



CHAPTER III

SUBSURFACE GEOLOGY OF THE LI BASIN

The subsurface geology of the Li basin is basically obtained from the drill-hole data and borehole geophysical data. The drill-hole data are essentially composed of the lithological description of both cutting and core samples of totally 616 coal exploration drill-holes with the total length of approximately 47.56 kilometres. In addition, the geophysical logs of 228 drill-holes with five main parameters, namely, gamma-ray, neutron, caliper, long-spacing density, and bed resolution density. The lineament map in the 1 : 50,000 scale interpreted from aerial photographs is being used in the present study.

Initially, the continuous lithological sequence of each drill-hole is prepared from the integration of cutting/core description and geophysical log interpretation. After that, an attempt has been made to correlate the lithological sequences of nearby drill-holes supplemented by the mine-pit data.

As a result, the three-dimensional subsurface geology of many areas within the Li basin have been defined. They are the Ban Pu sub-basin, Ban Hong sub-basin, Ban Pa Kha sub-basin, Ban Mae Long sub-basin, Ban Na Sai-Ban Mae Wang sub-basin and the external sub-basinal areas of the Li basin.

3.1 Sedimentary Sequence

3.1.1 Ban Pu Sub-Basin

The Ban Pu sub-basin, covering approximately 12 square kilometres, is located in the northernmost part of the Li basin. The area is penetrated by 56 coal exploration drill-holes of totally 4.075 kilometres in length. Amongst these drill-holes, there are 7 drill-holes with cutting/core description and geophysical logs and 49 drill-holes with only cutting/core description.

Upon integration of existing data previously stated, the continuous lithological sequence of all primary drill-holes are analyzed and interpreted from the ground surface down to the depth range of 18.50 to 365.00 metres. The typical lithological sequence of the Ban Pu sub-basin is represented by the combination of the subsurface data from drill-holes numbers P-32 and P-60.

The uppermost portion of the sedimentary sequence of the Ban Pu sub-basin is represented by the association of clay, silt and sand with pale yellowish brown to dark yellowish brown. The sand is characterized by very fine- to medium-grained, mostly very fine to fine, well sorted, angular to sub-angular, low sphericity with 20 % of clay content.

Below the surficial deposit is the association of medium and fine terrigenous sediments including sand, carbonaceous clay and clay with sandy and silty composition in parts, mostly sand and silt mixture. The sediments are characterized by olive gray to gray except the carbonaceous clay that is moderately brown. The clay is generally

soft with moderate to high plasticity, semi-consolidated. The clay - fine sediments mixture has clay content more than 70 %. The sandy - clayey silt includes very fine to fine sand, angular to sub-angular, plastic when wet, semi-consolidated. The sand is characterized by very fine- to coarse-grained, moderate to well sorted, angular to sub- angular, high sphericity with some coarser quartz fragments. The sand/clay ratio is approximately 0.5.

Under the upper sedimentary sequence earlier described is a coal seam with partings of clay, clayey sand and silty clay. The coal is characterized by dusky yellowish brown, dull to medium bright, hard. The clay is light olive gray to olive gray with high plasticity. The clayey sand is composed of 60 % of very fine to very coarse sand which is poorly sorted, angular to sub-angular, low sphericity, 30 % of clay and 10 % of rock fragments. The silty clay is composed of 70-75 % clay and 25-30 % silt.

The sedimentary sequence lying under the coal seam is the thick sequence of silty clay characterized by light gray with medium plasticity and semi-consolidated. The clay content is approximately 50-60 %. The thickness is about 8.75 metres.

The next underlying sedimentary sequence is the thick gravelly sand unit characterized by light gray. The sand is very fine- to very coarse-grained, poorly sorted, angular to sub-angular, low sphericity. The gravelly sand is composed of 90 % quartz and 10 % rock fragments. The thickness is approximately 11.5 metres.

Underlying the gravelly sand unit is the association of medium- and fine-grained terrigenous sedimentary unit. The sediments are clay with silty, sandy mixture and sand which is generally olive gray to brownish gray. The silty clay is composed of 70-75 % high plasticity clay. The sand is characterized by very fine- to fine-grained, well sorted, angular to sub-rounded, high sphericity, of mostly quartz.

The next underlying sedimentary unit is the lower coal seam. The coal seam is characterized by dusky yellowish brown, dull to medium bright, hard and dense. The thickness is varying from 0.1 metres to more than 50 metres.

Underlying the lower coal seam is the association of medium- and fine-grained sediments, composing of clay to sand size. The muddy sand is light gray, composed of 60 % very fine- to very coarse-grained sand, poorly sorted, angular to sub-angular, low sphericity, 30 % clay and 10 % rock fragments. The sandy mud is characterized by light gray, very fine to very coarse sand, poorly sorted, angular to sub-angular, low sphericity, composed of 60 % clay and 40 % sand-sized quartz. The thickness ratio of muddy sand and sandy mud is about 3.

The lowest sedimentary sequence obtained from the drill-hole data of the Ban Pu sub-basin is gravelly sand which is characterized by light gray to very light gray, very fine- to very coarse-grained sand, poorly sorted, angular to sub-angular, low sphericity with granule to boulder size of quartz, quartzite and slate. The sediments composed of 80 % quartz and 20 % rock fragments.

It is important to note that the two coal seams of Ban Pu sub-basin vary considerably in thicknesses. In the old mine pit in the western part of the area, the thickness of lower coal seam is increasing eastwardly with decreasing in depth. In the middle part, it seems that the coal seam is present at relatively shallower level and lying almost horizontally. In the eastern portion of the Ban Pu sub-basin, the lower coal seam in the western part splits into 2 coal seams eastwardly and finally pinch out.

The typical Cenozoic sedimentary sequence of the Ban Pu sub-basin is graphically represented in Figure 3.1.1.

3.1.2 Ban Hong Sub-Basin

The Ban Hong sub-basin, covering approximately 15 square kilometres, is located in the northwest of the Ban Mae Long sub-basin, northern part of the Li basin. The area is penetrated by 109 coal exploration drill-holes of totally 8.148 kilometres in length. Amongst these drill-holes, there are 46 drill-holes with cutting/core description and geophysical logs, and 63 drill-holes with only cutting/core description.

Upon integration of existing data previous stated, the continuous lithological sequence of all primary drill-holes are analyzed and interpreted from the ground surface down to the depth range of 6.00 to 128.5 metres. The typical lithological sequence of the Ban Hong sub-basin is represented by the combination of the subsurface data from drill-hole numbers H-75, H-98, H-103 and H-105.

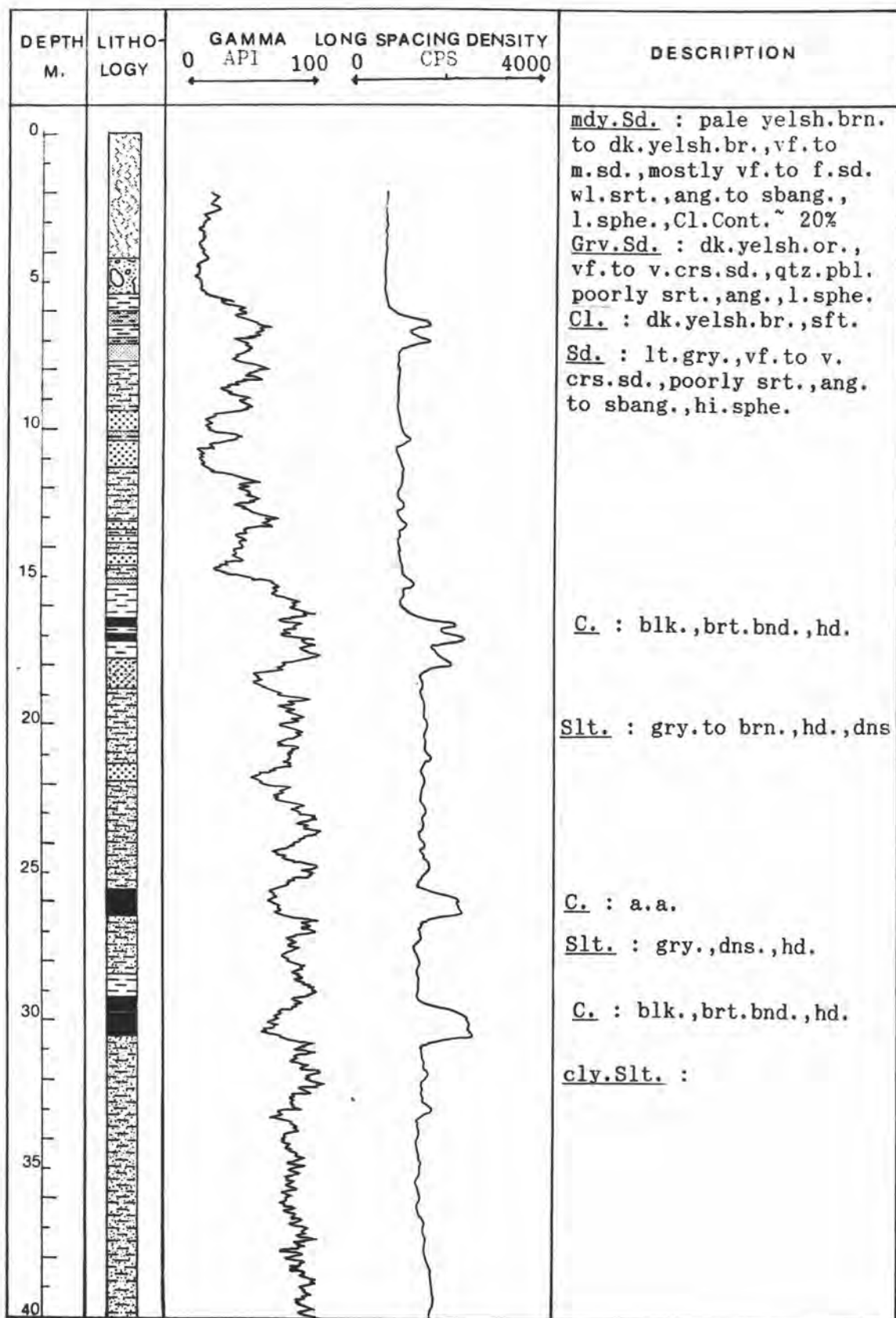


Figure 3.1.1 The representative subsurface lithological sequence of the Ban Pu sub - basin

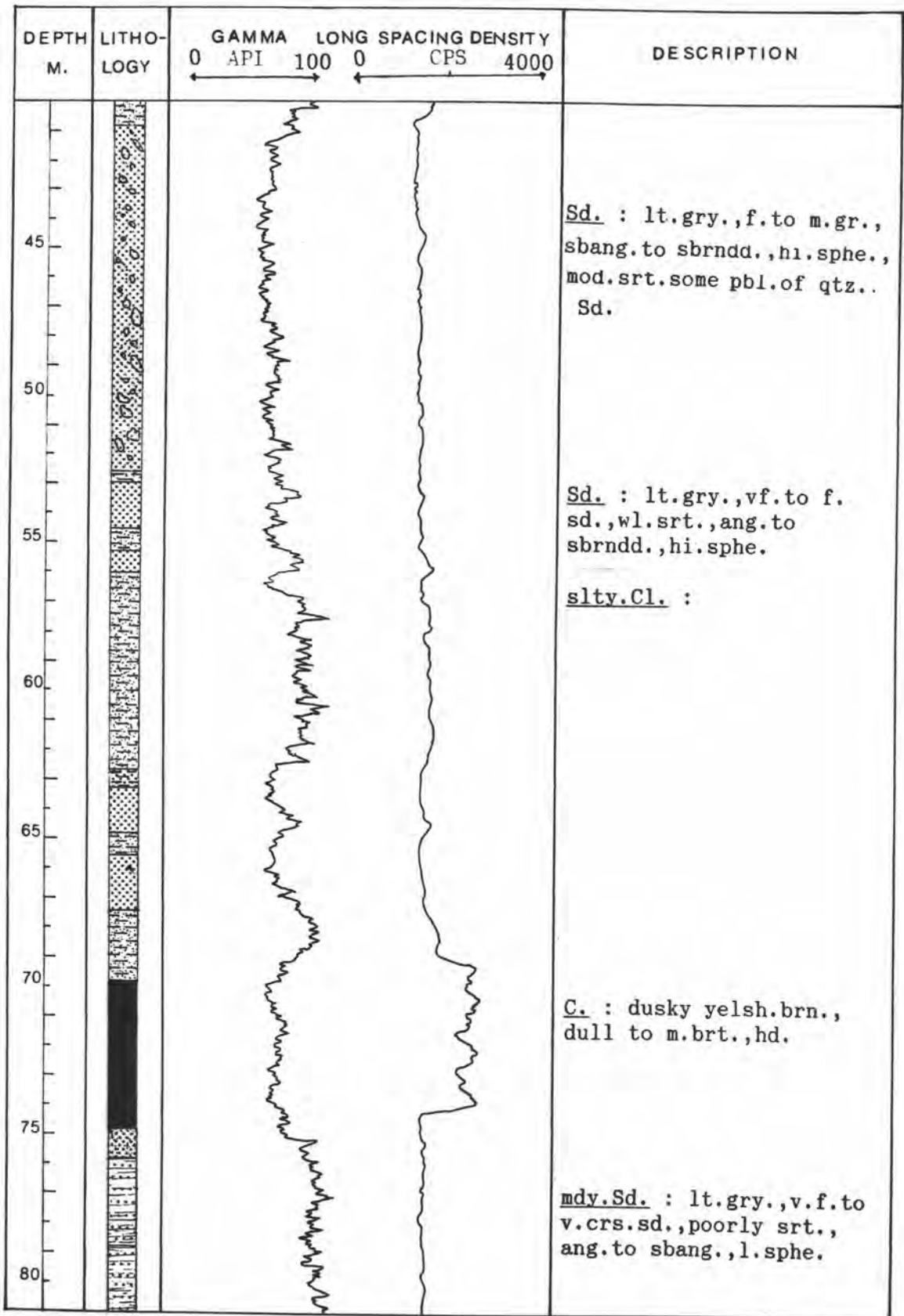


Figure 3.1.1 cont.

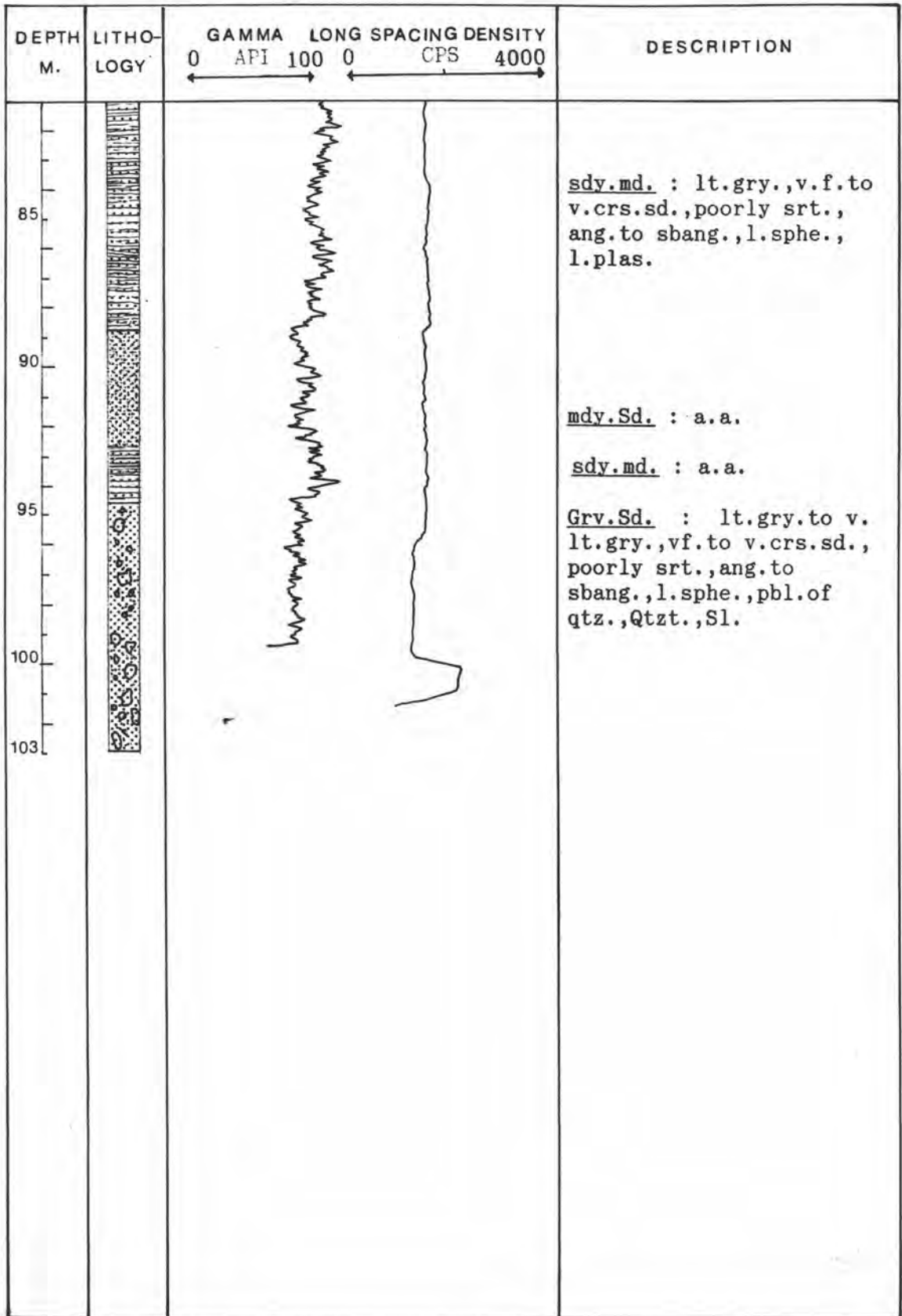


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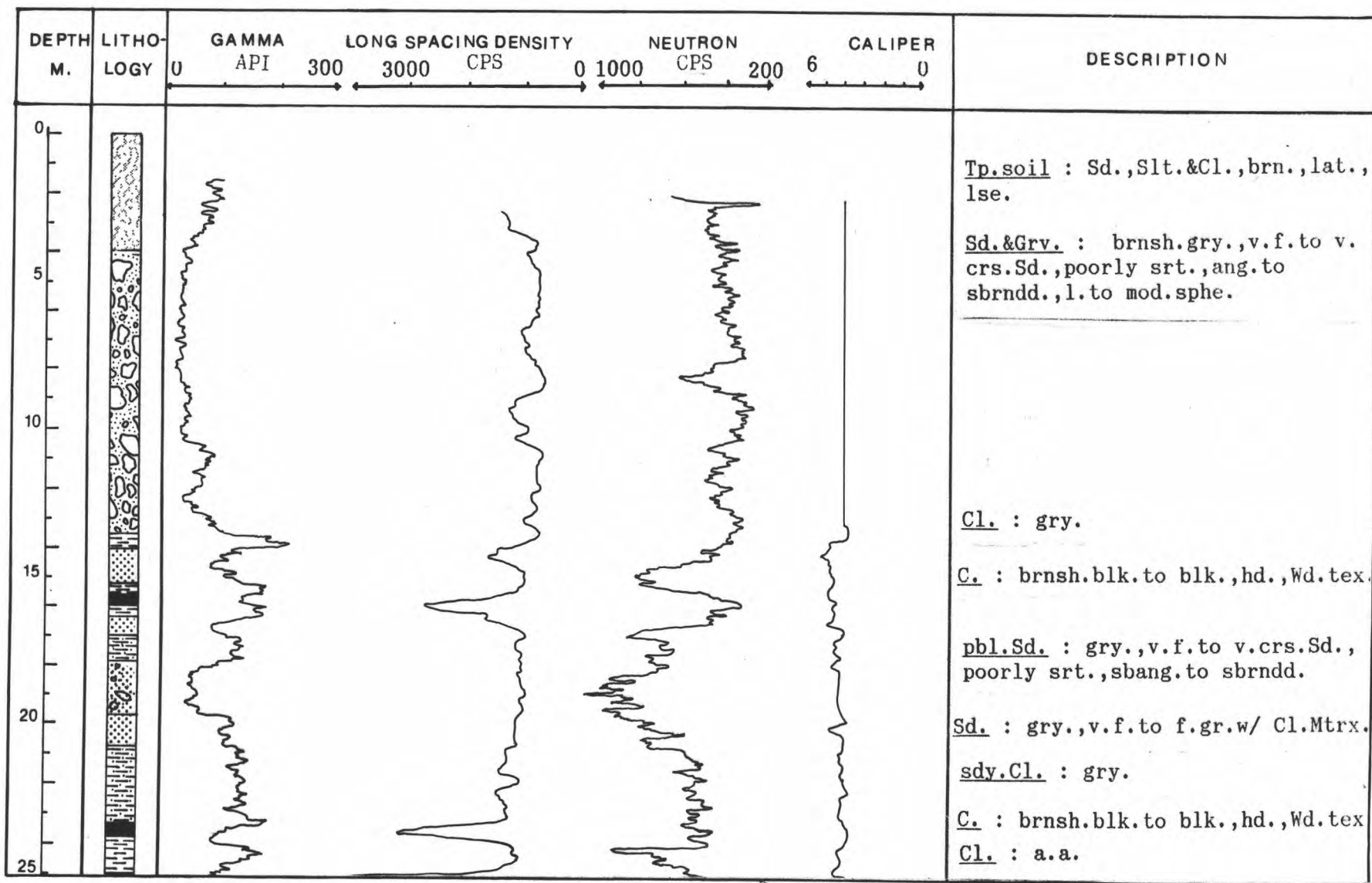


Figure 3.1.2 The representative subsurface lithological sequence of the Ban Hong sub - basin

The uppermost portion of the sedimentary sequence of the Ban Hong sub-basin is represented by the top soil deposit and the association of medium- and coarse-grained sediments. The sediment is characterized by the mixture of brown sand, silt and clay, loose, lateritic in composition in the upper part and characterized by light brown to brownish gray sand and gravel in the lower part. The lower part of this unit is generally very fine- to very coarse-grained sand and gravel, poorly sorted, angular to sub-rounded, low to moderate sphericity with gravel of quartz. The lower boundary is marked by the erosional surface.

Below the surficial deposit unit is the fine terrigenous sediments intercalated with thin coal beds. The sand is characterized by gray, very fine- to medium-grained, well sorted, angular to sub-rounded, low to moderate sphericity with some clay matrix, the phenoclasts are mostly quartz in composition and pebbles of quartz in the upper part. The clay is generally gray to brownish gray, sandy composition in some parts with common plant fossils. The coal beds are characterized by brownish black to black, sub-conchoidal fracture, hard with woody texture.

The sedimentary sequence under the upper coal seam is fine- to coarse-grained terrigenous sediment association of gray clay, sand and pebbly sand. The sand is characterized by very fine- to coarse-grained with some clay matrix, moderately sorted, mostly quartz in composition, interbedded with clay. For pebbly sand, pebbles are black slate, quartzite, sandstone, quartz and chert, poorly sorted, angular to sub-angular, moderate sphericity with some clay. Some parts of this unit are sandy claystone. The sand/clay ratio of this

unit is 11.4. It is important to note that this unit has lateral lithological variation. Locally, it is lenticular-shaped body of coarse-grained sediments with interbedding of fine-grained sediments. The maximum thickness of this lens is 30 metres.

Below the upper lithological sequence earlier described is a thick coal seam with some clay and carbonaceous and coaly clay partings. The characteristics of the coal is brownish black to black, hard, good brightness with woody texture. The clay partings are generally brownish gray to gray whereas the carbonaceous and coaly clay partings are brownish gray to dark gray. It is noted that the sand content in the clay partings increases downwardly.

The lowermost part of the sedimentary sequence above the unconformity between Cenozoic sediments and pre - Cenozoic rocks is the association of sand, sandy clay, and conglomeratic sandstone. The sand is gray, very fine- to very coarse-grained, poorly sorted, sub-angular to sub-rounded, moderate sphericity. The sandy clay is light gray to gray. The conglomeratic sandstone is characterized by gray, very fine- to very coarse-grained, poorly sorted, very fine grained sand and clay matrix, with pebbles of slate, quartzite, slightly metamorphosed sandstone, sandstone and chert.

The pre-Cenozoic rocks are characterized by dark gray, slightly metamorphosed sandstone with common quartz veinlets and pyrite-infilled fractures and joints, quartzite and phyllite.

The typical Cenozoic sedimentary sequence of the Ban Hong sub-basin is graphically represented in Figure 3.1.2.

