Stratigraphy and Petrology of the Nwabangyi Formation in The Ngazu-Nyaungbindaung Area, Kalaw Township, Southern Shan State

May Thu Aung[1], Khin San[2], Nyan Min Naing[3]

Abstract

The study area is located in the eastern part of the Kalaw and southern part of Aungban, Kalaw Township southern Shan State. It is lying between North Latitudes 20˚33´45″ and 20˚39´15″ and East Longitudes 96˚34´45″ and 96˚40´00″ in one-inch topographic map of 93D/10. In the study area, Nwabangyi Dolomite Formation is well exposed in the central part of Kalaw- Aungban car road and Kalaw- Panlong car road. The best outcrops can be seen near Nan-on chaung, Lamingyi quarry and Kyigon quarry. The Dolomite hills are rolling topography and spare vegetation. Nwabangyi Dolomite Formation is mainly consisting of grey to light grey, highly brecciated dolomites and with minor amount of dolomitic limestone. The middle part of the formation constitutes light grey to whitish grey colored, medium- to thick-bedded, medium- to coarse- grained, clastic limestone (calcirudite) with sugar texture. The upper part of the formation is composed of light grey to dark grey, brown colored and yellowish brown colored, medium-to thick-bedded, fine-grained, highly brecciated dolomite. Petrographically, Nwabangyi Dolomite Formation can be divided into five microfacies. They are (1) Dolomitized Dessicated Mudstone, (2) Dolomitized Packstone, (3) Dolomitized Grainstone, (4) Dolomitzed Crystalline Limestone, (5) Dolomitized Wackestone. Nwabangyi Dolomite Formation area begin with sediments from high energy debris in slope grading upward to moderate to high energy of the shoal and followed by the protected area and tidal flat and locally ending in supratidal setting.

Key Words –calcirudite, tidal flat, shoal

Introduction

Location, Size and Accessibility

The study area is located in the eastern part of the Kalaw and southern part of Aungban, Kalaw Township southern Shan State. It is lying between North Latitudes 20˚33´45″ and 20˚39´15″ and East Longitudes 96˚34´45″ and 96˚40´00″ in one-inch topographic map of 93 D/10. The study area is nearly 6.5 miles long from north to south and over 5.5 miles wide from east to west. Aungban town lies on the northern boundary of the area. This area is easily accessible during the whole season. The location map of the study area is shown in figure (1).

Methods of Study

Detailed measurements were taken along the stream and car road sections to investigate the stratigraphic units. Regional lithology trends and major geological structures were obtained from the satellite image of the research area. By using tape and compass method, the general strikes of rock units were obtained.

Hard and compact sandstones, limestone and dolomitic limestone collected from the field traverses were cut into thin- sections for study the petrography and modal compositions. Many thin- sections were studied under a polarizing microscope. The percentage of minerals

[1] Demonstrator, Geology Department, Panglong University
[2] Professor and Head, Geology Department, Magway University, Mgway
[3] Assistant Lecturer, Geology Department, Magway University, Mgway

and rock fragments of a thin- section were examined by visual estimation chart of Tucker, 2001.

