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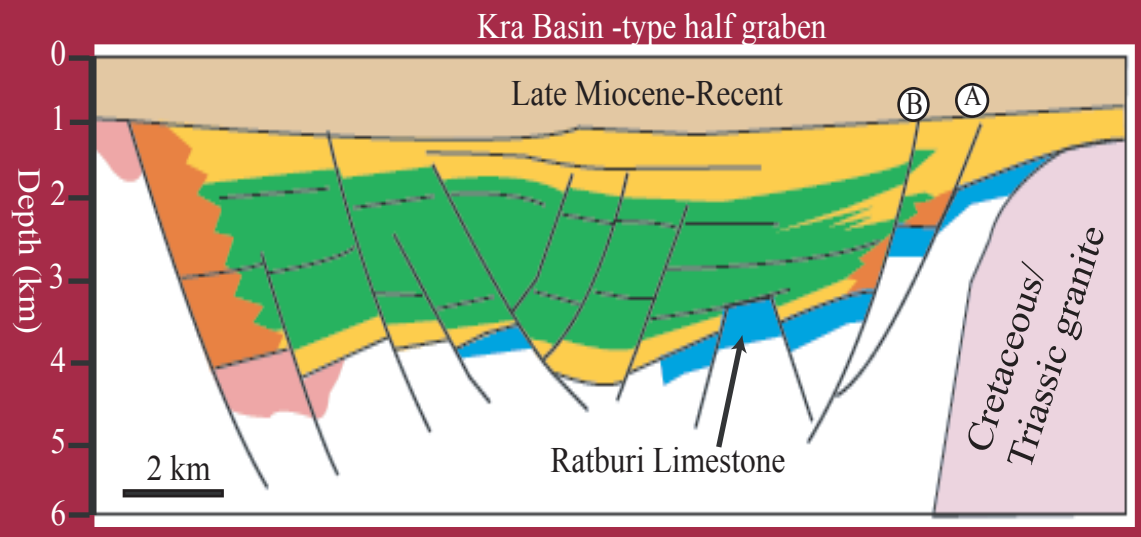

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Cover: A schematic model of the Kra Basin (page 3)

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Preface

The Bulletin of Earth Sciences of Thailand (BEST) has established itself as an international academic journal of the Geology Department, Chulalongkorn University (CU) since the year 2008. This Number 2 issue of Volume 3 is devoted specifically to the publications contributed by the International Petroleum Geoscience M.Sc. Program of the Geology Department, Faculty of Science, CU for the academic year 2009/2010. Certainly this Bulletin has attained more and more international recognition, not to mention the citation of publications in previous volumes, as can be seen from the contributions of 17 research papers by international students of the M.Sc. program. This program is an intensive one year curriculum that has been taught in the Geology Department of CU in the academic year 2009/2010 for the first year. These scientific papers were extracted from the students' independent studies which are compulsory for each individual student in the program. Because of the confidentiality reason of a number of contributions, the requirement of the Chulalongkorn Graduate School as well as time constraints of the program, only short scientific articles were able to release publicly and publish in this Bulletin.

Lastly, on behalf of the Department of Geology, CU, I would like to acknowledge the Department of Mineral Fuels, Ministry of Energy, Chevron Thailand Exploration and Production, Ltd, and the PTT Exploration and Production Public Co., Ltd., for providing full support for the Petroleum Geoscience Program and the publication cost of this issue. Sincere appreciation also goes to guest editors; Professors Joseph J. Lambiase, Ph.D., John K. Warren, Ph.D., and Philip Rowell, Ph.D., the full-time expat staff, for their contributions in editing all those papers. Deeply thanks also go to Associate Professor Montri Choowong, Ph.D., the current editor-in-chief, and the editorial board members of the BEST who complete this issue in a very short time. The administrative works contributed by Ms. Suphannee Vachirathienchai, Ms. Anamika Junsom and Mr. Thossaphol Ditsomboon are also acknowledged.

Associate Professor Visut Pisutha-Arnond, Ph.D.
Head of the Geology Department
August 2010

Facies Distribution and Stratigraphic Development in the Palaeo-Mahakam Delta, Indonesia

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Abstract

This study examined the sedimentary facies and stratigraphic architecture of the palaeo-Mahakam Delta succession exposed at Stadion Utama Kaltim, East Kalimantan, Indonesia. The nearly 200 m thick succession was logged for lithology, sedimentary structures, bed geometry, grain size and trace fossils. The observed sedimentary character such as fining upward, asymmetric ripples on the top of sand beds, and mud drapes on the cross laminae all suggest that the sediments were deposited by tidal currents. The most common burrows belong to the *Skolithos* ichnofacies indicating a shallow marine environment. However, the pervasive tidal influence and stacking pattern suggests a transgressive succession similar to that being deposited on the modern Mahakam delta. The outcrop is a potential analogue for subsurface reservoir sands within transgressive successions.

