Petrological Study on Igneous, Metaigneous and Metasedimentary Rocks of Nwalabo Taung – Natkyigyaung Area, Paung Township, Mon State

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Abstract

The research area situated in the middle part of Moattama Range, Paung Township, Mon State is mainly composed of granitic rocks, metaigneous, sedimentary and metasedimentary units. The Early Oligocene granitic rocks are intruded into the sandstone and shale of Martaban Bed (Late Permian to Early Triassic age) and pebbly greywacke of Taungnyo Formation (Early Carboniferous age). It is formed contact aureole such as hornfels zone due to the presence of contact metamorphic mineral, and belongs to the albite-epidote-amphibolite facies. The porphyritic biotite granite is the most abundant igneous rock type, which is a distinctive feature by the presence of large feldspar phenocrysts. Micrograninte dyke and quartz vein are intruded into this rock unit, but it is not common. According to the mineralogical and petrological criteria, the granitic rocks of the study area are considered to be magmatic in origin and are regarded as S-type. The emplacement of granitic rocks can be regarded as mesozonal level taken place by permissive emplacement during syntectonic. Porphyritic biotite granite is gradually changed to slightly foliated porphyritic biotite granite and then to granite gneiss. Granite gneiss formed at transitional contact with foliated porphyritic biotite granite due to the regional metamorphism which belongs to lower amphibolite facies.

Keywords: Granitoid rocks, Albite-epidote-amphibolite facies, Mesozone level, Syntectonic, Paung Towndhip

Introduction

Location and Physiography

The presence research area of Nwalabo Taung - Natkyigyaung area is situated in Paung Township, Mon State, which lies vertical grids 00-12 and horizontal grids 14-22, in one-inch topographic map, 94 H/6 and H/10 of Myanmar Survey Department (Fig. 1).

Topographically, the study area can be divided into two geomorphic features, the western alluvial plain and the eastern mountainous rugged terrain.

Purposes of Study

The present research will attempt to carry out the petrography and petrogenesis of igneous, metaigneous and metasedimentary rocks.

Previous Works

H.L. Chhibber (1934) reported "the weathered, fine to medium-grained granite of the type that occur in the district of Thaton, is probably sited as ornamental building stone".

I.G.C.P. Stratigraphic Commission Field Excursion in the Tenasseriam Division and Mon State; Field excursion no.2 (1975) stated that Banbwegon granites are very coarse-grained porphyritic granite and are considered mostly Late Mesozoic in age.

Khin Zaw (1990) stated that Thaton-Kyaikkkhami granitoids are coarse-grained biotite granites with very minor fine to medium-grained tourmaline granites and rhyolites, and it belongs to the Central Granitoid Belt. W-Sn bearing quartzofeldspathic veins are reported to occur within it.

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Zaw Myint Ni (1997) from Mawlamyine University studied the petrology of Zingyaik Range and Kalama Taung, which is the northern continuation of the present area, very coarse-grained Kalama Taung granite, microgranite, granite gneiss and biotite gneiss are exposed.

Khin Thuzar Minn (1998) from Mawlamyine University studied the regional geological setting, igneous and metamorphic petrology of Moattama rock units, Mon State, where porphyritic biotite granite and granite gneiss are intruding into the sedimentary rocks of the Taungnyo Formation and Martaban Beds.

Myat Thandar (2000) from University of Yangon studied the geology of the granitoid bodies of Banbwegon and Paung Area, where porphyritic biotite granite, slightly foliated porphyritic biotite granite and granite gneiss. Shales and sandstone of Martaban Beds and pebbly greywacke and shale of Taungnyo Formation are exposed.

Khine Khine Thet Lwin (2014) from Mawlamyine University studied "Petrology and Petrogenesis of Zingyaik Area, Paung Township, Mon State" for her PhD Degree Dissertation.

