The Affect Coal Facies to The Adsorption of Methane Gas in Coal of Tanjung Formation at Arang Alus Area , South Kalimantan Province

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Abstract

Tanjung Formation is an Eocene - Oligocene coal carrier formation. This formation is stratigraphically situated above the bedrock of Pratersier age. The location of this formation is in Binuang area, South Kalimantan, Indonesia.

The method of research by taking the Channel sampling from seam A (upper), B, C, and D (bottom) . Laboratory analysis is done in the form of coal petrography analysis and adsorption test.

Based on facies interpretation with the Tissue Preservation Index (TPI) - Gelification Index (GI) method, seam A, B, and D coal depositional environment in fen stage and seam C coal is in the depositional environment at the stage of wet forest swamp.

Based on the analysis of gas adsorption shows from the lower coal seam to upper with the range 412 – 674 SCF / Ton. The upper coal seam A, B, and D of the small gas adsorption while at the coal seam C is large gas adsorption. The difference in depositional environment affects the absorption of coal methane gas.

Key word : TPI, GI, GWI,VI, adsorption, coal facies, Tanjung Formation

INTRODUCTION

The Barito Basin in South Kalimantan province has several thick and widespread coal seams,One of the area that the coal currently being explored is Arang Alus area. The Arang Alus area is an area where the coal carrier formation is exposed. Coal outcrops include the Eocene Tanjung Formation (Heryanto,2009). Coal in the Barito basin is currently exploring the potential of coal methane gas (GMB). Based on hypothetical calculations, the volume of coal methane gas is quite large, namely 101 TCF [Steven and Hadiyanto,2004)]. The volume of coal methane gas is influenced by the ability to absorb methane gas in each different coal layer. The physical properties of coal influence the difference in adsorption of methane gas; one of the physical properties is maceral. The composition of maceral can be used to determine the environment in which peat is obtained (facies) (Diessel, 1986, Zhao et al, 2017). The depositional environment (facies) of coal resulting from maceral observations has been used since 1950 (Han et al,1996). The environment of deposition of peat can be seen from the coal maceral composition (Diessel, 1986). Determination of coal facies from coal mineral composition can be done by using the Gelification Index (GI) diagram - Tissue Preservation Index (TPI) (Diessel, 1986) and the Ground Water Index (GWI) diagram - Vegetation Index (VI) (Calder et al,1991) which is very popular and has been applied to coal formed in the delta environment. There is a close relationship between facies of coal in the delta environment with a small amount of adsorption of coal methane gas (Zhao et al, 2017).

Adsorption of methane gas formed during the coalification process will be absorbed in the coal micropore. The adsorption capability of coal methane gas is related to the physical properties of coal, including coal mineral and rank are essential factors in evaluating CBM (Dai et al, 2007). Coal facies built by maceral composition and coal structure are closely related to gas adsorption characteristics.
Calculation of gas adsorption by theoretical using the Langmuir equation (Dai et al, 2007).

Based on the above reasons, a more detailed assessment is needed in coal methane gas exploration. This study aims to determine the relationship of coal facies to the adsorption behavior of coal methane gas. This research was conducted to assess the condition of coal facies in absorbing methane gas, coal quality, and finding solutions to problems in methane gas exploration to be faster and more efficient.
The research location is in Arang Alus area, Banjar Regency, South Kalimantan Province, Indonesia.

SAMPLE AND METHOD

Primary data collected from the field data of four sampling locations representing coal seam A, B, C, and D. The sampling locations can be seen in the following table (Table1.)

Table 1 Location sampling coordinates

Seam Coals	Meter East	Meter North
A	294610	9638026
B	294612	9638039
C	294613	9638040
D	294620	9638085

Coal sample data is taken using the channel sampling method from the top to the bottom of each coal seam. Each coal seam correlated with wells at coordinates 292858,693 meters East and 9638682,718 meters North (Fig.1).

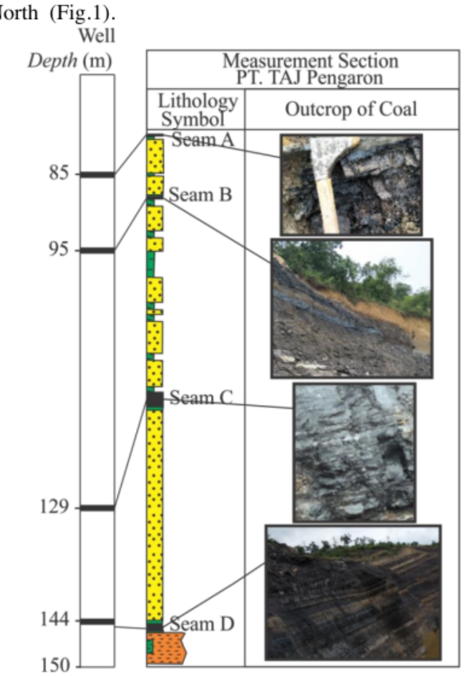

Fig.1 Correlation well log with outcrop along with number sampling

Subsequent samples were conducted laboratory tests to determine coal masals and vitrinite reflectors using the Craic Coal Microscope microscope. The sample was also tested proximate to determine the quality of coal

To determine coal facies using model of diagram Diessel (1989) with Gelification Index (GI) and

Tissue Preservation Index (TPI) parameters. Other parameters used to determine coal facies by knowing the value of the Ground Water Index (GWI) and Vegetation Index (VI), these values are then plotted in a diagram made by Calder et al, 1991 modified by Zhao, 2017

The adsorption isotherm test is carried out based on the volumetric method to determine sorption capacity as a function of pressure; the gas used is methane gas (CH_4) purity 99.9%.

