

表 1 咸水湖组火山岩锆石 U-Pb 同位素分析测试结果

Table 1 Analysis results of SHRIMP zircon U-Pb dating isotopic for the volcanic rocks from xianshuihu group

测试点	元素含量				同位素比值						年龄					
	U (ppm)	Th (ppm)	<sup>232</sup> Th / <sup>238</sup> U	<sup>206</sup> Pb (ppm)	<sup>238</sup> U / <sup>206</sup> Pb	±%	<sup>207</sup> Pb / <sup>206</sup> Pb	±%	<sup>208</sup> Pb / <sup>232</sup> Th	±%	<sup>238</sup> U / <sup>206</sup> Pb	"1σ err"	<sup>207</sup> Pb / <sup>206</sup> Pb	"1σ err"	<sup>208</sup> Pb / <sup>232</sup> Th	"1σ err"
PM14B44-1.1	544	205	0.39	32.3	14.47	1.3	0.05619	1.3	0.0211	1.8	430.4	5.4	438	35	417	9
PM14B44-2.1	429	233	0.56	27.6	13.33	1.3	0.05804	1.4	0.023	1.8	465.5	5.9	483	46	452	10
PM14B44-3.1	242	174	0.74	15.6	13.34	1.4	0.0575	1.8	0.0231	2	465.7	6.2	500	40	461	9
PM14B44-4.1	358	180	0.52	22.9	13.42	1.4	0.05639	1.5	0.0234	1.9	461.9	6.1	377	50	452	11
PM14B44-5.1	256	119	0.48	16	13.76	1.4	0.0576	1.7	0.0225	2.1	451.6	6	476	43	443	10
PM14B44-6.1	415	229	0.57	25.6	13.93	1.3	0.05541	1.5	0.022	1.8	446.3	5.7	384	37	432	8
PM14B44-7.1	246	111	0.47	15.9	13.33	1.4	0.0581	2.3	0.0227	2.2	464.9	6.2	437	71	433	13
PM14B44-8.1	326	169	0.54	21	13.32	1.3	0.05683	1.6	0.0234	1.9	465.7	6.1	411	49	455	10
PM14B44-9.1	266	183	0.71	17.3	13.26	1.4	0.0544	1.7	0.0231	2	468	6.4	342	42	455	9
PM14B44-10.1	212	122	0.6	13.8	13.22	1.5	0.0579	1.9	0.0235	2.2	469.7	6.7	495	51	465	11
PM14B44-11.1	393	30	0.08	21.6	15.64	1.3	0.05656	1.5	0.0227	3.4	398.2	5.1	362	55	339	44
PM14B44-12.1	176	91	0.54	22	6.874	1.4	0.06982	1.4	0.0446	2.1	875.2	11.5	913	29	877	19
PM14B44-13.1	281	116	0.43	18.7	12.87	1.4	0.05724	1.7	0.0245	2.1	481.3	6.3	431	50	472	12
PM14B44-14.1	445	244	0.57	26.9	14.2	2	0.06023	1.3	0.023	2.3	436.4	8.5	445	59	431	13
PM14B44-15.1	153	80	0.54	9.75	13.46	1.6	0.0596	2.2	0.0232	2.5	459.7	7.1	417	98	433	18
PM14B44-16.1	132	69	0.54	8.46	13.41	1.5	0.0601	2.4	0.0237	2.6	460.3	7	381	117	433	21
PM14B44-17.1	498	399	0.83	29.5	14.49	1.3	0.05567	1.3	0.0216	2	429.9	5.5	417	33	429	7
PM14B44-18.1	271	180	0.69	17.4	13.39	1.4	0.0617	1.6	0.0242	1.9	461.6	6.2	483	79	456	13
PM14B44-19.1	151	68	0.47	9.51	13.66	1.5	0.0593	2.3	0.0235	2.6	454.3	6.6	489	63	450	14
PM14B44-20.1	558	448	0.83	35.3	13.59	1.3	0.05717	1.2	0.0233	1.5	457	5.7	442	35	459	7
PM14B44-21.1	189	77	0.42	12.1	13.45	1.4	0.0585	2	0.0245	3.8	460.7	6.5	444	108	464	28
PM14B44-22.1	161	60	0.39	10.3	13.38	1.5	0.0596	2.2	0.0243	2.6	462.2	6.7	419	115	441	28

