Petrology of the Bodawgyi Area, Madaya Township, Mandalay Region

Myat Mon Mon Htet[1], Kyu Kyu Win[2], Chit Sein[3]

Abstract

Metasedimentary and igneous rocks are well exposed in the Bodawgyi area, Madaya Township, Mandalay Region. Metasedimentary rocks are white marble, phlogopite marble, banded diopside marble, calc-silicate rocks and banded biotite gneiss. The igneous rocks can be divided into two groups such as major and minor igneous rocks. Major igneous rocks are leucogranite, biotite granite and biotite microgranite whereas the minor igneous rocks are diorite and pegmatite. Two types of metamorphism are observed in the study area such as regional and contact metamorphism. The contact metamorphism can be observed in rocks adjacent to igneous intrusion. Regional metamorphisms are commonly observed in the gneiss and migmatite units.

Keywords: Petrology, Bodawgyi area, Madaya Township, Metasedimentary and Igneous rocks

Introduction

Metamorphic and igneous rocks are very well exposed in Bodawgyi area, Madaya Township, Mandalay Region. This region is situated between the Sagaing Fault which is the right-lateral strike-slip fault at the west and the Shan-scarp fault which is the normal steep fault at the east. Thus, the rocks of the area are strongly deformed and large scale emplacement of granite and related rock types can be found along this zone. These granitic rocks are regarded as the northern continuation of the tin tungsten bearing granite of the Tanintharyi area (Yin Yin Nwe, 1967; Maung Thein, 1973; Nyan Thin, 1984; Moe Kyaw, 1987). Many previous workers reported for the geology, however, a detailed petrological study is very few in this area. Therefore, the present work aims to analyse the detailed petrology of the different rock units in the study area.

Location

The study area is located about 56 km (35 miles) north of Mandalay and at Pin-le-in village, on the Manday-Singu-Mogok car road, Madaya Township, Mandalay Region (Fig. 1). It is situated between latitude 22˚ 21' 00" N to 22˚ 23' 00" N and longitude 96˚ 04' 00" E to 96˚ 07' 00"E. It occupies parts of the one inch topographic map no.93/B3. It extends about 6 km in length along the E-W, and 3.2 km in width along the N-S. The total areal coverage is about 19.2 sq. km.

Physiography

The study area is bounded by the Eastern Highland in the east and by the Ayeyawady River in the west. This area is moderately rugged. This area is occupied by moderately rugged and mountainous terrain, rolling hilly terrain and flat plain. The area under study forms isolated mountain ranges trending nearly N-S. Yetkanzin Taung is trending in the NNW-SSE direction, and it is nearly parallel to the Ayeyawady River. Bodawgyi Taung is trending in the ENE-WSW direction. The radial drainage pattern is dominated in the whole area especially in Bodawgyi Taung and toward the lake which shows the centripetal pattern whereas the dendritic pattern is observed in the rest of the region

[1]M.Sc Student, Department of Geology, Hinthada University
[2]Part-time Professor, Department of Geology, Hinthada University
[3]Associate Professor, Dr., Department of Geology, Hinthada University

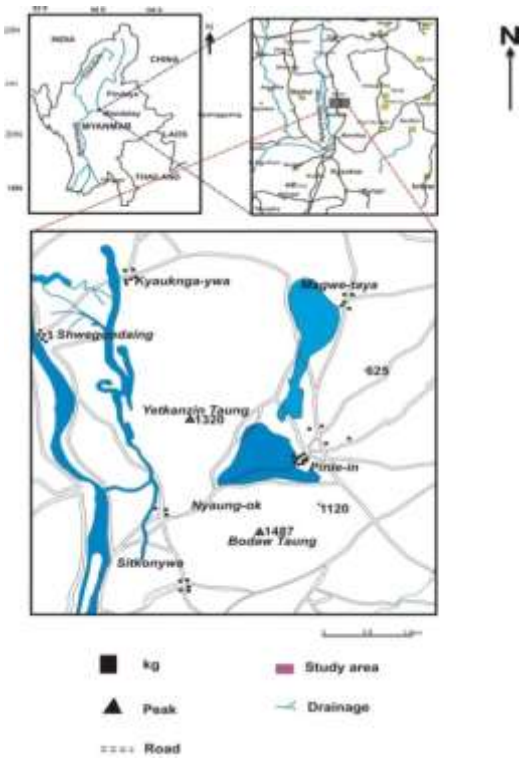

Fig. (1) Location map of the study area

Methods of study

The field works were conducted in the study area to know the various lithologic units, their types of contacts or boundaries and strikes, systematic sampling, measurements, observation and the relationship between the different rock units. About 120 rock samples, representing all rock varieties and their textures with the localities, and numbers, are collected.

More than 50 thin-sections were made for the petrographic study of igneous and metamorphic rocks under the polarizing microscope in the laboratory of Department of Geology, Hinthada University. Classification of plutonic igneous rocks is based on IUGS classification (after Streckeisen, 1976).

Regional Geologic Setting

The study area lies in the complex of metasedimentary rocks and igneous intrusive rocks lying between the Shan Massif in the east and Tertiary sediments of "Central Burma Basin" in the west. In other words, it lies in southern part of the "Mogok Belt' of Searle and Haq (1964). So these crystalline rocks or metasedimentary rocks are formed as a result of considerable tectonic activity related to the Himalayan Orogeny. This is characterized by metamorphism and migmatisation, drag folding of metasediments and complex igneous intrusions along the field area. These metasedimentary rocks are generally dipping toward the east. The Shan-Burma boundary fault system may be present at the extreme eastern part of the area. Triangular facets of truncated spurs of the eastern mountain ranges indicate presence of a fault line scarp. This fault may be part of the faults of the Shan-Burma boundary fault system. This area is bounded by the granitoid and non-basic intrusive rocks in the east, gabbro and related intrusive rocks in the north and alluvium is covered in the southern and western part of the area.

Petrology

The metasedimentary and igneous rocks are widely exposed in the study area (Fig. 2).

Igneous rocks

Igneous rocks are divided into two groups in the area: major igneous rocks and minor igneous rocks. The major igneous rocks includedthree rock types; they are biotite, microgranite and leucogranite. The minor igneous rocks include diorite, micro- granodiorite.

