Facies and Sedimentary Environment of the Nwabangyi Dolomite Formation Exposed in Napeng-Namon Area, Northern Shan State

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Abstract

Napeng-Namon area is situated about 7 miles south-east of Kayukme, located in the south-western part of the Lashio basin, on the Shan Plateau. The main objectives of this research were focused on description of facies and their distribution and the paleoenvironmental construction of Nwabangyi Dolomite Formation, in Napeng- Namon area. The Nwabangyi Dolomite Formation is thick, carbonate succession of the Late Permian to Middle Triassic age in northern Shan State. Twelve different microfacies types have been recognized by field observation, petrographic studies, identification of facies and facies association. Based on the typical characteristics features such as high dolomite content, high micrite content, desiccation cracks, algal mats, calcisphere, aggregate grains of many peloids, fairly rich in bivalves, gastropods, ostracods, and foraminiferas and other bioclasts, these carbonate microfacies can be divided into five major subenvironments, supratidal , tidal flat, lagoon, shoal and fore slope. The depositional environment of the Nwabangyi Dolomite Formation can be interpreted as a rimmed shelf, carbonate platform environments.

Keywords: microfacies, lateral facies, supratidal, tidal flat, Peritidal, fore- slope

Introduction

Napeng-Namon area is situated about 7 miles south-east of Kayukme, northern Shan State. This area lies between North Latitudes 22˚ 28′ and 22˚ 31′ and East Longitudes 97˚ 02′ and 97˚ 12′ and occupies parts of one-inch topographic maps of 93-F/2 and 93-F/3. It is about 8 miles long in North-South direction and about 4.5 miles wide in East-West direction, covering approximately 36 square miles. The Napeng- Namon area is also located in the south- western part of the Lashio basin, on the Shan Plateau (Fig.1). The whole of this unit consists of carbonate rocks that have been dolomitized. The rocks of the Nwabangyi Formation are very solid and contain changing ratios of dolomite and limestone (Fig.2).

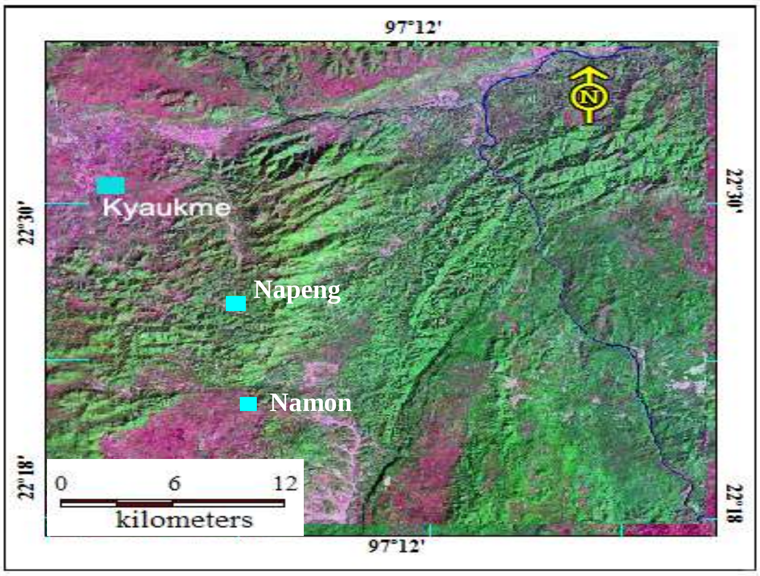

Figure (1) Satellite image of the study area and its environs (Google Earth, 2017)