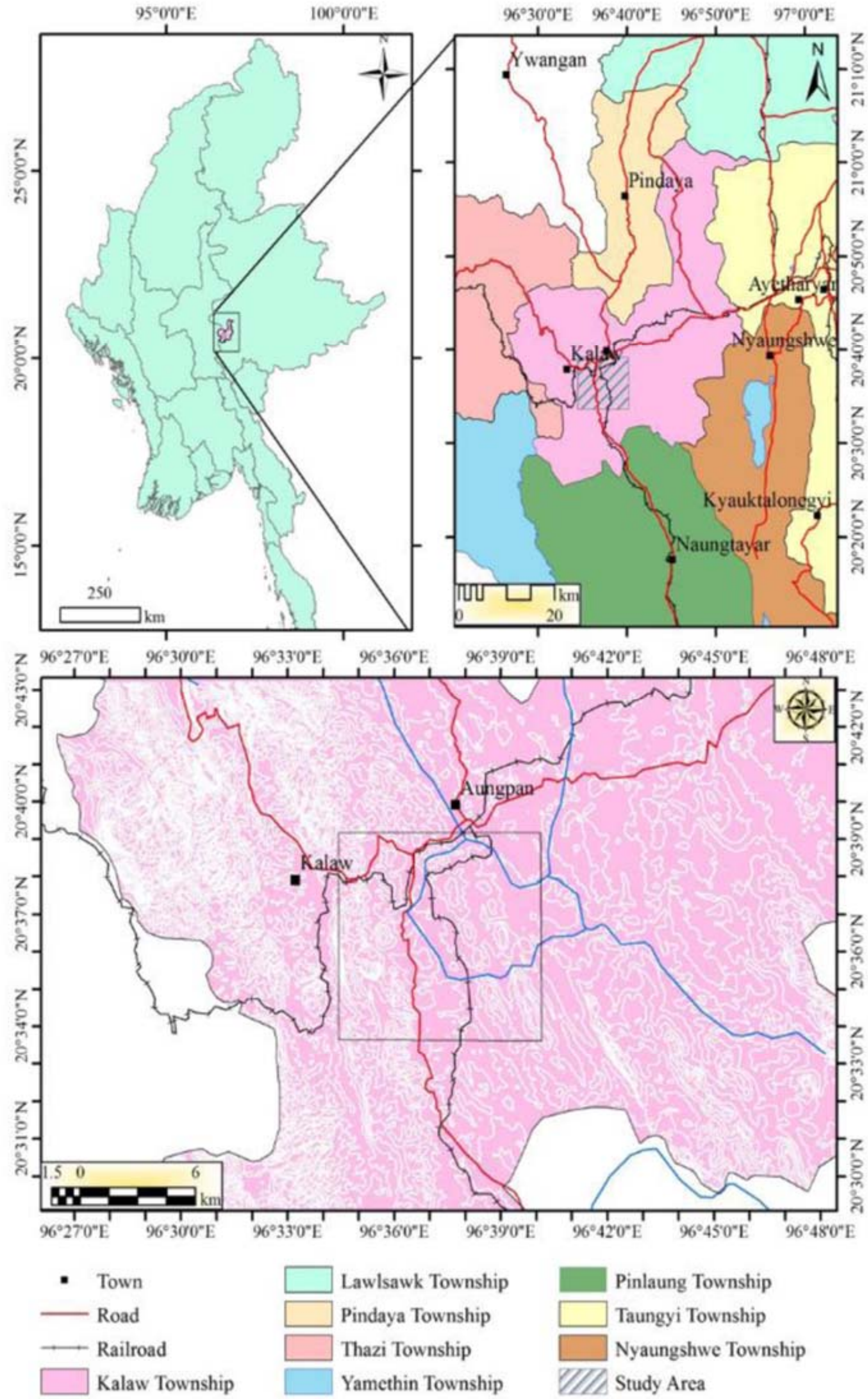


Figure (1). Location map of the study area.

Geographic setting

The study area is situated in the southwestern part of the southern Shan State. It is lying in the Eastern Highland. The study area is generally rugged in topography and most mountainous region. The general elevation of the study area is about 5000´ above sea level. The ridges are generally trending in NNW-SSE direction and it is paralleled to the lithological trends of the rock unit. The western and southeastern parts of the area are rough topography with high elevation. Noteworthy mountains are Myinmati taung (5687´) and Htinyugon (4800´).

Kalaw Chaung, Aungban Chaung, Wasoe Chaung occurred in local area. Kalaw chaung is the most prominent stream in the study area. Dendritic drainage pattern is developed in many places of the study area. It shows that the underlying rock may be sandstone, shale and limestone. Small streams are running more or less parallel to the regional strikes of the beds, thus trellis drainage patterns are developed in south-eastern and western part of the area. Due to the trellis drainage patterns, the study area is controlled by structure. A few small parallel drainage patterns are occurred in south western part of the study area. Parallel drainage pattern develops on fine-textured material with steep slopes. Angular and rectangular drainage patterns are developed in west and nearly central part of the area. The study area is mainly covered by pine forests.

Regional Geologic setting

Geotectonically, Myanmar can be subdivided into four broad belts which are trending from north to south liner belts. These are from east to west, Shan-Tanintharyi Block, Central Cenozoic Belt, Western Fold Belt and Rakhine Coastal Belt (Maung Thein, 2010). The study area is situated in Shan-Tanintharyi block of Myanmar. It consists of Kalaw basin and Lashio basin. Kalaw basin is also known as Kalaw- Panlong basin. The western boundary of the Shan-Tanintharyi Block is demarcated at the Shan Escarpment and the N-S trending granitic intrusions are sporadically stretching out along the foot-hills of this escarpment. Regionally, the Shan Plateau portion of the Eastern Highlands is underlain mainly by Precambrian, Paleozoic and Mesozoic strata which are partly deposited in mobile belts and partly on shelves and local basins and are locally metamorphosed and intruded by igneous rocks.

Kalaw-Panglong basin and its environs are fairly complexed by the Shan –Scrap Fault, and Nwalebo Fault. The Nwalabo Fault Belt is divided by subsidiary sub-parallel faults into numerous narrow wedges of widely different thickness and extent. One section of the NNW-trending faults controls the elongated, graben-like structures which, near Kalaw, contain the tightly folded Jurassic Loi-an Group and the overlying Kalaw Red Beds (in Bender, 1982).

Due to block faulting the Plateau Limestone units are cropping out almost throughout the entire length of the basin as N-S to NNW-SSE trending, high and rugged mountain ranged. Plateau Limestone units also occurred as the exposed inliers such as those of the Myinmati Hill at southeast of Kalaw, and outcrops near Inbyin village just east of Kalaw.

Nwabangyi Dolomite Formation

General Statement

This formation was named after the Nwabangyi village (in the Ye-ngan Township), situated about 6 miles NE of Kinda Dam (Garson *et al* 1976).

Brunnschweiler (1970) recognized only two formations within- Plateau Limestone of La Touché (1913): the dolomitized Devonian Shan Dolomite Formation, and undolomitized Permian Thonbo Limestone Formation.

