III MARKETING

III. MARKETING

III-1 Overview of the Malaysian Economy

III-1-1 Outlines of development plans, 1971–80 and their performances

After the outburst of racial conflict in Malaysia in 1969, the "New Economic Policy" (NEP), a socio-economic policy was designed, which aims to achieve national unity through eradication of poverty irrespective of race and restructuring society to eliminate the identification of race with economic function.

In order to realize those aims the "Outline Perspective Plan" (OPP), 1971–90, the broad socio-economic plan was made, which sets out in quantitative terms the major targets of the NEP, and demonstrated their feasibility and examined their implications for policy.
During the decade of 1970s two Five Year Economic Plans were made and practiced. Those were the "Second Malaysia Plan" (SMP), 1971–1975, and the "Third Malaysia Plan" (TMP), 1976–1980. The plans and the performances are reviewed in Table III-1-1 and Table III-1-2.

Against the plan of GDP growth in constant prices from M$12,510 million in 1970 to M$26,233 million in 1980, the actual performance was from M$12,308 million in 1970 to M$26,188 million in 1980. The actual performance of GDP growth made an average annual growth rate of 7.8% which is higher than the original plan of 7.7%, bringing the actual GDP (M$26,188 million) in 1980 closer to the planned one (M$26,233 million). This remarkable achievement was realized mainly due to larger consumption and investment performances (M$20,601 million and M/6,943 million respectively in 1980) than the planned ones (M$17,651 million and M$5,423 million respectively). The larger consumption (M$2,950 million more) was mostly brought about by larger private consumption, while the bigger investment (M$1,520 million more) was more attributable to bigger private investment though the public one itself has increased a little bit more than planned. The actual trade balance was more import (by M$1,176 million) instead of the more export (by M$3,459 million) was planned.

As shown in Table III-1-2 the actual growth rate of GDP at factor cost was 7.9% which was 0.1% lower than that planned (8.0%), though in terms of amount the actual performance of M$25,376 million is by M$2,303 million higher than that planned M$23,073 million in 1980. By Sector of Origin, Agriculture which used to be the largest sector of GDP accounting for 32.0% in 1970 has grown only at the average annual rate of 4.3% which is less than the planned 5.9%, and now it accounts for 22.9% of GDP at factor cost in 1980 which is 3.6% lower than planned. On the other hand the Manufacturing Sector and the Wholesale and retail trade, etc have made 12.5% and 7.3% annual growths respectively compared with the planned growth rates of 11.5% and 8.2% respectively, and they account for 21.2% and 13.0% of GDP at factor cost respectively. Though in the order of share, Agriculture Sector (22.9%) still ranks the first and Manufacturing Sector (21.2%) the second, the difference between them is narrower than planned.

Besides, there are other features of 1970s which are discussed in the Fourth Malaysia Plan (FMP) as follows:

a) This was "a period of rapid economic growth and structural change in Malaysia" (cf, p.l) and this is "the result of diversification of agriculture and the adoption of an export-oriented development strategies to maximize the comparative advantage of Malaysia's resource endowment". (cf. p.157)
b) The per capita income increased 4.9% per annum in real terms and the quality of life

was improved with respect to water, electricity, school and health care. (cf. p.2)

c) Real per capita consumption also grew 5.4% per annum. (from $856 in 1970 to $1,445 in 1980) (cf. p.3)

d) Increase in GDP is good for making it easy to realize redistribution, restructuring economy, and generation of employment. (cf. p3)

e) Unemployment declined from the level of 7.8% in 1970 to 5.3% in 1980. (cf. p.3)

f) The consumer price index in Peninsular Malaysia increased at average rate of 5.8% per annum. (cf. p.28)

Table III-1-1 Malaysia: GNP by Expenditure Category, 1970 – 1980, Plan and Performance

			Amount ($million in 1970 prices)			Average Annual Growth Rate (%)			Share of GDP (%)		
			1970	1975	1980	1971 ~75	1976 ~80	1971 ~80	1970	1975	1980
Plan	Consumption	Private	7,486	9,036	12,331	3.8	6.4	5.1	59.8	51.5	47.0
		Public	1,997	3,070	5,320	9.0	11.6	10.3	16.0	17.5	20.3
	Sub Total		9,483	12,106	17,651	5.0	7.8	6.4	75.8	69.0	67.3
	Investment	Private	1,459	2,062	3,315	7.2	9.9	8.6	11.7	11.7	12.6
		Public	693	1,560	2,108	17.6	6.2	11.8	5.5	8.9	8.0
	Sub Total		2,152	3,622	5,423	11.0	8.4	9.7	17.2	20.6	20.6
	+ Changes in stocks		315	△442	△300				2.5	△2.5	△1.1
	+ Exports of goods and non-factor services		5,367	7,151	10,704	5.9	8.4	7.1	42.9	40.8	40.8
	– Imports of goods and non-factor services		4,807	4,899	7,245	0.4	8.1	4.2	38.4	27.9	27.6
	= GDP at market prices		12,510	17,538	26,233	7.0	8.4	7.7	100.0	100.0	100.0
	– Indirect taxes less subsidies		1,802	2,223	3,160	4.3	7.3	5.8			
	= GDP at factor cost		10,708	15,315	23,073	7.4	8.5	8.0			
	– Net factor payment abroad		355	392	857						
	GNP at market prices*		12,155	17,146	25,376	7.1	8.2	7.6			
Performance	Consumption	Private	7,310	9,631	15,317	5.7	9.7	7.7	59.4		58.5
		Public	1,917	3,117	5,284	10.2	11.1	10.7	15.6		20.2
	Sub Total		9,227	12,748	20,601	6.7	10.1	8.4	75.0		78.7
	Investment	Private	1,490	2,454	4,635	10.5	13.6	12.0	12.1		17.7
		Public	706	1,482	2,308	16.0	9.3	12.6	5.7		8.8
	Sub Total		2,196	3,936	6,943	12.4	12.0	12.2	17.8		26.5
	+ Changes in stocks		357	△266	△180						
	+ Exports of goods and non-factor services		5,396	7,179	11,253	5.9	9.4	7.6	43.8		43.0
	– Imports of goods and non-factor services		4,868	6,232	12,429	5.1	14.8	9.8	39.6		47.5
	= GDP at purchaser's value		12,308	17,365	26,188	7.1	8.6	7.8	100.0		100.0
	+ Net factor payments		△355	△449	△744						
	GNP at purchaser's value		11,953	16,916	25,444	7.2	8.5	7.8			

* GNP at market prices = GDP at market prices - Net factor payment abroad

Sources: TMP and FMP

Table III-1-2 GDP by Sector of Origin in Malaysia, 1970 – 1980, Plan and Performance

	Sector	Amount ($million in 1970 prices)			Average Annual Growth Rate (%)			Share of GDP (%)		
		1970	1975	1980	1971 ~75	1976 ~80	1971 ~80	1970	1975	1980
Plan	Agriculture, forestry and fishing	3,432	4,563	6,106	5.9	6.0	5.9	32.1	29.8	26.5
	Mining and quarrying	613	612	806	0	5.7	2.8	5.7	4.0	3.5
	Manufacturing	1,307	2,197	3,872	10.9	12.0	11.5	12.2	14.4	16.8
	Construction	481	711	1,087	8.1	8.9	8.5	4.5	4.6	4.7
	Electricity, gas and water	245	401	622	10.4	9.2	9.8	2.3	2.6	2.7
	Transport, storage and communication	606	1,098	1,636	12.6	8.3	10.4	5.7	7.2	7.1
	Wholesale & retail trade, hotel & restaurants	1,423	2,086	3,122	7.9	8.4	8.2	13.3	13.6	13.5
	Ownership of dwellings, banking, insurance & real estate	836	1,109	1,658	5.8	8.4	7.1	7.8	7.2	7.2
	Public administration & defence	794	1,199	1,896	8.6	9.6	9.1	7.4	7.8	8.2
	Other services	874	1,237	1,947	7.2	9.5	8.3	8.2	8.1	8.4
	Statistical discrepancy	97	102	321						
	GDP at factor cost	10,708	15,315	23,073	7.4	8.5	8.0	100.0	100.0	100.0
Performance	Agriculture, forestry and fishing	3,797	4,804	5,809	4.8	3.9	4.3	32.0	28.4	22.9
	Mining and quarrying	778	792	1,214	0.4	8.9	4.6	6.6	4.7	4.8
	Manufacturing	1,650	2,850	5,374	11.6	13.5	12.5	13.9	16.9	21.2
	Construction	475	654	1,186	6.6	12.6	9.6	4.0	3.9	4.7
	Electricity, gas and water	229	365	592	9.8	10.2	10.0	1.9	2.2	2.3
	Transport, storage and communication	581	1,071	1,696	13.0	9.6	11.3	4.9	6.3	6.7
	Wholesale and retail trade, hotel and restaurants	1,633	2,219	3,295	6.3	8.2	7.3	13.8	13.1	13.0
	Finance, insurance, real estate and business services	1,036	1,468	2,155	7.2	8.0	7.6	8.8	8.7	8.5
	Government services	1,367	2,210	3,393	10.1	9.0	9.5	11.5	13.0	13.3
	Other services	306	478	657	9.3	6.6	7.9	2.6	2.8	2.6
	GDP at factor cost	11,852	16,911	25,376	7.4	8.5	7.9	100.0	100.0	100.0
	Less: Imputed bank charges	117	211	308						
	Plus: Import duties	573	665	1,120						
	Equals: GDP at purchaser's value	12,308	17,365	26,188	7.1	8.6	7.8			

Sources: TMP, FMP

III-1-2 Outline of present development plan – prospect and strategies for 1980s

(1) Outlook for the world economic situation

The Fourth Malaysia Plan (FMP), the present five year plan says that 1980s is characterized "by slow output growth in the midst of persisting inflation, rising rate of unemployment, slackening of world trade and increasing balance of payment deficits". (cf.p.166)

It is expected that GDP growth of industrialized countries during 1980s will be at average annual rate of 4.2% (cf. 1970s: 4.9%), among which Japan's will be 6.0%, while USA's and Europe's below 4.2%.

The world trade will grow at the average annual rate of 5.7% which is lower than that of 7.4% during the past decade, because the slower growth anticipated in the industrialized countries, which import over 65% of the world primary exports and over 60% of manufactured exports of the developing countries, will have direct effects on the export performance of developing countries and secondly because this slower growth in the industrialized countries are apt to be aggravated by rapidly changing imbalances in external payments due to ever increasing oil prices and other commodities, and thirdly because there will be protectionism growing which will further reduce world trade.

(2) Macro economic strategies

Under the rather unfavorable circumstances as discussed above Malaysia has to accomplish the long-term targets of the NEP, and also to compensate for the past shortfalls in terms of performance. So the planned growth rate was set at 7.9% which is 0.1% higher than the actual performance during the last decade. [In FMP, it is mentioned that the economy will have to grow at least by 8% per annum to enable the achievement of the various socio economic objectives, (cf. pp. 156–157), and the plan of GDP by Expenditure is formulated accordingly (cf. p. 158)].

As FMP says "Apart from ensuring rapid growth, strategies to effect the desired structural pattern of development is of paramount importance" (p. 157).

Important elements of development strategies for 1980s are as follows:

a) Increasing productivity of agriculture
b) The expansion and the diversification of industrial base
c) Modernization of the financial and service sectors
d) Diversifying the source of growth
e) Export promotion by developing new sources of export
f) Import substitution, especially in intermediate and capital goods, mainly to meet the input needs of export-oriented industries and to foster greater integrated production of goods
g) Balanced socio-economic development among the regions in the country
h) Protection of environment.

The outline of the economic development program between 1981 and 1985, while overviewing up to 1990 is as shown in Table III-1-3 and III-1-4. Here the GDP growth is set at 7.6% per annum, which is 1.0% lower than the actual 8.6% of the past five years and 0.2% lower than the actual 7.8% of the last decade. Per capita income will grow by 5% annum (p.252)*[1]. Consumption growth both by private and public will be 7.0 and

9.2% respectively, which are lower than the performances of 9.7% and 11.1 for the TMP period. Investment both by private and public will be 8.0 and Δ1.4% respectively which are also lower than those of 13.6% and 9.3% for the previous five year period. It is planned that growth rate of investment is to be made moderate for the present decade and there will be more private investment than public, because there will be more expenditure by government on defence and internal security.

The total public development expenditure between 1981–85 are as follows: (cf. pp. 240–243, FMP)

	(M$ million)	
a) Economic	22,764.50	(57.9%)
– Agriculture and rural development	8,359.09	(21.3%)
– Mineral Resources development	48.00	(0.1%)
– Commerce and Industry	5,433.05	(13.8%)
– Transport	4,116.07	(10.5%)
– Communication	1,523.52	(3.9%)
– Energy and Public Utilities	3248.76	(8.2%)
– Others	36.00	(0.1%)
b) Social	6,388.14	(16.2%)
c) Security	9,371.55	(23.8%)
d) Administration	805.31	(2.1%)
Total Federal Funds	39,320.50	(100.0%)
		[91.8%]
State Funds	1,380.00	[3.2%]
Statutory Funds	2,120.00	[5.0%]
Grand Total	42,829.50	[100.0%]

Looking at the economy by sector of origin Agriculture will grow at 3% per annum and its GDP share will be 17.8% in 1985 which is lower than 23.9% of Manufacturing. Manufacturing will grow at 11.0% which is lower than 13.5% for the previous five year term. The growth in both the agricultural and industrial sectors calls for rapid growth of a number of supporting sectors. Transport, Wholesale and retail trade, Financial and business services and Government services, on the average, will grow at 8.5%**.

The cumulative Federal and State Government revenue during FMP period is M$113.036 million, which consists of Federal Government revenue M$98,537 million (Direct taxes M$45,195 million, Indirect taxes M$48,622 and Non tax revenue M$4,720 million) and State Government revenue amounting to M$14,499 million.
Overall deficit of M$21,878.5 million during FMP (Government revenue M$113,036 million + Public authorities surplus M$33 million – Government expenditure M$102,118 million – Public sector development M$32,829.5 million) is to be financed by the net domestic borrowing (M$15,500 million), the net foreign borrowing (M$4,000 million) and use of accumulated assets and special receipts (M$23,785 million)**

Export will grow at 9.7% per year, while import at 8.6% in real terms and the cumulative trade balance for the present five year term will be plus some M$35,200 million.
Besides, employment will grow at 3.2% per annum during FMP period, which is higher than the labor force growth 3.1% leading to an unemployment rate of 4.9% in 1985

from 5.3% in 1980*5. The rate of inflation will be 6 ~ 7%*6 annually and the private consumption will grow at 7.0% annually.

Concerning the five-year plan for this period, it is stressed in FMP that "while there is major concern on the impact of external developments on Malaysian economy, in particular the rate of domestic price increase, the strong resource base of the economy, coupled with appropriate policies and programs will enable the economy to sustain the momentum of development"*7 and that there will be further expansion and diversification realized.

*1 FMP, cf. p.252
*2. Ibid, cf. p.160
*3. Ibid, cf. p.248
*4. Ibid, cf. p.249
*5. Ibid, cf. pp.226–236
*6. Ibid, cf. p.213
*7. Ibid, cf. p.197

Table III-1-3 GDP by Expenditure Category in Malaysia, 1980 ~ 1990

		Amount ($million in 1970 prices)			Average Annual Growth Rate (%)			Share of GDP (%)		
		1980	1985	1990	1981 ~1985	1986 ~1990	1981 ~1990	1980	1985	1990
Consumption	Private	15,317	21,483	31,420	7.0	7.9	7.4	58.5	56.8	55.4
	Public	5,284	8,200	12,617	9.2	9.0	9.1	20.2	21.7	22.2
	Sub Total	20,601	29,683	44,037	7.6	8.2	7.9	78.7	78.5	77.6
Investment	Private	4,635	6,813	10,972	8.0	10.0	9.0	17.7	18.0	19.3
	Public	2,308	2,151	3,464	Δ1.4	10.0	4.1	8.8	5.7	6.1
	Sub Total	6,943	8,964	14,436	5.2	10.0	7.6	26.5	23.7	25.4
+ Changes in stocks		Δ180	95	198	–	–	–	Δ0.7	0.2	0.4
+ Exports of goods and non-factor services		11,253	17,899	26,790	9.7	8.4	9.1	43.0	47.3	47.2
– Imports of goods and non-factor services		12,429	18,817	28,701	8.6	8.8	8.7	47.5	49.7	50.6
= GDP at purchaser's value		26,188	37,824	56,760	7.6	8.5	8.0	100.0	100.0	100.0

Source: FMP

Table III-1-4 GDP by Sector of Origin in Malaysia, 1980 ~ 90

Sector	Amount ($million in 1970 prices)			Average Annual Growth Rate (%)			Share of GDP (%)		
	1980	1985	1990	1981 ~1985	1986 ~1990	1981 ~1990	1980	1985	1990
Agriculture, forestry and fishing	5,809	6,720	8,193	3.0	4.0	3.5	22.2	17.8	14.4
Mining and quarrying	1,214	1,607	1,863	5.8	3.0	4.4	4.6	4.3	3.3
Manufacturing	5,374	9,040	15,121	11.0	10.8	10.9	20.5	23.9	26.6
Construction	1,186	1,824	2,938	9.0	10.0	9.5	4.5	4.8	5.2
Electricity, gas and water	592	953	1,500	10.0	9.5	9.7	2.3	2.5	2.6
Transport, storage and communications	1,696	2,492	3,834	8.0	9.0	8.5	6.5	6.6	6.8
Wholesale and retail trade, hotels and restaurants	3,295	4,841	7,279	8.0	8.5	8.2	12.6	12.8	12.8
Finance, insurance, real estate and business services	2,155	3,079	4,629	7.4	8.5	7.9	8.2	8.1	8.2
Government services	3,398	5,228	8,044	9.0	9.0	9.0	13.0	13.8	14.2
Other services	657	948	1,459	7.6	9.0	8.3	2.5	2.5	2.6
Less: imputed bank service charges	308	1,092	1,900	–	–	–	1.2	2.9	3.3
Plus import duties	1,120						4.3		
Equals: GDP at purchaser's value	26,188	37,824	56,760	7.6	8.5	8.0	100.0	100.0	100.0

Source: FMP

III-1-3 The construction sector

(1) The last decade

The value added in this sector recorded a rapid increase of 9.6% per annum, and share in GDP at factor cost of 3.9% in 1970 increased to 4.5% in 1980, largely due to the construction boom between 1976 and 1980 in response to demand for housing which rose rapidly, aided by mortgage and real estate markets. (cf. p.16 FMP)

Non-residential construction also increased significantly resulting from the implementation of major public sector infrastructural projects and construction investment associated with private sector manufacturing activities.

For reference the elasticity of cement demand against growth of the value added in the construction sector during 1970s is 1.29.

(2) The present decade

Construction sector will expand at 9.5% per annum which is slightly less than 9.6% during the last decade.

Measures will be taken to lower the cost of dwelling units through curbing speculation in real estate transactions, improving administrative procedures, and encouraging adequate supplies of construction materials and skilled labor. Research into cost reducing methods of construction will also be undertaken.*1

(3) FMP period

The value added in this sector is projected to increase at the average annual rate of 9% (cf. TMP 12.6%), because there will be decline in non-residential and engineering construction attributed to the public sector during FMP.

However, this decline is expected to be somewhat offset by the rapid expansion in construction by the private sector, in which the major source of growth will be related to the demand for non-residential buildings as a result of the expansion of the manufacturing and services sectors*2.

The demand for housing will continue to accelerate and receive priority attention by Government. While the magnitude of the housing problems will be sizable, priority will be given to expanding the supply of low-cost housing units. There will be expansion of Government resources to the public sector housing agencies and the state government to increase the supply of low cost houses, including provision of adequate incentives for house ownership and substantial loans.

Residential construction demand in the private sector will continue to be substantial in view of the encouragement given to home ownership and the relatively easy access to housing loans provided by both private and public sector institutions. There will be total residential building of 923.3 thousand constructed, of which 56.8% is to be done by the private sector*2.

In addition the expansion of infrastructure facilities and various projects in the social sector, such as education and health will generate additional demand for investment in the private sector.

However, there is a concern about the rising cost of construction materials and skilled labor. More efforts will be made to improve the supply of building materials through expansion of domestic production capacity and imports, and to increase the supply of labor through additional training facilities[*4].

*1. FMP, cf. p. 165~166
*2. Ibid, cf. p. 165
*3. Ibid, cf. p.223
*4. Ibid, cf. p.254

III-2 The Cement Industry

III-2-1 General

This industry's growth of the value added and its share in the total manufacturing during the last decade is as follows.

	1971 ~ 75	1976 ~ 80	1971 ~ 80
Average Annual Growth of the Value Added (%)	7.0	15.2	10.0
	1970	1975	1980
Share in Total Manufacturing (%)	5.4	4.9	5.2

(Source: p.294, FMP)

As FMP points out the growing demand for building materials to meet the public and private sector construction programs will require expanded domestic supplies of these materials, and considerable emphasis will be placed on the expansion of industries related to the manufacture of construction materials.*1

Moreover, from the viewpoint of increasing productivity, efforts are being made to promote the capital-intensive industries, and the Heavy Industries Corporation Malaysia Berhad (HICOM) is established. A number of projects including iron and steel, aluminum and cement plants as well as an encouraging servicing complex are potential industries for promotion during FMP.*2

The growth of the value added in the cement industry is estimated to be at the average annual rate of 13.0% during FMP period which is higher than 11% of the total manufacturing sector.*3

III-2-2 Demand and supply situation

(1) Cement consumption up to 1980

As shown in the Table III-2-1, which is made on Tables III-2-1 and III-2-2, consumptions of cement in Malaysia and Peninsular Malaysia in 1980 were 3,050.4 thousand metric tons and 2,608.4 thousand metric tons respectively. The cement consumption in Malaysia has grown at an average rate of 8.8% per annum during the period between 1962 and 1970, and 12.4% per annum during the period of 1971 and 1980. While the consumption in Peninsular Malaysia has grown at an average rate of 10.0% per annum between 1961 and 1970, and 12.1% per annum during the period between 1971 and 1980. Malaysia's cement consumption has grown at higher rate than that of Peninsular Malaysia in the last decade which is due to the faster growth of cement consumption in the East Malaysia.

The per capita cement consumption in Malaysia has grown at an average annual rate of 5.8% between 1962 and 1970, and 9.3% during the period between 1971 and 1980. In Peninsular Malaysia the per capita cement consumption growth during the period between 1961 and 1970, and between 1971 and 1980 are at an average annual rates of 7.4% and 8.8%, respectively. Here again the per capita consumption of cement in Malaysia has grown faster than that in Peninsular Malaysia due to the above same reason. And in 1980 the per capita consumption in Malaysia has reached 97.2% of that in Peninsular Malaysia.

*1 FMP, cf. p. 164
*2 Lbid, cf. p. 208, p. 300
*3 Ibid, cf. pp. 251 ~252

Table III-2-1 Cement Consumption in Malaysia, 1960 ~ 1980

		Consumption ('000M/T)		Per Capita Consumption (kg)	
		Malaysia	Peninsular Malaysia	Malaysia	Peninsular Malaysia
Year	1960		321.7		46.5
	1961	442.8		52.9	
	1965	740.6	657.1	78.6	81.7
	1970	946.3	834.3	87.8	95.1
	1975	1,821.3	1,583.2	152.8	158.4
	1980	3,050.4	2,608.4	213.9	220.1
Average Growth Rate Per Annum (%)	1961 ~ 1965	13.7*1	15.4	10.4*1	11.9
	1966 ~ 1970	5.0	5.0	2.2	3.1
	1961 ~ 1970	8.8*2	10.0	5.8*2	7.4
	1971 ~ 1975	14.0	13.7	11.7	10.7
	1976 ~ 1980	10.9	10.5	7.0	6.8
	1971 ~ 1980	12.4	12.1	9.3	8.8

*1 1962 – 1965
*2 1962 – 1970

(2) Cement supply up to 1980.

There have been five portland cement manufacturers in Malaysia, one of which is the grinding mill (CMS) located in Sarawak and the remaining four are located in Peninsular Malaysia.

As shown in Table III-2-2, which is made on Tables III-2-3 and III-2-4, the cement production in Peninsular Malaysia grew at 20.8% per annum between 1961 and 1965, and at 7.0% between 1966 and 1970, showing the average annual growth rate of 13.7% for the decade of 1960s, which also applies to Malaysia, because there was no cement production in East Malaysia.

The growth rates of cement production in both Malaysia and Peninsular Malaysia between 1971 and 1975 were 7.0% per annum, respectively. The growth rate in Malaysia between 1976 and 1980 was 12.5% per annum mainly due to CMS's starting operation during the period and that for Peninsular Malaysia was 10.2%. The average growth rate for the decade of 1970s was 9.7% for Malaysia and 8.6% for Peninsular Malaysia.

In Peninsular Malaysia there has been long delay of implementation by the two approved projects – Simen Perak and Pahang Cement. Expansion of 1.2 million tpy plant by APMC at Rawang was completed in December, 1980. However, due to technical problems, it is only in July, 1981 when it went on stream.

Table III-2-2 Cement Production in Malaysia, 1960 ~ 1980

(In '000 M. Tons)

		Malaysia	Peninsular Malaysia
Year	1960	286.4	286.4
	1965	737.8	737.8
	1970	1,029.5	1,029.5
	1975	1,445.7	1,445.7
	1980	2,607	2,349
Average Growth Rate per Annum (%)	1961 ~ 1965	20.8	20.8
	1966 ~ 1970	7.0	7.0
	1961 ~ 1970	13.7	13.7
	1971 ~ 1975	7.0	7.0
	1976 ~ 1980	12.5	10.2
	1971 ~ 1980	9.7	8.6

(3) Demand and supply balance up to 1980

As shown in Table III-2-3 the consumption of cement in Malaysia has always exceeded production since 1961 and the gap has been filled by import. The Malaysia's export of cement has been virtually negligible. While the import which accounted for some 43% of the total consumption (the domestic consumption plus export) in 1962 has kept decreasing since then year by year and the lowest level was some 21,100 tons (2.0%) in 1970. But it has kept increasing again since 1971, up to some 443 thousand tons (14.5% of consumption) in 1980, with exception between 1976 and 1979, during which there was increase in production capacities in East Malaysia. However, it should be noted that the clinker which was ground by CMS was not counted as the cement import as far as statistics is concerned. Therefore, in other words the import of both clinker and cement has kept increasing since 1971.

In Peninsular Malaysia the situation is somewhat different from Malaysia as a whole. During 1960 and 1970 the export has generally kept increasing up to some 202 thousand tons, while the import has generally kept decreasing up to some 6 thousand tons. During the period between 1971 and 1973 Peninsular Malaysia's production and consumption was virtually balanced. However, since 1974 both the import and export have kept increasing, though the amount of import has almost always been larger than the export. In other words in Peninsular Malaysia the cement has been of short supply since 1974, which was aggravated by so long delay of implementation by the approved projects.

Table III-2-3 Cement Consumption in Malaysia, 1960 ~ 1980

(In '000 M/T)

Year	Production*	Import	Export	Domestic Consumption	Population ('000)	Per Capita Consumption (kg)
1960	286.4				8,133	
1961	330.8	138.7	26.7	442.8	8,369	52.9
1962	325.6	243.6	2.3	566.9	8,633	65.7
1963	361.7	261.3	5.3	617.7	8,915	69.3
1964	465.5	272.1	4.8	732.8	9,155	80.0
1965	737.8	94.8	92.0	740.6	9,421	78.6
1966	783.9	86.4	153.3	717.0	9,725	73.7
1967	898.6	41.9	265.9	674.6	10,024.8	67.3
1968	937.3	49.5	236.4	750.4	10,313.2	72.8
1969	973.4	27.9	90.1	911.2	10,152.7	89.7
1970	1,029.5	21.1	104.3	946.3	10,776.9	87.8
1971	1,095.5	72.4	61.6	1,106.3	10,695.4	103.4
1972	1,160.3	137.1	14.3	1,283.1	11,003	116.6
1973	1,277.9	164.4	0.3	1,442.0	11,309	127.5
1974	1,363.9	263.7	0.7	1,626.9	11,607	140.1
1975	1,445.7	379.2	3.6	1,821.3	11,922	152.8
1976	1,739.3	263.8	0.1	2,003.0	12,236	163.7
1977	1,776.8	268.7	5.1	2,040.4	12,563	162.4
1978	2,266.5	158.8	2.8	2,422.5	12,949	187.1
1979	2,445**	289.4*	–	2,734.4	13,244	206.5
1980	2,607**	443.4*	–	3,050.4	14,261.2	213.9

* Including cement production by CMS

** Preliminary

Sources: Malaysia, Dept. of Statistics, Monthly Statistical Bulletin, West Malaysia.
Malaysia, Dept. of Statistics, Malaysia Annual Statistics of External Trade.

Table III-2-4 Cement Consumption in Peninsular Malaysia, 1960 ~ 1980

(In '000 M/T)

Year	Production	Import	Export	Domestic Consumption	Population ('000)	Domestic Consumption Per Capita (Kg)
1960	286.4	46.4	11.1	321.7	6,909.0	46.5
1961	330.8	94.1	28.3	396.6	7,136.8	55.6
1962	325.6	199.3	2.2	522.7	7,337.3	71.2
1963	361.7	200.6	5.6	556.7	7,610.8	73.1
1964	465.5	172.6	4.7	633.4	7,813.8	81.1
1965	737.8	11.1	91.8	657.1	8,039.0	81.7
1966	783.9	5.3	158.0	631.2	8,297.8	76.1
1967	898.6	2.1	306.8	593.9	8,540.1	69.5
1968	937.3	1.0	292.4	645.9	8,788.7	73.4
1969	973.4	3.0	181.4	795.0	8,583.6	92.6
1970	1,029.5	6.4	201.6	834.3	8,774.6	95.1
1971	1,095.5	4.9	155.2	945.2	9,017.9	104.8
1972	1,160.3	14.5	48.7	1,126.1	9,262.7	121.6
1973	1,277.9	11.8	43.1	1,146.6	9,502.1	120.7
1974	1,363.9	21.3	8.4	1,376.8	9,742.2	141.3
1975	1,445.7	141.1	3.6	1,583.2	9,997.3	158.4
1976	1,739.3	64.1	31.6	1,771.8	10,242.4	173.0
1977	1,776.8	100.6	44.0	1,833.4	10,510.1	174.4
1978	2,196.5	67.6	77.9	2,186.2	10,761.6	203.1
1979	2,265	165.4	67.1	2,363.3	11,088	213.1
1980	2,349	321.4	62.0	2,608.4	11,849	220.1

Sources: Malaysia, Dept. of Statistics, Monthly Statistical Bulletin, West Malaysia
Malaysia, Dept. of Statistics, Annual Statistics of External Trade, West Malaysia

However, with completion of 1.2 million tpy capacity in APMC's Rawaing Plant in 1980, the rated production capacity in Peninsular Malaysia became 3.76 million tons, making the actual capacities in 1981 and the following year 2.76 and 3.38 million tons respectively, and the demand is estimated by MIDA some 2.99 million tons in 1981 (cf. Tables III-2-6 and III-2-14).

