



## CHAPTER 1

### INTRODUCTION

The limestone terrain in Changwat Saraburi, central Thailand is economically important since it provides the construction materials, i.e. the crushed aggregates for most of the construction projects in nearby Bangkok. The sources of the raw materials for cement production, the marble quarries, etc. also locate here. Geologically, the Upper Paleozoic carbonate/clastic unit and other related rocks receive much attention since they are accessible in a highly cultivated area with a good quality information of yet complicate geology being recorded. The area had been visited by many groups of geoscientists in the past. One of the first studies was done by Brown et al. in 1951 when they tried to correlate the limestone unit, being named by them the Rat Buri Limestone then, throughout the country. Many more studies had followed, all to view the rock units there in various aspects. The present study is one, being designed to collect the structural geologic data.

#### 1.1 Purpose and Scope of Study

The understanding of the geologic structures is for estimating the distribution of the rock bodies being displaced in a deformation process. To do this, the primary and secondary structures of all scales, namely macroscopic, mesoscopic, and microscopic are examined. Generally, the observation of the mesoscopic structures,

in the size of an outcrop or a hand-specimen, is first done. This includes the description of the features and measurement of their geometric configuration and is usually done in the field. The data are then analyzed and synthesized for the larger regional macroscopic structures. The microscopic structures of the grain- or subgrain size can also be studied under the microscope to gain a full information. All these data are then combined to develop a tectonics hypothesis of the area. The study of the structural geology can be done more accurately with the additional data from the other study fields, e.g. Stratigraphy, Petrography, Photogeology, Geophysics, etc.

As the present study area had been extensively investigated, much background geologic information, though incomplete, is available for a review before a consideration of the geologic structures is performed. There are certainly some proposals on the structures in this area, but the knowledge is still scant scantily. The observation is thus needed to gain the further views for the new proposals, alternative idea, and the supporting evidences for the previous proposals. In the present study, the additional survey on the stratigraphy is also essential since there has never been one in detail before. The review of the past works plus the structural knowledge gathered in the present research, thus, leads to a construction of the areal geologic structures and to establish the process of tectonism concerned.

### 1.2 Location and Accessibility

The study area (Figure 1), some 900 square kilometer in size, locates in Changwat Saraburi, central Thailand, between the longitudes

$100^{\circ} 53' 11''$  E and  $101^{\circ} 13' 04''$  E and the latitudes  $14^{\circ} 34' 14''$  N and  $14^{\circ} 46' 13''$  N, and is covered by 4 sheets of the 1:50,000 - scale, series L7017 topographic map, namely sheets 5138 I (Amphoe Phatthana Nikhom), 5138 II (Changwat Saraburi), 5238 III (Amphoe Kaeng Khoi), and 5238 IV (Ban Khok Salung). This area lies slightly over 100 km north-northeast of Bangkok.

The highways provide the access to the study area include the Highways 1 (Paholyothin), 21 (Saraburi - Lom Sak) and 2 (Friendship) with the network of secondary all-weather roads, asphaltic as well as gravel-paved, branched out to every place. The land transportation in the area also includes the northeast-bound railway.

### 1.3 Climate and Physiography

The climatic condition of central Thailand, in where the study area locates, is of the savanna tropical type with the rainy season ranges from July to October while the rest of the year is relatively dry. The average annual temperature is  $28 - 30^{\circ}\text{C}$ , with a maximum of  $32^{\circ}\text{C}$  in March and a minimum of  $24^{\circ}\text{C}$  in December. The highest average monthly rainfall is 301.8 mm in September, the lowest 8.7 mm in December. The highest average of 13.6 rainy days occurs in September, the lowest 0.6 rainy day in January (Figure 2).

The physiography of the area consists of the flat low lands, rolling terrain, and limestone hills and ridges. The flat alluvial deposit low land of Chao Phraya River occupies the southwestern corner with the narrow belts of alluvial deposits along Pa Sak River in the middle and Muak Lek River at the eastern limit of the study area.

