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Petrology and Geochemistry of Granitic Rocks in South Sulawesi, Indonesia: Implication for Origin of Magma and Geodynamic Setting

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Abstract**—**Petrology and geochemical characteristics of granitic rocks from South Sulawesi, especially from Polewaliand Masamba area are presented in order to elucidate their origin of magma and geodynamic setting. The granitic rocks in these areas are dominated by granodiorite and granite in composition. Quartz, K-feldspar and plagioclase occur as major phases with hornblende and biotite as major ferromagnesian minerals. All of the samples were plotted in calc-alkaline field, show metaluminous affinity and typical of I-type granitic rock. Harker diagram indicates that granitic rocks experienced fractional crystallization during magmatic evolution. Both groups displayed an extreme enrichment of LILE, LREE and a slight negative Eu anomaly which resemble upper continental crust affinity. They were produced from partial melting of upper continental crust and have close relationship of sources composition within a suite. The geochemical characteristics explained the arc related subduction environment which later give an evidence of continent-continent collision between Australia-derived microcontinent and Sundalandto form continental arc environment.

Keywords**—**Geochemistry, Granitic Rock, Petrology, Sulawesi

I. Introduction

THE magmatismin Sulawesi Island in the central part of Indonesian Archipelagoranges from Tertiary to Quaternary in ages. They consist of basaltic-andesitic to granitic magma in composition [1], [2], [3]. Constrain on the magmatic history and source of the volcanic rocksas well as geochemical processes have been reported by previous studies (e.g. [4], [1], [3]) and discussions on their tectonic setting have been prevailed. However, there has been little systematic study of granitic rocks in this island despite their large distribution, tectonic significance and economic potential. A systematic study of particular granitic rock will provide detail magmatic and geochemical processes that perform in particular area.

Therefore, a systematic study on the granitic rocks from this island needs to be intensified. The aim of this paper is to address the petrological and geochemical characteristics of the granitic rocks in Polewali and Mamasa, in South Sulawesi and discuss the origin of magma and the geodynamic setting in these two areas.

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II. General Geology

The study areas are located at Polewali and Masamba in the northern part of south Sulawesi, approximately 300 km and 400 km north of Makassar, respectively (Fig.1). They are separated by mountainous topography consisting of Tertiary and Quaternary volcanic rocks. The general geology of this area consists of five sequences [5]: (1) Pre-tertiary meta sedimentary rocks including flysch deposit which was formed in a forearc basin setting, and ophiolites of Lamasi Complex; (2) Miocene to Pliocene syn-rifting sequence composed of siliciclastic, coal, volcanic and carbonates sedimentary deposit of the Toraja and Mallawa Formation; (3) Tertiary post-rifting sequence including the Eocene to Middle Miocene Carbonate Makale and Tonasa Limestone; (4) Middle Miocene to Pliocene granitic to gabbroic intrusive rocks; (5) Pliocene to Recent non marine to upper bathyal sedimentary deposits including Walanae Formation.

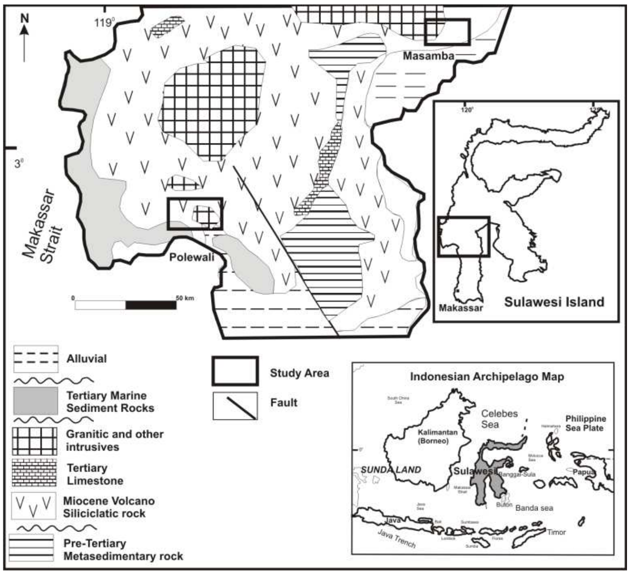

Fig. 1 Geologic map of study areas

The Polewali granitic rockis situated in the western part which belongs to granitic rock series consists of biotite granite [6]. They were classified as granodioriteby [7] and a recent report by [8] reported these rocks classified as granite, granodiorite, diorite, syenite, quartz monzonite and ryolite. The occurrence of Masamba granitic rock was reported by [9] who then classified them into Kambuno Granitic group which consists of granite, granodiorite and gneiss rocks. The age of these groups were interpreted as Tertiary as they intruded the Bonebone Formation which is Tertiary in age.

