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Tectonic Influence on Changes in Neogene Sediment Supply, Western Part of North Serayu Basin

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ABSTRACT

Western part of North Serayu Basin composed of Neogene sequence; Halang, Pemali and Rambatan Formation. The oil seeps discovery in this area is an indication of the presence an active petroleum system. Active tectonic condition occur coincidence with the time of deposition. The tectonic influence on change in sediment supply will be the subject of this research.
The combinations of subsidence, eustatic and sediment supply are corresponding to the accommodation space, moreover to the type of sediment which is deposited. The quantity and rate of sediment supply to the basin are closely related to the tectonic activity. In the context of Petroleum Potential, study of sediment supply will provide information about the potential source rock, reservoir and caprock that developed in the research area. During the Neogene at least there have been three times of sea level change in the research area which is related to thickening sedimentary sequence during middle of N18 and thinning in N13 to N17 in some place.

Keywords: Tectonic Influence; North Serayu Basin; Petroleum System; Sea Level

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1. INTRODUCTION

The western part of North Serayu Basin generally composed of Neogene sequences of Halang, Pemali and Rambatan Formation. This basin has potential petroleum system with the discovery of oil seepage. Tectonic condition in the research area during the sedimentation process is still active [1]. The combinations of subsidence, eustatic and sediment supply are corresponding to the accommodation space, moreover to the type of sediment which is deposited. The quantity of sediment supply to the basin closely related to the tectonic activity. In the context of Petroleum Potential, study of sediment supply will provide information about the potential source rock, reservoir dan caprock that developed in the research area. During the Neogene at least there have been three times of sea level change in the research area [2]. Furthermore, Astuti [1] mention that the sedimentary sequence is thickening in some research area during middle of N18 and thinning in N13 to N17.

Regional tectonic affecting the reseach area is the Oligo-Miocene north-south trending compression [3]. This tectonic led the formation of Java structural pattern [4] with east-west trending reverse fault [3]. Based on van Bemellen [5], phase of geosyncline evolution occured during Early to Middle Miocene period followed by uplift as geo-anticline during Middle to Late Miocene in South Serayu. The formation of geo-anticline cause the subsidence in North Serayu

geosynclines induced gravitational sliding movement from south direction and generate over thrust in the southern area [5]; [6] and [3]. Sliding movement in the eastern part of the basin precisely in Karangkobar area was repeated in the Pleistocene. In this study we try to analyze the control of tectonic for sedimentation in the research area, since the presence of active tectonic during the sedimentation process will affect the quantity and rate of sediment supply.

2. METODOLOGY

The data mainly are collected from Western part of North Serayu area. The stratigraphic and structural data are collected from the field work. These existing data's then analyzed to determine the amount of sediment supply during Neogene. The approach method for analysis is using stratigraphic and sedimentation pattern which will be described as dynamic of sedimentation.

3. GEOLOGICAL REVIEW

The interaction of eustacy, subsidence, sediment supply, basin physiography, and climate largerly control basin sedimentation [7]. One or more variables may be dominant. Different combination of each factor will be related to the relative sea level changes, furthermore to the accommodation space. The accommodation space is the potential space available for sediment to accumulate. On the shelf or marine environment, accommodation is controlled by relative sea level, while in fluvial environments; accommodation is controlled by the fluvial equilibrium profile. Stratigraphic record and its pattern can provide an overview how sedimentary rock is accumulated, factor controlling process and illustrate the dynamic sedimentation.

A discussion of the dynamic sedimentation is closely related with discussion of sedimentology. In general, the package of sedimentary rock is called facies and the set of facies as facies association. These facies or facies association is recorded in stratigraphic column. Stratigraphic column will provide an overview of kind of rocks and its composition, texture, structure, fabric, fossil content and change of stratigraphic element condition vertically and laterally [8].

