

附表 1 海苏沟岩体黑云母花岗岩 LA-ICP-MS 锆石 U-Pb 同位素测试结果

Appendix table 1 Zircon U-Pb isotope determination results of biotite granite of the Haisugou intrusive mass

测点号	$^{238}\text{U}$ ( $10^{-6}$ )	$^{232}\text{Th}$ ( $10^{-6}$ )	$^{232}\text{Th}/^{238}\text{U}$	同位素比值						年龄 (Ma)					
				$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$	
					$1\sigma$		$1\sigma$		$1\sigma$		$1\sigma$		$1\sigma$		$1\sigma$
HSGC-3-01	653.90	500.82	0.77	0.062 26	0.001 38	0.163 72	0.003 22	0.019 07	0.000 13	683.1	46.5	154.0	2.8	121.8	0.8
HSGC-3-02	544.45	228.85	0.42	0.048 91	0.001 07	0.145 27	0.002 83	0.021 54	0.000 14	143.7	50.4	137.7	2.5	137.4	0.9
HSGC-3-03	807.41	418.74	0.52	0.051 70	0.001 26	0.160 28	0.003 56	0.022 48	0.000 15	272.3	55.0	151.0	3.1	143.3	0.9
HSGC-3-04	445.63	151.91	0.34	0.050 88	0.002 19	0.156 88	0.006 45	0.022 36	0.000 23	235.6	96.2	148.0	5.7	143.0	1.0
HSGC-3-05	900.49	347.57	0.39	0.049 27	0.001 71	0.140 66	0.004 61	0.020 70	0.000 18	160.8	79.1	133.6	4.1	132.0	1.0
HSGC-3-06	556.83	251.66	0.45	0.048 85	0.001 89	0.145 14	0.005 34	0.021 55	0.000 20	140.8	88.3	137.6	4.7	137.0	1.0
HSGC-3-07	475.81	185.37	0.39	0.050 55	0.001 96	0.157 61	0.005 82	0.022 62	0.000 22	220.2	87.4	148.6	5.1	144.0	1.0
HSGC-3-08	527.15	176.20	0.33	0.049 30	0.001 09	0.146 12	0.002 88	0.021 50	0.000 14	162.3	50.7	138.5	2.6	137.1	0.9
HSGC-3-09	465.44	179.97	0.39	0.049 65	0.001 13	0.147 04	0.003 02	0.021 48	0.000 14	178.6	52.2	139.3	2.7	137.0	0.9
HSGC-3-10	392.73	151.10	0.38	0.049 80	0.002 43	0.153 79	0.007 35	0.022 40	0.000 23	419.7	86.2	160.8	5.6	143.0	1.0
HSGC-3-11	959.99	452.68	0.47	0.054 91	0.001 12	0.171 25	0.003 07	0.022 62	0.000 14	408.5	44.8	160.5	2.7	144.2	0.9
HSGC-3-12	522.96	211.39	0.40	0.050 19	0.001 44	0.148 90	0.003 97	0.021 52	0.000 16	203.6	65.3	140.9	3.5	137.0	1.0
HSGC-3-13	316.44	89.48	0.28	0.056 11	0.005 00	0.177 05	0.015 38	0.022 89	0.000 45	456.6	186.9	165.5	13.3	146.0	3.0
HSGC-3-14	107.71	38.86	0.36	0.048 61	0.002 43	0.144 66	0.007 00	0.021 59	0.000 23	129.0	113.7	137.2	6.2	138.0	1.0
HSGC-3-15	808.36	330.02	0.41	0.048 29	0.001 36	0.143 53	0.003 77	0.021 56	0.000 16	113.3	65.4	136.2	3.4	138.0	1.0
HSGC-3-16	701.68	298.25	0.43	0.049 49	0.001 67	0.145 70	0.004 65	0.021 36	0.000 18	171.2	77.1	138.1	4.1	136.0	1.0
HSGC-3-17	732.64	263.15	0.36	0.048 77	0.001 43	0.144 11	0.003 94	0.021 44	0.000 16	136.7	67.5	136.7	3.5	137.0	1.0
HSGC-3-18	1026.3	617.14	0.60	0.050 98	0.002 00	0.158 56	0.005 92	0.022 57	0.000 22	239.7	87.9	149.4	5.2	144.0	1.0
HSGC-3-19	1182.2	911.69	0.77	0.050 52	0.001 80	0.149 80	0.005 06	0.021 51	0.000 19	218.8	80.6	141.7	4.5	137.0	1.0
HSGC-3-20	762.62	402.71	0.53	0.049 99	0.002 85	0.155 05	0.008 55	0.022 50	0.000 30	194.7	127.5	146.4	7.5	143.0	2.0
HSGC-3-21	1 551.00	740.09	0.48	0.048 10	0.001 24	0.092 46	0.002 31	0.013 94	0.000 08	829.9	32.4	125.3	1.5	89.3	0.5
HSGC-3-22	648.33	283.53	0.44	0.050 10	0.001 35	0.148 32	0.003 70	0.021 47	0.000 15	199.8	61.6	140.4	3.3	136.9	0.9
HSGC-3-23	981.58	510.48	0.52	0.049 68	0.001 16	0.146 75	0.003 11	0.021 43	0.000 14	179.9	53.7	139.0	2.8	136.7	0.9
HSGC-3-24	813.08	384.47	0.47	0.049 83	0.001 70	0.147 50	0.004 75	0.021 48	0.000 18	186.9	77.4	139.7	4.2	137.0	1.0
HSGC-3-25	548.98	235.80	0.43	0.046 53	0.002 38	0.138 21	0.006 82	0.021 55	0.000 24	25.2	118.3	131.4	6.1	137.0	2.0