Tertiary magmatic complex in south and central Sulawesi, which includes the Tertiary Polewali and Masamba granitic rocks, is part of the West and North Sulawesi Pluto-volcanic arc province [10], [11], [12] which has been explained as a result of west dipping subduction of a microcontinent block [5].

III. Analytical Technique

Twenty four granitic samples were taken from the outcrops in both Polewali and Masamba areas. Polished thin sections were prepared for petrographic and analytical works. The samples were later crushed and pulverized and approximately 1 kg were crushed and milled to 200 mesh and then thoroughly mixed using a swing mill. Major and trace elements compositions were analysed at Dept. of Earth Resources Engineering, Kyushu University and ALS Chemex, Vancouver, Canada, respectively. Whole rock compositions were determined on fused disc and pressed powder using X-ray fluorescence spectrometer Rigaku RINT-300 whereas trace elements including REE were determined by ICP-MS method.

IV. Petrography

Polewali granitic rocks are coarse- to medium-grained and are hypidiomorphicequigranular. They generally contain quartz (20 to 40%), plagioclase (40 to 55%), alkali feldspar (<10%), biotite (10-15%) and hornblende (<10%) with minutes accessory of titanite, apatite, zircon, magnetite and ilmenite. Quartz grains are generally clustered between plagioclase with micrographic and occasional granophyric intergrowth. Plagioclase varies from oligoclase to labradorite with some crystals showing oscillatory zoning and sieve texture. In Some samples, plagioclase occurs as phenocryst which can reach 5 mm in length, showing polysynthetic twinning and containing abundant inclusion of quartz and biotite. Some plagioclase rim has been altered to carbonate and chlorite. Mymerkitic texture occurs but is not common in some samples. Alkali feldspar is orthoclase and sometimes occurs as matrix intergrowth with quartz. Sometimes microcline is found which is partially resorbed. Ferromagnesian mineral include hornblende (often altered to chlorite and calcite) and biotite (altered to chlorite). Hornblende occurs as dark brown crystal, ranging from 1 to 3 mm and sometimes more than 4 mm in size. Biotites are brown and greenish yellowish and common in almost all samples. Magnetite and ilmenite are the most common opaque phase.

Masamba granitic rocks are coarse- to medium-grained, hypidiomorphice quigranular texturewith grain size mostly in the range of 1 to 4 mm. The rocks are generally dominated by quartz (30-45%),plagioclase (20-30%), K-Feldspar (5-10%), biotite(5-8%) and hornblende (3-5%). Plagioclase is mostly subhedral and euhedral, and commonly show albite, albite-caldsbad twinning. Sometimes they occur as phenocryst in some samples, up to 8 mm in size and sometimes show a typical oscillatory zoning with quartz inclusion. Biotite occurs as flakes, brownish to yellowish and sometimes has been replaced partially by chlorite along with hornblende in the groundmass. Titanite, small tiny zircon, apatite and spots of iron oxide occur as accessory minerals. Mymerkitetexture was found in some samples. Chlorite occur as secondary mineral, usually found in the rim of plagioclase, biotiteand hornblende.

V. Geochemistry

The results of major and trace element compositions were listed in table 1. Most of the rocks were plotted in granodiorite and granite field with some of them plotted in quartz monzonite, monzodiorite and diorite fields in Total Alkali Silica (TAS) diagram of [13] (Fig. 2). The bulk composition of all samples shows high SiO_2 and K_2O contents with low MgO content.

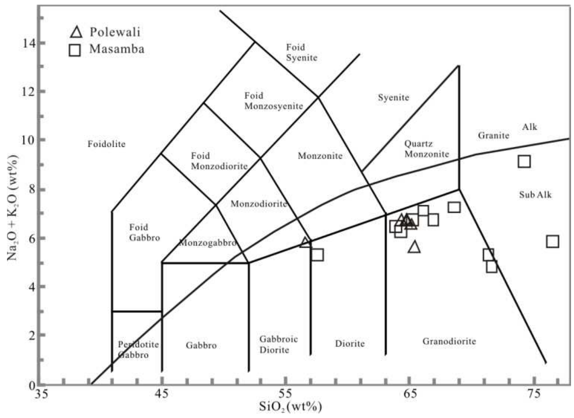

Fig. 2 Total Alkali and Silica (TAS) diagram of [13] of Polewali and Masamba granitic rocks

The Polewali granite is dominated by granodioritic rock, with subordinate monzodiorite and quartz monzonite. The SiO_2 content of granodiorite and quartz monzonite ranges from 64 to 65 wt% with K_2O and Na_2O content ranging from 3.9to 4.4 wt% and 1.1to 2.4wt%, respectively. Meanwhile, the monzodiorite is characterized by lower SiO_2 (56 wt %) and K_2O content (3.9wt %) as well as Na_2O content (1.9 wt %). This monzodiorite also shows a high content of LoI (loss on ignition).

