Petrographic study of Sandstone in Taungnyo Formation, Paung Township, Mon State

Saw Aung Zaw Aye
Department of Geology, Dagon University, Yangon, Myanmar
Aungzawaye77@gmail.com, *sawthataw2@gmail.com*

Abstract

The purpose of this research is to study the petrographic characteristics of sandstone in Taungnyo Formation in Moattama Range. The Taungnyo Formation is mainly made up of sandstone and shale. Pebbly greywacke, hard sandstone, and sand-shale interbedded units are the main three sandstone units in this formation. According to the microscopic study, sandstones of different rock units have a quartz-rich framework and it is followed by feldspar and rock fragments. Monocrystalline quartz is more abundant than polycrystalline quartz and orthoclase feldspar is dominant in these sandstone units. The detrital grains in greywacke unit show angular to surrounded shape, poorly sorted which float on the matrix. In hard sandstone unit, the detrital grains are sub-angular to well-rounded shape with poor sorting. They are cemented by silica and iron oxide. Sand-shale interbedded unit has the poorly sorted angular to sub-rounded shape of detrital grains which display various grain contacts due to the compaction.

Keywords— Sandstone, Taungnyo Formation, quartz, feldspar, detrital grains

Introduction

The study area is situated at about 3 miles northwest of Mawlamyine, Paung Township, Mon State (Fig. 1). It lies between latitude 16° 30' N to 16° 40' N and longitude 97°31' E to 97°39' E. The area is bounded by vertical grid 10 to 23 and horizontal grid 01 to 20 of one inch topographic map number 94 H/10. The general trend of the Moattama range is approximately running NNW-SSE direction. The alluvial plain occupies at the northeastern part and southwestern part of the area respectively.

The highest point in Moattama range is Taungnyo peak (1144'). Topographically the eastern part of the range is gentler than western part, and decreases in height at northern part. The general trend is mainly controlled by underlying lithology of competent and incompetent nature, showing the ridge and valley topography. In the northwestern most part, the area mainly consists of rounded top hills.

Geological Background

Taungnyo Formation in the study area is exposed in Moattama Range, Southearstern part of Paung Township. The term “Taungnyo Group” was used by Pascoe (1959). The name of Taungnyo Formation was established by Kyaw Min (1997) as formal lithostratigraphic units in the Taungnyo range which is located near Mawlamyine. In the previous study, Pascoe (1959) firstly gave the term “Martaban Series” and Bender (1983) gave the name Martaban Beds. The previous authors assumed the rock units exposed in the Moattama Range are Taungnyo Formation (Low Carboniferous), Moulmein Limestone (Upper Carboniferous to Lower Permian) and Martaban Bed (Upper Permian) according to the former stratigraphy correlation of Myanmar. However there was no exposure of the Moulemein Limestone in the Moattama range. Khin Thuzar Min (1998) studied the geology of Moattama Range and the

identified the exposed units as Taungnyo Formation (Low Carboniferous) and Martaban Beds (Upper Permian to Lower Traissic) with an unconformity between them. The pink colored shale unit and pebbly greywacke unit is present in Taungnyo Formation and three rock units are identified as yellowish color shale unit, white to light grey colored hard sandstone unit, and sandstone and shale interbedded unit in Martaban bed respectively.

