# CHAPTER I

# INTRODUCTION

## 1.1 Background

Up to the present time, many geoscientists have been interested in tectonic frameworks, and this becomes more increased due to the fact that the theory of global tectonics can explain vast several geological appearances. Outstandingly, the study of tectonics which is the study of the earth deformation and evolution such as folding, earth movement, etc. can be separated to several branches. One of its branches involves the study of tectonics that has occurred recently or in the present - day time, since it is mostly related to human and society. Presently, there are many technical terms adopted for such kind of this study. The popular term is active tectonics as proposed by Wallace (1986) which is defined as tectonic movements that are expected to occur within a future time span of concern to society. The more widely used term- neotectonics- as referred by Slemmons (1991) can be broadly described as tectonic events and processes that have been occurred in post - Miocene time. The other terms such as Holocene tectonics which concerns only with tectonics occurring within Holocene time, Neogene-Quaternary tectonics which deals with that taking place since Neogene, and Quaternary tectonics which involves that happening only in Quaternary time (see Stewart and Hancock, 1994). However, in many cases, these terms have been sometimes wrongly adopted for active tectonics or neotectonics. In this current research, the term "neotectonics" is applied herein as the prime topic for this thesis study.

Nowadays, there are several geologists who defined the term neotectonics. Actually this term was introduced long times ago. Apart from the definition mentioned above, Obruchev (1948) applied the term-neotectonics for "the study of the young and recent movements taking place at the end of the Tertiary and the first half of the Quaternary" (quoted in Pavlides, 1989). Morner (1990) defined neotectonics as the branch of tectonics concerned with understanding earth movements and both occurred in the past and are continuing at the present day.

In this study, neotectonics is defined as tectonics concerned with understanding earth movements that occurred in Qauternary and continue to the present day and the future that concern to society (combined and modified from Morner, 1990 and Wallace, 1986)

In the neotectonic investigation, several methodologies can be applied.

Good examples are those of Sieh & Wallace (1987) who used the geomorphological evidences for studying the western part of United State of America area. In Canada, Dragert (1986) utilized geodetic signal for seismic investigation at Vancouver Island area. In Central Asia Peltzer et al. (1989) applied remote sensing data for analyzing strike-slip tectonics and earthquake in the northern part of Tibet area. Ward (1990) using seismological indications for plate movement in Pacific Ocean of the North America continent. In Europe, Nur (1991) adopted historical and archeological records for studying earthquakes and neotectonics in Mediterranean area, Slemmons (1991) used geological and seismotectonic evidences for earthquake and paleoseismicity investigations in the southwestern region of United States. Subsequently Hailwood et al. (1992) applied the age-dating results for paleoseismic application at the northern part of Wales.

Most of the neotectonic studies are, to some extent, those related to the so-called active fault (Ambrasey, 1978, Stewart & Hancock, 1994). The study of neotectonics involves activities along the active faults (or the less - widely used capable faults), earthquakes and morphology that are results from the current continental movement (Stewart & Hancock, op. cit.).

The researches concerning neotectonics are relatively permissive and important for locating the natural hazard risk areas related directly and indirectly to volcanoes, earthquakes, landslides, floods, etc. This investigation can be essential data base for supporting engineering, rural and urban planning related with building design, infrastructure development, and transporting & communication system. Therefore, its wide-scheme application is inevitably crucial for preventing the natural hazards concerned to human society (Slemmons & de Polo, 1986).

Thailand, a country in mainland SE Asia, can be classified as the continental dynamic area. Some parts of the country, particularly those of the north and the west, display quite distinct neotectonics activity (Kosuwan et al., 1999). Good evidences for explaining this signal are earthquake activities and landforms produced by these activities. Neotectonic investigation of Thailand, anyhow, is quite new for Thai geoscientists, and to date it is in the stage of the beginning. Therefore it is rather difficult to find some researches related to such studies. Only a few have been done so far in the past two decades. Thiramongkol (1986) reported neotectonic study and the uplift rate in the eastern margin of the Lower Chao Phraya Basin. Sarapirome and Khundee (1994) investigated neotectonics in the Mae Hong Son - Khun Yuam Valley. Very recently, Fenton et al (1997) and Bott et al. (1997) studied Late Quaternary faulting and seismicity in northern Thailand recurrence and slip rate were also first reported.

