Petrochemistry of the Granitoid Rocks of the Pagaye Area, Dawei District, Tanintharyi Region

Thaire Phyu Win*, Htin Lynn Aung**, Khin Mg Htwe***, Hnin Wyut Ye****

Abstract

The present study area is located about 10 miles NE from Dawei, Tanintharyi Region. It lies between the Latitude 14° 11' 00" N to 14° 5' 30" N and Longitude 98° 16' 00" E to 98° 19' 00" E in one inch topographic map sheet 95 J/8. The study area is the southern part of the Shan–Tanintharyi Block of Myanmar. It also lies in the Central Granitoid Belt and a part of the western Tin belt of Southeast Asia Tin Province. The study area is composed of the granitoid rocks and clastic sedimentary rocks of the Mergui Group. The granitoid rocks are muscovite–biotite granite, muscovite granite, hornblende granite, and leucogranite. The igneous rocks of the study area may be emplaced at epizone by fractionation crystallization from the partial melting of peraluminous sedimentary source rocks during late Carboniferous to Paleocene. These rocks are high–K calc–alkaline and calc–alkaline rocks and also have peraluminous to metaluminous nature.

Key words: Dawei, granitoid rocks, fractionation crystallization, high–K calc–alkaline

Introduction

The present study area is located about 10 miles NE from Dawei, Dawei Township, Tanintharyi Region. The area lies between the Latitude 14° 11' 00" N to 14° 5' 30" N and Longitude 98° 16' 00" E to 98° 19' 00" E in one inch topographic map sheet 95 J/8. The study area can be accessed from Dawei – Hermyingyi car road. Figure 1 is location map of the Pagaye area.

Purposes of Investigation

The present study is mainly intended to establish the petrogenesis of the igneous rocks based on the petrochemical analysis.

Methods of Study

The geochemical results for 8 samples of granitoids were sent to the Department of Geology, Mandalay University. Major elements of whole–rock analyses were determined by wavelength dispersive XRF spectrometer. Standard CIPW norm (weight percent norm) and molecular norm (cation norm) were calculated.

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Regional Geology

The study area is the southern part of the Eastern Highland of Myanmar (Maung Thein, 2000). It also lies in the Central Granitoid Belt of Khin Zaw (1990). It is also a part of the Tanintharyi Granitic belt which is a part of the western Tin–bearing batholith intrusions known as western Tin belt of Southeast Asia Tin Province (Mitchell, 1997). There are three granitic ranges in Dawei area, namely the Coastal Range, Central Range and Frontier Range (Brown and Heron, 1919) and their trend is NNW–SSE, almost parallel to the regional strike of the Mergui rocks. The study area lies in the Central Range granite. The Central Range granite is predominantly of ilmenite–series granite which hosts several Sn–W deposits such as Wagone, Hermyingyi and Putletto. The regional geological map of the study area and its environs is shown in figure 2.

