Table S1. **Mineral assemblages of Anakit marbles, skarns, and dolerite**

Mineral	Formula	Dolerite	Skarn		Marble						
					Distance from contact						
					0.5 m	1.0 m	1.2 m	1.5 m	1.8 m	2.0 m	3.0 m
		PA-126-60	PA-147-60	PA-178-60	PA-169-60	PA-170-60	PA-171-60	PA-172-60	PA-173-60	PA-174-60	PA-176-60
	Polyanionic minerals										
Spurrite	$Ca_5(SiO_4)_2(CO_3)$				+ (71)	+ (38)	+ (44)	+ (61)	+ (48)	+ (25)	+ (31)
Tilleyite	$Ca_5(Si_2O_7)(CO_3)_2$				+		+ (23)	+ (35)			
Cuspidine	$Ca_4(Si_2O_7)F_2$					+	+	+	+		+
Chlorellestadite	$Ca_5(SiO_4)_{1.5}(SO_4)_{1.5}Cl$						+			+	
Fluorapatite	$Ca_5(PO_4)_3F$	+		+	+						
Rondorfite	$Ca_8Mg(SiO_4)_4Cl_2$						+	+			
Rustumite-2	$Ca_{10}(Si_2O_7)(SiO_4)(F_{0.3}OH_{1.7})(Cl_{1.8}OH_{0.2})$						+			+	+
Annite	$KFe^{2+}_3(AlSi_3O_{10})(OH)_2$	+									
Annite-Cl	$KFe^{2+}_3(AlSi_3O_{10})(Cl,OH)_2$	+									
K-Fe^{2+}-Cl edenite	$KCa_2Fe^{2+}_5(AlSi_7O_{22})Cl_2$	+									
Hydroxylellestadite	$Ca_5(SiO_4)_{1.5}(SO_4)_{1.5}(OH)$						+				+
Hydrogrossular	$Ca_3Al_2(SiO_4)_2(OH)_4$		+		+ (2)	+	+	+	+	+	+ (1)
Hydroandradite	$Ca_3Fe^{3+}_2(SiO_4)_2(OH)_4$		+		+	+	+	+	+	+	+
Vesuvianite	$Ca_{19}Fe^{3+}Al_4(Al_6Mg_2)(\square_4)\square[Si_2O_7]_4[(SiO_4)_{10}]O(OH)_9$		+		+	+		+	+	+	
Trabzonite	$Ca_4(Si_3O_9)(OH)_2$							+			
Jennite	$Ca_9(Si_3O_9)_2(OH)_8$ *$8H_2O$				+		+	+	+	+	
Hillebrandite	$Ca_2(SiO_3)(OH)_2$				+	+	+	+		+	+
Afwillite	$Ca_3(HSiO_4)_2$ *$2H_2O$							+			
CSHs-general (>6)					+	+	+	+	+	+	+
Cl-CSHs					+	+	+	+	+	+	+
Ca-Cl-silicate	$Ca_5(Si_2O_7)Cl_2(OH)_2$						+	+			+
Rustumite-1	$Ca_{10}(Si_2O_7)(SiO_4)(F_{0.1}OH_{1.9})(Cl_{0.8}OH_{1.2})$						+			+	+
Defernite	$Ca_6(CO_3)_{1.0}(Si_2O_7)_{0.5}(Cl,OH)_7$				+					+	+
Dovyrenite	$Ca_6Zr(Si_2O_7)_2(OH)_4$							+			
Ferro-actinolite	$\square Ca_2Fe^{2+}_5(Si_8O_{22})(OH)_2$	+									
Hastingsite	$NaCa_2(Fe^{2+}_4Fe^{3+})(Al_2Si_6O_{22})(OH)_2$	+									
Zn-serpentine	$(Zn,Mg)_3(Si_2O_5)(OH)_4$			+							
Greenalite	$(Fe,Mg)_3(Si_2O_5)(OH)_4$	+									
Chamosite	$(Fe^{2+},Mg,Al,Fe^{3+})_6(Si,Al)_4O_{10}(OH,O)_8$	+									
Hemimorphite	$Zn_4(Si_2O_7)(OH)_2$ H_2O			+							
Zn-Pb-Fe-silicate	$(Zn,Pb,Fe)_2(SiO_4)$ nH_2O			+							
Cl-Fe-silicate	$Fe^{2+}Fe^{3+}_4Si_3O_{12}(Cl_{1.2},OH_{0.8})$	+									