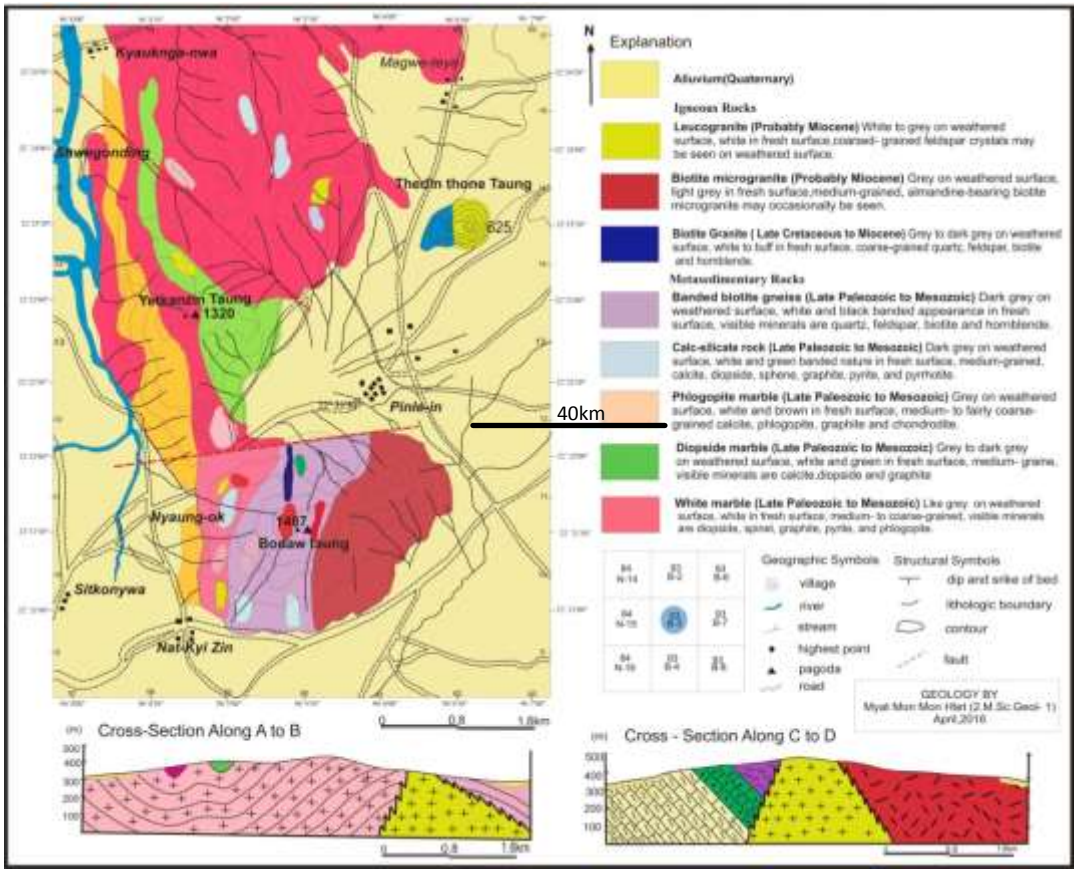

Fig. (2) Geological map of the Bodawgyi area

Diorite

Diorite is poorly exposed in the northern part of the area. It intruded into the metasedimentary rocks. In Bodaw Taung, diorite intruded into the white marble unit. The micromela diorites are found in Yetkanzin Taung range. Diorites intruded into the banded biotite gneiss in Bodaw Taung area. Dark grey colour is observed on weathered surface and light grey colour on fresh surface. Exposures of diorite are always observed as small blocks and sometimes as scattered floats. In some localities, the texture of diorite becomes too coarse-grained; both the hornblende and feldspar crystals attain up to about 1 cm in size (Fig. 3 A & B).

Microscopic study

Diorite mostly contains plagioclase about (41%), orthoclase (12%), hornblende (25%), biotite (13%), quartz (7%), and opaque minerals (2%). Biotite and hornblende are the dominant mafic minerals, and the biotite is partly chloritized and shows good cleavage (Fig. 4). Some chloritized biotites are faintly pleochroic and have low birefringence. Biotites in some sections

are not strongly pleochroic due to alteration. Minute inclusions of quartz and opaque minerals are clustered in some hornblende crystals. The texture is mostly allotrimorphic granular. The plagioclase occurs as twinned and anhedral broad laths Most of the plagioclase crystals are fractured and sericitization, usually starts along the fractures (Fig. 5).

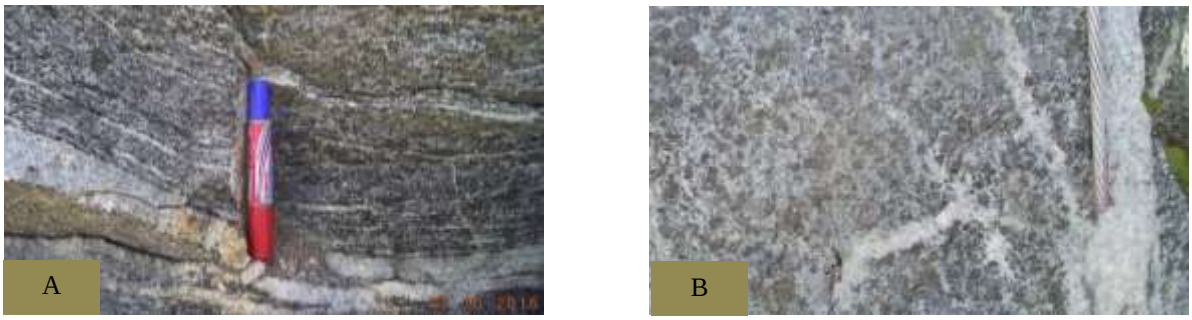

Fig. (3) Diorite exposure in the east of Nyaung-ok (22˚ 21' 28.1" N 96˚ 5' 3.5" E).
(A) Fresh surface of diorite, (B) coarse-grained hornblende and feldspar in diorite

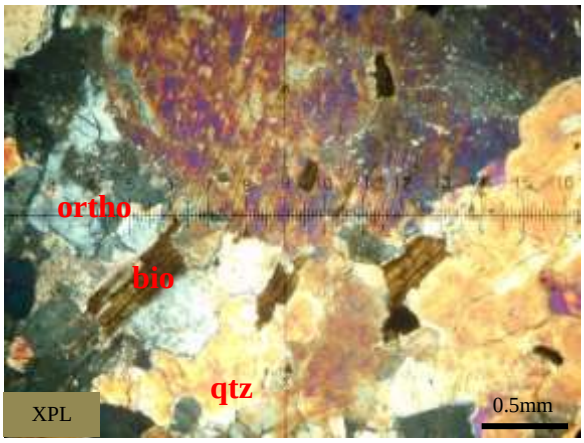

Fig. (4) Biotite, showing the perfect cleavage in diorite in XPL

Fig. (5) Subhedral cryatals of biotite in diorite in XPL

Microgranodiorite

Microgranodiorite is exposed in the eastern part of Bodaw Taung. It is medium-grained texture and weathered surface is dark grey to light grey and mainly composed of quartz,orthoclase and plagioclase feldspar and biotite (Fig. 6).