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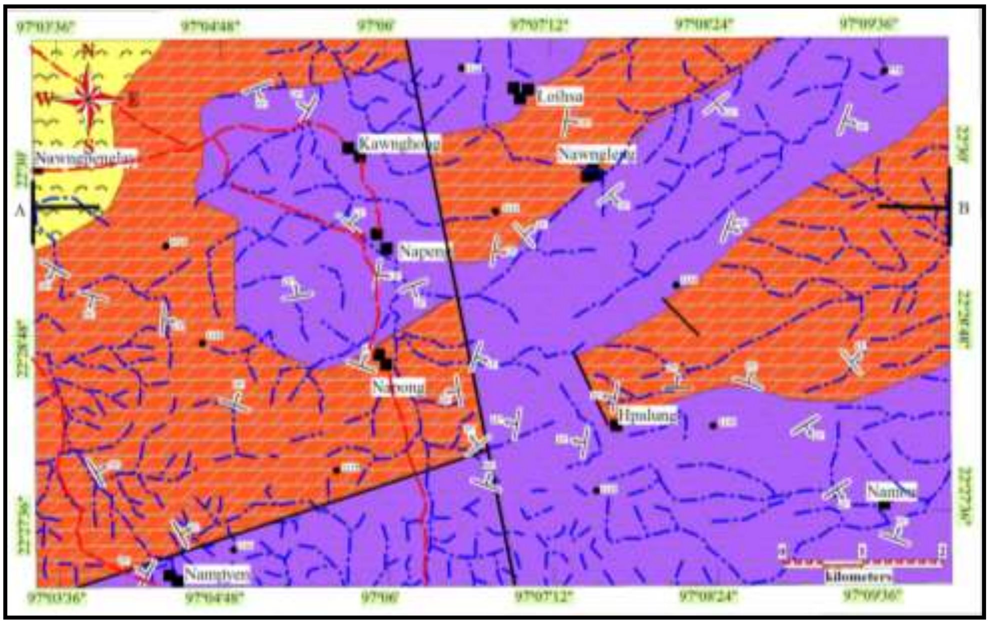

Figure (2) The general-geological map of the Napeng-Namon Area, northern Shan State

EXPLANATION

Quaternary	Younger Alluvium	Fault
Late Triassic	Napeng Formation	Stream
	Unconformity	Village
Late Permian to Middle Triassic	Nwabangyi Dolomite Formation	Dip and strike of bedding (20°)
		Spot height (in meter)
		Cart tract

Purpose of Study

Late Permian to Middle Triassic age of Nwabangyi Dolomite Formation in Napeng-Namon area attempts to describe the lithostratigraphic succession and interpret the depositional environments based on microfacies analysis following the works of Wilson (1975) and Flügel (2010). Terminology and definitions introduced by Dunham (1962) are used throughout this study.

Materials and Methods

Samples were taken at a regular interval of five- feet or at every significant lithologic change. At the laboratory, more than eighty specimens were cut into thin sections and studied under the microscope; and a hundred of thin sections were also prepared for microfacies analysis. Combination of results from the field observation and laboratory studies led to recognition of facies and microfacies of the carbonate rocks. The section measurements were made along the Napeng-Top of the Ngwe-Taung and Napong-SW of Napong road sections.

Facies Analysis

The sediments of the Nwabangyi Dolomite Formation in Napeng-Namon area have been grouped into twelve microfacies (Fig.3 & Table.1). Five major depositional environments are identified in Late Permian to Middle Triassic deposits on the basis of grain type, sedimentary structures, fossil and vertical and lateral facies relationship.

In order of increasing relative water depths, they are supratidal zone, tidal flat (restricted), lagoon (open marine), and sand shoals, protected and low-energy (restricted) to fore-slope depositional facies. They are arranged into metre-scale, upward deepening at the lower part and then, shallowing at the upper part of the Nwabangyi Dolomite Formation (see also Fig.3). Relations among facies and interpretation of facies associations are as follows:

1. Supratidal Facies Association

In the investigated area, two microfacies fall in the supratidal facies association. These two microfacies are dolostone facies (Fig.4a) and calcitic dolomite facies (Fig.4b).

