A NEW OCCURRENCE OF THE MIDDLE DEVONIAN UNIT IN THE LASHIO AREA, NORTHERN SHAN STATE

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Abstract

A new occurrence of the Middle Devonian Unit equivalent to the Padaukpin Limestone in Wetwin-Padaukpin area is recognized for the first time in the lower part of the Maymyo Formation, Lashio area, northern Shan State. It exposed as isolated outcrops only at two localities in Lashio area. The unit mainly composed of from base to top; (1) medium- bedded, grey to dark grey calcitic limestone intercalated with thin-bedded, black shale with abundant recrystallized gastropods (Quarry near the Hseing Hkai car-road, N 22˚ 53′ 36′′ and E 97˚40′ 51′′); (2) medium-bedded, ligh grey to buff, argillceous limestone with buff to black shale and siltstone containing abundant crinoid stems, cystoid plates and brachiopods and (3) medium-bedded, light grey to grey, calcitic limestone and buff coloured argillaceous limestone interbedded with buff to black shale and siltstone comprising abundant tabulate and rugose corals (along the car-road from Lashio to Muse at mile post 5-6 furlong, N 22˚ 54′ 02′′ and E 97˚42′08′′). This unit is also the sandwiched unit in the Maymyo Formation and laterally passed into the dolomite or dolomitic limestone. The age of the unit exposed at the Lashio area is defined by the strong faunal evidences such as gastropods: *Muchisonia* sp., *Loxonema* sp. and *Euromphalus* sp. and important tabulate and rugose coral species: *Favositesgoldfusi*, *Alveolites* sp., *Coenites* sp., *Aulocystics* sp., *Stringophyllum* sp., *Grypophyllum* sp., *Temnophyllum* sp., *Acanthophyllum* sp., *Peripaedium* sp., *Cyathophyllum*sp. and abundant *Calceolasandalina*. *Calceolasandalina* which are known as a typical Middle Devonian (Eifelian) species in Myanmar, Europe, USSR, Asia and Australia. It is a more complete succession of the faunal assemblage with Middle Devonian age and slightly different in lithology and faunal content with the type section of the Padaukpin Limestone.

Keywords: Middle Devonian, Lashio area, tabulate and rugose corals

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Introduction

Location and size

The study area is situated in Lashio Township, Northern Shan State. It lies about 175 miles NE of Mandalay, about 46 miles NE of Hsipaw and about 54 miles SW of Mu-se. It is located between the North Latitude 22°52'-22°56' and East Longitude 97°38'– 97°48'. The study area is located at 2297 9/13UTM topographic map. It is about 5miles long north-south and about 11.18miles wide east-west covering approximately 55.35square miles. This area is readily accessible by automobile or train throughout the whole year. The location map of the study area is shown in Figure (1). This paper mainly deals with on the investigation of the lithostratigraphic unit of the Maymyo Formation in the study area.

Methods of study

The field investigation of the study area was carried out from October 2016 to March 2017.Several traverses across the regional structures were made. Routine geological observation, description and sampling were conducted along the traverse lines. The stratigraphic succession of different rock units was established and carefully studied with detailed laboratory investigations of representative samples and diagnostic fossils.

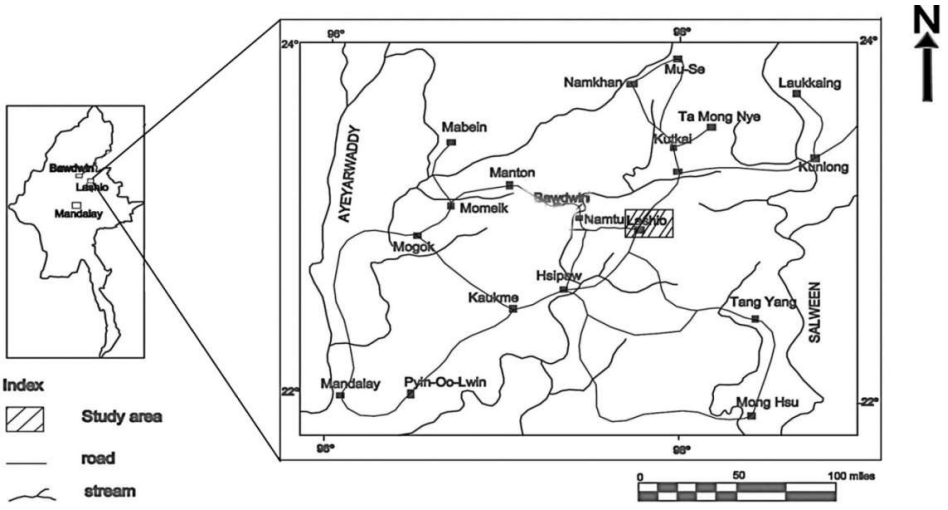


Figure 1. Location map of the study area.

Previous Work

The numerous work on the geology of the Shan State had been published by various authors. The geology of the Northern Shan State including the present area was described by La Touche (1913).Pascoe (1959), Brunnschweiler (1970), Amos (1975), Garson *et al* (1976) and Wolfart *et al* (1984). Tin Myo Myo Htwe, Hla Hla Htay and Nu Nu Yin (2003) investigated this area for their MSc dissertation. They gave accounts on the stratigraphy, geology and petrology of the Lashio-Panhone area, Northrn Shan State. Zaw Win (2010) described the stratigraphy and sedimentation of the Lashio and its environs, Lashio Township.

