Geological Society of Malaysia – Circum-Pacific Council for Energy and Mineral Resources
Tectonic Framework and Energy Resources of the Western Margin of the Pacific Basin
November 27 – December 2, 1992, Kuala Lumpur, Malaysia

Coal as an energy resource in Malaysia

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Abstract: Malaysia is well-endowed with energy resources, both fossil fuels as well as the renewable energy. Our oil resource can last 16 years at the current rate of depletion, gas more than 76 years and coal much longer based on the projected energy utilization plans. The location and distribution of some of these energy resources do not parallel those of population and energy demand centers. The four fuel energy strategy of the country assures adequate and secure energy supplies while at the same time promotes diversification and reduced dependence on oil. In the medium term, gas will emerge as the dominant fuel particularly in electricity generation, accounting for 70% of the generation mix, complemented by hydropower (18%), coal (9%) and oil (3%). This will be a dramatic change from the present composition of 33% oil, 22% hydropower, 35% gas and 10% coal. This change is inevitable because gas is abundant, easily available and accessible, easily handled and used and has lesser adverse effects on the environment. Large investments are already in place to encourage its greater use. Gas is also an economic fuel at the moment because of competitive pricing.

Use of coal as an energy source for cement manufacture and in power generation is relatively new. It is found to be competitive and is now the main source of energy for cement manufacture. Even at the prevailing low gas price, the electricity corporations also find coal to be more economical and they are seriously considering it as the fuel for their future plantup. After the year 2000 when gas price may be pegged to oil, electricity generation with coal may be the cheapest option.

We can foresee coal playing a greater role in the electricity generation mix after the year 2000. The coal resource in the country is as yet not tapped; it can be developed to meet the increased demand arising from the greater coal use in cement manufacture and electricity generation. A major consideration of greater coal use is its effects on the environment. If future clean coal technologies can mitigate or reduce various adverse effects on the environment, it will pave the way for even greater use of coal to and beyond 2010.

INTRODUCTION

Malaysia is made up of 3 geographical provinces; Peninsular Malaysia, Sarawak and Sabah. It has an area of 329,758 km^2 and a population of 17.6 million. The average population density is low — 53 inhabitants per km^2, with a much higher density in Peninsular Malaysia than in Sarawak and Sabah. It is fortunate that the country is endowed with significant energy resources with world ranking of 14 for gas and 23 for oil. In addition to the non-renewable fossil fuel resources of oil, gas and coal, it has very large potentials for renewable energy resources such as hydropower, solar power and biomass. However, the location and distribution of these resources do not parallel to those of population and energy demand centers (Table 1).

The energy sector during at least the past two and half decades was dominated by oil. The development of oil was a major stimulus to the economy; it contributed from 4% (1970) to 24% (1982) of the total export earnings, before it leveled off to 10% in the late 80's due to the world oil glut. Oil production had increased at an annual rate of 11.2% from 1980 to 1990 and production for 1990 was 30.6 million tonnes oil equivalent (toe).

Table 1: Distribution of energy resources by region.

	Peninsular Malaysia	Sarawak	Sabah
Hydropower (%)	13	71	16
Gas (%)	47	49	4
Oil (%)	50	33	17
Coal (%)	1	75	24
Population distribution (estimated 1991)	14,172,000 (80.7%)	1,648,000 (9.4%)	1,736,000 (9.9%)

*The views expressed herein are the author's own and do not necessary reflect those of the Government, energy agencies or electricity corporations.

Table 2: Energy demand.

Rate of Increase	1981-85	1986-90	1991-95	2010
Energy Demand	6.5	7.6	9.9	9.2
GDP	5.0	6.7	8.0	7.2

The energy demand of Malaysia grows at a faster rate than its GDP (Table 2).

The development of the vast energy resources has significantly contributed to the expansion of the Malaysian economy. Besides providing energy and widening the industrial base, the export of energy resources has increased our earnings and public sector revenue.

ENERGY POLICY

Consistent with Malaysia's economic growth and development objectives the government has formulated the national energy policy which has the following objectives:-

1. *Supply Objective:* to provide the nation with adequate and secure energy supplies by reducing our dependence on oil and by developing and utilising alternative sources of energy.
2. *Utilization Objective:* to promote and encourage the efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption.
3. *Environmental Objective:* to ensure that factors pertaining to the environment are not neglected in pursuing the supply and utilization objectives.

Several strategies were introduced to attain these objectives. These include the important four fuel energy strategy based on oil, hydropower, gas and coal formulated to diversify our energy base; assure adequate energy supplies for our continued economic growth; restructure the energy consumption pattern and eliminate waste by optimising the use of improved energy technology, education, legislation and research.

Against this background of economic development, existing policies and strategies on energy, let us examine the known energy resources of the country.

ENERGY RESOURCES

Malaysia has significant energy resources, mainly oil, natural gas, coal and hydropower (Table 3).

Table 3: Energy resources.

Oil	3,600 million bbls
Gas (Associated) (Non-Associated)	11.9 tscf 47.2 tscf
Hydroelectric Power Potential Capacity Potential Annual Energy	 29,000 MW 123,000 GWH
Coal	965 million tonnes

(bbls = barrels, tscf = trillion standard cubic feet)

Oil

The proven oil reserve of 3.6 billion bbls (barrels) is distributed over the 3 geographical regions of the country: 50% in the east coast of Peninsular Malaysia, 33% in Sarawak and 17% in Sabah. Based on a depletion rate of 650,000 bbls/d (barrels per day), the reserve will sustain production for 16 years.

Malaysia's sweet crude oil is of superior quality, the bulk of which produced is actually exported. The crude oil production for 1990 was about 31 mil. toe (million tonnes oil equivalent) whereas total import of petroleum products for the same year was 7 mil. toe (million tonnes oil equivalent), comprising 14.8% crude oil and 85.2% refined products.

Our strategy is to continue diversification of energy requirement away from oil. The share of oil and petroleum products in the total energy supply declined from 79% in 1980 to 53% in 1990. However, efforts on exploration and exploitation of petroleum and gas are given priority. Current exploration and development of the oil resource is further given impetus when the Production Sharing Contract (PSC) terms were revised in 1985 to attract more companies to carry out oil exploration in Malaysia. As at 1st January, 1991, there were 37 PSC involving 39 foreign companies which have entered into PSC with the National Oil Cooperation (PETRONAS). This resulted in several recent discoveries of oil and gas in Peninsular Malaysia, Sarawak and Sabah.

