

Sedimentary Petrology of the Shwetaung-Taw Area, Tada-U Township

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Abstract

The present area lies in the Tada-U Township, Mandalay Region. It is situated at the southeastern part of Shwebo-Monywa plain which lies in the Central Cenozoic Belt of Myanmar. This area consists mainly of Kyaukta Formation (Middle Miocene), Irrawaddy Formation (Upper Miocene to Pliocene) and Gravel Bed (Pleistocene). This sandstone consists of 63 to 68 % of the detrital grains and 32 to 38 % of chemical cements. According to Pettijohn's Classification (1975), the Kyaukta Formation falls within the field of "Subarkose". Kyaukta Formation is rich in cross-laminations, parting lineations and concretions. Irrawaddy Formation overlies unconformably upon the Kyaukta Formation and is composed mainly of variegated color gypsiferous massive clay and white to ash-white, soft to friable, coarse-grained to gritty sandstone and sand rock. The Irrawaddy Formation is characterized by the abundant presence of vertebrate bone fragments, crocodile teeth, shell fragments such as pelecypods, and sandstone concretions.

Keywords: Kyaukta Formation, Irrawaddy Formation, Gravel Bed, Pettijohn, subarkose,

Introduction

Location, Size and Accessibility

The study area is situated about 4 miles south of Tada-U in Tada-U Township, Mandalay Division. It is located at the east of Mandalay International airport. The study area lies between North Latitude 21° 43' to 21° 46' and East Longitudes 96° 0' to 96° 58' in the one inch topographic map of (84 O/13) and (84 O/14). The study area is about 5 miles in length and 2 miles in width, covering the area of 10 sq miles. It is easily accessible from Mandalay, Kyaukse and Tada-U by car throughout the year. The location of the study area is shown in Figure 1.

Topography and Drainage

A prominent physiographic feature in the area is the Shwetaung Taw Ridge. This ridge forms as a series of hills and hillocks. It is rising 383 feet above sea level and running N-S. In general, the hills to the east of this ridge are small isolated hills and the west is low-lying alluvial plain. Panlaung River flows from southeast to northwest at the East of the study area. This river combines to the Dottawaddy or Myitnge River at the east of Inn-Wa (Ava).

Regional Geologic Setting

According to Dr U Thein (1978), Myanmar may be geotectonically divided into four provinces. The study area is situated in the Central Cenozoic Belt. The Central Volcanic Line had been subdivided these Central Volcanic Belt into two halves such as the western trough and the eastern trough. The study area lies in the eastern trough of the Central Volcanic Line. General geology of the study area and its environs is shown in Figure 2. The study area is bounded by the Mogok Belt in the east, by Taungtalone area (Myint Thein, 1966) in the west, by Sagaing-Minwun area (Maung Maung, 1982) in the north and by the sedimentary terrain of Myittha Shweminwun area (Pyi Soe Thein, 2005) in the south.

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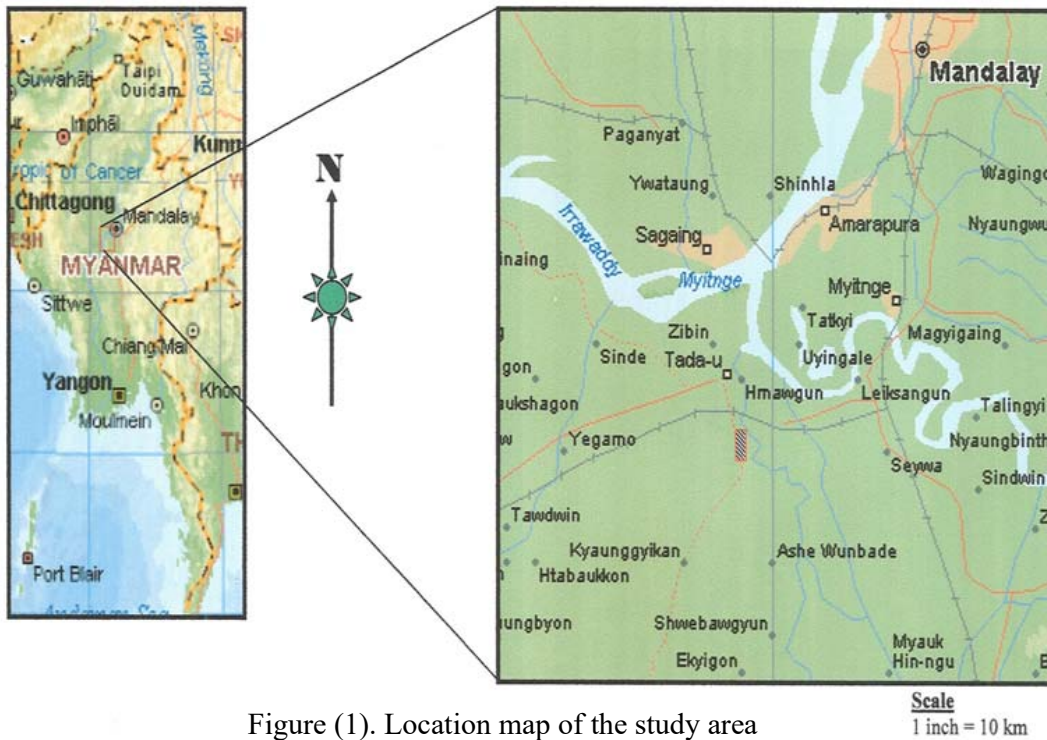