Results and Discussion

Stratigraphy

Stratigraphic Succession

The present area lies in the middle part of the Eastern Highland. It is constituted mainly of the Upper Paleozoic-Mesozoic units from Middle Devonian to Jurassic dolomitic limestone, dolomite, calcitic limestone, argillaceous limestone, siltstone, shale, sandstone and conglomerate. The lithostratigraphic units older than the Middle Devonian age are not exposed in this area. Geological map of the study area is shown in Figure 2.

The rocks of the present area can be differentiated into five lithostratigraphic units of formation rank on the basis of the lithology, stratigraphic position and faunal content. The stratigraphic succession in ascending order (from older to younger) is as follows;

Rock Units	Stratigraphic Sequence
5. Hsipaw Red Beds	Late Jurassic
4. Loi-an Group	Early – Middle Jurassic
3. Nwabangyi Dolomite Formation	Late Permian – Early Triassic
2. Plateau Limestone	Early – Middle Permian
1. Maymyo Formation	Middle Devonian

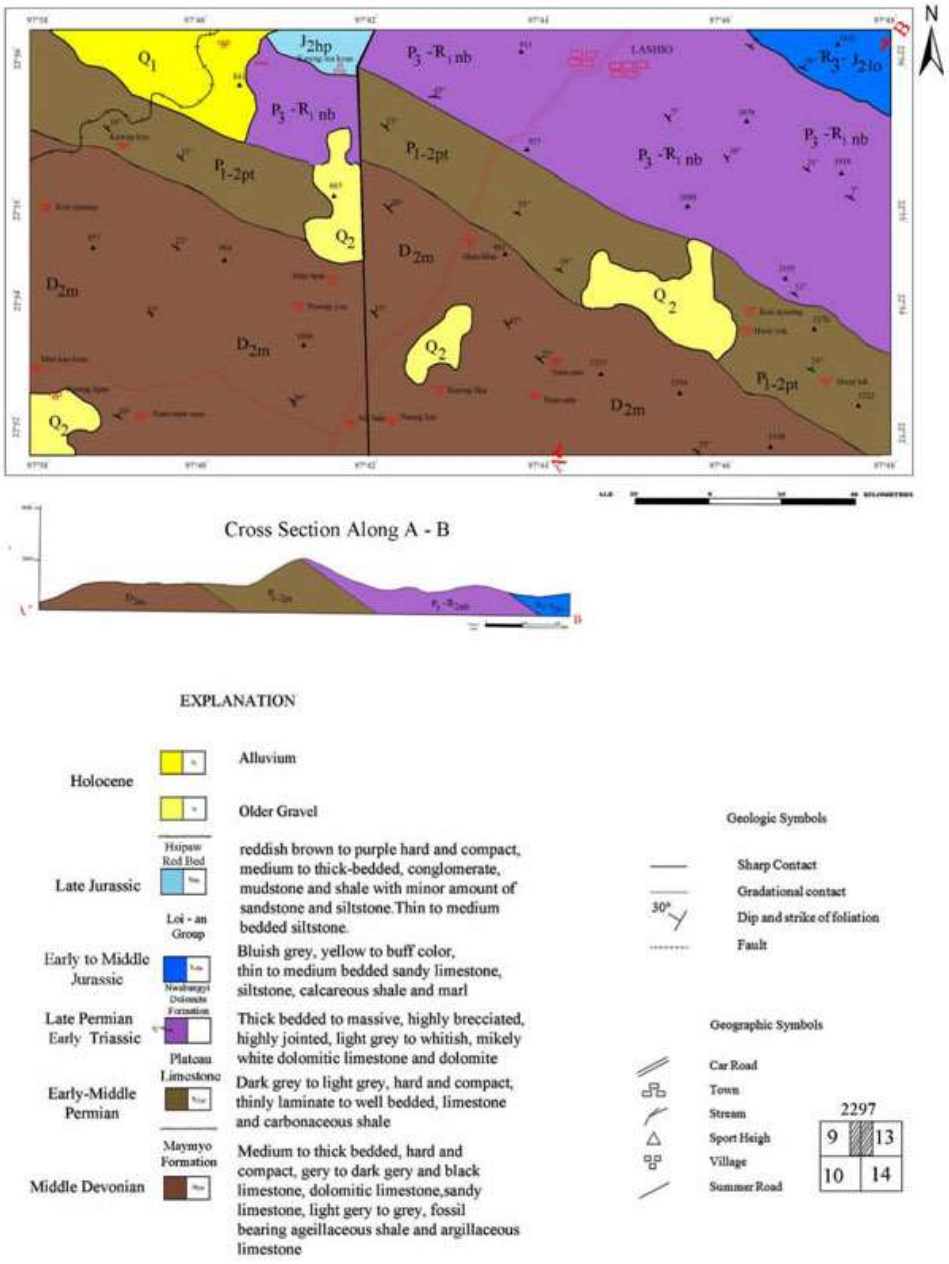


Figure 2. Geological map of the study area. (After Khin Nyein Chanthar et al, 2017)

The generalized composite stratigraphic column of the study area is shown in Table (1). The thickness of these beds varies from thin-bedded to massive. Permian to Jurassic units are successively overlain with gradational contact. There may be a major hiatus at the end of Middle Devonian with reference to the occurrence of carbonate breccias. This paper mainly deals with described on the stratigraphy of Middle Devonian unit.

