The Formation Environment of K-feldspar Porphyritic Granite from E-Mount, Yunnan

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Abstract—E-mount granite Pluton is located at the southwest part of Yangtze plate. To understand the formation environment of K-feldspar porphyritic granite from E-Mount, approaches such as major and trace element analysis and zircon LA- ICP-MS U-Pb dating are used. According to the tests and analysis results, Geochemical shows major elements of *w*(SiO_2) 64.7%~77.41% (> 67%), and A/CNK 0.889~1.234. The zircon age of K-feldspar porphyritic granite is 838.8±6Ma. Finally, infer the forming environment of K-feldspar porphyritic granite that magmatic activity should have been started since 838 Ma, related to post-collisional lithospheric delamination and upwelling of hot asthenosphere, and the tectonic environment of depressurization and warming.

Keywords-component; formation environment; K-feldspar; granite; E-Mount; LA- ICP-MS U-Pb

I. INTRODUCTION

E-Mount granite Pluton which rocky outcropping is about 200km^2 is located at southernmost Kang Dian axis in southwestern margin of the Yangtze Block. There are two rock types, commonly involvs (a)an early quartz diorite and granodiorite, and (b) a later K-feldspar porphyritic granit , which is the dominant rock type cropping out almost 180km^2 .

Predecessors have done many studies of E-Mount granite Pluton. But there is no consensus information age as the previous backward analysis technics. This paper focus on the formation environme such as Chronology and Genesis of K-feldspar porphyritic granit by analyzing new LA-ICP-MS zircon U–Pb ages and geochemical features.

II. GEOCHRONOLOGY

So far, the ages of 818±10Ma [1]and 828±21Ma [2] have been the more credible formation time of E-Mount granite, based on methods of SHRIMP zircon U-Pb method and zircon and monazite U-Pb dilution method respectively.

In this study, Samples D_{1-2} of K-feldspar porphyritic granit for U–Pb analysis were from FaWu village in the middle of Pluton(Table1). The work of Zircon separation and analysis experiment have been done by Institute of Geology and Mineral Resources Survey, Langfang, Hebei region and State Key Laboratory of Continental Dynamics, Northwest University, respectively. Test analysis method has been reported by Li Huaikun[3].

Due to varying degrees of recrystallization or Pb loss of zirconium in thermal event, we choose 3 biggest zircons with clearest oscillatory rings. From the three analyses of 3 zircons, they have Th=302~309ppm, U=705~840ppm, and rations of molecular Th/U=0.4~0.5(>0.1), suggesting from magma[4].

For these 3 analyses, ratios of $^{238}U/^{206}Pb$ shows age from 835~881Ma, In$^{207}Pb/^{235}Pb$ —$^{238}U/^{206}Pb$ concordia diagram using isoplot4.5 (Figure 1), zircons are in agreement and yield a concordant ages of 838.8±6Ma (2σ,MSWD = 0.63).But one analyse of zircon D_{1-2-3} is discordant with $^{207}Pb/^{206}Pb$ and $^{238}U/^{206}Pb$, indicating loss of radiogenic Pb from the analysed site.

III. CHEMICAL COMPOSITIONS OF K-FELDSPAR PORPHYRITIC GRANIT

This paper measured chemical compositions of 2 Samples and the other 29 samples have been compiled from the literature[5]. All samples plot in the granite and alkali granite field in the Q-A-P diagram. The Concentrations (in wt%) of SiO_2 (64.7~77.41), K_2O (3.375~5.38) span wide ranges. In SiO_2-K_2O diagram, most samples plot in K calc-alkaline series, some plot in Shoshonitic series. The ratio of K_2O /NaO is 1.06~2.3 suggesting that intrusions is characterized by potassium.

All samples of E-Mount granite with A/CNK ratios 0.889~1.234, plot in metaluminous – peraluminous field especially near 1.1 in A/CNK-A/NK diagram, possibly indicative of mixed I- and S-type compositions. These samples also have a wide range in Rb (57.2~352ppm), Sr(93.6~963ppm)and Ba (253~2641ppm). On the ORG-normalised spidergram, the K-feldspar porphyritic granit are characterised by strong enrichment in K, Rb, La and Th and pronounced negative anomalies of Ba, Nb, Sr, P, Ti, relative to neighbouring elements. Furthermore, they have generally similar REE patterns showing variable LREE-enrichment and moderate Eu anomalies.

IV. DISCUSSION

A. Genesis

The petrographic, mineralogical, and chemical characteristics, such as initial $\varepsilon Nd(t)$= -6.52~-8.43, T_{2DM} model ages 2.01~2.19Ga, weighted average 2.1Ga[1], resulting from granitic magmas in E-Mount Pluton is subdivided into KCG type[6], suggesting that nature of the source is main correspond to crustal origin of the magmas at the age of 2.1Ga.