Amos (1975) elevated Brunnschweiler’s Shan Dolomite to a status of a group. His Shan Dolomite Group consists of two formations; the Maymyo Dolomite Formation (Devonian) and Nwabangyi Dolomite Formation. Nwabangyi Dolomite Formation comprises all dolomitized carbonates of Permian and Triassic age.

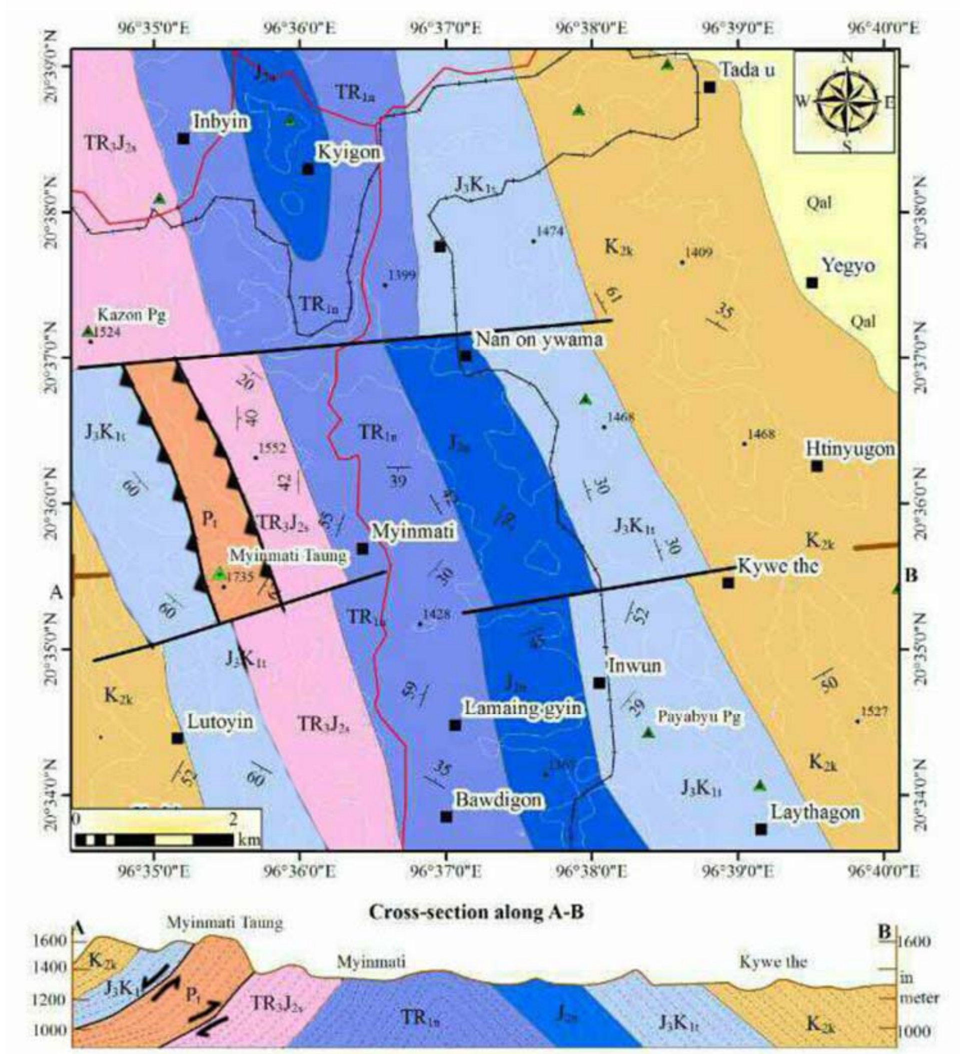
The all dolomitized carbonate sequence of Permian to Triassic age of Kalaw Township, southern Shan State is also adapted to describe in the present study area.

Distribution

In the study area, Nwabangyi Dolomite Formation is well exposed in the central part of Kalaw- Aungban car road and Kalaw- Panlong car road. Outcrops of the Nwabangyi Dolomite Formation are noted in the areas such as northern part of the Myinmati hill at the southeast of Kalaw, at east of Kyigon village, at near Inbyin village, just east of Kalaw and Aungban-Loikaw car road. The best outcrops can be seen near Nan-on chaung, Lamingyi quarry and Kyigon quarry. The Dolomite hills are rolling topography and spare vegetation.

Lithology

Nwabangyi Dolomite Formation mainly consists of grey to light grey colored, highly brecciated dolomites and with minor amount of dolomitic limestone. Dark grey to light grey colored, thick bedded to massive, fine- to medium-grained dolomitic limestone are mainly consisting in the lower part (figure 3 & 4). Crisscross patterns are occurring in this unit. Near Kyigon village, the best exposure can be seen.