Kanchanaburi (Figure 1.2) is one of the provinces in western Thailand where many earthquakes (Figure 1.3) have occurred. There are several major faults in Thailand including Mae Chan, Three Pagoda and Sri Sawat Faults that are documented to be associated with earthquake activities (Siribhadi, 1985, Charusiri et al., 1999a). These fault zones cut through many kinds of rocks of various ages, giving rise to the complexity of the geology. Some of them are assigned to be active, some are not. With the applications of several geologic and seismotectonic parameters, major active faults in Thailand are delineated. Figures 1.1a and 1.1b show such major fault zones that are regarded to be active.

Three Pagoda Fault Zone (Figure 1.1b) is located in the western part of Thailand and pass Kanchanaburi city, 150 km northwest of Bangkok. Its major trend is NW-SE. However, at present there are only few investigations that have been done so far on this fault. Geomorphology is one of the many procedures used for studying neotectonics (see Thiramongkol, 1986) because there are many evidences that can relate with faults and tectonic structures in the field, such as offset stream channels, shutter ridges, fault scarps, triangular facets, beheaded channels, terrace risings, offset ridges, and valleys. This method has been reported to become very useful and successful for studying neotectonics (Sieh & Wallace, 1987, Weldon et al., 1996, Chorowicz et al., 1999).

## 1.2 Objective

The main aim of this research is to study neotectonic evidences along the Three Pagoda Fault Zone in Changwat Kanchanaburi. The benefit out of this, to the author believes, is to apply such neotectonic evidences and methodology from this study can be applied for other parts of the country. This study can provide a case - study for the preliminary analysis of the paleoseismology of Thailand.

## 1.3 Methodology

The methodology of study is divided into 4 steps, viz. planning and preparation step, data interpretation and analyzing, field survey, and laboratory investigation.

### 1 Planning and preparation

The first stage involves mainly data collection in order to gain preliminary available information about the regional study area and to arrange and rearrange relevant information for subsequent step. Seeking for previous works, finding hot spring data, heat flow result (Figure 1.4), and earthquake epicenter, acquiring the