表 2 内蒙古额济纳地区咸水湖组火山岩主、微量元素测试结果

Table 2 Analysis results of major elements(%) and trace elements(ppm) for the volcanic rocks from xianshuihu group

样品编号	呼仍巴斯克咸水湖组										
	PM14b4	PM14b5	PM14b28	PM14b42	PM14b44	PM14b45	PM14b9	PM14b19	PM14b22	PM14b24	PM14b25
样品名称	玄武 安山岩	流纹岩	玄武 安山岩	安山岩	流纹岩	玄武岩	安山岩	玄武 安山岩	玄武 安山岩	玄武 安山岩	玄武岩
SiO <sub>2</sub> (%)	55.98	70.3	52.07	58.05	70.93	48.85	57.833	52.211	53.166	54.313	49.203
TiO <sub>2</sub> (%)	1.09	0.49	1.31	1.27	0.59	1.06	0.889	1.031	0.982	0.857	0.97
Al <sub>2</sub> O <sub>3</sub> (%)	15.8	14.37	18.01	16.16	14.19	17.48	16.712	19.31	14.756	16.377	17.85
TFeO(%)	7.85	3.69	8.22	7.44	3	9.14	7.137	8.18	9.285	6.896	10.054
MnO(%)	0.12	0.08	0.21	0.17	0.04	0.18	0.141	0.118	0.14	0.139	0.177
MgO(%)	3.49	0.42	4.29	1.62	0.34	5.53	3.976	2.638	2.363	4.263	5.139
CaO(%)	5.89	0.44	6.12	4.22	0.79	8.99	3.559	7.716	8.365	4.446	9.815
Na <sub>2</sub> O(%)	2.85	4.77	2.99	3.78	5.49	3.27	4.967	3.271	5.771	6.859	2.167
K <sub>2</sub> O(%)	2.68	3.83	2.28	2.68	3.41	1.24	1.176	1.78	0.111	0.547	0.627
P <sub>2</sub> O <sub>5</sub> (%)	0.28	0.07	0.43	0.45	0.11	0.23	0.227	0.265	0.176	0.184	0.165
Rb(ppm)	56.35	135.60	43.29	79.58	63.87	29.80	48.69	45.83	1.87	11.19	14.35
Sr(ppm)	269.50	145.50	455.70	439.70	186.10	573.20	354.04	616.09	474.11	270.15	457.30
Ba(ppm)	543.10	655.40	707.20	775.40	1036.00	650.80	366.07	451.24	131.37	154.04	199.00
Th(ppm)	8.52	22.15	6.07	5.98	14.33	3.62	11.91	3.96	1.91	11.76	1.55
U(ppm)	3.10	5.37	2.11	2.12	5.19	1.01	4.20	1.48	1.23	4.06	1.09
Nb(ppm)	7.44	16.75	9.99	8.50	13.90	4.97	8.80	4.81	3.56	8.69	2.55
Ta(ppm)	0.68	1.22	0.85	0.68	0.93	0.55	0.59	0.36	0.25	0.55	0.17
Zr(ppm)	235.90	563.80	191.30	199.80	411.60	89.89	254.46	111.53	77.03	244.58	62.59
Hf(ppm)	5.60	12.90	4.30	4.70	9.90	2.50	6.64	2.99	2.14	6.31	1.77
Co(ppm)	30.62	19.03	34.57	23.52	18.76	44.32	94.93	176.61	144.50	29.13	93.24
Ni(ppm)	25.77	3.69	16.69	1.93	3.33	34.17	40.43	9.43	18.72	34.43	36.46
Cr(ppm)	60.01	2.99	25.66	3.12	4.37	92.13	87.39	6.36	61.43	80.22	61.03
V(ppm)	172.00	15.63	213.20	137.30	19.17	267.80	134.24	178.97	215.52	182.83	262.16
Cs(ppm)	2.55	4.35	3.08	5.88	1.83	2.65	3.32	2.33	0.25	0.66	1.07
Ga(ppm)	18.86	17.24	23.82	22.55	13.33	22.09	15.59	20.48	17.15	16.04	18.27
Cu(ppm)	15.40	4.74	26.99	6.86	3.51	9.29	6.58	43.49	37.74	13.03	1000.77
Pb(ppm)	19.84	21.88	10.84	16.03	13.51	5.88	14.26	13.78	12.92	7.02	7.94
Zn(ppm)	76.71	57.09	120.20	100.30	37.18	88.80	99.15	81.08	46.80	116.14	74.38
Sn(ppm)	2.20	1.82	1.51	1.84	1.71	1.07	1.93	0.94	0.81	1.95	0.67
La(ppm)	21.01	22.84	27.08	26.33	34.01	18.60	20.16	19.34	12.70	19.15	9.63
Ce(ppm)	46.75	70.08	58.65	59.57	76.55	40.68	45.64	42.93	27.28	46.09	22.14
Pr(ppm)	6.45	6.42	7.79	8.24	10.18	5.75	5.53	5.35	3.48	5.60	2.99
Nd(ppm)	26.47	23.73	30.75	33.91	38.25	24.51	23.50	23.06	15.22	22.75	13.56

