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MICROFACIESAND DEPOSITIONAL ENVIRONMENT OF THE THITSIPIN LIMESTONE FORMATION EXPOSED IN THE HTI TA HKAW AREA, TAUNGGYI TOWNSHIP, SOUTHERN SHAN STATE

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Abstract

The Thitsipin Limestone Formation extensively covers the entire Shan State. The present investigated Hti Ta Hkaw area, is situated in Taunggyi Township, southern Shan State. The formation is characterized by thin-bedded to massive, bluish grey to dark grey limestone and dolomitic limestone with abundance of shallow marine fauna. The classification of microfacies is based on the presence and proportion of skeletal and nonskeletal components. Based on the detailed petrographic analysis, nine microfacies have been recognized comprising coral boundstone, bioclasticrudstone, algal packstone-grainstone, fusulinidpackstone, peloidalpackstone, intraclasticwackestone-packstone, foraminifer wackestone, lime mudstoneand dolomitic lime mudstone. On the basis of the observed microfacies types, the Thitsipin Limestone Formation would have been deposited in the rimmed platform condition under sub-environments of intertidal, subtidal channel lag, subtidal lagoon, back reef lagoon and open marine environment during the Middle Permian time.

Keywords: Microfacies, Depositional Environment, Thitsipin Limestone Formation, Middle Permian, Rimmed Platform

Introduction

In Myanmar, the Permian-Triassic thick carbonate sequence of the Plateau Limestone Group is widely distributed in entire Shan Plateau. The Middle Permian sequence in southern Shan Plateau was named the Thitsipin Limestone Formation by Garson et al., (1976) for the thick carbonate rocks, including a massive limestone facies, a massive cherty limestone facies and a well-bedded calcarenitefacies, exposed the area around Nayaungga and Ywangan. The stratigraphy of this unit has been studied by Aye Ko Aung and Hlaing Htut Aung (2005) and Aye Ko Aung (2012) in Htam Sang area. It is partly correlated with the dolomitic limestone unit, named by Zaw Win

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(2004), exposed in the area around Lungyaw-Sakangyi area on the western margin of southern Shan Plateau. ThuraOo et al. (2002) carried out the study area on the distribution, lithology and fauna of the Permian units of Myanmar. Although several researchers have conducted sedimentological and paleontological studies of the Thitsipin Limestone Formation in the western part of southern Shan State, it has not been studied well in detail sedimentology of the eastern part of southern Shan State. Thus, we here provide a detailed account of the microfacies and depositional environment of the Thitsipin Limestone Formation exposed the Hti Ta Hkaw area which is situated about 10 km northeast of Taunggyi town (Figure 1).

