Petrogenesis of Metacarbonate Rocks Exposed in the Yinswe Range, Kyaukse Township, Mandalay Region

Yadanar Win Swe[1], Kyi Kyi Lin[2], Thein Thein Tin[3], Wutyi Nandar Tun[4]

Abstract

The study area is located in Kyaukse Township, Mandalay Region, Myanmar. The vast of the rocks exposed in the area is belonged to the calcareous metasediments. Calcareous metasediments contains varieties of marble and calc-silicate rock. Petrogenesis of the metamorphic units is interpreted on the basis of lithology, mineral assemblages, field relationship and correlation of the rocks of other area. The metacarbonate fall within the upper greenschist or transition to amphibolite facies. Petrographic criteria of the pure white marble shows no diagnostic metamorphic mineral assemblage which determine the precise metamorphic grade.

Keywords: metacarbonate, upper greenschist facies, amphiolites facies

Introduction

Yinswe Area is situated about 8km ESE of Kyaukse, Figure.(1).As lie in the Mogok metamorphic belt (Seral and Haq, 1964), this area is mainly composed of calcareous metasediment. Calcareous group contains varieties of marbles and calc-silicate rocks. A varieties of marble and calc-silicate rock are well exposed in Yinswe Taung and Yadanamyezu Taung. The general trend of the most rock units is N-S with a few exception of localized area. The stratigraphic succession of various rock units including metamorphic rocks and minor igneous rocks of the study area was described by U Thein and U Soe Win (1969).

General Geology

The present area, as a whole, may be regarded as the boundary zone of the Sino-Burma Ranges (Eastern Highland) to the east and the Inner-Burma Tertiary Basin (Central Cenozoic Belt) to the west. The rock units exposed in the present study area is mainly calcareous.

The main bulk of rocks of the study area represent regionally metamorphosed Upper Paleozoic and Jurassic-Cretaceous sediment. The grade of metamorphism decreases eastward, that the metasedimentary sequence progressively losses its primary depositional features can be observed as one goes westward away from the Shan Scarp.

The most abundant calcareous metasediment rock occupied in this area is white marble, tremolite marble, bluish marble, pure-white marble and calc-silicate rock. White marble occur as a narrow exposure in the western part of Yadanamyezu Taung. Tremolite Marble is found to be locally intercalated with biotite schist. Bluish marble unit is found in the northwestern part of Yinswe Taung near glass factory. The pure white marble unit is crop out in the northwestern part of Yinswe Taung. Calc-silicate rock occurs in the western part of Yadanamyezu Taung.

Geological map of the area is shown in figure (2). The petrographic units observed in the study area are arranged in ascending order structurally, but not necessarily stratigraphically.

[1,3,4] Assistant Lecturer, Department of Geology, Yadanabon University
[2] Professor and Head, Department of Geology, Sagaing University

