minerals

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Supplementary

Table S1. Whole-rock geochemical data from the intrusive rocks in the Baiyinnuoer Zn–Pb deposit.

Sample No.	Granodiorite and Granodiorite Porphyry								Diorite		
	BY01	**BY02**	**BY03**	**BY04**	**BY05**	**BY06**	**BY07**	**BY08**	**BY09**	**BY10**	**BY11**
wt %											
SiO_2	68.25	65.05	67.98	67.41	67.55	68.10	67.59	67.10	60.14	53.53	57.82
TiO_2	0.52	0.55	0.47	0.49	0.41	0.37	0.41	0.49	0.59	0.64	0.61
Al_2O_3	13.83	13.11	13.37	14.30	13.59	13.75	13.92	14.07	12.76	12.71	14.07
Fe_2O_3	0.78	1.03	1.67	0.39	0.45	0.88	0.04	0.37	1.52	1.39	1.12
FeO	1.09	1.83	2.20	2.78	1.75	1.49	1.62	3.04	4.03	5.57	4.03
MnO	0.10	0.13	0.12	0.12	0.22	0.17	0.12	0.12	0.21	1.07	0.15
MgO	1.90	1.34	1.59	1.72	2.15	1.21	1.38	1.97	3.02	4.06	3.52
CaO	3.43	3.34	2.56	1.93	4.25	4.39	2.63	2.30	4.64	11.69	8.12
Na_2O	3.90	2.74	3.39	3.83	2.09	3.08	4.42	4.15	2.37	2.06	2.56
K_2O	4.28	5.42	2.40	3.43	4.14	3.17	3.85	2.56	4.31	3.61	4.45
P_2O_5	0.17	0.23	0.15	0.16	0.14	0.13	0.17	0.17	0.19	0.23	0.18
LOI	0.75	3.24	1.35	1.29	0.54	0.82	0.98	1.09	4.60	1.40	3.00
Total	99.01	98.02	97.25	97.85	97.28	97.55	97.12	97.43	98.38	97.96	99.61
A/CNK	0.79	0.79	1.04	1.05	0.86	0.83	0.85	1.01	0.74	0.44	0.59
A/NK	1.24	1.25	1.62	1.41	1.69	1.60	1.21	1.45	1.47	1.72	1.54
Mg#	65	46	43	49	64	49	60	51	50	51	55
ppm											
Rb	163.92	201.20	84.59	102.32	196.76	133.42	140.74	80.82	320.44	173.40	320.44
Sr	277.42	204.33	249.49	241.77	312.35	294.06	188.97	213.84	269.54	266.20	262.43
Ba	869.53	1083.31	561.13	717.57	812.67	607.70	707.30	563.67	603.40	680.82	594.41
Zr	164.00	142.00	135.00	148.00	166.00	131.00	161.00	129.00	156.00	119.00	169.65
Hf	6.65	4.75	6.65	5.70	7.60	4.75	5.70	5.70	5.70	3.80	6.59
Th	10.63	15.17	17.41	17.78	15.01	11.38	12.05	15.46	12.61	10.79	12.61
U	3.59	2.78	4.41	4.95	4.39	3.35	2.91	4.26	2.63	3.61	2.47
Y	16.69	18.95	14.89	16.04	14.35	13.95	16.11	16.49	19.39	18.15	9.32
Nb	7.02	8.50	6.79	6.89	7.98	7.07	7.28	6.79	8.85	6.04	8.85
Ta	0.56	0.80	0.74	0.81	0.69	0.53	0.48	0.76	0.83	0.44	0.93