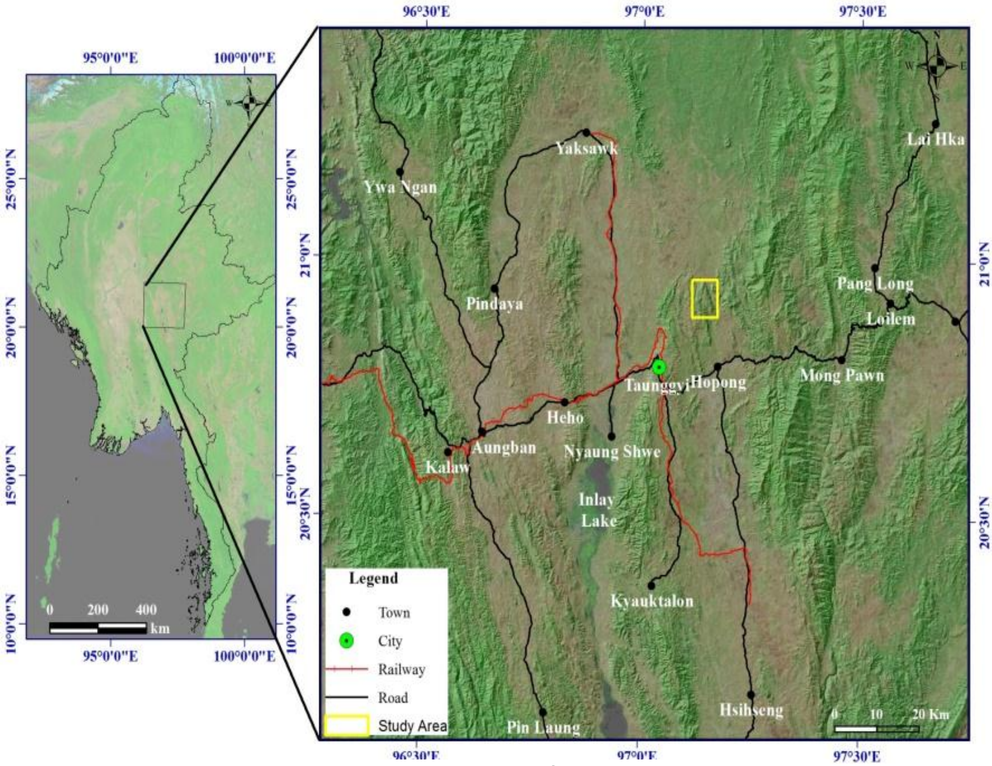

Figure 1: The location map of Hti Ta Hkaw area.

Geological Setting

Tectonically, the study area is situated in the western part of the SibumasuTerrane(Metcalfe, 2009 and 2011). During the Early Permian, the SibumasuTerrane rifted and separated from eastern Gondwana, and drifted northward from southern to northern hemispheres (Metcalfe, 2009). At the beginning of the early Middle Permian, marine sedimentation was initiated as a widespread carbonate platform in the western Shan Plateau region, developing into a warm, open, shallow shelf sea (Zaw Win et al., 2017).

The Middle Permian sequence of Thitsipin Limestone Formation is well exposed in the central part of the study area, and overlies unconformably on the Linwe Formation and passes up conformably to the overlying Nwabangyi Dolomite Formation (Figure 2). It is characterized by fine- to medium-grained, thick-bedded to massive, bluish grey to dark grey limestones; thick-bedded to massive light grey to pale grey micritic limestone and dolomitic limestone. This unit is usually fossiliferous and most of them are well preserved.

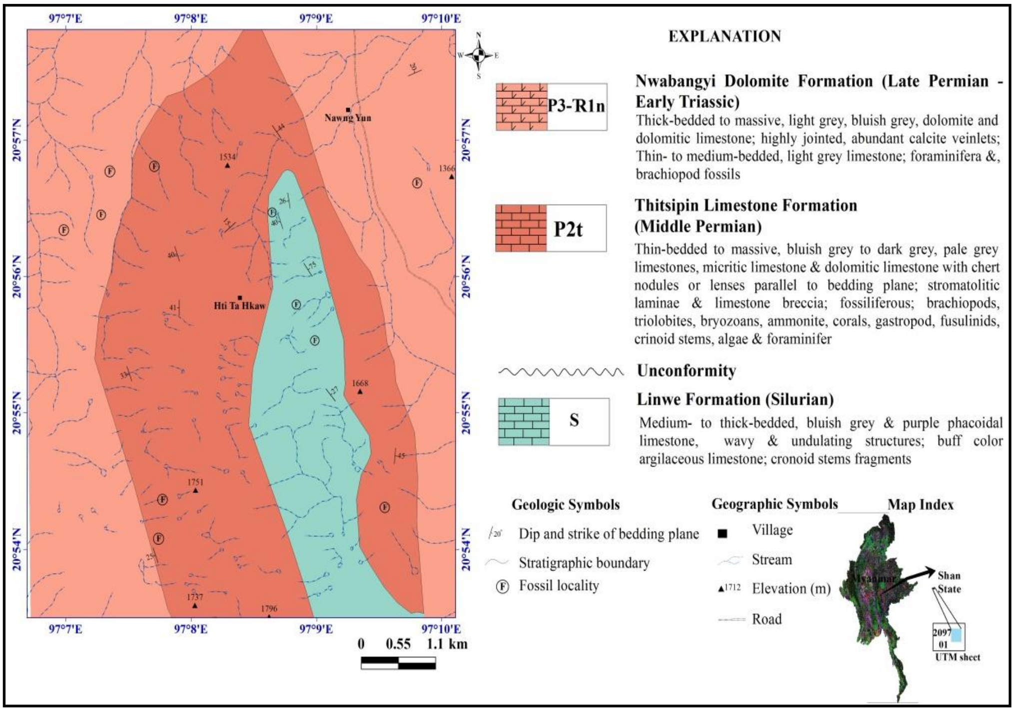

Figure 2: The geological map of Hti Ta Hkaw area.