Maymyo Formation

General Statement

The name "Plateau Limestone" was first given by La Touche (1913) for a unit of thick carbonate sequence which covers a large part of the Shan State. Brunnschweiler (1970) subdivided the Plateau Limestone into the Shan Dolomite of Devonian age and the Htoonbo Limestone of Carboniferous to Permian age. Amos (1975) proposed the Shan Dolomite group and can be subdivided into the Devonian Maymyo Dolomite Formation and the Permian-Triassic Nwabangyi Dolomite Formation. I.G.C.P (1980) gave the name "Maymyo Formation".

Distribution

This Formation is mainly exposed in the south-eastern and south-western parts of the study area. Good exposures of this formation occur in the vicinity of Nam Khai and Me Han Villages. This unit also crops out along the Mandalay-Muse high way.

Lithology

The Maymyo Formation is mainly comprised thick-bedded to massive, white to light grey dolomite and dolomitic limestone. They are locally dolomitized and highly brecciated and well-jointed. The dolomitic limestones are mostly massive to rarely thick bedded (Figs. 3 - 5). At quarry near the HseingHkai car-road and the mile-post 5 and 6 furlongs along the Lashio-Muse car-road, fossiliferous units occurred in the Maymyo Fromation. Stained red by iron oxides along the joint planes can be seen in this Formation. These two units are sandwiched between the dolomitic limestones. This sandwiched nature is clearly seen at the mile-post 5 and 6 furlongs along the Lashio-Muse

car-road. These two fossiliferous units are considered as the equivalent unit of the Padaukpin Limestone. They laterally passed into dolomite and dolomitic limestone. The composite stratigraphic measured section of the Maymyo Formation is shown in Fig.6.

Nature of Contact

The lower boundary of Maymyo Formation is not observed in this area. The Maymyo Formation is underlain unconformably by the Permian Plateau Limestone. This contact nature is clearly seem as carbonate breccias in (Fig.5). The upper contact is also a faulted contact with the Plateau Limestone due to Kyauk-taung longitudinal Fault.

Fauna, Age and Correlation

In the study area, abundant gastropods, crionoid stems and corals are observed in the Padaukpin Limestone of the Maymyo Formation. Except them, fossils are rare in this Formation due to the highly brecciation and intense dolomitization.

Figure 3. Thick-bedded to massive, white to light grey dolomite and dolomitic limestone of the Maymyo Formation. (N 22° 52' 56" and E 97° 41' 25")

Figure 4. Thick-bedded, grey to dark grey highly jointed dolomitic limestone of the MaymyoFormation (N 22° 53' 33" and E 97° 45' 28").

Figure 5. Unconformable evidence of carbonate brecciasbetween the dolomitic limestone of the Maymyo Formation and the Permian Plateau Limestone. (N 22° 52' 56" and E 97° 41' 25")

Figure 7. Medium to thick bedded, grey to dark grey, fossiliferousrecrystallized gastropods in limestone with silt patches of the Lower part of thePadaukpin Limestone near Lashio to HseingKhai car-road (N 22° 53' 36" and E 97° 40' 51")

Figure 8. Thin to medium-bedded, grey to dark grey, highly jointed limestone of the Lower part of the Padaukpin Limestone (N 22° 54' 04" and E 97° 42' 36")

Figure 10. Medium-bedded, buff to grey argillaceous limestone interbedded with shale containing abundant brachiopod fragments

Figure 11. Thin to medium bedded, buff to yellowish brown, highly jointed sandy limestone intercalated with black shale in the upper part of the Padaukpin Limestone (N 22° 54' 08" and E 97° 42' 06").

Figure 12. Medium-bedded, grey to buff, argillaceous limestone with abundant insitu tabulate corals of the upper part of the Padaukpin Limestone.

