



CHAPTER I

INTRODUCTION

Paleontology is the study of life in the geologic time. This study is one of an important subject in geology. Fossils can be used for stratigraphic correlation, interpretation of paleoenvironment, and as the evidence of evolution of life in the past.

Ammonoids are one of the best index fossils because they are widely distributed, and had rapid evolution. Ammonoidea is an Order of the Class Cephalopoda, Phylum Mollusca. They can be easily to recognized and identified even in the incomplete specimens because the study of ammonoids are mainly concentrated on the suture-line system. According to the record, they lived from the Early Devonian to the Late Cretaceous. In Thailand, ammonoids can be usually found in Carboniferous, Permian, Triassic and Jurassic siliclastics and carbonates. But, there are a few researches on biostratigraphy of ammonoids in detail.

Fusulinids lived from the Late Mississippian to the Late Permian. The researches of fusulinids in detail have been studied by many researcher in Thailand and many other countries, because of their widespread geographic distribution around the world. They had a rapid evolution, short range, survived in a suitable environment in warm and shallow marine. For these reasons fusulinids are one of the best index fossil. They are very useful for correlation of the rock strata around the world. In this study, the author would like to study fusulinids in association with ammonoids in the same area. They can give a good result and completely detail for biostratigraphy of the investigated area.

In the area of Khao Nong Hoi, Amphoe Pak Chong, Changwat Nakhon Ratchasima (Figure 1.1) the rocks in the study area were grouped as Permian limestones in the Nong Pong Formation of the Saraburi Group. They comprised of various groups of fossils including ammonoids and fusulinids. However, there was very rare data of ammonoids and never have the data from any research on biostratigraphy using ammonoids and fusulinids as index fossils. Thus the area of Khao Nong Hoi, Amphoe Pak Chong, Changwat Nakhon Ratchasima is suitable for study about biostratigraphy with data of ammonoids and fusulinids. And this study may be the good case study to correlate with other areas in both Thailand and other countries.

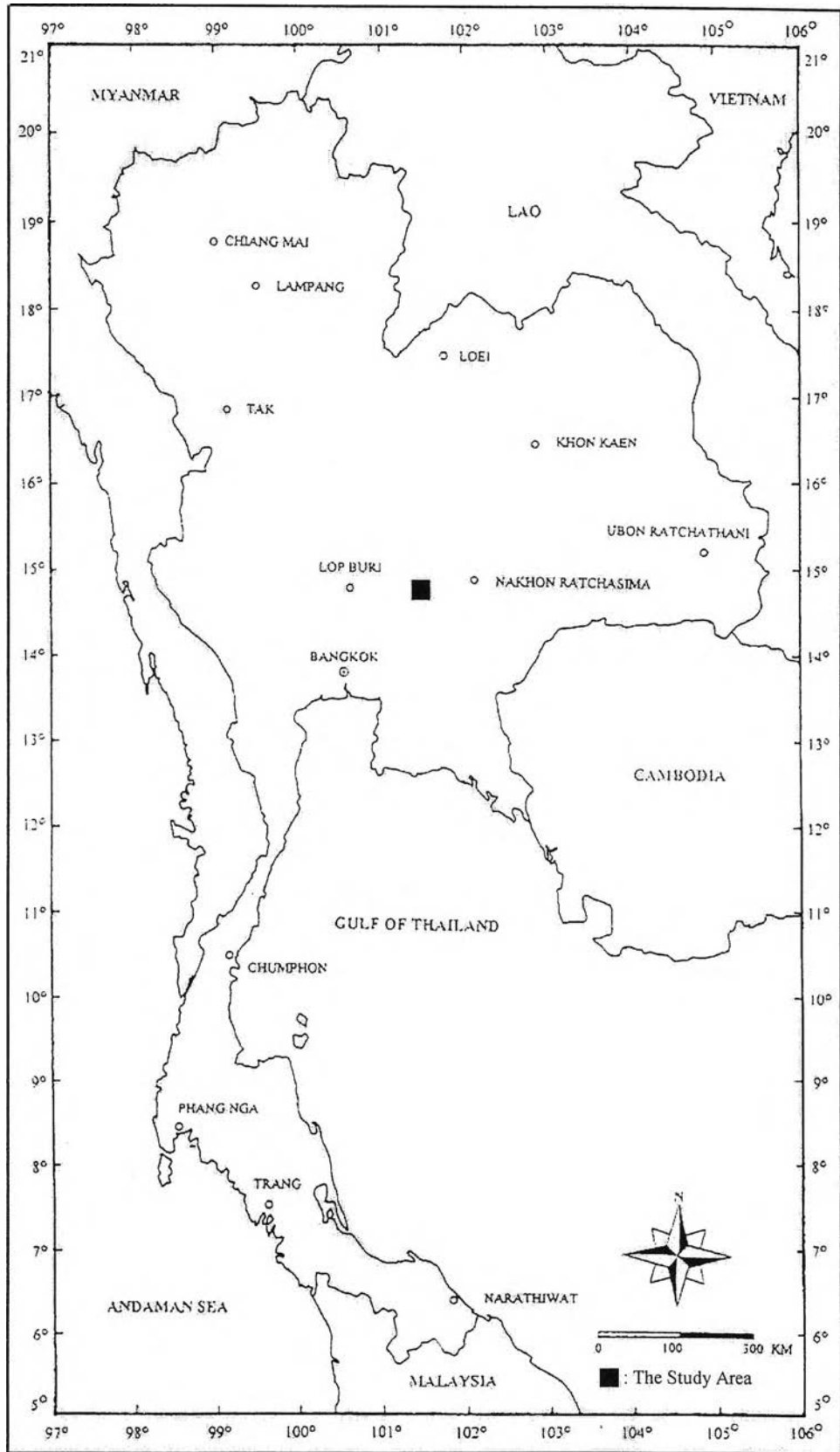


Figure 1.1 Index map of Thailand showing location of the study area in Changwat Nakhon Ratchasima.

