FACIES ANALYSIS OF THE KYAUKKOK FORMATION IN THE SINTHE CHAUNG NEAR MILEPOST 240 BETWEEN NAY PYI TAW-MANDALAY HIGH-WAY

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Abstract

The study area is located in the west of Tatkon Township, Mandalay Region. This area is well exposed of the Kyaukkok Formation (Burdiagalian), the Obogon Formation (Vindobonian) and the Irrawaddy Formation (Pontian to Pliocene). In the study area, the Kyaukkok Formation is well exposed in the Sinthe Chaung. The Kyaukkok Formation is mainly composed of thin to medium bedded, gray, yellowish brown, fine to medium grained sandstone. Micaceous sandstone hard band are locally exposed. In some place, concretions, ripples and cross-laminations are common in the Kyaukkok Formation. In the present research, primary sedimentary structures are used for the facies scheme. The lithology, nature of the bed base and paleocurrent direction is also used to perform facies analysis to interpret the sedimentary environments. The Kyaukkok Formation of the Sinthe Chaung are divided into seven lithofacies such as thick bedded bluish gray shale facies, sandstone and shale alternation facies, thin to medium bedded sandstone facies, massive sandstone facies, trough cross- bedded sandstone facies, hummocky cross- stratification sandstone facies, and sand- mud interlayer facies. These facies can be grouped as prodelta/ offshore facies association, delta front facies association, delta plain facies association and outer shelf facies association.The Kyaukkok Formation is deposited in subtidal, intertidal, and offshore/ shelf environment.

Keywords – Kyaukkok Formation, Facies Analysis

Introduction

Location and Size

The study area lies between latitude 20˚ 05' 00" and 20˚15' 00" N, longitude 95˚ 53' 00" and 95˚ 57' 00" E, along the Nay Pyi Taw - Mandalay High - Way (expressway) between mile post 233 -240,covering one inch topographic map No. 84 p/16 of Myanmar Survey Department (Figure.1). The study area is easily accessible by car all the year.

Physiography

The study area is located in northern part of the Bago Yoma and is mainly covered rolling hills and flat valleys. This rolling terrain is composed of several short ranges usually trending N-S direction. The study area has mainly gradual slopes and small number of steep slopes. The overburden soil covers over a wide area (Figure.2).The Sinthe Chaung is the northern boundary of the study area which is a main stream flowing from NNW-SSE direction. Dendritic drainage pattern is the most common in this area. Drainage pattern is medium to coarse texture in the all areas (Figure.3).

The study area is located in the Central Myanmar Region and semiarid climate is well developed. The rainy season is the most important season, because it takes place the flooding which has large effect on annual output of crop production, settlement pattern and transportation

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especially, Sinthe Chaungand its environs. In the study area, wood, bamboo, banana plant, bushes are observed. The alluvial plain is used as cultivated land, where peddy-fields and garden-fruit are grown.