III-2-3 Demand and supply forecast by Malaysian Government and the Industry

(1) Forecast by the Government

The Projected Supply and Demand of Portland Cement in Peninsular Malaysia prepared by MIDA, are shown from Table III-2-5 to III-2-11. In this projection it is estimated that the cement demand will grow at the average annual rate of 15% from 1981 to 1988. As for the supply and the consequent balances of supply and demand are estimated in three cases as follows:

Case I: It is assumed that the three approved projects and one new project will start operation as early as possible—no later than 1984. (Perak Halla, Pahang Cement, Simen Perak, and Kedah Cement)

Then there will be over supply of some 1.4 ~ 1.2 million tons in 1984 and 1985 because Simen Perak and Kedah Cement are assumed to start operation at the same time im 1984. However, if there were some export considered, amounting to about 10% or some more of the total consumption (domestic consumption plus export), the surplus would naturally become less by that amount. During the rest years there will always be shortage of supply.

Case II: It is assumed that two approved projects, such as Perak Halla and Pahang Cement, and a new project, Kedah Cement will be implemented in 1984, 1986 and 1984 respectively, while the project of Simen Perak will be written off.

Then there will be over supply of cement in 1985 and the previous 1984 when two projects start at the same time. However, the amount of over supply is less than 10% of the consumption. Therefore if we consider some export, accounting for some 10% of the total consumption, it may be said that there will be virtually no over supply or, rather there will always be shortage of cement.

Case III: Assumptions are that the two out of three approved projects will be implemented with one written off and there will be one new comer as in Case II, and that two existing cement manufacturers will make expansion (Tasek 1.5 million, CIMA 1 million tons in 1983) and that Kelantan Cement (provisional) will be newly approved and started in 1986.

Then the balance will be that from 1984 to 1987 there occurs over supply amounting to some 2.5 ~ 2.8 million tons, which will be too big to consume for export.

Table III-2-5 Peninsular Malaysia: Domestic Consumption of Portland Cement 1974 ~ 1980

(In '000 M/T)

Year	Production	Import	Export	Domestic Consumption	% Change in Consumption
1974	1,364	21	8	1,377	—
1975	1,446	139	4	1,581	+14.8%
1976	1,739	63	31	1,771	(+12.0%)
1977	1,777	99	43	1,833	(+3.5%)
1978	2,196	68	78	2,186	(+19.3%)
1979	2,264	165	67	2,362	12.0% (+ 8.0%) +10.6%
1980	2,354	316	68	2,602	(+10.2%)

Table III-2-6

Case I: Peninsular Malaysia: Projected Supply and Demand of Portland Cement

(Best possible supply situations with Perak Halla, Pahang Cement, Simen Perak and Kedah Cement come on stream as scheduled.)

(In '000 M/T)

Year	Demand*(A)	Supply**(B)	Balance (B – A)
1981	2,992	2,760	Δ 232
1982	3,441	3,380	Δ 61
1983	3,957	4,400	443
1984	4,551	5,930	1,379
1985	5,233	6,440	1,207
1986	6,018	6,440	422
1987	6,921	6,440	Δ 481
1988	7,959	6,440	Δ1,519

* Based on 15% annual growth.

** Export conditions totally relaxed.

Table III-2-7

Case I: Peninsular Malaysia: Projected Supply of Portland Cement 1981 ~ 1988

(Export conditions totally relaxed)

(In M/T)

Year	Existing 4 Manufacturers	APMC Expansion	Perak Halla	Pahang Cement	Simen Perak	Kedah Cement	Total
1981	2,400,000	360,000 (60%)	–	–	–	–	2,760,000
1982	2,300,000	1,080,000 (90%)	–	–	–	–	3,380,000
1983	2,300,000	1,080,000	720,000 (60%)	300,000 (60%)	–	–	4,400,000
1984	2,300,000	1,080,000	1,080,000 (90%)	450,000 (90%)	300,000 (60%)	720,000 (60%)	5,930,000
1985	2,300,000	1,080,000	1,080,000	450,000	450,000 (90%)	1,080,000 (90%)	6,440,000
1986	2,300,000	1,080,000	1,080,000	450,000	450,000	1,080,000	6,440,000
1987	2,300,000	1,080,000	1,080,000	450,000	450,000	1,080,000	6,440,000
1988	2,300,000	1,080,000	1,080,000	450,000	450,000	1,080,000	6,440,000

Figures in brackets denote capacity utilization.

Table III-2-8

Case II: Peninsular Malaysia: Projected Demand & Supply of Portland Cement, 1981 ~ 1988

(In '000 M/T)

Year	Demand*(A)	Supply**(B)	Balance (B – A)
1981	2,992	2,760	Δ 232
1982	3,441	3,380	Δ 61
1983	3,957	3,380	Δ 577
1984	4,551	4,820	269
1985	5,233	5,540	307
1986	6,018	5,840	Δ 178
1987	6,921	5,990	Δ 931
1988	7,959	5,990	Δ 1,969

* Based on 15% annual growth.

** Export condition totally relaxed.
Perak Halla Cement comes on stream in 1984.
Pehang Cement comes on stream in 1986.
Kedah Cement comes on stream in 1984.
Simen Perak is written off as a non-starter.

Table III-2-9

Case II: Peninsular Malaysia: Projected Supply of Portland Cement, 1981 ~ 1988

(Export conditions totally relaxed)

(In M/T)

Year	Existing 4 Manufacturers	APMC Expansion	Perak Halla	Pahang Cement	Kedah Cement	Total
1981	2,400,000	360,000 (60%)	–	–	–	2,760,000
1982	2,300,000	1,080,000 (90%)	–	–	–	3,380,000
1983	2,300,000	1,080,000	–	–	–	3,380,000
1984	2,300,000	1,080,000	720,000 (60%)	–	720,000 (60%)	4,820,000
1985	2,300,000	1,080,000	1,080,000 (90%)	–	1,080,000 (90%)	5,540,000
1986	2,300,000	1,080,000	1,080,000	300,000 (60%)	1,080,000	5,840,000
1987	2,300,000	1,080,000	1,080,000	450,000 (90%)	1,080,000	5,990,000
1988	2,300,000	1,080,000	1,080,000	450,000	1,080,000	5,990,000

Figures in brackets denote capacity utilization.

Table III-2-10

Case III: Peninsular Malaysia: Projected Demand & Supply of Portland Cement, 1981 ~ 1988

(In '000 M/T)

Year	Demand*(A)	Supply**(B)	Balance (B – A)
1981	2,992	2,760	Δ 232
1982	3,441	3,380	Δ 61
1983	3,957	4,130	173
1984	4,551	7,070	2,519
1985	5,233	7,790	2,557
1986	6,018	8,810	2,792
1987	6,921	9,320	2,399
1988	7,959	9,320	1,361

* Based on 15% annual growth.

** Export condition totally relaxed.
Perak Halla Cement comes on stream in 1984.
Pahang Cement comes on stream in 1986.
Tasek Cement's expansion comes on stream in mid-1983.
CIMA's expansion comes on stream in mid-1983.
Kedah Cement comes on stream in 1984.
Kelantan Cement comes on stream in 1986.
Simen Perak fails to take off the ground.

Table III-2-11

Case III: Peninsular Malaysia: Projected Supply of Portland Cement, 1981 ~ 1988

(Export conditions totally relaxed)

(In '000 M/T)

Year	Existing 4 Manufacturers	APMC Expansion	Perak Halla	Pahang Cement	Tasek Expansion	CIMA Expansion	Kedah Cement	Kelantan Cement	Total
1981	2,400	360 (60%)	–	–	–	–	–	–	2,760
1982	2,300	1,080 (90%)	–	–	–	–	–	–	3,380
1983	2,300	1,080	–	–	450 (60%)	300 (60%)	–	–	4,130
1984	2,300	1,080	720 (60%)	–	1,350 (90%)	900 (90%)	720 (60%)	–	7,070
1985	2,300	1,080	1,080 (90%)	–	1,350	900	1,080 (90%)	–	7,790
1986	2,300	1,080	1,080	300 (60%)	1,350	900	1,080	720 (60%)	8,810
1987	2,300	1,080	1,080	450 (90%)	1,350	900	1,080	1,080	9,320
1988	2,300	1,080	1,080	450	1,350	900	1,080	1,080	9,320

Figures in brackets denote capacity utilization.

(2) Forecast by the Cement Industry

The opinions of the existing cement manufacturers are that the cement demand will grow at the average rate of 10 ~ 12% per annum. If this estimate is applied for each of the three supply cases mentioned above the balance will naturally be that there will be more over supply than the Government estimate, which are shown in Table III-2-12.

Table III-2-12 Projected Supply and Demand of Cement in Peninsular Malaysia (In case the Cement Industry's estimate of demand is adopted.) (In '000 M/T)

Year	Demand (A)	Case I		Case II		Case III	
		Supply (B)	Balance (B–A)	Supply (C)	Balance (C–A)	Supply (D)	Balance (D–A)
1981	2,914	2,760	△ 154	2,760	△154	2,760	△ 154
1982	3,264	3,380	116	3,380	116	3,380	116
1983	3,656	4,400	744	3,380	△276	4,130	474
1984	4,095	5,930	1,835	4,820	725	7,070	2,975
1985	4,586	6,440	1,854	5,540	954	7,790	3,204
1986	5,136	6,440	1,304	5,840	704	8,810	3,674
1987	5,752	6,440	688	5,990	238	9,320	3,568
1988	6,442	6,440	△ 2	5,990	△452	9,320	2,878

Note: Demand is assumed to grow at the average annual rate of 12%.

III-2-4 Demand

(1) Demand by type of cement

According to the information from the existing manufacturers, most (90% or more) of the cement consumed is the ordinary portland cement which meets the British Standard, the rest of the cement consists of the Masonry Cement, the Rapid Hardening Cement and the White Cement which is not included in the statistics.

(2) Consumption by state

The cement consumption by state in 1980 is as shown in Table III-2-13.

Table III-2-13 Consumption of Cement by State 1979 ~ 1980

State		Consumption of Cement (In '000 M/T)			
		1979	1980		Per Capita (kg) 1980 (Adjusted)
				Adjusted	
Peninsular Malaysia	Perlis	22	31	32	203
	Penang	232	260	271	279
	Kedah	98	120	125	107
	Perak	372	398	416	222
	Selangor	873	951	993	388
	Negeri Sembilan	86	110	115	192
	Malacca	61	71	74	153
	Johore	182	225	235	138
	Pahang	111	132	138	168
	Trengganu	41	82	86	149
	Kelantan	83	118	123	132
	Sub Total	2,161	2,498	2,608	220
East Malaysia		250	256	442	183
Total		2,411	2,754	3,050	214

Note: The MTI's statistics does not include the import done by those who are not cement manufactures.
In 1980 the Adjusted Cement Consumption by State in Peninsular Malaysia was calculated as pro rata of the MTI's statistics so that it coincides with the total consumption in Peninsular Malaysia shown in Table III-2-4.
Source: MTI

In the adjusted figures in 1980 the cement consumption in Selangor is highest (993 thousand tons) and the per capita consumption is also highest (388 kg). The second biggest consumption is in Perak (416 thousand tons) and the per capita consumption there is 222 kg. With Penang added these three western states account for some 64% of total consumption in Peninsular Malaysia.

In the eastern coast states — Kelantan, Trengganu and Pahang, the total consumption accounts for some 13% of that in Peninsular Malaysia, and the per capita consumptions are 132, 149 and 168 kg respectively, all of which are lower than the average of Peninsular Malaysia (220 kg). In East Malaysia the per capita consumption is 183 kg which is some 86% of that in Malaysia.

(3) Consumption by field of application

There is no statistics available concerning the cement consumption by field of application.

(4) Consumption by type of packaging

According to the informations from the existing manufacturers about 87% of the total cement consumed in 1980 within Malaysia were packed in the bag, which contains 50 kg net in a unit, though the percentage of the bagged cement at the point of ex-factory is 56% as shown in Table III-2-16.

In Peninsular Malaysia the percentages of the bagged cement at the stage of delivered and the ex-plant were 86% and 51% respectively. There was one estimate obtained from one big manufacturer that percentage of bulk cement at delivered base will reach 24 ~ 25% in the near future.

It is understood that in Eastern Malaysia there is no bulk cement. In Peninsular Malaysia there are five packing depots and four or five independent ready mixed concrete companies and several secondary product companies to which the cement are shipped in bulk. The fact that the cement is delivered in bulk to those packing depot is the reason why the percentage of the bulk cement at the stage of ex-plant becomes higher.

(5) Preference of the brand

As far as we have checked, APMC's and Tasek's cement are very popular all over Peninsular Malaysia and the comments on them were generally good with respect to the quality and delivery. It is hard to tell which of the two brands are better. CIMA's cement was less popular mainly due to its smaller production and sales area are rather limited. However, their reputation was also very good. Little were known about MIMC's cement, because its production is very small and is delivered mostly to the captive market. Therefore, it is to be concluded that the customer's preference for the first three brands are more or less same.

III-2-5 Supply

As mentioned there are now five portland cement manufacturers in Malaysia, one of which is the grinding mill in East Malaysia and the rest four are located in western states in Peninsular Malaysia. The four companies are now operating five plants. Besides, there are three old approved projects, two newly approved projects (September, 1981) and two approved expansions. The name of the company, the location of plant, the capacity (registered and actual), the process, the brand name and others are shown in Table III-2-14, Fig. III-2-1 and Fig. III-2-2.

III-2-6 Import and export of cement

(1) Import

As shown in Table III-2-15 most of the cement imported into Malaysia in 1978 came from Japan, Philippines, Singapore and Taiwan. The packaging was bag. The average import price was some M$127 C&F per metric ton.

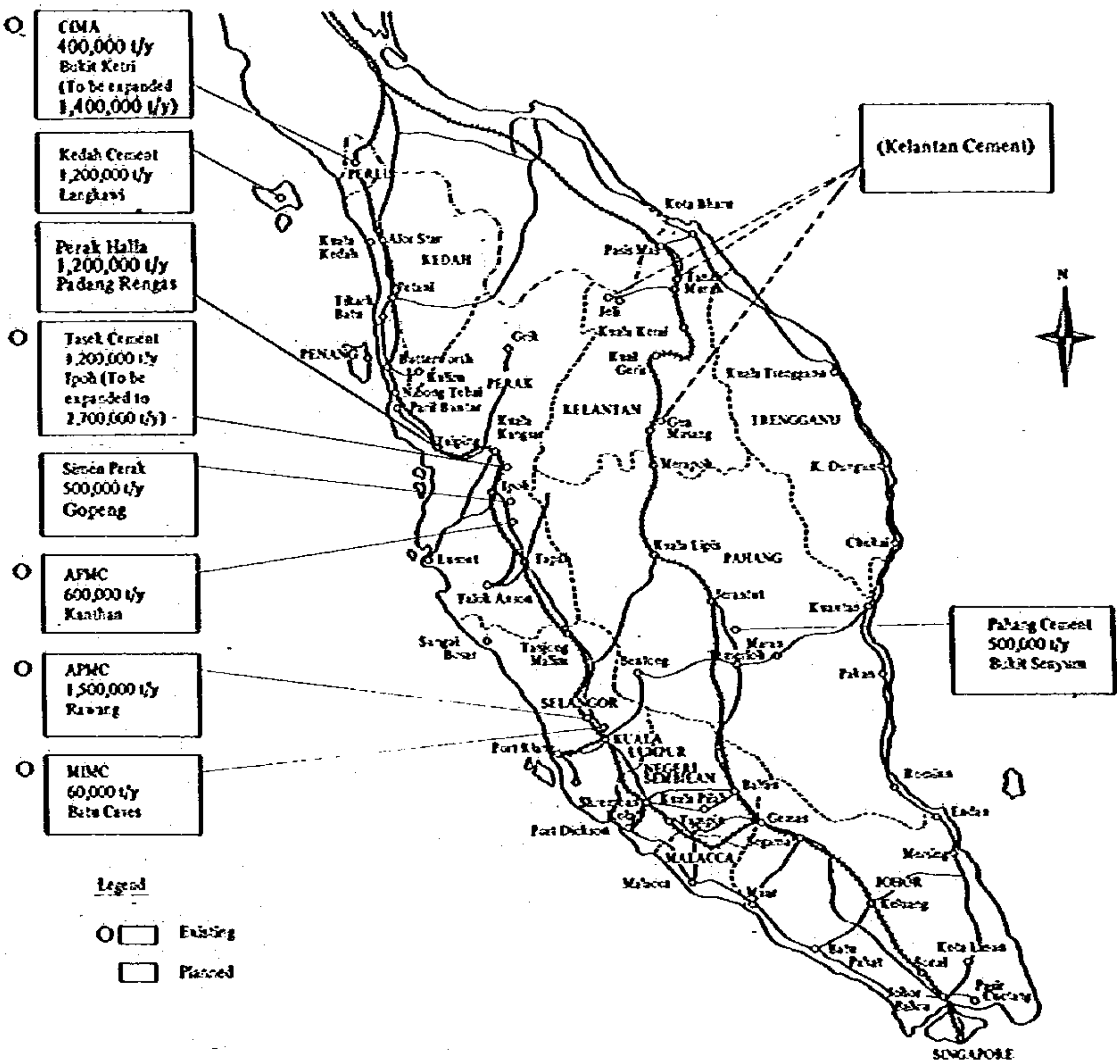
Though there were import of clinker from Japan and Korea in 1978 amounting to some 62,600 tons, these were not counted as the cement import in Tables III-2-3 and 4, because

Table III-2-14 Informations Concerning Existing Cement Manufacturers and New Projects

Manufacturer	Location of Plant	Start of Production	No. of Kiln	Process	Machinery	Rated Capacity 1980	Rated Capacity 1981	Rated Capacity 1982	New Project Approved	New Project Approved in 1981	Type of Cement Produced	Brand Name	Note
Associated Pan Malaysia Cement Sdn. Bhd. (APMC)	Rawang, Selangor	1953	2	Rotary Wet	Allis-Chalmer	300	300	300			OPC Masonry (120 thousand ton per year)	Hariman (Tiger) Rumah (House)	Joint venture between Malayan Cement Bhd. (Affiliate company of Blue Circle) and PMCW Expansion approved in 1978 without tax incentive with 50% export condition
		1981	1	NSP	IHI		1,200	1,200					
	Kanthan, Perak	1964	2	Rotary Wet	Allis-Chalmer	600	600	600					
	Sub Total		5			900	2,100	2,100					
Tasek Cement Bhd.	Ipoh, Perak	1964	3	SP	Polysius Kobe Steel	1,200	1,200	1,200		1,500	OPC, Masonry, Rapid Hardening	Loceng (Bell) Crocodile Kaki (Foot)	Expansion to 1.2^{MM} tons approved in 1973 without tax incentive. Export condition 20%. Expansion of 1.5^{MM} tpy approved in Sept., 1981, with export condition of 50%. No tax incentive.
Malaya Industrial and Mining Corp. Bhd. (MIMC)	Batu Caves, Selangor	1951	1	Lepol	Polysius	60	60	60			OPC		Approved in 1968 without tax incentive
Cement Industries of Malaysia Bhd. (CIMA)	Bukit Ketri, Perlis	1973	1	SP	KHD	400	400	400		1,000	OPC	Lion	Export condition of 50%, Expansion of 1^{MM} tpy approved in Sept., 1981 with export condition of 50%. No tax incentive.
Cement Manufacturers Sarawak Sdn, Bhd. (CMS)	Kuching, Sarawak	1977			F.L. Smidth	(432)	(432)	(432)		440*	OPC		Approved in 1973 as Pioneer. Joint venture between Sarawak and Sabah. Clinker grinding, Started in 1978. Clinker manufacturing plant approved in Jun., 1981 for Sarabah Cement (J.V. between Sarawak and Sabah.)
Simen Perak Sdn. Bhd.	Gopeng, Perak								500		OPC		Approved in 1974 without tax incentive with export condition of 50%, No positive progress
Pahang Cement Sdn. Bhd.	Bukit Senyum, Pahang								500		OPC		Approved in 1975 without tax incentive with export condition of 50% Joint venture (Pernas, Pahang, La Farge)
Perak Halla Cement Sdn. Bhd.	Padang Rengas, Perak			(NSP)					1,200		OPC		Approved in 1979 without tax incentive with export condition of 50% Joint venture (Perak State Gov't and Hyundai International)
Kedah Cement Sdn. Bhd.	Langkawi, Kedah			(NSP)	(IHI)					1,200	OPC		Approved in Sept., 1981 with export condition of 50%, Investment tax credit of 25%, Joint venture [HICOM 50%, Kedah State Gov't 30%, Singapore Gov't 10%, Japanese (Kawasho Corp., IHI, Sumitomo Cement) 10%]
				Rated Capacity Total		(432) 2,560	(432) 3,760	(432) 3,760	2,200	(440)* 3,700			
				Actual Capacity Estimated		(400) 2,400	(400) 2,760	(40[illegible]) 3,380	1,980	(400)* 3,330			

Note 1: Figures in the parentheses denote the clinker grinding capacity, which are not included in the total, and this is to be replaced by figures marked with *, once it is completed.
2: Rated and Actual capacities are MIDA's. (cf. Table III-2-5 ~ III-2-11)

Fig. III-2-1 Location of Existing and Planned Cement Plant in Peninsular Malaysia



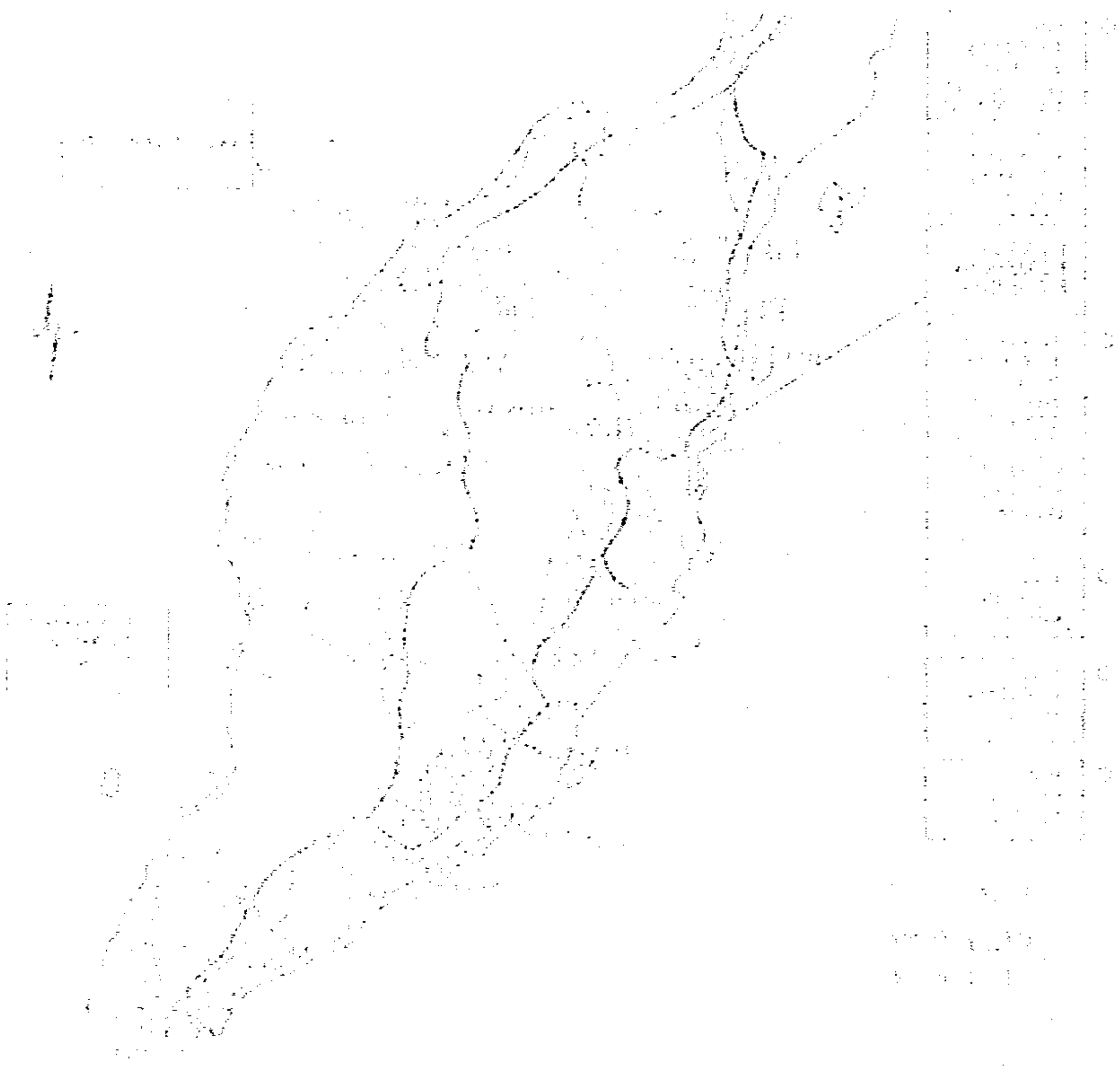


Fig. III-2-2 Location of Existing and Planned Cement Plant in East Malaysia

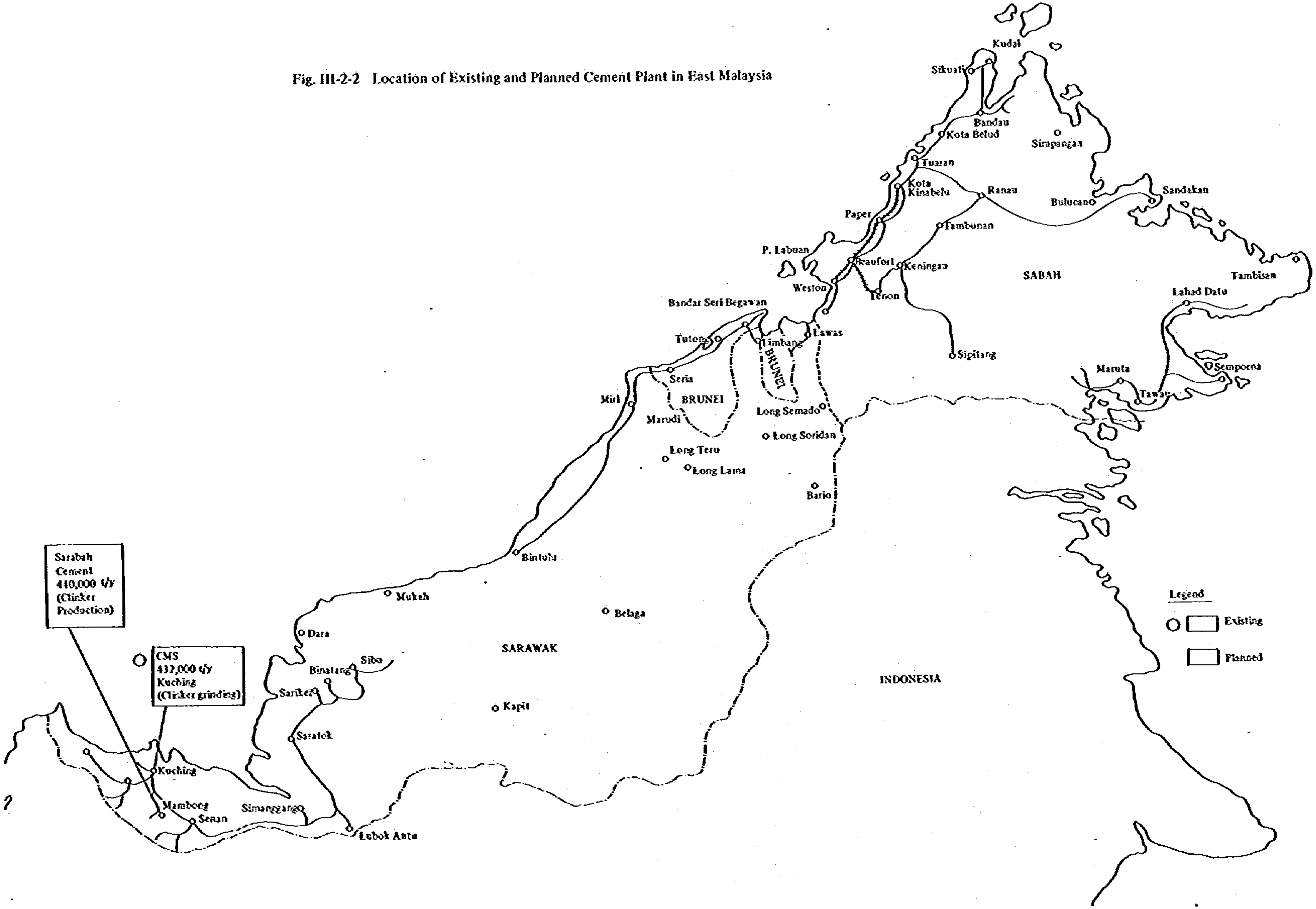


Table III-2-15 Import and Export of Cement To and From Malaysia and Peninsular Malaysia

(In M/T)

Import

	Source \ Year	Malaysia 1978	Peninsular Malaysia 1978	Peninsular Malaysia 1979	Peninsular Malaysia 1980	Peninsular Malaysia 1981 (Jan-Jun)
	Japan	39,036		117		
	Korea	1,400			438	
	Philippines	17,681				
	Singapore	69,982	67,063	164,102	319,649	167,898
	Taiwan	30,248				
	Others	471	571	1,228	1,295	529
	Total	158,818	67,634	165,447	321,382	168,427
	(M$/t)	(M$127.29)	($123.84)	(M$129.53)	(M$133.54)	(M$149.52)
Clinker	Japan	46,300				
Clinker	Korea	16,287				
Clinker	Singapore				733	8,936
Clinker	Taiwan				1,548	
Clinker	Others					
Clinker	Total	62,587		10	2,281	8,936
Clinker	(M$/t)	(M$80.91)		(M$360.00)	(M$104.10)	

Export

	Destination \ Year	Malaysia 1978	Peninsular Malaysia 1978	Peninsular Malaysia 1979	Peninsular Malaysia 1980	Peninsular Malaysia 1981 (Jan-Jun)
	Thailand			59,118	61,991	
	Brunei	640				
	Indonesia	2,048	2,045			
	Singapore	102	102			
	Sabah		34,934	7,925		
	Sarwak		40,775			
	Others			104	48	9
	Total	2,790	77,856	67,147	62,039	9
	(M$/t)	(M$97.76)	(M$112.02)	(M$101.45)	(M$100.85)	(M$414.15)
Clinker	Singapore	10,648	10,648	4,828		
Clinker	(M$/t)	(M$71.12)	(M$71.12)	(M$118.93)		

Sources: Malaysia, Dept. of Statistics
Annual Statistics of External Trade, Malaysia
Annual Statistics of External Trade, Peninsular Malaysia

CMS's cement production by grinding clinker was counted as the cement production.

