CHAPTER V

ECONOMIC APPRAISAL OF COAL DEPOSITS

In this study, additional attempt has been made to evaluate the economics of coal in terms of reserves and quality. Reserves of coal usually compiled from graphic representations, such as maps or plots which depict bed thickness, structure, and quality. Within the proposed system, the terms coal resource designates the estimated quantity of coal in the ground in such form that economic extraction is currently or potentially feasible. The coal reserve is that part of the resource for which rank, quality, and quantity have been reasonably determined and which is deemed to be minable at a profit under existing market conditions. Although not specifically noted, coal resources and reserves are classified according to the degree of geological assurances of existence and to the economic feasibility of recovery.

The degree of geological assurance in this system of coal classification is determined from the interrelations of;

a) proximity to or closeness of spacing of points where a coal bed is measured or sampled (reliability);

b) concepts, ideas, and models of depth (Fig 5a), rank and quality, thickness of coal (Fig 5b), arial extent, depositional patterns and correlations of coal beds and enclosing rocks,

c) knowledge of associated structural features as the control the distribution, extent, thickness, depth of burial, and metamorphism of coal resources.

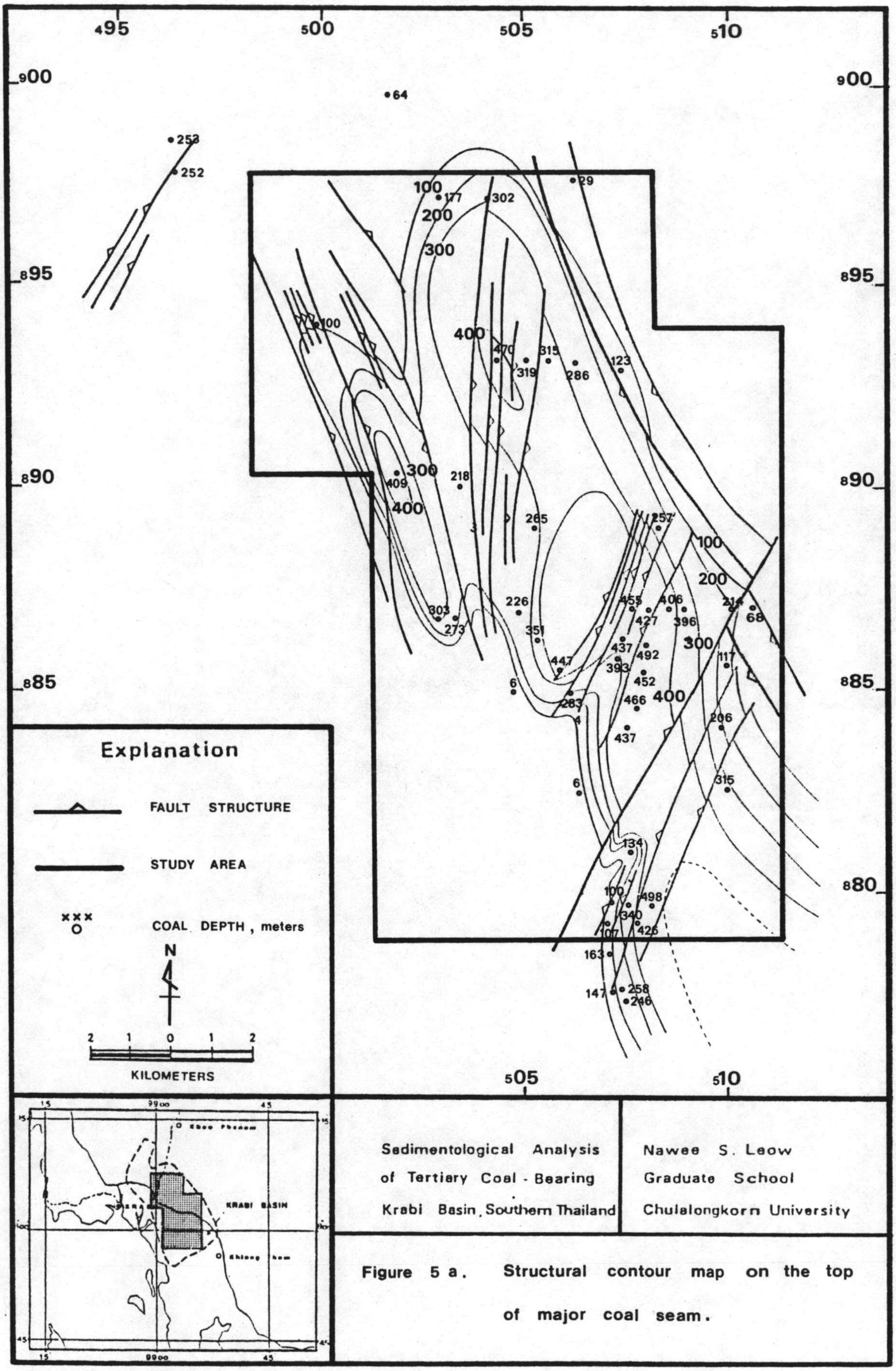


Figure 5 a. Structural contour map on the top of major coal seam.