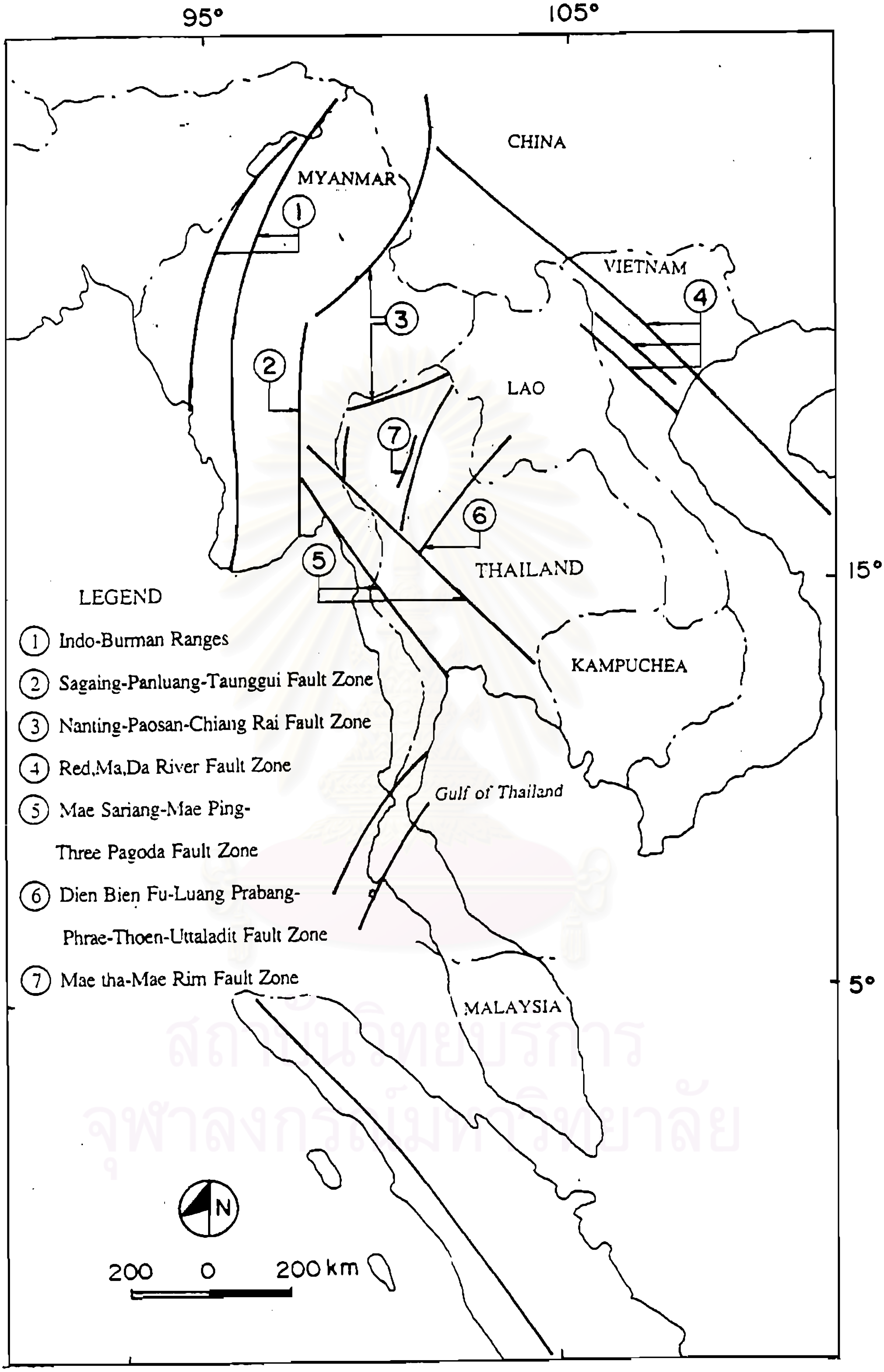


Figure 1.1a Major fault zones in mainland SE Asia from satellite imagery interpretation (Charusiri et al., 1997b).

