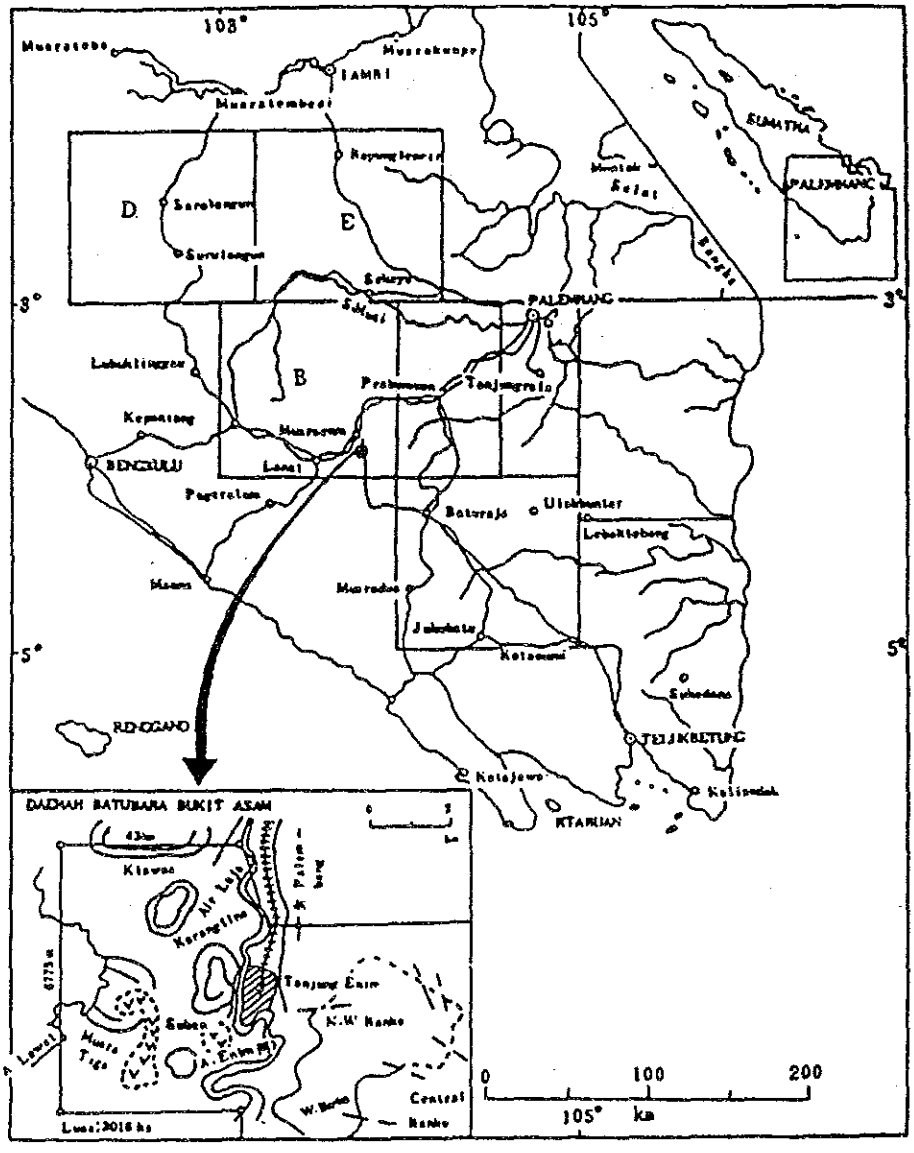
5-1 SUMMARY OF PAST SURVEY WORKS ON BANKO COAL FIELD

5-1-1 Survey Works done by the Shell Mijonbow N.V.

The Shell Mijonbow N.V., one of Indonesian Corporation of the Royal Dutch Shell group, which engaged in development and export of Indonesian coal, concluded a two year agreement on coal exploration in South Sumatra with the Indonesian Coal Corporation (PNTA) and acquired coal exploration right over area of 71,450 square kilometers shown in the Fig. 5-1-1.

Fig. 5-1-1 Blocks Covered by Shell's Exploration



The Shell had done geological and geophysical survey covered wide area and drilled 588 boreholes (average drilled depth is 150 meters and total drilled length is about 9,000 meters), at a cost of above $20 million in 1974 and 1975.

When the above agreement run out in May 1976, the Shell gave up the coal exploration right on most (75%) of the acquired area, and decided to concentrate their exploration activities on the most promising area, covered on the area of about 150 square kilometers, in the South of Tanjun Enim, then, acquired the detailed exploration right, on the above mentioned area.

Additional and detailed exploration works, carried out by the Shell, spent $48 million, between June 1976 and March 1978 were as follows:

490 boreholes (at grids of 200-400 meters, drilled depth is 15-215 meters and total drilled length is 12,000 meters)
50 of shafts, trenches and test pits

The above exploration works concentrated on North West Banko, Central Banko, West Central Banko and Central Banko, especially North-west Banko, and only preliminary survey works were done on Suban Jeliji area.

Although the summary of "the report prepared by the Shell" has been shown in the "Interim Report for the Feasibility Study on Effective Utilization of Banko Coal in the Republic of Indonesia - May 1985" prepared by the JICA, the gist of the report prepared by the Shell is put in order again in the Table 5-1-1. (see also the Fig. 5-1-1.)

The above "Contract between the Shell Mijonbow N.V. and the Indonesian Coal Corporation had been expired in 1978.

Table 3-1-1 Summary of the Shell Report (1)

Item	Banks: South-East Banks	West Banks	Central Banks	South Banks	South-East Banks
Location and accessibility	[illegible]	[illegible]	[illegible]		
Topography and vegetation	[illegible]				
Available base maps	[illegible]				
Exploration work done by the Shell	drilled boreholes : 43 [illegible] ; shafts/trenches and test pits : 37	boreholes : 38 [illegible]	boreholes : 10 ; shafts/trenches and test pits : 1	[illegible]	
Geology and deposit	[illegible]	[illegible]	[illegible]	[illegible]	
Coal seam thickness	[illegible]	[illegible]	[illegible]	[illegible]	
Coal quality	[illegible]	[illegible]	[illegible]	[illegible]	
Reserves	[illegible]	[illegible]	[illegible]	[illegible]	

note: [illegible]

Table 3-1-1 Summary of the Shell report (2)

	Suban Jeriji West	Suban Jeriji North	Suban Jeriji East
location and transportation	The large coal area of Suban Jeriji stretches as far as 8 kilometers from the east of Tanjung Enim. The Air Lematang (river) flows through the area from the south to the north dividing the area into a western and an eastern part. The area is accessible by a road branched from the main sealed road connecting Tanjung Enim with Muara Enim, which leads to Suban Jeriji village after crossing the Air [illegible]. The nearest and most north-westerly point of Suban Jeriji North is located immediately north of this road, 8 kilometers from Tanjung Enim. Suban Jeriji coal area also is accessible from the north-east direction by following a track northerly for [illegible] kilometers, which branches at the point of 12 kilometers on the main road to Tanjung Enim. The Suban Jeriji West section is situated about 3 kilometers south of the same access road, connecting Tanjung Enim with Suban Jeriji area. Suban Jeriji East is also accessible through the same road. Both access road is under unfavourable conditions.		
topography and vegetation	The area is covered by dense secondary forest, in the north and west. The high elevation area which forms the south-west section, leans to the north-west. The north-eastern part is located on gently-sloping high ground with small creeks, drained to the south-east or north-east. The northern part of Suban Jeriji East is mostly covered by grass or bush with minor patches of forest. Most of the southern part is grassland and dense vegetation is found partially along the bank of the Air Niru.		
available data	Topographic and vegetation map (scale 1/25000) prepared from aerial photography taken in 1976, borehole logs and some coal quality analysis data are available. moisture was not measured.		
exploration works done by the Shell	5 boreholes (however only 2 holes of them caught coal seams of interest.	13 boreholes (however only 7 holes of them are relevant for defining the area of interest.	18 boreholes (however only 8 holes of them are relevant to review the area.)
geology and deposit	Suban Jeriji West is a small area with the coals (A, B and C seams) close to surface. The area is located on the north-eastern flank of the south-westerly plunged Sungai-Niling anticline, between Suban Jeriji and North-West Bukit in the west of a major fault line, between on it, in the south-west of the Sungai-Taban syncline and the Sungai-Taban anticline structure. Moderately steep dip angles (10° or more) are common. major and minor faulting have not been recorded, however, the chance of minor structure is not nil.	The Suban Jeriji North area is located on the north-west flank of the North Suban Jeriji anticline. The area is divided by a major NW-SSE striking fault which laterally displaces both parts of deposit by 300 to 600 meters. The Jelawatan and the Enim seam are cropped out in the south of the area.	The northern part of the area lies along the northern flank of the North Suban Jeriji lies along the southern flank of the South Suban Jeriji anticline. The Jelawatan and the Enim seam exist in the area and their dip angles are rather low 2°~5° towards the north. A major NW-SSE fault with a lateral displacement of about 50 to 100 meters [illegible] the area from the structure and stripping ratio, the northern part seems to be important than the southern part. A minor doming effect caused by the Sungai-Taban anticline structure are seen in the center of Suban Jeriji East. In the southern part, a synclinal development related with the Sungai-Taban syncline which strike is NW-SE direction with a south-easterly plunge.

coal seam thickness

Suban Jeriji West:

	average (meters) coal seam	average (meters) overl. interburden	range (meters) coal seam	range (meters) overl./interburden
		30		0~130
Mangus 1 (A1) seam	75		90~120	
		375		35~45
Mangus 2 (A2) seam	123		120~125	
		1350		130~140
Suban 1 (B1) seam	1275		20~120	
		260		210
Suban 2 (B2) seam	60		40	
		330		330
Pelai (C) seam	18		13	
Total	520	510	410~530	

(note) The coal thickness was reduced to 39 meters (25% less) in the coal reserves calculation considering the following factors:
The number of boreholes are quite limited.
rather steep dips and structural uncertainties

Suban Jeriji North:

		average (meters) coal seam	average (meters) overl. interburden	range (meters) coal seam	range (meters) overl./interburden
			75		0~134
upper seam		70		-	
Jelawatan seam		135	-	102~27	
			134		230~620
Enim seam	upper split	31		25~27	
			47		5~96
	middle split	44		20~52	
			33		24~60
	lower split	74		59~83	
	sub-total	249		182~312	
Total		354		262~409	

(note) The upper seam exists only in the north-central part.
(note-1) Core log data admits to interprete that the upper seam is located at rather higher level but it is badly splited in the most northern part of the area.
The Enim Seam is generally splited into 3~4, however in the south-western part, only 2 splits are found. The most prominent splits are the upper and lower.

Suban Jeriji East:

		north part average (meters) coal seam	north part average (meters) overl. interburden	south part average (meters) coal seam	south part average (meters) overl. interburden
			3~62		2~60
upper seam		-			
Jelawatan seam		30*		30*	
			160		320
Enim seam	upper split	110		130	
			50		60
	middle split	-		-	
					-
	lower split	60		60	
	sub-total	170		190	
Total		220		220	

* high ash

It may safely be said that the coal is not recoverable economically at Suban Jeriji East

coal quality

Suban Jeriji West:

	T.M % calc.	T.M % anal.	S(d) %	A(d) %	VM(d) (daf) %	CV Kcal/kg (daf)	CV Kcal/kg net
Mangus 1 (A1) seam	31.40	-	1.60	4.50	47.70	7,322	4,235
Mangus 2 (A2) seam	32.90	-	0.23	2.64	49.80	7,130	4,420
Suban 1 (B1) seam	31.60	-	1.36	3.20	47.70	7,105	4,400
Suban 2 (B2) seam	33.10	-	1.13	5.80	47.80	7,120	4,130
Pelai (C) seam	26.70	-	0.43	5.49	41.60	7,355	4,700

Suban Jeriji North:

	T.M % calc.	T.M % anal.	S(d) %	A(d) %	VM(d) (daf) %	CV Kcal/kg (daf)	CV Kcal/kg net
Jelawatan seam	30.00	-	0.18	12.08	48.40	6,700	3,610
Enim Seam	40.60	-	0.22	5.39	51.40	7,051	4,255

Suban Jeriji East:

		T.M % calc.	T.M % anal.	S(d) %	A(d) %	VM(d) (daf) %	CV Kcal/kg (daf)	CV Kcal/kg net
Jelawatan seam	north part		..	7.52	31.99			
	south part			0.49	20.43			
	-do- BJ 31 SI		46.10	0.73	2.56	52.10	6,669	32.5
Enim seam	north part	12.90	-	0.23	7.24	36.80	6,710	3,170
	south part	50.40	-	0.23	6.16	31.10	68.5	3,435
	-do- BJ 31 SI	-	42.00	0.87	6.62	51.90	6,770	3,290

coal reserves

Suban Jeriji West: The coal resources can be classed as "inferred" only. The Shell had not calculated the coal reserve but assigned the thickness of the Mangus, Suban and the Pelai seams to 33 meters and 13 meters respectively.
If specific gravity is 1.30 and overburden removal depth is limited to 100 meters, the coal reserves within the area of 25 square kilometers is estimated at half million tons. The probable stripping ratio will reach 5 : 1.

Suban Jeriji North:

		south-west block	north-east block	total or average
	upper seam (Jelawatan)	-	-	65
tonnage (million tons)	Jelawatan seam	13	39	52
	Enim seam	81	129	190
	Total	74	168	262
geological waste-coal ratio		23 : 1	-	29 : 1
stripping ratio		5 : 1	4 : 1	-
estimated specific gravity		1.3	1.3	

(note) Stripping ratio is based on the supposition that overburden removing depth to the top of the Enim

Suban Jeriji East:

north part	south part	total or average
23	5.4	7.7
-	-	-
65.5	134	219.9
65.5	154	219.9
25 : 1	30 : 1	-
-	-	-
1.3	1.3	

(note) The Shell estimated the potential of Suban Jeriji at 100 million tons (including

The estimated coal reserves have to be classified in the "inferred" category because the number of drilled boreholes in the area are limited.

(note) The summary was made based on "A Sumatra Coal Exploration Project - Review Report - May, 1978 prepared by the Kuribull [illegible] Otto Gold Joint Venture.

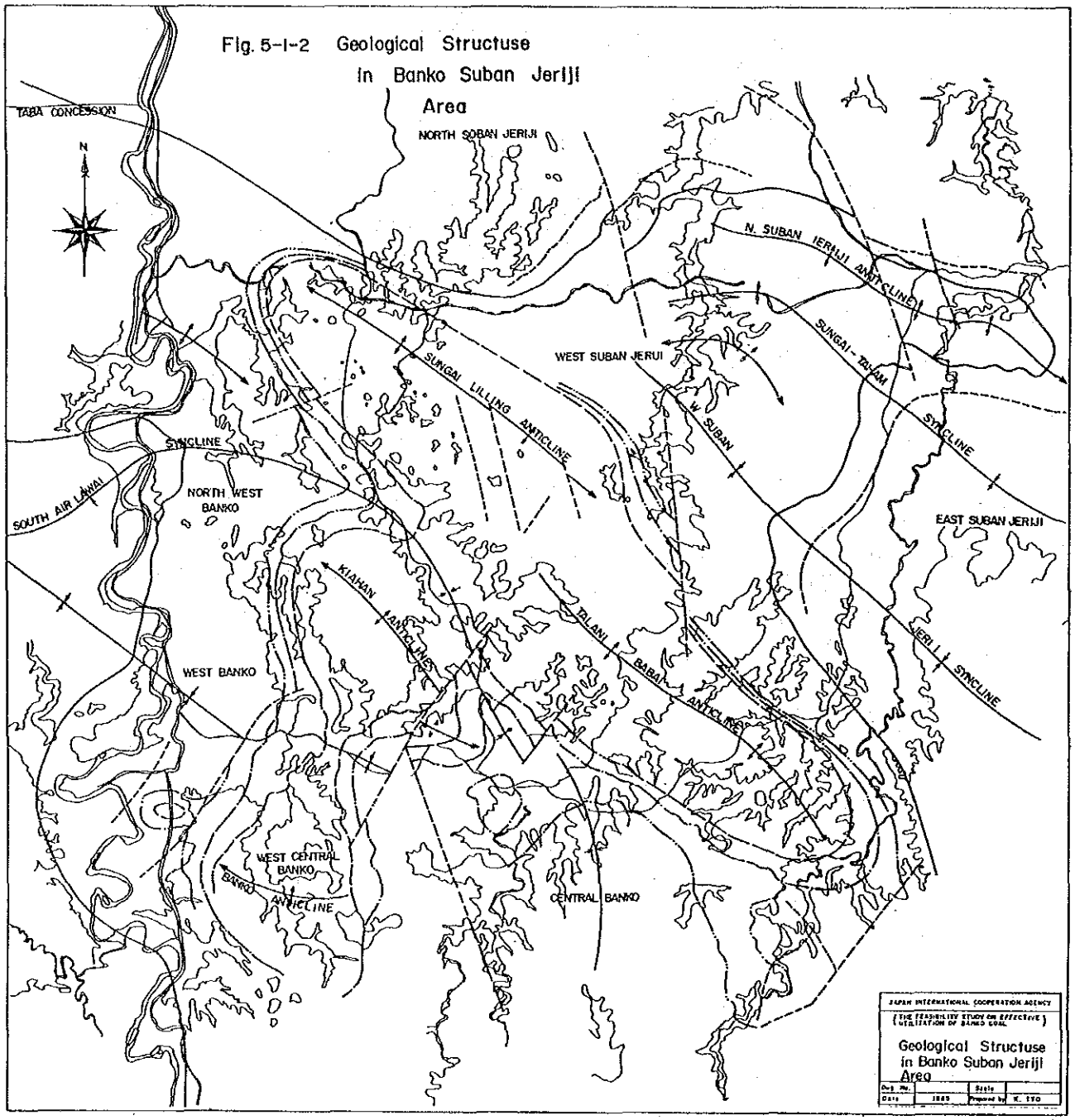


Fig. 5-1-2 Geological Structuse
In Banko Suban Jeriji
Area
TABA CONCESSION
NORTH SUBAN JERIJI
N. SUBAN JERIJI ANTICLINE
SUNGAI - TALANI
SYNCLINE
WEST SUBAN JERIJI
SUNGAI LILLING ANTICLINE
W. SUBAN
SYNCLINE
SOUTH AIR LAHAI
NORTH WEST
BANKO
EAST SUBAN JERIJI
KIAHAN
ANTICLINE
TALANI
BABAT
ANTICLINE
JERIJI
SYNCLINE
WEST BANKO
WEST CENTRAL
BANKO
BANKO
ANTICLINE
CENTRAL BANKO
JAPAN INTERNATIONAL COOPERATION AGENCY
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)
Geological Structuse
in Banko Suban Jeriji
Area
Drg. No.
Scale
Date
1985
Prepared by K. ITO

5-1-2 The Survey Works done by JICA and BPPT Team, in FY 1984

The preliminary general survey have been carried out by the survey team sent from the JICA, on Banko and Suban Jeliji areas in 1984.

The survey results and estimated preliminary mining cost of different two mining methods, have been reported in the last interim report in May 1985, prepared by the JICA.

The reported main items in the report are as follows:

(1) Coal quality in Banko area

1) Banko coal is classified into non-transportable coal because of such troublesome features as its easy spontaneous combustion, fragility during transportation and stock, and high moisture content.

2) Banko coal contains high Na_2O of more than 0.6% within coal and ash fusion temperature of some coal seams is very low (around 1,150°C). Therefore fouling and slagging may be caused on tubes in case of a conventional boiler.

3) Coal quality of North West Banko is summarized by Shell as follows:

Coal Quality of North West Banko Coal
(Average coal, dry base)

Ash (%)	6.7	
Volatile Matter (%)	45.4	
Gross C.V. (Kcal/kg)	6820	
Total Sulphur (%)	0.59	
In-situ Moisture (%)	25-35	(Range)
Sodium Oxide in Ash (%)	4-40	(Range)
Sodium Oxide below 40 m (%)	12	(Average)

(2) Site Reconnaissance and Chip Sampling

1) Outcrops and chip sampling

Slight amounts of coal samples were taken from shallow underground of 12 outcrops in the Banko, Suban Jeriji and Baturaja areas.

The analysis data suggest that the weathering of all samples has advanced because of sampling from near surface of the outcrops.

2) Study on sampling spot and method for coal gasification test
(see Table 5-1-2, 5-1-3 and 5-1-4)

Considering the purpose of coal gasification test, further study for selection of sampling spots and method shall be carried out in FY 1985, using small boring machine.

a) Analysis for an affect of weathering vs depth using small boring machine (up to 50 m depth)

b) To find out outcrops of each coal seem using small diameter auger drillings (up to 10 m depth)

c) To decide sampling spot and method based on a) and b), for coal gasification test

Table 5-1-2 Analysis Results of Coal Chip Samples, collected in the vicinity of the outcrops at the site

(%)

Item \ Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
Free Moisture	22.1	24.7	29.2	29.0	38.4	27.9	18.2	21.4	22.7	30.4	27.9	34.3
Total Moisture	32.1	34.7	38.2	38.1	46.4	35.5	28.1	31.8	32.6	40.8	37.1	41.0
Moisture	11.4	11.1	11.5	8.5	11.1	8.4	8.9	10.2	9.9	1.9	9.9	7.8
Ash	3.8	0.7	2.2	1.8	1.3	1.5	0.6	0.6	3.6	5.9	26.2	44.5
V.M	40.9	41.0	41.8	43.5	43.0	43.7	43.3	42.1	43.2	43.1	33.3	26.9
F.C	43.9	47.2	44.5	45.2	44.6	46.4	47.2	47.1	43.3	39.1	30.6	20.8
Ash	4.27	0.79	2.43	1.97	1.47	1.60	0.67	0.67	3.99	6.74	29.11	48.21
C	69.30	74.15	71.03	71.89	70.06	75.64	74.55	74.02	70.09	66.93	47.83	32.73
H	4.92	5.08	4.96	5.21	4.95	5.37	5.39	5.27	5.25	5.04	3.91	2.62
N	0.79	1.08	1.15	1.00	1.01	1.19	0.96	1.13	1.18	1.14	0.77	0.53
O	20.49	18.69	20.23	19.55	22.31	14.91	18.23	17.86	18.94	18.19	17.95	15.46
	0.23	0.24	0.20	0.38	0.20	1.29	0.20	1.05	0.55	1.96	0.43	0.45
GCV (Kcal/Kg)	5,880	6,320	5,950	6,170	5,810	6,810	6,510	6,470	6,190	5,750	4,060	2,850

Table 5-1-3 Ultimate Analysis of the above mentioned coal chip samples

(d.a.f) (%)

Sample No. / Elements	1	2	3	4	5	6	7	8	9	10	11	12
C	72.39	74.74	72.80	73.33	71.11	76.87	75.05	74.52	73.00	71.77	67.47	63.20
H	5.14	5.12	5.08	5.31	5.02	5.46	5.43	5.31	5.47	5.40	5.12	5.06
N	0.83	1.09	1.18	1.02	1.03	1.21	0.97	1.14	1.23	1.22	1.09	1.02
S	0.24	0.21	0.20	0.39	0.20	1.31	0.20	1.06	0.57	2.10	0.61	0.87
O	21.40	18.84	20.73	19.94	22.64	15.15	18.35	17.98	19.73	19.50	25.32	29.85
H/C	0.852	0.822	0.837	0.869	0.847	0.852	0.868	0.855	0.900	0.903	0.911	0.961
O/C	0.222	0.189	0.214	0.204	0.239	0.148	0.183	0.181	0.203	0.240	0.281	0.354

Table 5-1-4 Composition of Ash of the above mentioned coal chip samples

(%)

Sample No. / Elements	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	32.92	17.06	31.92	11.78	34.66	39.68	12.38	27.5	46.60	3.58	56.27	83.78
Al_2O_3	35.03	56.76	51.07	48.27	6.01	47.96	66.05	40.37	35.18	9.37	32.12	4.93
Fe_2O_3	7.23	8.76	3.11	3.39	15.44	2.87	10.36	11.55	6.19	18.36	5.25	1.92
CaO	13.17	8.14	5.79	16.23	21.17	2.45	5.59	8.88	5.39	28.14	2.27	2.32
MgO	0.95	0.66	0.77	2.09	3.85	0.86	0.57	0.50	1.24	8.14	0.90	0.63
Na_2O	0.24	0.32	0.24	0.32	0.43	0.13	0.25	0.17	0.19	0.22	0.15	0.15
K_2O	0.03	0.27	0.02	0.19	0.33	0.10	0.03	0.16	0.38	0.11	0.32	0.21
SO_3	8.32	3.72	3.32	5.32	16.61	3.07	1.51	8.04	3.92	29.47	1.09	1.45
P_2O_5	0.26	0.08	1.12	11.8	0.11	1.12	0.17	0.35	0.04	0.16	0.05	0.01
TiO_2	0.96	0.73	2.23	0.44	0.30	1.52	1.35	0.30	0.67	0.99	1.05	0.17
V_2O_5												
Total	99.11	96.50	99.59	99.91	98.91	99.76	98.26	97.82	99.80	98.54	99.47	95.57
I.D.T	1,305	1,500	1,500	1,370	1,150	1,500	1,300	1,310	1,320	1,320	1,500	1,500
H.T	1,340	1,500	1,500	1,500	1,200	1,500	1,500	1,500	1,500	1,400	1,500	1,500
F.T	1,355	1,500	1,500	1,500	1,220	1,500	1,500	1,500	1,500	1,440	1,500	1,500

(3) Preliminary mining cost estimation

Mining cost was estimated preliminary, based on the following mining parameters.

minable coal reserves	: 98 million tons (specific gravity 1.28)
over/interburden to be removed	: 287 million bank cubic meters
stripping ratio	: 2.82 (cubic meters): 1 (tons)

(note) Weathering, geological and mining loss are estimated at 5%, 10% and 5% respectively.

yearly production	: coal production 2.3 million tons waste removal 8.5 million bank cubic meters
yearly working days	: 302 days, 7 days/week, 3 shifts/day
climate condition	: average yearly precipitation 3,147 mm average yearly rainy days 162 days

(note) Production is asumed that it will be down to 53% of normal production, during rainy season.

