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All Authors	KhinKhin Lin, Myo Min, and Win Khant
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Keywords	lithostratigrraphy, petrography, metamorphic rocks, foliation
Citation	
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Stratigraphy of Lithologic Units exposed around Banmaw Township

Khin Khin Lin[1], Myo Min[2], Win Khant[3]

Abstract

The study area lies in Banmaw Townships, in the northern part of Myanmar and China to the east. This study mainly deals with the lithostratigraphy and petrography of the rock units exposed along the car road Banmaw-Lweje of Seinlon range, Banmaw-Dotphonyan and Wilartha Taung. The lithostratigraphic units exposed in the study area are granites, granitoid rocks, basic, ultrabasic and metamorphic rocks. Large bodies of granitic rocks and diorites are widely exposed along the car road from Momauk to Lweje. It is light gray to whitish grey coloured on fresh surface and dark gray or brownish coloured on weathered surface. Exfoliated or spheroidal weathered exposures are common. The granites are usually coarse-grained and mineralogically very similar throughout the entire region. Based on the radiometric dating, the age of biotite granite was Middle Miocene. The metamorphic rocks are generally trending nearly north-south and such as gneiss, protomylonite, calc-silicate rocks. Gneiss gives well-defined foliation and large scale banding. Foliated gneissose texture is peculiar in having alternates of dark color mafic minerals bands and light color quartzo-feldspathic bands due to metamorphic differentiation.

Introduction

Kachin State is located in the northern part of Myanmar between India to the west and China to the east and north. The present study area covers the eastern part of the Kachin State including in Banmaw Township (Fig.1). The present area, covering part of 92 H/7 and 8 of one inch topographic maps, lies between longitudes 97° 15′ and 97° 45′ East and latitude 24° 10′ and 24° 30′ North approximately and the eastern part is bordered by China. It is composed of highly mountainous regions which are part of Tibetan Plateau to the north. The eastern and northeastern part of the study area is occupied by rugged mountainous area while the rest by rolling hills and alluvial plains. The mountain ranges are deeply dissected and resulting many peaks.

[1] Lecturer, Geology Department, Shwebo University
[2] Lecturer and Head, Geology Department, Shwebo University
[3] Demonstrator, Geology Department, Banmaw University

The prominent geographic feature of this area is the Mount Seinlon which is about 6032 ft, nearly 2000 m height above sea level. The northwestern part is the Wilartha Taung (1551 ft) and the south western part is Teinpha Taung (750 ft). The 3D Landsat image and terrain map of the proposed area and its environs is shown in figure (2).

The area is geologically still unknown and systematic geological investigation had never been studied yet. Therefore, the geological investigation is also required to prepare to geological map of the study area with fairly detailed and to record the lithologic characteristics and possible mineralization and mineral resources. The present study is an attempt to fill up a gap of geology knowledge of the northern Myanmar.

