

Petrography and Lithofacies Analysis of Shwezetaw Formation, Northern Part of Letpanto Area, Pauk Township, Magway Region, Myanmar

Phone Pyae Nyunt¹ and Day Wa Aung²

Abstract

The present study area occupies a small portion of the Minbu basin. The study area is mainly underlain by mollassic clastic sedimentary rocks of Pegu Group in Tertiary Age. The stratigraphic units, namely, the Shwezetaw Formation (Early Oligocene), the Padaung Formation (Middle Oligocene) and the Kyaukkok Formation (Middle Miocene) are exposed in the study area. The Shwezetaw Formation consists of fine to medium grained, grey to yellowish brown coloured sandstone, which are Lithic Arkose and Feldspathic Litharenite in composition. The diagenesis of the study area can be categorized into two main stages such as early diagenesis and late diagenesis. Packing of the sandstone is largely dependent on the grain size, shape and sorting. The Shwezetaw Formation has four lithofacies representing two lithofacies association. They are delta plain facies association and delta front facies association. The Shwezetaw Formation was deposited in deltaic depositional environment during a regressive phase of sea level.

Introduction

The study area is located in the northern part of the Pauk Township, Pakokku District, Magway Region. It lies between the latitude 21° 41' N and 21° 45' N and longitude 94° 30' E and 94° 35'. Location of the study area, shown in (Fig. 1).

The geology of the study area had been carried out by many geologists but the main aims of the present paper are to study the sandstone petrography of rock units with emphasis on diagenesis, and the pore space nature, and to carry out sedimentary facies analysis.

¹ MSc Student, Department of Geology, University of Yangon

² Dr, Professor and Head of the Department of Geology, University of Yangon

Regional Geology and Stratigraphy

The study area is located in the Salin Basin (Minbu). Salin Basin is situated in the northern part of the Central Myanmar Basin. On the west flank of the basin, the Western Outcrops are separated by the Kabaw Fault complex from the Triassic and younger rocks of the Indo – Burman Ranges (Pivniket *al*, 1998). The long and continuous syncline occupying the entire western part of the Salin Basin also known as the Salin Synclinorium. The study area is located in the northern part of Salin basin. Most of the Oligocene - Miocene rocks mainly constituting of clastic rocks of Central Cenozoic Belt (Central Basin of Than Nyunt and Chit Saing, 1978) are very limited in distribution and are found mostly in Minbu infrabasin. The general regional geology map of the study area is shown in Fig. 2.

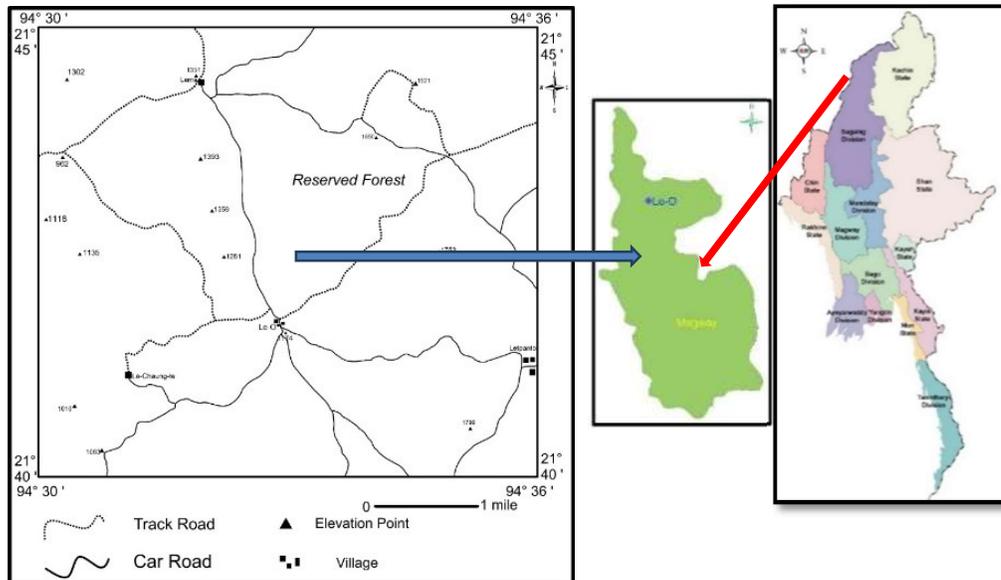


Figure 1. Location of the study area

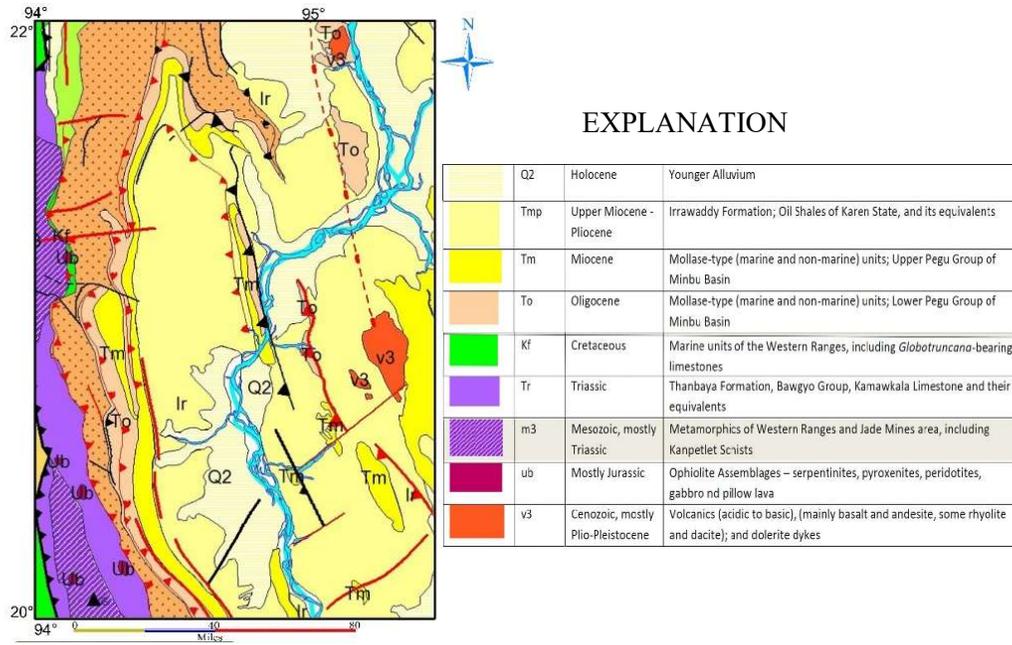


Figure 2. The general regional geology map of the study area (Myanmar Geosciences Society; Revised Version, 2011)

The study area is mainly composed of mollassic clastic sedimentary rocks of Pegu Group in Tertiary age. The stratigraphic succession of the study area is shown in Table. 1. The geological map of the study area can be seen in Fig. 3.