The Mamasa granite has more acidic composition as shown by the intensive distribution of granite and granodiorite with one sample show dioritic composition. The SiO_2content range from 63 to 68 wt% and more than 70 wt% for granodiorite and granitic rocks, respectively. K_2O content of the granodiorite ranges from 2.9 to 4.8 wt% whereas that of granitic rocks shows a relative wide range (1.9 to 5.8 wt%). The SiO_2 content of dioritic rock is 57.5 wt% with K_2O content of 2.9 wt%. The Na_2O content of all the samples is confined to a range from 2.3 to 3.8 wt%. ASI (Alumina Saturation Index) values for Polewali samples range from 0.88 to 0.92 whereas those from Masamba samples range from 0.82 to 1.1.

TABLE I
WHOLE ROCK AND TRACE ELEMENTS ANALYSIS OF POLEWALI AND MASAMBA GRANITIC ROCKS

Sample	Polewali granitic rocks						Masamba granitic rocks										
	POL-ST2	POL-ST3	POL-13	POL-ST1	POL 19	POL 11	M-ST13	M-ST6	M-RF2	M-RF4	M-RF6	M-ST3B	M-1	M-ST3A	M-RF7	M-RF4B	M-RF1
Rock name	Granidiorite	Monzodiorite	Granodiorite	Granodiorite	Quartz Monzonite	Granidiorite	Granodiorite	Granodiorite	Granodiorite	Granodiorite	Diorite	Granodiorite	Granodiorite	Granite	Granite	Granite	Granodiorite
Whole rock (wt%)																	
SiO2	64.33	56.61	65.16	64.78	64.78	65.42	66.14	64.33	65.29	68.66	57.57	71.67	63.89	76.59	74.28	71.40	66.97
TiO_2	0.68	0.69	0.52	0.63	0.56	0.40	0.54	0.64	0.58	0.51	1.00	0.43	0.70	0.16	0.13	0.44	0.56
Al_2O_3	14.28	14.15	15.18	14.19	14.68	14.20	14.54	14.65	15.00	14.41	16.08	13.40	14.83	12.66	13.57	13.48	15.07
FeOT	4.52	5.07	4.23	4.29	3.87	2.56	3.85	4.59	3.60	2.74	6.04	3.25	4.53	1.45	1.52	3.57	2.96
MnO	0.10	0.13	0.07	0.09	0.07	0.07	0.08	0.09	0.07	0.05	0.10	0.14	0.11	0.05	0.03	0.11	0.05
MgO	3.28	5.78	2.59	2.89	2.54	1.82	2.44	2.99	3.29	2.17	5.46	1.58	3.15	0.73	0.17	1.42	2.37
CaO	4.73	5.57	3.81	4.26	3.94	4.21	3.94	4.58	4.22	3.21	6.84	2.95	5.03	1.87	0.70	3.65	3.58
Na_2O	2.33	1.74	2.61	2.39	2.42	1.15	2.49	2.56	2.68	2.37	2.32	2.71	2.51	3.86	3.30	3.30	2.39
K_2O	4.39	3.89	3.93	4.31	4.98	4.43	4.59	3.65	4.05	4.85	2.94	2.07	3.94	1.98	5.82	1.99	4.31
P_2O_5	0.28	0.25	0.23	0.24	0.21	0.13	0.22	0.24	0.21	0.13	0.27	0.09	0.24	0.04	0.02	0.10	0.13
SO_3	0.03	0.04	0.02	0.04	0.01	0.00	0.01	0.14	0.00	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.00
LOI	0.82	5.81	1.34	1.60	1.60	5.40	0.89	1.33	0.81	0.71	1.14	1.63	0.82	0.58	0.40	0.46	1.44
Total	99.77	99.73	99.69	99.71	99.66	99.79	99.73	99.79	99.80	99.82	99.80	99.92	99.77	99.97	99.94	99.92	99.83
Trace elements (ppm)																	
Cr	30	160	30	30	30	10	30	40	70	30	120	<10	30	<10	<10	<10	40
Ni	<5	37	<5	<5	<5	<5	<5	5	20	6	33	<5	<5	<5	<5	<5	6
Rb	196	174	177.5	185.5	207	227	179.5	184.5	162	233	161.5	36.4	178	31.3	158	45	165