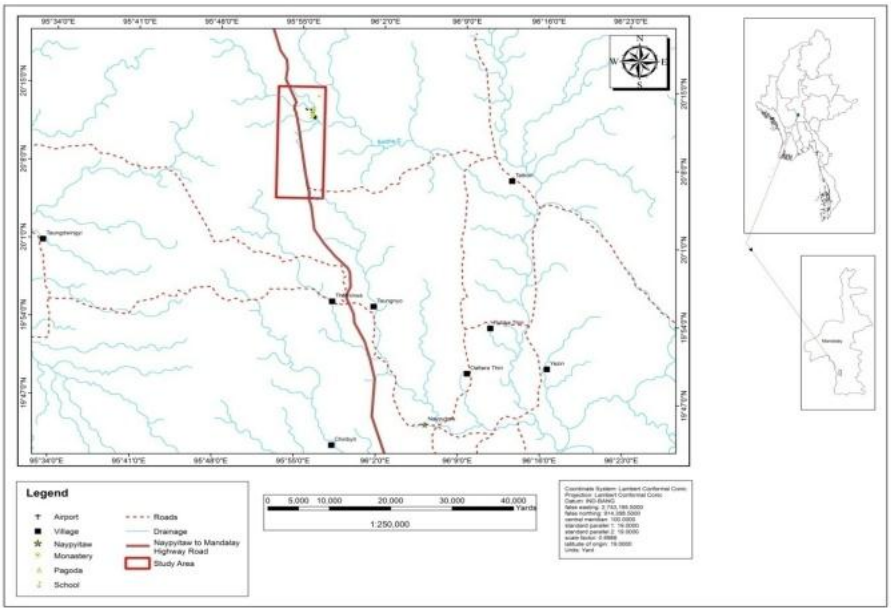

Figure 1 Location map of the study area

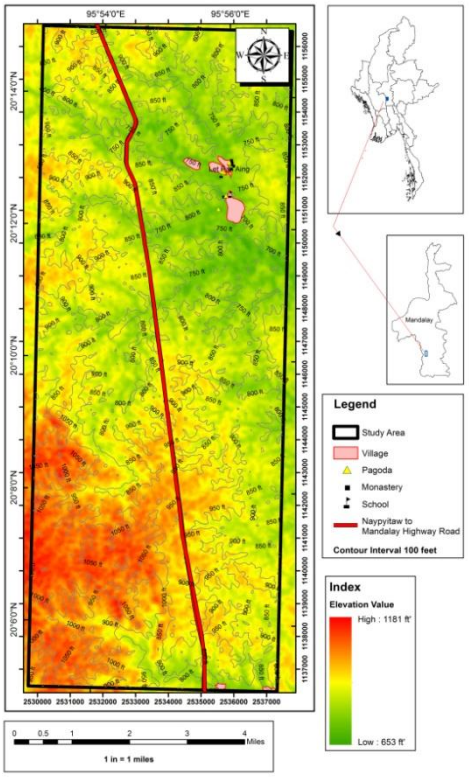

Figure 2 Topographic map of the study area.

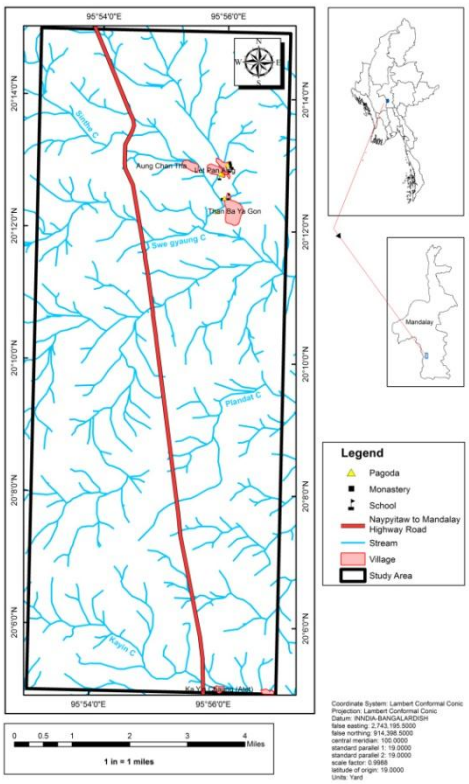

Figure 3 Drainage pattern map of the study area

Purpose of Research

The present research has been carried out according to the following objectives:

1. To prepare a fairly detail geological map with appropriate scale.
2. To conduct the sedimentary facies analysis and to interpret the depositional condition
3. To reveal the lithofacies association of the study area.

Material and Methods

The literature review, aerial photo analysis, reconnaissance field checking and also collecting sample were done initially. Based on the sedimentary structures observed in the rock unit of the study area, the facies analysis has been established.

Regional Geology

The study area occupies the hinge of the Eastern trough and Western trough of the Central Cenozoic Belts of Myanmar and situated just east of the Central Volcanic line and well-known Sagaing Fault those runs north-south. The geological formations encountered belong to Pegu group and Irrawaddy Formation. In the study area, Kyaukkok Formation mainly composed of yellowish brown to grayish brown, fine to medium grained sandstone with few alterations of shale and clay. Obogon Formation consists of medium to thick bedded, fine to medium grained, pale yellow to buff colour, soft sandstone and bluish gray to greenish gray shale. Irrawaddy Formation consists of yellowish to pinkish brown coloured, medium to thick bedded, coarse-grained, loosely consolidated sandstone with intercalated very thin bedded siltstone and clay/mudstone. These strata are generally NNW-SSE trending with east dipping but west dipping in some localities. The upper Pegu Group is bounded by an unconformity which occurs in Miocene and Mio-Pliocene Period (Figure 4 &5).

