GEOCHEMISTRY OF SELECTED UPPER PALEOZOIC KUANTAN GROUP AND TRIASSIC CARBONACEOUS SEDIMENTS OF PAHANG AND SOUTH TERENGGANU, WEST MALAYSIA

By

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ABSTRACT


had ankizon. Kesan yang terhasil dari peningkatan diagenesis timbunan disyorkan/dibayangkan oleh peningkatan darjah penghabluran illit didalam semua sampel yang dikaji.

Analisa geokimia menunjukkan ketepuan tinggi bagi SiO₂, Al₂O₃, K₂O dan Fe₂O₃ dan kandungan CaO dan MgO yang rendah. Ini secara amnya membayangkan kehadiran kuarza dan mineral-mineral silikat yang lain (seperti illit, kaolinit, klorit dan pirofilit) dan kekurangan mineral-mineral karbonat (kalsit dan dolomit) di dalam semua sampel-sampel yang dikaji.


Kromatogram gas bagi syal dan syal berarang mempamerkan taburan n-alkanes ahli hujung tinggi yang licin, melewati nC₃₀. Kelimpahan n-alkane yang rendah sedikit secara bandingan dipamerkan oleh sampel batukapur. Kebanyakan sampel mempamerkan bukti-bukti pembiodegredan yang sedikit. Ini yang dibayangkan oleh kehadiran sebatian-sebatian kompleks yang tidak terurai dan kehilangan sebahagian dari

Berdasarkan kepada kajian ini, walaupun perbezaan di antara enapan-enapan di dalam formasi-formasi yang berlainan tidak boleh dilakukan, perbezaan yang jelas boleh
ABSTRACT

This study investigates the organic and inorganic geochemistry of selected Carboniferous, Permian and Early Triassic carbonaceous sediments collected from three different localities in Pahang and South Terengganu, West Malaysia. The mineralogy, both organic and inorganic geochemical data are presented for thirty outcrop carbonaceous sediment samples. Detailed organic geochemical analyses were performed on nine of these samples, comprising six shales, two coaly shales and a limestone sample. The objectives of the study are to determine the mineralogy, clay mineralogy, organic carbon content (TOC) and biomarker (or geochemical fossils) distributions in assessing the type of organic matter, maturity and depositional environments.

The X-ray diffractograms show strong predominance of illite, kaolinite and quartz peaks in the shales / coaly shale, carbonaceous slate and phyllite of the studied samples. The predominant of the quartz mineral in these sediments suggest significant contribution of materials input rich in silica. The illite mineral is believed to have been formed from the deep burial diagenesis, and metamorphism of these sediment. Most of the samples show evidence of well crystallined illite and disordered kaolinite as suggested by the presence of narrow and symmetrical basal reflection of illite at 10A°, broad and a symmetrical basal reflection of kaolinite at 7A°. Pyrophyllite and small amounts of chlorite have been detected only in the Kemaman (lower Carboniferous age) slate and phyllite samples. The illite crystallinity of the metasediments in the Chukai samples indicate that the area was subjected to regional metamorphism of low grade type.
equivalent to limit of the anchizone. The effect of increased burial diagenesis are suggested by the enhancement of the degree of illite crystallinity in all of the samples studied.

Geochemical analysis shows high concentration of SiO₂, Al₂O₃, K₂O and Fe₂O₃ and low CaO and MgO content; reflect mainly the existance of quartz and other silicate minerals (e.g. illite, kaolinite, chlorite, and pyrophyllite) and deficiency of carbonates (calcite and dolomite) in all of the samples studied.

The saturated hydrocarbons of these sediments were analysed using gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). Petrographic study was performed using a photometry microscope in reflected white light and blue light excitation. The mean vitrinite reflectance (%Ro) for the shales/coaly shales and limestone is in range of 1.02% - 1.13%. This indicate that these sediments have reached a high level of thermal maturity (late oil-window maturation). Both the 22S/22S+22R C₃₂ hopane and 20S/20S+20R C₂₉ sterane ratios had reached equilibrium, thus supporting the vitrinite reflectance data. This high maturity suggests the sediments have been buried to considerable depth, prior to being uplifted to their present position.