Ba	1175	1105	1215	1540	2230	1020	1645	1010	730	747	586	344	1125	141.5	26.9	288	766
Th	36.9	43.4	47	47.7	43.9	54.4	44.5	58.5	26.3	23	26.5	4.41	40.7	2.59	35.3	7.36	16.05
U	9.04	10.2	9.33	10.1	8.82	10.5	9.34	11.1	7.52	6.14	6.98	0.54	8.53	0.93	3.98	1.66	4.2
Nb	17.4	16.6	17.5	17.4	14.9	20.8	15.4	17.7	11.7	11.4	16.5	5.5	18.3	1.4	3.6	5.3	9.6
Ta	1.4	1.3	1.3	1.4	1.2	1.9	1.2	1.4	1.2	1	1.5	0.4	1.5	0.2	0.4	0.4	0.9
Y	29.9	25.3	27.8	27.5	23	26.1	25.7	29.5	17.2	13.8	25.8	16.6	31.1	20.3	10	38.2	14.4
Sr	461	530	586	533	563	288	562	542	401	324	493	150.5	504	88.8	13.1	160.5	322
Zr	214	189	204	200	178	213	191	209	180	169	255	146	197	102	302	152	158
Hf	6.8	6	6.3	6.2	5.5	6.7	6.1	6.7	5.8	5.3	7.5	4.6	6.3	3.9	9.3	4.8	4.8
La	36	65.9	61	61	64	71.9	64.5	108.5	37.8	34.4	53	6.2	74.6	7.6	75.1	15.4	29.3
Ce	80.7	117	111	110	112	127.5	112	181	74.3	66.3	102.5	12.7	133	16.6	157	31.1	58.5
Pr	9.63	12.2	11.7	11.6	11.25	12.75	11.2	18.05	8.15	6.98	11.2	1.62	14	2.11	17.2	3.99	6.72
Nd	37.7	43.8	42.6	41.7	39.2	42.9	40.3	60.2	30.3	25.3	42	7.2	50.3	8.9	53	16.1	23.6
Sm	7.69	7.82	7.8	7.81	6.8	7.25	7.38	9.68	5.6	4.37	7.78	1.85	9.09	2.3	7.18	4.12	4.42
Eu	1.56	1.7	1.64	1.6	1.48	1.2	1.56	1.75	1.16	1.1	1.62	0.82	1.73	0.46	0.18	0.92	1.21
Gd	6.91	7.06	6.92	7.02	5.99	6.42	6.45	8.64	4.69	3.72	6.68	1.92	7.85	2.41	5.98	4.54	4.01
Tb	1.08	1.05	1.05	1.07	0.86	0.92	0.98	1.19	0.67	0.55	1.02	0.4	1.21	0.5	0.57	0.86	0.55
Dy	5.79	5.27	5.47	5.57	4.42	4.87	5.04	5.86	3.37	2.79	5.17	2.64	6.2	3.31	2.23	5.88	2.84
Ho	1.11	0.95	1.01	1.01	0.82	0.89	0.95	1.1	0.62	0.51	0.95	0.6	1.13	0.7	0.39	1.31	0.53
Er	3.2	2.74	2.96	2.98	2.41	2.64	2.76	3.21	1.81	1.44	2.79	1.87	3.36	2.23	1.22	4.21	1.52
Lu	0.21	0.23	0.22	0.22	0.23	0.18	0.23	0.19	0.23	0.27	0.22	0.44	0.20	0.20	0.03	0.21	0.29
Eu*	0.21	0.23	0.22	0.22	0.23	0.18	0.23	0.19	0.23	0.27	0.22	0.44	0.20	0.20	0.03	0.21	0.29
Σ LREE	171.72	248.42	235.74	233.71	234.73	263.50	236.94	379.18	157.31	138.45	218.10	30.39	282.72	37.97	309.66	71.63	123.75
Σ HREE	19.86	17.30	17.63	17.87	14.73	15.92	16.41	20.19	11.39	9.28	16.83	7.87	19.95	9.35	10.42	17.01	9.74
Σ REE	191.58	265.72	253.37	251.58	249.46	279.42	253.35	399.37	168.70	147.73	234.93	38.26	302.67	47.32	320.08	88.64	133.49
Σ REE + Y	221.48	291.02	281.17	279.08	272.46	305.52	279.05	428.87	185.90	161.53	260.73	54.86	333.77	67.62	330.08	126.84	147.89
LREE/HREE	8.64	14.36	13.37	13.08	15.93	16.56	14.44	18.78	13.82	14.91	12.96	3.86	14.17	4.06	29.73	4.21	12.71
HREE/REE	0.10	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.07	0.06	0.07	0.21	0.07	0.20	0.03	0.19	0.07
ASI	0.83	0.82	0.98	0.87	0.89	0.99	0.90	0.89	0.91	0.96	0.83	1.11	0.85	1.06	1.04	0.95	1.00
La_{N}/Yb_{N}	8.0	17.8	14.9	15.2	19.0	19.8	17.2	25.3	16.1	18.3	15.0	1.9	16.9	1.9	51.8	2.4	15.8

