discovered and produced mainly in Cenozoic basins which distributed in margin shelves. A minority of hydrocarbon production is from Paleozoic-Mesozoic basins. Vietnam, Malaysia, and Indonesia are known as the top countries in the region for their petroleum potentials. The Potential of Myanmar is smaller, but its opening may give a chance of investment. Thailand and Brunei are recorded as small potential countries while Laos, Cambodia, East Timor, and Singapore are very limited or not proven of the potential.

In fact, countries with high potentials have high success ratio. However, exploration investment in these countries is very difficult, because of their long histories of exploration and production resulting in fewer areas available for exploration. Remaining open blocks in these countries are located in very deep water causing very high exploration cost. Thus, to invest in these countries, companies need to have suitable technologies and be ready to take risks.

PVEP/PVEP Overseas has experiences in investing in the Southeast Asia with contracts signed in Indonesia, Malaysia, Myanmar, Laos, Cambodia and East Sea. Based on our evaluation, there is very little opportunity for investment in

Laos, Cambodia, Philippines, East Timor, and Singapore because of their limited petroleum potentials. Brunei and Thailand that have small potentials, a limited number of open blocks, high risk of geology and geography (deep water sea)... should not be considered for investment. Although Malaysia has the biggest potential in the region, the opportunity is not much because the open blocks are located in areas either very risky in terms of geology or with very deep water. In this country, all attractive blocks/areas belong to Petronas (Malaysia national petroleum company) and giant worldwide oil companies. Thus, it is very difficult for new investors to find success in remaining unattractive blocks.

Generally, referring to the conditions of potential and investment environment, only Myanmar and Indonesia in the Southeast Asia should be considered for studying and seeking for new ventures. In these countries, especially Indonesia, the potential in remaining open blocks is still expected. These countries have quite flexible environments for investment, high security and available infrastructure. Vietnam has close relationships with these countries for a long time. Petrovietnam has some experiences in making contracts with Indonesia and Myanmar. Investing in these countries could be conducted by joint studying, signing new petroleum contracts or farming in existing contracts...

Myanmar

Myanmar is a country with an area of 678,500 square kilometers and a long history of oil and gas industry and rather good petroleum infrastructure. The potential of Myanmar is at average level in the region, with gas reserves of about 50,200 billion cubic feet (mainly distributed in three offshore areas of Myanmar with a total reserve of 46,900 BCF) and oil reserves of 4,814 million barrels (located in onshore basins, of which 75% are located in the central basin). At present, Myanmar’s total oil and gas productions are about 22,000 barrels per day and 1,300 million cubic feet per day, respectively.

By the present time, Myanmar area has divided into 105 contract blocks, of which 53 blocks are onshore, and 52 blocks are offshore. The number of onshore blocks which were discovered for oil and gas is 49 while discovered offshore blocks are 26 (in the Rakhine, Tanintharyi and Mottamma basins).

Myanmar has totally 17 sedimentary basins (Fig. 7), including 14 Tertiary basins (11 onshore, 3 in shallow marine) and 3 Pre-Tertiary basins. Out of 14 Tertiary basins, there are 6 inland basins producing oil, gas, and condensate (Chindwin, Center, Prome (Pyay) Embayment, Rakhine Coastal, Ayeyarwaddy, and Bago Yoma); 3 basins on the continental shelf are producing gas and condensate (Moattama, Rakhine Offshore, and Tanintharyi); and 5 basins are still in exploration with no discovery yet (Hukawng, Shwebo-Monywa, Sittaung Valley, Mepale, and Mawlamyine). Currently, neither oil or gas has been discovered in Pre-Tertiary basins, which are small,

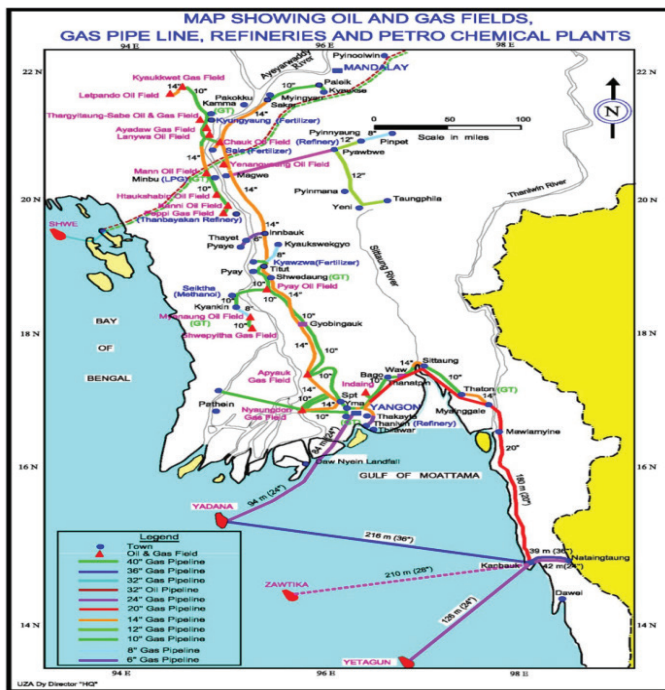


Fig. 7. Myanmar oil and gas infrastructure (MOGE, 2011 [4]).

