STUDY OF THE STRATIGRAPHY OF THE MARINE REPTILE FOSSIL BEARING LIMESTONE UNIT IN LASHIO AREA, NORTHERN SHAN STATE

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Abstract

The Triassic outcrops in northern Shan State have received relatively little study compared to correlative strata in the southern Shan State. Tirassic section to the west of Lashio, northern Shan State encompasses the Late Permian to Middle Triassic Nwabangyi Dolomite Formation. The marine reptile bearing limestone is the sandwiched unit of the Nwabangyi Dolomite Formation. Two specimens of Pachypleurosaurs are the only identifiable fossil collected from this limestone unit. It can be divided into four main facies (in ascending order); sedimentary breccias, laminated limestone, thin to medium-bedded limestone and thin-bedded, limestone intercalated with siltstone and shale. The exact stratigraphic position of the CMLV-1 Specimen is not known because of quarrying in this locality. YDBGLV-4 specimen bearing beds are medium-bedded, grey to dark grey, fine- to medium-grained limestone unit lie between the thin-bedded and laminated limestone facies. This limestone unit apparently grades into the surrounding dolomites.

Keywords*:* Triassic, Lashio, marine reptile, limestone

Introduction

The two specimens of Triassic marine reptile previously unrecorded from Myanmar were discovered in Lashio area, northern Shan State. Reptile and associated indeterminable scaly and bony fishes were occurred to the west of Lashio. This fossil-bearing limestone unit crops out in a mountain range, locally called Yebawhaung Kyauk-taung range, UTM map 2297-9; Lat 22˚56′04″, Long. 97˚42′49″ (Fig.1). This paper is mainly based on the stratigraphy, stratigraphic position and lithology of this limestone unit. Vertebrate fossils may help better constrain their ages. No adequate geological map of Lashio area exists, and this area also studied by MSc students from geology department of Mandalay University (2003) and geology department of Lashio University (2017) assigned Upper Permian to Middle Triassic Nwabangyi Dolomite Formation and Permian Plateau Limestone respectively. They gave, however, no paleontological evidence.

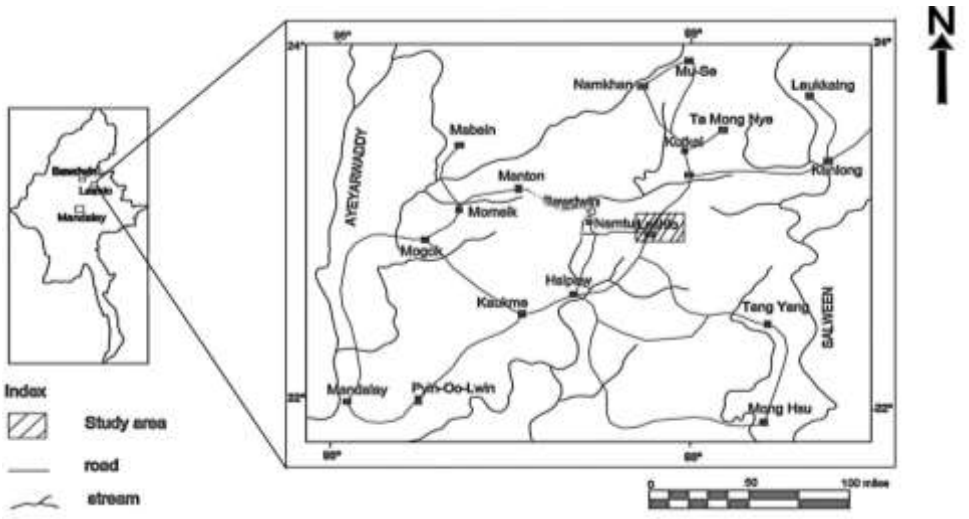

Figure 1 Localition map of the study area.

