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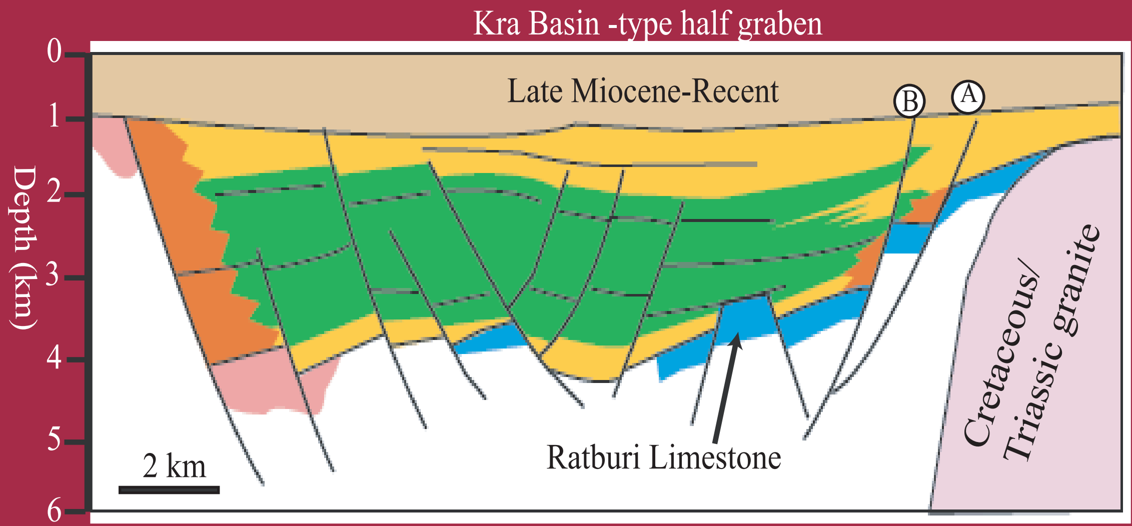

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Cover: A schematic model of the Kra Basin (page 3)

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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.

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Paleo-depositional Environment Reconstruction of Oligocene, Early Miocene Intervals in Northeast Part of Malay Basin

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Abstract

Paleo-depositional environment reconstruction is a useful tool to help portray the structural and stratigraphic evolution of a basin. It provides the interpreter with a “picture” of the depositional setting from which to predict reservoir beyond that observed in wells. Cores, well-logs and 3D seismic data were integrated to construct seven paleo-geographic maps of four sequences and three sub-sequences in Oligocene to early Miocene intervals of the Northeast Malay Basin. Sequence 1 deposition is controlled by formation of the initial syn-rift basin and is dominantly fluvial/alluvial environments. An uplift in the centre created two isolated lakes to the North and South of the high basement. The increase in sediment supply and sedimentation rate during this period resulted in development of extensive alluvial fans and braided rivers flowing into lakes. A significant rise in lake level combined with a low subsidence rate created a sediment starved basin in Sequence 2 of middle Oligocene age that accumulated thick lacustrine shale deposits. Sequence 2 is divided into three sub-sequences and the two lakes were connected. In late Oligocene of Sequence 3 and early Miocene post-rift of Sequence 4 regional drainage systems became better developed and delivered more sand rich sediments into the lakes. The depositional environment was dominated by an extensive alluvial plain characterized by a complex fluvial system consisting of multiple channels. Sequence 4 is a transitional environment to shallow marine.

Keywords: Sequence, sub-sequence, Paleo-depositional environment, paleogegraphic map

1. Introduction

In the northeast Malay Basin, depositional environments have not been thoroughly studied. There is limited seismic, well-log and core data , especially in the Oligocene to early Miocene succession that was deposited during an extensional phase. The highly tectonic-influenced depositional environments of the deep section are a challenge to assess. Hence, this study was conducted to define the stratigraphic sequences and their depositional environments as well as basin evolution in the Oligocene to early Miocene interval.

Successful paleo-environment interpretation requires interpretation and integration of multiple data sets (seismic, well-log, cores). As well logs offer better vertical resolution than seismic data, the study emphasized analyzing well-log patterns to interpret depositional environment in areas with well penetration. The geological information derived from the relevant well logs and core data both served as seismic calibration points and for providing an integrated approach to achieve consistent prediction of the possible depositional environments of all the sequences and sub-sequences in the Oligocene and early Miocene intervals. The study area is shown in Figure 1.

2. Methodology

Cores, well-log data, isopach maps, structural maps and seismic amplitude extraction maps were used to construct paleo-geographic maps in order to predict depositional environments in the Oligocene to early Miocene interval.

Figure 1. Location map of the study area.

3. Lacustrine environment

Lakes occur in many syn-rift basins. In general, there are five stratigraphic units in continental rifts. In order, these are basal sand, lacustrine shale, a fluvio-deltaic complex, syn-rift fluvial sand, and post-rift fluvial sand (Lambiase, 1990).

4. Paleo-depositional environment

In conjunction with a review of the regional geological setting of the basin, a series of paleo-geographic maps were constructed for Sequence 1 through Sequence 4. These maps provide a basis for understanding the depositional setting and basin evolution as well as the distribution of reservoirs and source rock. They also ensure that interpretations are consistent through geologic time.

Sequence 1: Deposition was controlled by the formation of the initial syn-rift basin. In early Sequence 1, the center of the study area was uplifted due to tectonic influence. This created two isolated paleo-lakes on the North and South sides of the high basement. These lakes both have a SW-NE orientation (Figure 2).