接上表:

Sm(ppm)	6.29	5.94	6.54	7.60	7.90	5.57	5.45	5.06	3.56	5.10	3.26
Eu(ppm)	1.40	1.03	1.67	1.98	1.35	1.64	1.00	1.41	1.41	1.05	1.05
Gd(ppm)	6.33	6.50	6.09	7.20	7.42	5.09	5.23	4.46	3.68	4.88	3.38
Tb(ppm)	0.99	1.16	0.89	1.08	1.18	0.76	0.82	0.66	0.56	0.82	0.54
Dy(ppm)	5.96	7.71	5.08	6.17	7.22	4.40	5.01	3.90	3.39	5.27	3.38
Ho(ppm)	1.14	1.61	0.96	1.16	1.45	0.83	0.99	0.74	0.65	1.03	0.65
Er(ppm)	3.22	4.95	2.64	3.27	4.35	2.27	2.88	2.09	1.84	3.09	1.80
Tm(ppm)	0.46	0.81	0.39	0.49	0.70	0.34	0.45	0.30	0.27	0.47	0.28
Yb(ppm)	2.91	5.35	2.46	3.17	4.65	2.15	2.98	1.97	1.60	3.10	1.78
Lu(ppm)	0.43	0.79	0.35	0.45	0.70	0.30	0.47	0.29	0.24	0.48	0.26
Y(ppm)	30.43	44.46	25.34	29.88	39.60	21.30	28.93	21.10	18.64	29.57	18.11