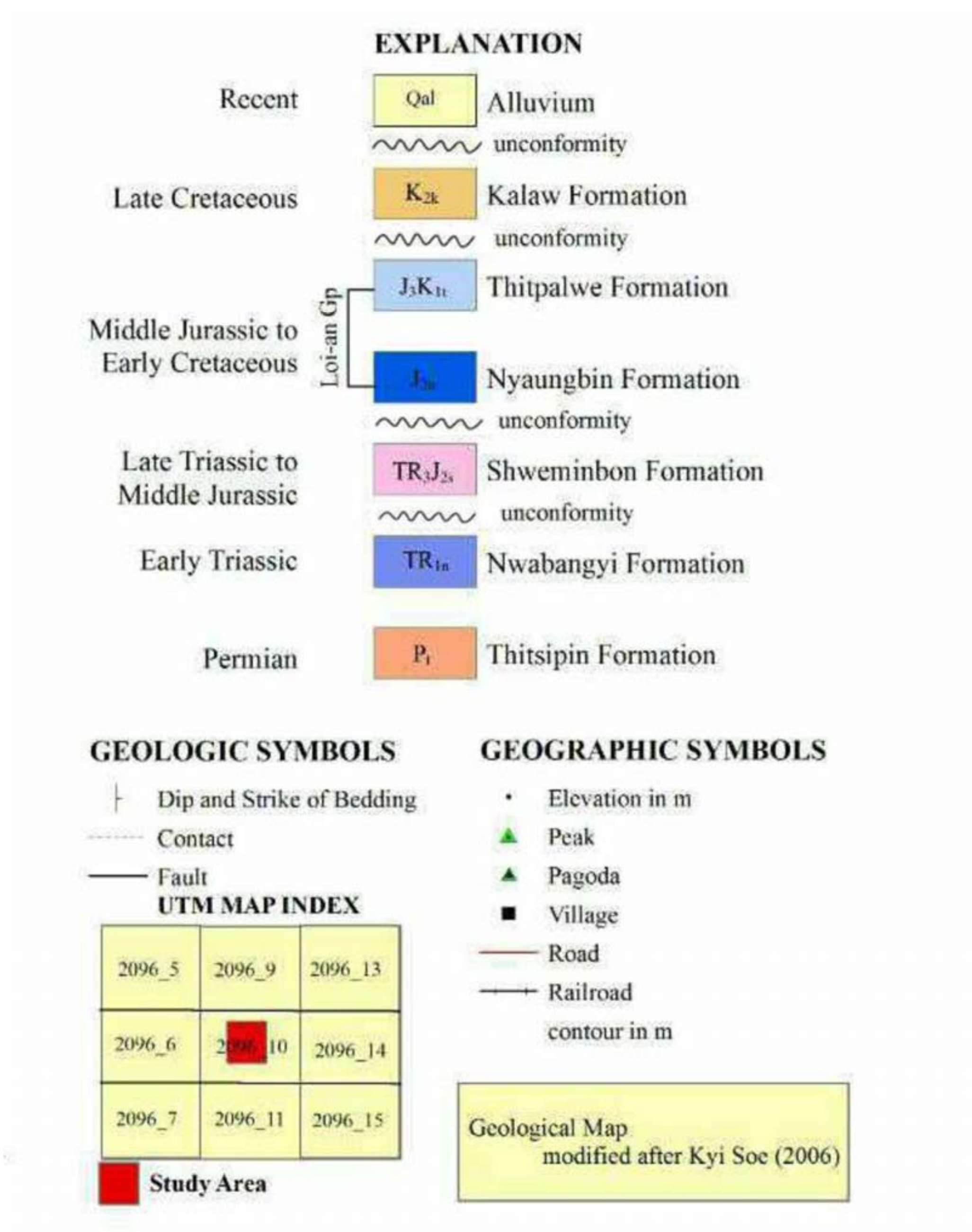


Figure (2). Geological Map (modified after Kyi Soe, 2006; Aung Win Swe, 2007)

Figure (3) Light grey colored, thick bedded to massive, fine- to medium-grained dolomitic limestone of the Nwabangyi Dolomite Formation (grid no. 114972)

Figure (4) Dark grey to grey colored, thick bedded to massive, fine- to medium-grained dolomite near Kyigon village (grid no.141020)

The middle part of the formation constitutes light grey to whitish grey colored, medium- to thick-bedded, medium- to coarse- grained, clastic limestone (calcirudite) with sugar texture (figure 5). Sizes are 1-2cm in diameter. It contains karstic phenomena. Calcite vein and cregging appearance occur in this unit. Whitish grey colored, coarse- grained, clastic dolomitic limestone also occurs (figure 6).

Figure (5) Dark grey colored, thick bedded, highly brecciated and dolomitized calcirudite unit of the Nwabangyi Dolomite Formation (grid no.138018)

Figure (6) Whitish grey colored, coarse-grained, Clastic limestone unit of the Nwabangyi Dolomite Formation (grid no.157938)

The upper part of the formation is composed of light grey to dark grey, brown colored and yellowish brown colored, medium-to thick-bedded, fine-grained, highly brecciated dolomite (figure 7&8). Calcitic layers are intercalated in brecciated dolomitic limestone. Pinkish grey to light grey colored, highly brecciated dolomite is overlain by cross bedded dolomitic sandy limestone. Minor amount of limestone breccia occurs in this unit. Terrarosa soils are overlain about 5ft thick in this unit. There is acid no reaction and crisscross patterns are occurring in this unit. Near Lutpyin village and along the Aungban-Loikaw car road, Nwabangyi Dolomite Formation are highly brecciated dolomitic limestone. Nwabangyi Dolomite Formation are rarely fossiliferous. This is due to dolomitization process.

