

Sedimentary Facies Analysis of Irrawaddy Formation in the Migyaungye- Kunon Area, Magway Township, Magway Region

Warr Warr Thidar Swam*, Khin San, Zin Maung Maung Thein***, Soe Myint******

Abstract

Migyaungye- Kunon area is situated far about 40 miles from the eastern bank of the Ayeyarwaddy River in the southeast of Magway Township,. It is located between the latitudes $19^{\circ} 53' N$ and $19^{\circ} 59' N$ and between the longitudes $95^{\circ} 06' E$ and $95^{\circ} 14'E$, referring to UTM topographic map 1995-01 (85 M-1). The sedimentary rocks found in the study area are subdivided into two formation based on the lithologic and faunal characteristics. They are Irrawaddy Formation (Late Miocene to Early Pleistocene) and Obogon Formation (Middle Miocene). Section measurements were particularly made in detailed along the well exposed sections which are perpendicular to structural trend. In the present study area, the Irrawaddy Formation is well exposed along the Ye Ngan Chaung, Sadaung Chaung and Kun on Chaung section. At least (9) lithofacies can be recognized and there are grouped into (3) lithofacies association of the Irrawaddy Formation, according to the feature of lithology, texture, sedimentary structures, fossil contents, etc. They are (1) Channel facies association, (2) Overbank facies association and (3) Flood plain facies association. According to the facies association and sedimentary characters, the Irrawaddy Formation is assigned to be deposited under meandering river dominated fluvial environment.

Key words: facies, facies association, fluvial environment

Introduction

The location of the Migyaungye- Kunon area is situated about 40 miles from the southeast of Magway Township lying on the eastern bank of the Ayeyarwaddy River (Fig:1). It is located between the latitudes $19^{\circ}53' N$ and $19^{\circ}59' N$ and between the longitudes $95^{\circ}06' E$ and $95^{\circ}14'E$, referring to UTM topographic map 1995-01 (85 M-1). The study area is 11 kilometers long in the north-south direction and 14 kilometers wide in east-west direction, covering an area of 154 square kilometers of rolling hill. The main purpose of the present study is to interpret the depositional environment of Irrawaddy Formation exposed in the study area and to reconstruct the depositional model of the Irrawaddy sediments by carrying out the facies analysis.