Sedimentary rocks recording the sedimentation processes during the deposition [9]. Sedimentary rocks formed by the physics, chemistry and biological process in particular sedimentary environment. The physical, chemistry and biological aspect is closely related to the provenance [10] and characterize its depositional environment both in erosion condition, non deposition and deposition. Product of depositional processes in particular sedimentary environment known as sedimentary facies [11]. Sedimentary facies record geometry, lithology, sedimentary structure, fossil content and paleocurrent data.

Regionally the research area included in the 1: 100.000 scale geological map of Majenang area [12] published by Geological Research and Development Centre. This geological map represent the regional stratigraphic sucession and structure that

developed in research area. Discussion issues related to the sediment supply regionaly associated with gliding tectonic mechanism.

Gliding tectonic is variation of gravity tectonic. This tectonic controlled by gravitational force mechanism producing folding and faulting in wide and varying complexity [13] Gravity/vertical tectonic generally associated with fold, thrusting up to gravity sliding from the top to flank of vertically rising fault block, structural arches, mantle, diapirs and like phenomena.

Sedimentary rocks filling the extensional North Serayu Basin in general are the Neogene turbidities rock with flysch character. These rocks were deposited on the back arc basin setting. The basin formed by subduction roll back mechanism with intensive structure controlled by rapid and active subsidence during Early to Late Miocene [14]

The extensional process occurred older than N19 until early N20 coincide with subduction process [1]. The rocks were deposited in the western part of the basin during the Middle Miocene to Pliocene from older to younger includes Rambatan, Halang, Pemali, Kumbang and Tapak Formation respectively. These formations generally deposited by debris to turbidity flow mechanism.