Materials and Methods

This investigation was done on the basis of the detail stratigraphic section of the Thitsipin Limestone Formation exposed in the Hti Ta Hkaw area. The choice of measured section was based on stratigraphic completeness. A detailed section measurement was undertaken bed by bed using a Jacob staff and tape that was put perpendicular to the bedding planes. A total of three-hundred oriented samples were collected from individual bed in thin- to thick-bedded limestone, whereas the massive limestones were sampled at one meter interval. All collected samples were cut perpendicular to the bedding plane and made into thin-sections for petrographic analysis. The textural classification of the rock unit was followed by Dunham (1962) and Embry and Klovan (1971).

Results

Microfacies Analysis

The classification of microfacies was based on textures, and the presence and proportion of skeletal and nonskeletal grains. The main skeletal components include bryozoans, echinoderms, brachiopods, bivalve, gastropods, foraminifer, corals, algae and trilobite. Peloids are the major nonskeletal grains and intraclasts are rather limited. Based on the detailed petrographic analyses, nine microfacies have been recognized for the Thitsipin Limestone Formation exposed in the study area.

Coral Boundstone (MF1)

The coral boundstone microfacies represent both solitary and colonial rugose corals (Figure 3a). *Syringopora* sp. has also been observed in some horizon. Macrofauna such as brachiopods, bryozoans, gastropod and crinoids stems are associated with those corals. This microfacies may correspond to the SMF 7 of Wilson (1975) and Flugel (2010).

The diverse assemblages of macrofauna indicate open marine, well oxygenated, high energy environment. The rigid frameworks of such colonial rugose corals are very common in reef environment. The presence of nature of growth positioned rugose corals and associated open marine fauna suggests that this microfacies would have been deposited in open marine bioherm environment.

Bioclastic Rudstone (MF2)

The bioclastic rudstone facies is characterized by a diverse fossil assemblage including macrofauna and microfauna. The most distinctive bioclasts are bryozoans and echinoderms (Figure 3b). Gastropod, brachiopod and trilobite are other significant components among the bioclasts. This microfacies may correspond to the SMF 9 of Wilson (1975) and Flugel (2010).

The high diversity of fauna may indicate open marine setting. The predominance of bryozoans suggests intertidal and upper subtidal depositional setting in areas of low sedimentation (Flugel, 2010). This microfacies would have been deposited in open marine environment.

Algal Packstone-Grainstone (MF3)

The algal packstone-grainstone facies indicates the abundance of green algae. The distinctivealgae are dasycladacean, gymnocodium and phylloid algae (Figure 3c). Bryozoan, gastropod, echinoderm, foraminifera and calcisphere are the minor constituents of this facies. This microfacies may correspond to the SMF 18 of Wilson (1975) and Flugel (2010).

The abundances of algae suggest deposition within the photic zone. The presence of gymnocodicean algae may indicate low energy lagoonal environment. The existence of calcispheres suggests that this microfacies was deposited in quiet water condition. Thus the depositional setting of this microfacies may be low energy back reef lagoonal environment.

Fusulinid Packstone (MF4)

The chief character of the fusulinid packstone facies is the abundance of fusulinid that are embedded in micritic matrix (Figure 3d). Other components, such as gastropod and peloids are often present in this facies. Most fusulinids grains were micritized. This microfacies may correspond to the SMF 18 of Wilson (1975) and Flugel (2010).

The larger benthic fusulinids foraminifers are common in shallow marine, high energy environment within the photic zone (Flugel, 2010). The presences of micritized grains suggest marine diagenesis. This microfacies is inferred to represent deposition in open marine environment.

Peloidal Packstone (MF5)

The peloidal packstone facies represents the predominance of peloids and some fecal pellets (Figure 3e). Some bioclasts, including fragments of echinoderms and foraminifer, are associated with those peloids. This microfacies may correspond to the SMF 16 of Wilson (1975) and Flugel (2010).

The fecal pellets were the products of animals' excretions during the deposition of this facies. They are more commonly preserved in subtidal and lower intertidal zones of inner platform setting with low water energy and reduce sedimentation rates (Flugel, 2010). Random size and sorting of peloids within this facies were produced by bio-erosion or micritization of existing bioclasts. This microfacies would have been deposited in subtidallagoonal environment.