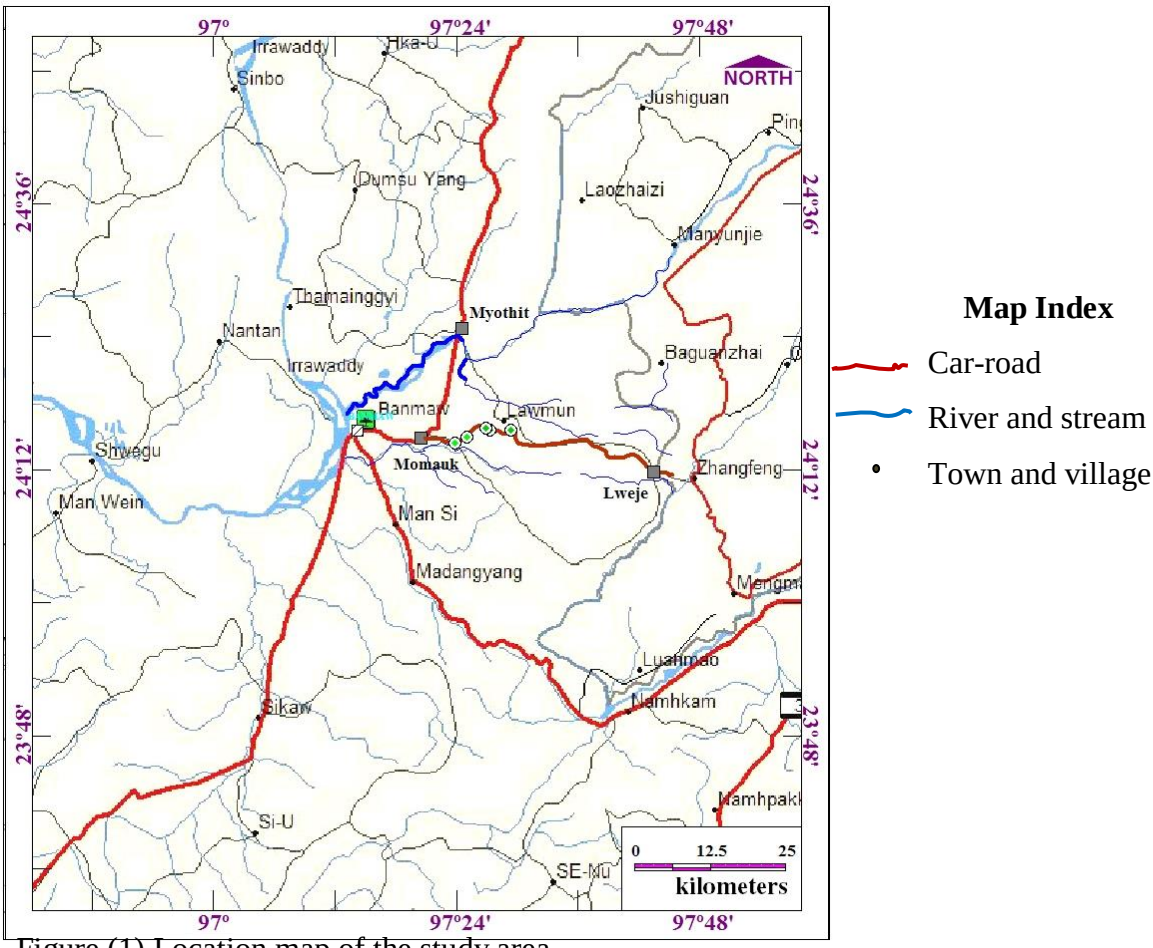


Figure (1) Location map of the study area.

Due to the extensively dense vegetation and very rugged terrain, field transverses could be made mostly along the road cut section along the northeastern and eastern part of Banmaw. The geological knowledge of the northern part of Myanmar is very limited; their regional geological mapping is based on air-photo study.

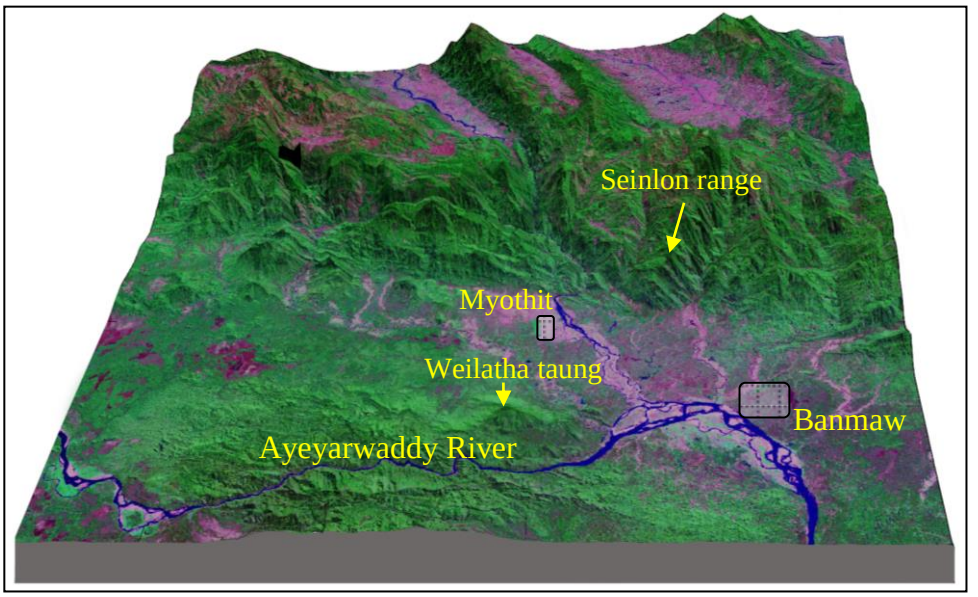


Figure (2) Landsat 3D image of the study area.