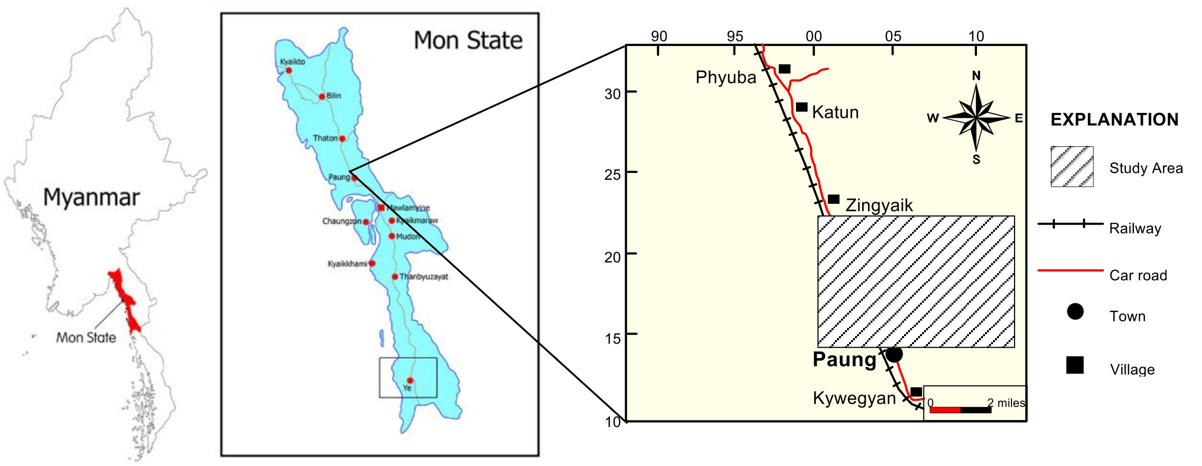

Figure (1). Location map of the study area

Field and Laboratory Works

Rock samples were collected at all points where the rocks were considered to have changed in characters. If there is no change at all in hand specimen, samples were normally collected at about 200' interval along the traverse line. Modal analysis of thin sections was made by using the mechanical point counter conjunction with the petrological microscope. Metamorphic grade and facies were determined, on the basis of .mineral assemblages

General Geology

Regional Geologic Setting

The study area is located in the southern part of Moattama Range. Regionally, it is situated at the eastern margin of Central Lowland and partly on the western margin of Shan-Taninthayi region. The western part of present area, is a part of western tin bearing batholith, known as Western Tin Belt of South-East Asia Tin Province (Mitchell 1997, Thein 1983, Nyan Thin 1984).

This intrusion may be the northern continuation of Tin-Tungsten mineralized granite of Taninthayi Division. It also lies within a part of Mogok Belt, which is extending from Putao in the north to Moattama in the south (Nyan Thin 1984).

In the present area, metasedimentary and igneous rocks are major rock units. The plutonic mass is commonly occurred in the central part of the area. Most of them are probably belong to post Carboniferous intrusive phase (Bender, 1983).

The regional geological setting of Nwalabo Taung–Natkyigyaung area, Paung Township, Mon State is shown in figure (2).

Rock Sequence

The rock sequence of the area is shown in (Table 1). There are four major rock units, grouped as igneous, metaigneous, sedimentary and metasedimentary rocks. Igneous rocks are mainly exposed along the central part and bounded by the metasedimentary, sedimentary and metaigneous rocks. The rock sequences are arranged on the basis of field relationship and lithologic character.

Table (1). Rock Sequences of Nwalabo Taung – Natkyigyaung Area

Younger Alluvium	Holocene
Older Alluvium and Lateritic Soil	Pleistocene
~~~ Unconformity ~~~	
Igneous Rocks	
Microgranite dyke and quartz vein	
Porphyritic biotite granite and slightly foliated porphyritic biotite granite	Early Oligocene
Metaigneous Rocks	
Granite gneiss	Probably Paleocene
Metasedimentary Rocks	
Hornfels: Tourmalinized quartz hornfels, Micaceous quartzite	Probably Early Carboniferous to Early Triassic
Sedimentary Rocks	
White to light grey coloured sandstone, reddish to yellowish coloured sandstone and shale intercalated of Martaban Beds	Probably Late Permian to Early Triassic
~~~ Unconformity ~~~	
Pink coloured shale and dark grey coloured pebbly greywacke unit of Taungnyo Formation	Early Carboniferous

