

Appendix 3 List of the Deep Drilling Equipment

Article	Model	Specification
Drilling machine	ZIF-650M	Capacity: diameter 76mm. 800m(diamond crown bit) and 500m(hard alloy) Rotation speed: 87;118;188;254;340; 460;576;800rpm
Drill pipes	TBDS	Length: 4,000mm Core diameter 76mm
Power unit	A2-72-4	Electric motor Revolution: 1,450rpm Related power:30kw
Hoist		Capacity: 4.4T
Mud pump	NB4-320/63	
Transportation	Automobile ZIL-131	
Water tank		Capacity:9m ³

Appendix 4 Amount of Consumed Materials of the Drilling Survey

Article	unit	Quantity
Diamond Bit(Longyear)75.4mm	Pcs	37
Cemented carbide bit 93mm	Pcs	9
Cemented carbide bit 112m	Pcs	6
Core box	Pcs	380
Bentonite	kg	720
Diesel	L	249,200
Gasoline	L	5,180

Appendix 5 List of Thin Section

Serial No.	Sample No.	Rock Name/Description	Minerals																									
			Primary						Secondary and Alteration																			
			Qz	Kf	Pt	Bt	Am	Px	Sph	Ap	M	Qz	Bt	Se	Tou	Ep	Ch	Ac	Ca	Px	Py	others						
1	MJTA-3-32.5	diorite porphyry	⊙	○	⊙	△						△	△	⊙														
2	MJTA-3-42	Bt granite	⊙	⊙	⊙	○																					•	cristobalite
3	MJTA-3-72.9	Ho Bt granite	⊙	⊙	⊙	⊙																						
4	MJTA-3-158.9	Bt adamellite	⊙	○	⊙	○																						
5	MJTA-3-163.9	silicified adamellite	⊙	○	⊙	○																						cristobalite
6	MJTA-3-201.2	Ho Bt granite	⊙	○	⊙	○																						
7	MJTA-3-233.1	altered Bt adamellite	○	○	○	?																						
8	MJTA-4-40.9	hornfels	○	△	○																							
9	MJTA-4-42.0	hornfels	○		○																							
10	MJTA-4-63.5	hornfels	⊙																									○
11	MJTA-4-133.2	silicified rock	•		⊙	?																						⊙
12	MJTA-4-156.0	fine grained diorite	•		⊙	△																						
13	MJTA-4-187.5	fine grained diorite	•		⊙	•																						
14	MJTA-4-205.0	altered diorite	•	•	⊙	•																						cristobalite
15	MJTA-5-34.7	Bt Ho granite	○	⊙	⊙	○																						
16	MJTA-5-36.5	Bt Ho granite	○	⊙	⊙	○																						
17	MJTA-5-64.5	Ho Bt granite	○	⊙	⊙	○																						
18	MJTA-5-65.4	altered Ho Bt granite	○	○	○	○																						
19	MJTA-5-104.2	altered Bt granite	○	⊙	○	△																						
20	MJTA-5-122.0	altered Bt Ho granite	○	⊙	○	○																						
21	MJTA-5-140.5	altered Bt Ho granite	○	○	⊙	○																						
22	MJTA-6-49.2	Bt granite	○	⊙	⊙	○																						
23	MJTA-6-96.7	Bt adamellite	○	○	⊙	○																						
24	MJTA-6-151.0	Bt adamellite	○	△	⊙	○																						
25	MJTA-6-153.0	Bt adamellite	○	△	⊙	△																						

Abundance of minerals: ⊙: abundant; ○: common; △: scarce; •: rare

Abbreviations: Qz: quartz; Kf: K-feldspar; Pt: plagioclase; Bt: biotite; Am: amphibole; Px: pyroxene; Sph: sphene; Ap: apatite; M: opaque minerals; Se: sericite; Tou: tourmaline; Ep: epidote; Ch: chlorite; Ac: actinolite; Ca: carbonate minerals; Py: pyrite

Appendix 5 List of Thin Section (Cont.)

