CHAPTER 3: GEOLOGICAL MAPPING

3.1 INTRODUCTION

The geological mapping of North Sarawak and Sarawak as a whole, were undertaken by Sarawak Shell Oil Company and the Geological Survey Department of the British Borneo Territories. The comprehensive account their works were described by Liechti et al (1960), was accompanied with the geological map of Sarawak and Sabah at the scale of 1:500,000. Later geological work was continued by Wilford (1961) and Haile (1962); who were respectively carried the geological mapping on the scale of 1: 250,000 of the Miri-Brunei and the Suai-Baram areas. As the result of these works, the area of North Sarawak was described more detailed; being underlain mainly by the marine and mixed marine sediments deposited during early Paleogene to Neogene. Even though, the standard guides for the stratigraphic nomenclature were yet to be established, the sediment in North Sarawak was described as; the Nyalau, Setap, Tangap, Sibuti, Belait, Lambir, Miri and Tukau Formations with their ages ranging from Oligocene to Pliocene (Fig. 19). The main criteria adopted for the nomenclature was not only the lithology but also the environment of deposition and age of the sediment. As it involved several criteria, the lithostratigraphic unit was often confused with the biostratigraphic and geochronologic units, thereby resulting the geological boundaries among the units were interfingering both vertically and laterally. The description of the lithostratigraphic units also were not accompanied by the descriptions of type section, locality, boundary, total column and thickness and therefore the lithostratigraphic units area considered as an informal unit.

3.2 OBJECTIVE OF THE GEOLOGICAL MAPPING:

The geological mapping is therefore, aimed at establishing a formal lithostratigraphic unit in accordance with the International Subcommission on Stratigraphic Classification (ISSC) 1994; totally based on the lithology and stratigraphic position of the sediments. A formal lithostratigraphic unit is therefore independent of inferred environment of deposition, geological history and time concept. In this investigation, a formal lithostratigraphic unit is provided with a detailed descriptions of type section, locality, boundary, total column and thickness.

3.3 METHODOLOGY

3.3a Location and accessibility

The detailed geological mapping on the scale of 1: 10,000 was carried out covering an area of 6420 km^2 or 5% the total area of Sarawak. It is bounded by

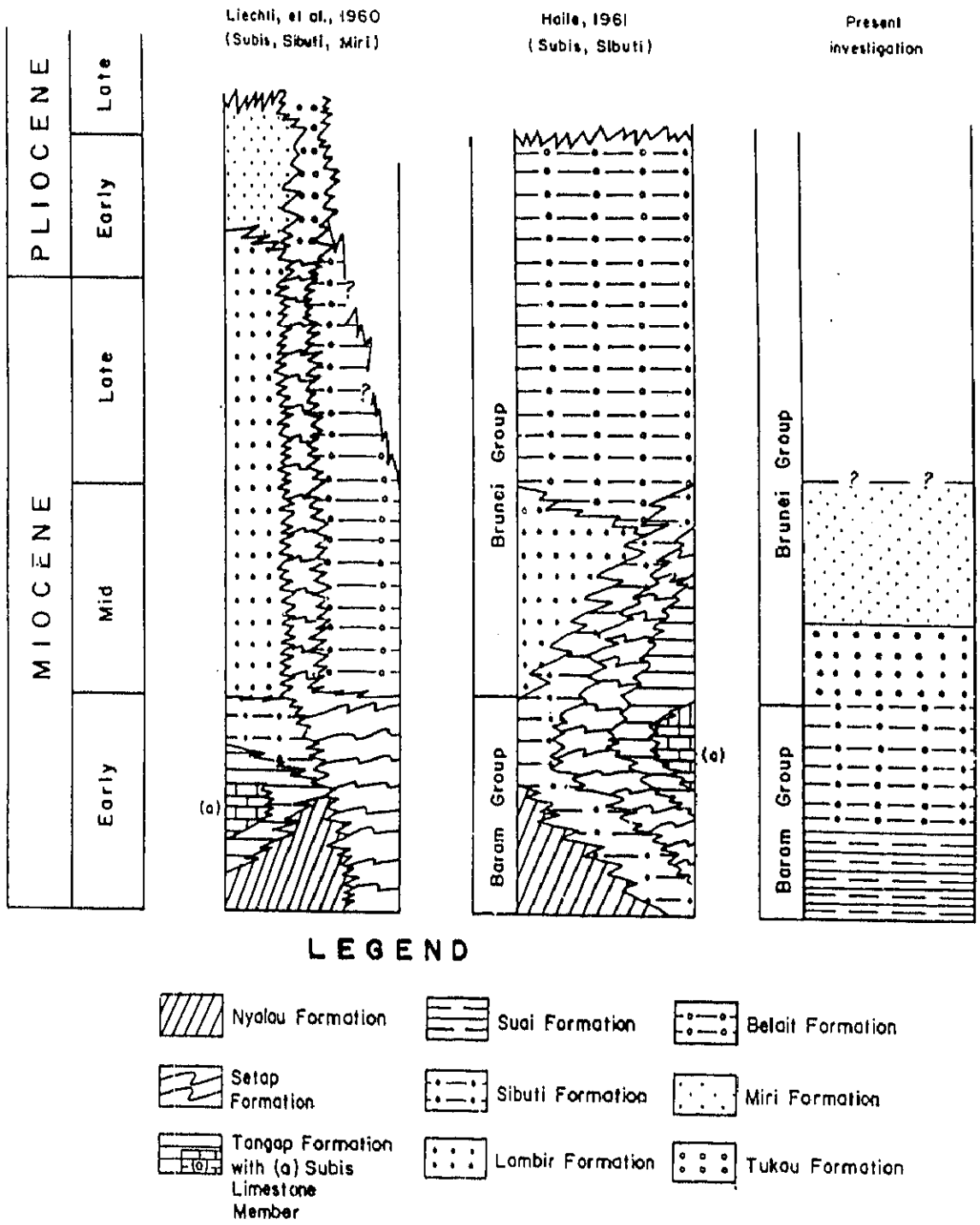

Figure 19. Development of lithostratigraphy of Northwest Sarawak

longitudes 113°30'E and 114°15'E and latitudes 3°30'N and 4°30'N, and is covered by the 1:50,000 scale topographic map sheets of Loagan Bunut (3/114/1), Suai-Niah (3/113/3 and 4/113/15), Gunung Subis (3/113/4), Bok-Tisam (3/114/5), Kampung Sawai (3/113/7), Ulu Niah (3/113/8), Pantu Buri (4/114/13), Bekenu (4/113/16) and Miri (4/113/12). Figure 20 shows the map sheet covering the study area.

The area is accessible by Bintulu-Miri trunk Road, Miri-Tinjar Road, Niah Road, Lamaus Road, Suai Road and Bukit Lembong Road. The interior areas are now more accessible by the plantation gravel roads, developed for the cultivation for oil palm. The towns located in this area are namely; Miri, Bekenu, Batu Niah, Niah and Bakong. Miri, with an international airport is the capital town for the northern region.

3.3b Route Geological Mapping

In order to establish a proper lithostratigraphy in the area, a detailed route mapping (Fig. 21) at the scale of 1: 10,000 was carried out by the tape and compass method. However, in most cases, the positions of outcrop were counter-checked with two hand-held Global Positioning System (GPS) models; Magellan and Garmin. The outcrops along the traversed route were studied in detailed for rock types and their physical charateristics, such as thickness and stratigraphic relationship. Other physical characters such as composition, textures, grain size were also taken into account during the present survey. However, sedimentary structures such as ripple and sole marks, even though were not required for the nomenclature, were also noted as they might be important for the study of the paleoenvironment and the geological evolution of the basin.

As the result the present investigation detailed survey, the Geological Map of the Northwest Borneo Basin was produced (enclosed at the back folder of the report) for this investigation. This map describes the detailed lithostratigraphy of the area.

The detailed works on the Miocene stratigraphy of Northwest Borneo Basin by Banda and Honza (in press) are being incorporated with the present investigation.

3.3c Terminology

In order to establish a proper lithostratigraphy of the area, the sedimentary sequences in the area are classified into the following terminologies/categories; i) massive sandstone, ii) sandy alternation, iii) shaly alternation and iv) bounded shale/mudstone (Fig. 22). These categories of sedimentary rocks are very commonly observed and easily recognised in the area. Other elements such as

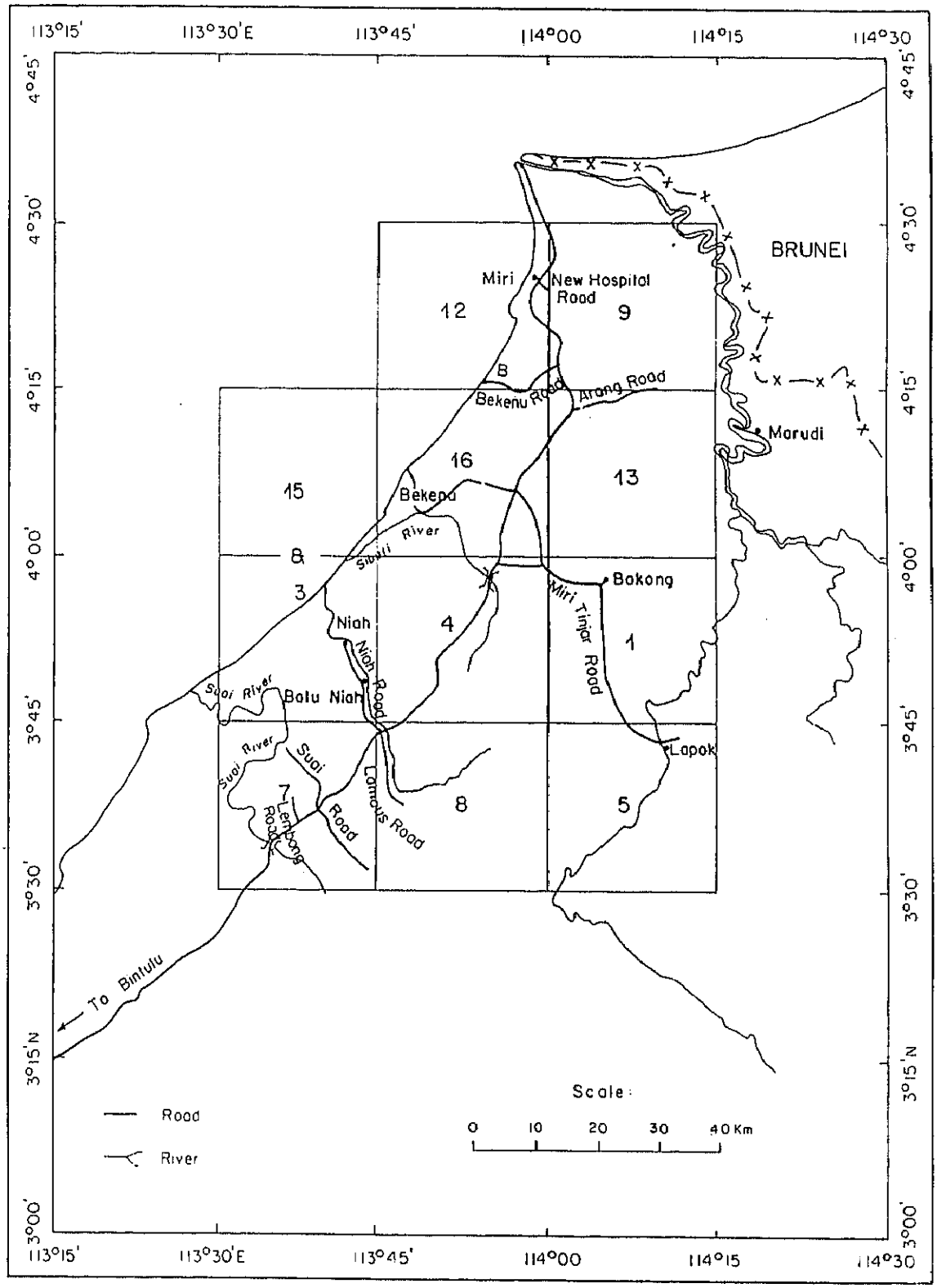

Figure 20. Index of topographic map sheet 1:50,000

1. Loagan Bunut, 3&15 Suai Niah, 4 Gunung Subis, 5 Bok-Tisam, 7 Kampung Sawai, 8 ulu Niah, 13 Pantu Buri, 16 Bekenu, 9 Bakong, 12 Miri.