Keywords: Facies, Middle Miocene delta, Stratigraphy

1. Introduction

Several facies have been observed in the ancient Mahakam delta deposits of East Kalimantan. Details of the palaeo-environments of the ancient Mahakam delta outcrop are not well understood. Cibaj and Wiweko (2008) interpreted the study area as ancient Mahakam delta outcrop as mixed fluvial – tidal processes in general terms. Husein and Lambiase (2005) observed transgressive deposits on the modern Mahakam delta. Recently, the transgressive models in modern Mahakam delta have not been interpreted in the ancient Mahakam delta deposits. Consequently, it has been selected to make an improvement the transgressive model in the ancient Mahakam delta deposits. The observation will make a good contribution as better predict the subsurface reservoir potential in transgressive model in ancient Mahakam delta deposits.

The study area is a part of Samarinda Anticlinorium and elongated around 200 m long with east to west direction (Figure 1).

2. Methods

The outcrops described by detail description of the sedimentary structures. All the information is summarized by rough sketched and written description. The observation includes are the texture such grain size trends, color, sorting, sphericity, sedimentary structures, the nature of bed contacts and trace fossils. The sedimentary features are necessary to interpret the depositional environment within ancient deposit in Mahakam delta.

3. Results

3.1 Sedimentary Facies

Ten facies were identified from outcrop observations.

Facies 1 Thick-bedded sandstones

The thick-bedded sandstone is interpreted as tidal channel and comprises fine to medium grained sand beds (Figure 2). Bed thickness is up to 1 meter. Most beds are massive at the base and pass upward into planar cross bedding, and some pass from planar cross bedding into parallel lamination. The bed tops are straight and sharp. Other features are mud drapes on the cross bedding and mud rip-up clasts. Trace fossils are rare.

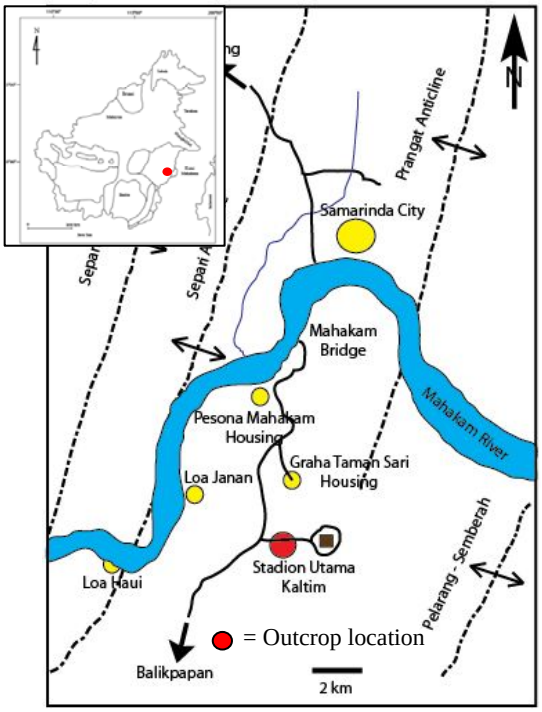

Figure 1. Location of the study (not to scale).

Facies 2 Stacked sandstones

The stacked sandstones are interpreted as the tidal channel. It comprises laterally stacked channels of fine sand. Basal contacts are sharp and scoured and beds have sharp tops. A distinctive feature in the sand beds is mud clasts. Vertical burrows occur with low ichnodiversity.

Facies 3 Amalgamated sandstones

This facies is interpreted as tidal channel and comprises sand beds with thin shale layers. It is underlain by alternating sandstone and shale. Individual basal contacts are massive, straight and sharp. The tops of the sand beds are straight and sharp with asymmetric ripples. Other distinctive features are cross lamination with mud drapes and current ripples.

Facies 4 Muddy sandstone

This facies comprises fine to medium sand. The base of beds consisting of coarse sand and basal contacts is generally straight and sharp, and a few are scoured. Toward the bed tops are parallel lamination, trough cross bedding and local carbonaceous drapes. Trace fossils were identified in a few locations. Consequently, this facies is interpreted as tidal sand flat.