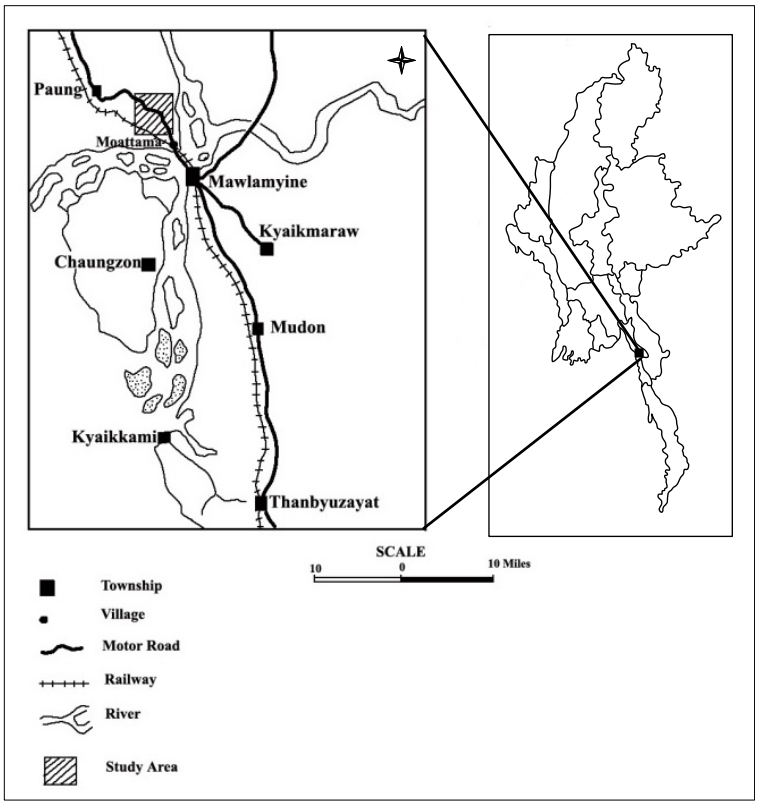
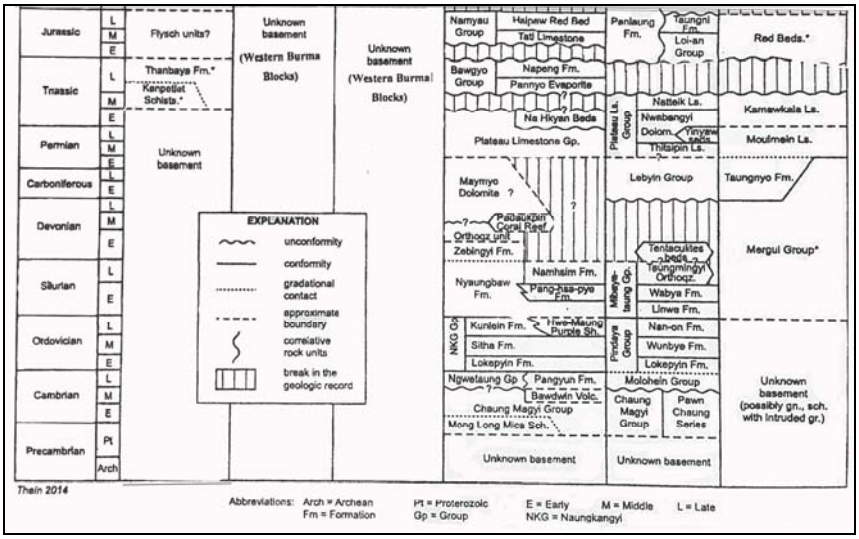


Figure 1. Location map of the study area

However, Saw Aung Zaw Aye (2006) studied the sedimentology on the Moattama range, there was no evidence of unconformity between Taungnyo Formation and Martaban bed. On the other hand, Martaban bed in the Moattama region is similar to lithology and fossil assembleges of Taungnyo Formation in Mawlamyine (Kyaw Min, 1997). For this reason, all of rock units in Moattama range have recently grouped together under Taungnyo Formation with respect to correlation table of stratigraphy of Myanmar (Maung Thein, 2014) (Table 1).

Table 1. The correlation of the stratigraphy of Myanmar (source, Thein, 2014)



The Taungnyo Formation is widely distributed in the Moattama region (Fig. 2). Among three sandstone units such as pebbly grey wacke unit, hard sandstone unit and sand-shale inter bedded unit, Greywacke is fine to medium grained, fairly hard, compact sandstone and grey color on fresh surface, and dark grey colored on weathered surface. It is mainly composed of reddish to yellowish colored, soft, thin to medium bedded sandstone. Hard sandstone unit is medium to coarse grained, light grey to white colored on fresh surface and dark grey colored on weathered surface, thick bedded to massive nature.

Methodology

The Specimens for thin sections were taken from the sandstone units by sampling in the field. Most petrographic data were obtained by standard microscopic examination. In each thin section, optical properties such as mineralogy, texture, and rounding were studied by the petrographic microscope.

Result and Discussion

Petrography

Pebbly greywacke Unit

The sandstones of pebbly greywacke unit are fine to medium grained. The detrital grains are poorly sorted, and the size of gains varies from 0.025 mm to 1mm. They are loosely packed and floating in matrix. The detrital grains of this sandstone unit show angular, subrounded to well rounded in shape (Fig. 3).