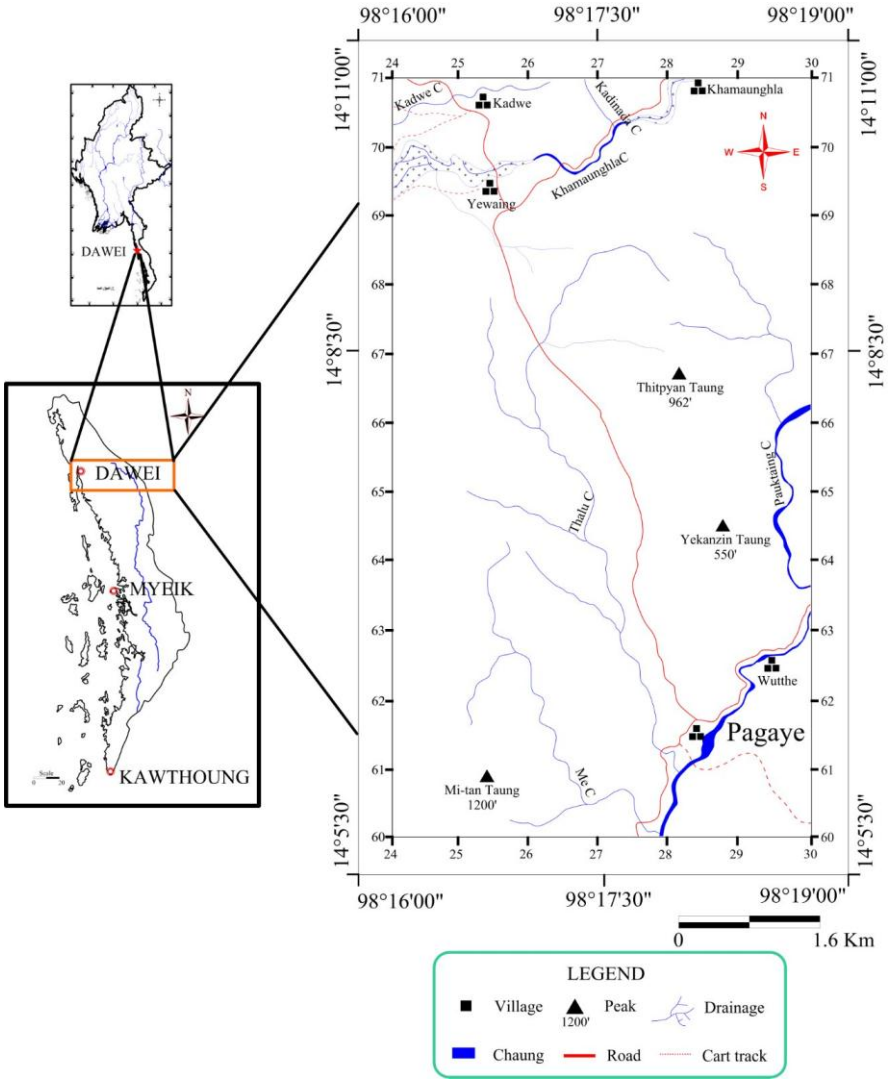

Figure 1. Location map of the Pagaye area

The study area is composed of clastic sedimentary rocks of the Mergui Group and the granitic rocks. The varieties of igneous rocks are muscovite granite, hornblende granite, and leucogranite. The age of the rocks of the study area may have been estimated by the previous authors. Jiang et al, (2017) and Li et al, (2018) designated as

Hermyingyi area is situated in the Paleocene granite and Permo–Carboniferous metasedimentary rocks of the Mergui Group. The granitoids intruded the Mergui Group during late Mesozoic to early Tertiary age.

