MICROFACIES ANALYSIS OF THE MAYMYO FORMATION IN PADAUKPIN AREA, PYIN OO LWIN TOWNSHIP, MANDALAY REGION

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Abstract

Maymyo Formation is widely exposed in the Padaukpin area in Pyin Oo Lwin Township, Mandalay Region. The present study focuses on microfacies analysis and facies association based on petrographic aspect and evidences for interpretation of depositional environment. Field method and laboratory method were used to determine the depositional environment of Maymyo Formation. The present study of microfacies analysis is based on the proportion of skeletal and non-skeletal component. Based on detailed petrographic analysis, Maymyo Formation may be divided into six microfacies. The nature and distribution of the fauna and the observed microfacies types, suggest the deposition of Maymyo Formation is reef facies under shallow marine conditions with low to moderate energy.

Keywords: Microfacies analysis, Maymyo Formation, Depositional environment

Introduction

The Padaukpin area is located about 12 miles northeast of Pyin Oo Lwin in Mandalay Region. It lies between the latitude 22º 5' N to 22º 7' N and longitudes 96º 35' E to 96º 38' E in UTM topographic map sheet No. 2296-12 and one-inch topographic map sheet 93B/12 and cover about 20 square miles in area. This area is located near the fantastically developed large limestone cave, so-called Peikchinmyaung cave (Fig.1).

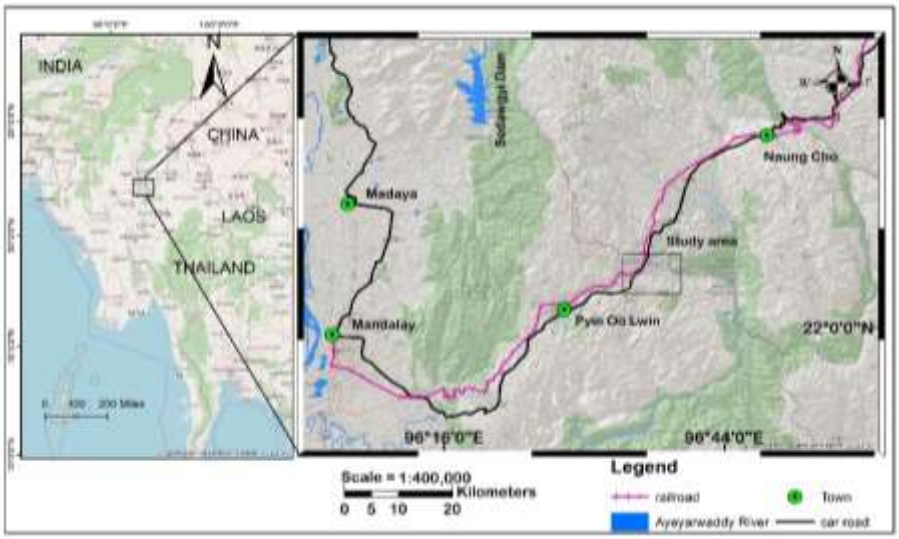

Figure 1. Location map of the Padaukpin area, Pyin Oo Lwin Township

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Regional Geologic Setting

Myanmar is made up of composite terranes including Sibumasu Block (Metcalfe, 1984) and West Myanmar Block (Hutchison, 1989) that were derived from the Gondwana origin. The two blocks rifted northward across the Tethys oceans in different time. Collision of the Sibumasu Block with the Sukhothai Island Arc in the Late Triassic after the closing of Palaeo-Tethys Ocean produces the Changning-Menglian-Inthanon Suture Zone. The study area lies in the Shan Plateau, which occupies on the western part of the Sibumasu Block.

Thick-bedded carbonate rocks of Ordovician, Silurian, Devonian, Permian and early Mesozoic age cover large area of the Shan Massif, which are deposited in the Myanmar Malaysian Geosynclines. The whole area consists of Paleozoic rocks ranging in age from Ordovician to Permian. The Shan Burma Boundary Fault runs along the western margin of the Shan Plateau and separates the Central Lowlands to the west from the Shan Plateau to the east. In the Padaukpin areas, carbonates sequences of Middle Devonian have been recognized in the "Maymyo Formation". The study area lies in the Shan Plateau, which occupies on the western part of the Sibumasu Block (Figure.2).