* Lecturer, Geology Department, Yadanarbon University

** Professor and Head, Dr, Geology Department, Myingyan University

*** Professor, Dr, Geology Department, Mandalay University

**** Lecturer, Geology Department, Yadanarbon University

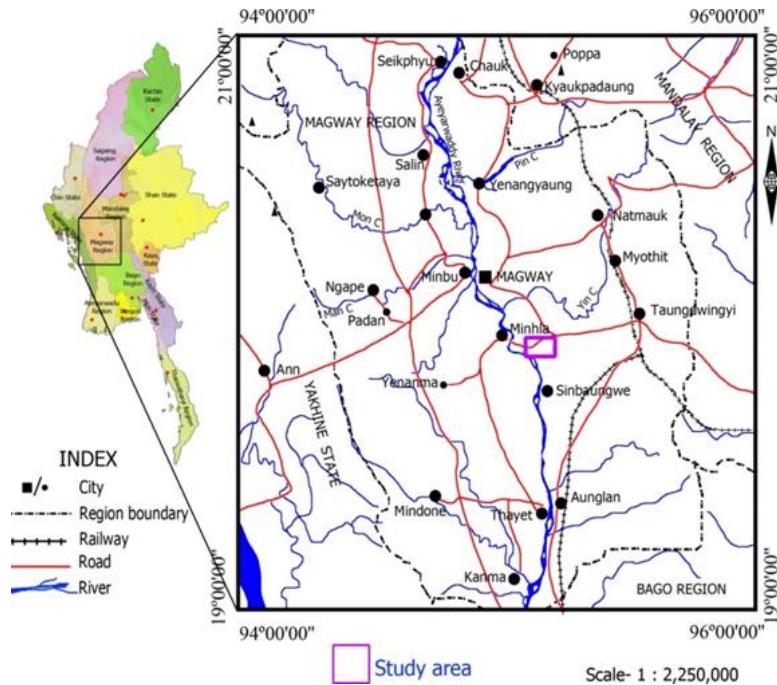


Fig: (1) Location map of the Migyaungye -Kunon Area, Magway Township

The study area is situated as a small segment of southernmost portion of the Minbu Basin of Central Cenozoic Belt. It mainly consists of the siliciclastic rocks belonging to the upper Pegu Group to Irrawaddy Formation. The regional tectonic setting and lithostratonomomic characteristics indicate the molasses nature of these sediments (fig 2). The sedimentary rocks in the study area are subdivided into two formation based on the lithologic and faunal characteristics. They are as follows;

- (2) Irrawaddy Formation (Late Miocene to Early Pleistocene)
- (1) Obogon Formation (Middle Miocene)

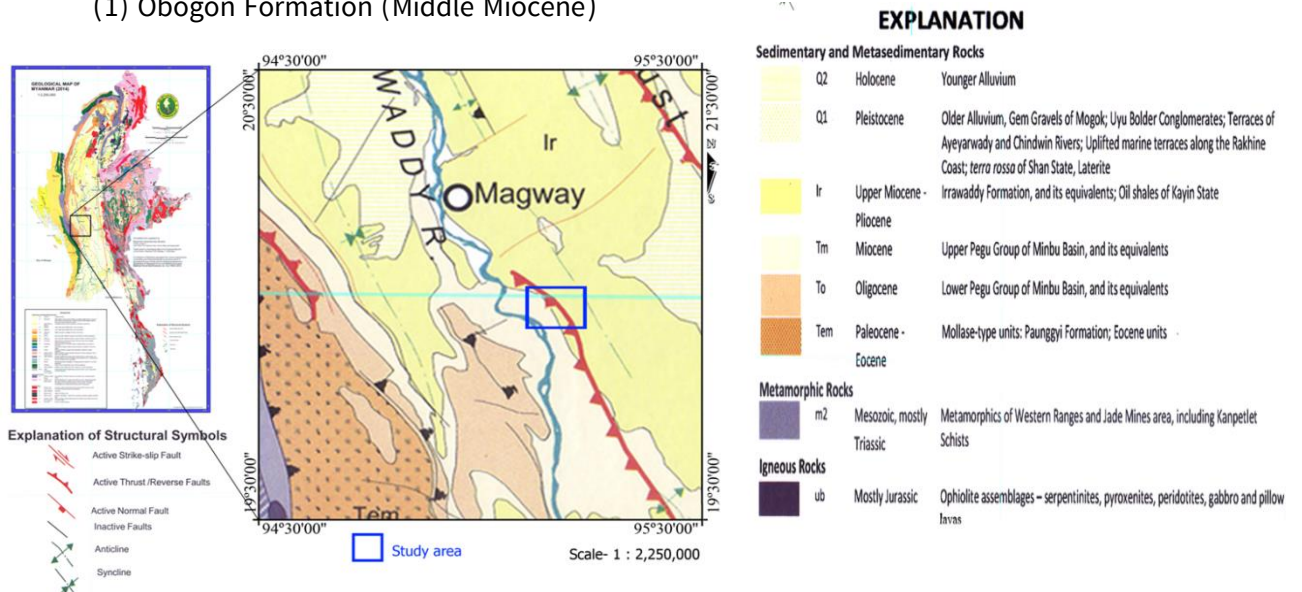


Fig (2) Regional geologic setting of the study area (After Geological Map of Myanmar, Myanmar Geoscience Society, 2014)

Previous Works

Irrawaddy Formation, exposed in the eastern part of the study area, yields several vertebrate taxa. Chit Sein (2006) studied the vertebrate fossils from present area for his doctoral thesis and described dental remains of several extinct mammals (*Chalicotherium*, *Amphicyon*, *Stegodon*, *Stegodolophdon*) from the late Miocene Irrawaddy Formation of proposed area (Chit Sein et al., 2008, 2009, 2011, 2014). Shimada et al., (2016) carried out the systematic paleontology of the extinct river shark from Obogon Formation of the study area.