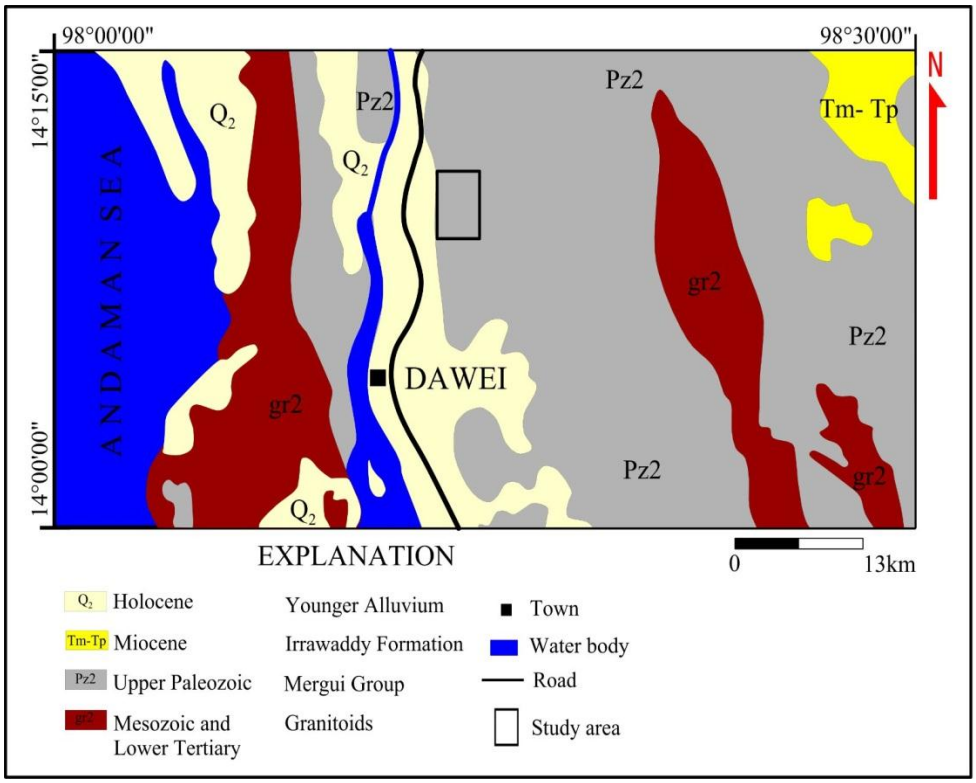

Figure 2: The regional geological map of the Pagaye area and its environs (modified from one million scale geological map of Myanmar, 1977)

Geochemistry

Characteristics of Major Elements

In the total alkali versus silica (TAS) diagram, the granitic rocks (the range of SiO_2 content is from 73.85% to 70.02%; Na_2O+K_2O is from 6.46% to 7.39 %) fall within the granite field (Figure 3). Due to the An– Ab–Or diagram, most rocks of the study area plot within the granite field (Figure 4).

To demonstrate the behavior of the elements using SiO_2, Harker variation diagrams are used for crystal fractionation process. All major oxides versus SiO_2 variation diagrams of the granitic rocks are shown in figure 4. The K_2O contents correlate positively with silica. But the MgO, Fe_2O_3, TiO_2, Al_2O_3, P_2O_5 and CaO contents show negative trends against silica increase (Figure 5). Therefore it can be suggested that these granitoids were derived from the evolved melts (Winter, 2013).

According to the major elements, the granitoids of the study area plot in calc–alkaline rocks (Figures 6 and 7) of the Irvine and Baragar (1971) classification scheme (in Philpotts, 1990) and they belong to normal calc–alkaline rocks. Base on the calc–alkaline

nature, the granitoids of the Pagaye area is genetically related to the subduction. On the K_2O versus SiO_2 diagram (Figure 8), six samples fall within the high–K calc–alkaline series whereas the other one sample falls in the calc–alkaline series.

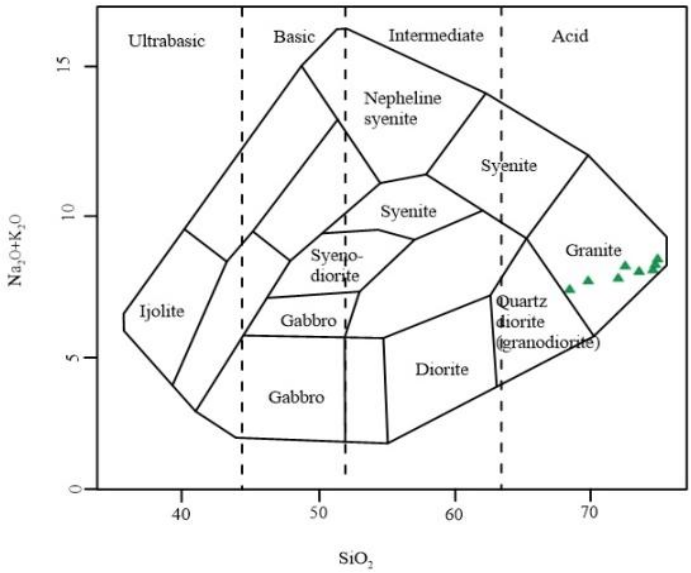

Figure 3: The chemical classification and nomenclature of the granitoids of the Pagaye area based on total alkali vs silica (TAS) diagram (After Cox et al, 1979 in Rollinson, 1995)

