Preliminary Study on the Distribution of the Rock Units exposed in the Dobin-Sinkin Area, Momeik Township, Northern Shan State: Criteria for Stratigraphy

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Abstract

The research area is situated within the Momeik Township. It chiefly constitutes metamorphic (metapelite, metacarbonate and metaigneous) and associated igneous rocks. The present work deals with the distributions of the rock units to support the stratigraphy. Based on the constituent mineral assemblages, Mommeik metamorphics in the study area can be grouped into three types: paragneisses (garnet biotite gneiss, biotite gneiss); metacarbonates (forsterite-graphite marble, phlogopite marble, diopside calc-silicate rock, diopside marble, white marble); metapelites and metasammites (silliminite schist, biotite schist, skarn rock). Careful field observations on premetamorphic sedimentary structures, bedding characteristics and the mode of stratigraphic sequence indicate that Momeik metamorphic rocks may be assigned as metamorphic equivalents of dolomitic, calcareous and pelitic sequences of the Early Paleozoic of Shan Plateau. The exposed igneous rocks in the study area are the younger intrusives which are mainly granitic in composition including leucogranite and biotite microgranite. These igneous sequences may be regarded as the products of the magmatism which have been taken place during Tertiary period, specifically at Miocene.

Key words: Metacarbonate, metaigneous, metapelite, stratigraphy

Introduction

The study area is situated within the Momeik Township, Northern Shan State. The area is bounded by latitude 23°02' N to 23°10'N and longitude 96°37' to 96°45'E in one inch to one mile scale topographic map of 93-A/12. It covers approximately about 202 square kilometer with 14 km in length and 13 kilometer in width of rugged and mountainous terrains (Fig.1-A&B).

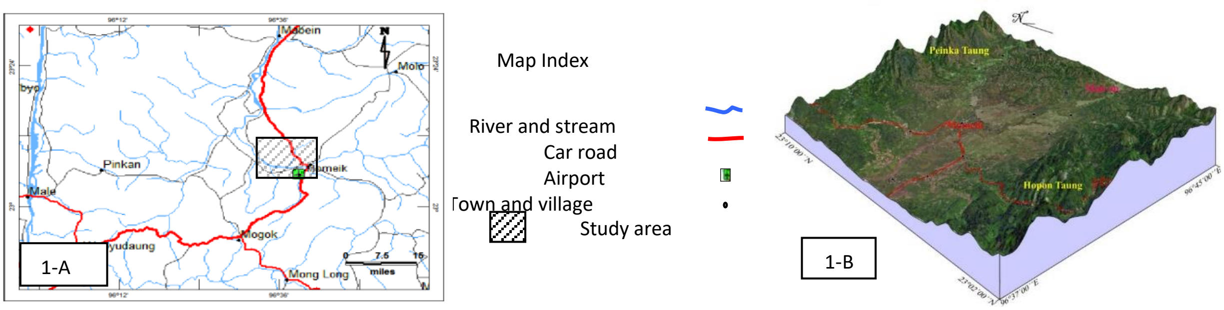

Figure (1-A&B) Location map and three dimensional satellite image of the Dobin-Sinkin area

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The study area included in the Mogok Metamorphic Belt is mainly composed of metamorphic (metapelite, metacarbonate and metaigneous) and associated igneous rocks. The main objective of this work is to study the distributions of the rock units and to describe the stratigraphy on the basis of lithology, detailed field observation and correlation to other areas.

Methods of Study

A detailed geological field investigation of lithologic contacts, structural trends, foliation and fault criteria was recorded with the aid of GPS and compass, and plotted on the base map. In the field, fresh representative samples were systematically collected from various rock units.

Regional Geologic Setting

The study area lies within the northern continuation of the Mogok Metamorphic Belt of Searle and Ba Than Haq (1964) which is a sickle-shaped belt of meta-sedimentary and meta-intrusive rocks and younger intrusions extending for 700 km northwards from Kyaikkhami (Amhast) to Mogok area. It continues in an eastward-convex arc through Mogok, and northeastern Myanmar and India. The regional geologic setting around the study area is shown in Figure (2).