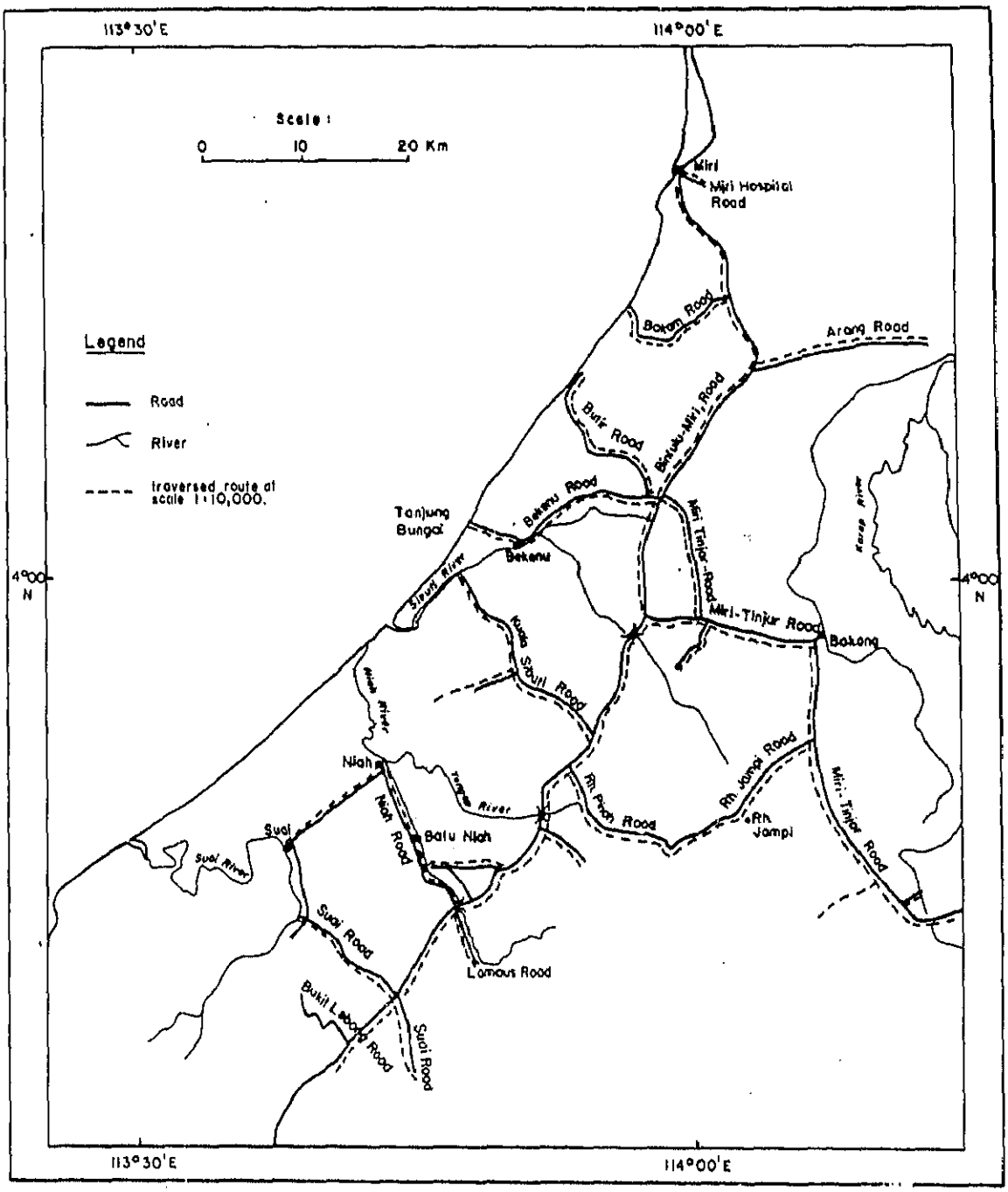

Figure 21. Traversed route map

environment and time concept are totally discounted here.

i) Massive sandstone:

This is used to describe thick and homogenous sandstone; having thickness more than 1.8 m (6 ft) (Kelley, 1956, p.294). Figure 23 shows typical massive sandstone in the study area.

ii) Sandy alternation: This term describes an outcrops or set of sedimentary beds consisting mainly of sandstone (more than 50 %) interbedded with shale or mudstone (Fig. 24). The individual thickness of each bed in the thick sandy alternation is more than 3 cm. Those thinner than 3 cm is termed as the fine alternation.

iii) Shaly alternation: This term to describe an outcrop or set of sedimentary beds consisting mainly of shale (more than 50 %) interbedded with sandstone or mudstone (Fig. 25). The individual thickness of each bed in the thick shaly alternation is more than 3 cm and those thinner than 3 cm is termed as the fine alternation.

iv) Bounded shale/mudstone: This term describes an outcrop or set of sedimentary beds consisting of mainly shale or mudstone bounded by thin layer of about 1 cm or thinner of siltstone or very fine sandstone. The thickness of each mudstone or shale bed is 0.3 m or more. Figure 26 shows the outcrop of this unit.

3.4 NOMENCLATURE OF LITHOSTRATIGRAPHIC UNIT

As the result of the detailed geological mapping on the scale of 1:10,000 undertaken along the existing roads in the area; the formal lithostatigraphic units established were namely: the Suai, Sibuti, Lambir and Miri Formations.

The Suai Formation is comprised mainly hard, semi-metamorphosed mudstone and shaly alternation; Sibuti comprises mainly mudstone and shaly alternations; Lambir comprises mainly sandy alternation and Miri Formation comprises sandy alternation and massive sandstone. The Suai Formation is the oldest in age, occurred at the lowest stratigraphic level, is successively overlied by the Sibuti, Lambir and Miri Formations.

The geographic terms Sibuti, Lambir and Miri that were first introduced by Liechti et al (1960), are being retained in this nomenclature. In cases where the type section, locality and boundary were not formally established previously, a new one is designated in accordance to rules stipulated by the International Subcommission on Stratigraphic Classification (ISSC), 1994 and Malaysian Stratigraphic Nomenclature Committee (1995).

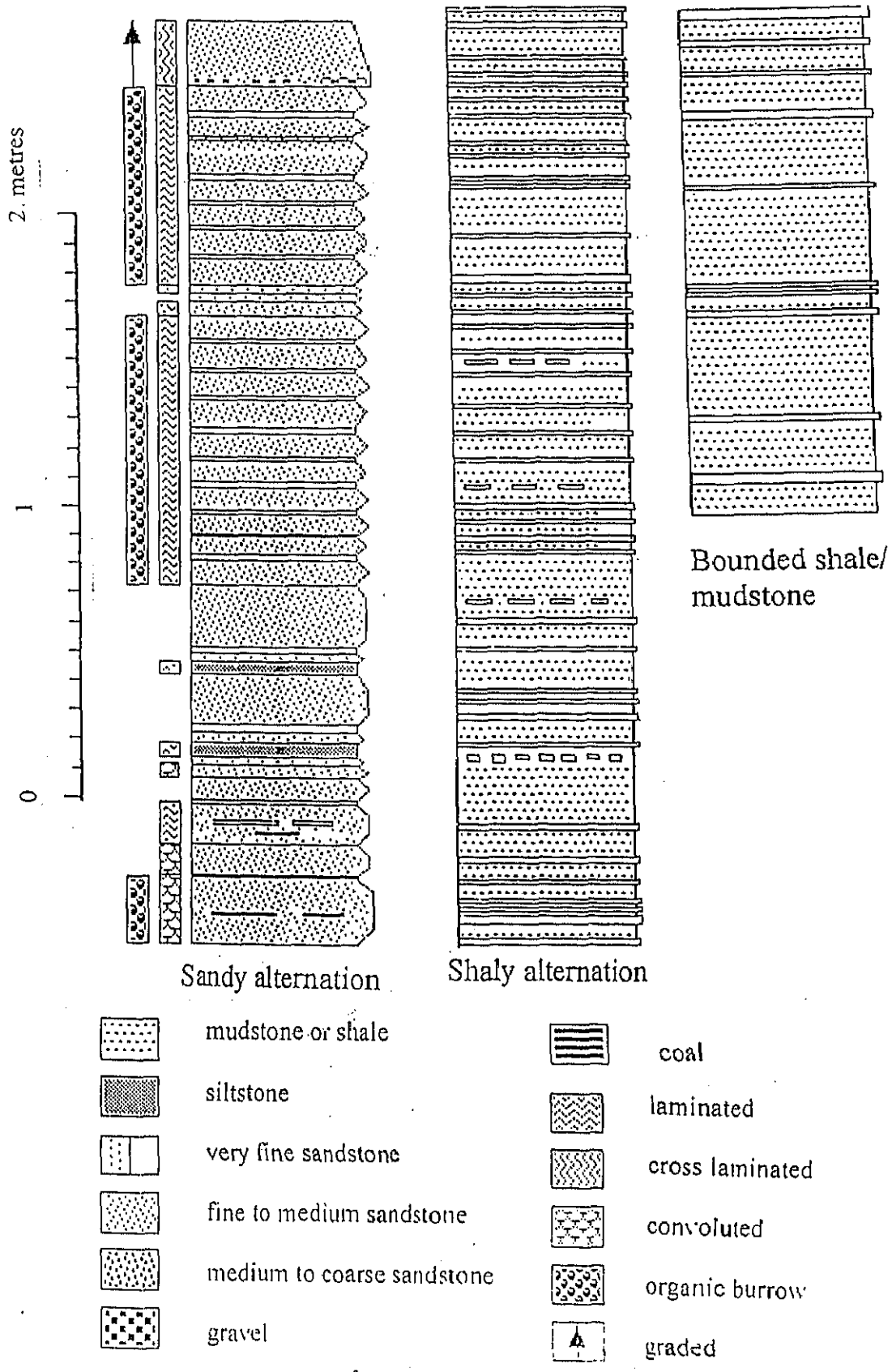

Figure 22. Typical bedding sequences of Northwest Borneo Basin

Figure 23. Massive sandstone bed, the Lambir Formation. Locality: Opposite to Rh. Councilor Pillai, Miri-Tinjar Road.

Figure 24. Sandy alternation, the Lambir Formation. Locality: Km 190.5, Miri-Bintulu Road.

Figure 25. Shaly alternation, the Sibuti Formation. Locality: Km 46.5, Miri-Bintulu Road.

Figure 26. Bounded shale, the Sibuti Formation. Locality: Km 127 Bintulu-Miri Road.

3.5 SUAI FORMATION

Synonymy

Upper Setap Formation of Paroh Anticline, Suai area (Liechti et al, 1960, p.149; Haile, 1962, p. 41).

Shaly alternation of Upper Nyalau Formation of Niah and Paroh Anticline, Suai area (Liechti et al, 1960, p.118, 120; Haile, 1962, p. 50-51).

Suai Formation (Banda and Honza, in press)

General lithology

The Suai Formation consists of regionally semi-metamorphosed bounded shale, mudstone, shaly alternation and massive sandstone bed. Most of the shale is hard, dark grey, often laminated and is non calcareous. In some places, the mudstone is quite hard, non calcareous often very fractured into angular chips. Massive sandstone beds are often several metres thick, is also hard and often fractured.

Geographic term and stratotype

The geographic term Suai is derived from a local village called Suai, located at the mouth of the Suai River. The type section is located along Suai Road, is comprising of bounded shale, mudstone, shaly alternation and massive sandstone bed (Figs. 27, 28, 29). The shale is hard, dark grey, often laminated and non calcareous whereas the mudstone is also hard, non calcareous and is often fractured into angular chips (Fig. 30). Massive sandstone beds are exposed in several localities along the section, and each bed is several metres thick, hard and often faulted. Most shale or mudstone is barren of microfossil. As indicated in the cross section, the beds are gently dipping in the northwestern area and steeply dipping in the area southeast of the Suai Fault.

