RESERVOIR ROCK IDENTIFICATION BY USING ACOUSTIC IMPEDANCE AND POROSITY RELATIONSHIP IN WICHIAN BURI SUB-BASIN, PHETCHABUN PROVINCE

Nanthana Yodlee

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Engineering in Geotechnology

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การจำแนกชั้นหินกักเก็บโดยการใช้ความสัมพันธ์ระหว่างอิมพีแดนซ์ทางเสียง และค่าความพรุนในแอ่งย่อยวิเชียรบุรี จังหวัดเพชรบูรณ์

นางสาวนันทนา ยอดดี

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for a Master's Degree.

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นันทนา ยอดดี : การจำแนกชั้นหินกักเก็บโดยการใช้ความสัมพันธ์ระหว่างอิมพีแดนซ์ทางเสียงและค่าความพรุนในแอ่งย่อยวิเชียรบุรี จังหวัดเพชรบูรณ์ (RESERVOIR ROCK IDENTIFICATION BY USING ACOUSTIC IMPEDANCE AND POROSITY RELATIONSHIP IN WICHIAN BURI SUB-BASIN, PHETCHABUN PROVINCE) อาจารย์ที่ปรึกษา : อาจารย์ ดร. อัฆพรรค์ วรรณโกมล, 167 หน้า.

หนึ่งในปัญหาที่เกิดขึ้นในการสำรวจปิโตรเลียมคือการจำแนกชั้นหินกักเก็บ ความสัมพันธ์ระหว่างอิมพีแดนซ์ทางเสียงและค่าความพรุนเป็นหนึ่งในเครื่องมือที่เป็นประโยชน์สำหรับการแก้ปัญหานี้ วัตถุประสงค์ของงานวิจัยนี้คือเพื่อจำแนกชั้นหินกักเก็บของแอ่งย่อยวิเชียรบุรีโดยการใช้อิมพีแดนซ์ทางเสียงและและค่าความพรุน พื้นที่ศึกษาจะจำกัดอยู่ที่แอ่งย่อยวิเชียรบุรี อำเภอวิเชียรบุรี จังหวัดเพชรบูรณ์ ประเทศไทย วิธีการศึกษาที่สำคัญคือ (1) การคำนวณค่าอิมพีแดนซ์ทางเสียงจากสัญญาณคลื่นตามยาวจากข้อมูลที่เลือกไว้ และ (2) การวิเคราะห์ข้อมูลเชิงปริมาณและเชิงคุณภาพโดยการพล็อตค่าระหว่างค่าอิมพีแดนซ์ทางเสียง ค่าความพรุน และความลึกเพื่อรับรู้หน่วยของหินเพื่อจำแนกหินกักเก็บ

ผลของการวิเคราะห์ในเชิงปริมาณแสดงให้เห็นว่าอิมพีแดนซ์ทางเสียงและค่าความพรุนมีความสัมพันธ์เชิงเส้นด้วยค่าความสัมพันธ์ในทางบวกสำหรับหินทุกชนิด หินกักเก็บแสดงค่าค่าสัมประสิทธิ์จากความสัมพันธ์เชิงเส้นตรงที่มากกว่าที่ได้จากหินที่ไม่ใช่หินกักเก็บ โดยทั่วไปความสัมพันธ์ระหว่างค่าอิมพีแดนซ์ทางเสียงของสัญญาณเสียงเดินทางในช่วงระยะสั้น (short spacing delta-time : DTLN) และสัญญาณเสียงเดินทางในช่วงระยะยาว (long spacing delta-time : DTLF) ได้แสดงค่าสัมประสิทธิ์ที่มากกว่า 0.5 และยิ่งกว่านั้นยังมีความสัมพันธ์เชิงเส้นระหว่างค่าอิมพีแดนซ์ทางเสียงของสัญญาณเสียงเดินทางในช่วงระยะสั้นและสัญญาณเสียงเดินทางในช่วงระยะยาวอีกด้วย หินทรายและหินโคลนจะมีค่าสัมประสิทธิ์มากกว่าหินเกรแวก (greywacke) และหินโคลนแปรสภาพ (metaclaystone) สำหรับการแบ่งตามชนิดของหิน ส่วนการแบ่งตามหน่วยหินจะแสดงค่าสัมประสิทธิ์ของหินหน่วยที่ 3 และหน่วยที่ 4 สูงกว่าชุดหินน้ำดุก (Nam Duk Formation)

ผลจากการวิเคราะห์ในเชิงคุณภาพแสดงความสัมพันธ์ระหว่างค่าอิมพีแดนซ์ทางเสียงและความลึก ความสัมพันธ์ระหว่างค่าความพรุนและความลึก ความสัมพันธ์ระหว่างอิมพีแดนซ์ทางเสียงของสัญญาณคลื่นเสียงที่เดินทางในช่วงระยะสั้นกับความลึกและรายละเอียดของชนิดหินสามารถอธิบายเกี่ยวกับระบบปิโตรเลียมว่าหน่วยหินที่ 3 มีแนวโน้มเป็นหินต้นกำเนิดและหินกักเก็บ ในขณะที่หน่วยหินที่ 4 มีแนวโน้มที่จะเป็นหินต้นกำเนิด ยิ่งกว่านั้นความสัมพันธ์ระหว่างอิมพีแดนซ์ทางเสียงของสัญญาณคลื่นเสียงที่เดินทางในช่วงระยะสั้นและระยะยาว

ยังสามารถแบ่งคุณสมบัติของหินในแง่ของการมีเนื้อเป็นรูพรุนหรือเนื้อแน่น โดยอธิบายได้ว่า ในบริเวณที่ข้อมูลมีการกระจายตัวมากจะเป็นบริเวณที่เนื้อหินมีค่าความพรุนสูง (porous zone) และมีแนวโน้มที่จะเป็นชั้นหินกักเก็บ ในทางกลับกันในบริเวณที่ข้อมูลเกาะกลุ่มกันมากจะแสดงว่า บริเวณนั้นเป็นบริเวณที่มีค่าความพรุนต่ำ (dense zone) และมีแนวโน้มที่จะเป็นชั้นหินปิดกั้นแทน

สาขาวิชาเทคโนโลยีธรณี ลายมือชื่อนักศึกษา ______________________

ปีการศึกษา 2554 ลายมือชื่ออาจารย์ที่ปรึกษา ________________

NANTHANA YODLEE : RESERVOIR ROCK IDENTIFICATION BY USING ACOUSTIC IMPEDANCE AND POROSITY RELATIONSHIP IN WICHIAN BURI SUB-BASIN, PHETCHABUN PROVINCE. THESIS ADVISOR : AKKHAPUN WANNAKOMOL, Ph. D., 167 PP.

ACOUSTIC IMPEDANCE CONTRAST/POROSITY/RESERVOIR IDENTIFICATION/WICHIAN BURI SUB-BASIN/PHETCHABUN PROVINCE

One of the main problems occurred during a petroleum field exploration is the reservoir rock identification. The relationship between acoustic impedance and porosity is one of a useful tool for solving this problem. The objective of this research is to identify reservoir rocks of Wichian Buri Sub-basin by using acoustic impedance and porosity relationship. The study area is mainly confined to Wichian Buri Sub-basin, Wichian Buri district, Phetchabun province, Thailand. The main research activities are : (1) the acoustic impedance data of compressional sonic logs from selected wells computing, and (2) quantitative and qualitative data analysis by cross-plotting among acoustic impedance, porosity and depth for recognition of lithological units to identify reservoir rock.

The result of quantitative analysis showed that acoustic impedance and porosity have a linear relationship with positive correlation for all rock types. The coefficients from this linear relationship show a higher value in the dataset of the reservoir rocks than that in the non-reservoir rocks. Relationship between acoustic impedance of short spacing delta-time (DTLN) and long spacing delta-time (DTLF) showed that the correlation coefficients are generally greater than 0.5 and there is a linear relationship between acoustic impedance of short spacing delta-time (DTLN) and long spacing delta-time (DTLF). Sandstone and claystone had higher correlation coefficient values than greywacke and metaclaystone in lithologic identification. For stratigraphic unit identification it had been showed that unit three and unit four had higher correlation coefficient values than Nam Duk formation.

The result of quantitative analysis showed that relationship between acoustic impedance and depth, relationship between porosity and depth, relationship between acoustic impedance of short spacing delta-time and depth and lithological description can be explained petroleum system of Wichian buri sub-basin as Unit Three tends to be source and reservoir rock whilst Unit Four tends to be source rock. Moreover, relationship between acoustic impedance of short spacing delta-time and long spacing delta-time can be used for identifying rock property in term of having porous or dense texture. It was showed that where the dataset had large distribution meant that area was a porous zone and tended to be a reservoir rock. On the other hand, if where the dataset had less distribution meant that area was a dense zone and tended to be a seal rock instead.

School of Geotechnology Student's Signature ____________________

Academic Year 2011 Advisor's Signature ____________________

ACKNOWLEDGEMENT

I would like to express my sincere thanks to my thesis advisor, Dr. Akkhapun Wannakomol for his invaluable help and constant encouragement throughtout the course of this research. I am most grateful for his teaching and advice, not only the research methodologies but also many other methologies in life. I would not have been completed without all the support that I have always received from him.

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Nanthana Yodlee

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SYMBOLS AND ABBREVIATIONS

Vp	=	Compressional wave velocity
N	=	North
E	=	East
S	=	South
W	=	West
BPD	=	Barrels Per Day
MMSCFPD	=	Million Standard Cubic Feet Per Day
V_p	=	Compressional wave velocity
P-wave	=	Compression wave
km	=	Kilometers
m	=	Meters
mAHBDF	=	meter Along Hole Below Drill Floor
mAH	=	meter Along Hole
mTVSS	=	meter True Vertical Depth Sub Sea
A-1	=	Name of allowed well
GR	=	Gamma Ray
DT	=	Short spacing delta-time (10’-8’ spacing; microsec/ft)
DTL	=	Long spacing delta-time (12’-10’ spacing; microsec/ft)
DTLN	=	Short spacing delta-time (10’-8’ spacing; microsec/ft)
DTLF	=	Long spacing delta-time (12’-10’ spacing; microsec/ft)
Φ	=	Porosity

SYMBOLS AND ABBREVIATIONS (Continued)

ρ_{ma}	=	Matrix (or grain) density
ρ_{fl}	=	Fluid density
ρ_b	=	Bulk density
R	=	Correlation coefficient
AI	=	Acoustic Impedance
ρ	=	Density
υ	=	Velocity
WB	=	Wichian Buri
SGR	=	Spectral Gamma-Ray
CGR	=	Computed Gamma-Ray
API	=	American Petroleum Institute
DRHO	=	The bulk density correction
NPHI	=	Neutron Porosity
RHOB	=	gamma ray bulk density

CHAPTER I

INTRODUCTION

1.1 Background and rationale

Sedimentary basins are economically important because of their potential of suitable and favorable sites for the accumulation of mineral and energy resources, especially oil, natural gas, and coal. Extensive researches on various geological aspects, including structural evolution and tectonic framework, sedimentation and depositional environment, and economic resources, of these basins have been carried out. The majority of petroleum geologists believe that oil and gas originate from organic matter buried in a sedimentary basin. These are no doubt that the search for oil and gas has been the major driving force behind the rapid expansion in sedimentology over the last quarter of this century.

Among all sedimentary basins of different geology ages, Tertiary basins appear to be the most attractive. Due to the fact that most of the petroleum producing strata of Thailand are Tertiary in age. The hydrocarbons have been reported to be generated and found in lacustrine/fluvial strata mainly of Miocene-Oligocene age.

Thailand currently consumes approximately 1.5 million barrels of crude oil equivalence per day (excluding traditional renewable); and the demand growth for commercial energy is about 5% annually. Approximately 60% of this demand is imported.

In response to the rising demand forecast, Thai government is accelerating the exploration and development of indigenous petroleum resources together with investment by Thai's companies for hydroelectricity and gas supplies from neighboring countries. To enhance the domestic investment attractiveness, revising contractual and fiscal regimes, expanding of natural gas pipeline network, and opening of new bidding round of petroleum concession are impending.

On recently completion, the 19th bidding round was very successful with 16 awarded concessions covering 21 blocks. At this time, the 20th bidding round offering 65 exploration blocks located onshore and in the Gulf of Thailand, providing the great opportunity for E&P investments in the growing Thailand's petroleum market.

For decades, hydrocarbons have been discovered and produced from Tertiary and Pre-Tertiary Basins.

Tertiary Basins are widely distributed in various parts of the country, onshore (North, Central and South) and offshore (Gulf of Thailand and Andaman Sea). Pre-Tertiary Basins, are mainly located in the Northeastern Thailand, comprises Triassic and Permian Basin.

Tertiary intermontane and rift basins in Thailand share some similarities in origin, timing, sedimentary environments, and basin structural styles. These similarities corresponded with northward movement of the India terrane. Those basins in the south formed relatively earlier than in the north, and those in the west earlier than in the east. Alluvial environments dominated in the lower and upper parts of the basin, while lacustrine, fluvio-lacustrine and swamp environments were predominant in the middle part. They contain major deposits of petroleum, coal, oil shale, diatomite and ball clay of the country.

Tertiary sedimentary basins in Thailand occurred throughout the country as intermontane and rift basins, except the Khorat plateau, with long axis of the basins normally oriented in N-S direction that were related to the collision of India with Asia. Most of them show graben and half-graben geometry. At present, at least 70 Tertiary basins have been named with most of large basins also contain numbers of sub-basins. These Tertiary rocks are poorly exposed in natural outcrop and covered by Quaternary sediments except in the margin of the basin where the rocks were often brought to the surface by faults. As a result of post- as well as syndepositional faults, the present Tertiary configuration is a remnant of an original larger basin that was uplifted and eroded.

Study of these rocks in the past was quite difficult due to scare published papers and most of subsurface data are confidential. It is realized that these rocks are so important not only as source rocks and reservoirs of oil and gas, but also accumulation of coal, oil shale, diatomite and ball clay. Mining activities were performed in several basins i.e. coal of mainly lignite and sub-bituminous ranks from Mae Moh, Mae Than, Chiang Muan, Bo Luang, Li, Nong Ya Plong, and Krabi basins with prospective reserves in number of basins such as Wiang Haeng, Ngao, Wang Nua, Chae Khon, Mae Ramat, Mae Lamao, Khian Sa, Saba Yoi; petroleum from Phitsanulok, Supan Buri, Fang, and basins in the Gulf of Thailand; ball clay in association with coal from Mae Than basin; diatomite from Mae Tha sub-basin of Lampang basin. Huge oil shale deposit was found in Mae Sot basin. Among them, 9 basins have generated significant qualities of petroleum: namely Fang, Phisanulok, Supanburi, Kampaeng Saen, Pattani, Malay, Chumphon and Songkhla Basins (Lawwongngam and Phillip, 1993).

This study is focused on the Petchabun Basin where hydrocarbons have been discovered in the Wichian Buri sub-basin as indicated by drill stem test, 500 BPD of oil and 5.4 MMSCFPD of gas are obtained from its exploratory wells respectively. The Wichian Buri sub-basin is selected for its favorable attributes with respect to the thesis's objective include: the geological knowledge of this basin is limited and not fully understood; intensive exploration programs, notable drilling exploration, geophysical information is property available. Last, it is expected that results from this study may benefit further understand of the development of other Tertiary basins which have similar geological setting.

1.2 Data source

The studied data had been provided by Department of Mineral Fuels (DMF) Thailand. The data consists of wireline logs, sidewall core descriptions, final report of petrographic study of sidewall core, the biostratigraphy and palaeoenvironments, and well completion report A-1, SW-1 concession.

1.3 Research objective

The objective of this research is to identify reservoir rocks of Wichian Buri Sub-basin by using acoustic impedance and porosity relationship.

1.4 Research methodology

1.4.1 Literature review

Relevant literatures were searched, reviewed, summarized and documented. The summary of the literature review was given in the thesis, which includes the relationship between acoustic impedance and porosity of Pratu Tao

Formation in the greater Pratu Tao area, Phisanulok basin. Data employed in this study were composed of wire-line geophysical logs of gamma ray, density, neutron and caliper.

1.4.2 Acoustic impedance computation

The sonic log data from selected wells were used to compute the compressional wave velocity (Vp), and their impedances.

1.4.3 Quantitative data analysis

Computed acoustic impedance, porosity and depth were classified, grouped and cross-plotter to find out the relationship among them.

1.4.4 Qualitative data analysis

Acoustic (P-wave) impedance was used to identify reservoir rock in study area.

1.4.5 Thesis writing and presentation

Results from the study were summarized and prepared for thesis writing and examination.

1.5 Scope and limitation of the study

The study area is limited to Wichian Buri Sub-basin. The basin is mainly confined to Amphoe Wichian Buri, Changwat Phetchabun in the northern central part of Thailand. The basin lies approximately between latitudes 15°15'N to 16°00'N and longitudes 101°00'E to 101°20'E. It is approximately 1698 km^2 and covered by the SW1A Concession. The basin is distinctly linear in outline with, approximately 80 km long, and varies in width between 36 and 18 km. The basin is currently drained by the Mae Nam Pa Sak and its tributaries flowing from north to south.

This study concentrated on data analysis only within 3 formations, namely; Unit Three, Unit Four and Nam Duk Formation in Wichian Buri sub-basin, Petchabun Province as showed in Figure 1.1

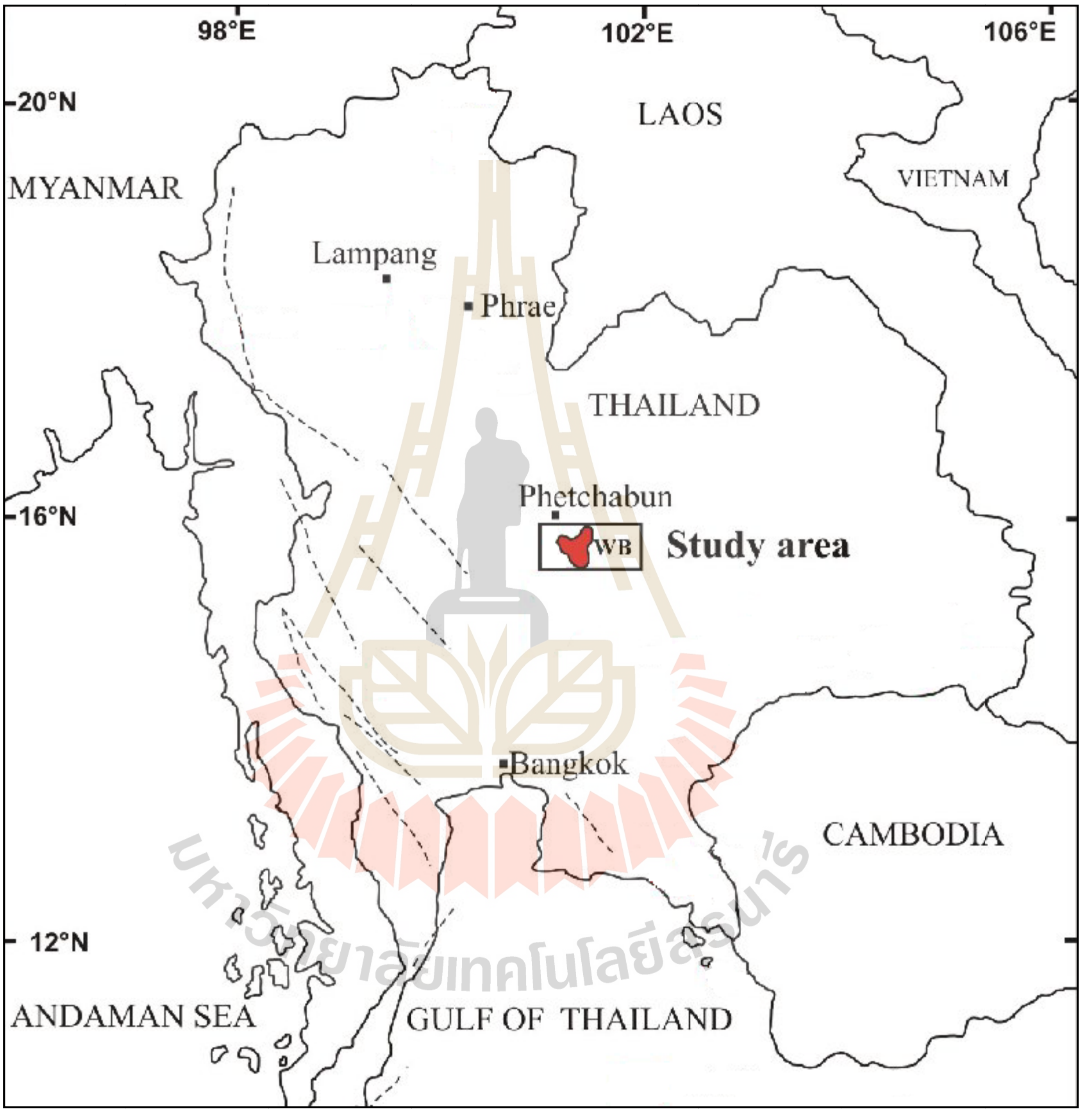


Figure 1.1 Map showing the location of wichain buri-sub basin (modified after Limtrakun et al., 2005).

CHAPTER II

REGIONAL AND GEOLOGICAL FRAMEWORK OF THE WICHIAN BURI SUB-BASIN

2.1 Introduction

In order to understand the origin of the formation of the Wichian Buri sub-basin, therefore, the discussion in this chapter focuses upon the physiography, geological setting, structure and geological history of not only the Wichian Buri sub-basin, but also covering the Phetchabun Basin and neighboring area.

2.2 Physiography of the basin

The Phetchabun Basin is located onshore in Thailand and is one of a series of north-south trending basins identified in Thailand. The basin covers an area within the Loei Fold Belt at the western edge of the Khorat Plateau. Both eastern and western margins of the basin are generally sharp and fault controlled. Paleozoic carbonates and marine clastic and Mesozoic continental sediments crop out around and within the basin margin; the Tertiary sequence deposited within the basin is largely covered by Quaternary alluvial sediments and Cenozoic basalts. The Phetchabun Basin is currently drained by the Mae Nam Pa Sak and its triburaries flowing from north to south.

The Phetchabun Basin consists of several north-south trending half-garbens as result of shear tectonics associated with right lateral movement on the northwest-south trending Mae Ping and Three Pagoda faults and left lateral movement along north/northeast - south/southwest trending conjugate strike-slip faults (Polachan and Sattayarak, 1989). Several conjugate strike-slip faults (Polachan and Sattayarak, 1989). Several conjugate strike-slip faults cut the basin and may have acted as the mechanism controlled the formation of individual half - garbens/garbens. These sub-basins vary in depth from 2,500 m. to 1,100 m. with deepest being in the south and progressively shallowing northwards (Remus et al., 1993).

The Wichian Buri sub-basin, one of five garben of Phetchabun Basin is N-S trending rift basin. It is bounded to the west and east by fault that divided the basin into 2 parts. From the seismic data, its maximum sediment thickness is estimated at 2,500 meters.

There are 4 sub-basins to the north of the Wichian Buri sub-basin, namely, Nong Chaeng Garben, Khon Khwang Garben, Chai Mongkhon Garben and North Phetchabun sub-basin. They contain sediments about 1,500-1,000 m. thick. These garbens including the Wichian Buri sub-basin are blanketed by Quaternary alluvial deposits.

2.3 Regional geologic setting

The Tertiary Phetchabun Basin is one of a series of north – south trending basins (Figure 2.1) identified onshore central Thailand (Figure 2.2) and in the Gulf of Thailand. These basins developed as grabens and half grabens during the Oligocene in response to dextral wrench faulting along major northwest – southeast fault zones (Red River, Mae Ping and Three Pagoda fault zones).

Sediments within the onshore basins are entirely terrestrial and include fluvial and lacustrine sequences. Lacustrine shakes are the primary source of oils discovered.

Reservoirs include fluvial and deltaic sands (in the Fang, Phetchabun, Phisanulok, and Suphan Buri Basins). Permain Carbonates (Chumpon Basin and in the case of the Phetchabun Basin, Miocene igneous units). A-1 was designed to test Miocene sands within a complexly faulted anticline overlying shallow basement in the northern portion of the Wichian Buri Sub-basin (Figure 2.3).

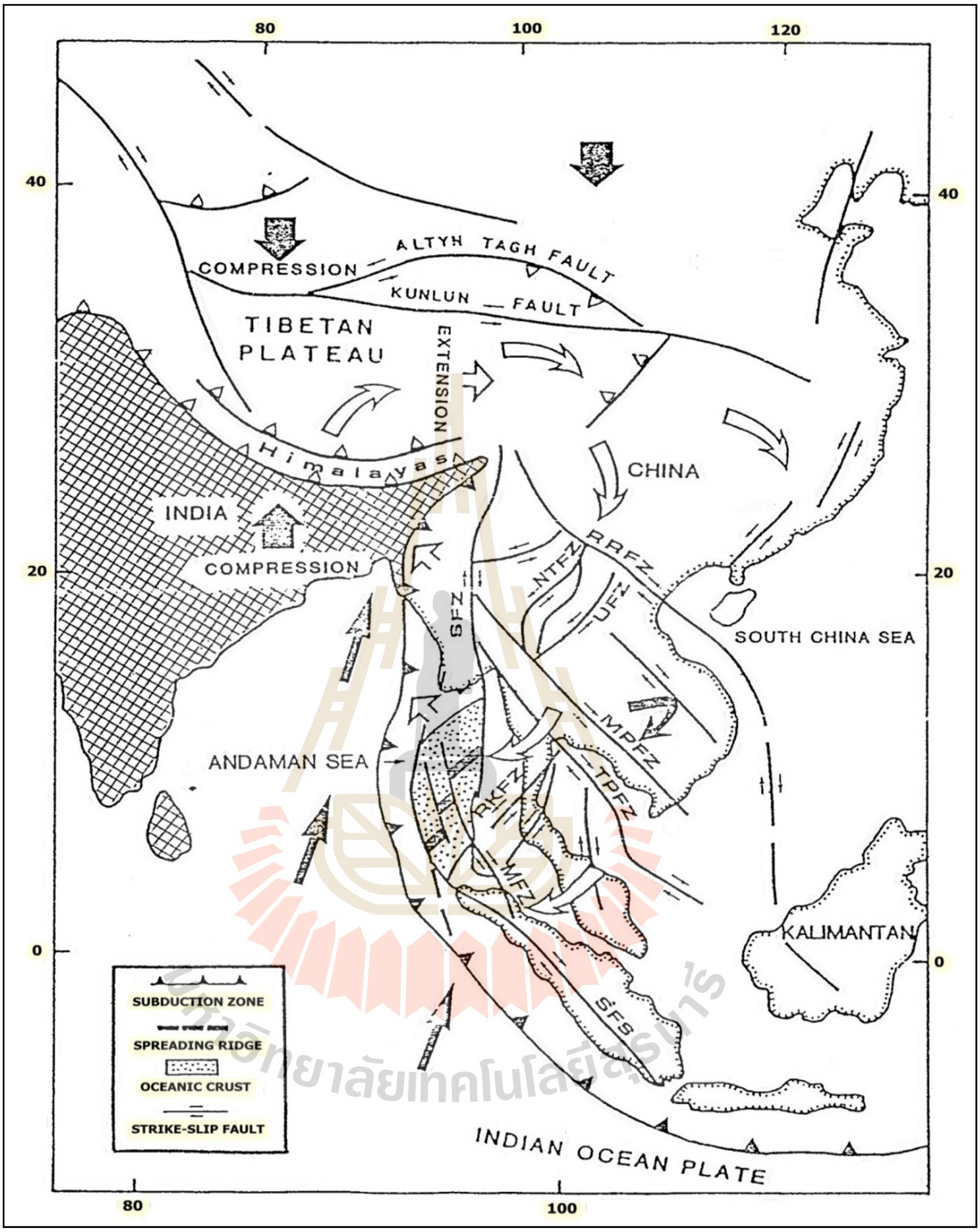


Figure 2.1 Tectonic map of S.E. Asia and South China (modified after Polachan, 1988).

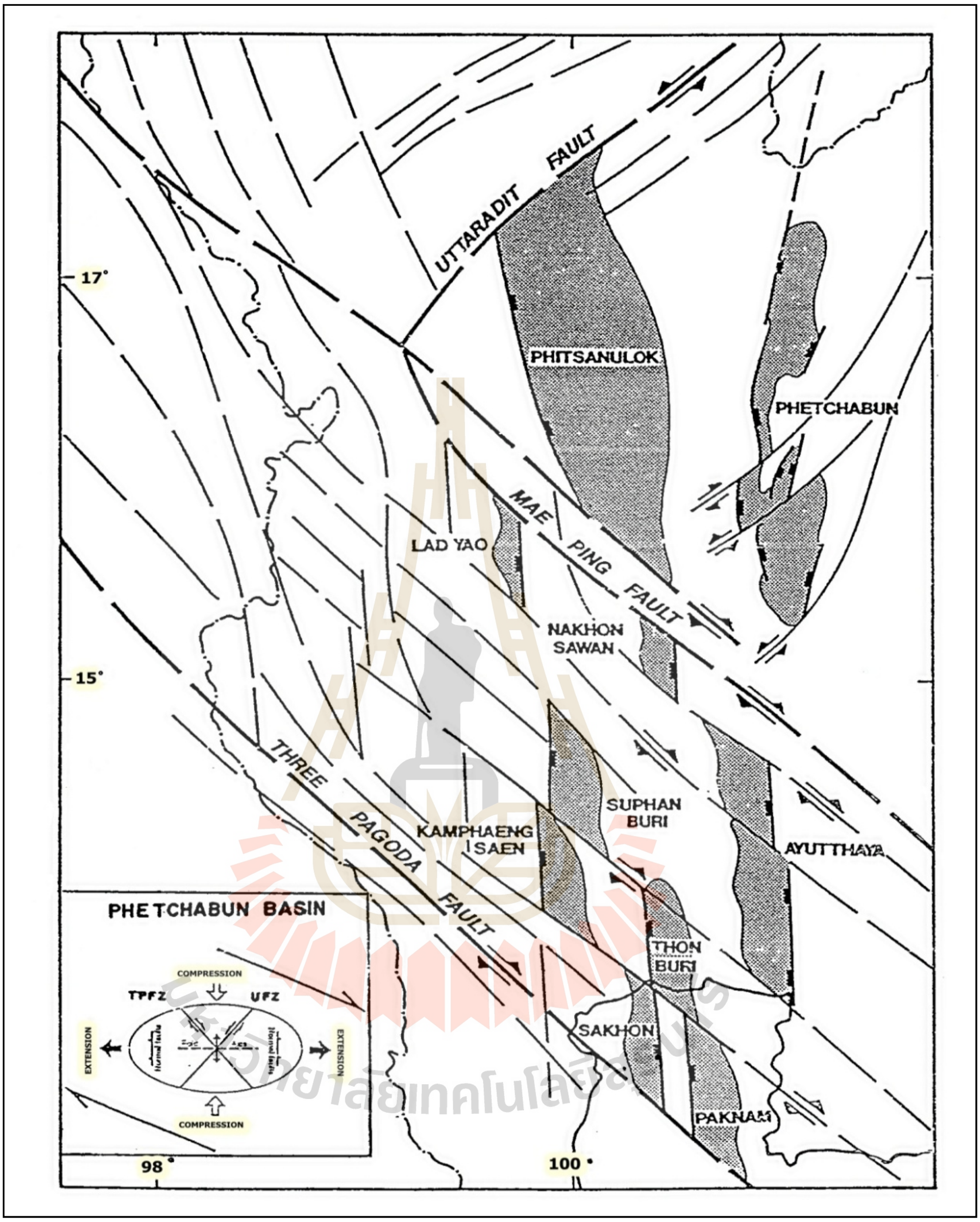


Figure 2.2 Structural map of the central of Thailand and the dextral transtensional shear model, Phetchabun Basin (modified after Polachan and Sattayarak, 1989).

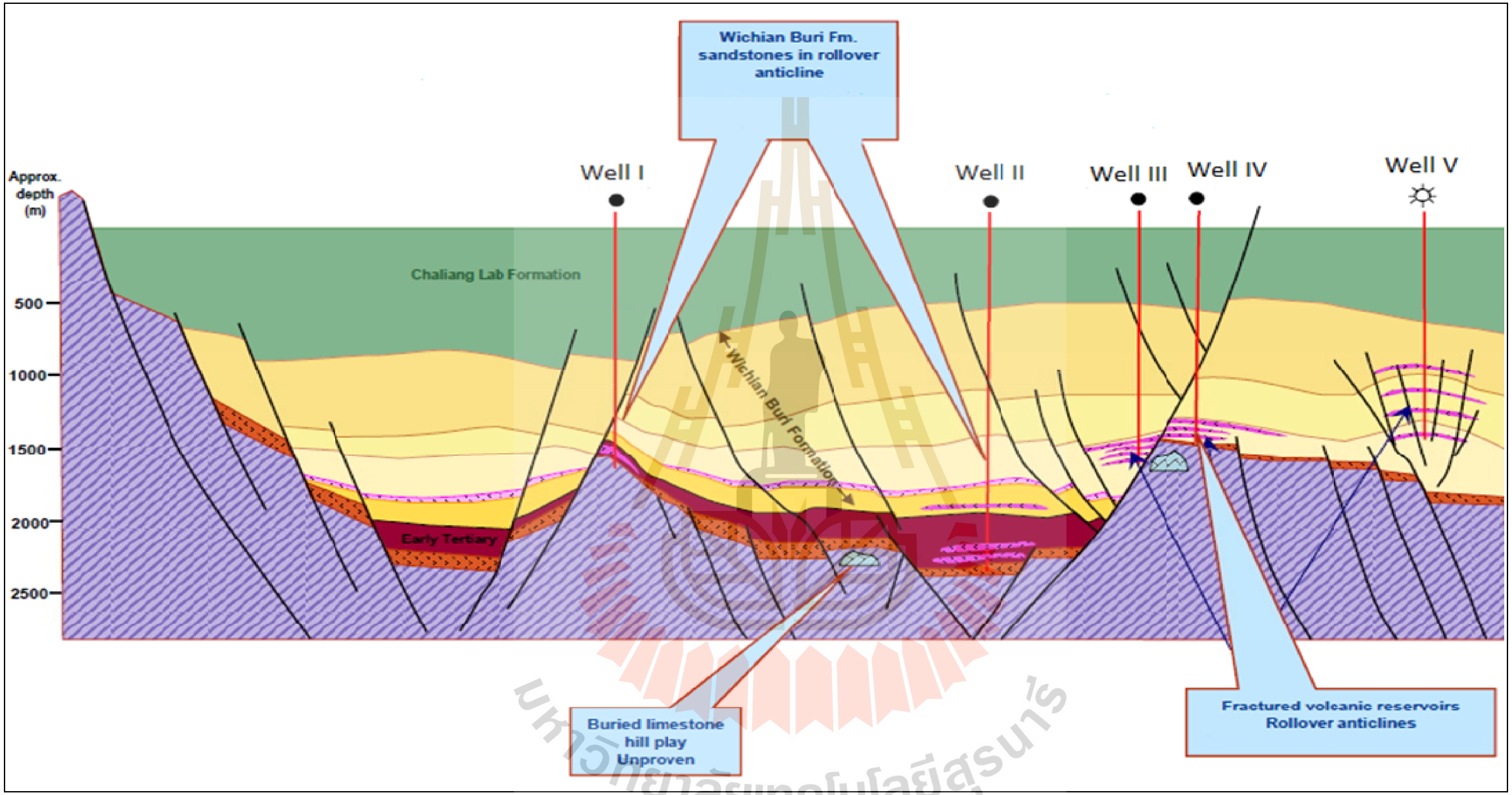


Figure 2.3 Wichian Buri Formation cross section (modified after http://www.carnarvon.com.au/docs/Invetsor%2012%20 Sept%20Bangkokl.pdf

2.4 Stratigraphy

In order to reconstruct a depositional system, first of all, we have to define its stratigraphy. The procedures for carrying this out are the subject of this chapter. In this study, an attempt is being made to define the stratigraphy of Tertiary sedimentary sequence in the Wichian Buri sub-basin.