Serious efforts are being taken to reduce the share of oil in the electricity generation mix. The role of oil is expected to decrease drastically from the current 2,089 MW (33%) to 500 MW (3%) by the year 2010.

Gas

A substantial proven reserve of 59.1 trillion standard cubic feet (tscf) of gas is found in the east coast of Peninsular Malaysia (27.5 tscf), Sarawak

(29.2 tscf) and Sabah (2.4 tscf). Some major new discoveries were also reported recently in Sarawak. Because of its abundance and availability, it will be the most important energy source of the country in the foreseeable future. This has led to the share of gas in the primary energy supply to increase from 20.5% in 1980 to 31.7% in 1990. The 1,000 mmcfd (million cubic feet per day) capacity PCU II pipeline will deliver gas to western and southern regions of Peninsular Malaysia and Singapore. The major demand for gas will be as feed stocks for petrochemical, LNG, fertiliser and middle distillate synthesis (MDS) plants, and for power generation, industrial, commercial and residential uses.

The greatest impact of gas will be in the electricity generation mix. In 1992, the total installed capacity is 6,325 MW of which gas contributes 35.4% (Table 4). However by the year 2010, the energy mix will be drastically different. Gas will dominate as the energy source. The total capacity is projected at 17,500 MW of which gas will account for 70.3%.

Table 4: Pattern of electricity generation mix to 2010.

	1992	2010
Installed Capacity (MW)	6,325	17,500
Oil	2,089 (33%)	500 (2.9%)
Gas	2,238 (35.4%)	12,300 (70.3%)
Hydropower	1,398 (22.1%)	3,100 (17.7%)
Coal	600 (9.5%)	1,600 (9.1%)

Hydropower

This primary energy source should be discussed in the context of electricity generation. Malaysia has a total potential hydro capacity of 29,000 MW equivalent to a potential annual energy resource of 123,000 gigawatt-hours. This represents a very large energy resource base, especially when in comparison with current energy consumption. As mentioned earlier, the location of hydropower resource does not match those of population and electricity demand centers. The present total installed hydropower capacity is 1,398 MW or 5,450 GWh/yr which is only 5% of the total potential.

The potential for hydropower in Peninsular Malaysia where the demand is greatest, is limited. A further 1,650 MW with an average output of 5,400 GWh/yr from 13 other sites constitute the remaining hydropower potential. Nearly all of these site are under various stages of study or planning and about 1,100 MW are expected to be developed by 2010.

In spite of the large total hydropower potential in Sarawak and Sabah, its development has been very slow. So far only 0.5% of the potential in Sarawak and 5.6% in Sabah are developed. The great distance between the principal watersheds and the load centers, high initial costs, and low consumption are the main reasons for the delayed development. The well publicised Bakun project of 2,400 MW capacity (18 TWh/yr) in Sarawak was initially conceived to provide electricity to Peninsular Malaysia via 659 km of undersea HVDC and overland HVAC cable. This is now being reconsidered in favour of development of smaller hydropower stations of several hundred MW capacities for consumption in Sarawak, Sabah and possibly Kalimantan and southern Philippines.

From the planning and implementation perspective, it is unlikely that hydropower in Sarawak and Sabah will be extensively developed by 2010. This is in view of the large accessible gas reserves, the commitment to the use of gas in electricity generation, and the very large investment already put into the PGU II pipe line which will bring gas to the high demand centres in southern and western Peninsular Malaysia. Therefore, hydropower, though of enormous potential, but because of its location, will remain a long term option in the overall energy scenario. Hydropower is projected to contribute an additional 1,700 MW of capacity. If the Bakun hydroelectric option is implemented by then, hydropower will contribute 4,100 MW to the new capacity. This will increase the hydropower contribution to 31.4% of the generation mix in 2010.

Coal

Against the background of abundant alternative energy sources, let us examine the role of coal in the overall energy scenario in the country.

Coal is found in all the 3 geographical provinces in Sarawak, Sabah and Peninsular Malaysia (Chen and Dorani, 1992). The total coal resource in the country is 965 million tonnes, 98% of which are found in the states of Sarawak and Sabah (Chen, 1986). All the coal are of Tertiary age and the quality ranges from lignite to anthracite. However, bituminous coal predominates. The total known coal area covers 5,823 km^2, 4,469 km^2 in Sarawak, 1,340 km^2 in Sabah and 14 km^2 in Peninsular Malaysia (Fig. 1).

The largest coal deposits in Malaysia are located in Merit Pila in central Sarawak and the Meliau basin in south central Sabah. The reserves from these 2 coal fields account for more than 50% of the total coal resource known in the country.

In the mining history of Malaysia, coal exploitation has been important at one time or another. Coal was mined from the Batu Arang coal field in Peninsular Malaysia between 1915 and 1960 and a total of 13.2 million tonnes had been produced. In Sarawak, the Sadong Colliery had produced about 1 million tonnes of coal for local consumption as well as for export between 1874 and 1931. In Sabah, the Labuan coal field was worked between 1848 and 1912, the Silimpopon coal field between 1905 and 1932, and the total productions were 0.5 and 1.5 million tonnes respectively.

Two small-scale coal mines were in operation in Sarawak – one opencast mine at Beredai in the Merit Pila coal field near Kapit and the other underground mine at Silantek near Kuching, which, however, has temporarily suspended operation since 1991.

Merit Pila Coal Field, Sarawak

The Merit Pila coal field is located in the upper reaches of the Rajang River, Sarawak, approximately 75 km upstream of the nearest town, Kapit in the Kapit Division. The coal deposits are hosted in an outlier of the Nyalau Formation of Miocene age, unconformably overlying the early Tertiary Belaga Formation. The outlier is elongated in shape, trending approximately east-west and covers an area of 260 km^2. The coal is hosted in the upper and the lower coal zones of the Nyalau Formation. The upper coal zone is 150-200 m thick which hosts 7 economic seams. The lower coal zone is 300 m thick; it hosts 18 seams, 5 of which are identified as economic seams. The coal seams within the lower coal zone range from 0.5 to 4 m thick and are continuous over a strike distance of 25 km (Fig. 2 and 3).

Detailed assessment of the coal since 1984 by the Geological Survey Department in the Merit, Tebulan and Musa blocks of the coal field have identified a measured reserve of 68.1 million tonnes, an indicated reserve of 63.3 million tonnes, and an inferred reserve 26.7 million tonnes. Of these amounts, about 10% may be won by the opencast method.