Figure (1). Location map of the study area

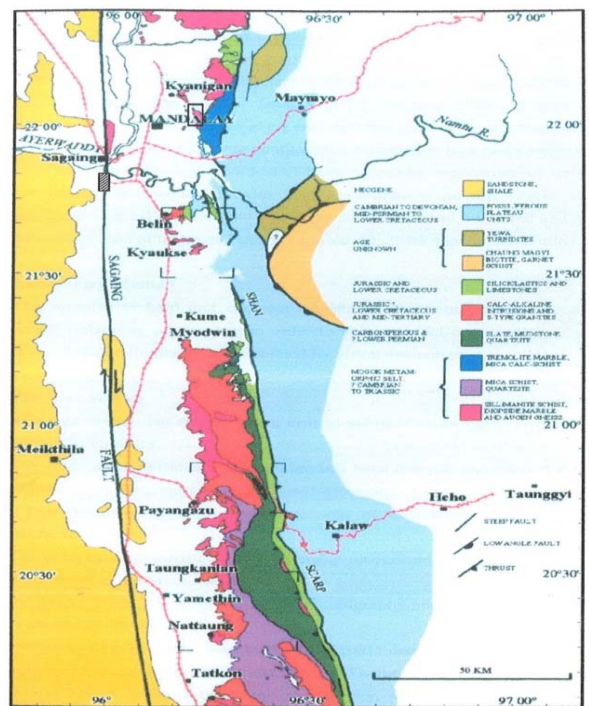


Figure (2). General outcrops and structural patterns of the Shwetaung Taw area and its environs.

The study area is a southern continuation of Sagaing-Minwun area and lies on the Sagaing Fault. The Sagaing Fault pierces through the sedimentary rock units of the study area. Further north up to Sagaing, this fault trace is mainly in the alluvium, isolated low hills (pressure ridge) formed by the Cenozoic sediments occur near the fault.

Purposes of Study

The purposes of the present study are;

1. To study the petrology of the rocks exposed in the area
2. To carry out a detail petrographic analysis of the study area

Laboratory Methods

The samples of hard and compact sandstones were cut into thin sections and studied under polarizing microscope in order to obtain modal composition. The modal composition of each thin section was obtained by visual estimation.

Stratigraphy

General Statement

The study area is the southern continuation of Sagaing Minwun Ridge and it comprises mainly clastic sedimentary rock units of Miocene and Pliocene sediments. Based on the sedimentary structures, lithological characters, paleontological evidences and the presence of an unconformity, the rock units of the study area can be divided into three lithostratigraphic units. They are (from lower to upper) Kyaukta Formation, Irrawaddy Formation and the Gravel Bed. Detail description of rock units in the study area is shown in Table 1. The correlation of the rock units of the study area with those of the neighbouring area is shown in Table 2.

