CHAPTER I

INTRODUCTION

Coal deposits in Thailand are almost entirely associated with Tertiary sediments deposited in widely scattered intermontane basins in the north, the west, and southern parts of the country (Chaodumrong, et al, 1983). However, the quality of Tertiary coals are mainly of low rank ranging from lignite to high volatile bituminous C according to A.S.T.M. classification (Ratanasthien,1983). Despite the fact that various types of geological resources, namely, petroleum, coal, diatomite, groundwater, etc. have been exploited from Tertiary deposits, the state of knowledge on Tertiary geology of Thailand is very limited and poorly defined.

One of the limiting factors in the study of Tertiary geology is that the scarcity of continuous surface data and information. This is basically due to the cover of Tertiary sediments in most parts by younger deposits of Quaternary age coupled with the relatively low degree of tectonism. Any attempt to study Tertiary sediments must be undertaken from subsurface data and information obtained from drilling explorations and subsurface geophysical explorations.

The Tertiary sediment and associated coal were first known geologically in Thailand in the early twentieth century. Prince Kamphaengbej, as commissioner of the Royal state Railways, seeking petroleum or coal for the railways'steam locomotives,engaged Wallace M.Lee, an American geologist, to investigate the mineral fuels then known in Thailand during 1921 to 1923. Upon the discovery of coal

deposit in Changwat Krabi, the Electricity Generating Authority of Thailand (EGAT) has installed three 20 MW power-plants using the coal as fuel. The total production of Krabi coal mine has increased from 275,000 tonnes in 1978 to 380,000 tonnes in 1982. At present, detailed coal exploration program has been conducted in order to define the coal reserves for future development and production.

Sedimentological analysis of Tertiary coal-bearing basin in Krabi area is considered to be very important in the coal exploration particularly regrading the understanding and establisment of exploration criteria. The findings from this study will be beneficial not only to the exploration program in Krabi area, but also some other areas in the peninsula which have similar geological setting. Besides, the depositional facies and environmental models can be applied to the petroleum exploration in the offshore areas adjacent to the peninsula . Considering from the viewpoint of geology of Thailand, the present study will undoubtedly contribute certain knowledge to the Tertiary stratigraphy of southern Thailand.

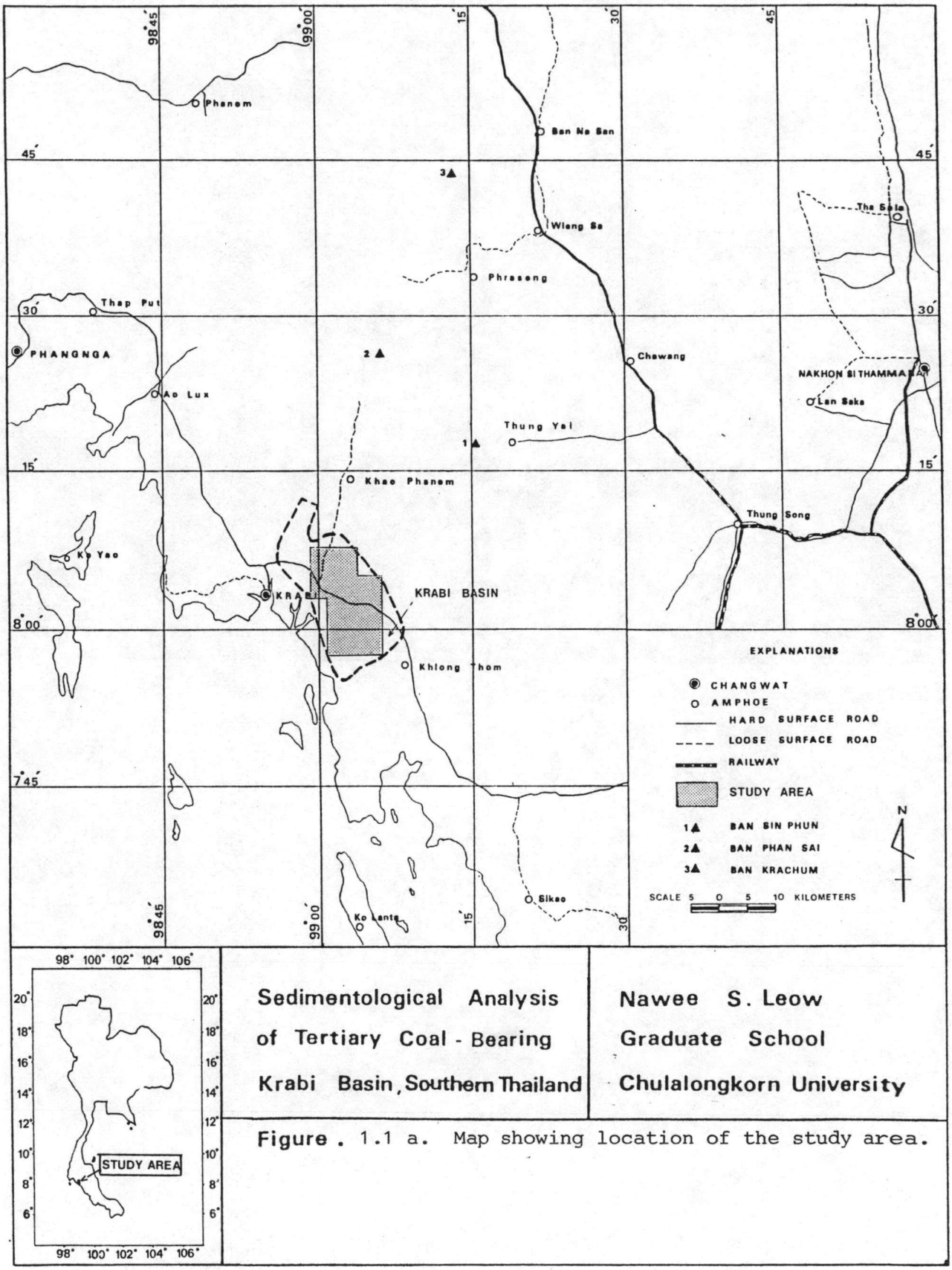
Krabi basin has been selected for the present study because of many reasons :

