PETROLOGY, RADIOMETRIC DATING AND ECONOMIC ASPECTS OF GRANITOID ROCKS IN NWALABO TAUNG AREA, PAUNG TOWNSHIP, MON STATE

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Abstract

NwalaboTaung is located 4.5 km northeast of Paung in Mon State and it lies on Yangon -Mawlamyine car road. The study area is principally composed of granitoid rocks, viz, foliated porphyritic biotite granite, porphyritic biotite granite, gneissose granite, biotite microgranite and tourmaline granite. Biotite microgranite and tourmaline granite occur as small stocks. Microgranite, pegmatite and schorl rocks are found as dykes and aplite and quartzofelspathic veins are also observed. Microdioritic xenoliths are also recognized in this area. Granitoid rocks intruded Taungnyo Formation and Martaban Beds. In this area, old local worksites of tin and tungsten are found at the place about 2.5 km north of Natkyigyaung village. Minor amounts of stibnite and pyrite occur in the northeastern part of the study area. Beside Banbwegon quarry, eastern and western Yetagon quarries near Sinywa yield huge quantity of porphyritic biotite granite for extraction of high quality dimension slabs as well as construction and road materials.

Introduction

The study area lies between Latitude 16˚35′00″ N to 16˚40′00″ N, and Longitude 97˚26′00″ E to 97˚32′00″ E. Nwalabo Taung is located 4.5 km northeast of Paung. It extends about 9.65 km from east to west and 8.05 km from north to south, covering approximately 77.7 square kilometers. Paung is located about 281.75 km southeast from Yangon and 29 km from Mawlamyine.

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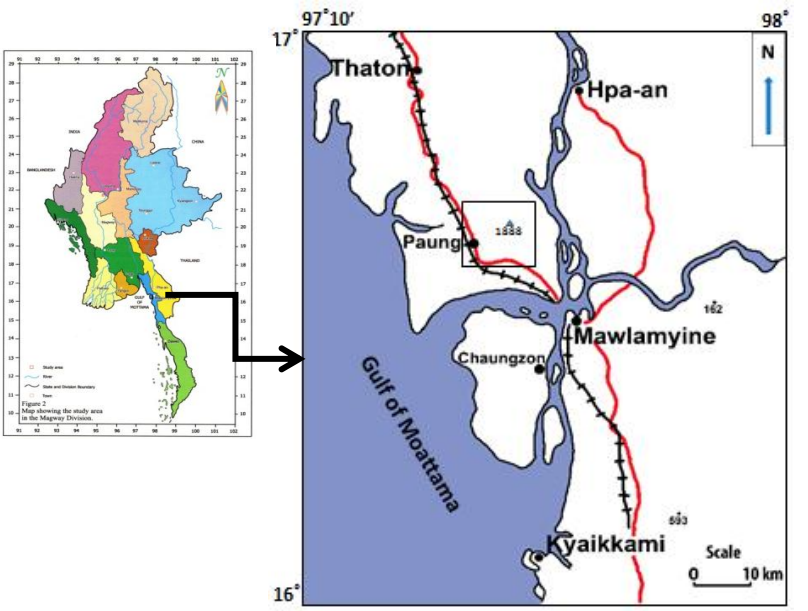

Figure 1: Location map of the study area

Petrology

The exposures of porphyritic biotite granite and foliated porphyritic biotite granite are mostly found as large and good exposures, large boulder sand large high cliffs. These rock units commonly show as vertical jointed nature and exfoliation. Large boulders of gneissose granite are also observed. In some places, granite exposure shows bedded nature and feldspar phenocrysts are nearly sub-parallel in alignment, generally NNW-SSE in direction, which is similar to the general trend of the granite body. Porphyritic biotite granite is the major rock unit covering about 70 percent of the total exposed surface area. Foliated porphyritic biotite granite is exposed in the western part and gneissose granite is exposed the westernmost part. Biotite microgranite, pegmatite and schorl rock dykes, and aplite, quartzofelspathic and quartz veins intrude the porphyritic biotite granite. Biotite microgranite and tourmaline granite occur as small stocks in the central part of the area.