Regional Geotectonic Setting

This region is geotectonically situated in the north-eastern part of the Myanmar, Eastern Highland or Shan-Taninthari Block of Maung Thein (1973). This belt extend southward through the Shan Plateau and Taninthari ranges and northward to the eastern Himalayas and Yunnan province of China. Western boundary of this section of continental crust is marked by the N-S striking Shan Boundary Fault, which accompanies the Shan Escarpment in the West and is presumed to continue to the south in the Gulf of Martaban. Also it form part of the land mass of the Indo-Chinese Peninsula (Yunnan, Thailand and Malaysia), which extends to the south in Sundaland (Hutchison, 1973).

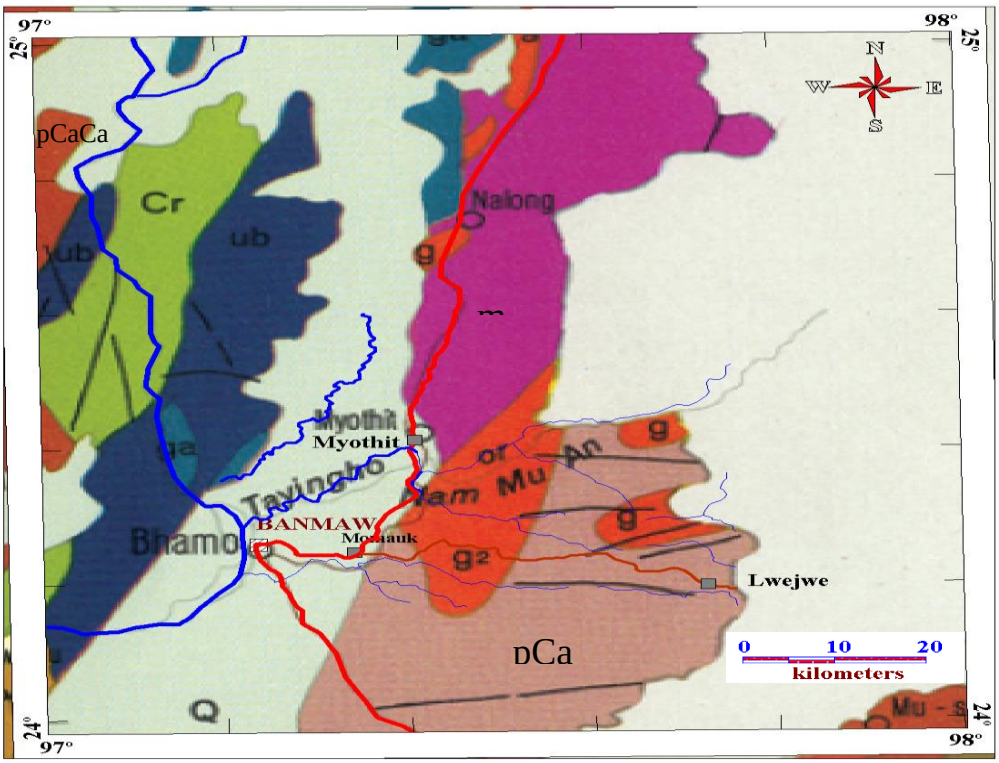
It is composed of Late Precambrian, Paleozoic and Mesozoic Sequences. The study area is composed of mostly igneous and metamorphic rocks. The crystalline rocks such as banded gneisses, crystalline schist, etc. of presumably Archean age are well exposed in this area. The rocks are known as undifferentiated metamorphic unit equivalent to Mogok Series of Bender (1983). Within these units, the acid, basic and ultrabasic igneous bodies are cropping out.

The Banmaw Plain is the broad Quaternary belt; the geological reconnaissance survey and interpretations of landsat imagery have shown that the Precambrian crystalline rocks of Mogok-Banmaw-Sadom-Wangohindam. It is also characterized by the numerous granite intrusions between Banmaw and Myitkyina area. Between Banmaw and the border with Yunnan (China), the occurrence of the approximately 130 km wide SE-NW striking belt of highly metamorphic rocks is regarded as the northern continuation of the Mogok Series.

In the Eastern part of the Banmaw District as far as the Shweli River and to the North into the border territory of Kachin State, the basement rocks complex consists of banded garnet-biotite gneiss and beds and lenses of amphibolites. There are also intercalations of crystalline limestone consisting of saccharoidal calcite with accessory minerals diopside, forsterite and graphite.