a) there are some subsurface geological and geophysical data available,

b) Tertiary geology including the occurence of coal are poorly understood, and

c) the findings of the study will be useful not only for academic purpose, but also for development planning of coal.

Therefore, an attempt has been made to utilize the existing data and information supplemented by field survey to analyse the Tertiary coal bearing sedimentary sequences in this basin.



Sedimentological Analysis of Tertiary Coal - Bearing Krabi Basin, Southern Thailand

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Figure . 1.1 a. Map showing location of the study area.

1.1 Study Area

Krabi basin is located in Amphoe Muang, Changwat Krabi in the southern part of Thailand, on the west coast of Thai-Malay peninsula connected to the Andaman sea. The basin is elongated in the northwest southeast direction covering an area of approximately 360 sq.km. The shape of the basin is nearly rectangular with maximum width of about 13 km. in the north-east direction and maximum length of about 28 km. in the northwest-southeast direction. The geographic position of the basin lies between latitude 7° 54' 49" N to 8° 12' 16" N, an and longitude 98° 11' 35" E to 99° 8' 35" E. The study area covers almost all part of Krabi basin occupying approximately 220 sq.km(Fig 1.1 a).

The topography of the basin is generally flat to slightly rolling with maximum elevation of about 50 m. above the mean sea level in the northern part. The southern part of the basin is largely covered by mangrove. The easthern part of the study area is bounded by isolated hills and mountains of clastic/carbonate rocks of Triassic-Jurrasic age, namely, Khao Thang, Khao Chong Khuan, oriented in the north-northwest/south-southeast direction. The western part of the study area is bordered by isolated hills of Permian limestone, namely, Khuan To, Khao Kaeu Bo K, Khuan Khamao and Khao Kaeo Thale. The main river system flowing to the study area southwardly is Khlong Pakasai and its tributaries, Khlong Kok Sai and Khlong Bang Phuog which eventually merge to form Khlong Phela flowing out into the Andaman Sea. In the western part of the area, there is an irregular channel which lies approximately in the north-south direction (Fig 1.1 b).