Because of the lack of Tertiary outcrop in the Wichian Buri sub-basin, its detailed stratigraphy was therefore based largely in subsurface data. From well completion report of A-1 SW-1 concession are showed in Table 2.1;

Plio-pleistocene deposits (5.1 – 105 m)

The youngest sediments drilled in the well comprise weathered lithic sandstones and varicoloured claystones. Lithic sandstones in this unit have probably been derived from the Quaternary basalts that crop out immediately to the northwest. The base of this unit is defined by an offset in log character. If the correlation with other wells in correct the contract at 105 m is a significant unconformity.

Lithology:

Sandstone: Light grey, light grey – green, dark green, friable to occasionally firm, very fine to fine, subangular to subrounded weathered lithics, with trace of very fine quartz, calcite and dolomite.

Claystone: In the upper part: Yellow, very light grey, light orange, light purple, soft, sticky, very soluble and amorphous, with trace weathered basalt fragments and lignite.

In the lower part: Medium to dark grey, medium olive grey, soft to firm, amorphous, with common silt and very fine sand micromicaceous in part.

Table 2.1 Stratigraphy of Wichian Buri Sub-basin (modified after well completion report A-1, SW-1 concession)

Stratigraphic Unit		Depth (mAHBDF)	Depth (mTVSS)	Thickness (mAH)	Lithology
Plio-Pleistocene deposits		5.1	-87.6	99.9	Sandstone with minor claystone, clay
Unconformity					
Wichian Buri Group	Unit One	105	12.3	30.3	Tuff with interbedded sandstone and claystone
	Unit Two	135	42.3	119	Claystone interbedded with sandstone, minor lignite.
	Unit Three	254	161.3	280	Claystone interbeded with sandstone, and siltstone weathered volcanics.
	Unit Four	534	441.3	166	Claystone with minor sandstone
Unconformity					
Nam Duk F.M.		700	607.3	208	Claystone interbeded with sandstone and siltstone
Total depth		908	815.3		

Remark : mAHBDF = meter Along Hole Below Drill Floor
mAH = meter Along Hole
mTVSS = meter True Vertical Depth Sub Sea

Wichian Buri Group (105-700 m)

The Wichian Buri Group makes up most of the sedimentary sequence in the Phetchabun sub-basin. The upper boundary is defined by the Mid-Miocene unconformity which is not identified at A-1. The lower boundary is defined by a distinctive lithological change at the top of the Basal Tertiary.

The Wichian Buri Group has been subdivided into four stratigraphic units.

Wichian Buri Group (Unit One, 105-135 m)

Unit one consist predominantly of tuff with interbeded sandstone and claystone. The upper boundary is defined by the Pliocene unconformity. The lower boundary is defined by the of a tuffaceous unit, also recognized in the Wichian Buri Wells and characterized by a low GR response. Much of this unit has been eroded A-1.

Lithology: Tuff: Light to dark grey, firm to hard, occasionally friable, blocky, vesicular with mineral inclusions.

Claystone: Medium grey, olive, firm, blocky, occasionally slightly calcareous, with trace micromica.

Sandstone: Light grey to green, lithic, very fine to fine grianed, subangular, moderately sorted, calcareous, argillaceous in part, abundant calcite in part , poor visible porosity.

Age and Environment of Deposition:

On the basis of a correlation with other wells, the age of unit one is considered to be Middle Miocene.

Wichian Buri Group (Unit Two, 135-254 m)

Unit Two consists predominantly of claystone, with interbeds, of sandstone and lignite at 213-218 m. The upper boundary is defined by the tuffaceous unit at the base of unit one. The lower boundary is tentatively identified at 254 m on the basis of log correlation.

Lithology: Predominantly claystone interbeded with sandstone and minor lignite.

Claystone: Red brown, green grey, light orange, becoming light to dark grey, friable to firm, blocky to subfissile, generally very calcareous, micromicaceous, occasionally silty in part.

Sandtone: Clear to translucent, fine to medium grained, subangular to subround, moderately sorted, with calcareous cement, algilaceous matrix, abundant lithic fragments, trace chlorite, poor visible porosity.

Lignite: Dark grey to dark brown, firm to brittle, blocky to subfissile, dull earthy luster, grading to clay in part.

Environment of deposition:

The predominance of claystone and abundance of Botryococus spp. and to a lesser extent the common occurrence of amorphous organic material indicate a supratidal lacustrine deposition. The lignite bed at 213-218 m may represent on overbank fluvial facies.

Wichian Buri Group (Unit Three, 254-534 m)

Unit Three indicate the ‘E’, ‘F’,’G’ and ‘H’ sand pack ages in the Wichian Buri Wells. The unit is tentatively identified at A-1 by the development of similar discrete sand packages. The sequence consists predominantly of claystone interbedded with sandstone and siltstone weathered volcanics occur in the lower part of the unit.

Oil shows were observed in cutting and sidewall cores from sandstones and weathered volcanic between 415 m and 532 m.

Lithology: Claystone: Light to medium brown, green, grey, locally light green grey, soft to firm, subblockly, suffisile to platy, occasionally soluble, slightly calcareous, locally carbonaceous, with common laminate, trace micromica, silty.

Sandstone: Clear, translucent, light brown, light green grey, brown grey, friable to firm, vary fine to coarse grained, subangular to subround, calcite cement in part, argillaceous matrix silty in part, predominantly feldspars and lithic fragments with trace quartz, trace basalt.

Siltstone: Light grey, light green grey, light brown grey, soft to firm, subblocky, calcareous, carbonaceous, occasionally arenaceous.

Volcanics: Medium to dark green, grey, translucent, firm to generally hard, very fine to medium grained, with lithic fragments, feldspar, pyrite, pyroxene, biotite and calcite, weathered, poor visible porosity.

Show: Oil shows were observed in the lower part of the igneous units and in sandstones (equivalent to ‘G’ and ‘H’ sand) in both cutting and sidewall core samples.

Environment of deposition:

The lithological association of interbedded sandstones within a predominantly claystone sequence indicate a marginal lacustrine environment of deposition. Palynological data confirm a fluvial / lacustrine setting and indicate an age not older than Oligocene for this unit.

Wichian Buri Group (Unit Four, 534-700 m)

Unit Four consists predominantly of claystone with minor interbeded sandstone and volcanic in the lower part of unit. The lower contact with the Permian Nam Duk Formation is defined by an electric log offset and lithology change.

Lithology: Mainly claystone interbeded with sandstone. Weathered volcanic at base.

Claystone: Medium to dark brown, dark grey brown, firm, subblocky to subfissile, calcareous, with carbonaceous laminate, occasional crush cut observed.

Sandstone: White grey, light brown grey, friable, fine to very coarse grained, argillaceous to silty matrix.

Siltstone: Light grey, white, light brown, firm, slightly calcareous, very sandy.

Volcanics: Dark grey, green grey, hard, occasionally friable, very fine to medium grained, with-crystals of plagioclase feldspar, pyroxene, occasionally calcite, quartz, calcite veins.

Show: CST run 2, #6 (602.6 m): very dull brown fluorescence, very faint cut.

Environment of depositions:

The formation consists predominantly of dark claystone which contains abundant amorphous organic material. Sporadically consistent Pediastrum spp., indicates a lacustrine depositional environment. The age cannot be confirmed because of low Palynamorph recovery but regional considerations suggest a late Oligocene age is most likely.

The basal volcanic may be intrusive related to either the Miocene igneous events or the Quaternary event, or they may be equivalent to the weathered extrusive units encountered within the Basal Tertiary Sequence elsewhere.

Nam Duk Formation (700-908 m)

The contact between the Tertiary Sequence and the Permian Nam Duk Formation is defined by an abrupt offset on the GR and sonic logs, and a lithological change to metasediments comprising dark claystone interbedded with sandstone (greywackes) and siltstone.

Lithology: Predominantly dark claystone interbedded with sandstone and siltstone.

Claystone: Very dark grey to black, dark brown, hard to very hard, blocky, calcareous, with mineral inclusions, occasional quartz and feldspar veins, metamorphosed.

Sandstone: Medium to dark grey, light grey, hard to very hard, occasionally friable, feldspar and quartz, very fine to fine grained, occasionally medium to coarse grained, subangular to subrounded, poorly sorted, poor visible porosity.

Show: Very rare yellow fluorescence, show streaming cut, very poor show.

Age: The lithologies are consistent with the early to middle Permian Nam Duk Formation, which crops out on the eastern margin of the Wichian Buri sub-basin and which was penetrated at Wichian Buri-1 to the South of A-1. Based on subsurface geological information, the sedimentary sequence in the Wichian Buri sub-basin can be summary in ascending order (Table 2.2).

Table 2.2 Lithologic log of Wichia n Buri Sub-basin, Phetchabun Province

Stratigraphic Unit	Depth (m)	Lithology	Lithology Description	Fluoresence	Depth (m)	Porosity	Average porosity
	290		290-320 -- Dark grey to black medium grained, black		290	12	9.65
			fine lithic fragments, calcareous sandstone	304: Rare trace pale yellow spotted fluorescence	300	26.36	26.81
					310	30.3	21.035
	320		320-321 -- Slightly calcareous claystone		320	24.24	28.83
	321		321-339 -- Calcareous cement sandstone		330	24.24	28.815
	339		339-364.4 -- Calcareous, carbonaceous,		340	41.515	38.14
			waxy luster claystone		350	27.27	30.78
	364		364.4-417.5 -- Light green to green grey, very fine		360	26.36	31.77
			grained, calcareous cement, argillaceous matrix,		370	39.39	31.21
			calcite, weatherd sandstone		380	34.85	30.54
					390	29.39	34.36
					400	26.67	34.24
Unit Three	418		417.5-418.1 -- Light to medium green grey claystone	417.5: Trace yellow fluorescence, no crush cut	410	29.09	25.98
	418		418.1-482 -- Light green grey, very fine to fine	418.1: Very rare dull yellow fluorescence	420	27.88	22.34
			grained, calcareous, well sorted, argillaceous	422.5: Trace speckled white to yellow fluorescence	430	23.64	24.16
			matrix sandstone	425.1: Rare trace spotted yellow brown fluorescence	440	25.15	29.935
				436: Trace yellow speckled, white to yellow fluorescence	450	38.48	31.36
				437.1: Trace spotted yellow brown fluorescence, no crush cut	460	24.24	23.75
				468.1: 30-40% yellow to orange fluorescence, instant streaming	470	33.33	30.77
	482		482-497 -- Calcite vein claystone	blooming light brown cut, thin residue, poor to fair show	480	29.39	24.88
	497		497-517 -- Grey, fine to medium grained, slightly	497: 5-10% yellow orange fluorescence, streaming light	490	3.64	4.85
			calcareous and agillaceous sandstone	straw cut, non residue, poor show	500	12.12	4.96
	517		517-526 -- Calcareous rubble, baked claystone	500.1: 5% dull yellow banded or laminated, streaming to	510	2.73	9.21
	526		526-602 -- Dark grey to green grey, very fine to fine	blooming colourless cut, no residue, poor show	520	20	14.72
			grained, argillaceous, firm to moderately hard,	501.5: Mineral fluorescence, no crush cut	530	10.91	19.07
	534		slightly calcareous, with lithic fragments sandstone	517.5: Trace yellow brown fluorescence, colorless crush cut.	540	26.97	30.23
				526: Yellow to orange fluorescence, slow streaming to	550	30.91	28.44
				blooming.	560	29.697	29
				530: Rare trace dull yellow brown fluorescence	570	26.67	31.84
				532: Rare trace dull yellow brown fluorescence	580	29.697	33.43
					590	33.94	34.78
Unit Four	602		602-634 -- Medium brown, firm to moderately hard,	602.6: Very dull brown fluorescence, very faint cut	600	37.27	31.84
			calcareous, carbonaceous, trace sandstone		610	35.15	36.73
			lamination, very fine to fine grained claystone		620	33.03	34.48
	634		634-664 -- White grey, light brown grey, friable,		630	33.33	31.88
			fine to very fine grained, weathered, argillaceous		640	24.24	13.35
			to silty matrix, calcite crystal and veins sandstone		650	0.29	6.87
	664		664-707 -- Dark to very dark grey, hard to soft,		660	5.15	3.26

Table 2.2 Lithologic log of Wichian Buri Sub-basin, Phetchabun Province (Continued)

Stratigraphic Unit	Depth (m)	Lithology	Lithology Description	Fluoresence	Depth (m)	Porosity	Average porosity
Unit Four			fractured, non calcareous, baked claystone		670	2.34	4.72
					680	2.63	4.67
					690	9.36	8.44
Nam Duk F.M.	707		707-806 -- Graywacke: Light to dark grey to black,		700	11.76	8.06
			silty recrystalline matrix, supporting hard black		710	5.88	8.63
			meta claystone fragments, non calcareous.		720	10.96	8.49
					730	10.96	7.345
					740	6.42	7.96
					750	5.61	7.24
					760	11.76	8.56
					770	7.22	7.58
					780	8.29	8.81
					790	6.42	6.68
	806		806-810 -- Meta claystone		800	5.88	7.16
	810		810-819 -- Graywacke		810	8.02	9
	819		819-822 -- Interbedded: Medium to dark grey		820	9.09	6.46
	822		claystone, non calcareous, no crush.		830	8.56	7.95
			822-900 -- Meta claystone: Black, hard,		840	8.02	7.7
			metamorphosed, fissile in part, non calcareous,		850	7.22	7.12
			occasionally sticky, carbonaceous, fractured,		860	6.95	7
			hydrated in part, trace calcite vein.		870	6.15	7.61
					880	6.95	8.94
					890	13.9	10.28
	900				900	3.21	8.23

Remark :
- Sandstone
- Claystone
- Greywacke

2.5 Geothermal gradient

Because a very high temperature was recorded during the first logging suite (69 degrees C at 290 m)Totco temperature meaturements were made while drilling the lower section and series of temperature measurements were recorded during logging.

The temperatures adoped as most likely values are the stabilized BHT extrapolated from the logs and the Totco measurement made at 264 m after logging and casing.

The temperature gradient derived from these two points shows two dog-legs, with an exception-ally high gradient (18.5 deg. C/100m) through the Plio-Pleistocene deposits and more typical gradients (3.9 deg and 3.2 deg C/100m) through the Tertiary Sequence. The most likely explanation for this trend is that the lithic sands above the Pliocene unconformity which are interpreted to have been derived from Quaternary basalts, are acting as an insulator to heat flow from the underlying sequence.

CHAPTER III

MATERIALS AND METHODOLOGY

3.1 Materials

In order to study acoustic impedance and rock properties, many sources of data were used and analyzed. Some of required and used data and listed as follows.

3.1.1 Well information

One well drilled in Wichian buri Sub-basin is allowed from Department of Mineral Fuels (DMF) Thailand to use in this study but is not allowed to show its name, so this allowed well is named A-1 in this study (Table 3.1). A-1 drilled in 1990-1991.

3.1.2 Lithological classification

Four rock types found in A-1 well drilled in the study area were classified for this study: metaclaystone, claystone, greywacke and sandstone based on lithologic log report. Sandstone is classified as reservoir rock and the others are non-reservoir rock.

3.1.3 Logging data

There are four log types; gamma ray, neutron, density, and sonic used in the quantitative and qualitative studies.

- **Gamma ray data**

The gamma ray log is a record of a formation's radioactivity emanating from naturally occurring uranium, thorium and potassium. Amongst the sedimentary rocks, shales present the strongest radiation. Therefore, the gamma ray logging data can be used to identify shale and correlate facies.

Table 3.1 The depth and log types used in this study

Log	**Depth (m)**
Sonic (DT)	292-620
Sonic (DTLN, DTLF)	268-904
Density, Neutron	290-908

- **Neutron data**

The neutron log provides a reaction of formation's neutron bombardment. This log is a measure of free pore-water which is related to a formation's hydrogen index. It is also used quantitatively to measure porosity and qualitative to discriminate between gas and oil. The neutron log usually combined with the density log to present the subsurface lithology indicators.

- **Density data**

The density log is a record of a formation's bulk density. The bulk density can be used as an indicator of the volume of free fluid enclosed in the formation. This log is used to calculate porosity and acoustic impedance, and hydrocarbon density quantitatively. It is also used as a lithology indicator.

- **Sonic data**

The sonic log shows a formation's interval transit time. The main use of the log is in seismic applications, calibration and generation of synthetics seismic data. It is also an essential parameter in the time to depth conversion of seismic data. When a transmitter of the sonic tool sends out a sound pulse, the log measures the arrival time of the pulse. The compressional (P) wave arrives ahead of the shear (S) wave and is consequently recorded first. The compressional wave travels in the same direction of motion. It propagates through the body of a medium. The particle motion of shear wave is perpendicular to the direction of propagation. The velocity of this wave is approximately one-half the velocity the compressional wave.

A-1 well was logged by Schlumberger and for Wireline Schlumberger Tools which run in A-1 well:

DT is short spacing delta-time (10’-8’ spacing; microsec/ft)

DTLN is short spacing delta-time (10’-8’ spacing; microsec/ft)

DTLF is long spacing delta-time (12’-10’ spacing; microsec/ft)

3.1.4 Porosity data

Porosity data is typically derived from the density log which measures the bulk density of the formation. The porosity can be defined as the percentage of voids to the total volume of rock. To calculate fractional porosities, the below equation is used:

$$\text{Porosity } (\phi) = \frac{\text{Volume of pores}}{\text{Total volume of rock}} \tag{3.1}$$

$$\text{Porosity } (\phi) = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_{fl}} \tag{3.2}$$

Where ρ_{ma} = matrix (or grain) density (g/cc)

ρ_{fl} = fluid density (g/cc)

ρ_b = bulk density (g/cc)

It is notable that a formation with high porosity indicates a good potential of reservoir quality.

3.1.5 Acoustic impedance data

The acoustic impedance is seismic velocity multiplied by density (Sheriff, 1997). The density data are obtained from the density log whilst the velocity data can be derived from the sonic log. The acoustic impedance data can imply rock properties which vary with lithology, porosity, fluid content and depth. The calculation of acoustic impedance can be expressed as follows:

$$\text{Acoustic impedance (AI)} = \text{Density}\ (\rho)\ \text{x Delta-Time (DT)} \tag{3.3}$$

Where Density (ρ) is in (g/cc)

Delta-Time (DT) is in (μs/ft)

3.2 Methodology

In this study, the process of data analysis has been divided into two parts; quantitative and qualitative. The quantitative analysis is defined as an analysis of lithological properties with statistic expression. For qualitative analysis, it is expressed as reservoir rock potentiality without any measurements. In quantitative analysis, all logging data had been cross-plotted so that the acoustic impedance response to lithology variations can be studied. Qualitative analysis in this study aims to apply acoustic impedance data to recognize reservoir rock potential. Both Quantitative and qualitative were used for stratigraphic unit and lithologic classification.

3.2.1 Quantitative analysis

The data that used in quantitative study were acoustic impedance and porosity. This data were cross-plotted on a graph, on which the x-coordinate represents the value of one data type and the y-coordinate the value of the others. This cross-plot can be used to understand how two data types are related. It is also useful for observing an aberrant data. The correlation coefficient, R, is the statistic symbol that is most commonly used to express the relationship between two data types. The correlation coefficient provides a measure of the linear relationship between two data types.

3.2.2 Qualitative analysis

In this study, acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF) data had been mainly used to determine the reservoir rock identification in Wichian Buri Sub-basin, Phetchabun province. These acoustic impedance data were cross-plot with depth and porosity to observe the relationship amongst them. Therefore, these observed relationships were then used in lithologic and stratigraphic identification as well.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Results of quantitative analysis

Results from cross-plot among acoustic impedance of short-spacing delta-time, and long spacing delta-time and porosity can be summarized as follows.

4.1.1 Relationship between acoustic impedance and porosity

The relationship between acoustic impedance and porosity had been plotted on the x and y-axes respectively (Figures 4.1 - 4.10 for lithologic identification and Figures 4.11 – 4.18 for stratigraphic unit identification). Results from Cross-plots showed that acoustic impedance and porosity had a linear relationship with its corresponding linear equation as showed in each Figure for all rock types. The coefficients also showed a higher value in the dataset of the reservoir rocks than that in the non-reservoir rocks. Consequently, they were selected for further analyses.

Table 4.1 and table 4.2 summarized the correlation coefficient obtained from cross-plotting between acoustic impedance and porosity to lithologic and stratigraphic identification in A-1 well respectively.

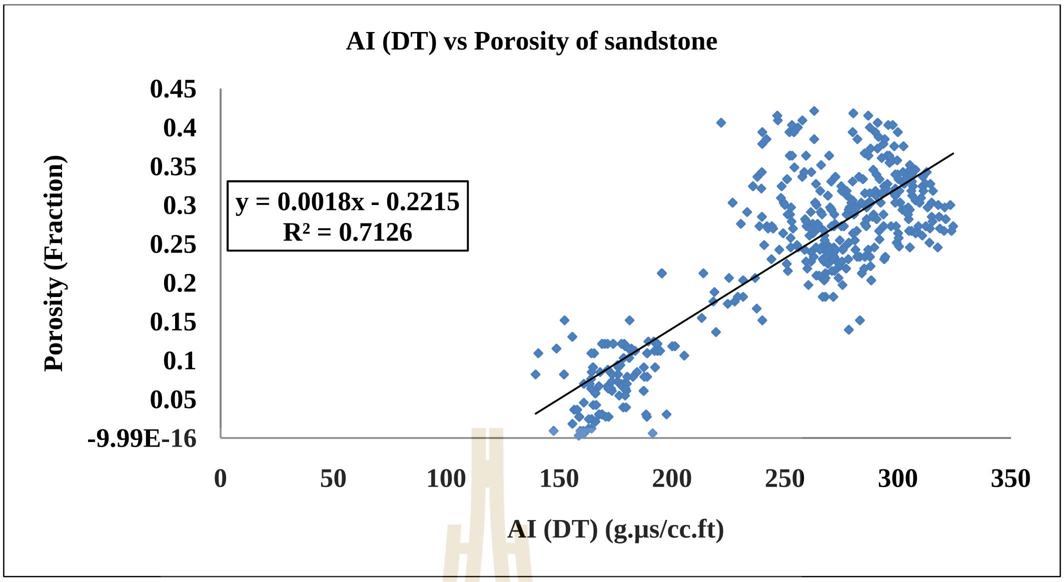


Figure 4.1 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and porosity of sandstone in well A-1

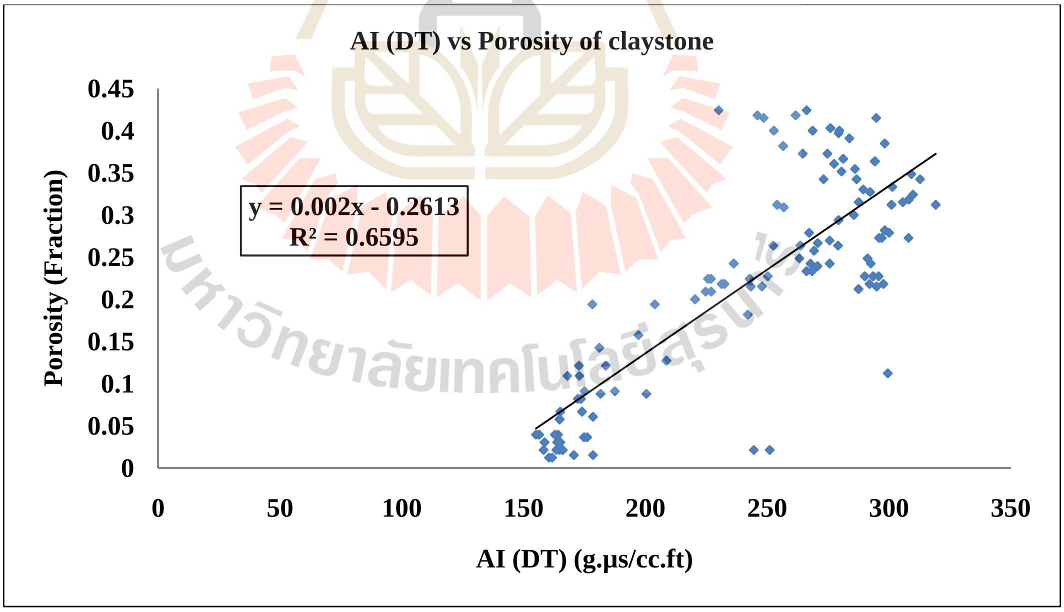


Figure 4.2 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and porosity of claystone in well A-1

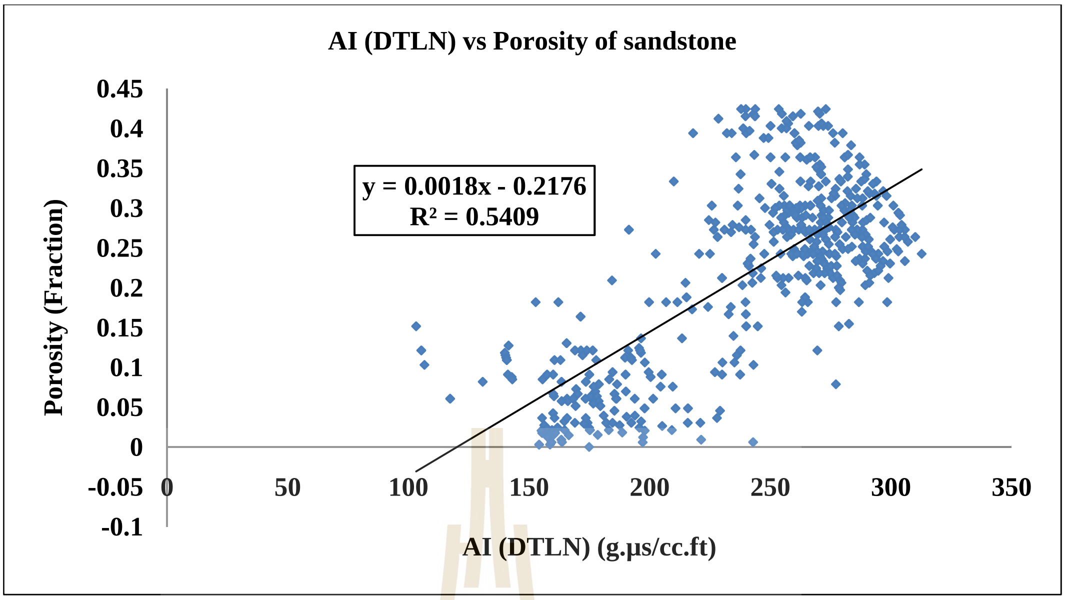


Figure 4.3 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of sandstone in well A-1

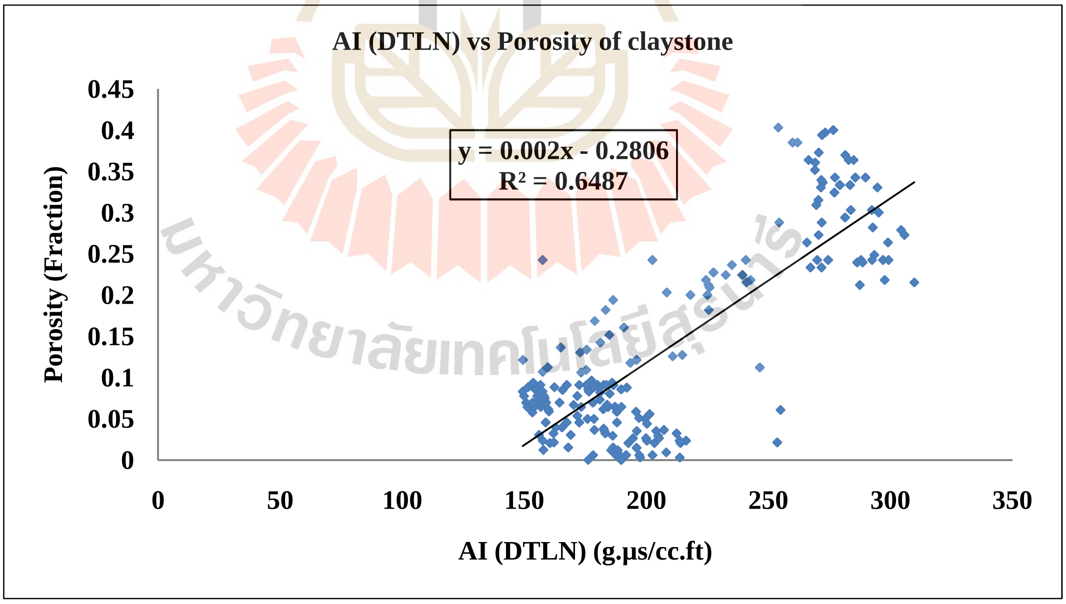


Figure 4.4 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of claystone in well A-1

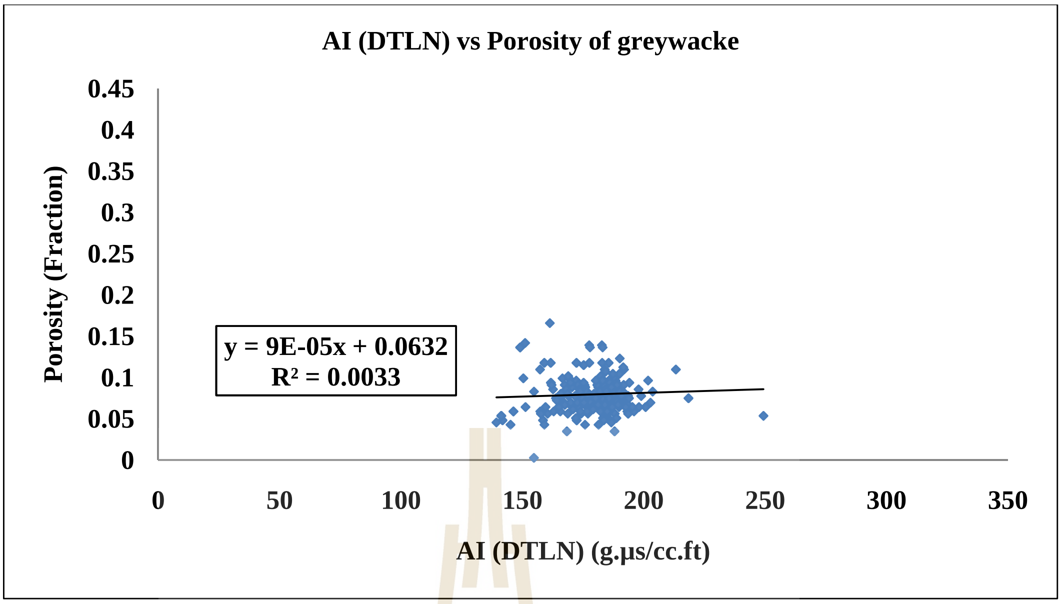


Figure 4.5 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of greywacke in well A-1

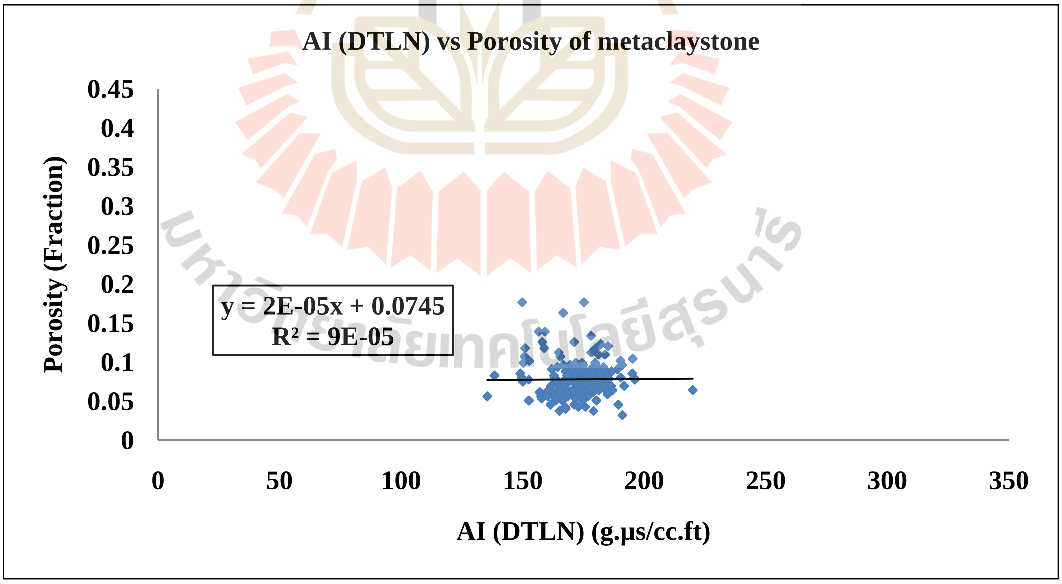


Figure 4.6 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of metaclaystone in well A-1

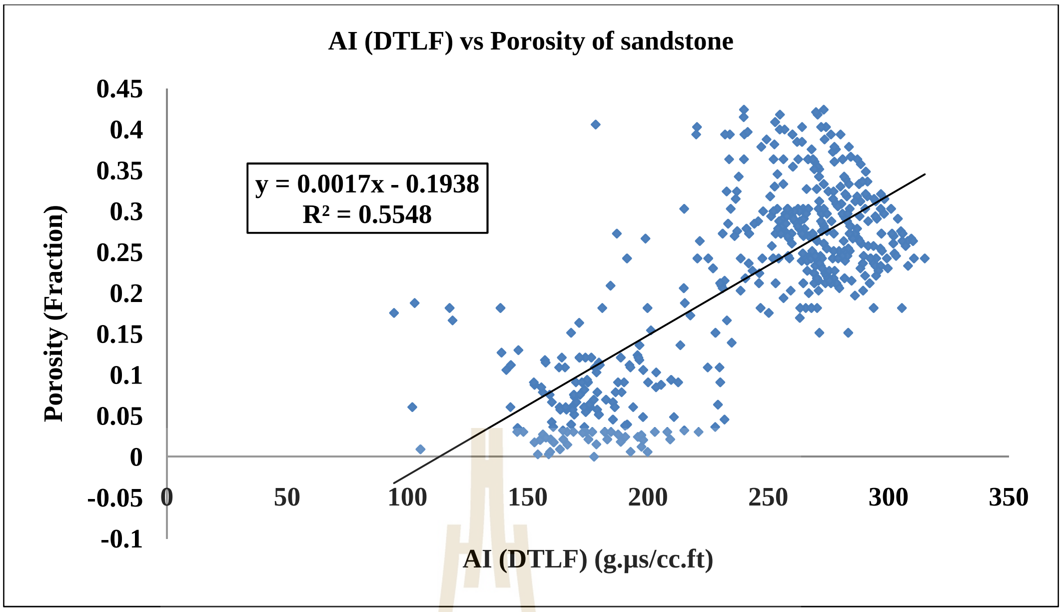


Figure 4.7 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of sandstone in well A-1

