J. Myanmar Acad. Arts Sci. 2018 **Vol. XVI. No. 5**

GEOLOGY AND PETROGRAPHY OF IGNEOUS ROCKS IN ANDIN AREA, YE TOWNSHIP

Su Latt Mon[1], Su Su Hlaing[2], Myat Thuzar Soe[3]

Abstract

The study area is located in the northwestern part of Ye Township, Mon State. The area coverage is about 35.84 square kilometres in one inch topographic map No. 95 E/15. The igneous rock units are generally trending NNW-SSE. Diorite is found along the shore-line. Porphyritic biotite granite is the most abundant rock type and well exposed in the central part. Biotite granite is second abundant rock type. It occurs in the southern part of the study area. Biotite microgranite exposed at the Phalaing Taung. Microdiorite is found as dyke which intruding the porphyritic biotite granite. Lamprophyre dyke is intruding porphyritic biotite granite and biotite microgranite. Quartzofeldspathic vein and quartz vein are also intruding older rock units. Hypidiomorphic granular texture is found occurs in diorite, porphyritic biotite granite, biotite granite and biotite microgranite. Panidiomorphic granular texture is observed in lamprophyre. Quartz, orthoclase, microcline and biotite are major components in granitic rocks. Muscovite, zircon, apatite, epidote, sphene and magnetite are found as accessory minerals. According to modal analysis of I.U.G.S classification diagram, diorite falls in the quartz-monzodiorite field. Porphyritic biotite granite, and biotite granite, and biotite microgranite falls in the syeno-granite and monzo-granite fields. Igneous rocks can be used as decorative stones, construction and road materials.

Key word:Diorite, porphyritic biotite granite, biotitemicrogranite, microdiorite dyke, lamprophyre dyke

Introduction

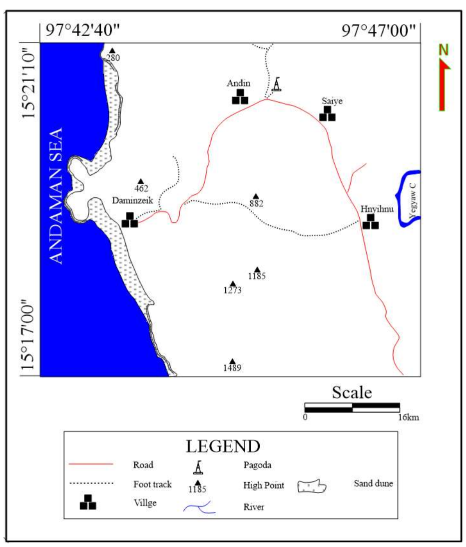
The study area is located in the northwestern part of Ye Township, Mon State. The approximate length, east to west is about 6.4 km and width is about 5.6 km from north to south. The area coverage is about 35.84 square kilometres in one inch topographic map No.95 E/15. The location map of the study area is shown in Figure (1). The highest peak is

1. MRes (Mineralogy Specialization)
2. Lecturer, Department of Geology, University of Yangon
3. Director, Professor, Applied Geology Department

Taungchon Taung (1489m). Physiography of the study area is shown by 3D modelling in Figure (2). The study area is a highly rugged terrain with locally thick soil and dense vegetation. The main stream is Yegyaw Chaung which flows from west to east. Phalein Chaung flows from west to east and finally enters the Andaman Sea. The drainage pattern of the study area is dendritic with medium to coarse texture.

Regional Geologic Setting of the Study Area

The study area lies in the southern continuation of the Shan Tanintharyi Block of Maung Thein (2000). The regional geological map of study area and its environs were taken from Myanmar Geosciences Society, 2014 and is shown in Figure (3). The granitoid plutons intrudedthe metasedimentary rocks of the Mergui Group, Chhibber (1934). These granitoids were possibly emplaced during the Late Mesozoic and Early Eocene (Khin Zaw, 1990). It is mainly composed of granitoid rocks such as granite and granodiorite. These granitoid rocks intruded sedimentary and metasedimentary rocks of Mergui Group which is possibly regarded as the Carboniferous-Late Permian (Win Swe, 2012) according to the stratigraphic correlation and relationship. The general structural trend of the study area is NNW-SSE. Thegranitoid rocks in the study area consist of diorite, porphyritic biotite granite, biotite granite, biotite microgranite, microdiorite dyke, lamprophyre dyke, quartzofeldspathic vein and quartz veins.



