COAL CHARACTERISTICS OF SAROLANGUN - PAUH REGION: Implication for Coalbed Methane potential

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ABSTRACT

The world energy crisis has effected the Indonesian energy supply, inspite of Indonesia is rich in another potential geo-resources, such as Coalbed Methane (CBM), which can be used for solving this crisis. The geology and coal characteristics of the Muaraenim Formation in Sarolangun - Pauh region, suggest that the Coalbed methane resource in this area is prospective. Detailed organic geochemical and petrographical study, using fresh surface and subcrop samples of coal was conducted. Petrographically, the coal mainly consists of vitrinite group, and is essentially composed telovitrinite, telocolinite, and detrovitrinite, with rare to sparse inertinite, and minor exinite and mineral matter. A geochemical result indicates the range of volatile matter content is from 13.39% to 33.50%, total sulphur from 0.11 to 2.38%, ash between 0.68% and 52.4%, and moisture 18.01 up to 40.18% , with vitrinite reflectance values ranges from 0.35% to 0.47% . Furthermore the feature of micro-cleats or micro-cracks from SEM analysis are dominated by strike lines although some curved and sub-curved lines are also present. Open microcleats are predominant compared to close microcleats. Based on Barbara and Winter diagram, coalbed methane content derived from the Sarolangun- Pauh coal seam is expected to be low - moderate level, with methane content is present from 2.89 m^3/t to 6.02 m^3/t. SBC coalfield area shows that gas content is around 338.001, 354.6234 scf, Lubuk Napal is 743.232.370, 6576 scf, whilst the Sungai Dingin about 419.343, 508.7245 scf.

Keywords : coal characteristics, Sarolangun-Pauh Region, coalbed methane (CBM).

SARI

Krisis energi dunia ikut mempengaruhi suplai energi di Indonesia, sebenarnya Indonesia kaya akan potensi sumberdaya geologi, salah satunya adalah Coalbed Methane *(CBM) yang dapat membantu menyelesaikan krisis energi ini. Geologi dan karakteristik batubara dari Formasi Muaraenim di Sarolangun - Pauh, merupakan daerah prospek penghasil cadangan* Coalbed Methane*. Analisis Geokimia dan petrografi organik telah dilakukan pada beberapa percontoh batuan permukaan yang diambil dari beberapa singkapan batubara. Secara petrografi batubara disusun oleh maseral vitrinit, berupa telovitrinit, telokolinit, dan detrovitrinit, dan maseral inertinit dalam jumlah jarang, serta sedikit maseral eksinit dan* mineral matter*. Analisis geokimia memperlihatkan kandungan zat terbang berkisar dari 13.39% - 33.50%, kandungan belerang 0,11 - 2,38%, kadar abu 0,68% - 52,4%, dan moisture 18,01 sampai 40,18%, dengan angka vitrinit reflektan berkisar dari 0.35% - 0.47%. Kenampakan* micro-cleat *atau* micro-crack *dari hasil analisis SEM berupa garis lurus, ada beberapa yang berbentuk kurva - semi kurva. Bukaan* micro-cleat *yang tampak umumnya tertutup. Berdasarkan diagram Barbara dan Winter, kandungan gas methane pada seam batubara Sarolangun- Pauh diperkirakan rendah - sedang, dengan kehadiran methane 2,89 m^3/t - 6,02 m^3/t. Kandungan methane di daerah SBC sekitar 338.001.354,6234 scf, Lubuk Napal 743.232.370, 6576 scf, dan Sungai Dingin 419.343.508, 7245 scf.*

Kata kunci : karakteristik batubara, Sarolangun-Pauh, Coalbed Methane (CBM).

INTRODUCTION

Coalbed Methane (CBM) has been becoming an alternative energy resources. Increasing exploratory in this field might be provided for security of supply energy in Indonesia, According to research investigation by Pertamina and PT. Caltex Pacific (Kun Kurnely *et al.*, 2003), coalbed methane potential in Indonesia was about 337 trillion cubic feet (TCF). These potential resources distributed in Sumatera, Kalimantan, Jawa and Sulawesi Island, the biggest potential can be observed in South Sumatera Basin with deposit is not less than 183 TCF.

Considering the geology and coal characteristics of the Muaraenim Formation in Sarolangun Regency, have real prospective for exploitation of the Coalbed

methane resource in this area. To gain a better understanding on the potential and resources of the CBM in this area, located in the Jambi Province, a research focused on coalbed methane inventory was performed. In 2006, is under the Coal Bed Methane Development Project (*Proyek Pengembangan Coal Bed Methane*), a program of the Research and Development Centre For Oil and Gas Technology (*Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi*) "LEMIGAS".

Several related previous research data gained from both published and unpublished report, predominantly the private coal company data, have supported the current field data and laboratory studies. More actual data leading to a better understanding on Miocene coal measures, related to deciphering the coalbed methane possibilities of the area.

Aim, Objectives, and Methods

The focus of the study is to invent CBM potential and resource in the Central Sumatera Sub-Basin, obtained from coal and its coal measures, both field and laboratory analyses. To have a better understanding on the coal characteristics relating to the CBM potential, focused within the Muaraenim Formation, results of analyses are very important.

