



Coal-bearing strata of Labuan: Mode of occurrences, organic petrographic characteristics and stratigraphic associations



Abdullah Wan Hasiah^{a,*}, Chai Peng Lee^b, Patrick Gou^a, Mustaffa Kamal Shuib^a, Tham Fatt Ng^a, Alsharif A. Albaghdady^c, Mohd Fazdly Mislan^a, Khairul Azlan Mustapha^a

^a Department of Geology, University of Malaya, 50603 Kuala Lumpur, Malaysia

^b 18, Jalan SS24/6, Taman Megah, 47301 Petaling Jaya, Malaysia

^c School of Geology & Geophysics, Graduate College, University of Oklahoma, United States

ARTICLE INFO

Article history:

Available online 17 June 2013

Keywords:

Labuan
Cenozoic coals
Vitrinite reflectance
Oil-prone mangrove coals
Hypautochthonous coal deposits

ABSTRACT

The current study describes the mode of occurrences of Labuan Cenozoic coals as observed in the field and identifies the coal macerals based on their organic petrographic characteristics as observed under reflected white light and blue light excitation. In this study some sedimentological aspects such as the depositional environment were correlated with the organic petrological characteristics of the coals. Based on the organic petrographic features and the thermal maturity as determined by vitrinite reflectance some new stratigraphic associations have been identified. Similarities in sedimentological and organic petrological characteristics suggest that the shaly strata associated with carbonaceous sandstones exposed on the north-western part of Labuan Island and the outcrop exposed in the south within the east Kiam Sam Peninsula belong to the same sequence within the Setap Shale Formation. Based on petrographic characteristics described and vitrinite reflectance values obtained from this study, at least four distinct units that are associated with coal-bearing sediments can be recognized. Strata with vitrinite reflectance (VR, %Ro) in the range of approximately 0.4–0.5% is the youngest and belongs to the Belait Formation which include the Tg. Layang-Layangan unit. The oldest sequence outcropping at Tg. Puni near the Labuan Crude Oil Terminal (Shell Terminal) belongs to the West Crocker Formation, possesses vitrinite reflectance in the range of 0.8–0.9%, whereas the intermediate unit is the Setap Shale Formation which possesses VR of 0.55–0.6% (including the East Kiam Sam sandstone unit) and Temburong Formation which possesses VR in the range of 0.65–0.75%.

It ought to be noted that the differences in the thermal maturity variations within the Cenozoic sediments of Labuan reported here does not form the fundamental basis of the stratigraphic subdivision of Labuan, but an attempt to associate it with what appear to be the still unresolved stratigraphic issues of Labuan. These VR values suggest the Belait Formation is immature, Setap Shale Formation is early mature, while the Temburong and West Crocker Formations are at peak maturity for liquid hydrocarbon generation. The analysed coals are predominantly mangrove-derived and considered to be oil-prone as suggested by the common occurrences of oil haze, suberinite, bituminite, exsudatinite and perhydrous vitrinite.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

This study is focused on the coal-bearing sequences that occur in various modes in the different stratigraphic intervals within sedimentary strata of Cenozoic age that represent different periods and depositional environments in the geological evolution of Labuan Island. Cenozoic age coals occur at several localities on Labuan Island. The locations of the study area where coals were sampled and analysed are shown in Fig. 1. Oil seeps were reported from a coal mine on Labuan in the late 1800s and

exploration for oil started in 1897 with drilling of a well on the adjacent Klias Peninsula on mainland Sabah but was unsuccessful in discovering hydrocarbons of commercial value (Madon et al., 1999). The northern tip of the island at Tanjung Kubong contains a network of underground tunnels and deep wells which were former sites of coal mining, which started in 1847. The mine was operated by various British companies for 64 years and was facilitated by an 8 mile long railway track to Victoria Port in the southern part for coal export. A series of mining accidents led to the closure of the mine in 1911. Situated on a rise at Tanjung Kubong is the famous “Chimney”, a 106 feet high red brick stack, possibly a ventilation shaft believed to be linked to the coal mining days.

* Corresponding author. Tel.: +60 379674232; fax: +60 379675149.

E-mail address: wanhasia@um.edu.my (A. Wan Hasiah).