Cr	54.25	75.15	58.63	55.57	49.73	34.28	51.44	69.68	81.75	121.26	76.90
Co	5.55	11.16	9.72	8.44	6.65	4.66	5.32	9.72	12.14	15.86	12.14
Ni	17.58	23.61	19.31	19.42	16.08	17.24	15.79	20.82	19.36	31.78	19.36
La	23.88	19.88	23.88	25.58	31.20	17.43	24.08	34.95	24.63	55.40	28.15
Ce	53.88	48.10	52.77	56.83	59.04	41.99	55.68	60.05	54.40	79.92	49.49
Pr	6.51	5.83	6.07	6.71	7.16	5.11	6.75	7.22	6.86	9.76	5.93
Nd	22.80	22.28	21.14	23.69	24.93	18.50	24.61	24.87	25.01	33.81	17.64
Sm	4.25	4.45	3.96	4.32	4.51	3.55	4.40	4.53	4.88	5.81	2.82
Eu	0.92	0.93	0.97	0.98	0.72	0.80	0.86	0.93	0.89	1.66	0.77
Gd	3.50	3.40	3.10	3.71	3.42	2.86	3.27	3.58	3.96	4.25	3.87
Tb	0.54	0.57	0.50	0.58	0.51	0.45	0.51	0.58	0.65	0.60	0.44
Dy	3.01	3.17	2.86	3.21	2.77	2.65	2.95	3.12	3.50	3.20	1.55
Ho	0.61	0.66	0.55	0.63	0.56	0.52	0.59	0.63	0.70	0.64	0.29
Er	1.59	1.69	1.47	1.66	1.50	1.36	1.51	1.61	1.70	1.75	1.18
Tm	0.27	0.30	0.25	0.28	0.26	0.24	0.24	0.28	0.29	0.29	0.16
Yb	1.67	1.76	1.44	1.68	1.61	1.33	1.50	1.78	1.57	1.68	1.24
Lu	0.25	0.27	0.23	0.24	0.24	0.25	0.23	0.25	0.22	0.26	0.18
REE	123.69	113.30	119.17	130.08	138.45	97.03	127.18	144.36	129.26	199.03	113.70
δEu	0.71	0.71	0.82	0.73	0.54	0.74	0.66	0.68	0.60	0.98	0.72
δCe	1.02	1.06	1.03	1.02	0.92	1.06	1.04	0.86	0.99	0.76	0.88
$(La/Yb)_N$	9.63	7.60	11.19	10.26	13.05	8.83	10.79	13.27	10.55	22.23	15.27

Note: δEu =2 × (Eu/0.0735)/((Sm/0.195) + (Gd/0.259)); δCe =2 × (Ce/0.808)/((La/0.310) + (Pr/0.122)); $(La/Yb)_N$ = (La/0.310)/(Yb/0.209); A/CNK = molar $Al_2O_3/CaO + Na_2O + K_2O$; A/NK = molar $Al_2O_3/Na_2O + K_2O$.

Table S2. Sr–Nd isotopic data from the intrusive rocks in the Baiyinnuoer Zn–Pb deposit.

Sample No.	Age	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	2σ	$(^{87}Sr/^{86}Sr)_i$	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$	2σ	$\varepsilon Nd(t)$	T_{DM}(Ma)	T_{DM2}(Ma)
Granodiorite															
BY08	248 Ma	96.2	26.1	1.0682	0.709230	13	0.7054	3.8	19.7	0.1163	0.512560	11	1.3	904	916
Diorite															
BY10	249 Ma	194	382	1.4708	0.709625	17	0.7044	5.75	35	0.0995	0.512574	11	1.8	768	880

Table S3. Pb isotopic data fromthe intrusive rocks in the Baiyinnuoer Zn–Pb deposit.

Sample No.	$^{208}Pb/^{204}Pb$	2σ	$^{207}Pb/^{204}Pb$	2σ	$^{206}Pb/^{204}Pb$	2σ
Granodiorite						
BY08	38.56	0.008	15.557	0.003	18.712	0.004
Diorite						
BY10	38.203	0.01	15.557	0.004	18.334	0.004

Table S4. LA-ICP-MS zircon U–Pb isotopic data from the intrusive rocks in the Baiyinnuoer Zn–Pb deposit.