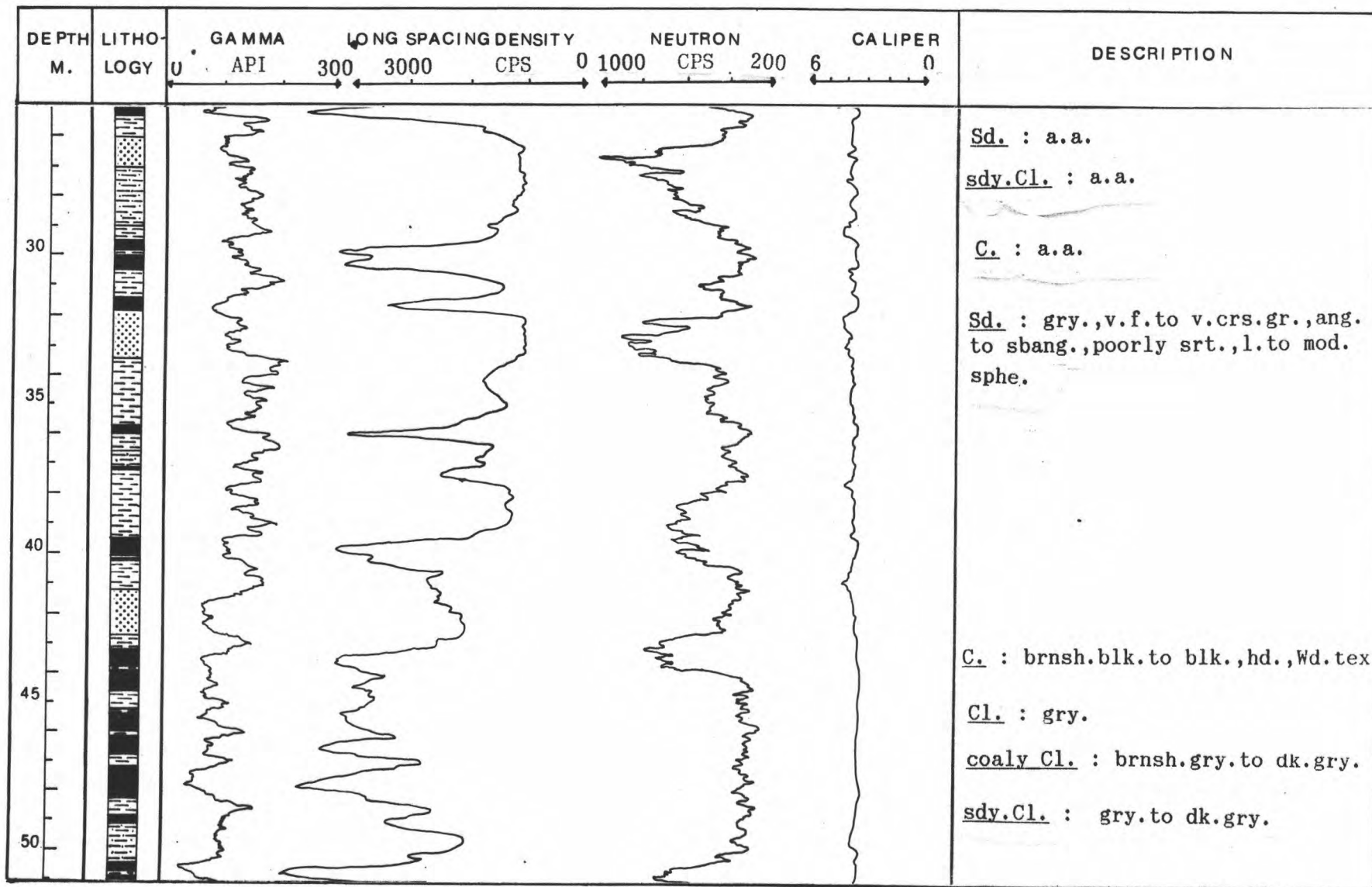


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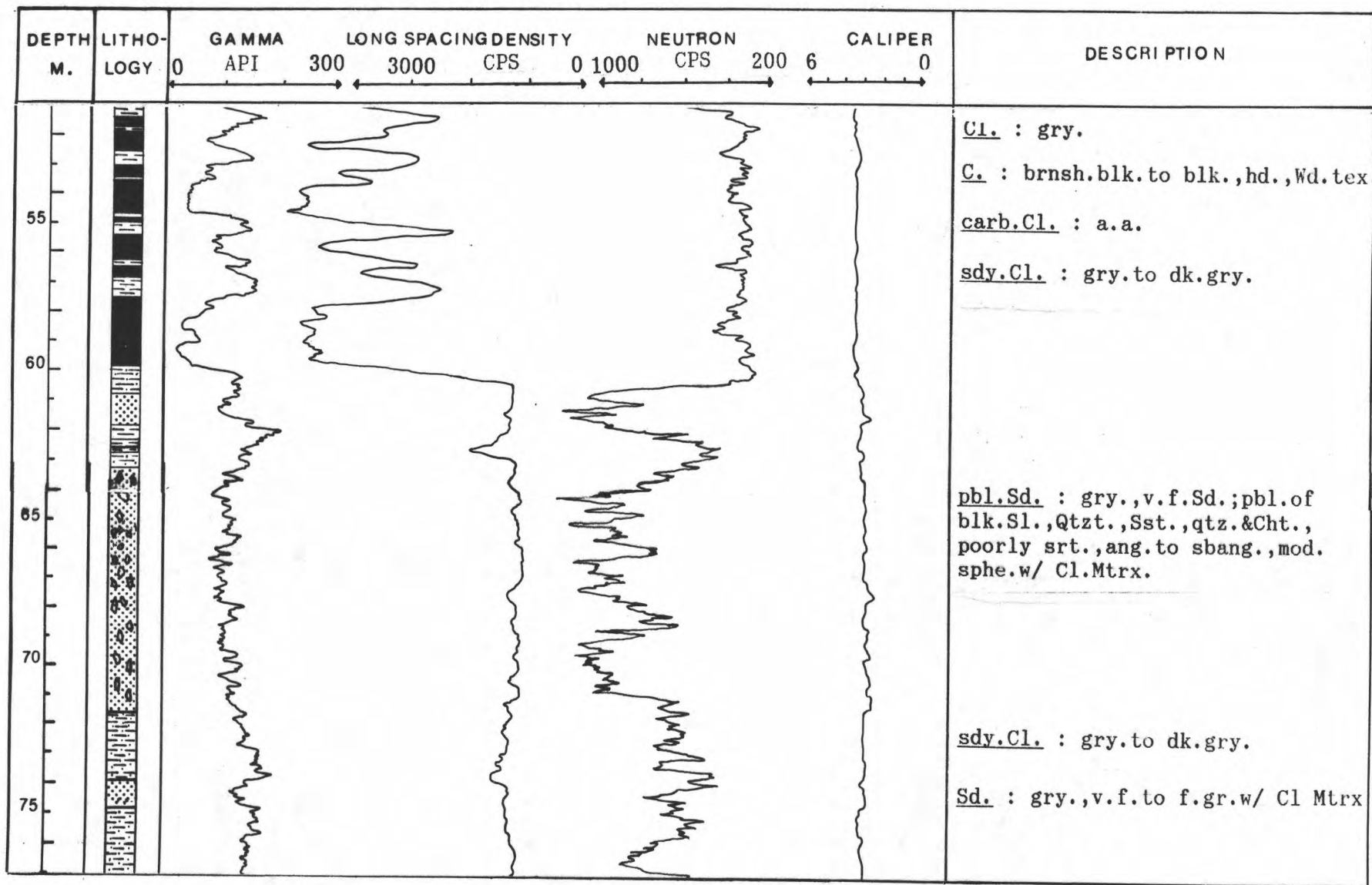


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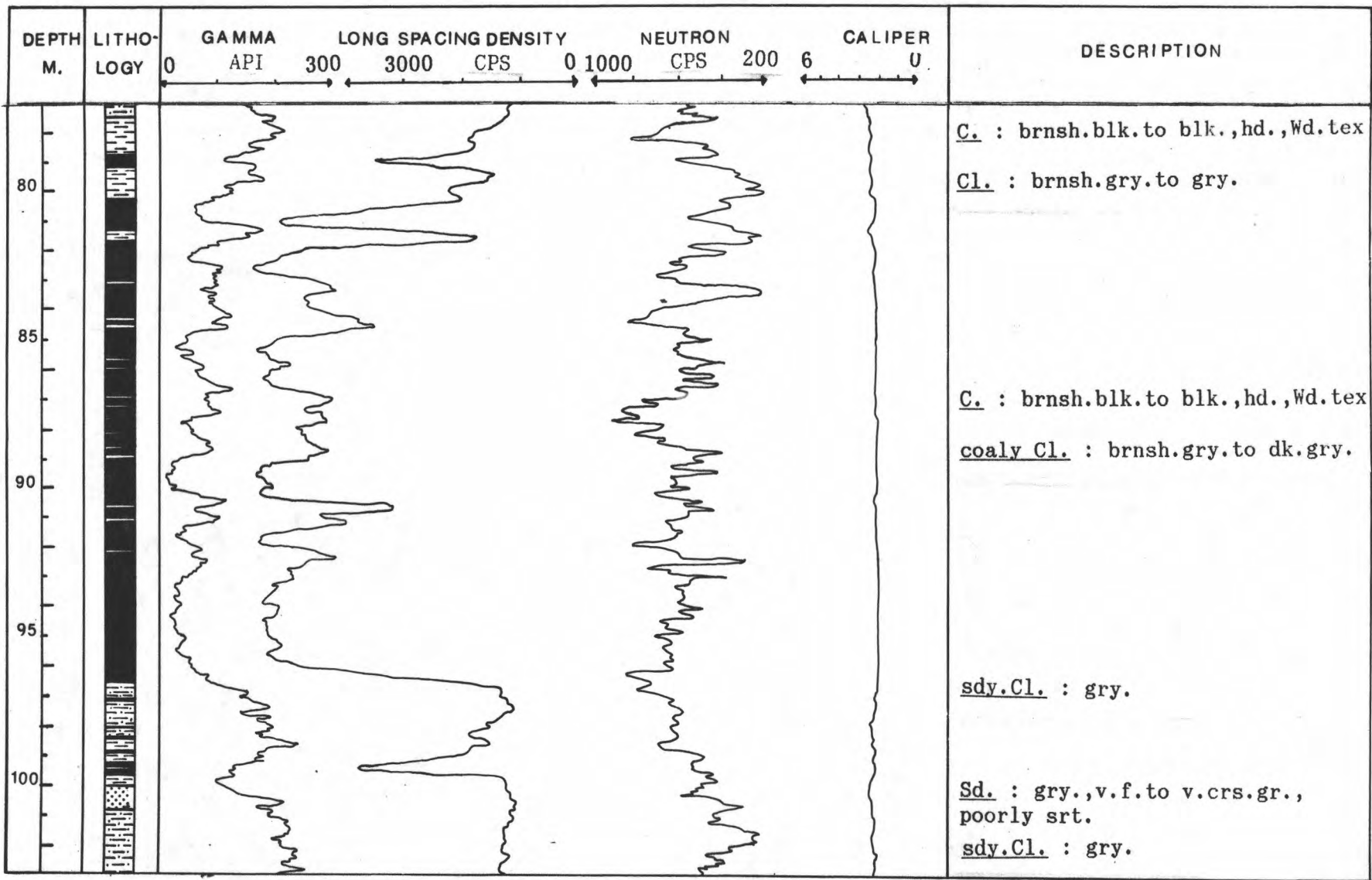


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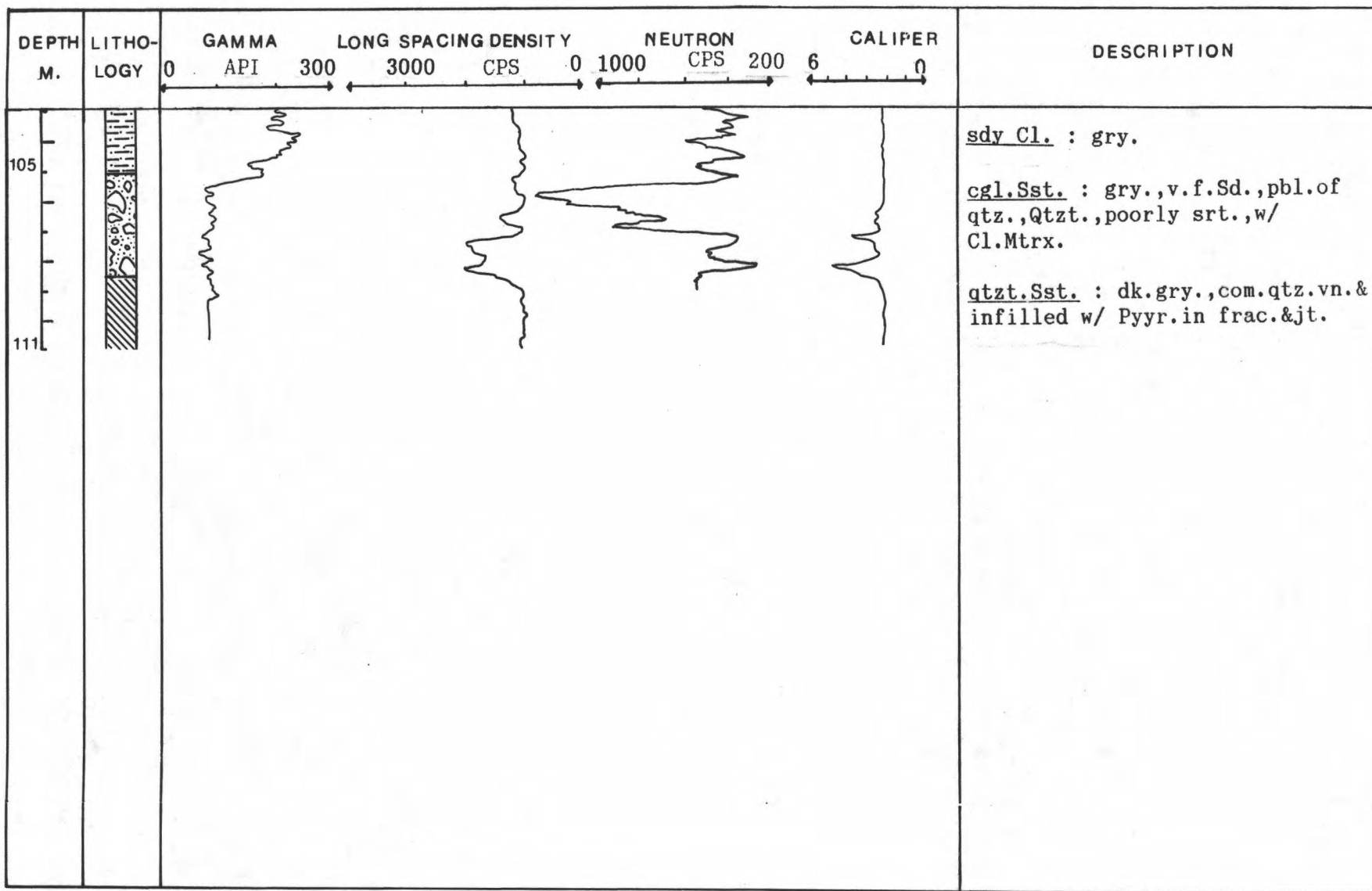


Figure 3.1.2 cont.

3.1.3 Ban Mae Long Sub-Basin

The Ban Mae Long sub-basin, covering approximately 10 square kilometres, is located in the north of Ban Mae Long village, eastern part of the Li basin. The area is penetrated by 101 coal exploration drill-holes of totally 7.662 kilometres in length. Amongst these drill-holes, there are 32 drill-holes with cutting/core description and geophysical logs and 69 drill-holes with only cutting/core description.

Upon integration of existing data previous stated, the continuous lithological sequence of all primary drill-holes are analyzed and interpreted from the ground surface down to the depth range of 6 to 162.8 metres. The typical lithological sequence of the Ban Mae Long sub-basin is represented by the combination of the subsurface data from drill-hole numbers K-106 and K-139.

The uppermost portion of the sedimentary sequence of the Ban Mae Long sub-basin is represented by the top soil deposits in the upper part and the association of clay to pebble in the lower part. The sediments are characterized by reddish brown clay, silt and sand mixture, lateritic in composition in the upper part with sand and gravel in the lower part. The sand is generally very fine- to very coarse-grained, poorly sorted with some gravels to boulders of quartzite and sandstone. The lower boundary of this sedimentary portion is represented by the erosional surface.

Underlying the upper sedimentary sequence earlier described is clay interbedded with sand. The total thickness of this portion is approximately 20 metres. The clay is characterized by gray and

brownish gray with some coal fragments at the upper part of this clay unit. The sand to pebbly sand is characterized by gray to light gray, very fine- to very coarse-grained, poorly sorted, angular to sub-rounded, moderate sphericity with clay matrix and granules of quartz, quartzite, sandstone and slate. The sand/clay ratio is about 1.

The sedimentary sequence under the sand/clay unit is the thick sequence of clay with shale intercalation. The sediments are characterized by gray to light gray.

Below the clay unit is the thick upper coal seam with some carbonaceous and coaly clay partings. The thickness of this unit is approximately 10.5 metres. The characteristics of coal is brownish black to black, hard, bright with intercalation of dull bands, brittle, sub-waxy to sub-resinous luster, sub-conchoidal to conchoidal fracture with woody texture in some parts.

The sedimentary sequence under the coal seam is fine- to medium-grained terrigenous sediments of mainly clay with silty, sandy and sand intercalations. The clay is characterized by brownish gray to light gray, soft, well-bedded, silty or carbonaceous in some parts. The sand is characterized by gray to brown, very fine- to very coarse-grained, poorly sorted with clay matrix and mainly quartz composition.

Under the upper lithological sequence earlier described is the lower coal seam with clay and carbonaceous clay partings. The coal is brownish black to black, dull, brittle, hard but soft in some parts. The clay partings are white to gray.

The lowermost part of the sedimentary sequence overlying the unconformity between the pre-Cenozoic rocks and Cenozoic sediments is the association of clay and pebbly sand. The clay is similar in characteristics to the clay partings of the lower coal seam earlier described. The sand is characterized by brown to brownish gray, very fine- to very coarse-grained sand with clay matrix, poorly sorted, intercalated with granule to cobble of white quartz, slate and quartzite.

The pre-Cenozoic rocks are characterized by white to light gray quartzite and slate, light to greenish gray slightly metamorphosed sandstone with numerous fractures.

It is important to note that the thickness of terrigenous sediments is increasing westwardly, whereas the thicknesses of both coal seams are decreasing towards the central part of the sub-basin in the west and the south.

The typical Cenozoic sedimentary sequence of the Ban Mae Long sub-basin is graphically represented in Figure 3.1.3.

3.1.4 Ban Pa Kha Sub-Basin

The Ban Pa Kha sub-basin, covering approximately 8.5 square kilometres, is located in the southeastern direction of the Ban Mae Long sub-basin and the eastern part of the Li basin. The area is penetrated by 189 coal exploration drill-holes of totally 12.25 kilometres in length. Amongst these drill-holes, there are 124 drill-holes with cutting/core description and geophysical logs, and 65 drill-holes with only cutting/core description.

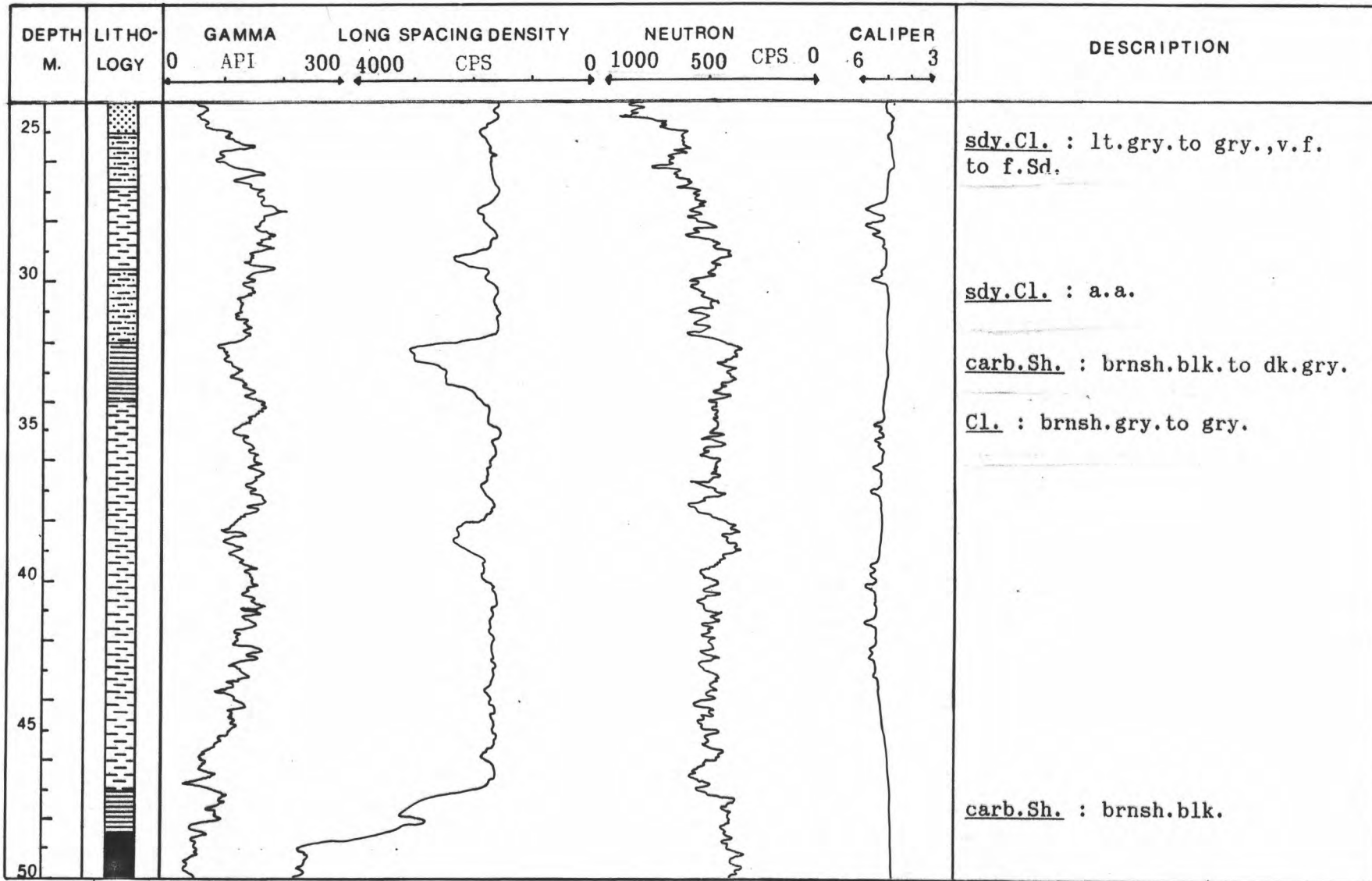


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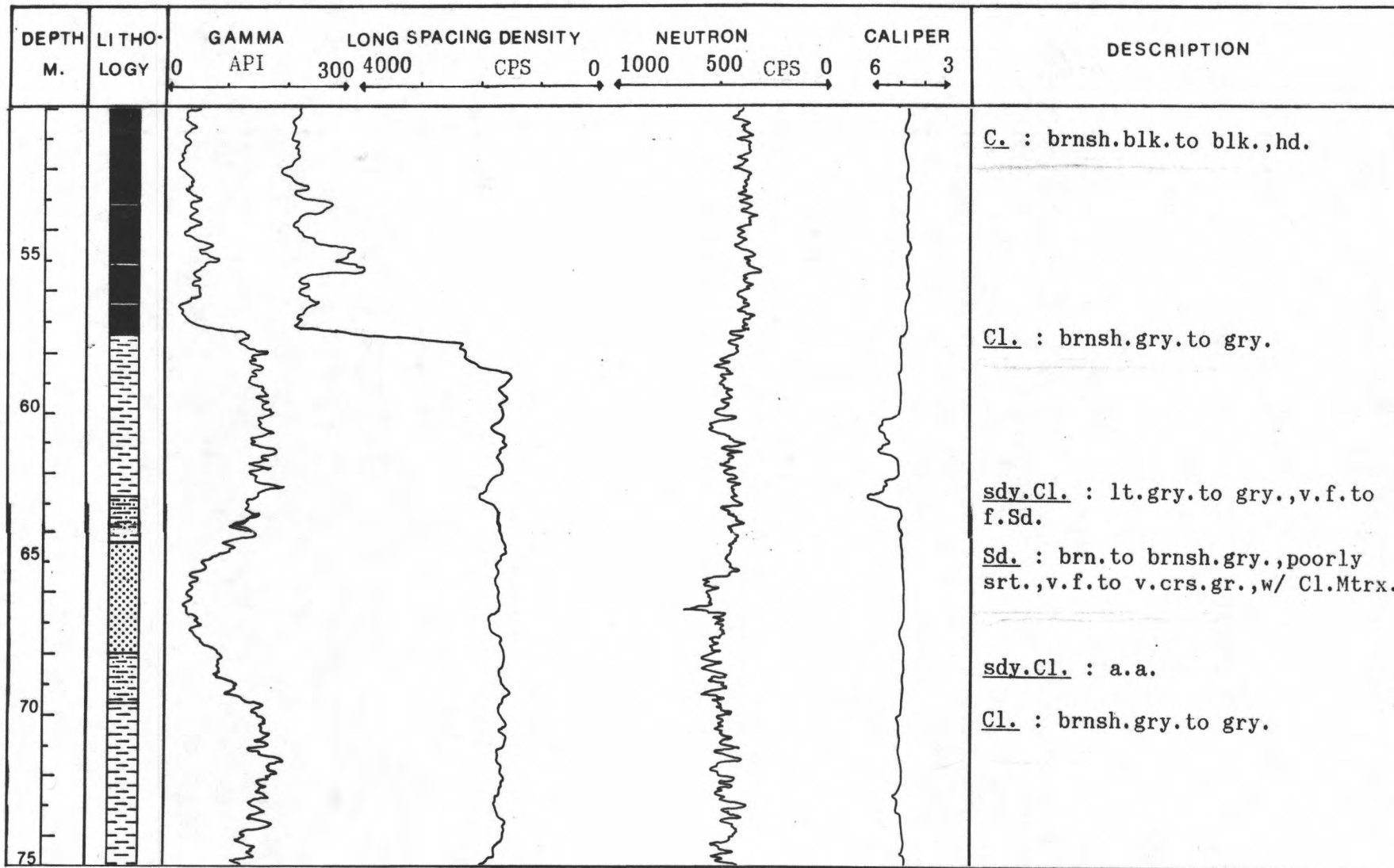