	Silicates										
Merwinite	$Ca_3Mg(SiO_4)_2$		+		+ (11)	+ (5)	+ (5)	+ (2)	+ (8)	+ (9)	+ (9)
Akermanite	$Ca_2Mg(Si_2O_7)$				+ (4)	+(9)	+ (12)	+	+ (8)	+ (5)	+ (7)
Gehlenite	$Ca_2Al(AlSiO_7)$				+	+	+	+	+	+	+
Monticellite	$CaMg(SiO_4)$				+	+		+	+	+	
Glaucochroite	$CaMn(SiO_4)$		+								
Larnite	$Ca_2(SiO_4)_2$				+						
Rankinite	$Ca_3(Si_2O_7)$									+	
Baghdadite	$Ca_3Zr(Si_2O_7)O_2$				+		+	+	+	+	+
Andradite	$Ca_3Fe^{3+}{}_2(SiO_4)_3$			+(96)							+ (2)
Grossular	$Ca_3Al_2(SiO_4)_3$			+							
Fayalite	$(Fe,Mg)_2(SiO_4)$	+									
Ferrosilite	$(Fe,Mg)_2(Si_2O_6)$	+									
Augite	$(Ca,Mg,Fe)_2(Si_2O_6)$	+									
Diopside	$CaMg(Si_2O_6)$		+	+							
Hedenbergite	$CaFe^{2+}(Si_2O_6)$	+		+							
K-feldspar	$K(AlSi_3O_8)$	+									
Anorthite	$(Ca,Na)(Al_2Si_2O_8)$	+									
Ca-Fe-silicate (dorrite-like)	$Ca_4Fe^{2+}{}_9Fe^{3+}{}_3(Fe^{3+}{}_3Si_9O_{36})O_4$	+									
Si-rich glass	>70 мас.% SiO_2	+									
	Carbonates										
Calcite	$CaCO_3$		+	+ (4)	+ (12)	+ (48)	+ (15)	+ (2)	+ (36)	+ (61)	+ (51)
Pb-calcite	$(Ca,Pb)CO_3$			+							
Strontionite	$SrCO_3$										+
Magnesite	$MgCO_3$										+
Cerussite	$PbCO_3$			+							
	Sulfides										
Troilite	FeS				+	+	+	+	+	+	+
Pyrrhotite	$Fe_{1-x}S$	+			+	+	+	+	+		
Alabandite	(Mn,Fe)S				+	+			+		
Sphalerite	(Zn,Fe)S		+	+	+			+		+	+
Galena	PbS		+	+	+			+	+		
Chalcopyrite	$CuFeS_2$	+									
Violarite	$Fe^{2+}Ni^{3+}{}_2S_4$		+								
Pyrite	FeS_2						+				
Loellingite	$FeAs_2$										+
Rammelsbergite	$NiAs_2$										+
Arsenopyrite	(Fe,Co)AsS			+							+

Djerfisherite	$K_6(Fe,Ni,Cu)_{25}S_{26}Cl$				+	+	+	+	+	+	
Valleriite	$(Fe^{2+},Cu)_4(Mg,Al)_3S_4(OH,O)_6$			+	+			+		+	+
Ca-valleriite	$Fe^{2+}{}_4(Ca,Fe^{2})_3S_4(OH,O)_6$				+	+	+	+	+	+	
	Sulfates										
Barite	$BaSO_4$		+				+		+		
Anhydrite	$CaSO_4$						+				
	Oxides										
Perovskite	$CaTiO_3$		+		+	+	+	+	+	+	+
Ilmenite	$FeTiO_3$	+									
Quartz	SiO_2	+									
Magnetite	$Fe^{2+}Fe^{3+}{}_2O_4$	+									
Ulvite	$Fe^{2+}{}_2TiO_4$	+									
Coronadite	$Pb(Mn^{4+}{}_6Mn^{3+}{}_2)O_{16}$		+								
Coronadite-Zn	$Zn(Mn^{4+}{}_6Mn^{3+}{}_2)O_{16}$		+								
	Hydroxides										
Goethite	$Fe^{3+}O(OH)$						+	+			
Brucite	$Mg(OH)_2$			+							+

Note. Percentages of mineral content determined by XRD (wt.%). Symbol "+" – SEM-EDS data. *Italic* = secondary phases, normal = primary phases

Table S2. **Trace element compositions (in ppm) of marbles and skarns from the Anakit contact aureole**