Shwezetaw sandstones are yellowish brown, grey brown, fine to medium grained and thick bedded to massive. This Formation is mainly consists of sandstone and interbedded with minor amounts of sandy shale, silty shale and clay, also intercalated with clay partings, coal stringers and micaceous sandstone, (Fig. 4). This Formation also consists of abundant silicified fossil wood. In the study area, the stratigraphic thickness of the Shwezetaw Formation is 2540 feet.

The Padaung Formation is mainly consist of clay, light grey coloured and fairly soft, clay and shale interbedded with dark grey to yellowish brown coloured sandstone, thin to medium bedded and fine to medium grained. Sedimentary structure of flaser and lenticular beddings are shown in (Fig. 5).

Table 1. The stratigraphic succession of the study area.

Stratigraphic Succession	Lithologic Subunit	Lithologic Description	Geologic Age	Thickness Feet
Irrawaddy Formation	Sandstone	Unconsolidated sandstones interbedded with gritty beds	Late Miocene to Pliocene	2230
 Unconformity				
Kyaukkok Formation	Sandstone	Thin to thick bedded, light grey to yellowish grey sandstone	Middle Miocene	1750
 Unconformity				
Padaung Formation	Clay	Dark green to dark bluish grey colour, fine to medium grained, thin to medium bedded, locally massive	Middle Oligocene	1190.8
Shwezetaw Formation	Sandstone	Yellowish brown to yellowish grey loose sandstone, medium to thick-bedded	Early Oligocene	2540
 Unconformity				
Yaw Formation	Sandstone	Shales interbedded with siltstone beds	Late Eocene	2850

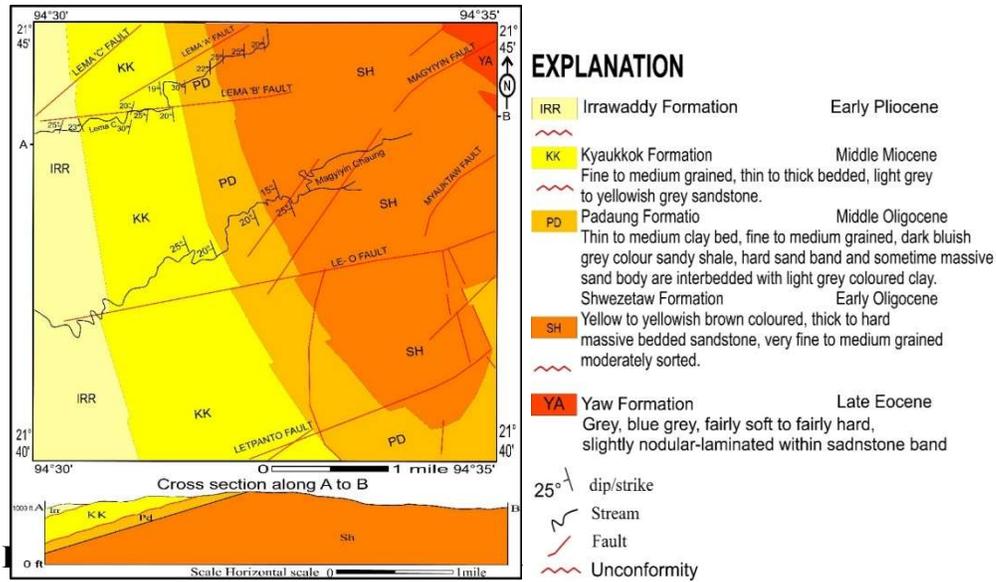


Figure 3: Geology map of the study area (MOGE, 1988)



Figure 4. Small coal seams intercalated with sandstone of Shwezetaung Formation (GPS N21°43'32" E 94°32'45.2", Photo Facing 155°)

Figure. 5 Flaser interbedded with dark grey coloured sandstone of Padaung Formation (GPS N21°42'.35" E 94°31' 48.6", Photo Facing 255°)

The Kyaukkok Formation consists of massive to thick bedded, yellowish grey to greenish grey, fine to medium grained sandstones and are interbedded with bluish grey shale which are soft laminated and carbonaceous and fine alternations of sandstones and clays, (Fig. 6). The Kyaukkok Formation overlies unconformably the Padaung Formation.



Figure 6. Bluish grey shales are interbedded with thick bedded yellowish grey coloured sandstone of Kyaukkok Formation (GPS N21°44'00.5" E 94°31'18.2", Photo Facing 185°)

Methods of Study

In the field, tape and compass traverse method was applied for geological mapping and section measurement. Thin sections were systematically studied under the polarizing microscope. To learn the content of the framework grain and cement, point counting by using mechanical stage was also carried out for modal analysis. From point counting, the various detrital grain were recorded. Based on point counted data and microscopic study, classification of rock type, pore space analysis, packing and diagenesis can be interpreted.

Petrography of Shwezetaw Sandstones

The sandstones of Shwezetaw Formation are fine-to medium grained, grey to yellowish brown coloured and mainly composed of detrital fragments such as quartz, feldspar, mica, rock fragments and minor accessories such as chert, schist, serpentine, authigenic clay mineral and volcanic fragment. Detrital quartz constitutes 26% to 33% of the total detrital fractions. In quartz population, 87% to 100% is monocrystalline quartz and 0% to 13% is polycrystalline quartz. Feldspar constitutes 27% to 36% of the total detrital fractions. Detrital feldspars are orthoclase, plagioclase and microcline. Orthoclase feldspar constitutes 94% to 96% and plagioclase feldspar comprise 6% to 4% of the total feldspar fragments. Mica constitutes 3% to 6% of the total detrital fractions. Biotite mica is more abundant than muscovite. Rock fragments consists of 17% to 21% of the total detrital fractions. The iron-oxide cement constitutes 0.7% to 5.2% of the total rock volume. Calcite cement contains 17% to 20% of the total rock volume. The sandstone of Shwezetaw Formation can be named as Lithic Arkose and Feldspathic Litharenite,(Fig. 7).