This study mainly used with organic petrography and organic geochemistry of coal from the Muaraenim Formation. The specific objectives include to : (a) determine quantity and quality of CBM generated from the Sarolangun coals, and exploration implication of CBM as a source for a new alternative energy, and (b) determine, analyze, and evaluate the characteristics of coals.

Achieving the aims of the study, specific geologic field investigations and laboratory techniques were carried out. In selected sites occupied by the relatively complete coal seams, the fieldwork investigations including detailed determination, observations, and measurement on cleat, lithotype, position, and characteristics of the coals and also gas-in-place content measurement (Q1) within the coal measures were performed.

The goals of this report are to prepare geological information of the study area, new information on coal characteristics both of macroscopically and microscopically related to the CBM potential.

Locality and Accessibility

The fieldwork area, that is the Pauh-Sarolangun one, is located in the Sarolangun Regency, administratively, included into the Jambi Province. However, the study has been focused in the Sungai Belati Coal (SBC) Coalfield, Lubuk Napal, Sungai Dingin and Karang Jering regions, which are presumed to be occupied by potential coalbed methane resources. Additionally, the other coal seam regions were also studied to gain more coal information for references and comparison.

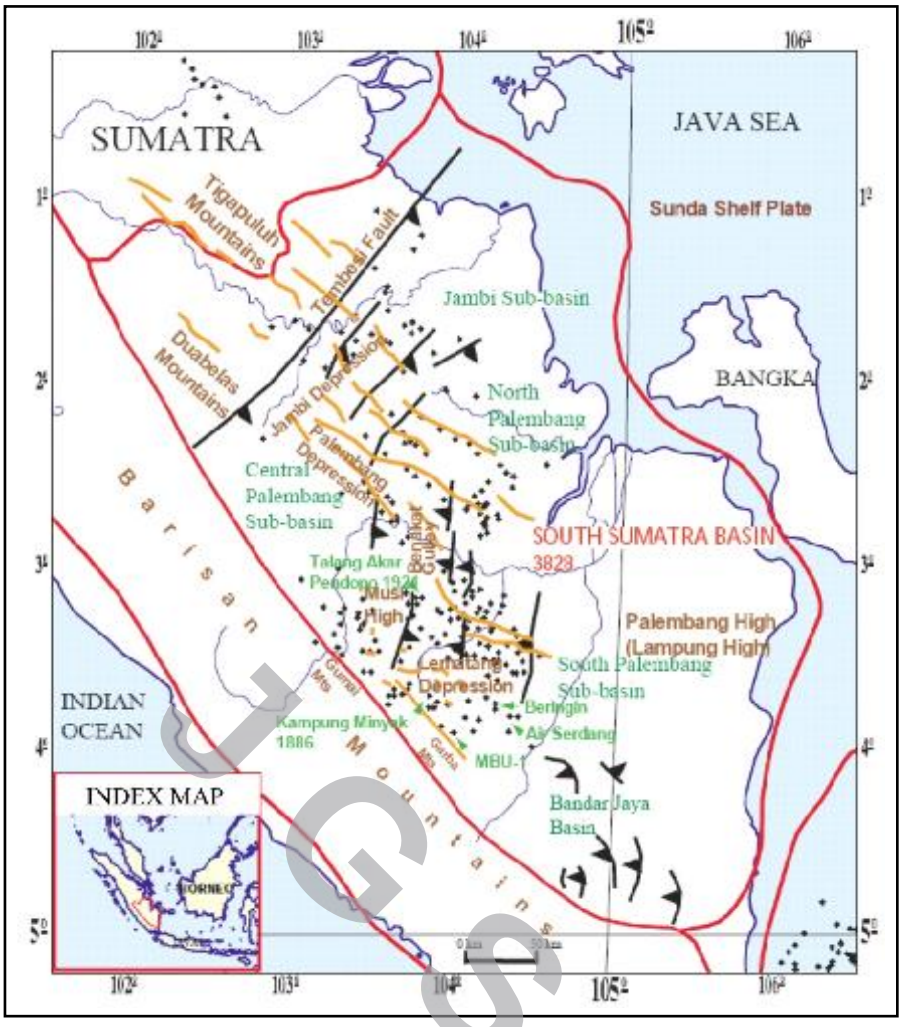
Surface and subcrop coal research, related to coalbed methane investigation in the area, is easily to perform, because the coal seams to be observed are almost well-outcropped, whether in the coal working face and coal excavation of the in-progress exploitation such as in the Sungai Belati Coalfield, and in exposed surficial coal seams. Predominantly, the study localities have to be reached both on foot and by means of cars and also motor-bikes.

GEOLOGICAL SETTING

Geologically, the Pauh - Sarolangun region is located within the Central Palembang Sub-Basin, at the northwestern part of South Sumatera Basin (Figure 1).

The geological setting of the South Sumatera Basin, where the study area is included, has been described in several published and unpublished report. According to de Coster (1974), this basin, located in the southern part of Sumatra Island, is regarded as a back-arc basin.