Most of the cement imported into Peninsular Malaysia between 1978 and 1980 came from Singapore by rail or lorry. The average C&F import prices were some M$124 in 1978, M$130 in 1979, M$134 in 1980 and M$150 in 1981.

Very small amount of clinker was brought into Peninsular Malaysia between 1979 and 1981. However, these were not counted as the cement import due to the same reason as mentioned above.

(2) Export

The export of the cement from Malaysia in 1978 was very little. Only some 2,000 tons were brought to Indonesia. The average export price was some M$98 FOB.

Some 10,600 tons of clinker were exported to Singapore, by rail and lorry in 1978. The average price was M$71. Again this was not counted as the cement export, because the clinker for export was not counted as the cement production.

From Peninsular Malaysia some 75,700 tons were exported to East Malaysia which accounted for almost all of the cement exported in 1978. The average price was some M$112 FOB. In 1979 and 1980 there were no cement exported to East Malaysia. Most export cement were brought to Thailand when there were much import done by that country. The average export prices were M$101 in 1979 and also M$101 in 1980.

The clinker export of some 11,000 tons in 1978 and 5,000 tons in 1979 were destined to Singapore, though there was no export to there in 1980. The average export prices were some M$71 in 1978 and M$119 in 1979. As there is much price increase between 1978 and 1979, it may be suspected that some special type cement clinker was exported in 1979. Again due to the above reason the clinker was not counted as export of cement.

(3) Governmental policies on import and export.

Generally speaking it seems to be the policy of the Malaysian Government to substitute the import, while encouraging the export. However, when it comes to the cement, the import is expected to be substituted by their own product, but the export is not expected much as a means of earning the foreign exchange.

Both the import and export have to be approved by Government upon application considering the demand and supply situation in the country – it is more important to secure enough supply of the cement within the country.
However, as there is short of supply, virtually the cement import is free and the export is prohibited at present.

In Peninsular Malaysia there used to be 5% of surtax levied on the imported cement. However, it was lifted in March, 1981. In East Malaysia there used to be M$17 per metric ton of the import tax, and 5% of the surtax imposed on the imported cement, which were changed to M$15 per metric ton, and 5% respectively in October, 1981.

On the other hand the export of cement can not be realized unless it is specially permitted by the Government upon application, because there is short of cement at present. The export duty used to be 5%, but was lifted in October, 1981.

III-2-7 Means of transportation

As shown in Table III-2-16 it is estimated that within total Malaysia the proportions of shipment by rail, lorry and vessel in 1980 at the ex-plant basis were some 35%, 58%, 7% respectively. The first figure consists of 8% in bag and 27% in bulk, the second 40% in bag and 18% in bulk, and the third is all in bag.
On the delivered base some 9% is by rail and 91% by lorry. The former 9% is in bag and the latter consists of 78% in bag and 13% in bulk.

In Peninsular Malaysia some 39% of the cement shipped at the stage of ex-plant is by rail and 61% by lorry. The former figure consists of some 10% in bag and 29% in bulk, and the latter figure consists of some 41% in bag and 20% in bulk.
On the delivered base some 9% is by rail and some 91% is by lorry. The former is in bag and the latter consists of some 77% bag and 14% bulk.

The wagons which are used for the transportation of the bagged cement by rail are 15^t (CG) and 30^t (BCG). The wagon for bulk cement is average 30^t. The lorries for bagged cement can be loaded 10^t and 20^t. Those for bulk are 12.5 and 25^t loaded.
All the bulk cement delivered by lorry (14%) is mainly to the large customers, the ready-mixed concrete companies, and the secondary product companies.

Table III-2-16 Means of Transportation and Type of Packaging in 1980

(In '000 M/T)

Means of Transportation		Packaging	Malaysia	%	Peninsular Malaysia	%
Ex-Plant basis	Rail	Bag	235	8.6	235	9.5
		Bulk	723	26.6	723	29.4
		Total	958	35.2	958	38.9
	Lorry	Bag	1,095	40.2	1,018	41.3
		Bulk	487	17.9	487	19.8
		Total	1,582	58.1	1,505	61.1
	Vessel	Bag	181	6.7	–	–
	Grand Total	Bag	1,511	55.5	1,253	50.9
		Bulk	1,210	44.5	1,210	49.1
		Total	2,721	100	2,463	100
Delivered basis	Rail	Bag	235	8.6	235	9.5
		Bulk	–	–	–	–
		Total	235	8.6	235	9.5
	Lorry	Bag	2,142	78.8	1,884	76.5
		Bulk	344	12.6	344	14.0
		Total	2,486	91.4	2,228	90.5
	Grand Total	Bag	2,377	87.4	2,119	86.0
		Bulk	344	12.6	344	14.0
		Total	2,721	100	2,463	100

III-2-8 Distribution Channel

Almost all the cement shipped out of the plant are sold to the distributor or wholesaler, out of which 20% or less is sold to the dealer for resale. The distributors are nominated by the manufacturer and also registered to the government.

The commission for the distributor is 5.0 ~ 7.5% of the net sales value (less duty and freight.) In case the cement which is bought from the distributor is resold by the dealer, the dealer is to mark up the price. However, there is a limitation that the retail price after it is marked up should not exceed the control price which is set by the government.
The distributor buys the cement from the manufacturer at some 60 days credit for which the former gives the latter the bank guarantee. The terms of payment between the distributor and dealer is determined case by case. The dealer's commission is some 62 ~ 67% of that for the distributor.

The terms of payment between the customer and the distributor or dealer is determined depending upon the demand and supply situation. Except during the period of cement shortage when most of payment is done by cash, the long time big customer is usually given the average 75 day credit terms of payment by the distributor, ranging 60 to 90 and very exceptionally to 100 days.

III-2-9 Price

The cement price is controlled by the government. From November, 1980 to March 24, 1981 there was uniform price all over the country, that was M$8.20 per bag (50 Kg) for retail (M$164 per metric ton).

Effective March 25, 1981 the cement price was increased by some 10%. The new price was determined on a geographically differentiated basis considering the distance from the sources of supply. The new retail prices range from M$8.80 ~ 9.60 per bag (M$176 ~ 192 per metric ton), including M$1.97 per ton of the excise tax, which is to be levied both on the domestic and imported cement. This system is what they call "the ladder system", which used to be practiced up to November, 1980. However, in October, 1981, the excise tax was lifted.

Comparing the cement price in Malaysia with those in other countries in Southeast Asia, it is apparent that as shown in Table III-2-17 the cement price in Peninsular Malaysia, after price increase effective March 25, 1981, is higher than those in Indonesia, Thailand, Taiwan and possibly Korea, and more or less same with that in Japan, but it is cheaper than Philippines'. This relatively higher cement price is mainly due to higher fuel oil and power costs.

Table III-2-17 Domestic Cement Prices in South East Asian Countries, 1981

(US$ per metric ton)

	Country / Month	Malaysia	Japan	Korea	Taiwan	Philippines	Thailand	Indonesia	Singapore	Hong Kong
		April	April	April	June	April	March ~ June	January ~ June	April	April
Bagged (M. Ton)	Ex-Factory			$65.25	$65	$83.25	$58.68	$58.76		
	Ex-Railway Station	$85.71			$71.83					
	Delivered	$85.71	$86.50		$74.61			$78	$73.18	$74
Bulk (M. Ton)	Ex-Factory			$61.81		$76.60	$56.23			
	Delivered		$80.90		$69.44*			$69.60	$72.79	$72
Governmental Control		Controlled		Controlled	Controlled		Controlled	Controlled		
Tax (M. Ton)	Sales Tax						$1.03	5%		
	Corporate Tax							1%		
	Commodity Tax	$0.88			$14		$0.95			
Tax included in price or not		Included			Included		Included	Included		
Energy Cost	Power (kwh)	$0.089	$0.077	$0.08	$0.06	$0.04	$0.08	$0.0416		
	Heavy Oil (kℓ)	$261.16	$258.80	$283.06	$211	$236.00	$228.88	$80.10		
	Coal (t)		CIF$60.87	CIF$80	CIF$82	$37*		$32.80		
Exchange Rate		M$2.24	¥215.22	W671.30	NT$36	Peso 7.50	Baht 21	Rupiah 625	S$2.07	HK$5.50
Notes					* Within radius of 70 km	* Ex-Coal Mine		* The purchase price by Gov't		

IV ASSESSMENT OF RAW MATERIALS

IV. ASSESSMENT OF RAW MATERIALS

To clarify the reserves and quality of the raw material deposits is one of the critical items in studying a new cement plant establishment. A few survey reports on the raw materials for cement plant such as limestone, clay, silica rock and iron ore in the state of Kelantan are written by the Geological Survey Department, Ministry of Primary Industries, Malaysia. As far as limestone deposits are concerned, it is well known that the state of Kelantan has a plenty of deposits, although almost all the deposits are located in areas with poor accessibility.
Prior to undertaking the field survey, the Japanese Study Team had a meeting with the Geological Survey Department, Kota Bharu to select appropriate limestone deposits to survey and decided to pick up the following three areas.

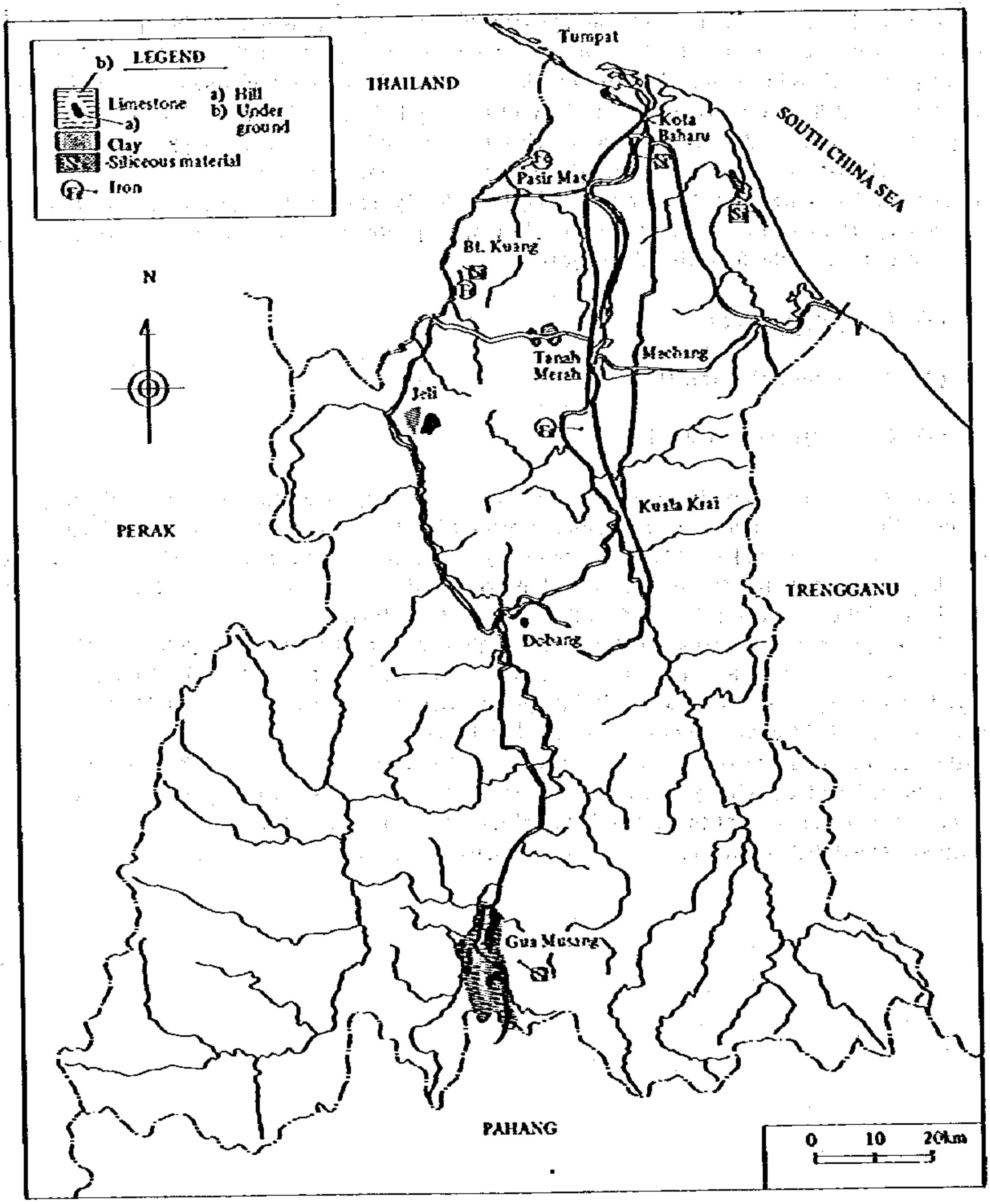
(1) Gua Setir near Jeli

(2) 4 limestone hills near Dabong

(3) Gua Panjang near Gua Musang

The other limestone deposit areas have difficulties in surveying at present due mainly to poor accessibility. In addition, some deposits are reported as to contain higher magnesia which is not suitable for cement. (1) and (2) above are surveyed to confirm the previous results. (3) provides the largest one through the field survey, but no analytical report is available. Therefore, main emphasis of the survey is laid on at Gua Panjang near Gua Musang.
Field surveys on clay are conducted at Jeli, Tanah Merah and Gua Musang. Siliceous Materials are surveyed at Sungai Kelantan, near Gua Musang, Bukit Kuang and Bachok. Iron ore is surveyed at Temangan, Bukit Lata and Bukit Kuang. Report on gypsum deposit in Malaysia is not available. The field survey areas are shown in Fig. IV-1-1.
110 pieces of limestone grab samples, 35 clay samples, 13 silica samples and 8 iron ore samples are collected and chemically analyzed. All raw materials represented by these samples proves suitable for cement except two east side hill blocks at Gua Panjang which show a higher magnesia content. The detailed study results on raw materials are described hereinafter.

Fig. IV-1-1 The Field Survey Location Map of Cement Raw Material in Kelantan



IV-1 Geological Investigation

IV-1-1 Outline of Geology in Kelantan

The description here is made on the basis of "Geology and Mineral Resources of North Kelantan and North Trengganu" published by Dr. S. MacDonald, Geological Survey, Malaysia and "Geological Map of West Malaysia" published by Director of Geological Survey Department, Malaysia. The geology of Kelantan state is stratigraphically understood as shown in Table IV-1-1.
Geohistory of the state is understood as follows.
The sedimentary rocks which belong to Carboniferous to Triassic era were unconformably deposited on a basement of Metamorphic rocks (Taku Schists) of unknown age. The metamorphic rocks distribute from Tanah Merah to the west of Kuala Krai. They are folded in an anticline which trends north. The bed trends north-south and dips 40–80 degree east-west. The sedimentary rocks distribute throughout Kelantan state. The bed trends north-south just as the metamorphic rocks, and dips 40–90 degree east-west.
After these era, quartz porphyry is exposed along the boundary of these rocks. Iron ore deposits have been formed in relation to this igneous activity near Temangan.
Granite was intruded twice during the Mesozoic era from the Triassic to the Cretaceous all over the Kelantan state. Basaltic extrusive rocks of the Cenozoic era are locally distributed. Recent deposit in the Quantanary Alluvium is composed of gravel, sand and clay and distributes around river and valley.

Table IV-1-1 Stratigraphy of Kelantan State

Geological Age	Litho Facies	Rock Facies	Cement Raw Material
Cenozoic era			
Quaternary	Alluvium	Gravel, Sand and Clay	Gravel, Sand: Siliceous material
Teritary	Dykes	Dolerite, Lamprophyre	
Paleozoic-Mesozoic era	Granite rocks	Granite, Granodiorite	
	Dykes	Quarz Porphyry	The only occurence shown in the Temangan dyke. Iron ore deposits are found at the bounday of these rocks
Paleozoic-Mesozoic era Triassic-Carboniferous	Sedimentary rocks	Shale, Sandstone Quartzite, Limestone	Shale: Clay Sandstone: Siliceous material Limestone
Unknown	Metamorphic rocks	Schist, Quartz schist Amphibole schist Serpentine	Schist, Quartz schist: clay

IV-1-2 Limestone Deposits

(1) History of investigation and survey method

In accordance with raw materials investigation for cement, three papers are written by Geological Survey Deportment, Malaysia and one paper is prepared by Onoda, Japan. Summary of these papers is as follows.

(i) Proposed Cement Factory in Kelantan by Dr. Jaafar bin Ahmad, 1973 Geological Survey Department

18 limestone samples from Gua Setir and 4 limestone samples from Gua Maka are analyzed. The results show they are suitable for cement manufacturing. In addition to these, 10 limestone samples from near Dabong and 7 limestone samples from near Bertam are analyzed. This report is cited in the following papers as an original investigation for cement raw materials.

(ii) A Geological Investigation on the Limestone Hills near Dabong

by Dr. Chu Ling Heng, 1976
Geological Survey Department

Three limestone hills – Gua Tembacau, Gua Ikan and Gua Pagar – near Dabong are examined for industrialization. Gua Tembacau and Gua Pagar are recommended for exploitation especially in the field of slabs but Gua Ikan shall be preserved because of being a favourable holiday resort. The results of chemical analysis of these hill limestone samples show they are suitable for the cement industry.

(iii) Preliminary Study for Proposed Cement Factory in Kelantan, Malaysia

by Onoda Engineering and Consulting Co. Ltd. 1977

Gua Setir and a hill near Gua Musang railway station are investigated. A few samples from these hills are analyzed and it is concluded that the limestone is expected to be a suitable raw material for cement manufacturing. The estimated reserves of Gua Setir limestone deposit amount to about 20,000,000 tons, but Gua Setir is formed such a narrow hill with vertical cliffs that the bench cut method which is the most economical for quarrying can not be used.

(iv) Cement Raw Material in the State of Kelantan

by Aw Peck Chin, 1980
Geological Survey Department

Gua Setir and Gua Maka near Jeli are explained to summarize Dr. Jaafar paper. Three hills near Dabong are written from Dr. Chu's paper. A total of 48 samples from six limestone hills near Gua Masang have been sampled and analyzed. The results show 3 of the 6 hills are recommended to be set aside for future industrial uses other than cement manufacture because of high purity. The rest shall be re-sampled to determine the magnesia content.

The survey for this report was executed by the Japanese Study Team (JICA) with regards to the geological investigation, mining and transportation methods in co-operation with the Geological Survey Department. Chemical analysis and physical test of the grab samples collected from the field were performed by the Central Research Laboratory of Ube Industries, Ltd.

(2) Location and accessibility

Three field survey areas for limestone deposits are indicated in Fig. IV-1-2.

(i) Gua Setir

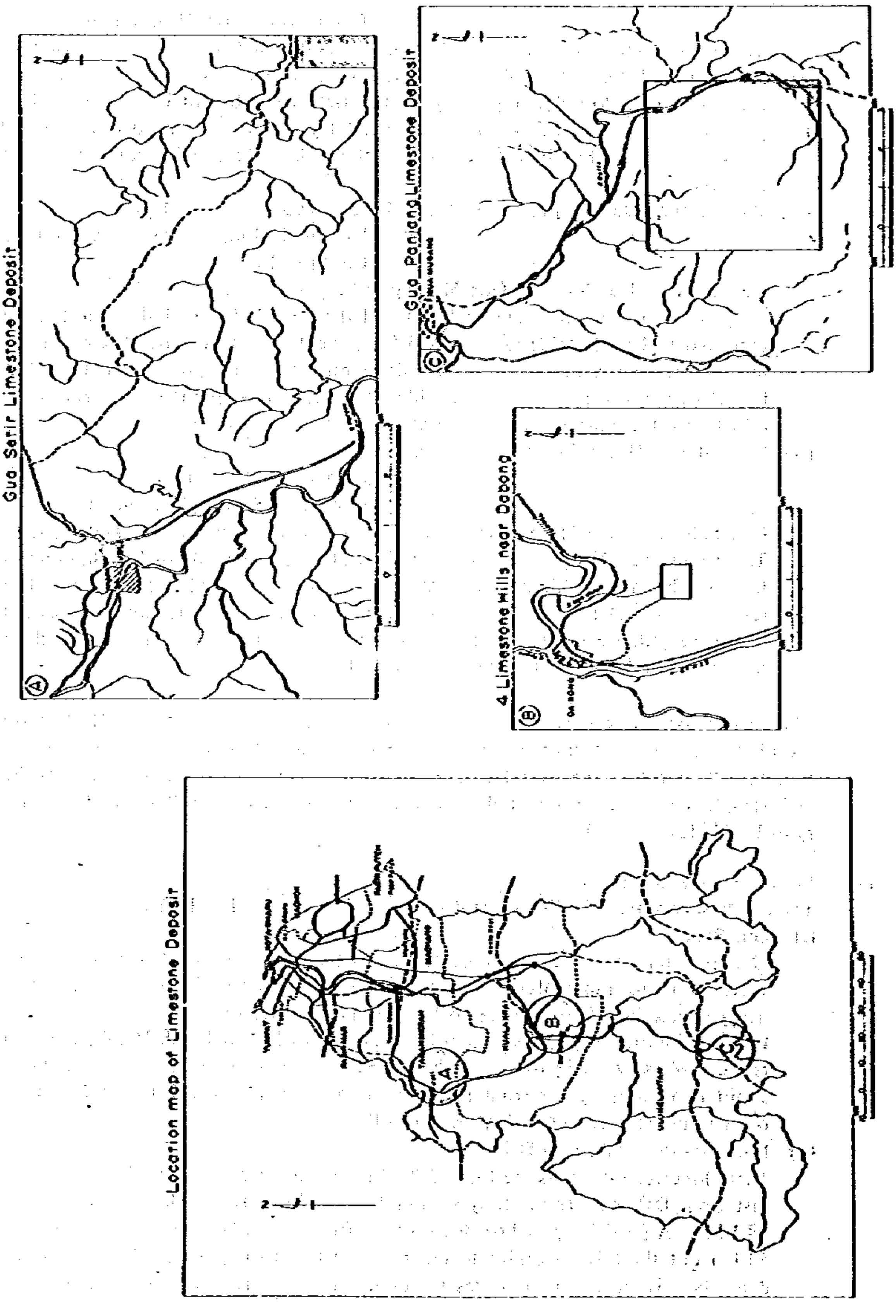
Gua Setir limestone deposit is located about 8 km east-southeast from Jeli. From Kota Bharu to Tanah Merah, it is 37.2 km on railway and 49 km on paved road. The distance from Tanah Merah to Jeli is 50 km on paved road.

From the entrance point which is 3 km east from Jeli to Tanah Merah, a timber truck road is available to approach Gua Setir in the distance of 11 km. It takes about two hours by car from Kata Bharu to the entrance point near Jeli, then one additional hour to Gua Setir by Land Rover.

(ii) Four limestone hills near Dabong

These limestone deposits are located 2.5 km in straight distance on the map southeast from Dabong. The railway station distance from Tanah Merah to Dabong is 88.1 km. A partially paved road is available from Jeli to Dabong in the distance of 54 km but there is no bridge to cross Sungai Galas to approach these limestone deposits. There are two routes to reach these, one is a timber truck route in

Fig. IV-1-2 Field Survey Areas for Limestone Deposit



the southeast direction from Dabong station about 5 km. Another route is a good foot path from the valley of Sungai Mas Puteh which is located 2.5 km east from Dabong Station along railway. The distance on the foot path to limestone deposits is about 1.5 km.

(iii) Gua Panjang

Gua Panjang limestone deposit is located about 8 km south-southeast in a straight line from Gua Musang. The railway station distance from Tanah Merah to Gua Musang is 154.7 km. The Italian-Thai road is now under construction between Kuala Krai and Gua Musang. An unpaved truck road is available to approach Gua Panjang in the distance of 10 km approximately.

(3) Topography and vegetation

(i) Gua Setir limestone deposit forms a hill surrounded with vertical cliffs on a fairly mild slope in the elevation of 75 to 150 m above the sea level. A maximum height of the deposit is about 100 m from the ground. The shape of the deposit is a long narrow bed extending over a length of about 1300 m in south-north direction and its width is only 80 m on average. This deposit has numerous caves and some large caves run through this deposit from the cliff of the east side to that of the west. Ground area around the hill is generally covered with primary jungle of thick and dense vegetation, and the hill top is also covered with Vegetation.

(ii) Four limestone hills near Dabong

There are five limestone hills near Dabong; Gua Master, Gua Pagar, Gua Ikan, Gua Tembakau and Gua Buaru. The first four hills are located along a timber truck route, but Gan Buaru is located about 500 m from the route and filled up by a primary jungle. These deposits from hills just like Gua Setir along a moderately sloped valley extending northwest and west-northwest with vertical cliffs. The maximum height of the cliffs is about 40 m above the ground level. These deposits except Gua Pagar are of a round shape, about 150–250 m in width. Gua Pagar has two round hills which form a longer deposit in the northwest direction. These deposits have many caves. Especially, Gua Ikan has a cave with a stream passing through a deposit from south to north. This has become a favourite picnic spot for the local people. The ground area around the hills are covered with primary jungle as Gua Setir.

(iii) Gua Panjang near Gua Musang

Gua Panjang is one of the huge deposit in Kelantan, extending 3 km northsouth and 4 km eastwest approximately. The ground around the deposit is fairly flat with an about 150 m elevation from the sea level except the west side of the deposit being a mild slope in the west declined direction. This deposit is divided by valleys of northsouth and northwest direction surrounded with vertical cliffs. The height of the cliffs differs from the west side to the east side which seems to have a maximum height of 100 m from ground level.

It has many caves like other deposits. Around the ground of the deposit, palm trees are planted on the north, east and south sides, and rubber trees are planted on the west side. The deposit itself is covered by primary jungle.

(4) Geology and deposit

Three limestone deposit areas surveyed are estimated that the formation of all deposits belongs to the same geological era. They are Sedimentary rocks which consist of shale, sandstone, quarzite and limestone mainly as described in IV-1-1. Shale distributes widely in these areas but sandstone and quarzite are observed at some areas as a thin layer. Limestone deposits lie among these layers but their topological shape is affected by sedimentary rock weathering.

(i) Gua Setir

This limestone deposit forms a long-narrow hill as described in IV-1-2(3)(i). The strike line indicates N20W and dip is almost vertical. Foward the nothern part, however it changes to a dip westward. The deposit seems to be intercalated with no other rocks. This limestone is generally greyish-white in color and is compact, microcrystalline.

Geological map of Gua Setir limestone deposit is shown in Fig. IV-1-3.

(ii) Limestone deposits near Dabong

Geological Survey Report written by Dr. L. H. Chu introduced in IV-1-2 (1)(ii) explains the general geology and local geology of these deposits. Three hills, Gua Pagar, Gua Ikan and Gua Tembakau, are described in this paper. But Gua Master is not indicated in. This is located at the northeast end of this area and forms a round hill with 250 m width. Limestone is just like that of Gua Setir.

Geological map of 4 limestone hills near Dabong is shown in Fig. IV-1-4.

(iii) Gua Panjang

By the size and sampling analysis, Gua Panjang can be divided into four blocks, A, B, C and D indicated in Fig. IV-1-5. Block A is distributed along railway at the east end of Gua Panjang. This limestone is generally greyish-white in color, compact and microcrystalline. Block B limestone is very akin to that of block A, but a thin layer of dolomite is partially found in it. Block C limestone includes some shale layers and its color is mainly black. Block D limestone is separated by a shale layer which forms valley and moderate slope. This limestone seems to represent a large part of Gua Panjang. It is greyish-white in color, compact and microcrystalline. Shale layers are found in western and southern area at Gua Panjang, the thickness of layer varies 30 cm to 100 m. The strikes are north and/or northwest, dips vary east to west. Generally, these show steep declines consisting of a monocline.

Black limestone found in block C shows a flat face by hammering.

(5) Reserves

The reserves of the limestone are calculated based on the topographical map in the previous papers and the field survey of this time. The maps and sections for calculation are shown in the drawings bellow.