low exploration level, and being offered (Namyau, Hsipaw-Lashio, Kalaw).

The regional assessment shows that the Center-Prome, Rakhine Offshore and Moattama sedimentary basins have been discovered and exploited for oil and gas. Significant oil reserves have been found, open blocks are available, and the ability to buy assets and tendering in open blocks is high (Table 1). Therefore, the Central-Prome, Rakhine Offshore, and Moattama basins are priorities when selecting a basin for

Table 1. The potential blocks for investments (MOGE, 2015).

Basin	Area (km ²)	Number of Blocks	Block with Operato	Open Blocks	Oil and Gas Fileds		Oil and Gas Reserves				Cumulative Production		Selected Basins
					Discovered	Producing	Oil (MMbb)		Gas (TCF)		Oil (MMbb)	Gas (BCF)	
							P1	P2+3	P1	P2+3			
Onland		53	18				3405.6	2.95	504.1	757.6			
Center	34320	17	8	9		8	1793.33	2243.81	0.678	0.279	516.55	318.63	v
Prome	16027	15	5	10	18	4	144.46	627.15	0.416	1.38	36.03	289.55	v
Irrawaddy	33996	5	2	3	8	1							
Chindwin	35198	3	1	2	3	0							
Bago & Sittaung	55200	4	1	3	1	0							
Hukawnd	24237	1	1	1		1							
Rakhine Coastal	25175	2	1	1		0							
Shwebo - Monywa	27333	1	1		1								
Mepale	1259	1		1									
Namyaw	5110	1		1									
Hsipaw Lashio	2126	1		1									
Kalaw	3320	1		1									
Mawlamvine	11494	1		1									
Offshore Coast		53						19.52	37.68				
Rakhine Offshore	29546	28		22		3		3.37	10.64				v
Moatama	46070	13		3	3	5		11.8	25.8				v
Tanintharyi	171297	14			7	1		4.35	1.24				
					2								

investing in oil and gas industry in Myanmar.

Currently, the negotiation of new contracts in Myanmar is relatively favourable because there are still open areas/blocks. Operators in Myanmar are also willing to call on investors to participate in exploratory risk sharing. Therefore, investment opportunities in Myanmar are quite feasible.

Indonesia

Indonesia is a country with an area of 1,919,440 km² and over 60 sedimentary basins, in which 30 basins had oil and gas exploration activities, and 14 basins have been under production activities, while other 22 basins still have little or no petroleum production activities. Proven reserves are 4.2 billion barrels of oil and 108 trillion cubic feet of gas. Indonesia also has a long history of oil and gas exploration for over 130 years. Commercial discoveries take place in 10 basins (Fig. 8), (Pertamina 2003 [5], PVEP Overseas, 2013 [6]).

Due to the differences in geological conditions, the sedimentary basins in Indonesia can be divided into two groups: the western group and the eastern group. The western Indonesian basins are assessed with denser and earlier exploration history than the eastern basins. Most of the western basins have been explored, whereas 20 of 38 basins in the eastern Indonesia have not been explored. That limited exploration activity in the eastern Indonesia reflects difficulties in terms of infrastructure and logistics, wild areas, and deep-water (> 200 m).

Western Indonesia basins:

The group of basins with large oil and gas potential in the western part of Indonesia is mainly distributed in continental or shallow water areas. The basins generally exhibit similar

