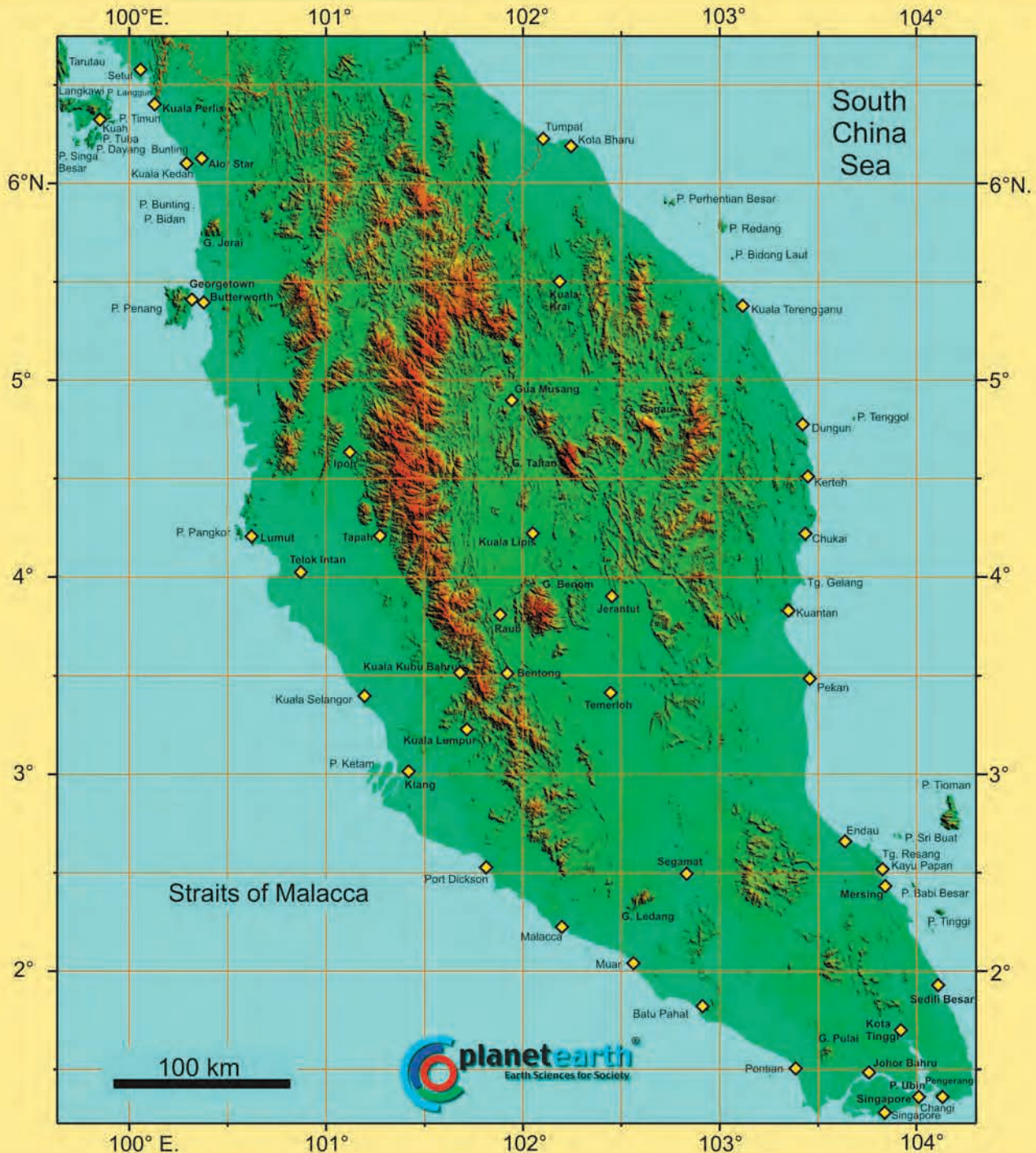


GEOLOGY OF PENINSULAR MALAYSIA

Editors: C. S. Hutchison and D. N. K. Tan



Published by the University of Malaya and the Geological Society of Malaysia



Sponsored by Murphy Oil Corporation
and the University of Malaya



GEOLOGY OF PENINSULAR MALAYSIA

GEOLOGY OF PENINSULAR MALAYSIA

edited by
Charles S. Hutchison
professor emeritus

and
Denis N. K. Tan

formerly professor
Department of Geology,
University of Malaya,
50603 Kuala Lumpur,
Malaysia

published jointly by



The University of Malaya



The Geological Society of Malaysia

Sponsored by Murphy Oil Corporation and the University of Malaya



University of Malaya
50603 Kuala Lumpur
Malaysia

Geological Society of Malaysia
Department of Geology
University of Malaya
50603 Kuala Lumpur, Malaysia

All rights are reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of the University of Malaya and the Geological Society of Malaysia.

© Geological Society of Malaysia
First published by
The University of Malaya and
The Geological Society of Malaysia
2009

ISBN 978-983-44296-6-9

The book cover was designed by Robert Tate. The map is a shaded digital elevation model generated from Shuttle Radar Topography Mission (SRTM) datasets. The source of the data is www2.jpl.nasa.gov/srtm/

A 1 : 1 000 000 scale geological map of Peninsular Malaysia, compiled by Robert Tate, Denis Tan and Ng Tham Fatt, is included in the back pocket and is an integral part of this book and subject to the same reproduction regulations.

Printed in Malaysia

GEOLOGICAL PUBLICATIONS

This book has drawn extensively on the maps and publications of the Geological Survey of Malaysia, now known as the 'Minerals and Geoscience Department Malaysia'. The 8th edition of the geological map of the whole peninsula, scale 1 : 750,000, was published in 1985. Detailed quadrangle geological maps have been published, the early ones at a scale of 1 : 63,000. Most of the maps are included in a memoir or map bulletin. Most of the peninsula has been mapped on a detailed scale. Details and sales are available from the following address:

Minerals and Geoscience Department Malaysia,
Bangunan Tabung Haji, floor 20,
Jalan Tun Razak,
50658 Kuala Lumpur
e-mail: imgkl@jmg.gov.my

Many papers on the offshore areas have been published in the bulletin series of the Geological Society of Malaysia, facilitated by annual meetings of the Society dedicated to Petroleum geology. A great landmark has been 'The Petroleum Geology and Resources of Malaysia', published by PETRONAS (1999), available from

Petroleum Nasional Berhad (PETRONAS),
Tower 1, PETRONAS Twin Towers,
50088 Kuala Lumpur
www.petronas.com.my

Acknowledgements

The editors and authors of this book and the officers of the Geological Society are extremely grateful to Murphy Oil Corporation and the University of Malaya for generous donations to allow this book to be published locally, thereby keeping the selling price within reach of local students and geologists. Ching Yu Hay drafted many of the figures from authors' sketches, where necessary. Special thanks are due to Dr Ng Tham Fatt for compiling maps from satellite and SETM data.

CONTENTS

1	INTRODUCTION	1
	Authors and Contributors	2
	Charles S. Hutchison	2
	Denis N. K. Tan	2
	Lee Chai Peng	2
	Mustaffa Kamal Shuib	3
	Samsudin Hj Taib	3
	John Kuna Raj	3
	Wan Hasiyah Abdullah	3
	Robert B. Tate	3
	Nuraiteng Tee Abdullah	4
	Azman A Ghani	4
	Ng Tham Fatt	4
	Geological publications	4
	Acknowledgements	4
2	GEOMORPHOLOGY	5
2.1	Introduction	5
2.2	Topography	6
2.3	Mountain ranges	6
2.4	Undulating and rolling terrain	9
2.5	Karst	9
2.6	Granite landforms	11
	2.6.1 Core-boulders	12
2.7	Drainage	12
2.8	Lakes	16
	2.8.1 River capture	16
2.9	Weathering processes and profiles	17
	2.9.1 Granite bedrock	17
	2.9.2 Sedimentary bedrock	19
	2.9.3 Metamorphic bedrock	20
	2.9.4 Laterite	21
	2.9.5 Bauxite	22
	2.9.6 Mineral stability	22
2.10	Coastal plains	22
	2.10.1 West Coast	23
	2.10.2 East Coast	25
2.11	Inland plains and infilled valleys	26
2.12	Terraces	27
2.13	Denudational chronology	28
2.14	Elliptical or circular structures	28
3	REGIONAL GEOLOGICAL SETTING	31
3.0	Introduction	31
3.1	Dissimilarity from Sarawak	31
3.2	The Andaman Sea	33
3.3	Correlation with Sumatra	33
	3.3.1 Bentong-Raub Suture	33
	3.3.2 Structural similarity	36
	3.3.3 Stratigraphic similarity	36
	3.3.3.1 'Greywacke terrane'	37
	3.3.3.2 'Quartzite terrane'	37

3.3.3.3	'Mutus Assemblage'	38
3.3.3.4	Mid-Miocene basalts	38
3.4	Correlation with Thailand	38
3.4.1	Sibumasu Block	38
3.4.2	The Palaeo-Tethys Suture	38
3.4.3	East Malaya Block	40
3.4.4	Cenozoic intermontane basins	40
3.4.5	Neogene alkaline basalts	40
3.5	Tin mineralization in South-East Asia	40
3.6	Sea level changes	40
4	BENTONG–RAUB SUTURE	43
4.0	Introduction	43
4.1	Central area	43
4.1.1	Schist Series	45
4.1.2	Chert-argillite sequence	45
4.1.2.1	Palaeontology and age of the slaty shale	45
4.1.2.2	Palaeontology and age of the chert	45
4.1.3	Mélange and olistostrome	47
4.1.4	Amphibole schist	47
4.1.5	Serpentinite	47
4.1.6	Bilut Redbeds	47
4.2	Genting Sempah enclave in the Main Range Granite	48
4.3	East of the Cameron Highlands	48
4.4	East–West Highway	48
4.5	Southern Area	51
4.5.1	Jelebu district	51
4.5.2	Kuala Pilah district	51
4.5.3	Malacca	51
4.6	Correlatives along western margin of the Main Range	52
4.6.1	Port Dickson	52
4.6.2	Kajang Schist	52
4.6.3	Dinding Schist	52
4.6.4	Hawthornden Schist	52
4.6.5	Kuala Kubu Baharu and Fraser's Hill area	52
4.6.6	Trolak Formation	52
4.7	Chemistry of igneous and metamorphic rocks	53
5	PALAEOZOIC STRATIGRAPHY	55
5.0	Introduction	55
5.0.1	Western Belt	55
5.0.2	Central Belt	57
5.0.3	Eastern Belt	57
5.1	Palaeozoic formations in the Western Belt	57
5.1.1	Northwest Domain	57
5.1.1.1	Machinchang Formation	58
5.1.1.2	Jerai Formation	60
5.1.2	Setul Group	61
5.1.2.1	Kaki Bukit Limestone (replacing the Lower Setul Limestone)	61
5.1.2.2	Tanjong Dendang Formation (replacing the Lower Detrital Band)	64
5.1.2.3	Mempelam Limestone (replacing the Upper Setul Limestone)	65
5.1.3	The Timah Tasoh Formation (replacing the Upper Detrital Member)	67
5.1.3.1	Lalang Member (lower part of Timah Tasoh Formation)	67
5.1.3.2	Bukit Raja Member (upper part of Timah Tasoh Formation)	68

5.1.4	Chepor Formation	68
5.1.4.1	Langgun Redbeds	68
5.1.4.2	Hutan Aji Member	69
5.1.5	Transitional nomenclature: Setul –Singa–Kubang Pasu Formations	69
5.1.6	Singa and Kubang Pasu Formations	69
5.1.7	Chuping Formation	71
5.1.8	South Kedah Palaeozoic Formations	71
5.1.9	North Perak Palaeozoic Formations	71
5.1.10	Kinta Valley Palaeozoic Formations	72
5.1.10.1	Devonian and older rocks	73
5.1.10.2	Carboniferous	73
5.1.10.3	Permian	73
5.1.11	Palaeozoic west of the Kinta Valley	75
5.1.12	Palaeozoic Formations of Selangor and Kuala Lumpur	76
5.1.12.1	Lower Palaeozoic	76
5.1.12.2	Kenny Hill Formation	76
5.1.13	Western Belt east of the Main Range	77
5.1.13.1	Bentong Group	78
5.1.13.2	Pelong Beds	78
5.1.13.3	Karak Formation	78
5.2	Palaeozoic rocks of the central belt	79
5.2.1	Bera Formation	79
5.2.2	Raub Group	80
5.2.2.1	Gua Musang Formation	80
5.2.2.2	Jengka Pass Outcrop	81
5.2.2.3	Aring Formation	81
5.2.2.4	Jelebu Schist	82
5.2.2.5	Kepis Beds	82
5.2.2.6	Taku Schist	82
5.3	Palaeozoic rocks in the eastern belt	82
5.3.1	Kambing Beds	83
5.3.2	Seri Jaya Beds	83
5.3.3	Kuantan Group	84
5.3.4	Sungai Perlis Beds	84
5.3.5	Dohol Formation	84
5.3.5	Linggiu Formation	84
5.3.6	Sedili Volcanics	85
5.3.7	Pinang and Redang Beds	85
5.3.8	Murau Formation	85
5.4	Synthesis	86
6	MESOZOIC STRATIGRAPHY	87
6.0	Introduction	87
6.1	Western Belt	88
6.1.1	Kodiang Limestone	88
6.1.1.1	Stratigraphy and Sedimentology	88
6.1.1.2	Depositional Setting	92
6.1.2	Chuping Limestone	93
6.1.3	Semanggol Formation	93
6.1.3.1	Stratigraphy and Sedimentology	95
6.1.3.2	Depositional Setting	99
6.1.3.3	Discussion	99
6.1.4	Saiong Redbeds	100
6.1.5	Nenering Beds	101
6.2	Central Belt	102

6.2.1	Gua Musang Formation	102
6.2.1.1	Stratigraphy and Sedimentology	103
6.2.1.2	Discussion	106
6.2.2	Semantan Formation	106
6.2.2.1	Areal Distribution and Correlation	107
6.2.2.2	Stratigraphy	107
6.2.2.3	Sedimentology	110
6.2.2.4	Palaeontology	113
6.2.2.5	Discussion	113
6.2.3	Post-Semantan Formation redbeds	114
6.2.3.1	Tembeling Group	115
6.2.3.2	Koh Formation	119
6.2.3.3	Bertangga Sandstone	120
6.2.3.4	Ma'Okil Formation	120
6.2.3.5	Paloh Formation	122
6.2.3.6	Depositional Setting	122
6.3	Eastern Belt	124
6.3.1	Gagau Group	124
6.3.1.1	Badong Conglomerate	124
6.3.1.2	Lotong Sandstone	124
6.3.1.3	Depositional Setting	126
6.3.2	Lesong Sandstone and Ulu Endau Beds	126
6.3.3	Panti Sandstone	127
6.3.4	Tebak Formation	128
6.4	Correlation	129
7	CENOZOIC STRATIGRAPHY	133
7.0	Introduction	133
7.1	Onshore Tertiary Basins	134
7.1.1	Bukit Arang Basin, Perlis and Kedah	135
7.1.2	Enggor Basin, Central Perak	136
7.1.3	Batu Arang Basin, Selangor	138
7.1.3.1	Boulder Beds	139
7.1.3.2	Coal Measures (Batu Arang Beds)	139
7.1.3.3	Oil Shale	141
7.1.4	Kampung Durian Chondong Basin, northwest Johor	143
7.1.5	Kluang–Niyor Basin, central Johor	144
7.1.6	Layang-Layang Basin, south Johor	145
7.1.7	Lawin Basin, North Perak	145
7.1.8	Correlation of the Tertiary Basins	146
7.2	Offshore Straits of Malacca	148
7.2.1	Northern Straits (associated with North Sumatra Basin)	153
7.2.1.1	Northern Graben	153
7.2.1.2	MSS-XA Graben	153
7.2.2	Southern Straits (associated with Central Sumatra Basin)	154
7.2.2.1	Central belt	154
7.2.2.2	Port Klang belt	155
7.2.2.3	Johor belt	157
7.3	Quaternary	157
7.3.1	Boulder Beds	159
7.3.2	Simpang Formation (Old Alluvium)	160
7.3.3	Kempadang Formation	160
7.3.4	Beruas Formation (Young Alluvium)	161
7.3.5	Gula Formation	161
7.3.6	Peat Occurrence Offshore	162

7.3.7	Present-day Onshore Peat Swamp Distribution	162
7.4	Distribution of Quaternary Sediments	164
7.4.1	North Kedah and Perlis	164
7.4.2	South Kedah and Penang	164
7.4.3	North and Central Perak	164
7.4.4	South Perak	165
7.4.5	Kinta Valley	165
7.4.6	Selangor	166
7.4.7	Kuala Lumpur	166
7.4.8	Negeri Sembilan and Malacca	167
7.4.9	West Johor	167
7.4.10	South Johor	167
7.4.11	East Johor	167
7.4.12	Pahang	167
7.4.13	South and Central Terengganu	168
7.4.14	North Terengganu and Kelantan	168
7.5	Other Quaternary Deposits	169
7.5.1	Basaltic Flow	169
7.5.2	Rhyolitic Ash	169
7.5.3	Cave Deposits	169
7.6	Tectonic Evolution of the Cenozoic Basins	170
7.7	Sea Level Changes	172
7.7.1	Pleistocene	172
7.7.2	Holocene	173
8	MALAY AND PENYU BASINS	175
8.0	Introduction	175
8.1	Tectonic Development	177
8.2	Malay Basin	177
8.2.1	Structural Framework	181
8.2.2	Stratigraphy and Depositional Environments	182
8.2.2.1	Palaeocene(?) to early Lower Miocene Syn-rift:	185
8.2.2.2	Late Lower to Late Miocene:	187
8.2.2.3	Pliocene to Recent:	189
8.2.3	Heat Flow and Geothermal Gradients	189
8.2.4	Abnormal Pressure	189
8.3	Penyu Basin	193
8.3.1	Structural Framework	193
8.3.2	Stratigraphy and Depositional Environments	194
8.3.3	Heat Flow and Geothermal gradients	196
8.3.4	Abnormal Pressure	196
9	VOLCANISM	197
9.0	Introduction	197
9.1	Geochronology	198
9.2	Western belt	199
9.3	Genting Sempah Complex	199
9.3.1	Age	200
9.3.2	Petrology	201
9.3.3	Geochemistry	202
9.4	Eastern Belt	202
9.4.1	Kelantan and Pahang	203
9.4.2	Southern Peninsula	204
9.4.2.1	Explosive ignimbritic volcanism in East and Southeast Johor	204
9.4.2.2	Tioman, Sibuluan and Tinggi islands.	205

9.4.2.3	Teluk Ramunia, Pengerang	207
9.4.2.4	Endau Rompin	207
9.4.2.5	Geochemistry	207
9.5	Cenozoic Volcanism	208
9.5.1	Kuantan Basalt	209
9.5.2	Segamat Basalt	209
9.5.3	Mafic to intermediate dykes	210
10	PLUTONISM	211
10.1	Introduction	211
10.2	Geochronology	211
10.2.1	Main Range Granite	211
10.2.2	Eastern Belt granites	216
10.2.3	Cretaceous granites	216
10.3	The Main Range Granite province	216
10.3.1	Field Occurrence	216
10.3.2	Texture	217
10.3.3	Mineralogy	217
10.3.3.1	Feldspars	217
10.3.3.2	Biotite	217
10.3.3.3	Amphibole	217
10.3.3.4	Muscovite	217
10.3.3.5	Garnet	218
10.3.3.6	Tourmaline	218
10.3.3.7	Others	218
10.3.4	Secondary textured granite	218
10.4	Central plutonic province	218
10.4.1	The Benta Alkalic Series	218
10.4.2	Stong Complex	219
10.5	Eastern Belt	220
10.5.1	The Perhentian Kecil Syenite	221
10.5.1.1	Mineralogy	221
10.5.2	Mafic rocks associated with granitic plutons	221
10.5.2.1	Pemanggil and Aur Islands, Johore	221
10.5.3	Mineralogy of Eastern Belt Granitoids	222
10.5.3.1	Plagioclase	222
10.5.3.2	K-Feldspar	222
10.5.3.3	Amphibole	222
10.5.3.4	Biotite	222
10.5.3.5	Others	222
10.6	Cretaceous Plutonic rocks	222
10.7	Geobarometer studies	223
10.8	Enclaves	223
10.9	Geochemistry	224
10.9.1	Secondary-textured granites	228
10.9.2	Alkalic series	229
10.9.3	Tectonic setting of the plutonic rocks	230
10.10	Conclusions	231
11	METAMORPHISM	233
11.0	Introduction	233
11.1	Stong Migmatite Complex	233
11.1.1	Granitoids	233
11.1.2	Granitoid-metamorphic rock relationships	233
11.1.2.1	Sungai Renyok	235

11.1.3	Metamorphic paragenesis	236
11.2	Taku Schist	237
11.2.1	Granite	237
11.2.2	Structure	237
11.2.3	Metamorphic paragenesis	237
11.2.4	Age	239
11.3	Relation of the Taku Schist and Stong Complex to the overlying rocks	239
11.4	Gunung Jerai dome	239
11.4.1	Granite age	240
11.4.2	Metamorphic rocks	240
11.4.3	Metamorphic facies	241
11.5	Gunung Ledang aureole	242
11.5.1	Granite age	242
11.5.2	Rock types	242
11.5.3	Mineralogy	243
11.6	Relationship of granites to metamorphism	244
11.7	Low grade metamorphic rocks	244
11.7.1	Mersing Beds	244
11.7.2	Langkawi	244
11.8	Eastern Belt hornfels aureoles	245
11.9	Tourmaline-corundum rocks	245
12	MAJOR FAULTS	249
12.0	Introduction	249
12.1	Terrane Bounding Faults	253
12.1.1	Bentong-Raub Suture Zone	253
12.1.2	Lebir fault zone	252
12.2	Terrane Parallel Faults	255
12.2.1	Kisap Thrust	255
12.2.2	Balau-Murau Fault zone	257
12.2.3	Bukit Keluang and Kapas Faults	258
12.3	Terrane-crossing faults	258
12.3.1	NNW–SSE and NW–SE faults	258
12.3.1.1	Kuala Lumpur Fault Zone	258
12.3.1.2	Bukit Tinggi Fault Zone	260
12.3.1.3	Seremban Fault Zone	262
12.3.1.4	Bok Bak Fault Zone	263
12.3.1.5	Ruok Fault Zone	264
12.3.1.6	Galas Fault Zone	265
12.3.1.7	Lepar Fault Zone	266
12.3.1.8	Mersing-Endau Fault Zone	266
12.3.2	North–South Fault Zones	268
12.3.2.1	Terengganu	268
12.3.2.2	Negeri Sembilan.	268
12.3.3	NNE–SSW and NE–SW Fault Zones	268
12.3.4	The East–West Fault Zones	269
12.4	Synthesis and timing	269
13	STRUCTURES AND DEFORMATION	271
13.0	Introduction	271
13.1	Jurassic–Cretaceous basins	272
13.1.1	Deformation of Jurassic–Cretaceous strata	274
13.1.2	Transverse Ranges	278
13.1.3	Structural synthesis of Jurassic–Cretaceous strata	279
13.2	Pre-Jurassic Formations	281

13.2.1	Northwest Area	281
13.2.2	Kuala Lumpur to Malacca area	283
13.3	Structural synthesis of the Western Belt	286
13.4	Central Belt	287
13.4.1	Bentong-Raub Suture Zone	288
13.4.1.1	Deformation of the Schist Series	288
13.4.1.2	Deformation of the Serpentine	289
13.4.1.3	Deformation of the Chert-argillite sequence	290
13.4.1.4	Deformation of the olistostromes	291
13.4.1.5	Redbeds	292
13.4.1.6	Permian– Middle Triassic metasediments and limestone	292
13.4.1.7	Deformation of Middle to Late Triassic strata	295
13.4.2	Structural synthesis	296
13.5	Eastern Belt	297
13.5.1	Southeast and East Johore	297
13.5.2	Terengganu and Pahang	300
13.5.3	Structural synthesis	304
13.6	Metamorphism	304
13.7	Structural evolution	305
13.7.1	Lower Cambrian	305
13.7.2	Lower to Mid Devonian	306
13.7.3	Pre-Lower Permian	306
13.7.4	Middle Devonian to Permo-Triassic along Bentong-Raub Zone	306
13.7.5	Permo-Triassic in the Bentong-Raub Zone	306
13.7.6	Pre-Middle Triassic Pan-Peninsular Orogeny	306
13.7.7	Upper Triassic to Lower Jurassic	307
13.7.8	Middle to Upper Cretaceous	308
13.7.9	Lower to Middle Eocene	308
14	TECTONIC EVOLUTION	309
14.0	Introduction	309
14.1	Palaeo-Latitude Measurements	310
14.2	Stratigraphic Distinction Between Sibumasu and Cathaysia	310
14.2.1	Plants	310
14.2.2	Limestones and volcanic rocks	312
14.2.3	Marine diamictites (pebbly mudstones)	312
14.2.4	Non diamictite-bearing formations	312
14.3	Lower Permian Gondwanaland assembly	314
14.4	Palaeogeographic Reconstructions of the Drift Pattern	315
14.5	The Indosinian Orogeny	316
14.6	Tertiary extrusion tectonics and oroclinal bending	316
14.7	Palaeomagnetic research on Peninsular rocks	318
14.7.1	Upper Jurassic–Lower Cretaceous	318
14.7.2	Upper Triassic Main Range Granite	319
14.7.3	Lower Palaeozoic Setul Limestone	321
14.7.4	Permo-Triassic limestones	323
14.7.5	Regional tectonic implications	324
14.8	Global Positioning System (GPS) results	324
14.9	Regional Gravity Profiles	324
14.9.1	Kuala Lumpur to Kuantan	324
14.9.2	Northwest peninsula	330
15	MINERAL DEPOSITS	331
15.0	Introduction	331
15.1	Recent Mining Developments	331

15.2	Regional Distribution of Tin	331
15.3	Placer Tin	332
	15.3.1 Stratigraphic Relationships	333
	15.3.2 Cassiterite grain-size and deposition	335
	15.3.3 Eluvial and colluvial placers	335
	15.3.4 Alluvial fan placers	336
	15.3.5 Residual bottom placers	337
	15.3.6 Fluvial allochthonous bottom placers (kaksa)	337
	15.3.7 Fluvial above-bottom placers (mintjan)	337
	15.3.8 Fluvial cave placers	338
	15.3.9 Littoral and marine placer environment	338
15.4	Primary Tinfields	338
	15.4.1 Mineralogical associations	339
	15.4.2 Major faulting in and around the tin fields	339
	15.4.3 Relationship between tin deposits and granites	340
	15.4.4 Hydrothermal veins and lodes	340
	15.4.4.1 Cornish-type lodes (Sungai Lembing)	340
	15.4.4.2 Veins, stringers and stockworks	344
	15.4.5 Skarn (pyrometasomatic) mineralisation	345
	15.4.5.1 Pelepah kanan	345
	15.4.5.2 Stanniferous skarns	346
	15.4.5.3 Stanniferous pegmatites and aplites	347
15.5	Iron Deposits	347
	15.5.1 Bukit Besi	348
	15.5.2 Bukit Ibam	348
	15.5.3 Others	351
15.6	Volcanic Arc Mineralization	351
	15.6.1 Manson's Lode	351
	15.6.2 Mengapur	354
	15.6.3 Tasek Chini Prospect	354
	15.6.4 Others	355
15.7	Gold Mineralisation in Quartz Veins	355
	15.7.1 Western Gold Belt	356
	15.7.2 Central Gold Belt	358
	15.7.2.1 Selinsing (No. 4, Fig. 15.13)	358
	15.7.2.2 Kecau Tui (No. 5, Fig. 15.13)	358
	15.7.2.3 Penjom (No. 6, Fig. 15.13)	358
	15.7.2.4 Tersang (No. 7, Fig. 15.13)	359
	15.7.2.5 Raub–Bukit Koman (No. 8, Fig. 15.13)	359
	15.7.2.6 Kanan Kerbau (Buffalo Reef) (No. 10, Fig. 15.13)	360
	15.7.3 Gold Belt 3: Base metal-gold	360
	15.7.4 Eastern Gold Belt 4	360
	15.7.5 Source of gold	361
15.8	Tungsten Deposits	361
	15.8.1 Kramat Pulai	361
	15.8.2 Others	363
15.9	Bauxite	363
15.10	Barite	363
15.11	Limestone Quarried for Cement	363
15.12	Others	363
16	OIL AND GAS	365
	16.0 Introduction	365
	16.1 Acreage Situation	365
	16.2 Exploration History	368

16.3	Oil and Gas Occurrences and Resources	371
16.4	Malay Basin	372
16.4.1	Hydrocarbon Distribution	372
16.4.2	Petroleum Systems	373
16.4.2.1	Source Rocks	374
16.4.2.2	Reservoir Rocks	377
16.4.2.3	Seal Rocks	379
16.4.2.4	Overburden Rocks	379
16.4.2.5	Generation, Migration and Accumulation	379
16.4.2.6	Trap Formation	381
16.4.3	Petroleum Plays and Trap Styles	381
16.4.3.1	Compressional Anticlines	381
16.4.3.2	Traps Associated with Normal Faults	383
16.4.3.3	NE Ramp Margin Plays	384
16.4.3.4	High Pressure High Temperature (HPHT) Play	385
16.4.3.5	Fractured Basement Play	385
16.4.4	Fields	385
16.4.4.1	Dulang Field	385
16.4.4.2	Guntong Field	389
16.4.4.3	Seligi Field	390
16.4.4.4	Semangkok Field	392
16.4.4.5	Tapis Field	392
16.4.4.6	Tinggi Field	394
16.4.4.7	Angsi Field	397
16.4.4.8	Jerneh Field	398
16.4.4.9	Sotong Field	401
16.5	Penyu Basin	403
16.5.1	Exploration History	403
16.5.2	Hydrocarbon Occurrences	404
16.5.3	Petroleum Systems	404
16.5.3.1	Source Rocks	404
16.5.3.2	Reservoir Rocks	404
16.5.3.3	Seal Rocks	404
16.5.3.4	Generation, Migration and Accumulation	404
16.5.3.5	Trap Formation	404
16.5.4	Petroleum Plays and Trap Styles	404
16.5.4.1	Post-rift Sunda Fold Play	404
16.5.4.2	Late Syn-rift Basement-Drape Play	404
16.5.4.3	Fractured Basement Play	405
	REFERENCES	407
	INDEX	451

Introduction

C.S. Hutchison

More than 30 years have passed since the John Wiley publication of *Geology of the Malay Peninsula* (Gobbett & Hutchison, 1973). This book was compiled under great hardship by the two editors because it was based on many unpublished manuscript memoirs of the Geological Survey and the editors frequently drove to Ipoh, along the old winding road, to make notes from the draft manuscripts. Readers may be interested to learn the current whereabouts of the authors. Derek Gobbett and Charles Hutchison live in retirement in Yorkshire and Petaling Jaya, respectively. Ken Hosking retired to Spain and then back to England, where he died in 1991 in his hometown of Camborne (Hutchison & Haile, 1992). Peter Herman Stauffer now works for the U.S. Geological Survey in Menlo Park. Professor Emeritus Tjia Hong Djin is retired in Putrajaya and does consultancy work. Clive Roderick Jones lives in retirement in England and Cedric Keith Burton lives in retirement in Jakarta.

Many requests for a second edition have been made over the years but a suitable nucleus of experienced geologists has not, until now, been motivated to undertake a new compilation. This is not a second edition, for too much new information, understanding and updated concepts have necessitated a completely new compilation. The paradigm of plate tectonics requires a totally new approach. Since the publication of the *Geology of the Malay Peninsula* in 1973, a generation of Malaysian geologists have worked and carried out research on the geology of Peninsular Malaysia. Most of them are graduates of the University of Malaya, and many have reached retirement age. It is felt that the time is right to capture and document the knowledge of these experienced geologists before they fade into the sunset. Thus, the University of Malaya and the Geological Society of Malaysia have agreed to jointly publish this book on the geology of Peninsular Malaysia.

Unlike the previous book, this book also includes the geology of the offshore Tertiary basins.

This book and the accompanying map are built predominantly upon the regional mapping programme of the Geological Survey Department of Malaysia that, like many other geological surveys, no longer carries out regional geological quadrangle mapping. Therefore, the areal geology of Peninsular Malaysia may now be considered finalised. A major landmark in the history of the Geological Survey occurred in the middle of 1967. The late Mr. S. K. Chung (Chung Sooi Keong) became its first Malaysian director. He replaced Mr. W. D. Proctor, who retired upon Malaysianization. Proctor was appointed director a year earlier upon the departure of Dr. J.B. Alexander, who left behind an impressive backlog of unpublished memoirs and bulletins extending back as far as 1958.

A publications editor, Mr. Gray Darling, was seconded from Canada under the Colombo Plan. He edited and oversaw into publication most of the draft manuscripts that remained from the directorship of Dr J. B. Alexander. Mr. Darling found the draft memoir on Perlis, Langkawi and North Kedah too long for him to successfully condense and edit. Dr. P. H. Stauffer carried out the task and eventually Memoir 17 was published in 1981 after a long delay. On 1 July 1999, the Geological Survey Department and the Mines Department were merged to form the Minerals and Geoscience Department.

At the time of publication of Gobbett and Hutchison (1973), Peninsular Malaysia was a pre-eminent tin mining country. Petroleum Nasional Berhad (PETRONAS) was established in 1974 and the first oil production from the Malay Basin came only in 1978. Collapse of the international tin price in 1985 resulted in near extinction of the tin industry and recent dramatic increase in metal prices has not revived the industry because many alluvial tin tailings

had been reworked, and towns had expanded to cover up former mining areas. The last two placer tin dredges, one in the Kinta Valley, the other near Dengkil, are no longer in operation and are planned to become tourist attractions. There is still a tin smelter in Butterworth and only a very few placer mines in the Kinta Valley. Gold mining has expanded because of the dramatic increase in the metal price.

The earlier book presented a woefully inadequate picture of the ages of the granites. This situation has been dramatically improved beginning with the pioneering work of John Bignell (Bignell & Snelling, 1977), followed by extremely significant work by Liew (1983). The outstanding work of Cobbing *et al.* (1992) later ensured that the granites, their ages and geochemical signatures, became well known. Arising from this great body of work, the Main Range Granite of Peninsular Malaysia became the world standard for collisional S-type granite (Pearce *et al.*, 1984).

The collision was identified as the Upper Triassic Indosinian Orogeny that resulted from closure of the Palaeo-Tethys Ocean and much research has been carried out to describe and refine the age of the Bentong–Raub suture. The accurate identification of the radiolaria contained in the ribbon cherts proved to be invaluable (Metcalf *et al.*, 1999). The recognition of the suture led to the realisation of the stratigraphical differences between that part of the peninsula west of the suture and that lying east.

The terrain lying west of the suture has similarities with Sumatra and western Thailand and has come to be referred to as “Sibumasu”. Its stratigraphy contains undeniable Carboniferous–Permian Gondwanaland affinities, notably marine pebbly mudstones of glacial origin. The terrain lying east of the suture has undeniable similarities with eastern Thailand in having affinities with Indochina and southern China. It is said therefore to have Cathaysian affinities. No generally acceptable name has been coined for it. “Indochina” is unsuitable because that is a political entity. In this book we refer to it as “East Malaya”.

AUTHORS AND CONTRIBUTORS

Charles S. Hutchison

spent most of his academic career at the University of Malaya (1957–1992), where he obtained his Ph.D. in 1967. In 2005 he was conferred the title of professor emeritus by the

University. He is a recognised authority on the geology and tectonics of Southeast Asia through his books and papers. He recently taught courses part-time at the Universiti Brunei Darussalam and continues to teach part-time at the University of Malaya. He has been visiting professor at Kansas and Cornell universities. He worked for ESRI at the University of South Carolina, for CCOP in Bangkok, and for an oil company in Trinidad. He received the *Special Commendation Award* in 1994 from the AAPG. He was president of the Geological Society of Malaysia from 1969 to 1970 and was awarded its honorary membership in 1986.

Denis N. K. Tan

worked as a geologist in the Geological Survey of Malaysia in Kuching from 1972 to 1984. During this time, he was involved in regional mapping and published two reports. In late 1984, he joined Sarawak Shell Berhad where he worked mainly in regional geological review and exploration geology. In addition to Miri, he had assignments for Shell in The Hague (1990 to 1993), Kuala Lumpur (1999 to 2001), and Houston (2002 to 2004). He retired from Shell in November 2004, and joined the University of Malaya as a Professor in Petroleum Geology in September 2005. He retired from the University in August 2008, and is enjoying his retirement in travelling.

Lee Chai Peng

started his academic career as a tutor in the Department of Geology, University of Malaya in 1977. He was appointed a lecturer on completion of his M.Sc. on the Cambrian of the Machincang and Tarutao Formations. He obtained a Ph.D. from Liverpool University on the Macrostratigraphy of the North Downs Chalk in 1988 under a Commonwealth Academic Staff Scholarship. He was promoted to Associate Professor in 1992 and Professor in 2005. His research interests include Upper Palaeozoic glacial marine deposits, scyphocrinoid loboliths, Palaeozoic stratigraphy, regional tectonics, Miocene trace fossils, geohazards in limestones, reclamation of ex-tin mining lands, geo-conservation and geo-art. He was President of the Geological Society of Malaysia from 2004 to 2007. He was appointed Deputy Dean of the Science Faculty in September 2007.

Mustaffa Kamal Shuib

is an associate professor in structural geology and tectonics at the University of Malaya. He graduated from the University of Malaya and did his post-graduate studies at Imperial College, University of London. He has been actively involved in teaching and research at the University of Malaya since 1987. His current research interest is on the tectonic evolution of Peninsular Malaysia. He has published papers on structural geology, tectonics and engineering geology.

Samsudin Hj Taib

is an associate professor in the Department of Geology, University of Malaya. He graduated from the University of Malaya in 1979 and joined the geology department as a tutor. He did his postgraduate studies in the Virje Universiteit Brussels (1979), Belgium, (MSc in Quaternary Geology – Geophysics), Imperial College, University of London (1980), (MSc in Geophysics), and University of Durham (1986), United Kingdom, (PhD in Geophysics). He was appointed a Lecturer in 1981 and has since served the University of Malaya as a Geophysicist. His research interest is application of the geophysical methods for geological and engineering applications.

John Kuna Raj

graduated from the University of Malaya in August 1972 with a B.Sc. (Hons) degree in Geology. He received the Diploma in Photo-Interpretation for Geomorphology in July 1973 and the M.Sc. degree in January 1975 at the International Institute for Aerial Survey and Earth Sciences at Enschede, Netherlands. He joined the University of Malaya as a lecturer in March 1975, where he received his Ph.D. in July 1983. He was promoted to Associate Professor in January 1985 and appointed Professor of Engineering Geology in August 1994. He retired in October 2004, but continues as a professor on contract.

Dr. Raj was Deputy Dean of the Science Faculty from October 1991 to March 1992 and was the Head of the Department of the Geology Department from April 1994 to March 1998. He was Vice-President in 1984 and President of the Geological Society of Malaysia in 1985–1986. He was honorary secretary of the Institute of Geology of Malaysia from 1986 to 1990. He has

also been active as a consultant on geology and has been involved in several engineering projects in Malaysia. Dr. Raj's main research interests and publications are on landslides and the geotechnical properties of weathered materials.

Wan Hasiah Abdullah

began her academic career in 1984 upon undertaking a tutorship/postgraduate programme in the U.K. and started teaching in the Department of Geology, University of Malaya, in 1990. She was appointed Associate Professor in 1999 and Professor in 2005. She specializes in organic petrology and petroleum geochemistry. Her research interest is in assessing the oil-generating potential of coals and determining depositional environments of oil-prone source rocks. For her MSc, she worked on the Brent Formation coals of the North Sea and for her PhD she worked on a succession of sedimentary rocks from Spitsbergen (Norway). She has also taken up consultancy work with Sarawak Shell Bhd., Sabah Shell Petroleum Company, and PETRONAS Research and Scientific Services Sdn. Bhd. She was Head of the Department of Geology from 2004 to 2007 when she oversaw the introduction of an M.Sc. degree programme in Petroleum Geology by coursework, the first of its kind in Malaysia.

Robert B. Tate

was a graduate of Imperial College, University of London. He commenced his career in the Geological Surveys of Nigeria and Ghana, mapping basement rocks and conducting mineral exploration. He was then appointed State Geologist, Negara Brunei Darussalam, in 1966 and studied palaeo-environments of the Miocene-Pliocene sequences that are exposed spectacularly along the coast. He worked subsequently in Afghanistan, Ethiopia, Somalia, Sudan, and China. He graduated with an M.Sc. from the University of Malaya and in 2001, he compiled a CD Rom on the "Geology of Borneo" as well as the first complete regional geological map of Borneo. He compiled Bulletin 50 of the Geological Society of Malaysia and has compiled a 1:1 million geological map of the Malay Peninsula to parallel the new edition of this volume as was done in the original 1973 publication. Sadly, Robert died in Warrington on the 22nd August 2008 before he could see the map and book published.

Nuraiteng Tee Abdullah

is a Senior Lecturer in the Geology Department, University of Malaya. She is a former graduate of the department and joined the department upon obtaining her doctorate from the University of London. Her current research interest is on the biostratigraphy and sedimentology of the Permian and Tertiary carbonates of Malaysia.

Azman A. Ghani

graduated from the University of Malaya in August 1992 with a B.Sc. (Hons) degree in Geology. He completed his Ph.D. at Liverpool University on the geochemistry of Donegal Granites, Ireland, in 1997, and joined the University of Malaya as a lecturer in the same year. He was appointed Associate Professor in 2001 and Professor in 2006. He has been visiting professor at the National Taiwan University. He

is presently Head of the Geology Department of the University of Malaya. Dr. Azman's main research interests are on geochemistry and petrology of igneous rocks. He has published papers on geochemistry and mineralogy of igneous rocks from Peninsular Malaysia and granite of Donegal, Ireland. He was appointed Head of the Geology Department in September 2007.

Ng Tham Fatt

graduated from the University of Malaya in August 1987 with a B.Sc. (Hons) degree in Applied Geology. He obtained an M.Phil. degree in 1993 and a Ph.D. in 2002 from the same university. He worked as an independent consultant before joining the University of Malaya in April 2007 as an Associate Professor. He has compiled Bulletin 34 of the Geological Society of Malaysia. His current research interest is microstructures of fault rocks and application of GIS to geology.

2

Geomorphology

J. K. Raj

2.1 INTRODUCTION

Peninsular Malaysia, with a total land area of 130,268 km², forms part of Sundaland, which includes Borneo, Java and Sumatra, as well as the intervening shallow seas from which emerge a number of smaller islands (van Bemmelen, 1949). Sundaland is the partly submerged southeastern extension of the Asian continent to which the Peninsula is connected by the Isthmus of Kra, which at its narrowest is only 64 km wide. The Peninsula is elongated in a general NNW–SSE direction with a maximum length of 750 km and breadth of 330 km. To the south, it is separated from Singapore Island by the narrow Johor Strait whilst, to the west, it is separated from Sumatra Island by the Straits of Malacca. To the southeast and east the South China Sea separates the Peninsula from Borneo Island.

The Peninsula has been largely or entirely emergent throughout the Cenozoic and is considered to have been relatively stable tectonically; activity being confined to epeirogenic uplift and tilting, some fault movement, and local gentle downwarps (Stauffer, 1973a; Gobbett & Tjia, 1973). More recent work in Sumatra, however, suggests otherwise and it is pertinent to briefly describe here its Cenozoic geologic history that started with shallow-water continental margin sediments deposited directly on the eroded surface of the pre-Tertiary Sundaland basement; erosion extending from the latest Cretaceous into the early Tertiary (de Smet & Barber, 2005). In the Late Eocene, continental margin sedimentation was brought to an end by the development of horst and graben structures throughout Sundaland from Late Eocene to Late Oligocene. This process had a dramatic impact on landscapes and sedimentation patterns; the former Sundaland peneplain being transformed into a mountainous landscape with isolated deep, lake-filled, basins where terrestrial, fluvial

and lacustrine sediments were deposited (Barber *et al.*, 2005a).

In the Late Oligocene, there was a change in the regional tectonic regime, with an area of predominant uplift in Sumatra, marked by the Barisan Mountains, becoming contrasted with areas of continued sedimentation in fore-arc and back-arc basins, west and east of the Barisan Mountains, respectively. There was then regional subsidence in a sag phase from the Late Oligocene to Middle Miocene, the effects of which extended well to the east of Sumatra into Malaysia. At the same time, the arc system of Sumatra started developing and the Barisan Mountains became an important source of sediments for the fore-arc and back-arc basins. For the first time in the Tertiary, rivers formed regional inter-connected systems that transported their sediment load to a few broad basins; deltas extending westwards from Malaysia and from the present Gulf of Thailand, controlling sedimentation in Central Sumatra (de Smet & Barber, 2005).

Continued regional subsidence led to marine transgression from Early to Middle Miocene and, at the time of maximum transgression in the Mid-Miocene, the sea gained access to almost the whole of Sumatra with source areas in the Malayan Shield, much reduced in size and relief, and the Barisan Mountains almost drowned. The climax of uplift and erosion of the Barisan Mountains occurred in the Late Pliocene and was accompanied by intense volcanism; this event coinciding with inversion tectonics in the back-arc basins. Quaternary deposits in Sumatra mostly consist of conglomerates derived from the Barisan Mountains with a high proportion of volcanic debris in the neighbourhood of Recent volcanoes, passing into fluvial deposits away from the mountains, and swamp deposits to the east along the shores of the Straits of Malacca and the Java Sea (de Smet & Barber, 2005).

The geomorphological development of

3

Regional geological setting

C. S. Hutchison

3.0 INTRODUCTION

Peninsular Malaysia is an integral part of the Eurasian Plate, the South-East Asian part of which is known as Sundaland (Hutchison, 1989, 1996). The Sunda Shelf, with less than 200 metre water depth, is a continuation eastwards and southwards and Sumatra, Natuna and western Borneo are integral parts of the same plate and the Sunda Shelf is common to all

(Fig. 3.1). The edge of the Sunda Shelf extends N-S a short distance east of Vietnam and then curves eastwards as far as the West Baram Line (Hutchison, 2004, 2005). East of the Shelf edge is the continental slope-rise, formed of continental crust that is increasingly attenuated eastwards. On navigation charts it is shown as 'Dangerous Grounds', characterized by deep water containing a large number of reefs.

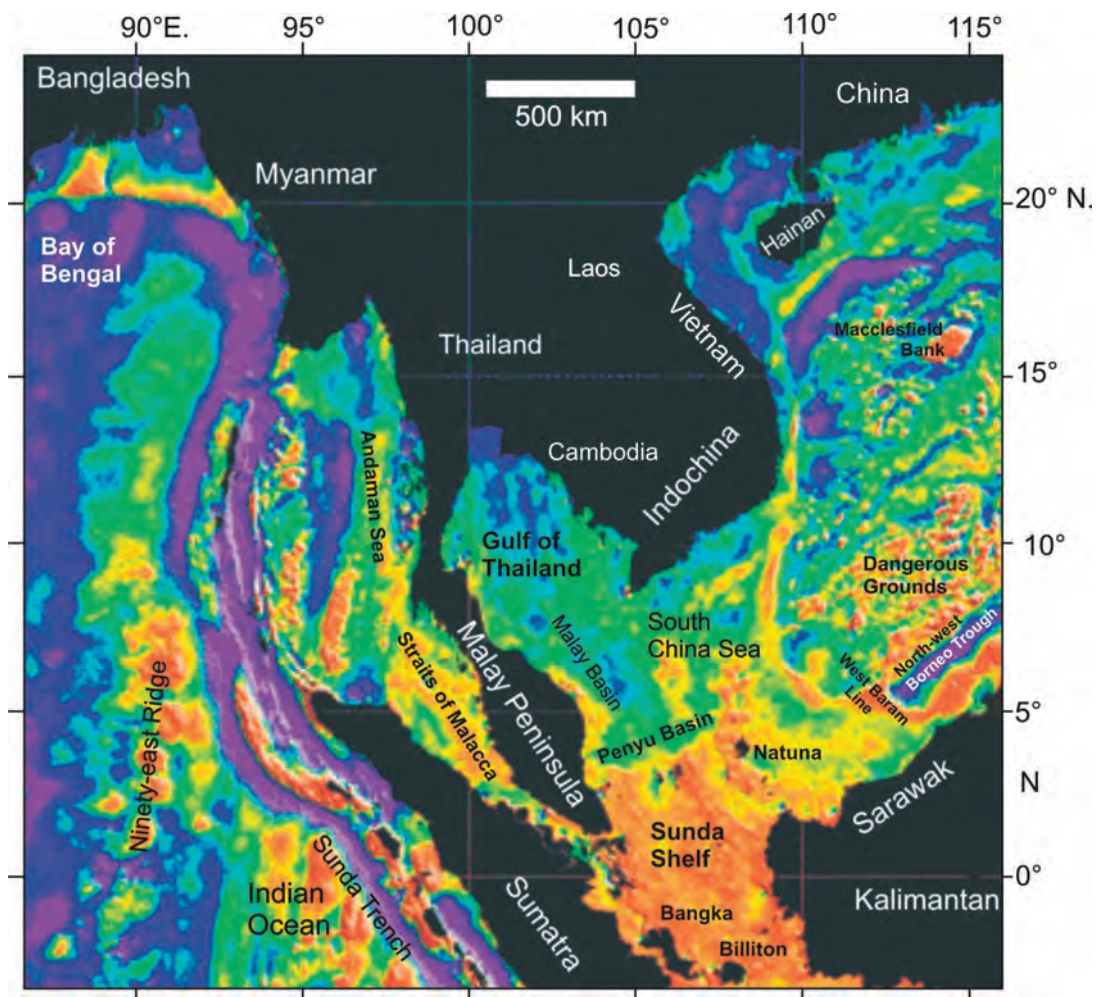


Fig. 3.1: Global marine gravity anomalies from SEASAT, GEOSAT, ERS-1 and TOPEX/POSEIDON altimeter data of South-East Asia by Oxford University Department of Earth Sciences (www.earth.ox.ac.uk).

Bentong—Raub Suture

C.S. Hutchison

4.0 INTRODUCTION

Because the eastern 'Foothills' of the Main Range are constructed of metasediments, associated with radiolarian chert and contain serpentinite and metabasite, Jones (1968, 1973) interpreted them as marking a 'eugeosyncline' separating western from eastern Peninsular Malaysia (Malaya). Haile and Stauffer (1972) pointed out rather amusingly that the "Bentong Group" of Alexander (1968) should be abandoned because it contained both radiolarian chert and continental redbeds, but they were sceptical that the Foothills Range represented a subduction zone. Haile (1973) and Hutchison (1973d) then interpreted the Foothills as a former subduction zone. The 'Foothills' zone thus became recognised as the central Malaya suture and Hutchison (1975) named it the "Bentong-Raub ophiolite line", that subsequently became widely known as the "Bentong-Raub Line". The main occurrences of the suture zone rocks are shown in Fig. 4.1, after Metcalfe (2000b). The Bentong-Raub Suture represents the Palaeo-Tethys in Peninsular Malaysia. It is a southwards extension of the Nan-Uttaradit and Sra Kaeo sutures of Thailand. The suture zone contains oceanic ribbon chert that has been dated by radiolaria ranging in age from Upper Devonian to Upper Permian (Metcalfe, 1999). Graptolites in the associated slates of the Tuan Estate south of Karak are dated Lower Devonian (Jones, 1970). Limestone clasts in mélangé are of Lower and Upper Permian age. The Palaeo-Tethys therefore opened in the Lower Devonian, caused by separation of Sibumasu from Gondwanaland, and closed in the Triassic, caused by the Indosinian orogenic collision with the Indochina Block that was earlier sutured to Eurasia.

4.1 CENTRAL AREA

The most accessible and therefore the best known part of the suture extends southwards from Cheroh (Fig. 4.2), through the Raub and Bentong areas and southwards towards the Kuala

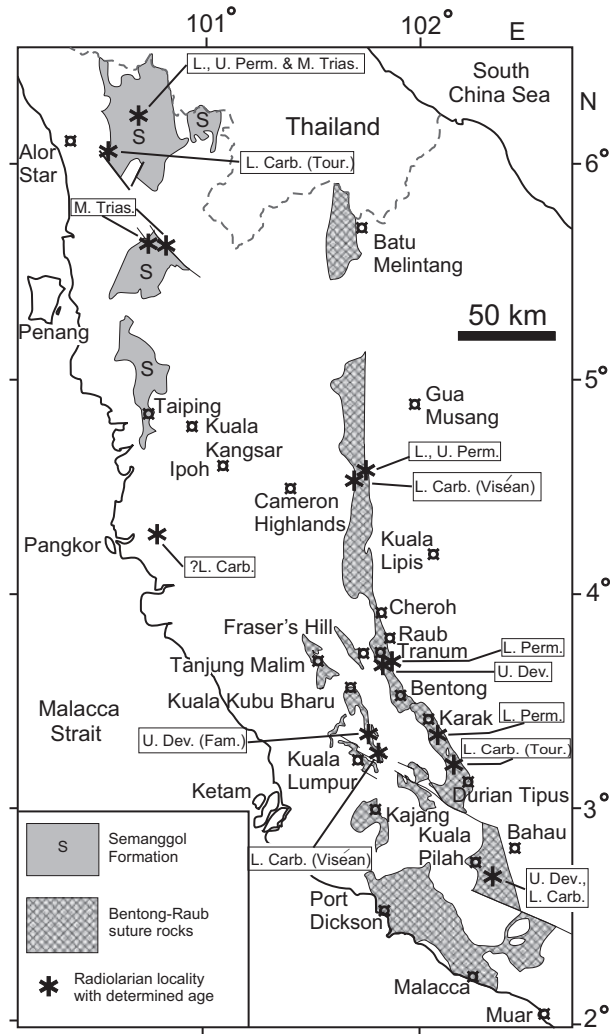


Fig. 4.1: Bentong-Raub suture zone. Distribution of suture zone rocks in Peninsular Malaysia and ages determined from radiolarian chert localities. The Semanggol Formation is interpreted to be related to the suture and may represent a foredeep basin. Redrawn and modified after Metcalfe (2000b).

Palaeozoic Stratigraphy

Lee Chai Peng

5.0 INTRODUCTION

Palaeozoic rocks outcrop over about 25% of the Peninsula. Forty-two formations were included in the Stratigraphic Lexicon of Malaysia (Lee *et al.*, 2004), but several new formations have been added since, particularly in refining the stratigraphy of the transitional units between the Setul Group and the Singa Formation in the northwest (Meor & Lee, 2002a, 2002b, 2004, 2005, Cocks *et al.*, 2005).

Another advancement, after Jones (1973a), is the replacement of the geosynclinal concept by the plate tectonic paradigm. This necessitated updating the familiar subdivisions of the Palaeozoic rocks in different parts of the geosyncline, such as miogeosyncline, geanticline and eugeosyncline, into their modern equivalents. The miogeosyncline, of shallow marine shelf sediments, is now recognised as part of the margin of Gondwanaland, to which Langkawi was attached on its west in the Early Palaeozoic. The geanticline represents the accretionary prism with volcanic input from the forearc, and the mud-rich deepwater eugeosynclinal sediments are oceanic.

The Peninsula may be subdivided into three belts characterised by different stratigraphy (Fig. 5.1). The western belt contains a northwestern domain that is also shown in this figure. A summary of the stratigraphy is given in Fig. 5.2.

5.0.1 Western Belt

Lower Palaeozoic rocks are confined to the western part of the peninsula, and Upper Palaeozoic rocks are found in all three belts in the tripartite peninsular divisions (Figs. 5.1, 5.2). The most complete sequence of Palaeozoic sedimentary rocks, ranging in age from Upper Cambrian to Upper Permian, is exposed in the Northwestern Domain of the Western Belt, in Langkawi, Kedah and Perlis. These

are mainly shallow-marine shelf sediments of the Machinchang and Jerai Formations, Setul Group, Timah Tasoh and Chepor Formations, Singa and Kubang Pasu Formations and Chuping Limestone that deepen eastwards to the Mahang and Sungai Patani Formations.