Light grey to whitish grey, medium-to thick-bedded, brecciated, fine-grained dolomitic limestone or dolomite are the major component of dolostone and calcitic dolomite facies. Dolostone facies are pervasive dolomitized packstone-grainstone.

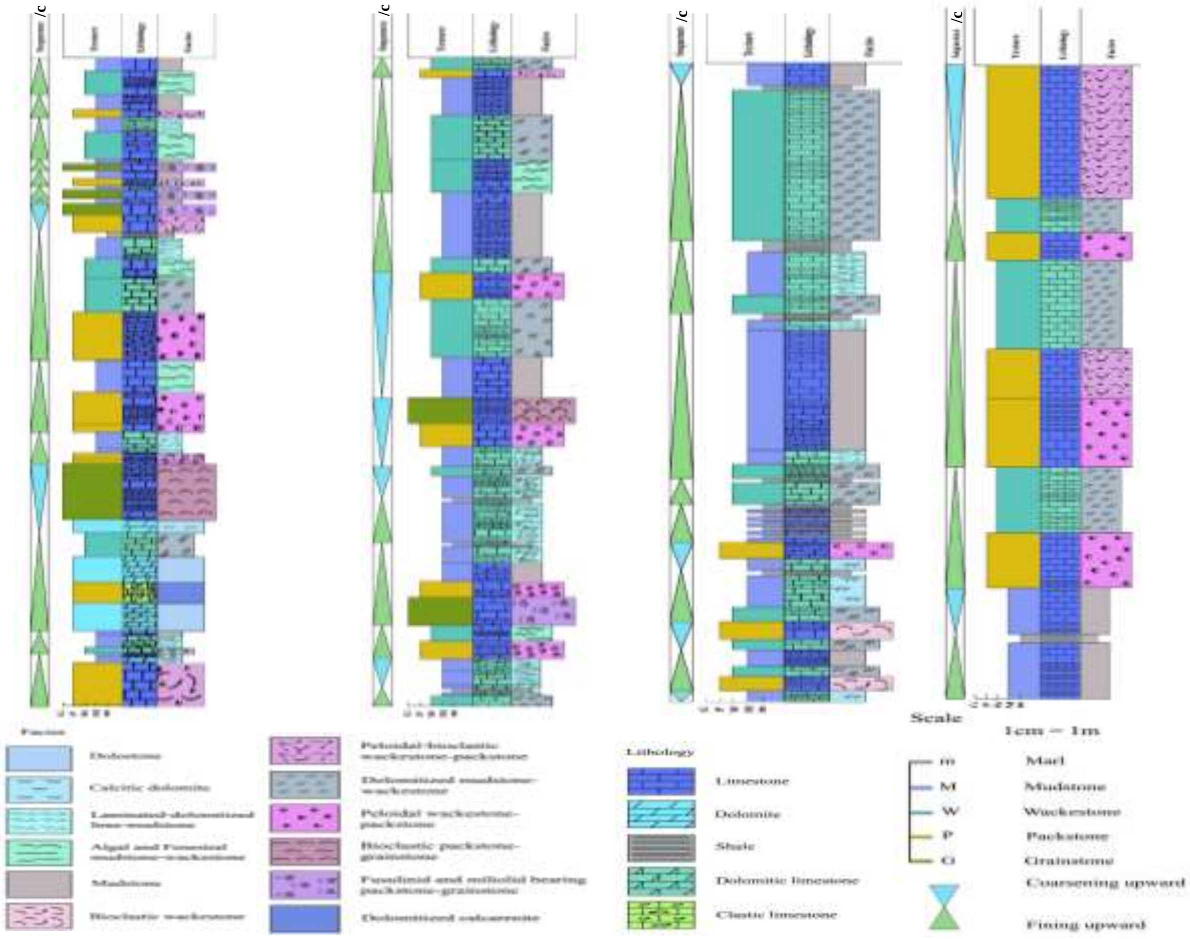

Figure (3) Detailed measured section and distribution of facies association of the Nwabangyi Dolomite Formation exposed at NE of Napeng - top of Ngwe Taung and Napong-Nampyem road sections