Coal is also known in other parts of the coal field at Longhills, Letong, Stapang-Skroh, Kupit-Selong, Beredai and Belawie Mujun. These areas give an additional 21.5 million tonnes of measured, 18.4 million tonnes of indicated and 208 million tonnes of inferred reserves. Thus the total potential

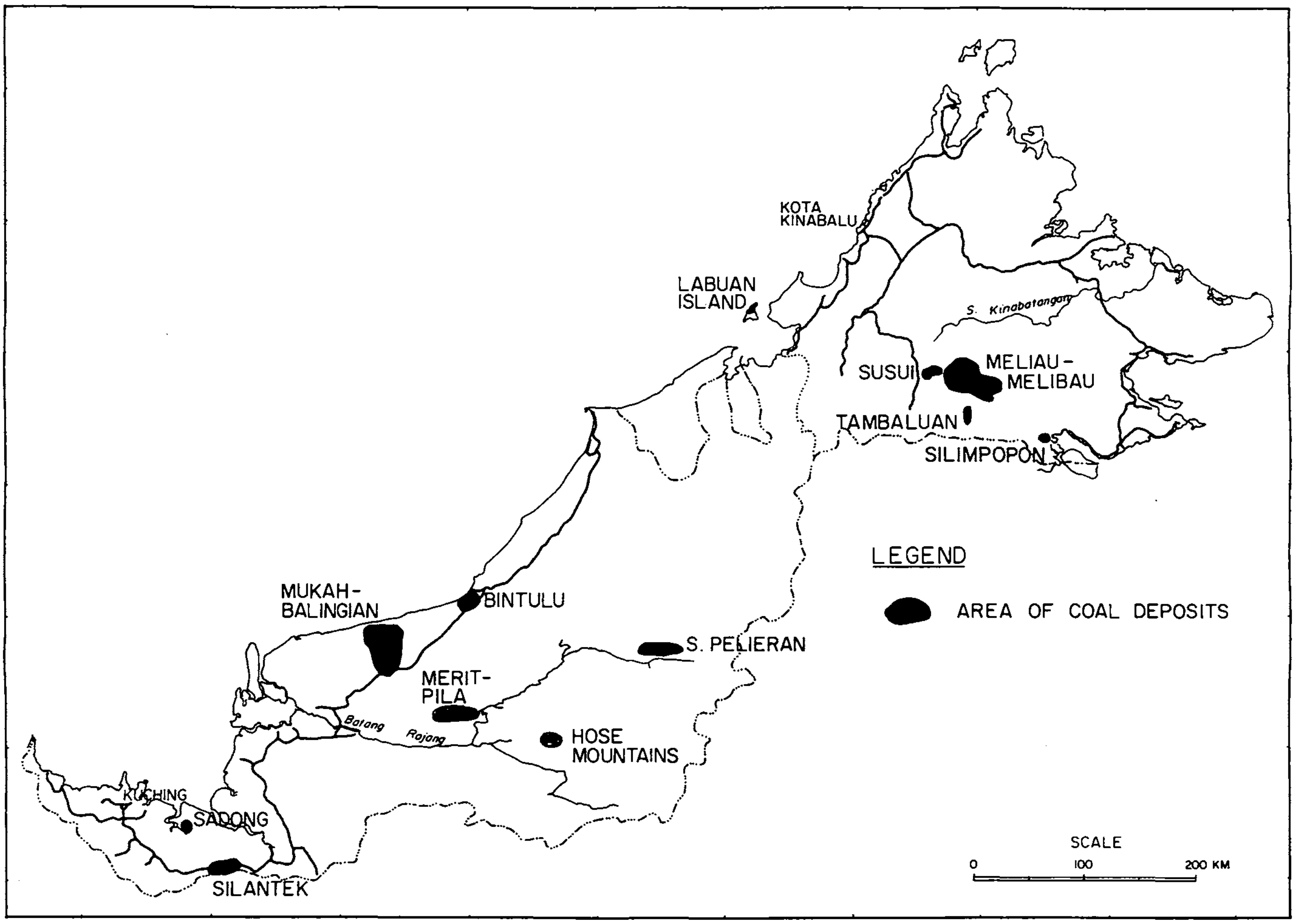

Figure 1. Coal deposits in Sarawak and Sabah.

of the Merit Pila coal field amounts to about 400 million tonnes.

Apart from variations in the ash content, the coal is quite uniform in quality. It can be described as a very low sulfur, moderate to high volatiles, moderate moisture and average calorific value sub-bituminous B coal. Some seams have exceedingly low ash content of less than 5%. The ash fusion temperature and the grindability index are well within the acceptable range, and there is no deleterious trace elements that exceed the permissible limits. Sulfur and nitrogen contents are within acceptable limits (Table 5). Therefore the Merit-Pila coal can easily be used as a fuel, and for power generation. The recent successful test burning of the Merit Pila coal as a blende with imported coal at the Sultan Salahuddin Abdul Aziz (SSAA) power station has assured the use of local coal in electricity generation. A contract to supply Merit coal to the SSAA station at Kapar has also been concluded recently (Gold, 1989).

Coal from Merit Pila will be one of the main sources of supply in the country.

The Meliau Coal Field, Sabah

Coal is known to occur in several places covering 1,340 km^2 in Sabah: the Meliau and Malibau basins and Susui areas in central south Sabah, located about 100 km from the coast, and in the Tambaluan and Silimpopon areas (Fig. 4). The main deposits are, however, found in the Meliau basin where coal occurs literally all along its escarpment (Lim and Tunggah, 1989).

In the north-eastern part of Meliau basin, 16 coal seams have been located; 7 of which are more than 1.5 m thick. These seams dipping about 12° are laterally continuous for distances of more than 5 km.

In the western part, several coal seams of more than 1 m thick are also known. In the south, thinner seams of less than 1 m have also been observed; one seam is, however, more than 1.2 m

Table 5: Typical quality of coal in Malaysia.