Palaeozoic rocks of the rest of the Western Belt are distributed in the foothills along both flanks of the Main Range granite batholith stretching from the Malaysian–Thai border southwards to Malacca. On the western side of the Main Range is the Baling Group sediments consisting of the Papulut Quartzite, Grik Siltstone, Lawin Tuff and Bendang Riang Formation in north Perak of probable Cambrian to Permian age. Other important Palaeozoic

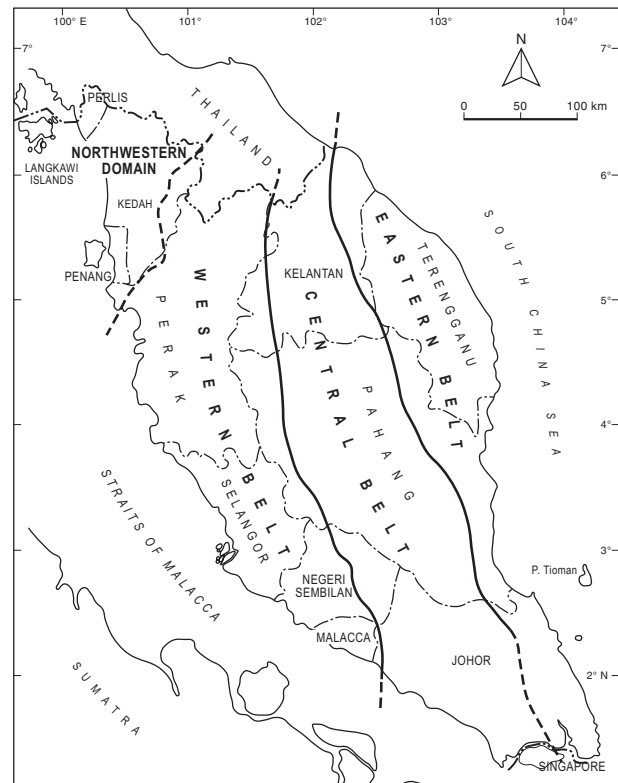


Figure 5.1: Map of Peninsular Malaysia showing the three belts and the northwestern domain within the Western Belt.

Mesozoic Stratigraphy

Nuraiteng Tee Abdullah

6.0 INTRODUCTION

At the beginning of the Mesozoic Era, a large part of the newly-formed landmass of the Peninsula was uplifted and remained subaerially exposed. Marine sedimentation was centred in two areas: the northwestern Kodiang–Semanggol depocentre and the Gua Musang–Semantan depocentre in the Central Belt (Fig. 6.1). The former was developed on the Upper Palaeozoic Sibumasu landmass, and was the only remnant of what was once an extensive area of marine deposition in Late Palaeozoic time. The Gua Musang–Semantan depocentre was areally more extensive and was developed on the Upper Palaeozoic shelf of East Malaya. The extensive occurrences of tuff and associated lava, tuffaceous siliciclastics and conglomerate, in the Gua Musang–Semantan depocentre during Triassic times, indicate that volcanic activities and basinal instability were active during the life span of the basin. In the deeper parts of the Gua Musang–Semantan depocentre, thick accumulations of turbidites have prompted geologists to refer to these rocks as flysch.

As the Triassic period ended, a new regional pattern of sedimentation was established in the aftermath of tectonic disturbances and widespread plutonism that formed the Main Range, Central Belt and the Eastern Belt plutons. Voluminous sediments, eroding from newly elevated sources, were transported and infilled existing basins. Significant faulting, especially strike-slip, dissected the landmass, created new basins and caused partial inversion of earlier ones. These new basins were infilled rapidly by red, ferric-rich, siliciclastics that were deposited in diverse terrestrial settings, ranging from alluvial fans, braided rivers, flood plains, lakes and deltas. These redbeds, aptly named in reference to their colour, were likened to molasse deposits and marked the end of marine

sedimentation throughout the Peninsula during Jurassic to Cretaceous times.

Burton (1973a) remarked that the Peninsula was given its present form during the Mesozoic Era. His statement remains undisputed and his work on the Mesozoic of Peninsular Malaysia continues to be the standard reference. Much

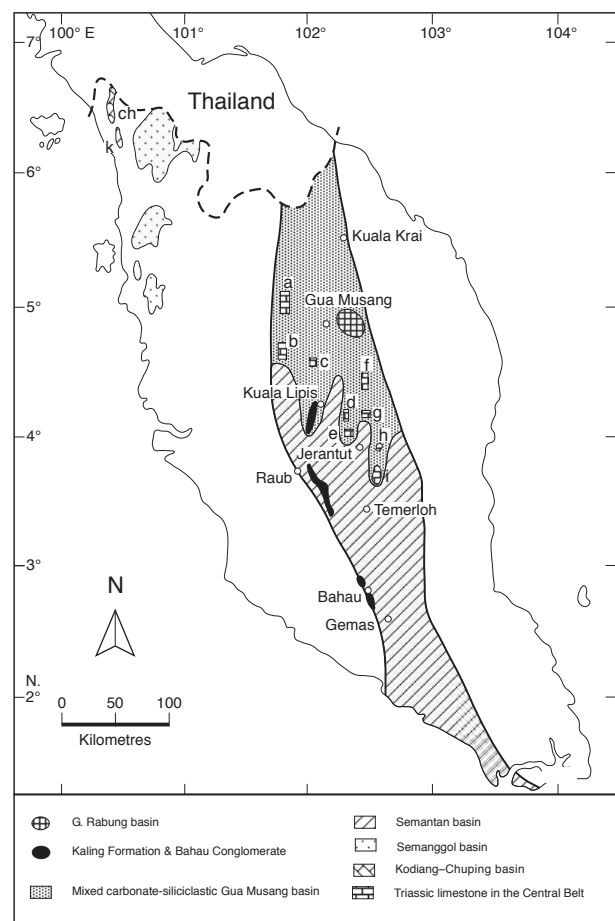


Figure 6.1 Triassic depocentres of Peninsular Malaysia (modified after Khoo, 1983; Kamal, 1990; Fontaine & Ibrahim Amnan, 1994). Localities of Triassic limestone in the Central Belt: (a) Kg. Lambok – Gua Cha; (b) South of Pos Blau (G. Belong); (c) Gua Panjang; (d) Sg. Kenong Area; (e) South of Kerambit; (f) Gua Telinga – Gua Luas; (g) Bt. Darang Harimau; (h) Kota Gelanggi; (i) G. Sinyum – G. Jebak Puyuh. Localities of Kodiang Limestone: (ch) Chuping, (k) Kodiang.

Cenozoic Stratigraphy

J.K. Raj, D.N.K. Tan and
Wan Hasiah Abdullah

7.0 INTRODUCTION

Cenozoic sedimentary rocks occur both onshore, mainly along the West Coast, and offshore in the Straits of Malacca and the South China Sea. The Peninsula onshore has been almost entirely emergent throughout the Cenozoic, with inland Tertiary sedimentary rocks reported from ten localities. Most recent work, however, indicates that only seven have proven, or very likely to have, sedimentary rocks of Tertiary age. These occur at isolated and widely separated sites on the West Coast, indicating that the sediments were probably deposited in individual discrete basins. These are pull-apart basins that developed during the Eocene to Oligocene and occur at Bukit Arang in north Perlis and Kedah, Lawin in north Perak, Enggor in central Perak, Batu Arang in Selangor and Kampong Durian Chondong, Kluang–Niyor and Layang-Layang in central Johor. Other localities that were previously suspected to have Tertiary sedimentary rocks are at Nenering in north Kedah (now known to be of Cretaceous age) and at Tanjong Rambutan in north Perak and Merapoh in north Pahang (now believed to be Quaternary). The onshore basins can be separated into four broad groups: a northwestern occurrence at Bukit Arang, a north-central group comprising Lawin and Enggor, a central occurrence at Batu Arang, and a southern group comprising Kampong Durian Chondong, Kluang–Niyor and Layang-Layang.

Most of the Tertiary sedimentary rocks occur offshore in the Straits of Malacca and South China Sea. In the Straits of Malacca, they were deposited in 15 grabens and half-grabens, which can be grouped into four N–S-trending belts. The northern belt consists of the Northern, MSS-XA, Thai Border West and Thai Border East grabens. The Central belt comprises the Southern, Central, Eastern, and the West, East

and North Penang grabens. The Port Klang belt is made up of the Port Klang, Angsa and Sabak grabens, and the Johor belt consists of the Johor and Kukup grabens. These offshore grabens are probably related to the North and Central Sumatra basins in Indonesia. The relationship, if any, between these offshore grabens and the onshore Tertiary basins is uncertain. However, it would not be unreasonable to surmise that the onshore Batu Arang basin may be related to the Port Klang belt, and the Kampong Durian Chondong, Kluang–Niyor, and Layang-Layang basins to the Johor belt. It is interesting that the onshore basins are much smaller in size than the offshore grabens. The relationship between the onshore basins in the north to the offshore basins is less clear.

The two major Tertiary basins are the Malay and Penyu basins, which occur in the South China Sea, offshore East Coast (see Chapter 8). These two basins are distinctly different from the onshore basins and the Straits of Malacca grabens, and are filled with more than 14 km of Tertiary sediments.

The Quaternary Period is represented by extensive deposits of unconsolidated to semi-consolidated boulders, gravel, sand, silt and clay that underlie the coastal and inland plains as well as infilled valleys. Such sediments also form river terraces and beach ridges, locally known as '*permatang*'. All these sediments have traditionally been known as 'alluvium', though some are definitely of a colluvial, littoral or marine origin. Ongoing research indicates that some of them may be much older, possibly Middle to Late Tertiary.

The coastal lowland regions contain a discontinuous fringe of peat swamp and mangrove forests that form a transition buffer between the land and sea. The peculiar conditions responsible for the formation of peat swamp forest resulted in the establishment of a unique ecosystem that

Malay and Penyu Basins

D. N. K. Tan

8.0 INTRODUCTION

The Malay and Penyu Basins, offshore the East Coast of Peninsular Malaysia, are part of a series of Cenozoic sedimentary basins in the South China Sea and Gulf of Thailand, extending from the Pattani Basin (or Pattani Trough) in Thailand, in the north, to the West Natuna Basin in Indonesia in the southeast (Fig. 8.1).

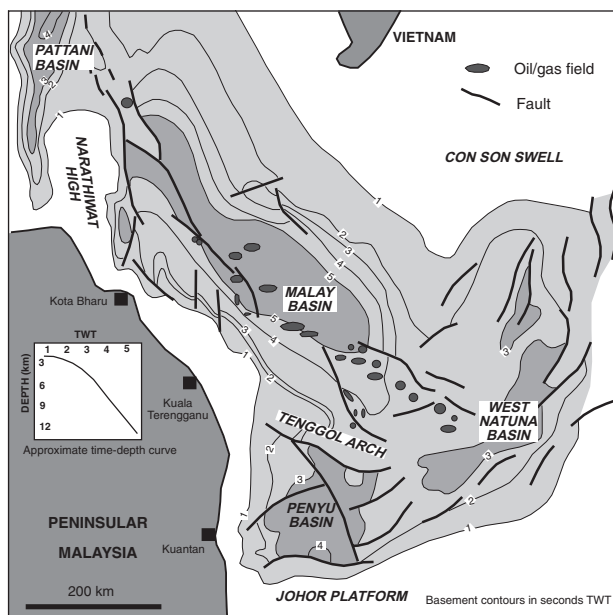


Fig. 8.1: Outline of the Malay and Penyu basins (modified from Khalid *et al.*, 1996; Tjia, 1998b)

The Malay Basin, separated from the Pattani Basin in the north by the Narathiwat High, and from the Penyu Basin in the south by the Tenggol Arch, is about 500 km long and 200 km wide, with a total area of about 83,000 km² (Tjia, 1999b; Bishop, 2002). To the northeast, the basin rises to shallow depths over the vast Con Son Swell. The Western Hinge-line Fault forms the southwest margin of the basin. The basin is elongated NW–SE to NNW–SSE, generally parallel to Peninsular Malaysia.

It comprises 2 parts: a southern part which trends NW–SE, and a northern part that trends NNW–SSE. These two are separated by a broad transition zone, the so-called Kapal–Bergading Tectonic Line, aligned along the 103° 30′ E longitude (Tjia & Liew, 1996). The basin is filled with more than 14 km of Cenozoic sediments. The Malay Basin is an important hydrocarbon province in Malaysia, with production of more than 1.9 billion bbls (barrels) of oil and 2.8 TCF (trillion cubic feet) of gas by end of 1997 (Wong, 1999).

The Penyu Basin is separated by the Tenggol Arch from the Malay Basin to the north and the West Natuna Basin to the east. It is bounded to the south by the Johor Platform and the northwest by the Pahang Platform. The basin probably extends onshore under the Sungai Pahang delta (Tjia, 1998b). The basin is elongated roughly E–W, approximately 160 km by 100 km, and is filled with up to 8 km of Cenozoic sediments (Mazlan & Azlina, 1999). It is separated by the NW–SE-trending Rumbia fault into 2 parts (Khalid *et al.*, 1996). The western part is dominated by two E–W-trending half-grabens, whereas the eastern part is characterised by NW–SE- to WNW–ESE-trending structures (Tjia, 1998b).

The Malay and Penyu basins are filled with Cenozoic siliciclastic sediments, ranging in age from Oligocene to Recent. The stratigraphy of the Malay Basin is different from that in the Penyu Basin. Different stratigraphic schemes have been used in the Malay Basin by different companies and workers, and these are summarised in Figure 8.2, which also shows the stratigraphy of the Penyu and West Natuna basins.

The fault patterns in onshore Peninsular Malaysia and in the offshore Malay and Penyu basins are shown in Figure 8.3. The onshore faults are described in Chapter 12. The offshore faults were inferred from structural styles in the overlying sediments and magnetic/gravity

Volcanism

Azman A. Ghani

9.0 INTRODUCTION

Contemporaneous lavas and pyroclastic rocks occur interstratified within Lower and Upper Palaeozoic and Mesozoic strata. There are also post-orogenic flows of Cenozoic age. Most are dated by their stratigraphic position. Early studies by Willbourn (1917) grouped them under the name Pahang Volcanic Series, because most are best developed in Pahang (Fig. 9.1). However, later field investigations showed that contemporaneous volcanic and pyroclastic rocks are much more extensive and include occurrences within Lower Palaeozoic strata in the Western Belt and Upper Palaeozoic and Mesozoic strata in the Central and Eastern Belts. The latter are mainly rhyolitic to dacitic and are both pyroclastics and lavas. The other significant volcanic occurrence is the Cenozoic

post-orogenic flows of alkaline basaltic lavas in the Segamat and Kuantan areas. This chapter also includes the dykes of intermediate to basic composition that intrude mainly the rocks of the Eastern Belt.

The overall occurrences of volcanic rocks have been reviewed by Hutchison (1973a) and this chapter does not repeat the details of the field relationships and their petrography. This chapter will focus more on the available geochemical data. These volcanic rocks have generally only been studied at reconnaissance level, mainly to correlate them with the closure of the Tethys Ocean during Permo–Triassic time. A complete modern geochemical and radiometric-based study that comprises data for all the volcanic rocks from the Peninsula does not yet exist. Not many have been dated and analysed for major,

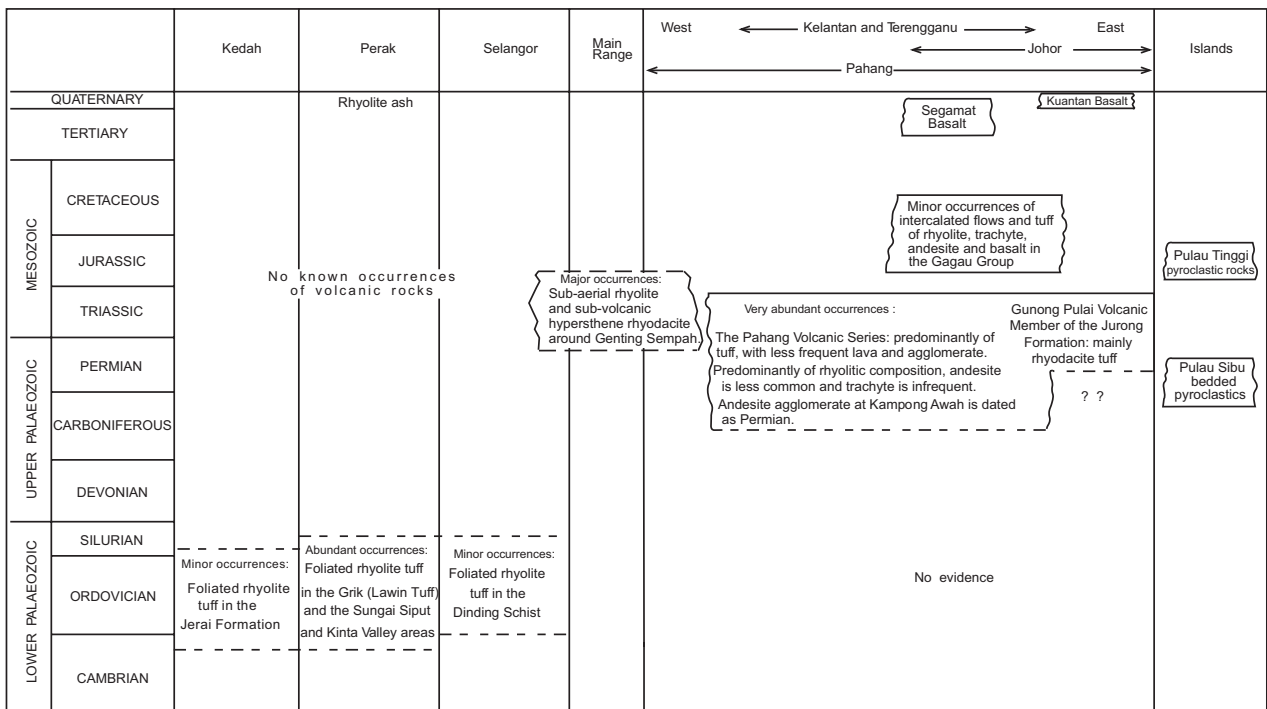


Fig. 9.1: Summary of ages of volcanic rocks across the peninsula (modified after Hutchison, 1973a).

Plutonism

Azman A Ghani

10.1 INTRODUCTION

The plutonic rocks are part of the Southeast Asian tin belt (Schwartz *et al.*, 1995). More than 90% are granitic. The granitoids of Malaysia, Thailand and Myanmar have petrological and geochronological characters that permit them to be put into belts (Cobbing *et al.*, 1992). They have been divided into three: Western province, Eastern province and Main Range province (Hutchison & Taylor, 1978; Beckinsale, 1979; Cobbing *et al.* 1986) (Fig 10.1).

The Main Range granites are concentrated mainly in Peninsular Malaysia but extend through Peninsular Thailand as far as the latitude of Bangkok. The Main Range and Eastern Belt granites of Peninsular Malaysia demonstrate distinctly different petrological and geochemical varieties. These provinces are separated by the Bentong-Raub suture (Hutchison, 1975). The Main Range granites have a more restricted composition ($\text{SiO}_2 > 65\%$) whereas the Eastern Belt granitoids are compositionally expanded, SiO_2 ranging from 50 to 78%. The granites that have been responsible for the tin mineralization are exclusively of S-type, formed by collision of continental lithosphere. The Eastern and Central belts consist of both I and S type granitoids. In contrast to the Western Belt, some of the complexes and plutons of the Eastern Belt contain mafic to intermediate plutonic rocks that are closely spatially related to the granitic plutons. The mafic rocks constitute less than 5% of the total exposed plutonic areas. They are marginal to the granitic plutons, as well as synplutonic dykes and as late intrusive dykes mainly of dolerite composition. In this chapter the plutonic rocks will be divided into three: (1) The Main Range, (2) the Eastern Belt, and (3) Cretaceous plutonic rocks. The distribution of the Peninsular Malaysian granitic plutons and associated rocks is shown in Fig.10.2.

10.2 GEOCHRONOLOGY

Geochronological studies of the granitoid batholiths were initiated by the Institute of Geological Sciences (IGS) of London in 1974 and the results of the Rb–Sr and K–Ar work were published by Bignell and Snelling (1977). Bignell (1972) carried out the field work and subsequent laboratory analyses for his D.Phil. thesis. The striking feature of all west Coast Province granites is the large discrepancies between K–Ar mica age, Rb–Sr whole rock isochrons and the U–Pb zircon ages. The K–Ar data give a wide range between 40 to 210 Ma in contrast to the Rb–Sr and U–Pb data, which give Late Triassic ages (200 to 230 Ma) (Bignell & Snelling 1977, Liew 1983, Darbyshire 1988). The absence of K–Ar ages older than 210 Ma was interpreted to be the result of Ar loss caused by Late Triassic intrusions and young fault-related disturbance (Bignell & Snelling 1977). A summary of the geochronology of the Peninsula is shown in Table 10.1.

10.2.1 Main Range Granite

The ages of 207–230 Ma are in agreement with the results of Bignell & Snelling (1977), Liew (1983) and Darbyshire (1988). The high initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios are in agreement with the S–type characteristics. The initial ratios range from 0.71 to 0.73 as shown in Fig. 10.3, from Hutchison (2007), using the data of Cobbing *et al.*(1992).

However there are also some younger granitic rocks in the western part of the Main Range, for instance the Gunung Jerai Granite of Kedah Peak. Analyses of different rock types in this pluton gave an age no more than 135 ± 6 Ma. Biotite and muscovite from the Jerai Granite have been dated using the K–Ar method to give an age of 47 ± 3 Ma and 59 ± 3 respectively (Bignell & Snelling 1977). The oldest component of this

Metamorphism

C.S. Hutchison

11.0 INTRODUCTION

High-grade metamorphic complexes are confined to the northern part of the Peninsula, giving rise to the general belief that the Peninsula has been uplifted and more deeply eroded in the north and tilted down towards the south.

11.1 STONG MIGMATITE COMPLEX

This migmatite complex forms mountainous country lying about 8 km west of the railway towns of Kemubu and Dabong. It is readily identified from the railway line by the reclining spine-like protrusion at the summit of Gunung Stong. Excellent outcrops occur in rapids along the Sungai Kenerong and Sungai Semuliang, both accessible from Kemubu (Fig. 11.1). The road links Dabong with Jeli, and some 17 km north of Kuala Balah, it transects the Sungai Renyok. Ibrahim Abdullah and Jatmika Setiawan (2003) described the Late Cretaceous Kenerong Leucogranite and its enclaves, exposed at waterfalls near the electricity power station.

11.1.1 Granitoids

There are three plutonic components (Singh *et al.*, 1984). The earliest two phases (Berangkat Tonalite and Kenerong Leucogranite) are in part highly deformed in a manner similar to that of the marginal country rocks (Fig. 11.1). The third phase, the distinctive pink Noring Granite, is undeformed.

The Berangkat Tonalite, at the southern end, is a coarse grey K-feldspar megacrystic biotite-hornblende tonalite that locally is highly deformed. It may be of Permo-Triassic age (Cobbing *et al.*, 1992), but no dating has been carried out and the similar abundance of enclaves to the Kenerong Leucogranite suggests that a Cretaceous age may be more appropriate. The tonalite is cut by the Kenerong leucogranite. It forms a complex network of

small intrusives and vein systems emplaced into the predominantly pelitic amphibolite-facies metasedimentary envelope. Three samples define an Upper Cretaceous Rb:Sr age of 79 ± 3 Ma, with an initial ratio of 0.70801 (Cobbing *et al.*, 1992). The pink Noring Granite is an undeformed megacrystic biotite-hornblende granite. It is a larger pluton extending northwards to intersect the East-West Highway west of Jeli. The Rb:Sr data define an isochron of 90 ± 30 Ma with an initial ratio of 0.70865. The Noring Granite intrudes the earlier Kenerong Leucogranite. Bignell and Snelling (1977) have reported the following K:Ar ages: 65 ± 2 for muscovite and 70 ± 2 Ma for biotite in the Noring Granite at Batu Melintang, and 69 ± 2 Ma for the Kenerong Leucogranite of the Stong Complex. These dates reinforce the interpretation of a Cretaceous age.

11.1.2 Granitoid-metamorphic rock relationships

The appropriate description is that the Stong is an injection migmatite of great complexity. The three main types of migmatite are well represented, with transitions between them (Fig. 11.2):

- Agmatite, in which angular enclaves of darker gneiss and schist are surrounded by more homogeneous granitic material. It appears to have formed by magmatic injection. Some contacts are concordant while others are discordant. Good examples occur along the Sungai Kenorong and Sungai Seladang.
- Venite, in which discrete layers and patches of granitic material occur in schist. The individual layers are narrower than in agmatite. Good examples occur along the Sungai Semuliang (Fig. 11.2)
- Nebulite, in which there is a more complete mixing of granitic material and schist. They are more homogeneous but contain schlieren generally enriched in biotite and hornblende,

Major Faults

Mustaffa Kamal Shuib

12.0 INTRODUCTION

The Peninsula has a NNW–SSE elongated shape with a slight dog-leg bend in the south near Klang and Mersing. The shape is controlled by the regional structures. The NNW–SSE general structural trend is also influenced by the distribution of the Main Range Granite, the backbone of the Peninsula. Extending from the Malaysia–Thailand border to the southern state of Negeri Sembilan, this central spine effectively separates the eastern and western parts of the Peninsula (Fig. 12.1).

As reflected by the strike ridges illustrated in the lineament map (Fig. 12.1) and the geological map (back pocket), the main structural trend of the Peninsula is NNW–SSE, defined by the strike of bedding and lithological boundaries, axial traces of folds and the strike of axial planes.

This NNW–SSE general structural trend is superimposed by later N–S, NW–SE, NNE–SSW, and E–W major faults (Fig. 12.2). These later structures, combined with the bedrock lithologies, controlled the irregularity of the surface topography and the coastlines. The dog-leg bend, which starts at the western coastline near Klang and ends at the eastern shoreline near Mersing, is because of NW–SE-trending strike-slip faults and, to a lesser extent, NNE–SSE-trending faults. In the East Coast, especially in southeast Johor, the strike ridges and faults control the coastline.

The NNW–SSE structural trend is reflected by the elongation of the Peninsula, Straits of Malacca and Sumatra. There are important differences as well as similarities between the Peninsula and Sumatra, because of a regional orocline, shown in Figure 3.4(C). The NW–SE faults of the Peninsula are parallel to the structural grain of most of Sumatra (Fig. 12.1). By contrast, the N–S structural grain of the Peninsula is parallel to faults in central Sumatra (Hutchison,

1994). The spectacular Bengkalis Graben, aligned at 102.3°E, extends southwards from the Straits of Malacca over a distance of 265 km.

The N–S to NNW–SSE structural grain has been used to divide the Peninsula into 3 major belts (Fig. 5.1) with a less obvious fourth domain in the NW (Tjia & Zaiton, 1985). The boundaries between the NW Domain and Western Belt are less well defined than the boundaries between the Western, Central and Eastern Belts. The NW Domain has a N–S grain, compared to the NNW–SSE structural grain of the rest of the Peninsula. A distinct N–S lineament along the eastern foothills of the Main range, called the Bentong–Raub Line (Hutchison, 1973d), separates the Western Belt from the Central Belt. The boundary between the Central and Eastern Belts is marked by the Lebir Fault Zone. Most workers correctly showed that the longitudinal belts of the Peninsula curved towards the southeast (Fig. 3.4) to include the “tin islands” of Bangka and Billiton (Hutchison, 1994). However, Tjia and Zaiton (1985) and Tjia (1989a) proposed that the Bentong and Lebir lineaments, which bound the Central Belt, may be extended across the Straits of Malacca in a southerly direction along the N–S-trending Lalang and Berangkat Lineaments of Central and South Sumatra. However, this proposal was not supported by Barber *et al.* (2005a), as shown in Figure 3.4.

These structures are the expression of several brittle-ductile deformations ranging from the pre-late Lower Permian to the Tertiary. The general NNW–SSE structural trend is believed to be the result of three main deformation phases: an Upper Triassic–Lower Jurassic transpression and Upper Cretaceous and Tertiary strike-slip deformations. The Upper Triassic–Lower Jurassic orogenic event is popularly believed to be due to the collision between Sibumasu and East Malaya. The Upper Cretaceous event not only deformed

Structures and Deformation

Mustaffa Kamal Shuib

13.0 INTRODUCTION

The structures of the Peninsula reflect a long and complex tectonic evolution, starting possibly from as early as Cambrian right up to the Cenozoic. It is thought that the western Gondwana part of the Malay Peninsula (Sibumasu) collided with the Indochina continental block (East Malaya) during the Upper Triassic Indosinian Orogeny. The Bentong–Raub Line is taken as the collision suture zone (Hutchison, 1975). Although the long suture zone, extending from Thailand to Peninsular Malaysia, has been widely accepted in almost all palaeo-tectonic reconstructions of Southeast Asia, it is also believed that the Bentong–Raub Line could represent a major normal fault (Tan, 1976; Harbury *et al.*, 1999) that formed the western boundary of a Mesozoic graben and that the geology reveals a major orogeny in the Permian and a less severe deformation in the Cretaceous (Harbury *et al.*, 1990). These contrasting views on the palaeo-tectonics have wide implication for the tectonic development of Southeast Asia as well as the evolution of Gondwanaland and the Tethys.

Several authors have reviewed the structural geology. They include Khoo and Tan (1983), Tan (1976, 1981b, 1982, 1996), Tjia (1972, 1978, 1986a, 1996), Tjia and Zaiton (1985), Harbury *et al.*, (1990), Mustaffa and Abdul Hadi (1999), Metcalfe (2000b) and Mustaffa (2000a). This chapter summarises the current state of knowledge.

The Peninsula can be divided into three major belts with a less clearly defined fourth domain in the NW (Fig. 5.1). It is popularly believed that the three-belt configuration and structural trends are the result of tectonic developments in the Mesozoic. The widely-accepted subduction-collision models assume that the Mesozoic Central basin is either a back-arc basin (Hutchison, 1973d; Ridd, 1980), a

fore-arc basin (Mitchell, 1977; Şengör 1984b, 1986; Hutchison, 1989a), a fore-arc/intra-arc basin (Hutchison, 1989a) or a post-suturing extensional basin (Tjia & Syed Sheikh, 1996). Extensional models assume that the Central Basin is a graben (Tan 1981; Khoo & Tan, 1983) or a Triassic back-arc basin (Harbury *et al.*, 1990). Since its nature is disputed, the structural styles within and along its margins are very significant for elucidating its configuration, leading to a more accurate interpretation.

The boundaries between the NW Domain and Western Belt are less well defined than the others. A distinct N–S lineament along the eastern foothills of the Main Range, called the Bentong–Raub Line (Hutchison, 1975), separates the Western from the Central Belt. Isolated serpentinite outcrops associated with radiolarian chert, schist, chaotic deposits and conglomeratic diamictites occur along the lineaments. These associations have been popularly used to indicate that the Bentong–Raub Line is a tectonic suture zone. The chaotic deposits have been referred to as *mélange*, olistostrome or slump deposits. Their clasts have been stretched, boudinaged and sheared. Mud injection structures along the extended clasts indicate soft-sediment deformation. However, convincing tectonic *mélange* with scaly matrix has yet to be reported. Bedding-parallel shear zones, wrapped around the clasts, suggest that soft-sediment deformation is consistent with tectonic faulting or they may have been superimposed later.

The boundary between the Central and Eastern Belts is marked by the Lebir Fault Zone. It is marked by NNW–SSE-trending curvilinear lineaments along Sungai Lebir near Manek Urai in Kelantan (see Chapter 12). It is believed that uplift and subsidence along the fault zone give rise to deposition of the Jurassic–Cretaceous Gagau and Koh Formations. Tjia and Zaiton

Tectonic Evolution

C.S. Hutchison

14.0 INTRODUCTION

It has been shown in Chapters 3 and 4 that the Bentong–Raub Suture is an important line separating terranes of contrasting geology and that the suture can be traced northwards into Thailand. To the west of the suture lies the *Sibumasu* tectonic block, an acronym coined by Metcalfe (1984a), constructed from *Si* (Sino = China), *bu* (Burma), *ma* (Malay Peninsula = Shan-Thai of western Thailand and western Peninsular Malaysia) and *su* (Sumatra). The name has become more universally used than *Sinoburmalaya* (Gatinsky *et al.*, 1984). The

equivalent term *Shan-Thai* terrain of Bunopas and Vella (1983) remains only of local use in Thailand. *Sibumasu* extends from Sumatra and Peninsular Malaysia as far north as Yunnan in southwest China. To the east of the suture lies the East Malaya terrane that continues beneath the Gulf of Thailand to reappear as the Indochina terrane. *Sibumasu* and East Malaya (Indochina Block) have contrastingly different geology until they amalgamated at the Triassic Indosinian Orogeny. The sutures and terranes are shown in Figure 14.1, after Wakita and Metcalfe (2005).

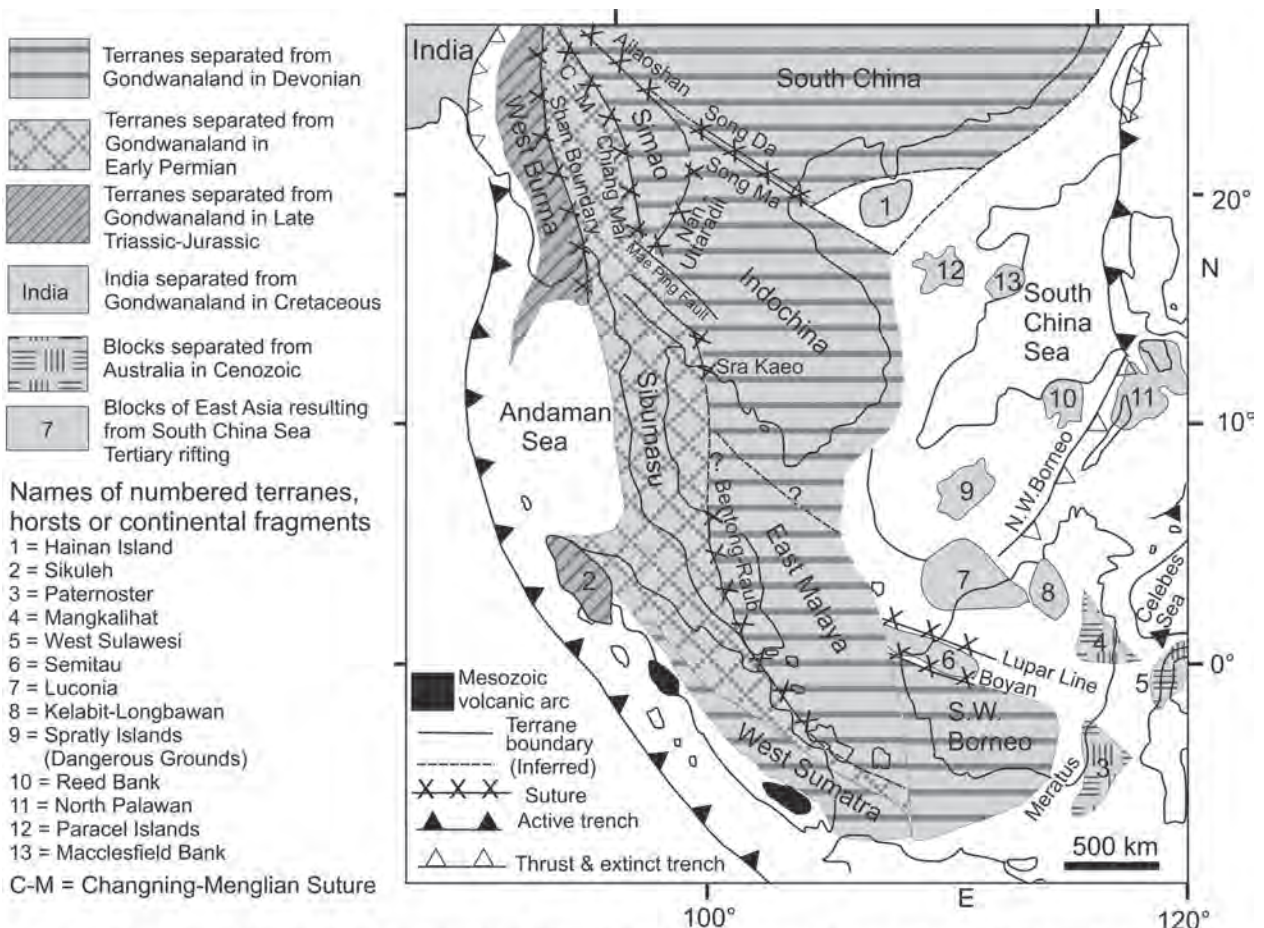


Fig. 14.1: Distribution of continental blocks, fragments, terranes and principal sutures of Southeast Asia, redrawn from Wakita and Metcalfe (2005).

Mineral Deposits

C.S. Hutchison

15.0 INTRODUCTION

Peninsular Malaysia was the pre-eminent tin mining region of the world until the industry crisis following the collapse of tin price in 1985. At the peak of the mining, the ore was smelted in Penang, the daily tin price set there, and posted above the long bar at the Royal Ipoh Club in the heart of the great Kinta Valley. Rapid decline in price and demand, as plastic replaced tin plate, caused near extinction of the industry and the great placer tinfields and their tailings were built upon by housing estates. Many of the tailings had already been reworked as separation techniques became more efficient. Increase in price to RM 32.77 per kilogram in December 2004 has only slightly revived the industry, but Malaysia may well take a lead from the ongoing revival in Cornwall.

Tungsten was never as important as tin, and mining came to an end much earlier. Iron was extracted at two large and remote mines and elsewhere iron is presently produced on a limited scale. Bauxite was mined at Pengerang on the southern tip of the Peninsula but is now in severe decline.

Gold continues to be mined. Placer workings were numerous. Lode mining continues to be important immediately to the east of the Bentong–Raub Suture Zone.

15.1 RECENT MINING DEVELOPMENTS

The 2004 mining developments were reviewed by Azemi and Salmiah (2007), and are summarised below:

Perak: There were ten mines (gravel pump and opencast) that produced a total of 2,153 t of tin in 2004. Twenty among treatment plants recovered ilmenite, monazite, zircon, stuverite and rutile. Fourteen mines in the district of Batang Padang produced a total of 220,737 t kaolin. Two mines near Bidor produced 136,000 t of mica.

Selangor: Five opencast mines produced a total 392 t of tin in 2004. There were five among treatment plants.

Johor: Bauxite continued to be mined in two localities at Telok Ramunia, Pengerang, but total output has dramatically declined to only 1,680 t in 2003. Two mines produced a total of 33 t of tin in 2004. Three mines produced a total of 44,225 t of kaolin in 2004.

Pahang: Five gold mines produced a total of 4.181 t of gold in 2004. Four iron mines produced a total of 313,822 t iron ore. Two mines produced a total of 146 t of tin in 2004. One mine produced 36,000 t of kaolin.

Terengganu: Two iron mines produced 196,910 t of iron ore in 2004. The single gold mine at Sungai Kerak produced 1.122 t of gold but closed in late 2004.

Kelantan: In 2004 there were four gold mines, but only one remained operating at the end of the year. Total production in 2004 was 38.182 t gold

15.2 REGIONAL DISTRIBUTION OF TIN

The cratonic core of peninsular Sundaland was the source of more than 70% of the tin mined last century in the whole world. The major producing centres lay in a broad arc 3400 km long and up to 800 km wide. The distribution of tin is strongly heterogeneous, with six major centres accounting for over 75% of the mined output. The balance comes from a further fourteen minor fields (Fig. 15.1).

The tinfields fall into two distinct types, those where virtually all the production was derived from mining placers, and those with a significant deep mined production. The former are by far the larger and the first four fields (Fig. 15.1) fall into this group. They were the unique feature of the region and the reason for its former dominance in world production. The larger and

Oil and Gas

D.N.K. Tan

16.0 INTRODUCTION

The oil and gas fields are located offshore in the Malay Basin. Exploration for oil and gas in the offshore Tertiary basins of Peninsular Malaysia commenced in 1968, with the award of concession blocks to Esso Exploration and Conoco. Esso's acreage covered the offshore Malay Basin, north of the 5° N latitude, whereas the acreage south of the 5° N latitude, covering the southern Malay Basin and Penyu Basin, was granted to Conoco (Fig. 16.1). Off the west coast, Mobil was awarded a concession in the northern part of the Straits of Malacca (Fig. 16.1). The first exploration well was drilled in 1969 in the Malay Basin, resulting in the Tapis discovery. Exploration efforts have continued in the Peninsula since 1969. By the end of 1997, more than 194,000 line-km of 2D seismic and 247,000 line-km of 3D seismic have been acquired, and a total of 158 wildcat and 184 appraisal wells have been drilled (Wong, 1999). These exploration activities resulted in significant successes in the Malay Basin. Unfortunately, results in the Penyu basin and the Straits of Malacca have been disappointing.

The exploration efforts up to end of 1997 resulted in the discovery of 53 oil and 28 gas fields, with oil-initially-in-place (OIIP) of 12.5 billion bbls (barrels) and gas-initially-in-place (GIIP) of 57.1 TCF (trillion cubic feet). The estimated recoverable reserves are 4.3 billion

bbls oil and 39.4 TCF gas, excluding small oil discoveries with <8 million bbls (MMB) recoverable reserves and gas discoveries with <50 billion cubic feet (BCF) recoverable reserves.

The first oil production from the Malay Basin came from the Tapis field in March 1978, and the first gas production was from the Duyong field in 1984 (Mazlan *et al.*, 1999a). By the end of 1997, 15 oil and 4 gas fields were in production, with cumulative production of some 1.9 billion bbls oil and 2.8 TCF gas (Wong, 1999).

16.1 ACREAGE SITUATION

In 1971, the acreage situation of exploration blocks, awarded under the concession system, in offshore Peninsular Malaysia consisted of 3 blocks, namely, Mobil's block in the northern part of Straits of Malacca, Esso's block in the northern half of the Malay Basin north of the 5° N latitude, and Conoco's block south of the same latitude (Fig. 16.1).

In 1974, Malaysia introduced the Petroleum Development Act (PDA), under which the entire ownership of the petroleum resources of the country was entrusted to the newly-established government-owned company, called Petroliam Nasional Berhad (PETRONAS). This company was incorporated on 17 August 1974. PETRONAS introduced Production Sharing Contracts (PSCs) to replace the concessions previously

ACRONYMS and TERMS used in this chapter: **Acreage** = an area of land or sea; **API gravity** = American Petroleum Institute specific gravity; **AU** = Assessment Units; **Bbl** = barrel = 36 imperial gallons or 42 U.S. gallons (roughly 192 litres); **bbls/d** = barrels per day; **BCF** = billions of cubic feet; **Boe** = bbls of oil equivalent; **CPOC** = Carigali-PITTEP Operating Company; **CTOC** = Carigali-Triton Operating Company; **E & P** = exploration and production; **EPMI** = Esso Production Malaysia Inc.; **EUR** = estimated ultimately recoverable; **FAMM** = Fluorescence Alteration of Multiple Macerals; **GHA** = Gas Holding Area; **GIIP** = gas-initially-in-place; **GOC** = Gas-oil contact; **GWC** = gas-water contact; **HC/g** = hydrocarbon content per gram; **HI** = hydrogen index in pyrolysis; **HPHT** = High-pressure high-temperature; **IPC** = International Petroleum Corp.; **JAPEX** = Japan Petroleum Exploration; **JDA** = Joint Development Area; **md** = millidarcies (measure of permeability); **MMB** = million barrels [Scientists use M for million, oil companies use MM]; **MMscf/d** = million standard cubic feet per day; **MTJA** = Malaysia-Thailand Joint Authority; **OIIP** = oil initially in place; **OWC** = Oil-water contact; **PCSB** = PETRONAS Carigali Sdn. Berhad; **PETRONAS** = Petroliam Nasional Berhad; **PIDC** = Petroleum Investment and Development Company; **PSC** = Production Sharing Contract; **PTT** = Petroleum Authority of Thailand; **PTTEP** = PTT Exploration and Production; **R/C** = Revenue-Over-Cost; **scf** = standard cubic feet; **STOIIP** = Stock Tank Oil Initially In Place; **TCF** = trillion cubic feet; **TOC** = total organic carbon; **TPS** = total petroleum systems; **VRe** = equivalent vitrinite reflectance.

Index

A

- A vs B of Main Range Granite Fig. 10.22
- abnormal pressure
Malay Basin 189
Penyu Basin 196
- Abodonlophora* in Jurong Formation, 112
- aborted rift, Semantan 114
- abrasion platform placers 338
- accessory minerals
Eastern Belt 222
Main Range 218
- accretionary wedge 52, Fig. 3.4
- accumulation of hydrocarbons 379
- ACF diagram,
Jerai aureole Fig. 11.8
Stong Complex Fig. 11.3
Taku Schist Fig. 11.5
- acknowledgements v
- ACNK
granite values 225
vs SiO₂ for granites Fig. 10.13
- acreage
allocations 365
Malay Basin
1971 Fig. 16.1
1976–77 Fig. 16.2
1990 Fig. 16.3
1999 Fig. 16.4
2006 Fig. 16.5
- actinolite
Bukit Ibam 349
Kramat Pulai 361
schist 52
- Aequitriradites inornamentus* 127
- ages of Malaysian
granites Table 10.1
volcanic rocks Table 9.1
- agglomerate
Chini prospect... Fig. 15.12
Manson Lode... Fig. 15.11
- aggradation
land 23
Kedah plains 23
- agmatite, Stong Complex 233
- Air Hangat, Langkawi, cement 363
- Air Hitam, Johor Graben 157
- AKF diagram
Jerai aureole Fig. 11.8
Stong Complex Fig. 11.3
Taku Schist Fig. 11.5
- albite alteration, Raub 360
- Alcock Rise 33
- Alexander, J.B. 1
- algae,
Chuping Limestone 93
Kodiang Limestone 90
- algal
boundstones, Gua Panjang 104
Kodiang Limestone 88, 92
- alkali
basalt lavas 197,
SE Asia 208, 209
Neogene 40
- feldspar
alteration, Raub 360
decomposition 19
Eastern Belt granites 222
- olivine basalt, Kuantan 209
- plot of granites 226
- series 224
chemistry 229
vs. silica,
dyke rocks Fig. 9.12
volcanic rocks Fig. 9.9
- allochthonous
kaksa 337
limestone lenses, Chert Member 96
- alluvial
bauxites 22
deposits
Malay Basin 185
stratigraphy... Figs. 15.1–15.2
- environment, Malay Basin 185
- fan facies, Malay Basin 182, Fig. 15.2
- plain 10, 15
- terraces 23
- tinfields... Table 15.1
- alluvium, fluvial origin 333
- almandine garnet, Gunung Jerai 347
- Alor Star rainfall 15
- alteration, Kecau Tui 358
- alumina vs. silica, volcanic rocks Fig. 9.10
- aluminous enclaves 223
- Alur Lebey Fault 269, Fig. 12.3
- amang 339
treatment plants in 2004 331
- ammonites, Triassic, Gua Musang Formation 104
- Ampang Fault Fig. 13.13
- amphibole
bearing granite 217
eastern Belt granites 222
Main Range granite 217
schist 45, 47, Fig. 4.2, Table 4.1
- amphibolite
Batu Melintang Fig. 4.5
- facies
dating 304
metamorphism 237, Fig. 11.3
Jerai aureole... Fig. 11.7
Genting Sempah... Fig. 4.4
Taku Schist 238
Stong Complex 236
- Anak Datai Beds 58
- Anambas zone 32
- anatexis, Stong Complex 237
- andalusite
hornfels 220, 245
Gunong Ledang 243
Main Range 218
- Andaman
Islands Fig. 3.3
Sea marginal Basin 32, 33, Fig. 3.3
- andesite
agglomerate, Kampong Awah 203
occurrences Fig. 9.2
Pulau Tioman 207
volcanism, Eastern Belt 203
- Anding Barat fractured
basement 405
- angiosperm pollens 119
- Angsa Graben, Straits of
Malacca 154, 156, Fig. 7.14
- Angsi Field
development 397
exploration 397
geology 397, 398
location 397

- structure 397, Fig. 16.24, Fig. 16.25
 –Tapis, Malay Basin 186
 anhydrite pseudomorphs, Kodingang Limestone 90, 92
 Anisian
 fossils, Gua Musang Formation 104
 Kodingang Limestone 92
 limestone, Gua Panjang 104
 radiolarian age, Chert Member 96
 anthophyllite, Bukit Ibam 349
 anticline
 traps 381
 trends 381
 compressional 381
 Malay Basin... Fig. 16.7, Fig. 16.14
 Dulang Field... Fig. 16.17
 Malay Basin 182, 381, Fig. 16.15
 anti-clockwise rotation 318
 Borneo 324
 Sundaland 324
 problem with escape tectonics 324
 antimony, Raub 359
 apatite crystals in enclaves 223
 aplite dykes
 Kramat Pulai 361
 tin-bearing 347, Fig. 15.3
 Arang Formation... Fig. 8.2
 Ar-Ar geochronology 198
Araucarioxylon
 cf. *japonicum* 127
telentangensi 127
 Arenaceous
 Formation 47
 Series 84
 argentite, Manson's Lode 354
 argillaceous rocks, Gua Musang Formation 103
 argillic alteration (argillisation)
 Penjom 359
 Raub 360
 Selinsing mine 358
 Tasek Chini 355
 Tersang 359
 Aring Formation 81, 103, 119
 agglomerate 106
 mainly volcanic 103
 arsenian sulphide, Manson's Lode 354
 arsenopyrite
 Beatrice Pipe 347
 Buffalo Reef 360
 Kramat Pulai 361
 Leong Sin Nam Pipe 347
 Manson's Lode 354
 Mengapur 354
 Pelepah Kanan 345
 Penjom 359
 Raub 359
 Selinsing 358
 Sungai Lembing 340
 Tersang 359
 Artinskian age, Chert Member 96
 Asahan Arch 150, 154
 aulocogens of Gondwanaland... 314, Fig. 14.5
 Aur Island 220
 gabbro 221
 Axial Malay fault 177, 182, Fig. 8.5
 axinite, Kramat Pulai 361
 Azman A, Ghani, c.v. 4
- ## B
- Ba versus Sr Genting Sempah Fig. 9.5
 back-arc basin 177, 271
 Semantan 114
 Badak Shale Member 145
 Badong Conglomerate 124, 131, Fig. 6.22
 Bagan Datoh Member 161
 Bahau 268
 Arenites 82
 Conglomerate 113, Fig. 6.1
 gravity high 327
 redbeds 109
 river capture 17
 Balam–Pematang system 155
 Bakri area of Johore 339, 347
 tin pegmatites 347
 Balau Fault 269, 299
 Balau–Murau Fault Zone 257, Fig. 12.3 Fig. 12.9, Fig. 12.10
 Balik Pulau Quaternary 164
 Baling area 263
 argillaceous Rhythmic Member 97
 Baling Group 72, 199
 Bampo Formation 152
 Bangak metasediments 116
 Bangka Island 36, 335, 249, 253
 alluvial cross section... Fig. 15.1
 seismic placer deposits Fig. 15.1
 tinfield Fig. 15.1
 Baong Formation 152
 Baoshan, Yunnan 312
 Barat Formation... Fig. 8.2
 Barisan Mountains 5, 28
 barite deposits 363
 fissure filling, Trengganu 363
 strata-bound, Tasek Chini 363
 barium vs. silica, volcanic rocks Fig. 9.10
 Barren Island 33
 Barrovian metamorphic facies... Fig. 11.5, Fig. 11.8
 amphibolite 236, 241
 series, Taku Schist 239
 basalt 318
 flows 169, Fig. 9.2
 Mid-Miocene, Sumatra 38
 sheared 51, Table 4.1
 base-metal sulphide ores 360
 basement
 Malay and Penyu Basins... Fig. 8.6
 Straits of Malacca 148
 basin inversion 172
 Batang Melaka
 dating 216
 Cretaceous 222
 Batang Padang, Perak 347
 Batu Arang
 Basin 40, 76, 133, 134, 138, 170, 259, 363, Fig. 7.3, Fig. 7.5, Fig. 12.13
 Beds 139, 170
 biomarker data 141
 boulder beds 159
 coal, reflected light Fig. 7.4
 lacustrine strata 141
 oil-shale 141, 143, Fig. 7.6
 organic facies 140, 141
 Batu Caves 76
 limestone anomaly 329, 330
 Batu Dam area 16
 panned gold 358
 structures 284
 Batu Gajah 73, 75
 Batu Melintang 48, 233, 265, 288
 granite dating 51
 suture outcrops Fig. 4.5, Fig. 13.14
 Batu Pahat 24
 granite outlier 23
 Johor Graben 157
 Quaternary 167
 redbeds 121
 Batu Tiga, magnetite 348
 bauxite
 formation 22
 metamorphism 246
 mining 363
 pebbles 22
 production in 2004 331
 source rocks 207
 beach
 placers 338
 ridges 16, 26, 28, 163
 east coast 26
 Kelantan 168 Fig. 2.13, Fig. 2.14
 Kuantan 168
 Peninsular Malaysia Fig. 2.11
 Terengganu 168
 tin deposits... Table 15.1
 Beatrice pipe lode 346, Fig. 15.8, Fig. 15.15
 bedded lodes 338
 Bedung area sandy Rhythmite Member 98
 Bekok Formation 184, Fig. 8.2
 Belata Formation 77
 Bell's Lode, tin... Fig. 15.5
 belts of Peninsular Malaysia 55
 Belumai Formation 152
 Belumut
 Granite 128, 145
 Malay Basin 185
 Belut Formation... Fig. 8.2
 Bendang Riang Formation 72