Table (1) Summary of depositional facies of Nabangyi Dolomite Formation, Napeng-Namon area, correlated with Standard Microfacies and Standard Facies Belts of Flügel (2010) and Wilson (1975)

Identified Microfacies	Wilson (1975) and Flügel (2010)		Environmental Interpretation
	Standard Microfacies SMF	Facies Belts FB	
1.Dolostone	SMF.23 Homogeneous, non-fossiliferous micrite SMF.20 Laminated,stromatolite bindstone/mudstone	FB.9 Evaporites on sabkhas-salinas	-Low energy, supratidal or saline or evaporites -low energy tidal flat, Peritidal
2.Calcitic dolomite			
3.Laminated, dolomitic mudstone	SMF.20 Laminated,stromatolite bindstone/mudstone	FB.8 Restricted circulat-ion and tidal flat	-gentle tidal current, tidal flat, intertidal-supratidal, Peritidal
4.Algal and Fenestral mudstone-wackestone	SMF.21 Fenestral packstone/bindstone SMF.23 Homogeneous, non-fossiliferous micrite	FB.8 Restricted circulation and tidal flat	-protected tidal flat -shallow water with only moderate water circulation,Peritidal
5.Limemudstone			
6.Bioclastic wackstone	SMF.8 Whole fossil wackestone/floatstone SMF.18 Grainstone/packstone with abundant forams or algae SMF.17 Aggregate grain grainstone	FB.7 Shelf lagoon open circulation	-lagoonal, -quiet water to open lagoon, subtidal to intertidal on an open marine shelf
7.Peloidal-bioclastic wackestone-packstone			
8.Dolomitized peloidal mudstone-wackestone			
9.Peloidal wackestone-packstone			
10.Bioclastic packstone-grainstone	SMF.11 Coated bioclastic grainstone	FB.6 Winnowed edge sands	-sand shoal, -shallow water, moderate-high energy condition, platform margin
11.Fusulinids and miliolids bearing packstone-grainstone			
12. Dolomitized calcarenite	SMF.4 Bioclastic,lithoclastic, microbreccia	FB.4 Fore slope	-resedimented carbonate, fore- slope environment

1mm

Figure (4) Photomicrograph showing (a) dolostone facies, (b) calcitic dolomite facies

The most common features of dolostone and calcitic dolomite facies are high dolomite content, the presence of shell fragments of ostracods, foraminiferas and other bioclasts, desiccation cracks and algal mat structure. So, these two facies might be deposited supratidal origin under the influence of a humid climate.

2. Tidal Flat (restricted) Facies Association

The tidal flat facies is represented by the combination of three microfacies such as laminated, dolomitic limestone (Fig.5a), algal and fenestral mudstone-wackestone (Fig.5b) and mudstone (Fig.5c).

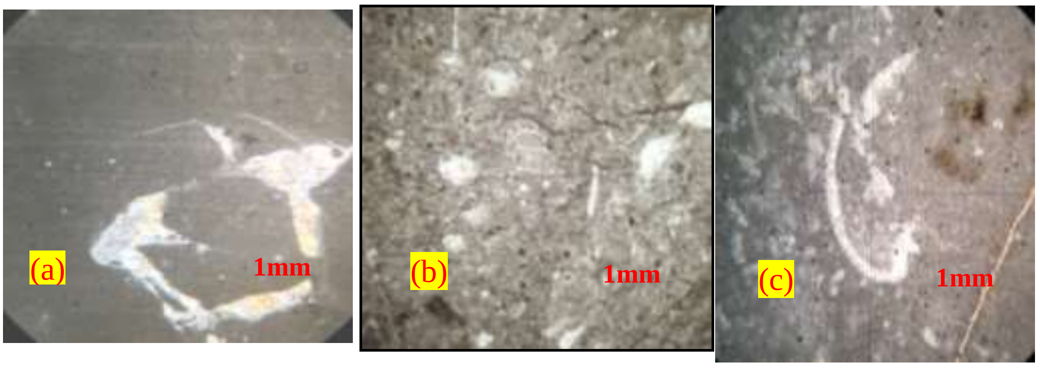

Figure (5) Photomicrograph showing (a) dolomitic limestone facies, (b) algal and fenestral mudstone-wackestone facies, and (c) mudstone facies