Serial No.	Sample No.	Rock Name/Description	Minerals																			
			Primary										Secondary and Alteration									
			Qz	Kf	Pl	Bi	Am	Px	Sph	Ap	M	Qz	Bt	Se	Tou	Ep	Ch	Ac	Ca	Px	Py	others
26	MJTA-6-202.3	Bt monzonite	.	⊙	⊙	?																
27	MJTA-6-229	altered Bt granite	⊙	○	○	○								△	⊙							
28	MJTA-6-249	altered Bt adamellite	⊙	○	⊙	○								△	⊙					muscovite		
29	MJTA-7-94	Bt Ho granite	⊙	⊙	○	○	⊙			.				△	⊙							
30	MJTA-7-124	altered Bt adamellite	⊙	○	⊙	?								△	○					muscovite		
31	MJTA-7-188.2	Bt Ho adamellite	⊙	○	⊙	?								○	○							
32	MJTA-7-216	altered andesite		?	?									○	⊙							
33	MJTA-8-37.5	Bt Qz porphyry	⊙	△	⊙	⊙	○							△	△							
34	MJTA-8-55.6	Bt Qz porphyry	⊙	△	⊙	○	○							△	⊙							
35	MJTA-8-70.8	Bt Qz porphyry	⊙	△	⊙	○	?							△	⊙							
36	MJTA-8-84	Bt Qz porphyry	⊙	△	⊙	⊙	△							△	⊙							
37	MJTA-8-104	Bt Qz porphyry	⊙	△	⊙	○	○							△	⊙							
38	MJTA-8-151	strongly silicified rock	△	?	?	?	?							△	⊙							
39	MJTA-8-157	strongly silicified rock	△	?	?	?	?							△	⊙					⊙		
40	MJTA-8-231	Bt Qz porphyry	⊙	?	○	○	?							○	○							
41	MJTA-8-249.4	Bt Qz porphyry	⊙	?	○	○	?							○	○					.		
42	MJTA-9-45.7	Qz porphyry	○	?	△	?	?							○	○							
43	MJTA-9-109.3	Qz porphyry	○	?	△	?	?							○	○							
44	MJTA-9-170	Qz porphyry	○	?	⊙	?	?							○	○							
45	MJTA-9-185.5	adamellite (silicified breccia)	⊙	○	⊙	?	?							△	⊙							
46	MJTA-9-190	Bt adamellite	⊙	○	○	○	?							△	⊙					△		
47	MJTA-9-195	Bt adamellite	⊙	○	⊙	?	?							△	⊙							
48	MJTA-9-224	adamellite	△	○	⊙	?	?							△	○					⊙		
49	MJTA-9-250	adamellite	⊙	○	⊙	○	?							△	○					○		
50	MJTA-9-273	adamellite	⊙	○	⊙	○	.							○	⊙					△		

Abundance of minerals: ⊙: abundant; ○: common; △: scarce; .: rare

Abbreviations: Qz: quartz; Kf: K-feldspar; Pl: plagioclase; Bi: biotite; Am: amphibole; Px: pyroxene; Sph: sphene; Ap: apatite; M: opaque minerals; Se: sericite; Tou: tourmaline; Ep: epidote; Ch: chlorite; Ac: actinolite; Ca: carbonate minerals; Py: pyrite

Appendix 6 List of Polished Section

Seri No.	Sample No.	Host rock	Mineralogy																
			Il	Mt	Po	Cb	Cp	Mo	Bn	Cv	Bs	Ak	Gn	Sp	Py	Ht	Go		
1	MJTA-3-32.5	diorite porphyrey		○		△	△										⊙		△
2	MJTA-3-41.4	diorite porphyrey		○	△												⊙		
3	MJTA-3-158.9	Bt adamellite		⊙				○									○	○	
4	MJTA-3-163.9	silicified adamellite			△			○									⊙		
5	MJTA-3-164.8	silicified adamellite		○			⊙										△	○	
6	MJTA-3-174.4	silicified adamellite		○			⊙		○								○	○	
7	MJTA-3-195.4	altered Ho Bt granite			○												⊙		△
8	MJTA-3-215.3	silicified granite		○			○										⊙		
9	MJTA-4-40.9	hornfels		⊙	○		△										⊙	△	△
10	MJTA-4-42.0	hornfels															⊙	△	△
11	MJTA-4-43.0	hornfels			△												⊙	△	△
12	MJTA-4-62.0	hornfels						○									⊙		○
13	MJTA-4-63.5	hornfels (tuff)						△									⊙		○
14	MJTA-4-133.2	silicified rock			○												⊙		○
15	MJTA-4-248.6	andestic tuff		○													⊙		○
16	MJTA-5-70.5	Bt granite						○									⊙		○
17	MJTA-5-104.2	altered Bt granite					△										⊙		○
18	MJTA-5-134.2	altered Bt granite		○				⊙									○		○
19	MJTA-5-219.6	silicified granite						○									⊙		○
20	MJTA-5-280.0	silicified granite		○				△		⊙							⊙		○
21	MJTA-6-49.2	Bt granite								○							⊙		○
22	MJTA-6-96.7	Bt adamellite			△												⊙		○
23	MJTA-6-151.0	Bt adamellite						△									⊙		○
24	MJTA-6-153.0	Bt adamellite						△									⊙		○
25	MJTA-6-202.3	Bt monzonite															⊙		○
26	MJTA-6-228.2	altered Bt granite						△									⊙		○