Intraclastic Wackestone-Packstone (MF6)

The intraclastic wackestone-packstone facies is characterized by the presence of fine to coarse-grained, poorly sorted angular carbonate clasts (Figure 3f). Microstylolites are also present between some grains. This microfacies may correspond to the SMF 24 of Wilson (1975) and Flugel (2010).

Intraclasts can form in many environments, but most typically are formed in setting with intermittently high energy conditions (Scholle& Ulmer Scholle, 2003). The occurrence of microstylolites can be interpreted that this microfacies was affected by chemical compaction due to deep burial diagenesis. This microfacies would have been deposited in subtidal channel lag environment.

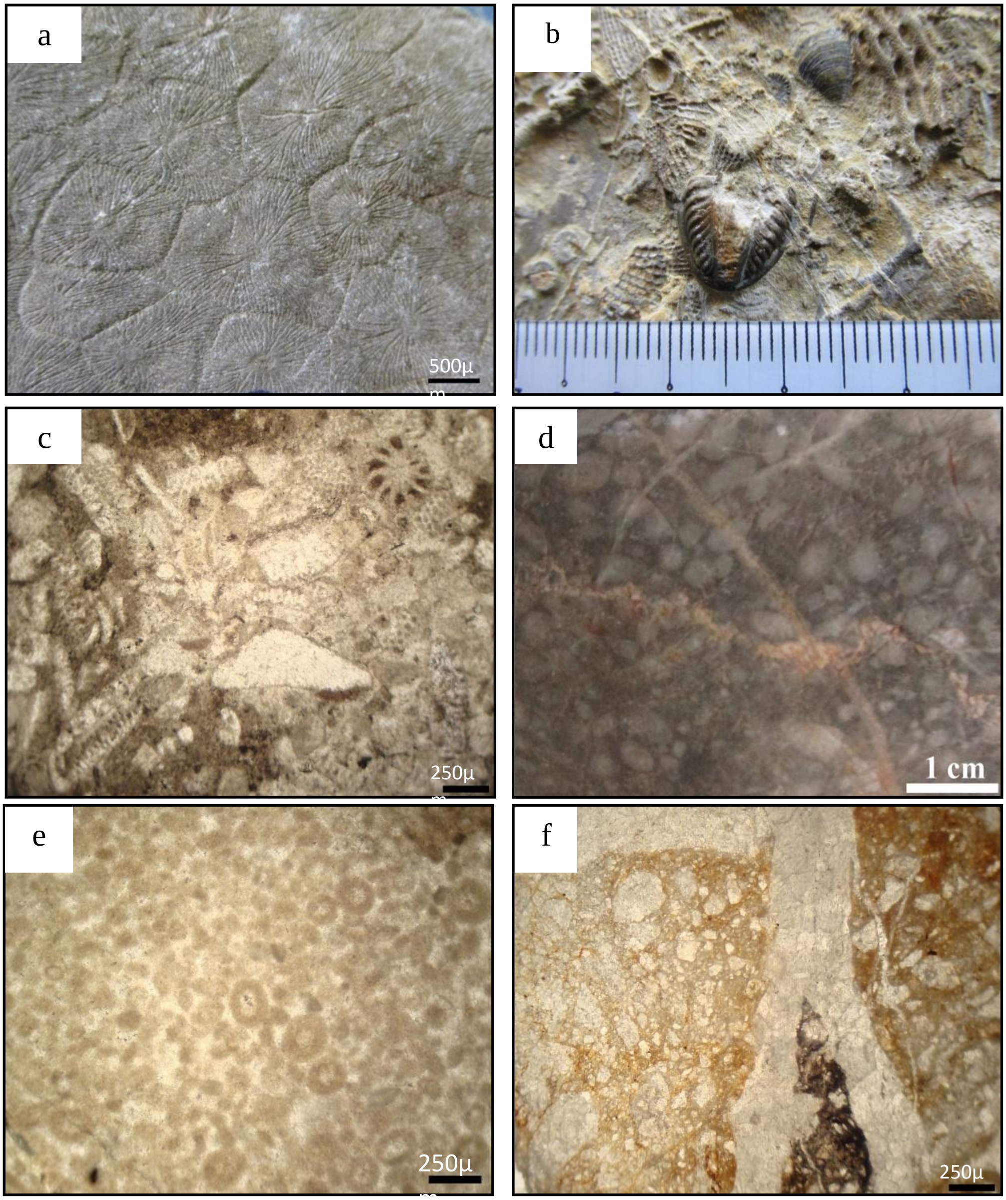

Figure 3: Thin-section photomicrographs showing the microfacies of the Thitsipin Limestone Formation. (a) Coral boundstone; (b) Bioclasticrudstone; (c) Algal packstone-grainstone; (d) Fusulinidpackstone; (e) Peloidalpackstone; (f) Intraclasticwackestone-packstone.