Fig. (6) Close up view of the microgranodiorite in Bodaw Taung

Microscopic study

Microscopically, microgranodiorite mostly contains Plagioclase about (36%), orthoclase (27%), quartz (24%), biotite (9%), and opaque minerals (4%). It is holocrystalline

rock and medium- to coarse-grained, allotrimorphic granular texture. Most of the biotitte mineral are altered to chlorite. It is medium- to coarse-grained, anhedral crystal and shows prominent good cleavage. The maximum grain size of biotite is 0.5mm in diameter. Biotite is highly pleochroic and change color from light yellowish brown to dark brown.

Plagioclase shows allotrimorphic granular texture with anhedral grains. It also shows the myrmekitic texture (Fig. 7). Plagioclase is distinguished by the polysynthetic twins (Fig. 8). Orthoclase and minor amount of hornblende crystals are present together with opaque minerals (magnetite). Microcline is observed in microgranodiorite with the typical appearance 'tartan twins'.

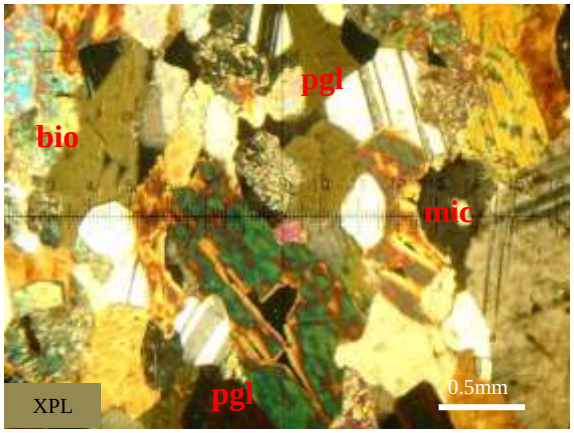

Fig. (7) Plagioclase shows the myrmekitic texture developed at the top right in microgranodiorite in XPL

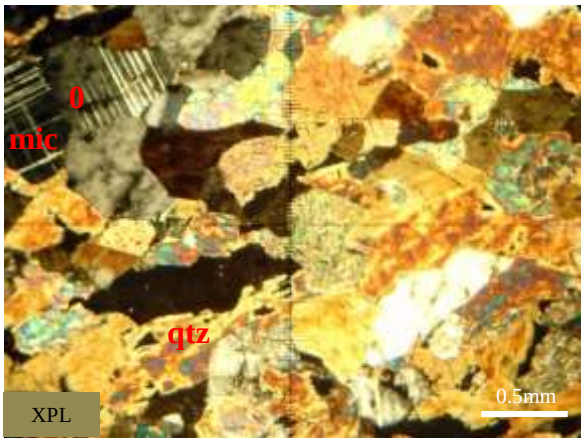

Fig. (8) Plagioclase showing carlsbad-albite twinning in microgranodiorite in XPL

Biotite microgranite

Biotite microgranite is well exposed at eastern part of Bodaw Taung and along the Pin-le-in to Nyaung-ok village cart tract. It is medium-grained, moderately to well jointed, and massive nature (Fig. 9, A). Grey colour is observed on weathered surface and white or light brown colour on fresh surface (Fig. 9, B).

Fig. (9) Biotite granite Pin-le-in to Nyaung-ok village cart tract (22˚ 21' 50.1" N 96˚ 6' 24.2" E). (A) Massive and well jointed nature, (B) Weathered and fresh surfaces

Microscopic study

Biotite microgranite is mostly composed of orthoclase (47%), plagioclase (16%), quartz (24%), biotite (10%), hornblende (1%), and opaque minerals (2%). It is coarse-grained, hypidiomorphic granular texture. The chief feldspar is plagioclase, shows compositional zoning. Zone plagioclase is more abundant in this rock. Orthoclase feldspar is

less than plagioclase feldspar (Fig. 10). The orthoclase is found as mostly anhedral grains and some are cloudy in appearance due to alteration to kaoline. The simple twin (Carlsbad twin) is observed in the orthoclase. Quartz is found as mostly anhedral grain. Biotite is the chief mafic mineral and shows allotriomorphic granular texture (Fig. 11). Some biotites are partly chloritized. It is strongly pleochroic and the pleochroic scheme of biotite is (α = brown), (β = yellowish brown), (r = reddish brown). Biotite crystals are comparatively smaller than quartz and feldspar grains. They occur mostly between grains boundaries of quartz and feldspar.

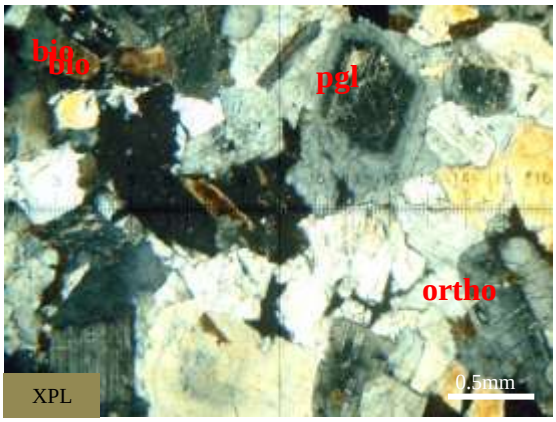

Fig. (10) Zone plagioclase developed at the top right in biotite microgranite in XPL

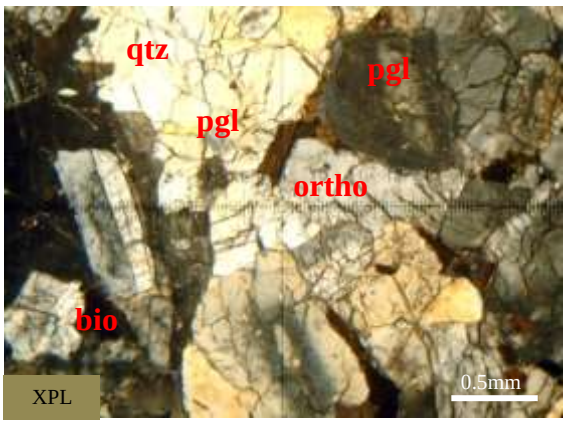

Fig. (11) Allotrimorphic granular texture showing laths of biotite crystal in XPL

Leucogranite

Leucogranite is mainly exposed in the western part of Bodaw Taung. It is observed to grey colour on weathered surface and white on fresh surface (Fig. 12, A). Sometimes, large feldspar crystals are recognized on weathered surfaces (Fig. 12, B). It exhibits a coarse-grained, massive appearance. Leucogranite intruded into the diopside marble and phlogopite marble in the places of the Yetkanzin Taung. The minerals are mainly composed of quartz, feldspar and mica. It is practically devoid of mafic minerals. It shows equal granular texture and grain size. At some localities, leucomicrogranite and pegmatite veins are found in the leucogranite body. Pegmatite exhibits a coarse-grained and vein-like nature. Pegmatite intruded or injected, or otherwise emplaced into the surrounding rocks. Veins of pegmatite form a network within the biotite microgranite and as dykes along the joint in the metamorphic rocks. Their shapes are largely determined by the pre-existing structure of the host rocks. The visible mineral constituents are feldspar and quartz. It occurs in the places of Bodaw Taung.