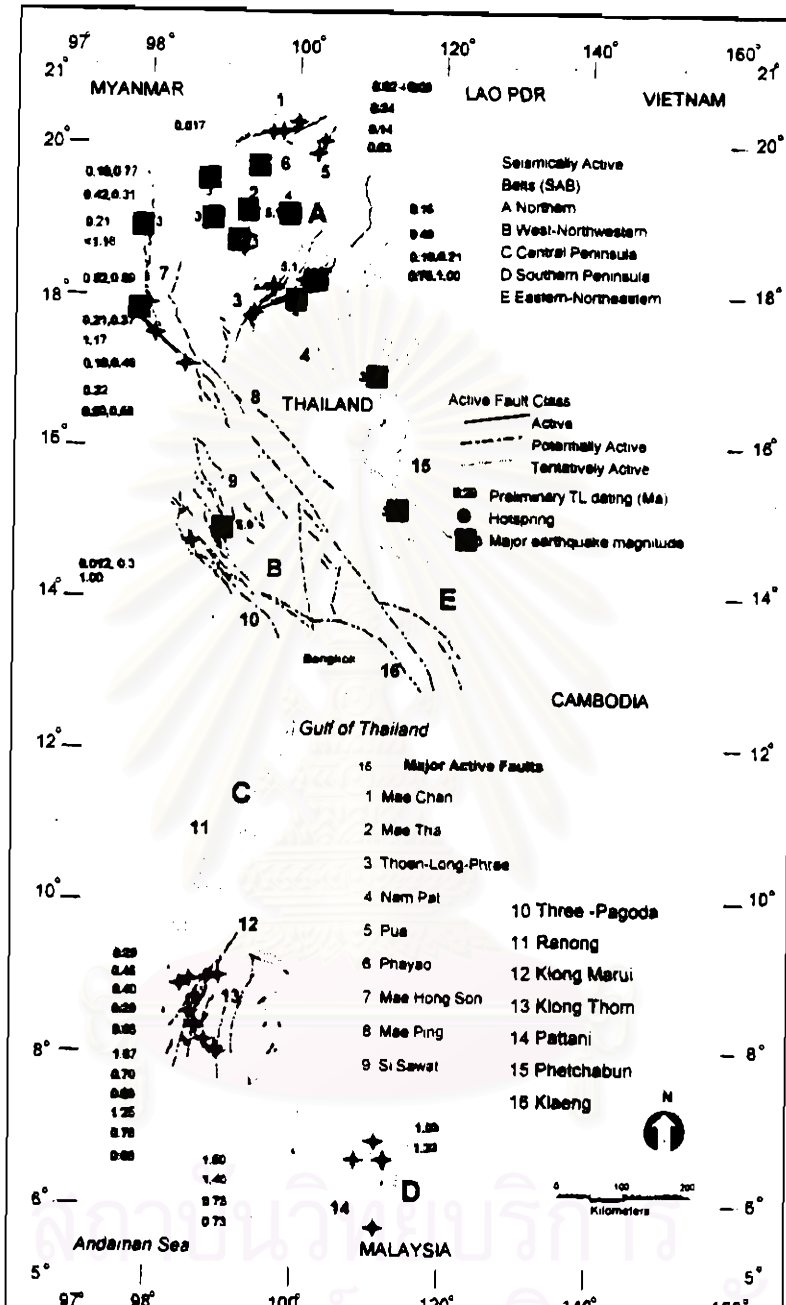


Figure 1.1b Major active faults in Thailand showing preliminary TL dates and hotspring and epicentral distribution (Charusiri et al., 1999c).