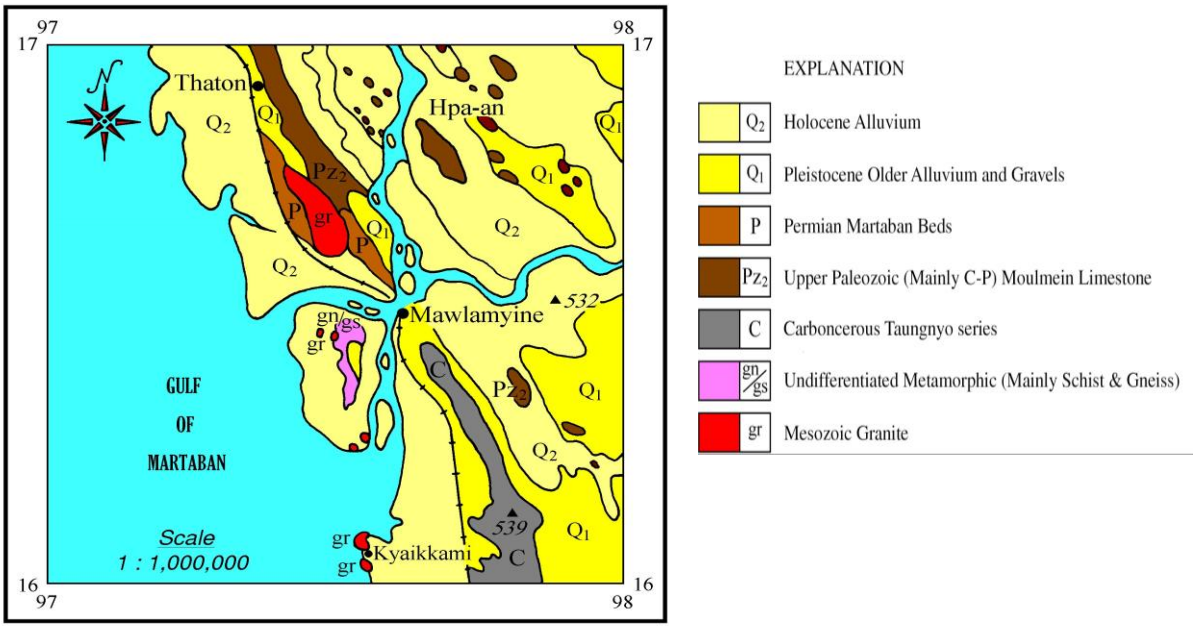

Figure (2). Regional geological map of the study area

Petrography

General Statement

The present study area is mainly composed of igneous, metaigneous, sedimentary and metasedimentary rocks. Petrographic study and determining of each rock unit is mainly based on textural, lithological and mineralogical criteria that are observed on the field evidence and petrographic studies. The present research is mainly emphasis on igneous, metaigneous and metasedimentary rocks.

Petrography of Metasedimentary Rocks

At the eastern part of the area, poor exposures of metasedimentary rock units are found. They are exposed between the porphyritic biotite granite and clastic sedimentary rock. It is known as hornfels zone. They are considered to be a contact aureole suggests that the area is affected by contact metamorphism into the clastic sedimentary rocks.

The contact between plutonic bodies and hornfels zone is sharp, whereas hornfels zone, sandstone and shale units of Taungnyo Formation are transitional contact. Galena, pyrite fragment sandwich into the micaceous quartzite of hornfels unit and other iron occurred in some place.

Tourmalinized Quartz Hornfels

Field and Megascopic Studies

At the contact zone, tourmalinized quartz hornfels are found. They are composed mainly of quartz, and tourmaline, hard and compact (Fig. 3). The pneumatolytic process (especially torumalinization) occurred near the granitic intrusion, where the country rocks are sandstone, greywackes and tourmaline come from a magmatic source. Tourmalinized quartz hornfels are consider to be formed by the production of boron from nearly by the magmatic source into the preexisting sandstone (Williams, 1954).

Microscopic Studies

It consists of fine to medium-grained quartz, tourmaline and minor amount of orthoclase and biotite. It is shown granoblastic texture. Quartz shows wavy extinction.

Tourmaline can be observed as both longitudinal and basal section which is about 1.5 mm shown in (Fig. 4). Subhedral tourmaline crystals are also found. Minute biotite flakes can be seen at intergranular grains of quartz. The argillaceous matrix is mostly sericite. Small amount of muscovite are also observed.

Micaceous Quartzite

Field and Megascopic Studies

Micaceous quartzite exposed near the contact zone. It has medium-grained and granoblastic texture. It is mainly composed of quartz, muscovite, feldspar and small amount of biotite. It is shown light grey to grey colour on weathered and fresh surface (Fig. 5). In some place, micaceous quartzite veins are intruded into greywacke at Loc: no. 123141 shown in (Fig. 6).

Microscopic Studies

It is fine to medium-grained, granoblastic texture and mainly composed of quartz, muscovite, alkalifeldspar and minor constituent of biotite. Accessory minerals are hematite, magnetite, garnet, zircon, scapolite and sphene. Tourmaline is also observed.

Quartz shows subrounded to anhedral form. The size of quartz grains are 0.1 to 0.5 mm. Most quartz grains are crushed, some quartz grain shows suture contact. It shows first order grey colour and wavy extinction.

Muscovite occurs as subhedral short prismatic crystal. Some muscovite cleavages are slightly bent. It shows second order bright colour in between cross-nicols. Minute flakes of muscovite also occurred as the space of quartz grains (Fig. 7).

Minor amount of orthoclase and biotite are also found. Accessory opaque minerals, zircon and garnet are occurred at the intergranular space of quartz grain. Scapolite closely associated with alkali feldspar. Rhomb shaped sphene minerals are also observed.

Petrography of Metaigneous Rocks

Metaigneous rock unit is well exposed at the western part of the study area. They are observed, especially near the Paung Town, Dawezu and along the mild western part of Mo-neik San to northern part of We-thagyaw San and near Zingyaik village at the Palat quarry. These units have gradationally changed to slightly foliated porphyritic biotite granite at nearly middle part area. The trend of granite gneiss is generally NNW-SSE direction.