The GC fingerprints of the shales and coaly shales display a smooth high end-member distribution of n-alkanes extending beyond nC₃₀. A relatively lower abundance of n-alkanes is displayed by the limestone sample. Most of the samples show evidence of slight biodegradation as suggested by the presence of unresolved complex compounds and the loss of some of the lower molecular weight n-alkanes. The strong predominance of high molecular weight n-alkanes in the shales / coaly shales of the Charu, Sagor,
Permian and Semantan formations suggest significant input of higher land plant organic matter into these sediments. The distinction between the shales and the coaly shale samples is mainly based on petrographic observation and TOC (total organic carbon) content. The Panching limestone sample is dominated by nC$_{17}$ – nC$_{19}$ alkanes suggesting significant contributions of algal derived organic matter. The lack of higher land plant-derived organic matter within the Panching limestone sample is evident from the low concentration of higher molecular weight n-alkanes compared to the Charu, Sagor, Permian and Semantan sediments. The high Pr/Ph and Pr/nC$_{17}$ ratios in the Charu, Sagor, Permian and Semantan samples compared to the Panching limestone sample are most likely to be associated with the source of the organic matter (i.e. higher land plant material) and is not indicative of the extent of anoxicity/oxicity of the depositional condition. No distinct variation is observed for the Ts/Tm ratio (generally considered to be associated with higher land-plant organic matter) among the samples studied suggesting this ratio may not be indicative of source input but are strongly influenced by the high thermal maturity attained by all of these samples. The high abundance of C$_{24}$, tetracyclic terpanes could be associated with either higher land-plant, algae or microbial sources. The presence of significant marine influence is suggested by the high abundance of tricyclic terpanes in all of the samples studied.

Based on this study, although differences between the sediments within a particular formation could not be made, distinction can be made between the dominant type of organic matter that is present in the shales/coaly shales compared to the limestone. The Charu, Sagor, Permian and Semantan formations seem to have received
substantial amount of land-derived organic matter that has been transported into the marine depositional setting, while the Panching Limestone is dominated by algal-derived organic matter and lacks higher plant material. Although of high maturity, the samples are still within the oil-window range, suggesting that they have not been too severely effected by thermal metamorphism or active tectonic activities of the Eastern and Central Belts of Peninsular Malaysia.
CONTENTS

Abstract
Abstract
List of Tables
List of Plates
List of Figures
Glossary
Acknowledgements

CHAPTER 1

INTRODUCTION

1.1.1 Preface
1.2 Purpose of study
1.3 Location and accessibility
1.4 Geography
1.4.1 Drainage
1.4.2 Vegetation and Land use
1.5 Geomorphology
1.5.1 Topography
1.5.2 Karst Topography
1.5.3 Sink holes
1.6 Previous Geological work
1.7 Regional Geology

Page
i.
v
xvi
xix
xxiv
xxx
xxxii

1
1
2
2
2
4
5
5
6
6
8
| 1.7.1 | Outlines on the tectonics of South East Asia | 8 |
| 1.7.2 | General Geology | 10 |
| 1.7.2.1 | Geological outline of peninsular Malaysia | 10 |
| 1.7.2.2 | General Geology of the study areas | 10 |
| 1.7.2.2.1 | Geology of the Central Pahang | 10 |
| 1.7.2.2.2 | Geology of the Panching – Sg. Lembing Area | 12 |
| 1.7.2.2.3 | Geology of the Bt. Pak Sagor | 13 |
| 1.7.2.2.4 | Geology of the Kemaman | 13 |
| 1.7.3 | Paleozoic Rocks of Peninsular Malaysia | 14 |
| 1.7.4 | Triassic Rocks in Peninsular Malaysia | 16 |

**CHAPTER 2**

| 2.1 | Location of sample | 17 |
| 2.2 | Methods of study | 21 |
| 2.2.1 | Inorganic Methods | 21 |
| 2.2.1.1 | Mineralogical and clay Minerals Analysis | 21 |
| 2.2.1.2 | Geochemical Analysis | 22 |
| 2.2.1.2.1 | Glassy disks | 22 |
| 2.2.1.2.2 | Pressed sample powder pellets | 22 |
| 2.2.1.3 | Loss on Ignition (L.O.I) | 22 |
| 2.2.1.4 | Grain-size analysis | 23 |
| 2.2.2 | Organic Methods | 23 |
| 2.2.2.1 | Petrology | 23 |
2.2.2.1.1 Polished blocks 23
2.2.2.1.2 Microscopic Examination and vitrinite reflectance 25
2.2.2.2 Geochemistry 25
2.2.2.2.1 Total Organic Carbon (TOC) 25
2.2.2.2.2 Biomarker Extraction 25
2.2.2.2.3 Column Chromatography 27
2.2.2.2.4 Gas chromatography (GC) and Gas chromatography -Mars spectrometry (GC-MS) 29