Both granite groups define a typical calc-alkaline trend on an AFM (proportion of total alkali (A) + FeO (F) + MgO (M)) diagram (Fig.3) though SiO_2vs K_2O diagram show the high K affinity for almost all samples. In A/CNK (mole $Al_2O_3/(CaO + Na_2O+K_2O)$) and A/NK (mole $Al_2O_3/(Na_2O+K_2O)$) classification, almost all rocks were plotted into metaluminous field except three granitic rocks from Masamba which were plotted in the transition between metaluminous and peraluminous field (Fig 4). This diagram also classified the granitic rocks into I-type granitic rocks which is further confirmed by SiO_2 and P_2O_5 ratio diagram [14] (Fig.5). The overall mineralogy of the rocks which consists of biotite, hornblende, magnetite, apatite and zircon also strongly suggest metaluminous source of the rocks.

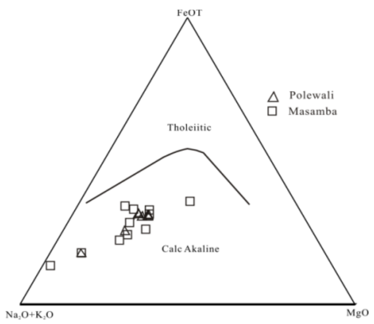

Fig. 3 AFM diagram of Polewali and Masamba granitic rocks

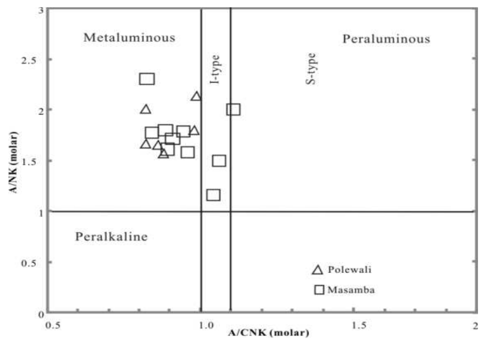

Fig. 4 A/NK-A/CNK diagram of Polewali and Masamba granitic rocks

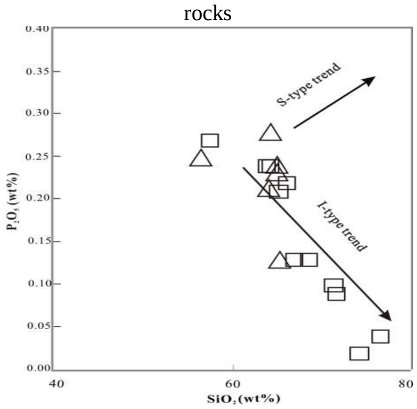

Fig. 5 P_2O_5vs SiO_2 diagram of Polewali and Masamba granitic rocks[14]. Note the I-type trend of most samples

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Harkerdiagrams of major elementexhibit the whole rock major and trace elements variation (Fig. 6). The diagrams indicate that most of the major and trace elements show systematic variation with respect to the of SiO_2contents. They clearly indicate a decreasing trend with increasing SiO_2 except K_2O and Na_2O which is nearly constant and show an increasing trend, respectively. In line with the some major elements, some of incompatible elements particularly Nb and Zr also show decreasing trend with increasing SiO_2 (Fig.7). In addition, Sr and Ba as well as Y content show similar negative trend whereas Rbis relatively constant.