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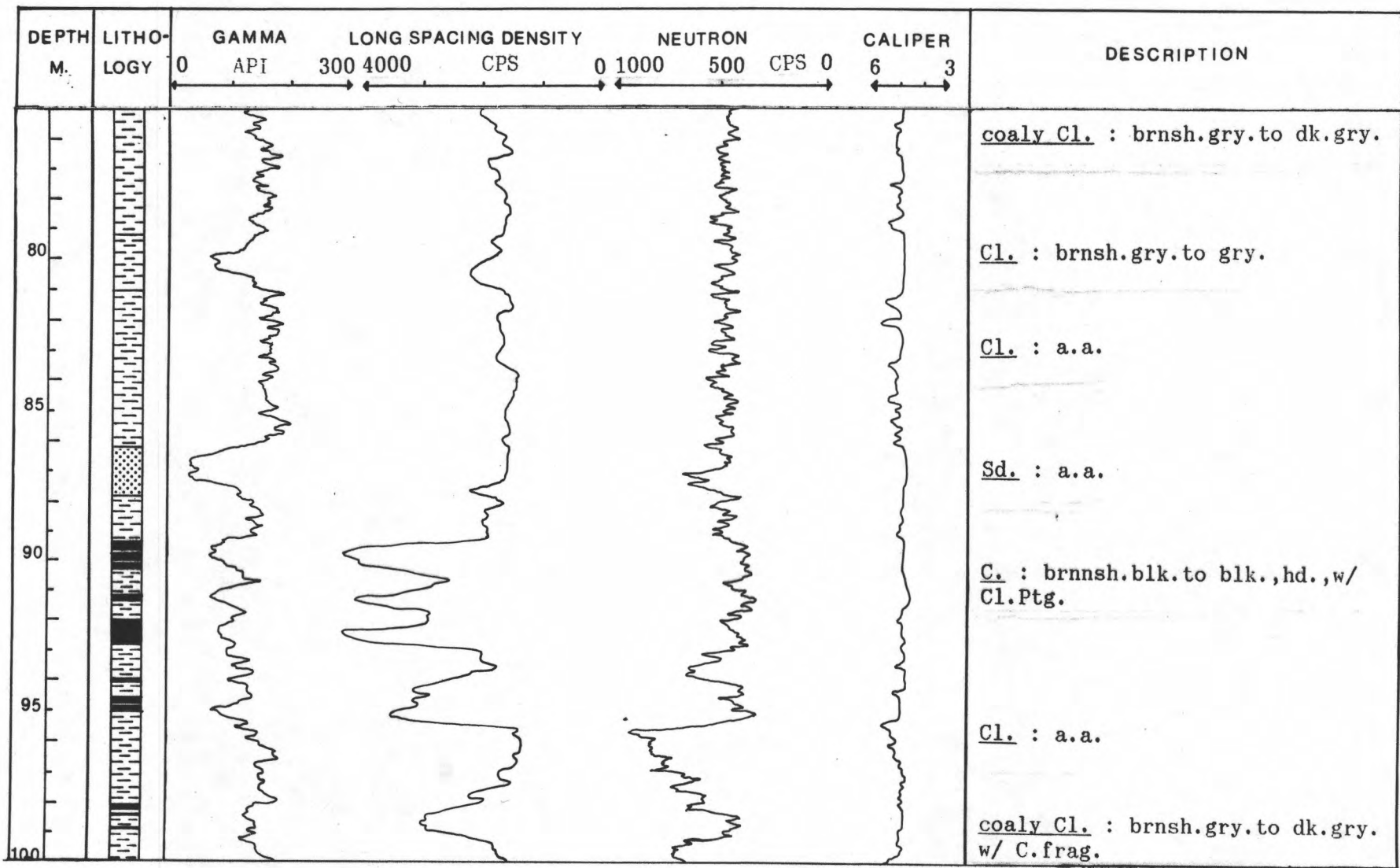


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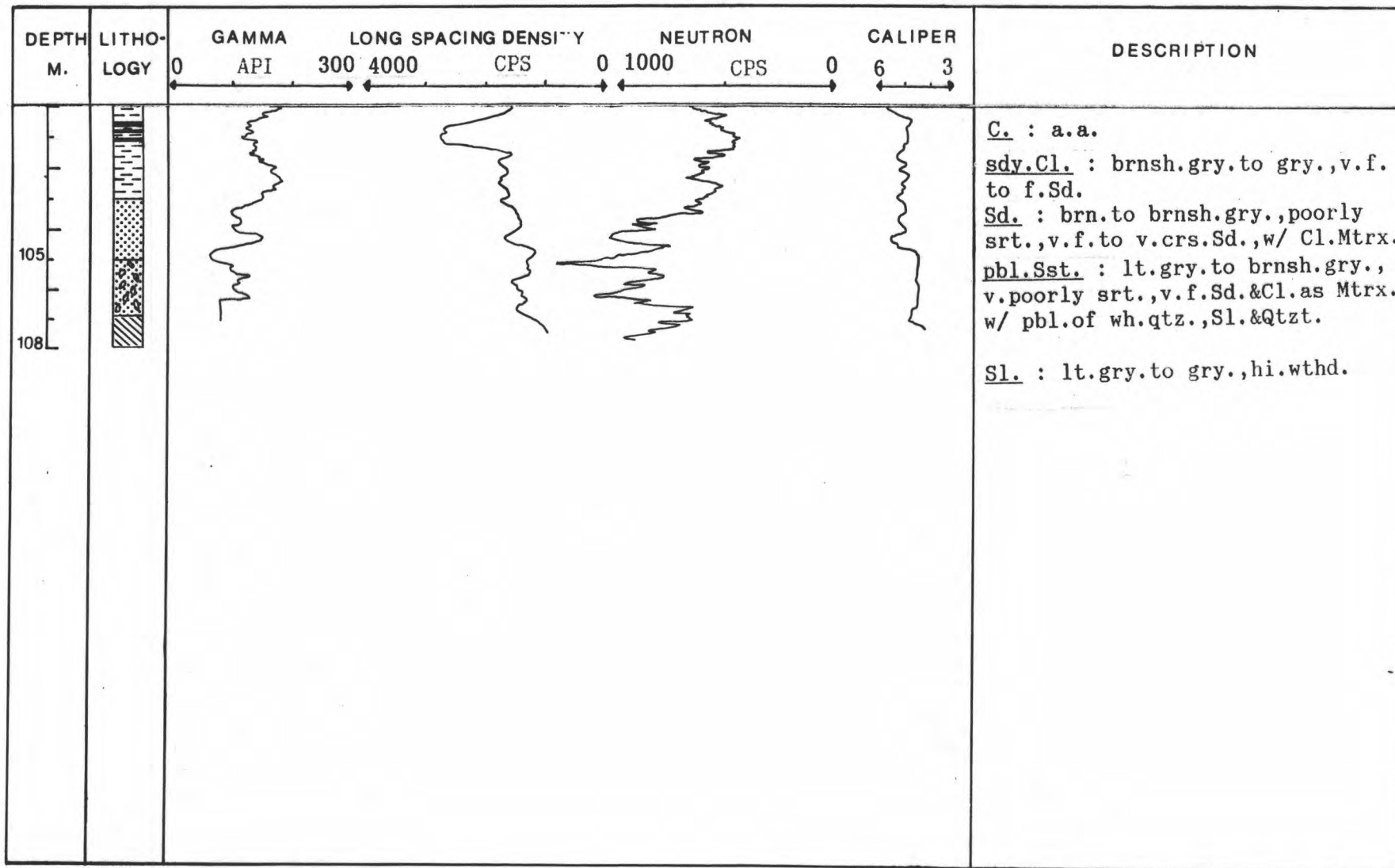


Figure 3.1.3 cont.

Upon the integration of existing data previous mentioned, the continuous lithological sequence of primary drill-holes are analyzed and interpreted from the ground surface down to the depth range of 1.65 to 300.5 metres. The typical lithological sequence of the Ban Pa Kha sub-basin is represented by the subsurface data of the drill-hole number N-74.

The uppermost part of the lithological sequence of the Ban Pa Kha sub-basin is the top soil and the association of sand, silt, and clay in the lower part of yellowish to reddish brown. The sand, silt, clay mixtures contain rock fragments in the lower part. The sand is characterized by fine- to coarse-grained, angular to sub-angular, loose, lateritic composition. Gravel is generally sub-rounded to rounded quartz, quartzite and sandstone.

Underlying the surficial deposit unit is the fine terrigenous sediments of clay and oil shale with only one thick sand interbed. The clay is generally gray to brown, laminated and highly compacted. Thin bedded oil shale is characterized by brown to dark brown with common plant-leaves remains, interbedded in some parts of clay. The sand is characterized by gray to brownish gray, fine- to medium-grained, sub-rounded to rounded, high sphericity, moderate to well sorted, poorly cemented with clay matrix, commonly laminated with small coal fragments. The maximum thickness of this sedimentary unit is 160 metres.

Under the upper lithological sequence earlier described is the upper coal seam with partings of carbonaceous clay and shale. The coal is brown to black, hard, bright with dull interband, commonly

interbedded with carbonaceous clay and shale. The thickness is about 10-15 metres.

The sedimentary sequence underlying the upper coal seam is the fine terrigenous sediments interbedded with sand. The sand is present in the upper part while the lower part is clay and oil shale. The sand is characterized by light gray, fine- to medium-grained, rounded to well-rounded, high sphericity, well sorted. The clay is gray, soft, well compacted, laminated to well bedded with commonly plant-leaves remains. Thin-bedded oil shale of brown to dark brown is interbedded in the lower portion. The thickness of this sedimentary unit is between 15 to 40 metres.

Underneath the sedimentary unit earlier described is the lower coal seam with carbonaceous clay partings in the lower part. The coal is characterized by black, hard, bright band with sub-conchoidal fracture, dense, and massive in the upper part. The carbonaceous clay parting is brown to black and compacted.

The lowermost part of the Ban Pa Kha sedimentary sequence is claystone, sandstone and conglomeratic sandstone. The sandstone is gray, fine- to coarse-grained, sub-angular to sub-rounded, high sphericity, moderately sorted with some small pebbles of quartz and sandstone. The clay is light gray to gray, compacted, interbedded in sandstone. The conglomeratic sandstone is gray, fine- to coarse-grained, sub-angular to angular, low sphericity, poorly sorted, phenoclasts are fragments of basement rocks of mainly quartzite, greenish gray sandstone with clay matrix. The thickness varies from only a few metres to greater than 30 metres.

It is important to note that the Ban Pa Kha sedimentary sequence is mainly semi-consolidated with varying in thicknesses. Generally, the sequence is thinning towards the central part of the sub-basin and thickening eastwardly and westwardly.

The typical Cenozoic sedimentary sequence of the Ban Pa Kha sub-basin is graphically represented in Figure 3.1.4.

3.1.5 Ban Na Sai-Ban Mae Wang Sub-Basin

The Ban Na Sai-Ban Mae Wang sub-basin, covering approximately 14 square kilometres, is located in the southern rim of the Li basin. The area is penetrated by 99 coal exploration drill-holes of totally 5.681 kilometres in length. Amongst these drill-holes, there are 19 drill-holes with cutting/core description and geophysical logs and 80 drill-holes with only cutting/core description.

Upon integration of existing data previous stated, the continuous lithological sequence of all primary drill-holes are analyzed and interpreted from the ground surface down to the depth range of 4.90 to 122.00 metres. The typical lithological sequence of the Ban Na Sai-Ban Mae Wang sub-basin is represented by the subsurface data from drill-hole number B-12.

The uppermost portion of the sedimentary sequence of the Ban Na Sai - Ban Mae Wang sub-basin is represented by top soil deposit and sediments of pebbly clay. The sediments are characterized by reddish brown clay muddled up with sand and silt, loose and lateritic in composition. The gravel is lying at the bottom part. The average thickness is about 5 metres.

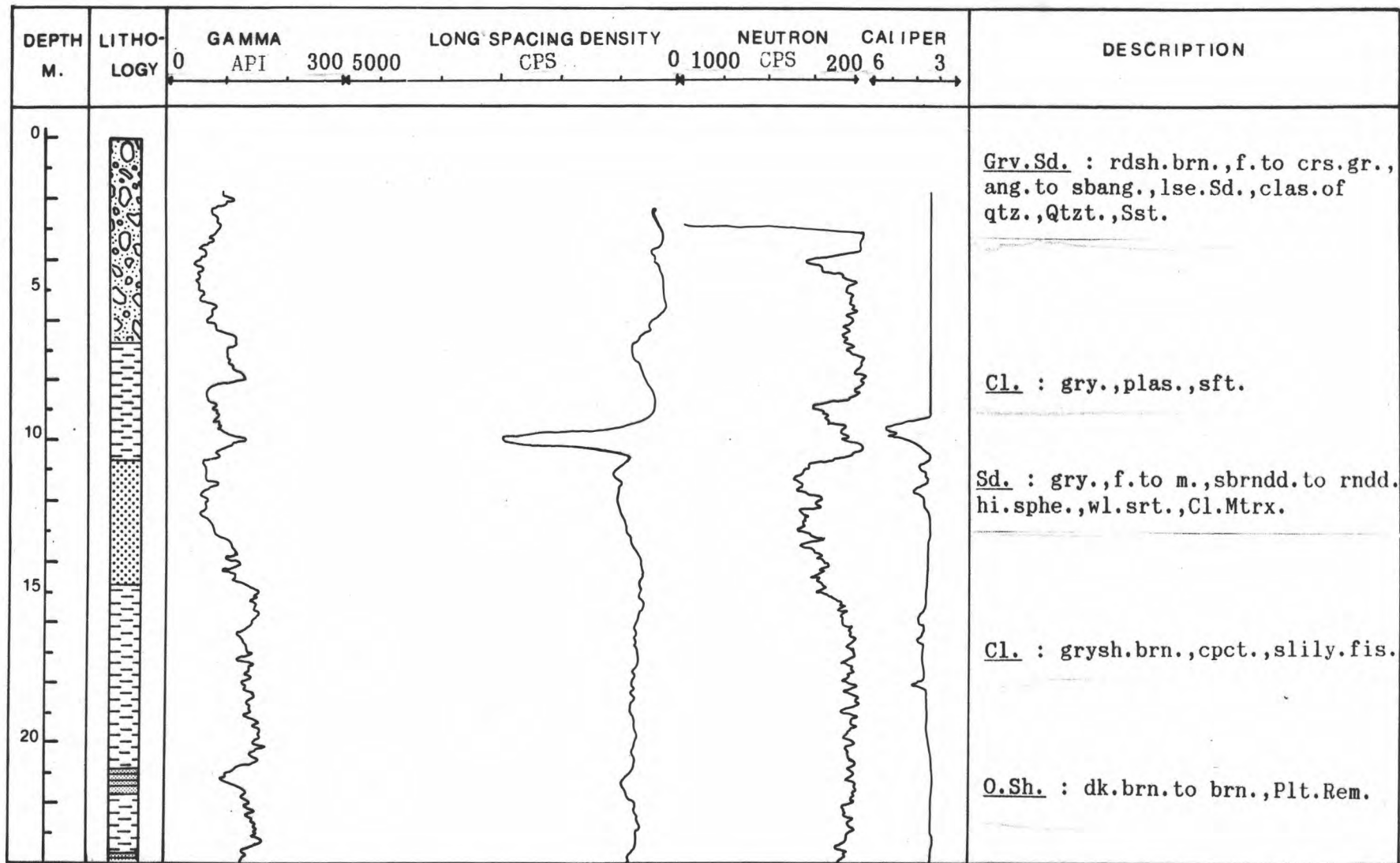


Figure 3.1.4 The representative subsurface lithological sequence of the Ban Pa Kha sub - basin

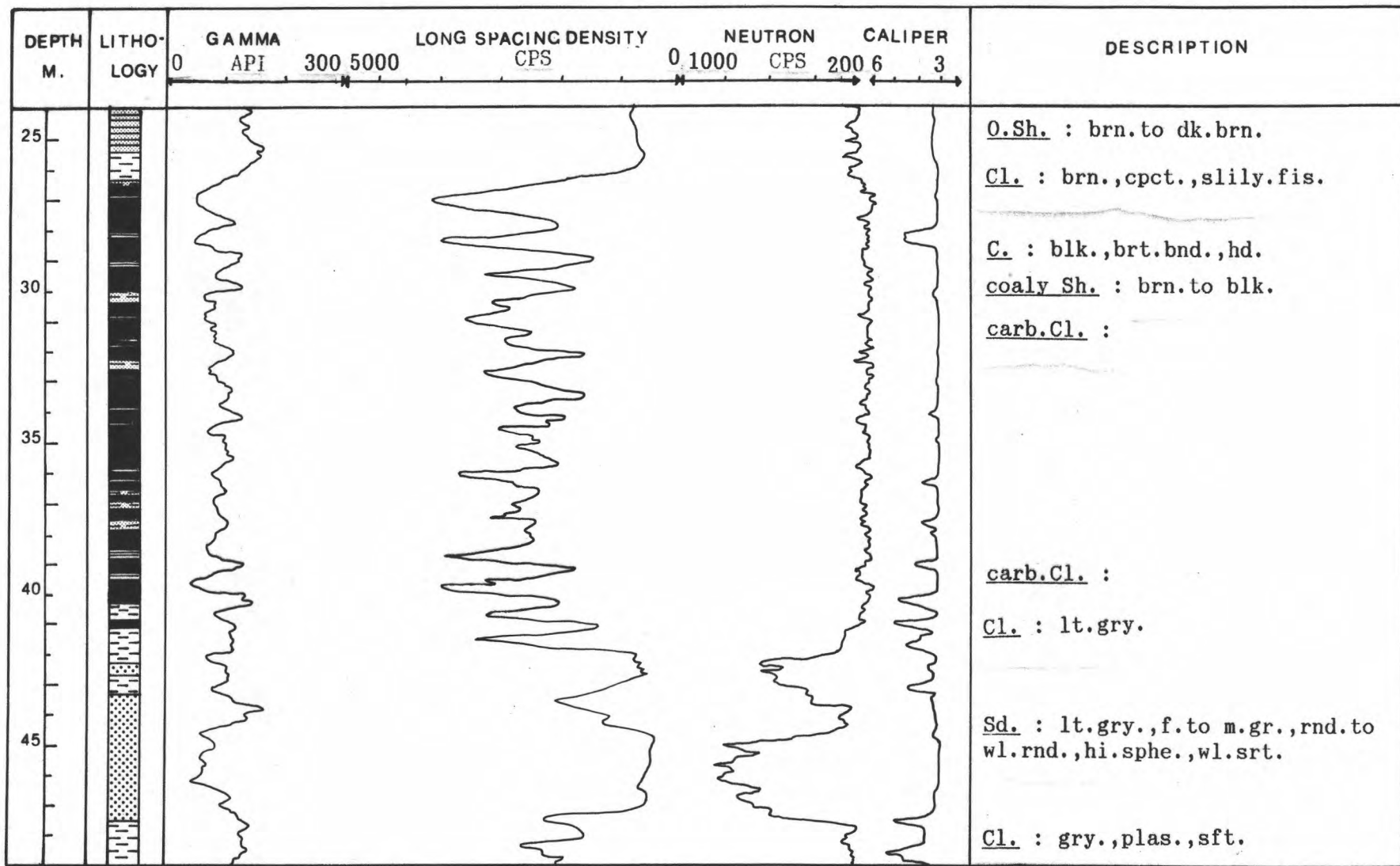


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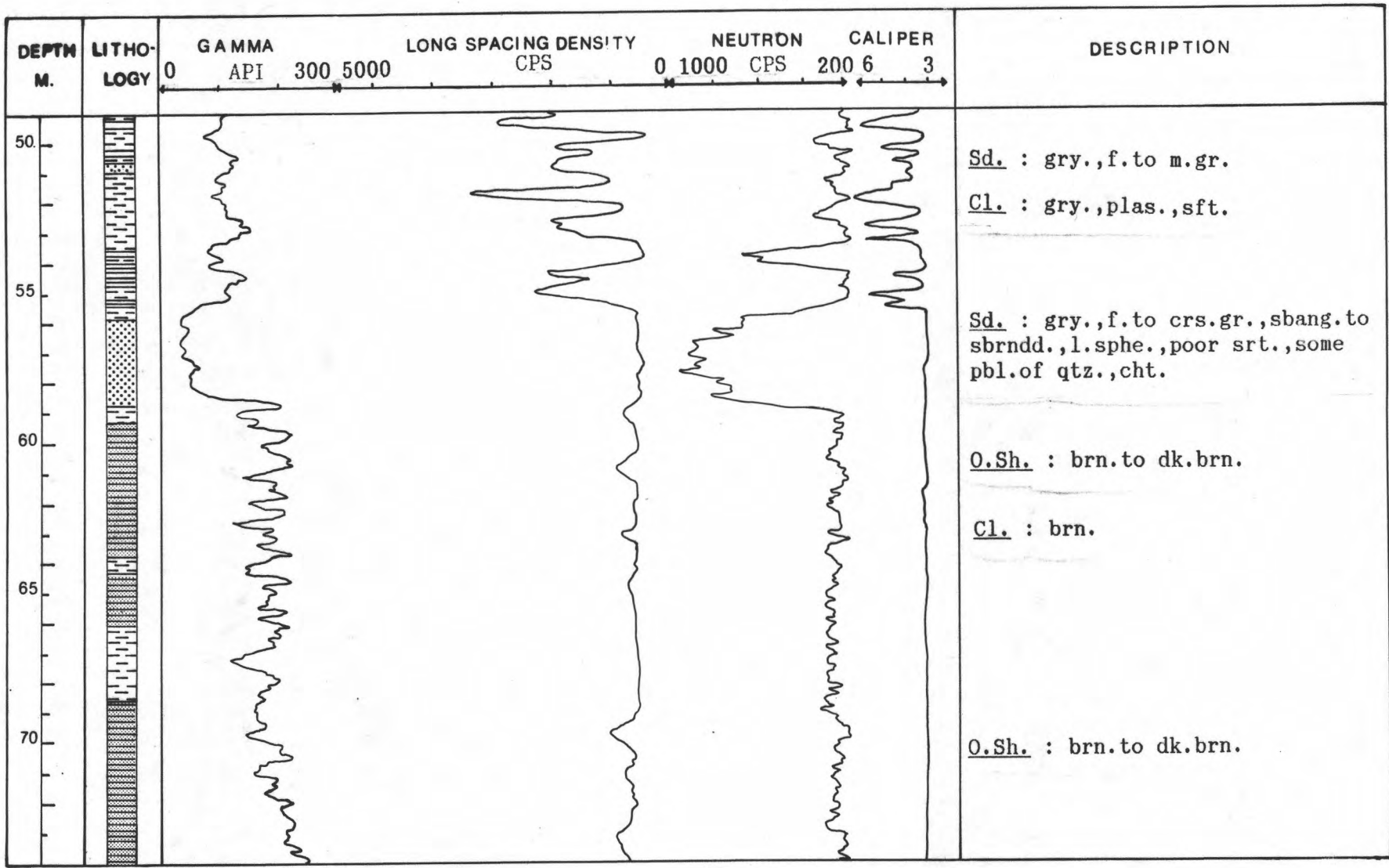


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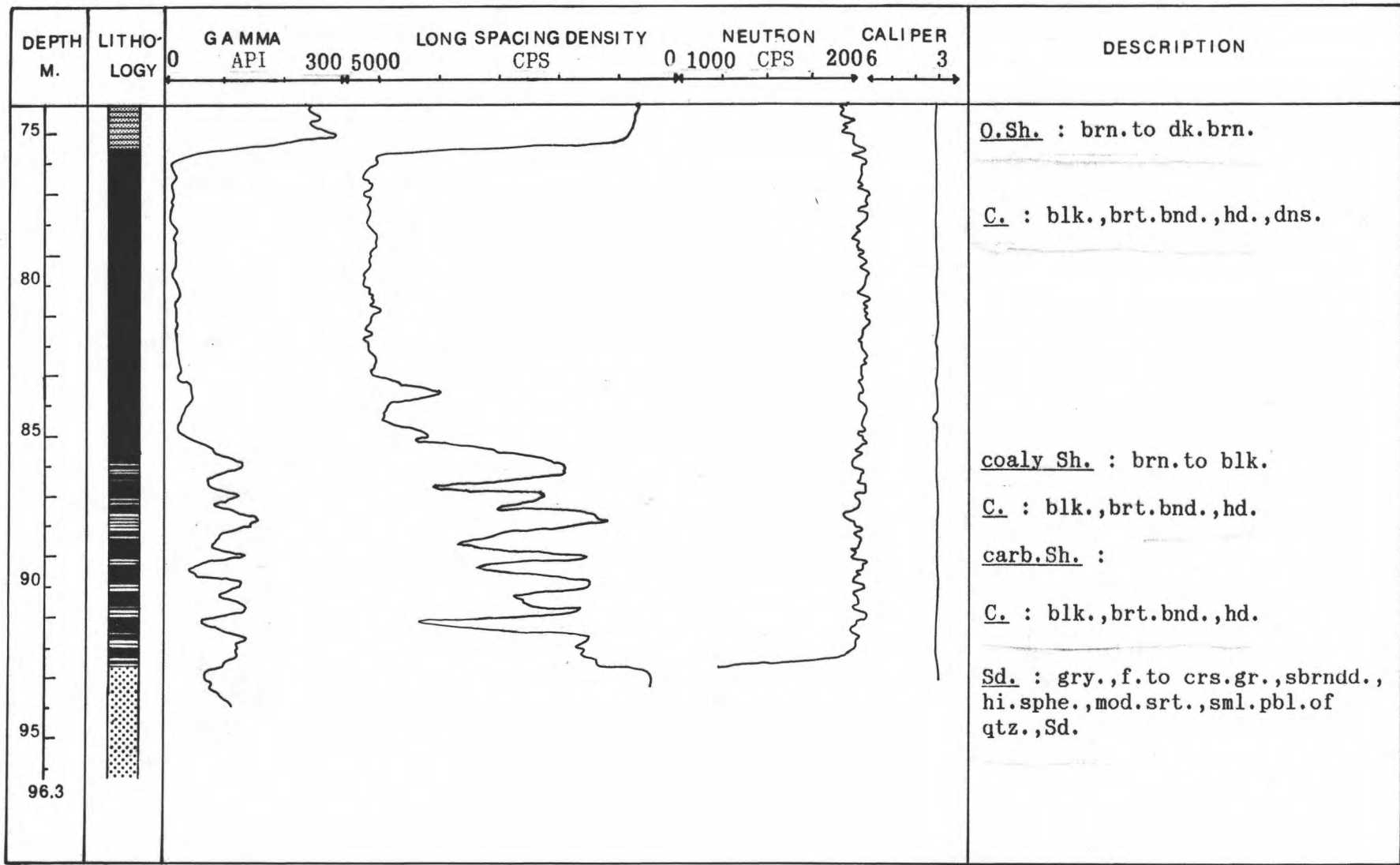


Figure 3.1.4 cont.