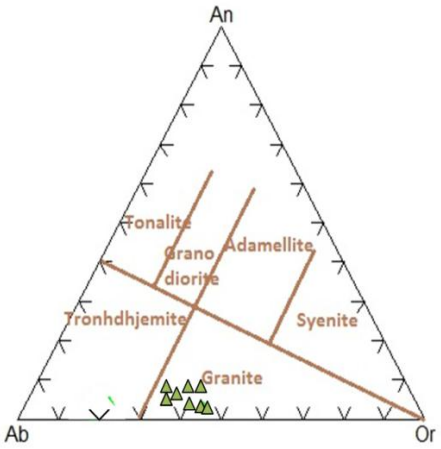

Figure 4: Molecular normative An–Ab–Or diagram for granitoids of the Pagaye area (After Barker, 1979 in Rollinson, 1995)

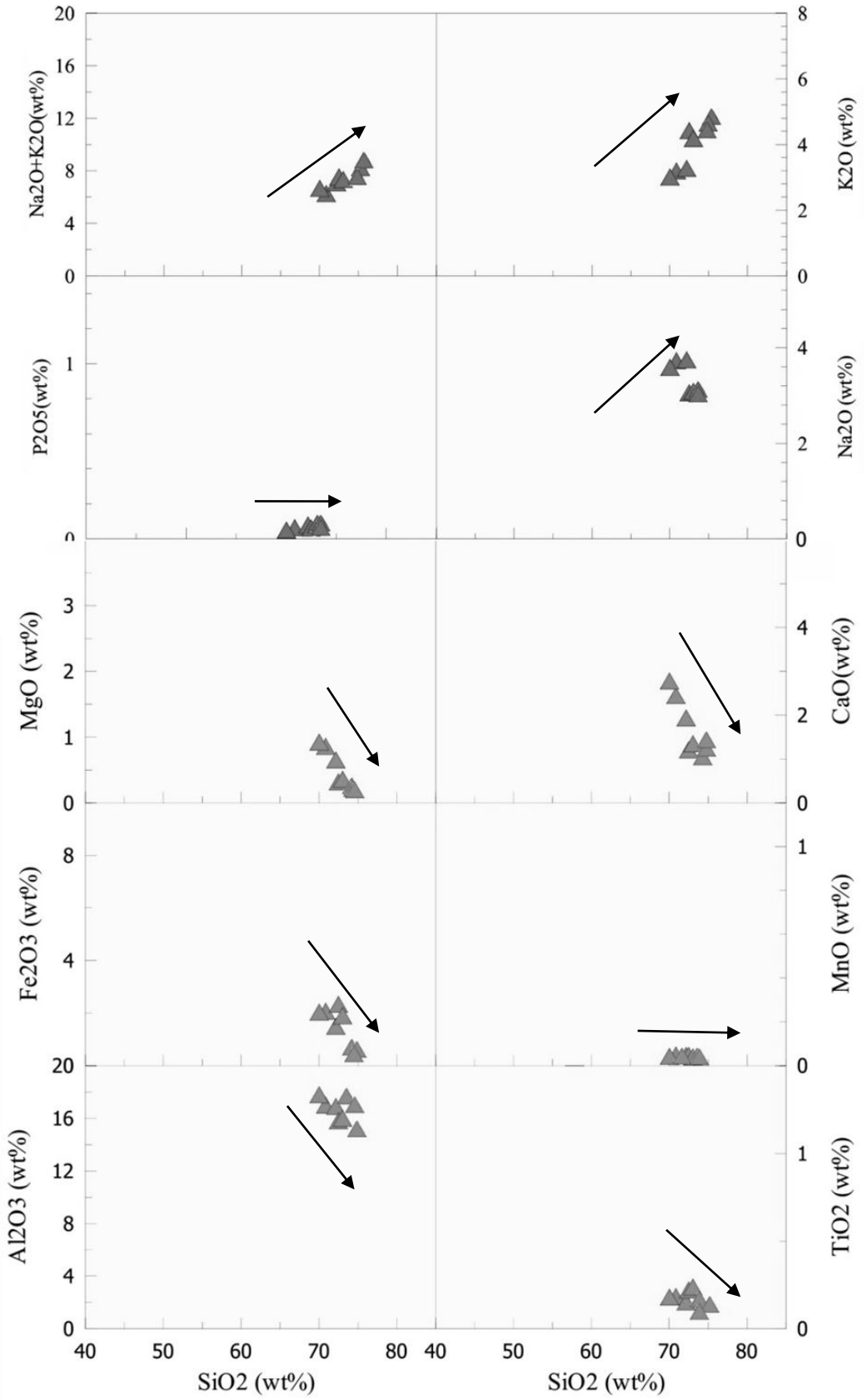

Figure 5: SiO_2 vs major oxide (wt.%) variation plots of the granitoids of the Pagaye area. The fractionation trend is indicated by arrows with increasing silica content.

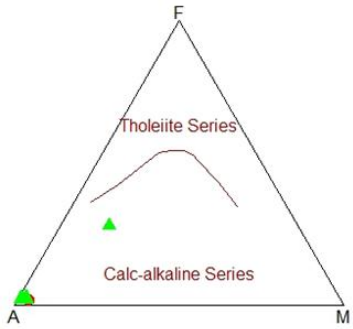

Figure 6: AFM diagram showing the classification of Tholeiite– calc–alkaline of the granitic rocks (Irvine and Baragar, 1971 in Philpotts, 1990)

The alumina saturation index (ASI) ranges from 1.12to 1.39 for the granitic rocks. Chemically, the granitic rocks from the study area have alumina greater than the sum of lime, soda and potash [Al_2O_3> (CaO+ Na_2O + K_2O)]. In