PETROGENESIS OF METASEDIMENTARY ROCKS IN BILIN AND ITS ENVIEONS, BILIN TOWNSHIP, MON STATE

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Abstract

According to field and petrological characters, the metasedimentary rocks of the study area consist of slate, phyllite intercalated with quartz mica schist and quartzite. The mineral assemblages of the Bilin area had been subjected to two types of metamorphism; regional metamorphism reinforced by local contact metamorphism. Regional metamorphism of pelitic rocks gave rise to the formation of slate and phyllite intercalated quartz mica schist. Generally, the grade of metamorphism increases gradually towards the west. The regional metamorphism was superimposed by contact metamorphism by the emplacement of igneous intrusion especially biotite granite and diorite intrusion. Furthermore, the presences of spotted phyllites are the indication of the existence of contact metamorphism. The grain size becomes coarser with increasing in grade of metamorphism such as in slate, phyllite and schist. According to the mineral assemblages, the regional metamorphism of the study area had taken place within the "Greenschist facies". Greenschist facies results from low temperature and pressure condition and the formation of some minerals indicate a temperature of approximately 250˚C to 400˚C and depth of about 2kb to 4kb. The metamorphic rocks of the study area belong to the Mergui Group. The metamorphism of the study area probably took place Post Carboniferous in age.

Keywords: *mineral assemblages, contact and regional metamorphism, Greenschist facies*

Introduction

The study area is situated about 170 km (106 miles) north-east of Yangon and about 96 km (60 miles) north-west of Mawlamyine in Mon State. It is lying between Latitude 17˚12′45′′ N to 17˚21′45′′ N and Longitude 97˚09′00′′ E to 17˚14′45′′ E in one inch topographic map No. 94G/3 and G/4. It extends about 8 kilometers from east to west and 14.4 kilometers from north to south. The total areal coverage is about 116.5 kilometers (45 square miles). The location map of the study area is shown in Fig (1).

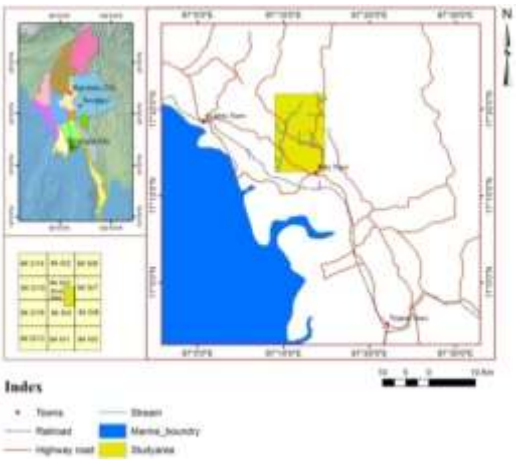

Figure 1 Location map of the study area

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Purpose of study

- To prepare a fairly detailed geological map of the assigned area
- To determine the nature of metamorphism of the study area
- To interpret the probable conditions of metamorphism in Bilin area

Method of Study

The preparation of thin sections was carried out 50 thin sections from metasedimentary rocks were made for identification and mineralogical studies. Detailed petrographic studies of metamorphic rocks were done and then based on the mineral assemblages of the metamorphic rocks, the metamorphic grade and P.T condition of this area is determined.

Regional Geologic Setting

The investigated area is situated in the Eastern Highland (Shan Tanintharyi Block), one of the tectonic provinces of Myanmar by Maung Thein (1976). It is located in Bilin Plain, which lies in the northern continuation of Thaninthayi granite belt, which is actually a part of western tin bearing batholiths known as western tin belt of South East Asia Tin Province (Mitchell, 1977 and Nyan Thin, 1984). Structurally, the study area is bounded by NNW-SSE trending two major fault systems. They are Three Pagoda fault and Papun fault. The main stream of the Bilin River flows north to south, especially at the eastern boundary of the study area. The Pleistocene alluvium covered the south-west and south-east of the area as lateritic terrain. The Regional Geological map of the study area is shown in Fig (2).