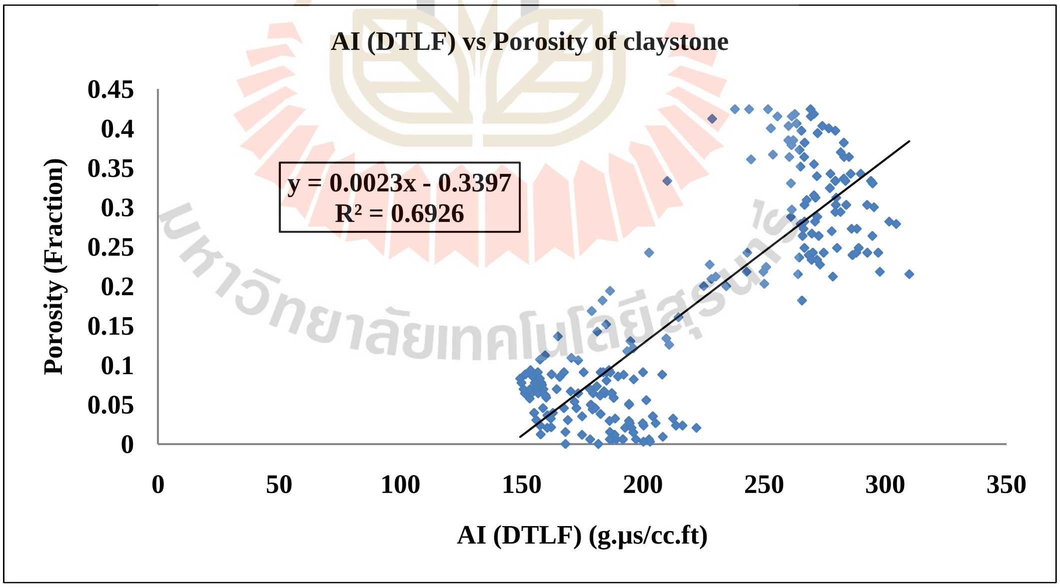


Figure 4.8 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of claystone in well A-1

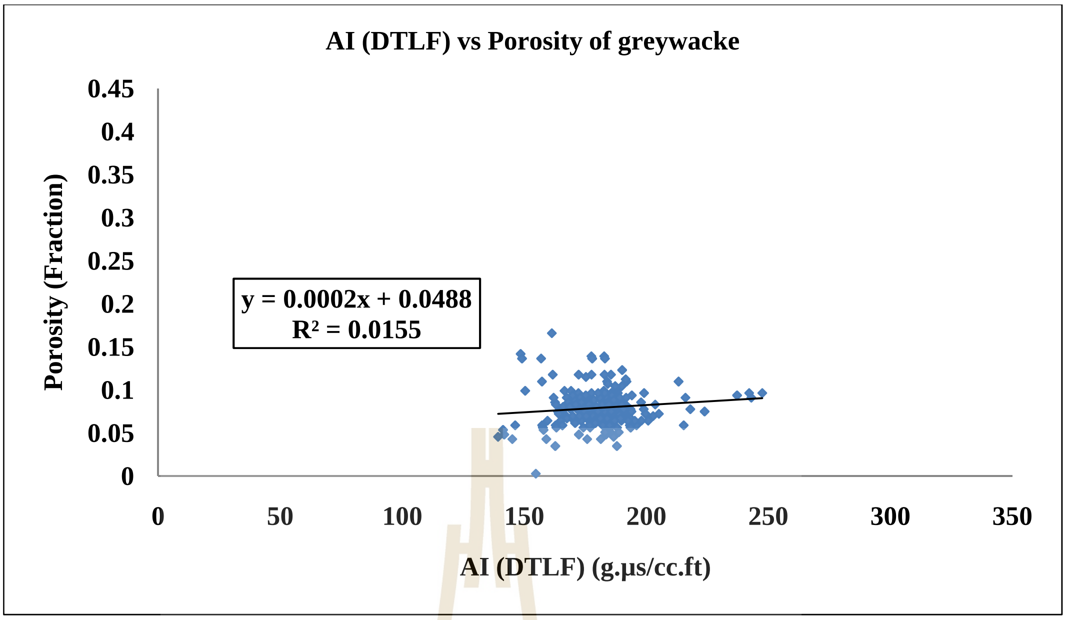


Figure 4.9 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of greywacke in well A-1

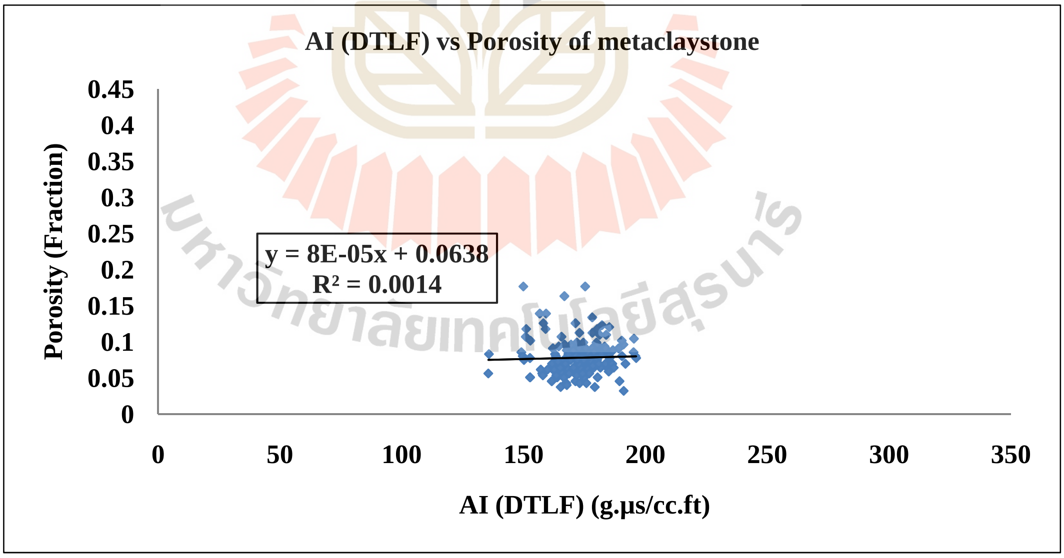


Figure 4.10 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of metaclaystone in well A-1

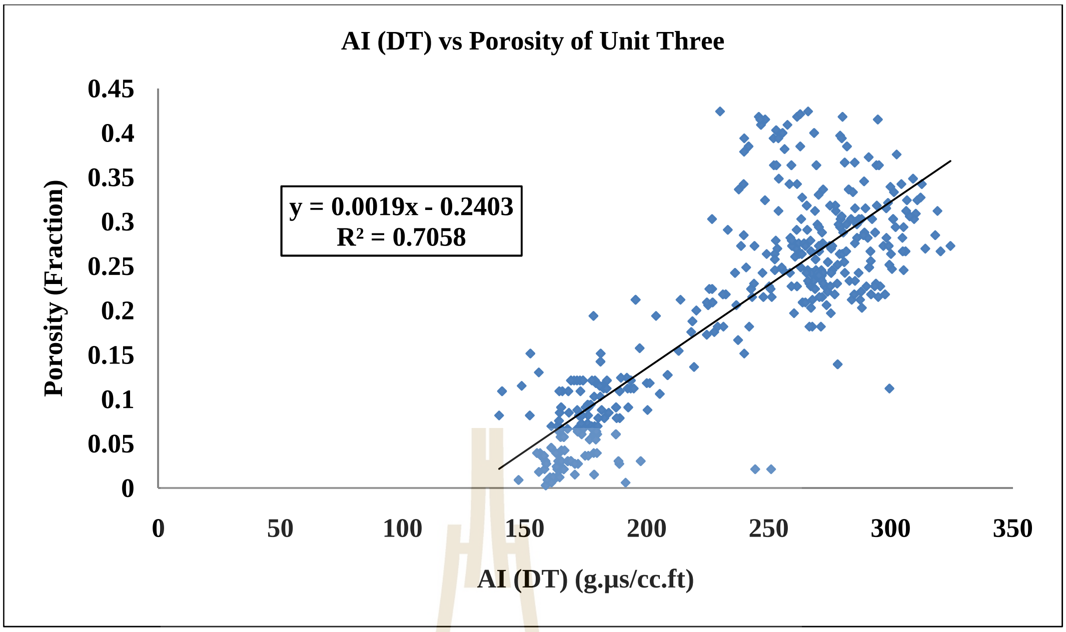


Figure 4.11 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and porosity of unit three in well A-1

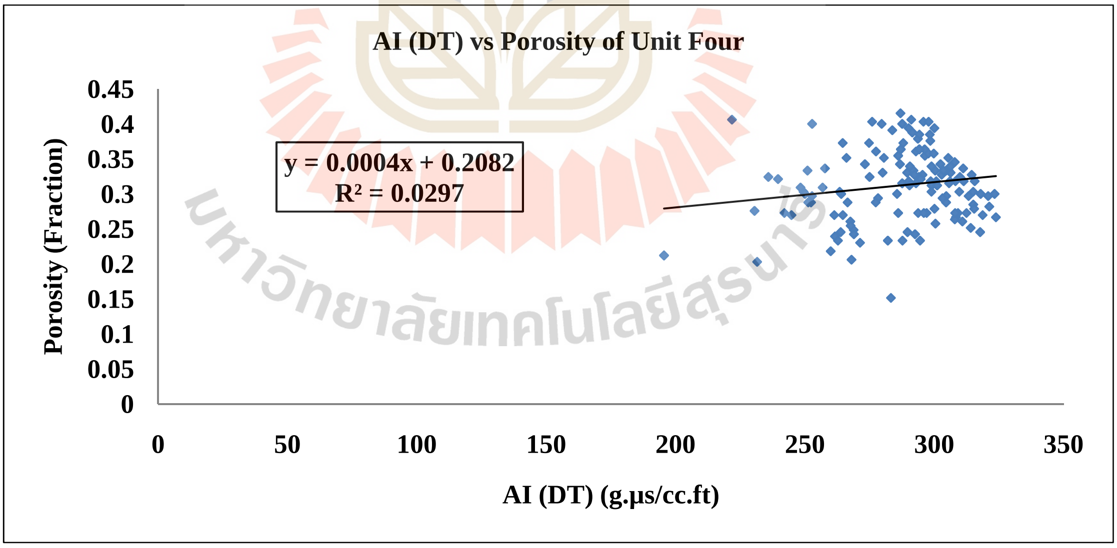


Figure 4.12 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and porosity of unit four in well A-1

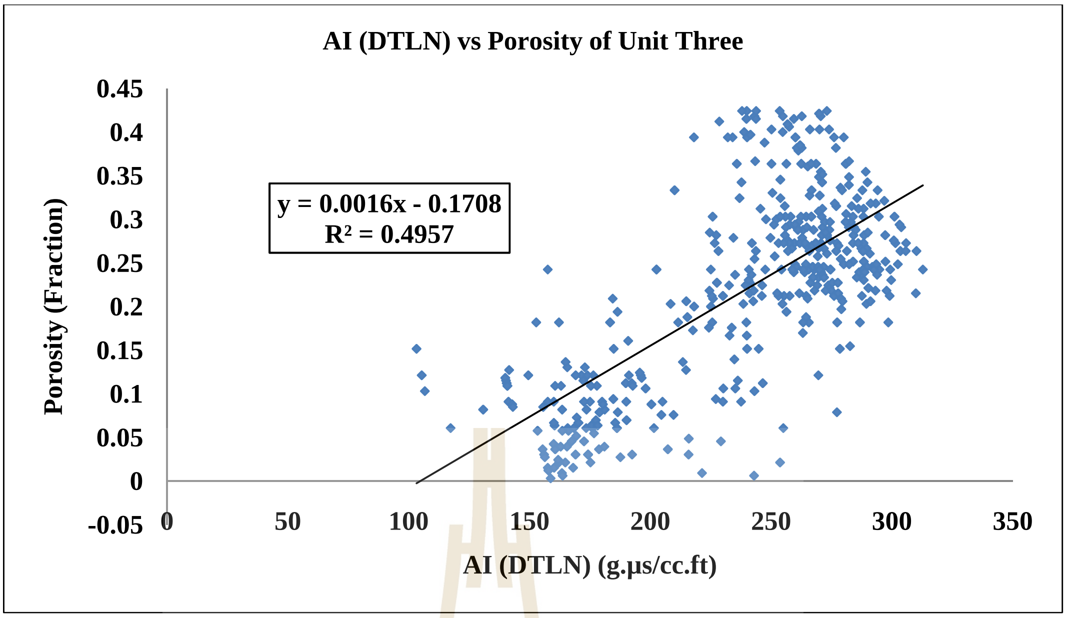


Figure 4.13 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of unit three in well A-1

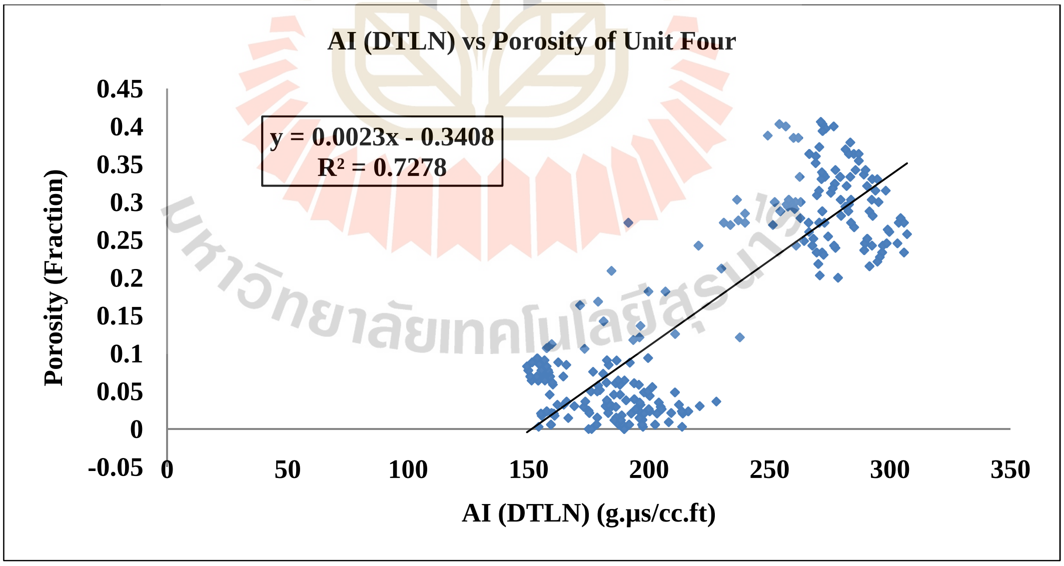


Figure 4.14 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of unit four in well A-1

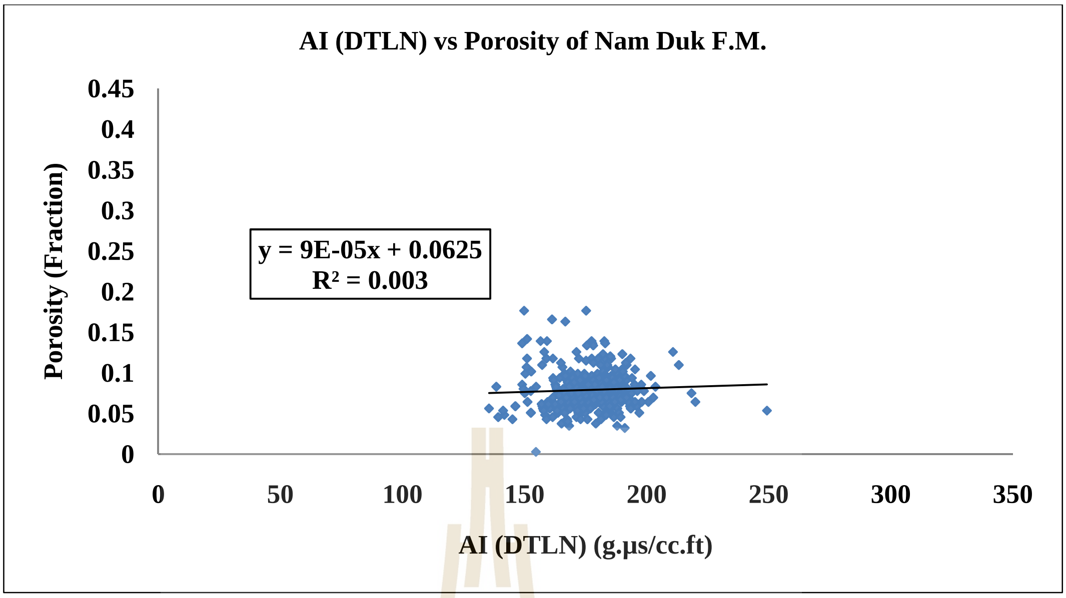


Figure 4.15 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and porosity of Nam Duk Formation in well A-1

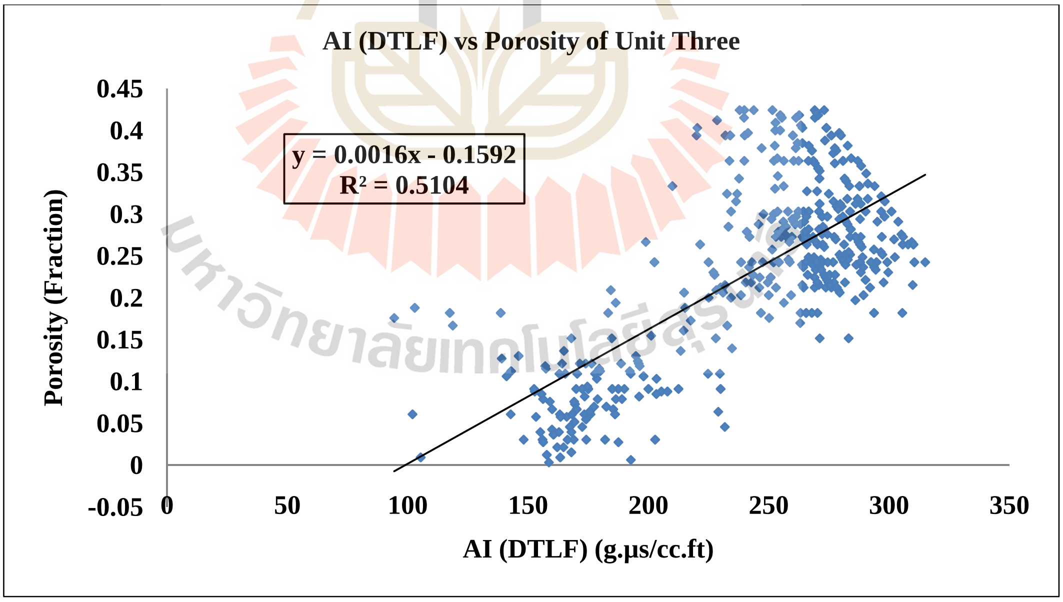


Figure 4.16 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of unit three in well A-1

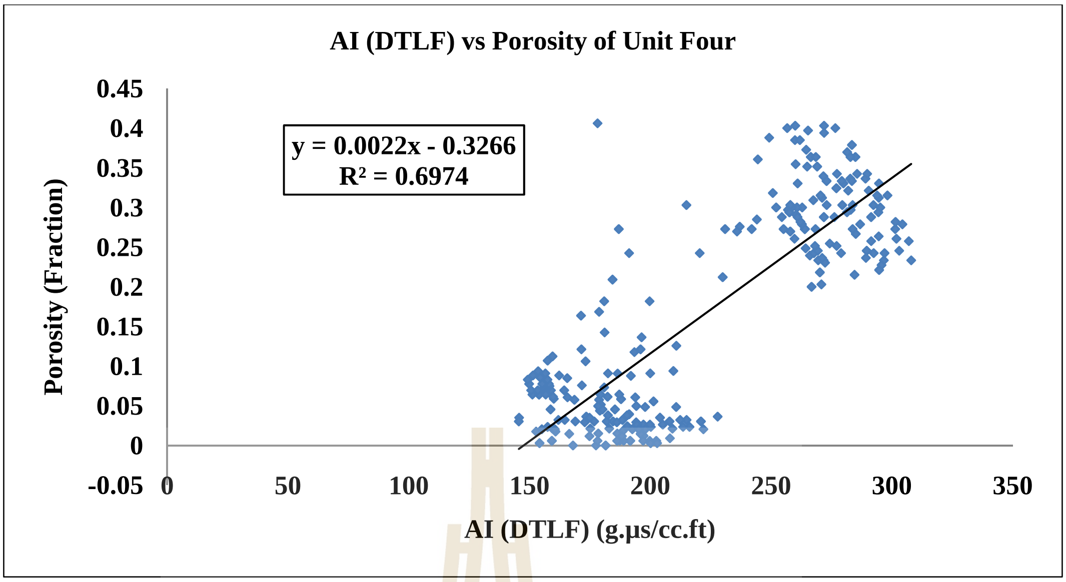


Figure 4.17 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of unit four in well A-1

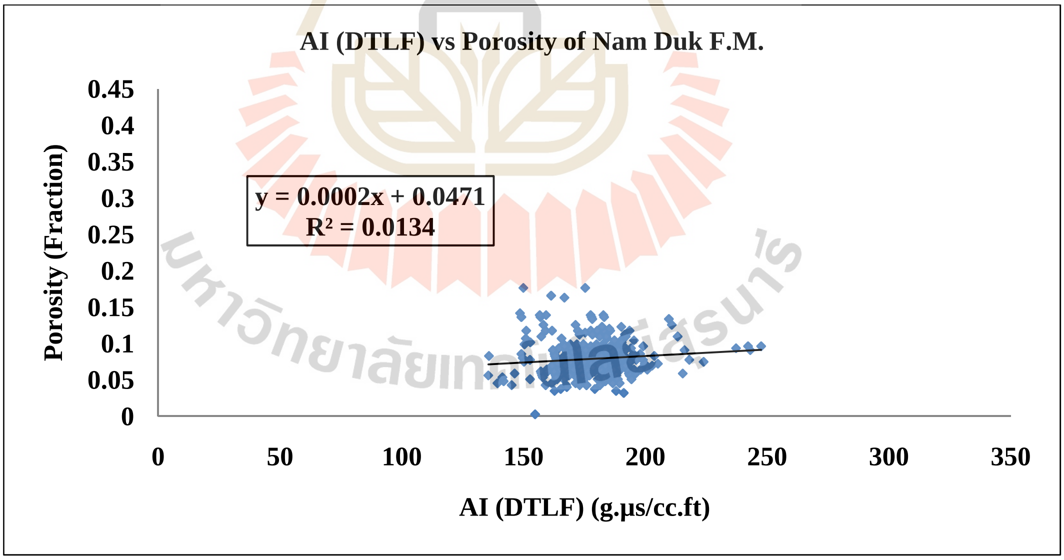


Figure 4.18 A cross-plot showing a relationship between acoustic impedance (AI (DTLF)) and porosity of Nam Duk Formation in well A-1

Table 4.1 Summary of correlation coefficients obtained from the linear relationship between acoustic impedance and porosity in lithologic identification

Sonic Log Type	**Non-reservoir**						**Reservoir**	
	Claystone		**Metaclaystone**		**Greywacke**		**Sandstone**	
	Number of data	**Correlation Coeff.**	**Number of data**	**Correlation Coeff.**	**Number of data**	**Correlation Coeff.**	**Number of data**	**Correlation Coeff.**
DT	258	0.659	-	-	-	-	864	0.712
DTLN	416	0.648	392	0.00009	486	0.003	1086	0.54
DTLF	462	0.692	382	0.001	490	0.015	1034	0.554

Table 4.2 Summary of correlation coefficients obtained from the linear relationship between acoustic impedance and porosity in stratigraphic unit identification

Sonic Log Type	**Unit Three**		**Unit Four**		**Nam Duk F.M.**	
	Number of data	**Correlation Coeff.**	**Number of data**	**Correlation Coeff.**	**Number of data**	**Correlation Coeff.**
DT	838	0.705	284	0.029	-	-
DTLN	942	0.495	522	0.727	924	0.003
DTLF	936	0.51	536	0.697	904	0.013

4.1.2 Relationship between acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF)

The dataset of acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF) were cross-plotted and x- and y-axes were represented to acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF) respectively (Figures 4.19 - 4.24 for lithologic identification and Figures 4.25 – 4.26 for stratigraphic unit identification). The cross-plots indicated that the correlation coefficients were generally greater than 0.5 and there was a linear relationship between acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF) with its corresponding linear equation as showed in each Figure.

Table 4.3 and table 4.4 summarized the correlation coefficient obtained from cross-plotting between acoustic impedance of short spacing delta-time and long spacing delta-time to lithologic and stratigraphic identification in A-1 well respectively. As noticeable from cross-plotting, sandstone and claystone have higher correlation coefficient values than greywacke and metaclaystone in lithologic identification. For stratigraphic unit identification it was found that unit three and unit four had higher correlation coefficient values than Nam Duk Formation.

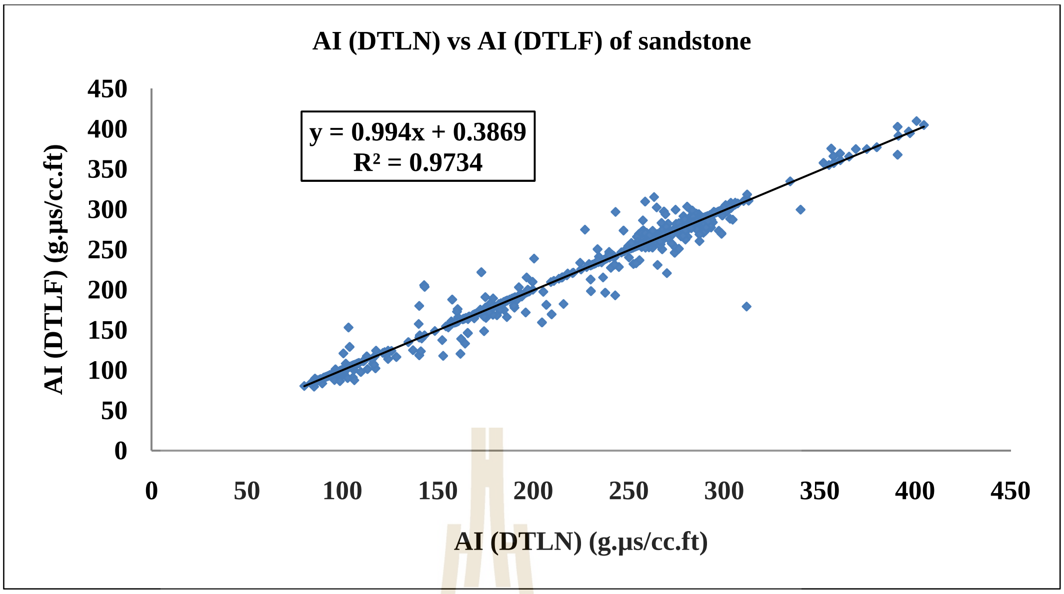


Figure 4.19 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of sandstone in well A-1

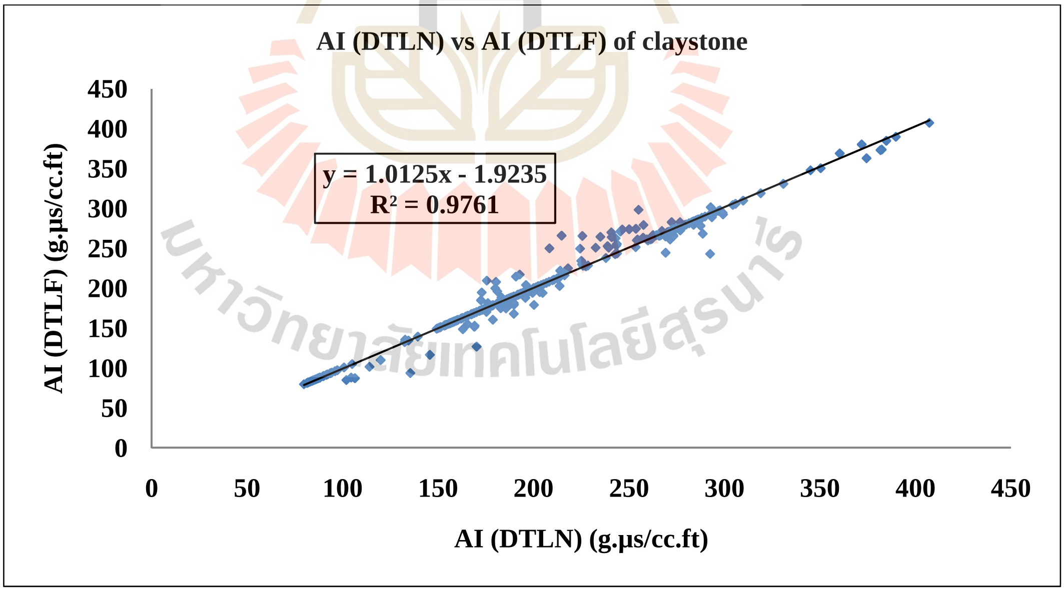


Figure 4.20 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of claystone in well A-1

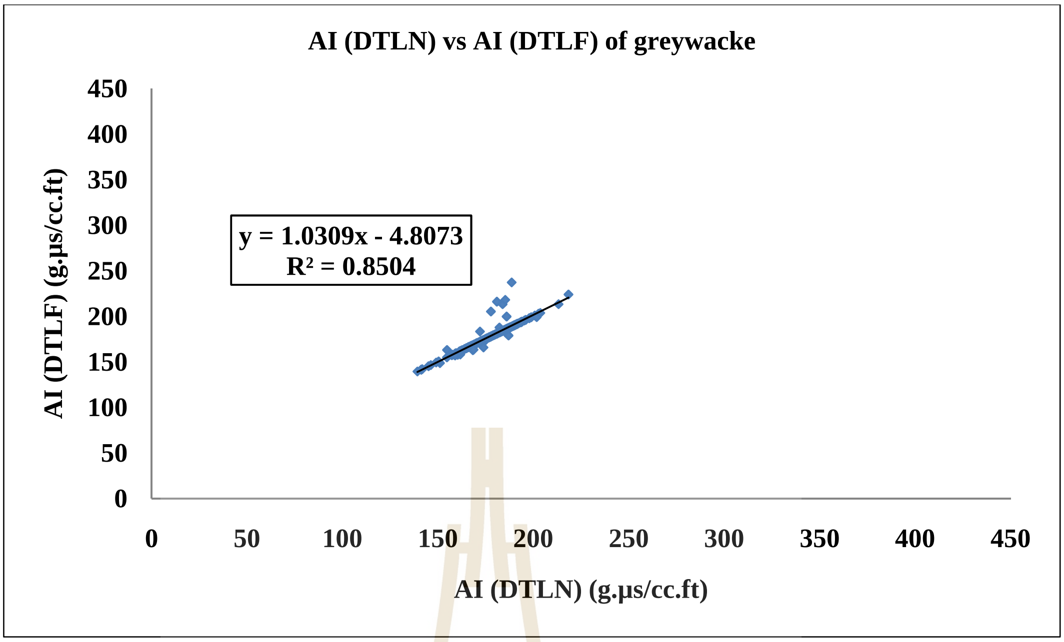


Figure 4.21 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of greywacke in well A-1

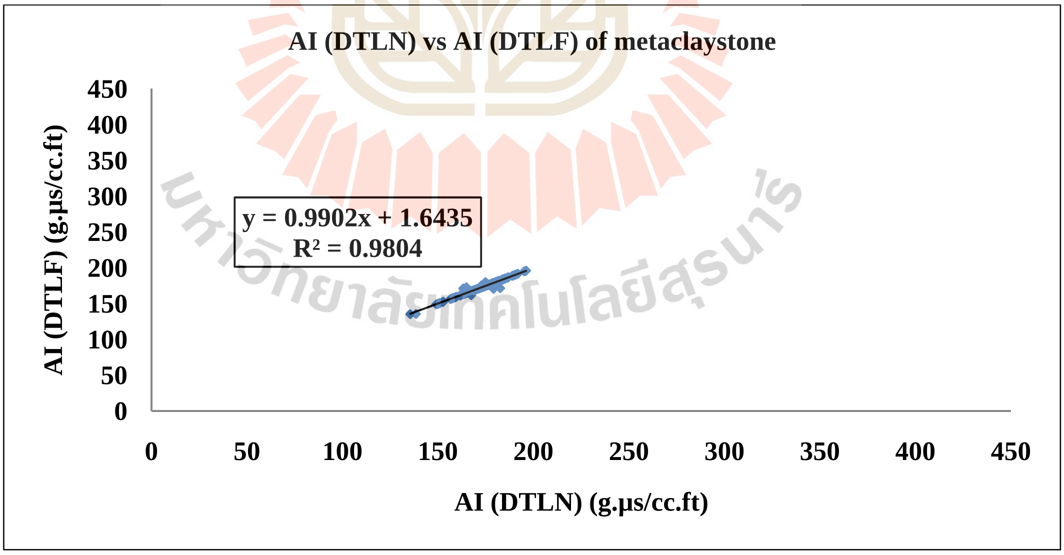


Figure 4.22 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of metaclaystone in well A-1

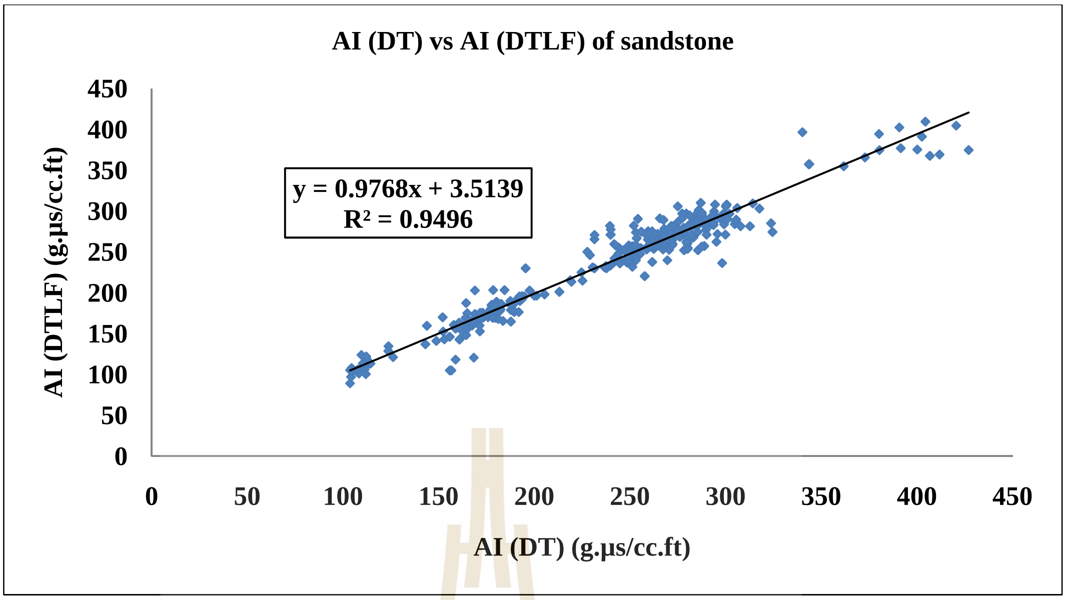


Figure 4.23 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and AI (DTLF) of sandstone in well A-1