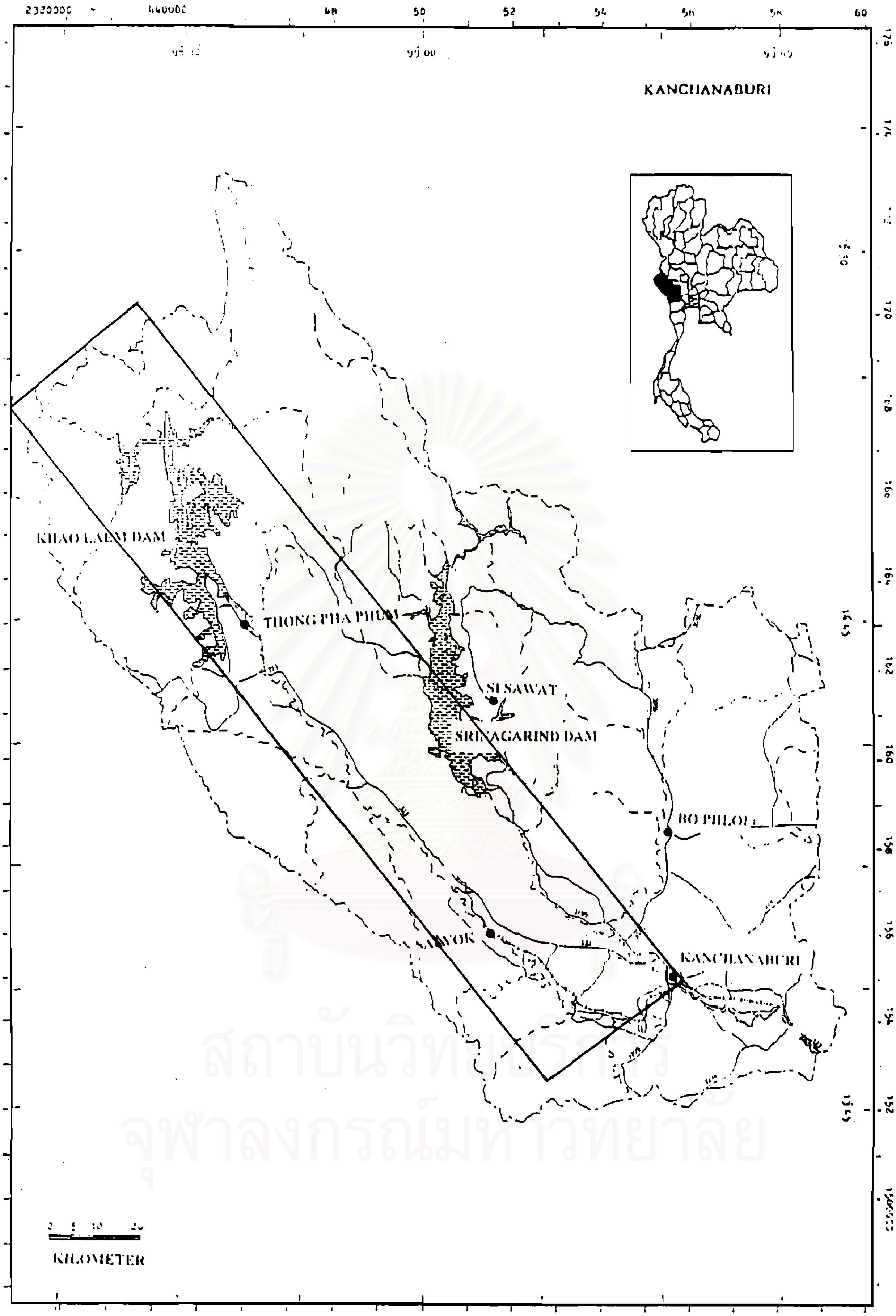


Figure 1.2 Index map of Changwat Kanchanaburi showing the study area (in box).