Abbreviation: Ak: aikinite(?); Bn: bornite; Bs: bismuthinite(?); Cb: cubanite; Cp: chalcopyrite; Cv: covellite;
 Gn: galena; Go: goethite; Ht: hematite; Il: ilmenite; Mo: molybdenite; Mt: magnetite; Po: pyrrhotite;
 Py: pyrite; Sp: sphalerite; ⊙: ≥30%; ○: 10-30%; △: 5-10%; +: <5%

Appendix 6 List of Polished Section (Cont.)

Seri No.	Sample No.	Host rock	Mineralogy																
			Il	Mt	Po	Cb	Cp	Mo	Bn	Cv	Bs	Ak	Gn	Sp	Py	Ht	Go		
27	MJTA-6-249.0	altered Bt granite					Δ										⊙		○
28	MJTA-7-124.0	altered Bt granite			Δ												⊙		○
29	MJTA-7-188.2	Bt Ho adamellite					Δ								Δ		⊙		○
30	MJTA-8-55.6	Qt porphyry			Δ												⊙		○
31	MJTA-8-84.0	Qt porphyry			Δ												⊙		Δ
32	MJTA-8-86.0	Qt porphyry			Δ					Δ							⊙		○
33	MJTA-8-102.0	Qt porphyry		Δ	○												⊙		
34	MJTA-8-104.0	Qt porphyry			Δ												⊙		○
35	MJTA-8-121.0	Qt porphyry			Δ												⊙		○
36	MJTA-8-150.4	strongly silicified rock			Δ												⊙		○
37	MJTA-8-157.0	strongly silicified rock			○												⊙		○
38	MJTA-8-240.2	Qt porphyry			○												⊙		○
39	MJTA-8-249.4	Qt porphyry															⊙		○
40	MJTA-9-45.7	Qt porphyry															⊙		○
41	MJTA-9-109.3	Qt porphyry			Δ												⊙		○
42	MJTA-9-136.0	Qt porphyry															⊙		○
43	MJTA-9-161.0	silicified breccia															⊙		○
44	MJTA-9-163.0	silicified breccia								Δ							⊙		○
45	MJTA-9-185.5	silicified breccia		Δ													⊙		○
46	MJTA-9-195.0	Bt adamellite			Δ												⊙		○
47	MJTA-9-209.0	Bt adamellite															⊙		○
48	MJTA-9-212.5	Bt adamellite			Δ												⊙		○
49	MJTA-9-224.5	intense altered rock															⊙		○
50	MJTA-9-239.0	intense altered rock															⊙		○
51	MJTA-9-277.0	Bt adamellite			Δ												⊙		○
52	MJTA-9-281.7	Bt adamellite															⊙		○

Abbreviation: Ak: aikinite(?); Bn: bornite; Bs: bismuthinite(?); Cb: cubanite; Cp: chalcopyrite; Cv: covellite; Gn: galena; Go: goethite; Ht: hematite; Il: ilmenite; Mo: molybdenite; Mt: magnetite; Po: pyrrhotite; Py: pyrite; Sp: sphalerite; ⊙: ≥30%; ○: 10-30%; Δ: 5-10%; +: <5%