附表 2 海苏沟岩体二长花岗岩 LA-ICP-MS 锆石 U-Pb 同位素测试结果

Appendix table 2 Zircon U-Pb isotope determination results of monzonitic granite of the Haisugou intrusive mass

测点号	$^{238}\text{U}$ ( $10^{-6}$ )	$^{232}\text{Th}$ ( $10^{-6}$ )	$^{232}\text{Th}/^{238}\text{U}$	同位素比值						年龄 (Ma)					
				$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$	
					1 $\sigma$		1 $\sigma$		1 $\sigma$		1 $\sigma$		1 $\sigma$		1 $\sigma$
XJC-9-01	817.57	377.02	0.46	0.051 27	0.001 18	0.139 89	0.002 10	0.019 78	0.000 22	253.0	52.2	132.9	1.9	126.3	1.4
XJC-9-02	546.35	204.74	0.37	0.053 47	0.001 27	0.145 90	0.002 33	0.019 78	0.000 22	348.5	52.9	138.3	2.1	126.3	1.4
XJC-9-03	74.33	46.77	0.63	0.050 89	0.002 60	0.139 82	0.006 62	0.019 92	0.000 28	235.9	113.7	132.9	5.9	127.1	1.8
XJC-9-04	870.72	372.77	0.43	0.051 92	0.001 19	0.142 61	0.002 13	0.019 92	0.000 22	281.7	51.6	135.4	1.9	127.1	1.4
XJC-9-05	598.64	260.89	0.44	0.050 51	0.001 19	0.135 61	0.002 14	0.019 46	0.000 22	218.6	53.5	129.1	1.9	124.3	1.4
XJC-9-06	713.67	253.99	0.36	0.049 22	0.001 18	0.135 71	0.002 23	0.019 99	0.000 23	158.2	55.0	129.2	2.0	127.6	1.4
XJC-9-07	753.15	320.96	0.43	0.050 85	0.001 18	0.140 59	0.002 17	0.020 05	0.000 22	233.8	52.6	133.6	1.9	128.0	1.4
XJC-9-08	394.48	126.59	0.32	0.049 61	0.001 56	0.153 43	0.004 55	0.022 44	0.000 19	176.9	71.7	144.9	4.0	143.1	1.2
XJC-9-09	958.44	317.19	0.33	0.049 92	0.001 11	0.133 17	0.001 87	0.019 34	0.000 21	191.4	50.8	126.9	1.7	123.5	1.4
XJC-9-10	515.42	221.09	0.43	0.051 99	0.016 10	0.160 14	0.048 66	0.022 35	0.001 45	285.0	586.4	150.8	42.6	142.5	9.2
XJC-9-11	1 065.91	713.03	0.67	0.049 90	0.005 11	0.151 27	0.015 12	0.021 99	0.000 51	190.5	222.3	143.0	13.3	140.2	3.2
