

CHAPTER 2

GEOLOGY

2.1 Physiography

The peninsular Thailand is situated under the influence of tropical monsoon climate (The Glenn T. Trewartha classification system, Arthur and Alan, 1979) except an area along the eastern coast from Nakhon Si Thammarat to Songkhla which has the tropical rainfall climate. The temperature is fairly uniform within the range of 24° - 28°C, and there is a cold season with temperature down to just below 20°C during November to mid February. The average annual rainfall of the region is very high of approximately 1,866 mm (Table 2.1 and Figure 2.1) with heavy rainfall throughout most of the year with no distinct dry season.

The topography of area can be subdivided into 3 zones, namely, high mountainous, undulating, and flat areas. The high mountain ranges of mainly limestone, conglomerate and sandstone rocks of Khao Sam Chom, Khuan Sanai and Khao Yai extending in the central part of study area covering about 40% of the study area. The highest peak is Khao Sam Chom with approximate elevation of 754 metres above the mean sea level. The undulating area is located in the central and western parts of area with the elevation ranges of 150-200 metres above the mean sea level covering about 35% of the study area. The flat areas of mainly floodplain deposits of Khlong Min, Khlong Thom, and Khlong Lam Daeng have the elevation range between 120-150 metres above the mean sea level.

Most of the major drainage systems flow approximately towards the north and northeast directions except Khlong Lam Daeng and Khlong Thom which flow

Table 2.1 Monthly rainfall and relative humidity:1997(Department of Meteorological,
cited in Statistical reports of Krabi Province, 1998)

Month	Rainfall (mm)	No. of rainy days	Temperature °(C)		Relative Humidity %	
			Minimum	Maximum	Minimum	Maximum
Jan.	4.2	2	18.20	35.20	47.39	88.65
Feb.	142.5	8	22.20	35.10	54.93	90.18
Mar.	14.9	3	20.50	37.10	47.65	89.19
Apr.	134.2	9	22.10	36.90	54.43	90.83
May	106.9	17	23.40	35.70	62.97	92.48
Jun.	232.2	17	22.40	34.50	64.50	93.83
Jul.	178.3	20	22.10	33.50	68.58	94.48
Aug.	585.2	16	21.80	34.30	67.23	93.42
Sep.	297.0	17	22.40	33.40	68.67	94.50
Oct.	372.7	23	22.40	34.00	64.48	95.68
Nov.	103.6	17	21.70	34.20	64.77	94.07
Dec.	91.2	11	21.30	34.30	61.32	93.13
Annual	2263.1	160	18.20	37.10	60.58	92.54

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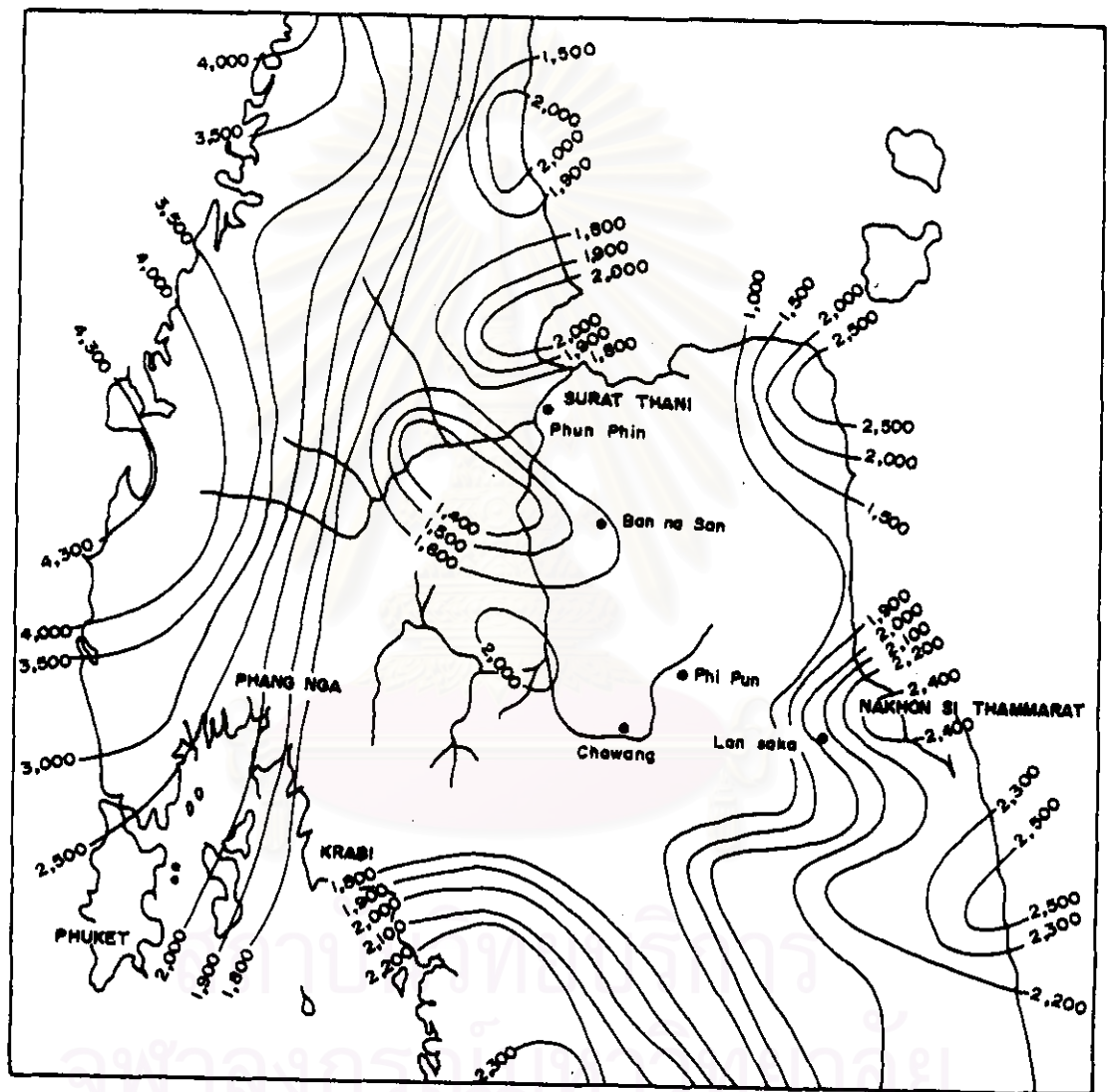


Figure 2.1 The average annual rainfall of peninsular Thailand.

towards the southeast and south directions into the Andaman Sea. The main rivers are Khlong Min and Khlong Lam Daeng in the central part of the study area.

