SEDIMENTOLOGICAL LOG OF THE UPPER PEGU GROUP EXPOSED IN NATOGYI-TAUNGTHAR AREA, MANDALAY REGION

Htay Win*

Abstract

The study area is situated about 6 miles southwest of the Natogyi Township, Mandalay Division. The field area lies between East Longitude 95°30' to 95°41'and North Latitude 21°15' to 21°26' in one-inch topographic map 84 O/11. The stratigraphic succession of the study area in ascending order is: (1) Moza Formation (Middle Miocene), (2) Khabo Sandstone (Upper part of Middle Miocene) and (3) Irrawaddy Formation (Pontian to Pliocene). The detailed graphic logs were constructed in a tabulated form by plotting sedimentary features such as structures on bedding plane, structures within the layers, fossil content, etc. and these features were represented by means of symbols. The graphic log of Moza Formation consists of 51 layers and has a total thickness of about 3200 centimeters. It can be divided into four units. The graphic log of Khabo Sandstone contains 148 layers and attains nearly 4130 centimeters in thickness. It can be divided into five units. The frequency of vertical layer thickness variation of these two formations is quite different. It is clear that the beds of Khabo Sandstone are thicker than those of Maza Formation. According to the study of sedimentological log, Moza Formation was deposited under a fairly variable hydrodynamic regime of deltaic environment. On the other hand, the sediments which belong to the Khabo Sandstone were deposited under more turbulent flow conditions.

Keywords: Sedimentological log, deltaic environment, turbulent flow, Moza and Khabo Formations

Professor& Head, Department of Geology, Lashio University

1. Introduction

1.1. Location and Size

The study area is located about 6 miles south west of the Natogyi Township, Mandalay Division. The field area lies between longitude 95°30'E to 95°41'E and latitude 21°15'N-21°26'N of one-inch topographic map 84 O/11. The field area covers approximately (144) square miles and is located on the southern side of the Mandalay-Myingyan car-road. Therefore, the field area is readily accessible by car throughout the year. The location map of the study area is shown in Fig (1.1).

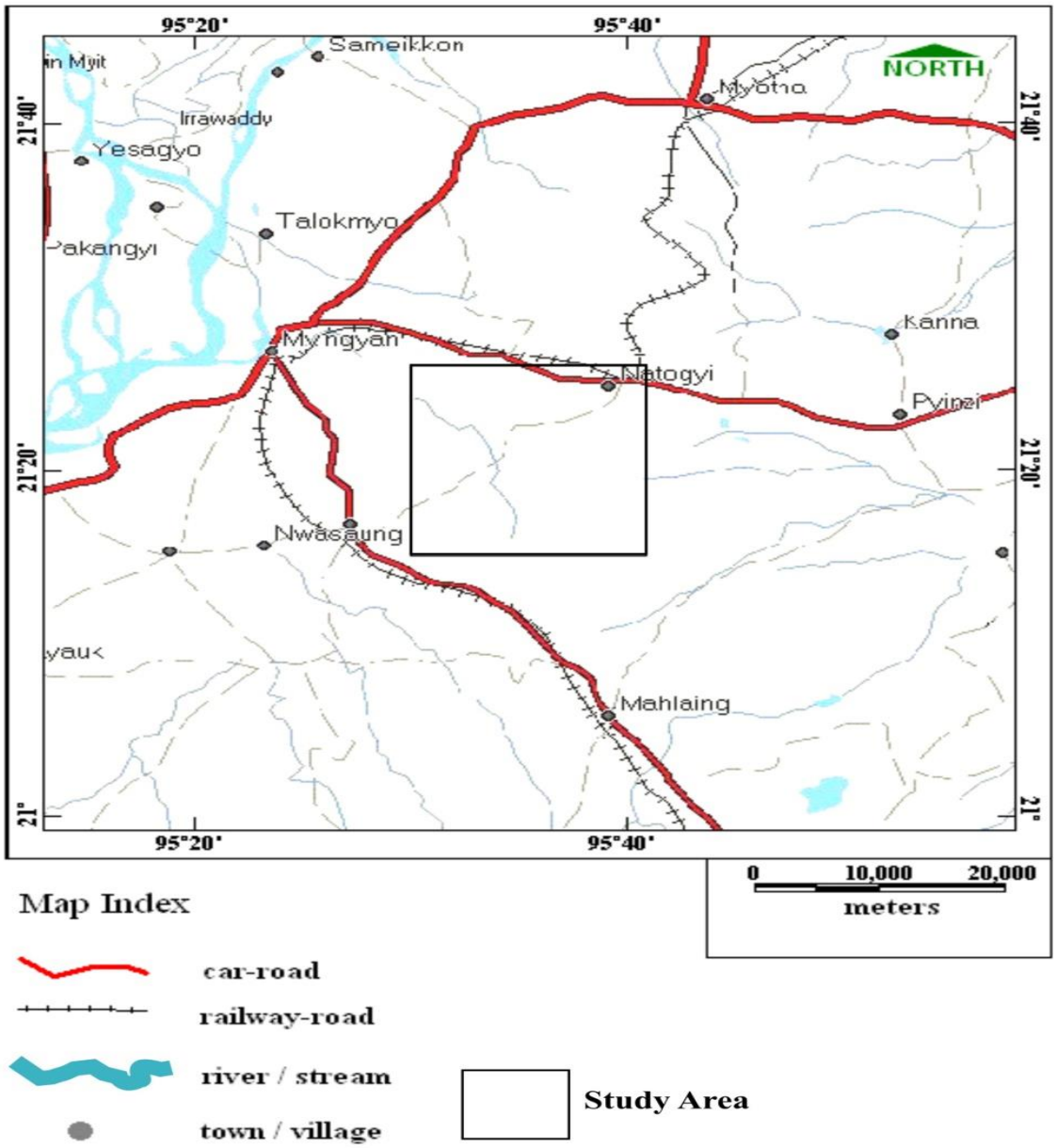


Figure (1.1) Location map of the Natogyi-Taungtha Area

1.2. Purposes of investigation

The present project is intended to curry out the following tasks.