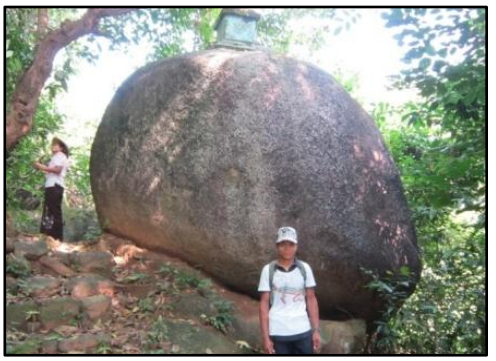

Figure 2: Large boulder of porphyritic biotite granite in Banbwegon San at (16˚36′33″N and 97˚28′50″E)

Figure 3: Bedded nature of porphyritic biotite granite at Banbwegon quarry (16˚36′20″N and 97˚29′55″E)

Figure 4: Vertically jointed nature of Porphyritic biotite granite at YetagonChaung (16˚39′ 33″N and 97˚ 30′ 40″E)

Figure 5: Exfoliated of porphyritic biotite granite at (16˚39′23″N and 97˚28′52″E)

Table :1 Rock Sequences of the Study Area

Igneous Rocks	
Dykes and Veins (Microgranite, Pegmatite and schorl rock dykes, Aplite, Quartzofelspathic and Quartz veins)	Late Cretaceous
Tourmaline granite	
Biotitemicrogranite	
Gneissose granite	
Porphyritic biotite granite	
Foliated porphyritic biotite granite	

Foliated Porphyritic Biotite Granite

Field and Megascopic Studies

In the study area, this unit is faulted contact with gneissose granite in the west. It is lying between gneissose granite and porphyritic biotite granite. The difference between this unit and porphyritic biotite granite is the presence of biotite alignment showing foliated texture in this unit. These rocks are coarse-grained, showing porphyritic texture and the phenocrysts of feldspar are between 10 to 5 cm in length and 1 to 2 cm in width.

Microscopic Studies

Microscopically, it is mainly composed of alkalifeldspar, quartz, plagioclase and biotite. Accessory minerals are apatite, sphene, zircon and magnetite. Some biotites show curved cleavage and pleochroic haloes in biotite are noted. Sphene crystals and minute crystals of zircon are observed. Zoned plagioclase feldspars are observed. Alkalifeldspars are represented by orthoclase, perthitic orthoclase, microcline and microcline microperthite. Types of perthites are patch, vein andstring. Sericitization is common and epidotization occurs as small patches along the cleavage traces of these alkalifeldspar. Quartz occurs in two types; a single large crystal showing wavy

extinction and recrystallized minute grains of quartz around orthoclase feldspar, showing mortor structure. In some slide, the grain contact of quartz and alkalifeldspar, quartz and plagioclase also show graphic texture.

Porphyritic biotite granite

Field and Megascopic Studies

Porphyritic biotite granite is the major rock type covering about 70 percent of the total area. It is the southern continuation of Kalama Taung granite, which has about 30 square miles in total exposed area. This unit lies between the foliated porphyritic biotite granite in the west and hornfels unit in the east. The western contact is a gradational contact whereas the eastern contact is sharp. The exposures are mostly weathered and exfoliation features are common. Large and good exposures of porphyritic biotite granite exposed in Shwebontharmonestry in Banbwegon village, Kyauk Kwe Taung, near Kywegyan village, Yetagon Chaung, Gangaw San and along the foot path of Nwalabo Taung. In some places, granitic exposure shows bedded nature. These phenocrysts mostly range in size between 1.5-7 cm in length and 1-3 cm in width.

