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PALEO-ENVIRONMENT MODEL OF SUB-BITUMINOUS COAL SEAM BASED ON MACERAL DATA ANALYSIS IN BANKO BARAT

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ABSTRACT: Depositional model are a substantial way to to achieve a better understanding about coal properties and seam characteristics. There are many ways to interpret depositional models, one of them is by analysing macerals of the coal obtained from the core. Tissue Preservation Index (TPI) and Gelification Index (GI) plotted in the formula of Diessel (1986) to know the depositional environment. Maceral group observed from coal in Banko Barat show dominant Vitrinteecontent such as teloVitrinte and detroVitrinte. Cutinite and Resinite appear as a part of Liptinit while Funginit-Semifusinit as a part of Inertinite. These group of maceral was a character of Tertiary Coal Seam. High value of Vitrinte and Lower percentage of liptinite/Inertinite indicate that peat swamp in research area was situated in unstable basin between upper delta plain and lower delta plain. Thus, the depositional environment shifted, causing mineral matter filling in the coal.

From the TPI versus GI formula, depositional environment achieved and show that the coal seams were deposited primarily in a Limited Influx Clastic Marsh. At some point, depositional environmental change to Limno Telmatic and Wet Forest Swamp. TPI values from research area varied ranging from 0,022 to 3,36. On the other hand, GI value of the coal ranged from 11,54 to 79,58. These are happened as the effect of high content of Vitrinte Maceral (approximately 89,72%) and Low content of Inertinite (about 3,91%).

INTRODUCTION

Banko Barat is one of the coalmine concessions in Tanjung Enim, South Sumatra (Figure 1). It has five coal seams that produce a coal product. Coal rank in this field is between lignite to sub-bituminous. Calorific value ranged from 4600 kcal/kg to 5500 kcal/kg as received in this field Coal properties and seam characteristics were mainly affected by maceral and mineral matter filled in the coal. These features belongs to specific depositional environments (Figure 2) and the percentage of each maceral unit (Vitrinte, liptinite, Inrtinite) and mineral matter. Thus, it is imperative to get a better insight about coal properties and the seam distribution in the field.

The percentage of maceral of a coal seam has a firm connection to depositional facies when the peat and coal accumulated, so maceral analysis could be used to reconstruct the coal depositional environment.

Coal samples were obtained from the core of a borehole. From this core, some samples were taken to laboratory to conduct maceral analysis. Maceral composition analysis was conducted to obtain the percentage of maceral content of the coal sample. A reflected light microscope was used along with a point Counter. Observation of coal maceral compositions conducted in 1000 points accordance to ASTM D2799-13.In normal reflected white light mode, maceral type could be determined based on degree of reflectivity. Inertinite was the most reflective type of maceral, while liptinite was on the contrary. Reflected fluorescence mode used to observe maceral compositions in liptinite. Fluorescence intensity depleted as the increasing of organic

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rank/maturity (Cook, 1982; Teichmuller, 1985). It conducted as the adjustment to Diessel Diagram (1986) which will be used to interpret depositional environment in Banko Barat.

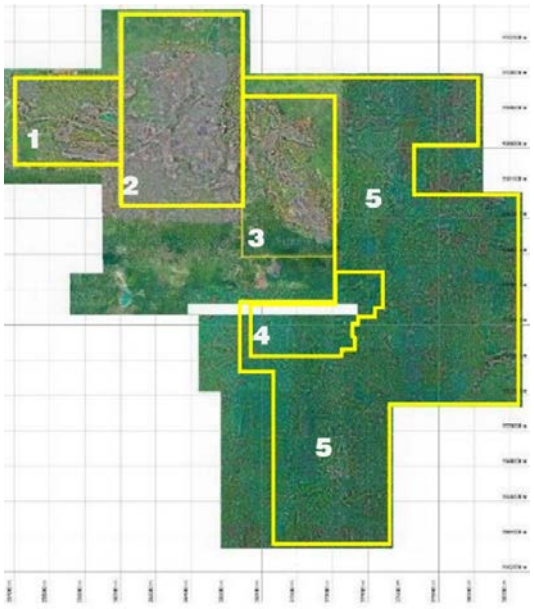

Figure 1: Banko Barat Location as one of Bukit Asam Coalmine Concession (number 3)