Lithostratigraphic Units

The lithostratigraphic units exposed in the study area are metamorphic units and igneous units. Large bodies of granitic rocks, probably belong to the so-called Eastern Granitoid Belt (Khin Zaw, 1990) are found along the road section of Banmaw-Lweje. Igneous units of granite, granodiorite, leucogranite, basalt, diorite and hornblende diorite are mostly abundant. The metamorphic rocks are generally trending nearly north-south and such as gneiss, protomylonite, calc-silicate rocks. They are mostly cropped out the road section near Shwemyaung village on Banmaw-Myitkyina motor road and Tarpain bridge; 42 mile post of Momauk-Lweje car road. Igneous rocks are intruded into the metamorphic rocks.



Explanation

Quaternary	Q	
Cretaceous	Cr	Flysch-type sediments and Globotruncana-Limestones of Indoburman Ranges; Orbitolina-limestones of Northern Burma; and Kabaw Shales of Inndrburman
Precambrian-Cambrian	pCaCa	Chaung Magyi Group, and equivalents
Precambrian	pCa	Mogok Series, and equivalents
Metamorphics, undifferentiated	m	Mainly schist and gneisses, ? equivalent to Mogok Series
Granite and other Non-basic intrusions	g^2	of Mesozoic and Cenozoic age
	g	of unknown age
Ultrabasic and basic intrusives	ub	(Mainly Peridotite and Serpentite) of Cretaceous-Eocene age
Gabbro and related intrusives	ga	

Figure (3) Regional geological map of the study area (Bender, 1983)

Metamorphic units of Gneiss are widely distributed in the central part of the area along northern part of Banmaw Township through Myothit to Dotphonyan and Momauk. It is medium- to coarse-grained, gray coloured on fresh surface and reddish brownish color is remarkable on weathered surface. Gneiss gives well-defined foliation and large scale banding (Fig.4). Foliated gneissose texture is peculiar in having alternates of dark color mafic minerals bands and light color quartzo-feldspathic bands due to metamorphic differentiation. Based on the constituent minerals, gneiss in the study area mainly biotite gneiss.

Highly jointed calc-silicate rocks are found nearly Byanwai village (Fig.5). Protomylonites are found at 42 mile post along Banmaw-Lweje car road. Petrographically, the quartz grains are crushed and these evidences are indicated that these rocks are along the shear fault zone or near normal fault (Figs. 14 and 15). It is contact metamorphosed rock, with granulation and flowage being due to overthrusts following the contact surfaces between intrusion and country rock (Holmes, 1920).

Large bodies of granitic rocks and diorites are exposed along the car road from Momauk to Lweje. The granite is usually medium- to coarse-grained, light gray coloured on fresh surface and dark gray or brownish coloured on weathered surface., Biotite granite is one of the major intrusive igneous rocks in the research area in near Lawmun, Lawdon and Seinlonkabar villages on the motor road (Figs. 7 and 8). Exfoliated or spheroidal weathered exposures are common in this area (Fig.7). It is hard, compact and massive, homogeneous in texture and younger in age than the leucogranite. It is medium–grained, hypidiomorphic-granular texture. It is mainly composed of quartz, feldspar, biotite, and minor amount of apatite and zircon.

Quartz occur anhedral grains in irregular aggregate. Orthoclase shows twinned and untwinned crystal, these subhedral orthoclase shows pronounce Carlsbad twin and sometimes show zoning. Sometimes, myrmekitic texture of quartz and feldspar intergrowth can be seen. Plagioclases are subhedral to euhedral crystals showing polysynthetic twinning. Biotite is chief mafic mineral in this rock. It is subhedral form and small flakes. It shows strong pleochroism (Figs.10 and 11). Sometimes, it alters to chlorite along the cleavage and margin. The average grain size ranges from 0.3mm. Inclusions of apatite and zircon present in the quartz and feldspar grains (Fig.10).

Figure (4) Gneiss from Myothit.

Figure (5) Calc-silicate near Byanwai village.

Figure (6) Leucogranite near Seinlon.

Figure (7) Biotite Granite showing Onion structure near Seinlon Kabar.

Figure (8) Biotite granite with xenolith from Lawdon area.

Figure (9) Basalt showing flow structure from Wilartha Taung.

Based on the radiometric dating, the age of Biotite granite was estimated 15.8±1.1 Ma, Middle Miocene (Bertrand *et al.*, 2001).