Microscopic Studies

Microscopically, it shows coarse-grained, porphyritic texture and is mainly composed of alkali fekdspars, quartz, and plagioclase and biotite. Accessory minerals are apatite, sphene, zircon and pyrite. Myrmekitic texture is abundant at the grain contact of quartz and alkalifeldspar, quartz and plagioclase. Rim and intergranular myrmekites are common. Bulbous myrmekite indicates that the host rock has been deformed (Phillips, 1974). Plagioclase feldspar exhibits well albite twinned euhedral grains. Zoning is occasionally developed. Euhedral megacrysts of perthites are string, vein, patch and braid perthites. These perthites are believed to be formed under temperature (about 500˚C) by exsolution process, where string perthites formed at any early stage in the evolution of feldspar and film perthites is probably formed at a later stage than string perthite (Alling, 1932). By further replacement of the alkali feldspar (microcline) by albite, braid and vein

perthites grade into patch type perthite. Patches of kaolinization and sericitization occur along the cleavage traces of alkali feldspars.

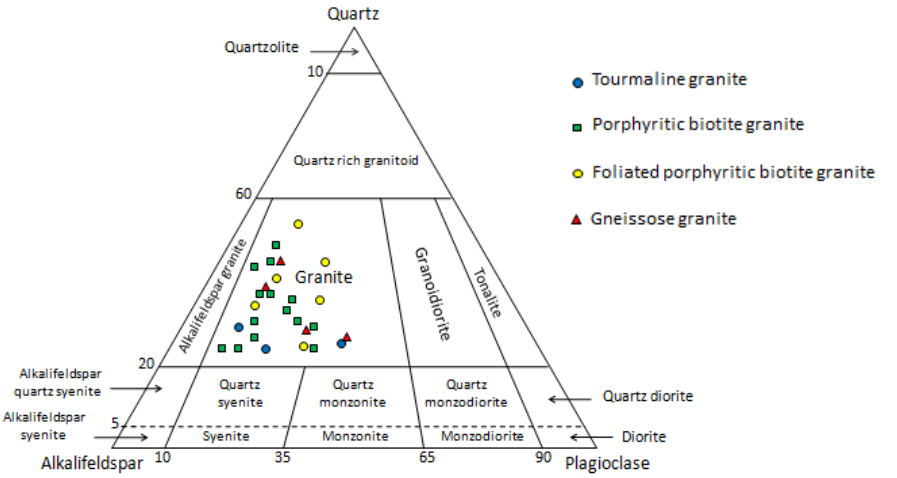

Figure 6: Igneous rocks in the study area plotted on the I.U.G.S classification diagram of Le-Maitre, 2001

Figure 7: Foliated porphyritic biotite granite in Kyaukmandut at (16˚35′45″N and 97˚29′31″ E)

