

Petrology of Granitic Rocks exposed in Leiktho-Naplawkaw Area, Thandaung Township, Karen State

Chaw Su Hlaing¹, Myat Thuzar Soe² and Tun Tun Min³

Abstract

Leiktho-Naplawkaw area is situated in northern part of Thandaung Township in Karen State. It lies between latitudes 19°13'30" N to 19°15'00"N and longitude 96°35'10"E to 96°38'30"E in one inch topographic map number is 94 A/12. The total area coverage is about 17.92 square kilometers. The study area is covered by igneous, meta-igneous and meta-sedimentary rock units. The igneous rocks are biotite granite, porphyritic biotite granite with minor amount of microgranite dyke, diorite dyke and microdiorite dyke. Granitic rocks are formed from magmatic origin and it is mainly composed of quartz, alkali feldspar and biotite. Feldspar phenocrysts are found in porphyritic biotite granite. The granitic rocks in the study area are possible emplacement during the Late Cretaceous to Early Eocene. In gneissose granite, the main constituent minerals are quartz, alkali feldspar with minor amount of plagioclase and biotite. In diorite dyke and microdiorite dyke, the main constituents' minerals are plagioclase, hornblende, minor amount of quartz and biotite. In diorite, the composition of plagioclase range from An₃₇ to An₄₇ (Andesine). Petrographic study was employed by modal analysis and determined based on IUGS classification. Granitic rocks are fall in the granite field. According to the SiO₂ vs A/CNK diagram of Chappel and White (1974), the granitic rocks of the study area regarded as the S-type granitic rocks.

Keywords: Leiktho, granitic rocks, IUGS, S-type

Introduction

Location, Topography and Drainage

The present study area lies in the eastern most part of Yedashe Township, north-eastern part of Taungoo Township in Bago Region and northern part of Thandaung Township in Karen State. It is situated between latitudes 19° 13' 30" N to 19° 15' 00"N and longitudes 96° 35' 10" E to 96° 38' 50" E. The area is bounded by vertical grids 30 to 34 and horizontal grids 08 to 15 in one inch topographic map no. 94 A/12, Fig 1. It extends about (3.2km) along the N-S and (5.6km) along the E-W, with an approximate (17.92) square kilometers of aerial coverage.

Topographically, most of the study area can roughly be regarded as a mountainous rugged terrain with the exception of a lower hilly region which is made up of metasedimentary rocks. The mountainous rugged terrains for the most parts are covered by granitic rocks. In the study area, dendritic patterns are well developed. Zale Chaung and Thakho Chaung are the main streams of the study area. Zale Chaung is flowing from north to south and Thakho Chaung is flowing from east to west.

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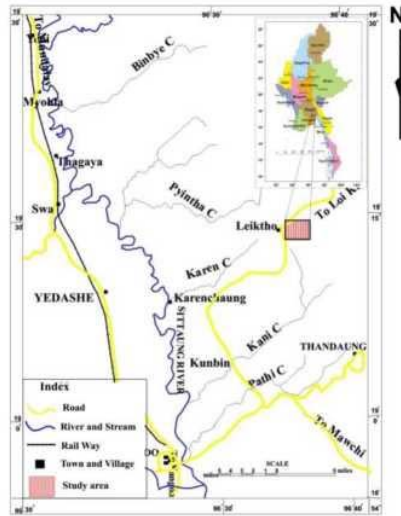


Figure (1). Location map of the study area

Regional Geologic Setting

The area under investigation is situated within the western margin of Shan Scarp. It shows geology, structure and tectonic map of the region between Pinyin and Taungoo areas (MGS 2014). It is generally bounded by the Eastern Highland, comprising Paleozoic units in the east, and bounded by younger Tertiary sedimentary rock units in the west. The study area can be divided into two units' viz., the older metasedimentary rocks in the easternmost part and the younger intrusive in the central and western parts. The granitic and metamorphic rocks of this area lie within the Mogok belt of Searle and Haq (1964) extending from Putao to Martarban, measuring about 1450 km in length and 50 km in width. Some metamorphic rocks of this area from a part of Mawchi belt: One of the seven metamorphic belts of Myanmar established by Maung Thein (1985), composed of schists, gneisses, quartzites and marbles. They are mostly low to medium grade and regarded as a northern continuation of the metasedimentary rocks of Mawchi area. In the eastern part, the older Paleozoic rocks and in the western part the younger Paleozoic rocks are exposed.

