Bulletin of Earth Sciences of Thailand

Research Article

Petrography and Geochemistry of Granitic Rocks at Silapetch Waterfall, Pua District, Nan Province, Northern Thailand

Wachirayut Budnark, Pitsanupong Kanjanapayont* and Piyaphong Chenrai

Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
*Corresponding author e-mail: pitsanupong.k@hotmail.com

Abstract

Petrography of the granitic rocks at Silapect waterfall and nearby area shows plagioclase, quartz, biotite and hornblende that are major minerals composition. Minor minerals composition contains; K-feldspar, chlorite, apatite, epidote and opaque minerals. Modal analysis on the rock slabs and thin-sections were applied to medium to coarse grained granitic specimen, while only classical point counting in thin-sections was applied fine to medium grained granitic specimen. The results show that this study area can be divided into two categories, namely, granodiorite and monzodiorite. Granodiorite rocks were observed as outcrops, which show equigranular and primary texture with medium to coarse grain. The loose blocks of monzodiorite present same texture as granodiorite but there are difference in grain size (fine to medium grain). Geochemically, the granitic rock in the study area have an extended composition range, high values of Na_2O moreover 3.2%, values of $Al_2O_3/(Na_2O+K_2O+CaO)$ content drop off 1.1% and CIPW norm of corrundum less than 1%.The study area can be classified as I-type granites which is clearly a part of the Eastern Granitiod Belt.

Key words: Petrography, Geochemistry**,** Granitic rocks**,** I-type granites

1. Introduction

The study area is located in Silapetch waterfall, Pua District, Nan Province is located in the Eastern Granitoid Belt of Thailand (Teggin, 1975; Pongsapich and Mahawat, 1977). It associated with Nan or Nan-Uttaradit Suture granite and Sukho-Thai fold belt (Cobbing et al., 1986; Charusiri, 1989). The previous researches are focused on regional scale. Therefore, this study emphasizes on the petrography and geochemistry to classify the granitic rock in Changwat Nan.

2. Materials and Methods

2.1. Geological setting

Most plutonic rocks in the Nan area are granitic rocks belonging to granite belt of Thailand (Charusiri et al., 2002). Based on the stratigraphic correlation and dating results of previous study, the granite rocks in this area can be divided into 2 categories, Permo-Triassic Granite and Triassic Granite, however both are of I-type (Chrusiri et al., 2002). The Permo-Triassic granite is well exposed in the east of Nan area, particularly at Chiang Kan and Muang Districts, Loei Province. It is composed of micro granite and quartz-monzonite, granodiorite and plagio-granite. The Triassic granite is well exposed in the central and east of the Nan area, especially at Tha Pla District, Uttarradit Province and Pua District, Nan Province.

2.2. Analytical methods

The first step is to interpreted aerial photography and satellite image. This was performed before field investigation. Next step is the field investigation and sample collection. All rocks were randomly collected for petrography and geochemistry in laboratory. Then, thin sections of igneous rocks in the study area were done for petrographic study using polarized light microscope. Modal analysis on the rock slabs

and thin-sections was applied to medium to coarse grained granitic specimen, while only classical point counting in thin-sections was applied fine to medium grained granitic specimen. Afterwards, whole rock samples were analyzed for major and minor element using X – Ray Fluorescence Spectrometry (XRFs) and wet chemical analysis; Ferrous iron (FeO) was determined by titration.

3. Results

3.1. Field investigation

The granitic rocks in the study area can be distinguished into two categories from hand specimen, namely, medium to coarse grained granitic rock and fine to medium grained granitic rock. The granitic rocks are characterized by phaneritic rocks that are equigranular texture and primary texture (Cobbing et al., 1992), composed of mineral; quartz, feldspar, hornblende, biotite, chlorite and epidote. Xenoliths of mafic igneous rocks can found in some outcrop.

