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Research Advances

New Zircon U-Pb Age of Devonian Granites in the Niukutou Lead-Zinc Deposit, Qinghai Province and its Significance for Prospecting Blind Orebodies

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Object

The Eastern Kunlun Orogen (EKO), An important part of the Tethyan orogenic belt in the northern margin of the Qinghai–Tibet Plateau (Li et al., 2014; Ren Haidong et al., 2016), is a key area for geological research and mineral exploration (Li Bile et al., 2015). The Qimantag Mountain is located in middle segment of the EKO, which has experienced the Early Paleozoic and Late Paleozoic–Early Mesozoic superimposed orogenesis, together with multi-episodic magmatism and metallogenesis.

The newly discovered Niukutou large-sized sakrn-type Pb-Zn deposit is located in the eastern part of the Qimantag Fe-Pb-Zn-Ag polymetallic metallogenic belt of Qinghai Province, China. It has Pb+Zn reserves of more than one million tons at Pb+Zn grade of >15% and contains associated metals such as Fe, Cu and Ag. Most previous studies consider that the skarn type Pb-Zn deposits in this area are closely associated with the Middle -Late Triassic granodiorites (Ren et al., 2016; Chen et al., 2017), and the orebodies occur in a contact zone between Indosinian granitoid and Carboniferous Diaosu group marbleization limestone as well as along the NW- and NNW-trending fault systems. However, a new type of Pb-Zn orebody in a contact zone between the Early Hercynian granite and Ordovician volcano-sedimentary rocks has been recently discovered for the first time in the Niukutou deposit during the follow-up of M_2 magnetic anomaly in 2017. In this paper, we present new LA-ICP-MS zircon U-Pb ages for the Niukutou ore-forming granite in the M_2 magnetic anomaly, in order to provide some new information for prospecting in this area and the wider Qimantag Mountain for skarn Pb-Zn polymetallic mineralization.

Methods

Two samples No. zk04-1 and zk04-2 for zircon dating in this work were collected from the M_2-zk04 drill core at the −20 m and −858 m elevation in the Niukutou Pb-Zn deposit. Zircon grains were extracted from whole rock samples and handpicked at the Langfang Yuneng Mineral Separation Limited Company, Hebei Province, China. The cathodeluminescence (CL) images of zircons and the LA-ICP-MS zircon U-Pb analysis were completed at the State Key Laboratory of Continental Dynamics of Northwest University, Xi'an, China. The zircon U-Pb dating was done by Varian 820-MS quadrupole plasma mass spectrometry of Varian. The laser ablation system is GeoLas2005 produced by MicroLAS of Germany, which is composed of ComPex102 Excimer laser produced by Lambda Physik of Germany and MicroLAS's optical system. The spot size was 36 μm, and the standard zircon samples were 91500, GJ-1 and NIST SRM 610. Zircon CL analysis was performed by affiliated MonoCL3+ system of the field emission scanning electron microscope produced by FEI Company.

Results

The CL images show that the zircon grains are euhedral -subhedral with short-long columnar shapes, and range in size from 60 to 150 μm. Most zircon grains show spongy texture in the core due to the dissolution by fluids. And the rims normally show oscillatory zoning (Fig. 1). Most zircons have high concentrations of Th (zk04-1:69–862 ppm; zk04-2: 88–1473 ppm) and U (zk04-1:103–862 ppm; zk04-2:78–1228 ppm) with large Th/U ratios (zk01-1:0.443–1.968; zk04-2:0.634–1.620), which are indicative of typical magmatic zircons. Combined with the characteristics of CL images (Fig. 1), the analyzed zircons are inferred to be a magmatic origin (Rubatto et al., 2000) (Appendix 1). Therefore, the LA-ICP-MS U-Pb zircon ages can represent the crystallization age of magma.