样品编号	呼仍巴斯克咸水湖组		依哈托里咸水湖组			
	PM14b35	PM14b47	GS-66	GS-67	GS-68	BS063b
样品名称	安山岩	玄武安山岩	变安山岩	变英安岩	变质安山玄武岩	玄武岩
SiO <sub>2</sub> (%)	59.722	51.193	53.8	63.36	49.06	48.97
TiO <sub>2</sub> (%)	1.221	1.538	0.88	0.48	0.95	1.27
Al <sub>2</sub> O <sub>3</sub> (%)	16.437	17.05	16.56	17.22	15.37	16.42
TFeO(%)	6.398	12.429	8.793	3.791	8.563	10.79
MnO(%)	0.125	0.195	0.16	0.09	0.19	0.21
MgO(%)	2.747	2.983	5.2	1.82	3.91	5.04
CaO(%)	1.826	5.427	8.42	3.48	9.36	7.75
Na <sub>2</sub> O(%)	6.823	3.94	2.76	6.44	3.49	1.78
K <sub>2</sub> O(%)	1.234	1.86	0.53	0.56	3.68	2.27
P <sub>2</sub> O <sub>5</sub> (%)	0.491	0.337	0.33	0.12	0.22	0.26
Rb(ppm)	30.49	54.70	12.5	63.5	14.2	41.2
Sr(ppm)	242.39	469.13	218	439	556	666
Ba(ppm)	346.51	457.87	155	593	292	463
Th(ppm)	9.39	5.08	2	2.4	1.2	0.47
U(ppm)	3.53	2.17	1.5	1.7	1.7	0.47
Nb(ppm)	10.92	7.53	2.76	2.36	2.14	2.16
Ta(ppm)	0.70	0.52	0.5	0.5	0.5	0.2
Zr(ppm)	277.57	168.72	120	77.2	81.7	76.4
Hf(ppm)	7.20	4.62	2.3	3.3	2.1	1.99
Co(ppm)	19.54	166.92	21	6.5	15	
Ni(ppm)	0.52	17.75	44.5	4.62	7.78	
Cr(ppm)	1.25	19.15	157	28.4	36.6	
V(ppm)	47.56	277.75	90.4	197	238	

接上表:

Cs(ppm)	1.78	3.38	1.3	2.5	2		
Ga(ppm)	16.69	19.11					
Cu(ppm)	4.58	5.10					
Pb(ppm)	21.67	11.99					
Zn(ppm)	220.74	119.72					
Sn(ppm)	2.32	1.80	0.9	3.8	1.9		
La(ppm)	39.15	22.59	9.52	6.66	5	7.79	
Ce(ppm)	93.66	49.61	15.6	11.6	11.3	18.9	
Pr(ppm)	10.56	6.35	2.24	1.1	1.62	2.97	
Nd(ppm)	43.20	27.16	10.7	5.78	8.74	14.4	
Sm(ppm)	9.21	6.46	2.61	1.38	2.22	3.98	
Eu(ppm)	2.18	1.57	0.92	0.58	0.83	1.25	
Gd(ppm)	8.39	6.17	2.57	1.35	2.46	4.13	
Tb(ppm)	1.26	0.99	0.46	0.26	0.43	0.63	
Dy(ppm)	7.61	6.34	2.73	1.56	2.67	4.3	
Ho(ppm)	1.46	1.26	0.54	0.38	0.54	0.92	
Er(ppm)	4.05	3.53	1.61	1.19	1.46	2.44	
Tm(ppm)	0.60	0.55	0.25	0.18	0.22	0.36	
Yb(ppm)	3.88	3.53	1.61	1.32	1.39	2.37	
Lu(ppm)	0.60	0.53	0.29	0.2	0.19	0.36	
Y(ppm)	39.25	34.01	14.1	8.1	12	24.2	