Figure 2 Regional Geological map of the study area (Myanmar Geosciences Society, 2014)

Rock Sequence of the study area

The study area is chiefly covered by igneous and metasedimentary rocks in Fig (3). Igneous rocks are well exposed in the northern, north-western and south-eastern parts and then metasedimentary rocks are cropped out in the central and western parts of the study area. In the study area, the major igneous rocks include biotite granite, biotite-muscovite granite, diorite, meladiorite, microdiorite, hornblendite, biotite microgranite, leucogranite and pyroxenite. Metasedimentary rocks consist of slate, phyllite intercalated with schist and quartzite.

Younger Alluvium Older Alluvium (laterite and lateritic soil)	Holocene
Igneous rocks	
Pegmatite, Dolerite, Lamprophyre (spessartite) Dykes	
Aplite, Quartzofeldspathic and Quartz Veins	
Leucogranite	
Biotite microgranite	
Biotite granite, Biotite-muscovite granite	Eocene
Diorite, Meladiorite, Hornblendite	
Pyroxenite	
Metasedimentary rocks	
Slate, Phyllite intercalated with Schist	Silurian-Carboniferous (Mergui Group)
Quartzite	

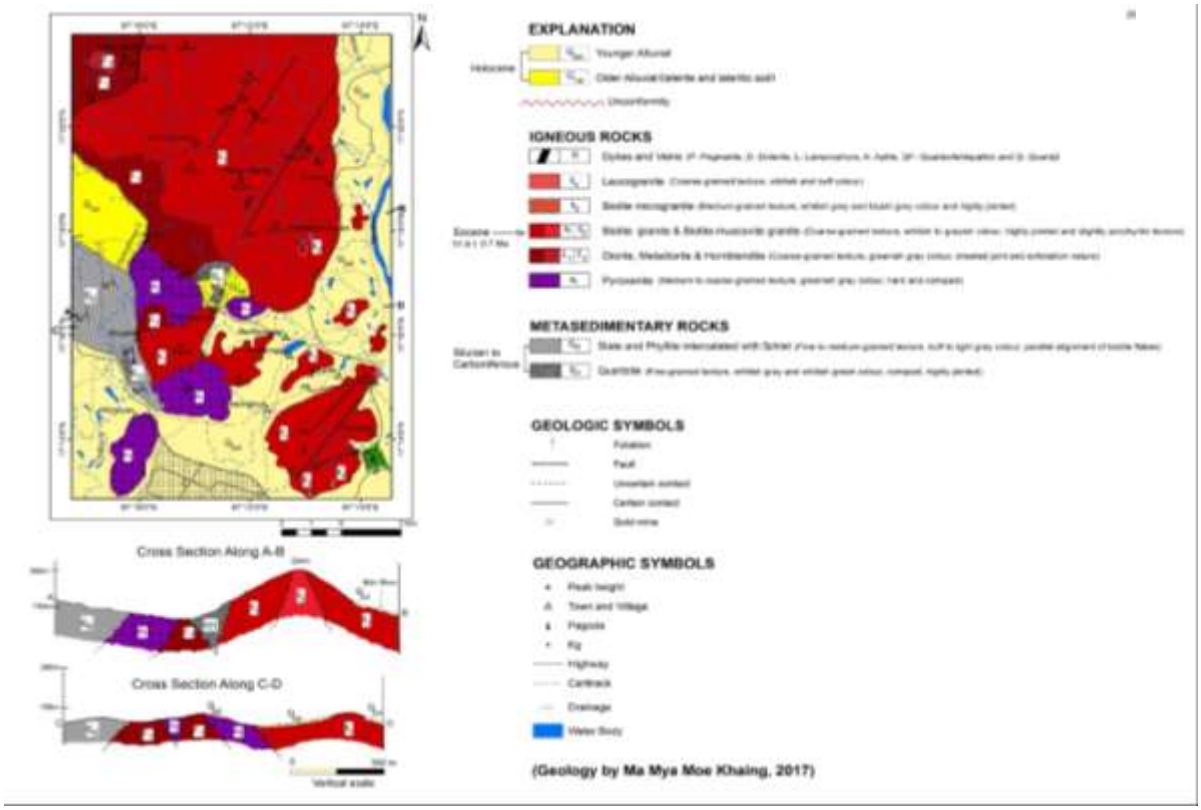

Figure 3 Geological Map of Bilin area and its environs

Results and Findings

Petrogenesis of Metasedimentary rocks

Metasedimentary rocks are divided into the following units, according to field and petrological characters. They are 1. Slate and phyllite intercalated with quartz mica schist 2. Quartzite

