MICROFACIES ANALYSIS OF SILURIAN CARBONATE ROCKS IN THE AREA BETWEEN YATSAWK AND BAWSAING, SHAN STATE (SOUTH)

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Abstract

Carbonate microfacies analysis was systematically carried out focusing on the sedimentological characters for the rock units exposed in the area between Yatsawk and Bawsaing, Yatsawk township, Shan state (south), Myanmar. It lies between latitude 21° 03' N and 21° 07'N, longitude 96° 45' E and 96° 55'E, representing one inch topographic map index of 93 C/16. Most of the exposed rock units are limestone and dolomite with different lithologic characters in different geological age, with minor amount of clastic rocks. Detailed sedimentological analysis and interpretations are carried out for the Linwe Formation. It consists of purple, pink and grey, medium to thick bedded phacoidal limestones, fine-grained, poorly jointed, wavy and discontinuous laminated, argillaceous limestone, bluish-grey calcareous shale and calcareous mudstone. Based on the partical component, texture and sedimentary structure six microfacies such as lime mudstone, bioclastic lime mudstone, biointraclastic wackestone, bioclastic wackestone, bioclastic lithoclasticpackstone and bioclastic packstone are recognized. By the microfacies analysis, Linwe Formation can be subdivided into four different facies associations falling into four main depositional environments, namely, foreslope, open sea shelf, deep shelf margin and basin by identifying their grain type, physical, biologic and sedimentary structures.

Keywords: Shan State, Linwe Formation, foreslope, open sea shelf, deep shelf margin, basin, microfacies, facies association

Introduction

The research area lies between the latitude 21° 03' N to 21° 07' N and longitude 96° 45° E to 96° 55' E. This area occupies between Yatsauk and Bawsaing. Location map of the research area is as shown in Figure (1). Stratigraphically Bawsaing range is covered with the rocks of the Chaungmagyi Group (Precambrian), the Pindaya Group (Ordovician), the

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Mibayataung Group (Silurian), the Zebingyi Formation (Early Devonian) and the plateau Limestone Group (Permian to Early Triassic) (National Committee, I.G.C.P., 1980). This research comes out from the microfacies analysis of the Silurian carbonate rocks of the Linwe Formation in this investigated area. At least 6 microfacies can be distinguished from the rocks of Linwe Formation.

Terminology and classification for microfacies is according to Dunham (1962) and Wilson (1975). Terminology of Folk (1965) for carbonate crystal shapes is also adopted for this research.

