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Tectonic Evolution of Granitoid Rock Granit Garba Based on Major Element in Tanjung Beringin, Muaradua, South OKU, South Sumatra

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Abstract: Granit Garba is one of the basements that make up the Garba Hills. Research on granitoid rocks that make up Granit Garba was carried out in the village of Tanjung Beringin and its surroundings, Muaradua District, South OKU Regency, South Sumatra Province. The formation of Granit Garba occurs due to the double subduction between Meso – Tethys with Woyla Arc and West Sumatra Block. The complete subduction of the Meso-Tethys plate then caused the collision between the two plates. The characteristics and tectonic evolution of the granitoid rocks were analyzed by conducting an XRF geochemical analysis of the major elements. The results of the analysis of the major elements of granitoid rocks have SiO_2 content values ranging from 63.71% to 69.55% it showing that Granit Garba is composed of quartz monzonite and granodiorite. The magma affinity of the two rocks is included in the calc-alkaline series with alumina saturation levels in the form of peraluminous and showing I-type granite.

Keywords: Granit Garba, Granitoid, Major Element, Tectonic Evolution

Introduction

The research was conducted in Tanjung Beringin Village, Muaradua District, South OKU Regency, South Sumatra Province with an area of 16 km^2. The research area is a series of Garba Hills which is composed of basement rocks of the South Sumatra Basin. The South Sumatra Basin was formed as a result of tectonic activity that occurred from the Paleozoic to the Mesozoic. One of the formations that make up the Garba Hills is the Granit Garba which is formed as a result of double subduction between Meso-Tethys with Woyla Arc and West Sumatra Block, then complete subduction occurs resulting in a collision between Woyla Arc and West Sumatra Block. The collision of the two plates causes the formation of a magmatic arc known as Granit Garba. The granitoid rocks have acidic composition and intrude the andesite rocks of the Garba Formation.

The granitoid rocks of Granit Garba have interesting characteristics and history for further research. Thus, a study was conducted on seven granitoid rock samples using major element geochemical analysis using the XRF method. The major element analysis aims to provide an overview and chemical evidence of the environment and the tectonic evolution of granitoid igneous rocks from Granit Garba.

The research area consists of six formations such as Insu Member of the Garba Formation, Granit Garba, Cawang Member of Kikim Formation, Talangakar Formation, Baturaja Formation, and Ranau Formation which are regionally included in the Geological Map of the Baturaja Sheet (Figure 1). The dominant formation is Granit Garba and is the focus of this research. The formation with the oldest age is Insu Member of Garba Formation which is composed of andesite igneous rocks. Granit Garba is a granitoid intrusion formed in the Late Cretaceous. The Cawang member of the Kikim

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Formation is the first sedimentation that occurred in the South Sumatra Basin with the constituent lithology in the form of quartz conglomerate. Talangakar Formation was deposited in the transgression phase with a fluvial depositional environment composed of siltstone containing mollusks and claystone. Next is the deposition of the Baturaja Formation in the Middle Miocene with the constituent lithology, limestone. The formation with the youngest age is the Ranau Formation which is composed of pyroclastic rocks in the form of tuff.

The structure that develops in the research area is a local structure. The structure was formed in the second phase due to the extensional force (Pulonggono et al., 1992). The second phase of tectonic activity on Sumatra Island occurred in the Late Cretaceous - Early Tertiary which resulted in a structure in the form of a right horizontal fault and a left horizontal fault. In the research area, the geological structure that develops is found in andesite rocks of the Insu Member of Garba Formation and granite rocks in the Granit Garba Formation. The structure consists of a joint structure and a fault. The joint structure was found in the Tekana Village with the analysis results obtained by the name vertical strike-slip fault (Fossen, 2010). The fault structure is a strike-slip dominated fault (Fossen, 2010) found in Tanjung Beringin Village and a vertical strike-slip fault (Fossen, 2010) found in the Biabia River, Tanjung Beringin Village.