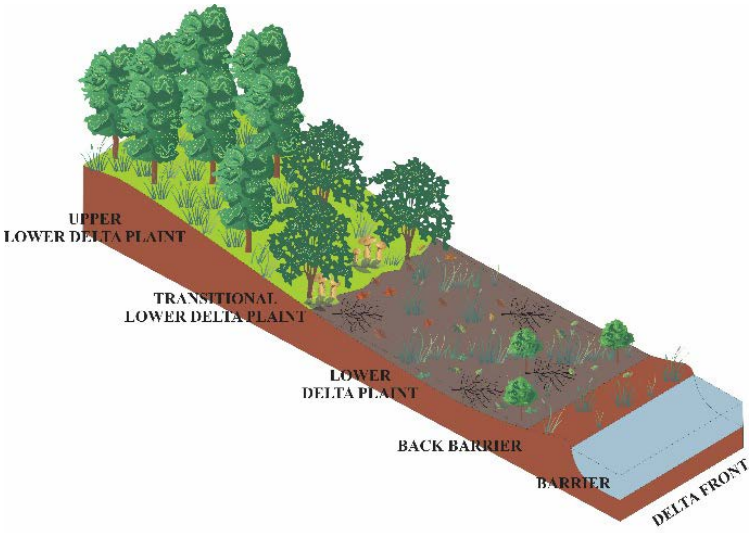

Figure 2: Coal Depositional Environment Model (Horne, *et al*., 1978)

DATA AND METHOD

At the final step, Tissue Preservation Index versus Gelification Index was applied to determine the exact depositional environment.

Tissue Preservation Index (TPI) determines the percentage of tree density within the area. The more the value of TPI, the more abundance of tree. On the other side, Gelification Index (GI) were useful to determine whether the environment was dry or wet. It shows how much water was involved in the environment. The more water involved, the more Vitrintee produced in coal compositions. This diagram (Figure3) was composed by Tissue Preservation Index values (x axis) and Gelification Index (y axis). Low value of TPI and GI was interpreted as deposited on Open Marsh while the higher value of both TPI and GI shows Wet Forest Swamp. Low value

of TPI and High value of GI are determined as Limited influx Clastic Marsh. High values of TPI and low values of GI as Dry Forest Swamp.

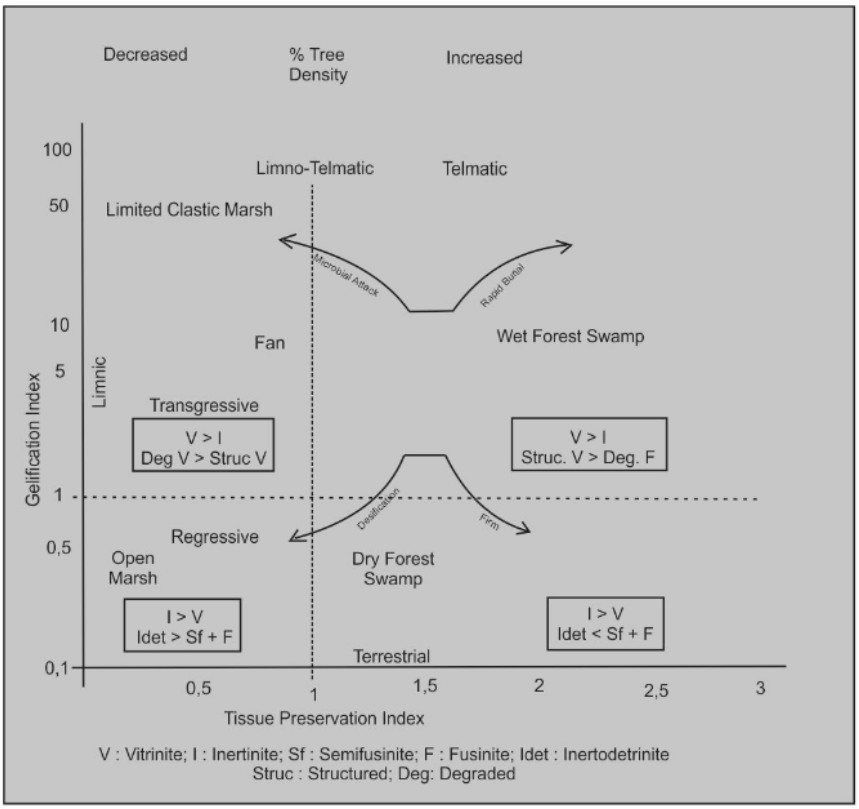

Figure 3: Depositional Environment Analysis Diagram Modified from Lamberson (1991)