Underlying the upper sedimentary portion is the fine terrigenous sedimentary sequence. The sediments are shale interbedded with calcareous silty clay in the upper part and graded to silty clay in the lower part. The shale is characterized by light gray colour, well laminated. The silty clay is also light gray, compacted, well bedded with calcareous composition. There are some plant remains in the upper part of the sequence. The average thickness of the upper portion is about 25 metres.

The lower part of this sedimentary sequence is mostly composed of silty clay that characterized by light gray, compacted, poorly bedded with calcareous cement. In the bottom part, it is composed of some plant remains and gastropod fragments. The average thickness of this bottom part is about 15 metres.

Below the fine-grained sedimentary sequence is the coal seam with partings. The coal is characterized by brownish black, dull with some bright band, massive in hard part, dense, brittle, irregular fracture, commonly interbedded with partings of very fine to fine sand and clay. The water saturation is the typical characteristics of this coal seam. The average thickness of the coal seam is approximately 4 metres.

The lowermost sedimentary sequence of the Ban Na Sai-Ban Mae Wang sub-basin is silty clay to sandy clay and graded to pebbly sand in the northern part of the sub-basin. The silty clay is characterized by brownish gray, poorly bedded, calcareous in composition. Underneath the silty clay is the white to light gray sandy clay, soft, poorly bedded. The average thickness is about 12

metres.

The pre-Tertiary rocks underlain the Tertiary sedimentary sequence are gray limestone, white to light gray quartzite, slate with highly fractured.

It is important to note that the sedimentary sequence of the Ban Na Sai - Ban Mae Wang sub-basin is composed of only one coal seam while the other sub-basins are composed of two coal seams. The coal quality of Ban Na Sai-Ban Mae Wang sub-basin is relatively lower than those of other sub-basins because of higher clay impurity.

The typical Cenozoic sedimentary sequence of the Ban Na Sai - Ban Mae Wang sub-basin is graphically represented in Figure 3.1.5.

3.1.6 The External Sub-Basinal Areas

The external sub-basinal areas, covering the whole areas within the Li basin except the 5 important sub-basins, are divided into 3 parts, namely, the western part, the middle part, and the eastern part of the Li basin. The drill-holes in these areas are sparse with high spacing, so the sedimentary sequence represented the areas are considered from limited data. The sedimentary sequences of the areas are as follows :

3.1.6.1 The Western Part of the Li Basin

The uppermost portion of the sedimentary sequence of the western area of the Li basin is represented by top soil deposit of lateritic composition with granules of quartz and rock fragments.

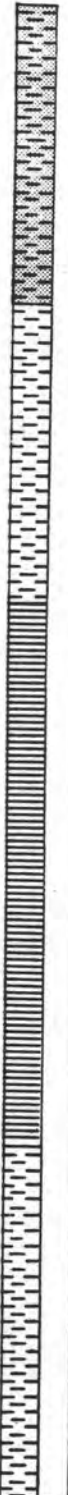
DEPTH M.	LITHO- LOGY	DESCRIPTION
0 5 10 15 20 25 30 35 40		<p data-bbox="503 466 953 504"><u>sdv.Cl.</u> : lt.brn.,f.Sd.size</p> <p data-bbox="503 732 754 769"><u>Cl.</u> : v.lt.gry.</p> <p data-bbox="492 1114 1235 1167"><u>Sh.</u> : v.lt.gry.,mass.,wl.fis.,w/ wh.calc.spt.</p> <p data-bbox="492 1632 1177 1685"><u>Cl.</u> : v.lt.gry.,mass.,slily.fis.@ some pt.</p>

Figure 3.1.5 The representative subsurface lithological sequence of the Ban Na Sai-Ban Mae Wang sub - basin

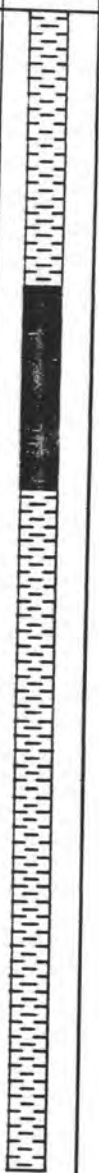
DEPTH M.	LITHO- LOGY	DESCRIPTION
45 50 55 60 65 71		<p data-bbox="508 422 1182 466"><u>Cl.</u> : v.lt.blsh.gry.,mass.slty.@ some pt.</p> <p data-bbox="508 694 1376 798"><u>C.</u> : blk.,dull,mass.bd.,brit.,irr.frac.,w/ some calc. <u>Gast.</u> & pt.of insects</p> <p data-bbox="508 1026 664 1070"><u>Cl.</u> : a.a.</p>

Figure 3.1.5 cont.

Below the top soil deposit down to the pre-Tertiary basement is the thick lithological unit of clay with intercalation of sand graded to shale in the lower part. The clay is characterized by light gray, plastic in the upper part, slightly calcareous in the lower part.

The typical Cenozoic sedimentary sequence of the western part of the Li basin is graphically represented in Figure 3.1.6.a.

3.1.6.2 The Middle Part of the Li Basin

The uppermost portion of the sedimentary sequence of the middle part of the Li basin is represented by top soil deposit with fine sand and clay mixture. The top soil deposit is characterized by brown, lateritic composition.

Under the top soil deposit is the sand/clay unit. The sand is characterized by fine- to medium-grained, sub-rounded, moderately sorted.

The next sedimentary sequence is the very thick clay unit with one bed of sand intercalated in the lower part. The clay is characterized by light gray, plastic when wet. The sand is generally fine- to medium grained, sub-rounded, moderately sorted.

The lowermost sedimentary unit lying on the pre-Tertiary rocks is the gravelly sand. The characteristics of sediments are fine to very coarse sand, sub-rounded, moderately sorted with the pebble of basement rocks, notably, slate, mudstone and quartz.

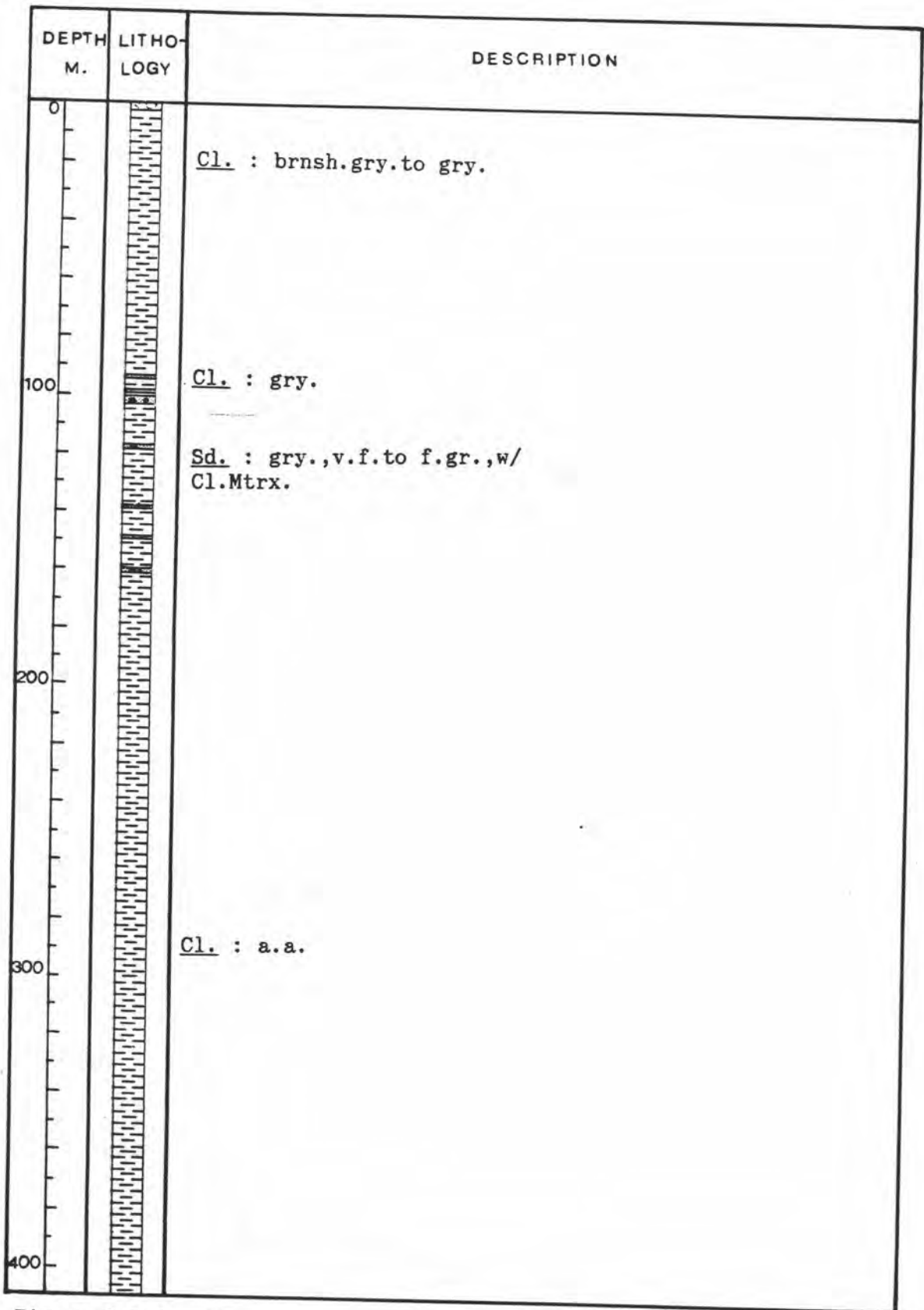


Figure 3.1.6.a The representative subsurface lithological sequence of the Western Part of the Li basin

The typical Cenozoic sedimentary sequence of the middle part of the Li basin is graphically represented in Figure 3.1.6.b.

3.1.6.3 The Eastern Part of the Li Basin

In this context, the eastern part of the Li basin means the areas out-side the main sub-basins earlier referred to.

The uppermost part of the sedimentary sequence of the eastern part of the Li basin is represented by thin top soil deposit.

Under the top soil deposit is the lithological unit of clay intercalated with gravelly sand. The clay is characterized by brown colour, some parts are silty in composition. The gravelly sand is generally medium to coarse sand, rounded, poorly sorted, with gravels of quartz, quartzite and sandstone of basement rocks.

The typical Cenozoic sedimentary sequence of the eastern part of the Li basin is graphically represented in Figure 3.1.6.c.

3.2 Sedimentary Facies

The aims of the present investigation is to define the sedimentary facies of the Tertiary deposits in the Li intermontane basin. This analysis is depending on the availability of the subsurface geological/geophysical data and information in terms of distribution pattern of data points, quantity and quality of data, etc..

Upon the preliminary appraisal of the existing data, it is possible to conduct the sedimentary facies analysis in 5 separate target areas, namely, Ban Pu, Ban Hong, Ban Mae Long, Ban Pa Kha, and

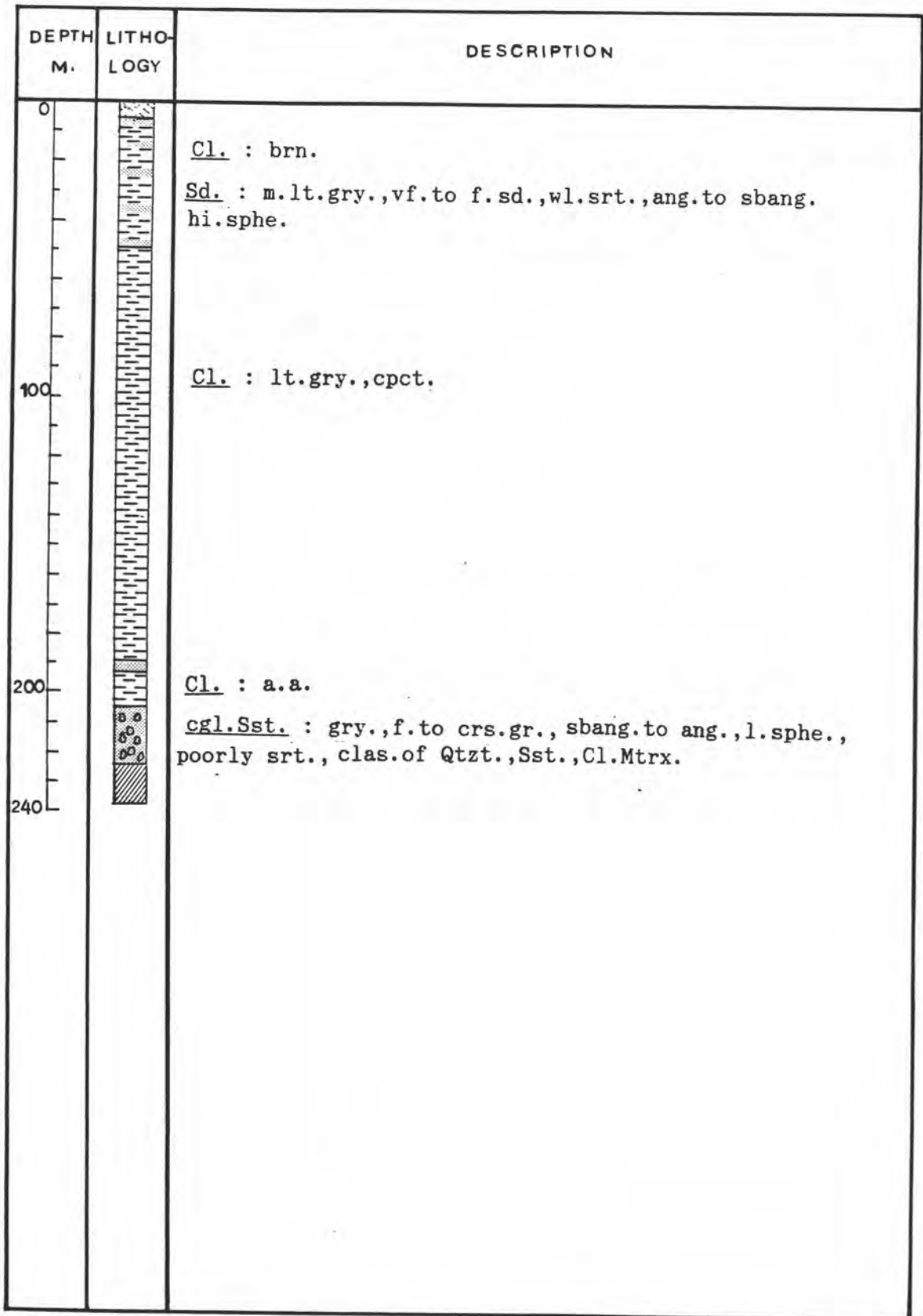


Figure 3.1.6.b The representative subsurface lithological sequence of the Middle Part of the Li basin

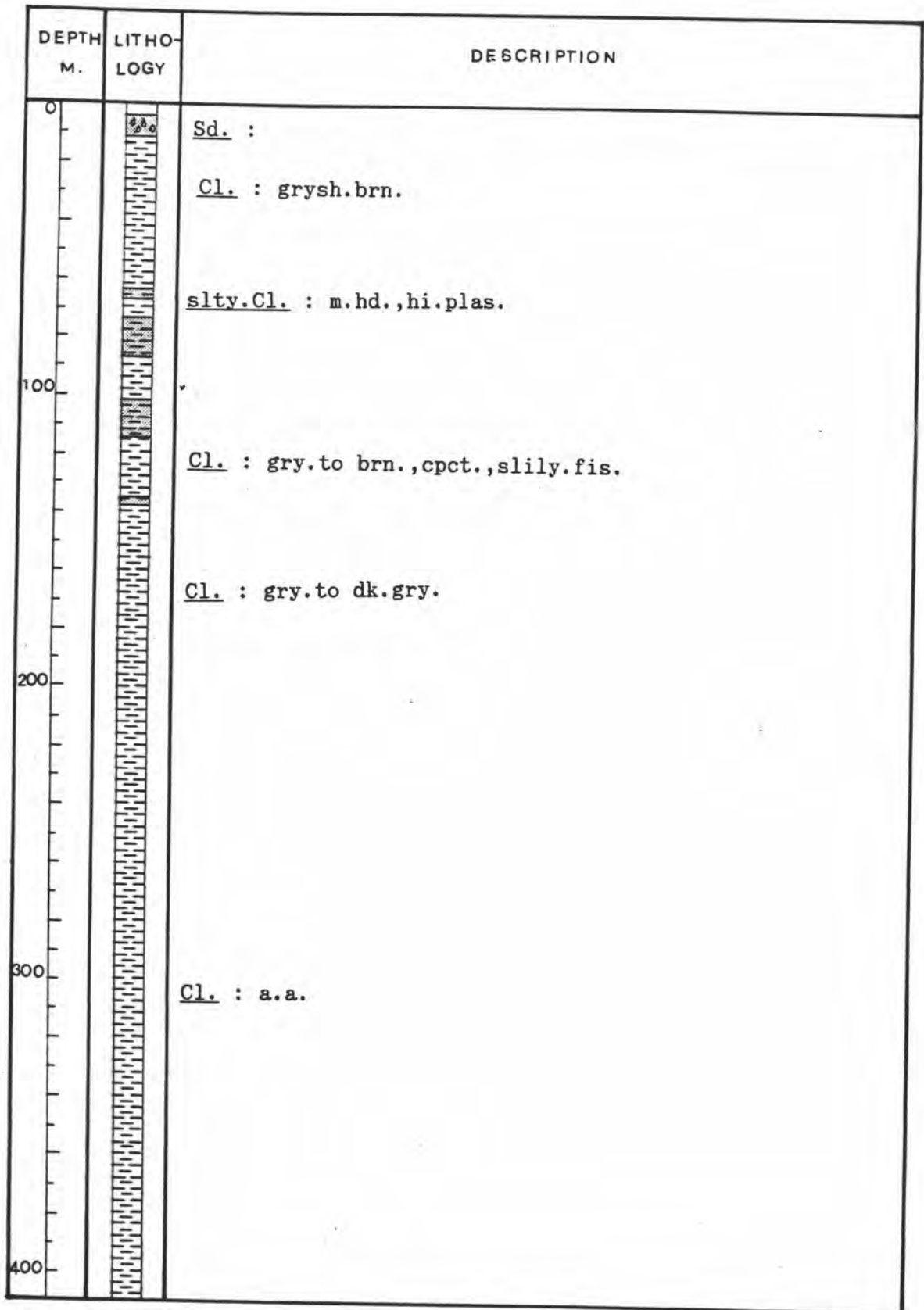


Figure 3.1.6.c The representative subsurface lithological sequence of the Eastern Part of the Li basin

Ban Na Sai-Ban Mae Wang. Besides, the sedimentary facies of external sub-basinal areas within the Li basin have been analyzed to fulfill the understanding of the overall facies of the basin. The facies analysis relies on the reconstruction of the basin morphology and bedding architecture, determination of gross lithology, delineation of the geometry, and recognition of vertical and lateral succession of the facies association. In addition, the aspect of tectonic sedimentation has to be fully appreciated.

The lithological sequence of each area earlier identified will be employed in the determination of the depositional sequence concerned or sedimentary facies using facies models. Fundamentally, the concept of facies model is a summary of a depositional environment and its products. The facies models used in this study are described in Rust (1983) and Miall (1978) for alluvial fan facies; Miall (1978) for braided fluvial facies; Allen (1964) for meandering fluvial facies; Visher (1965), Kukal (1971) and Picard and High (1972) for lacustrine facies. Therefore, the foregoing discussion will be focusing upon the sedimentary facies analysis in each of the target area within the Li basin.

3.2.1 Ban Pu Sub-Basin

The uppermost portion of the lithological sequence of the Ban Pu sub-basin is represented by top soil deposit underlain by thin layer of gravelly sand.

Below the top soil deposit is the association of medium and fine terrigenous sediments. The gamma-ray log signature represents rather irregular pattern. This lithological succession suggests that

they were deposited under the condition of shallow fresh-water paleo-lake of terrigenous clastics.

Below the uppermost lacustrine facies is the thin lithological unit of interbedding of sand, clay and coal. The gamma-ray log signature is characterized by a series of bell-shaped pattern. This lithological unit is considered to be deposited under relatively high energy environment with nearby lower energy condition of channel and back swamp of fluvial environments, respectively. Therefore, the cycle of fining upward sequence is concluded to be the meandering fluvial facies, and thin coal bands are concluded to be back-swamp facies.

Underneath the meandering fluvial facies is the lithological unit of clay interrupted by very fine to fine sand. The geophysical log signatures are similar to those of the uppermost lacustrine facies. This lithological succession is interpreted to be deposited under the condition of fresh-water paleo-lake of terrigenous clastics.

Under the upper lacustrine facies is the lithological sequence of coal with clay partings. The geophysical log signatures represent rather irregular pattern. This lithological unit is considered to be deposited under low energy conditions of peat swamp and lacustrine environments.

The sedimentary unit under the upper peat swamp facies is the clay unit. The gamma-ray log signature represents irregular shale line pattern. This lithological sequence is considered to be deposited under low energy condition of fresh water paleo-lake of

terrigenous clastics.

Below the lacustrine facies is the gravelly sand unit of about 12 metres thick. The gamma-ray log signature shows cylindrical-shaped pattern. This lithological unit is therefore regarded as the braided fluvial facies.

Underlying the sand dominant of fluvial facies is a sequence of fine-grained clastics interrupted by fine to very fine sand. The geophysical log signatures represent rather irregular shale line pattern. This lithological unit is interpreted to be deposited in low energy condition of shallow fresh-water paleo-lake of terrigenous clastics.

Underneath the lower lacustrine facies is the lower coal seam unit. The geophysical log signatures represent rather smooth pattern, show the exceptionally thick coal seam with some partings. This lithological unit is considered to be deposited under rather distinct condition of slowly subsiding peat swamp environment.

The sedimentary sequence underlying the lower coal swamp facies is the mud unit associated with sand. The gamma-ray log signature represents the irregular pattern on shale line. This sedimentary sequence is interpreted to be deposited in low energy condition of paleo-lake of terrigenous clastics.

Below the lowermost lacustrine facies is the sedimentary unit of very fine to very coarse sand with some granules of quartz, quartzite, and slate. The sedimentary sequence is interpreted to be deposited under relatively high energy environment of alluvial fan

facies.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the Ban Pu sub-basin are summarized and presented in Figures 3.1.1, 3.2.1.a and 3.2.1.b.

3.2.2 Ban Hong Sub-Basin

The uppermost portion of the lithological succession of the Ban Hong sub-basin, is represented by top soil deposit with sand, silt and clay mixture.

Underneath the top soil deposit is the lithological unit of sand to gravel. The geophysical log signature is represented by the rather irregular sand line pattern. This lithological unit is considered to be deposited under the high energy condition which of alluvial fan.

Underlying the sand dominant of alluvial fan facies is a sequence of coal seam interbedded with fine- to medium-grained clastic sediments. The geophysical log signatures represent irregular pattern. The sedimentary sequence is regarded to be deposited in the rather low to low energy conditions of shallow fresh-water paleo-lake and peat swamp environment, respectively. Therefore, it is concluded to be peat swamp facies associated with shallow lacustrine facies.