XJC-9-12	220.32	159.60	0.72	0.053 38	0.003 62	0.130 86	0.008 60	0.017 78	0.000 29	344.8	145.9	124.9	7.7	113.6	1.8
XJC-9-13	736.80	379.68	0.52	0.053 76	0.001 21	0.148 47	0.002 20	0.020 03	0.000 22	360.7	50.2	140.6	1.9	127.8	1.4
XJC-9-14	641.58	308.98	0.48	0.049 78	0.002 46	0.135 51	0.006 47	0.019 74	0.000 24	184.8	111.3	129.0	5.8	126.0	1.5
XJC-9-15	978.24	494.57	0.51	0.048 48	0.001 07	0.133 94	0.001 87	0.020 04	0.000 22	122.7	51.0	127.6	1.7	127.9	1.4
XJC-9-16	822.76	423.43	0.51	0.051 83	0.003 32	0.142 11	0.008 82	0.019 88	0.000 31	277.7	140.3	134.9	7.8	126.9	1.9
XJC-9-17	627.53	220.40	0.35	0.049 00	0.001 11	0.135 02	0.002 02	0.019 98	0.000 22	147.8	52.1	128.6	1.8	127.5	1.4
XJC-9-18	391.99	126.74	0.32	0.049 30	0.001 51	0.148 05	0.004 28	0.021 78	0.000 18	162.2	70.3	140.2	3.8	138.9	1.2
XJC-9-19	686.09	287.85	0.42	0.053 36	0.001 19	0.147 08	0.002 15	0.019 99	0.000 22	344.0	49.6	139.3	1.9	127.6	1.4
XJC-9-20	873.01	512.09	0.59	0.047 97	0.001 04	0.132 66	0.001 84	0.020 05	0.000 22	96.5	51.8	126.5	1.7	128.0	1.4
XJC-9-21	638.37	283.96	0.44	0.052 55	0.001 22	0.142 49	0.002 30	0.019 66	0.000 22	309.5	52.0	135.3	2.0	125.5	1.4
XJC-9-22	626.17	232.93	0.37	0.050 19	0.001 14	0.138 10	0.002 13	0.019 95	0.000 22	203.8	52.0	131.4	1.9	127.3	1.4
XJC-9-23	977.79	515.40	0.53	0.048 15	0.001 27	0.129 52	0.002 63	0.019 50	0.000 23	106.8	61.3	123.7	2.4	124.5	1.4
XJC-9-24	822.28	383.93	0.47	0.047 23	0.001 06	0.127 57	0.001 91	0.019 59	0.000 22	60.2	53.0	121.9	1.7	125.0	1.4
XJC-9-25	405.43	207.01	0.51	0.050 09	0.003 31	0.119 66	0.007 66	0.017 32	0.000 28	199.4	146.5	114.8	7.0	110.7	1.8

附表3 海苏沟钼矿床辉钼矿 Re-Os 同位素数据

Appendix table 3 Molybdenite Re-Os isotope determination results of the Haisugou molybdenum ore deposit