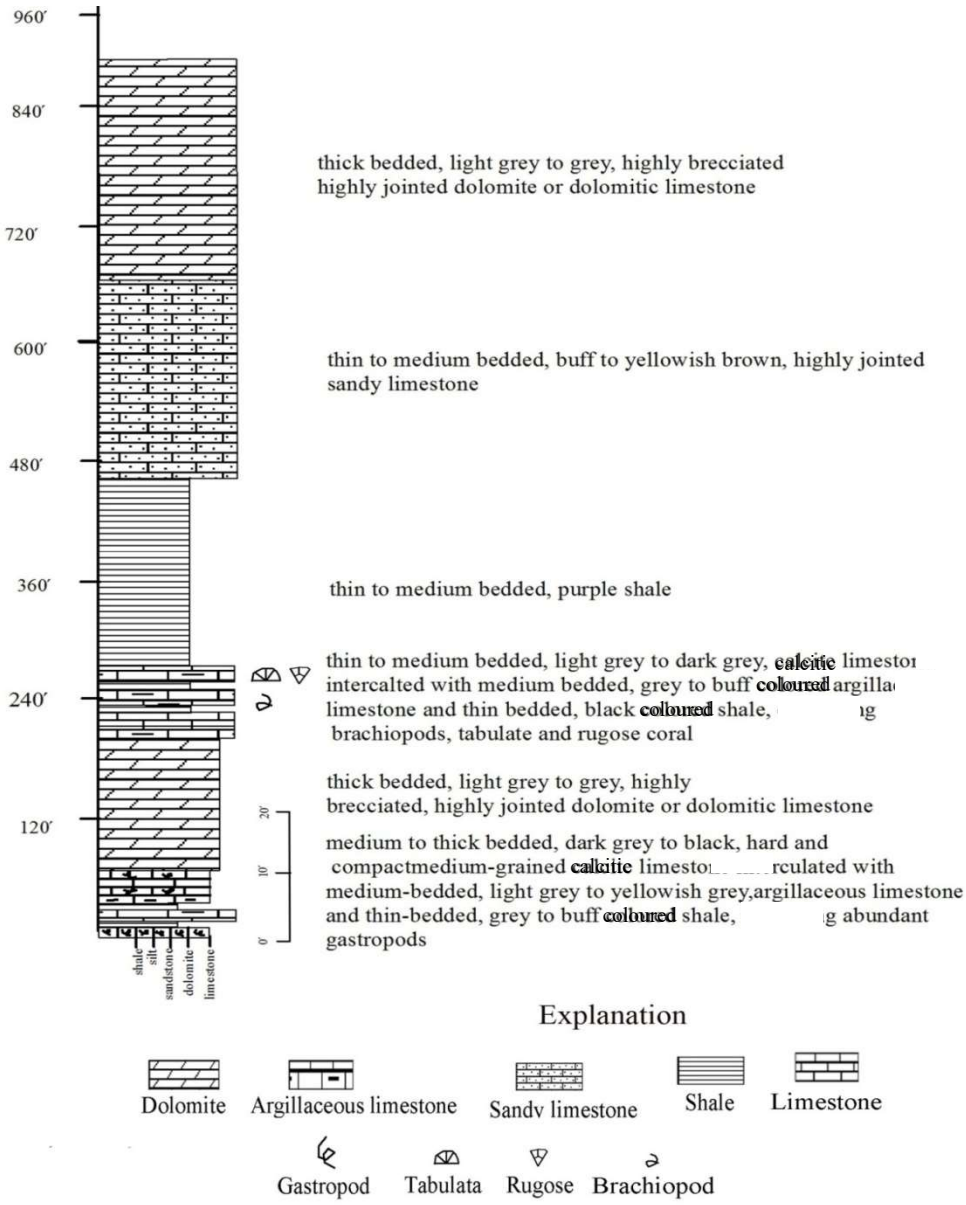


Figure 6. Composite Stratigraphic mesasured section of the Maymyo Formation (Along the Lashio-Muse Car-road; Base at N 22° 53' 36"-E 97° 40' 51" and top at N 22° 54' 20"-E 97° 42' 07").

On the basis of the stratigraphic position, the lithologic character and the sandwiched unit of the fossiliferous Padaukpin Limestone, the age of Maymyo Formation in this area is regardedas Middle Devonian (Eifelian).

Maymyo Formation can be correlated with the lower Plateau Limestone of La Touche (1913), Shan Dolomite of Brunnschweiler (1970), the Maymyo Dolomite Formation of Amos (1975), Maymyo Formation of I.G.C.P (1980), Maymyo Formation of Aye KoAung (2004), Maymyo Formation of KhaingKhaing San (2005).

Padaukpin Limestone

General Statement

The Padaukpin Limestone has previously been placed in the lower part of the Plateau Limestone (lower dolomitic part) of Devonian age (Reed, 1908&1929;La Touche,1913), the Shan Dolomite of Devonian age (Brunnschweiler,1970), and the lower division of the dolomitic part of the Plateau Limestone (Anderson *et al*., 1969) and the Maymyo Dolomite Formation (Amos, 1975). Aye Ko Aung (2001) proposed, on the faunal basis that the Wetwin Shale and the Padaukpin Limestone should be considered as the members the Maymyo Formation. The type section is located near Padaukpin village about 1.6km ESE of the Wetwin railway station on the Mandalay-Lashio track. Khaing Khaing San (2005) pointed out that Padaukpin Limestone and Wetwin Shale do not rank as Members. They are merely the fossiliferous sandwiched units of the Maymyo Formation which escaped the dolomitization process. This study also found that the Padaukpin Limestone as the sandwiched unit of the Maymyo Formation. Wetwin Shale is not exposed in this area.

Distribution

Padaukpin Limestone is mainly exposed in the south western part of the study area. Good exposures of Padaukpin Limestones occur at the mile post 5-6 furlong of the Mandalay-Muse high-way road and the quarry in the northern part of the Lashio to Hseing Khaicar road (N22º53'36" and E96º40'50").

Lithology

The Padaukpin Limestone consists of thin- to medium-bedded, grey to black calcareous limestone, argillaceous limestone and shale. In some places, where shale orargillceous materials are dominant, fossils fragments areabundantly occurred and easily extracted from this unit. Argillaceous limestone and shale usually associated with yellow, soft and loose claystone-mudstone. Brachiopods and corals are easily extracted from the soft, yellow, muddy horizon. The numerous fossils from Padaukpin Limestone include corals, brachiopods, gastropods, crinoids etc. The Padaukpin Limestone is limitedly exposed in this area and the occurrence of the Padaukpin Limestone is slightly different from the type section. The lower most part is medium. bedded, dark- grey to black, medium grained limestone intercalated with thin bedded, dark-grey to black shale containing abundant recrystallized gastropods 66feet in thickness (Figs. 7, 8&9). The middle part is medium to thick bedded, light grey to buff argillaceous limestone containing abundant crinoid stems and few small brachiopods (Figs. 10 & 13). The upper part is mainly composed of well-bedded, light grey to grey limestone and argillaceous limestone interbedded with thin-bedded, buff colored shale and claystone-mudstone containing abundant tabulate and rugosecorals. The lower part occurs as isolated outcrops, the middle and upper parts are continuously exposed alnong Lashio-Muse car-road and 80 feet in thickness (Figs.11, 12 & 13).