(1) To study the sedimentological log of the study area

(2) To predict the various depositional environments

1.3. Method of Study

The geological investigation of the study area was carried out in April, 2007 and 2008, and June, 2009. The topographic map of 84 O/11 with an enlarged scale of 2 inches to one mile was used as a base map. Tape and compass traverse method is used to measure the stratigraphic units. Detailed observations and measurements of each stratum were undertaken along the good exposures of the stream sections. Not only topographic map reading but also G.P.S readings were used to get the accurate locality. During the field trips, the digital camera was used to take the good quality photographs of field evidences wherever necessary. The suitable rock specimens were systematically collected for the petrographic study.

1.4. Previous Works

The first geological survey of the Taungtha area was done by Cotter (1908). His attempt was to evaluate the structure and age of the Taungtha hills, Myingyan district.

Sarin (1964) stated the "Petrography and origin of Taungtha Formation exposed at Taungtha, Myingyan district ".He described about the primary cement (hematite) and the secondary cement (calcite).Hematite is coating around the detrital grains while calcite is to be found in the intervening pore spaces.

In 1969, Aung Khin and Kyaw Win carried out a research work on geology and hydrocarbon prospect of Myanmar Tertiary Geosyncline and Cenozoic paleogeography of Myanmar.

The stratigraphic study of the rocks exposed in the north and east of the study area were carried out by many workers. The nomenclature of the formations used in the project area and surrounding area were described by Myint Thein (1966).The detailed graphic logs of the Myotha-Ngazun area was given by Maung Maung (1978).The nature and assemblage of the primary sedimentary structures of Yondoe-Koke area, Natogyi Township was described by Kyi Myint (1980). Moreover, the sedimentological study of Mingon Taung area located in the northwest of the study area was submitted by Thike Tun Thaw (1977).

The study area was also studied by Bo San (1981). His work mainly dealt with "The Stratigraphy and Sedimentation of the Natogyi-Taungtha Area". He studied the sedimentary structure, petrography of the sedimentary rocks and their heavy mineral analysis. In addition, the stratigraphy and sedimentology of sedimentary rocks in Taungtha Area located in the northwest of the project area was carried out by Khin Khin Lin (1999). Neogene strata of the northern part of the Pegu Yoma Range (the southern continuation of the study area) were observed by Kyi Khin and Myitta (1998).

1.5. Regional Geologic Setting

There are four major tectonic provinces in Myanmar such as the Shan-Tenasserim Block, Central Cenozoic Belt, Western Fold Belt and Rakhine Coastal Plain. They are well differentiated from each other by geomorphically and tectonically (Maung Thein, 1983) (Fig. 1.2). The Sagaing Fault – an active right-lateral strike-slip fault runs in north-south direction in the Central Cenozoic Belt. In the west of the Sagaing Fault, the Central Volcanic Line is transversing generally along the north-south direction in this belt. The dominant rocks of this belt are Cenozoic Sedimentary rocks. The general trend of the stratigraphic units is trending in north-south direction in this belt.

The study area is located in the eastern half of the Central Cenozoic Belt. It lies between the Sagaing Fault in the east and the Central Volcanic Line in the west of the area.

In the eastern part of Natogyi area, clastic sediments of Mio-Pleistocene age are exposed as dome-shaped inliers amidst the Quaternary deposits, while the western part forms a north-plunging anticline. Sediments of Pliocene age and later deposits are mostly exposed in the synclinal area. Medium to coarse-grained sandstone with large scale cross-stratification are exposed in this part.

Regional geologic setting of the area and its environ is shown in figure (1.3).

