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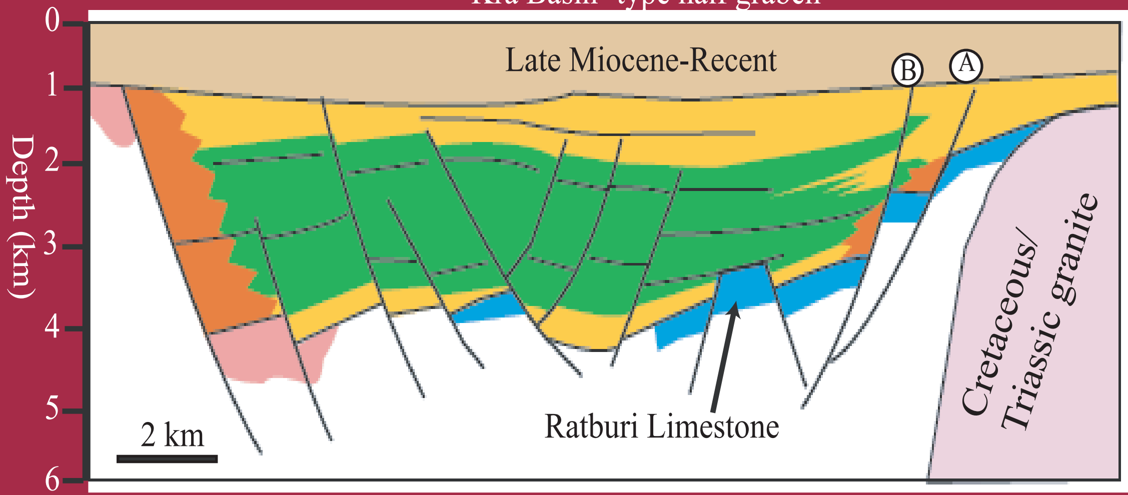
Kra Basin -type half graben



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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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August 2010

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Seismic Sequence Stratigraphy in a Pliocene to Recent Delta

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Abstract

This study focuses in terms of sequence stratigraphy on the evolution of a modern delta which has had significant changes in relative sea level, sediment supply and subsidence rate affecting its development. Eight sequence boundaries and associated depositional sequences observed during the early Pliocene to Recent in study area represent the stratigraphic evolution of the deltaic system through time. Depositional patterns are placed into a sequence stratigraphic framework in order to evaluate the variable influences of these factors on depositional processes within a deltaic environment.

Keywords: Seismic sequence stratigraphy, Pliocene delta.

1. Introduction

The study area is located on a broad continental shelf approximately 260 km S-E from the present day delta. Another smaller delta is situated to the west of the study area (Figure 1).

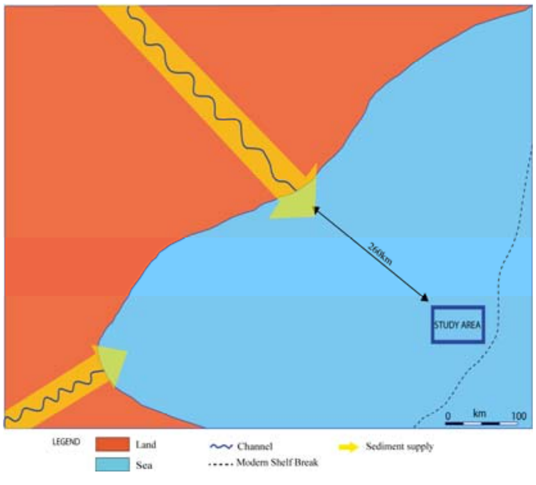

Figure 1. Base map of study area.

2. Seismic Interpretation

This study relies entirely on interpretation using a 3D seismic dataset. The seismic volume consists of approximately 934 sq km of 3D post-stack data. Throughout the dataset the 3D seismic has excellent resolution. Multiple reflections and some geological features complicate interpretation in some areas

This research was accomplished in several parts: 1) identification and mapping of the main sequence stratigraphic units, 2) interpretation of the sediment processes within each unit based on seismic facies analysis, and 3) understand the external processes that affect stratigraphic architecture in the area.

3. Results

The seismic data shows a stacked prograding sequence of depositional episodes interpreted as a prograding delta.