Morphologically, to the west, the basin is bounded by the Barisan Mountain Range. The South Sumatra Basin was formed during east-west extension which took place during Late Cretaceous to Early Tertiary subduction time of the Indian-Australian Plate beneath the Eurasian Plate within the western margin of the Sumatera Island (Daly *et al*., 1987). The tectonic history and stratigraphy of this basin have been described by de Coster (1974), Gafoer and Purbohadiwidjoyo (1986) and Darman and Sidi (2000). The regional tectonic situation and stratigraphy of South Sumatera Basin.



Gambar 1. Map showing the location of the Pauh - Sarolangun region in the Central Palembang Sub-Basin, Sumatera Basin (adopted from Bishop, 2001).

Stratigraphy

Geologically, the Central Palembang Sub-Basin was occupied by shallow marine-brackish (at the base), paludal, delta plain and non-marine environments during the deposition of clastic sediments comprising sandstone, mudstones and coal beds of the Muaraenim Coal Measures. The lower boundary of the measures in the southern part of the basin is usually marked by coal bed, and in the Jambi Trough area by equivalent strata where the top contact is picked at the highest glauconitic sandstone of the Airbenakat Formation. The number of beds and thickness of coal decreases from south to north in the South Sumatera Basin.

The main coal-bearing unit, referred to as the Muaraenim coal measures or Formation, represents part of a major regressive Late Miocene-Pliocene sequence, which was deposited during the uplifted time of the Barisan Mountains.

The coal-bearing Muara Enim Formation, deposited during the Late Miocene -Early Pliocene, consists of claystones and siltstones with several sandstone layers and some coal seams. In detail, the formation comprises stacked shallowing upward parasequences, typically 10 - 30 m thick, with shallow marine or bay clays at the base and shoreline and delta plain facies (sand, silt, clay, coal) at the top. Thickness of the Muara Enim Formation varies between 450 - 750 m (Darman and Sidi, 2000). The overall regressive Air Benakat and Muara Enim Formations are interpreted as representing deposition in a humid tropical deltaic system.

RESULTS OF INVESTIGATION

Coal Geology

The stratigraphic of the Pauh - Sarolangun area are comprised of coals, mudrocks, siltstones, tuff, sandstones, and intercalation of coal and siltstone. In general, coal, black in colour, brittle, rarely mineral matter, altered by brown mudrocks, 3 m in thickness, with the stratigraphic position mainly in the bottom of the stratal.

In the Pauh - Sarolangun area, the study has been focused in the Sungai Belati Coal (SBC) Coalfield, Lubuk Napal, Sungai Dingin and Karangjering regions (Figure 2). The geology and coal characteristics of each area studied which are related to the CBM potential, are described as follows:

Sungai Belati Coalfield (SBC)

The SBC coalfield is not far from Sarolangun Town, approximately 15 km to the northeast direction. The coalfield is connected to the well asphalted Sarolangun - Muaratembesi road, by a semi-hardened gravelly road. The coal seams form a slightly good exposure, overlain conformably by alternating sandstone and mudstone.

In the area, a fine to medium-grained clastic sediments and coal seam succession of the Muaraenim Formation is recognized. The top of this formation is overlain unconformably by volcanic clastic sediments of the Kasai Formation. Two stratigraphic columns show alternating coal, sandstone and mudstone successions (Figure 3). Megascopically, the coal was observed as a dull - dull banded lithotype, with blackish brown to brown in colour, brown in streak, rather hard, choncoidal to sub choncoidal fracture, moderately cleated, and scattered resin (0.1 mm - 3 cm). The coal is significantly categorised as low to moderate rank, also supported by the browner colour and duller appearance.

The coal quality is gained from coal lithotype and petrographic analysis data (Table 1). Lithotypically, it is dull to dull banded (Photo 1). Moreover, petrographically, the SBC coals are characterised by the presence of predominant vitrinite maceral group (up to 77.4 %) (Photo 2), with minor inertinite (13 %), exinite (6.8 %), and their vitrinite reflectance value measured at 0.45 %.

The geochemical analysis results of the selected coal samples in the SBC Coalfield, presents that ash content is 0.68 %, volatile matter of 28.57 %, total sulfur is 0.11 - 0.90 %, whilst the inherent moisture content is 42.60% (Table 2).

Table 1. Organic Petrographic Anasysis Data of Selected Sarolangun Coals.

No	Sample No.	Lithotype	V %	I %	E %	Rv %
1	06 TH 21A	DB	70.2	5	17.8	0.42
2	06 TH 21B	DB	81.8	6	6.8	0.45
3	06 TH 21C	DB	70	8.6	9.4	0.43
4	06 TH 21D	DB	80.4	9.4	8.4	0.45
5	06 TH 21E	DB	85.6	3.4	7	0.47
6	06 TH 21F	DB	78.6	8.4	4.6	0.47
7	06 TH 22A	DB	80.4	10.8	7.2	0.45
8	06 TH 22B	DB	93.8	1.6	2.8	0.45
9	06 TH 22C	DB	71	19.2	8	0.44
10	06 TH 22D	DB	79	10.6	9	0.47
11	06 TH 22E	DB	80.6	6.6	9.6	0.45
12	06 TH 22F	DB	72.4	10.6	9.4	0.47
13	06 TH 22G	DB	84.2	7	6.6	0.45
14	06 TH 23	D	77.4	13	6.8	0.45
15	06 TH 25	D	91	2.4	2	0.4
16	06 TH 27A	D	87.6	1.4	1.4	0.37
17	06 TH 27B	D	74.8	2.4	2.4	0.38
18	06 TH 27 C	D	79.2	0.6	3.4	0.37
19	06 TH 28	D	40.6	2	1	0.35

