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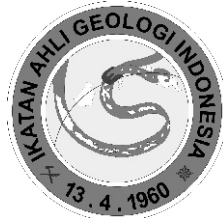
**Joint Convention
Malang 2017**

► JCM PROCEEDINGS

September 2017

“Natural Resources and Infrastructure Development for National Sovereignty”

— JCM 2017



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PROCEEDINGS OF JOINT CONVENTION MALANG 2017

September 25-28, 2017, Malang, Indonesia

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PREFACE

7th Joint Convention & Exhibition Malang (JCM 2017) has been jointly hosted by Indonesian Association of Geophysicists (HAGI), Indonesian Association of Geologists (IAGI), the Indonesian Association of Petroleum Facility (IAFMI) and the Indonesian Association of Petroleum Engineer (IATMI). This is Indonesia's largest event devoted to the geoscientists and engineers, and it will give participants a platform to exchange ideas, discover novel opportunities, reacquaint with colleagues, meet new friends, and broaden their knowledge.

The theme of the convention is *Natural Resources & Infrastructure Development for National Sovereignty*. The slump in oil price and mining commodities to their lowest level in a decade is the challenges for geoscientists, engineers and other industry professionals gather at this event to plan their E&P business program and share their knowledge. The main theme covering two main topics, i.e. energy and infrastructures, that have dependency in supporting economic growth strategy for national sovereignty.

The proceedings may contain all papers presented in the JCM 2017, covering various topics including:

1. Natural Mineral, Coal, and Energy Geothermal Resources Management
2. Environmental Issues and Hazard Mitigation
3. Geodynamics, Seismology, Petrology and Volcanology
4. Sediment and Stratigraphy
5. Geology, Geophysics, Geochemistry Methods, Technology and Application
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7. Petroleum Engineering, Technology and Application
8. Petroleum Geoscience
9. Unconventional and Renewable Energy
10. Deepwater, Production Facilities Oil and Gas Optimization, Decommissioning
11. Business Development
12. Geotourism and Others.

The papers are written by experts from various background including geological, geophysical, petroleum, mining and infrastructural community. It will broadly cover all disciplines of geoscience and engineering from fundamental research to "blue sky" applications of E&P activities.

On behalf of IAGI, HAGI, IAFMI and IATMI, we would like to thank all authors, paper reviewers and editorial board for providing the support and feedback necessary to find, develop, and publish material of such consistent high quality. I also would like to extend my thanks to all sponsor from industry, universities and government for their contributions and involvements. We highly appreciate our readers' feedback, so please share your ideas and thoughts with us.

Fatrial Bahesti – Chairman of JCM 2017

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Thickness Variation of Coal Seams in Loa Janan Anticline: Implications for Exploration and Mining Activities

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³ PT. Madani Citra Mandiri an subsidiary PT. Bosowa

Abstract

Study area of spatial is limited to the narrow asymmetry anticline that is on the forelimb of Loa Janan Anticline. In geological time, this study observed thickness variations of coal seam on the Balikpapan Formation which is a coal bearing formation from the Kutei Basin. The coal seam has four thickness variations that can be separated into pinch out, washout, splitting, and coal seam gradually turning into shally coal. The phenomenon of thickening and thinning in the coal seams can occur at close distances though. Accurate data on the coal seams thickness is very important to know, because it is closely related to the aspects of resources and reserves. Resource and reserve calculations require clarity of coal seams thickness. Errors determining the coal seams thickness can lead to errors in resource until reserves estimation. This study is descriptive-observative, so the source of data relies on field observation results, then supported by analysis to determine the effect of geological processes on thickness variation of coal seams. Furthermore, the final derivative is a combination of descriptive and genetic models of coal seams as well as the implication of thickness variation on exploration and mining activities.

Introduction

Thickness is part of the unity of coal seam geometry parameters that are interpreted as aspects of dimensions or size of a coal seam. Jeremic (1985), classifies the coal seam geometry based on their relationship between the coal seams that can be mined and the stability of the coal seams, including:

1. Coal seam thickness: (a) very thin, if the thickness is <0.5 m, (b) thin 0.5-1.5 m, (c) medium 1.5-3.5 m, (d) thick 3.5-25 m, dan (e) very thick, if >25 m.
2. Dip of coal seam: (a) horizontal seam, (b) slope seam, if its dip is <25°, (c) sloping seam 25°-45°, (d) steep sloping seam 45°-75°, dan (e) vertical.
3. Distribution pattern: (a) regular dan (b) irregular.
4. Coal seam continuities: (a) hundreds of meters, (b) thousands of meters 5-10 km, dan (c) continuously up to more than 200 km.