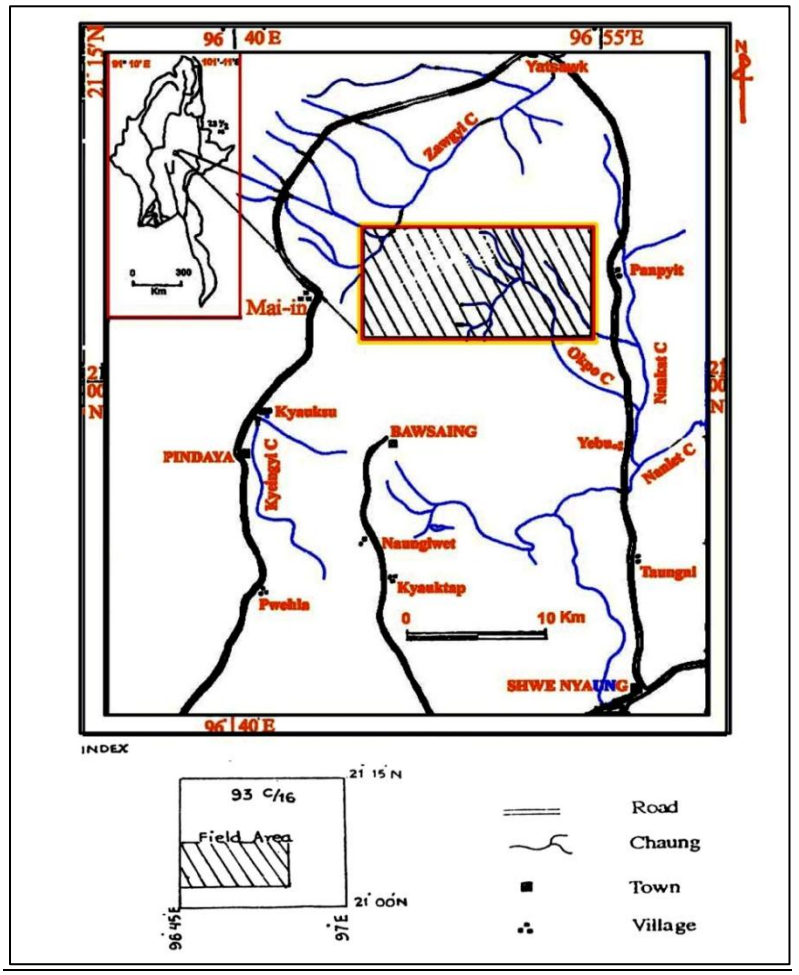


Figure 1: Location map of the research area

Methods of Study

- Tracing lithologic contact from one inch topographic map and aerial photographs
- Field investigation and collecting the samples
- Microscopic examination
- Staining Analysis

Microfacies Analysis of the Silurian carbonate rocks, Linwe Formation

The Linwe Formation is widely distributed in this area. The rocks of the Linwe Formation can be classified into six microfacies based on the particle component, texture and sedimentary structure. These microfacies are –

(1)	lime mudstone	(L-1)
(2)	bioclastic lime mudstone	(L-2)
(3)	biointraclastic wackestone	(L-3)
(4)	bioclastic wackestone	(L-4)
(5)	bioclastic-lithoclastic packstone	(L-5)
(6)	bioclastic packstone	(L-6)

Petrographic plots of the Linwe Formation based on the orthochem and allochem compositions are as shown in figure (2).

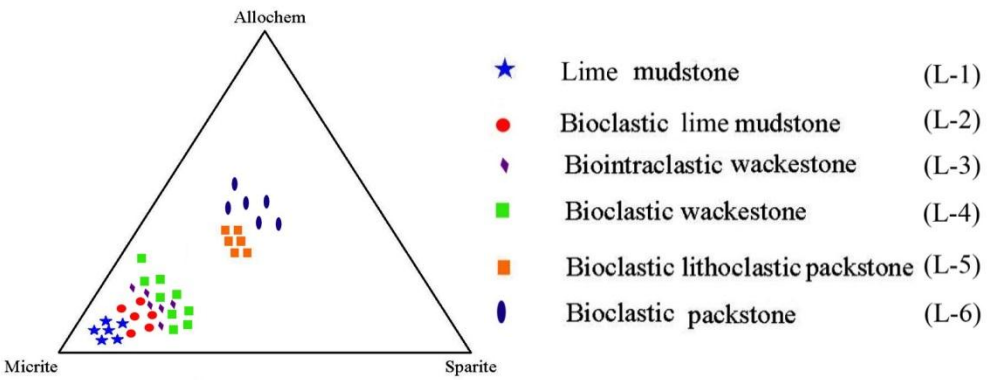


Figure 2: Petrographic plots of the Linwe Formation based on the orthochem and allochem content.

Microfacies 1: Lime mudstone (L-1)

Microfacies description

This microfacies consists of planar laminated (lamination is maximum 4cm), grey, thin to medium bedded argillaceous limestone with bluish grey calcareous shale. The rocks of this microfacies occupy the lower and middle part of measured section. The rock consists of dense, dark grey, organic rich micrite and argillaceous lime mudstone.

Microfacies interpretation

There is no evidence for high current energy. High micrite accumulation reflects low energy condition. The fact that the rock has lack of fossil evidence indicates the environment of deposition is not hospitable for marine life. Most fine-grained sediments are largely deposited by suspension. Thinly, flat laminated limestone and its fine-grained nature of this facies strongly suggests slow rate of sedimentation in low energy quiet water environment.