The general drainage patterns of the study area are dendritic and subdendritic and the origin of the land form can be subdivided into 3 distinctive types (Figure 2.2) as follows:

1. Landform of denudation origin consists of high land and isolate hills covering about 50% of the area. This high mountain ranges extend northeastwardly to southwestwardly. This type of landform is underlain by limestone, shale interbedded with sandstone and conglomerate.

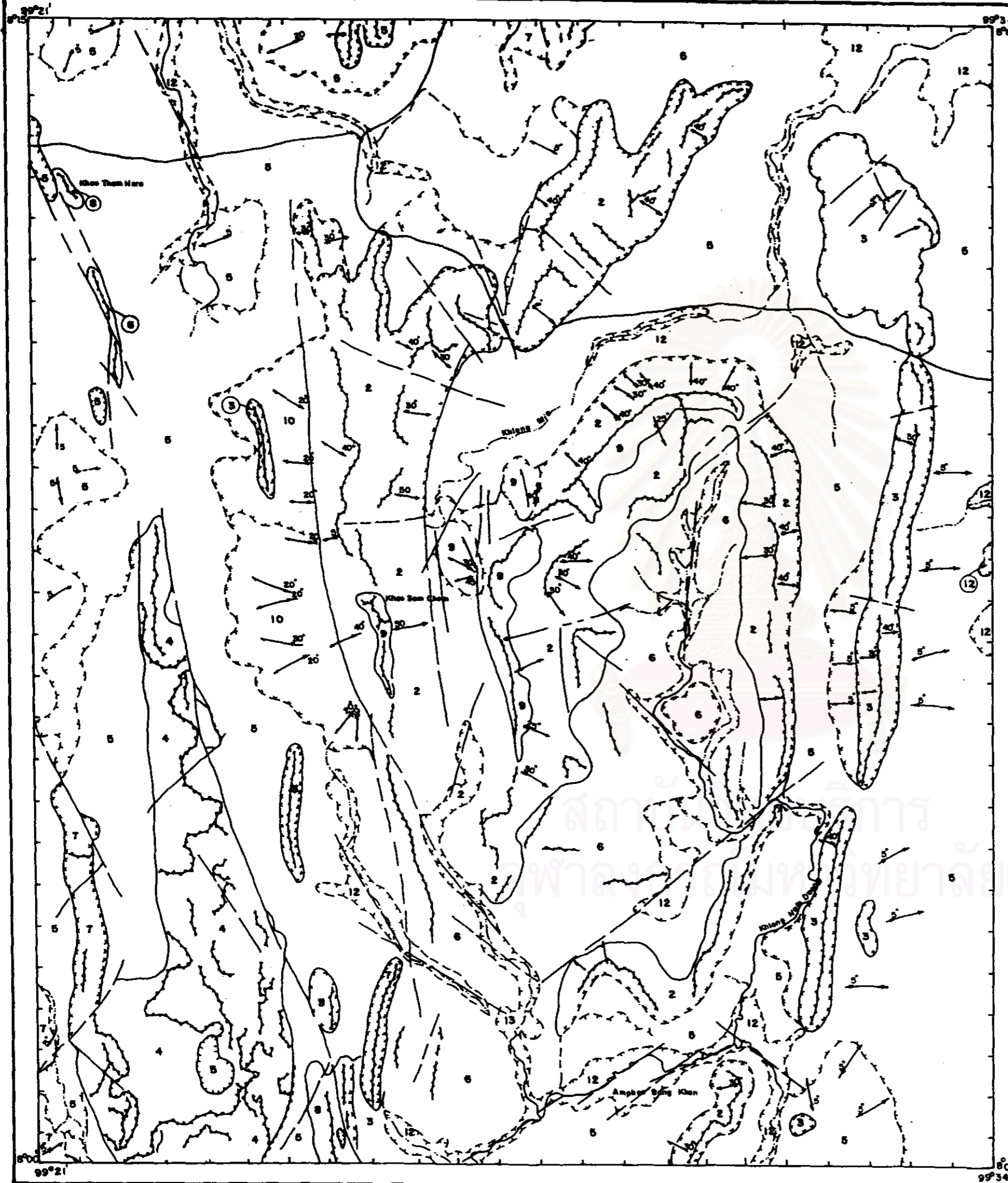
2. Landform of colluvium and slope movement origins consists of the undulating and slope features covering about 40% of the area. It composes of soil, debris and loose blocks of talus and old landslide masses.

3. Landform of alluvium origin is mainly present along the main rivers, Khlong Min and Khlong Lam Daeng. It consists of river terrace and floodplain deposits of gravel, sand, silt and clay.

2.2 Distribution of Mesozoic rocks in the lower southern Thailand

The Mesozoic sediments are rather widespread in Thailand and may be roughly classified as continental and marine deposits. The marine deposit consists of Triassic sediments in numerous areas of Lampang, Phrae, Nan, Tak, Mae Sarieng, Chantaburi, Rayong, Kanchanaburi, Pattalung and Songkhla (Chonglakmani, 1983), as well as the marine Jurassic sediments of Tak, Kanchanaburi, and Chumphon. The continental red beds are mostly distributed in the Khorat plateau and the lower southern Thailand.

Figure 2.2 **GEOMORPHOLOGICAL MAP**
THUNG YAI-KLONG THOM AREA



EXPLANATION
GEOMORPHOLOGICAL UNITS

I. UNITS OF DENUDATION ORIGIN

- 1 Mountainous area of conglomerate
- 2 Mountainous area of sandstone(1)
- 3 Mountainous area of shalesandstone
- 4 Mountainous area of limestone
- 5 Hilly area of colluvium
- 6 Hilly area of sandstone(2)
- 7 Hilly area of sandstone(1)
- 8 Hilly area of limestone

II. UNITS OF COLLUVIUM AND SLOPE MOVEMENT ORIGIN

- 9 Landslide
- 10 Tala
- 11 Colluvium

III. UNITS OF ALLUVIUM ORIGIN

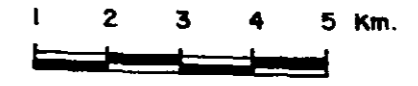
- 12 Floodplain
- 13 Terrace

SYMBOLS

- Cliff
- Concave break of slope
- Concave change of slope
- Shape ridge or crest
- Convex slope in east association
- Convex slope
- Concave slope
- Irregular and convex slope
- Fault
- Sinkhole



Scale



In southern region, sedimentary sequences of marine and non-marine origins extend from Chumphon, Surat Thani, Nakhon Si Thammarat to Trang.