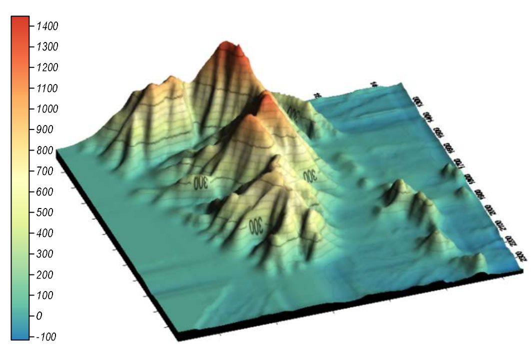


Figure 1. Location map of the study area **Figure 2.** The physiography of the study area

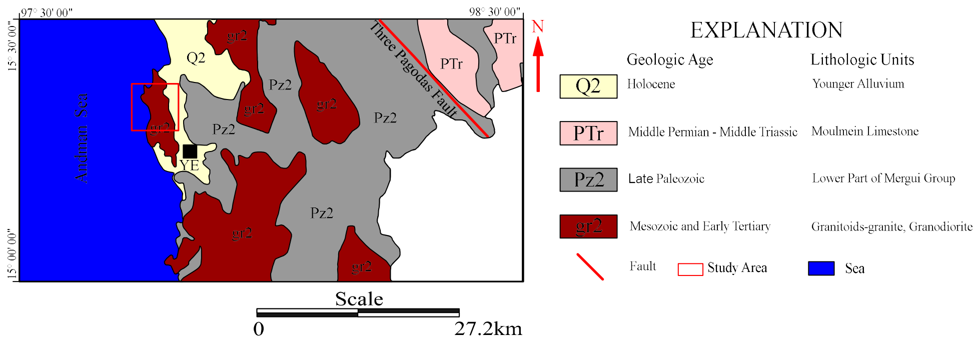


Figure 3. Regional geological map of the study area and its environs (After Geological Map of Myanmar Geosciences Society, 2014)

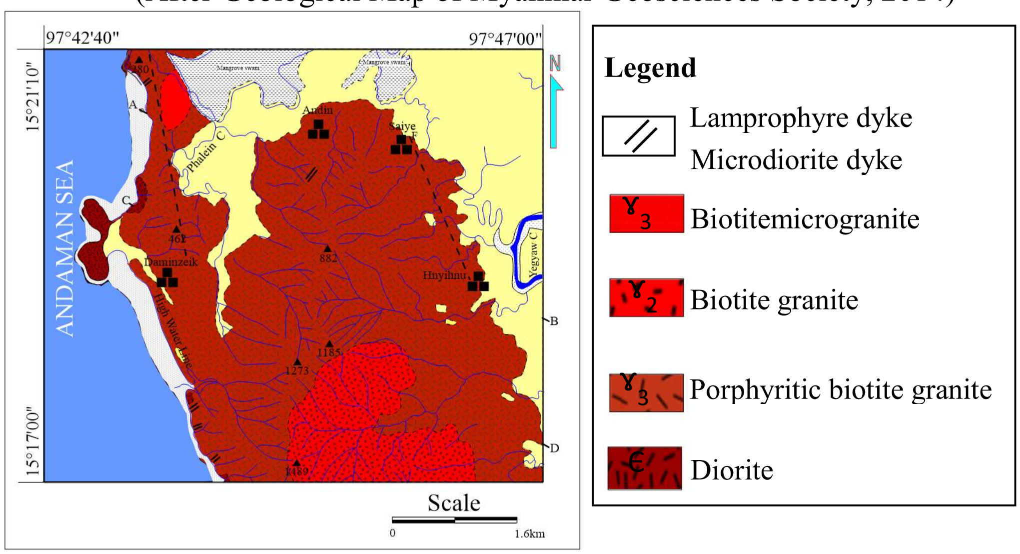


Figure 4. Geological Map of the Andin Area, Ye Township

Geology of Andin Area

The study area is mainly composed of igneous rocks. They are diorite, porphyritic biotite granite, biotite granite and biotite microgranite. Microdiorite dyke, lamprophyre dyke, quartzofeldspathic veins and quartz veins intruded the older granitoid rocks.