样品名	样重 (g)	Re ( $10^{-9}$ )		$^{187}\text{Re}$ ( $10^{-9}$ )		$^{187}\text{Os}$ ( $10^{-9}$ )		模式年龄 (Ma)	
		测定值	$1\sigma$	测定值	$1\sigma$	测定值	$1\sigma$	测定值	$1\sigma$
XJZ01	0.005 18	2124	25	1335	16	3.205	0.041	143.9	2.9

附表4 海苏沟岩体花岗岩类样品主量(%)、微量和稀土元素( $10^{-6}$ )组成Appendix table 4 Major(%), trace ( $10^{-6}$ ) and REE ( $10^{-6}$ ) compositions of the granitic rocks sample of the Haisugou intrusive mass

样品号	XJC-9	XJC-10	XJC-11	HSGC-1	HSGC-3	HSGC-4	XJZC-1	XJZC-3	XJZC-4
SiO <sub>2</sub>	76.87	77.18	77.37	70.82	70.66	68.81	58.53	69.99	66.97
TiO <sub>2</sub>	0.11	0.12	0.12	0.43	0.38	0.55	1.05	0.36	0.48
Al <sub>2</sub> O <sub>3</sub>	12.08	12.25	12.22	13.99	14.61	15.17	16.27	14.15	15.40
Fe <sub>2</sub> O <sub>3</sub> <sup>T</sup>	0.89	0.88	0.89	2.97	2.95	3.15	7.47	2.91	3.43
MnO	0.02	0.02	0.02	0.05	0.03	0.03	0.12	0.05	0.07
MgO	0.15	0.20	0.25	1.11	0.84	1.32	2.35	0.56	1.07
CaO	0.57	0.58	0.43	2.52	2.14	2.88	4.64	1.53	2.64
Na <sub>2</sub> O	3.48	3.39	3.49	3.65	3.54	3.88	3.44	3.65	4.42
K <sub>2</sub> O	4.83	4.77	4.68	3.55	3.65	2.92	2.55	4.63	3.43
P <sub>2</sub> O <sub>5</sub>	0.03	0.02	0.03	0.12	0.11	0.15	0.32	0.11	0.13
LOI	0.42	0.53	0.46	0.74	1.05	0.61	2.70	1.51	1.35
Total	99.45	99.94	99.95	99.95	99.96	99.47	99.44	99.45	99.39
Na <sub>2</sub> O+K <sub>2</sub> O	8.31	8.16	8.17	7.20	7.19	6.80	5.99	8.28	7.85
A/CNK	1.01	1.04	1.05	0.97	1.07	1.03	0.97	1.03	0.98
A/NK	1.10	1.14	1.13	1.42	1.49	1.59	1.93	1.28	1.40
Cu	2.13	3.22	3.37	9.17	22.6	36.9	15.3	16.5	8.69
Pb	35.2	27.2	28.5	34.2	26.6	24.3	29.2	79.8	44.1
Zn	28.5	23.5	29.2	66.7	39.9	39.4	120	88.4	89.1
W	2.53	1.65	2.25	0.90	17.6	4.00	2.37	1.40	2.38
Mo	6.42	5.57	6.02	33.9	70.2	41.4	30.1	17.0	14.6
Cd	0.12	0.12	0.13	0.33	0.18	0.15	0.34	0.29	0.24
Ga	14.7	14.1	14.4	18.3	20.1	19.4	22.2	23.8	22.3
Co	0.95	0.90	0.73	6.14	7.70	6.98	17.4	4.72	7.06
Ni	2.25	4.78	1.38	1.98	2.39	2.73	3.15	4.57	3.17
Rb	212	204	202	147	181	155	89.2	227	141
Sr	75.4	69.0	77.1	351	389	405	611	244	510
Ba	346	282	290	500	533	490	647	573	510
Cs	14.5	10.6	9.15	10.6	11.1	17.3	10.9	9.10	5.33
In	0.01	0.01	0.01	0.04	0.02	0.02	0.06	0.06	0.13
Tl	1.00	0.93	0.99	1.03	1.60	1.35	0.77	1.08	0.87
Cr	1.66	1.37	1.43	5.59	4.43	6.35	3.93	3.75	7.04
V	8.55	9.03	9.65	54.7	53.6	62.5	126	32.1	62.9
Li	12.5	12.2	13.0	32.4	33.5	41.6	26.4	61.9	28.9
Be	3.04	2.36	2.64	3.06	2.89	3.07	2.18	4.44	2.98
Nb	8.83	6.37	7.59	8.85	7.47	8.69	9.63	14.5	8.33
Ta	1.51	1.00	1.64	1.22	1.04	1.32	0.96	1.78	1.12
Zr	80.1	85.1	70.1	49.0	47.0	48.9	36.2	89.5	36.3