Detailed geological studies and mapping of the study area have not been attempted before. To the east and south of the study area lies the northwestern boundary of the Eastern Highland which constitutes medium to high-grade metamorphic rocks of Mogok Belt. To the north, the study area is bounded by low-grade metamorphics of Tagaung-Myitkyina Belt. About 64 miles to the west of the study area is the Ayeyarwaddy River which flows from north to south along the trace of the well-known Sagaing Fault, a north-south trending right lateral strike-slip fault. Structurally, the distinguishing and traceable major linearments are bent into sigmoid forms to the southeastern adjacent part of the study area. The sigmoidal bands occurring to the southeastern adjacent part of the study area reflect the considerable left lateral movement ult. To the west of the studv area.

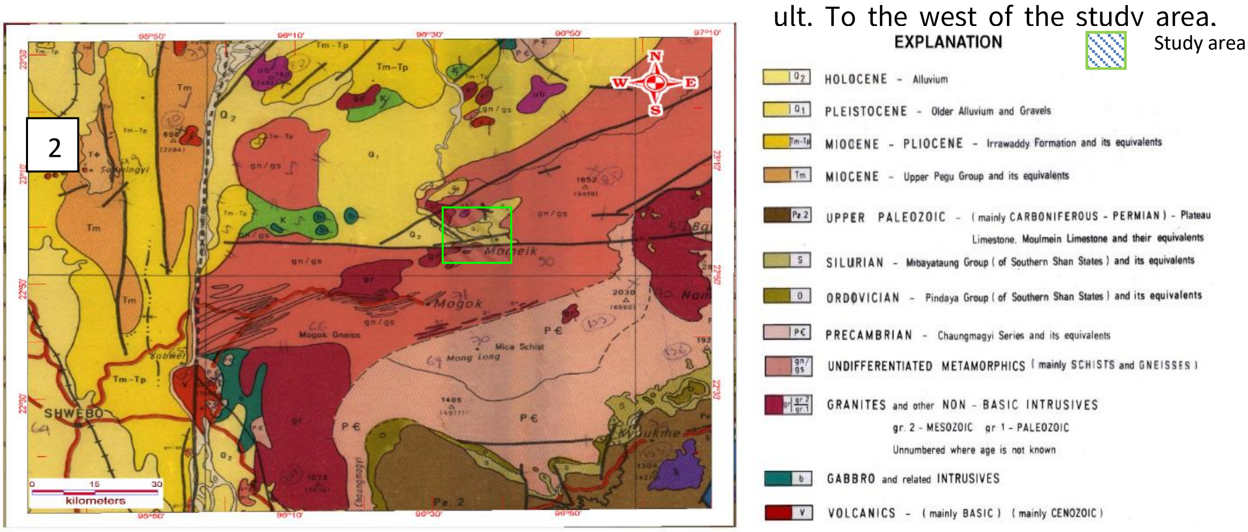
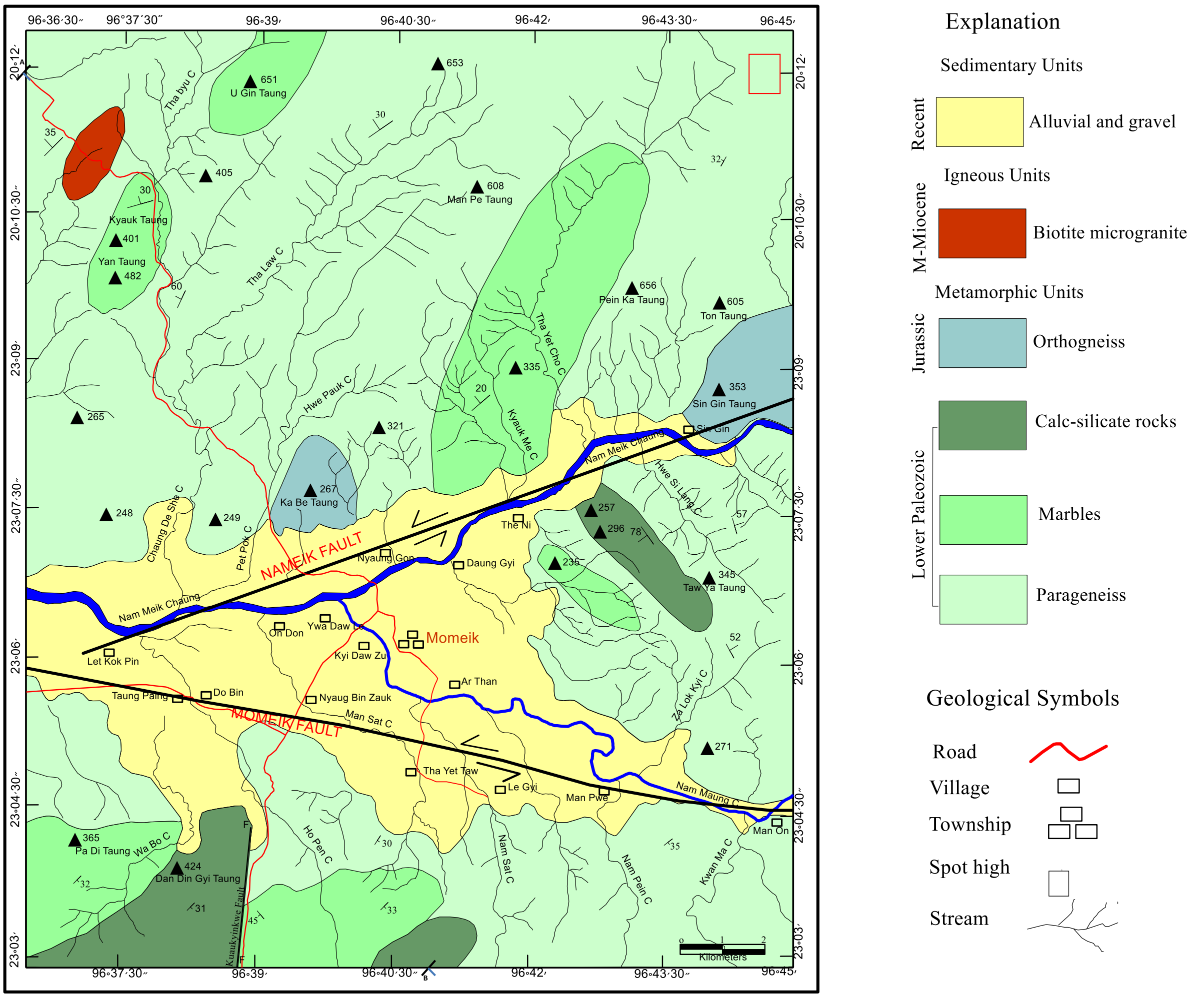