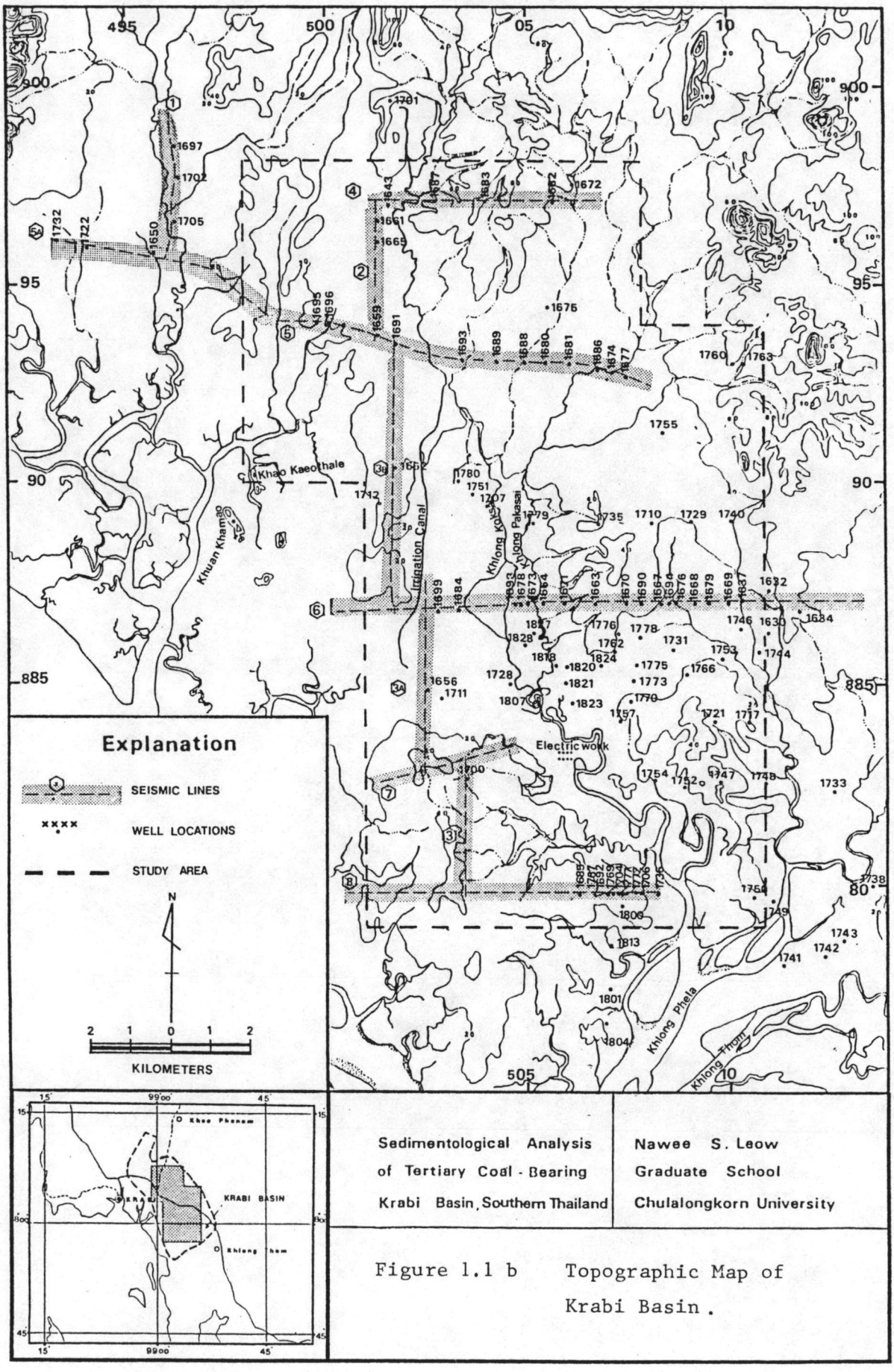

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Figure 1.1 b Topographic Map of Krabi Basin.

The average annual temperature varies between 26°-28°C with an exception in March and April which the average temperature is slightly higher in the range of 28° - 30°C. The average annual rainfall is 1852.3 mm. with the highest average monthly rainfall of 298.9 mm. in September and lowest average monthly rainfall of 24.7 mm in February. The average annual rainy day is 83.5 days. The annual rainfall and rainy day are summarized in Figure 1.1 c.

1.2 Objectives of the Study

The present investigation aims at utilizing the subsurface and surface geological and geophysical data and information in establishing the lithostratigraphy of Tertiary coal-bearing sedimentary sequences of Krabi basin. Additional attempt is made to define these sequences in terms of sedimentary facies for the purpose of reconstruction of depositional environment. Besides, the coal reserve within the study area will be estimated.