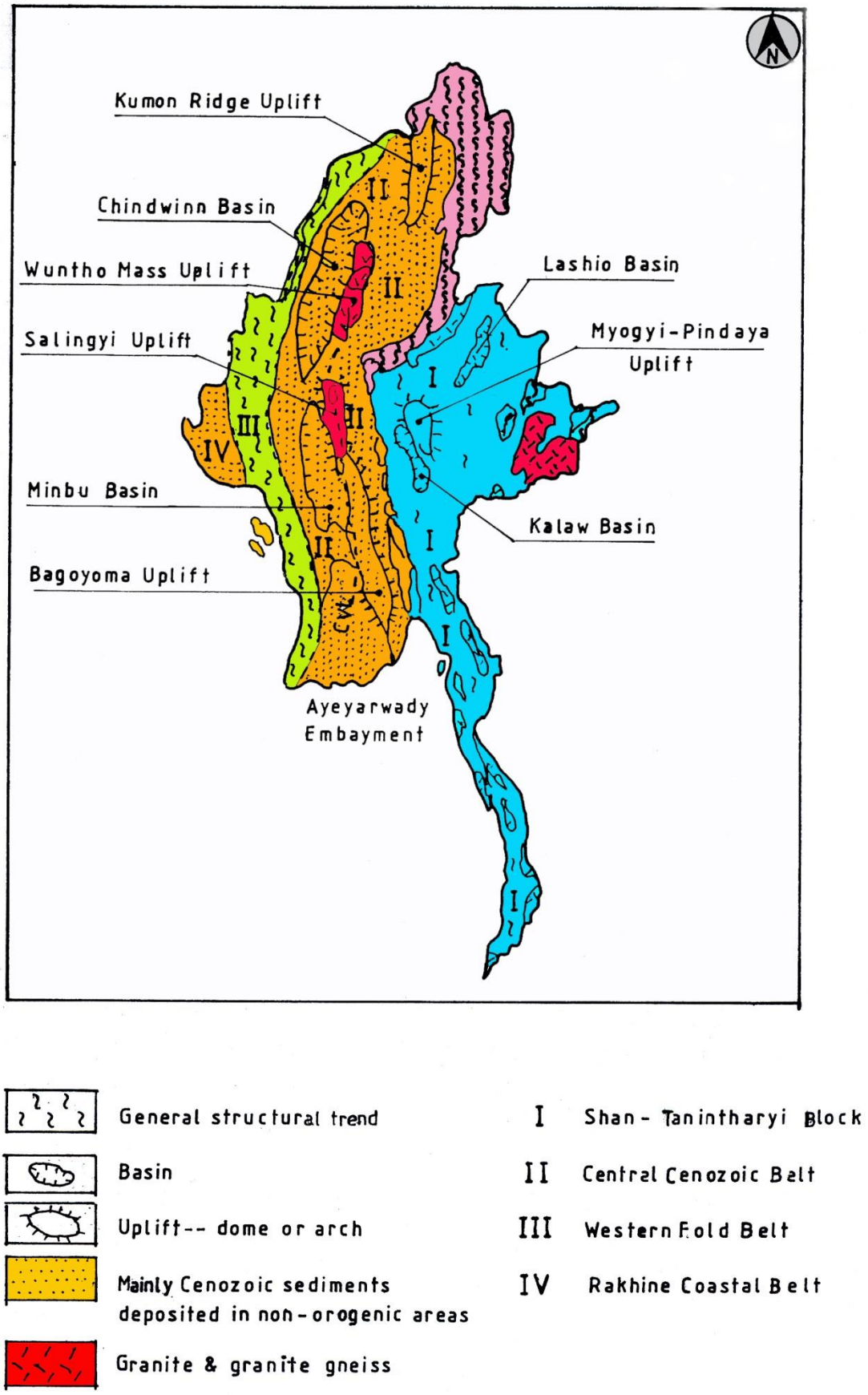
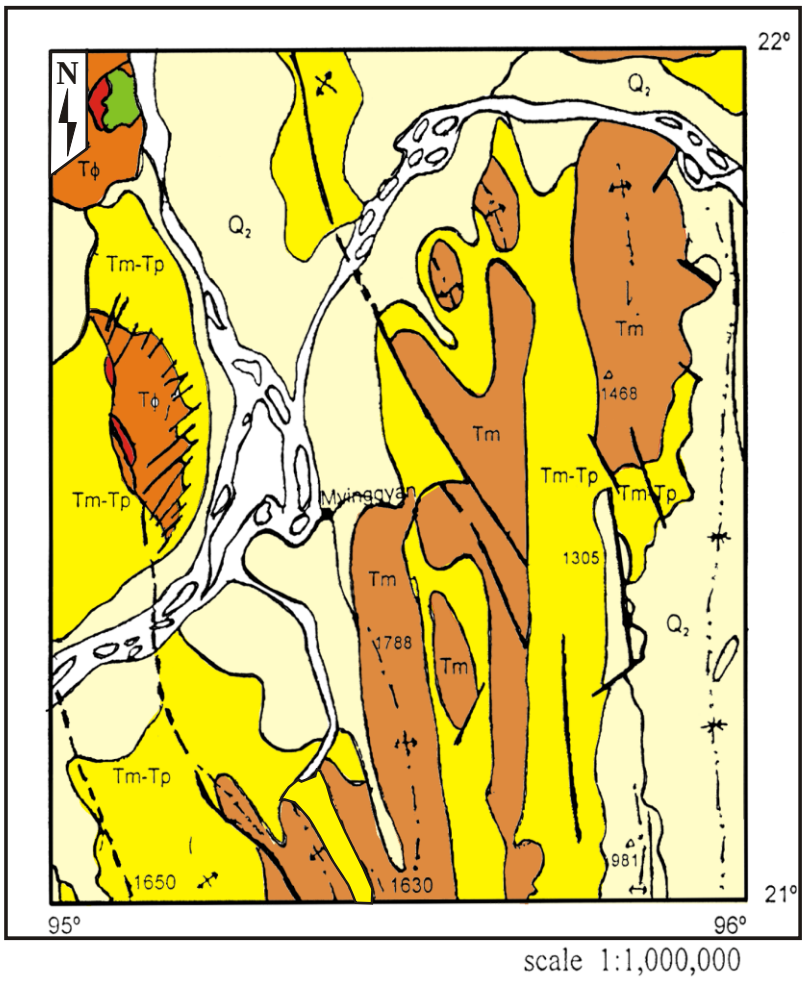