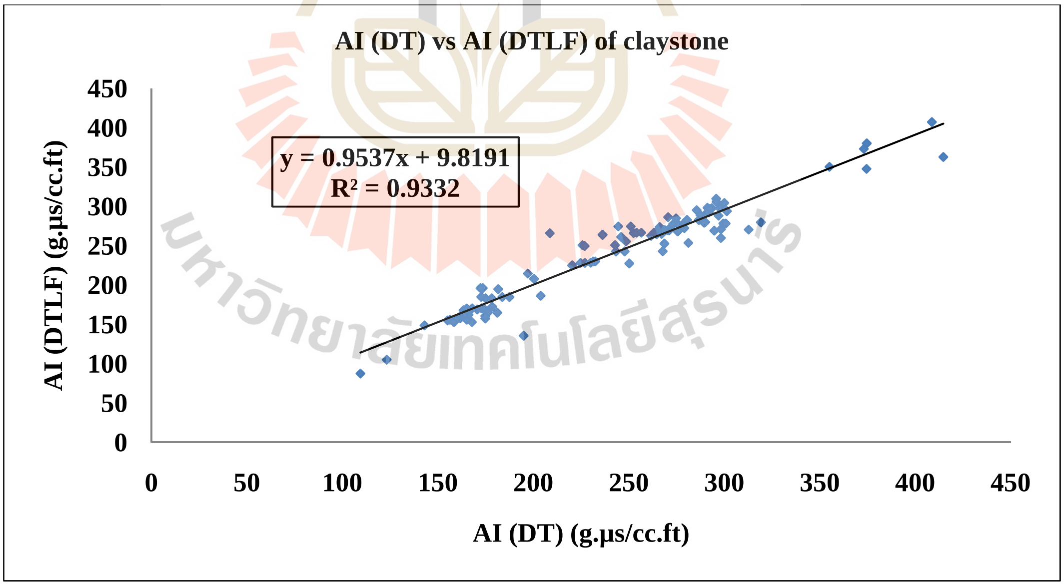


Figure 4.24 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and AI (DTLF) of claystone in well A-1

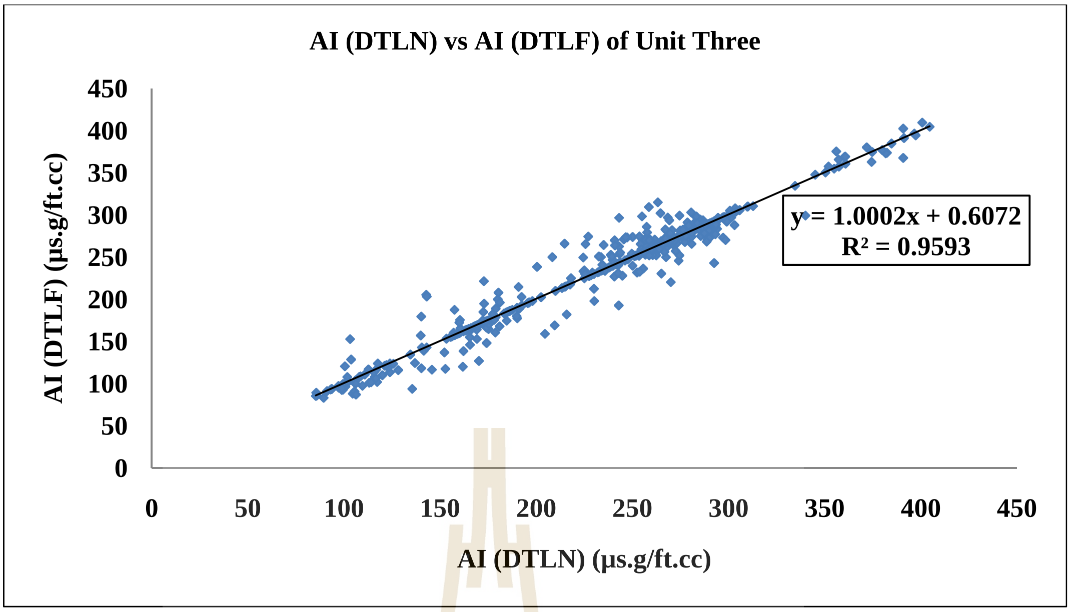


Figure 4.25 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of unit three in well A-1

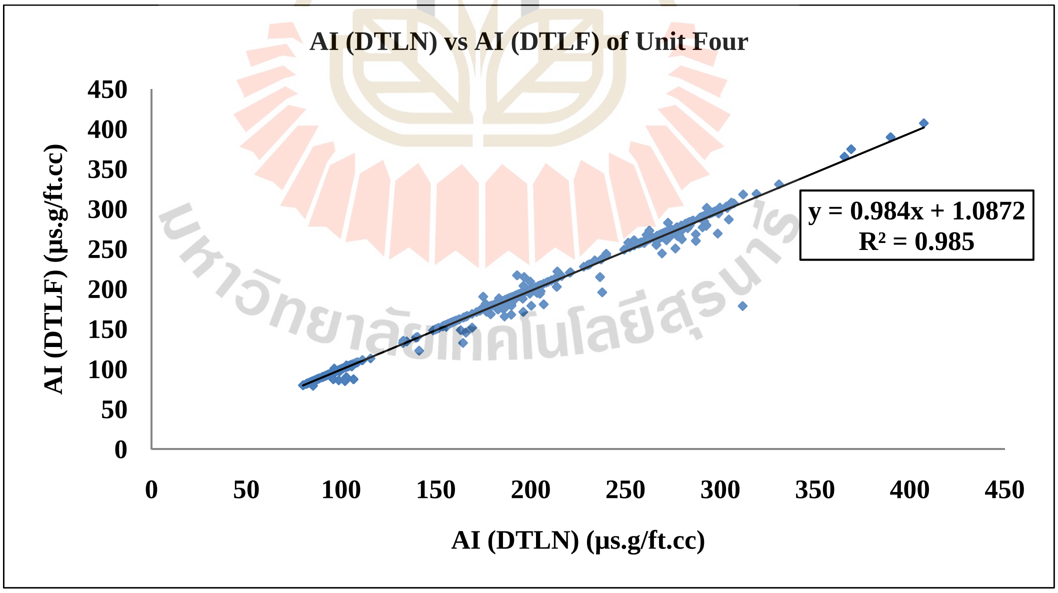


Figure 4.26 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of unit four in well A-1

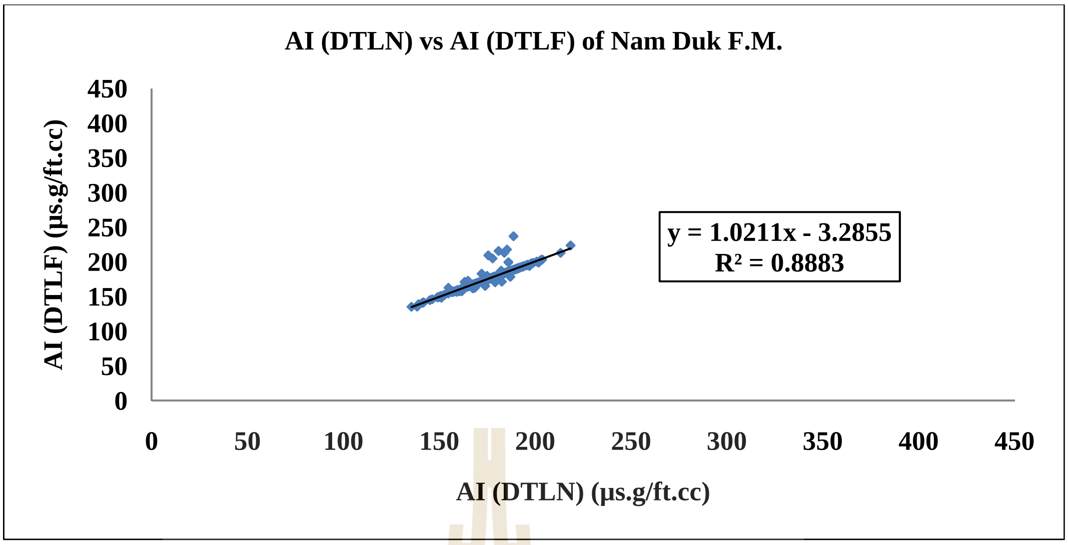


Figure 4.27 A cross-plot showing a relationship between acoustic impedance (AI (DTLN)) and AI (DTLF) of Nam Duk Formation in well A-1

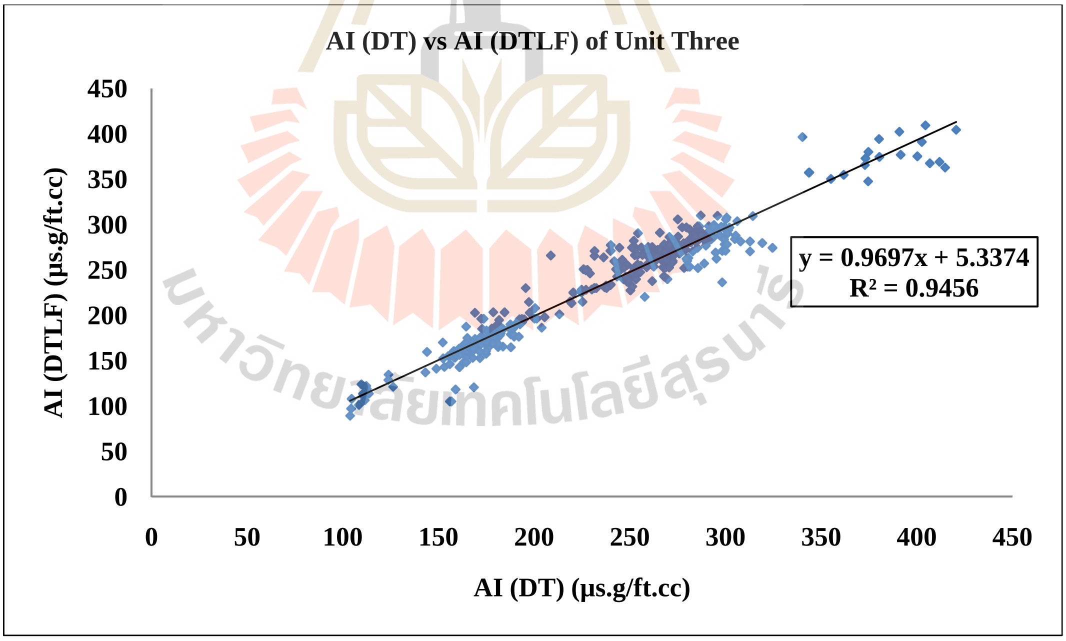


Figure 4.28 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and AI (DTLF) of unit three in well A-1

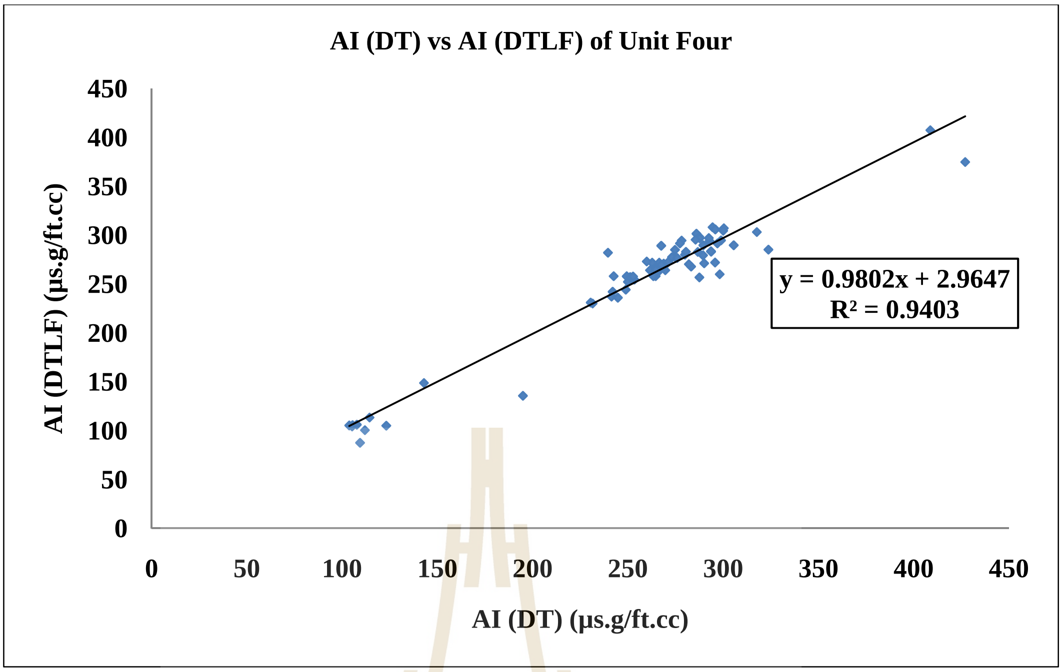


Figure 4.29 A cross-plot showing a relationship between acoustic impedance (AI (DT)) and AI (DTLF) of unit four in well A-1

Table 4.3 Summary of correlation coefficients obtained from the linear relationship between acoustic impedance of DT, DTLN, DTLF in lithologic identification

Sonic Log Type	Non-reservoir						Reservoir	
	Claystone		Metaclaystone		Greywacke		Sandstone	
	Number of data	Correlation Coeff.	Number of data	Correlation Coeff.	Number of data	Correlation Coeff.	Number of data	Correlation Coeff.
DTLN & DTLF	588	0.976	380	0.98	468	0.85	1278	0.973
DT & DTLN	234	0.957	-	-	-	-	754	0.96
DT & DTLF	244	0.933	-	-	-	-	768	0.949

Table 4.4 Summary of correlation coefficients obtained from the linear relationship between acoustic impedance AI and AI in stratigraphic unit identification

Sonic Log Type	Unit Three		Unit Four		Nam Duk F.M.	
	Number of data	Correlation Coeff.	Number of data	Correlation Coeff.	Number of data	Correlation Coeff.
DTLN & DTLF	1038	0.959	790	0.985	890	0.888
DT &DTLN	834	0.963	156	0.929	-	-
DT &DTLF	850	0.945	164	0.94	-	-

4.2 Results of qualitative analysis

Results from cross-plot among acoustic impedance, porosity, and depth of A-1 well data can be summarized as follows.

4.2.1 Relationship between acoustic impedance and depth

The data were cross-plotted on the graph, on which the x-axis represented the value of the acoustic impedance of short spacing delta-time (DT, DTLN) and long spacing delta-time (DTLF) and the y-axis represented the depth respectively (Figures 4.30 - 4.32 for lithologic identification and Figures 4.33 – 4.35 for stratigraphic unit identification).

4.2.2 Relationship between porosity and depth

In this plot the x-axis represented the value of porosity data and the y-axis represented the depth respectively (Figures 4.36 for lithologic identification and Figures 4.37 for stratigraphic unit identification).

Furthermore, there were the relationship between acoustic impedance and depth comparing with relationship between porosity and depth as showed in Figure 4.38 and a plot between acoustic impedance (DTLF) and depth comparing to lithological description as showed in Figure 4.39 to support two above plotting results. As a result among sonic velocity log tools Acoustic Impedance of short spacing delta-time (12’-10’ spacing; microsec/ft) DTLF was the best tool used for lithologic and stratigraphic identification purpose because the others that plot with the same method tended in the same way and could not use for this purposes. Figure 4.39 can also depict the petroleum system as Unit Three (From 290 m to 490 m) could be source and reservoir rock, Intrusive Unit (From 490 m to 530 m) is heat source, Unit Four (From 530 m to 700 m) is source and Namduk Formation (From 700 to 910 m).

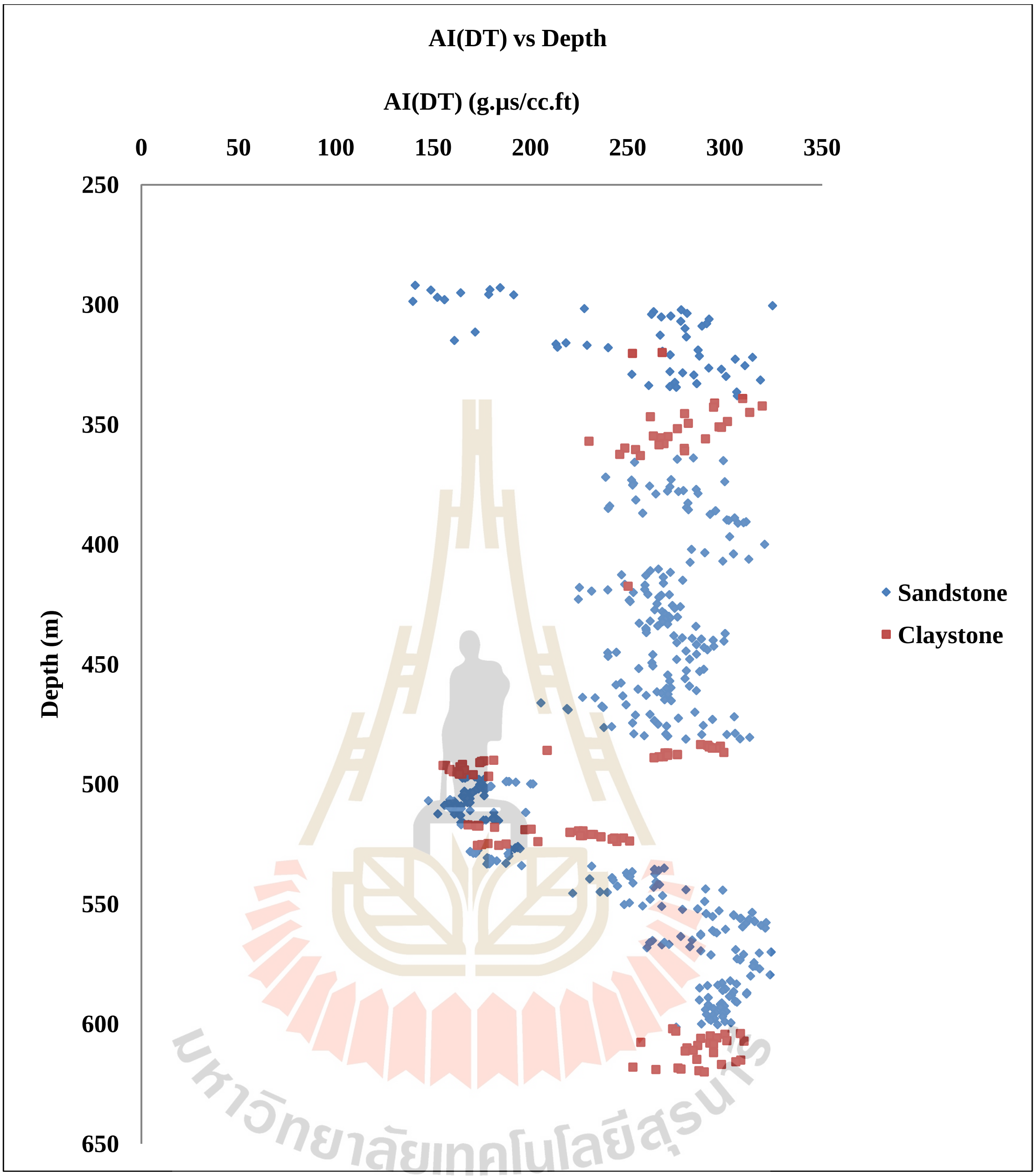


Figure 4.30 Relationship between acoustic impedance (AI (DT)) and depth in lithologic identification

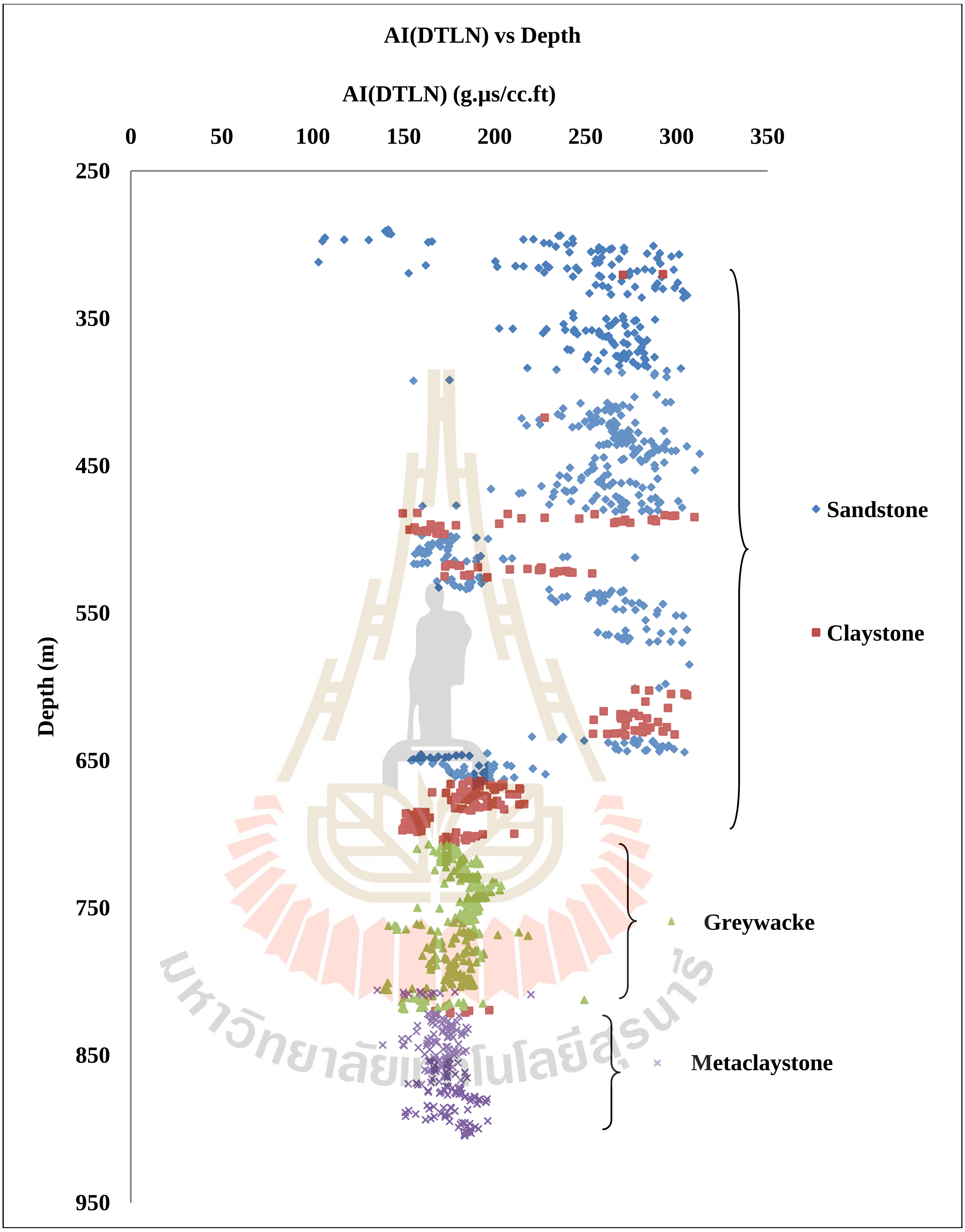


Figure 4.31 Relationship between acoustic impedance (AI (DTLN)) and depth in lithologic identification

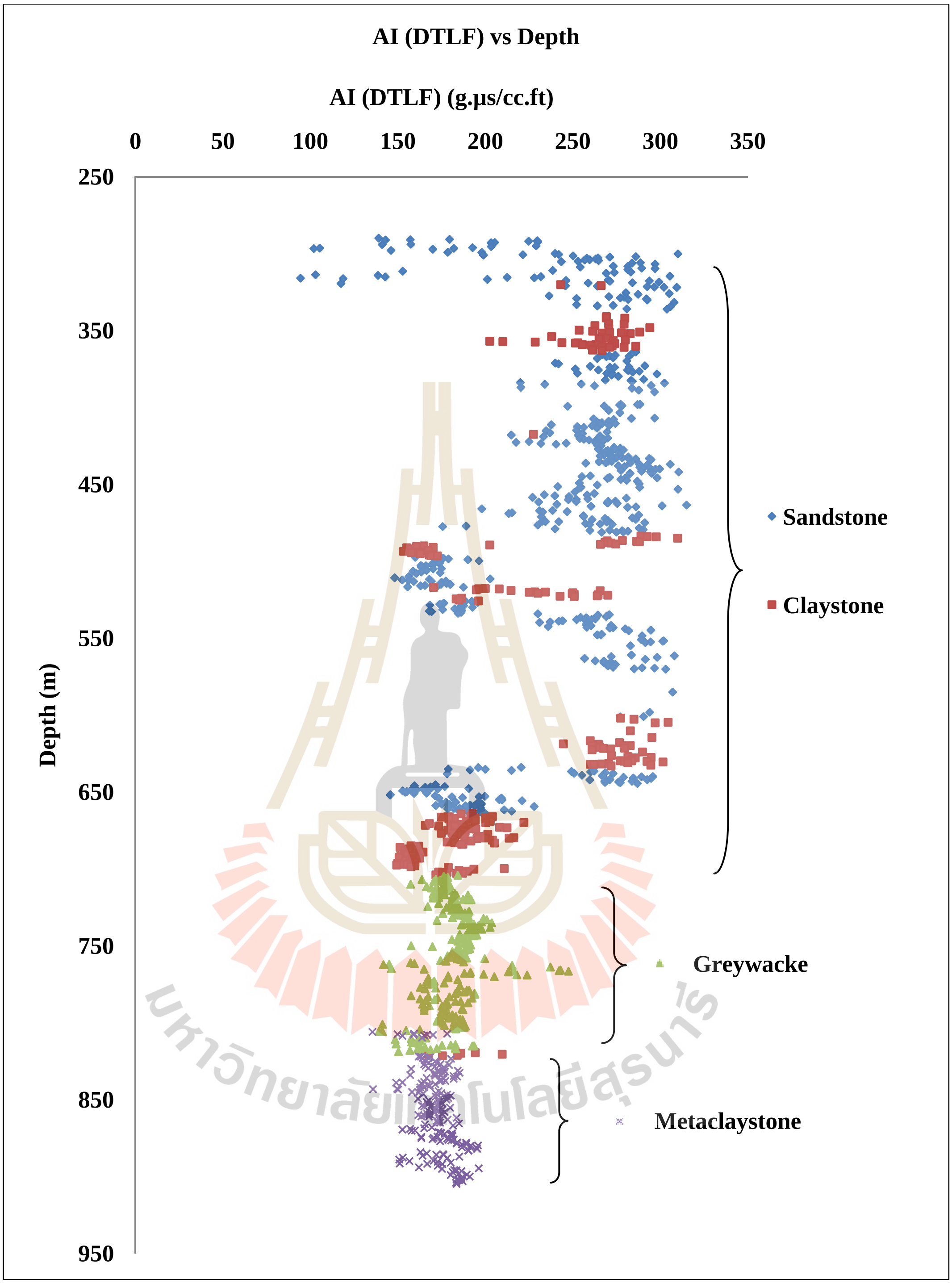


Figure 4.32 Relationship between acoustic impedance (AI (DTLF)) and depth in lithologic identification

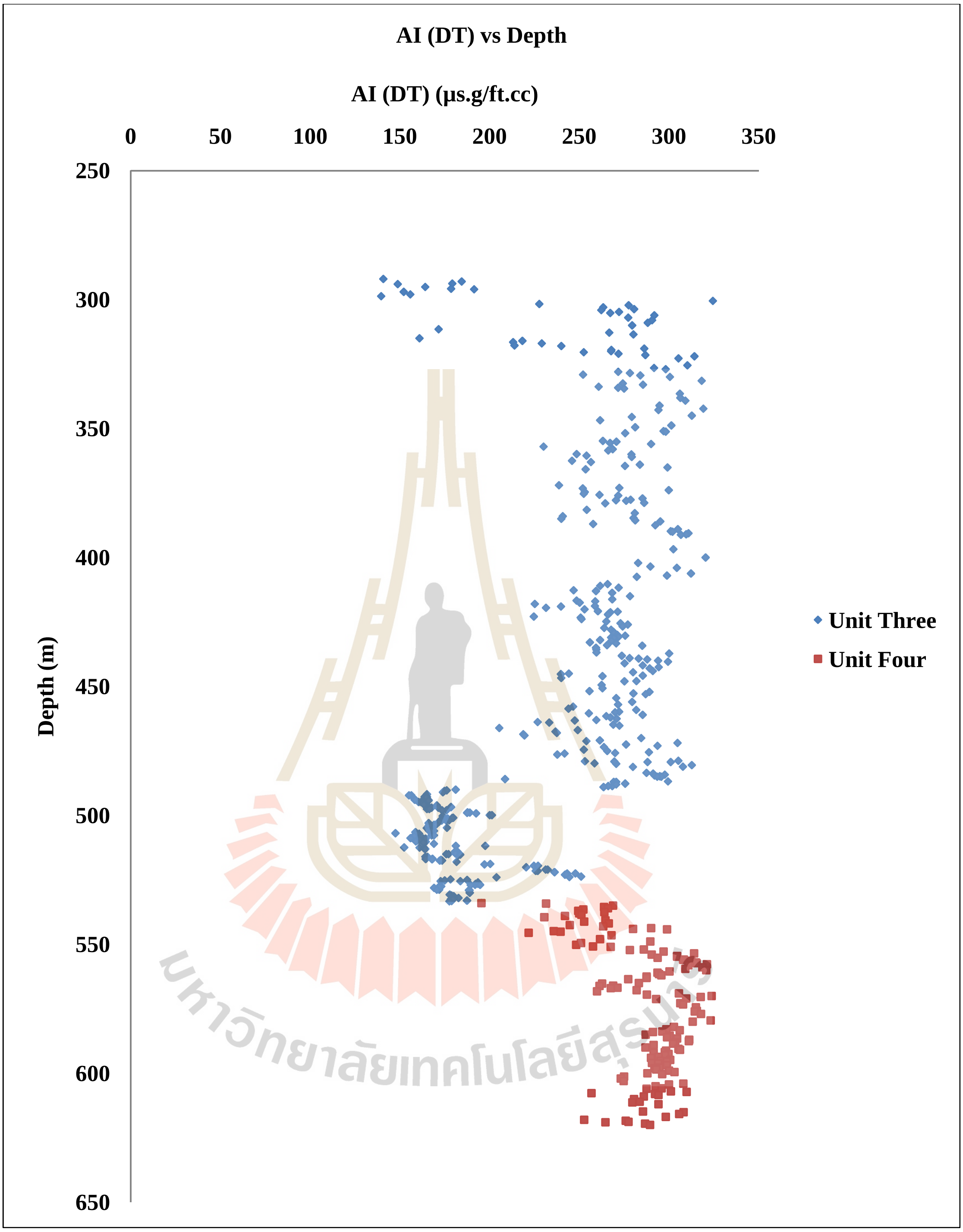


Figure 4.33 Relationship between acoustic impedance (AI (DT)) and depth in stratigraphic unit identification

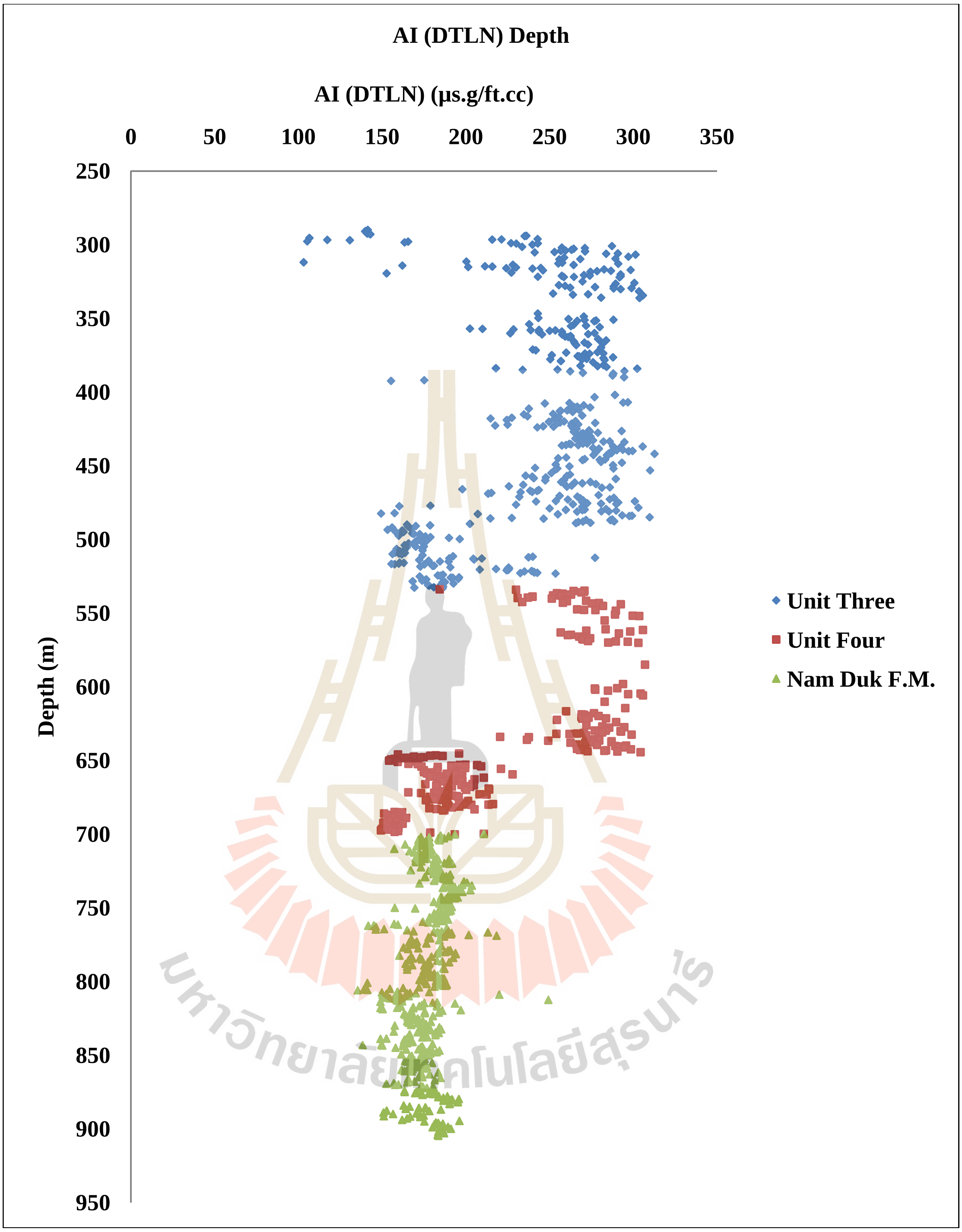


Figure 4.34 Relationship between acoustic impedance (AI (DTLN)) and depth in stratigraphic unit identification

