

## Research Advances

## LA-ICP-MS Zircon U-Pb Age of Longtou Syenite body in South Songxian County, Southern Margin of the North China Craton

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### Objective

Indosinian magmatic rocks mainly locate in west Qinling Orogen, which are, however, extremely rare in east Qinling Orogen (Lu Xinxiang, 2000; Zhang Guowei et al., 2001; Guo Xianqing et al., 2017). The Zhifang-Huangzhuang (ZH) area in south Songxian County is located in the southern margin of the North China Craton (Fig. 1a), which is an important Indosinian alkaline magmatic occurrence including 32 syenite bodies and syenitic dykes in east Qinling Orogen. There are five syenite bodes in the ZH area, i.e., the Lang'aogou, Mogou, Longtou, Jiaogou and Wusanggou from west to east (Fig. 1b). All of them are significant to the Indosinian tectonic evolution of east Qinling Orogen. The Mogou and Wusanggou bodies, however, have become reserach focus (Qiu Jiaxiang et al., 1993; Ren Fugen et al., 2001; Liu Chuxiong et al., 2010; Mao et al., 2010; Lu Ren et al., 2013; Cao Jing et al., 2015; He et al., 2016; Liang Tao and Lu Ren, 2017). In fact, a comprehensive geochronolgy and geochemistry research for syenite bodies and syenitic dykes in ZH area is better to understand their petrogenesis and deep process. Therefore, LA-ICP-MS zircon U-Pb dating of the Longtou body was completed firstly in this study.

### Methods

Zircon grains were extracted from about 8.5 kg whole-rock syenite sample named LT212 of the Longtou body by standard crushing, sieving, heavy liquid and magnetic separation techniques. The selected zircons were mounted in epoxy and polished to obtain an even surface. Based on transmissive, reflected and cathodoluminescence (CL) images for all zircons, target zircon and site for U-Pb analyses has been designed.

LA-ICP-MS zircon U-Pb isotope analyses were carried

out at the School of Resources and Environmental Engineering, Hefei University of Technology. The instrument configuration consists of an Agilent 7500a ICP-MS instrument equipped with a 193 nm GeoLasPro laser invented by Coherent Inc. Both sample zircons of LT212 and standard samples of NIST SRM610, 91500 and Plesovice were analyzed orderly. The ICPMSDataCal program (Liu et al., 2010) was used for processing the assay data, and data reduction was conducted using Isoplot (Ludwig, 2001).

### Results

Most zircons from the syenite sample No. LT212 are colorless and transparent, and fractures and inclusions can be seen in some zircons. About one third of the zircons have shown integrated crystal, and most of them are long column shape ranged from 100 to 150  $\mu\text{m}$  in major axis and 50  $\mu\text{m}$  to 100  $\mu\text{m}$  in minor axis with length-to-width ratios of 3:1 to 2:1. Approximate two thirds of the zircons have incomplected crystal, and most of them are sharply angular-subangular shape and allotriomorphic granular. Most of zircons are characteristic of distinct oscillatory zoning and occasionally exhibit sector zoning (Fig. 1c), suggestive of a magmatic origin.

All 30 zircons of sample LT212 were analyzed, and they are in U-Pb concordant (Fig. 1d). The  $^{206}\text{Pb}/^{238}\text{U}$  age of spot LT212-28 is  $273.2\pm 8.1$  Ma, and the  $^{206}\text{Pb}/^{238}\text{U}$  ages of the rest 29 spots are from  $230.6\pm 6.8$  Ma to  $255.8\pm 7.6$  Ma (Appendix 1), which yield a weighted mean  $^{206}\text{Pb}/^{238}\text{U}$  age of  $241.8\pm 2.6$  Ma (Fig. 1d). According to zircon CL image features, the age of  $241.8\pm 2.6$  Ma is interpreted as the crystallization age of Longtou syenite body.

### Conclusion

The whole rock K-Ar age of the Longtou syenite body is 241.6 Ma (Zeng Guangce, 1990), which is nearly