CHAPTER 3 PETROGRAPHY AND CLAY MINERALOGY 32
3.1 Introduction 32
3.2 Field observation and Samples description 32
3.2.1 Semantan Formation Samples 32
3.2.2 Permian sequence Samples 33
3.2.3 Charu Samples 33
3.2.4 Panching Limestone Samples 40
3.2.5 Sagor Samples 45
3.2.6 Kemaman (Chukai) metasediments Samples 47
3.3 Clay minerals investigations 51
3.4 Clay mineralogy 51
3.4.1 Illite 51
3.4.1.1 Crystallinity of illite 53
3.4.1.2 Crystallite size determination 78
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1.3</td>
<td>Fe₂O₃ total content</td>
<td>118</td>
</tr>
<tr>
<td>4.2.1.4</td>
<td>Magnesium content (MgO)</td>
<td>120</td>
</tr>
<tr>
<td>4.2.1.5</td>
<td>Calcium content (CaO)</td>
<td>120</td>
</tr>
<tr>
<td>4.2.1.6</td>
<td>Sodium content (Na₂O)</td>
<td>121</td>
</tr>
<tr>
<td>4.2.1.7</td>
<td>Potassium content (K₂O)</td>
<td>121</td>
</tr>
<tr>
<td>4.2.1.8</td>
<td>Titanium content (TiO₂)</td>
<td>123</td>
</tr>
<tr>
<td>4.2.1.9</td>
<td>Manganese content (MnO)</td>
<td>123</td>
</tr>
<tr>
<td>4.2.1.10</td>
<td>Phosphorus content (P₂O₅)</td>
<td>124</td>
</tr>
<tr>
<td>4.2.1.11</td>
<td>Loss on ignition (L. O. I)</td>
<td>124</td>
</tr>
<tr>
<td>4.2.1.12</td>
<td>Sulphur content (S)</td>
<td>125</td>
</tr>
<tr>
<td>4.2.1.13</td>
<td>Minor Elements</td>
<td>126</td>
</tr>
<tr>
<td>4.2.2.1</td>
<td>Ba content</td>
<td>126</td>
</tr>
<tr>
<td>4.2.2.2</td>
<td>Cobalt (Co) content</td>
<td>127</td>
</tr>
<tr>
<td>4.2.2.3</td>
<td>Chromium (Cr) content</td>
<td>128</td>
</tr>
<tr>
<td>4.2.2.4</td>
<td>Gallium (Ga) content</td>
<td>128</td>
</tr>
<tr>
<td>4.2.2.5</td>
<td>Niobium(Nb) content</td>
<td>129</td>
</tr>
<tr>
<td>4.2.2.6</td>
<td>Rubidium (Rb) content</td>
<td>129</td>
</tr>
<tr>
<td>4.2.2.7</td>
<td>Strontium (Sr) content</td>
<td>130</td>
</tr>
<tr>
<td>4.2.2.8</td>
<td>Zirconium (Zr) content</td>
<td>131</td>
</tr>
<tr>
<td>4.3</td>
<td>Relationship between chemical composition and grain-size</td>
<td>131</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Interpretation</td>
<td>133</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3.4.1.2.1</td>
<td>Introduction</td>
<td>78</td>
</tr>
<tr>
<td>3.4.1.2.2</td>
<td>Measurement of average crystal size of illite</td>
<td>78</td>
</tr>
<tr>
<td>3.4.1.2.3</td>
<td>Interpretation of Results</td>
<td>79</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Kaolinite</td>
<td>81</td>
</tr>
<tr>
<td>3.4.2.1</td>
<td>Kaolinite Crystallinity</td>
<td>83</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Chlorite</td>
<td>86</td>
</tr>
<tr>
<td>3.5</td>
<td>Pyrophyllite</td>
<td>86</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Introduction</td>
<td>86</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Identification of Pyrophyllite</td>
<td>87</td>
</tr>
<tr>
<td>3.6</td>
<td>Non Clay minerals</td>
<td>92</td>
</tr>
<tr>
<td>3.7</td>
<td>Indicator of very low grade metamorphism</td>
<td>104</td>
</tr>
<tr>
<td>3.8</td>
<td>Diagenesis</td>
<td>107</td>
</tr>
<tr>
<td>3.8.1</td>
<td>Illite diagenesis</td>
<td>108</td>
</tr>
<tr>
<td>3.8.2</td>
<td>Diagenesis of Kaolinite</td>
<td>108</td>
</tr>
<tr>
<td>3.9</td>
<td>Interpretation and discussions</td>
<td>108</td>
</tr>
<tr>
<td>3.10</td>
<td>Conclusion</td>
<td>110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 4</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>111</td>
</tr>
<tr>
<td>4.2</td>
<td>Results and Discussion</td>
<td>111</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Major Elements</td>
<td>111</td>
</tr>
<tr>
<td>4.2.1.1</td>
<td>Silica content (SiO₂)</td>
<td>111</td>
</tr>
<tr>
<td>4.2.1.2</td>
<td>Alumina content (Al₂O₃)</td>
<td>117</td>
</tr>
</tbody>
</table>
4.4 Interpretation of Geochemistry for the environment of deposition. 143