Figure 8: Sphene crystal in foliated porphyritic biotite granite, Between XN

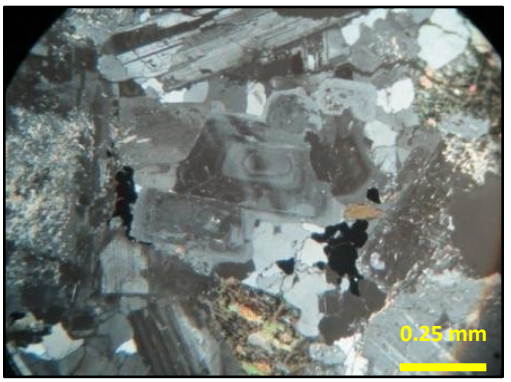

Figure 9: Zoned plagioclase in foliated porphyritic biotite granite, Between XN

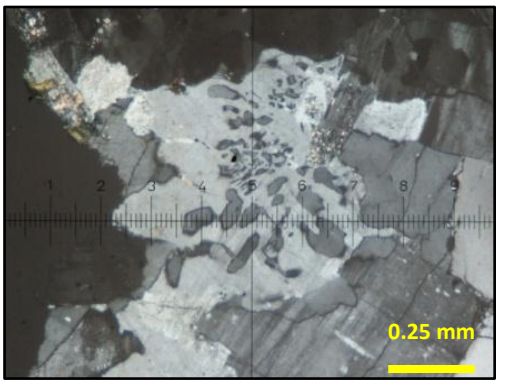

Figure 10: Graphic texture in foliated porphyritic biotite granite, Between XN

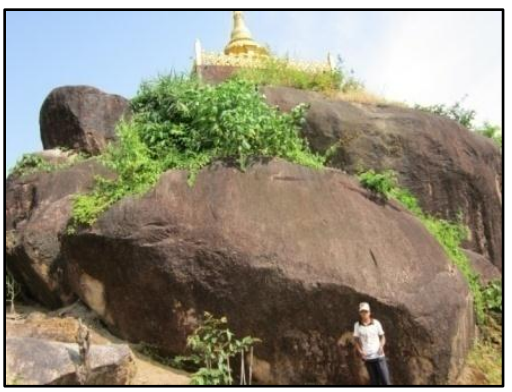

Figure 11: Porphyritic Biotite Granite exposed in Banbwegon at (16˚35′57″N and 97˚29′42″E)

Figure 12: Porphyritic biotite granite in YetagonChaung at (16˚39′33″N and 97˚ 30′40″E)

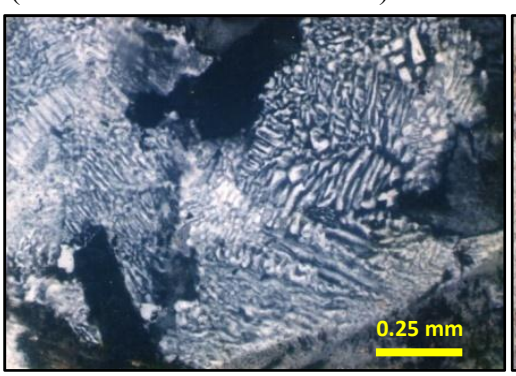

Figure 13 Myrmekitic texture in porphyritic biotite granite, Between XN

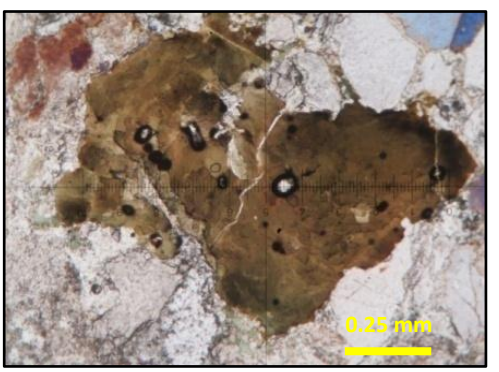

Figure 14: Pleochroic haloes in biotite flake found in porphyritic biotite granite, Under PPL

