

# Contents

---

1. INTRODUCTION	1
1.1. General	1
1.2. History of geological studies	3
1.2.1. Thailand	3
1.2.2. Burma	4
1.2.3. Indochina (Kampuchea, Laos, Vietnam)	4
1.2.4. Indonesia	5
1.2.5. Philippines	5
1.2.6. Peninsular Malaysia and Singapore	5
1.2.7. Sarawak, Sabah, and Brunei	6
1.3. The modern era of geological co-operation	6
2. LATE MESOZOIC AND CAINOZOIC TECTONIC FEATURES	8
2.1. General	8
2.2. Wallace's Line and its meaning	8
2.3. Oceanic crust of the Indian Ocean and marginal seas	10
2.3.1. Okinawa Trough	10
2.3.2. Western Philippine Sea Basin	10
2.3.3. Palau Ridge and Ayu Trough	12
2.3.4. Banda Sea	13
2.3.5. Celebes Sea Basin	13
2.3.6. Sulu Sea	13
2.3.7. South China Sea Basin	14
2.3.8. Indian Ocean Basin	14
2.3.9. Andaman Sea Basin	17
2.4. The Bengal and Nicobar abyssal fans	18
2.5. Gravity measurements	21
2.6. Active plate margins	21
2.6.1. Ryukyu island arc	21
2.6.2. Taiwan	25
2.6.3. Philippine sector	25
2.6.4. Molucca Sea collision zone	28
2.6.5. Banda Sea	32
2.6.6. Collision between the Australian continent and the Banda arc	34
2.6.7. Sunda arc-trench system	35
2.6.8. The Burman arc-trench system	41
2.7. The main continental plates and microcontinents	45
2.7.1. Sundaland	46

2.7.2.	Australia	46
2.7.3.	Continental fragments between Sundaland and Australia	48
2.8.	Fracture system of south-east Asia	57
2.8.1.	Palaeomagnetic evidence	60
3.	CAINOZOIC SEDIMENTARY BASINS	63
3.1.	Basin classification	63
3.1.1.	Basins on rifted rigid lithosphere	63
3.1.2.	Atlantic-type miogeoclinal basins	65
3.1.3.	Cratonic basins	67
3.1.4.	Deep sea trenches	67
3.1.5.	Foredeep or retro-arc basins	67
3.1.6.	Fore-arc basins	67
3.1.7.	Intra-arc basins	67
3.1.8.	Marginal sea basins	67
3.1.9.	Back-arc basins	67
3.1.10.	Basins on and peripheral to microcontinents	67
3.1.11.	Pannonian-type	67
3.1.12.	Major river deltas	67
3.2.	Effect of global sea level cycles	69
3.3.	Geothermal gradients	71
3.4.	The basins of south-east Asia	71
3.4.1.	Basins of Sumatra and Java	72
3.4.2.	Tertiary basins of Borneo	77
3.4.3.	Basins of the Sunda Shelf and Gulf of Thailand	88
3.4.4.	Basins of the Philippine archipelago	94
3.4.5.	Basins of eastern Indonesia	99
3.4.6.	Northern Australian shelf, margins and basins	101
4.	PHANEROZOIC TECTONIC FRAMEWORK	104
4.1.	Introduction	104
4.2.	Analysis of the tectonic framework	104
4.2.1.	Gondwana and Cathaysia affinities	107
4.2.2.	Method of analysis	108
4.2.3.	The information source	108
4.3.	Tectono-stratigraphic evolution	111
4.3.1.	Cambrian to Silurian (530–425 Ma)	111
4.3.2.	Silurian to Devonian (425–380 Ma)	111
4.3.3.	Devonian to Carboniferous (380–340 Ma)	113
4.3.4.	Carboniferous to Permian (340–255 Ma)	113
4.3.5.	Permian to Triassic (255–220 Ma)	116
4.3.6.	Triassic to Jurassic (220–150 Ma)	119
4.3.7.	Jurassic to Cretaceous (150–80 Ma)	121