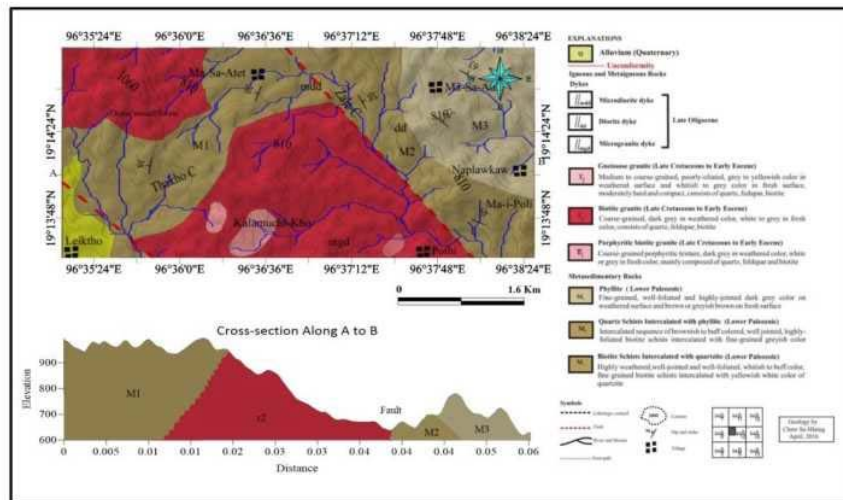


Figure (2). Geological map of the study area

Petrology

In the study area, igneous rocks, metaigneous rocks and metasedimentary rocks are well exposed.

Igneous and metaigneous rocks

Granitic rocks are widely distributed in the study area. These rocks are mostly porphyritic biotite granite, biotite granite and gneissose granite. Based on the field observation, six igneous rock units have been recognized.

Porphyritic Biotite Granite ($\gamma 1$)

Porphyritic biotite granite is locally distributed in the south-eastern part of Thakho Chaung (Figs: 3 and 4). It is moderately hard and compact. It shows coarse-grained porphyritic texture and the weathered colour is grey and the fresh colour is whitish grey. It is mainly composed of quartz, feldspar and biotite.

Microscopic Description

It is coarse-grained, porphyritic texture and essentially made up of quartz, alkali feldspar phenocryst, plagioclase and biotite. As plotted on the IUGS Classification diagram Fig 5, porphyritic biotite granite falls in granite field.

Quartz is usually observed as coarse anhedral grains, filling the interstices between early formed minerals, and also found as inclusion in alkali feldspar and plagioclase. Alkali feldspar represents by orthoclase, microcline and perthites. Most of the orthoclase feldspars are altered to sericite. Microcline showing cross-hatched twinning and is observed as phenocrysts. Perthites are patch, string and flame perthite Figs 6. Myrmekitic texture is also found Fig 7. Plagioclase occurs as polysynthetic twinning. Some of the plagioclase is partly or wholly altered to saussurite especially along the cleavage plane. The composition of plagioclase is albite, An6 to An9. The major ferromagnesium minerals present in this rock is biotite, which occurs as small flakes with irregular edges and usually anhedral to subhedral in form. Biotite flakes are found to be occasionally altered to chlorite along the cleavage plane.



Figure (3). Close-up view of porphyritic biotite granite, Loc: N: 19° 13' 12.3" E: 96° 35' 41" (Facing: 92° NE)



Figure (4). Boulder clusters of porphyritic biotite granite, Loc: N: 19° 13' 12.3" E: 96° 35' 41" (Facing: 340° NW)

Table (1) Modal composition of four representative samples of porphyritic biotite granite (in volume percent)

Sample no	Sample no A2	Sample no C7-1	Sample no C7-2	Sample no C9
Location	N: 19° 13' 05.6" E: 96° 36' 17.5"	N: 19° 13' 13.4" E: 96° 36' 50.1"	N: 19° 13' 13.4" E: 96° 36' 50.1"	N: 19° 13' 9.7" E: 96° 36' 27.7"
Quartz	31%	28.8%	26.5%	35%
Alkali feldspar	54%	50.9%	55.8%	42%
Plagioclase	9%	12%	10%	13%
Biotite	5%	7%	5%	10%
Opaque and other	1%	1.2%	0.2%	
Total	100%	99.9%	100.5%	101%