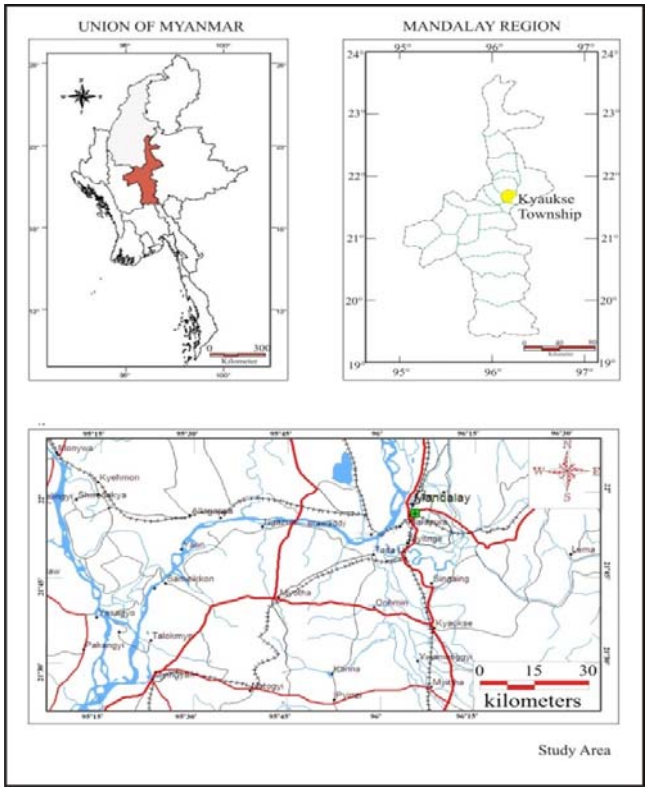

Figure (1). Location map of the study area

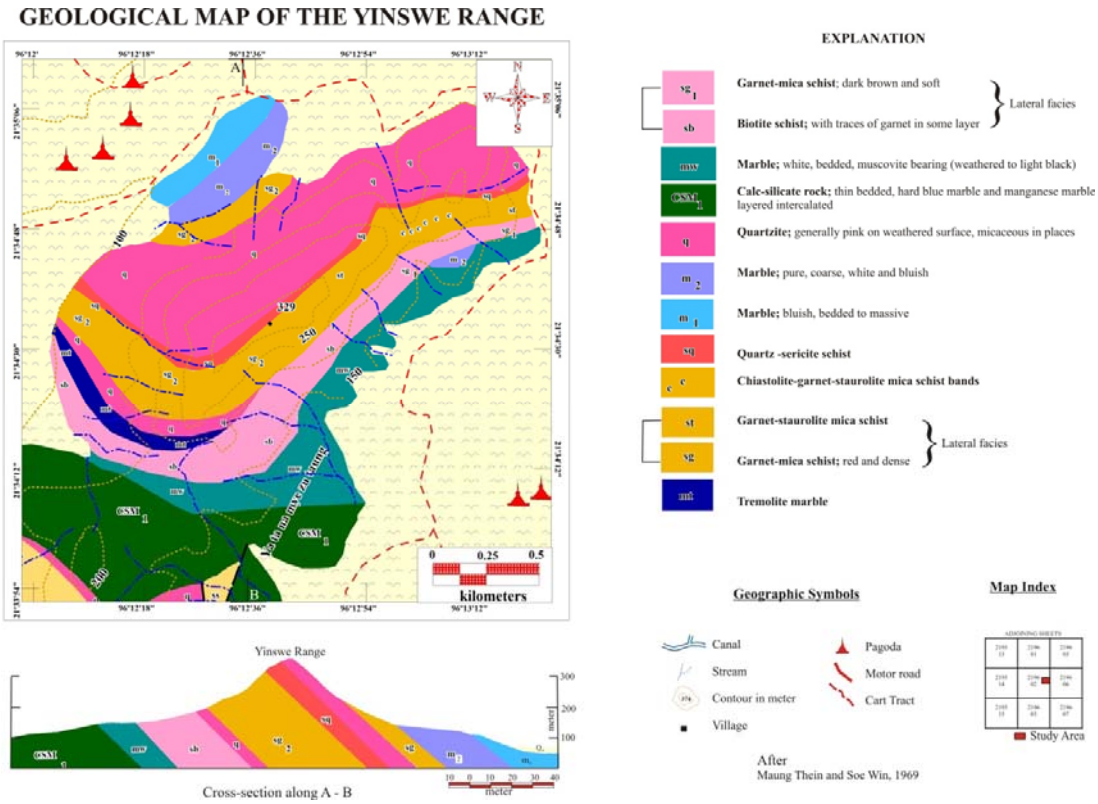

Figure (2). Geological map of the area

Petrography of Metasedimentary Rocks

White Marble

Megascopic Study

The rock unit is mainly composed of calcite and quartz. The color of weathered surface is light-grey to dark-grey and fresh surface is white. The rock is fairly hard, compact and well banded. The banded nature is observed in white marble. White marble contains muscovite but other distinct metamorphic minerals are not.

Microscopic Study

Microscopically, the most of constituent minerals are fine- to medium-grained. The rock exhibits granoblastic texture. Calcite grain occurs either as xenoblastic or idioblastic grains. Tremolite is present as minor constituent. Tremolite also occurs as long prismatic crystal in some section. Calcite grains are characterized by rhombohedral cleavage and polysynthetic twinning. Quartz occurs as scattered grains throughout the rock. It also occurs as inclusions in calcite.

Tremolite Marble

Megascopic Study

The typical mineral constituents of the rocks are calcite, tremolite and quartz. Diopside and phlogopite are presented as minor constituent. The color of tremolite marble is whitish grey on fresh surface and dark-grey on weathered surface. Generally, they are hard and compact and slightly banded. This rock type is a massive crystalline marble. Fibrous aggregates of tremolite minerals are recognized on weathering surface of tremolite marble. Tremolite also occurs as long prismatic crystals in some outcrop.