Slate is observed along the bullock track at Alugale village. It has very fine-grained texture. It is mainly composed of biotite, quartz, chlorite and muscovite, in Fig (3, A). Phyllite is well distributed at Alugale, Alugyi, Winpyan villages and Alontaung Pagoda. This unit consists of phyllite and quartz mica schist. Quartz vein are intruding into this units. Good exposures are observed along the bullock track of Alugale village. It has fine-grained, exhibits phyllitic texture. It is mainly composed of muscovite, quartz, chlorite, biotite, graphite and iron oxides, in Fig (3, A). Biotite and muscovite occurs as fibrous aggregates, in Fig (3, B). Quartz mica schist shows slightly foliated nature. The main constituent minerals in this rock are mica, quartz and feldspar, in Fig (3, C). Exposures can be observed along the bullock track at the Alugale village, and it is intercalated with phyllite. The common mica is biotite and it is yellowish brown in colour, mica shows alignment on weathered surface. It is generally weathered to the dark yellowish brown colour due to predominance of biotite and fresh colour is gray or yellowish gray. It has fine to medium-grained, schistose texture. Schistosity is shown by lepidobalstic mineral grains of mica. It is mainly composed of quartz, orthoclase, plagioclase, biotite and muscovite, in Fig (3, D). Crystallization of platy minerals under a directed stress results in a preferred orientation of the plates normal to the direction of maximum stress. The resulting foliation is one of the most prominent features of regional metamorphosed rocks. Quartzites are well exposed at the northern part of Paingdawe village and at the hillside of Alontaung Pagoda (117 m peak). It has fine-grained, sugary texture and compact. It is mainly composed of quartz, feldspar, mica and epidote, in Fig (3, E and F).