Fauna, Age and Correlation

The following important fossils are common in the Padaukpin Limestone. They arerecrystallized gastropods, brachiopods, crinoids, rugose and tabulate corals (Plates 1 & 2).

The fauna collected from the Padaukpin Limestone are;

Rugosa: *Calceola sandalina, Temnophyllum pyinoolwinensis., Macgeea maniseptata, Cyathophyllum winwinkyiae, Peripaedium minutum, Stringophyllum* sp. A,B&C, *Enallophrentis* sp., *Gurichiphyllum*sp., *Grypophyllum*sp., *Acanthophyllu* sp.

Tabulata: *Favosite goldfusi, Alveolites suborbicularis*,

Alveolites aff. *expatiate, Alveolites illusa*

Coenites escharoides, *Alocystis conigera*

Gastropoda: *Loxonema* sp.,*Euomphalus* sp., *Murchisonia* sp.

Brachiopoda: *Indospirifer* sp., *Mesodouvillina* sp., *Devonaria* sp.

Based on the previous work and the occurrence of above faunal assemblage the age of the Padaukpin Limestone in this area can properly be designated as Middle Devonian (Eifelian).

It can be correlated with the Padaukpin coral reef of La Touche (1913), Padaukpin Biostrome of Arderson (1969), Padaukpin Limestone Member of Aye Ko Aung (1995), Padaukpin Limestone of Khaing Khaing San (2005) and Pwepon Limestone of Khaing Khaing San (2005). The comaprison of the Middle Devonian unit in Padaukpin area and Lashio area is shown in Table (1).