The following two mining methods were investigated to estimate mining cost.

i) continuous mining method (combination of bucket wheel excavators and belt conveyors)

ii) non-continuous mining method (combination of shovels, rear dump trucks and belt conveyors)

Estimated mining cost are $19.76/ton and $13.88/ton respectively.

5-2 ADDITIONAL INFORMATION PROVIDED BY THE INDONESIAN SIDE

5-2-1 Core Drilling Data drilled by the Directorate of Coal

The Directorate of Coal (D.O.C.), has been started core drilling works in North-West Banko and Central Banko, beyond the limit of the area surveyed by the Shell, in 1984.

The data furnished by the Directorate of Coal are very beneficial and valuable to analyze coal reserves, geological structure, coal seam structure and coal quality.

The Japanese side would like to express great gratitude to the Directorate of Coal who furnished their valuable data.

An example of core logs prepared by the D.O.C. and those prepared by the Shell and the D.O.C. are rearranged as shown in the Fig. 5-2-1 and the Fig. 5-2-2 respectively, and the Fig. 5-2-3 shows holizontal relation between boreholes drilled by the Shell and the D.O.C.

5-2-2 Maps

Topographic maps, geologycal maps, and outcrop/sub-outcrop maps was prepared by the PPTM.

A combined map after rearranging them is shown on Fig. 5-2-3.

The above maps furnished by the PPTM are very helpful and valuable to proceed the field work and to analyze the survey result in FY 1985.

Fig.5-2-1 An example of core log prepased by the D.O.C.

DIRECTORATE GENERAL OF MINES
COAL MINE DEVELOPMENT PROJECT

BORE HOLE SUMMARY OF BUKIT ASAM COAL AREA

BORE HOLE	64.013	COORDINATE	: X 364 068 64 / Y 9 564 238 661	GEOLOGIST	BAKTI
COAL FIELD	SOUTH SUMATRA	ELEVATION	: 64.621	DRILLED BY	USMAN DACHRO CS
LOCATION	BANKO	TOTAL DEPTH	: 221.00 M	STARTED	: APRIL 20th 1965
SCALE	1:200	DEPTH REACHED (LOG)	: 220.00 m	COMPLETED	: APRIL 27th 1965

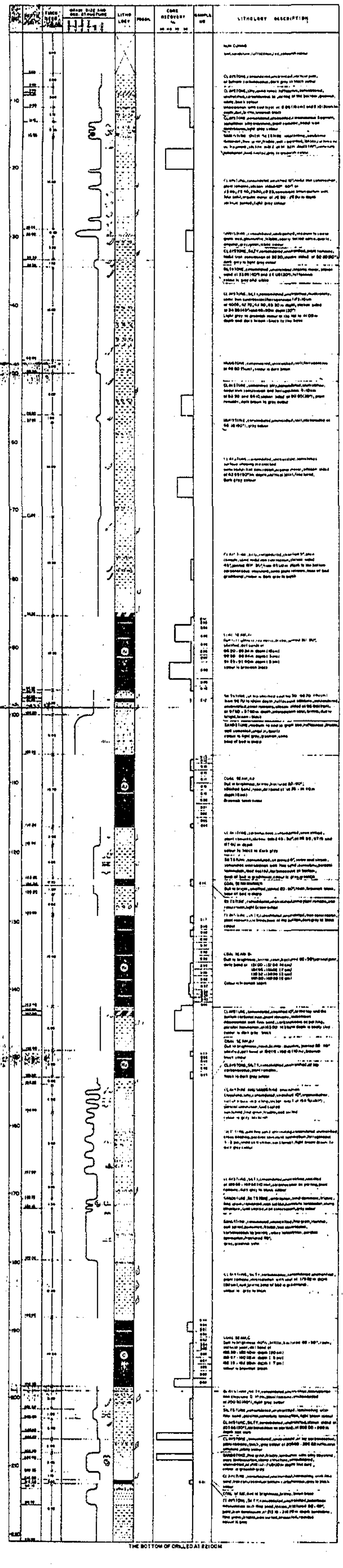
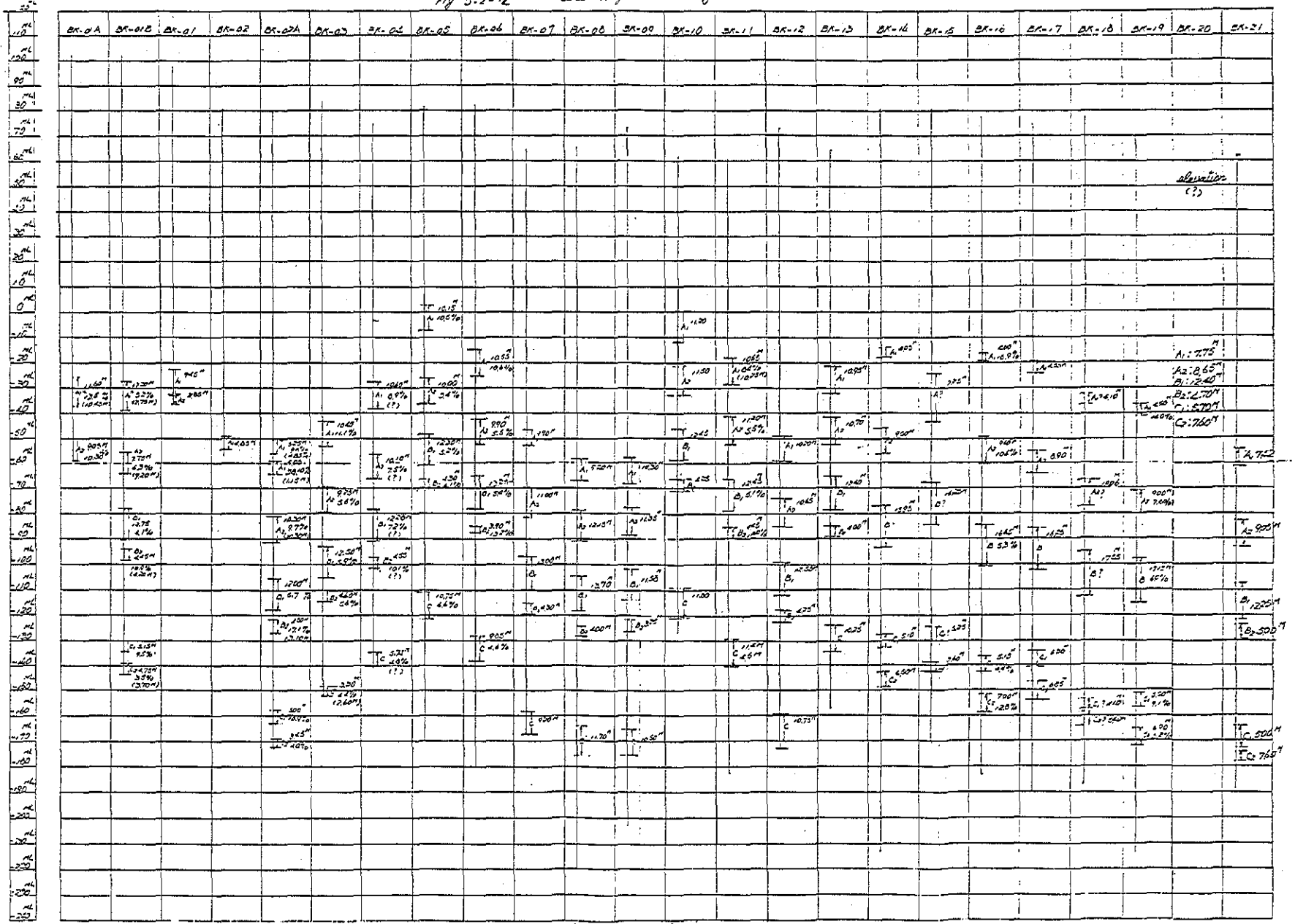
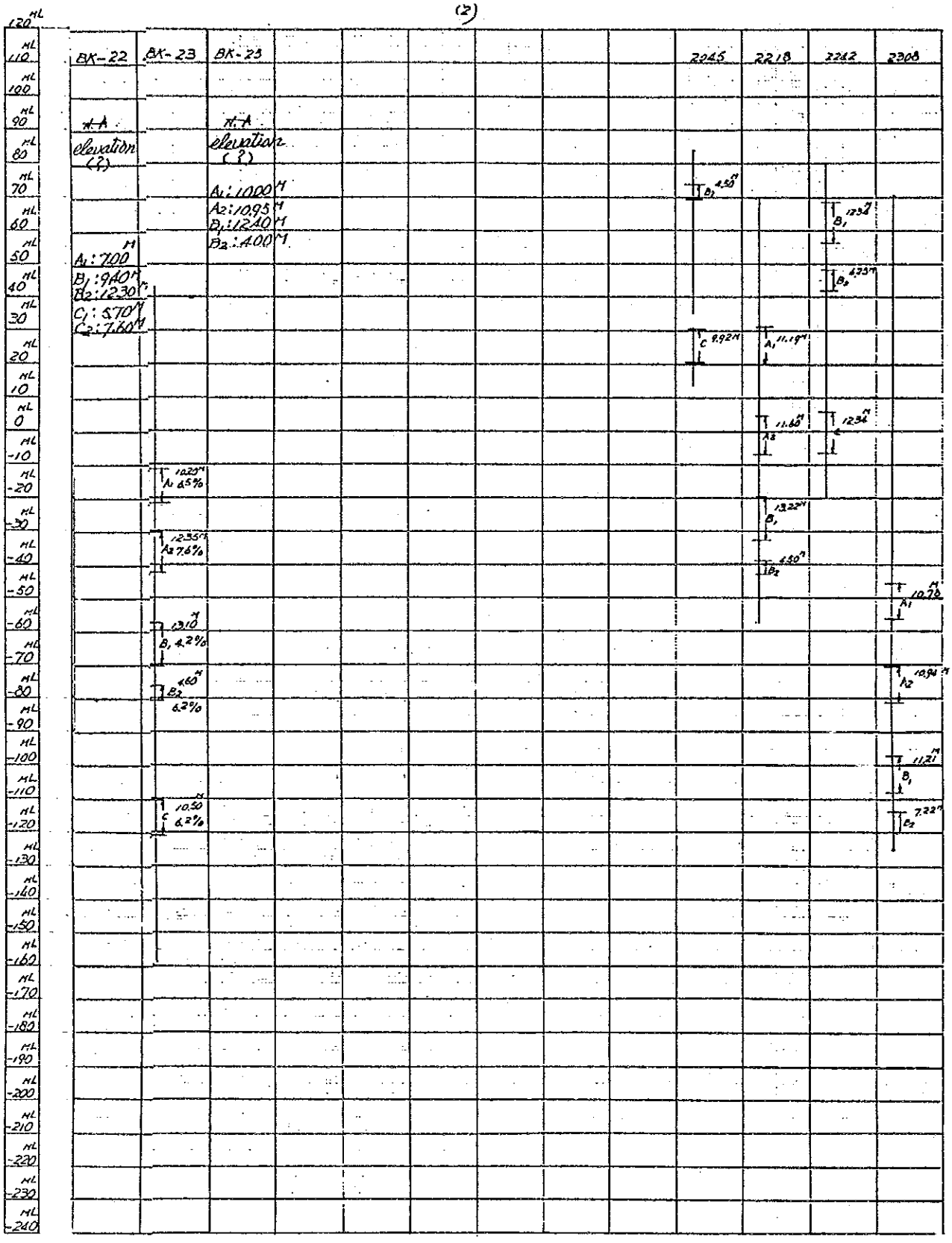


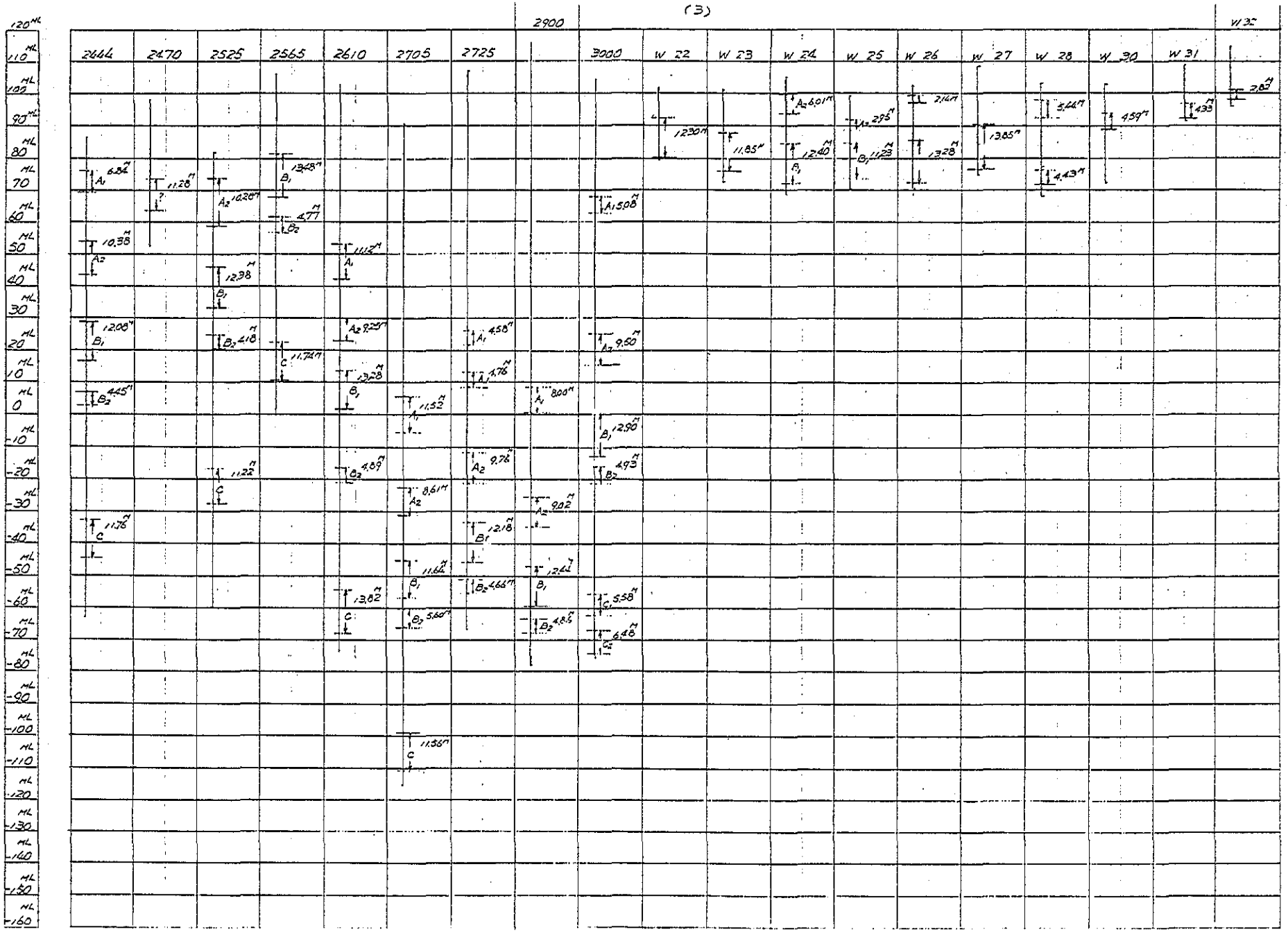
Fig 5.7-2 core logs drilled by the Sekell and the D.O.C.



(note) BK: boreholes drilled by the Sekell
others: boreholes drilled by the Sekell

(2)


BK-22
BK-23
BK-23
2245
2218
2242
2308
elevation (?)
elevation (?)
A1: 7.00 M
B1: 9.40 M
B2: 12.30 M
C1: 5.70 M
C2: 7.60 M
A1: 10.00 M
A2: 10.95 M
B1: 12.40 M
B2: 4.00 M
4.50 M
12.34 M
4.23 M
9.92 M
11.19 M
11.60 M
13.22 M
4.50 M
10.78 M
10.94 M
11.21 M
7.22 M
10.29 M
12.35 M
13.10 M
4.60 M
10.50 M
6.2%
4.2%
7.6%


(3)
2900
2644
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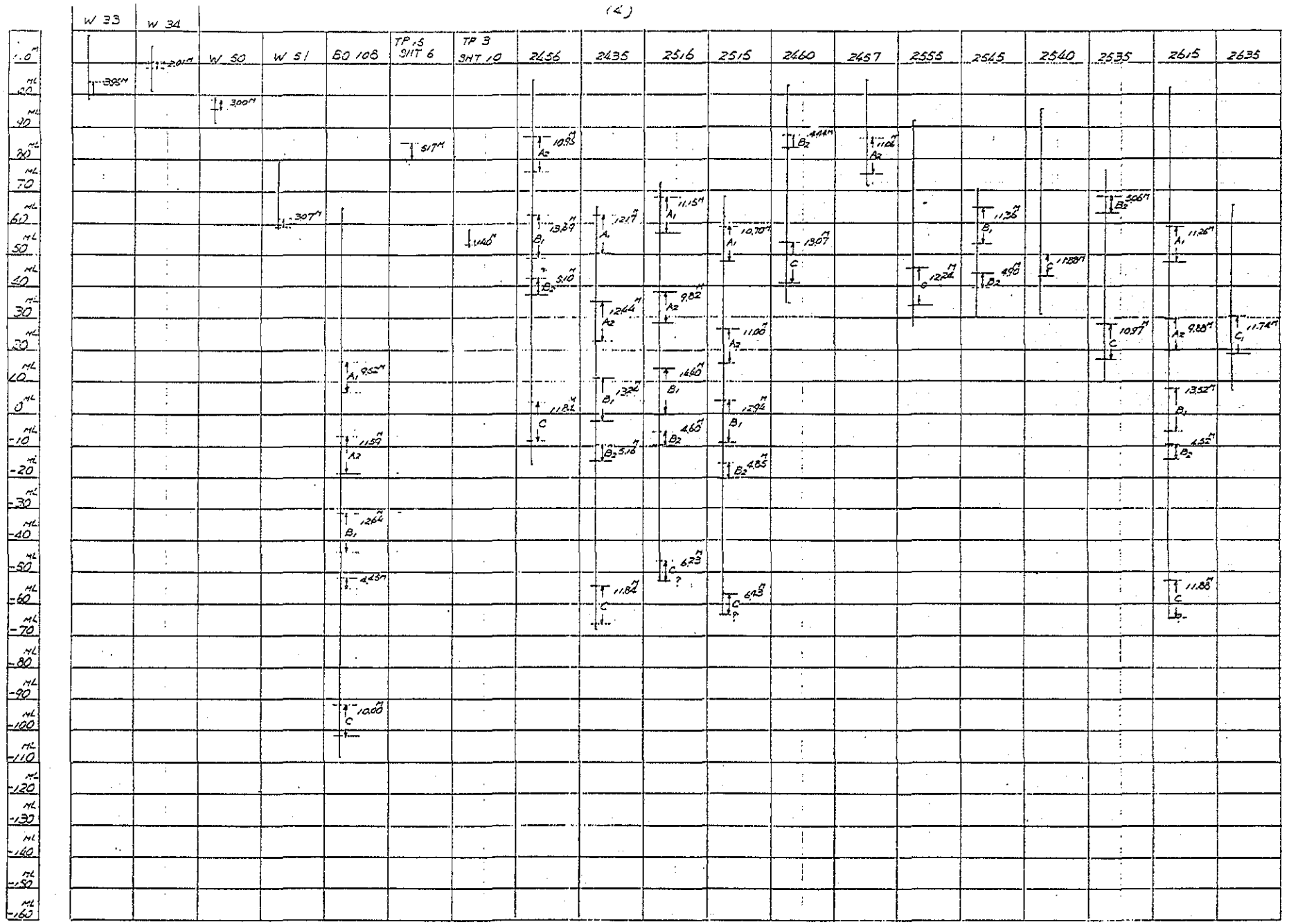
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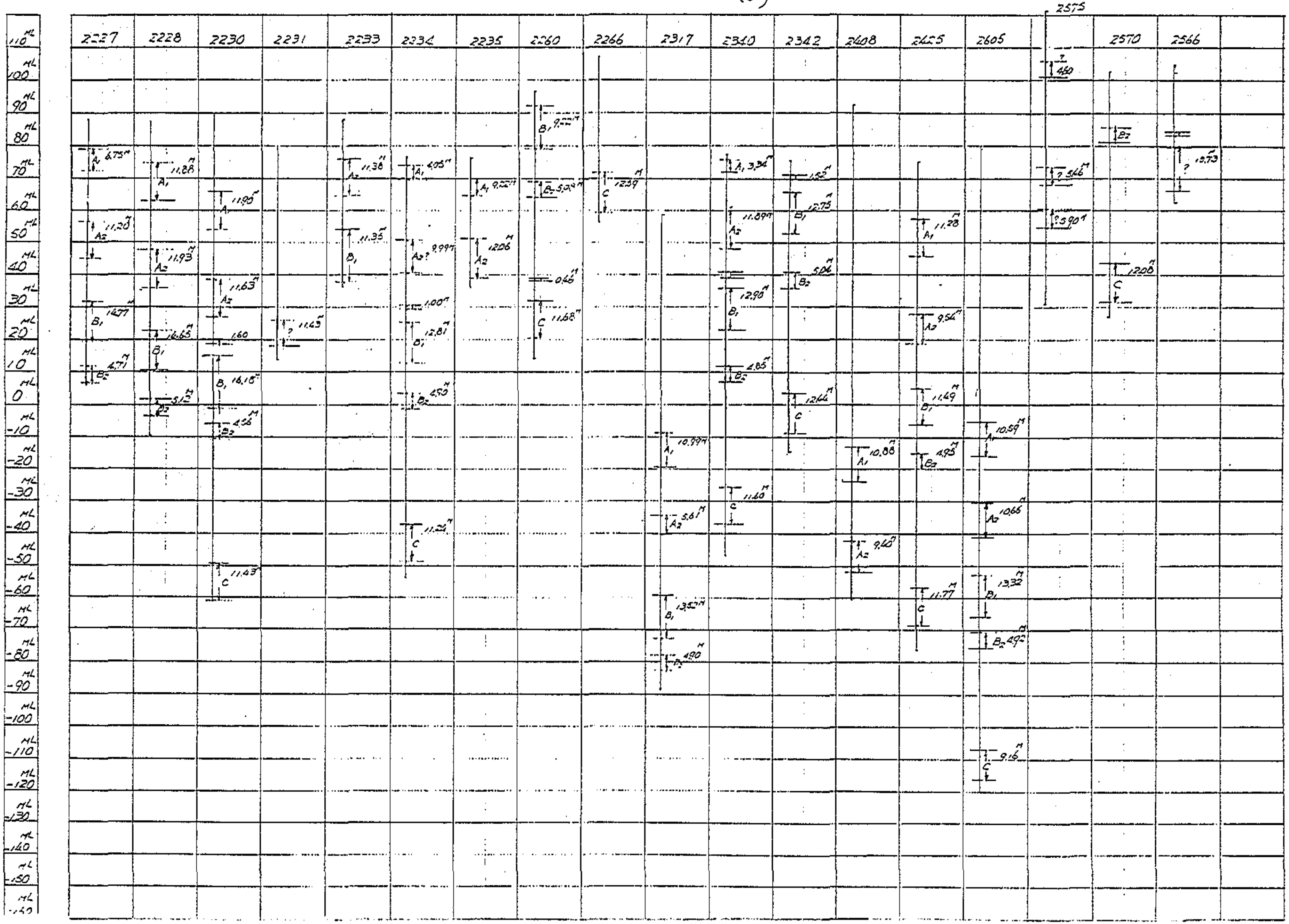
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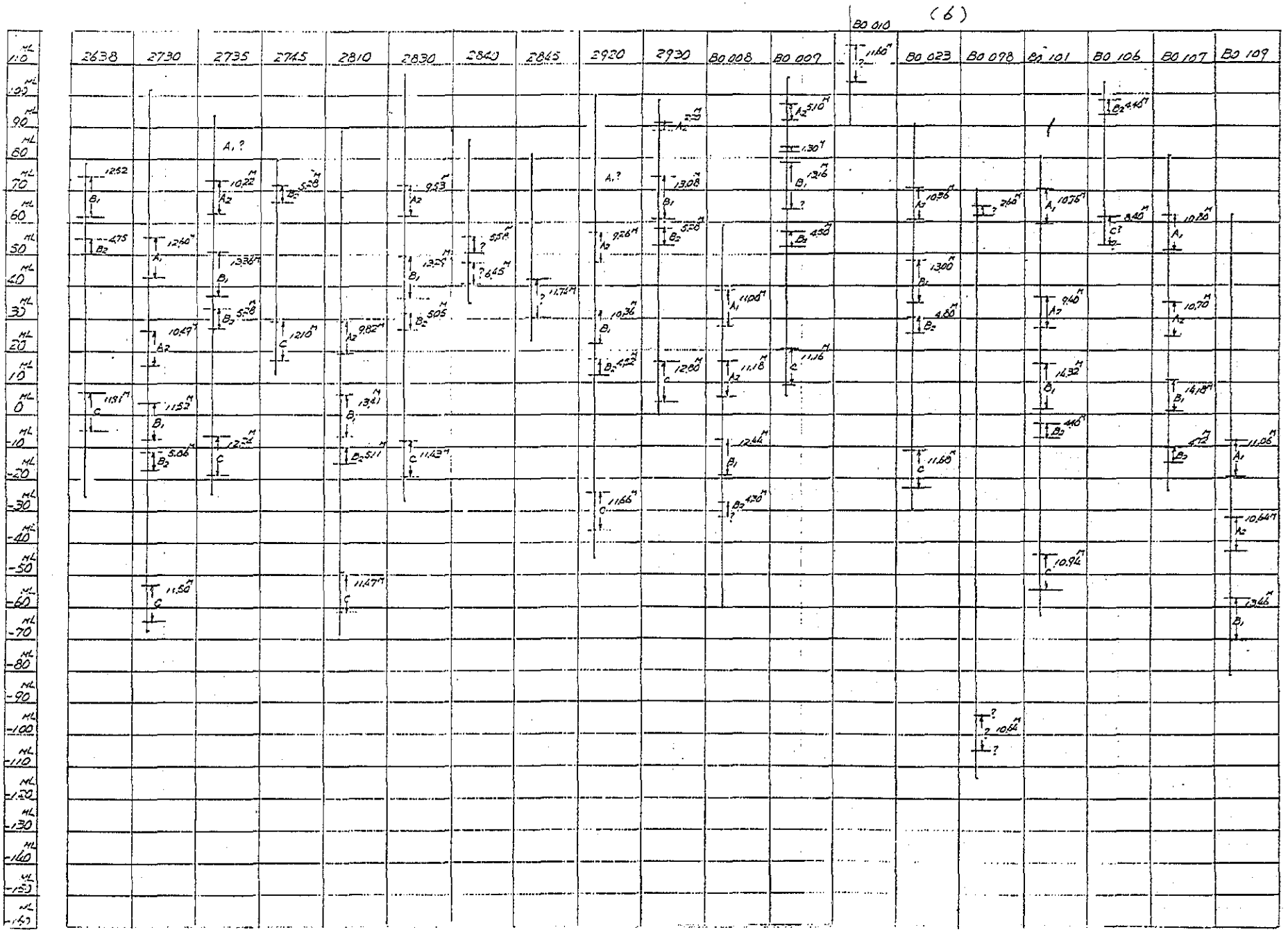
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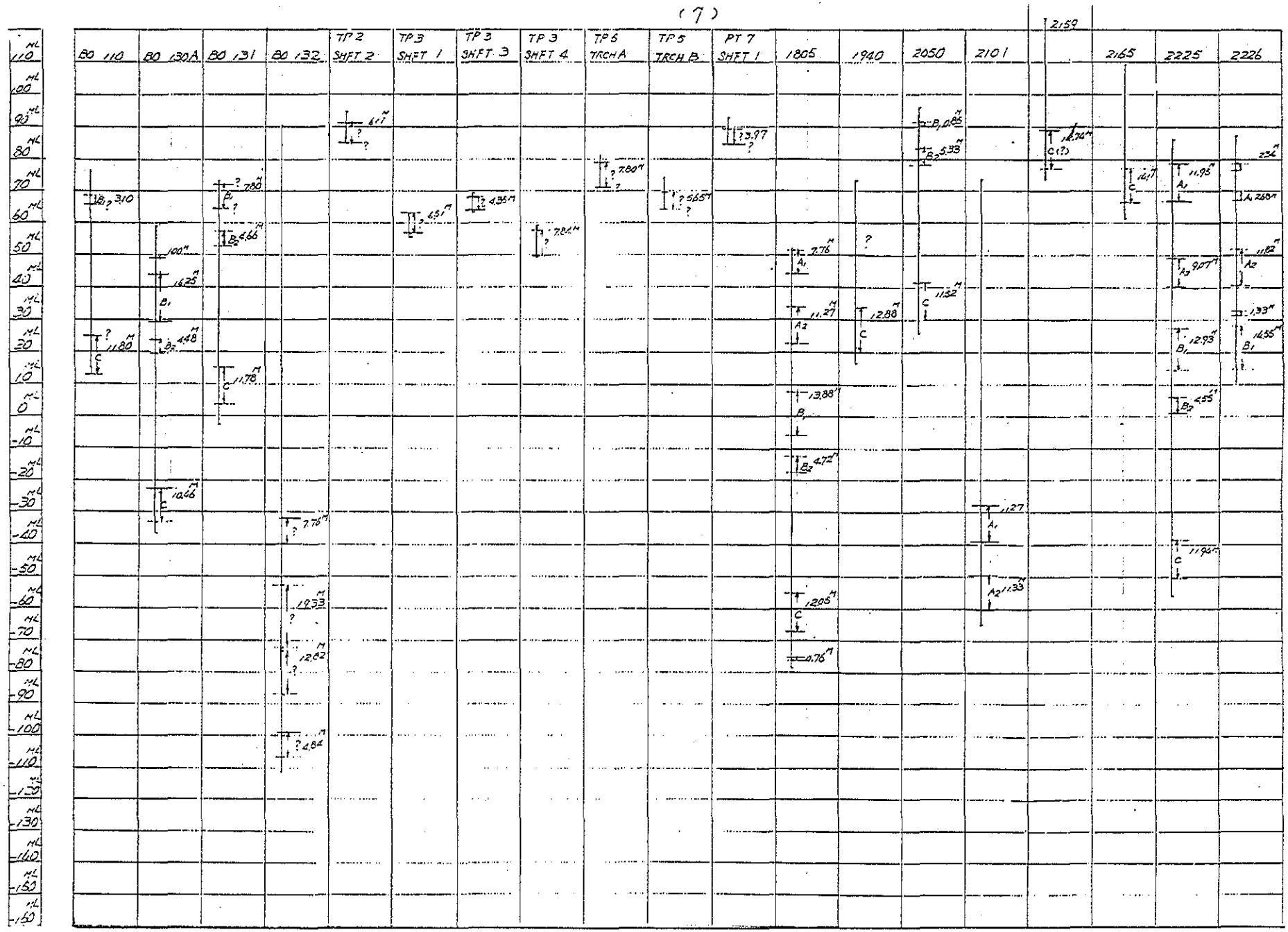
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BO 130A
BO 131
BO 132
TP 2 SHFT 2
TP 3 SHFT 1
TP 3 SHFT 3
TP 3 SHFT 4
TP 5 TRCH A
TP 5 TRCH B
PT 7 SHFT 1
1805
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2101
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Fig.5-2-3 Houzontal Relation Between Baseholes drilled By the Shell and the D.O.C.