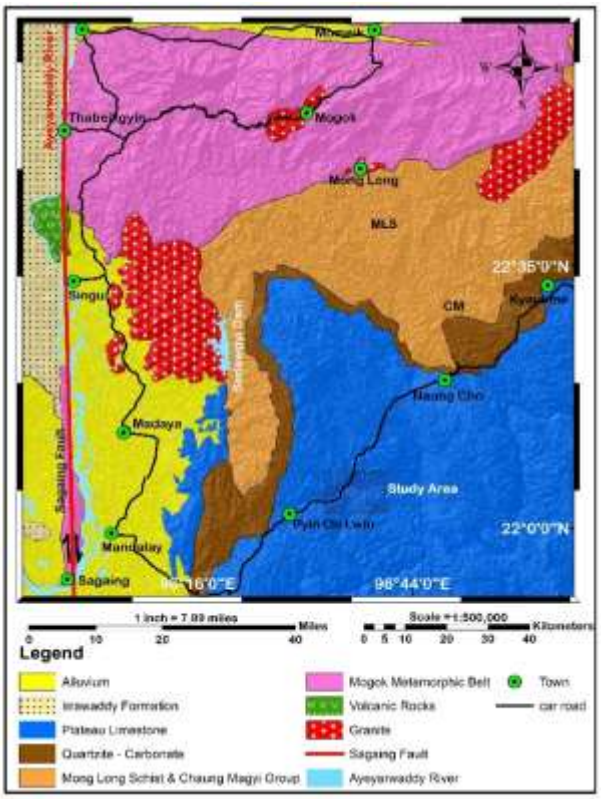

Figure 2. Regional Geological map of the study area and its environ (Source: after Mitchell, 2012, MGS, 2014)

Material and Methods

The present investigation focuses on the sedimentological studies of Maymyo Formation (Padaukpin area). Detailed stratigraphic measurements were made in appropriate section for stratigraphic units by using tape and compass methods. Samples have been collected by layer-by-layer basis for microfacies analysis. All collected samples and fossils were intended to various

analyses for the research such as petrographic study and paleontological study. Dilute hydrochloric acid was used to identify limestone and dolomite in the field. The mega- and micro-fauna of rock units were identified using megascopic and microscopic identifications. For the nomenclatures and depositional environment of the carbonate rocks, classification of the limestone by Wilson (1975), Reed (1981), Folk (1959) and Dunham (1962) are applied.

Stratigraphy

The Padaukpin area is covered by the Paleozoic strata, which are generally trending NE-SW direction. It is occupied by five units of formation rank (in ascending order); Sitha Formation (Middle Ordovician), Kyaingtaung Formation (Upper Ordovician), Nyaunbaw Formation (Silurian), Maymyo Formation (Middle Devonian) and Taungpuhla Limestone (Permian). The geological map of the Padaukpin area is shown in figure 3.

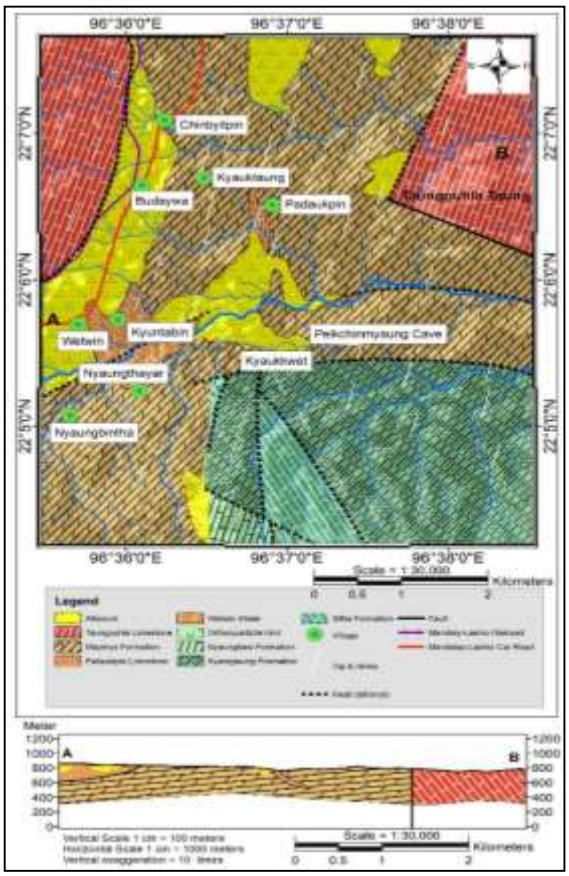

Figure 3. The geological map of the Padaukpin area (after Khaing Khaing San, 2005)

