Microfacies Analysis of Zebingyi Formation exposed along the Doganaing Chaung, the Zebingyi-Anisakan Area, Pyin-Oo-Lwin Township

Mar Lar Aye Shwe[1], Min Nyo Htet, Paw Htay, Pan Phyu Phyu Win

Abstract

This area is located about 12 miles due east of Mandalay and 3 miles southwest of Pyin-Oo-Lwin in Pyin-Oo-Lwin Township. The Paleozoic strata from Ordovician to Permian units are exposed in this area. These units are composed mainly of the limestone, argillaceous limestone, sandy limestone and dolomitic limestone. The present study area is mainly emphasized on the petrography of the Zebingyi Formation. Microfacies analysis reveals the 11 microfacies which are: silty pelmicrite, silty biomicrite, shale, biomicrite, silty micrite, biopelmicrite, micrite, sparitized biomicrite, dolomitized biomicrite, dolomitized micrite and quartzose sandstone. From the petrographic study, the Zebingyi Formation of the study area may have been deposited in the basin of a euxinic condition in the earliest time and was later replaced by the shallowness of the basin due to the shoaling of the water.

Keywords: Ordovician, Triassic, Paleozoic, Euxinic

Introduction

Location and Size

The study area is situated about 12 miles due east of Mandalay and 3miles southwest of Pyinoolwin in Pyinoolwin township. It is located between North latitude 21° 51.5' to 22° and East longitude 96° 18' to 96° 26'. It is bounded by 82 to 97 vertical grids and 50 to 67 horizontal grids in one-inch Topographic map of 93 C/5. It covers approximately about 78.85 square miles of rugged and mountains terrain. The location map of the study area is shown in figure 1.

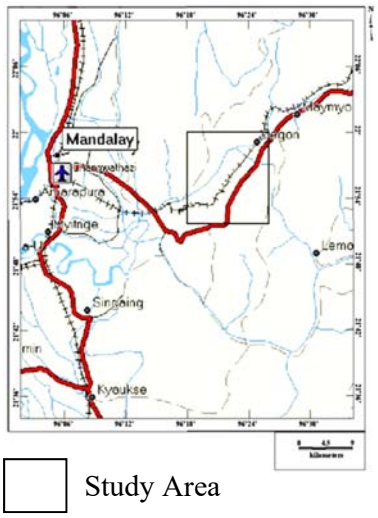

Figure (1) The Location map of the Study Area.

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Purpose of Study

The objectives of the present investigation are to be described the detailed microfacies analysis of the Zebingyi Formation exposed in the study area. Actually, this paper is a part of my M.Sc. Thesis, which has not been published under this topic yet.

Methods of Study

Detailed sedimentary facies measurements were carried out from traverse lines, representative sample collection and taking photographs were done wherever necessary.

For laboratory study, 50 thin-sections were prepared for detailed petrography and visual estimation of the constituent grains. Thin sections were examined under polarizing microscope. The rock of the study area can be divided into different microfacies types and interpret the possible depositional environments.

Physiography

The study area is subdivided into three main physiographic provinces; they are the eastern province, central province and western province. Each province is represented by the distinct morphological features, such as the central province occurs as flat plain whereas the eastern and western provinces as a hilly tract.

In this area, topography of the eastern part contains fairly rugged mountain terrain with an average elevation of 3,500 feet, in which the4 height attains of 4,174 feet at Kyaingtaung peak. The central province also reveals the underlying folded structure, such as anticlinal and synclinal structures. The western province occupied the Zebingyi syncline.

Regional Geologic Setting

The study area occupies the western margin of the Eastern Highlands, which is separated from the central lowlands by the Shan-Burma-Boundary Fault, so called Nwalabo-Panlaung Fault to the West.

The elevation of the Eastern Highlands is between 1,968 feet in the peripheral belt and over 6560 feet in central region. The physiography is largely controlled by faults. The Shan-Tanintharyi Massif is largely covered by the Shan State. To the west, it is separated from the central basin by the Shan Scarp Fault running from the Gulf of Mottama through Mandalay into the Kumon Ranges in the northern Myanmar.