Twenty-five U-Pb analyses of zircons were obtained from zk04-1. All date points have small variation range and are distributed in one group on the concordant line. The analyzed zircons yield $^{206}Pb/^{238}U$ ages ranging from

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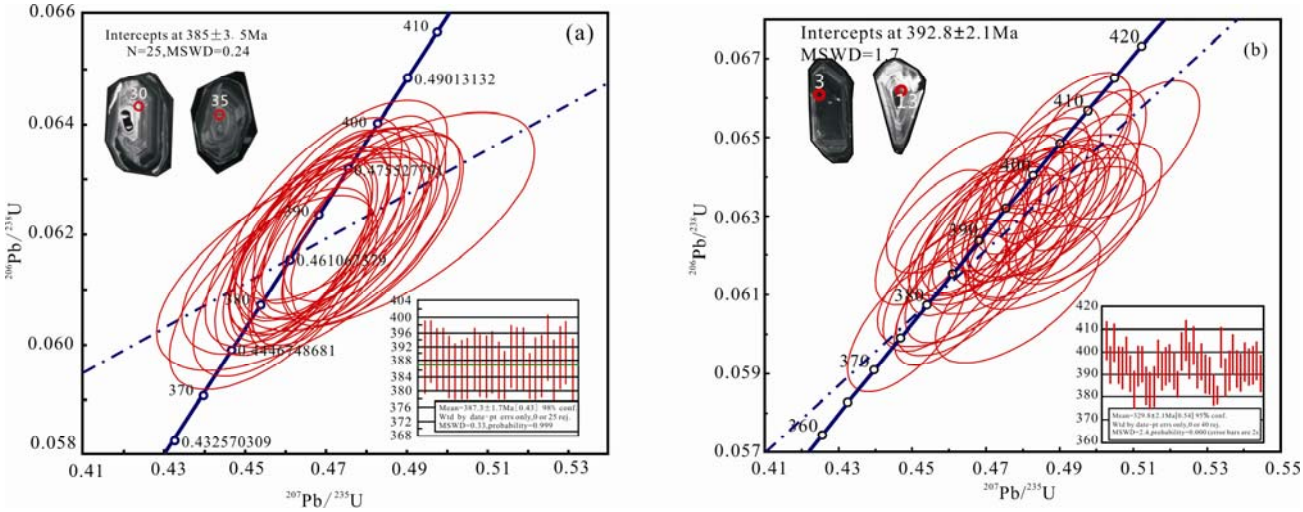

Fig. 1. U-Pb concordia diagram and cathodoluminescence images for zircons from the granite in the Niukutou lead-zinc deposit.

384.1 Ma to 391.6 Ma with a concordant age of 385.2±3.2 Ma (MSWD=0.24), which is identical to the weighted mean age of 387.3±1.7 Ma (MSDW=0.33, Fig. 1a) and is regarded as the magma crystallization age of this sample. Forty U-Pb analyses were obtained from zk04-2, and most date points have a small variation range and distribute in one group on the concordant line. The analyzed zircons yield $^{206}Pb/^{238}U$ ages ranging from 376.9 Ma to 405.1Ma with a concordant age of 392.8±2.1 Ma (MSWD=0.17), which is identical to the weighted mean age of 392.8±2.1 Ma (MSDW=2.4, Fig. 1b).

Conclusions

A suite of granite has been identified in the Niukutou lead-zinc deposit. The dating results of two granite samples are 387.3±1.7 Ma and 392.8±2.1 Ma, respectively, which represent another main metallogenic age of the deposit. It is thus inferred to be a new found of lead-zinc polymetallic metallogenic epoch in the southern margin of the Qaidam Basin.

This study highlights that except the Cretaceous Pb-Zn polymetallic mineralization in the Qimantag region, the Early Ordovician could also be another significantly Pb-Zn mineralization period. The Early Ordovician should be a new direction for the regional prospecting of Pb-Zn polymetallic deposits in the southern margin of the Qaidam Basin.

Acknowledgments

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References

Chen Guohao, Pei Xianzhi, Li Ruibao, Li Zuochen and Liu Chengjun, 2017. Paleo-Tethyan oceanic crust subduction in the eastern section of the East Kunlun Orogenic Belt: geochronology and petrogenesis of the Qushi'ang granodiorite. *Acta Geologica Sinica* (English Edition), 91(2): 565–580.

Ren Haidong, Wang Tao, Zhang Lei, Wang Xiaoxia, Huang He, Feng Chengyou, Teschner Claudia and Song Peng, 2016. Ages, sources and tectonic settings of the Triassic igneous rocks in the easternmost segment of the East Kunlun Orogen, central China. *Acta Geologica Sinica* (English Edition), 90(2): 641–668.