Fig. (1.2) Tectonic Provinces of Myanmar. (Source: Maung Thein, 1993)



EXPLANATION

Q_2	Holocene - Alluvium
Tm-Tp	Miocene-Pliocene-Irrawaddy Formation and its equivalents
Tm	Miocene - Upper Pegu Group and its equivalents
Tϕ	Oligocene - Lower Pegu Group and its equivalents
b	Gabbro and relative Intrusives
v	Volcanics (Mainly Basic) (Mainly Cenozoic)
	Geologic Contact
	Faults
	Anticlinal Axis
	Synclinal Axis

Figure (1.3) Regional geologic setting and its environs of the study area
(Source: The Geological Map of the Union of Burma, 1977)

2. Stratigraphy

2.1. General Statement

In the study area, a considerable thickness of clastic sediments is well exposed. They are observed as Upper Peguan rocks and Irrawaddy Formation.

The general trend of the rock units in the study area is from NNW to SSE. In some locality, the rock units are cut across by some diagonal faults.

The Rocks of Upper Pegu Group are exposed as anticlinal dome-shaped inliers between the Irrawaddy Formation and younger superficial deposits. This group is subdivided into two units of formation rank such as Moza Formation and Khabo Sandstone. In the field area, the only sedimentary rocks are exposed with the sequences of sandstones, siltstone, shale and clay layers. According to the former study of Bo San (1981), the lithologic characters and fossil assemblages of the study area are rather similar to those of the Taungtalon area (Myint Thein, 1966), Mingon Taung area (Thike Tun Thaw, 1977), Myotha area (Kyi Myint, 1980) and Taung Tha area (Khin Khin Lin, 1999). Out of the five lithostratigraphic units of the Taungtalon area, only three rock units are well exposed in the field area.

The geological map of the study areas is shown in Figure (2.1). Moreover, the stratigraphic succession of the study area is shown in Table (2.1).

Table (2.1) Stratigraphic Succession of the Natogyi-Taungtha Area

(After Bo San, 1981)

Geological Age	Group	Formation	Member	Thickness in feet
Pontian to Pliocene	Upper Pegu	Irrawaddy Formatin	Upper Member Lower Member	778
		Unconformity		
Middle Miocene		Khabo Sandstone	Upper Member Lower Member	2329
		Moza Formation	-	1076