- Bengkalis
 Graben 17, 28, 36, 249, 253
 Trough 142, 150, 157
- Benom Complex 227
 alkalic series 229
 granitoids Rb vs Sr Fig. 10.11
 K_2O vs SiO_2 Fig. 10.15
 Zr vs SiO_2 Fig. 10.12
 chemistry 229
 granite 8, 107
 age 216
 no gravity low 327
- Benta Complex
 alkalic series 218
 intermediate to mafic rocks 218
 mineralogy 219
 textures 219
- Bentong 43
 –Bengkalis Suture 36, 253
 conglomerate 78
 Group 43, 77, 78, 79
 olistostrome 292
 schists stereogram Fig. 13.15
 –Raub edge of Samantan Basin 114
- Bentong-Raub suture Zone 2, 33, 38, 43, 78–79, 86, 202, 211, 216, 249, 253, 268–269, 271, 274, 287–288, 296, 306, 316, Fig. 3.4, Fig. 3.6, Fig. 4.1, Fig. 4.3, Fig. 8.3, Fig. 10.1, Fig. 12.3, Fig. 14.1, Fig. 14.4
- Bentong Fig. 4.3
 Cameron Highlands Fig. 4.5, Fig. 12.4
 cartoon Fig. 14.8
 central area 43
 Cheroh Fig. 4.2
 cross-sections... Fig. 14.8
 E–W Highway... Fig. 4.5
 extrusion... Fig. 14.10
 Genting Sempah... Fig. 4.4
 Karak Highway Fig. 4.3
 olistostrome 291
 palaeontology 45
 radiolaria Fig. 4.1
 reactivation 308
 regional position... Fig. 3.4, Fig. 14.6
 southern part 51
 timing 306
 Thailand extensions... Fig. 3.6
- Bera
 Fault 120
 Formation 79, 108
 River 17
- Berangkat
 anticline Fig. 13.4
 lineament 249
 tonalite 219, 233, Fig. 10.6, Fig. 11.1
- Berantai anticline & syncline 118, Fig. 13.4, Fig. 13.6
- Berkelah Conglomerate 116, 117
- Bertangga
 Basin 114
 Sandstone 120, 266, 274, 279
- Beruas Formation 158, 161, 165–167
- beryl, Kramat Pulai 361
- Besut Fault zone 268, Fig. 12.3
- betafite, Gunung Jerai 347
- Bicoemleptopteris hallei* 310
- Bidor
 kaolin 363
 –Taph alluvial gold in tin mining 355, 356
- Billiton Island 249, 253, 338, 348, tin mining 332
 field Fig. 15.1
- Bilut
 Redbeds 47, 108, Fig. 4.2, Fig. 4.3
 post Indosinian Orogeny... Fig. 14.7
 unconformity 47
 Valley 45, 79
- Binjal Formation, Perlis 67, 68, Fig. 5.15
- Bintang
 Conglomerate 245
 Granite Complex 217
 Range 8
- biomarker data Batu Arang 141
- biostratigraphy, Malay Basin 184
- biotite
 decomposition 18
 Eastern Belt Granites 222
 granite weathering... Table 2.3
 low stability 22
 Main Range Granite 217
 –muscovite schist, Stong 236
 –quartz hornfels 45
- birdseye structures, Kodiang Limestone 90
- bismuth
 Bukit Ibam 349, 351
 native, Mengapur 354
- bismuthinite in wolframite veins 363
- bivalves, Triassic
 Chert Member 97
 Rhythmite Member 98
- black shales
 Semantan Formation 110
 weathered 20
- Blaini glacial deposits... 315, Fig. 14.5
- Blocks, continental
 South China Sea rifting... Fig. 14.1
 Australia rifting... Fig. 14.1
- Bohorok Formation... 37, 312, Fig. 14.4
- Bok Bak Fault zone 148, 171, 263, 269, 283, 287, Fig. 8.3, Fig. 12.3, Fig. 12.15
 displacement 263
 gravity 330
 reactivation 308
- bombs
 size in Santi ignimbrites Fig. 9.6
 welded tuff, Santi Fig. 9.3
- Bonaparte Gulf Basin... Fig. 14.5
- bones in caves 170
- bornite
 Beatrice Pipe 347
 Mengapur 354
- boudinage 266, 271, 274
 granite sills 286, 287
 quartz 45
 Stong Complex 235, Fig. 13.10
- Bouguer gravity
 anomaly map
 Penang-Kedah Fig. 14.18
 Port Klang-Kuala Lumpur Fig. 14.17
 southern peninsula Fig. 14.16
 traverse across peninsula Fig. 14.14
- Boulder Beds 135–136, 139, 146, 158–159, 171, 333, 363, Fig. 15.2
 age 159
 Batu Arang Fig. 7.3
 Gopeng 336
 weathered clasts 159
- Boulder Clays 159
- Boulder-strewn granite
 landform... 12, Fig. 2.8
- Bouma sequence, Semantan Formation Fig. 6.13
- Boundary Range Granite
 Batholith 220, Fig. 11.4
 ages Table 10.1
 chemistry 229
- bournonite Kecau Tui 358
- brachiopods, Kodiang Limestone 90
- braided channels 15
 reservoirs 377
- braided streams 333, 334
- breccia
 Gunung Rabong Formation 106
 intraformational, Kodiang Limestone 90
 Kodiang Limestone 88
 texture. Sungai Lembing 341
- brittle-ductile deformations 249
- Brooklands Estate Quaternary 166
- Brown Shale, Sumatra 142
- bryozoa
 Chert Member conglomerate 96
 Kodiang Limestone 90
- Buffalo Reef gold deposit 360
- Bujang Melaka stock 260
- Buke Granite 237
- Bukit
 Ampar conglomerates 121
 Anak Takun 76
 Arang Basin, Thai Border 133–135, Fig. 7.2
 gravity 330
 stratigraphy Fig. 7.2
- Bangkong iron 351
- Batu
 Barak, conodonts age, Chert Member 96, 97
 Batok Jurong Formation 112
 Batu Besar 106

- Bukit (*continued*)
 Belabing granite 242
 Belah 122
 Bertangga 108
 Besi iron mine, Terengganu 348,
 Fig. 15.9
 tin content 348
 skarn 338
 Bintang 145
 metamorphism 245
 Biwah 84
 Botol fault zone barite 363
 Bucu folding 301
 Chabang... Fig. 2.6
 Charas 84
 Chuping
 limestone 11, 71, 93
 shore line 173
 Cinta Manis 79
 Dinding 76, 199
 Gasing 259
 Gombak, norite 221
 Hangus, Triassic bivalves 104
 Hantu, Kodiang Limestone 90,
 129
 Hulu Pelong 78
 Ibam iron mine, Pahang 347, 348,
 Fig. 15.10
 Cornwall-type 351
 structures Fig. 13.8
 Jerneh, Perlis... Fig. 2.6
 Chuping Limestone 93
 Kachi (Kedah), tungsten 361
 Kajang rhyolite porphyry 359
 Kaling fossils 111
 Kalong, Kodiang Limestone 88,
 92, Fig. 6.3
 Kambing 83
 Kampung Yoi, Permian chert 97
 Kechil
 calcareous sandstones 91
 Kodiang Limestone 88, 90, Fig.
 6.3
 Kepala, Kedah Fig. 2.5, Fig. 2.7
 Kepelu 91, 129
 Keluang 303
 chert 306
 Conglomerate 258
 age 303
 Fault 258
 structures 306
 Kemuning Pluton 220
 Keriang, Kedah 23
 Keteri, Chuping
 Limestone 93, Fig. 2.6
 cement 363
 Koman = Raub Gold Mine
 Koman Gold Mine 358, 359, Fig.
 13.17, Fig. 15.14
 anticlinorium 292
 granite porphyry... Fig. 15.14
 structure 307
 Kukus, Kedah
 Chert Member 95
 strike-slip faults 100
 Larang, gabbro 52
 Larek, Kedah, Chert Member 95
 Lentor (Terengganu),
 tungsten 361
 wolframite 363
 Lop 121
 Mambai 122
 Mengapur 83
 Merah Conglomerate Member 98
 Mertajam 24
 Mulong Kodiang Limestone 88,
 91
 Nyan, Kedah, Chert Member 95,
 97
 Pak Sagor 84
 Panching 84
 Pantai structure 285
 Payung folds 274
 Penagoh, redbeds 292
 Peninjau 8
 Perak 263
 Putus Fault 268
 Raja Member 67, 68, 69
 Resam Clastic Member 108, 113
 Rokan, Barat estate 51
 serpentinite 289
 Sagor strip mining 355
 Sagu 84
 cement 363
 Saiong 100, 265, 280
 Selegi 126
 Serampang coal 143
 Seraya 24
 Tajoh fault 258, Fig. 13.13
 Takun, Templer Park Fig. 2.4, Fig.
 2.6
 Temiang 70, 71
 Tengku Lembu 11, 71
 Tinggi Fault Zone 15, 48, 148,
 260, 269, 281, 287, Fig. 8.3,
 Fig. 12.3, Fig. 12.13
 basalt 169
 isotopic age 262, 308,
 mylonite Fig. 12.14
 Wang Pisang 71
 buried karst 11
 burrows in Singa Formation folded
 strata Fig. 13.12
 Burton, C.K. in retirement 1
 Buta Anticline, Langkawi 282
- ## C
- calc alkali series 224, Fig. 10.15
 calcareous graphitic shales... Fig.
 15.14
 Calcareous Series 84
 calc-silicate hornfels,
 Ledang 242, Fig. 11.9
 Pelepah Kanan 345
 calcite
 Leong Sin Nam Pipe 347
 Raub 359
 Caledonian Orogeny 310
 Cambrian deformation 305
 Cameron Highlands 48
 suture rocks Fig. 4.5
 Canning Basin, Australia... 70, 86,
 314, Fig. 14.5
 diamictites 314
 Capitanian conodonts, Gua Musang
 Formation 105
 carbon dioxide in gas 381
 carbonaceous slates, Sungai
 Pelong 361
 carbonate-base metal deposits,
 Penjom 359
 carbonate compensation depth,
 Semanggol Basin 99
 Carboniferous
 stratigraphy... Fig. 14.3
 Kinta 73
 –Permian
 palaeolatitudes 322
 Gondwanaland... Fig. 14.5
 sandy facies... Fig. 14.3
 shales, Bukit Besi 348
 –Triassic, continental drift Fig.
 14.6
 Carnarvon Basin, Australia... 314,
 Fig. 14.5
 Carnian age
 algae and foraminifers 105
 ammonites, Gua Musang
 Formation 105
 conodonts
 Chert Member 96, 97
 Kodiang Limestone 90
 Chuping Limestone 93
 limestones, Gua Telinga and Gua
 Luas 104
 Rhythmite Member fossils 98
 Semantan 113
 cassiterite
 arsenopyrite & pyrite 339
 Beatrice Pipe 347
 Bukit Besi 348
 chlorite and chalcopyrite 339
 coarse grained 335
 columbite 339
 ferromagnetic 346
 grain-size 335
 ilmenite, zircon & monazite 339
 Kramat Pulai 361
 Leong Sin Nam Pipe 347
 lepidolite & columbite-
 tantalite 339
 magnetic susceptibility 346
 malayaite & varlamoffite 339
 Manson's Lode 354
 Nb-bearing 347
 paramagnetic 347
 Pelepah Kanan 345
 pleochroic 347
 poly-metallic sulphides & sulpho-
 salts 339
 pyrrhotite and magnetite 339
 stannite & complex sulphides 339

- cassiterite (*continued*)
 Sungai Lembing 340
 Ta and Nb substitution 347
 Ta-bearing 347
 travel distance 335
 Wang Tangga cave 170
 wolframite 339
- cataclastic granite 237
- Cathaysia
 affinities 2
 flora 81, 85, 86, Fig. 3.5
 plant occurrences SE Asia Fig. 14.3
 position in Gondwanaland Fig. 14.5
- Cathaysialand 310, 316
 before Indosinian Orogeny... Fig. 14.7
- Cathaysian terrain 254, 315
 extrusion... Fig. 14.10
 flora 311
 Malaysia–Sumatra Fig. 14.4
 Palaeozoic stratigraphy Fig. 14.3
 stratigraphy... Fig. 14.3
- cave 10, 11
 placer deposits 169, 335, 338
- cement plants 363
- Cenozoic
 basalt volcanism 197, 208
 basins 40
 biostratigraphic markers 171
 evolution 170
 kinematics 171
 Eocene–early Oligocene 171
 history 5
 placer stratigraphy Fig. 15.2
 sediments distribution, Peninsular Malaysia Fig. 7.1
- Central Basin
 graben 271
 gravity high 326
- Central
 Belt 57, 249
 deformation 307
 faults 268
 folding phases 295
 gold deposits 355, 358
 grabens 154
 granite plutons Fig. 10.2
 ages Table 10.1
 metasediments 306
 mineralization... Fig. 15.3, Fig. 15.4
 Palaeozoic 79
 stratigraphy Fig. 5.2
 structures 287, 296
 Triassic Formations Fig. 6.1
- Graben, Straits of Malacca 155, Fig. 7.11
 stratigraphy Fig. 7.12
- group grabens 150
 plutonic province 218
- Sumatra
 Basin 37, 148
 sedimentation 5
- cephalopods, Trolak Formation 52
- cerium anomaly 45
- cerussite, Raub 359
- chalcedony, Semanggol Chert Member 95
- chalcocite, Tasek Chini 355
- chalcopyrite
 Bukit Besi 348
 Chini prospect... Fig. 15.12
 Kecau Tui 358
 Manson's Lode 354
 Mengapur 354
 Penjom 359
 Raub 359
 Selinsing 358
 Sungai Lembing 341
 Tasek Chini 354
 Tersang 359
 wolframite veins 363
- chamosite in bauxite 22
- Chao Phraya Fault 38, Fig. 3.6
- Charu Formation 83, 84
- Chemendong Volcanics 204
- chemical
 analyses, volcanic rocks Table 9.2
 plots of granites 224
- Chemor Limestone
- Chenderiang, Kinta Valley 339
- Chendering
 deformation 300, 308
 structures 301
- Chenderoh Lake 16
- Chenderong in Terengganu
 scheelite 363
 wolframite 363
- Chepor Formation, Perlis 66–69, Fig. 5.15
- Cheroh district 43
 Bentong-Raub Fig. 4.2
 Jerus Limestone 104
 –Raub, possible Gua Musang Formation 104
 serpentinite 289
- chert 45
 beds, Bukit Kechil 91
 bedded ribbon, in Palaeo-Tethys... Fig. 14.7
 Bentong-Raub Line Fig. 4.2
 Bentong Fig. 4.3
 boudinaged 291
 Cheroh district... Fig. 4.2
 clasts
 Conglomerate Member 95, 98
 redbeds 108
 Semanggol Formation 98
 deformation, Raub 290
 duplexing 290
 faulting 290
 Genting Sempah Fig. 4.4
 isoclinal folds 285, 291
 layers and nodules, Kodiang Limestone 90
 mylonite zones 290
 palaeontology 45
 radiolarian 48, 51
 Bentong Raub Fig. 4.1
 slump structures 290
- Chert-Argillite Formation 292, 296
 deformation 290, 306
 faulting 291
 Genting Sempah 45, 47, Fig. 4.4
 recumbent folds 285
 structure 285
- chevron folds, Mersing Beds 298, Fig. 13.22
- chiastolite
 aureoles 246
 hornfels 220
- Chinchin Member 58
- Chini = Tasek Chini 354
- Chini
 deposit 351
 prospect... Fig. 15.12
- chlorite
 Bukit Besi 348
 Pelepah Kanan 345
 stability 22
- chloritisation
 Penjom 359
 Raub 360
 Selinsing mine 358
 Tersang 359
- chloritoid porphyroblasts 241
- chondrite-normalised spider diagrams Fig. 9.11, Fig. 10.16
- Chung Sooi Keong ('S.K.') 1
- Chuping Limestone Formation 38, 71, 90, 312
 extension into Triassic 93
 hill... Fig. 2.4, Fig. 2.6
 karst 11
 metamorphism 244
 palaeomagnetism 323, Fig. 14.13
 Perlis to North Kedah 93
 similar to Kodiang Limestone 93
 Straits of Malacca 148
- Cicatricosisporites*
australiensis 122, 127
ludbrookii 122
- Cimmerian Continent... 316, Fig. 14.6
- Cini Fault 120
- Cinta Manis 290, Fig. 13.16
 limestone 291
 road 111
- circular structures 29
- Circulina*, Mangking Sandstone 118
- Classopollis classoides* 118, 127
- Classopollis* spp. 119, 122, 124
- clasts in tuff, Pulau Tioman Fig. 9.7
- Clavatipollennites* 119
- clay minerals
 Batu Arang coal 149
 weathering product 20
- cleavages at Dungun Fig. 13.25
- clinopyroxene, amphibole-enriched enclaves 223
- clinozoisite, Taku Schist 238
- clockwise declinations, volcanic 319
- clockwise rotation 279, 319
 Peninsula 317

- Khorat Plateau 324
 coal 363
 Bukit Arang 135
 microscopy Fig. 7.4
 beds, Batu Arang Basin Fig. 7.3,
 Fig. 7.5
 Enggor 136
 Malay Basin 188–189, 376–377
 Measures 139
 mining, Batu Arang 138
 seams 140
 Gagau Group 126
 Kampong Durian
 Chondong 143
 Tebak Formation 128
 signature 374
 source rocks 377
 Malay Basin Fig. 16.9
 coastal
 drowning, Langkawi 23
 plain 6, 22
 Eastern 25
 Kedah 23
 Kelantan Fig. 2.12, Fig. 2.13
 Muar 24
 widths 23
 prograding, east coast 26
 sedimentation 15
 swamps 23
 coaxial refolding, Machinchang
 Fm 281
 collision
 orogeny... Fig. 14.7, Fig. 14.8
 S-type granite 2
 colluvial placers 335
 columbite-tantalite with
 cassiterite 344, 347
 compositionally expanded rocks 211,
 220
 Con Son Swell 175, 177–178, Fig.
 8.1, Fig. 8.4
 conglomerate
 Bilut redbeds 47
 central belt 114
 clast lithology 111
 flaser 292
 Member, Semanggol
 Formation 94, 98
 Gagau Group 124
 intraformational, Kodiang
 Limestone 90
 Ma'Okil Formation 121
 Paloh Formation 122
 Payung Formation 121
 polymict 114, 116
 Gagau Group 126
 Tebak Formation 128
 Saiong Redbeds 100
 Semanggol Formation 98
 Semantan Formation 110
Conites 128
 Conoco 365
 1971 acreage... Fig. 16.1
 1977 acreage... Fig. 16.2
 conodont
 Carnian, Kodiang Limestone 90
 Chuping Limestone 93
 early Triassic, Gunung Keriang 90
 Gua Musang Formation 104
 stratigraphic ranges Fig. 6.6
 thermal heating, Semanggol 100
 Triassic Fig. 6.5, Fig. 6.7
 contact metamorphic aureoles 220
 continental
 blocks SE Asia Fig. 14.1
 crust thinning 177
 diamictites, Gondwanaland Fig
 14.5
 drift Carboniferous-Triassic Fig
 14.6
 slope 31
 Kodiang Limestone 92
 contributors' *curriculum vitae* 2
 coquinas, Semantan Formation 111,
 113
Cordaites, Sumatra 311
 cordierite
 –andalusite hornfels 245
 hornfels 245
 porphyroblasts
 Ledang 243
 Pelepah Kanan 345
 Stong Complex (uncertain) 236
 core
 boulders 11, 12, 18, Fig. 2.7, Fig.
 2.8, Table 2.3
 stones 11, 18, 20
 Cornish-type tin lodes 340, Fig. 15.5
 eastern belt 340
 Cornwall-type mineralization 351
 correlation
 Thailand Fig. 3.6
 Sarawak Fig. 3.5
 Sumatra Fig. 3.5
 corundum 246
 Kinta Valley Fig. 11.10
 Kramat Pulai 361
 pebbles, Kramat Pulai 361
 rock 246
Costatoria species 106, 116
 Semantan 111, 113
 country rocks, Main Range
 Granite 216
 crenulation cleavage
 Langkawi 282
 Mersing Beds Fig. 13.23
 Cretaceous
 deformation 308
 doubly-plunging folding 308
 granite 280
 ages 216
 Gunong Ledang 242, Fig. 11.9
 –Jurassic basin map Fig. 6.16
 offshore Fig. 3.5
 peneplain laterite 22
 Phuket 38
 plutonic rocks 178, 222, Fig.
 10.2
 Stong Complex 219, 233
 Taku Schist 237
 crinoid
 Kodiang Limestone 90
 stems
 Chert Member conglomerate 96
 Koh Formation 120
 cross sections
 Langkawi Islands Fig. 12.7
 Malay Basin Fig. 8.7
 Penyu Basin Fig. 8.19
 Tenggol Arch... Fig. 8.9
 cuestas
 Panti Sandstone 127
 Tebak Formation 128
 current directions, Straits of
 Malacca 25
 Cuu Long basin 177, Fig. 8.4
Cycadophytes 118 119
- ## D
- Dabong... 233, 237, Fig. 11.4
 slaty cleavage 294
 Dachang 339
 dacite
 dykes, Sungai Lembing 342
 Penjom 358
 plug, Mengapur 354
 Pulau Tioman 207
 damar 160
 in alluvium 333
 dams causing lakes 16
 Dangerous Grounds 31
 Danish International Development
 Association 134
Daonella 113
 Chert Member 97
indica, Conglomerate Member 99
 cf. *indica* 107
 Rhythmite Member 98
 Dara Jade, Bukit Ibam 351
 Darling, Gray 1
 dasyclads, Kodiang Limestone 92
 Datai
 Anticline, Langkawi 282
 Beds 282, 305
 unconformity 286
 deformation
 Cambrian 305
 Devonian 306
 events, Peninsular Table 13.1
 Permian 306
 soft-sediment, Semantan 111
 deglaciation, Sunda Shelf 41
 deltaic environments, Malay
 Basin 188
 Dengkil peat 166
 denudation
 chronology 28
 processes 28
 Sundaland 28
 deposition environment
 Malay Basin 182
 Penyu Basin 194

- depth-seismic velocity
relationship... Fig. 8.1
- Desaru 244
Mersing beds outcrops Fig. 13.23
structure 297
- Detrital
Beds structures 282
Members 61
- Devonian
deformation 306
Kinta Valley 73
- dextral faults, Tembeling Group 119
- diamictite... Fig. 14.4
absence 312
continental 314, Fig. 14.5
glacial-marine 312
Genting Sempah 48
Krau Satu road 293
marine... Fig. 14.5
Sibumasu... Fig. 14.3
Singa Formation 70
- diamonds in Phuket alluvium 33
- diaspore
Kramat Pulai 361
metamorphism 246
- Dicynodon* conodonts... Fig. 14.6
- Dienerian
conodonts, Gua Musang
Formation 104
limestones 105
- differentiation
index of granites Fig. 10.10
sequence of granites 228
- Dinding Schist 52, 76, Fig. 13.13
folding 284
rhyolite 199
tuff 199
volcanics Fig. 9.3
- Dindings
alluvial cross section... Fig. 15.1
granite 8
peat 165
Pluton chemistry 228
secondary textured granite 218
seismic placer deposits Fig. 15.1
- diopside
–garnet, Langkawi 245
–phlogopite marble, Stong 236
–tremolite
hornfels Table 4.1
–wollastonite, Langkawi 245
- diorite
Bukit Ibam 349
Pemanggil and Aur Islands 221,
222
plutons 220
- discrimination diagram,
granites 230, Fig. 10.20
- distribution, volcanic rocks Fig. 9.2
- Djambi = see Jambi
- Dohol Formation 82, 84, 86, 244
- dolines 9
- dolomitisation, Kodiang
Limestone 90, 92
- domal structures, Kodiang
Limestone 88
- Donegal Granite, Ireland, Rb vs
Sr Fig. 10.11
- doubly plunging Tembeling
folds 274, 278
- drag
folds 268
refolding 258
- drainage pattern & divides,
Peninsular Malaysia 13, 16,
Fig. 2.7, Fig. 2.9
- dredge, tin alluvium Fig. 15.16
- drift pattern of terranes 315
- dropstones, glacial 70, 86, Fig. 14.4
- Dulang Field
development 386
exploration 386
geology 386, 388
location 385
oil and gas Fig. 16.18
structure 385, Fig. 16.17
- Dungun, Terengganu 348
Basin 178
Fault 177, Fig. 8.5
folds and cleavage Fig. 13.25
Graben 179, Fig. 8.8, Fig. 16.6
- Durian Tipus 78
- Dusun Tua hot spring 260, 268, Fig.
12.13
- Duyong
Anticline, seismic Fig. 8.10
–Besar, Malay Basin 185
gas discovery 365
- dykes
basic 197
chemistry, Eastern Belt 210, Fig.
9.12
intermediate 210
mafic 210, 269
- ## E
- East
Coast
dykes 210
multiple deformation 301
Range 9
rivers 15
structural analysis 304
- Malaya
Block 2, 40, Fig 3.4, Fig. 3.5,
Fig. 14.1
continental drift... Fig. 14.6
High Fig. 14.9
hornfels 245
palaeolatitudes Fig. 14.2
terrain 309
- Penang graben 155
- West
faults 269
Highway structural map Fig.
12.16
Bentong-Raub suture 48, Fig.
4.5
- Eastern
Belt 57, 86, 249
chemistry 224
dyke chemistry Fig. 9.12
enclaves 223
granite 220
ages 216, Table 10.1
mineralogy 222
plutons Fig. 10.1, Fig. 10.2
Rb vs Sr Fig. 10.11
textures 220, Fig. 10.7
Zr vs SiO₂ Fig. 10.12
mineralization... Fig. 15.3, Fig.
15.4
multiple deformation 297
Palaeozoic 82
stratigraphy Fig 5.2
structure 297
dating 304, 306
volcanism 202
- coastal plains 25
- Gold Belt 360
- Graben 155
- lode channel, Raub 359
- Province tin belt 211
- ejectamenta size in rhyolitic
ignimbrite, Santi Fig. 9.6
- electrum, Penjom 359
- elevations
Peninsular Malaysia Fig. 2.1
topographic units Table 2.1
- elliptical structures 29
- eluvial
regolith movement 12
gold, Tersang 359
placers 335
- emplacement level, Main Range 216
- enclave in granite 223
mineralogy 223
Perhentian 221
- Endau
delta 16
Fault zone 266, 267
permatang 26
Quaternary 167
–Rompin
tuffs Fig. 9.8
volcanics 207
chemistry 207, Fig. 9.9, Fig.
9.10
mineralogy 207
- endothyrids, Koh Formation 120
- Enggor Basin 27, 133–134, 136
- Entolium*, Semantan 113
- environment of deposition
Malay Basin Fig. 8.11
Sotong Field Fig. 8.12
- Eocene
anticlockwise rotation, southern
Sundaland 324
deformation 308
–early Oligocene rifting 171
- Ephedripites* 119 122

epidote
 schist Table 4.1
 stability 22
 epizonal emplacement 220
 erosion rates 41
 escape tectonics Fig. 3.4, Fig. 14.10
 Esso
 acreage 1971... Fig. 16.1
 1977... Fig. 16.2
 Exploration 365
 Production Malaysia Inc.
 (EPMI) 182, 365
 Eu anomalies
 granites 228, 229
 Tioman 208
 secondary textured granite Fig.
 10.18
Exesipollenites 119
 exploration
 acreage blocks 1990 Fig. 16.3,
 Table 16.1
 acreage blocks 1999... Fig. 16.4,
 Table 16.2
 acreage blocks 2006... Fig. 16.5,
 Table 16.3
 acreage, offshore Malaysia... Fig.
 16.1, Fig. 16.2
 history 368–370
 expulsion of hydrocarbons, Malay
 Basin Fig. 16.11
 extensional basin 271
 extrusion tectonics 177, 316, 317,
 Fig. 14.10

F

fahlore group minerals, Manson's
 Lode 354
 fanglomerates, Boulder Beds 159
 faults 249
 ages 249
 Cretaceous 308
 Dulang Field... Fig. 16.17
 E–W 269
 Malay & Penyu basin 176, 182,
 Fig. 8.3
 Ma'Okil Formation 121
 NNW–SSE and NW–SE
 trending 258
 N–S 268
 Peninsular Malaysia Fig. 8.3, Fig.
 12.1, Fig. 12.3
 related trapping, Malay
 Basin... Fig. 16.7, Fig. 16.14,
 Fig. 16.15
 right-lateral ... Fig. 3.4
 terrane
 –bounding 253
 –crossing 258
 –parallel 255
 timing 269
 tinfields related 339
 traps, normal 383
 trends 249, 251, 252

feldspar
 stability 22
 structural state 201
 X-Ray diffraction data 217
 felsite, Penjom 358
 fenestrae, Kodiang Limestone 92
 fengcong 9
 fenglin 9
 ferberite, Kramat Pulai 361
 fission-track ages 216
 flooding 15
 flow-banded
 rhyolite, Dinding Schist Fig. 9.3
 tuff, Pulau Tinggi Fig. 9.7
 flow-texture in rhyodacite, Endau
 Rompin Fig. 9.8
 flower structures 272
 Kedah 283
 Malay Basin 182
 fluorobrite, Beatrice Pipe 347
 Fluorescence Alteration of Multiple
 Macerals 379
 fluorite
 Beatrice Pipe 347
 cassiterite association 344
 Kramat Pulai 361, Fig. 15.15
 Main Range 218
 Pelepah Kanan 345
 –scheelite Kramat Pulai 361
 flute marks
 Semanggol Formation 98
 granite surfaces... 2, Fig. 2.7, Fig.
 2.8
 fluvial
 above-bottom placers 335, 337
 allochthonous bottom placers 337
 bottom placers 335
 cave placers 338
 channels, Malay Basin
 –deltaic source rocks 374
 –glacial deposits 314
 currents... Fig. 14.5
 –lacustrine environments 377
 sequences 185
 origin of alluvium 333
 terraces 27
 fluid inclusion analysis
 Kcau Tui 358
 Penjom 359
 Raub 360
 Sungai Lembing 343
 Tersang 359
 folds
 events, timing Table 13.1
 style Tembeling Group 274
 Tanjong Chendering Fig. 13.26,
 Fig. 13.27
 Tembeling Formation Fig. 13.4
 Foothills Formation 77, 107
 foraminifera in Kodiang
 Limestone 90
 fore-arc basin 271
 Semantan 114, 316
 foredeep 43
 Semanggol Basin 99, 316

fractional crystallization 228
 fractured basement play 385
 Penyu Basin 405
 Fraser's Hill 52
Frenelopsis 118
malaiana 118, 127
parvifolia 127 128
 freshwater swamps, east coast 26

G

gabbro
 Benta 219
 Eastern Belt 221
 Kemuning Hill 221
 mineralogy, Eastern Belt 221
 Pemanggil and Aur Islands 221,
 222
 Perhentian 221
 plutons 220
 Gabus Formation... Fig. 8.2
 Gagau
 Group 124
 dip 124
 environment 126
 stratigraphy 124, Fig. 6.22
 volcanism 204
 Upland 124, Fig. 6.22
 Galas Fault Zone 265, 280, Fig. 12.3
 galena
 cassiterite association 344
 Kcau Tui 358
 Kramat Pulai 361
 lode 351
 Manson's Lode 354
 Penjom 359
 Selinsing 358
 Sungai Lembing 341
 Tasek Chini 354, 355
 wolframite veins 363
 Gambang
 no gravity low 327
 tinfield 335
 Gap 8
 garnet
 hornfels, Pelepah Kanan 345
 Kramat Pulai 361
 Main Range 217
 marble, Langkawi 235
 skarn
 Chini prospect... Fig. 15.12
 Tasek Chini 355
 Taku Schist 238
 gas
 expulsion, Malay Basin... Fig.
 16.11
 fields, Malay Basin 373, Fig. 8.1,
 Fig. 16.7, Fig. 16.9, Fig. 16.16
 generating potential Fig. 16.10
 occurrences, Malay Basin 370
 –oil contact, Malay Basin... Fig.
 16.17

- resources, Malay Basin... Table 16.4, Table 16.5, Table 16.6
window 381
Malay Basin Fig. 16.13
- Gejiu 339
- Gemas Formation 107
structure 36
- gemstones, Thailand 40
syntaxis occurrence 316
- general structural trend 249
- generation of hydrocarbons 379
- Genting
Peras Fault Zone 268
Sempah
Bentong-Raub complex 8, 45, 199, Fig. 4.4, Fig. 13.13
dating 200
geochemistry 202
microgranodiorite Fig. 4.4
petrology 201
schist outcrops Fig. 13.14
structure 285
suture enclave 48
volcanic rock
chemistry Fig. 9.5
complex 199, Fig. 9.4
- geobarometer studies 223
- geochemistry of granites 224
- geochronology
granite 211
volcanic rocks 198
- geological
maps of Malaysia v
publications v
sections, north Sumatra Fig. 7.9
similarity with Sumatra... Fig 3.5
Survey Department 1
- geomorphology 5
- geoseismic sections of placer tinfields Fig. 5.1
- geothermal gradient
Malay Basin 177, 189, Fig. 8.17
Penyu Basin 196
- gibbsite, bauxite 22
- Gigantopteris* flora 40, 310, 316
- glacial
deposits, Sibumasu 311,
diamictite 86
Langkawi Fig. 5.16
SE Asia Fig. 14.3
dropstones 312
–eustatic sea levels 172
marine
deposits, Gondwanaland... Fig. 14.5
dropstones 2, 70
- glass shards
devitrified 118
Genting 201
- glauconitic sandstones, Malay Basin 189
- Gleichenoides* 118
gagauensis 117, 118, 122, 126
maranensis 119
- pantiensis* 118, 122, 127
- Global
Environment Facility 134
Positioning System 324
- Glossopteris* flora 312
- gneissic
suture 51
texture, Stong 235
- Gobbett, D. J.
& Hutchison, C. S. (1973) 1
in retirement 1
- goethite 22
- gold
base metals association 360
bearing veins, Central Belt 358
belt 3 360
map... Fig. 15.13
Buffalo Reef 360
deposits, Central Belt 355
epigenetic to granites 361
fissure fillings, Raub 359
Kecau Tui 358
lode deposits, map... Fig. 15.13
Manson's Lode 354
map of deposits and prospects... Fig. 15.13, Table 15.4, Table 15.5
Mengapur 354
mine, Raub Fig. 13.17, Fig. 15.14
mineralisation
belts 356
quartz veins 355
temperature formation 356
Selinsing 358
- mining 2
in 2004 331
Penjom Fig. 15.16
- Penjom 359
- quartz
lodes, Bukit Koman... Fig. 15.14
–sulphide veins, Penjom 358, 359
Raub 359
replacements, Raub 359
rush, Lubok Mandi 360
Selinsing 358
source
lower crust or mantle 361
smoker vents 361
volcanic association 361
- Gombak
Chert 48
iron mine 348
- Gondwana
blocks, Palaeozoic stratigraphy Fig. 14.3
plate 254
terranes
extrusion... Fig. 14.10
Malaysia Sumatra Fig. 14.4
stratigraphy... Fig. 14.3
- Gondwanaland 316
assembly, Permian 314
attachment 322
glaciations 70
ice age 312
northern margin... Fig. 14.5
reassembled in Palaeozoic Fig. 14.5
rifting 315
episodes... Fig. 14.5, Fig. 14.7
Sibumasu attachment 310
terranes, Devonian
separation... Fig. 14.1
Gondwanas of India map Fig. 14.5
- Gopeng
Beds 158
Consolidated Mine 347
Kinta Valley 334
- gossan
manganiferous, Manson's Lode 354
sulphides, Manson's Lode 354
strip mining 355
iron-manganese 355
Manson Lode... Fig. 15.11
- GPS of peninsula 324
- graben
formation, Semanggol Basin 99
Malay Basin... 179, 182, Fig. 8.5, Fig. 8.9
onland and offshore 133
Penyu Basin 193
Straits of Malacca 133
- granite
ages by Sr isochrons Fig. 10.3
arcs offshore Fig. 3.5
belts, Southeast Asia Fig. 10.1
Bukit Besi 348
iron mine... Fig. 15.9
chemical plots 224
core-boulders Fig. 2.7, Fig. 2.8
discrimination Fig. 10.20
dykes, Tioman 207
Eastern Belt Fig. 10.7
no gravity low 327
enclaves 45, 223
epizonal, Eastern 244
flow texture, Stong Complex Fig. 10.6
fluting, Johor... Fig. 2.8
geochemistry 224
geochronology 211
gneiss, Taku 239
gravity modeling 326
injection, Bok Bak Fault 264
landforms 11, Fig. 2.6
Redang Island... Fig. 2.8
modal compositions Fig. 10.8
plutons, naming Fig. 10.2
porphyry,
Pelepah 345
Raub gold mine... Fig. 15.14
porphyritic texture
biotite, Pelepah Kanan 345
Pelepah Kanan... Fig. 15.7
provinces, Peninsula 211
Redang Islands Fig. 2.6

- granite (*continued*)
- trends Peninsula-Billiton... Fig. 3.2
 - two-phase texture Fig. 10.5
 - wash 334
 - Johor 167
 - weathering 12, 17
 - core-boulders 18
 - speed 12
 - zones 18, Fig. 2.8, Fig. 2.10, Table 2.3
- granodiorite
- Bukit Ibam... Fig. 15.10
 - series 224
- granophyre, Pengerang 363
- graphite stability 22
- graptolites
- Devonian 45
 - Tuan Estate 43, 45
- gravel, weathering product 18
- gravity
- anomaly
 - map southern peninsula Fig. 14.16
 - traverse across peninsula Fig. 14.14
 - contour map
 - Kuala Lumpur–Klang... Fig. 14.17
 - northwest peninsula... Fig. 14.18
 - Peninsula... Fig. 14.16
 - data southern Peninsula 327
 - high
 - over coastal plains 329
 - Kedah 330
 - minimum over Main Range 326
 - modeling 326
 - northwest peninsula 330
 - profile
 - across Peninsula 324
 - faults 255
 - measurement stations southern peninsula Fig. 14.15
- greenschist facies
- Jerai aureole Fig. 11.7
 - Lower Palaeozoic 304
 - metasediments, Taku 239
- greisen
- bordered veins 334
 - Ulu Langat 363
 - muscovite 217
- greisenisation 344
- tinfields 340
- Grès Supérieurs* 128
- Greywacke Terrain 37, Fig. 3.5
- Griesbachian
- conodonts, Gua Musang Formation 104
 - limestones 105
- Grik
- Formation 72
 - volcanic rocks 199
- grooves, karst 11
- grossularite garnet, Jerai 240
- Kramat Pulai 361
- ground slope, Peninsular Malaysia Fig. 2.2
- Group K sandstones
- grunerite, Pelepah Kanan 346
- grykes 11
- Gua
- Badak 11
 - Bama, breccias, Gunung Rabong Formation 106
 - Batu Tangga, Anisian forams 104
 - Batu Telahup, Anisian forams 104
 - Cha karst hills 104
 - Musang Formation 80
 - argillaceous facies 105
 - Basin 114, Fig. 6.1
 - carbonate platform 106
 - Cameron Highlands road 253
 - circular structures 29
 - folding 306
 - group status 102
 - karst hills 103
 - lateral facies changes 103
 - limestones 103
 - lithologies 103
 - Permian-Triassic 102
 - platform 114
 - Semantan depocentre 87, 102–103 120, 129
 - structure 294, Fig. 13.19
 - stratigraphy and sedimentology 103
 - Panjang karst hills 104
 - Sai, Gua Musang Formation 103
 - Tempurung
 - Kinta Valley Fig. 2.5
 - river... Fig. 2.7
- guano deposits 169
- Guar
- Jentik, Perlis 65, 69
 - Sanai 65, 68, Fig. 5.13
- Gubir beds, Semanggol Formation 98
- gufeng 9
- gugup 12
- Gula Formation 158, 161, 164–168
- Gulf of Thailand 374
- Gunong
- Ayam conglomerate 103
 - Bakau 344
 - topaz-aplite 347
 - Bekok Granite 122
 - Belong karst hills 104
 - Belumut 128
 - Benom 8, 268
 - Complex 218
 - Granite 218
 - Gagau 124
 - elevation 131
 - geology Fig. 6.22
 - Hijau 8
 - Hutan Aji 70
 - Jebak Puyoh limestones 104
 - Jerai, Kedah 60, 269, 339, 347
 - dome 239
- granite map 211, Fig. 11.6
- gravity 330
- map... Fig. 11.6
- metamorphic aureole Fig. 11.6, Fig. 11.8
- rocks 240
 - porphyry 199
- Kanthan 73
- Keriang, Kodiang Limestone 90
- Korbu 8
- Kuang, Kanthan, cement 363
- Lanis 116
- Lang, Ipoh Fig. 2.4, Fig. 2.6
- Ledang 8, 33, 263
- aureole 242
 - Cretaceous 222
 - granite Fig. 11.9
 - age 216, 242
 - metamorphic aureole Fig. 11.9
- Lesong 126
- Melaka 12
- Panti 127
- Barat 127
- Perak 6
- Pondok, Padang Remgas, cement 363
- Pulai
- Cretaceous 222
 - dating 216
 - Volcanic Member 108
- Rabong Formation = Semantan Formation
- Rabong Formation 103, 105
- basal conglomerates 106
 - basin Fig. 6.1
 - may be northern Semantan 106
 - volcanic topographic highs 106
- Rajah 8
- Rapat, Ipoh 11, 159, Fig. 2.5
- notches... Fig. 2.7
- Rawang Mata Hari 8
- Raya Granite, Langkawi 244, 321, 330
- Semanggol 93
- Conglomerate Member 98
 - structures 283
- Sempah 8
- Sinyum, Gua Musang Formation 103
 - limestone 105, 106, 113
 - Complex 233
- Stong Complex 12, Fig. 11.1, Fig. 11.4
- dating 216
- Sumalayang 84
- Tahan 8, 120, Fig. 2.9, Fig. 6.17
- Tangga Dua Belas 120
- Tasek, Perak, cement 363
- Ulu Kali 8
- Ulu Semangko 8
- Guntong Field
- development 389, 388
 - exploration 389
 - geology 388
 - location 389
 - Malay Basin... 185, Fig. 8.13

reservoir parameters Table 16.8
 stratigraphy Fig. 8.13
 structure... 389, Fig. 16.19
 Gurun... Fig. 11.6
 gymnosperm palynomorphs 119
 gypsum pseudomorphs, Kodiang
 Limestone 90

H

H.S. Lee beds 75, 312
 haematite
 bauxite 22
 Bukit
 Besi 348
 Ibam... 349, Fig. 15.10
 –cassiterite 344
 clasts, Ma'Okil Formation 121
 tinfields 340
 Hainan Island, basalt 40
 half-graben 170
 Batu Arang 146
 Penyu Basin 193
 halloysite formation 22
Halobia 113
 Conglomerate Member 99
 Chert Member 97
 Rhythmite Member 98
 hawaiiite, Kuantan 209
 Hawthornden Schist 52, 76, Fig.
 13.13
 folding 284
 heat flow
 Malay Basin 177, 189, 379, Fig.
 8.16
 models 189
 Penyu Basin 196
 high
 heat flow, Malay Basin 189
 –K calc-alkali series 227, Fig.
 10.15
 level alluvium 158
 –pressure high-temperature
 play 385
 hilltop laterites 22
 hilly terrain 6
 Kedah... Fig. 2.3
 Holocene sea levels 28, 172
 hornblende
 –bearing rocks 220
 –biotite-quartz schist, Stong 236
 geobarometer 223
 –quartz schist, Stong 236
 hornfels, eastern Malaya 245
 Hosking died in Camborne 1
 hot
 spot thinning 177
 springs, Kuala Lumpur 260
 Huai Hin Lat Formation 40
 Hulo Member 58
 Hulu Lepar 116, 118
 humid tropics weathering 17
 Hutan Aji Fig. 5.15
 Member 67–69

Hutchison, C.S. c.v. 2
 in retirement 1
 hydrocarbon
 accumulation 379, Fig. 16.12
 Groups D & E Fig. 16.18
 discoveries Malay Basin Fig. 16.7
 distribution Malay Basin 373
 generation 379, Fig. 16.12
 Malay Basin 380
 migration 379, Fig. 16.12, Fig.
 16.13
 occurrence, Dulang Field... Fig.
 16.18
 preservation Fig. 16.12
 hydrogen index
 Batu Arang 143
 source rocks Fig. 16.10
 hydrothermal
 alteration, granites 229
 veins 340, 334
 tin, map Fig. 15.3
 lodes 340

I

I type granite 211, 226, 231, Fig.
 10.14, Fig. 10.22
 melts 231
 Palaeo-Tethys subduction... Fig.
 14.7, Fig. 14.8
 iceberg melting 314
 ignimbrite Fig. 9.2
 Bukit Ibam 348
 dyke... Fig. 11.4
 Genting Sempah 48, Fig. 4.4
 Pengerang 363
 rhyolite 199
 Santi, Johor 205, Fig. 9.6
 volcanism Johor 204
 illite in weathering 21
 ilmenite
 amang 339
 –series 217
 granites 339
 imbricate structure 288
 impounded tin mineralization,
 western belt 340
 India
 Gondwana rift basins... Fig. 14.5
 indentation into SE Asia... 316,
 Fig. 14.10
 Indochina
 block 309
 rifting from Gondwanaland Fig.
 14.7
 map Fig. 14.1
 palaeolatitudes Fig. 14.2
 terrain 309
 Indochinese Cimmerides 316
 Indonesian placer names 334
 Indosinian collisional Orogeny 2,
 43, 230, 237, 239, 271, 279,

304, 309–310, 316, 321, Figs.
 14.7–14.8
 palaeomagnetisation 24
 infilled valleys 28
 injection complex 254
 inland plains 26, 28
 inselbergs 12
 Institute of Geological Sciences 211
 intermediate
 facies series 236
 microcline 220
 Eastern Belt 222
 plutonic rocks 211
 rock absence 232
 intermontane basins 142
 intra-arc basin 271
 inversion
 anticlines, Malay Basin... Fig.
 16.15
 Malay Basin... 182, 188, 193, Fig.
 8.10, Fig. 8.14
 Penyu Basin... Fig. 8.20
Iranophyllum 312
 iron
 –bearing skarns Fig. 15.4
 ore
 Bukit Besi Fig. 15.9
 Bukit Ibam Fig. 15.10
 deposits 347
 Pelepah Kanan, Johor Fig. 15.7
 strata-bound, Bukit Ibam 348
 tin content 346–347
 origin, Bukit Besi 348
 replacement of shale 348
 rich roof pendants 348
Ischyosporites
scaberis 127
variegates 127
 Isthmus of Kra 5

J

Jalan Penarikan 17
 Jambi Depression Fig. 3.5
 jamesonite, Leong Sin Nam
 Pipe 347
 Jasin Volcanics 85, 204, 300
 palaeomagnetic data map Fig.
 14.12
 Jelai Formation 107
 Jelebu 51
 Fault 259
 Schist 79, 82
 Jempol
 Negeri Sembilan 17
 Slate, Mengapur 83, 354
 Jemurok Member 58
 Jengka
 Pass 40, 86, 108, 109, 116, 310
 flora... Fig. 14.3
 roadcuts 81, Fig. 5.22
 stratigraphy Fig. 6.18
 unconformity 295, 297

sketch Fig. 5.21
 Triangle volcanism 203
 Jentik Formation 66, 67, 69
 Jerai
 Formation 60, Fig. 11.6
 ripple marks and trace fossils Fig. 5.7
 rhyolite 199
 granite... Fig. 11.6
 age 240
 metamorphics... Fig. 11.8
 Metaquartzite 240, Fig. 11.7
 pluton 218
 Schist 240, Fig. 11.7
 Jeram Padang Ridges
 conglomerate 111
 Jerantut 108
 gravity high 327
 volcanism age 198
 Jerneh Field 189
 development 401
 exploration 398,401
 geology 401
 location 398
 stratigraphy Fig. 16.27
 structure 398, Fig. 16.26
 Jerong batholiths 220
 Jerus Limestone, Gua Musang
 Fm. 103, 104, 292
 Johor
 Bahru Quaternary 167
 Graben, Straits of Malacca 154,
 157, Fig. 7.16
 graben belt 157
 group grabens 150, 154
 Platform 175, 177, 193, Fig. 8.1,
 Fig. 8.6, Fig. 8.9, Fig. 8.18,
 Fig. 16.6
 Quaternary 167
 structures 297
 undulating terrain... Fig. 2.4
 volcanics 204
 chemistry 207
 joint
 control in karst 11
 Development area Fig. 8.5, Fig.
 8.8
 Julu Rayeu Formation 152
 Jurassic
 –Cretaceous basins 272, Fig. 6.16
 strata deformation 274, 279,
 297, 308
 timing 307
 Jurong Formation, Singapore 107,
 108, 112, 113
 stratigraphy Fig 6.12

K

K₂O vs
 Na₂O of granites Fig. 10.14
 SiO₂ granites Fig. 10.15
 Genting Sempah Fig. 9.5
 Kaeng Krachan Group 38
 Kajang Schist 52, 76
 Kaki Bukit
 cave 170
 fill... Table 15.1
 placers 335, 338
 Limestone 61, Fig. 5.9, Fig. 5.10
 kaksa deposits 334, 335, 337
 allochthonous 337
 grain size 335
 Kaling Formation 80, 111, 113, Fig.
 6.1
 Kambau, Ulu Sedili granite... Fig.
 2.8
 Kambing Beds 82, 83
 Kampar 73
 stratigraphy Table 5.2
 Kampong
 Awah 81
 andesite 203
 dating 198
 limestone 108
 volcanism 40, 312
 Batu Hitam basalt 169
 Binjal 67, 68
 Buluh fault zone 268, Fig. 12.3
 Chengkenik Semantan
 Formation 107
 Dong rhyolite ash 169
 Durian Chondong basin 133, 134,
 143, 267, Fig. 12.17
 Guar Jentik 65, 67, 68
 Jelai, Kepis cement 363
 Kayu Papan 205
 Padang Masirat Quaternary 164
 Permatang Buloh Quaternary 164
 Sena Formation 70
 Seri Jaya 83
 Sungai Jerik 108
 Kanan Kerbau gold deposit 360
 Kanching valley, Boulder Beds 159
 Kankoi fault 258
 Kanthan Limestone 73, Fig. 5.17
 kaolin quarrying 363
 kaolinisation, tinfields 340
 kaolinite
 bauxite 22
 formation 22
 weathering 21
 Kapal
 batholiths 220
 –Bergading Tectonic Line 175,
 181
 Kapas
 Conglomerate 258, 269, 302–303
 age 303
 Fault Zone 258, 302, Figs.
 12.11–12.12
 Karak 107, 110, 268
 Formation 292
 Group 45, 78, 79
 Highway 262
 Bentong-Raub Fig. 4.3
Karavankina species 108
 karang deposits 334
 karren 9
 karst
 hills
 Kinta 72
 Perlis Fig. 2.4, Fig. 2.6
 landforms 9, Fig. 2.4, Fig. 2.6
 notches Fig. 2.5
 pinnacles 27
 weathering 335
 Kati
 Beds 75
 Formation 314
 Kcau Tui gold deposit 358
 Kedah
 gravity 330
 contour map... Fig. 14.18
 Palaeozoic 71
 Peak = Gunung Jerai 6
 granite gravity 330
 Quaternary 164
 sediments 164
 –Singgora Range 6
 stratigraphy Fig. 5.3
 Kelang Lama terrace 27
 Kelantan
 beach ridges... Fig. 2.14
 coastal plain... 25, Fig. 2.13
 delta 169
 Quaternary 168
 volcanism 202, 203
 Kelapa Kampit
 bedded lodes 338
 tin mine 338
 Kelau
 Fault Fig. 8.3
 –Karak Fault Zone 268
 Keliu Slates 83
 Keluang, Johor 108
 –Nyior Basin location Fig. 12.17
 redbeds 122
 Kemahang
 granite... 237, 265, 269, Fig. 11.4
 leucogranite 280
 Kemaman coastal plain 26
 Kempadang Formation 158, 160
 Kemubu 233
 Kemuning Hill
 gabbro 221
 tholeiite 227
 Kenerong
 Leucogranite 233, 235, 236, 237,
 266, 280, Fig. 11.1–11.2
 dating 216
 enclaves 233
 microgranite, Stong Complex 219
 Kenny Hill Formation 38, 76, 287,
 307, 314, Fig. 5.19, Fig. 13.13
 folds 284
 recumbent Fig. 5.20
 vergence 287
 soft-sediment deformation 285
 structure 287

- weathering... 19, Fig 2.9, Fig. 2.11, Table 2.4
- Kenyir Lake 16
- Kepis Beds 51, 82, 108
- Kepulauan Aruah Nose 154
- Keramutan Fault Fig. 14.9
- Kerdau Formation 107
- Kerogen type 374
- Kerteh Quaternary 168
- Kerum Formation 106, 109, 115, 116, Fig. 6.6, Fig. 6.18, Fig. 13.5
- lithologies 116
- Keutapang Formation 152
- Khlong Marui Fault 339, Fig. 3.3, Fig. 15.1
- Khorat
- Basin 40
- early rifts ... Fig. 3.6
- Platform 178
- Swell 182
- Khuan Din So Shale 38
- Kilim, Kisap Thrust 256
- Kim Loong
- No. 1 beds 73
- No. 3 beds. 73
- kinematics, Tertiary basins Table 7.4
- Kinta
- River 245
- Valley 27, 344
- alluvium 333
- stratigraphy... Fig. 15.1
- faults 268, 340
- geological map Fig. 5.17
- iron ore 348
- karst 10
- limestones... Fig. 14.3
- mineral zonation... Fig. 15.15
- Palaeozoic 72
- Quaternary 165
- schists 72
- sequence 312
- skarns 346
- stratigraphy 75, Fig. 14.3, Table 5.2
- tin placer stratigraphy Fig. 15.1
- zonation Fig. 15.15
- Kisap Thrust, Langkawi 255–256, 269, 282, 287, Fig. 12.6, Fig. 12.8
- reactivation 308
- Klang
- alluvium gravity high... Fig. 14.16
- Gates quartz ridge 9, 36, 76, 283, 258–259, 340, Fig. 2.3, Fig. 2.5, Fig. 12.14, Fig. 13.13
- age 287
- reservoir hot springs 260
- gravity contour map... Fig. 14.17
- plain has gravity high 328
- Valley gravity 329
- Kledang Range 344
- granite 8, 27, 73, 246, Fig. 15.15, Fig. 5.17
- Klian Intan, Perak 8, 344
- Kluang
- Limestone... Fig. 14.4
- Niyor Basin 133–134, 144, 267
- station 144
- knick points, Bentong 15
- knolls 12
- Kodiang
- cliffs 11
- Limestone 88, Fig. 6.1, Fig. 6.2
- conodont ranges Fig. 6.6
- depositional setting 92
- palaeomagnetic data map Fig. 14.13
- Permian–Triassic boundary 90
- similar setting to Chuping Limestone 93
- stratigraphy 88, Fig. 6.3, Fig. 6.4
- structure 88
- Sumatra correlatives 93
- Semanggol depocenter 87, 114, 129
- stratigraphy 87
- Koh Formation 106, 119, 271
- conglomerate 104
- correlatives 120
- lithology 119, 120
- redbeds 120
- stratigraphy Fig. 6.16
- Tembeling basins 131
- Kota
- Bharu rainfall 15
- Gelanggi 106, 116, 117, 272
- Gua Musang Formation 103
- limestone 105, 113
- conglomerates 106
- Jin limestones 105
- Tampan 27
- rhyolite ash 169
- Tinggi 267
- kaksa... Table 15.1
- waterfall 345
- Kramat Pulai, Kinta Valley 361
- scheelite mine... Fig. 15.15
- structure 361
- Krau Satu road 104, 293
- structure Fig. 13.18
- Kroh Formation 72, 101
- Krusin Flora 33
- Kuala
- Abang folds 300, Fig. 13.25
- Balah... 233, Fig. 11.1, Fig. 11.4
- Basin, Sumatra Fig. 14.9
- Betis, Gua Rabong Formation 103
- Dipang granite 75
- Dungun folding 300
- Kangsar 27
- Kelawang 82, 262
- biotite-rich 217
- Kemasik metamorphism 245
- Krai granites 229
- Kubang Badak 61
- Kubu Baharu 52, 260
- Kurau mangrove 163
- Langat
- peat 163
- Quaternary 166
- Lipis, Gua Musang Formation 103, 107
- Lumpur
- Fault Zone 171, 258, 262, 268, 280, 287, Fig. 8.3, Fig. 12.3, Fig. 12, 13
- dating 283
- folds 283
- geological map Fig. 13.13
- gravity contour map... Fig. 14.17
- Limestone 52, 76, 287, Fig. 5.19, Fig. 13.13
- offshore 156
- Straits of Malacca 148
- lowland 27
- Palaeozoic 76
- placer tinfield Fig. 15.1
- Quaternary 166
- secondary textured granite 218
- Mentiga 245
- Pahang Quaternary 167
- Perlis Quaternary 164
- Pilah 43, 45, 51, 268
- Prai Quaternary 164
- Rompin Quaternary 167
- Sedili structure 297
- Selangor graben offshore 156
- Sungai Perong, wolframite 343
- Tembeling, Gua Musang Formation 103
- limestones 103
- Semantan Formation 107
- Terengganu coastal plain 26
- Kualu
- Formation, Sumatra correlated with Semanggol Formation 100
- rift basin, Sumatra 100
- Kuan On beds 73
- Kuantan 86
- alkaline basalt dating 199, 209
- Basalt 40, 169, 197, 209, Fig. 9.1
- chemistry 209
- dykes 210
- palaeomagnetism 318, Fig. 14.11
- age 199, 209
- relation to basalt 209
- mineralogy 209
- relation to dykes 209
- Fault 193, Fig. 8.18
- Group 84
- folds 295
- metamorphism 245
- Graben 193, Fig. 8.19
- pluton 220
- Quaternary 167
- Kubang Pasu Formation 38, 67, 68, 69, 70, 312, 314
- deformation 308
- Straits of Malacca 148
- Kukup Graben 157
- Kulim 9

rivers 15
sandy Rhythmite Member 97
kulit deposits 334
Kundur 316
Kuroko deposits 351, 360. Table 15.2
kyanite, Taku Schist 239