Type area and lateral extent

The type area for the Suai Formation is located both along North Suai Road and South Suai Road areas, where several good outcrops of this unit are exposed. Several good exposures of shaly alternation, predominantly consisting of bounded shale and hard, fine to medium grained hard sandstone were observed, such as at station 43 along North Suai Road. However, the exposures of this unit are getting shalier toward northwest of this road such as at the stretch of station 110-130, is underlain predominantly mudstone interbedded with bounded shale. In the area along South Suai Road, there are several localities of good outcrops of hard bounded shale interbedded with shaly alternation. In the shaly alternation, the sandstone beds are normally hard or

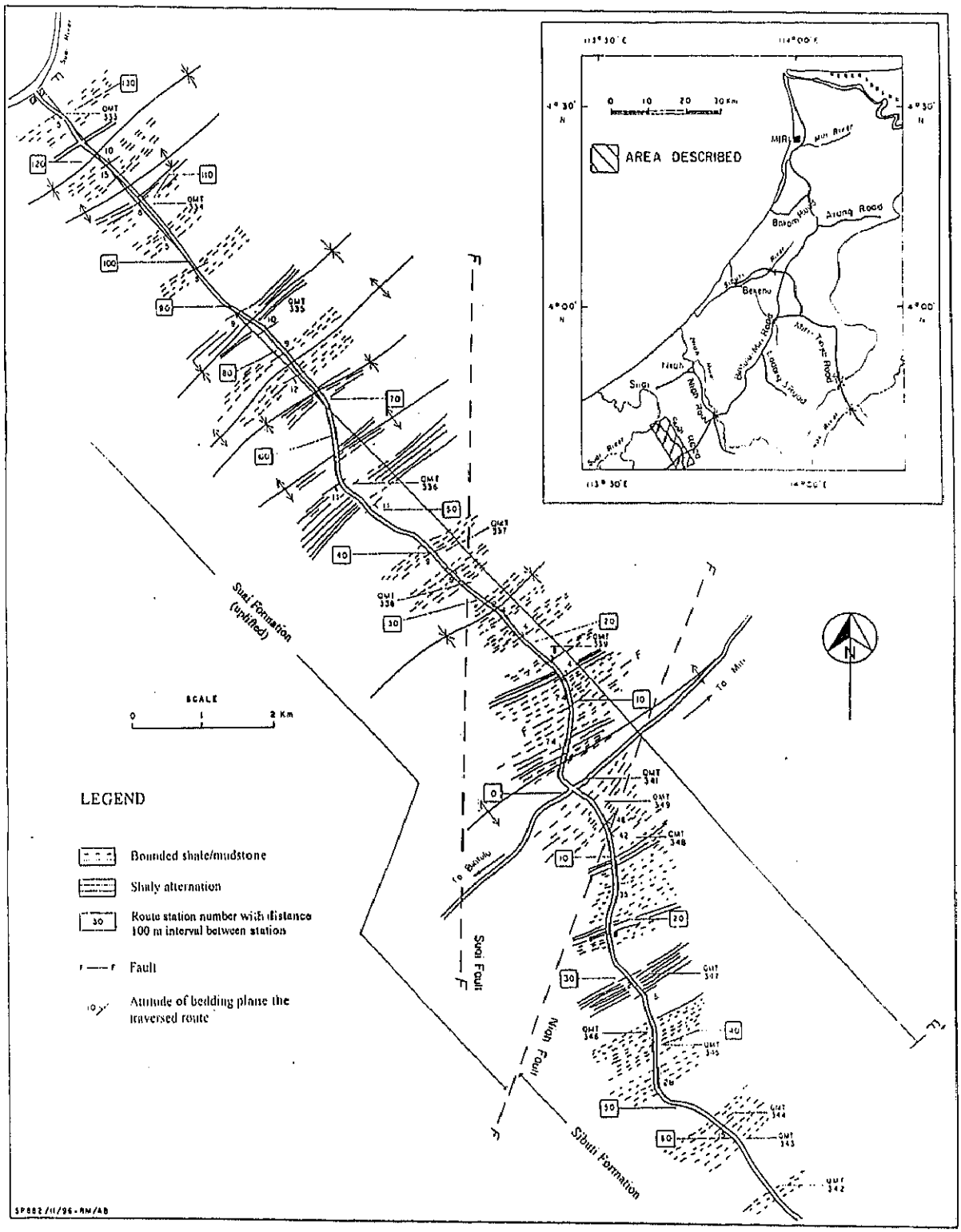

Figure 27. Route map of the type section of the Suai Formation faulted against the overlying the Sibuti Formation along Suai Road

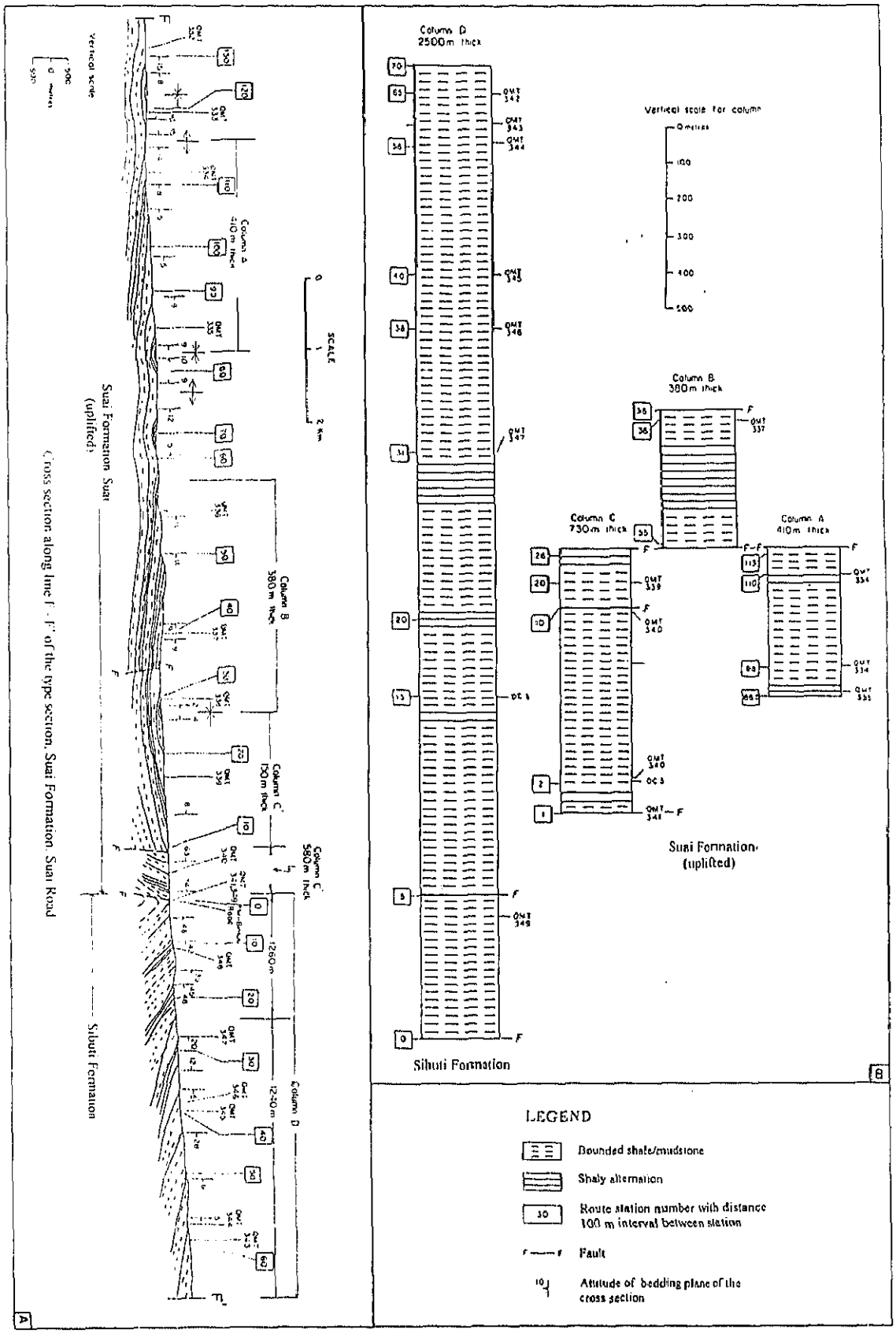

Figure 28. Cross section and columnar section of the type section faulted against the overlying the Sibuti Formation along Suai Road

Figure 29. Massive sandstone interbedded with shaly alternation, the Suai Formation. Locality: Km 1, North Suai Road.

Figure 30. Brecciated mudstone of the Suai Formation. Locality: Km 1.5, North Suai Road.

semi-metamorphosed. Also along the road section of both North and South Niah Roads, there are two major faultings namely Suai and Niah Fault.

The lateral extent of the Suai Formation is extensive covering North and South Roads, Niah Town areas, and it also stretches covering the Bintulu-Miri trunk road areas at the Sarawak Land Development Scheme Oil Palm Estate and the Forest School at Sebubok. The areas underlain by this unit is undulating towards northwestern part, such as along North Suai Road and Niah Town, but hilly in the southeastern part, such as along South Suai Road and the trunk road, the Bintulu-Miri Road. The rock unit in these roads are tightly folded and dipping steeply compared to the northwestern region.

Boundary stratotype

The upper boundary of this unit with the overlying Sibuti Formation is a fault contact, divided by major fault namely the Niah Fault. However, the boundary stratotype that separates this unit with the underlying unit is not observed during the present investigation.

Thickness

Based on the correlation of the horizontal and vertical sections of the unit, the thickness is estimated 2700 metres in Suai Road and 1400 metres in Bukit Lembong Road.

Reference section (Hypostratotype)

The Bukit Lembong Road section (Fig. 31) is served as the reference section. This section comprises predominantly bounded shale with lenses of limestone occurred at the top of the section.

Later Discussion and Reference

Banda and Honza (in press) described this unit as the Suai Formation is early Miocene in age. However, in term of plate tectonic setting, this unit is placed within the Miri Zone, is interpreted as a part of the continent drifted since Late Cretaceous, during the opening of South China Sea (Hutchison, 1988).

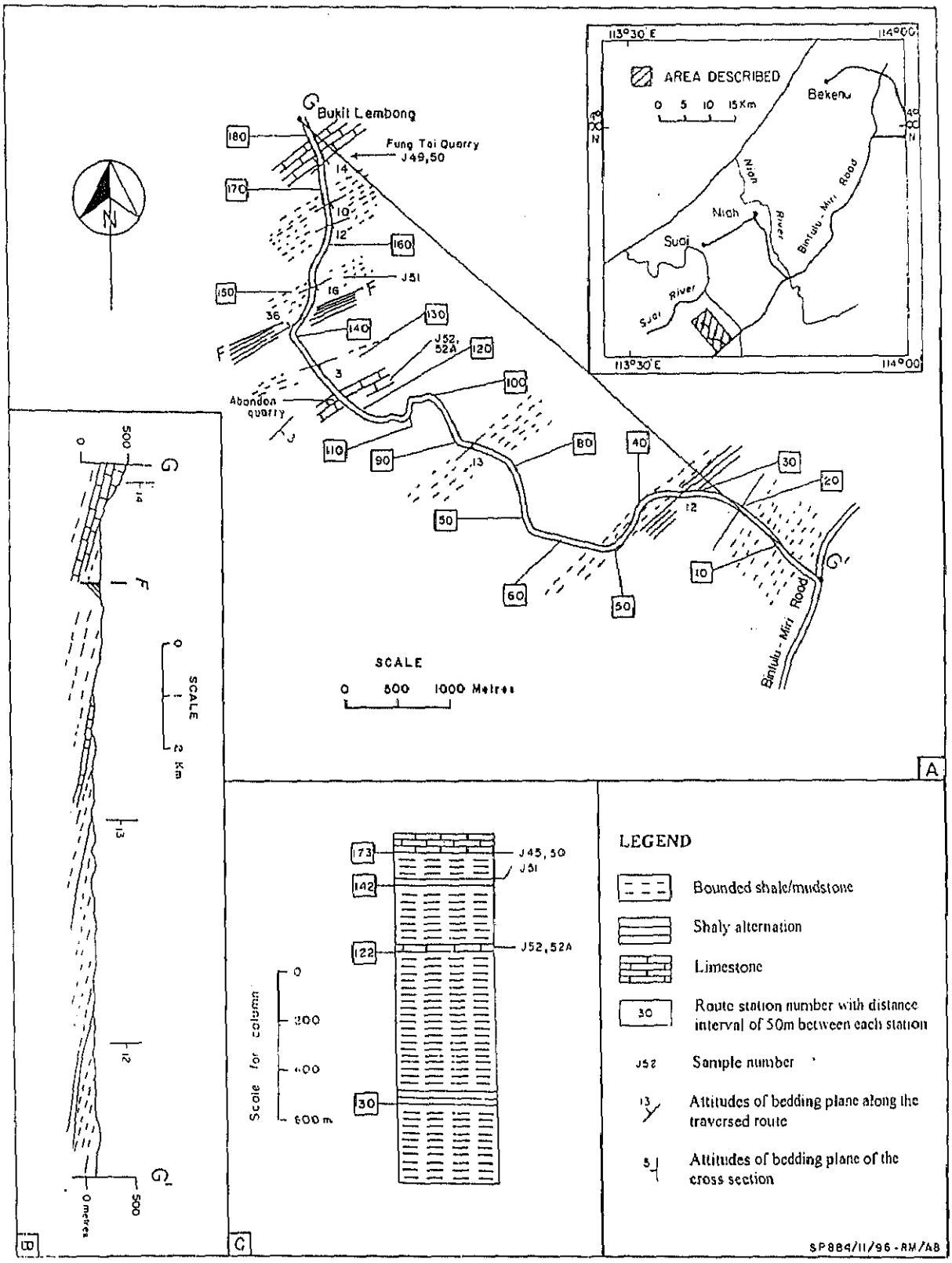

Figure 31. Route map (A), cross section (B) and columnar section (C) of the reference section, of the Suai Formation along Bukit Lembong Road

3.6 SIBUTI FORMATION

Synonymy

Tangap Formation (Liechti et al, 1960, p.161-166; Haile, 1962, p. 45-50).

Upper Setap Formation of the Niah and Tinjar area (Liechti et al, 1960, p.143, 149; Haile, 1962, p. 41-42).

Shaly alternation of the Upper Nyalau Formation of Paroh Anticline, Suai area (Liechti et al, 1960, p.118, 120; Haile, 1962, p. 51).

Sibuti Formation (Banda and Honza, in press)

General lithology

This unit comprises of mainly mudstone interbedded with the shaly alternation of shale and siltstone or fine grained sandstone. The Subis Limestone Member is an interfingering body within this unit, occurred as the basal section of the formation.

