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ABSTRACT

Research Characteristics of quality and porosity Coal Formation Tanjung, Barito Basin aims to determine the relationship among the permeability with coal quality . Sampling was conducted at PT Tanjung Alam Jaya in Tanjung Formation coal in seam A,B, C, and D by channel sampling. Proximate analysis, permeability and porosity were performed on the above samples. The problem in this research is how the relationship with coal porosity, permeability, and quality in Tanjung Formation middle coal rank on methane gas absorption. Based on the characteristics of the porosity in the coal seam A, B, C, and D have a porosity range of 2. 38 to 2.64 % while the permeability has a value of 0.52 – 0.62 mDarcy. Proximate analysis results on ash 2.56 – 23.16 %,adb, moisture 2.51 – 3.74 %, adb, carbon 35.91 – 47.7 %, adb, and sulfur 0.32 – 044 %, adb. Methane gas absoprtion on seam A : 294 scf/t,seam B : 315 scf/t, seam C : 431 scf/t, and seam D : 425 scf/t. The relationship between ash content, carbon, and permiability to the absorption of methane gas has a regular graph, where the lower ash content , the greater of carbon, the greater of permiability will have a large absorption of methane

Keyword : adsorption, Tanjung Formation, ash, methane gas, coal rank.

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. Coalbed methane (CBM) is a form of natural gas (hydrocarbon) with methane gas as its main component. This methane gas is formed naturally in the formation of coal. This gas is trapped and adsorbed into coals in the form of cleat and matrix, so that the pores' structure, depth, maceral composition, and coal rank are some important factors in the development of coalbed methane gas field (Flores, 2014). Methane gas isn't the only gas contained in coals, but this gas can provide 90-95% of the total gas contained in coals. Different kinds of coals have different levels of absorbency (Singh, 2010). The success of coalbed methane is very dependent to the gas flow rate, the gas price, and economy of the gas (Moore and Mares, 2008). Gas flow rate is reliant on porosity and permeability. This gas is expected to be an alternative energy in Indonesia that needs to be developed.

There are two kinds of porosity in coalbeds, porosity that's located in cleats and matrix. Pores classification is classified into micropores (pores that have diameter less than 2 nm), mesopores (diameter of 2-50 nm), and macropores (diameter bigger than 50 nm) follows International Union of Pure and Applied Chemistry (Orr, 1977). Pores in a matrix have various structures that aren't uniform and irregular surface. Porosity is affected by the composition and characteristics of maceral and chemical structure in coalbed (Liwen, et al, 2012), other than that porosity is also affected by the rank of coal (Flores, 2014). According to the size of pores in matrix, there are two kinds that are macropores and micropores, macropores are found in low-grade coals while micropores are found in high-grade coals (Flores, 2014). Coal maceral have an influence on pore's surface area and volume. Coal with vitrainous lithotypes composed by vitrinite and inertinite macerals have micro pores, while coal with fusing lithotypes have mesopores (Flores, 2014). According Hou et al, 2017 when coal has a vitrinite percentage of less than 82% of pores that develop mesopore size composed by inertinite, the micropores are composed by vitrinite. If the vitrinite percentage is more than 82% mesopore in vitrinite and micropore dominance is arranged inertinite.

This research is to know the relationship between porosity with maceral in lignite coal Formation of Tanjung in Arang Alus area, Banjar Regency, South Kalimantan Province.

LOCATION RESEARCH

The research area is located at PT ALAM TANJUNG RAYA, Arang Alus, Banjar - South Kalimantan , which is one of the Tertiary Basins in South Kalimantan (Figure 1). 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.)

Figure 1. The location of research area to element tectonics of Barito Basin

Table 1 Location sampling coordinates

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

SAMPLING

Sampling is done in the open mine of PT ALAM TANJUNG RAYA approximately 10 km East Binuang city. In this open pit there are 4 seam of coal contained in the Tanjung Formation..

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 (Figure.2). The samples were wrapped in aluminium foil, stored in plastic bags and transported to the laboratory.