L

Labis area 109
Paloh Formation 122
Labu 339
labradorite, Genting Sempah 202
lacustrine
shale 375
Malay Basin 187, Fig. 8.11
signature 374
source rocks 374
Malay Basin Fig. 16.9
strata
Batu Arang 141
Malay Basin... 185, Fig. 8.14,
Fig. 8.15
Ladinian age
algae and foraminifera 105
Chert Member 96
radiolarian age 96
Chuping Limestone 93
limestones, Gua Telinga and Gua
Luas 104
Semantan 113
lagoons, east coast 26
Lahat
–Menglembu, Kinta Valley 339
Pipe 347
lake 16
Toba eruption 169
Lalang Member 67, 69, Fig. 5.13,
Fig. 5.14
Lanchang
acid volcanics, cross section... Fig.
14.8
road 111
landforms, Karst Fig. 2.4
landslips, damming of river 17
LANDSAT imageries 251, 255
Langgun Redbeds 67–69, Fig. 5.13,
Fig. 5.15
Langkawi Islands 314
Canning Basin similarity 314
cross sections Fig. 12.7
deformation 286
episodes 286
geological map Fig. 12.6
gravity contour map... Fig. 14.18
greenschists 244
karst 10
Kisap Thrust 255
metamorphism 244
Quaternary 164
stratigraphy Fig. 5.3
Lanis Conglomerate 113, 116, 119,

131, Fig. 6.6, Fig. 6.18, Fig.
13.5, Fig. 13.6
lapis 10
large ion lithophile modeling 227
laterite 21
argillaceous bedrock 22
concretions... Table 2.4
hardening upon drying 21
Port Dickson 52
lavas, age distribution 197
Lawin 133, 135
Basin 145, 263, Fig. 12.15
Tuff 72, 199
Lawit batholith 220
Layang-Layang 267
Basin 133, 135, 145, 269, Fig.
12.17
Formation 145
Lebir Fault Zone 119, 126, 249,
253–254, 265–267, 269, 271,
273–274, 279, 308, Fig. 8.3,
Fig. 12.3, Fig. 12.5, Fig. 13.5,
Fig. 14.9, Fig. 15.1
edge of Semantan Basin 114
Ledang Formation... 184, Fig. 8.2
Lee Chai Peng c.v. 2
Leong Sin Nam Pipe 347
Lepar
Fault Zone 119, 266, 279, Fig.
8.3, Fig. 12.3, Fig. 12.5
Granodiorite 118
Mengapur 354
lepidolite pegmatites 340
Lesong
fault bounded 274
Sandstone 126
letter classification, Malay
Basin... 185, Fig. 8.2
leucite
basanite & tephrite, Segamat 209
leucogranite veins, Stong 219
levees 15
Terengganu 168
Lhasa Block Fig. 14.10
lignite 363
Batu Arang 140
Kluang–Niyor 144
limestone
and schists, Kramat Pulai 361
anomaly Batu Caves 329
bands & lenses in Chert
Member 96
bedrock, Tekka mine... Fig. 15.6
breccias, Kodiang Limestone 90
Bukit Ibam 351
conglomerate
Gua Musang Formation 105
Kodiang Limestone 88, 90
country rocks, Beatrice
Mine... Fig. 15.8
Gua Musang Formation 103, 104
hill formation 11
Kramat Pulai mine... Fig. 15.15
lenses, Semantan Formation 110
Manson's Lode 351, Fig. 15.11

Permian–Triassic 292, 323
quarried for cement 363
silicified, Bukit Ibam 349
topographic highs 106
limonite
bauxite 22
Bukit Ibam... Fig. 15.10
Linden Hill
olivine eucrite 221
tholeiite 227
lineaments 254, 269
RADARSAT... Fig. 12.2
Lingga 316
Linggiu
Formation 40, 84, 128, 310
flora... 85, Fig. 14.3
lithophile elements 229
lit-par-lit leucogranite 280
littoral placers 338
lode channels, Bukit Koman... Fig.
15.14
Loei, Thailand 311
Gigantopteris 40
loellingite, Pelepah Kanan 345
Lojing hot spring 269
longshore currents, Peninsular
Malaysia 25–26, Fig. 2.11
Lotong Sandstone 119, 124, Fig.
6.22
cross bedding 126
low level alluvium 158
Lower
Clay 173
Detrital Band 64
Setul Limestone 61
Luit Tuffs, Mengapur 83, 354
Lubok Mandi
gold lode mine 355, 360
Lumut
Quaternary 160
–Dindings
beach placers 338
fan 336
Lupar Line map Fig. 14.1

M

Ma'Okil Formation 109, 120–123,
Fig. 6.19–6.20
stratigraphy Fig. 6.19
structure 121
Machang coastal plain Fig. 2.12,
Fig. 2.13
Machinchang Formation 38, 57–58,
245, Fig. 5.4
deformation 286
outcrops Fig. 5.6, Fig. 5.9
Straits of Malacca 148
stratigraphy Fig. 5.5
structure 281
Mae Ping Fault 38, Fig. 3.6, Fig. 8.4
mafic
dykes 269

- microgranular enclaves 223
- plutonic rocks 211
- rocks associated with granite 221
- magmatic evolution, Gentingv202
- magnetic linear anomalies 274
- magnetite
 - Bukit Ibam 349
 - Chini prospect... Fig. 15.12
 - inclusions in cassiterite 347
 - iron ore, Bukit Ibam... Fig. 15.10
 - Manson's Lode 354
 - martite-haematite, Pelepah 345
 - Mengapur 354
 - ore, Bukit Besi 348
 - Pelepah Kanan 345
 - Tasek Chini 354
 - tin content 348
- Mahang Formation 71, 240, 263, Fig. 11.6
- Main Range 8, 9
 - batholiths 216
 - chemistry 224
 - collision related granites Fig. 10.19
 - contrast with Eastern Belt Fig. 10.10
 - emplacement level 216
 - enclaves 52, 223
 - foothills 43
 - Granite 45, 199, 211, 253, 269, 316, 344, Fig. 4.2, Figs. 4.3–4.4, Fig. 10.1, Fig. 15.15, Fig. 15.17
 - age 211, Table 10.1
 - Australian difference 231
 - country rocks 216
 - mineralogy 217
 - palaeolatitude 324
 - palaeomagnetism 319
 - pluton names Fig. 10.2
 - prominent gravity low 326–327
 - province 216
 - secondary amphibole 217
 - spine 249
 - textures 217–218, Fig. 10.4
 - Kramat Pulau 361
 - Zr vs SiO₂ Fig. 10.12
- gravity
 - anomaly decreases southwards 327
 - minimum... Fig. 14.14, Fig. 14.16
- High, Late Triassic... Fig. 14.9
- Karak Highway Fig. 4.4
- mountain watershed 216
- origin of placers 335
- palaeomagnetic data map Fig. 14.12
- province 211
- Rb vs Sr granites Fig. 10.11
- small intrusive centres 216
- spider diagrams Fig. 10.16
- western margin schist 52
- major
 - belts of peninsula 249
 - faults of peninsula 249
- Malacca 51
 - beach placers 338
 - folds 283
 - Platform 153
 - Quaternary 166
 - reefs 152
 - serpentinite 36
 - Strait 28
- Malay
 - Basin 175, 177, Fig. 8.1, Fig. 8.3
 - acreage
 - 1971 Fig. 16.1
 - 1976–77 Fig. 16.2
 - 1990 Fig. 16.3
 - 1999 Fig. 16.4
 - 2006 Fig. 16.5
 - basement rocks and topography 178, Fig. 8.6
 - biostratigraphy 184
 - coaly source rocks Fig. 16.9
 - cross sections Fig. 8.7
 - crustal thickness 177
 - depositional environments 182, Fig. 8.11
 - development model Fig. 8.4
 - divisions 371
 - Dulang Field Fig. 16.17
 - E–W grabens Fig. 8.5
 - exploration 365
 - faults 182, Fig. 8.3
 - gas fields Fig. 16.9
 - geothermal gradient map Fig. 8.17
 - grabens 179
 - Group
 - H petroleum... Fig. 16.12
 - I petroleum... Fig. 16.12
 - heatflow
 - geothermal gradient 177
 - map Fig. 8.16
 - hydrocarbon discoveries Fig. 16.7
 - inversion 182, Fig. 8.14
 - lacustrine source rocks Fig. 16.9
 - letter classification... Fig. 16.13
 - map Fig. 8.1
 - Miocene development 187
 - northern section Fig. 16.13
 - oil and gas fields... 365, Fig. 16.6, Fig. 16.9
 - origin model 177
 - Palaeocene–Oligocene development 185
 - palaeo-environments... Fig. 8.15
 - palaeofacies maps Fig. 8.15
 - palaeogeography Fig. 8.14
 - petroleum resource regions Fig. 16.6
 - Pliocene development 189
 - porosity and permeability Table 16.7
 - reservoir rocks Fig. 16.8
 - sealing formations... Fig. 16.8
- sedimentary
 - environments... Fig. 8.12
 - source rocks Fig. 16.8, Fig. 16.9, Fig. 16.10, Fig. 16.11
 - stratigraphy 182, Fig. 8.2, Fig. 8.11
 - age range 175
 - structure 181, Fig. 8.8–8.9
 - syn-rift stage 185
 - tectonic events 177, Fig. 8.4, Fig. 8.11, Fig. 16.8
 - trap styles Fig. 16.7, Fig. 16.14, Fig. 16.15
 - dome theory... 177, Fig. 8.4
- Malayan Collieries Ltd 138, 143, 144
- malayaite 339, 347
- Malaysia-Thailand Joint Authority 368
- Manchis
 - conglomerates 111
 - Granite 107
- Manek Urai 239
- manganese gossans 355
- Mangking Sandstone Formation 113, 116–120, 274, Fig. 6.6, Fig. 13.5, Fig. 16.18
- lithologies 118
- mangrove
 - pollen 163
 - swamps 23
 - Johor 24
- Manik Urai 82
- Manson's Lode, Ulu Sokor, Kelantan... 351, Fig. 15.11, Table 15.2
 - reserves 354
 - structure 351
- mantle plume 230
 - model 177, Fig. 8.4
- map of the major faults of the Peninsula Fig. 12.3
- Maran 86, 117, 273
 - florule 118, 126, 127
 - Jerantut 272
 - River, plant localities 118
- Maras Bukit Jong Granite pluton 220, 223
- marble
 - quarry 363
 - Langkawi 244
 - mining Simpang Pulau Fig. 15.16
 - silicified zones, Keau Tui 358
 - Stong Complex 236
- marine
 - diamictites Gondwanaland Fig. 14.5
 - placers 338
 - sandstone, Malay Basin 187
 - transgressions 335
- martite
 - Bukit Besi 348
 - Pelepah Kanan 345
- massive sulphide deposits 360
- properties... Table 15.2

- Matang Gelugor Member 161, 164, 165, 166, 167, 168
 Matang Timbul Member 161
 maturation Malay Basin Fig. 16.11
 Mawchi in Myanmar 338–339
 maximum microcline, Main Range 217
 meanders 15
 Medial Malaya = see Bentong-Raub suture
 Medial Malaya Suture Fig. 14.4
 Medial Sumatra Suture Fig. 14.4
 tectonic High Fig. 14.9
 megacryst
 biotite granite 217
 broken Fig. 10.5
 granite textures Fig. 10.4
 microgranite 199
 mélange 47–48, 271
 Cinta Manis Fig. 13.16
 Genting Sempah 48
 Mempelam Limestone fossils Fig. 5.12
 Perlis 65, 67, 69, Fig. 5.13–5.14
 Mengapur
 barite 363
 deposit 351, 354
 Limestone 83, 354
 mineralogy Table 15.3
 Menglembu, Kinta Valley... Fig. 11.10
 Quaternary 159
 tourmaline-corundum 246
 Mengkarang Formation 311
 Mengkudu placer 338
 Mentakab 107
 bypass 110
 Mentawai Fault 33
 Mentulu Formation 37, 312
 Merapoh 78, 80
 Gua Musang Formation 103
 karst hills 104
 Meratus Mountains 32
 Merbau Pulas Chert Member 97
 Merchang fresh water swamps 26
 Merchong Graben 193, Fig. 8.19
 mercury mineralization, Raub 359
 Mergui Basin 33
 Mersing
 Beds 205, 244, 257, 304, folding Figs. 13.21–13.24
 analysis 297
 multiple deformation 298
 structure 244, 297
 analysis 298
 coastline folds 298
 –Endau Fault Zone 266, 269
 Fault Zone 274, 260, Fig. 8.3, Fig. 12.3
 RADARSAT Fig. 12.17
 gold 355
 mining 361
 Group 127
 multiple folding 297
 permatang 26
 Quaternary 167
 mesas, Panti Sandstone 127
 Meso-Tethys Ocean 316, Fig. 14.6
 mesothermal veins... Table 15.4, Table 15.5
 gold 356
 Mesozoic strata
 correlations 129
 Jengka Pass Fig. 5.22
 stratigraphy 87, Fig. 6.24
 metabasites 43
 metal zonation, Kinta Valley Fig. 15.15
 metaluminous granites 225, Fig. 10.13
 metallogenic belts 338
 metamorphic aureole
 Bukit Ibam 349
 Jerai 242
 country rocks, Stong Complex 219
 facies
 diagram... Fig. 11.3, Fig. 11.5
 Gunong
 Jerai 241, Fig. 11.8
 Ledang aureole Fig. 11.9
 Stong Complex Fig. 11.3
 Taku Schist Fig. 11.5
 minerals, Jerai aureole Fig. 11.7
 paragenesis, Stong Complex 236
 rock weathering 20
 metamorphism 233
 related to structure 304
 meta-pelites
 Ledang... Fig. 11.9
 Stong Complex 236
 metaquartzite 45
 metarhyolite, Dinding Schist, Kuala Lumpur 52, 199
 metasedimentary enclaves 266
 metasediments
 Pelepah Kanan... Fig. 15.7
 Permian–Triassic 292
 metasomatised peridotite 230
 mica
 crystallinity values 305
 schist 45
 Jerai 241
 microcline, intermediate 245
 microcontinents SE Asia map Fig. 14.1
 micro
 granite in Main Range 216
 granodiorite, Genting Sempah 48, Fig. 4.4
 rhyodacite, Genting Sempah Fig. 9.4
 migmatite
 injection 233
 Stong Complex Fig. 11.1, Fig. 11.2, Fig. 13.10
 migration
 hydrocarbons 379
 pathways 380
 oil, Malay Basin... Fig. 16.13
 Minas Formation 154–155, 157
 mineral
 stability 22
 zonation
 Kinta Valley... Fig. 15.15
 lodes 340
 Minerals and Geoscience Department Malaysia v, 1
 Mining
 developments 331
 tin
 dredging 332
 hydraulic 332
 mintcan placers 334
 mintjan 337
 placers 334, 337
 grain size 335, 337
 Mobil 365
 1971 acreage... Fig. 16.1
 1977 acreage... Fig. 16.2
 Mogok Gneiss 316
 mogote hills, karst... 9, Fig. 2.6
 molasse
 deposit, Tebak Formation 128
 facies, Saiong Beds 114
 molybdenite
 Beatrice Pipe 347
 Mengapur 354
 Penjom 359
 Tasek Chini 354, 355
 monazite
 amang 339
 Gunung Jerai 347
 monsoon 15
 montmorillonite in weathering 21–22
 monzonite
 Benta 219
 series 224
 textures 219
 Mount Faber Ridge 9
 Mount Ophir 216
 granite Fig. 11.9
 mountain
 ranges 6
 terrain, Kedah... Fig. 2.3
 MSS-XA Graben 153
 Muar
 –Pekan overland 17
 River = Sungai Muar
 Muda
 Dam area Semanggol conglomerates 98
 Formation... Fig. 8.2
 mudstone
 Chert Member 95
 laminated, Semantan 110
 Rhythmite Member 97
 Muntahak Granite 127
 Murai
 mine
 alluvial gold 358
 tin, Bentong 355
 Murau
 Formation 257, 299, 303
 –Bukit Keluang Fault 85
 Conglomerate 85, 117

deformation dating 305
structure 304

muscovite
Gunung Jerai 347
Main Range 217
pegmatite, Jerai 240
–quartz schists 51
–tourmaline greisenization 344

Mustaffa Kamal Shuib c.v. 3

Mutus
assemblage 38, Fig. 3.5
correlated with Semanggol Formation 100
Basin 316, Fig. 14.4, Fig. 14.9

mylonite 253–254, 260, 263
Bentong area... Fig. 4.3
dating 308
zones 260

Myophoria fauna 113
Bukit Resam 113
Semantan 111

N

Nakawan Range 6

Nam Con Son Basin 177

Nam Loong beds 73, 312

Namurian shales, Sungai
Leming... 340, Fig. 15.5

Nan Uttaradit suture 38, 43, Fig. 3.6, Fig. 14.1

Narathiwat High 175, Fig. 8.1

Narcondam Island 33

nautiloid
fauna, Langkawi 314
orthoceraconic 45

Nb-Ta-Ti oxides, Gunung Jerai 347

nebulite, Stong Complex 233

negative lineaments on
Peninsula Fig. 12.2, Fig. 12.3

Negeri Sembilan
faults 268
Quaternary 166

Nenering Beds 101, 133
conglomerates 101
outcrops Fig. 6.10
palynomorphs 102
Upper Unit 101

Neocalamites 118, 119

Neocomian plants 119

Neoschizodus 116
Semantan 113

New Lahat Mine 246

Nicobar Fan & islands Fig. 3.3

Nilam Marble, Gua Musang
Formation 103, 104, 119

Ninetyeast Ridge map Fig. 14.10

Nongson Formation of Vietnam 33

Norian
Chuping Limestone 93
conodonts, Koding Limestone 92
Rhythmite Member fossils 98

Noring
Granite, Stong Complex 219, 233,
Fig. 11.1
chemistry 228
dating 216
spider diagram Fig. 10.17

hornblende-biotite
granodiorite Fig. 10.6

North
China palaeolatitudes... Fig. 14.2

Penang graben 155

Sumatra
Basin 36, 148
stratigraphy Fig. 7.9

North–east
ramp margin plays 385
trending faults 268

North–South Fault Zones 268

North–west Domain 55, 57, 86,
249, 271
Palaeozoic stratigraphy Fig. 5.2,
Fig. 5.3
structures 281

Northern
Graben, Straits of Malacca 151,
153, Fig. 7.10
Group grabens 150
Straits Tertiary basins 151, 153

notches
limestone hills... 11, Fig. 2.7
wave-cut 172

nubbins 12

Nuraiteng Tee Abdullah, c.v. 4

O

oblique convergence subduction 33,
269

ocellar texture in enclaves 223

offshore
bar sandstones 378
peat 162

oil
chemistry 377
companies in Malaysia
1990... Table 16.1
1999... Table 16.2
2006... Table 16.3
company acronyms 365
discovery history 365
expulsion, Malay Basin... Fig.
16.11
fields, Malay Basin 373, 385, Fig.
8.1, Figs. 16.6–16.7, Fig. 16.9,
Fig. 16.16

gas
discoveries Penyu Basin Fig.
16.6
fields Malay Basin Fig. 16.6
generating potential Fig. 16.10
Batu Arang 143
microscopy Fig. 7.6
occurrences, Malay basin 370
resources Malay & Penyu
Basin Table 16.4

shale
Batu Arang 141, Fig. 7.5
Kampong Durian
Chondong 143
–water contact, Malay
Basin... Fig. 16.17
window 381
Malay Basin Fig. 16.13

Old Alluvium 158, 160, 165, 171,
333, 337, Fig. 15.2

Older
Arenaceous Series 77
marine unit... Fig. 15.2
Sedimentary Cover 333

olistoliths
limestone
Gunung Rabong Formation 106
Semanggol Basin 100
Triassic 105

olistostrome 45, 47, 48, 253, 271,
290, 296, 306
Bentong area... Fig. 4.3
Cameron Highlands Fig. 4.5, Fig.
12.4
Cinta Manis 291, Fig. 13.16
clasts 291
debris flow 292
deformation 291
East-West Highway Fig. 12.16
fault vergence 291
redbed clastic clasts 292
Semantan Formation 114
sigmoid clasts 291–292
soft-sediment deformation 291

olivine
eucrite, Linden Hill 221
nephilinite, Kuantan 209

ooids, Koding Limestone 92

oolitic grainstones, Gua Panjang 104

open-cast mining of stockworks 344

ophiolite 43, 51

ore
mineralogy, massive sulphide
deposits Table 15.2
skarn deposits Table 15.3
vein deposits... Table 15.4,
Table 15.5
types, Bukit Ibam Fig. 15.10

organic
facies Batu Arang 141, 142
mud and peat 158
petrology, Batu Arang 140

oroclinal
bending 279, 316–317
model... Fig. 3.4
shape 249

orthoclase, Eastern Belt
granites 220, 222, 244

orthoconglomerate, Semanggol
Formation 98

orthopyroxene rhyodacite 199
Genting Sempah Fig. 9.5
mineralogy 201
petrology 201

Osborne and Chappel 136, 364

- Matang Gelugor Member 161, 164, 165, 166, 167, 168
- Matang Timbul Member 161
- maturation Malay Basin Fig. 16.11
- Mawchi in Myanmar 338–339
- maximum microcline, Main Range 217
- meanders 15
- Medial Malaya = see Bentong-Raub suture
- Medial Malaya Suture Fig. 14.4
- Medial Sumatra Suture Fig. 14.4
- tectonic High Fig. 14.9
- megacryst
- biotite granite 217
- broken Fig. 10.5
- granite textures Fig. 10.4
- microgranite 199
- mélange 47–48, 271
- Cinta Manis Fig. 13.16
- Genting Sempah 48
- Mempelam Limestone fossils Fig. 5.12
- Perlis 65, 67, 69, Fig. 5.13–5.14
- Mengapur
- barite 363
- deposit 351, 354
- Limestone 83, 354
- mineralogy Table 15.3
- Menglembu, Kinta Valley... Fig. 11.10
- Quaternary 159
- tourmaline-corundum 246
- Mengkarang Formation 311
- Mengkudu placer 338
- Mentakab 107
- bypass 110
- Mentawai Fault 33
- Mentulu Formation 37, 312
- Merapoh 78, 80
- Gua Musang Formation 103
- karst hills 104
- Meratus Mountains 32
- Merbau Pulas Chert Member 97
- Merchang fresh water swamps 26
- Merchong Graben 193, Fig. 8.19
- mercury mineralization, Raub 359
- Mergui Basin 33
- Mersing
- Beds 205, 244, 257, 304, folding Figs. 13.21–13.24
- analysis 297
- multiple deformation 298
- structure 244, 297
- analysis 298
- coastline folds 298
- Endau Fault Zone 266, 269
- Fault Zone 274, 260, Fig. 8.3, Fig. 12.3
- RADARSAT Fig. 12.17
- gold 355
- mining 361
- Group 127
- multiple folding 297
- permatang 26
- Quaternary 167
- mesas, Panti Sandstone 127
- Meso-Tethys Ocean 316, Fig. 14.6
- mesothermal veins... Table 15.4, Table 15.5
- gold 356
- Mesozoic strata
- correlations 129
- Jengka Pass Fig. 5.22
- stratigraphy 87, Fig. 6.24
- metabasites 43
- metal zonation, Kinta Valley Fig. 15.15
- metaluminous granites 225, Fig. 10.13
- metallogenic belts 338
- metamorphic aureole
- Bukit Ibam 349
- Jerai 242
- country rocks, Stong Complex 219
- facies
- diagram... Fig. 11.3, Fig. 11.5
- Gunong
- Jerai 241, Fig. 11.8
- Ledang aureole Fig. 11.9
- Stong Complex Fig. 11.3
- Taku Schist Fig. 11.5
- minerals, Jerai aureole Fig. 11.7
- paragenesis, Stong Complex 236
- rock weathering 20
- metamorphism 233
- related to structure 304
- meta-pelites
- Ledang... Fig. 11.9
- Stong Complex 236
- metaquartzite 45
- metarhyolite, Dinding Schist, Kuala Lumpur 52, 199
- metasedimentary enclaves 266
- metasediments
- Pelepah Kanan... Fig. 15.7
- Permian–Triassic 292
- metasomatised peridotite 230
- mica
- crystallinity values 305
- schist 45
- Jerai 241
- microcline, intermediate 245
- microcontinents SE Asia map Fig. 14.1
- micro
- granite in Main Range 216
- granodiorite, Genting Sempah 48, Fig. 4.4
- rhyodacite, Genting Sempah Fig. 9.4
- migmatite
- injection 233
- Stong Complex Fig. 11.1, Fig. 11.2, Fig. 13.10
- migration
- hydrocarbons 379
- pathways 380
- oil, Malay Basin... Fig. 16.13
- Minas Formation 154–155, 157
- mineral
- stability 22
- zonation
- Kinta Valley... Fig. 15.15
- lodes 340
- Minerals and Geoscience Department Malaysia v, 1
- Mining
- developments 331
- tin
- dredging 332
- hydraulic 332
- mintcan placers 334
- mintjan 337
- placers 334, 337
- grain size 335, 337
- Mobil 365
- 1971 acreage... Fig. 16.1
- 1977 acreage... Fig. 16.2
- Mogok Gneiss 316
- mogote hills, karst... 9, Fig. 2.6
- molasse
- deposit, Tebak Formation 128
- facies, Saiong Beds 114
- molybdenite
- Beatrice Pipe 347
- Mengapur 354
- Penjom 359
- Tasek Chini 354, 355
- monazite
- amang 339
- Gunung Jerai 347
- monsoon 15
- montmorillonite in weathering 21–22
- monzonite
- Benta 219
- series 224
- textures 219
- Mount Faber Ridge 9
- Mount Ophir 216
- granite Fig. 11.9
- mountain
- ranges 6
- terrain, Kedah... Fig. 2.3
- MSS-XA Graben 154
- Muar
- Pekan overland 17
- River = Sungai Muar
- Muda
- Dam area Semanggol conglomerates 98
- Formation... Fig. 8.2
- mudstone
- Chert Member 95
- laminated, Semantan 110
- Rhythmite Member 97
- Muntahak Granite 127
- Murai
- mine
- alluvial gold 358
- tin, Bentong 355
- Murau
- Formation 257, 299, 303
- Bukit Keluang Fault 85
- Conglomerate 85, 117

- Group, Sumatra 142, 153, 155, 156
- Penang
gravity 330
contour map... Fig. 14.18
Island 23
offshore graben 153
Quaternary 164
- Pengeli
Fault 146
Sand Member 145
- Pengerang 205
bauxite 22, 363
faulting 267
volcanics 207
dated 199
palaeomagnetic data map Fig. 14.12
- Pengkalan Member 161, 166, 167, 168
peat 166
- Peninsular Malaysia
basement 148
dimensions 5
elongation 249
lineaments Fig. 12.2
major trend 272
structural trends 249, Fig. 12.1
uplift in north 131
zones Fig. 5.1
- Penjom
gold lode mine 358 Fig. 15.16
structure 293
thrust 288
felsites and tonalite 293
Thrust 293
- Penyu Basin 175, 193, 403, Fig. 3.5, Fig. 8.1, Fig. 8.3, Fig. 16.6
basement Fig. 8.6, Fig. 16.29
drape play 404
fractured play 405
cross sections Fig. 8.19
development model Fig. 8.4
exploration 403
faults Fig. 8.3
gas window Fig. 16.29
hydrocarbon
accumulation 404
generation 404
migration 404
occurrence 404
lacustrine shale Fig. 16.29
oil
–gas discoveries Fig. 16.6
window Fig. 16.29
petroleum
plays 404
systems 404
reservoir rocks 404
Rhu Ridge... Fig. 16.29
seal rocks 404
source rocks... 404, Fig. 16.29
strata age range 175
stratigraphy Fig. 8.2, Fig. 8.20
structural map Fig. 8.8, Fig. 8.18
- Sunda fold play 404
tectonic development... 177, Fig. 8.4
trap
formation 404
styles 404
- Penyu Formation... 194, Fig. 8.2, Fig. 8.20
- Penyu Rift extension to Pekan 329
- Perak Nose 154
- Perak
Palaeozoic 71
Quaternary 164–5
River 27
- peraluminous granite 225, Fig. 10.13
melt 232
- Perhentian
Complex 227
Granite 221
Island 220
Kechil syenite 221, 229
chemistry 228
mineralogy 221
Zr vs SiO₂ Fig. 10.12
- Perlis
gravity... 330, Fig. 14.18
karst 10
Quaternary sediments 164
stratigraphy Fig. 5.3
- permatang 25, 28, 133, 161
east coast... Fig. 2.13, Fig. 2.14
- permeability Malay Basin
rocks Table 16.7
- Permian
andesitic rocks 316
conodonts, Krau Satu 104
deformation 306
Kinta Valley 73
limestone
Jengka Pass 81, Fig. 5.22
Kodiang 90
palaeomagnetic data... Fig. 14.13
radiolarian ages in Chert Member 96
stratigraphy... Fig. 14.3
–Triassic boundary
absence from Semanggol 100
Bukit Hantu 90
–Triassic volcanics palaeomagnetic data... Fig. 14.12
- Pertang Fault 263
- Petani Formation 153–4
- Petasih, serpentinite 289
- petroleum
Development Act 365
plays 381
resource regions Malay Basin Fig. 16.6
systems, Malay Basin... 373, Fig. 16.12
- PETRONAS, (Petroleum Nasional Berhad) v, 1, 365
Carigali 365
- Peutu Formation 152
- Phangnga 339
diamictites 312
tinfield... Fig. 15.1
- phengite stability 22
- phenocrysts within black volcanics, Pulau Tioman Fig. 9.8
- Phong Saly 311
Gigantopteris 40
- Phosphorus plot versus silica 231
- Phuket 314, 339
granite 33
Group 37, 38, 70, Fig. 14.4
diamictites 312
similarity to Canning Basin 314
tin field Fig. 15.1
- phyllite 45, 51
Jerai 240
Manson's Lode 351, Fig. 15.11
shale 45
Taku Schist 239
tourmaline-corundum 246
- phyllonites 266
- piedmont fan
facies Fig. 15.2
placers 334
- Pilah Schist 51–52
- Pilong Formation... 184, 196, Fig. 8.2, Fig. 8.20
- pinch-and-swell structure 257
- Pinyok skarn 339
- Pinang Beds 85
- Ping Teris Fault Fig. 12.3
- pinnacle topography 11
- pisolitic
limestones, Gua Panjang 104
texture 247
- placer
fields statistics Table 5.1
Gunung Jerai 347
mining, tin 331
stratigraphy 333, Fig. 15.2
tin deposits 332
tinfields of the peninsula Table 5.1
- plagioclase
decomposition 18
Eastern Belt granites 222
- plasticene
indentation experiment
model 316, Fig. 14.10
- platform in limestone notch... Fig. 2.7
- Pleistocene
deposits 168
Kinta Valley 165
sea levels 172, 334
- pleonaste, tourmaline-corundum 246
- plutonic rocks, tectonic setting 230
- Podozamites pahagenesis* 122
- Pokok Sena 70, 263
cross sections Fig. 12.15
Permian cherts 97
- poljes 9
- polybasite, Manson's Lode 354
- Ponson Conglomerate 111

- porosity Malay Basin rocks Table 16.7
- porphyritic
 biotite granite, Taku 237
 weathering... 18, Table 2.3
 microgranite 217
- porphyroblasts, Singa Formation, deformed 287
- porphyry copper
 deposits 354
 system, Tasek Chini 355
- Port Dickson 76
 schist 52
- Port Klang
 Graben, Straits of Malacca 153, 154, 156, Fig. 7.14
 stratigraphy Fig. 7.15
 gravity anomaly map Fig. 14.17
 group grabens 150, 154–156
- Port Weld Member 161, 165
- Pos Blau
 chert structure 290
 suture roadcut... 48, Fig. 4.5
- Pos Mering
 serpentinite 289
 suture rocks Fig. 4.5
- Posidonia* 113
 Chert Member 97
 Conglomerate Member 99
 Jurong Formation 112
kedahensis 107
 Rhythmite Member 98
- post-rift
 phase, Malay Basin 182
 subsidence 177
- post-Semantan strata 114
- potassic ankaramite, Segamat 209
- potassium-argon dating 211
- potholes 11
- pre-Jurassic formation
 deformation 281
- pre-Semanggol Formation beds 98
- prehnite-pumpellyite facies 305, 307
- pressure
 abnormal 189
 Penyu 196
 compartments, Malay Basin 193
- primary
 textured granite 218
 tinfields 338
- Proctor, W.D... 1
- production acreage
 1990... Fig. 16.3
 1999... Fig. 16.4
 2006... Fig. 16.5
- propylitization
 dacitic dykes, Sungai Lembing 342
 Mengapur 354
- proto-mylonite 262
- protolith source of granites 232
- PSC blocks Malay Basin
 1990 Table 16.1
 1999 Table 16.2
 2006 Table 16.3
- pseudo tachylite 260
- ptilophyllum* cf. *pterophylloides* 122, 128
- ptygmatic folding,
 Stong Complex 235, 237, Fig. 11.2
 structures 285
- publications on offshore areas 4
- Pulai Formation... 184, Fig. 8.2
- Pulau
 Dayang Bunting 71, 244, 255
 lake 16
- Bunting porphyry 199
- Jong 71
- Jemur 259
- Kapas 258, 269, Fig. 12.11
 deformation setting 305
 folding 300, Fig. 13.28
 structure 302, 304, 306
- Kerengga, Redang granite... Fig. 2.8
- Langgun 16, 61, 67, 69
 coastal outcrop map Fig. 5.8
 fossils Fig. 5.12
 palaeomagnetism 321
- Langkawi
 cross sections Fig. 12.7
 geological map Fig. 12.6
- Pinang 85
- Rebak 23
- Redang 85
- Sibu volcanic dating 199
- Singa Besar 69, 71, 282
 recumbent folds 282
- Singa Kechil 71
- Tanjong Tembus Dendang 61
- Tepor folds 282
- Tinggi
 tuff Fig. 9.7
 volcanic chemistry Fig. 9.9, Fig. 9.10
 volcanic dating 199
- Tioman 12, 33
 deformed clasts in tuff Fig. 9.7
- Granite,
 Cretaceous 222
 dating 216
 metamorphism 245
 pyroclastic rocks 206
 rare earths 208, Fig. 9.11
 volcanic rocks 207
 –granite Fig. 9.8
 chemistry 207–8, Fig. 9.9, Fig. 9.10
- Timun 244
- Tuba 244
 folding Fig. 13.11
 structures 282
- Ular 70
 structures 282
- pull-apart basins 170, 274, 279
- Putrajaya multiple deformation 285
- pyrargyrite, Manson's Lode 354
- pyrite
 Beatrice Pipe 347
 Buffalo Reef 360
- Bukit Besi 348
- Kecau Tui 358
- Kramat Pulai 361
- Leong Sin Nam Pipe 347
- Manson's Lode 354
- Mengapur 354
- Pelepah Kanan 345
- Penjom 359
- Raub 359
- Selinsing 358
- skarn, Tasek Chini 354
- Sungai Lembing 340
- Tersang 359
 –wolframite veins 363
- pyroclastic rocks
 age distribution 197
 Johor islands 205
 Tasek Chini 354
- pyrometasomatic
 skarn, Bukit Besi 348
 tin mineralization 345
- pyrophyllite, Jerai 241
- pyrrhotite
 Beatrice Pipe 347
 Bukit Besi 348
 Kramat Pulai 361
 Manson's Lode 354
 Mengapur 354
 Penjom 359
 Sungai Lembing 340
 wolframite veins 363

Q

- QAP diagram granites Fig. 10.8
- Qiang-Tang 316
- quartz
 –alkali feldspar-plagioclase plots 224
 –biotite hornfels 52
- boudinaged 288
- cassiterite
 stockworks 344
 veins 344
 Bakri 347
- dykes 9
- feldspathic enclaves 223
- gangue
 Kecau Tui 358
 Kramat Pulai 361
- mica schist 45, 51, 52
- Port Dickson 52
- garnet, Taku Schist 238
- weathering 20
 zones... Fig. 2.10, Fig. 2.12, Table 2.5
- monzonite porphyry 354
- Pedas area 263
- Pelepah Kanan 345
- porphyry Fig. 9.2
 Chini prospect... Fig. 15.12
 dykes, Ulu Sokor 351
 gold relationship 361

- Jerai 241
 Raub 359
 Tasek Chini 354
 reef, Gombak 363
 ridge, Klang Gates... Fig. 2.5
 shear zones, Raub 359
 stability 22
 sulphide-gold veins, Kecaui
 Tui 358
 'sweat-outs' 45, 288
 –topaz
 –cassiterite 344
 greisenization 344
 veins 306, 307
 deformation 280, 298
 gold-bearing 356
 isoclinally folded 285
 Mersing 361
 Pelepah Kanan 345
 –pods, weathering 20, 21
 structure,
 Raub 360
 Tersang 359
 –sulphide, Penjom 359
 swarms, -sericite,
 Mengapur 354
 Quartzite terrane 37, 314, Fig. 3.5
 Quaternary
 environments 133
 sediments 157, 164
- ## R
- R1 vs R2 diagram of granites 230,
 Fig. 10.19
 radar imagery 29, 254–255, 260
 Ma'Okil and Payung
 formations Fig. 6.20
 Tembeling Group 115, Fig. 6.17
 Radiolaria
 Bentong-Raub
 age Fig. 4.1
 localities Fig. 4.1
 Bukit Kechil 91
 chert 2, 43, 47
 Member
 subdivisions 96
 Triassic age 96
 Genteng Sempah 48
 Pos Blau 48
 Semanggol Formation
 localities Fig. 6.8
 zones Fig. 6.9
 radiometric age dating
 granites Fig. 10.3, Table 10.1
 volcanic rocks 198, Fig 9.1
 programme 2
 rainfall regime 15
 raised beaches 27
 Raj, John, Kuna c.v. 3
 ramp margin trapping, Malay
 Basin... Fig. 16.14
 Ramunia volcanic chemistry Fig.
 9.9, Fig. 9.10
 Ranong Fault... Fig. 15.1
 rapids 14
 Rare earth
 granite
 plots 228
 primary textured Fig. 10.18
 secondary textured 228, 229,
 Fig. 10.18
 dyke analyses 210
 rock/chondrite, Pulau Tioman Fig.
 9.11
 Ratburi Limestone 38, 312
 –Chuping Limestone
 platform... Fig. 14.8
 Straits of Malacca 148
 Raub 43
 Australian Gold Mine 358, 359,
 Fig. 13.17, Fig. 15.14
 Gold Mine = Bukit Koman
 gold mine 359,
 structure 292
 granitoids 229
 Group 79, 80, 107, 108, 293, Fig.
 15.14
 Rawang limestone cement
 quarry 363
 Rb
 vs MgO of granites Fig. 10.9
 vs Nb + Y discrimination
 diagram Fig. 10.20
 vs SiO₂ of granites Fig. 10.9
 vs Sr plot of granites Fig. 10.11
 /Sr vs differentiation index for
 granites Fig. 10.10
 /Sr vs SiO₂ of granites Fig. 10.9
 recumbent folds
 Kenny Hill Fig. 5.20
 Langkawi 282
 Machinchang Formation 281
 Pantai Dalam 284
 Puchong 284
 Pulau Tuba Fig. 13.11
 Singa Formation Fig. 13.12
 Redang
 Beds 85
 Conglomerate age 303
 granite 221, Fig. 2.7
 landform... Fig. 2.8
 Red River Fault Zone 316, 324
 Redbeds 114, 292
 Bilut 108
 continental 43
 central belt 114, 120, 296
 eastern belt 124
 Gagau Group 124
 Ma'Okil Formation 121
 Mangkok Sandstone 118
 member, Koh Formation 120
 possible age 296
 post Indosinian Orogeny Fig. 14.7
 sequence 306
 structures 114
 Tembeling Group 119
 western belt 114
 refolded folds 257
 Kuala Abang Fig. 13.25
 Mersing Beds Fig. 13.21, Fig. 13.22
 Pulau Kapas Fig. 13.28
 structures, Kuala Lumpur 284
 Tanjung Kempit Fig. 13.24
 regional geological setting 31
 regolith
 granite... 11, Fig. 2.8
 thickness 12, 22
 weathered 333
 remanent magnetism 318
 replacement bodies, Raub 359
 reservoir
 parameters, Guntong... Table 16.8
 permeabilities 378
 porosities 378
 quality, Malay Basin 189
 rocks Fig. 16.12
 Malay Basin 377, Fig. 16.8
 Penyu Basins 404
 seals 379
 structure, Guntong Field... Fig.
 16.19
 residual
 bottom placers 337
 laterite, Pengerang 363
reticulatisporites pudens 122
 reverse faults 307
 Chuping Formation 282
 Rhu Rendang
 deformation 308
 folding 301
 rhyodacite
 Genting Sempah 48
 dating 199
 porphyry 199
 tuff
 Endau-Rompin Fig. 9.8
 Lawin 199
 volcanic rocks, Semantan 113
 volcanism, Eastern Belt 203
 rhyolite
 ash 27, 169
 Kinta Valley 158
 bauxite source 22
 Dinding Schist, Kuala Lumpur Fig.
 9.3
 flows 199
 Genting Sempah 199, Fig. 4.4
 chemistry Fig. 9.5
 ignimbrite... Fig. 4.4
 Main Range 216
 Manson's Lode 351
 mineralogy 201
 occurrences Fig. 9.2
 Pengerang 363
 phenocrysts 201
 porphyry, Bukit Kajang 359
 Pulau Tioman 207
 tuff 199
 Bukit Ibam 348, 351, Fig. 15.10
 Eastern Belt 203
 Genting Sempah Fig. 9.4
 Semantan Formation 107, 110
 volcanism, explosive 316

- Rhythmite Member, Semanggol Formation 94, 97
- ria coasts, Langkawi 23
- Riau Archipelago 33
- ribbon cherts, Palaeo-Tethys Ocean Fig. 14.7
- rift
- phase, Malay Basin 179
 - related granite 231
- right-lateral wrenching 115
- river
- capture 17, 317
 - flooding 15
 - limestone cave... Fig. 2.7
 - mouth displacement Fig. 2.11
 - patterns 13, 16
 - Peninsula... Fig. 2.9
 - terraces 27, 28
 - youthfulness 15
- roads with gravity traverses... Fig. 14.15
- rodingite 51
- rolling terrain 9
- Rompin delta 16
- rotation, clockwise, of Peninsula... Fig. 3.4
- rubidium
- contents of granites 224
 - strontium dating 211
 - ratios 224, 227
- Rumbia
- Fault 175, 177, 193, Fig. 8.8, Fig. 8.18
 - Graben 193, Fig. 8.19
- Rupat Island 38
- Ruok Fault Zone, E-W Highway 264, Fig. 12.16
- ## S
- S type granite 231, 339, Fig. 10.14, Fig. 10.22
- crustal melts 224, 231
 - Indosinian Orogeny collision... Fig. 14.7, Fig. 14.8
 - orogen stitching Fig. 14.7, Fig. 14.8
 - plutons 340
 - tin-bearing 211, 316
- Sabak Graben, Straits of Malacca 156, Fig. 7.13, Fig. 7.14
- Sadao Basin 136
- Sadong Formation 33
- sag phase, Malay Basin 179, 187
- Sagaing
- Fault 32, 33
 - Sumatra faults... Fig. 3.3
- Sagenopterus* 118, 119
- Sagor Formation 84
- Saiong basin 131
- beds overlie Semanggol Formation 94, 100
- Redbeds 100, 114, 265, 280
- conglomerate ridges 100
- Salak
- Baru Beds 75
 - Ridge 259
 - South 77
 - Tinggi 77
- Salu Island 36
- Samsudin Hj Taib c.v. 3
- Sanai Limestone Member 65, 67
- sand
- bars 26
 - spits 26
- Sand/coal Formation... 184, Fig. 8.2
- sandstone
- Chert Member 95
 - Rhythmite Member 97
 - shale interbeds, Conglomerate Member 98
- Santi
- ignimbrites, Johor Fig. 9.6
 - Pengerang volcanism 205
- Saraburi Limestone 40, 312
- Sarawak
- correlation Fig. 3.2
 - dissimilarity with the Peninsula 32
 - palaeomagnetism 324
- Satun Shale 38
- scapolite, Ledang 243
- scheelite
- Bukit Besi 348
 - cassiterite 344
 - fluorite ore, Kramat Pulai... Fig. 15.15
- Kecau Tui 358
- major tungsten ore of the Peninsula 361
- Mengapur 354
- Pelepah Kanan 345
- Raub 359
- Selinsing 358
- schist
- Bentong-Raub suture 51
 - Cameron Highlands Fig. 12.4
 - deformation 306
 - high Fig. 13.14
 - multiple 289
 - enclaves... Fig. 11.1
 - Taku Schist 237
 - faulting 289
 - gneiss 307
 - Central Belt 304
 - multiple 288
 - sweat-outs 359
 - limestone, Kramat Pulai 361
 - Series 45, 51, 77, 78, 79, Fig. 4.2
 - chemistry 53
 - Cheroh Fig. 4.2
 - conglomerates 78
 - deformation 288
 - lithology 78
 - structure 47
 - structure stereogram Fig. 13.15
- tourmaline-corundum 246
- weathering
- grades 21
 - zones 21, Fig. 2.10, Table 2.5
- Scyphocrinoid fossils, Langkawi Fig. 5.12
- Scythian
- bivalves, Gua Musang Formation 105
 - limestones 106
 - Permian conodonts, Krau Satu 104
 - radiolarian age, Chert Member 96
- sea
- connection, Malay Basin 189
 - erosion, notches 11
- sea level 172
- curve, Sunda Shelf Fig. 3.6
 - variation in Sundaland... 28, 40, Fig. 3.7
 - high Fig. 7.18
 - Holocene Fig. 7.18
 - Kinta Valley 159
- seabed cores 162, Fig. 7.17
- seal
- Malay Basin Fig. 16.8
 - formations, Malay Basin... Fig. 16.8
 - rocks 379, Fig. 16.12
- SEASAT altimeter gravity... Fig. 3.1
- Seberang Prai 23, 27
- Quaternary 164, 165
- secondary textured granite 217
- chemistry 228
 - Main Range 218
- Sedili
- faulting 267
 - granite fluting... Fig. 2.8
 - volcanic 300
 - Formation 85, 128, 204, 205
- sedimentary environments, Malay Basin..... Fig. 8.14, Fig. 8.15
- rock weathering 19
- Segamat 267
- alkaline basalt 40, 209, Fig. 9.1
 - age 199
 - mineralogy 209
 - palaeomagnetism 318, Fig. 14.11
- seismic velocity-depth relationship... Fig. 8.1
- Selangor
- Palaeozoic 76
 - Quaternary 166
- Selayang hot spring 260
- Seligi
- Field
 - development 390
 - exploration 390
 - geology 390, 392
 - location 390
 - structure... 390, Fig. 16.20
 - Formation... 184, Fig. 8.2

- Selim
 pluton chemistry plots 228
 secondary textured granite 218
- Selinsing gold mine 358
- Selut Schist 45, 48, Fig. 4.4
 structure 285
- Semanggol
 Basin 129, Fig. 6.2, Fig. 6.8, Fig. 14.9
 environment 99
 foredeep Fig. 14.8
 post-Carnian closure 100
 proximity to Kodiang
 Limestone 99
 rift 316
 starved of terrestrial input 99
 correlation with Sumatran Kuala Formation 100
- Formation 93, Fig. 4.1
 correlated with Mutus Assemblage 100
 depositional setting 99
 discussion 99
 drag 263
 member ages 94
 radiolarian zones Fig. 6.9
 stratigraphy and sedimentology 94
 strike ridges 263
 structure 94, 283
 tight folding 97
 –Mutus rift basin 38, Fig. 14.9
 –Saiong unconformity 114
- Semangkok
 Field 189
 development 392
 exploration 392
 geology 392
 location 392
 structure 392
- Semantan
 asymmetrical folds 295
 axial planar cleavage 295
 Basin 116, 129, 316, Fig. 6.1, Fig. 14.9
 development 113, 114
 fore arc Fig. 14.8
 gravity high... 328, Fig. 14.14, Fig. 14.16
 termination 114
- Formation 103, 105–106, 113, 307
 Bouma sequence Fig. 6.13
 correlation 107
 deformation 297, 308
 folding 296, Fig. 13.20
 = Gunung Rabong Formation
 Jengka Pass 109
 lower boundary 108
 palaeontology 113
 sedimentology 110
 slumps 295
 stratigraphy 111, Fig. 6.14, Fig. 6.15
 structure 36, 107, 111, 278
 syn-sedimentary structures 295
 unconformity Fig. 6.11
 upper boundary 109
- Semenyih hot spring 260, 268
- Sempah Conglomerate... 48, Fig. 4.4
- Senang Island 36
- Seremban
 Fault Zone 262
 RADARSAT Fig. 12.13
 faults 268
 hot springs 269
- Serentang Tuffs 118
- Seri Gading = Batu Pahat
- Seri Jaya Beds 82, 83
 folded and slumped Fig. 5.23
- Serian Volcanic Formation of Sarawak 32
- sericitisation
 Raub 360
 Selinsing mine 358
- Serkam granite outlier 23
- serpentine 253, 271, 289
 Bentong-Raub Suture 43, 45, 47, 51–52, Fig. 4.2, Table 4.1
- Bukit Ibam 349, 351
 Bukit Rokan 289
 deformation 289
 shear zones 289
 Taku Schist 238
- Serting River 17
- Setapak hot springs 260, Fig. 12.13
- Setul
 Boundary Range 6, 11, 16, 61
 Formation 244, 255
 deformation 286
 slumps 282
- Group (Formation) 38, 61, 69
 stratigraphy Table 5.1
- Limestone 10, 38, 153
 metamorphism 245
 palaeolatitude 322
 too far south 324
 palaeomagnetism 321
 data map Fig. 14.13
 Straits of Malacca 148, 152
- Seurula Formation 152
- Sewell Rise 33
- shale
 Chert Member 95
 black
 Kodiang Limestone 88
 weathering 20
 –quartzite beds, Conglomerate Member 98
- Shan-Thai Terrain 309
- shear
 olistostrome, E-W Highway Fig. 13.14
 zones
 dextral 257
 Mersing Beds 298
 serpentinite 289
 rocks, Karak Highway 285
 serpentinite 289
- Shikamai*, H. S. Lee Beds Fig. 5.18
- shore
 face sandstones 378
 lines 172
- shoshonite
 series Fig. 10.15
 Benta 219
 field 227
- shuttle radar
 imagery... Fig. 2.1, Fig. 2.2
 topography 250
- Sibu Island rhyolite & tuff 204–205, Fig. 9.7
- Sibumasu 2, 38, 86, 114, 314, 316, Fig. 3.4–3.5, Fig. 14.1
 before Indosinian Orogeny... Fig. 14.7
 block 309
 cartoon Fig. 14.8
 Cathaysialand contrast 310
 collision 271
 continental drift... Fig. 14.6
 diamictites 315
 drift from Gondwanaland 312, Fig. 14.7
 extrusion tectonics... Fig. 14.10
 Gondwana attachment
 position 322, Fig. 14.5
 palaeolatitudes... Fig. 14.2
 regional extent... Fig. 3.4
 Upper Carboniferous position 310
 Yunnan 310
- Sihapas Group 153–56
- silicification
 Mengapur 354
 Penjom 359
 Raub 360
 Selinsing mine 358
 Tersang 359
 tinfields 340
- sillimanite
 garnet-biotite gneiss, Stong Complex 236
 hornfels 245
 Jerai 241
 Ledang 243
 Taku Schist 239
 Tioman 245
- silver, Manson's Lode 354
- Simao... Fig. 14.1
- Simpang
 Formation 146, 158, 160–161, 165–169, 172
 fossil age 160
 Pulau marble
 mining Fig. 15.16
 polishing 363
- Singa Formation 37, 38, 69, 86, 256, 312, Fig. 5.16, Fig. 14.4
 deformed porphyroblasts 287
 facies 70
 Pulau Singa Besar Fig. 13.12
 Straits of Malacca 148, 155
 structures 282
- Singapore 36
 norite 221

- Sinoburmalaya = Sibumasu
 Sintok, Kedah
 batholiths 100
 wolframite 363
 Siputeh, Kinta Valley 246
 skarn
 copper-bearing... Fig. 15.12
 deposit 339
 iron 351
 Kramat Pulai 361
 Map Fig. 15.4
 mineralogy Table 15.3
 garnet, Tasek Chini 354
 iron-tin 348
 Langkawi 245
 magnetite 348
 Mengapur 354
 mineralization 351
 tin 345
 tin 346
 –iron-bearing... Fig. 15.4
 weathered 354
 slate 45
 calcareous, Raub 359
 slaty cleavage 307
 slickensides 254, 263, 268
 slope gradients, Peninsula... Fig. 2.2, Table 2.2
 slump
 deposits 271
 directions, Kodiang Limestone 92
 folds
 Chert Member 95
 Kodiang Limestone 90
 horizons, Semantan 111
 Smithian conodonts 90
 Gua Musang Formation 104
 soft-sediment deformation, Semantan 114
 Song Ma suture 310, Fig. 14.1
 Southeast Asian granite belts Fig. 10.1
 Sotong
 Field, Malay Basin... 186, Fig. 8.12
 development 401
 exploration 401
 geology 401
 location 401
 sedimentary model Fig. 8.12
 stratigraphy Fig. 8.12
 structure Fig. 16.28
 sandstone and shale... 184, Fig. 8.2
 structure 401
 source rocks Fig. 16.12
 fluvio-deltaic 375
 Malay Basin 374, 380
 characteristics Fig. 16.8, Fig. 16.10
 pods... Fig. 16.9
 maturation and expulsion Fig. 16.11
 Penyu Basin 404
 South China
 Carboniferous 310
 continental drift... Fig. 14.6
 escape tectonics Fig. 14.10
 map Fig. 14.1
 palaeolatitudes Fig. 14.2
 Sea basins 133
 Southeast Asian tin
 belt 211
 fields Fig. 15.1
 Southern
 Graben, Straits of Malacca 154, Fig. 7.11
 Straits basins 152, 154
 Southwest Borneo... Fig. 14.1
 Spathian conodonts 90
 Krau Satu 104
 specularite-pyrite mineralization 351
 sphalerite
 Kecau Tui 358
 Kramat Pulai 361
 Manson's Lode 354
 Mengapur 354
 Penjom 359
 Selinsing 358
 Sungai Lembing 340, 341
 Tasek Chini 354, 355
 –wolframite veins 363
 spider diagrams, granites 228
 Central Belt Fig. 10.17
 Eastern Belt Fig. 10.17
 Main Range Fig. 10.16
 sponge spicules, Kodiang Limestone 90
 spreading axis, Andaman Sea... Fig. 3.3
 Sr vs CaO of granites Fig. 10.9
 Sra Kaeo suture 38, 43, Fig. 3.6, Fig. 14.1
 Sri
 Bangun, cassiterite in iron ore 348
 Jaya Formation 245
 SRTM DEM imagery 251, 252
 stalactites and stalagmites... 169, Fig. 2.7
 stannite
 –cassiterite 344
 Beatrice Pipe 347
 Leong Sin Nam Pipe 347
 Manson's Lode 354
 Stauffer, P.H... 1
 staurolite-garnet-biotite schist, Stong Complex 236
 steer-head profile, Malay Basin 179
 stibnite
 Buffalo Reef 360
 –cassiterite 344
 Kramat Pulai 361
 Raub 359
 Selinsing 358
 Tasek Chini 355
 stilbite stability 22
 stockworks
 mineralogy 344
 quartz-cassiterite 344
 tin 344
 stolzite, Kramat Pulai 361
 Stong migmatite Complex 219, 233, 265–266, 269, 304, 308, Fig. 10.6, Fig. 11.1–11.2, Fig. 13.10
 Cretaceous 222
 dating 216
 metamorphism 305
 facies diagram... Fig. 11.3
 granite textures 219
 overlying strata 239
 Straits of Malacca
 Angsa Graben Fig. 7.14
 Central Graben Fig. 7.11
 exploration 365
 grabens 133, 148
 Johor Graben Fig. 7.16
 Northern Graben Fig. 7.10
 Port Klang Graben Fig. 7.14
 Sabak Graben Fig. 7.13, Fig. 7.14
 sand banks 148
 Southern Graben Fig. 7.11
 stratigraphy 150, Fig. 7.8
 structural grain 153
 Tertiary Basins Fig. 7.7, Table 7.3
 strata
 –bound barite, Trengganu 363
 similarity with Sumatra... Fig. 3.5
 stratigraphy
 Bukit Arang Basin Fig. 7.2
 Central Graben Fig. 7.12
 Dulang Field... Fig. 16.18
 Gagau Group Fig. 6.22
 groups, Malay Basin 184
 Guntong Field, Malay Basin... Fig. 8.13
 Jerneh Field... Fig. 16.27
 Jurong Formation Fig. 6.12
 Kampar Table 5.2
 Kodiang Limestone Fig. 6.4
 Koh Formation Fig. 6.16
 letter groups 184
 Lexicon 55
 Ma'Okil Formation Fig. 6.19
 Malay Basin 182, Fig. 8.2, Fig. 8.7, Fig. 8.11
 Mesozoic formations Fig. 6.24
 north Sumatra Fig. 7.9
 Northwest Domain Fig. 5.3
 numbers, Malay Basin 184
 onland Tertiary Basins Table 7.2
 Palaeozoic Fig. 5.2
 Payung Formation Fig. 6.21
 Penyu Basin 194, Fig. 8.2, Fig. 8.20, Fig. 16.29
 Port Klang Graben Fig. 7.15
 Seligi Field... Fig. 16.20
 Semantan Formation Fig. 6.14, Fig. 6.15
 Setul Group Table 5.1
 similarity with Sumatra 36
 Sotong Field Fig. 8.12
 Straits of Malacca 150, Fig. 7.8
 Tembeling
 Formation, Jengka Pass Fig. 6.18
 Group Fig. 6.16
 West Natuna Basin Fig. 8.2
 zones of Peninsula Fig. 5.1

