CHAPTER II

THE NATURE OF SPENT SHALE

2.1 Oil Shale Reserves in Thailand

The main oil shale reserves in Thailand was found at Mae Sot Basin (Figure 2.1), Tak Province where surface outcrops can be easily observed. The basin of Mae Sot is one of the numerous socalled intermontane basins filled with Tertiary sediments, which are found all over Northern Thailand and in some parts of the Thai peninsula. The basin of Mae Sot is a synclinal, through-like structure trending roughly in a North-South direction and extending into Burmese territory on its western part. The basin is made up of Tertiary sediments of more than 500 metre thickness. There are two areas where oilshale crops out at numerous locations. Area 1 is situated 6-10 kms northwest of Amphoe Mae Sot along Huai Mae Sot and Mae Nam Moei. Area 2 is situated about 10 kms south of Amphoe Mae Sot along Huai Mae Ku, Huai Pha Lat and Mae Nam Moei. Comparing the geological situation and calorific properties of oilshales of both areas, it must be concluded that area 2, South of Amphoe Mae Sot looks more promising. Fig 2 . 2 shows the location of oil shale reserve in Thailand. The first estimation of the oil shale reserve was given as 2.79 billion tous.[10]

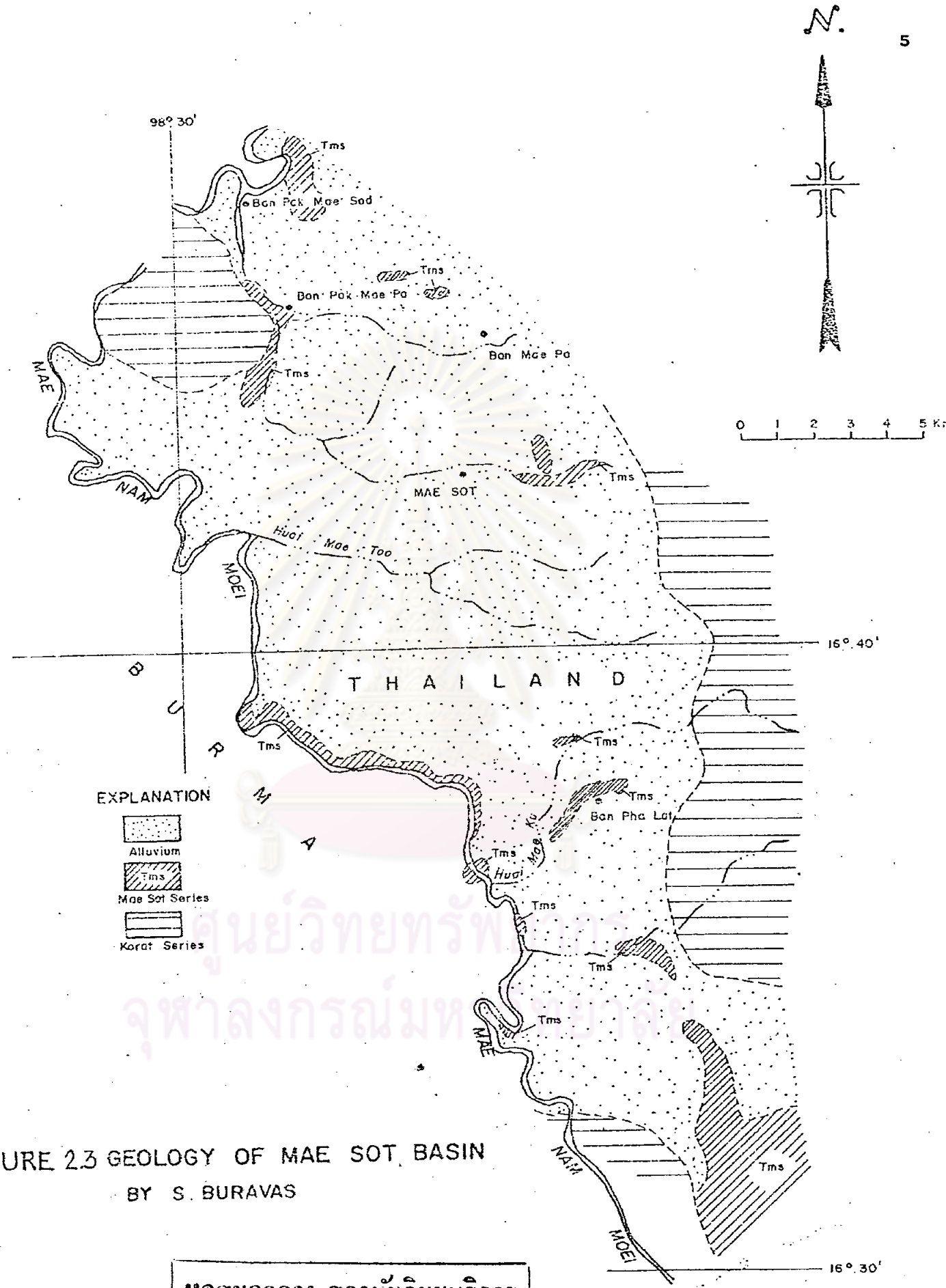

FIGURE 2.3 GEOLOGY OF MAE SOT BASIN
BY S. BURAVAS

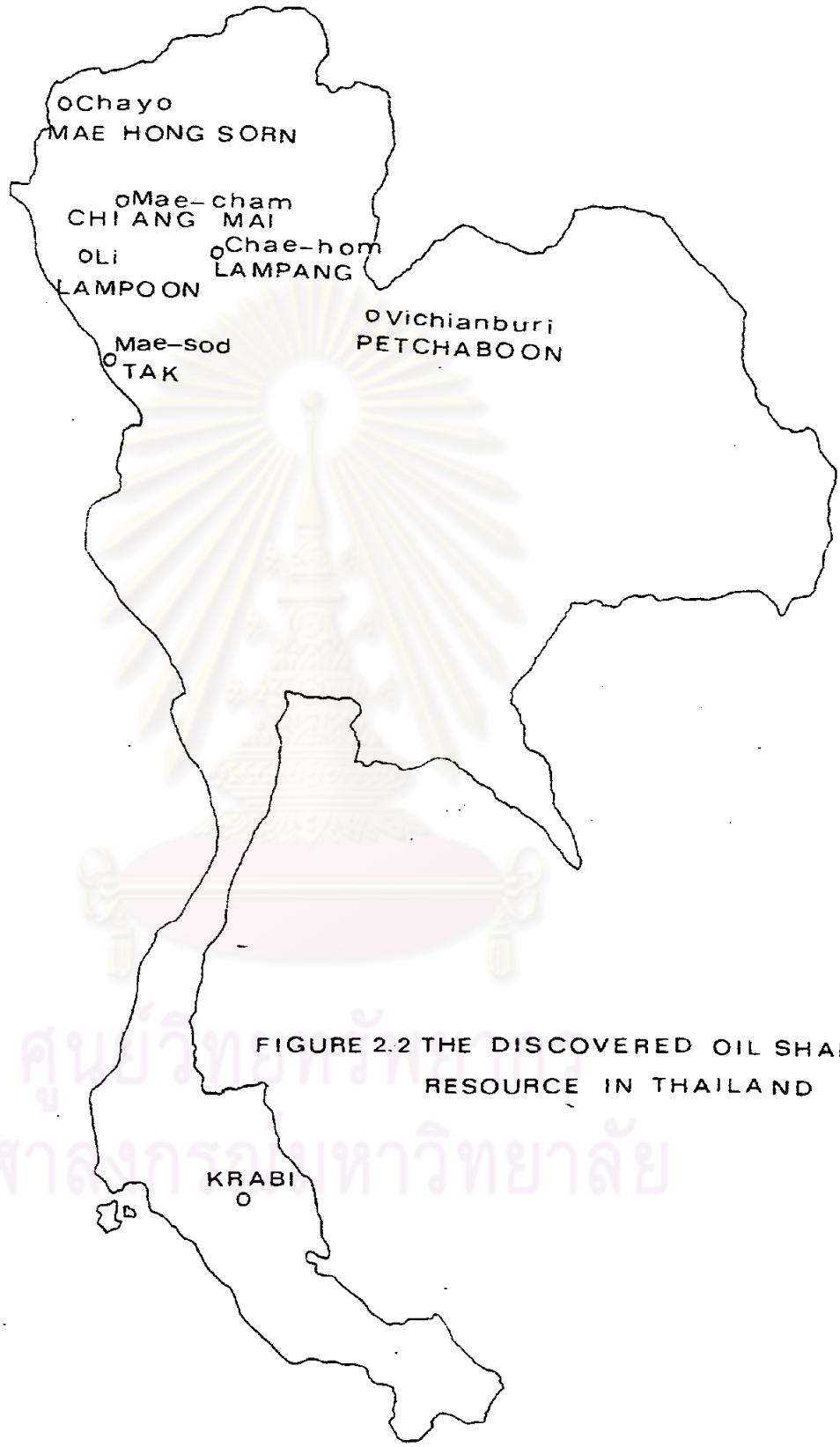

FIGURE 2.2 THE DISCOVERED OIL SHALES RESOURCE IN THAILAND

Another oil shale resource was discovered at Li, Lampoon Province by a survey team from the Military Energy Department. The estimated reserve of Li oil shale was 15 million tons[10] (Poothai) 1966) with the oil contents ranging from 12 to 41 gal/ton.