The Study Area

Location

The study area is situated at Khao Nong Hoi, Amphoe Pak Chong, Changwat Nakhon Ratchasima. It covers approximately 4 square kilometers and lies between the latitude of 14° 40' 15" to 14° 42' 00" and longitude 101° 12' 30" to 101° 13' 28". The investigated area is located within the topographic map scale 1: 50,000 of The Royal Thai Department, of sheet 5238III, series L7017, Amphoe Kaeng Khoi (Figure 1.2).

Accessibility

Accessibility to the study area is illustrated in figure 1.3. It can be conveniently accessed from Bangkok by following the Royal Highway No. 1 (Phahon Yothin Highway) to Saraburi, then follows the Royal Highway No. 2 (Mittraphab Highway) from Saraburi cross Muak Lek River to Amphoe Pak Chong, Changwat Nakhon Ratchasima. After crossing the Muak Lek River 1 kilometres on the Highway No. 2 turn left and follow the paved road for approximately 5 kilometres to Khao Nong Hoi in the area of Amphoe Pak Chong, Changwat Nakhon Ratchasima

Physiography and Climate

The study area is the western part of Changwat Nakhon Ratchasima. The climate of the study area is savanna tropical type with the rainy season ranges from July to October while the rest of the year is relatively dry. The mean annual rainfall is 1492.10 mm. The annual average temperature is 26° - 28° C.

The physiography of the study area consists of the flat low land, rolling terrain, and limestone hills and ridges. There is a Muak Lek River passing through the western part near the study area.

The average elevation of the study area lies between 150-300 meters above mean sea level.

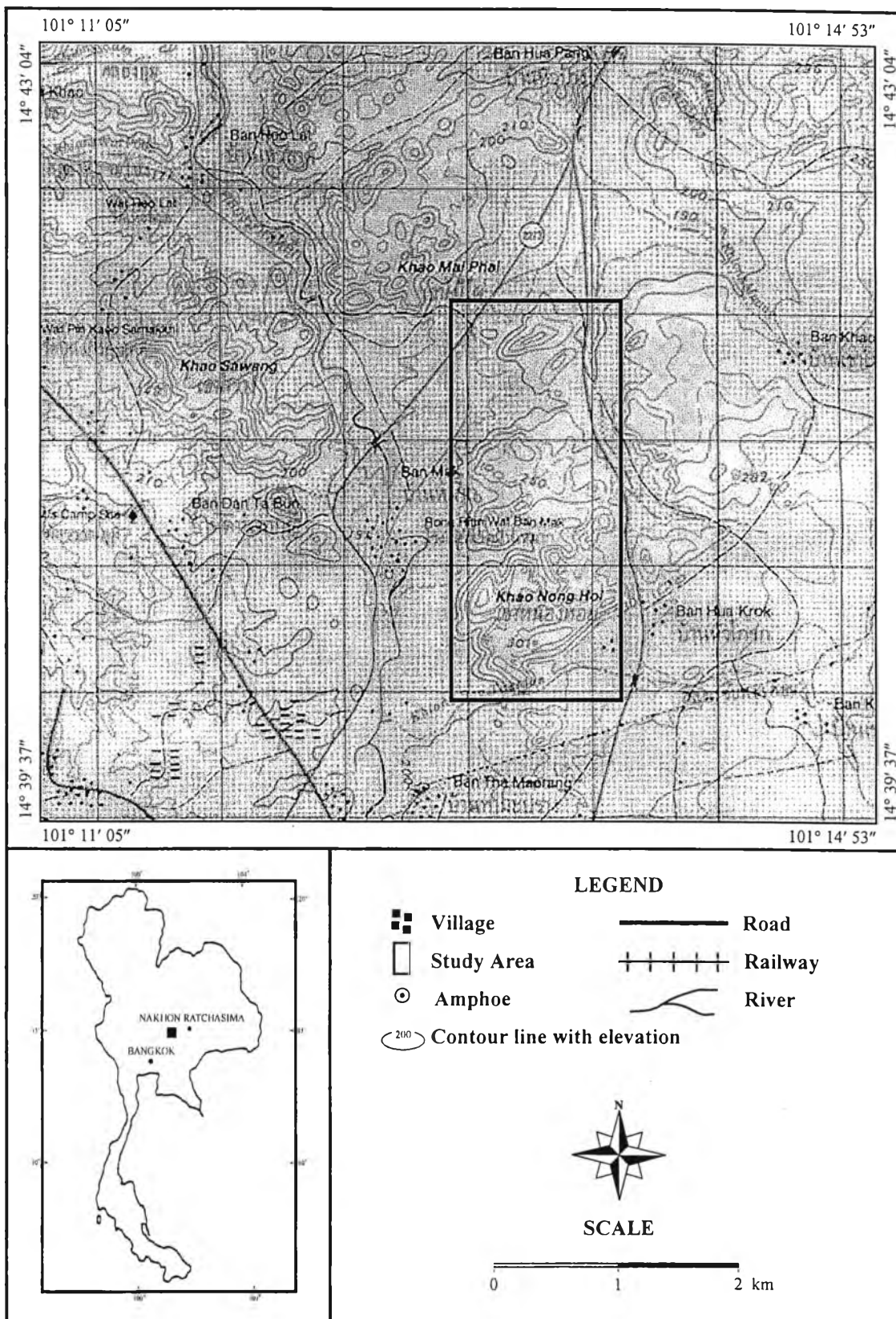


Figure 1.2 Topographic map of the study area in topographic map sheet 5238 III.