Below the sedimentary facies earlier described is the unit of medium- to coarse-grained clastic sediments. The sand/clay ratio is about 11.4. The geophysical log signatures represent cylindrical pattern. This sedimentary unit is therefore regarded as the braided

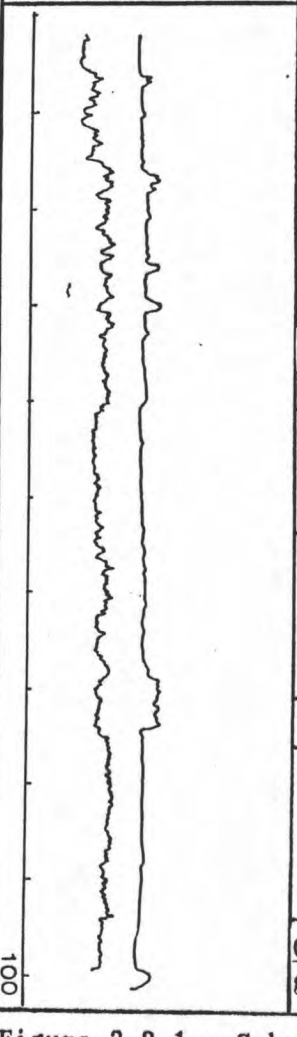
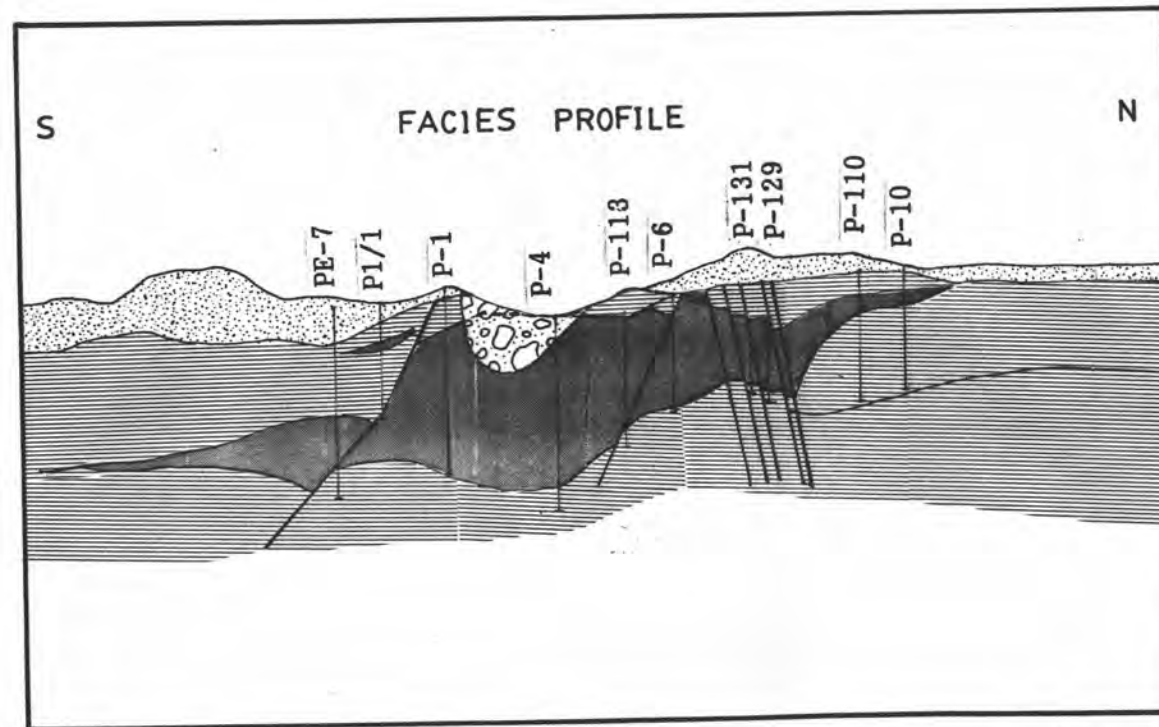
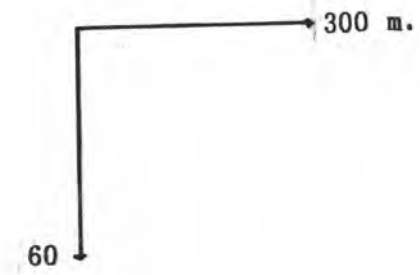
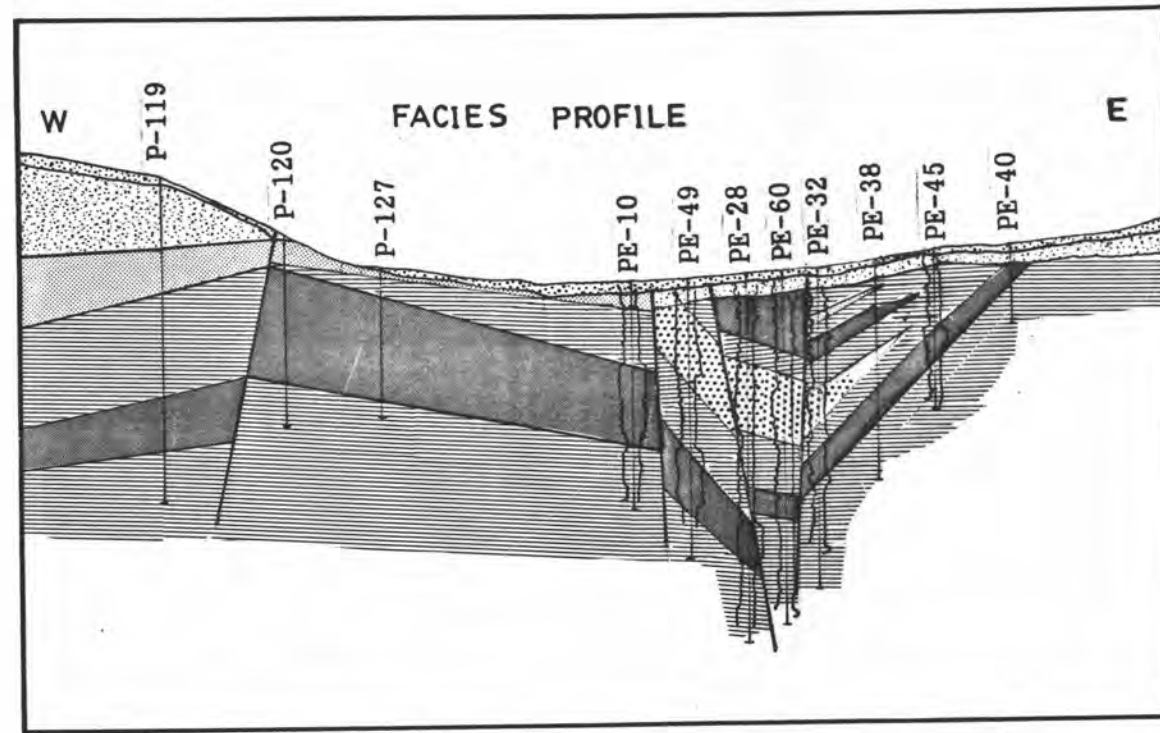
Geophysical Log	Description	Sedimentary Facies	Depositional Environment
	<u>Top soil</u> Sd.,slt.&Cl.,pale yelsh.brn.	Top soil	
	-----	-----	-----
	Sd.,carb.Cl.,Cl. w/sdy.&slty.comp.in pt., mostly Sd.&slt.Sd.=olv.gry.to gry. v.f.to crs.,ang.to sbang.,mod.to wl.srt.,hi.sphe. C.w/Ptg.of Cl.,cly.Sd.&slty.Cl.	Lacustrine	Fresh-water shallow lake
	sdy.cly.Slt.=v.f.to f.Sd.,ang.to sbang.	Meandering fluviate	Meandering river
	C.=dusky yelsh.brn.,dull to m.brt.hd.	Lacustrine	Fresh-water shallow lake
	C.=dusky yelsh.brn.,dull to m.brt.hd.	Peat swamp/Lacustrine	Fresh-water peat swamp
	slt.Cl. = lt.gry.,m.plas.,Cl.Cont.~50-60%	Lacustrine	Fresh-water lake
	Grv.Sd. = lt.gry. Sd.=v.f.to v.crs.,poorly srt.,ang.to sbang.,l.sphe.,qtz.Cont.~90%, Rk.frag.~10%	Braided river of Donjek type	Braided fluviate
	Sd.&Cl. w/slty.&sdymix. olv.gry.to brnsh.gry. slty.Cl. = hi.plas.Cl.Cont.70-75% Sd. = v.f.to f.gr.,wl.srt.,ang.to sbrndd.	Lacustrine	Fresh-water shallow lake
	C. = dusky yelsh.brn.,dull to m.brt.,hd.	Peat swamp	Fresh-water peat swamp
mdy.Sd. = lt.gry. Sd.=v.f.to v.crs.gr., poorly srt.,ang.to sbang.,l.sphe.	Lacustrine	Fresh-water shallow lake	
sdy.md. = lt.gry. Sd.=v.f.to crs.,poorly srt.,ang.to sbang.,l.sphe.,Cl.Cont.~60%,			
Grv.Sd.=v.lt.gry.to lt.gry.,v.f.to v.crs.gr.,poorly srt.,ang.to sbang.,l.sphe.,	Alluvial fan	Alluvial fan	

Figure 3.2.1.a Subsurface sedimentary facies and depositional environment of the Ban Pu sub-basin









-  Alluvial fan facies
-  Braided fluvial facies
-  Meandering fluvial facies
-  Peat swamp facies
-  Lacustrine facies
-  pre-Tertiary rocks

Figure 3.2.1.b Representative sedimentary facies profile of the Ban Pu sub-basin

fluviatile facies.

The sedimentary unit under the braided fluviatile facies is the clay unit interrupted with sand and silt. The gamma-ray log signature represents the irregular shale line to irregular sand line patterns. This sedimentary unit is regarded to be deposited in the low energy condition of shallow fresh-water paleo-lake of terrigenous clastics.

Under the upper lacustrine facies is the unit of coal seam with partings of clay to carbonaceous clay. The geophysical log signatures represent irregular dominant coal pattern. This unit is considered to be deposited in the low energy condition of peat swamp environment. Therefore, it is concluded to be peat swamp facies.

Underneath the lower peat swamp facies is the sedimentary sequence of sandy clay. The gamma-ray log signature represents irregular shale line pattern. This sedimentary unit is considered to be deposited under the low energy condition of shallow fresh-water paleo-lake environment. It is concluded to be lacustrine facies.

The lowermost Tertiary sedimentary sequence of the Ban Hong sub-basin, lying unconformably pre-Tertiary rocks, is represented by a unit of conglomeratic sandstone with clasts of pre-Tertiary rocks. The gamma-ray log signature represents the irregular sand line pattern. The lithological characteristics and geophysical log signatures indicate that this sedimentary unit was deposited in the high energy condition of alluvial fan.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the Ban Hong sub-basin are summarized and presented in Figures 3.1.2, 3.2.2.a, and 3.2.2.b.

3.2.3 Ban Mae Long Sub-Basin

The uppermost portion of the sedimentary succession of the Ban Mae Long sub-basin is represented by top soil deposit with the association of very fine sand, silt and clay of lateritic in composition.

Under the top soil deposit is the sedimentary unit of medium-grained clastic sediments. The sediments are represented by very very fine to very coarse sand with some pebbles. The gamma-ray log signature represents smooth sand line pattern. This sedimentary unit is considered to be deposited under the high energy condition of alluvial fan.

Underneath the sand dominant of alluvial fan facies is a sequence of interbedding of sand and clay. The gamma-ray log signature is characterized by series of bell-shape pattern. This lithological unit is interpreted to be deposited under relatively high energy condition of channel environment. Therefore, the cycle of fining upward sequence is concluded to be meandering fluvial facies.

Below the sedimentary sequence of meandering fluvial facies is the thick unit of fine terrigenous sediments. The gamma-ray log signature is characterized by the irregular shale line pattern.

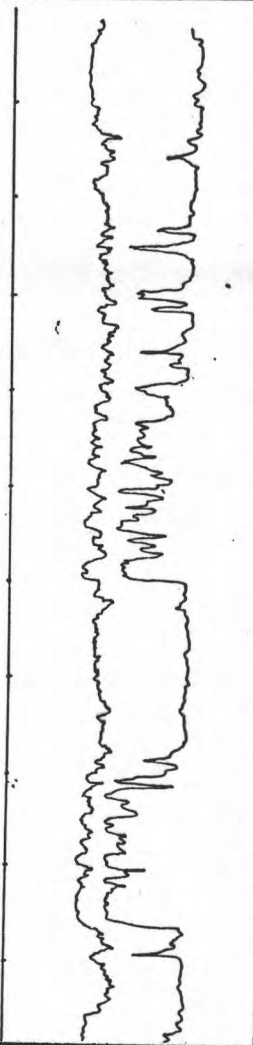
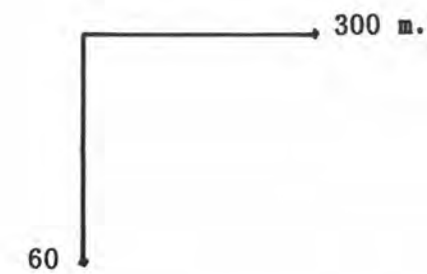
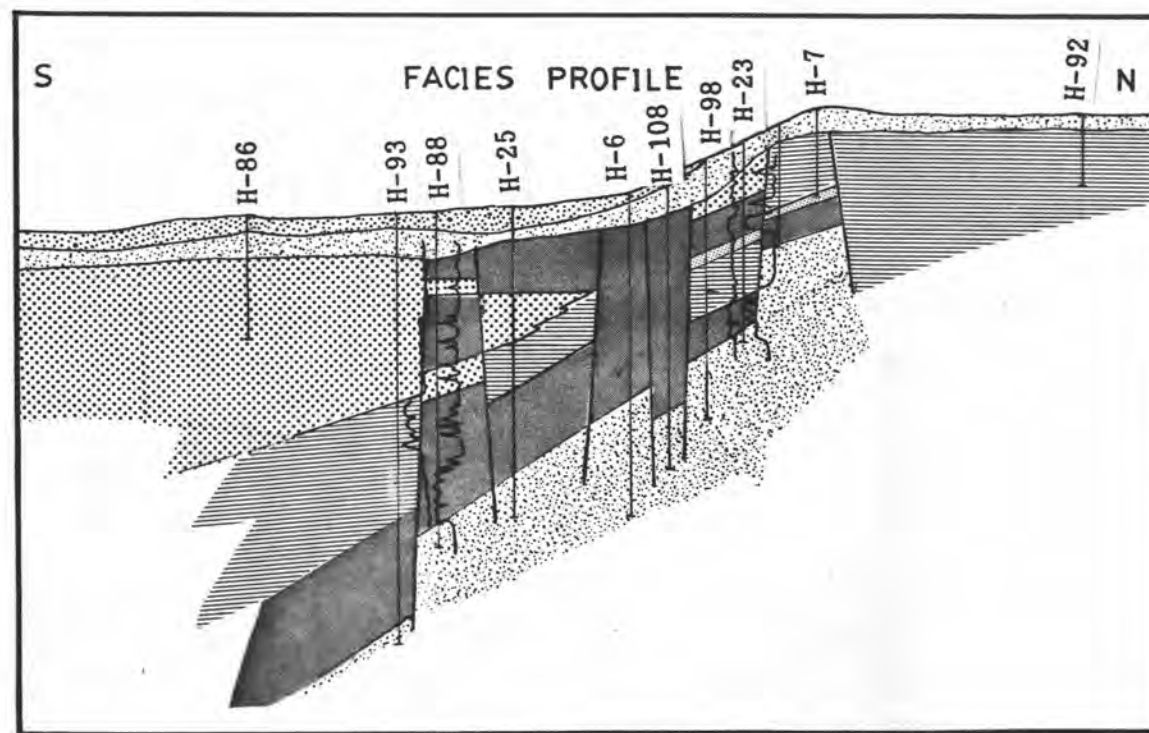
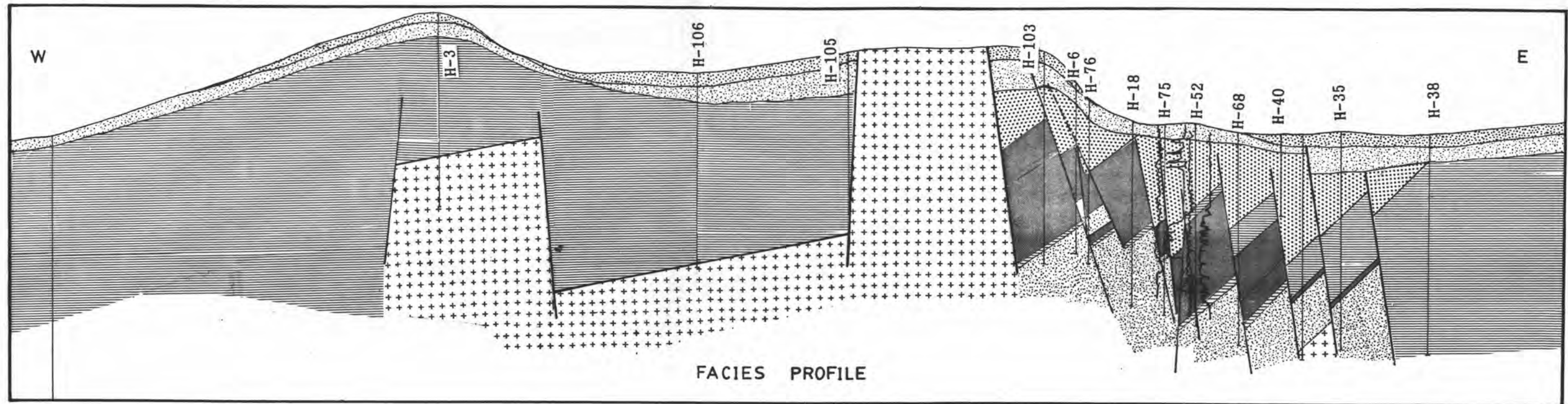
Geophysical Log	Description	Sedimentary Facies	Depositional Environment
	Tp.soil. Sd.,Slt.&Cl. lse.,lat.	Top soil	
	Sd.to Grv.,lt.brn.to brnsh.gry., v.f.to v.crs.gr.,poorly srt.,ang.	Alluvial fan	Alluvial fan (Distal)
	Cl.= gry.to brnsh.gry.,Plt.Foss. Sd.= gry.,v.f.to m.gr.,wl.srt.,ang.to sbrndd.,l.to mod.sphe. Cl.Mtrx.,qtz.pbl. in the u.pt. C.=brnsh.blk.to blk.,hd.,Wd.tex. C.=brnsh.blk.to blk.,hd.,sbconch.frac., Wd.tex. Cl.=lt.gry.to gry.	----- Unconformity ----- Peat swamp with shallow lacustrine association	----- Fresh-water peat swamp with shallow lake association
	Pbl.Sd.=gry.,poorly srt.,v.f.Sd.&Cl.as Mtrx.,Pbl.of blk.Sl.Qtzt.,Sst.,qtz.&Cht.	Braided fluvialite	Braided river of Donjek or S.Saskatchewan type
	sdy.Cl.=gry.to dk.gry. Sd.=gry.,f.to crs.gr.,w/Cl.Mtrx.,mod.srt.	Lacustrine	Fresh-water lake
	C.=brnsh.blk.to blk.,hd.,gd.brtness., Wd.tex. Cl.to carb.Cl.=brn.gry.to dk.gry. sdy.Cl.@ Btm.pt.	Peat swamp	Fresh-water peat swamp
	sdy.Cl.=lt.gry.to gry.	Lacustrine	Fresh-water lake
	Cgl.Sst.=gry.,v.f.to v.crs.gr.	Alluvial fan	Alluvial fan

Figure 3.2.2.a Subsurface sedimentary facies and depositional environment of the Ban Hong sub-basin



- Alluvial fan facies
- Braided fluvial facies
- Meandering fluvial facies
- Peat swamp facies
- Lacustrine facies
- pre-Tertiary rocks

Figure 3.2.2.b Representative sedimentary facies profile of the Ban Hong sub-basin

This sedimentary unit was considered to be deposited in the low energy to quiet conditions of fresh water lacustrine environment.

The sedimentary sequence under the lacustrine facies is the coal seam with some clay partings. The geophysical log signatures show the dominant coal pattern. This coal seam is considered to be deposited in the calm condition of fresh-water peat swamp environment.

The next sedimentary sequence is the thick sequence of clay with one bed of sand intercalation. The geophysical log signatures represent irregular shale and sand line patterns. The lithological unit is considered to be deposited in a relatively low energy condition of fresh water lacustrine environment with influence of surface run-off.

Underlying the lacustrine facies is the sequence of coal with clay and carbonaceous clay partings. The geophysical logs signature represent the coal pattern and irregular shale line pattern. This lithological sequence is considered to be deposited in the low energy condition of fresh-water peat swamp environment.

The lowermost sedimentary unit of the lithological succession of Ban Mae Long sub-basin is the sand dominant unit. The gamma-ray log signature shows the irregular sand line pattern. This sedimentary unit was concluded to be deposited under the high energy condition of alluvial fan environment.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the

Ban Mae Long sub-basin are summarized and presented in Figures 3.1.3, 3.2.3.a, and 3.2.3.b.

3.2.4 Ban Pa Kha Sub-Basin

The uppermost portion of the lithological succession of the Ban Pa Kha sub-basin, is represented by top soil deposit with association of sand, silt and clay of lateritic in composition.

The sedimentary sequence under the top soil deposit is the thick sequence of fine terrigenous clastic sediments. The sediments are clay and oil shale with one bed intercalation of fine to medium sand. The geophysical log signatures represent the irregular shale line pattern. This sedimentary unit is considered to be deposited under the low energy condition of fresh water paleo-lake. The products of this paleo-lake is sedimentary rocks of lacustrine facies.

Underlying the sedimentary rocks of the lacustrine facies is the thick unit of coal seam with carbonaceous clay and shale partings. The geophysical log signatures show the coal character pattern. This upper coal seam is considered to be deposited in the rather calm condition of slowly subsiding fresh-water peat swamp environment.

The next sedimentary sequence is the thick sequence of clay and shale unit with the association of fine to medium sand in the upper part. The geophysical logs signature represent the irregular shale and sand lines patterns. This lithological unit is considered to be deposited under low energy condition of lacustrine environment.

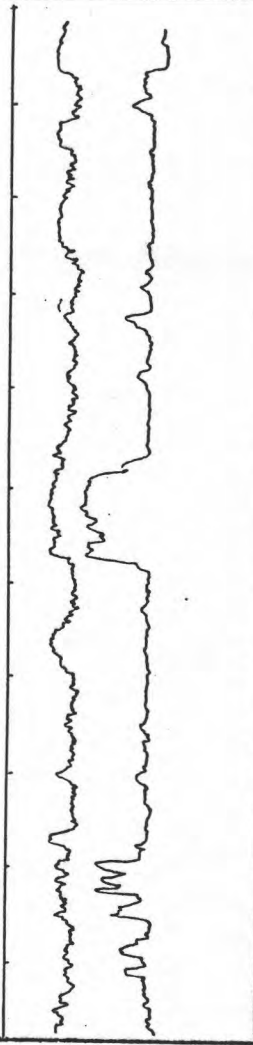
Geophysical Log	Description	Sedimentary Facies	Depositional Environment
	<u>Top soil.</u> , Sd., Slt. & Cl., rdsh. brn., lat.	Top soil	
	Sd.=v.f. to v.crs.gr., poorly srt., Grv.	Alluvial fan	Alluvial fan (Distal)
	<u>Cl. intbd. w/Sd.</u> Cl.=gry. to brnsh.gry., w/C.frag. Sd.=gry. to lt.gry., v.f. to v.crs.gr.,	Meandering fluviatile	Unconformity Meandering river
	Cl.=lt.gry. to gry. cly.Sd.=v.f. to v.crs.Sd., poorly srt., ang to sbang., l.sphe.	Lacustrine	Fresh-water lake
	<u>C.=brnsh.blk., hd., brt., w/dull bnd.</u> intercal., brit, subwaxy to conch.frac.	Peat swamp	Fresh-water peat swamp
	<u>Cl., slty. to sdy comp. & Sd. intercal.</u> Cl.=brnsh.gry. to lt.gry., sft., wl.bd., some pt. are slty. Cl., carb. Cl. Sd.=gry. to brn., v.f. to v.crs.gr., poorly srt., Cl.Mtrx.	Lacustrine	Fresh-water lake with influence of surface water
	<u>C. w/Cl. & carb. Cl. Ptg.</u> C.=brnsh.blk., dull, brit., sft. in some pt. Cl.=wh. to gry.	Peat swamp	Fresh-water peat swamp
	<u>Sd.=brn. to brnsh.gry., v.f. to v.crs.gr.,</u>	Alluvial fan	Alluvial fan (Distal)

Figure 3.2.3.a Subsurface sedimentary facies and depositional environment of the Ban Mae Long sub-basin

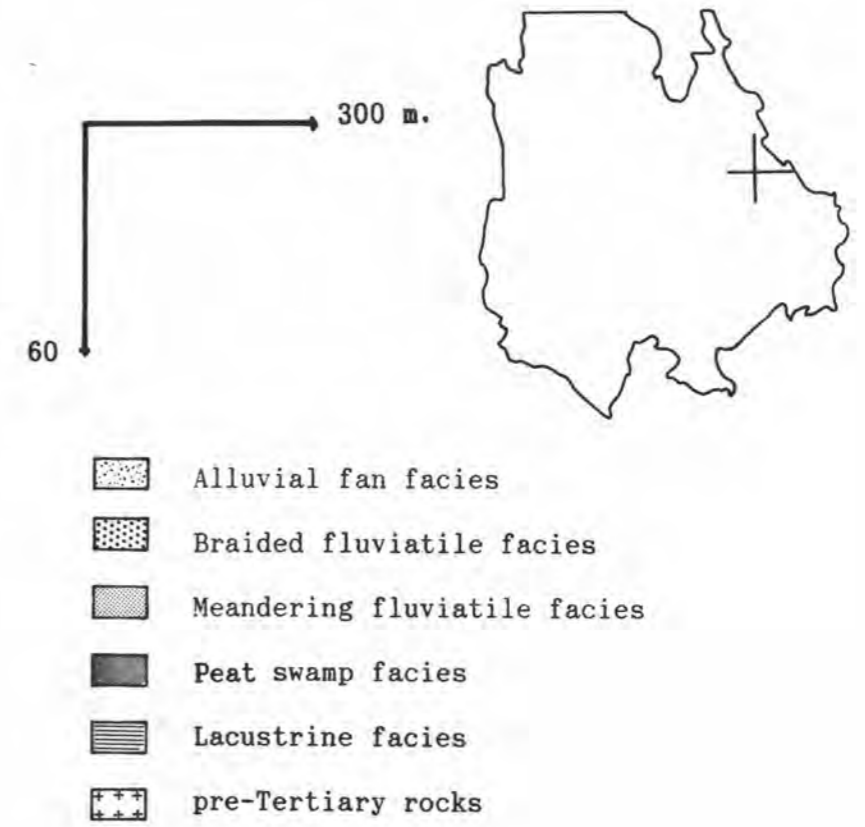
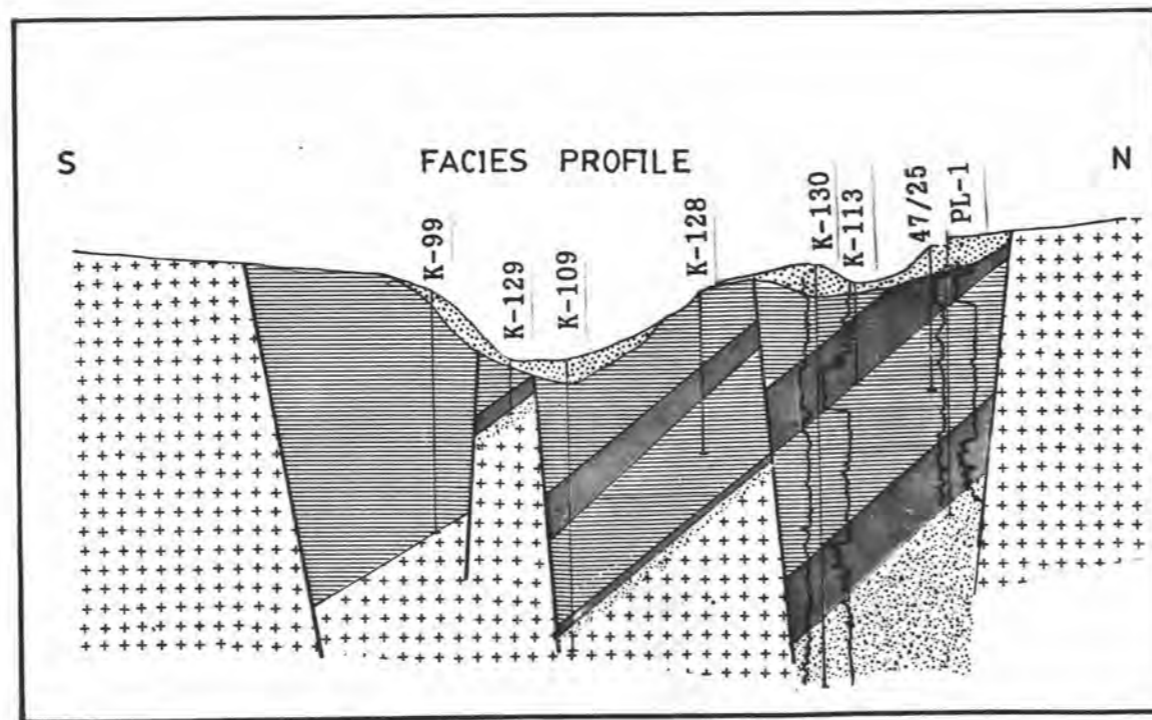
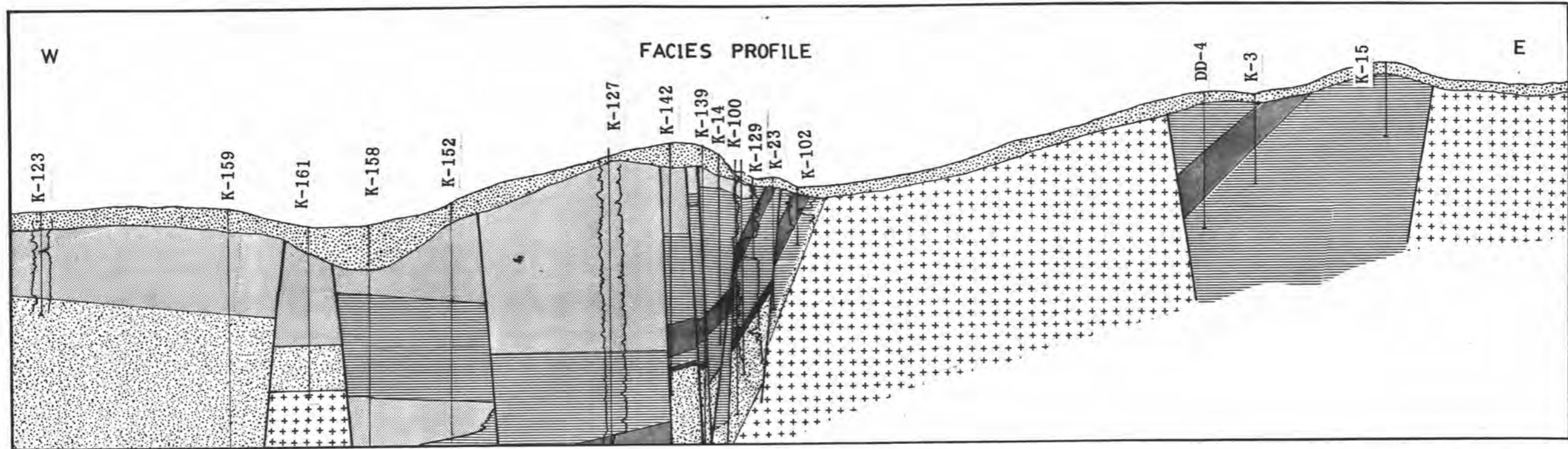


Figure 3.2.3.b Representative sedimentary facies profile of the Ban Mae Long sub-basin

with influence of surface run-off.