This formation is widely distributed around the environ of Pyin Oo Lwin Township. This formation consists of dolomitic limestone with relict fossils, dolomite, silty limestone with nodular bedding and minor amount of shale and siltstone. Outcrop nature of Maymyo Formation are shown in figure 4. Middle Devonian corals of the Padaukpin Limestone (Maymyo Formation) are shown in figure 5.

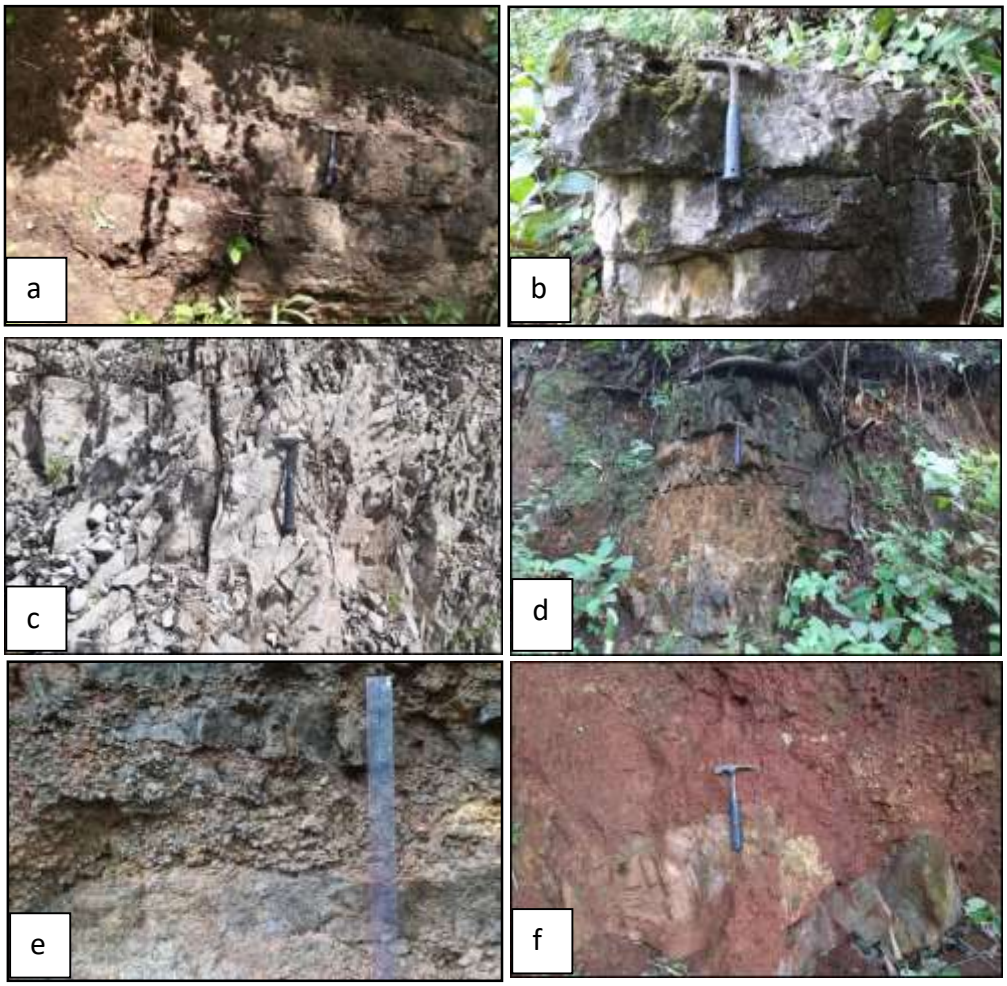

Figure 4 Outcrop nature of Maymyo Formation; (a) Light to dark grey, medium-bedded, relic fossil-bearing dolomitic limestone of the Maymyo Formation, (b) Light to dark grey color limestone with thickening upward and dolomitic nature in Maymyo Formation near two-step cave, (c) Closely jointed and intense brecciation of Maymyo Dolomite Formation in the north of Wetwin village, (d) Thick-bedded to massive, sandy limestone with bryozoans in the Maymyo Formation along Gaelaung Chaung and card-road of the Wetwin hydropower station, (e) Coral- bearing siltstone are interbedded with thin- to medium- bedded, grey to bluish grey limestone of the Maymyo Formation, (f) Carbonate unit overlain by hematite- bearing mudstone and siltstone forming deep red brown colored soil of the Maymyo Formation

Figure (5.a) Polished section of *Macgeea birmanicum* species corals collected near Padaukpin village (N 22º 10′ 54″ - E 96º 59′ 52″)

Figure (5.b) Polished section of *Temnophyllum pyinoolwinwinensis* species collected near Padaukpin village (N 22º 10′ 54″ - E 96º 59′ 52″)

Result

Microfacies Analysis

In the study area, carbonate rocks are widely distributed. The rock specimens are collected form all units of the area for the petrographic studies and about 60 thin sections were made and examined. Descriptive petrography for each stratigraphic units is attempted in this chapter. For the nomenclatures and depositional environment of the carbonate rocks, classification of the limestone by Wilson (1975), Reed (1981), Folk (1959) and Dunham (1962) are applied.

(1) Dolomitized Mudstone-Wackestone

The rock is medium- to thick- bedded, dark grey in weathered colour and light gray to milky white in fresh colour dolomitic limestone and highly brecciated. This rock shows choppy surface, strongly foetid odour and is extensively cropped out at the north of Wetwin village.