Fig. (2) Regional geologic setting around the study area. (Source: Earth Science Research Division, 1977)

Stratigraphy

The most abundant metamorphic rocks occupied in this area are metapelites (garnet-biotite gneiss, biotite gneiss, silliminite schist and biotite schist) which are well exposed at the northern and southern parts of the study area. Metacarbonate units (forsterite-graphite marble, phlogopite marble, diopside marble, white marble and diopside calc-silicate rock) are found in the northern and northwestern part of the study area. Metaigneous rocks (Orthogneiss) are commonly observed along the Momeik fault zone in the central part of the area. The igneous units are found in northwestern part of the area.

Depending upon the available field relationship, structural and stratigraphic evidences, the rock sequence arranged in descending order in age is shown in Table (1) and their distributions are shown in geological map of the study area in Figure (3).



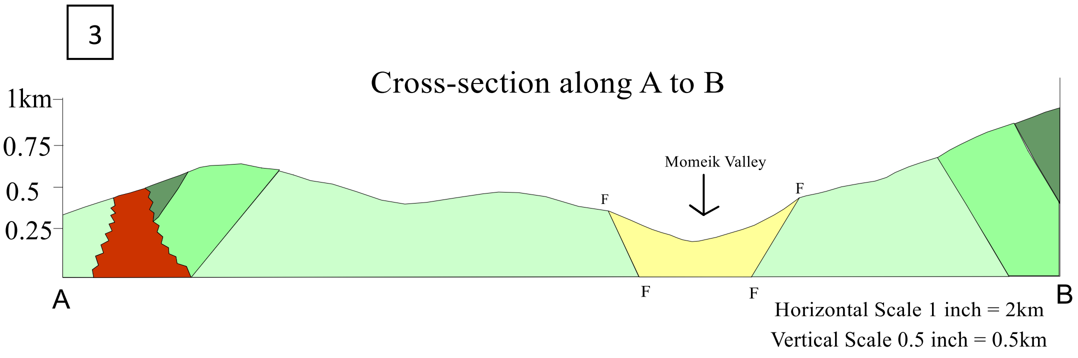


Figure (3) Geological map of the Dobin-Sinkin area

Table (1) Rock sequence of the Dobin-Sinkin area

	Lithologic Units		Age
	Sedimentary Unit		
	Alluvium and gravely soil		Recent
	Igneous Unit		
	Biotite microgranite	}	Miocene
	Leucogranite		
Metagranitoid	**Metamorphic Unit**	}	Late Jurassic-Early Cretaceous
	Biotite Gneiss	Unconformity	
	Skarn rock	}	Early Paleozoic
Metapsammite and metapelite	Biotite Schist		
	Silliminite Schist		
Metacarbonates	White Marble		
	Diopside Marble		
	Diopside calc-silicate rock		
	Phlogopite Marble		
Paragneiss	Forsterite-graphite Marble		
	Biotite gneiss		
	Garnet-biotite gneiss		

Paragneisses

Garnet-biotite gneisses are well exposed in the southeastern part of the study area, especially on steep slope and in gullies of Man-Pe Taung and Peinka Taung. Good exposures are also observed along the stream sections of Kyaukme chaung which drain into Nammeik chaung (Fig. 4). Garnet minerals are visible to the naked eyes and easily identified on this exposure (Fig. 5). The outcrops are trending in the direction of NW-SE. Biotite gneiss is well cropped out at 7 milepost on the Momeik-Myitson road-cut section (Fig. 6). The outcrop of biotite gneiss at Mogok-Momeik car-road is characterized by foliated and very friable nature (Fig. 7). This unit is underlain by the garnet biotite gneiss and overlain by marble and calc-silicate units. The foliation of the unit generally trends NE-SW.

Fig. (4) Garnet-biotite gneiss outcrop displayed by the alternate layers of mafic and felsic minerals at the upstream of Kyaukme chaung section (Loc: N 23° 16' 15" & E 96° 37' 51")

Fig. (5) Easily identified garnet grains in the garnet-biotite gneiss exposed at southern part of Peinka Taung (Loc: N 23° 15' 20" & E 96° 39' 30")

Fig. (6) Well foliated biotite gneiss displayed by the alternate layers of felsic and mafic minerals on the Momeik-Myitson car road. (Loc: N 23° 08' 10" & E 96° 38' 30")

Fig. (7) Friable biotite gneiss on the Momeik-Mogok road-cut section (Loc: N 23° 06' 16" & E 96° 43' 06")

Metacarbonates

Forsterite graphite marble well crops out at southern part of the study area. This rock is well exposed at Lwe-Ngin Taung and Ho-Pon Taung (Fig. 8). This unit shows dark gray color on weathered surface and whitish color on fresh one. Phlogopite marble is well exposed at the base of eastern cliff of Yan Taung (locally called Kyauk Taung) located at the junction of Momeik-Myitson and Momeik-Molo road. At Yan Taung, the outcrop has pitted surface, cavities, caves and erosional pots and characterized by thick bedded to massive nature (Fig. 9). The rocks are thick-bedded to massive and grey coloured on weathered surface. This unit is intercalated with calc-silicate and biotite gneiss. Diopside Calc-silicate rocks are found along the Mogok-Momeik road, near Hopon Taung and Lwe-Ngin Taung. Good exposures are well observed at the area between Theni village and Tawya Taung (Figs. 10 & 11). They are interclatted with marble units. In general, this unit shows NE-SW strike with NW dips. They are characterized by rib and furrow structure due to the differential weathering. Diopside marble mainly occurs at U-gin Taung beside the Momeik-Molo road and at south of Momeik-Mogok road. As a result of chemical weathering along joints, the rock is exposed in the form of knobs and knolls protruding from the cliff face of U-gin Taung (Fig. 12). The rocks are mostly medium-grained, non-foliated and fairly hard and compact. White marble is the most common rock unit among the marbles in the study area. Good exposures are well observed at the northern part and southwestern part of the area. It is also well exposed at east of Theni village and southwestern part of Taung Gaing village (Fig. 13). This unit is roughly trending NE-SW and dipping NW with amounts of 35° to 50°.