RESULT AND DISCUSSION

Observation on maceral groups showed dominant vitrinte content, where almost all samples dominated by the vitrinte group such as telovitrinte and detro vitrinte as much as 89,72%. On the other side, liptinite group (such as cutinite and resinite) and Inertinite group (such as funginit and semifusinite) has lower percentage approximately 3,91%. These groups of maceral are an example of tertiary coal character. High value of Vitrinte and low value of liptinit/Inertinite indicated that peat swamp in Banko Barat located at unstable basin between upper delta plain and lower delta plain. Depositional environment shifting had an effect on this unstable basin and caused the formation of mineral matter filling in the coal.

TPI value varied from 0,22 at the lowest (BTR 09 seam B1) and 3,36 at the highest (BTR 15 seam B1). GI value also varied from 11,54 (BTR 08 seam A1) to 79,58 (BTR 07 seam B2).

From TPI vs GI plots, it can be concluded that Seam C was deposited mainly in Limited Clastic Marsh. Along with the time, seam B2 was deposited in Limited Clastic Marsh but with some samples in Limno-Telmatic Marsh. Seam B1 was more Telmatic with the regression period of deposition. Seam A2 was not different from seam B1. Finally, transgression happened again while seam A1 was deposited in Limited Clastic Marsh, back to the condition where seam C deposited.

Figure 4 shows that all coal of seam B1 was rich in Vitrinte content. Vitrinte content has lateral relationship with Gelification Index. The majority of coal B1 has low Tissue Preservation Index just one of the sample has a higher value. In conclusion, seam A1 was deposited mainly on Limited Clastic Marsh and one of sample show Limno Telmatic as depositional environment.

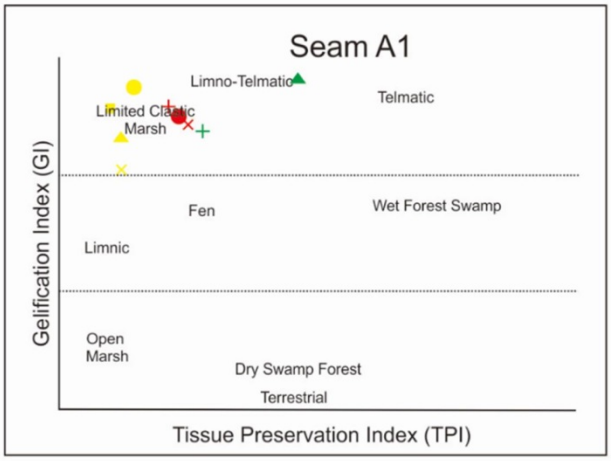

Figure 4: TPI vs GI diagram of seam A1

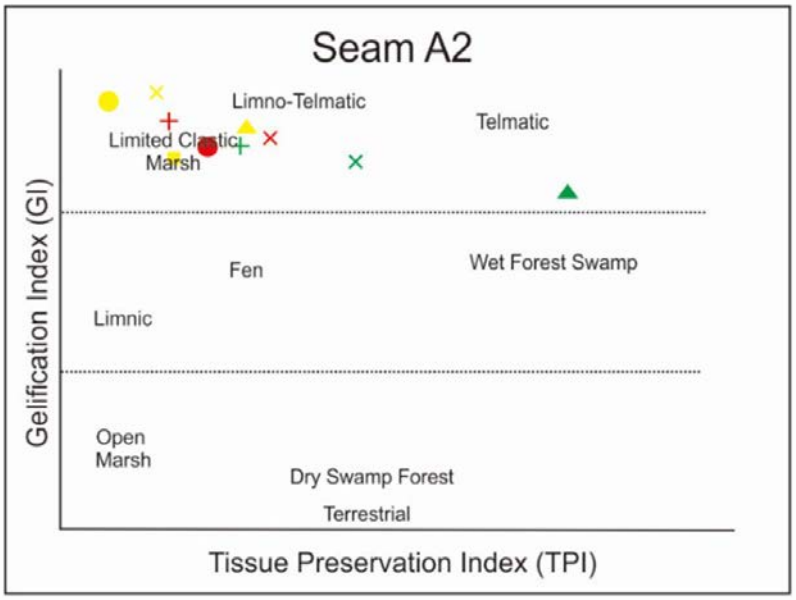

Figure 5: TPI vs GI diagram of seam A2

In Figure 5, a diagram of Seam A2 showing that all coal of seam A2 was rich in Vitrintee content. The majority of coal A2 has low Tissue Preservation Index although some of them has higher value. In conclusion, seam A2 was deposited mainly on Limited Clastic Marsh with some sample show Limno Telmatic as dopositional environment.