Table (1). Lithostratigraphic units and their rock types and predominant lithology with geological age

Geological Age	Lithostratigraphic Unit	Rock type and predominant lithology
Holocene	Alluvium	Sandy, clayey, silty soil
Pleistocene	Gravel Bed	Subrounded to rounded quartz pebbles, metamorphic rock pebbles, sandstone pebbles and fossil wood
Upper Miocene to Pliocene	Irrawaddy Formation	Variegated colour, gypsiferous massive clay with the vertebrates bone fragments and crocodile teeth, shell fragments (pelecypods) and concretions and white to ash-white, soft to friable, coarse-grained to gritty sandstone and sand rock
Middle Miocene	Kyaukta Formation	Yellowish brown to light gray, fine- to coarse-grained sandstone and gritty, thin laminated to thick bedded sandstone, siltstone and shale with the presence of leaf imprints, wood chips and the shell fragments of <i>Cyrena</i> sp. and <i>Turritella</i> sp.

Table (2). Correlation chart of the stratigraphic units with those of other areas

Age	Taungtalone Area Myint Thein, 1966	Myotha- Ngazun Area Maung Maung, 1978	Shwetatung Taw Area Maung Maung, 1982	Shwetatung Taw Area Than Bo, 1967	Shwetatung Taw Area Kyin Kyin Moe, 2006
Pleistocene	Plateau Gravel and Red Earth	Plateau Gravel and Red Earth	Plateau Gravel	Plateau Gravel	Gravel Bed
Pliocene	Thittawpya Sandstone	Thittawpya Sandstone	Irrawaddy Formation	Irrawaddy Series	Irrawaddy Formation
Middle Miocene	Khabo Sandstone	Khabo Sandstone	Kyaukta Formation	Kyaukta Formation	Kyaukta Formation
	Moza Formation	Moza Formation	Not exposed	Not exposed	Not exposed

Sedimentary Petrology

Petrology of Rock Units

For petrographic study, sandstone samples were collected from different stratigraphic horizons. These samples were cut and made into thin sections. The compositional detrital framework was obtained from thin section.

The percentages of the mineral constituents are determined from the visual estimation chart.

Kyaukta Formation

From the study of thin sections, the mineral composition of Kyaukta Formation was determined. This sandstone consists of 63 to 68 percent of the detrital grains and 32 to 38 percent of chemical cements. The detrital grains are embedded in chemical cement. The constituents of these sandstones are mainly of quartz, feldspar, mica, rock fragments and heavy minerals. The maximum diameter of the grains varies from 0.2 mm to 0.15 mm. According to Folk and Word's parameter (1954), this sandstone of sorting value is about 0.8. Therefore, this sandstone is characteristic of the moderate sorting. Most of the detrital grains are angular to subangular and their rounding index varies from 0.3 to 0.6. The contacts between the grains are tangential or point.

Detrital Fraction

Quartz

Quartz is the most dominant constituent detrital mineral in these sandstones. It constitutes approximately 61 to 66 % of total detrital minerals which are angular to subangular. Generally monocrystalline quartz grains are more than polycrystalline quartz grains. Most of the quartz grains have not only gaseous or liquid inclusions but also mineral inclusions such as zircon and tourmaline. Most of total quartz contents are igneous in origin, although some are metamorphic. The rest is vein quartz with the composite extinction. Some of these quartz grains are corroded by the calcite cement.

Feldspar

Feldspar is the second most abundant detrital grains. They consist of 20 to 25 % of the total detrital fractions. The feldspars are included with orthoclase, plagioclase and microcline. Orthoclase feldspar is more prominent than plagioclase feldspar. Mineral amount of microcline are also observed. Orthoclase and plagioclase are altered to sericite but microcline is fresh. Muscovite inclusions are present in some feldspar grains. The calcite cement is replaced in some feldspar grains.

Mica

Mica constitutes about 3 to 5 % of total detrital fractions. Biotite is more abundant than the muscovite. They show preferred orientation. Biotite is brown pleochroic and some are partly or wholly oxidized. The muscovites are elongated plates and formed by the reaction between clay matrix and iron-oxide. Commonly, the micas are seemed to bending and splitting due to displasive growth of calcite cement. All micas are characterized by their aligment parallel to the bedding plane.

Rock Fragments

Quartzite, chert, schist, shale and volcanic fragments are present in the rock fragments. The rock fragments are about 9 to 11 % of total detrital fractions. Quartzites and cherts are the most abundance of rock fragments.

Heavy Minerals

The rest of the detrital fraction is composed of heavy minerals, mainly hornblende, garnet, epidote, diopside, tourmaline, zircon and rutile. They are less than 1 % of total detrital fractions.