Since 1974 the Department of Mineral Resources has conducted an extensive exploration to estimate the oil shale reserve of the Mae Sot Basin. The survery covered the northern and southern region of the basin within the areas of 24 and 29 square kilometers respectively. The Mae Sot oil shale reserve under these survey areas was estimated to be 18.67 billion metric tons.[20] If a 5% oil content were assumed, the shale oil reserve in this area would amount to 6.4 billion barrels.

The most resent oil shale utilization and development was performed under the contract between Lurgi and NEA (National Energy Administration) in September, 1979 where Lurgi was to elaborate a preliminary study on the oil shale project. The complete results of the Lurgi investigation has not yet been available.

Spent shale is the solid waste material remaining after retorting and other processing steps have removed hydrocarbon values and possibly associated mineral values from oil shale.

2.2 Characteristics of spent shale

From direct burning of oil shale;[24, 28]

1. light weight
2. sharped edges
3. silty or sand
4. hard grain without any plasticity
5. easy to grind (which contrast to oil shale)
6. Pozzolan
7. high percentage of silicon oxide (SiO_2)

After retorting processed;[2, 28]

1. high PH
2. high percentage of Silicon oxide (SiO_2)
3. Specific gravity about 2.69
4. light weight

2.3 Utilization of Spent Shale

The amount of spent shale after retorting processes varies considerably which depends on the selected retorting process and the characteristics of the retort feed. Generally, a remaining amount of spent shale is 60-80% by weight of retorting feed. This causes water and soil pollution. Thus, it is convincing to make use of it instead of treat it as a waste.

The spent shale from oil shale retorting and from boiler or direct burning can be used as :[4, 28]

1. An admixture in concrete or mortar.
2. An admixture for making construction bricks.
3. The road-base and soil stabilization.

4. The ceramic materials.

