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Electrofacies and Depositional Environments of Sajau Coal Formation in Berau Basin, Northeastern Kalimantan, Indonesia

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Abstract: ***This study analyses depositional environments of the Early Pliocene Sajau Coal Formation, northeastern Berau Basin, based on cores and well log data. On basis of log pattern and lithology composition the lithofacies in this area can be grouped into 4 lithofacies i.e sandstone, coal, clay and shale. This lithofacies suggests that this Sajau Formation have been deposited in Fluvial, Upper Delta Plain and Lower Delta Plain setting and represents transgressive succession. This transgressive succession is controlled by tectonic subsidence.***

Keywords: Coal, depositional environment, lithofacies, Sajau Formation, Berau Basin

1. Introduction

Distribution of coal is needed as information for the exploration of coal. Depositional environment influence distribution of coal. Because of this, the depositional environment is really important. The depositional environment can be identified by electrofasies analysis. Electrofasies analysis is one of the methods using log pattern for the identification lithofacies in the well and interpretation depositional environment. Classification of electrofacies has been correlated with grain size distribution. This electrofacies using well log data mainly gamma ray log [1,2].

Physiographically, the Berau Basin are bordered in the southeastern part by Suikerbrood Ridge, Mangkalihat High, towards the western part of Berau Basin limited by Sekatak-Berau High; To the north is limited by the horizontal fault of Maratua Fault and Latong High which separates with the Tidung Basin. Berau basin opens to the east bordering with the Tarakan Basin [3,4].

The Sajau Formation have been deposited in the eastern part of the basin which is a coal bearing formation of Pliocene with a total thickness of about 775 m. This Sajau Fomrmation consist of coal, siltstone, sandstone, conglomerate. The Sajau formations were deposited in fluvial and delta environment [5,6].

The character and relative importance of deltaic process is influenced by the various factors, ranging from climate to the shape, configuration and tectonics of the receiving basin. The vertical facies profiles of deltaic deposits as seen either in the field or on electric logs. Tectonically generated physiographic changes may produce significant facies differences [7,8].

The objectives of the research were to evaluate the depositional environments and lithofacies which had been outlined by the previous authors with wireline logging analysis.

2. Data and Methods

The research location in Sajau Formation, Berau Basin, East Kalimantan. Well log and core data can be contributed to better identify depositional environment. This study combines of wireline logging analysis, core/cutting sedimentological description and electrofacies analysis to define depositional environment of coal in The Sajau Formation.

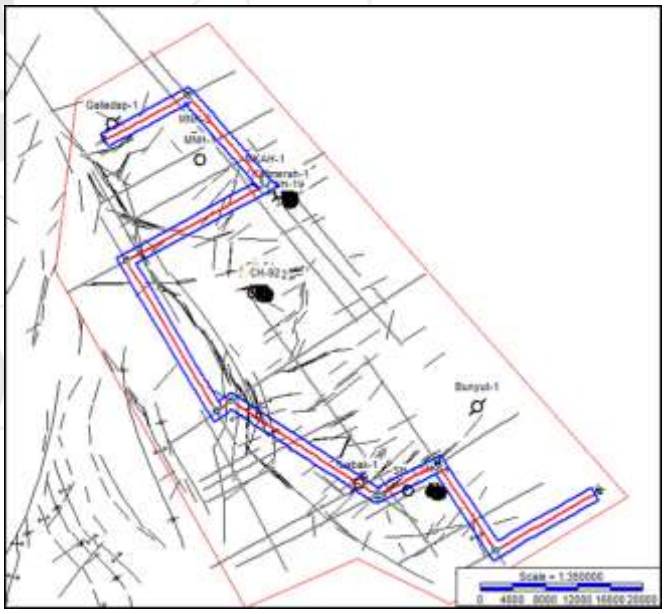

Figure 1: Location of well exploration in research area, Sajau Coal Formation in Berau Basin, Northeastern Kalimantan, Indonesia

3. Result

3.1 Crossplot Analysis

The crossplot analysis is commonly used to identify and estimate facies probabilities. The crossplot analysis is carried out using the well log data. Crossplotting of attributes was introduced to visually display the relationship of gamma ray

and density to acoustic impedance. In this area, this crossplot represents four lithofasies, i.e coal (green to yellow green), clay (blue to purple), shale (arctic to blue) and sandstone (yellow to brown).