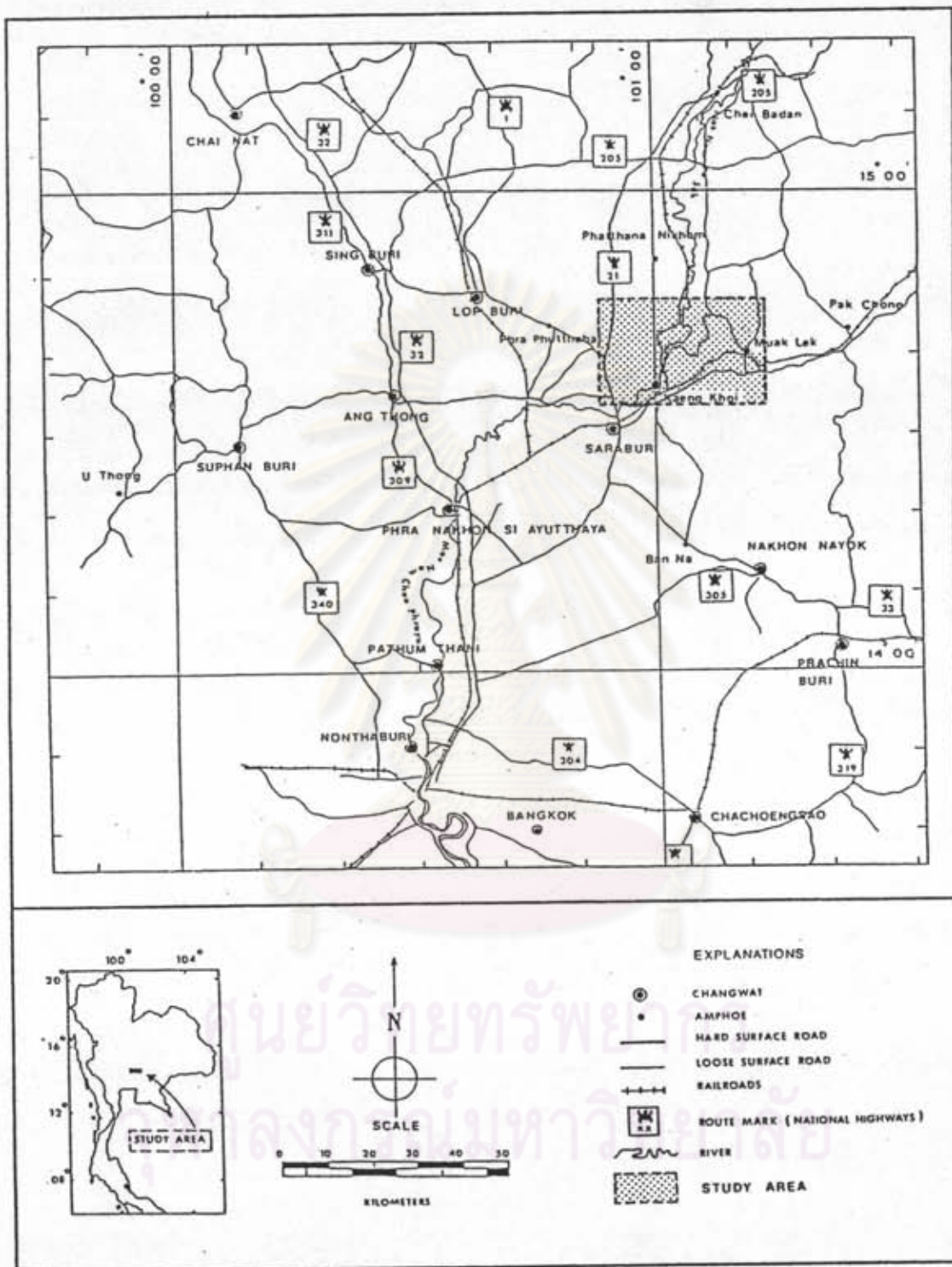


Figure 1 Location of the study area.