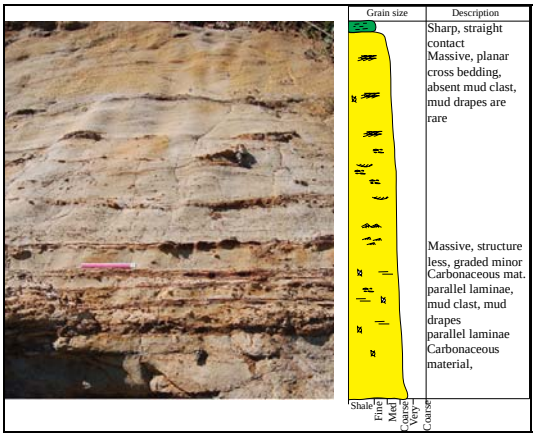

Figure 2. Sedimentary structures from the base to top of sandstone beds.

Facies 5 Massive sandstone

It is distinguishable from other sandstone facies by predominant trough cross bedding. The base of beds consists of coarse sand and basal contacts are generally scoured. Toward the bed tops are trough cross bedding, asymmetric ripples and carbonaceous drapes. Trace fossils are abundant near the bed tops. This facies is interpreted as tidal channel.

Facies 6 Bioturbated sandstone

It occurs between thick shale beds. The base of beds is straight and sharp. Sedimentary structures are dominated by low angle planar cross stratification and parallel lamination. Ripples with organic rich mud drapes and there are abundant *Ophiomorpha* burrows. Based on the observation, this facies interpreted as tidal sand bar deposit.

Facies 7 Alternating sand and shale

This facies is interpreted as tidal sand flat, identified as interbedded sand and shale beds, bed thicknesses up to 1 m. The thin sand have ripples on the top.

Facies 8 Sand alternated with thin shale

This facies comprises sand that is relatively thicker than shale. Sand alternating with thin shale isolates from thick shale

beds. The base of sand beds is straight and sharp. Toward the top of sand beds are asymmetric ripples and cross lamination with mud drapes and sharp tops. Consequently, this facies is interpreted as tidal sand bar deposit.

Facies 9 Thick shale bed

This facies is commonly underlain and overlain to sandstone facies. It contains dark massive shale with occasional thin siltstone intercalations. Bioturbation is moderate to high abundance. The thick shale bed is interpreted as tidal mud flats.

Facies 10 Coal

Coal is generally black and has a strong smell of sulphur. It occurs throughout the outcrop succession. Most coal is massive although some are bedded. It is probably as marginal marine coal.

3.2 Stratigraphic Architectures

In general, the stratigraphic succession in the study area is stacked transgressive parasequences. The overall succession deepens and fines upward.

The vertical stacking from the lower part of parasequences fines upward. Tidal influence is common. Tidal sands at the base are overlain by tidal mud flat followed by coal. Above the coal there are thick mud flat deposits and thin sand and shale beds. Those facies succession are transgressive deposits. These features are repeated throughout the outcrop succession.

4. Discussion

The outcrop succession includes four environments based on sedimentary characteristics. These are tidal channel, tidal sand flat, tidal mud flat, and tidal sand bar.

Previous studies interpreted the depositional environment of the study area as the delta front above prodelta shale in a regressive succession that coarsens upward (Cibaj and Wiweko, 2008). The present study recognizes that sandstones and shale deposited as tide-dominated transgressive parasequences that fine upward.

The outcrop is a good analogue for subsurface reservoirs within transgressive successions of the palaeo-Mahakam delta.

5. Conclusions

Facies 1, 2, 3, and 5 are interpreted as tidal channel sandstone. The occurrences of mud drapes, mud clasts, and asymmetric ripples within the thick, massive sand beds reflect tidal current activity. The occurrence of trace fossils suggests a shallow marine environment.

Facies 4 and 7 are interpreted as tidal sand flats due to their sedimentary characteristics.

Facies 6 are 8 are tidal sand bar deposits. The sand beds are continuous for 16 meters.

Facies 9 shales were deposited on tidal mud flats. The presence of flaser bedding and lenticular bedding within the thin shale beds suggests tidal current activity.

Facies 10 probably is marginal marine coal due to its strong sulphur smell and stratigraphic location between marine shale beds.

Overall, the stacking pattern of the Stadion Utama Kaltim outcrop is interpreted as highly aggradational transgressive succession.

6. Acknowledgements

The author would like to thank the Petroleum Geoscience Program for funding this research project. I am gratefully acknowledged my supervisor Prof. Joseph J. Lambiase for helpful comments and his valuable ideas.

7. References

Cibaj, I. and Wiweko, A., 2008. Recognition of progradational shelf deposits in the middle Miocene of Kutai Basin. *Indonesian Petroleum Association, Proceeding 32nd Annual Convention*, Jakarta, G – 171.

Husein, S. and Lambiase, J.J., 2005. Modern sediment dynamics of the Mahakam delta. *Indonesian Petroleum Association, Proceeding 30th Annual Convention*, Jakarta, G – 086.