The main minerals consist of quartz and feldspar. Other rock fragment minerals include as minor amount. Quartz grains are subangular to well rounded in shape. Most of the quartz are monocrystalline quartz with the proximately amount of 87% of the rock volume. Polycrystalline quartz grains are rarely found in this unit. Some monocrystalline quartz grains show wavy extinction (Fig.4).

Feldspars are orthoclase, plagioclase, microcline (Fig. 5) and perthite (Fig. 7). Orthoclase feldspars is more abundant than other feldspar. Most of feldspar display weathered appearance and fracture filling with iron oxide.

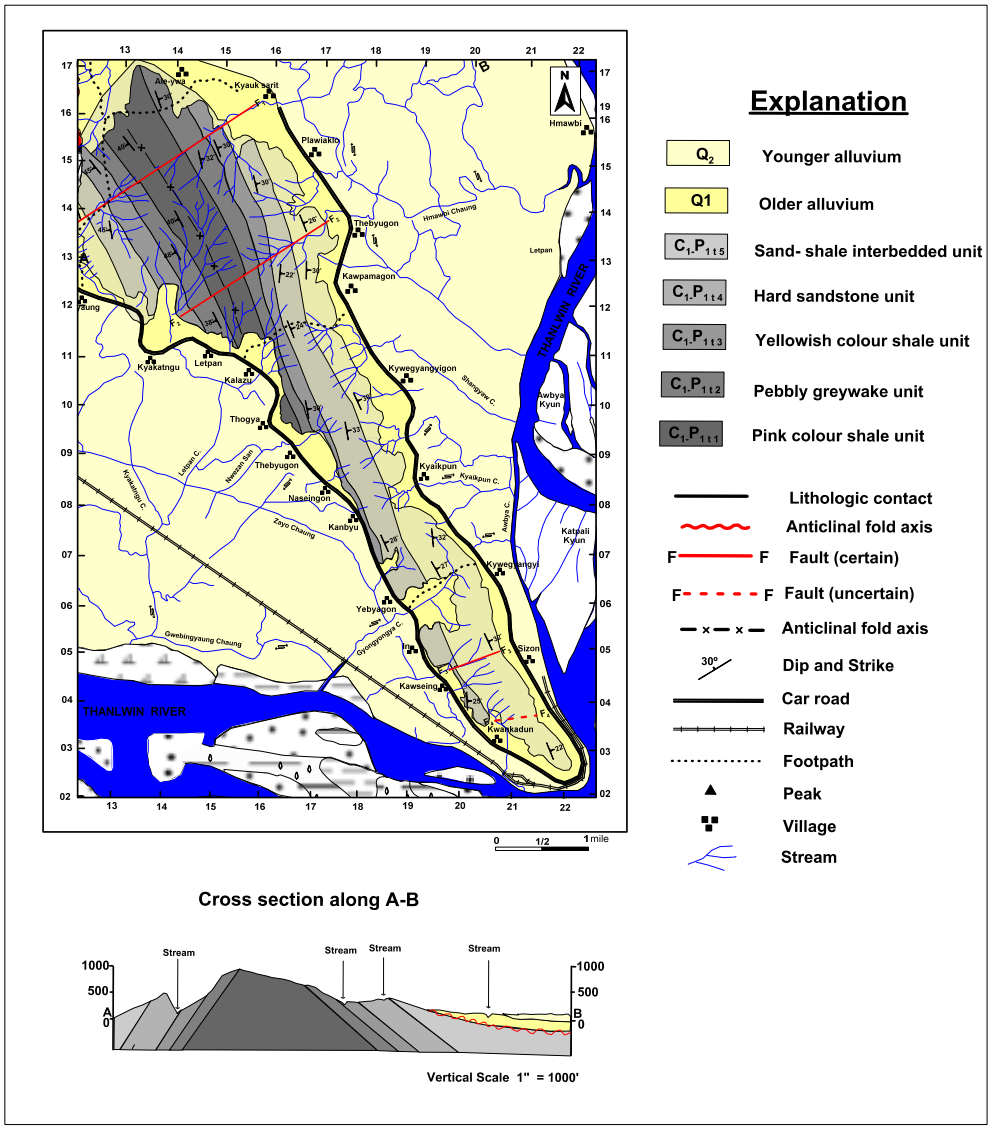


Figure 2. Geological map of Moattama area

The sedimentary rock fragments are chert (Fig. 4), limestone fragment (Fig. 8). Minute quartz and feldspar present in lime fragment are assumed to be sandy limestone. Some of limestone fragments are coated by iron oxide. Most of metamorphic rock fragments are quartzite fragment. Micro-lath of feldspar in rock fragments are assumed as volcanic rock fragment (Fig. 6).