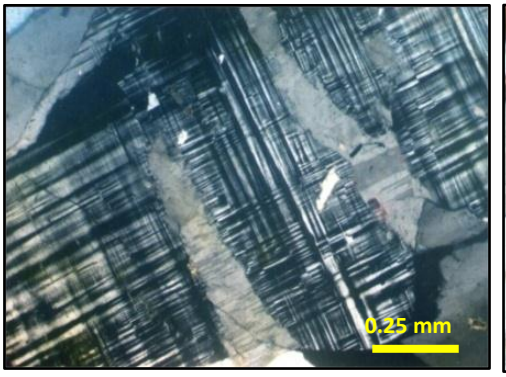

Figure 15: Cross–hatched microcline in porphyritic biotite granite, Between XN

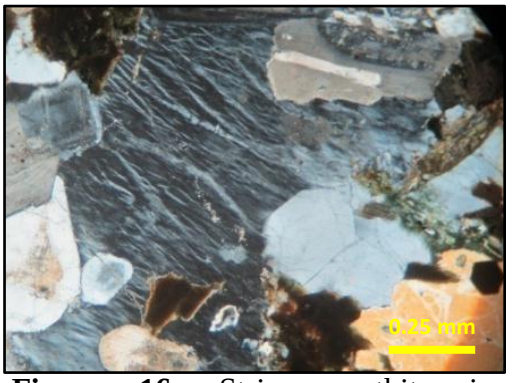

Figure 16: String perthite in porphyritic biotite granite, Between XN

Gneissose granite

Field and Megascopic Studies

This unit observed at the westernmost part of the study area near Paung Town, Dawezu and Mone quarters. This unit is separated from foliated porphyritic biotite granite with faulted contact occurs at the eastern margin of this unit. The gneissose granite is nearby foliated porphyritic biotite granite. They are well exposed and some are moderately weathered. Biotite and other mafic minerals occur as foliations around augen like quartzofelspathic minerals. Soaugen texture is common on both weathered and fresh surfaces. The trend of foliation is generally NNW-SSE which is similar to the regional trend of the igneous body. Most feldspar porphyroblasts are 1 to 2 cm in length and 0.5 to 1 cm in width.

Microscopic Studies

Microscopically, it is medium to coarse-grained, showing gneissose texture and mainly composed of alkalifeldspar, quartz, plagioclase, hornblende, biotite and minute flakes of muscovite. Zircon, sphene and magnetite occur as accessory minerals. Alkalifeldspars are orthoclase, microcline and microperthites. Orthoclase feldspar porphyroblasts surrounded by fine-grained recrystallized quartz and biotite flakes. Marginal granulation of quartz around orthoclase feldspar is found in gneissose granite. Most feldspar crystals are surrounded by recrystallized quartz and biotite flakes

resulting in augen texture. Minute grains of recrystallized quartz occur and are infiltrating into cracks, fractures and interspaces between the grains. Large crystals of quartz show wavy extinction. Biotite occurs as elongated flakes, aligned between the feldspar porphyroblasts. Some biotite shows bending of cleavage and some are altered to chlorite. Minute flakes of muscovite (sericite) occur in the fractures between large plagioclase feldspar grains. Vein perthite, string and film perthite are still observed. Sericitization is also noticed.

Figure 17: Exposure of gneissose granite on the top of Sutaungpye Taung (16˚ 37′28.6″N and 97˚ 27′36.8″E)

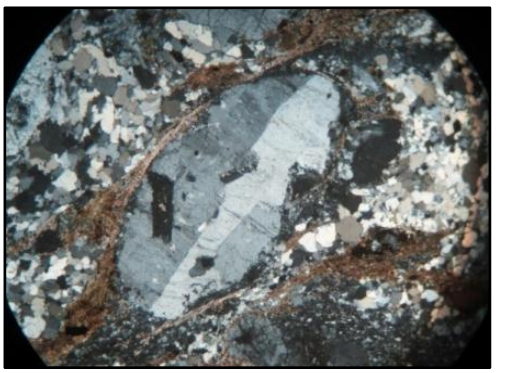

Figure 18: Orthoclase feldspar porphyroblasts surrounded by fine-grained recrystallized quartz and biotite flakes in gneissose granite, Between XN

Figure 19: Exposure of biotite microgranite occurs at (16˚38′42″N and 97˚27′54″E)

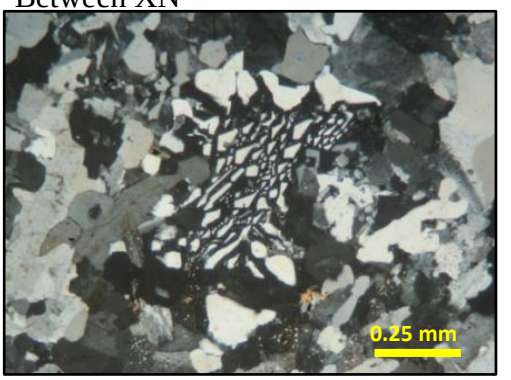

Figure 20: Graphic texture result from eutectic crystallization of quartz and alkali feldspar found in biotitemicrogranite, Between XN

BiotiteMicrogranite

Field and Megascopic Studies

Biotite microgranite intruded into porphyritic biotite granite and foliated porphyritic biotite granite. Exfoliation features are also observed. The trend of this unit is mostly NNW-SSE in direction.

Microscopic Studies

Microscopically, it has medium-grained and hypidiomorphic granular texture and is mainly composed of orthoclase, microcline, quartz, plagioclase and biotite. Graphic texture is shown in and spherulitic feldspar fibres are observed in this rock. Zircon crystals are found as accessory minerals.