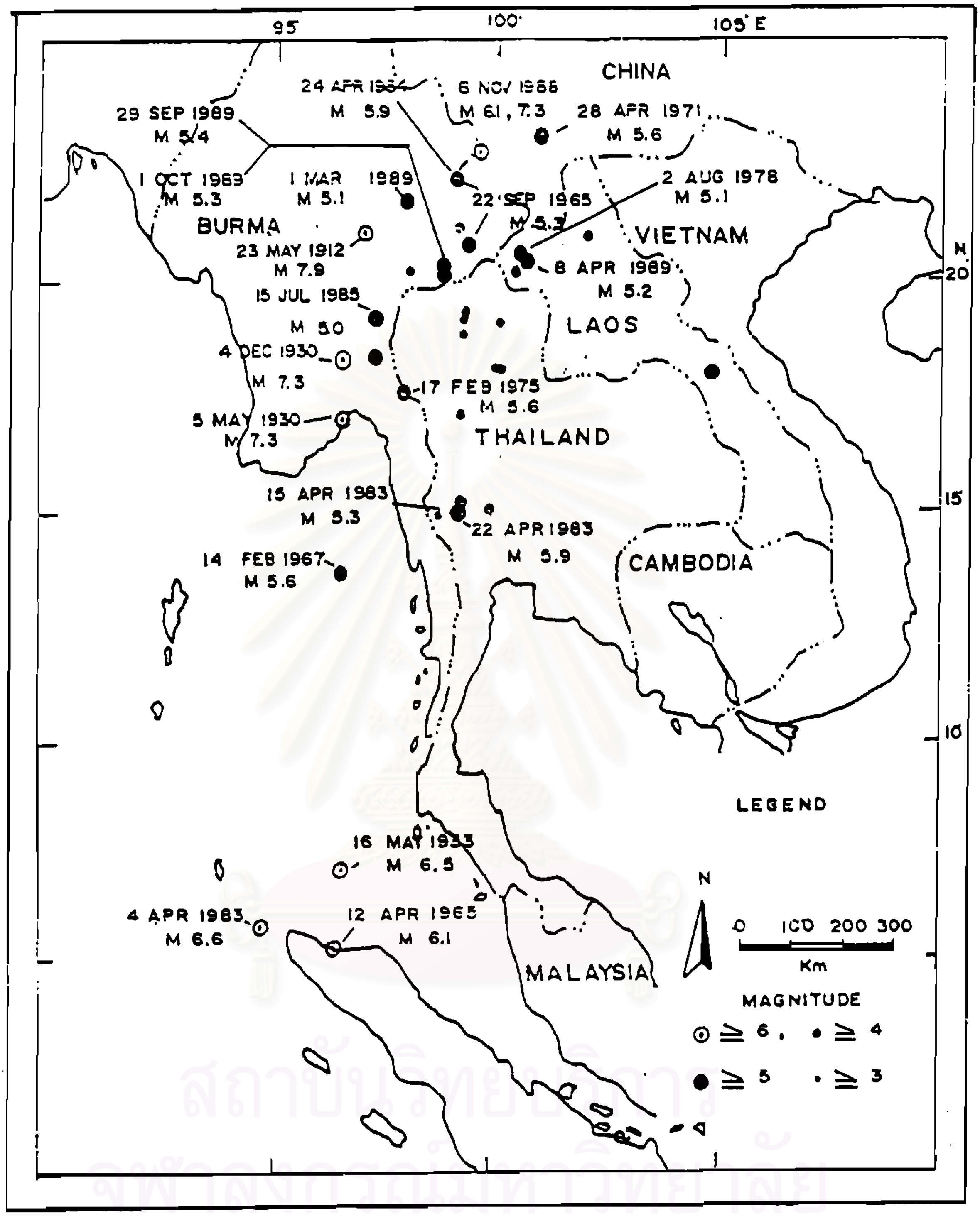


Figure 1.3 Distribution of earthquakes in mainland SE Asia showing epicentral location with earthquake magnitude large than 3 in Ricther scale (Charusiri et al., 1997b).

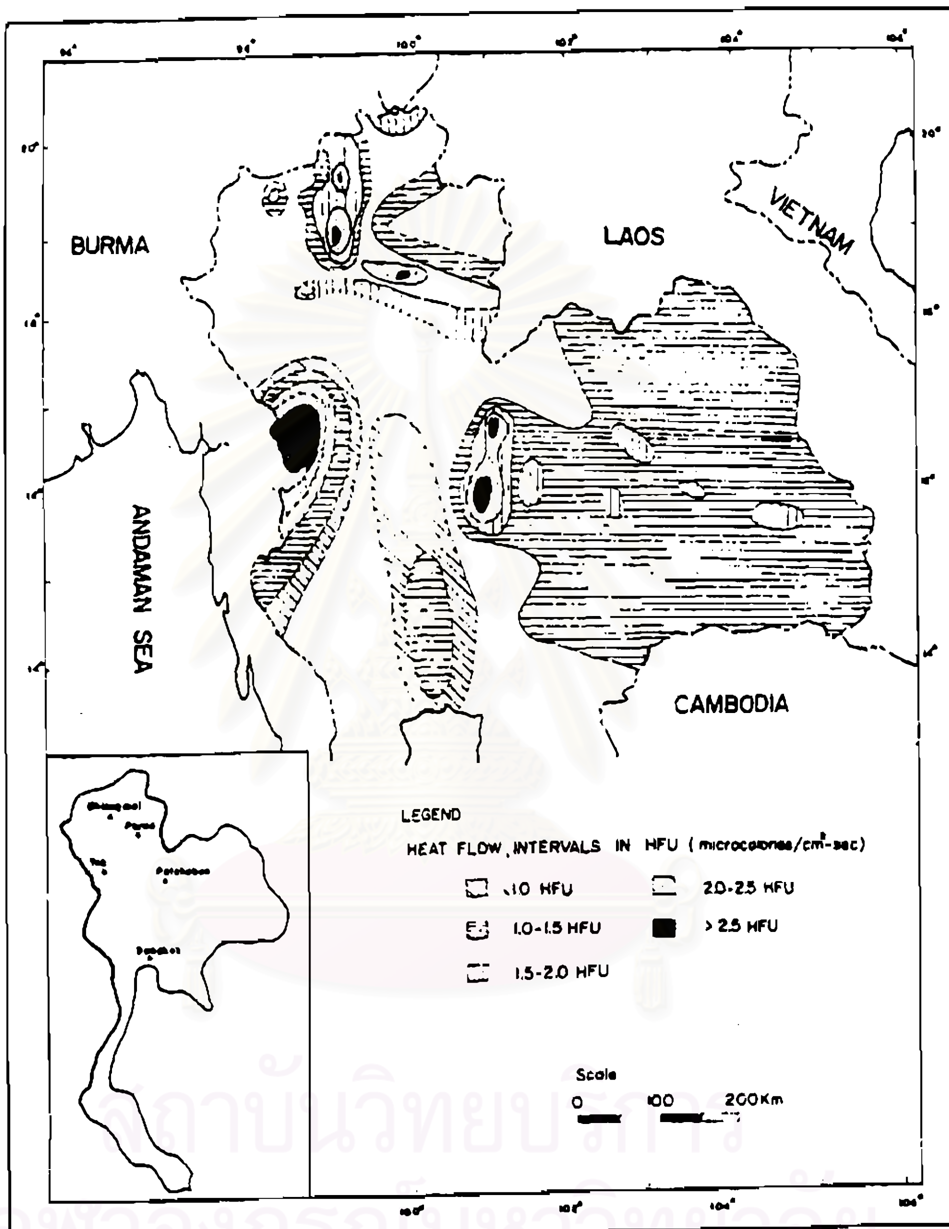


Figure 1.4 Heat flow map of the northern western, and northeastern parts of Thailand (Thienprasert and Raksaskulwong, 1983).

satellite images, aerial photographs, collecting data on ancient-town location, preparing topographic, geologic and related maps, are regarded as the cryptic data base for this stage.