Appendix 7 List of the results for X-ray Diffraction analysis

No.	Area	Sample No.	Description	Detected minerals													
				Qz	Pl	Hor	Chl	Ill / Mc	Kao	Smec	Prp	Lau	Cc	Gyp	Py		
1	Zalturbulck	MJTA-3-32.5	Py-dism diorite porphyry (1~2%) stgly silicified zone with chlorite network with patches of Kfd	◎	○		○										
2	Zalturbulck	MJTA-3-122.7	stgly chloritized zone with some sulfides	◎	○		△									○	
3	Zalturbulck	MJTA-3-163.9	gypsum veinlets (w=3m-4mm) in white~pink argillic zone ∠50°	◎	○		△										◎
4	Zalturbulck	MJTA-3-172.5	white mineral veinlet				·										◎
5	Zalturbulck	MJTA-3-204.6	weakly silicified green colored andesite with Py-dism	◎	○		△	○									
6	Zalturbulck	MJTA-4-42.0	strongly silicified~argilled zone with Py-dism veinlets	◎	·		△									·	
7	Zalturbulck	MJTA-4-63.5	white clay													◎	·
8	Zalturbulck	MJTA-4-180.3	dark gray, c.grnd andeestic rock chlorite, Kf?, Ep, Qz?	○	○		○										
9	Zalturbulck	MJTA-4-187.5	strongly chloritized rock with strong py dism with white vein (calcite?)	○	○		○										
10	Zalturbulck	MJTA-4-205.0	pink+Chl+Qz+etc	△	·		○									◎	△
11	Zalturbulck	MJTA-4-217.1	Ho-Bi or Bi-Ho granodiorite?	◎	○		△										
12	Zalturbulck	MJTA-5-34.7	pink colored alteration band	◎	○		△										
13	Zalturbulck	MJTA-5-36.5	flesh (little bit argillized) granite	◎	◎		△										
14	Zalturbulck	MJTA-5-64.5	pink colored altered granite (with Ep)	◎	○		△										
15	Zalturbulck	MJTA-5-65.4	strongly ep, chloritized rock, pink granite, with minor calcite veinlets	◎	○		△										
16	Zalturbulck	MJTA-5-122.0	weakly argilled rock with Ep-Chl network	◎	○		△										
17	Zalturbulck	MJTA-5-140.5	argillic alteration zone with slight silicification	◎	○		△										
18	Akmola	MJTA-6-20.8	stgly silicified zone with py-dism Chloritization, Epidotization	◎													
19	Akmola	MJTA-6-49.2	stgly silicified rock with pyrite dism (3%)	◎	○		△										
20	Akmola	MJTA-6-96.7		◎	○		△										△

abundant, ◎ : common, ○ : a little, △ : rare, ·
 Abbreviations: Qz: quartz; Pl: plagioclase; Hor: hornblende; Chl: chlorite; Ill/Mc: Illite/Micas mixed layer; Kao: kaolinite
 Smec: smectite; Prp: pyrophyllite; Lau: laumontite; Cc: calcite; Gyp: gypsum; Py: pyrite

Appendix 7 List of the results for X-ray Diffraction analysis (Cont.)