5-3 SURVEY WORKS CARRIED OUT IN FY 1985

5-3-1 The Purpose of the Work

The survey work in Banko area in FY 1985 have been carried out under the joint team, composed by the JICA, the BPPT and the MTDC, for the following purposes.

1) investigating and selecting coal bulk sampling method and places for coal gasification test at Supong.

2) grasping dispersion on sodium content in coal seam in horizontal and vertical direction

3) Confirmation of coal seam outcrops estimated by the Shell

5-3-2 Work Allotment between the Japanese Side and the Indonesian Side

The survey works which were mutually agreed to carry out in the 1985/86 fiscal year are as follows:

i) drilling two deep holes (one at the northern part of North-West Banko and the other at the southern part of the North-West Banko, if the budget of the BPPT permits, one more hole in West Banko)

ii) drilling 33 effective shallow holes (27 holes in North-West Banko and 6 holes in West Banko)

iii) proximate analysis, ultimate analysis and ash component analysis, and, measuring caloric value, specific gravity for cores obtained through deep holes

proximate analysis and sodium content analysis for cores obtained through shallow holes

Indonesian side (the BPPT and the PPTM) performed all field works mentioned in the Table 5-3-1, at its own expenses, dividing into two parts, owing to the BPPT's budgetary procedure..

Three engineers and about 40 labour were engaged at the work and the Japan International Cooperation Agency sent 4 engineers to cooperate with the Indonesian side.

Table 5-3-1 Field Works carried out in FY 1985

	1st stage	2nd stage	Total
(geological) reconnaissance	9 lines (in North-West Banko	3 lines (in West Banko	12 lines
topographic survey	4 lines (in North-West Banko)	8 lines (5 lines in North-West Banko and 3 lines in West Banko	12 lines
deep hole drilling	nil	1 hole	1 hole
shallow holes drilling	9 holes (in North-West Banko)	30 holes (22 holes in North-West Banko and 8 holes in West Banko	39 holes
analysis	-	analyzed coal sample obtained from drilled deep holes	34
		analyzed coal sample obtained from drilled shallow holes	120

5-3-3 Progress of Work

(1) Reconnaissance

Planned 12 lines (9 lines in North-West Banko and 3 lines in West Banko) had been wholly reconnoitered, then outcrops shown in the table 5-3-2 had been confirmed.

(2) Topographic survey

Planned 12 lines had been surveyed.

(3) Deep hole drilling

Although one hole were planned to drill in the northern and southern part in North-West Banko respectively, however one hole in the southern part were compelled to give up, because of the BPPT's budgetary circumstances.

(4) Shallow holes drilling

Shallow holes which were planned to drill in the vicinity of each base line, after concerned outcrops, had been confirmed by reconnaissance.

39 shallow holes exceed the original plan (33 holes) were drilled.

The table 5-3-3 shows number of drilled shallow holes on each base line.

(5) Coal analysis

Number of coal sample obtained in 1975 FY for analyses by the means of shallow and deep holes drilling is 154 (shallow holes 120, deep holes 34).

Those sample have been analyzed by hands of the PPTM in accordance with the minutes of meeting among concerned three parties however analysis results have not been be distributed to the parties concerned as of today.

The table 5-3-4 shows summary of analysis results done by hands of PPTM, the Japanese side, and, by joint hands of the BPPT, the PPTM and the Japanese team sent by the JICA headquarters.

Analyses done by the later two parties were only for comparison with ones done by the PPTM.

LECO's analyses apparatuses which were prepared by the JICA headquarters and will be donated to the BPPT in the near future were used and the JICA headquarters sent two specialist to guide in operation.

Table 5-3-2 Outcrops confirmed by means of reconnaissance on each line

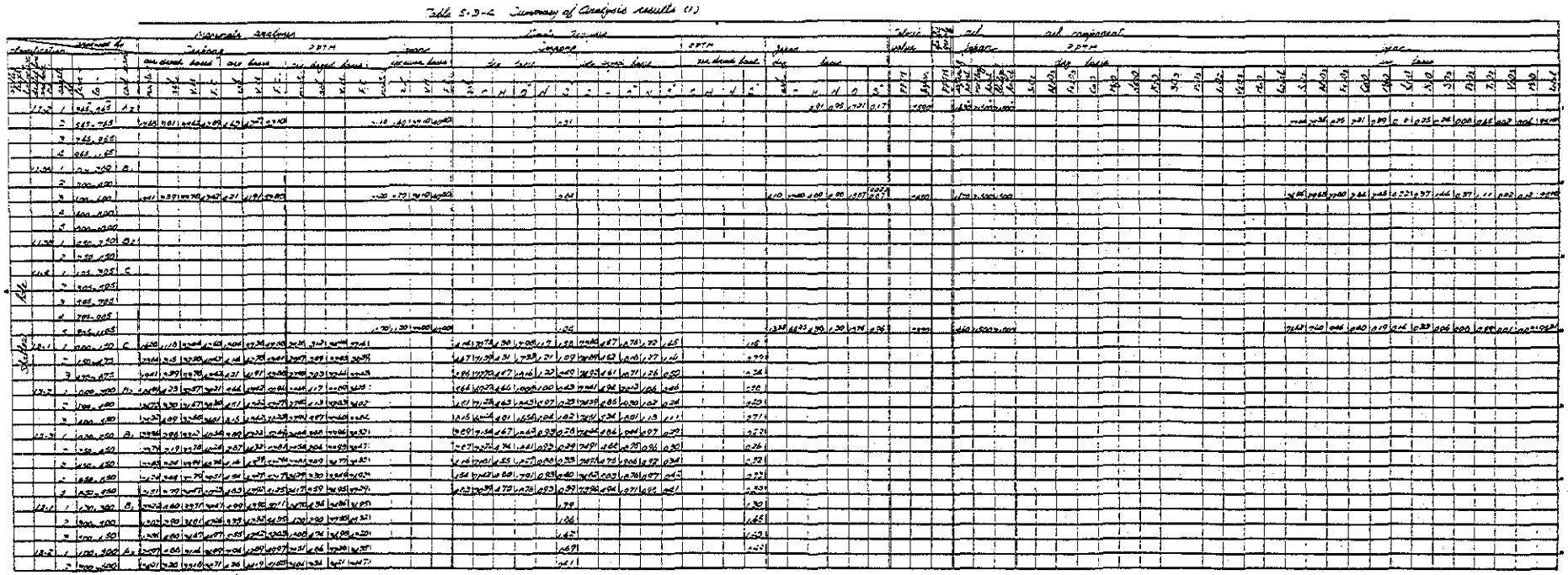
Base line	Mangus 1 (A_1)	Mangus 2 (A_2)	Suban 1 (B_1)	Suban 2 (B_2)	Petai 1 (C_1)	Petai 2
1		o	o	o	o	
2			o	o	o	
3	o	o	o			
4	o	o	o			
5	o	o	o	o	o	
6	o	o				
7		o		o	o	
8		o o			o (or C_2?)	
9		o	o		o	
10			o	o	o	
11	o	o				
12		o	o	o		

Table 5-3-3 Shallow Holes Drilled Results

coal seam / base line	Mangus 1 (A_1)	Mangus 2 (A_2)	Suban 1 (B_1)	Suban 2 (B_2)	Petai (C)
1		o (11.65 m)	o (10.00 m)	o (4.50 m)	o (11.05 m)
2			o (9.50 m)	o (5.50 m)	o (6.75 m)
3	o (10.50 m)	o (9.00 m)	o (6.50 m)		
4	o (10.50 m)	o (6.70 m)	o (10.25 m)		
5	o (6.00 m)	o (4.75 m)	o (8.15 m)		
6	o (6.50 m)	o (5.50 m)			
7		o (10.00 m)	o (4.50 m)	o (4.75 m)	
8		o (8.50 m)			o (2.00 m) C_2?
9		o (6.00 m)	o (6.00 m)	o (4.50 m)	o (7.50 m)
10			o (3.75 m)	o (3.00 m)	o (3.00 m)
11	o (6.00 m)	o (6.00 m)			
12	o (8.25 m)	o (2.00 m)		o (8.00 m)	

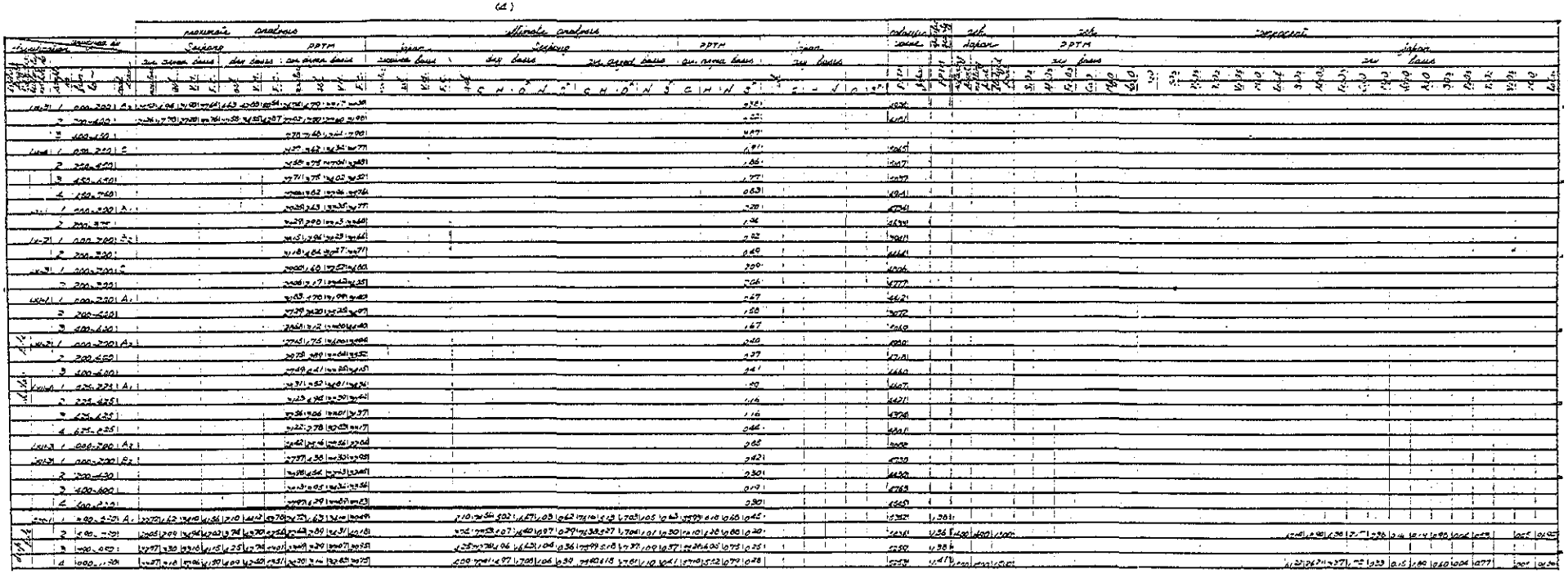
(note) Figures in parentheses show drilled length.

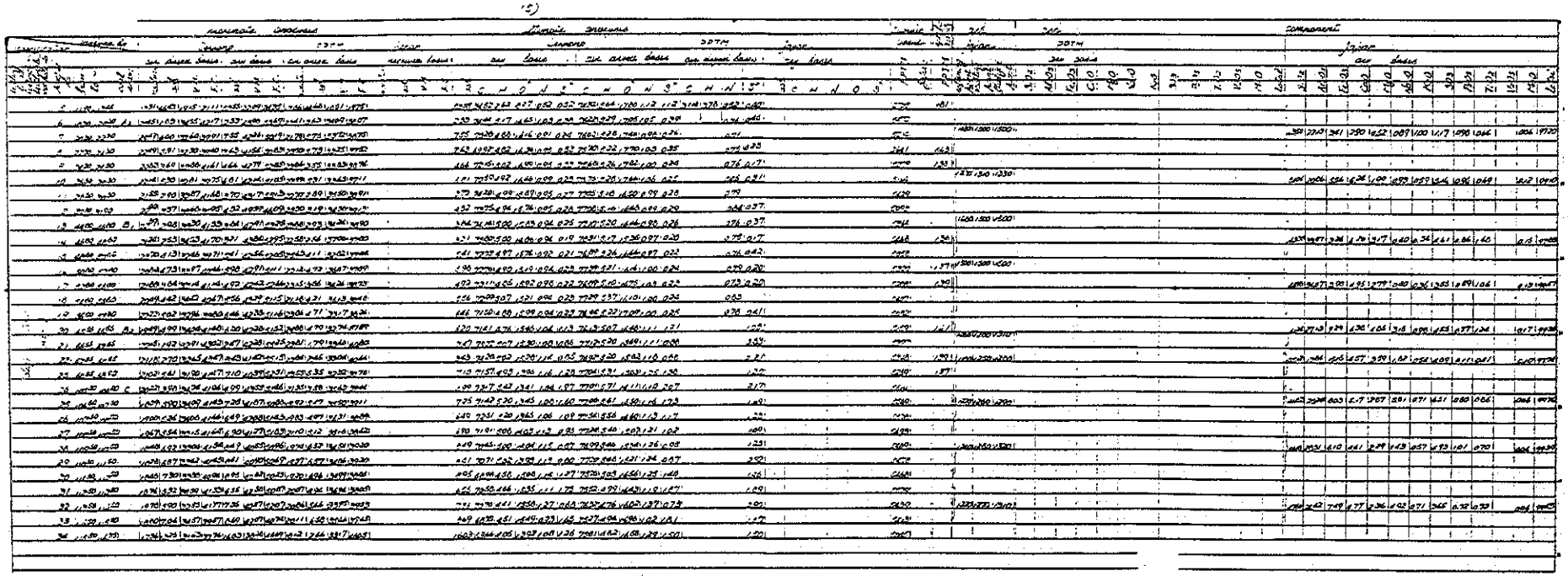
Table 5.3-2 Summary of Analysis results (1)



[illegible]

Classification	No.	Interval	Minerals analysis (pairs)	Liquid analysis	Value
	3	400–610	[illegible]	.052	[illegible]
	4	600–720	[illegible]	.059	[illegible]
	1	000–200	[illegible]	.149	[illegible]
	2	200–400	[illegible]	.129	[illegible]
	3	400–650	[illegible]	.063	[illegible]
	1	000–200	[illegible]	.220	[illegible]
	2	200–400	[illegible]	.244	[illegible]
	3	400–650	[illegible]	.228	[illegible]
	1	000–200	[illegible]	.243	[illegible]
	2	200–400	[illegible]	.059	[illegible]
	3	400–600	[illegible]	.152	[illegible]
	4	600–800	[illegible]	.154	[illegible]
	5	800–900	[illegible]	.115	[illegible]
	1	000–200	[illegible]	.174	[illegible]
	2	200–400	[illegible]	.255	[illegible]
	3	400–650	[illegible]	.270	[illegible]
	1	100–400	[illegible]	.249	[illegible]
	2	400–575	[illegible]	.036	[illegible]
	1	050–250	[illegible]	.327	[illegible]
	2	250–450	[illegible]	.288	[illegible]
	3	450–650	[illegible]	.221	[illegible]
	4	650–850	[illegible]	.129	[illegible]
	1	000–220	[illegible]	.040	[illegible]
	1	000–200	[illegible]	.148	[illegible]
	2	200–400	[illegible]	.284	[illegible]
	3	400–600	[illegible]	.092	[illegible]
	1	000–220	[illegible]	.019	[illegible]
	2	200–400	[illegible]	.020	[illegible]
	3	400–600	[illegible]	.017	[illegible]
	1	000–200	[illegible]	.059	[illegible]
	2	200–400	[illegible]	.019	[illegible]
	3	400–600	[illegible]	.032	[illegible]





5-4 DATA ANALYSIS AND INTEGRATION

5-4-1 Coal Seam Structure

The Shell had drawn up topographic maps geological maps and outcrops/sub-outcrops maps separately.

The Japanese side integrated those maps in one map (see 5-4-1) after temparing with its own reconnaissance results (see the Fig. 5-4-2, Fig. 5-4-3, Fig. 5-4-4, Fig. 5-4-5, Fig. 5-4-6, Fig. 5-4-7, Fig. 5-4-8, Fig. 5-4-9, Fig. 5-4-10, Fig. 5-4-11, Fig. 5-4-12 and Fig. 5-4-13).

And twenty of estimated coal seam vertical sections (see the Fig. 5-4-14, Fig. 5-4-15, Fig. 5-4-16, Fig. 5-4-17 and Fig. 5-4-18) were drew up based on the above combined map consulting the Shell and the D.O.C. core drilling results.

Estimation on coal seam done by the Shell is considered that it is reasonable, as a whole.

Fig. 5-4-1 Combined Topographical, Geological and Outcrops / Sub-Outcrops Map

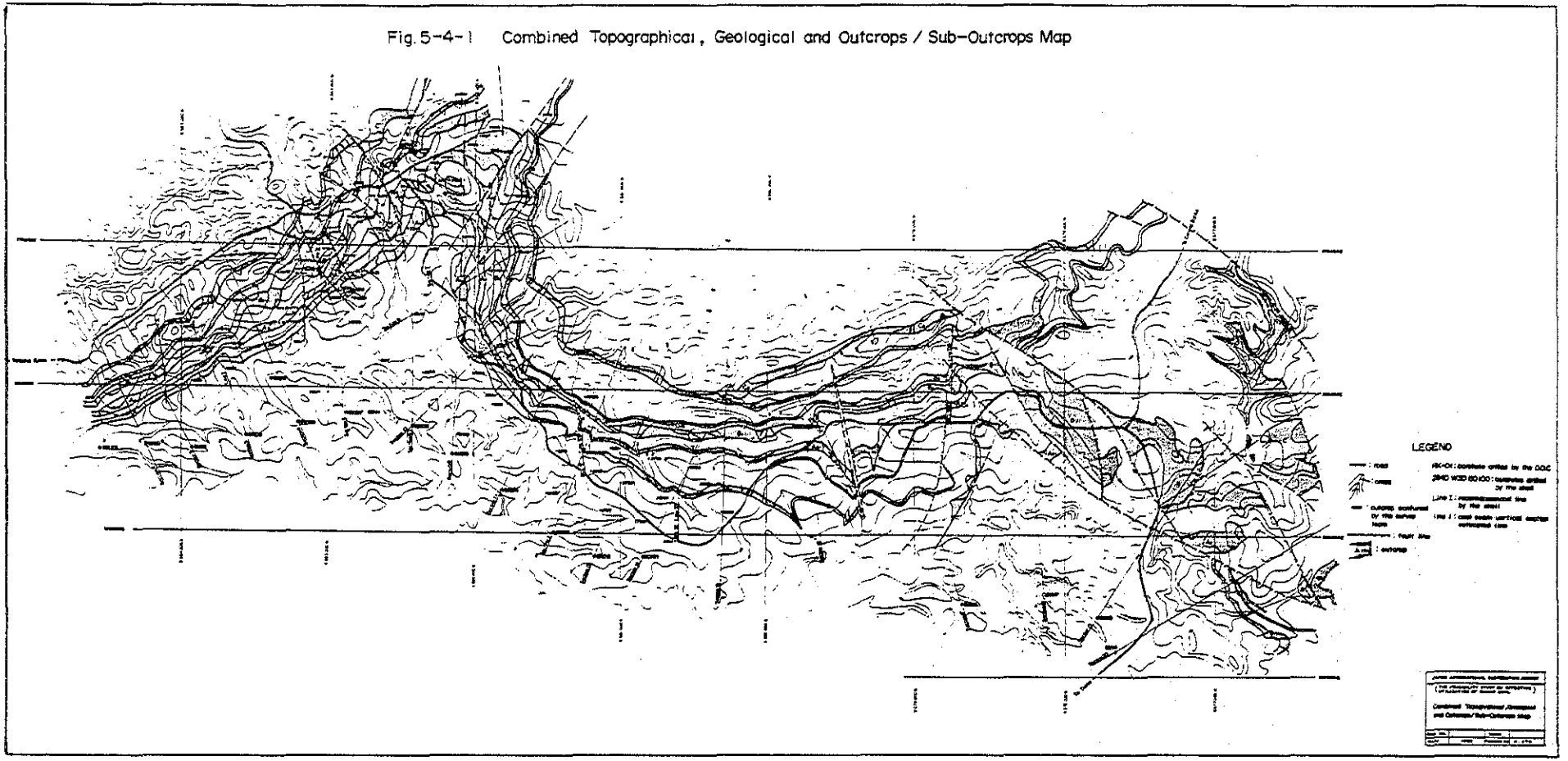
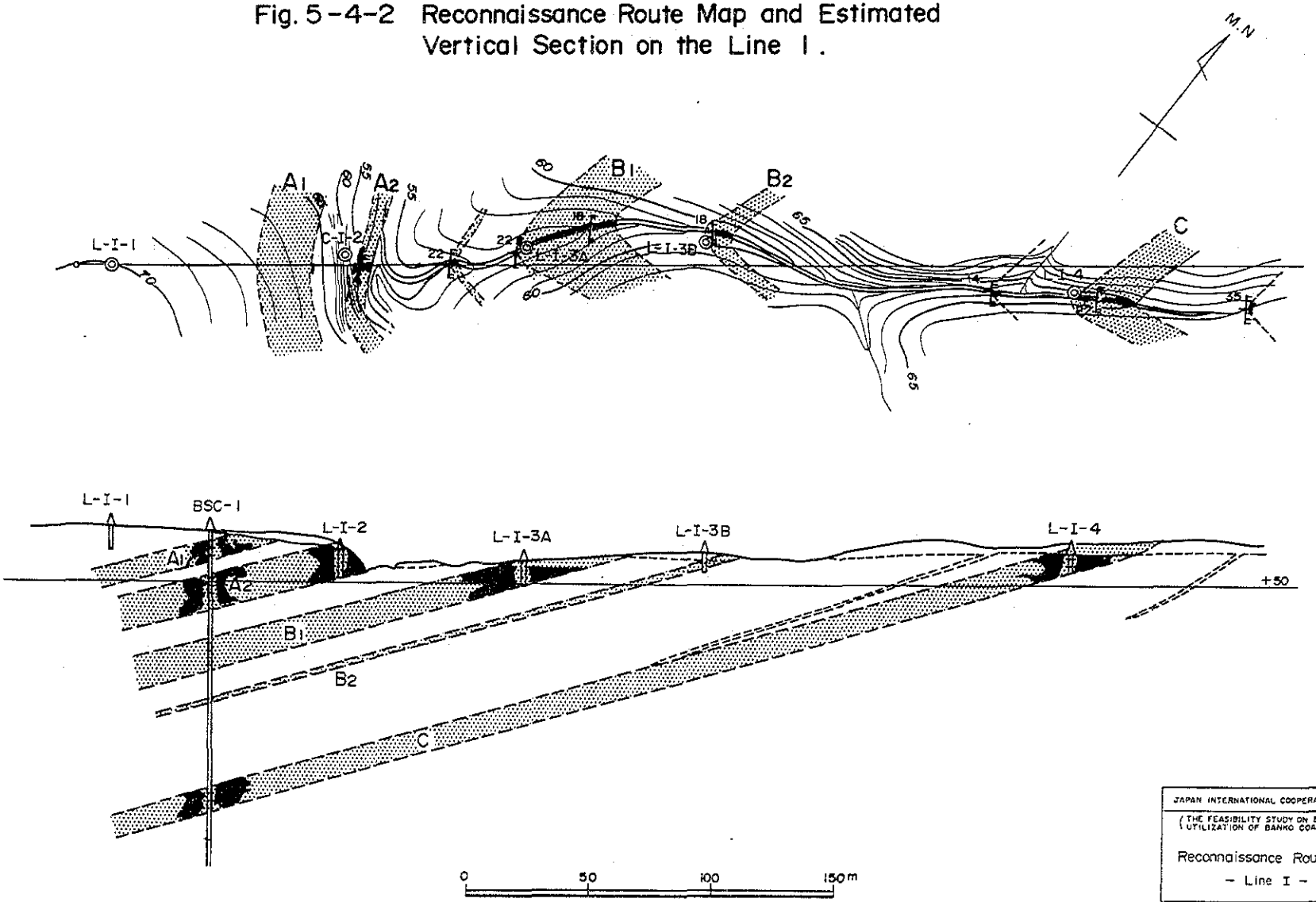


Fig. 5-4-2 Reconnaissance Route Map and Estimated Vertical Section on the Line I.