Figure (7) Yellowish brown colored, fine-grained dolomitic limestone unit of the Nwabangyi Dolomite Formation (grid no.138018)

Figure (8) Whitish grey colored and highly brecciated dolomite unit of the Nwabangyi Dolomite Formation (grid no.143934)

Stratigraphic Relationship

Thitsipin Limestone Formation in the southern Shan State with very irregular contact to the Nwabangyi Formation, it appears to be not a clear-cut stratigraphic contact. The rocks of the Nwabangyi Formation uncomformably underlies on the Shweminbon Formation. The Loi-an Group overlap on the Nwabangyi Dolomite Formation.

Age

The index fossils have not yet been found. Although strong paleontological evidences are lacking in the area, the age of formation has been regarded as Upper Permian to Middle Triassic based on the stratigraphic position and lithology.

Petrographic Description of the Nwabangyi Dolomite Formation

Mainly based on the petrographic study, Nwabangyi dolomites can be divided into (5) microfacies.

(1) Dolomitized Dessicated Wackestone

Megascopically, this limestone is dark grey colored, fine-grained dolomitic limestone unit of Nwabangyi Dolomite Formation.

Microscopically, this microfacies composed of more than 10 percent of grain, which are mud-supported. This rock is Nwabangyi Dolomite Formation is mainly composed of dolomite. Dolomite mosaic is idiotopic. Dolomite crystal size are polymodal. Dolomite crystal contains more than 90 percent. Calcite vein are occurring. Calcite vein size are range from 0.1 to 0.5 mm. Calcite vein are replaced by iron (hematite). Distinctive features of this facies are the desiccation cracks. Near angular to desiccated cracks are found (figure 9). They are extremely irregular patches and scattered within the micrite (figure 10). It changes from desiccated mud cracks.

According to Dunham (1962), this facies can be named as “Dolomitized Desiccation Wackestone”. Based on the dolomite the content, the rock can be named as “Dolostone” (Tucker, 2001).

Depositional Environment

Desiccation feature is the result of normal marine tide in lowest energy tidal flat existing on peritidal (Tucker, 2001). So, this is interpreted to be deposited in shallow to subaerial environment (figure 18) (Tucker and Wright, 1990). This facies assigned to MFN 1.

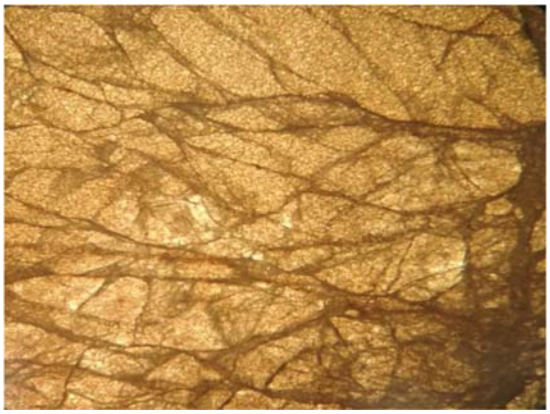


Figure (9) Photomicrograph showing dessication cracks of the Dolomitized Dessicated Wackestone in the Nwabangyi Dolomite Formation Under XN.4X

Figure (10) Photomicrograph showing irregular patches &scattered within the micrite with calcite veins of the Dolomitized Dessication Wackestone in the Nwabangyi Dolomite Formation Under X.N.4X

(2) Dolomitized Packstone

Megascopically, this limestone is whitish grey colored, coarse-grained dolomitic limestone unit of Nwabangyi Dolomite Formation.

Microscopically, this microfacies contains grain supported and mainly of intraclasts. This rock is mainly composed of dolomite 60 percent, micrite 40 percent. Intraclasts sizes are range from 0.2mm to 1mm. Intraclasts are replacing into dolomitized. Dolomite crystal sizes are polymodal and idiotopic mosaic in the intraclasts (figure 11). Fracture are common. Calcite vein are occurring and some places are filled with sparite (figure 12). In some places, original intraclasts are replacement by doloarenite size dolomite. Micrite are altered to dolomite but rare. There are fewer straight boundaries and the fabric is non-planar anhedral.

According to Dunham (1962), this facies can be named as “Dolomitized Packstone”. Based on the dolomite the content, the rock can be named as “Calcitic Dolomite” (Tucker, 2001).

Depositional Environment

Re-sedimented limestone are usually ascribed to either the slope apron or base-of-slope apron models depending on whether the re-sidemented limestone interfinger with the shallow-water shelf limestone (Tucker, 2001). This sediment deposited under shallow water (figure 18) (Tucker and Wright, 1990). This facies assigned to MFN 2.