Al_2O_3–Na_2O–K_2O diagram too, all the granitic rocks fall within the peraluminous to metaluminous field (Figure 9). On the alumina saturation indices diagram, the granitoids of the Pagaye area poses peraluminous field (Figure 10).

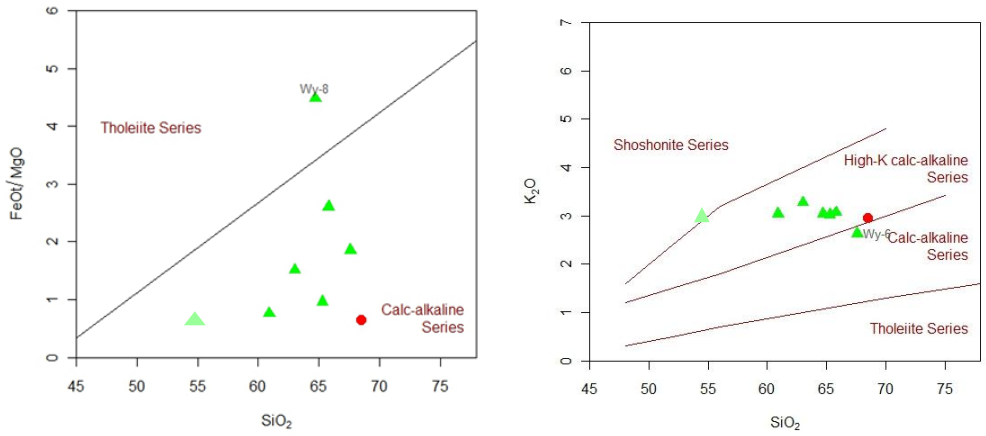

Figure 7: SiO_2 vs FeO/MgO diagram depicting the classification of Tholeiite– calc–alkaline of the granitoids of the Pagaye area (Irvine and Baragar, 1971 in Philpotts, 1990)

Figure 8: SiO_2 vs K_2O diagram depicting high– K. Calc–alkaline nature of the granitoids of the Pagaye area (After Le Maitre et al, 1989 in Rollinson, 1995)

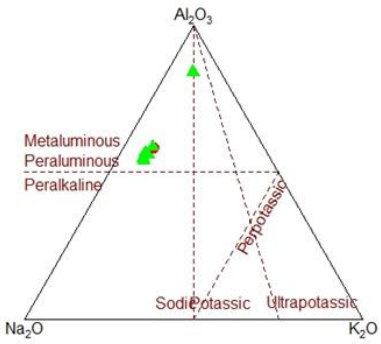

Figure 9: Al_2O_3– Na_2O – K_2O diagram depicting the peraluminous nature of the granitoids of the Pagaye area (Shand, 1943 in Winter, 2013)