In the initial syn-rift, the rate of tectonically controlled topographic rejuvenation exceeds the rate of deposition and fluvial and alluvial environments dominate. High granitic basement was weathered, eroded, and transported downdip to lower parts of the basement high forming alluvial fans, alluvial plain, and fan deltas. Lacustrine deposits are laterally restricted and relatively thin. Turbidite sands and thick lacustrine shale can be well developed in the deep water area.

A relative rise of lake level in the late early Oligocene deposited the late Sequence 1 succession, which extended the alluvial/fluvial plain to both sides of the high basement area.

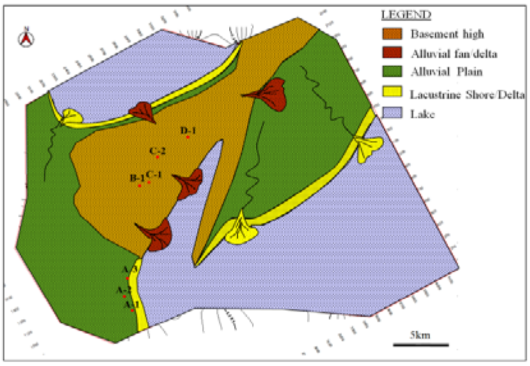

Figure 2. Sequence 1 paleo-geographic map.

Sequence 2: This succession formed in middle Oligocene and comprises 3 sub-sequences. This period marked a significant change of depositional environment. A significant rise in lake level along with a low sediment supply rate created a sediment starved basin that persisted long enough to accumulate a thick sequence of fine grained lacustrine sediments. The lacustrine shale in this sequence can be up to one thousand meters thick. This thick lacustrine shale is considered the main source rock in Malay Basin (Figure 3).

Sequence 3: There was a significant fall of lake level in this period. The sediment supply rate surpassed subsidence rate. Regional drainage systems became better developed and delivered more sand rich sediments into the lakes. Lakes become shallower and they were filled with fluvio-deltaic sediments. The lacustrine deposits were laterally restricted. The dominant depositional environments were fluvial/alluvial plain (Figure 4).

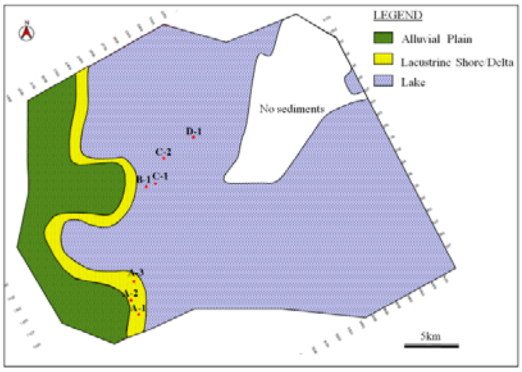

Figure 3. Sub-sequence 2.1 paleo-geographic map

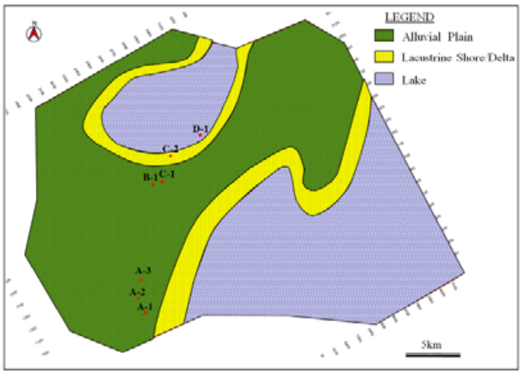

Figure 4. Sequence 3 paleo-geographic map

Sequence 4: This sequence was deposited in the early post-rift phase with dominant alluvial/fluvial deposits (Figure 5). Lake level continued to fall and lakes were successively filled with sand rich complex fluvial systems consisting of multiple channels.

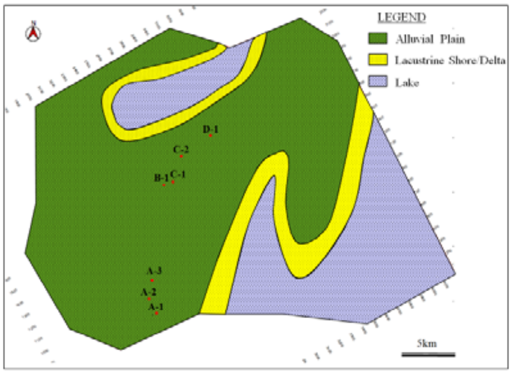

Figure 5. Sequence 4 paleo-geographic map

5. Conclusions

Sequence 1 formed in the early syn-rift stage with potential reservoirs in alluvial fan, fan delta and lacustrine turbidite sands. The lacustrine shale in the deep basin is a potential source rock. Sequence 2 of middle Oligocene sediments comprises mostly lacustrine shale and has been interpreted to be the main potential source rock of the study where its thickness reaches approximately 1500 m. Sequence 3 of late Oligocene sediments is dominated by fluvial/alluvial plain sands which are considered to be potential reservoirs. Sequence 4 sediments are dominated by potential reservoirs in fluvial, alluvial, lake shoreface and deltaic sands deposited in brackish water in a saline lake. This sequence is considered to be transitional to a shallow marine environment.

6. Acknowledgments

The author would like to thank to Prof. Joe Lambiase and Dr. Phillip Rowell for their valuable discussion and guidance.

7. Reference

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