Microfacies 2: Bioclastic lime mudstone (L-2)

Microfacies description

It is composed of grey to buff coloured, medium bedded, thickening upward in bedding and lamination, argillaceous limestone with shale. Thickness of intercalated shale lamination is about 3mm to 5mm.

The rock comprises bioclasts such as ostracods 4-5%, crinoids 3-5% and thin bivalve shells 1% by volume which are well packed by microcrystalline carbonate mud (Figure 3). Unbroken bioclasts are more common than broken one and filled with sparry calcite mosaic. Their size is 0.1mm in diameter, and moderately to well sorted. Interparticle pores are filled with microcrystalline carbonate mud same as matrix. Microstylolites are locally common; along which clay materials are observed. Scattered pyrite bits are 0.025mm to 0.075 mm in size containing less than 1% by volume. They are idiotopic fabric with rectangular outline (Figure 4).

Microfacies interpretation

High content of lime mud is evidence for lower energy condition. Parallel lamination indicates the low energy condition and medium bedded nature shows slow rate of sedimentation. Limestone with intercalated argillaceous layer suggests the alternate deposition of clastic rich sediments and carbonate-rich sediments with fluctuation in current energy condition. Bioclasts are possibly derived from up slope.

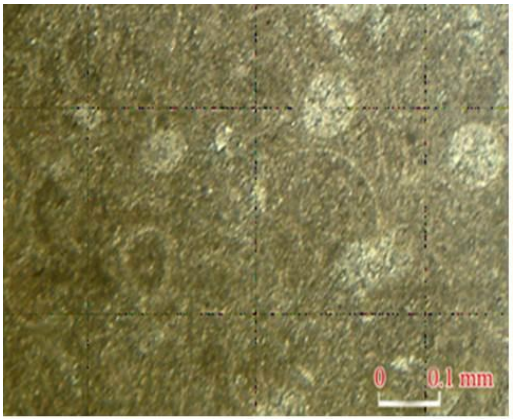


Figure 3: Well preserved ostracod shells (o) are well packed by microcrystalline carbonate mud (m) in bioclastic lime mudstone microfacies (MF-2) PPL.(S.No.A 12)

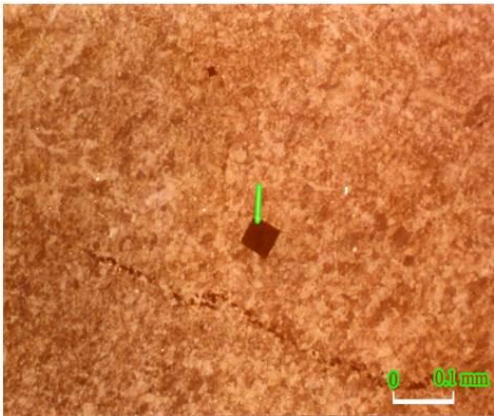


Figure 4: Pyrite (arrow) with rectangular outline scattered in bioclastic lime mudstone showing reducing environment. PPL. (S.No. B.7)

Microfacies 3: Biointraclastic wackestone (L-3)

Microfacies description

This rock is made up of buff coloured, thinly bedded and very fine-grained, limestone. Argillaceous content is higher upward and slump feature is common.

This rock consists of bioclasts about 1-2% by volume and slightly lithified intraclast 20%. Intraclasts are 1mm in maximum diameter. They are roughly equidimensional, not well sorted, but sub-rounded in appearance and clayey material coated (Figure 5). Matrix is bioclastic mudstone. Intraclasts and matrix are same. Interparticle pores are filled with microcrystalline calcite mud.

Microfacies interpretation

High micrite accumulation reflects low energy condition. Previously lithified intraclasts are transported by current from up slope and probably deposited in unstable inclined slope. Subrounded appearance of intraclasts shows slight wave energy condition.