**2 Preliminary data interpretation and analysis**

The second stage forms the main task of this thesis study involving remote sensing interpretation commencing at the small scale with satellite imagery. Both enhanced Landsat and JERS satellite images are the basic data for the interpretation. Lineaments are then interpreted for locating attitude and orientation of the Three Pagoda Fault Zone. Segmention of the fault is performed at this step. When the fault segments are already defined. Progressing to the more detailed investigation includes defining individual characteristic of fault segments with the uses of stereoscopic aerial photographs. This later procedure is done for locating zones of active deformation and gathering neotectonic evidences.

**3 Field study**

Once the fault zones are defined, emphasis is placed on subsequent detailed geomorphic mapping in areas where Quaternary landforms and deposits are situated. Morphotectonic landforms and styles were delineated at this stage. In this study, geomorphic mapping related to neotectonic evidences aids in evaluating locations of active faults, nature of faulting, and identifying sequences of faulting in the focus areas. Geological data are collected particularly along the fault segments for studying the characteristic of faults.

**4 Laboratory analysis**

Sampling of geological materials related to earthquakes is then carried out. In this study two kinds of geochronological approaches are selected – Electron Spin Resonance (ESR) and Thermoluminesence (TL) datings. Methodology of these two methods are almost the same. Detailed analysis of both methods can be found in Takashima and Watanabe (1994) and will not be repeated herein. Brief description of the theoretical backgrounds and methods of calculation is shown in Appendix B. A flow chart depicting the general procedure for this research study is shown in Figure 1.5.