3.2. Petrography

The granitic rock in study area shows holocrystalline, equigranular with suture texture (irregular boundary)**,** pokilitic textures and primary-textured granite with coarse interlocking grain boundaries**.** Crystal forms are allotrimorphic to subidiomorphic. Thin sections show minerals compositions consist of plagioclase (oligoclase to andesine), quartz (shown primary-textured granite with coarse interlocking grain boundaries), dark brown, green and reddish brown biotite, olive-green or pale-green hornblende, apatite and K-feldspar. The secondary minerals contain chlorite, epidote and opaque minerals.

3.3. Modal analysis

Modal analysis of the granitic rocks show that this study area can be divided into two categories, namely, granodiorite and monzodiorite (Fig.1).

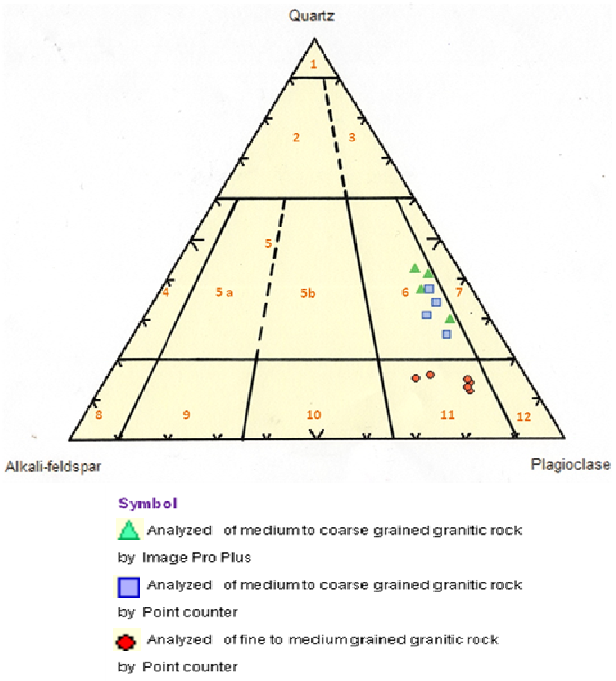

Figure 1. Simplified modal composition (quatz, alkali feldspar and plagioclase) of granitic rock from Silapetch waterfall and nearby area, plotted on QAP diagram recommended by IUGS subcommission on the Systematic of Igneous Rock (Streckeisen, 1976).

3.4. Geochemistry

Geochemical character of the granitic rocks can be summarized as follow Table 1 and Table 2.

Table 1 Whole-Rock Analysis of the granitic rocks (granodiorite and monzodiorite) in study area.

Element Oxide	Wt.%
SiO_2	50.76– 64.97%
TiO_2	0.48–1.76%
Al_2O_3	14.69–20.01%
Fe_2O_3	2.47–5.76%
FeO	2.02–6.44%
MnO	0.12–0.20%
MgO	1.67–4.93%
CaO	1.95 – 8.80%
Na_2O	2.55–5.27%
K_2O	0.84–3.35%
P_2O_5	0.16–0.92%

Table 2 CIPW Norms of the granitic rocks (granodiorite and monzodiorite) in study area.

Mineral composition	Wt.%
Quartz (q)	2.58-19.58%,
Albite (ab)	21.58-44.59%
Anorthite (an)	8.43-38.16%
Orthoclase (or)	4.96-19.91%
Corundum(c)	0.00%
Diopside(di)	0.00–11.23%
Hypersthene(hy)	7.00-16.33%
Ilmenite(il)	0.97-3.34%
Magnetite(mt)	4.38-8.35%
Apatite(ap)	0.37–1.39 %

Harker diagram is type of variation diagram which is the plotting weight percent of major oxide versus wt% of SiO2 (Fig.2) showing the decrease in the element oxides of MgO, Al_2O_3, CaO and FeO which composition of mafic mineral, with SiO_2 negative correlation with MgO, Al_2O_3, CaO and FeO and showing the increase in the element oxides of Na_2O_3 and K_2O which SiO_2 positive correlation with Na_2O_3 and K_2O.