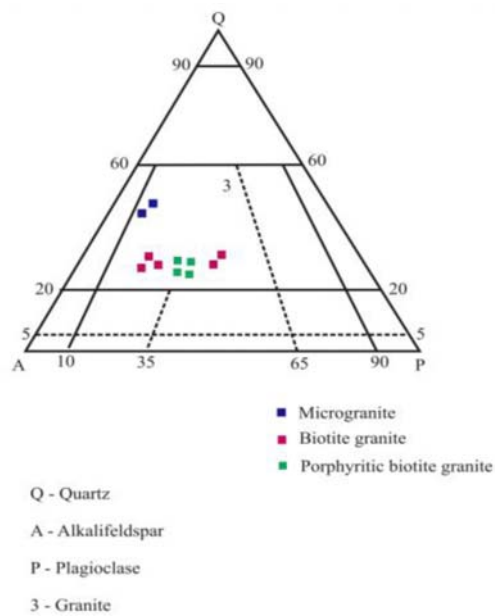


Figure (5). Plotted data of the igneous rocks of the study area on the IUGS classification diagram (After Le Maitre, 2001)

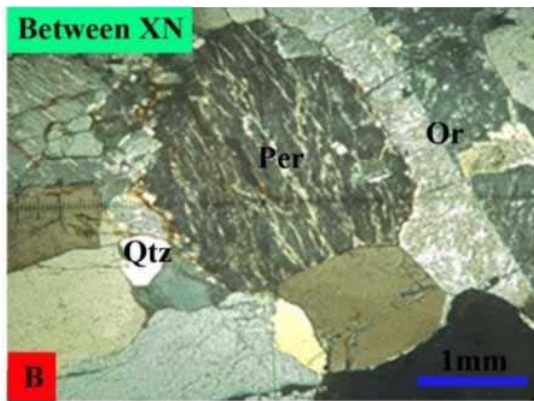


Figure (6). Photomicrograph showing flame (Per) perthite in porphyritic biotite granite

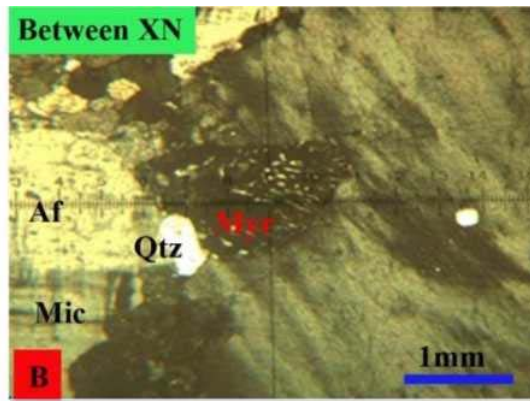


Figure (7). Photomicrograph showing myrmekitic texture (Myr) in porphyritic

Biotite Granite (γ_2)

These rocks are exposed in the central part and western part of Ma-sa-Atet and it is the most dominant rock type. The best exposures are observed at the western part of Pothi village Figs 8 and 9. It also occurs along the western part of Zale Chaung as small outcrops. Exfoliation nature of chemical weathering is observed in this unit. Biotite granite is coarse-grained crystalline texture. It gives moderately hard and compact in the field nature.

Microscopic Description

It is coarse-grained, hypidiomorphic granular texture and essentially made up of alkali feldspar, quartz, plagioclase and biotite. As plotted on the IUGS Classification diagram Fig 5, biotite granite falls in granite field. Orthoclase can be recognized by simple or contact twin Fig 10. Same orthoclase feldspar alters to sericite mineral. Microclines appear as large subhedral grains and interstitials as groundmass, showing pronounced cross-hatched twin and occurs forms of perthite are string, flame and patch-perthite. The maximum length of the perthitic alkali feldspar is about 2mm to 2.5 mm. Quartz occurs as anhedral grains. The maximum length of the quartz grain is about 2 mm. Plagioclase mostly occurs as subhedral form. Most of the plagioclases are altered to saussurite along the twin bands. Polysynthetic twinning is well displayed. The composition of plagioclase range from An7 to An10 (Albite). The biotite, major mafic mineral, and shows subhedral grains and pleochroism of light yellow to dark brown. Some biotites alter to chlorite.