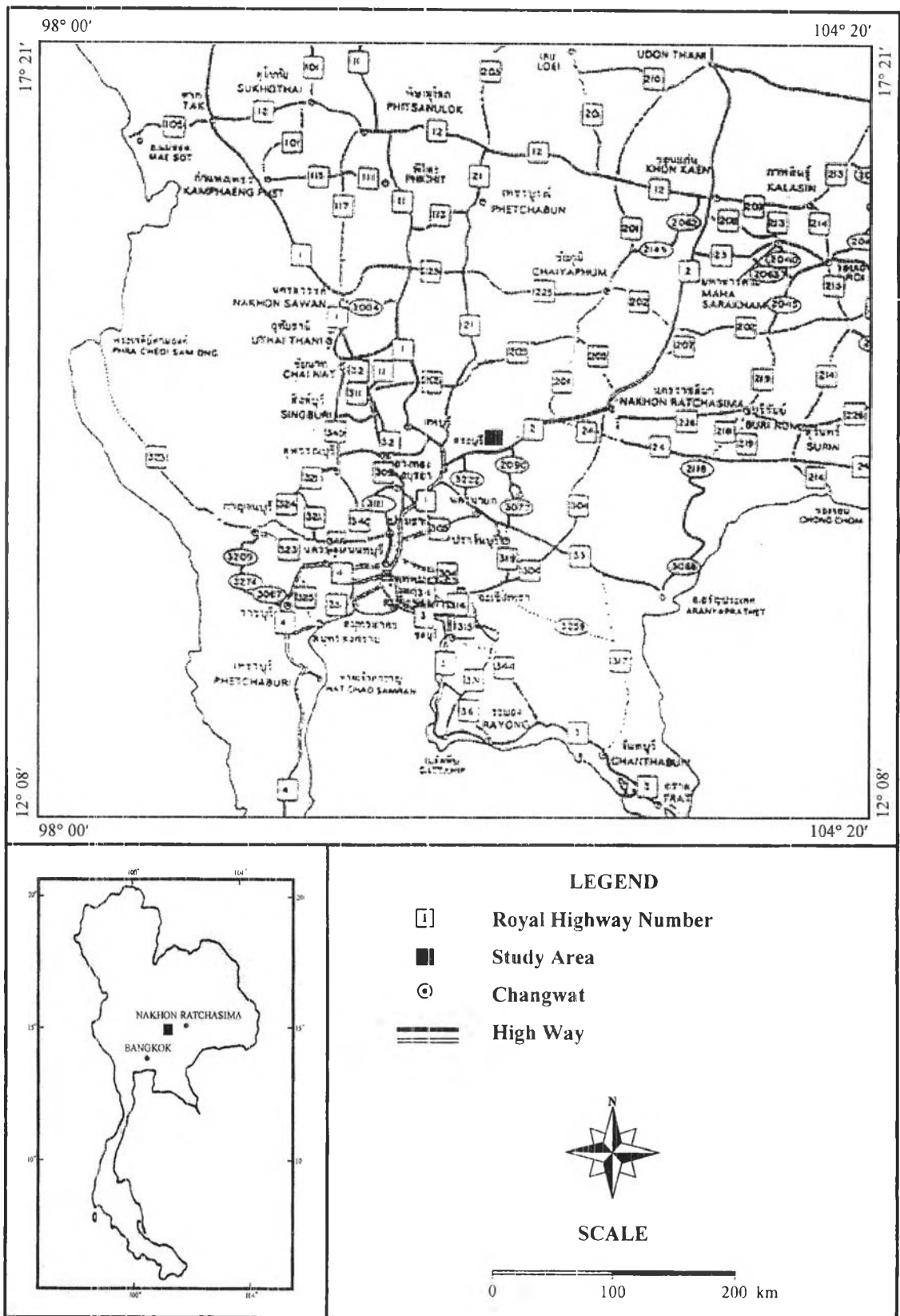


Figure 1.3 A route map showing the accessibility to the study area (Road Association of Thailand, 1994).

Objectives of the Study

1. To study morphology, taxonomy, and classify the group of ammonoids and fusulinids in the study area.
2. To study the biostratigraphy, correlation, classification and determine age of rock in the study area by using the data of ammonoids and fusulinids

Methods of the Study

The summarized flow chart showing methods of the study is illustrated in figure 1.4. The methods of study can be divided into 6 steps as followed:

1. Preparation

- 1.1 Study the topographic map, and geologic map of the study area.
- 1.2 Study the previous work, research paper, and report on biostratigraphy and study of ammonoids and fusulinids.

2. Field Investigation

- 2.1 Measuring section of the strata in the study area.
- 2.2 Collecting rock samples, fossil specimens in every fossil-bearing strata.

3. Laboratory Investigation

- 3.1 Excavating ammonoids specimens from rock samples collected from the investigated area.
- 3.2 Preparing thin section to study fusulinids.
- 3.3 Take the photographs of fossil fusulinids and other by stereo-zoom microscope.
- 3.4 Study morphology, suture-line system, size measurement in detail for classification and identification of ammonoids by microscope with the drawing attachment.

- 3.5 Study morphology, size measurement, of fusulinids in detail for classification and identification by stereo-zoom microscope.
 - 3.6 Study lithology in each strata.
4. Interpretation, Discussion, and Conclusion
 - 4.1 Prepare the range chart of fossil ammonoids and fusulinids found in the study area and establish the biostratigraphic column of the study area based on the ammonoids and the fusulinids
 - 4.2 Discuss and conclude the result of study
5. Presentation and Preparing Thesis Report
 - 5.1 Presentation in the seminar.
 - 5.2 Writing thesis.