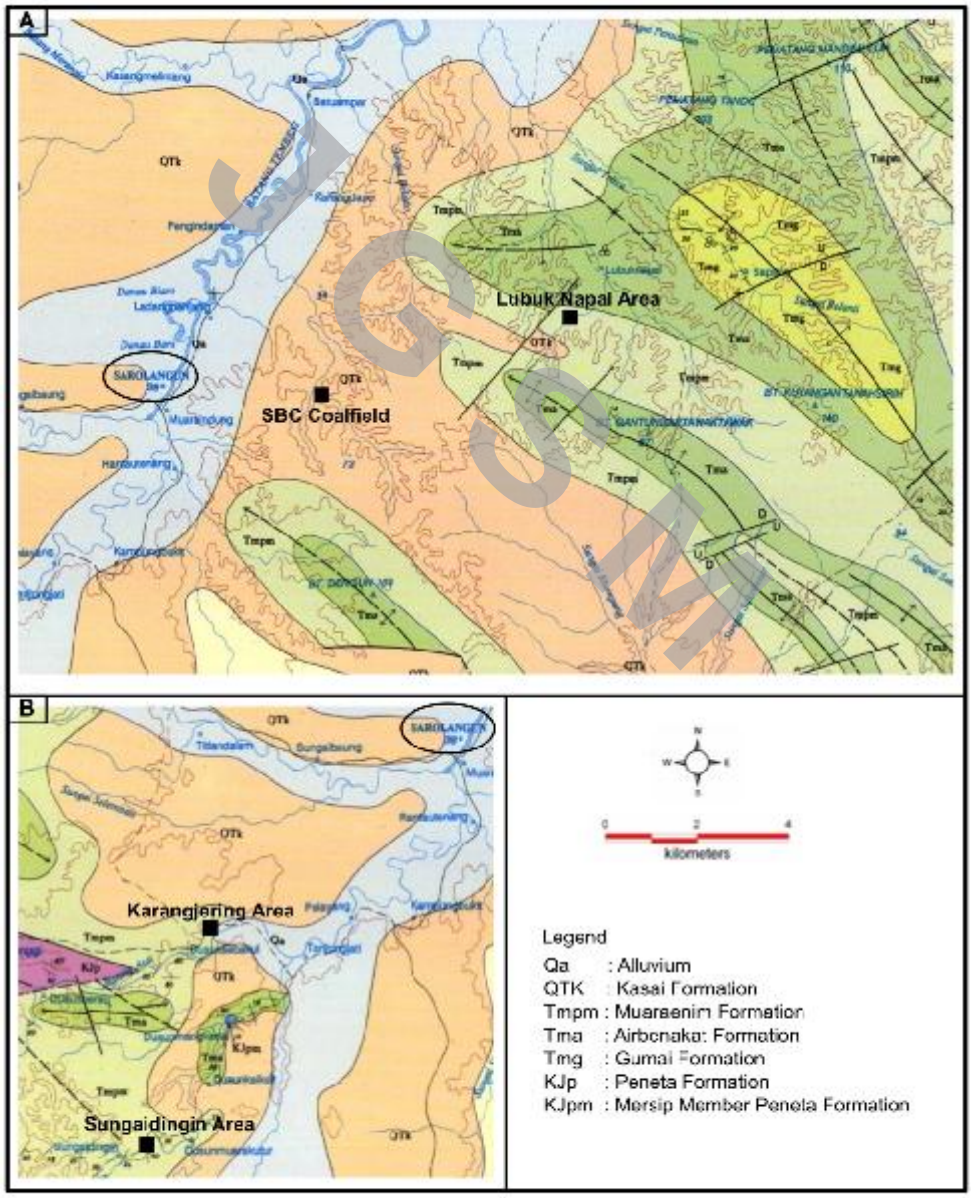
Legends: DB : dull banded V : vitrinite E : Exinite
D : dull I : Inertinite Rv : vitrinite reflectance

Based on fieldwork investigation, fairly moderate developed cleat systems occurring within the SBC coal seams, can be recognised. Face cleat spacing is between 1 -14 cm, with dominant spacing varies from 2 - 8 cm (Photo 2). Furthermore, cleat aperture ranges from 0.2 - 4 cm, density of 0.0001 cm^{-1}, and frequency of 0.349 cm^{-1}. Dip direction of face cleat is N38°E/72° and N212°E/76°. Based on the parameters influencing the coal adsorption capacity, coalbed methane content derived from the SBC coal seam, on the basis of Barbara-Winter diagram, is expected to be low level, with methane content 3.98 m^3/t. However, during the fieldwork, Q1 values were also determined.