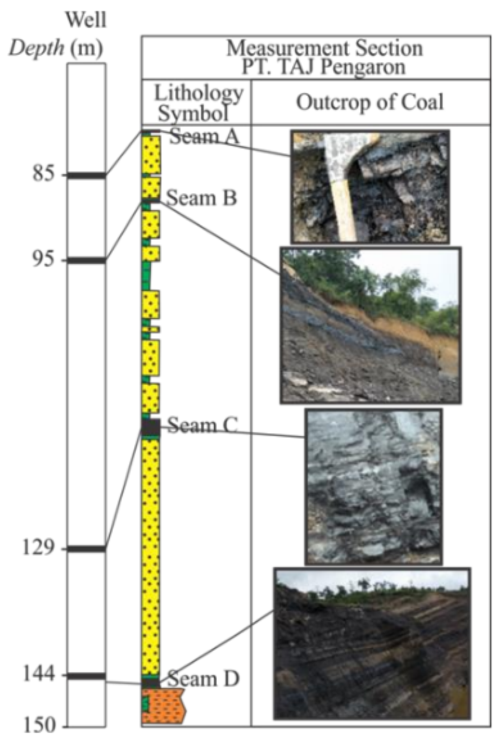

Figure 2. Correlation well log with outcrop along with number sampling

METHOD

Coal samples were dried at 40°C then crushed, then samples were taken using a reliable 250 gram method, Then sieved with 1 mm particle for coal petrographic and 0.012 mm for isotherm analysis. The samples resulting from sieving 0.6 - 1.0 mm, were used to make polishing sections with the Meta Serv 250 tool, standard observation procedures (ASTM 2856,1986). Vitrinite reflectance was measured using the Craic Coal Pro microscope (ASTM 2856, 1986. ASTM, 2009). The procedure to determine vitrinite reflectance is to standardize the sample first with the vitrinite reflectance measurement standard in the microscope: Spinel = 0.427, Sapphire = 0.505, N Last 46 A = 1.37, after standardizing the vitrinite reflectance and then observing the magnitude of the vitrinite reflectance. The Isotherm Adsorption Test requires a weight of 250 grams of the sample, the sample is crushed with a crusher to form a grain-sized powder that passes through the screen 0.121 mm (80 mesh) opening. The initial isotherm adsorption test process uses ASTM D1412-85. The sample reconditioning must weigh and place the sample in the decicator below given a K2 SO4 solution then in a vacuum condition conditioned at 300 C. 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 (CH4) purity 99.9%.

The volumetric method refers to Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO). In this method, the volume of gas absorbed by the sample is measured indirectly by injecting methane gas gradually with pressure varying to 16 Mpa (2320 psi) with varying temperatures. This test kit is operated automatically via a computer with the software Adsorption Isotherm System (CSIRO) so that the pressure when injection can control.

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:

$$Gs= ((VL\ P))/((PL+P)$$

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

Porosity and permeability measurement are done by cutting the coal sample into beam shape with size 2 cm and length 2,5 cm. Next put the dry sample into the vacuum desiccator to be expressed 1 hour and then saturated with kerosene, then the weighing are done.

RESULT AND DISCUSSION

Based on the analysis of permiability, porosity, vitrinite reflectance, mineral matter, and adsorption of methane gas from 4 samples (Table 2).

Table 2 Analysis data of Tanjung coal

No	Seam	RV	Porosity	Permeability	Mineral Matter	Adsorption Gas
		%	%	m Darcy	%	Scf/T
1	A	0.52	2.51	0.341	1.4	294
2	B	0.53	2.63	0.221	6	315
3	C	0.58	2.38	0.356	1.2	431
4	D	0.62	2.64	0.12	4	425

Based on vitrinite reflectance (RV) showed coal in the study area including bituminious coal. Porosity has an effect on permeability, from table 2 it shows that if the porosity of coal is low, it will have high permeability, and vice versa. Mineral matter is one of the factors that causes the differences above. If the mineral matter is high, it will cause a small permeability, conversely, if the mineral matter is small, the permeability will be large. Mineral matter generally resides in the intergranular space (the space between the maceral detritus) or fills in the maceral, especially the inertinite maceral group (Figure 3).

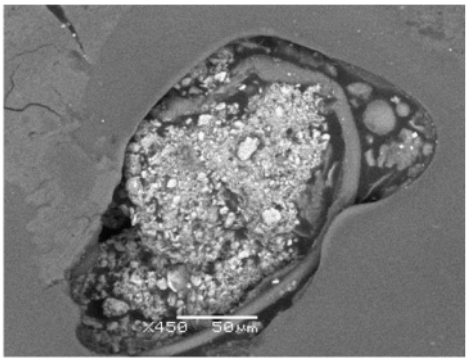

Figure 3 Photomicrography of SEM shows pyrite minerals that fill inertinite group maceral

The porosity and permeability of coal also depend on the pores of coal. Chen et al, 2015 grouped coal pores into: plant tissue pores, intergranular pores, namely the space between maceral detritus, metamorphic pores, especially pores due to gas release, and inter-molecular pores (i.e. pores between chains).

Porosity is influenced by coal rank, when coal rank gradually increases from 0.52% - 0.62%, the relationship between the two is not very clear because the increase in coal rank is very small (Figure 4).

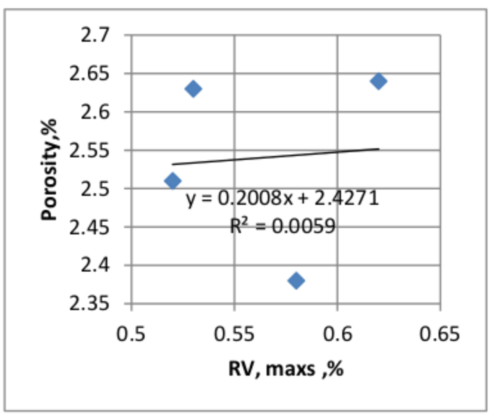

Figure 4 Relationship between coal rank and porosity

The relationship between porosity and coal rank has a positive correlation with R2 = 0.0059. The low correlation is because this coal has almost the same reflectance value so that the pores that develop are the same, in this rank coal the pores that develop are meso-pores and micro-pores. This is due to the fact that the meso-pores and micro-pores are evenly distributed and homogeneous due to mass compaction with increasing rank of coal (Liu and Nie, 2016). Meso-pores and micro-pores are affected by the coalification process combined with physical compaction which increases slowly. When an increase in coal rank will cause an increase in the gas produced, as a result, the porosity will increase.