Fig. (12) Leucogranite in Bodaw Taung (22˚ 21' 25.2" N; 96˚ 06' 39.7" E). (A) Outcrop nature of Leucogranite, (B) Showing large feldspar and quartz crystals

Microscopic study

Leucogranite mostly contains orthoclase (41%), Plagioclase about (10%), quartz (40%), biotite (5%), tourmaline (3%) and opaque minerals (1%). It shows coarse-grained, allotriomorphic granular texture. Quartz grains are found as coarse anhedral grains. Abundant inclusions of quartz grains in feldspar are present (Fig. 13). Sometimes, aggregrates of quartz grains are observed and highly fractured. Some sections give alignments of biotite crystals. Orthoclase feldspar shows anhedral crystals with myrmekitic texture developed and plagioclase feldspars show polysynthetic twin and some feldspar crystals are found with quartz inclusions. Perthitic feldspars with cluster of biotite and opaque minerals are occurred (Fig. 14). Plagioclase crystals with randomly oriented inclusion of biotite are found. The border of the plagioclase is also corroded. The content of plagioclase feldspar is less common than the orthoclase feldspar.

Biotite shows linear alignment, subhedral form and medium in grain size. Some cleavages of biotite occur as crenulated and are found as clusters. Biotite is highly pleochroic and the pleochroic scheme of biotite is (∞ =brown), (β = yellowish brown),(r = reddish brown). Euhedral, accicular crystals of tourmaline show parallel alignment of biotite mineral.

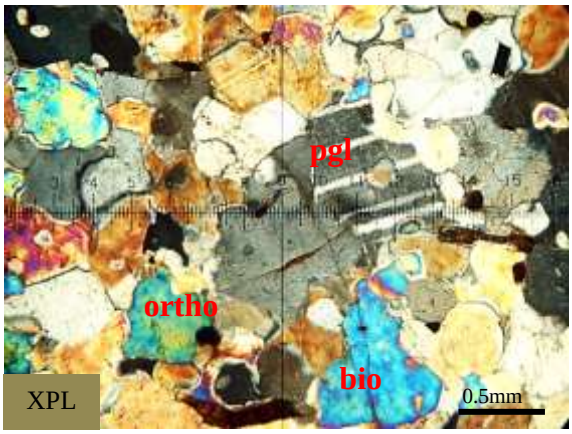

Fig. (13) Anhedral crystal of plagioclase in leucogranite in XPL

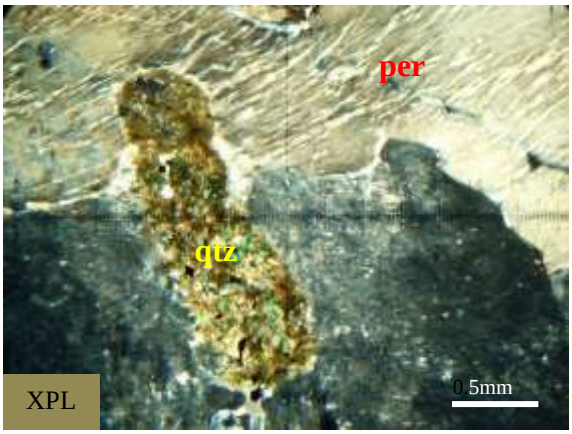

Fig. (14) Perthitic feldspar with cluster of biotite and opaque minerals in leucogranite

Petrology of metasedimentary rocks

Metasedimentary rocks have been described as eight units. They are skarn, migmatite, banded biotite gneiss, calc-silicate rocks, banded diopside marble, phlogopite marble, and white marble.

White marble

White marble unit is well exposed in the Yetkanzin Taung area (Fig. 2). The outcrop nature is massive with pitted surface. It is hard and compact, fine- to coarse-grained, granoblastic texture. It shows poorly jointed nature, non-foliated texture. Criss-cross pattern is present on the weathered surface of coarse crystalline white marble. Sometimes, it is intercalated with phlogopite marble and diopside marble.

It shows the light grey colour on weathered surface, and white colour on fresh surface (Fig. 15, A & B). It is mainly composed of calcite, are the visible minerals. The diopside, spinel, graphite, pyrite, and phlogopite are rarely found.

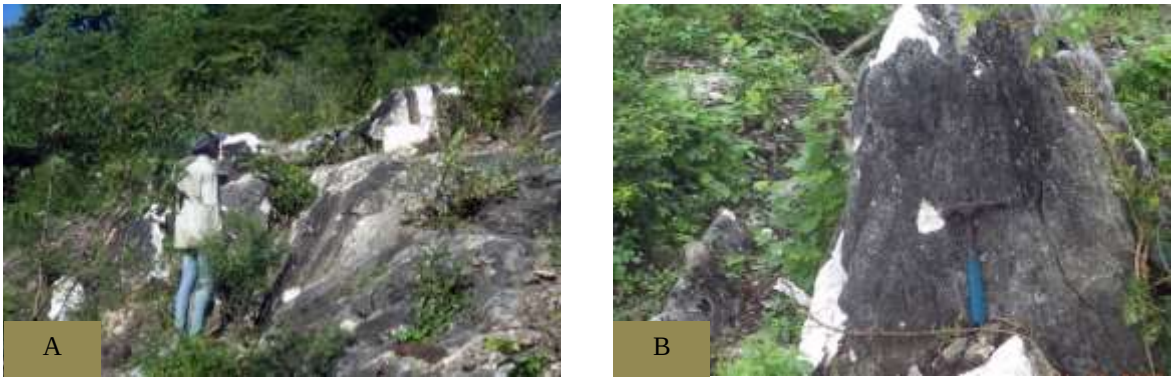

Fig. (15) White marble unit, near the Yetkanzin Taung car road (22˚21'30"N; 96˚04'57.5"E), (A) massive outcrop nature of White marble, (B) close up view of White marble

Microscopic study

Pure marble is fine to coarse-grained granoblastic texture. It is mainly composed of calcite, small amount of tremolites are also present. Calcite grains exhibit defiormational texture and numerous cracks are present. Chondrodite crystal shows subhedral form and weak pinkish to greenish pleochroism. Fosterite crystal (olivine) shows second order interference color and faint cleavages.

Diopside is found near the tremolite mineral and coarse-grained in texture (Fig. 16). Tremolite shows subhedral crystal and one set of cleavage is clear (Fig. 17). Diopside shows bright interference color between crossed nicols. Graphite marbles are found within white marble and it is mainly composed of calcite and graphite. In this section, calcites are seen as subhedral form, coarse-grained granblastic texture and show characteristic of rhombohedral cleavage. Cleavage and twin lamellae are common. Graphite occurs as disseminated scales and seen as opaque. Phlogopite bearing marble is mainly composed of calcite, phlogopite and some opaque minerals. Calcite shows rhomboidal cleavage and iridescent twin lamellae. Phlogopite shows brown color and bent cleavages.