Tourmaline Granite

Field and Megascopic Studie

Tourmaline granite occurs as small stock and quartz and tourmaline segregation develops in some places. Segregation pockets are up to 2 feet in diameter. It is exposed as the transition zone, between schorl rock and porphyritic biotite granite. It shows coarse-grained texture and mainly consists of quartz, feldspar and tourmaline. Acicular black tourmaline crystals are radially exposed in granite, where biotite is absent.

Microscopic Studies

Microscopically, it is mainly composed of quartz, alkalifeldspar, plagioclase, tourmaline and muscovite. Pyrite is present as opaque mineral. Quartz occurs as anhedral large grains, with some showing wavy extinction. Contact Carlsbad twinned orthoclase and spherulitic feldspar fibres are present in this rock. Triangular and prismatic crystals of tourmaline aggregate occur. Tourmaline is mostly occurs in prismatic section. Small muscovite flakes occur as interstitial minerals. Euhedral crystals of apatite and zircon occur as accessory minerals.

Figure 21: Tourmaline Granite exposed at (16˚38′51″N and 97˚29′52″E, Facing 125˚)

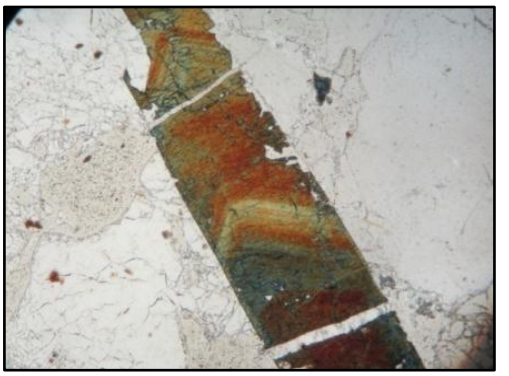

Figure 22: Prismatic section of tourmaline crystal in tourmaline granite, Under, PPL

Dykes and Veins

In the study area, microgranite and pegmatite occur as dykes and, aplite, numerous quartz veins and quartzofelspathic veins are observed. Microgranite dyke intruded into the porphyritic biotite granite. Pegmatite dyke intruded into porphyritic biotite granite and foliated porphyritic biotite granite. Aplite and quartzofelspathic veins also intruded into the porphyritic biotite granite. Numerous quartz veins intruded into porphyritic biotite granite and foliated porphyritic biotite granite. The trends of the dykes are mostly NNW-SSE and NE-SW in direction. The contact between dyke and host rock is sharp.

Radiometric Dating

The representative samples of some igneous rocks collected from the Nwalabo Taung area were sent to the geochemical and isotope laboratory in the University of Tasmania for LA-ICP-MS geochronological studies. Four rock samples (A5-16˚38′42″N and 97˚ 27′54″E- biotite microgranite, K3-16˚38′42″N and 97˚27′20″Egneissose granite,B12-16˚ 39′03″N and 97˚ 29′40″E-Porphyritic biotite granite, C5-16˚ 37′29″N and 97˚ 28′08″E-foliated porphyritic biotite granite) from the study area were analyzed for radiometric dating. The U-Pb zircon ages of the analyzed rocks are listed in Table (2).The age of biotite microgranite was 67.24± 0.66 Ma, gneissose granite was 71.42

± 0.75 Ma, porphyritic biotite granite was 72.07 ± 0.78 Ma and foliated porphyritic biotite granite was 73.1 ± 1.4 Ma.

Thus radiometric dating of the granitoid rocks emplaced in Late Cretaceous age.