JAPAN INTERNATIONAL COOPERATION AGENCY

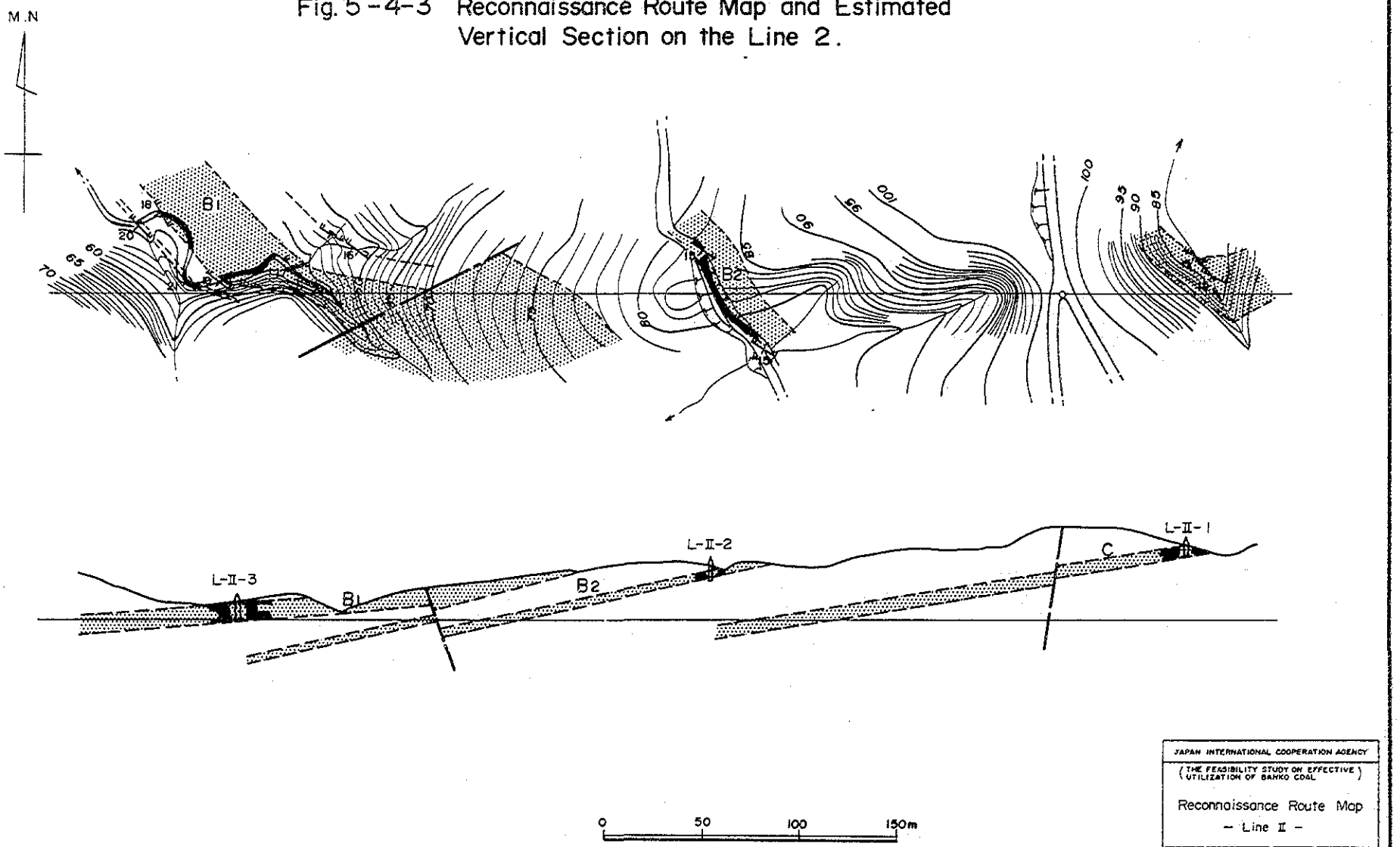
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

Reconnaissance Route Map

- Line I -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-3 Reconnaissance Route Map and Estimated Vertical Section on the Line 2.



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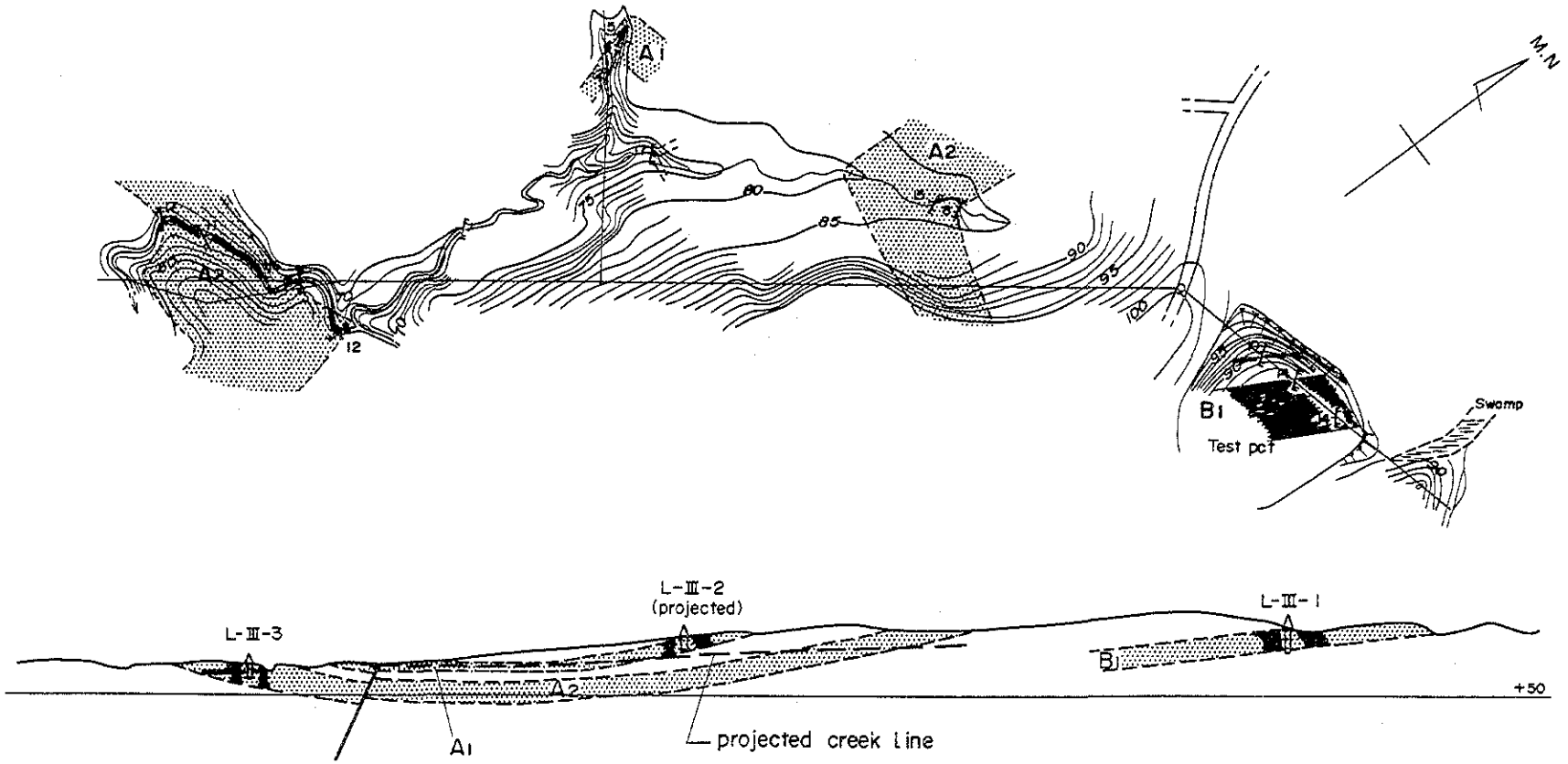
Reconnaissance Route Map
— Line II —

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-4 Reconnaissance Route Map and Estimated Vertical Section on the Line 3.



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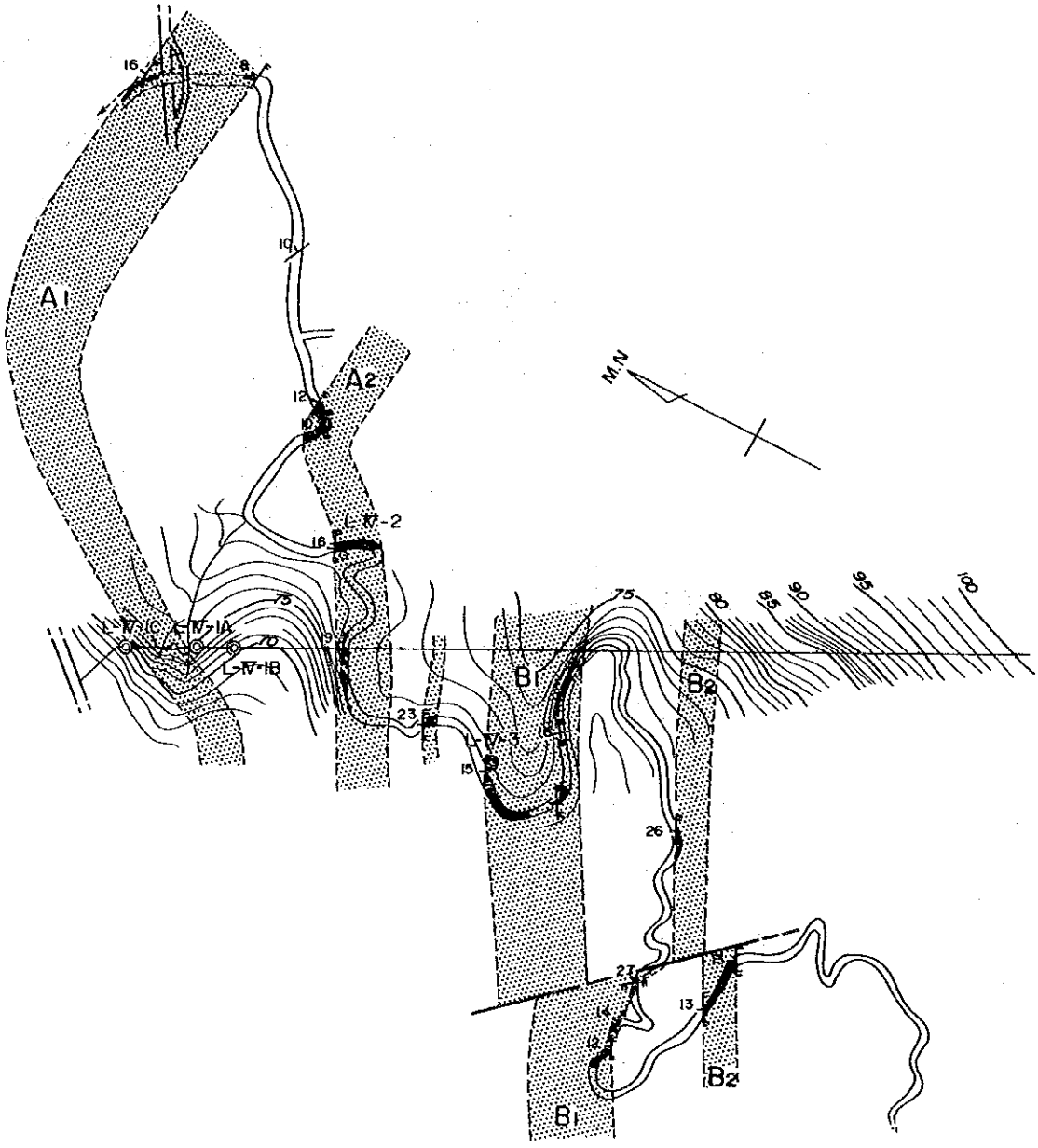
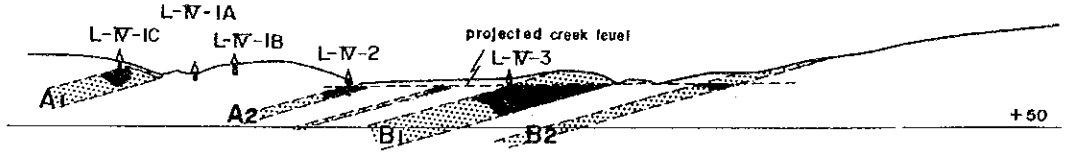
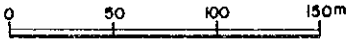
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)			
Reconnaissance Route Map - Line III -			
Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-5 Reconnaissance Route Map and Estimated Vertical Section on the Line 4.







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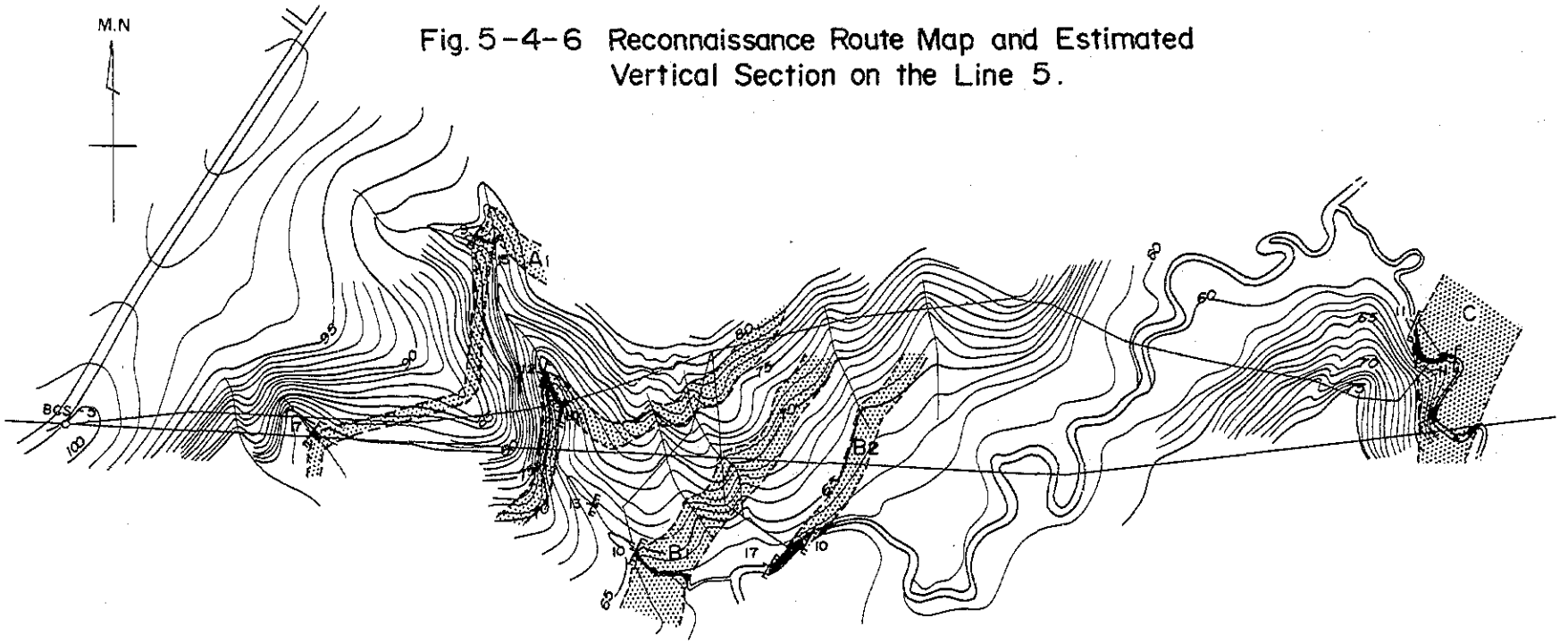
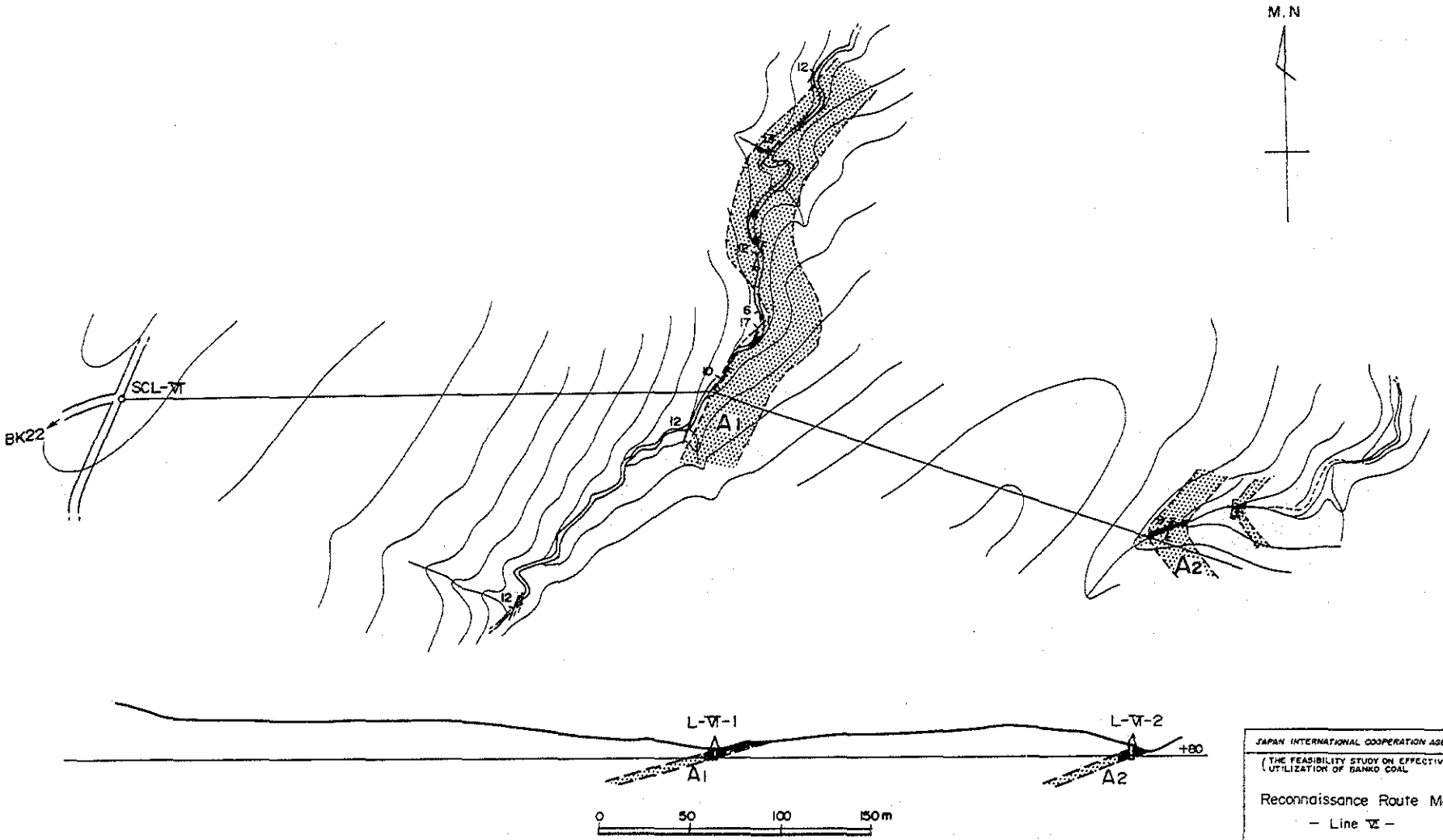
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)			
Reconnaissance Route Map – Line Ⅳ –			
Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-6 Reconnaissance Route Map and Estimated Vertical Section on the Line 5.



JAPAN INTERNATIONAL COOPERATION AGENCY			
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)			
Reconnaissance Route Map – Line V –			
Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-7 Reconnaissance Route Map and Estimated Vertical Section on the Line 6.



JAPAN INTERNATIONAL COOPERATION AGENCY

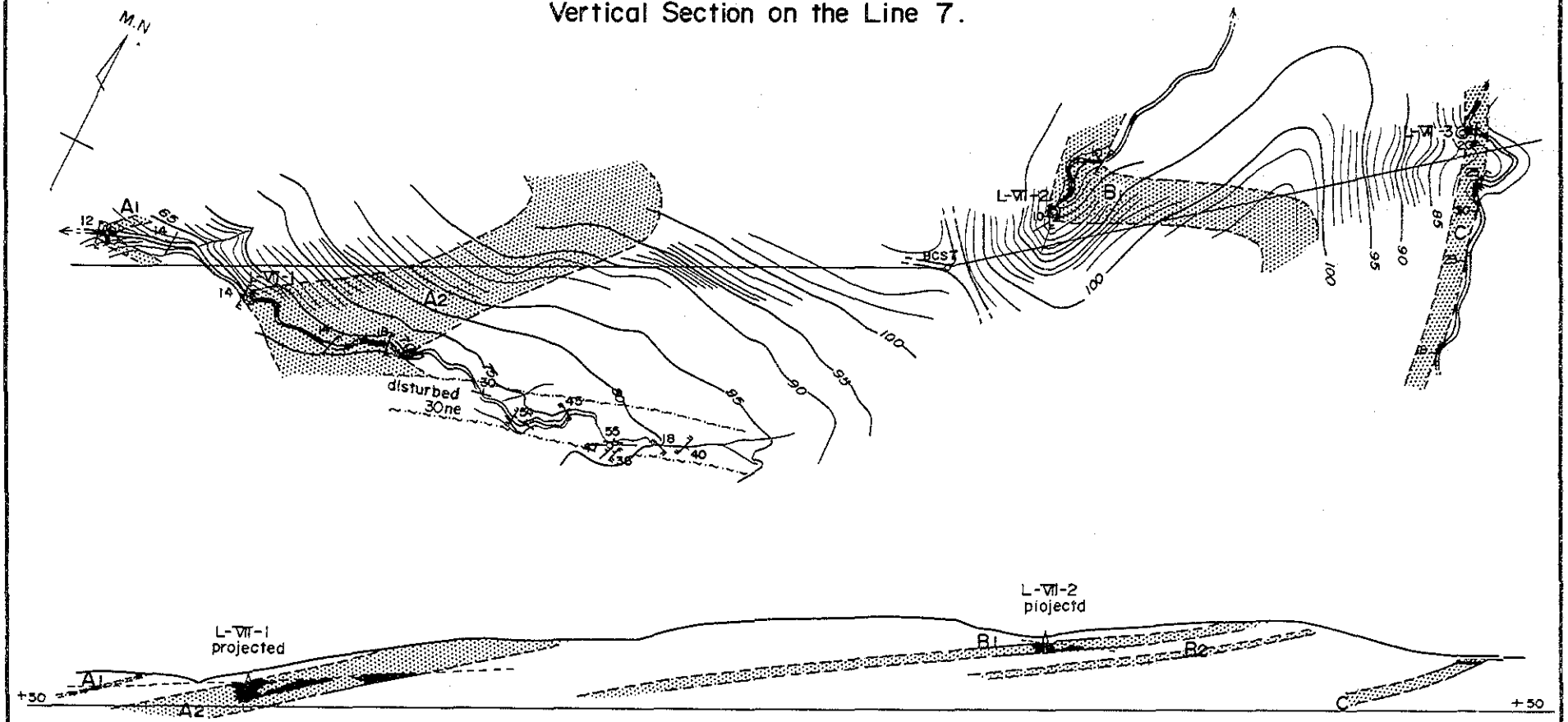
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

Reconnaissance Route Map

— Line Ⅵ —

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-8 Reconnaissance Route Map and Estimated Vertical Section on the Line 7.



JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

Reconnaissance Route Map
– Line Ⅶ –

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-9

Reconnaissance Route Map and Estimated Vertical Section on the Line 8

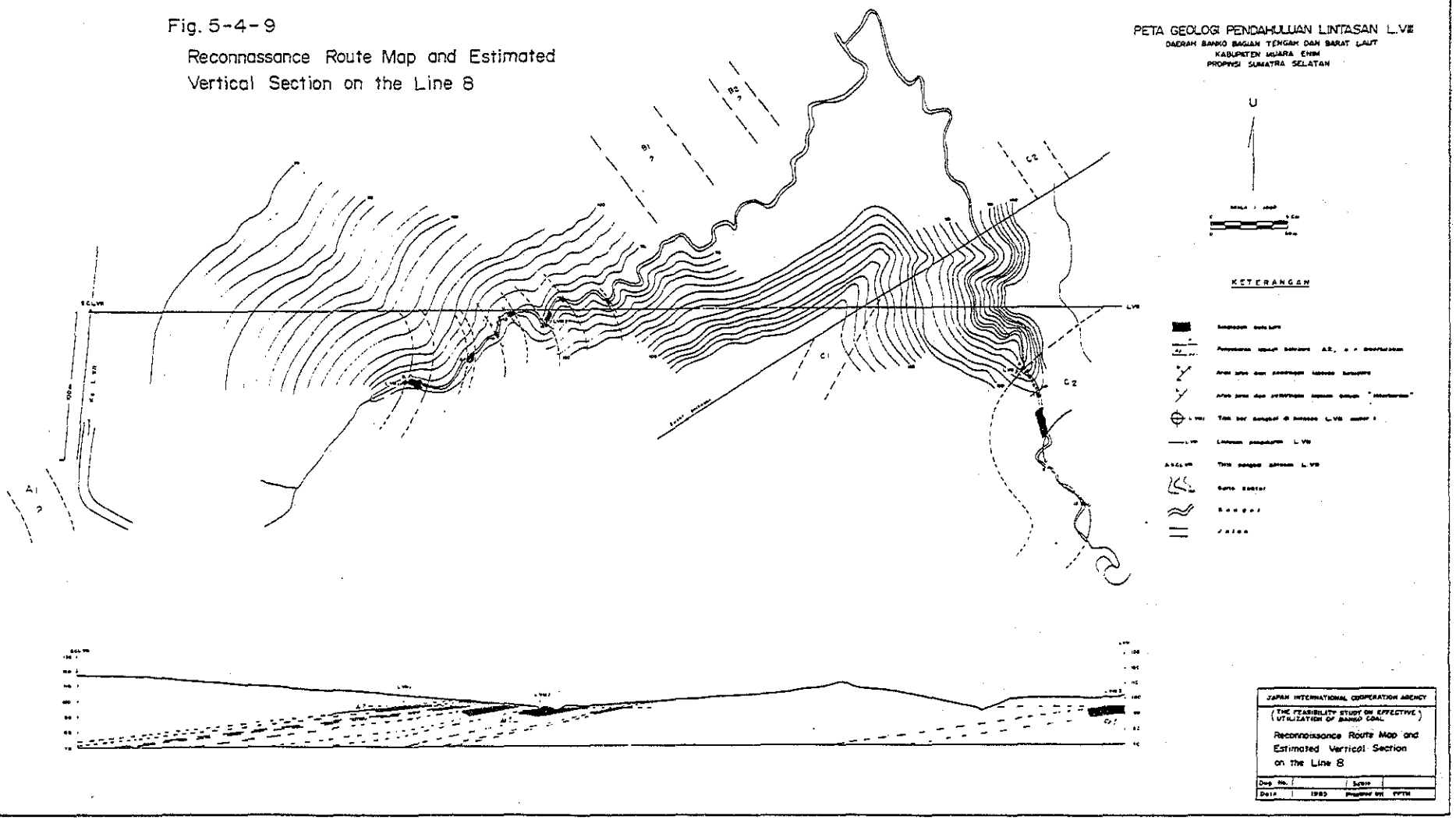


Fig. 5-4-10

Reconnaissance Route Map and Estimated Vertical Section on the Line 9

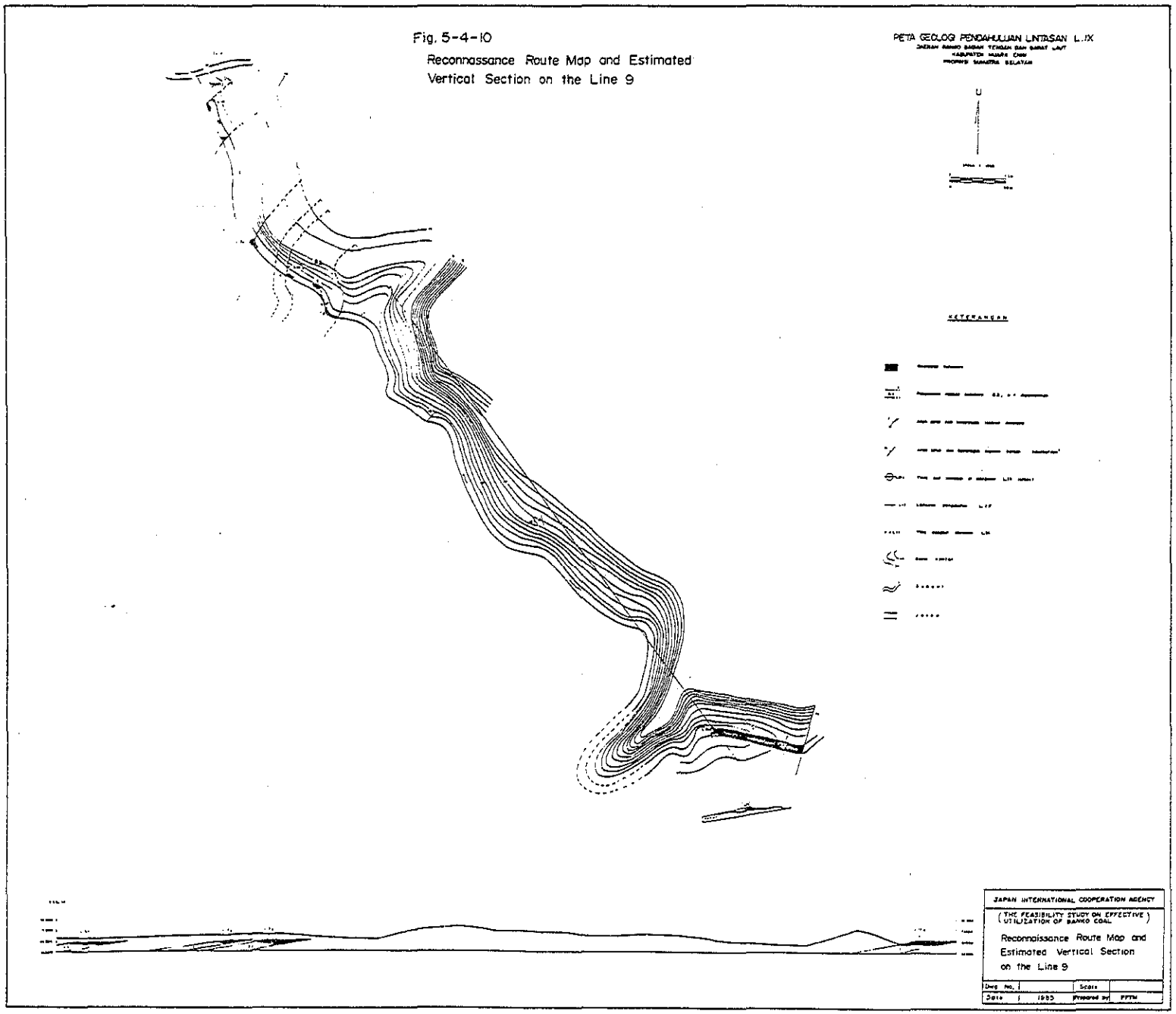


Fig. 5-4-11

Reconnaissance Route Map and Estimated Vertical Section on the Line 10

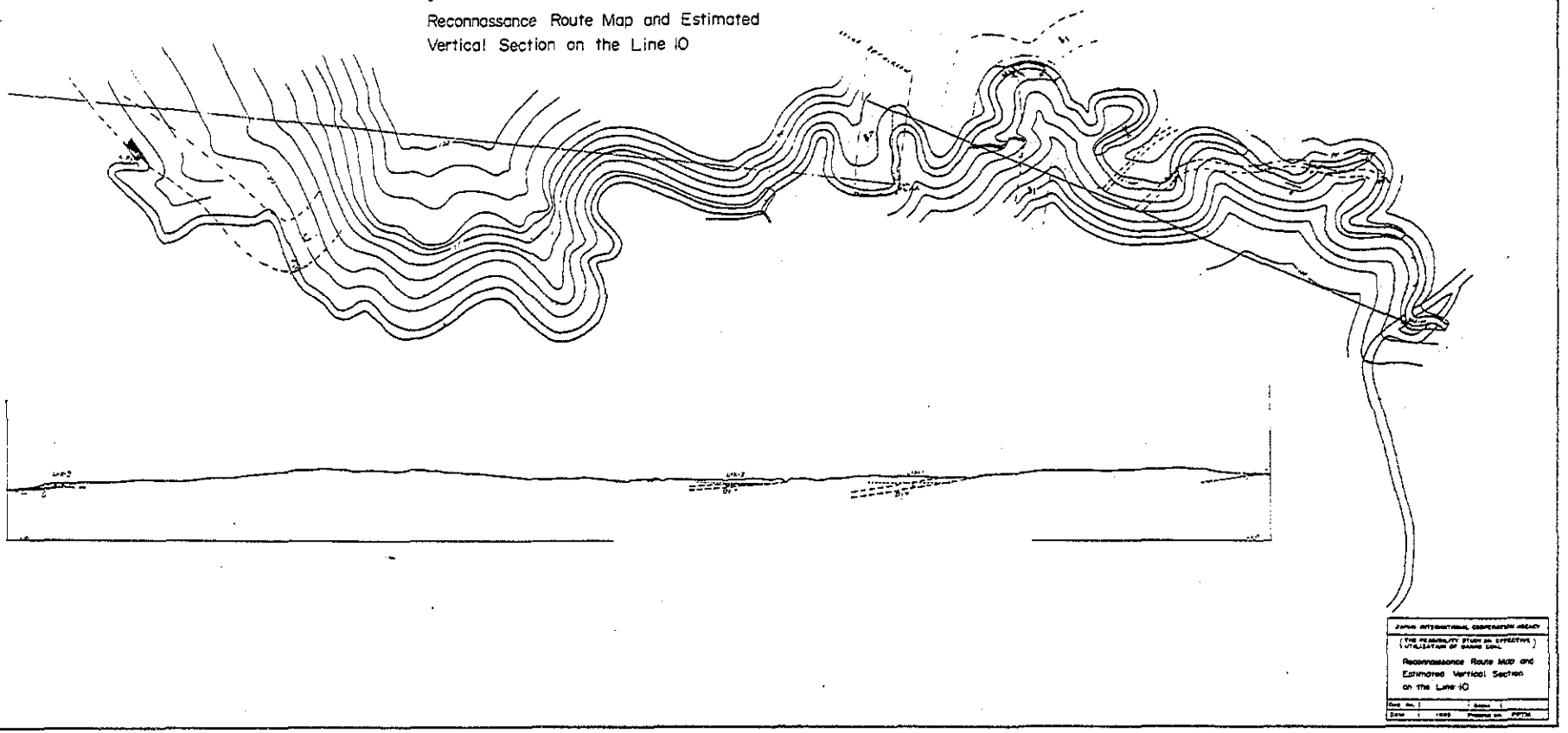
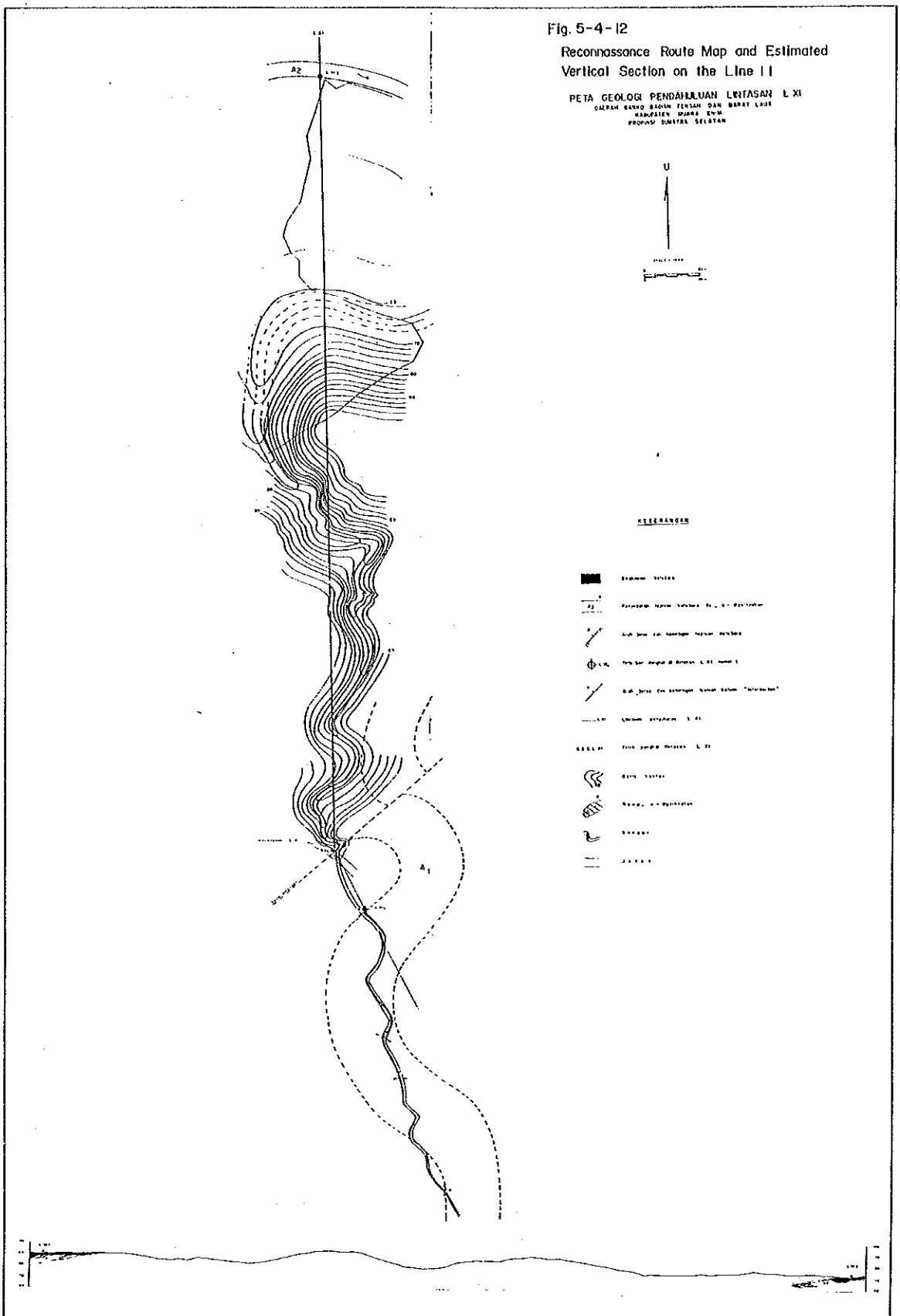


Fig. 5-4-12

Reconnaissance Route Map and Estimated Vertical Section on the Line I I



JAPAN INTERNATIONAL COOPERATION AGENCY			
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)			
Reconnaissance Route Map and Estimated Vertical Section on the Line I I			
Dwg. No.		Scale	
Date	1985	Prepared by	PTTM

Fig. 5-4-13

Reconnassance Route Map and Estimated Vertical Section on the Line 12

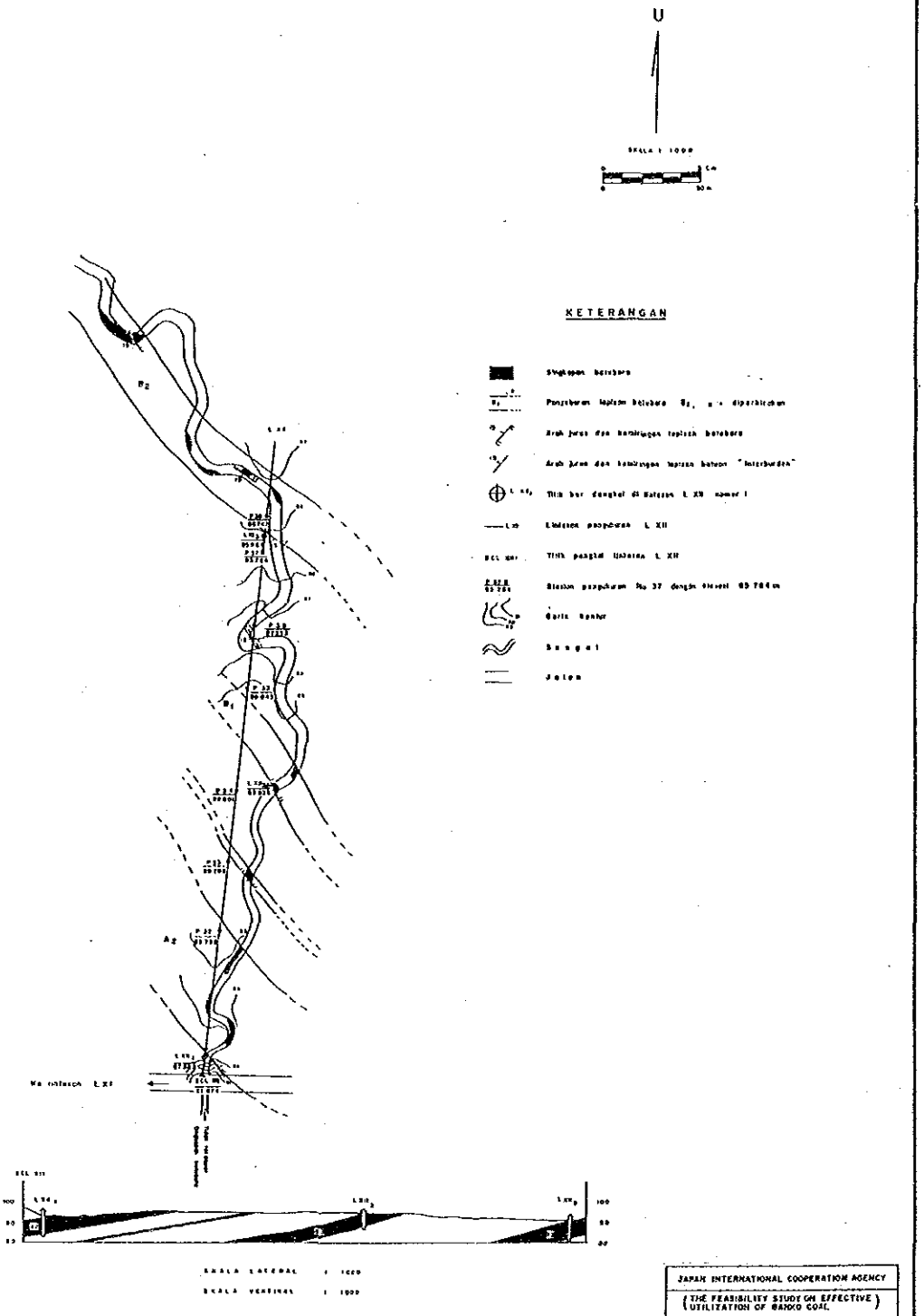
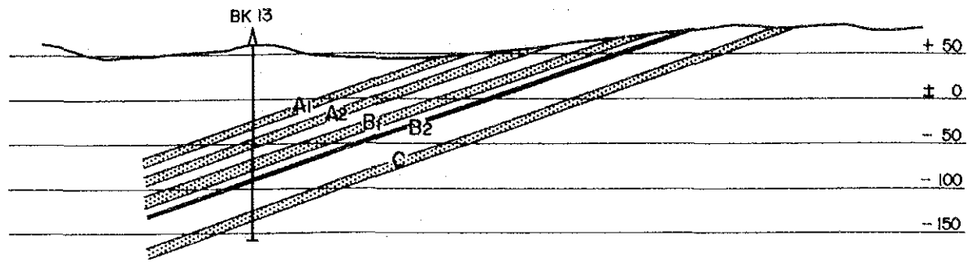


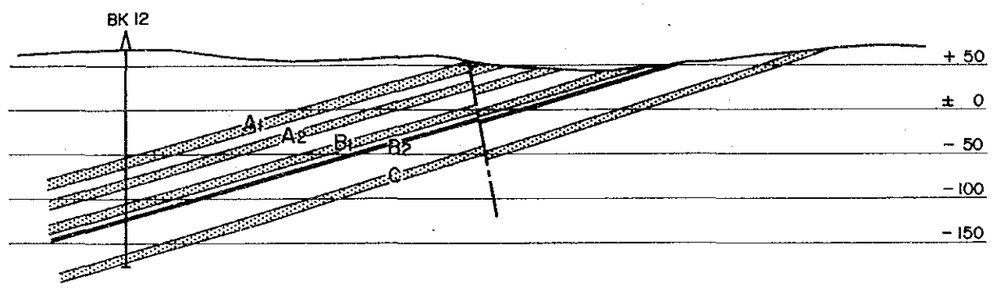
Fig.5-4-14

Estimated Vertical Section

Section 1



Section 2



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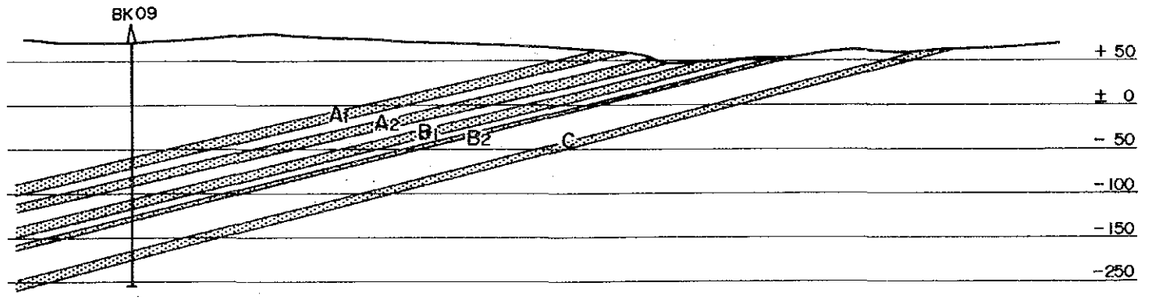
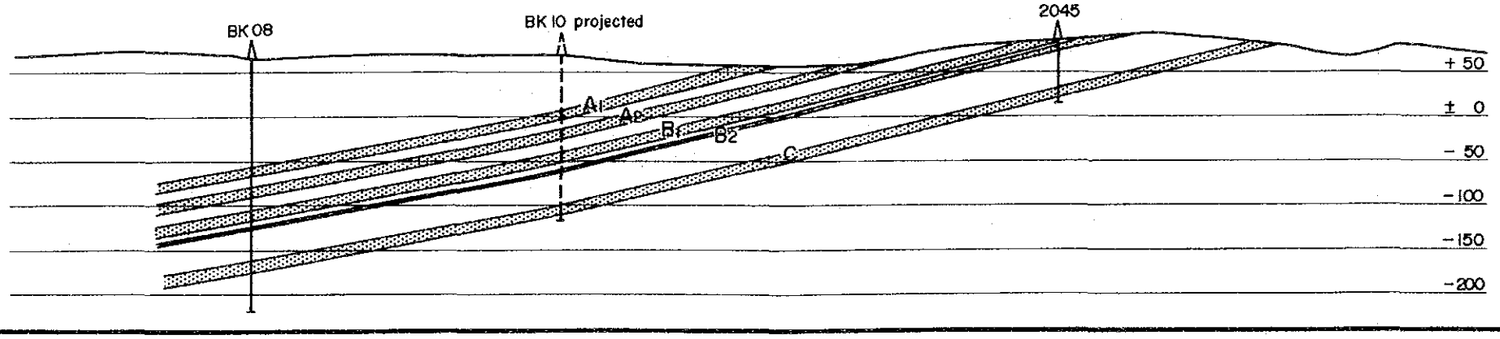
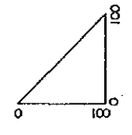


Section 4





JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

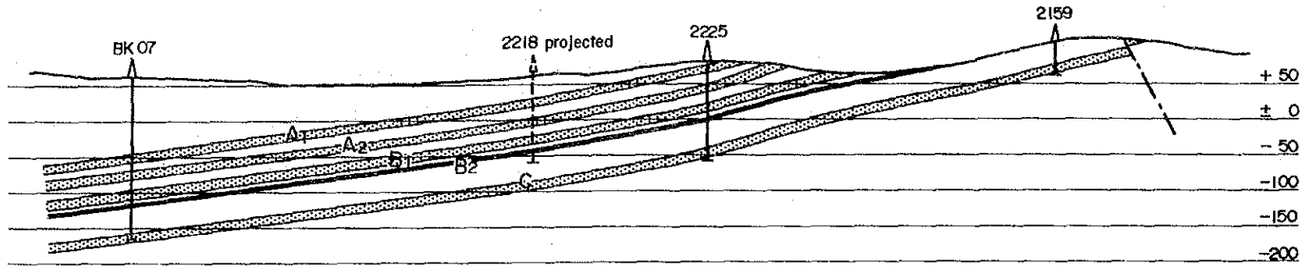
Cross Section

- 1 ~ 4 -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-15 Estimated Vertical Section