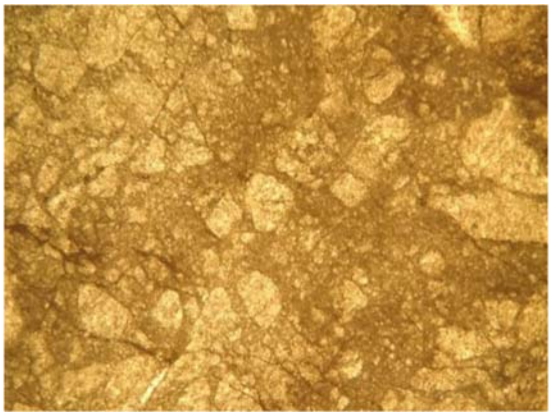


Figure (11) Photomicrograph showing Intraclasts sizes are polymodal and idiotopic mosaic of the Dolomitized Packstone in the Nwabangyi Dolomite Formation Under X.N, 4X

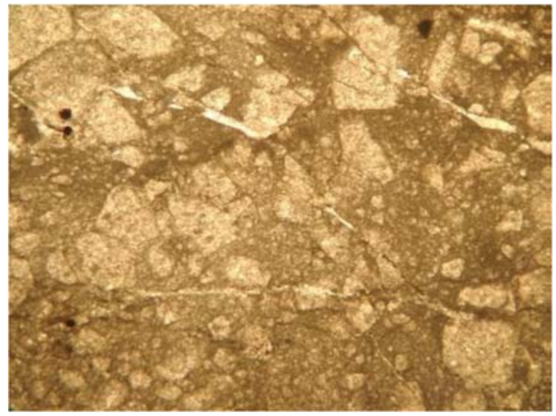


Figure (12) Photomicrograph showing thin let of calcite of the Dolomitized Packstone in the Nwabangyi Dolomite Formation Under PPL, 4X

(3) Dolomitized Grainstone

Megascopically, this limestone is dark grey colored, fine-grained, medium- to thick-bedded dolomitic limestone unit of Nwabangyi Dolomite Formation.

Microscopically, this microfacies composed grain supported. It consists of 90 to 95 % of dolomite crystals (figure 13). Thin- let of calcite cut by the sediment. Fracture are common (figure 14). Dolomitization incompletely destroys all the evidence of original depositional lithofacies. Anhedral to subhedral dolomite crystals form which especially show of xenotopic to hypidiotopic crystal mosaic.

According to Dunham (1962), this facies can be named as “Dolomitized Grainstone”. Based on the dolomite the content, the rock can be named as “Dolostone” (Tucker, 2001).

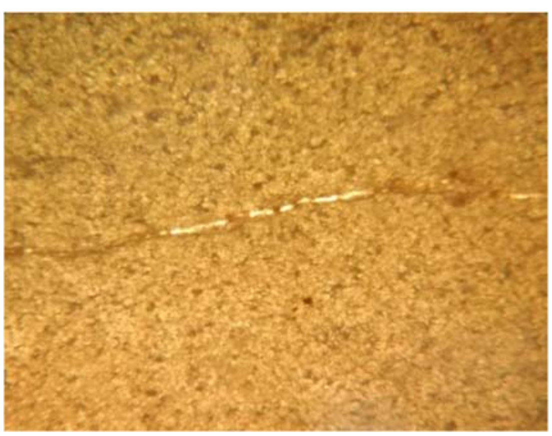


Figure (13) Photomicrograph showing dolostone with thin- calcite vein of the Dolomitized Grainstone in the Nwabangyi Dolomite Formation Under X.N, 4X

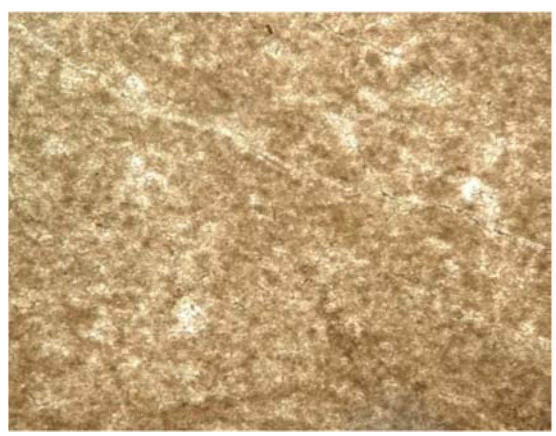


Figure (14) Photomicrograph showing anhedral to subhedral and xenotopic mosaic of the Dolomitized Grainstone in the Nwabangyi Dolomite Formation Under X.N, 4X

Depositional Environment

The small crystal size, they inferred restricted subtidal to supratidal environment (Amthor &Friedman, 1991 in Cho Cho Lwin, 2013). It is indicated that the supratidal environment (Tucker and Wright, 1990). This facies assigned to MFN 3.

(4) Dolomitized Crystalline Limestone

Megascopically, this limestone is light grey to dark grey colored, fine- to medium-grained crystalline limestone.

Microscopically, this rock mainly composed of crystalline carbonate sediment. It contains more than 90 percent of dolomite. Crystal sizes are unimodal and xenotopic to idiotopic texture (figure 15 & 16). These dolomite forms dense mosaic interlocking of subhedral to anhedral crystals. As through dolomitization of fractures are occurred. Multiple fractures cutting a dolomitic limestone. Horizontal calcite vein is cut by secondary vertical calcite vein (figure 17).