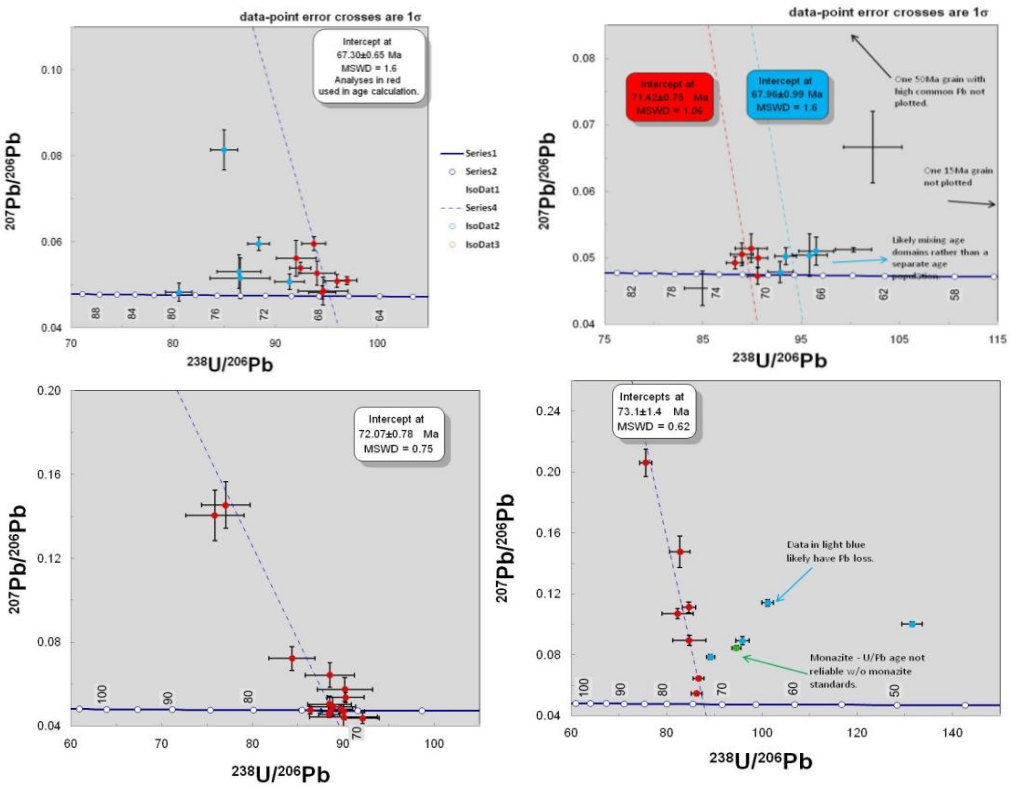

Figure 23: The Concordia diagram for $^{238}U/^{206}Pb$ - ^{207}Pb / ^{206}Pb of separated zircon from A5- biotite microgranite, .K3- gneissose granite, B12- porphyritic biotite granite and C5- foliated porphyritic biotite granite of NwalaboTaung Area

Economic Aspects

In the study area, economically workable important mineral deposits have not yet been found. But abandoned, old local tin and tungsten mines are found about 2.5 km north of Natkyigyaung village. Minor amounts of stibnite

and pyrite occur in the northeastern part of the study area. Construction and road materials can be extracted in huge quantity.

Construction and Road Materials

The porphyritic biotite granite in Banbwegon quarry was extracted for construction and road materials. The Banbwegon quarry has been extracted since in 1998. Crusher plant is situated between Banbwegon and Kyonka villages. The quarry is regarded as most reliable source of supply of less than 200 mm, 20 mm to 5 mm and less than 5 mm size of crushed granite. Finished products ranging from 20 mm to 5 mm in size are a graded granite aggregate used for high grade concrete. In 1998, the granite quarry also produced good quality dimension slabs. Since 2001, this quarry has not extracted granite slabs.

Today, this quarry stopped their production because of mining accident. This quarry is close to the residential in Banbwegon and Kyonka villages and large blocks of granite frequently fell onto the houses during mining. In the study area, Myanmar Ye Man Co. Ltd., Global Vertex Co. Ltd., Shwe Myint Mo Tun Co. Ltd. and Yamanya United Co. Ltd., are extracting porphyritic biotite granite for construction and road materials and dimension slabs. These quarries have been started in 2012-13.They use 120 tons/hr small-sized mobile crusher plant, 250 tons/hr medium-sized mobile crusher plant and 450 tons/hr large-sized mobile crusher plants. It is well organized, modern quarry with systematic bench blasting. The crusher plant is a high capacity structure consisting of jaw and cone crushers with synchronized electrical systems.