Foraminifera Wackestone (MF7)

The major constituent of the foraminifer wackestone facies is benthic foraminifer (Figure 4a). Ostracods and brachiopods are also associated with those foraminifers. Minor amount of peloids are scattered in the micritic matrix. This microfacies may correspond to the SMF 18 of Wilson (1975) and Flugel (2010).

The presences of benthic foraminifer and other fauna assemblages may indicate well oxygenated shallow water conditions. The minor amount of peloids and wackestone texture suggest in low energy depositional setting. This microfacies would have been deposited in open marine back reef lagoonal environment.

Lime Mudstone (MF8)

The typical characters of the lime mudstone facies are rare biota and predominance of micritic matrix. Only the traces of trilobite, ostracode shells and crinoids have been observed (Figure 4b). Stylolitic seams are frequently occurred. The isolated dolomite rhombs and pyrite are floated in the matrix. This microfacies may correspond to the SMF 23 of Wilson (1975) and Flugel (2010).

The predominance of micrite suggests low energy depositional setting. Most lime mudstone accumulates in a wide range of environments ranging from tidal flat to deep basin condition. The association of lime mud and shallow marine fauna is interpreted to have been formed in lagoonal setting. The presences of dolomite were resulted from dolomitization process that is very common in lagoonal setting. This microfacies would have been deposited in low energy subtidallagoonal environment.

Dolomitic Lime Mudstone (MF9)

The dolomitic lime mudstone facies is characterized by the abundance of replacement dolomite in the micritic matrix (Figure 4c). Generally the crystal sizes are fine- to medium-grained texture. Fauna are very rare in this microfacies. This microfacies may correspond to the SMF 23 of Wilson (1975) and Flugel (2010).

Lime muds are preferentially and many nucleation sites for dolomite replacement that result in a fine-grained texture (Tucker & Wright, 1990). The small crystal sizes are restricted in subtidal to supratidal setting and an early replacement origin (Amthor& Friedman, 1991). Penecontem poraneousdolomitization may take place in intertidal to supratidal setting, giving fine-grained dolomite mosaics (Tucker, 2001). This microfacies was probably deposited in intertidal environment, and dolomitization processes may have been formed by increasing salinity during a relative fall of sea-level.