Below the sedimentary unit of lacustrine facies is the thick massive coal seam with carbonaceous clay parting in the lower part. The geophysical logs signature show the smooth coal dominant pattern in the upper part and grade to irregular line in the lower part. This lower coal seam is considered to be deposited under the condition of fresh water peat swamp. The thick massive coal seam referred to the subsiding rate equivalent to rate of peat accumulation without influence of surface run-off for a relatively long period of time.

Underneath the lower peat swamp facies is the sand dominant unit with some small pebbles of basement rocks. The lithological characteristics indicate that this unit was deposited in moderately to rather high energy condition of meandering fluvial environment.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the Ban Pa Kha sub-basin are summarized and presented in Figures 3.1.4, 3.2.4.a and 3.2.4.b.

3.2.5 Ban Na Sai-Ban Mae Wang Sub-Basin

The uppermost portion of the lithological succession of Ban Na Sai-Ban Mae Wang sub-basin is represented by top soil deposit. The sediment is characterized by sandy clay, light brown with fine sand.

Under the top soil deposit is the very thick sequence of fine terrigenous sediments. The sediments are clay interbedded with shale. The lithological characteristics indicate the depositional environment of fresh-water paleo-lake with quiet condition.

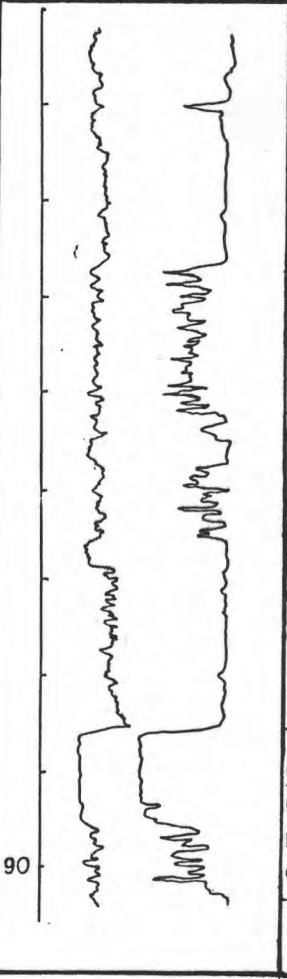
Geophysical Log	Description	Sedimentary Facies	Depositional Environment
	<u>Top soil</u> = Sd., Slt., Cl. mix.; yelsh. brn. to rdsh. brn., w/Rk. frag. @ the u. pt.	Top soil ----- Unconformity	
	<u>Cl. & O. Sh.</u> w/one Sd. intbd. Cl. = gry. to brn., lam., hi. cpct. O. Sh. = brn. to dk. brn., w/com. Plt. -leaves rem., intb. in some pt. of Cl.	Lacustrine	Fresh-water lake
	<u>C.</u> w/Ptg. of carb. Cl. & Sh. C. = brn. to blk., hd., brt. w/dull intb., com. intbd. w/carb. Cl. & Sh.	Peat swamp	Fresh-water peat swamp
	<u>Cl., O. Sh. & Sd.</u> Sd. = lt. gry., f. to m. gr., rnd to wl. rnd., hi. sphe., wl. srt. Cl. = gry., sft., wl. cpct., lam. to wl. bd., wl. com. Plt. -leaves rem. O. Sh. = brn. to dk. brn.	Lacustrine	Fresh-water lake with influence of surface water
	<u>C.</u> w/carb. Cl. Ptg. C. = blk., hd., brt. bnd., w/sbconc. frac., dense mass. in u. pt. carb. Cl. pt. = brn. to blk., cpct.	Peat swamp	Fresh-water peat swamp
	<u>Cl., Sst. & Cgl. Sst.</u> Sst. = gry., f. to crs. gr., sbang. to sbrndd.	Meandering fluviatile	Meandering river

Figure 3.2.4.a Subsurface sedimentary facies and depositional environment of the Ban Pa Kha sub-basin

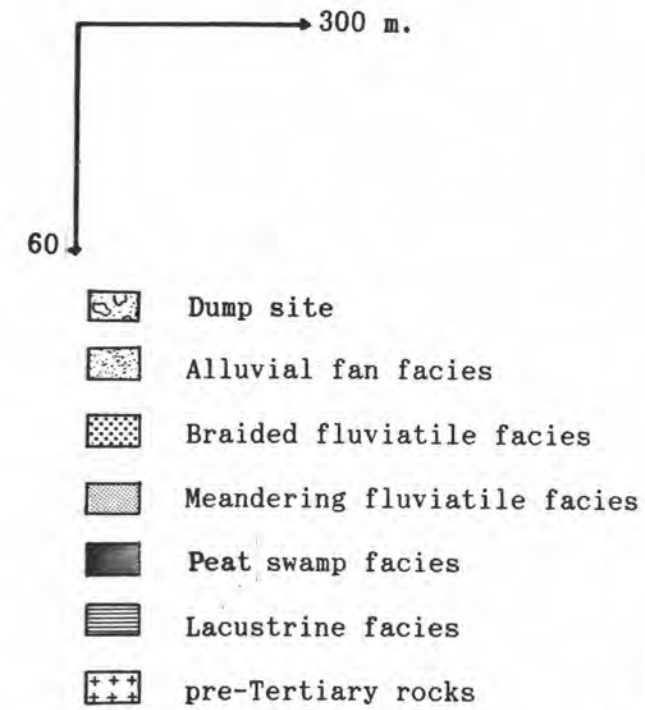
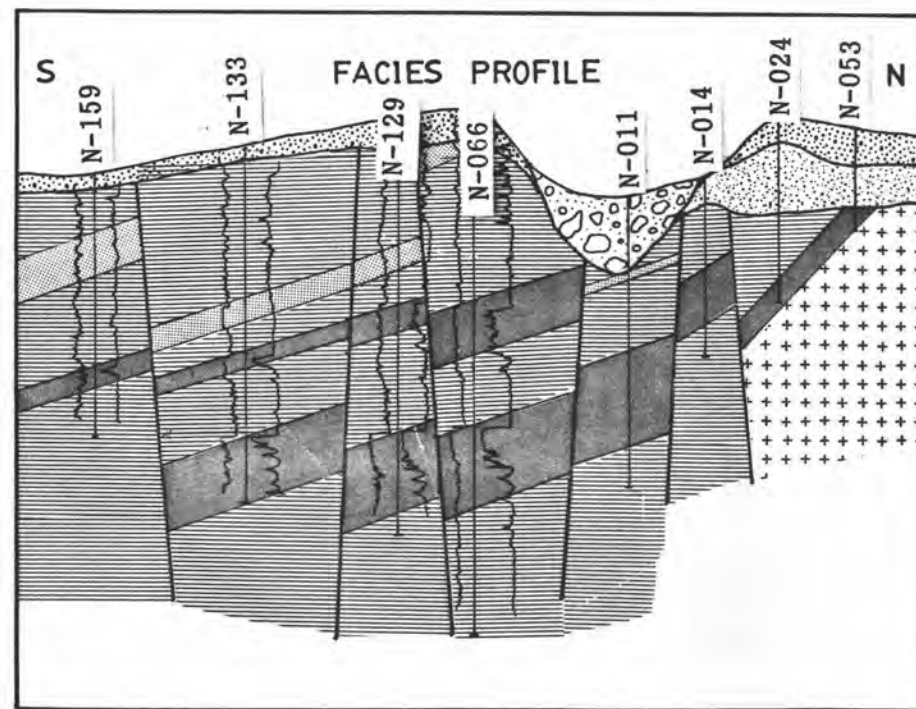
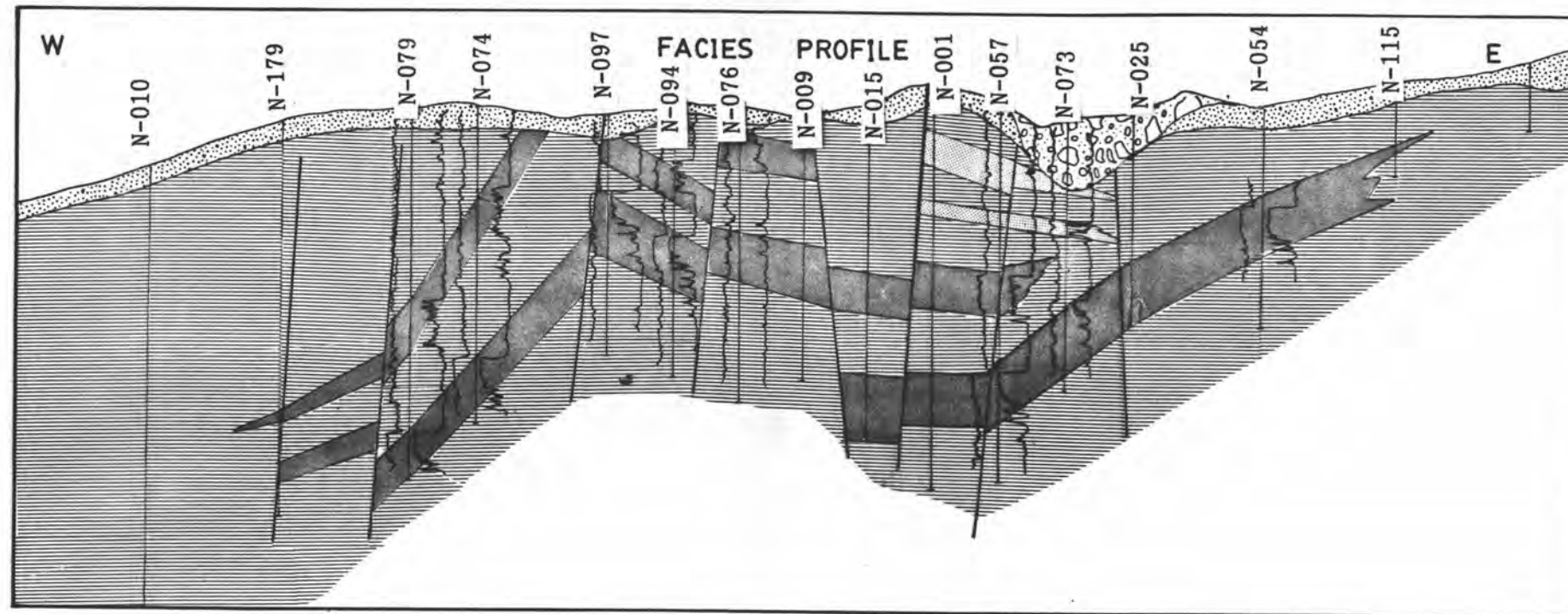


Figure 3.2.4.b Representative sedimentary facies profile of the Ban Pa Kha sub-basin

Underneath the thick clay/shale unit is the coal seam with some clay partings. This coal seam is considered to be deposited under the low energy condition of peat swamp environment.

Below the peat swamp facies is the thick clay unit. The lithological characteristics of the sedimentary rock indicated the depositional environment of clam condition of fresh-water paleo-lake.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the Ban Na Sai-Ban Mae Wang sub-basin are summarized and presented in Figures 3.1.5, 3.2.5.a, and 3.2.5.b.

3.2.6 The External Sub-Basinal Areas

3.2.6.1 The western part of the Li basin

The uppermost part of the sedimentary sequence of the western part of the Li basin is top soil deposit, lateritic^m composition with granules of quartz and rock fragments.

Underlying the top soil deposit down to the pre-Tertiary basement is the extraordinary thick unit of clay with intercalation of sand. The clay is graded to be shale in the lower part.

This lithological unit is considered to be deposited in the distinct condition of lacustrine environment. It is the fact that the very thick clay unit is referred to the fine-grained clastics sedimentation for a long period with quiet condition in deep basin.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the

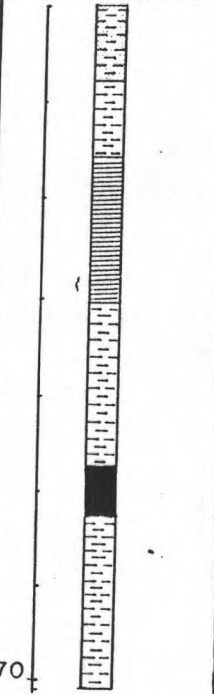
Geological Log	Description	Sedimentary Facies	Depositional Environment	
	<u>sd.</u> Cl. : lt.brn.,f.Sd.size	Top soil		
	<u>Sh.</u> : v.lt.gry.,mass.,wl.fis.,w/ wh.calc. <u>Sh.</u> : v.lt.gry.,mass.,bd. <u>Cl.</u> : v.lt.gry.,mass.,slily.fis.@ some pt	Lacustrine	Unconformity	Fresh-water lake
	<u>C.</u> : blk.,dull,mass.bd.,brit.,irr.frac.	Peat swamp	Fresh-water peat swamp	
	<u>Cl.</u> : v.lt.gry.	Lacustrine	Fresh-water lake	

Figure 3.2.5.a Subsurface sedimentary facies and depositional environment of the Ban Na Sai-Ban Mae Wang sub-basin

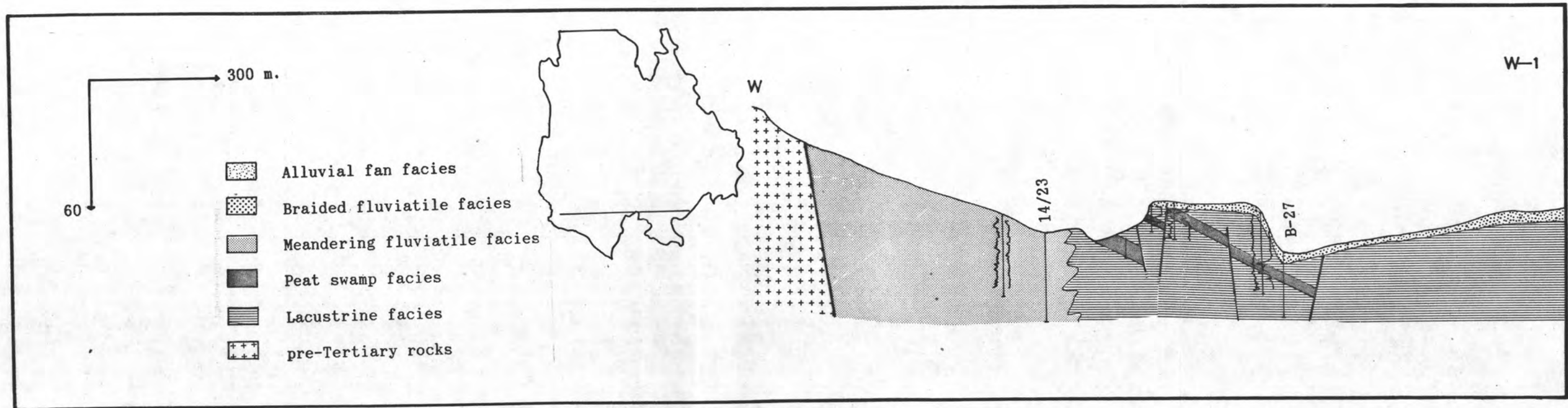
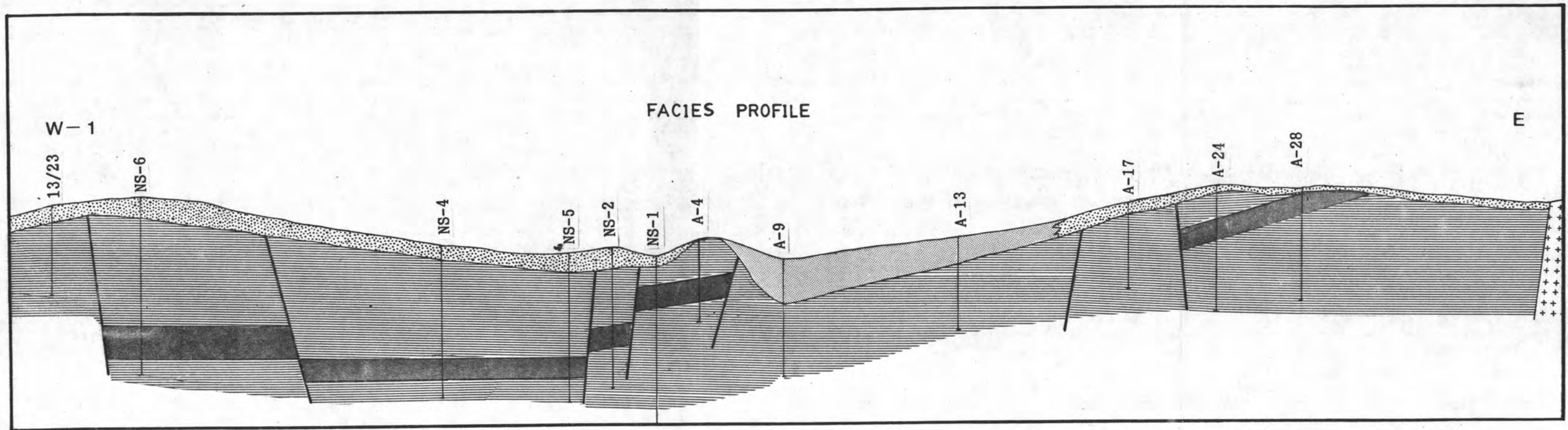


Figure 3.2.5.b Representative sedimentary facies profile of the Ban Na Sai-Ban Mae Wang sub-basin

western part of the Li basin are summarized and presented in Figures 3.1.6.a, 3.2.6.1.a, and 3.2.6.1.b.

3.2.6.2 The middle part of the Li basin

The uppermost portion of the lithological sequence of the middle part of the Li basin is represented by top soil deposit with fine sand and clay mixture, lateritic in composition.

Underneath the top soil deposit is the unit of sand interbedded with clay. This unit is considered to be deposited under the medium energy condition of meandering fluvial environment.

The next lithological sequence under meandering fluvial facies is the very thick sequence of clay with one sand bed intercalated in the lower part. This sedimentary sequence is regarded to be deposited in nearly calm condition of lacustrine environment.

The lowermost sedimentary unit lying on the basement rocks of pre-Tertiary period is the sand to gravelly sand unit. The lithological characteristics suggests that it is deposited in the relatively high energy condition of alluvial fan environment.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the middle part of the Li basin are summarized and presented in Figures 3.1.6.b, 3.2.6.2.a, and 3.2.6.2.b.

3.2.6.3 The eastern part of the Li basin

The uppermost portion of the lithological sequence of the eastern part of the Li basin is top soil deposit.

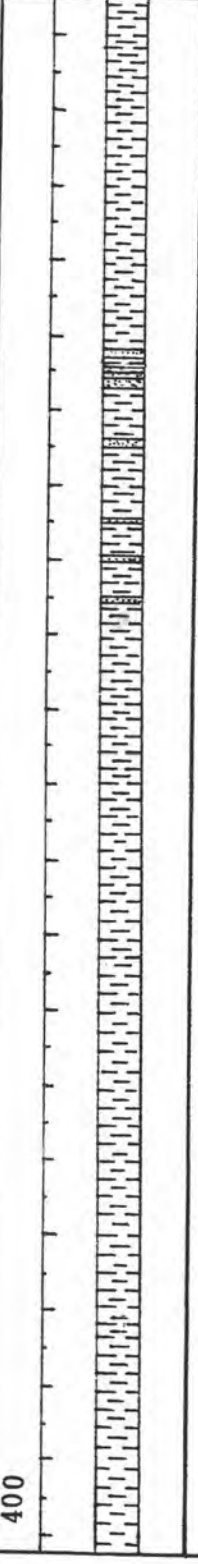
Lithology	Sedimentary Facies	Depositional Environment
	<p>Lacustrine</p>	<p>Fresh-water lake interrupted by shallow lake</p>

Figure 3.2.6.1.a Subsurface sedimentary facies and depositional environment of the Western Part of the Li basin

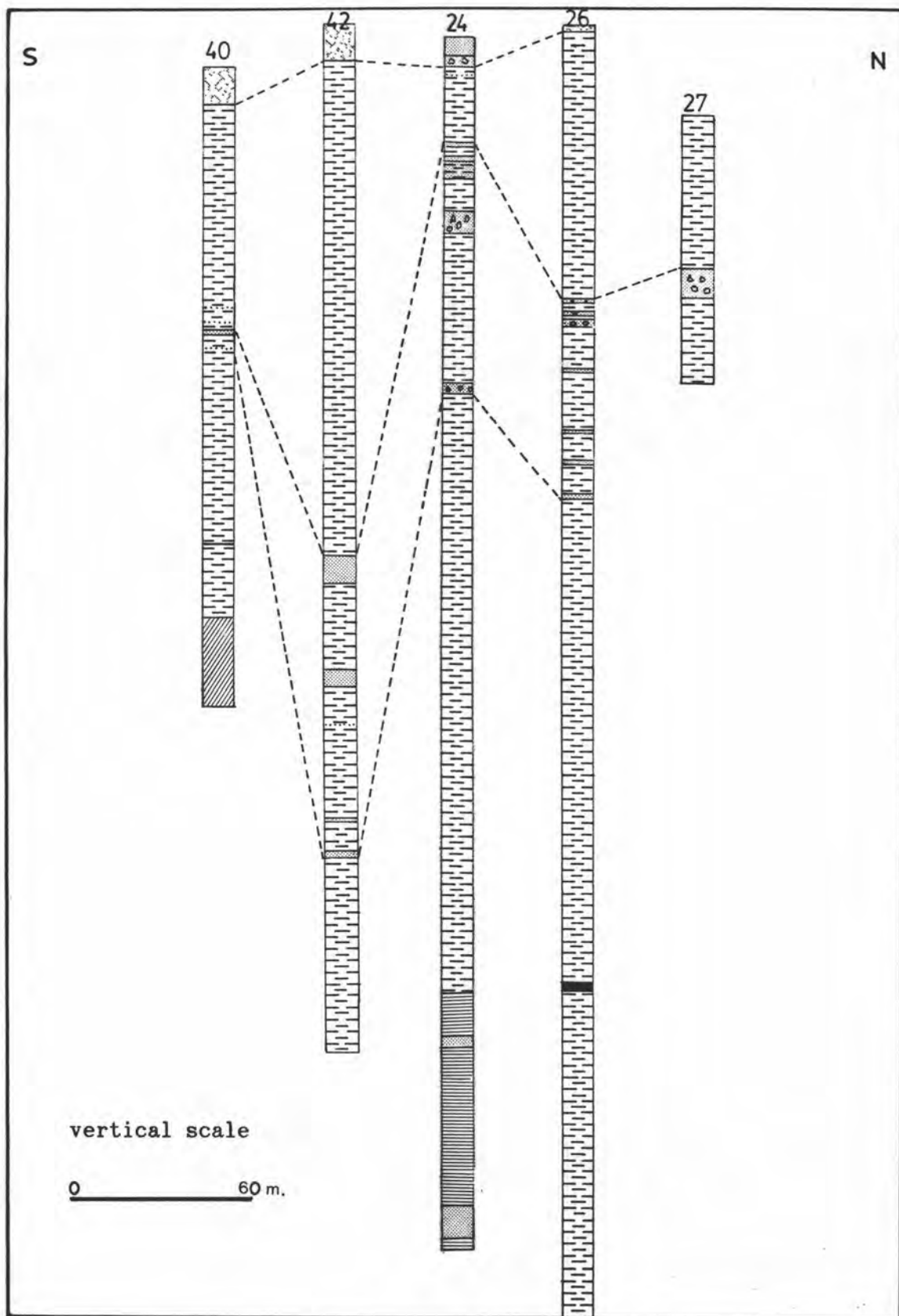


Figure 3.2.6.1.b The correlation of drill-holes of Western Part of the Li basin /