Geographic term and stratotype

The term Sibuti, is derived from the name of the river draining the area, Sibuti River. The Sibuti Formation was first introduced by Liechti et al, (1960) to describe a predominantly argillaceous, calcareous and fossiliferous rocks in the area, with the type section located along Sibuti River. However, the detailed description of the type section was the unpublished report of Sarawak Shell Oil Company (Waite, 1940d; quoted by Liechti et al, 1960, p.343); which is not accessible to the public and therefore is considered informal as stipulated in International Subcommission on Stratigraphic Classification (ISSC), 1994. However, since the term Sibuti Formation is established name, therefore it is being retained in this report to describe the same rock unit.

The section which is considered for the type section is located along Miri-Tinjar Road section (Figs.32, 33), comprises predominantly mudstone interbedded with a single occurrence of shaly alternation. The shaly alternation is located at station 190, at a place locally known as Serpin, about 4 km west of Bakong Town, along Miri-Tinjar Road. The shaly alternation is correlated to occur in the middle of the total column of the type section. The mudstone is calcareous and fossiliferous, and it contains stringers of siltstone.

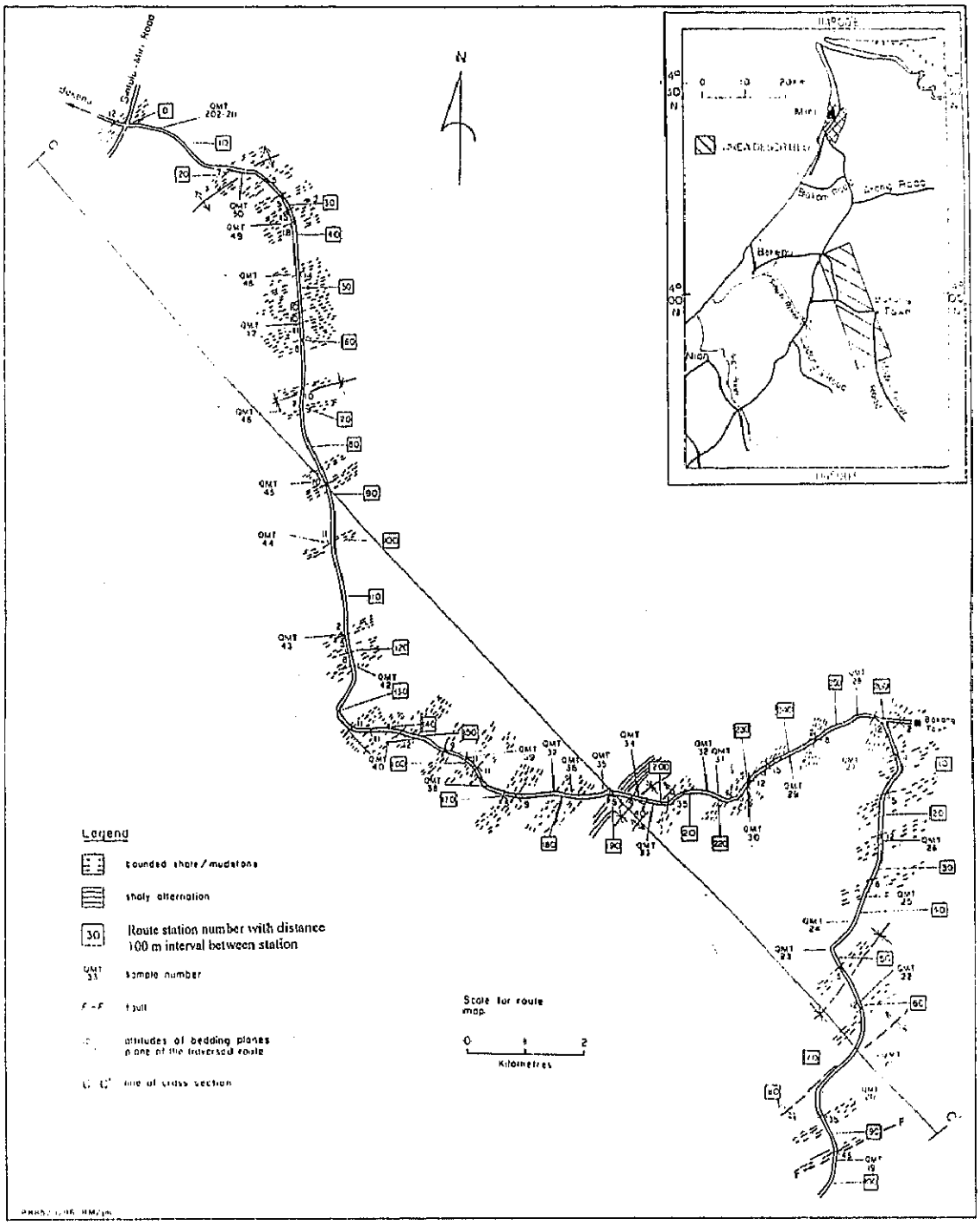

Figure 32. Route map of the type section of the Sibuti Formation along Miri-Tinjar Road

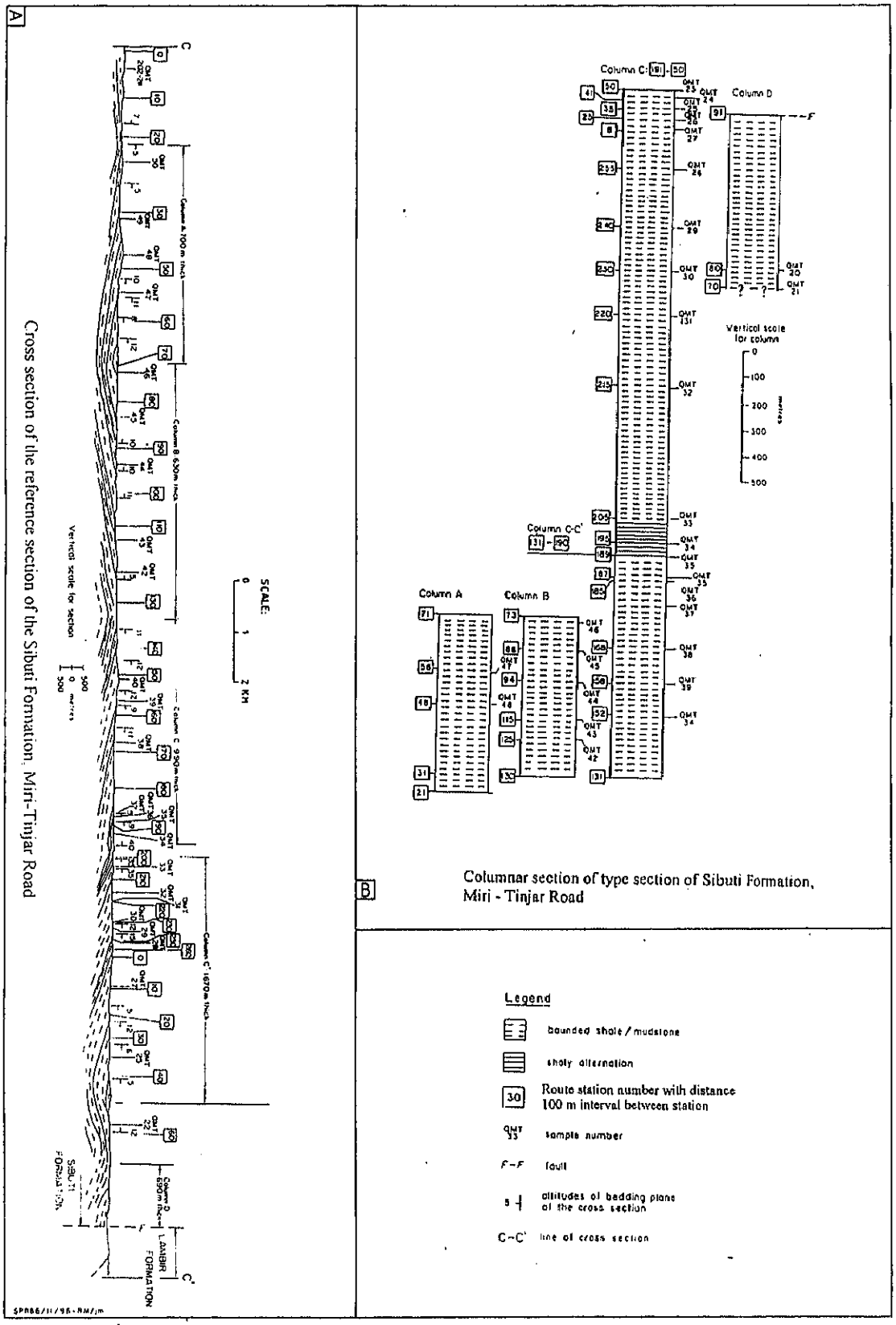

Figure 33. Cross section and columnar section of the type section, Sibuti Formation along Miri -Tinjar Road

Type area and lateral extent

The type area of this unit is the Sibuti area, is being drained by Sibuti River and its tributaries. The unit is also exposed extensively in other areas; such as along the Bintulu-Miri road, Miri-Tinjar Road and Bekenu Road. A typical and fresh exposure of the unit is located at Km 127, Bintulu-Miri Road.

The lateral extent of this unit is extensive; extends to Bekenu Town and Entulang in the northeast, and Niah Town and Upper Niah River in the southeast. The unit also extends to Lapok, Tinjar in the western part of the study area.

Boundary stratotype

The upper boundary stratotype of the unit is located at Km 174.5, Bintulu-Miri Road, disconformably overlain by the Lambir Formation (Fig. 34). The lower boundary is however, a fault contact with the underlying Suai Formation which is exposed along the South Suai Road. The upper boundary stratotype comprises bounded shale, is fossiliferous, but containing very rare planktic foraminifers and abundant benthic foraminifers. The bounded shale is also dark brown in colour, often laminated with siltstone and on weathering, is disintegrated into layers angular granules, covering the fresh rock.

The Lambir Formation which is disconformably overlying the upper boundary stratotype of the Sibuti Formation, is comprised mainly sandy alternation of sandstone, interbedding with shale-siltstone beds. The sandstone is fine to medium grained, with sedimentary structures such as cross bedded, truncation and bioturbation.

Reference section (Hypostratotype)

The sections along Niah Road (Figs. 36, 37) and Ladang 3 Road (Fig. 38) are designated as the reference sections of this unit. The limestone complex formed Mount Subis is described as a member of the Sibuti Formation. The reference section along Niah Road, comprises mainly mudstone and bounded shale with a few occurrences of shaly alternations, dipping gently northwest. In some of the mudstone samples they are specks of microfossils observed. Another reference section for the formation is the Ladang 3 section; is having the same lithology as the Niah Road section, except more steeply dipping and in many places, faultings do occurred.

Thickness

Based on the correlation of the horizontal and the vertical extents, the thickness of this unit is estimated 2700 m in the Miri-Tinjar Road, however thinning into southwards. In the Niah and Ladang 3 Roads, the unit is about 1700 m thick. The Subis Limestone Member is estimated 150 metres thick,

Figure 34. Upper boundary stratotype of bounded shale, the Sibuti Formation disconformably overlain by sandy alternation, the Lambir Formation. Locality: Km 174.5, Bintulu-Miri Road

Figure 35. Subis Limestone Member, the Sibuti Formation. Locality: Batu Niah Town.