A. Songkhla area

In the area, south to southeast of Songkhla, Grant-Mackie et al.(1978) reported marine Triassic sequences are similar to those of the Lampang Group in northern Thailand, except the lacking of volcanogenic components, and containing excessive conglomerate. The informal name, Na Thawi formation, is applicable to most of the Triassic strata in the region. The formation is characterised by a thin-bedded turbidite sequence with the fold structure axis transverse to the regional north-south structural trend, so-called the Payang Syncline. They also estimated the thickness of the Na Thawi formation to be of 3,000 metres containing *Daonella* sp.(Ladinian-Carnian). Besides, at one locality immediately west of the syncline, or approximately 60 kilometres south of Songkhla. The 500-metre thick conglomerate, so-called Khao Mai Kiat Conglomerate, consists of poorly sorted clasts up to small cobble size of quartzites, with the current-bedding indicating the northwardly flow direction. This conglomerate is likely to be the basal conglomerate of the Triassic strata.

The marine Triassic rocks in this area had been studied in detail again by Grant-Mackie et al.(1980). Details can be summarized as follows:

(1) Saba Yoi area

Grant-Mackie et al. (1980) studied some of the marine Triassic strata and further subdivided them into 4 lithostratigraphic units in descending order as follows:

Sani formation: It is characterised by the association of siltstone, siliceous or non-siliceous fine sandstone, black chert, and fine to medium conglomerate of totally 4,300 metres thick.

Klong Kon Limestone: It consists of light gray to gray massive limestone of up to 600 metres thick.

Chedi Conglomerate: It consists of massive quartzose-conglomerate of totally 250 metres thick.

Suan Chan formation: It consists of siltstone interbedded with graded sandstone of totally 1,700 metres thick.

They further correlated the Klong Kon Limestone to the Pha Kan Formation of Lampang Group.

(2) Na Thawi area

At the Na Thawi District, along the highway no. 42, a sedimentary sequence of marine Triassic has been exposed in descending order as follows:

Lam Long Sandstone: It consists of thin-bedded fine-grained sandstone of totally 3,700 metres thick.

Wang Yai Siltstone: It consists of gray laminated sandy siltstone of 3 metres thick.

Na Thawi formation: It consists of interbedded siltstone and siliceous sandstone with *Daonella* sp. of totally 3,000 metres thick. Its age, indicated by *Daonella* sp., is Middle Carnian.

Mai Kiat Conglomerate: It consists of quartzite conglomerate of totally 500 metres thick.

B. Chumphon area

Ammonites and bivalves indicated the Early Bajocian have been found in shaly rocks at Khao Lak, about 80 kilometres north of Chumphon (Meesook et al., 1994). The Khao Lak Formation consists of interbedded sandstone and shale with cherty limestone. Furthermore, the outcrops of these rocks and fossils are exposed in Tha Sae, Chumphon. The succession and assemblage of fossils are similar to those of the Khlong Min formation (Maneeni, pers. comm., 1999).

C. Eastern Nakhon Si Thammarat area

In this area, the Mesozoic rocks are exposed at Khao Phra Bat and Khao Daeng located in Chian Yai and Hua Sai. They are characterised by the association of sandstone, siltstone and mudstone, brown to brownish gray with bivalves and plant remains. They further proposed the name of this lithostratigraphic unit as Pra Bat Formation. Meesook and Grant-Mackie (1994) reported the age of the Pra Bat Formation is Toarcian.

D. Surat Thani-Trang area

Raksaskulwong (1994) proposed the non-marine Mesozoic rocks in this area as well as other neighbouring areas as the Trang Group. They consist of reddish brown shale, sandstone, conglomerate and reddish brown fine-grained sandstone of totally 760 metres thick. This sequence unconformably overlies the Ratburi Group. They are exposed in the area of Wiang Sa of Surat Thani, Thung Yai of Nakhon Si Thammarat, Khlong Thom of Krabi, and Wang Vi Set of Trang. This rock unit covers approximately 3,500 square kilometres as shown in Figure 2.3.

The area is predominantly underlain by sedimentary rocks of different ages ranging from Permian to Quaternary. Some volcanics and shallow intrusive rocks are