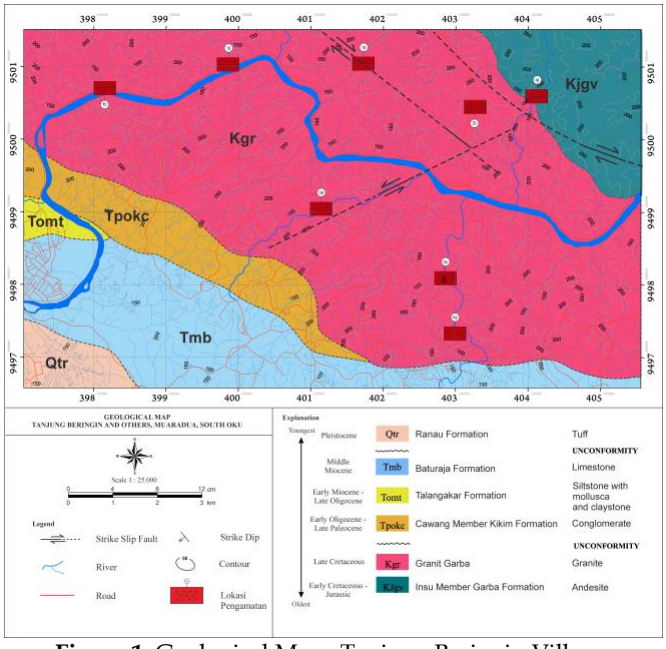

Figure 1. Geological Maps Tanjung Beringin Village, Muaradua District, South OKU Region, South Sumatra (Modified by author)

Method

The data used in this study are primary data and secondary data. Primary data was obtained from the results of field observations carried out in Tanjung Beringin Village and its surroundings, Muaradua District, South OKU Regency. Field observations were carried out within a period of three weeks with activities in the form of observing outcrops and taking rock samples. The rock samples were taken using geological equipment in the form of a geological hammer. There are seven granitoid rock samples taken and scattered in the study area. While secondary data was obtained through a previous literature review. The literature review aims as supporting data from the research.

Primary data in the form of rock samples were carried out for geochemical analysis of the major elements. Geochemical analysis of the major elements of granitoid rocks was carried out using the XRF (X-Ray Fluorescence) method. The granitoid rock samples were pulverized and filtered to a mesh size of 200 which was then prepared. XRF geochemical analysis was carried out at the Geological Engineering Laboratory of Gadjah Mada University (UGM). After laboratory analysis, the data of the main geochemical elements of granitoid rocks were normalized and plotted on the diagram. Software that is used on analysis such as Microsoft excel, GCDkit, and R software, CorelDRAW, etc.

Result and Discussion

The results of geochemical analysis of granitoid rocks from Granit Garba were carried out on seven rock samples with sample codes LP 12, LP 19, LP 23, LP 34, LP 54, LP 61, and LP 63 (Table 1).

Table 1. Normalization of the major elements of granitoid rocks without LOI.

Sample	LP 12	LP 19	LP 23	LP 34	LP 54	LP 61	LP 63
SiO_2	68.15	67.10	69.55	64.26	63.71	67.78	64.99
Al_2O_3	12.62	12.23	19.48	13.70	12.17	12.78	14.62
Fe_2O_3	5.23	5.71	2.27	6.61	8.09	5.82	6.39
MnO	0.10	0.08	0.06	0.14	0.15	0.16	0.11
MgO	0.54	0.74	0.94	1.04	1.08	0.60	0.99
CaO	2.65	4.76	2.23	4.45	5.28	3.17	2.60
Na_2O	2.44	2.46	2.24	2.13	2.20	2.18	2.58
K_2O	8.08	6.71	3.11	7.34	6.79	7.31	7.47
P_2O_5	0.18	0.21	0.12	0.33	0.53	0.20	0.24

The major elements of rock geochemistry show SiO_2 content ranging from 63,71% to 69,55% so based on the classification of $Na_2O + K_2O$ and SiO_2 content, it is obtained that the rock names that makeup Granit Garba are Quartz Monzonite and Granodiorite (Figure 2).

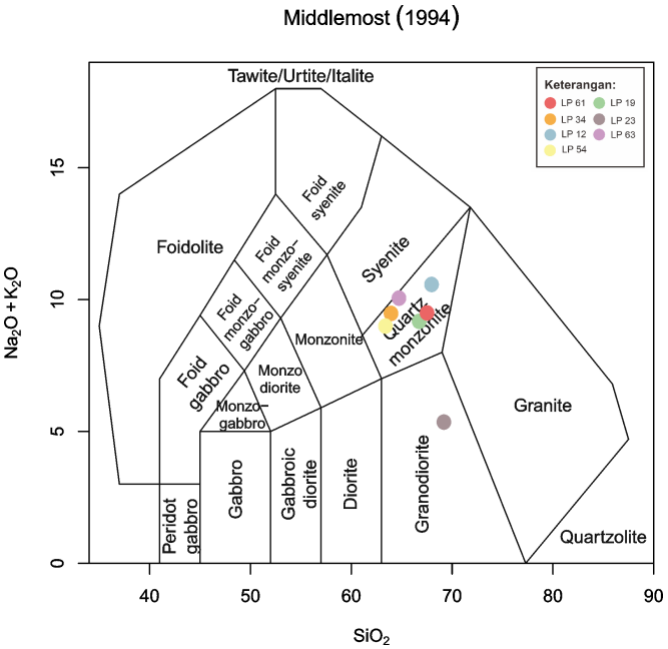

Figure 2. Classification of Granitoid Rocks (Middlemost, 1994)