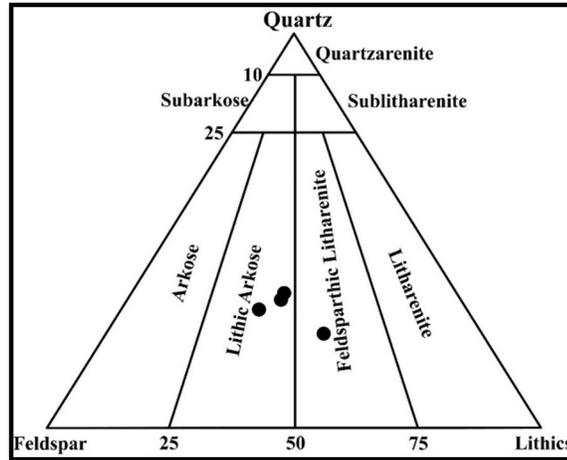


Figure 7. Triangular diagram of Folk's (1974), Shwezetaw sandstone showing of Shwezetaw sandstone

Sandstone Diagenesis

Effects of Compaction

Compaction involves dewatering and a closer packing of grains (Tucker, 1991). The petrographic features such as the packing readjustments of the framework grains, ductile deformation, grains bending, fracturing and pressure solution are observed in the sandstones of the study area due to the effects of compaction, (Fig. 8). Quartz overgrowth, bending and splitting of mica flakes, breaking down of shell fragments developed by the initial compaction are the early diagenetic features (Tucker, 1991).

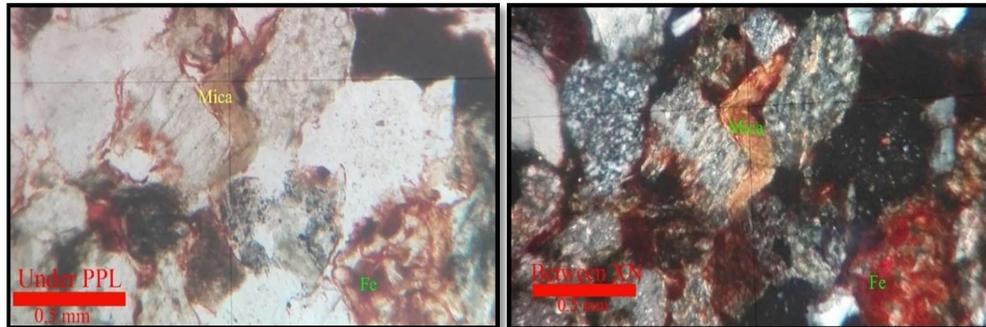


Figure 8. Photomicrograph showing bended mica (Mica), early iron oxide cementation (arrow) and iron oxide replacement by feldspar (Fe) of sandstone in Shwezetaw Formation

Quartz Overgrowth

Some syntaxial overgrowth were recognized around monocrystalline quartz grain, (Fig. 9). The three most probable sources of silica that form these quartz overgrowths are pressure solutions, the transformation of smectite to illite in the adjacent interbedded shale units (Boles and Franks, 1979) and the solubility of silica with increasing pH, so silica cements occur where acid fluids have moved through the pore.

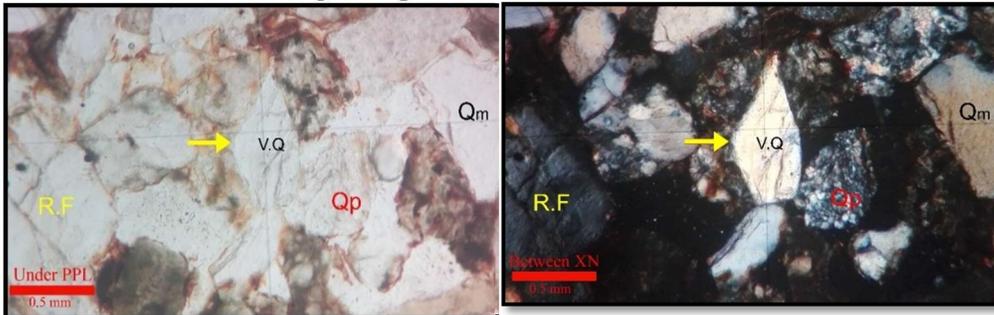


Figure 9. Photomicrograph showing quartz overgrowth (V.Q), polycrystalline quartz (Q_p) monocrystalline quartz (Q_m) and rock fragment (R.F) of sandstone in Shwezetaw Formation

Early Iron-oxide Cementation

The iron oxide cement plays a minor role in the cementing material of Shwezetaw sandstone. The iron oxide occurs in cement as well as coating on detrital grains. Some iron oxide inclusions observed in the calcite cement, this means that the iron cementation took place in an earlier stage. This cement is found as filling of interstitial pores and minor amount is present as coating on detrital grains. Moreover, some bioclasts and volcanic rock fragment are also coated with iron-oxide, (Fig. 8).

Clay Coating (Chlorite rims)

Diagenetic chlorite are observed as rims around the detrital grains in the Shwezetaw sandstone, (Fig. 10). The chlorite rims and pore infillings appear to form by direct precipitation and only where chlorite occasionally replaced lithic and feldspar grains and there are evidence of pre-existing minerals being altered to form clay (Imam and Shaw, 1985).