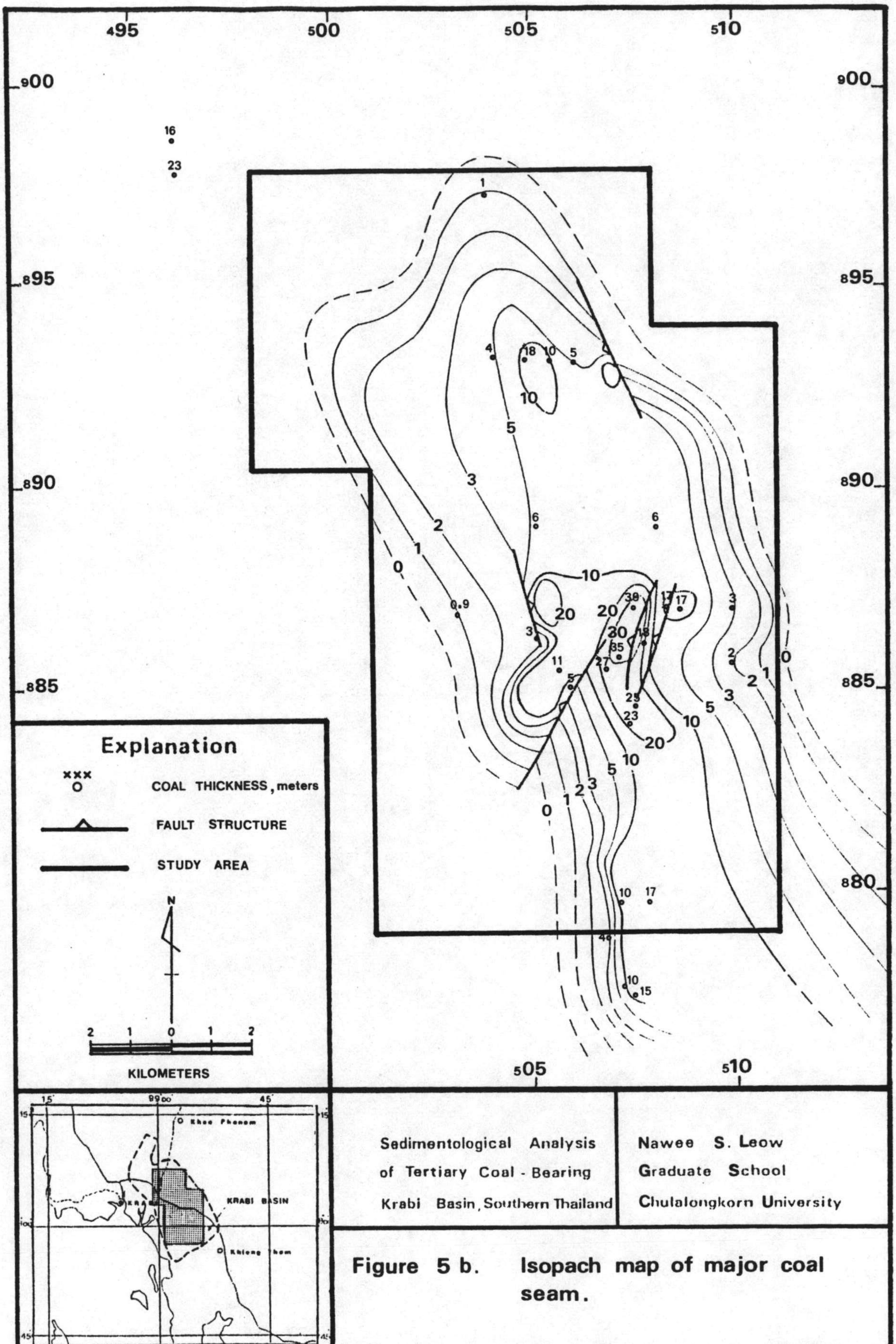


Figure 5 b. Isopach map of major coal seam.

An understanding of these elements as they relate to the three dimensional configurations of stratigraphic sequence is necessary to provide the highest degree of geological assurance as to the existence and continuity or lack of continuity of specific coal beds.

The degree of economic feasibility is determined by interrelating the

a) thickness of coal

b) thickness of overburden

c) rank and quality of coal as ascertained from analysis that may be from the same bed or adjacent beds and which may be projected on geological evidence for several kilometers

d) costs of mining, processing, labor, transportation, selling, interest, taxes, demand and supply

e) exacted selling price

f) expected profits.