No.	Area	Sample No.	Description	Detected minerals													
				Qz	Pl	Hor	Chl	Ill / Mc	Kao	Smec	Prp	Lau	Cc	Gyp	Py		
21	Akmora	MJTA-6-228.2	silicified rock (green colored) with Py dism	⊙					Δ								
22	Akmora	MJTA-6-229.0	epidotitized & chloritized rock with slightly silicified	⊙	Δ			Δ									
23	Akmora	MJTA-6-249.0	epidotitized & chloritized rock with slightly silicified (with Qz+Py network)	⊙	○			Δ	Δ								•
24	Akmora	MJTA-7-104.5	strongly silicified rock (with a little Py)	⊙					○								
25	Akmora	MJTA-7-124.0	stgly argilled rock with py dism (porphyry?)	⊙	⊙			Δ	Δ								•
26	Akmora	MJTA-7-176.4	clay vein	⊙	○			Δ									•
27	Akmora	MJTA-7-188.2	argillic zone with py dism	⊙	⊙			Δ									•
28	Akmora	MJTA-7-216.0	silicified & argilled rock in fractured & sheared zone	⊙					Δ								Δ
29	Akmora	MJTA-7-237.0	white clay alteration, granitoid, argilled & chloritized (dacite) porphyry with network of Qz, clay	⊙	○			Δ									•
30	Akmora	MJTA-8-37.5	argilled & silicified rock with network	⊙	Δ			○	○	○							
31	Akmora	MJTA-8-84.0	argilled & silicified rock with network	⊙	○			Δ	○	○							
32	Akmora	MJTA-8-104.0	argilled & slightly silicified rock with network	⊙	Δ			Δ	Δ								•
33	Akmora	MJTA-8-150.4	stgly silicified & argilled rock with Py dism	⊙	Δ			Δ	Δ								•
34	Akmora	MJTA-8-231.0	silicified rock, Kfd alteration?	⊙	○			Δ									
35	Akmora	MJTA-8-249.4	silicified zone with clay, Qz network with Py dism	⊙	○			Δ	Δ								•
36	Akmora	MJTA-9-74.0	white, argilled rk with Py & black sulfide	⊙					Δ	○							
37	Akmora	MJTA-9-87.5	argilled & silicified rock with Py dism & black colored minera	⊙					Δ	•							
38	Akmora	MJTA-9-206.0	pale greenish light gray colored granite, weakly altered with Py dism	⊙	○			○	Δ								Δ
39	Akmora	MJTA-9-224.0	light gray silicified granite with Py dism with Qz-veinlets	○	⊙			•	Δ								
40	Akmora	MJTA-9-250	dark green silicified granite	⊙				Δ	Δ								

abundant, ⊙ : common, ○ : a little, Δ : rare, •

Abbreviations: Qz: quartz; Pl: plagioclase; Hor: hornblende; Chl: chlorite; Ill/Mc: Illite/Micas mixed layer; Kao: kaolinite
Smec: smectite; Prp: pyrophyllite; Lau: laumontite; Cc: calcite; Gyp: gypsum; Py: pyrite

Appendix 8 Chemical Composition of Granitic Rocks

Sample	Rock Name	Area	Al ₂ O ₃ (%)	CaO (%)	Cr ₂ O ₃ (%)	Fe ₂ O ₃ (%)	FeO (%)	K ₂ O (%)	MgO (%)	MnO (%)	Na ₂ O (%)	P ₂ O ₅ (%)	SiO ₂ (%)	TiO ₂ (%)	LOI (%)	Total (%)
MJTA-9-156S	Intense altered granitoid	Akmola	14.72	1.71	<0.01	3.21	0.75	2.52	2.31	0.05	3.61	0.15	65.34	0.56	4.41	99.34
MJTA-7-94S	Hb Bt adamirite	Akmola	14.63	3.16	<0.01	4.09	2.20	4.13	1.79	0.09	3.12	0.14	65.64	0.50	1.43	100.92
A2115D	Ho diorite porphyry	Aktau west	16.79	4.76	<0.01	4.96	2.42	2.22	1.45	0.10	3.57	0.14	63.42	0.54	1.28	101.65
A3001	Ho Bt granite	Western Zaiturbulak	14.02	2.11	<0.01	2.67	1.25	3.98	0.81	0.07	3.47	0.08	70.55	0.30	0.86	100.17
A3006	Bt Hb granodiorite	Western Zaiturbulak	15.29	3.85	<0.01	4.39	2.25	3.17	1.97	0.09	3.32	0.12	65.56	0.51	1.12	101.64
A3007	Bt Hb granodiorite	Western Zaiturbulak	14.93	3.58	<0.01	4.59	2.48	3.55	2.00	0.09	3.18	0.13	64.47	0.53	1.58	101.11
A3008	Bt Hb granodiorite	Akmola	15.14	4.28	<0.01	4.49	2.44	3.15	2.28	0.09	3.11	0.11	64.87	0.46	1.12	101.54
C2053	Porphyritic granodiorite-Hb Bt granite	Akmola	14.80	3.55	<0.01	4.76	1.46	3.42	2.83	0.11	2.72	0.18	63.12	0.58	2.85	100.38
M143D	Hb Px diorite-gabbro	Zaiturbulak	16.41	7.68	<0.01	8.03	5.98	1.64	5.42	0.10	2.52	0.20	53.84	0.79	2.43	105.04