The relationship of volume - pressure at a certain temperature (sorption isotherm) can be used to determine the gas storage capacity and estimate the volume of released gas from the sample in line with the decrease in reservoir pressure. In general, the relationship between storage gas capacity and pressure uses the Langmuir equation:

$$Gs = (VLP) / (PL + P) \quad (1)$$

Where: Gs = Storage gas capacity, m3 / ton
P = Pressure, KPa
VL = Langmuir Volume Constant, m3 / ton
PL = Langmuir pressure constant, KPa

RESULT AND DISCUSSION

Based on the results of previous researchers the depositional environment of the Tanjung Formation is the lower delta plain and upper delta plain transitions, the type of coal facies in the form of wet forest swamp. Peatland plant composition is dominated by woody plants and there are herbaceous plants [Heryanto and Pangabean, 2013]. Based on the Tissue Preservation Index (TPI) and Gelification Index (GI) values in Table 2 which are then plotted on the Diessel coal facies diagram (1986) it can be interpreted that the coal seam C in the Tanjung Formation was formed in the wet forest swamp stadium depositional environment. Seam coal A, B, and D are deposited in telmatic conditions with a depositional environment at Fen stadium.

Based on the plot of the Ground Water Index (GWI) and Vegetation Index (VI) in Table 2, then plotted in diagram of the Calder et al, 1991 modified by Zhao et al, 2017, Tanjung Formation coal facies can be grouped into two types of coal facies:

a). Delta Plain Wet Forest Swamp: a mire formation zone that is controlled by variations in surface water. This facies is characterized by relatively moist coal with a small percentage of herbaceous peat-filling plants.

b). Delta Plain Fen: is a zone of peat formation or mire which is controlled by the percentage of transgression and regression. The plants formed at this stage are herbaceous plants which supply peat in wet conditions. Arborescent plants are very rare at this stage and plant tissue decomposes very strongly. Strong decomposition will cause a reduction in micro pores.

At this stadium fen when flooding will cause preservation of high organic sulfur which causes high sulfur content (Han et al, 1996)

GWI and TPI are effective indicators in explaining the evolution of peat in the study area. The coal facies in the Tanjung Formation on the bottom coal seam, in this case, seam D is the delta plain fen facies, then the coal seam above sem sem is the delta plain wet forest swamp facies, then the coal seam B returns to the plain fen delta coal facies Coal Seam A is the uppermost layer of the Tanjung Formation deposited with coal facies at the delta plain fen stage.

The process of transgression continues on seam A, then there is seaweed, this is marked by the formation of limestone Berai Formation which is above the Tanjung Formation

Pratama and Amijaya (2015) state that there is a link between the depositional environment and pyrite minerals in Warukin coal, South Kalimantan. Pyrite minerals formed are closely related to geotite minerals carried by water currents (Suit, S.N. and Arthur M.A, 2000). Pyrite (FeS2) is a mineral that contributes greatly to the sulfur content in coal, or better known as pyritic sulfur (Taylor et al, 2000)

Coal Seam C has a pyrite mineral value of 1.2% due to the depositional environment that is in the delta plain wet forest swamp facies in the telmatic zone. The telmatic zone is a zone where peatlands are controlled by variations in surface water (Diessel, 1986). In this zone when peat is formed, it is not disturbed by the flowing water so that the mineral pyrite is low.

Coal seam A, B, and D have pyrite values of 1.8 - 6%, (Table 2), because the coal deposition environment is in the delta plain fen facies in the limmo-telmatic zone. The limmo - telmatic zone is a zone where peatlands are controlled by tides. The magnitude of the value of pyrite minerals characterizes the effect of the process of water transition when peat formation takes plac

Table 2. Results of proximate, maceral, and calculation TPI, GI, GWI, and VI

	Proximate				Maceral									
SC	Ash	VM	M	FC	Te	Des	TV	TI	TL	Py	TPI	GI	GWI	VI
	%,Adb	%,Adb	%,Adb	%,Adb	%	%	%	%	%	%				
A	2.56	48.75	3.74	44.95	26.6	43.4	70	28.2	0	1.8	1.11	2.93	0.03	0.79
B	14.94	45.26	2.51	37.29	21.5	41.1	62.6	31	0.4	6.0	1.1	2.39	0.1	0.75
C	5.44	43.16	3.7	47.7	46	29	75	23.8	0	1.2	2.36	3.22	0.02	1.72
D	23.16	38.02	2.91	35.91	24.6	42.4	67	27.3	1.7	4	1.11	2.772	0.06	0.811

