CHAPTER 1

INTRODUCTION

1.1 Introduction

The use of construction materials is strongly related to economic growth and the level of national development. Sand is one of construction materials. It is widely distributed in coastal and alluvial plains. However, more and more claims of other land-uses, like urbanization and agriculture obstruct the exploitation of construction materials. Depletion of the present near surface resources forces exploitation into deeper strata and even into offshore area.

Expertise in Quaternary geology is of vital importance in searching economically relevant sand resources. The required properties of construction sand depend on the desired application. For the fabrication of high quality products such as concrete, the requirement and for raise and fill material low quality sands are allowed. By mixing, sorting, washing, chemical cleaning, etc., many of the available raw materials can be made suitable for various applications in construction.

The western part of the Lower Central Plain of Thailand, the weathered granite has been eroded and transported along the Khwae Noi and Khwae Yai to the Mae

Klong. The eroded materials consist of gravel, sand, silt and clay. The fine silt and clay materials are carried for downstream and eventually to the estuary, while the coarse gravel and sand are deposited along the channel forming channel bar and point bar deposits. As a result of the deposition mentioned above, the Mae Klong has changed its course several times in the past, and forms an alluvial plain in the east of the present river. The Mae Klong sand therefore at present is river sand and land sand.

River sand used to be abundant along the Mae Klong from Kanchanaburi to Ratchaburi. Due to the construction of Wachiralongkon and Si Nakkharin Dams, however, there is now no new sand deposits mentioned above has almost been entirely used up, and some sand dredging operators have moved upstream to the Khwae Noi.

Mae Klong land sand is found on alluvial plain east of the present river. This flat deltatic plain and fan terrace complex has a deviated fan-shape configuration with its apex at Kanchanaburi. Sand deposits do not distribut over the entire area of the alluvial plain, but are confined mainly along the old channels. Several such sand deposits have opened up in Kamphaeng Saen.

Construction sand is the important material for concrete mixing. It is in fine aggregate material type and many sizes, its sizes have less than 6.4 mm. (1/4") to the

same dust size. At present the popular constrution sand is natural sand, manufactured sand, or a combination there of. The construction sand often have 33% to 45% of quantity that mixes in the used rock fragments.

The gradation of rock fragments and sand sizes are quite importance, therefore rock fragments and sand that have good gradation size will have two advantages as the following :

a. The suitability of the proportions of coarse and fine aggregates make compressive strength of concrete.

b. Lower the paste quantity usage that may seal the holds of rock and sand and help use lower cement to save money.

The gradation of size is one agent that make a compressive strength of concrete to change for each mixed method that is limited.

At present there is no collection of the used sand data of each year. But sand for concrete can be calculated from the used cement in the country. The results are in 1984 the used cement was 8.3 million metric tons and about 7.9 million metric tons in 1985. According to the sand used solely for concrete work, the value increases more than 10 millions cubic meters per year. However, the current sand uses for all purposes the whole country had a

par value of over 1,000 million bath (compare price of sand in 1985).

As the afore - mentioned reasons, the author has decided to study land sand in the western part of the Lower Central Plain. View from the point that construction sand is vary importance in economy; but due to the construction of dams there is now no new sand deposits in the lower part of the dams or has now been entirely used up. Thus it is pertinent that study of land sand deposit would help economize the cost of sand as far as the distance and time are concerned.

1.2 Objectives

1.2.1 To study geology and geomorphology of construction sand deposits in the area of Changwat Kanchanaburi, Suphanburi, Nakhon Pathom and Ratchaburi.

1.2.2 To study the physical properties of sand sediments particularly the trend of grain size distribution in the study area.

1.2.3 To find and presents the methodology to specify and maps of sand deposits of which the properties are within the specification and standard for concrete aggregates.

1.3 Location

The study area is located between the Mae Klong and Tha Chin. It covers about 3,500 square kilometers of Kanchanaburi, Suphanburi, Nakhon Pathom and Ratchaburi provinces. The area lies between latitude 13° 30′ N and 14° 20′ N, longitudes 99° 30′ E and 100° 15 E (Figure 1.1)

The study area can be access by highways, from Nakhon Pathom to Ratchaburi, Nakhon Pathom to Kanchanaburi, Kanchanaburi to U-thong and Nakhon Pathom to U-thong There are also many good secondary roads and many loose surface roads and cart tracts. In addition three railways lines run through the area, from Bangkok to Ratchaburi, Bangkok to Kanchanaburi and Bangkok to Suphanburi (Figure 1.2).