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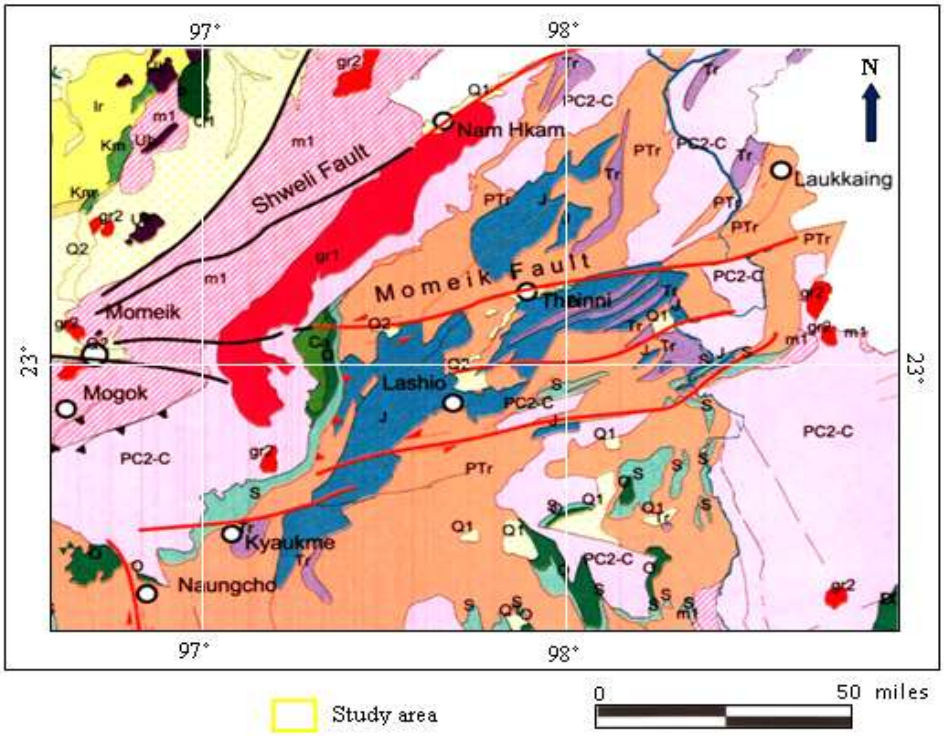
Regional geologic setting

Myanmar can be tectonically divided into four provinces. They are from east to west, (1) Shan-Tanintharyi Block, (2) Central Cenozoic Belt, (3) Western Fold Belt and (4) Rakhine Coastal Belt (Chhibber, 1934, Win Swe, 1972 and Maung Thein, 1973). MaungThein stated that the Shan-Tanintharyi Block contains Lashio Basin, Kalaw Basin and Myogyi-Pindaya Uplift. The present area is situated in the Shan-Tanintharyi Block of Lashio Basin which is lying in the northern part of the Shan Massif. The regional geologic setting of the Lashio and its environs is shown in (Fig.2).



Q2	Holocene	Alluvium
Q1	Pleistocene	Older Alluvium, Gravels
Km	Cretaceous	Kalaw Red Beds; and Kabaw Fromation and other marine units
J	Jurassic	Loi-an Group; Namyau Group; and their equivalents; Red Beds of Tanintharyi Region
Tr	Triassic	Thanbaya Formation; Bawgyo Group; Kamawla limestone; and their equivalents
PTr	Middle Permian-Middle Triassic	Plateau Limestone Group; Moulmein Limestone; and their equivalents; Yinyaw beds, and its equivalents
S	Silurian	Mibayataung Group; Nyaungbaw Formation; Pang-hsa-pye Fm; Namhsin Fm; and their equivalents
Pe2e	Upper Precambrian-Lower Cambrian	Chaung Magyi Group (including Mong Long Mica Schists); Pawn Chaung Series; and their equivalents
m1	Paleozoic and partly Jurassic	Metamorphosed units of mainly Lower Paleozoic rocks- Mogok Metamorphic Belt and its extensions
gr2	Mesozoic and Lower Tertiary	Granitoids- granite, granodiorite, diorite, and non-basic intrusives; locally transformed into granite gneiss and metadiorite
gr1	Upper Paleozoic	Granitoids