Figure (8).Close-up view of biotite granite, Figure (9).Outcrop nature of biotite granite,
Loc: N: 19° 13' 15.1" E: 96° 36' 35.7" (Facing: 92° NE) Loc: N: 19° 13' 9.7" E: 96° 37' 27.7" (facing: 180° S)

Table (2) Modal composition of four representative samples of biotite granite
(Involume percent)

Sample no	Sample no A1	Sample no C3	Sample no C8	Sample no E1
Location	N: 19° 13' 1.5" E: 96° 36' 24.6"	N: 19° 13' 12.3" E: 96° 35' 41"	N: 19° 13' 21.7" E: 96° 36' 3.1"	N: 19° 13' 17.0" E: 96° 37' 32.2"
Quartz	30%	24.1%	23.5%	25.1%
Alkali feldspar	55.5%	54%	54.6%	53.7%
Plagioclase	5.2%	11.7%	11.5%	7.9%
Biotite	8%	10%	9%	11%
Opaque and other	1.5%	0.8%	1.3%	2.3%
Total	100.2%	100.6%	99.9%	100%

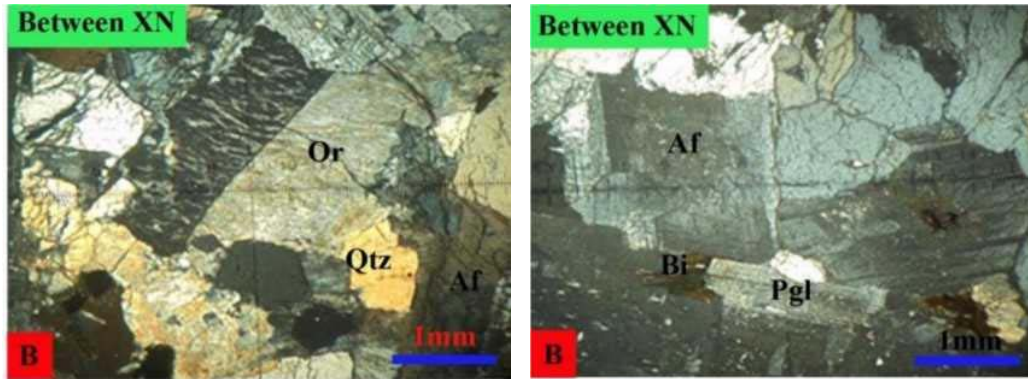


Figure (10). Photomicrographs showing alkali feldspar (Af), polysynthetic twinning of plagioclase (Pgl) and biotite (Bi) in biotite granite

Gneissose Granite (γ_3)

Gneissose Granite is locally distributed in the south western part of Pohti village Fig 11. Gneissose granite look likes granite in external features. It is coarse-grained texture and poorly foliated. Weathered colour is grey to yellowish colour and the fresh colour is whitish to grey. It is also moderately hard and compact.



Figure (11). Photograph showing the exposure nature of gneissose granite, Loc: N: 19° 13' 05.5" and E: 96° 37' 30.9" (Facing: 139° SE)

Microscopic Description

It is coarse-grained, hypidiomorphic granular texture and essentially made up of alkali feldspar, quartz, plagioclase and biotite.

Alkali feldspars are orthoclase and microcline. Orthoclase can be recognized by simple or contact twin. Most of the orthoclase feldspars are altered to sericite. Microclines show cross-hatched twin Fig 12. Quartz occurs as anhedral grains and shows undulose extinction. Plagioclase consists of 14%. It occurs in subhedral forms with bent and broken twin lamellae. In some section, plagioclase is corroded by the mineral of quartz. Most of the plagioclases are altered to saussurite. Plagioclase composition is range from Am to Anio (Albite). Minor amount of biotite occurs as small flakes in the alkali feldspar. Biotite flakes are parallel orientation.