Microfacies 4: Bioclastic wackestone (L-4)

Microfacies description

This rock consists of light grey to pinkish or purple, medium to thick bedded, fine-grained, poorly jointed, wavy discontinuous laminated argillaceous limestone. Phacoidal structure is also developed and nodular bedding is common. Crinoid fragments are locally scattered on weathered surface. This microfacies is widely distributed throughout the measured section.

The rock consists of bioclasts such as echinoids up to 20%, ostracods about 4-10%, gastropods 10%, brachiopod 5% by volume. Bioclasts are not sorted in size and shapes. Interpartical pores are filled with microcrystalline carbonate mud. Internal sediments of the bioclasts is same as micrite matrix. Types of bioclasts are diverse. Aggraded neomorphosed bioclast is shown in (Figure 6). Degraded neomorphosed Brachiopod shell is shown in (Figure 7). Drusy calcite cement filled the interparticle pores (Figure 8). Amplitude of microstylolite (Figure 9) ranges from 0.1mm to 0.3 mm. This microfacies can be correlated with S.M.F 9 (Wilson, 1975).

Microfacies interpretation

Low energy condition is suggested by high content of lime mud accumulation. Wavy discontinuous argillaceous laminations indicate slight current condition within sufficient supply of fine clastic sediments by intermittent storm. Diverse shelly fauna reflects oxygenated normal marine salinity with adequate water circulation. The fact that unbroken shells are more than broken bioclasts suggests that shells were not influenced by wave action and they are well packed by micrite.

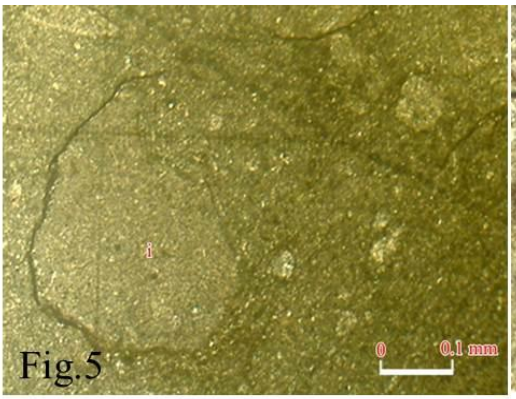


Figure 5: Previously lithified intraclasts (i) which are same as matrix in biointraclastic wackestone microfacies in lower part of measured section. PPL. (S.No . A.29)

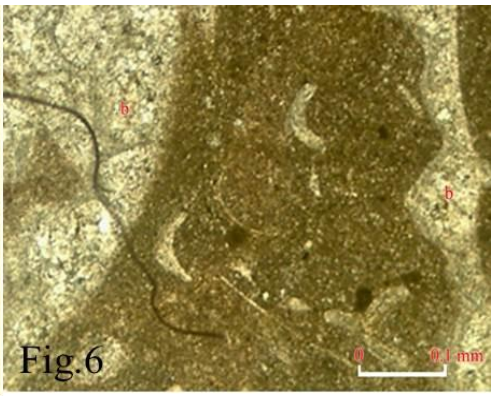


Figure 6: Bioclastic wackestone in which bioclasts (b) are aggrading neomorphosed, middle part of measured section PPL. (S.No. A.42)

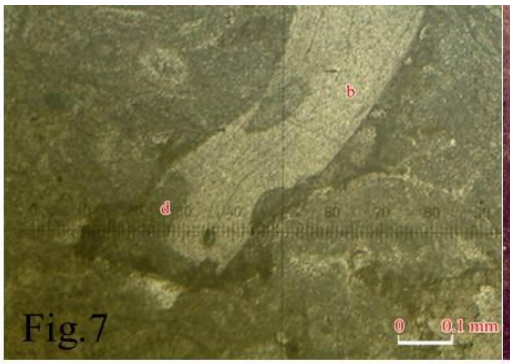


Figure 7: Degrading neomorphism (d) in brachiopod shell fragments (b) in bioclastic wackestone, lower part of measured section PPL. (S.No. A2)