The combination of the degree of geologal assurance and degree of economic feasibility lead to the resource system of U.S. Bureau of Mines and U.S. Geological Survey (1976). Later on the same concept of classification had been modified for coal resource classification system (1976) which is presented in Figure 5c.

In the present study, the coal reserve used is modified after the coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey (1976). However, emphasis have been given only to the degree of geological assurance for the reserve estimation. In addition to reserve estimation, the rank of coal has also been determined. The foregoing paragraph will be focussing upon rank of coal and coal reserve estimation.

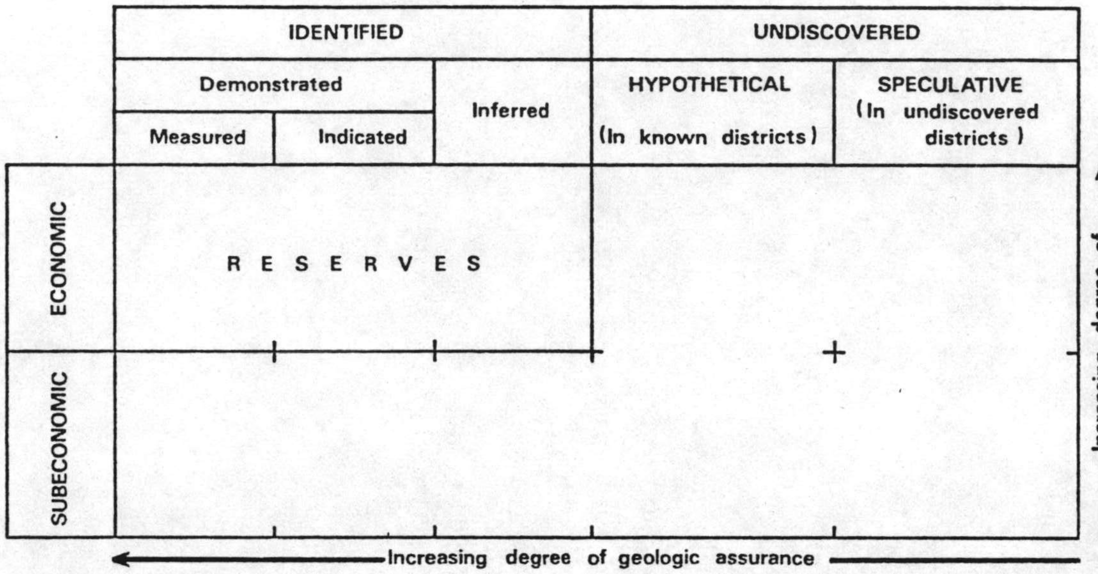


Figure 5 c. Classification of coal resources. (From the U.S. Bureau of Mines and U.S. Geological Survey, 1976.).

Table 5.1 . Classification of coals by rank (From ASTM., 1981.) .