It is mainly composed of dolomite rhombs 90% and micrite 10%. Fine-grained calcite is composing more than half of the total volume and no transformation into neospar. Subhedral to euhedral dolomite rhombs are scattered in the micrite. These dolomite crystals are ranging in size from 0.05mm to 0.03mm and are formed by later diagenetic process: neomorphism. The dolomite aggregates are mosaics of anhedral or subhedral grains and tightly interlocked (Fig. 6.a). According to the classification of Dunham (1962), the rock can be named as **dolomitized mudstone-wackestone**. On the basic of the aforementioned petrographic data, the depositional environment of this limestone can be interpreted as restricted circulation shelf with water of Mg-rich situation (deep shelf margin/ Reef front).

(2) Packstone-Grainstone

This rock is medium- to thick- bedded, bluish grey to dark grey calcitic limestone, which is locally dolomitized and exposed near the Padaukpin village.

The limestone is mainly composed of sparry calcite 90%, neospar 7% and pyrite 3%. Most of the calcite crystals are twinned and the twin planes can be seen to be slightly bent. They elongated in one direction and oriented parallel to one another. Euhedral calcite with distinct twin planes indicates the later neomorphism in (Fig.6.b). Equigranular calcite crystals with different extinctions are also noted. Inter-granular pore spaces between calcite crystals indicate the secondary void-filling processes.According to the classification of Dunham (1962), the rock can be name as **packstone-grainstone**.

Occurrence of homogeneous sparite component and scarcity of biota in this limestone may be deposited in low to moderate energy bottom current in a relatively deeper water condition (fore Reef).

(3) Dolomitized Packstone – Grainstone

Megascopically, these limestones are medium-bedded, grey to dark gery, fine- to medium-grained and highly brecciated.

This facies is composed of (60%) of calcite and (35%) micrite, plus accessory minor allochems (5%). Spars are common with distinct cleavage-planes. Due to selective dolomitization, euheral dolomite rhombs are also found in the area of sparite (Fig.6.c). Some dolomite rhombs range from 0.05mm to 0.3mm in size and are subhedral. Patches of sparry calcite are irregularly developed within the micrite. According to the classification of Dunham (1962), the rock can be name as **dolomitic packstone – grainstone**.

On the basic of the aforementioned petrographic data, this limestone may be deposited in an open sea shelf (Reef Crest) and later dolomitization by metasomatic processes.