Figure 2 Regional geologic setting of the Lashio area. (Source: MGS, 2014)

Previous Works

The fossil bearing limestone was previously mapped and designated as the Nwabangyi Dolomite Formation (Brönnimann et al., 1975) as Upper Permian to Middle Triassic based on the occurrence of foraminiferal association of *Glomospirella irregularis* in Kyaukme-Longtawkno area, northern Shan State. The occurrence of the lowermost Triassic (early Scythian) beds in northern Shan State was recorded by Sahni (1936) at Na-hkan, north of Lashio and west of Hsenwi. Ammonite fauna occur abundantly in the argillaceous limestones and shales that are intercalated in dolomite. He gave the name Na-hkan Beds, which is in need of revision. Locally, this area also studied by MSc students from geology department of Mandalay University (2003) and geology department of Lashio University (2017).

Results and Discussion

Lithostratigraphy of the reptile bearing limestone

The marine reptiles were found in rocks of the Lashio Basin, in the northern part of the Shan Massif, which is part of the Shan-Tanintharyi Block. The Lashio area is composed mainly of sedimentary rocks that date from the Middle Devonian to the Jurassic dolomitic limestone, dolomite, calcitic limestone, argillaceous limestone, siltstone, shale, sandstone and conglomerate. The fossil-bearing limestone is sandwiched between thin- to medium-bedded, light to dark grey, hard and compact limestone and red to purple, uniformly thin-bedded, siltstone and mudstone. This unit apparently grades into the surrounding dolomites. The stratigraphic measured section of the limestone unit is shown in (Fig. 3).

Distribution

The units are generally striking NW-SE direction and well exposed at the mountain range, locally called the Yebawhaung Kyauk-taung range (UTM map 2297-9; 22°56′04″ N,97°42′49″ E).