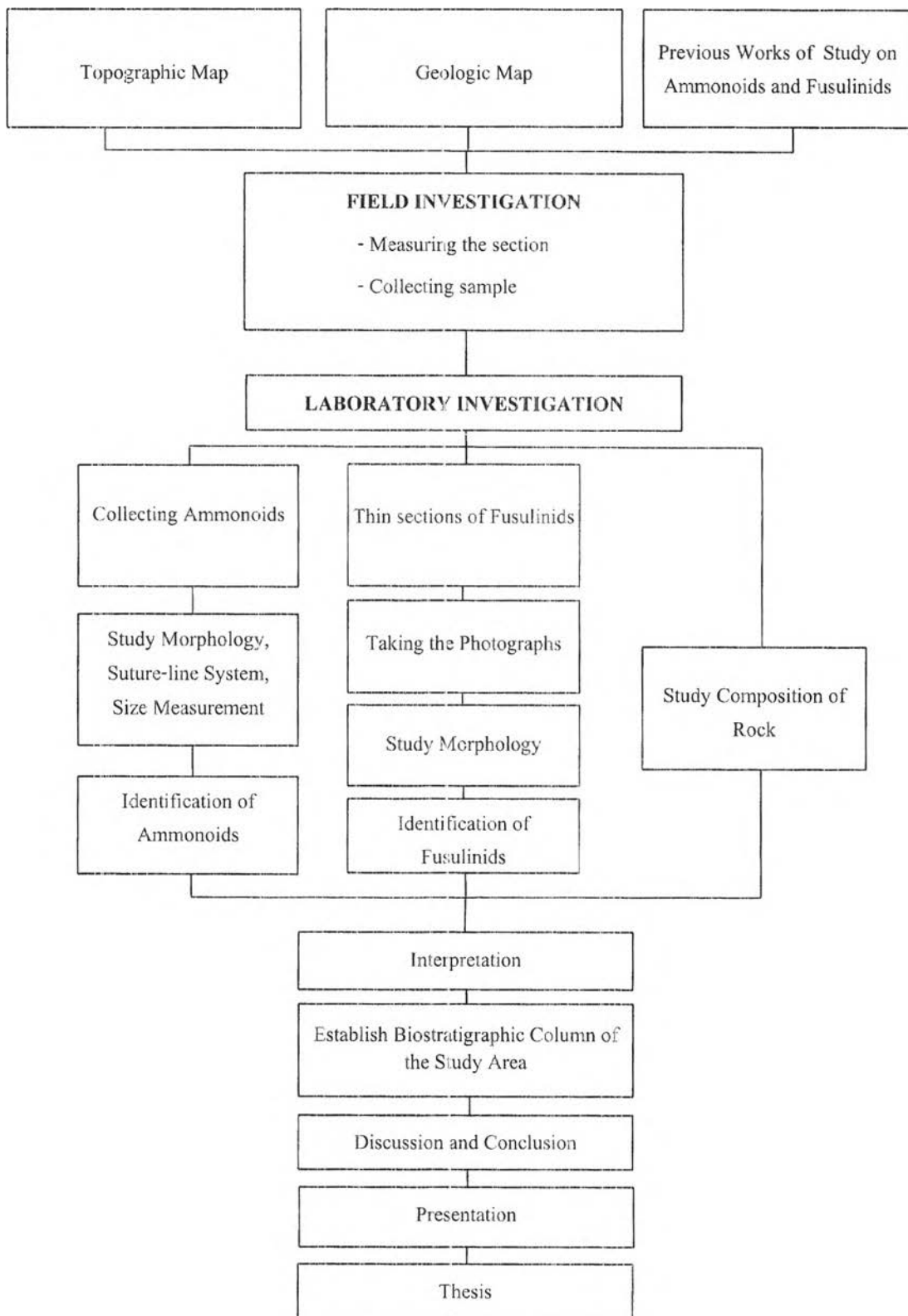


Figure 1.4 Flow chart showing the methods of the study.

Previous Investigation

Geological study in the investigated area was performed by Hinthong et al., 1985. According to the result of this Geological team, the Department of Mineral Resources has published a geologic map scale 1 : 250,000; map sheet ND 47-8; Changwat Pranakhon Si Ayutthaya. They reported that the investigated area is part of the Nong Pong Formation. The Nong Pong Formation is an Early Permian (Artinskian-Kungurian) age and is a part of the Saraburi Group. The detail about geology in the study will be reported in the Chapter II.

Previous Investigation of Ammonoids

The study of ammonoids in Thailand can be collected and summarized as followed:

Department of Mineral Resources, 1985 published “ Fossil of Thailand, Volume 2 ” compiled by Pitakpaivan et al. They recorded about two species of Permian ammonoids. *Agathiceras* aff. *suessi* Gemmellaro, 1887, Permian in age, represented by specimens number TF 649 and TF 675. The specimen number TF 649 was discovered at Phu Pha Dang, Tambon Sritan, Amphoe Phukadung, Changwat Loei and specimen number TF 675 was discovered at Na Nong Thum, Amphoe Chumphae, Changwat Khon Kaen. *Propinacoceras* sp. Permian in age, represented by specimen number TF 676, was discovered at Na Nong Thum, Amphoe Chumphae, Changwat Khon Kaen. Furthermore, Fossil of Thailand, Volume 2 also reported the discovery of the Triassic, Carboniferous and Jurassic ammonoids.

Ishibashi and Chonglakmani, 1990 studied the geology at the boundary between Permian rocks of the Ratburi Group (at present is officially named the Saraburi Group) and Triassic rocks of the Lampang Group at Doi Pha Phlung, Changwat Lampang. Ammonoids discovered in this area are *Pseudogastrioceras* aff. *szechuanense* Chao et Liang, 1965 from specimens number TF 2327, TF 2328, *Paratriolites nakornsrii* Ishibashi and Chonglakmani, 1990 from specimens number TF 2326, TF 2325, and *Xenodiscus* ? sp. indet from specimen number TF 2329. They use *Paratriolites nakornsrii* Ishibashi and Chonglakmani, 1990 as an index of Uppermost Permian (Upper Dorashamian) to indicate the boundary between the Permian and Triassic.

Glenister et al., 1990 reported four species of ammonoids discovered from Khao Nong Hoi, Amphoe Pak Chong, Changwat Nakhon Ratchasima. Those ammonoids consisted of *Miklukhoceras* cf. *pamiricum* Pavlov (1967), specimen number PTF 1; *Agathiceras mediterraneum* Toumanskaya (1949), specimens number PTF 2-4; *Perrinites* cf. *hilli* (Smith, 1903), specimens number PTF 5-8 and *Prostacheceras* cf. *oshense* (Toumanskaya, 1938), specimen number PTF 9. And they concluded that the strata contain all of these ammonoids have the age of Late Artinskian.

This publication was the pioneer study of Permian Ammonoid at Khao Nong Hoi by Prof. Dr. Brian F. Glenister, Prof. Dr. William M. Furnish and Prof. Dr. Zhou Zuren who are all experts in Permian ammonoids. They identify the ammonoids specimens from Khao Nong Hoi which were firstly discovered in 1985 by Assist. Prof. Dr. Malai Liengjarern and brought to them in 1990.