The tectonic active during Miocene period influence the sediment deposition rate

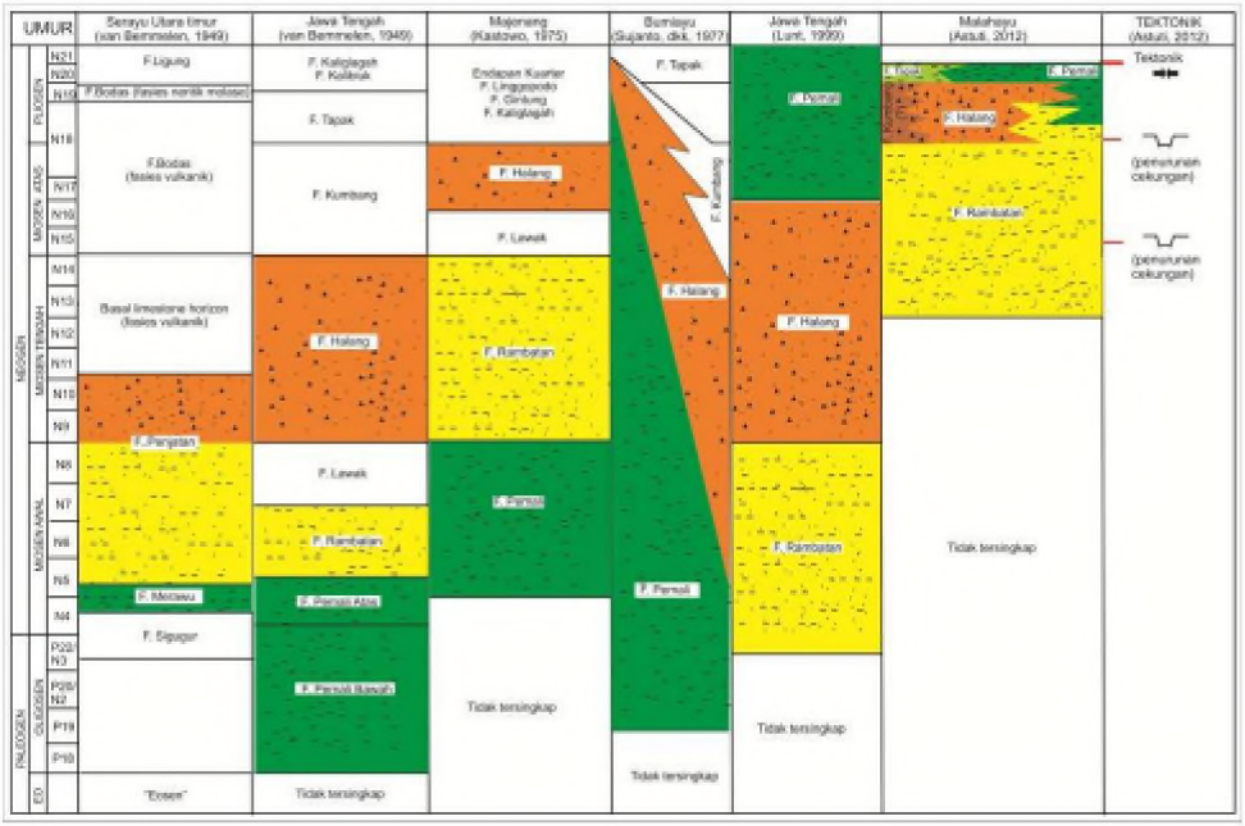

Fig. 1. Stratigraphic compilation by several researchers (Astuti, 2012) show the regional stratigraphic and tectonic.

and change of accomodation space [14]. The contrast between the rates of change in accommodation and the sedimentation rates in locations placed in the vicinity of the shoreline allows one to understand why the shoreline may shift either landward or seaward during times of relative sea-level change. Accommodation outpacing sedimentation generates transgression or relative sea level rise, whereas an overwhelming sediment supply may result in shoreline regression or relative sea level fall [15].

The relative sea level changes correspond to the shifting of depositional environment during sedimentation process. Shifting of depositional environment recording in stratigraphic record. Sedimentary structure and fossil analysis in western part of North Serayu Basin [2] indicates there are three times sea level changes during Middle Miocene to Pliosen, i,e., sea level rise, fall and rise.