4.5 Diagenesis and interrelationship between organic and inorganic reactions. 148

4.6 Summary of the results. 150

CHAPTER 5 ORGANIC GEOCHEMISTRY 153

5.1 Background of study 153

5.1.1 Introduction 153

5.1.2 Hydrocarbon compounds in sediments 153

5.1.3 Types of organic matter 154

5.1.4 Variety and characteristics of Hydrocarbons 155

5.1.4.1 Saturated hydrocarbons 156

5.2 Results 157

5.2.1 Petrography 157

5.2.2 Interpretation of vitrinite reflectance 159

5.2.3 Fluorescence Microscopy 159

5.2.4 Total organic carbon (TOC) 166

5.2.5 Normal alkane and acyclic isoprenoids 174

5.2.5.1 Pr/Ph ratio 180

5.2.5.2 Carbon preference index (CPI) 181

5.2.6 Gaschromatography- Mars spectrometry (GC-MS) 182
5.2.6.1 Tricyclic and tetracyclic terpanes (M/Z 191) 182
5.2.6.2 Pentacyclic terpanes 191
5.2.6.2.1 Hopane 191
5.2.7 Steranes M/Z 217 191
5.3 Discussion 192
5.3.1 Maturity 192
5.3.2 Type of organic matter 197
5.3.3 Depositional environment 199
5.4 Conclusions 201
APPENDIX A Preparation of clays for X-ray diffraction examination. 203
APPENDIX B X-ray fluorescence spectrometry method of analysis and sample preparation. 205
APPENDIX C Determination of loss on ignition (L.O.I). 207
APPENDIX D Maximum and minimum vitrinite reflectance measurements. 208
REFERENCES 210
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Distribution of clay minerals in the sediments studied.</td>
</tr>
<tr>
<td>3.2A</td>
<td>The behaviour of basal reflections of illite upon treatments (bulk analysis).</td>
</tr>
<tr>
<td>3.2B</td>
<td>The behaviour of basal reflections of illite upon treatments &lt;2μm fractions.</td>
</tr>
<tr>
<td>3.2C</td>
<td>The behaviour of basal reflections of illite upon treatments (bulk analysis) of Kemaman samples.</td>
</tr>
<tr>
<td>3.2D</td>
<td>The behaviour of basal reflection of illite upon treatments &lt;2μm fractions of Kemaman samples.</td>
</tr>
<tr>
<td>3.3</td>
<td>Crystal-size measurements of illite.</td>
</tr>
<tr>
<td>3.4A</td>
<td>The behaviour of basal reflections of kaolinite (&lt;2μm fractions) after being treated.</td>
</tr>
<tr>
<td>3.4B</td>
<td>The behaviour of (001) basal reflections of kaolinite after being treated (bulk analysis).</td>
</tr>
<tr>
<td>3.4C</td>
<td>The behaviour of (001) reflections of kaolinite after being treated (clay-sized fractions) in the Kemaman samples.</td>
</tr>
<tr>
<td>3.5</td>
<td>The behaviour of (002) and (004) basal reflections of pyrophyllite in the Kemaman samples.</td>
</tr>
<tr>
<td>3.6</td>
<td>Metamorphic grade for very low grade metamorphism for Kemaman samples.</td>
</tr>
</tbody>
</table>
4.1 Major, minor and trace chemical analysis of the carbonaceous sediments, in the studied areas, major elements in % and minor elements in $10^{-6}$. 112