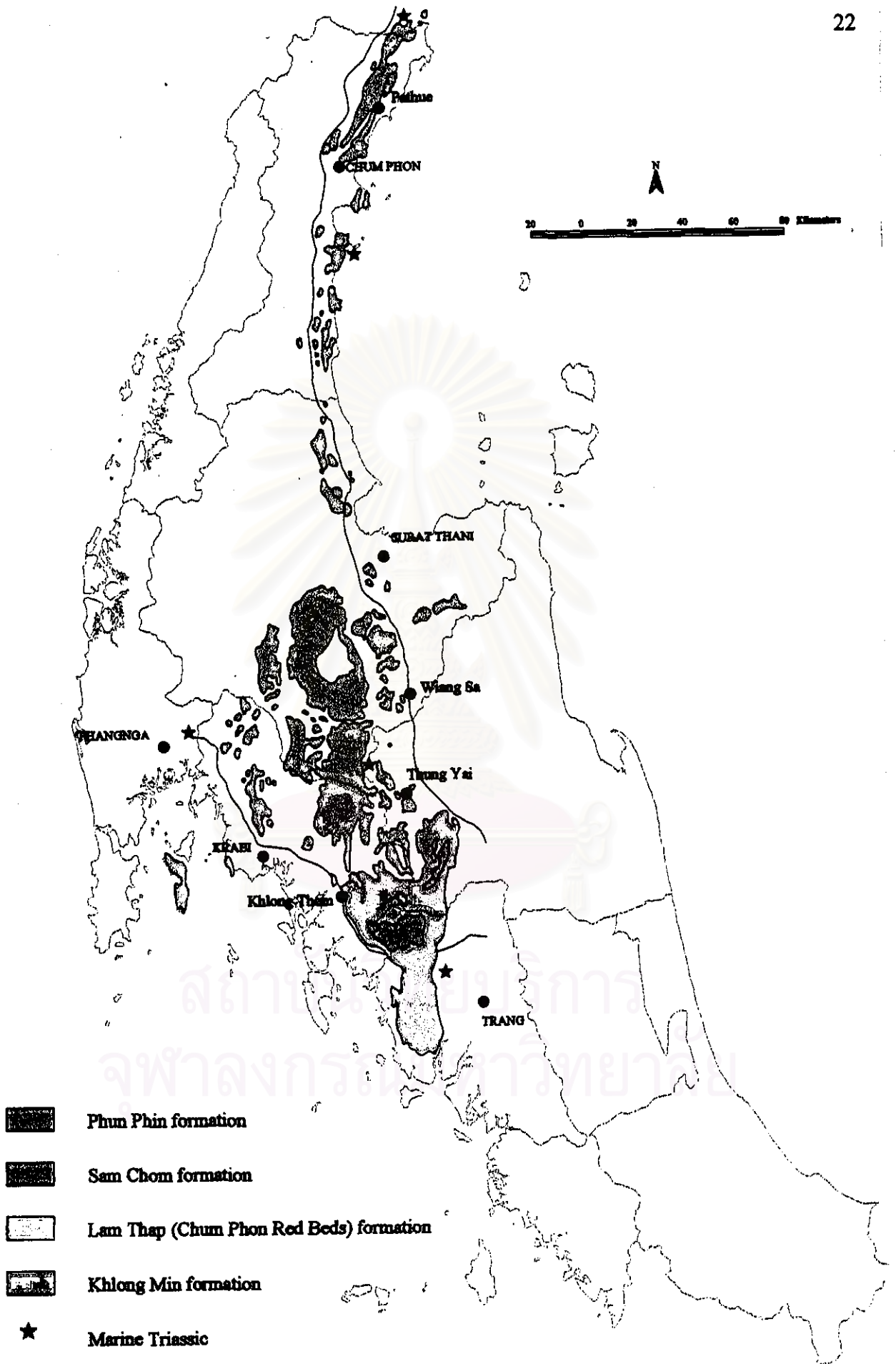


Figure 2.3 The distribution of the Trang group, southern Thailand (modified after Raksaskulwong, 1994).

exposed along the north-western margin of Sin Pun basin and eastern margin of Krabi basin (Raksaskulwong et al., 1989). The regional trend lies in the north-south direction. Lithostratigraphically, the non-marine Mesozoic rocks in the Thung Yai-Khlong Thom area have been designated by Raksaskulwong (1994) in ascending order as follows: Sai Bon formation, Chumphon red beds formation, Khlong Min formation, Khao Sam Chom formation, and Phun Phin formation, respectively.

2.3 Regional stratigraphy of the study area

The following stratigraphic subdivision and their nomenclature follow those adopted and established by the Department of Mineral Resources which appear in the 1:2,500,000 Geological Map of Thailand published in 1987. In addition, a few names proposed and added by other authors to outline the completion of the stratigraphy of the Thai peninsula (Tables 2.2 and 2.3).

Stratigraphy

The study area is underlain by contains rocks ranging in age from Permian to Recent (Figure 2.3). The geology of the region has been previously described previously by various workers i.e. Kobayashi&Tokuyama (1959), Hayami (1960), Javanaphet (1969), Garson et al. (1975), Snansieng et al. (1977), Grant-Mackie et al. (1978), Grant-Mackie et al. (1980), Udomratn et al. (1981), Asama et al. (1981), Raksaskulwong et al. (1989), Prasomsap et al. (1989), Chaimanee et al. (1990), Chonglakmani (1990), Meesook and Grant-Mackie (1994), Raksaskulwong (1994), Buffetaut et al. (1994), and Geology students of Department of Geology , Chulalongkorn University (1996, 1998) etc. Stratigraphic sequences in the central part consists mainly of thin-bedded to very thick-bedded limestone known as the Ratburi Group. The western and eastern part are mainly non-marine Mesozoic rocks. The description of those rock units are given below from the oldest to the youngest.

Table 2.2 Summarized stratigraphy of peninsular Thailand

System		Hayami 1960	Sawata & Arrykul, 1977	Grant- Mackie 1980 (Saba Yoi)	Grant- Mackie 1980 (Na Thawi)	Udomratn 1981	Lexicon,DMR 1982	Chonglak Mani 1983	Meesook 1994	Raksaskulwong 1994	Ampornmaha 1995	Fieldwork,CU 1998	This Thesis 1999	
Tertiary							Krabi Group			Krabi Group			Krabi Group	
Cretaceous	U						Undiff			Phun Phin Fm.		Khao Yai fm.	Na Dang fm.	Phun Phin fm.
	L													
Jurassic	U	<i>Eomiodon Chumphonensis</i> (arg.sst)	Phrabat Fm. (97.7m.)			Upper Unit	Undiff	?	Khao Lak Fm. and Phra Bat Fm.	Trang group				Sam Chom fm.
	M			Middle Unit	SK-PK	<i>Eomiodon bed</i> ?		Khlong Min Fm.			Lang Khao fm.	Sam Chom fm.		
	L			Lower Unit	Fm.			Chumphon red beds Fm.				Lam Thap fm.		
Triassic	U			Sani Fm.	Lam Long sst.	Low.most Unit	Mae Moei	Undiff.				Khuan Whwang fm.		Sai Bon fm.
	M			Chedi Cong.	Wang Yai slt.		Group	Khorat G.						
	L			Suan Chan Fm.	Na Thawi fm.		Lampang Group				(3 members)			
Permian	U													
	M											Khok Chak Phra fm.		Ratburi Group
	L						Ratburi Group							Ratburi Group

Table 2.3 Stratigraphic subdivision of Thailand (after Department of Mineral Resources, 1992)

Region System	Western Highland	Northern Highland	Peninsula	Eastern Gulf	Central Plain	Phetchabun Ranges	Khorat Plateau
Quaternary	Mae Taeng F		-	-	Bangkok Clay	-	-
Tertiary	Mae Moh G		Krabi G		(Mae Moh G)		-
Cretaceous				Undiff.			Maharakham F Khok Krut F Phu Phan F
Jurassic	Undiff. Sao Khua F Phu Kradung F	Phra Wihan F Phu Kradung	Undiff. Sao Khua F Phu Kradung		Phra Wihan F Phu Kradung F	Undiff. Sao Khua F Phu Kradung F	Sao Khua F Phra Wihan F Phu Kradung F
Triassic	Mae Moei G		Undiff. L Khorat G		Lampang G ?		Huai Hin Lat-NamPhong G
		Undiff	Lampang G Nam Pat F				
Permian		Ratburi G		Ratburi G ?	Saraburi G		
Carboniferous	Mae Hong Son F	Phrae F DanLanHoi G	Kaeng Krachan F	Dan Lan Hoi G ?		Wang Saphung F	
Devonian	Thong Pha Phum G	Sukhothai G	Sukhothai G				Pak Chom F
Silurian							
Ordovician	Thung Song G ?		Thung Song G	Thung Song G ?			
Cambrian	Tarutao G ?		Tarutao G	Tarutao G ?			
Pre-Cambrian	Lan Sang Gneiss Complex		Lan Sang Gneiss Complex ?				

(Mae Mo Group) = Concealed Group ? = Uncertain F = Formation - = Not known □ = No exposure
 G = Group Undiff = Undifferentiated

Permian

The Permian rocks in the Thai peninsula are mainly limestones which commonly show karstic topography. The name "Ratburi Group" (Javanaphet, 1969) or "Ratburi Limestone" (Brown et al., 1951) has been applied for the Permian succession through most part of Thailand.

The Ratburi Limestone is widely distributed throughout this area as isolated hills or monadnocks, exposing at Khao Thale Pron, Khao Thalu, Khao Tham Phedan and Khao Sam Nuai. Besides, this limestone forms the mountain ranges of Khuan Hin Som, Khuan Chong Hin and Khao Na Pu.

