

Mineral composition (representative analyzes) from rocks of Asubulak ore cluster

Table S1. Composition of plagioclases (oxides in wt. %)

Sample	SiO ₂	Al ₂ O ₃	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	Total		An	Or	Ab
Sample VK-1. Biotite granite. Phase 1 Kalba complex											
VK-1_Pl-02	63.84	22.71	4.14	9.17	0.13	–	99.99		0.20	0.01	0.79
VK-1_Pl-03	63.47	23.22	4.37	9.17	0.25	–	100.98		0.21	0.01	0.78
VK-1_Pl-04	63.58	22.84	4.06	9.46	0.23	–	100.17		0.19	0.01	0.80
VK-1_Pl-06	61.87	23.20	4.62	8.94	0.20	–	99.09		0.22	0.01	0.77
VK-1_Pl-07	63.71	22.16	3.36	9.50	0.29	–	99.02		0.16	0.02	0.82
VK-1_Pl-09	62.98	23.34	4.27	9.06	0.33	–	99.97		0.20	0.02	0.78
VK-1_Pl-10	63.69	23.22	4.35	9.35	–	–	100.62		0.20	0.00	0.80
VK-1_Pl-11	64.65	21.77	2.74	10.12	0.23	–	99.51		0.13	0.01	0.86
VK-1_Pl-15	61.66	24.20	5.43	8.51	0.16	–	99.95		0.26	0.01	0.73
VK-1_Pl-16	60.59	24.32	5.71	8.24	0.24	–	99.09		0.27	0.01	0.71
VK-1_Pl-17	62.79	23.07	4.32	9.11	0.19	–	99.49		0.21	0.01	0.78
VK-1_Pl-18	62.34	23.56	4.95	8.65	0.16	–	99.67		0.24	0.01	0.75
VK-1_Pl-19	61.51	24.32	5.43	8.53	0.22	–	100.00		0.26	0.01	0.73
VK-1_Pl-21	62.77	23.52	4.76	8.94	0.27	–	100.25		0.22	0.02	0.76
VK-1_Pl-22	63.54	23.64	4.48	9.07	0.23	–	100.95		0.21	0.01	0.78
VK-1_Pl-23	63.07	22.92	4.04	9.42	0.20	–	99.66		0.19	0.01	0.80
VK-1_Pl-24	63.32	22.90	3.92	9.64	0.16	–	99.94		0.18	0.01	0.81
VK-1_Pl-25	62.21	24.00	5.01	8.90	0.25	–	100.37		0.23	0.01	0.75
VK-1_Pl-26	60.50	24.32	5.72	8.36	0.25	–	99.15		0.27	0.01	0.72
VK-1_Pl-27	63.32	22.71	4.04	9.04	0.19	–	99.32		0.20	0.01	0.79
VK-1_Pl-28	61.70	23.37	5.02	8.78	0.17	–	99.04		0.24	0.01	0.75
VK-1_Pl-29	62.60	23.28	4.46	8.94	0.16	–	99.43		0.21	0.01	0.78
VK-1_Pl-30	62.81	23.24	4.25	9.26	–	–	99.57		0.20	0.00	0.80
Sample VK-2. Albite-microcline pegmatite, near Yubileinoe deposit											
VK-2_Pl-07	68.07	20.22	0.59	11.43	0.22	–	100.53		0.03	0.01	0.96
VK-2_Pl-08	68.29	19.78	–	11.71	–	–	99.79		0.00	0.00	1.00
VK-2_Pl-09	68.31	19.84	0.28	11.77	0.14	–	100.34		0.01	0.01	0.98
VK-2_Pl-10	67.22	20.14	0.74	11.38	0.14	–	99.62		0.03	0.01	0.96