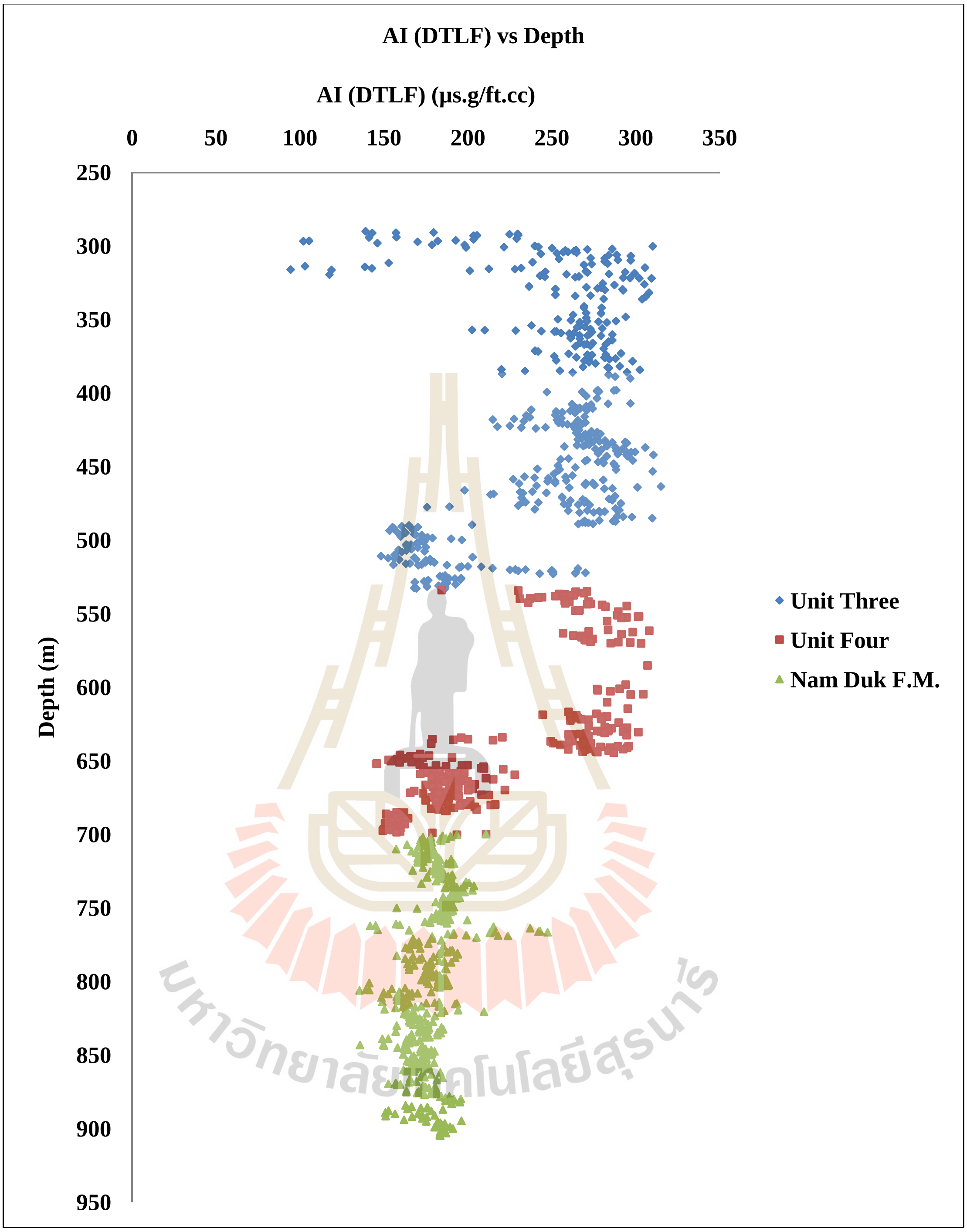


Figure 4.35 Relationship between acoustic impedance (AI (DTLF)) and depth in stratigraphic unit identification

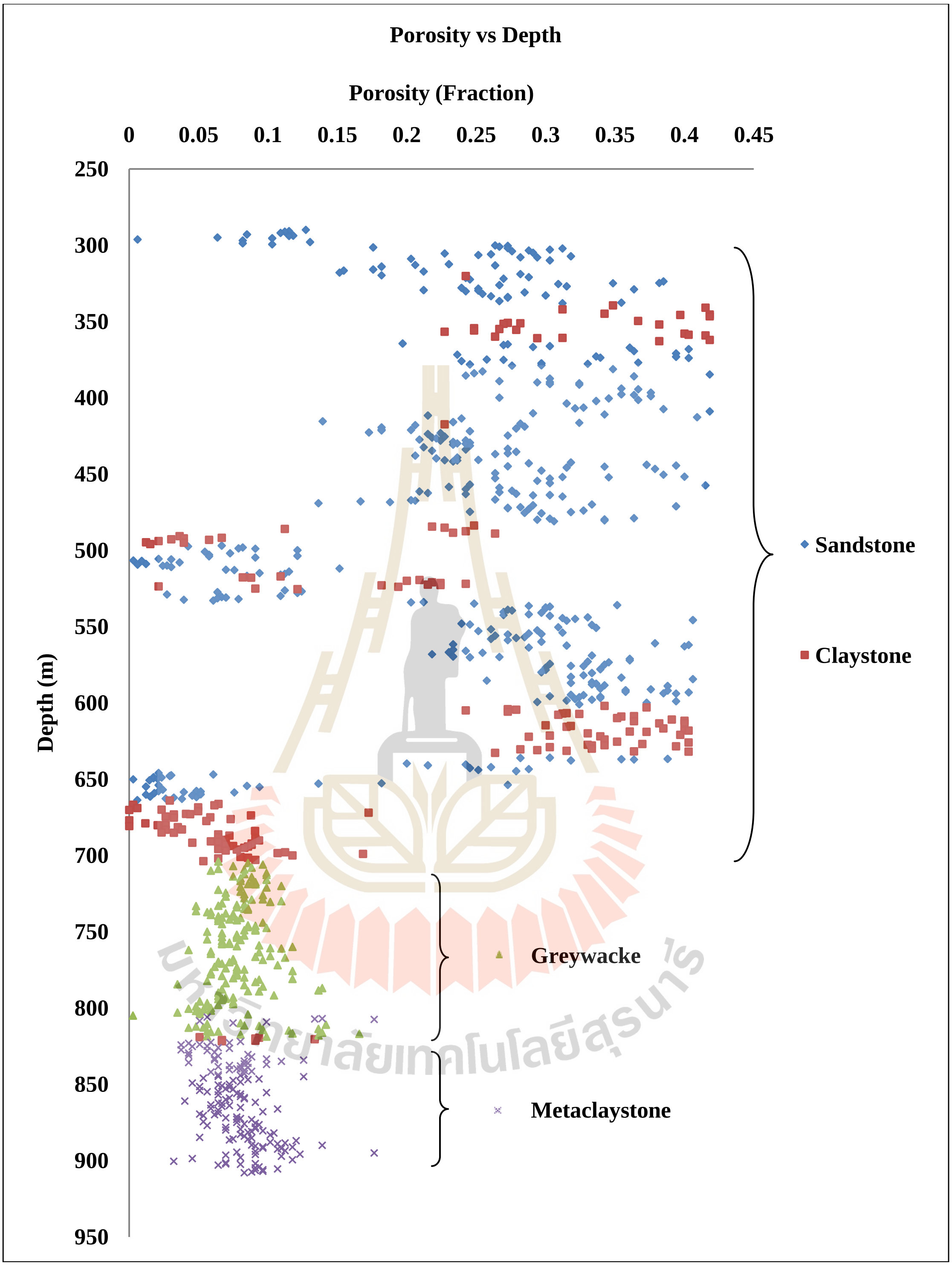


Figure 4.36 Relationship between porosity and depth in lithologic identification

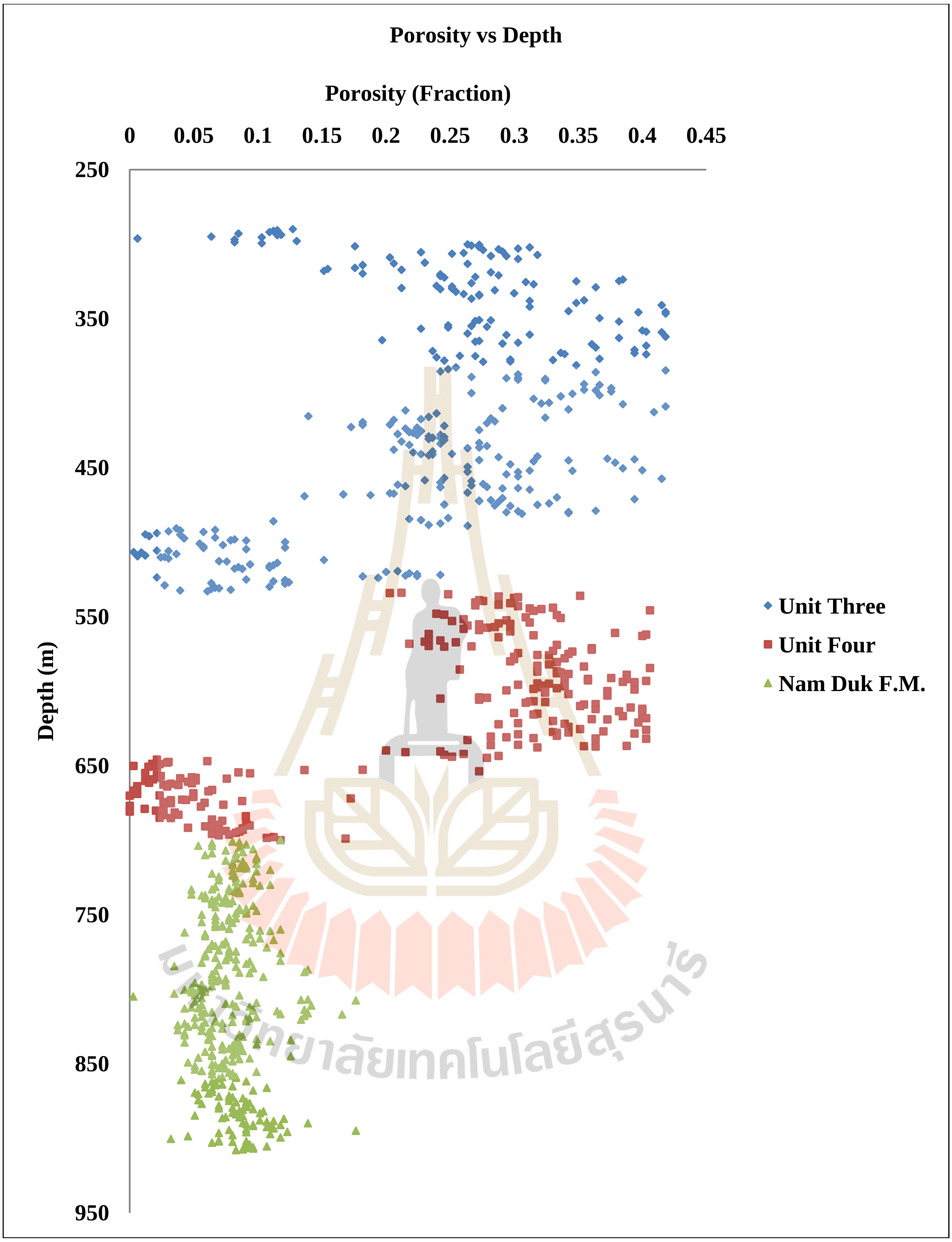


Figure 4.37 Relationship between porosity and depth in stratigraphic unit identification

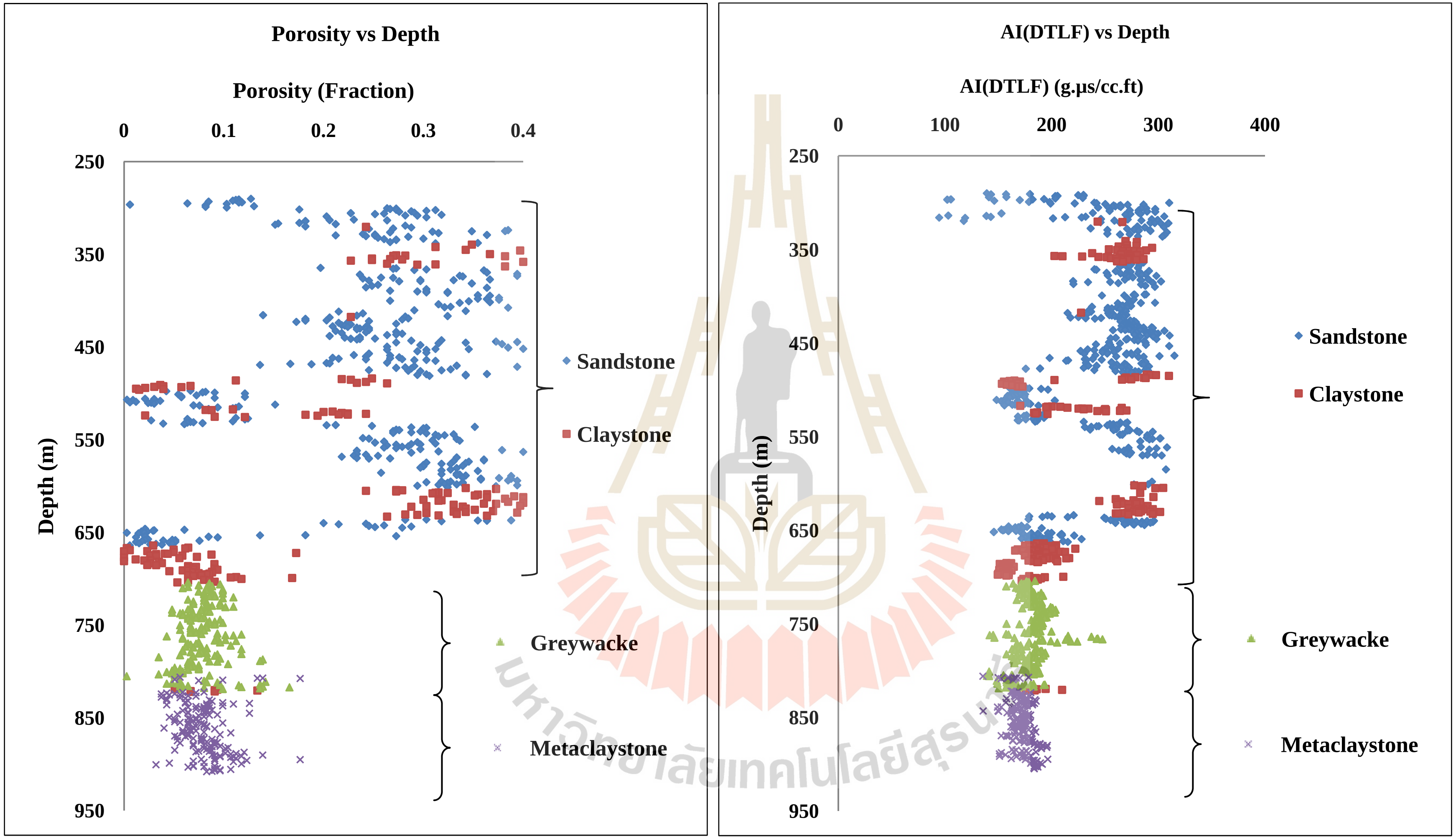
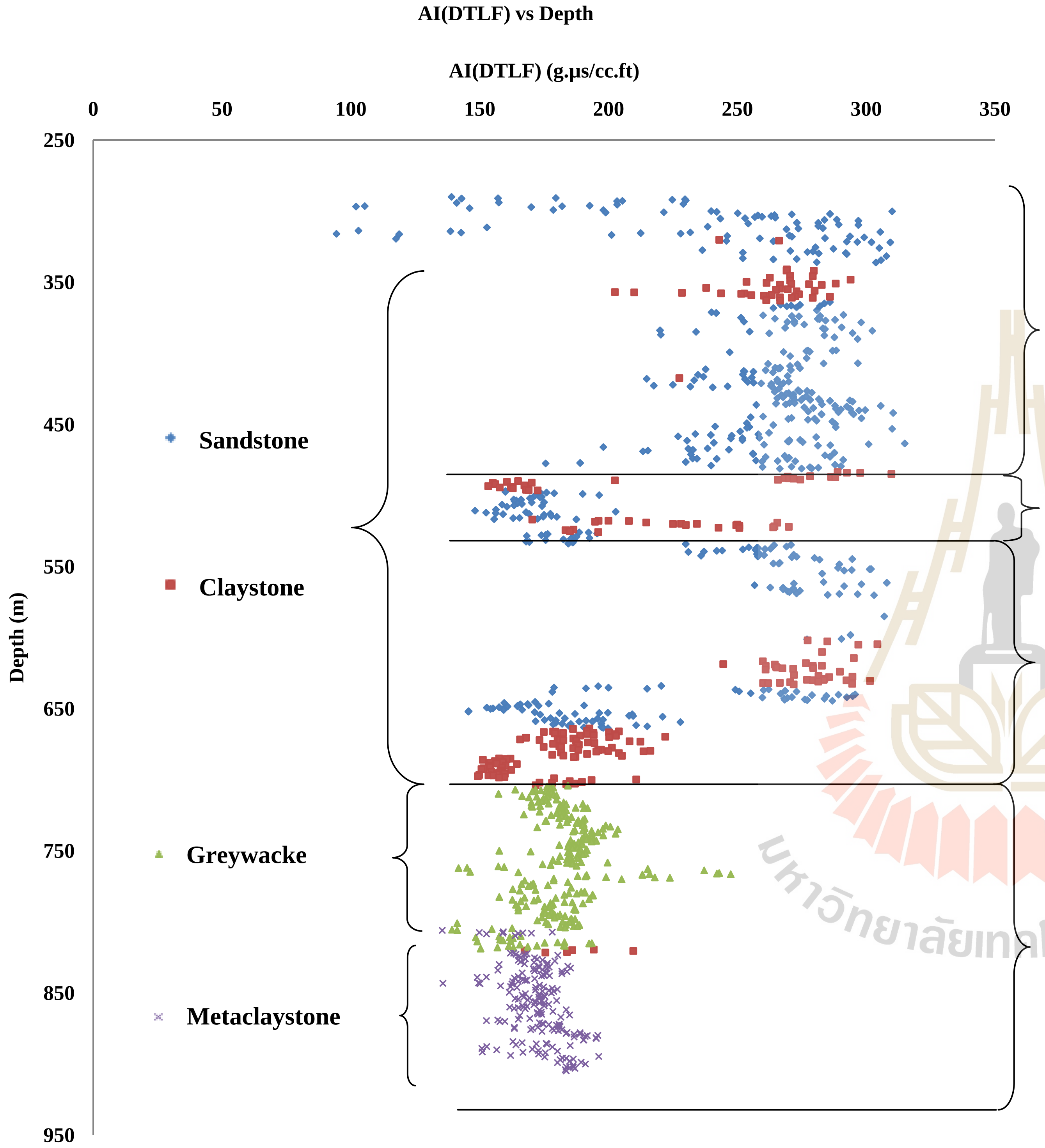


Figure 4.38 Relationship between acoustic i mpedance and depth compare with relationship between porosity and depth.



Formation	Petroleum system	Lithology	Environment of Deposition
UNIT THREE	Source And Reservoir	Claystone interbedded with sandstone and siltstone, F sand and weathered volcanics.	Fluvial/Deltaic Lacustrine
INTRUSIVE	Heat Source/Fracture Intrusive	Diorite, diabase	
UNIT FOUR	Source	Predominantly claystone with minor Interbeded of siltstone and sandstone	Lacustrine
Nam Duk F.M.		Varicoloured silty claystone with interbeds of lithic or quartzose sandstone and weathered fine grained volcanics	

Note: For Unit Three, sandstone is reservoir rock and claystone is source rock.

Figure 4.39 Acoustic impedance & depth and lithology description in well A-1

4.2.3 Relationship between acoustic impedance of short spacing delta-time (DTLN) and long spacing delta-time (DTLF) and rock properties (porous and dense zone)

The dataset of acoustic impedance of short spacing delta-time (DTLN) and long spacing delta-time (DTLF) were cross-plotted and x- and y-axes were represented to acoustic impedance of short spacing delta-time (DTLN) and long spacing delta-time (DTLF) respectively, and then they were used for porous and dense zone identification as showed in Figure 4.39 (for sandstone and claystone recognition) and Figure 4.40 (for greywacke and metaclaystone recognition). From the figures it can be concluded that where the dataset has more distribution imply that zone is porous or has high porosity and possible to be a reservoir rock, on the other hand where the dataset has less distribution imply that zone is dense zone or has low porosity and possible to be source rock.

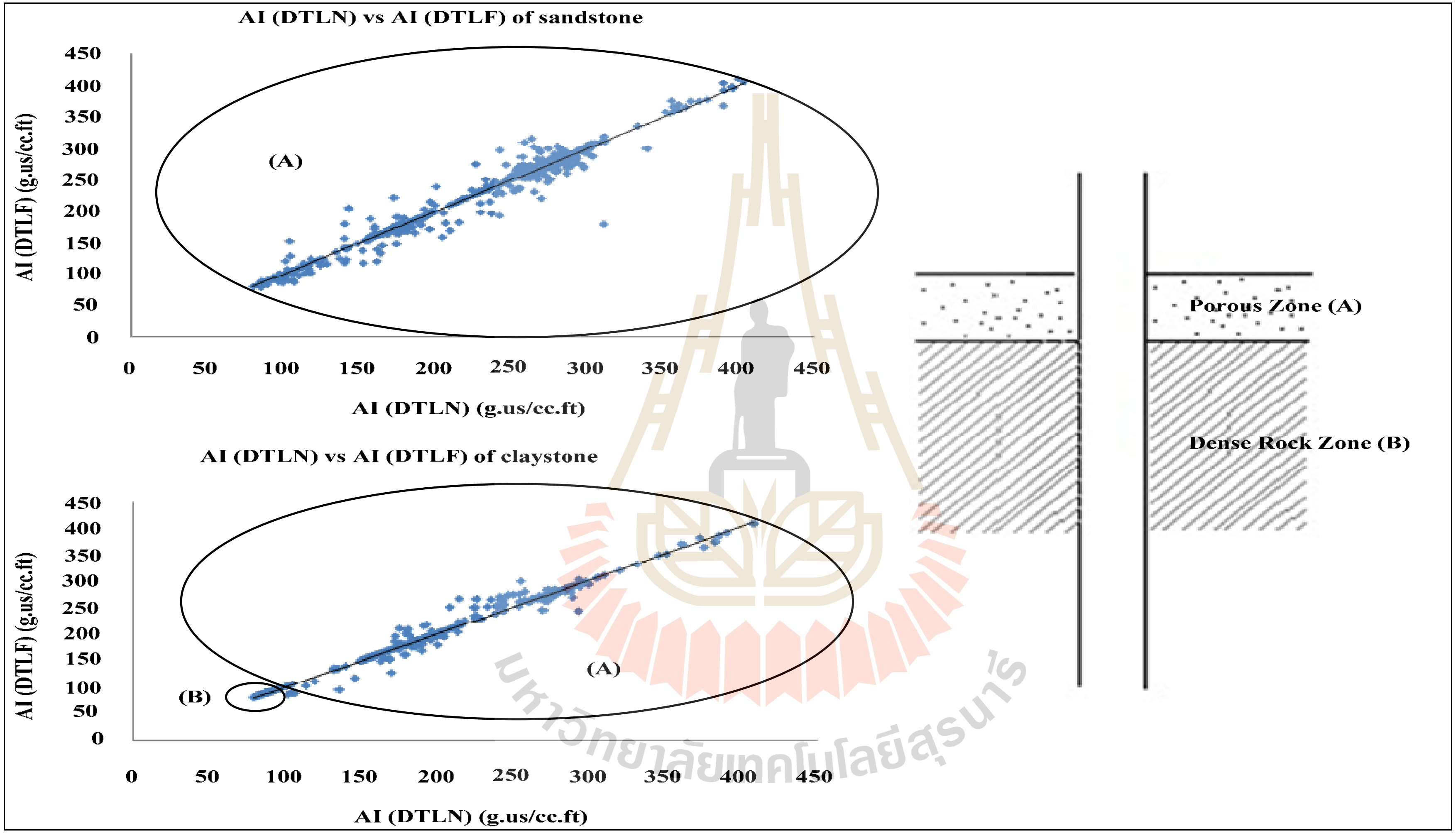


Figure 4.40 DTLN vs DTLF and rock properties (porous and dense zone) of sandstone and claystone in well A-1

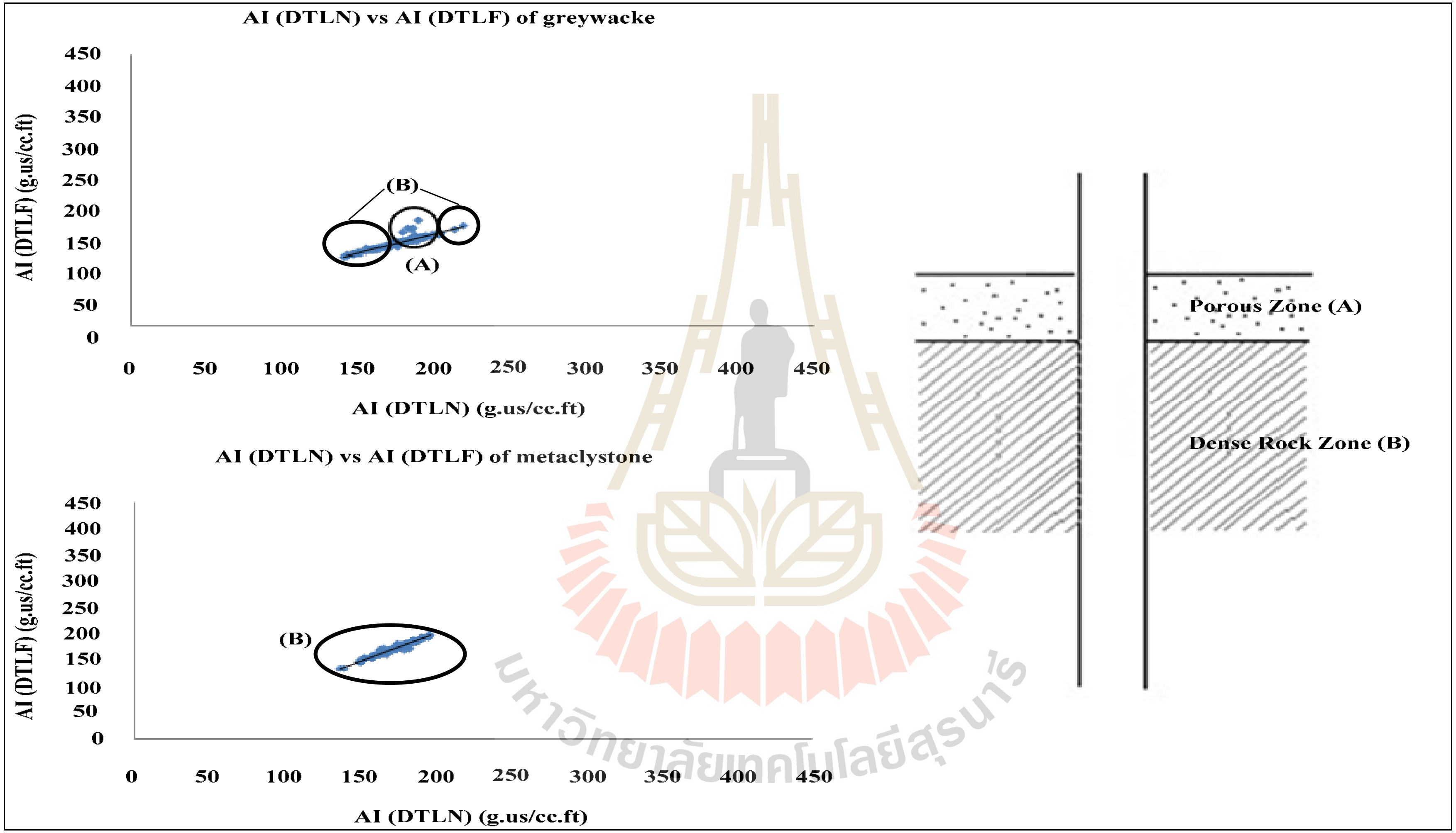


Figure 4.41 DTLN vs DTLF and rock properties (porous and dense zone) of greywacke and metaclaystone in well A-1

4.3 Discussion

4.3.1 Discussion on the quantitative results

- **Limitation of data caused by the confidential of data**

The main problem in this study is limitation of data by the confidential of data. The logging data were allowed only from one well, which later was named A-1 well. The other data such as stratigraphic unit, lithological and sidewall core descriptions were also allowed only on A-1 well so data analysis were then concentrated only in A-1 well.

- **Comparison between acoustic impedance of short spacing delta-time (10'-8' spacing; microsec/ft) (DT and DTLN)**

The quality of logging data acquired in DTLN (904 m) is higher because this log ran deeper into rock formations than DT (620 m). The data acquired in short spacing delta-time (DT) has been limited in use to poor data but it is still used to support the reservoir rock identification. So DTLN is more useful than DT.

4.3.2 Discussion on the qualitative results

- **New approach to identify reservoir rock**

The acoustic impedance data reflects the reservoir rock possibility as it can show higher value range than the others. As a result, acoustic impedance can be used as a tool to depict petroleum system as Unit Three (From 290 m to 490 m) is source and reservoir, Intrusive Unit (From 490 m to 530 m) is heat source, Unit Four (From 530 m to 700 m) is source, and Namduk Formation (From 700 m to 910 m).

- **New approach to identify rock properties (porous zone and dense zone)**

Relationship between acoustic impedance of short spacing delta-time (10’-8’ spacing; microsec/ft) (DTLN) and long spacing delta-time (12’-10’ spacing; microsec/ft) (DTLF) is not only applied in quantitative analysis but also implied rock properties (porous zone and dense zone).

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Acoustic impedance and porosity data can be used for evaluating reservoir rocks.

5.1.2 Linear relationships between acoustic impedance from logging data and porosity can be observed in the Wichian Buri Group and Nam Duk Formation with their corresponding linear equations.

5.1.3 The result of cross-plot between acoustic impedance of short spacing delta-time (10'-8' spacing; microsec/ft) (DT, DTLN) and long spacing delta-time (DTLF) (12'-10' spacing; microsec/ft) suggests relationship trend lines between short spacing delta-time and long spacing delta-time are in the same way.

5.1.4 The relationship between acoustic impedance of short spacing delta-time (10'-8' spacing; microsec/ft) (DT, DTLN) and long spacing delta-time (DTLF) (12'-10' spacing; microsec/ft) not only show in quantitative analysis, but it could be analysis in qualitative to classify rock properties to be porous zone and dense zone. It can be concluded that where the dataset has more distribution imply that zone is porous or has high porosity and possible to be a reservoir rock, on the other hand where the dataset has less distribution imply that zone is dense zone or has low porosity and possible to be source rock.

5.2 Recommendations

The recommendations for further study in this area are addressed below;

5.2.1 This research had been studied under limited logging and other essential data, thus it might have some errors. Therefore, if acoustic impedance, porosity, and/or lithologic logs are more available, relationship among acoustic impedance, porosity, depth, and lithology of this study area should be restudied.

5.2.2 Other kinds of cross-plot among acoustic impedance, porosity, permeability, depth, lithology data should be conducted and tested to verify results of the study and may give other new approaches to identify source rock more easily.