This sequence consists predominantly of medium-to very thick-bedded limestone, light gray to gray, with chert nodules, locally becoming dolomitic limestone and dolomite. Fossils of fusulinids (*Paraschawagerina*(?), *Yangchienia* sp., *Sumatrana annae*, *Afghanella* sp.), smaller forams (*Pachyphloia* sp., *Langella* sp., *Climacammina*(?) *sphaacrica*) and algae (*Tubiphytes obscurus*) are found at Khuan Hin Som mountain range (Grid reference 443921, Ban Thang Luang map sheet) (Figure 2.4) indicating Murghabian-Midian in age (Jumnongthai, pers. comm., 1999). The thickness of the Ratburi Limestone is less than 800 metres (Kosuwon, 1996). The Ratburi Limestone conformably overlies the clastic rocks of the Kaeng Krachan Group.

Triassic

Chaiburi Formation

Ampornmaha (1995) proposed the Chaiburi Formation representing the Triassic rocks at Phatthalung area and further divided it into 3 members, the Phukhaothong Dolomite, Chiak Limestone, and Phanomwang Limestone, respectively

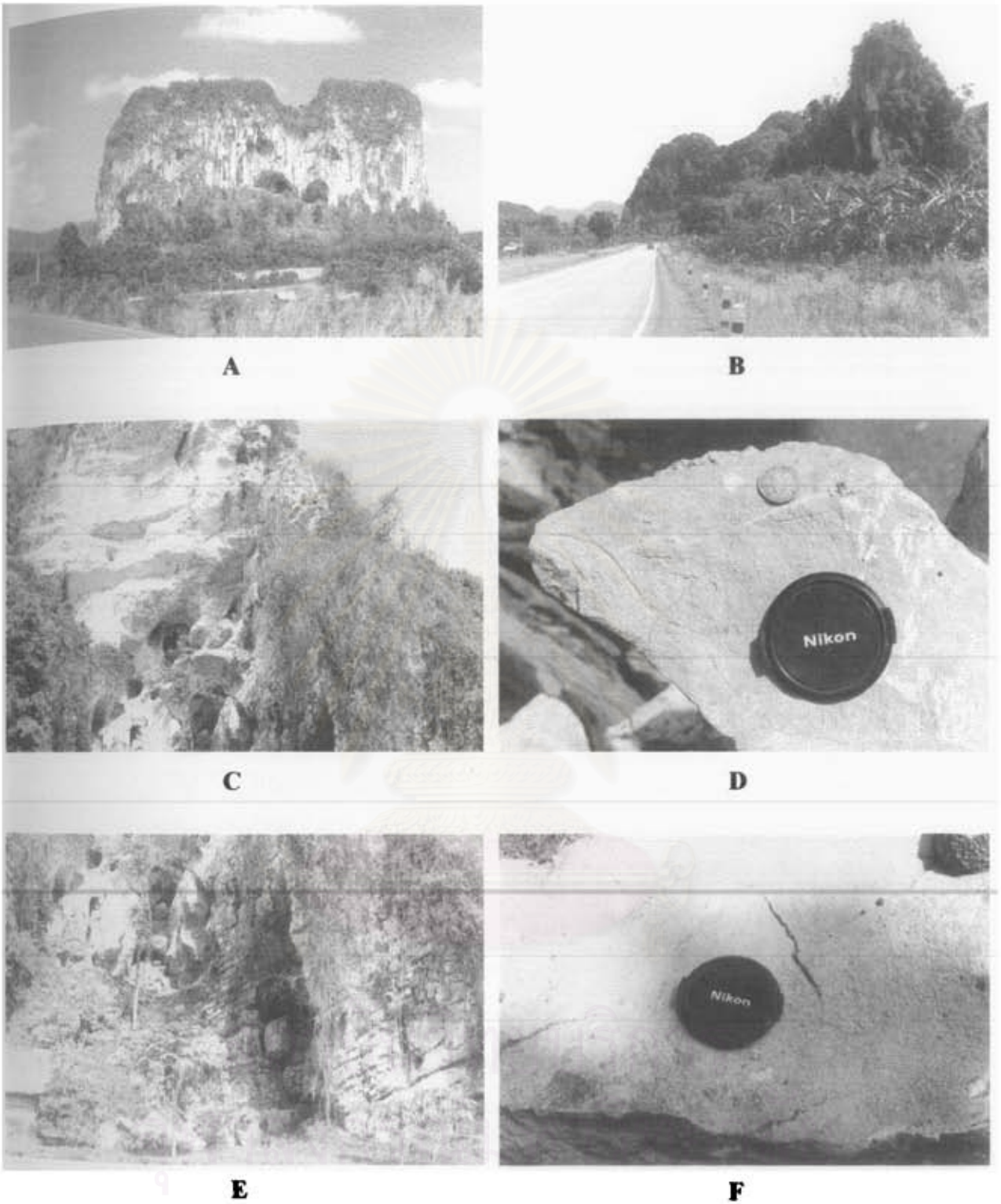


Figure 2.4 The Permian rocks. (A) At Khuan Sam Nuai; (B) Khuan Ying Moo; (C, D, E and F) The very thick-bedded limestone with abundant fusulinids at Khuan Ying Moo.

in ascending order. The conodont identification indicates Dienerian to Smithian (Early Triassic) to Carnian (Late Triassic).

1. The Phukhaothong Dolomite member consists of thick-bedded to massive dolomite and yields *Neospathodus kummeli* Sweet, N. *Waageni* Sweet, N. cfr.

2. Chiak Limestone member consists of bedded and laminated limestone commonly yields Early-Middle Triassic conodonts such as *Neospathodus timorensis* (Nogami) and *Neospathodus kockeli* (tatge).

3. The Phanomwang Limestone member is mostly massive limestone and yields abundant fossils indicating Carnian (Late Triassic).

Sai Bon Formation

The Sai Bon Formation was named by Raksaskulwong (1989) after the name of the village in Thung Yai of Nakhon Si Thammarat, northeastern part of the study area. This formation exposes as well as small hill near Sai Bon village and at Khao Kaew east of Thung Yai, Khao Khom and Khao Hin Luk Chang east of Khlong Thom (Figure 2.5). In the central part of the area, this formation is exposed as small hill near Ban Pak Phreak, the road cut exposure of Lam Thap-Bang Khan road (grid reference 450918, Ban Thang Luang map sheet), Khuan Sanai and Khlong Bang Khan. In the western part of the area, the formation crops out at Ban Thon Chamuk Khwai, Khlong Bang Tiew and small hill east of Khuan Thang.