Figure 6 shows that all coal of seam B1 was rich in Vitrinte content. The majority of coal B1 has a low Tissue Preservation Index although some of them have higher value. In conclusion, seam B1 was deposited mainly on Limited Clastic Marsh and Limno Telmatic.

In Figure 7, a diagram showing that all coal of seam B2 was rich in Vitrinte content. The majority of coal B2 has low Tissue Preservation Index although some of them have higher values. In conclusion, seam B2 was deposited mainly on Limited Clastic Marsh and some sample show Limno Telmatic as depositional environment.

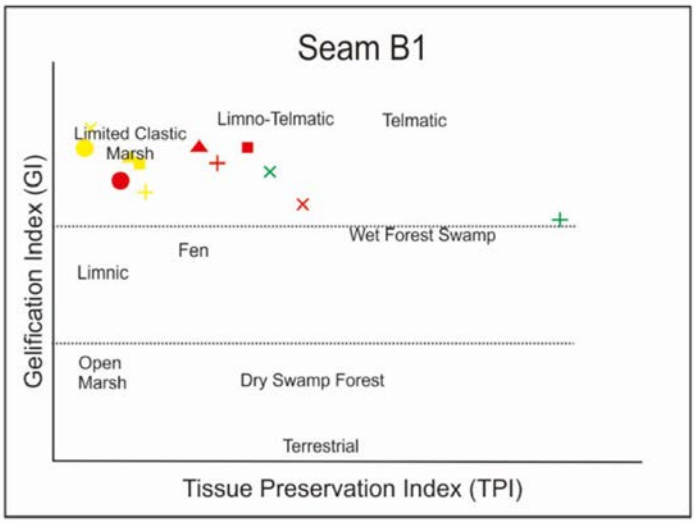

Figure 6: TPI vs GI diagram of seam B1

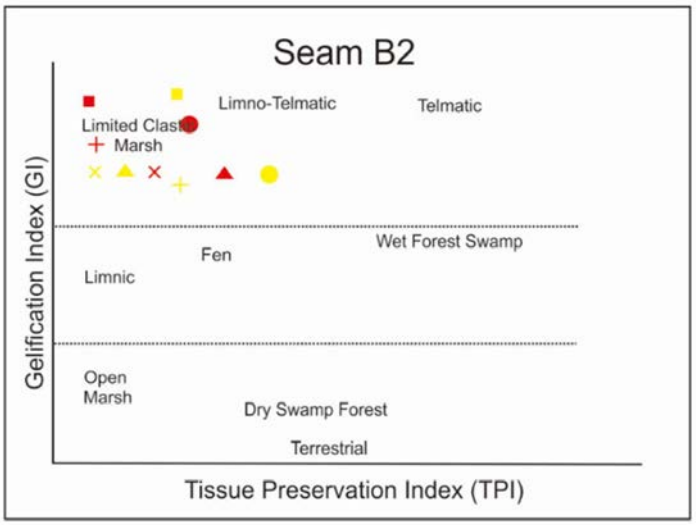

Figure 7: TPI vs GI diagram of seam B2

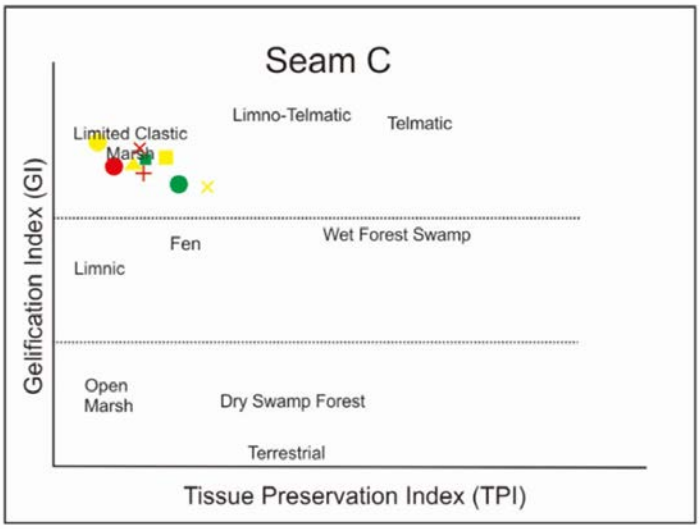

Figure 8: TPI vs GI diagram of seam C

Diagram of seam C shows that all coal of seam C was rich in Vitrinte content. All of coal B1 has low Tissue Preservation Index. In conclusion, seam C was deposited on Limited Clastic Marsh.