Lithofacies of Irrawaddy Formation

In the present study area, the Late Miocene to Early Pleistocene age for Irrawaddy Formation is well exposed along the Yengan Chaung, Sadaung Chaung and Kun on Chaung section. At least (9) lithofacies can be recognized in the Irrawaddy Formation according to the feature of lithology, texture, sedimentary structures, fossil contents, etc. The detail facies column of the Irrawaddy Formation measured along the Ye Ngan Chaung (Fig 3).

Facies (A): Medium to thick bedded conglomerate

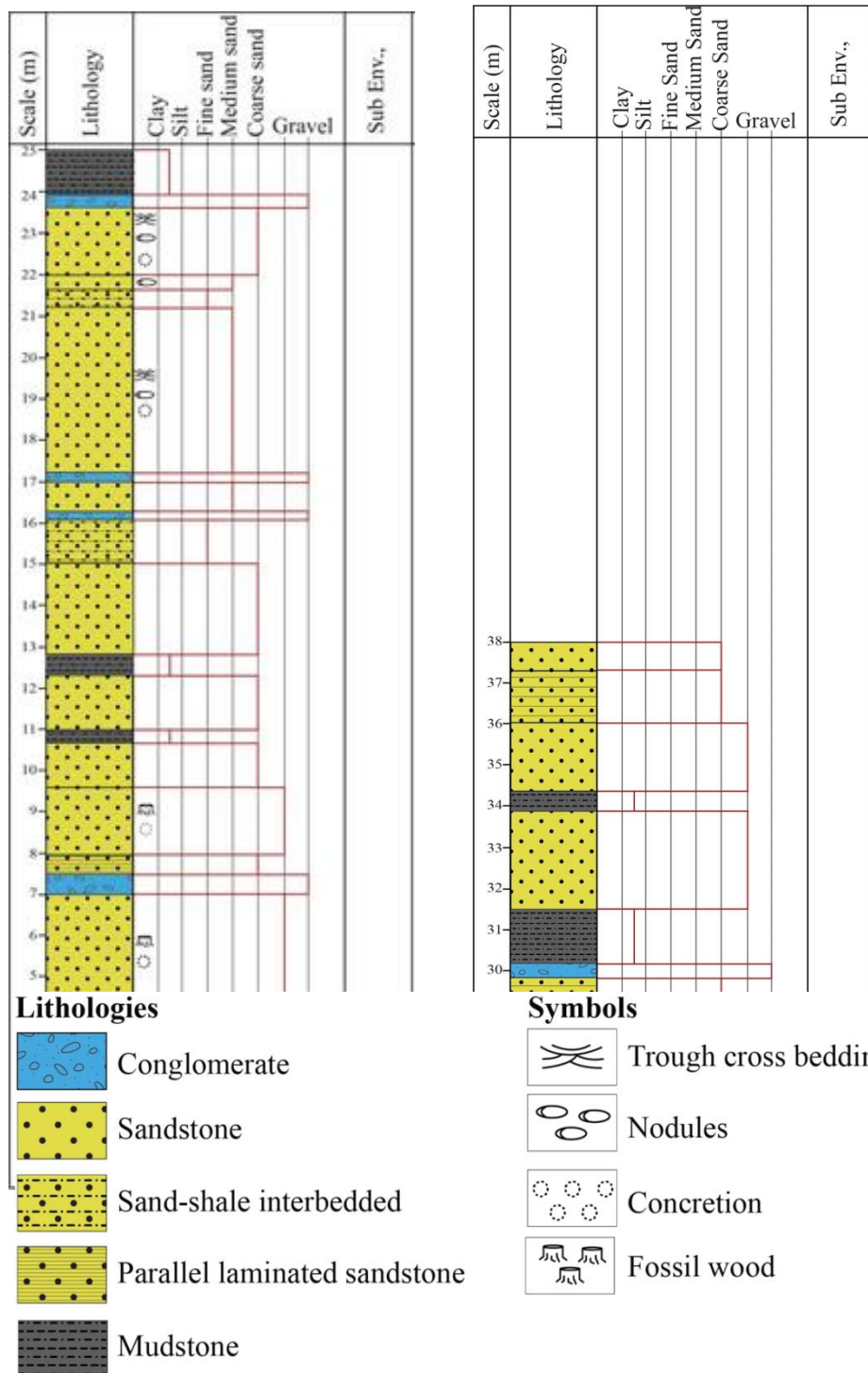
This facies is occurred in the lower part of the Irrawaddy Formation. It is mainly composed of reddish brown, thick bedded massive conglomerate (Fig. 4). The conglomerates are composed of sand, pebble, mud, iron concretion, fossil wood and bone fragments. It ranges from 10 to 70 cm. In some place, ferruginous conglomerate are occurred in the area. This facies may be formed lag at the base of the channel deposits (Mial, 1987).

