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Research Advances

New Zircon U-Pb Ages of Granitic Rocks in Northeastern Jiagedaqi of the Da Hinggan Mountains and their Significance

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Objective

The research area is located in the north of the Xing'an block and within the Ali River-Zhalantun granite belt in the eastern part of the Xingmeng orogenic belt. The geotectonic setting and geological evolution history of this area are complex with strong magmatic activity and extremely developed granite rocks. Since predecessors have not obtained accurate dating result, there is much controversy over the formation of granitic rocks. Therefore, this work conducted zircon U-Ph dating on alkali-feldspar granite and granite porphyry in the northeast of Jiagedaqi to provide age constraint. The age data shows that the forming age is the Early Cretaceous and provides age basis for the tectonic evolution of the Da Hinggan Mountains.

Methods

The sample of alkali-feldspar granite (No. PM006TC64) was collected from the Daheishan granites (4329.723N, 2576.965E) and the granitic porphyry sample (No. PM021LT36-1) was collected from the Sishilidadianzi granites (4025.565N, 14525.569E). Two zircon samples were tested. After being crushed and sorted out, transparent zircons with good shape were placed on glass plate under binocular to fill epoxy resin in order to prepare target. They were then milled to half and polished after solidification to expose their internal texture, and were conducted cathodoluminescence imaging. Zircon U-Pb isotope analysis was performed at the LA-ICP-MS Laboratory of Tianjin Institute of Geology and Mineral Resources. Instrument optimization was performed using NIST SRM610, a synthetic reference material for silicate glass developed by the National Institute of Standards and Technology. In-situ zircon U-Pb analysis was performed using a 91500 standard zircon external calibration method with a laser beam spot diameter of 40 μm. The Isplot program was used to calculate the weighted age and obtain concordia plot.

Results

Alkali-feldspar granite sample has better zircon crystal morphology, mostly long columnar shape, euhedral to subhedral, with clear zonal structure. The Th^{232}/U^{238} ratios are often larger than 0.4 (Appendix 1), indicative of a magmatic origin. Twenty-four zircon spots are located on or near the concordia line (Fig. 1). The $^{206}Pb/^{238}U$ apparent age is 119–129 Ma and the weighted age is 124.19±0.80 Ma (MSWD=4.0). The granite porphyry zircon grains are in the form of euhedral crystals with some residual crystalline core and solid enclaves, with a clear magma oscillatory zonal structure. Th^{232}/U^{238} ratios are larger than 0.4 (except for a point of 0.0628), indicating a magmatic origin. Twenty-four spots are all located on the concordia line. The $^{206}Pb/^{238}U$ zircons have apparent ages of 127–131 Ma and a weighted mean age of 128.45±0.54 Ma (MSWD=14). It shows that the emplacement crystallization time of alkali-feldspar granite and granite porphyry is the Early Cretaceous.

The alkali-feldspar granite and granite porphyry in the study area belong to high-K calc-alkaline series and have undergone a high degree of differentiation and evolution. The chemical features of the rock are high silicon, alkali-rich and poor magnesium, iron and calcium. Large ion lithophile elements such as K and Rb are enrichment, and high field-strength elements such as Nb, P and Ti are loss. Nb/Th ratios range from 1.24 to 5.61; Rb/Sr ratios are higher than 1, and $^{238}U/^{206}Pb$ and $^{232}Th/^{208}Pb$ ratios are greater than 100, suggesting the origin from the upper crust (Yan Xueming et al., 2000). It may form partial melting of igneous rocks after the collided thickened crust.

Due to the rotation of the Siberia plate relative to the sino-mongolia block, the Mongolia-Okhotsk Ocean was caused by the scissor-type closure from the Late Triassic to the Late Jurassic from west to east (Xu Meijun et al., 2013). The Cretaceous Mongol-Okhotsk tectonic belt, due

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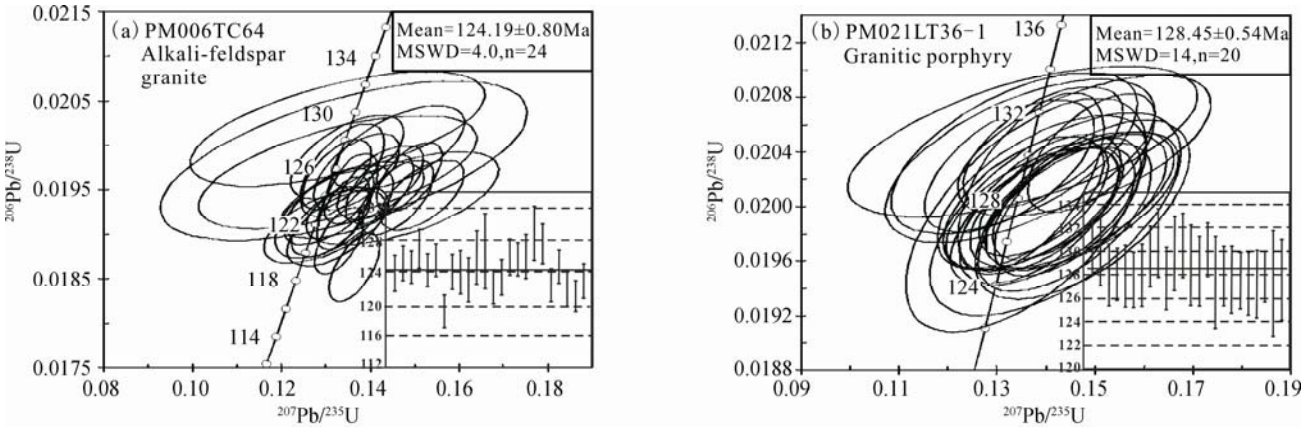

Fig. 1. Concordia $^{207}Pb/^{235}U$-$^{206}Pb/^{238}$ diagrams of the granitic rocks.

to crust decompounding, formed a wide range of extensional effects in the region and formed a large number of Cretaceous magmatic rocks (Huang Shiqi et al., 2016). Therefore, the Early Cretaceous granitic rocks in the study area are the products of the Mongolia-Okhotsk Ocean after a closure, collisional, orogenesis and extensional environment.