The Sai Bon Formation overlies the Ratburi Limestone with angular-unconformity. Tantiwanit et al.(1989) reported that the basal conglomerate of the Sai Bon Formation crops out at Ban Lang Khao and Khao Khieo in Phanom, Surat Thani. The formation is consisting of mainly brownish red siltstone, mudstone and fine-grained sandstone of totally 110 metres thick (Raksaskulwong,1994). Well bedded

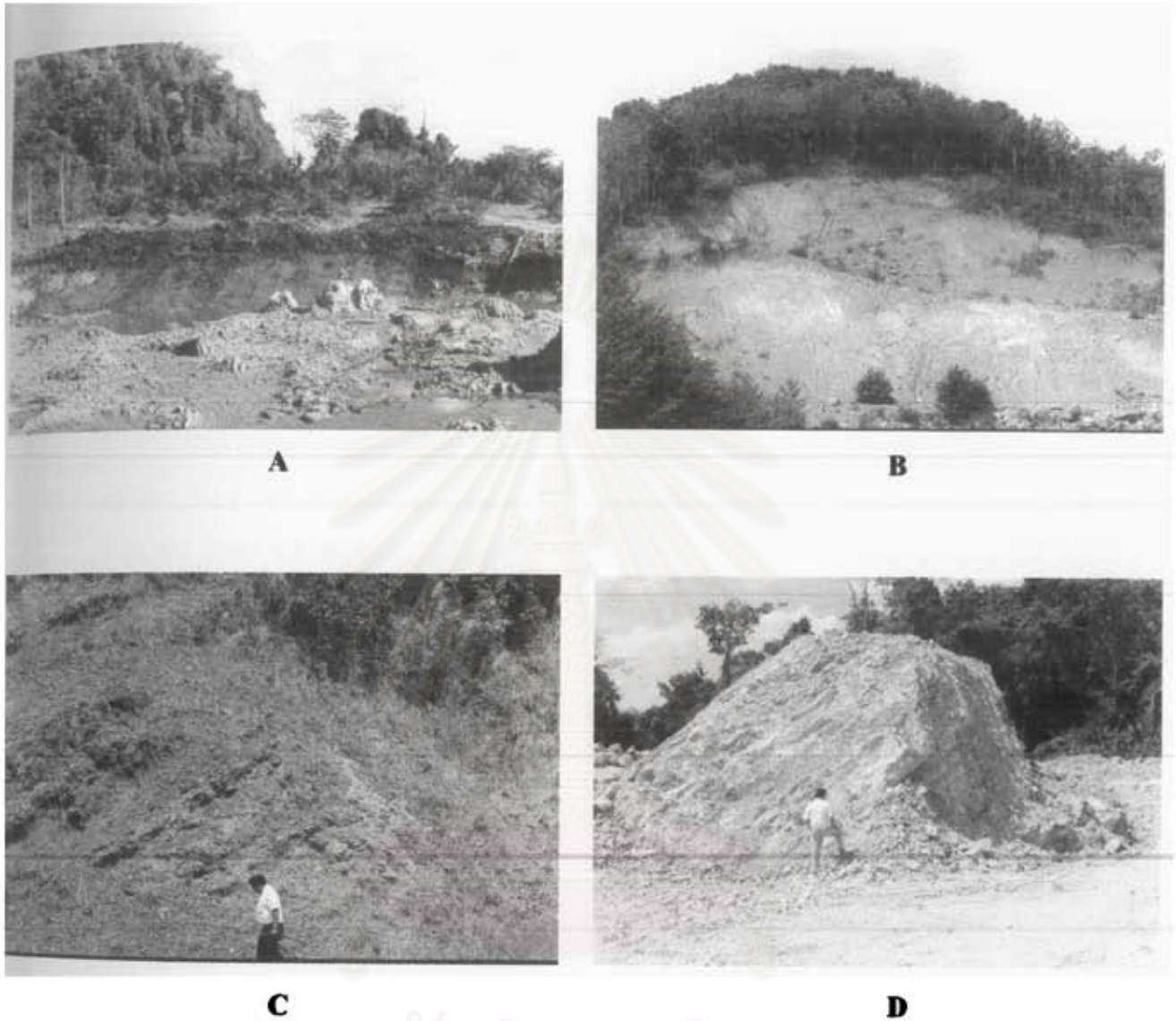


Figure 2.5 The Sai Bon formation. (A) Dolomitic limestone at western of Khao Noi (grid 320799, 4824 I); (B) Siltstone with limestone lenses at northern part of Khao Khom (grid 596091, 4824 I); (C, D) Sandstone interbedded with limestone and mudstone at Khuan Sanai.

sandstone, siltstone and fine to medium-grained sandstone are present in the middle and upper parts, respectively. Lenses of dolomitic limestone are commonly present in the lower part. Pelecypods (*Plaeocardita* sp.) (Figure 2.6) , gastropods and plant remains are common both in brownish red mudstone and dolomitic limestone lenses. This fossil assemblage indicates that the environment of deposition was the shallow marine during Upper Triassic (Raksaskulwong et al., 1989).

Jurassic-Cretaceous

The non-marine Jurassic-Cretaceous sequence is represented in the middle part of the Thai peninsula as the Trang Group (Raksaskulwong, 1994) which is well exposed from Chumphon to Trang. The Trang Group unconformably overlies the marine Triassic rocks with basal conglomerate in many localities of these areas.

Trang Group

Raksaskulwong (1994) divided the Trang Group into 4 formations in ascending order as follows: Chumphon red beds, Khlong Min formation, Sam Chom formation and Phun Phin Formation, respectively (Table 2.4).

Chumphon red beds Formation

This unit exposes along north-south trend at Ban Thang Luang, Ban Nua Khlong villages of Khlong Thom district and west of Wiang Sa district. The basal conglomerate mainly crops out at “Khao Reak Pol and Khao Kwang” as shown in the Ban Nua Khlong map sheet (4825 III). The succession comprises of thick to very thick-bedded, yellowish brown, white, arkosic sandstone with cross bedding of totally 350 metres thick (Figure 2.7). This sandstone is intercalated with greenish gray, reddish brown siltstone, sandstone and mudstone. Some plant remains are found in

**A****B**

Figure 2.6 The Sai Bon formation of Triassic rocks. (A) Dolomitic limestone lenses at northern part of Khuan Sanai (grid 417913, 4825 II); (B) Fossiliferous limestone at Khuan Sanai , Pelecypods (*Plaeocardita* sp.), gastropods, and plant remains.