Sample	PA-147-60	PA-156-60	PA-157-60	PA-158-60	PA-159-60a	PA-160-60б	PA-161-60	PA-150-60	PA-163-60	PA-165-60
		Sample site 65								
Rock	Skarn	Marble								
As	15.5	61.9	7.00	58.6	5.99	3.53	0.63	7.13	1.59	29.9
Ba	121	3367	21.5	3182	71.8	15.8	59.3	39.8	48.3	51.8
Be	0.05	0.26	0.18	0.16	0.11	0.21	0.14	0.13	0.26	0.16
Bi	0.04	0.14	0.03	0.22	0.07	0.02	<0.01	0.10	<0.01	0.18
Cd	0.76	0.13	0.15	0.13	0.10	0.16	0.11	0.14	0.16	0.16
Co	3.19	2.73	2.21	1.91	1.58	2.18	1.78	2.01	2.53	1.94
Cr	10.8	17.5	10.6	11.8	6.76	16.4	12.7	22.1	15.2	11.3
Cs	0.02	0.25	0.06	0.25	0.06	0.03	0.15	0.05	0.06	0.16
Cu	4.41	13.7	8.24	8.11	4.63	7.48	4.12	7.53	6.51	7.51
Ga	3.13	2.75	1.74	1.78	1.24	1.85	1.48	1.52	2.52	1.67
Hf	0.127	1.15	1.74	0.90	1.20	1.59	0.98	1.88	1.25	1.37
Li	2.40	6.07	3.53	4.42	3.15	3.50	4.44	4.06	11.9	6.29
Mn	25610	305	305	228	156	289	290	189	305	257
Mo	<0.10	<0.10	0.22	<0.10	<0.10	0.53	<0.10	<0.10	<0.10	0.11
Nb	1.29	1.29	0.81	0.77	4.33	0.95	2.81	4.80	4.43	4.17
Ni	6.67	9.24	7.17	6.97	5.80	10.2	5.84	6.92	8.48	6.87
Pb	272	5.97	1.49	6.48	1.32	1.43	1.47	2.19	2.82	2.52
Rb	0.187	15.3	4.52	14.8	2.39	2.28	1.72	2.35	2.31	2.35
Sb	0.39	0.36	0.10	0.34	0.37	0.124	0.33	0.65	0.31	0.51
Sc	0.64	3.08	2.17	1.96	1.76	2.39	2.00	2.38	3.18	2.41
Se	<0.50	<0.50	0.92	<0.50	0.63	1.84	1.73	0.90	1.51	1.29
Sn	0.20	0.38	0.18	0.33	0.29	0.88	0.13	0.64	0.27	0.34
Sr	168	598	286	589	722	471	446	690	772	633
Ta	0.15	0.21	0.14	0.12	0.26	0.18	0.25	0.67	0.33	0.28
Te	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Th	0.25	1.00	0.39	0.50	0.31	0.45	0.52	0.45	0.63	0.42
Ti	636	647	383	426	283	539	417	408	641	411
Tl	0.01	0.06	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
V	12.1	10.6	13.5	7.25	3.79	7.92	8.06	4.63	10.4	4.83
W	0.64	1.69	0.23	0.50	0.66	1.06	1.53	1.59	0.16	1.79
Zn	1108	52.0	40.4	69.8	196	121	183	20.6	269	84.9
Zr	5.01	43.4	76.1	33.5	55.2	69.0	41.3	83.5	54.6	60.0
U	0.82	0.86	0.55	0.61	0.71	0.74	0.86	0.83	0.95	0.86