Photo 1. Photograph of coal outcrop showing dull banded lithotype intercalated by tonstein, exposed in the SBC Coalfield working face, Sarolangun.

Table 2. Results of Coal Geochemical Analysis of the Sarolangun Region.

No	Sample Number	Total Moisture %, ar	Ash %, ar	Volatile Matter %, ar	Fixed Carbon %, ar	Calorific Value cal/g, ar	Total Sulfur %, ar
1.	06 TH 21E	37.27	1.4	32.28	29.05	4196	0.89
2.	06 TH 21F	38.18	2.24	30.11	29.47	3976	1.21
3.	06 TH 22A	40.4	1.96	28.95	28.69	3886	0.18
4.	06 TH 22B	34.06	6.2	24.39	35.35	4250	0.61
5.	06 TH 22C	39.15	1.16	29.38	30.31	3950	0.13
6.	06 TH 22D	40.18	1.19	29.09	29.45	3938	0.13
7.	06 TH 22E	38.6	1.55	31.24	28.61	4117	0.13
8.	06 TH 22F	36.94	2.02	33.5	27.54	4295	0.15
9.	06 TH 22G	39.21	1.05	29.78	29.96	3952	0.15
10.	06 TH 23	42.6	0.68	28.57	28.15	3780	0.11
11.	06 TH 26	22.77	22.42	22.9	31.91	3767	0.44
12.	06 TH 27A	18.01	26.71	23.44	31.84	3782	0.74
13.	06 TH 27B	20.16	35.2	20.5	24.14	2803	0.56
14.	06 TH 27 C	18.95	37.18	20.43	23.44	2742	0.54
15.	06 TH 28	23.91	52.4	13.01	10.68	1225	2.38



Gambar 2. Geological map of the study area that show the position of Lubuk Napal and SBC Coalfield (A); (B) Karangjaring and Sungai Dingin (based on Suwarna et al., 1992).

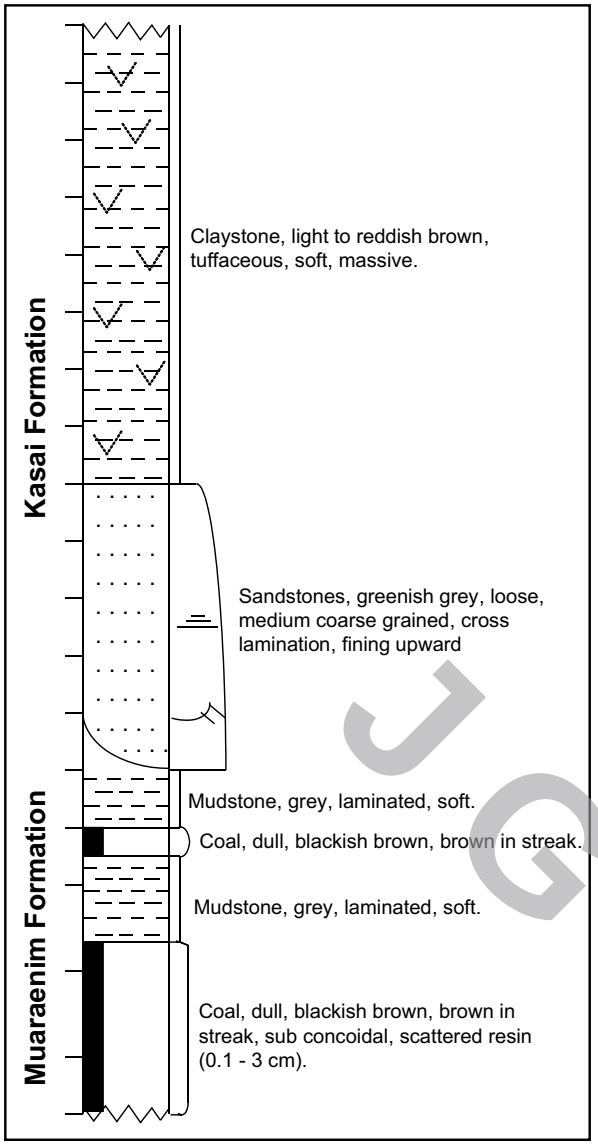


Figure 3. A stratigraphic column showing a succession of the Muaraenim Formation in he SBC Coalfield area.

Lubuk Napal

The region is located approximately 60 km to the northeast of Sarolangun Town. Coal section measurements are carried out in two sites, Firstly, in km-18 not far from road Pauh to Lubuk Napal and second ones is around 3 km to the north from first area. Both of them spreading out on the Monobegading River are presented in Photos 2 and 3, respectively.

Two coal seams within the region as presented in Photos 2 and 3 show that the coal in the Monobegading River ranges from dull to dull banded lithotype. However, the dominant lithotype is dull banded. Megascopically, the coal shows blackish brown in colour, brown streak, slightly to highly cleated, scatterred resin (2 mm - 2 cm), some showing very thin layer of sulphur (pyrite) (0,1 - 0,2 mm). Thickness of each coal sub-seam is less than 1.5 m (Figure 4).