Fig. IV-1-6 Map for quantity calculation of Gua Setir Limestone Deposit
Fig. IV-1-7 Map for quantity calculation of Gua Masta Limestone Deposit
Fig. IV-1-8 Map for quantity calculation of Gua Pagar Limestone Deposit
Fig. IV-1-9 Map for quantity calculation of Gua Ikan Limestone Deposit
Fig. IV-1-10 Map for quantity calculation of Gua Tembakau Limestone Deposit
Fig. IV-1-11 Map for quantity calculation of Gua Panjang Limestone Deposit

Fig. IV-1-3 Geological Map of Gua Setir Limestone Deposit

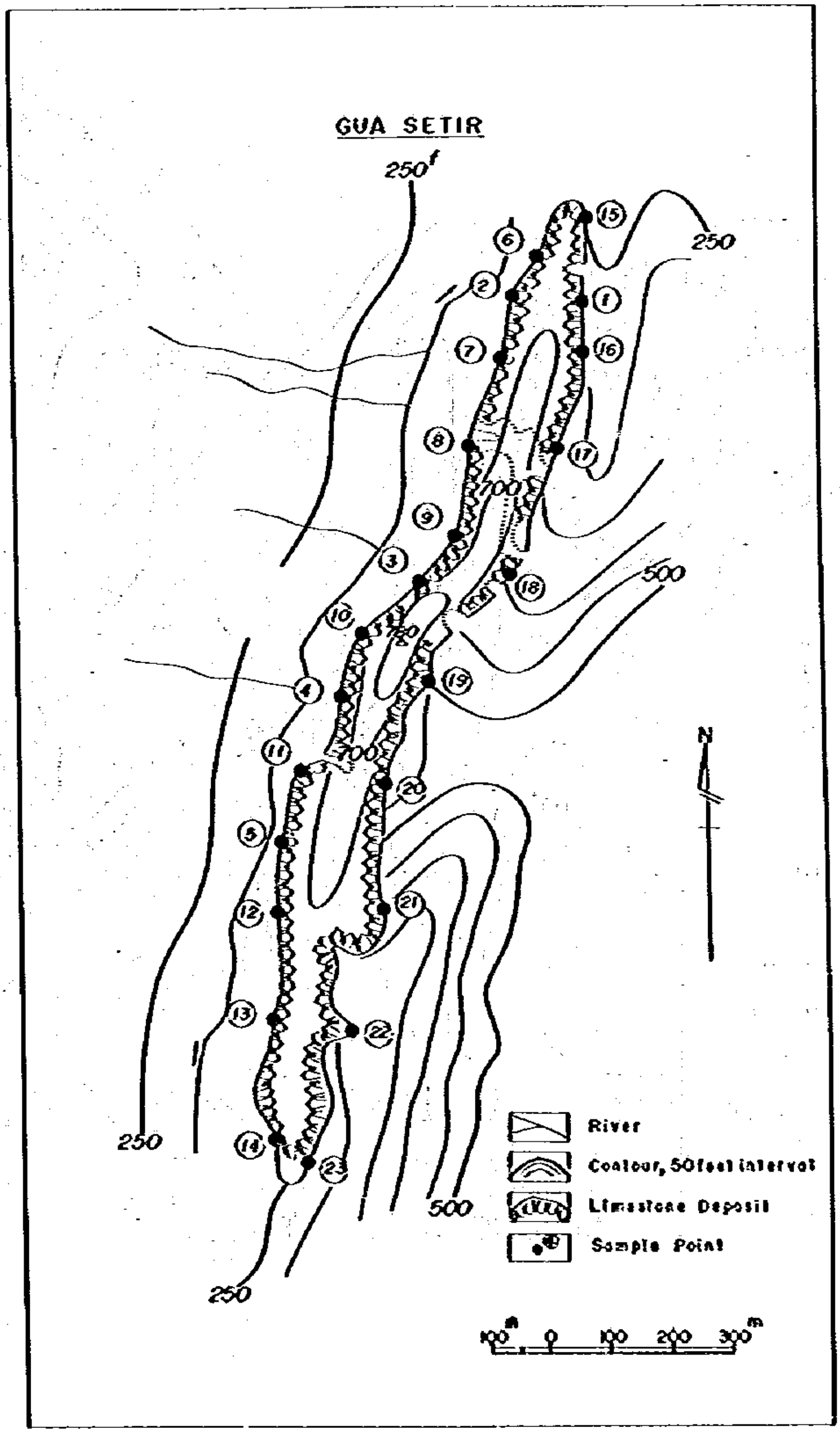


Fig. IV-1-4 Geological Map of 4 Limestone Hills Near Dabong

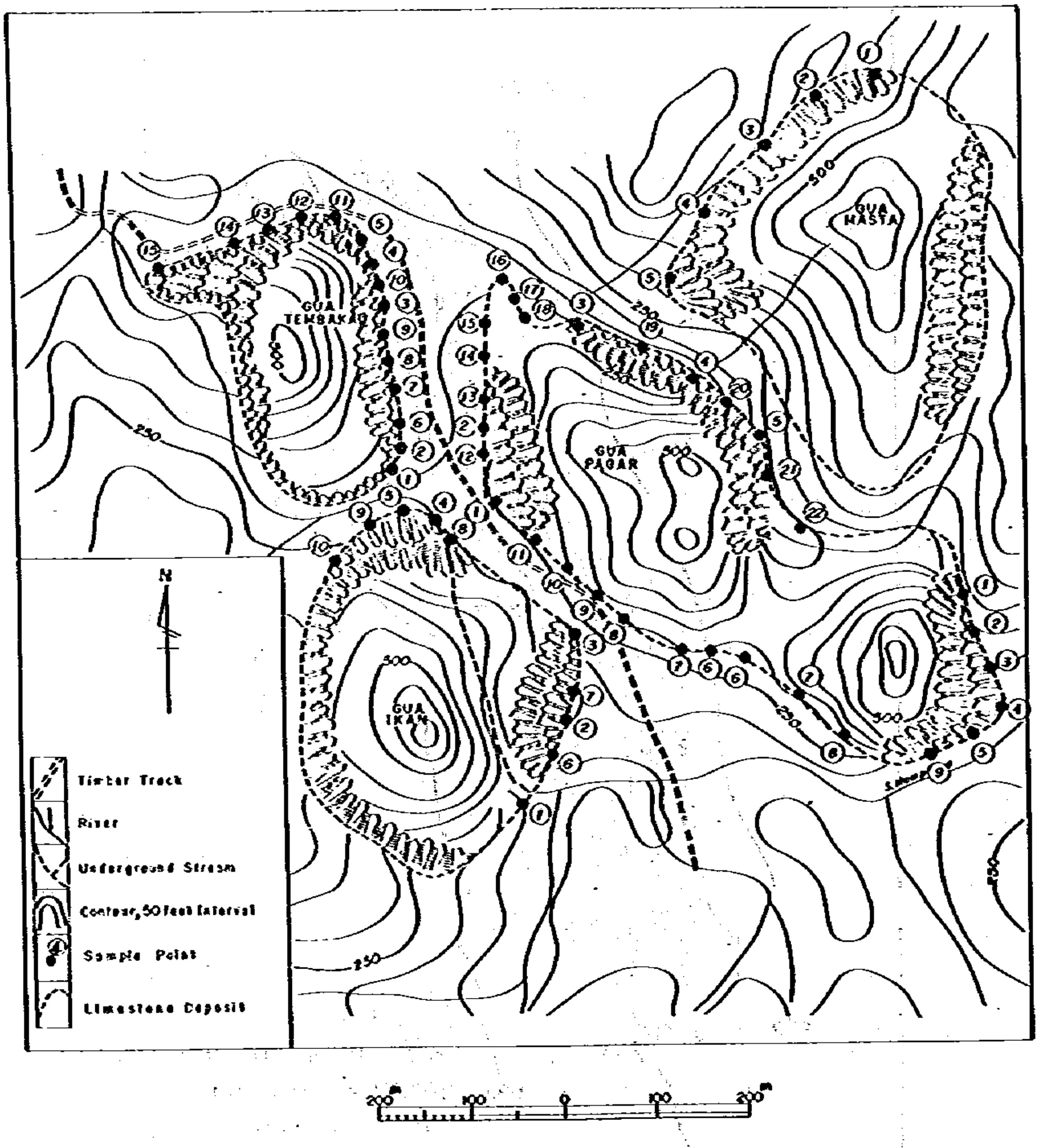


Fig. IV-1-5 Geological Map of Gua Panjang Limestone Deposit

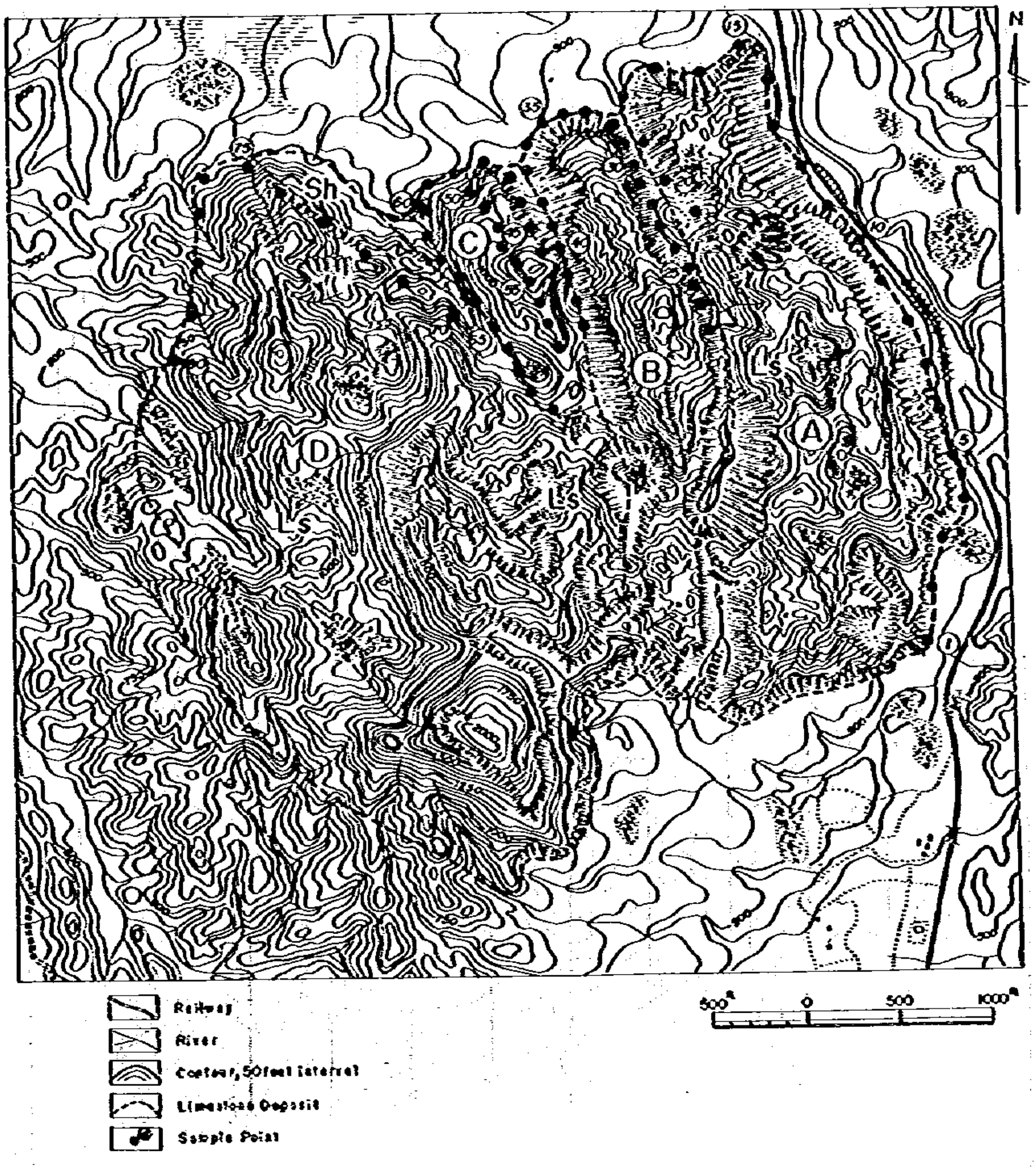


Fig. IV-1-6 Map for Quantity Calculation of Gua Setir Limestone Deposit

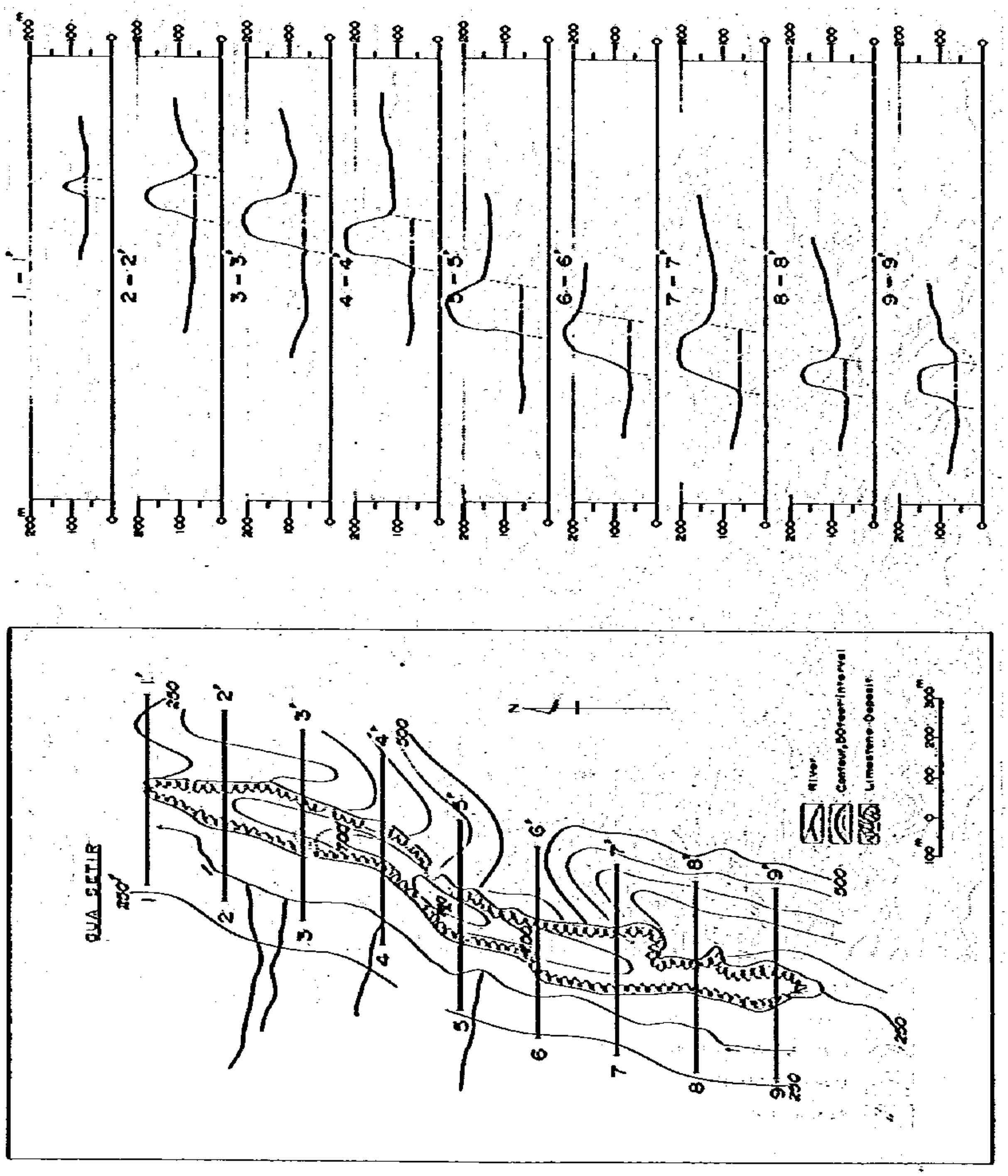


Fig. IV-1-7 Map for Quantity Calculation of Gua Masta Limestone Deposit

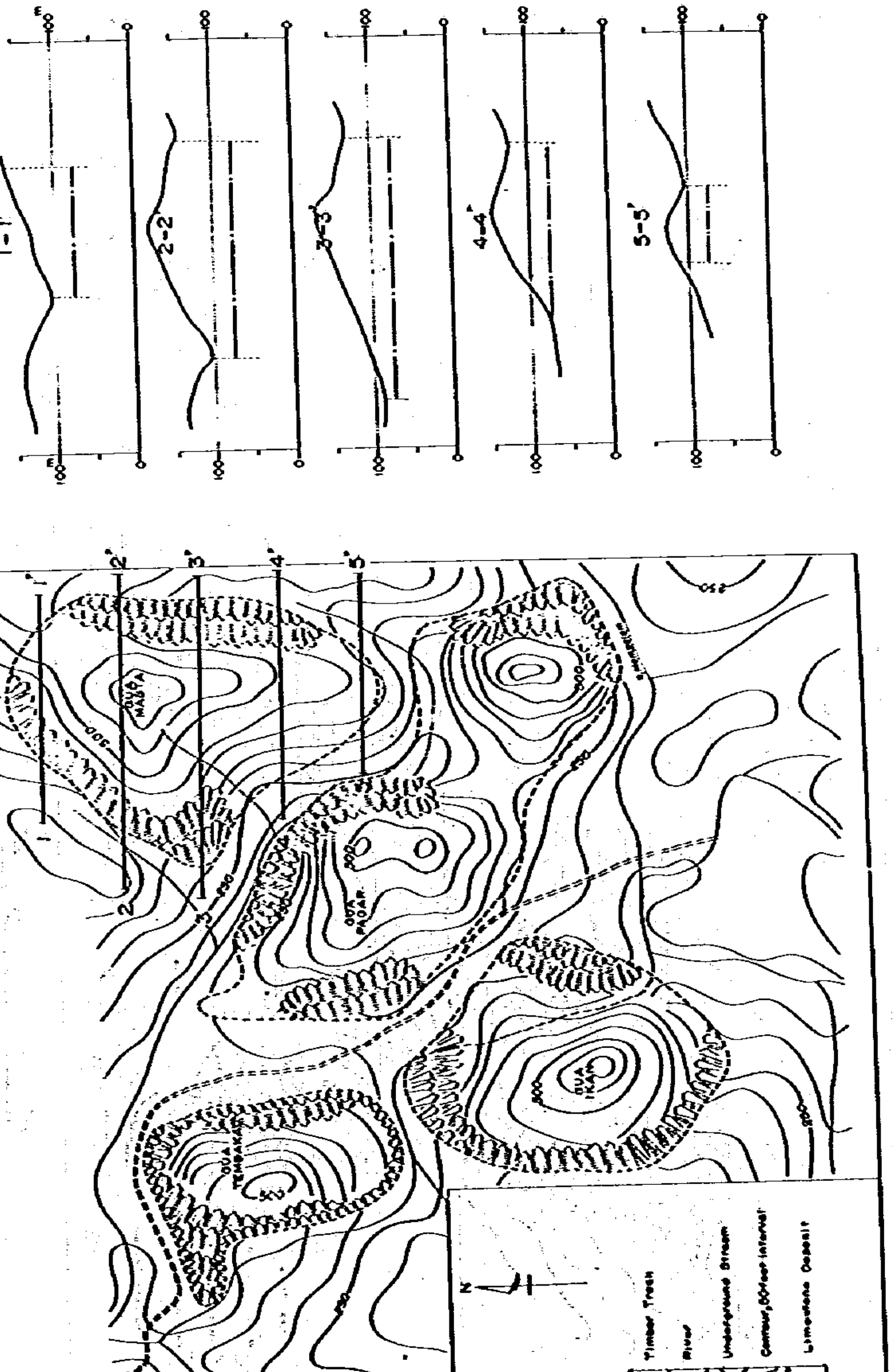


Fig. IV-1-8 Map for Quantity Calculation of Gua Pagar Limestone Deposit

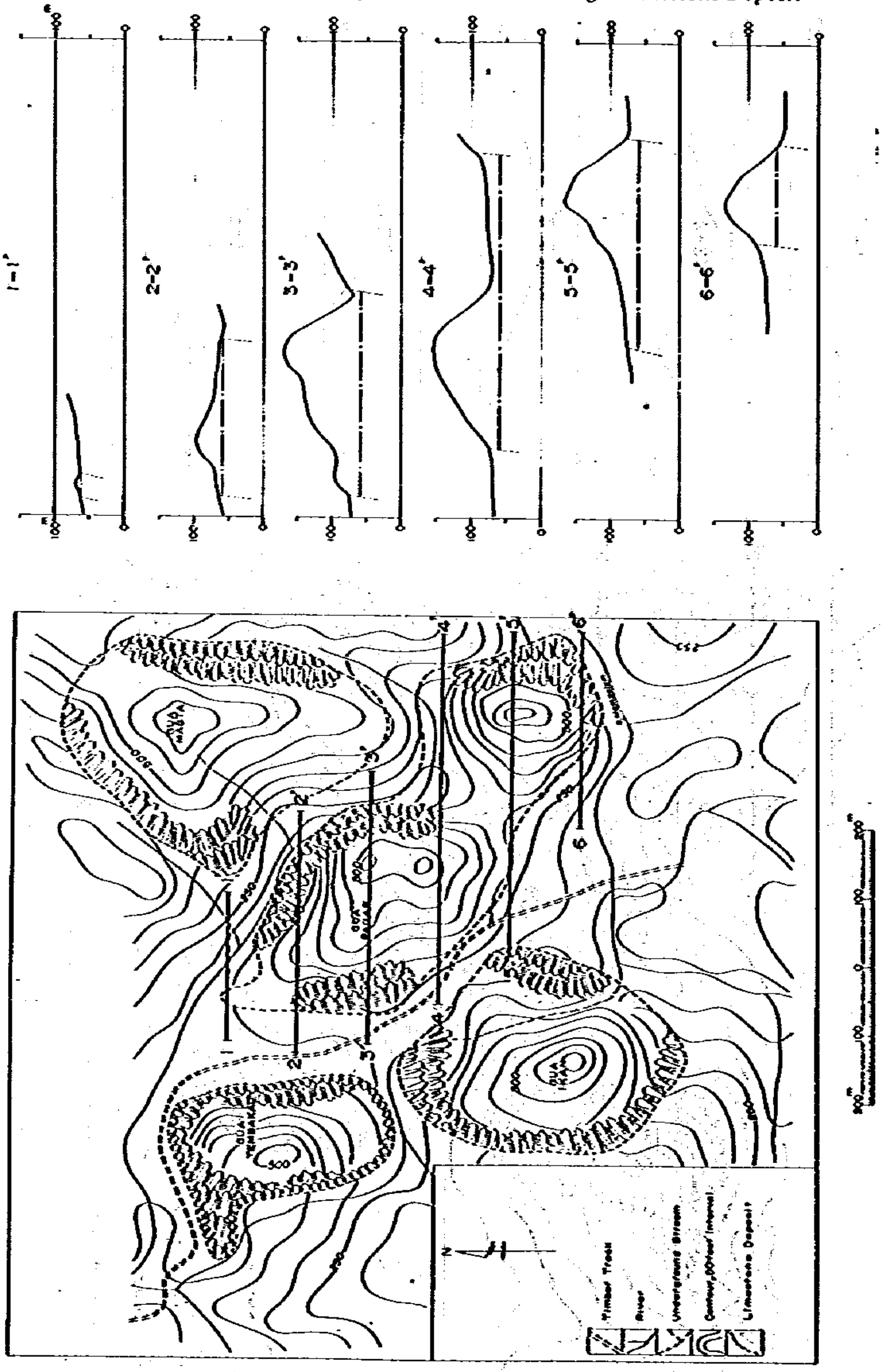


Fig. IV-1-9 Map for Quantity Calculation of Gua Ikan Limestone Deposit

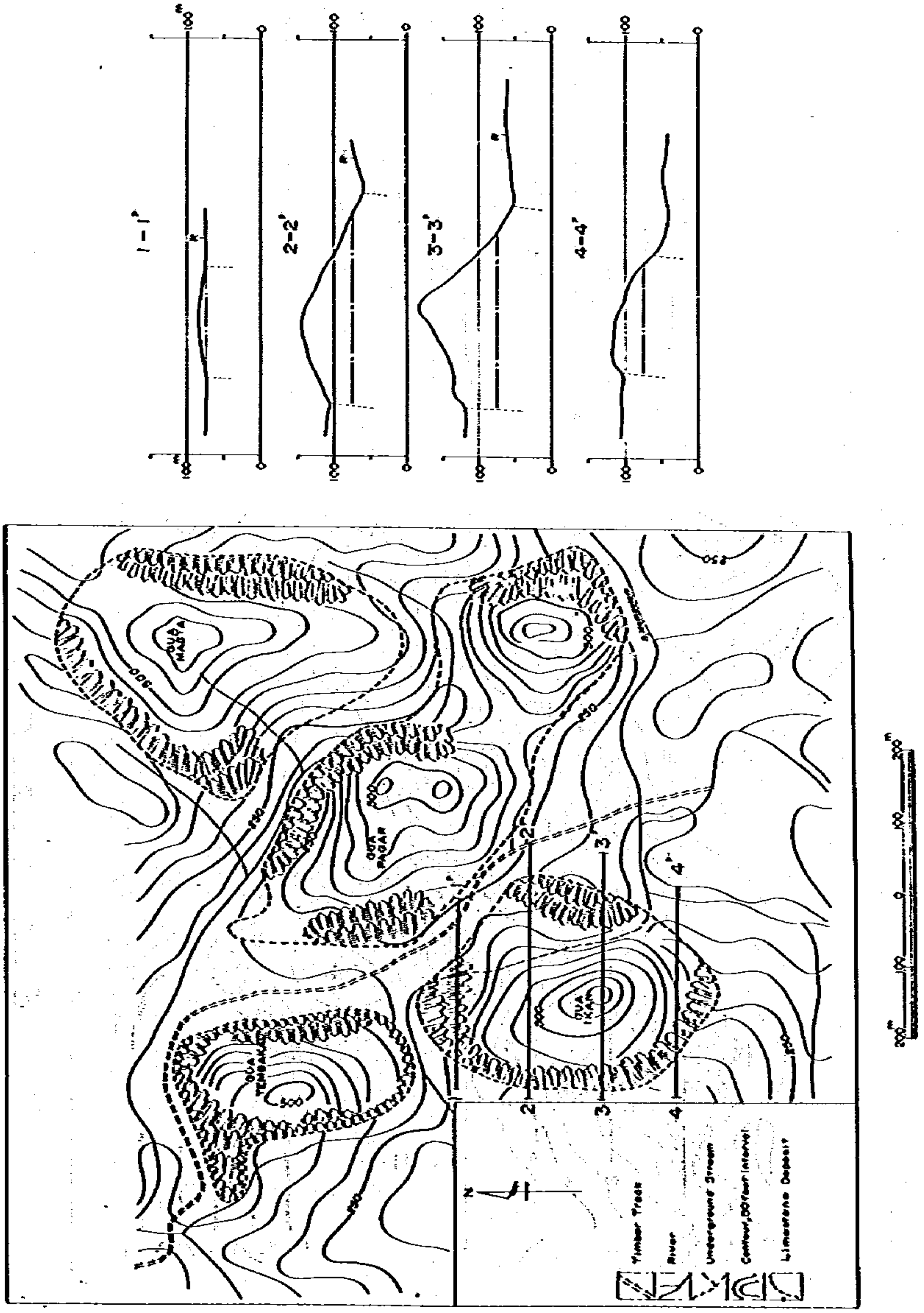


Fig. IV-1-10 Map for Quantity Calculation of Gua Tembakau Limestone Deposit

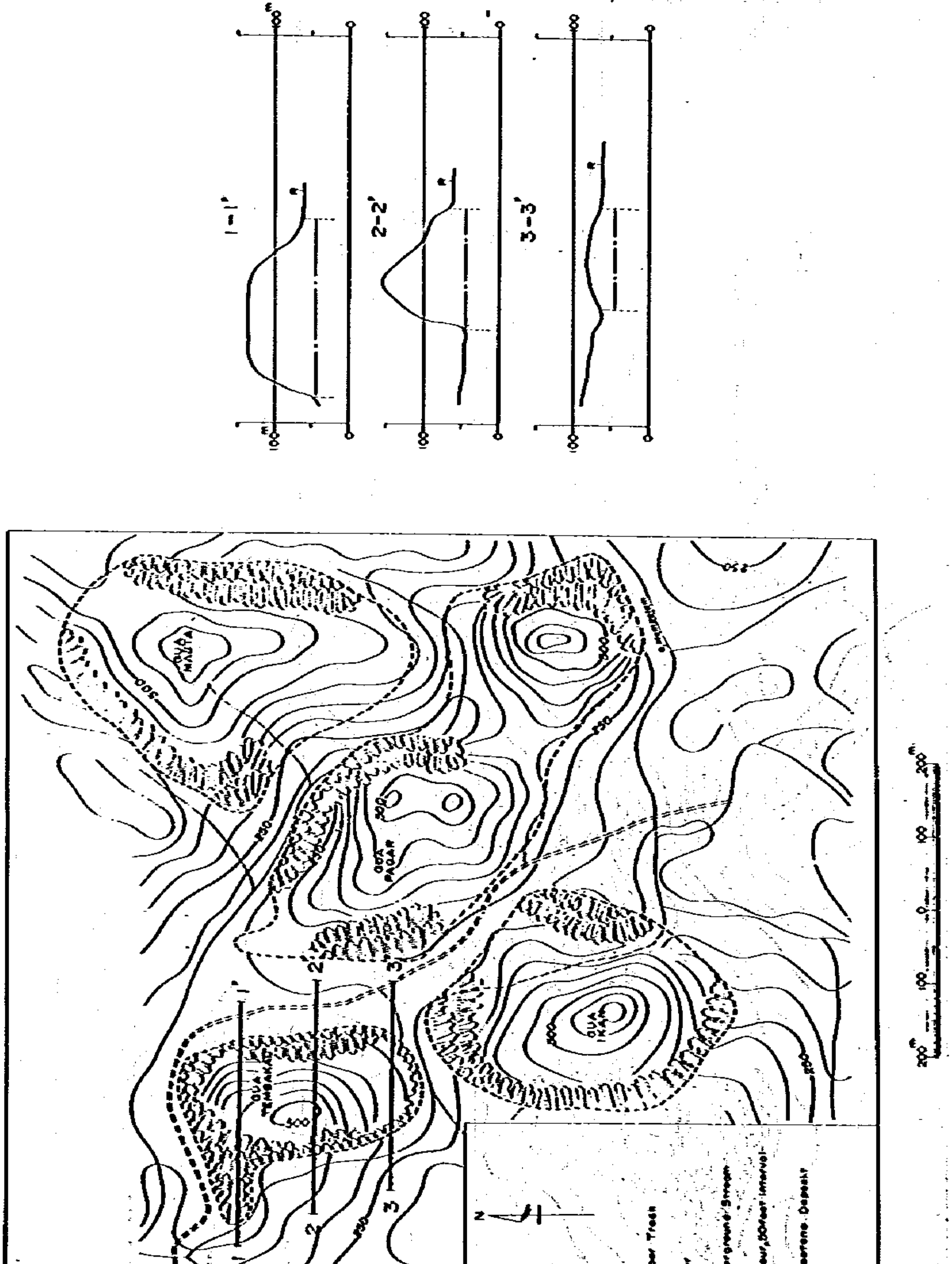
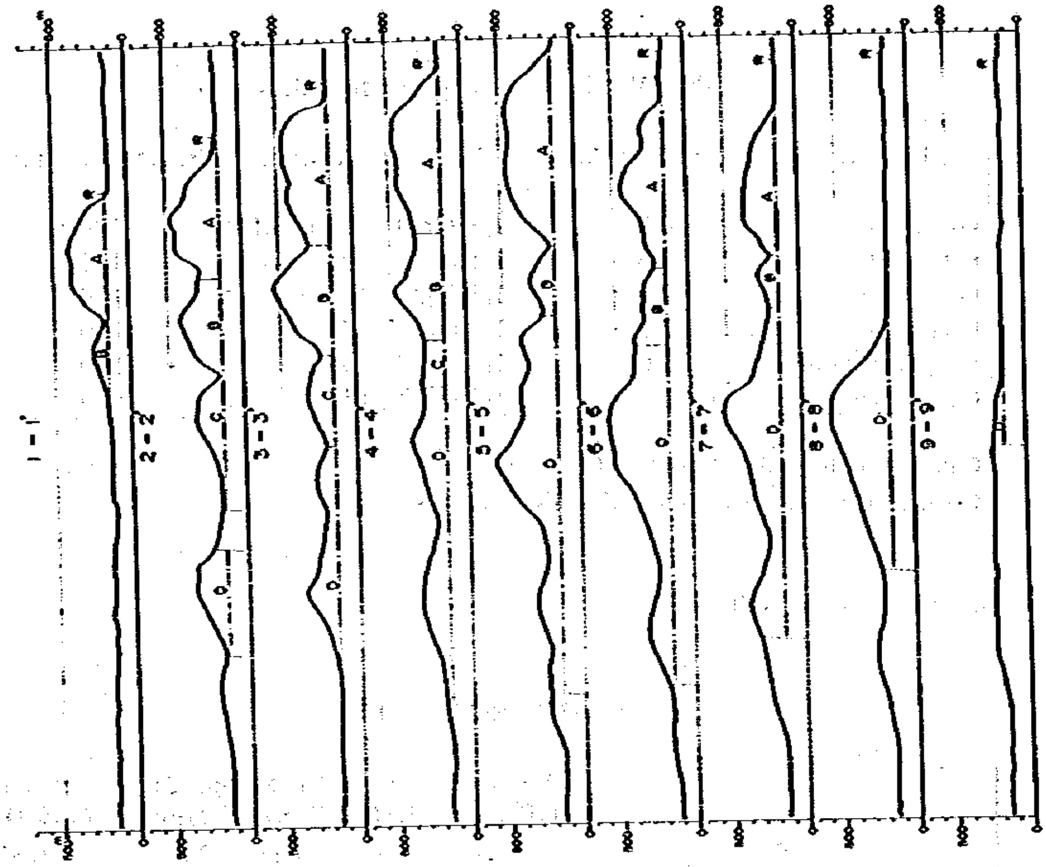