4.3.8. Cretaceous to Neogene (80–20 Ma)	123
4.4. Re-activation of suture zones	123
4.5. Palinspastic reconstructions	125
4.5.1. Earliest Palaeozoic times	126
4.5.2. Late Devonian to Early Carboniferous	126
4.5.3. Late Permian to Early Triassic	128
4.5.4. Late Triassic–Early Jurassic	128
4.5.5. Late Jurassic–Early Cretaceous	129
4.5.6. Late Cretaceous	130
4.5.7. Cainozoic era	131
<b>5. TERRAINS OF CATHAYSIAN AFFINITY</b>	<b>133</b>
5.1. South China Block	133
5.1.1. Yangzi Platform basement	133
5.2. Palaeogeographic position of Cathaysia	141
5.3. North Vietnam complex suture-fault zone	142
5.3.1. Cainozoic faulting	143
5.3.2. Area north of the Song Chay Fault	146
5.3.3. Area between the Song Chay and Song Ma faults	147
5.3.4. Area south-west of the Song Ma Fault	150
5.3.5. Palaeo position of Indosinia relative to Cathaysia	151
5.3.6. The unanswered questions	151
5.4. Indosinia Block	151
5.4.1. Kontum Massif	152
5.4.2. Other Precambrian massifs	152
5.4.3. The Phanerozoic sedimentary cover of Indosinia	153
5.5. Eastmal Block (Eastern Peninsular Malaysia)	161
5.5.1. Terrain A	163
5.5.2. Terrain B	165
5.5.3. Terrain C	167
5.5.4. Western platform of Eastmal	168
5.5.5. The major structures	176
5.5.6. Post-orogenic rift tectonics	180
5.6. West Borneo Basement Block	181
5.6.1. West Borneo Basement	181
5.6.2. Kuching Zone	184
5.6.3. Sibul Zone	188
5.7. Eastern Borneo	189
5.7.1. Miri Zone	189
5.7.2. Rajang Group flysch belt	191
5.7.3. Eastern ophiolite-mélange zone	192
5.7.4. Tectonic scenario	194
5.8. Sumatra	196

5.8.1.	Djambi overthrust mass	197
5.8.2.	Peusangan Group	199
5.8.3.	Woyla Group	200
6.	GONDWANA AFFINITY TERRAINS	201
6.1.	Introduction	201
6.2.	The Tibet Plateau	201
6.2.1.	The Tanggula tectonic block	201
6.2.2.	The Lhasa block	206
6.3.	The Himalayan tectonic terrain	208
6.3.1.	Tethyan Himalayas	208
6.3.2.	Lesser Himalayas	211
6.3.3.	Siwalik Range	212
6.3.4.	Structure of the Himalaya and Tibet	212
6.3.5.	Palaeomagnetic position	214
6.4.	The Indian Plate	216
6.4.1.	Precambrian basement	216
6.4.2.	The Gondwanas	218
6.4.3.	Post-glacial Gondwanas	220
6.4.4.	The Godavari coastal graben	221
6.4.5.	The Rajmahal Traps	221
6.4.6.	Indo-Gangetic Plains	221
6.4.7.	West Bengal–Surma–Digboi Basin	221
6.5.	West Burma Block	225
6.6.	Sinoburmalaya	226
6.6.1.	Precambrian basement	227
6.6.2.	Machinchang–Tarutau–Moloheim Formations	229
6.6.3.	Ordovician platform	232
6.6.4.	Silurian	233
6.6.5.	Devonian	235
6.6.6.	Carboniferous diamictite belt	237
6.6.7.	Carboniferous outside of the diamictite zone	239
6.6.8.	Permian	241
6.6.9.	Triassic	243
6.6.10.	Tectonic evolution	245
6.6.11.	Jurassic	248
6.6.12.	Cretaceous	250
6.6.13.	Cainozoic continental basins on Sundaland	250
7.	OPHIOLITES AND SUTURES	253
7.1.	Ophiolitic sutures	253
7.1.1.	Donqiao ophiolite of the Bangong–Dengqen–Nujiang suture	253
7.1.2.	Indus–Yarlung–Zangbo ophiolite suture	255