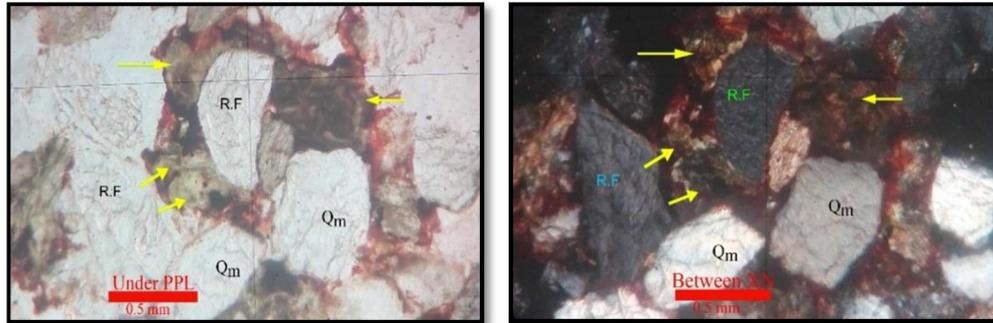


Figure 10. Photomicrograph showing chlorite rims around the detrital grains (arrow) of sandstone in Shwezeta Formation

Pore Lining Clay

Pore linings are formed by clay coating deposited on surfaces of framework grains, except at points of grain to grain contact, (Fig. 11). The individual clay particles or aggregates commonly exhibit a preferred orientation normally or parallel to the detrital grain surface. Pore linings grow outward from the grain surfaces and may merge with the linings on adjacent grains. Pore lining clays may be developed during subsequent cementation by such materials as quartz and feldspar overgrowths (Wilson and Pittman, 1977).



Figure 11. Photomicrograph pore lining clay (arrow), volcanic quartz (V.Q), monocrystalline quartz (Q_m) of sandstone in Shwezeta Formation

Late Hematite Cementation and Pigmentation

The hematite typically occurs as a very thin coating around grains, but it also stains red infiltrated or authigenic clay minerals and authigenic quartz and feldspar. These features of the hematite, together with the absence of hematite coating at grain contacts indicate as late hematite cementation (Tucker, 1991), (Fig. 12).

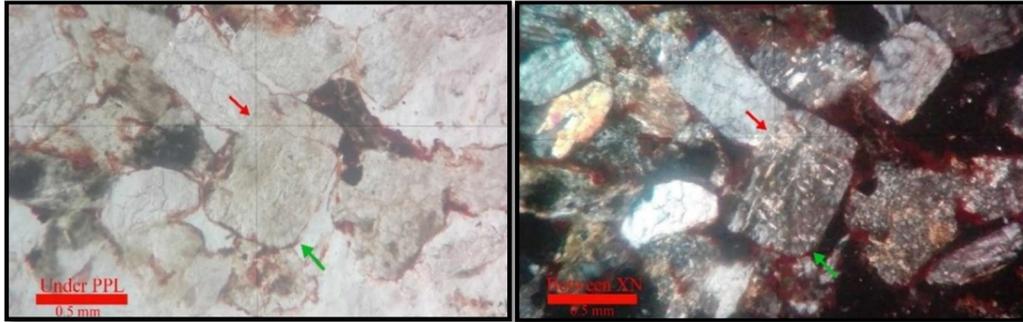


Figure 12. Photomicrograph showing absence of hematite coating at grain contacts (red arrow) and late hematite coating is on detrital grains boundary (green arrow) of sandstone in Shwezetaw Formation

Carbonate Cementation

The source of the calcium carbonate may be the pore water itself, but in marine sandstone, much is probably derived from dissolution of carbonate skeleton grains (Tucker, 1991). As a result of calcite precipitation there is commonly a displacement of grains so that they appear to float in the sediment, (Fig. 13).

Dissolution of Grains

Secondary porosity can be formed by the pressure dissolution of detrital grains and authigenic minerals. Siebert *et al.*, (1984) proposed that the clay and organic matter in shales produce the necessary water, acid and complexing agents for the dissolution of framework grains, resulting in the creation of secondary porosity. Pressure induced dissolution, due to compaction, has resulted in some suturing between quartz grains, (Fig. 13).

Replacement

Calcite commonly partially replaced and corrosion of grain can be observed in the sandstones, (Fig. 13). The detrital framework grain appears to float in iron, calcite cement and there is also evidence of corrosion by the cementing fluid along the outer margins of the grains (Imam and Shaw, 1985).



Figure 13. Photomicrograph showing calcite cement (Cal) corroded by monocrystalline framework grain dissolution has been quartz (Q_m) of sandstone in Shwezetaw Formation

Paragenetic Diagenesis

Diagenetic paragenesis of the Shwezetaw sandstones is shown in Table. 2. The following paragenetic sequence outlines the diagenetic events that modified the sandstone framework and pore space.

Table 2. Paragenetic sequence of postdepositional changes in Shwezetaw sandstones.

No.	Paragenesis Sequence
1	↓ Compaction
2	↓ Quartz overgrowth
3	↓ Early iron-oxide cementation
4	↓ Clay coating (chlorite rims)
5	↓ Pore lining clay
6	↓ Carbonate Cementation
7	↓ Dissolution of Grains
8	↓ Replacement
9	Late Hematite cementation and pigmentation

Grains Packing Analysis of the Shwezetaw Sandstone

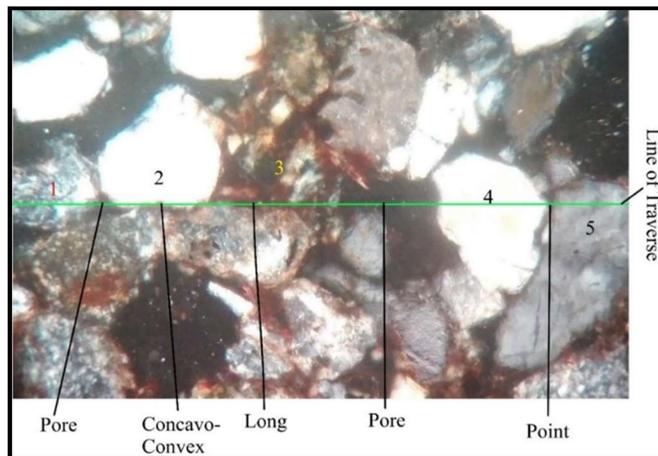
The packing of sediment grains is an important consideration since it affects porosity and permeability. Packing is largely dependent on the grain size, shape and sorting. The type of contact between grains is studied in thin section. In the ideal case of packed spheres, the only observed contacts between grains would be tangential ones. But in the case of nonspherical grains or where compaction has taken place, three other types of contacts can be observed (Taylor, 1950). The four possible types of contacts are (a) point, (b) long, (c) concavo-convex and (d) suture contact that appears as a straight line in the plane of section.