Sample No.	Contents (ppm)			Th/U	Isotopic Ratio						Age (Ma)					
	Pb	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Granodiorite and granodiorite porphyry																
BY02																
1	41.0	320.4	835.0	0.38	0.05031	0.00126	0.27731	0.00674	0.03983	0.00044	209	57	249	5	252	3
2	23.4	146.6	504.6	0.29	0.04782	0.00165	0.26503	0.01169	0.03968	0.00078	100	81	239	9	251	5
3	29.3	164.6	623.4	0.26	0.04850	0.00200	0.26815	0.01344	0.03998	0.00145	124	92	241	11	253	9
4	30.4	207.4	633.8	0.33	0.05466	0.00134	0.29625	0.00748	0.03899	0.00040	398	56	263	6	247	2
5	59.2	438.4	1181.5	0.37	0.05354	0.00136	0.29476	0.00727	0.03975	0.00052	350	55	262	6	251	3
6	47.3	326.5	962.1	0.34	0.05091	0.00115	0.27801	0.00608	0.03938	0.00047	235	52	249	5	249	3
7	24.7	127.4	513.5	0.25	0.05153	0.00158	0.28317	0.00818	0.03973	0.00062	265	77	253	6	251	4
8	54.7	399.3	1095.2	0.36	0.05183	0.00119	0.28664	0.00630	0.03985	0.00050	280	49	256	5	252	3
9	63.9	529.4	1250.8	0.42	0.05551	0.00189	0.30391	0.00685	0.03947	0.00044	432	76	269	5	250	3
10	19.8	153.6	404.6	0.38	0.05067	0.00154	0.27311	0.00827	0.03881	0.00050	233	70	245	7	245	3
11	25.5	132.6	528.2	0.25	0.05288	0.00144	0.29022	0.00764	0.03957	0.00045	324	61	259	6	250	3
12	54.2	377.4	1120.7	0.34	0.05398	0.00135	0.29203	0.00668	0.03915	0.00061	369	56	260	5	248	4
13	38.5	281.6	800.5	0.35	0.05342	0.00208	0.28344	0.01067	0.03825	0.00064	346	87	253	8	242	4
14	24.0	162.7	493.9	0.33	0.05342	0.00221	0.28669	0.01126	0.03875	0.00066	346	94	256	9	245	4
15	36.7	230.3	773.7	0.30	0.05252	0.00152	0.28397	0.00790	0.03896	0.00051	309	67	254	6	246	3
16	29.3	199.3	601.3	0.33	0.05497	0.00151	0.29816	0.00803	0.03908	0.00045	409	61	265	6	247	3
17	47.5	339.7	972.4	0.35	0.05358	0.00166	0.29083	0.00895	0.03901	0.00048	354	69	259	7	247	3
18	52.1	359.6	1050.9	0.34	0.05376	0.00120	0.29683	0.00673	0.03966	0.00043	361	50	264	5	251	3
19	74.7	574.3	1517.9	0.38	0.05176	0.00108	0.28165	0.00592	0.03914	0.00046	276	44	252	5	247	3
20	66.6	614.4	1323.5	0.46	0.05377	0.00132	0.29389	0.00717	0.03937	0.00055	361	56	262	6	249	3
21	30.5	192.0	642.6	0.30	0.04925	0.00151	0.26633	0.00865	0.03877	0.00052	167	72	240	7	245	3
22	58.3	476.6	1206.1	0.40	0.05148	0.00149	0.28190	0.00829	0.03937	0.00058	261	67	252	7	249	4

								BY08								
1	35.1	243.8	720.8	0.34	0.04491	0.00116	0.24929	0.00590	0.03929	0.00042	No data		226	5	248	3
2	35.0	272.8	704.3	0.39	0.04690	0.00103	0.25707	0.00577	0.03971	0.00049	43	52	232	5	251	3
3	14.0	101.1	289.5	0.35	0.04470	0.00152	0.24518	0.00810	0.03984	0.00066	No data		223	7	252	4
4	19.0	154.4	383.4	0.40	0.04717	0.00154	0.25921	0.00846	0.03997	0.00062	58	143	234	7	253	4
5	19.1	119.6	391.2	0.31	0.04793	0.00236	0.26473	0.01262	0.04007	0.00073	95	115	238	10	253	5
6	25.6	186.4	522.0	0.36	0.04877	0.00149	0.26847	0.00781	0.03998	0.00048	200	70	241	6	253	3
7	23.1	182.8	465.9	0.39	0.05024	0.00142	0.27667	0.00773	0.03993	0.00048	206	97	248	6	252	3
8	24.7	207.1	521.5	0.40	0.05229	0.00164	0.28694	0.00941	0.03974	0.00058	298	68	256	7	251	4
9	26.8	238.2	546.9	0.44	0.04902	0.00131	0.26528	0.00736	0.03921	0.00054	150	63	239	6	248	3
10	30.4	241.6	624.6	0.39	0.05161	0.00126	0.28506	0.00730	0.03990	0.00055	333	56	255	6	252	3
11	35.2	282.1	732.3	0.39	0.05170	0.00140	0.28487	0.00736	0.04008	0.00046	272	61	255	6	253	3
12	10.6	74.4	222.0	0.34	0.04931	0.00189	0.27010	0.01050	0.03961	0.00065	161	86	243	8	250	4
13	22.4	164.7	511.5	0.32	0.05040	0.00189	0.26990	0.00948	0.03912	0.00058	213	87	243	8	247	4
14	45.1	506.5	931.1	0.54	0.04957	0.00106	0.27159	0.00690	0.03969	0.00061	176	55	244	6	251	4