Section 5



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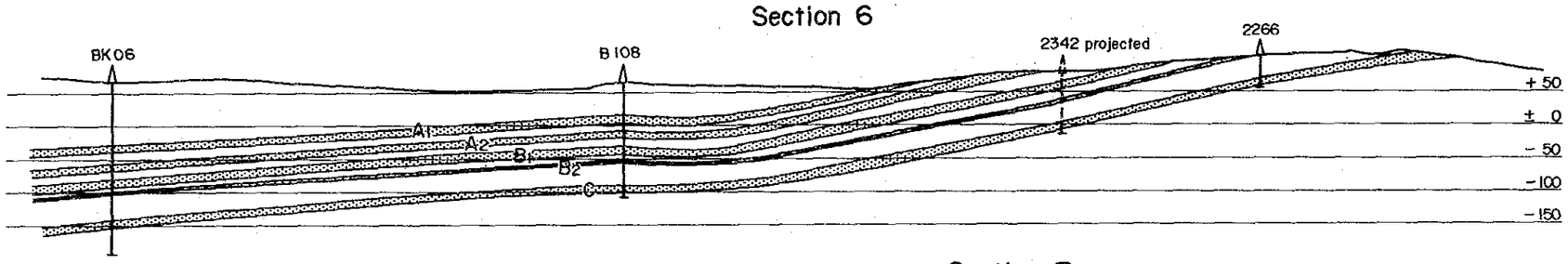

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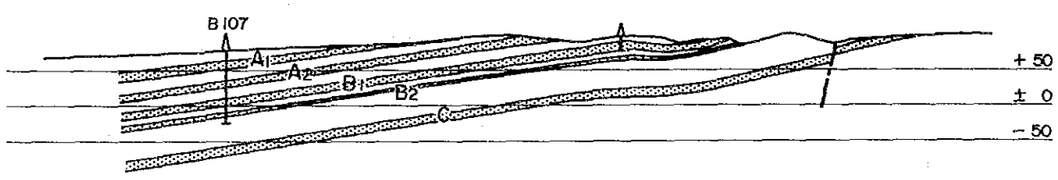

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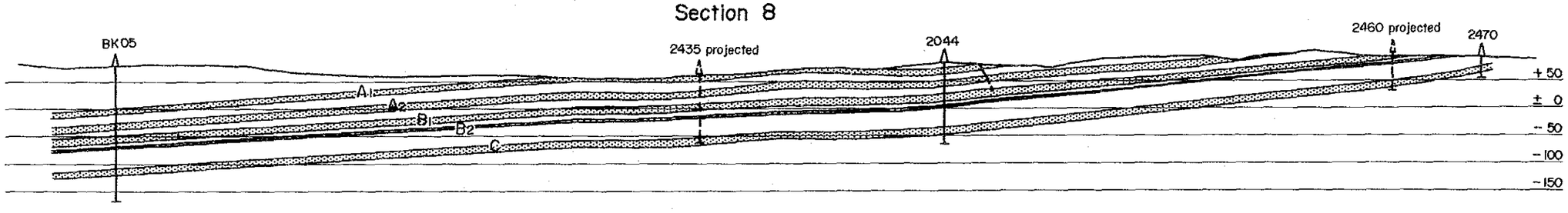
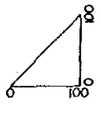




JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

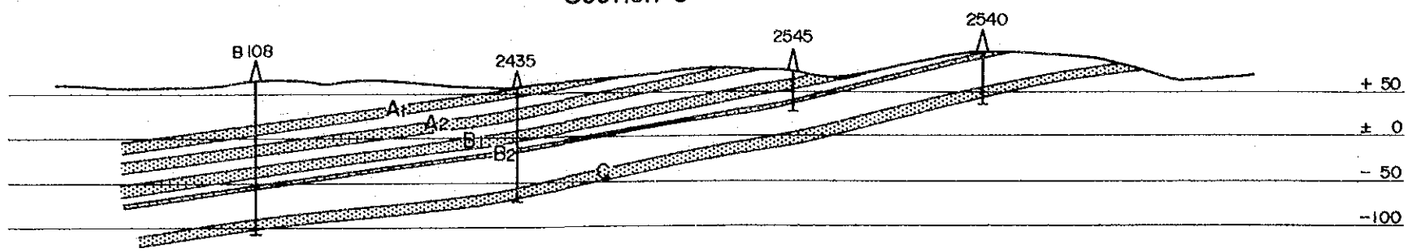
Cross Section

- 5 ~ 8 -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig.5-4-16 Estimated Vertical Section

Section 9



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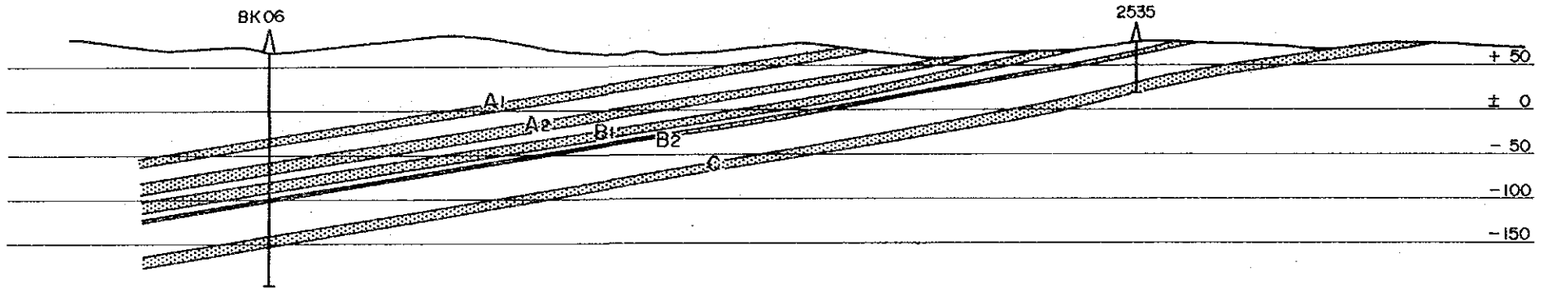

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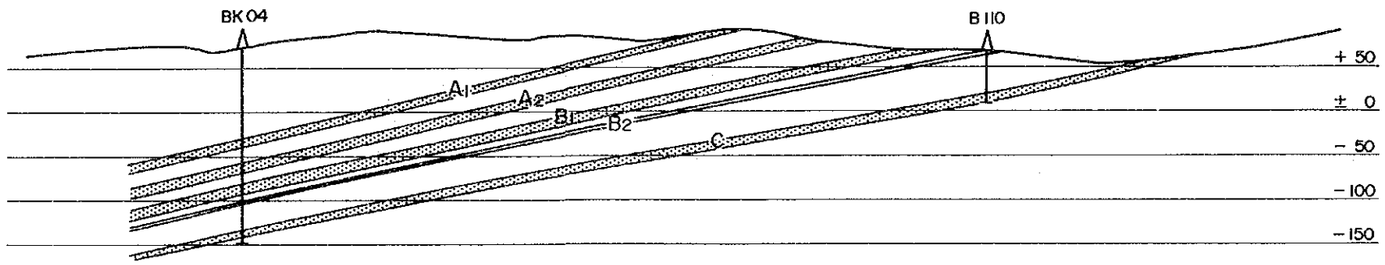

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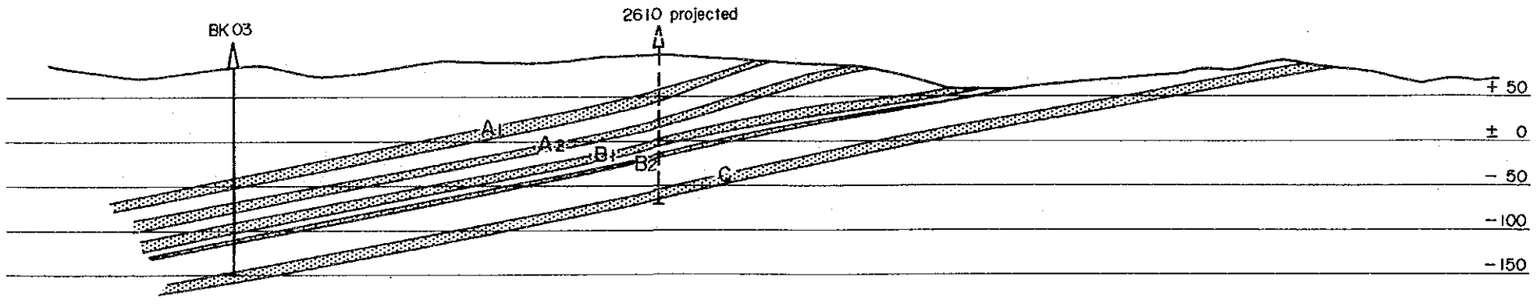
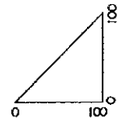




JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

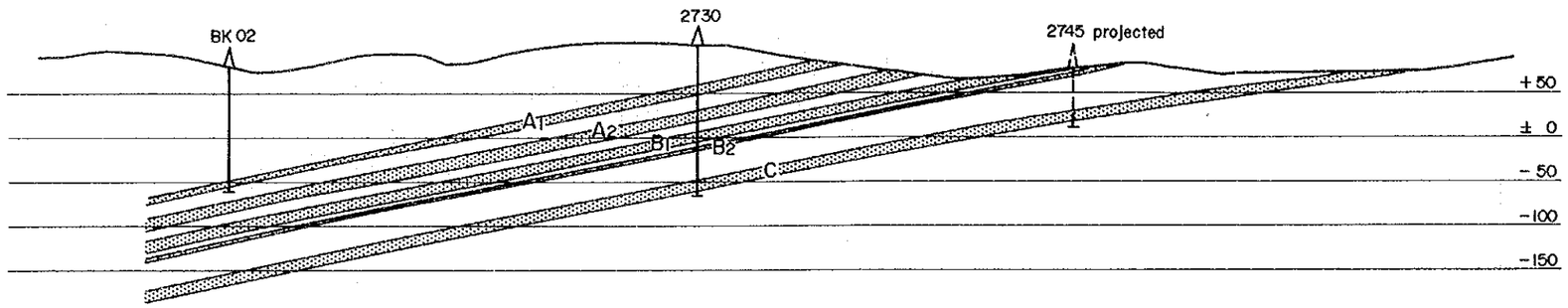
Cross Section

- 9 ~ 12 -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-17 Estimated Vertical Section

Section 13



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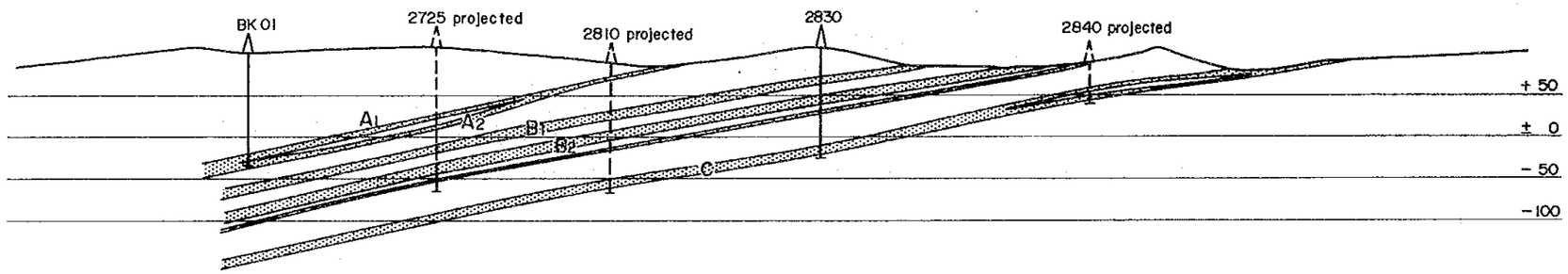
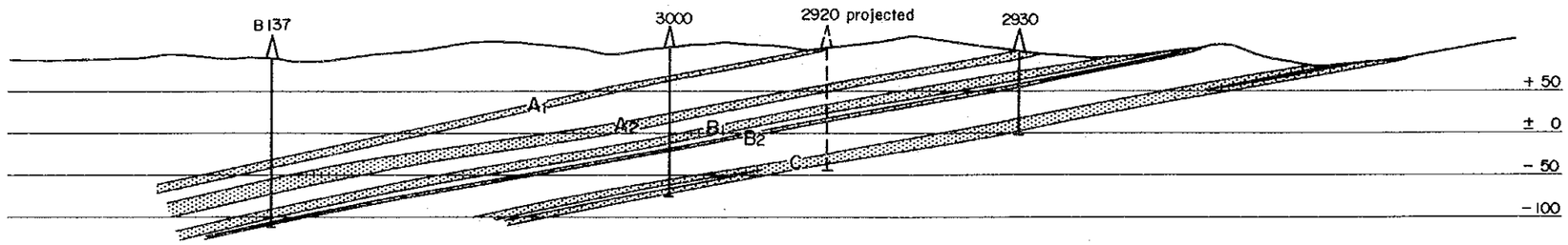
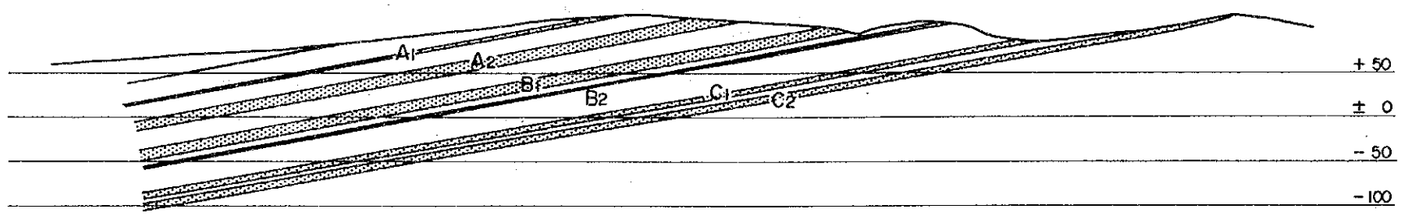
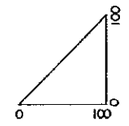


Section 15



Section 16





JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

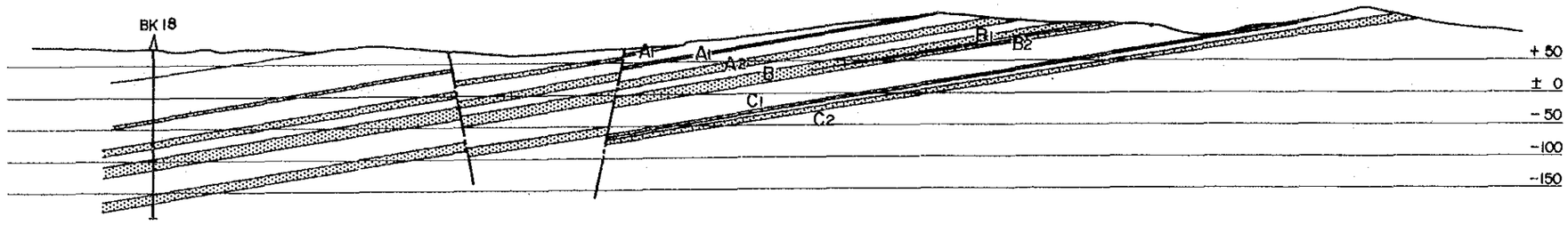
Cross Section

- 13 ~ 16 -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

Fig. 5-4-18 Estimated Vertical Section

Section 17



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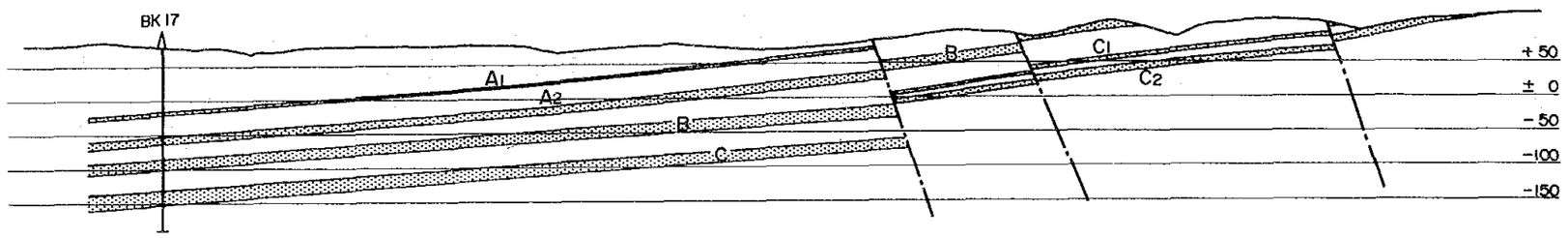

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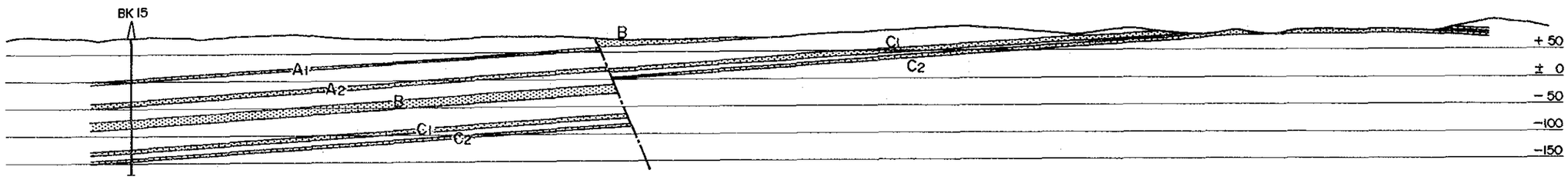

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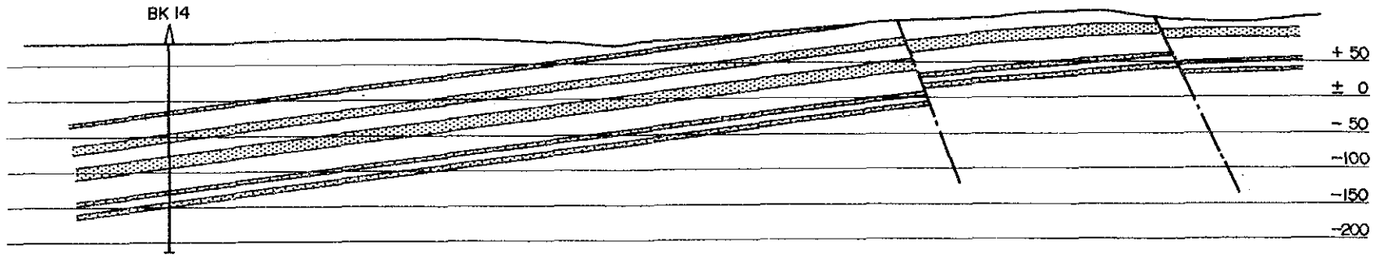
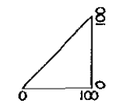




JAPAN INTERNATIONAL COOPERATION AGENCY

(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)

Cross Section

- 17 ~ 20 -

Dwg No.		Scale	
Date	1985	Prepared by	K. ITO

5-4-2 Coal Quality

Enough coal analysis data to discuss the subject at the point of time of making the report have not been prepared as mentioned in 5-3-3 (5).

Therefore the discussion on the subject is laid under the necessity of leaving over until the next fiscal year.

Although, most of shallow holes were drilled from exposed surface of outcrops, severe weathering influence are not found in analyses results.

Therefore it is decided to take bulk coal sample 5 meters below the surface.

5-4-3 Sodium Content in Coal

The counterpart has provided the Shell data giving the following account in connection with the general tendency of sodium oxide contents in its report:

"Sodium oxide level in the ash have been found to be in range of 4 to 40% and although the higher values occur with increasing depth below surface the average sodium - in-ash content below 40 meters is 12%." (see "Shell Report - Technical Study of the Northwest Banko coal project - Executive Summary - April 1983, page 15). And two figures (the Fig. 5-4-19 and Fig. 5-4-20, which show the relationship between total ash (%) and sodium oxide in ash, and relationship between sodium contents and sample depth below surface, have been attached to the above report.

It is understandable, according to the above two figures that;

1) 6,000 PPM of sodium oxide content in coal substance is nearly the maximum value.

2) Reverse mutual relation exists between total ash (%) and sodium oxide content (%) in ash.

3) Sodium oxide contents in coal (%) increases in proportion to vertical depth from the surface.

Ash component analysis done by hands of the Japanese side also shows 2 - 6% of sodium oxide contents in ash and those high values are seen in B_2 and C coal seam (below an elevation of 30 meters).

It should be investigated continuously consulting with new data which will be obtained in 1985 FY and analyses results done by the shell and the PPTM that

1) High sodium oxide contents are characteristic of specially designated coal seal (for example B_2 and C coal seam)

2) or vertical depth to coal seam from the surface has the influencing power on sodium oxide contents.

Fig. 5-4-19 Relationship Between Total Ash (%) and Sodium Oxide in Ash

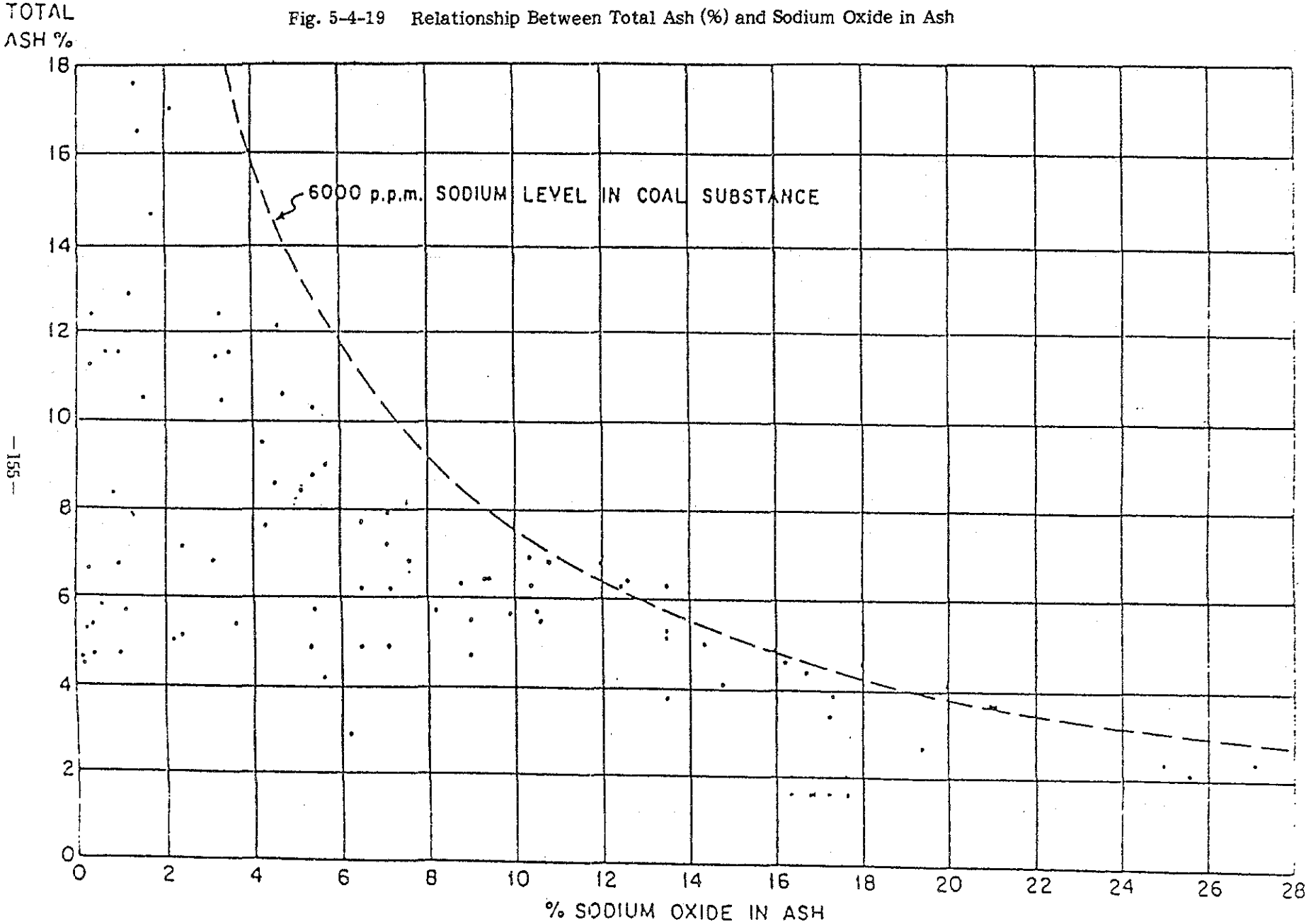
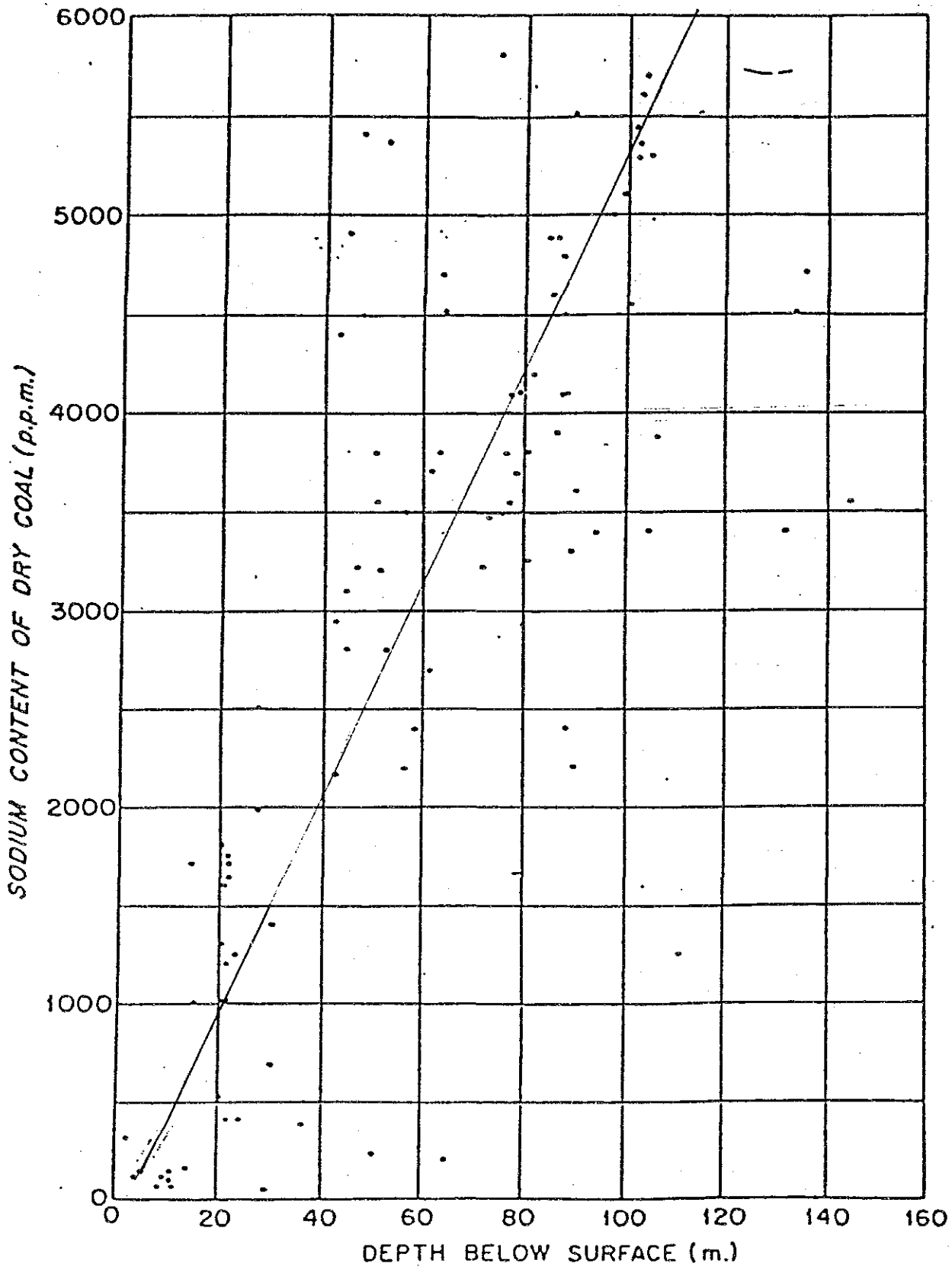


Fig. 5-4-20 Relationship Between Sodium Content and Sample Depth Below Surface



5-4-4 Recommended Sampling Schedule, Places and Method

(1) Bulk coal sampling schedule

As mentioned before, the main purpose of the survey work in 1985 is to decide bulk sampling method and sampling places, for the coal gasification test at Serpong in and after 1986/87.