Ishibashi, Nakornsri, and Nagai, 1994 have studied about the Permian-Triassic boundary at Doi Pha Phlung, Changwat Lampang. They found a large groups of fossils such as fusulinids, bivalve, and ammonoids. Permian ammonoids they discovered are *Paratirolites nakornsrii*, *Pseudogastrioceras* aff. *szechuanense*, *Xenodiscus?* sp. Furthermore they also found the new species, *Tapashanites yaowalakae* Ishibashi and Nakornsri, 1994.

Ishibashi, Fujikawa, and Nakornsri, 1996 studied at Changwat Loei and reported that they found ammonoids species *Agathiceras* aff. *suessi* Gemmellaro, 1887, *Properrinites boesei* (Plummer and Scott, 1937), *Popanoceras* sp., *Propinacoceras* sp., *Artinskia loeiensis* Ishibashi, Fujikawa, and Nakornsri, 1996. *Properrinites boesei* and *Artinskia loeiensis* are the species first discovered in the Indochina region

Zhou and Liengjarern, 1997 reported that they found Permian ammonoids *Perrinites* fauna immediately in associated with *Misellina* fusulinid fauna.

Ishibashi, Fujikawa, and Nakornsri, 1997 proposed the correlation chart of ammonoid and fusulinid zones in Thailand. This research is the first time to establish zonation of ammonoids, as illustrated in Table 1.1.

Period	Stage (Leven, 1992, Ingavat, 1984)	Ammonoid Zone		Fusulinid Zone (Ingavat et al., 1980, Ingavat, 1984)	
		North America	Thailand		
Permian	Late	Drashamian	<i>Cyclolobus</i>	<i>Paratirolites</i> - <i>Tapashanites</i>	<i>Palaeofusulina</i> <i>Colaniella</i> <i>Reichelina</i> <i>Lepidolina</i> <i>Yabeina</i> <i>Neoschwagerina</i> <i>Cancellina</i> <i>Misellina</i> <i>Chalartoschwagerina</i> <i>Robustoschwagerina</i> <i>Paraschwagerina</i> <i>Pseudoschwagerina</i> <i>Conodofusulina</i> <i>Parafusulina</i> <i>Pseudofusulina</i>
		Dzhuifian			
		Midian			
	Middle	Murgabian	<i>Waagenoceras</i>		
		Kubergandian			
		Bolorian		<i>Perrinites</i>	
	Early	Yahtashian	<i>Properrinites</i>	<i>Properrinites</i> - <i>Artinskia</i>	
		Sakmarian			
		Asselian			
Carboniferous	Late	Gzhelian	<i>Parashumardites</i> <i>Boesites</i> <i>Parategocercs</i> <i>Diaboloceras</i> <i>Axorobus</i>	<i>Branneroceras</i> <i>Pronorites</i> <i>Protocanites</i>	<i>Triticites</i>
		Kasimovian			<i>Fusulina-Fusulinella</i>
		Moscovian			<i>Profusulinella</i>
		Bashkirian			
	Early	Namurian	<i>Branneroceras</i>		<i>Millerella-Eostaffella</i>
		Visean	<i>Bilinguies</i>		
		Tournaisian	<i>Cravenoceras</i>		

Table 1.1 Correlation chart of ammonoids and fusulinids zones in Thailand (Ishibashi et al., 1997).

Previous Investigation of Fusulinids

The study of fusulinids in Thailand has been studied since 1939. Dunbar described fusulinids in limestone collected by Heim and Hirschi in 1939 from central-north Thailand. (Ingavat, 1993). After that, there are numerous studies on fusulinids from many researchers. The published fusulinid zonations of Thailand are as follows:

Igo, 1972 established the standard columnar section showing stratigraphic position and range of fusulinacean from Middle and Upper Carboniferous to Lower Permian by studying fusulinacean assemblage from the sections of the Wang Saphung - Loei areas and Petchabun - Lomsak areas. (Table 1.2)

Toriyama et al., 1974 have established biostratigraphic zonation from Lower to Middle Permian fusulinids at Khao Phlong Phrab, Amphoe Phra Phutthabat, Changwat Saraburi. They expected that this section may be the standard biostratigraphic section for Thailand. Furthermore, they compared this section with Southeast Pamir, Cambodia, South China, Kuma, Kyushu, Japan, Akiyoshi, Southwest Japan, Akasaka, Central Japan, as illustrated in Table 1.3.

Toriyama et al., 1975 studied and collected data about biostratigraphic zonation of Middle Carboniferous to Middle Permian fusulinids in Thailand and Malaysia. They used and improved the detail from previous researches of Igo, H. in 1972 and Toriyama, R. et al. in 1974. They also correlated this biostratigraphic zonation with Southeast Pamir, Shan State, Burma, Cambodia, South China, and Japan, (Table 1.4)

Ingavat, Toriyama, and Pitakpaivan, 1980 established the fusulinids zonation of the Ratburi Group (at present is officially named the Saraburi Group) in Thailand and its equivalents in Malaysia of Carboniferous and Permian age and correlated with Transcaucasia, Iran, Southeast Pamir, Afghanistan, Pakistan, Malaysia, Indonesia, South China, Southwest Japan, and other previous researches in Thailand as shown in Table 1.5 and Table 1.6.

Ingavat, 1984 correlated the fusulinid fauna records studied from western, central, and eastern provinces in Thailand. This research is illustrated in Table 1.7.

Dawson and Racey, 1993 have studied fusulinid faunas of Saraburi Limestone at Changwat Saraburi. They established the fusulinid zonation of Lower Permian to Upper Permian, as illustrated in Table 1.8.