Facies (B): Massive sandstone

This facies occupies in the upper and the lower portion of the Irrawaddy Formation exposed in the study area. This facies is mainly composed of yellowish brown, medium to coarse-grained, massive friable sandstone (Fig 5). The thickness of each bed varies from 70 to 400cm. In some places, concretions, fossil wood and calcareous nodule are also occurred. The boundaries between the associated facies are sharp and erosional contact. This facies may be assigned to have been deposited by channel lag deposits (Reineck and Singh, 1980).

Facies (C): Trough cross-bedded sandstone

The facies distributes in the upper and lower member of the Irrawaddy Formation. It contains buff coloured, coarse grained sandstone with small to medium scale trough cross-bedding (Fig 6). Unidirectional trough cross stratification also occurs in the study area. Cosets of trough cross-bedded sandstone are 30 to 90 cm thick. Lower and upper contacts of cosets are sharp and erosional. This facies is interpreted as formed under lower flow regime condition by migration of three-dimensional bedforms (dune and mega ripple). (Reineck & Singh, 1980).



Fig(3) Detail sedimentary facies column of the Irrawaddy Formation measured along the Yengan chaung section (Loc: 19°57'43", 95°08'49").

Facies (D): Planar cross-bedded sandstone

The facies is observed in the lower member of the Irrawaddy Formation. It mainly consists of yellowish brown to buff colored, medium to coarse grained lithic sandstone with medium to large scale planar cross-bedding (Fig 7). Cosets of low angle cross-bedding are 30 to 100 cm. Mud intercalation along the cross-bedding are present in the study area. The contact of

the facies is sharp and gradational. It may be formed from transverse bars and distributary channel (Miall, 1988).



Fig (4) Reddish brown, medium to thick bedded conglomerate with pebble, sand, mud, fossil wood and bone fragments (Facies A) of Irrawaddy



Fig (5) yellowish brown, medium to coarse grained, massive sandstone (Facies B) of Irrawaddy Formation



Fig (6) Yellowish brown thick bedded to massive sandstone with larger trough cross-bedding (Facies C) of Irrawaddy Formation



Fig (7) Whitish grey, medium to thick bedded sandstone with larger coset parallel cross-bedding (Facies D) of Irrawaddy Formation

Facies (E): Ripple cross-laminated sandstone

This facies occurs in the upper and lower member of the Irrawaddy Formation and it is followed by the well bedded sandstone facies. The sandstones are yellowish to buff colored, medium-grained and its characteristic feature is the presence of megaripples (Fig.8). Megaripple without superimposed small ripple are produced at a relatively higher energy. It is the indicator of environments involving large and rapid sand accumulation (Reineck and Singh, 1980). By the presence of megaripples, it is interpreted to have been formed in fluvial environment.

Facies (F): Parallel laminated sandstone

It is found in lower member of Irrawaddy Formation. The facies contain Yellowish brown to buff colored, fine to medium grained, medium to thick-bedded sandstone (Fig 9). Mud clasts and disc shape nodule also occur in this sandstone. Parallel lamination is produced under a wide range of low energy condition. The facies have sharp with overlying and erosional with underlying facies. It may be assigned as upper flow regime (Miall, 1987).