Knowing well that the coal seam thickness that tend to vary in the same coal seams are very important in the calculation of coal resources and reserves. Determination of the amount of coal resources and reserves, when viewed from the arithmetical usual is a simple problem and can be done

by many people. However, if you want to find coal deposits that have economical resources and already involve the genetic aspects, then the problem will be complex and require its own subject.

According to Kuncoro (2000), coal seam thickness is an important element that directly relates to resource calculation, exploration planning, production system, to the life of the mine. In understanding the varying coal seams thickness, then syn and post depositional processes need to be well understood. So it is necessary to understand the controlling factors of the direction of changes in thickness, pinch out, splitting, and can ensure the time of occurrence. Understanding of thickness, it is necessary to explain whether the coal seam thickness includes parting (gross coal thickness/GCT), coal seam thickness does not include parting (nett coal thickness/NCT), or mineable thickness. If the technical and genetic aspects are considered, the result of the determination of the coal seam thickness parameters will represent the conditions in nature.

Scope of this study is confined to the Loa Janan Anticline on anticline pathways on the surface forming a parallel north-south trending line (Fig. 1). Stratigraphically, is in coal bearing formation, that is Balikpapan Formation. Structurally, it is in the folded of coal seam, the observation of a unity of control of the same geological structure. Observation position in forelimb (east flank). The position at the top of the anticline and the syncline is not easily obtained in the field, because generally at the peak of the anticline is eroded and at the top of the syncline is still buried in the overburden.

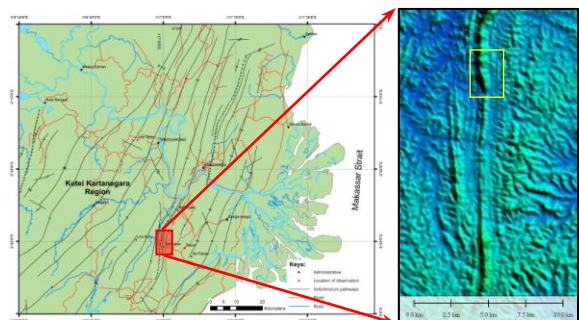


Figure 1: Study area is located within one Samarinda Anticlinorium system, locally in Loa Janan Anticline (left). The imagery showing the north-south trending ridge pattern is the straightness of Loa Janan Anticline (right).

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Tectonic setting in the Kutei Basin that forms the Samarinda Anticlinorium also controls the coal seams thickness. Ferm and Staub (1984), states that the active tectonic system during coal deposition controls the spatial, basin orientation, and distribution of coal bearing formations. The observed coal bearing formation is Balikpapan Formation. According to Supriatna et al. (1995), Balikpapan Formation who Middle Miocene age is dominated by intercalation with sandstone and claystone, as well as interbedded siltstone, shale, and coal. The thickness of the coal bearing strata in Balikpapan Formation is 4 km, coal seam thickness from several centimeters to 3.7 m (Cook, 1999).

Moore and Bellamy (1974) in Ross (1984), stated that coal geologists should look at coal from various aspects, namely the depositional environment of coal aspects and coal genesis. Both can be used to predict the continuity of the

wide lateral coal seams, recognizing the thickness variation of coal seams, through the condition of the roof and floor layers during mining activities.

Data and Method

This study is based on descriptive-observation, that is based on the result of field observation, then realized to be the outcrop profile (Fig. 2), and supported by the result of analysis. So try to do a thick measurement directly in each coal outcrop by applying trenching and test pit method up to the roof and floor contact. The objective is to observe the character of the coal body, to observe the presence of parting on coal outcrops that are not fully exposed. This study is based on coal seam thickness and parting thickness, so it has a broad understanding of GCT and exactly determine NCT.



Figure 2: Profile on each coal outcrop along with thick NCT and GCT data on coal seams that have parting.

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Study object consisted of coal seam thickness. The object of the observation is to measure NCT and analyze if there is a thickness difference in the same seam. Stages in this study consisted of data acquisition, analysis, and synthesis. Final synthesis of syn and post depositional to thickness variations of coal seams in the study area. Furthermore, the final derivative is a combination of description and genetic model of thickness variations of coal seams and determines the implications for exploration and mining activities.

Thickness variation of coal seam is also affected by processes that work syn depositional and post depositional. Syn depositional processes include the velocity difference of coal accumulation, the morphological of coal basin, the process of basin subsidence at the time of sedimentation, syn-fault and karst process. Post depositional process, it is channelling like washout, will affect the thickness and continuity of coal seams. Tectonics that develop in sedimentary basins also affect thickness variations (Fig. 3). Based on the control of its depositional environment, Horne (1978), states that the coal formed in the back-barrier environment tends to be thin. In the lower delta plain environment is generally also thin, vice versa on upper delta plain and transitional lower delta plain relatively thick.