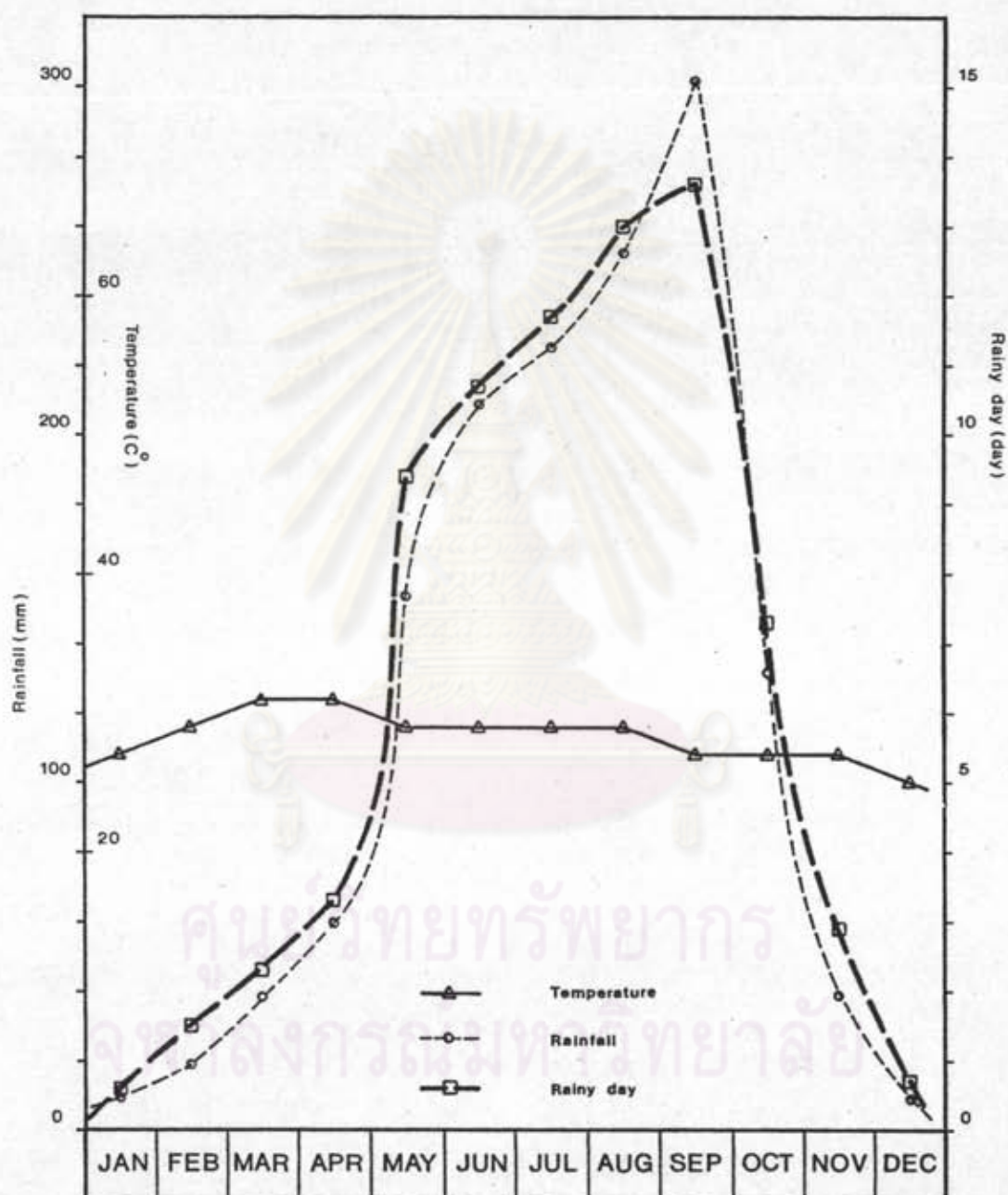


Figure 2 The 30-year average rainfall and rainy day (1931-1960), and temperature of Changwat Saraburi (1951-1980) (Constructed from Meteorological Department, 1964 and 1981).

The elevation of these low lands ranges from 15 m to 65 m above the mean sea level. The limestone hill-series and ridges, trending east-west to northwest-southeast, occupy the central part. The hills and ridges stand clear above the surrounding low topography to the highest altitude of 595 m on the top of Khao Nam Tok. In the northeastern part of the study area, the terrain is generally rolling with the elevation ranging from 50 to 400 m.

The surface drainage system here is composed of Pa Sak River, one of its main tributary, Khlong Muak Lek, and other tributaries. Pa Sak River flows from north to south, bisecting the study area, while Khlong Muak Lek which marks the eastern limit of the area flow from south to north. There are 2 distinctive drainage patterns here : the one on the flat land is subdendritic, the other passing through the hills is subdendritic, subparallel, angulate and swallow hole with the degree of density varying from fine to coarse.