1.4 CLIMATE

The climate of the study area is basically a Tropical Savanna Type. The anual rainfall of the region ranges from 800 to 1200 mm. According to the rainfall data for 3 stations (Figure 1.3), the general trend of greatest contrast in rainfall is seen in May till October when the western region is humid and wet, while the remaining months are dry and almost rainless. The period of high precipitation in this region can be explained by the

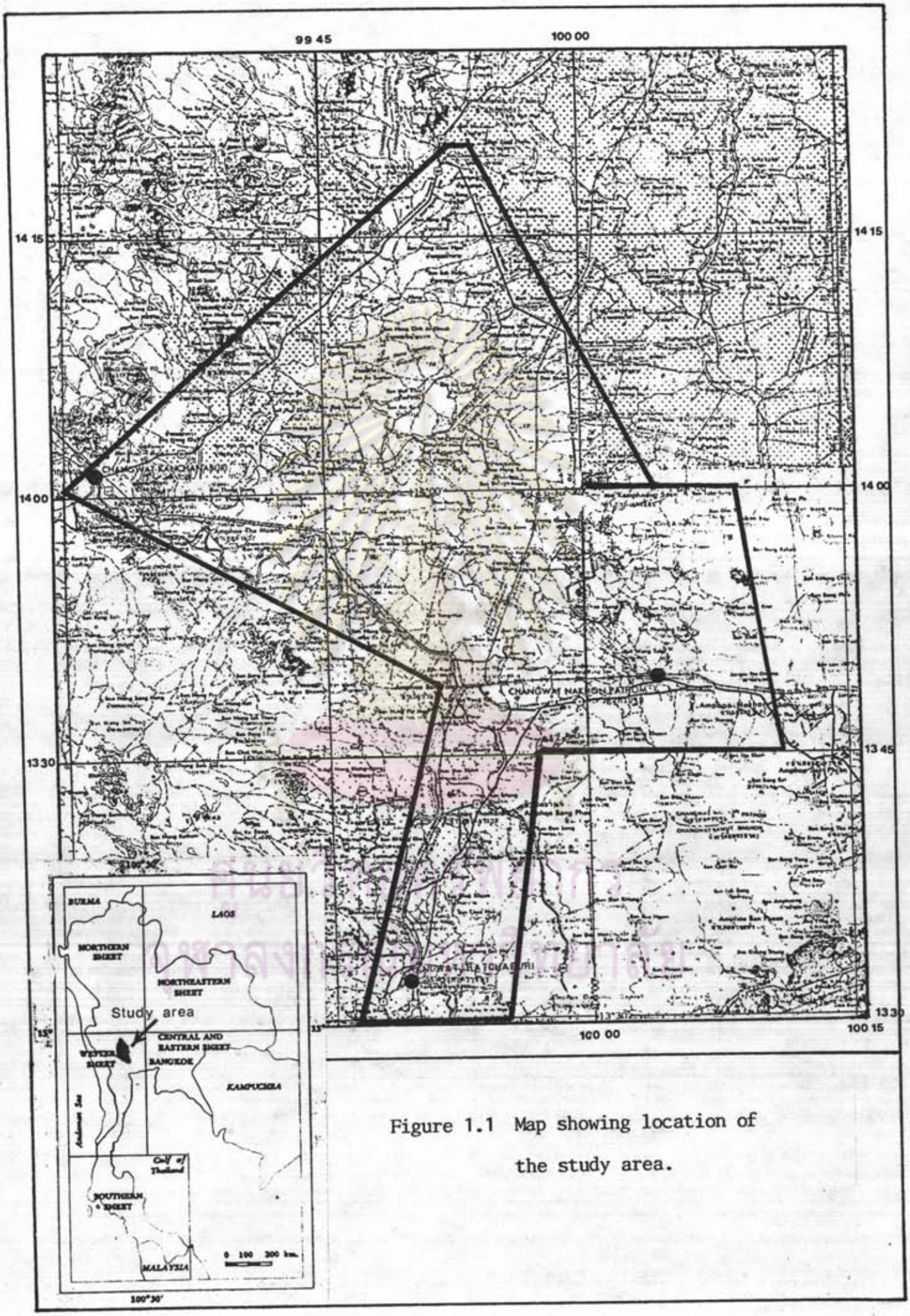

Figure 1.1 Map showing location of the study area.

