

**PETROLEUM POTENTIAL ASSESSMENT OF THE  
CHONNABOT PROSPECT IN NORTHEASTERN  
REGION OF THAILAND**

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**A Thesis Submitted in Partial Fulfillment of the Requirements for the  
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การประเมินศักยภาพปิโตรเลียมในโครงสร้างกักเก็บชนบท  
ภาคตะวันออกเฉียงเหนือ ประเทศไทย

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต  
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CHONNABOT PROSPECT IN NORTHEASTERN  
REGION OF THAILAND**

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งานวิจัยนี้มีวัตถุประสงค์หลักสองประการ คือ การประเมินศักยภาพปิโตรเลียม และการ  
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พื้นที่บริเวณอำเภอชนบท อำเภอเวียงใหญ่ และอำเภอเวียงน้อย จังหวัดขอนแก่น หรืออยู่ทาง  
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การประเมินทรัพยากรปิโตรเลียมที่ยังไม่ถูกค้นพบของโครงสร้างกักเก็บชนบท กระทำโดย  
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พบว่าผู้รับสัมปทานจะเริ่มมีผลกำไรเมื่อราคาก๊าซธรรมชาติไม่น้อยกว่า 3.16 เหรียญสหรัฐต่อล้านบีทียู

ในกรณีศึกษาที่มีโอกาสการค้นพบระดับสูงคือมีศักยภาพทรัพยากรก๊าซธรรมชาติ 122.433 พันล้าน  
ลูกบาศก์ฟุต ผู้รับสัมปทานจะสามารถเริ่มมีผลกำไรเมื่อราคาก๊าซธรรมชาติไม่น้อยกว่า 5.82 เหรียญ  
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ลายมือชื่อนักศึกษา\_\_\_\_\_

ลายมือชื่ออาจารย์ที่ปรึกษา\_\_\_\_\_

SAKCHAI GLUMGLOMJIT : PETROLEUM POTENTIAL ASSESSMENT  
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UNDISCOVERED PETROLEUM RESOURCE/PETROLEUM POTENTIAL  
ASSESSMENT/PETROLEUM ECONOMICS/CHONNABOT PROSPECT/  
NORTHEASTERN REGION OF THAILAND

The objectives of this research are to assess the petroleum potential and to evaluate economical value of the petroleum resources in the Chonnabot prospect. The study area covers the area of Chonnabot, Waeng Yai, and Waeng Noi district, Khon Kaen province which located in the southwestern part of northeastern region of Thailand between latitudes 15°45' to 16°15' North and longitudes 102°15' to 102°45' East. The Chonnabot prospect is chosen for this study in order to enhance the knowledge of the geological evolution and petroleum potential of Permian reservoir which is important in northeastern region of Thailand.

The undiscovered petroleum resources assessment of the Chonnabot prospect is performed by FASPU software and the results can be summarized as follows; (1) the quantities of oil accumulation is 41.1836 MMbbl but the chance of discovery is only 5 percent. (2) The quantities of non-associated gas accumulation are vary in size depended on the chance of discovery as 122.433 Bcf at 95 percent chance of discovery (high confidence), 270.895 Bcf at 75 percent chance of discovery, 470.444 Bcf at

50 percent chance of discovery (most likely), 816.987 Bcf at 25 percent chance of discovery, and 1,807.66 Bcf at 5 percent chance of discovery, respectively.

The economical evaluated result of the petroleum resources in the Chonnabot prospect indicated that it has sufficient economics potential to be developed in the future. In economic evaluated of the most likely case (petroleum resource size 470.444 Bcf) with its initial gas production flow rate of 100 MMcfd and gas price 6.00 US\$/MMBTU, the discounted internal rate of return is equal to 18.86 percent and the profit to investment ratio is 0.80 (discount factor rate is 10 percent) and the net present value is 228.88 MMUS\$. Results of sensitivity analysis on gas price indicate that the concessionaire will start obtaining the benefit when the minimum gas price is more than 3.16 US\$/MMBTU. In high confidence case (petroleum resource size 122.433 Bcf), the concessionaire will start obtaining the benefit when the minimum gas price is more than 5.82 US\$/MMBTU.