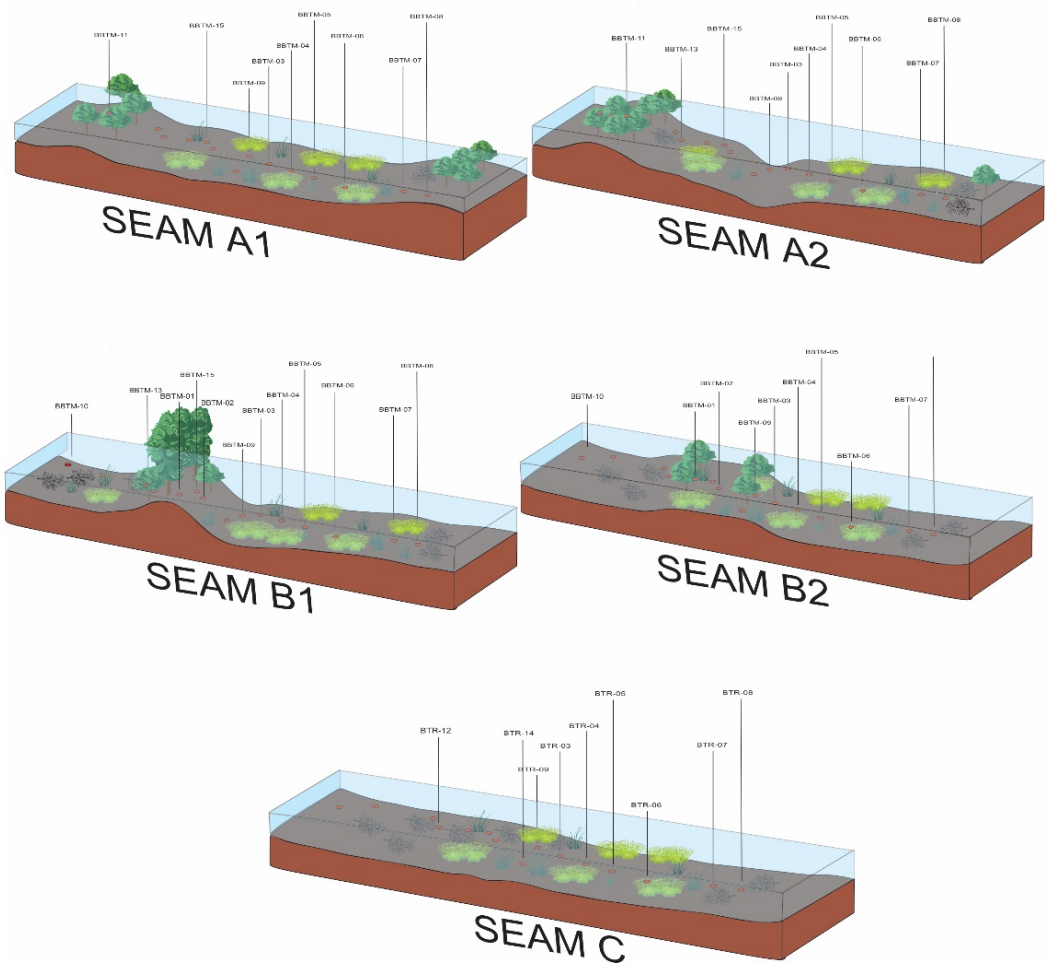

Figure 9: Paleo-environment model for each of Banko Barat Seam

CONCLUSIONS

Liptinite and Inertinite were rarely found in samples from the field, while Vitrinte was very abundant. Vitrinte rich coal shows that this coal was deposited in a water-rich environment. This coal is still categorized as lignite type despite has high value of Vitrinte. It is due to low reflectance of the Vitrinte.

Observations and analysis of TPI vs GI in all samples resulted in the interpretation that the main coal seams in the Banko Barat were deposited in Limited Clastic Marsh. It is the environment where tree density is low and water was abundant. In some samples also found characteristics that shows more tissue preserved where indicated it deposited on more tree density.

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