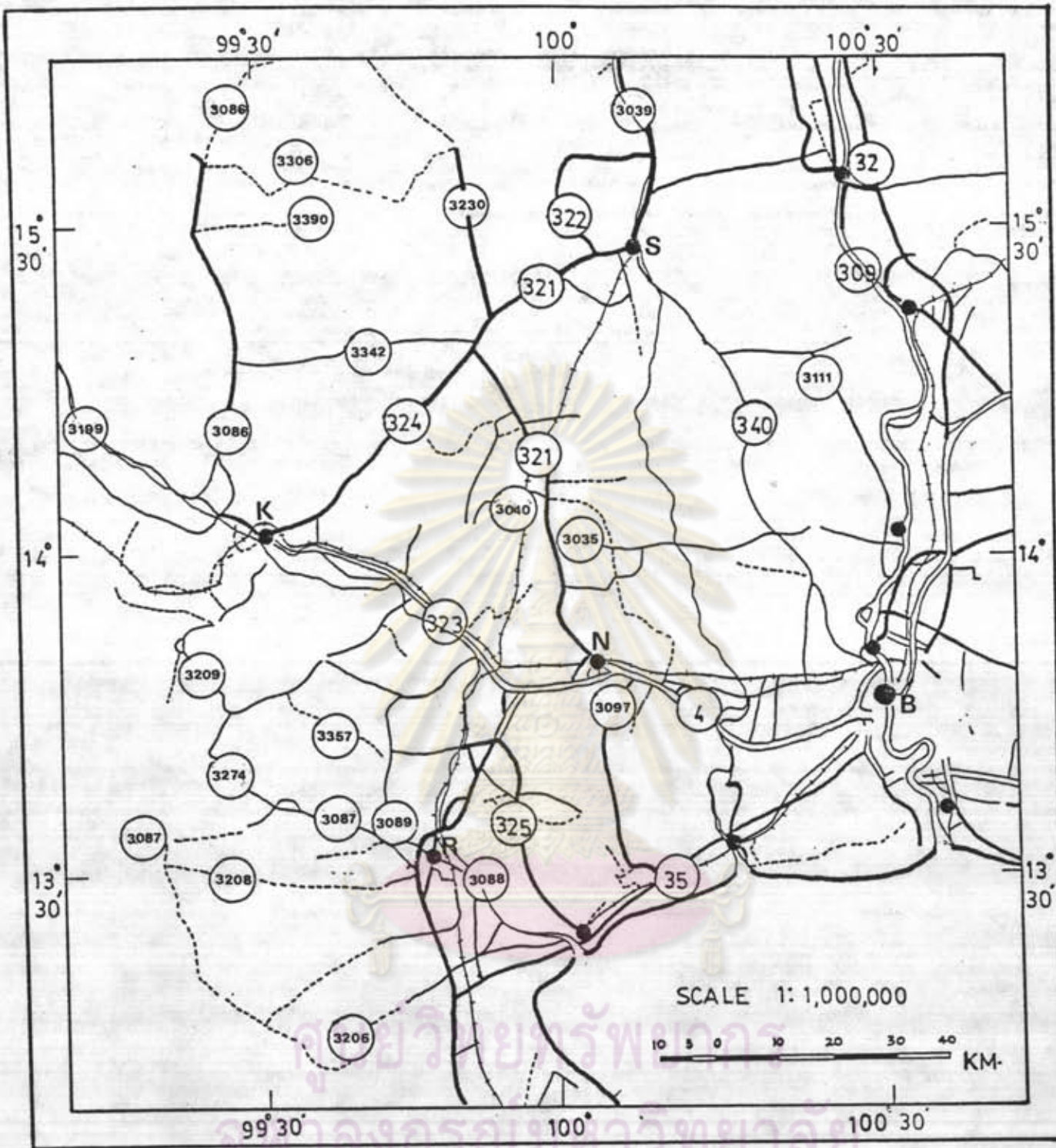

Figure 1.2 Map showing road and railway in the western part of the Lower Central Plain.
(After Highway Department, 1983)