The rock units are repeatedly exposed due to a series of nearly north-south trending major anticlinal and synclinal structures, and associated longitudinal faults and cross faults. The contacts between the rocks sequence are either gradational or, conformable or tectonic. A regional unconformity is separated between the Zebingyi Formation and the Thitsipin Limestone Formation. The study area and its environs are well established and most of the structural attitudes are well known for the geologists. From west to east, the Htonbo anticline, the Zebingyi syncline, the Pyintha anticline, the Thondaung syncline and Kyaingtaung anticline are easily recognized for them.

Stratigraphy

The rocks in the present area can be described dividing into five lithostratigraphic units of formation based on the ratio of limestone and shale-siltstone, the stratigraphic relationship and the fauna content. The stratigraphic succession in ascending order, from older to younger is as below;

5. Thitsipin Limestone Formation
4. Zebingyi Formation
3. Nyaungbaw Formation
2. Kyaingtaung Formation
1. Sitha Formation

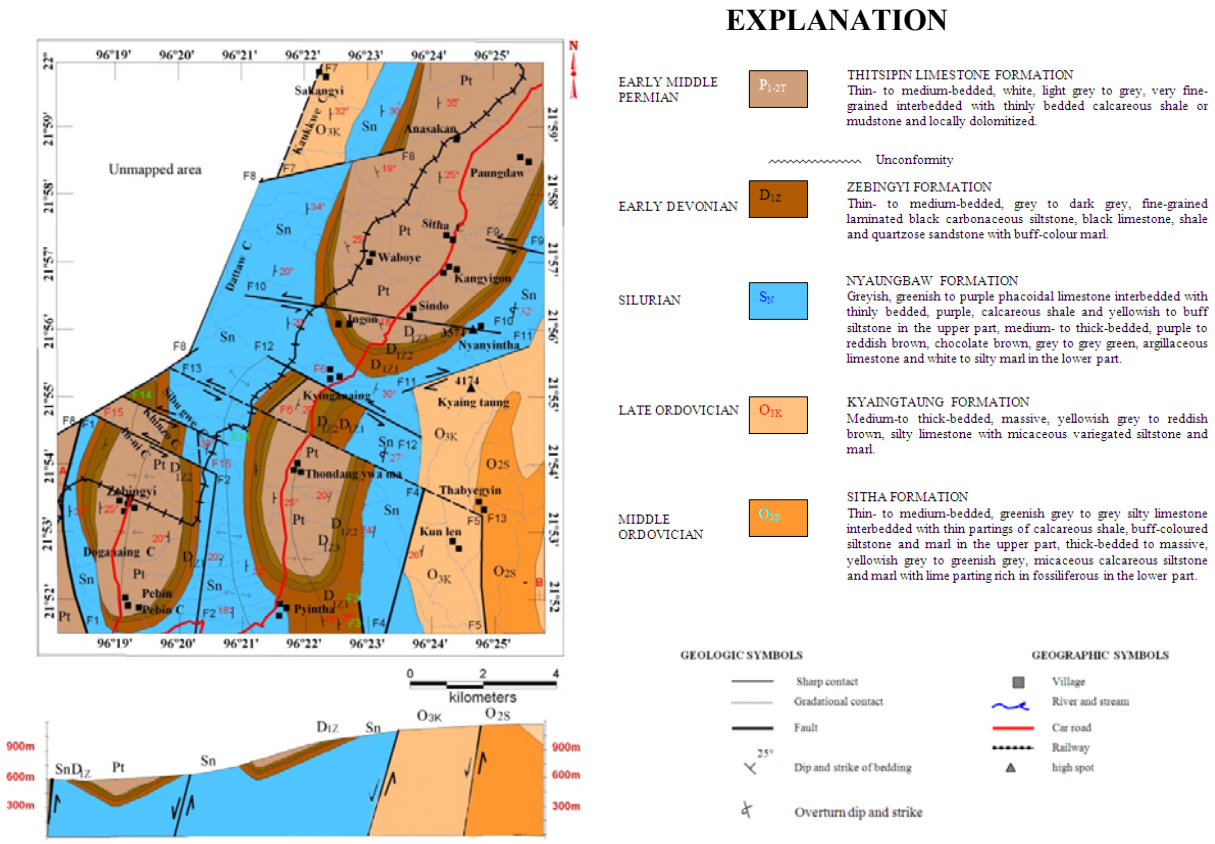


Figure (2). Geological map of the study area (after Zaw Min Thein, 1995, Myint Oo, 1997 and Khaing Khaing San, 1999)

Although there are five stratigraphic units in the present area, I mainly presented the Zebingyi Formation.