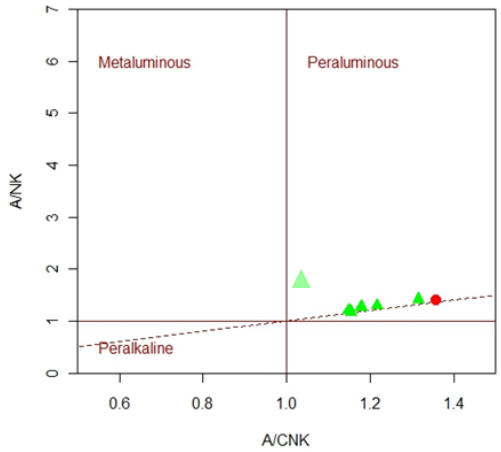

Figure 10: A/NK (molecular Al_2O_3/Na_2O+K_2O) vs A/CNK (molecular $Al_2O_3/CaO+Na_2O+K_2O$) diagram reveals the peraluminous nature of the grannitoids of the Pagaye area (Shand, 1943 in Winter, 2013)

Types of Granitic Rocks

The distribution of the granitic rocks as discordant character, their calc–alkaline affinity and peraluminous character, relatively high K_2O content, more felsic type (typically SiO_2>73Wt%), having CIPW corundum content > 1% strongly suggest that the granitic rocks in the present study area are of S–type. In addition, in the ACF diagram, the plots coincide with the S – type field (Figure 11). Therefore, it can be suggested that S – type granites of the study area may be formed by partial melting of peraluminous sedimentary source rocks (Winter, 2013).

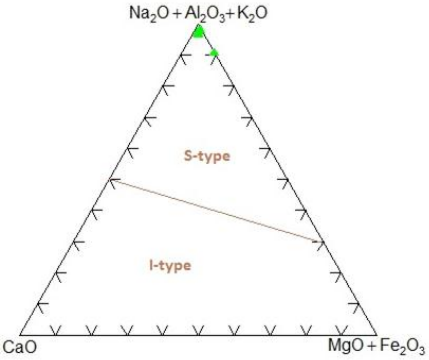

Figure 11: ACF diagram for the granitic rocks of the Pagaye area (after Hyndman, 1985)
(Molar ratio: A – $Al_2O_3 + Na_2O + K_2O$, C – CaO, F – $Fe_2O_3 + MgO$)

Tectonic Discrimination of Granitic Rocks

According to Maniar and Piccoli (1989), tectonic discrimination diagrams based on major oxides present in the granitic rocks of the study area are described in (Figures 12a–d). In figure 12a, K_2O vs SiO_2 diagram, the granitic rocks of the study area plot within the IAG + CAG + CCG + CEUG + RRG fields. In Al_2O_3 vs SiO_2 and MgO and SiO_2 diagrams, the granitoids plot within the fields of IAG + CAG + CCG (Figures 12b and c). In Shand's index diagram (Figure 12d), the granitids of the study area belong to the CCG field only.

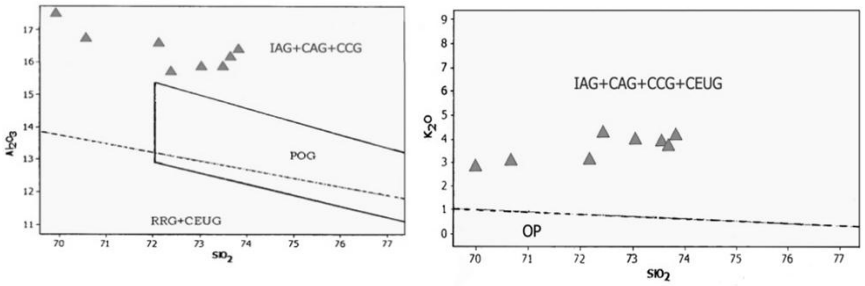

Figure 12 (a): K_2O vs SiO_2 diagram reveals the tectonic environment of the granitoids of the Pagaye area