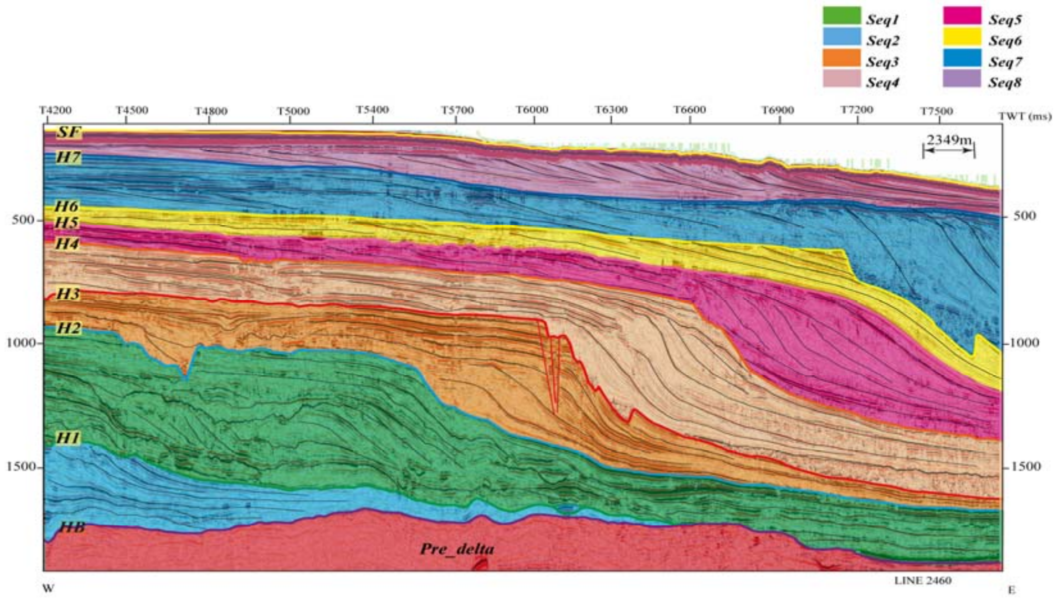

Figure 2. Sequence boundaries identified in deltaic complex

The deltaic megasequence can be broken down into eight depositional sequences. Eight horizons and one seafloor surface were picked and are labeled as HB (Base horizon), H1 (Horizon 1) H2 (Horizon 2), H3 (Horizon 3), H4 (Horizon 4), H5 (Horizon 5), H6 (Horizon 6), H7 (Horizon 7) and SF (Seafloor) (Figure 2).

Sequence 1 (HB to H1) is bound by an erosional surface H1 and HB. Irregular characteristics in the lower section are likely related to erosion during lowstand whilst the progradational packages suggest that the upper part may be deposit in a more distal environment with high sediment supply during the following highstand.

Sequence 2 (H1 to H2) is bound by an erosional surface H2 and H1 horizon and has an overall clinoform-shape. In the lower section of this sequence, incisions on the shelf are interpreted to be deposited during relative sea level low. Progradational character of the upper section indicates that sediment supply increased and exceeded the accommodation space on the shelf.

Sequence 3 (H2 to H3) is defined by two significant erosional surfaces H2 and H3. Noticeable incised channels are well observed on the shelf, suggesting a long period of relatively low sea level. Two channels observed in H2 and H3 horizons support the idea of having different sediment sources. Sediment progrades in seaward direction.

Sequence 4 (H3 to H4) is bound by an erosional surface H3 and a conformable surface H4. Turbidite fans and incised channels occurred during the lowstand of this sequence suggesting a significant fall in relative sea level at H3 time. Sigmoid-oblique clinoforms in the upper part indicate huge sediment supply to the basin.

Sequence 5 (H4 to H5) has not much erosion in both bounding surfaces (H4 and H5). Shingled clinoforms recognized on the shelf indicate high sediment influx compared to a low subsidence rate on the shelf setting.

Sequence 6 (H5 to H6) is defined by surfaces H5 and H6 with quite parallel, continuous reflections suggesting a stable depositional environment. High sediment supply influences gravity instability causing sediment slides basinward.

The seismic character of sequence 7 (H6 to H7) is quite similar to sequence 6 with shingled clinoforms indicating sediment deposited on the shelf, builds out rapidly and accumulated in the basin.

Sequence 8 (H7 to SF) is bound by the downlap surface H7 and the seafloor (SF). Internal characters show shingled and oblique clinoforms indicating that sediment progrades out very quickly to the basin.

4. Discussion

Based on the relative sea level curve of Wornardt *et al*. (2001), the delta boundary HB was correlated with a lowstand event at 3.95 Ma. H1, H2 and H3 can be correlated with sea level lowstands at 3.21 Ma, 2.00 Ma and 1.40 Ma, respectively. H4 and H7 are likely correlated to 0.8 Ma and 0.2 Ma lowstands.

In general, sediments prograde basinward from west to east. In the period of sequence 1 to sequence 3 the rate is stable, in the sequence 4 the rate increases, and in the final four sequences, the rate increases and exceeds the accommodation space. Channel incisions were observed in sequence 2 to sequence 3 indicate that there are two sediment sources coming into the basin.

Through sequence 1 to sequence 3, incisions are observed across the shelf suggesting low subsidence rate. More progradational clinoforms are observed during sequence 4 to sequence 5 suggesting the rate of subsidence is higher. The youngest sequences (sequence 6, 7 and 8) has low subsidence rate by observed shingled clinoforms and toplap terminations.

Based on those observations four stages of the delta evolution can be proposed. Stage 1 (sequence 1): Highstand deposition with low energy from a distant source point. Stage 2 (sequence 2 and 3): Dominantly lowstand deposition, incision of SW channels on the shelf and basin floor fans. Stage 3(sequence 4): Dominantly highstand deposition with a change in direction of increasing sediment supply. Stage 4 (sequence 5, 6, 7 and 8): High frequency of highstand deposition with rapid sediment deposition.

5. Conclusions

This study provides a view of the recent sedimentary depositional processes within a modern deltaic system. Eight major depositional sequences were recognized on the seismic sections, each sequence is characterized by a specific seismic configuration and termination patterns which are related to depositional processes.

This study also focuses on sediment stratigraphy framework during the Pliocene to Recent of the delta with the relationship of changes in sediment supply, relative sea level and subsidence rate. This was then used to interpret four stages of the delta evolution through time.

6. Acknowledgements

I would like to thank Pearl Energy for their financial support during the M Sc program. I am extremely grateful to my supervisor, Dr. Philip Rowell, for his instruction, useful advice that led to the completion of this thesis. My gratitude also goes to Prof. Joseph Lambiase, Prof. John Warren and all visiting lecturers for their lectures. My sincere thanks also go to Landmark Graphics Corporation for their generous donation of software to the University. Thanks to my classmates for their support and advice.

7. Reference

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