Lamination and the high concentration of dolomite crystals are the characteristic features of laminated, dolomitic limestone facies. The presence of the fine crystal size, lamination, dolomite content indicates gentle tidal current (Nakazawa *et al.*, 2004).

The typical characteristic features of tidal flat environments are the algal mat which consists of filamentous and unicellular microorganisms, mainly blue green algae (Walker, 1984). The small scale laminations associated with pellets, small intraclasts, and ooids may represent the strom deposits (Tucker,1990). Laminated algal mats occur on sediments surface of peritidal facies and planar mat dominate protected tidal flat (Tucker, 2001). The large amount of highly micrite content also indicates relatively quiet water environment.

3. Lagoonal Facies Association

The lagoonal facies consists of bioclastic wackestone (Fig.6a), peloidal-bioclastic wackestone-packstone (Fig.6b), dolomitized peloidal mudstone-wackestone (Fig. 6c) and peloidal wackestone-packstone (Fig.6d).

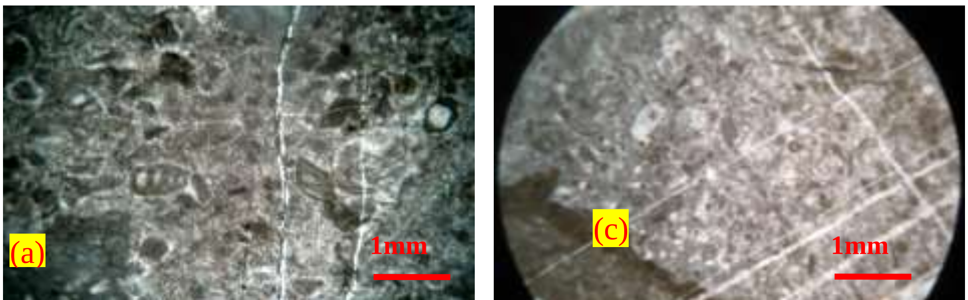

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Figure (6) Photomicrograph showing (a) bioclastic wackestone facies, (b) peloidal-bioclastic wackestone-packstone facies, (c) dolomitized peloidal mudstone-wackestone facies, and (d) peloidal wackestone-packstone facies

Grey to dark grey, medium -to thick- bedded, hard and compact, fine-grained limestone are major component of bioclastic wackestone and wackestone-packstone. Lagoonal sediments are characterized by calcisphere rich lime mudstone (Tucker, 1991). The presence of high content of lime mud, pellets, ostracods, foraminiferas (Textularids, Nodosarids and miliolids), algal mat, calcisphere, and micritic envelops indicates relatively quiet water to open lagoon condition. The aggregate grains of peloids in carbonate mud are originated in lagoonal environment.

4. Shoal Facies Association

Shoal facies are represented by the association of two facies. They are bioclastic packstone-grainstone (Fig.7a) and fusulinids and miliolids bearing packstone-grainstone (Fig.7b). These grainstone and packstone are probably formed in high energy shoals.

