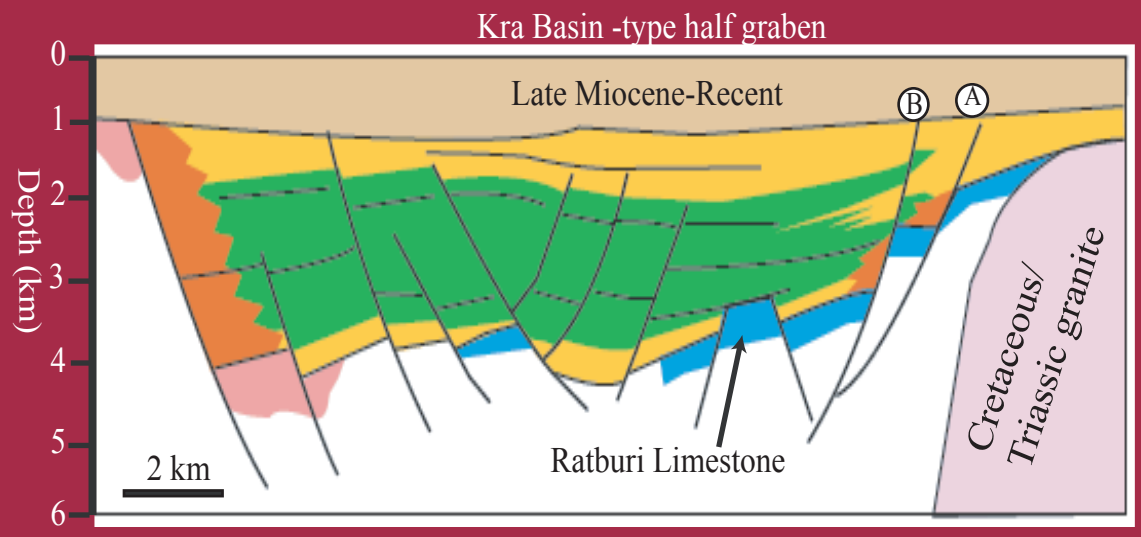
Bulletin of Earth Sciences of Thailand (BEST)

Volume 3 Number 2 October 2010

BEST

International Journal



Petroleum Geoscience

ISSN 1906-280X

Bulletin of Earth Sciences of Thailand (BEST)
International Journal of Earth Sciences

Bulletin of Earth Sciences of Thailand (BEST) is an international journal and publishes peer-reviewed works across the geosciences and earth sciences disciplines from fundamental theory and sciences to applied research of relevance to sustainable management of the environment.

ISSN: 1906-280X

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

Editorial office:
Department of Geology, Faculty of Science, Chulalongkorn University, Phrayathai Road., Bangkok 10330, THAILAND.
Telephone: 66-2-218-5445, 218-5442-3 Fax: 66-2-218-5464
Website: http://www.geo.sc.chula.ac.th/geonew/Page/BESTjournal.php Editor Email: monkeng@hotmail.com

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

Sedimentology, Depositional Environment, Stratigraphy and Reservoir Quality of the Redbeds in Laem Thai Ran Dok Mai, Chanthaburi, Thailand

Pham Thi Dieu Huyen*

Petroleum Geoscience Program, Department of Geology, Faculty of Science,

Chulalongkorn University, Bangkok 10330, Thailand

*Author email: phamdieuhuyen1982@yahoo.com

Abstract

The main objectives of this study are to determine the sedimentology, stratigraphy and depositional environment of the redbeds in Laem Thai Ran Dok Mai. In this study, 6 lithofacies are classified based on field work, thin section analysis and spectral gamma signatures which are shale, fine to coarse sandstone, coarse sandstone with clasts, granular sandstone, pebbly sandstone and conglomerate. These redbeds mainly contain sandstones. In the lower part, sandstones interbed with conglomerates, some pebbly sandstones and granular sandstones. Generally, spectral gamma signatures match quite well with sedimentary features. These redbeds were deposited by a braided stream system. Based on their characteristics, these redbeds are interpreted as belonging to the Nam Phong Formation. These rocks have poor reservoir potential because of low porosity. They are compacted, strongly influenced by diagenesis and filled by infiltrated clay.