The hills and ridges are covered with trees and bushes, the rest are cultivated for the rice paddy fields, corn and cotton fields, fruit orchards, and livestock ranches.

#### 1.4 Previous Works

In 1951, Brown et al. had studied the Upper Paleozoic limestone unit in the present study area and elsewhere and formally designated it as the Rat Buri Limestone after the type locality in Changwat Ratchaburi. Prior to their work the rock unit was mentioned by Lee (1923, 1927) in his reconnaissances on the general geology of Thailand and of particularly the northeastern plateau. After 1951, several writers also mentioned the

Limestone" which occurred here and elsewhere in their works (La-Moreaux et al., 1959 , Kobayashi, 1960 , Klompe, 1962 , Toriyama and Sugi, 1959 , etc.). As those works did not describe the present study area in detail, no serious review of the papers was attempted.

More detailed studies on the carbonate/clastic rock unit (later renamed the Ratburi Group by C. Javanaphet in 1969, according to the guidelines for International Stratigraphic Codes, in his preparation for a 1:1,000,000 - scale geologic map of Thailand) were done in 1960's on the geology of the area. These works include the works of Pitakpaivan et al. (1969) on the Permian fossils from the coralline limestone in Changwat Saraburi and of Borax and Stewart (1966) who did the work on the Paleozoic stratigraphic correlation of northeastern Thailand and who first recognized an unusual boundary in the stratigraphic succession as a thrust fault (the structure was named "Thap Kwang Thrust" in this paper after the type locality near Ban Thap Kwang, Amphoe Kaeng Khoi). In 1976, Tittirananda had done a research for her Ph.D. dissertation on the stratigraphy and paleontology of the limestones along Highway 21 from Km. 6 to Km. 14. She also reported her findings in a conference in 1978 (a, b) (Her name was changed to O.T. Dawson then).

The Geology Department of Chulalongkorn University was also interested in the area. The department had the fourth- and fifth-year students doing the summer field work in this area for several consecutive years (i.e. 1963, 1970, 1971, 1972 and 1985). Most of the reports, unfortunately, remain as they are. Only twice that the reports be compiled, still unpublished, i.e. the works of Abele and Beeser (1962) and Campbell et al. (1972). Recently in 1985 a fourth-

year student of this department, Mr. N. Comviravong did his senior project on the structural correlation on Highway 21 from Km. 0 to Km. 12. The last work is the only one that deals directly with the geologic structures of the area, but to a very limited extent.

Perhaps the most acceptable work which covers the present study area is that of Hinthong (1981) who compiled the geology of the whole 1:250,000 - scale topographic map sheet of ND 47 - 8 (Changwat Phra Nakhon Si Ayutthaya). The work described more on the lithology, stratigraphy & stratigraphic succession, and on the general structures. Though the scale of the map is too small to contain any detail, it is the only one that best describes the geology here. For this reason, the following chapters, when dealing with the general geology and structures, and the stratigraphic division, depend so much of Hinthong's (1981) work.

### 1.5 Methods of Investigation

The methods of investigation performed in this study are shown as a flow chart in Figure 3. In the work procedure, the previous works were first extensively reviewed, followed by an interpretation of the apparent geologic and geomorphologic conditions in the black-and-white vertical air photographs of an approximate scale 1:46,000. Most of the field visit was done from March to May, 1985, aiming to do the standard field mapping of the rock distribution, to study the mesoscopic structures, and to collect some 340 handspecimens for the further petrographic and other studies in the laboratory. The topographic base maps used in the field survey are the 1:25,000 - scale directly-enlarged versions of the already mentioned 1:50,000 - scale