- stream patterns 13
- stress relief, metamorphic weathering 20
- strike
- ridges of the Peninsula 249, Fig. 12.2, Fig. 12.3
 - slip fault 250, 257, 263, 269, 274, 280, 288, Bok Bak 263
 - conjugate 280
 - reactivation 308
 - Semanggol Basin 99
 - wrenching 278, 279
 - slip pull apart basin 177
- stringers, tin 344
- stromatolites, Kodingang Limestone 88
- strontium
- isochrons of granites Fig. 10.3
 - isotope
 - ratios of granites 211, Fig. 10.3
 - values, Genteng 202
- structure
- Angsi Field... Fig. 16.24, Fig. 16.25
 - Bukit Koman gold mine Fig. 13.17
 - Dulang Field Fig. 16.17
 - evolution 305
 - geology reviews 271
 - grain
 - Peninsular Malaysia Fig. 12.1
 - Straits of Malacca 153 - Gua Musang Formation Fig. 13.19
 - history, Malay Basin Fig. 8.9
 - inversion, Malay Basin... Fig. 8.10
 - Jerneh Field... Fig. 16.26
 - Jurassic-Cretaceous strata Fig. 13.8
 - Krau Satu road Fig. 13.18
 - Malay Basin 181, Fig. 8.8
 - cross sections... Fig. 8.7 - Mersing Beds Fig. 13.21
 - Penyu Basin Fig. 8.8, Fig. 8.18
 - map Fig. 8.8, Fig. 8.18
 - sections... Fig. 8.19 - Semangkok Field... Fig. 16.21
 - Semantan Formation Fig. 13.20
 - Sotong Field... Fig. 16.28
 - Sumatra similarity with the peninsula 36, Fig. 3.4
 - Tapis Field... Fig. 16.22
 - Tertiary basins Table 7.4
 - Tinggi Field... Fig. 16.23
 - traps, Malay Basin 385
 - trends Fig. 3.1, Fig. 3.2
 - Kedah Fig. 12.15
 - Peninsula to Borneo... Fig. 3.2, Fig. 3.4
- struverite in amang 339
- subaerial emergence, Gua Musang Formation 105
- subduction
- beneath East Malaya 316
 - PalaeoTethys Ocean Fig. 14.8
 - related volcanics 316
 - zone 43
- submarine fan deposits 111
- submarine exhalative Kuroko deposits 351, 354, 360
- sulphides
- Bukit Besi iron mine... Fig. 15.9
 - Kuroko deposits 351, Table 15.2
 - Manson Lode Fig. 15.11
 - Pelepah Kanan 345
- Sumalayang Limestone member 84
- Sumatra
- basins 5, 28
 - correlation with the Peninsula 33, Fig. 3.5
 - Fault 33, Fig. 3.3, Fig. 12.1
 - geological cross sections Fig. 7.9
 - North, extensions of the Kodingang Limestone 93
 - N–S faults 268
 - shape 249
 - strike slip fault margin 32
 - structural grain Fig. 12.1
 - western terrains
 - stratigraphy... Fig. 14.3
- Sun Malaysia Petroleum Company 153
- Sunda
- Basin 36
 - fold 194
 - play, Penyu Basin 404
 - Land 5, 31, 41
 - 15,580 years ago... Fig. 3.7
 - anticlockwise rotation 324
 - GPS 324
 - greater during low sea levels Fig. 3.6
 - regolith 334, Fig. 15.2
 - southern, anticlockwise rotation 324
 - weathering 28 - Shelf 31, 172, 334
 - arcuate trends Fig. 3.5
 - bathymetry Fig. 3.6
 - sea levels 40
 - valleys
 - subduction trench Fig. 3.3
- Sungai
- Aring 81, 107, 119, 254
 - deposit 351
 - Badong 124
 - Bebar beach ridges 26
 - Benus 15
 - Bera 16
 - Bernam coastal plain 23
 - Besi Tin Mine 27
 - alluvium 166 - Chekir anomaly 351
 - Chiku Triassic bivalves *Daonella*, *Posidonia* 104, 105
 - Dohol 84
 - Dungun, Quaternary 168
 - Endau 25
 - Galas, Kelantan 238, Fig. 11.4
 - Jajawi 24
 - Jeleteh, Gua Musang Formation 104
- Jempul 109
- Johor 15, 24
- Kawan 263
- Kedah 23, 25
- Kelah hot spring 269
- Kelantan 14, 15, 16, 25
- beach ridges 26
- Keliu 83
- Kemaman Quaternary 168
- Kenerong 233, 265
- Keniyam Kecil Triassic limestone 104
- Kenong Triassic limestone 104
- Kepis 82
- Kerum 116
- Klang 27
- Koh 119
- Kuantan 15
- Quaternary 168
- Langat 25
- Lebir 254
- deposit 351
 - Gua Musang Formation 105
- Lembing
- Cornish lodes 340
 - lode geometry 340
 - metamorphism 245
 - Permian granite 340
 - tin mine 338
 - geology... Fig. 15.1, Fig. 15.5
- Lepar 266
- Linggiu 84
- Quaternary 167
- Lipis 27
- Lotong 126
- Mangkok 117
- Mangkuk 119
- Merbok Quaternary 164
- Mersing 25
- Muar 17, 28
- Muda 23
- Pahang 14, 15, 16, 17, 25, 168, 193
- delta 167, 175
- Pandan 15
- Patani Formation 71, Fig. 11.6
- Pelepah Kanan 15
- Pelong gold 355, 361
- Penjuring 291
- Perak 14, 16, 23, 25
- coastal plain 23
 - rhyolite ash 169
- Perdah, Kelantan, barite 363
- Pergau limestones 51
- Perlis 25, 84
- Beds 82, 84
 - structure 304
- Pertang Pandak, chert 110
- Pulai 24
- Relai 107
- Renyok, Stong Complex, 235, 266
- outcrops Fig. 13.10
- Rompin 8
- Sam, Gua Musang Formation 105

- Sungai (*continued*)
- Selangor
 - dam 260
 - peat swamp 166
 - Serai 269
 - Siput rhyolite 199
 - Taku 82
 - Tanglir 15
 - Tebak 128
 - Tekai 115, 116, Fig. 13.5
 - Tembeling Formation Fig. 6.18
 - Telong,
 - Carnian bivalves 105
 - Ladinian bivalves 105
 - Tembeling map Fig. 13.5
 - Terengganu 16, 25
 - Quaternary 168
 - Teris Semantan Formation 107
 - Tiang Conglomerate Member 98
 - Trengan barite 363
 - Ulu Sedili 85
 - Yih 118
- surmicaceous enclaves 223
- suture zone 271
 - radiolarian localities... Fig. 4.1
 - rocks... Fig. 4.1
- swales 163
- swallow holes 11
- swamp 15, 16, 23
 - deposits 168
 - drainage for agriculture 16
 - east coast 26, 168
 - vegetation, east coast 25
- syenite
 - Benta 219
 - Perhentian Kecil 221
- syn-collisional granites Fig. 10.20
 - Main Range 230
- synplutonic dykes 211
 - Perhentian 221
- syn-rift
 - deposits, Penyu Basin... Fig. 8.20
 - environment, Malay Basin... 182, 185, Fig. 8.14
- syn-sedimentary
 - deformation 279
 - faulting, Semantan 113
 - structures 272
- syntaxis, Yunnan-Assam 316
- T**
- Ta and Nb in cassiterite lattice 347
- Tabak, fault bounded 274
- Tahan
 - Anticline 120
 - Anticlinorium 280
 - Range 8, 265
- Taiping
 - beach ridges 165
 - granite chemistry 228
- Taku Schist 82, 237, 254, 266, 294, Fig. 11.4
 - age 237, 239
 - facies diagram... Fig. 11.5
 - metamorphism dating 304
 - mineralogy, 237, 238
 - overlying strata 239
 - structure 237
- talc, Bukit Ibam 349
- Talchir Boulder Beds 314, Fig. 14.5
- Tambelan Island 33
- Tampin 268
 - knolls 12
- Tampur Formation 152, 153
- Tan, D.N.K. c.v. 2
- Tanah Merah volcanism age 198
- Tanchintongia*, H. S. Lee beds 75, Fig. 5.18
- Tanjong
 - Balau, Johor 307, Fig. 12.9
 - deformation 308
 - Mersing beds folds Fig. 13.21
 - structures Fig. 13.22
- Batu
 - Quaternary 167
 - Sireh dykes 221
- Beruntum felsic volcanic 207
- Champadek dykes 318
- Chendering folds Fig. 13.26, Fig. 13.27
- Dendang Formation 61, 64, 71, Fig. 5.11
- Duabelas Quaternary 166
- Gelang
 - folding 300
 - Quaternary 168
 - transposed folds Fig. 13.27
- Jaga 240, Fig. 11.6
- Jara folding 301
- Kelang, metamorphism 245
- Kempit 244
 - Mersing Beds Fig. 13.24
 - multiple folding 298
- Kling, Malacca 23
- Leman 85, 258, 299
 - structures 306
- Malim 76, 77
 - chert 52
- Mat Amin
 - folding 300
 - structures 301
- Murau 117, 257, 258
 - structure 298, 306
- Rambutan 133, 135
- Tok Mat, palaeomagnetism 321
- tantalite inclusions in cassiterite 347
- Tapah gold panning 358
- Tapanulu Group 37
- tapiolite inclusions in cassiterite 344, 347
- Tapis
 - 1 cores 162
- Field
 - development 394
 - exploration 394
 - geology 394
 - location 392
 - structure & details Field Fig. 16.22
- Formation and Sandstone 184, Fig. 8.2
- oil discovery 365
- structure 394
- Tarim Block palaeolatitudes... Fig. 14.2
- Tarutao
 - Formation 38, 60
 - Island 60, Fig. 5.6
 - Canning Basin 314
- Tasek
 - Bera 16, 79, Fig. 2.9
 - drainage divide Fig. 2.7
 - peat 163
 - Chini 16, 17, 245
 - barite 363
 - massive sulphides Table 15.2
 - Prospect 354
 - Dayang Bunting 16
 - Gelugor Quaternary 164
- Tate, Robert c.v. 3
- Tawar
 - conodonts in Chert Member 97
 - Formation = Chert Member
- Tebak
 - Basin 267
 - Formation 127, 128, 131
- Tebing Tinggi 24
- tectogenic glass 260
- tectonic
 - cross-sections 316
 - evolution 271, 309
 - Malay & Penyu basins 177, Fig. 8.11, Fig. 16.8
 - grain of Peninsula Fig. 3.4
 - setting, plutonic rocks 230
 - subdivisions, Malaysia and Sumatra Fig. 14.4
- Tekai
 - anticline Fig. 13.4, Fig. 13.6
 - syncline Fig. 13.4
- Tekali quartz ridge 259, Fig. 13.13
- Tekam Tuffs 83
- Tekka, Kinta Valley
 - Clays 159
 - tin deposit... 344, Fig. 15.6
 - mine, Kinta Valley 339
 - map locality... Fig. 15.15
- tektites 335
- Telaga Jatoh Formation 67
- telescoping of minerals 344
- tellurides, Penjom 359
- Teluk Prai Tawar Quaternary 164
- Telong Formation
 - deformation 297
 - Gua Musang Formation 81, 103, 105, 107, 119
- Teluk
 - Anak Datai 60
 - Intan Member 161
 - peat 165

- Mempelam 65, 69, Fig. 5.8
- Ramunia
 Quaternary 167
 volcanic rocks 207
 chemistry 207
- Temangan ignimbrite 203, Fig. 9.2
- Tembeling Formation or Group 40,
 81, 85, 107, 109, 115, 116,
 118, 122, 272, 296, 317, Fig.
 6.18, Fig. 13.5
- age 118
- anticline Fig. 13.6
- basins 114, 274
- conglomerates 17, 109
- deformation 280
- environment 119
- folds Fig. 13.3, Fig. 13.6
 model Fig. 13.9
 NNW–SSE-trending 274
 style 274
- foliation 274
- metamorphism 305
- mountains 115
- outcrops Fig. 13.1, Fig. 13.2
- palaeomagnetic data map 318,
 Fig. 14.11
- RADARSAT image Fig. 6.17, Fig.
 13.4
- redbeds 109
- slumping 273
- strata, fault bounded 274
- stratigraphy Fig. 6.16
- structure 274, Fig. 6.18
- thrusts Fig. 13.3
- Temenggor Lake 16, 265
- Temerloh
 olistostrome 295
 road 107, 110
- Templer Park, Kuala Lumpur... 347,
 Fig. 2.6
- Temurun Beds 58
- Tengchong
 –Baoshan terrain 312
 flora 312
- tennantite, Leong Sin Nam Pipe 347
- Tenggaroh 85
- Tenggol
 Arch 175, 177–178, 182, 193,
 Fig. 8.1, Fig. 8.3, Fig. 8.6,
 Fig. 8.8–8.9, Fig. 8.18, Fig.
 16.6–16.7, Fig. 16.16
 trapping... Fig. 16.14
 Fault Fig. 8.9
 seismic Fig. 8.10
- Terapai Metasiltstones 83
- Terengganu
 continental conglomerates 303
 deformation timing 303
 faults 268
 Formation... 184, 196, Fig. 8.2,
 Fig. 8.20
 Penyu Basin... Fig. 8.20
 Highlands 9
 Quaternary 168
 Shale 184, 196, Fig. 8.2, Fig. 8.20
- structures 300
- Termus Shale 274, Fig. 6.16, Fig.
 6.18, Fig. 13.5
 Barremian 116–119
 cleavages 274
- Terolak Formation 52, 76
- terraces 9, 27
 erosional 9
- terrain
 classes... Table 2.2
 model 6, Fig. 2.1
 Peninsular Malaysia Fig. 2.1, Fig.
 2.3
- terranes
 bounding faults 253
 crossing faults 258
 drift pattern 315, Fig. 14.6
 palaeolatitudes Fig. 14.2
 parallel faults 255
 separated from
 Gondwanaland... Fig. 14.1
 Southeast Asia... Fig. 14.1
- terrestrial redbeds 87
- Tersang gold deposit 359
- Tertiary
 basins
 correlation 146
 fault
 control 287
 related 146
 onland 133–134, Table 7.1
 stratigraphy Table 7.2
 Straits of Malacca 148, Fig. 7.7,
 Table 7.3
 structure and kinematics Table
 7.4
 sediments deformation 308
- Tethys
 = see Palaeo- and Meso-Bentong–
 Raub suture
 Ocean 315
 Carboniferous-Triassic Fig. 14.6
 closure 197
 Kodiang Limestone 92
 palaeogeographic
 reconstructions Fig. 14.6
- tetradymite, Mengapur 354
- tetrahedrite
 Kceau Tui 358
 gold content 358
 Penjom 359
 Selinsing 358
- textures of granites, Main Range Fig.
 10.4
- Thailand correlation with the
 peninsula 38, Fig. 3.6
- thermal gradient == see geothermal
 gradient
- tholeiitic
 dykes 210
 series 224, 227
- Three Pagodas Pass Fault 38, 177,
 Fig. 3.6, Fig. 8.4
- thrombolites, Kaki Bukit
 Limestone 65, Fig. 5.10
- thrust
 Kenny Hill 287
 vergence 308
- Thung
 Song Limestone 38, 60
 Wa Shale 38
- Thye On beds 73
- tidal
 estuarine sands, Malay Basin 188
 flats 23
 swamps, Kelantan... Fig. 2.14
- Tiga Puluh
 Group 37
 Mountains 36, Fig. 3.4, Fig. 3.5
- Tikus in Billiton 339
- tilloids occurrences Sibumasu, SE
 Asia Fig. 14.3
- Timah Tasoh Formation 67, 69, Fig.
 5.14
- timing
 hydrocarbon events Fig. 16.12
 structural events Table 13.1
- tin
 aplites Fig. 15.3
 belt,
 bifurcating 338
 SE Asia 211
 deposits
 distribution... Fig. 15.3
 impounded at granite
 contact 340
 related to granites 340
 Southeast Asia... Fig. 15.1
- dredge, Batu Gajah 2, Fig. 15.16
- fields
 primary 338
 Southeast Asia Fig. 15.1
- grades of placer fields... Table
 15.1
- hydrothermal veins map Fig. 15.3
- islands of Indonesia Fig. 10.1
- lodes of Sungai Lembing... Fig.
 15.5
- mineral
 associations 339
 belts... Fig. 15.13
- mineralization 40, 217
- mining
 2004... 331
 collapse 1
 decline 331
 pegmatites, Fig. 15.3
 pipe, Beatrice Mine... Fig. 15.8
 production... Table 15.1
 regional distribution 331
 skarns map... Fig. 15.4
- Tinggi
 Field
 details Fig. 16.23
 development 397
 exploration 395
 geology 397
 location 394
 structure Fig. 16.23
 island volcanism 204, 205
 structure 394

- Tinjar Fault 324
 Tioman Island volcanism 204, 205
 Titi area gold flakes 358
 Tjia in retirement 1
 Toh Tuck, Jurong Formation 112
 Tok Bidan Graben 131, 179, Fig. 8.8, Fig. 16.6
 tombolo, Langkawi 23
 Tomo Fault 253, 265, 266
 Tonkin Flora of Hongay 33
 topography
 elevation units... Table 2.1
 Peninsular 6
 topaz
 –aplite at Gunong Bakau 347
 Gunung Jerai 347
 Total organic carbon 374
 Malay Basin... Fig. 16.10
 source rocks Fig. 16.10
 tourmaline
 –corundum rocks... 73, 245, Fig. 11.10
 chemistry 246
 origin 247
 Gunung Jerai 347
 Kinta Valley 246
 Kramat Pulai 361
 Main Range 218
 tin association 344
 tourmalinization 217
 tinfields 340
 tower karst 9
 trace
 element plots 228
 fossils, Jerai Formation 60
 transextensional tectonics 317
 Transitional Unit... 338, Fig. 15.2
 placers 337
 transposed
 fabric 288
 folds, Tanjong Geliga Fig. 13.27
 foliation 288
 transpression 254, 257, 266, 280
 Bok Bak 263
 Central Belt 297
 deformation 296, 300, 303, 307
 folding 279, Fig. 13.9
 orogenic deformation 307
 tectonics 317
 transtension 260, 272
 transverse ranges 278, 317
 Tembeling Formation Fig. 6.17, Fig. 13.4, Fig. 13.9
 trap
 formation 381, Fig. 16.12
 Malay Basin Fig. 16.7, Fig. 16.14, Fig. 16.15
 normal faults 383
 styles 381
 Tras redbeds 292
 tremolite
 Beatrice Pipe 347
 Kramat Pulai 361
 Leong Sin Nam Pipe 347
 schist Table 4.1
 Trenggan barite 363
 Triassic
 conodonts Fig. 6.5–6.7
 deformation timing 307
 depocentres Fig. 6.1
 granite
 arc Fig 3.5
 palaeomagnetic data... Fig. 14.12
 Kodiang Limestone 90
 limestone blocks, Gua Musang Formation 106
 palaeogeographic map SE
 Asia Fig. 14.9
 redbeds near Raub... Fig. 15.14
 strata folding 295
 trilobite tracks, Jerai Formation Fig. 5.7
 triple junction failed, Malay Basin... 177, Fig. 8.4
 trodhjemite
 clast 70
 dropstones 312
 series 224
 trough topography 11
 tufa 11
 tuff
 Chini prospect... Fig. 15.12
 Koh Formation 120
 Manson Lode... 351, Fig. 15.11
 Semantan
 Basin 114
 Formation 110
 graded 110
 rhyolitic 110
 tuffaceous
 conglomerate 110
 Gua Musang Formation rocks 103
 Selensing metasediments 358
 Tuhur Basin, Sumatra Fig. 14.9
 tungsten
 deposits 361
 Kramat Pulai mine Fig. 15.15
 skarn 361
 tungstite, Kramat Pulai 361
 turbidite
 Gunung Rabong Formation
 beds 105, 106
 Semanggol Formation
 characters 99
 Semantan Formation 111–113
 Twin Towers, Kuala Lumpur 76
 two-phase granite variants 217, 228
 texture Fig. 10.5
 fault bounded 274
 volcanism 207
 Kenong, Triassic bivalves 104
 Klang Fault 258, Fig. 13.13
 Langat 77, 344
 scheelite 363
 Lepar Semantan Formation 107
 Muar Limited 143
 Sedili granite fluting Fig. 2.7
 Sokor
 Kuroko massive sulphides Table 15.2
 strata bound deposits 351
 Sungai Perak gold flakes 358
 unconformity,
 Malay Basin 182, 188
 Semantan-limestone Fig. 6.11
 undercompaction, Malay Basin 193
 underground river, Gua
 Tempurung... Fig. 2.7
 undulating terrain 9
 Johor... Fig. 2.4
 uplift of Peninsula 22
 Upper
 Arenaceous Series 77
 Clay 173
 Detrital Member 67
 Setul Limestone 65
 uvalas 9
 uranium contents, granites 227
- ## V
- valleys, infilled 26
 varlamoffite with cassiterite 344
 vein
 deposit properties... Table 15.4, Table 15.5
 swarms, Tekka mine... 344, Fig. 15.6
 tin 344
 venite, Stong Complex 233
 vergence of olistostrome
 deformation 291
 vesuvianite
 Kramat Pulai 361
 Ledang 243
 virtual geographical pole 318
 Viséan shales, Sungai
 Lembing... 340, Fig. 15.5
 vitrinite reflectance 380
 Batu Arang 140, 142, 143
 Malay Basin 189
Vjalovognathus conodonts... Fig. 14.6
 volcanic
 arc
 granites Fig. 10.20
 Eastern Belt 230
 mineralization 351
 ash, Kampong Durian
 Chondong 143
 bombs 205
- ## U
- Udang Formation... Fig. 8.2
 Ulu
 Endau
 Arenaceous Formation 127
 Basin 267
 Beds 126

clasts
 in granite, Pulau Tioman Fig. 9.8
 size 205
 –exhalative iron deposits 351
 rocks
 Buffalo Reef 360
 Carboniferous–Permian 312
 chemistry Table 9.2
 distribution, Peninsular
 Malaysia Fig. 9.2
 Gagau Group 126
 Johor islands 205
 Manson's Lode 351
 radiometric ages Fig. 9.1
 Tasek Chini 354
 tuffs, Santi area, Johor Fig. 9.6
 volcanoclastics Penjom Mine 358
 volcanogenic
 deposit properties... Table 15.2
 –exhalative
 gold relationship 361
 tin 338
 origin of iron deposits 347

W

wackestones
 Gua Panjang 104
 Kodiang Limestone 90
 Wan Hasiah Abdullah c.v. 3
 Wang Kelian 263
 Formation 67, 68
 Red Beds 68
 Wang Tangga cave 170
 wangs 9
 Wangsa Maju = Bukit Dinding
 waterfalls 14
 watershed, Bentong area 15
 wave-cut notches 11, 172
 Kedah 23
 waxy oils 377
 weathering
 grades 18
 granite profile Fig. 2.8, Table 2.3
 Kenny Hill Formation Fig. 2.9,
 Fig. 2.11, Table 2.4

metamorphic rock 20, Fig. 2.10,
 Table 2.5
 morphological zones... Table 2.3,
 Table 2.4
 processes 17, 18
 schist 21
 sedimentary rock 19
 stability 22
 zones 17
 porphyritic biotite granite
 weathering 18
 quartz mica schist Fig. 2.10,
 Table 2.5
 welded tuff 204
 Genting Sempah Fig. 9.4
 Johor 205
 rhyolitic, Santi Fig. 9.3
 West
 Baram Line 31, 324,
 Myanmar map Fig. 14.1
 Natuna Basin 175, Fig. 8.1
 stratigraphy... Fig. 8.2
 tectonic development... Fig. 8.4
 Penang graben 155
 Sumatra Block Fig. 3.4
 Western
 Belt 55, 86, 249
 granite trend Fig. 10.22
 Mesozoic 88
 mineralization... Fig. 15.3, Fig.
 15.4
 stratigraphy Fig. 5.2
 structural analysis 286
 volcanism 199
 Boulder Clays 159, 334
 coastal plains 23
 Gold Belt 356
 Hinge-line Fault Zone 175, 177,
 178, 182, Fig. 8.5
 lode channel, Raub 359
 tin province belt 211
 Willinks
 Fault 342
 Tin Lode... Fig. 15.5
 within plate granites Fig. 10.20
 wolframite
 –cassiterite 344
 Kramat Pulai 361
 Kuala Sungai Perong 343
 quartz veins 363

wollastonite, Ledang 243
 wood, silicified
 Lotong Sandstone 126
 Ulu Endau 127
 Woyla Block Fig. 3.4
 wrench
 faulting
 Malay Basin 182
 right-lateral 317
 tectonics, Eastern belt 129
 wigglyite skarns 345

X

X-ray diffraction data, Eastern Belt
 granites 222
 xenoliths
 country rocks 224
 Stong Complex 219
 xenothermal veins 339
 xenotime in amang 339
 Xihuashan region 339

Y

Yala district, South Thailand 339
 Yangzi Platform 311
 Gondwanaland... Fig. 14.5
 Yong Peng redbeds 122
 Young Alluvium 158, 161, 165, 333,
 Fig. 15.2
 Younger Sedimentary Cover..... Fig.
 15.2
 yttrotungstite, Kramat Pulai 361
 Yunnan Syntaxis 316–317

Z

Zamites microphylla 119
 zircon
 amang 339
 stability 22
 zonation of Kinta Valley, Fig. 15.15
 Zr vs SiO₂ granites, Fig. 10.9, Fig.
 10.12

References

A

- Abdul Hamid M.B., Asmuri M.M., Azman A. Ghani, Umor, M.R. & Ismail M.A. (2002). Petrology of igneous rocks from the Pemanggil island. *Geological Society of Malaysia Bulletin*, **45**, 247–251.
- Abdul Majid Sahat (1987). Bukti lapangan sesar Bok-Bak di luar kawasan Baling (Field evidence of the Bok-Bak Fault beyond the Baling area). *Geological Society of Malaysia Warta Geologi*, **13**, 161–164.
- Abdul Rahim Samsudin, Kamal Roslan Mohamad, Ibrahim Abdullah & Ab. Ghani Rafek (1994). Kajian geofizik di Kuala Betis, Kelantan. *Geological Society of Malaysia Bulletin*, **35**, 169–174.
- Abdullah Mohd Salleh (1983). A systematic investigation of the Quaternary deposit in the coastal plain of Lumut, Perak (Sheet 63). *Geological Survey of Malaysia Annual Report*, **1981**, 178–184.
- Abdullah Sani Hj. Hashim (1983). Pemetaan geologi kawasan Teluk Datuk dan Sepang, Selangor (syit 101 & 102). *Geological Survey of Malaysia Annual Report*, **1983**, 163–167.
- Abdullah Sani Hj. Hashim (1985). Discovery of an ammonoid (*Agathiceras* sp.) and crinoid stems in the Kenny Hill formation of Peninsular Malaysia, and its significance. *Geological Society of Malaysia Warta Geologi*, **11**, 205–211.
- Abu Bakar Sulaiman (1990). *Geologi kawasan Belungkur, Pengerang, Johor Darul Takzim*. Unpubl. B.Sc. thesis, Dept. of Geology, University of Malaya.
- Achache, J. & Courtillot, V. (1985). A preliminary Upper Triassic paleomagnetic pole for the Khorat plateau (Thailand): consequences for the accretion of Indochina against Eurasia. *Earth & Planetary Science Letters*, **73**, 147–157.
- Achache, J., Courtillot, V. & Besse, J. (1983). Paleomagnetic constraints on the Late Cretaceous and Cenozoic tectonics of Southeastern Asia. *Earth & Planetary Science Letters*, **63**, 123–136.
- Adam, J.W.H. (1960). On the geology of the primary tin-ore deposits in the sedimentary formation of Billiton. *Geologie en Mijnbouw*, **22**, 406–426.
- Ahmad Hussain, Egbogah, E.O. & Hovdestad, W.R. (1992). Reservoir management of the Dulang Oil Field, offshore Peninsular Malaysia: The Heuristic approach. *Society of Petroleum Engineers Paper SPE 25012*; European Petroleum Conference, Cannes, France, 15–18 Nov. 1992, 16 pp.
- Ahmad Jantan (1973). *Stratigraphy of the Singa Formation (Upper Palaeozoic) in the southwestern part of the Langkawi Island Group, West Malaysia*. Unpubl. M.Sc. thesis, Dept. of Geology, University of Malaya.
- Ahmad Jantan, Basir Jasin, Ibrahim Abdullah, Abdul Rahim Samsudin & Uyop Said (1987a). Facies model of the Triassic Semanggol Formation sequence at Pedu Dam, Kedah. *Geological Society of Malaysia Warta Geologi*, **13**, 73.
- Ahmad Jantan, Basir Jasin, Ibrahim Abdullah, Abdul Rahim Samsudin & Uyop Said (1987b). Note on the occurrence of limestone in the Semanggol Formation, Kedah, Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **13**, 151–159.
- Ahmad Jantan, Basir Jasin, Ibrahim Abdullah, Uyop Said & Abdul Rahim Samsudin (1989). The Semanggol Formation - lithology, facies association and distribution and probable basin setting. *Geological Society of Malaysia Warta Geologi*, **15**, 28.
- Ahmad Jantan, Ibrahim Abdullah, Che Aziz Ali & Juhari Mat Akhir (1993). The Nenering

- Sequence: Sedimentology, stratigraphy and probable basin initiation – A second opinion (Abstract). *Geological Society of Malaysia Warta Geologi*, 19, 117.
- Ahmad Jantan, Ibrahim Abdullah & Uyop Said (1988). The Murau Formation: lithostratigraphy, lithofacies and sedimentary environment (abstract). *Geological Society of Malaysia Warta Geologi*, 14, 268.
- Ahmad Jantan, Kamal Roslan Mohamad, Che Aziz Ali, Ibrahim Abdullah, Uyop Said & Abd. Rahim Samsudin (1991). Relationship and depositional setting of the Lanis Conglomerate, Mangkin Sandstone and Termus Shale of the Tembeling Group in Tekai Valley, Pahang. *Geological Society of Malaysia Warta Geologi*, 17, 158.
- Ahmad Jantan, Uyop Said & Mohamad Md. Tan (1994). The nature of Permian-Triassic junction in the rock sequence in central Pahang. *Geological Society of Malaysia Warta Geologi*, 20, 99.
- Ahmad Munif Koraini (1993). Tertiary palynomorphs from Batu Arang, Malaysia (Abstract). *Geological Society of Malaysia Warta Geologi*, 19, 116.
- Ahmad Munif Koraini, Azmi Mohd. Yakzan & Uyop Said (1994). Palynological study of outcrop samples from Layang-Layang Formation, Bandar Tenggara. Johor; (Abstract). *Geological Society of Malaysia Warta Geologi*, 20, 236.
- Ahmad Rosdi bin Abdul Razak (1982). *Geology of Eastern Langkawi Islands, Kedah, Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Alberti, G.K.B. (1997). Planktonische tentakuliten des Devon. *Palaeontographica Abteilung A* 224, 85–142.
- Aleva, G.J.J. (1973). Aspects of the historical and physical geology of the Sunda Shelf essential to the exploration of submarine tin placers. *Geologie en Mijnbouw*, 52, 79–91.
- Aleva, G.J.J. (1985). Indonesian fluvial cassiterite placers and their genetic environment. *Journal of Geological Society of London*, 142, 815–836.
- Alexander, F.E.S. (1959). Observations on tropical weathering: a study of the movement of iron, aluminium and silicon in weathering rocks at Singapore. *Quarterly Journal of the Geological Society of London*, 115, 123–142.
- Alexander, J.B. (1946). Report on special investigation of coal-bearing formation at Bukit Arang in the State of Perlis during 1941. *Malayan Union Geological Survey Annual Report, 1946*, Govt. Press, Kuala Lumpur, 44–46.
- Alexander, J.B. (1950). Progress report on geological work in southwest Pahang, Selangor and Malacca. *Geological Survey of Malaya Annual Report 1949*, 230–282.
- Alexander, J.B. (1959). Pre-Tertiary stratigraphic succession in Malaya. *Nature*, 183, 230–231.
- Alexander, J.B. (1965). *Geological map of Malaya*, 6th edition (Diamond Jubilee), 1:500,000, Geological Survey Department, West Malaysia.
- Alexander, J.B. (1968). Geology and mineral resources of the Bentong area, Pahang. *Geological Survey of West Malaysia District Memoir* 8, 250 pp.
- Alexander, J.B. & Flinter, B.H. (1965). A note on varlamoffite and associated minerals from the Batang Padang district, Perak, Malaysia. *Mineralogical Magazine*, 35, 622–627.
- Alexander, J.B., Harral, G.M. & Flinter, B.H. (1964). Chemical analyses of Malayan rocks, commercial ores, alluvial mineral concentrates 1903–1963. *Professional Paper, Geological Survey Department, West Malaysia, E64.IC*, 295 pp.
- Ang, N.K. & Zainol Abidin bin Sulaiman (1984). Hydrogeological investigation in the Seri Gading Area (Batu Pahat), Johor. *Geological Survey of Malaysia Annual Report, 1982*, 219–231.
- Angus, N.S. (1962). Ocellar hybrids from the Tyrone igneous series, Ireland. *Geological Magazine*, 99, 9–26.
- Ann Yasmin Nordin (1990). Applications of sequence stratigraphy to the Triassic limestones in northwest Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, 16, 266–267.
- Armitage, J.H. & Viotti, C. (1977). Stratigraphic nomenclature – southern end Malay Basin. *Proceedings of the 6th annual convention of Indonesian Petroleum Association*, Jakarta, 69–94.
- Arth, J.G., Barker, F., Peterman, Z. E. & Friedman, I. (1978). Geochemistry of the Gabbro-diorite-tonalite-trondhjemite suite of southwest Finland and its implication for the origin of tonalitic and trondhjemitic magmas. *Journal of Petrology*, 19, 289–316.
- Asama, K. (1973). Lower Carboniferous Kuantan flora, Pahang, W. Malaysia. In:

- Kobayashi, T. & Toriyama, R. (eds). *Geology and Palaeontology of Southeast Asia*, 11, 109–117.
- Asama, K. (1976). *Gigantopteris* flora in Southeast Asia and its phytopalaeogeographic significance. In: Kobayashi, T. & Toriyama, R. (eds). *Geology and Palaeontology of Southeast Asia*, 17, 191–207, University of Tokyo Press.
- Asama, K., Hongnasonthi, Iwai, J., Kon'no, E., Rajah, S.S. & Veeraburas, M. (1975). Summary of the Carboniferous and Permian plants from Thailand, Malaysia and adjacent areas. In: Kobayashi, T. & Toriyama, R. (eds). *Geology and Palaeontology of Southeast Asia*, 15, 77–102.
- Assavarittiprom, V., Muhammad Adib A.H. & Chenboonthai, N. (2001): Hydrocarbon discovery and potential in the Malaysia-Thailand Joint Development Area. *Geological Society of Malaysia Warta Geologi*, 27, 239–243.
- Au-Yong, M.H. (1974). *The geology of the Bukit Bintang area, Trengganu, with some aspects of geotechnics*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Aw, P.C. (1964). *The geology of the Temangan-Sokor area, Kelantan*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Aw, P.C. (1967). Ignimbrite in central Kelantan, Malaya. *Geological Magazine*, 104, 13–17.
- Aw, P.C. (1974). Geology of the Sungai Nenggiri-Sungai Betis Area, Sheet 44. *Geological Survey of Malaysia Annual Report, 1972*, 115–119.
- Aw, P.C. (1982). Investigation of coal and the study of Tertiary sediments in Perlis. *Geological Survey of Malaysia Annual Report, 1982*, 171–179.
- Aw, P.C. (1990). Geology and mineral resources of the Sungai Aring area, Kelantan Darul Naim. *Geological Survey of Malaysia District Memoir*, 21, 116 pp.
- Aw Yong, M.A. & Olsen, B.S. (1999). Tapis – New opportunities from a maturing field. *Society of Petroleum Engineers Paper SPE 54339*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Jakarta, 20–22 April 1999, 16 pp.
- Aw Yong, T.O. & Soffian, R.M. (1992). Development planning of Seligi Field Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 22409*, SPE International Meeting on Petroleum Engineering, Beijing, 24–27 Mar. 1992, 12 pp.
- Azemi Haji Eki & Salmiah Nawi (2007). Mining activities in Malaysia. http://www.jmg.gov.my/files/Mining_Actv_2004.pdf.
- Azhar Hussin (1990). Late Paleozoic and Triassic carbonate platform and basin sedimentation along the western margin of the Central Belt of Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, 16, 124.
- Azhar Hussin (1993). Re-interpretation of the stratigraphy of the Gunong Semanggol Area, perak Darul Ridzuan and its implication. *Geological Society of Malaysia Warta Geologi*, 19, 113–114.
- Azhar Yusof (1987). *Geologi am kawasan Keluang, Johor*. Unpubl. B.Sc (Hons) thesis, Dept. of Geology, University of Malaya.
- Azman A. Ghani (1998a). Occurrence of synplutonic dyke from the Perhentian Kecil island, Besut Terengganu. *Geological Society of Malaysia Warta Geologi*, 24, 65–68.
- Azman A. Ghani (1998b). Occurrence and chemistry of clouded apatite from the Perhentian Kecil Syenite, Besut Terengganu. *Geological Society of Malaysia Warta Geologi*, 24, 169–173.
- Azman A. Ghani (2000a). Mesozoic mafic dykes from Eastern Belt (Part 1): Textural study of the older dykes. *Proceedings Dynamic Stratigraphy & Tectonics of Peninsular Malaysia (3rd seminar), The Mesozoic of Peninsular Malaysia*, 48–54 (unpubl.). Geological Society of Malaysia.
- Azman A. Ghani (2000b). Mesozoic mafic dykes from Eastern Belt (Part 2): Geochemistry of the younger dykes. *Proceedings Dynamic Stratigraphy & Tectonics of Peninsular Malaysia (3rd seminar), The Mesozoic of Peninsular Malaysia*, 96–105 (unpubl.). Geological Society of Malaysia.
- Azman A. Ghani (2000c). Chemical variation of muscovite from the Kuala Lumpur granite, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 44, 117–124.
- Azman A. Ghani (2000d). Hornblende chemistry and its application to geobarometry of the Noring Pluton, Stong Complex, Kelantan. *Proceedings Geological Society of Malaysia Annual Geological Conference 2000*, 81–85.
- Azman A. Ghani (2000e). The Western Belt granite of Peninsular Malaysia: some emergent problems on granite classification and its implication. *Geosciences Journal*, 4, 283–293.

- Azman A. Ghani (2001). Petrology and geochemistry of the granite and syenite from Perhentian island, Peninsular Malaysia. *Geosciences Journal*, **5**, 123–137.
- Azman A. Ghani (2002). Geochemistry of biotite from Kuala Lumpur granite. *Malaysian Journal of Science*, **21**, 159–164.
- Azman A. Ghani (2003). Petrochemistry of Maras Jong granite from the Eastern Belt of Peninsular Malaysia: an example of 'S' type granite in the Eastern Belt of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **46**, 19–24.
- Azman A. Ghani (2005a). Trace and major elements composition of Alkali Olivine and Olivine Nephelinite basaltic lavas from Kuantan: Late Cainozoic Basaltic rock from the Indochina Block of Peninsular Malaysia. *Proceedings 1st International Symposium Geological Anatomy of East and SE Asia: Paleogeography and Paleoenvironment in Eastern Tethys (IGCP 516)*, 10–17 October 2005, Tsukuba Japan, 24–25.
- Azman A. Ghani (2005b). Highly evolved S type granite: Selim Granite, Main Range Batholith, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **51**, 95–101.
- Azman A. Ghani (2006). Batuan vulkanik dari Pulau Tinggi dan Pulau Sibul Johor. *Geological Society of Malaysia Bulletin*, **52**, 63–66.
- Azman A. Ghani & Khoo, T.T. (1998). Field relation and petrology of igneous rocks in the Perhentian island and its surrounding area, Besut Terengganu. *Geological Society of Malaysia Warta Geologi*, **24**, 175–185.
- Azman A. Ghani & Nur Iskandar Taib (2007). New trace, major and rare earth element data for early Pleistocene alkali olivine basalt and olivine nephelinites from Kuantan, Pahang: plume related rift volcanics or wrench related crustal extension. *Geological Society of Malaysia Bulletin*, **53**, 111–117.
- Azman A. Ghani & Singh, N. (2005). Petrochemistry and geochemistry of Sempah volcanic complex: Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **51**, 103–121.
- Azman A. Ghani, Ibrahim, A.T, Mohamad, M., Wan Ibrahim, W.Z, Rashid R.A., Wan Harun, W.S., Yusoff, I., Muda, A., Roselee, K.H., Othman, A.S., Ismail, A. & Hasan, M.A. (2001). Occurrence, field relation and petrochemistry of the mafic dykes from Kenyir area, central Terengganu. *Proceedings Geological Society of Malaysia Annual Geological Conference 2001*, 141–145.
- Azman A. Ghani, Khoo, T.T. & Grapes, R. (2002a). Geochemistry of Mafic dykes from the Perhentian and Redang islands: an example of the younger (dolerite) dykes petrogenesis from the Eastern Belt of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **45**, 235–241.
- Azman A. Ghani, Ramesh, V., Yong, B.K., Khoo, T.T. & Shafari Muda (2002b). High Ba rocks from the Central Belt of Peninsular Malaysia and its implication. *Geological Society of Malaysia Bulletin*, **45**, 45–49.
- Azman A. Ghani, Ramesh, V., Yong, B.T. & Khoo, T.T. (2006). Geochemistry and Petrology of syenite, monzonite and gabbro from the Central Belt of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **49**, 25–30.
- Azman A. Ghani, M. Rashid Saluki & A. Tajuddin Ibrahim (2001). Contrasting textural and geochemical composition of mafic microgranular enclave in granodiorite and syenogranite from Lawit batholith, Terengganu. *Geological Society of Malaysia Warta Geologi*, **27**, 1–7.
- Azman A. Ghani, Yusoff, I. & Meor Hakif Amir Hassan (2007). Geology and Geochemistry of Volcanic and Granitic rocks from Endau Rompin National Park, Johore, Malaysia. In: Mohamad, H. & Zakaria Ismail M. (eds). *The Forest and Biodiversity of Selai Endau Rompin*, 1–10, University of Malaya.
- Azman Samsudin (1987). *Geologi bagi kawasan Endau-Rompin, Johor*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Azmi Ab. Rashid (1995). *Kajian Petrografi dan Paleontologi, Bukit Batu Kapur Kota Gelanggi, Jerantut, Pahang Darul Makmur*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Azmi Mohd Yakzan, Awalludin Harun, Bahari Md Nasib & Morley, R.J. (1996). Integrated biostratigraphic zonation for the Malay Basin. *Geological Society of Malaysia Bulletin*, **39**, 157–184.

B

- Bai, Y., Chen, G., Sun, Q., Sun, Y., Li, Y., Dong, Y. & Sun, D. (1987). Late Paleozoic polar wander path for the Tarim Platform and its

- tectonic significance. *Tectonophysics*, **139**, 145–153.
- Barber, A.J. & Crow, M.J. (2005a). Pre-Tertiary stratigraphy. In: Barber, A.J., Crow, M.J. & Milsom, J.S. (eds). *Sumatra: geology, resources and tectonic evolution*. Geological Society of London Memoir, **31**, 24–53.
- Barber, A.J. & Crow, M.J. (2005b). Structure and structural history. In: Barber, A.J., Crow, M.J. & Milsom, J.S. (eds) *Sumatra: Geology, Resources and Tectonic Evolution*. Geological Society of London, Memoir, **31**, 175–233.
- Barber, A.J., Crow, M.J. & De Smet, M.E.M. (2005a). Tectonic evolution. In: Barber, A.J., Crow, M.J. & Milsom, J.S. (eds). *Sumatra: geology, resources and tectonic evolution*. *Geological Society of London Memoir*, **31**, 234–259.
- Barber, A.J., Crow, M.J. & Milsom, J.S. (eds) (2005b). *Sumatra: Geology, Resources and Tectonic Evolution*. Geological Society of London, Memoir, **31**.
- Barr, S.M. & MacDonald, A.S. (1978). Geochemistry and petrogenesis of Late Cenozoic alkaline basalts of Thailand. *Geological Society of Malaysia Bulletin*, **10**, 25–52.
- Barr, S.M., MacDonald, A.S., Yaowanoyothin, W. & Panjasawatwong, Y. (1985). Occurrence of blue schist in the Nan mafic-ultramafic belt, northern Thailand. *Geological Society of Malaysia Warta Geologi*, **11**, 47–50.
- Basir Jasin (1995). Occurrence of bedded radiolarian chert in the Kubang Pasu Formation, north Kedah, Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **21**, 73–79.
- Basir Jasin (1996). Discovery of Early Permian radiolaria from Semanggol formation, NW Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **22**, 283–287.
- Basir Jasin (1997). Permo–Triassic radiolaria from Semanggol Formation, NW Peninsular Malaysia. *Journal of Asian Earth Sciences*, **15**, 43–53.
- Basir Jasin & Che Aziz Ali (1997). Lower Permian radiolaria from the Pos Blau area, Ulu Kelantan, Malaysia. *Journal of Asian Earth Sciences*, **15**, 327–339.
- Basir Jasin & Zaiton Harun (2001a). Some Triassic Radiolarians from the Kodiang Limestone, northwest Peninsular Malaysia. *Proceedings Geological Society of Malaysia Annual Geological Conference 2001*, 105–107.
- Basir Jasin & Zaiton Harun (2001b). Some radiolarians from the bedded chert of the Kubang Pasu formation. *Proceedings Geological Society of Malaysia Annual Geological Conference 2001*, 111–114.
- Basir Jasin & Zaiton Harun (2007). Stratigraphy and sedimentology of the chert unit of the Semanggol Formation. *Geological Society of Malaysia Bulletin*, **53**, 103–109.
- Basir Jasin, Ahmad Jantan, Ibrahim Abdullah, Uyop Said & Abdul Rahim Samsudin (1989). The Semanggol Formation – Lithostratigraphy of the Semanggol rocks in the light of latest concept in stratigraphic practice: a suggestion. *Geological Society of Malaysia Warta Geologi*, **15**, 29.
- Basir Jasin, Che Aziz Ali & Kamal Roslan Mohamed (1995a). Late Triassic Radiolaria from the Kodiang Limestone, northwest Peninsular Malaysia. *Journal of Southeast Asian Earth Sciences*, **12**, 31–39.
- Basir Jasin, Uyop Said & Rosmah Abdul Rahman (1995b). Late Middle Permian Radiolaria from the Jengka area, central Pahang, Malaysia. *Journal of Southeast Asian Earth Sciences*, **12**, 79–83.
- Basir Jasin, Zaiton Harun & Siti Norhajar Hassan (2003). Black siliceous deposits in Peninsular Malaysia: their occurrence and significance. *Geological Society of Malaysia Bulletin*, **46**, 149–154.
- Basir Jasin, Zaiton Harun, Uyop Said & Sulaiman Saad (2005a). Permian Radiolarian Biostratigraphy of the Semanggol Formation, south Kedah, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **51**, 19–30.
- Basir Jasin, Zaiton Harun & Uyop Said (2005b). Triassic Radiolarian Biostratigraphy of the Semanggol Formation, south Kedah, Peninsular. *Geological Society of Malaysia Bulletin*, **51**, 31–39.
- Batchelor, B.C. (1978). Post ‘Hoabinhian’ Coastal Settlement Indicated by Finds In Staniferous Langat River Alluvium Near Dengkil, Selangor, Peninsular Malaysia. *Federation Museums Journal, New Series*, **22**, 1–55.
- Batchelor, B.C. (1979a). Discontinuously rising Late Cainozoic eustatic sea levels with special reference to Sundaland, Southeast Asia. *Geologie en Mijnbouw*, **58**, 1–20.
- Batchelor, B.C. (1979b). Geological characteristics of certain coastal and offshore placers as essential guides for tin

- exploration in Sundaland, Southeast Asia. *Geological Society of Malaysia Bulletin*, **11**, 283–313.
- Batchelor, B.C. (1983). *Sundaland tin placer genesis and Late Cainozoic coastal and offshore stratigraphy in Western Malaysia and Indonesia*. Unpubl. Ph.D. thesis, Dept. of Geology, University of Malaya.
- Batchelor, B.C. (1988). Dating of Malaysian fluvial tin placers. *Journal of Southeast Asian Earth Sciences*, **2**, 3–14.
- Batchelor, B.C., Harsono, R., Sirinawin, T. & Praditwan, J. (1988). *Conceptual exploration of Quaternary tin placer deposits*. SEATRAD Centre, Workshop manual, 25–29 October, Ipoh, Malaysia, 255 pp.
- Bateman, P.C., Clarke, L.D., Huber, N.D., Moore, J.G. & Rinehart, C.D. (1963). The Sierra Nevada batholith, a synthesis of recent work across the central part. *United States Geological Survey Professional paper*, **414D**, 46 pp.
- Bau, M. (1996). Controls on the fractionation of isovalent trace elements in magmatic and aqueous systems: evidence from Y/Ho, Zr/Hf, and lanthanide tetrad effect. *Contributions to Mineralogy and Petrology*, **123**, 323–333.
- Bean, J.H. (1969). The iron-ore deposits of West Malaysia. *Geological Survey of Malaysia Map Economic Bulletin*, **2**, 194 pp.
- Bean, J.H. (1972). Geology, petrography and mineral resources of Pulau Tioman, Pahang. *Geological Survey of Malaysia Map Bulletin*, **5**, 92 pp.
- Beckinsale, R.D. (1979). Granite magmatism in the tin belt of South-East Asia. In: Atherton, M.P. & Tarney, T. (eds). *Origin of granite batholiths: Geochemical evidence*. Shiva Publishing Ltd., Orpington, UK, 34–45.
- BEICIP (1985). *Hydrocarbon potential of western Indonesia*, 239 pp.
- Berry, W.B.N. & Boucot, A.J. (1972). Correlation of the Southeast Asian and Near Eastern Silurian rocks. *Geological Society of America Special Paper*, **137**, 1–65.
- Best, J.L. & Brayshaw, A.C. (1985). Flow separation — a physical process for the concentration of heavy minerals within alluvial channels. *Journal of Geological Society of London*, **142**, 747–755.
- Bignell, J.D. (1972). *The geochronology of the Malayan granites*. Unpubl. D.Phil. thesis, University of Oxford.
- Bignell, J.D. & Snelling, N.J. (1977). Geochronology of Malayan granites. *Overseas Geology and Mineral Resources*, **47**, Institute of Geological Sciences, H. M. Stationery Office, London, 72 pp.
- Bishop, M.G. (2002). Petroleum systems of the Malay Basin province, Malaysia. *United States Geological Survey Open-File Report*, **99-50T**, 30 pp.
- Borhan Doya, M. (1995). *Petrology and geochemistry of granitoid from Penang, Kedah-Perak and general geology*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Bosch, J.H.A. (1986a). Young Quaternary sediments in the coastal plain of Southern Perak, Peninsular Malaysia. *Geological Survey of Malaysia Quaternary Geology Section Report*, **QG/1**, 83 pp.
- Bosch, J.H.A. (1986b). Young Quaternary sediments in the coastal plain of Kelantan, Peninsular Malaysia. *Geological Survey of Malaysia Quaternary Geology Section Report*, **QG/2**, 42 pp.
- Bosch, J.H.A. (1988). The Quaternary deposits in the central plains of Peninsular Malaysia. *Geological Survey of Malaysia Report*, **QG/1**, 87 pp.
- Boucot, A.J. (1975). *Evolution and Extinction Rate Controls*. Developments in Palaeontology and Stratigraphy, 1, Elsevier, New York, 427 pp.
- Boucot, A.J., Johnson, J. G. & Jones, C.R. (1966). Silurian brachiopods from Malaya. *Journal of Paleontology*, **40**, 1027–1031.
- Bowden, P., Batchelor, R.A., Chappell, B.W., Didier, J. & Lameyre, J. (1984). Petrological, geochemical and source criteria for the classification of granitic rocks: a discussion. *Physics of the Earth and Planetary Interiors*, **35**, 1–11.
- Bowen, Z.P., Rhoads, C. & McAlester, L. (1974). Marine benthic communities in the Upper Devonian of New York. *Lethaia*, **7**, 93–120.
- Bradford, E.F. (1957). The occurrence of tin and tungsten in Malaya. *Ninth Pacific Science Congress*, No. 12, 378–398.
- Bradford, E.F. (1965). *The geology and mineral resources of the Gunong Jerai area, Kedah, Malaya*. Unpubl. Ph.D. thesis, University of London.
- Bradford, E.F. (1972). The geology and mineral resources of the Gunong Jerai area, Kedah. *Geological Survey of Malaysia District Memoir*, **13**, 242 pp.
- Brami, J.B. & Mohd Yusof Muhaiyuddin (1984).