1.3 Study Methodology

Basically, the existing information on regional geology of the Thai-Malay peninsula are reviewed to serve as a background of the present study. Later on,the study is focussing upon the geological setting of Krabi basin and adjacent areas in order to fully understand the geological history, sedimentation pattern as well as tectonic evolution of the area.

Afterthat, the geological reconnaissance survey to the area of Krabi basin is made including the visit of the active mine pit. Besides, the existing information and data regarding the subsurface geological and geophysical conditions obtained from drilling exploration and ground

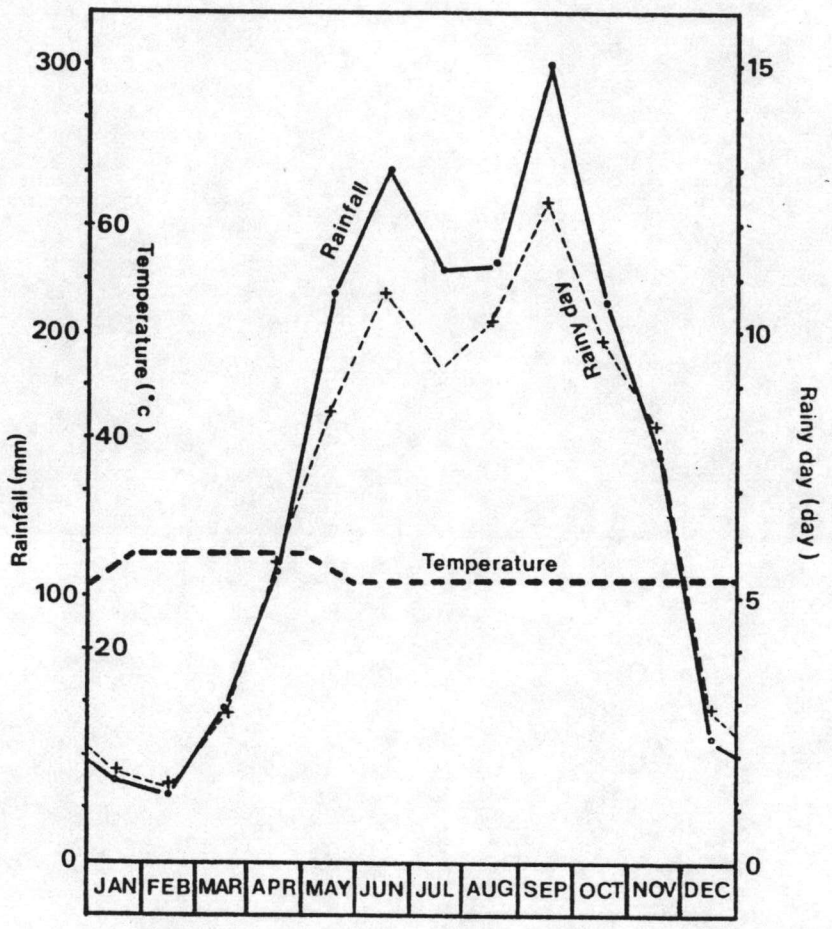

Figure 1.1 c. The average rainfall, rainy day, and temperature of Peninsular Thailand (1951-1980) modified after Meteorological Department, 1982.

seismic survey are intensively reviewed.

It is against the existing background information, the present detailed investigation is designed and carried out in order to analyse the Krabi basin from the sedimentological point of view. Detailed geological investigation in the field has been undertaken aiming to obtain the additional data on basinal basement characteristics from the marginal area of the basin, geological conditions of the active mine pit, etc.

The subsurface data obtained from 136 drill-holes with average depth of penetration of approximately 330 m. are employed in the study. Among these, there are 136 drill-holes data with lithological logs including 92 drill-holes with additional geophysical logs (see Appendix A). The geophysical parameters from drill-hole are caliper, long density, gammaray, and neutron (see Appendix B). The average well density of the study area under present investigation is approximately 0.5 well per sq.km. Moreover the ground seismic survey data of about 60 line-kilometres are obtained and utilized in the analysis of subsurface geology. It is noted that the resolution of ground seismic survey data has the reliability from the depth of 50 m. down to 300 m. (see Appendix C).