Diorite is exposed along the shore-line, especially in the western part of the study area. It is well exposed and minor faults cut across it.

Porphyritic biotite granite is the most abundant and widely distributed in the study area. It is well exposed in the northwestern part of Tharkayan Taung area. Most of the outcrops are highly jointed. It occurs not only as large massive boulders but also as highly weathered outcrops along the shore-line. Randomly oriented feldspar phenocrystsare found in porphyritic biotite granite. Some are gradually transformed into laterite. **Biotite granite** is well exposed in the southern part of the study area. Large massive boulders with exfoliation weathering features are common. **Biotitemicrogranite** is exposed in the northeastern and eastern part of the study area. It shows sheeted joint nature due to tidal wave erosional effect along the shore-line. It also intruded porphyritic biotite granite. **Microdiorite** occurs as dyke intruding porphyritic biotite granite unit. **Lamprophyre dykes** are trending nearly NE-SW. It intruded porphyritic biotite granite. Geological Map of The Andin Area is shown in Figure (4). Outcrop natures of each rock unit are shown in Figure (5).

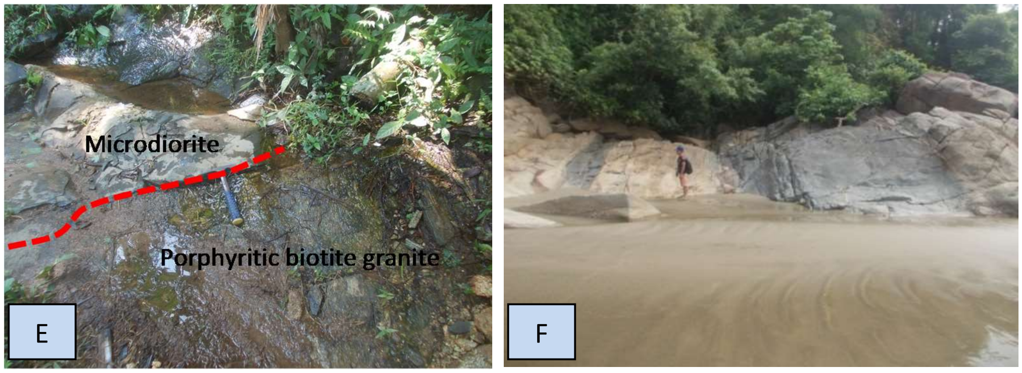


Figure (5) (A) Diorite outcrop along the shore-line (Looking-220°)
(B) Randomly oriented feldspar phenocrysts in porphyritic biotite granite
(C) Exfoliation nature of biotite granite
(D) Sheeted nature of biotitemicrogranite at the shore-line
(E) Contact of microdiorite and porphyritic biotite granite in the northern part of the study area
(F) Lamprophyre dyke intruding porphyritic biotite granite. (15° 20′ 17.0″ N, 97° 45′ 06.5″ E)

Field Relationship of Igneous Rocks in the Study Area

The rock sequence of the study area is recognized from the field relationships of some igneous rocks. Biotite microgranite intruded porphyritic biotite granite in the southeastern part of the study area. It indicates that porphyritic biotite granite is older than biotitemicrogranite, Figure (6) (A). Biotite microgranite intruded diorite in northwestern part of the study area,indicating that diorite is older than biotite mocrogranite, Figure (6) (B). Diorite xenoliths occur in biotite microgranite in the northwestern part of the study area. This indicates that diorite is older than biotite microgranite, Figure (6) (C). Lamprophyre dyke intruded porphyritic biotite granite and diorite in the western part of the study area. This indicates that porphyritic biotite granite and diorite are older than lamprophyre dyke, Figure (6) (D).

Figure 6 (A) Biotite microgranite intruding porphyritic biotite granite

(B) Biotite microgranite intruding diorite

(C) Diorite xenoliths in porphyritic biotite granite

(D) Lamprophyre dyke intruding diorite

Rock Sequence of the Study Area

The rock sequence of the study area is established on the basis of the field relationship and lithologic characters.