Zebingyi Formation is formally defined and subdivided into three members, In-ni Chaung Limestone Member and Doganaing Chaung Quartzose Sandstone Member by Aye Ko Aung and he assigned Early Devonian in age.

The newly selected type section is established Doganaing Chaung approximately 2.5 km south of Zebingyi village (Aye Ko Aung, 2006). The present study selected the reference section as along the railway line milepost 403/13 to 404/2 from Mandalay to Zebingyi.

Petrography

The rock of the Zebingyi Formation can be classified into eleven microfacies. Each sample was classified according to the methods proposed by Folk (1962) and Dunham (1962). Eleven microfacies in Zebingyi Formation which is mainly composed of micrite 65.5%, quartz 17.3%, bioclasts7.4%, sparry calcite3.3%,dolomite3.2%,pelloid1.9%and pyrite 1.4%. The correlations of the microfacies of Zebingyi Formation with Standard Microfacies of Tucker and Wright (1990) is shown in Table 1.

Table (1). The correlation table of the microfacies of Zebingyi Formation with Standard Microfacies of Tucker and Wright (1990)

No	Present study	Standard Microfacies of Tucker and Wright(1990).	Depositional environment
11	quartzose sandstone		
10	dolomitized micrite/ wackestone	Type 9	shallow water, open ciuculation environment
9	dolomitized biomicrite/ dolomitized bioclastic wackestone-packstone	Type 9	lagoonal open circulation
8	sparitized biomicrite/ bioclastic	Type 9	shallow water open circulation environment
7	Micrite/ mudstone	Type 3	marine shelf environment
6	biopelmicrite / bioclastic pelloidal packstone	Type 19	restrited bay or pond
5	silty micrite/Wackestone	Type 1	deep water environment with slow sedimentation
4	biomicrite/bioclastic-wackestone	Type 1 and 2	marginal basin (euxinic) environment
3	shale/siltstone	Type 2	basinal environment
2	silty biomicrite/silty lime mudstone	Type 1	deeper-basinal environment
1	silty pelmicrit /silty peloidal wackestone-packstone	type 1	deep-water environment with slow setimentation

Facies Description

Microfacies I: Silty pelmicrite/ silty peloidal wackestone-packstone

This microfacies are the lowermost part of the Khinzo Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite 70%, quartz silt 22%, pellet 5% and bioclast 3%. The overall matrix is mainly composed of microcrystalline calcite. The quartz grains are scattered in the micrite. The detrital quartz grains are angular to sub-angular and ranges in size from 0.5mm to 0.25mm in diameter. Quartz grains occur in some bioclast. Bioclast include cystoid plates and sponge spicules sp. They are commonly replaced by calcite. The pellets are occurred as the small grain darkest portions of the rocks.

The abundant occurrence of micrite, spicules and dark colour indicate the deposition of deep-water environment with slow sedimentation (i.e. basinal environment) (Tucker & Wright, 1990). The presence of silt size detrital quartz grains pointed out the winnowing action of this microfacies.

Microfacies II: Silty biomicrite/ silty lime mudstone Bilclastic silty micrite/ Bioclsastic wackestone

This unit is the Khinzo Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite (62%), quartz silt (25%), matrix is mainly composed of dark colour microcrystalline calcite. Bioclasts are *tentaculites* sp.,*styliolina* sp., bryozoans, brachiopod shell fragments, bivalves shell, crinoid stems and cystoid plates. *Tentaculites* sp. are found on transverse and longitudinal section. Cubic form pyrites are observed in the micrite and one of the *tentaculites* sp. Rounded shape transverse section of *tentaculites* is 0.3mm. The longitudinal section of the wedge shapes 0.9mm long and it is nearly parallel to each other. Most quartz grains are angular shape and ranges on the micrite **(**Fig. 3**).**