All detrital grains are mainly cemented by muddy matrix. Iron oxide occurs as minor amount and it show blood red color. Iron oxide cements acts as grains coating and staining on detrital grain or fracture filling in this rock unit (Fig. 8).

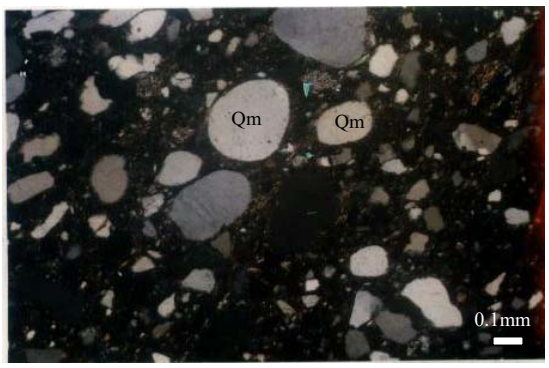


Figure 3. Photomicrograph showing well rounded nature of quartz grain (Qm) floating in matrix as poorly sorted nature in pebbly greywacke unit (Between X.N)

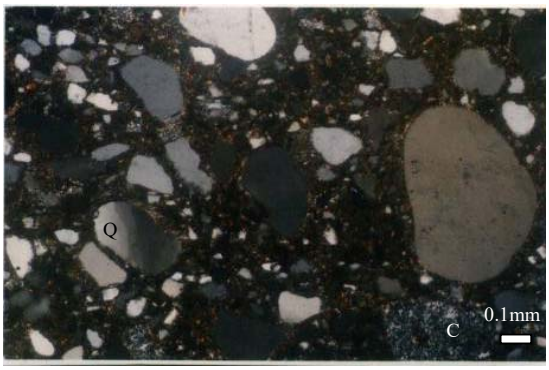


Figure 4. Photomicrograph showing wavy extinction of quartz grain (Q) and chert (C) in pebbly greywacke unit (Between X.N)

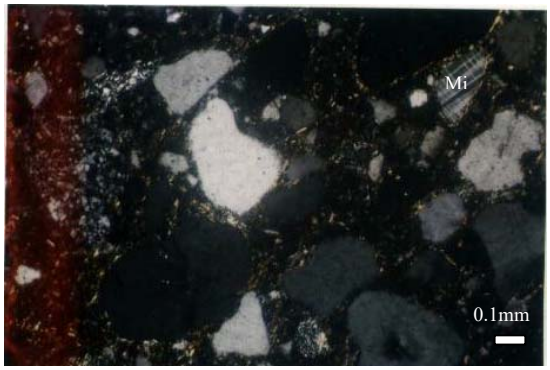


Figure 5. Photomicrograph showing microcline feldspar (Mi) in pebbly greywacke unit (Between X.N.).

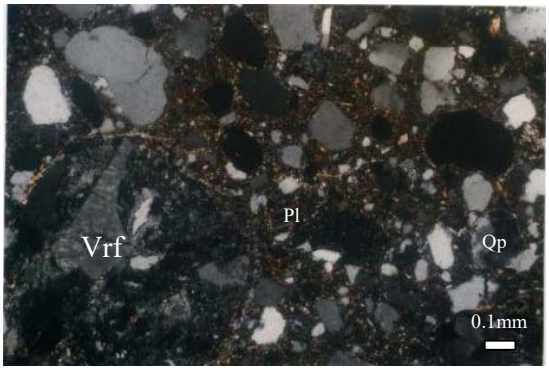


Figure 6. Photomicrograph showing plagioclase feldspar (Pl), polycrystalline quartz (centre right) and volcanic rock fragment (Vrf) in pebbly greywacke unit (Between X. N).