Fig. (4.26) Subhedral form crystal of tremolite in white marble in XPL

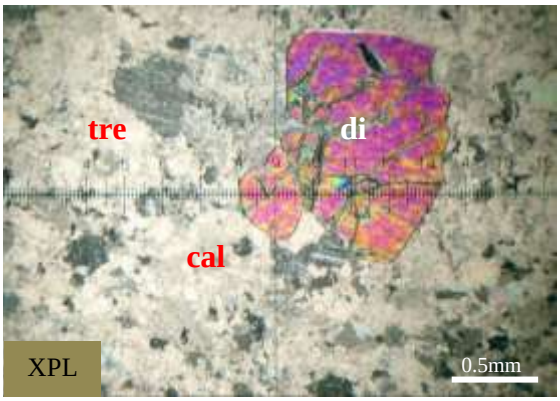

Fig. (4.27) Recrystallizations at calcite grain boundaries and crystal of diopside in white marble in XPL

4.2.2 Phlogopite marble

Phlogopite marble is well exposed along the western part of Yetkanzin Taung and Bodaw Taung. Phlogopite marble unit is alternately exposed with the white marble at the Yetkanzin Taung range. Phlogopite marble is intercalated with diopside marble and spinel-chondrodite marble. Nature of outcrop is massive and faintly foliated. It is hard and compact. It shows the grey colour on weathered surface, and the white color on fresh surface (Fig. 18,

A & B). It is mainly composed of medium- to coarse-grained, granoblastic texture, crystalline calcite. The visible minerals are calcite, phlogopite, and disseminated minerals such as graphite, chondrodite and diopside.

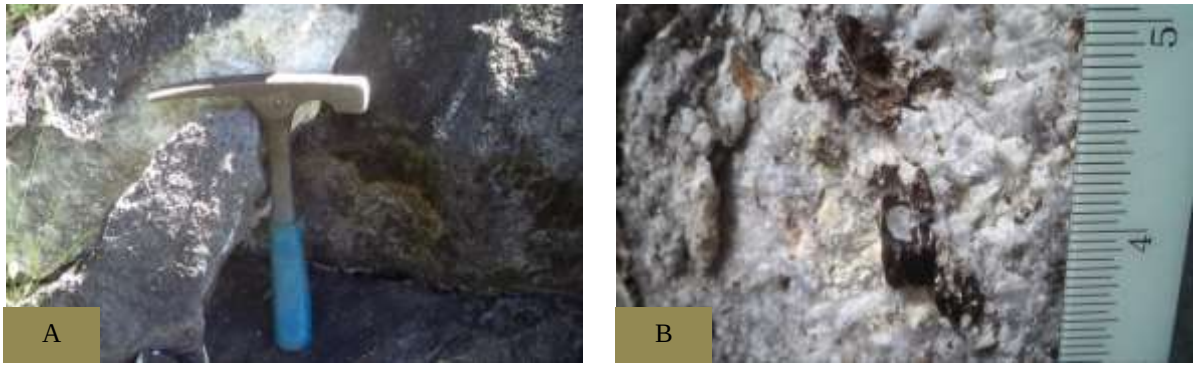

Fig. (18) Phlogopite marble unit, South of Nyaung-ok village (22˚20'54.2"N; 96˚04'55"E), (A) outcrop view, and (B) close up hand specimen view

Microscopic study

Phlogopite marble mainly consists of calcite, phlogopite and diopside showing foliation direction with the alignment of calcite crystal and phlogopite crystals (Fig. 19). Calcite crystals usually show subhedral grains and its size ranges from medium- to coarse-grained. It shows characteristic rhombohedral cleavage and iridescent twin lamellae (Fig. 20). Some calcite grains exhibit deformational texture such as bent twin bands.

Phlogopite is pale brown in color with faint pleochroism. Pleochroic scheme of phlogopite is same as biotite. It occurs as small laths crystals. Most of the Phlogopite are flaky in form and display one set of perfect cleavage. The extinction is usually parallel to the cleavage traces. Bright interference colors of diopside are distinct. They show anhedral grains with good cleavage.

Fig. (19) Foliation direction with the alignment of calcite crystal and phlogopite crystal in phlogopite marble (XPL)

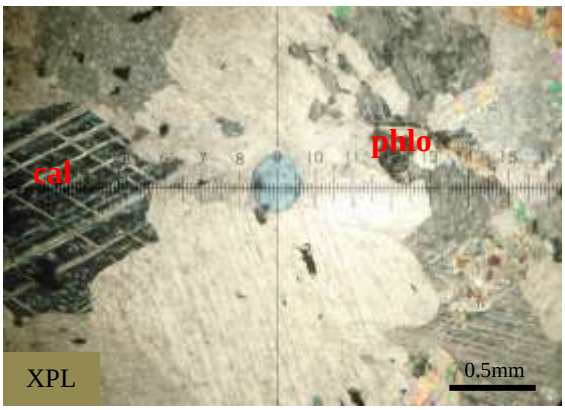

Fig. (20) Rhombohedral cleavage of calcite cleavages in phlogopite marble (XPL)

Banded diopside marble

Diopside marble is well exposed in the west of Bodaw Taung and among the white marble unit of Yetkanzin Taung (Fig. 2). Diopside is common and occurs as dark green and rounded crystal. It shows the grey to dark grey colour on the weathered surface, and white and green colour on fresh surface (Fig. 21, A & B). It is medium-grained, granoblastic texture crystalline calcite, moderately foliated, and more or less s-type fabric (non-directional fabric).

The visible minerals are calcite and diopside with disseminated such as sphene, graphite. The lower and upper boundaries are contact with white marble units.

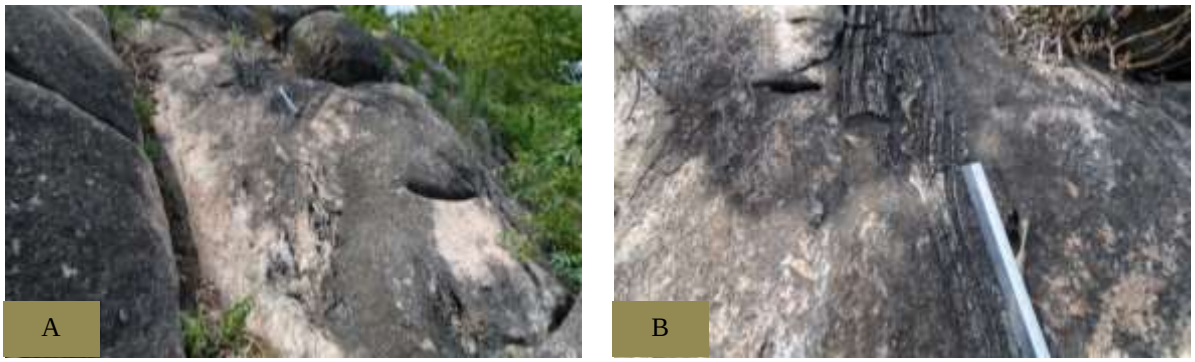

Fig. (21) Diopside marble unit, northeast of Yetkanzin Taung (22˚ 20'47.2"N; 96˚ 5'2.1" E), (A) the outcrop view, and (B) close up view.

