Acta Geologica Sinica (English Edition), 2019, 93(4): 1152–1153

Research Advances

Zircon U-Pb Ages of the Muchang Alkali Granites in Zhenkang Block, Western Yunnan: Implication for the Time Limit on Tectono-Magmatic Activities

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Citation: Yang et al., 2019. Zircon U-Pb Ages of the Muchang Alkali Granites in Zhenkang Block, Western Yunnan: Implication for the Time Limit on Tectono-Magmatic Activities. Acta Geologica Sinica (English Edition), 93(4): 1152–1153. DOI: 10.1111/1755-6724.13845

Objective

The Luziyuan super-large Pb-Zn-Fe polymetallic ore district is located in the southern section of the Baoshan-Zhenkang block, which is an important part of the Pb-Zn-Cu-Fe-Sn-Au polymetallic metallogenic belt, SW China. Previous researchers have suggested that the metallogenic materials of the Luziyuan Pb-Zn-Fe polymetallic deposit were mainly derived from concealed intermediate-acid granite. The Muchang alkali granites are located in the southeast of the Luziyuan ore district, which were suggested to the “sister” rock of the unexposed granite host in Luziyuan Pb-Zn deposit, but these granites lack of systematic and precise age. Furthermore, the formation of these rocks is very important for understanding the tectono-magmatic activities in Zhenkang block and the tectonic evolution of Tethys orogenic belt. In this work, we determined the LA-ICP-MS zircon U-Pb ages of the Muchang alkali granites in order to constrain the time limit of tectono-magmatic activities in Muchang.

Methods

The zircon U-Pb dating was performed using the LA-ICP-MS dating techniques at the Key Laboratory of Sedimentary Basins and Oil and Gas Resources, Ministry of Land and Resources. The testing established zircon microdomain U-Pb dating by high resolution inductively coupled plasma mass spectrometer ELEMENT2 and GeoLasPro 193nm-typoe excimer laser ablation system, and we completed the data processing and plotting with ICPMSDataCal and Isoplot.

Results

The Muchang alkali granites are gray, with hypidiomorphic granular texture and massive structure. Minerals mainly include K-feldspar, quartz, alkaline dark-minerals (sodium amphibole and amosite). The study selected 30 zircons from the MC-01 sample (alkali granites) as test objects and obtained 15 valid data (presented in Appendix 1). Zircon cathodoluminescence (CL) images show that all the zircons show a better idiomorphic degree and develop clear oscillatory zoning. Th/U ratios range from 0.6 to 11.6, which belong to magmatic zircons. The analyzed zircons yield $^{206}Pb/^{238}U$ ages ranging from 231 to 249 Ma with a weighted mean age of 240.5±3.7Ma (MSWD=0.48) (Fig. 1), which represent the emplacement crystallization period of the Muchang alkali granites.

Combining with geology, geophysical and geochemical prospecting and remote sensing data, we can know that the northwestern low density bodies correspond well with the Luziyuan NE-SW anticline, and the Luziyuan Pb-Zn-Fe polymetallic deposit is distributed in SW semi-circular area. Southeastern low density and high resistivity bodies are consistent with the known Muchang concealed granites, and the mineralization and alteration at the rock contact zone often lead to polarization effect. According to the geodynamic background of this area, we believe that the formation process of the Muchang alkali granites is as follows. As the eastward subduction of Paleo-Tethys Ocean (Changning–Menglian Ocean) in the Early Triassic, a compressional environment was formed and large-scale dehydration occurred. A large number of magmatic intrusions were induced, and large-scale magmatic activities enabled the migration of ore-forming elements (Sn, Nb, Pb, Zn, etc.) in early sedimentary rocks in this region. Sn, Nb, Pb, Zn and other elements are difficult to enter the crystal structure of rock-forming minerals because of their incompatibility, but are relatively enriched in residual magma or hydrothermal solution. Under the energy-driven mechanism, the ore-bearing hydrothermal solution rich in Sn, Nb, Pb, Zn and other metallogenic elements was filled along the secondary fault zone of Luziyuan anticline, and was consolidated to form the Muchang alkali granites. Morever, Sn-Nb-Pb-Zn polymetallic mineralization was formed in Muchang