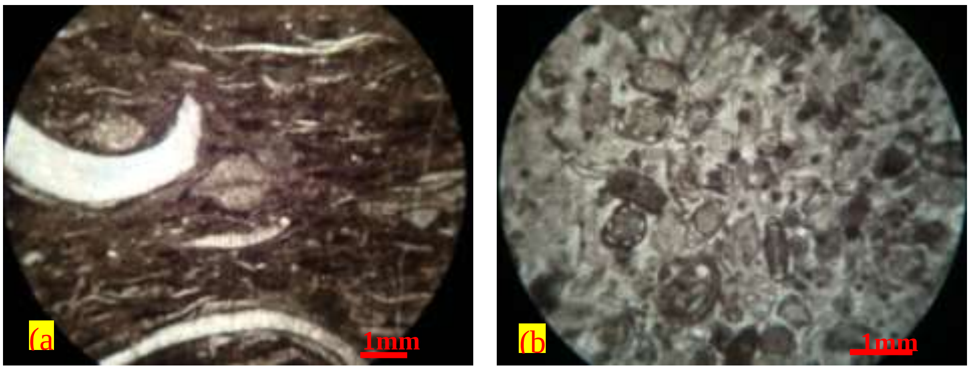

Figure (7) Photomicrograph showing (a) bioclastic packstone-grainstone facies (b) miliolids bearing packstone-grainstone facies

The most characteristic features of fusulinid and miliolid bearing packstone-grainstone facies are abundant fusulinids and miliolids foraminiferas (*Hemigordius* sp., *Tetrataxis*, *Hemigordiopsida*, *Nankinella*, *Rauserella erratica*, *Neohemigordius* sp., Hemigordius *schlumbergeri*, *Hemigordiellina*, *Reichelina* sp., *Cornuspira pachygra*, *Verbeekina*msp.) (Davydov & Arefifard, 2007., Jones, 1956., Aghai & Vachard, 2005, Cushman, 1959, Blazejowskj, 2009, Moore, Lalicker & Fischer, 1952, Flügel, 2010). Other bioclasts (mollusca, ostracods), calcisphere and algal mat, pellets, micritic intraclasts are present (Fig. 8). So, this microfacies is deposited in a shoal environment.