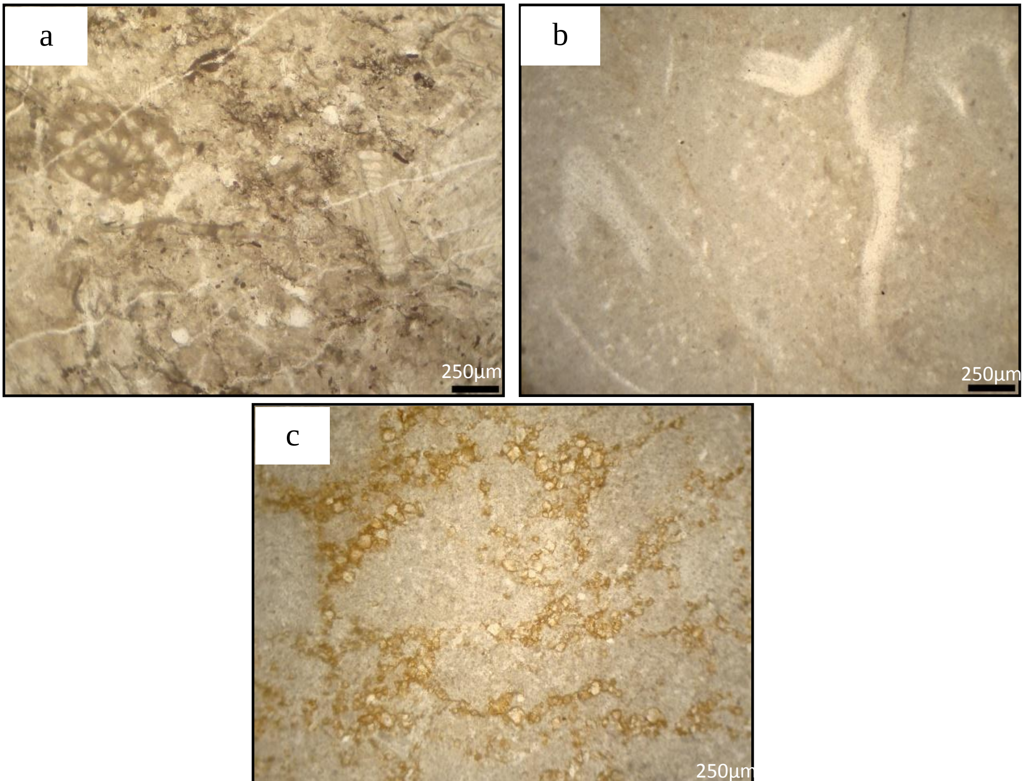

Figure 4: Thin-section photomicrographs showing the microfacies of the Thitsipin Limestone Formation. (a) Foraminifer wackestone; (b) Lime mudstone; (c) Dolomitic Lime mudstone.

Depositional Environments

Based on the analysis of the above microfacies, rimmed shelf carbonate platform model is proposed for the Thitsipin Limestone Formation exposed in the study area (Figure 5). This model occupies platform interior setting and subsequently six sub-environments are defined on the basis of constituent fauna, textures, carbonate grains and hydraulic conditions. They are intertidal, subtidal channel lag, subtidal lagoon, back reef lagoon, open marine and bioherm environments.

The shallowest facies in this model represents intertidal environment that representsthe dolomitic lime mudstone facies. Subtidal channel lag environment includes intraclastic wackestone-packstone facies. Peloidal packstone and lime mudstone facies were deposited in subtidal lagoon environment. Back reef lagoon environment represents algal packstone-grainstone, fusulinid packstone, and foraminifer wackestone facies. Open marine environment includes bioclastic rudstone facies. Coral boundstone facies was deposited in bioherm.

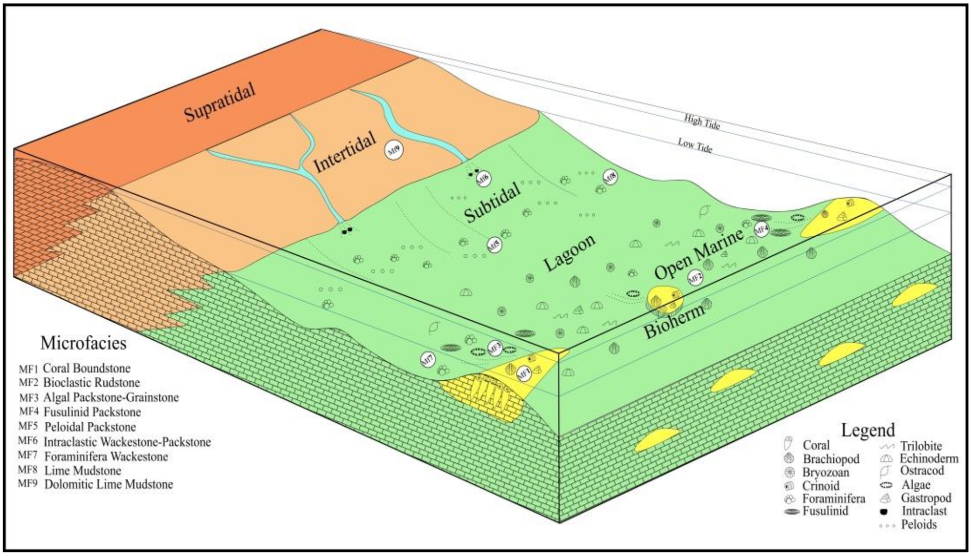

Figure 5: Idealized depositional model for the Thitsipin Limestone Formation

Conclusion

The Middle Permian carbonate sequence of the Thitsipin Limestone Formation exposed in Hti Ta Hkaw area is composed of fine- to medium-grained, thin-bedded to massive, light to dark grey carbonate facies. Based on field and petrographic evidences, the nine microfacies have been observed, and rimmed shelf carbonate platform model is proposed for the Thitsipin Limestone Formation exposed in the study area. The development of these microfacies types and high diversities of shallow marine fauna may indicate that the northward drifting of Sibumasu Terrane was warmer region during the Middle Permian time.

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