School of Geotechnology

Academic Year 2010

Student's Signature \_\_\_\_\_

Advisor's Signature \_\_\_\_\_

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## LIST OF ABBREVIATIONS

bbbl	=	barrel
bbbl/month	=	barrel per month
Bcf	=	Billion cubic feet
Bcfd	=	Billion cubic feet per day
BTU	=	British thermal unit
oF/100 ft	=	fahrenheit degree per 100 feet
Ma	=	Million ages
Mcf/bbl	=	Thousand cubic feet per barrel
MMbbl	=	Million barrels
MMcf	=	Million cubic feet
MMcfd	=	Million cubic feet per day
MMcf/month	=	Million cubic feet per month
MMcf/year	=	Million cubic feet per year
MMUS\$	=	Million US\$
MMUS\$/km	=	Million US\$ per kilometer
MMUS\$/well	=	Million US\$ per well
ppg	=	pound per gallon
TD	=	total depth
US\$/MMBTU	=	US\$ per Million British thermal unit
US\$/MMcf	=	US\$ per Million cubic feet

# CHAPTER I

## INTRODUCTION

### 1.1 Rationale and background

Most of Thailand's primary energy consumption today comes from mainly petroleum fossil fuels. For at least the next decade, petroleum will keep its place in the national energy picture and so the security of petroleum supply needs to be enhanced. Adding to the capability of securing mineral fuels from domestic sources through in assessing the potential of domestic mineral fuels, with a focus on the feasibility of developing petroleum deposits contained in geological structures that differ from today's structures and petroleum potential assessment for areas with complex geological conditions.

As in 2008 annual report, department of Mineral Fuels Strategic plan is to promote petroleum assessment through greater data security, update, and organize annual technical seminars to share views with concessionaries in the northeast, academicians, and the interested public to add further insight and ease exploration success.

Exploration and production of petroleum in the northeast of Thailand has been going moreover four decades, today only two natural gas fields namely Nam Phong and Sinphuhorm are on production. The petroleum provinces in the northeast have a high potential for exploration and development. The reservoir rocks in this vast region are Permian carbonates which contain in anticlines resulting from transversing

fault lines, creating fractures, and adding porosity to the carbonates. More than 30 wells drilled were confirmed this fact, but to date only the Nam Phong and the Sinphuhorm gas fields have production. It is expected that more gas fields will be developed in the carbonate reservoir rock Chonnobot prospect.

## **1.2 Research objectives**

The objectives of this research are (1) to identify and assess the potential of petroleum resources, and (2) to evaluate the economical of resource of the Chonnobot prospect. In order to achieve these goals, this research is divided into four main parts. The first part describes the stratigraphy and sedimentation evolution of this area. The second part describes the petroleum geology and petroleum engineering system of the area. Assessment of the potential of the undiscovered petroleum resource in the area is the third part. The last part deals with economics analysis of the undiscovered petroleum resources.

## **1.3 Research methodology**

### **1.3.1 Literature review**

Relevant literatures are searched, reviewed, summarized and documented. The summary of the literature review will be given in the thesis which includes geology information of the Permian carbonate in the northeast of Thailand and carbonate reservoir rock properties. The sources of information are from journals, technical reports, and conference papers.

### **1.3.2 Data collection and analysis**

The same geological characteristics will be identified and grouped in the same type of play for petroleum play analysis. The play analysis is a quantitative approach for estimating undiscovered oil and gas resource at a play scale.

### **1.3.3 Undiscovered resources assessment**

The undiscovered petroleum resource of the Chonnabot prospect will be evaluated using the FASPU program. Hydrocarbon resource estimates of oil, non-associated gas, associated-dissolved gas, and total gas will be calculated in terms of probability distributions.

### **1.3.4 Petroleum economics**

The petroleum economics of the hydrocarbon resource from the FASPU program will be evaluated. The results of cash flow analysis will be studied and analyzed to determine the base case from Internal Rate of Return (IRR) and Profit to Investment Ratio (PIR).

### **1.3.5 Thesis writing and presentation**

All research activities, methods, and results of undiscovered hydrocarbon resource and petroleum economics evaluation will be fully documented and complied the thesis. Finally, the thesis will be submitted at the end of the research.