Quality of coal is indicated by coal lithotype and petrographic analysis data. Petrographically, the Lubuknapal coals are characterised by the presence of predominant vitrinite maceral group (up to 93.8%) with minor inertinite ranges from 1.6% - 19.2%, and exinite 2.8% - 9.6% (Photo 4). Vitrinite reflectance value measured at 0.46% - 0.47%. Futhermore, geochemically, the Lubuknapal coals have ash content ranging from 1.05% - 6.20%, volatile matter 24.39% - 33.50%, total sulfur is 0.13% - 1.21%, whilst the inherent moisture content is from 34.06% - 40.40%.

Photo 2. Coal outcrop showing cleated dull banded lithotype, cropping out in the Monobegading River, Lubuknapal area.

Photo 3. Coal cleat measurement on a dull banded coal seam, cropping out in the Mononobegading River, Lubuk Napal region.

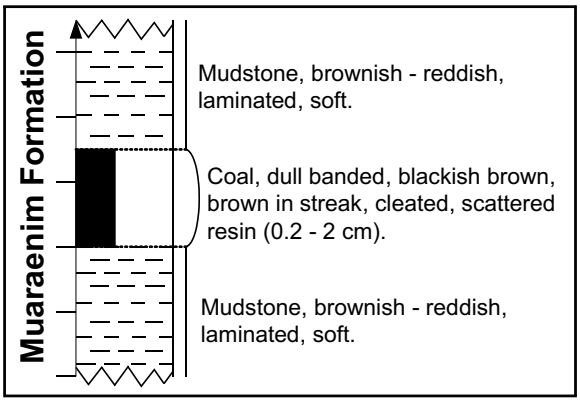


Figure 4. A stratigraphic column showing a succession of the Muaraenim Formation in the Lubuk Napal area.

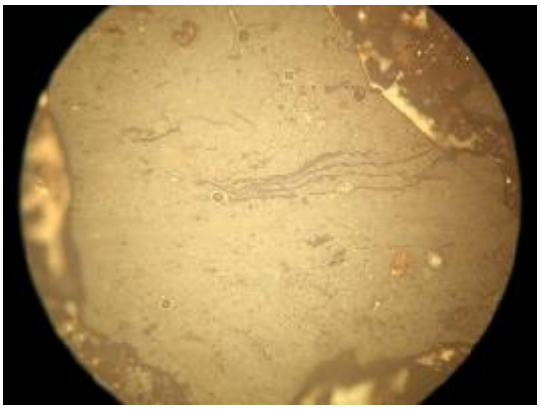


Photo 4. Photomicrograph of telocollinite sub-maceral, embedded with sclerotinite, inertodetrinite, suberinite, and mineral matter, of Lubuknapal coal (Reflected light). Sample: 06 AP 05C.

Cleats of the coal which can be recognized in Lubuknapal are fairly moderate developed cleat systems. Face cleat spacing is between 0.5 - 8 cm (Photos 2 and 3). Furthermore, cleat aperture ranges from 1 - 6 mm, density of 0.0001 cm-1, and frequency of 0.625 cm-1 to 1.545 cm-1with Northwest to Southeast direction. Based on the parameters influencing the coal adsorption capacity, coalbed methane content derived from the Lubuk Napal coal seam is expected to be low to moderate level, with methane content ranges from 3.73 m^3/t. - 5.3 m^3/t.

Sungai Dingin

Location of the Sungai Dingin area is approximately 40 km to the southwest from the Sarolangun town. The coal outcrop occurs along the river of Sungai Keruh.

The Sungai Dingin area is occupied coal seam showing dull lithotype, brown in colour and streak, medium hard, resinous about 0,5 - 3,5 cm in diameter (Figure 5). Petrographically, they comprises predominantly vitrinite maceral group (up to 91.0%) with minor exinite from 1.4% - 3.4% (Photo 5), inertinite ranging from 0.6% - 2.4%, and mineral vitrinite reflectance value measured varies from 0.37% - 0.40%.

In addition, geochemically, the coal is characterized by the ash content from 22.42% - 37.18%, volatile matter of 20.43% - 23.44%, total sulfur is between 0.44% - 0.56%, and inherent moisture content ranging from 18.01% - 22.77%.

Within the Sungai Dingin coal seams, a fairly moderate developed cleat system occurs. Face cleat spacing is between 0.6 - 10.5 cm, whilst, cleat aperture ranges from 1 - 4 mm, density of 0.0001 cm-1, and frequency of 0.596 cm-1 to 1.852 cm-1 with direction from southwest to northeast and west to east. Based on the Barbara-Winter diagram, coalbed methane content derived from the Sungai Dingin coal seam is expected to be moderate level, with methane content ranges around 5.35 m^3/t.

Karangjering

The Karangjering area is located between Muaralimun and Hulumengkua Villages, by the Pelawan - Batangasai gravelly road. It is situated approximately 35 km to the west from Sarolangun. The area, can be reached by car directly from Muara Limun or Sarolangun.

From the lithotype viewpoint, the coal in the Karangjering is dull to dull banded one. It shows brown in colour and streak, moderately hard, contains scattered resin (0.5 - 1.5 cm), some showing very thin layer of bright type around 0.5 mm thick (Figure 6).