Keywords: Redbeds, Laem Thai Ran Dok Mai, braided, poor reservoir.

1. Introduction

The redbeds in Laem Thai Ran Dok Mai were discovered and first mapped by Ridd and Wainwright (1969) and since then have appeared on every edition of geological map published by the Thai Department of Mineral Resources.

Several studies were carried out in this area such as Bunopas (1981), Ridd (1997) and DMR's maps. All of them studied regional geology. Most of them defined these redbeds as a specific formation or tried to correlate them with other redbeds. The newest geological map of Thailand defines the redbeds in Laem Thai Ran Dok Mai, Chanthaburi province as belonging to the Khorat Group.

However, none of these researches were detailed so that the sedimentology, stratigraphy and depositional environment of these redbeds are not well understood. Hence, their potential in terms of reservoir, their relationship with the subsurface and their value as analogues remain unknown.

The age of the redbeds is uncertain. Geard (2008) gave the age as 196 $\pm$ 8 Ma based on zircon isotopes but most reported ages are based on correlations with other units, although it is certain that they are no older than Early Jurassic.

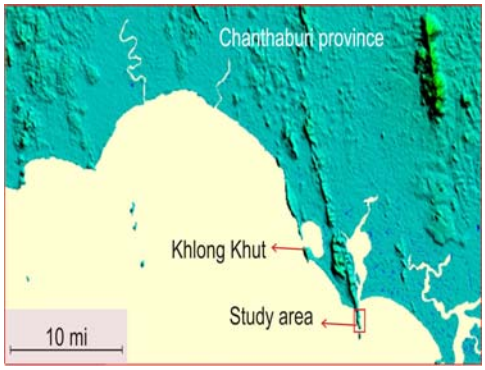


Figure 1. Map of Chanthaburi province showing the location of study area.

2. Methodology

The outcrops in Laem Thai Ran Dok Mai outcrop were mapped and logged in detail to define the stacking patterns and geometry of the sedimentary units. Lithology, grain size and composition were used to define six different lithofacies. Grain size, sedimentary architecture, bed contacts, and changes in grain size were recorded and strike and dip were measured. Paleo-flow direction was estimated based on the direction of cross bedding and the orientation of imbricated clasts in conglomerate beds.

Twelve samples were collected for thin section analysis to determine grain size, the ratio of different grain size groups and sorting as well as grain shape. Matrix and diagenetic characteristics also were recorded. All these data were used to interpret depositional environment and stratigraphic architecture. XRD analyses were used to determine the composition of each sample.

3. Results

3.1 Sedimentology

The redbeds in Laem Thai Ran Dok Mai are mainly sandstones. In the lower part of the succession, sandstones are interbedded with conglomerates, some granular sandstones and pebbly sandstones. Sandstones are fine to medium and poorly sorted. Beds are 1.5 to 2 m thick with trough cross-bedding, parallel lamination and low to high angle planar cross-bedding. Conglomerates are mainly pebbles, although clast size ranges from granules to cobbles. Clasts are sub-angular to sub-rounded and some are imbricated. Pebbly sandstones also are imbricated with some low angle cross-bedding. Granular sandstones have low angle cross-bedding and parallel lamination. Clasts are sub-angular to angular. The matrix of the gravel lithofacies is medium to coarse red sandstone. The upper part of the succession is mostly stacked coarse sandstones with large scale (40 - 60 cm) high angle cross-bedding. A 6 m thick red shale separates the upper and lower parts of the succession.

3.2 Spectral gamma

Gamma logs match quite well with the sedimentological log (Figure 2). The coarse sandstones in the upper part have the lowest gamma values. In the lower part, gravels have lower gamma values than sandstones. Uranium, potassium and thorium curves display lower values in gravels indicating less organic matter, clay minerals and heavy minerals in gravels which was confirmed by thin section and XRD analysis. In gravel lithofacies, conglomerates have the lowest gamma values, pebbly sandstones and granular sandstones have similar gamma values.