The concentration of large ion lithophile elements (LILE) such as Rb, Ba, Th and U seems to be similar in both granitic groups. However, high field strength elements (HFSE) such as Nb, Zr and Y concentration inPolewali granitic show relatively higher concentrations. Trace element of Polewali and Masamba granitic rocks were normalized against primitive mantle (PM) [15] (Fig. 8 and 9). The Polewali granitic rocks show an extreme enrichment in LILE (Rb, Ba, Th and U) and depletionin HFSE, particularly Nb and Ta. Similar pattern is also displayed by Masamba granitic rocks which also show enrichment in LILE and depletion in HFSE, particularly Nb and Ta. Trace elements pattern of both granitic rocks also resemble the upper continental crust pattern [16].Th/U ratio (more than 2.5) of the samples further suggests the continental crust affinity as proposed by [17] for the upper continental composition.

Chondrite-normalised are earth element (REE) pattern of Polewali granitic samples show enrichment in LREE (light rare earth element) with $La_N/Yb_N = 15$ and a slight negative Eu anomaly $(Eu_N/\sqrt{[(Sm_N).(Gd_N)]})$($Eu^* = 0.21$) with relatively flat HREE (heavy rare earth element) pattern (Fig. 9a,b). Chondrite-normalised REE pattern of Masamba granitic samples show a quite similar pattern to those from Polewaliwith some variation in Eu content. The enrichment of LREE was shown by the high La_N/Yb_N ratio = 16 with relatively flat HREE pattern. Negative Eu anomaly was reflected byvalue of Eu* (0.22) from most samples with two samples (MRF2 and MST3B) show a slightly depleted and positive Eu anomaly, respectively. Both of groups also resemble the upper continental composition of [17]. ∑ REE in Polewali granitic rocks range from 191 to 279 ppm with an average of 249 ppm and those in Masamba granitic rocks are lower with an average of 194 ppm.

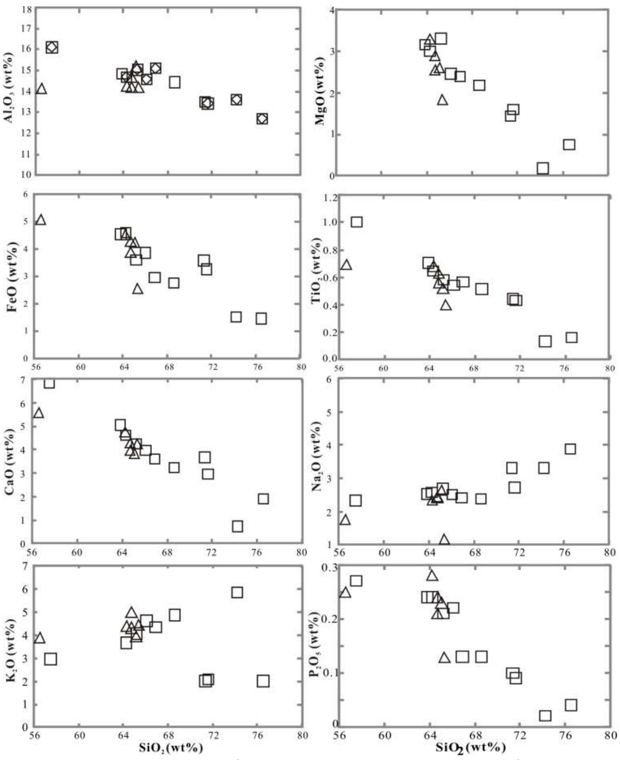


Fig. 6 Harker diagrams of major elements against SiO_2 of Polewali and Masamba granitic rocks

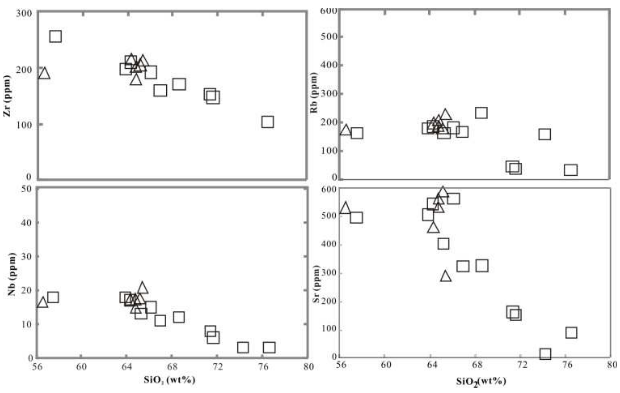
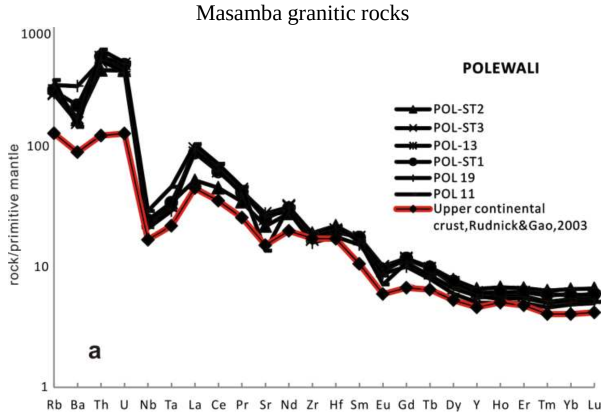