Type	Subtype	Cross section	Frequency
Depositional	Due to differentiated rate of coal accumulation		common
	Due to sedimentary basin morphology		common
	Due to synsedimentary subsidence (splitting)		common
	Due to synsedimentary erosion		rather rare
	Due to synsedimentary faulting		rare
	Due to synsedimentary karst		rare
Postdepositional	Erosional		common
	Tectonic		rather rare

Figure 3: Thickness variations of coal seams based on geological processes (Cecil and Medlin, 1987).

Result and Discussion

Thickness variations of coal seams in the study area can be separated into four thickness variations consisting of:

- Pinch out on coal seams

Based on the results of the on strike correlation of Profile Bp21, Bp25, and Bp27 (Fig. 4), found a phenomenon in the

same coal seams is pinch out. Coal seam thickness at Bp 21 is 3.55 meters. Then Bp21 and Bp27 on the same of coal seam thickness decreased to 1.5 and 1.65 m.

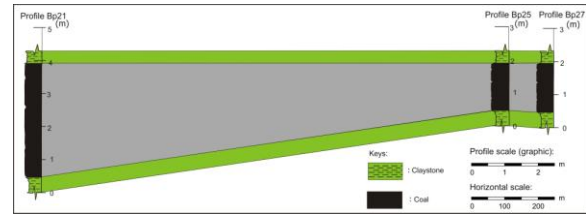


Figure 4: On strike correlation of Seam A Profile, thinning of coal seam phenomenon is called pinch out.

The possible occurrence to illustrate the pinch out is due to the morphological difference in the coal basins where of coal are deposited. Thus pinch out on strike occurs coal syn-depositional process not because of the factor coal post depositional.

- Washout on coal seams

Based on the results of the on strike correlation of Profile Bp26, Bp23, and Bp22 found the phenomenon of sandstone lenticular body, which scour and fill some existing coal. Based on Bp23 field data, there is an erosional contact between coal and sandstone above it. Then after reconstruction can be seen the difference of roof with the same coal seam where on Bp23 roof sandstone with erosional contact (Fig. 5).

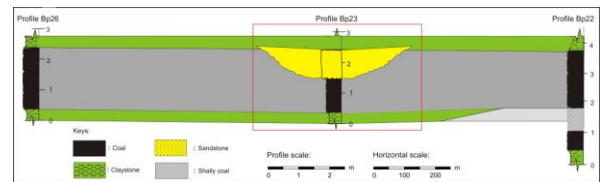


Figure 5: On strike correlation Seam B Profile, washout phenomenon on coal seams.

An event that may explain how washout occurring in the study area is that a channel carrying a coarse-grain material eroded some of the coal seams so the contact between sandstone and coal is erosional (see Fig. 5). Then because some of the coal seams are replaced by sandstones so that the coal seam on Bp23 are thinner than the coal seam on Bp26 and Bp22.

- Splitting on coal seams

Based on the result of the on strike correlation from Profile Bp28, Bp29, and Bp30 (Fig. 6). In Profile Bp28 and Bp29 inside the coal is interbedded by claystone while in Bp30 coal seam is not inserted by claystone. Based on the facts

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found in the phenomenon of coal split, the non-coal layer separates the coal layer with each other. Non-coal material which separates coal seams from one another is referred to as parting. The occurrence of separate coal seams is called splitting.

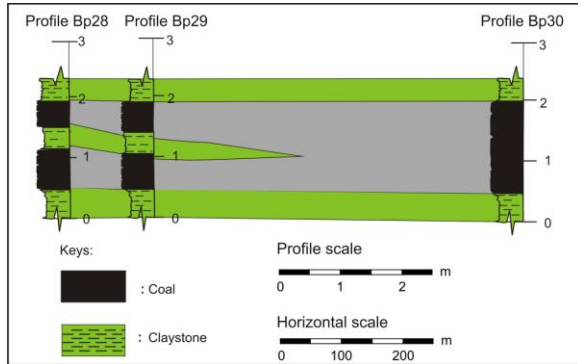


Figure 6: On strike correlation Seam C profile, splitting phenomenon on coal seams.

An event that may explain how splitting occurs in the study area is due to the supply of accumulation of clastic sediments replacing the accumulation of organic material when the coal syn-depositional, so that when the accumulation of clastic sediments begins to run out while the organic material continues to re-deposited coal. The incident resulted in a layer of splitting coal. This incident can also be explained because of the growth of fault along with the coal genesis.

- Coal seam gradually turning into shally coal

Based on the results of the on strike correlation from Profile Bp31, Bp32, and Bp33 (Fig. 7A) and on strike correlation from Profile Bp30 and Bp24 (Fig. 7B) are found coal seam gradually turning into shally coal (Fig. 8). Events that can explain how the change of coal seam is turned into a shally coal because the supply of mixed clastic sediment accumulation with the organic material accumulation at the beginning or end of become coal genesis so that the organic material should be coal because it is mixed with macerals.