Sample No.	Contents (ppm)			Th/U	Isotopic ratio						Age (Ma)					
	Pb	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
								Diorite								
								BY10								
1	53.1	502.3	1086.0	0.46	0.04878	0.00143	0.26268	0.00730	0.03893	0.00048	200	64	237	6	246	3
2	25.0	272.5	491.9	0.55	0.04833	0.00158	0.26742	0.00863	0.03999	0.00058	122	78	241	7	253	4
3	19.7	135.0	396.1	0.34	0.04895	0.00157	0.26872	0.00838	0.03991	0.00057	146	71	242	7	252	4
4	29.9	276.4	626.1	0.44	0.05016	0.00130	0.27221	0.00684	0.03923	0.00052	211	59	244	5	248	3
5	19.3	117.3	383.8	0.31	0.05980	0.00294	0.33701	0.02224	0.03968	0.00118	598	106	295	17	251	7
6	26.8	166.0	563.5	0.29	0.04775	0.00185	0.26396	0.01069	0.03987	0.00065	87	89	238	9	252	4
7	38.9	424.9	772.5	0.55	0.05211	0.00118	0.28352	0.00641	0.03924	0.00040	300	52	253	5	248	3
8	43.5	312.3	903.8	0.35	0.05209	0.00115	0.28722	0.00580	0.03984	0.00039	300	50	256	5	252	2
9	28.9	185.6	563.8	0.33	0.06074	0.00566	0.32935	0.01412	0.03911	0.00068	632	202	289	11	247	4
10	22.4	206.1	456.3	0.45	0.05025	0.00128	0.27281	0.00682	0.03917	0.00043	206	59	245	5	248	3
11	33.4	225.7	681.0	0.33	0.05049	0.00118	0.28078	0.00740	0.04004	0.00060	217	86	251	6	253	4
12	38.7	290.9	779.0	0.37	0.05233	0.00134	0.29133	0.00720	0.04019	0.00044	298	64	260	6	254	3
13	18.0	131.1	377.3	0.35	0.04933	0.00207	0.26702	0.01079	0.03918	0.00061	165	98	240	9	248	4
14	22.8	176.0	472.5	0.37	0.05032	0.00139	0.27709	0.00819	0.03955	0.00049	209	63	248	7	250	3
15	18.5	130.1	373.9	0.35	0.05087	0.00189	0.28295	0.01091	0.04007	0.00075	235	87	253	9	253	5
16	30.6	231.3	617.9	0.37	0.05742	0.00312	0.31353	0.01784	0.03923	0.00094	509	125	277	14	248	6
17	36.1	242.0	753.5	0.32	0.05101	0.00140	0.27528	0.00725	0.03893	0.00053	243	63	247	6	246	3

18	65.2	912.0	1243.8	0.73	0.05158	0.00162	0.27793	0.00832	0.03871	0.00055	333	75	249	7	245	3
19	30.4	206.3	633.5	0.33	0.05312	0.00179	0.28634	0.00915	0.03908	0.00068	345	76	256	7	247	4
20	39.5	331.1	801.7	0.41	0.05017	0.00127	0.27088	0.00662	0.03920	0.00058	211	59	243	5	248	4
21	44.4	344.5	924.9	0.37	0.04978	0.00108	0.26887	0.00567	0.03898	0.00041	183	52	242	5	247	3
22	61.4	517.0	1149.4	0.45	0.06309	0.00148	0.35236	0.00899	0.04024	0.00063	711	50	306	7	254	4
23	15.4	136.2	315.3	0.43	0.05144	0.00150	0.28024	0.00790	0.03948	0.00054	261	67	251	6	250	3