Granite Gneiss

Field and Megascopic Studies

This rock unit has medium to coarse-grained, dark grey colour on weathered surface and light grey colour on fresh surface. It shows moderately to well jointed nature at near the Palat quarry **(**Fig. 8). They are composed of quartz, feldspar and biotite. They are observed generally massive, dome-shaped, hard and compact. It shows gneissose texture with alternately bands of quartzofeldspathic minerals and mafic biotite mineral. The feldspar phenocrysts are 1 to 2 cm in diameter.

Microscopic Studies

In thin section, granite gneiss show medium to coarse-grained, gneissose texture. It is mainly composed of alkali feldspar, quartz, plagioclase and biotite. Minute flakes of muscovite are also found. As accessory minerals, apatite, tourmaline and opaque minerals are observed.

Alkali feldspars are microcline, microcline perthite, perthite and orthoclase. They are shown first order grey colour and subhedral form. Microcline shows cross-hatch twinning and string or vein and flame perthites are also found. Orthoclase feldspar occurs both simple contact twin and untwin. Some alkali feldspar altered to sericite and kaolin mineral. Minute grains of recrystallized quartz are found in cracks, fractures and the interspaces between the some large grains of quartz and feldspar. Some quartz gains display wavy extinction (Fig. 9).

Plagioclase feldspar is seen as subhedral prismatic crystals and as porphyroblasts. They are closely spaced twinned. According to Michel-levy's method, "An" percentage is about Ab_{92}-An_{8} to Ab_{82}-An_{18} (albite-oligoclase) range. Boundaries of plagioclase are bounded by small grains of quartz and biotite. Myrmekitic texture occurs at some contact of plagioclase with quartz and orthoclase. Some plagioclase show sericitization and sassuratization effect along the twin plane (Fig. 10).

Biotite occurs as elongated flakes, but short prismatic form is also found. Some biotite are altered to chlorite. Biotite shows yellowish to brown and greenish in paleochroism. In some biotite, cleavages are slightly bent. High relief long prismatic form of tourmaline minerals found between the biotite. It is shown second order reddish brown and greenish brown colour in cross-nicol (Fig. 11). Apatite minerals are also found as inclusion in biotite. Minute flakes of muscovite closely associated with biotite and some muscovite altered to sericite. The minor amounts of opaque minerals are polygonal outline of garnet, hematite and magnetite. The opaque minerals are observed as irregular grain in thin section.

Petrography of Igneous Rocks

In the study area, plutonic igneous rocks are mainly exposed. The igneous rocks of the area can be divided into two units.

2. Porphyritic biotite granite

1. Slightly foliated porphyritic biotite granite

They are major rock units and in some place, minor amount of micrograninte and quartz veins are also found usually associated with granitic rock in the area. Representative of major rock unit were determined by point counting analysis and the plotting on the I.U.G.S classification diagram (1989) as shown in (Fig. 12).

Slightly Foliated Porphyritic Biotite Granite

Field and Megascopic Studies

This rock unit is well exposed in the middle part of the study area. This granite is hard, compact and moderately to well jointed nature. In some place, exfoliation features are also observed. It is light grey on fresh surface and weathered colour show grey to dark grey. Mostly they are coarse-grained and porphyritic texture with the phenocrysts of quartz and feldspar. A distinctive feature of this rock unit has been shown the parallel alignment of mafic biotite minerals and subparallel of feldspar phenocrysts (Fig. 13).

Microscopic Studies

It displays typically coarse-grained, porphyritic texture and mainly composed of alkali feldspar, quartz, plagioclase and biotite. Accessory minerals are muscovite, apatite, zircon, tourmaline and other iron ore. Results are plotted on I.U.G.S classification diagram, these granites fall in Syenogranite field (Fig. 12).

Alkali feldspars are microcline, microcline perthite, perthite and orthoclase. Microcline and microcline perthite are most common shown as cross-hatch twin (Fig. 14).

The various kinds of perthite and orthoclase are observed. According to Alling (1932) and Barth (1969), the presence of string, vein and flame perthites indicates a low temperature condition of original magma. Sericitization and kaolinization are also found along the cleavages traces of alkalifeldspar.

Quartz is mostly seen as anhedral crystal. Some quartz shows undulose extinction and prominent cracks due to strain effect. The suture contact of small quartz grains are found at the boundary of K-feldspar and plagioclase.

Plagioclase feldspar displays subhedral prismatic crystal. It is shown polysynthetic twinning and some twin planes are slightly bent (Fig. 15). The compositional range determined by Michel Levy's method is Ab_{90}-An_{10} to Ab_{82}-An_{18} (albite-oligoclase) range. Myrmekitic texture is also observed.

Biotite content is about 6.8% of the total volume of constituent minerals. Some biotite cleavage is bent (Fig. 16). Minute biotite flakes show parallel alignment and are mostly surrounded to large grain of feldspar and quartz. At the boundary of biotite, small amount of muscovite are observed. Apatite is also observed in the boundary of some biotite and some apatite enters at the flakes of biotite as the inclusion.