The magma affinity of the seven major elements of granitoid rock samples based on the AFM content classification diagram shows that they belong to the calc-alkaline to tholeiite series (Figure 3). The magma affinity series shows high alkali and silica content. This means that there is crystal fractionation due to a decrease in magma temperature and pressure. The affinity of the granitoid magma of the study area with the calc-alkaline to tholeiite series is related to the subduction zone and to the continent area.

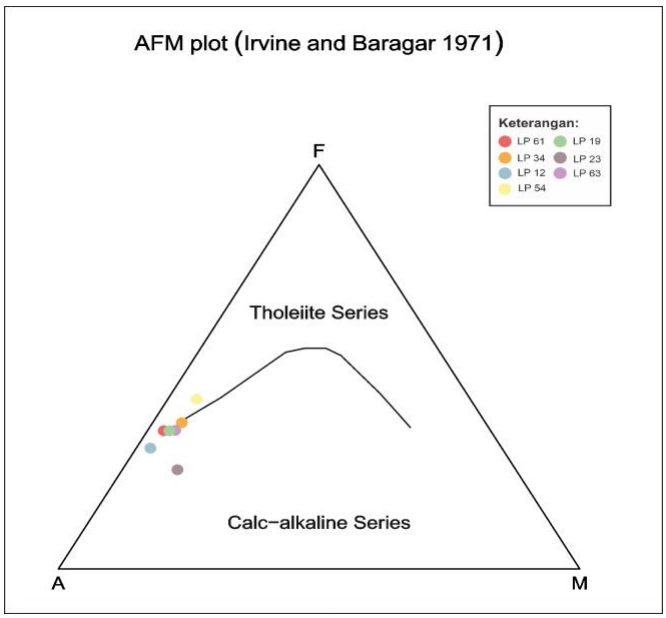

Figure 3. Magma Affinity (Irvine & Baragar, 1971 on Rollison, 1993)

The saturation content of alumina levels based on the ratio of A/NK and A/CNK (molar Al_2O_3 / (CaO+ Na_2O+ K_2O) belongs to the peraluminous to low metaluminous type (Figure 4). A/NK and A/CNK ratios as well as a binary plot diagram of the content of SiO_2 vs. P_2O_5 show that Granit Garba is composed of I – type granite (Figure 5). Harker diagram of the major elements of granitoid rocks in the study area shows a negative and spreading pattern (Figure 6). A negative pattern or trend is indicated by a decrease in MgO, CaO, P_2O_5 elements, FeO_t and MnO followed by the addition of SiO_2 elements. While the spreading pattern is shown by the elements Al2O3, Na2O, and K2O. The spreading pattern of the major elements is evidence of crystal fractionation from the mixing of two different magmas. The evolution of magma occurs with the mechanism of alkaline magma that changes due to the fractionation of crystals into magma with acidic properties.