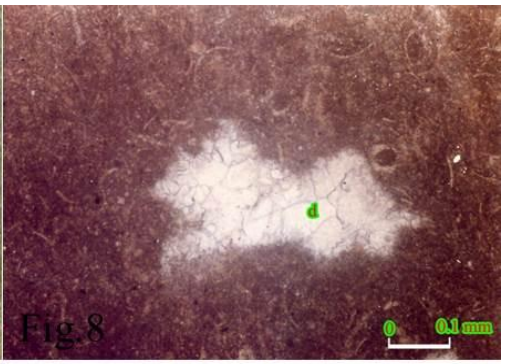


Figure 8: Drusy calcite cement (d) filled in the interparticle pores in the bioclastic wackestone microfacies, PPL. (S. No. B.9)

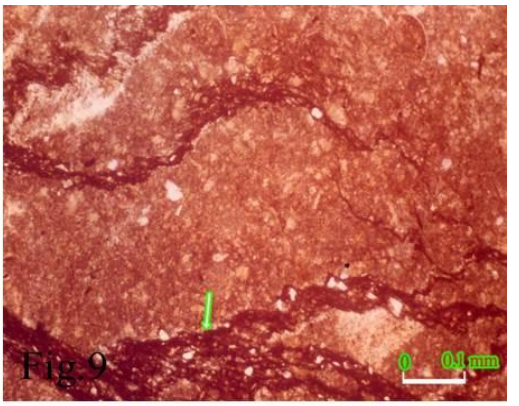


Figure 9: Network type microstylolite (arrow) due to pressure solution in late diagenetic process, bioclastic wackestone. PPL. (S. No. B. 11)

Microfacies 5: Bioclastic-lithoclastic packstone (L-5)

Microfacies description

This rock comprises buff coloured, micaceous, soft, thin to medium bedded, poorly exposed limestone with shale and silt intercalation.

This rock composed of bioclastic lithoclasts fragments 50% by volume and previously lithified lithoclastic fragments (Figure 10). Bioclasts and lithoclasts are coated, subrounded and poorly sorted. Size of bioclastic grains is up to 0.2mm in diameter. This microfacies can be correlated with S.M.F 4 of by Wilson, 1975.

Microfacies interpretation

Dominant particles are of high energy environment and have moved down to local slopes to be deposited. Coarse shell fragments may be derived from up slope by slight energy current velocity. Abundant occurrence of lithoclasts in various size and rock type strongly suggests the rocks are made up entirely of marine talus and coarser debris probably derived by submarine slumping or turbidity current.

Microfacies 6: Bioclastic packstone (L-6)

Microfacies description

This rock is greenish to pinkish, medium to coarse crystalline, thick bedded wavy laminated, poorly jointed, nodular limestone. Crinoids stems commonly occur on the bedding plane and weathered surface. The rocks are composed of bioclasts more than 50% by volume. Matrix is microcrystalline carbonate and clayey materials. Crinoids are most abundant bioclasts in this microfacies. Some bioclastic grains are 0.2mm in diameter. Bioclastic grains are poorly sorted, rounded. Grains are showing syntaxial overgrowth, later subjected to micritisation (Figure 11). This microfacies coincide with S.M.F 5 by Wilson, 1975.

Microfacies interpretation

This microfacies with high diversity large amount of fauna strongly suggests good current circulation and normal marine salinity with well oxygenated condition. Wavy discontinuous lamination reflects the slight current condition with intense wave activities above normal wave base. Some coarser shell fragments were probably derived from up slope by current transportation.

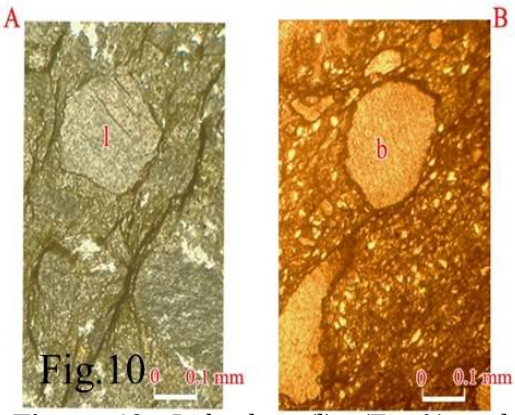


Figure 10: Lithoclast (l), (Fig.A) and corroded bioclastic lithoclast(b), (Fig.B) in bioclastic lithoclastic packstone microfacies. Notice that there is no grain to grain contact showing lack of deep burial compaction. PPL. (S. No. A40)