5. The raw material in manufacturing Portland Cement

Further more the spent shale from direct burning can be used as an admixture in glaze and direct blending with hydraulic cement.

2.4 Reasons for the usage of spent shale in producing cement.

From chemical analysis of Mae Sot spent shale, it is composed of four major oxides SiO_2 (37-50%), Al_2O_3 (12-17%), Fe_2O_3 (4-7%) and CaO (14-24%)[4, 28] which are the same chemical major oxide as Portland cement (Table 2.1). Therefore, it, may be possible to make portland cement from spent shale by blending with another raw materials such as limestone to compensate the deficient CaO content of spent shale.

Table 2.1 Comparison of oxide compsitions between Portland cement type I and various spent shales.

Spent-Shale composition (%)	Brazil (Irati)	China (Fushun)	U.S.A. (Colorado)	Thailand (Mae Sot)[28]	Portland Cement Type I
SiO_2	66.00	62.30	43.60	37.78	21.08
Al_2O_3	17.40	26.70	11.10	12.78	5.79
Fe_2O_3	10.80	6.10	4.60	5.07	2,86
CaO	1.90	0.10	22.70	22.66	63.85
MgO	1.50	1.80	10.00	7.32	2.47
other	2.40	3.00	8.00	14.39	3.95

On the production of shale oil, spent shale is left considerbly about 60-80% by weight of retorting feed. It should be studied how to make use of it instead of treat it as a waste.

Matzick[4] reported the gross heating values of spent shale obtained from Fischer assays. When kerogen is pyrolyzed, an organic carbonaceous residue is left on fragments of spent shale, varies with the type of retorting process and the grade of the feed shale. The residual carbon generally represent 300,000 to 900,000 BTU per ton of spent shale. Thus, producing cement from spent shale will lower fuel consumption because of its inextractive combustible materials.

The utilization of spent shale as a raw material in the manufacture of Portland cement becomes more predominant. Hence, it is the topic of further study.