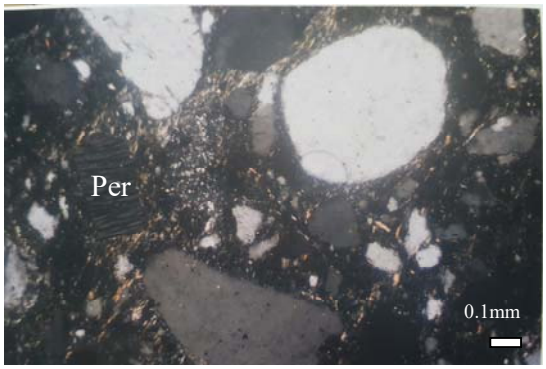


Figure 7. Photomicrograph showing perthite (Per) in pebbly greywacke unit (Between X. N)

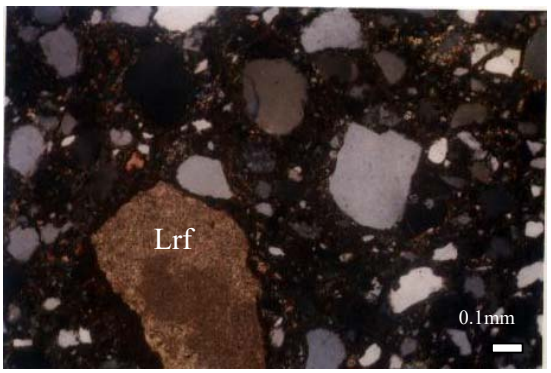


Figure 8. Photomicrograph showing iron oxide staining and coating limestone fragment (Lrf) in pebbly greywacke unit (Between X.N)

Hard sandstone Unit

Hard sandstone unit is generally fine to coarse grained. According to the microscopic study, these sandstones are mainly composed of quartz, feldspar, rock fragments and other accessory minerals. Texturally, the detrital grains are found as angular to moderately sorted. Grain sizes vary from 0.05mm to 1mm in diameter. The detrital grains are highly compact, and the grain to grain contacts are observed as point contact, long contact, tangential contact, concavo-convex and sutured contact (Fig. 17, 18). Quartz minerals are dominant and it comprises about from 80% to 95 % of the total rock volume. Monocrystalline quartz grains are more abundant than polycrystalline quartz (Fig. 10). More than 88% are monocrystalline quartz in quartz population of the rock volume and the rest are polycrystalline quartz. Chalcedonic quartz is also noted in this rock unit (Fig. 11). Some quartz grains possess overgrowth, and large euhedral quartz overgrowths can also be seen in clean sands with detrital cores sometime outlined by dust rings (Fig. 12). The cracks in some quartz grains are formed by the dewatering process (Fig. 17, 18).

The feldspars are mainly orthoclase, plagioclase and rarely microcline. Most of the feldspars which display weathered appearance on the surface may alter to sericite (Fig 9, 12, 13). The rock fragments include chart (Fig.14), quartzite fragment (Fig. 15), siltstone fragment (Fig. 9) and schist fragment (Fig. 16). Phosphate also occurs as minor amount (Fig.17).

Silica cement is dominant and it can be found as pore filling material. Silica cement is precipitated around the quartz grain, optical continuity of the grain and cement are extinguished together under crossed polarizers. Iron oxide has reddish brown color under P. P. L. and also found as grain coating and fracture filling material in the detrital grain (Fig 17, 18). In this unit, clay are also found as grain coating clay and pore filling clay in the place of cement and matrix (Fig.17).

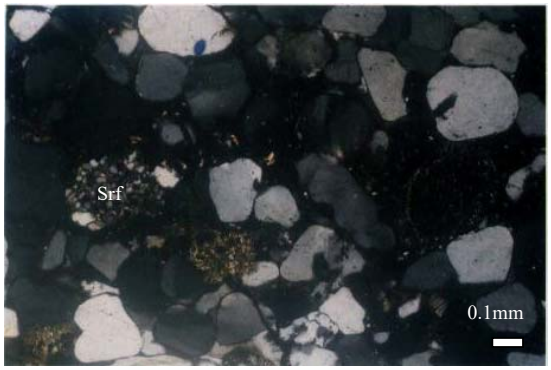


Figure 9. Photomicrograph showing grain to grain contact, siltstone fragment (Srf) in hard sandstone unit. (Between X. N)