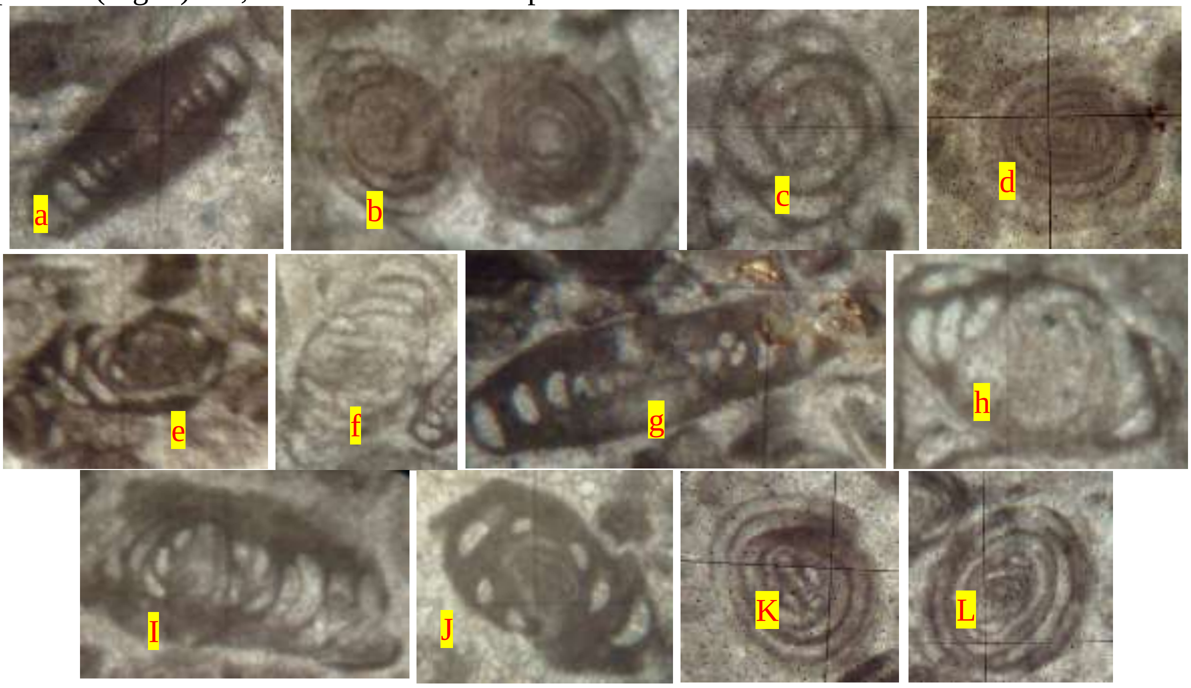

Figure (8) Close-up view of microfossils: (a) *Hemigordius* sp.,
(b) *Tetrataxis*, (c) *Hemigordiopsida,* (d) *Nankinella*,
(e) *Rauserella, erratica,,* (f) *Neohemigordius* sp.(Altiner,1978),
(g) *Hemigordius* sp. (Howchin,1895), (h) *Hemigordiellina* sp.,
(i-j) *Reichelina* sp., (k) *Cornuspira pachygra*,and (l)*Verbeekina* sp.

5. Foreslope Facies Association

Foreslope facies consists of only one, dolomitized calcarenite (Fig. 9). The sediments were eroded and transported from adjacent area by strong current and wave activities. So, this facies is deposited in foreslope environment.

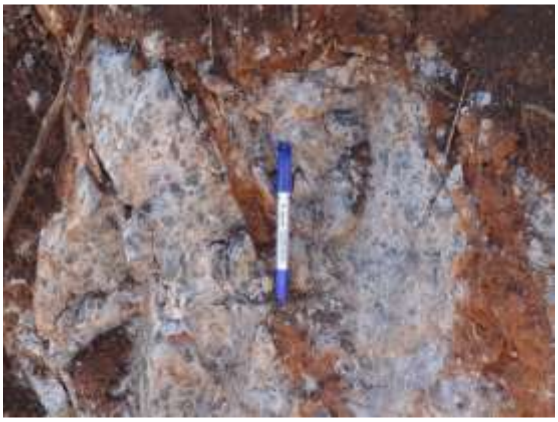

Figure (9) Photograph showing light grey to dark grey, medium- to thick- bedded, highly brecciated clastic limestone in dolomitized calcarenite facies

6. Depositional Model

The Nwabangyi Dolomite Formation delineated twelve different depositional facies or microfacies in the Napeng- Namon area (Table 1). These twelve microfacies or lithofacies represent five major environments. These are supratidal, tidal flat (restricted), lagoonal, shoal and foreslope environments depend on a variety of sedimentologic indicators including grain types and textures, bedding styles and sedimentary structure, composition, as well as microfacies, biofacies and vertical and lateral facies relationship. Stratigraphy, morphology and microfacies changes lead to be regarded as this carbonate sequence of the Napeng - Namon area deposited on a rimmed shelf carbonate platform (Fig.10).