Fig. (8)


Fig. (9)


Fig. (10)


Fig. (11)


Fig. (12)

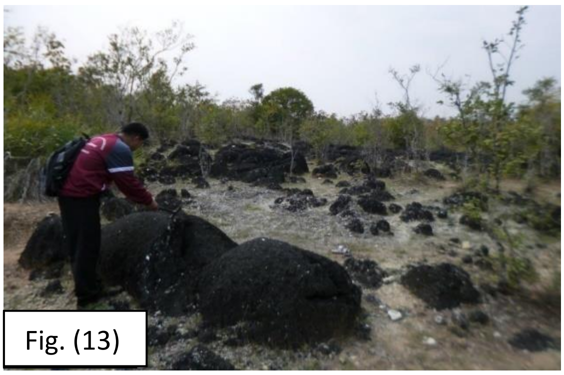


Fig. (13)

Fig. (8) Massive outcrop of forsterite graphite marble exposed at Lwe-Ngin Taung

(Loc: N 23° 3' 45" & E 96° 40' 15")

Fig. (9) Massive outcrop nature of phlogopite marble exposed at Yan Taung

(Loc: N 23° 10' 47" & E 96° 37' 38")

Fig. (10) Banded calc-silicate showing steeply inclined dipping at 2 km northeast of Theni village

(Loc: N 23° 07' 07" & E 96° 42' 34")

Fig. (11) Calc-silicate rock showing rib and furrow structure exposed at east of Theni village (Loc: N 23° 07' 34" & E 96° 42' 05")

Fig. (12) Knobs and knolls nature of diopside marble protruding from the flank of U-gin Taung. (Loc: N 23° 12' 10" & E 96° 39' 09")

Fig. (13) Massive nature of white marble exposed at southern part of Taung Gaing village. (Loc: N 23° 4' 55" & E 96° 37' 30")

Metapelite and Metasammite

Silliminite schist is scarcely exposed as an unmappable unit at the downstream of Aung-Lut Chaung (Fig. 14). The rock is hard, compact and well foliated. Silliminite crystals are well observed on the surface of this unit. Biotite schist is poorly cropped out as an unmappable unit at the foot hill north of Sin Kin village (Fig. 15). The exposures occur as a piece of block due to the fault effect. Skarn rock occurs in the contact zone between biotite microgranite and diopside calc-silicate rocks at the northwestern part of the study area. Various sizes of garnet crystals are found at the upland plain in the east of Thakinma Taung (Fig. 16).

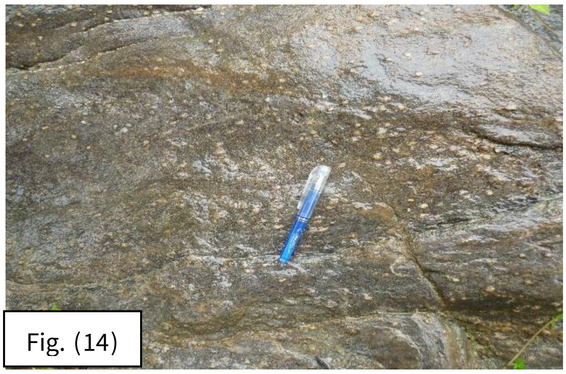


Fig. (14)


Fig. (15)