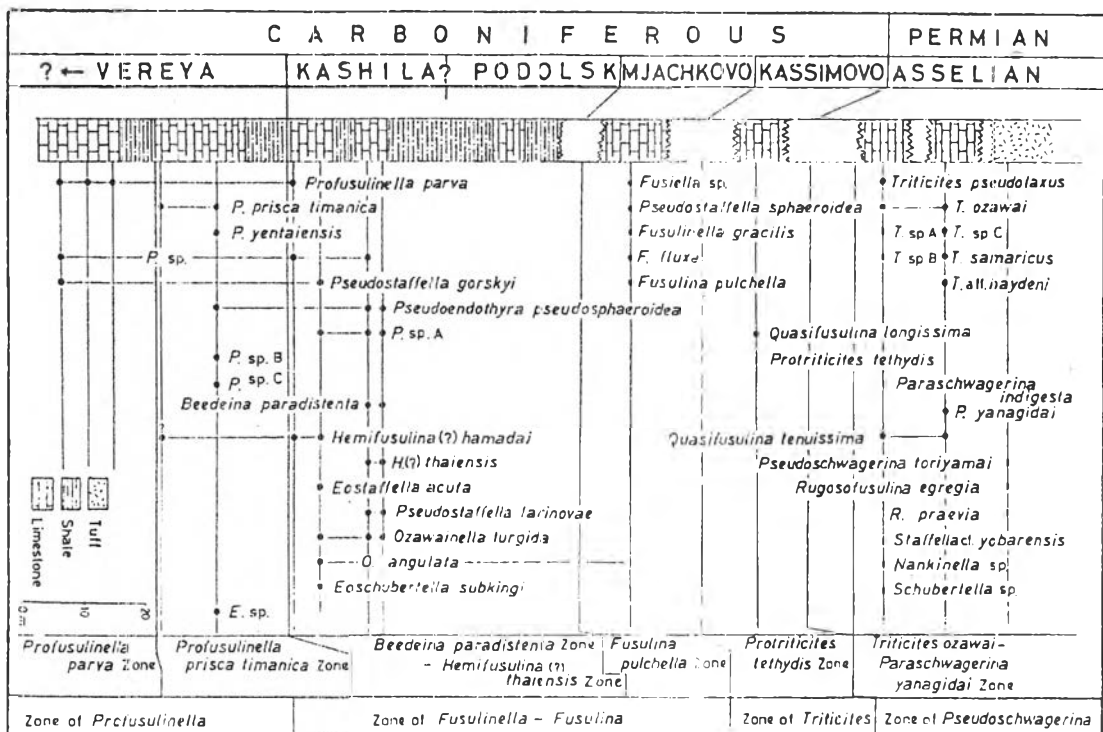


Table 1.2 Standard columnar section showing stratigraphic position and range of fusulinids (Igo, 1972).

		Khao Phlong Phrab, Thailand	Southeast Pamir (Murgab-Aksu) (LEVEN, 1967)	Cambodia (ISHII, KATO & NAKAMURA, 1969)	South China (SIENG, 1963)	Kuma, Kyushu, Japan (KANMERA, 1963)	Akiyoshi, Southwest Japan (OTA et al. 1973)	Akasaka, Central Japan (OZAWA, 1927)	
PERMIAN	Upper		<i>Reichelina</i> <i>Palaeofusulina</i> <i>Colaniella</i>		<i>Palaeofusulina</i> <i>Codonofusiella</i>				
	Middle	C Formation		D IV <i>Lepidolina multiseptata</i>		<i>Lepidolina kumaensis</i> – <i>L. multiseptata shiraiwensis</i>	Pua <i>Lepidolina multiseptata</i> <i>shiraiwensis</i>	"Sarasa" [limestone conglomerate]	
		(Khao Khao section)		C III <i>Sumatrina annae longissima</i> – <i>Lepidolina multiseptata</i>		<i>Yabeina</i>	Pmδ <i>Colania douvillei</i>	Ng <i>Yabeina globosa</i>	
				B II <i>Sumatrina annae longissima</i> – <i>Yabeina asiatica</i>		<i>Yabeina globosa</i>	Pmy <i>Verbeekina verbeeki</i>	Nm <i>Neoschwagerina margaritae</i>	
				A I <i>Pseudodoliolina pseudolepida</i> – <i>Pseudofusulina ambigua</i> <i>pursatensis</i>		<i>Neoschwagerina</i>	<i>Neoschwagerina margaritae</i> Hashiri- mizu Fm.	Pmβ <i>Neoschwagerina craticulifera</i>	Nc <i>Neoschwagerina craticulifera</i>
		B ₇ <i>Presumatrina schellwieni</i>		?		<i>Neoschwagerina craticulifera</i>	Pma <i>Parafusulina kaerimizensis</i>	Nn <i>Cancellina nipponica</i>	
		B ₆ <i>Neoschwagerina simplex</i>		<i>Neoschwagerina schuberti</i> <i>Sumatrina</i> , <i>Verbeekina</i>		<i>Cancellina</i>	PIδ <i>Misellina claudiae</i>		
		B ₅ <i>Maklaya sethaputi</i>		<i>Neoschwagerina simplex</i> <i>Presumatrina</i>		<i>Misellina</i>	PIγ <i>Pseudofusulina ambigua</i>		
	B ₄ <i>Maklaya pamirica</i>		<i>Cancellina</i> , <i>Armenia</i> <i>Parafusulina</i>			PIβ <i>Pseudofusulina vulgaris</i>			
	Lower		<i>Misellina</i> , <i>Pseudodoliolina</i> <i>Parafusulina vulgarisiformis</i>			PIα <i>Triticites simplex</i>			
		<i>Monodioxodina shiptoni</i>							

Table 1.3 Correlation of the Khao Phlong Phrab section with the selected sequences in the eastern part of Tethys (Toriyama et al., 1974).