The acquisition of existing data and information for the present study are mainly obtained from the Electricity Generating Authority of Thailand (EGAT), Department of Mineral Resource (DMR), and the review of geological literatures concerned. Additional required data are obtained from the geological field survey conducted during the course study in 1983. These data and information are then prepared and manipulated in such a manner previously designed to serve the objectives of the study program. Finally, they are represented in the forms of well

location map, geological map, well data sheet with both geological and geophysical logs, geological sections, fence diagram and pseudo basement structural contour map.

It is realized that one of the primary tasks for the successful understanding of depositional system in basin analysis is the ability to visualize model environment as would appear in the rock record to interpret the paleoenvironment represented by the rocks preserved in the stratigraphic record. To deal with sedimentary rock bodies, either on the earth's surface or from subsurface data, it is necessary to obtain a working knowledge of the terminology and concepts of stratigraphy, the subsurface geological information and data previously prepared and manipulated are then expressed in terms of lithostratigraphy. Various lithostratigraphic units have been classified, correlated, and described. Finally, sedimentary sequences of the study area are repressented as geological sections showing distribution of lithostratigraphic units concerned,and lithostratigraphic chart. The procedures employed in the compilation and acquisition of data, preparation of data and establishment of lithostratigraphy of the present study are summarized and presented in Figure 1.3 a.

Vertical sedimentary successions which have been stratigraphically defined are correlated in order to illustrate their horizontal successions using Walther's law (1894) of the correlation (or succession) of facies. Afterthat the subsurface lithostratigraphy is analysed in terms of sedimentary facies using Selley's method (1980). The definition of sedimentary facies under the present investigation follows Moore (1949).