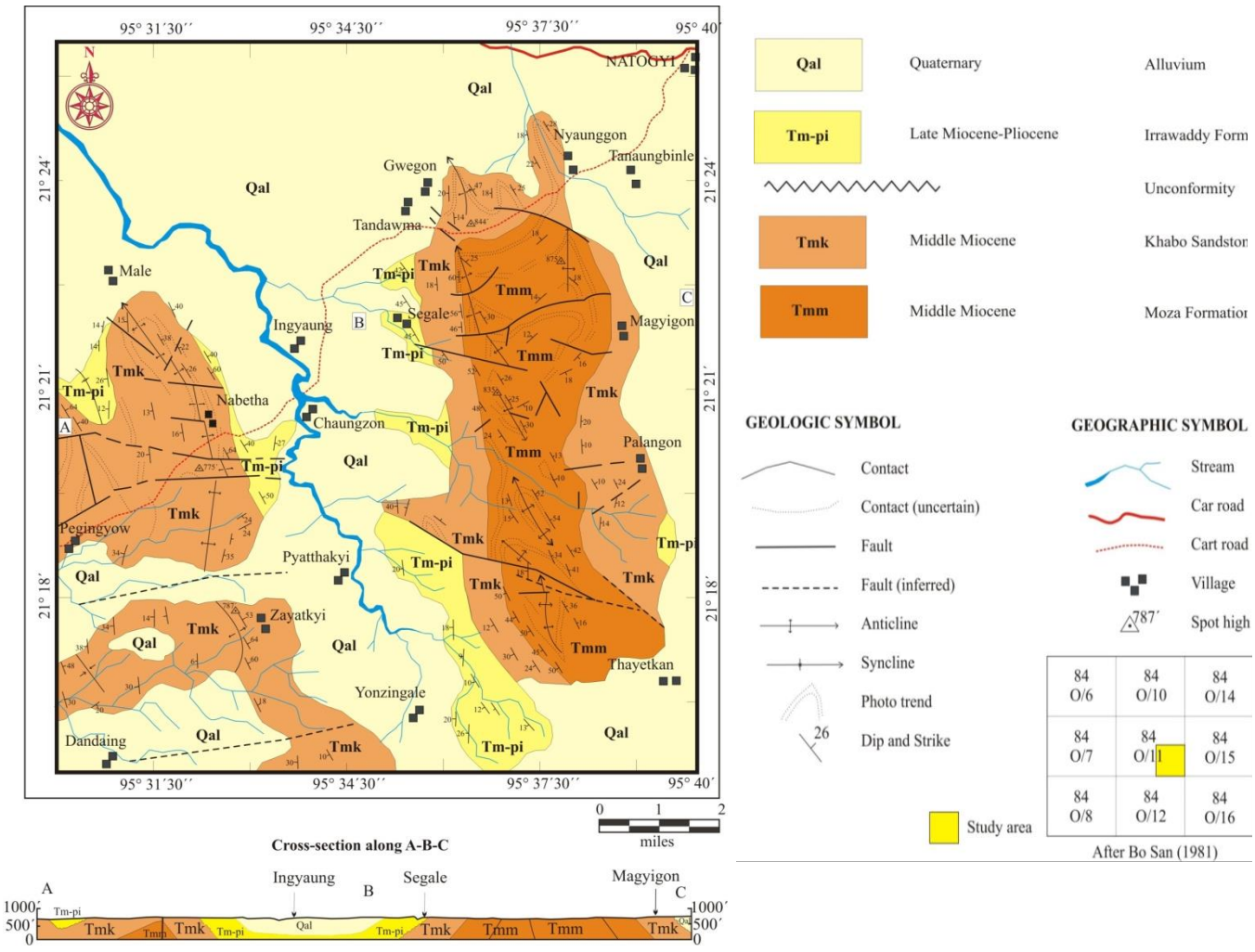


Fig. (1.4) Geological map of the study area.

3.Sedimentological log of upper pegu group

3.1. General Statement

The study of this work is to analyze the sedimentary properties of the formation of Upper Pegu Group. It is aimed to reveal the differences and resemblance between structures, textures and layer properties of the various units. For the study of this work, the techniques suggested by Bouma and Nota (1961), (in Maung Maung, 1978) have been used.

The detailed graphic logs were constructed in a tabulated form by plotting sedimentary features such as structures on bedding plane, structures within the layers, fossil content, etc. and these features were represented by means of symbols.

The present investigation attempts to describe lithologic units by means of detailed graphic logs. There is rare occurrence of fossils in the study area. Therefore, it is impossible to delimit contact boundaries of sedimentary formations based on paleontological data. The

general characters of the Peguan sediments are similar. However, the construction of detailed graphic logs will appropriate to identify the slight differences of units involved. It can be noted that the detailed graphic logs may serve as an effective tool in local correlative purposes. Moreover, it will also lead to deduce the possible sedimentary environments of the study area.

3.2. Sedimentological Log of Moza Formation

The graphic logs of the Moza Formation were obtained by detailed measurement of a section exposed at the eastern bank of Yebok chaung near Taungphila pagoda. The measured section is carried out at the upper part of Moza Formation. This section consists of 51 layers and has a total thickness of about 3200 centimeters. All the sedimentological characters of this formation are confined to this measured section. It can be divided into four units (unit A, B, C and D) (Fig. 3.1).

Unit A

This unit is composed of a total number of 13 layers. It is characterized by a suite of silty clay and coarse- to fine-sand layers. The colour of the silty clay is yellow while sand layers vary grey to yellowish grey. The induration degree of this unit varies from 2 to 3. Most of the silty clays are fissile. The bedding plane character of this unit is sharp flat to undulating contact.

The trough cross-stratification and ripple marks are common in the upper portion of this unit. The horizontal lamination and ripple marks are common in the lower part of this unit. On the other hand, the ripple marks are rather common in the middle part of this unit. (Fig. 3.2, 3.3, 3.4)

