SEDIMENTOLOGY AND POTENTIAL COAL RESOURCES IN SUSUI BLOCK, PINANGAH, SABAH

DAULIP DD LAKKUI

FACULTY OF SCIENCE AND NATURAL RESOURCES

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I hereby declare that the material in this dissertation is my own except for quotations, excerpts, equations, summaries and references, which have been duly acknowledged.

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Daulip DD Lakkui

PS 20108216

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NAME : **DAULIP DD LAKKUI**

MATRIC NO. : **PS 20108216**

TITLE : **SEDIMENTOLOGY AND POTENTIAL COAL RESOURCES IN SUSUI BLOCK, PINANGAH, SABAH**

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CERTIFIED BY

SUPERVISOR
Professor Dr. Felix Tongkul

Signature

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ABSTRACT

The Susui Block in Pinangah area located northwest of the greater Maliau Basin in central Sabah is underlain by the coal-bearing Tanjong Formation of Early-Middle Miocene age. This study was conducted to determine the sedimentary characteristic of the coal bearing sequence, the quality of the coal and the coal resources in the area. The methods employed included geological field investigation and laboratory analyses. The field survey comprises mapping of coal outcrops and studying core samples recovered from portable Winkie Drill machine. Laboratory analyses comprises mainly of proximate and ultimate analyses, as well as organic geochemistry analyses (pyrolisis) and petrographic analysis for maceral identification.

The coal bearing sequence comprised of four main facies namely a) Coal Facies, b) Carbonaceous Mudstone Facies, c) Mudstone Facies and d) Heterolithic Siltstone Facies. The sedimentary structures found within the Mudstone Facies and Heterolitic Siltstone Facies such as parallel lamination, cross lamination and bimodal lamination indicate a protected mid-flat tidal environment of deposition whereas the Coal Facies and Carbonaceous Facies were deposited in a lagoon environment. The sulphur content of the coal is more than 0.5 % indicating sea water intrusion. The atomic ratio for Hydrogen and Oxygen plotted onto the Van Krevelen's diagram showed that the coal is made up of immature to mature organic matters deposited in a swamp or lagoon environments. Petrographic analysis conducted for maceral identification categorized the coal as humic of Clarite Microlithotype (vitrinite + liptinite> 95 %) derived from humification process of terrestrial plant with minor association of planktonic algae probably from the aquatic environment.

Four coal seams were mapped in the area aligned in a semi-circular basin with dipping inclinations ranging from 12^{o} to vertical towards the centre of the area. The coal resource is estimated at 44.6 million tonnes of high volatile bituminous coal (hvbc), a premium quality for electricity generation. The study shows a good potential for coal mining development and the coal mining life could extend for at least 30 years operation, based on projection of 90,000 metric tonnes of monthly production.

ABSTRAK

SEDIMENTOLOGI DAN POTENSI SUMBER ARANG BATU DI BLOK SUSUI PINANGAH, SABAH

Kawasan kajian di Blok Susui Pinangah adalah terletak di bahagian barat-laut Lembangan Maliau dalam Formasi Tanjong yang berusia Awal hingga Tengah Miosen. Objektif kajian di kawasan jujukan arang batu ini adalah untuk menentukan ciri-ciri batuan sedimen di sekitaran pengendapan arang batu, kualiti serta jumlah rizab arang batu di kawasan ini. Metodologi kajian utama meliputi kajian singkapan arang batu termasuk teras gerudi Winkie dan analisa kimia. Analisa kimia meliputi proximate dan ultimate, kandungan kimia organik dan kajian petrografi kandungan maceral.

Jujukan arang batu di kawasan ini meliputi empat fasis utama iaitu a) Fasis Arang Batu, b) Fasis Batu Lumpur Berkarbon, c) Fasis Batu lumpur dan d) Fasis Selang-lapis Batu Pasir dan Batu Lumpur-berpasir. Struktur sedimen seperti laminasi selari, bersilang dan laminasi dua-arah pada batuan Fasis Batu Lumpur dan Fasis Selang-lapis menunjukkan batuan ini diendapkan di sekitaran pasang surut yang terlindung atau mid-flat, manaka endapan Fasis Arang Batu dan Fasis Batu Lumpur pada sekitaran laguna. Kandungan sulfur dalam arang batu melebihi 0.5 % menandakan wujud sebaran air laut. Nisbah kandungan atom Hidrogen dan Oksigen yang diplot pada diagram Van Krevelen menunjukkan karbon organik arang batu tergolong sebagai oraganik belum matang hingga matang dienapkan pada sekitaran tasik atau laguna. Analisa petrografi kandungan maceral menunjukkan arang batu di kawasan kajian terbentuk hasil pereputan flora daratan dan sedikit akuatik iaitu jenis Clarite Michrolithotype (vitrinite + liptinite > 95 %).