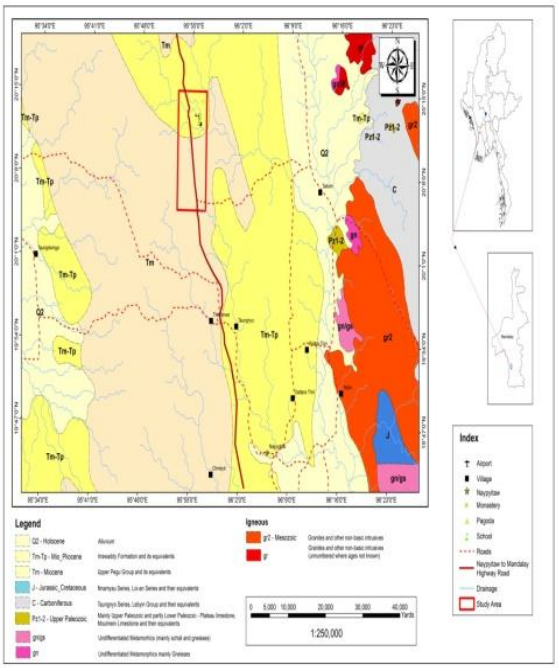

Figure 4 Regional geological map of the study area and its environs
(**source**: Myanmar Geosciences Society, 2014.)

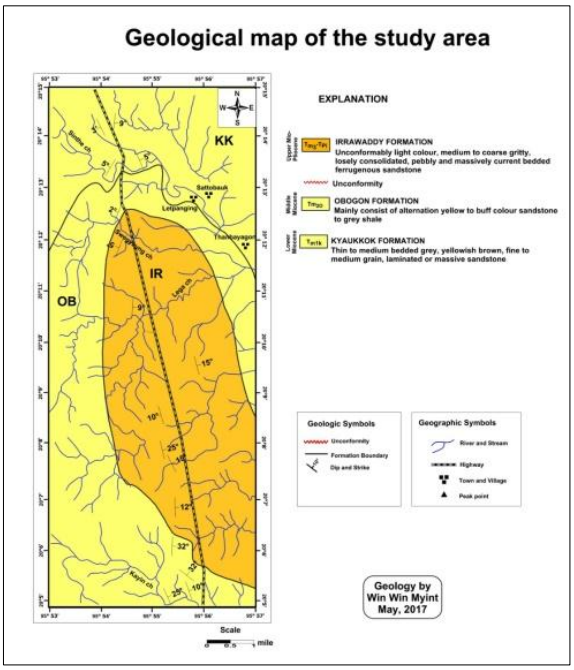

Figure 5 Geological map of the Study area.

Results and Discussion

Sedimentary Facies Analysis

In the study area, the depositional sedimentary features are used for the facies scheme. The lithology, nature of the bed base and paleocurrent direction were used to perform facies analysis and to interpret the sedimentary environments. Moreover, the petrographic characteristics can be used and certain conditions as an aid to the facies analysis.

To analysis the sedimentary facies of Kyaukkok Sandstones, sedimentologic measurements were made along the Sinthe Chaung near milepost 240 between Nay Pyi Taw – Mandalay High-Way.

Classification of Sedimentary Facies

In the study area, measurable exposures are observed. The columnar sections are established for each sedimentary facies. The clastic sedimentary rock sequences of the study area are subdivided into (7) facies as follow. (See Appendix)

They are:	Lithofacies (A)	Thick bedded bluish grey shale Facies
	Lithofacies (B)	Sandstone and shale alternation Facies
	Lithofacies (C)	Thin to medium bedded sandstone Facies
	Lithofacies (D)	Massive sandstone Facies
	Lithofacies (E)	Trough cross-bedded sandstone Facies
	Lithofacies (F)	Hummocky cross-stratification sandstone Facies
	Lithofacies (G)	Sand-mud interlayer Facies

Thick bedded bluish grey shale Facies

Description

This facies is mainly composed of bluish gray color and thin to medium bedded shale and nodular type (Figure.5). Locally, upward increase the shale content is occurred. Desiccational joints and calcareous sand concretion are common. Sand layer intercalated in shale units are also observed. The contacts of two adjacent layers are sharp, erosional and transitional.

Interpretation

Shale can occur away from the coast and settle out of suspension. The settlement of finer particle can be occurred in low energy environments. The presences of sandstone layers denote the storm generated sand layers. The bluish gray shale of nodular type was deposited in prodelta area (Reineck and Singh, 1980). Reading (1981) pointed that these thick accumulations of shale can be occurred in offshore or prodelta area.

Sand and shale alternation Facies

Description

In the study area, the alternations of sandstone and shale layers are widely distributed. Sandstones are gray to yellow, fine to medium grained and parallel laminations are common. Wavy and ripple laminations are also found in some horizons. Sandstones are hard and compact (Figure.6). Shales are bluish gray, thinly lamination and soft. The average thickness of sand bed

is about 6 cm to 30 cm thick and shale is about 1cm to 2.5 cm. Sharp, erosional and transitional contact is common.