Microscopic study

Diopside marble contains calcite, and diopside as principal minerals and other accessory mineral is graphite as an opaque mineral. The constituent minerals grains are hypidiomorphic granular and the maxium grain size is (1 mm) in diameter. Banded nature is prominent with peculiar diopside minerals bands. Calcites are seen as alternate bands with diopside due to metamorphic differentiation. They are anhedral to subhedral forms and show characteristics of rhombohedral cleavage (Fig. 22). They are coarse-grained granoblastic texture, and in some sections, cleavage and twin lamellae are bent due to strain effect. This fact indicates that the rock had suffered from some degree of deformation. The iridescent broken twin lamellae of calcite are found in banded diopside marble (Fig. 23).

Diopside usually occurs as subhedral to anhedral form and coare-grained in texture. It is quickly confirmed by it pale to dark green in color and one set of cleavage. Diopside grains are randomly oriented and it shows bright interference color between cross-nicols. Minor amount of pale brown phlogopite is found as tabular lath shape crystals form with one set of cleavage and show parallel extinction. Phlogopite shows faint pleochroism and the pleochroic scheme is (α = colorless), (β =neutral), (r =pale green to light green).

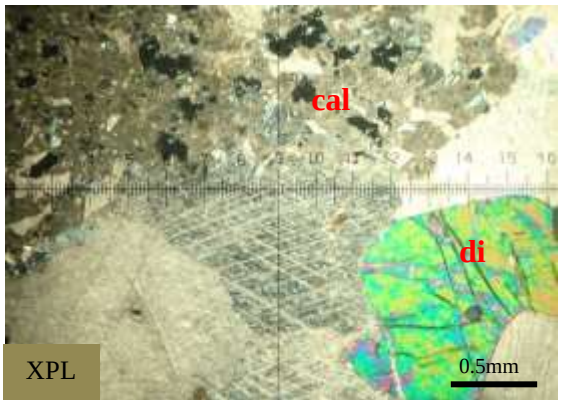

Fig. (22) Recrystallisation at calcite grain boundaries in banded diopside marble (XPL)

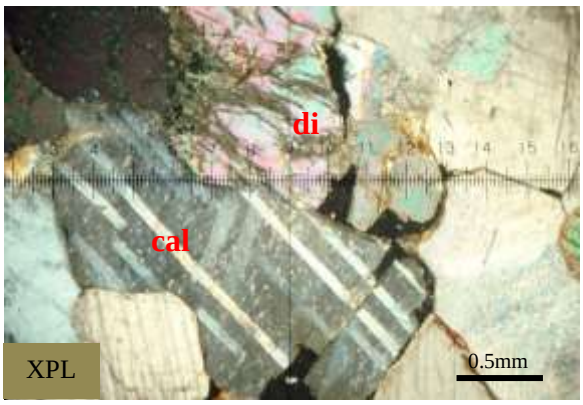

Fig. (23) Iridescent broken twin lamellae of calcite in banded diopside marble (XPL)

Calc-silicate rocks

This unit is well exposed in the white marble unit. Calc-silicate rocks are common in the lower part and white marble is more dominant in the upper part. Thin layers of banded biotite gneiss are found in this white marble unit at the location of 22˚ 21'48.5" N; 96˚05' 3.6"E. Some exposures are found between the banded biotite gneiss of Bodaw Taung.

The calc-silicate rocks are very hard and compact and exposed as thin layers. Dark grey colour is observed on weathered surface and white and green banded nature on fresh surface (Fig. 24, A). It is medium-grained, foliated, and minor drag folds are significant (Fig. 24, B). Alternation of siliceous and calcareous bands is developed and thus the ridge and furrow structures are well prominent on the weathered surface. It consists of calcite, quartz, diopside, sphene, graphite, pyrite and pyrrhotite. Diopside is fine- to medium-grained, and shows dark green colour. Pyrites are fresh showing a brass yellow colour with metallic lustre and oxidized ones gives reddish brown spots to the whole rock. Pyrrhotite shows a bronze colour and metallic lustre. Diopsides occur in patches or in bands. Weathering of calcite rich bands gives ridges and silica rich bands show furrow structure due to differential weathering.

Fig. (24) Calc-silicate rocks unit in the north of Nyaung-ok (22˚ 21'48.5" N; 96˚05' 3.6"E) (A) showing the ridge and furrow structures; (B) minor drag folds on weathered surface

Microscopic study

Calc-silicate rock is mainly composed of calcite, quartz, and diopside. Calcite occurs as medium- to coarse-grained, anhedral to subhedral crystals with clear cut twin lamellae and it shows granoblasitc texture (Fig. 25). The calcite shows rhombohedral cleavages (Fig. 26). The iridescent twin lamellae are very common in calcite.

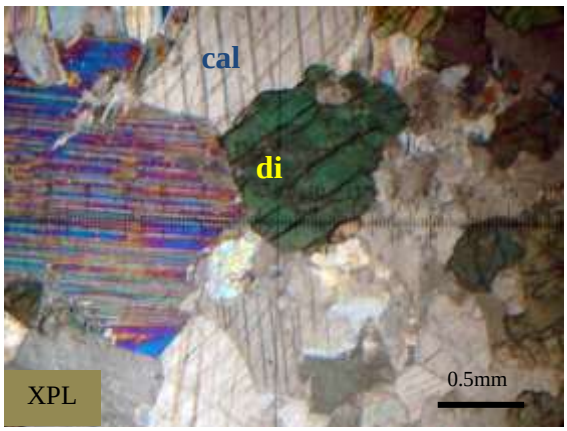

Fig. (25) Rhombohedral cleavage of calcite in calc-silicate rocks (XPL)

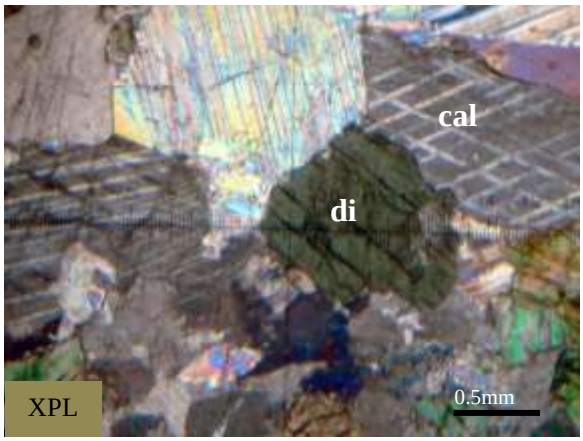

Fig. (26) Granoblastic texture in calc-silicate rocks in calc-silicate rocks (XPL)

Banded biotite gneiss

This rock unit is mainly distributed in the Bodaw Taung. It is conformable with the white marble and calc-silicate rocks. In some places, thin layers of banded biotite gneiss are interbedded with calc-silicate rocks and well developed gneissose texture. Dark grey colour is observed on weathered surface and white and black banded appearance is observed on fresh surface (Fig. 27, A). Biotite granite intruded into the banded biotite gneiss (Fig. 27, B).