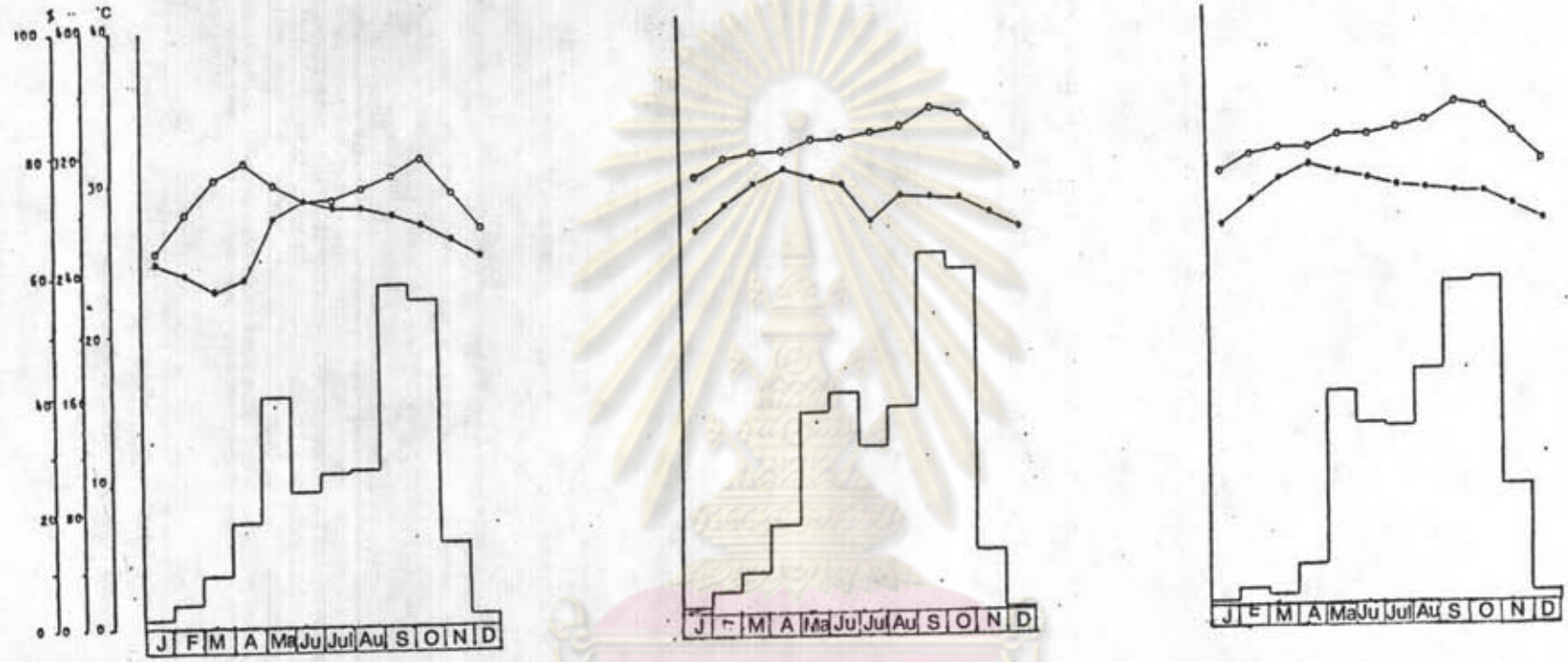

Figure 1.3 The 30-year average rainfall, evaporation, temperature and relative humidity of Changwat Nakhon Pathom, Kanchanaburi, Ratchaburi. (After Department of Meteorological, 1984)

influence of the southwest monsoon. The dry period occurs when the northeast monsoon previals.

The annual temperature although fairly stable, is cooler in Kanchanaburi than in other part of the region. However, for the entire region April is the hottest month (29 C-31 C) and the coldest mount (25 C-26 C) occurs in December.

The relative humidity, in general, follows the pattern of the precipitation. In the rainy season the relative humidity becomes higher than that in the dry season. The relative humidity of other areas range from 62 to 84%, average 70%.

1.5 Previous Geological Investigation

The first general outline of the Quaternary deposits in the Central Thailand was made by Brown and others (1951). The authors described briefly the physiography of the Chao Phraya Plain (Central Plain) and its surrounding areas, and summarized the general lithologic characteristics of Quaternary sediments. The Chao Pharaya Plain includes beds of deltaic character and consists of dark gray heavy clay overlies marine or estaurine marly beds, sand and gravels.

The first attempt to establish Quaternary stratigraphy in the Central Plain was made by Aleseev and

Takaya(1967). Four principal stratigraphic units were established base on topographic levels. In Mae Klong Basin the Lower Pleistocene (Q1) is clay with calcareous concretions. The Middle Pleistocene (Q2) is characterized by loosely cemented sand, clay and gravel with calcareous concretions (erosion). The upper Pleistocene (Q3) is clayey deposits with pisolitic concretions. The Holocene (Q4) consists of loamy alluvial of terrace I and alluvial of flood plain (Table 1.1).

Selvakumar (1977) made a detailed study of the landforms of the Lower Central Plain and divided them into geomorphic regions base on (1) elevation, (2) slope (3) direction of slope. The studied area is classified as a part of Kanchanaburi alluvial fan of Tanao Sri Piedmont which the regional direction is N 80 E, the average slope is 0.5 m./Km. and elevation is 5-25 meters above M.S.L. (Figure 1.4 and Table 1.2).

Nanthaphisarn (1976) explored groundwater in the Mae Klong Fan and along Mae Klong River. According to the drilling log the thickness of Mae Klong Fan deposits is more than 80 meters and zone of saturation in shallow aquifers depth 5-10 meters from top soil.

Vanasin and Supajanya (1980) studies the old shorelines of several places around the Gulf of Thailand

Chrono Stratigraphic Units				Index	Surveyed Areas						
					Northern Basin	Nakhon Sawan Area	Southern Basin (Bangkok Plain)	Easthern Margin Area	Mae Klong Drainage		
									Mae Klong Basin	Kwae Yai Valley	Kwae Noi Valley
QUATERNARY	HOLOCENE			O_4	Alluvium of Flood Plain with "Sawankalok earthernware"	Loamy or sandy Alluvium of Flood Plain	Soft blue sandy clay. silt and fine sand	Alluvium of Flood Plain	Alluvium of Flood Plain	Loamy or sandy Alluvium of Flood Plain	Alluvium of Flood Plain
					Loamy alluvium of Terrace I	Loamy alluvium of Terrace I		Black soil	Loamy alluvium of Terrace I	Loamy alluvium of Terrace I	Loamy alluvium of Terrace I (Pebble – tools on Terrace II)
	PLEISTOCENE	UPPER		O_3	Alluvium of Terrace II with pisolitic concretions	Clayey deposits of Terrace II. with pisolitic concretions	Firm gray and brown plastic clay		Clayey deposits with pisolitic concretions	Surface of Terrace II	Gravel of Terrace III
					weathering of (surface of Terrace III)	weathering of (surface of Terrace III)	(sand)		(weathering)	(weathering)	(weathering)
		MIDDLE		O_2	Sandy alluvium of Terrace III	Sandy alluvium of Terrace III with remains of Hippopotamus, Stegodon and Bubalus	Stiff red and gray clay with laterite		Loosely cemented sand, clay and gravel with calcareous concretions	Alluvium of Terrace III	Terrace — like surface
								Loose calcareous non-stratified sediments	(erosion)	Laterized alluvium of Terrace IV (erosion)	
		LOWER		O_1	Thin laterites developed upon remnants of peneplains		coarse sand		Clay with carcareous concretions	Peneplanation(?) and weathering	
NEOGENE	PLIOCENE	UPPER		N_2^2							

Table 1.1 Correation of Quaternary deposit in the Lower Central Plain (Alekseev and Takaya, 1967).