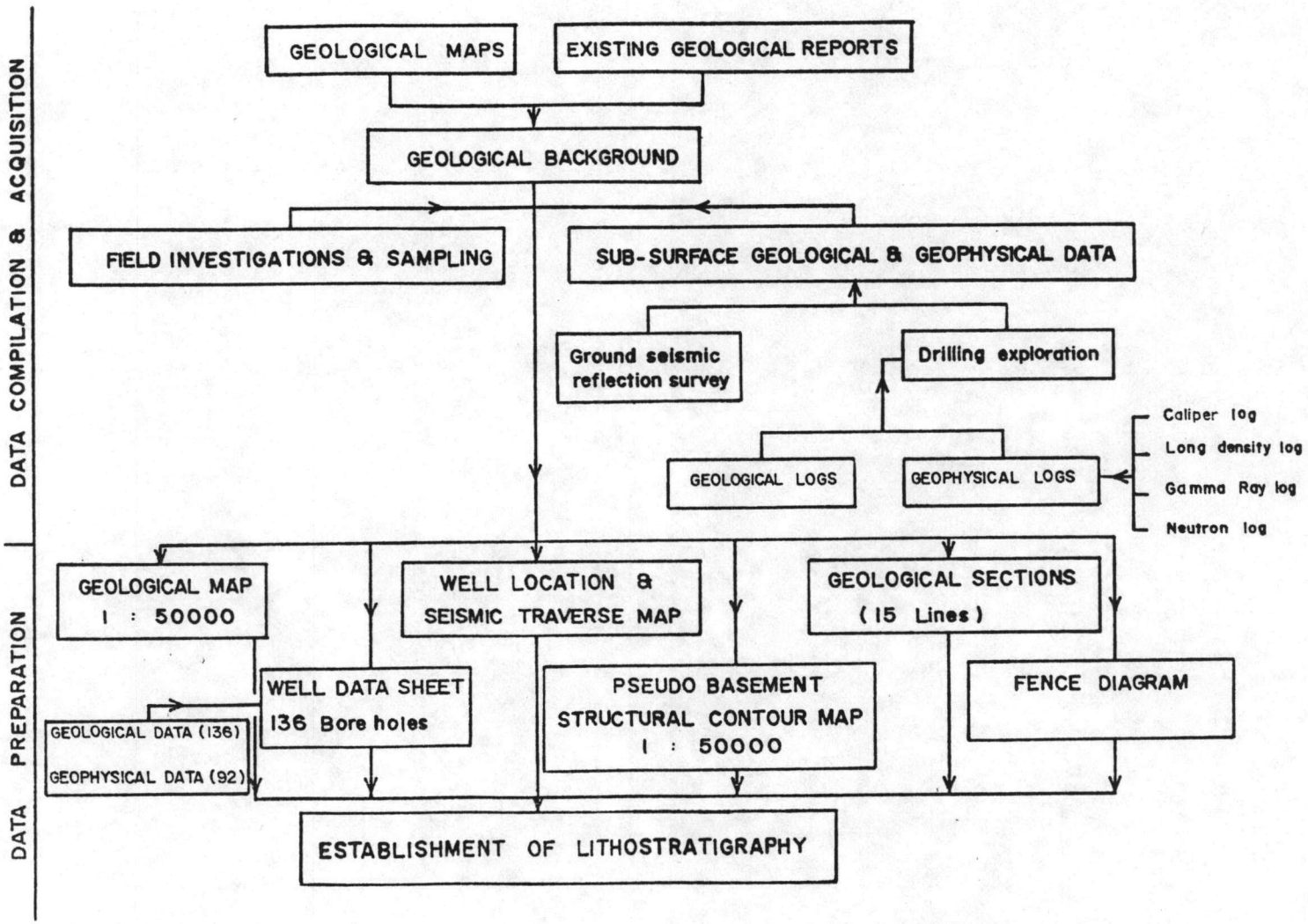

Figure 1.3 a. The summarized flow chart illustrating the study methodology for data compilations, acquisition and data preparation.

"A sedimentary facies is defined as an areally restricted part of a designated stratigraphic unit which exhibits characters significantly different from those of other parts of the unit ".

With regards to the interpretation of facies, it is realized that the establishment of simplified models is essential. However, a limited number of facies models have been developed, each representing a particular environment, namely, Selley's sedimentary model, Walker's facies model (1976) etc. The sedimentary model acts as a norm for purpose of comparison and as a framework and guide for future observation. It also acts as a predictor in new geological situations and is the basis for hydrodynamic interpretation of the environment. Divergence from the norm can then be used to enlighten our understanding of particular formations. In the interpretion of ancient depositional environment from the sedimentary facies, there are three stages of interpretation, notably, initial working hypothesis formulation, paleogeographical interpretation, and realistic interpretation.

Finally, the sedimentary basin is reconstructed within the framework of regional geological setting of the study area and the utilization of analogous modern-ancient models concerned.

Additional attempt has been made to carry out a preliminary appraisal of the geological coal reserve within the study area. The reserve refered to in the present study is classified as in situ reserve and resource (the U.S. Bureau of Mines and U.S.G.S., 1976). The method used in the calculation of coal reserve is volume integration by Simpson's formula . The procedure for facies analysis, reconstruction of depositional environment, and coal reserve estimation are summarized and presented in Figure 1.3 b.