Microscopic Study

Under the microscope, the marble is fine-to medium-grained. The rock exhibits granoblastic texture. Commonly, calcite grains are elongated with long axes parallel to the foliation planes. Calcite and quartz are seen to be juxtaposed. The calcite grains show common rhombohedral cleavage. Fairly large fibrous aggregates of tremolite crystals can be observed in hand specimen. In some section, a group of long prismatic crystal of tremolite is observed in tremolite marble (Fig.3.a.). Under the microscope, basal section of tremolite mineral is recognized (Fig.3.b.).

Pure White Marble

Megascopic Study

The rock is mainly composed of calcite and a few quartz. It shows whitish color on fresh surface and light-grey color on weathered surface.

Microscopic Study

Under the microscope, the most constituent minerals are coarse-grained. The rock exhibits equigranular granoblastic texture. Most calcites are xenoblastic grains. Calcite grains show their characteristic rhombohedral cleavages.

Calc-silicate Rock

Megascopic Study

The major mineral of calc-silicate rocks are calcite, quartz, diopside, tremolite and epidote. The minor minerals are plagioclase and muscovite. The rock shows greenish-grey color on fresh surface and buff color on weathered surface.

Microscopic Study

Under the microscope, calcites are xenoblastic to idioblastic grains. Their twin lamellae can be easily recognizable under cross-nicol. Diopside, tremolite and epidote grains segregate in parallel manner forming distinctive layers in calc-silicate rock. Muscovites are sometimes found as scattered grains. Some calc-silicate minerals contained in these rocks are so minute that it is difficult to identify precisely. Mineral assemblages of calcite, quartz, diopside, epidote and tremolite are developed in calc-silicate rock (Fig.4.).

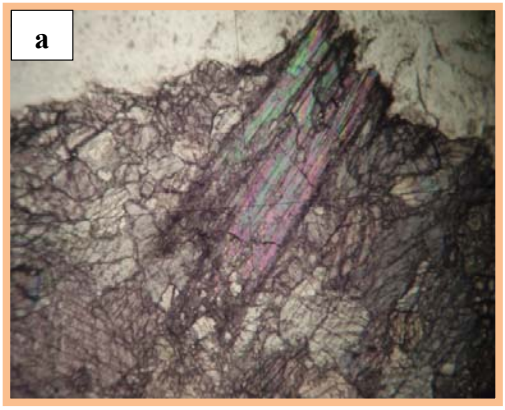

Figure (3).(a). Long prismatic crystal of tremolite observed in tremolite marble (between XN)

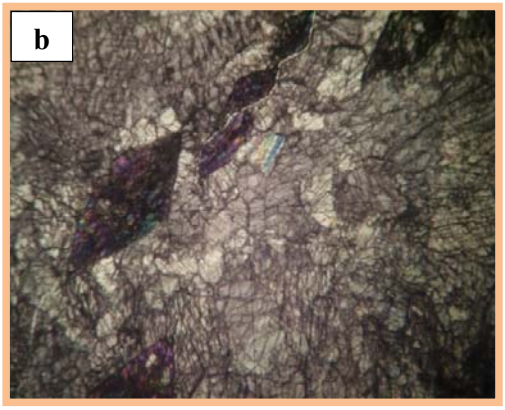

Figure (3).(b). Basal section of tremolite mineral observed in tremolite marble (between XN)

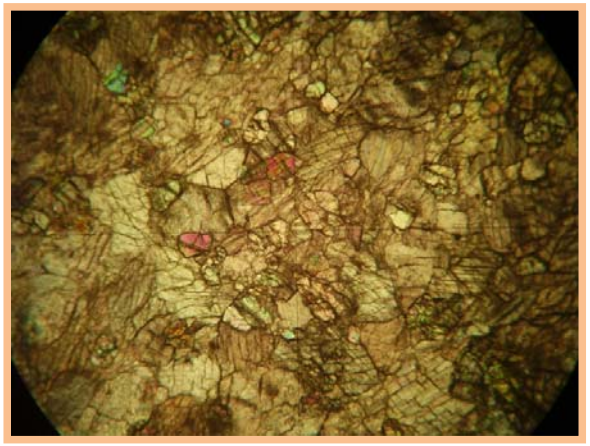

Figure (4). Mineral assemblage of calcite, quartz, diopside, epidote and tremolite developed in calc-silicate rock (between XN)

Petrogenesis of metacarbonates

General Statement

In the present investigated area, the rock units are composed mainly of metamorphic rocks. Petrogenesis of the metamorphic units is interpreted on the basis of the lithology, mineral assemblages, field relationships and correlation to the rocks of other area.