Long prismatic crystals of tourmaline are closely occurs at the quartz and feldspar (Fig. 17). Zircon is also observed in biotite as the inclusion. Garnet and other opaque minerals such as hematite and magnetite are also found.

Porphyritic Biotite Granite

Field and Megascopic Studies

This unit is most abundant in the study area. It is coarse-grained, porphyritic texture. This granite is exposed at southern continuation of Kalama Taung Granite. The colour of the granite unit is light grey on fresh surface and grey to dark grey on weathered surface. The characteristic feature of this granite is the presence of randomly feldspar phenocrysts (Fig. 18). In some place, feldspar phenocrysts are shown subparallel alignment. It is hard and compact, and moderately jointed. At the Nwalabo Taung, nearly vertical jointed natures are found. They are mainly composed of quartz, feldspar and biotite. The phenocryst of feldspar range is 1 to 5 cm in length and 0.7 to 2 cm in width.

The long axis of the plutonic igneous body is trending nearly NNW-SSE direction. Microgranite dyke or Dartwekyauk (local name) may be found in the middle part of near Kyauk Htat Pagoda (Loc. no. 062191).

Microscopic Studies

It shows coarse-grained, hypiodiomorphic granular and porphyritic texture. It is mainly composed of alkali feldspar, quartz, plagioclase and biotite. Accessory mineral are apatite, zircon, tourmaline and other opaque minerals. According to I.U.G.S classification diagram, this granite falls in Syenogranite (Fig. 12).

Alkali feldspar occurs as phenocrysts, orthoclase shows both simple contacts twin and untwined. Microcline occurs as subhedral form and it shows cross-hatch twinning (Fig. 19). The various kind perthite, such as microcline perthite, string and flame perthite are also observed (Fig. 20). Some orthoclase feldspar is altered to sericite along the fracture and cleavage traces.

Anhedral crystal of quartz shows undulatory extinction due to strain effect. Small quartz grains are found as inclusion in alkali feldspar and plagioclase. In some slide, suture contacts of quartz are also found.

The plagioclase is found as subhedral prismatic crystals. It shows polysynthetic twinning. Twin bands are closely spaced and determined the composition of plagioclase by Michel Levy's method is Ab_{90}-An_{10} to Ab_{82}-An_{18} (albite-oligoclase) range. Sericitization and sassuratization occurs along the twin plane of plagioclase (Fig. 21). Myrmekitic texture is also found (Fig. 22).

The chief mafic mineral of biotite occurs as flakes or as inclusion in feldspar crystal. It shows pale yellow to dark brown and greenish brown in paleochroism and it displays subhedral to anhedral form. Some biotite cleavages are slightly bent. Some biotite is altered to chlorite along the cleavage and margins. Tourmaline crystal is also found in this granite. A small amount of muscovite, apatite, zircon, tourmaline, garnet and iron ore are present as accessories. Minute flakes of muscovite occur as the boundaries of biotite and feldspar. Small perfect six-sided elongated rectangular section of apatite occurs as inclusion in biotite (Fig. 23). Opaque minerals especially hematite, magnetite and other iron ore are also noted.

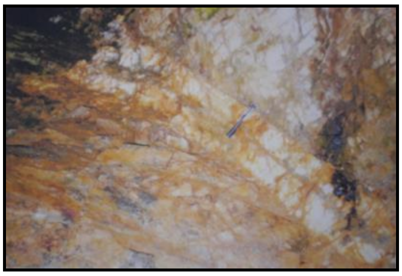

Figure (3). Outcrop nature of tourmalinized quartz hornfels (Loc: 122154)

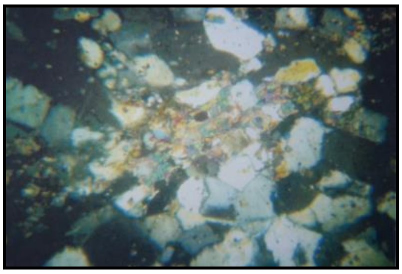

Figure (4). Tourmaline and quartz grains in tourmalinized quartz hornfels (between X.N) (Loc: 123153)

Figure (5). Bedding nature of micaceous quartzite exposure (Loc: 121141)

Figure (6). Micaceous quartzite vein intruded into the greywacke of Taungnyo Formation (Loc: 123141)

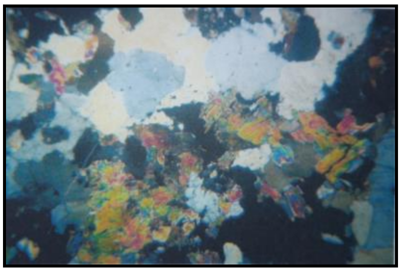

Figure (7). Minute flakes of muscovite mica in micaceous quartzite (between X.N) (Loc: 121141)

Figure (8). Highly jointed nature of granite gneiss, near the Palat quarry (Loc: 014221)