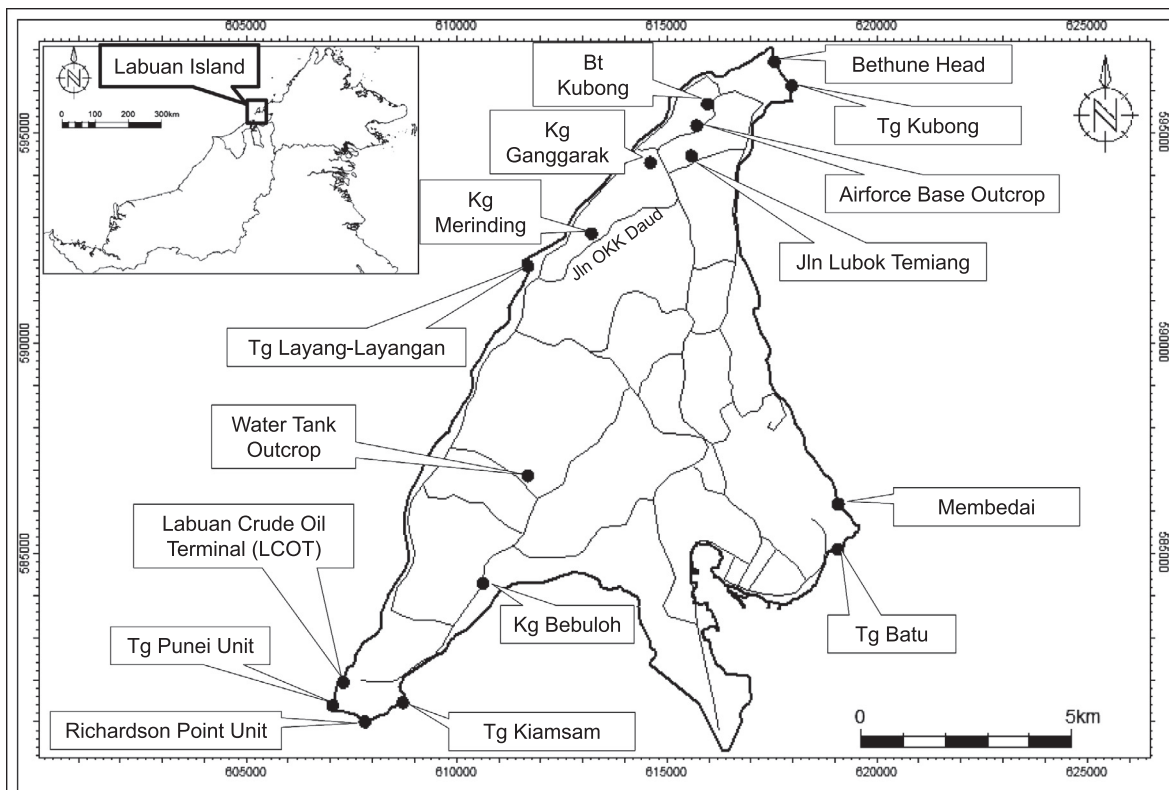


Fig. 1. Location of the study area on Labuan Island. Easting (X) and Northing (Y) coordinates are in metres, Borneo Rectified Skewed Orthomorphic (BRSO) projection, Timbalai 1948 datum. Location of Labuan Island in NW Borneo is shown in the inset map.

Age	Letter Classification	Geological Unit/Formation
Quaternary		Alluvium
		Liang
Pliocene	Tgh	Belait
Upper Miocene	Te ₅ - f	Meligan
Lower Miocene	Te ₁ - 4	Setap Shale
		Temburong
Oligocene	Tcd	Crocker (cr)
Eocene	Tab	
Paleocene	Early Ta	Paleocene (Undifferentiated)
Cretaceous		Sapulut

Fig. 2. Simplified stratigraphy of Labuan and Padas area (redrawn after Wilson, 1964).

The aims of this study are as follows: (i) to describe the mode of occurrences of the coals that are presently exposed on Labuan Island; (ii) to determine the organic petrological characteristics of the coal, in particular the maceral content and thermal maturity; (iii) to associate the thermal maturity of the organic matter to

the different geological formations of the sedimentary rocks on Labuan Island within the northern to south-western region. However, it ought to be noted that the differences in the thermal maturity variations reported here does not form the fundamental basis of the stratigraphic subdivision of Labuan, but is an attempt to associate and address the stratigraphic uncertainties of Labuan that has been studied by many workers as discussed in Section 3.0.

2. Methodology

In this study the mode of occurrence of the coals were identified in the field and their organic petrographic characteristics were described using a Leica DM 6000M photometry microscope equipped with Diskus Fossil software. Polished blocks of crushed whole rock samples were prepared using slow-setting resin which had been mixed with resin hardener. Upon hardening, they were subsequently polished using successively finer grades of silicon carbide paper, followed by alumina (initially 1 µm, then 0.3 µm and finally 0.05 µm grade). Water was used as lubricant for coals and isopropyl alcohol was used for coaly shale/sandstone samples. The objectives of this petrological study included the determination of the coal thermal maturity based on the reflectance measurements of vitrinite macerals using a 50× oil immersion objective under white light, and depositional environment interpretation based on maceral analysis (500 counts) performed on *in situ* coals and large coal clasts under white light and blue light excitation.

The determination of vitrinite reflectance (VR, %Ro) has become a common method of measuring the level of thermal maturity (or rank) of coals and disseminated organic matter in sediments. There are established correlations between reflectance and coal chemistry, and with aspects of the potential of rocks as source of petroleum (Taylors, 1998). The range of “oil generation window” as proposed by Peters and Cassa (1994) based on VR values are as

Download English Version:

<https://daneshyari.com/en/article/4731035>

Download Persian Version:

<https://daneshyari.com/article/4731035>

[Daneshyari.com](https://daneshyari.com)