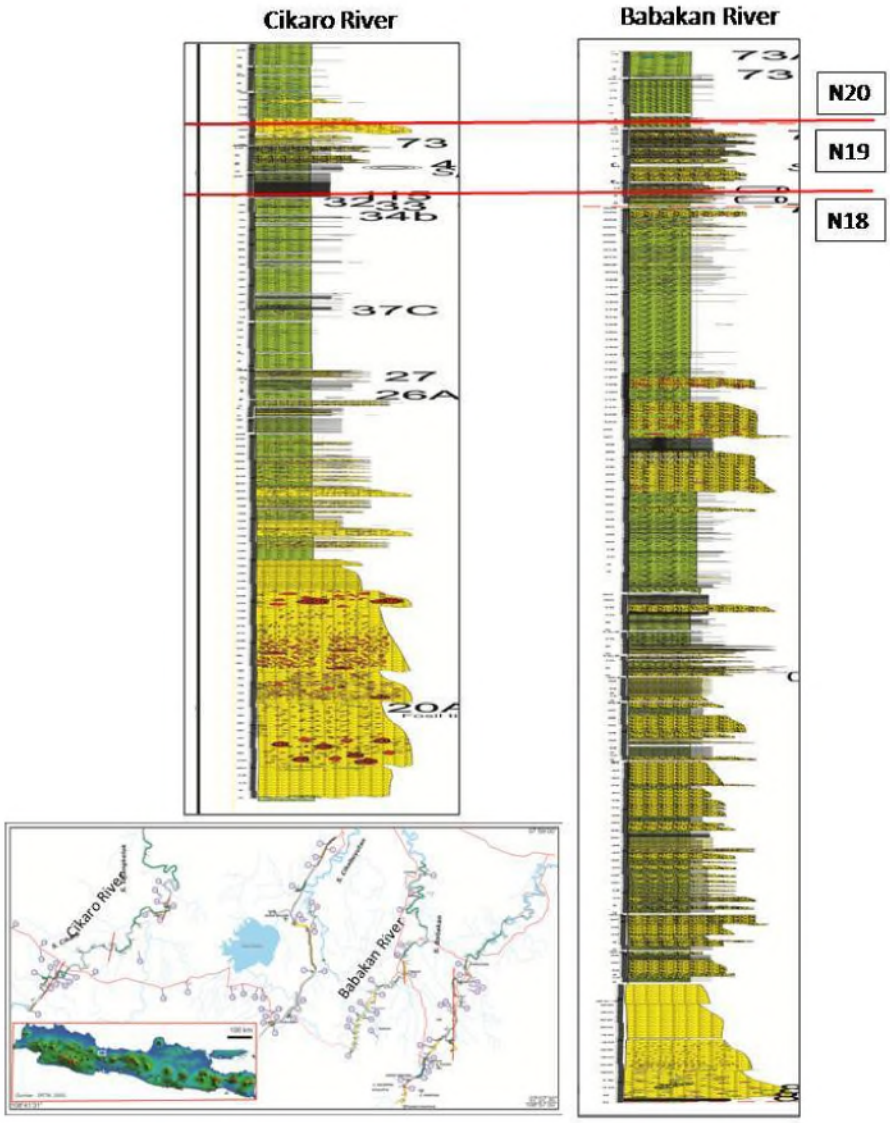

Fig. 2. Stratigraphic column of research study in Cikaro River (left) Babakan River (right), were deposited in N18-N20.

The sea level rise in N13 to Middle N18 represent by finning upward stacking pattern with depositional environment in the lower fan, upper bathyal. The sea level fall take place in Middle N18 to N19 shown by coarsening upward sequence in the lower to upper fan Upper and Lower Bathyal environment, support with the presence of supra fan lobe. The latest sea level rise start in N19-20 which is indicate with finning upward pattern in the tidal zone to the basin plain or in the neritic to lower bathyal. Relative sea level rise in the research area followed with reducing of sediment supply [2], while sea level fall is related to erosional process in emerge land and increasing of sediment supplay as supra fan lobes.

4. RESULT AND DISCUSSION

Based on stratigraphic measurements in the study area (Fig. 2), the rock sequences in the research area were deposited in upper Neogene (N13 to N20) and distinguished into 10 sequences. N13 to N14 are included in the Middle Miocene, N15 to N18 as the upper Miocene, and N19 to N20 included in the Pliocene. The depositional environment of these facies range from upper or inner fan to basin plain, and partly included tidal zone.

The sediment supply analysis, partly applied with secondary data from some previous researchers. Based on regional study, North Serayu Basin during the Middle Miocene to late Miocene was compressed and uplift which is produce geanticlines in South Serayu [5], [1]. Subsidence in western part of North Serayu takes place at N15 and middle N18 (Figure 1). In the eastern part of the basin, gravitational sliding movements occur from south to north as Nappe Worawari [5], [16]. The provenance is a product of volcanic activity from southern area [16].

The stratigraphic measurement show the decreasing of sediment supply in the eastern part of basin, and increasing in the western part. The age of lithology in the eastern part of reserach area based on paleontological analys is N13 to N17, with erosional event at N15. The erosional event is an evidence of basin uplift which resulted in the absence of deposition. During the middle of N18 the sediment supply increasing especially in Cikaro River and Babakan River in conjunction with the basin subsidence [1] & [2]. The combination increasing of sediment supply and basin subsidence caused the accommodation space is constant and the relative sea level is stand still.

Increasing of sediment supply in N19 also occur in the eastern part of resecarch area (Rambatan River). This indicates some uplifted area produce amount of sediment and deposited in the basin afterwads. The sediment covered entire the basin. The increasing sediment supply is not equal with the basin subsidence, however based on Astuti [2] the eustatic is rise. The combination of these factors indicate that accomodation space is constant start in N18-early N19. During N19-N20 the sediment supply is reduced [1], the basin subsidence is constant but the eustatatic sea level is rise [2].

5. CONCLUSIONS

Sediment supply based on stratigraphic measurement during N13 to N17 period is minimum, that is followed by uplift and subsidence of the basin. The maximum increasing sediment supply in the reseach area occurrs in N18, and thereafter start from N 19 to N20 the sediment supply is decrease. Increasing sediment supply during N18 followed by basin subsidence and eustatic sea level rise. Decreasing sediment supply takeplace during N19- N20, the basin subsidence is constant, in the other hand the eustatic sea level is rise.