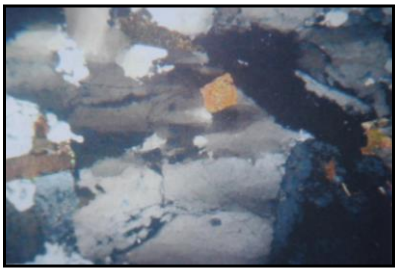

Figure (9). Undulatory (wavy) extinction of quartz grains in granite gneiss (Between X.N) (Loc: 043177)

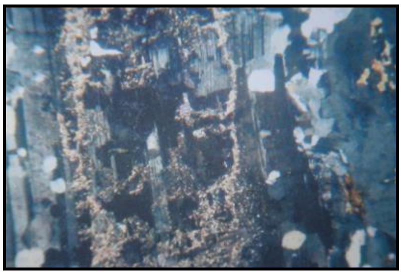

Figure (10). Sericitization along the twin plane of plagioclase feldspar in granite gneiss (Between X.N) (Loc: 037187)

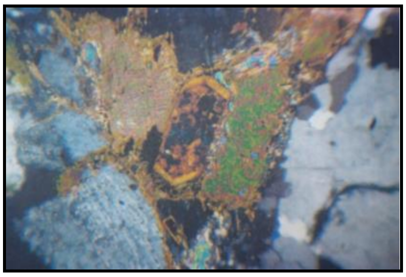

Figure (11). Zonal feature of tourmaline crystal in granite gneiss (Between X.N) (Loc: 039208)

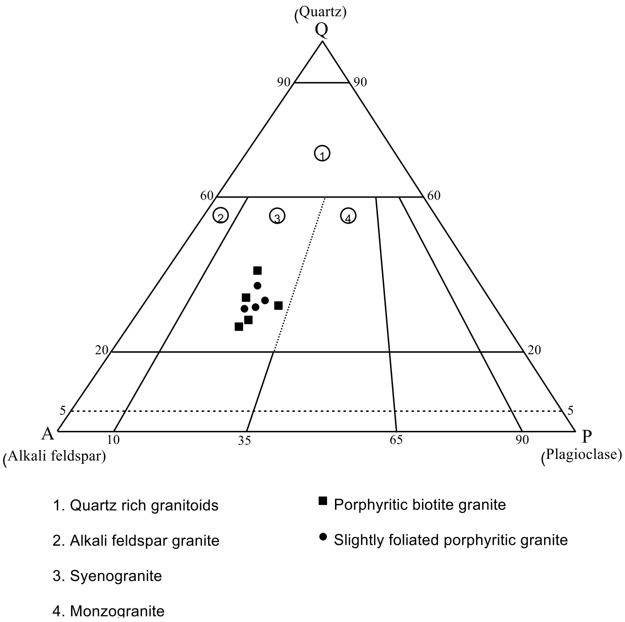

Figure (12). Plotted data of the igneous rocks on the I.U.G.S (1989) classification diagram

Figure (13). Subparallel alignment of feldspar phenocrysts in slightly foliated porphyritic biotite granite (Loc: 057195)

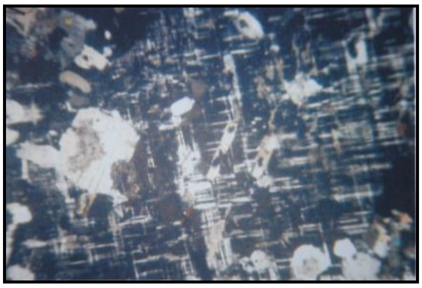

Figure (14). Cross-hatched twinning of microcline in slightly foliated porphyritic biotite granite (Between X.N) (Loc: 052172)

Figure (15). Slightly bended nature of plagioclase twin plane in slightly foliated porphyritic biotite granite (Between X.N) (Loc: 061198)

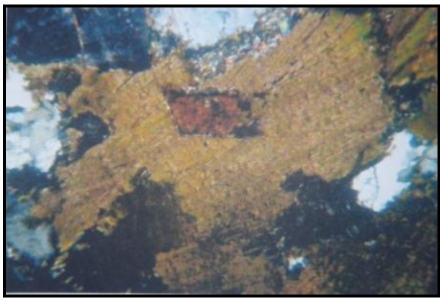

Figure (16). Bending of biotite cleavage and inclusion of tourmaline crystal in biotite from slightly foliated porphyritic biotite granite (Loc: 051195)

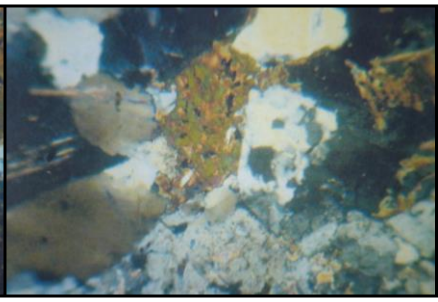

Figure (17). Tourmaline crystals in slightly foliated porphyritic biotite granite (Between X.N) (Loc: 052172)