Table S2. **Continue**

Sample	PA-169-60	PA-170-60	PA-171-60	PA-172-60	PA-173-60	PA-174-60	PA-176-60
	Sample site 66						
Rock	Marble						
As	16.1	21.7	23.4	1.05	2.26	16.7	4.11
Ba	43.3	34.8	1911	18.9	9.84	32.4	40.4
Be	0.20	0.15	0.16	0.02	0.11	0.11	0.17
Bi	0.18	0.10	0.02	<0.01	0.02	0.31	0.02
Cd	0.16	0.19	0.15	0.14	0.35	0.16	0.20
Co	2.09	1.77	2.05	1.08	1.55	1.70	2.08
Cr	17.0	10.2	25	11.4	9.53	8.36	13.3
Cs	0.08	0.35	0.14	0.05	0.06	0.20	0.05
Cu	12.8	6.69	6.21	3.69	5.09	6.75	5.97
Ga	2.39	1.52	1.56	0.31	1.07	1.24	1.89
Hf	1.68	2.24	0.90	0.40	0.28	1.16	2.55
Li	5.29	7.64	15.5	5.92	11.2	5.62	8.50
Mn	337	224	358	243	320	206	408
Mo	0.48	0.48	0.133	0.20	0.20	0.17	0.13
Nb	6.53	2.49	0.93	0.62	1.01	3.43	4.28
Ni	8.78	6.33	8.60	4.18	4.50	5.60	6.50
Pb	2.94	1.76	4.39	2.41	3.19	7.10	4.11
Rb	3.17	2.65	9.28	0.57	0.66	2.37	2.01
Sb	0.55	0.06	0.12	<0.10	<0.10	0.70	0.44
Sc	2.53	2.23	1.46	1.83	1.94	1.95	2.75
Se	2.28	1.38	<0.50	<0.50	<0.50	1.17	0.66
Sn	0.46	0.34	0.24	<0.10	<0.10	0.34	0.90
Sr	346	565	353	155	328	688	752
Ta	0.36	0.20	0.17	0.39	0.28	0.30	0.35
Te	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Th	0.65	0.36	0.63	0.112	0.20	0.40	0.63
Ti	446	362	555	103	312	320	465
Tl	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
V	18.7	7.69	9.66	14.3	6.51	5.50	9.40
W	0.53	1.49	0.21	1.09	1.62	0.21	0.21
Zn	78.9	95.9	67.5	5.94	35.8	67.5	69.6
Zr	77.3	108	38.5	12.4	8.17	54.4	114
U	1.84	0.74	1.21	0.21	0.66	1.30	1.00

Table S2. **Continue**

Sample	PA-178-60	PA-180-60	PA-181-60	PA-185-60	PA-186-60	PA-188-60a	PA-188-60б
	Sample site 68			Sample site 69			
Rock	Skarn	Marble		Marble			
As	29.5	1.55	2.86	0.61	2.90	<0.10	2.47
Ba	40.6	35.8	39.4	228	43.4	9.92	277
Be	<0.05	0.08	0.18	0.16	0.10	0.16	0.10
Bi	0.07	0.02	0.02	0.05	0.06	<0.01	0.05
Cd	1.95	0.14	0.17	0.58	0.20	0.21	0.23
Co	6.54	1.38	2.56	1.27	1.02	1.61	1.48
Cr	33.2	5.27	11.8	10.5	10.5	7.62	12.2
Cs	0.02	0.06	0.09	0.03	0.05	0.11	0.07
Cu	29.2	3.12	7.31	12.2	17.0	4.74	2.45
Ga	2.57	1.19	1.91	0.53	0.68	1.11	1.12
Hf	0.60	1.07	1.82	0.33	0.75	0.33	1.05
Li	0.88	8.03	14.3	0.93	2.16	7.18	12.3
Mn	3846	200	295	5230	1368	276	410
Mo	0.20	0.12	0.19	<0.10	<0.10	<0.10	0.35
Nb	0.17	3.61	3.84	0.69	2.84	0.94	3.11
Ni	3.96	4.16	8.47	3.24	3.79	4.64	4.32
Pb	182	3.30	3.04	145	3.36	2.20	5.78
Rb	0.24	2.12	2.39	0.53	1.63	0.86	1.80
Sb	0.92	0.37	0.36	0.17	0.62	<0.10	0.41
Sc	0.32	1.81	2.95	2.32	1.32	2.39	1.78
Se	2.93	0.99	1.96	<0.50	0.66	<0.50	1.57
Sn	1.29	0.42	0.91	<0.10	0.44	<0.10	0.22
Sr	31.0	715	643	631	700	485	318
Ta	<0.04	0.40	0.30	0.33	0.23	0.31	0.19
Te	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Th	0.06	0.24	0.59	0.24	0.20	0.31	0.29
Ti	121	215	470	149	164	362	274
Tl	<0.01	<0.01	<0.01	0.03	0.02	<0.01	<0.01
V	3.04	5.92	11.7	3.42	7.47	5.72	9.70
W	4.24	0.73	0.27	0.52	0.41	0.52	0.18
Zn	1123	42.4	25.2	901	46.9	52.4	1149
Zr	30.6	46.8	81.1	9.88	36.8	9.91	43.4
U	0.36	0.72	0.90	0.30	0.57	0.61	0.69

Table S3. **Yttrium and REE concentrations (ppm) in bulk samples of marbles and skarns from the Anakit contact aureole**