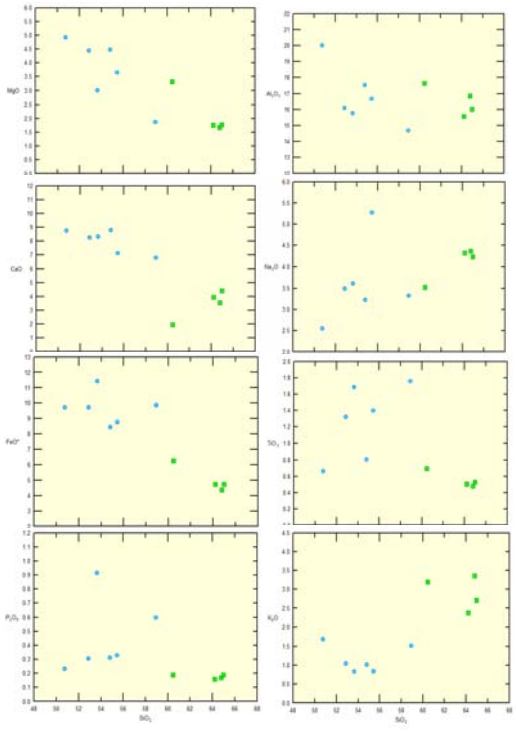

Figure 2. Harker variation diagram plotted on weight percent of major oxide versus wt% of SiO_2.

Chemical analyses indicate that the granitic rocks in study area are metaluminous, with Al_2O_3 / (NA_2O+K_2O+CaO) ranging from 0.70 to 1.00, high sodium (Na_2O 2.55-5.27 wt %), negligible normative corundum (nil to 5.00 wt %) and compositionally spanned type of granite. Harker diagram appear to linear or near-linear trends.

Figure 3 show the magmatism source of the granitic rocks in study area is calc-alkaline magmatism.

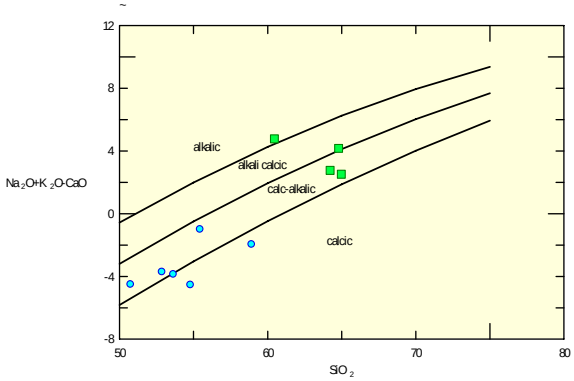

Figure 3. Alumina index diagram (Frost et al., 2001) can be refer to calc-alkaline magmatism source.

4. Discussions and Conclusions

Based upon the results of this study, discussion can be categorized into 2 topics including petrochemical characteristics (4.1) and tectonic setting (4.2).

4.1. Petrochemical characteristics

The characteristic of I-type granites advocated by Chappell and White (1974) and Cobbing et al. (1992) and I-type eastern province or eastern belt granite (Cobbing et al., 1992; Charusiri et al., 1992) are characterized by equigranular, primary-textured granite with coarse interlocking grain boundaries of quartz, pale-green to olive-green hornblende, brown to reddish-brown biotite, plagioclase (oligloclase-andesine) and apatite. Geochemically, major and minor element (wt %) and CIPW Norm are shown compositionally spanned type of granite rock, high Na_2O and the low normative corundum and Al_2O_3/ (NA_2O+K_2O+CaO). The low Al_2O_3/ (NA_2O+K_2O+CaO) can be indicated granitic type as metaluminous. Harker

variation diagrams appear to linear or near-linear trends of the compositional range of the igneous rocks.