Sebanyak empat lipit arang batu telah dipetakan dengan corak sebaran separa bulat dengan miringan lapisan memusat berjulat 12^{o} *hingga tegak. Rizab arang batu di kawasan kajian dianggarkan 44.6 juta tan metrik dengan kualiti arang batu bituminos berperuapan tinggi (hvbc), merupakan kualiti utama untuk kegunaan janakuasa elektrik. Kajian ini menunjukkan kawasan Blok Susui Pinangah adalah berpotensi untuk pembangunan lombong arang batu yang mampu beroperasi lebih 30 tahun berdasarkan kapasiti pengeluaran bulanan sebanyak 90,000 metrik ton.*

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LIST OF ABBREVIATIONS

a.d	-	air dried
a.r	-	as received
ASTM	-	American Society for Testing Materials
BC	-	Bright coal
C.V	-	Calorific value
Cl	-	Coal
ClSh	-	Coaly shale
cm	-	Centimeter
E	-	East
F.C	-	fixed carbon
hvAb	-	high volatile A bituminous
hvBb	-	high volatile B bituminous
hvCb	-	high volatile C bituminous
m	-	meter
Mdst	-	Mudstone
N	-	North
NE	-	Northeast
NW	-	Northwest
S	-	South
SE	-	Southeast
Sh	-	Shale
ShCl	-	Shaly coal
Sst	-	Sandstone
SW	-	Southwest
W	-	West

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CHAPTER 1

INTRODUCTION

1.1 Background

The International Energy Outlook 2017 (IEO 2017) has projected the total world energy consumption rises from 575 quadrillion British thermal units (Btu) in 2015 to 736 quadrillion Btu in 2040, an increase of 28% particularly in developing countries including China and India due to strong and long-term economic growth that accelerate the increasing demand for energy. Much part of the energy demand derived from fossil fuel which oil and coal accounted for 77% of energy use throughout 2040.

Although the coal usage for electricity demand comparatively remains flat in developed countries, however in a developing countries the rise of coal for electricity remain high especially in India and southeast Asia which is projected to be at least 22% in 2040 (IEO2017). Asia is projected to double its energy consumption over the next 20 years where gas and coal are likely to show the greatest change with increases of 65 and 74 percent respectively.

Malaysia demand for coal primarily for electricity generation continue to increase as the present burning of 23 million metric tonnes coal annually to be increased to 37 million tonnes by 2020 as reported by Malaysia Corporate Business (2017). It is expected base on increased electricity demand from 33% now to 42% equivalent in 2020.

The coal procures from Indonesia (70%), Australia (19%), South Africa (12%) and Russia (2%). Tenaga Nasional Bhd (TNB), the sole coal importer for the power sector and supplier for the country's independent power producers, imported RM2.74 billion worth of coal in the first-half of 2013 (1H13) amid a stable period in supply and price, at US$74 (RM235.32) per tonne in July. Due to increasing demand of coal for power energy, the coal price is fluctuating especially when the coal producers intensify their policy as happened before where coal price double to nearly US$160/ tonnes in 2008. Any interruption in supply could affect the nation's economic growth.

In recent global coal price especially (2018) from Kalimantan and Australia, every tonnes of coal could price up to US$230 for coking coal and US$105 for thermal coal respectively generally with coal specification of Sulphur (0.8%), Moisture (8.0%), Ash (13.0%) and calorific value of 6,300 kcal/kg. The Sabah coal especially in Pinangah area has a better coal quality specification which could price up to US$135 and US$250 for thermal and coking coal respectively.

The coal resources in Malaysia is amounted to be at least 1,724 million tonnes (mt) mostly spread over (>95 %) in Sarawak and Sabah states of east Malaysia (JMG, 2013). The deposit varies in thickness, distribution and quality. As far as coal deposit is concerned, the geometry (thickness & extension) and quality are the most fundamental factors for future development consideration. The geometry and quality of the coal deposits are very much related to the depositional environment, and the source of organic matter.

The coal resources in Malaysia are all of Tertiary age and the quality ranges from lignite to anthracite, with bituminous coal being dominant. At present, coal mining are only available in Sarawak after the old Silimpopon coal mine in Tawau District ceased it operation in 1932 after 27 years in operation. The total extracted coal reserved was 1.5 mt and much of the coal are still remain, estimated to be at least 14 mt (Collenette, 1965). In 1999, a total of four Diamond Drill holes were sunk by the Geological Survey Department (Now JMG) to delineate the seam extension further to the south where three of the drilling holes had successfully hit the coal seam with increasing thickness, an opposed to the earlier interpretation of thinning seam. The drilling results had increased the resources at Silimpopon to almost double the early estimation by Collenette to 22.4 mt.