LOCALITY	GROSS CALORIFIC VALUE (kcal/kg) A.D.B.	TOTAL SULFUR % A.D.B.	PROXIMATE %				ULTIMATE %			
			TOTAL MOISTURE AS RECEIVED	ASH A.D.B.	VOLATILE MATTER A.D.B.	FIXED CARBON A.D.B.	C D.A.F.	H D.A.F.	N D.A.F.	O D.A.F.
Silantek, Sarawak	6870-8020	0.40-0.61	2.1-5.4	1.2-10.2	24.7-27.7	63.3-68.0	86.1-87.2	5.42-6.77	1.91-2.20	5.4-5.5
Mukah-Balingian, Sarawak	4030-5700	0.14-0.78	25.4-43.4	1.0-27.7	30.8-42.7	30.3-43.5	67.1-70.0	4.75-5.96	1.01-1.44	23.0-24.8
Bintulu, Sarawak	6940-7690	0.62-0.93	4.2-6.9	0.5-11.4	39.5-49.6	36.5-52.7	75.6-81.1	5.33-6.60	1.27-1.93	10.6-16.9
Maliau Basin, Sabah	5530-8100	1.19-4.70	3.4-6.4	2.3-27.7	31.6 42.9	38.7-53.1	77.0-83.0	6.01-6.24	1.58-1.71	8.0-12.0
Batu Arang, Selangor	5100-5800	0.47-0.56	26.7	5.1-16.3	35.8-38.4	38.9-46.5	72.4	5.56	1.17	20.9
Merit Block, Merit-Pila Coal Field, Sarawak	4860-5680	0.13-0.16	16.7-19.1	7.9-22.5	34.1-41.7	35.9-39.8	72.5-73.2	5.20-5.43	1.17-1.27	20.3-21.1
Tebulan Block, Merit-Pila Coal Field, Sarawak	5150-6050	0.14-0.16	16.4-17.4	3.9-16.1	36.1-45.4	35.0-40.8	71.8-73.0	5.44-5.70	1.10-1.39	20.3-21.1
Merit Block South Merit-Pila Coal Field	4800-5770	0.12-0.16	18.3-19.8	2.6-14.8	35.4-42.9	36.2-42.9	71.0-72.1	5.17-5.51	1.26-1.31	21.5-22.5

A.D.B. — Air Dried Basis D.A.F. — Dry, Ash Free thick. About 30 km to the west of Meliau in the Susui area, thick seams of more than 5 m were also recorded (Fig. 5).

Near the base of the sedimentary sequence in the eastern part, there is good coal seam development over a large area, and the main seam which can be traced for 6.5 km with an average thickness of 2.7 m is the possible target for mine development. This coal area covering 25 km^2 down to a depth of 500 m would have a reserve of 90 million tonnes. The total *in-situ* resource from this seam near the base of the coal zone would be around 200 million tonnes. Because of a combination of limited seam thickness (1.5-3.4 m), moderate dip and often irregular surface topography, underground mining would be necessary to exploit the resource.

The Meliau coal appears to be of excellent quality with low ash, low to moderate sulfur and high specific energy. It is classified as high volatile bituminous A coal and the main market would be the major utility companies (Table 5).

Mukah-Balingian Coal Field, Sarawak

The third largest coal field is in the Mukah-Balingian area where coal occurs extensively in the low-lying coastal plain between the Mukah and the Balingian rivers. This coal bearing area covers about 1,600 km^2 (Fig. 6).

Exploration drilling has indicated that some thick coal seams with gentle dips of less than 10° occur in the Penareh, Lemai, Bawan and Balingian areas. Three of the seams in the Penareh area are 1.5 to 5 m thick; in the Bawan area, 5 seams 1.3 to 15.4 m thick have been encountered. In the Balingian area, the coal seams are about 2 m thick. It is estimated that the potential reserve in the Balingian area is 150 million tonnes and that of the other areas is another 120 million tonnes.

A local company in its detailed exploration in the Penareh area, after completion of more than 50 holes over an area of 17.5 km^2, has identified more than 5 main seams, some with thickness of more than 6 m. The total reserve within this area down to 100 m is estimated at 51 million tonnes.

Generally, the coal has low ash, low sulfur and moderate to high moisture contents. The calorific value on air dried basis is 4,400 kcal/kg. Due to its low rank and high moisture content, the Mukah Balingian coal is best used as a mine-mouth fuel, for on-site consumption such as electricity generation (Table 5).