Interpretation

The alternate nature of sandstone and shale bedding resembles the current action and slack water depositional condition. The sand layers are deposited during current and wave activity. Most mud is deposited during period of slack water and just before and after the slack water condition. Alternate deposition of thick sandstone and shale layer can operate in areas other than tidal environments (Reineck and Singh, 1980). Therefore, the alternation of sandstone and shale layers might be formed by the alternation of transgression and regression condition.

Figure 5 Photograph showing thick bedded bluish gray shale exposed in the Sinthe Chaung (N 20˚ 13′ 26″, E 95˚ 54′ 48″), facing east.

Figure 6 Photograph showing sandstone and shale alternation in the Sinthe Chaung (N 20˚ 13′ 22″, E 95˚ 54′ 26″), facing south-east

Thin to medium bedded sandstone Facies

Description

This facies is mainly consists of thin to medium bedded, fine to medium grained, gray to buff coloured sandstone with thin mud intercalation resting on wavy or slight erosional base (Figure.7). The sandstone beds of this facies are generally wavy laminated. Some of the beds are composed of parallel laminated sandstone whereas wave ripples present on top of some beds. Moreover, the rare case is that the micro deformational features such as flame structure are occurred at the base of some beds intercalated in shale veneer. This facies is generally associated with thick bedded bluish gray facies, and flaser or lenticular-bedded facies. This facies is thickening upward nature.

Interpretation

Thin to medium bedded sandstone of Kyaukkok Formation was deposited in delta front environment. The initially associated wavy laminations were form between the storm wave base and fair-weather wave base (Walker, 1992). The micro-deformational features are indicative of the prodeltaic environment under the high rate of sedimentation. The beds thickness and facies association show that this facies was deposited in lower subtidal or delta front area. The present of sand beds alternative with mud intercalation point out the area of the energy condition and slack water period (Reineck and Singh, 1980).

Massive sandstone Facies

Description

Massive sandstone and some clay are interbedded in these sandstones. Massive sandstone is dark grey in fresh colour and yellow colour in weather surface (Figure.8). Mud pebbles are found. Sandstones are fine to medium grained, moderately hard and compact. The bed thicknesses are variable and coarsening upward nature is the characteristic feature in this facies. Sharp (parallel and erosional) contact is characterized, but in some horizons, transitional contact is also common.

Interpretation

Massive sandstones are representing the abundance of sand supply conditions during high energy regime. The intraformational mud pebbles are commonly concentrated at the base of point bar (Reineck and Singh, 1980). The lithologic character and facies scheme tend to regard that it may be either upper shore face (fore shore) or shallow channel. Therefore it may be deposited in near shore or beach environment.

Figure 7 Photograph showing thin to medium bedded sandstone exposed in the Sinthe Chaung (N 20˚ 13′ 22″, E 95˚54′ 26″), facing south-east.

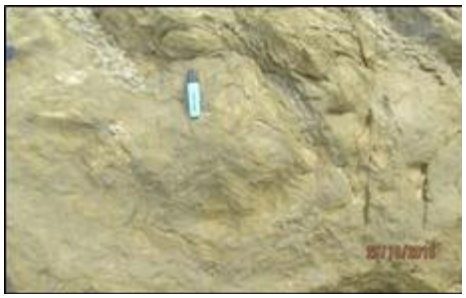

Figure 8 Photograph showing thick bedded sandstone exposed in the Sinthe Chaung. (N20˚ 13′ 22″, E 95˚54′ 26″), facing south-east.

Trough cross-bedded sandstone Facies

Description

This facies is mainly composed of fine-grained, gray colour, soft to moderately hard sandstone. The primary sedimentary structure is trough cross bedded and wavy laminations (Figure.9). Paleocurrent directions of cross-beds sets show southwest in lower horizon whereas the northeast in the upper part of Kyaukkok Formation. The bed base type of this facies is erosional type. The average thickness of this cross bedding is about 4 to 8 inches in height and 8 to 12 inches wide.

Interpretation

The sandstones with cross bedded on erosional base point out that the depositional environment is channel area where erosive base occurs. The unidirectional paleocurrent indicate that the deposition medium was influenced by river. They are mostly as a result of depositional from migration small current and ripples (Reineck and Singh, 1980). This facies is deposited under shallow marine intertidal environment.