Al_2O_3+MgO+FeO^T+TiO_2>15 and Al_2O_3/(MgO+FeO^T+TiO_2)<5 illustrates that samples plot in the basaltic magmas and metagreywacke field and some in overlapping areas of them, suggesting that these magmas may derive from hybrid magmas, formed by reaction of basaltic melts with metagreywacke of supracrustal origin. [7]

According to the experiments of Rapp, R. P.,[8], the basaltic melt may have $Mg^{\#}$<0.4,but when the mantle components involved, it may have $Mg^{\#}$>0.4. K-feldspar granit from E-Mount Pluton have $Mg^{\#}$=0.2~1.1, indicated mantle not only provides heat , also contributions to the origin of granitic magmas.

B. Tectonic Environment

All date from K-rich granitoids plot exclusively within the “post-collision granitoid” field on the Y + Nb versus Rb diagram.

The relative temperatures of SP granite melts are reflected in their Al_2O_3/TiO_2 ratios. Hot (>875℃) SP granite melts with low (<100)Al_2O_3/TiO_2 ratios[9]. Granit from E-Mount Pluton have Al_2O_3/TiO_2=22~86. Like in low-pressure and high-temperature collisional orogens, Crustal anatexis was related to post-collisional lithospheric delamination and upwelling of hot asthenosphere. In comparison, Chemical compositions of post-collisional granites in E-Mount may be in the tectonic environment of depressurization and warming.

V. CONCLUSION

The best estimate of the crystallisation age of K-feldspar porphyritic granit is between 818~838Ma, which supporting the viewpoint that E-Mount granite Pluton formed in Jinning epoch.

TABLE I. LA-ICP-MS U–Pb ANALYTICAL DATAS FOR ZIRCONS FROM E-MOUNT (FAWU)

Grain D_{1-2}	Zircon number			
	unit	*1*	*2*	*3*
^{238}U	ppm	765	840	705
^{232}Th	ppm	302	338	369
TU/U	/	0.4	0.4	0.5
$^{207}Pb/^{206}Pb$	/	0.0707	0.0627	0.1551
	(±1δ)	0.0026	0.0021	0.0142
$^{207}Pb/^{235}U$	/	1.3667	1.2014	3.2058
	(±1δ)	0.0499	0.0379	0.324
$^{206}Pb/^{238}U$	/	0.1397	0.1382	0.1465
	(±1δ)	0.0015	0.0015	0.0023
$^{207}Pb/^{235}U$	age(Ma)	875	801	1459
	(±1δ)	21	17	78
$^{206}Pb/^{238}U$	age (Ma)	843	835	881
	(±1δ)	9	9	13

a. Data is tested in Wuhan geological survey center of China Geological Survey

Nature of the source is main correspond to crustal origin of the magmas, derived from hybrid magmas, formed by reaction of basaltic melts with metagreywacke of supracrustal origin and had continuous evolution characteristics.

Since 838 Ma, Magmatic activity should have been started, related to post-collisional lithospheric delamination and upwelling of hot asthenosphere, and the tectonic environment of depressurization and warming.

TABLE II. COMPOSITIONS OF GRANITES

Element	Sample	
	D_{1-1}	*D_{1-2}*
Major elements (wt.%)		
SiO_2	64.74	74.35
Al_2O_3	15.18	14.08
Fe_2O_3	0.492	0.304
FeO	4.64	0.776
CaO	2.64	0.432
MgO	1.86	0.033
K_2O	3.37	5.38
Na_2O	3.18	3.94
TiO_2	0.622	0.047
P_2O_5	0.193	0.246
MnO	0.082	0.016
Ratios		
Q	30.17	22.85
A	64.83	37.93
P	1.1	22.54
A/CNK	1.11	1.076
(DI)	71.12	95.56
AR	2.16	4.59
σ43	1.92	2.77
K_2O/Na_2O	1.06	1.37
Al_2O_3/TiO_2	24.41	299.57
Trace elements (ppm)		
Rb	57.2	352
Sr	400	104
Ba	1060	253
Ratios		
Rb/sr	0.143	3.385
Rb/Ba	0.054	1.391

Datas are tested in Wuhan geological survey center of China Geological Survey

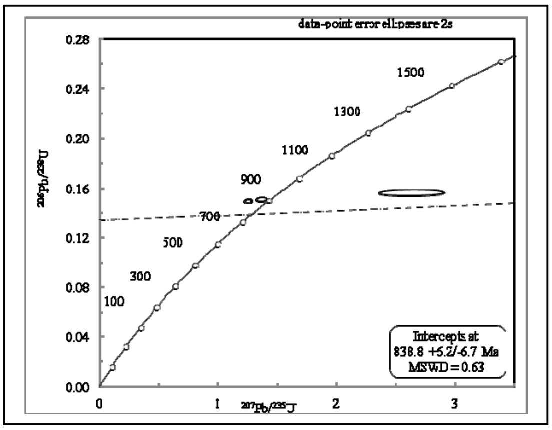

FIGURE I. ZIRCON u-Pb CONCORDIA DIAGRAM OF ESHAN GRANITE

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