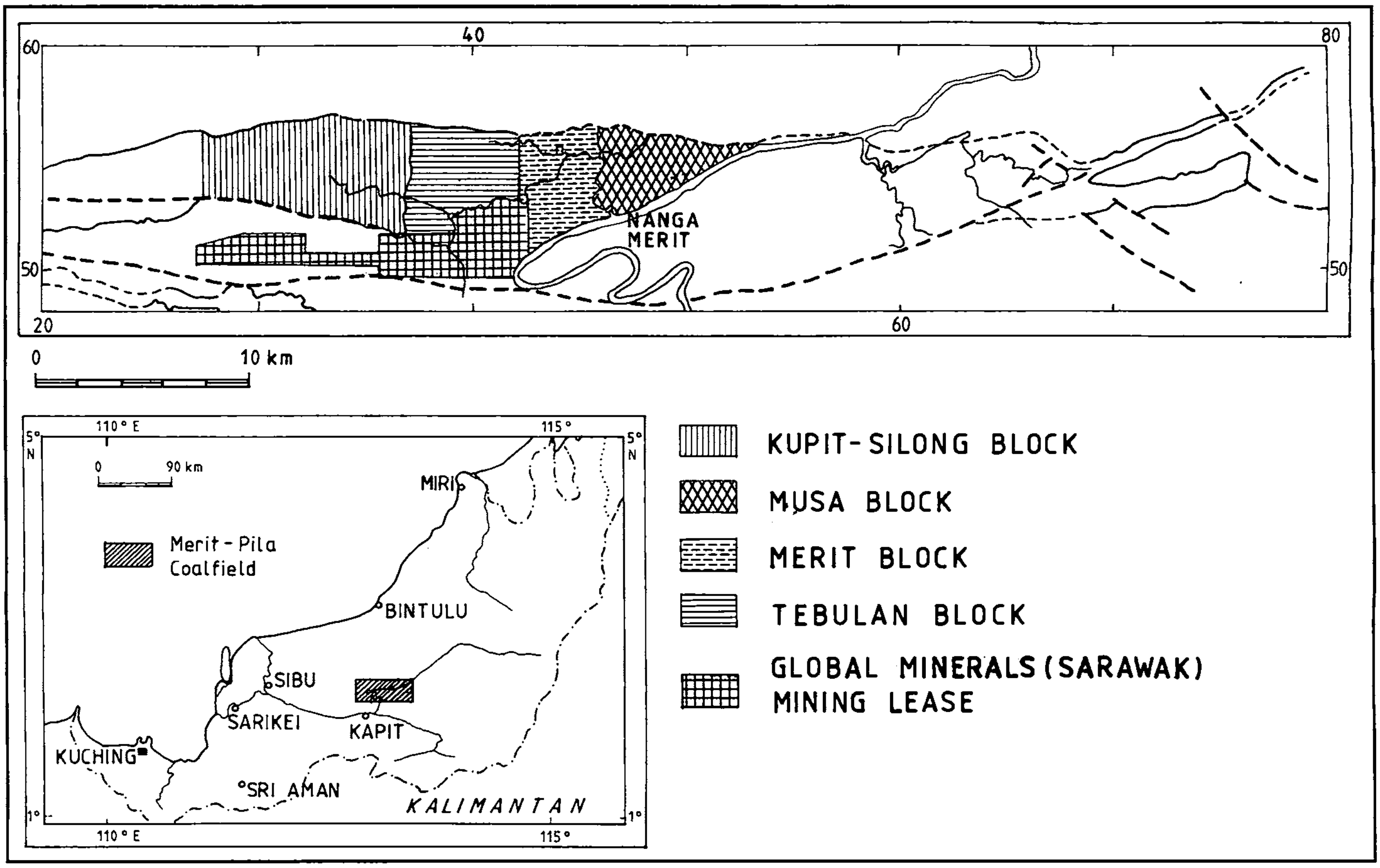

Figure 2. Map of Merit-Pila coal field.

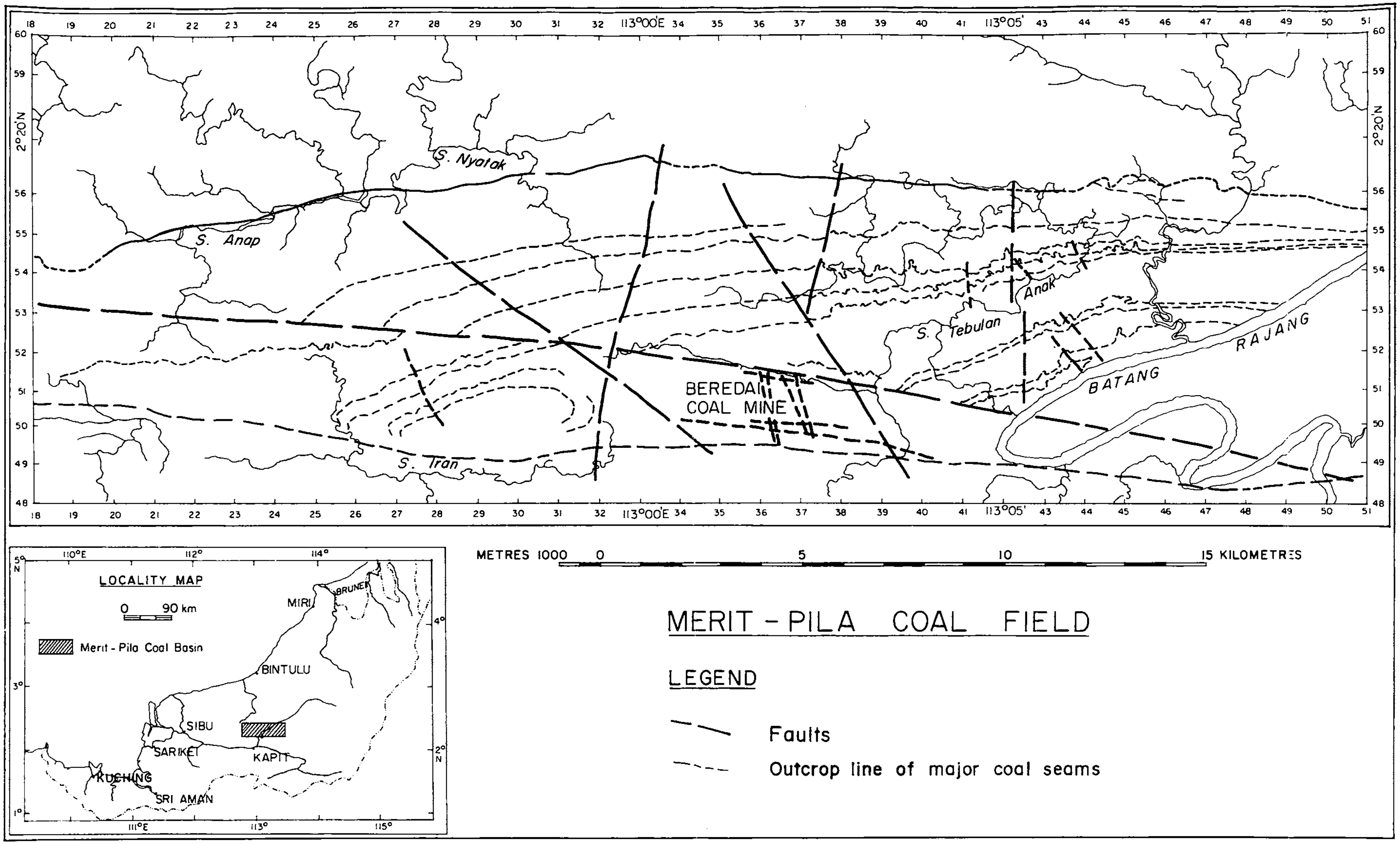

Figure 3. Merit-Pila coal field.