Conclusions

The new zircon U-Pb chronological data shows that the Crystallized age of alkali-feldspar granite in northeastern Jiagedaqi of Da Hinggan Mountains is 124.19±0.80 Ma and the crystallization age of granite porphyry is 128.45±0.54Ma, both of which were formed in the middle of the Early Cretaceous. It is the product of the closure, collisional, orogenesis and extensional Mongolia-Okhotsk Ocean and formed igneous rocks partially melted in the thickened crust.

Acknowledgements

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Appendix 1 Zircon U-Pb data of the Early Cretaceous granitic rocks

Sample No.	Element content			Isotopic ratio			Age (Ma)		
$PM_{006}TC64$	Pb(ppm)	U(ppm)	$^{232}Th/^{238}U$	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$
1	21	1124	0.3102	0.0509	0.1360	0.0194	235	129	124
2	24	1081	1.4610	0.0527	0.1423	0.0196	316	135	125
3	40	2038	0.5264	0.0528	0.1421	0.0195	321	135	125
4	19	922	1.2035	0.0492	0.1348	0.0199	158	128	127
5	34	1719	0.7867	0.0566	0.1518	0.0194	476	143	124
6	82	4212	0.2942	0.0550	0.1489	0.0196	411	141	125
7	72	3629	0.3154	0.0531	0.1364	0.0186	334	130	119
8	37	1692	1.4891	0.0545	0.1460	0.0194	393	138	124
9	8	392	0.8263	0.0550	0.1473	0.0194	414	140	124
10	12	610	0.8940	0.0497	0.1319	0.0193	180	126	123
11	9	400	1.1387	0.0488	0.1326	0.0197	140	126	126
12	3	119	0.7277	0.0491	0.1341	0.0198	150	128	127
13	20	940	0.8241	0.0494	0.1301	0.0191	168	124	122
14	17	829	0.5628	0.0492	0.1309	0.0193	155	125	123
15	23	971	1.1868	0.0504	0.1369	0.0197	214	130	126
16	57	2008	2.0002	0.0489	0.1325	0.0197	141	126	126
17	12	583	0.7465	0.0492	0.1337	0.0197	155	127	126
18	7	301	0.7770	0.0476	0.1326	0.0202	82	126	129
19	9	471	0.0628	0.0531	0.1463	0.0200	335	139	127
20	52	2136	1.5534	0.0497	0.1312	0.0191	181	125	122
21	130	4991	2.0146	0.0504	0.1357	0.0195	215	129	125
22	36	1640	1.1614	0.0504	0.1324	0.0191	212	126	122
23	68	3440	1.0454	0.0510	0.1331	0.0189	240	127	121
24	56	1773	2.1986	0.0505	0.1339	0.0192	216	128	123
$PM_{21}TC36-1$									
1	9	391	0.6701	0.0495	0.1394	0.0204	171	133	130
2	5	229	0.6840	0.0475	0.1336	0.0204	75	127	130
3	6	246	0.8779	0.0532	0.1472	0.0200	339	139	128
4	9	409	0.7686	0.0505	0.1395	0.0201	217	133	128
5	7	315	0.8105	0.0529	0.1462	0.0200	326	139	128
6	8	400	0.4742	0.0498	0.1372	0.0200	186	131	128
7	7	322	0.9596	0.0525	0.1452	0.0200	309	138	128
8	6	260	0.6644	0.0474	0.1325	0.0203	67	126	130
9	5	218	0.7830	0.0479	0.1352	0.0205	93	129	131
10	7	305	0.7536	0.0524	0.1445	0.0200	303	137	128
11	5	204	0.6599	0.0481	0.1347	0.0203	102	128	130
12	5	209	0.8577	0.0524	0.1478	0.0204	305	140	130
13	13	343	1.1884	0.2306	0.8169	0.0257	3056	606	164
14	9	357	1.2260	0.0492	0.1369	0.0202	157	130	129
15	5	218	0.8102	0.0502	0.1391	0.0201	203	132	128
16	12	448	1.3740	0.0531	0.1493	0.0204	333	141	130
17	7	256	1.3485	0.0516	0.1419	0.0199	268	135	127
18	8	334	0.6956	0.0490	0.1354	0.0200	148	129	128
19	7	380	0.0628	0.0504	0.1388	0.0200	213	132	128
20	6	275	0.8255	0.0503	0.1386	0.0200	211	132	127
21	8	331	1.1088	0.0507	0.1394	0.0199	229	132	127
22	9	366	1.0570	0.0524	0.1439	0.0199	302	137	127
23	24	904	1.7539	0.0516	0.1424	0.0200	267	135	128
24	3	142	0.6619	0.0495	0.1359	0.0199	170	129	127
25	5	231	0.6536	0.0535	0.1474	0.0200	351	140	128