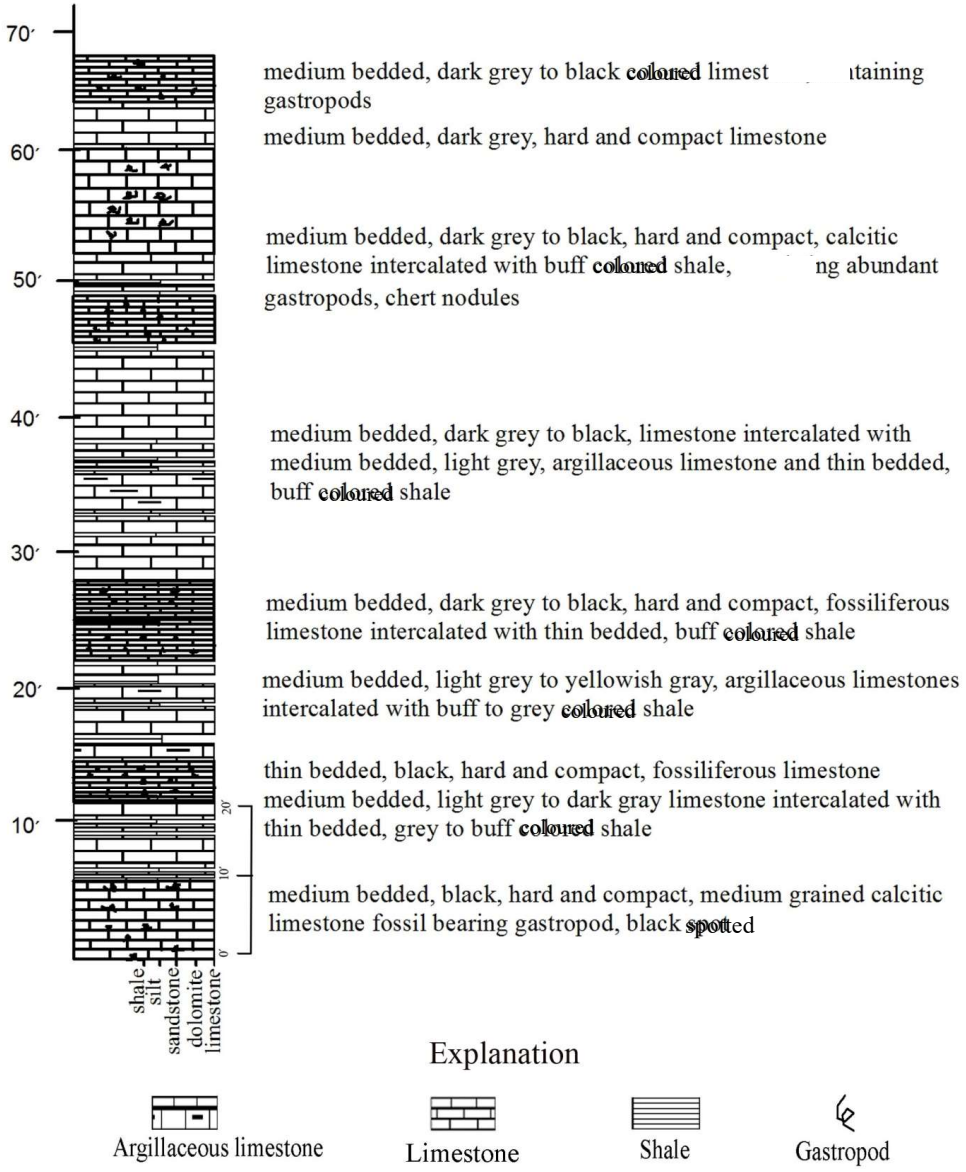


Figure 9: Stratigraphic mesasured section of the lower part of the Padaukpin Limestone (Quarry near the Hseing-Khai car-road; base at N 22° 53' 36"- E 97° 40' 51" and top at N 22° 53' 34"- E 97° 40' 48")

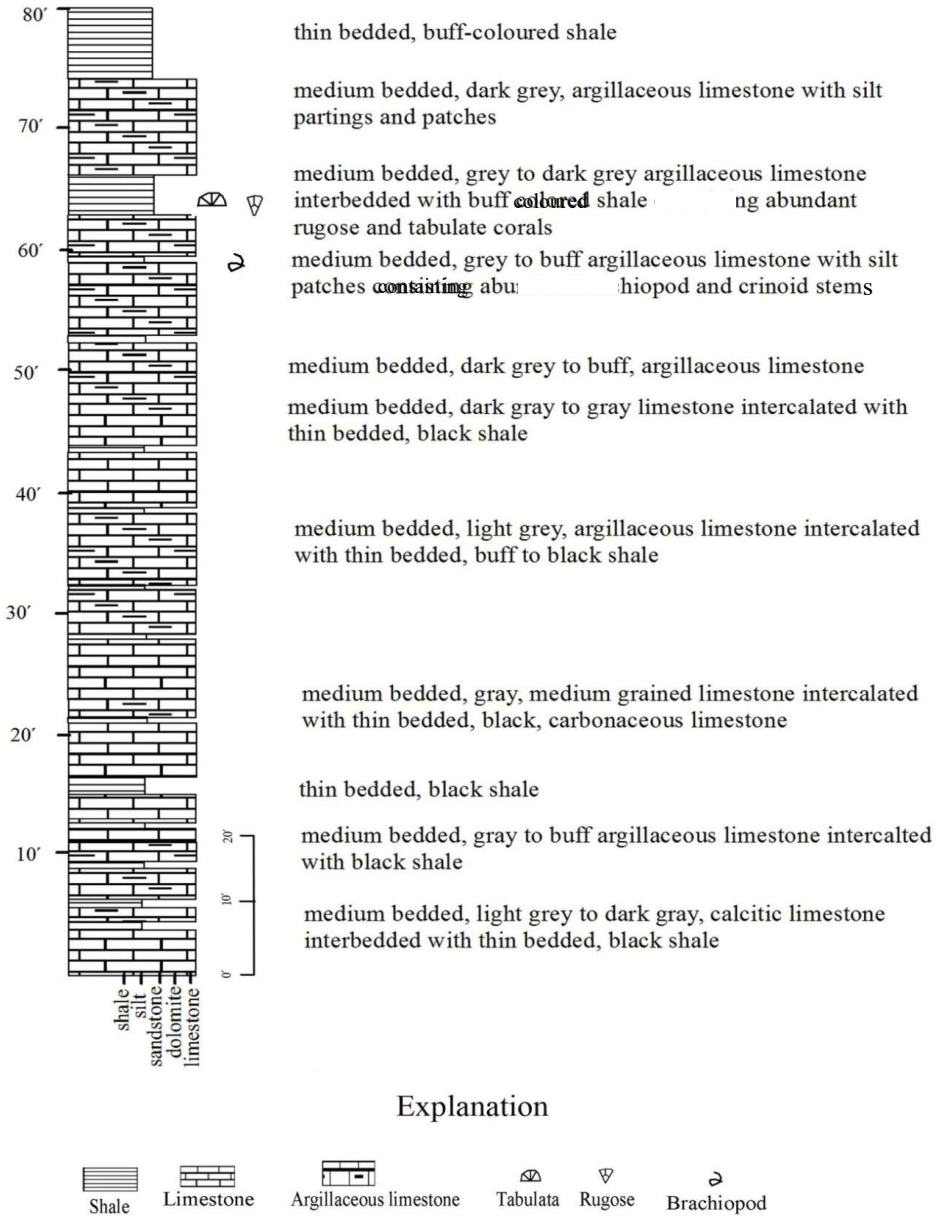
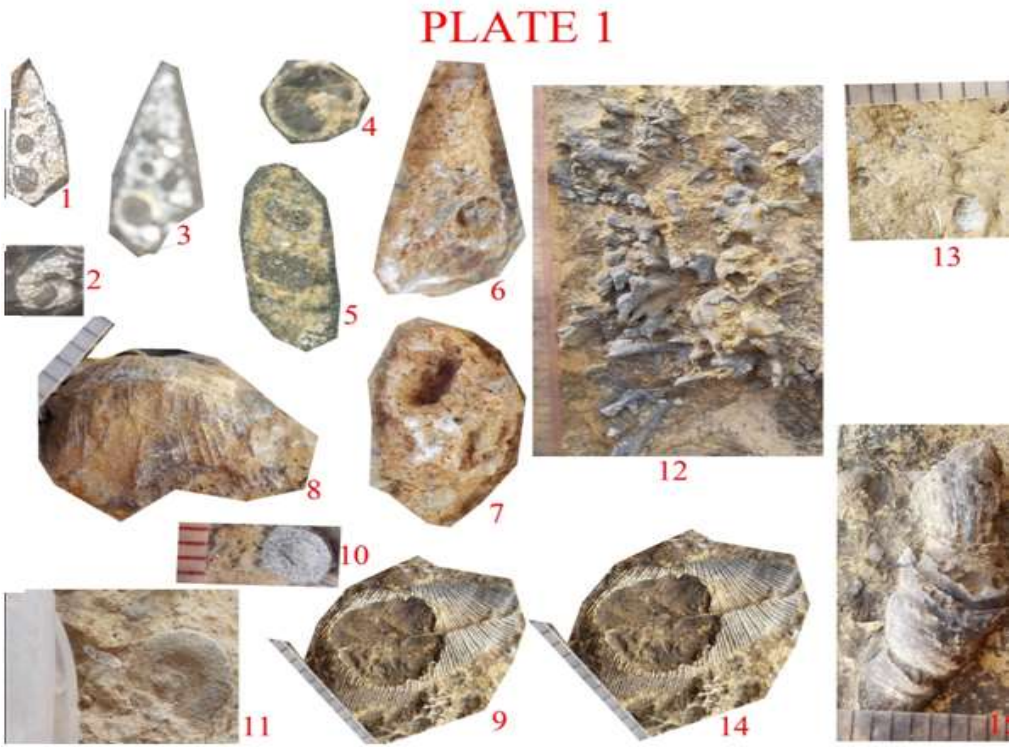