Cement

The common cementing agent is calcite in the Kyaukta sandstone. It consists of 30 to 35 % of the total volume. The calcite cement is formed in the interstial porespace and the incipient fractures of other detrital grains.

Nomenclature of Sandstone

According to Pettijohn's classification (1975), the Kyaukta Formation may be classified as "Subarkose" where quartz contains less than 75 % and the total feldspar exceeds rock fragment. Matrix is absent although cement is present.

According to Gilbert's Classification, this sandstone must fall within the group of "Lithic subarkose" because of the ratio of quartz, feldspar and rock fragments.

Heavy minerals

Heavy mineral grains of the Shwetaung Taw Sandstones were found by U Than Bo (1967). Distribution of the heavy mineral grains is listed in Table (3.2). The more common heavy minerals are amphibole, garnet, epidote, and pyroxene (Than Bo, 1967).

Table (3). Detrital percentage of Kyaukta Sandstone exposed in Shwetaung Taw Area

Rock Formation	Sample No.	Essential Framework Percentage			
		Quartz	Feldspar	Rock Fragments	Symbol
Kyaukta Formation	1	73	16	11	▲
	2	68	20	12	▲
	3	70	19	11	▲
	4	65	21	14	▲
	5	68	19	13	▲

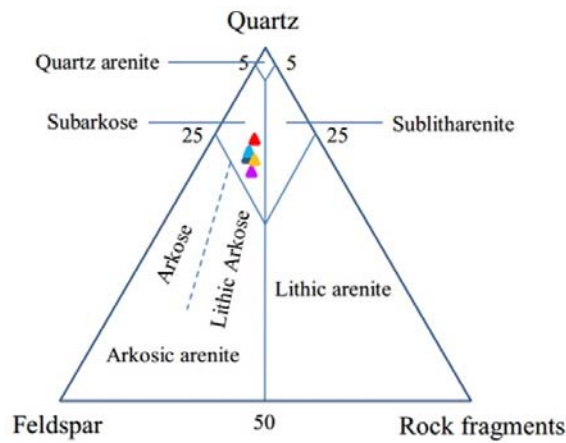


Figure (3). Diagram to show the composition of Kyaukta Sandstone exposed in the Shwetaung Taw Area. (From Pettijohn’s Classification, 1975)

Table (4). Heavy Minerals grains of the Shwetaung Taw Area

Sr. No.	Hornblend	Epidote	Garnet	Hypersthe	Magnetite	Tremolite	Diopside	Augite	Zircon	Tourmalin	Rutile	Actinolite	Andalucite	Staurolite	Kyanite
1	33	15	12	10	7	6	11	3	2	1	1	-	-	-	-
2	38	11	12	5	7	10	8	2	1	2	1	1	1	-	-
3	18	15	23	6	12	13	6	2	-	1	1	-	2	1	-
4	32	16	10	9	7	10	7	3	-	1	-	1	2	2	-
5	43	14	13	7	8	6	4	1	-	-	1	1	1	-	1
6	46	11	5	6	1	9	7	6	-	4	-	2	1	-	2
7	41	13	10	9	7	9	5	2	-	1	-	-	1	1	1
8	35	16	9	14	10	7	6	1	-	-	-	1	1	-	-
9	34	16	10	5	3	15	7	3	-	1	-	2	3	-	1
10	34	13	8	10	6	13	4	3	-	2	-	1	1	-	-
11	38	17	12	4	7	12	7	1	-	1	1	-	1	-	-

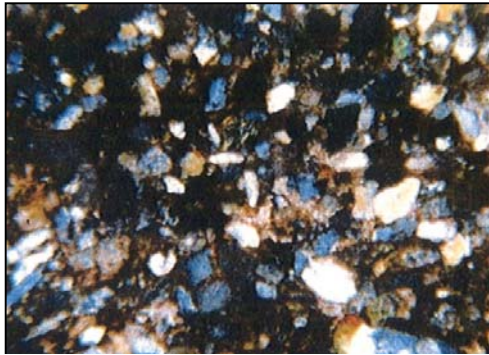


Figure (4). Photomicrograph showing petrographic view of fine-grained arkose sandstone under X.N (40X).