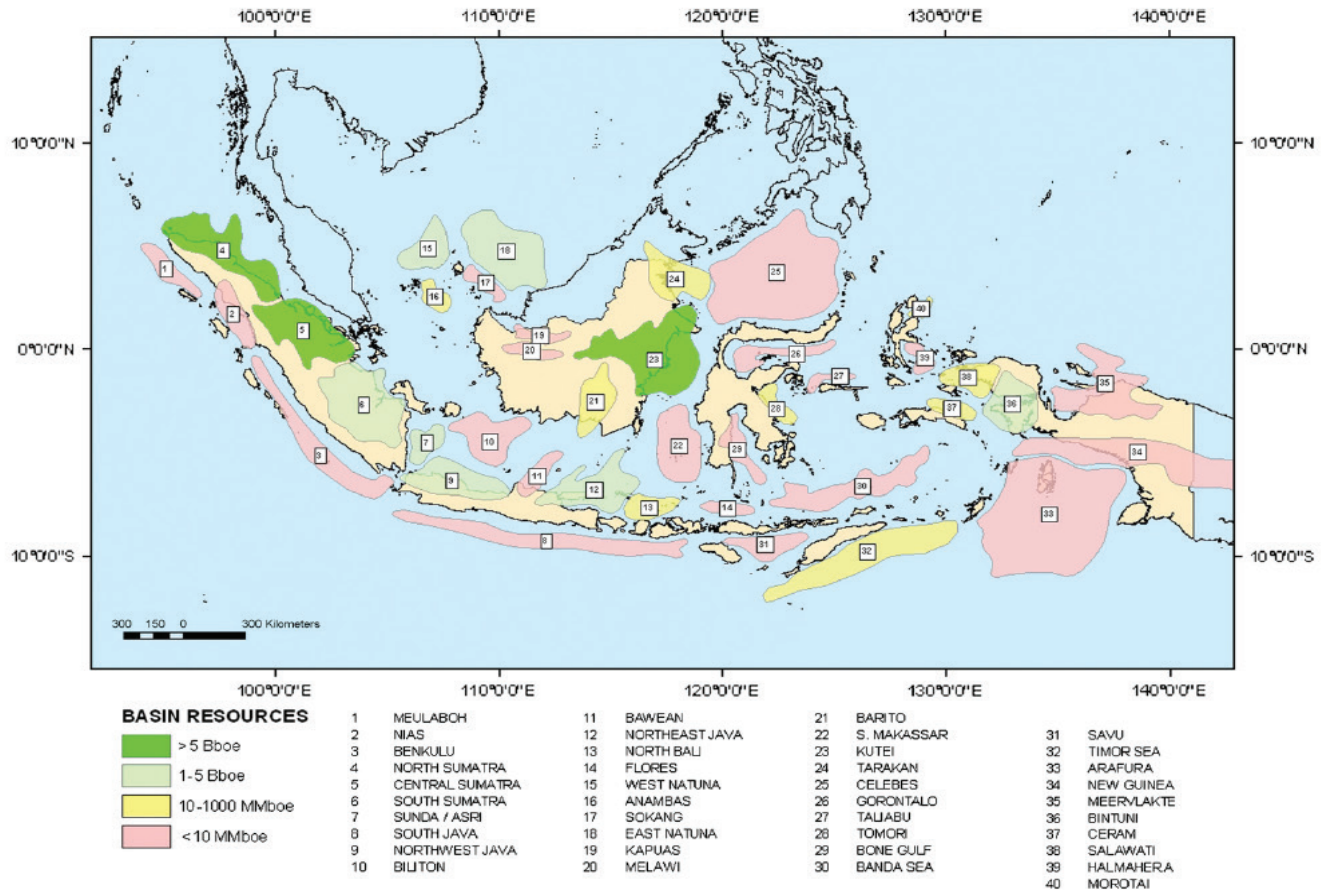


Fig. 8. Indonesian sedimentary basins & potential (Doust & Noble, 2008 [7]).

structural and stratigraphic similarities, reflecting the similar control regime of tectonic throughout the history of Cenozoic development. The basins with similar geological setting lie in the southeast of the Sunda Shelf, undergoing general tectonic effects related to the movement of the Indo-Australasian, Eurasian Plates and the global change of sea level, which influence the filling of sedimentary basins.

Some of the similarities of the western Indonesia basins: (1) the initial rifting phase occurs in mid-late Eocene. This phase is filled by river-lake sediments, which can form an important oil and gas source rock; (2) The sea progradation proceeds from Middle Oligocene to Middle Miocene, which is characterized by changes in sediment- deposit-environment, from river, delta to shallow waters and shallow seas, forming terrigenous reservoirs of river and delta facies and carbonate reservoirs. The regional seal related to the maximum sea level in the Middle Miocene is formed; (3) The late of Miocene-Pliocene compression related to the collision between Australian Continental Plate with Euro-Asia Plate.