Fig. IV-1-11 Map for Quantity Calculation of Gua Tembakau Limestone Deposit



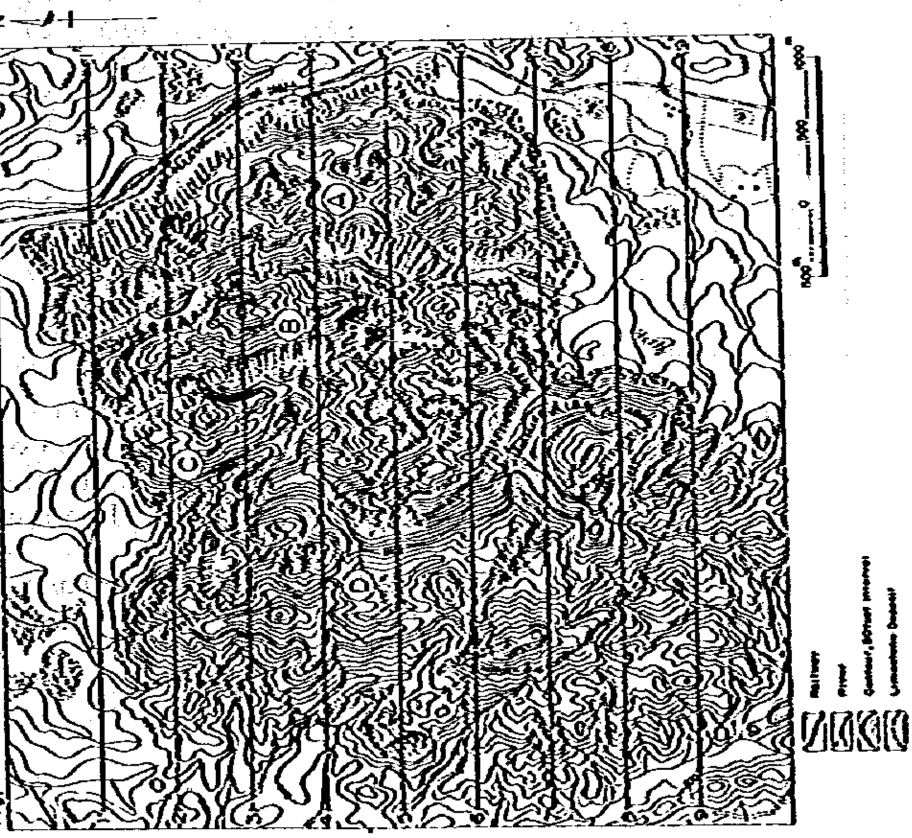


Fig. Map for quantity calculation of Gua Panjang Limestone Deposit

(i) Basic condition for calculation

Table IV-1-2 Basic condition for calculation

Deposit	Calculation Area	Map	Altitude	Cross Section Interval
Gua Setir	10 ha	1/10,000	75 m S.L.	200 m
Gua Masta	10.6	1/5,000	75	100
Gua Pagar	12.5	1/5,000	60	100
Gua Ikan	7.5	1/5,000	75	100
Gua Tembakau	5.0	1/5,000	45	100
Gua Panjang	1200	1/25,000	150	500

Calculation formula: Prismoidal Formula
Cross section areas are indicated in Table IV-1-3

(ii) Calculation result

Table IV-1-4 Reserves of Limestone

		Volume (10^3m^3)	S.F. for Map	S.F. for Deposit	Specific Gravity	Reserves ($x\ 10^3t$)
	Gua Setir	24,540	0.9	0.85	2.7	50,687
Dabong	Gua Masta	6,105	0.95	0.90	2.7	14,093
	Gua Pagar	5,632	0.95	0.90	2.7	13,001
	Gua Ikan	3,001	0.95	0.90	2.7	6,927
	Gua Tembakau	2,715	0.95	0.90	2.7	6,268
	Total	17,453				40,289
Gua Panjang	A	676,875	0.85	0.80	2.7	1,242,743
	B	371,250	0.85	0.80	2.7	681,615
	C	84,583	0.85	0.80	2.7	155,295
	D	1,063,958	0.85	0.80	2.7	1,953,427
	Total	2,196,666				4,033,080

Based on Jafaar's report, Gua Setir reserve is estimated at 67 million tons as against Onoda report's forecast of 20 million tons which seems too conservative. L.H. Chu's report estimates 4.9 million m^3 for Gua Pagar, 2.64 million m^3 for Gua Ikan and 2.63 million m^3 for Gua Tembakau. But Gua Ikan should be preserved because of its being a favourite holiday resort.
Block A and B of Gua Panjang are not suitable for cement manufacturing because of a higher magnesia content.

Table IV-1-3 Cross Section of Limestone Deposit

(m²)

Deposit / Cross Section Line	Gua Setir	Dabong				Gua Panjang			
		Gua Masta	Gua Pagar	Gua Ikan	Gus Tembakan	A	B	C	D
1	2,250	9,000	250	1,000	16,750	143,750	37,500		
2	11,250	21,750	3,000	10,750	11,250	150,000	118,750	62,500	75,000
3	20,250	19,000	18,750	14,500	4,500	275,000	187,500	75,000	143,750
4	20,250	10,000	17,250	4,500		262,500	175,000	56,250	287,500
5	22,500	4,250	15,750			312,500	125,000		500,000
6	18,000		6,000			218,750	87,500		525,000
7	22,500					87,500	25,000		425,000
8	6,750								368,750
9	6,750								6,250

IV-1-3 Clay

Three papers in IV-1-2(1)(i), (iii) and (iv) report on clay that clay itself is very common in the nature and easily found close to the limestone deposit. The other three reports listed below describe on clay for the purpose of agriculture application and brick manufacturing.

a) Natural Resource Study Pergau-Galas Region Kelantan by Anzdec Ltd. Agricultural & Forestry Consultants for ENEX of New Zealand, Dec. 1980
b) Detailed Reconnaissance Soil Survey of the KESEDAR Region, Kelantan by Lim Jit Sai and A.H. Basit, Yew Hwee Hwang, Soils and Analytical Services Branch, Division of Agriculture June, 1980
c) Brick Clay Investigation near Gua Musang, Kelantan by A.C. OOI and P.C. AW, Geological Survey Department, Sep. 1980

Intended to get a proper mixing proportion as one of cement raw materials and to estimate deposit, this study carried out clay survey around three proposed plant sites, i.e. Jeli, Tanah Merah and Gua Musang.

(1) Jeli

Clay around Jeli is surveyed and sampled along a timber truck route from Jeli to Gua Setir. Clay is deposited quite widely over a length of approximately 4 km on a slightly-sloped hills which are 76 to 143 m above the sea level. The west side of the deposit is the highest, followed by the east side and the south side, in that order. Generally, the area is covered by primary jungle. This clay comes from argillaceous rocks which distributes widely in this area. Clay consists mainly of weathered or half weathered tuffaceous shale and partly of from silt stone and mud stone.

At the lower areas, alluvial clay is also found. Color of clay varies as red-brown, grey or greyish-black. It might be expected to be difficult to mine during the rainy season because these weathered or alluvial clays are soft and adhesive. The thickness of the clay layer is estimated 3 m on average. The results of chemical analysis and physical test show that this clay is suitable for portland cement manufacturing.

(2) Tanah Merah

Clay deposits around Tanah Merah are studied at two areas – west side and north side of the town. The west side deposit distributes along the paved road to Jeli about 7 km from Tanah Merah over 5 km length lie approximately. The deposit is located about 9 km from the proposed plant site at Tanah Merah. The north side deposit is located at about 1.5 km north-northeast from the town. It is located very conveniently from the proposed plant site only about 1 km southeast therefrom.

Generally, these areas are located at a mild sloped hills.

Rubber trees are mainly planted there. Private houses can be seen along the road where bananas and coconuts are planted.

Geologically, these areas consist of takuschists which is estimated as Precarboniferous. Clay in the west deposit consists mainly of weathered and half weathered taku schists which is yellow to red-brown, and partially includes alluvial and siliceous siltstone. Clay in the north deposit is weathered Porphyritic Diorite which distributes at the east side of the town. Color of this clay is brown to black-brown. The recoverable depth is estimated to be 3 m on average. The result of chemical analysis shows different components depending on the areas. The west deposit samples contain high silica which can save silica sand usage in cement manufacturing. The north deposit samples contain high alumina and iron. Prior to the project implementation, a more detailed survey is recommended in order to establish a precise raw material mixing proportion and its quality control. Of course, they are suitable for cement manufacturing.

(3) Gua Musang

Clay deposits around Gua Musang are studied at two areas – south side and northeast side of the town. The south side deposit is located between Sungai Galas and Sungai Ketil until Gua Panjang. The north side deposit distributes along Italian-Thai road under construction. Both areas provide a very easy access from the proposed plant site and is located on a mild sloped hills. Rubber trees are planted mainly.

Clay in these areas comes mainly from tuffaceous shales and partly include mudstone, siltstone and phyllite. They are generally called argillaceous rock. Color of clay varies widely from brown-yellow to red-brown, greyish-white to pale-yellowish-brown and greyish-black at the south side; red-brown, grey to greyish-black, yellow at the north east side. Alluvial clay is also found at lower area. They are suitable for cement manufacturing.

(4) The calculation range of reserve is based on Fig. IV-1-12, -13, -14, -15. The other basis for calculation and the results are shown in Table IV-1-5. 1/25000 map is used for reserve area calculation.

Table IV-1-5 Clay Reserve Calculation Results

Deposit	Class	Area ($10^3 m^2$)	Thickness (m)	Density	Safety F.	Reserve ($10^3 t$)
Jeli	A	6,730	3	2.1	0.7	29,679
	B	1,240	3	2.1	0.7	5,468
Tanah Merah West	A	4,630	3	2.0	0.7	19,446
	B	930	3	2.0	0.7	3,906
Tanah Merah North	A	460	3	2.1	0.6	1,739
	B	50	3	2.1	0.6	189
Gua Musang South	A	3,270	3	2.1	0.6	12,361
Gua Musang Northeast	A	3,010	3	2.1	0.7	13,274
	B	1,450	3	2.1	0.7	6,394

Note: Class A means this area is sampled. Class B means this area is only observed.

Fig. IV-1-12 Sampling Points Map of Jeli

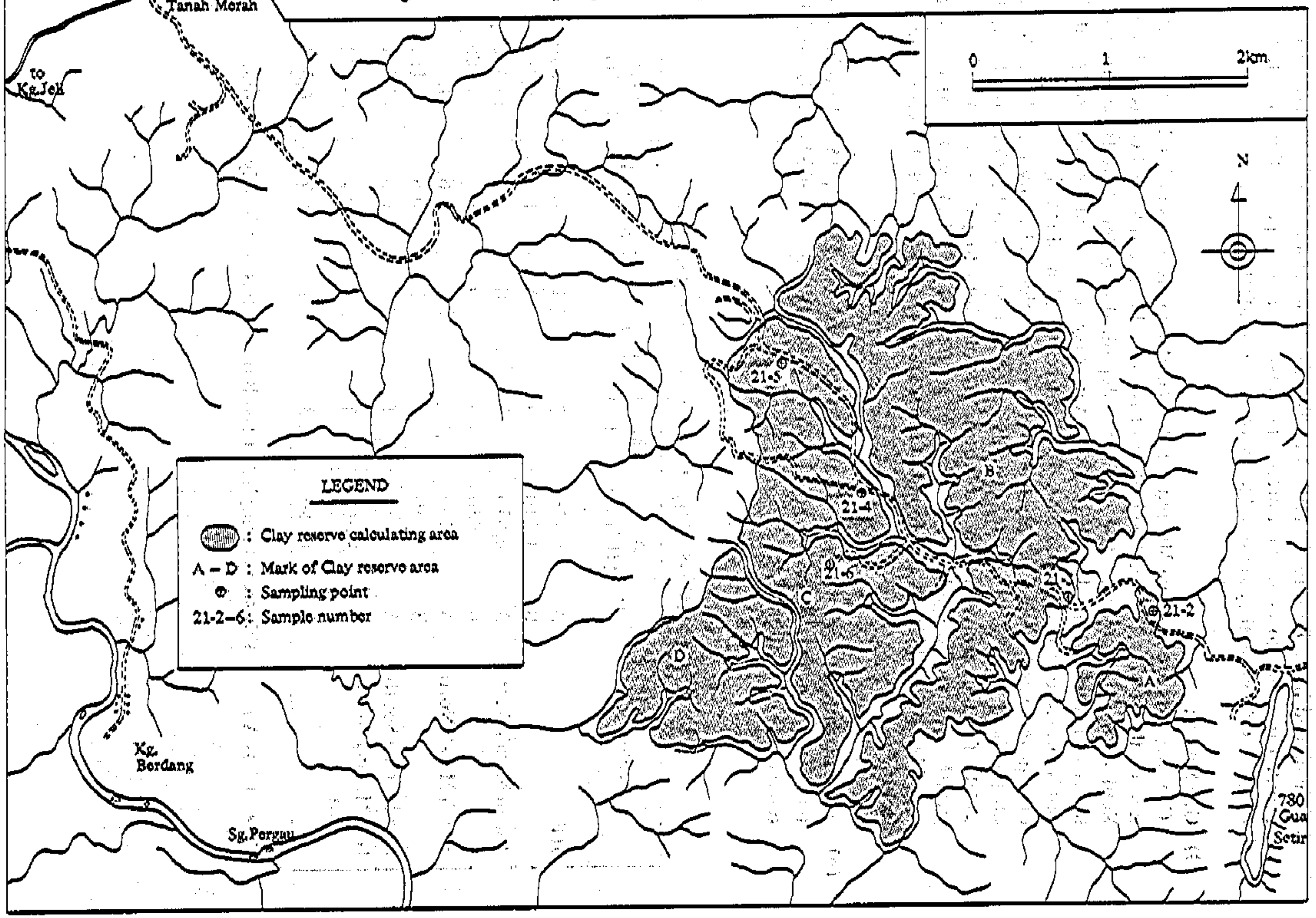


Fig. IV-1-13 Sampling Points Map of Tanah Merah

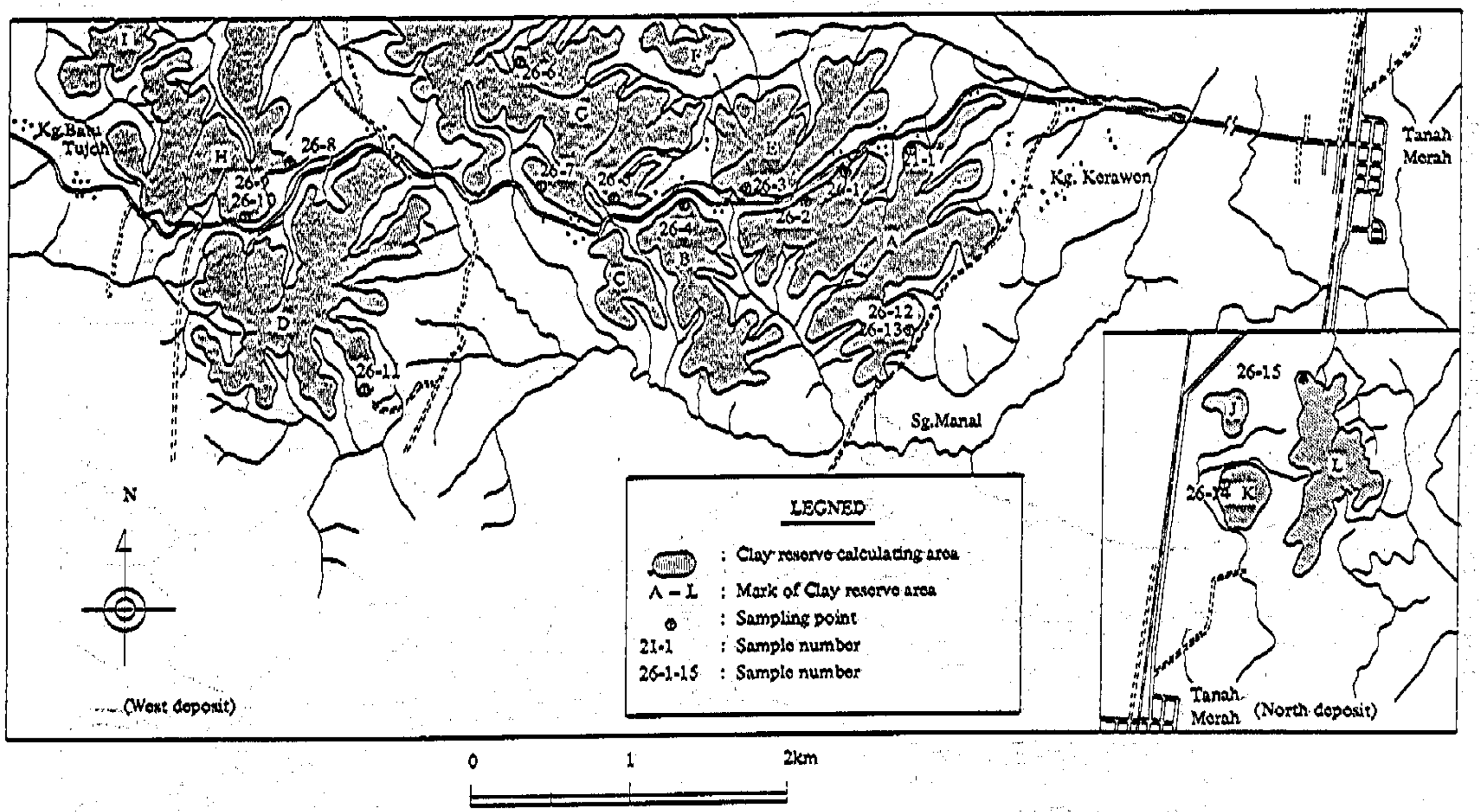


Fig. IV-1-14 Sampling Points Map of Gua Musang South

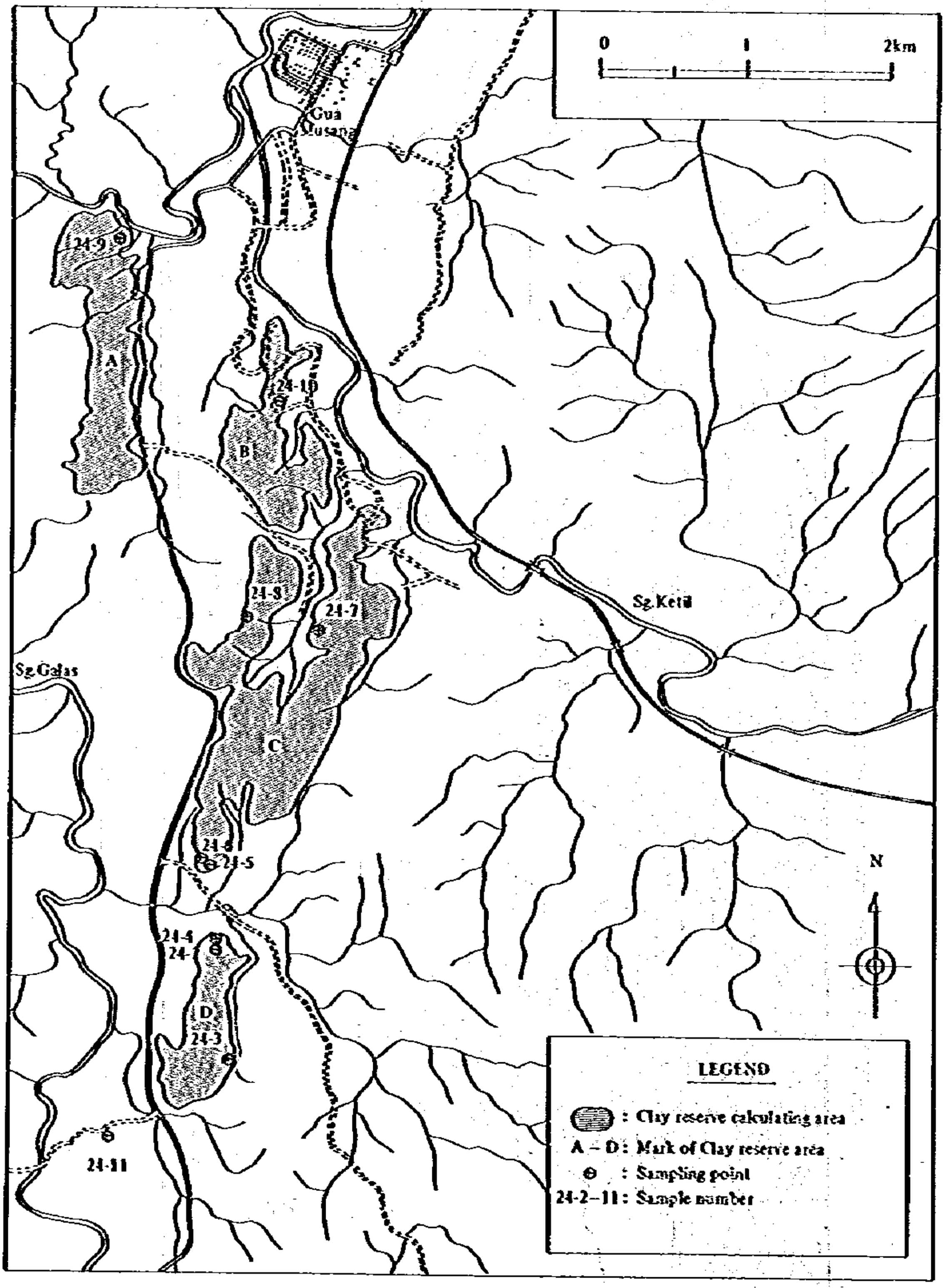
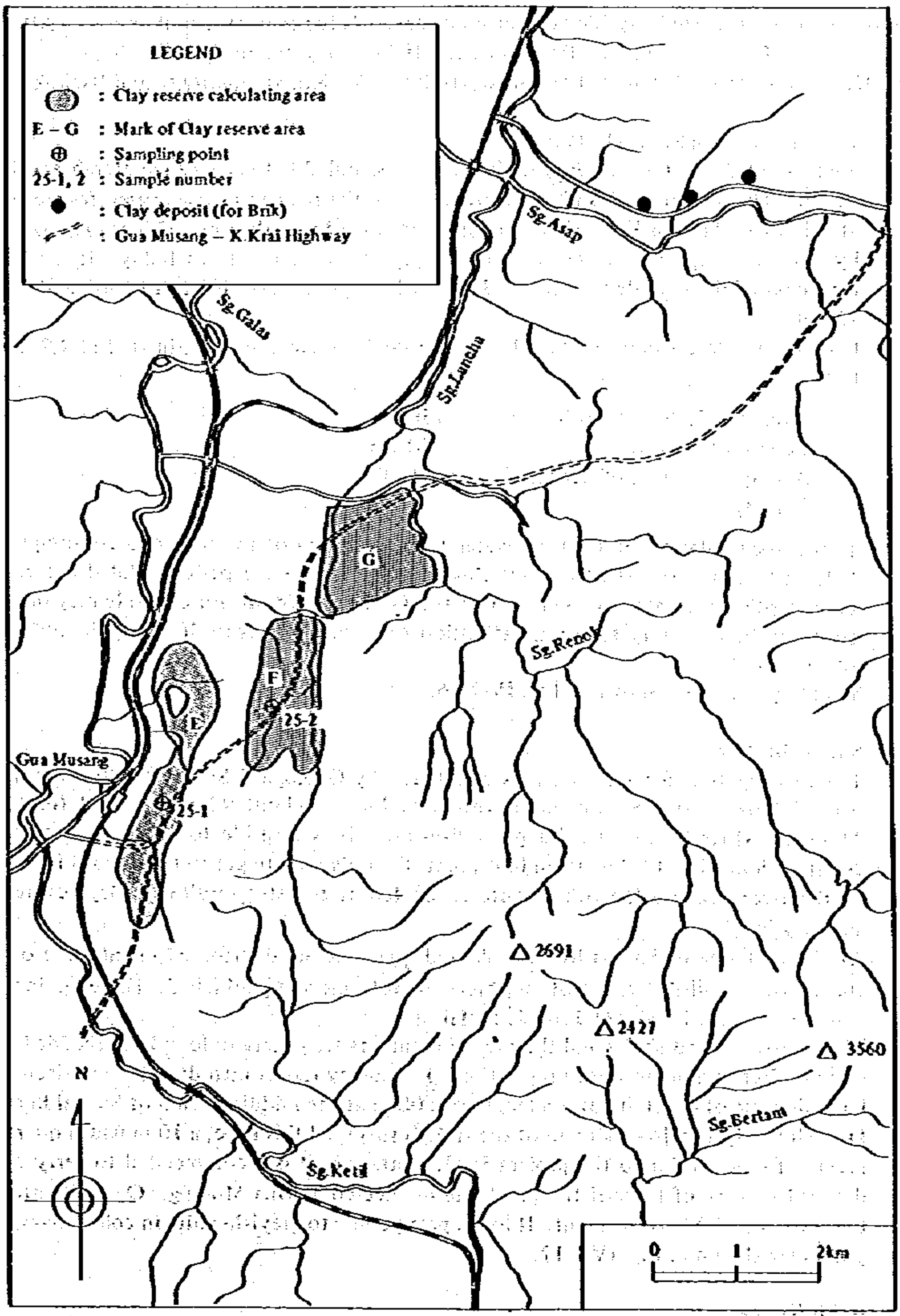


Fig. IV-1-15 Sampling Points Map of Gua Musang North East



IV-1-4 Siliceous materials

There is no studies reported anything on siliceous materials for cement manufacturing. After the discussions with Geological Survey Department, a field survey for the purpose is carried out at Sungai Kelantan-river sand, Sungai Bertam-quartzite, Bukit Kuang–quartzite and Bachok–coast sand.

(1) River sand along Sungai Kelantan

River sand deposit along Sungai Kelantan is sampled between Tanah Merah and Kota Bharu. The size of sand is bigger at upstream of the river and some aggregates are found at this area. Around Kota Bharu, the deposited sand is fairly fine. This sand is collected by a sand pump and utilized as concrete aggregate at the town today. It is said the thickness of the sand deposit seems 3 m at 7 km upstream of the river mouth and 1 m at 15 km.

Using a simple assumption as follows, the sand reserve can be estimated at 4,200,000 tons.

Average width of deposit	150 m
Length of deposit	20 km
Average thickness of deposit	1 m
Density	1.4 t/m^3

If the accumulation of sand by water from upstream of the river and consumption is balanced, it is expected to utilize this deposit for a longer period. But if the cement consumption increases, the demand of the sand as aggregate for concrete may increase, so it will be necessary to pay an attention to maintain river itself during the utilization of river sand.

Sampling points are shown in Fig. IV-1-16.

(2) Sungai Bertam

The investigation for sand stone is conducted by Geological Survey Department along Sungai Bertam and Sungai Ketil which are located about 9 km southeast from Gua Musang. Through an oil palm plantation area, it is possible to approach the branch point of Sungai Ketil, but from that point, the only way to get to the deposit is by foot in the river because the other route is located at the steep wall of valley covered by primary jungle.

At the east side of Sungai Ketil, shale and quartzite are distributed mainly, the others are mudstone, siltstone, sandstone, breccias, volcanic and pebblebed. These marine and continental mixed facies of Jurassic to Triassic.

The quartzites and shales and their lesser members are generally found interbedded with one another in a monotonous repetition. The survey report introduced above decribes a large deposit of quartzite over a length of 500 m at the middle stream of Sungai Bertam. Deposite only the down stream of the river is surveyed this time, a 10 m width quartzite layer is found. Prior to the project implementation, it is recommended to carry out a detailed survery of these if the plant site is selected at Gua Musang. Quartzite around the area is suitable for cement. It looks pale-yellow to greyish-white in color. Sampling points are shown in Fig. IV-1-17.

(3) Bukit Kuang

Bukit Kuang is located 25 km from Tanah Merah in the west-northwest direction near the border of Thailand. An 18 km paved road is available from Tanah Merah to Kg.