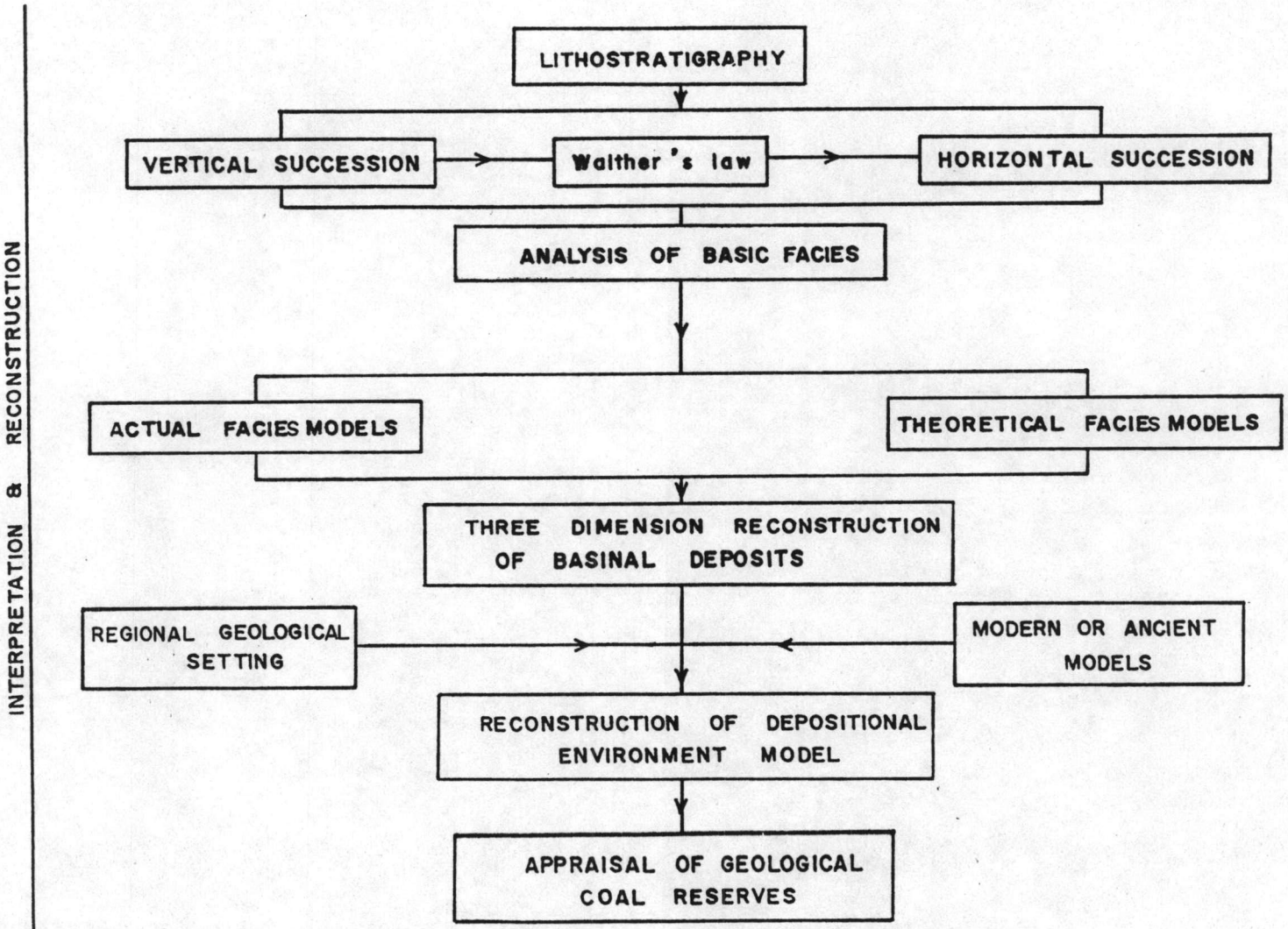

Figure 1.3 b. The summarized flow chart illustrating the study methodology for interpretation and reconstruction of depositional environment .

1.4 Previous Works

The Tertiary deposits in Peninsular Thailand was first reported by Lee (1923). He refered to the Tertiary sediments which were deposited in simple synclinal fold-or fault-controlled basins. Brown et al (1951) named Krabi Series for the Tertiary rocks found in the southern Thailand and reported eight basins in peninsular Thailand, namely, Kiansa, Hin Roa, Hang Nak, Krabi, Sinpun, Kantang, Bukit Arang and Betong. Besides, they reported that the Tertiary sediments at Krabi basin were composed of sandy shale, coal, and marl of about 125 m. thick underlying 30-50 m. of marl, bituminous shale, gypsum, and marine limestone. The fossils of marine gastropods of late Tertiary or possibly Pleistocene age were found in marl and limestone a few meters above the coal seam.

Javanaphet (1969) chose the term Krabi group to represent all of Tertiary beds in Thailand. Garson et al. (1975) named the Krabi Formation for Tertiary rocks within Phuket, Phan-nga, and Takua Pa areas. They reported that many localities with outcrops of the Krabi Formation, resting uncomfortably on strata of the Phuket Group, Ratburi Limestone and Ko Yao Formation.

Longworth-CMPS engineers (1980), Australian exploration group carried out the geophysical exploration at Krabi basin for EGAT. The result indicated that the structure within the basin was largely unknown, due to lack of outcrop or other information. However, it was some suggestion of a north-northwest trending basin axis and a shallow inlet channel in the north-west.

Ratanasthien (1983) reported that the strata of Wai Lek basin showed the effect of marine influence of both marine transgression and regression as indicated by fossils and depositional features, such as,

fossiliferous limestone, sandstone, calcareous sandstone deposited by coastal wind. The strikes of Tertiary sediments are approximately north-northwest to north with dip angle of 45 degree to the east, lying unconformably under the younger sediments of Quaternary age.

Dheeradilok (1983) reported that the major geological structures in southern Thailand as a major syncline with its axial lies in the north-south direction from Surat Thani to Krabi and Trang provinces, and probably extending further towards the offshore area. The Klong Marui and Phangnga faults are remarkable major fault zones lying in northeast-southwest direction along the west border of the basin.