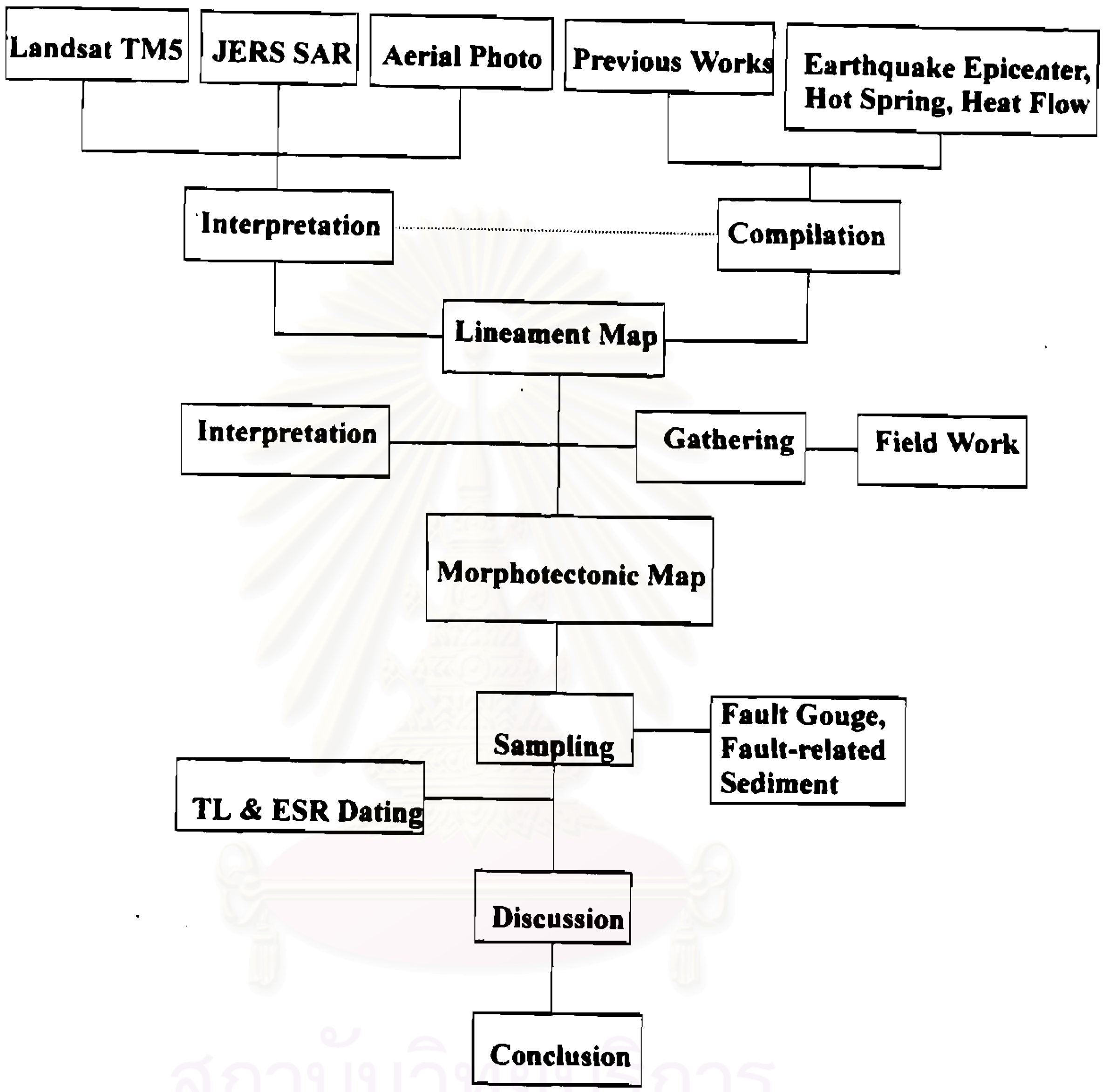


Figure 1.5 Simplified flow chart illustrating investigation procedure for the research study.

## 1.4 Previous works

At present, no detailed study on neotectonics has been performed in Kanchanaburi area. However, a few researches have been reported more or less concerning with geological structures and seismology in the Kanchanaburi region.

Nutalaya et al. (1984, 1985) studied the seismology of Thailand and structural framework of the Chao Phaya Basin and seismotectonic source zones are subsequently delineated.

Siribhakdi (1985) studied seismogenic of Thailand and periphery and reported earthquakes in Thailand recorded through out her past 1,500 years history. Many of the earthquakes are found to have close relation with four major faults, namely the Three Pagoda, the Si Sawat, the Moei-Uthai Thani and the Mae Hong Son-Mae Sarieng Faults.

Klaipongpan et al. (1986) investigated geological and seismicity evaluation of April 1983 earthquake at the Srinagarind Dam. The results obtained from evaluation of overall characteristic seismicity, review of world-wide data on seismic, geologic and characteristics of reservoir triggered seismicity (RTS) ensure to accept the high possibility of reservoir induced seismicity phenomena.

Hetrakul et al. (1986) investigated the post evaluation on reservoir triggered seismicity (RTS) of Khao Laem Dam . The results clearly differentiate the reservoir induced earthquakes phenomena from natural tectonic earthquake.

Shrestha (1987) studied the active faults in Kanchanaburi province. He reported that the Three Pagoda Fault Zone is the one of the active faults in Thailand as marked by young tectono-geomorphic features. A slip rate of 3.9 mm per year has been proposed.

Hinthong (1991) investigated the role of tectonic settings in earthquake events in Thailand. He reported that the seismic source zone in Tenasserim range (or Zone F of Nutalaya et al., 1985) was responsible for principal present-day NW-SE right-lateral strike slip Fault Zones, i. e., the Moei Uthai Thani Fault Zone, the Three Pagoda Fault Zone, and the associated Si Sawat Fault. Those faults and fault zones are believed to be responsible for the historic earthquakes in western Thailand.

Sarapirome and Khundee (1994) presented a preliminary study on neotectonics in the Mae Hong Son-Khun Yuam valley. They used the statistic parameters of trending and length of lineaments, data on earthquake epicenters and hot springs including Quaternary faults were gathering and analyzed in order to find out how these data could be used to imply the neotectonics of their study.

Charusiri et al. (1997b) applied several remote sensing techniques to geostructures related to earthquakes in Thailand and neighboring countries. The result is useful in determining the seismic - source zones to indicate the earthquake - prone areas. A new seismotectonic (or seismic-source zone) map is also proposed.