The fore-arc basins are generally considered to have lower prospect due to limited source rocks, poor reservoir quality and low heat. Most of the recoverable reserves (85% of Indonesia's

reserves) are mostly back-arc basins, which have large potential reserves, such as North Sumatra Basins, Sumatra Centers, South Sumatra, Sunda-Asri, West Java, East Java, Kutei, East and West Natuna (Table 2).

Table 2. Proven reserves in major Indonesian sedimentary basins (USSG, 2012).

No	Sedimentary Basin	Oil Reserves(MMbbbl)	Gas Reserves(TCF)
1	North Sumatra	3,111.89	21.28
2	Central Sumatra	3,790.48	8.56
3	South Sumatra	909.80	17.90
4	West Java	556.52	3.7
5	East Java	1,022.35	6.4
6	Natuna	383.35	51.46
7	East Kalimantan (Kutai)	670	18.33
8	Sulawesi	49.78	4.23
9	Matuku	48.07	15.22
10	Papua	94.93	24.32

Eastern Basins in Indonesia:

The eastern Indonesian sedimentary basins are geologically distinguishable from the western basins, they locate in a very complex area geologically affected by collision of continental plates, arcs, and remnant oceans. Sedimentary basins in eastern part are small, mostly undeveloped, and located in deep water, remote areas, or forested areas with limited infrastructure.

Although the petroleum potential of the eastern Indonesian basins is estimated less than that of the western Indonesian basins, the eastern basins are currently attracting the interest of oil and gas companies; as exploration activities are limited in the area, some of the new commercial discoveries in the Mesozoic reservoirs, even very large discovered field (Tanggung gas field ~ 20 Tcf, Paleogene and Jura objects, Bintuni basin).

It is clear that oil and gas exploration activities, as well as important commercial discoveries, are concentrated in some areas such as Sumatra, Java, East Kalimantan, Sulawesi, Natuna, and Papua (the contiguous part of Papua New Ghine). Most of the best hydrocarbon systems can be found mainly in the western region, including Sumatra, Java, Natuna, and East Kalimantan (Kutei) basins. There are some gas discoveries in the eastern region of Tanggu, West of Irian Jaya. In the eastern part, only Salawati Basin on Irian Jaya's Bird's Head is considered to have an active hydrocarbon system. With the development of geological understanding and technological advances, exploration costs in remote and deep-water areas are reduced; recent exploration has been shifted from west region to east region. Indonesia has a long and relatively well-developed oil and gas infrastructure, which is very favourable for oil and gas exploration and exploitation.

In Indonesia, investors can purchase assets or sign contracts as the country annually maintains international tenders for new blocks or relinquished areas. With the remaining relatively large potential - especially deep-water prospects, many operators are also willing to share interests in the exploration and production blocks; therefore, investment possibilities in Indonesia are quite attractive.

Conclusions

Southeast Asia is an active economic development zone with high demand for energy development and has favourable conditions for investment in oil and gas exploration and production.

Oil and gas are explored and produced in Southeast Asia in both Paleo-Mesozoic and Cenozoic sedimentary basins, with various types of sedimentary basins and complex geological features. The great oil and gas potential is concentrated mainly in the Cenozoic basins, with many large fields discovered and distributed on the margin of the continental shelf of Southeast Asia.

Some countries including Vietnam, Indonesia, Malaysia, Brunei, Myanmar, and Thailand have great petroleum potentials and well-developed infrastructures. However, Thailand, Malaysia, and Brunei have no open blocks or limited access. Meanwhile, Laos, Cambodia, Philippines, East Timor, and Singapore have very limited or no oil or gas potential. Therefore, investment in these countries should not be considered.

Looking for investment opportunity is currently most feasible in Indonesia and Myanmar, ranging from new exploration contracts to asset purchase. In Myanmar, Central, Prome, Rakhine Offshore, and Moattama basins should be priorities for investment. Whereas, in Indonesia, the most preferred basin groups are the western Indonesian basins such as Sumatra, Java, East Kalimantan (Kutai), Sulawesi and Natuna. For Eastern Indonesian basin group, the basin in the Papua Islands region and most notably the Bintuni basin may attract interest.

REFERENCES

- [1] USGS (2012), *Hydrocarbon Reserves of Southeast Asia*.
- [2] Hall (2004), *Tectonic Evolution of Southeast Asia*.
- [3] PVEP Mekong (2008), *Characteristics of Indochina Structural Geology*.
- [4] MOGE (2011), *Annual Magazine of July 2011*.
- [5] Pertamina (2003), *Petroleum Geology of Indonesia*.
- [6] PVEP Overseas (2013), *Petroleum Potential Review of Southeast Asia*.
- [7] Doust and Noble (2008), *Petroleum System of Indonesia*.