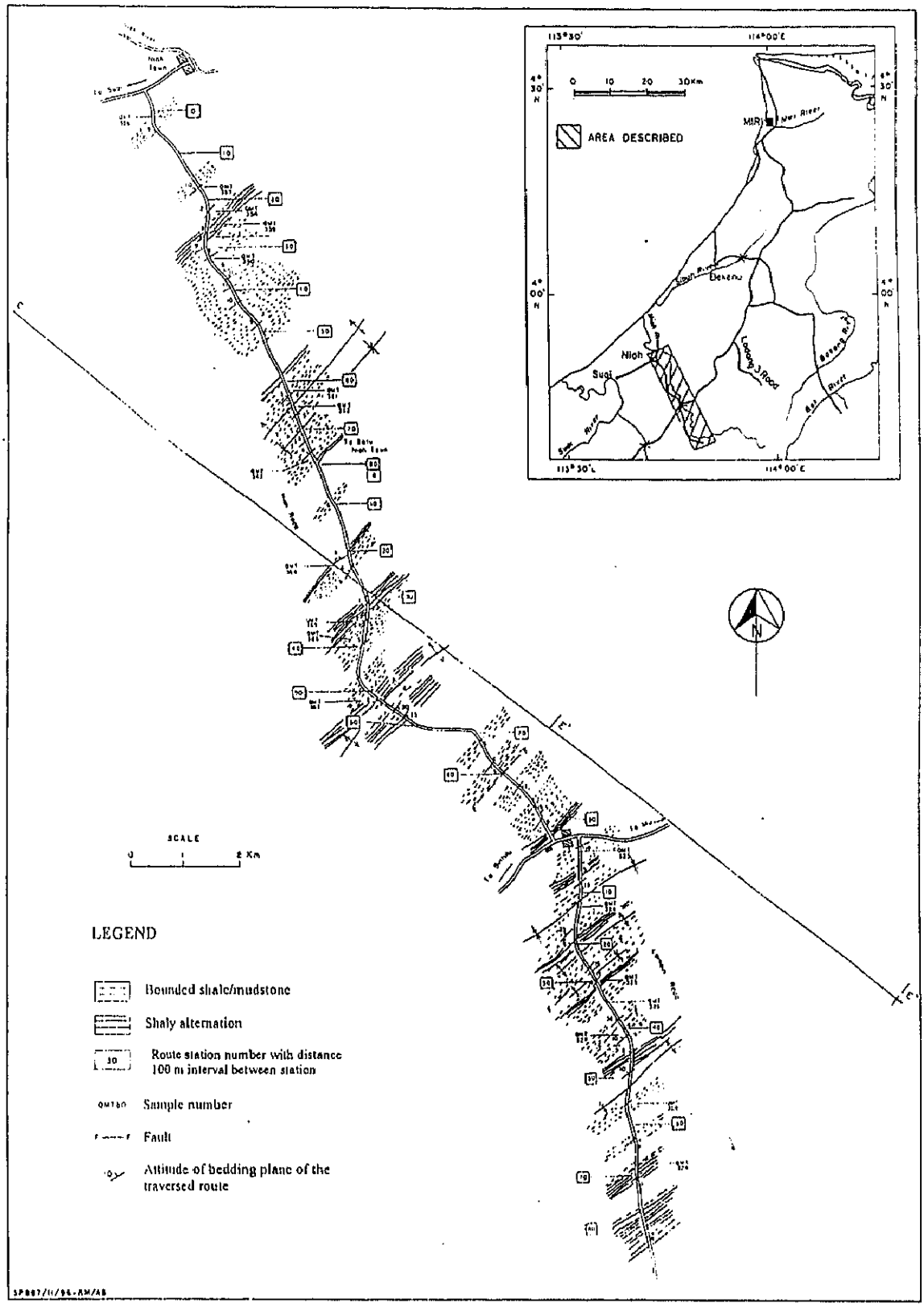

Figure 36. Route map of the reference section of the Sibuti Formation along Niah Road

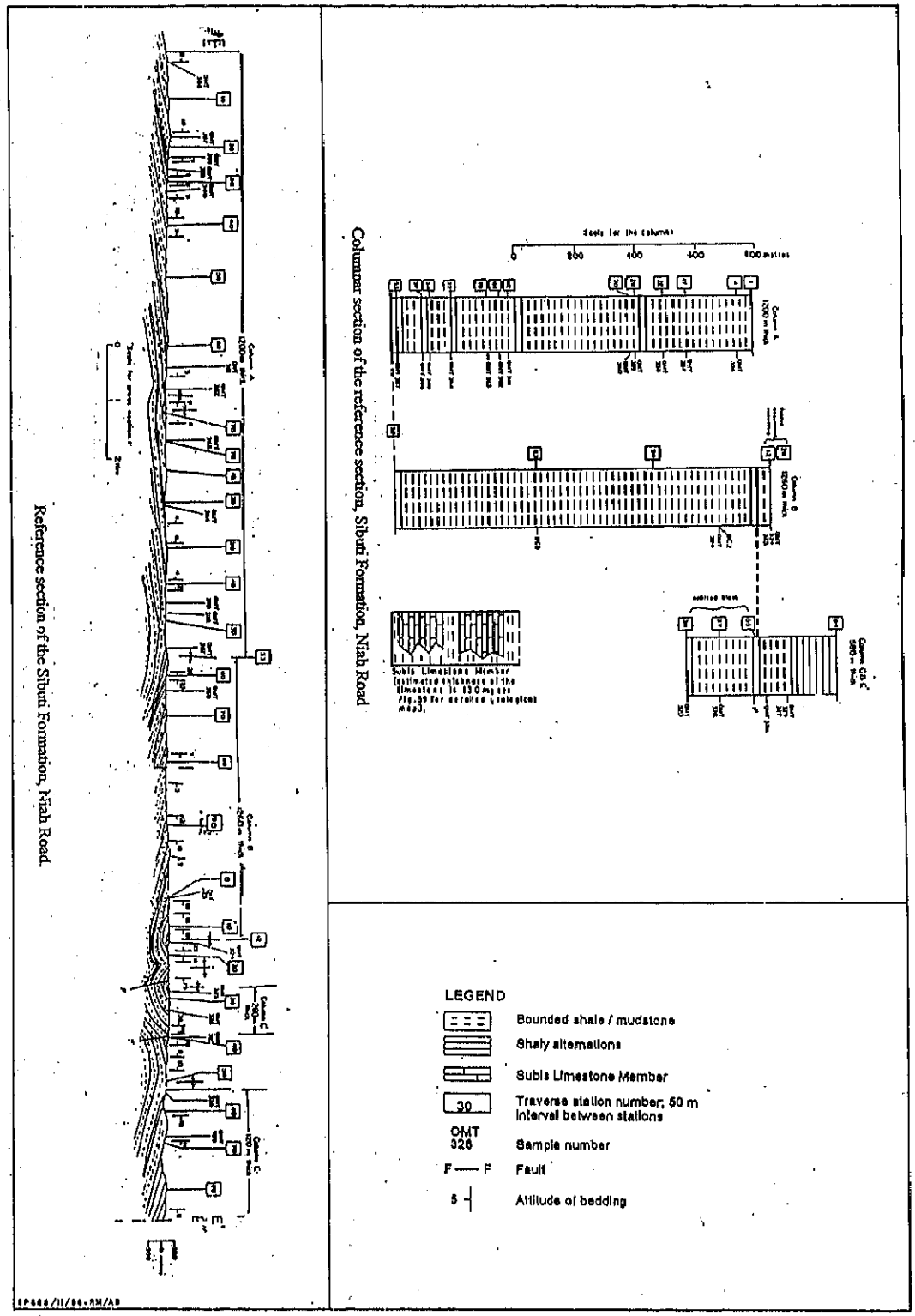

Figure 37. Cross section and columnar section of the reference section of the Sibuti Formation along Niah Road

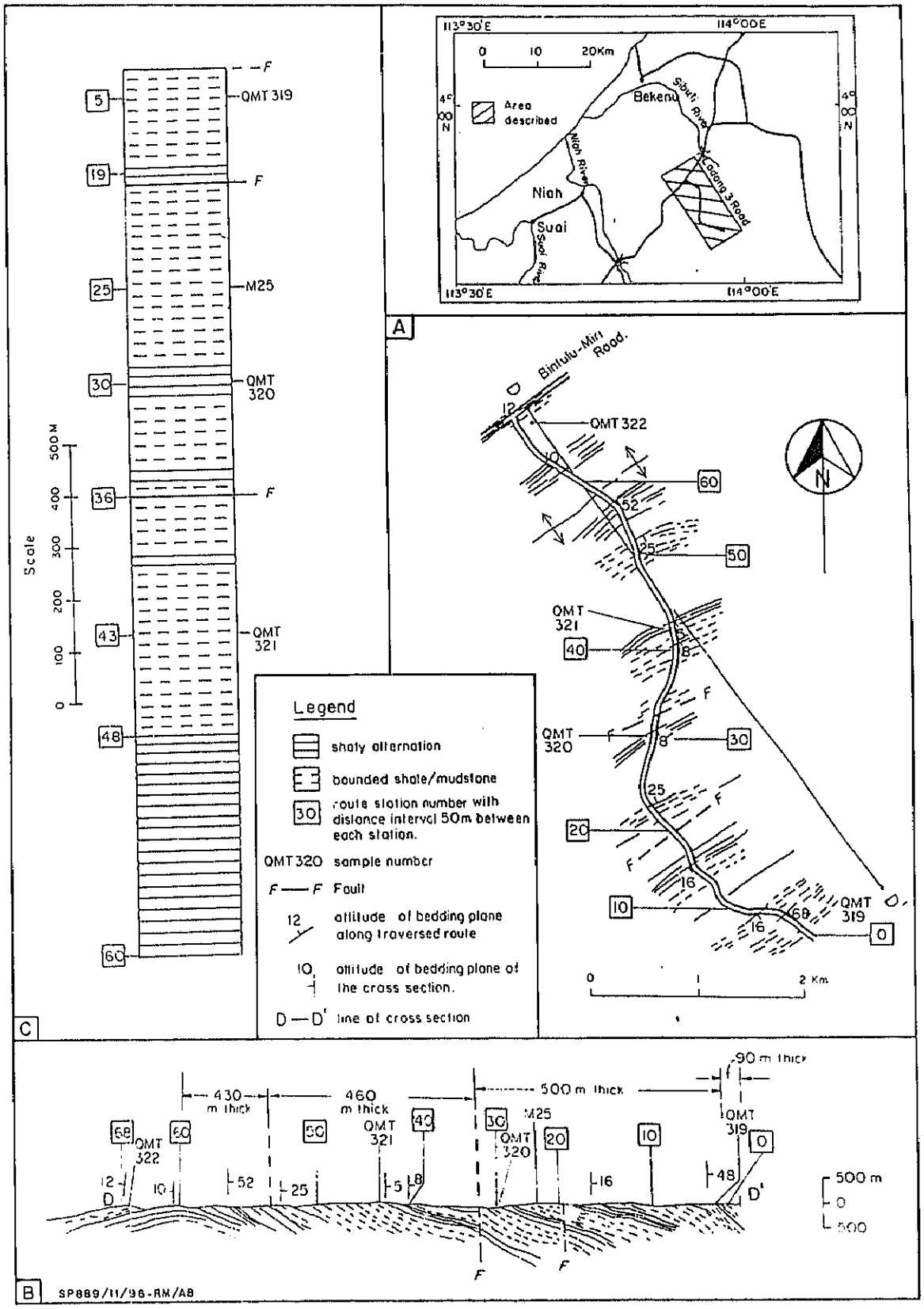

Figure 38. Route map (A), cross section (B) and columnar section (C) of the reference section, Sibuti Formation along Ladang 3 Road

located at the base of the unit.

Later Discussion and Reference

There is no published account on the nomenclature of this unit beside the earlier descriptions of Liechti et al, (1960) and Haile (1962). However, the unpublished account (Bait and Banda, 1992) has assigned this unit as the Sibuti facies of the Setap Formation.

In terms of plate tectonic setting, the unit is interpreted to belong to the continent of the Miri Zone, which was drifted as the result of the opening of the South China Sea since Late Cretaceous (Hutchison, 1988).

3.6a SUBIS LIMESTONE MEMBER, SIBUTI FORMATION

Synonymy

Subis Limestone Member, Tangap Formation (Liechti et al, 1960, p.162-163; Haile, 1962, p. 45-46).

Subis Limestone Member, Sibuti Formation (Banda and Honza, in press)

General lithology

This unit comprised of limestone which forms Mount Subis (Gunung Subis); 395 metres high above sea level, forming karstic peaks surrounded by the undulating ground of the Sibuti Formation (Fig. 35). However, they are few beds or sequences of shaly alternations interbedded with limestone such as located along the Terusan Fault. The mount is comprised of two varieties of limestone; algal and coral limestones. Figure 39 shows the geology of the Mount Subis area.

Geographic term and Stratotype

The term Subis Limestone Member was introduced by Liechti et al, (1960, p. 162-163) was after the name of Mount Subis. Since it is an established name describing the limestone mountain in the area and therefore is being retained in this report. The Subis Limestone Member comprises white and grey limestones; contained abundant coral and algae, respectively. The beds of limestone are massive, forming an anticline with the fold axis trending northeast-southwest with beds dipping gently away from the axis.