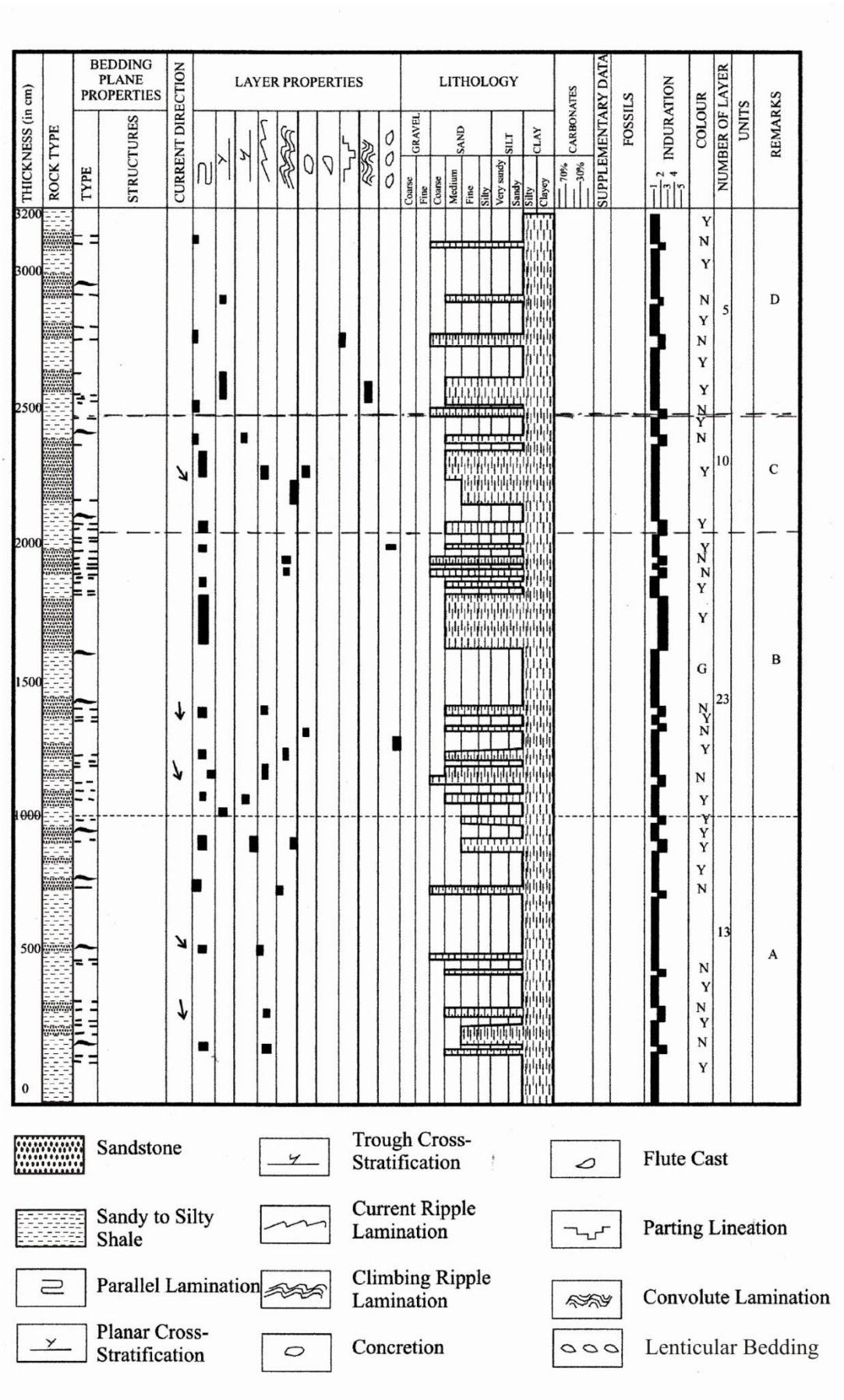


Figure (3.1) Sdimentologica log of Moza Formation at eastern side of Yebok Chaung near Taungphila Hill (N 21°17'43.5", E95°38'12.6")

Unit B

This unit contains 23 layers of alternating silty clay and medium bedded sand layers. The bedding plane character of this unit is observed such as sharp flat contact to undulating contact. The induration of this unit varies from 2 to 3. The colour of silty clay is pale greenish yellow to yellow, while the medium- to coarse bedded sand layers are mostly light grey to yellow.

The horizontal laminations, current ripples, mud clast inclusions and warm burrows are commonly observed in the upper part. Both the current ripple marks and climbing ripples are plentiful in the middle part of this unit. Moreover, the planar cross-stratification, lenticular bedding and wavy beddings are the characteristic of the lower most units. (Fig. 3.5, 3.6, 3.7)

Unit C

This unit is consisted of a total number of 10 layers. This unit is characterized by an alternate arrangement of coarse- to medium-sand and silty clay. The bedding planes are generally undulated. These layers are generally separated by mica rich wavy planes. The induration of this unit varies from 2 to 3. The colour of the sandstone in this unit is generally yellow and the silty clay is pale greenish yellow. The climbing ripples and concretions are abundant in the middle part of this unit. (Fig. 3.8, 3.9).

Unit D

This unit is composed of a total number of 5 layers. This unit is characterized by a suite of coarse-sandstone layers and silty clay. The colour of sandstone is generally yellowish grey to yellow and silty clay is light greenish yellow. The induration degree varies from 2 to 3. The planar type cross-stratifications and herring bone structure are generally common in the middle part of this unit. (Fig. 3.10, 3.11)

3.2.1. Interpretations of the graphic logs of the Moza Formation

In the present study of the Moza Formation, there are thin layers of fine- to medium grained sandstones with current ripples, climbing ripples, cross-stratifications and lenticular bedding. The sandstone concretions are rather common. They are interbedded with thick clays and siltstone sequences. There are also coarse-grained and well indurated sandstone with mud clasts inclusions. The colour of these sandstone in this formation can be observed as grey, light grey and yellow.

Fig (3.2) The alternative strings of sandstone bands and clay sequences which are parallel along the strike line in Moza Formation, (near Yebok-chaung)

Fig (3.3)Clay, silt and indurated hard sandstone band intercalated in Moza Formation, (near Yebok-chaung)

Fig (3.4) Thick clay sequence (a) with climbing rippled sandstone in Moza Formation near eastern bank of Yebok-chaung

Fig (3.5) Trace fossil in indurated hard sandstone of Moza Formation eastern bank of , Yebok-chaung

Fig (3.6) Lenticulr bedding in clay sequence in Moza Formation near eastern bank of Yebok-chaung

Fig (3.7) Wavy bedding in Moza Formation near eastern bank of Yebok-chaung

Fig (3.8) Alternative sequence of silt and clay in Moza Forrmation, eastern bank of Yebok-chaung

Fig (3.9) Climbing ripple in medium grained sandstone of in Moza Formation, near Yebok-chaung

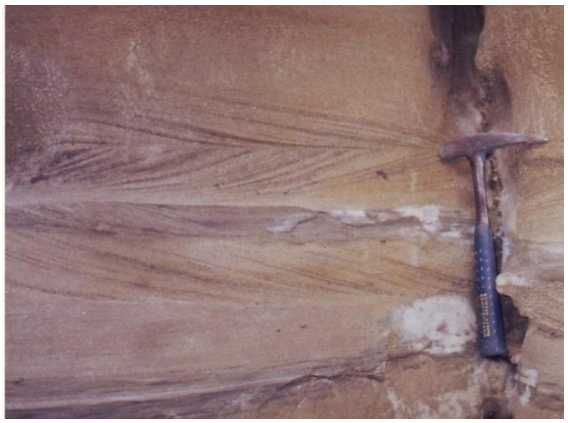


Fig (3.10) Small scale herring bone structure of silty sandstone in Moza Formation near eastern bank of Yebok-chaung

Fig (3.11) Thin to medium bedded sandstone of Moza Formation near eastern bank of Yebok-chaung

According to the above mentioned characters, it can be suggested that the sediments of the Moza Formation were deposited under a fairly variable hydrodynamic regimes (Reineck and Singh, 1980).