Hummocky cross-stratification sandstone Facies

Description

Hummocky cross-stratification are found in fine to medium grained, gray to dark gray colour, thick bedded to massive sandstones. The hummocky cross-stratification of curving laminations, both convex-up (hummocky) and concave-up (swale) (Figure.10). Base contact is erosional and upper contact is parallel. The thickness of this bed is 6 cm to15 cm. These beds are truncated each other in this facies. The thickness of this facies is about 10 m.

Interpretation

Hummocky cross-stratification indicated that storms domination dominated facies succession (Walker, 1984). It may be deposited in the middle shelf platform where these was a storm action. Moreover, these were generated in storm condition by geostrophic currents especially in sub- tidal are. Storm deposits are commonly preserved in prograding shore face successions (Dyson, 1995). Cores of possible hummocky cross-stratifications have been obtained from the shore face (Greenwood and Sherman, 1986). Therefore, this facies is deposited in sub-tidal environment under influence of storm.

Figure 9 Photograph showing trough cross bedded sandstone unit exposed in the Sinthe Chaung (N 20˚ 13′ 22″, E 95˚54′ 26″), facing south-east

Figure 10 Photograph showing wave ripple and small hummocky cross-stratification sandstone exposed in the Sinthe Chaung (N 20˚ 13′ 28″, E 95˚ 54' 16" facing east.

Sand-mud interlaying Facies

Description

Sand-mud interlayer facies composed of flaser, lenticular, and sand/ mud alternate heterolithic beds (Figure.11, 12). The flaser facies comprises the micro cross-laminated sand layers alternating with bluish gray mud concentrating on the trough of the adjacent ripple with unidirectional or bi-directional paleocurrents. Sand-shale ratio is 3:2 in average. The lenticular-bedded sandstone facies is characterized by ripple (linguoid) topped thin-bedded sand-mud alternation.

Both fining and coarsening sequence occur and associate with trough cross bedded sandstone facies and shale facies. Thin sand mud alternation facies comprises various proportions of fine sand and mud with transional bedding character. This facies can be observed in the Sinthe Chaung.

Interpretation

Flaser, lenticular bedded sandstone facies was confirmed to be deposited in intertidal mixed flat area (Klevin, 1971). These alternate beddings are mostly related to the tidal currentand slack water phases (Reineck and Singh, 1980). The bi-directional micro-cross laminated indicates the tidal influence. Moreover, the flaser beddings, lenticular beddings, wavy ripples and finely interlayered sand-mud beddings are the characteristic features of the intertidal mixed flat (Reading, 1980). Under the constant fluctuation but relatively in a low energy condition (Reineck and Sighn, 1980).

Figure 11 Photograph showing hummocky cross-stratification sandstone with event horizontal though to be deposited of seismite in the Sinthe Chaung (N 20˚13' 28″, E 95˚ 54' 16"), facing east.

Figure 12 Photograph showing the sand-mud inter layer bedding the sand composed of micro-cross lamination (N 20˚ 13′ 27″, E 95˚ 54′ 16), facing east.

Facies Association

A combination of one or more facies which are formed in the same deposition environment at a certain geologic time can be grouped as a facies association. A facies association can be used for the more detailed interpretation of depositions handled the transgressive-regressive eposides. Thus, these facies can be grouped as prodelta/ offshore facies association (thick bedded bluish grey shale facies), delta front facies association (sandstone and shale alteration facies, thin to medium bedded sandstone facies, shale intercalated with sandstone facies), delta plain facies association (massive sandstone facies, trough cross-bedded sandstone facies, hummocky cross-stratification sandstone facies), and outer shelf facies association (sand mud inter layer facies).

Summary and Conclusion

The study area is located in west of Tatkon Township, Mandalay Region. It is mainly composed of Neogene and Quaternary clastic sedimentary rocks. The three lithostratigraphic units namely the Kyaukkok Formation, the Obogon Formation and Irrawaddy Formation have been observed. The present study mainly focused on facies analysis of the (Early Miocene) Kyaukkok Formation. Totally seven sedimentary facies can be divided in this area: (A) Thick bedded grey shale Facies, (B) Sand and shale alteration Facies,(C) Thin to medium bedded sandstone Facies, (D) Massive sandstone Facies, (E)Trough cross-bedded sandstone Facies,(F) Hummocky cross-stratification sandstone Facies, and (G) Sand-mud interlayer Facies. They can be grouped into three lithofacies association; (i) Intertidal Facies Association, (ii) Subtidal Facies association and (iii) Prodelta /Offshoe Facies Association. The sandstone of Kyaukkok

Formation was laid down shore face during Early Miocene (Burdigalian). Thus a short term marine regression took place. After then, this area may become deeper in latter transgression period of Burdigalian which is documented by the thick clay unit underlying the sandstones. This transgression was followed by subsequent minor regression leading to be formed the tidal flat sedimentation. The sandstones of the Kyaukkok Formation are economically used as construction and road materials.