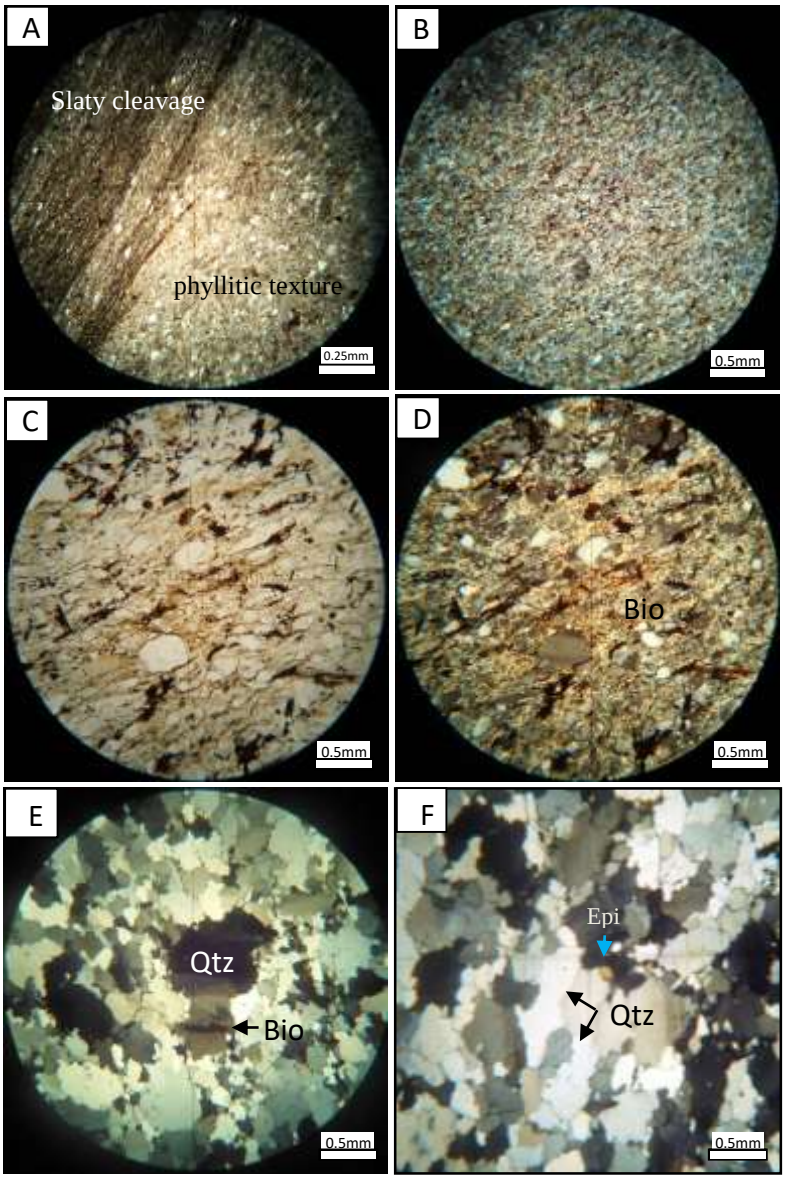

Figure 3 (A) Slaty cleavage and phyllitic texture (under PPL and between X.N, 10X)

(B) Parallel orientation of fibrous aggregates mica in phyllite (between X.N, 4X)

(C, D) Development of foliation (schistosity) by alignment of mica in quartz mica schist (under PPL and between X.N, 4X)

(E) Undulose or wavy extinction of quartz and granoblastic texture in quartzite (between X.N, 4X)

(F) Epidote crystal with elongated quartz in quartzite (between X.N, 4X)

Types of Metamorphism

The mineral assemblages of the Bilin area had been subjected to two types of metamorphism; regional metamorphism reinforced by local contact metamorphism. Regional metamorphism of pelitic rocks gave rise to the formation of slate and phyllite intercalated quartz mica schist. Generally, the grade of metamorphism increases gradually towards the west. The regional metamorphism was superimposed by contact metamorphism by the emplacement of igneous intrusion especially biotite granite and diorite intrusion. Furthermore, the presences of

spotted phyllites are the indication of the existence of contact metamorphism. Pelitic rocks such as clay, shale and mudstone were transformed into slate, phyllite and schist by the effect of regional metamorphism. They are characterized by strong schistosity which is defined by preferred orientation of mica flakes. The grain size becomes coarser with increasing in grade of metamorphism such as in slate, phyllite and schist. Quartzite in the study area can be regarded as being derived from quartz rich sandstone.

Mineral assemblages

The nomenclature, defining mineral assemblages and metamorphic facies classification made in the study area are based on Turner and Verhoogen (1960), Barth (1962), Hyndman (1972) and Winter (2013). On the basis of various mineral assemblages, low grade metamorphic mineral of chlorite is obvious that this rock had greenschist facies. Greenschist facies is regarded in the western and the central parts of the study area. Slate and phyllite intercalated quartz mica schist are cropped out at Alugale village. Epidote quartzite is exposed at the northern part of Paingdawe village.

The mineral assemblages recognized in slate unit are;

Biotite + quartz + chlorite + muscovite

The mineral assemblages recognized in phyllite unit are;

Biotite + quartz + chlorite + muscovite

Muscovite + quartz +chlorite+ sericite

Biotite + quartz + kaoline

The mineral assemblages recognized in spotted phyllite unit are;

Biotite + quartz + muscovite + chlorite

The mineral assemblages recognized in schist unit are;

Biotite + quartz +orthoclase $\pm$ plagioclase

Biotite +muscovite +quartz + orthoclase+ plagioclase

Biotite +muscovite +quartz + chlorite + orthoclase

The mineral assemblages recognized in quartzite unit are;

Quartz + epidote + plagioclase

Quartz + orthoclase + muscovite + sericite

Quartz + orthoclase + microcline + muscovite

The above mentioned mineral assemblages were plotted on AKF diagram, in Fig (4). The mineral assemblages are used to define the metamorphic facies.