3.3. Sedimentological log of Khabo Sandstone

The graphic log of the Khabo Sandstone was obtained by detailed measurement of a section exposed at the northeastern bank of stream near northeast of Taungphila pagoda. This section is measured at the upper part of Khabo Sandstone. This section consists of 148 layers and has a total thickness of about 4130 centimeters. This measured section is

containing nearly all sedimentological characters of this formation. It can be divided into five units such as unit A, B, C, D and E (Fig. 3.12).

Unit A

This unit is composed of a total number of 38 layers. It is characterized by thin to medium beds of alternating coarse- to medium-sand layers and silty clay layers. Mud clast inclusions are observed in sand layers. The individual layers are separated by thin-silty clay layers. The colour of the sandstone layers vary yellowish gray to buff colour. The induration degree of this unit varies from 2 to 3. The boundary of bedding plane of this unit is commonly sharp flat to undulating contact.

The trough cross-stratification is common in the lower portion of this unit. The horizontal stratification and spheroidal sandstone concretions are also observed in the lower and middle portion of this unit. On the other hand, the ripple marks are rather common in this unit.

Unit B

This unit contains 52 layers of thin to medium bedded sand layers intercalated with thin silty clay layers. The bedding plane character of this unit is mainly sharp flat. The induration of this unit varies from 2 to 3. The colour of medium to coarse grained sand layers are grey, yellowish grey to buff colour, while silty clays are also pale yellow.

The horizontal laminations are common in this unit. The planar cross-stratification is commonly observed in the upper part of this unit. The current ripple marks are also common in the upper part of this unit. Bioturbation is common in the lower and middle part of this unit.

Unit C

This unit is composed of a total number of (18) layers. This unit is characterized by medium-to coarse-grained sand layers intercalation with thin, silty clay layers. The bedding planes are generally sharp flat. The induration degree of this unit varies from 2 to 3. The predominant colour of this unit is light grey to buff colour. The spherical sandstone concretions are common in the lower and middle portion of this unit. The parting lineation and current ripple marks are well observed in the middle part of this unit.

Unit D

This unit consists of a total number of (25) layers. This unit is characterized by an alternate arrangement of medium-to coarse-grained sand and thin silty clay layers. The bedding planes are generally sharp flat to undulated.