Class	Group	Fixed Carbon Limits, percent (Dry, Mineral-Matter-Free-Basis) Equal or Greater Than	Fixed Carbon Less Than	Volatile Matter Limits, percent (Dry, Mineral-Matter-Free-Basis) Greater Than	Volatile Matter Equal or Less Than	Calorific Value Limits BTU per pound (Moist, Mineral-Matter-Free Basis) Equal or Greater Than	Calorific Value Less	Agglomerating Character
I. Anthracite	1. Meta-anthracite	98	—	—	2	—	—	nonagglomerating
	2. Anthracite	92	98	2	8	—	—	
	3. Semianthracite	86	92	8	14	—	—	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	—	—	commonly agglomerating
	2. Medium volatile bituminous coal	69	78	22	31	—	—	
	3. High volatile A bituminous coal	—	69	31	—	14 000	—	
	4. High volatile B bituminous coal	—	—	—	—	13 000	14 000	
	5. High volatile C bituminous coal	—	—	—	—	11 500	13 000	
		—	—	—	—	10 500	11 500	agglomerating
III. Subbituminous	1. Subbituminous A coal	—	—	—	—	10 500	11 500.	nonagglomerating
	2. Subbituminous B coal	—	—	—	—	9 500	10 500	
	3. Subbituminous C coal	—	—	—	—	8 300	9 500	
IV. Lignite	1. Lignite A	—	—	—	—	6 300	8 300	
	2. Lignite B	—	—	—	—	—	6 300	

5.1 The Determination of Krabi Coal Rank

There is a vast scientific and technical literature on coal classification schemes. In principle, there are several ways of classifying coal, namely:

a) according to the type of source vegetable matter;

b) by means of a genetic system

c) by means of a petrographic system

d) by means of a selected set of characteristics obtained by ultimate or proximated analysis

e) by degree of coalification.

From the point of views of a generalized analysis of the economic role of coal, the coal rank classification particularly of the ASTM.(1981) has been commonly used including this investigation.

The rank is the classification of coals according to their degree of metamorphism, progressive alteration, or coalification (maturation) in the natural series from lignite to anthracite. Classification is made on the basis of analysis of coal in accordance with Table 5.1. The rank of coal can be used to infer the approximate dry, mineral-matter-free heat value, fixed carbon, and volatile matter in a coal, because the amounts of the constituents vary little with each coal rank.

In the ASTM Classification of coal by rank, the calorific value limited on the basis of moist, mineral-matter-free is the most essential criteria for low-rank coals, notably lignitic and subbituminous. The calculation of calorific value on the moist, mineral-matter-free basis is carried out using the Parr's formula (Parr, 1928) as followed;

Moist, Mm-free Btu = (Btu-50S)/ (100-(1.08A + 0.55S)) x 100

where:

Mm - mineral matter,

Btu - British thermal units per pound (calorific value)

A - percentage of ash

S - percentage of sulfur.

Above quantities are all on the inherent moisture basis. This basis refers to coal containing its natural inherent or bed moisture, but not including water adhering to the surface of the coal.

First, the analytical data of coal qualities, namely, calorific values (dry basis) and ash content of altogether 132 samples obtained from the EGAT's laboratory are used to determine their interrelationships. Figure 5.1a shows that the ash content has a linear relationships with calorific value for Krabi coal.

Additional attempt has subsequently been made to determine the distribution pattern of coal rank on the moist, mineral-matter-free basis. Altogether 132 computed calorific value are plotted on the histogram (Fig. 5.1b) in order to obtain the distribution pattern of coal rank. Generally, the Krabi coal rank is spreading from lignite B to subbituminous B with the model values lie in the rank of lignite A. Therefore, it is concluded that the Krabi coal lies within the average rank of lignite A according to ASTM classification (1981). This means that the average calorific value limit is between 6300-8300 Btu/lb or 3528-4648 kcal/kg.

5.2 Geological Coal Reserve and Resource Estimations

The classification of geological coal reserve under the present investigation is basically base on the classification system of U.S.