Regional metamorphism

According to the mineral assemblages, the regional metamorphism of the study area had taken place within the "**Greenschist facies**" (Turner, 1968) or low grade (Winkler, 1979). Biotite in phyllite in study area can be formed according to this reaction (Winkler, 1973).

K-feldspar + chlorite $\longrightarrow$ biotite + muscovite + quartz + water

Biotite is common in schist. With increasing metamorphism biotite become stable mineral. Biotite is formed from chlorite (Barth, 1962)

Chlorite + orthoclase $\longrightarrow$ biotite + quartz + water

Contact metamorphism

Spotted phyllites are observed in the vicinity of Alugale village and are indicative of the resulting contact metamorphic effects. Spotted phyllites include biotite + quartz + muscovite+ chlorite. The spotted phyllites are found at the contact of some igneous rocks and adjacent metasedimentary rocks, in Fig (5).

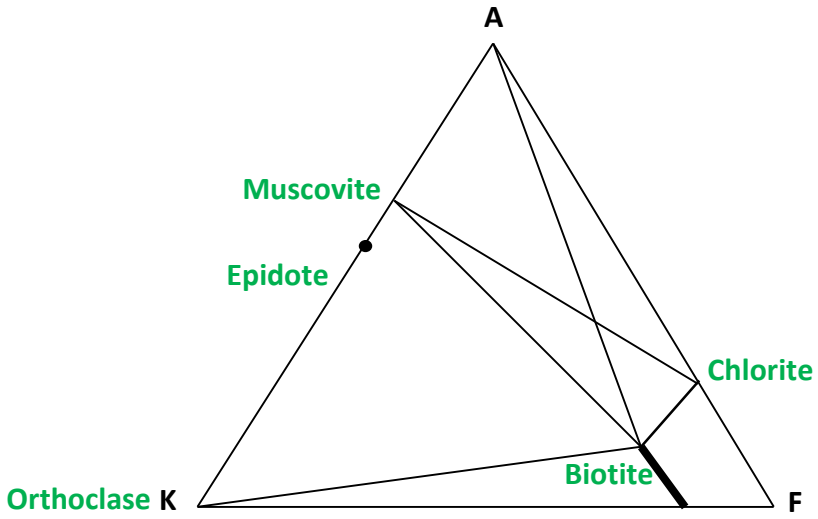

Figure 4 AKF diagram showing the mineral assemblages of Greenschist facies (after Turner and Verhoogen, 1960)

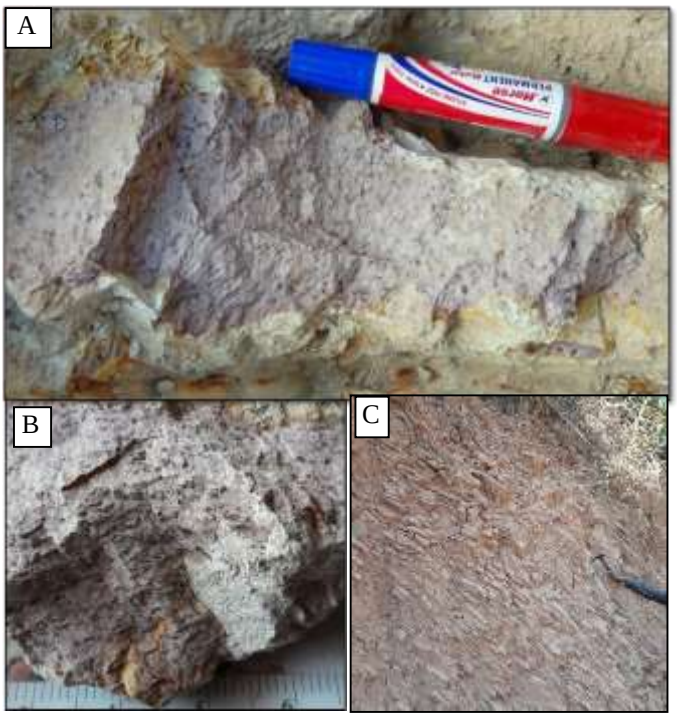

Figure 5 (A, B) Spotted phyllite exhibits spotted nature on fresh surface at Alugale village, facing 120˚ (Loc: N 17˚ 15′ 36″ E 97˚ 09′ 35″)

(C) Spotted phyllite exposed at Alugale village, facing 150˚ (Loc: N 17˚ 15′ 36″ E 97˚ 09′ 35″)

Estimation of P-T Conditions

The estimation of P-T conditions for metamorphic mineral assemblages in the study area can be explained as follow:

Greenschist facies results from low temperature and pressure condition and the formation of some minerals indicate a temperature of approximately 250˚C to 400˚C and depth of about 2kb to 4kb (Winkler, 1979), in Fig (6).