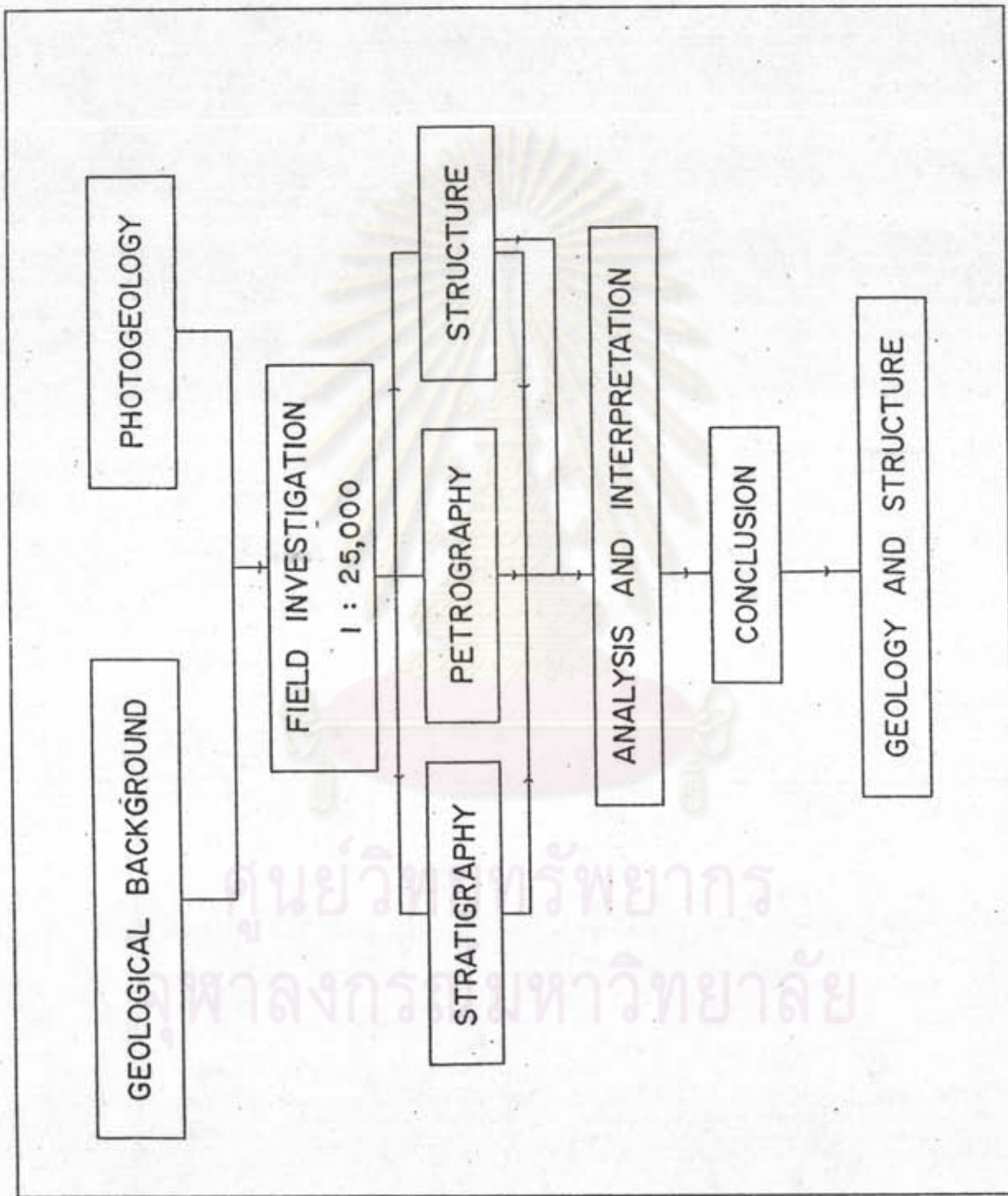


Figure 3 The study-method flow chart of the present study.

topographic maps. Most of the well-exposed outcrops were visited and studied for the rock types and observable structures. The field data together with the petrographic study of more than 300 thin-sections lead to the correlation of the stratigraphy and areal structures. The field-collected data of the mesoscopic-scale structures and the observation of 6 oriented specimens were analysed for the statistic significance of the structures, thence to support the field-observed structural correlation. The analysis was done using a lower-hemisphere equal-area stereographic net plot with a 1-percent area counter developed by D.E. Dunn of the University of North Carolina at Chapel Hill, U.S.A. In addition, the description of the field observed structures, some of which the petrofabrics, was done to encourage the detailed study on the geologic structures, to be followed in the future.

As the geologic structures are the main concern in this report, no serious investigation was done on the Quaternary (?) alluvial deposits. The deposits only received an attention during the work phase of air-photographic interpretation.

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