- History and geology of the Tinggi Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 12382*, 5th Offshore South East Asia, Singapore, 21–24 Feb. 1984, 13 pp.
- Brett, C.E., Boucot, A.J. & Jones, C.R. (1993). Absolute depths of Silurian benthic assemblages. *Lethaia*, **23**, 25–40.
- Bunopas, S. (1982). Palaeogeographic history of western Thailand and adjacent parts of Southeast Asia — a plate tectonics interpretation. *Geological Survey paper*, **5**, Department of Mineral Resources, Bangkok, Thailand, 810 pp.
- Bunopas, S. (1983). Paleozoic succession in Thailand. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 39–76.
- Bunopas, S. & Vella, P. (1983). Tectonic and geologic evolution of Thailand. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 307–322.
- Bunopas, S., Maranate, S. & Vella, P. (1989). Palaeozoic and Early Mesozoic rotation and drifting of Shan-Thai from Gondwana Australia. *4th International Symposium on pre-Jurassic evolution of East Asia, IGCP Project 224, Reports and abstracts*, **1**, 63–64.
- Burley, A.J. & Jamaludin Othman, (1990). A gravity survey of Perlis, Kedah and Penang, *Geological Society of Malaysia Bulletin.*, **26**, 13–20.
- Burrett, C. & Stait, B. (1985). South East Asia is a part of an Ordovician Gondwanaland — a paleobiogeographic test of a tectonic hypothesis. *Earth & Planetary Science Letters*, **75**, 184–190.
- Burrett, C. & Stait, B. (1986). Southeast Asia as a part of an early Palaeozoic Australian Gondwanaland. *Geological Society of Malaysia Bulletin*, **19**, 103–107.
- Burton, C.K. (1959). A note on the geology of the tin and iron-bearing deposits located near Sungei Pelepah Kanan district of Kota Tinggi, Johore. *Geological Survey of Malaysia Papers*, **3**, 17–37.
- Burton, C.K. (1964). The Older Alluvium of Johore and Singapore. *Journal Tropical Geography*, **18**, 30–42.
- Burton, C.K. (1965). Wrench faulting in Malaya. *Journal of Geology*, **73**, 781–798.
- Burton, C.K. (1967). The Mahang Formation: a mid-Palaeozoic euxinic facies from Malaysia-with notes on its conditions of deposition and palaeogeography. *Geologie en Mijnbouw*, **46**, 167–187.
- Burton, C.K. (1972). The geology and mineral resources of the Baling area, Kedah and Perak. *Geological Survey of Malaysia District Memoir*, **12**, 150 pp.
- Burton, C.K. (1973a). Mesozoic. In: Gobbett, D.J. & Hutchison, C.S., (eds). *Geology of the Malay Peninsula*, Wiley-Interscience, New York, 97–141.
- Burton, C.K. (1973b). Geology and mineral resources Johore Bahru–Kulai area, south Johore. *Geological Survey of Malaysia Map Bulletin*, **2**, 72 pp.
- Burton, C.K. (1986). The Baling Group/Bannang Sata Group of the Malay/Thai Peninsula. *Journal of South East Asian Earth Science*, **2**, 93–106.
- Burton, C.K. (1988). The geology and mineral resources of the Bedung Area, Kedah, West Malaysia. *Geological Survey of Malaysia Map Bulletin*, **7**, 103 pp.

C

- Calvert, C.S., Helwick, S.J., Hill, R.E., Hubbard, R.S., Vijay Khare, Wahrmund, L.A. & Wang, G.S. (1997). Seismically integrated geologic modeling: Guntong Field, Malay Basin. *Society of Petroleum Engineers Paper SPE 38697*; SPE Annual Technical Conference & Exhibition, San Antonio, TX, 5–8 Oct. 1997, 7 pp.
- Chakraborty, K.R. (1977). Olivine Nephlinite and limburgite from Kuantan Pahang. *Geological Society of Malaysia Warta Geologi*, **3**, 1–5.
- Chakraborty, K.R. (1980). On the evolution of the nephlinite to hypersthene normative alkali basaltic rock Kuantan, Pahang, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **12**, 79–86.
- Chakraborty, K.R. (1988). Subduction-collision models for the Malay Peninsula: an appraisal (abstract). *Geological Society of Malaysia, petroleum geology seminar '88, programme and abstracts of papers*.
- Chakraborty, K.R. (1994). Recent advances and emergent problems in the tectono-magmatic evolution of the granitoids of the Main Range province, Peninsular Malaysia (abstract). *Geological Society of Malaysia Warta Geologi*, **20**, 240–242.

- Chakraborty, K.R. (1995). Genting Sempah volcanic Complex: Genetic implication for the Main Range granite. *Geological Society of Malaysia Warta Geologi*, **21**, 216–217.
- Chakraborty, K.R. & Amerizal, G.D. (1984). P-T-H₂O conditions of Sungei Ara granite, Penang island, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **17**, 1–7.
- Chakraborty, K.R. & Kamineni, D.C. (1978). Chemical characteristics and classification of Segamat volcanics. *Geological Society of Malaysia Warta Geologi*, **4**, 85–91.
- Chakraborty, K.R. & Metcalfe, I. (1983). Intrabed andalusite abundance variation as an indicator of graded beds: an example from Kuala Kemasik, Trengganu. *Geological Society of Malaysia Bulletin*, **16**, 159–166.
- Chakraborty, K.R. & Metcalfe, I. (1984). Analysis of mesocopic structures at Mersing and Tanjung Kempit, Johore. *Geological Society of Malaysia Bulletin*, **17**, 357–371.
- Chakraborty, K.R. & Metcalfe, I. (1988). Deformation and age of Limestone at Sungei Bilut, near Raub. *Geological Society of Malaysia Warta Geologi*, **14**, 115–123.
- Chan, L.S., Wang, C.Y. & Wu, X.Y. (1984). Paleomagnetic results from some Permian-Triassic rocks from southwestern China. *Geophysical Research Letters*, **11**, 1157–1160.
- Chand, F. (1978). The geology and mineral resources of the Ulu Paka area, Trengganu. *Geological Survey of Malaysia Memoir*, **16**, 124 pp.
- Chandra Kumar Sivapragasam (1981). Gabbroic rocks from the southern Malaya Peninsula and their relation to other orogenic zones. *Geological Society of Malaysia Bulletin*, **14**, 75–100.
- Chandra Kumar Sivapragasam (1985). *The enclaves of Peninsular Malaysian granitoids*. Unpubl. Ph.D. thesis, Dept. of Geology, University of Malaya.
- Chaodumrong, P., Y. Ukakimapan, S. Snansieng, S. Janmaha, S. Praditdan & N.S. Leow (1983). A review of the Tertiary sedimentary rocks of Thailand. *Proceedings of the workshop on stratigraphic correlation Of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 159–187.
- Chappell, B.W. (1999). Aluminium saturation in I- and S-type granites and characterization of fractionated haplogranites. *Lithos*, **46**, 535–551.
- Chappell, B.W. & White, A.J.R. (1974). Two contrasting granite types. *Pacific Geology*, **8**, 173–174.
- Che Aziz Ali (1996). Dolomitization in the Kodiang Limestone, Kedah. *Geological Society of Malaysia Warta Geologi*, **22**, 219–220.
- Che Aziz Ali & Kamal Roslan Mohammed (1996). Diagenesis dan Asal Mula Dolomit dan Kuarza di dalam Batu Kapur Kodiang, Kedah. *Sains Malaysiana*, **25**, 47–68.
- Che Aziz Ali and Kamal Roslan Mohamed (1997). Konglomerat di Jalur Timur: hubungan genetic di antara Konglomerat Murau, Pulau Redang, Pulau Kapas dan Bukit Keluang. *Sains Malaysiana*, **26**, 1–18.
- Che Shaari Abdullah (2006). Exploring for high pressure and high temperature (HPHT) hydrocarbon pools: Technology challenge versus pessimism – Guling Deep-1 experience. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2005, 6–7 Dec. 2005, Kuala Lumpur, Program & Abstracts*, 41.
- Cheang, K.K. & Zulkifli Che Kasim (1988). Gold-bearing quartz veins from Ajmal Mine, Kuala Lipis area, Pahang, Malaysia (Abstract). *Geological Society of Malaysia Annual Geological Conference 1988, Warta Geologi*, **15**, p.30.
- Chen, X. & Wang, Z. (1988). Distribution of tin deposits in China and their metallogenic conditions. *In: Hutchison, C.S. (ed). Geology of tin deposits in Asia and the Pacific*. Springer-Verlag, Heidelberg, 235–244.
- Cheney, E.S. & Patton, T.C. (1967). Origin of the bedrock values of placer deposits. *Economic Geology*, **62**, 852–853.
- Cheng, G., Bai, Y. & Sun, Y. (1988). Palaeomagnetic study on the tectonic evolution of the Ordos block, North China. *Seismological Geology*, **10**, 81–87.
- Chinbunchorn, N., Praditdan, S. & Sattayarak, N. (1989). Petroleum Potential of Tertiary intermontane basins in Thailand. *Proceedings of the international symposium on Intermontane basins: geology and resources*, Chiang Mai University, Thailand, 29–42.
- Chong, F.S. & N.K. Ang (1980). Preliminary groundwater investigation at Pulau Langkawi, Kedah. *Geological Survey of Malaysia Annual Report, 1978*, 246–258.
- Chong, N.H. (1976). *Tungsten occurrences of the Thai-Malay Peninsula*. Unpubl. M.Sc.

- thesis, Dept. of Geology, University of Malaya.
- Choy, K.W. (1970). *Geology of the western Kuala Lumpur area, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Chu, L.H., Chand, F. & Singh, D.S. (1988). Primary tin mineralization in Malaysia: aspects of geological setting and exploration strategy. In: Hutchison, C.S. (ed). *Geology of tin deposits in Asia and the Pacific*. Springer-Verlag, Heidelberg, 593-613.
- Chu, Y.S. (1992). Petrographic and diagenetic studies of the reservoir sandstone of the Malay Basin. *Geological Society of Malaysia Bulletin*, 32, 261-283.
- Chua, B.Y. & Wong, R. (1997). Some possible new exploration ideas in the northern and western Malay Basin of Peninsular Malaysia. *Proceedings ASCOPE '97 Conference*, 24-27 Nov. 1997, 17 pp.
- Chung, S.K. (1959). Geological Investigations of Pulau Bunting. *Geological Survey Department, West Malaysia, Unpubl. Report GS 58/F/031/33*.
- Clarkson, E.N.K. (1986). *Invertebrate Paleontology and Evolution (Second edition)*. Allen & Unwin, London, 383 pp.
- Cobbing, E.J., Mallick, D.I.J., Pitfield, P.E.J. & Teoh, L.H. (1986). The granites of southeast Asia. *Journal of Geological Society of London*, 143, 537-550.
- Cobbing, E.J., Pitfield, P.E.J., Darbyshire, D.P.F. & Mallick, D.I.J. (1992). The granites of the South-East Asian tin belt. *British Geological Survey Overseas Memoir*, 10, Her Majesty's Stationery Office, London, 369 pp.
- Cocks, L.R.M. & Fortey, R.A. (1988). Lower Paleozoic facies and faunas around Gondwana. In: Audley-Charles, M.G. & Hallam, A. (eds.) *Gondwana and Tethys*. Geological Society of London Special Publication, 37, 101-118.
- Cocks, L.R.M., Fortey, R.A. & Lee, C.P. (2005). A review of Lower and Middle Palaeozoic biostratigraphy in west peninsular Malaysia and southern Thailand in its context within the Sibumasu Terrane. *Journal of Asian Earth Sciences*, 24, 703-717.
- Cook, A. C. & Sherwood, N.R. (1991). Classification of oil shales, coals and other organic-rich rocks. *Organic Geochemistry*, 17, 211-222.
- Cook, R.H., Suntharalingam, T., Chong, F.S. & Evans, G.M. (1968). Geology and mineral resources of the Malacca-Mersing area. *Geological Survey of Malaysia Annual Report*, 1968, 89-94.
- Cooper, M.A., Herbert, R. & Hill, G.S. (1989). The structural evolution of Triassic intermontane basins in northeastern Thailand. *Proceedings of the international symposium on Intermontane basins: geology and resources*, Chiang Mai University, Thailand, 231-242.
- Corbett, C., Solomon, G.J., Sonrexa, K., Salehudin Ujang & Tajul Ariffin (1995). Application of seismic-guided reservoir property mapping to the Dulang West Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 30568*, SPE Annual Technical Conference & Exhibition, Dallas, TX, 22-25 Oct. 1995, 9 pp.
- Courtier, D.B. (1962). Note on terraces and other alluvial features in parts of Province Wellseley, south Kedah, and north Perak. *Professional Paper Geological Survey Dept., Federation of Malaya*, E62.1-T, 6 p.
- Courtier, D.B. (1974). The geology and mineral resources of the neighbourhood of the Kulim area, Kedah. *Geological Survey of Malaysia Map Bulletin*, 3, 50 pp.
- Cox, L.R. (1937). On a freshwater shale with *Viviparus* from Johore (Malay States). *Geological Magazine*, 74, 78-81.
- Creaney, S., Abdul Hanif Hussein, Curry, D.J., Bohacs, K.M. & Redzuan Hassan (1994). Source facies and oil families of the Malay Basin. Abstracts American Association of Petroleum Geologists International Conference & Exhibition, Kuala Lumpur, 21-24 August, 1994. *American Association of Petroleum Geologists Bulletin*, 78, 1139.
- Croft, G. (2007). Petroleum Geology of the Gulf of Thailand, Greg Croft Inc., <http://www.gregcroft.com/thailand.ivnu>.
- Curry, J.R. (2005). Tectonics and history of the Andaman Sea region. *Journal of Asian Earth Sciences*, 25, 187-232.

D

- Darbyshire, D.P.F (1988). Geochronology of Malaysian Granites. *NERC Isotope Geological Report, British Geological Survey*, 3, 60 pp.
- Davies, P.R. (1984). Tertiary structural evolution and related hydrocarbon occurrences, North Sumatra Basin. *Proceedings of 13th*

- annual convention of Indonesian Petroleum Association*, Jakarta, 1, 453–495.
- Davis, G.H. (1984). *Structural Geology of rocks and regions*. John Wiley and Sons, New York, 492 pp.
- Dawson, J., MacDonald, S., Paton, J.R., Slater, D. & Singh, D.S. (1968). *Geological map of Northwest Malaya, 1 : 250,000*, Geological Survey Department, West Malaysia.
- Dawson, O.T. (1978). Depositional and diagenetic fabrics of Permian limestone from Saraburi, central Thailand. In: Nutalaya, P. (ed). *Proceedings of the third regional conference of geology and mineral resources of S.E. Asia*, 47–60, Asian Institute of Technology, Bangkok.
- De Coo, J.C.M. & Smit, O.E. (1975). The Triassic Koding Limestone Formation in Kedah, W. Malaysia. *Geologie en Mijnbouw*, 54, 169–176.
- De la Roche, H., Leterrier, J., Grande Claude, P. & Marchal, M. (1980). A classification of volcanic and plutonic rocks using R1-R2 diagrams and major element analyses - its relationship and current nomenclature. *Chemical Geology*, 29, 183–210.
- De Smet, M.E.M. & Barber, A.J. (2005). Tertiary Stratigraphy. In: Barber, A.J., Crow, M.J. & Milsom, J.S. (eds). *Sumatra: geology, resources and tectonic evolution*. Geological Society of London Memoir, 31, 86–97.
- Debon, E. & LeFort, P. (1983). A chemical-mineralogical classification of common plutonic rocks and associations. *Transaction Royal Society of Edinburgh, Earth Sciences*, 73, 135–149.
- Didier, J. & Barbarin, B. (1991). *Enclaves and granite petrology. Development in Petrology*, 13, Elsevier, Amsterdam, 626 pp.
- E**
- Ekweozor, C.M. & Udo, O.T. (1988). The oleananes: Origin, maturation and limits of occurrence in Southern Nigeria sedimentary basins. *Organic Geochemistry*, 13, 131–140.
- Elliot, G.F. (1968). Three new Tethyan Dasycladaceae (calcareous algae). *Paleontology*, 11, 491–497.
- Encik Aris Yub (1981). *Geology of Southeastern Langkawi Islands, Kedah, Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Enkin, R.J., Yang, Z., Chen, Y. & Courtillot, V. (1992). Paleomagnetic constraints on the geodynamic history of the major blocks of China from the Permian to the Present. *Journal of Geophysical Research*, 97, 13953–13989.
- Eubank, R.T. & Makki, A.C. (1981). Structural geology of the Central Sumatra back-arc basin. *Proceedings of 10th annual convention of Indonesian Petroleum Association*, Jakarta, 153–196.
- Eugster, H.P. & Choi, I.M. (1979). A model for the deposition of Cornwall-type magnetite deposits. *Economic Geology*, 74, 763–774.
- Eyles, R.J. (1970). Physiographic implications of laterite in West Malaysia. *Geological Society of Malaysia Bulletin*, 3, 1–7.
- F**
- Fanani, F., Boyce, B., Wong, R., Fahrul, A. & Alwyn, C. (2006). Fractured basement plays, Penyu Basin, Malaysia. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts*, 61–62.
- Fariz Fahmi (2006). Jerneh full field studies – an integrated approach to the identification of new development opportunities. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts*, 134.
- Fariza Zahari, Nik M. Ruzaim Akhmal, A. Rahman B. M. Eusoff, Prama Arta, Yu S. M. & M. Rapi M. Som (2006). Reservoir properties and depositional environment of the Group M cored interval in Lendang Tengah, Block PM309, Malay Basin. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts*, 151.
- Fitch, F.H. (1949). Evidence for recent emergence of the land in East Pahang. *Journal Malayan Branch Royal Asiatic Society*, 22, 115–122.
- Fitch, F.H. (1952). The geology and mineral resources of the neighbourhood of Kuantan, Pahang. *Geological Survey Department Federation of Malaya Memoir*, 6, 144 pp.
- Fitch, T.J. (1972). Plate convergence, transcurrent faults and internal deformation adjacent to Southeast Asia and the western Pacific. *Journal of Geophysical Research*, 77, 4432–4462.
- Flores, D.J. & Kelm, C.H. (1982). Development

- and reservoir engineering studies of the Pulau field, offshore Peninsular Malaysia. *Offshore Southeast Asia 82 Conference*, 9–12 Feb. 1982, Singapore, 15 pp.
- Fontaine, H. (1986). The Permian of Southeast Asia. *CCOP Technical Bulletin* 18, 1–109.
- Fontaine, H. (1989). Peculiarities of the Permian of Peninsular Thailand. *CCOP Newsletter*, 14, 15–20.
- Fontaine, H. (1992). Pre-Tertiary sediments found at the bottom of wells drilled in Malacca Straits. *CCOP Newsletter*, 17, 12–17.
- Fontaine, H. & Gafoer, S. (eds.) (1989). *The pre-Tertiary fossils of Sumatra and their environments*. CCOP technical papers, 19.
- Fontaine, H. & Ibrahim bin Amnan (1994). The importance of Triassic limestone in the Central Belt of Peninsular Malaysia. *Proceeding International Symposium on Stratigraphic Correlation of Southeast Asia*, Bangkok, 195–205.
- Fontaine, H. & Workman, D.R. (1978). Review of the geology and mineral resources of Kampuchea, Laos and Vietnam. In: Nutalaya, P. (ed). *Geology and Mineral resources of Southeast Asia*, 538–603, Asian Institute of Technology, Bangkok.
- Fontaine, H., Ibrahim Amnan, Khoo, H.P., Nguyen, D.T. & Vachard, D. (1994). Discovery of Upper Permian to Triassic limestone in the lower basin of Sungai Kenong, Kuala Lipis Area, Pahang. *Geological Survey of Malaysia Geological Papers*, 4, 45–55.
- Fontaine, H., Khoo, H.P. & Vachard, D. (1988). Discovery of Triassic fossils at Bukit Chuping, in Gunung Senyum area, and at Kota Jin, Peninsular Malaysia. *Journal of Southeast Asian Earth Sciences*, 2, 145–162.
- Fontaine, H., Rodziah Daud & Singh, U. (1990). A Triassic “reefal” limestone in the basement of the Malay Basin, South China Sea: Regional Implications. *Geological Society of Malaysia Bulletin*, 27, 1–25.
- Foo, B.N. (1977). Mineral paragenesis, fluid inclusion studies and geochemistry of the Sungei Lembing tin lodes, West Malaysia. *Transaction of Institution Mining and Metallurgy*, 86, B163.
- Foo, K.Y. (1964). *Geology of the north central region of Pulau Langkawi*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Foo, K.Y. (1983). The Palaeozoic sedimentary rocks of Peninsular Malaysia – stratigraphy and correlation. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, 1: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 1–19.
- Foo, K.Y. (1990). Geology and Mineral Resources of the Taiping–Kuala Kangsar Area, Perak Darul Ridzuan. *Geological Survey of Malaysia Map Report*, 1, 145 pp.
- Foo, S.J. (1986). *Geophysical surveys and general geology of the Port Dickson–Seremban area*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Foo, W.Y. (1979). *Stratigraphy and structure of the islands west of Gunung Jerai and the area south of Merbok estuary, Kedah*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Foss, C.A. (1986). Results of a gravity survey in the Kuala Lumpur area. *Geological Society of Malaysia Bulletin*, 19, 643–652.

G

- Gan, A. S. (1979). The significance of a Fossil find in Tanjong Malim area (Sheet 76). *Geological Survey of Malaysia Annual Report 1979*, 158–162.
- Gan, A.S. (1992). Geology and mineral resources of the Tanjong Malim area, Perak Darul Ridzuan. *Geological Survey of Malaysia Map Report*, 4, 65 pp.
- Gan, L.C. (1980). *Manson Lode, a stratabound base metal-silver deposit in North Kelantan, Malaysia*. Unpubl. Ph.D. dissertation, University of Leoben.
- Ganesan Nadeson, Nor Aidil Anua, Ashok Singhal & Ramli Ibrahim (2004). Water-Alternating-Gas (WAG) Pilot Implementation, A first EOR Development Project in Dulang Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 88499*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Perth, 18–20 Oct. 2004, 9 pp.
- Ganeshram, S. (1989). *Geology of south Kuala Pilah*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Garson, M.S., Young, B., Mitchell, A.H.G. & Tait, B.A.R. (1975). The Geology of the tin belt in Peninsular Thailand around Phuket, Phangnga and Takua Pa. *Institute of Geological Sciences, London, Overseas Memoir*, 1, 112 pp.

- Gatinsky, Y.G. & Hutchison, C.S. (1987). Cathaysia, Gondwanaland and the Palaeotethys in the evolution of continental Southeast Asia. *Geological Society of Malaysia Bulletin*, **20**, 179–199.
- Gatinsky, Y.G., Hutchison, C.S., Nguyen, Minh, N. N. & Tri, T.V. (1984). Tectonic evolution of Southeast Asia. *27th International Geology Congress Reports* **5**, Colloquium **5**, Tectonics of Asia, 225–240.
- Gibling, M.R. (1988). Cenozoic lacustrine basins of South-east Asia, their tectonic setting, depositional environment and hydrocarbon potential. In: Fleet, A.J., Kelts, K. & Talbot, M.R (eds). *Lacustrine Petroleum Source Rocks*, Geological Society of London Special Publication No. **40**, 341–351.
- Gibling, M.R. & Ratanasthien, B. (1980). Cenozoic basins of Thailand and their coal deposits: A preliminary report. *Geological Society of Malaysia Bulletin*, **13**, 27–42.
- Gibling, M.R., Sucharitpornchaikul, O. & Supertipanish, S. (1982). The Cenozoic coal-bearing basin at Ban Huai Dua, Mae Hongson Province, Thailand. In: Fernandez, J.C. (ed). *Proceedings of the Fourth Regional Conference on the Geology and Mineral Resources of Southeast Asia*, Manila, Philippines, 809–815.
- Gillieson, D. (2005). Karst in Southeast Asia. In: Gupta, A. (ed.), *The Physical Geography of Southeast Asia*; Oxford University Press, 157–176.
- Gobbett, D.J. (1965a). The Lower Palaeozoic rocks of Kuala Lumpur. *Federation Museums Journal*, **9**, 67–79.
- Gobbett, D.J. (1965b). The formation of limestone caves in Malaya. *Malayan Nature Journal*, **19**, 4–12.
- Gobbett, D.J. (1966). The brachiopod genus *Strigocephalus* from Malaya. *Journal of Paleontology*, **40**, 1345–1348
- Gobbett, D.J. (1972). Geology of the Rebak Islands, Langkawi, West Malaysia. *Geological Society of Malaysia Newsletter*, **37**, 1–5.
- Gobbett, D.J. (1973). Upper Palaeozoic. In: Gobbett, D. J. & Hutchison, C.S. (eds). *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 61–95.
- Gobbett, D.J. & Hutchison, C.S. (eds) (1973). *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 438 pp.
- Gobbett, D.J. & Tjia, H.D. (1973). Tectonic history. In: Gobbett, D.J. & Hutchison, C.S. (eds). *Geology of the Malay Peninsula*, Wiley-Interscience, New York, 305–330.
- Goh, S.T. (1973). *Geology of the Kemaman area, Trengganu, Peninsular Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Goh, S.T., Heacock, D.W. & Loveless, D.E. (1983). Exploration, development, and reservoir engineering studies for the Tapis Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 10480*, *Journal Petroleum Technology*, June 1983, p. 1051–1060.
- Goldman, D. & Mitchell, C.E. (1990). Morphology, systematics, and evolution of Middle Devonian Ambocoeliidae (Brachiopoda), Western New York. *Journal of Palaeontology*, **64**, 79–99.
- Gopalakrishnan, S.G., Razli Shawari, Kamal Kassim, Mohd Naguib Ab Majid & M Nazri M Nor (1999). Angsi: Malaysia's 1st tight gas development. *Society of Petroleum Engineers Paper SPE 54335*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Jakarta, 20–22 April 1999, 12 pp.
- Grubb, P.L.C (1965). Undersaturated potassic lavas and hypabyssal intrusives in north Johore. *Geological Magazine*, **102**, 338–346.
- Grubb, P.L.C. (1966). Distribution and genetic significance of aluminium hydrates in south-east Johore. *Proceedings Royal Society of Victoria*, **79**, 257–265.
- Grubb, P.L.C. (1968). Geology and Bauxite deposits of the Pengerang area, southeast Johore. *Geological Survey West Malaysia district memoir*, **14**, 125 pp.
- Grubb, P.L.C. & Hannaford, P. (1966). Magnetism in cassiterite. *Mineralium Deposita*, **2**, 148–177.

H

- Hada, S. (1966). Discovery of Early Triassic ammonoids from Gua Musang, Kelantan. Malaya. *Journal of Geoscience Osaka City University*, **9**, 111–113.
- Haile, N.S. (1969). Quaternary deposits and geomorphology of the Sunda Shelf off Malaysian shores. *INQUA VIII International Congress, Paris*, 1969, 161–164.
- Haile, N.S. (1971). Quaternary shorelines in West Malaysia and adjacent parts of the Sunda Shelf. *Quaternaria*, **V.XV**, 333–343.
- Haile, N.S. (1973). The recognition of former subduction zones in Southeast Asia. In:

- Tarling, D.H. & Runcorn, S.K. (eds). *Implications of continental drift in the earth sciences*, 2, 885–892, Academic Press, London.
- Haile, N.S. (1975). Postulated Late Cainozoic high sea-levels. *Journal Malaysian Branch Royal Asiatic Society*, 48, 78–88.
- Haile, N.S. (1979a). Rotation of Borneo microplate completed by Miocene. Paleomagnetic evidence. *Geological Society of Malaysia Newsletter*, 5, 19–22.
- Haile, N.S. (1979b). Palaeomagnetic evidence for rotation and northward drift of Sumatra. *Journal of Geological Society of London*, 136, 541–545.
- Haile, N.S. (1980). Paleomagnetic evidence from the Ordovician and Silurian of northwest Peninsular Malaysia. *Earth & Planetary Science Letters*, 48, 233–236.
- Haile, N.S. & Briden, J.C. (1982). Past and present palaeomagnetic research and tectonic history of East and Southeast Asia. *Paleomagnetic research in Southeast and East Asia*. Technical Publication 13, 25–46, CCOP, Bangkok.
- Haile, N.S. & Khoo, H.P. (1980). Palaeomagnetic measurements on Upper Jurassic and Lower Cretaceous sedimentary rocks from Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 12, 75–78.
- Haile, N.S. & Mohammad Ayob (1968). Note on radiometric age determinations of samples of peat and wood from tin-bearing Quaternary deposits at Sungei Besi Tin Mines, Kuala Lumpur, Selangor, Malaysia. *Geological Magazine*, 105, 519–520.
- Haile, N.S. & Stauffer, P.H. (1972). Redbeds and radiolarian chert: uneasy bedfellows of the “Bentong Group”. [Abstract] In Discussion Meeting 16–17 February 1973. *Geological Society of Malaysia Newsletter*, 41, 5.
- Haile, N.S., Beckinsale, R.D., Chakraborty, K.R., Abdul, Hanif Hussein. & Hardjono, T. (1983). Palaeomagnetism, geochronology and petrology of the dolerite dykes and basaltic lavas from Kuantan, West Malaysia. *Geological Society of Malaysia Bulletin*, 16, 71–85.
- Haile, N.S., Stauffer, P.H., Krishnan, D., Lim, T.P. & Ong, G.B. (1977). Palaeozoic redbeds and radiolarian chert: reinterpretation of their relationships in the Bentong and Raub areas, West Pahang, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 8, 45–60.
- Halliday, A.N. & Stephens, W. E. (1984). Crustal controls on the genesis of the 400 Ma old Caledonian granites. *Physics of the Earth and Planetary Interiors*, 35, 84–104.
- Hamada, T. (1969). Devonian brachiopods from Kroh, Upper Perak in Malaysia (Malaya). In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, 7, 1–13.
- Hamdan Mohamad & Idris Mohamed (2003). Oil discovery in the Sepat Field. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2003, 17–18 Dec. 2003, Kuala Lumpur, Program & Abstracts*, 122.
- Hamdan Mohamad, Nurazlina Jaini & M. Redzuan Tajuddin (2006). Drilling of deep-seated reservoir in high pressure regime in the north of Malay Basin. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts*, 161.
- Hamilton, W. (1979). Tectonics of the Indonesian region. *United States Geological Survey Professional Paper*, 1078, 345 pp.
- Hamilton, W. (1989). Convergent-plate tectonics viewed from the Indonesian region. Geologi Indonesia, J.A. Katili commemorative volume (60 years). *Journal of the Indonesian Association of Geologists*, 12 (No. 1), 35–88.
- Hammarstrom, J.M. & Zen, E.A. (1986). Aluminium in hornblende: An empirical igneous geobarometer. *American Mineralogist*, 71, 1297–1313.
- Hanebuth, T., Statterger, K. & Grootes, P.M. (2000). Rapid flooding of the Sunda Shelf: a late glacial sea-level record. *Science*, 288, 1033–1035.
- Harbury, N.A., Jones, M.E., Audley-Charles, M.G., Metcalfe, I. & Mohamed, K.R. (1990). Structural evolution of Mesozoic Peninsular Malaysia. *Journal of Geological Society of London*, 147, 11–26.
- Harminzar Mansor, Ibrahim Abdullah, Azirul Liana Abdullah, Jatmika Setiawan, & Mohd Syukri Wahid (2004). Struktur dan canggaan lapisan Mersing di Telok Bangka, Mersing, Johor. *Geological Society of Malaysia Bulletin*, 49, 85–91.
- Harun Mohd Noor (1987). Tinggi field – analyzing the DHIs. *Geological Society of Malaysia Bulletin*, 21, 133–149.
- Hasnol Hady Ismail, Mazlan Madon & Zainol Affendi Abu Bakar (2007). Sedimentology

- of the Semantan Formation (Middle – Upper Triassic) along the Karak – Kuantan Highway, central Pahang. *Geological Society of Malaysia Bulletin*, **53**, 27–34.
- Hayati Turiman (2000). *Kajian tekstur batuan, kaitan lapangan dan geokimia granit Maras bukit Jong kawasan Batu Rakit, Kuala Terengganu, Terengganu Darul Iman*. Unpubl. B.Sc. thesis, Dept. of Geology, University of Malaya.
- Heru Sigit Purwanto, Ibrahim Abdullah, & Juhari Mat Khir (2000). Rekondstruksi tegasann kuno kawasan Penjom Kuala Lipis, Pahang. *Proceedings of Geological Society of Malaysia Annual Conference 2000*, 39–43.
- Hesse, R. (1988). Diagenesis # 13. Origin of chert: Diagenesis of biogenic siliceous sediments. *Geoscience Canada*, **15**, 171–192.
- Hibbard, M.J. (1991). Textural anatomy of twelve magma-mixed granitoid systems. In: Didier, J. & Barbarin, B. (eds). *Enclaves and granite petrology*. Development in Petrology, **13**, 431–443.
- Hill, R.D (1966). Changes in beach form at Sri Pantai, Northeast Johore. *Malaysian Journal of Tropical Geography*, **23**, 19-27.
- Hill, R.I., Campbell, I.H., Davies, G.F. & Griffiths, R.W. (1992). Mantle plumes and continental tectonics. *Science*, **256**, 186–193.
- Ho, W.K. (1999). Malaysia E&P Business. In: PETRONAS. *The Petroleum Geology and Resources of Malaysia*; Kuala Lumpur, 19–31.
- Hollister, L.S., Grissom, G.C., Peters, E.K., Stowell, H.H. & Sisson, V.B. (1987). Conformation of the empirical correlation of Al in hornblende with pressure of solidification of calc-alkaline plutons. *American Mineralogist*, **72**, 231–239.
- Hooijer, D.A. (1963). Report upon a collection of Pleistocene mammals from tin-bearing deposits in a limestone cave near Ipoh, Kinta Valley, Perak. *Federation Museums Journal*, **7**, 1–5.
- Hosking, K.F.G. (1970a). Aspects of the geology of the tin fields of South-East Asia. *Second Technical Conference on Tin, Bangkok 1969*, **1**, 41–80. (ed. W. Fox), International Tin Council, London.
- Hosking, K.F.G. (1970b). The primary tin deposits of Southeast Asia. *Minerals Science and Engineering*, **2**, 24–50.
- Hosking, K.F.G. (1973). Primary mineral deposits. In: Gobbett, D.J. & Hutchison, C.S. (eds). *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 335–390.
- Hosking, K.F.G. (1977). Known relationships between the 'hard rock' tin deposits and the granites of Southeast Asia. *Geological Society of Malaysia Bulletin*, **9**, 141–157.
- Hosking, K.F.G. (1979). Tin distribution patterns. *Geological Society of Malaysia Bulletin*, **11**, 1–70.
- Hosking, K.F.G. (1988). The world's major types of tin deposit. In: Hutchison, C.S. (ed.). *Geology of tin deposits in Asia and the Pacific*. SpringerVerlag, Heidelberg, 3–49.
- Huang, K. & Opdyke, N.D. (1991). Paleomagnetic results from the Upper Carboniferous of the Shan–Thai–Malay block of western Yunnan, China. *Tectonophysics*, **192**, 333–344.
- Huchon, P., Le Pichon, X. & Rangin, C. (1994). Indochina Peninsula and the collision of India and Eurasia; *Geology*, **22**, 27-30.
- Hutchinson, R.W. (1981). Lode tin deposits of exhalative origin. Complex tin ores and related problems. *Technical Publication*, **2**, SEATRAD Centre, Ipoh, 81–97.
- Hutchinson, R.W. (1986). Massive sulphide deposits and their possible significance to other ores in Southeast Asia. *Geological Society of Malaysia Bulletin*, **19**, 1–22.
- Hutchison, C.S. (1961). The basement rocks of Malaya and their palaeo-geographic significance in Southeast Asia. *American Journal of Science*, **259**, 181–185.
- Hutchison, C.S. (1964). A gabbro-granodiorite association in Singapore Island. *Quarterly Journal Geological Society of London*, **120**, 283–297.
- Hutchison, C.S. (1969). Some notes on the Stong Metamorphic Complex. *Geological Society of Malaysia Newsletter*, **21**, 8–11.
- Hutchison, C.S. (1971). The Benta Migmatite Complex. Petrology of two important localities *Geological Society of Malaysia Bulletin*, **4**, 49–70.
- Hutchison, C.S. (1973a). Volcanic activity. In: Gobbett, D.J. & Hutchison, C.S. (eds). *Geology of the Malay Peninsula*, Wiley-Interscience, New York, 177–214.
- Hutchison, C.S. (1973b). Plutonic activity. In: D.J. Gobbett & C.S. Hutchison (eds), *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 215 – 252.
- Hutchison, C.S. (1973c). Metamorphism, In: Gobbett, D.J. & Hutchison, C.S., (eds), *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 253–303.

- Hutchison, C.S. (1973d). Tectonic evolution of Sundaland: a Phanerozoic synthesis. *Geological Society of Malaysia Bulletin*, **6**, 61–86.
- Hutchison, C.S. (1975). Ophiolite in Southeast Asia. *Geological Society of America Bulletin*, **86**, 797–806.
- Hutchison, C.S. (1977). Granite emplacement and tectonic subdivision of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **9**, 187–207.
- Hutchison, C.S. (1978). Southeast Asian tin granitoids of contrasting tectonic setting. *Journal of Physics of the Earth*, **26** (supplement), S221–S232.
- Hutchison, C.S. (1983a). Multiple Mesozoic Sn-W-Sb granitoids of Southeast Asia. In: Roddick, J.A. (ed), *Circum-Pacific plutonism terranes*. Geological Society of America Memoir, **159**, 35–60.
- Hutchison, C.S. (1983b). *Economic Deposits and their tectonic setting*. MacMillan, London, 365 pp.
- Hutchison, C.S. (1988a). The tin metallogenic provinces of Southeast Asia and China: A Gondwanaland inheritance. In: Hutchison, C.S. (ed). *Geology of tin deposits in Asia and the Pacific*. Springer-Verlag, Heidelberg, 225–234.
- Hutchison, C.S. (1988b). Tectonic settings of tin-tungsten granites in Southeast Asia. In: Hutchison, C.S. (ed). *Exploration and evaluation techniques for tin/tungsten granites in Southeast Asia and the Western Pacific Region*. Technical Publication, **6**, SEATRAD Centre, Ipoh, 1–24.
- Hutchison, C.S. (1989a). *Geological Evolution of South-East Asia*. Oxford monographs on geology and geophysics, **13**, Clarendon Press, Oxford, 368 pp.
- Hutchison, C.S. (1989b). The Palaeo-Tethyan realm and Indosinian Orogeny system of Southeast Asia. In: Şengör, A.M.C. (ed), *Tectonic evolution of the Tethyan region*. NATO ASI series C, **259**, Kluwer, Dordrecht & London, 585–643.
- Hutchison, C.S. (1989c). Chemical variation of biotite and hornblende in some Malaysian and Sumatran granitoids. *Geological Society of Malaysia Bulletin*, **24**, 101–119.
- Hutchison, C.S. (1994). Gondwana and Cathaysian blocks, Palaeotethys sutures and Cenozoic tectonics in South-East Asia. *Geologische Rundschau*, **82**, 388–405.
- Hutchison, C.S. (1996a). *Geological evolution of South-East Asia*. Geological Society of Malaysia, Kuala Lumpur [paperback reprint of Hutchison, 1989a], 369 pp.
- Hutchison, C.S. (1996b). *South-East Asian Oil, Gas, Coal and Mineral Deposits*. Oxford Monographs on Geology and Geophysics **36**, Clarendon Press, Oxford, 265 pp.
- Hutchison, C.S. (2004). Marginal basin evolution: the southern South China Sea. *Marine and Petroleum Geology*, **21**, 1129–1148.
- Hutchison, C.S. (2005). *Geology of North-West Borneo*. Elsevier, Amsterdam, 421 pp.
- Hutchison, C.S. (2007). *Geological Evolution of South-East Asia*, second edition, Geological Society of Malaysia, Kuala Lumpur, 433 pp.
- Hutchison, C.S. & Haile, N.S. (1992). Kenneth Frederick George Hosking—obituary. *Journal of Southeast Asian Earth Sciences*, **7**, 87–88.
- Hutchison, C.S. & Taylor, D. (1978). Metallogenesis in S.E. Asia. *Journal of Geological Society of London*, **135**, 407–428.
- Hutton, A.C. (1984). Geology of oil shale deposits within the Narrow Graben, Queensland, Australia: discussion. *American Association of Petroleum Geologists Bulletin*, **68**, 1055–1057.
- Hutton, A.C., Kantsler, A.J., Cook, A.C. & McKirdy, D.M. (1980). Organic matter in oil shales. *Journal of the Australian Petroleum Exploration Association*, **20**, 44–67.

I

- Ibrahim Abdullah (1996). Struktur Geologi Konglomerat Murau. *Geological Society of Malaysia Warta Geologi*, **22**, 186.
- Ibrahim Abdullah (1997). Evolusi struktur Kepulauan Langkawi (structural evolution of langkawi islands). *Warisan Geologi Malaysia*, Lestari, Universiti Kebangsaan Malaysia, 119–134.
- Ibrahim Abdullah (2001). Gaya struktur kawasan Chendering Rhu Rendang, Marang, Terengganu: satu cadangan kehadiran batuan Pra-Karbon di Jalur Timur Semenanjung Malaysia. *Proceedings of Geological Society of Malaysia Annual Geological Conference 2001*, 79–83.
- Ibrahim Abdullah (2002). Struktur dan sejarah canggaan batuan Pulau Kapas, Terengganu. *Geological Society of Malaysia Bulletin*, **45**, 345–340.

- Ibrahim Abdullah (2006). On the presence of Pre-Carboniferous metasediments in the Eastern Belt: A structural view. *Geological Society of Malaysia Bulletin*, **49**, 79–84.
- Ibrahim Abdullah & Jatmika Setiawan (2003). The kinematics of deformation of the Kenerong Leucogranite and its enclaves at Renyok waterfall, Jeli, Kelantan. *Geological Society of Malaysia Bulletin*, **46**, 307–312.
- Ibrahim Abdullah & Kamal Roslan Mohamed (1993). The coaxial superimposed tectonic deformations onto the sedimentary folds of the Semantan Formation (Tindakan canggaan tektonik sepaksi ke atas sedimen Formasi Semantan) [abstract]. *Geological Society of Malaysia Warta Geologi*, **19**, 132.
- Ibrahim Abdullah & Kamal Roslan Mohamed (1994). Struktur batuan Jura-Kapur Bukit Keluang, Bukit Bubus, dan Bukit Dendong Besut Terengganu [abstract]. *Geological Society of Malaysia Warta Geologi*, **20**, 220–221.
- Ibrahim Abdullah, Ahmad Jantan & Uyop Said (1988). The Murau Formation: Murau structures and their significance to regional geology [abstract]. *Geological Society of Malaysia Warta Geologi*, **15**, 269.
- Ibrahim Abdullah, Basir Jasin, Ahmad Jantan, Abdul Rahim Samsudin & Uyop Said (1989). The Semanggol Formation post Semanggol structures and their significance to regional geology. *Geological Society of Malaysia Warta Geologi*, **15**, 28–29.
- Ibrahim Abdullah, Johari Mat Akhir, Abd. Rashid Jaapur & Nor Azian Hamzah (1991). The Tertiary basin in FELDA Nenering, Pengkalan Hulu (Keroh), Perak. *Geological Society of Malaysia Warta Geologi*, **17**, 181–186.
- Ibrahim Amnan & Fontaine, H. (1996). New palaeontological data of the limestones in Southwest Kelantan and North Pahang, Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **22**, 88–89.
- Ichikawa, K. & Yin, E.H. (1966). Discovery of Early Triassic Bivalves from Kelantan, Malaya. *Journal of Geosciences, Osaka City University*, **9**, 101–105.
- Ichikawa, K., Ishii, K. & Hada, S. (1966). On the remarkable unconformity at the Jengka Pass, Pahang, Malaysia. *Journal of Geoscience, Osaka City University*, **9**, 123–130.
- Idris, M.B. (1989). Early Silurian multi-element conodont assemblages from Pulau Tanjung Dendang, northeastern Langkawi Islands, Kedah. *Geological Society of Malaysia Warta Geologi*, **15**, 63–68.
- Idris, M.B. (1990). *Araucarioxylon telentangensis*, a new species of fossil coniferous wood from the Ulu Endau area, Johore, Malaysia. *Journal of Southeast Asian Earth Sciences*, **4**, 55–59.
- Idris, M.B. & Hashim, C.N. (1988). An Upper Permian fossil assemblage from Gunung Sinyum and Gunung Jebak Puyoh Limestone, Pahang. *Geological Society of Malaysia Warta Geologi*, **14**, 199–203.
- Idris, M.B. & Zaki, S.M. (1986). A Carboniferous shallow marine fauna from Bukit Bucu, Batu Rakit, Terengganu. *Geological Society of Malaysia Warta Geologi*, **12**, 215–219.
- Igo, H. (1984). Summary of the Paleozoic conodonts from Malaysia and Thailand. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **25**, 289–293.
- Igo, H. & Koike, T. (1966). Ordovician and Silurian Conodonts from the Langkawi Islands, Malaya. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **3**, 1–29.
- Igo, H. & Koike, T. (1968). Ordovician and Silurian conodonts from the Langkawi Islands, Malaya, Part II. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **4**, 1–21.
- Igo, H. & Koike, T. (1973). Upper Silurian and Lower Devonian conodonts from the Langkawi Islands, Malaysia with note on conodont fauna of the Thung Song Limestone, southern Thailand and the Setul Limestone, Perlis, Malaysia. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **13**, 1–22.
- Igo, H., Koike, T. & Yin, E.H. (1966). Triassic Conodonts from Kelantan, Malaya. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **2**, 157–177.
- Igo, H., Rajah, S.S. & Kobayashi, F. (1979). Permian Fusulinaceans from the Sungai Sedili area, Johore, Malaysia. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **20**, 95–118.
- IHS Energy (2004). *Basin Monitor Malay Basin – Malaysia, Vietnam, Thailand, Indonesia, Cambodia, Malaysia/Thailand* JDA, August 2004.
- Ingham, F.T. (1938). The geology of the

- neighbourhood of Tapah and Telok Anson, Perak, F.M.S. with accounts of mineral deposits. *Geological Survey Department Federation of Malaya Memoir*, 2, 72 pp.
- Ingham, F.T. & Bradford, E.F. (1960). The geology and mineral resources of the Kinta Valley, Perak. *Federation of Malaya Geological Survey District Memoir*, 9, 347 pp.
- Intan Suhaila Mustafa (1998). *Sedimentologi dan stratigrafi Lapisan Boulder Kawasan Batu Arang, Selangor*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Irber, W. (1999). The lanthanide tetrad effect and its correlation with K/Rb, Eu/Eu, Sr/Eu, Y/Ho, and Zr/Hf of evolving peraluminous granite suites. *Geochimica et Cosmochimica Acta*, 63, 489–508.
- Ishihara, S. (1977). The magnetite-series and ilmenite-series granitic rocks. *Mining Geology*, 27, 293–305.
- Ishihara, S., Sawata, H., Arpornsuwan, S., Busaracome, P. & Bungbrakearti, N. (1979). The magnetite-series and ilmenite-series granitoids and their bearing on tin mineralization, particularly in the Malay Peninsula region. *Geological Society of Malaysia Bulletin*, 11, 103–110.
- Ishii, K. (1966). On some fusulinids and other foraminifera from the Permian of Pahang, Malaysia. *Journal of Geoscience Osaka City University*, 9, 131–135.
- Ishii, K. & Nagomi, Y. (1966). Discovery of Triassic conodonts from the so-called Palaeozoic limestone in Kedah, Malaya. *Journal of Geoscience Osaka City University*, 9, 93–98.
- Ismail, M.A., Azman A. Ghani, Rozi M. Umor, & Noran, A.S. (2003). Geochemistry and petrology of the volcanic rocks from Tioman island. *Geological Society of Malaysia Bulletin*, 46, 415–419.
- Iwai, J. (1971). Reconnaissance of Mesozoic Stratigraphy in Central Pahang, Malaysia. Part 1. The Jengka Pass to Maran. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, 9, 147–159.
- J**
- Jaafar Ahmad (1976). Geology and mineral resources of the Karak and Temerloh areas, Pahang. *Geological Survey of Malaysia District Memoir*, 15, 127 pp.
- Jaafar Ahmad (1979). The petrology of the Benom igneous complex. *Geological Survey of Malaysia Special Paper*, 2, 141 pp.
- Jaafar Ahmad (1980). Geology and Mineral Resources of the Sungai Teris Area, Pahang. *Geological Survey Malaysia District Memoir*, 18, 148 pp.
- Jaeger, H. (1988). Devonian Graptoloidea. In: McMillan, N.J., Embry, A.F. & Glass, D.J. (eds), *Devonian of the World III. Proceedings of the Second Symposium on the Devonian System. Calgary, Alberta 1988*, 431–438, Alberta Society Petroleum Geologists.
- Jasmi Ab. Talib (1992). Geologi dan Sumber Mineral Kawasan Kuala Tembeling (Syit 69), Pahang Darul Makmur. *Proceedings of 23rd Geological Conference, Technical Papers, Geological Survey of Malaysia*, 1992, 59–71.
- Jatmika Setiawan & Ibrahim Abdullah (2003). The structure and deformation history of the serpentinite bodies along the Bentong suture: a case study of Bukit Rokan Barat. *Geological Society of Malaysia Bulletin*, 46, 329–334.
- Jennings, J.R. & Lee, C.P. (1985). Preliminary note on the occurrence of Carboniferous-age coals and in-situ plant fossils in eastern Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, 11, 117–121.
- Jin, X. (1994). Extent and timing of the Permo-Carboniferous glacio-marine deposits bearing units in southwestern China. In: Cho, M. & Kim, J.H. (eds) *IGCP 321 Gondwana dispersion and Asian accretion. Fourth International Symposium and Field Excursion, Abstracts Volume*, 43–47.
- Johnson, M.C. & Rutherford, M. J. (1989). Experimental calibration of the aluminium in hornblende geobarometer with application to Long valley Caldera, California volcanic rocks. *Geology*, 17, 837–841.
- Jones, C.R. (1961). A revision of the stratigraphical sequence of the Langkawi Islands, Federation of Malaya. *Proceedings 9th Pacific Science Congress*, 12, 287–300.
- Jones, C.R. (1965). The limestone caves and cave deposits of Perlis and North Kedah. *Malayan Nature Journal*, 19, 21–30.
- Jones, C.R. (1967). Graptolites of the *Monograptus hercynicus* type recorded from Malaya. *Nature*, 215, 497.
- Jones, C.R. (1968). Lower Paleozoic rocks of Malay Peninsula. *American Association of*

- Petroleum Geologists Bulletin*, **52**, 1259–1278.
- Jones, C.R. (1970a). On a Lower Devonian fauna from Pahang, West Malaysia. *Geological Society of Malaysia Bulletin*, **3**, 63–75.
- Jones, C.R. (1970b). The Geology and Mineral Resources of the Grik Area, Upper Perak. *Geological Survey West Malaysia District Memoir*, **11**, 144 pp.
- Jones, C.R. (1973a). Lower Paleozoic. In: Gobbett, D.J. & Hutchison, C.S. (eds). *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 25–60.
- Jones, C.R. (1973b). The Siluro-Devonian graptolite faunas of the Malay Peninsula. *Overseas Geology and Mineral Resources*, **44**, 1–28.
- Jones, C.R. (1981). The Geology and Mineral Resources of Perlis, North Kedah and the Langkawi Islands. *Geological Survey of Malaysia District Memoir*, **17**, 257 pp.
- Jones, C.R., Gobbett, D.J. & Kobayashi, T. (1966). Summary of fossil record in Malaya and Singapore 1900–1965. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **2**, 309–359.
- Jones, R.W. (1987). Organic Facies. In: Brooks, J. & Welte, D. (eds) *Advances in Petroleum Geochemistry*, **2**, 1–90. Academic Press, London.
- Jones, W.R. (1917). The origin of the secondary stanniferous deposits of the Kinta District, Perak (Federated Malay States). *Quarterly Journal of Geological Society of London*, **17**, 165–197.
- Jones, W.R. (1925). *Tinfields of the world*. Mining Publications Ltd., London, 423 pp.
- ## K
- Kabir, A.H., Othman, M., Talib, M. Hitam, S., Janor, M., Osman, A. & Yunus, A. (1999). Revitalizing an aging field – Tinggi production decline mitigation. *Society of Petroleum Engineers Paper SPE 57252*; SPE Asia Pacific Improved Oil Recovery Conference, Kuala Lumpur, 25–26 Oct. 1999, 8 pp.
- Kamal Roslan Mohamed (1989). Stratigrafi Batuan Trias Di Zon Tengah Semenanjung Malaysia. *Laporan Teknik FSFG*, **3**, Universiti Kebangsaan Malaysia, 87–98.
- Kamal Roslan Mohamed (1990). Sistem Trias di Jalur Tengah. *Sains Malaysiana*, **19**, 11–22.
- Kamal Roslan Mohamed (1996a). Taburan Formasi Semantan Semenanjung Malaysia. *Sains Malaysiana*, **25**, 91–114.
- Kamal Roslan Mohamed (1996b). Stratigrafi Jalur Tengah Semenanjung Malaysia. *Geological Society of Malaysia Warta Geologi*, **22**, 220–222.
- Kamal Roslan Mohamed, Che Aziz Ismail, Che Abdul Rahman Jaafar & Azmi Ismail Aziz Ali (2001). Pemetaan awal air panas kawasan Lojing, Gua Musang, Kelantan. In: Ibrahim Komoo, Tjia, H.D. & Mohd Shafeea Leman (eds). *Pemetaan Sumber warisan dan pencirian geotapak*, LESTARI Universiti Kebangsaan Malaysia, Bangi, 147–159.
- Kamal Roslan Mohamed & Ibrahim Abdullah (1993). The occurrence of the oolitic limestone facies in the Semantan Formation. *Geological Society of Malaysia Warta Geologi*, **19**, 153–158.
- Kamal Roslan Mohamed & Mohd. Shafeea Leman (1994). Formasi Gua Musang: Satu pemikiran semula. *Geological Society of Malaysia Warta Geologi*, **20**, 97–99.
- Kamal Roslan Mohamed, Basir Jasin & Che Aziz Ali (1993). Sekitaran pengendapan batu kapur Trias di Barat laut Malaysia. *Sains Malaysiana*, **22**, 57–80.
- Kamal Roslan Mohamed, Che Aziz Ali & Ibrahim Abdullah (1999). Satah Ketakselarasan di Pulau Kapas: Satu Warisan geologi. In: Ibrahim Komoo & Mohd Shafeea Leman (eds). *Warisan geologi Malaysia*, **2**, 329–340.
- Kamaludin Hassan (1989a). Palynology of the lowland Seberang Prai and Kuala Kurau areas, Northwest Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **23**, 119–215.
- Kamaludin Hassan (1989b). Significance of palynology in Late Quaternary sediments in Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **24**, 57–66.
- Kamaludin Hassan (1990). A summary of the Quaternary geology investigations in Seberang Prai, Pulau Pinang and Kuala Kurau. *Geological Society of Malaysia Bulletin*, **26**, 47–53.
- Kamaludin Hassan (1993). The changing mangrove shorelines in Kuala Kurau, Peninsular Malaysia. *Sedimentary Geology*, **83**, 187–197.
- Kamaludin Hassan (2004). The postglacial and Holocene periods. In: Nik Hassan Shuhaimi (ed) *Early History, The Encyclopedia of Malaysia*, Archipelago Press, 16–17.
- Kamar, S.A., Sinjeng, P.P. & Mian, K.H. (1994).

