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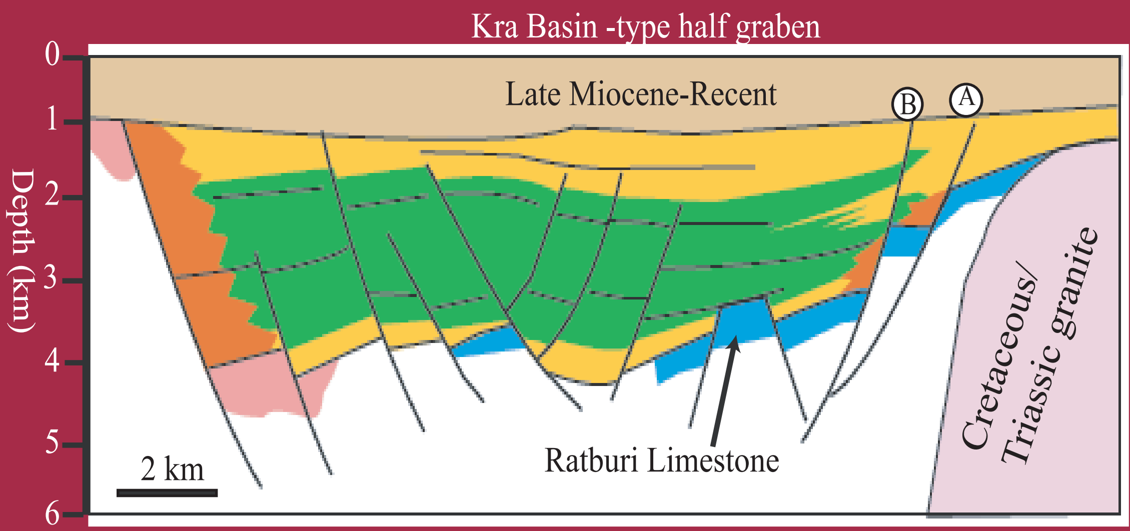


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**Cover**: A schematic model of the Kra Basin (page 3)

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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.
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# Depositional Environment of Sands Beneath the Mid-Miocene Unconformity in the Plamuk-L and Surat-C Field Areas, Gulf of Thailand, Using Cuttings Identification, Well Log and Seismic Interpretation

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## Abstract

The sub-MMU sand in the Plamuk-L and Surat-C areas is a blocky, extensive thick sand (40-60 ft thick), deposited below the MMU and within the Upper Red Bed unit (Sequence IV), which was deposited under more oxic-conditions during exposure in a marine regression. This sand shows 23% - 34% porosity and 8% - 11% clay volume, which qualifies it as a good quality potential reservoir. Regional sand features interpreted from seismic amplitude map show pocket-like shapes, aligned along a tortuous trend in a northeast – southwest direction. This distribution indicates variations that are likely tied to deposition as channel point-bars. The studied sand is filled with oil and gas in wells drilled into closed structures (SUWC-32 and 33), while hydrocarbons are absent in areas of non-closure.

**Keywords**: MMU, Plamuk-L, Surat-C, Red Bed, sand, channel point-bars

## 1. Introduction

Most potential pay reservoir windows in Pattani basin, start below the top of Sequence IV (Upper red bed) or the Mid-Miocene Unconformity (MMU) (Jardine, 1997). The sub MMU transition is typically defined by an abrupt change in color of shales. The low average sand-shale ratios, and compaction of the coarser grains in Sequence IV likely influence trap and seal failure in this section. For these reasons, this section of the stratigraphy, especially in the interval close to MMU, has not been a target of drilling in various development projects that focused on the underlying rocks. However, after some thick hydrocarbon sands were found within this MMU-related section in a number of drilled wells, it has become necessary to better understand the depositional environment, sand distribution, and quality of sands in this zone immediately below the MMU.

## 2. Database

Chevron Thailand Exploration and Production, Ltd. provided the data used for this research, including mud logs, wireline logs from 39 development wells and 3 exploration wells (Surat-05, Plamuk-04 and Plamuk-08), as well as the seismic data of the Plamuk-L (PMWL) and Surat-C (SUWC) areas. Seismic data were provided in OpenWork / SeisWork format from SPF_PLATONG project. The relevant data volume covers the area between Trace 3500 – 4490, Line 4400 – 7100 and Time 500 – 2500 ms.

## 3. Well Log Analysis

Lithological determination in the Plamuk-L and Surat-C areas, based on wireline log signatures, can be divided into 3 main groups which are sandstones, shales and coals. More indurated and gas-bearing sands are also found in the section below MMU. Lithological interpretation from wireline data in this study is supported by the cutting descriptions from mudlogs.

Reliable MMU identification is a necessary step before studying the target sand, which occurs at 100-120 ftTVDss below the MMU. The MMU can be recognized from a decrease in the neutron trend, an increase in the density trend in shales at MMU depth in some wells, and an absence of low radiogenic coals in the sub MMU section. In combination, these may indicate higher compaction in the section below MMU and an abrupt change in geological events or a hiatus in deposition Wireline log responses across this sand show a blocky-shaped Gamma ray, which implies little or no grain size variation (Rider, 2002). The average clay volume is low, between 8%-11%. The average net thickness of this sand varies from 40ft (in PMWL) to 60ft (in SUWC), with 23%-34% neutron porosity that varies over the whole area (Figure 1c).