Figure (18). Randomly oriented feldspar phenocrysts in porphyritic biotite granite (Loc: 074216)

Figure (19). Microcline showing cross-hatched twinning in porphyritic biotite granite (Between X.N) (Loc: 069188)

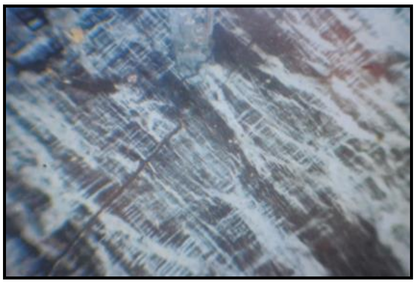

Figure (20). Microcline perthite in porphyritic biotite granite (Between X.N) (Loc: 067203)

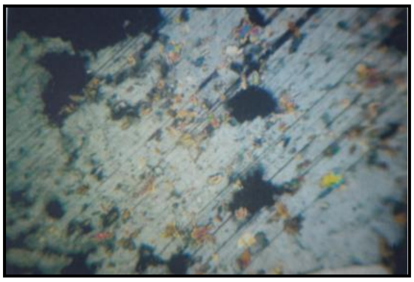

Figure (21). Saussuratization process along the twin plane of plagioclase in porphyritic biotite granite (Between X.N) (Loc: 069188

Figure (22). Myrmekitic texture in porphyritic biotite granite (Loc: 069188)

Figure (23). Small prismatic and longitudinal section of apatite crystal in porphyritic biotite granite (Between X.N) (Loc: 035220)

Petrogenesis

Suggested Origin of the Granitic Rocks

In the present investigated area, granitic rocks are considered to be magmatic origin and base on the following factors:

1. Lack of ghost structure within the granitic body
2. Lack of migmatite association
3. Presence of perthites and alkali feldspar phenocrysts
4. Presence of twinning and zoning of K-feldspar and plagioclase
5. Presence of euhedral zircon and six-sided apatite crystals
6. Presence of biotite mica in granite
7. Presence of myrmekitic textures in granite
8. Presence of contact aureole

Dyke and veins are rare in the study area. They are intruded into all the granitic units and granite gneiss. They are considered as the late stage magmatic activities of the area.

Genetic Types of Granitic Rocks

The type of the Central Granitoid Belt of Myanmar is regarded as both I-type and S-type (Khin Zaw, 1990). Therefore, the granitic rocks of the present research area are regarded as S-type base on the field and petrographic evidences.

1. Hornblende is absent, within the granitic rock
2. Muscovite is presence associated with quartz and biotite boundaries
3. Presence of accessory almadine garnet mineral
4. Biotite is present as principle mafic mineral (up to 10.8%)
5. Accessory mineral of apatite is observed in the granitic rock

Possible age of granitic rocks

In the investigated area, possible age of granitic rock is based on the absolute dating of adjacent area. The age of granites and other syn-tectonic granitoid rocks in the study area are based on the age of granites of Tenasserim and north-western Thailand regions.

It lies in the Central Granitoid Belt of Myanmar (Khin Zaw, 1990) and characterize by Mesozonal and mostly Late Cretaceous to Lower Eocene. But the radiometric dating of the granite samples, which are collected by the G.I.A.C field trip (1996) are as following.

Kyaikhto Area	Porphyritic granite	My.	96.211
	(Ar.Ar method)	Bio.	31 ± 0.9 Ma
Kyaikhto	Isotropic granite	My.	96.213
	(Ar.Ar method)	Bio.	2.2 Ma
		Q + F	30.5 ± 0.9 Ma
Thaton Area	Isotropic granite	My.	96.222
	(Ar.Ar method)	Bio.	29.2 ± 0.7 Ma
		Q + F	25.6 ± 0.7 Ma
Thaton Area	Foliated granite	My.	96.217
	(Ar.Ar method)	Bio.	25.6 ± 0.5 Ma

Therefore, a probable age for igneous rocks of the study area is used their absolute age of G.I.A.C field trip. Assumed that, igneous activity in this area is probably during Early Oligocene age (Between 32.2 Ma and 25.6 Ma).

Granite Emplacement

The igneous rocks of the study area may have been emplaced in the upper part of mesozonal level. The evidences are as follow:

1. Dykes and veins are not common
2. Metasedimentary enclaves are absent in granitic body
3. The associated volcanic rocks are absent
4. Contact metamorphic aureole and metamorphic index minerals are present
5. Contact migmatite are present
6. The intrusive bodies are partially concordant with the regional trend of country rocks.

Mechanism of Emplacement

In the study area, granitic intrusions are considered to have taken place by permissive emplacement during syn-tectonic on the basic of the following evidences:

1. The granitic rocks in the area show a linear flow structure (the alignment of feldspar phenocrysts)
2. Presence of bending of cleavages in biotite flakes
3. Some quartz grains show wavy extinction.