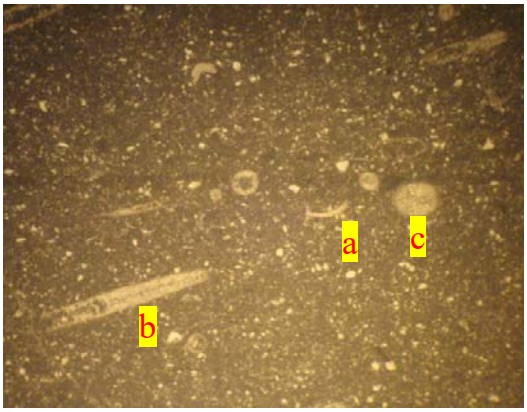


Figure (3) Silty Biomicrite in which thin shell bivalve (a), longitudinal section, (b) and transverse section (c) of tentaculitids and quartz grains are scattered in the micrite under XN, X.40. (Khinzo Chuang Limestone Member)

The micrite matrix composed of tantaculitids, styliolinids and ostracods fauna and rare content of small brachiopods and ostracods suggests as sedimentation in a deeper, basinal environment (Tucker and Wright, 1990). This microfacies assigned to Standard Microfacies 1 of Tucker and Wright (1990).

Microfacies III: Shale / Siltstone

The rocks contain thin-bedded, black, fissile, laminated carbonaceous shale of the Carbonated Limestone Member of the Zebingyi Formation. Microscopically, it consists of fine-grained matrix (80%), quartz grains (11%), bioclast (8%), and pyrite (1%).Bioclast are Tentaculitid, styliolinid and brachiopods shell fragments. Silt-sized quartz grains are noted they are mostly parallel to the lamination (Fig 4). Bioclast are also nearly parallel. The presence of colour clayey mudstone indicates the deposition of basinal environment and also correlated with the Standard Microfacies type of Tucker & Wright (1990).

Figure (4) Shale showing echinoderm plate (a) with accessory of pyrite (b) in the silt and mid microlamination. Under X.40 (Khinzo Chaung Limestone Member)

Microfacies IV: Biomicrite/ bioclastic-wackestone

This unit occurred in the Khinzo Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite (70%), bioclast (18%), quartz silt (10%) and pyrite (2%). Both bioclast and quartz grains are scattered in dark-grey micrite. Bioclast are Tentaculitids, Styliolinids, brachiopod shell fragments, and thin-shelled bivalve**.** (Fig 5-8) Both conularids are found as a transverse and longitudinal section. Most of the bioclast are partially or completely replaced by calcite. Tentaculitids have a maximum length of 1.8mmin longitudinal section and diameter of 0.25mm in transverse section. The transverse section of tentaculites occur as (Fig 6) which is taken with polars crossed showing the extinction cross resulting the radial orientation of individual calcite prisms. The curred twin planes of calcites clearly seen in the plane polarized light of tentaculitids transverse section. Quartz grains are moderately sorted and angular in shape. Pyrite crystals are observed in some of the bioclast, micrite, microspar and filled in veins.

This microfacies suggests as sedimentation in a basin (euxinic) environment or open sea shelf near the lower slope, deeper shelf margin due to the present of black-colour micrite, bioclast of tentaculitids, styliolinds, thin-shelled bivalve fragment and graptolites.

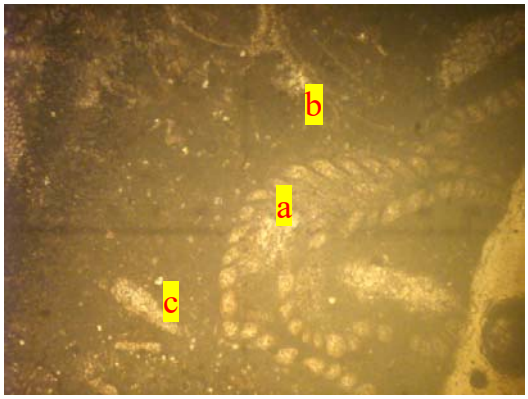
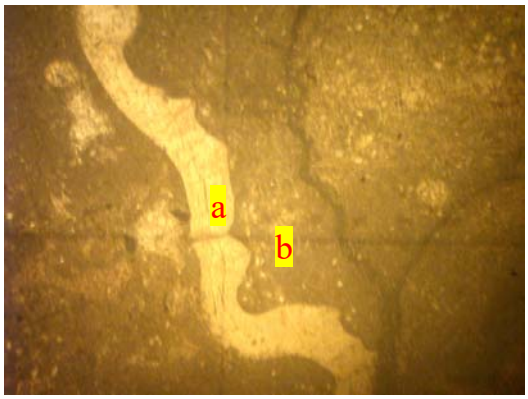


