Vol. 91 No. 5 pp. 1928–1929 ACTA GEOLOGICA SINICA (English Edition) Oct. 2017

Research Advances

New Discovery of the Late Triassic Terrigenous Sediments in the Great Xing'an Range Region, NE China and its Geological Significance

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Objective

The Great Xing'an Range is located in the eastern section of Central Asian Orogenic Belt (CAOB). As a superposed position of multiple tectonic domains, its structural evolution has always been a focused issue of geological research. The Triassic is a critical turning point of geological history and is an important link for the study of tectonic evolution in the Great Xing'an Range region. However, Triassic terrigenous sediments in the Great Xing'an Range region have been poorly understood, especially the Late Triassic sediments have not been recorded ever before (Fig.1a). Here we briefly reported the occurrence of the Upper Triassic deposits at Chaihe Town of Zhalantun City in the central Great Xing'an Range region, NE China. These terrigenous sedimentary formations of the Late Triassic are exposed in the west of Chaihe Town, Zhalantun City with an outcrop area of about 8 km^2.

Methods

One fresh hornblende andesite sample (CA-6) was collected from volcanic sedimentation in the upper part of the formation near the Chaihe town (47°35′18.2″N, 121°11′17.2″E). Target fabrication, cathodoluminescence (CL) and LA-ICP-MS zircon dating were carried out at the State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an, China. The detailed experimental process, analysis steps and data analysis method followed some references. Isotopic ratios and elemental concentrations were calculated using the GLITTER 4.0 software. U-Pb age calculations and concordia diagrams were performed using the ISOPLOT program of Ludwig.

Results

The zircon grains from sample (CA-6) are euhedral to

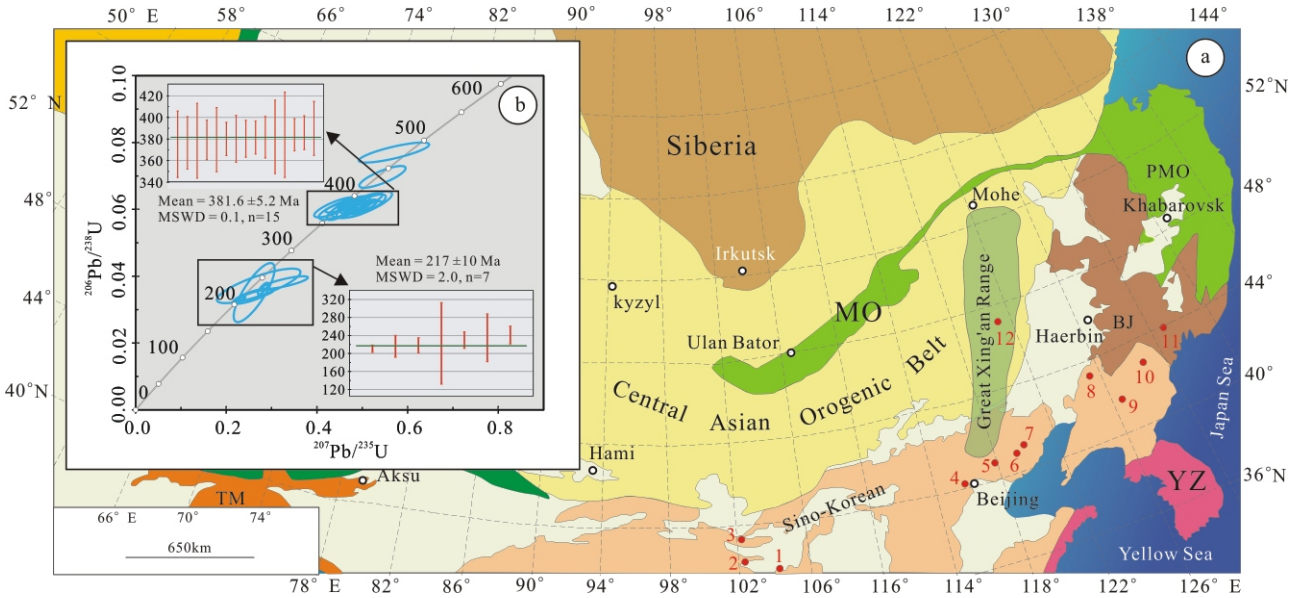

Fig. 1. Location map of the Late Triassic terrigenous sediments in the Great Xing'an Range Region and its surrounding areas (a) and concordia diagram of LA-ICP-MS zircon U-Pb grains for the sampled volcanic rocks in the Upper Triassic deposits in the central Great Xing'an Range (b).