样品编号	呼仍巴斯克白云山组					希热哈达白云山组			
	PM13 b69	PM13 b70	PM13 b71	PM13 b73	PM13 b79	11BS007b	11BS008b	11BS009b	11BS010b
样品名称	凝灰岩	凝灰岩	凝灰岩	凝灰岩	凝灰岩	玄武岩	玄武岩	玄武岩	玄武岩
SiO <sub>2</sub> (%)	70.49	78.50	80.69	77.23	75.30	48.93	48.50	47.85	52.30
TiO <sub>2</sub> (%)	0.43	0.25	0.17	0.20	0.29	0.79	0.90	0.92	1.33
Al <sub>2</sub> O <sub>3</sub> (%)	14.04	10.26	10.10	10.90	12.46	16.10	15.62	15.76	17.04
TFeO(%)	3.52	2.34	1.93	2.10	2.71	8.70	9.06	9.14	8.50
MnO(%)	0.06	0.04	0.03	0.04	0.04	0.15	0.17	0.16	0.15
MgO(%)	1.64	1.19	0.88	0.90	1.25	9.49	9.14	8.79	4.21
CaO(%)	0.96	0.85	0.18	1.21	0.35	8.52	8.42	8.99	7.71
Na <sub>2</sub> O(%)	3.34	3.38	3.28	3.58	3.35	2.35	2.53	2.25	3.87
K <sub>2</sub> O(%)	2.15	1.00	0.97	0.98	1.62	0.44	0.39	0.64	0.77
P <sub>2</sub> O <sub>5</sub> (%)	0.12	0.04	0.03	0.04	0.07	0.12	0.12	0.12	0.29
Rb(ppm)	85.09	29.20	38.43	37.64	62.38	21.50	16.30	31.00	28.40
Sr(ppm)	250.27	398.68	231.13	201.47	235.24	258.00	261.00	291.00	402.00
Ba(ppm)	333.24	227.88	182.96	136.15	220.70	117.00	145.00	153.00	247.00
Th(ppm)	16.94	16.64	18.47	13.07	16.74	1.01	0.82	0.70	1.90

接上表:

U(ppm)	5.35	5.15	5.44	4.08	4.09	0.41	0.46	0.39	0.98
Nb(ppm)	11.45	9.44	10.62	8.65	8.36	1.61	1.48	1.25	3.47
Ta(ppm)	0.87	0.85	0.85	0.67	0.79	0.20	0.16	0.19	0.28
Zr(ppm)	247.45	141.88	120.97	147.29	162.08	72.50	71.10	64.60	146.00
Hf(ppm)	5.75	3.48	3.48	3.65	4.30	1.49	1.73	1.39	3.50
Sc(ppm)	9.04	5.87	4.17	5.39	6.37				
La(ppm)	41.40	22.45	23.56	34.61	28.40	6.13	5.46	5.05	11.60
Ce(ppm)	71.98	46.03	47.25	64.35	51.00	14.00	13.00	12.30	27.60
Pr(ppm)	10.31	5.58	5.84	7.89	6.39	2.02	1.96	1.85	4.01
Nd(ppm)	38.86	21.20	22.35	29.63	22.90	9.44	9.62	8.92	18.80
Sm(ppm)	8.08	4.53	5.12	5.97	4.48	2.59	2.63	2.60	4.55
Eu(ppm)	0.93	0.43	0.38	0.47	0.53	0.88	0.90	0.83	1.46
Gd(ppm)	7.09	3.96	4.28	5.26	3.72	3.02	3.14	2.98	4.99
Tb(ppm)	1.19	0.68	0.74	0.87	0.64	0.46	0.46	0.43	0.77
Dy(ppm)	7.29	4.44	4.68	5.27	3.94	3.31	3.59	3.73	5.46
Ho(ppm)	1.47	0.99	0.99	1.08	0.81	0.70	0.68	0.69	1.11
Er(ppm)	4.14	2.91	2.96	3.16	2.41	1.80	1.94	1.85	2.95
Tm(ppm)	0.64	0.48	0.49	0.47	0.39	0.29	0.35	0.35	0.54
Yb(ppm)	4.21	3.23	3.36	3.18	2.66	1.90	1.97	1.87	3.38
Lu(ppm)	0.62	0.49	0.50	0.47	0.39	0.32	0.35	0.32	0.51
Y(ppm)	38.13	25.86	25.52	29.51	22.85	19.20	21.00	20.30	31.80

呼仍巴斯克地区数据根据本文, 依哈托里及希热哈达地区数据根据《1:250000 红宝石幅区域地质调查报告》, 其中 BS063b 样品根据王国强等 (2014)