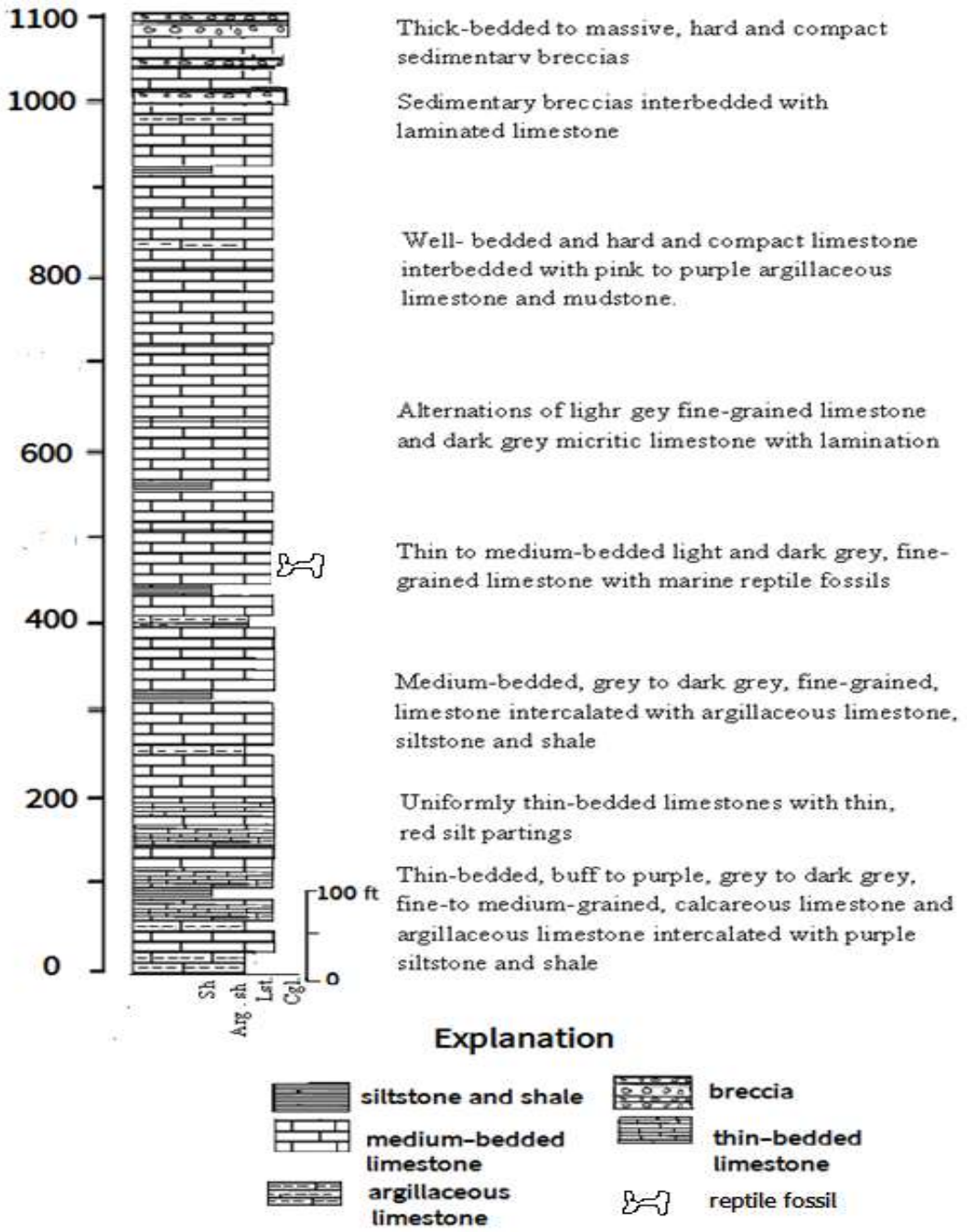


Figure 3 Stratigraphic measured section of the reptile bearing Limestone unit.

Lithology

In Yebaw-Haung Kyauktaung Quarry, the unit is consisted of thin- to medium-bedded, gery, purple and buff color and grey limestones, argillaceous limestone with lamination intercalated with siltstone and shale.The upper most part of the unit is overlain by medium- to thick-bedded sedimentary breccias. The stratigraphic succession of the unit in ascending order is as follows;

4. Sedimentary breccias – thick-bedded to massive, hard and compact forms 50 to 80 feet thick, interbedded with laminated limestone in the upper most of the unit (Figs. 20 & 21). The breccias consist of angular blocks or pebbles of various sizes of clasts such as laminated limestone,

calcareous siltstone, micritic limestone and dolomitic limestone which are sometimes flexed or contorted in the calcitic matrix (Fig. 22). It is polymitic breccias unit (Fig. 23).

3. Laminated limestone – Alternations of lighr gey fine-grained limestone and dark grey micritic limestone about 500feet in thickness (Figs. 15&16). They show horizontal bedding, well-bedded and hard and compact character. They are interbedded with pink to purple argillaceous limestone and mudstone (Figs. 17&18). At the Quarry, minor amount of ore minerals (Lead-zinc) can be observed in argillaceous limestone. In some laminated limestone also gives a folded and contorted structure (Fig. 19). The surface of the formation is extremely irregular, lacking surface drainage and swallow-holes are common. Microscopically, it is sandy micrite and mainly composed of micrite, quartz, iron oxide mineral and others and micritic dolomitic limestones consist of laminated algae. The limestone is dominance of limemud, generally light in colour.The laminated micrites are probably of algal origin in a tidal flat environment.

2. Thin to medium-bedded limestone - Thin to medium-bedded, light and dark grey, fine-grained limestone, compact and occasionally criss-crossed structure with marine reptile fossils about 200- 300 feet in thickness (Figs. 8-12). This unit is rather hard and compact and Iron stained red colour in some parts of the bed (Figs. 13&14). Under the microscopic study, most of the limestones are dismicrite and pelmicrite composed of micrite, pelloids and bioclasts.