7.1.3. Song Ma ophiolite	259
7.1.4. Song Da synclinorium	259
7.1.5. Tamky-Phuocson Trungson zone	259
7.1.6. Uttaradit-Luang Prabang-Dien Bien Phu line	259
7.1.7. Sra Kaeo ultramafics	260
7.1.8. Bentong-Raub line	261
7.1.9. Arakan Yoma-Chin-Naga Hills	262
7.1.10. Mandalalay-Jade Mines	263
7.1.11. Meratus Mountains of SE Borneo	264
7.1.12. Serabang line	265
7.1.13. Boyan mélange	265
7.1.14. Lupar line	265
7.1.15. Tatau-Mersing line	267
7.1.16. Tjiletuh Bay-Loh Ulo, Java	267
7.1.17. Gumai, Garba Mountains, and Aceh line	267
7.1.18. Andaman-Nicobar islands	268
7.1.19. Nias	268
7.2. Ophiolites of Cainozoic island arcs	268
7.2.1. Darvel Bay-Labuk-Palawan	268
7.2.2. Taiwan	271
7.2.3. Philippines	271
7.2.4. Halmahera (Indonesia)	273
7.2.5. Sulawesi (Indonesia)	273
7.2.6. Timor (Indonesia)	275
7.2.7. Southern Banda Arc, east of Timor	275
7.2.8. Seram, north-east of Ambon	275
7.2.9. Irian Jaya (West New Guinea)	275
8. THE GREAT SUNDA-PACIFIC VOLCANIC ARCS	276
8.1. Gandise arc of the Indus-Zangbo-Yarlung system	276
8.2. Burma-Andaman Sea sector	277
8.3. Indonesia	278
8.3.1. Age of volcanism	278
8.3.2. Eruptive activity	280
8.3.3. Sumatra	281
8.3.4. Java to Flores	281
8.3.5. The extinct sector north of Timor	283
8.3.6. Banda arc	283
8.3.7. Molucca Sea collision zone	284
8.3.8. Source of the lavas	284
8.4. Borneo	285
8.4.1. Hose Mountains	285
8.4.2. Linau-Balui Plateau	285

8.4.3. Usun Apau Plateau	285
8.4.4. Nieuwenhuis Mountains	285
8.4.5. Sebuda	285
8.4.6. Sekatak–Kujau	285
8.4.7. Sesayap	285
8.4.8. Gunung Didi and Malinau–Bahau Ridge	286
8.4.9. Volcanic plateaus east and west of the Upper Bahau	286
8.4.10. Plateaus north and south of Pujungan	286
8.4.11. East Kayan volcanic zone	286
8.4.12. The Bayangkara Formation	286
8.4.13. Tungku Formation, Dent Peninsula	286
8.5. Philippines	286
8.5.1. Cagayan Ridge of the Sulu Sea	286
8.5.2. Semporna–Sulu Archipelago arc	286
8.5.3. Mindanao	288
8.5.4. Central islands of Negros to Leyte	288
8.5.5. Luzon	288
8.6. Taiwan	289
8.6.1. Eastern Coastal Range	289
8.6.2. North Taiwan	289
8.6.3. Penghu islands	290
8.7. Ryukyu arc	290
8.8. Cainozoic rift-related alkaline basalt	290
8.8.1. Related to the Malaya and Penyu basins	290
8.8.2. Related to the Tonle Sap–Mekong basin	291
8.8.3. Red River–Gulf of Bacbo	291
9. GRANITE AND ASSOCIATED PLUTONIC ROCKS	293
9.1. Tibet	293
9.1.1. Gandise or Transhimalayan batholith system	293
9.1.2. Lhagoi–Kangri belt	295
9.1.3. High Himalayan belt	295
9.1.4. Lesser Himalayan belt	295
9.2. Sanjiang fold system of western Yunnan	296
9.3. South-east China	298
9.4. Indochina region	300
9.4.1. Precambrian magmatism	300
9.4.2. Early Palaeozoic magmatism	300
9.4.3. Late Palaeozoic to Triassic	301
9.4.4. Mesozoic intrusions	303
9.4.5. Palaeogene intrusions of North Vietnam	303
9.5. Sundaland granite belts	305
9.5.1. Eastern calc-alkaline volcano-plutonic arc	305

## CONTENTS

xv

9.5.2. Central belt	306
9.5.3. Gneissic granites and metamorphic complexes along the western margin of the Central Basin and eastern margin of the Main Range	307
9.5.4. Main Range batholith system	307
9.5.5. South Peninsular Thailand	309
9.5.6. North-west continental Thailand	310
9.5.7. Late Cretaceous granites of western Thailand–Burma	310
9.5.8. Late Cretaceous rift-related granites	314
9.5.9. Sumatra	314
9.5.10. Borneo	315
9.5.11. Eastern Indonesia	316
<b>References</b>	<b>318</b>
<b>Index</b>	<b>350</b>