Unit			Elevation in m above M.S.L.	Trend	
				slope m/km	Direction
Tanao Sri Piedmont	Pediplain	Upper Lat Yao	120 – 100	1.29	N83°E
		Lat Yao	60 – 40	1.74	N42°E
		Nong Khayang	60 – 30	1.67	S85°E
	Alluvial Fan	Don Chedi	35 – 5	0.75	S70°E
		Kanchanaburi	25 – 5	0.50	N80°E
Khorat Apron	Tak Fa Bahada	4 Coaleasing Alluvial Fans	100 – 30	4.00	–
	Bahada	Khok Samrong Alluvial Fan	55 – 30	2.5	N45°W
		Lop Buri Alluvial Fan	35 – 10	2.5	S45°W
		Saraburi Alluvial Fan	30 – 20	2.0	S45°W
	Alluvial Fan	Pai Sali	80 – 30	2.0	S 6°W
		Nakhon Nayok	5 – 15	0.45	S36°W
		Prachantakham	25 – 15	1.3	S45°W
	Terrace	(Pa Sak) Saraburi Left	20 – 10	0.53	S52°W
		(Pa Sak) Saraburi Right	20 – 10	0.80	S36°W
		(Hanumar) Kabin Buri	30 – 20	0.80	S38°W
Chao Phraya Plain	Terrace	Uthai Thani	20 – 16	0.08	S24°E
		Chainat	20 – 17	0.09	S15°W
		Phak Hai	8 – 6	0.16	N 3°E
		Khok Phip	20 – 10	0.56	S25°W
	Flood Plain-Tidal Flat	Bangkok	4 – 2	–	–
Marine	Terrace	In Buri – Sam Chuk	12 – 8	0.10	S29°E
		Lower Chainat	14 – 7	0.13	S23°E
		Rat Buri	9 – 6	0.14	S67°E
		Prachin Buri Left	10 – 8	0.21	N 5°W
		Prachin Buri Right	10 – 7	0.17	S30°W
		Chachoengsao	30 – 27	0.23	N18°W
		Upper Chachoengsao	50 – 35	0.64	N13°W
Structurally Controlled Landforms	Gulf Coastal Plain		3 – 2	–	–
	Krok Phra Ridge		60 – 30	–	–
	Troughs	Nakhon Sawan	30 – 23	–	
		Ban Phraek Embayment	5 – 2	–	NW–SE
		Suphan Buri	20 – 2	–	NE–SW
		Mae Klong	50 – 20	–	NW–SE
	Swell	Bang Sai	6 – 3	–	EW
		Bangkok	5 – 3	–	EW

Table 1.2 Landforms of the Central Plain of Thailand. (Selvakumar, 1977).