Rock Type	**Possible Age**
	(After Su Su Hlaing, 2014)
alluvium	- Quaternary

Veins and dykes

Quartzofeldspathic vein and Quartz vein

Lamprophyre dyke

Microdiorite dyke

Igneous Rock

Biotitemicrogranite	Paleocene
Biotite granite	
Porphyritic biotite granite	
Diorite	- Older thanPaleocene

Petrography of Igneous Rocks

Diorite has coarse-grained, hypidiomorphic granular texture. It is mainly composed of hornblende, plagioclase and subordinate amount of biotite, orthoclase and quartz. Sphene, zircon, apatite, epidote and magnetite occur as accessory minerals. The grain size of plagioclase is about 0.3mm to 1mm in diameter. The composition range of plagioclase is An_{34} to An_{45} (andesine). Plagioclase feldspar is altered to clay minerals at the core, Figure (7) (A). Twin bands are slightly bent due to deformation, Figure (7) (C). Apatite occurs as inclusion in plagioclase, Figure (7) (B). Hornblende occurs as subhedral to anhedral grains and the grain size varies from 0.3mm to 2mm in diameter. It is the chief ferromagnesium mineral in diorite. Sometimes, it shows simple contact twinning. Zircon and opaque minerals also occur as inclusios in hornblende crystals. Biotite occurs as small flakes and displays light yellow, pale brown to dark brown pleochroic colours. Quartz occurs as interstitial grains within hornblende and plagioclase. Some biotite are altered to chlorite. Orthoclase and microcline are present in small amounts and occur as anhedral grains. Sphene displays subhedral form and high relief. Myrmekitic worm-like bodies of quartz are found along the edge of plagioclase. Zircon, sphene, apatite, and magnetite occur as accessory minerals, Figure (7) (D).

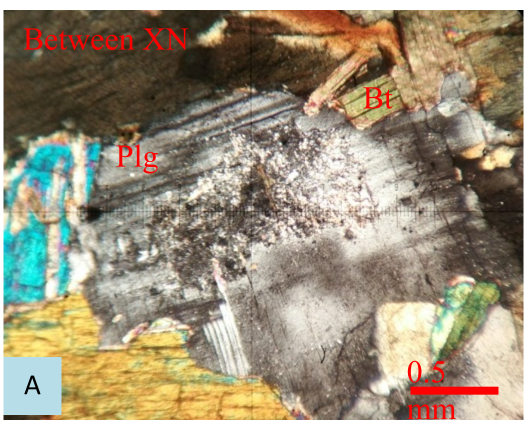
Porphyritic biotitegranite is coarse-grained with hypidiomorphic granular texture and porphyritic texture. It is mainly composed of alkalifeldspar as phenocrysts, orthoclase, microcline, perthite, quartz, plagioclase and biotite. The accessory minerals consist of zircon, muscovite, apatite, sericite and magnetite. Alkalifeldspar comprise orthoclase, perthitic orthoclase, Figure (7) (E) and microcline. The grain size varies from 3mm to 6mm in diameter. Orthoclase is subhedral in form and shows simple contact twin. Most of orthoclase is altered to sericite, Figure (7) (F). Perthitic texture is formed by the intergrowth of alkalifeldspar and albite. Some microcline arefound as large phenocrysts. The grain size of plagioclase feldspar varies from 2mm to 5mm in diameter. The composition range of plagioclase is An_{10-12} (albite to oligoclase). Quartz usually occurs as anhedralgrains and shows undulatory extinction. The aggregates of very small anhedral grains along the margin of large grains are found as garland. It is the characteristic effect of stress. Biotite occurs in subhedral form and the grain size varies from 0.2mm to 1mm. It shows strong pleochroism from yellow to dark brown. Zircon occurs as inclusions in orthoclase. Hornblende occurs insubhedral form and shows pleochroism from dark green to yellow. Sphene shows neutral colour, subhedral and very high relief under PPL. Myrmekitic texture is the intergrowth of quartz and alkalifeldspar. Zircon, sphene and magnetite occur as accessory minerals.