Table 2.4 Stratigraphic classification of the Trang Group in Upper southern Thailand (after Raksaskulwong, 1994)

Time (ma)	Era	Period		Group	Formation	Thickness (m)	Lithology	Interpretation
65 100 140 180 200	CENOZOIC	TERTIARY		KRABI				Lacustrine deposits
		MESOZOIC	CRETACEOUS		Upper	TRANG	Phun Phin	80
	Lower			Fluviatile, braided stream				
	JURASSIC		Upper	Sam Chom	140		Conglomerate and coarse-grained sandstone, poor cemented, fern-plant remains.	Fluviatile and alluvial fan deposits
			Middle	Khlong Min	80		Argillaceous limestone interbedded with shale containing both vertebrate and abundant invertebrate fauna.	Lacustrine sediments
			Lower	Chum Phon red beds	350		Red sandstone interbedded with siltstone and shale, few bivalve and plant remains.	Transitional zone deposits
			TRIASSIC		Sai Bon		110	Red sandstone interbedded with argillaceous limestone, dolomitic limestone lenses, abundant bivalve fauna, coral, gastropods and ammonite.

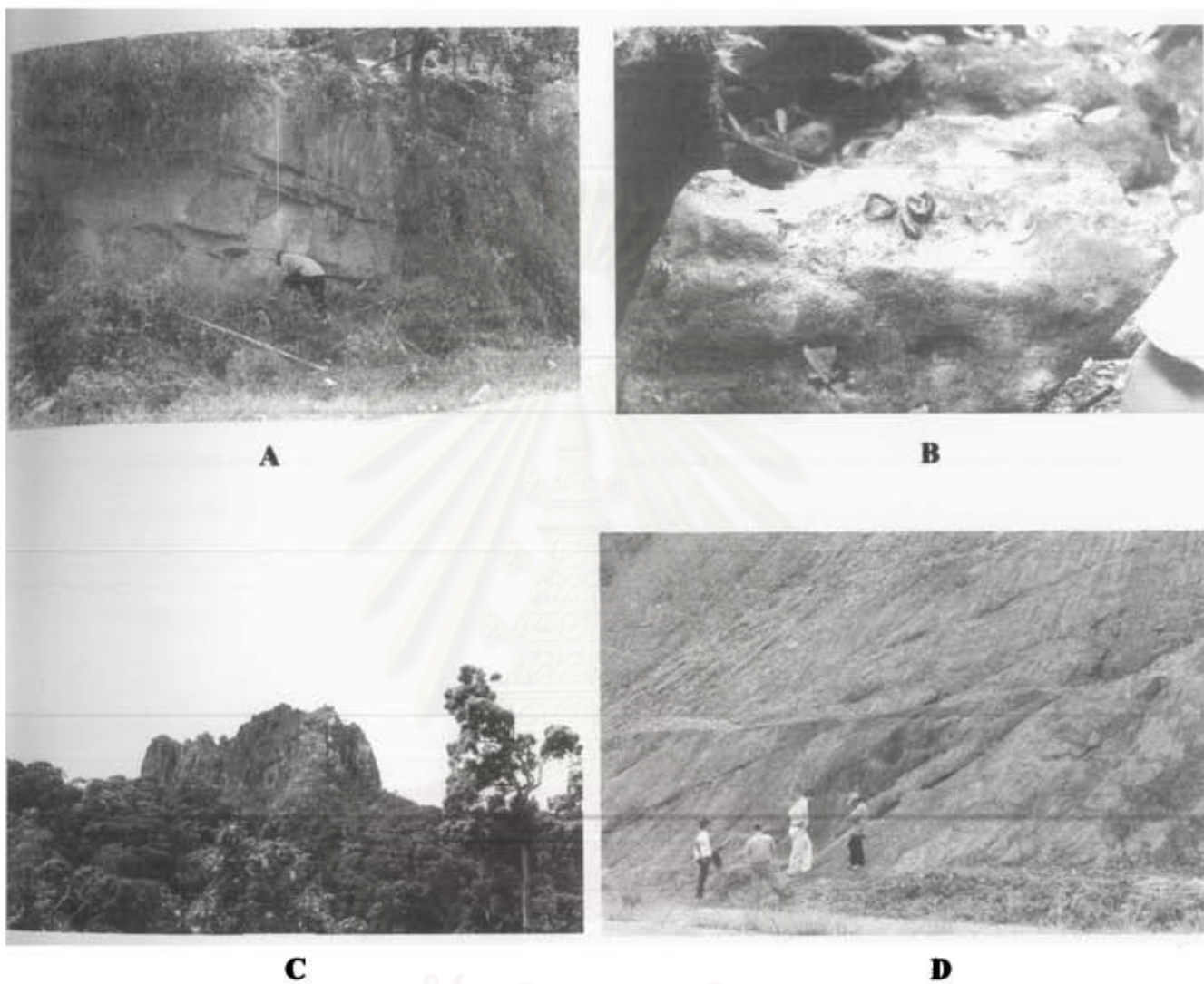


Figure 2.7 Lithostratigraphic units of the Trang Group. (A) Chum Phon red beds Formation; (B) Khlong Min Formation; (C) Khao Sam Chom; (D) Phun Phin Formation.

mudstone. The unit is believed to be deposited in transitional marine environment. It is Jurassic in age.

Khlong Min Formation

This unit crops out locally at Khlong Min, Ban Map Ching (Ban Thang Luang map sheet), Ban Pak Phraek, Khlong Tae Pa northwest of Khlong Thom and Laem Paew of Ban Bo Muang.

It mainly consists of fossiliferous limestone interbedded with mudstone containing abundant fossils of vertebrates, conchostracans (*Estheria*), bivalves, gastropods, ostracods and pollens (Figure 2.7). The thickness of this formation is approximately 80 metres. The environment of deposition is concluded to be lacustrine environment. The whole sequence is believed to be of middle Lower Jurassic.

Sam Chom Formation

This unit is exposed locally at Khao Sam Chom (Figure 2.7), Khao Nam Daeng, Khao Khao, Khao Chong Din, Ban Map Ching (Ban Thang Luang map sheet) and Khao Khrop Katha east of Khlong Thom. The morphology during the time of deposition of this formation is believed to be the very high mountainous area.

Sam Chom Formation predominantly consists of conglomerate and poorly cemented coarse-grained sandstone. It overlies the Khlong Min Formation. The clasts of conglomerate are quartzite, chert, volcanic rock, brownish sandstone and siltstone. The maximum size of the clast is about 12 centimetres in diameter. It is 10-180 metres in thick. Raksaskulwong et al. (1989) stated that this formation is deposited in braided stream or alluvium fan in Jurassic age.

Phun Phin Formation

This unit represents those rocks are exposed at Ban Wat Kanang, 12 kilometres east of Thung Yai, the area west of Wiang Sa of Surat Thani and area in the northeast of Khlong Thom of Krabi along the road no. 4038 km.10 from Khlong Thom to Lam Thap of Krabi (Figure 2.7). The boundary between this formation and the others remains uncertain.