(4) Ferruginous Bioclastic-Wackestone

Megascopically, this rock is medium-bedded, purple to reddish brown, ferruginous calcareous limestone with abundant fossils such as corals, brachiopods, bryozoans and crinoids.

Microscopically, it is composed of ferruginous micrite (60%), bioclasts (30%), and silt size quartz (10%). All layered structures are composed essentially of iron materials. Various bioclasts possibly solitary corals and brachiopods' shells are embedded in the ferruginous micritic groundmass (Fig.6.d). Minute quartz-silt grains in the micrite are also noted. Microcrystalline calcite, ferruginous materials and quartz-silt dominantly occupy the mircritic groundmass. Minute brachiopod with pedicle view (pedicle opening filled with cements) is also present. According to the classification of Dunham (1962), the rock can be named as **ferruginous bioclastic-wackestone**.

Deeper water carbonates may be red, pink, or purple through preservation of Fe and Mn oxide pigments. The observed petrofabric features and pisoids may probably be indicated the shoal environment in agitated water (Reef front).

(5) Bioclastic Mudstone-Wackestone

Megascopically, this rock is medium-bedded, purple to reddish brown, ferruginous and calcareous limestone containing abundant fossils such as corals, brachiopods, bryozoans and crinoids.

This facies is composed of 45% allochems (mainly brachiopods) and micrite with iron materials 50 %, and quartz silt 5%. Thin-shell bivalves and minute bioclasts are embedded in micrite. Large shell (? Fenestrate bryozoan) embedded in micrite is highly crenulated on the outer wall whereas inner wall built with thin laminated layers (Fig.6.e). Outer wall is marked by neospars. Parallel orientation of quartz-silt and minute argillaceous materials are also observed.

According to the classification of Dunham (1962), the rock can be named as **bioclastic mudstone-wackestone**. Deeper water carbonates may be red, pink, or purple through preservation of Fe and Mn oxide pigments. The most probable depositional environment is postulated as "Fore Reef" with relatively deep-water condition.

(6)Dolomitic Bioclastic Wackestone-Packstone

This rock type is thin- to medium-bedded, grey to dark grey, highly jointed and brecciated dolomitic limestone with relict fossils.

This rock is composed abundantly of branching type bryozoan (70%) that are frond-like fenestrate types, micrite (20%) and dolomite (10%). It is also resembles with the part of a fern or palm tree. Outer margins constituted with minute spines and inner parts are composed of calcite crystals (Fig.6.f). Area between stipes showing selective dolomitization and non-dolomitized micrite still exit. According to the classification of Dunham (1962), the rock can be named as **dolomitic bioclastic wackestone-packstone.**

This type of rock may be deposited in an open marine environment. The associated fauna in this rock strongly suggests the good current circulation and normal marine condition. Later dolomitization is caused by metasomatic processes. On the basis of faunal content (Branching Bryozoans) and petrofabric characters, this facies is probably deposited on the "Reef Front" with moderately deep water condition.