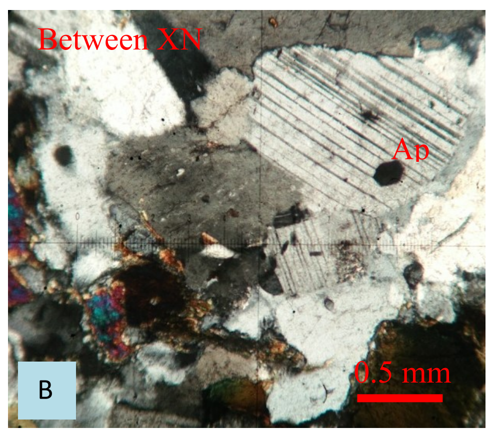
Biotite granite is coarse-grained with hypidiomorphic granular texture. It is mainly composed of orthoclase, microcline, quartz, plagioclase and biotite. The accessory minerals consist of zircon, apatite, hornblende and magnetite. Most of the alkali feldspar is represented by orthoclase and microcline. Orthoclase shows simple contact twin, Figure (8) (A). Microcline is in subhedral form and displays cross-hatched twin. Quartz is found inanhedral form and the grain size varies from 2mm to 6mm in diameter. It shows wavy extinction and sometimes displays suture contact. Plagioclase feldspar displays good polysynthetic twinning and twin bands are closely spaced. The composition range of plagioclase is An_{9-10} (Albite). Some twin bands are bent due to deformation, Figure (8) (B). Biotite is in subhedral form and shows light yellow and pale brown and dark brown pleochroiccolours. Biotite occurs insubhedral flaky form having 0.5mm to 2mm in diameter. In some sections, it commonly altered to chlorite along the cleavage planes.

Zircon displays high relief and pleochroic haloes and occurs as inclusions in biotite, Figure (8) (C). Accessory minerals comprise zircon, apatite, sphene and magnetite.

Biotite microgranite is medium-grained with allotriomorphic granular texture, Figure (8) (D) and equigranular in nature. It is mainly composed of quartz, orthoclase, plagioclase, microcline and biotite. Accessory minerals consist of sphene, zircon and muscovite. Quartz grains show undulose extinction and anhedral form. Alkali feldspar is represented by orthoclase, microcline and perthite. It shows subhedral to anhedral form and the grain size varies from 1mm in diameter. Biotite displays subhedral flaky form and 0.2mm to 0.5mm in diameter. It shows yellowish to dark brown in pleochroism. Plagioclase showssubhedral form and the grain size varies from 0.2mm to 1mm in diameter, Figure (8) (E). The composition range of plagioclase is An_{8-10} (Albite). Myrmekite texture is formed by the intergrowth of quartz and alkalifeldspar. Zircon occurs as inclusions in alkalifeldspar, Figure (8) (F).

Microdiorite has medium-grained, hypidiomorphic granular texture. It is composed of plagioclase, hornblende, biotite, quartz, orthoclase and magnetite. Plagioclase occurs in subhedral form and grain size varies from 0.1mm to 1mm in diameter. The composition range of plagioclase is An_{32} (oligoclase to andesine). Euhedral zoned plagioclase is found in