Appendix 1 LA-ICP-MS U-Pb data of zircons from the granite in the Niukutou Pb-Zn deposit

Analysis Spot	Content (ppm)			Th/U	Isotopic composition				Age(Ma)			
	Pb	Th	U		$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$		$^{207}Pb/^{235}U$	2σ	$^{206}Pb/^{238}U$	2σ
Zk04-1-01	48	113	186	0.608	0.4845	0.0152	0.0622	0.0008	401.2	10	389.2	5
Zk04-1-02	75	169	285	0.593	0.4785	0.0078	0.0625	0.0007	397	5	390.6	4
Zk04-1-05	113	237	432	0.548	0.4796	0.0075	0.0621	0.0007	397.8	5	388.5	4
Zk04-1-06	42	71	160	0.443	0.4718	0.0098	0.0622	0.0007	392.4	6	388.9	4
Zk04-1-08	53	133	206	0.645	0.4652	0.0126	0.0617	0.0007	387.9	8	385.9	4
Zk04-1-09	187	765	726	1.054	0.4616	0.0078	0.0615	0.0006	385.3	5	384.8	4
Zk04-1-10	113	862	438	1.968	0.4704	0.0077	0.0616	0.0007	391.4	5	385.6	4
Zk04-1-13	69	136	268	0.507	0.4639	0.0072	0.0617	0.0007	386.9	5	386.1	4
Zk04-1-14	38	69	146	0.472	0.4757	0.0098	0.0622	0.0007	395.1	6	389.1	4
Zk04-1-16	43	94	165	0.569	0.4656	0.0081	0.0619	0.0007	388.2	5	387.2	4
Zk04-1-17	62	172	239	0.719	0.4676	0.0088	0.0619	0.0007	389.5	6	387	4
Zk04-1-18	43	94	163	0.577	0.4814	0.0092	0.0621	0.0007	399.1	6	388.2	4
Zk04-1-19	168	695	651	1.067	0.4659	0.0062	0.0615	0.0006	388.4	4	385.1	4
Zk04-1-22	97	201	378	0.531	0.4593	0.0090	0.0611	0.0007	383.8	6	382.5	4
Zk04-1-26	99	221	379	0.583	0.4701	0.0065	0.0623	0.0007	391.3	4	389.4	4
Zk04-1-27	49	92	190	0.484	0.4698	0.0086	0.0622	0.0007	391	5	388.9	4
Zk04-1-28	46	99	178	0.556	0.4813	0.0089	0.0621	0.0007	399	6	388.7	4
Zk04-1-29	64	152	248	0.612	0.4570	0.0105	0.0609	0.0007	382.2	7	381.4	4
Zk04-1-30	79	237	308	0.769	0.4693	0.0102	0.0617	0.0007	390.7	7	386	4
Zk04-1-33	62	106	238	0.445	0.4671	0.0076	0.0618	0.0007	389.2	5	386.9	4
Zk04-1-35	58	119	224	0.531	0.4735	0.0108	0.0626	0.0007	393.6	7	391.6	4
Zk04-1-37	27	89	103	0.864	0.4641	0.0147	0.0614	0.0007	387.1	10	384.6	4
Zk04-1-38	47	105	181	0.580	0.4739	0.0071	0.0622	0.0007	393.9	5	389.2	4
Zk04-1-39	61	150	234	0.641	0.4703	0.0075	0.0624	0.0007	391.4	5	390.4	4
Zk04-1-42	55	151	211	0.715	0.4614	0.0087	0.0617	0.0007	385.2	6	385.9	4
Zk04-2-01	225	678	867	0.782	0.4950	0.0059	0.0648	0.0007	408.3	4	404.9	4
Zk04-2-02	72	325	285	1.140	0.4825	0.0072	0.0630	0.0007	399.8	5	394.3	4
Zk04-2-03	91	369	354	1.042	0.5097	0.0074	0.0647	0.0007	418.3	5	404	4
Zk04-2-04	81	363	321	1.130	0.4795	0.0065	0.0631	0.0007	397.7	4	394.3	4
Zk04-2-05	43	224	172	1.302	0.4739	0.0116	0.0629	0.0008	393.9	8	393	5
Zk04-2-06	90	273	353	0.773	0.4825	0.0063	0.0638	0.0007	399.8	4	398.5	4