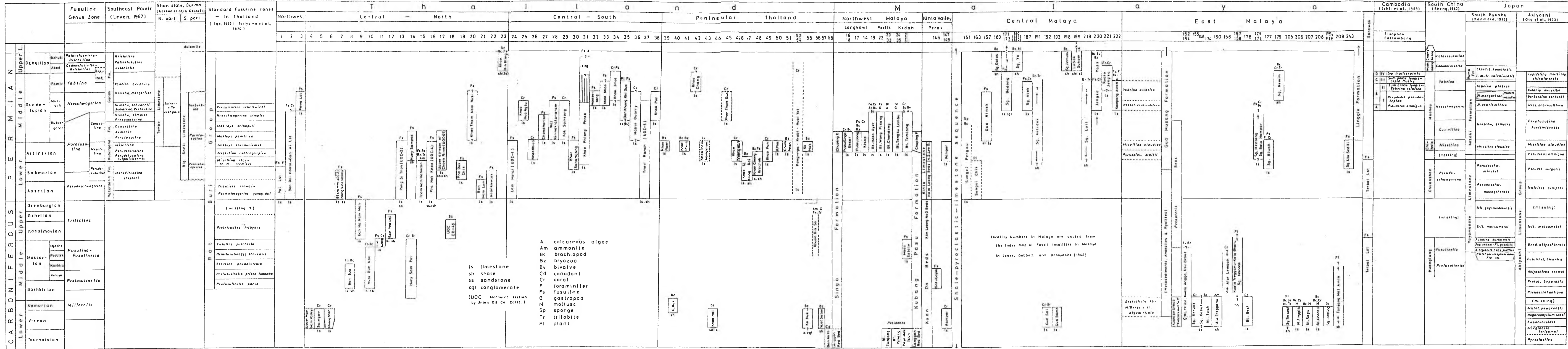


Table 1.4 Fusulinid zonation of Thailand correlated with southeast Pamir, Burma (Shan state), Cambodia, south China, south Kyushu and Akiyoshi of Japan (Toriyama et al., 1975).

System	Series	Fusuline Zonation
PERMIAN	Upper	<i>Palaeofusulina</i> aff. <i>bella</i> – <i>Colaniella parva</i> zone
	Middle	<i>Lepidolina multiseptata multiseptata</i> zone <i>Colania dauvillei</i> – <i>Verbeekina verbeeki</i> zone <i>Neoschwagerina haydeni</i> zone <i>Afghanella schencki schencki</i> zone <i>Presumatrina schellwieni</i> zone <i>Neoschwagerina simplex</i> zone <i>Maklaya sethaputi</i> zone <i>Maklaya pamicica</i> zone
	Lower	<i>Maklaya saraburiensis</i> <i>Misellina otai</i> – <i>Misellina termieri</i> zone (missing?) <i>Triticites ozawai</i> – <i>Paraschwagerina yanagidai</i> zone
CARBONIFEROUS	Upper	(missing?) <i>Protriticites tethydis</i> zone
	Middle	<i>Fusulina pulchella</i> zone <i>Hemifusulina (?) thaiensis</i> zone <i>Beedeina paradisiensis</i> zone <i>Profusulinella prisca timanica</i> zone <i>Profusulinella parva</i> zone
	Lower	(missing?) <i>Eostaffella mosquensis</i> – <i>Millerelia rossica</i> zone

Table 1.5 Fusulinid zonations of the Ratburi Group in Thailand and its equivalents in Malaysia (Ingavat et al., 1980).

10 ⁶ y	System	Series	Fusuline Genus Zone	Transcaucasia (Ruzhencev & Sarycheva, 1965; Leven, 1975)	Iran (Abadeh) (Taroz, 1971-74)	Southeast Pamir (Miklukho Maklai, 1963; Leven, 1967)	Afghanistan (Sieni, 1967; Lys & Lapparent, 1971; Leven, 1971; Lys, 1977)	Pakistan (Nakazawa et al., 1975)	Thailand (Pitakpaivan, 1963; Baum et al., 1970; Igo, 1972; Toriyama et al., 1974; 1978; Pitakpaivan & Ingavat, 1978)	Malaysia (Igo, 1964; Ishii, 1966; Ozawa, 1976; Aw et al., 1977)	Indochina (Cambodia) (Saurin, 1967; Ishii et al., 1969)	South China (Sheng, 1963)	Southwest Japan (Ota et al., 1973; Nakazawa et al., 1973)
247	TRIAS	Lower		Claraia Beds				Mianwali Fm.	Lampang Group			Yehiang	Komura Fm.
		Upper	Dorashamian Palaeofusulina-Colaniella	Paratirillites Sheyrevites Phisonites Vedicoceras Arazoceras Arazilevis	Dzhuif. Induan 8 7 6 5 4	Paratirillites Sheyrevites Vedicoceras Arazoceras Arazilevis	Paratirillites Sheyrevites Vedicoceras Arazoceras Arazilevis	Basal Kathwai	Palaeofusulina sinensis		Claraia Palaeofusulina at. bella Colaniella parva	Palaeofusulina sinensis Colaniella parva	Palaeofusulina at. sinensis - Colaniella parva
253		Upper	Abadehian Codonofusiella-Reichelina	Codonofusiella Reichelina Chusenella	Abadeh, Dzhuif. 3 2	Codonofusiella Reichelina Chusenella	Codonofusiella Reichelina Chusenella	Colaniella minima	Lepidolina multiseptata		Yabeina asiatica	Codonofusiella Colaniella minima	Palaeofusulina simplex - Colaniella minima Lepidolina kumaensis
259		Middle	Guadalupian Neoschwagerina	Chusenella abichi Sumatrina Eopolydierodina Verbeekina Pseudodaliolina	Guadalupian 3 2	Chusenella sp. A Neoschwagerina margaritae Neoschwagerina schuberti Sumatrina, Verbeekina Neoschwagerina simplex Presumatrina	Chusenella abichi Neoschwagerina margaritae Neoschwagerina schuberti Sumatrina, Verbeekina Neoschwagerina simplex Presumatrina	Neoschwagerina margaritae	Colonia douvillei Verbeekina verbeeki		Yabeina asiatica	Lepidolina multiseptata Sumatrina annae longissima - Lepidolina multiseptata	Lepidolina multiseptata Lepidolina shiraiwensis Colonia douvillei Neoschwagerina margaritae Neoschwagerina craticulifera
269		Lower	Artinskian Para-lusulina	neoschwagerinoid Cancellina Paralusulina	Asniy 1	neoschwagerinoid Cancellina Paralusulina	neoschwagerinoid Cancellina Paralusulina	Glassopteris Gangamopteris Monadiazodina	Maklaya sethaputi Maklaya pamirica Maklaya saraburiensis Misellina conragospira Misellina alai M. cl. termieri		Neoschwagerina craticulifera Neoschwagerina simplex	Cancellina	Alphonella schencki Paralusulina Kaerlmzeensis Cancellina nipponica
278		Lower	Sakmarian Pseudofusulina	Misellina Pseudofusulina	Dabaly	Misellina Pseudofusulina	Misellina Pseudofusulina	Saradhai F. Warchha F. Dandot F. Tobra F.	Trilicites ozawai - Pseudoschwagerina yanagidai		Misellina claudiae Pseudofusulina kraffti	Misellina	Misellina claudiae Pseudofusulina ambigua Pseudofusulina vulgaris Trilicites simplex (missing) Trilicites matsumotoi
289		Upper	Orenburgian Gzhelian Kassimovian	Trilicites		Trilicites	Trilicites						
306	CARBONIFEROUS	Middle	Moscovian Fusulina-Fusulinella	Fusulina Fusulinella		Fusulina Fusulinella	Fusulina Fusulinella		Fusulina pulchella Hemifusulina(?) thalensis Beedeina paradistenta Profusulinella prisca Himanic Profusulinella parva		Fusulines		Beedeina akiyoshiensis Fusulinella biconica Akiyoshiella ozawai Profusulinella beppensis
330		Middle	Bashkiran Millerella-Eostaffella	Millerella Eostaffella		Millerella Eostaffella	Millerella Eostaffella						Pseudostaffella antiqua (missing) Millerella yowarensis Nagatophyllum satoi Zaphrentoides sp. Marginatia toriyamai
341		Lower	Namurian Visean										
355		Lower	Tournaisian										
367		Lower											