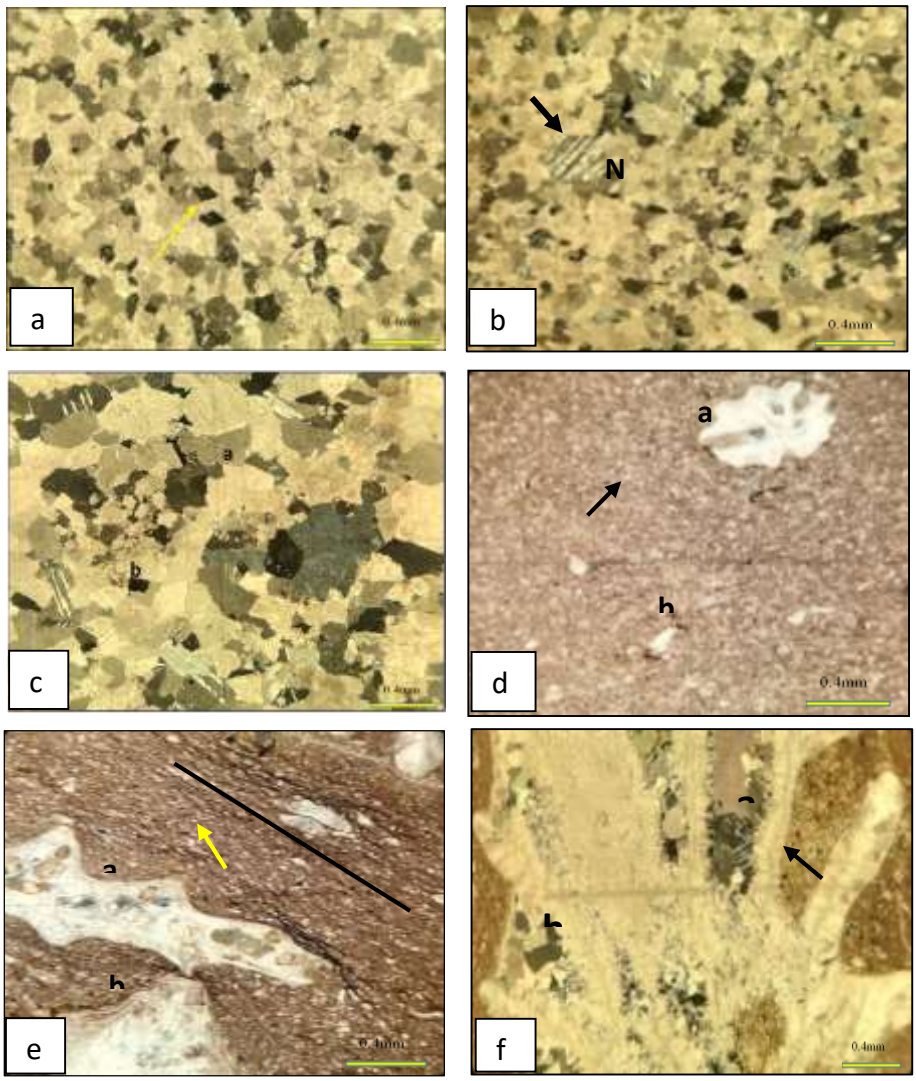

Figure (6) Thin section of photomicrograph showing the microfacies of the Maymyo Formation (Padaukpin area).**(a)** dolomitized mudstone-wackestone, euhedral dolomite crystal (arrow);**(b)** packstone-grainstone with neospar (N), and equigranular calcite (arrow);**(c)** dolomitized packstone – grainstone with irregular sparry calcite (a), and subhedral dolomite (b);**(d)** ferruginous bioclastic-wackestone with a small echinoid spine (a), bioclasts (b) with strongly foliated body whorl, and minute quartz-silt grains (arrow);**(e)** Bioclastic Mudstone-Wackestone containing thin-shell bivalves (a), large bioclast (? Coral) (b), minute bioclasts (c) and parallel orientation of bioclasts and grains (black line) ; **(f)** Dolomitic Bioclastic Wackestone-Packstone with selective dolomitization (a), dolomite rhombs (b) and frond-like fenestrate type's bryozoan (arrow)

Depositional Environments

Based on the analysis of the above microfacies Maymyo Formation (Padaukpin area) was deposited under shallowing marine conditions with low to moderate energy**.** Proposed schematic depositional environmental model of the Padaukpin-Wetwin area is shown in figure (7).

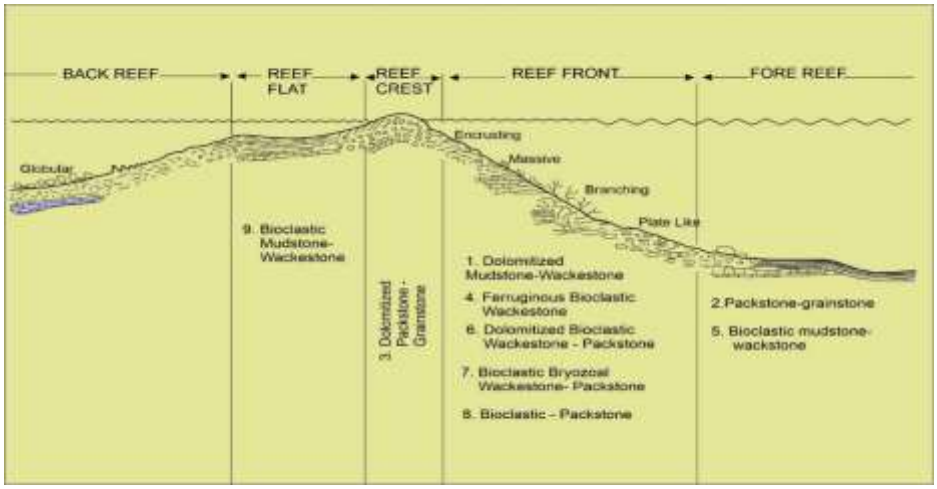

Figure 7. Proposed schematic depositional environmental model of the Padaukpin-Wetwin area (Tucker, 2001)