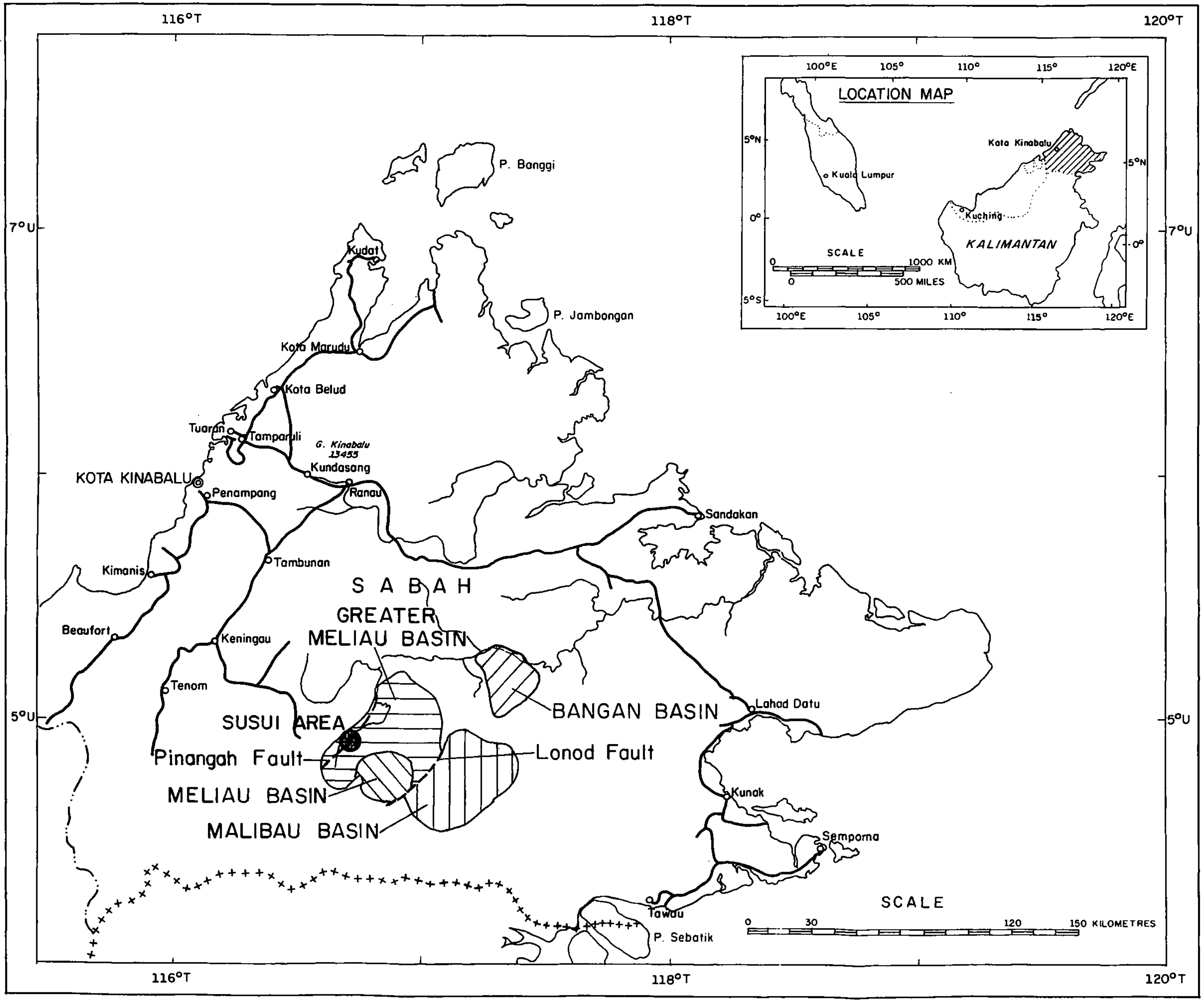

Figure 4. Meliau Basin and other coal areas in Sabah.

Other Coal Deposits

Besides the main coal fields described, other smaller deposits at Silantek, Bintulu and Sadong in Sarawak; Silimpopon and Labuan in Sabah and Batu Arang in Peninsular Malaysia are also well documented. Coal deposits with substantial reserves are also known in the interior areas of the Usun Apau and Hose Mountains of Sarawak. Because of their inaccessibility, however, not much follow-up work has been done.

The Silantek coal field is located 130 km southeast of Kuching near the Sarawak-Kalimantan border. The coal field covers an area of 60 km^2. The 1.2 m thick main seam has until recently been mined. Because of the nature of the topography, and dip of the seam of about 12°, mining was by the underground technique. The deposit was mined on a small scale since 1989 with a planned capacity of 60,000 tonnes per year. The Silantek coal is of high rank compared with coal from other deposits. It has high calorific value and the moisture content is low. Some parts of the deposit are of cocking quality and some anthracitic due to the thermal effect of igneous intrusions (Table 5).

The small bituminous coal deposit located near Bintulu with a potential of 20 million tonnes is of greater interest as the quality of the coal, with high heating value, is good. The proximity of the deposit