Fig (8) Yellowish to buff colored, medium-grained with megacurrent ripples (Facies E) of Irrawaddy Formation



Fig (9) Yellowish brown to buff colored, fine to medium grained, parallel laminated sandstone with disc shape nodule and mud clast (Facies F) of Irrawaddy Formation

Facies (G): Medium-bedded sandstone interbedded with shale

These facies are widely occurred in the upper member of the Irrawaddy Formation. It is composed of light yellow colored, fine grained, thin to medium-bedded sandstone interbedded with greenish grey colored shale. The hard sandstone bands are highly jointed (Fig 10). The bed thickness of sandstone is ranging from 10 to 45 cm whereas shale layer with 2 to 15 cm. Its upper boundary is erosional. In this facies, sandy layers are deposited during period of current activity, and shales are deposited during slack water periods. These may be regarded as overbank and flood plain environment (Reineck & Sigh, 1980).

Facies (H): Massive mudstone

These facies outcrops occur locally as patches in the lower member of Irrawaddy Formation. Mudstone is composed of bluish grey colored, fine-grained, massive type indurated mudstone (Fig 11). The boundary is sharp and erosional. These facies may be assigned to have been deposited as very rapid sedimentation in the slack water condition of overbank and flood plain environment (Reading, 1981).

Facies (I): Laminated or massive clay and shale

These facies of distributed in the upper part of the Irrawaddy Formation. It is widely observed greenish grey colored, massive shale with sand lenses concretion (Fig 12). Shale is characterized by bluish grey colored, very friable, massive but occasionally show layering as thin bed. The overlying contact is sharp and underlying contact is non-erosional. These facies may also be interpreted as overbank and flood environments (Reading, 1981).



Fig (10) Light yellow to reddish brown colored, fine grained, thin to medium-bedded sandstone interbedded with greenish grey coloured shale (Facies G) of Irrawaddy Formation



Fig (11) Bluish grey colored, fine-grained, massive type indurated mudstone (Facies H) of Irrawaddy Formation



Fig (12) whitish grey colored, laminated clay and shale (Facies I) of Irrawaddy Formation

Lithofacies Association of Irrawaddy Formation

The term “Facies Association” was defined by Potter (1959) as a collection of commonly associated sedimentary attributes. On the basis of sedimentary structure, texture, lithology, and fossils, (9) lithofacies have been classified. Two or more lithofacies are grouped to form a facies association. At least (3) lithofacies association can be established in late Middle Miocene sequence of Irrawaddy Formation in the study area. They are

- (1) Channel Facies Association
- (2) Overbank Facies Association
- (3) Flood Plain Facies Association

Channel Facies Association

These facies association consists of medium to thick bedded conglomerate (A), medium to coarse-grained, massive sandstone (B), trough cross-bedding(c), planar cross bedding sandstone (D) and parallel laminated sandstone (F).Channel lag sequence is usually covered by thick bedded conglomerate (A) and coarse-grained, massive sandstone (B). Trough cross-bedding(c), planar cross bedding sandstone (D) and parallel laminated sandstone (F) are deposited in point bar sequence.

Overbank Facies Association

The overbank facies association is developed in medium-bedded sandstone interbedded with shale (G) and Laminated or massive clay and shale (I). Sandy units are overlain by muddy unit (H). Sometime, sand and shale layer are equal in thickness or shale layer are thinner than sand layer. Ripple cross-laminated sandstone (E) and parallel laminated sandstone (F) are also occurred in this association.

Flood Plain Facies Association

This association consists of bluish grey colored, massive type indurated mudstone (H) and Laminated or massive clay and shale (I). This association generally follows the finer particles which were deposited in the lower, low to very low current condition, especially in the localized basin, stagnant or back swamp area. Some massive friable sandstone indicated the low velocity overbanks flow. Fossil wood and larger bone fragments are occurred in the flood plain deposits.