Kahn (1956) devised packing proximity measures for use in thin section studies. The packing proximity is the ratio of the number of grain to grain contacts (encountered in a traverse across the thin section) to the total number of contacts of all kinds encountered in the same traverse, (Fig. 14). If the grains have only small areas of contact with each other, most of the contacts observed in a thin section will be contacts between a grain and matrix or cement; so the packing proximity will be small. In a rock in which there has been compaction without the introduction of much cement, most of the grain contacts observed will be grain to grain contacts and packing proximity will be large. Grains packing analysis of the Shwezetaw sandstone is shown Table. 3 and in Fig. 15.

For Examples-

Packing proximity = 60%

Pore space proximity = 40%



$$\text{Packing Proximity} = \frac{\text{Total number of contacts encountered } 3 \times 100}{\text{Total number of grains encountered } 5}$$

Figure 14: Grain contact types contact types and packing proximity (J. S. Kahn, 1956)

Table 3. Relationship between grain to grain contacts, total grain number, pore space number and porosity

Sample No.	Point contact	Suture contact	Long contact	Concavo-concave contact	Pore space	Total grains number	Total grain contacts	Packing proximity (%)	Pore space proximity (%)
1	31	5	81	20	65	207	137	66%	34%
2	33	3	141	23	72	278	205	73%	27%
3	33	10	163	15	38	271	221	81%	19%
4	46	-	266	9	54	370	320	84%	16%
5	22	1	310	3	42	363	336	92%	8%

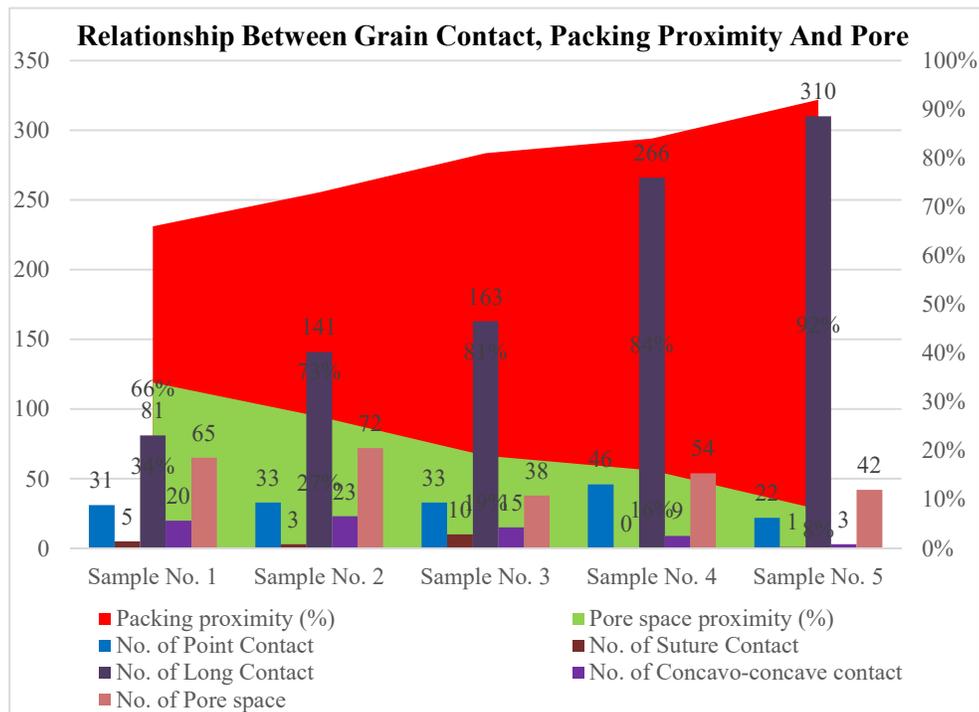


Figure 15. Relationship between grain contact, packing proximity and pore space proximity

Shwezetaw sandstones exposed in the study area are found to be a mixture of medium and fine detrital grain. Most distributary channel sandstones consist of medium detrital grain size but some constitute fine detrital grain. Inter granular pore filling is more or less found in medium grain

sandstones and between the detrital grains are filled with fine detrital grains, (Fig. 16). The effect of inter pore filling clay in sandstone, the reservoir has a decrease in the porosity but does not affect the permeability (Wilson and Pittman, 1977). Sandstones that have many fine detrital grains can be found in crevasse splay environment. In the many fine-grained sandstone, pore space diameter is small. Compared with distributary channel, crevasse splay environment has more clay matrix. The decreased porosity and permeability of fine detrital grained sandstones is well marked.



Figure 16. Photomicrograph showing the detrital grains being filled with fine detrital grains (arrow) of sandstone in Shwezetaung formation

Iron oxide cements can be found not only on the boundary of detrital grains but they also fill pore space and fracture grains, and these effects decrease both porosity and permeability.

Another important case is grain contact. Sandstones which consist of many long contact, suture contact and concavo-convex contact can generate the decreased permeability and porosity. The reason of many long contact is having the same grain size, grain shape and grain orientation. Suture and concavo-convex contact can be caused by the effect of compaction. If there are many point contact, there will be many blank pore spaces and will increase chance of permeability and porosity, (Fig. 17). Replacement, pore filling and pore lining can be found in authigenic clay. Replacement and pore filling can decrease porosity and pore lining can decrease permeability. Other important

controls in porosity and permeability are sorting, packing and textural maturity.