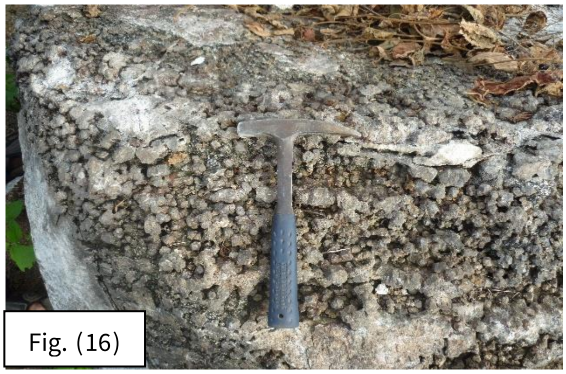


Fig. (16)

Fig. (14) Silliminite grains distinctly scattered on the surface of schist unit at the downstream of Aung-lut chaung (Loc: N 23° 09' 35" & E 96° 44')

Fig. (15) Pieces of schist block scattered the whole hill near Sin-Kin village due to fault effect (Loc: N 23° 08' 45" & E 96° 43' 55")

Fig. (16) Various sizes of garnet crystals in the skarn zone at the upland plain east of Thakinma Taung. (Loc: N 23° 13' 17" & E 96° 40' 12")

Metaigneous Rocks

Biotite gneiss (Orthogneiss)

This rock is largely developed along the Mommeik fault zone in the central part of the area, especially at the Sin-kin Taung and on the northeastern flank of the Kabe Taung (Fig. 17). It is characterized by well foliated nature, augen structure and the nature of massive boulder character (Fig. 18).


Fig. (17-A)


Fig. (17-B)

Fig. (17- A & B) Gigantic boulder of well-foliated biotite gneiss near Sin-Kin village and surface of orthogneiss showing augen structure (Loc: N 23° 08' 47" & E 96° 44' 50")

Igneous Rocks

Leucogranite is poorly cropped out as an unmappable unit in the area between Tawya Taung and Theni village (Fig. 18). It also occurs in the vicinity of upstream of Zalokkyi chaung. It is highly weathered and highly jointed in almost every exposure. Biotite microgranite is the main distinctive plutonic rock in the study area. It is well exposed as large intrusive body at the left side of Momeik-Molo road west of U-gin Taung and at the eastern part of Nammeik chaung southeast of Theini village (Fig. 19). It is very similar in lithology to the Kabaing granite. They display spheroidal weathered blocks which are the products of chemical weathering along joints in the rock mass. These spheroidal weathered blocks are the surface expression of an underlying gigantic or batholithic mass of granite (Fig. 20). Pieces of gneiss are sometimes observed as xenoliths into the granite rock mass (Fig. 21). By the evidence of xenoliths of metamorphic rocks within the granite body, biotite microgranite is younger than the surrounding metamorphic rocks.


Fig. (18)

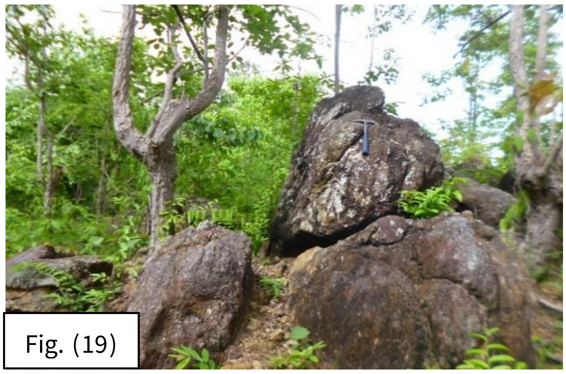


Fig. (19)

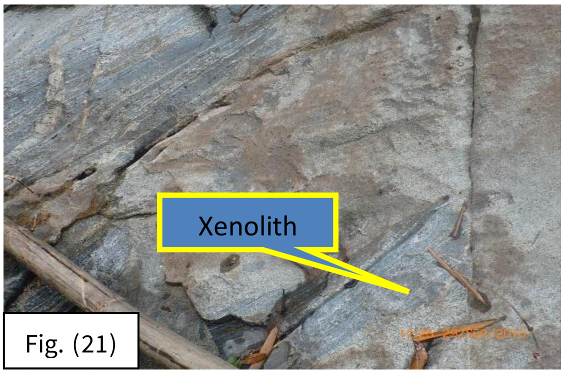


Fig. (18) Highly weathered and jointed leucogranite exposed between Tawya Taung and Theni village. (Loc: N 23° 07' 46" & E 96° 43' 23")