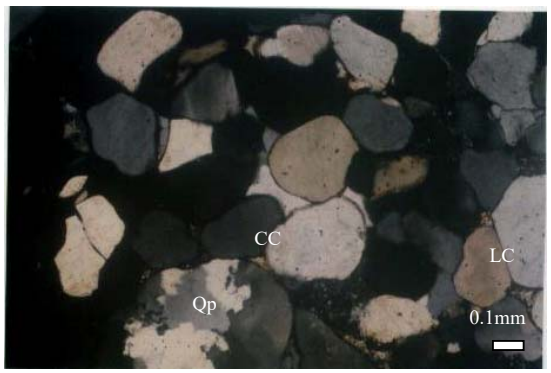


Figure 10. Photomicrograph showing long contact (LC), concavo-convex (CC) and polycrystalline quartz (Qp) in hard sandstone unit. (Between X. N)

Figure 11. Photomicrograph showing chalcedonic quartz grian (Ch) and weathered feldspar (F) in hard sandstone unit (Between X. N)

Figure 12. Photomicrograph showing quartz overgrowth (Arrow), weathered feldspar (F) and suture contact in hard sandstone unit (Between X.N.)

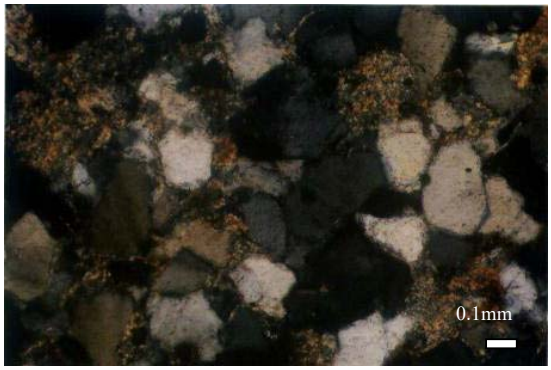


Figure 13. Photomicrograph showing feldspars alter sericite in hard sandstone unit (Between X.N)

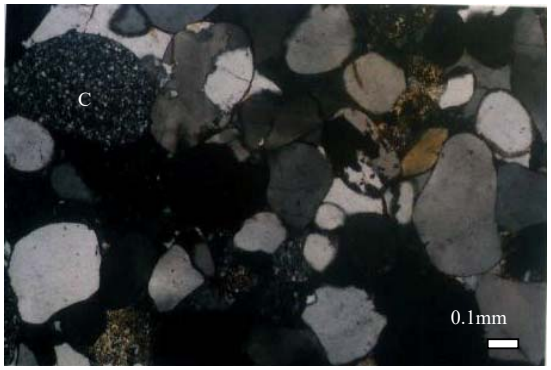


Figure 14. Photomicrograph showing chert (C) in hard sandstone unit (Between X. N)

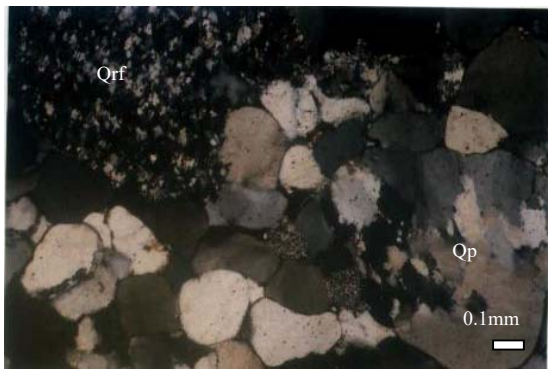


Figure 15. Photomicrograph showing quartzite fragment (Qrf) and polycrystalline quartz (Qp) in hard sandstone unit (Between X. N)

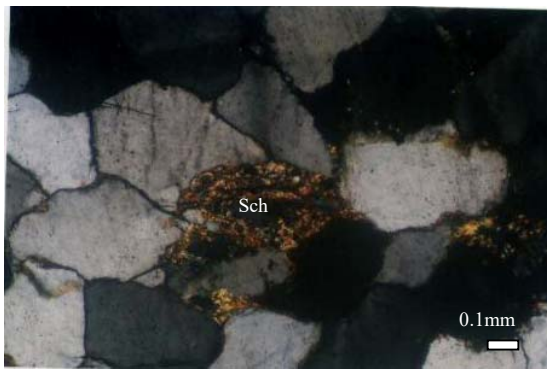


Figure 16. Photomicrograph showing schist fragment (centre) in hard sandstone unit (Between X. N)