Figure 5



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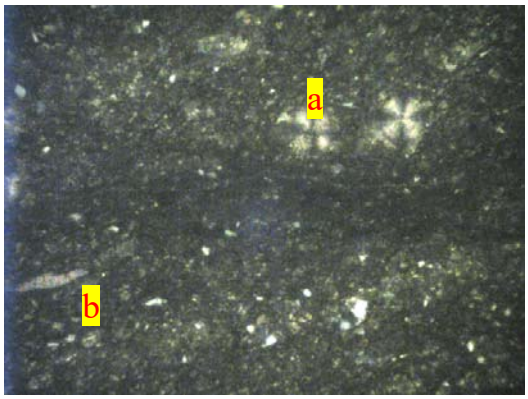

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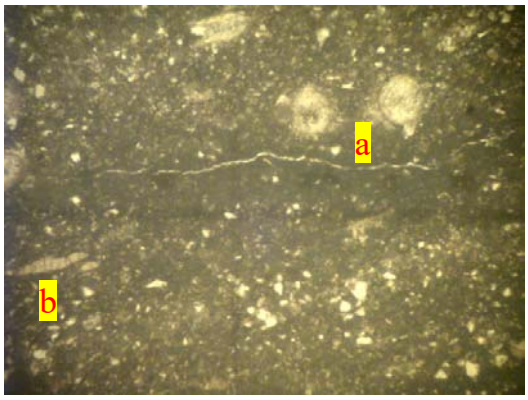

Figure 8

Figure (5). and (6). Biomicrite showing the scattered bioclast of algae (a), thin shell bivalves (b), echiodern plate (c), brachiopod shell fragment (d) and stylolite seam (e) which are partly filled by microspar. Under XN, X.40 (Khinzo Chaung Limestone Member)

Figure (7). and (8). Biomicrite showing the traverse (a) and longitudinal (b) section of tentaculitid and styliolinid .Under XN (Khinzo Chuang Limestone Member)

Microfacies V: Silty micrite / wackestone

This rock exposed at the upper part of the Khinzo Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite (75%), quartz silt (23%) and bioclast (2%) (Fig. 9**).** The quartz grains show parallel orientation. The silt size quartz grains are angular and ranges in size from 0.5 to 0.25mm in diameter. Sorting is moderate. It can be suggested that the source area of the quartz grains are not away from the depositional environment. The bioclast are rare and most are crinoid stem and cystoid plates. The abundance of micrite and generally dark colour water environment with slow sedimentation and the presence of silt size quartz grains indicate the winnowing action.

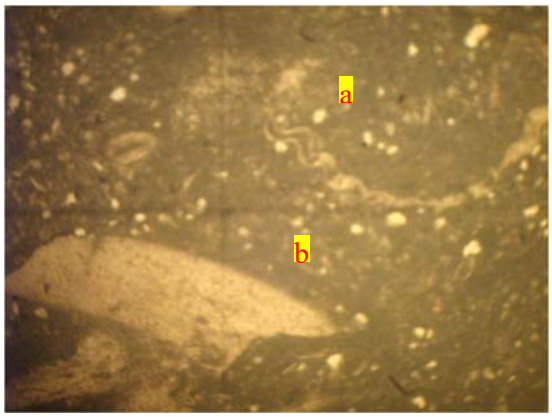

Figure (9). Silty micrite showing scattered silt size quartz grains, the brachiopod shell (a) and enchinodern plate (b) in the micrite. Under X.40 (Inni Chaung Limestone Member)

Microfacies VI: Biopelmicrite/Bioclastic packstone-grainstone

This rock exposed at the upper part of the Khinzo Chaung Limestone Member of the Zebingyi Formation. It consists of micrite (50%), bioclast (30%), pellet (15%), quartz silt (5%). The fine grained darkest portions of the rocks are pellet. They have nearly the same size and scattered in the micrite. They are sharply distinguished from the matrix by their component of darker micrite and elliptical shape. Bioclast are Tentaculitids, Styliolinids, Crinoid stems, Brachiopod shell fragments, dasycladacean algae and thin shell bivalves. Conulhrid are occured in the form of transverse longitudinal and oblique section. Crinoid stems and echinoderm plates are occured as rounded, isometric and rectangular in shape. Syntaxial rim cement around them is clearly observed in thin-section. The probable dasyclads algae occur as the transverse section with hollow centers (Fig 10). Cubic form, pyrite crystals are embedded in the dark grey micrite. Microspar filled in the veins and fossils fragment. The formation of pelloids, abundance of conularids and rare occurrence of algae and dark colour reflect a restricted bay or pond (Tucker & Wright, 1990).