Zk04-2-07	81	533	329	1.620	0.4664	0.0061	0.0624	0.0007	388.7	4	390.5	4
Zk04-2-08	47	168	190	0.884	0.4589	0.0069	0.0613	0.0007	383.5	5	383.3	4
Zk04-2-09	34	156	134	1.164	0.4831	0.0096	0.0630	0.0007	400.2	6	393.9	4
Zk04-2-10	136	484	539	0.898	0.4929	0.0061	0.0631	0.0007	406.9	5	394.5	4
Zk04-2-11	43	251	176	1.426	0.4659	0.0073	0.0615	0.0007	388.4	5	384.8	4
Zk04-2-12	36	183	147	1.245	0.4645	0.0077	0.0612	0.0007	387.4	7	382.7	4
Zk04-2-13	31	143	128	1.117	0.4663	0.0105	0.0615	0.0007	388.6	4	384.8	4
Zk04-2-14	122	1125	481	2.339	0.4843	0.0060	0.0635	0.0007	401	5	397.1	4
Zk04-2-15	113	432	451	0.958	0.4682	0.0079	0.0626	0.0007	390	4	391.5	4
Zk04-2-16	63	366	250	1.464	0.4767	0.0067	0.0629	0.0007	395.8	4	393.6	4
Zk04-2-18	227	937	898	1.043	0.4894	0.0058	0.0632	0.0007	404.5	4	395.3	4
Zk04-2-19	115	420	460	0.913	0.4826	0.0063	0.0626	0.0007	399.9	4	391.7	4
Zk04-2-20	74	390	303	1.287	0.4607	0.0064	0.0609	0.0007	384.8	4	381	4
Zk04-2-21	315	1473	1228	1.199	0.4873	0.0057	0.0640	0.0007	403.1	5	400.2	4
Zk04-2-22	68	414	261	1.586	0.4909	0.0075	0.0648	0.0007	405.6	4	405.1	4
Zk04-2-23	52	175	204	0.858	0.4765	0.0069	0.0633	0.0007	395.7	4	395.9	4
Zk04-2-24	171	419	660	0.634	0.4989	0.0059	0.0645	0.0007	410.9	4	402.7	4
Zk04-2-25	87	372	347	1.072	0.4704	0.0061	0.0627	0.0007	391.5	4	391.9	4
Zk04-2-26	95	474	373	1.270	0.4760	0.0061	0.0633	0.0007	395.3	4	395.8	4
Zk04-2-27	51	191	204	0.936	0.4899	0.0096	0.0624	0.0007	404.8	6	390.4	4
Zk04-2-28	80	379	322	1.177	0.4746	0.0083	0.0623	0.0007	394.3	6	389.5	4
Zk04-2-29	19	88	78	1.128	0.4786	0.0091	0.0610	0.0007	397.1	6	381.8	4
Zk04-2-30	45	285	189	1.507	0.4485	0.0066	0.0602	0.0007	376.2	5	376.9	4
Zk04-2-31	68	410	265	1.547	0.4889	0.0084	0.0643	0.0007	404.1	5	402	4
Zk04-2-32	58	345	233	1.481	0.4645	0.0064	0.0622	0.0007	387.4	4	388.9	4
Zk04-2-33	36	172	146	1.178	0.4889	0.0097	0.0627	0.0007	404.2	6	391.9	4
Zk04-2-34	123	447	479	0.933	0.4957	0.0065	0.0639	0.0007	408.8	4	399.1	4
Zk04-2-35	82	361	326	1.107	0.4673	0.0060	0.0628	0.0007	389.3	4	392.3	4
Zk04-2-36	15	108	102	1.059	0.4710	0.0082	0.0625	0.0007	.91.9	5	390.8	4
Zk04-2-37	37	170	147	1.156	0.4880	0.0094	0.0633	0.0007	403.6	6	395.5	4
Zk04-2-39	97	432	386	1.119	0.4814	0.0064	0.0629	0.0007	399.1	4	393.3	4
Zk04-2-40	26	90	106	0.849	0.4969	0.0085	0.0631	0.0007	409.7	5	394.3	4
Zk04-2-41	25	128	100	1.280	0.4618	0.0071	0.0634	0.0007	385.5	5	396	4
Zk04-2-42	51	229	203	1.128	0.4557	0.0064	0.0625	0.0007	381.3	4	390.5	4