VK-2_Kfs-01	64.35	18.29	0.32	16.24	99.20		0.00	0.97	0.03
VK-2_Kfs-04	65.14	18.61	0.38	16.37	100.50		0.00	0.97	0.03
VK-2_Kfs-06	65.14	18.57	0.34	16.25	100.99		0.00	0.97	0.03
VK-2_Kfs-07	64.39	18.71	0.38	16.35	99.82		0.00	0.97	0.03
VK-2_Kfs-08	65.02	18.42	0.32	16.37	100.13		0.00	0.97	0.03
VK-2_Kfs-09	64.67	18.67	0.39	16.42	100.15		0.00	0.97	0.03
VK-2_Kfs-13	64.97	18.50	0.24	16.47	100.46		0.00	0.98	0.02
VK-2_Kfs-14	65.64	18.46	0.26	16.43	100.78		0.00	0.98	0.02
VK-2_Kfs-15	64.39	18.44	0.39	16.29	99.51		0.00	0.96	0.04
Sample VK-10. Albite pegmatite with spodumene, Transheinoe deposit									
VK-10_Kfs-01	64.16	18.20	0.31	15.74	98.41		0.00	0.97	0.03
VK-10_Kfs-02	64.91	18.12	0.34	15.25	98.62		0.00	0.97	0.03

Table S3. Composition of Muscovites (oxides in wt. %, formula calculated on the basis of 11 oxygen atoms)

Sample	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	MgO	Na ₂ O	K ₂ O	Cs ₂ O	F	Total		Si	Ti	Al	Fe	Mg	Mn	Na	K	F
Sample VK-1. Biotite granite. Phase 1 Kalba complex																					
VK-1_Ms-01	45.97	1.68	31.55	2.02	–	1.33	0.24	10.85	–	–	93.66		3.16	0.09	2.55	0.12	0.08	0.00	0.03	0.95	
VK-1_Ms-02	45.12	0.52	32.20	3.31	–	1.72	0.24	10.99	–	–	94.09		3.11	0.03	2.62	0.19	0.10	0.00	0.03	0.97	
VK-1_Ms-03	47.30	–	31.78	1.99	–	1.53	0.35	11.14	–	–	94.10		3.23	0.00	2.56	0.11	0.09	0.00	0.05	0.97	
VK-1_Ms-04	45.78	1.08	32.90	1.90	–	1.23	0.32	10.93	–	–	94.14		3.12	0.06	2.64	0.11	0.07	0.00	0.04	0.95	
Sample VK-2. Albite-microcline pegmatite, near Yubileinoe deposit																					
VK-2_Ms-04	45.76	–	36.03	1.67	–	0.43	0.54	10.77	–	–	95.21		3.06	0.00	2.84	0.09	0.02	0.00	0.07	0.92	
VK-2_Ms-05	46.27	0.42	32.90	2.62	–	1.03	0.31	11.02	–	–	94.57		3.15	0.02	2.64	0.15	0.06	0.00	0.04	0.96	
VK-2_Ms-06	46.47	0.47	32.99	2.55	–	1.03	0.24	10.77	–	–	94.51		3.15	0.02	2.64	0.14	0.06	0.00	0.03	0.93	
VK-2_Ms-07	46.00	–	36.71	1.61	–	0.40	0.71	10.17	–	–	95.60		3.05	0.00	2.87	0.09	0.02	0.00	0.09	0.86	
VK-2_Ms-08	45.61	–	35.09	1.84	–	0.51	0.42	10.53	–	–	94.00		3.09	0.00	2.80	0.10	0.03	0.00	0.06	0.91	
Sample VK-5. Albite pegmatite with turmaline, Yubileinoe deposit																					
VK-5_Ms-13	48.22	–	37.51	–	–	–	–	10.72	–	–	96.45		3.13	0.00	2.87	0.00	0.00	0.00	0.00	0.89	
Sample VK-9. Albite-lepidolite greisen, Transheinoe deposit																					
VK-9_Ms-02	49.33	–	28.19	–	0.44	–	0.28	10.72	–	5.55	94.52		3.47	0.00	2.34	0.00	0.00	0.05	0.04	0.96	1.24
VK-9_Ms-03	49.46	–	28.25	–	0.43	–	0.30	10.72	–	5.65	94.80		3.47	0.00	2.34	0.00	0.00	0.05	0.04	0.96	1.25
VK-9_Ms-05	49.29	–	28.15	–	0.34	–	0.24	10.85	–	5.34	94.22		3.48	0.00	2.34	0.00	0.00	0.04	0.03	0.98	1.19
VK-9_Ms-06	50.17	–	27.93	–	0.28	–	0.27	10.88	–	5.21	94.74		3.51	0.00	2.30	0.00	0.00	0.03	0.04	0.97	1.15
VK-9_Ms-10	50.21	–	27.81	–	0.35	–	0.38	10.79	–	5.66	95.20		3.51	0.00	2.29	0.00	0.00	0.04	0.05	0.96	1.25
VK-9_Ms-12	49.50	–	34.07	–	–	–	0.70	10.37	–	–	94.64		3.27	0.00	2.65	0.00	0.00	0.00	0.09	0.87	0.00