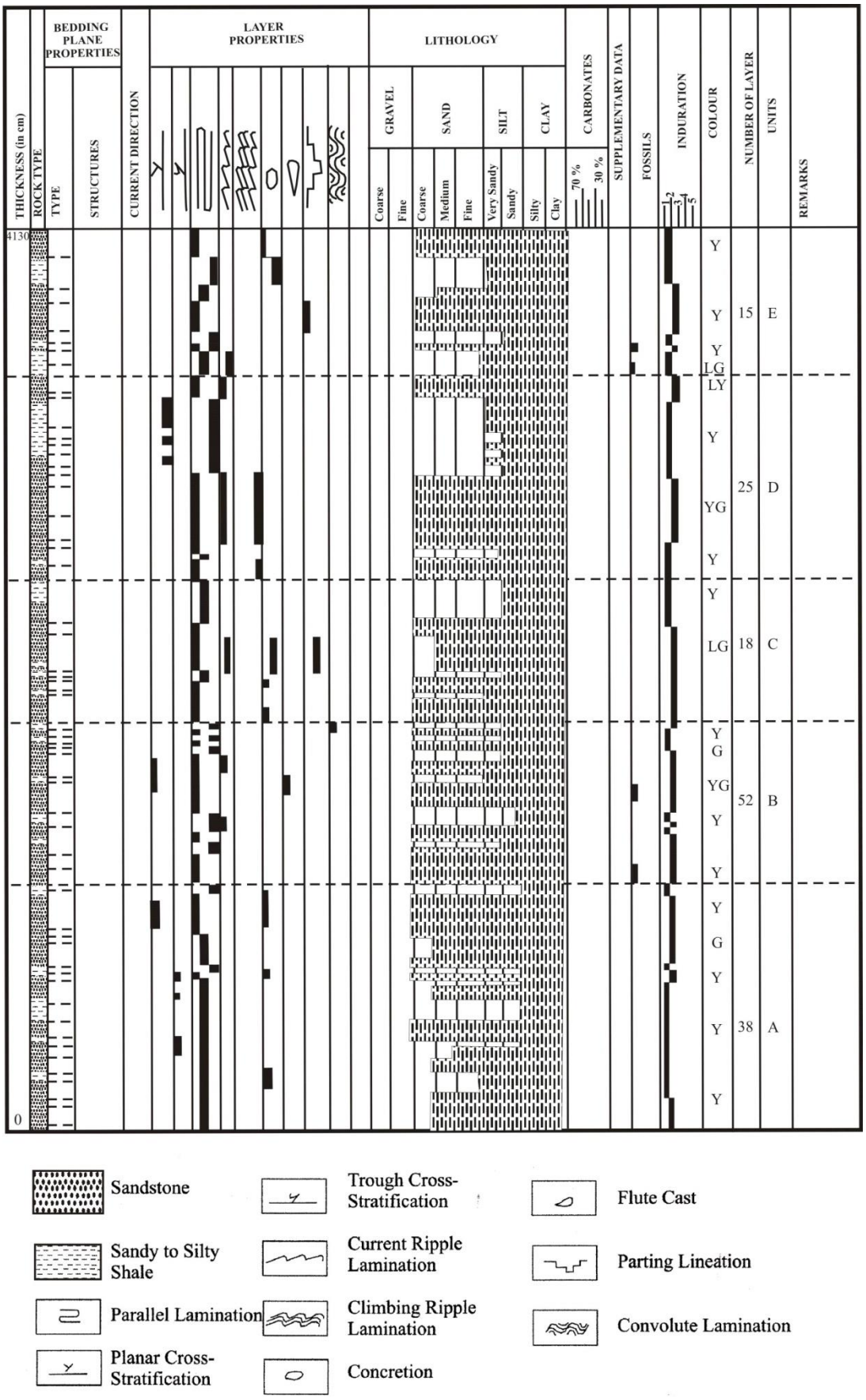


Fig (3.12) Sedimentological log of Khabo Sandstone at northeastern side of Taungphila Hill(N21°17'52.1", E95°38'19.6")

Among them, the medium bedded sandstone stratifications are separated by very thin silt layers. The induration of this unit varies from 2 to 3. The dominant colour of this unit is light yellow to buff colour.

The horizontal stratifications are commonly observed in this unit. The planar cross-stratification is well observed in the upper part. On the other hand, the sandstone concretions are also observed mainly at the lower part and middle part of this unit. Moreover, climbing ripples are also well noted in the middle part.

Unit E

This unit is composed of a total number of (15) layers. This unit is characterized by medium-to coarse-grained sandstone interbedded with thin silt and clay layers. The dominant colour of sandstone beddings are grey, pale yellow to buff colour while silt and clay intercalations are pale green. The induration degree of this unit varies from 2 to 3. The bedding plane character of this unit is generally flat. The current ripple marks are common in the lower part of this unit. The sandstone concretions are also observed in the upper part of this unit. On the other hand, bioturbation is also remarkable in the lower portion of this unit.

3.3.1. Interpretations of the graphic log of the Khabo Sandstone

In the present study of the Khabo Sandstone, it is remarkable that the medium to thick layers of medium to coarse grained sandstone are dominant. The sedimentary structures such as current ripples, climbing ripples, planar and trough cross-stratifications, parting lineation are well observed in this formation. The sandstone concretion and bioturbation are also common in this formation. Thin silt and clay intercalations are well observed in the medium to thick bedded sandstone.

From the detailed log study of the project area, it appears that the Khabo Sandstone and the former described Moza formation are somewhat different from each other. The frequency of vertical layer thickness variation of these two formations is quite different. It is quite clear that the beds of Khabo Sandstone are thicker than those of Maza Formation.

It can be recognized that the difference of colour between the Khabo Sandstone and Moza Formation. Generally, the sandstones which belong to the Moza Formation are reddish grey to yellowish grey in colour, while the Khabo Sandstone generally has grey to buff colour. Moreover, the large-scale planar type and trough type cross-stratification ripple marks and spherical sandstone concretions are dominant in Khabo Sandstone while the Moza Formation belongs to small scale structures.

All the above mentioned considerations, suggest that the sediments of the Moza Formation were deposited under a fairly variable hydrodynamic regimes of deltaic environment (Reineck and Singh, 1980). On the other hand, the sediments which belong to the Khabo Sandstone were deposited under more turbulent flow conditions (Reading, 1981).

4. Summary and conclusions

The stratigraphic succession of the study area is: (1) Moza formation (Middle Miocene), (2) Khabo Sandstone (Upper part of Middle Miocene) and (3) Irrawaddy Formation (Pontian to Pliocene).

The detailed graphic log of Moza Formation was constructed in a tabulated form by plotting sedimentary features. Detail measurements were carried out at a good exposure of the eastern side of Yebokchaug near Taungphila Hill.

The measured section was composed of 51 layers and has a total thickness of about 3200 cm. It can be divided into four units. Unit A contains 13 layers and composed of a suite of silty clay and coarse- to fine-sand layers. Horizontal lamination and ripple marks are commonly observed in this unit. Unit B contains 23 layers of alternating silty clay and medium bedded sand layers. Mud clast inclusions, current ripples and warm burrows are more common. Unit C is composed of 10 layers. The alternative arrangements of coarse- to medium-sands and silty clays are abundant. The planar cross-stratification, climbing ripple and sandstone concretions are common. Unit D contains 5 layers. It is composed of coarse sand layer and silty. The planar cross-stratification is common. According to the sedimentary structures and layer properties, the Moza Formation was deposited under a fairly variable hydrodynamic regime of deltaic environment.

Detailed measurements for the graphic log of Khabo Sandstone were carried out at a good exposure of the northeastern side of Taungphila Hill. The measured section was composed of (148) layers and has a total thickness of about 4130cm. It can be divided into five units such as unit A, B, C, D and E. According to the study of sedimentology log, Moza Formation was deposited under a fairly variable hydrodynamic regime of deltaic environment. On the other hand, the sediments which belong to the Khabo Sandstone were deposited under more turbulent flow conditions.

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