- Mineralogy and petrology of the Penjom gold prospect, Kuala Lipis, Pahang. *Proceedings International conference on recent advances in material and mineral resources '94*, 3-5 May 1994, Universiti Sains Malaysia, 389–401.
- Katili, J.A. (1967). Structure and age of the Indonesian tin belt with special reference to Bangka. *Tectonophysics*, **4** (4-6), 403–418.
- Katz, B.J. (1995). Stratigraphic and lateral variations of source rock attributes of the Pematang Formation, Central Sumatra. *Geological Society of Malaysia Bulletin*, **37**, 13–31.
- Kee, T.M. (1966). *Geology of Gunong Panti area, southern Johore, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept of Geology, University of Malaya.
- Khalid Ngah (2000). Upper Oligocene – Lower Miocene sandstone reservoirs, southern Malay Basin. *Search & Discovery Article # 10008* (2000), <http://www.searchanddiscovery.com/documents/khalid/index.htm>. Accessed 20 June 2007.
- Khalid Ngah & Derksen, S.J. (1971). Geology of the eastern half of sheet 103. *Geological Survey of Malaysia Annual Report*, **1971**, 81–90.
- Khalid Ngah, Mazlan Madon & Tjia, H.D. (1996). Role of pre-Tertiary fractures in formation and development of the Malay and Penyu basins. In: Hall, R. & Blundell, D. (eds) *Tectonic Evolution of Southeast Asia*. Geological Society of London Special Publication, **106**, 281–289.
- Khandwala, S.M., Abd Malek Abd Rani & Mohd Nasir Abdul Rahman (1984). Field development planning for the Semangkok Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 12410*, 5th Offshore South East Asia, Singapore, 21–24 Feb. 1984, 28 pp.
- Khoo, H.P. (1969). *Mineralization at Pelepah Kanan, Kota Tinggi, Johore, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Khoo, H.P. (1977). The geology of the Sungai Tekai area. *Geological Survey of Malaysia Annual Report*, **1977**, 93–103.
- Khoo, H.P. (1983). Mesozoic Stratigraphy in Peninsula Malaysia. In: *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 370–383.
- Khoo, K.K. (1973). The geology of Bahau area, Sheet 104, (Kuala Pilah), Negeri Sembilan. *Geological Survey of Malaysia Annual Report*, **1972**, 93–103.
- Khoo, K.K. (1978). Serpentinite occurrence at Telok Mas, Malacca. *Geological Society of Malaysia Warta Geologi*, **4**, 1–5.
- Khoo, K.K. (1998). Geology and Mineral Resources of the Kuala Pilah Area, Negeri Sembilan. *Geological Survey of Malaysia Map Report*, **11**, 93 pp.
- Khoo, T.T. (1974). A glimpse at the geology of Pulau Tioman. In: Lee, D.W., Stone, B.C., Ratnasabapathy, M. & Khoo, T.T. (eds.). *The Natural History of Pulau Tioman*. Merlin Samudera Tioman, 5–17.
- Khoo, T.T. (1980). On the reported occurrence of glaucophane in Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **6**, 127.
- Khoo, T.T. (1983). Metamorphic episodes of the western foothills of Gunung Ledang (Mt. Ophir), Johore–Malacca, with a background account on the geology. *Geological Society of Malaysia Bulletin*, **16**, 117–138.
- Khoo, T.T. (1984). The terrane of the Patani Metamorphics. *Geological Society of Malaysia Bulletin*, **17**, 79–95.
- Khoo, T.T. (1993). Geology of East–West transect of Peninsular Malaysia: an Introductory essay. *Guidebook for Field Excursion East–West Transect of Peninsular Malaysia*. Third International Symposium and Field Excursion, 23–28 August 1993, Kuala Lumpur. UNESCO IGCP **321**, 1–34.
- Khoo, T.T. (2002a). An in-situ occurrence of tourmaline-corundum rock at Menglembu, Kinta Valley, Perak. *Geological Society of Malaysia Warta Geologi*, **28**, 33–36.
- Khoo, T.T. (2002b). Composition of colour zoned garnet from the Redang aureole. *Geological Society of Malaysia Warta Geologi*, **28**, 293–295.
- Khoo, T.T. (2002c). Diaspore-corundum rock: a new member of the tourmaline-corundum rock diaspora from the New Lahat Mine, Lahat, Kinta Valley, Perak. *Geological Society of Malaysia Warta Geologi*, **28**, 149–152.
- Khoo, T.T. & Lim, S.P. (1983). Nature of the contact between the Taku Schists and adjacent rocks in the Manek Urai area, Kelantan and its implications. *Geological Society of Malaysia Bulletin*, **16**, 139–158.
- Khoo, T.T. & Tan, B.K. (1983). Geological evolution of Peninsular Malaysia. *Proceedings of workshop on stratigraphic*

- correlation of Thailand and Malaysia*, 1: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 253–290.
- Khoo, T.T., Yaw, B.S., Kimura, T.C. & Kim, J.H. (1988). Geology and palaeontology of the Redang Islands, Trengganu, Peninsular Malaysia. *Journal of Southeast Asian Earth Sciences*, 2, 123–130.
- Khor, S. (2007). *Sedimentology and Structural Geology of Simpang Jengka 8 Kota Gelanggi, Jerantut, Pahang*. Unpubl. B.Sc thesis, Dept. of Geology, University of Malaya.
- Kidd, R. (1998). *Overview of exploration, Penjom Gold Mine, Empang Jalih, Mukim of Lipis, Pahang*. Unpublished company report.
- Kimura, T. & Jones, C.R. (1967). Geological structures in the northeastern and southern parts of the Langkawi Islands, northwest Malaya. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 3, 123–124.
- Kingston, D.R., Dishroon, C.P. & Williams, P.A. (1983). Global basin classification system. *American Association of Petroleum Geologists Bulletin*, 67, 2175–2193.
- Ko Ko, U. (1986). Preliminary synthesis of the geology of Bangka Island, Indonesia. GEOSEA V Proceedings, *Geological Society of Malaysia Bulletin*, 20, 81–96.
- Kobayashi, T. (1963). Halobia and some other Fossils from Kedah, Northwest Malaya. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 5, 69–87.
- Kobayashi, T. (1984). On the geological history of Thailand and West Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 25, 3–42.
- Kobayashi, T. & Hamada, T. (1971a). Acyclopygid-bearing Ordovician faunule discovered in Malaya with note on Cyclopygidae. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 8, 1–18.
- Kobayashi, T. & Hamada, T. (1971b). Silurian trilobites from the Langkawi Islands, West Malaysia, with notes on the Dalmanitidae and Raphiophoridae. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 9, 87–134.
- Kobayashi, T. & Hamada, T. (1972). A unique trilobite assemblage of the Devonian Kroh Fauna in West Malaysia, with notes on the Tentaculites Facies and the older Palaeozoic faunal sequence in Thailand-Malaya. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 10, 1–34.
- Kobayashi, T. & Hamada, T. (1973). Cyrtosymbolids (Trilobita) from the Langgun Red Beds in Northwest Malaya, Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 12, 1–28.
- Kobayashi, T. & Hamada, T. (1978). Upper Ordovician trilobites from the Langkawi Islands, Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 19, 1–27.
- Kobayashi, T. & Tamura, M. (1984). The Triassic Bivalvia of Malaysia, Thailand and Adjacent Areas. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 25, 201–228.
- Kobayashi, T., Burton, C.K., Tokuyama, A. & Yin, E.H. (1966). The Daonella and Halobia Facies of the Thai-Malay Peninsula Compared with those of Japan. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 3, 98–122.
- Koike, T. (1973). Triassic Conodonts from Kedah and Pahang, Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 12, 91–113.
- Koike, T. (1982). Triassic Conodont Biostratigraphy in Kedah, West Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 23, 9–51.
- Koning, T. & Darmono, F.X. (1984). The geology of the Beruk Northeast Field, Central Sumatra: oil production from pre-Tertiary basement rocks. *Proceedings 13th Annual Convention of Indonesian Petroleum Association*, Jakarta, 1, 385–406.
- Kon'no, E. (1966). Some younger Mesozoic plants from Malaya. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 3, 135–164.
- Kon'no, E. (1968). Addition of Some Younger Mesozoic Plants from Malaya. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 4, 139–155.
- Kon'no, E. & Asama, K. (1970). Some Permian plants from the Jengka Pass, Pahang, West Malaysia. *In: Kobayashi, T. & Toriyama, R. (eds) Geology and Palaeontology of Southeast Asia*, 8, 87–132.

- Kon'no, E., Asama, K. & Rajah, S.S. (1971). The Late Permian Linggiu flora from the Gunung Blumut area, Johore, Malaysia. In: T. Kobayashi & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, 9, 1–85.
- Koopmans, B.N. (1964). Geomorphological and historical data of the lower course of the Perak River (Dindings). *Journal Malaysian Branch Royal Asiatic Society*, 37, 175–191.
- Koopmans, B.N. (1965). Structural evidences of a Paleozoic orogeny in North West Malaya. *Geological Magazine*, 102, 501–520.
- Koopmans, B.N. (1968). The Tembeling Formation—a lithostratigraphic description (West Malaysia). *Geological Society of Malaysia Bulletin*, 1, 23–43.
- Krähenbuhl, R. (1991). Magmatism, tin mineralization and tectonics of the Main Range, Malaysian Peninsula: consequences for the plate tectonic model of Southeast Asia based on Rb-Sr, K-Ar and fission track data. *Geological Society of Malaysia Bulletin*, 29, 1–100.
- Kueh, S.R.M., Mohamad, W.N.W. & Sim, C.H. (2005). Initiatives for improving oil recovery at Guntong. *Society of Petroleum Engineers Paper SPE 97692*, SPE International Improved Oil Recovery Conference in Asia Pacific, Kuala Lumpur, 5–6 Dec. 2005, 13 pp.
- Kwak, T.A.P. (1984). An overview of Sn-sulphide replacement style deposits in Australia. (Abstract), GEOSEA V, *Geological Society of Malaysia*, 17.
- Kwan, T.S. (1990). K-Ar dating of micas from granitoids in the Kuala Lumpur–Seremban area. *Geological Society of Malaysia Bulletin*, 26, 77–96.
- Kwan, T.S. & Yap, F.L. (1986). The pattern of K/Ar ages of biotites from the granites of Penang: its interpretation in the light of available Rb/Sr and U/Pb data. *Geological Society of Malaysia Bulletin*, 19, 281–289.
- L**
- Lane, H.R., Muller, K.J. & Ziegler, W. (1979). Devonian and Carboniferous conodonts from Perak, Malaysia. *Geologica et palaeontologica*, 13, 213–222.
- Law, W.M. (1961). *The Batu Arang Coalfield, Selangor*. Unpubl. B.Sc. (Hons) Thesis, Dept. of Geology, University of Malaya.
- Law, S.F. & Tjia, H.D. (1985). An intrusive swarm near Mentakab, Pahang: A probable volcanic centre. *Geological Society of Malaysia Warta Geologi*, 11(2), 43–46.
- Leake, B.E. (1978). Nomenclature of amphiboles. *Canadian Mineralogist*, 16, 501–520.
- Leamy, M.L. & Panton, W.P. (1960). Soil Survey Manual for Malayan Conditions. *Department of Agriculture Bulletin*, 119, 226 pp.
- Lee, A.K. (1990). The Geology and mineral resources of the Hulu Lebar area, Pahang. *Geological Survey of Malaysia District Memoir*, 22, 235 pp.
- Lee, A.K., Foo, K.Y. & Ong, W.S. (1986). Gold mineralization and prospects in North Pahang Darul Makmur, Peninsular Malaysia. *Geological Survey of Malaysia Regional Mineral Exploration Project Report*, 97 pp.
- Lee, C.P. (1981). *A study of the Machinchang and Tarutao Formations of Pulau Langkawi and Tarutao, Malay Peninsula*. Unpubl. M.Sc. thesis, Dept. of Geology, University of Malaya.
- Lee, C.P. (1983). Stratigraphy of the Tarutao and Machinchang Formations. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, 1: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 20–38.
- Lee, C.P. (2001). Occurrences of *Scyphocrinites* loboliths in the Upper Silurian Upper Setul limestone of Pulau Langgun, Langkawi, Kedah and Guar Sanai, Berseri, Perlis. *Proceedings Geological Society of Malaysia Annual Geological Conference 2001*, 99–104.
- Lee, C.P. (2004). Part 1 Palaeozoic. In: Lee, C. P., Leman, M.S., Hassan, K., Nasib, B.M. & Karim, R. (eds). *Stratigraphic Lexicon of Malaysia*. Geological Society of Malaysia, 3–35.
- Lee, C.P. (2005). Discovery of plate-type scyphocrinoid loboliths in the uppermost Pridolian-lowermost Lochkovian Upper Setul limestone of Peninsular Malaysia. *Geological Journal*, 40, 331–342.
- Lee, C.P. (2006). The Cambrian of Malaysia. *Palaeoworld*, 15, 242–255.
- Lee, C.P. & Azhar Hussin (1991). The Wang Kelian Redbeds, a possible extension of the Unnamed Devonian Unit (Rebanggun Beds) into Perlis? (Abstract). *Geological Society of Malaysia Warta Geologi*, 17, 160.
- Lee, C.P., Leman, M.S., Hassan, K., Nasib, B.M. & Karim, R. (2004). *Stratigraphic Lexicon*

- of Malaysia. Geological Society of Malaysia. 162 pp.
- Lee, C.Y. (1998). The Bukit Arang Tertiary Basin in Chuping, Perlis. *Geological Society of Malaysia Bulletin*, **42**, 179–186.
- Lee, S.C. (1972). *The geology of the Mersing area*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Lee, S.G., Masuda, A. & Kim, H.S. (1994). An early Proterozoic leuco-granitic gneiss with the REE tetrad phenomenon. *Chemical Geology*, **114**, 59–67.
- Leo, C.T.A.M (1997). Exploration in the Gulf of Thailand in deltaic reservoirs, related to the Bongkot Field. In: Fraser, A.J., Matthews, S.J. & Murphy, R.W. (eds) *Petroleum Geology of Southeast Asia*. Geological Society of London Special Publication, **126**, 77–87.
- Li, Y., McWilliams, M., Cox, A., Sharps, R., Li, Y., Gao, Z., Zhang, Z. & Zhai, Y. (1988). Late Permian palaeomagnetic pole from dikes of the Tarim craton, China. *Geology*, **16**, 275–278.
- Liew, K.K. (1994). Structural development at the west-central margin of the Malay Basin. *Geological Society of Malaysia Bulletin*, **36**, 67–80.
- Liew, K.K. (1995a). Timing of Cenozoic basin formation in northern Sundaland, Southeast Asia. *Geological Society of Malaysia Bulletin*, **37**, 231–251.
- Liew, K.K. (1995b). Structural patterns within the Tertiary basement of the Strait of Malacca. *Geological Society of Malaysia Bulletin*, **38**, 109–126.
- Liew, K.K. (1996). Structural history of Hinge fault system of the Malay Basin. *Geological Society of Malaysia Bulletin*, **39**, 33–50.
- Liew, K.K. (1997). Structural analysis of the Malay Basin. *Geological Society of Malaysia Bulletin*, **40**, 157–176.
- Liew, T.C. (1977). *Petrology and structural relationship of rhyolitic rocks and microgranodiorite east of Genting Sempah, Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Liew, T.C. (1983). *Petrogenesis of Peninsular Malaysia granitoid batholiths*. Unpubl. Ph.D. thesis, Australian National University.
- Liew, T.C. & McCulloch, M.T. (1985). Genesis of granitoid batholiths of Peninsular Malaysia and implication for models of crustal evolution: evidence from Nd-Sr isotopic and U-Pb zircon study. *Geochimica et Cosmochimica Acta*, **49**, 587–600.
- Liew, T.C. & Page R.W. (1985). U-Pb zircon dating of granitoid plutons from the West Coast Province of Peninsular Malaysia. *Journal of Geological Society of London*, **142**, 515–526.
- Liggett, D.L. (1990). Geochemistry of the garnet bearing Tharps Peak granodiorite and its relation to other members of the Lake Kaweah intrusive suite, southwestern Sierra Nevada, California. In: Anderson, J.L. (ed) *The nature and origin of Cordilleran magmatism, Boulder Colorado*. Geological Society of America Memoir, **174**, 225–236.
- Lim, K.K. & Nuraiteng T.A. (1994). Development of Permian volcanoclastics-limestone succession at Gua Bama, Pahang Darul Makmur. *Geological Society of Malaysia Warta Geologi*, **20**, 243–244.
- Lim, P.L. (1978). Canggaaan radiolaria di Genting Sempah, Selangor-Pahang. *Sains Malaysiana*, **7**, 9–32.
- Lim, T.C., Sharafuddin, M., Sulaiman, M., Teh, G.H. & Abdul Aziz, J.H. (2001). Geology, structure, mineralisation and geochemistry of the Penjom gold deposit, Penjom, Pahang. *Proceedings of Geological Society of Malaysia Annual Geological Conference 2001*, 61–63.
- Lin, J. (1987a). Late Carboniferous paleogeographic reconstruction. *11th International congress of Carboniferous stratigraphy and geology, Abstracts*, 283.
- Lin, J. (1987b). The apparent polar wander path for the South China Block and its geological significance. *Scientia Geologica Sinica*, **4**, 306–315.
- Lin, J. & Fuller, M. (1990). Palaeomagnetism, North China and South China collision and the Tan-Lu Fault. *Philosophical Transaction of the Royal Society of London*, **A331**, 589–598.
- Lin, J., Fuller, M. & Zhang, W. (1985). Preliminary Phanerozoic polar wander paths for the North and South China Blocks. *Nature*, **313**, 444–449.
- Liu, M. (1982). Some characteristics of vein-type tungsten ore deposits in southern China and their metallogenic patterns. In: Hepworth, J.V. & Zhang, Y. (eds) *Tungsten Geology, Jiangxi, China*. ESCAP/RMRDC, Bandung, Indonesia, 327–338.
- Loganathan, P. (1977). The Geology and Mineral Resources of the Segamat Area (Sheet

- 115), Johore. *Geological Survey of Malaysia Annual Report, 1977*, 104–107.
- Loganathan, P. (1980). The Ma'Okil Formation—an outlier of the Tahan supergroup. *Geological Survey of Malaysia Annual Report for 1978*, 119–131.
- Loganathan, P. (1981). The geology and mineral resources of the Segamat area (Sheet 115), Johore. *Geological Survey of Malaysia Annual Report, 1979*, 104–107.
- Loganathan, P. (1993). Geology and mineral resources of the Durian Tipus area, Negeri Sembilan Darul Khusus. *Geological Survey of Malaysia Map Report, 6*, 118 pp.
- Loh, C.H. (1979). The Geology of the Keluang Area (Sheet 124), Johore. *Geological Survey of Malaysia Annual Report, 1979*, 142–146.
- Loh, C.H. (1980). Geology of the Keluang area, Sheet 124, Johore. *Geological Survey of Malaysia Annual Report, 1978*, 131–135.
- Loh, C. H. (1987). Quaternary Geology of the Teluk Intan Area, Sheet 64, Perak. *Geological Survey of Malaysia Annual Report, 1986*, 127–133.
- Loh, C.H. (1992). Quaternary Geology of The Teluk Intan Area, Perak Darul Ridzuan. *Geological Survey of Malaysia Quaternary Geology Bulletin, 3*, 46 pp.
- Loke, M.H., Lee, C.Y. & van Klinken, G. (1983). Interpretation of regional gravity and magnetic data in Peninsular Malaysia. *Geological Society of Malaysia Bulletin, 16*, 1–21.
- Longley, I.M., Barraclough, Bridden, M.A. & Brown, S. (1990). Pematang lacustrine petroleum source rocks from the Malacca Strait PSC, Central Sumatra, Indonesia. *Proceedings of the 19th annual convention of Indonesian Petroleum Association, Jakarta*, 279–297.
- Lovatt Smith, P.E., Stokes, R.B., Bristow, C. & Carter, A. (1996). Mid-Cretaceous inversion in the northern Khorat Plateau of Lao PDR and Thailand. In: Hall, R. and Blundell, D. (eds) *Tectonic evolution of Southeast Asia*. Geological Society of London Special Publication, 106, 233–247.
- M**
- MacDonald, E.H. (1983). *Alluvial Mining—the geology, technology and economics of placers*. Chapman and Hall, London, 508 pp.
- MacDonald, S. (1968). The Geology and Mineral resources of north Kelantan and north Terengganu. *Geological Survey West Malaysia District Memoir, 10*, 202 pp.
- MacGregor, D.S. & McKenzie, A.G. (1986): Quantification of oil generation and migration in the Malacca strait region Central Sumatra. *Proceedings of the 15th annual convention of Indonesian Petroleum Association, Jakarta, 1*, 305–320.
- Mackie, J.B. (1938). Malayan Collieries Limited, Batu Arang. *Supp. Annual Report for 1937, Chief Inspector of Mines, Federated Malay States*, 59–74.
- Magoon, L.B. & Dow, W.G. (1994). The Petroleum System. In: Magoon, L.B. & Dow, W.G. (eds) *The petroleum system – from source to trap*. American Association of Petroleum Geologists Memoir, 60, 3–24.
- Mah, W.H. (1972). *The geology of the area southeast of Endau, Johore*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Mahendran, G. (1992). *The geology of Batu Arang, Selangor Darul Ehsan*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Mahendran, G., Mustaffa Kamal Shuib & Raj, J.K. (1991). The stratigraphy of the Batu Arang area [abstract], *Geological Society of Malaysia Warta Geologi, 17*, 166.
- Maranate, S. & Vella, P. (1986). Paleomagnetism of the Khorat Group, Mesozoic, Northeast Thailand. *Journal of Southeast Asian Earth Sciences, 1*, 23–31.
- Matsubayashi, O. & Uyeda, S. (1979). Estimation of heat flow in certain exploration wells in offshore areas of Malaysia. *Bulletin Earthquake Research Institute, 54*, 31–44.
- Mazlan Madon (1994). Depositional and diagenetic histories of reservoir sandstones in the Jerneh field, central Malay Basin. *Geological Society of Malaysia Bulletin, 36*, 31–53.
- Mazlan Madon (1997). Analysis of tectonic subsidence and heat flow in the Malay Basin (offshore Peninsular Malaysia). *Geological Society of Malaysia Bulletin, 41*, 95–108.
- Mazlan Madon (1999). Basin types, tectono-stratigraphic provinces, and structural styles. In: PETRONAS. *The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 79–111.
- Mazlan Madon (2006). Overpressure history of the Malay Basin, offshore Peninsular Malaysia. *Geological Society of Malaysia Bulletin, 49*, 135–144.

- Mazlan Madon & Azlina Anuar (1999). Penyu Basin. *In: PETRONAS. The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 219–233.
- Mazlan Madon & Mansor Ahmad (1999). Basins in the Straits of Melaka. *In: PETRONAS. The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 235–249.
- Mazlan Madon & Watts, A.B. (1998). Gravity anomalies, subsidence history and the tectonic evolution of the Malay and Penyu Basins (offshore Peninsular Malaysia). *Basin Research*, **10**, 375–392.
- Mazlan Madon, Abolins, P., Mohammad Jamaal Hoesni & Mansor Ahmad (1999a). Malay Basin. *In: PETRONAS. The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 171–217.
- Mazlan Madon, Azlina Anuar & Wong, R. (1997). Structural evolution, maturation history, and hydrocarbon potential of the Penyu Basin, offshore Peninsular Malaysia. *In: Howes, J.V.C. & Noble, R.A. (eds.): Proceedings of the IPA Petroleum Systems of SE Asia and Australasia*, 21–23 May 1997, Indonesian Petroleum Association, Jakarta, 403–424.
- Mazlan Madon, Rashidah Abd. Karim & Wong, R.H.F. (1999b). Tertiary stratigraphy and correlation schemes. *In: PETRONAS. The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 115–137.
- Mazlan Madon, Yang, J., Abolins, P., Redzuan Abu Hassan, Azmi M. Yakzan & Saiful Bahari Zainal (2006). Petroleum systems of the Northern Malay Basin. *Geological Society of Malaysia Bulletin*, **49**, 125–134.
- McCabe, P.J., Ryder, R.T. & Bishop, M.G. (2000). Chapter R3 Region 3 Asia Pacific – Assessment Summary. *In: USGS World Energy Assessment Team (2000). US Geological Survey World Petroleum Assessment 2000 – Description and Results*. United States Geological Survey Digital Data Series DDS-60, four CD-ROMs.
- McCaffrey, M.A., Abolins, P., Mohammad Jamaal Hoesni & Huizinga, B.J. (1998). Geochemical characterization of Malay Basin oils: some insight into the effective petroleum systems. *9th Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia – GEOSEA '98*, Kuala Lumpur, 17–19 August, 1998, Programme and Abstract, 149, Geological Society of Malaysia.
- McCaffrey, R. (1996). Slip partitioning at convergent plate boundaries of SE Asia. *In: Hall, R. & Blundell, D. (eds) Tectonic evolution of Southeast Asia*. Geological Society of London Special Publication, **106**, 3–18.
- McElhinny, M.W., Embleton, B.J.J., Ma, X.H. & Zhang, Z.K. (1981). Fragmentation of Asia in the Permian. *Nature*, **293**, 212–216.
- McElhinny, M.W., Haile, N.S. & Crawford, A.R. (1974). Palaeomagnetic evidence shows Malay Peninsula was not part of Gondwanaland. *Nature*, **252**, 641–645.
- McFadden, P.L., Ma, X.H., McElhinny, M.W. & Zhang, Z.K. (1988). Permo-Triassic magneto-stratigraphy in China: northern Tarim. *Earth & Planetary Science Letters*, **87**, 152–160.
- Md Nazri Ramli (1988). Stratigraphy and palaeofacies development of Carigali's Operating Areas in the Malay Basin, South China Sea. *Geological Society of Malaysia Bulletin*, **22**, 153–187.
- Md Zin Che Lah, Lancelot Sering, Azlee Abu Bakar, Sundal, E. & Daudey, J. (2000). Real-Time Data Analysis While Drilling Provides Risk Management for Both Geological and Geometric Uncertainties in the Sotong K2.0 Reservoir. *Society of Petroleum Engineers Paper SPE 64477*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Brisbane, 16–19 Oct. 2000, 11 pp.
- Meor Hakif Hassan (2004). *Stratigraphy and paleontology of the transitional sequence between the Upper Setul Limestone and Kubang Pasu/Singa Formation in northwest Peninsular Malaysia*. M.Sc. thesis (unpubl.), University of Malaya, 139 pp.
- Meor Hakif Hassan & Lee, C.P. (2002a). Stratigraphy of the Jentik Formation, the transitional sequence from the Setul Limestone to the Kubang Pasu Formation at Guar Sanai, Kampung Guar Jentik, Beseri, Perlis – a preliminary study. *Geological Society of Malaysia Bulletin*, **45**, 171–178.
- Meor Hakif Hassan & Lee, C.P. (2002b). The Jentik Formation, a Devonian – Lower Carboniferous succession in Northwest Peninsular Malaysia. *Programme & Abstracts, Geodynamic Processes of Gondwanaland – Derived Terranes in East & Southeast Asia; Their Crustal Evolution, Emplacement and Natural Resources Potential. Fourth Symposium of IGCP Project No. 411*, 17–25 Nov. 2002, Thailand, 108–109.

- Meor Hakif Hassan & Lee, C.P. (2003). The Sanai Limestone Member – a Devonian limestone unit in Perlis. *Geological Society of Malaysia Bulletin*, **46**, 137–141.
- Meor Hakif Hassan & Lee, C.P. (2004). The depositional environment of the Mid-Palaeozoic red beds at Hutani Aji, Perlis and its bearing on global eustatic sea level change. *Geological Society of Malaysia Bulletin*, **48**, 65–72.
- Meor, H. H. & Lee, C.P. (2005). The Devonian-Lower Carboniferous succession in Northwest Peninsular Malaysia. *Journal of Asian Earth Sciences*, **24**, 719–738.
- Metcalfe, I. (1981). Permian and Early Triassic conodonts from Northwest Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **14**, 119–126.
- Metcalfe, I. (1984a). Stratigraphy, palaeontology and palaeogeography of the Carboniferous of Southeast Asia. *Mémoire de la société géologique de France*, **147**, 107–118.
- Metcalfe, I. (1984b). The Permian-Triassic boundary in Northwest Malaya. *Geological Society of Malaysia Warta Geologi*, **10**, 139–147.
- Metcalfe, I. (1985). A Middle Triassic Fauna from the Bt. Jeram Padang Ridge at Bahau, N. Sembilan, Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **11**, 111–115.
- Metcalfe, I. (1987). An occurrence of sheared diamictite near Genting Sempah. *Geological Society of Malaysia Warta Geologi*, **13** (3), 97–103.
- Metcalfe, I. (1990a). Stratigraphic and tectonic implications of Triassic conodonts from northwest Peninsular Malaysia. *Geological Magazine*, **127**, 567–578.
- Metcalfe, I. (1990b). Lower and Middle Triassic conodonts from Jerus Limestone, Pahang, Peninsular Malaysia. *Journal of Asian Earth Sciences*, **4**, 141–146.
- Metcalfe, I. (1990c). Triassic Conodont Biostratigraphy in the Malay Peninsula. *Geological Society of Malaysia Bulletin*, **26**, 133–145.
- Metcalfe, I. (1991). Late Palaeozoic and Mesozoic palaeogeography of Southeast Asia. *Palaeogeography, Palaeoclimatology and Palaeoecology*, **87**, 211–221.
- Metcalfe, I. (1992a). Upper Triassic conodonts from the Kodiang Limestone, Kedah, Peninsular Malaysia. *Journal of Southeast Asian Earth Sciences*, **7**, 131–138.
- Metcalfe, I. (1992b). Lower Triassic (Smithian) conodonts from northwest Pahang, Peninsular Malaysia. *Journal of Micropaleontology*, **11**, 13–19.
- Metcalfe, I. (1993). Permian conodonts from Raub Gold Mine, Pahang, Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **19**, 85–88.
- Metcalfe, I. (1996). Pre-Cretaceous evolution of SE Asian terranes. In: Hall, R. & Blundell, D. (eds) *Tectonic evolution of Southeast Asia*. Geological Society of London Special Publication, **106**, 97–122.
- Metcalfe, I. (1999). The Palaeo-Tethys in East Asia. *Geological Society of Malaysia Bulletin*, **43**, 131–143.
- Metcalfe, I. (2000). The Bentong–Raub suture zone. *Journal of Asian Earth Sciences*, **18**, 691–712.
- Metcalfe, I. 2002. Devonian and Carboniferous conodonts from the Kanthan Limestone, Peninsular Malaysia and their stratigraphic and tectonic implications. In: Hills, L.V., Henderson, C.M. and Bamber, E.W. (eds), *The Carboniferous and Permian of the World*. *Canadian Society of Petroleum Geologists Memoir* **19**, 552–579.
- Metcalfe, I. & Azhar Hussin (1995). Implications of new biostratigraphic data for stratigraphic correlation of the Permian and Triassic in Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **38**, 173–177.
- Metcalfe, I. & Chakraborty, K.R. (1983). Occurrence of a thick intraformational conglomerate horizon within the Semantan Formation (Triassic) near Temerloh, Pahang. *Geological Society of Malaysia Warta Geologi*, **9**, 194–195.
- Metcalfe, I. & Chakraborty, K.R. (1994). A stratigraphic log of Semantan Formation along part of the Mentakab-Temerloh Bypass, Pahang. *Geological Society of Malaysia Bulletin*, **55**, 37–46.
- Metcalfe, I., Idris, M. & Tan, J.T. (1980). Stratigraphy and palaeontology of the Carboniferous sediments in the Panching area, Pahang, West Malaysia. *Geological Society of Malaysia Bulletin*, **13**, 1–26.
- Metcalfe, I., Sivam, S.P. & Stauffer, P.H. (1982). Stratigraphy and sedimentology of the Middle Triassic rocks exposed near Lanchang, Pahang, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **15**, 19–30.
- Miller, C.F., Stoddard, E.F., Bradfish, L.J. &

- Dollase, W.A. (1981). Composition of plutonic muscovite: genetic implications. *Canadian Mineralogist*, **19**, 25–34.
- Milliman, J.D., Farnsworth, K.L. & Albertin, C.S. (1999). Flux and fate of fluvial sediments leaving large islands in the East Indies. *Journal of Sea Research*, **41**, 97–107.
- Milsom, J.S. (2005). Seismology and neotectonics. In: Barber, A.J.; Crow, M.J. & Milsom, J.S. (eds) *Sumatra: geology, resources and tectonic evolution*. Geological Society of London Memoir, **31**, 7–15.
- Mitchell, A.H.G. (1977). Tectonic settings for emplacement of Southeast Asian tin granites. *Geological Society of Malaysia Bulletin*, **9**, 123–140.
- Miyashiro, A. (1973). *Metamorphism and metamorphic belts*. George Allen and Unwin, London, 492 pp.
- Moh, G.H. (1985). Complex tin-bearing sulphides of the south China ore type. *Geological Society of Malaysia Bulletin*, **19**, 369–374.
- Mohamad Barzani Gazim (1988). Geologi struktur Pulau Kapas, Marang, Terengganu. *Sains Malaysiana*, **17**, 3–15.
- Mohamad Othman, Zaimi Salleh, Redmond, D., Jakobsson, N.M., A. Rahman Yunus & A. Kamarolaili Abu (2003). Angsi waterflood management and surveillance – an integrated team approach. *Society of Petroleum Engineers Paper SPE 80538*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Jakarta, 15–17 April 2003, 10 pp.
- Mohammad Ayob (1965). *Studies in bedrock geology and sedimentology of Quaternary sediments at Sungei Besi Tin Mines, Selangor*. Unpubl. B.Sc. (Hons) thesis, Dept of Geology, University of Malaya.
- Mohammad Ayob (1968). *Stratigraphy and sedimentology of the Tembeling Formation in the Gunung Berantai area, Pahang*. Unpubl. M.Sc. thesis, Dept. of Geology, University of Malaya.
- Mohammad Ayob (1970). Quaternary sediments at Sungei Besi, West Malaysia. *Geological Society of Malaysia Bulletin*, **3**, 53–61.
- Mohammad Daud Hashim (1986). *Structural geology of Tanjong Siang, Tanjong Balau and Tanjong Lompat, east Johore, Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Mohd Azamie W.A. & Azman A. Ghani (2003). Granitic rocks from Pos Slim–Kampung Raja (Part 1): Identification and characteristics of different granitic bodies. *Geological Society of Malaysia Bulletin*, **46**, 35–40.
- Mohd. Fadlee Baba (1995). Geologi Kuaterner kawasan Telok Datok, Syit 101, Selangor. *Geological Survey of Malaysia Proceedings 25th Geological Conference 1994*, **6**, 44–55.
- Mohd Firdaus Abdul Halim (1994). Geothermics of the Malaysian sedimentary basins. *Geological Society of Malaysia Bulletin*, **36**, 163–174.
- Mohd Imran Idris (1996). *Petrology and geochemistry of granitoid and general geology of Rajang Redang – Sumpitan area, Perak Darul Ridzuan*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Mohd. Raji Mat Yaacob (1990). *Geologi dan pemineralan emas kawasan Batu Melintang–Kalai, Jeli, Kelantan Darul Naim*. Unpubl. B.Sc. (Hons) thesis, Dept of Geology, University of Malaya.
- Mohd. Razali Che Kob (1986). *Sedimentologi, Stratigrafi dan Struktur Kawasan Sg. Rak–Sg. Sam, Kuala Krai, Kelantan*. Unpubl. B.Sc. (Hons) thesis, Dept of Geology, University of Malaya.
- Mohd Shafeea Leman (1993). Upper Permian brachiopods from northwest Pahang, Malaysia. *Proceedings of the International Symposium on Biostratigraphy of Mainland Southeast Asia: Facies and Palaeontology, Chiang Mai, Thailand*, **1**, 203–218.
- Mohd Shafeea Leman (1996). The occurrence of brachiopods from pebbly mudstone near Kilim, Langkawi: Their age, paleobiogeography and paleoclimatic implication. Abstract. *Geological Society of Malaysia Warta Geologi*, **22**, 100–102.
- Mohd Shafeea Leman (2003). An Early Permian (Early Sakmarian) brachiopod fauna from the Sungai Itau Quarry and its relationship to other Early Permian brachiopod horizons in Langkawi, Malaysia. *Geological Society of Malaysia Bulletin*, **46**, 155–160.
- Mohd Shafeea Leman (2004). Part 2 Mesozoic. In: Lee, C.P., Leman, M.S., Hassan, K., Nasib, B.M. & Karim, R. (eds) *Stratigraphic Lexicon of Malaysia*. Geological Society of Malaysia, 37–64.
- Mohd Shafeea Leman & Asmaniza Yop (2002). Early Permian sequence from Sungai Itau quarry, Langkawi: its age, depositional environment and paleoclimatic implication. *Geological Society of Malaysia Bulletin*, **46**, 163–170.

- Mohd Shafeea Leman & Sone, M. (2001). Conglomerate from Setia Jasa near Temerloh, Pahang, peninsular Malaysia: Its stratigraphic position and depositional environment. *Proceedings of Geological Society of Malaysia Annual Conference 2001*, 115–119.
- Mohd Shafeea Leman & Yusri Zakariah (1995). Iron rich conglomerate of Ma'Okil Formation at Bukit Lop, Chaah, Johor. *Geological Society of Malaysia Warta Geologi*, 21, 293–299.
- Mohd Shafeea Leman, Ibrahim Komoo & Tjia, H.D. (1987). Geologi kawasan kemuncak Gunung Tahan, Pahang: beberapa cerapan. *Sains Malaysiana*, 16, 49–64.
- Mohd Shafeea Leman, Kamal Roslan Mohamed & Ibrahim Komoo (1999a). Geologi rentasan Kuala Chichir-Gunung Gagau, Taman Negara. In: Ibrahim Komoo & Mohd Shafeea Leman (eds). *Warisan Geologi Malaysia*, Lestari, 187–208.
- Mohd Shafeea Leman, Kamal Roslan Mohamed & Sone, M. (2000). On the New Permian Bera Formation from the Bera District, Pahang, Malaysia. *Proceedings of Geological Society of Malaysia Annual Conference 2000*, 151–158.
- Mohd Shafeea Leman, Kamal Roslan Mohamed, Uyop Said, Ibrahim Amnan & Juhari Mat Akhir (1999b). Geomorfologi dan geologi Bukit Batu Besar, Taman Negara Pahang. In: Ibrahim Komoo & Mohd. Shafeea Leman (eds). *Warisan Geologi Malaysia*, Lestari, 209–240.
- Mohd Shariff Kader (1994). Abnormal pressure occurrence in the Malay and Penyu basins, offshore Peninsular Malaysia – a regional understanding. *Geological Society of Malaysia Bulletin*, 36, 81–91.
- Mohd Tahir Ismail. & Rudolph, K.W. (1992). Structural trap styles of the Malay Basin. *Symposium on Tectonic Framework and Energy Resource of the Western Margin of the Pacific Basin*, 29 Nov. – 2 Dec. 1992, Kuala Lumpur, Abstract, 44, Geological Society of Malaysia.
- Mohd Tahir Ismail, Shahrul Amar Abdullah & Rudolph, K.W. (1994). Structural and sedimentary evolution of the Malay Basin. Abstracts American Association of Petroleum Geologists International Conference & Exhibition, Kuala Lumpur, August 21–24, 1994, *American Association of Petroleum Geologists Bulletin*, 78, 1148.
- Mohd Zaid Jaafar (1998). *Kajian petrografi dan geokimia gambut di kawasan Tanjung Duabelas, Kuala Langat, Selangor*. Unpubl. B.Sc. thesis, Dept. of Geology, University of Malaya.
- Molina, J. (1985). Petroleum geochemistry of the Sunda Basin. *Proceedings of the 14th annual convention of Indonesian Petroleum Association*, Jakarta, 2, 143–179.
- Morley, C.K. (2004). Nested strike-slip duplexes, and other evidence for Late Cretaceous–Palaeogene transpressional tectonics before and during India–Eurasia collision in Thailand, Myanmar and Malaysia. *Journal of Geological Society of London*, 161, 799–812.
- Morley, C.K. & Westaway, R. (2006). Subsidence in the super-deep Pattani and Malay basins of Southeast Asia: a coupled model incorporating lower-crustal flow in response to post-rift sediment loading. *Basin Research*, 18, 51–84.
- Morley, R.J. & Samsuddin Jirin (2006). The sequence biostratigraphy and chronostratigraphy of the Malay Basin. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006*, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts, 77.
- Mosley, M.P. & Schumm, S.A. (1977). Stream junctions—a probable location for bedrock placers. *Economic Geology*, 72, 691–697.
- Moulds, P.J. (1989). Development of the Bengkalis Depression, Central Sumatra, and its subsequent deformation—a model for other Sumatran grabens? *Proceedings of the 18th annual convention of Indonesian Petroleum Association*, Jakarta, 1, 217–245.
- Murphy, R.W. (1989). Inversion tectonics – a discussion. *Geological Society of London Special Publication*, 44, 336–337.
- Murray, A.P., Sosrowidjojo, I.B., Alexander, R., Kagi, R.I., Norgate, C.M. & Summons, R.E. (1997). Oleananes in oils and sediments: Evidence of marine influence during early diagenesis? *Geochimica et Cosmochimica Acta*, 61, 1261–1276.
- Murray, R.W., Buchholtzen, Brick, M.R., Jones, D.L., Gerlach, D.C. & Price Russ III G. (1990). Rare earth elements as indicators of different marine environments in chert and shale. *Geology*, 18, 268–271.
- Mustaffa Kamal Shuib (1984). *Structural geology of Pulau Singa Besar, Pulau Langkawi*.

- Kedah. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Mustaffa Kamal Shuib (1991). Structure and deformation of the Stong Complex at Sg. Renyok, Kelantan (Abstract). *Geology Department, UM Academic staff Seminar Unpubl.*
- Mustaffa Kamal Shuib (1994a). Interference of compressional and strike slip structures in the Semanggol formation North Kedah. Seminar and field trip on Permo-Triassic of Malaysia and its associated mineralization. April 14 – 17 1994 Abstract. *Geological Society of Malaysia Warta Geologi*, **20**, 95–96.
- Mustaffa Kamal Shuib (1994b). Multiphase deformation in the Late Permian Raub Gold Mine strata, Pahang. *Geological Society of Malaysia Warta Geologi*, **20**, 402–403.
- Mustaffa Kamal Shuib (1994c). Structures within the Bentong Suture Zone along the Cameron Highlands-Gua Musang road (abstract). *Geological Society of Malaysia Warta Geologi*, **20**, 232–233.
- Mustaffa Kamal Shuib (2000a). The Mesozoic Tectonics of Peninsular Malaysia – An overview. In: *GSM Dynamic Stratigraphy & Tectonics of Peninsular Malaysia – Seminar III. The Mesozoic of Peninsular Malaysia*, *Geological Society of Malaysia Warta Geologi*, **26**, 5.
- Mustaffa Kamal Shuib (2000b). Syndepositional deformations in the Permo-Triassic and Latest Triassic to Cretaceous Central Basins of Peninsular Malaysia. In: *Dynamic Stratigraphy & Tectonics of Peninsular Malaysia – Seminar III. The Mesozoic of Peninsular Malaysia*, seminar proceedings, 30–47. *Geological Society of Malaysia*.
- Mustaffa Kamal Shuib (2000c). The Olistostromes in the Bentong Area, Pahang and their tectonic implications. *Proceedings of Geological Society of Malaysia Annual Geological Conference 2000*, 51–55.
- Mustaffa Kamal Shuib (2003). Transpression in the strata of Pulau Kapas, Terengganu. *Geological Society of Malaysia Bulletin*, **46**, 299–306.
- Mustaffa Kamal Shuib (2004). Synsedimentary deformation of the Kapas Conglomerate, Pulau Kapas, Terengganu. *Geological Society of Malaysia Bulletin*, **48**, 103–109.
- Mustaffa Kamal Shuib & Abdul Hadi Abd. Rahman (1999). A Five-fold stratigraphic and tectonic subdivision of the Malay peninsula and the implication on its tectonic evolutionary history. *Geological Society of Malaysia Warta Geologi*, **25**, 65–66.
- Mustaffa Kamal Shuib & Tajul Anuar Jamaluddin (1999). *Multiple deformations in the Upper Palaeozoic Mersing Beds of the Tg. Balau and Tg. Lompat, Desaru, Johore – A Field Guide Book*. Geological Society of Malaysia, 27 pp.
- Mustaffa Kamal Shuib, Tajul Anuar Jamaluddin, Zuraimi Ahmad & Jamin Jamil (1999). Structural History of the Upper Palaeozoic Mersing Beds of the Kuala Sedili area, Johore. (Abstract). Annual Geological Conference 1999, 29–30 May 1999, Desaru. *Geological Society of Malaysia Warta Geologi*, **20**, 122–123.
- Mutalib, A.A., Lim, J.S., Wong, M.H. & Koonvai, L. (1991). Characterization, distribution and utilization of peat in Malaysia. In: Aminuddin Yusoff & Tan, S.L. (eds) *Tropical peat*. Proceedings of the International Symposium on Tropical Peatland, 6-10 May 1991, Kuching, MARDI, 7–16.

N

- Newell, R.A. (1971). Characteristics of the stanniferous alluvium in the southern Kinta Valley. *Geological Society of Malaysia Bulletin*, **4**, 15–37.
- Ng, T.F. (1986). *Geology and mineralization of the Padang Tengku area, Pahang Darul Makmur*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Ng T.F. (1994). Microstructures of the deformed granites of the eastern part of Kuala Lumpur—implications for mechanism and temperature of deformation. *Bull. Geol. Soc. Malaysia*, **35**, 47–59.
- Ng, T.S. (1987). Trap styles of the Tenggol Arch and the southern part of the Malay Basin. *Geological Society of Malaysia Bulletin*, **21**, 177–193.
- Nguyen, T.G. (1982). Palaeomagnetic studies of Cenozoic basalts in Vietnam. *Palaeomagnetic Research in Southeast and East Asia. CCOP TP*, **13**, 58–63.
- Nik Ramli (1986). Depositional model of a Miocene barred wave- and storm-dominated shoreface and shelf, southeastern Malay Basin, offshore West Malaysia. *American Association of Petroleum Geologists Bulletin*, **70**, 34–47.
- Nik Ramli (1988). Characteristics of J Sandstone (Tapis Formation) reservoirs in

the southeastern part of the Malay Basin, offshore West Malaysia. *7th Offshore South East Asia Conference*, 2–5 Feb. 1988, Singapore, SEAPEX Proceedings, VIII, 239–248.

- Noor Azim Ibrahim & Mazlan Madon (1990). Depositional environments, diagenesis, and porosity of reservoir sandstones in the Malong Field, offshore West Malaysia. *Geological Society of Malaysia Bulletin*, **27**, 27–55.
- Noraini Surip & Taylor, G. (2000). StereoSAR DEM for mapping of geological structures in Selangor, Malaysia. *Geological Society of Malaysia Annual Conference 2000 September 8-9, Penang*, 399–403.
- Norizan Yaacob & Uyop Said (2002). Plant fossils from Bukit Belah, Batu Pahat, Johor. *Geological Society of Malaysia Bulletin*, **45**, 287–291.
- Nossin, J.J. (1964a). Beach ridges on the east coast of Malaya. *Journal of Tropical Geography*, **8**, 111–117.
- Nossin, J.J. (1964b). Geomorphology of the surroundings of Kuantan. *Geologi en Mijnbouw*, **43**, 157–182.
- Nossin, J.J. (1965). Analysis of younger beach ridge deposits in Eastern Malaya. *Zeitschrift fur Geomorphologie*, **9**, 186–208.
- Nur Syamsiah Abdul Majid & Uyop Said (2002). A sedimentological study at Bukit Belah, Batu Pahat, Johor. *Proceedings of Geological Society of Malaysia Annual Geological Conference 2002*, 283–286.
- Nuraiteng, T.A. & Abdul Hadi Rahman (1995). Discovery of Upper Permian carbonates from the Kenong Wildlife Reserve, Pahang, Malaysia. *Geological Society of Malaysia Bulletin*, **38**, 79–89.
- ### O
- Oglethorpe, R.D.J. (1987). *A mineralogical and chemical study of the interaction between granite magma and pelitic country rock, Thorr pluton, Co. Donegal, Eire*. Unpubl. Ph.D. thesis, University of Liverpool.
- Ong, G.B. (1974). *Geology of an area southwest of Raub, Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Ong, S.S. (1969). *Geology of the Muda Dam Area, Kedah, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Ong, S.T. & Basir, J. (2007). Discovery of a Lower Devonian Dacryoconarid bed from Hill B, Guar Jentik, Perlis: Its significance and implications. *Geological Society of Malaysia Bulletin*, **53**, 1–6.
- Ong, W.S. (1993). The Geology and Engineering Geology of Pulau Pinang. *Geological Survey of Malaysia Map Report*, **7**, 74 pp.
- Ong, Y.H. (2001). Geology and Mineral Resources of the Gunung Ledang Area, Melaka and Negeri Sembilan. *Mineral and Geoscience Department Malaysia Map Report*, **14**, 93 pp.
- Ooi, J.B. (1968). *Land, People and Economy in Malaya*. Longman, London. 437 pp.
- Opdyke, N.D., Huang, K., Xu, G.; Zhang, W.Y. & Kent, D.V. ((1986). Paleomagnetic results from the Triassic of the Yangtze Platform. *Journal of Geophysical Research*, **91**, 9553–9568.
- Orsini, B. (1976). Les granitoides hercyniens Corso-Sardes: mise en evidence de deux associations magmatiques. *Bulletin de la Société Géologique de France*, **18**, 1203–1206.
- ### P
- Pagel, M. & Leterrier, J. (1980). The subalkaline potassic magmatism of the Ballons massif (Southern Vosges, France): shoshonitic affinity. *Lithos*, **13**, 1–10.
- Pahang Forestry Department (2005). *Pekan Peat Swamp Forest, Pahang, Malaysia; The role of water in conserving peat swamp forest*. Pahang Forestry Department, 36 pp.
- Paramanathan, S. (1964). *The geology of the Gunong Jerai massif, south-west Kedah*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Paramanathan S. & Soo, S.W. (1968). Reconnaissance Soil Survey of Perlis. *Department of Agriculture Malayan Soil Survey Report*, **37**, 49 pp.
- Paton, J.R. (1964). The origin of the limestone hills of Malaya. *Journal of Tropical Geography*, **18**, 134–147.
- Pearce, J.A., Harris, N.B.W. & Tindle, A.G. (1984). Trace element discrimination diagrams for the interpretation of granitic rocks. *Journal of Petrology*, **25**, 956–983.
- Peccerillo, A. & Taylor, S.R. (1976). Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamona area, northern Turkey. *Contributions to Mineralogy and Petrology*, **58**, 63–81.

- Pereira, J.J. (1996). *The geology and mining of gold deposits, their tailings disposal and subsequent impact on the physical environment in selected areas of Peninsular Malaysia*. Unpubl. Ph.D. thesis, Dept. of Geology, University of Malaya.
- PETRONAS (2006). *Exploration prospectivity & investment opportunities in Malaysia: Exploring new frontiers and ideas*. Petroleum Management Unit, Oct. 2006.
- PETRONAS (2007). *Chronostratigraphic Chart of the Cenozoic and Mesozoic Basins of Malaysia*. Petroleum Management Unit, 71 pp.
- Philp, R.P. & Gilbert, T.D. (1986). Biomarker distributions in Australian oils predominantly derived from terrigenous source material. In: Leythaeuser, D. and Rullkotter, J. (eds) *Advances in Organic Geochemistry 1985*, 73–84, Pergamon Press, Oxford.
- Pimm, A.C. (1967). Triassic volcanic rocks in East and West Malaysia. Geological Papers 1966. In: P. Collenette (ed) *Geological Survey, Borneo Region Malaysia, Bulletin*, 8, 36–40.
- Pitcher, W. S. (1979). Comments on the geological environments of granites. In: M.P. Atherton, M.P. & Tarney, T. (eds) *Origin of granite batholith: geochemical evidence*, Shiva Publishing Ltd., Orpington, UK, 1–8.
- Pitcher, W.S. (1983). Granite type and tectonic environment. In: K. Hsu (ed) *Mountain building processes*, Academic Press, London, 19–40.
- Pitfield, P.E.J., Teoh, L.H. & Cobbing, E.J. (1990). Textural variation and tin mineralization in granites from the Main Range province of the Southeast Asia tin belt. *Geological Journal*, 25, 419–430.
- Procter, W.D. (1980). Geology and Mineral Resources, Benta Area, Pahang. *Geological Survey of Malaysia Map Bulletin*, 4, 25 pp.
- Pulunggono, A. & Cameron, N.R. (1984). Sumatran microplates, their characteristics and their role in the evolution of the Central and South Sumatra Basins. *Proceedings of the 13th annual convention of Indonesian Petroleum Association*, Jakarta, 1, 121–144.
- Pun, V.T., & Singh, J. (1978). Geology and mineralization of Sungei Lembing tin deposits. *Abstract of Papers, International symposium on Geology of tin deposits, Geological Society of Malaysia, Annex to Newsletter*, 4, 7–8.
- PWD (1976). *Geology of the Republic of Singapore*. Public Works Department, Singapore, 79 pp.

Q

- Qalam Azad Rosle (1995). *Stratigraphy, sedimentology and structural geology of the Betong–Lepang Nenering border area*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Qalam Azad Rosle & Teh, G.H. (1998). The stratigraphy, structure and significance of the Nenering Tertiary beds, Pengkalan Hulu (Keroh), Hulu Perak. *Geological Society of Malaysia Bulletin*, 42, 161–177.

R

- Rahimah Abd. Karim, M. Shaufi Dahlan, Khairul Anuar Noordin & Harun M. Noor (2006). Successful application of six key elements in integrating people and technology towards quality achievements of Angsi Field Development Team. *Society of Petroleum Engineers Paper SPE 102804*, 2006 SPE Annual Technical Conference & Exhibition, San Antonio, TX, 24–27 Sept. 2006, 8 pp.
- Raj, J.K. (1982a). A note on the age of the weathering profiles of Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, 8, 135–137.
- Raj, J.K. (1982b). Net directions and rates of present-day beach sediment transport by littoral drift along the East Coast of peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 15, 57–70.
- Raj, J.K. (1982c). A reappraisal of the Bok Bak Fault. *Geological Society of Malaysia Warta Geologi*, 8, 35–41.
- Raj, J.K. (1983). *A study of residual soils and the stability of their slope cuts*. Unpubl. Ph.D. Thesis, Dept. of Geology, University of Malaya.
- Raj, J.K. (1985a). Characterisation of the weathering profile developed over a porphyritic biotite granite bedrock in Peninsular Malaysia. *International Association of Engineering Geologists Bulletin*, 32, 121–128.
- Raj, J.K. (1985b). Recent and near-future coastal changes of Kelantan State, Malaysia. *Journal of International Institute of Aerial Survey & Earth Sciences*, 1, 21–31.
- Raj, J.K. (1990). The Kuantan Basalts - A multi-

- vent origin. *Geological Society of Malaysia Warta Geologi*, **16**, 203–210.
- Raj, J.K. (1992). The Holocene history of the West Coast of Peninsular Malaysia. (Abstract). *Geological Society of Malaysia Warta Geologi*, **18**, 127–128.
- Raj, J.K. (1993). Clay minerals in the weathering profile of a quartz-mica schist in the Seremban area, Negeri Sembilan. *Journal of Tropical Agricultural Science*, **16**, 129–136.
- Raj, J.K. (1995a). Point load strengths of Tertiary sedimentary rocks from the Batu Arang area, Peninsular Malaysia. *Malaysian Journal Science*, **16B**, **1**, 49–57.
- Raj, J.K. (1995b). Clay minerals in the weathering profile of a graphite-quartz-muscovite schist in the Kajang area, Selangor. *Geological Society of Malaysia Warta Geologi*, **21**, 1–8.
- Raj, J.K. (1998). Tectonic evolution of the Tertiary basin at Batu Arang, Selangor Darul Ehsan, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **42**, 197–210.
- Raj, J.K., Abdul Hadi Abd. Rahman & Mustaffa Kamal Shuib (1998). Tertiary basins of inland Peninsular Malaysia: review and tectonic evolution. *Geological Society of Malaysia Bulletin*, **42**, 211–226.
- Rajah, S.S. (1969a). Younger Mesozoic sedimentary rocks, State of Johor, West Malaysia. *American Association of Petroleum Geologists Bulletin*, **53**, 2187–2189.
- Rajah, S.S. (1969b). A brief note on ignimbrite in Johore. *Geological Society of Malaysia Newsletter*, **20**, 1–2.
- Rajah, S.S. (1970). *The geology and sulphide mineralization in the Ulu Sokor area, Kelantan, Malaysia, with special reference to Manson's Lode*. Unpubl. DIC dissertation, Imperial College, University of London.
- Rajah, S.S. (1979). The Kinta Tinfield, Malaysia. *Geological Society of Malaysia Bulletin*, **11**, 111–136.
- Rajah, S.S. (1982). Tungsten mineralization in Peninsular Malaysia. In: J. V. Hepworth, J.V. & Zhang, Y. (eds) *Tungsten Geology, Jiangxi, China*. ESCAP/RMRDC, Bandung, Indonesia, 179–195.
- Rajah, S.S. (1986). The Geology and Mineral Resources of the Gunung Belumut Area, Johore. *Geological Survey of Malaysia District Memoir*, **19**, 191 pp.
- Rajah, S.S. & Chand, F. (1973). Brief outline of the mineral resources of Peninsular Malaysia. *Geological Survey of Malaysia Annual Report*, **1973**, 82–92.
- Ramlee, A.R. & Bedingfield, J.R. (1996). Mid J Group sequence stratigraphy and reservoir architecture in Block PM-9, Malay Basin. *PRSS Technology Forum*, 12–13 Sept. 1996, Awana Genting, Kuala Lumpur, (unpublished).
- Rastall, R.H. (1927). The geology of the Kinta Valley. *Mining Magazine, London*, **36**, 329–338.
- Redfern, J. (1991). Glacial facies – their sedimentology, distribution and hydrocarbon potential (abstract). *Geological Society of Malaysia Warta Geologi*, **17**, 194.
- Reid, I. & Frostick, L.L. (1985). Role of settling, entrainment and dispersive equivalence and of interstice trapping in placer formation. *Journal of Geological Society of London*, **142**, 739–746.
- Remington, C.H. & Pranyoyto, U. (1985). A hydrocarbon generation analysis in northwest Java Basin using Lopatin's method. *Proceedings of the 14th annual convention of Indonesian Petroleum Association*, Jakarta, **2**, 121–141.
- Renwick, A. & Rishworth, D.E.H. (1966). *Fuel Resources (Coal, Lignite & Petroleum) in Malaya*. Geological Survey of Malaya, 123 pp.
- Richardson, J.A. (1939). The geology and mineral resources of the neighbourhood of Raub, Pahang, Federated Malay States, with an account of the geology of the Raub Australian gold mine. *Geological Survey Department, Federated Malay States, Memoir*, **3**, 166 pp.
- Richardson, J.A. (1946). The stratigraphy and structure of the Arenaceous Formation of the Main Range Foothills. *F. M. S. Geological Magazine*, **83**, 217–229.
- Richardson, J.A. (1950). The geology and mineral resources of the neighbourhood of Chegar Perah and Merapoh, Pahang. *Geological Survey Department, Federation of Malaya, Memoir*, **4** (new series), 162 pp.
- Richter, B. & Fuller, M. (1996). Palaeomagnetism of the Sibumasu and Indochina blocks: implications for the extrusion tectonic model. In: Hall, R. and Blundell, D. (eds) *Tectonic evolution of Southeast Asia*. Geological Society of London special publication, **106**, 203–224.
- Richter, B., Schmidtke, E., Fuller, M., Harbury, N. & Samsudin, A.R. (1999). Paleomagnetism of Peninsular Malaysia. *Journal of Asian Earth Sciences*, **17**, 477–519.