The facies classification, nomenclature and defining mineral assemblages used in this paper mainly based on the concept first described by Ramberg (1952), later modified by Barth (1962) and Heitanen (1967) (in Maung Thein *et al.,* 1969). Some rock types do not show diagnostic assemblages at some particular metamorphic grade. From these consideration, Bucher and Frey (1994) proposed that it should be searched for diagnostic mineral assemblages and it may be sufficient to recognize a metamorphic facies with the aid of only one such assemblages. These mineral assemblages will coexist over a particular range of metamorphic conditions, temperature and pressure.

Several thin sections cut from various rock types were studied for the mineral assemblages are graphically represented by means of CMS diagrams.

Tremolite Marble

The diagnostic mineral assemblages recognized in this rock unit are:

(i) Dolomite-calcite-quartz-tremolite,

(ii) Calcite-quartz-tremolite-diopside,

Dolomite-calcite-quartz-tremolite is characteristic mineral assemblage of tremolite marble, and talc is not present in this rock. Absence of talc in marble may be regarded in two ways. Firstly, the tremolite-producing reaction consumed all talc. These reactions can be expressed as:

$$3\ Dol + 4\ Qtz + H_2O \rightarrow Tlc + 3\ Cal + 3\ CO_2 \quad \text{---------- (1)}$$

$$5\ Tlc + 6\ Cal + 4\ Qtz \rightarrow 3\ Tr + 6\ CO_2 + 2\ H_2O \quad \text{---------- (2)}$$

Reaction (1) has been observed by Guitard (1966), Steck (1969), Hoffer (1973) and Trommsdroff (1972), and reaction (2) by Jasen *et al.* (1978), Duhan and Hoffer (1973), Trommsdroff (1972) (in Winkler, 1979). Talc is removed from the marble by reaction (2), and tremolite is therefore, the first recognizable mineral in this marble. The assemblage tr-cal-qtz typically represents the upper greenschist or transition to amphibolite facies. These reactions are graphically represented by means of CMS diagram as shown in figure (5.a.).

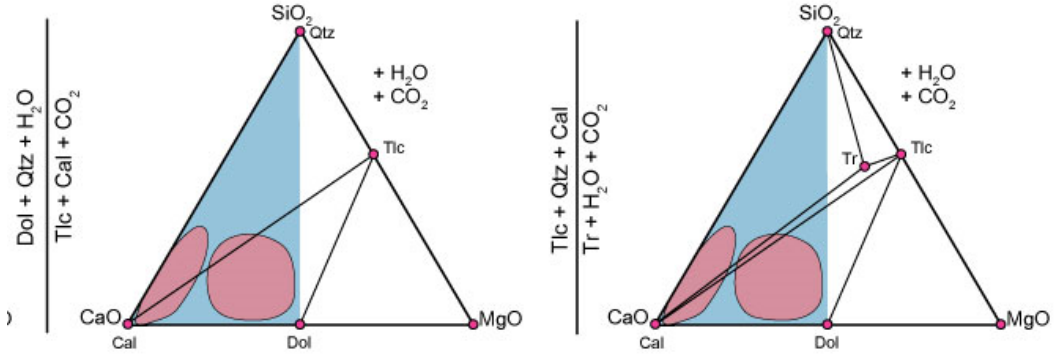

Figure (5).(a). CMS diagrams showing development of mineral assemblages in tremolite marble (Source: Winter 2001)

Secondly, the first tremolite forming reaction in siliceous dolomite limestone can be represented by the following reaction:

$$5\ Dol + 8\ Qtz + H_2O \rightarrow Tr + 3\ Cal + 7\ CO_2 \quad \text{---------- (3)}$$

During progressive metamorphism, at upper amphibolite facies Reaction (3) is represented by the important assemblage Dol-Qtz-Tr-Cal, and it can be illustrated in CMS diagrams as shown in figure (5.b.).

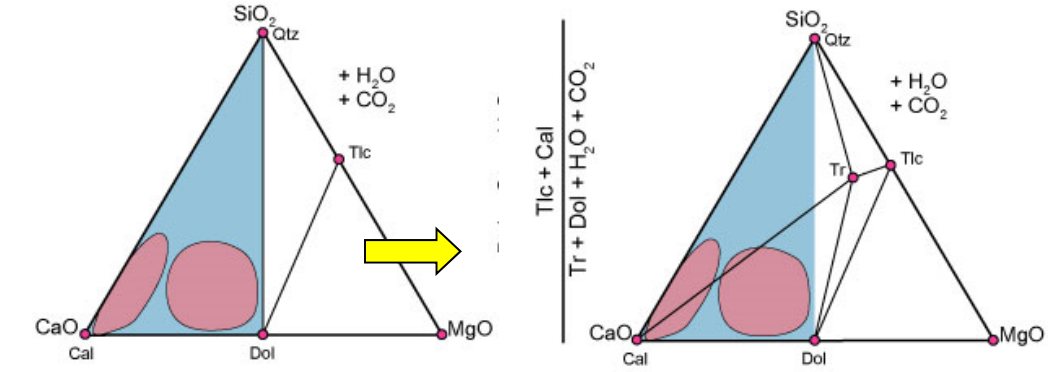

Figure (5).(b). CMS diagrams showing development of mineral assemblages in tremolite marble (Source: Winter 2001).