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Table 1 LA-ICP-MS U-Pb data of zircons from the volcanic rocks in the central Great Xing'an Range

Spot	Pb (ppm)	Th (ppm)	U (ppm)	Th/U	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$t_{206/238}$ (Ma)	1σ
C6-A-01	12.2	62	147	0.42	0.0546	0.0044	0.4612	0.0347	0.0610	0.0016	381.7	10
C6-A-02	17.5	197	380	0.52	0.0499	0.0020	0.2310	0.0094	0.0332	0.0006	210.5	4
C6-A-03	10.1	144	197	0.73	0.0645	0.0105	0.2615	0.0369	0.0351	0.0072	222.4	45
C6-A-04	103.4	349	2213	0.16	0.0550	0.0022	0.2810	0.0094	0.0363	0.0014	229.8	9
C6-A-05	9.60	63	121	0.52	0.0576	0.0062	0.4600	0.0461	0.0605	0.0028	378.5	17
C6-A-06	10.20	50	131	0.38	0.0584	0.0043	0.4767	0.0345	0.0601	0.0020	376.4	12
C6-A-07	44.50	328	532	0.62	0.0575	0.0017	0.4846	0.0155	0.0607	0.0013	380	8
C6-A-08	16.10	217	311	0.7	0.0546	0.0052	0.2656	0.0311	0.0344	0.0013	218.2	8
C6-A-09	48.5	325	566	0.57	0.0561	0.0026	0.4774	0.0222	0.0614	0.0012	383.9	7
C6-A-10	14.5	90	322	0.28	0.0603	0.0188	0.2716	0.0753	0.0371	0.0042	234.9	26
C6-A-11	8.7	45	83	0.54	0.0534	0.0060	0.5700	0.0635	0.0770	0.0024	478.2	15
C6-A-12	17.6	136	202	0.68	0.0554	0.0026	0.4764	0.0242	0.0617	0.0013	385.9	8
C6-A-13	15.5	86	189	0.45	0.0593	0.0030	0.5005	0.0266	0.0607	0.0018	380.2	11
C6-A-14	13	69	157	0.44	0.0589	0.0041	0.5033	0.0338	0.0623	0.0021	389.8	12
C6-A-15	23.6	168	470	0.36	0.0628	0.0084	0.3300	0.0410	0.0381	0.0015	241	10
C6-A-16	39	149	495	0.3	0.0595	0.0048	0.5053	0.0381	0.0610	0.0028	381.9	17
C6-A-17	54.1	368	642	0.57	0.0524	0.0043	0.4408	0.0382	0.0606	0.0024	379.4	15
C6-A-18	23.1	144	235	0.61	0.0562	0.0045	0.5446	0.0418	0.0697	0.0027	434.5	16
C6-A-19	24.5	178	307	0.58	0.0593	0.0056	0.5046	0.0500	0.0614	0.0033	383.9	20
C6-A-20	34.5	235	424	0.55	0.0555	0.0049	0.4583	0.0298	0.0599	0.0025	375.1	15
C6-A-21	15.1	92	187	0.49	0.0587	0.0042	0.4981	0.0373	0.0606	0.0015	379.2	9
C6-A-22	2.6	40	57	0.7	0.0501	0.0057	0.2569	0.0346	0.0341	0.0019	215.9	12
C6-A-23	19.8	183	226	0.81	0.0580	0.0028	0.4880	0.0220	0.0610	0.0013	381.5	8
C6-A-24	14.5	101	176	0.58	0.0580	0.0027	0.4898	0.0240	0.0608	0.0014	380.3	9

subhedral columnar zircon crystals. They are 80–150 μm in size, with aspect ratio of about 4:1 to 3:1, and part of the occurrence of mechanical crushing was irregular, with regular oscillatory zoning in CL images. The U content of zircon is between 57 ppm and 2213 ppm, and the Th content is between 40 ppm and 368 ppm. The Th/U ratio of these zircon grains ranges from 0.16 to 0. 81, 0.52 on average. The above features show that they are of an igneous origin. U-Pb dating on24 zircons mainly yielded three concordia age groups on the concordia diagram (Fig. 1b). The weighted average $^{206}Pb/^{238}U$ age of the youngest age groups is 217±10 Ma (95% confidence, MSWD=2.0, *n*=7), which is considered to represent the crystallization age of the volcanic rocks. The weighted average $^{206}Pb/^{238}U$ age of the older age groups is 381.6±5.2 Ma (95% confidence, MSWD=0.1, *n*=15). The oldest age groups just have two ages of 434 Ma and 478 Ma. The latter two age groups represent the age of inherited or captured zircons. Considering zircon U-Pb isotopic ages, it is suggested that the terrigenous sediments age is the Late Triassic.

Conclusion

Field geological survey shows the terrigenous sediments is a set of proximal molasses formation mainly composed of coarse debris under terrigenous sedimentary environment. The appearance of proximal molasses indicated that the orogenic movement that was after the closure of the Palaeo-Asian Ocean was ended. It can be seen that the influence of the Palaeo-Asian Ocean tectonic domain in the Greater Xing'an Mountains continued until the Late Triassic. In addition, the discovery of the Late Triassic sedimentary formation in the Great Xing'an Range region is helpful for the stratigraphic classification and comparison, and it also provides new material for the study of ancient climate in Northeast Asia.

Acknowledgments

This study was financially supported by the National Nature Science Foundation of China (grants No. 41340024 and 41602209).