Figure 12 (b): Al_2O_3 vs SiO_2 diagram reveals the tectonic environment of the granitoids of the Pagaye area

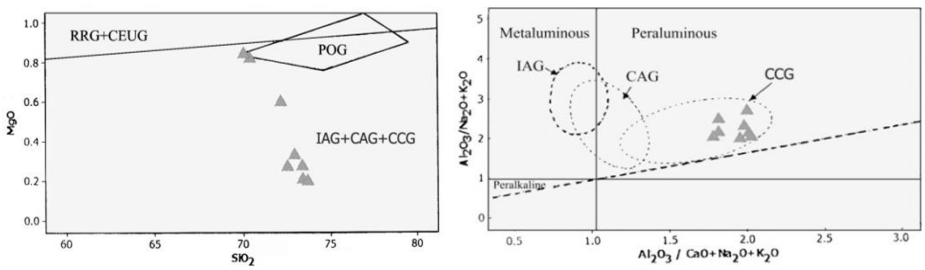

Figure 12 (c): MgO vs SiO_2 diagram reveals the tectonic environment of the granitoids of the Pagaye area

Figure 12 (d): Shand's index diagram reveals the alumina saturation and tectonic environment of the granitoids of the Pagaye area

IAG – Island arc granitoids CAG – Continental arc granitoids
CCG – Continental collision granitoids POG – Post orogenic granitoids

RRG–Rift related granitoids OP – Oceanic plagiogranites
CEUG–Continental epiorogenic uplift granitoids

According to the above mentions, it can be considered that the granitoids of the Pagaye area are orogenic granitoids, and were formed on the continent owing to the subducted oceanic plate beneath the continent.

Discussion and Conclusions

Regionally, the study area lies in the Central Granitoid Belt and also a part of the western Tin belt of Southeast Asia Tin Province. It also belongs to the central range among three granitic ranges in Dawei area. The igneous rocks are muscovite granite, hornblende granite, muscovite–biotite granite (two mica granite), and leucogranite.

According to the Harker's variation diagrams the granitic rocks of the study area has been emplaced by fractional crystallization process from the evolved melts. According to the major elements, the granitoids of the Pagaye area plot in calc–alkaline rocks. Therefore, it can be considered that the granitoids of the Pagaye area are genetically related to the subduction.

On the alumina saturation indices diagram, the granitoids of the Pagaye area belong to peraluminous field. In Al_2O_3–Na_2O – K_2O diagram too, all the granitic rocks fall within the peraluminous to metaluminous field. The distribution of the granitic rocks as discordant character, their calc–alkaline affinity and peraluminous character, relatively high K_2O content, more felsic type, having CIPW corundum content > 1% strongly suggest that the granitic rocks in the Pagaye area are of S–type. Therefore, it can be suggested that S – type granites of the Pagaye area may be formed by partial melting of peraluminous sedimentary source rocks.

In K_2O vs SiO_2 diagram, all granitoids plot within the IAG + CAG + CCG + CEUG + RRG fields. In Al_2O_3 vs SiO_2 and MgO and SiO_2 diagrams, the granitoids plot within the fields of IAG + CAG + CCG. In Shand's index diagram, all granitic rocks belong to the field of CCG only. According to the above mentioned, it can be considered that the granitoids of the Pagaye area are orogenic granitoids which were formed on the continent owing to the subducted oceanic plate beneath the continent.

Acknowledgements

I am especially indebted to Rector, Dr Maung Maung Naing, and Pro-rectors, Dr Si Si Khin, Dr Tint Moe Thuzar, Yadanabon University for their kind permission to submit this research. I would like to express my sincere gratitude to Dr. Htay Win, Professor and Head, Department of Geology, and Dr Khaing Khaing San, Professor, Department of Geology, Yadanabon University for their energetic discussion.

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