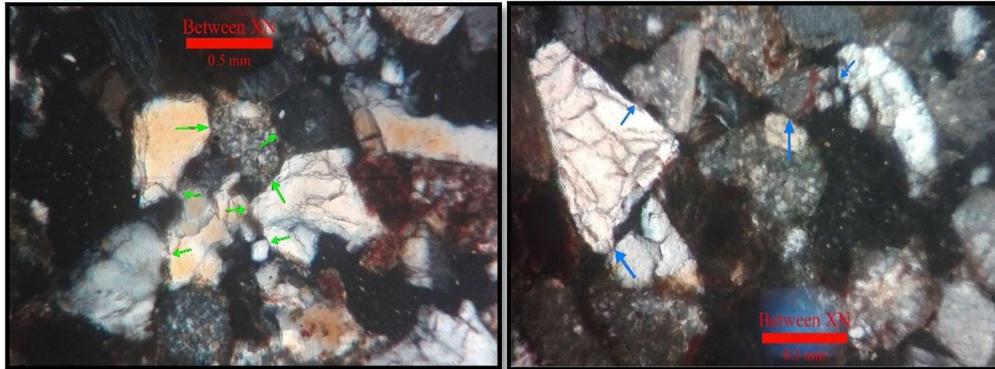


Figure 17. Photomicrograph shows point contacts, porosity and permeability nature (arrow) of sandstone in Shwezeta formation

Lithofacies Analysis

Thick Bedded to Massive Cross Bedded Sandstone Facies

This facies is mainly consisted of thick bedded to massive, buff coloured, fine to medium grained unidirectional cross bedding sandstones. The thickness of sand beds varies from 90 centimetres to massive,(Fig. 18). The bed base type of this facies is erosional. Thin shale lamination and small gravel size mud pebbles are present in some sand beds, (Fig. 19). Sometimes, shale layers are ranged from 10 centimetres to 50 centimetres thick intercalated with sand beds are also noted. This facies is well observed in the Lema– Chaung section. Facies log is shown in Table. 4.

The sandstone with cross bedding of fine- to medium-grained and medium size cross bedding indicates the depositional areas decrease in velocity. The cross bedded sandstone on erosional base points out that the deposition is a channel where erosive base occurs. The unidirectional paleocurrent indicates that the depositional process was influence by rivers. Beds and cross laminae usually are separated by thin mud drapes and clay or shale lineation is a major feature of distributary channel (Allen, 1989).

Therefore, the depositional environment should be assigned as distributary channel in delta plain environment.



Figure 18. Thick bedded to massive, unidirectional cross bedding of Shwezetaw Formation (GPS N21°44'33.5" E 94°32'17.9", Photo Facing 270°)



Figure 19. Thin shale lamination and small gravel size mud pebbles are present in sand beds of Shwezetaw Formation (GPS N21°44'33.5" E 94°32'17.9", Photo Facing 270°)

Medium to Thick Bedded Very Low Angle Cross Bedded Sandstone Facies

This facies is mainly consisted of medium grain, medium to thick bedded, light yellow to light grey coloured sandstone. The thickness of sand beds varies from 30 centimetres to 120 centimetres. Shale layers rarely intercalated with sand beds and shale layers are ranging from 10 centimetres to 90 centimetres, (Fig. 20). The bed base type of this facies is erosional type. The main primary sedimentary structure is very low angle unidirectional cross bedding, (Fig. 21). These cross beddings are 20 centimeter in height and 90 centimeter in length. Cross bedding angles are ranging from 10° to 15°. This facies is well exposed at the Lema-Chaung section. Facies log is shown in Table. 5.

Very low angle cross bedding and fine to medium grains indicate the high velocity depositional environment. The intercalated shale shows that deposition in quiet relatively deep water from out of suspension (Selley, 1984). The unidirectional low angle cross bedding represents the channel

characteristic features by the fluvial influence (Galloway, 1975). The sandstone with low angle cross bedding on erosional base points out the deposition is a channel where erosive base occurs. Therefore, the depositional environment should be distributary channel in delta plain environment.



Figure 20. Shale layers are intercalated with medium to thick bedded, very low angle, crossbedded sandstone of Shwezeta Formation (GPS N21°44'30.8"E 94°32'14.8", Photo Facing 230°)



Figure 21. Very low angle cross bedding of Shwezeta Formation (GPS N21°44'30.8" E 94°32'14.8", Photo Facing 230°)

Sand – Mud Interlayer Facies

This facies is mainly composed of light grey coloured, thick bedded sandstones interlayered with mud. Generally 30 centimetres to 60 centimetres thick sand layers are interlayered with 15 centimetres to 30 centimetres thick mud layer,(Fig. 22). The thickening upward character is shown in sand layers. The sand – shale ratio is generally 2:1. The thickness of this facies is from 60 centimetres to 120 centimetres. The bed base type of this facies is wavy to transitional type. This facies generally underlying is thick bedded to massive cross bedded sandstone facies and overlying is medium- to thick cross-bedded sandstone facies. This facies is poorly exposed at the Lema-Chaung section. Facies log is shown in Table. 6.



Figure 22. Thin to medium bedded sand – interlayer of Shwezeta Formation (GPS N21°44'23.9" E 94°32'02.3", Photo Facing

The sand – mud interlayer beddings are mostly related to slack water and the tidal current periods (Reineck and Singh, 1980). This facies is formed by under the condition of current or wave action deposition and alternating. Moreover, this facies is vertically associated with medium to thick cross bedded facies. Therefore, this sand – mud interlayer facies was deposited under low energy condition and depositional environment may be distributary mouth bar area.

Medium to Thick Cross Bedded Sandstone Facies

This facies is mainly composed of fine to medium grain, medium to thick bedded, light grey to grey coloured cross bedded sandstone (Fig. 23). The thickness of sand beds is from 30 centimetres to 190 centimetres with thickening upward nature (Fig. 24). The bed base type of this facies is erosional type. The size of the cross bed sets is approximately 20 centimetres high and 60 centimetres in length and approximately inclined to 30°. The shale layers are interbedded with sand beds. This facies is vertically associated with thick bedded to massive cross bedded sandstone facies. This facies is well exposed at the Lema – Chaung section. Facies log is shown in Table. 4.

This facies is the result of deposition from migrating small waves. This lithofacies sequence of cross bedded sandstone indicate that sediments were deposited in the unidirectional current of the distributary channel. The

erosional bed denotes the base of the channel and the cross bedded sandstones are due to the deposition of sand and the water velocity decreased towards upper horizon. Therefore, this facies can be interpreted as distributary channel in a lower delta plain.