According to, the granitic rocks at Silaphet waterfall and nearby areas show both mineralogical and geochemistical results which are interpreted as I–type granites advocated by Chappell and White (1974) and Cobbing et al. (1992). Therefore, the granitic rocks in study area are I-type granite. The results of the cross plot of Harker variation diagram are indicated that granitic rocks in this area come from the same magma source.rocks in this area come from the same magma source.

4.2 Tectonic setting

Pitcher (1983) stated that tectonic setting or environment can be correlated with granitic rock using combined geochemical characteristics. He state that the granitic rocks are I-type affinity, metaluminous and calc-alkaline magmatism which can be referred to oceanic island arc. The oceanic island arc is generated by collision between oceanic plate and continental plate which oceanic plate subduct into continental plate (Beckinsale et al., 1979).

As the result of geochemical characteristics, the granitic rocks in study area are I-type affinity, metaluminous and calc-alkaline magmatism. Consequently, the granitic rocks in area are related with oceanic island arc.

5. Acknowledgements

The authors thank Dr. Punya Charusiri for his encouragement, valuable discussion and willingness, helpful suggestion and discussion on petrography and geochemistry through this study. Thanks go to Department of Geology, Chulalongkorn University for the permission of numerous facilities for this work.

6. References

Beckinsale, R.D., Suensilpong S., Nakhapadungrat S., Walsh, J.N., 1979. Geochronology and geochemistry of granite magmatism in Thailand in relation to a plate tectonic model, *Journal of Geological Society London*, 136, 529-540.

Chappel, B.W., White, A.J.R., 1974. Two contrasting granite types, *Pacific Geology*, 8, 173-174.

Charusiri, P., Clark, A.H., Farrar, E., 1989. Miocene (-Oligocene) Event in Thailand: Granite belt in Thailand: evidence from ^{40} Ar/^{39} Ar and K-Ar Geochronology, In Ounchanum, P., Ratanasthien, B. (eds.), *Prodeedings of the Annal Technical Meeting 1989 and IGCP-246 (1991)*, Chiang Mai University, Thailand, p. 245-262.

Charusiri, P., Daorerk, V., Archibald, D., Hisada, K.I., Ampaiwan T., 2002. Geotectonic Evolution of Thailand: A New Synthesis, *Journal of the Geological society of Thailand*, 1, 1-20.

Cobbing, E.J., Mallick, D.I.J., Pitfield, P.E.J., Toeh, L.H., 1986. The granites of the SE Asian Tin Belt. *Journal of Geological Society of London*, 143, 537-550.

Cobbing, E.J., Pitfield, P.E.J., Darbyshire, D.P.F., Mallick, D.I.J., 1992. The granites of the South-East Asian tin belt. *Overseas Memoir 10*, British Geological Survey, London, 369 p.

Frost, S.K., Dumaurier, M.J., Wain-Hobson, S., Leigh Brown, A.J., 2001. Genetic drift and within-host metapopulation dynamics of HIV-1 infection. *Proceedings of the National Academy of Sciences of the United States of America*, 98, p. 6975–6980.

Mahawat, C., 1982. The petrochemistry and geochemistry of the granitic rocks of the Tak Batholith, Thailand. Unpublished Ph.D. thesis, University of Liverpool.

Pitcher, W.S., 1983. Granite type and tectonic environment. In Hsu, K. (ed.), *Mountain*

building process, London, Academic Press, p. 19-44.

Pongsapich, W., Mahawat, C., 1977. Some aspects of Tak granites, northern Thailand. *Bulletin of Geological Society of Malaysia*, 9, 175-184.

Streckeisen, A.L., 1976. To each plutonic rock its proper name. *Earth Science Review*, 12, 1-32.

Teggin, D.E., 1975. The granites of Northern Thailand. Unpublished Ph.D. thesis, University of Manchester, U.K.