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APPENDIX A

A-1 WELL LOGGING DATA

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
290	35	28	-	-0.051	2.445
290.8	34	28	-	-0.117	2.455
291.2	33	29	-	-0.069	2.465
291.9	34	30	-	-0.093	2.47
292.1	31	29	-	-0.078	2.48
292.5	32	30	-	-0.093	2.5
293	33	31	-	-0.057	2.51
293.8	35	30	-	-0.087	2.455
294	38	32	-	-0.081	2.46
294.5	34	30	-	-0.117	2.5
295	35	31	-	-0.048	2.54
295.5	34	30	-	-0.069	2.475
296	34	28	-	-0.09	2.575
296.3	35	28	-	-0.081	2.64
296.8	34	27	-	-0.093	2.525
297.2	37	28	-	-0.069	2.515
298	33	25	-	-0.12	2.435
298.2	32	23	-	-0.09	2.5
298.8	33	23	-	-0.117	2.515
299.5	32	24	-	-0.033	2.48
300	30	24	-0.25	-0.135	1.95
300.2	44	34	-0.25	0.42	2.215
300.5	45	36	-0.05	0.411	2.2
301	43	35	0.0525	0.441	2.21
301.5	39	33	0.02	0.258	2.36
302	28	34	0.05	0.399	2.2
302.2	42	37	0.035	0.369	2.135
303	38	35	0.005	0.336	2.15
303.5	40	35	0.035	0.357	2.175
304	38	33	0.05	0.375	2.195
304.5	36	31	0.05	0.351	2.195
305	34	30	0.035	0.381	2.17
305.5	39	31	0.025	0.39	2.275
306	43	33	0.01	0.435	2.22
306.5	46	35	0.05	0.396	2.235
307.3	50	40	0.105	-0.126	2.125

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
308	47	37	0.1	-0.15	2.185
308.1	50	38	0.08	-0.132	2.165
309	43	32	0.05	0.345	2.315
309.5	47	35	0.06	0.366	2.25
310	40	30	0.055	0.36	2.15
310.2	41	31	0.06	0.366	2.155
311.5	31	26	0.1	0.18	2.505
312.2	33	27	0.045	0.363	2.3
312.5	40	30	0.005	0.345	2.27
313	41	33	0.04	0.39	2.31
313.3	45	36	0.035	0.405	2.215
314	36	30	0.01	0.27	2.35
314.2	32	29	0.005	0.21	2.35
315	30	30	0.025	0.123	2.575
316	55	47	0	0.393	2.36
316.5	54	48	-0.015	0.387	2.38
316.8	56	49	-0.01	0.384	2.395
317.3	40	30	0	0.3	2.3
317.8	39	30	0.015	0.294	2.365
318	40	30	0.02	0.315	2.4
318.8	44	33	0.04	0.411	2.2
319	49	38	0.0525	0.39	2.19
319.2	43	35	0.03	0.36	2.3
319.8	43	36	0.01	0.381	2.35
320.3	43	37	0	0.318	2.235
321	47	40	0	0.375	2.175
321.5	50	43	0.035	0.417	2.25
322	46	40	0.05	0.39	2.205
322.5	47	40	0.03	0.369	2.245
322.8	45	40	0.015	0.42	2.15
323.2	52	43	0.01	0.183	2.02
323.8	50	42	0	0.21	1.975
324	50	41	-0.015	0.201	1.95
324.2	50	40	-0.005	0.201	1.99
324.8	45	37	0	0.171	2.02
325	50	39	0	0.18	2.05

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
325.5	47	37	0	0.171	2.14
326.2	49	38	0.005	0.396	2.205
326.5	48	37	0	0.405	2.2
327	49	38	0	0.429	2.13
327.8	47	37	0	0.357	2.25
328	46	37	0	0.375	2.255
328.2	42	35	0	0.393	2.24
328.5	45	38	0	0.384	2.235
329	44	37	0.065	0.372	2.05
329.5	43	36	0.105	0.36	2.3025
329.8	44	37	0	0.375	2.235
330.3	46	38	0	0.39	2.25
330.8	43	36	0	0.414	2.2
331	42	35	0	0.42	2.19
331.2	46	37	0	0.426	2.185
331.8	43	35	0	0.447	2.215
332	44	36	0	0.384	2.235
332.8	41	34	0.025	0.432	2.175
333	44	37	0.04	0.396	2.155
333.5	44	38	-0.005	0.399	2.22
334	45	39	0	0.381	2.2
334.5	43	38	0.005	0.405	2.2
335.2	51	42	0	-0.102	2.9
335.5	50	42	0.01	-0.111	2.86
336	47	40	0.015	0.441	2.1
336.2	44	39	0.01	0.426	2.2
336.7	46	40	0.02	0.441	2.215
337.2	48	39	0.09	-0.135	1.95
332.7	49	38	0.11	-0.147	2.065
338.1	48	37	0.04	-0.12	2.14
338.8	50	39	-0.015	-0.072	2.855
339	51	39	-0.01	-0.114	1.95
339.5	50	39	0	-0.078	2.075
339.8	52	40	0	-0.12	2.825
340.2	50	38	0.025	-0.069	2.685
340.8	51	40	0.09	-0.135	2.95

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
341	47	37	0.1	-0.105	1.965
341.5	49	40	0.08	-0.138	2.945
342.1	50	40	0.25	-0.099	2.135
342.3	51	41	0.25	-0.096	2.06
342.8	50	40	0.2	-0.132	2.92
343	50	40	0.1	-0.12	2.885
343.2	47	37	0.125	-0.075	2.915
343.5	47	37	0.1	-0.063	2.75
343.8	47	36	0.085	-0.075	2.675
344.2	46	35	0.135	0.429	2.915
344.8	45	34	0.155	0.45	2.05
345	50	41	0.13	-0.135	2.085
345.2	47	40	0.115	-0.129	2
345.5	48	40	0.105	-0.144	1.96
345.8	45	37	0.14	0.45	1.995
346.2	43	35	0.135	0.387	2.88
346.7	44	35	0.145	0.408	1.965
347	48	36	0.11	0.444	2.92
347.3	46	34	0.115	0.411	2.95
347.8	45	33	0.12	0.399	2.875
348	47	35	0.15	0.399	1.975
348.3	49	36	0.17	-0.135	2.1
348.6	50	37	0.15	-0.105	2.925
349	46	35	0.115	-0.12	2.855
349.7	44	34	0.18	0.45	2.045
350	45	35	0.15	0.411	2.905
350.2	47	36	0.135	0.414	2.02
350.5	43	34	0.175	0.402	2.16
350.8	43	34	0.18	0.39	2.19
351	44	35	0.17	0.408	2.2025
351.2	45	36	0.125	0.39	2.185
351.6	44	36	0.13	0.372	2.205
352	48	39	0.15	0.402	2.05
352.2	47	38	0.165	0.417	1.965
352.5	45	37	0.15	0.408	2.935
352.8	48	40	0.105	0.42	2.86

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
353.2	43	37	0.115	0.39	1.95
353.8	47	40	0.075	0.414	2.775
354.5	46	40	0.01	0.339	2.245
355	47	41	0.065	0.39	2.21
355.5	45	39	0.03	0.399	2.19
356	48	40	0	0.42	2.235
356.8	44	36	0	0.345	2.275
357.8	50	38	0.15	0.426	1.955
358	50	37	0.15	0.429	2
358.5	46	34	0.15	0.384	1.95
358.8	47	33	0.15	0.447	1.985
359.2	50	35	0.165	0.438	1.965
360	43	33	0.09	0.372	2.21
360.8	45	35	0.025	0.408	2.135
361	46	36	0.07	0.39	2.165
361.5	44	35	0.0975	0.42	2.9
361.8	50	37	0.07	0.411	2.805
362	50	38	0.075	0.417	2.9
362.5	48	37	0.1	0.411	1.96
363	49	37	0.165	0.441	2.025
363.2	48	37	0.135	0.429	2.925
363.5	47	38	0.115	0.438	2.87
364	44	35	0.125	0.39	2.15
364.5	46	37	0.05	0.342	2.325
365	47	38	0	0.405	2.1975
365.5	43	36	-0.0025	0.357	2.205
366.2	49	40	0.05	-0.15	2.145
366.8	50	40	0.075	0.351	2.175
367.2	47	36	0.06	0.414	2.06
368	49	37	0.11	-0.141	1.95
368.2	51	39	0.14	-0.15	1.985
369	50	40	0.085	-0.102	2.75
369.5	50	39	0.1	0.441	2.05
370	50.5	39	0.125	-0.144	2.9
370.2	47	35	0.08	-0.129	2.815
370.8	44	33	0.09	0.423	2.92

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
371	44	33	0.1	0.432	2
371.8	40	32	0.015	0.366	2.265
372.5	45	34	0.08	0.441	2.84
373	47	34	0.14	0.429	2.095
373.2	45	33	0.115	0.447	2
373.8	50	35	0.1	0.45	2.09
374	49	36	0.085	0.42	1.985
374.2	50	37	0.09	0.429	2.07
375	42	32	0.005	0.339	2.225
375.2	39	30	0	0.336	2.205
376	44	33	0	0.369	2.255
376.5	45	34	0	0.429	2.2
377	51	37	0.1	0.444	2.045
377.5	47	34	0.195	0.42	2.155
378	43	32	0.1	0.408	2.105
378.2	47	34	0.05	0.411	2.245
378.8	50	37	0.035	0.36	2.16
379	44	31	0.06	0.375	2.195
379.2	47	34	0.08	0.399	2.085
379.5	46	34	0.11	0.39	2
380	50	37	0.11	0.426	2.895
380.5	48	37	0.135	0.405	2.925
380.7	50	39	0.11	0.42	2.91
381	45	37	0.1	0.42	2.005
381.3	47	39	0.12	0.429	2.075
381.8	50	40	0.15	0.405	2.9
382	47	39	0.1	0.42	2.76
382.5	50	40	0.045	0.39	2.2
382.8	47	37	0.05	0.399	2.23
383	50	37	0.085	0.411	2.19
383.2	47	33	0.08	0.405	2.86
383.8	42	30	0.065	0.39	2.05
384	46	33	0.065	0.375	2.24
384.5	48	34	0.065	0.45	2.05
384.8	49	34	0.115	0.42	1.96
385.1	45	32	0.085	0.396	2.15

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
385.5	45	32	0.075	-0.123	2.25
386	50	34	0.145	0.45	2
386.3	49	34	0.11	-0.147	2.875
386.8	48	33	0.08	0.45	2.73
387	47	33	0.1	-0.15	2
387.5	44	33	0.125	0.438	2.15
388.2	49	38	0.15	-0.117	2.835
388.8	44	36	0.1	0.444	2.135
389	47	37	0.05	0.438	2.2
389.2	46	37	0.015	-0.129	2.21
389.8	50	39	0.05	-0.147	2.15
390	45	36	0.055	-0.138	2.17
390.5	48	39	0.045	-0.15	2.115
390.8	45	38	0.025	-0.123	2.145
391	48	40	0	-0.12	2.15
391.2	45	40	0	-0.129	2.115
391.8	46	40	0.025	-0.096	1.95
392	43	39	0.025	-0.096	2.7
392.3	44	39	0.01	-0.078	2.59
392.8	43	38	0.015	-0.081	2.5
393	46	40	0.015	-0.105	2.285
393.5	46	40.5	0	-0.126	2.05
394	45	40	0	-0.12	2.065
394.3	44	39	0	-0.075	2.045
394.8	47	40	0	-0.102	2.055
395	44	36	0	-0.105	2.05
395.5	42	34	0.05	-0.123	2.9
396	47	37	0.025	-0.075	2.855
396.7	44	35	0	-0.12	2.08
397	45	36	0	-0.102	2.845
397.8	41	33	-0.005	-0.15	2.065
398.2	43	33	-0.01	-0.105	2.05
398.8	40	30	-0.01	-0.135	2.035
399.2	44	34	0	-0.12	2.03
400	41	33	0	-0.15	2.215
400.5	44	35	0	-0.12	2.085

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
400.8	41	34	0	-0.117	2.075
401	43	36	0	-0.135	2.065
401.5	46	39	0.005	-0.114	2.045
402	40	35	0.03	-0.129	2.075
402.2	44	37	0.035	-0.087	2.095
403	43	37	0.005	-0.135	2.7
403.3	41	37	0	0.423	2
403.8	45	39	0.01	-0.12	2.135
404.2	41	35	-0.005	-0.108	2.04
404.8	46	37	0.045	-0.09	2.865
405.2	45	36	0.05	-0.06	2.8
405.5	46	37	0.02	-0.09	2.735
405.8	49	39	0.05	-0.105	2.9
406.2	50	40	0.035	-0.06	2.095
406.8	53	41	0.015	-0.129	2.115
407	48	38	0.065	-0.132	2.12
407.5	47	37	0.1	0.438	2.015
408	49	38	0.13	0.447	2.875
408.2	50	40	0.11	0.42	2.75
408.5	48	38	0.1	0.414	2.85
409	50	40	0.115	-0.114	1.955
409.5	47	37	0.1	-0.144	2.895
410	46	36	0.15	0.429	2.15
410.2	43	33	0.155	0.426	2.17
410.8	45	34	0.15	0.378	2.165
411	43	33	0.125	0.405	2.58
411.7	44	34	0.08	0.399	2.295
412	45	36	0.115	0.45	2.15
412.5	47	37	0.1	0.411	1.975
413	46	37	0.1	0.45	2.05
413.6	46	38	0.105	0.399	2.255
414	50	40	0.06	0.429	2.77
414.8	45	38	0.135	0.39	2.15
415.5	40	36	0.03	0.297	2.425
416	48	43	0.1	0.36	2.235
416.5	47	41	0.155	0.399	2.27

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
417	45	40	0.1	0.384	2.185
417.5	50	43	0.01	0.33	2.275
418	37	30	0	0.294	2.315
419	50	36	0.09	0.369	2.175
419.5	42	30	0.05	0.3	2.35
420	50	34	0	0.36	2.19
421	43	30	0.165	0.348	2.35
421.2	47	31	0.15	0.346	2.315
421.8	44	30	0.1	0.345	2.35
422	44	30	0.01	0.33	2.245
422.8	40	27	0.04	0.252	2.365
423.2	37	24	0.01	0.33	2.28
423.8	47	33	0.005	0.315	2.3
424	43	30	0	0.33	2.285
424.8	47	34	0	0.36	2.2
425	50	35	0	0.372	2.24
425.2	49	36	0	0.363	2.255
425.5	50	37	0.0025	0.375	2.28
426	45	32	0.005	0.366	2.275
426.2	47	33	0.005	0.36	2.295
426.8	46	31	0	0.399	2.28
427.5	50	33	-0.0025	0.345	2.305
428	46	31	0.01	0.36	2.26
428.2	46	34	0.02	0.348	2.28
429	49	35	0.005	0.36	2.27
429.5	46	34	0.0025	0.327	2.245
430	49	35	0	0.36	2.26
430.2	48	37	0	0.387	2.25
430.8	47	37	-0.0025	0.36	2.265
431	50	38	0	0.348	2.25
431.5	48	37	0	0.318	2.2475
432.2	45	36	0	0.348	2.295
432.8	45	36	0	0.321	2.3
433.5	46	37	0.025	0.39	2.2
434	48	38	0.01	0.351	2.25
434.2	46	37	0.01	0.36	2.25

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
434.8	43	35	0.01	0.351	2.285
435	42	35	0.01	0.363	2.275
435.5	40	34	0.01	0.348	2.2
436	40	35	0	0.354	2.185
436.5	43	37	-0.0025	0.345	2.2
437	49	40	0.015	0.405	2.215
437.3	47	39	0.045	0.414	2.25
438	43	36	0.005	0.366	2.3
438.5	50	37	0	0.354	2.31
439.2	43	32	0.02	0.39	2.26
439.8	46	33	0.035	0.423	2.285
440	45	32	0.005	0.42	2.28
440.8	48	33	0.03	0.378	2.24
441	45	33	0.02	0.39	2.28
441.2	45	31	-0.0025	0.411	2.26
441.8	49	34	-0.005	0.381	2.265
442.5	44	32	0.05	0.417	2.125
443	48	34	0.1	0.396	2.175
443.2	47	33	0.125	0.447	2
443.8	47	33	0.11	0.435	2.95
444	45	33	0.135	-0.15	2.035
444.5	47	35	0.11	0.42	2
445	42	31	0.1	0.375	2.2
445.2	45	33	0.1	0.423	2.085
445.8	50	37	0.13	0.405	2.13
446.2	45	33	0.075	0.435	1.955
446.8	45	33	0.1	-0.147	2.025
447.2	47	36	0.135	0.42	2.895
447.8	46	36	0.185	0.432	2.165
448	51	40	0.165	0.408	2.12
448.2	43	35	0.12	0.414	2.875
448.8	45	37	0.0975	0.396	2.765
449	46	37	0.1	0.399	2.05
449.5	43	35	0.07	0.384	2.215
450	46	38	0.08	0.42	2.925
450.5	50	40	0.12	-0.135	2.015

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
451	47	38	0.1	0.45	2.835
451.8	46	37	0.0975	0.39	1.995
452	43	35	0.12	-0.15	2.135
452.2	45	36	0.1	-0.141	2.08
452.8	44	37	0.08	0.396	2.215
453	50	40	0.075	0.42	2.15
453.3	43	39	0.09	-0.12	2.09
454	50	41	0.07	-0.09	2.89
454.5	47	39.5	0.095	0.42	2.165
455	48	39	0.1	0.399	2.925
455.2	46	39.5	0.105	0.411	2.9
455.7	50	41.5	0.1	0.408	2.05
456	49	40	0.065	0.429	2.15
456.5	43	35	0.075	0.39	2.185
457	46	36	0.085	0.339	2.245
457.5	48	37	0.07	0.411	1.965
458	45	36	0.115	0.429	2.175
458.5	44	36	0.065	0.33	2.27
459	43	35	0.07	0.417	2.215
460	42	33	0.015	0.33	2.25
460.2	46	36	0.025	0.336	2.25
460.5	43	34	0.05	0.36	2.245
461	48	37	0.07	0.405	2.195
461.5	46	35	0.035	0.375	2.305
462	48	37	0.07	0.387	2.21
462.5	44	35	0.065	0.36	2.295
463	47	39	0.095	0.402	2.24
463.2	46	37	0.115	0.339	2.275
463.8	45	38	0.105	0.33	2.15
464	44	37	0.125	0.345	2.17
464.3	47	40	0.105	0.384	2.15
464.8	45	40	0.07	0.42	2.135
465	47	42	0.065	0.45	2.2
465.2	50	44	0.075	0.408	2.3
466	30	25	0.025	0.33	2.48
466.8	43	31	0.07	0.363	2.215

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
467.2	40	30	0.03	0.27	2.315
467.5	40	30	0.015	0.261	2.305
468	36	27	0.02	0.267	2.38
468.5	32	26	0.015	0.285	2.34
469	33	27	0.005	0.249	2.425
470	47	40	0.075	0.447	2.1
470.3	47	40	0.09	0.435	2.175
470.8	45	37	0.07	0.447	2.16
471.2	48	39	0.015	0.399	2
471.5	50	40	0.05	0.375	2.15
471.8	48	38	0.06	0.417	2.18
472.2	47	37	0.075	0.396	2.2
472.5	46	37	0.085	0.408	2.1975
473	44	35	0.12	0.381	2.175
473.5	49	37	0.15	0.417	2.11
474	44	36	0.1	0.342	2.245
475	47	38	0.12	0.426	2.12
475.5	49	40	0.15	0.381	2.185
475.8	46	39	0.14	0.426	2.16
476	47	39	0.15	0.429	2.175
476.8	48	40	0.005	0.345	2.4
477	55	43	0	0.255	2.475
477.5	55	44	-0.0025	0.24	2.545
478	55	45	0.01	0.27	2.45
478.5	47	35	0.1	0.399	2.165
478.8	50	37	0.125	0.45	2.1
479	50	37	0.09	0.42	2.05
479.3	49	36	0.1	0.393	2.15
479.8	49.5	36	0.135	0.447	2.075
480	47	35	0.14	0.387	2.165
480.5	53	40	0.115	-0.135	2.085
481	51	40	0.135	0.42	2.145
482	47	34	0.09	-0.045	2.855
482.8	27	24	0	0.195	2.59
483.8	50	35	0.025	0.42	2.235
484.1	53	37	0.005	0.399	2.285

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
484.5	50	35	0	0.42	2.29
485	47	34	-0.0025	0.405	2.295
485.2	44	33	-0.005	0.42	2.275
486	41	32	0	0.321	2.465
486.5	48	35	0.0025	0.435	2.265
487	47	34	0.005	0.42	2.255
487.5	50	36	0	0.399	2.25
487.8	50	36	0	0.408	2.25
488.2	50	37	0	0.39	2.265
488.8	49	36	-0.005	0.42	2.25
489.1	43	40	-0.005	0.405	2.215
490	57	42	0	0.3	2.425
490.8	37	28	0.005	0.225	2.585
491.5	56	44	0.015	0.231	2.565
491.8	56	44	0.01	0.18	2.54
492.2	55	43	0.06	0.15	2.58
492.5	52	41	0.08	0.159	2.585
492.8	55	43	0.1	0.18	2.6
493.2	49	39	0.02	0.216	2.555
494	36	30	0	0.249	2.615
494.8	32	27	-0.0025	0.24	2.63
495.1	33	29	-0.01	0.234	2.585
495.5	32	28	-0.015	0.246	2.6
496.5	55	40	0.0025	0.186	2.585
496.8	53	40	0	0.21	2.3
497	56	41	0	0.195	2.29
497.5	53	40	-0.0025	0.204	2.58
498.2	52	40	-0.005	0.231	2.515
498.8	53	40	0	0.2415	2.515
499.2	50	39	0	0.231	2.465
499.5	51	40	0	0.255	2.455
500	50	40	0	0.267	2.45
501	55	41	0	0.171	2.565
501.3	59	43	-0.005	0.174	2.55
502	57	41	-0.015	0.186	2.53
503	57	40.5	0	0.159	2.56

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
503.7	48	37	0.04	0.228	2.45
504	47	38	0.03	0.207	2.555
504.8	40	33	0	0.27	2.5
505.5	33	30	-0.0025	0.231	2.615
506	36	33	0	0.264	2.6
506.7	34	30	-0.0025	0.252	2.645
507	37	32	-0.005	0.249	2.635
508	30	27	0.0025	0.294	2.59
508.5	33	31	-0.005	0.243	2.615
509	33	31	-0.0025	0.252	2.625
509.5	36	32	0	0.24	2.64
510	37	31	0.005	0.231	2.605
510.2	34	29.5	0	0.249	2.615
511	38	30	-0.005	0.222	2.6
511.8	57	40	-0.005	0.294	2.4
512.8	53	46	0	0.15	2.535
513	55	47	0.005	0.147	2.53
513.2	55	46	0.015	0.171	2.53
514	65	41	-0.0025	0.246	2.465
515	65	40	0	0.216	2.495
515.5	54	37	0.015	0.285	2.465
516	54	35	0	0.282	2.47
516.8	573	40	0	0.291	2.51
517.2	52	38	0.01	0.342	2.47
517.8	56	41	0	0.351	2.515
518	53	40	0	0.36	2.5
518.2	56	43	0	0.375	2.45
518.8	53	40	-0.0025	0.351	2.4
519	57	42	0	0.36	2.39
519.5	55	40	0.01	0.396	2.305
520	51	39	0.025	0.408	2.32
520.5	53	40	0.015	0.384	2.31
521	53	40	0	0.429	2.285
521.5	51	40	0	0.411	2.28
522	54	40	-0.005	0.444	2.25
522.5	52	39.5	-0.0025	0.39	2.295

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
522.8	54	40	0	0.375	2.275
523	47	35	0	0.342	2.3
523.7	50	37	0	0.33	2.35
524	50	37	0	0.339	2.325
524.5	51	40	0	0.345	2.35
525.1	37	33	0.0025	0.225	2.5
525.5	31	27	0.005	0.207	2.45
526	30	27	0	0.267	2.45
526.3	33	26	0	0.231	2.465
527	37	30	0	0.249	2.445
527.5	47	36	0	0.216	2.545
528	48	37	0.005	0.294	2.45
529	37	33	0.025	0.282	2.605
530	34	32	-0.01	0.339	2.465
530.7	29	29	0	0.306	2.54
531	30	30	0	0.33	2.535
531.5	29	29	0	0.36	2.545
532	26	26	0	0.33	2.52
532.5	35	30	0.0025	0.255	2.585
533	35	29	0	0.27	2.55
534	54	43	0.01	0.345	2.3
534.2	52	41	0.015	0.369	2.315
535	47	38	0	0.384	2.245
536	50	36	0.015	0.429	2.07
536.5	47	36	0	0.399	2.175
537	44	36	0	0.411	2.15
537.5	49	39	0	0.396	2.155
538	47	37	0	0.42	2.155
538.2	45	36	0	0.378	2.165
538.5	47	36	-0.0025	0.369	2.175
539	46	34	-0.01	0.372	2.2
539.5	49	36	-0.01	0.36	2.195
540	46	35	0.005	0.432	2.2
540.5	49	36	0.015	0.45	2.19
541	43	33	0.015	0.423	2.155
541.2	49	37	0.02	0.411	2.17

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
541.8	50	37	0.01	0.45	2.175
542.2	51	39	0.015	0.435	2.175
542.8	49	36	0.035	0.4185	2.205
543.2	43	40	0.01	0.447	2.15
543.8	50	40	0.025	0.411	2.125
544	53	42	0.065	0.444	2.105
544.5	50	40	0.05	-0.135	2.135
545	49	37	0.03	-0.099	2.115
545.2	50	37	0.085	-0.12	2.12
545.8	50	37	0.055	0.42	1.985
546.2	50	38	0.035	0.447	2.135
547	50	36	0.06	-0.09	2.805
547.9	45	30	0.05	0.414	2.2
548.1	49	31	0.045	0.42	2.2525
548.8	49	32	0.0525	0.393	2.245
549	47	30	0.05	0.399	2.005
549.5	50	33	0.06	-0.111	2.8
550	50	33	0.025	0.414	2.65
550.5	50	34	0.1	-0.135	2.14
550.9	47	33	0.115	-0.12	2.0975
551.2	45	32	0.05	0.426	2.2
551.8	49	35	0.025	0.423	2.225
552	48	34	0.05	0.411	2.2
552.5	47	34	0.095	0.42	2.16
553	47	34	0.05	0.435	2.235
553.5	46	34	0.01	-0.144	2.175
554	46	33	0.06	0.426	2.135
554.5	45	31	0.065	-0.138	2.175
554.9	49	33	0.025	0.435	2.16
555.2	45	30	0.005	0.39	2.2
556	49	33	0	0.405	2.215
556.5	47	32	-0.0025	0.399	2.2
557	49	31	0	0.426	2.18
557.1	49	31	0	0.42	2.19
557.8	50	33	-0.005	0.447	2.185
558.2	55	36	-0.0025	0.417	2.22

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
558.8	50	32	0	0.444	2.215
559.2	48	30	0.0025	0.402	2.185
559.8	51	33	0.015	0.423	2.165
560	50	33	0.075	0.414	2.16
560.5	48	31	0.115	0.435	2.1
561	45	30	0.085	0.42	2.025
561.7	45	30	0.05	0.39	2.265
562	49	33	0.06	-0.126	2.05
562.1	50	36	0.05	0.435	1.985
562.5	51	37	0.06	0.4185	2.135
563	49	36	0.04	-0.126	1.99
563.2	49	36	0.055	0.435	2.075
563.5	46	35	0.05	0.396	2.17
563.8	47	34	0.07	0.399	2.175
564	49	36	0.06	-0.141	2.935
564.2	50	36	0.08	-0.123	2.905
565	49	35	0.03	0.384	2.235
565.2	50	36	0.005	0.39	2.265
565.8	47	35	0	0.399	2.25
566.3	52	39	0	0.366	2.265
566.9	50	37	-0.0025	0.402	2.275
567.2	47	33	0.01	0.45	2.23
567.8	46	32	0.025	0.405	2.27
568.2	50	34	0	0.39	2.295
569	46	32	0.05	0.444	2.1
569.5	46	33	0.04	0.42	2.265
569.9	48	33	0.045	0.435	2.235
570	47	32	0.05	0.42	2.21
570.2	47	31	0.085	0.423	2.245
571	50	33	0.05	0.45	2.15
571.2	48	32	0.005	0.435	2.14
571.8	52	34	0	-0.135	2.08
572	51	34	-0.0025	-0.123	2.055
572.8	47	31	0.005	0.441	2.105
573	49	32	0.005	0.447	2.085
573.8	50	35	0	-0.129	2.08

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
574.5	46	33	-0.0025	0.441	2.15
575	47	34	-0.005	-0.144	2.085
575.2	45	33	-0.005	0.441	2.1
575.8	49	35	0	-0.147	2.125
576	45	34	0	-0.135	2.11
576.8	50	37	0.0025	0.411	2.155
577.5	45	33	0.0025	-0.102	2.12
578	52	39	-0.0025	-0.138	2.085
578.5	51	39	-0.005	0.429	2.155
578.8	50	37	0.025	0.435	2.13
579.2	48	35	0.03	0.411	1.96
579.8	52	38	0.055	0.45	2.16
580	47	34	0.055	-0.141	2.165
580.5	50	35	0.025	-0.15	2.11
580.8	48	34	0.01	-0.087	2.1
581	53	40	0.005	-0.108	1.98
581.5	52	40	0	-0.093	2.945
582	54	42	0	0.447	2.105
583	43	34	0.02	-0.132	2.125
583.2	49	38	0.02	-0.099	2.065
583.8	49	38	0.005	-0.114	2.085
584.5	59	45	0.025	-0.069	1.975
585.5	41	31	0	0.42	2.225
586	46	33	0.01	0.441	2.135
586.2	44	32	0.005	-0.15	2.11
586.5	45	33	0	0.45	2.1
587	49	35	0.0025	-0.117	2.125
587.5	46	33	0.0025	-0.129	2.095
588	50	34	0.0025	-0.105	2.1
588.2	54	36	0.0025	-0.087	2.08
588.5	52	34	0.0025	-0.105	2.09
589	53	33	0	-0.147	2.025
589.5	50	32	0	-0.066	2
589.8	50	31	-0.0025	-0.09	2.91
590	50	31	0	-0.141	1.975
590.3	47	30	0	-0.138	2.075

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
590.8	51	33	0	-0.12	2.09
591.2	50	33	0	-0.126	2.035
591.8	51	35	0	-0.12	2.065
592	53	38	-0.0025	-0.108	2.01
592.8	48	35	0	-0.135	2.06
593.2	53	40	0.005	-0.111	1.985
593.8	50	39.5	0	-0.096	2.015
594	52	39	0	-0.111	2.005
594.5	50	35	0	-0.15	2.1
595	49	33	0	-0.114	2.125
595.2	48	32	0	-0.129	2.11
595.7	50	32	0	-0.12	2.15
596	49	33	-0.0025	-0.135	2.095
596.3	52	32	0	0.447	2.115
597	52	31	0	-0.111	2.09
597.5	57	32	0.005	-0.117	2.12
598	59	32	0.015	-0.135	2.1
598.5	48	26	0.015	-0.15	2.135
599	50	27	0.085	-0.126	2
599.5	49	26	0.09	0.429	2.165
600	49	26	0.055	-0.111	2.035
600.5	47	27	0.065	-0.12	2.05
601	35	20	0.005	0.42	2.115
601.2	32	19	0	0.387	2.12
601.8	30	20	0	0.42	2.085
602.3	29	23	0	0.399	2.07
603	38	30	0.0025	0.417	2.035
603.5	51	40	0.05	-0.135	2.94
604	50	40	0.045	-0.126	2.2
604.5	51	40	0.005	0.42	2.195
605	43	36	0	0.411	2.25
605.8	49	40	0	-0.141	2.2
606.5	50.5	40.5	0.01	0.432	2.13
607	48	39	0.05	-0.135	2.135
607.5	44	37	0.04	0.447	2.11
608	40	34	0.01	-0.12	2.14

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
608.7	41	34	0.015	-0.141	2.05
609	40	33	0.01	-0.15	2.065
609.5	44	37	0.01	-0.141	2.92
610	47	39	0.065	0.447	2.07
610.2	44	37	0.08	-0.135	2.05
610.5	46	39	0.07	-0.114	2.93
611	43	37	0.05	-0.093	2.005
611.3	45	39	0.03	-0.15	2
611.8	41	36	0.03	-0.144	1.99
612	45	40	0.05	0.447	2.05
612.5	48	37	0.06	-0.135	2.825
613	43	32	0.1	0.42	1.95
613.2	45	33	0.105	0.432	1.99
613.5	43	32	0.08	-0.135	2.015
614	45	33	0.05	-0.129	2.86
614.7	40	31	0	0.417	2.155
615.2	49	35	0.01	-0.15	2.12
615.7	45	32	0.03	0.408	2.13
616.2	44	32	0.085	-0.141	2.815
616.8	47	34	0.105	0.447	2.065
617.2	43	32	0.0975	-0.12	2.865
618	46	34	0.1	-0.138	1.985
618.2	49	37	0.075	-0.141	1.975
618.8	43	33	0.1	0.435	2.055
619	42	32	0.115	-0.147	2.035
619.5	38	29	0.05	0.435	2.1
620	39	30	0.005	0.393	2.105
621	43	33	0.055	-0.123	1.995
621.5	49	37	0.05	0.414	2.15
622.2	46	36	0.065	0.369	2.175
622.8	47	37	0.005	-0.135	2.545
623.5	47	38	0.06	-0.126	2.915
623.8	45	38	0.05	-0.117	2.08
624	43	38	0.065	-0.12	2
624.5	42	37	0.05	-0.135	2.845
624.8	43	37	0.0525	-0.09	2.915

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
625.2	46	37	0	-0.15	2.07
626	35	30	-0.0025	-0.102	1.985
626.5	33	26	0	0.444	2.04
627	40	30	0.005	0.411	2.045
627.5	43	30	0.055	0.447	2.105
627.8	47	34	0.1	0.429	2.085
628	48	34	0.165	0.426	2.095
628.5	45	33	0.125	-0.138	2
629	40	30	0.09	0.411	2.15
629.8	45	36	0.115	-0.117	2.095
630.5	39	33	0.025	0.36	2.19
631	34	32	0.005	0.351	2.17
631.5	43	36	0.1	0.411	2.05
631.8	47	39	0.15	0.45	2.055
632	46	38	0.135	-0.138	1.985
632.8	45	37	0.055	0.39	2.215
633.2	49	38	0.045	0.429	2.895
633.5	50	38	0.085	0.414	2.025
634	25	21	0.1	0.447	2.25
635	27	22	0	0.231	2.565
636	47	37	0.12	0.441	2.155
636.2	48	37	0.1	0.447	2.185
636.8	47	37	0.05	0.438	2.01
637	44	33	0.04	0.45	2.065
637.2	48	36	0.03	-0.147	2.05
637.8	43	33	0.085	-0.117	2.13
638.5	45	34	0.075	-0.06	2.865
639	41	30	0.15	0.408	2.16
639.8	40	29	0.02	0.432	2.315
640.5	44	34	0.035	0.39	2.25
641	43	35	0.015	0.411	2.295
641.5	45	36	0.025	0.42	2.275
641.8	46	36	0.03	0.411	2.265
642.2	46	35	0.01	0.447	2.22
642.8	49	38	0.015	0.441	2.245
643.2	50	38	0.01	-0.147	2.2

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
643.8	50	40	0.005	0.435	2.175
644	45	36	0.02	0.417	2.23
644.8	40	32	0.025	0.447	2.19
646	25	23	-0.015	0.171	2.615
647	30	27	-0.005	0.192	2.55
647.5	40	33	-0.0025	0.162	2.6
648	48	41	-0.005	0.168	2.66
648.5	46	40	-0.0025	0.156	2.66
648.8	44	39	0	0.168	2.68
649	46	40	-0.0025	0.174	2.67
649.5	43	37	0	0.183	2.68
649.8	46	39	0	0.18	2.675
650.2	47	40	0	0.21	2.705
650.8	45	37	0	0.18	2.665
651.2	46	38	0.005	0.171	2.72
651.8	46	37	-0.0025	0.18	2.65
652	51	39	0	0.171	2.625
652.8	50	38	0.15	0.33	2.35
653	54	40	0.165	0.381	2.425
653.8	45	32	0.07	0.33	2.2
654	47	33	0.095	-0.057	2.62
654.5	49	33	0.15	0.276	2.505
655	50	33	0.24	0.321	2.635
655.2	53	37	0.2	0.33	2.495
655.8	51	35	0.14	0.27	2.65
656.5	63	44	0.06	0.24	2.685
657	61	43	0.12	0.273	2.615
657.2	58	41	0.12	0.276	2.665
657.8	63	47	0.1	0.288	2.57
658	62	47	0.155	0.282	2.615
658.2	60	46	0.135	0.279	2.565
658.5	56	42	0.15	0.3	2.585
658.8	51	39	0.165	0.339	2.525
659.5	55	40	0.08	0.297	2.615
660	57	41	0.135	0.3	2.565
660.2	55	40	0.15	0.27	2.635

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
660.8	51	37	0.115	0.267	2.575
661.5	62	43	0.155	0.342	2.63
661.8	56	40	0.125	0.3	2.57
662	55	39	0.15	0.258	2.655
662.8	60	40	0.1	0.279	2.665
663	63	40	0.05	0.285	2.645
663.8	64	40	0.005	0.24	2.7
664.2	63	39	0.03	0.21	2.665
664.8	63	39	0.01	0.192	2.75
665	60	36	0	0.198	2.76
665.5	60.5	37	0.025	0.189	2.715
666	51	31	0.11	0.246	2.65
666.3	42	29	0.1	0.195	2.6
666.8	54	39	0.05	0.213	2.705
667	53	36	0.085	0.201	2.605
667.8	54	38	0.105	0.231	2.725
668.5	49	38	0.05	0.234	2.625
669	50	38	0.09	0.204	2.705
669.5	54	41	0.085	0.249	2.68
670	49	37	0.065	0.21	2.67
670.2	48	35	0.02	0.204	2.71
671	55	43	0.05	0.234	2.625
672	50	40	0.215	0.303	2.415
672.8	51	40	0.125	0.261	2.64
673	53	40	0.1	0.258	2.63
673.2	51	38	0.1	0.252	2.655
673.8	52	39	0.075	0.273	2.555
674.5	53	39	0.03	0.234	2.665
675	52	37	0.05	0.24	2.61
675.2	50	34	0.065	0.228	2.655
675.8	48	32	0.05	0.24	2.63
676.2	46	32	0.065	0.273	2.58
677	40	29	0.1	0.246	2.71
677.5	48	32	0.1	0.27	2.61
678	39	22	0.045	0.195	2.745
678.2	37	22	0.07	0.21	2.765