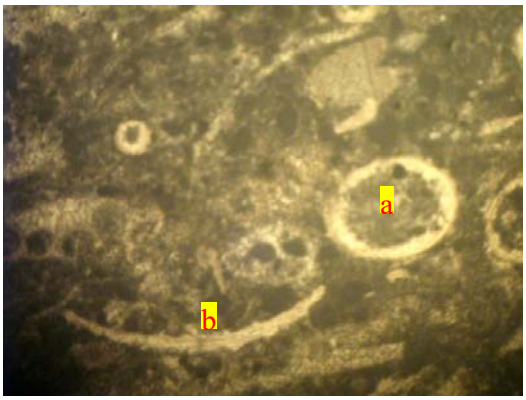

Figure (10). Biopelmicrite in which pelloids of same size are scattered in micrite with thin shell bivalves (a), brachiopod (b) and partly filled sparitized echinoderm plate (c). under XN, X.40. (Khinzo Chaung Limestone Member)

Microfacies VII: Micrite / Mudstone

The rocks contain medium-bedded, ash-white to light-grey, fine-grained limestone. Microscopically, it consists of micrite (85%), sparry calcite (7%), quartz silt (5%), pyrite (3%) and bioclast (1%). Bioclast include crinoid stem. The overall matrix is mainly composed of microcrystalline calcite. Angular to subangular quartz grains are scattered in the light grey micrite. Sponge spicules are filled by sparite. Sparry calcites are filling in the

patches and veins occur as microspar and pseudospar (Fig 11 & 12). Calcite veins transverse across the micrite. The euhedral pyrite crystal observed as the accessory constituent. The abundance of micrite and generally light colour suggests that the sediment is deposited under shallow water condition probably marine shelf environment for this microfacies.

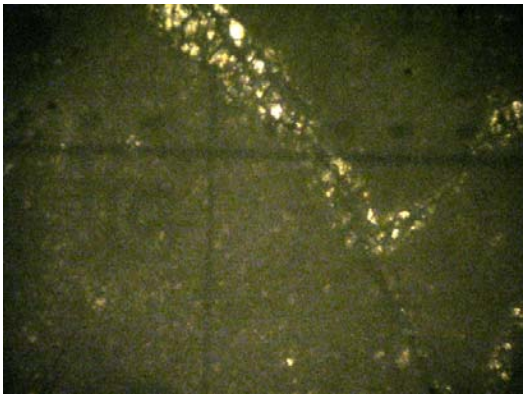

Figure 11

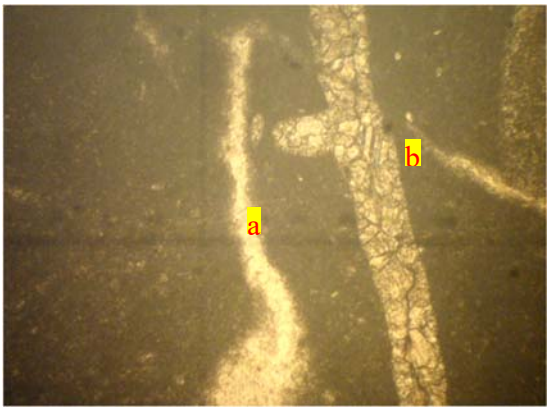

Figure 12

Figure (11). Micrite showing the transverses vein filled by sparite. Under X.N, X.40. (Inni Chaung Limestone Member)

Figure (12). Micrite showing the veins replaced by microspar and pseudospar. Under X.40. (Inni Chaung Limestone Member)

Micrifacies VIII: Sparitized biomicrite/ bioclastic wackestone

The rock contains medium-bedded, ash white to light-grey, fine-grained limestone, the In-ni Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite 80%, sparite 10%, quartz silt 6% and bioclast 4% (Fig 13).