4.2 Major, minor and trace chemical analysis of the Kemaman carbonaceous sediments, major elements in % and trace elements in $10^{-6}$. 113

4.3 Major, minor and trace chemical composition (average) of carbonaceous sediments. Major elements in % and trace elements in $10^{-6}$. 114

4.4 Parameters of grain-sized distribution of the carbonaceous sediments in the study areas sediments. 132

4.5 An average values of $\text{Al}_2\text{O}_3 : \text{TiO}_2$ ratio in the carbonaceous sediments of the study area. 144

4.6 The Sr and Ca relationship with Rb and K in the carbonaceous sediments of the study area. 146

5.1 Vitrinite reflectance values (%Ro) for the studied sediments. 158

5.2 TOC %. 166

5.3 Identification for mass fragmentograms in M/z 217. 189

5.4 Identification of peaks in M/z 217. 189

xvii
5.5 Organic geochemistry data.

5.6 Biomarker parameters for selected rock extracts in the area of study.
LIST OF PLATES

2.1 Master grain size machine 24
2.2 Soxhlet apparatus 26
2.3 Column chromatography 28
2.4 Buchi evaporation 30

3.1 Handspecimen show sharp contact between tuffaceous sandstone and alternating shale-mudstone beds. Semantan Formation. 34

3.2a Graded tuffaceous sandstone handspecimen Semantan Formation. 35

3.2b Tuffaceous sandstone show layer of mudstone. Semantan Formation. 36

3.3 Permian limestone handspecimen show small joints and fracture distributed randomly filled with secondary calcite. "Jengka Pass" 37

3.4 Carbonaceous shale hand specimen illustrate plant remains, "Permian Formation". Location Jengka Pass. 37

3.5 Black shale show lamination with alternation dark and grey color. Permian sequence at Jengka Pass. 38

3.6 Weathered black shale of Charu Formation which change to friable soil (28 km to Kuantan town). 39
3.7 Black shale in Charu Formation show thinly beds of coaly shale (28 km to Kuantan town).

3.8 Coaly shale hand specimen from Charu Formation sample Cha (28 km to Kuantan town)

3.9 Black shale in Charu Formation show dark and light lamination. (28 km to Kuantan town)

3.10 Dark grey limestone show small joints and fracture distributed randomly, filled with secondary calcite (sample Pa1; Bt. Panching)

3.11 Light grey color limestone show fracture filled with secondary calcite, botom side right red color due to weathering of hematite grains (sample Pa2 Bt Panching).

3.12 Handspecimen of black shale show fissibility (sample Sa2, Bt. Sagor).

3.13 Plant leaf fragment preserved between bedding planes of the carbonaceous shale (sample Sa1, Bt. Pak Sagor).

3.14 Photograph of Bt. Tg. Mat Amin (Chukai).

3.15 Handspecimen show rock cleavage and siliky sheen in black slate (sample Km1 Bt. Tg. Mat Amin).
3.16 Phyllite show marked luster due to high content of carbon in the form of graphite. (sample Km4, Bt. Tg. Mat Amin).

3.17 Photograph shows repetition of strata by folding Bt. Tg. Mat Amin (Chukai).

3.18A Scanning electron micrograph of (sample Ch4) illustrate flaky platelets illite.

3.18B Scanning electron micrograph of (sample Per2) display flaky platelets illite.

3.18C Scanning electron micrograph of (sample Tr3) show flaky platelets illite.

3.18D Scanning electron micrograph of (sample Sa4) show flaky platelets illite.

3.19 Scanning electron micrograph of sample Ch4 show kaolinite.

3.20 Scanning electron micrograph of (sample Per1) showing framboids pyrite.

3.21 Scanning electron micrograph show rhombic morphology of calcite (sample Per3).

3.22 Scanning electron micrograph of show calcite mineral (sample Per1).
5.1a and b
Photomicrographs showing dark brown bitumen staining occurring within a ground mass with fine grained, highly reflecting vitrinite particles, inertinite quartz and clay matrix. Reflected white light; field width = 0.21 mm.