Boundary stratotype

Both the upper and lower boundaries of this unit are interfingering with the surrounding bounded shale and shaly alternation. The upper boundary was observed at the Geragok Quarry, where the limestone beds are interfingering

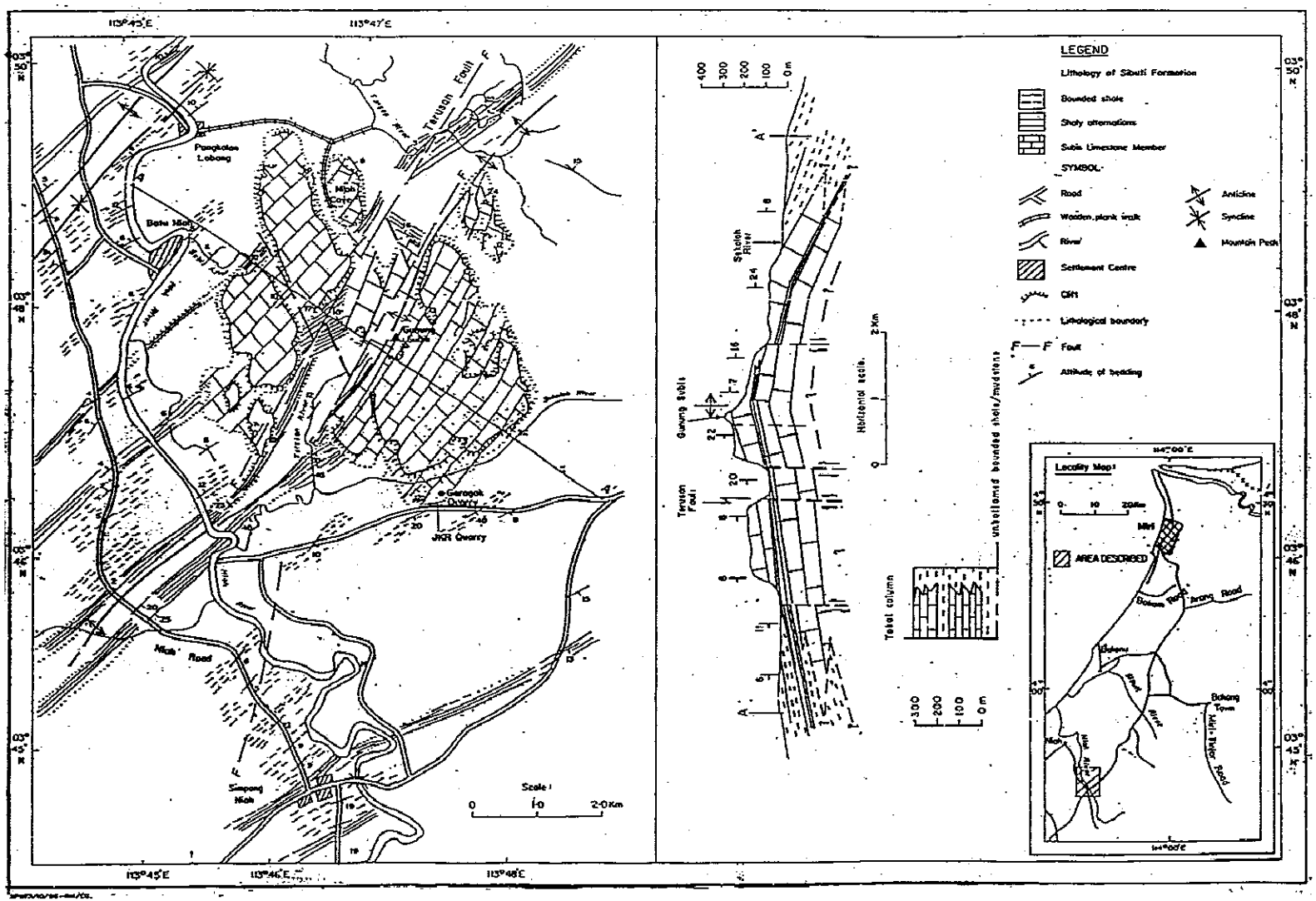

Figure 39. Lithological map of the Gunung Subis area, Subis Limestone Member, the Sibuti Formation

Figure 40. Interfingering contact of the partly weathered shale (s) with the Subis Limestone (l), both of the Sibuti Formation.
Locality: Geragok Quarry

Figure 41. Massive sandstone, the Lambir Formation. Locality Bukit Song, Km 186, Bintulu-Miri Road

with the shaly alternation (Fig. 40). The lower boundary of the limestone was not observed during the present investigation.

Thickness

The total thickness of this member is about 150 metres; estimated from the cross section and total column of the unit; and also intercalated with the shaly alternation of estimated 30 metres thick. The Subis Hill which formed the Subis Limestone Member of the Sibuti Formation formed an anticline trending SSW-NNE, parallel to the general strike of the anticlines in the region.

Later Discussion and Reference

They are many published accounts on the study of the limestone, such as Liechti et al (1960), Haile (1962) and Azhar et al (1992). Azhar et al (1992), made a detailed study of this limestone, indicated limestone was an isolated bioherm growth-reef character. The build up of this isolated bioherm in the amidst argillaceous sediments, was bound to suitable water conditions, which appear to have been confined to the clear shallow-shelf waters (down to a depth of 60 metres) of the Tertiary sea. Tectonic has apparently predated the build up of the limestone in creating a shoal environment with the deposition of fine sands. The construction of a carbonate platform started on these shoals by the settling of down of a flora of coralline algae and large foraminifera. Probably due to continuos uplifting, the shallow shelf zone was reached and changed in faunal and floral characteristics took place, culminating into a coral-algal reefoid growth (Fig. 42).

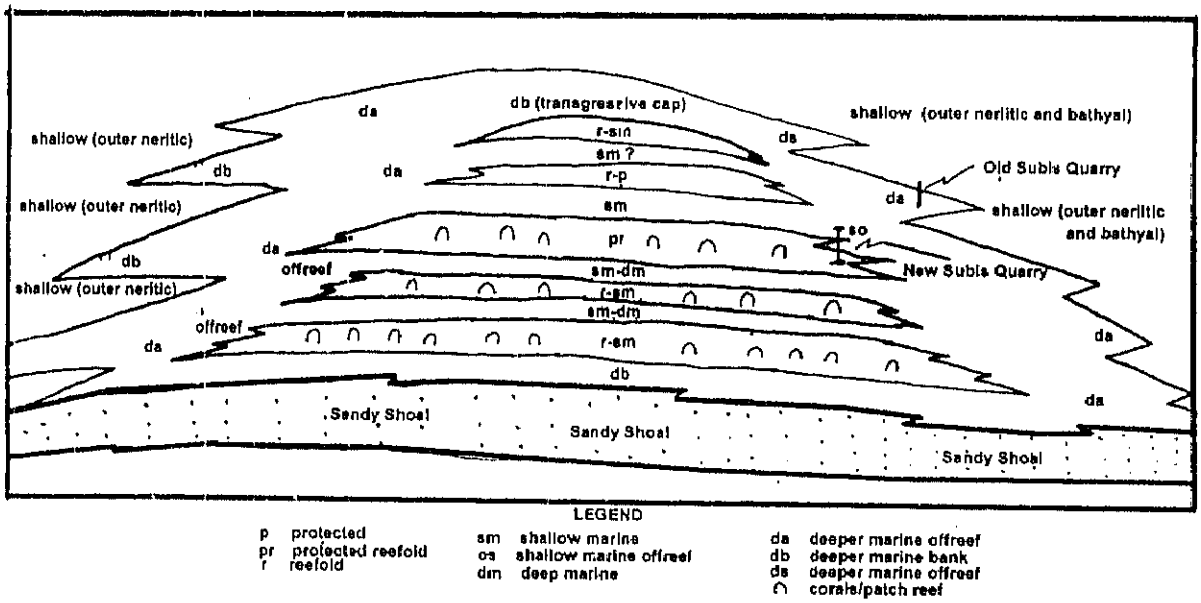

Figure 42. Development of isolated biohermal limestone of the Subis Limestone Member, Sibuti Formation (after Azhar et al, 1992)

3.7 LAMBIR FORMATION

Synonymy

Tukau Formation (Liechti et al, 1960, p. 199-201)
Belait Formation Liechti et al,1960, p. 177-187)
Lambir Formation, Bok Syncline (Lim, Mohd Shafeea, 1992, p. 1-5)
Lambir Formation (Banda and Honza, in press)

General lithology

Lambir Formation comprises mainly of sandy alternation, shaly alternation with massive sandstone.

Geographic term and stratotype

The term Lambir Formation was introduced by Waite, 1940 (quoted by Liechti et al, 1960, p. 187) after the name of the Lambir Hill. The hill is a prominent geographic feature in the area, is 508 metres high. The term Lambir Formation, is an established name to describe rocks predominantly sandy alternation of mainly sandstone and shale in the area, and therefore is being retained in this study. The type section assigned by Liechti et al, (1960, p. 187) was paleontological section of corehole and disturbed blocks of sandstone in the Bakam and Subis areas; described in the unpublished report of Sarawak Oil Company (Waite, 1940d; quoted by Liechti et al., 1960, p.342) is therefore informal unit as stipulated in the International Subcommission on Stratigraphic Classification (ISSC), 1994.

The type section is redescribed in this study, is located along station 0-220, Bintulu-Miri Road (Figs. 43, 44); comprises predominantly sandy alternation and thick beds of sandstone (Fig. 41). Thick beds of sandstone were observed at station 75-90 (Fig. 44) in the Bukit Song area. The sandy alternation comprises predominantly sandstone interbedded with shale and siltstone. The sandstone is fine to medium grained. However, thick graded sandstone beds at station 50 and 90 are graded made up layers of granules that are fining upwards. Cross beddings are also commonly observed in this unit; such as at station 48 and 68, Bintulu-Miri Road. Most of the sandstone is mostly friable, however, there are beds of hard sandstone such as at station 80, the Bukit Song area.

Type area and lateral extent

The type area is located at the Lambir Hill area where the formation is continuously exposed along the stretch Km 174.5 to Km 190, Bintulu-Miri Road. The exposure comprises predominantly of sandy alternation interbedded with shale. The formation formed a ridge striking with estimated distance of 12 kilometres from Lambir hill to Tanjung Bungai area in the southwest. The width

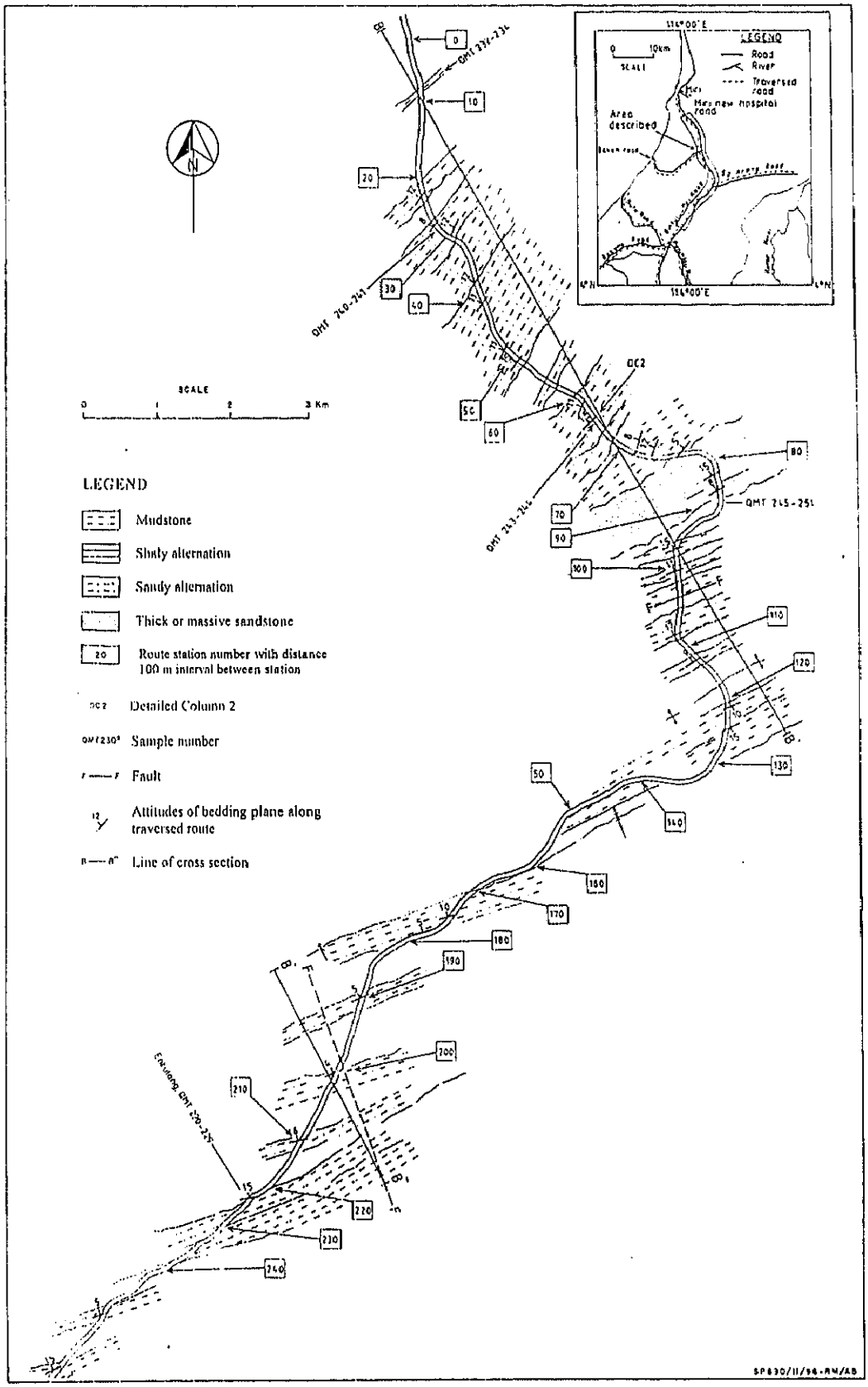

Figure 43. Route map of the type section of the Lambir Formation along Bintulu-Miri Road