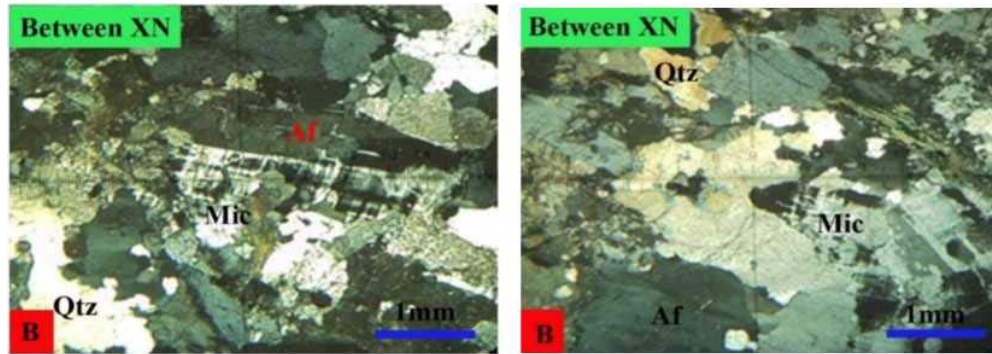


Figure (12). Photomicrographs showing alkali feldspar (Af), anhedral quartz (Qtz) and cross-hatched twin of microcline (Mic) in gneissose granite between XN

Microgranite dyke

This rock unit is locally distributed in the south-eastern part of the Zale Chaung, especially location N Lat: 19° 13' 39" and E Lon: 96° 38' 5.4" Fig 13. It is also very hard and compact. Microgranite dyke shows grey colour in weathered surface and grey to whitish colour in fresh surface. It shows medium-grained texture and also found intruding into biotite granite at the south-western part of Pothi village.



Figure (13). Photograph showing the exposure nature of microgranite dyke, Loc: N: 19° 13' 21.7" and E: 96° 37' 3.1" (Facing: 355° NW)

Microscopic Description

It is medium-grained, hypidiomorphic granular texture, essentially made up of alkali feldspar, quartz, plagioclase and minor amount of biotite.

Quartz occurs as anhedral grains between feldspars. A few grains are elongated and some occurs as small grains between interstices of larger grains Fig14. It shows strain effect due to marginal granulation and deformation. Orthoclase usually occurs as subhedral grains and alters to sericite. Plagioclase mostly occurs as subhedral form and it gives polysynthetic twinning. Most of the plagioclases are altered to saussurite. The chief mafic mineral is biotite. It occurs as subhedral form and small flakes. Strong pleochroism shows pale brown to yellowish brown in color. Some biotites are altered to chlorite along the cleavage plane.

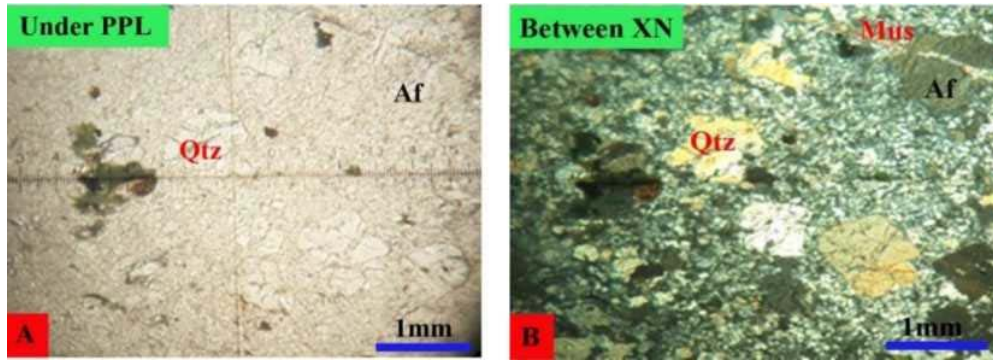


Figure (14). Photomicrographs showing anhedral quartz (Qtz), alkali feldspar (Af) and muscovite (Mus) in microgranite dyke under PPL and between XN

Diorite Dyke

Diorite units are poorly distributed near Zale Chaung, especially location N: 19° 14' 4.4" and E: 96° 37' 10.5" Fig 15. It is exposed as a massive body. Diorite is hard and compact. Weathered colour is dark grey colour and the fresh colour is bluish grey. It is found intruding into quartz schists unit at the north-eastern part of Zale-Chaung.