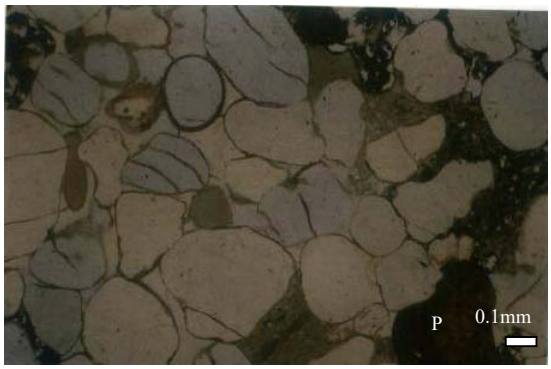


Figure 17. Photomicrograph showing phosphate grain (P) in hard sandstone unit (Under P.P.L)

Figure 18. Photomicrograph showing iron oxide fracture filling (Arrow-left) in hard sandstone unit (Between X. N)

Sand-shale interbedded Unit

Sand-shale interedded unit is fine to coarse grained, yellowish to reddish brown and light grey color in the outcrop nature. Under the microscope, the sandstones of this unit is composed of quartz, feldspar, rock fragments. The mineral grain in this sandstone unit reveal the angular to subrounded shape and poorly to moderated sorted. The grains show different size which vary from 0.05mm to 0.5mm in diameter. The detrital grains display suture contact, point contact, and concavo convex contact (Fig. 20). Quartz grains are the abundant mineral in this rock unit which shows angular to subrounded shape. Monocrystalline quartz grains are numerously found. But polycrystalline quartz are rarely found in this unit. Some monocrystalline quartz grains display quartz overgrowth (Fig. 20). Feldspars are orthoclase, plagioclase, and orthoclase is more than plagioclase. However, most of feldspar grains are being transformed to sericite due to weathering. Schist fragment and mica (Fig. 24) can be clearly seen in this rock unit. Even though muscovite and biotite are common in this unit, muscovite is more abundant than biotite. Some mica grains have been crushed or deformed and squeezed, often exhibit slightly bent, broken and irregularly bifurcate due to compaction

of detrital grain (Fig. 22, 23). Silica cement and matrix are formed in this unit. Iron oxide cement which has the color of reddish brown acts as fracture filling and staining grain.

Figure 19. Photomicrograph showing angular to subrounded in shape of detrital grain in sand-shale interbedded unit (Between X. N)

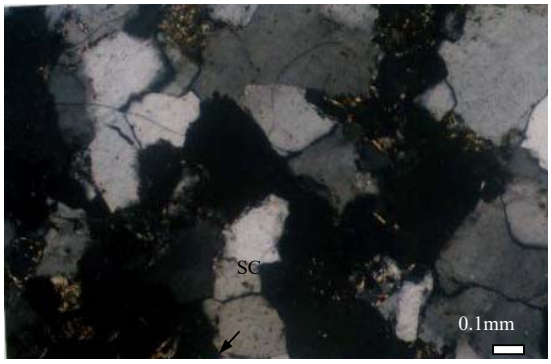


Figure 20. Photomicrograph showing quart overgrowth (Arrow) and grain to grain contact of detrital grain in sand-shale interbedded unit (Between X.N)

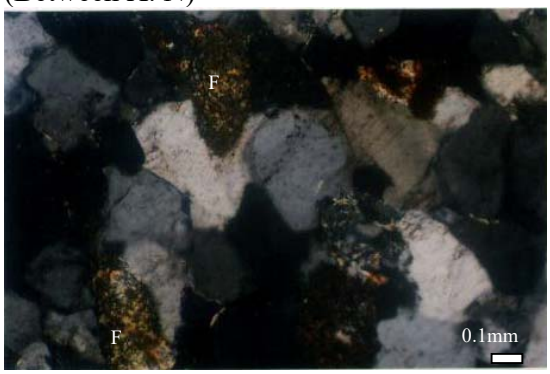


Figure 21. Photomicrograph showing weathered feldspar (F) in sand-shale interbedded unit (between X. N)