Discussion on Depositional Environment

In Migyungye-Kunon area, the southeastern part of the Minbu Basin, Irrawaddy Formation is characterized by channel facies association, point bar facies association, overbank facies association and flood plain facies association. The channel association consists of medium to thick bedded conglomerate, massive coarse grained sandstone and massive mud rock. There occur a vast majority of channel facies comprising gravelly and sandy material deposit by high energy flows. These facies associations indicate that the Irrawaddy Formation may be deposited as meandering dominated fluvial environment. The terrestrial and aquatic vertebrate fossils of this formation in the present area also indicate the deposition in terrestrial environment such as the riverine environment associated with flood plain.

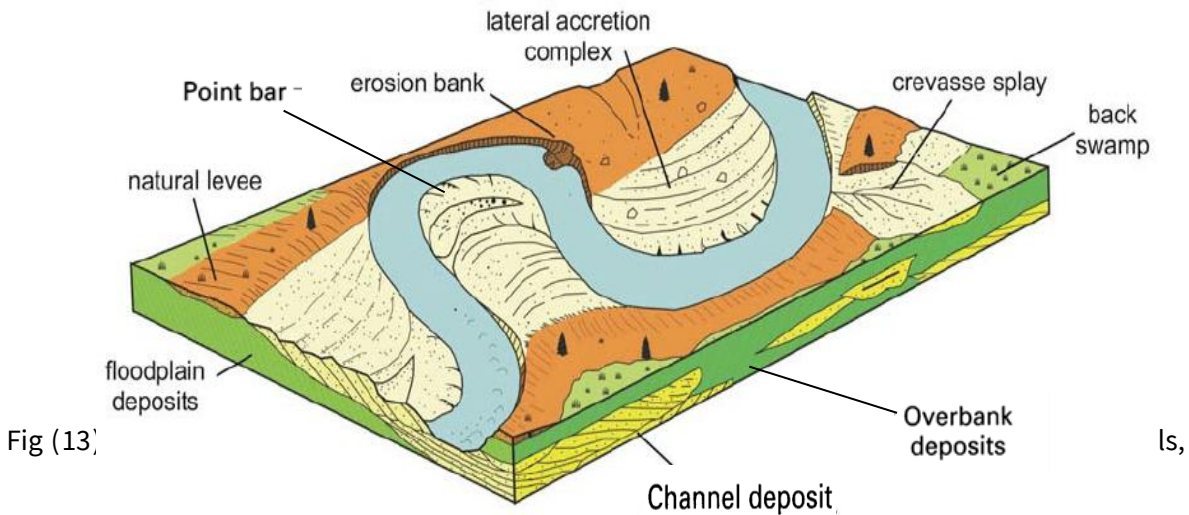


Fig (13)

Summary and Conclusion

The Migyaungye- Kunon area is situated about 40 miles southeast of Magway Township lying on the eastern bank of the Ayeyarwaddy River. It is located between the latitudes $19^{\circ} 53' N$ and $19^{\circ} 59' N$ and between the longitudes $95^{\circ} 06' E$ and $95^{\circ} 14' E$, referring to UTM topographic map 1995-01 (85 M-1). The sedimentary rocks in the study area are subdivided into two formation based on the lithologic and faunal characteristics. They are Irrawaddy Formation (Middle Miocene) and Obogon Formation (Late Miocene to Early Pleistocene). The Irrawaddy Formation of the present area is widely occurred fossil wood, vertebrate bones, teeth and vertebrate fragments. In the present study area, Late Miocene to Early Pleistocene sequences of Irrawaddy Formation is well exposed along the Ye Ngan Chaung, Sadaung Chaung and Kun on Chaung section. At least (9) lithofacies can be recognized and they are grouped into (4) lithofacies association of the Irrawaddy Formation, according to the feature of lithology, texture, sedimentary structures, fossil contents, etc. They are (1) Channel facies association, (2) Overbank facies association and (3) Flood plain facies association. According to the facies association and sedimentary characters, the Irrawaddy Formation is assigned to be deposited under fluvial environment.

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