Conclusion

Maymyo Formation (Padaukpin area) is widely distributed around the environ of Pyin Oo Lwin Township. The Padaukpin area is covered by the Paleozoic strata, which are generally trending NE-SW direction. The "Maymyo Formaiton" consists predominantly of light to dark grey, medium-bedded, relic fossil-bearing dolomitic limestone. Maymyo Formation (Padaukpin area) may be divided into six microfacies. According to my field evidences, nature and distribution of the fauna, microscopic analysis of the current study combination with previous worker's field research evidences, the study area Maymyo Formation (Padaukpin area) was deposited as reef facies under shallowing marine conditions with low to moderate energy environment.

Acknowledgements

We sincerely thank Dr. Ba Han, Rector of Meiktila University, for his permission and support in conducting this research. We are indebted to Dr. Theingi Oo, Professor and Head of the Department of Geology, University of Mandalay, for her encouragement and support for the present research. We are especially grateful to Dr. Win Min Oo, Professor and Head of the Department of Geology, Meiktila University, for facilitating fieldwork during the preparation of this study. We also thanks Dr. Aye Ko Aung, Retired Professor and Head of the Department of Geology, Dagon University, for providing essential literature and engaging in valuable discussions. We extend our appreciation to all those who assisted during the fieldwork in the study area.

References

Adams, A.E. & Mackenzie W.S., 1984. *A Color Atlas of Carbonate Sediments and Rocks under the Microscope*. Manson Publishing.

Anderson, M.M.*et al*., 1969.Eifelian brachiopods from Padaukpin, N.S.S., *Burma, Bull*. Br .Mus. Nat. Hist.18, p.105-163.

Aye Ko Aung, 2012. The Paleozoic stratigraphy of Shan Plateau, Myanmar-An updated version. *Journal of Myanmar Geoscience Society, 5(1),* pp. 173.

Hutchison, C. S., 1989. Geological Evolution of South East Asia. *Oxford Monographs on Geology and Geophysic*, 13, Oxford University Press, 368p.

Khaing Khaing San, 2010.Middle Devonian Rugose Corals of the Padaukpin Limestone, Pyin Oo Lwin Township, Mandalay Division. PhD.Thesis, Dept. of Geology, Mandalay Universiy.

Ko Ko Gyi, 1991.Geology and mineral resources of the Kywenadauk-Okpho area, Pyinoolwin Township: M.Sc.Thesis, Dept. of Geology, Mandalay Universiy.

Metcalfe, I., 1984. Stratigraphy, Palaeontology and Palaeogeography of the Carboniferous of Southeast Asia. *Memoirs of the Geological Society of France*, 147, p. 107118.

Reed, F.R.C., 1908. The Devonian Faunas of the Nothern Shan State: *Mem.Geol.Surv.India*, Paleont.Indica.N.S.21, 3, p.1-130.

Reineck, H.E. and Singh, I.G., 1980: *Depositional Sedimentary Environments*. 2nd edition. Springer, New York.

Scholle. P.A & Ulmer-Scholle D.S., 2003: A color Guide to the Petrography of Carbonate Rocks: Grains, textures, porosity, diagenesis. Published by The American Association of Petroleum Geologists Tulsa, Oklahoma, U.S.A.

Tucker, M.E., 2003: *Sedimentary Rocks in the Field*: The geology field guide series. Wiley and Sons, Ltd ISBN: 0-470-85123-6.

Wilson, J.L., 1975. *Carbonate Facies in Geologic History*, 471p. Springer – verlag, Berlin.

Win Win Kyi, 1990.Geology and mineral resources of Pathin-Kyadwinye area, Pyin Oo Lwin Township: M.Sc. Thesis, Dept. of Geology, Mandalay University.