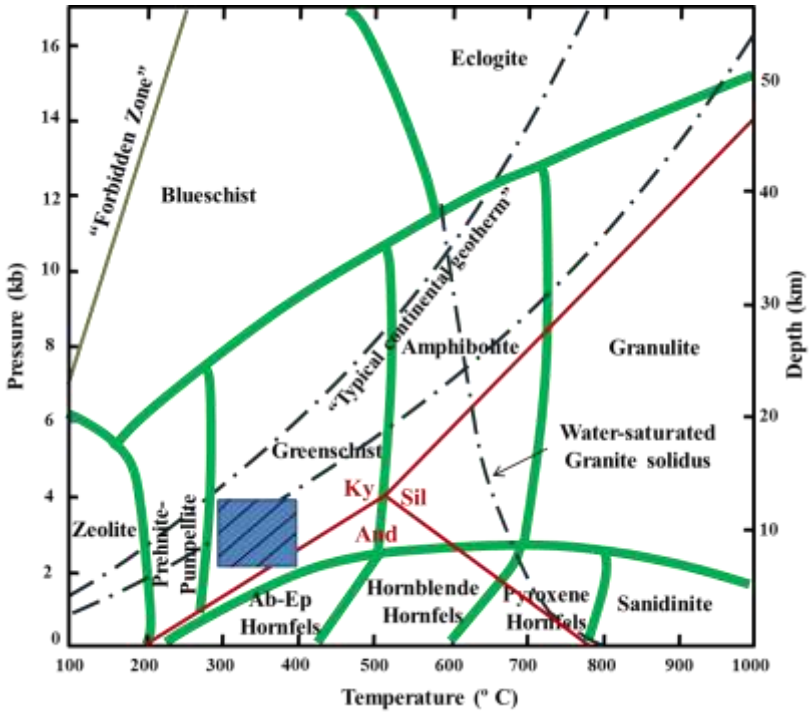

Figure 6 Temperature-pressure diagram showing the probable conditions of metamorphism (after Winter, 2013)

Age of metamorphism and metamorphic rocks

The metamorphic rocks of the study area belong to the Mergui Group. Its lower part has not been separated mapped yet. The lower part may be older in age, possibly Silurian to Carboniferous. Therefore, the metamorphism of the study area probably took place "Post Carboniferous" in age.

Conclusion and Discussion

Metasedimentary rocks consist of slate, phyllite intercalated with schist and quartzite. The mineral assemblages of the Bilin area had been subjected to two types of metamorphism; regional metamorphism reinforced by local contact metamorphism. Generally, the grade of metamorphism increases gradually towards the west. The regional metamorphism was superimposed by contact metamorphism by the emplacement of igneous intrusion especially biotite granite and diorite intrusion. Pelitic rocks such as clay, shale and mudstone were transformed into slate, phyllite and schist by the effect of regional metamorphism. They are characterized by strong foliation which is defined by preferred orientation of mica flakes. Quartzite in the study area can be regarded as being derived from quartz rich sandstone. Spotted phyllites are observed in the vicinity of Alugale village and are indicative of the resulting contact metamorphic effects. The spotted phyllites are found at the contact of some igneous rocks and adjacent metasedimentary rocks. On the basis of various

mineral assemblages, the regional metamorphism of the study area had taken place within the "Greenschist facies". Greenschist facies results from low temperature and pressure condition and the formation of some minerals indicate a temperature of approximately 250˚C to 400˚C and depth of about 2kb to 4kb. The metamorphic rocks of the study area belong to the Mergui Group. The metamorphism of the study area probably took place Post Carboniferous in age.

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