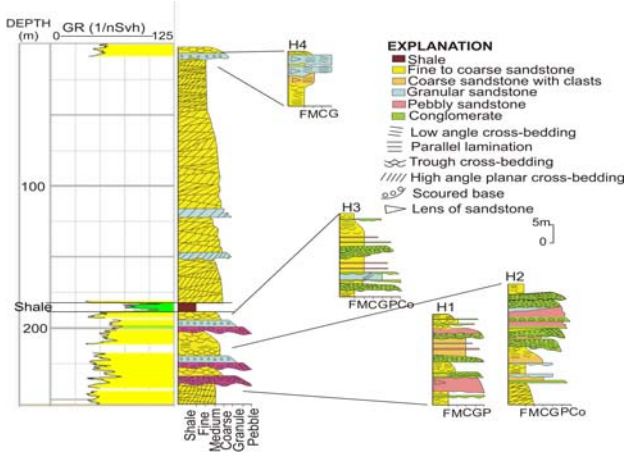


Figure 2. Total gamma log traverse tied to stratigraphic columns of the redbes in Laem Thai Ran Dok Mai.

3.3 Depositional environment

Figure 2 includes several cycles of grain size decreasing from conglomerate to fine – medium sandstone, indicating repeated upward decreases in energy. Similar energy fluctuations occur at a smaller scale within each cycle and within individual beds, as indicated by the sedimentary structures.

The sharp contacts and scoured bed bases indicate rapid changes in flow energy. Cross-bedding has several different orientations and is often cross-cutting. The depositional system comprised multiple minor channels that switched location frequently.

The multiple channels, strong flow and rapid, frequent changes in energy represent a braided stream system.

3.4 Reservoir quality

The rocks in this study have low primary porosity because of infiltrated clay. The strong development of polycrystalline, penetrated and sutured margin quartz overgrowths combined with compaction make secondary porosity very low. Although the formation in Laem Thai Ran Dok Mai has both small and large sand bodies with good connectivity, the low porosity and permeability make it a poor reservoir.

5. Discussion

The presence of a significant amount of dispersed clay indicates environments with abundant suspended materials. Iron oxides are also present. These characteristics result from the strong mechanical and chemical weathering that is typical of humid tropical climates.

This study suggests that gamma logs are poor indicators in a system where porosity is controlled by diagenesis. Braided streams deposits are primarily sand and gravel which have similar radioactivity levels to each other and most common cements.

6. Conclusions

This study of the redbed outcrops at Laem Thai Ran Dok Mai concluded that:

(a) The redbeds were deposited by a braided stream system.

(b) They are interpreted as belonging to the Nam Phong Formation, Khorat Group with an age not older than early Jurassic.

(c) They have very low porosity and permeability because of burial compaction and cementation.

7. Acknowledgements

I would like to express my sincere thanks and deep gratitude to my supervisor Professor Joseph Lambiase and Professor John K Warren for their conduct, encouragement and support that helped me through this research project and throughout this course. I am very grateful to Dr. Phillip Rowell for his valuable teaching.

8. References

Bunopas, S., 1981. Paleogeographic History of Western Thailand and Adjacent Part of Southeast Asia. Ph.D. dissertation, Victoria University of Wellington, New Zealand.

Geard, A. K., 2008. Geology of the Klaeng Region (Southeast Thailand): Lithology, structure and geochronology. Unpublished B.Sc thesis, University of Tasmania.

Ridd, M.F., 1997. Khao Thalai Red-beds, a Lower Triassic or older formation in Chanthaburi and Rayong Provinces, SE Thailand, in *Post – symposium Excursion Guidebook*, 1 – 12.

Ridd, M.F. & Wainwright, A.C.J. 1969. Reconnaissance Geology of Southern Thailand. Unpublished report for BP Petroleum Development Limited, London.