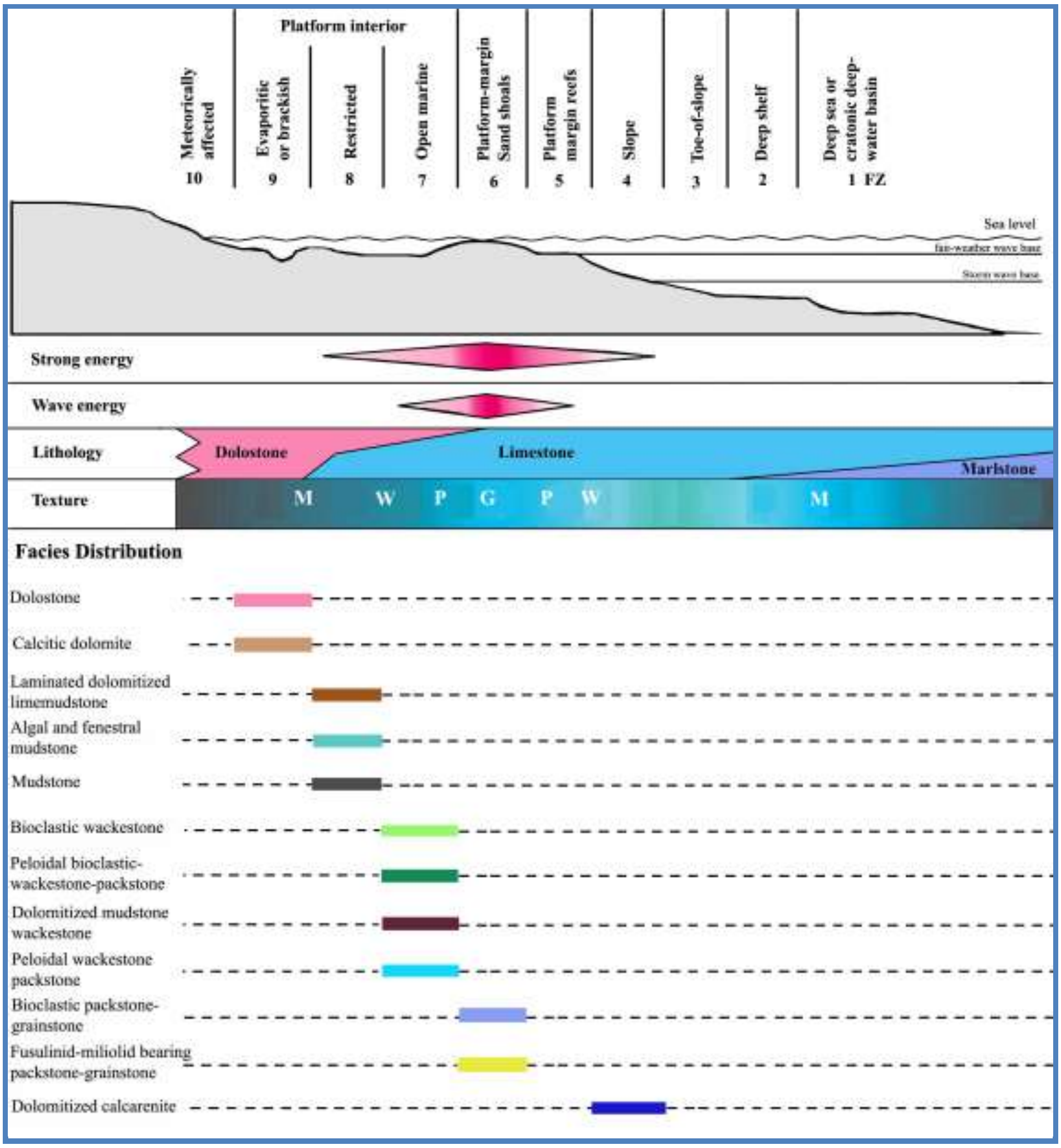

Figure (10) Overview chart: depositional model for the facies distribution along the rimmed shelf carbonate platform in Napeng-Namon area. M-mudstone; W-wackestone; P-packstone and G- grainstone. (Based on Palermo *et al*., 2010)

Conclusion

There are twelve microfacies in the Nwabangyi Dolomite Formation (Late Permian-Middle Triassic) exposed in Napeng-Namon area, southeast of Kyaukme Township. The Nwabangyi Dolomite Formation in the study area is composed of carbonate rocks. These twelve microfacies or lithofacies represent five major environments. Much of the Nwabangyi Dolomite Formation in the Napeng-Namon area was deposited in supratidal, tidal flat, lagoon, shoal and foreslope in rimmed shelf platform environment.

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