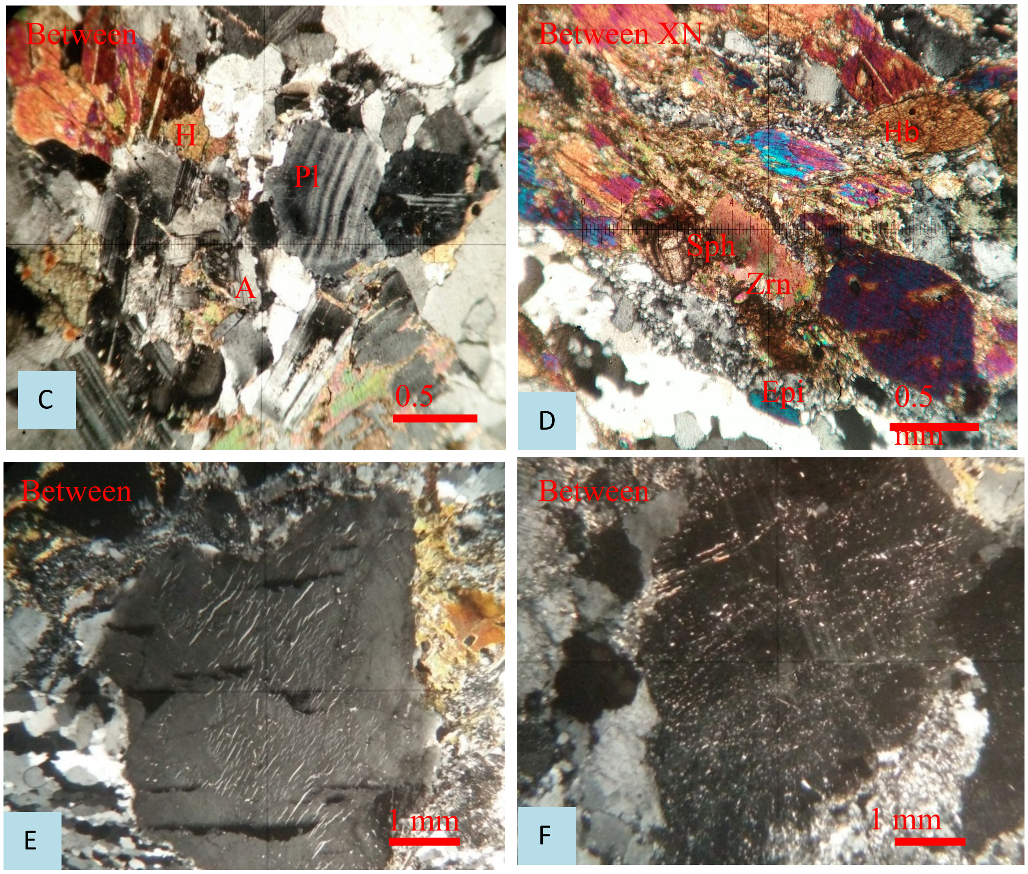


Figure 7: (A) Plagioclase altered to clay minerals in diorite

(B) Apatite inclusions in plagioclase in diorite

(C) Plagioclase twins bent due to deformation in diorite

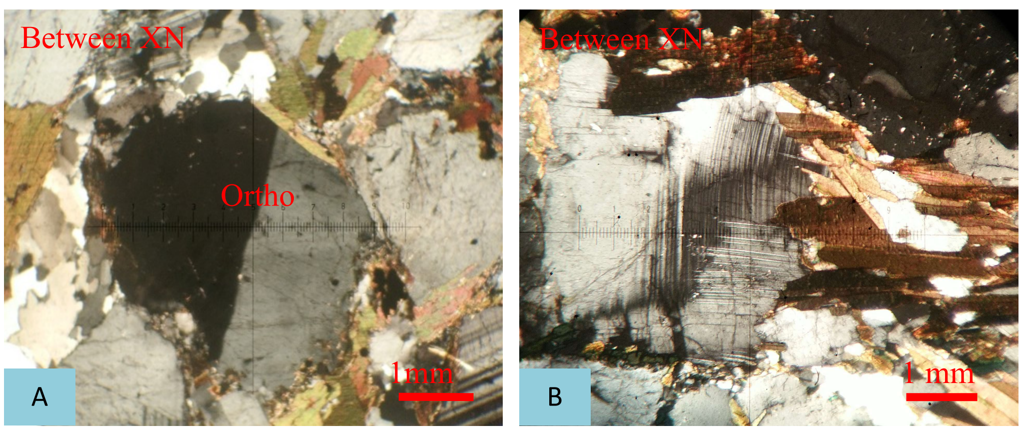
(D) Sphene, zircon, hornblende occurring in diorite

(E) Perthite in porphyritic biotite granite

(F) Orthoclase altered to sericite in porphyritic biotite granite.

Figure (9) (A). Hornblende occurs as anhedral, Figure (9) (B) and showing strong pleochroism from yellowish brown to yellowish green in color. Biotite occurs as subhedral form and grain size varies from 0.1mm to 0.3mm in diameter. It shows pleochroic from yellowish brown to greenish brown. Quartz grains occur as anhedral crystals and wavy extinction. Zircon, sphene and magnetite occur as accessory minerals.

Lamprophyre is medium-grained, panidiomorphic granular texture and porphyritic texture. It is mainly composed of hornblende and plagioclase. Epidote, zircon, apatite and pyrite occur as accessory minerals. Euhedral hornblende occurs as phenocryst in fine to medium-grained groundmass. Six-sided basal hornblende crystals are also found in Figure (9) (C, D). Some hornblende shows simple contact twin and as long prismatic crystals. Euhedral plagioclase occurs as lath-shaped and as phenocrysts in Figure (9) (E). Zircon occurs as sub-rounded form and very high relief. It has second-order interference color and pleochroic haloes. Pyrite occurs as four-sided euhedral crystals, Figure (9) (F).