Microscopic Description

It is coarse-grained, hypidiomorphic granular texture. It is essentially made up of plagioclase, hornblende, alkali feldspar, biotite and quartz.

Plagioclase mostly occurs as subhedral to euhedral form. Most of the plagioclases are altered to saussurite along the twin bands. Polysynthetic twinning is the most common Fig 16. The twin bands are closely spaced. Size varies from 1.5mm to 2 mm. Plagioclase composition range from An37 to An47 (Andesine). Hornblende is the major mafic minerals in diorite. It shows strong pleochroism of deep green to yellowish green. Some hornblende crystals occur as inclusions in quartz and feldspar and some are altered to chlorite along fracture and cleavage plane. The size ranges from 0.5mm to 1.5 mm. Maximum extinction angle is 25°. Biotite is brown to yellowish brown in color. Some biotites altered to chlorite. Cracks are common in quartz grains and brecciating in marginal granulation.



Figure (15). Photograph showing the exposure nature of diorite dyke, Loc: N: 19° 14' 41.4" and E: 96° 37' 10.5" (Facing: 30° NE)

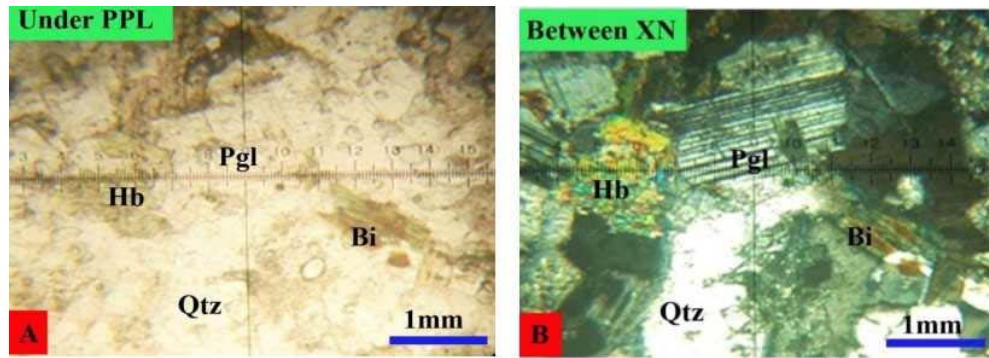


Figure (16). Photomicrographs showing polysynthetic twinning of plagioclase (Pgl), hornblende (Hb), biotite (Bi) and quartz (Qtz) in diorite dyke under PPL and between XN

Microdiorite Dyke

Microdiorite dyke is exposed at near the north western part of Zale Chaung, especially at location N: 19° 14' 49.5" and E: 96° 36' 49.6" Fig 17. When fresh, this rock is whitish to greyish in colour but often shows brownish or dark grayish colour due to weathering. It is medium-grained texture. The presence of both biotite and hornblende are also recognized. It is found intruding into biotite schists unit at the north-western part of Zale Chaung.

Microscopic Description

It is medium-grained, hypidiomorphic granular texture. It is mainly composed of plagioclase, hornblende with minor amount of alkali feldspar (orthoclase), biotite and quartz.

Plagioclase is the predominant variety of feldspar. Some twin bands are slightly bent and fractured due to deformation. Some plagioclases are altered to saussurite. Fig 18. Inclusions of mafic hornblende minerals and sericite are found in plagioclase crystals. Size varies from 0.5mm to 2mm. Plagioclase composition is range from An37 to An47 (Andesine).

Hornblende is the major mafic minerals in microdiorite. It is usually green colour and shows one set of cleavage in longitudinal section. It shows strong pleochroism. Some hornblendes alter to chlorite. Maximum extinction angle is 24°. Biotite is present in microdiorite. It occurs as flakes and alters to chlorite. The maximum length of biotite crystal is about 1mm. Alkali feldspar especially orthoclase is present as minor amount.