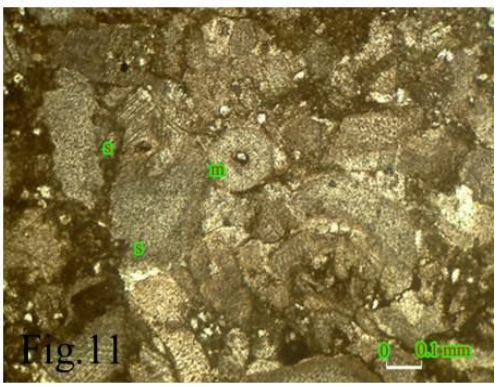


Figure 11: Bioclastic grains cemented by syntaxial overgrowth (s),later micritization occur. Bioclastic packstone microfacies PPL.(S.No. A.44)

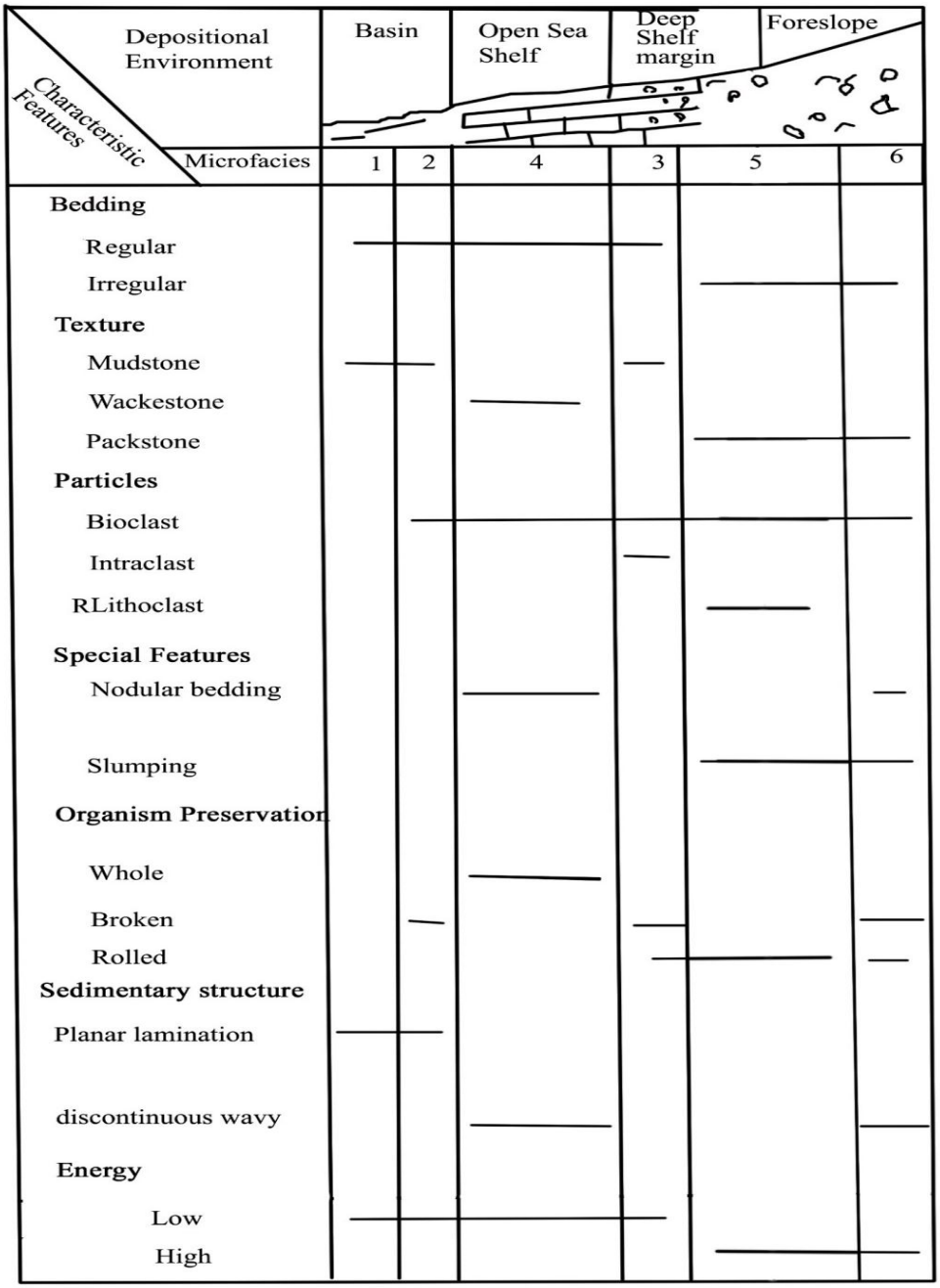
Microfacies Association and Depositional Environment