Table 1.6 Fusulinid zonation in Thailand compare with Transcaucasia, Iran (Abadeh), southeast Pamir, Afghanistan, Pakistan, Malaysia, Indonesia (Cambodia), South China, Southwest Japan (Ingavat et al., 1980).

System	Stage (Leven 1981)	Fusulinid zone	Thailand Pitakulvan 1963, Bacon et al 1973 Igo 1972, Forlyann et al 1974, 1979, Pitakulvan & Ingavat 1978, Ingavat & Douglass 1980, Sakagami 1982	Fossil Location of Western Province	Fossil Location of Central Province	Fossil Location of Eastern Province
UPPER PERMIAN	Dorashamian	Palaeofusulina	<i>Palaeofusulina sinensis</i> <i>Colaniella parva</i>		Doi Pha Phlung fauna Nan fauna Phrae fauna	
	Dzhulfian	Reichelina	Codonofusuliella <i>Shanita intercalaria</i> ?	Rhlong Phra Saeng fauna Phangnga fauna		
	Midian	Lepidolina Yabeina		<i>Lepidolina multiseptata</i> <i>Codonofusuliella</i>		Sra Keow fauna
MIDDLE PERMIAN	Murgabian	Neoschwagerina	<i>Colania douvillei</i> , <i>Verbeekina verbeeki</i> K4 <i>Neoschwagerina haydeni</i> K3 <i>Alghanella schencki</i> B7K2 <i>Presumatrina schellwieni</i> B6K1 <i>Neoschwagerina simplex</i>	Sau Kam Pang fauna Mae Sarieng fauna		
	Kubergaudian	Cancellina	B5 <i>Maklaya sethaputi</i> B4 <i>Maklaya pamlica</i> B3 <i>Maklaya saraburiensis</i>	Sri Racha fauna Ban Na San fauna Kui Buri fauna Umphang fauna	Phrae fauna	
	Bolorian	Parafusulina Misellina	B2 <i>Misellina confragaspira</i> B1 <i>Misellina otai</i> <i>M. cf. termier</i>	Sai Yok fauna		
	Yabfashian	Parafusulina Chalroschwagerina	<i>Monadiesulina shiptoni</i> <i>M. sutchaica</i>	Sri Sawat fauna Mae Sarieng fauna Mae Ramad fauna Chiang Dao fauna		Huey Sam Pod fauna Khao Chakan fauna
	Sakmarian	Pseudofusulina Robustoschwagerina Paraschwagerina	<i>Robustoschwagerina lucida</i>	Pak Tho fauna Pra Chuab Kiri Khan fauna Chumphon fauna Sorat Thani fauna		Phu Duk Chik Khao Singto fauna Khan Chon To fauna Ban Tok fauna Tham Nam Mahoran fauna Ban Nua Lom fauna Phu Doen fauna
	Asselian	Pseudoschwagerina	<i>Tritiflites ozawii</i> <i>Pseudoschwagerina yanagida</i>	Doi Huato fauna Pai fauna Phrao fauna		

Table 1.7 Zonation and correlation on foraminiferal faunas from the western, central, and eastern provinces in Thailand (Ingavat, 1984).

	Permian Tethys stage scale in the Mediterranean-Alpine fold belt; after Leven, 1981.	Fusuline Genenc Zones	Fusuline Assemblage Zones from Sarabun Limestone (Dawson, 1991).	Stratigraphic sections of carbonate facies in this paper.		
Late Permian	Dorashamian	Palaeofusulina			<p>KEY</p> <ul style="list-style-type: none"> Dolomitised algal mats, Permial flats Interbedded shale with biopeloidal packstones, protected lagoon. Fossiliferous limestone, inner platform with patch reef. Fossiliferous algal reef and marginal buildups, Outer platform. Dolomitised algal packstones. Turbidites, slope 	
	Dzhullian	Reichelina				
	Midian	Lepidolina Yabeina				
Middle Permian	Murghabian	Codonofusuliella	Metadololina lepida -- Verbeekina verbeeki			
			Neoschwagerina haydeni Alghanella schencki			
			Neoschwagerina craticulifera Alghanella pesulensis Pseudodololina pseudolepida			
	Kubergandian	Parafusulina	Cancellina	Parafusulina -- Paraverbeekina Chusenella		
			Misellina	Armenina Misellina contragaspira Misellina otai		
Bolorian						
Early Permian	Yahtashian	Pseudofusulina	Chalarioschwagerina Pseudofusulina vulgaris Chalarioschwagerina			
	Sakmarian		Robustoschwagerina -- Paraschwagerina Nagatoella			
	Asselian		Pseudoschwagerina			

Table 1.8 Fusulinid assemblage zones from Saraburi Limestone (Dawson and Racey, 1993)