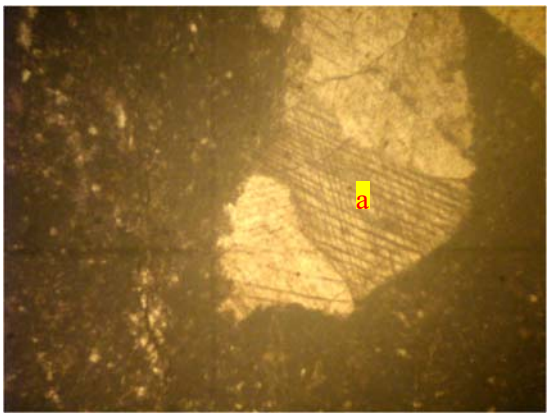

Figure 13

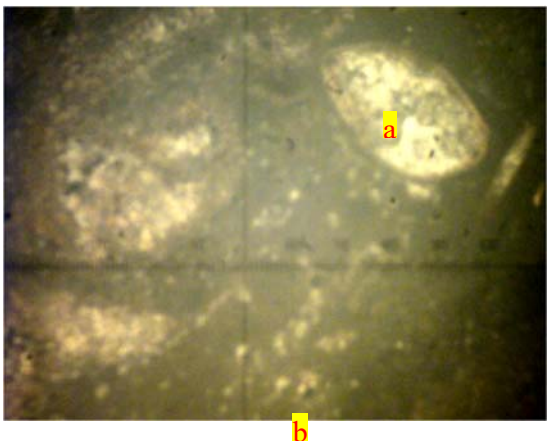

Figure (14)

Figure (13). Sparitized Biomicrite including echinoderm plate with syntaxial rim cement (a) and patches of sparite in the micrite. Under X.40. (Inni chuang Limestone Member)

Figure (14). Sparitized Biomicrite showing the sparitized bivalve (a) and patches of microspar (b) in the micrite. Under X.40. (Inni Chaung Limestone Member)

The overall matrix is mainly composed of microcrystalline calcite. Sparry calcites are filling in the patches and bioclast occured as microspar and pseudospar (Fig 14). Quartz grains are angular to sub-angular in shape and scattered on the micrite. Pyrite is also present as the accessory constituent. Bioclast are Tentaculite, Styliolinids and bivalve shells. They are scattered in the micrite and they are filled by sparry calcite. The present of bioclast and composed of micrite suggests that the sediment is deposited under shallow water open circulation environment.

Microfacies IX: Dolomitized biomicrite/ Dolomitized bioclastic Wackestone- Packstone

The rock contains medium-bedded, fine-grained, ash-white to light-grey, compact and locally domomitize limestone. Microscopically, it consists of micrite 65%, dolomite 9%, Bioclast 17%,sparry calcite 9%, detrial quartz grain 1%.The overall matrix is mainly composed of light grey microcrystalline calcite. Bioclast are scattered in the micrite. Most bioclast are crinoid ossicles and echinoderm plates. They are filled by sparite and partly replaced by dolomite grains in some bioclast (Fig 15**)**. Sparry calcites are filling in the void occurred as the patches. Dolomite grains are scattered in the micrite and in some bioclast. Spong spicules are also present and the syntaxial rim cement is occurred around the echinoderm plate. The present of light colour micrite and crinoid skeletal suggests that the sediments ate deposited in the environment of shallow water with open circulation.

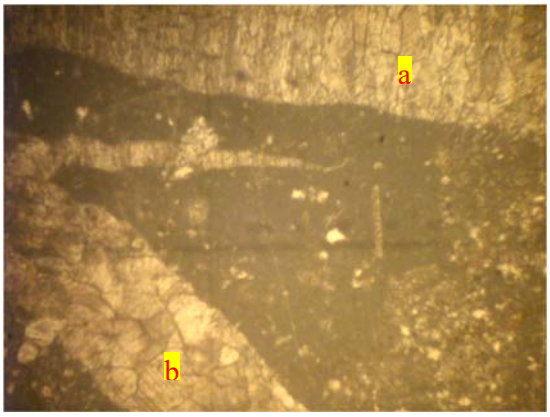

Figure (15). Dolomitized Biomicrite showing microspar filled te brachiopod shell fragments (a), pseudospar filled the vein (b) and the minute dolomite grains in the micrite. Under X. 40. (Inni Chaung Limestone Member)