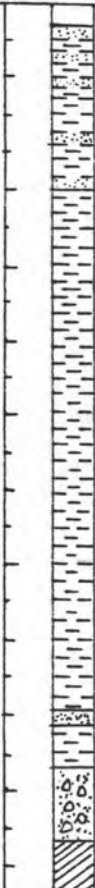
Lithology	Sedimentary Facies	Depositional Environment
 240	----- Unconformity -----	
	Meandering fluviatile	Meandering river
	Lacustrine	Fresh-water lake
	Alluvial fan	Alluvial fan
	----- Unconformity ----- Basement rocks	

Figure 3.2.6.2.a Subsurface sedimentary facies and depositional environment of the Middle Part of the Li basin

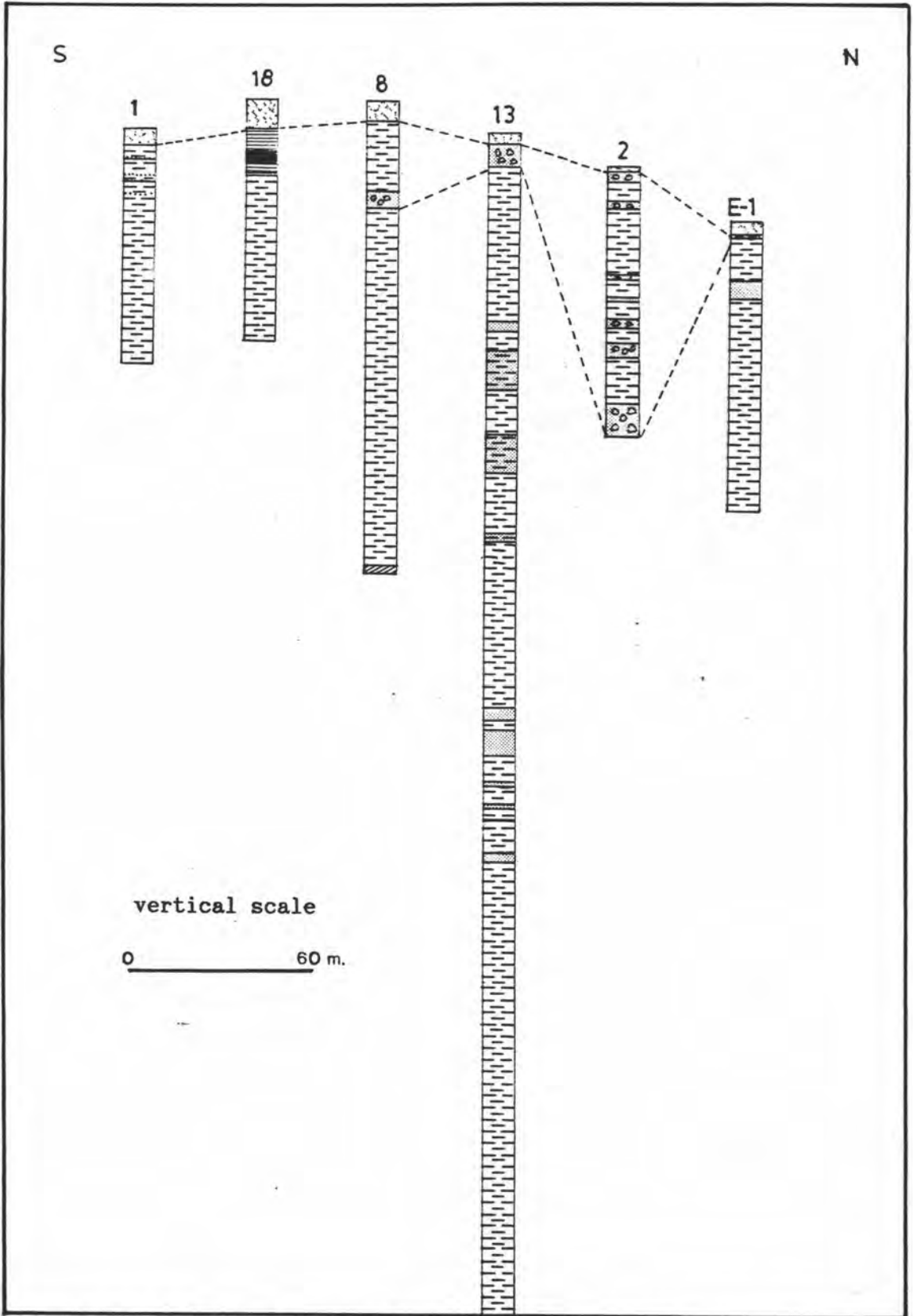


Figure 3.2.6.2.b The correlation of drill-holes of Middle Part of the Li basin

The sediments lying under the top soil deposit is the sequence of clay interbedded with sand. The lithological characteristics indicate that the sediments were deposited under the condition of distinctive environment of low energy shallow paleo-lake.

The lithological sequence, reconstructed depositional environment, and sedimentary facies of the Tertiary deposits at the eastern part of the Li basin are summarized and presented in Figures 3.1.6.c, 3.2.6.3.a, and 3.2.6.3.b.

3.3 Intrabasinal Structures

The analysis of drill-hole data in some areas of the Li basin as well as the structural geological mapping of the mine pit areas have further revealed the detailed structures of the Tertiary deposits. Under the present investigation, only 4 sub-basins, namely, Ban Hong, Ban Mae Long, Ban Pa Kha, and Ban Na Sai-Ban Mae Wang, have been selected to illustrate some intrabasinal structures.

For the Ban Hong sub-basin, located in the northern part of the Li basin, the intrabasinal structure is mainly characterized by a series of north/northwest-south/southeast faults cross-cutting the basinal basement rocks and all the Tertiary sequence. These faults are mainly normal faults and block faults (Figure 3.2.2.b). In addition, there are also a set of minor faults oriented approximately in north/northeast-south/southwest direction. The structural maps illustrating the intrabasinal structure are shown in Figures 3.3.1.a, 3.3.1.b, 3.3.1.c and 3.3.1.d.

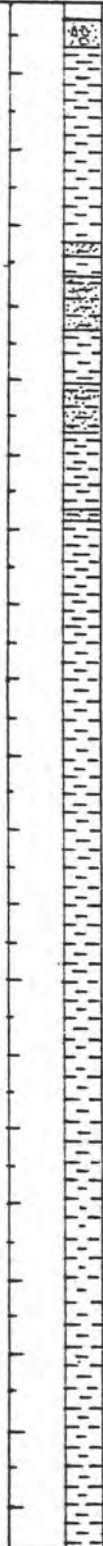
Lithology	Sedimentary Facies	Depositional Environment
	<p data-bbox="588 387 729 420">Top soil</p> <hr style="border-top: 1px dashed black; margin: 5px 0;"/> <p data-bbox="831 409 1027 442">Unconformity</p> <p data-bbox="564 818 736 851">Lacustrine</p>	<p data-bbox="1011 785 1372 884">Fresh-water lake interrupted by shallow lake</p>

Figure 3.2.6.3.a Subsurface sedimentary facies and depositional environment of the Eastern Part of the Li basin

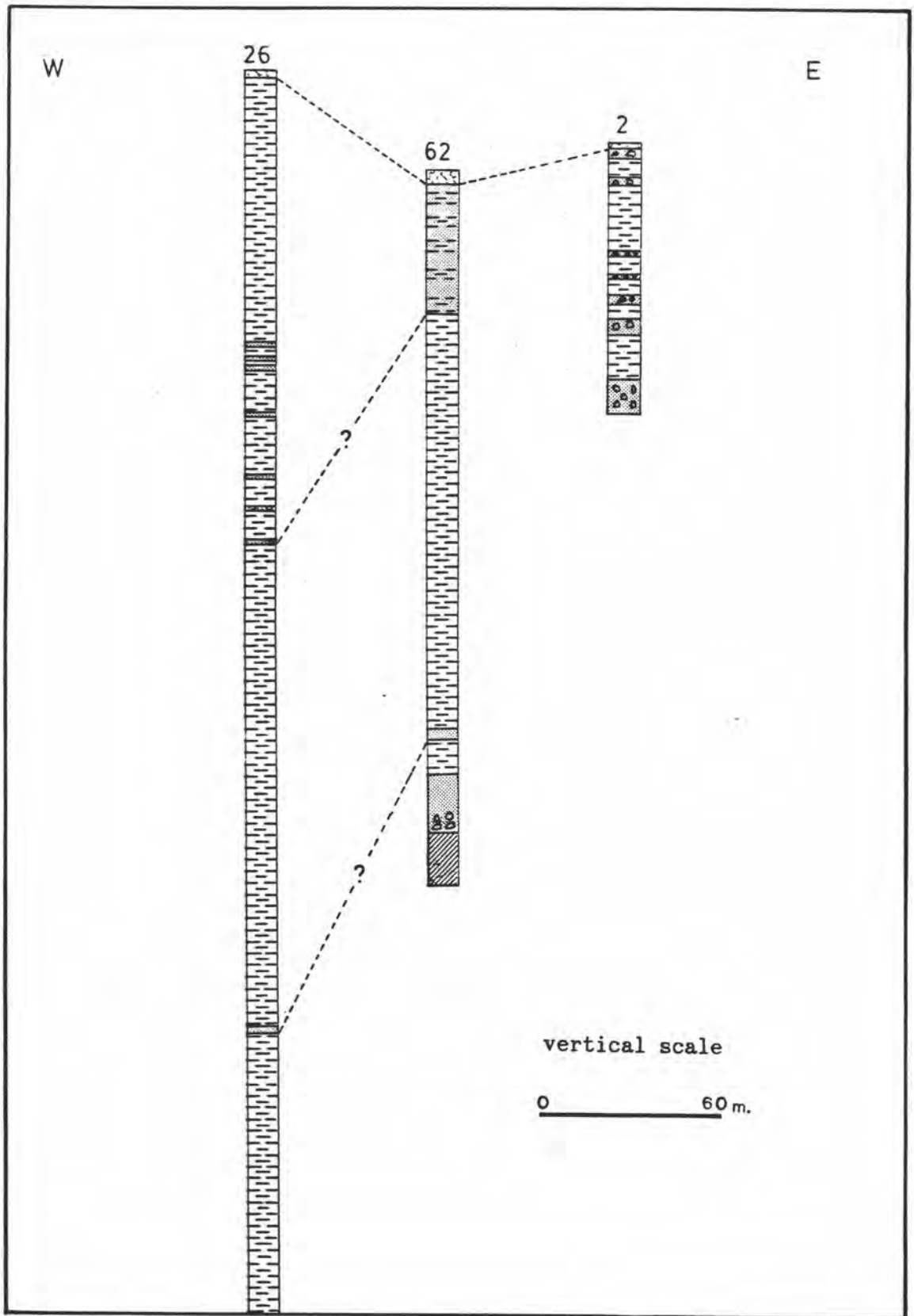


Figure 3.2.6.3.b The correlation of drill-holes of Eastern Part of the Li basin

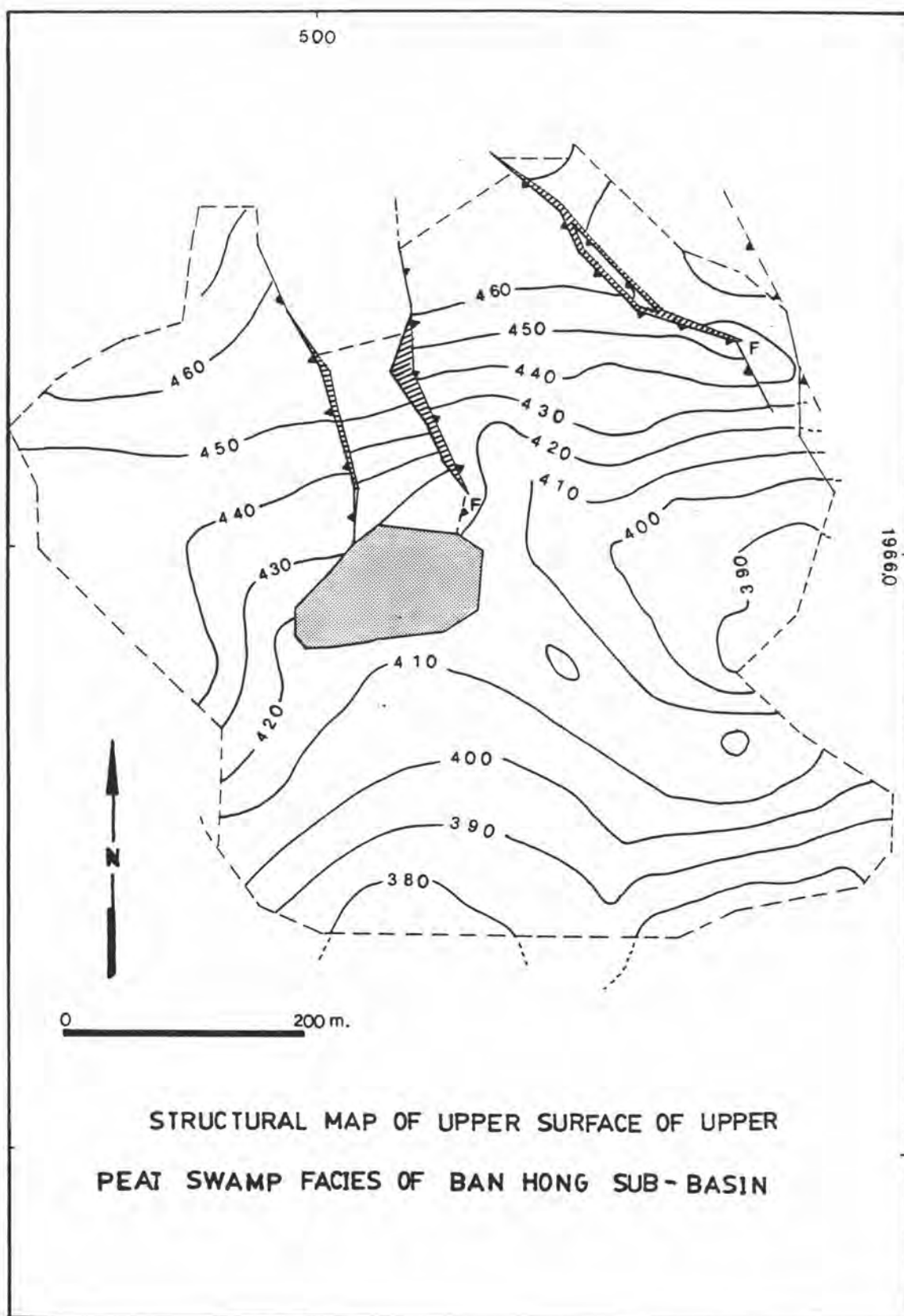


Figure 3.3.1.a Structural map of upper surface of upper peat swamp facies of Ban Hong sub-basin

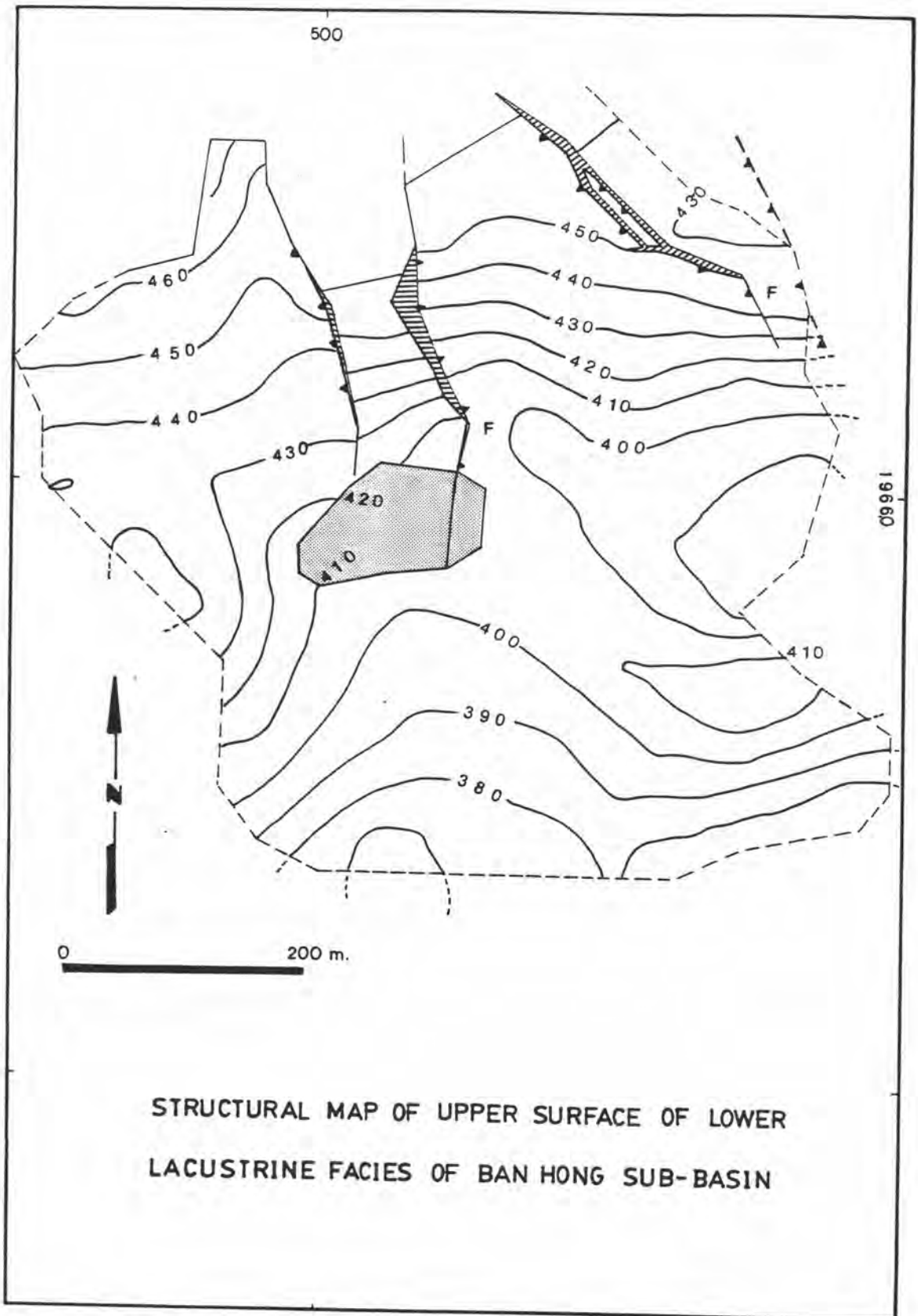


Figure 3.3.1.b Structural map of upper surface of lower lacustrine facies of Ban Hong sub-basin

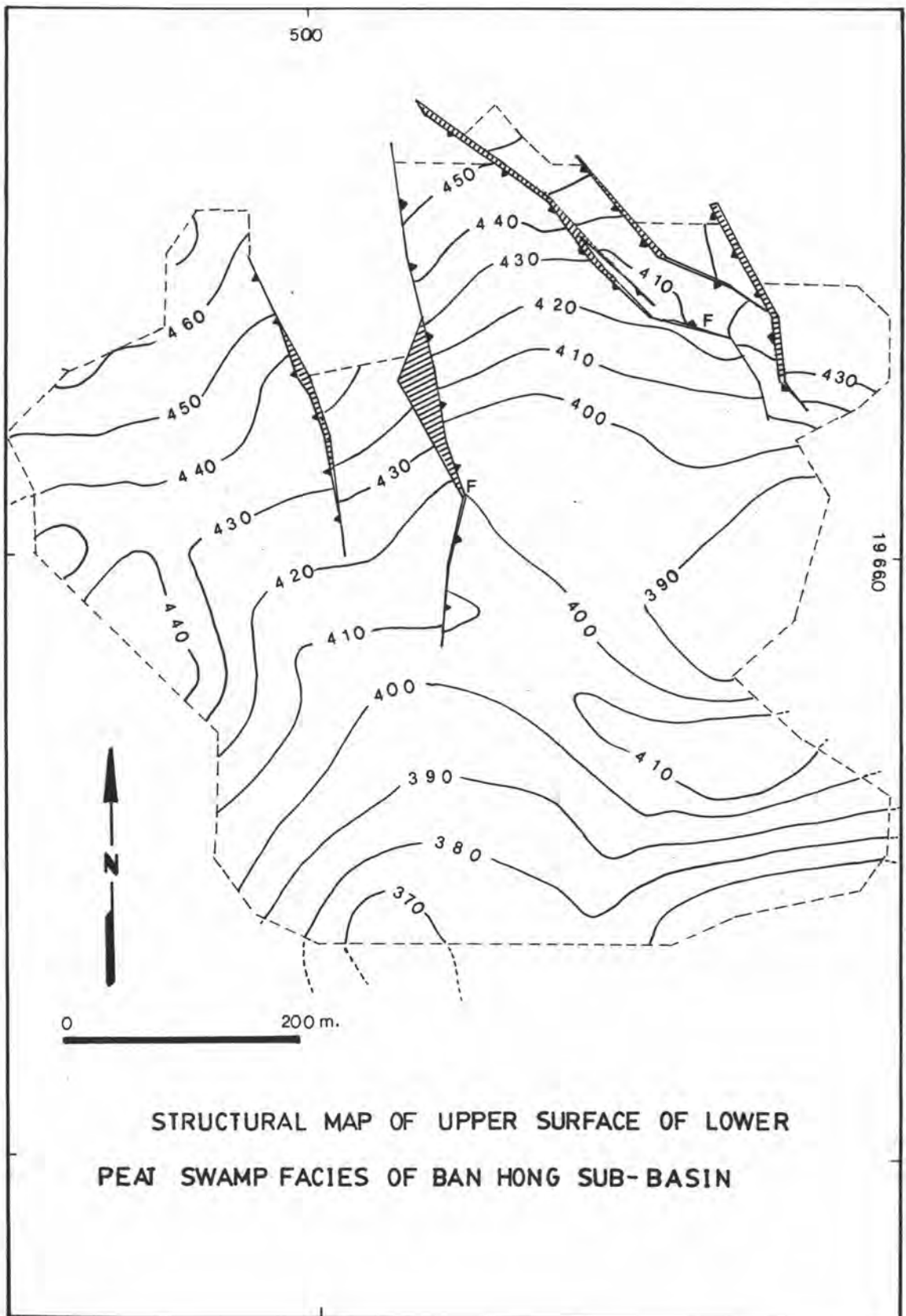


Figure 3.3.1.c Structural map of upper surface of lower peat swamp facies of Ban Hong sub-basin

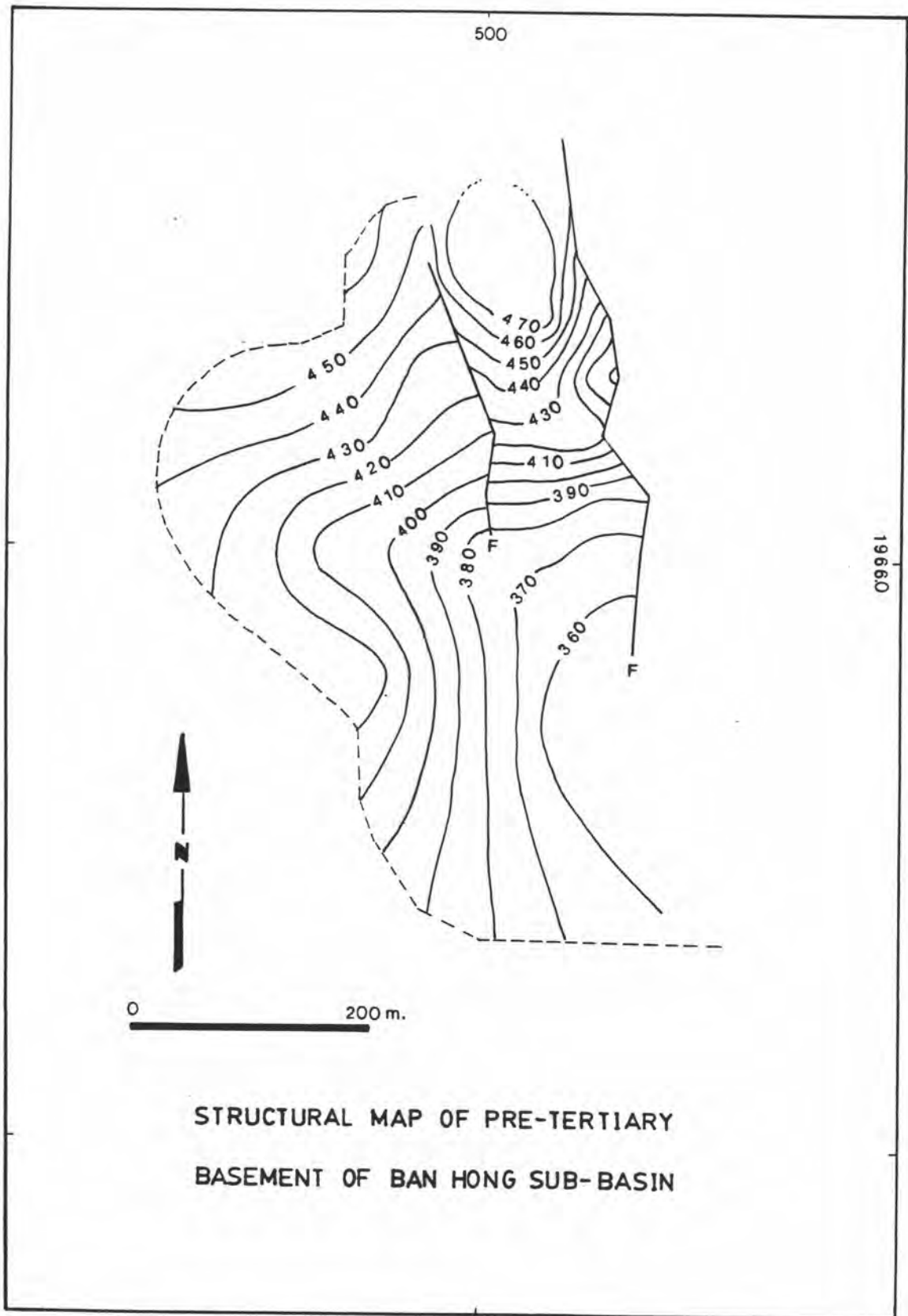


Figure 3.3.1.d Structural map of pre-Tertiary basement of Ban Hong sub-basin

It is noted that the upper surfaces of Tertiary sedimentary deposits within the Ban Hong sub-basin are folded in the southeastern part. This is probably the result of the late tectonic events of post-depositional stage.