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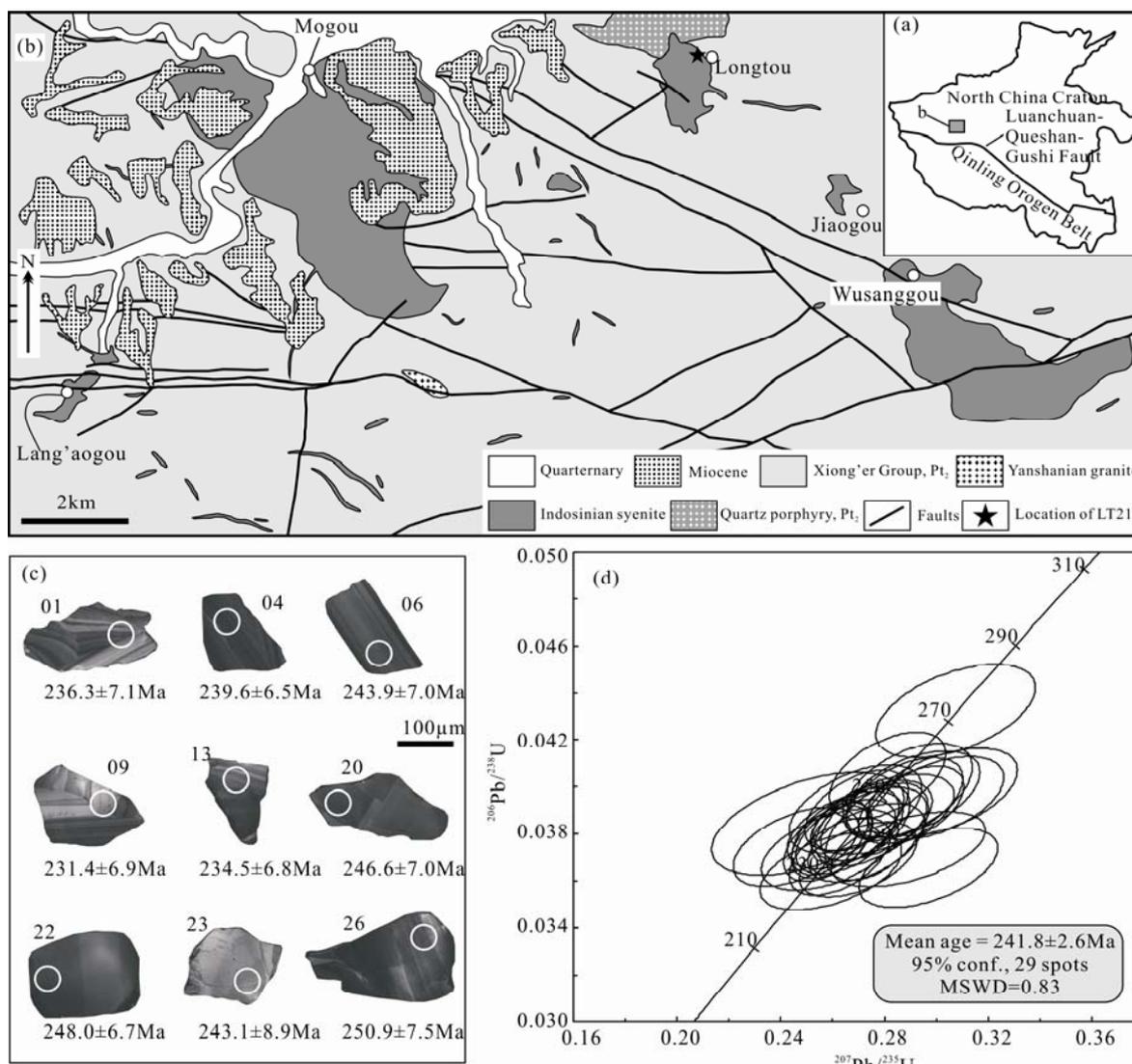


Fig. 1. (a), Simplified tectonic map of Henan Province (after Bureau of Geology and Mineral Resources of Henan Province, 1989); (b), Simplified geologic map of syenite bodies in south Songxian County, western Henan Province (after Bureau of Geology and Mineral Resources of Henan Province, 1990); (c), Cathodoluminescence images of zircons from the Longtou syenite; (d), Concordia diagrams for U-Pb age of zircons of the sample LT212 from the Longtou syenite.

identical with zircon LA-ICP-MS age of  $241.8 \pm 2.6$  Ma. It has suggested that the formation age of Longtou syenite body is  $241.8 \pm 2.6$  Ma (MSWD = 0.83) in the Middle Triassic, and it is the product of the early Indosinian alkaline magmatic activity. Furthermore, the  $^{206}\text{Pb}/^{238}\text{U}$  age of  $273.2 \pm 8.1$  Ma from zircon spot LT212-28 indicates the existence of  $\sim 273$  Ma regional magmatic event in the south Songxian area.

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## References

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Appendix 1 LA-ICP-MS zircon U-Pb analytical results of sample LT12 from Longtou syenite body in south Songxian County, southern margin of the North China Craton