Microfacies X: Dolomitized micrite/wackestone

This is the dolomitized limestone of the Inni Chaung Limestone Member of the Zebingyi Formation. Microscopically, it consists of micrite 70%, dolomite 25% and sparry calcite 5%. The overall matrix is mainly composed of microcrystalline calcite. Dolimite grains are scattered in the micrite, partly replaced in micrite. The minute dolomite crystals are mostly the granular aggregate (Fig 16). Sparry calcite are filled in the veins and patches occured as microspar and neospar. The present of light coloured micrite and dolomitization suggests that the sedimentation is deposited in shallow water with open circulation.

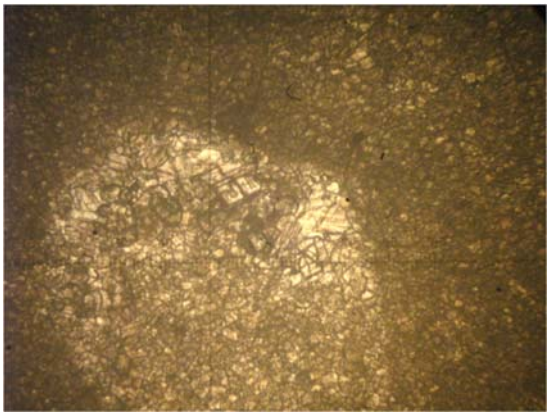

Figure (16). Dolomitized micrite including the replacement of euhedral dolomite crystal in micrite. Under X. 40. (Inni Chaung Limestone Member)

Microfacies XI: Quartzose sandstone

This unit is the uppermost part of the Zebingyi Formation. Microscopically, it consists of detrital quartz grains 85%, microcrystalline calcite 14% and magnetite 1%. The constituent of quartz grains are embedded in the micrite. The detrital quartz grains are angular to subangular and range in size from 0.25mm to 0.5mm (Fig 17). They are moderately sorted. The contact between the quartz grains mostly tangential and some concavo-convex and solution contact are also occurred. Most of the monocrystalline quartz indicates that they are formed by the sedimentary origin. Most of the pore spaces are filled with micro-crystalline calcite.

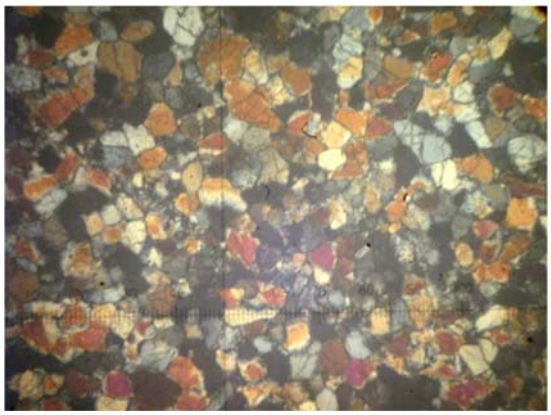

Figure (17). Quartzose sandstone showing subrounded, moderately sorted monocrystalline quartz grains. Under X.N, X.40. (Doganaing Chaung Quartzose Sandstone Member)

Conclusions

The study area is located between north latitude 21°51.5' to 22° and east longitude 96° 18′ to 96° 26′, in the Pyinoolwin Township. It is a part of 93 C/5 and covering 78.85 square miles. It is a fairly rugged and mountainous terrain with the flat plane in the central portion. It lies in the western marginal zone of the Eastern High land. The study area is covered by a thick carbonate sequence of Ordovician to Permian age. On the basis of Folk's (1959, 1962) classification and Dunham's (1962) Classification. Zebingyi Formation can be subdivided in to eleven microfacies, from lower to upper: 1. Silty pelmicrite, 2. Silty biomicrite, 3. Shale, 4.

Biomicrite, 5. Silty micrite, 6. Biopelmicrite, 7. Micrite, 8. Sparitized biomicrite, 9. Dolomitized biomicrite, 10. Dolomitized micrite, 11. Quartzose sandstone. On the basic of fauna content and petrographic interpretation Zebingyi formation is deposited in euxinic basin condition in early stage and later shallowing of basin due to the shoaling of the water.

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