Quartzo-feldspathic veins cut and transverse to foliation. The visible minerals are quartz, feldspar, biotite and hornblende. Biotite shows brown colour and vitreous lustre and locally as segregation. Banded biotite gneisses are conformable with the marble units of the study area, it indicates that it is paragneiss.

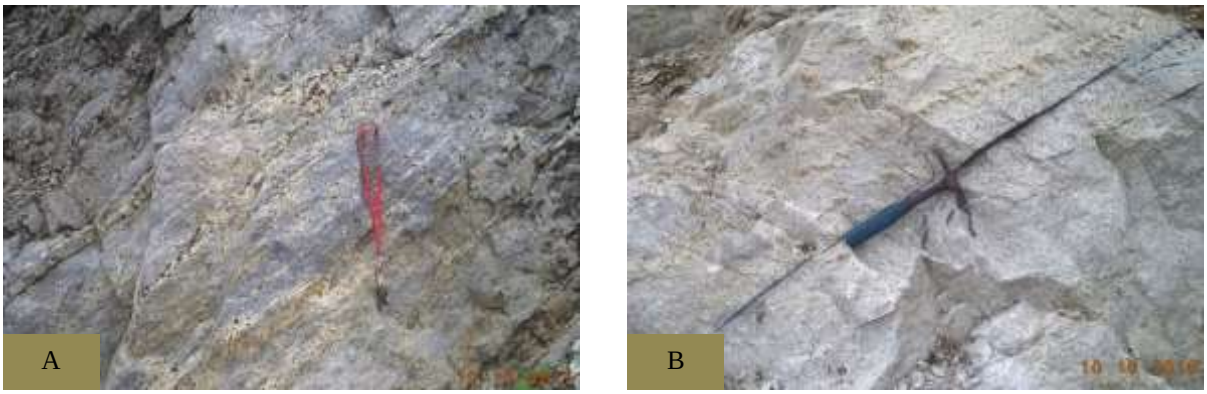

Fig. (27) Banded biotite gneiss unit, northwest of Pin-le-in village (22˚23'31.5"N; 96˚05'45.9"E), (A) white and black banded nature; (B) biotite granite intruded into banded biotite gneiss

Microscopic study

Banded biotite gneiss is composed of quartz, orthoclase feldspar, and biotite. Almost all minerals constituent are coarse-grained allotrimorphic texture. Alternation of quartz and feldspar shows that banded gneiss nature. Alternation of quartz and feldapar shows that banded foliations nature. Quartz and feldspar crystals are subhedral to anhedral and highly fractured. Strain quartz is also present showing wavy extinction. Most feldspar crystals are in subhedral form and biotite crystals are in small lath shape. Some biotite crystals are altered to chlorite. Mostly biotites are euhedral to subhedral form and gneissose texture is illustrated by biotite rich band. Banded biotite gneiss shows the alignment of feldspar and quartz crystals together (Fig. 28).

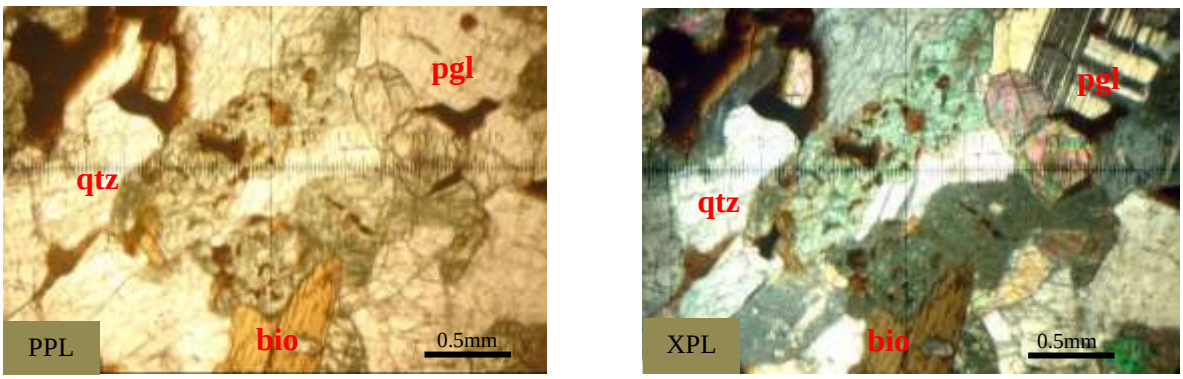

Fig. (28) Banded biotite gneiss showing alignment of feldspar and quartz crystals together with biotite crystals in PPL (left) and XPL (right)

Migmatite

Dark grey colour is observed on weathered surface and dark colour on fresh surface in this unit (Fig. 29, A). Leucosomes consist of quartz and feldspars with igneous texture and the melasomes of gneissose texture. Migmatised pelitic rocks show the schistose or gneissose texture (Fig. 29, B). It is micaceous. In some places, migmatised pelitic rocks are mixed with the pegmatites. Very small scale minor folds are observed in this unit.

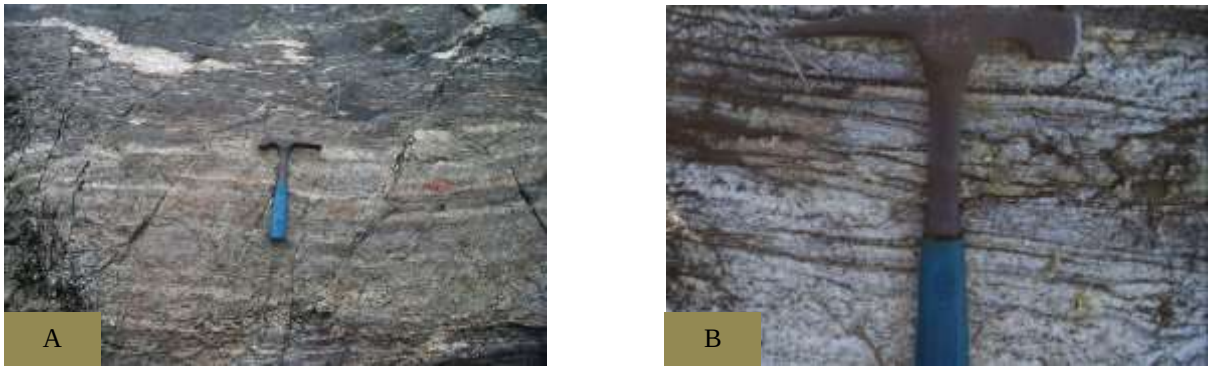

Fig. (29) Migmatite unit in the northeast of Natkyisin village (22˚ 24' 29" N; 96˚ 04' 45.2" E)
(A) Grey colour on weathered surface; (B) showing schistose or gneissose texture

Microscopic study

Typically, the rock contains lighter layers (leucosomes) comprised of light-colored minerals such as quartz, feldspar, and muscovite**.** The appearance of microcline in a migmatite shows 'Tartan Twins (Fig. 30). Anhedral crystals and light colored minerals of quartz and feldspar in (leucosome) in migmatite (Fig. 31).