Figure (17). Photograph showing the exposure nature of microdiorite dyke, Loc:N: 19° 14' 54.8" and E: 96° 36' 47.0" (Facing: 135° NE)

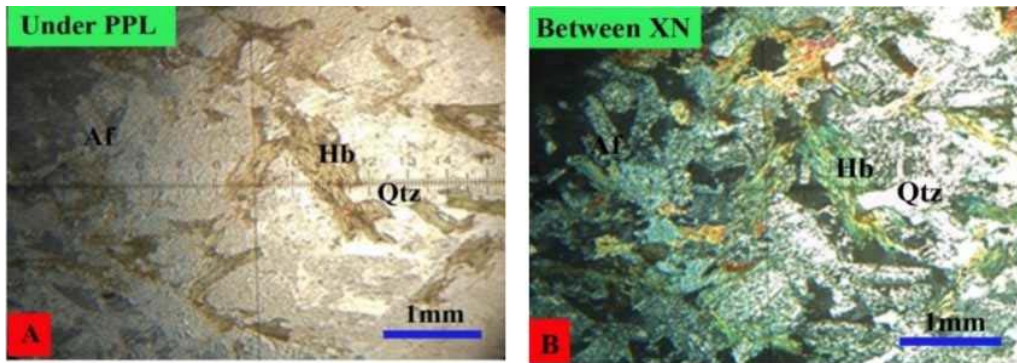


Figure (18). Photomicrographs showing the quartz (Qtz) and hornblende (Hb) in microdiorite dyke under PPL and between XN

Table (3) Major oxide (Wt %) of the igneous rocks from the study area

Sample No	C3	C6	E1	D5	D2	D7
SiO ₂	69.36	69.29	67.4	69.67	50.32	55.66
Al ₂ O ₃	15.47	15.95	15.7	15.77	17.83	18.02
Fe ₂ O ₃	2.19	2.58	3.5	2.14	95.5	7.36
MgO	0.36	0.43	0.5	0.32	4.22	2.79
MnO	0.06	0.052	0.1	0.07	0.19	0.17
CaO	1.59	1.74	1.8	1.54	6.86	5.34
Na ₂ O	4.53	3.31	3.5	3.30	3.15	2.29
K ₂ O	5.74	5.62	6.15	6.38	5.26	5.86
P ₂ O ₅	0.12	0.16	0.21	0.16	0.56	0.67
TiO ₂	0.19	0.024	0.3	0.32	1.34	0.96
Cr ₂ O ₃	-	-	-	-	-	0.02
Total	99.60	99.87	99.16	99.67	99.3	99.13

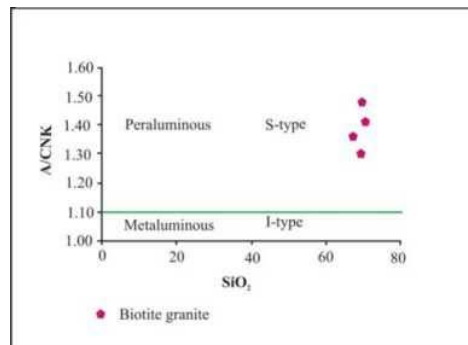


Figure (19). SiO₂ vs Al₂O₃/CaO+Na₂O+K₂O (A/CNK) diagram for the igneous rocks of the study area, (after Chappell and White, 1974) Symbols as in Table 3

Conclusion

The study area is situated in Thandaung Township, Karen State. Igneous rocks include biotite granite, porphyritic biotite granite and with minor amount of microgranite dyke, diorite dyke and microdiorite dyke. Metagneous rock consists of gneissose granite.

Biotite granite is widely distributed in the study area. It is coarse-grained and mainly

made up of quartz, feldspar and biotite. Porphyritic biotite granite is found in the western part of Zale Chaung area. It is coarse-grained porphyritic texture and the main constituents' minerals are quartz, alkali feldspar and biotite. Microgranite dyke, diorite dyke and microdiorite dyke are also locally distributed in the study area. Microgranite dyke is composed of quartz, alkali feldspar and biotite. Diorite dyke and Microdiorite dyke are mainly composed of plagioclase feldspar, hornblende and minor amount of quartz, biotite and muscovite.

Gneissose granite is locally distributed in the south western part of the study area. It is coarse-grained and mainly composed of quartz, alkali feldspar and biotite. According to the petrographic study, granitic rocks was employed by modal analysis and determined based on IUGS classification (after Le Maitre. R.W. 2001), granitic rocks are fall in the granite field.

Acknowledgements

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