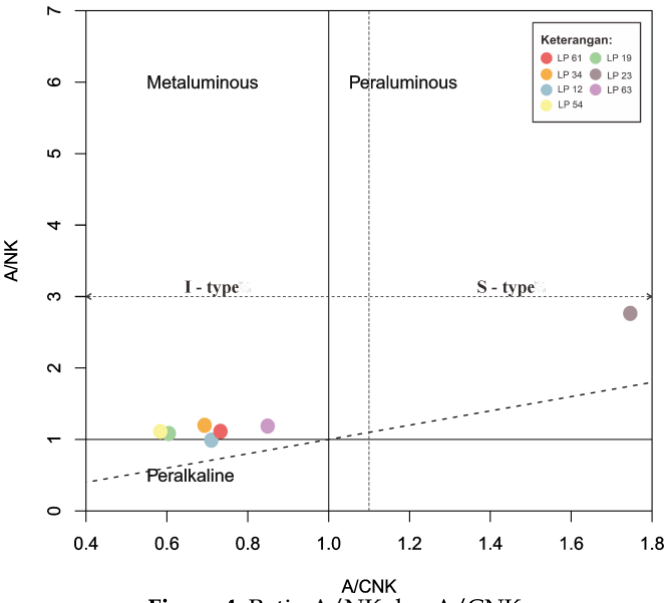

Figure 4. Ratio A/NK dan A/CNK

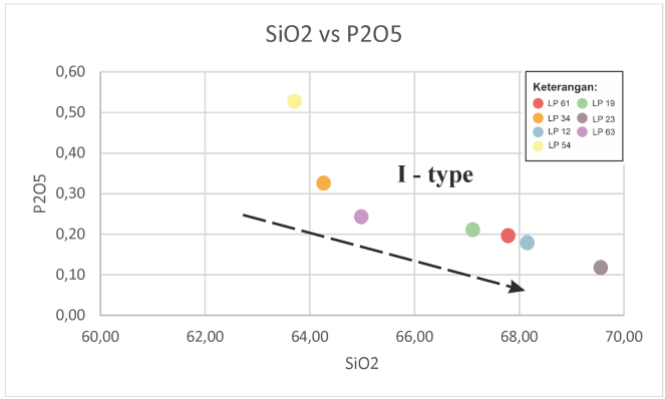

Figure 5. Diagram of SiO_2 vs P_2O_5 content

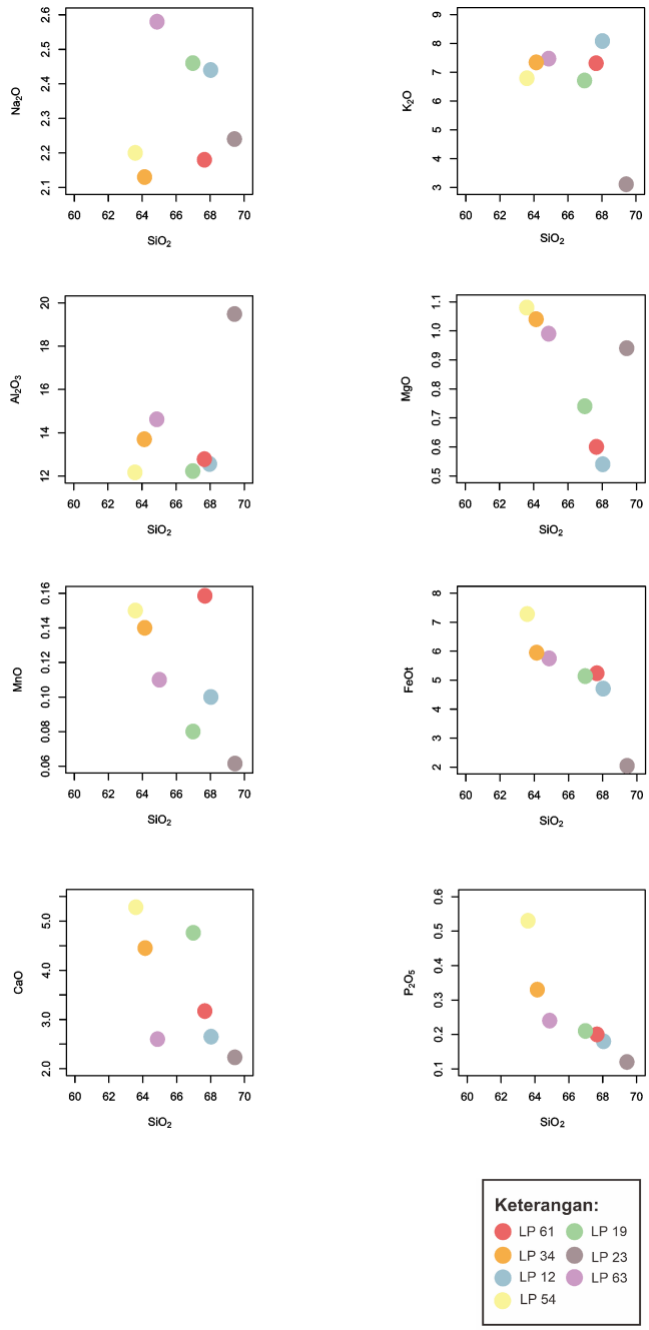

Figure 6. Harker's Diagram of Major Elements

Conclusion

The results of the geochemical analysis of the major elements in the seven rock samples show that there are two types of granitoids that make up Granit Garba, such as Quartz Monzonite and Granodiorite. The magma affinity of these rocks is included in the calc-alkaline to tholeiite series and is included in the I - type granite with saturation levels of alumina peraluminous to low metaluminous. The tectonic evolution of the granitoid rocks that make up Granit Garba occurs due to the mixing of two different magmas with the mechanism of alkaline magma turning into acidic magma due to crystal fractionation. The tectonic environment for the formation of Granit Garba based on geochemical analysis of the major elements is a subduction zone and is included in the continent arc.

Acknowledgments

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