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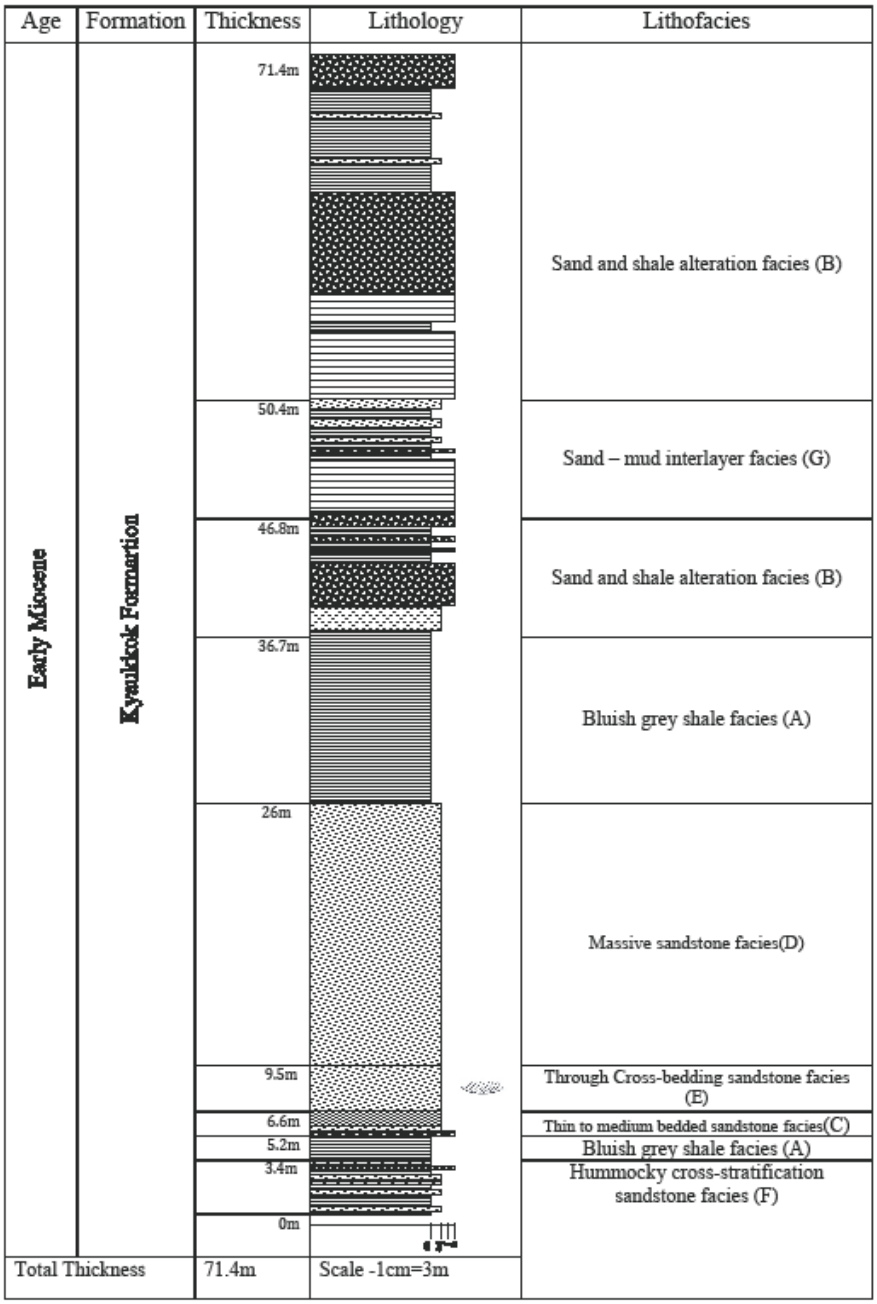
Appendix



Stratigraphic column of Kyaukkok Formation exposed along the Sinthe Chaung (N 20˚ 13′ 22″ to 20˚ 13′ 28″ and E 95˚ 54′ 16″ to 95˚ 54′ 26″)