The Karangjering coal comprises predominantly vitrinite maceral (40.6%) with minor inertinite (2.0%), exinite (1.0%), and high mineral matter (59.4%) (Photo 6); whilst vitrinite reflectance value measured at 0.35 %. Likewise, the coal of this area contains ash content of about 52.40%, volatile matter 13.01%, and total sulfur of 2.38%, with inherent moisture content of 23.9 1%.

Coal cleat is hardly recognized in Karangjering. Afterwards, based on the parameters influencing the coal adsorption capacity, coalbed methane content derived from the Sungai Dingin coal seam is expected to be moderate level, with methane content of 6.02 m^3/t. However, during the field activity in the study area, as common, the Q1 measurement was also performed (Photo 7).

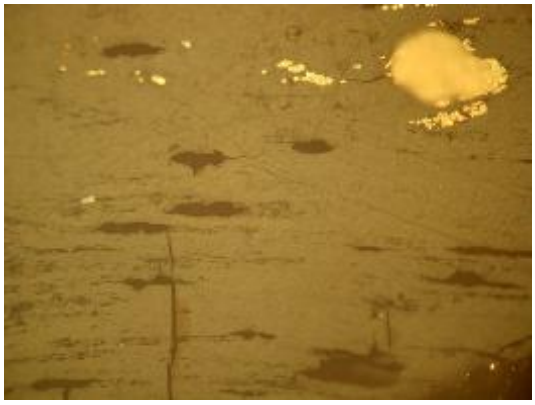


Photo 5. Photomicrograph of telocollinite associated with exsudatinite, sporinite, and framboidal pyrite within the Sungai Dingin Coal (Reflected light). Sample: 06 TH 21F.

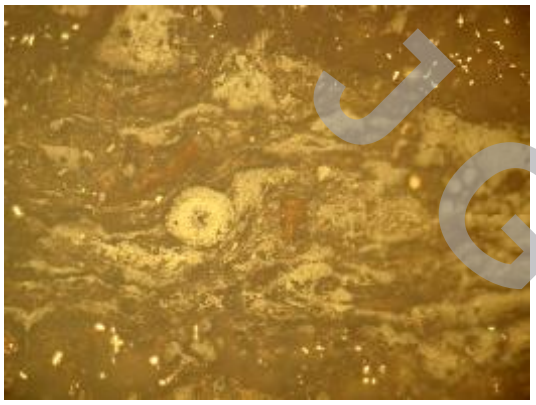


Photo 6. Photomicrograph of an association of detrovitrinite, sclerotinite, pyrite, and clay minerals occurring in the Karangjering coal (Reflected light). Sample: 06 TH 27A.

Photo 7. In-situ measurement (Q1) of methane gas, by the Mengkua River, in the Hulumengkua/ Karangjering region, using simple field equipment.

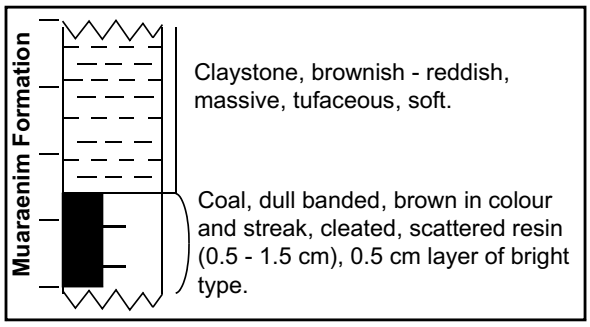


Figure 5. A stratigraphic column showing a succession of the Muaraenim Formation in the Sungai Dingin area.

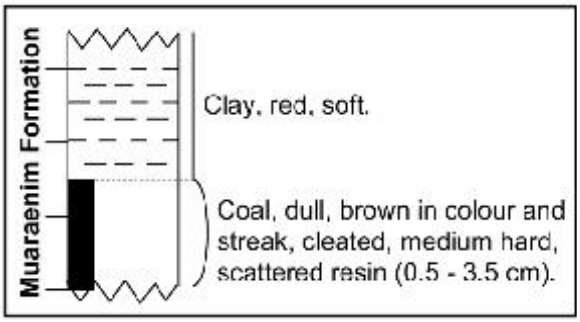


Figure 6. A stratigraphic column showing a succession of the Muaraenim Formation in the Karangjering area.

DISCUSSION

Coalbed Methane Potential and Coal Quality

The coal characteristics of Sarolangun- Pauh region show dull to dull banded lithotype, from petrography analysis indicates that coal samples dominated by vitrinite with minor contents of inertinite and exinite. Although several samples show low vitrinite content of only 40.6 %, the whole samples collected indicate that the coals are not included into poor category, and exinite maceral appears low to medium in content, ranging from 1.0% to 9.6%. Additionally, vitrinite reflectance shows the value from 0.35 % to 0.47 % in average, which indicates a low to medium rank coal. Therefore, on the basis of these characteristics, the coal in Pauh - Sarolangun region is suggested to be potential in biogenic coalbed methane. It is also supported by the analysis result that the methane content of the coalbed gas within the Sarolangun area studied varies from 13.56 - 100 %.