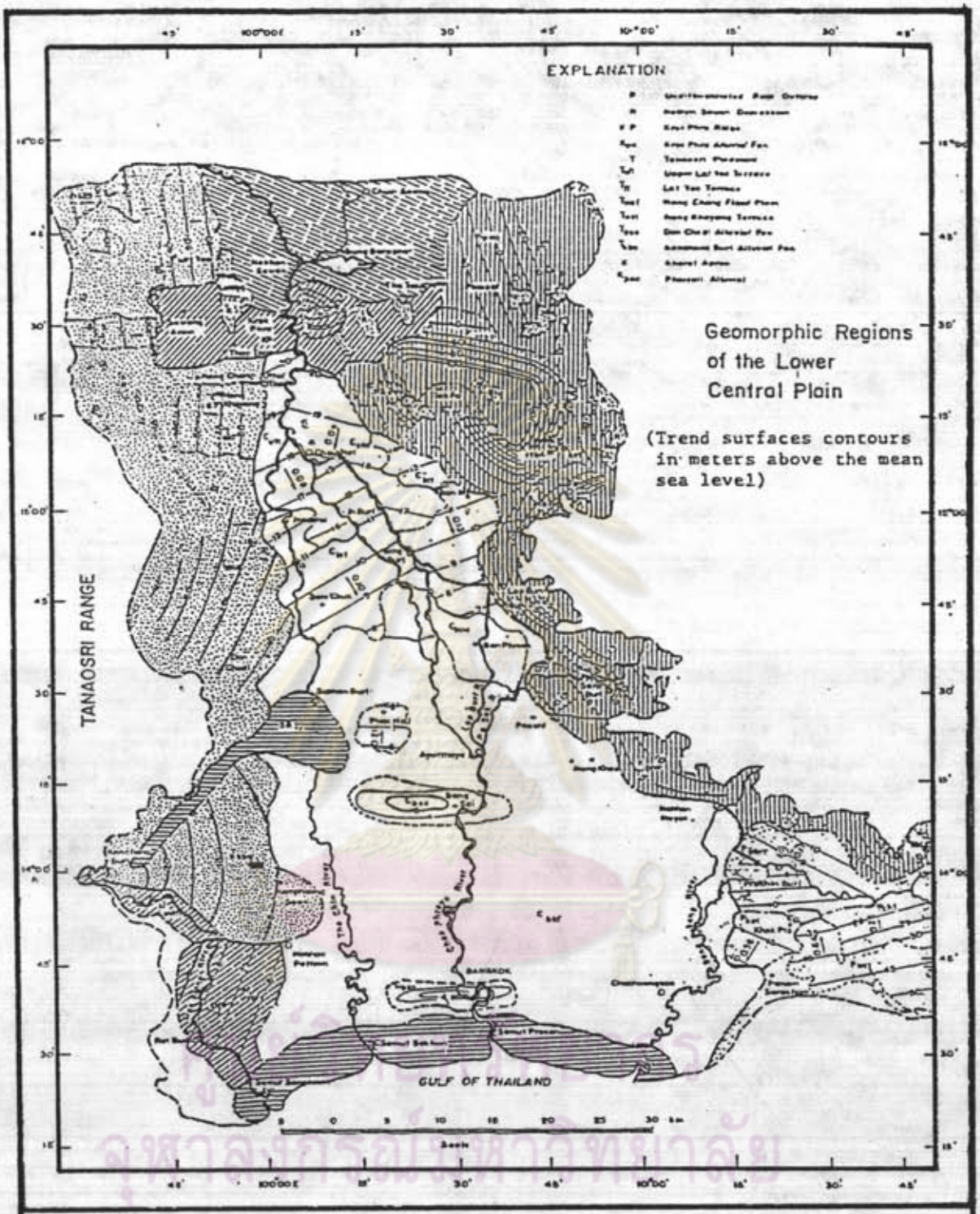

Figure 1.4 The studied area and geomorphic regions of the Lower Central Plain.
(After Nutalaya et. al., 1984)

They delineated the shorelines by basing on data derived from interpretation of aerial photographs, landsat imageries, and topographic map. The study reveals that the existing ancient shorelines found in the Lower Chao Phraya plain were at least 3 levels : 3.5-4 meters, 6-8 meters and 15-18 meters higher than the present sea level (Figure 1.5).

Nutalaya and Rau (1981) described the Quaternary geological history and deposits of the Bangkok region and structural framework of the Lower Central Plain of Thailand. It is interesting to note that five major cities of the Lower Central Plain are located either on or near the beach which defines the edge of the Bangkok embayment (Figure 1.6). These cities, Ratchaburi, Nakhon Pathom, Ayudhya, Nakhon Nayok and Prachinburi at one time may have been parts on the edge of the Bangkok embayment.

Takaya and Thiramongkol (1982) classified the lower part of Central Plain of Thailand into several units base on physical environment, characteristic of Quaternary sediments, soils, vegation, drainage and landforms In the western part of the Lower Central Plain, this area consists of natural levee, young fan and tidal flat of Middle Pleistocene to Holocene age.

Thiramongkol (1984) which classified landforms delicated and Quaternary deposits following characteristic