Fig. IV-1-16 Sampling Points Map of River Sand and Coast Sand

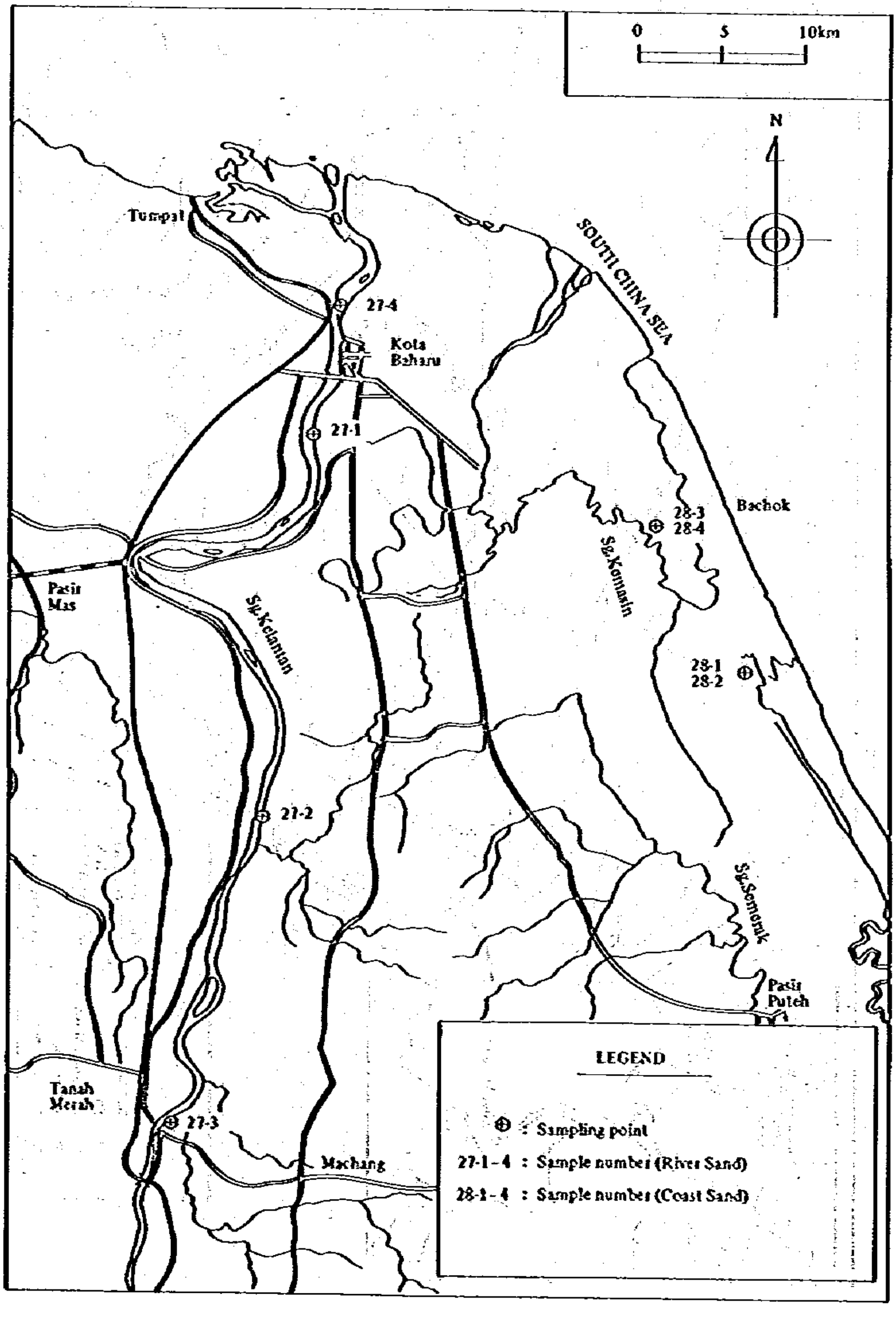
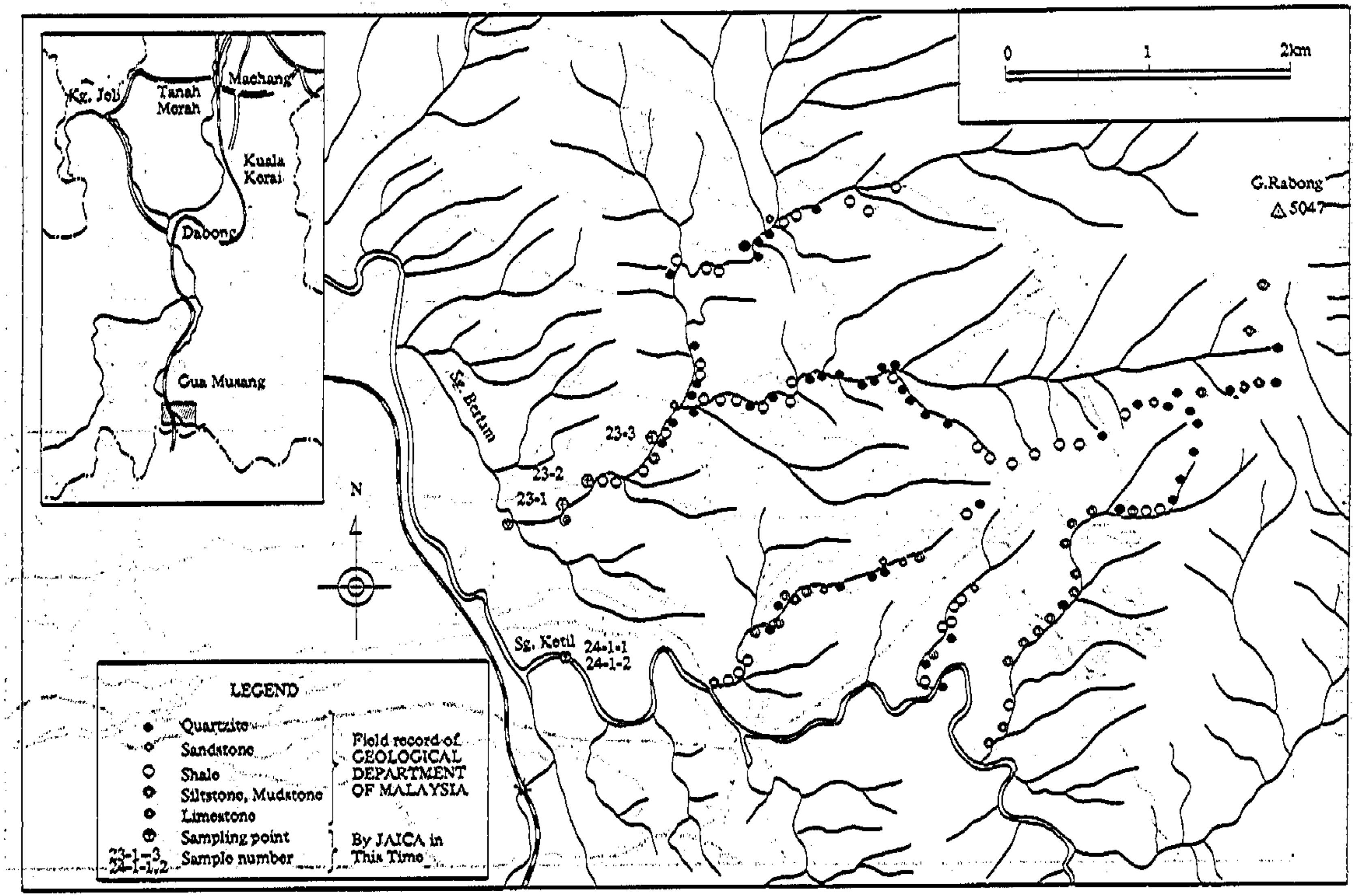


Fig. IV-1-17 Route Map Along Sungai Bertam

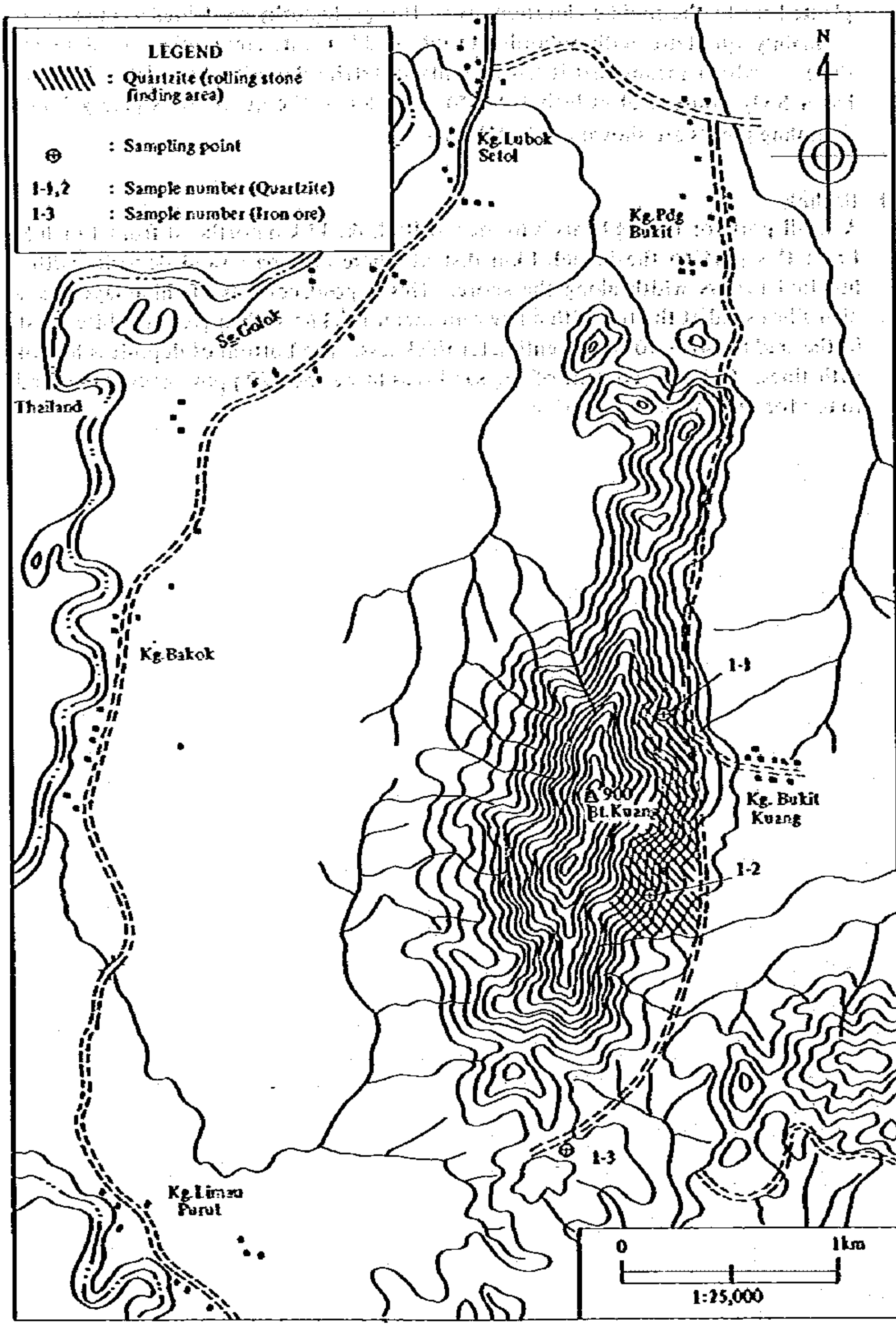


Jedok, then a 21 km unpaved road exists as an access way to Bukit Kuang. This hill stands independently on a flat ground, and has a fairly steep slope. Rubber trees are planted up to the middle elevation area. It is geologically explained as arenaceous rock – mainly quartzite with subordinate interbedded grit, grexwacke, conglomerate and shale –, which means that it has a plenty quartzite deposit. Sample analysis shows it has a SiO_2 content of as high as 97.44%. Color of the quartzite is pale yellow-white. Sampling points are shown in Fig. IV-1-18.

(4) Bachok

A small port for fishing boats is located at Bachok, 37 km northeast from Tanah Merah. From this port to the inland 4 km distant, there are coast sand deposits with a few hundred meters width along the shore. This deposit consists of three layers, a white, high silica sand at the top with a few centimeter thickness, then greyish-white coast sand in the middle with 40 to 50 centimeter thickness. The bottom of deposit is brown sand with fines. Chloride content of the sand is as low as 50–70 ppm, making the sand easy to use for cement manufacturing.

Fig. IV-1-18 Sampling Points Map of Bt.Kuang



IV-1-5 Iron ore

The history of iron ore deposit in the state of Kelantan began at Temangan in 1921. Two Japanese firms tried to mine at the beginning of 1930, then 1,140,000 tons ore was mined by Southern Mining Co., Ltd. between 1935 and 1941. There is no record of mining from 1942 to 1957. In 1955, Oriental Mining Co., Ltd., a joint venture of English and Japanese opened Temangan again. The record of total mined ore says over 4,910,000 tons in 8 years – 1958/1965. Then the resultant shortage of reserve caused the mine to be closed again. These products were exported to Japan.
A paper "Iron ore deposits of West Malaysia" by J.H. Bean, O.B.E., Geological Survey Department is published in Sep. of 1969. Based on the paper and other information, three areas including Temangan, Bukit Lata and Bukit Kuang are studied in this report. Magnetometer survey was conducted around the southern area of Gua Musang by Geological Survey Department, while, it was rather difficult to carry out the field survey using these information at this time.

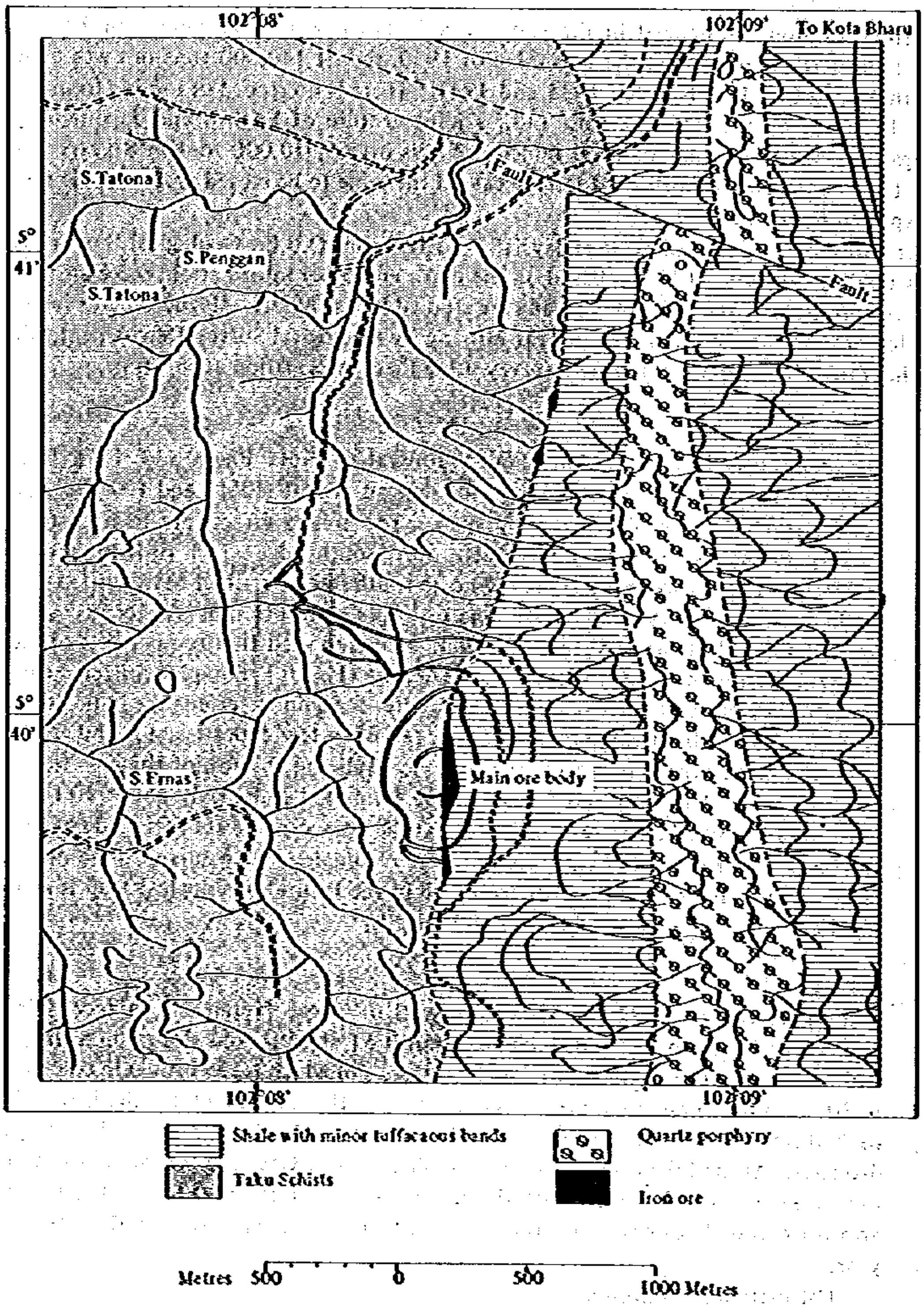
(1) Temangan
The deposit is located 53 km south-southwest of Kota Bhara and 4 km from the village of Temangan. Co-ordinates of the deposit are 50° 40' N. and 102° 08' E, and it can be reached from Temangan by road. The area is effectively isolated from the country to the east by a very prominent north-south ridge which rises to an elevation of 280 m. The orebodies lie along the north-south line of contact between Taku-Schists to the west and shales to the east. The main ore concentration was located along the crest of the hill, at an elevation of 224 m. It is reported that ore consists of Siderite ($FeCO_3$), Limonite ($Fe_2O_3 \cdot nH_2O$) and Hematite (Fe_2O_3). Samples collected this time indicate they are Goethite–a kind of Limonite–. Sampling points are indicated in Fig. IV-1-20. During the field survey at Temangan, very few deposits are found around the west wall from center to north, the entrance wall and the top of the east wall at the northern side. These scattered reserves are estimated to be only about 10 thousands tons. As a few small iron ore bodies occur at the northern and southern side of the main ore body that have not been exploited, it is recommended to survey these deposits in detail if these reserves are proper to utilize in the future. Geological map is shown in Fig. IV-1-19 and sampling points in Fig. IV-1-20.

(2) Bukit Lata
Bukit Lata is located 32 km north-northwest of Tanah Merah and is accessible from Tanah Merah by a paved road. Its elevation is 51 m with mild slopes on a flat ground with rubber trees plantation. Under the surface soil which is red-brown in color with 20 to 30 cm in thickness, a red-brown clay containing Hematite and Geothite is found in 50 to 200 cm in thickness. The size of Hematite and Geothite is about 5 to 50 mm in diameter. Around the clay mining area, shale and large Geothite (more than 1 m in dia.) can be seen. Rough estimate of the reserve is around 260,000 tons. The soil in this area is excavated for road construction and, therefore, the reserve will decrease year by year.

Calculation Assumption	
Deposit Area:	350,000 m²
Deposit Thickness:	0.5 m
Density:	3.0 t/m³
Safety Factor:	0.5

Sampling points are indicated in Fig. IV-1-21.

Fig. IV-1-19 Geological Map of Temangan Iron Mine



by S.Mac DONALD

Fig. IV-1-20 Sampling Points Map of Temangan Iron Mine

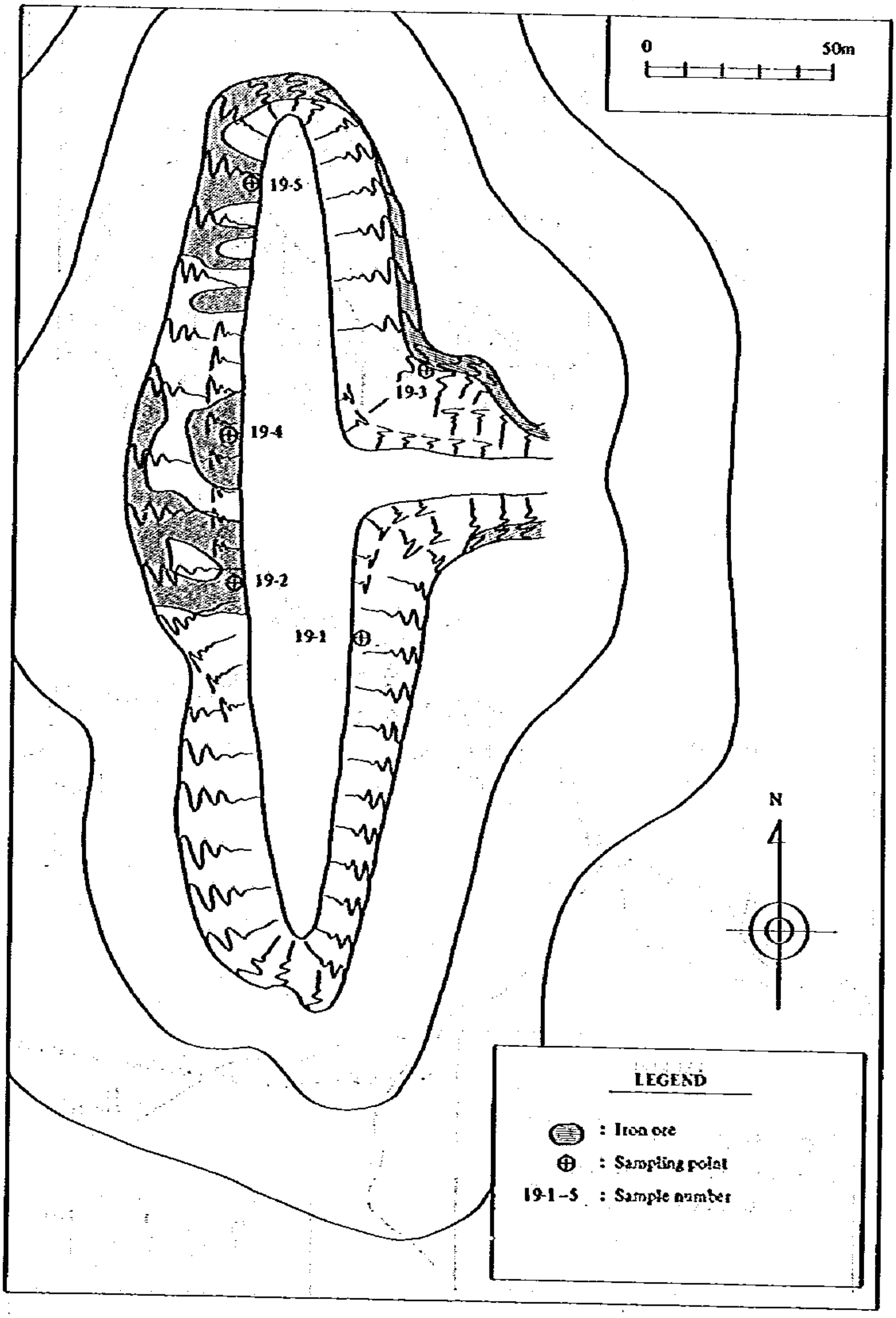
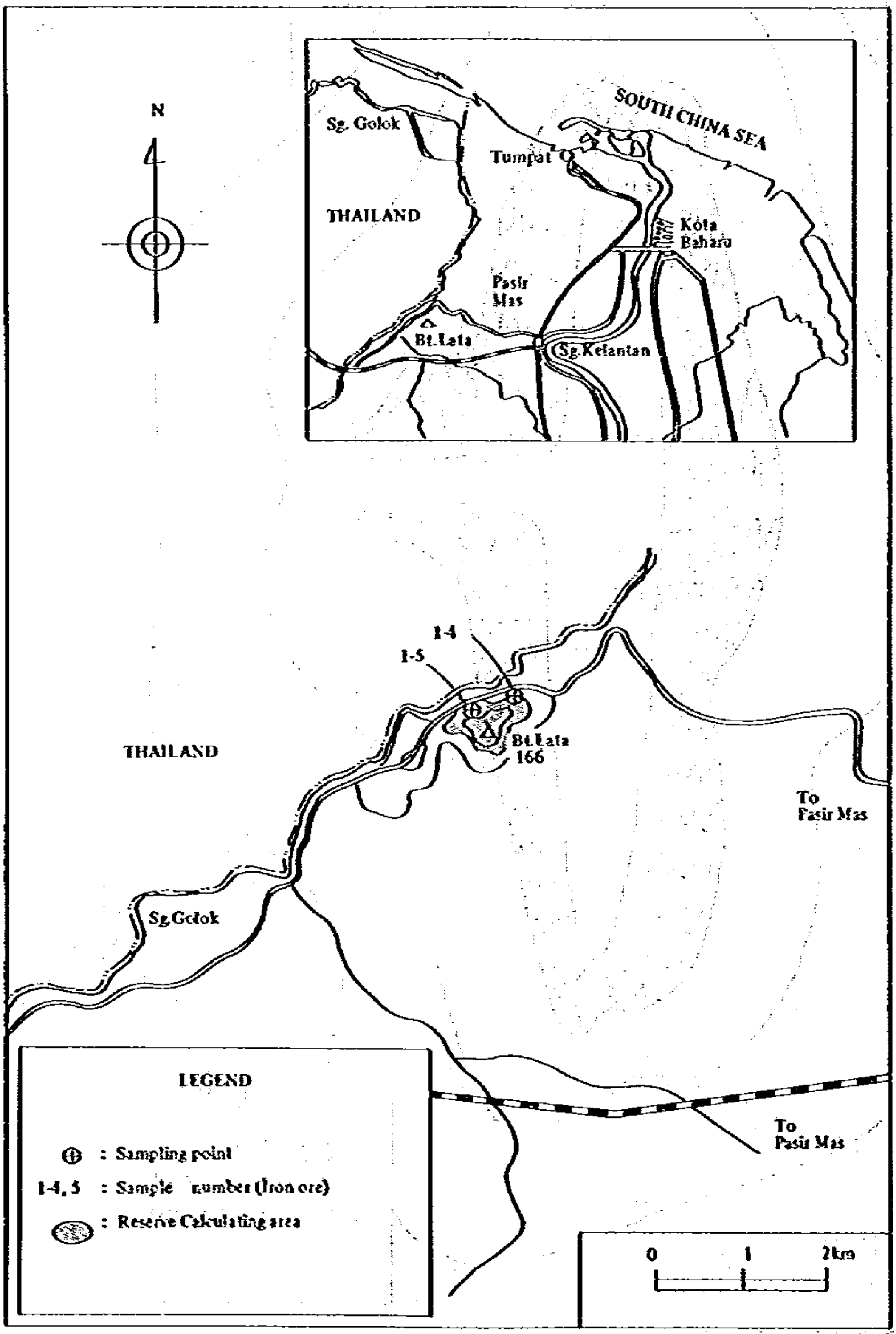


Fig. IV-1-21 Sampling Points Map of Bt.Lata



(3) Bukit Kuang

Based on the report "Iron ore deposits of West Malaysia", it is confirmed that the iron ore deposit lies around the south foot of Bukit Kuang. 5 to 30 mm dia. Hematites are distributed in the red-brown soil. The paper above describes there is a primary deposit in the deep area, and this estimates a 1,250,000 tons reserve in this area. It is recommended to survey in details to clarify the estimation.

The other iron ore occurences are shown in Table IV-1-6

Table IV-1-6 Other Iron Occurrences in Kelantan

Locality	Co-ordinates		Type of Deposit	Grade (Fe per cent)	Reserves
	North	East			
Channing Estate.	5° 27'	102° 12'	Boulders and outcrops of limonite and haematite, some of which are mildly magnetic. At a second nearby locality there are boulders of high-grade magnetic.	Variable	No figures available
Ulu Anak Sungei Sokor.	5° 39'	102° 04'	Boulders of magnetic showing an advanced stage of alteration to limonite. Sulphides also altering to limonite.	No figures available	No figures available
Gua Musang	4° 53'	101° 58'	Reported to be micaceous haematite.	No figures available	No figures available
Sungei Tasin	5° 14'	102° 01'	Mainly boulders of magnetite and haematite, but also some small primary bodies.	No figures available	Small
Sungei Tuang	4° 44'	101° 56'	Boulders of mixed magnetic hematite ore.	Up to 62	No figures available
Kuala Bala	5° 26'	101° 55'	Unusually rich concentrations of magnetite in stream sands.	No figures available	Unknowns

by J.H. BEAN, O.B.E

IV-1-6 Gypsum

Reports describing gypsum deposits in Malaysia are not available at present. Cement factories in Malaysia are utilizing Thailand gypsum today. An alternative source of gypsum may be Australia.

IV-1-7 Reserves and Duration

Reserves and their duration depending upon cement plant capacity are shown in Table IV-1-7. Limestone deposits at Gua Setir, Dabong hills and Gua Panjang are quite suitable for the project. Gua Musang is estimated to have a huge quantity of reserve.

Clay deposits at Jeli, Tanah Merah and Gua Musang are also quite suitable for the project. For the study purpose, it is assumed that the river sand at Sungai Kelantan will be used as siliceous materials, because it is difficult to estimate the reserve of Bachok coast sand.

The Bukit Lata deposit is assumed as a source of iron ore, although the reserve is not large enough. It is recommended to make further study on iron ore deposit at Bukit Kuang, Temangan and others.

Table IV-1-7 Relation between Capacity of Cement and Duration of Reserves

Kind of the Raw Materials	District	Plant Site	Available Reserves (x 1,000 t)	Duration of the Reserves (Year)			
				Capacity of the Plant			
				1500 t.Cl/d	2000 t.Cl/d	2500 t.Cl/d	3300 t.Cl/d
Lime stone	Gua Setir	Jeli	50,687	83	63	50	–
	Dabong	Tanah Merah	40,289	65	49	39	–
	Gua Panjang (C)	Gua Musang	155,295	492	371	296	229
	Gua Panjang (D)	Gua Musang	1,953,427	6,211	4,663	3,728	2,876
	"	Tanah Merah	1,953,427	–	2,424	–	
Clay	Jeli	Jeli	35,148	317	237	189	–
	Tanah Merah West	Tanah Merah	23,352	156	116 (112)*	93	–
	North	Tanah Merah	1,928	250	187 (80)*	150	–
	Gua Musang	Gua Musang	32,029	259	194	155	138
Silica Sand	S. Kelantan	Jeli	4,200 + α	81 + α	61 + α	48 + α	–
		Gua Musang	4,200 + α	148 + α	111 + α	89 + α	68 + α
Iron Ore	Bt. Lata	Jeli	260 + α	19 + α	14 + α	11 + α	–
		Tanah Merah	260 + α	39 + α	29 + α (35 + α)*	23 + α	–
		Gua Musang	260 + α	18 + α	13 + α	11 + α	8 + α

* Figure in brackets denote Case A.