The assemblage Dol + Cal + Qtz + Tr defines the talc-out isograd and tremolite-in isograd. Its temperature is about 500 °C and rather independent of the precise position of the geotherms in orogenic metamorphic terrains.

The upper limit for Tr + Cal + Qtz (Tr + Cal + Qtz out isograd) coincides with the diopside-in isograd at pressure above about 5 kbar. Below this pressure the isograd occurs at slightly higher T than the diopside-in isograd.

Pure White Marble

Petrographic criteria of the pure white marble show no diagnostic metamorphic mineral assemblages which determine the precise metamorphic grade. So the metamorphic condition for this rock can only be ascertained by studying the textures the rock. It can be assumed that the texture of this rock is much mature. This fact is evidenced by its grain size and grain boundary relationship.

Calc-silicate Rocks

The mineralogy of this rock is very simple. Common calc-silicate mineral, diopside, epidote, tremolite, calcite and quartz are recognized in the rock. The mineralogy of common calc-silicate rock is fairly complex. Winter (2001) expressed that calc-silicate rocks begin as carbonate-bearing pelitic sediments (sometimes called calcareous pelites or marl). Since calc-silicate rocks involving additional components result a correspondingly larger range of minerals, it is difficult to postulate the precise P-T condition from calc-silicate mineralogy. Moreover, the presence of diopside indicates the fairly high metamorphic condition. The rock in which this mineral assemblage is belongs to the lower amphibolite facies.

Type of Metamorphism

Metamorphism which affected the rock units of the study area is regional metamorphism. It is deduced from following factors;

- The metamorphic rocks of the study area show texturally distinct foliation, lineation and metamorphic differentiation.
- Successive formation of new mineral assemblages are observed as a result of recrystallization and neomineralization processes.
- The mineral zones of regional metamorphism is characterized by the appearance and disappearance of mineral.
- The mineral assemblages observed are different from that of the thermal metamorphism.

Conclusion

The metacarbonate falls within the upper greenschist to amphibolite facies. According to the successive formation of mineral zones observed may be compared to that of Buchan facies series. The characteristic mineral assemblages defining these facies are graphically represented by means of the CMS diagrams.

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References

Bender, F., 1983. *Geology of Burma.* Gebruder Borntraeger, Berlin

Bucher, K and Frey, M., 1994. *Petrogenesis of Metamorphic Rocks.* 6th Ed., Springer-Verlag, New York

Chhibber, H.L., 1934. *Geology of Burma.* Macmillan, Landon

La Touche., T. H. D., 1913. Geology of the Northern Shan State. *Mem. Surv*. India, vol. 39

Maung Thein, Soe Win, 1969. The metamorphic petrology, structure and mineral resources of the Shantaung-U-Thandawmywet Range, Kyaukse District, Burma, *Burma Jour. Sci, Tech*

Myint Thein, Bo San and Myint Thein, 1997. A geological reinvestigation of Kyaukse-Belin-Dattaw area, Mandalay Division. *Paper.* Read at the Research Congress Commemorating Mandalay University College Golden Jubilee

Myint Thein, Kyaw Tint, and Kan Saw, 1982. Geology of the part of the Eastern Margin of the Central Burma Belt between Sagaing and Tagaung. *Paper,* Research Congress, 1982

Searle, M.P., S.R. Noble., J.M. Cottle., D.J. Waters., A.H.G. Mitchell, Tin Hlaing & M.S.A. Horstwood, 2007. Tectonic evolution of the Mogok metamorphic belt, Burma (Myanmar) constrained by U-TH-Pb dating of metamorphic and magmatic rocks, *American Geophysical Union*, Tectonics, vol. 26, TC 3014, pp. 1-24

Winkler, H. G. F., 1979. *Petrogenesis of Metamorphic Rocks.* 5th Ed., Springer-Verlag, New York

Winter, J. D., 2001. *An Introduction to Igneous and Metamorphic Petrology.* Prentice Hall, New Jersey