- Ridd, M.R. (1980). Possible Palaeozoic drift of S.E. Asia and Triassic collision with China. *Journal of Geological Society of London*, **137**, 635–640.
- Rishworth, D.E.H. (1974). The Upper Mesozoic terrigenous Gagau Group of Peninsular Malaysia. *Geological Survey of Malaysia Special Paper 1*, 1–78.
- Roe, F.W. (1940). The coal field at Batu Arang, Selangor. *1940 Yearbook, Fed. Malay States Chamber of Mines*, 142–150.
- Roe, F.W. (1941). *Report on the deposit of tin-ore and iron-ore at Pelepah Kanan, Kota Tinggi, Johore*. Encl. No. 19 in Geological Survey Federation of Malaya File 61141 (unpubl.).
- Roe, F.W. (1951). The geology and mineral resources of the Fraser's Hill area, Selangor, Perak and Pahang, Federation of Malaya, with an account of the mineral resources. *Geological Survey Department, Federation of Malaya, Memoir*, **5** (new series), 138 pp.
- Roe, F.W. (1953). The Geology and Mineral Resources of the Neighbourhood of Kuala Selangor and Rasa, Selangor, Federation Of Malaya, With an Account of the Geology of the Batu Arang Coal-Field. *Geological Survey Department, Federation of Malaya Memoir*, **7** (new series), 163 pp.
- Roslant bin Abu (1981). *Stratigraphy and petrography of the Mersing area, Johore, Peninsular Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Runnegar, B. & Gobbett, D.J. (1975). *Tanchintongia* gen. nov., a bizarre Permian myalinid bivalve from West Malaysia and Japan. *Palaeontology*, **18**, 315–322.
- Ryall, P.J.C. (1982). Some thoughts on the crustal structure of Peninsular Malaysia — results of gravity traverse. *Geological Society of Malaysia Bulletin*, **15**, 9–18.
- S**
- Saadon Kairon & Schroeter, D.R. (1986). High angle shallow depth drilling in the South China Sea. *Offshore South East Asia Conference & Exhibition*, 28–31 Jan. 1986, Singapore, *Society of Petroleum Engineers Paper SPE 14615*, 12 pp.
- Sabatier, H. (1980). Vaugnerites et granites: une association particuliere de roches grenues acides et basiques. *Bulletin de Mineralogie*, **103**, 507–522.
- Safeen Baharuddin (1995). Hidrogeologi dan prospek air tanah kawasan aluvium Pantai Timur Pahang dan Johor. *Geological Survey of Malaysia Proceedings 25th Geological Conference, 1994*, **6**, 335–349.
- Sakagami, S. (1963). Bryozoa from Pulau Jong, the Langkawi Islands, north-west Malaya. *Japanese Journal of Geology and Geography*, **34**, 205–209.
- Samsudin Hj. Taib, Jamaluddin Othman & Nor Dalila Desa (2000). The Magnetic anomaly across Peninsular Malaysia between Muar and Endau (Abstract). *Geological Society of Malaysia Warta Geologi*, **26**, 191.
- Sandberg, C.A. (1984). Late Devonian icriodontid biofacies models and alternate shallow-water conodont zonation. In: Clark, D.L. (ed) *Conodont Biofacies and Provincialism*. Geological Society of America Special Paper, **196**, 143–178.
- Sasajima, S. & Maenaka, K. (1987). A paleomagnetic aspect on the assemblage of East Asian fragmented continents. *IGCP Project 224. Pre-Jurassic geological evolution of eastern continental margin of Asia, Report 2*, 139–150.
- Sasajima, S., Otofujii, Y., Hirooka, K., Suparka, Suwijanto & Hehuwat, F. (1978). Palaeomagnetic studies on Sumatra Island and the possibility of Sumatra being part of Gondwanaland. *Rock magnetism and Paleogeophysics*, **5**, 104–110.
- Sashida, K., Adachi, S., Igo, H., Koike, T. & Ibrahim Amnan (1995). Middle and Late Permian radiolarians from the Semanggol Formation, Northwest Peninsular Malaysia. *Transaction and Proceedings of the Palaeontological Society of Japan, New Series*, **177**, 43–58.
- Sattayarak, N. (1983). Review of the continental Mesozoic stratigraphy of Thailand. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand, Geological Society of Malaysia, 127–148.
- Sattayarak, N.; Srilulwong, S. and Pum-im, S. (1989). Petroleum potential of the Triassic pre-Khorat intermontane basin in northeastern Thailand. *Proceedings of the international symposium on Intermontane basins: geology and resources*, Chiang Mai University, Thailand, 43–58.
- Savage, H.E.F. (1937). The geology of the neighbourhood of Sungei Siput, Perak, Federated Malay States, with an account

- of the mineral deposits. *Geological Survey Department, Federation Malaya Memoir*, 1, 46 pp.
- Sazli Kamaruddin, Md Zin Che Lah, Lancelot Sering, Good, A. & Lim, H.K. (2000). Pushing the envelope – extending the limits of current drilling technology. *Society of Petroleum Engineers Paper SPE 64696*, SPE International Oil and Gas Conference & Exhibition, Beijing, 7–10 Nov. 2000, 5 pp.
- Schmidt, M.W. (1992). Amphibole composition in tonalite as a function of pressure: an experimental calibration of the Al in hornblende barometer. *Contributions to Mineralogy and Petrology*, 110, 304–310.
- Schmidtke, E., Fuller, M. & Haston, R. (1990). Paleomagnetic data from Sarawak, Malaysian Borneo, and the Late Mesozoic and Cenozoic tectonics of Sundaland. *Tectonics*, 9, 123–140.
- Schwartz, M.O. & Askury, A.K. (1990). Granite magmatism and tin-tungsten metallogensis in the Kuantan–Dungun area, Malaysia. *Geological Society of Malaysia Bulletin*, 26, 147–179.
- Schwartz, M.O., Rajah, S.S., Askury, A.K., Putthapiban, P. & Djaswadi, S. (1995). The Southeast Asian tin belt. *Earth Science Reviews*, 38, 95–293.
- Scrivenor, J.B. (1910). The tourmaline-corundum rocks of Kinta (Federated Malay States). *Quarterly Journal of Geological Society of London*, 66, 435–449.
- Scrivenor, J.B. (1913a). Geology of Malaya. *Quarterly Journal of the Geological Society of London*, 69, 343–369.
- Scrivenor, J.B. (1913b). The Gopeng Beds of Kinta. *Quarterly Journal Geological Society of London*, 68, 140–163.
- Scrivenor, J.B. (1917). Report on the Enggor Coal-field. *Supplement to FMS Gazette Year 1917*, Government Press, Kuala Lumpur, 1–3.
- Scrivenor, J.B. (1926). The palaeontology of British Malaya. *Journal British Royal Asiatic Society*, 4, 173–184.
- Scrivenor, J.B. (1928). *The geology of the Malayan ore deposits*. MacMillan Press, London, 216 pp.
- Scrivenor, J.B. (1931). *The Geology of Malaya*. Macmillan and Co. Ltd., London, 217 pp.
- Scrivenor, J.B. & Jones, W.R. (1919). *The Geology of South Perak, North Selangor and the Dindings*. Government Press, Kuala Lumpur, 196 pp.
- Seet, C.P. (1982). Geology of the Gunung Tahan Area (Sheet 58). *Geological Survey of Malaysia Annual Report, 1982*, 118–124.
- Selamat, S., Goh, S.T. & Lee, K.S. (1999). Seligi depletion management. *Society of Petroleum Engineers Paper SPE 57251*; SPE Asia Pacific Improved Oil Recovery Conference, Kuala Lumpur, 25–26 Oct. 1999, 11 pp.
- Şengör, A.M.C. (1984a). The Cimmeride orogenic system and the tectonics of Eurasia. *Geological Society of America Special Paper*, 195, 82 pp.
- Şengör, A.M.C. (1984b). The Cimmerides of eastern Asia: history of the eastern end of Palaeo-Tethys. *Mémoires de la Société Géologique de France*, 147, 139–167.
- Şengör, A.M.C. (1986). The dual nature of the Alpine–Himalayan system; progress, problems and prospects. *Tectonophysics*, 127, 177–195.
- Shamsudin Jirin & Morley, R.J. (1994). Lower Cretaceous Palynomorphs from the Termus and Mangking Formations (Tembeling Group), Peninsular Malaysia: their stratigraphic and climatic significance. *Abstract, Annual Geological Conference '94, Geological Society of Malaysia*, 45.
- Shand, S.J. (1943). *Eruptive rocks*. T. Murby and Co., London, 2nd edition, 444 pp.
- Shaw, S.E. & Flood, R.H. (1981). The New England batholith, eastern Australia: Geochemical variation in time and space. *Journal of Geophysical Research*, 86, 10530–10544.
- Sherwood, N.R., Cook, A.C. & Tantisukrit, C. (1984). Petrology of a suite of sedimentary rocks associated with some coal-bearing basins in northwestern Thailand. *International Journal of Coal Geology*, 4, 45–71.
- Shi, G.R. & Archibold, N.W. (1995). Permian brachiopod faunal sequence of the Shan-Thai terrane: biostratigraphy, palaeobiogeographical affinities and plate tectonics/ palaeoclimatic implications. *Journal of Southeast Asian Earth Sciences*, 6, 25–39.
- Shi, G.R. & Waterhouse, J.B. (1991). Early Permian brachiopods from Perak, West Malaysia. *Journal of Southeast Asian Earth Sciences*, 6, 25–39.
- Shi, G.R., Mohd Shafeea Leman & Tan, B.K. (1997). Early Permian brachiopods of Gondwana affinity from the Singa Formation, Langkawi Island, northwestern Peninsular Malaysia. *In: Phisit Dheeradilok et al.*

- (eds) *Proceedings International Conference on stratigraphy and tectonic evolution of southeast Asia and the South Pacific and the associated meetings of IGCP 359 and IGCP 383*, Bangkok. 67–72.
- Shu, Y.K. (1969). Some northwest trending faults in the Kuala Lumpur and other areas. *Geological Society of Malaysia Newsletter*, 17, 1–5.
- Shu, Y.K. (1989). Geology and mineral resources of the Kuala Klawang area, Jekebu, Negeri Sembilan. *Geological Survey of Malaysia District Memoir*, 20, 208 pp.
- Simons, W.J.F.; Socquet, A.; Vigny, C.; Ambrosius, B.A.C.; Haji Abu, S.; Promthong, C.; Subarya, C.; Sarsito, D.A.; Matheussen, S.; Morgan, P. & Spakman, W. (2007). A decade of GPS in Southeast Asia: resolving Sundaland motion and boundaries. *Journ. of Geophysical Research*, 112, B06420, doi: 10.1029/2005JB0003868.
- Singapore (1976). *Geology of the Republic of Singapore*, Public Works Department, Singapore, 1–79.
- Singh, D.S. (1985). Geological map of Peninsula Malaysia (8th edition). *Geological Survey of Malaysia*.
- Singh, D.S. & Bean, J.H. (1967). Some general aspects of tin minerals in Malaysia. *Technical Conference on Tin, London 1967*, 2, 459–478, International Tin Council.
- Singh, D.S., Chu, L.H., Teoh, L.H., Loganathan, P., Cobbing, E.J. & Mallick, D.I.J. (1984). The Stong Complex: a reassessment. *Geological Society of Malaysia Bulletin*, 17, 61–77.
- Singh, I. & Ford, C.H. (1982). The occurrence, causes and detection of abnormal pressure in the Malay Basin. *Offshore South East Asia 82 Conference*, 9–12 Feb. 1982, Singapore, 11 pp.
- Singh, N. & Azman A. Ghani (2000). Sempah Volcanic Complex, Pahang. *Proceeding of the Geological Society of Malaysia Annual Geological Conference 2000*, 67–72.
- Sita Ram, G., Chakraborty, K.R. & Sharifah Barlian Aidid (1980). Instrument neutron activation analysis for rare earth elements in dolerite dykes of Kuantan area, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 13, 87–92.
- Siti Norhajar Hassan & Basir Jasin (2004). Kajian awal radiolarian berusia Trias dari Formasi Semanggol di Bukit Lada, Kedah. *Geological Society of Malaysia Bulletin*, 49, 67–70.
- Sivam, S.P. (1968). Radiocarbon dates in the Kinta Valley. *Geological Society of Malaysia Newsletter*, 15, 1.
- Sivam, S.P. (1969). *Quaternary alluvial deposits in the north Kinta Valley, Perak*. Unpubl. M.Sc. thesis, Dept. of Geology, University of Malaya.
- Slingerland, R. (1984). Role of hydraulic sorting in the origin of fluvial placers. *Journal of Sedimentary Petrology*, 54, 137–150.
- Slingerland, R. & Smith, N. (1986). Occurrence and formation of water-laid placers. *Annual Review of Earth and Planetary Science*, 14, 113–147.
- Smiley, C.J. (1970). Later Mesozoic Flora from Maran, Pahang, West Malaysia. Part 1: Geologic Consideration. *Geological Society of Malaysia Bulletin*, 3, 77–88.
- Smith, J.M. (1969). Report on mineral investigations in the Ulu Sokor area. *Geological Survey of Malaysia Internal Report*.
- Smith, N.D. & Beukes, N.J. (1983). Bar to bank convergences: a contribution to the origin of alluvial placers. *Economic Geology*, 78, 1342–1349.
- Snelling, N.J. (1967). Age determination Unit. Summary of results from the Pacific and S.E.Asia. *Institute of Geological Sciences Annual Report for 1966*, 32–33.
- Solomon, G.J., Chandramohan, S., Karra, S. & Sonrexa, K. (1995). Hidden oil leg: Case study of the Lower D1 Miocene sandstone, Dulang Field, offshore Peninsular Malaysia. *Society of Petroleum Engineers Paper SPE 29294*, SPE Asia Pacific Oil & Gas Conference & Exhibition, Kuala Lumpur, 20–22 Mar. 1995, 18 pp.
- Sonrexa, K., Azly Aziz, Solomon, G.J., Bandal, M., Mohd Khalid Embong & Hashim Wahir (1995). Role of reservoir simulation of complexly-faulted, multi-reservoir Dulang Field, offshore Malaysia. *Society of Petroleum Engineers Paper SPE 29855*; SPE Middle East Technical Conference & Exhibition, Bahrain, 11–14 Mar. 1995, 24 pp.
- Soo, S.W. (1968). Reconnaissance Soil Survey of Perak. *Department of Agriculture Malayan Soil Survey Report*, 1.
- Spiller, F.C.P. (2002) Radiolarian Biostratigraphy of Peninsular Malaysia and Implications for Regional Palaeotectonics and Palaeogeography. *Palaeontographica Abteilung A*, 266, 1–91.

- Spiller, F.C.P. & Metcalfe, I. (1995). Late Palaeozoic radiolarians from the Bentong–Raub suture zone, and the Semanggol Formation of Peninsular Malaysia—initial results. *Journal of Southeast Asian Earth Sciences*, **11**, 217–224.
- Stait, B.A. & Burrett, C.F. 1984. Early Ordovician polyplacophoran *Chelodes whitehousei* from Tarutao Island, southern Thailand. *Alcheringa*, **8**, 112.
- Stauffer, P.H. (1969). Tin mineralization and faults in the Kuala Lumpur region, *Geological Society of Malaysia Newsletter*, **20**, 5–7.
- Stauffer, P.H. (1968). The Kuala Lumpur Fault Zone: a proposed major strike-slip fault across Malaya. *Geological Society of Malaysia Newsletter*, **15**, 2–4.
- Stauffer, P.H. (1973a). Cenozoic. In: Gobbett, D.J. & Hutchison, C.S. (eds) *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 143–176.
- Stauffer, P.H. (1973b). Late Pleistocene age indicated for volcanic ash in West Malaysia. *Geological Society of Malaysia Newsletter*, **40**, 1–4.
- Stauffer, P.H. (1973c). Kenny Hill Formation. In: Gobbett, D.J. & Hutchison, C.S. (eds) *Geology of the Malay Peninsula*. Wiley-Interscience, New York, 87–91.
- Stauffer, P.H. (1978). Anatomy of the Australasian tektite strewnfield and probable site of its source crater. In: Nutalaya, P. (ed) *Proceedings of the third regional conference of geology and mineral resources of S.E. Asia*, 285–289, Asian Institute of Technology, Bangkok.
- Stauffer, P.H. & Lee, C.P. (1986). Late Paleozoic glacial marine facies in Southeast Asia and its implications. *GEOSEA V Proceedings*, *Geological Society of Malaysia Bulletin*, **20**, 363–397.
- Stauffer, P.H. & Mantajit, N. (1981). Late Paleozoic tilloids of Malaya, Thailand and Burma. In: Hambrey, M.J. & Harland, W.B. (eds) *Earth's pre-Pleistocene glacial record*. Cambridge University Press, 331–337.
- Stauffer, P.H. & Snelling, N.J. (1977). A Precambrian trondhjemite boulder in Palaeozoic mudstones of NW Malaya. *Geological Magazine*, **114**, 479–482.
- Stephens, W.E. & Halliday, A.N. (1984). Geochemical contrasts between late Caledonian granitoid plutons of northern, central and southern Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **75**, 259–273.
- Subramaniam, S. (1996). *Geologi dan stratigrafi kawasan Genting jengka, Pahang Darul Makmur, Malaysia*. Unpubl. B.Sc. thesis, Dept. of Geology, University of Malaya.
- Sugeng S. Surjono, Mohd Shafeea Leman, Che Aziz Ali. & Kamal Roslan Mohamed (2004). A review of the Paleozoic stratigraphy of East Johore. *Geological Society of Malaysia Bulletin*, **49**, 71–78.
- Sugeng S. Surjono, Mohd Shafeea Leman, Kamal Roslan Mohamed & Che Aziz Ali (2006). Sedimentary facies development of breccia deposit in Tanjung Sekakap-Tanjung Murau area, near Mersing, Johore, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **49**, 157–167.
- Suggate, S. & Hall, R. (2003). Predicting sediment yields from SE Asia: a GIS approach. *Proceedings of 29th annual convention of the Indonesian Petroleum Association*, Jakarta, 289–304.
- Suhaileen Shahar (2005). The prospectivity of fractured basement play of the Malay Basin. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2005, 6–7 Dec. 2005, Kuala Lumpur, Program & Abstracts*, 42.
- Suntharalingam, T. (1968). Upper Palaeozoic stratigraphy of the area west of Kampar, Perak. *Geological Society of Malaysia Bulletin*, **1**, 1–15.
- Suntharalingam, T. (1983a). Cenozoic stratigraphy of Peninsular Malaysia. *Proceedings of the workshop on stratigraphic correlation Of Thailand and Malaysia, 1: Technical papers*, Geological Society of Thailand & Geological Society of Malaysia, 149–158.
- Suntharalingam, T. (1983b). Stratigraphy of the Quaternary deposits in the Taiping - Beruas - Lumut area, Perak. *Geological Survey of Malaysia Annual Report 1981*, 167–171.
- Suntharalingam, T. (1984a). Quaternary stratigraphy and prospects for placer tin in the Taiping-Lumut area, Perak. *Geological Society of Malaysia Bulletin*, **17**, 9–32.
- Suntharalingam, T. (1984b). Studies on the Quaternary geology of Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **10**, 101–110.
- Suntharalingam, T. (1987). Quaternary Geology of the Coastal Plain of Beruas, Perak.

- Geological Survey of Malaysia Quaternary Geology Bulletin*, **2**, 70 pp.
- Suntharalingam, T. (1991). Geology and Mineral Resources of the Hulu Sedili Area, Johor Darul Ta'zim. *Geological Survey Malaysia Map Report*, **2**, 86 pp.
- Suntharalingam, T. & Ghani Ambak (1984). Quaternary stratigraphy and prospects for tin placer deposits in the Kuantan area, Pahang. *Geological Society of Malaysia Bulletin*, **20**, 791–801.
- Suntharalingam, T. & Teoh, L.H. (1985). Quaternary geology of the coastal plains of Taiping. *Geological Survey of Malaysia Quaternary Bulletin*, **1**, 64 pp.
- Syed Sheikh Almashoor (1996). New value of displacements of Bok Bak Fault and its implication on the Chuping Limestone Formation of Kedah and Perlis, Malaysia. *Geological Society of Malaysia Bulletin*, **39**, 101–104.
- Syed Sheikh Almashoor & Tjia, H.D. (1987). A prominent fault across the Malaysia-Thai boundary; preliminary report. *Geological Society of Malaysia Warta Geologi*, **13**, 35–37.
- ## T
- Tam C.F. (2005). *Clastic sedimentology in Kota Gelanggi, Pahang and surrounding areas*. Unpubl. B.Sc. thesis, Dept. of Geology, University of Malaya.
- Tamura, M. (1968). *Claraia* from North Malaya, with a note on the distribution of *Claraia* in Southeast Asia. In: Kobayashi, T. & Toriyama, R. (eds) *Geology and Palaeontology of Southeast Asia*, **5**, 78–87.
- Tan, B.K. (1976). Tectonic development of Peninsular Malaysia (Abstract). *Geological Society of Malaysia discussion meeting on "Geology of South China Sea area including its continental rim"*, Ipoh.
- Tan, B.K. (1981). On the supposed existence of the Kisap thrust in the Langkawi Islands, Northwest Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **14**, 127–133.
- Tan, B.K. (1982). Structures in Peninsular Malaysia and their interpretations. *Geological Society of Malaysia Bulletin*, **15**, 1–7.
- Tan, B.K. (1984). The tectonic framework and evolution of the Central Belt and its margins, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **17**, 307–322.
- Tan, B.K. (1996). 'Suture Zones' in Peninsular Malaysia and Thailand: implications for paleotectonic reconstruction of Southeast Asia. *Journal of Southeast Asian Earth Sciences*, **13**, 242–249.
- Tan S.B. (1977). *Geology and geochemical studies of Pulau Aur, Pulau Pemanggil and the southern rim of Pulau Tioman including the adjacent seafloor, Johore Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Tanner, J.J. & Kennett, W.E. (1972). Petroleum development in Far East in 1971. *American Association of Petroleum Geologists Bulletin*, **56**, 1823–1845.
- Tantiwanit, W., Raksaskulwong, L. & Mantajit, N. (1983). The Upper Palaeozoic pebbly rocks in southern Thailand. *Proceedings of the workshop on stratigraphic correlation of Thailand and Malaysia*, **1**: Technical papers, Geological Society of Thailand & Geological Society of Malaysia, 96–104.
- Tapponnier, P., Peltzer, G., Le Dain, A. Y., Armijo, R. & Cobbold, P. (1982). Propagating extrusion tectonics in Asia, new insights from simple experiments with plasticine. *Geology*, **10**, 611–616.
- Tarling, D.H. (1981). Models for fragmentation of Gondwana. In: Cresswell, M.M. and Vella, P. (eds) *Gondwana Five*, A.A. Balkema, Rotterdam, 261–266.
- Tarney, J. & Jones, C.E. (1994). Trace element geochemistry of orogenic igneous rocks and crustal growth models. *Journal Geological Society of London*, **151**, 855–868.
- Taylor, D. (1971). An outline of the geology of Bukit Ibam orebody, Rompin, Pahang. *Geological Society of Malaysia Bulletin*, **4**, 71–89.
- Taylor, D. (1986). Some thoughts on the development of the alluvial tinfields of the Malay-Thai Peninsula. *Geological Society of Malaysia Bulletin*, **19**, 375–392.
- Taylor, D. & Toh, S.C. (1981). Regional mineral exploration, Pahang Tenggara: a case history of base-metal project in the Malay Peninsula. *Asia Mining, Proceedings of the 1981 meeting*, 67–78.
- Taylor, R.G. (1979). *Geology of tin deposits*. Development in Economic Geology **11**, Elsevier, Amsterdam, 543 pp.
- Teh, G.H. (1981). The Tekka tin deposit, Perak, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **14**, 101–118.

- Teh, G.H. (1994). Barite and associated massive sulphide and Fe-Mn mineralization in the Central Belt of Peninsular Malaysia. *Geological Society of Malaysia Warta Geologi*, **20**, 101–102.
- Teh, G.H. & Sia, S.G. (1991). The Nenering Tertiary deposit, Keroh, north Perak – a preliminary study. *Geological Society of Malaysia Warta Geologi*, **17**, 49–58.
- Teh, T.S. (1976). Evolution of the Older Permatang Series of Kelantan. *Geographica*, **11**, 20–29.
- Teh, T.S. (1980). Morphostratigraphy of a double sand barrier system in Peninsular Malaysia. *Malaysian Journal of Tropical Geography*, **2**, 45–55.
- Teichmüller, M. (1974). Generation of petroleum-like substances in coal seams as seen under the microscope. In: Tissot, B. & Biener, F. (eds) *Advances in Organic Geochemistry 1973*, 321–348. Editions Technip, Paris.
- Teoh, L.H. (1992). Geology and Mineral Resources of Sungai Tiang Area, Kedah Darul Aman. *Geological Survey of Malaysia Map Report*, **5**, 93 pp.
- Thambydurai, R., Mustapha, A.F., Mueller, K.H. & Dixon, M.R. (1988). Jerneh Gas Field development planning. OSEA 88199, 7th Offshore South East Asia Conference, Singapore, 2–5 Feb. 1988, 11 pp.
- Thi, L.K. (1984). *Geological and geophysical surveys of south-eastern portion of Malacca*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Thomas, B.M., Moller-Pedersen, P., Whitaker, M.F. & Shaw, N.D. (1985): Organic facies and hydrocarbon distributions in the Norwegian North Sea. In: Thomas, B.M., Doré, A.G., Eggen, S.S., Home, P.C. & Larsen, R.M. (eds) *Petroleum Geochemistry in Exploration of the Norwegian Shelf*, 3–26. Norwegian Petroleum Society.
- Thomas, H.D. (1963). Silurian corals from Selangor, Federation of Malaya. *Overseas Geology and Mineral Resources*, **9**, 39–46.
- Thomas, H.D. & Scrutton, C.T. (1969). Palaeozoic corals from Perak, Malaya, Malaysia. *Overseas Geology and Mineral Resources*, **10**, 164–171.
- Tjia, H.D. (1964). Topographic lineaments in Riau and Lingga archipelagoes, Indonesia: their structural significance. *International Geological Congress, report of the 22nd session, New Delhi*, **4**, 566–581, Sundaram, Calcutta.
- Tjia, H.D. (1969). Regional implication of Lebir fault zone. *Geological Society of Malaysia Newsletter*, **19**, 6–7.
- Tjia, H.D. (1970). Quaternary shore lines of the Sunda Land, Southeast Asia. *Geologie en Mijnbouw*, **49**, 135–144.
- Tjia, H.D. (1972). Strike-slip faults in West Malaysia. *International Geological Congress, 24th Session, Montreal, Section 3*, 255–262.
- Tjia, H.D. (1973). Geomorphology. In: Gobbett, D.J. & Hutchison, C.S. (eds) *Geology of the Malay Peninsula*, Wiley-Interscience, New York, 13–24.
- Tjia, H.D. (1974). Sesar Sungkup dan cangaan bertindan di Kuala Dungun. *Sains Malaysiana*, **3**, 37–66.
- Tjia, H.D. (1975a). Western extension of the Kuala Lumpur Fault Zone. *Geological Society of Malaysia Newsletter*, **1** (2), 30–33.
- Tjia, H.D. (1975b). Holocene eustatic sea levels and glacioisostatic rebound. *Zeitschrift für Geomorphologie*, N.F., suppl. Bd. **22**, 57–71.
- Tjia, H.D. (1976). Lepar Fault Zone, Pahang. *Geological Society of Malaysia Warta Geologi*, **2**, 99–101.
- Tjia, H.D. (1977). Western extension of the Kuala Lumpur Fault Zone. *Geological Society of Malaysia Bulletin*, **8**, 123–125.
- Tjia, H.D. (1978). Structural geology of Peninsular Malaysia. In: Nutalaya, P. (ed) *Proceedings of the third regional conference of geology and mineral resources of S.E. Asia*, 673–682, Asian Institute of Technology, Bangkok.
- Tjia, H.D. (1982). Disharmonic folds at Tanjung Mat Amin, Trengganu. *Geological Society of Malaysia Warta Geologi*, **8**, 258–259.
- Tjia, H.D. (1983). Cangaan bertindan di Tanjung Gelang, Pahang. *Sains Malaysiana*, **12**, 101–117.
- Tjia, H.D. (1984). Multi-directional tectonic movements in the schist of Bentong, Pahang. *Geological Society of Malaysia Warta Geologi*, **10**, 187–189.
- Tjia, H.D. (1986a). Geologic transport directions in Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **20**, 149–177.
- Tjia, H.D. (1986b). Disparate Late Quaternary shorelines in Peninsular Malaysia - shift of the geoids or crustal movement? (Abstract). *Geological Society of Malaysia Warta Geologi*, **12**, 91.
- Tjia, H. D. (1987). Olistostrome in the Bentong area, Pahang. *Geological Society of Malaysia Warta Geologi*, **13**, 105–111.

- Tjia, H.D. (1988). Tectonic history of the Bentong–Bengkalis Suture. *Geological Society Malaysia Petroleum Geology Seminar 1988 (Abstract)*.
- Tjia, H.D. (1989a). Tectonic history of the Bentong–Bengkalis suture. *Geologi Indonesia*, **12**, 89–111.
- Tjia, H.D. (1989b). Structural geology of Datai beds and Macincang Formation, Langkawi. *Geological Society of Malaysia Bulletin*, **23**, 85–120.
- Tjia, H.D. (1989c). Superimposed structures in Upper Palaeozoic metasediments, Eastern Johor (abstract). *Geological Society of Malaysia Warta Geologi*, **15**, 33.
- Tjia, H.D. (1992). Holocene sea-level changes in the Malay–Thai Peninsula, a tectonically stable environment. *Geological Society of Malaysia Bulletin*, **31**, 157–176.
- Tjia, H.D. (1993). The Kisap Thrust in the Kampung Kilim area, Pulau Langkawi. *Geological Society of Malaysia Warta Geologi*, **19**, 247–250.
- Tjia, H.D. (1994). Inversion tectonics in the Malay Basin: evidence and timing of events. *Geological Society of Malaysia Bulletin*, **36**, 119–126.
- Tjia, H.D. (1996). Tectonics of deformed and undeformed Jurassic–Cretaceous strata of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **39**, 131–156.
- Tjia, H.D. (1997). The Kuala Lumpur Fault Zone revisited. *Geological Society of Malaysia Warta Geologi*, **23**, 225–230.
- Tjia, H.D. (1998a). Meridian-parallel faults and Tertiary basins of Sundaland. *Geological Society of Malaysia Bulletin*, **42**, 101–118.
- Tjia, H.D. (1998b). Origin and tectonic development of the Malay–Penyu–West Natuna basins. *Geological Society of Malaysia Bulletin*, **42**, 147–160.
- Tjia, H.D. (1999a). Structural overprinting in the northwest and west domains of Peninsular Malaysia (abstract). *Geological Society of Malaysia Warta Geologi*, **25**, 208–213.
- Tjia, H.D. (1999b). Geological setting of Peninsular Malaysia. In: PETRONAS. *The Petroleum Geology and Resources of Malaysia*, Kuala Lumpur, 139–169.
- Tjia, H. D. (1999c). Regional north-south Terengganu faults: Besut, Kampung Buluh and Ping-Teris (abstract). *Geological Society of Malaysia Warta Geologi*, **25**, 120.
- Tjia, H.D. (2000a). Tectonics of deformed and undeformed Jurassic–Cretaceous strata of Peninsular Malaysia (abstract). *Geological Society of Malaysia Warta Geologi*, **26**, 80.
- Tjia, H.D. (2000b). Tectonic and structural development of Cenozoic basins of Malaysia (abstract). *Geological Society of Malaysia Warta Geologi*, **26**, 163.
- Tjia, H.D. (2004). Periglacial involutions, large folded recumbent folds and tectonic overprints at Putrajaya. *Geological Society of Malaysia Bulletin*, **48**, 97–102.
- Tjia, H.D. & Liew, K.K. (1996). Changes in tectonic stress field in northern Sunda Shelf basins. In: Hall, R. & Blundell, D. (eds) *Tectonic Evolution of Southeast Asia*; Geological Society of London Special Publication, **106**, 291–306.
- Tjia, H.D. & Mohd Idrus Ismail (1994). Tectonic implications of well-bore breakouts in Malaysian basins. *Geological Society of Malaysia Bulletin*, **36**, 175–186.
- Tjia, H.D. & Syed Sheikh Almashoor (1988). Geology and the chaotic deposits at Bukit Penagoh, Negeri Sembilan. *Sains Malaysiana*, **17**, 121–135.
- Tjia, H.D. & Syed Sheikh Almashoor (1996). The Bentong suture in southwest Kelantan, Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **39**, 195–211.
- Tjia, H.D. & Zaiton Harun (1985). Regional Structures of Peninsular Malaysia. *Sains Malaysiana*, **14**, 95–107.
- Tjia, H.D., Fujii, S. & Kogoshi, K. (1977). Changes of sea level in the southern South China Sea area during Quaternary times. *CCOP Technical Publication*, **5**, 11–36.
- Toh, E.S.C. (1978). Comparison of exploration for alluvial tin and gold. *11th Commonwealth Mining and Metallurgy Congress, Hong Kong 1978 Proceedings*, 269–275.
- Towner, R.R. (1981). Late Paleozoic tillites of the Canning Basin, Western Australia. In: Hambrey, M.J. & Harland, W.B. (eds) *Earth's pre-Pleistocene glacial record*. 449–452, Cambridge University Press.
- Tulloch, A.J. (1979). Secondary Ca–Al silicates as low grade alteration products of granitoid biotite. *Contributions to Mineralogy and Petrology*, **69**, 105–117.
- Tulyatid, J. & Fairhead, J.D. (1999). Tectonic development of Central Thailand: new evidences from airborne geophysical data. *Proceedings of GEOSEA '98, Geological Society of Malaysia Bulletin*, **43**, 63–76.
- Twidale, C.R. (2005). Granitic terrains. In: Gupta, A. (ed) *The Physical Geography of*

Southeast Asia, Oxford University Press, 123–141.

U

- UNDP (2006). Malaysia's Peat Swamp forests, Conservation and sustainable use. *United Nations Development programme*, 1–33. Ministry of Natural resources and environment, Malaysia, Danida, GEF, UNDP.
- Uyop Said & Che Aziz Ali (1997). Nenering continental deposits: its age and palynological evidence [abstract], *Geological Society of Malaysia Warta Geologi*, **23**, 170–171.
- Uyop Said & Che Aziz Ali (2000). On the Palynomorph Assemblage from the Panti Sandstone, Kota Tinggi, Johor. *Proceedings of Geological Society of Malaysia Annual Conference 2000*, 137–138.
- Uyop Said & Shahfuddin Mustaffa (1999). A palynomorph assemblage from Bukit Mambai, Labis, Johor. *Geological Society of Malaysia Warta Geologi*, **25**, 131.
- Uyop Said & Syahrul Salehudin (2001). A palynological study on an Early Cretaceous rock sequence at Bukit Belah, Batu Pahat, Johor. *Proceedings of Geological Society of Malaysia Annual Conference 2001*, 91–97.
- Uyop Said, Marahizal Malihan & Zainey Konjing (2007). Neocomian palynomorph assemblage from Central Pahang, Malaysia. *Geological Society of Malaysia Bulletin*, **53**, 21–25.
- Veevers, J.J. & Tewari, R.C. (1995). Gondwana master basin of Peninsular India: between Tethys and the interior of the Gondwanaland province of Pangea. *Geological Society of America Memoir*, **187**, 1–73.
- Vernon, R.H. (1990). Crystallisation and hybridism in microgranitoid enclave magmas: microstrutural evidence. *Journal of Geophysical Research*, **95**, 17849–17859.
- Verstappen, H.Th. (1974). On palaeo climates and landform development in Malaysia. *Modern Quaternary Research in SE Asia*, **1**, 3–35.
- Vijayan, V.R. (1990). Gravity survey of the Layang-Layang Tertiary Basin in Johor, Peninsular Malaysia - A preliminary report. *Geological Society of Malaysia Bulletin*, **26**, 55–70.
- Villaseca, C., Barbero, L. & Herreros, V. (1998). A re-examination of the typology of peraluminous granite types in intracontinental orogenic belts. *Transactions of the Royal Society Edinburgh: Earth Sciences*, **89**, 113–119.
- Vilpponen, A.B. (1988). *Sedimentology and Stratigraphy of the Jurong Formation, Singapore*. Unpubl. M.A. thesis, National University of Singapore.
- Voris, H.K. (2000). Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems and time durations. *Journal of Biogeography*, **27**, 1153–1167.
- Vozenin-Serra, C. (1989). Lower Permian continental flora of Sumatra. In: Fontaine, H. & Gafoer, S. (eds). *The pre-Tertiary fossils of Sumatra and their environments*. CCOP technical papers, **19**, United Nations, Bangkok, 53–57.

V

- Van Bemmelen, R.W. (1949). *The geology of Indonesia*, 1A: *General geology of Indonesia and adjacent archipelagos*, 2: *economic geology*, 1B: *portfolio and index*, 1st edition, Government Printing Office, The Hague, 732 pp.
- Van Bemmelen, R.W. (1970). *The geology of Indonesia*, 1A: *General geology of Indonesia and adjacent archipelagos*, 2: *economic geology*, 1B: *portfolio and index*. 2nd edition, Martinus Nijhoff, The Hague, 732 pp.
- Van de Graaff (1981). Early Permian Lyons Formation, Carnarvon Basin, Western Australia. In: Hambrey, M.J. & Harland, W.B. (eds) *Earth's pre-Pleistocene glacial record*. 453–458, Cambridge University Press.

W

- Wakita, K. & Metcalfe, I. (2005). Ocean plate stratigraphy in East and Southeast Asia. *Journal of Asian Earth Sciences*, **24**, 679–702.
- Walker, D. (1956). Studies on the Quaternary of the Malay Peninsula. I. Alluvial deposits of Perak and the relative levels of land and sea. *Journal Federation Museum*, **1 & 2**, (New Series), 19–34.
- Wan Fuad Wan Hassan & Heru Sigit Purwanto (2002). Type deposits of primary gold mineralization in the Central Belt of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, **45**, 111–115.

- Wan Fuad Wan Hassan & Heru Sigit Purwanto (2004). Radiometric age of Kampung Awah Andesite. *Geological Society of Malaysia Bulletin*, **48**, 51–54.
- Wan Hasiah Abdullah (1997a). Depositional palaeoenvironment determination based on organic facies characterisation — A case study of the Batu Arang coal-bearing sequence. *Summary of Abstracts Geological Society of Malaysia Annual Conference 1997*, 93.
- Wan Hasiah Abdullah (1997b). Evidence of early generation of liquid hydrocarbon from suberinite as visible under the microscope. *Organic Geochemistry*, **27**, 591–596.
- Wan Hasiah Abdullah & Abolins, P. (1998). Organic petrological and organic geochemical characterisation of the Tertiary coal-bearing sequence of Batu Arang, Selangor, Malaysia. *Journal of Asian Earth Sciences*, **16**, 351–367.
- Wan Ismail Wan Yusoff (1984). Heat flow study in the Malay Basin. *Combined Proceedings Joint ACOPE/CCOP Workshops on Heat Flow*, CCOP Technical Publication, **15**, 77–87.
- Wan Ismail Wan Yusoff (1988). Heat flow in offshore Malaysian basins. *Proceedings of CCOP Heat Flow Workshop*, CCOP Technical Publication, **21**, 39–54.
- Wan Mohamad, W.N., Abdullah, M.A.Y, Selamat, S. & Elias, M.R. (2005). Applications of improved and enhanced oil recovery strategies in the Tapis Field. *Society of Petroleum Engineers Paper SPE 97693*, SPE International Improved Oil Recovery Conference in Asia Pacific, Kuala Lumpur, 5–6 Dec. 2005, 11 pp.
- Wang, Z. & Tan, X. (1994). Palaeozoic structural evolution of Yunnan. *Journal of Southeast Asian Earth Sciences*, **9**, 345–348.
- Waples, D.W., Mahadir Ramly & Leslie, W. (1995). Implications of vitrinite-reflectance suppression for the tectonic and thermal history of the Malay Basin. *Geological Society of Malaysia Bulletin*, **37**, 269–284.
- Waples, D.W., Mahadir Ramly & Meor Shahrin Mahmood (2000). Geochemistry of gases in the Malay Basin. *American Association of Petroleum Geologists International Conference & Exhibition, 15–18 Oct. 2000, Bali, Indonesia* (Abstract).
- Waterhouse, J.B. (1982). An early Permian cool-water fauna from pebbly mudstones in South Thailand. *Geological Magazine*, **119**, 337–354.
- Wee, H.T. & Taylor, D. (1974). A major unconformity exposed in Sungei Siput, Pahang. *Geological Society of Malaysia Bulletin*, **7**, 79–88.
- White, A.J.R. & Chappell, B.W. (1983). Granitoid types and their distributions in the Lachlan Fold Belts; southeastern Australia. In: Roddick, J.A. (ed). *Circum-Pacific plutonic Terranes*. Geological Society of America Memoir, **159**, 21–34.
- White, J.M., Jr. & Wing, R.S. (1978): Structural development of the South China Sea with particular reference to Indonesia. *Proceedings of the 7th Annual Convention of the Indonesian Petroleum Association*, Jakarta, 159–178.
- Wikarno, D.A.D., Suyatna & Sukardi, D. (1988). Granitoids of Sumatra and the tin islands. In: Hutchison, C.S. (ed) *Geology of Tin Deposits in Asia and the Pacific*. Springer-Verlag, Heidelberg, 571–589.
- Willbourn, E.S. (1917). The Pahang Volcanic Series. *Geological Magazine*, **54**, 447–462.
- Willbourn, E.S. (1922). *An account of the geology and mining industries of south Selangor and Negeri Sembilan*. Baptist Mission Press, Calcutta, 115 pp.
- Willbourn, E.S. (1926-1927). The Beatrice Mine, Sebilin, Federated Malay States. *Mineralogical Magazine*, **35**, 329–338; **36**, 9–15.
- Willbourn, E.S. (1931). The occurrence in-situ of corundum-bearing rocks in British Malaya. *De Mijnggenieur, Bandung*, **10**, 170–176.
- Willbourn, E.S. (1936). A short account of the geology of those tin-deposits of Kinta that are mined by alluvial methods. *Journal Engineers Association of Malaya*, **4**, 255–264.
- Willbourn, E.S. & Ingham, F.T. (1933). Geology of the scheelite mine, Kramat Pulai, F.M.S. *Quarterly Journal of the Geological Society of London*, **89**, 449–479.
- Williams, H.H., Kelly, P.A., Janks, J.S. & Christensen, Rm.M. (1985). The Paleogene rift basin source rocks of Central Sumatra. *Proceedings of the 14th Annual Convention of the Indonesian Petroleum Association*, Jakarta, **2**, 57–90.
- Williamson, B.J., Downes, H. & Thirwall, M.F. (1992). The relationship between crustal magmatic underplating and granite genesis: an example from the Velay granite complex, Massif Central, France. *Transaction of*

- Royal Society Edinburgh: *Earth Sciences*, **83**, 235–245.
- Winkler, H.G.F. (1967). *Petrogenesis of metamorphic rocks*. Springer-Verlag, Berlin, 237 pp.
- Wong, I.F.T. (1960). *The agglomerate of Bukit Kepayang, Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Wong, L.C. (1974). *Geology of the Kampong Batu Melintang area, north west Kelantan, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Wong, R.H.F. (1999). Petroleum resources, Peninsular Malaysia. In: PETRONAS. *The Petroleum Geology and Resources of Malaysia*; Kuala Lumpur, 253–272.
- Wong, R.H.F, Boyce, B., Krebs, S., Md Yazid Mansor, Barber, P., Morley, R.J., Shamsudin Jirim, Jaizan Hardi Mohamed Jais, M. Jamaal Hoesni, Kirk, R., Meldrum, G., Pott, M., Mazlan Madon & Mansor Ahmad (2006). Chronostratigraphic chart of the sedimentary basins of Malaysia. *Geological Society of Malaysia Petroleum Geology Conference & Exhibition 2006*, 27–28 Nov. 2006, Kuala Lumpur, Program & Abstracts, 82–84.
- Wongsosantiko, A. (1976). Lower Miocene Duri Formation sands, Central Sumatra basin. *Proceedings of the 5th Annual Convention of the Indonesian Petroleum Association*, Jakarta, 63–76.
- Wongwanich, T., Burrett, C.F., Tasathien, W. & Chaodumrong, P. (1990). Lower to Mid Palaeozoic stratigraphy of mainland Satun province, southern Thailand. *Journal of Southeast Asian earth sciences*, **4**, 1–9.
- Wopfner, H. (1994). Late Palaeozoic climates between Gondwana and Western Yunnan. In: Cho, M & Kim, J. H. (eds). *IGCP 321 Gondwana dispersion and Asian accretion. Fourth International symposium and field excursion, Abstract volume*, 127–131.
- Wüst, R.A.J. & Bustin, R.M. (2004). Late Pleistocene and Holocene development of the interior peat-accumulating basin of tropical Tasek Bera, Peninsular Malaysia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **211**, 241–270.
- Wüst, R.A.J., Bustin, M., Lee, C.P. & Wan Hasiah Abdullah (1999). Holocene peat accumulation in a tropical intermontane mire system, Tasik Bera, West Malaysia: implication for coal formation. *Geological Society of Malaysia Bulletin*, **43**, 229–249.
- Wüst, R.A.J., Bustin, R.M. & Lavkulich, L.M. (2003). New classification systems for tropical organic-rich deposits based on studies of the Tasek Bera Basin, Malaysia. *Cantena*, **53**, 133–163.

Y

- Yancey, T.E. (1975). Evidences of Devonian unconformity and middle Paleozoic Langkawi folding phase in NW Malaya. *American Association of Petroleum Geologists Bulletin*, **59**, 1015–1019.
- Yancey, T.E. & Boyd, D.W. (1983). Revision of the Alantoconchidae: a remarkable family of Permian bivalves. *Palaeontology*, **26**, 497–520.
- Yang, W. (1994). Lower Permian palynological studies of the Tenchong Block in western Yunnan, China. *International symposium on Permian stratigraphy, environments and resources, Abstracts*, Guiyang, China, 44–45.
- Yang, Z., Cheng, Y. & Wang, H. (1986). The geology of China. *Oxford monographs on geology and geophysics*, **3**, Clarendon Press, Oxford, 303 pp.
- Yap, F.L. (1986). Age determination on the Kuantan granite and dolerite dykes. *Geological Society of Malaysia Bulletin*, **20**, 415–422.
- Yap, F.L. and Kwan, T.S., (1984). Age of cassiterite mineralization near Wing Sang Cheong tin mine, Ipoh. *Geological Society of Malaysia Warta Geologi*, **10**, 247–248.
- Yap, K.T. (1996). Tapis Field: Lower Group J Reservoir. *PRSS Technology Forum*, 12–13 Sept. 1996, Awana Genting, Kuala Lumpur, 1 p.
- Yap, L. S. (1976). *Geology of the Tanjong Gelang area, Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yap, L.S. & Tan, B.K. (1980). Deformation of the Upper Paleozoic rocks at Tanjong Gelang, Pahang. *Geological Society of Malaysia Bulletin*, **12**, 45–54.
- Yates, K.R. (1970). *Preliminary report on the Ulu Sokor lead-zinc-silver-gold deposit in the State of Kelantan, West Malaysia* (unpubl.) McPhar Geophysics Pty. Ltd., Australia.
- Yeap, C.H. (1966). *Geology of the Sungai Lembing area, Pahang, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.

- Yeap, C.H. (1979). Prospecting of a deep alluvial tin deposit. *SEATRAD Centre Seminar On Drilling & Sampling Techniques in Tin Prospecting*.
- Yeap, C.H. (1980). The Kuala Lumpur tinfield. *SEATRAD Centre Technical Publication*, 1, 23–56.
- Yeap, C.H. (1981). *The Kuala Langat Tin Field*. Paper presented at the 5th World Conference on Tin, Kuala Lumpur, 19–23 October 1981, 19 pp.
- Yeap, E.B. (1970). *Geology of the Petaling Jaya–Salak South area, Selangor, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yeap, E.B. (1982). Reinterpretation of the Fe–Sn mineralization at the Waterfall Mine, Pelepah Kanan, Johore. *Geological Society of Malaysia Warta Geologi*, 8, 228–229.
- Yeap, E.B. (1984). Geology of some Malaysian Fe–Sn deposits and their significance. Abstracts of Papers, GEOSEA V. *Geological Society of Malaysia*, 39.
- Yeap, E.B. (1993). Tin and gold mineralization in Peninsular Malaysia and their relationships to the tectonic development. *Journal of Southeast Asian Earth Sciences*, 8, 329–348.
- Yeap, E.B. (1997). The types and the origin of carbonate karsts in Malaysia and their significance. *Proceedings of Geological Society of Malaysia Annual Geological Conference 1997*, 98–104.
- Yeap, E.B. & Pereira, J.J. (1993). The structure and gold mineralization in the Kim Chuan Gold Mine, Bukit Koman, Pahang (Abstract). *Geological Society of Malaysia Warta Geologi*, 19, 137.
- Yeap, K.L. (1986). *Geology of an area south of Bahau*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yeoh, G.C. (1975). *Geology of the Genting Highlands area, Selangor-Pahang, with some aspects of geotechnics*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yeow, Y.H. (1975). *Weathering of rocks in humid tropical conditions*. Unpubl. Ph.D. thesis, Dept. of Geology, University of Malaya.
- Yew, C.C. (1971). *The geology and mineralization of the eastern Kuala Lumpur area, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yii, S.S. (1980). *Conodont Biostratigraphy of the Kodiang Limestone, Kodiang, Kedah, West Malaysia*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Yin, E.H. (1965). Provisional draft report on the Geology and Mineral Resources of the Gua Musang Area, Sheet 45, South Kelantan. *Geological Survey of Malaysia*, 49 pp.
- Yin, E.H. (1976). *Geological Map of Kuala Lumpur*. Geological Survey of Malaysia.
- Yin, E. H. (1988). *Geological Map of Peninsular Malaysia*, 8th edition, Geological Survey of Malaysia, Kuala Lumpur.

Z

- Zakaria, A.S. (1975). The geomorphology of Kelantan delta (Malaysia). *Cantena*, 3, 337–350.
- Zakaria Hussain (1986). Laporan kemajuan: Pemetan Geologi Kawasan Labis, syit 116, Johor. *Geological Survey of Malaysia Annual Report 1986*, 142–151.
- Zainol Affendi, A.B. (1988). *General Geology and dolerite dykes from Kuantan Pahang*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Zainal Ismail (1984). *Petrology and geochemistry of Santi area, Pengerang, South-east Johore*. Unpubl. B.Sc. (Hons) thesis, Dept. of Geology, University of Malaya.
- Zaiton Harun (1994). Zon sesar Alur Lebey (The Alur Lebey Fault Zone). [abstract], *Geological Society of Malaysia Warta Geologi*, 20, 219–220.
- Zaiton Harun (2002). Late Mesozoic – early Tertiary faults of Peninsular Malaysia. *Geological Society of Malaysia Bulletin*, 45, 117–120.
- Zaiton Harun & Basir Jasin (1999). Implications of Bok Bak fault movements on the structure and lithostratigraphy of the Pokok Sena area, *Geological Society of Malaysia Bulletin*, 43, 145–153.
- Zaiton Harun & Basir Jasin (2000). The occurrence of thrusts in north Kedah and Perlis (Abstract). *Geological Society of Malaysia Warta Geologi*, 26, 163.
- Zakaria Hussain (1986). Laporan kemajuan : Pemetan Geologi Kawasan Labis, syit 116, Johor. *Geological Survey of Malaysia Annual Report, 1986*, 142–151.
- Zalina Zainal (1997). *Geochemical and palynology studies of the peat sequence in the New Lahat Mine Sdn Bhd (Eastern Part), Lahat, Perak, Malaysia*. Unpubl. B.Sc. thesis, Dept of Geology, University of Malaya.

- Zhai, Y.J., Zhang, Z.K., Li, Y.A., Li, Q., Li, Y.P. *et al.* (1988). A study of Upper Carboniferous palaeomagnetism for the Tarim Block. *Geosciences*, **2**, 43–56, in Chinese with English abstract.
- Zhao, X. & Coe, R.S. (1987). Palaeomagnetic constraints on the collision and rotation of North and South China. *Nature*, **327**, 141–142.
- Zhao, Z.H., Masuda, A. & Shabani, M.B. (1993). REE tetrad effects in rare metal granites. *Chinese Journal of Geochemistry*, **12**, 206–219.
- Zwierzijcki, J. (1935). Die geologischen Ergebnisse der Palaobotanischen Djambi-Expedition 1925. *Jaarboek Mijnwezen Nederlandsch Oost Indië, Verhandelingen* 1930, **59** (2), 1–70.