VK-9_Ms-13	48.84	–	28.98	–	0.27	–	–	10.61	0.85	4.49	94.05		3.43	0.00	2.40	0.00	0.00	0.03	0.00	0.95	1.00
VK-9_Ms-14	49.42	–	28.32	–	0.36	–	0.24	10.88	–	4.97	94.19		3.47	0.00	2.34	0.00	0.00	0.04	0.03	0.97	1.10
VK-9_Ms-16	49.91	–	27.47	–	0.30	–	0.36	10.60	–	5.72	94.37		3.52	0.00	2.28	0.00	0.00	0.03	0.05	0.95	1.28
VK-9_Ms-17	49.78	–	27.74	–	0.36	–	0.34	10.66	–	5.54	94.42		3.50	0.00	2.30	0.00	0.00	0.04	0.05	0.96	1.23
VK-9_Ms-18	49.68	–	28.64	–	0.27	–	0.26	10.72	–	4.96	94.53		3.47	0.00	2.36	0.00	0.00	0.03	0.04	0.96	1.10
VK-9_Ms-20	50.51	–	26.70	–	–	–	0.42	9.95	1.89	5.28	94.74		3.57	0.00	2.22	0.00	0.00	0.00	0.06	0.90	1.18
VK-9_Ms-22	49.95	–	27.98	–	0.28	–	0.30	10.6	0.54	5.21	94.87		3.50	0.00	2.31	0.00	0.00	0.03	0.04	0.95	1.15
VK-9_Ms-25	49.89	–	28.12	–	0.39	–	0.24	10.94	–	5.76	95.33		3.49	0.00	2.32	0.00	0.00	0.04	0.03	0.98	1.27
VK-9_Ms-26	50.53	–	28.23	–	0.35	–	0.28	10.97	–	5.91	96.28		3.50	0.00	2.31	0.00	0.00	0.04	0.04	0.97	1.30
VK-9_Ms-27	47.86	–	30.35	–	–	–	0.43	10.79	–	4.89	94.32		3.36	0.00	2.51	0.00	0.00	0.00	0.06	0.97	1.09
VK-9_Ms-28	49.80	–	27.81	–	0.35	–	0.36	10.65	–	5.71	94.69		3.50	0.00	2.30	0.00	0.00	0.04	0.05	0.96	1.27
VK-9_Ms-29	50.02	–	27.47	–	0.26	–	0.28	10.76	–	5.59	94.38		3.52	0.00	2.28	0.00	0.00	0.03	0.04	0.97	1.25
Sample VK-10. Albite pegmatite with spodumene, Transheinoe deposit																					
VK-10_Ms-01	45.91	–	37.37	–	–	–	0.40	10.82	–	–	94.51		3.06	0.00	2.93	0.00	0.00	0.00	0.05	0.92	
VK-10_Ms-07	45.93	–	38.38	0.33	–	–	0.53	10.61	–	–	95.78		3.02	0.00	2.97	0.02	0.00	0.00	0.07	0.89	
VK-10_Ms-11	44.99	–	38.09	–	–	–	0.49	10.70	–	–	94.26		3.01	0.00	3.00	0.00	0.00	0.00	0.06	0.91	
VK-10_Ms-12	45.08	–	37.56	0.26	–	–	0.40	10.67	–	–	93.97		3.02	0.00	2.97	0.01	0.00	0.00	0.05	0.91	
VK-10_Ms-13	44.97	–	37.60	–	–	–	0.42	10.58	–	–	93.56		3.02	0.00	2.98	0.00	0.00	0.00	0.05	0.91	
VK-10_Ms-16	44.56	–	37.81	–	–	–	0.46	10.72	–	–	93.55		3.00	0.00	3.00	0.00	0.00	0.00	0.06	0.92	
VK-10_Ms-17	48.86	–	34.35	–	–	–	0.28	11.07	–	–	94.57		3.24	0.00	2.69	0.00	0.00	0.00	0.04	0.94	
VK-10_Ms-24	45.72	–	36.66	–	–	–	0.26	10.59	–	0.40	93.62		3.08	0.00	2.91	0.00	0.00	0.00	0.03	0.91	0.09
VK-10_Ms-26	45.93	–	36.56	–	–	–	0.55	10.48	–	1.07	94.60		3.09	0.00	2.90	0.00	0.00	0.00	0.07	0.90	0.23