Coal gasification facilities prepared by the JICA will be installed in 1986 and mechanical and process test run will be carried out at the end of the same year.

Then, regular coal gasification test is expected to carry out in 1987, driving into two periods (the first part of them will carry out at the beginning of the fiscal year).

Therefore, bulk coal samples to be used for the mechanical and process test run shall be prepared in FY 1986. If rainy season in Sumatra Island which is at the peak in the second half of the fiscal year, is taken consideration, bulk samples shall be prepared before the rainly season.

Furthermore, it is recommended to prepare bulk coal samples to be used for the first stage coal gasification test starting from June 1987, shall be prepared in the dry season of 1986, when governmental budget execution in Indonesia, starts from the middle of July.

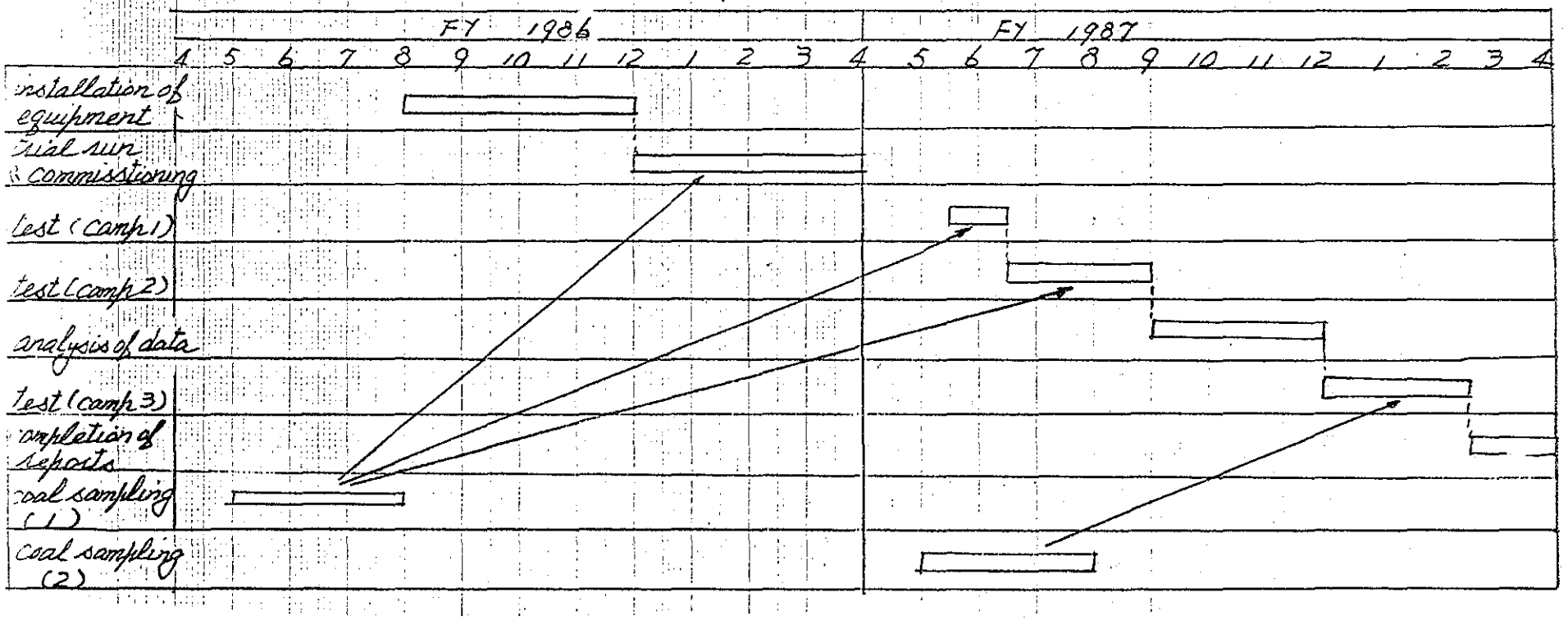
Unless they are not prepared in 1986, the first coal gasification test is impossible in the first quarter of FY 1986.

Obtained bulk coal samples must be stocked properly (for example in sealed drums) and deterioration in the quality of coal samples caused by storage shall be checked by means of chemical analysis.

The coal gasification test at second stage will be carried out in the first quarter of FY 1987, therefore bulk coal samples to be used at second stage shall be obtained in the FY 1987, considering deterioration in coal quality.

Relationship between bulk coal sampling and coal gasification test is as shown in the Fig. 5-4-21.

Fig. 5-4-21 Coal Gasification Test and Coal Sampling Timetable



(2) Bulk coal sampling method

The basic idea of the heading has been discussed in September 1985 among the JICA survey team, the representative of the BPPT and the PPTM.

The outline of the dissussed matter is as follows:

1) needed numbers of coal sample are ten samples and each sample consists of 200 kgs.

2) Typical, fresh, and unweathered bulk coal samples shall be taken from each coal seam equally.

When bulk coal samples are taken under the above mentioned pre-conditions, large diameter core drilling method (O.D. 131 mm, I.D. 101 mm) will be more favorable with due regard to the capacity of core drilling machine held by the PPTM, by following reasons:

1) When small scale pit excavation method is adepted and even if pit ultimate slope is 25°, excavating volume will be too huge (about 30,000 times of coal sample).

Moreover, it is quite difficult to heap excavating overburden and surplus excavating coal near the pit then excavated materials must be carried to suitable heaping place by a troop of trucks in bad road conditions. Therefore, it is obvious that that the sampling cost per unit would be very expensive.

2) In the case of small sesction shaft excavation method, shaft section shall be at least 1.50 m x 1.50 m, to work labours inside it, therefore excavating volume will be also too huge (about 3,000 times of coal sample) to obtain a little samples.

Moreover, proper hoisting machines and special experienced supporting technique to keep excavated wall are needed.

(3) Bulk coal sampling places

Bulk coal samples shall be taken from wide area covering the whole Banko area (including Suban Jeriji). North-West Banko is well surveyed and it is fit for obtaining the above mentioned needed coal samples. In West Banko and Central Banko, combined map same as the Fig. 5-4-1 must be prepared beforehand.

In Suban Jeriji, it is needed to begin with preparing topographic map drawn on a scale of 1 to 10,000 at least (if possible 1 to 5,000) based on aerial photographs prepared by the Shell.

Survey works which shall be carried out in and after FY 1986, are invest- Tanjung Enim
gated in the following section in detaily taking into account the above mentioned basic idea and the present situation.

5-5 PROPOSAL FOR SURVEY WORKS IN AND AFTER FY 1986

Essential works to be done at the site hereafter are as follows:

1) Bulk coal sampling for the coal gasification test at Serpong in FY 1986, and FY 1987.

2) Investigation of proper coal supply source for the project

Following works shall be performed, year after year for three years ahead from now.

(1) Works in FY 1986

1) Bulk coal sampling

It would be wiser from the viewpoint of expenditure safety in work operations and the term of works, to obtain coal samples by large diameter core drilling method as discribed above, and it also desired to take many different type of coal samples for the coal gasification test.

Therefore, it is thinkable that bulk coal sampling will be done in the northern part (along the section 3 see Fig. 5-4-14) and southern part (along the section 16 see Fig. 5-4-15) in North-West Banko which were surveyed in detail, in FY 1986 and the combined map (Fig. 5-4-1) has been drawn up by hands of the Japanese side, by reason of obtaining coal samples from all coal seams equally and keeping time loss caused by core drilling machine movement at a minimum.

Core drilling plans on each drilling line are shown in the Table (5-5-1).

Actual needed number of working days (excluding preparation before starting works at the site and settlement after finishing works at the site, but including a day off every a week) is 87 days when working parameters are estimated as follows and they are increased by 20 persents considering

core drilling machine availability
core recovery
lack of experience in large diameter core drilling in Indonesia
error on estimating thickness of overburden and/or coal seam at each drilling spot

Table 5-5-1 Core Drilling Plan

Drilling		Coal Seam	drilling length a hole			core diameter	sample *1 weight per drilling meter	needed *2 number of drilling holes	total drilling length
Section No.	Spot No.		overburden	coal seam	total				
3	1	Petai (C)	5.0 m	13.0 m	18.0 m	101	10.4 kg	2 (1.48)	36.0
	2	Suban 2 (B_2)	5.0	4.0	9.0	101	10.4	5 (4.80)	45.0
	3	Suban 1 (B_1)	5.0	15.0	20.0	101	10.4	2 (1.28)	40.0
	4	Mangus 1 (A_1)	5.0	10.5	15.5	101	10.4	2 (1.83)	31.0
	5	Mangus 2 (A_2)	5.0	10.5	15.5	101	10.4	2 (1.83)	31.0
	average or sub-total		(5.0)	(9.1)	(14.1)	(101)	(10.4)	13	183.0
16	6	Petai (C)	5.0	5.0	10.0	101	10.4	4 (3.85)	40.0
	7	Suban 2 (B_2)	5.0	11.0	16.0	101	10.4	2 (1.75)	32.0
	8	Suban 1 (B_1)	5.0	10.0	15.0	101	10.4	2 (1.92)	30.0
	9	Mangus 2 (A_2)	5.0	5.0	10.0	101	10.4	4 (3.85)	40.0
	10	Mangus 1 (A)	5.0	12.0	17.0	101	10.4	2 (1.60)	34.0
	average or sub-total		(5.0)	(7.6)	(12.6)	(101)	(10.4)	14	176.0
average or total			(5.0)	(8.3)	(13.3)	(101)	(10.4)	27	359.0

(note 1)* $\frac{(0.101^{m}/2)^2}{(\text{radius})^2} \times \underline{3.14} \times \underline{1.3}_{\text{specific gravity}} \times 1^{m} = 10.4$ kg

*2 200 kg - (10.4 kg x drilling length a hole in coal seam)

(note 2) Figures in parentheses on "average or sub-total" or "average or total" line show weighted average by drilling length a hole and number of drilling holes at each drilling spot.

working parameters:

drilling performance	:	3 m/shift
working system	:	3 shifts/day, 8 hrs/shift a day off every a week

machine movement from drilling line to drilling line (including installation) by a dozer : 2 days

machine movement from drilling spot to drilling spot on the same line (including installation) by manpower : 1 day

changing machine direction at the same drilling spot : 1 shift/day

number of core drilling machine to be used : 1 unit

The JICA headquarters has a mind to prepare some large diameter core drilling tools and accessaries shown in the table 5-5-2, considering the time for their delivery when they are procured in Indonesia, in order to cut down expenditures of bulk coal sampling and to carry out the work safely and efficiently.

Obtained coal bulk samples shall be stocked in sealed and water-filled drums after arriving at Serpong by hands of BPPT and shall be analysed to check quality deterioration during storage, comparing with analysis results which shall be done after breaking the seal

Needed number of staffs, labours machines and their accessaries, and tools which shall be provided by the Indonesian side are shown in the table 5-5-3.

Table 5-3-2 List of Large Diameter Core Drilling Tools and Accessaries to be Prepared by JICA Headquarters

Articles	Specification	Quantity
FJ drilling rods	NW x 3 m	7 pcs
FJ drilling rods	NW x 1.5 m	2 pcs
double tube core barrel ass'y	SK-3, OD 131 mm, ID 101 mm	2 sets
metal bits	SK-3, 131 mm	7 pcs
metal reamers	SK-3, 131 mm	4 pcs
core lifters	SK-3, 131 mm	4 pcs
core lifter cases	SK-3, 131 mm	4 pcs
outer tube	SK-3, 131 mm	1 pc
inner tube (upper)	SK-3, 131 mm	1 pc
inner tube (lower)	SK-3, 131 mm	1 pc
outer extension tube	SK-3, 131 mm	1 pc
inner extension tube	SK-3, 131 mm	1 pc
oil seal	SK-3, 131 mm	1 pc
bearings		2 sets
water swivel	sub, NW-C, RGB-6-3	1 set
FJ casing pipes	JIS, 142 mm x 1.0 m	4 pcs
FJ casing pipes	JIS, 142 mm x 0.5 m	4 pcs
casing metal shoes	142 mm	5 pcs
casing swivel	142 mm, NW-C	1 pc
casing head	142 mm	1 pc
wing bit	146 mm, NW-C	1 pc
hoisting swivel	sub, NW-C	1 set
casing band	with frame, NW	1 set
chack piece	NW-C	1 set

Table 5-3-3 List of Needed Number of Staffs, Crews, Machines and Tools

	Item	Number	Term	Remarks
engineers and labours	geologist	1	3 months	concurrently resident manager
	well site geologist	1	- do -	
	logistic	2	- do -	
	mechanic	2	- do -	
	surveyor	1	- do -	
	assistant surveyor	1	- do -	
	drillers	7	- do -	1 for shallow holes drilling
	local labours	30	- do -	
machine and tools	core drilling machine	1 unit		spindle I.D.: more than 93 mm engine output: 30 ps including standard accessaries with following machines 1) drilling mast (tripod, effective height 5.5 m, load capacity 5 tons, head pully diameter 250 mm) 1 unit 2) mud pump (capacity: more then 87 ℓ/min at 20 kg/cm^2, including standard accessaries and 10-15 ps engine) 3) water supply pump (including 5-7 ps engine and standard accessaries) 4) mud mixer (capacity 100-200 ℓ, including 5-7 ps engine) 5) lowering/lifting tools (hoisting wire rope with safety clevis tongs and wrenches)
	surveying machines and tools	1 set		
supplies	bentonite	1 ton		
	Others			used drums; stakes; fuel oil; lubricant; grease, hand tools; plastic sacks etc.
rent	4 wheel drive car	2-3 unit		
	dozer	10 days		

2) Reconnaissance

Bulk coal samples shall be obtained in West Banko and Central Banko or Suban Jeriji North in FY 1987 for the coal gasification test in the last quarter of FY 1987, as discribed above.

Reconnaissance shall be performed to choose proper coal sampling places in Central Banko and a combined map same as the Fig. 5-4-1 shall be drawn up to make up coal sampling plan.

Central Banko and Suban Jeriji North are the most promising block in the remained area, therefore coal samples shall be obtained in one of two blocks (if possible, in Suban Jeriji North in a sense that coal samples are obtained in addition to Banko area in a narrow sense.)

Reconnaissance shall be done in Central Banko or Suban Jeriji North (the latter block is desirable)

3) Work allotment between the Japanese side and the Indonesian side.

The whole work at the site shall be performed by hands of the Indonesian side with cooperation of engineers sent from the Japanese side.

(2) Survey works in FY 1987

Bulk coal samples shall be taken from two places in West Banko. However, when promising result by preliminary reconnaissance in Suban Jeriji North, is obtained sampling places in West Banko shall be reduced from two places to one and newly one place shall be added in Suban Jeriji North.

In such a case, detailed reconnaissance in Suban Jeriji North shall be carried out at the beginning of the year.

Preliminary reconnaissance in remained blocks, they are Suban Jeriji West and North Central Banko and South Banko, also shall be carried out as much as possible to obtain information on coal quality in the whole Banko area.

(3) Survey works in FY 1988

Preliminary mine layout and mining cost estimation, on remained blocks shall be carried out in FY 1988 in addition to North-West Banko to select the most suitable coal supply source for coal gasification.

5-6 CONCLUSION

1) The survey study in the FY 1985, was carried out as previously arranged.

In North-West Banko, the survey results exceed the plan were obtained by utilizing additional core drilling data furnished by the D.O.C.

2) Bulk coal sampling in the FY 1986 will be carried out at 10 places (along the two drilling lines) by large diameter core drilling method.

3) It is advisable to review mining cost of North West Banko as a part of feasibility study at the second stage.

In the above investigation, various losses (weathering geological and mining losses) estimated in the 1984 FY shall be reviewed in detail.

6. PRELIMINARY EVALUATION OF ECONOMIC FEASIBILITY

PART SUMMARY

In order to grasp the outline of the methanol production from Banko coal in terms of its financial viability and profitability, financial analysis on the hypothetical coal-to-methanol project (hereafter referred to as the project) was carried out following the site reconnaissance and the conceptual design of the 5,000 ton/day methanol production complex.

The results are,

Minimum sales price	;	143 Rupiah/kg (25.9 Yen/kg)
IRR on total project investment (before tax, interest)	;	13.5%
First year to have profit before tax	;	3rd Year
Clear off of accumulated loss	;	5th Year

where sales price and project life are set at 194 Rupiah/kg (35 Yen/kg) and 30 years, respectively.

(1) Reconnaissance of Banko area and Surroundings

The reconnaissance was mainly carried out to survey,

(i) The geographical and topographical conditions of proposed plant sites (3 places)
(ii) The means of equipment transportation

1) Proposed plant site

Three proposed plant sites (Tanjung Priok, Desa Muara Enim, N.W. Banko) have the following advantages in common.

Proximity to river
Spacious and flat
Proximity to mine site

The exact geological and topographical data, however, are not yet available that it is impossible to choose one out of three in this stage.

For this cost estimation study, Tanjung Priok was selected tentatively for its convenience of the equipment transportation.

2) Equipment Transportation Means

Because the bridges on the road from Palembang to Muara Enim was found *intolerable for heavy equipment transportation, the transportation by means of* barge through the Musi and the Lematang River was taken into account.

Speculated from some hydrographic data obtained from DPMA (Directrate of Water Resources), the river condition from the Port of Palembang to Muara Enim where the equipment are expectedly unloaded is sufficient enough for the transportation.

(2) Conceptual Plant Design

Conceptual design work was carried out considering the results of the site survey.

1) Tanjung Priok was selected as plant site.

2) Mined coal is carried by belt conveyor for 13 km from Banko to the plant site.

3) The plant consists of coal handling and gasification, methanol synthesis and distillation, utility supply system and other supporting facilities so that all the utilities except for coal and raw water are generated and consumed internally.

Basic specifications are,

Raw Material	;	Low grade coal reserved in Banko area	
Product	;	Fuel methanol (Chemical grade is tentatively assumed)	
Capacity	;	Coal	- 3,800,000 ton/year (19% used as fuel)

		Product	- 1,600,000 ton/year
Technology	;	Gasification	- Molten iron bath process
		Methanol Synthesis	- Standard process for chemical grade methanol production

4) Infrastructures are not considered since the major ones are existing in this area.

5) Estimated Plant Construction Cost is 989,500 10^6 Rupiah (178,600 10^6 Yen)

(3) Financial Analysis

1) Assumptions

Debt/Equity ratio	;	75/25
Project life	;	30 years (1994-2023)
Interest rate	;	8% p.a.
Sales price at plant gate	;	194 Rupiah/kg (35 Yen/kg)

2) Results

IRR on total investment before tax, interest	;	13.5%
Break-even price (IRR = Interest Rate)	;	143 Rupiah/kg (25.9 Yen/kg)
First year to have profit before tax	;	3rd year
Clear off of accumulated loss	;	5th year

As far as IRR is concerned, the resulting 13.5% of IRR cannot be considered as high rate in general standard due to large investment costs and low sales price. Being linked with the price of crude oil, the methanol price was set rather low in this study reflecting the current oil price which is extremely declined.

Provided that the crude oil price rises higher than 30$/bbl, for example, the viability of the project would be enhanced because the noncommercial Banko coal is not affected by oil price increase.

3) Sensitivity of major cost factors

The sensitivity analysis reveals that the methanol price and the construction costs vividly affect the profitability of the project while raw material costs affect it a little. In addition to it, yen's appreciation can not be ignored as long as loan is raised by yen.

Variation		IRR %
Sales Price	30% down	7.0
Sales Price	30% up	18.5
Construction Costs	20% down	16.5
Construction Costs	20% up	11.2
Material Costs	30% up	12.3
Exchange Rate (Rupiah to Yen)	20% down	12.2

(4) Viability of Fuel Methanol

By using the fuel efficiency (kcal/km) and the price (Yen/l) of methanol, gasoline and diesel oil, the fuel costs equivalent to 1 liter of methanol were estimated on the assumption that the produced methanol at Banko area is imported to Japan and delivered through the existing supply system.

Results

	Volume Ratio (l/l-methanol)	Fuel Cost (Yen/l-methanol equiv.)
Methanol	1.0	44
Gasoline	0.63	Before Tax 60 (After Tax 95)
Diesel Oil	0.44	Before Tax 36 (After Tax 46)

In order to promote the utilization of fuel methanol in Japan, which may decrease NOx emission from vehicles, the adjustment of taxation regulation for diesel oil is required.

6-1 CIRCUMSTANCE OF BANKO AND ITS SURROUNDINGS

This section introduces the circumstance of Banko and its surroundings such as location and traffic, population and facilities, climate, port and river which are the basis to determine the plant location and configuration as well as to carry out the overall conceptual design.

6-1-1 Location and Traffic

Banko area (at 104° east longitude and 3°40' south latitude) lies 10 - 15 km to the southeast of Tanjung Enim, stretching for 10 - 20 km in gentle unduration with a clump of bushes in South Sumatra Province. (See Fig. 6-1-1)

Tanjung Enim, a small town with a population of 5,000, is 190 km away or 4-hour-drive distance from Palembang, and 20 km south of Muara Enim where the "Coal-to-Methanol Plant" is assumed to be located nearby in this study.