Figure 13. Stratigraphic mesasured section of the middle and upper parts of the Padaukpin Limestone (mile-post 5 to 6 furlong along the Lashio-Muse Car-road); Base at N 22° 54' 01" –E 97° 42' 08" and top at N 22° 54' 02"- E 97° 42' 07"



Figures 1-7 are collected from the lower part and figures 8-11 are from the middle part of the Middle Devonian, Padaukpin Limestone, Maymyo Formation, Lashio, northern Shan State

Figures 1, 3. Recrystallized Murchisonia sp.,

Figure 2. Recrystallized *Euomphalus* sp.

Figure 4, 5. recrystallized Transverse and longitudinal section of the *Loxonema* sp.

Figures 6, 7. Highly recrystallized gastropod

Figure 8. Incomplete specimen of *Devonaria miuta,*

Figure 9. Incomplete specimen of *Mesodouvillina birmanica*

Figures 10, 11. Large crinoid stems

Figures 12, 13 are collected from the middle part and figures 14,15 are from the upper part of the Middle Devonian, Padaukpin Limestone, Maymyo Formation, Lashio, Northern Shan State

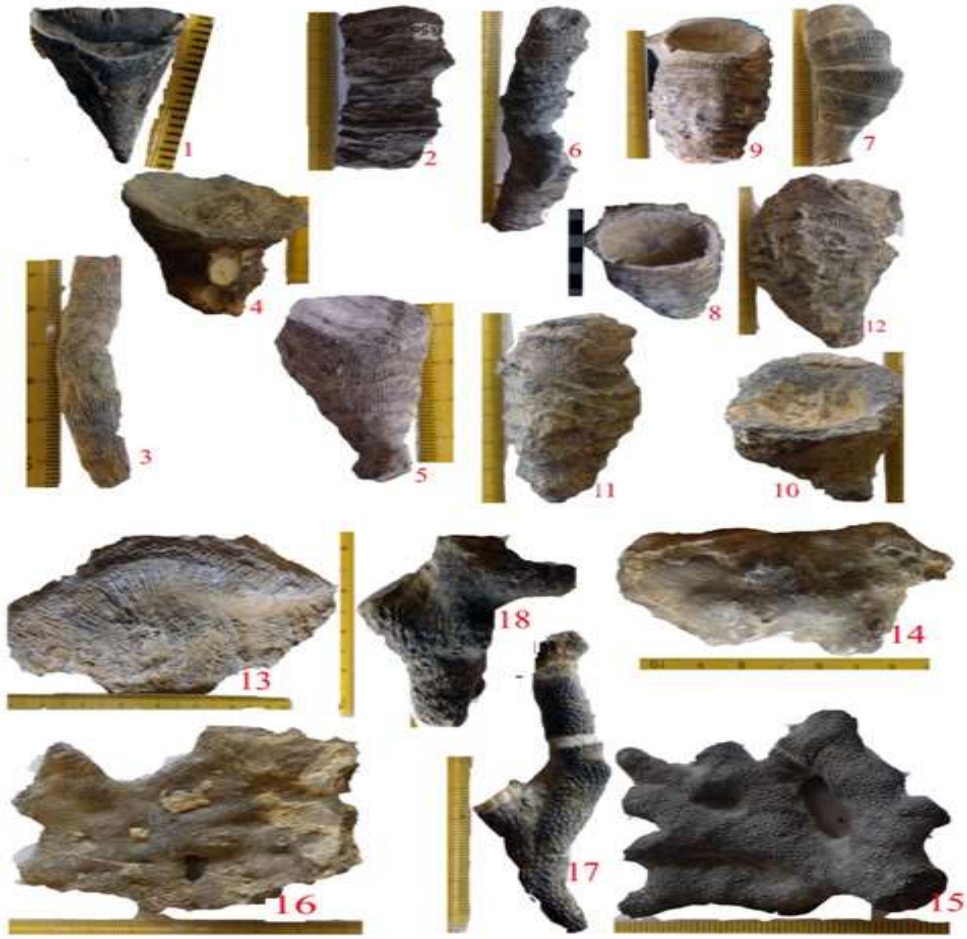
Figure 12. Unidentifiabe smaller brachiopod