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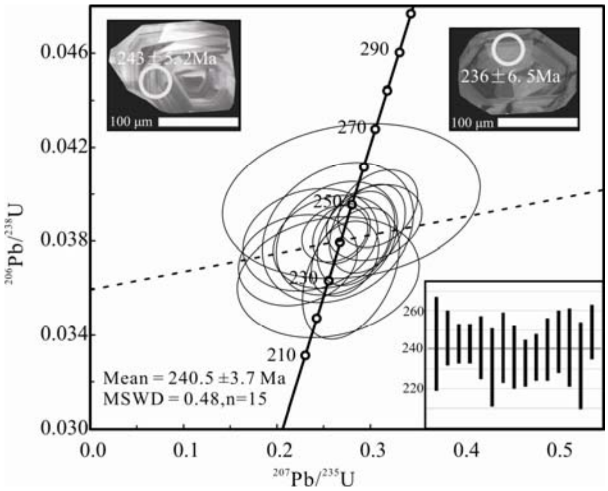

Fig. 1. The zircon U-Pb concordia diagram for alkali granites in the Zhenkang block, western Yunnan.

accompanied by metallogenic hydrothermal activity.

Conclusion

The LA-ICP-MS zircon U-Pb data of the Muchang granites yield a weighted mean age of 240.5±3.7 Ma (MSWD=0.48), indicative of the timing of magmatic crystallization age of Muchang granites, which was formed in the eastward subduction of Paleo-Tethys Ocean (Changning–Menglian Ocean) in the Early Triassic. And simultaneous large-scale tectono-magmatic activities enabled the migration of the metallogenic elements (Sn, Nb, Pb, Zn, etc.) in early sedimentary rocks in the region. The ore-bearing hydrothermal fluid rich in metallogenic elements of Sn, Nb, Pb, Zn, etc was filled along the secondary fault zone and consolidated to form the Muchang alkali granites. Morever, the Sn-Nb-Pb-Zn polymetallic mineralization was formed in Muchang along with the metallogenic hydrothermal activity.

Acknowledgements

This study was financially supported by the National Natural Science Foundation of China (grants No. 41862009 and 41502076), Yunnan Science and Technology Award-Outstanding Contribution Award Project Topic 4 (grant No. 2017001), Construction Funds for Key Disciplines of Mineral Resource Prospecting and Exploration of Kunming University of Science and Technology (grant No. 14078170).

Appendix 1 LA-ICP-MS zircon U-Pb data for alkali granite in the Zhenkang block

Spot	Contents		Ratio	Isotopic ratio						Isotopic ages(Ma）					
	Th	U	Th/U	^{207}Pb/^{206}Pb	1σ	^{207}Pb/^{235}U	1σ	^{206}Pb/^{23}8U	1σ	^{207}Pb/^{206}Pb	1σ	^{207}Pb/^{235}U	1σ	^{206}Pb/^{238}U	1σ
1	113	30.6	3.7	0.0696	0.0172	0.2648	0.0536	0.0384	0.0020	917	349	238	43	243	12
2	495	82.1	6.0	0.0576	0.0071	0.3039	0.0339	0.0388	0.0011	515	200	269	26	246	7
3	317	210	1.5	0.0482	0.0041	0.2618	0.0235	0.0383	0.0008	109	161	236	19	243	5
4	360	197	1.8	0.0512	0.0041	0.2688	0.0204	0.0383	0.0008	248	133	242	16	243	5
5	350	54.0	6.5	0.0589	0.0079	0.2844	0.0275	0.0381	0.0013	562	151	254	22	241	8
6	148	32.6	4.5	0.0509	0.0113	0.2546	0.0646	0.0365	0.0017	235	397	230	52	231	10
7	54.4	97.7	0.6	0.0482	0.0085	0.2353	0.0477	0.0381	0.0014	110	313	215	39	241	9
8	36.9	54.3	0.7	0.0478	0.0094	0.2219	0.0421	0.0372	0.0013	90	294	203	35	236	8
9	1124	96.9	11.6	0.0556	0.0052	0.2807	0.0206	0.0368	0.0010	436	116	251	16	233	6
10	166	89.8	1.9	0.0548	0.0054	0.2727	0.0240	0.0373	0.0010	403	148	245	19	236	6
11	63.6	53.4	1.2	0.0511	0.0081	0.2585	0.0416	0.0380	0.0013	245	286	233	34	240	8
12	284	61.4	4.6	0.0593	0.0067	0.2967	0.0270	0.0386	0.0012	579	142	264	21	244	8
13	152	34.3	4.4	0.0568	0.0097	0.2637	0.0430	0.0382	0.0016	485	290	238	35	241	10
14	436	54.4	8.0	0.0713	0.0150	0.2791	0.0343	0.0367	0.0018	967	171	250	27	232	11
15	135	72.3	1.9	0.0570	0.0065	0.3080	0.0281	0.0394	0.0011	490	154	273	22	249	7