The average of the total moisture in each sample ranges from 18.01 % to 40.18 %; with average calorific value around 5545 to 5745 cal/g. One sample shows extremely low caloric value of 1225 kcal/kg. This is owing to high ash content around 52.40 %.

The average ash content in each sample, ranging from 0.11 % to 2.38 %. These values are correlated to the content of mineral mater of clay in the organic petrographic analysis (0.8 - 52.2 %). These values also correlated to the calorific value, eventually these samples are not coal samples, but probably coaly shale.

The volatile mater in Sarolangun and its surrounding area indicates that within several samples ranges from 13.39 % to 33.50 %. The coals in this area seems to contain volatile matter of low to medium level, thus the gas content is categorized as moderately potential of methane. Fixed Carbon content in the area ranges between 10.68 % and 31.91 %.

Despite petrographic characteristics, cleats are very important textures to be considered in all coal samples analyzed, since they may likely to be useful guides in helping to define the potential seam for CBM content. In general, cleats are fairly moderate developed in all location, except in Karangjering region.

The result of SEM analysis for each samples, apart from maceral and organic matter, all textures, features and other constituents are visually well exposed in three-dimensional. Hence, the dimension of micro-cleats or micro-cracks can quantitatively be measured in microns scale. The result of measurements of micro-cleats or micro-cracks found in each sample (Panggabean and Hermiyanto, 2006).

The feature of micro-cleats or micro-cracks is dominated by strike lines although some curved and sub-curved lines are also present. Open microcleats are predominant compared to close microcleats.

The micro-cleats having good or high density are identified in sample 06 TH 21A, 06 TH 22D, and 06 TH 23 ranging from 0.4 to 0.8. On the other hand, poor to fair density of micro-cleats are found in samples 06 TH 26, 06 TH 27B, 06 TH 28.

Gas In-Place Resources

Parameters used to calculate the gas in-place potential of the Sarolangun and its surrounding area coals consist of theoretical gas content based on the Barbara and Winter Diagram, and Lost Gas during drilling (Q1) plus gas desorption during transportation (Q2).

In order to calculate the theoretical gas in-place potential of the study area, the required important parameter is the volatile matter content of the coal.

The gas in-place potential/content of each selected coal seam is shown as follows:

- SBC coalfield area on the Barbara/Winter Diagram shows that gas content is averaged 3.98 m^3/t of pure coal.
- In the Lubuk Napal area and surrounding areas on the Barbara/Winter Diagram shows that gas content is ranges from 3,73 m^3/t. - 5.3 m^3/t of pure coal.
- The Sungai Dingin area, in the Barbara/Winter Diagram shows averaged value of 5.35 m^3/t.
- In the Karangjering area and surrounding areas on the Barbara/Winter Diagram shows that gas content is averaged 6.02 m^3/t of pure coal

It can be summarized, that based on the parameters influencing the coal adsorption capacity (Barbara and Winter diagram), gas content derived from the Sarolangun coal seam is expected to be low - moderate level, with methane content is present from 2,89 m^3/t. - 6,02 m^3/t.

Moreover, the vast majority of the gas in CBM reservoirs is stored in the coal matrix by sorption. The following equation (Aminian, 2007) is generally used to estimate the total initial adsorbed gas in a CBM reservoir:

As can be seen from Equation, average in-situ gas content, coal thickness, reservoir or well drainage area, and average in-situ coal density are the parameters that are needed for estimating gas-in-place in a CBM reservoir. From this parameter the gas in-place potential/content of each selected coal seams are shown as follows:

- SBC coalfield area shows that gas content is around 338,001,354.6234 scf.
- In the Lubuk Napal area and surrounding areas shows that gas content is 743, 232,370.6576 scf.
- The Sungai Dingin area and surrounding areas shows that gas content is about 419.343.508.7245 scf.

In addition, according to these parameters it can be concluded that the Sarolangun coal seam has total average of gas content about 500, 189, 411.3382 scf.

CONCLUSIONS

- The Sarolangun coal lithotype, ranging from dull to dull banded, dominated by the dull one.
- Generally, the coal consists of vitrinite, with minor inertinite, exinite, and mineral matter that indicates the samples are not included into a poor coal category.
- Coal geochemical analysis shows that volatile matter content varies from 13.39 % to 33.50 %, total sulfur 0,11 - 2.38 %, ash content 0.11 % to 2.38 %, and moisture content 18.01 % up to 40.18 %.
- The vitrinite reflectance measurements show the value ranging from 0.35 % to 0.47 % in average. It is affected by moderately thermal heating. Therefore, the expected gas present suggested being of biogenic origin consistent with a moderate thermal maturity.
- The coals are moderately cleated. Coal cleat orientation trending southeast -northeastward. The micro-cleats or micro-cracks are dominated by strike lines although some curved and sub-curved lines are also present.
- An insitu coal have low - moderate level, with methane content is present from 2,89 m^3/t. - 6,02 m^3/t. SBC coalfield area shows that gas content is around 338,001,354.6234 scf. Moreover, in the Lubuk Napal and surrounding areas, the gas content is 743, 232,370.6576 scf, whilst the Sungai Dingin and surrounding areas is characterized by gas content of about 419.343.508.7245 scf.

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