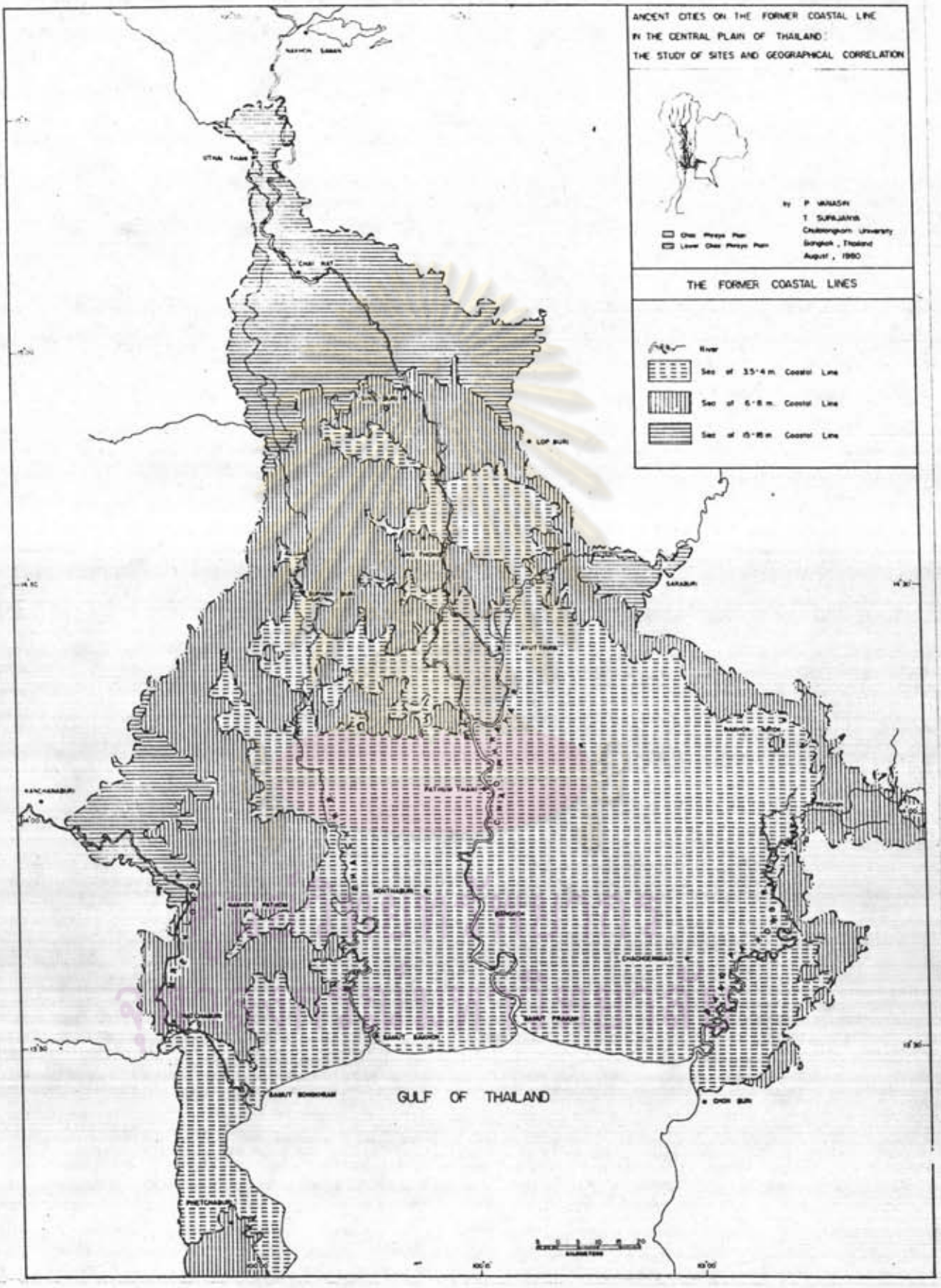

Figure 1.5 Ancient cities on the former coastal line in the Central Plain of Thailand. (After Supajanya, 1980)

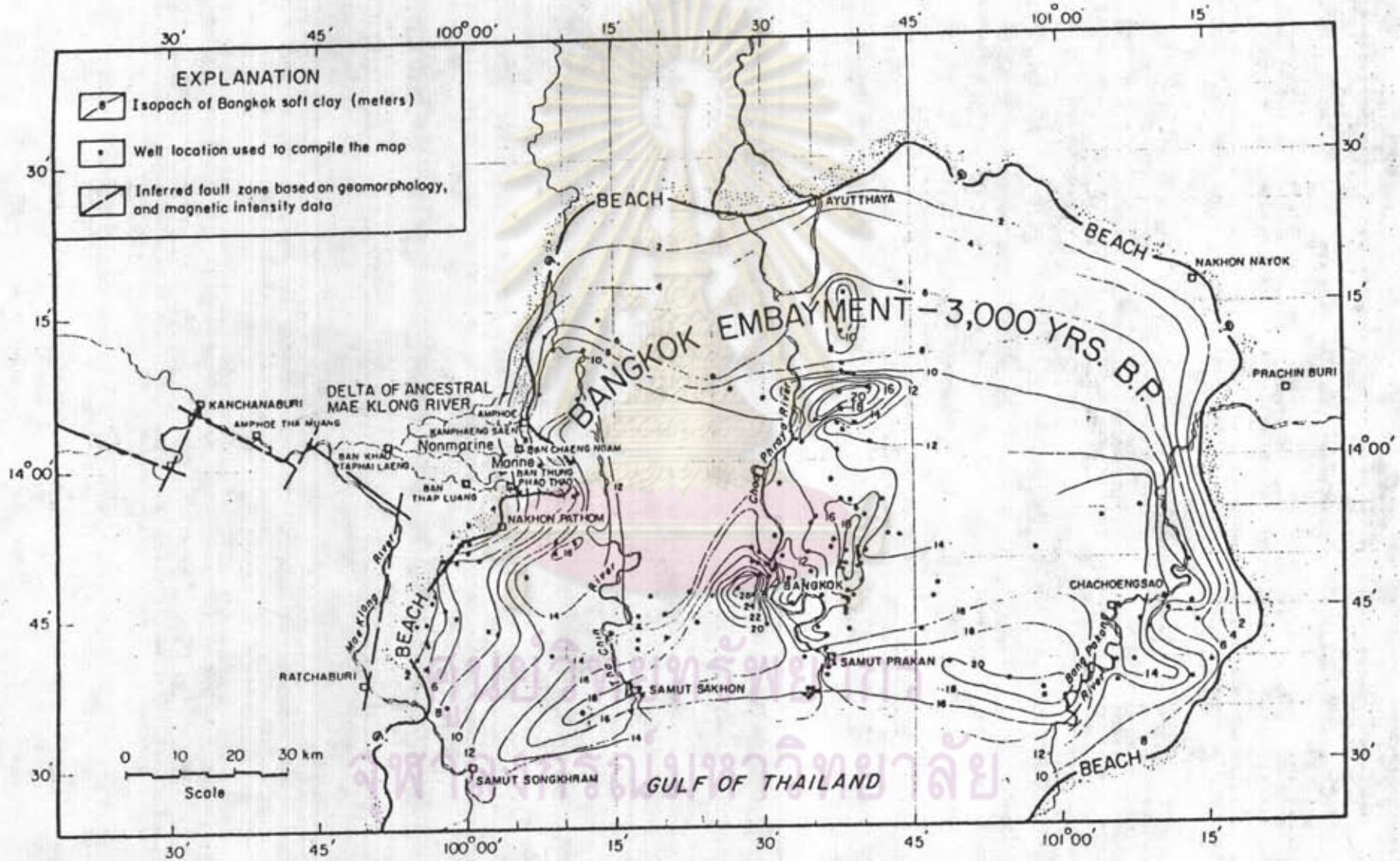

Figure 1.6 Isopach map of Bangkok soft clay.
(After Nutalaya and Rau, 1981)

of geomorphology, degree of weathering, characteristic of sediment and dating emphatic environment of deposition and geomorphic history in the Western part of the Lower Central Plain. According to Thiramongkol, flood plain consists of natural levees and back swamps, tidal flat of brackish clay forms extensive low-land plain, and young alluvial fan forms a gently undulating terrain. The deposits of those landform range from upper Holocene to Upper Pleistocene (Figure 1.7).