According to Dunham (1962), this facies can be named as "Dolomitized Crystalline Limestone". Based on the dolomite the content, the rock can be named as "Dolostone" (Tucker, 2001).

Depositional Environment

The small crystal size, they inferred restricted subtidal to supratidal environment (Amthor &Friedman, 1991 in Cho Cho Lwin, 2013). Fine-grained dolomite mosaics are deposited in intertidal-supratidal condition due to take place penecontemporaneous dolomitization (Tucker, 2001). This is interpreted to be deposited in intertidal-supratidal environment (Tucker and Wright, 1990). This facies assigned to MFN 4.

(5) Dolomitized Wackestone

Megascopically, this limestone is light grey to dark grey colored, medium-grained dolomitic limestone unit of Nwabangyi Dolomite Formation.

Microscopically, this microfacies contain more than 10 percent of allochem, which are mud supported. The shape of dolomites is anhedral to subhedral and xenotopic. Crystal type are baroque. Shell fragments are contained. Ostracods and bioclasts are filled with calcite (figure 18). Thin- lets of calcite cut the sediments. Two generation of fracture are now filled with sparry calcite. A fine-grained limestone composed show almost entirely of calcium carbonate grains of microspar size. Organic mud layers are occurring. Dolomite contains 25 percent.

According to Dunham (1962), this facies can be named as "Dolomitized Wackestone". Based on the dolomite the content, the rock can be named as "Dolomitic Limestone" (Tucker, 2001).

Depositional Environment

Fine-grained dolomite mosaic is deposited in intertidal-supratidal condition due to take place penecontemporaneous dolomitization (Tucker, 2001). It is indicated that the supratidal environment (figure 19) (Tucker and Wright, 1990). This facies assigned to MFN 5.

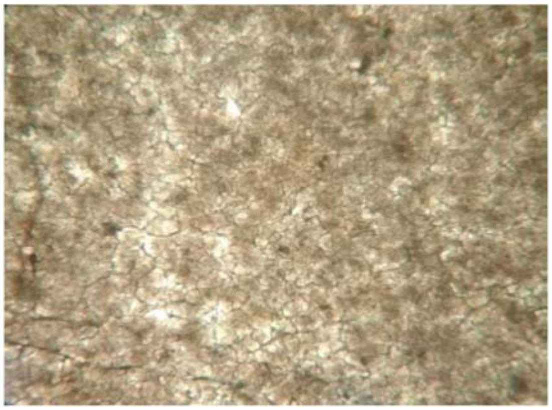


Figure (15) Photomicrograph showing anhedral to subhedral and xenotopic mosaic of the Dolomitized Crystalline Limestone in the Nwabangyi Dolomite Formation Under X.N, 10X

Figure (16) Photomicrograph showing anhedral to subhedral and idiotopic mosaic of the Dolomitized Crystalline Limestone in the Nwabangyi Dolomite Formation Under X.N, 10X

Figure (17) Photomicrograph showing three generation of calcite vein of the Dolomitzed Crystalline Limestone in the Nwabangyi Dolomite Formation, Under X.N, 10X

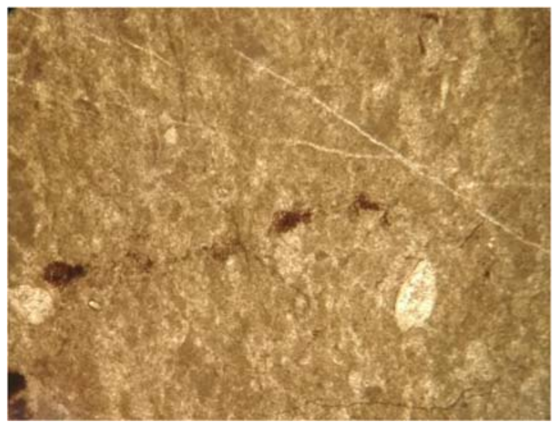


Figure (18) Photomicrograph showing Ostracods and bioclasts and thin- lets of calcite vein of the Dolomitized Wackestone in the Nwabangyi Dolomite Formation Under X.N, 4X

Paleoenvironment of Nwabangyi Dolomites

According to the petrographic descriptions, Nwabangyi dolomites are mainly composed of (1) Dolomitized Dessicated Mudstone, (2) Dolomitized Packstone, (3) Dolomitized Grainstone, (4) Dolomitzed Crystalline Limestone, (5) Dolomitized Wackestone.

Carbonate mud also occur in the shallow sub tidal. Desiccated layer are indicated that flat plain, tidal, supratidal or back carbonate ramp environment. Lime mud are precipitated only in the shallow water of the topic. Laminated, dolomitic limestone was deposited in flood -plain, tidal flat, supratidal environment. The high content micrite indicate that most deposition occurred under relatively quiet water condition. Fine- carbonate sediments occur on tidal flat and on the slopes and in deep basin around the platform. The presence of intraclasts indicate resedimented deep-water limestone. Resedimented limestone are usually ascribed to either the slope apron or base of slope apron (figure 19 & 20).