Fig. 7 Harker diagram of trace elements against SiO_2 of Polewali and Masamba granitic rocks



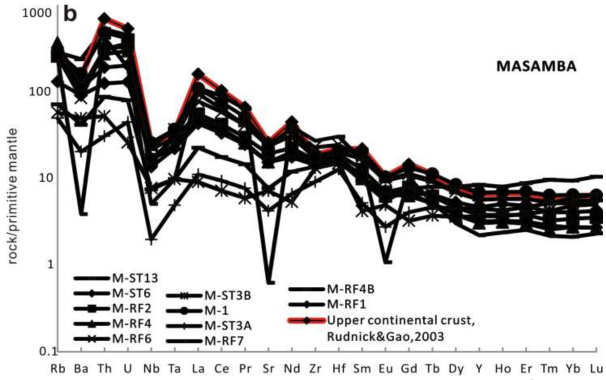


Fig. 8 Primitive mantle normalized trace element patterns of granitic rocks in Polewali (a) and Masamba (b).Note the similarity with upper continental crust trend from [16]

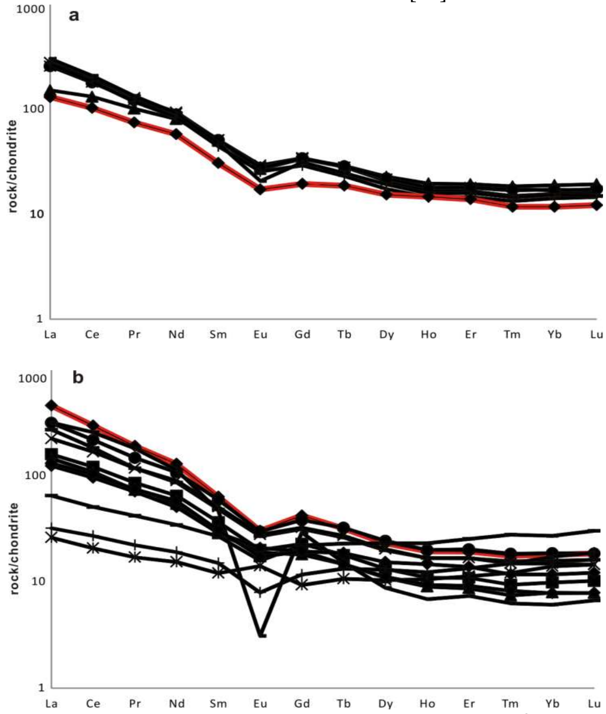


Fig. 9 Chondrite normalized rare earth elements patterns of granitic rocks from Polewali (a) and Masamba (b). Symbol as in Fig.8

VI. Discussion

A. Fractional Crystallization

Compositional trend of the studied granitic rocks from both areas is relatively similar to each other. Fractional crystallization during the magmatism was recognized by the Harker diagram pattern since chemical composition of trace and rare earth elements of igneous rocks are mainly controlled by mineral/melt partition coefficients. The negative correlations between Al_2O_3, CaO, P_2O_5, MgO, FeOT, MnO, $TiO_2$and SiO_2suggest that the granitic rocks are likely the result of fractional crystallization during magmatic evolution. The fractional crystallization is also confirmed by the Sr depletion and Eu negative anomaly (Fig 8 & 9) which indicate continuous plagioclase fractionation during differentiation. The decrease in P_2O_5, MgO and FeO during magmatic evolution indicates separation of apatite and mafic mineral (such as biotite) during crystallization.Early fractionations of apatite and ilmenite were evidenced by the systematic decreasing trend of P_2O_5 and TiO_2 along with FeO with increasing SiO_2, respectively. The I-type and calc-alkaline granitic rocks were characterized by the fractionation of hornblende [14], [18], [19]. The hornblende fractionation also occurs in Polewali and Masamba granitic rocks which was shown by the gradual decrease of Y contents with increasing SiO_2. Pronounced negative correlation between SiO_2 and Nb, Zr, Sr and Rb further demonstrate that fractional crystallization occurred during the formation of the granitic rocks.