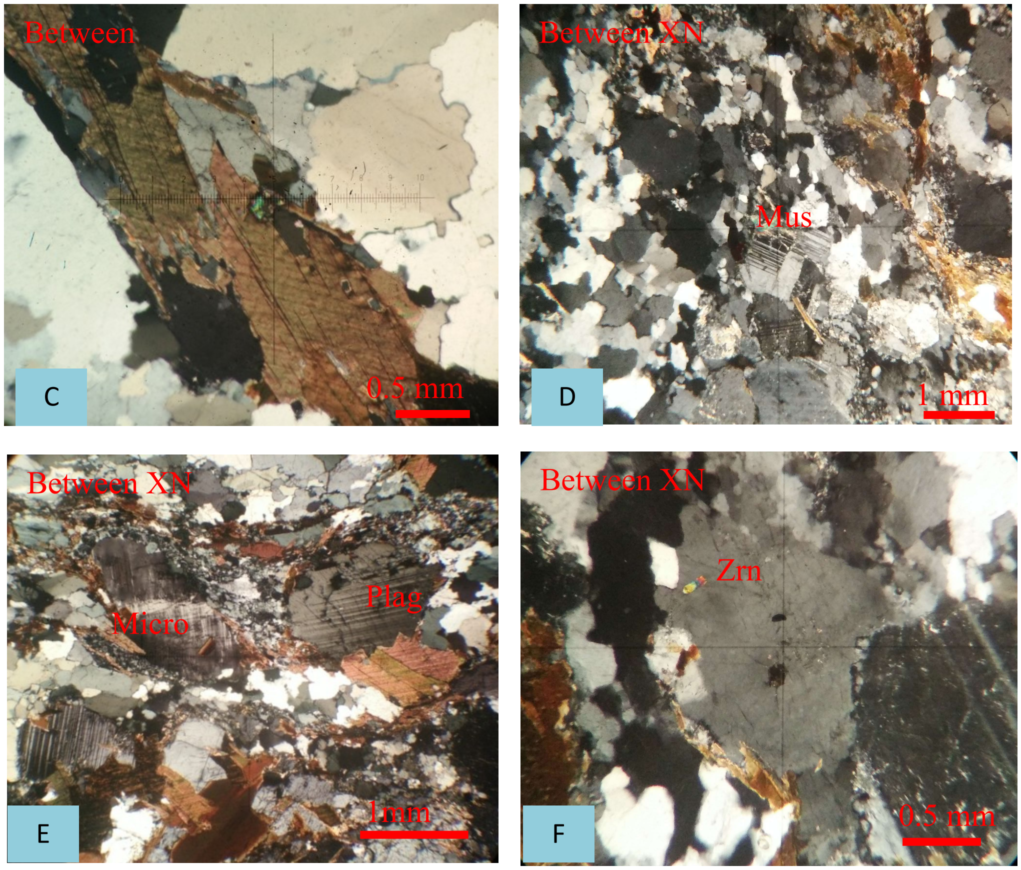


Figure 8: (A) Simple twin orthoclase in biotite granite.

(B) Plagioclase in biotite granite.

(C) Zircon inclusionsbiotite in biotite granite.

(D) Allotriomorphic granular texture in biotitemicrogranite.

(E) Plagioclase, microcline and biotite in biotitemicrogranite.

(F) Zircon inclusions in alkalifeldspar in biotitemicrogranite.

Figure 9: (A) Biotite and plagioclase in microdiorite
(B) Anhedral hornblende in microdiorite
(C, D) Euhedral and twinned basal section hornblende in lamprophyre
(E) Euhedral zoned plagioclase in lamprophyre
(F) Euhedral four-sided pyrite mineral in lamprophyre