Cutting determinations illustrate that this sand contains loose quartz sand, which is moderately sorted and medium to coarse grained. The grain shape is subrounded to subangular. Its color varies between yellowish brown and brown. There is some weak calcareous cementation.

## 4. Seismic Analysis

The MMU horizon was interpreted on a reflectivity peak. It is a strong event and has a good continuity in 3D seismic. The correlation of MMU was started from well SUWC-32 and PMWL-17 and was correlated through the whole area of SUWC and PMWL, named as “Near MMU” horizon.

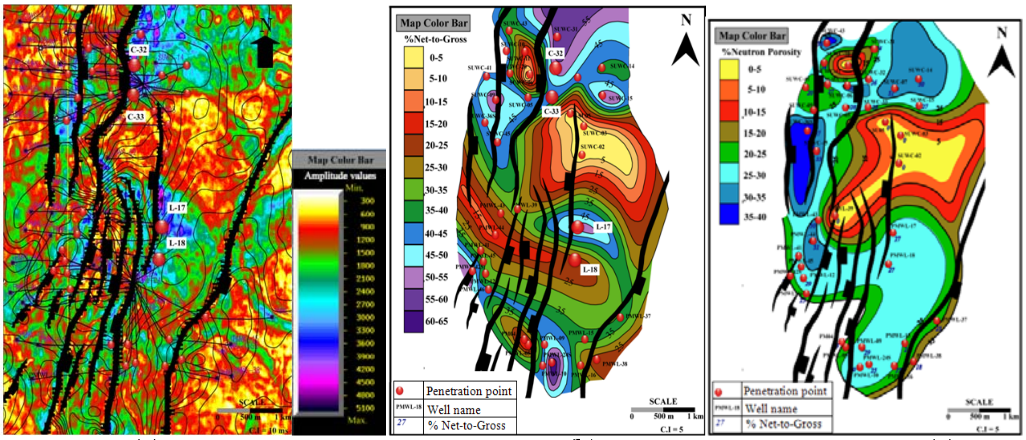
The top of the studied sand relates to a distinctive trough on the seismic reflection data. However, the top of this sand is around 110 ft below MMU and essentially parallel to the MMU through most parts of the study area. Therefore, the top of this sand horizon was created by shifting down +30ms from the Near MMU horizon and was named the “Top of studied sand” horizon.

Seismic amplitude extractions within a 30 ms window below the “Top of studied sand” was carried out regionally (Figure 1a), in order to study the distribution of sand reservoirs. The maximum trough amplitude map and RMS amplitude map illustrate similarly that a channel-like sand feature exists, trending in a NNE-SSW direction.

## 5. Integrated Geologic and Geophysic Study

Net-to-gross sand values were evaluated in the zone of interest (165 ft thick) covering the same window used for the seismic amplitude extractions. There is an acceptable correlation between the sand and amplitude maps in some areas (Figure 1a and 1b), such as the region of high net-to-gross sands in the northern and central part of the study area. Amplitude features in the maps show possible sand loops probably related to channel point-bar deposition and show a northeast-southwest general trend. Therefore, the amplitudes seem to represent reservoir rather than hydrocarbons.

A comparison of the porosity distribution map and the RMS amplitude map (Figure 1a and 1c) shows a good correlation between porosity and the amplitude response, as in the central to southern zones of this area. Porosity is higher where the negative amplitude is stronger, probably reflecting the location and orientation of the studied sand.




(a) (b) (c)

**Figure 1**. Comparison between (a) RMS amplitude map of 30ms window below top of the studied sand horizon and, (b) N/G sand map calculated within the same interval (165 ft thick) from 42 well logs, and (c) porosity map of the studied sand.

## 6. Conclusion

Integration of well log and seismic data analysis from the Plamuk-L and Surat-C areas suggest the following conclusions;

(a) The studied sand was deposited in a fluvial environment.

(b) This sand contains 8%-11% clay volume within a variable sand thickness ranging between 40 and 60 ft.

(c) The pocket-like shaped sand trend in a NE – SW direction likely indicates amplitude variations that are related to thicker sand deposition in channel point-bars.

(d) Porosity distribution in of sub-MMU sand varies between 23% and 34%. Porosity reduction in the sands is probably influenced by two sets of process-mechanisms; clay diagenesis and mechanical compaction (Chanthnaphalin, 2002).

(e) The quality of the studied sand is higher in the SUWC area where is located on a horst, compared equivalent sand in the half-grabens and grabens of the PMWL area.

(f) The studied sand it is a likely good quality potential reservoir, which filled with oil and gas in wells drilled into closed structures (SUWC-32 and 33).

## 7. References

Chanthnaphalin, U., 2002. Fluvial sandstone characterization from well Plamuk 3, 4 and 5 in Pattani Basin, using a combination of petrographic and wireline data: Unpublished M.Sc thesis, Department of Petroleum Geoscience, UniversitiBrunei Darussalam, 72p.

Jardine, E., 1997. Dual Petroleum Systems Governing the Prolific Pattani Basin, Offshore Thailand: Petroleum Systems of S.E. Asia and Australia Conference, Jakarta, May 21-23, 1997.

Rider, M. H., 2002. The Geological Interpretation of Well Logs, Scotland, Rider-French Consulting, 280 p.