Fig. (19) Boulder outcrop of biotite microgranite exposed at southeast of Theni village. (Loc: N 23° 07' 11" & E 96° 42' 32")

Fig. (20) Exfoliated spheroidal blocks of biotite mrcrogranite on the left side of Momeik-Molo car-road west of U-gin Taung (Loc: N 23° 12' 20" & E 96° 38' 27")

Fig. (21) Gneiss xenolith in biotite microgranite rock mass. (Loc: N 23° 12' 28" & E 96° 38' 50")

Discussion on Protoliths of Metamorphic Units

The consideration of the protoliths of the Momeik metamorphics is attempted with careful field observations on premetamorphic sedimentary structures, bedding characteristics and the mode of stratigraphic sequence deduced from the concerning metamorphic units. Based on the lithologic characters, textural evidences, index minerals and mineral assemblages in each rock type, the metamorphic rocks of the study area are probably metamorphosed from three major types of protolith: calcareous, pelitic and felsic igneous sequences.

The biotite gneiss found along the Mommeik fault zone shows boulder and exfoliation characteristics, and the distributions of the rocks are irregular and isolated whereas that of the paragneiss is extensive and persistent. Hence, the precursor rock, for this rock under consideration, can be determined as felsic igneous origin which is probably intruded during Late Jurassic-Early Cretaceous. The massive character, lateral continuity and structural trends of the marble units are similar to those of the marble units of the Mogok area. Myint Lwin Thein et al; (1990) correlated the Wabyudaung marble with the Ordovician Wunbye Formation of Southern Shan State and Sitha Formation of Northern Shan State, mainly based on bedding characteristics and lithologic similarity. The paragneisses of the study area include biotite gneiss and garnet-biotite gneiss which are intercalated with marble units. They probably are the metamorphic equivalents of the Namh-sim Formation of fine- to coarse-clastic sedimentary sequences. Myint Lwin Thein et al, (1990) suggested that the gneisses and marbles of the Mogok Metamorphic Belt were correlated with Silurian and Ordovician units of Shan Plateau.

On the basis of the facts mentioned above, the metamorphic sequence of the present area points out explicitly that the original sedimentary rocks could be a bedded sequence of dolomitic, calcareous and pelitic sequences of the Early Paleozoic of Shan Plateau.

Discussion on Age of Igneous Rocks

The igneous rocks in this area may be regarded as the products of the magmatism related to a prolong subduction of the Indian Plate underneath the Eurasian Plate (Maung Thein, 1983), i.e., related to Himalaya Orogeny. Thus, the age of igneous activity in the study area might have been taken place during Tertiary period, specifically at Miocene in contemporaneous to emplacement of the Kabaing granite.

Conclusion

The study area is situated within the Momeik Township, Northern Shan State. This area lies within the northern continuation of the Mogok Metamorphic Belt. The present work deals with the distributions of the rock units to support the stratigraphy. In the Momeik area, the metamorphic sequences arranged from lower to upper are garnet-biotite gneiss, biotite gneiss, forsterite-graphite marble, phlogopite marble, diopside calc-silicate rock, diopside marble, white marble, silliminite schist, biotite schist, quartzite and skarn rock. Based on the bedding characteristics, lithologic characters, index minerals and mineral assemblages in each rock type, these rocks may be described as metamorphic equivalents of dolomitic, calcareous and pelitic sequences of the Early Paleozoic of Shan Plateau. The biotite gneiss (orthogneiss) found along the Mommeik fault zone can be determined as felsic igneous origin which is probably intruded during Late Cretaceous-Eocene. The igneous rocks found in the study are tourmaline granite, leucogranite and biotite microgranite. These igneous sequences may be regarded as the products of the magmatism which took place during Tertiary period, specifically at Miocene.

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