Hf	3.70	3.76	2.90	2.23	1.98	2.17	2.09	3.72	1.70
Th	24.1	36.2	27.4	14.2	15.2	13.9	10.4	31.9	14.3
U	1.94	3.62	2.87	7.21	9.01	3.70	0.85	2.24	2.10
Sc	0.97	0.86	0.87	5.41	5.05	6.35	13.6	5.24	5.89
Sb	0.69	0.43	0.31	0.33	0.66	0.30	0.70	0.24	1.24
Se	0.18	0.12	0.16	2.35	5.63	0.95	0.44	0.69	0.81
Re	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
La	29.6	23.0	33.5	27.9	25.2	28.9	30.0	28.2	20.2
Ce	49.9	43.8	50.0	53.0	48.6	54.4	59.7	92.4	39.7
Pr	5.51	4.75	6.19	6.13	5.30	6.33	7.41	6.30	4.77
Nd	19.1	15.3	21.9	23.1	19.8	24.3	30.4	23.5	19.2
Sm	3.18	2.47	3.62	4.41	3.88	4.18	5.83	4.78	3.79
Eu	0.39	0.35	0.41	0.85	0.84	0.84	1.49	0.77	0.95
Gd	2.80	2.01	3.14	3.87	3.51	3.67	5.03	4.27	3.33
Tb	0.48	0.35	0.53	0.71	0.62	0.60	0.89	0.79	0.63
Dy	2.75	1.89	2.73	3.75	3.39	3.06	4.70	4.26	3.34
Ho	0.56	0.37	0.55	0.75	0.65	0.60	0.93	0.79	0.68
Er	1.68	1.17	1.66	2.09	1.81	1.65	2.53	2.15	1.90
Tm	0.35	0.24	0.33	0.38	0.33	0.28	0.44	0.40	0.35
Yb	2.38	1.72	2.25	2.52	2.08	1.93	2.57	2.40	2.34
Lu	0.35	0.25	0.33	0.34	0.30	0.27	0.33	0.33	0.32
Y	16.3	10.7	16.0	21.8	19.0	17.4	25.5	23.9	21.0
∑REE	119.03	97.66	127.13	129.80	116.32	131.00	152.24	171.33	101.49
LREE/HREE	9.49	11.23	10.04	8.01	8.16	9.87	7.74	10.14	6.88
δEu	0.40	0.48	0.37	0.63	0.69	0.66	0.84	0.52	0.81
(La/Yb) <sub>N</sub>	8.92	9.59	10.68	7.94	8.69	10.74	8.37	8.43	6.19
FeO <sup>T</sup> /MgO	5.31	4.08	3.20	2.41	3.17	2.15	2.86	4.66	2.88
10 000Ga/Al	2.30	2.18	2.23	2.47	2.60	2.42	2.58	3.18	2.74
Zr+Nb+Ce+Y	155.13	145.97	143.69	132.65	122.07	129.39	131.03	220.30	105.33

注：LOI.烧失量； A/CNK=molar Al<sub>2</sub>O<sub>3</sub>/(CaO+Na<sub>2</sub>O+K<sub>2</sub>O)。