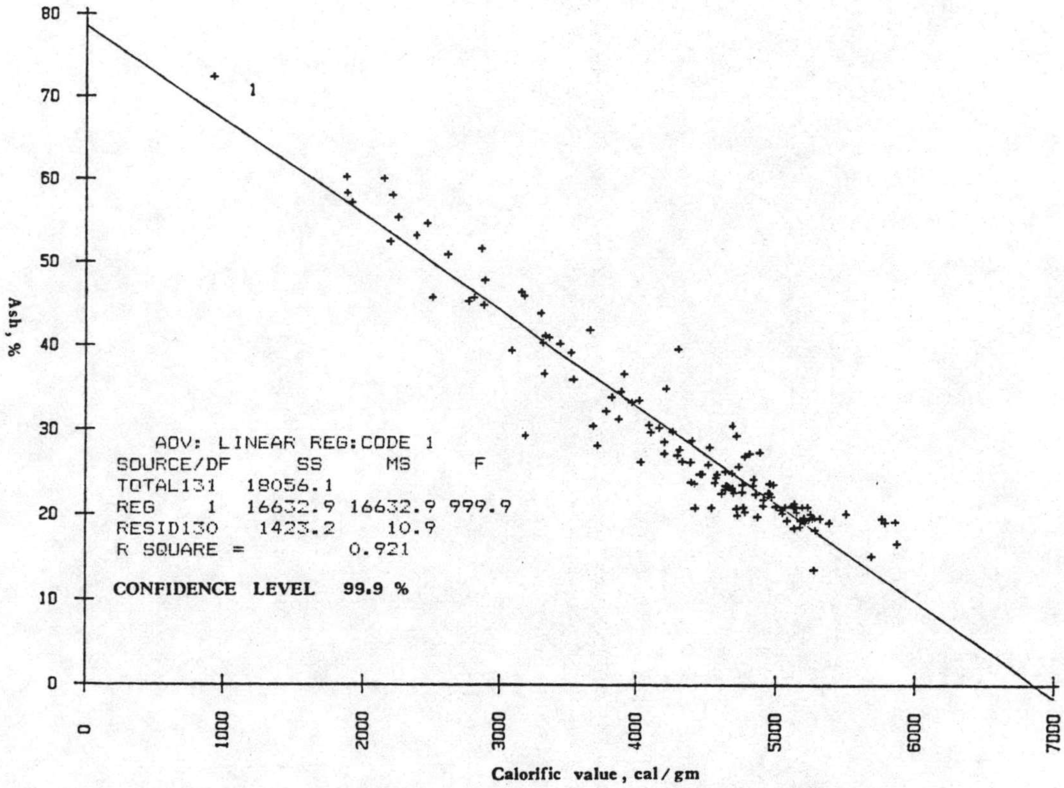


Figure 5.1a.Crossplot of calorific value (dry basis) versus ash (dry basis).