5.2
Photomicrograph showing yellow orange fluorescing bitumen staining. Same view as plate 5.1b under blue light excitation.

5.3a and b
Photomicrographs showing possible poorly, preserved graphitized plant remains. Reflected white light; field width = 0.21 mm.

5.4
Photomicrograph showing a particle with distinct cellular structure of unknown identity. Reflected white light; field width = 0.21 mm. Sample Km2 phyllite, location Bt. Tg. Mat Amin (Chukai).

5.5a and b
Photomicrographs showing amorphous organic matter. Reflected blue light; field width = 0.21 mm.

5.6a and b
Photomicrographs showing yellow orange fluorescing bitumen occurring within ground mass of unrecognisable macerals. Reflected blue light; field width a = 0.65 mm and b = 0.21 mm.
Scanning electron micrograph show cellular carbonaceous wood fragments preserved in Sample Km4 (phyllite). Location: Bt. Tg. Mat Amin (Chukai).
LIST OF FIGURES

1.1
Location map showing areas surveyed 3

1.2
Setting of the Eastern Peninsular Malaysia in 9
the tectonic of South East Asia.

1.3
Location of the three geological belts in 11
the West Malaysia.

2.1a
Sampling localities of the Kuantan Group. 18

2.1b
Sampling Localities of the Permian and 19
Semantan formations.

2.1c
Sampling localities of the Kemaman (lower 20
Carboniferous age) carbonaceous sediments.

2.2
Scheme for extraction and analysis geochemical 31
Fossils.

3.1A
X-ray diffraction pattern of untreated sample 54
Ch<sub>5</sub> < 2µm

3.1B
X-ray diffraction pattern of untreated sample 55
Sa<sub>1</sub> < 2µm

3.1C
X-ray diffraction pattern of untreated sample 56
Tr<sub>1</sub> < 2µm

3.1D
X-ray diffraction pattern of untreated sample 57
Per<sub>1</sub> < 2µm

3.1E
X-ray diffraction pattern of untreated sample 58
Km<sub>1</sub> < 2µm
3.1F  X-ray diffraction pattern of untreated sample

Km4 < 2μm

3.2A  Energy Dispersive X-ray spectrum (EDX)

of illite sample Ch4

65

3.2B  Energy Dispersive X-ray spectrum (EDX)

illite sample Per3

67

3.2C  Energy Dispersive X-ray spectrum (EDX)

of illite sample Tr3

69

3.2D  Energy Dispersive X-ray spectrum (EDX)

of illite sample Sa4

71

3.3A  X-ray diffraction pattern of sample Ch5

after being glycolated.

72

3.3B  X-ray diffraction pattern of sample Ch5

after being heated.

73

3.3C  X-ray diffraction pattern of sample Sa4

after being glycolated.

74

3.3D  X-ray diffraction pattern of sample Sa4

after being heated.

75

3.3E  X-ray diffraction pattern of sample Per1

after being glycolated.

76

3.3F  X-ray diffraction of sample Per1

after being heated.

77
3.4 Average crystallite size as a function of peak width at half height (After Griffin 1971)

3.5 Energy Dispersive X-ray spectrum (EDX) of kaolinite sample Ch4

3.6A X-ray diffraction pattern of sample km3 after being glycolated.

3.6B X-ray diffraction pattern of sample km3 after being heated.

3.6C X-ray diffraction pattern of sample km4 after being glycolated.

3.6D X-ray diffraction pattern of sample km4 after being heated.

3.7A X-ray diffraction pattern of untreated sample ch3 bulk analysis.

3.7B X-ray diffraction pattern of untreated sample Sa4 bulk analysis.

3.7C X-ray diffraction pattern of untreated sample Per1 bulk analysis.

3.7D X-ray diffraction pattern of untreated sample Tr1 bulk analysis.