Spot	Pb (ppm)	Th (ppm)	U (ppm)	Th/U	Isotopic ratios				Age (Ma)							
					$^{207}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{206}\text{Pb}/^{238}\text{U}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{206}\text{Pb}/^{238}\text{U}$	$1\sigma$	$1\sigma$				
LT1212-01	37.0	1156	523	2.21	0.0499	0.0033	0.2590	0.0174	0.0373	0.0011	190.8	153.7	233.8	14.1	236.3	7.1
LT1212-02	11.35	274	212	1.30	0.0478	0.0033	0.2459	0.0160	0.0374	0.0011	100.1	155.5	223.2	13.0	237.0	6.9
LT1212-03	24.6	909	328	2.77	0.0536	0.0033	0.2740	0.0147	0.0383	0.0011	353.8	138.9	245.9	11.7	242.2	6.9
LT1212-04	33.0	1041	500	2.08	0.0506	0.0024	0.2651	0.0127	0.0379	0.0010	233.4	111.1	238.7	10.2	239.6	6.5
LT1212-05	48.7	2911	335	8.68	0.0498	0.0028	0.2648	0.0147	0.0382	0.0011	187.1	133.3	238.5	11.8	241.4	6.7
LT1212-06	14.74	288	266	1.08	0.0525	0.0031	0.2749	0.0155	0.0386	0.0011	305.6	135.2	246.6	12.4	243.9	7.0
LT1212-07	13.25	246	242	1.02	0.0522	0.0035	0.2796	0.0180	0.0388	0.0011	300.1	153.7	250.4	14.3	245.5	7.0
LT1212-08	6.05	119	117	1.01	0.0510	0.0038	0.2593	0.0180	0.0364	0.0011	239.0	204.6	234.1	14.5	230.6	6.8
LT1212-09	11.69	328	194	1.69	0.0598	0.0038	0.2969	0.0177	0.0366	0.0011	594.5	135.9	264.0	13.8	231.4	6.9
LT1212-10	18.9	496	322	1.54	0.0530	0.0030	0.2698	0.0150	0.0369	0.0010	327.8	129.6	242.5	12.0	233.7	6.5
LT1212-11	49.8	1670	710	2.35	0.0512	0.0022	0.2727	0.0113	0.0384	0.0011	250.1	98.1	244.8	9.1	243.2	6.6
LT1212-12	48.6	1135	876	1.30	0.0557	0.0037	0.2891	0.0197	0.0373	0.0010	442.6	148.1	257.8	15.5	236.4	6.5
LT1212-13	22.6	725	335	2.16	0.0513	0.0026	0.2627	0.0129	0.0370	0.0011	253.8	118.5	236.9	10.3	234.5	6.8
LT1212-14	86.9	969	1891	0.51	0.0492	0.0019	0.2591	0.0098	0.0379	0.0011	153.8	88.9	234.0	7.9	239.5	6.5
LT1212-15	58.7	435	1346	0.32	0.0496	0.0020	0.2598	0.0103	0.0377	0.0011	189.0	126.8	234.5	8.3	238.7	6.6
LT1212-16	32.3	1238	410	3.02	0.0525	0.0030	0.2730	0.0148	0.0376	0.0011	309.3	131.5	245.1	11.8	238.1	6.9
LT1212-17	33.1	1048	490	2.14	0.0532	0.0026	0.2771	0.0131	0.0381	0.0014	344.5	104.6	248.3	10.4	241.0	8.5
LT1212-18	69.4	1429	1278	1.12	0.0504	0.0019	0.2695	0.0106	0.0383	0.0011	216.7	88.9	242.3	8.5	242.4	6.7
LT1212-19	43.0	884	802	1.10	0.0496	0.0022	0.2582	0.0113	0.0376	0.0011	176.0	97.2	233.2	9.1	237.8	6.6
LT1212-20	34.1	410	700	0.59	0.0503	0.0026	0.2693	0.0132	0.0390	0.0011	209.3	118.5	242.1	10.5	246.6	7.0
LT1212-21	70.8	1999	914	2.19	0.0546	0.0033	0.2997	0.0174	0.0395	0.0012	394.5	137.0	266.2	13.6	249.8	7.2
LT1212-22	54.2	822	1033	0.80	0.0531	0.0024	0.2903	0.0134	0.0392	0.0011	344.5	103.7	258.8	10.5	248.0	6.7
LT1212-23	7.77	159	137	1.17	0.0503	0.0056	0.2505	0.0245	0.0384	0.0014	209.3	240.7	227.0	19.9	243.1	8.9
LT1212-24	73.6	2104	962	2.19	0.0509	0.0028	0.2812	0.0148	0.0405	0.0012	235.3	130.5	251.6	11.7	255.8	7.6
LT1212-25	29.2	1170	325	3.60	0.0502	0.0036	0.2688	0.0169	0.0390	0.0012	211.2	164.8	241.7	13.5	246.9	7.7
LT1212-26	44.5	1212	650	1.86	0.0533	0.0032	0.2910	0.0170	0.0397	0.0012	342.7	132.4	259.4	13.4	250.9	7.5
LT1212-27	24.3	554	394	1.41	0.0538	0.0033	0.2889	0.0165	0.0398	0.0013	364.9	138.9	257.7	13.0	251.8	8.2
LT1212-28	53.2	1452	650	2.23	0.0517	0.0034	0.3074	0.0203	0.0432	0.0013	333.4	153.7	272.2	15.8	272.8	8.1
LT1212-29	151	5619	1466	3.83	0.0527	0.0028	0.2877	0.0148	0.0395	0.0012	322.3	124.1	256.8	11.7	249.6	7.2
LT1212-30	34.4	747	557	1.34	0.0533	0.0034	0.3023	0.0191	0.0398	0.0012	338.9	146.3	268.2	14.9	251.4	7.7