IV-2 Raw Material Quarry

IV-2-1 Raw material requirement

In order to plan the development of quarry to supply raw materials to cement plant, it is necessary to fix the required quantity for each case to be studied. As described in V-4-4, the case study is carried out based on three different levels of plant capacity at three proposed plant sites. At first, the raw material quarries are decided for each proposed plant site by its availability and cost. Then the quality requirement of plant product – portland cement is fixed by the British Standard as described in V-6-1. Finally, raw mix composition is calculated as described in V-6-2. Final figures of the required quantities for each case are shown in Table IV-2-1. Conversion factors from dry base consumption to wet base quantity are listed below.

a) Tanah Merah

	Quarry	Dry Base Consumption (t/t•cl)		Moisture (%)
		Case A	Case 1A, 7	
Limestone	Gua Musang (D)	1,239	-	
	Dabong	–	1,276	2.5
Clay A	Tanah Merah West	0.279	0.268	15
Clay B	Tanah Merah North	0.028	0.012	26
Iron Ore	Bukit Lata	0.011	0.013	7
Gypsum	Thailand	0.050	0.050	3

b) Gua Musang

	Quarry	Dry Base Consumption (t/t•cl)	Moisture (%)
Limestone	Gua Panjang C	0.644	2.5
Limestone	Gua Panjan D	0.644	2.5
Clay	Gua Musang	0.187	28
Silica Sand	Sungai Kelantan	0.058	3
Iron Ore	Bukit Lata	0.029	7
Gypsum	Thailand	0.050	3

c) Jeli

	Quarry	Dry Base Consumption (t/t•cl)	Moisture (%)
Limestone	Gua Setir	1.243	2.5
Clay	Jeli	0.191	18
Silica Sand	Sungai Kelantan	0.106	3
Iron Ore	Bukit Lata	0.027	7
Gypsum	Thailand	0.050	3

Table IV-2-1 Raw Material Requirement

Unit: ton per year net

Cement Production Cap.		500,000 ton/year			666,000 ton/year				833,000 ton/year			1,080,000 ton/year
Plant Site		Tanah Marah	Gua Musang	Jeli	Tanah Marah		Gua Musang	Jeli	Tanah Marah	Gua Musang	Jeli	Gua Musang
Case Study		1	2	3	4	A	5	6	7	8	9	B
Limestone	Dry Base	607,620	306,670	591,910	809,350	805,860	408,480	788,420	1,012,290	510,910	986,110	679,320
	Wet Base	623,200	314,530	607,080	830,100	826,520	418,950	808,630	1,038,250	524,010	1,011,400	696,740
Limestone	Dry Base		306,670				408,480			510,910		679,320
	Wet Base		314,530				418,950			524,010		696,740
Clay	Dry Base	127,620	89,050	90,950	170,620	207,800	118,610	121,780	213,410	149,150	152,320	232,280
	Wet Base	150,140	123,680	110,920	200,730	244,180	164,740	148,520	251,070	207,150	185,760	283,270
Clay	Dry Base	5,710			7,610	23,980			9,520			
	Wet Base	7,720			10,290	32,580			12,870			
Silica Sand	Dry Base		27,620	50,480			36,790	67,230		46,010	84,090	61,560
	Wet Base		28,470	52,040			37,930	69,310		47,440	86,690	63,460
Iron Ore	Dry Base	6,190	13,810	12,860	8,250	7,330	18,390	17,130	10,310	22,210	21,420	31,430
	Wet Base	6,660	14,850	13,830	8,870	7,880	19,780	18,420	11,090	23,890	23,030	33,860
Gypsum	Dry Base	23,810	23,810	23,810	31,710	31,710	31,710	31,710	39,670	39,670	39,670	51,430
	Wet Base	24,550	24,550	24,550	32,700	32,700	32,700	32,700	40,890	40,900	40,890	53,020

IV-2-2 Limestone quarry

The basic plan to develop limestone quarries at three deposits – Dabong, Gua Panjang and Gua Setir – adopts the bench cut method by constructing a mining road up to the top of the deposit. The quarry capacity varies with the cement plant capacity, however, it is possible to supply the required quantity from the proposed deposit, though all deposits are surrounded by steep cliffs. Blasted rock is transported up to the primary crusher installed at the foot of the deposit by loader and truck. This plan is utilizing two crushers – the primary jaw crusher and the secondary impact crusher – by the reason of easy maintenance, although it is more economical to install a single stage impact crusher instead of two stage crushers. Finished limestone of size under 70 mm in diameter is stored at an open storage yard at Gua Setir and Gua Musang, and stored in a railway loading hopper at Dabong before transport to the proposed plant site by railway – Dabong and truck – Gua Setir. In the case of Gua Musang, it is possible to transport limestone directly to the plant by belt conveyor. In Case A of Tanah Merah limestone is transported by railway. As for their operations, 8 hours per day and 25 days per month are respectively applied.

(1) Dabong quarry
Estimated reserves are 13 million tons at Gua Pagar and 14 million tons at Gua Masta respectively, which are considered to be relatively small in scale as described in IV-1-2 (5). The plan is assumed to mine these two deposits at the same time for the maximum requirement case.
A mining road is constructed between the foot of the deposit (61 m from the sea level) and the bench cut level of Gua Pagar (137 m from the sea level). This is 1,400 m long with an average inclination of 5.4% (3°05). (Fig. IV-2-1, Fig. IV-2-2)
The branch road from the above is constructed, 800 m long with 10.5% (5°59') of average inclination between 84 m from the sea level and 168 m from the sea level at Gua Masta. Over burden of deposit is removed at the bench cut area. The height of the bench is 10 m. A sketch is shown in Fig. IV-2-3.

(2) Gua Panjang quarry
This reserve is estimated at 4,000 million tons, but block C (150 million tons reserve) and block D (1,950 million tons reserve) are decided to be mined because of the test results as described in IV-3-1 (iii).
A mining road is constructed between the foot level of Gua Panjang (128 m S.L.) and a primary crusher level (244 m S.L.) and it is 1,200 m long with 9.7% (5°31') of average inclination. The road from a primary crusher level to block C bench cut level (360 m S.L.) is 1,400 m long with 8.3% (4°44') of average inclination. The road to block D bench cut level is 2,200 m long with 5.3% (3°01') of average inclination. (Fig. IV-2-4)
A jaw crusher as the primary crusher is installed around the meeting point of the mining roads to block C and block D, and a impact crusher as the secondary crusher is installed at the foot of Gua Panjang. From the primary crusher to the secondary crusher, the belt conveyor of 600 m length with 11°8' of average inclination is installed. A sketch is shown in Fig. IV-2-5.

(3) Gua Setir
This deposit forms a long, narrow hill having a width of only 80 m on average surrounded by steep cliffs as described in IV-1-2 (3) (i). This suggests the difficulty in developing quarry and mining works.

Fig. IV-2-1 Dabong Location Map

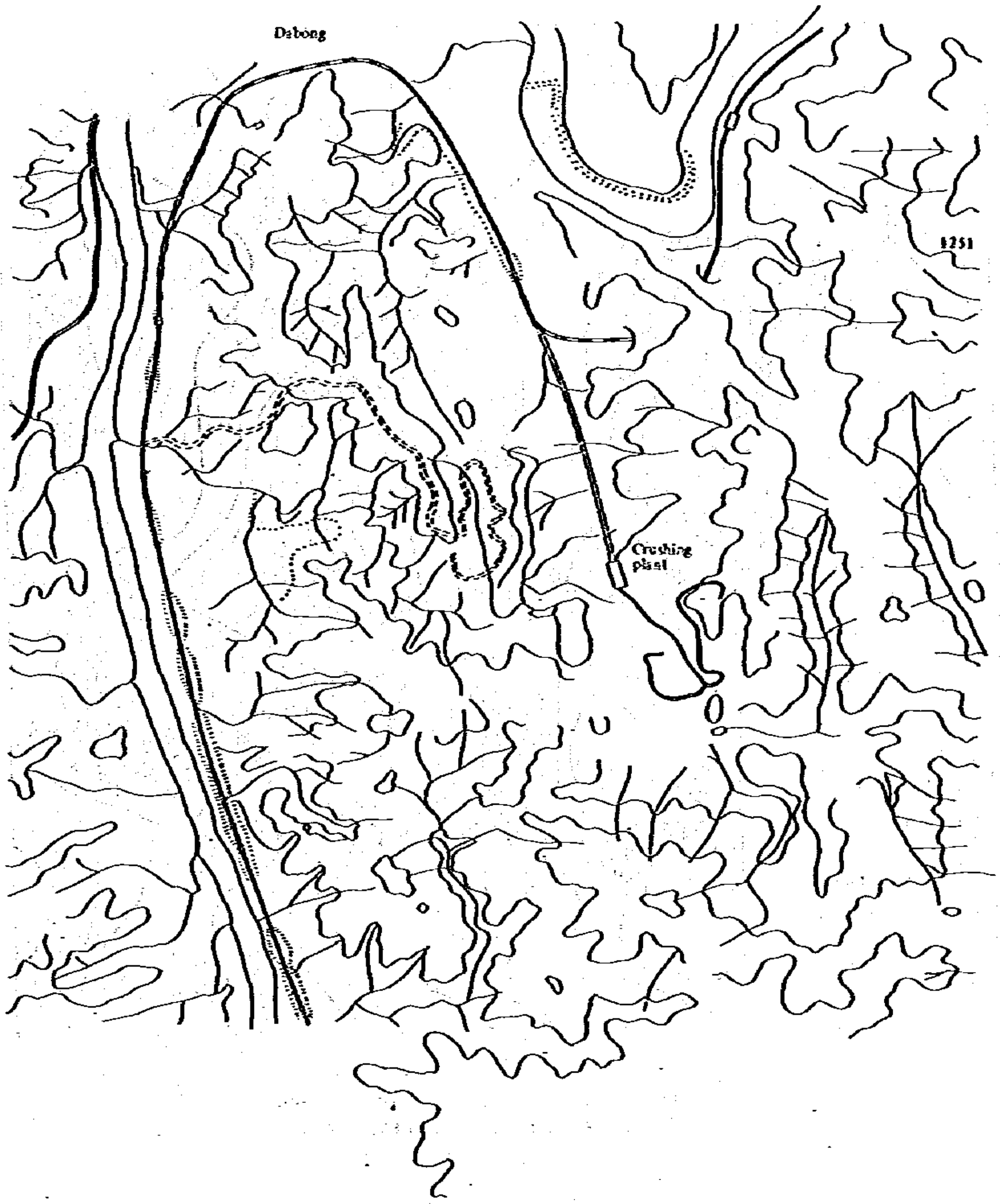


Fig. IV-2-2 Dabong Limestone Quarry

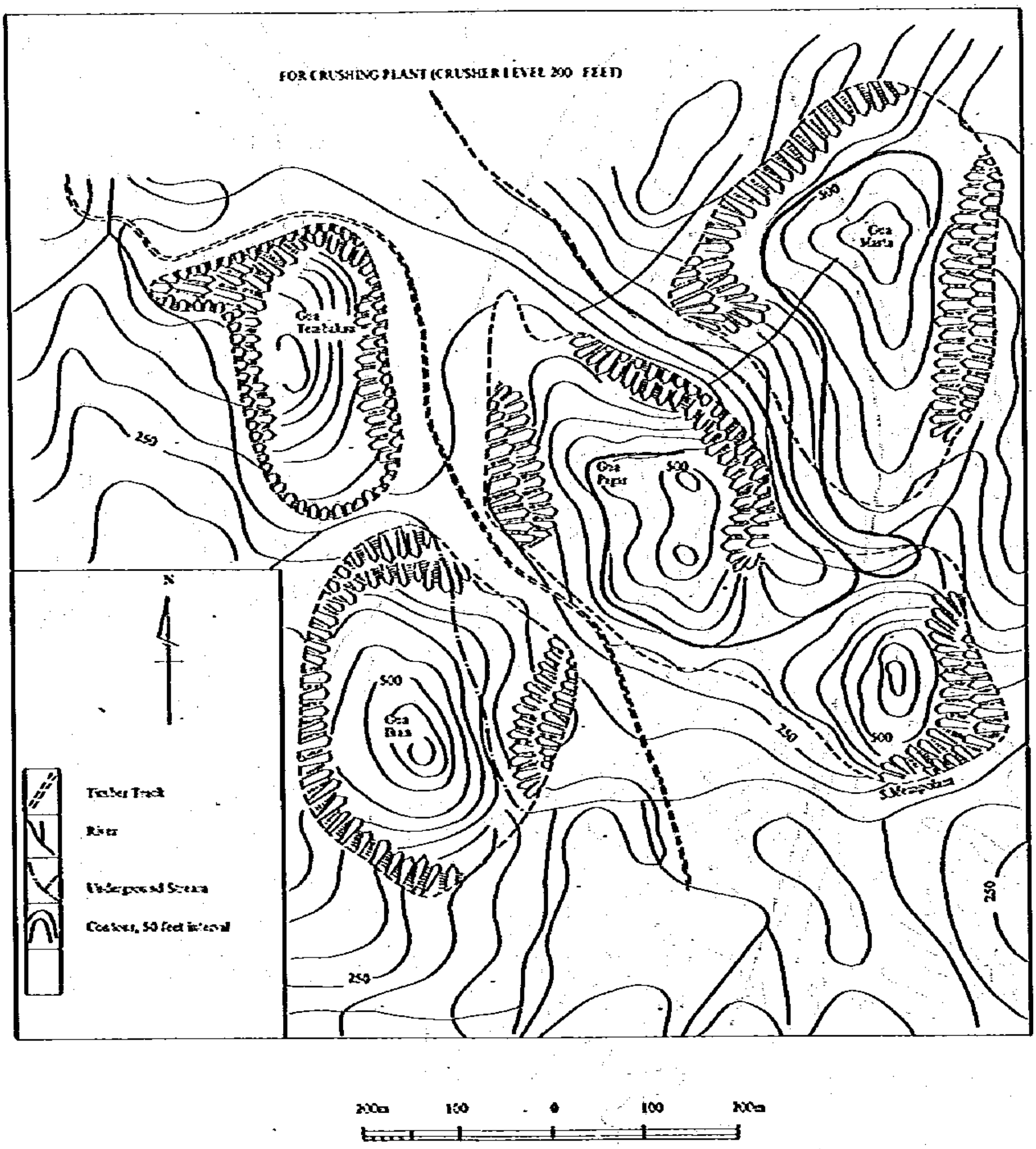
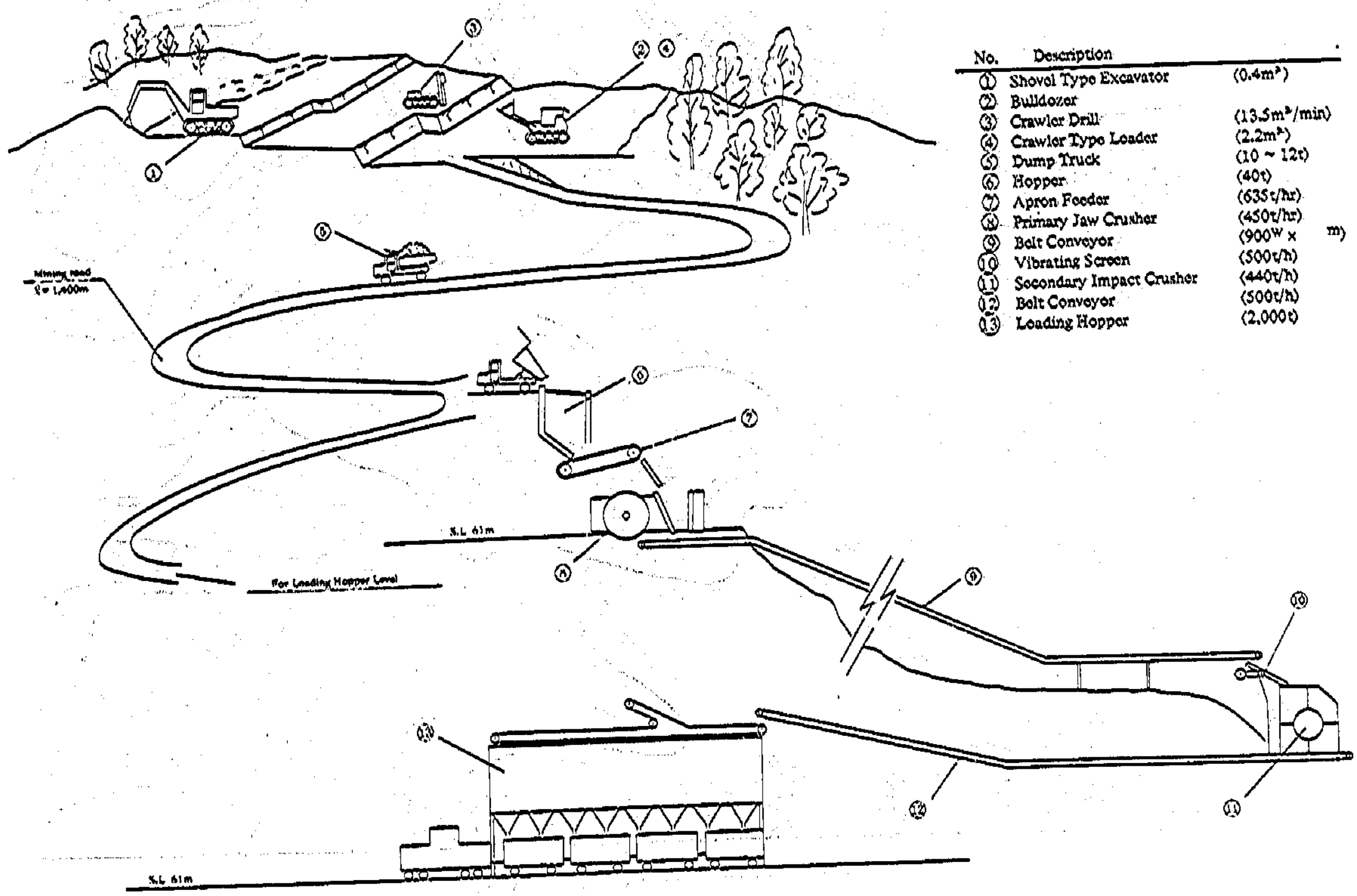


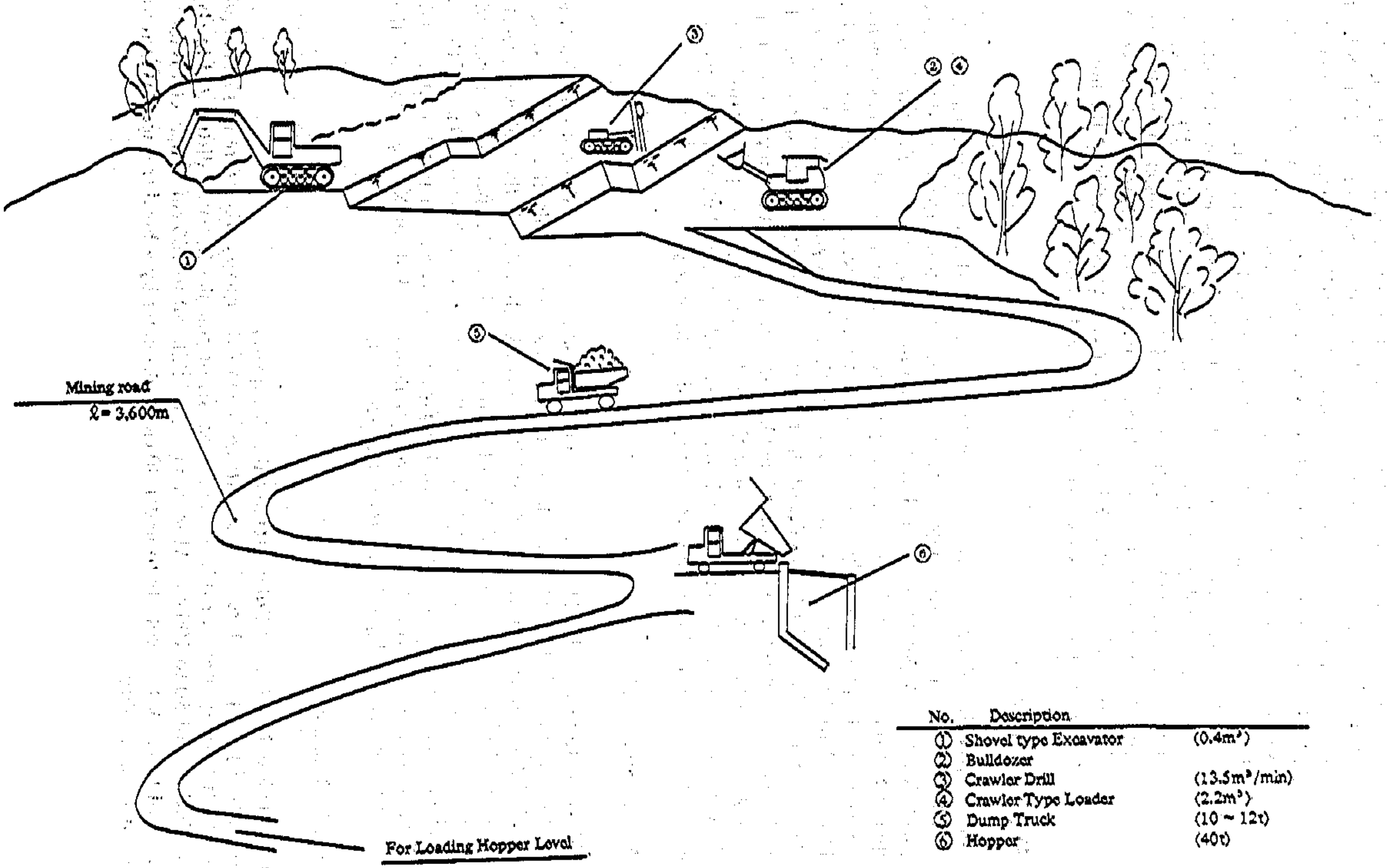
Fig. IV-2-3 Quarry Plan at Dabong (84,000 t/m)



No.	Description	
①	Shovel Type Excavator	(0.4m³)
②	Bulldozer	
③	Crawler Drill	(13.5m³/min)
④	Crawler Type Loader	(2.2m³)
⑤	Dump Truck	(10 ~ 12t)
⑥	Hopper	(40t)
⑦	Apron Feeder	(635t/hr)
⑧	Primary Jaw Crusher	(450t/hr)
⑨	Belt Conveyor	(900W × m)
⑩	Vibrating Screen	(500t/h)
⑪	Secondary Impact Crusher	(440t/h)
⑫	Belt Conveyor	(500t/h)
⑬	Loading Hopper	(2,000t)

Fig. IV-2-4 Gua Musang Limestone Quarry

Fig. IV-2-5 Quarry Plan at Gua Panjang (84,000 t/m)



No.	Description	
①	Shovel type Excavator	($0.4m^3$)
②	Bulldozer	
③	Crawler Drill	($13.5m^3$/min)
④	Crawler Type Loader	($2.2m^3$)
⑤	Dump Truck	(10 ~ 12t)
⑥	Hopper	(40t)

A timber truck route is available at the northern part of deposit up to 107 m from the sea level. A mining road is constructed from 107 m S.L. up to 152 m S.L. at the east side of deposit, and is 800 m long with 5.4% (3°05') of average inclination. The extended mining road from 152 m S.L. through the top of deposit (238 m S.L.) up to 198 m S.L. at the northern end of deposit, 1,650 m long. (Fig. IV-2-6)

Because of the narrow width deposit, blasted rock transporting road between benches can not be constructed. Therefore blasted rock is pushed down to both sides of the northern part of deposit by large bulldozers. A bench itself is 10 m heigh and is made at the northern end of deposit (198 m S.L.) at the beginning. Limestone piled at the foot of deposit is transported up to a primary crusher by loaders and trucks. A crushing plant is installed at 61 m S.L. where a flat ground is available at the northern side of a timber truck route. A sketch is shown in Fig. IV-2-7.

IV-2-3 Clay quarry

All the clay deposits are excavated by bulldozers or shovel excavators after removing useless surface soil, plants and their roots if necessary. The dump truck transports the clay to a cement plant directly. A powered loader, like a crawler loader or portable belt conveyors may be required to load the clay to the truck. It may be necessary to remove a large unweathered rock by a bulldozer. To prevent muddy water in and out at the quarry, the road in the quarry is designed to have a 1 to 3% upward inclination covered with sand and gravel. A pond at the entrance of the quarry and ditches at both sides of the road may be usefull. A good size storage of the clay at the cement plant is required to maintain plant operation during the rainy season. Tanah Merah quarry development is the easiest because the west side quarry has a paved road in the center of the deposit and the north side quarry is very close to the proposed plant site. Any special equipment such as crushers and screens are not required at the quarry.

IV-2-4 Silica sand

Silica sand from Sungai Kelantan is planned to use if siliceous material is not sufficiently available from limestone and clay. One simple way to get silica sand from the river is to excavate directly by a bulldozer or excavator, then to load it to a truck. But during the high-water-level season, this method may prove impractical. An alternative method now in operation commercially along the river is to use a sand pump installed in a floating house at 20 m or 30 m off the riverside. River sand with water is pumped through a pipe to a truck hopper installed at a suitable site, where water is separated. Quartzite at Sungai Bertam and Bukit Kuang is so hard that some mining facility such as a granite quarry will be required.

IV-2-5 Iron ore

Iron ore is to be mined at Bukit Lata like the clay quarry.

The paved road passes through the northern side of the quarry, therefore it is not required to construct a transportation road. Iron ore consists of granular hematite distributed in clay with the thickness of 50 to 100 cm. At some areas, goethite 50 to 100 cm in diameter is found. It is required to break the geothite to under 30 cm in diameter by a breaker since it is ferrous material of a good quality.

Fig. IV-2-6 Gua Setir Limestone Quarry

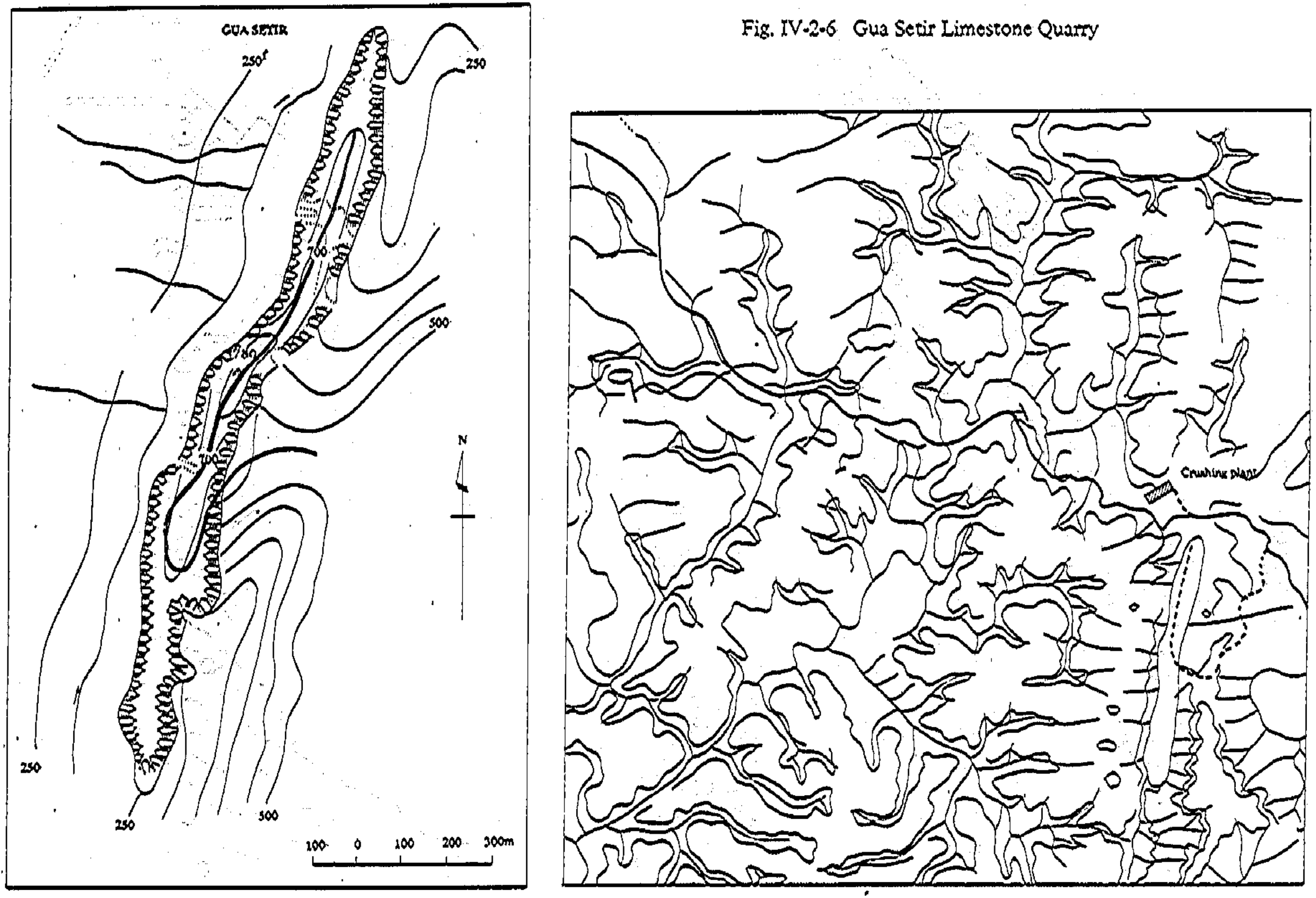
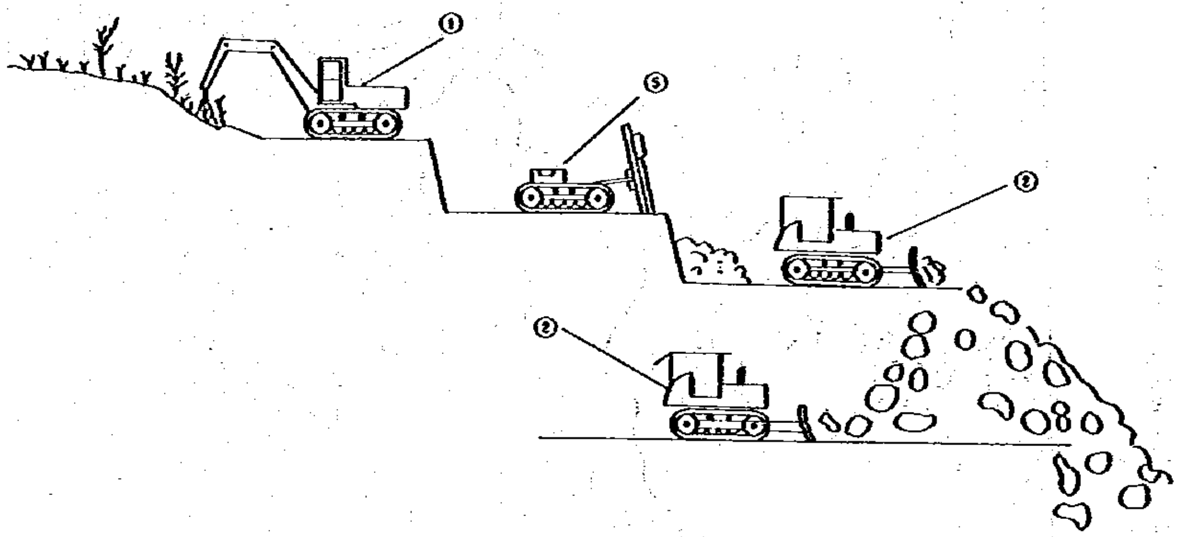
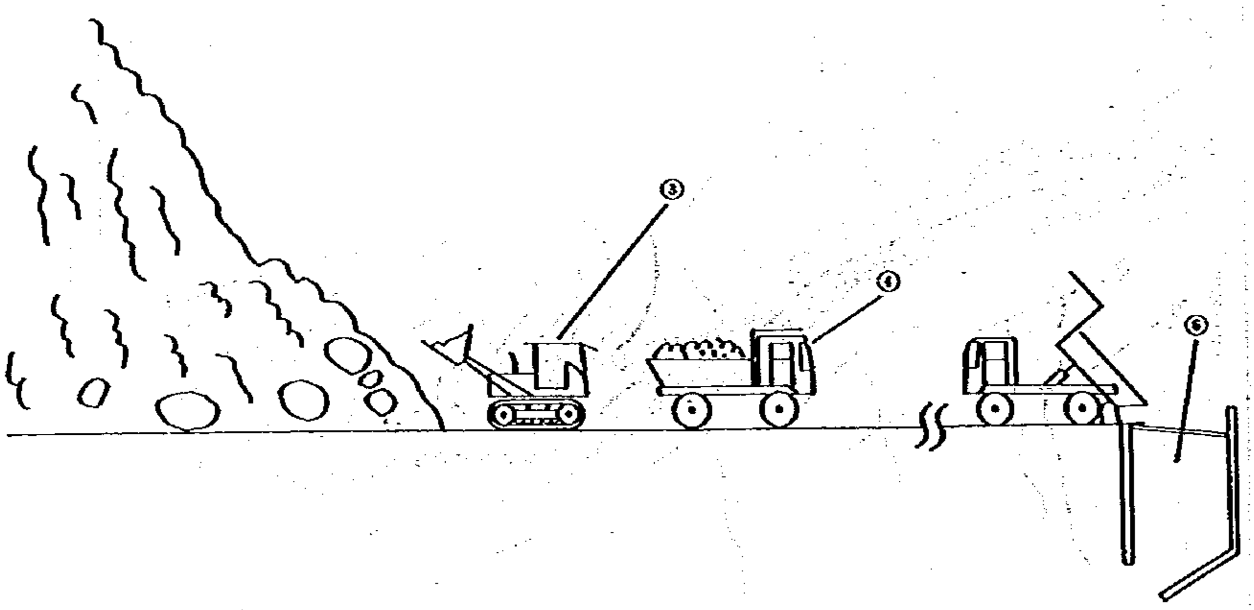


Fig. IV-207 Quarry Plan at Gua Setir (50,000 t/m)



No.	Description	
①	Shovel type Excavator	(0.4m³)
②	Bulldozer	
③	Crawler Type Loader	(2.2m³)
④	Dump Truck	(10 ~ 12t)
⑤	Crawler Drill	(13.5m³/min)
⑥	Hopper	(40t)



IV-3 Quality of raw materials

IV-3-1 Characteristics of raw materials

The characteristics of raw materials sampled during the field survey and studied for the Project based on the test results and the previous reports, are described in this section. The test results are summarized in the separate part.