Figure 13. Incomplete specimen of *Devonariamiuta*

Figure 14. Abundant tabulate corals in argillaceous limestone

Figure 15. *Stringophyllum* sp. in calcitic limestone with silt patches

PLATE 2



All specimens are collected from the upper part of the Middle Devonian, Padaukpin Limestone, Maymyo Formation, Lashio, northern Shan State

Figure 1. *Calceolasandalina,* Figure 2. *Enallophrentis* sp.,
Figure 3. *Gurichiphyllum* sp. Figure 4. *Acanthophyllum* sp.,
Figure 5. *Grypophyllum* sp., Figure 6. *Stringophyllum* sp.A
Figure 7. *Stringophyllum* sp.B, Figure 8. *Stringophyllum* sp.C,
Figure 9. *Temnophyllum* sp., Figure10. *Macgeea* sp.,
Figure 11. *Cyathophyllum* sp., Figure 12. *Peripaedium* sp.
Figure 13. *Favositesgoldfusi,* Figure14. *Alveolitessuborbicularis*
Figure 15. *Alveolites* aff. *Expatiate,* Figure16. *Alveolitesillusa*
Figure 17. *Coenitesescharoides,* Figure 18. *Aulocysticscornigera*

Table 1. Comaprison of the Middle Devonian unit in Padaukpin area and Lashio area.

Padaukpin Area	Lashio Area
Maymyo Formation	
➢ Less argillaceous	➢ More argillaceous with siltstone, shale &mudstone
➢ Occurrence of Wetwin Shale	➢ No occurrence of Wetwin Shale
➢ Less brecciation and friable	➢ More brecciation and friable
➢ Occurrence of relic fossils	➢ No occurrence of relic fossils
Padaukpin Limestone	
➢ Few occurrence of gastropods	➢ Abundant of recrystallized gastropods
➢ Abundant of brachiopods & bryozoans	➢ Few occurrence of brachiopods and bryozoans
➢ Abundant colonial rugose corals, i.e. *Phillipsastrea*, *Thamnophyllum*	➢ Few colonial rugose coral and absence of *Phillipsastrea*&*Thamophyllum*
➢ Less complete section	➢ Complete section and more abundant corals

Summary and Conclusion

The study area is situated in Lashio Township, Northern Shan State. The rocks of the present area can be differentiated into five lithologic units in asscending order: Hsipaw Red Bed (Late Jurassic), Loi-an Group (Late Triassic to Middle Jurasssic), Nwabangyi Dolomite Formation (Late Permian to Early Triassic) andMaymyo Formation.

This study is mainly deals with the Middle Devonian unit in Lashio area.It is mainly composed of thick-bedded to massive, white to light grey dolomite and dolomitic limestone. Fossiliferous Padaukpin Limestone is the sandwiched unit of the Maymyo Formation. Stratigraphy and paleontology of Middle Devonian unit in this area is slightly different from the type section of

Padaukpinarea. In this area, Maymyo Formation is more argillaceous with shale, siltstone and mudstone, more brecciated and friable with no occurrence of Wetwin Shale and relic fossils. The Padaukpin Limestone consists of medium- to thick-bedded, black to dark grey calcitic limestone containing abundant fossils of gastropods in the lower part at Hseing Hkaicar-road quarry. These gastropods are highly recrystallized and identified mainly by their shapes. The middle part of the Padaukpin Limestone consists of medium-bedded, dark-grey to buff limestone, argillaceous limestone, shale and siltstone with abundant crinoids and brachiopods. The upper part of the Padaukpin Limestone is composed of medium-bedded, grey to dark grey calcitic limestone interbedded with buff-coloured shale, siltstone and mudstone with abundant tabulateand rugose corals. The middle and upper part of the Padaukpin Limestone are clearly observed on the Lashio-Muse car road at 5 to 6 furlong mile post. Based on the fauna occurrence, the age of the Padaukpin Limestone can properly be designated as the Middle Devonian (Eifelian). The Maymyo Formation is also regarded as Middle Devonian (Eifelian) according to the fossiliferous Padaukpin Limestone. The comparison of the Middle Devonian unit in Padaukpin area and Lashio area is shown in Table (1).

Fossils dated Middle Devonian units are previously described as limitedly exposed unit in Myanmar such as Wetwin-Padaukpin and Pwepon. This area is the new occurrence of Middle Devonian unit which has been previously described as Triassic Nwabangyi Dolomite Formation in Northern Shan State as well as in Myanmar. It can be concluded that Middle Devonian unit is not limitedly exposed which are widely distributed unit in northern Shan State. So, it is necessary to reinvestigate the stratigraphy and paleontology of the Triassic Nwabangyi dolomite Formation in southern Shan State. Some may be the Middle Devonian units.

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