These quarries produce the granite aggregate by systematic bench blasting, level by level. Before completion of the main access road to the higher part of the hill, temporary working face was used to produce graded granite aggregate. The production is based on blasting at 120 m-130 m level. In these quarries, they extract crushed granite (9 inches x 6 inches), (5 inches x 3 inches) and (2 inches x 1 inch). Finished products having (2 inches x 1 inch) size are a quality controlled graded granite aggregate used for high grade concrete. Particles less than 1 inch can also be used for construction such as hollow blocks, road materials and line concrete. Besides, these

quarries also produce good quality dimension slabs (1 ft x 1 ft) for foreign export.

Ore Minerals (Tin and Tungsten, Stibnite and Pyrite)

At about 2.5 km north of Natkyigyaung village, there are three sites of tin and tungsten mine, locally known as San-She mine. Up to 1993, this mine produced tin and tungsten but the mine ceased to operation at the present. It is economically not workable and these sites are covered by soil and thick vegetation.

In this area, stibnite occurs along the contact between Taungnyo Formation and intrusive igneous bodies. It shows acicular to irregular form, lead gray colour and metallic lustre. They are frequently associated with biotite microgranite. It is not economically workable.

In the northeastern part of the area, pyrite is mainly hosted in the porphyritic biotite granite. Cubic and octahedron pyrite crystals are observed along the fractures and some crystals are associated with tourmaline granite. But it is not economically important as the quantity is trivial.

(a) (b)

Figure 24: (a) Myanmar Ye Man Co. Ltd.,(b) Global Vertex Co. Ltd. extracting porphyritic biotite granite for construction and road materials and quality dimension slabs.

(c) (d)

Figure 24: (c) Shwe Myint Mo Tun Co. Ltd., and (d) Yamanya United co. Ltd., extracting porphyritic biotite granite for construction and road materials and quality dimension slabs.

(a) (b)

Figure 25: (a and b) Exploration adits of tin and tungsten deposit, locally known as San-She mine, 2.5 km north of Natkyigyaung village. (southwest facing)

Summary and Conclusions

The Nwalabo Taung area is principally composed of foliated porphyritic biotite granite, porphyritic biotite granite, gneissose granite, biotite microgranite and tourmaline granites. Biotite microgranite and tourmaline granite occur as small stocks. Microgranite, pegmatite and schorl rocks found as dykes and, aplite and quartzofelspathic veins are also

observed. The representative samples from Nwalabo Taung area were sent to the geochemical and isotope laboratory of the University of Tasmania in Australia. The results from zircon crystallization age suggest that granitic rocks from the study area were emplaced in the Late Cretaceous time. In this area, old local tin and tungsten mine was found 2.5 km north of Natkyigyaung village. Minor amounts of stibnite and pyrite occur in the northeastern part of the study area. Construction and road materials and granite slab can be extracted in huge quantity from this area.

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References

Alling, (1932). *The process of modification of the anorthositic magma*, Cascadeville, Mt. Marcy quadrangle, p. 207-312.

Bander, F., (1989).*Geology of Burma*. Gebuder Borntraeger, Belin, Stuttgart, 278 p.

Chhibber, H.L., (1934). *The Geology of Burma*, Mac Millan, 538p

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

Le-Maitre, R.W, (2001). Igneous Rock; A Classification and Glossary of Terms. 2nd ed., Recommendations of the international Union of Geological Sciences Subcommission on the systematic of Igneous Rocks. *Cambridge University Press.*

Mi Pike, (2013), Petrology and Mineral Resources of Mawpalaw Taung Area, Thanbyuzayat Townshop, Mon State. *Ph.D Thesis (Unpublished)*, University of Yangon.

Phillips, W.J. (1974). *Structural behaviour of igneous rocks*. Geol. Soc., University of New Brunswick, 121p.