The coal in the Sajau Formation is estimated by low gamma ray which the density ranges from 1 to 1.7 g/cc and the acoustic impedance range from 6809 - 8838 gr/cc * ft/s.

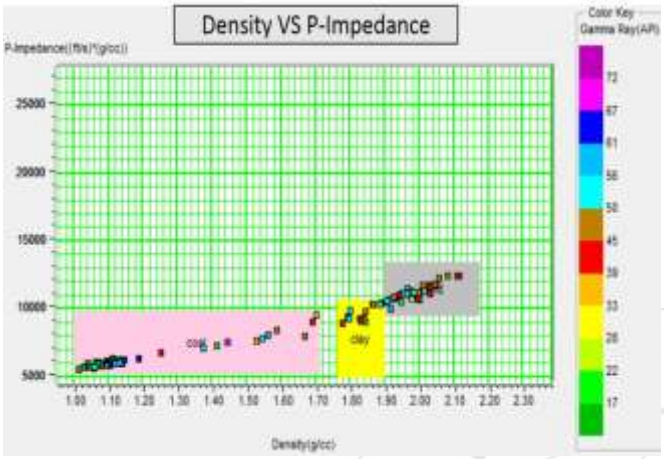

Figure 2: Cross plot of density log vs acoustic impedance log at Kalimerah#1

3.2 Coal Identification Based on Well Log Data

The coal at Kalimerah#1 is was determined through mud log data analysis (gas reading, oil show, lithology), wireline logging data, cutting data, sidewall cores data and cross plot data (lithology). At Kalimerah#1, the wireline logs comprising of gamma ray, spontaneous potential, resistivity, density, neutron and sonic.

Nine coal seams are identified within the wireline logs (named seam A, B, C, D, E, F, G, H and I). The lithofacies commonly overlies the alternated sequences of sandstone, clay and shale. At places, the coal may grade into shaly coal. Interseam partings of shale is commonly present and represents high gamma ray on coal (Figure 3).

Based on burial history, the coal is classified as lignite which the temperature ranges from 60-150F^0. The gamma ray values of coal seam can be described into 2.48 to 28.25 API. Meanwhile, the resistivity values of coal can be informed about 3.30 to 23.74 ohm.

Three identified informal part of the Sajau Formation are recognizeable. This part of the Sajau Formation, i.e Upper Part Sajau, Middle Part Sajau and Lower Part Sajau.

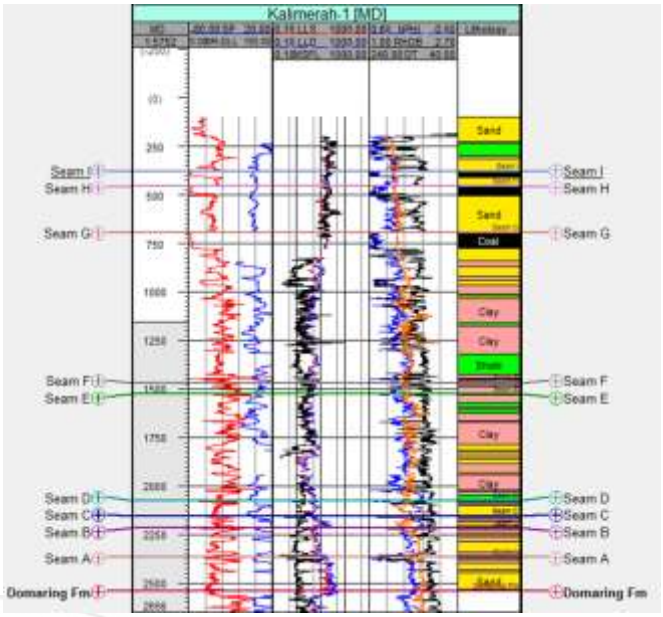

Figure 3. Nine coal zones of Sajau Formation in Kalimerah#1

3.3 Electrofacies of Sajau Coal Formation

Electrofacies in Sajau Coal Formation mainly consists of serrated to cylindrical and contains funnel shape and bell shape (Figure 4, Table 1).