(1) Limestome

Limestone deposits in three areas surveyed are suitable as raw material for cement manufacturing. The result of chemical analysis of the composite samples is shown in Table IV-3-1. The three major components of the composite samples as the critical ones for cement manufacturing are plotted in Fig. IV-3-1.

(i) Limestone deposits of Gua Setir

The CaO content, as the main component of limestone is more than 52% for almost all samples which shows it high quality.

The MgO content, as foreign matter is less than 2%.

Other foreign matter, such as SiO_2, Al_2O_3 and Fe_2O_3 are less than 1% for the greater part of the samples.

The SO_3 content, Na_2O content, K_2O content, P_2O_5 content and Cl content as minor components are almost nil in chemical analysis, therefore, this limestone is suitable for raw material of cement.

Limestone is made mostly of calcite crystal as a result of microcopy.

Partially, however, iron mineral such as pyrite is found.

Calcite crystal is formed of uniform particles of less than 100 μ, which is called as microcrystalline limestone.

(ii) Limestone deposits of Dabong

The CaO content, the main component of limestone, in this area is 51 ~ 54%.

The MgO content as foreign matter is less than 3% for almost all samples.

Other foreign matters, such as SiO_2, Fe_2O_3 and Al_2O_3 are less than 2% except a few samples.

The minor components, as explained in Gua Setir deposit, are almost nil, therefore this limestone is suitable for use as raw material for cement.

Limestone is made mostly of calcite crystal, however, in part, minerals such as quartz and pyrite are found.

Calcite crystal is mostly composed of crystalline grain of equal size with less than 100 μ, the other minerals such as quartz and pyrite are composed of uniform crystalline particles with 100 ~ 200 μ, which is slightly larger than that of calcite. This limestone is also called as microcrystalline.

(iii) Limestone deposits of Gua Panjang

This limestone deposit is divided into four blocks according to its physical shape and quality.

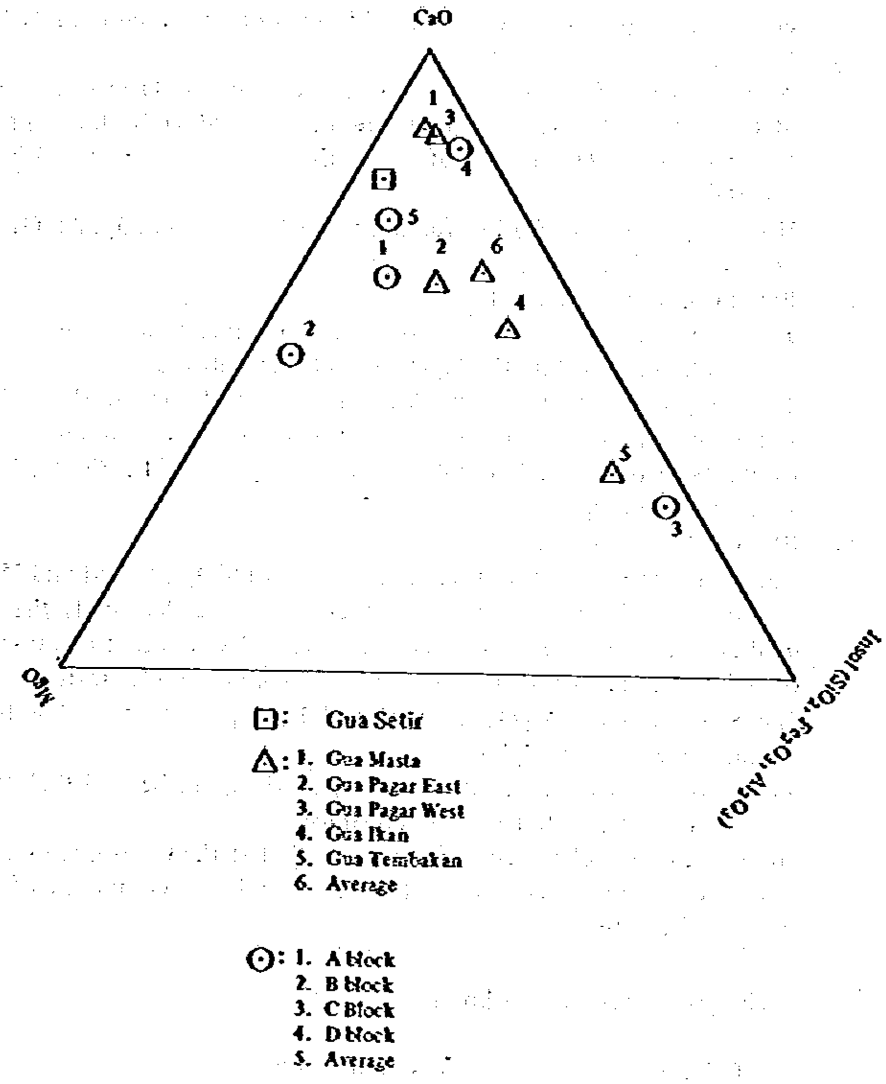
The following explains the characteristics of each deposit.

Table IV-3-1 Chemical Analysis of Mixed Sample

wt. % on a dry basis

Sample (number)		L.O.I	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Na_2O	K_2O	Total	P_2O_5	Cl
Gua Setir (5)		43.93	0.24	0.17	0.05	53.51	1.92	0.02	0.01	0.02	99.87	0.011	0.003
Dabong	Gua Masta (5)	43.73	0.34	0.23	0.04	54.61	0.79	0.04	tr	0.02	99.80	0.027	0.005
	East Gua Pagar (5)	43.31	1.42	0.60	0.16	52.28	2.02	0.03	0.04	0.07	99.93	0.018	0.005
	West Gua Pagar (5)	43.58	0.40	0.24	0.06	54.88	0.66	0.06	0.01	0.03	99.92	0.017	0.009
	Gua Ikan (5)	42.48	2.77	0.76	0.26	52.01	1.26	0.04	0.04	0.10	99.72	0.023	0.002
	Gua Tembakau (5)	40.92	4.86	1.46	0.54	50.54	1.03	0.04	0.14	0.25	99.78	0.031	0.002
	Average (25)	42.80	1.96	0.66	0.21	52.86	1.15	0.04	0.05	0.09	99.82	0.023	0.005
Gua Panjang	A (21)	43.39	0.92	0.34	0.10	51.83	2.77	0.05	0.01	0.05	99.46	0.25	0.003
	B (22)	44.34	0.49	0.11	0.07	49.97	4.87	0.04	tr	0.01	99.90	0.018	0.003
	C (26)	40.28	6.71	1.11	0.26	50.43	0.56	0.04	0.07	0.17	99.63	0.028	0.005
	D (11)	43.24	1.02	0.25	0.06	54.65	0.49	0.07	0.01	0.03	99.82	0.020	0.004
	Average (80)	42.82	2.29	0.45	0.12	51.72	2.17	0.05	0.02	0.07	99.71	0.079	0.004

Fig. IV-3-1 CaO-MgO-Insol Triangle Coordinate



a) Block A limestone deposit

The CaO content as the main component of limestone is more than 50% for almost all samples.

Contents of foreign matters such as MgO, SiO_2, Al_2O_3 and Fe_2O_3 are mostly less than 2%.

However, since limestone of dolomite matter is partly included in the collected samples, the mean value of MgO content is considerably high.

b) Block B limestone deposit

Approx. 40% of limestone in this area contains CaO less than 50%. As for MgO content, limestone with more than 3% MgO is abundant, especially, limestone of CaO content of more than 5% accounts for 20% of all the samples.

However, contents of other foreign matters, such as SiO_2, Al_2O_3 and Fe_2O_3 are less than 2%.

c) Block C limestone deposit

The CaO content as the main component of limestone is more than 50% for almost all samples. And the MgO content is less than 2%.

The SiO_2 content of almost all limestone samples is less than 1%, however, some samples contain more than 5% of SiO_2 as siliceous materials.

Contents of other foreign matters such as Al_2O_3 and Fe_2O_3 are less than 2%, a figure low enough.

d) Block D limestone deposit

Compared with the above three deposits, both SiO_2 content and MgO content are low, which shows that this block limestone deposit is the heighest in quality among Gua Panjang deposits. The CaO content of samples is more than 52% and MgO content is less than 2% for all samples tested.

The SiO_2 content, Al_2O_3 content and Fe_2O_3 content are less than 1% for the majority of the samples.

As far as minor components are concerned, it can be said that all the limestones tested seem safe for commercial use.

The microscopic observation has indicated that the limestone samples consist mainly of calcite crystal except a few which are composed of crystals of quartz and pyrite.

The grain sizes are as follows:

Calcite	:	less than 100 μ
Dolomite	:	100 – 200 μ
Quartz	:	Approx. 100 μ
Pyrite	:	Approx. 20 μ

Most of limestone from the Gua Panjan deposit is microcrystalline, although samples from Blocks A and B contain dolomite.

(2) Clay

(i) Jeli area

The main chemical compositions of clay in this area fall within the following ranges:

SiO_2 : 55 ~ 63% Al_2O_3 : 21 ~ 22%
Fe_2O_3 : 3 ~ 11%

The Fe_2O_3 content varies widely whilst the Al_2O_3 content scarcely flacturates.
The minor compositions are in the following ranges.

Na_2O	:	0.2 ~ 0.4%	K_2O	:	1.0 ~ 4.2%
P_2O_5	:	360 ppm	Cl	:	30 ppm

The mineral components of clay are quartz, kaolinite, muscovite (or halloysite) and feldspar.
The specific gravity is 2.64 in a mixed sample and the apparent specific gravity is 1.88 ~ 2.38.
The moisture of this clay ranges from 13.5 to 22.3%; however, this figure may fluctuate subject to weather.
Generally, clay located in the vicinity of the surface area is well weathered, although some clay shows otherwise. Even in the latter case, however, the clay can be mined without much difficulty.
Judging from the above, the clay in the Jeli area is suitable for the manufacture of portland cement.

(ii) Tanah Merah area

(a) Tanah Merah western deposit

The main chemical compositions of clay in this deposit are in the following ranges.

SiO_2	:	51 ~ 86%	Al_2O_3	:	9 ~ 26%
Fe_2O_3	:	1 ~ 16%			

All of the main components vary to a large extent in compositions.
The content of each component fluctuates mainly in the horizontal direction, but some samples such as No.26 ~ 9 and No.26 ~ 10 show fluctuation, though to a less extent, in the vertical direction as well.
The minor compositions are in the following ranges.

Na_2O	:	0.1 ~ 0.3%	K_2O	:	0.2 ~ 2.2%
P_2O_5	:	320 ppm	Cl	:	35 ppm

The mineral components of the clay are quartz, kaolinite and halloysite (or muscovite).
The content of each component differs substantially.
The specific gravity is 2.4 in mixed samples (26–1 ~ 13 and 21–2) and the apparent specific gravity is 1.7 ~ 2.4.
The moisture of this clay ranges from 9.1 to 21.5%.
The semi-weathered clay of schist sample Nos. 26–1, 26–11 and 21–1, and the sandy clay of high silica content, 26–12 and 26–13, are a bit scant of viscosity.

On the other hand, high-Al_2O_3 and Fe_2O_3 clay such as 26–3, 26–5, 26–7 and 26–10 are viscous.

Judging from the above, the clay in this area is suitable for the manufacture of portland cement.

In mining this deposit, however, where to be cut should be carefully determined on the basis of accurate understanding of the variation in the content of each component through prior survey, since the content of each component of the clay varies not only in the horizontal direction but in the vertical direction as well. At the same time, it is necessary for the clay to be mixed thoroughly at the storage yard.

(b) Tanah Merah northern deposit

The clay of this deposit is weathered clay of porphyritic diorite and its main components are in the following ranges of contents.

SiO_2	:	40 ~ 41%	Al_2O_3	:	27 ~ 28%
Fe_2O_3	:	16 ~ 17%			

The Al_2O_3 content and Fe_2O_3 content are high and homogeneous in quality. The minor components are in the following ranges.

Na_2O	:	0.1%	K_2O	:	0.5%
P_2O_5	:	600 ppm	Cl	:	58 ppm

The mineral components of the clay are quartz, haolinite and halloysite.

The specific gravity is 2.55 and the apparent specific gravity is 2.07.

The moisture is 25 to 27%, figures much higher than that at other deposits. The clay in this area, unlike that of Tanah Merah western deposit, has a high alumina content and iron content.

Judging from the above, the clay of this deposit is suitable for cement manufacturing.

(iii) Gua Musang area

(a) Gua Musang southern deposit.

The main components of clay are in the following ranges except the sample 24–5 which is very high in silica content.

SiO_2	:	53 ~ 64%	Al_2O_3	:	19 ~ 26%
Fe_2O_3	:	3 ~ 13%			

The Fe_2O_3 content varies widely.

The minor components fall within the following ranges of contents:

Na_2O	:	0.1 ~ 0.5%	K_2O	:	2.2 ~ 4.5%
P_2O_5	:	340 ppm	Cl	:	19 ppm

The mineral components of this clay are mainly quartz, muscovite (or halloysite) and kaolinite.

The specific gravity is 2.63 in mixed samples and the apparent specific gravity is 1.8 ~ 2.4.

The moisture of the clay ranges from 10 to 30%.
The clay is soft and easy to be mined by a bulldozer.
However, it may be otherwise in the wet season.
Judging from the above, the clay of this deposit is suitable for the manufacture of portland cement.

(b) Gua Musang North-Eastern deposit

The compositions of main components of 2 samples are in the following ranges.

SiO_2	:	53 ~ 58%,	Al_2O_3	:	24 – 27%
Fe_2O_3	:	7 ~ 8%			

Thus, the variations between both samples are not appreciable. The minor compositions range as follows:

Na_2O	:	0.1 ~ 0.2%	K_2O	:	2.5 ~ 3%
P_2O_5	:	420 ppm	Cl	:	15 ppm

The mineral components of clay are quartz, kaolinite and muscovite (or halloysite).
The specific gravity is 2.65 and the apparent specific gravity is 2.11.
The moisture of the clay ranges from 24 to 26%.
Judging from the above, the clay of this deposit is suitable for cement manufacturing.

(3) Siliceous Materials

(i) River sand of S. Kelantan

The chemical compositions of the river sand in S. Kelantan are highly homogeneous as shown in Appendix II. More notably, there can be found virtually no difference in the composition between the sand alone and a mixture of the sand and gravel.

SiO_2	:	90 ~ 93%,	Al_2O_3	:	4 ~ 5%
Fe_2O_3	:	0.6 ~ 0.8%			

The minor components are in the following ranges of composition.

Na_2O	:	0.4 ~ 0.6%	K_2O	:	1.5 ~ 2.8%
P_2O_5	:	200 ppm	Cl	:	39 ~ 65 ppm

The mineral components of this river sand are mainly quartz, feldspar and muscovite.
The specific gravity is 2.62 ~ 2.69 and the measure weight per unit is 1.52.
The moisture of the sand is 2.9%.
The size distribution in the Tanah Merah area is under 40 mm due to gravel mixture and the distribution in the Kota Bharu area is under 10 ~ 20 mm because of no gravel being mixed.
The following shows the size distribution in Tanah Merah area.

Sieve Passing (%)

20 m/m	10 m/m	5 m/m	2.5 m/m	1.2 m/m	0.6 m/m	0.3 m/m	0.15 m/m
100	94.4	92.0	82.2	57.4	24.2	5.3	0.7

Grindability of this sand shows 43.1 in hardgrove index, which is equal to that of hard silica rock.
The above indicates that the river sand in S. Kelantan is suitable as siliceous materials for cement manufacturing.

(ii) Quartzite of S. Bertam
The main components of quartzite are in the following ranges.

SiO_2	: 80 ~ 92%	Al_2O_3	: 3 ~ 5%
Fe_2O_3	: 2 ~ 3%		

The minor components range as follows:

Na_2O	: 0.1 ~ 0.3%	K_2O	: 0.5 ~ 1.0%
P_2O_5	: 400 ppm	Cl	: 39 ppm

The mineral components of this quartzite are mostly quartz including a small amount of muscovite.
Microscopic tests indicate that the crystal grain of quartz is under 200 μ in diameter and that there exists a small quantity of clay between quartz.
The specific gravity is 2.65 and the apparent specific gravity is nearly equal to that of Bt. Kuang.
Grindability of this quartz shows 45.5 ~ 78.8 in hardgrove index, which is considered to be in the middle class as silica rock.
Judging from the above, the quartzite in S. Bertam area is suitable for raw material for manufacture of cement.

(iii) Quartzite of Bt. Kuang
The main components of quartzite in the Bt. Kuang are relatively homogeneous and the quality of SiO_2 is also relatively high as described below.

SiO_2	: 97 ~ 98%	Al_2O_3	: 0.9 ~ 1.0%
Fe_2O_3	: 0.6~0.7%		

The minor components range as follows:

CaO	: 0.2 ~ 0.3%	Na_2O	: less than 0.1%
K_2O	: 0.1 ~ 0.2%	P_2O_5	: 60 ppm
Cl	: 40 ppm		

The mineral components of this quartzite is quartz alone as confirmed through X-ray tests.
Microscopic observation reveals that the crystal grain of quartz is 30 – 100 μ in diameter and is of chert.

The specific gravity, though not measured, seems equal to that of quartzite in the S. Bertam area.
The apparent specific gravity is 2.53.
Grindability, though not measured, seems to be equal to that of quartzite in the S. Bertam area, as estimated from visual observation and hammer crushing, which indicates that the quartzite is in the middle class grindability.
From the above, it can be judged that the quartzite in Bt. Kuang is suitable as siliceous materials for the manufacture of cement.

(iv) Coastal sand of Bachok

The main chemical compositions of coastal sand in Bachok area are in the following ranges.

SiO_2	: 92 ~ 98%	Al_2O_3	: 0.9 ~ 1.0%
Fe_2O_3	: 0.6 ~ 0.7%		

As shown above, there is considerable difference in the content of SiO_2.
Referring to the quality of sand in this area in terms of SiO_2 content, the sand from the upper layer of grey-white, fine sand lying 40 to 50 cm below the earth tends to have a higher quality, i.e. 97 ~ 98% in SiO_2 content, whilst the sand from the lower layer of brown, fine sand has a lower quality, i.e. approx. 92% in silica content.
The minor components range as follows.

Na_2O	: 0.1 ~ 0.2%	K_2O	: 0.4 ~ 0.8%
P_2O_5	: 140 ppm	Cl	: 50 ~ 70 ppm

X-ray tests have revealed that the mineral components of the coastal sand are quartz and a very small quantity of feldspar.
The size varies slightly depending upon the place and depth, but, is generally fine; under 5 mm and under 2.5 mm.
Judging from the above, the coastal sand in this area is suitable as siliceous materials for the manufacture of cement.

(4) Iron ore

(i) Iron ore of Temangan

The main chemical compositions of iron ore in Temangan are in the following ranges.

SiO_2	: 2 ~ 24%	Al_2O_3	: 0.4 ~ 6.8%
Fe_2O_3	: 58 ~ 86%		

The minor components range as follows:

Na_2O	: 0.04 ~ 0.11%	K_2O	: 0.09 ~ 1.73%
P_2O_5	: 440 ppm	Cl	: 16 ppm

Although the previous documents suggest that the iron ore in the Temangan area consists of limonite, hematite and sederite, the result of the X-ray test indicates that it comprises geothite of the limonite group.

The specific gravity is 3.93 in 5 mixed samples and the apparent specific gravity is 3.68.

The grindability varies widely from 45.4 to 108.5 in hardgrove index.

Judging from the above, the iron ore in the Temangan area is suitable as iron source for the manufacture of cement.

(ii) Iron ore of Bt. Lata

The main chemical compositions of the iron ore in the Bt. Kuang area is in the following ranges.

SiO_2	: 8 ~ 15%	Al_2O_3	: 8 ~ 18
Fe_2O_3	: 54 ~ 69%		

The minor components range as follows:

Na_2O	: 0.1 ~ 0.2%	K_2O	: 1.0 ~ 1.2%
P_2O_5	: 4100 ~ 8520	Cl	: 23 ppm

The mineral components are mainly hematite and haolinite for the granular ore and mainly goelhite including foreign matters such as muscovite (or halloysite) for lump ore.

The specific gravity is approx. 3.42 ~ 3.75.

The grindability of granular hematite is 68.3 in hardgrove index, a figure higher than that of iron slime.

The moisture is approx. 7% because a small amount of clay is included.

Judging from the above, the iron ore in the Bt. Lata area is suitable as raw material for cement manufacturing.

(iii) Iron ore of Bt. Kuang

The main chemical compositions of the iron ore in the Bt. Kuang area are in the following ranges.

SiO_2	: 6.2%	Al_2O_3	: 10.7%
Fe_2O_3	: 58.5%		

The minor components range as follows:

Na_2O	: 0.17%	K_2O	: 0.11%
P_2O_5	: 1240 ppm	Cl	: 21 ppm

The mineral components are mainly geothite with a small amount of clay mineral. The specific gravity and the grindability are nearly equal to those of Bt. Lata. Judging from the above, the iron ore in Bt. Kuang is suitable for cement manufacturing.

IV-3-2 Other uses of limestone

The main consumer of limestone is the cement industry followed by the steel industry and the lime industry. On a much smaller scale, limestone is also used as raw materials for carbide, aggregate for concrete and lime products.
The quality standards required for specific applications are discussed hereunder.

(1) White cement
White cement falls within the category of portland cement. What distinguishes it particularly from ordinary portland cement is that the Fe_2O_3 content of the former cement is substantially lower compared with the latter.
In manufacturing pure white cement, it is usually required to keep the Fe_2O_3 content of cement less than 0.3%.
The Table IV-3-2 shows the chemical analysis of the white cement sold in Japan.
To meet the stringent requirement for the Fe_2O_3 content of white cement, the Fe_2O_3 content of limestone itself should preferably be controlled to less than 0.1%.

(2) Steel industry
The role of limestone in steelmaking is to extract slag which is easily dissolved upon contact with iron ore and ash in coke. Further, limestone also acts to desulfurize and dephosphorize molten iron and steel.

(3) Carbide
Carbide is manufactured by melting in an electric furnace carbonaceous materials such as coke and anthracite coal with quicklime which is produced by burning limestone.

(4) Aggregate for concrete
To impart sufficient durability and refractoriness to concrete, high-quality aggregate like basalt and andesite is necessary. In the localities where such high-quality aggregate is not available, it is advisable to use limestone instead of granite which is inferior in quality. The Table IV-3-3 shows the test results on granite and limestone collected on site.
According to the Table, the limestone is nearly equal to the granite in quality, indicating applicability of the limestone as raw material for aggregate.

(5) Lime products
What are generally called lime products includes lime powder, heavy and light calcium carbonite, quicklime and hydrated lime, being made of limestone.

Table IV-3-2 Chemical Analytical Value of White Cement

Chemical Composition (%)											Module of Cement		
L.O.I	Insol	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Na_2O	K_2O	Total	H.M	S.M	I.M
2.59	0.16	23.91	4.49	0.21	63.90	1.78	2.15	0.86	0.26	100.34	2.18	3.09	21.38

Table IV-3-3 Test Result of Aggregate

Sample		Apparent Specific Gravity	Absorption (%)	Compressed Strength (kg/cm^2)	Speed (m/s)		Specific Gravity	Stability (%)
					P Wave	S Wave		
Gua Panjang White Limestone	1	2.67	0.15	1,150	6,150	4,100	2.69	0.9
	2	2.72	0.00	1,600	6,350	3,860		
	3	2.68	0.00	1,580	6,250	3,180		
	4	2.67	0.00	1,020	6,280	3,840		
	Average	2.68	0.04	1,340	6,260	3,750		
Gua Panjang Black Limestone	1	2.60	0.30	920	5,830	3,480	2.69	0.8
	2	2.64	0.31	1,000	5,850	3,350		
	Average	2.62	0.31	960	5,840	3,420		
JKR Quarry Granite	1	2.55	0.45	2,280	5,470	2,880	2.59	1.5
	2	2.53	0.47	1,930	5,440	3,290		
	3	2.55	0.47	2,140	5,400	2,870		
	4	2.58	0.48	2,350	5,560	3,450		
	5	2.56	0.33	2,440	5,500	2,860		
	6	2.53	0.17	2,420	5,460	3,460		
	Average	2.55	0.40	2,260	5,470	3,140		

Table IV-3-4 Quality and Standard by Use

Use		Limestone								
		Pig Iron	Steel	Ferro-Alloy	Carbide	White Cement	Limestone Filler for Bituminous Materials	Agricultural Liming Materials	Aggregate for Concrete	Quickline and Limestone for Sulfite Pulp Manufacture
Spec.							JIS A 5008–1976	ASTM C 602–1969	Architectural Institute of Japan Japan Society of Civil Engineers	ASTM C 46–1962
Chemical Composition (%)	CaO	54 ≦	54 ≦	54 ≦	$CaCO_3$ 98 ≧					$CaO + MgO$ ≧ 95.0
	MgO	0.5 ≧	0.5 ≧	0.5 ≧	0.5 ≧	2.0 ≧				
	SiO_2	1.0 ≧	0.5 ≧	1.0 ≧	1.0 ≧					SiO_2 3.0 ≧
	Fe_2O_3				1.0 ≧	0.1 ≧		0.1		Fe_2O_3 3.0 ≧
	S	0.01 ≧	0.01 ≧	0.01 ≧						Al_2O_3 3.0 ≧
	P	0.01 ≧	0.02 ≧	0.005 ≧	P_2O_5 0.01 ≧					
							Moisture Max. 1.0% Specific Gravity ≧ 2.60	Calcium Carbonate Equivalent (C.C.E) Min. 80%	Saturated surface dry specific gravity M in 2.5 Absorption Max. 2.0% Stability Max. 10.0%	

Table IV-3-5 Mixed Sample of Limestone

Use		Limestone: Pig Iron	Steel	Ferro-Alloy	Carbide	White Cement	Limestone Filler for Bituminous Materials	Agricultural Liming Materials	Aggregate for Concrete	Quicklime and Limestone for Sulfite Pulp Manufacture
Gua Sela		X	X	X	X	O	O	O		O
Dibong	Gua Marta	X	X	X	X	O	O	O		O
	Gua Pagar	X	X	X	X	X	O	O		O
	Gua Ikan	X	X	X	X	X	O	O		O
	Gua Tembusan	X	X	X	X	X	O	O		X
Gua Panjang	A	X	X	X	X	X	O	O	O	O
	B	X	X	X	X	X	O	O	O	O
	C	X	X	X	X	X	O	O	O	X
	D	X	X	X	X	O	O	O	O	O

X : Not suitable
O : Suitable