1.6 Expected Results and Application

1.6.1 The data on grain size distribution could produce grading zone map of the study area. This map differentiates area of sand deposits according to specification of fine aggregate for concrete.

a. Areas or locations of good quality construction sand for concrete are known.

b. Poorly graded sand can be improved by adding the missing grade sizes to them, so that a high quality material can be produced with correct blending.

1.6.2 Results of the study on landforms and geology can provide a framework on environment of deposition of sand deposits in the study area. The knowledge of environment of deposition of sand deposits in this area can apply to other areas in the Lower Central Plain.

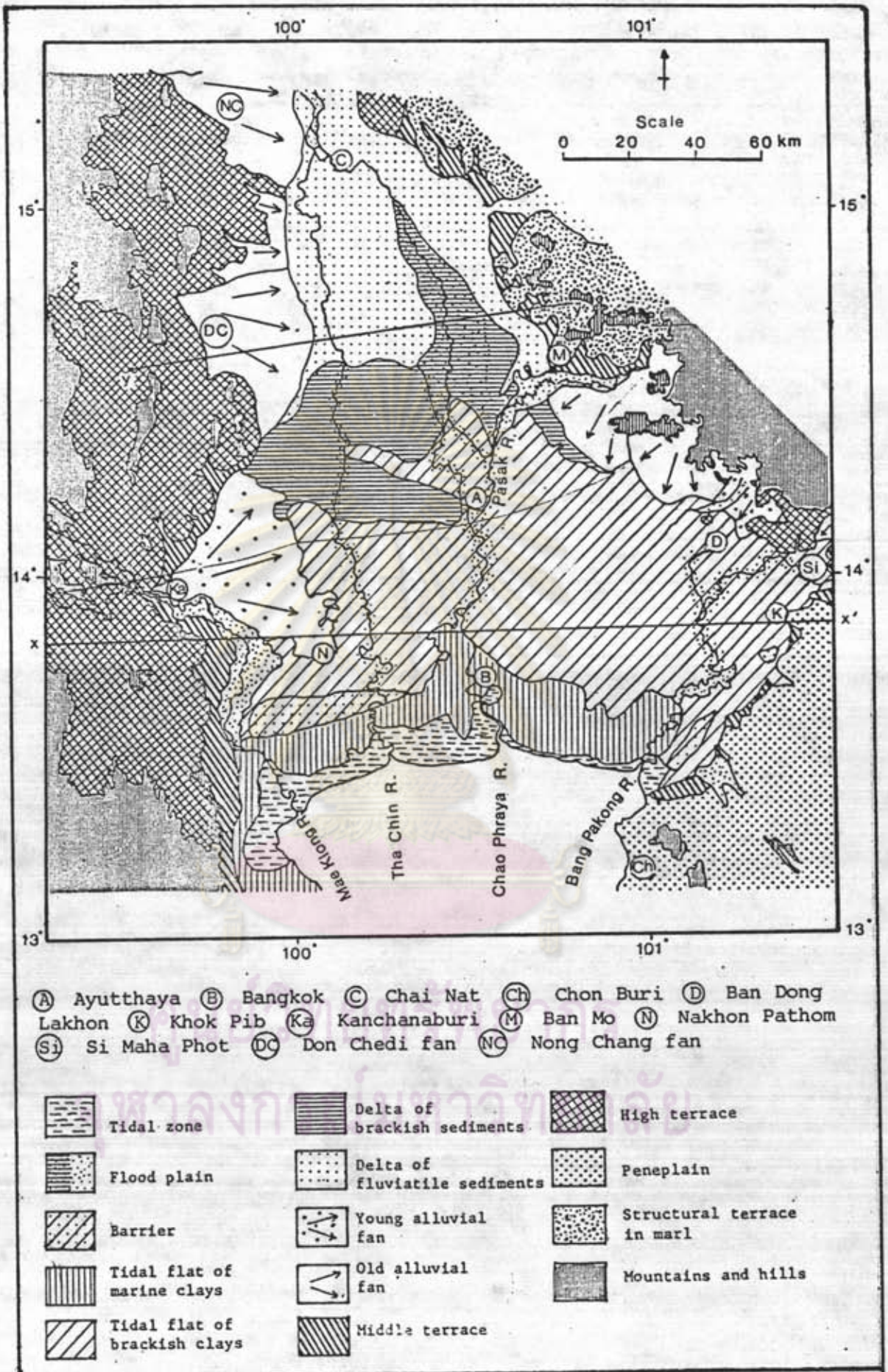

Figure 1.7 Geomorphological map of the Lower Central Plain of Thailand. (After Thirmongkol, 1984)