SC = Sample coal, VM = Volatile matter, M = Moisture, FC = Fix carbon, Te = Telocolinite
Des = Desmocolinit, TV = Total Vitrinite, TI = Total Inertinite, TL = Total Liptinite, Py = Pyrite
TPI = Tissue Preservation Index, GI =Gelification Index, GWI =Ground Water Index ,VI = Vegetation Index

Based on the adsorption analysis of methane gas isotherm, the adsorption capacity of methane gas in each sample can be seen in table 3

Table 3 Hasil Uji Adsorpsion of methane gas

Seam coals	Adsorption of methane	PL	VL
	Scf/ton	PSI	SCF/Ton
A	308	1018	464
B	336	1072	466
C	450	2220	856
D	407	2230	884

According to Zhao et al., 2017 states that there is a link between the adsorption of coal methane gas and depositional environment (facies). Adsorption of coal methane gas in different facies will cause different gas uptake; this difference is strongly influenced by peat-forming plants and different water conditions. Arborescent plants will decrease in percentage from delta plain wet forest swamp to delta plain fen, while herbaceous plants in the delta plain fen have a higher percentage, this is characterized by greater maceral desmocolinite pada seam C (Figure 2). Herbaceous plants will experience decomposition resulting in micropores. In the delta plain fen water conditions that increase, this is indicated by the higher GWI values in coal seam A,B, and D compared to the GWI values in coal seam C. Changes in water conditions will also cause changes in plant tissue, oxidation, and mineral content. Adsorption of abundant methane gas if the accumulation of peat and peat landfill is running fast and the mineral content will occur a little in the Upper Delta plan for wet forest swamp [Zhao, 2017]. Figure 2 shows the ash content and pyrite in coal seam A, B, and D is relatively larger with coal seam C. This shows that the seam A, B, and D were deposited in the delta plain fen , based on Figure 2 shows that the adsorption value of coal methane gas in coal seam A, B, and D is relatively smaller compared to the coal seam C.

The adsorption of coal methane gas in the seam C with coal facies in the delta plain wet forest swamp is higher than the adsorption of methane gas in coal facies of delta plain fen at coal seam A,B ,and D.
Coal rank has a positive influence on the absorption of methane gas, and this show in Figure 6. Based on research by Li Ziwen et all, 2014 concluded that the rank of coal with Ro, max <1.0 Langmuir pressure decreases with an increase in coal ratings marked by a large number of micropores and the surface of the pore is broad so that it increases the absorption of methane gas. The relationship between Langmuir pressure and coal rank in the study area has a positive correlation of $r2 = 0.877$. The relationship shows that the higher the Langmuir pressure, the higher the rank of coal so that the absorption of methane gas will also increase.

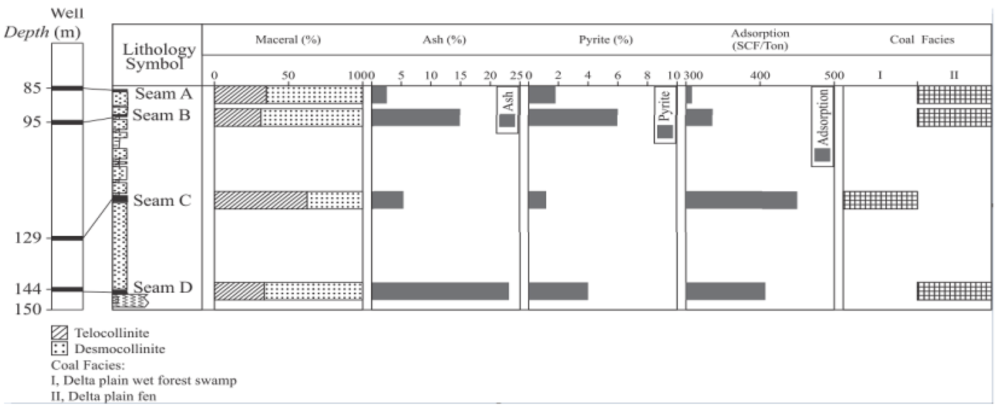

Figure 2 The relations of maceral, proximate, TPI-GWI-TPI, adsorption of methane gas and coal facies in the study area

CONCLUSION

Based on the GI-TPI and GWI-VI diagrams, coal facies in the Tanjung Formation are delta plain wet forest swamp and delta plain fen. Delta plain wet forest swamp in coal of Tanjung Formation is at the coal seam C, while at the coal seam A, B, and D of the developing facies is delta plain fen. Coal facies in the Tanjung Formation at the bottom develop in delta plain fen , ts upper part (coal seam C) develops a delta plain wet forest swamp, while at the upper part develops facies delta plain fen . Based on the absorption value of methane in each coal facies changes. Absorption of methane gas in coal facies in the delta plain wet forest swamp is large, while the absorption of methane gas in delta plain fen facies is small.

Changes in adsorption of methane gas in different facies are due to different plant factors and changes in water activity at the time of peat formation.

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