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
679	53	39	0.015	0.24	2.685
679.3	51	38	0.01	0.231	2.685
680	48	35	0.05	0.261	2.665
680.2	47	34	0.075	0.267	2.68
680.5	40	30	0.065	0.183	2.7
680.8	42	32	0.08	0.21	2.71
681	53	39	0.09	0.258	2.675
681.5	50	37	0.065	0.24	2.65
682	44	32	0.06	0.234	2.765
682.5	45	32	0.1	0.168	2.7
683	50	35	0.15	0.231	2.645
683.2	50	36	0.115	0.264	2.665
684	48	33	0.05	0.261	2.555
684.8	35	25	0.005	0.111	2.67
685.2	38	26	0	0.114	2.655
686	35	25	0	0.06	2.715
686.5	33	26	0	0.054	2.75
687	37	28	-0.015	0.06	2.73
687.5	34	27	-0.01	0.087	2.74
688	32	25	-0.005	0.09	2.75
689	37	29	-0.005	0.144	2.7
689.8	33	26	-0.005	0.117	2.74
690.2	33	26	-0.005	0.15	2.695
690.8	36	27	-0.0025	0.111	2.76
691	35	26	0	0.12	2.75
691.7	35	26	0.005	0.117	2.785
692.2	32	25	0	0.171	2.705
692.8	37	29.5	0	0.168	2.735
693	38	30	-0.0025	0.174	2.705
693.8	37	31	-0.0025	0.141	2.73
694.2	35	32	-0.005	0.12	2.715
694.8	36	33	-0.005	0.135	2.71
695.2	33	30	-0.0025	0.114	2.715
695.8	34	32	0	0.114	2.755
696.2	37	33	-0.005	0.111	2.725
696.8	34	30	0	0.108	2.74

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
698	30	30	-0.015	0.147	2.66
698.5	33	31	0	0.18	2.67
699	40	35	0.05	0.279	2.555
699.5	47	39	0.075	0.315	2.635
700	54	42	0.05	0.297	2.655
701	52	42	0.0025	0.264	2.72
701.5	51	41	0.0025	0.273	2.71
702	60	42	0.005	0.261	2.75
703	63	44	0.005	0.27	2.7
703.5	54	40	0.015	0.261	2.75
703.8	54	40	0.02	0.267	2.77
704	60	43	0.015	0.243	2.735
704.5	58	40	0.01	0.246	2.72
704.9	60	41	0.015	0.249	2.71
705.2	63	42	0	0.243	2.71
705.8	60	41	-0.0025	0.258	2.7
706.2	62	42	0	0.216	2.69
706.8	60	42	0	0.234	2.72
707.2	59	41	0	0.207	2.725
708	60	43	0.005	0.21	2.7
708.8	53	40	0.01	0.234	2.755
709.2	55	40	0	0.246	2.715
710	50	36	0.025	0.201	2.765
710.8	60	43	0.01	0.267	2.73
711.5	57	42	0.015	0.231	2.685
712.2	60	45	0	0.261	2.715
712.8	62	46	0.0025	0.264	2.685
713	63	47	0.005	0.249	2.7
713.8	61	48	0.03	0.255	2.73
714.2	67	50	0.01	0.243	2.705
714.7	63	47	0.01	0.258	2.715
715	59	43	0.015	0.246	2.72
715.8	61	46	0	0.267	2.7
716	59.9	45	0.0025	0.273	2.68
716.5	61	47	0.02	0.261	2.715
717	56	43	0.04	0.27	2.72

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
717.5	53	41	0.025	0.261	2.7
718	60	44	0.01	0.291	2.705
718.5	54	42	0.015	0.249	2.7
719	57	44	0.005	0.27	2.715
719.5	60	46	0	0.255	2.7
720	57	44	0.005	0.297	2.665
720.5	52	40	0.015	0.249	2.72
721	56	43	0	0.258	2.685
721.5	60	46	0.005	0.243	2.705
722	47	43	0.01	0.255	2.72
722.5	60	45	0.005	0.24	2.75
723	58	43	0	0.225	2.745
723.8	60	43	-0.0025	0.237	2.72
724.2	53	39	0.01	0.216	2.74
725	55	40	0.005	0.231	2.74
725.2	60	43	0	0.225	2.715
726	57	42	0.02	0.255	2.69
726.5	51	40	0.025	0.243	2.74
727	55	41	0.02	0.27	2.745
727.5	62	46	0	0.258	2.715
728	60	47	0	0.24	2.715
728.8	52	42	0.005	0.264	2.69
729	50	42	0.02	0.27	2.705
730	57	47	0.015	0.243	2.665
730.5	60	50	0.01	0.273	2.68
731.5	52	44	0.04	0.231	2.745
732	59	46	0	0.24	2.715
732.2	57	44	-0.0025	0.267	2.725
733	50	37	0.01	0.219	2.78
734	55	43	0	0.237	2.73
734.5	60	45	-0.005	0.231	2.715
735	62	44	-0.005	0.252	2.72
735.5	60	43	-0.0025	0.228	2.71
736.2	50	38	0	0.213	2.75
736.8	56	41	0	0.255	2.775
737	55	40	0	0.237	2.76

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
737.2	53	39.5	0	0.24	2.765
738.2	58	40	-0.005	0.225	2.73
738.8	53	39.5	0	0.237	2.765
739	60	43	0	0.228	2.75
740	53	40	0	0.243	2.73
740.8	59	42	-0.005	0.246	2.745
741	60	44	-0.015	0.231	2.72
741.5	56	42	-0.015	0.234	2.75
742	60	44	-0.01	0.24	2.735
742.5	53	40	-0.015	0.237	2.725
743	60	43	-0.01	0.246	2.75
743.5	60	43	-0.005	0.24	2.71
744	62	45	-0.0025	0.24	2.685
744.5	60	43	0	0.225	2.71
745	59	41	0	0.231	2.715
745.8	67	47	0	0.237	2.705
746.2	63	46	-0.0025	0.225	2.7
746.8	64	49	-0.005	0.234	2.71
747	69	50	-0.005	0.228	2.7
747.5	69	51	-0.005	0.231	2.685
748	70	52	0	0.249	2.69
748.5	66	50	0.01	0.234	2.7
749	60	48	0.01	0.252	2.715
749.2	60	49	0.015	0.261	2.7
750	53	45	0.01	0.216	2.765
751	60	50	-0.005	0.246	2.745
752	61	50	0	0.267	2.725
752.5	65	52	0	0.276	2.715
753	57	44	0	0.291	2.725
753.5	52	42	0	0.24	2.74
754	59	45	0	0.258	2.73
754.5	55	42	0.01	0.231	2.765
755.2	54	40	-0.005	0.24	2.75
755.8	63	44	-0.015	0.234	2.72
756.2	63	43	-0.005	0.24	2.745
756.8	65	45	-0.005	0.249	2.735

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
757.2	62	44	-0.0025	0.234	2.735
757.8	59	43	-0.005	0.24	2.745
758	62	45	-0.005	0.255	2.735
758.2	63	46	0	0.258	2.745
758.8	52	40	0.025	0.234	2.7
759	54	41	0.04	0.249	2.695
759.7	57	43	0.01	0.228	2.725
760	56	42	0.02	0.255	2.65
760.8	43	32	0.045	0.231	2.675
761	45	33	0.035	0.234	2.665
762	41	31	0	0.126	2.785
762.5	48	35	0	0.12	2.77
763	50	40	0.01	0.195	2.75
763.5	60	45	0.015	0.243	2.695
763.8	56	44	0.005	0.24	2.7
764.5	45	37	0	0.165	2.76
765.5	60	46	-0.015	0.219	2.7
766	57	43	0	0.195	2.675
766.5	50	40	0.015	0.216	2.7
767	55	42	0.095	0.192	2.66
768	63	45	0	0.258	2.73
768.5	60	44	0	0.24	2.69
769	60	43	0	0.234	2.725
769.5	61	43	-0.0025	0.231	2.73
769.8	54	40	-0.01	0.21	2.75
770	60	43	-0.01	0.198	2.73
770.5	56	42	-0.0025	0.228	2.75
771	53	40	-0.005	0.21	2.745
771.8	70	53	-0.005	0.216	2.735
772	58	47	0.015	0.231	2.67
772.5	49	41	0.02	0.219	2.72
773	50	40	0	0.195	2.755
773.5	53	41	0	0.24	2.725
774	58	43	-0.0025	0.258	2.735
774.8	53	40	-0.005	0.213	2.715
775	52	39	0	0.21	2.725

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
775.8	60	42	0.015	0.24	2.65
776	57	40	0.035	0.249	2.695
776.8	43	31	0.005	0.201	2.76
777	42	30	0	0.21	2.75
777.5	50	39	-0.005	0.198	2.725
777.8	50	40	-0.0025	0.189	2.75
778	50	40	0	0.21	2.76
778.7	67	47	0	0.243	2.725
779	64	45	-0.005	0.24	2.74
779.2	64	46	-0.01	0.246	2.745
779.8	67	48	-0.015	0.228	2.725
780	72	51	-0.01	0.231	2.715
780.5	67	48	0	0.213	2.73
781	68	49	0.07	0.255	2.65
781.5	69	50	0.05	0.27	2.7
782.3	38	27	0.01	0.144	2.77
783	53	43	0.025	0.21	2.7
783.3	50	40	0.02	0.198	2.725
783.8	51	41	0.015	0.24	2.74
784	48	40	0.005	0.243	2.75
784.5	41	35	0.005	0.21	2.805
785	50	42	0	0.18	2.72
785.5	50	43	0.03	0.21	2.72
786	60	48	0.03	0.246	2.685
786.5	57	45	0.02	0.3	2.67
787	59	46	0.05	0.279	2.61
787.8	52	40	0	0.264	2.745
788	54	40	-0.0025	0.264	2.7
788.5	53	39	0.02	0.27	2.615
789	57	41	0.035	0.234	2.71
789.2	57	40	0.03	0.24	2.695
790	49	35	0.06	0.216	2.75
790.5	66	44	0	0.255	2.725
791.2	65	43	0.015	0.228	2.69
791.8	52	40	0.025	0.243	2.675
792.2	47	33	0.005	0.201	2.75

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
792.8	56	39	0	0.204	2.735
793	55	39.5	0.0025	0.198	2.74
793.2	54	40	0.005	0.192	2.73
793.8	57	43	0	0.189	2.745
794	57	43	0	0.183	2.74
794.2	58	43	0	0.18	2.75
794.8	59	44	0	0.192	2.745
795	55	43	-0.005	0.213	2.76
795.8	60	44	0	0.201	2.775
796	54	42	-0.005	0.189	2.73
796.8	56	43	0	0.198	2.765
797.2	61	43	0.0025	0.207	2.73
798	60	42	0	0.201	2.745
798.8	53	36	0	0.213	2.765
799	53	36	0	0.201	2.78
799.5	59	40	0	0.192	2.775
800	52	35	-0.0025	0.189	2.76
800.5	55	37	0	0.171	2.795
801	56	39	0.005	0.156	2.775
801.8	61	43	-0.005	0.18	2.765
802	58	40	-0.0025	0.183	2.78
802.8	59	40	0	0.168	2.775
803	55	38	0	0.171	2.8
803.2	59	41	0	0.171	2.805
804	49	35	0.035	0.147	2.775
804.2	51	37	0.065	0.18	2.705
805	48	35	-0.005	0.111	2.87
805.8	47	35	0	0.135	2.765
806	50	38	0.01	0.15	2.765
807	59	45	0.085	0.228	2.61
807.2	58	44	0.115	0.207	2.615
807.5	55	43	0.105	0.246	2.545
808.5	50	41	0.02	0.171	2.775
809	58	48	0.05	0.18	2.75
809.2	56	47	0.055	0.204	2.685
809.8	63	50	0.055	0.198	2.73

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
810	59	47	0.03	0.213	2.72
810.5	62	50	0.075	0.204	2.765
811	60	48	0.15	0.267	2.605
811.5	57	45	0.1	0.255	2.715
811.8	53	43	0.05	0.24	2.695
812.2	50	41	0	0.204	2.785
812.8	53	42	-0.005	0.204	2.775
813	54	43	0	0.195	2.79
813.8	63	50	0.05	0.234	2.615
814	63	49	0.09	0.225	2.69
814.2	61	47	0.07	0.225	2.69
814.8	62	47	0.105	0.228	2.655
815.2	63	48	0.05	0.195	2.765
815.5	60	47	0.015	0.195	2.75
815.8	57	44	0.015	0.18	2.76
816.2	63	49	0.095	0.24	2.61
816.8	61	49	0.14	0.24	2.65
817	60	48	0.13	0.264	2.56
817.5	50	42	0.115	0.213	2.72
818	58	47	0.15	0.237	2.615
818.5	50	42	0.175	0.159	2.765
818.8	57	44	0.105	0.18	2.685
819	58	45	0.12	0.21	2.78
819.5	54	43	0.1	0.189	2.695
820	60	45	0.13	0.198	2.7
820.5	50	36	0.14	0.18	2.62
821	57	40	0.09	0.204	2.745
821.5	53	38	0.065	0.21	2.7
821.8	54	40	0.095	0.201	2.745
822	60	42	0.085	0.195	2.72
822.2	57	40	0.1	0.1785	2.755
822.8	60	41	0.115	0.207	2.735
823.5	55	39	0.015	0.18	2.785
823.9	58	40	0.005	0.171	2.775
824.2	47	33	0	0.153	2.8
825	60	41	0	0.18	2.765

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
825.2	51	35	0	0.198	2.785
826	55	40	0.025	0.195	2.75
826.5	61	44	0.015	0.192	2.735
827.5	53	40	0.0175	0.225	2.8
828	54	40	0.005	0.18	2.765
828.5	60	43	0	0.18	2.76
829	61	44	0	0.171	2.755
829.5	54	40	-0.005	0.177	2.795
830	50	37	0	0.165	2.765
830.5	54	40	0.11	0.204	2.71
831	60	41	0.075	0.201	2.795
831.5	61	44	0.02	0.189	2.765
831.8	59	43	0.025	0.177	2.75
832	61	44	0.015	0.219	2.705
833	59	43	0	0.201	2.755
833.5	55	41	0.1	0.24	2.69
833.9	57	42	0.125	0.27	2.755
834	56	42	0.025	0.291	2.635
834.8	53	40	0.03	0.231	2.715
835	54	41	0.015	0.216	2.665
835.5	56	43	0.03	0.222	2.75
835.8	51	39	0.025	0.219	2.79
836	55	40	0.005	0.21	2.71
836.7	61	47	0.025	0.24	2.715
837	56	46	0.025	0.246	2.685
837.2	59	48	0.005	0.258	2.7
837.8	55	46	0	0.234	2.735
838	61	50	0	0.249	2.72
838.5	56	45	0.015	0.21	2.75
839	44	34	0	0.144	2.715
839.5	51	40	0.025	0.21	2.72
839.8	52	40	0.04	0.24	2.725
840	53	40	0.025	0.246	2.715
840.5	59	43	0.0025	0.246	2.735
841	58	41	0.01	0.231	2.715
841.5	56	40	0.005	0.249	2.71

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
842	55	40	0.005	0.237	2.76
842.2	60	45	0.0025	0.252	2.73
843	54	40	0.005	0.21	2.72
843.5	59	42	0.005	0.189	2.715
844	51	38	0	0.204	2.755
844.2	59	43	0.05	0.201	2.72
844.8	58	42	0.105	0.27	2.75
845	52	40	0.07	0.3	2.635
846	49	39.5	0	0.237	2.775
846.7	56	44	0.015	0.27	2.695
847	63	47	0	0.267	2.71
847.5	60	46	-0.005	0.24	2.73
848	61	46	0	0.216	2.725
848.5	60	45	0.005	0.219	2.72
849.2	50	37	0	0.168	2.785
850	56	32	-0.0025	0.21	2.735
850.5	58	32	-0.005	0.198	2.75
851	55	30	-0.01	0.228	2.745
851.5	54	32	-0.0025	0.24	2.78
852	60	36	-0.0025	0.225	2.735
852.5	62	38	-0.005	0.222	2.74
853.2	57	33	0	0.201	2.73
853.8	60	34	0.01	0.222	2.75
854.2	50	35	0.015	0.186	2.775
854.8	53	37	0.015	0.195	2.75
855	54	37	0	0.177	2.76
855.5	60	40	0	0.24	2.685
856	62	42	0	0.252	2.73
856.2	60	41	-0.0025	0.264	2.725
857	63	43	-0.005	0.24	2.75
857.5	62	42	-0.0025	0.21	2.75
857.8	63	44	0	0.207	2.725
858.2	61	42	-0.005	0.18	2.73
858.8	65	46	-0.005	0.21	2.72
859	60	40	-0.0025	0.201	2.73
859.5	50	30	-0.005	0.171	2.725

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
859.9	51	31	0	0.198	2.74
860.1	49	29	-0.005	0.198	2.74
860.5	54	31	-0.005	0.204	2.75
861	50	30	0	0.198	2.795
861.8	72	49	0	0.21	2.7
862.2	69	48	0	0.225	2.75
862.5	71	49	-0.005	0.231	2.745
863	70	49.5	-0.0025	0.222	2.75
863.2	71	50	-0.0025	0.237	2.755
863.5	70	49	0	0.24	2.76
864	71	50	-0.005	0.24	2.735
864.5	68	49	-0.01	0.231	2.74
865.2	74	52	0	0.222	2.72
865.9	69	50	0.055	0.219	2.755
866.2	72	53	0.02	0.231	2.675
867	66	50	-0.005	0.231	2.75
868	63	48	0	0.216	2.735
869	52	37	0.005	0.111	2.75
869.7	57	40	0	0.147	2.78
870	54	39	0	0.129	2.755
870.5	60	40	0	0.18	2.77
871	60	40	0	0.207	2.75
871.5	61	40.5	0	0.204	2.725
872	59	41	-0.005	0.24	2.74
872.5	58	41	-0.005	0.261	2.72
873	60	42	0	0.24	2.725
873.2	62	45	0	0.246	2.705
874.5	52	40	0.015	0.2085	2.77
875	57	42	0.03	0.228	2.715
875.5	58	44	0	0.207	2.7
876	57	43	0	0.255	2.715
876.5	63	49	-0.0025	0.222	2.695
877	51	43	-0.0025	0.24	2.765
877.2	54	46	0	0.249	2.75
877.8	53	45	0.015	0.24	2.7
878	56	48	0.015	0.228	2.74

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
878.7	53	45	0.005	0.243	2.695
879.5	61	49	0	0.228	2.725
880	60	46	0	0.222	2.745
880.5	64	41	0	0.237	2.69
881	60	44	0.005	0.222	2.705
881.5	62	45	0.005	0.234	2.71
882	60	44	0.01	0.231	2.675
882.9	52	39	0	0.27	2.725
883.2	60	43	0	0.243	2.68
883.7	56	40	0	0.24	2.72
884	57	40.5	-0.005	0.27	2.715
884.8	48	31	0	0.234	2.775
885.2	54	36	0.015	0.237	2.705
885.8	56	37	0.02	0.252	2.73
886	60	40	0.01	0.249	2.71
886.5	55	38	0.01	0.267	2.735
887	65	43	0.015	0.24	2.645
887.5	57	37	0.035	0.222	2.67
888	60	40	0.01	0.27	2.685
888.5	64	43	0.03	0.282	2.655
889	68	46	0.07	0.255	2.67
889.8	62	41	0.075	0.3	2.705
890	61	40	0.025	0.27	2.61
890.5	66	43	0.035	0.3	2.7
891	70	46	0.01	0.291	2.69
891.2	67	43	0.035	0.279	2.65
891.8	70	46	0.045	0.27	2.69
892	70	46	0.015	0.291	2.675
892.5	75	48	0.015	0.279	2.67
892.8	76	50	0.01	0.285	2.675
893.5	81	48	0.01	0.252	2.665
894	70	40	0.08	0.261	2.7
894.5	74	42	0.165	0.255	2.725
895	78	42	0.06	0.306	2.54
895.8	75	36	0.045	0.27	2.635
896	74	35	0.05	0.246	2.7

Table A.1 SGR, CGR, DRHO, NPHI and RHOB of A-1 Well (Continued)

Depth (m)	SGR (GAPI)	CGR (GAPI)	DRHO (g/c3)	NPHI (v/v)	RHOB (g/c3)
896.5	75	31	0.01	0.258	2.735
897	74	27	0.01	0.261	2.665
897.5	76	22	0.03	0.186	2.7
898	76	17	0.02	0.171	2.715
898.7	76	10	0.065	0.168	2.785
899	76	8	0.035	0.177	2.75
899.5	76	5	0.045	0.171	2.65
900	76	0	0.025	0.18	2.81
900.7	76	97	0.01	0.159	2.78
901.5	76	96	0.015	0.18	2.74
902	76	96	0.035	0.18	2.7
902.2	76	96	0.065	0.18	2.735
902.5	76	96	0.05	0.18	2.72
903	76	96	0.035	0.18	2.75
903.5	76	96	0	0.18	2.72
904.2	76	96	0.1	0.18	2.695
904.8	76	96	0.14	0.18	2.7
905.5	-	96	0.135	0.18	2.67
906	-	-	0.15	0.183	2.69
906.5	-	-	0.15	0.183	2.7
907	-	-	0.15	0.183	2.69
907.5	-	-	0.16	0.183	2.7
908	-	-	0.165	0.183	2.715

Table A.2 GR and DT of A-1 Well

depth (m)	GR (GAPI)	DT (us/f)
292.1	24	57
292.5	24	60.5
293.2	20	73.5
293.8	22	73
294.2	22	64
294.4	21	65.5
294.9	2	60.5
295.1	18	64.5
295.8	20	72
296	24	68.5
296.7	24	72.5
297	22	65
297.1	21	60.5
297.5	20	65
298	20	64
298.7	20	55.5
299.2	21	56.5
299.4	20	50
299.5	20	150
299.7	19	50
300.8	29	147.5
301.7	24	96.5
302.2	25	130
303	26	122.5
303.7	24	129
304.1	25	119.5
304.8	23	124
305.2	24	117.5
306.1	29	131
307	32	130.5
307.3	30	131
308	31	133
309	30	124.5
309.7	30	126
310	26	130
310.3	29	121.5
311.5	20	68.5

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
312.1	27	106.5
312.8	26	117.5
312.9	27	114.5
313.5	28	126.5
314.9	18	62.5
316	37	92.5
316.5	42	89
317	34	97.5
317.8	25	93
319	35	131
319.5	30	114
320	30	119
320.4	28	114
321	33	125
321.5	33	127.5
322	31	142.5
322.8	32	136
323	31	150
323.1	31	50
323.5	32	55
324	33	63.5
324.5	35	62.5
325	36	50
325.1	35	150
325.5	32	145
326	31	140
326.5	32	132
327	33	140
327.9	32	120.5
328.5	32	124
328.9	31	124.5
329.1	31	123
329.4	33	123.5
330	32	122.5
330.7	32	134
331	30	132.5
331.7	33	146

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
332.5	30	123
333	35	132.5
333.8	31	117.5
334.2	30	123.5
334.5	30	125
335.1	36	150
335.2	38	50
335.5	33	53.5
335.7	32	50
335.8	33	150
336.2	34	138
336.5	30	138.5
336.7	30	138
337	31	140
337.6	29	150
337.8	27	50.5
338	28	150
338.3	34	143.5
338.7	29	150
338.8	41	50.5
339	40	150
339.2	37	149
339.3	36	150
339.4	40	50
340	40	55.5
340.9	32	62.5
341	31	50
341.1	32	150
341.9	31	140
342.3	34	149.5
342.8	30	143.5
343.3	30	140
344.2	32	139
344.8	35	150
344.9	34	50
345	32	150
345.5	30	140

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
346	30	144
346.8	29	133.5
347.5	30	123.5
348.8	30	143.5
349.5	35	137.5
350	40	135
350.5	40	122.5
351.1	31	136.5
351.8	34	125
352.2	30	136
353.1	31	130
353.8	29	135
354.8	28	117.5
355.1	33	122.5
355.6	33	122
356	37	127.5
357	34	118
357.9	35	136
358.1	38	134
358.5	33	136.5
359.9	31	126.5
360.5	29	119
361.5	30	135
362.2	39	131.5
362.8	37	125.5
363.5	30	130
364	29	132
364.5	31	118.5
365.1	31	136
365.8	25	115
366	27	150
366.1	27	50
366.3	26	72
366.5	24	68
367	30	65
367.7	19	94.5
368	23	93.5

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
368.3	25	94
368.6	22	93.5
368.7	20	94
369.5	28	77.5
370.6	24	54
370.9	23	55.5
371	22	52.5
371.2	25	54.5
371.4	26	50
371.5	27	150
372	29	108.5
372.6	28	145
373.2	29	126
373.9	23	143.5
374.6	27	127.5
375.3	30	113.5
375.7	31	118.5
376	30	119.5
376.3	29	120.5
377.1	36	139.5
377.6	30	129
378	34	123
378.8	33	132.5
379.1	33	120.5
379.9	35	134
380.2	37	138.5
381.5	31	122.5
382	29	145
382.8	37	126
383.2	34	133
383.7	30	130
384	29	107.5
384.7	30	143
385	30	120
385.6	31	125
386	30	144
386.5	32	131

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
386.9	34	132.5
387	35	130.5
387.5	33	136
387.9	34	134.5
388.5	33	142
389	30	138
389.3	38	139.5
389.8	30	140
390	29	139.5
390.6	30	147
391	32	144
391.2	32	145
391.3	31	150
391.4	30	50
392.2	24	72.5
393.5	34	51
394	32	55
394.5	35	54.5
395	31	53
395.1	31	54
395.4	30	50
396	28	59
396.3	31	50
396.5	32	150
396.8	31	149
397	30	150
397.2	30	148.5
397.3	31	150
397.5	30	50
398	31	53
398.5	28	54
398.9	27	53.5
399.2	31	70.5
399.6	30	50
399.7	30	150
400	29	145
400.1	29	50

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
400.4	28	59.5
401	30	55
401.2	30	53.5
401.5	31	55
401.6	30	50
401.7	30	150
402.1	24	135
402.2	23	150
402.3	24	50
402.8	25	77
403	24	50
403.1	24	150
403.5	28	136
404	30	146.5
404.1	29	145.5
404.2	28	150
404.3	27	50
404.5	27	55
404.9	29	52
405.1	31	61.5
405.3	32	50
405.4	33	150
405.9	39	142
406.2	37	148
407	34	141
407.2	32	140
408	32	128
408.3	33	125
409.1	35	140.5
410	31	125
410.3	35	122.5
410.9	31	125.5
411.7	30	118.5
412.1	34	125.5
412.7	37	125
413	37	126.5
413.7	32	119

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
414.1	33	124
415	34	115
416.2	29	118.5
416.7	30	117.5
417	29	118.5
418	29	97.5
418.8	33	115
419.5	30	98.5
420.1	34	115.5
420.8	35	112
421.1	32	115.5
421.6	30	113.5
422.1	29	118.5
422.9	25	95
423.3	30	110
423.9	36	109.5
424.8	38	120.5
425	40	120
425.5	35	120
426	33	121
426.7	37	120
427	33	118.5
427.3	38	114.5
428	34	119
428.8	35	118
429.2	34	120
430	35	120
430.3	34	122.5
431	33	119
431.2	32	120
432	32	115
432.3	35	116.5
432.9	34	114
433.3	31	123
433.9	30	118
434.2	29	124.5
435	30	114

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
435.7	30	118.5
436.8	35	118
437.2	35	135.5
438.1	28	118.5
439	30	122.5
439.2	33	125
439.5	33	126
440	32	129.5
440.4	31	134
441	30	121
441.8	35	126
442.5	33	138.5
443	30	133
444	28	143
444.1	29	150
444.2	29	50
444.3	28	150
445.1	32	115
445.8	30	134
446	32	134.5
447	31	118.5
447.2	29	117.5
447.9	32	130.5
448	31	129.5
448.5	30	137.5
449.4	30	118.5
450	30	141
450.9	35	130.5
451.1	33	131.5
451.8	29	128.5
452.1	30	139
452.7	35	126.5
453	31	133.5
453.8	30	145.5
454.1	27	125
454.5	28	125
454.8	30	125

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
455.5	31	135
457	30	121
457.8	33	125.5
458.6	28	107.5
459.1	27	127.5
459.8	28	121
460	30	120
460.4	28	114
461	30	130
461.5	31	115
462	33	121
462.5	30	118
463	32	118.5
463.8	33	105.5
464.9	27	126
465.2	25	120
466.1	20	83
466.9	29	112.5
467.2	28	102.5
468	22	100
469	25	90.5
470	32	135.5
470.9	31	120.5
471.2	30	127
471.9	32	139.5
473.3	31	124.5
473.7	32	125
474.3	30	112.5
475.3	32	132.5
476	32	120
476.4	29	113.5
477.1	44	72
477.7	45	69.5
478.8	31	141
479.1	31	123.5
479.7	34	134
480	35	124

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
480.5	31	150
481.2	34	130.5
481.7	32	150
481.75	31	50
481.8	30	55.5
482	26	50
482.5	25	150
482.9	19	81.5
483.5	38	125
483.8	40	130
484.2	38	130
484.8	37	128.5
485	40	130
485.9	30	85.5
486.7	37	122
487	36	121
487.7	39	122.5
488.6	41	118.5
489	38	119
490	45	75
490.5	30	67.5
491	28	68.5
492.2	47	60.5
493	40	64.5
493.9	26	60.5
494.1	21	63.5
494.8	22	61
495	20	63.5
495.8	22	63
496.1	40	65
496.8	46	70
497.3	42	64
498	42	70
498.9	40	75
499.2	38	77
499.9	40	81.5
500.3	40	71

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
500.9	40	70.5
501	40	70
501.2	42	69
502	39	69.5
503	40	65
503.6	34	69
504	35	65
504.9	23	66
505.6	24	63.5
506	27	65
506.5	23	60
506.7	22	61
507.1	21	61
507.7	23	64.5
508.7	25	60.5
509	26	62
509.7	27	60.5
510	23	61
510.2	22	63
511	30	65
511.8	40	75.5
512.5	45	63.5
513	46	65
514	50	74
515	50	70.5
515.3	50	74
516.1	40	67
516.8	40	67
517	39	68
517.4	43	68.5
518.8	42	80
519.5	40	97.5
520.1	40	95
521	41	101.5
521.5	45	99.5
522	40	106
522.8	39	106.5

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
523.9	40	93.5
524.8	39	76.5
525.2	21	-429.5
526	24	79
526.5	21	78
526.9	23	78.5
528	41	68
528.1	40	70
528.8	22	66
529	21	72.5
530	20	76.5
531	16	70.5
532	20	72.5
532.5	22	69
533	22	73.5
533.2	30	73
535	37	120
535.5	38	117.5
536	35	128.5
536.5	36	116
537	37	116
537.8	37	122.5
538	37	116
538.5	40	115.5
539	40	110
539.8	39	105
540.9	34	120
541.2	32	117
541.9	38	122.5
542.5	36	111
543	36	122.5
543.7	31	136.5
544	32	133
544.2	33	140
544.9	31	111.5
545.1	30	113
545.5	30	112

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
546.5	32	116
547	33	119
547.3	30	120
548	31	116
548.9	30	129
549.5	38	119.5
550	35	125
550.2	31	116
550.8	33	123
551	30	120.5
552	30	130
552.2	32	128.5
552.8	30	135
553.5	30	140.5
554	29	136
554.8	30	141
555.2	28	133.5
555.9	30	139.5
556	27	139
556.4	30	142
557	35	144.5
557.2	36	144
557.7	37	147
558.1	37	140
558.9	35	144.5
559.5	37	140.5
560	38	148.5
560.5	34	143
560.9	31	145
561.5	30	130
562	32	149
562.5	30	135
563	33	144.5
563.5	34	127.5
564.5	30	147
565	32	118
565.2	40	116

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
566	32	119.5
566.1	31	118.5
566.8	36	119.5
567	38	120
567.3	35	120
567.8	34	124.5
568.2	37	113.5
569	30	145.5
569.5	29	127
570	28	146.5
570.4	26	141.5
571	33	144
571.2	35	142.5
572	32	150
572.2	33	50.5
572.4	35	150
572.8	40	145.5
573.3	33	148
573.8	35	150
574	31	150
574.4	30	146.5
574.8	30	150
575	30	50.5
575.2	34	150
575.8	30	148.5
576	30	149
577	35	147.5
577.3	32	150
578	35	50.5
578.7	39	50
579	32	57
579.4	37	50
579.5	39	150
580	36	145
580.2	33	150
580.3	33	50
581	36	54.5

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
581.3	40	50
581.4	40	150
582	43	143.5
582.9	31	140.5
583.3	33	144
583.8	35	143.5
584	40	147
585	37	140
585.4	26	135
586	33	140
586.5	32	145
587	31	146.5
587.3	33	148.5
588	34	144.5
588.1	35	145
589	33	145
589.5	36	148.5
590	34	146
590.5	35	147.5
590.9	31	146.5
591.2	33	147
591.8	38	144.5
592	38	145
592.3	37	145.5
593	32	150
593.6	38	146
594	37	145
595	34	140.5
595.2	40	140
595.4	39	139
596.2	42	139
596.9	39	143
597.8	43	139
598	40	139
598.2	31	137.5
599	35	150
599.5	33	140

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	GR (GAPI)	DT (us/f)
600	33	141.5
600.3	33	144.5
601.3	20	130
601.8	15	131
602	18	131
603	30	135
603.7	35	144.5
604	37	140
604.3	35	137
605	30	130
606	32	135
607	32	141
607.2	30	146.5
608	30	138.5
608.4	26	143.5
609	30	138.5
609.5	28	143.5
610	30	135.5
611	31	141.5
611.3	30	140.5
612	29	143.5
612.1	29	150
612.2	29	50
612.9	28	69
613.1	28	55
613.8	28	61
614	28	50
614.1	28	150
614.8	28	132.5
615.1	28	145
615.8	28	143.5
616.4	28	150
616.9	28	148
617		150
617.1		50
617.2		150
618		127

Table A.2 GR and DT of A-1 Well (Continued)

depth (m)	**GR (GAPI)**	**DT (us/f)**
618.4		139
619		130
619.2		135
619.5		137.5
620		137.5