It consists of fine-to medium-grained arkosic sandstone, maroon to reddish brown, intercalated with thin-bedded, reddish brown siltstone, mudstone and conglomerate/breccia showing matrix-supported, and containing pebble size, angular to subangular clasts of quartz, chert, quartzite, sandstone with poorly to moderately cemented in the upper part of totally about 80 metres thick. The sandstone is moderately cemented and commonly displays trough and planar cross-beddings. This formation is believed to be deposited under the braided stream environment in Cretaceous age.

Trace fossils of *Thalassinoides*, bivalve of *Modiolus sp.*, fern-like leaves and small lenses of bituminous jets, in fine-grained sandstone of Chumphon red beds Formation and vertebrate fossils of turtle plate, crocodile teeth, amphibians, bivalves in muddy limestone of Khlong Min formation are considered to be equivalent to the lower part of the Khorat Group in northeastern Thailand and to some parts of the Gagau Group in Malay Peninsula.

Tertiary

The isolated Tertiary basins are mainly grabens and/or half grabens or tilted fault-blocks formed by reactivation of basement structures (Chaodumrong *et al.*, 1983). The shape and trend of the basins are elongated following regional strike of the older formations, which are also controlled by subsequent faulting. Tertiary sediments

are mainly fresh and brackish water shale, sandstone, marlstone and coal beds. The Krabi Group is applied to represent Tertiary strata in peninsular Thailand. The well known shell cemetery and pollen associated with claystone have been recently determined as Oligocene age.

Quaternary

Quaternary marine and fluvial formations are widely spread along the coastal zone around the Gulf of Thailand and west coast of the Thai peninsula. The Pleistocene fluvial sediments are characterised by their high plasticity, high oxidation, with mottled structure and some traces of plant remains unconformably overlie older basements. The gradual change of depositional environment from fluvial to shallow marine environment reflected by massive clay with some sand lenses. The sea level at that time was generally 10 meters higher than the present one. The marine influence decrease upwards probably caused by highly sedimentary influx from upland area as well as tectonic uplifting and global sea level drop during late Quaternary (Chaimanee, 1987).

2.4 Geological Structures

The Thai-Malay mobile belt is a structurally complex area (Figure 2.8), with folding and overthrusting towards the east (Bunopas, 1981). The belt extends from northern Thailand through the Gulf of Thailand. The area is characterised by strong volcanism (calc-alkaline volcanics) during Late Permian to Middle Triassic. It is interpreted as a collision belt on sutured zone between the Shan Thai and the Indochina blocks (Bunopas, 1981, Mitchell, 1981, and Hahn *et al.*, 1986)

Two major different fault systems in southern Thailand can be distinguished: (1) NE-SW strike-slip faults and (2) N-S normal faults. The NE-SW trending fault zones are the Ranong and the Khlong Marui fault zones. The N-S normal faults are

predominant in the Gulf of Thailand. There are 6 major Mega-anticlines and synclines in N-S trending between the Gulf of Thailand and Andaman sea (Figure 2.8).



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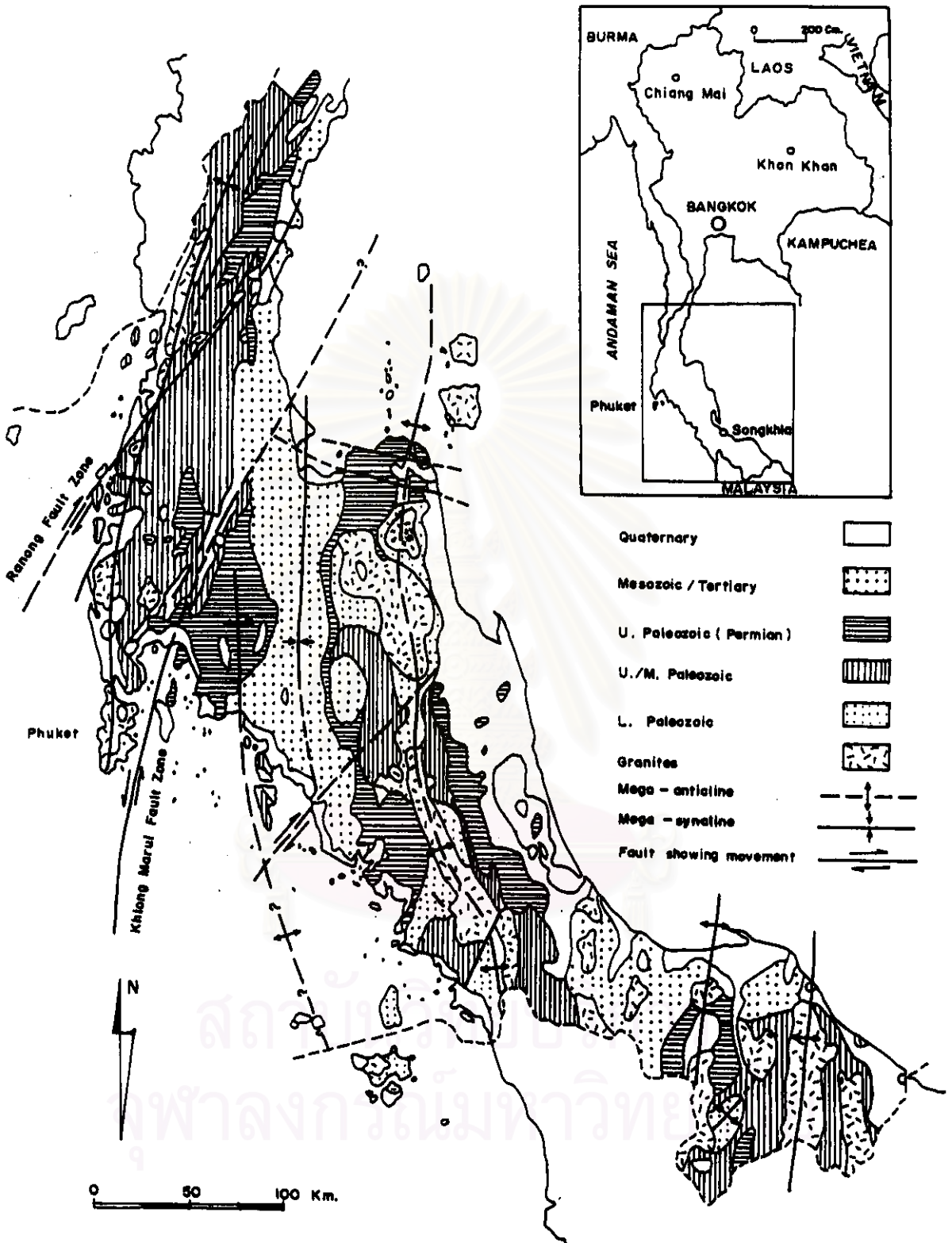


Figure 2.8 Regional geological structures in southern peninsular Thailand (modified from Suensilpong et al., 1978).