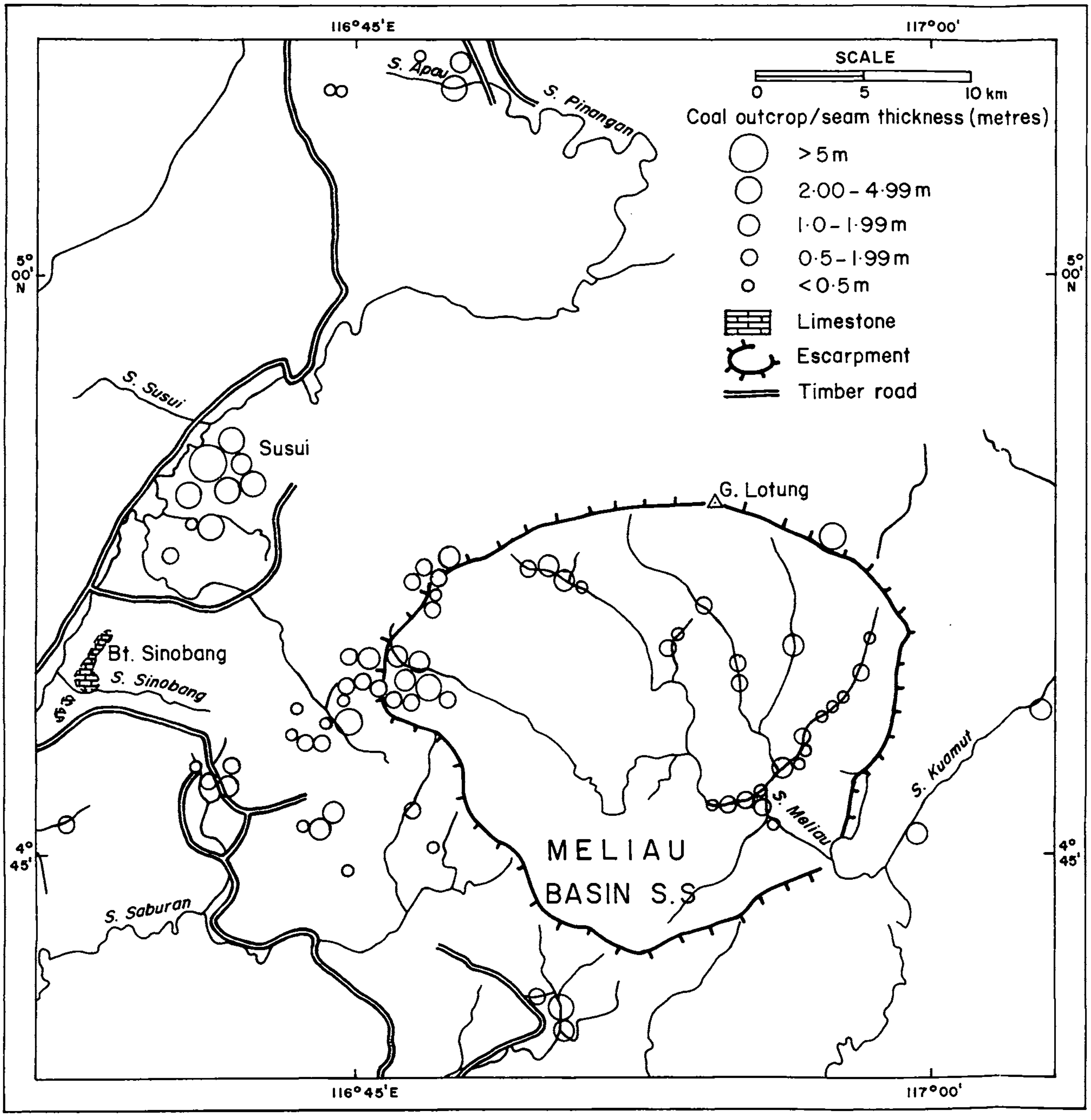

Figure 5. Coal outcrops in the Meliau Basin.

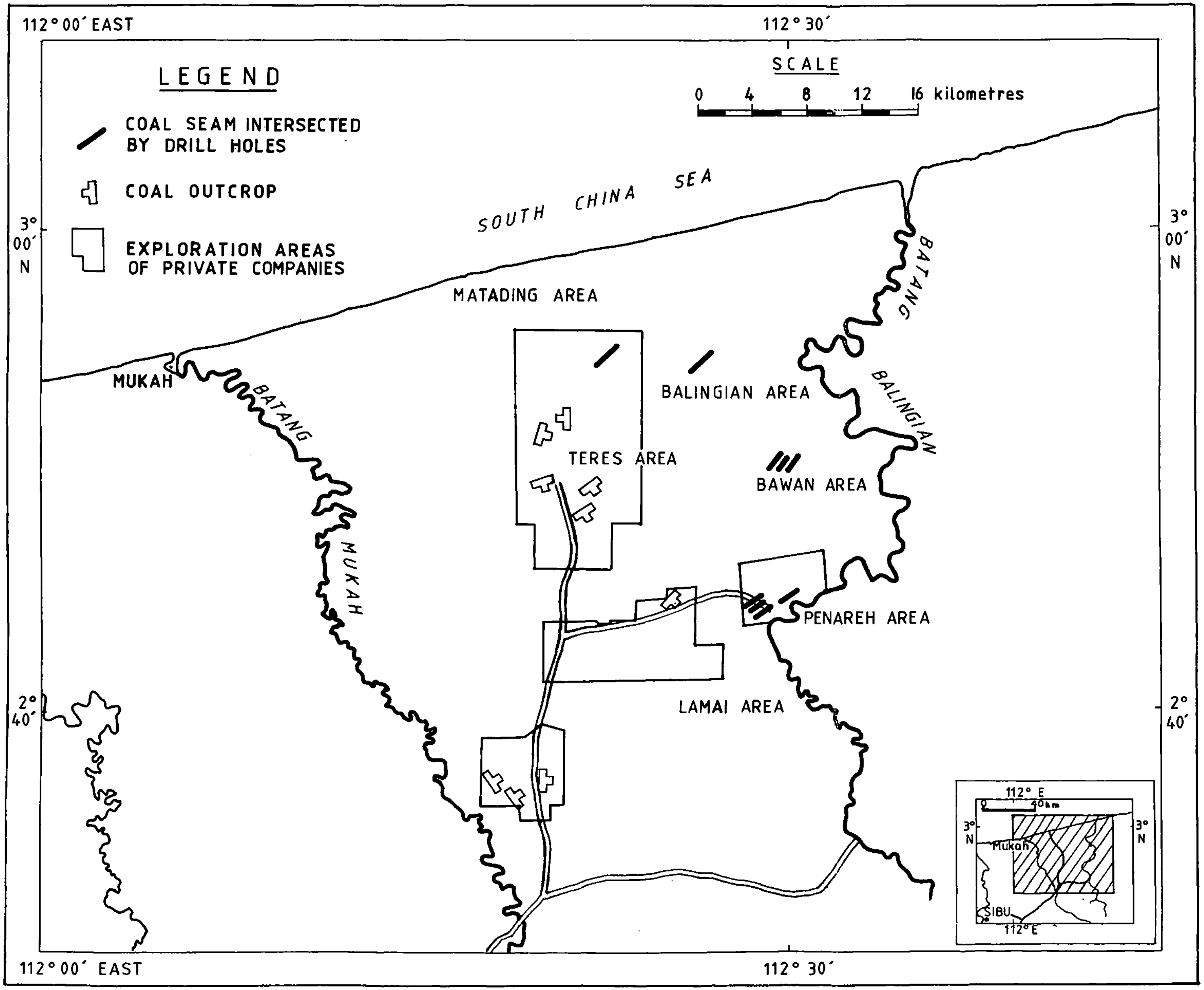

Figure 6. Mukah-Balingian coal field.

to an existing deep sea port would favour its early development.

Other coal areas that are known include the Plieran and Murum deposits in the far interior of the Usun Apau area where in the Plieran area, seams of 0.9 to 3.7 m thick occur over an area of 130 km^2. The Murum deposits consist of several coal seams up to 1.5 m. In the southern part of the Hose Mountains area, thinner seams of up to 1 m thick have been reported: thicker seams of up to 2.1 m have also been reported in Sungai Taman. In view of the remoteness of the deposits, they are unlikely to be developed in the near future.