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
268.0	34	64	-
268.2	33	58	-
268.8	32	57	-
269.0	38	57	-
270.0	30	58	-
270.5	35	65	-
271.0	32	58	-
271.5	37	57	-
272.0	35	58	-
272.5	31	57	-
273.0	40	59	-
273.5	29	56	-
273.9	34	66	-
274.0	36	47	-
274.2	34	62	-
274.5	31	68	-
274.8	33	57	-
275.0	32	57	136
275.5	33	57	135
275.8	32	68	82
276.0	35	69	97
276.2	30	59	95
276.5	29.5	67	98
276.7	29	75	74
277.0	33	63	70
277.7	30	57	80
278.0	34	58	73
278.2	33	68	82
278.5	36	70	70
278.8	34	73	71
279.0	35	57	73
279.5	30	65	60
279.8	33	58	50
280.0	33	57	64
280.8	31	59	90
281	34	70	80
281.2	30.5	67	61

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
281.5	35	78	54
282	30	95	63
282.2	31	97	77
282.5	30	80	73
282.8	30.5	73	133
283	30	100	127
283.5	33	140	90
284	30	140	110
284.5	34	140	117
284.8	33	140	101
284.9	34	140	93
285	30	140	140
285.8	35	140	63
286	34	140	65
286.5	37	126	40
286.8	39	128	130
287	38	116	122
287.5	35	140	135
287.8	38	96	119
288.2	30	103	106
288.4	30	76	60
288.5	29	83	40
288.8	33	71	43
289	33	81	45
289.5	38	65	73
289.7	35	65	40
289.8	34	65	65
290	35	58	57
290.8	30	57	73
291	33	57	64
291.2	31	57	58
291.7	33	57	93
292	34	57	91
292.5	33	56.5	92
292.8	35	57	82
293	31	57	81
294	38	96	64

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
294.2	36	95	57
294.5	35	107	100
295	36	97	90
295.2	37	97	98
295.5	33	96	95
295.6	32	140	90
295.8	35	43	82
296.2	34	92	73
296.5	34	84	40
296.6	33	83	70
296.8	33	46	40
297	34	52	119
297.2	37	136	68
297.8	30	43	134
298	35	68	60
298.5	29	65	107
299	33	91	110
299.2	32	98	72
299.3	32	93	80
300	31	123	123
300.2	39	65	140
300.5	43	70	45
300.6	45	67	110
300.8	44	78	100
301	43	130	90
301.7	35	99	106
302	40	117	130
302.3	37	127	127
302.8	42	123	123
303	40	120	120
303.5	41	121	121
304	40	118	118
304.2	38	117	117
304.6	40	125	122
305	35	115	115
305.3	40	106	107
306	40	131	130

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
306.2	45	127	127
306.8	53	137	135
307.5	43	42	68
308.2	50	136	125
308.3	50	88	130
308.8	45	115	113
309.5	40	125	125
309.8	39	122	135
310	40	119	54
310.5	37	87	130
311	35	57	106
311.5	37	80	61
312	36	43	118
312.3	35	112	119
312.7	40	112	121
312.8	44	111	117
313	42	126	60
313.7	40	103	50
313.8	37	113	44
314.2	29	69	59
314.7	30	90	130
314.9	42	84	120
315	42	89	90
315.2	41	79	56
315.5	45	92	85
315.8	52	102	95
316	50	95	40
316.3	52	101	50
316.8	47	118	84
317.2	36	127	115
317.5	39	107	107
317.8	36	122	125
318	40	116	113
318.5	41	122	133
319	44	104	130
319.2	43	70	115
319.5	44	65	50

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
320.2	41	130	108
320.7	44	123	121
321	47	126	113
321.2	48	117	120
321.5	50	130	130
321.8	45	109	133
321.9	44	120	137
322	41	117	140
322.2	42	130	49
322.8	44	56	59
323	50	53	53
323.3	47	56	50
323.7	52	55	55
324	50	69	69
324.5	51	60	60
325	46	130	43
325.5	50	40	131
326	52	137	139
326.5	44	131	130
326.8	50	40	40
327.5	43	120	111
328	42	115	120
328.4	46	129	125
328.8	42	126	126
329.2	47	128	123
329.5	46	130	127
329.8	44	129	126
330.2	42	130	130
330.7	45	41	41
331.2	41	43	43
331.7	50	137	139
332	47	128	129
332.2	42	130	123
332.5	46	129	129
333.2	41	117	117
333.8	44	123	123
334	43	120	120

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
334.5	49	139	139
335	45	55	57
335.5	51	50	50
336	47	137	137
336.2	49	140	140
336.8	46	44	44
337.5	43	47	47
338	44	40	40
338.5	50	56	56
339	54	48	48
339.3	49	55	49
339.6	52	60	55
340	46	69	60
340.2	44	63	57
340.8	46	51	46
341	45	40	137
341.5	47	47	40
341.8	46	42	138
342	50	54	131
342.8	50	51	43
343	47	59	44
343.3	43	50	40
343.9	47	129	130
344.2	45	135	135
344.3	44	139	132
345	48	65	45
345.5	47	44	138
345.8	46	40	140
346.2	43	130	126
346.8	50	124	134
347	43	120	120
347.5	47	130	130
347.8	41	133	130
348.2	46	40	140
348.8	43	131	131
349	46	135	135
349.8	47	119	124

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
350	42	124	127
350.5	48	121	121
351	40	131	131
351.2	43	124	124
351.5	44	126	126
351.7	42	124	124
352	49	137	140
353	40	126	129
353.5	47	134	137
354	46	122	122
354.5	43	118	119
355	45	123	122
355.3	43	120	121
356	51	125	125
356.5	45	45	120
357	48	90	90
357.2	45	100	100
357.5	48	116	116
357.9	49	125	125
358	50	120	127
358.2	46	130	129
358.5	50	126	138
359	45	130	133
359.2	43	124	130
359.5	42	46	127
360	45	125	123
360.2	43	103	130
360.7	47	125	122
360.9	46	115	127
361	47	119	129
361.5	45	130	44
361.8	47	136	40
362	45	134	43
362.3	45	132	133
362.7	42	129	129
363	47	130	132
363.5	44	133	130

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
364	40	120	123
365	45	129	129
365.8	50	120	121
366	45	130	127
366.5	45	126	126
366.8	41	130	130
367	45	129	131
367.8	44	140	140
368.2	47	134	133
369	50	51	43
369.8	46	137	137
370	47	127	127
370.5	43	41	41
371.2	46	120	120
371.7	41	107	107
372.3	45	140	140
372.8	46	127	130
373	43	133	139
373.3	50	130	130
373.8	50	135	135
373.9	49	131	131
374	43	138	138
375	39	113	113
375.7	42	121	120
375.8	43	119	125
376	45	120	125
376.5	43	130	130
377	50	138	139
377.5	42	126	126
378	47	120	120
378.3	50	131	138
379	40	117	124
379.8	49	138	138
380.2	53	135	139
380.5	50	137	140
381	45	124	124
381.8	48	136	140

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
382	45	129	136
382.2	45	131	131
382.5	46	125	127
383	44	130	130
383.2	47	131	131
383.9	42	109	110
384.2	50	135	135
385	46	117	117
385.8	42	131	131
386	45	128	128
386.5	50	125	122
386.8	44	130	130
387	43	136	111
387.5	41	134	132
388	46	42	42
388.5	43	138	138
388.8	44	137	137
389.2	50	45	42
390	40	137	138
390.2	43	46	46
390.5	45	44	44
390.8	44	47	45
391	43	46	43
391.5	39	46	45
392	44	67	63
392.5	40	60	60
393	39.5	51	51
393.5	44	57	53
394	40	56	55
394.5	39.5	57	52
395	43	57	57
395.2	39	45	80
395.8	40	56	90
396	40	55	85
396.5	40	50	60
396.6	43	54	48
397	41	128	45

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
397.5	43	50	50
397.8	41	60	60
398	40	54	140
398.1	41	55	135
398.2	40	56	140
398.5	40	59	136
398.9	37	65	137
399.1	43	55	132
399.3	43	70	122
399.5	40	66	60
399.8	42	70	63
400	41	45	45
400.5	44	43	40
400.8	46	50	62
401	49	60	55
401.2	44	60	58
401.5	40	50	50
402	39	140	131
402.5	45	60	59
403	35	40	40
403.5	42	130	130
404	40	51	50
404.5	45	60	60
404.9	44	70	70
405	46	59	65
405.2	45	60	60
405.8	50	50	50
406	50	53	50
406.5	54	50	43
407	42	140	140
407.2	43	140	135
407.5	47	130	130
407.8	50	123	136
408	49	130	130
408.5	43	128	130
409	49	140	140
409.1	50	138	138

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
409.2	50	140	130
409.7	46	135	127
410	42	124	124
410.2	41	122	122
410.5	50	127	127
410.7	50	124	124
410.8	50	126	126
411.3	40	114	114
411.8	45	114	118
412	43	123	120
412.5	48	129	125
412.8	44	130	128
413	44	125	125
413.5	40	117	117
414	50	128	128
414.2	47	129	129
414.9	47.5	117	117
415.2	38	97	97
416	40	119	119
416.5	45	112	112
417	43	117	117
417.5	39	100	100
418	40	93	93
418.2	43	110	110
418.5	40	113	118
419	46	103	107
419.8	42	113	113
420	46	115	120
420.2	48	114	116
420.7	44	110	110
421	48	118	114
421.5	43	112	112
422	40	119	119
422.2	43	100	100
422.8	37	92	92
423	38	111	111
423.3	44	108	108

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
423.5	45	110	101
424	40	106	105
424.5	44	120	120
425	51	117	117
426	47	120	120
426.5	44	128	121
426.9	46	120	120
427	45	115	115
427.7	48	121	121
428	40	120	120
428.5	50	118	118
429	42	120	120
429.5	45	119	119
430.2	49	122	123
430.8	45	120	120
431	47	119	119
431.5	41	121	121
431.6	40	118	118
432	45	121	121
432.2	46	120	123
432.8	44	120	121
432.9	48	117	120
433	50	120	121
433.2	48	121	132
433.5	43	130	130
433.7	42	126	126
434	45	131	131
435	41	119	118
435.1	40	120	121
435.2	40	119	120.5
435.5	37	120	121
436	40	116	120
436.1	41	119	126
436.3	40	117	117
436.9	49	130	130
437	50	138	138
437.5	40	130	130

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
438	44	120	120
438.5	45	121	121
439	41	127	127
439.2	42	130	130
439.5	48	127	127
440	42	132	132
440.2	45	133	133
441	43	122	122
441.5	45	127	128
441.8	43	126	130
442	41	139	138
442.8	43	130	133
442.9	42	131	136
443	45	131	130
443.5	41	50	41
444	43	50	53
444.5	40	130	130
445	44	116	116
445.5	43	130	130
446	45	140	140
446.2	40	138	138
446.8	47	42	137
447	46	137	137
447.5	48	130	130
448	45	138	135
448.2	47	137	136
448.8	40	121	121
449.2	44	118	118
449.7	43	130	130
450	46	45	45
450.1	43	135	135
450.5	45	130	131
450.9	44	135	135
451	44	126	129
451.5	45	121	121
451.9	43	128	128
452	50	135	135

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
452.5	43	122	122
453.2	46	140	140
453.8	42	46	44
454	48	140	140
455	41	116	116
455.5	46	131	130
456	47	122	122
456.8	43	115	114
457	46	116	115
457.5	45	122	122
458	48	115	115
458.5	40	106	100
459	48	129	125
459.5	41	117	117
459.8	40	115	112
460	37	110	110
461	50	125	125
461.1	45	116	122
461.2	44	122	112
461.5	46	115	100
462	45	122	122
462.2	45	115	120
462.5	44	121	120
463	50	107	110
463.5	45	117	140
464	49	105	140
464.3	43	120	120
464.7	45	134	134
465	43	127	127
466	33	80	80
466.5	40	110	44
467	45	103	103
467.2	40	105	100
467.8	38	102	105
468	36	98	98
468.5	35	92	92
469	30	88	88

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
470	48	133	137
470.5	44	118	118
471	48	127	122
471.2	49	116	116
471.8	43	132	130
472.2	40	122	122
472.8	48	130	130
473	50	120	120
473.5	43	128	128
474	45	120	110
474.2	41	140	109
474.3	43	110	110
474.5	40	120	120
475	49	137	137
475.5	43	125	118
476	49	133	125
476.2	47	120	118
476.5	43	100	100
477.2	58	71	75
477.5	60	63	69
478	50	110	110
478.5	45	140	133
479	47	122	117
479.5	46	132	135
480	50	120	120
480.2	46	126	130
480.5	45	139	135
481	50	131	130
481.1	50	135	130
481.2	51	130	130
481.7	48	138	135
482.2	35	70	70
482.5	30	61	110
482.8	28	80	121
483	30	100	117
483.7	47	131	129
484	46	133	130

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
484.2	49	130	130
485	48	135	135
485.5	40	100	58
485.8	38	88	109
486	46	100	111
486.5	46	125	121
486.8	47	120	119
487	44	127	127
487.3	50	128	128
487.8	47	128	119
488	51	120	120
488.2	47	118	120
488.8	50	122	122
489	48	120	120
489.5	55	90	90
490	54	68	68
490.5	36	69	62
491	49	67	67
491.2	48	64	60
492	58	60	60
493	55	65	65
493.5	40	60	60
494	33	62	62
494.5	35	60	60
495	30	63	63
496	36	64	64
496.3	55	65	65
496.5	51	67	67
497	55	63	63
497.5	50	62	62
498	50	69	69
498.1	55	69	69
498.5	49.5	71	71
499	53	76	76
499.8	49	80	80
500.1	58	70	70
501	50	69	68

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
501.2	55	68	68
502	50	67	67
502.2	57	67	67
502.9	50	65	64
503	53	65	65
503.5	43	69	67
504	47	64	64
504.8	41	70	70
505	32	67	67
505.5	34	63	63
506	36	67	64
506.5	31	60	60
507	39	62	62
507.5	30	67	67
508	32	62	62
508.8	35	60	40
509	34	60	131
509.2	33	62	134
509.7	34	61	120
510	34	60	60
510.2	35	62	46
510.8	31	67	57
511.5	60	74	78
511.8	59	100	70
512.2	54	95	61
512.5	53	110	62
512.9	51	75	70
513	57	83	67
513.2	60	81	63
513.7	55	82	70
514	60	70	140
514.5	70	72	72
515	65	74	70
515.1	66	77	73
515.8	64	65	67
516	59	66	66
516.5	56	64	69

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
516.7	55	62	62
516.9	53	63	75
517	58	71	69
517.8	54	72	80
517.9	55	72	78
518	54	72	83
518.5	55	71	80
519	53	80	90
519.2	60	96	113
519.9	51	98	99
520	50	97	101
520.1	49	94	97
520.5	51	90	108
520.8	52	98	100
521	50	98	109
521.5	55	105	110
521.8	50	104	117
522.1	55	107	120
522.5	50	105	115
522.7	49	106	106
522.9	50	102	110
523.2	46	97	105
524	43	80	80
524.5	48	78	78
524.7	50	77	77
525.2	30	69	74
525.8	33	80	80
526	31	78	77
526.1	32	78	78
526.8	28	80	80
527.2	37	72	72
527.8	50	69	69
528	49	71	71
528.5	40	66	66
529	36	72	72
529.2	38	73	73
530	33	78	78

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
530.5	27	73	73
531	30	70	72
531.5	26	70	69
532	28	74	74
532.5	36	70	65
532.8	34	66	66
533.2	40	73	73
533.9	53	80	80
534.2	50	100	100
534.8	55	117	117
535	51	118	118
535.5	49	123	120
536	50	130	130
536.5	45	117	117
536.8	44	119	119
537	48	120	120
537.5	45	122	122
537.8	50	121	121
538	47	117	117
538.2	45	119	119
538.8	45	110	112
539	50	109	110
539.5	45	108	108
539.8	44	105	105
540.2	48	114	117
541	48	120	120
541.3	49	120	119
541.7	50	125	125
542	44	120	120
542.5	53	106	107
543	50	120	120
543.2	51	130	127
543.5	48	129	127
544	50	139	133
544.8	45	41	138
545.2	50	133	133
545.8	51	43	40

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
546	47	45	41
546.8	57	53	53
547	46	50	50
547.5	49	130	130
547.9	45	123	120
548	48	123	118
548.5	43	129	129
549.5	51	47	41
549.8	50	55	51
550.2	47	41	41
550.5	50	48	42
550.8	47	40	40
551	50	138	138
551.8	40	135	136
552	40	138	137
552.5	50	45	136
552.9	44	40	131
553	43	41	41
553.3	47	45	45
554	47	52	52
554.5	43	47	47
555	50	131	131
555.3	41	41	41
555.8	44	43	43
556	43	44	44
556.2	45	42	42
556.5	47	45	45
557	48	47	47
557.2	52	44	46
557.8	50	46	46
558	52	41	41
558.5	55	45	45
559	48	44	44
559.5	50	40	40
560	45	44	44
560.5	45	40	40
560.6	50	45	45

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
561	43	140	140
561.5	47	135	136
561.8	45	40	40
562	50	137	137
562.5	49	140	140
563.2	50	129	129
564	44	135	135
564.5	49	127	129
564.8	44	120	120
565	48	116	119
565.5	43	120	120
566	47	119	119
567	47	120	120
567.1	45	123	123
567.5	42	119	119
568	51	118	118
569	48	130	130
569.3	51	129	129
569.5	50	131	131
570	44	129	129
571	50	47	47
571.5	46	50	51
572	51	51	51
572.7	44	45	45
573.3	48	51	51
573.7	44	50	50
574	49	50	50
574.5	40	49	49
575	50	50	50
575.8	44	51	51
575.9	46	50	50
576.2	42	49	49
576.7	49	50	50
577	45	48	48
578	50	52	52
578.5	51	49	49
579	54	54	54

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
579.3	52	49	49
579.5	53	49	48
580	45	50	50
580.5	48	55	54
581	49	52	52
581.5	53	46	46
582.2	49	46	46
582.9	43	44	44
583.2	52	48	47
583.8	50	45	45
584.1	57	49	49
585.1	44	138	138
586	45	45	45
587	44	50	50
588	50	47	47
589	47	50	50
589.2	43	51	51
590	53	48	48
590.5	44	51	51
591	50	49	49
591.5	45	47	47
592	52	50	50
592.5	43	48	48
593	49	52	52
593.5	50	47	47
594.1	51	45	45
594.8	43	41	41
595.1	52	42	42
595.5	50	44	44
596	53	41	41
596.5	50	44	44
596.7	51	41	41
597	50	45	45
597.5	56	41	41
598	51	43	43
598.2	50	138	138
598.7	49	44	44

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
598.9	50	47	47
599.1	45	40	40
599.7	50	42	42
600	48	41	41
600.2	50	43	43
601	40	137	137
601.2	32	131	131
602	30	133	133
602.7	31	139	139
603.7	49	48	48
604	47	41	41
604.2	49	41	41
604.7	50	139	139
605	40	132	132
605.9	46	139	139
606.3	50	41	41
607	42	45	45
607.2	43	46	46
608	40	40	40
608.2	41	44	44
608.5	38	46	46
609	41	41	41
609.5	41	46	46
610	40	40	40
610.2	43	138	138
610.8	38	139	139
611	40	43	43
611.2	43	40	40
611.9	46	42	42
612	43	41	41
612.5	50	47	48
613	42	44	44
613.8	46	52	52
614	42	57	52
614.5	43	137	137
615	44	43	43
615.5	43	48	40

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
615.9	48	50	41
616	44	41	41
616.1	46	47	47
616.2	43	40	40
616.4	44	44	44
616.7	40	129	129
617	48	41	41
617.5	41	59	53
618	44	139	139
618.7	45	131	119
619	40	133	130
619.5	40	41	41
619.8	40	130	135
619.9	36	133	133
620	35	129	124
620.5	36	130	128
621	44	137	133
621.5	42	132	130
621.7	41	126	125
622	43	130	130
622.5	44	117	120
623	41	140	140
623.2	46	45	45
623.7	42	41	41
624	43	139	139
624.3	42	137	137
625	45	42	42
625.5	42	40	40
625.9	39	43	43
626	40	41	41
626.3	38	136	136
627	35	138	138
627.5	40	140	140
627.8	50	137	137
628	44	48	48
629	39	132	132
629.7	42	131	131

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
629.8	43	135	135
630	42	133	133
630.1	43	136	136
630.5	34	134	138
631	37	130	130
631.4	37	127	127
631.8	40	130	130
632	41	128	131
632.1	43	130	130
632.5	44	135	133
633	49	125	125
633.5	46	110	110
634	40	98	98
634.2	30	97	80
635	25	55	48
635.2	30	122	70
635.3	30	110	80
635.7	34	123	85
636	45	110	100
636.5	50	128	120
636.7	50	124	124
637	48	139	126
637.5	43	140	131
637.9	45	130	118
638	43	125	130
638.2	40	137	90
638.3	42	132	103
638.5	43	140	100
639.2	40	121	116
639.5	41	120	115
640	40	130	130
640.2	45	128	128
640.5	40	130	124
641	43	127	124
641.2	42	129	129
641.9	40	45	120
642	42	42	130

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
642.2	44	120	117
642.5	45	133	120
643	48	120	120
643.1	49	129	129
643.5	48	130	127
643.8	48	124	122
644	50	130	124
644.5	45	139	131
645	46	73	59
645.3	24	80	70
646	25	61	61
646.5	25	70	68
646.8	23	70	66
647	25	73	65
647.5	30	65	65
647.8	40	67	73
648	46	65	65
648.2	49	62	62
648.5	46	60	60
649	48	59	59
649.1	47	58	57
650	40	59	59
650.2	47	57	57
650.8	41	62	62
651	44	59	59
651.2	45	58	54
651.8	46	116	55
652	46	140	140
652.1	45	100	56
652.3	43	64	140
652.5	42	72	72
652.9	52	85	85
653.1	52	81	81
653.2	53	88	77
653.7	52	87	85
654	50	80	80
654.2	45	67	67

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
654.5	50	73	110
654.9	51	40	121
655	52	120	80
655.2	53	80	84
655.7	49	85	85
656.2	53	68	65
656.5	60	75	67
656.7	65	66	67
656.8	67	70	70
657	63	75	75
657.2	64	71	71
657.8	60	77	77
658	60	67	67
658.5	54	75	74
658.9	60	70	68
659	61	76	76
659.1	60	72	72
659.5	54	88	88
660	52	70	70
660.5	55	75	75
660.7	50	70	70
660.8	49	72	72
661	45	68	68
661.7	61	82	82
662	53	71	71
662.5	53	74	81
662.9	54	77	74
663.2	60	72	72
663.5	63	74	74
663.8	64	73	74
664	62	72	72
664.2	60	70	70
664.8	63	73	73
665	59	70	70
665.5	63	71	80
665.6	60	71	71
666	54	77	77

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
666.1	54	67	68
666.2	50	73	69
666.4	42	69	66
666.7	45	73	74
667	50	77	73
667.1	55	70	70
667.5	60	76	68
667.7	59	71	71
667.9	58	76	76
668	60	75	75
668.5	55	76	74
669	42	70	70
669.1	50	79	75
669.8	54	80	83
670.5	46	70	62
671	55	71	71
671.2	50	73	70
671.7	54	66	66
672	49	75	75
672.1	50	70	70
672.5	45	71	71
673	50	79	79
673.2	55	80	80
673.8	53	75	75
674.2	55	73	73
674.8	50	68	68
675	52	75	72
675.5	50	69	71
676	46	72	72
676.5	49	70	70
676.9	49	69	65
677	43	65	67
677.5	50	77	77
677.8	40	70	69
678	38	67	67
678.9	45	73	73
679	50	70	70

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
679.3	47	73	73
679.7	50	81	81
679.9	49	75	75
680	46	80	80
680.2	50	76	73
680.8	39	70	67
681.3	55	74	77
681.9	43	71	71
682	42	69	69
682.2	43	70	70
682.5	40	66	66
683	51	69	69
683.2	50	77	77
683.9	48	72	72
684	50	73	73
685	35	59	59
685.2	32	61	61
685.5	34	60	60
686	31	55	55
687	34	57	57
687.5	30	58	58
687.8	33	57	57
688	31	56	56
688.5	34	57	57
688.6	33	58	58
689	36	60	60
690	31	57	57
690.2	30	58	58
691	33	56	56
691.5	27	57	57
692	30	56	56
692.5	28	55	55
693	35	60	60
693.5	28	58	58
694	33	58	58
694.5	30	57	57
695	33	58	58

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
695.8	32	58	58
696	34	57	57
696.5	32	55	55
696.9	34	56	56
697	32	57	57
697.5	37	55	55
698	32	60	60
698.5	30	59	59
699	33	70	70
699.8	50	80	80
700.2	56	73	73
701	50	68	68
701.5	54	70	70
702	51	63	63
702.2	59	65	65
702.8	55	68	68
703	59	68	68
703.2	53	67	67
703.9	55	62	62
704.2	60	67	67
704.8	59	65	65
705	63	65	65
705.5	61	66	66
706.1	56	66	66
706.8	62	63	63
707	58	60	60
707.5	60	64	64
708	52	65	65
708.2	56	62	62
709	54	65	65
709.5	55	65	65
710	49	57	57
710.5	60	65	65
711	62	66	66
711.5	55	62	62
711.9	61	64	64
712	60	65	65

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
712.5	63	63	63
713	60	65	65
713.5	54	64	64
714	62	66	66
714.5	69	65	65
715	63	64	64
715.5	64	64	64
716	60	68	68
716.2	57	63	63
716.8	53	65	65
717	56	70	70
717.2	54	68	68
717.8	56	67	67
718.2	53	63	63
718.5	52	64	64
719	60	63	63
719.2	54	67	67
719.8	59	70	70
720	54	72	72
720.2	54	70	70
720.8	50	67	67
721	61	68	68
721.5	57	68	68
722	60	67	67
722.5	53	63	63
723	60	66	66
723.5	54	67	67
723.6	53	66	66
723.8	57	67	67
724.5	50	61	61
725	60	65	65
725.5	59	67	67
725.8	60	68	68
726.2	53	69	69
727	60	66	66
727.5	55	70	70
727.8	56	68	68

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
728.5	57	70	70
728.6	54	70	70
729	56	65	65
729.2	50	65	65
730	60	69	69
730.5	56	70	70
730.8	53	71	71
731.2	58	70	70
731.7	53	66	66
732	53	70	70
732.2	56	73	73
733	52	73	73
733.5	50	62	62
734	52	70	70
735	60	75	75
735.5	55	69	69
735.8	59	70	70
736	54	71	71
736.5	49	67	67
737	56	71	71
737.5	52	70	70
738	52	74	74
738.5	55	70	70
739	52	70	70
739.2	57	72	72
740	52	71	71
741	60	70	70
741.5	59	69	69
742	63	70	70
742.5	53	68	68
743	58	71	71
743.5	55	71	71
744	63	70	70
744.5	56	70	70
744.8	59	68	68
745	54	68	68
745.5	60	70	70

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
746	70	67	67
746.8	60	69	69
747	67	68	68
747.8	64	70	70
748	70	69	69
748.5	63	70	70
749	61	70.5	70.5
749.5	60	71	71
750	50	57	57
750.5	56	63	63
751	55	67	67
751.2	60	69	69
751.8	55	70	70
752	60	68	68
752.5	63	70	70
753	59	69	69
753.8	50	66	66
754.1	59	68	68
754.5	50	67	67
755	59	68	68
755.2	53	68	68
756	63	67	67
756.5	60	65	65
757	70	68	68
757.5	55	66	66
758	60	69	69
758.3	57	68	73
758.5	59	67	67
759	50	69	69
759.5	55	64	64
760	58	67	67
760.5	49	68	70
761	42	59	59
761.5	45	58	58
762	41	52	52
762.2	43	51	51
762.8	42	53	78

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
763.8	57	70	88
764.5	43	55	133
764.8	40	53	53
765.2	50	60	60
765.7	53	70	90
766	58	63	96
766.1	57	69	90
766.3	54	67	80
766.5	54	68	92
766.7	50	80	80
767	48	69	80
767.1	50	72	72
767.8	62	69	69
768	55	70	70
768.5	60	75	74
768.8	66	68	80
769	59	80	82
769.5	60	68	65
770	53	65	75
770.8	59	65	65
771	43	61	61
772	66	69	69
773	49	62	62
773.5	54	61	61
774	51	62	62
774.2	53	65	65
775	49	62	62
776	63	70	70
777	42	59	59
777.5	47	63	63
778	43	60	60
778.8	64	70	70
779	63	69	69
779.5	68	70	70
780	66	68	68
780.1	73	69	69
780.8	66	71	71

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
781	71	69	69
781.5	60	72	72
782.5	38	58	57
783	50	62	62
783.2	47	66	66
783.8	50	63	63
784	52	70	70
784.5	40	60	58
785	45	64	63
785.5	50	61	61
786	62	68	68
786.3	56	69	69
786.8	60	68	68
787	52	72	72
787.5	57	65	65
788	53	60	60
788.5	50	68	68
789	58	62	62
789.2	50	65	65
789.7	55	65	65
790	52	60	60
791	60	69	69
791.5	62	70	70
792	50	60	60
792.8	58	65	65
793	55	65	65
793.2	56	64	64
793.8	56	64	64
794	56	64	64
794.5	60	65	65
794.8	59	66	66
795	60	65	65
795.3	54	64	64
795.9	61	66	66
796.1	60	66	66
796.9	57	63	63
797	54	65	65

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
797.8	60	68	68
798	59	68	68
798.2	61	67	67
799	50	62	62
799.9	59	66	66
800	57	67	67
800.2	60	63	63
801	50	51	51
801.7	60	64	64
802	56	66	66
802.2	60	68	68
802.9	54	67	67
803	59	67	67
803.5	55	65	65
804	50	62	66
804.5	55	60	60
805	47	54	54
805.5	50	50	50
805.8	43	51	51
806	49	49	49
807	59	61	61
807.2	58	68	68
807.5	57	59	59
807.8	55	65	65
807.9	53	60	60
808	51	63	63
808.2	52	60	60
808.5	50	55	55
808.8	51	58	140
809	49	80	112
809.1	50	56	110
809.7	60	60	60
810	59	61	61
810.2	65	57	57
810.9	59	61	61
811	60	58	57
811.8	52	60	138

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
812	50	57	110
812.5	52	90	57
813	53	57	57
813.5	50	60	60
813.8	60	57	57
814.2	57	68	68
814.5	60	67	67
814.7	58	66	66
815	61	70	70
815.2	60	102	70
816	54	63	60
816.5	65	70	70
816.8	60	65	65
816.8	58	70	70
817	54	63	63
817.5	55	62	62
817.9	50	60	89
818	47	57	60
818.2	54	61	59
818.8	50	56	56
819.5	60	71	70
819.9	51	69	69
820.1	59	62	62
820.5	55	67	80
820.8	50	65	93
821.2	54	67	67
821.5	50	65	65
822	59	61	59
822.1	60	60	60
822.5	55	61	61
822.8	50	60	60
823	63	60	60
823.5	59	65	65
824.2	49	59	59
825	60	60	60
826	50	61	61
826.2	49	63	63

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
826.9	60	64	64
827	58	60	60
827.5	55	64	64
828	60	60	60
828.5	56	62	62
829	60	64	64
829.5	57	60	60
830	50	57	57
830.5	51	65	65
831	55	62	62
831.2	57	67	67
831.8	61	64	64
832.1	50	64	64
832.5	58	68	68
832.9	55	64	64
833.1	56	65	62
833.3	61	64	64
833.7	60	63.5	63.5
834	55	57	57
834.5	57	65	65
834.7	54	67	67
835	54	69	69
835.8	55	63	63
835.9	51	60	60
836	49	65	65
836.5	57	67	67
837	52	65	65
837.5	60	64	64
837.9	57	65	65
838	59	64	64
838.5	50	60	60
838.8	55	56	56
839	47	55	55
839.5	48	60	60
840	56	60	63
840.5	58	61	61
840.7	57	62	62

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
841	60	62	62
841.2	63	62	62
841.9	53	60	60
842	57	59	59
842.5	55	66	99
843	60	55	55
843.2	59	51	50
843.5	57	55	55
843.7	60	59	59
844.2	52	64	107
844.5	60	63	63
845	52	60	60
845.1	55	59	59
845.5	52	130	60
845.8	50	63	63
846	52	62	62
846.2	50	61	61
846.7	53	66	66
847	65	68	109
847.5	59	66	66
848	61	67	63
848.2	59	65	65
848.8	63	64	64
848.9	60	65	65
849.5	47	58	58
850	60	65	65
850.5	51	61	61
851	60	63	63
851.5	52	60	60
852	60	64	64
852.5	56	64	64
852.8	64	63	63
853	60	61	61
853.5	53	62	62
853.8	56	63	63
854	47	59	59
854.5	48	60	60

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
855	53	61	61
855.3	51	67	67
855.9	63	64	64
856	60	63	63
856.5	62	63	63
856.9	58	64	64
857	63	63	63
857.2	61	63	63
857.7	53	63	63
858	63	65	65
858.2	60	63	63
859	62	61	61
859.1	58	64	64
859.5	50	62	62
859.8	45	61	61
860	45	59	59
860.3	40	60	60
860.9	50	59	59
861.1	45	60	60
861.8	55	68	68
862.1	66	63	63
863	64	65	65
863.5	71	63	63
863.8	76	63	63
864.5	75	63	63
864.8	60	63	63
865	65	64	64
865.5	66	67	67
866	60	62	62
867	73	66	66
868	55	63	63
868.5	61	60	60
869	56	57	57
869.5	50	55	55
870	57	58	58
870.2	50	57	57
871	60	63	63

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
871.5	52	64	64
871.8	59	66	64
872	54	66	66
872.3	55	65	65
872.7	54	66	66
873	60	66.5	66.5
873.7	50	67	67
874	48	63	63
874.2	51	59	59
874.9	45	62	62
875	50	60	60
875.2	49	66	66
875.8	54	63	63
876	54	67	67
876.2	52	66	66
876.5	59	67	67
877	44	63	63
877.8	53	68	68
878	48	70	70
878.5	47	67	67
878.9	47	70	70
879	50	69	69
879.8	43	72	72
880	42	70	70
880.5	53	71	71
881	47	69	69
881.5	44	72	72
882	46	73	73
883	43	70	70
883.2	43	71	71
884.2	43	60	60
885	43	60	60
885.5	43	65	65
885.8	43	63	63
886	43	65	65
886.5	43	60	60
887	43	70	70

Table A.3 GR, DTLN, and DTLF of A-1 Well Main log 1:200 (Continued)

depth (m)	GR (GAPI)	DTLN (us/f)	DTLF (us/f)
887.7	43	57	57
888	43	67	67
889	43	56.5	56.5
889.6	43	63	63
890	43	60	60
891	43	65	67
891.5	43	57	57
892	43	64	65
893	43	62	65
894	43	60	60
894.7	43	72	72
895	43	69	69
896	43	68	68
897	43	68	68
898	43	68	68
899	43	68	68
900	43	68	68
901	43	68	68
902	43	68	68
903	43	68	68
904	43	68	68

BIOGRAPHY

Miss Nanthana Yodlee was born on the 25th of May 1987 in Thatum District, Surin Province. In 2005, she studied for her Bachelors degree at School of Geotechnology, Institute of Engineering, Suranaree University of Technology, Nakhon Ratchasima Province. After graduating, she continued to study for Masters degree in Petroleum Technology at the School of Geotechnology, Institute of Engineering, Suranaree University of Technology.