B. Possible Sources Material

Possible sources material of igneous rocks can be interpreted using trace and rare earth elements patterns coupled with some major elements discriminations. Primitive mantle normalized trace element patterns have shown that both of groups show the upper continental crust affinity. This is also supported by chondrite normalized rare earth element patterns which is comparable with those of upper continental crust composition. The enrichment of LREE and negative Eu anomaly suggesting that melts were generated from source materials with abundant plagioclase. The Polewali and Masamba granitic rocks are characterized by the high-K, calc-alkaline affinity, Ba, Sr and Nb negative trends and enrichment of Rb, K, and La which are compatible to those of typical crustal melt [20]. Therefore, the most plausible sources would have been dioritic or granodioritic rocks in composition that might be widely distributed in the upper continental crust. The absence of S-type granitic rock within these areas indicates that sedimentary rock is not dominated in the source area. Th/U ratio (more than 2.5) of the samples suggests the continental crust affinity as proposed by [17] for the upper continental composition. The scarcity of mafic rock, S-type granitic affinity, negative Sr and Nb anomaly as well as negative Euanomaly further support a crustal source for Polewali and Masamba granitic rocks. From this point of view, it is likely that these two granitic groups have close relationship of sources composition within a suite and were produced from partial melting of upper continental crust.

C. Geodynamic Setting

Petrographic analysis coupled with geochemistry, particularly trace and rare earth elements analysis, can be used to determine the geodynamic setting of the granitic rocks. The enrichment in LILE and depletion in HFSE, particularly Nb and Ta of most samples confirms the arc-related origin and strongly suggests that all the granitic rocks are product of subduction [21], [22].Most of the samples were plotted in volcanic arc granitic field in Rbvs (Y+Nb) diagram, Y vsNb diagram and Ybvs Ta diagram from [23] (Fig. 10a, b and c). The arc-related sources of the granitic rocks were also shown by Zr and Y diagram (Fig. 10d). The Polewali and Masamba granitic rock consists mainly of granodiorite and granite with subordinate monzodiorite and diorite. Metaluminous composition, strong mineralogical and geochemical characters indicate that these granitic rocks groups have affinity with I-type granite. In this context, a west dipping subduction zone between the micro continent derived from Australia and Sundaland could have accounted for arc volcanism within this area. This scenario is relevant with the detachment of blocks of the microcontinent derived from Australia in Tertiary along Sorong Fault in the western of Sulawesi Island as proposed by [5].

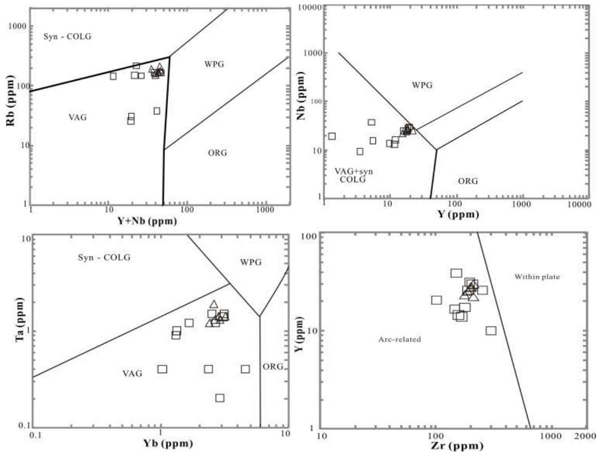


Fig. 10 Discrimination diagrams of Rbvs(Y+Nb), Nbvs Y, Yb+Ta, Zr+Yof Polewali and Masamba granitic rocks. Note the Volcanic arc granitic affinity of most of the samples

VII. Conclusion

The granitic rocks from Polewali and Masamba areas are dominated by granodiorite and granite in composition. They have I-type granitic characters, strong metaluminous affinity and belong to calc-alkaline groups. Fractional crystallization was pronounced during the formation of the granitic rocks as shown by negative correlation between SiO_2 and some major and trace elements. The geochemical characters indicate that the sources of these granitic rocks would have upper continental crust affinity which probably dioritic or granodioritic rocks in composition. Similar pattern of trace and rare earth elements of granitic rocks from both areas reflects the possibility of similar magma sources and tectonic setting. The geochemical characteristics explained the arc related subduction environment which later give an evidence of continent-continent collision between Australia-derived microcontinent and Sundalandto form continental arc environment.

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