With respect to the Ban Mae Long sub-basin, located on the eastern part of the Li basin, the intrabasinal structure is considered to be less complicated as compared with that of Ban Hong sub-basin. The structure is mainly characterized by normal faults dipping to the east and west directions cross-cutting the lower part of the Tertiary sequence which have been tilted ^{down} to the west of the sub-basin (Figure 3.2.3.b). The structural maps illustrating the intrabasinal structure are shown in Figures 3.3.2.a, 3.3.2.b, and 3.3.2.c.

For Ban Pa Kha sub-basin, located approximately on the eastern margin of the Li basin, the intrabasinal structure is considered to be relatively more complicated as compared with those of the other sub-basins within the Li basin. The structure is mainly characterized by a series of north/northwest-south/southeast faults cross-cutting all the Tertiary sequence, dipping to the east and the west with maximum spacing of 70 metres (Figure 3.2.4.b). In addition, there are also a set of faults oriented approximately in the north/northeast-south/southwest direction with spacing of 40 metres. The structural maps illustrating the intrabasinal structure are shown in Figure 3.3.3.a, 3.3.3.b and 3.3.3.c. It is also noted that the beddings of Tertiary sequence are slightly folded in the eastern part of the sub-basin.

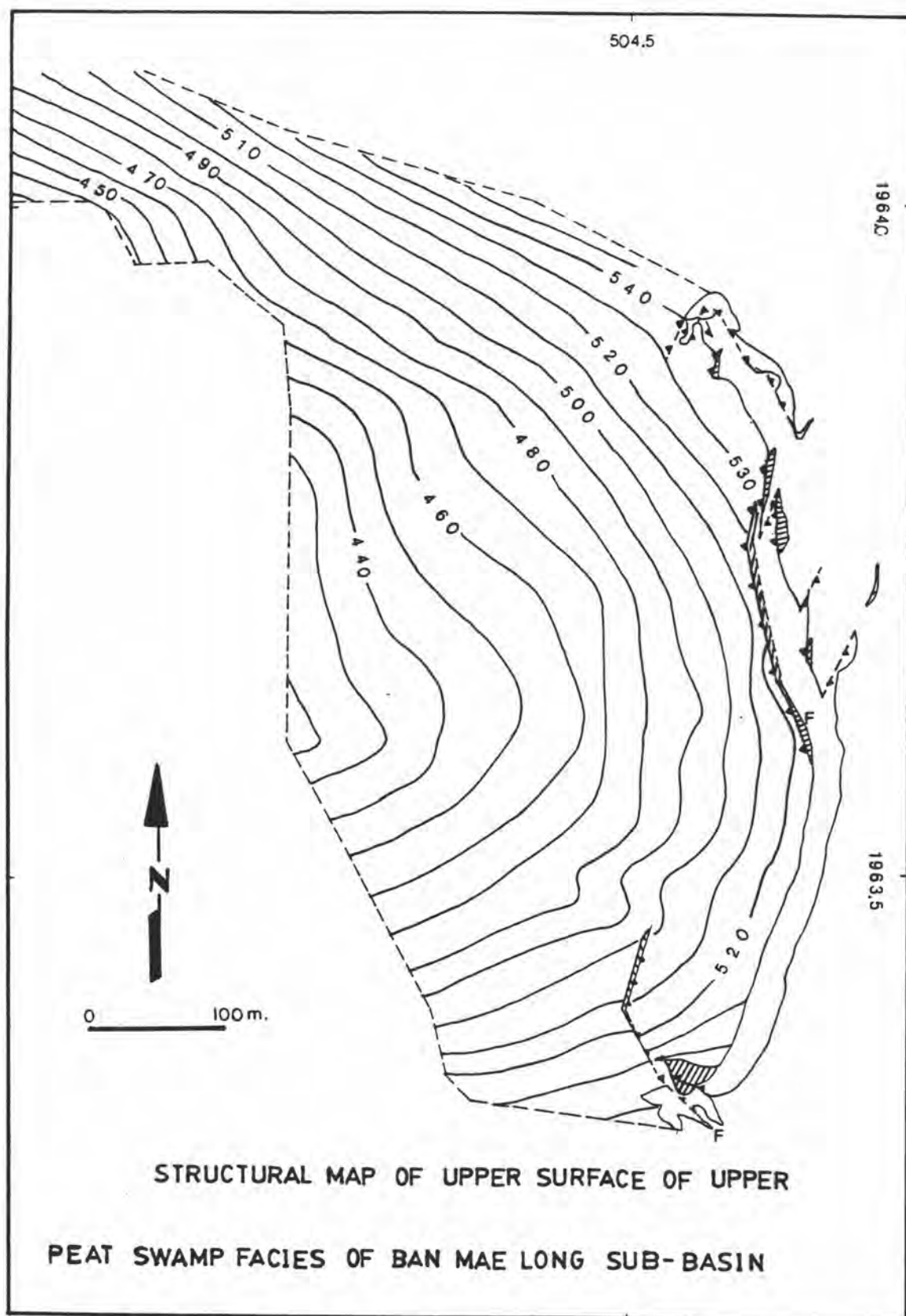


Figure 3.3.2.a Structural map of upper surface of upper peat swamp facies of Ban Mae Long sub-basin

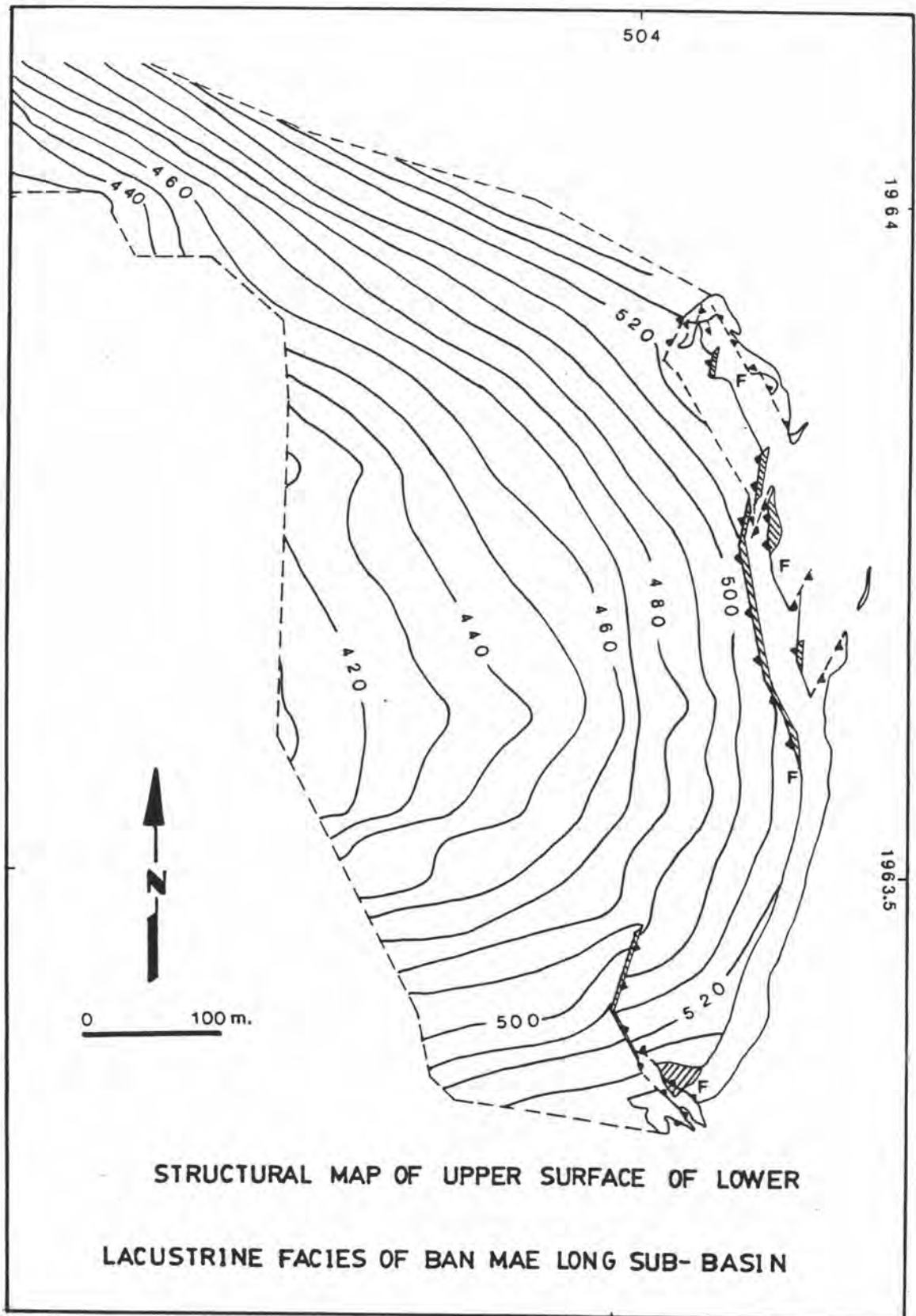
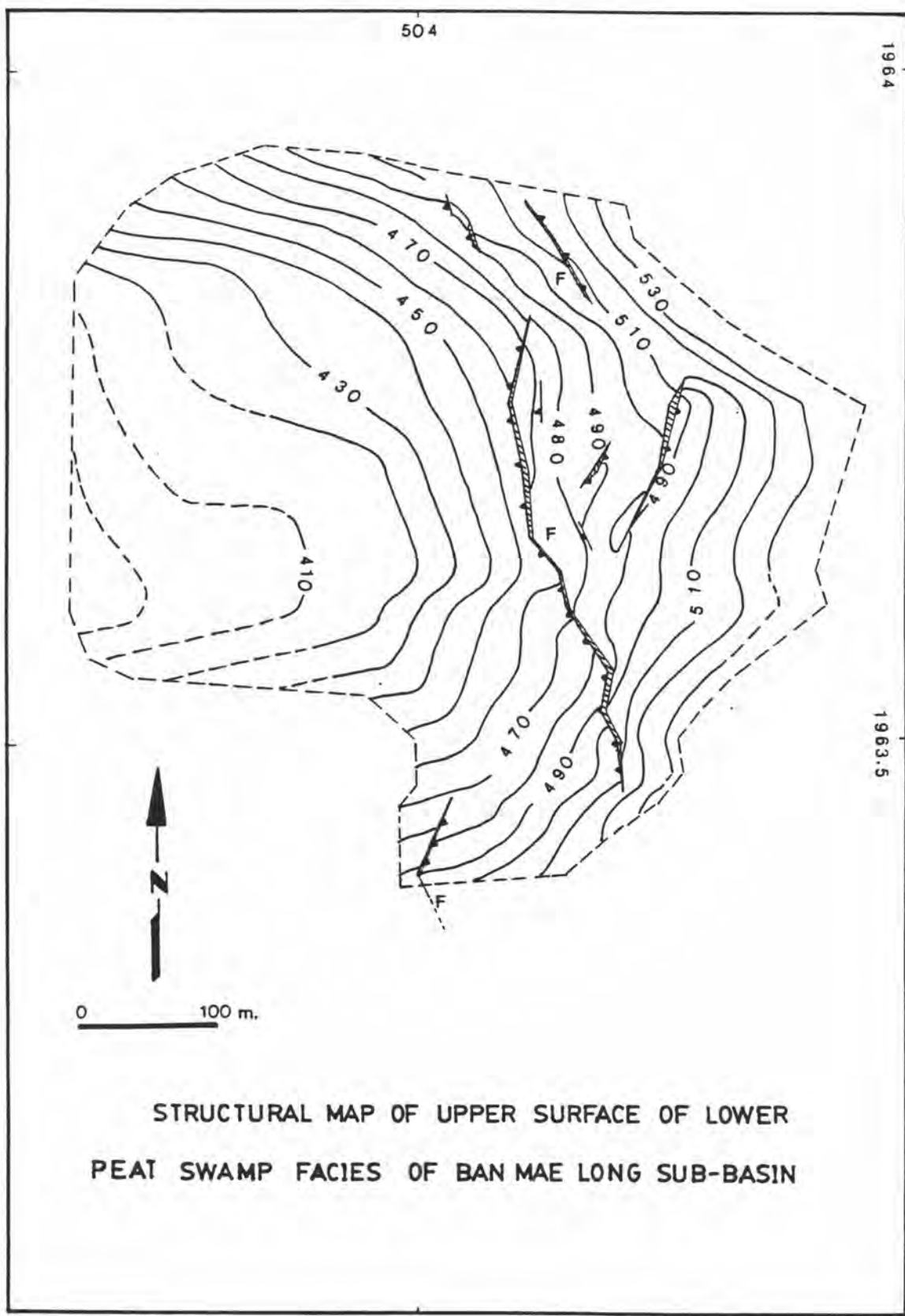


Figure 3.3.2.b Structural map of upper surface of lower lacustrine facies of Ban Mae Long sub-basin



STRUCTURAL MAP OF UPPER SURFACE OF LOWER
PEAT SWAMP FACIES OF BAN MAE LONG SUB-BASIN

Figure 3.3.2.c Structural map of upper surface of lower peat swamp facies of Ban Mae Long sub-basin

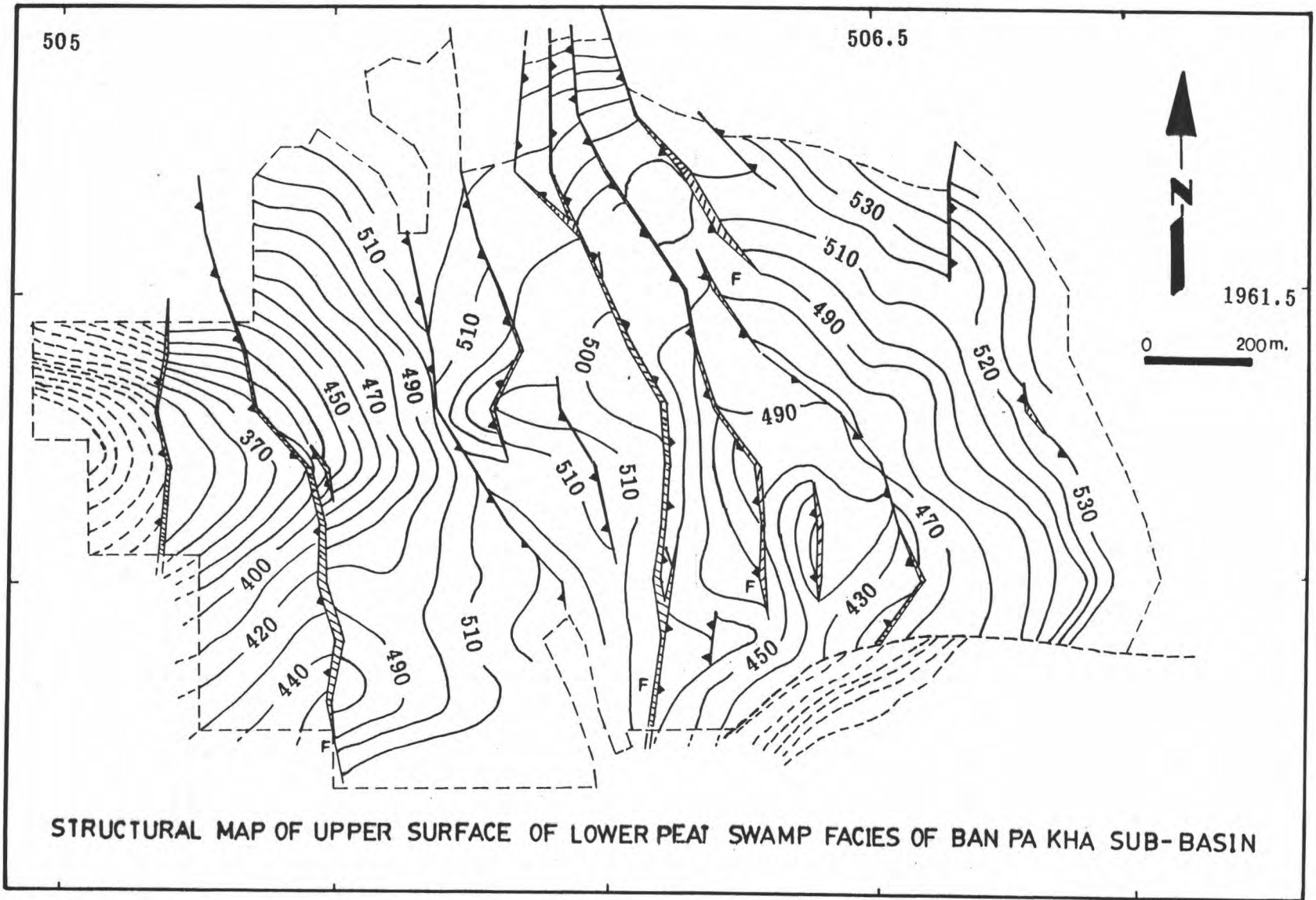


Figure 3.3.3.c Structural map of upper surface of lower peat swamp facies of Ban Pa Kha sub-basin

For Ban Na Sai-Ban Mae Wang sub-basin, located on the southern margin of the Li basin. The preliminary Intrabasinal structure is characterized by a series of northeast/southwest normal faults, and inferred northwest/southeast faults cross-cutting all the Tertiary sediments within the sub-basin (Figure 3.2.5.b, 3.3.4.a and 3.3.4.b).

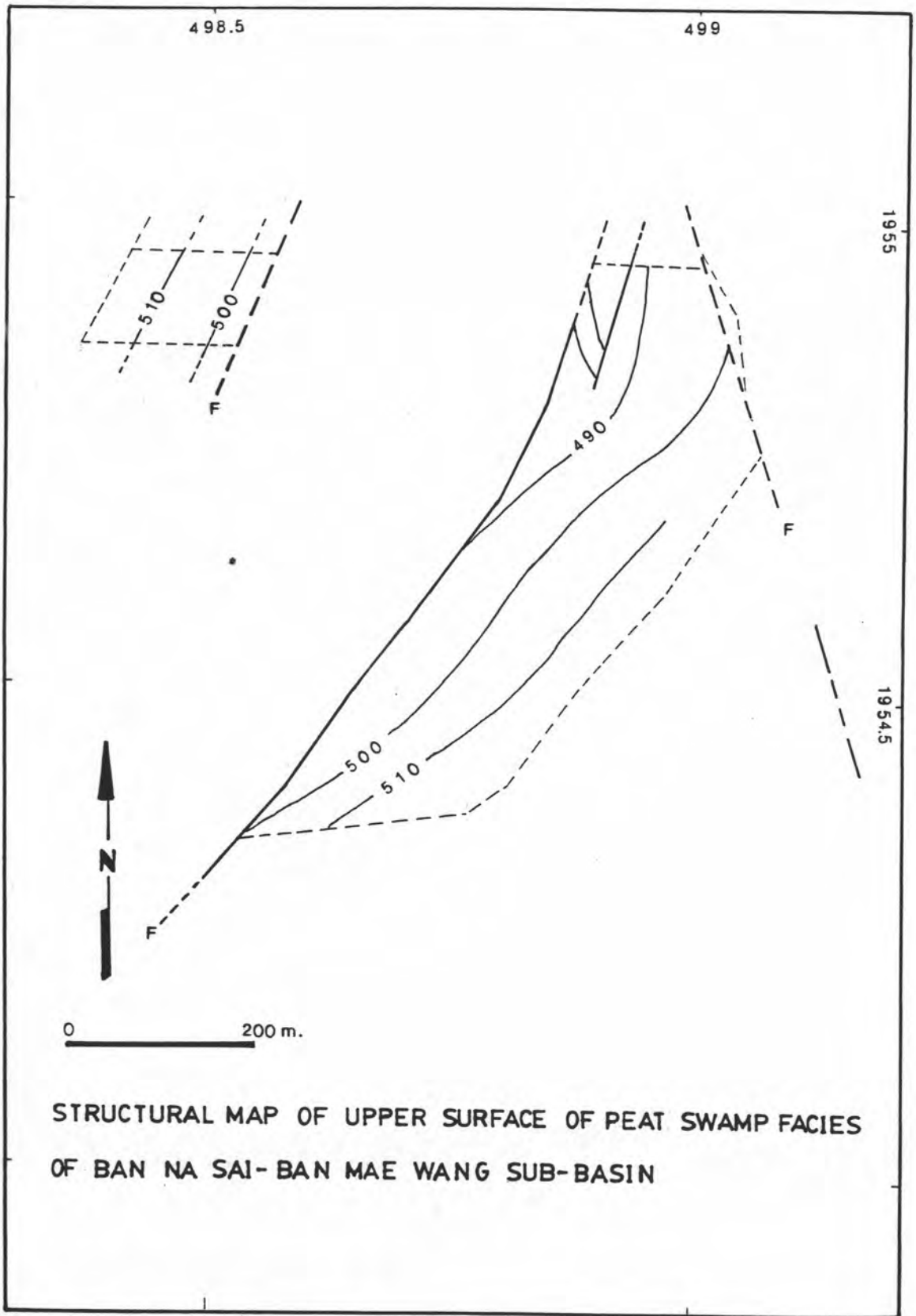


Figure 3.3.4.a Structural map of upper surface of peat swamp facies of Ban Na Sai-Ban Mae Wang sub-basin

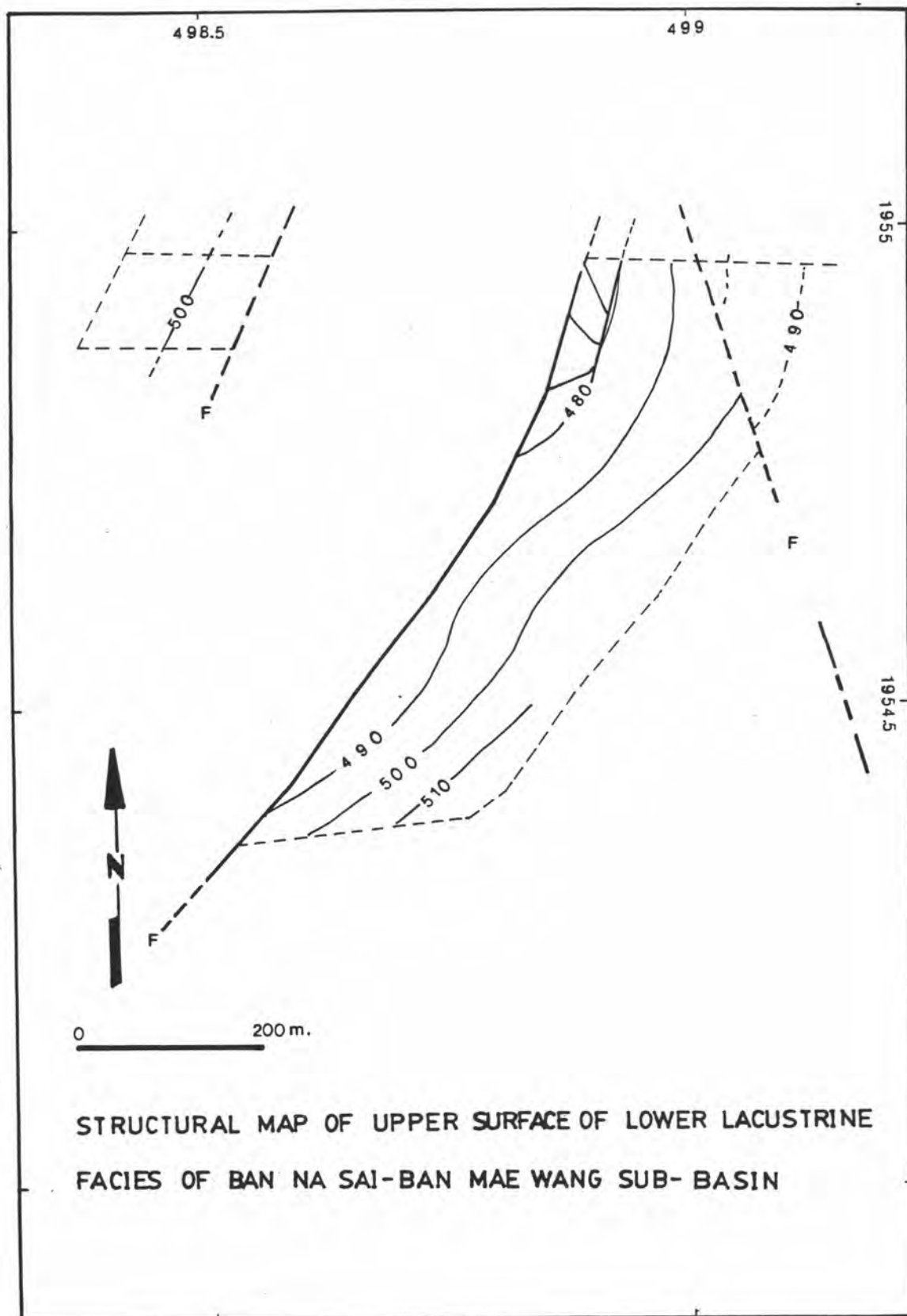


Figure 3.3.4.b Structural map of upper surface of lower lacustrine facies of Ban Na Sai-Ban Mae Wang sub-basin