1. Thin-bedded limestone - Thin-bedded (1-8 cm), buff to purple, grey to dark grey, fine- to medium-grained, hard and compact, calcareous limestone and argillaceous limestone intercalated with purple siltstone and shale about 200 feet in thickness. Uniformly thin-bedded limestones with thin, red silt partings are observed in this unit (Figs.4&5). Weathered surface shows yellowish brown, purple to light grey color whereas grey color on fresh surface (Figs. 6&7). Microscopically, these limestones are biomicrite and mainly composed of micrite, bioclasts (foraminiferal and thin-shelled bivalve) and iron oxide and ferruginous micrite composed of micrite, sparry calcite and iron oxide.

Thick carbonate sequence is mostly shallow marine water condition probably shelf environment.

Nature of contact

In this area, the upper contact between the reptile bearing limestone unit and dolomitic limestone of Nwabangyi Dolomite Formation and the overlying Hsipaw Red Bed is faulted contact in the southern part of Sin Taung and occurs as unconformable contact in the eastern part of Sin Taung. It grades laterally into dolomite or dolomitic limestone. The lower contact of the unit is not clearly observed in this area due to covered soil which may be the conformable contact with the Plateau Limestone.

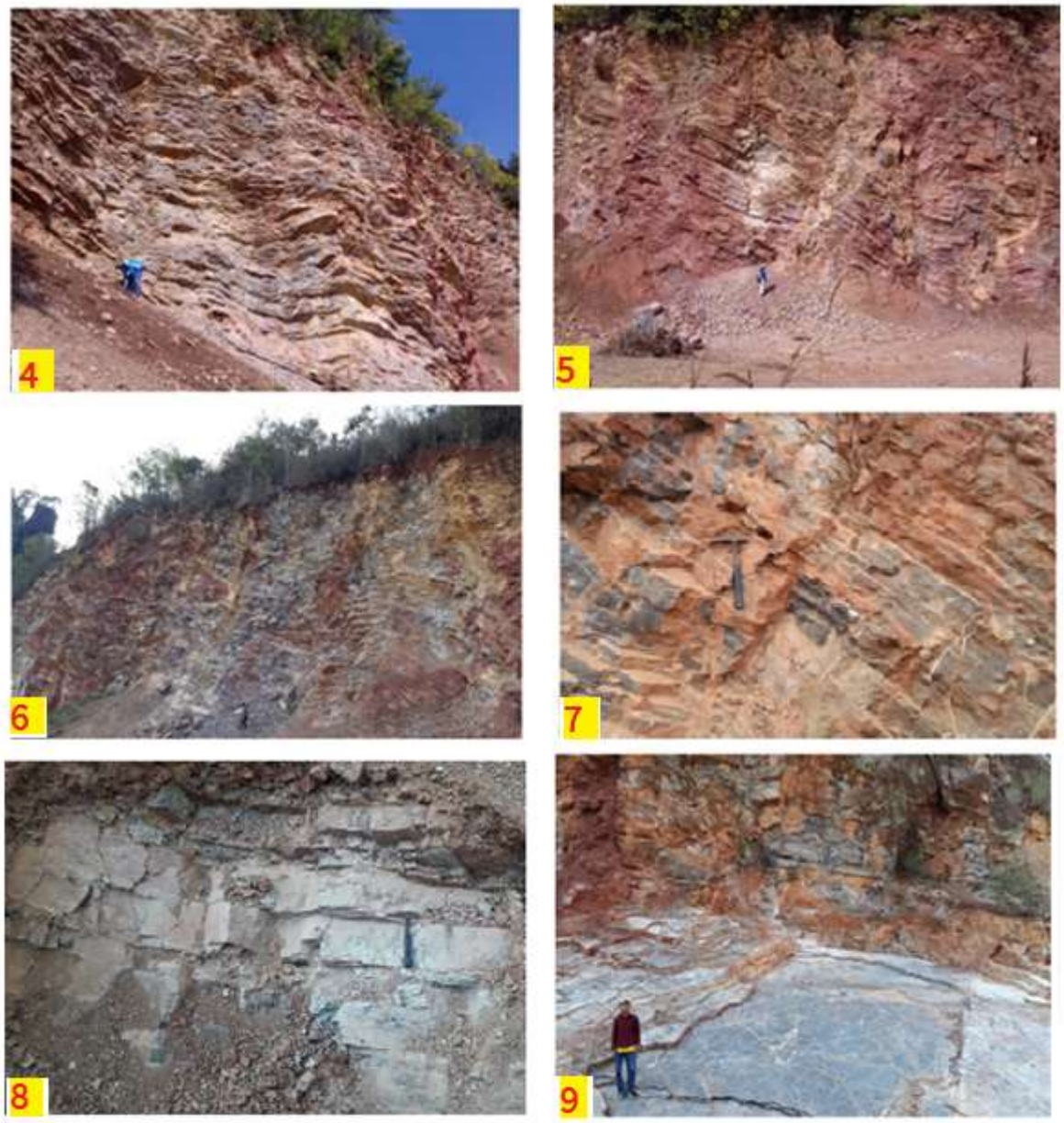


Figure 4 Thin-bedded, grey to purple limestone intercalated with thinly bedded, argillaceous limestone in the lower most part of the unit. (N225552, E974258)

Figure 5 Quarry site of thin-bedded limestone intercalated with purple limestone. (N225552, E974258)

Figure 6 Thin-bedded, grey limestone intercalated with buff-colored argillaceous limestone. (N225606, E974303)

Figure 7 Thin-bedded, grey limestone intercalated with purple siltstone and shale. (N225606, E974303)

Figure 8 Medium-bedded, grey to dark grey, fine-grained limestone with marine reptile fossil in the middle part of the unit. (N225604, E974308)

Figure 9 Medium-to thick-bedded, grey to purple, fine-grained limestone with secondary calcite veins. (N225604, E974305)

Figure 10 Thin-bedded, grey, micritic limestone interbedded with purple mudstone at YebawHaung quarry near Namkhai village.

Figure 11 Thin- to medium-bedded, grey limestone with iron stained red coloration on the bedding plane. (N225611, E974305)