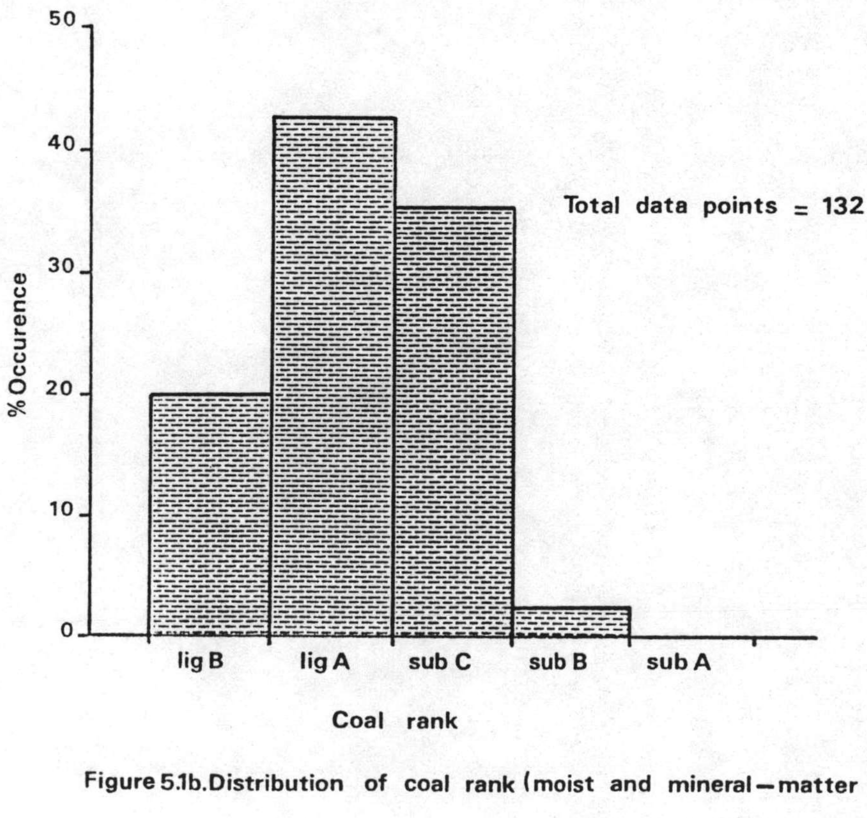
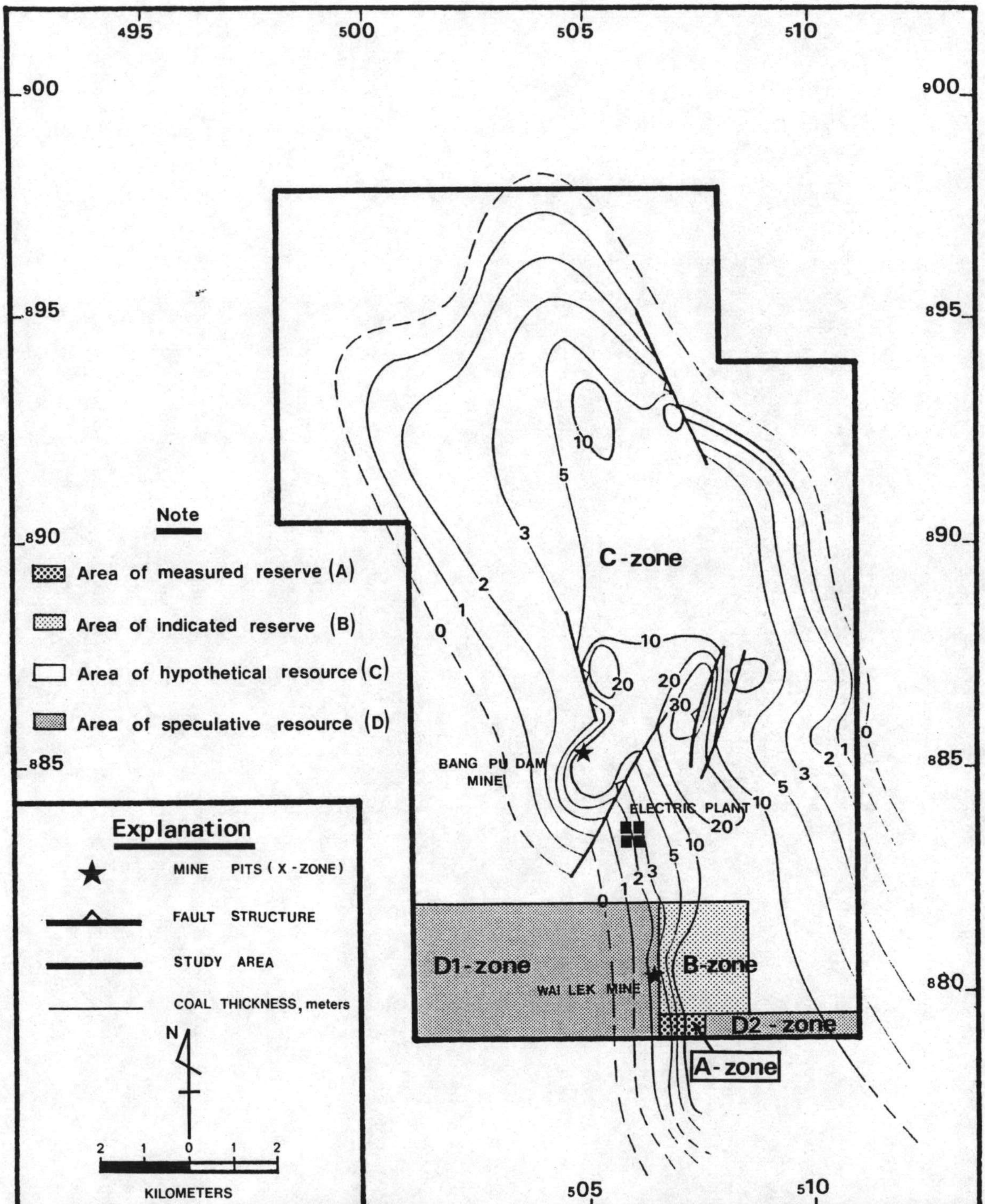