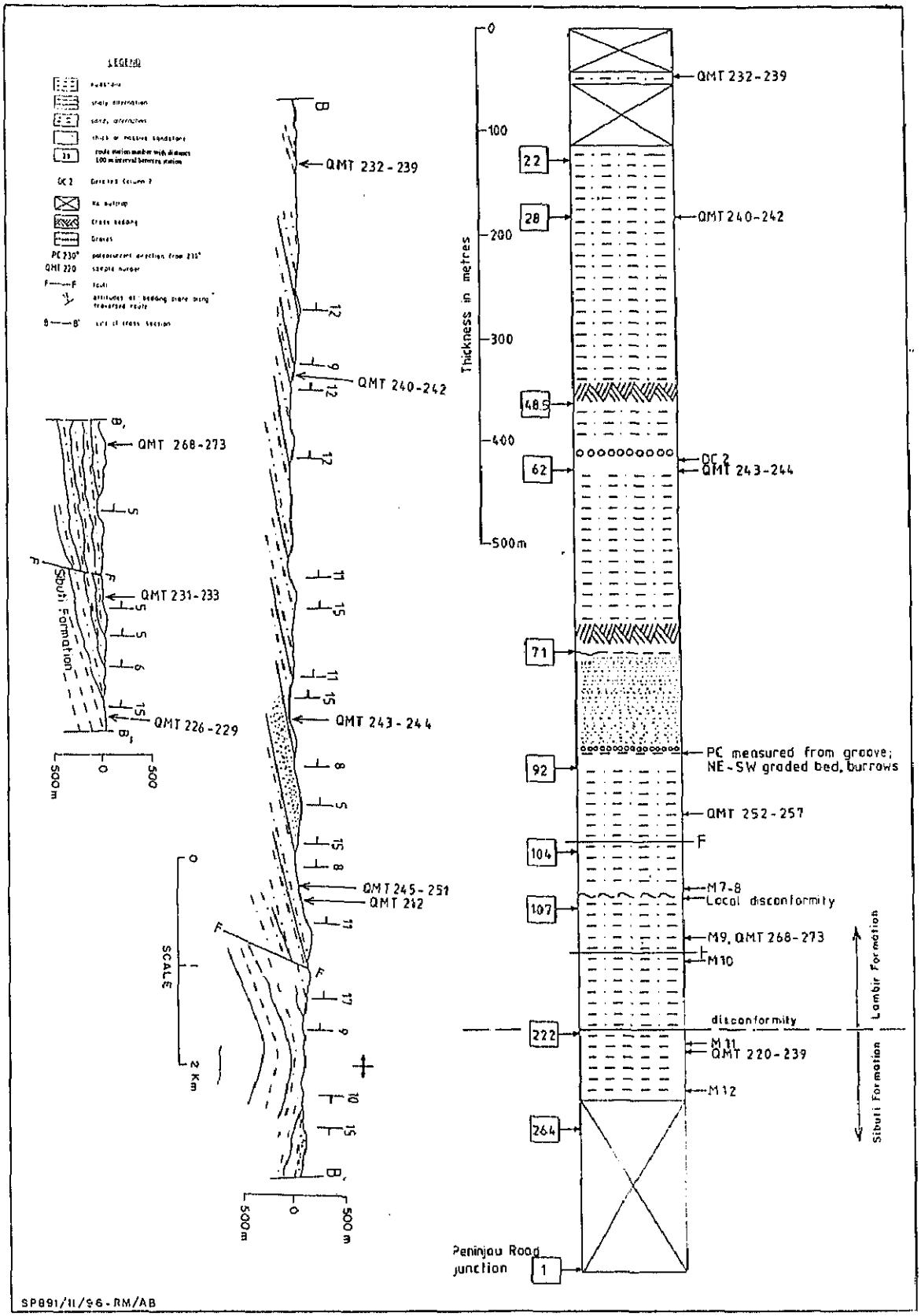

Figure 44. Cross section and columnar section of the type section, of the Lambir Formation along Bintulu-Miri Road

of the ridge is estimated 5 kilometres at Lambir Hill area, however narrowed to a width of 1 km in the Tanjung Bungai area. This unit is also widespread in the Bakong area where it was formerly described as the Belait Formation (Liechti et al., 1960); comprised predominantly sandy alternation, and in places, a thin bed of coal was located. The Lambir Formation in the Bakong area is making a fault contact with the underlying Sibuti Formation (Figs. 45, 46).

Boundary stratotype

The lower boundary stratotype of this formation is located in Entulang, Km 174.5, Bintulu-Miri Road. This boundary stratotype have been described in detailed earlier on, together with the upper boundary of the Sibuti Formation, comprised mainly cross bedded sandy alternations of sandstone, siltstone and little shale. However, the upper boundary stratotype with the Miri Formation could not be established because lack of exposure, being obscured by the swamp. However, based on the false colour satellite imageries interpretation, the Lambir Formation is a fault contact with the overlying Miri Formation.

Reference section (Hypostratotype)

The section is located along the stretch station 100-292, Figure 47 and 48, between Laong River and Bok River, are served as a reference section for this formation; comprises mainly sandy alternation interbedded with the shaly alternation. In places, massive, cross bedded sandstone (Fig. 23) and coal beds were observed, such as at station 245, opposite to Rh. Councilor Pillai (Fig. 47), Miri-Tinjar Road.

Thickness

Based on correlation of the horizontal and the vertical extents, the thickness of this unit is estimated 925 metres in Lambir area and 1900 metres in the Bakong area.

Later Discussion and Reference

This unit was later discussion by Lim and Mohd Shafea (1992); based on lithology and sedimentary structures, the exposures in Bok area show the same lithology as those in Lambir Hill, and thus is considered belonged to the Lambir Formation. The rock unit in the area was formerly described as Belait Formation (Liechti et al, 1960).

Figure 45. Fault contact between the Lambir Formation (l) and the Sibuti Formation (s). Locality: Sg. Bakas, Miri-Tinjar Road.

Figure 46. Bakong Fault Zone. Locality: Station 98, Figure 20, Miri-Tinjar Road.

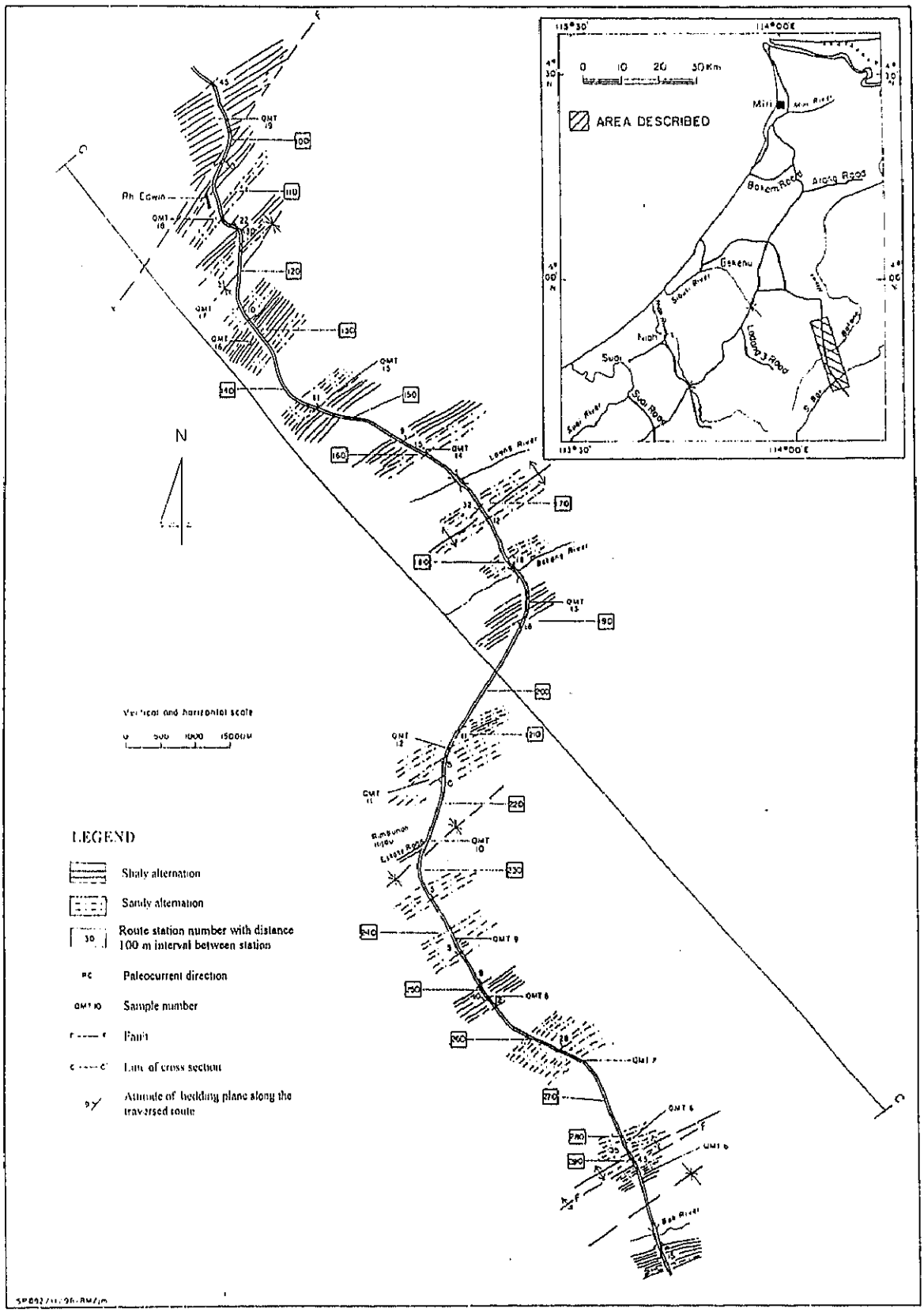

Figure 47. Route map of the reference section of the Lambir Formation along Miri-Tinjar Road

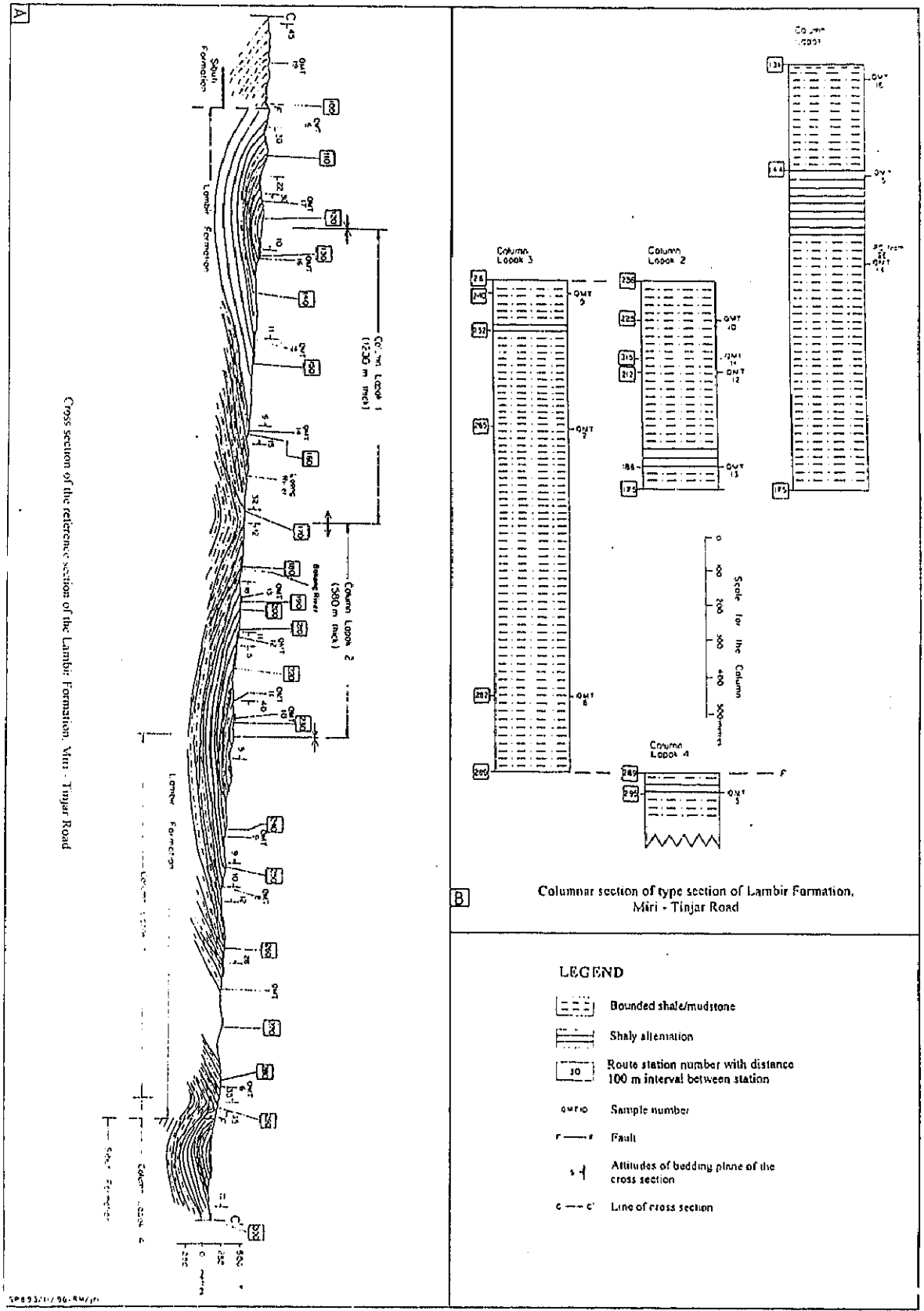

Figure 48. Cross section and columnar section of the reference section of the Lambir Formation along Miri-Tinjar Road

3.7 MIRI FORMATION

Synonymy

Miri Formation (Liechti et al, 1960, p.191 - 195)
Miri Formation (Banda and Honza, in press)

General Lithology

This formation comprises almost exclusively of sandy alternation. However, a sequence of shaly alternation and bounded shale are located at the top layer of this formation.