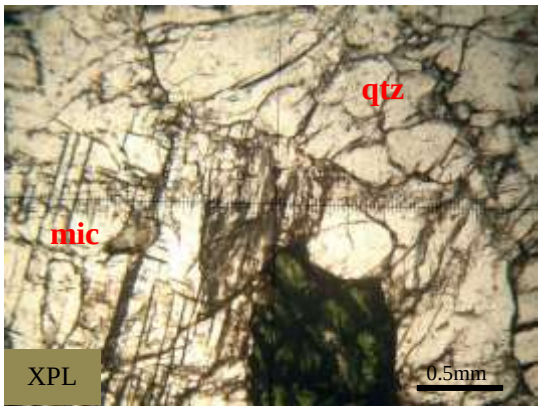

Fig. (30) The typical appearance of microcline in a migmatite with 'tartan twins in XPL

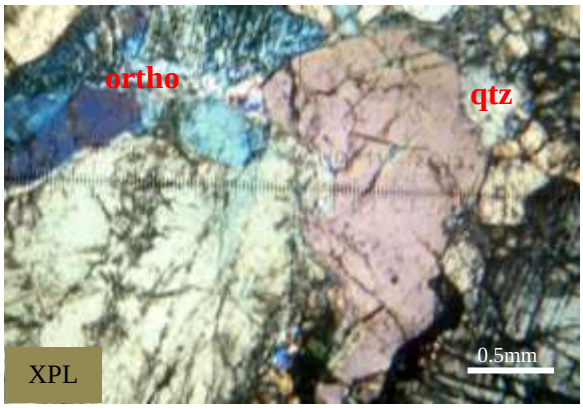

Fig. (31) Anhedral crystals and light colored minerals of quartz and feldspar in (leucosome) in migmatite in XPL

Skarn rocks

Skarn rocks are formed by contact metamorphism. It is well exposed in Bodaw Taung. This rock is conformable with white marble unit at the Yetkanzin Taung. It is hard and compact. The visible minerals are calcite, quartz, grossularite, diopside, and sphene. Lens and pockets of diopside are found in the skarn rocks (Figs. 32 & 33).

Fig. (32) Grossularite garnet skarn in the northeast of Nyaung-ok (22˚21'51.6" N; 96˚ 05' 1.7"E)

Fig. (33) Diopsie-almandine garnet skarn in the north of Bodaw Taung (22˚ 21' 35" N; 96˚ 05' 23.1"E)

Microscopic study

Diopside -grossularite skarn is coarse-grained and mainly composed of grossularite garnet, diopside and quartz. Grossularite garnet is large crystals and shows high relief, internal fracturing of grains is present. Numerous inclusions of quartz grains act as sieve texture in grossularite (Fig. 34.). Diopside-almandine skarn is coarse-grained and composed of almandine garnet, diopside, quartz, feldspar, and sphene. Diopside minerals are found as anhedral grains, the color is green and one set of cleavage is prominent (Fig. 35). Anhedral grains of quartz are found between the orthoclase feldspars, showing intergranular texture. The presence of garnet and diopside in skarn rocks indicate that the contact metamorphism of hornblende honfels facies.

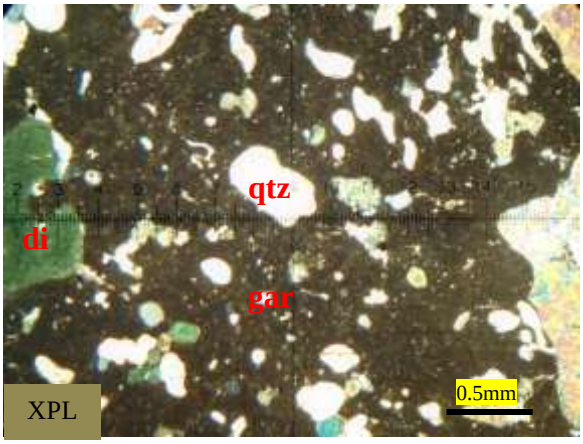

Fig. (34) Garnet crystal, show seive texture with inclusions of anhedral crystals of quartz and diopside in XPL

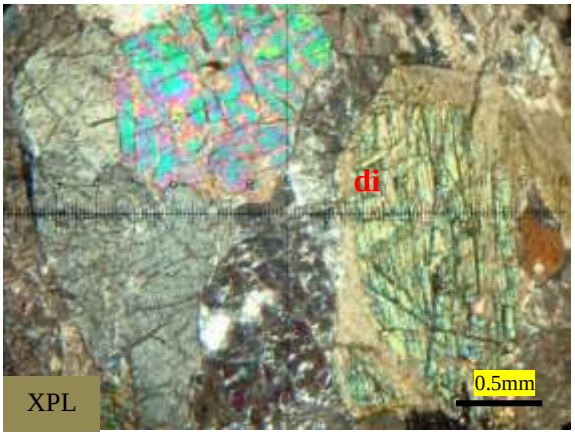

Fig. (35) Anhedral crystals of diopside with one set of cleavage in XPL

Conclusion

The study area is located about 56 km north of Mandalay and Pin-le-in village is on the Mandalay-Singu-Mogok car road. The present work aims to analyse the detailed petrology of the igneous and metasedimentary rock units of the study area. The study area is mainly covered by igneous and Metasedimentary rocks. Igneous rocks are mainly exposed in the southern part of the area and Metasedimentary rocks are mainly exposed in the northern part of the area. Biotite granite, biotite microgranite, leucogranite and diorite rocks are igneous rocks and white marble, phlogopite marble, banded diopside marble, banded biotite gneiss, migmatite and skarn rocks are also metasedimentary rocks. Some tremolite crystals

are found in the white marble. It indicate that metamorphic facies is lower amphibolite facies. The banded diopside marbles are also found within the white marble unit. Phlogopite marbles are in contact with diopside marbles but the graphite marbles are found within the white marble units as patches especially at the western part of Yetkanzin Taung. The mineral assemblages indicate that the study areas had been subjected to regional metamorphism and contact metamorphism. The mineral assemblages of calcareous rocks and banded biotite gneiss indicate the lower amphibolite facies.

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