Types of Metamorphism and Metamorphic Facies

In the study area, the types of metamorphism are classified based on the observation of mineral assemblages. Defining of mineral assemblages, nomenclature and facies classifications are based on Turner (1968) and Turner and Verhoogen (1960).

There are two types of metamorphic facies, such as regional and contact metamorphic facies. The mineral assemblages and metamorphic facies of the area are shown in (Table 2). The facies diagram as shown in (Figs. 24 and 25).

Table (2). Mineral assemblage and metamorphic facies of the area

1. Regional metamorphism		
Lower amphibolite facies		
Quartzofeldspathic rock		
Granite gneiss	-	quartz + microcline + plagioclase + biotite + muscovite
2. Contact metamorphism		
Albite-epidote amphibplite facies		
Pelitic Rocks		
Tourmalinized quartz hornfels	-	quartz + orthoclase + tourmaline + biotite + muscovite
Micaceous quartzite	-	quartz + muscovite + orthoclase + biotite

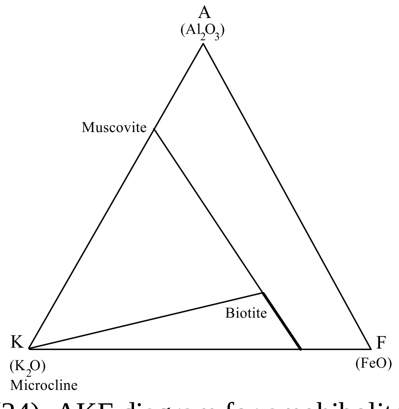

Figure (24). AKF diagram for amphibolite facies of regional metamorphism and mineral assemblages recognized in the study area. Quartz is an additional phase in the diagram

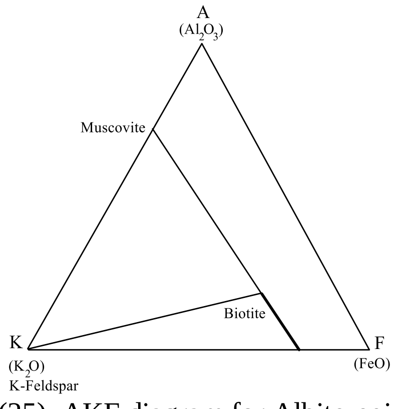

Figure (25). AKF diagram for Albite-epidote amphibolite facies contact metamorphism and mineral assemblages recognized in the study area. Quartz is an additional phase in the diagram

Probable P-T Condition

The probable P-T condition of high-grade regional metamorphic rocks (granite gneiss) of lower amphibolite facies, which is range in temperature between 550 to 700°C and fluid pressure normally between 4 kilobars and 8 kilobars (Turner and Verhoogeen, 1960).

In low-grade contact metamorphic rocks of the albite-epidote amphibolite facies, and also according to Turner and Verhoogen (1960), the probable P-T condition is about temperature range from 350°C to 550°C and PH_2O 2.5 to 4.5 kilobars.

Conclusion

The area is principally composed of two units of sedimentary rocks, one unit of metasedimentary rock; three units of granitic rocks and one unit of metaigneous rock are exposed. Slightly foliate porphyritic biotite granite and porphyritic biotite granite are major granitic rocks in the area. Modal analysis plotted in the I.U.G.S (1989) classification diagrams, these two units fall in the syenogranite field. Slightly foliated porphyritic biotite granite, porphyritic biotite granite and granite gneiss are mainly composed of alkali feldspar. quartz, plagioclase and biotite . Plagioclase range is albite-oligoclase.

The granitic rocks of the study area are considered to be magmatic in origin. Dykes and veins are considered at the late stage magmatic activities of the area. The granitic rocks are regarded as S-type. On the basis of field and petrographic evidences, the granitic emplacement is regarded as in the depth of Mesozone level. The mechanism of emplacement is considered to be taken place by permissive emplacement during syntectonic. The age of granitic rocks are regarded as Early Oligocene. This is based on the radiometric dating done by G.I.A.C field trip (1996) in Thaton and Kyaikhto Areas.

The sedimentary rocks were intruded by the granitic intrusion and due to the contact effect, metasedimentary rock of micaceous quartzite and metaigneous rock of tourmalinized quartz hornfels are formed along the igneous-sedimentary contact about. Micaceous quartzite consists of fine to medium-grained of quartz, muscovite, orthoclase feldspar and small amount of biotite. Tourmalinized quartz hornfels are formed due to intrusion of boron from nearby magmatic source into pre-existing sandstone, causing tourmaline crystals sees in granoblastic quartz, and minor constituent of orthoclase feldspar, biotite and argillaceous matrix.

According to the mineral assemblages and grade of metamorphism, the regional metamorphism affected on granite gneiss is as Lower Amphibolite Facies. In contact metamorphic rocks, micaceous quartzite and tourmalinized quartz hornfels, indicate to Albite-epidote-amphibolite facies.

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