## **1.4 Scope and limitations of the study**

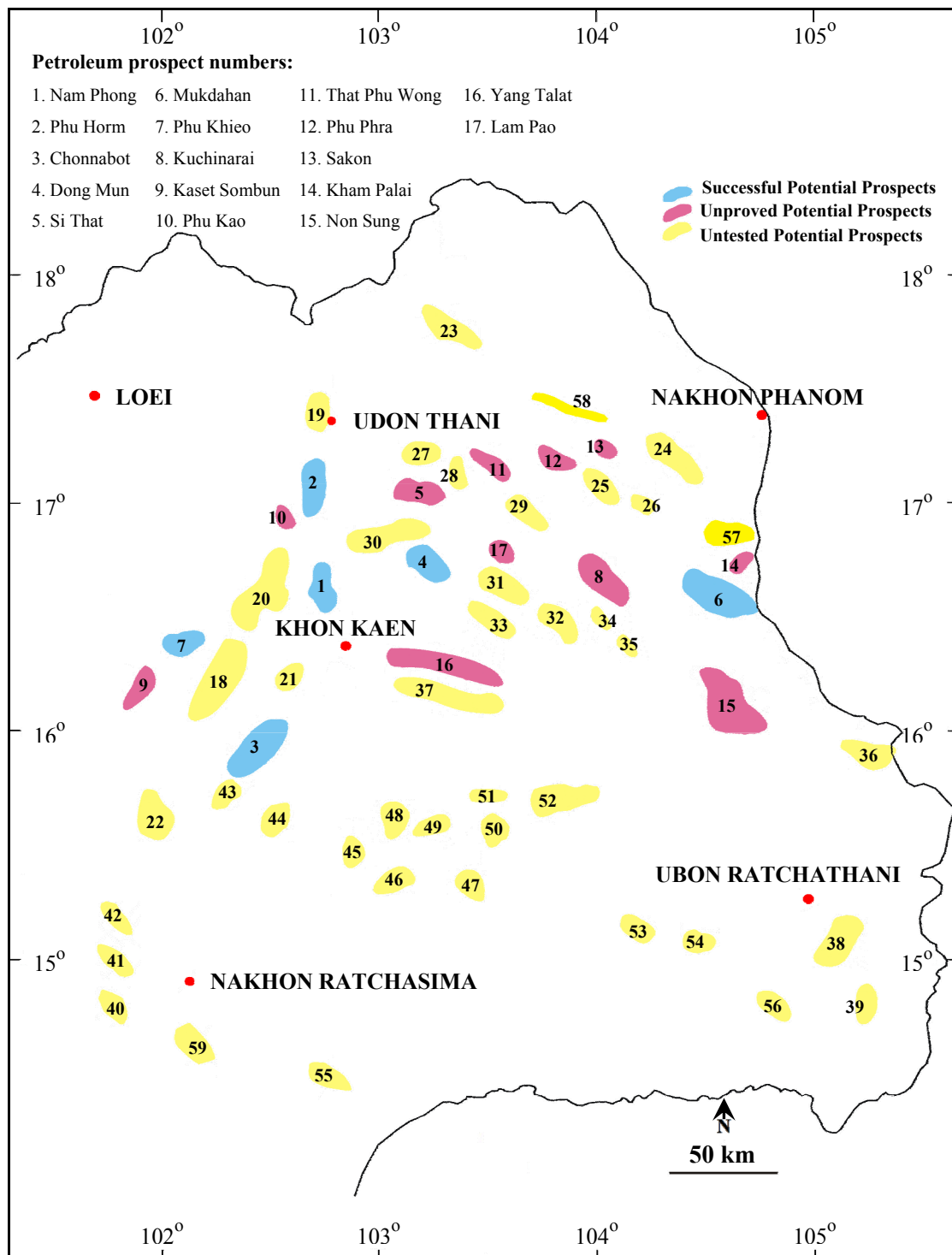
The study area covers the area of Chonnabot, Waeng Yai, and Waeng Noi district, Khon Kaen province which located in the southwestern part of northeastern region of Thailand between latitudes 15°45' to 16°15' North and longitudes 102°15' to

102°45' East. The Chonnabot prospect is chosen for this study in order to enhance the knowledge of the geological evolution and petroleum potential of Permian reservoir which is important in northeastern region of Thailand.