Geographic term and stratotype

The term Miri Formation was first introduced by Liechti et al (1960), after the name of the prominent geographic feature Miri Hill; is an established name describing the sandy formation in the Miri area, and also the Belait area in Brunei, is being retained in this report.

The type section of this formation was assigned by Liechti et al, (1960, p. 187) based the paleontological sections of well; Bakam 3, Tudan 3, Rasau 4, Belait 11, 13 Jerudong 1-19 drilled in Miri and Seria (Brunei) areas, described in the unpublished report of Sarawak Shell Oil Company which is not available for the public to review. Therefore the type section is considered an informal as stipulated in International Subcommission on Stratigraphic Classification (ISSC), 1994. Beside that, the well section is a subsurface section, is not recommended when the good surface sections are readily available for the purpose of nomenclature, such as the sections along the New Hospital Road and Miri Hill (Item 3.2, Malaysian Stratigraphic Nomenclature Committee (1995, p. 8).

In this investigation, the outcrop section located along the New Hospital Road, is assigned as the type section for this formation, also located in the same type area of Liechti et al 's (1960) nomenclature; comprises predominantly sandy alternation with occurrence at the top of the sequence are shaly alternation and bounded shale; strikes across the Miri Anticline (Figs. 49, 50). The sandy alternation consists mainly soft, friable, fine grained sandstone interbedded with siltstone-laminated shale. Most of the sandstone beds are massive, however the graded bedded and tuffaceous varieties were also observed such as at station 3 of the type section. The shale and laminated siltstone are mostly bioturbated, but in places such as at station 6, contained some coaly materials.

The top layer of the type section comprises of the shaly alternation and bounded shale; respectively 5 m and 10 m thick, located at the junction of New Hospital Road with Bintulu-Miri Road (Fig. 51). The shaly alternation comprises mainly soft shale bed interbedded with siltstone and sandstone. The bounded

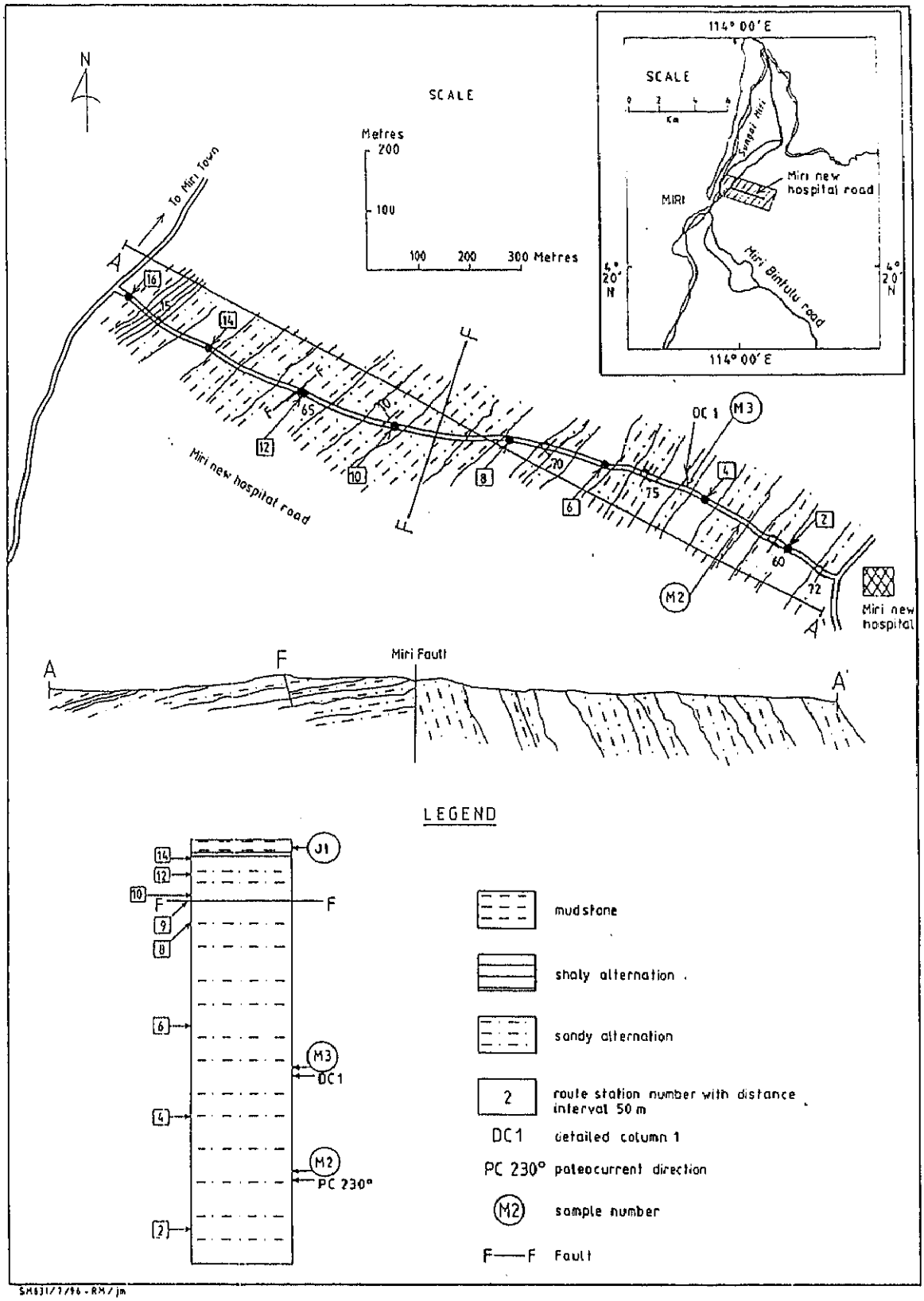

Figure 49. Route map, cross section and columnar section of the type section of the Miri Formation along New Hospital Road

Figure 50. Sandy alternation, the Miri Formation. Locality: Station 9, New Hospital Road

Figure 51. Bounded shale, the Miri Formation. Locality: Station 15, New Miri Hospital Road.

shale comprises mainly soft sticky dark grey mudstone bounded by thin layers of siltstone.

Miri Fault is cutting through the middle of the type section, is located at station 9 of New Hospital Road, characterized by 10 m choatic zone of broken beds and breccia.

Type area and lateral extent

The type areas for the Miri Formation are the Miri Hill and Canada Hill areas, both underlain the Miri Anticline. The Miri Anticline is 2.5 km wide, is extending from the Pujut to Bakam area for a distance of 12 km in the direction of the NNE-SSW. This anticline formed a good reservoir for the petroleum which was extracted during the period of 1910-1950; such as Well Number 1 of Sarawak Shell Oil Company located at the Canada Hill (Fig. 52). Both Miri and Canada Hill are being surrounded by the undulating grounds of the Quaternary deposit.

Several excavation works for the road construction and the housing projects, have exposed many parts the Miri Formation in the area, particularly surrounding Miri Hill and Canada Hill.

Boundary Stratotype

Both the upper and lower boundary stratotype were not encountered during the present investigation. However, the lower boundary is interpreted as a major fault with the underlying Lambir Formation.

Reference Section

The reference for this formation is the Miri-Bintulu Road section located at Miri Hill (Figs. 53, 54), comprises exclusively of sandy alternation forming the Miri Anticline. The sandy alternation are made mainly sandstone interbedded with siltstone-laminated shale. The sandstone and the siltstone-laminated shale are both cross bedded, friable, bioturabated; are estimated 10 cm thick, even though in some places the bed can be as thick as 3 metres.

Thickness

Based on the correlation of the horizontal and vertical sections, the thickness of the type section is estimated 810 m whereas the thickness of the reference section is estimated 240 m.

Figure 52. Well Number 1. Locality: Canada Hill.

Figure 53. Sandy alternation, the Miri Formation. Locality: Miri Hill

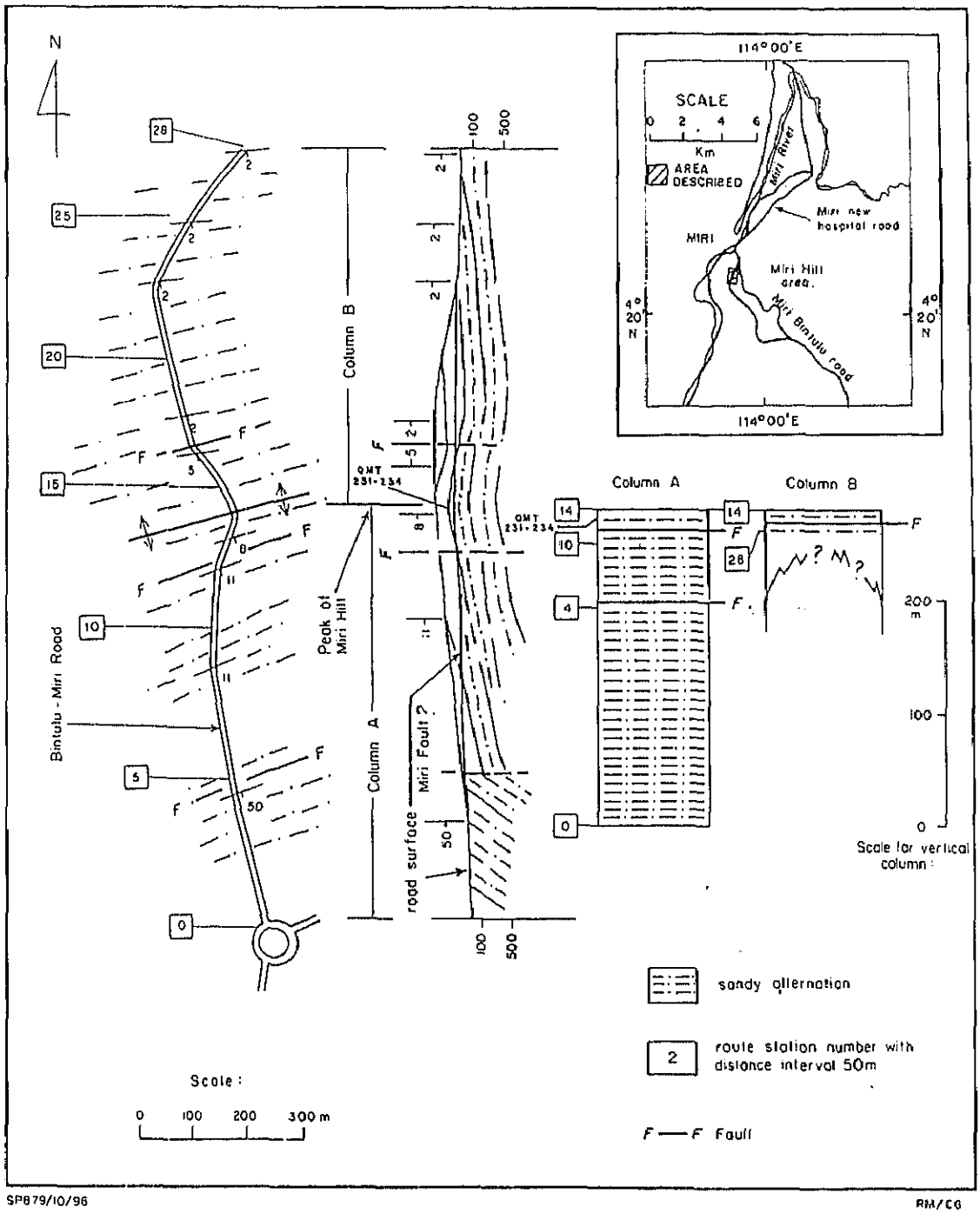

Figure 54. Route map, cross section and columnar section of the reference section, of the Miri Formation along Bintulu-Miri Road at Miri Hill

Later Discussion and References

There is no later attempt to undertake the nomenclature of this unit since the Liechti et al's, (1960). However, Cline and Huong (1992), undertook the study the satellite imageries of the area; focussing on the geomorphological evolution of Miri Hill since Pleistocene.