Table 1: Facies Association of Depositional Environment, Sub-Depositional Environment, Electrofacies and Lithofacies

Lingkungan Pengendapan	Sub-Lingkungan Pengendapan	Elektrofasies	Litofasies
Delta	Lower Delta Plain	Serrated	Batubatulempung dan serpih
		Cylindrical	Batubara, batupasir
		Bell Shape	Batupasir, batubatulempung
		Funnel Shape	Batupasir
	Upper Delta Plain	Serrated	Batubatulempung dan serpih; batupasir dan batubatulempung
		Cylindrical	Batubara
		Funnel Shape	Batubatulempung, batupasir
Fluvial	Braided River	Serrated	Batupasir dan batubatulempung
		Cylindrical	Batupasir
		Bell Shape	Batupasir, batubatulempung

The presence of low gamma ray and high gamma ray represents alternating of coal and sandstone to mudstone.

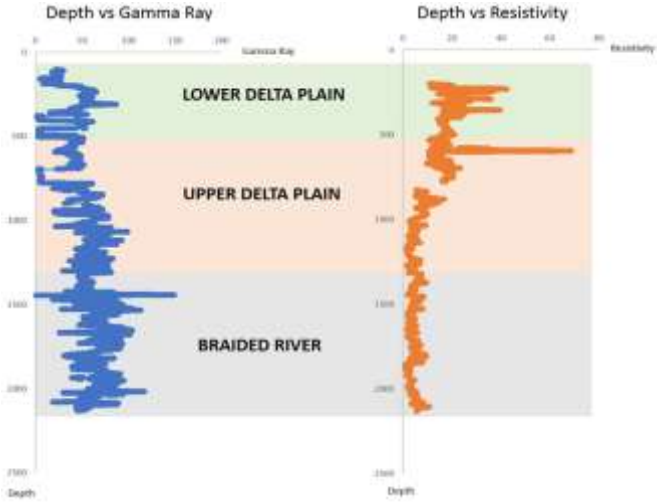

Figure 4: Stacking sheet element Kalimerah#1 of gamma ray log and resistivity log

3.3.1. Upper Part Sajau Formation

Electrofacies in the Upper Part of Sajau Formation consists of cylindrical, serrated, funnel shape and bell shape. In this area, the funnel shape represents coarsening upward and the serrated describes alternating beds of sandstone and clay to shale. The cylindrical suggests that the coal is homogeneous and thick. The thick coal in this area represents a long persistent, slowly subsiding and densely vegetated backswamp. Thin mudstone at the top of the channel sandstone is described by bell shape and represents fining upward in this area.

The lithofacies in this area can be grouped into four lithofacies i.e sandstone, coal, clay and shale. Shale suggests that the sediment was deposited in creavasse splay environment with frequent variation of current energy condition. Thin mudstone at the top of the channel sandstones indicates deposition from suspension during channel abandonment. The thick sandstone associated with coal seams suggests deposition by vertical accretion in backswamp environment. Sandstone is the most dominant of floor in coal seam. This depositional environment suggests that this Uper Part of Sajau Formation have been deposited in Lower Delta Plain setting and represents transgressive succession. This transgressive succession is controlled by tectonic subsidence.

Two coal seams are identified in the Upper Part of Sajau Formation i.e Seam H and I.

3.3.2 Middle Part of Sajau Formation

Electrofacies in the Middle Part of Sajau Formation consists of cylindrical, serrated and funnel shape. In this area, the funnel shape represents coarsening upward and the serrated describes alternating beds of sandstone and clay to shale. The cylindrical suggests that the coal is homogeneous and thick. The thick coal in this area are influenced by local aggradation of channel, slow and steady subsidence of the basin area and long period of stable time characterized by alternating beds of sandstone and clay to shale.