Figure 12 Medium-bedded, grey, micritic limestone in the middle part of the unit. (N225640, E974250)

Figure 13 Thick-bedded, grey to purple, highly jointed limestone intercalated with purple siltstone and shale. (N225640, E974250)

Figure 14 Medium-bedded, grey to purple, fine-grained limestone in the middle part of the unit. (N225640, E974250)

Figure 15 Medium-bedded, light grey to grey, fine-grained laminated limestone in the middle part of the unit. (N225603, E974308)

Figure 16 Close up view of Medium-bedded, light grey to grey, fine-grained laminated limestone in the middle part of the unit.

Figure 17 Medium- to thick-bedded, grey, micritic limestone with parallel lamination in the middle part of the unit.

Figure 18 Medium-bedded, grey to purple, highly jointed laminated limestone. (N225609, E974248)

Figure 19 Medium-bedded, grey to purple, hihly contorted and slightly folded, laminated limestone in the middle part of the unit. (N225604, E974249)

Figure 20 Contact between the laminated limestone and sedimentary breccias. (N225512, E974245)

Figure 21 Thick-bedded to massive, hard and compact, sedimentary breccia in the upper part of the unit. (N225512, E974245)

Figure 22 Interbedded nature of laminated limestone and breccias in the upper part of the unit. (N225552, E974258)

Figure 23 Sedimentary breccias with angular blocks or pebbles of various sizes of clasts such as laminated limestone, calcareous siltstone, micritic limestone and dolomitic limestone.

Fauna and Age

The present limestone unit crops out in a mountain range. Khaing Khaing San et al. (2019) discovered the first Triassic vertebrate fossils (Pachypleurosaurs) from Yebaw-Haung Kyauktaung Quarry. Both specimens were found in a ferruginous, micritic limestone, associated with indeterminate fish bones and scales.

The fossil reptiles are embedded in ferruginous, micritic limestone layers sandwiched between the thin- to medium-bedded, light to dark grey, hard and compact limestone, red to purple, uniformly thin-bedded, siltstone and mudstone. Minor amount of ore (lead-zinc) mineralization can be observed in some parts of the bed. This limestone unit apparently grades into the surrounding dolomites. As these fossils are preserved by the replacement of iron for calcium, the detailed morphological structures are slightly obscured. In this unit, fossils are rare except the reptile and fish fauna.