The permeability of gas absorption depends on the connectivity between the pores. Low rank coals generally have high permeability because the connectivity of the pores that develop is macro-pores and fractures, while for coal with bituminious rank, the pores that develop are meso-pores and micro-pores so that the permeability will be small (Table 2). The relationship between coal rank and permeability in the study area has a negative relationship with the correction value (R2) = 0.3056 (Figure 5).

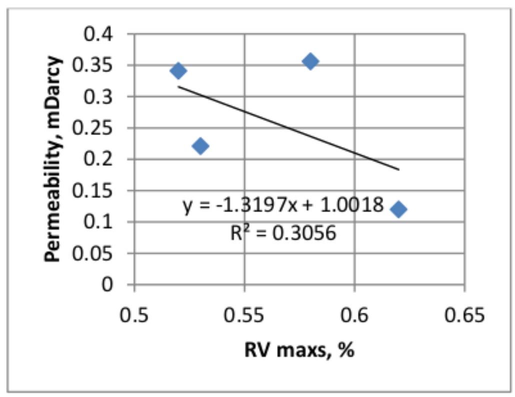

Figure 5 Relationship between coal rank and permeability

his low relationship is due to the decrease in meso-pores and micro-pores decreasing slowly which will cause a gradual decrease in permeability.

The absorption capacity of methane gas is affected by the pore size distribution and the complexity of the pore surface structure in terms of almost the same coal rank. The smaller the pore diameter and the more complex the pore surface, the he greater the pore surface area. The pore surface area will affect the absorption of methane gas, the higher the rank of the coal, the greater the surface area which will lead to stronger absorption capacity of methane gas (Figure 6).

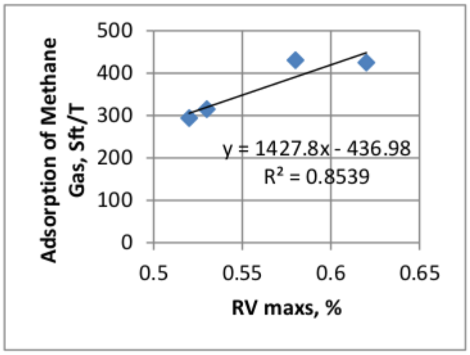

Figure 6 Relationship between coal rank and adsorption of methane gas

Coal with the same coal rank may not necessarily have the same absorption of methane gas, this depends on the presence of ash content, carbon, and mineral matter Table 3. Figure 7 shows the relationship between ash content, mineral matter, carbon and permeability. If the ash content is high, it will reduce the permeability as a result, the gas absorption will also be reduced. This is because the ash content will affect the size of the carbon content. If the carbon content is high, the ash content is small which will cause high gas absorption, and vice versa.

Table 3. Proximate analysis from coal bearing Tanjung Formation

Sampel	Moisture (%,adb)	Ash (%, adb)	Volatile Matter (%, adb)	Fix Carbon (%, adb)	Calory (cal/gr,adb)	Sulfur (%,adb)
A	3.74	2.56	48.75	44.95	7756	0.41
B	2.51	14.94	45.26	37.29	6722	0.32
C	3.7	5.44	43.16	47.7	7318	0.39
D	2.91	23.16	38.02	35.91	6936	0.44

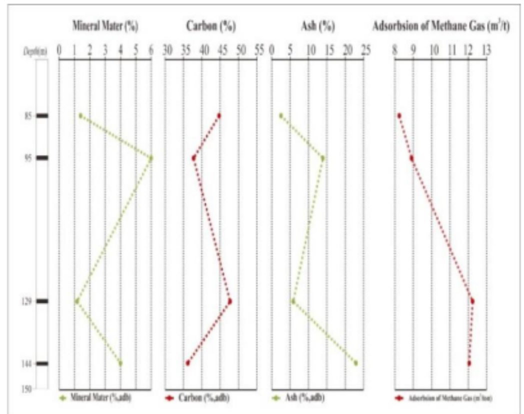

Figure7 The Value of adsorption methane gas, mineral matter, crbon, and ash content

The graphic pattern in the image above shows that the greater the value of mineral matter, the smaller the carbon value, and the greater the ash value which can reduce the volume of gas absorption, and vice versa.

Coal with the same rank will cause differences in methane gas uptake depending on the size of the mineral matter content. If coal contains large mineral matter, absorption of methane gas will be small, and vice versa. This is because mineral matter generally fills the pores between maceral detritus or fills the pores in inertinite maceral. The presence of mineral matter will disturb the absorption of methane gas.

CONCLUSION

The size of the methane absorption depends on the rank of the coal, the ash content, and the mineral matter. If coal has large mineral matter, the coal will have a small methane gas absorption, meaning that the coal reservoir will have a small gas content.

if the carbon content is low, the ash content is high as a result, the gas absorption will be low

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