Figure 23. Cross bedding and small mud ripples are found in sand bed of Shwezetaw Formation (GPSN21°44'22.1" E 94°31'56.0", Photo Facing 195°)



Figure 24. Medium to thick cross bedded sandstone of Shwezetaw Formation (GPS N21°44'22.1" E 94°31'56.0", Photo Facing 195°)

Facies Association

Thick-bedded to massive cross bedded sandstone facies, medium to thick bedded very low angle cross bedded sandstone facies, and medium to thick cross bedded sandstone facies of the Shwezetaw Formation can be grouped into a delta plain area which represents an area where these sediments were deposited. The delta plain facies association mainly consists of distributaries channel sands and delta plain mud. The sedimentary structure of large to medium scale cross – bedded sandstone with unidirectional cross bedding shows that the deposition took place in a channel of upper delta plain. The deposition of cross bedded sandstone with mud clasts is the typical delta plain deposits. In delta front facies association, sand – mud interlayer facies of the Shwezetaw Formation can be grouped to point out an area of deposition, namely delta front environment.

Table 4. Thick bedded to massive cross bedded sandstone facies and medium to thick cross-bedded sandstone facies log

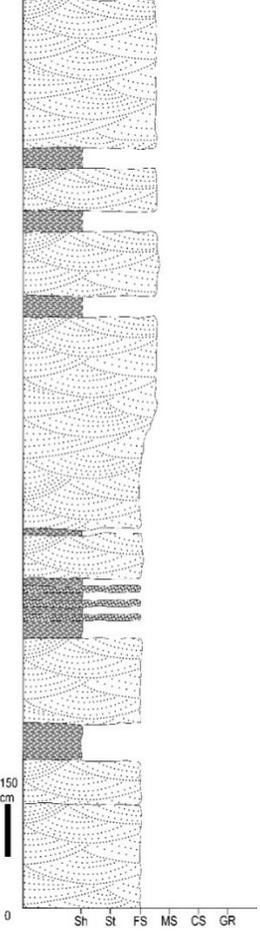
Facies Log	Description	Sedimentary Structure	Depositional Environment
	<p>Medium to Thick Cross Bedded Sandstone Facies</p> <p>The thickness of sand beds various from 30 centimetres to 190 centimetres. The natural of beds are medium to thickening upward sequence. The shale layers are interbedded with sand beds. The bed base type is erosional type.</p> <p>Thick Bedded To Massive Cross Bedded Sandstone Facies</p> <p>The bed base type of this facies is erosional type. Thick bedded to massive, buff colour, fine- to medium-grained sandstones. Thin shale laminations and small gravel size mud pebbles are present in some sand beds. Shale layers are intercalated with sand beds.</p>	<p>Cross bedding and locally sand layers show small mud ripples</p> <p>Primary sedimentary structure is unidirectional cross bedding.</p>	<p>Distributary channel in a delta plain</p> <p>Distributary channel in delta plain</p>

Table 5. Medium to thick bedded very low angle cross bedded sandstone facies log

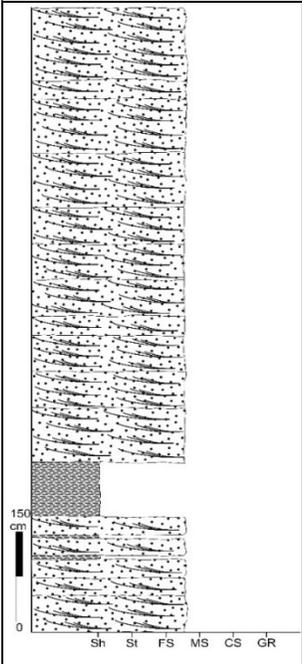
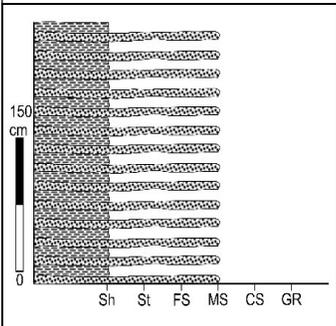
Facies Log	Description	Sedimentary Structure	Depositional Environment
	<p>Fine- to medium-grained, medium- to thick-bedded, light yellow to light grey coloured sandstone.</p> <p>Shale layers rarely intercalated with sand beds are range from 10 centimetres to 90 centimetres.</p> <p>These low angle cross bedding angles range from 10° to 15°.</p> <p>The bed base type of this facies is erosional type.</p>	<p>Main primary sedimentary structure is very low angle cross bedding.</p>	<p>Distributary channel in delta plain</p>

Table 6. Sand mud interlayer facies log

Facies Log	Description	Sedimentary Structure	Depositional Environment
	<p>Light grey coloured, thick-bedded sandstones are interlayered with mud. The thickening upward character is shown in sand layers. The sand – shale ratio is generally 2:1. The bed base type of this facies is wavy to transitional type.</p>	<p>Thin to medium-bedded sand – interlayer.</p>	<p>Distributary mouth bar in delta front.</p>

Sedimentation History of Shwezetaw Formation

From the facies analysis, the depositional history of the Shwezetaw Formation can be interpreted. A fluctuation of sea level took place within the Oligocene time and the gradual shallowing of sea during the early Oligocene led to the deposition of sandy strata of the Shwezetaw Formation in the marginal marine to deltaic environment with sandstones interbedded with minor clay and shale. The deltaic deposits of the Shwezetaw Formation were deposited on the prodelta to shelf mud of the Yaw Formation. This means that the Shwezetaw Formation was deposited in a regressive phase, (Fig. 25). The deltaic deposition protruded into the open sea by its fluvial dominated natures. The sand body of distributaries channel, distributaries mouth bar and delta front sand bar deposited in that available depositional area. This sand body was overlain by thick bluish grey shale pointing out that the depositional area was transgressed again.