This fossil indicates the Triassic age for the undolomitized part of the Nwabangyi Dolomite Formation. So, the age of this Formation has probably been regarded as Late Permian – Middle Triassic on the basis of stratigraphic position, lithologic character and faunal contact.

Correlation

On the basis of the lithologic similarities and stratigraphic position, the reptile bearing unit of the present area can be correlated with the undolomitized part of Nwabangyi Dolomite Formation of the Southern Shan State (Garson et al, 1976).

Discussion

La Touche (1913) first used the term Plateau Limestone of thick carbonate sequence in the Northern Shan State. He divided into the lower dolomitic part and upper calcitic part. Amos (1975) described the name Sha Dolomite Grup and can be subdivide the two dolomitic units into the Maymyo Dolomite Formation and Nwabangyi Dolomite Formation. The calcitic part in the two doloitic units is named as the Thitsipin Limestone Formation.

Garson et al. (1976) subdivided the Permo-Triassic unit of southern Shan State into three distinct Formations; the Thitsipin Limestone, the Nwabangyi Dolomite Formation and the Natteik Limestone Formation. He gave the Nwabangyi Dolomite Formation to a sequence of dolomitized carbonate rocks of Permian-Triassic age exposed in the vicinity of Nwabangyi village, Ye-ngan Township, Southern Shan State.

Garson et al. (1976) divided the brecciation escaped rocks of Nwabangyi Dolomite Formation into four main facies. They are from upper to lower-

4. Light and dark grey, fine-grained limestone facies

3. Sedimentary breccias facies

2. Laminated and turbiditic limestone facies

1. Thin-bedded foraminiferal limestone facies

In this study, Nwabangyi Dolomite Formation is used to describe a thick-bedded to massive, light grey to grey, highly brecciated dolomite and dolomitic limestone, thin- to medium-bedded, dark grey limestone, laminated argillaceous limestone and breccias.

The fossil-bearing limestone was previously mapped as belonging to the Nwabangyi Dolomite Formation (Garson et al. 1976), considered Late Permian to Middle Triassic in age based on the occurrence of the foraminiferan *Glomospirella irregularis* in the Kyaukme-Longtawkno area of northern Shan State (Brönnimann et al. 1975). This limestone has been correlated with the

Thigaungtaung Limestone (Early–Middle Triassic, Induan–Anisian) of southern Shan State (Amos 1975; Whittaker in Brönnimann et al. 1975; see also the recent review of the "Plateau Limestone" of southern Shan State by Win et al. 2015). Furthermore, Sahni (1936) compiled other records of lower-most Triassic units (Scythian, Induan–Olenekian) at Namhkam (north of Lashio and west of Hsenwi), to which he gave the informal name of the "Na-hkan Beds". The detailed stratigraphy, correlations, and ages of these various units are in need of revision. Vertebrate fossils may help better constrain their ages.

Conclusion

Garson et al. (1976) assigned the Nwabangyi Dolomite Formation as Late Permian to Middle Triassic based on the occurrence of foraminifera. Wolfart et al (1984) also described the youngest rocks of the Nwabangyi Dolomite are probably Anisian/Ladinian (Middle Triassic age) of the Northern Shan State. The dolomitized part of the Nwabangyi Dolomite Formation is mainly composed of thick-bedded to massive; light grey to grey, fine-grained, highly brecciated and highly jointed dolomite and dolomitic limestone. They are sandy to touché and have a granular texture. In the present study of the limestone unit, the Triassic index fossils of marine reptile (Pachypleurosaurs) have been found. Some micro-fossils and shell fragments have also been found in this unit under thin-section view. It grades laterally into dolomite or dolomitic limestone.of the Nwabangyi Dolomite Formation and can be conclude that it is the undolomitized, sandwiched unit of Nwabangyi Dolomite Formation.

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