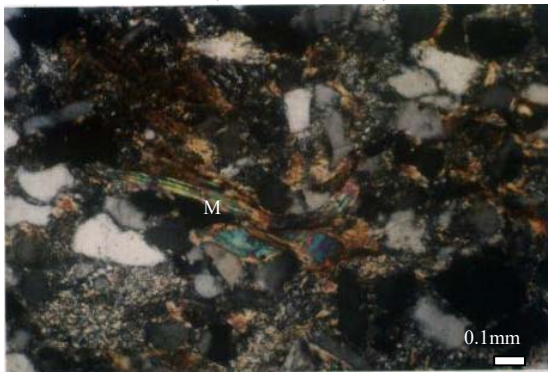


Figure 22. Photomicrograph showing bifurcated mica (muscovite) due to compaction of detrial grain (M) in in sand-shale interbedded unit (Between X. N)

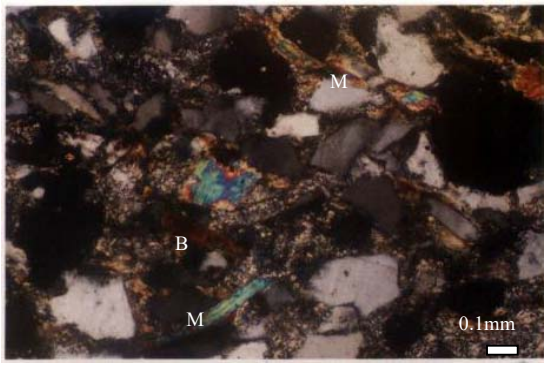


Figure 23. Photomicrograph showing biotite (B), bent and broken mica (M) in sand-shale interbedded unit (Between X. N)

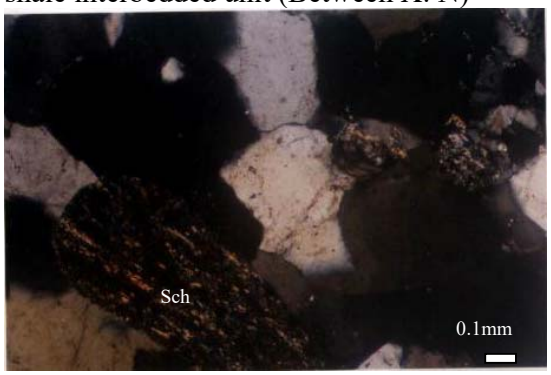


Figure 24. Photomicrograph showing schist fragment (Sch) with well rounded shape in sand-shale interbedded unit (Between X.N)

After studying the petrography of sandstone, some sandstone diagenesis was noted in the study area. The grain to grain contact is formed by dissolution of grains at points of contact if they are of a similar solubility/hardness. Concavo-convex contacts occur where one grain dissolves preferential. Quartz overgrowth is noted in quartz grain as silica cement which is precipitated around the quartz grain. The quartz overgrowths decrease the porosity and permeability. Nonetheless the bending of flexible grains such as mica flakes, deformation of ductile grains and the fractured grains is the visual evidence of the compaction (Farhaduzzaman et al., 2015**)**. Clay coating is demarcated between the overgrowth and grain. The clay rim can become impregnated with hematite or altered to other clay during diagenesis. The matrix in some sandstone unit is likely to be formed diagenetically by alteration of detrital feldspars and rock fragments (Boggs, 2009).

Conclusion

Sandstone in Moattama range has divided into three units; pebbly greywacke unit, hard sandstone unit and sand-shale interbedded unit. The sandstones of different rock units have a quartz-rich framework and it is followed by feldspar and rock fragments. The detrital grains in greywacke unit show angular to surrounded shape, poorly sorted which float on the matrix. Limestone fragement, chert and volcanic rock fragment are clearly seen in this unit. The staining and grain coating iron oxide can also be seen in some detrital grain. In hard sandstone unit, the detrital grains are subangular to well rounded shape with poorly sorted. They are cemented by silica and iron oxide. The detrital grains are observed as various types of grain to grain contact as a result of high compaction. Quartz overgrowth feldspar weathering can be seen in this unit. Siltstone, schist and quartzite fragments occur as the rock fragments. Sand-shale interbedded unit has the poorly sorted angular to subrounded shape of detrital grains. Some Quartz grains display quartz overgrowth and weather appearance can be found in feldspar mineral. Mica minerals reveal as the bent, broken and bifurcate due to compaction. The details study of provence, lithostratigraphy and deposition environment of sandstone in Moattama area should be carried out for the future investigation.

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