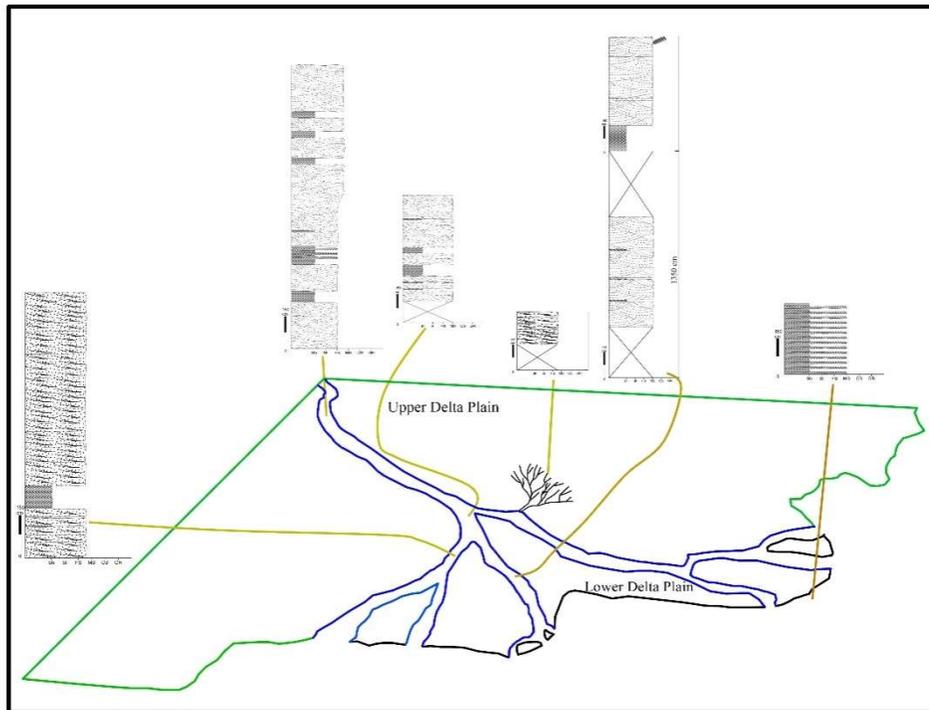


Figure 25. Potential paleo-environment depends on lithofacies of Shwezetaw Formation

Conclusions

Shwezetaw sandstones are fine- to medium-grained mainly made up of detrital grained chemical cement, lithic arkose and feldspathic litharenite in composition. The diagenetic features such as compaction, quartz overgrowth, early iron-oxide cementation, clay coating (chlorite rim), pore lining clay, carbonate cementation, dissolution, replacement and late hematite cementation (pigmentation) are found in Shwezetaw sandstone. By the packing analysis, if there are many point contacts, there will be many blank pore spaces and will increase chance of permeability and porosity. If sandstones have absence or less amount of point contact and has more amount of other three types of grain contact or has one of three other types of grain contacts as dominant type, it is not good for quality of reservoir. Due to the study on the petrography compared with packing analysis, the Shwezetaw sandstone are deposited in the distributary channel have medium detrital grain size but some constitute fine detrital grain and diminished due to clay content. Inter pore filling is more or less found in medium grain sandstones. The effect of inter pore filling in sandstone, the reservoir has a decreased in the porosity but does not effect on permeability. Iron oxide cements can be found not only on the boundary of detrital grains but they also fill pore space and fracture grains, and this effects decrease both porosity and permeability. By the facies study, the sedimentary facies such as thick bedded to massive cross bedded sandstone facies, medium to thick bedded very low angle cross bedded sandstone facies, sand-mud interlayer facies and medium to thick cross bedded sandstone facies encountered in Shwezetaw Formation which represent the fluvial dominated delta environment.

Acknowledgements

The authors wish to express their thanks to the Myanmar Academy of Art and Science Association for accepting the paper. They also gratefully acknowledge U Win Paing family Le – O village and the villagers for their helps during the field trip.

References

- Allen, G. P, Coadou, A, Mercier, F., (1989). Surface Analysis of Deltaic Reservoir Systems. p. 1-9.
- Boles, J. R., and Franks, S. G., (1979). Clay Diagenesis in the Wilcox Formation Sandstones of Southwest Texas: implications of smectite diagenesis on sandstone cementation: *Jour. Sed.Petrology*, v. 49, p. 55-70.
- Cloud, P. E., JR., (1953). Physical limits of Glauconite Formation. American Association of Petroleum Geologists Bulletin, v. 39, No. 4, p. 485-491.
- Folk R. L., (1974). Petrology of Sedimentary Rocks: Hemphill Publishing Co., Austin, TX.
- Galliher, E. W., (1935). Glauconite Formation, Bull. Amer. Petro. Geol., v. 39-No. 41, p. 1569-1601.
- Galloway, W. E.,(1975). Process Framework for describing the morphologic and Stratigraphic Evolution of Deltaic Depositional System. In: *Deltas, Models for Exploration* (Ed. M. L. Broussard), p. 87-98. Houston Geological Society, Huston, TX.
- Imam, M. B., Shaw, H. F., (1985). The diagenesis of Neogene Clastic Sediments from Bengal Basin, Bangladesh. *Journal of Sedimentary Petrology*. v. 55, p. 665-671.
- Kahn, J. S., 1956. The analysis and distribution of the properties of packing in sand size sediments. *J. Geol.* 64, 385-395.
- Pivnik, D. A *et al.*, (1998). Polyphase Deformation in a Fore-Arc/Back-Arc Basin, Salin Sub basin, Myanmar (Burma). The American Association of Petroleum Geologists Bulletin, v. 82, No. 10, p. 1837-1856.
- Reineck, H. E and J. B Sing., (1980). *Depositional Sedimentary Environments*; Springer-Verlag, N. V.
- Selley. R. C., (1984). *Ancient Sedimentary Environments and their Sub-Surface Diagnosis*. p. 121.
- Reineck, H. E and J. B Sing., (1980). *Depositional Sedimentary Environments*; Springer-Verlag, N. V.
- Taylor, J. M., (1950). "Pore-Space Reduction in Sandstone," *Amer. Assoc. Pet. Geol. Bull.*, 34, 701-706. (Original paper defining the different types of grain to grain contacts as seen in thin section.)
- Than Nyunt and Chit Saing., (1978). Onshore the Sedimentary Basins of Burma: Central Basin., ESCAP Stratigraphic Correlation Programmer, Bur. 2-Bur.7, p. 6-10.
- Tucker M. E, (1991). *Sedimentary Petrology, An Introduction to the Origin of Sedimentary Rocks*, second edition.
- Wilson, M. D., and Pittman, E. D., (1977). Authigenic Clays in Sandstone: Recognition and Influence on Reservoir Properties and Paleoenvironmental Analysis, *Journal of Sedimentary Petrology*, v. 47, No. 1, p. 3-31.