ENVIRONMENTAL CONSIDERATION OF COAL USE

The largest coal users in the country are the cement manufacturers and electricity producer. The total consumption of coal at present is about 2.2 million tonnes per year. The use of coal is relatively new, with some of the cement plants converting from oil to coal in the early 1980's and the commissioning of the only coal fired SSAA power station at Port Kelang in 1989 (Lim, 1991). Nevertheless, the possible adverse effects of coal use to the environment is viewed seriously (Kalsom, 1990). Under the Environmental Quality Act 1987 (Revised), cement plants and power station fall under the prescribed activities which required that an Environment Impact Assessment be prepared and approved by the Department of Environment before they are allowed to commence operation. Nearly all the cement factories were built before 1985. Nevertheless, their operation would have to conform to the clean air standards as laid down by the Department of Environment. Environment Impact Assessment was carried out for the SSAA power station.

In cement manufacture, the amount of coal use is relatively small, and the operation of a cement plant, with its inherent dust problem is more severe and acute. Electrostatic precipitators or bag filters are the common anti-pollution equipment.

At the SSAA power station, various measures are taken to minimise the adverse effects of power generation with coal on the environment. These include the completion, and approval by the Department of Environment, of an environment impact assessment in 1984 well before the commencement of operation of the station, subsequent environmental audit and continuous monitoring of the air quality in the environs of the power station.

An environmental audit emphasizing the ambient air, surface water, thermal effects of cooling discharge and marine life was carried out in October 1989 upon completion of the power station project to compare the actual measured impact of the operational power station against the predicted expectations. The audit also analysed the cause of variance or deviations between the actual results and the predictions.

Monitoring of the air quality is continuously being carried out. To minimise the potential pollution during plant operation, the boiler flue gas emission is continuously being monitored so that corrective measures can be taken if necessary. In addition, the ambient air quality at incremental distances away from the power station is monitored by an array of well spread out air monitoring network. Similarly waste water from the power plant is checked for its pollutants such as pH, BOD, iron and oil traces. Pollutants are subjected to chemical and physical treatments.

In the coal yard, dust dispersion is suppressed by water sprayed from a sprinkler system, and combustion of the coal pile minimised by first in first out management of the coal stock. Temperature of the coal pile is monitored by a system of temperature probes to detect heat build-up.

Fly ash from the power plant is collected by electrostatic precipitator. Part of the fly ash is stored in silos for use as raw material in cement manufacture. The unused fly-ash together with the bottom ash is removed in the form of slurry to the ash settling pond. Trace elements in the pond effluent is also being regularly monitored to ensure the discharge is pollutant free.

The on-going monitoring system indicates that the environmental problems associated with coal use are so far dealt with effectively. This regular monitoring is going to continue concurrent with the operation of the power station. The environmental problems associated with coal burning is greatly reduced with the use of better quality coal. However, as we are getting more and more environmental conscious every day, it is envisaged that future coal-fired power station would have more sophisticated anti-pollution installation to further reduce the adverse effects of coal use to the environment.

COAL AS AN ENERGY RESOURCE

The role of coal as an energy resource is assured under the national four fuel strategy (Ministry of Energy, Telecommunication and Post, Malaysia, 1991). Its present use is confined almost entirely to the generation of electricity and in the cement industry, with only a very small percentage being used in the metallurgical and other industries (Chen, 1989). In 1992, coal contributes to 9.5% of the country's electricity generation mix. In view of the very large gas resource both in Peninsular Malaysia and Sarawak, the substantial investment that is already in place for the greater use of gas, its easy handling and use, and minimum adverse effects on the environment, gas is destined to be the preferred fuel. Furthermore with the prevailing attractive pricing at least to the year 2000, it would be an extremely economic fuel.

However, after the year 2000 when gas may be pegged to oil price, the scenario may change. In Peninsular Malaysia, even at the prevailing agreed gas price, it is proven that coal is still marginally cheaper than gas. In view of this, the National Energy Corporation (Tenaga Nasional Berhad) is seriously considering the use of coal in the new Port Kelang III and Port Kelang IV plantup; Port Kelang III consisting of 2 x 500 MW plants is scheduled for commissioning in 1996 (Mohd. Zamzam and Loo, 1990; National Electricity Board, 1990; Tenaga Nasional Berhad, 1992). With the recent implementation of the policy of allowing independent power producers (IPP) to operate, coal being a more economical energy source will likely to be the preferred fuel in the medium to long term plantup by the private sector.

Plans are already in hand to convert most of the existing oil fired power stations to gas. Total plantup to the year 2000 will be about 5,000 MW of which 1,000 MW may be coal based. Assuming that the additional new capacity of 1,000 MW is based on coal, it will boost the domestic coal consumption for power generation to 3.7 million tonnes of coal per year.

Other potential coal users like in brick manufacture and small boilers are likely to use gas as the preferred fuel, if available; the demand for coal in the metallurgical and other industries would not significantly affect the overall consumption. However, the cement industry which is the second most important coal user would use coal if it is economical for them to do so. It is versatile, and can easily switch fuel when required. Therefore, the coal demand by the cement industry to the year 2000 may be still in the order of 1 million tonnes.

In Sarawak and Sabah, where most of the energy resources are located, coal needs to compete fiercely with other alternative energy sources. Unless the inter-connection is established with Peninsular Malaysia, or southern Philippines and Kalimantan, any new plantup in these states are expected to be of small capacities. The cost of coal-based generation may be too hard-pressed as to be able to compete with gas because of the inadequate infrastructure, inaccessibility of the coal deposits, and the projected small scale operation of mines if they are dedicated to supply coal only to local power stations. However, from the diversification of energy sources and location perspectives, coal still has a role in the energy scenario of Sarawak and Sabah.

The rationale of the four fuel strategy is diversification, stability of supply and balance. By 2010, the electricity generation mix will achieve about 70% gas. This is unlikely to increase further. Otherwise it will create a situation of over dependence on a single source of fuel, a condition reminiscent of our over dependence on oil in the 1970's. Coal will be a strong candidate for future plantup, particularly if the gas price is pegged to oil.

Another important consideration for further coal use is the environment factor. We are very conscious of the adverse effects of coal burning to the environment. The noxious oxides of sulfur and nitrogen can be substantially removed, but the increasing contribution of CO_2 to the atmosphere remains problematical. With the rapid advance in clean coal technologies, however, the adverse effects of coal burning may be further reduced paving the way for greater coal use.

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Manuscript received 11 January 1993