Table S4. Composition of Tantalite-Columbite (oxides in wt%, formula calculated on the basis of 6 oxygen atoms)

Sample	Nb ₂ O ₅	Ta ₂ O ₅	FeO	MnO	Total		Nb	Ta	Fe	Mn
Sample VK-9. Albite-lepidolite greisen, Transheinoe deposit										
VK-9_TC-01	56.58	23.40	0.90	18.17	99.04		1.60	0.40	0.05	0.96
VK-9_TC-02	36.29	45.15	5.11	12.46	99.02		1.14	0.85	0.30	0.73
VK-9_TC-03	37.57	44.32	5.26	12.41	100.37		1.16	0.83	0.30	0.72
VK-9_TC-04	46.03	33.90	2.12	16.36	98.41		1.38	0.61	0.12	0.92
VK-9_TC-05	45.71	34.48	1.83	16.10	98.12		1.37	0.62	0.10	0.91
VK-9_TC-06	55.89	23.74	0.71	18.32	98.66		1.59	0.41	0.04	0.98
VK-9_TC-07	46.19	33.71	1.93	16.53	98.36		1.38	0.61	0.11	0.93
VK-9_TC-08	36.97	44.35	5.21	12.23	98.75		1.16	0.84	0.30	0.72
VK-9_TC-09	37.37	44.17	3.40	14.20	99.13		1.16	0.83	0.20	0.83

VK-9_TC-10	59.31	19.74	1.09	18.18	98.33		1.66	0.33	0.06	0.95
VK-9_TC-11	60.60	18.55	0.98	18.52	98.64		1.68	0.31	0.05	0.96
VK-9_TC-12	61.07	18.10	1.14	18.43	98.74		1.69	0.30	0.06	0.96
VK-9_TC-13	47.19	33.13	1.96	16.45	98.73		1.40	0.59	0.11	0.91
VK-9_TC-14	48.94	31.19	2.53	16.24	98.90		1.44	0.55	0.14	0.89
VK-9_TC-15	47.91	32.48	2.07	16.06	98.52		1.42	0.58	0.11	0.89
VK-9_TC-16	60.78	18.43	1.17	18.28	98.66		1.69	0.31	0.06	0.95
VK-9_TC-17	55.13	24.49	–	18.48	98.11		1.58	0.42	0.00	0.99
VK-9_TC-18	58.54	21.59	0.68	18.81	99.62		1.63	0.36	0.04	0.98
VK-9_TC-19	61.67	17.78	1.14	18.63	99.23		1.70	0.29	0.06	0.96
VK-9_TC-20	61.58	18.46	1.13	18.49	99.67		1.69	0.30	0.06	0.95
VK-9_TC-21	51.70	28.61	0.64	18.05	99.00		1.50	0.50	0.03	0.98
VK-9_TC-22	62.34	16.67	1.26	18.22	98.49		1.72	0.28	0.06	0.94
VK-9_TC-23	52.94	27.63	–	18.13	98.71		1.53	0.48	0.00	0.98
VK-9_TC-24	64.02	14.98	1.75	17.81	98.55		1.75	0.25	0.09	0.91
VK-9_TC-25	63.86	14.97	1.24	18.66	98.72		1.75	0.25	0.06	0.96
VK-9_TC-26	63.95	15.19	1.12	18.62	98.87		1.75	0.25	0.06	0.95
VK-9_TC-27	37.51	43.38	4.90	12.77	98.56		1.17	0.82	0.28	0.75