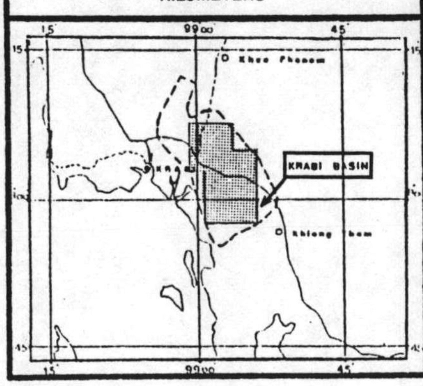
Figure 5.1b.Distribution of coal rank (moist and mineral–matter free basis).

Bureau of Mine and U.S. Geological Survey (1976). However, a certain modification is made particularlly regarding the degree of geological assurance. Generally, the geological coal reserve has been classified into three categories, namely, measured, indicated, and inferred reserves. The minimum thickness of coal bed employed in the calculation of reserve in this study is 20 cm. For measured coal reserve, the spacing of the drill-holes necessary to demonstrate continuity of the coal are no greater than 100 m. For indicated coal reserve, the spacing of the drill-holes necessary to demonstrate continuity of coal are between 100-300 m., and for inferred coal reserve the spacing of the drill-holes necessary to demonstrate continuity of coal are between 300-500 m. All the above values are the boundary condition of the reserve determination.

Besides, an attempt has been made to determine the coal resource of Krabi into two different categories, namely, hypothetical and speculative resources. For hypothetical coal resource, the spacing of between drill-holes to confirm the existence and quantity is greater than 500 m. For speculative coal resource,the coal may occur in a favourable geological setting where few discoveries have been made, or in deposits that remain to be recognized. It is noted that the classification of coal reserves and resources under the present investigation is purely based on degree of geological assurance without taking any degree of economic feasibility into consideration. The method for coal resource and reserve calculation is based on Simpson method (see Appendix F). The specific gravity of coal used in the calculation is 1.28.

The area under the present investigation has been classified on the basis of density of drill-holes into four types for coal reserves and resources estimate (Fig . 5.2). The first one is the area with





Sedimentological Analysis of Tertiary Coal-Bearing Krabi Basin, Southern Thailand	Nawee S. Leow Graduate School Chulalongkorn University

Figure 5.2. The map shows the area of reserve and resource.

highest density of drill-holes 132 drile-holes/sq.km. covering 0.25 sq.km. is located in the most southern part. The coal reserves in this area fall in categories of measured reserves of totally 4 million metric tons. The second type of area is located further north covering 5 sq.km. with the density of drill-holes of 12.6 drill-holes/sq.km. The coal reserve in this area is the indicated reserves of totally 64 million metric tons. It is noted that none of the area has been identified for inferred reserve estimation. This is basically due to the absence of area with drill-hole spacing of 300-500 m. with respect to coal resource in the study area, two types of area have been identified for two different categories of resource estimation, notably, hypothetical and speculative resource. The hypothetical coal resource estimation yields approximately 888 million metric tons, whereas the speculative coal resource estimation. is about 31 million metric tons.

It is noted that at present there are two active mines, namely, Wai Lek Mine and Bang Pu Dum Mine, of EGAT (X-zones) where coal reserve and resource estimations under the present study do not include. This is due to the unavailability of data.

The geological coal reserve and resource estimation under the present investigation are summarized in Table 5.2.

Table 5.2. The Krabi coal reserve and resource.

ZONE			RESERVES million metric tons			RESOURCES million metric tons	
Area sq.km		Drill-hole density drill-holes / sq.km	Measured	Indicated	Inferred	Hypothetical	Speculative
0.25	A	132	4	–	–	–	–
5	B	12.6	–	64	–	–	–
208	C	0.9	–	–	–	888	–
5	D1	–	–	–	–	–	4
1.75	D2	–	–	–	–	–	27
	TOTAL		4	64	–	888	31