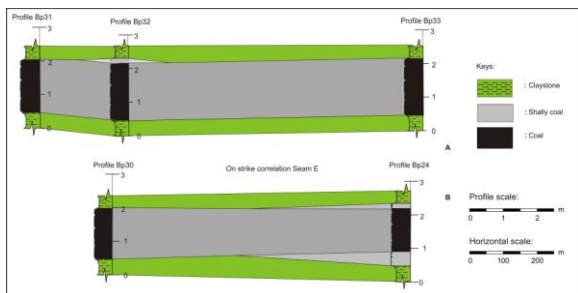


Figure 7: Coal seam gradually turning into shally coal.



Figure 8: Coal outcrop Bp32 with $N6^{\circ}E/76^{\circ}$, bottom image shows contact between coal with shally coal.

- Implications of thickness variations in coal seams on exploration and mining activities

The phenomenon of thickness variation on coal seams above can even occur at close distances though, so that this condition can be used for large-scale planning and exploration program standards, including those aspects that are selectively chosen for more precise drill plans. Matters relating to exploration planning and coal mining activities and some examples of the use of such data (Table 1).

Conclusion

Accurate data on the coal seams thickness is very important to ascertain, because it is closely related to the aspects of resources and reserves. Resource and reserve calculations require clarity of coal seam geometry consisting of thickness, the continuity of coal seam, dip of coal seam, distribution pattern, regularity, weathering conditions, and coal seam shape (Jeremic, 1985). Errors in the measurement and determination of coal seams thickness can lead to errors in the estimation of resources/reserves.

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Coal seams thickness is generally done for technical reasons but it is actually necessary to consider the genetic aspects. If genetic rules are taken into consideration, then the result of determining the coal seams thickness will

represent the condition in nature. Finally, the estimation of resources and reserves will be more accurate, is closer to the realization during mining activities. These genetic aspects include the syn and post-depositional processes.

Table 1. The thickness variation of coal seams can affect exploration planning and mining activities.

Seam	Thickness variation phenomenon	Implications for exploration	Implications for mining activities
A	Pinch out on coal seams	<ul style="list-style-type: none">▪ Inadequate understanding of the thickening and thinning of coal seams will be a problem in determining the size of coal resources.▪ Become a problem in planning the development or expansion of exploration areas.	<ul style="list-style-type: none">▪ Mining system to be implemented, selection of mine layout, and application of mining technology.▪ Determination of production planning.▪ Determining the age of the mine as it relates to coal resources/reserves.
B	Washout on coal seams	<ul style="list-style-type: none">▪ Coal seams thickness decreases as some layers of coal are replaced by channels so that the coal seams are thinning.▪ Coal seams is not continuous because scour and fill by channel.▪ Become a problem in determining the size of coal resources.	<ul style="list-style-type: none">▪ Coal seams replaced by materials carried by the channel so that the equipment used to excavate coal often finds it difficult to penetrate non-coal material that has replaced coal seam position.▪ Materials brought by the channel can affect slope stability.▪ Sandstone brought by the channel can become an aquifer so as to bring water in mine pit.▪ Mining planning and development.
C	Splitting on coal seams	<ul style="list-style-type: none">▪ Coal seams thickness is reduced due to non-coal materials inserts.▪ Affects resource/reserve calculations.▪ If in parting sampling can not be separated properly and mixed with coal, it will affect the determination of coal quality.	<ul style="list-style-type: none">▪ A split shape with a slope 45° accompanied by cohesive changes in the rock will cause problems in open pit mining and slope stability.▪ Being problematic when coal removal due to parting must be well separated, will affect the coal quality.
D	Coal seam gradually turning into shally coal	<ul style="list-style-type: none">▪ Be a problem in coal resource calculation.▪ If in sampling can not be separated properly and mix with coal will affect the determination of the coal quality.	<ul style="list-style-type: none">▪ Coal mining stage that gradually becomes shally coal if the shally coal can not be separated properly and mixed with coal at the time of mining it will affect the coal quality.▪ The presence of non-coal materials can affect slope stability.

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The theme of the convention is Natural Resources & Infrastructure Development for National Sovereignty. Despite the abundance of energy resources, Indonesia is often plagued by blackouts – particularly outside the bigger cities on Java and Bali – because of shortages in the country's energy supply. Lack of adequate infrastructure in Indonesia seriously undermines the attractiveness of Indonesia's investment climate. Thus, energy and infrastructure have dependency in supporting economic growth strategy for national sovereignty.

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