The rocks of the Linwe Formation can be categorized into six microfacies. These microfacies are grouped into four main facies associations for four different depositional environments, such as, basin, open sea shelf, deep shelf margin and fore slope environment respectively. Table (1) describes-microfacies association, their depositional environment and respective characteristic features. Table (2) shows four main depositional environments identified by microfacies analysis of the Linwe Formation based on grain type, physical, biologic and sedimentary structure putting into (Wilson, 1975 and Reckmann & Friedman, 1981) modal.

Table 1: Depositional environment and characteristics features of the Silurian carbonate rocks, Linwe Formation

Micro facies No	Microfacies	Environment	Characteristic features
1.	Lime mudstone	Basin	▪ Lime mudstone with some calcisilt
2.	Bioclastic lime mudstone		• Low energy, rhythmic bedding
			• Some shale, fine clastic
3.	Biointraclastic wackestone	Deep shelf margin	❖ Slump, talus
			❖ Regular bedding
			❖ Low energy
			❖ Slightly lithified intraclast
			❖ Organism rolled particle
4.	Bioclastic wackestone	Open sea shelf	✓ Wackestone, diverse fossil, nodular bedding
5.	Bioclastic-lithoclastic	Foreslope	➢ Lime sand,
	packstone		➢ Abundant organism
			➢ Lithoclast
6.	Bioclastic packstone		o High energy

Table 2: Characteristic Features of Depositional Environment for microfacies of the Silurian carbonate rocks, Linwe Formation



Summary and Conclusion

The investigated area is situated in the west of Yatsawk- Shwenyaung motor road, Yatsawk Township, southern Shan State. This area is demarcated by latitude 21° 03' N to 21° 07' N and longitude 96° 45' E to 96° 55' E with one-inch to pographic map sheet No.93C/16.

Silurian carbonate rocks, Linwe Formation can be classified into 6 microfacies which fall into 4 different facies association. Lime mudstone (L-1) and Bioclastic lime mudstone (L-2) are probably deposited in basin environment. Characteristic feature of basin environment possessed in these microfacies are low energy lime mudstone, rhythmic bedding, some shale and fine clastics.

Biointraclastic wackestone (L-3). May be deposited in deep shelf margin due to the presence of regular bedding, slump, low energy condition and rolled particle organism and slightly lithified organism.

Bioclastic wackestone (L-4) having the characteristic features of diverse fossil, nodular bedding, discontinuous wavy lamination, is accumulated in open sea shelf environment.

Foreslope facies association contains bioclastic-lithoclastic packstone (L-5) and bioclastic packstone (L-6). These microfacies possess the characteristic features such as lime sand, abundant organism, lithoclast, high energy condition..

Sedimentation of the Linwe Formation may be brought about transitionally on foreslope, deep shelf margin, open sea shelf and basin at the time of Silurian.

Acknowledgement

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