6. REFERENCES

[1] Astuti, 2012, Stratigrafi dan Sedimentasi Batuan Neogen di Cekungan Serayu Utara, Daerah Kuningan, Jawa Barat – Larangan, Brebes, Jawa Tengah, Thesis, tidak dipublikasikan.

[2] Astuti, 2015, Perubahan Muka Air Laut Di Cekungan Serayu Utara Bagian Barat Selama Miosen Tengah Hingga Pliosen Di Daerah Kuningan Jawa Barat, Retti

[3] Satyana, A. H., 2007, Central Java, Indonesia – "A Terra Incognita" in Petroleum Exploration : New Considerations on The Tectonic Evolution and Petroleum Implications, Proceedings of Indonesian Petroleum Association Annual Convention, IPA07-G-085, p. 22.

[4] Pulunggono, A. & Martodjojo, S., 1994, Geologi Daerah Pegunungan Selatan: Suatu Kontribusi, pada : Sriyono., Hendrayana, H., Rahardjo, W. dan Wiyono, S. (Eds.), Perubahan Tektonik Paleogene-Neogene merupakan peristiwa Terpenting di Jawa. dalam Geologi dan Geotektonik Pulau Jawa, sejak akhir Mesozoik hingga Kuarter; Nafiri, Yogyakarta, Jurusan Teknik Geologi Fakultas Teknik , Universitas Gadjah Mada, hal 37-50.

[5] Van Bemmelen, 1949, The Geology of Indonesia; vol. I A, General Geology; Government Printing Office, The Hague, P. 732. Cox, K. G., Bell, J. D., and Pankhurst, R. J., (1979). The Interpretation of Igneous Rocks: London, England, George Allen & Unwin, Ltd., 450 p.

[6] Satyana, A.H., dan Armandita, C., 2004, Deepwater plays of Java, Indonesia : Regional evaluation on opportunities and risks, IPA Annual Convention Proceedings, DFE04-OR-002, p 27.

[7] Vail, P. R., Audemard, F., Bowman, S. A., Eiser, P. N, Perezcrus, G., 1990, The Stratigraphic Signatures of Tectonic, Eustasy and Sedimentation, AAPG International Lecture, Manuscrip vertion, p. 99.

[8] Rahardjo, W., 1995, Foraminifera Besar Tersies Indonesia (merupakan kumpulan artikel yang diterbitkan Wetenshappelijke Mededeelingen Dienst van Den Minjnbouw in Nederlandch-Indie), Teknik Geologi, Fakultas Teknik UGM.

[9] Tucker, M.E., 1991, Sedimentary petrology : an introduction to the origin of sedimentary rocks, Blackwell scientific publications. P. 260.

[10] Boggs, S. Jr., 2006, Principles of Sedimentology and Stratigraphy, fourth edition, Upper Saddle River, New Jersey, p. 662.

[11] Selley, R.C., 1977, Ancient Sedimentary Environment, Cornell University Press, New York, p. 317.

[12] Kastowo, 1975, Peta Geologi Lembar Majenang, Jawa, P3G, Bandung.

[13] Satyana, A. H., 2010, Gravity Tectonics in Indonesia-A Companion to Plate Tectonics : Cases of Isostatic Exhumation and Gravitational Gliding, Proceedings PIT IAGI Lombok, p. 12.

[14] Koesoemadinata, R. P. dan Martodjojo, S., 1974, Penelitian Turbidit di Pulau Jawa, Laporan research no. 1295174, Badan

research Institut Teknologi Bandung, 237 hal.

[15] Cateuneanu, 2006, Principles of Sequence Stratigraphy, Elsevier.

[16] Astuti, B. S., 2016, Identifikasi Provenance Selama Miosen Tengah Hingga Pliosen Di Cekungan Serayu Utara Bagian Barat Di Daerah Kuningan Jawa Barat, Jurnal Technoscientia, Akprind, Yogyakarta.