Leucogranite and aplite are also found. In hand specimen, it medium to coarse-grained, dark grayish on weathered surface and whitish on fresh surface. It is characterized by its light colour. It mainly consists of quartz and feldspar. Texture is coarse-grained, hypidiomorphic granular texture. It is mainly composed of quartz, feldspar and subordinate amount of biotite, apatite and iron.

Hornblende diorite is the second most abundant igneous roc in the study area. Lithologically it is a dark-grey, medium- to coarse-grained rock composed mainly of feldspar and hornblende. Quartz, biotite and magnetite are present in minor amounts. Quartz is subhedral to anhedral and myrmekitic texture of quartz and feldspar intergrowth can be found (Figs. 12 and 13). Among feldspars, plagioclase is the most abundant, consisting up to 50%., Plagioclase is tabular or prismatic, anhedral to subhedral and coarse-grained. Hornblende shows long prismatic form, bright color under cross Nicols and brownish colour under PPL.

Basalts are mainly occurred in Wilartha Taung and Tainpha Taung located in western part of the research area. They are usually fine-grained, massive body, dark brown to dark green when fresh and dark color in weathered surface. Some Basalt from Wilartha Taung shows lava flow structure in the research area (Fig. 9). Petrographically, they are mainly composed of laths of plagioclase, clinopyroxene, olivine, orthoclase, little amount quartz, and opaque minerals. One phenocryst of clinopyroxene (augite) crystal is clearly visible at the top edge of the field of view (Figs. 16 and 17). Microphotograph of basalt from Wilartha Taung shows spherulitic texture that is a radiate aggregate of acicular alkali feldspars with glass between them, though quartz or other minerals may be present, resulting in an intergrowth texture (Fig. 18).

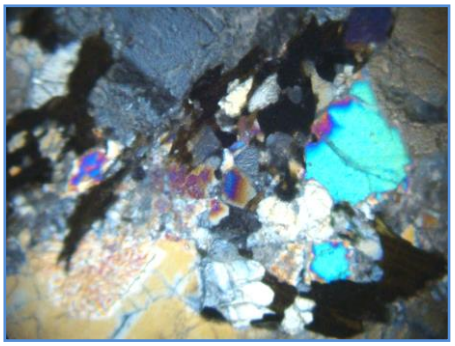


Figure (10) Microphotograph of Granite near Seinlon Kabar. (under XN, 40x).

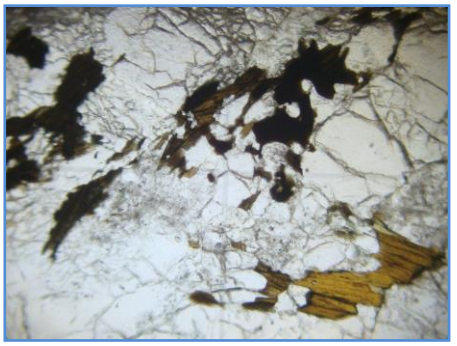


Figure (11) Microphotograph of Granite near Seinlon Kabar (under PPL, 40x).

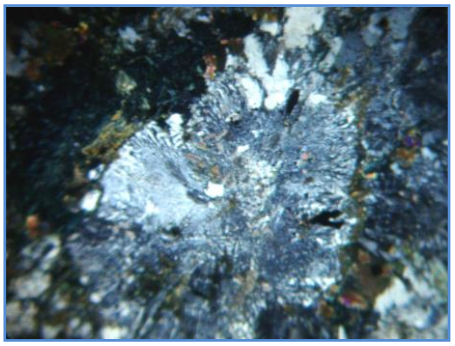


Figure (12) Microphotograph of Hornblende diorite showing myrmekitic texture near Dotphonyan (under XN, 40x).

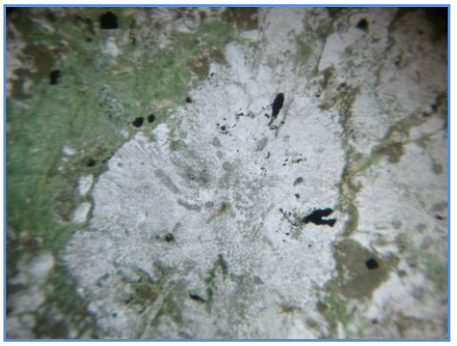


Figure (13) Microphotograph of Hornblende diorite showing myrmekitic texture from near Dotphonyan (under PPL, 40x).