3.7E X-ray diffraction pattern of untreated sample bulk analysis.
X-ray diffraction pattern of untreated sample km1
bulk analysis phyllite sample. 98

3.8
Energy Dispensive X-ray spectrum (EDX)
of pyrite sample Per1 100

3.9
Energy Dispensive X-ray spectrum (EDX)
of calcite sample Per1 103

3.10
First illite basal reflection sample km1(slate).
Location Bt. Tg. Mat Amin (Chukai). 105

3.11
First illite basal reflection sample km1 (phyllite)
Location Bt. Tg. Mat Amin (Chukai). 106

4.1
Major elements composition of the carbonaceous
Sediments of the Charu, Sagor, Permian, Semantan
formations and Kemaman metasediments. 115

4.2a
Cumulative frequency curve of sample Ch1 134

4.2b
Cumulative frequency curve of sample Ch2 135

4.2c
Cumulative frequency curve of sample Sa1 136

4.2d
Cumulative frequency curve of sample Per1 137

4.2e
Cumulative frequency curve of sample Per2 138

4.2f
Cumulative frequency curve of sample Tr1 139

4.2g
Cumulative frequency curve of sample Tr2 140

4.2h
Cumulative frequency curve of sample Km2 141

4.2i
Cumulative frequency curve of sample Km12 142
4.3 Scheme illustrate diagenetic reactions and origin of the ions forming the diagenetic minerals.

5.1A and B Vitrinite reflectance histograms. A) sample Ch2; B) sample Ch4. Location: Charu Fm. Pahang.

5.2A and B Vitrinite reflectance histograms. A) sample Sa1; B) sample Sa4. Location: Bt. Pak Sagor.

5.3A and B Vitrinite reflectance histograms. A) sample Per2; B) sample Per1. Location: Jengka Pass.

5.4A and B Vitrinite reflectance histograms. A) sample Tr1; B) sample Tr2. Location: Semantan Fm.

5.5A and B Vitrinite reflectance histograms. A) sample Kmg (slate); B) sample Km2 (phyllite). Location: Bt.Tg. Mat Amin, Chukai.

5.6 Vitrinite reflectance histograms of the Panching Limestone (Pa1). Location: Bt. Panching.

5.7 Gas chromatograms of saturated hydrocarbons

A) Charu Fm (Ch4); B) Panching limestone Fm. (Pa1).

5.8 Gas chromatograms of saturated hydrocarbons

A) Sample Ch1; B) Sample Ch2; Charu Fm.

5.9 Gas chromatograms of saturated hydrocarbons

A) Sample Tr2; B) Sample Tr4; Semantan Fm.
5.10 Gas chromatograms of saturated hydrocarbons
A) Sample Sa₂; B) Sample Sa₄; Sagor Fm.

5.11 Gas chromatograms of saturated hydrocarbons
Sample Per₁; Jengka Pass.

5.12A and B (M/Z 191) mass chromatograms showing the relative distribution of terpanes and triterpanes released from the Charu Fm. A) sample Ch₁;
B) sample Ch₄

5.13 (M/Z 191) mass chromatograms showing the relative distribution of terpanes and triterpanes released from A) Panching Fm (Pa₁);
B) Sagor Fm (Sa₂)

5.14 M/Z 191 mass chromatograms showing the relative distribution of terpanes and triterpanes released from A) Permian Fm. (Per₁);
B) Semantan Fm (Tr₂).

5.15A and B Sterane M/Z 217 distributions from rocks extracts of the Charu Fm. A) sample Ch₁;
B) sample Ch₄

5.16 Sterane M/Z 217 distributions from rocks extracts of A) The Panching limestone (Pa₁);
B) The Sagor Fm (Sa₂)
5.17  Sterane M/Z 217 distributions from rocks extracts.

A) The Permian Fm (Per1) ;

B) The Santan Fm (Tr2)

188

5.18  Structures of commonly occurring biomarkers

in the samples studied.

190
## GLOSSARY

<table>
<thead>
<tr>
<th>Malay</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bukit</td>
<td>Bt. hill</td>
</tr>
<tr>
<td>Gunung</td>
<td>G. mountain</td>
</tr>
<tr>
<td>Kampung</td>
<td>Kg. Village</td>
</tr>
<tr>
<td>Kuala</td>
<td>K. mouth of river</td>
</tr>
<tr>
<td>Pulau</td>
<td>P. island</td>
</tr>
<tr>
<td>Sungai</td>
<td>Sg. River</td>
</tr>
<tr>
<td>Tanjung</td>
<td>Tg. cape</td>
</tr>
</tbody>
</table>
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