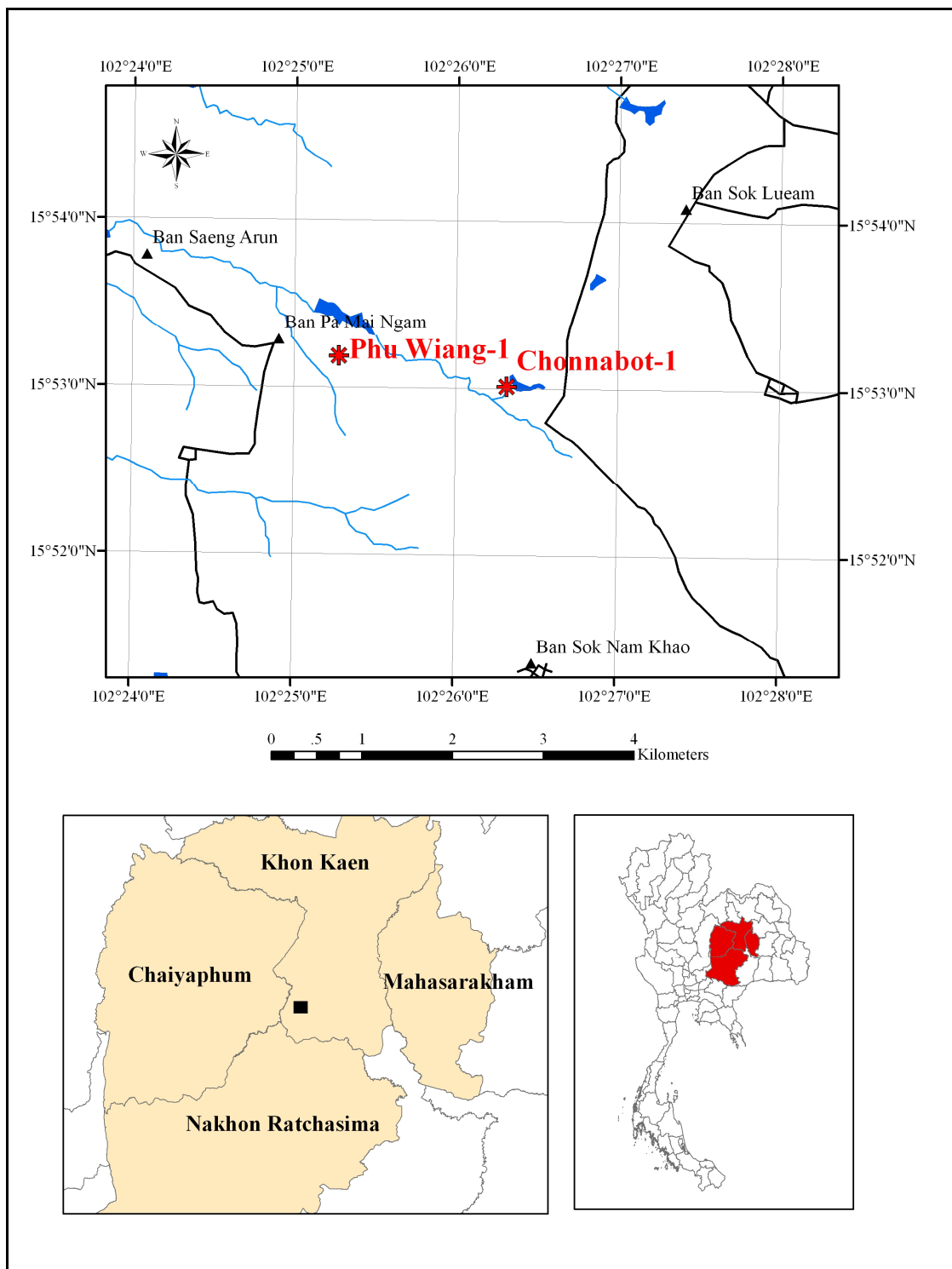
This research uses the existing and published data which are provided by Department of Mineral Fuels (DMF), Thailand. The data included wireline logs, drilling data, palaeontological reports, and other general geological and petroleum engineering information.

## **1.5 Thesis contents**

**Chapter I** introduces the study by describing the rationale and background, research objectives, research methodology, scope and limitations. **Chapter II** summarizes results of the literature review. **Chapter III** describes the method of the study. **Chapter IV** describes the geological model and petroleum reservoir engineering parameter for undiscovered resources assessment. **Chapter V** analyzes the results from the FASPU program in terms of petroleum economics. **Chapter VI** reports conclusion and discussion the research results, and recommendation for future research studies.



**Figure 1.1** The petroleum prospects map of northeastern region of Thailand (from Chantong, W., 2007).



**Figure 1.2** The petroleum exploration wells in Chonnabot prospect of northeastern region of Thailand.