Thus, these facts Nwabangyi Dolomites are two major environments. These are supratidal and fore slope environments. It is deposited on a rimmed shelf carbonate platform and fore slope apron. The depositional cycle of Middle Permian to Middle Triassic sequence in Nwabangyi Dolomite Formation area begin with sediments from high energy debris in slope grading upward to moderate to high energy of the shoal and followed by the protected area and tidal flat and locally ending in supratidal setting (figure 20).

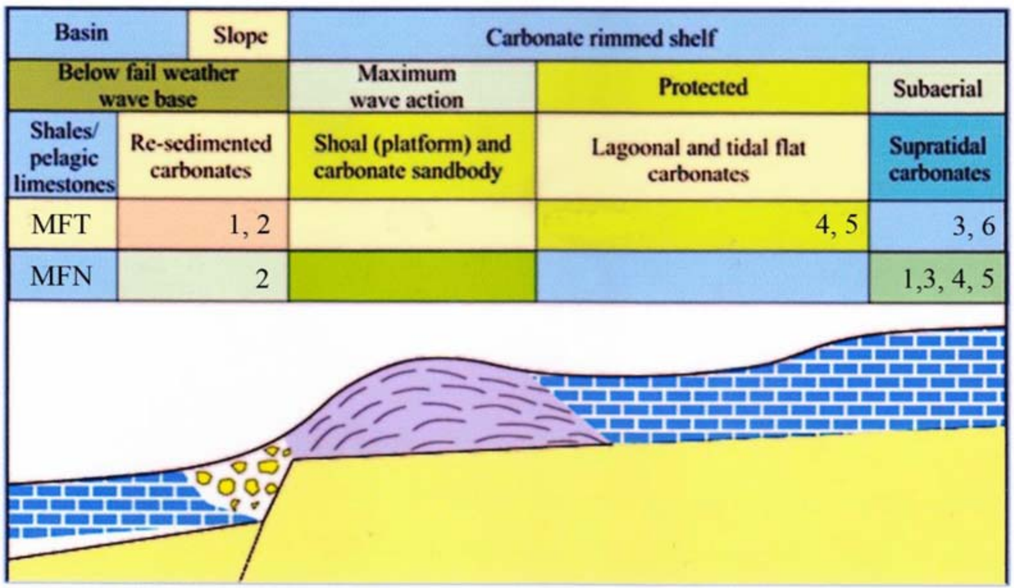


Figure (19). Proposed Paleoenvironments of the Nwabangyi Dolomite Formation of study area (modified after Tucker, 2001)

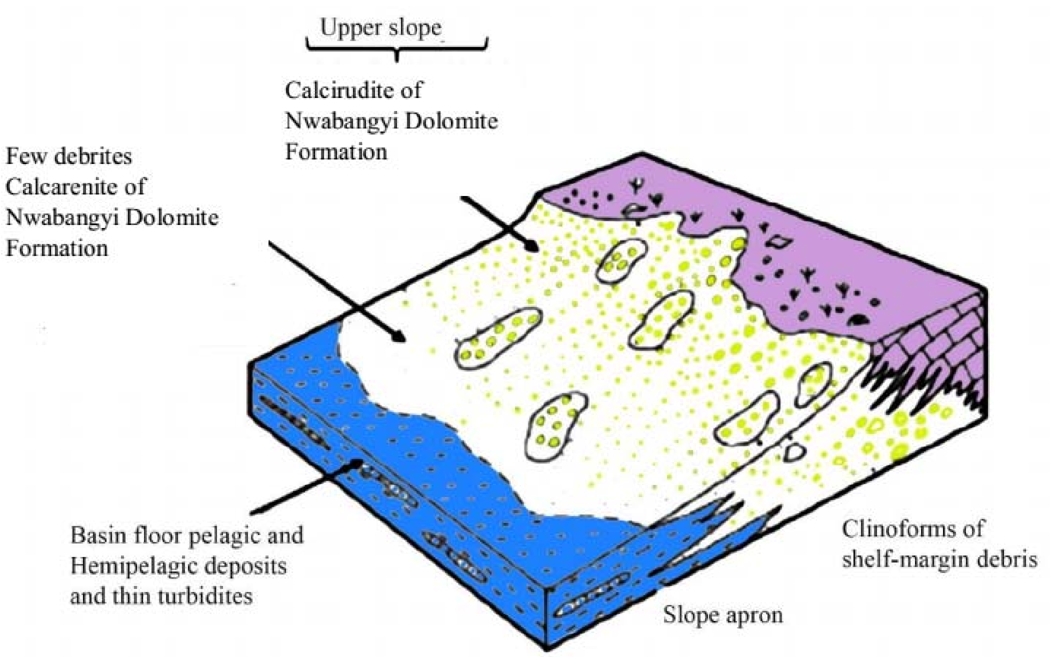


Figure (20). Proposed Depositional Modal (Slope apron) of clastic Limestone Units Nwabangyi Dolomite Formations (After Tucker and Wright, 1990).

Acknowledgements

We would like to express our profound thanks to Dr. Yin Yin Nwe, Pro-Rector, Panglong University, for their kind permission and encouragements to carry out this work. We are indebted to Dr. Zaw Win, Associate Professor and Head of the Department of Geology, Panglong University, for her enthusiastic reading and comments for this work.

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