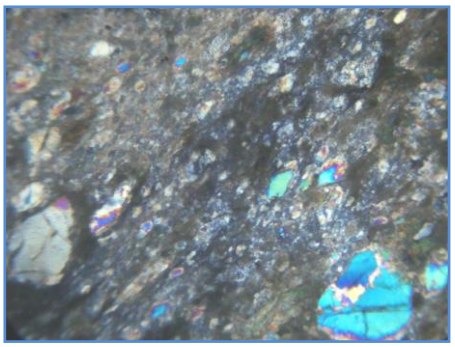


Figure (14) Microphotograph of Proto mylonite near 42 mile-post on the Banmaw-Lweje road. (under XN, 40x).

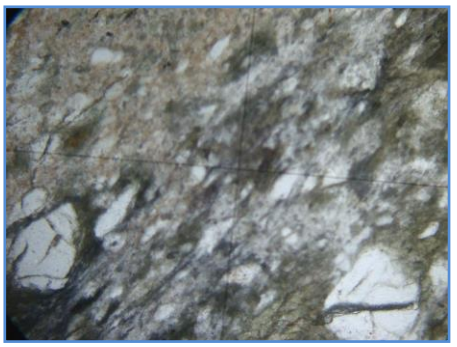


Figure (15) Microphotograph of Proto mylonite near 42 mile-post on the Banmaw-Lweje road. (under PPL, 40x).

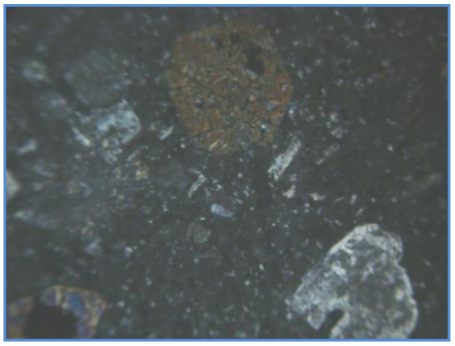


Figure (16) Microphotograph of Basalt showing euhedral crystal (Augite) from Wilartha Taung (under XN, 40x).

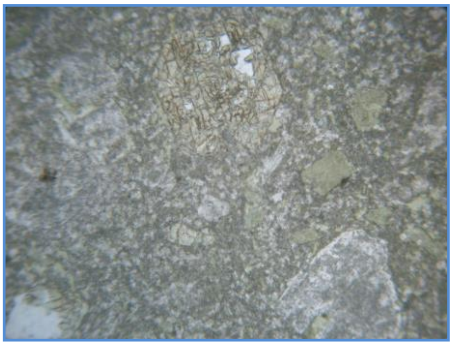


Figure (17) Microphotograph of Basalt showing euhedral crystal (Augite) from Wilartha Taung (under PPL, 40x).

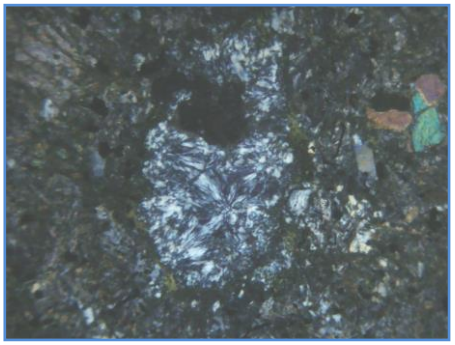


Figure (18) Microphotograph of Basalt showing spherulite texture (quartz) from Wilartha Taung (under XN, 40x).

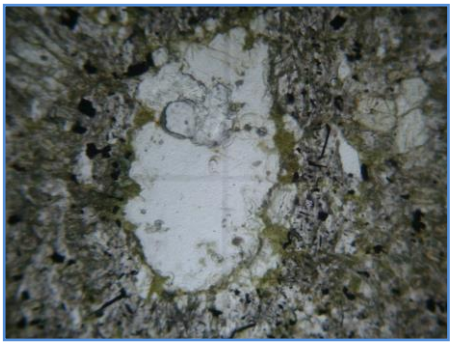


Figure (19) Microphotograph of Basalt showing quartz from Wilartha Taung (under PPL, 40x).

Conclusion

This is merely a preliminary investigation carried out on field trips to give information about the presence of igneous and metamorphic units. The mainly occurrences of granite from Seinlon range are very similar in lithology with the Kabaing granite. Age assignments for biotite granites are tentative, and need to be checked by further field investigation. Moreover, the granites in the study area can reveal that the granites in the easternmost

part of Shan Massif are definitely the northern extension of the Western Granitoid Belt of Thailand which is intruded mainly in Triassic time.

Acknowledgements

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