The lithofacies in this area can be grouped into four lithofacies i.e sandstone, coal, clay and shale. Shale suggests that the sediment was deposited in floodplain environment with frequent variation of current energy condition. Thin mudstone at the top of the channel sandstones indicates deposition from suspension during channel abandonment. The thick mudstone associated with coal seams suggests deposition by vertical accretion in backswamp environment. This depositional environment suggests that this Middle Part of Sajau Formation have been deposited in Upper Delta Plain setting and represents transgressive succession. This transgressive succession is controlled by tectonic subsidence.

Three coal seams are identified in the Middle Part of Sajau Formation i.e Seam E, F and G.

3.3.3 Lower Part of Sajau Formation

Electrofacies in the Lower Part of Sajau Formation consists of cylindrical, serrated and bell shape. In this area, the bell shape represents fining upward and the serrated describes alternating beds of sandstone and clay. The cylindrical suggests that the sediment was deposited in Braided River setting. The thin coal seam contains abundant splits of sandstone and clay that indicates a short-lived flooding during that period.

The lithofacies in this area can be grouped into three lithofacies i.e sandstone, coal and clay. This lithofacies suggests that this Lower Part of Sajau Formation have been deposited in Fluvial setting. Four coal seams are identified in the Lower Part of Sajau Formation i.e Seam E, F and G.

4. Conclusion

Depositional environment can be identified by electrofacies analysis. Electrofacies in Sajau Coal Formation mainly consists of serrated to cylindrical and contains funnel shape and bell shape in. The lithofacies in this area can be grouped into 4 lithofacies i.e sandstone, coal, clay and shale. This lithofacies suggests that this Sajau Formation have been deposited in Fluvial environment at Lower Part Sajau, Upper Delta Plain setting at Middle Part Sajau and Lower Delta Plain setting at Upper Part Sajau. All of this depositional environment represents transgressive succession. This transgressive succession is controlled by tectonic subsidence.

References

[1] Diessel, Claus F.K. 1992. Coal-Bearing Depositional Systems. Springer-Verlag. Berlin Heidelberg. p. 727.
[2] Walker, R.G. and James, N.P. 1992. Facies Models Response to Sea Level Change. Geological Association of Canada, Department of Earth Science. Canada. 157 p.
[3] Hamdani A. H., Diana P. H., and Welly A. R. 2013. Well log and seismic application in delineating CBM sweet spot in Berau Basin, Northeast Kalimantan. American Physics Institute. p. 4.
[4] Situmorang, R.L., and Burhan, G. Geological. 1995. Map of the Tanjungredeb Quadrangle, Kalimantan, scale 1:250.000. Geological Research and Development Centre. Bandung.
[5] Sunardi E., and Hamdani, A.H. 2014. Sedimentology and Petrography of Sajau Coal Formation in Berau

Basin, East Kalimantan. International Journal of Science and Research. v. 3. pp. 1184-1191.

[6] Vera Christianti, Hamdani, A.H., and Winantris. 2015. Pliocene Pollen and Spores from Sajau Coal, Berau Basin, Northeast Kalimantan, Indonesia. Environmental and Climatic Implication. International Journal of Science and Research. v. 4. pp. 533-538.

[7] Coleman, J.M. 1980. Deltaic Sand Bodies: A Short Course, Education Course Note Series # 15. American Association of Petroleum Geologist. Coastal Studies Institute, Louisiana State University.

[8] McLean. J.R., Jerzykiewicz, T. 1978. Cyclicity, tectonics and coal: some aspects of fluvial sedimentology in the Brazeau-Paskapoo Formations, Coal Valley Area, Alberta, Canada. In: Miall, A.D., (eds.), Fluvial Sedimentology. Canadian Society of Petroleum Geologists. Alberta, Canada.