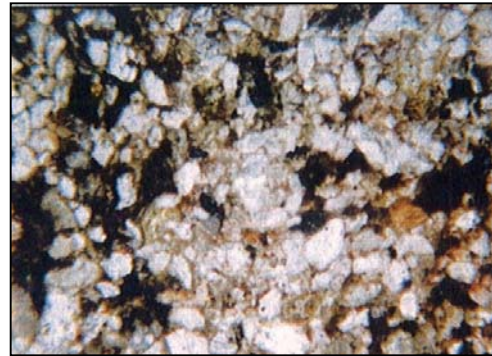


Figure (5). Photomicrograph showing petrographic view of fine-grained arkose sandstone under P.P.L (40X).

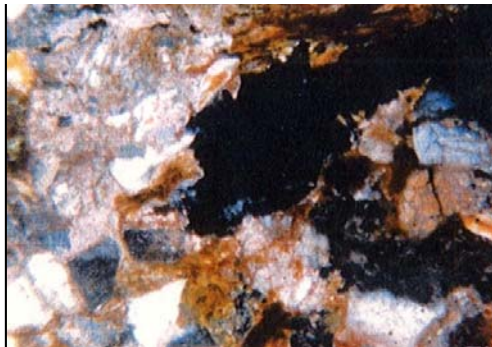


Figure (6). Photomicrograph showing petrographic view of medium-grained arkose sandstone under X.N (40X).

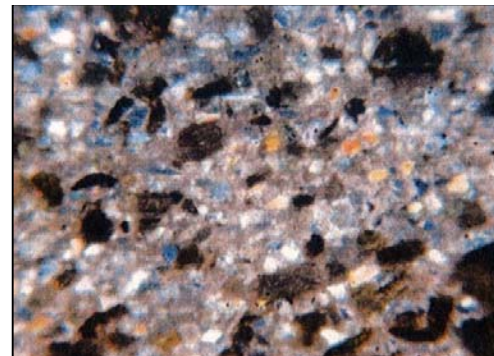


Figure (7). Photomicrograph showing random to parallel orientation of mica in arkose sandstone under X.N (40X).

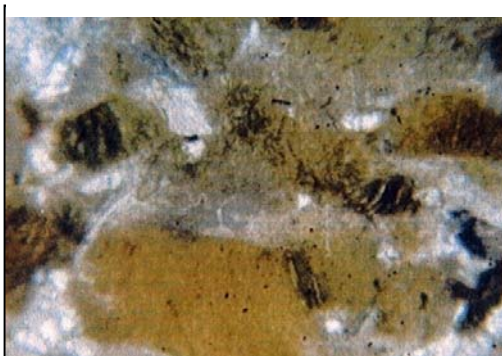


Figure (8). Photomicrograph showing bifurcation of biotite in coarse-grained arkose sandstone under X.N (40X).

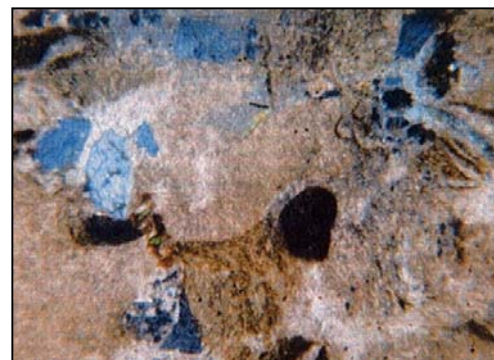


Figure (9). Photomicrograph showing authigenic muscovite, quartzite in coarse-grained arkose sandstone under X.N (40X).

Summary and Conclusion

1. The Shwetaung Taw area is situated 4 miles south of Tada-U and east of Mandalay International Airport.
2. In the present area, the clastic sedimentary rocks are well exposed which may be divided into three lithostratigraphic units. They are Kyaukta Formation, Irrawaddy Formation and Gravel Bed.
3. Irrawaddy Formation mainly consists of variegated colour, gypsiferous massive clay with the shell fragments (pelecypods), vertebrate bone fragments and concretions and white to ash-white, soft to friable, coarse-grained to gritty sandstone and sandrock.
4. The Grave Bed deposits mainly composed of subrounded-rounded quartz pebbles, metamorphic rock pebbles, sandstone pebbles and fossil wood. These deposits are overlying upon the Irrawaddy Formation and occur along the Sagaing Fault zone.
5. The investigation of composition, amount of constituent and texture of quartz, feldspar, rock fragments and heavy minerals indicates that these Kyaukta sediments were probably derived from plutonic igneous rocks.

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