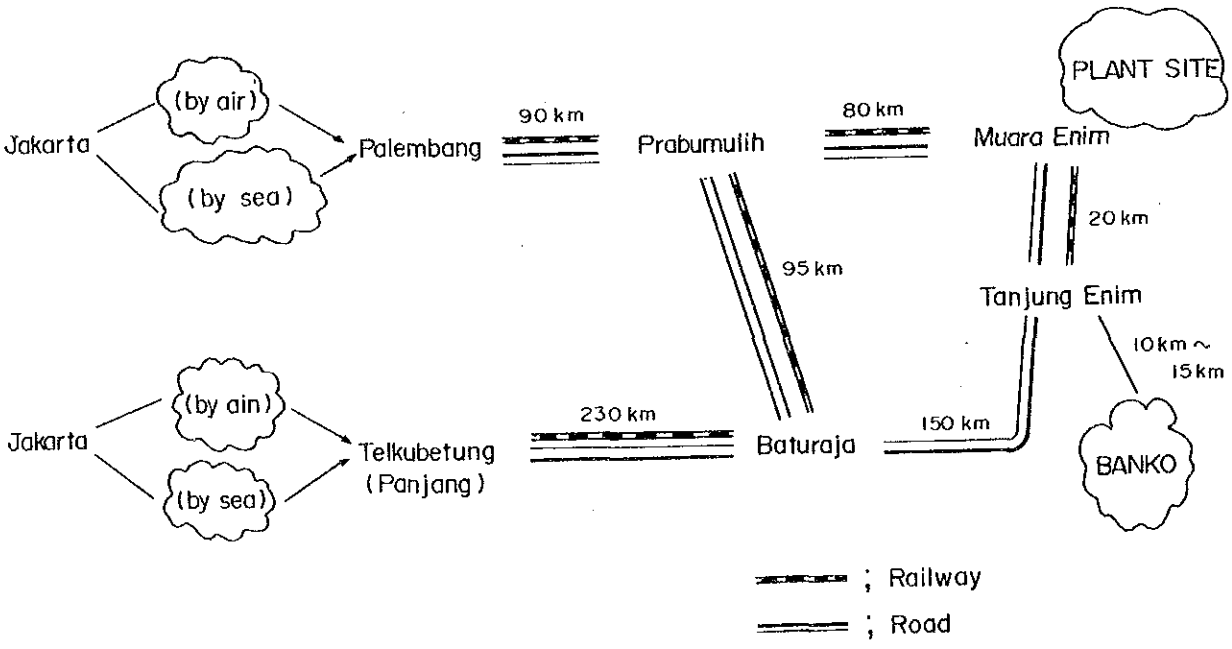


Fig. 6-1-1 *Location of Banko*

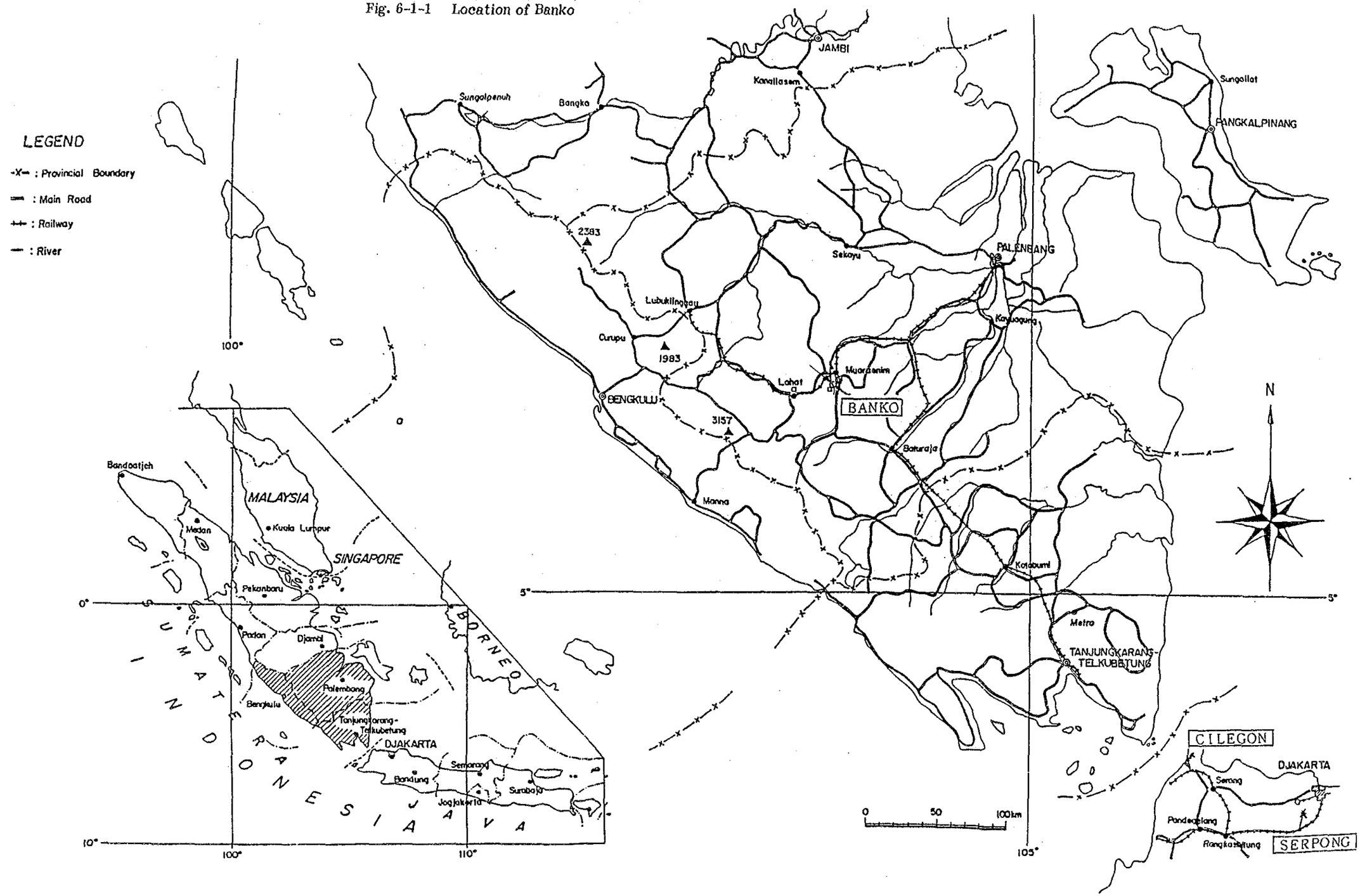
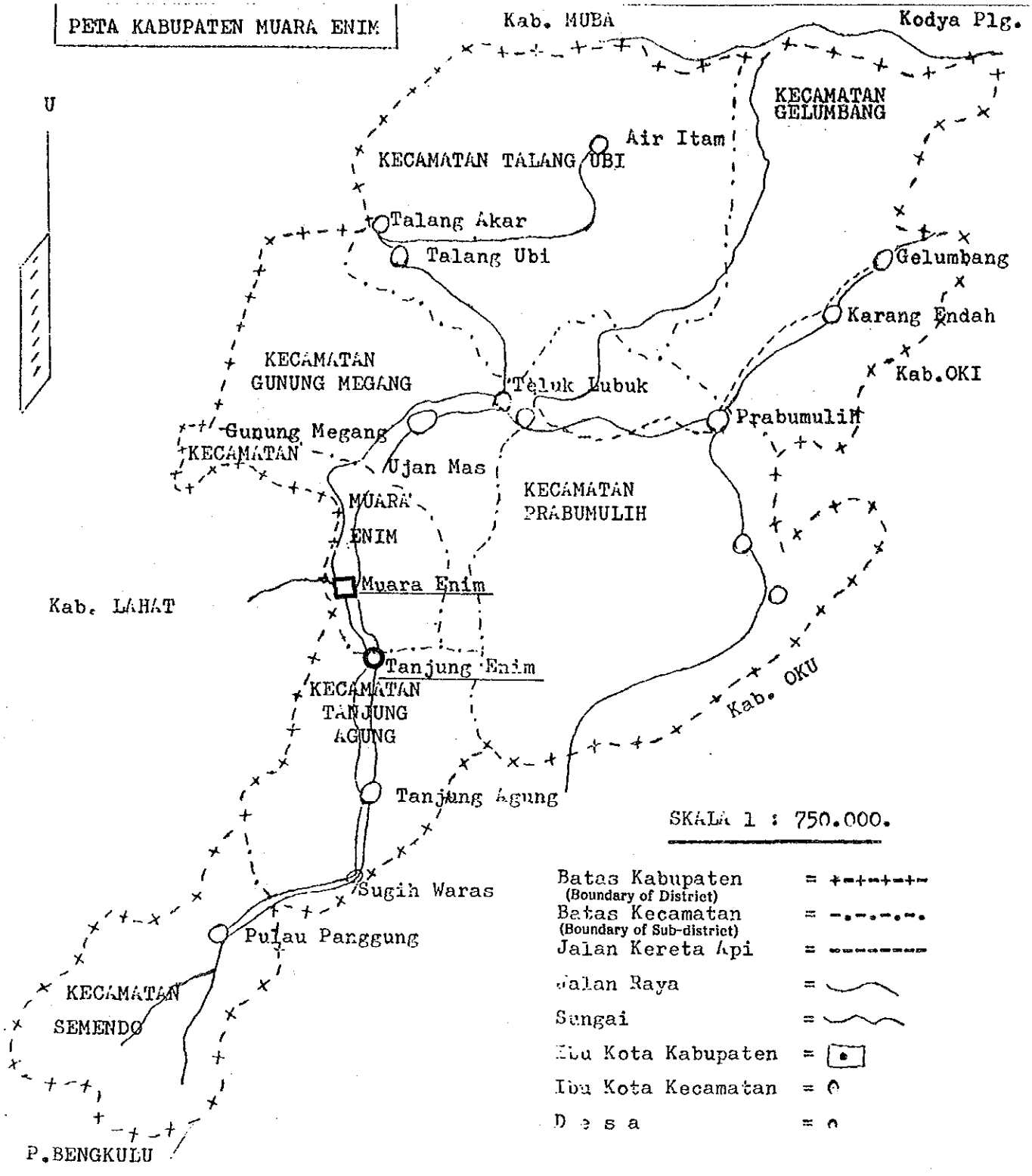


Fig. 6-1-2 Map of Muara Enim district



Source; KABUPATEN MUARA ENIM, DALAM ANGKA, 1982

Table 6-1-1 Population and Public Facilities of Muara Enim District

(1982)

Sub-district	Semendo	Tanjung Agung	Muara Enim	Genung Megang	Talang Ubi	Prabumulih	Gelumbang	Total
Area, km^2	900	850	475	1,900	1,850	2,150	1,450	9,575
Population, persons	29,932	57,857	34,337	43,346	90,207	115,854	79,637	451,170
Density, persons/km^2	33	68	72	23	49	54	55	47
No. of Villages	31	32	20	23	41	48	66	261
No. of Schools								
. Elementary	38	54	42	37	70	99	92	432
. Jr. High School	4	6	6	4	10	10	6	46
. High School	1	3	6	1	3	7	1	22
No. of Hospitals	-	1	1	-	1	2	-	5
(No. of Beds)	(-)	(unknown)	(28)	(-)	(20)	(115)	(-)	(163)
No. of Medical Clinics	3	5	4	5	5	11	9	42
No. of Mosques	93	98	45	48	111	217	98	710
No. of Hotels	0	2	4	0	2	7	0	15

Source; KABUPATEN MUARA ENIM, DALAM ANGKA, 1982

6-1-2 Population and Facilities

Muara Enim District, which Banko area belongs to, is devided into 7 sub-districts as depicted in Fig. 6-1-2. Table 6-1-1 shows the population, number of villages and the conditions of public facilities for each sub-district as of 1982.

On the opposite side of Tanjung Enim across the Enim River, the Bukit Asam Coal Mining Company (P.T.B.A) is producing about 600,000 tons per year of steam coal and anthracite, and its expansion project is underway aiming at annual production of 3,000,000 ton-coal in 1987.

In the vicinity of P.T.B.A., Bukit Asam Power Station (30,000 kw) is also under construction.

By the time both two projects are completed, the population and the public facilities in this area will be increased in number.

6-1-3 Climate

Lying close to the equator, this area is in a tropical climate having two seasons through a year; a dry season from May to October, and a rainy season from November to April.

Some climate data are shown in Table 6-1-2 and Table 6-1-3.

Table 6-1-2 Climate of Tanjung Enim

		March, '83	August, '84
Monthly average temperature	°C	27.7	27.4
Monthly max. temperature	°C	34.0	33.5
Monthly min. temperature	°C	21.5	20.0
Monthly average relative humidity	%	78.2	72.8
Monthly max. relative humidity	%	99.0	99.0
Monthly min. relative humidity	%	48.0	41.0
Average wind velocity	m/s	2.5	2.8
Max. wind velocity	m/s	8.0	8.0

Source; HYDROLOGY FIELD PROGRAM, BACOMDAT PROJECT

Table 6-1-3 Rainfalls at Muara Enim

(1980)

	Rainfall in mm	No. of Rainy Days
Jan.	726	19
Feb.	396	18
Mar.	419	22
Apr.	422	26
May	172	5
Jun.	106	8
Jul.	89	9
Aug.	175	11
Sep.	293	13
Oct.	193	13
Nov.	432	20
Dec.	344	18
Total	3,767	182

Source; HYDROLOGY FIELD PROGRAM, BACOMDAT PROJECT

6-1-4 Port

The Port of Palembang will be the port where the methanol produced in the Plant is unloaded to methanol tankers to deliver it for users. Outline of the Port of Palembang is shown in Fig. 6-1-3.

According to the Head Officer of the Port Authority of Palembang, this port is so congested that no adjacent place may be available for newly-built-methanol tanks as well as for using one of the existing berth for methanol shipping exclusively.

It was suggested by the Head Officer, however, that the methanol tanks could be built in the residential area surrounding this port by purchasing their land, and that the existing offshore berth could be extended for a methanol tanker anchoring.

(Some parts of residential area are being planned as a certain facility construction site, according to his remarks).

In this case, methanol is unloaded from the onshore tank to the offshore berth by pipeline.

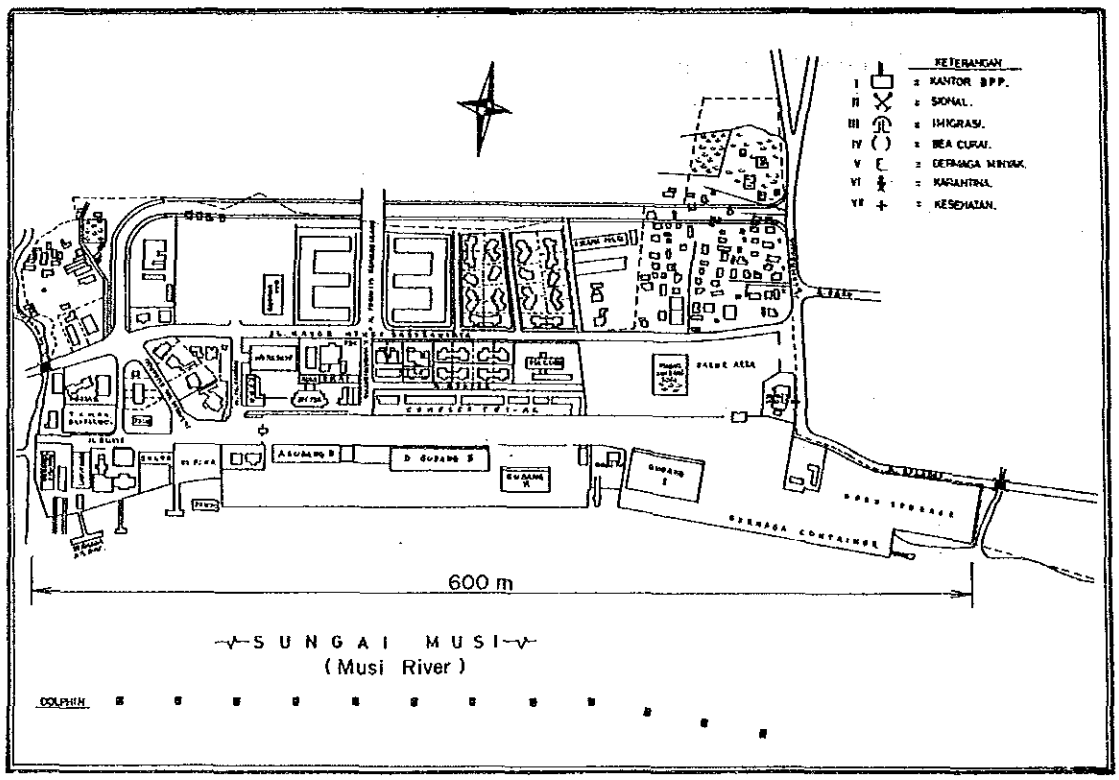
The maximum tanker capacity in Palembang Port is 17,000 ton, and the Musi River is dredged annually keeping the river depth below 7 m.

Fig. 6-1-3 Port of Palembang

Location	;	2°58'S, 104°46'E
Whole Area	;	500 ha
Facilities Area	;	22.5 ha
River Depth	;	9 - 11 m Lws
River Width	;	350 m
Max. Tanker to anchor	;	17,000 DWT

Jetty

Owner	Length	Width	Capacity	Depth
Boom Baru	476 m	10.5 m	3 t/m^2	7 m Lws
Kontainer	180 "	19.5 "	3.2 "	9.3 "
PPL. S. Lais	185 "	15.0 "	1.5 "	2.5 "
Pusri	680 "			
Pertamina	301 "			
"	314 "			
"	80 "			
"	250 "			



Source: Catalog for the Port of Palembang

6-1-5 River

As transportation means and water resources for the plant, the river condition largely affects the economic aspect of the Project.

The Fig. 6-1-4 shows the approximate location of the towns and rivers concerned for this study as well as the locations of the places where the relevant data and pictures were taken.

With regard to the transportation of heavy equipment through the river to the plant site, Table 6-1-4 and Fig. 6-1-5 show the hydrographic data for 4 points on the route taken in Nov., 1985.

Picture A and B show the existing jetties at the downstream of Muara Enim where the Lematang and the Enim river meet, and Picture C is the Ampera Bridge at Palembang which is the only bridge over the river between Palembang and Muara Enim.

For other informations regarding the barge transportation;

- 150-ton-container was reportedly unloaded without trouble in dry season at the jetty shown in Picture A.
- Rivers fractuate for about four meters through a year.
- There is a small and low bridge over the Enim River between Muara Enim and Tanjung Enim so that this bridge may become an obstacle provided that the barge ascends the Enim River.

As far as the above data indicates, there seems to be no problem to transport heavy equipment to Muara Enim by barge.

In terms of water resource, the flow rate of the Lematang River seems to be sufficient enough even in dry season because the water requirement for the plant is less than 1 m^3/sec or 3,600 ton/hour.

For the quality of the river water, however, there is no data available so that the quality of water should be examined and to be reflected to the plant design in the final stage of the Project.

Fig. 6-1-4 Hydrographical Map

- through Palembang and Muara Enim -

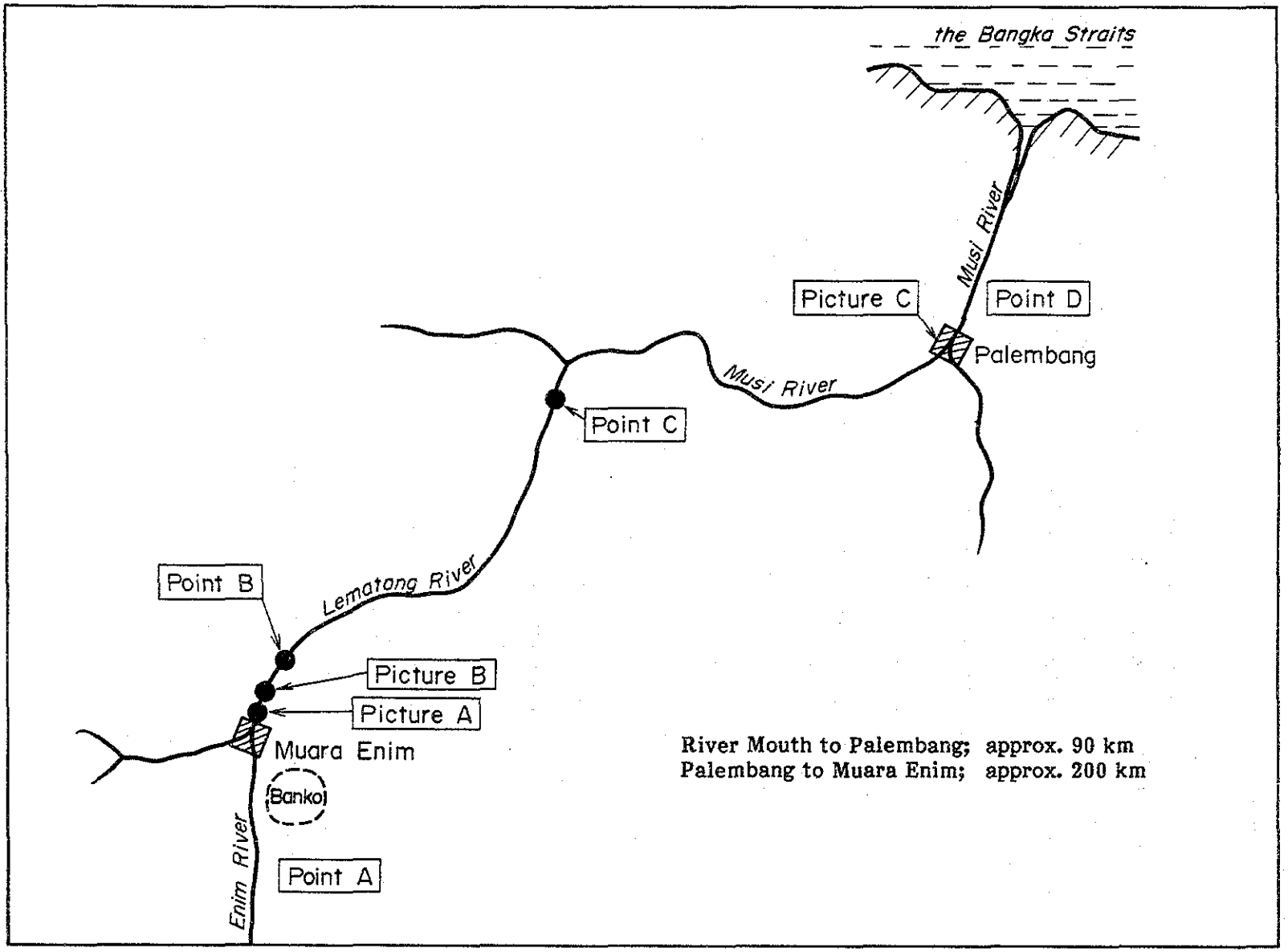


Table 6-1-4 Hydrographic Data of Rivers

(Nov., 1985)

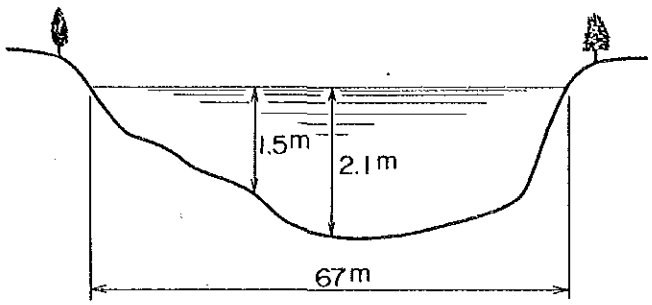
Point		A	B	C	D
Place		Lingga	Pinang Belarik	Sungairotan	Tebing Abang
River		Enim	Lematang	Lematang	Musi
Location		Unknown	10 km downstream of Muara Enim	100 km downsteam of Muara Enim	unknown
Width,	m	67	99	93	390
Depth (Max.)	m	2.1	3.6	6.4	8.1
Velocity,	m/sec	0.58	0.82	0.84	0.84
Flow Rate, (estimated)	m^3/sec	49	208	398	2,302

* See also Fig. for reference.

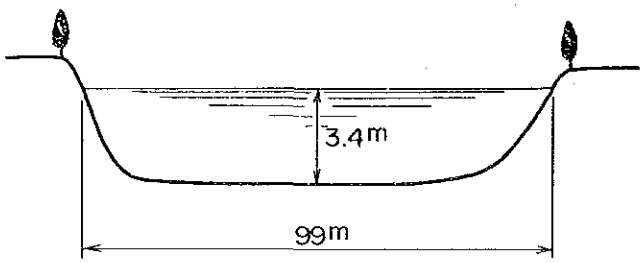
Source; DIRECTORAT PENYELIDIKAN MASALAR AIR (DPMA)

Fig. 6-1-5 Cross Section of Rivers (Nov., 1985)

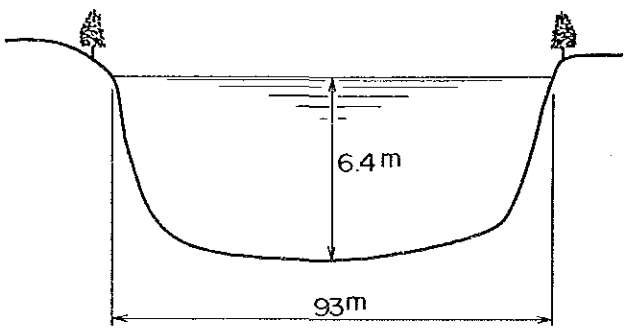
Point A
(Lingga)
Scale ;
V = 1 : 100
H = 1 : 1,000



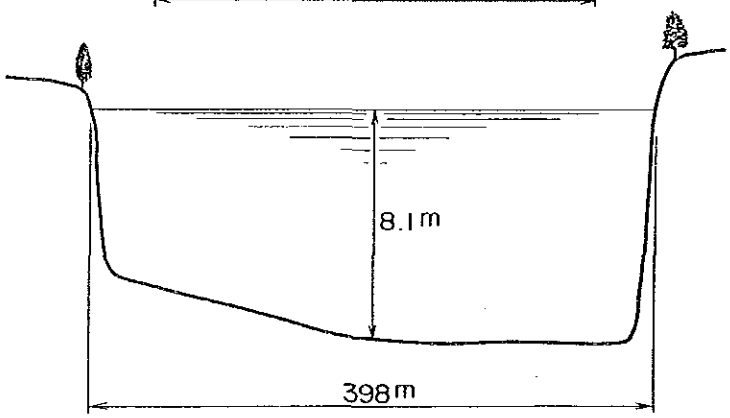
Point B
(Pinang Belarik)
Scale ;
V = 1 : 250
H = 1 : 1,500



Point C
(Sungairotan)
Scale ;
V = 1 : 250
H = 1 : 1,500



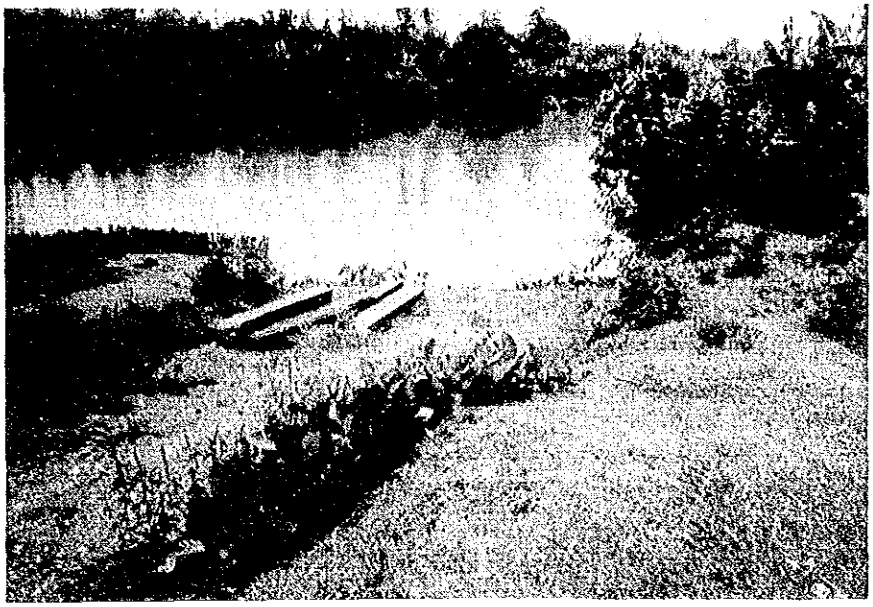
Point D
(Tebing Abang)
Scale ;
V = 1 : 250
H = 1 : 5,000



Source; DIRECTRAT PENYELIDIKAN MASALAR AIR (DPMA)

Picture A

A Jetty at Desa Muara Enim where 150-ton-container was unloaded



Picture B

A Jetty in use by Pertamina

Picture C

Ampera Bridge at Palembang, the only bridge over this route