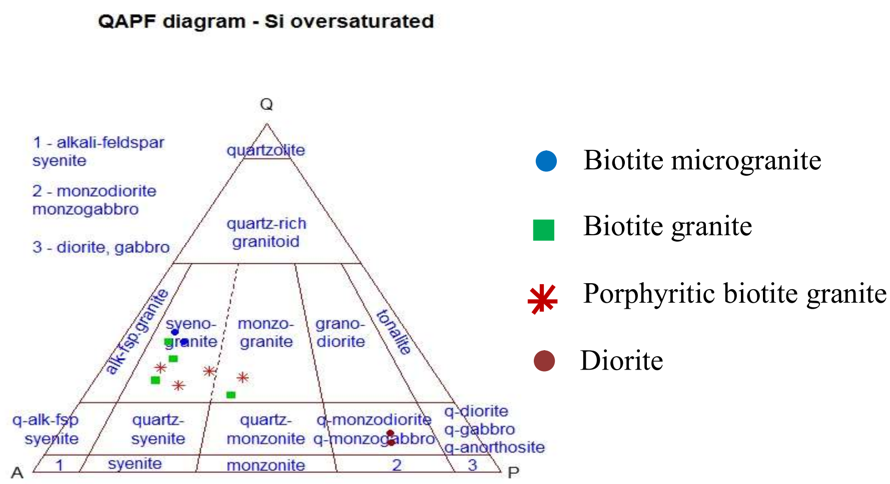


Figure 10: Plotted data of the igneous rocks of the study area (Source; IUGS Classification, Streekeisen, 1974)

Summary and Conclusion

The study area is mainly underlain by of igneous rocks. The igneous rock units consist of diorite, porphyritic biotite granite, biotite granite, biotite microgranite, microdiorite dykes, lamprophyre dykes, quartzofeldspathic veins and quartz veins. The modal composition of granitoid rocks in the study area are plotted on the IUGS classification diagram as shown in Figure (10). According this diagram, diorite falls in the quarz-monzodiorite field. Porphyritic biotite granite, biotite granite and biotite microgranite falls in the syeno-granite field and monzo-granite field. Diorite is found in the western part of the study area and mainly composed of hornblende, plagioclase and biotite. Porphyritic biotite granite is widely distributed in the northern part of the study area. It is mainly composed of quartz, orthoclase, plagioclase and biotite. Biotite granite is found in the southern part of the study area. It is mainly composed of orthoclase, quartz, plagioclase and biotite. Microdiorite dykes intruded porphyritic biotite granite. Lamprophyre dykes are mostly fine-grained and mainly composed of plagioclase and hornblende. Lamprophyre dykes intruded porphyritic biotite granite and diorite. They are mainly composed of hornblende and plagioclase. Quartzofeldspathic veins and quartz veins intruded the older rock units. Petrographically, hypidiomorphic granular texture in porphyritic biotite granite and biotite granite, allotriomorphic granular texture in biotite microgranite and panidiomorphic granular texture in lamprophyre are encountered in the study area. Granites from the study area can be used as decorative stones, dimension stones, construction and road materials.

Acknowledgements

The author would like to express her sincere thanks to Dr. Day Wa Aung, Professor and Head of the Geology Department, University of Yangon, Dr. Htay Lwin and Dr. Thet Tin Nyunt, Professors, Geology Department, University of Yangon for their permission and valuable administrative supports.

References

Bender, F., (1983).*Geology of Burma*, Gebruder Borntraeger, Berlin and Stuttgart.

Chhibber, (1934).*The Geology of Burma, Physical Geology*, Fifth Edition.

Kerr; P. F, (1959).*Optical Mineralogy*, Mc. graw hill book company, New York.

Khin Zaw, (1990). *Geological, Petrological and Geochemical Characteristics of Granitic Rocks in Myanmar: with Special Refernece to the Associated W.Sn Mineralization and their Tectonic Setting*. *Jour. Southeast Asian Earth Sci., vol.4*, p.293-335.

Maung Thein, (2000). *Summary of Geological History of Myanmar*, Unpublished paper, p.8.

Nyan Thin, (1984). *Some Aspects of Granitic Rocks of Tenasserism Division (Unpublished), Department of Geology, University of Yangon*.

Streckeisen, (1974).*"QAPF classification diagram".*

Su Su Hlaing, (2014). *Mineralogical and Petrological Aspects of the Granitics Rocks of Tawmore Taung Areas, Launglon Township, Dawei Distinct, Tanintharyi Region.* Ph.D (Dissertation), Department of Geology, University of Yangon.

Williams, H, F. J Turner and C. M. Guilbert.(1982). *Petrology and introduction to the study of Rocks in Thin Section*. W. H. Freeman Company, New York.

Winter, J.D. (2010).*Principles of Igneous and Metamorphic Petrology*, second edition.

Win Swe, (2012). *Outline geology and Economic mineral occurrences of the Union of Myanmar*. Journal of the Myanmar Geosciences Society, Special Publication No.(1), p.120-125.