Sample	Rock	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	∑REE
Sample site 65																	
PA-147-60	Skarn	3.28	1.69	2.97	0.43	1.75	0.36	0.10	0.46	0.08	0.43	0.10	0.29	0.04	0.26	0.03	9.00
PA-156-60	Marble	9.06	5.95	8.93	1.21	4.80	0.91	0.26	1.23	0.17	1.11	0.24	0.74	0.10	0.67	0.11	26.4
PA-157-60	Marble	7.92	3.98	6.30	0.92	3.71	0.81	0.23	1.01	0.14	0.97	0.21	0.66	0.10	0.65	0.10	19.8
PA-158-60	Marble	6.01	4.17	6.30	0.86	3.63	0.75	0.20	0.87	0.13	0.79	0.17	0.51	0.07	0.48	0.07	19.0
PA-159-60a	Marble	4.29	2.54	3.96	0.55	2.09	0.43	0.11	0.53	0.08	0.53	0.11	0.34	0.05	0.33	0.05	11.7
PA-160-60б	Marble	6.71	4.12	6.06	0.89	3.43	0.67	0.19	0.84	0.13	0.91	0.20	0.56	0.08	0.55	0.09	18.7
PA-161-60	Marble	6.60	3.92	5.70	0.85	3.33	0.77	0.21	0.81	0.12	0.79	0.17	0.50	0.09	0.47	0.08	17.8
PA-150-60	Marble	4.27	2.95	4.75	0.63	2.54	0.51	0.10	0.62	0.09	0.61	0.13	0.38	0.05	0.36	0.05	13.8
PA-163-60	Marble	7.45	4.67	7.25	1.03	4.16	0.91	0.24	1.04	0.16	1.02	0.23	0.63	0.10	0.57	0.09	22.1
PA-165-60	Marble	5.16	3.05	4.92	0.66	2.60	0.56	0.15	0.67	0.10	0.70	0.14	0.42	0.07	0.41	0.06	14.5
Sample site 66																	
PA-169-60	Marble	8.89	5.10	7.69	1.08	4.27	0.93	0.30	1.07	0.16	1.12	0.23	0.67	0.11	0.68	0.10	23.5
PA-170-60	Marble	5.69	3.17	4.92	0.70	2.74	0.57	0.15	0.71	0.10	0.66	0.16	0.46	0.07	0.43	0.07	14.9
PA-171-60	Marble	4.84	3.48	5.04	0.73	3.15	0.59	0.13	0.68	0.12	0.65	0.14	0.41	0.06	0.38	0.06	15.6
PA-172-60	Marble	4.53	2.44	4.05	0.57	2.39	0.52	0.18	0.55	0.09	0.58	0.12	0.40	0.06	0.39	0.06	12.4
PA-173-60	Marble	4.71	2.70	4.58	0.67	2.76	0.60	0.16	0.70	0.11	0.69	0.16	0.46	0.06	0.42	0.07	14.1
PA-174-60	Marble	4.92	2.67	4.09	0.60	2.35	0.47	0.11	0.82	0.09	0.47	0.11	0.37	0.06	0.33	0.05	12.6
PA-176-60	Marble	6.91	3.93	5.95	0.86	3.65	0.77	0.19	0.84	0.14	0.92	0.21	0.62	0.09	0.56	0.11	18.8
Sample site 68																	
PA-178-60	Skarn	0.93	0.91	1.15	0.132	0.50	0.105	0.03	0.129	0.02	0.123	0.03	0.09	0.01	0.08	0.01	3.33
PA-180-60	Marble	2.78	1.88	2.96	0.41	1.60	0.32	0.10	0.36	0.06	0.36	0.08	0.24	0.04	0.23	0.03	8.67
PA-181-60	Marble	5.85	4.23	6.18	0.84	3.43	0.75	0.21	0.79	0.12	0.74	0.15	0.50	0.07	0.48	0.06	18.6
Sample site 69																	
PA-185-60	Marble	2.34	2.35	3.37	0.47	1.87	0.40	0.12	0.41	0.06	0.38	0.07	0.22	0.03	0.19	0.03	9.96
PA-186-60	Marble	3.09	1.62	2.63	0.37	1.49	0.34	0.07	0.37	0.05	0.39	0.08	0.23	0.04	0.24	0.04	7.96
PA-188-60a	Marble	4.25	2.64	4.56	0.63	2.67	0.61	0.13	0.65	0.10	0.66	0.15	0.41	0.06	0.38	0.05	13.7
PA-188-60б	Marble	4.89	3.05	4.49	0.63	2.53	0.52	0.21	0.63	0.09	0.62	0.12	0.41	0.06	0.40	0.05	13.8

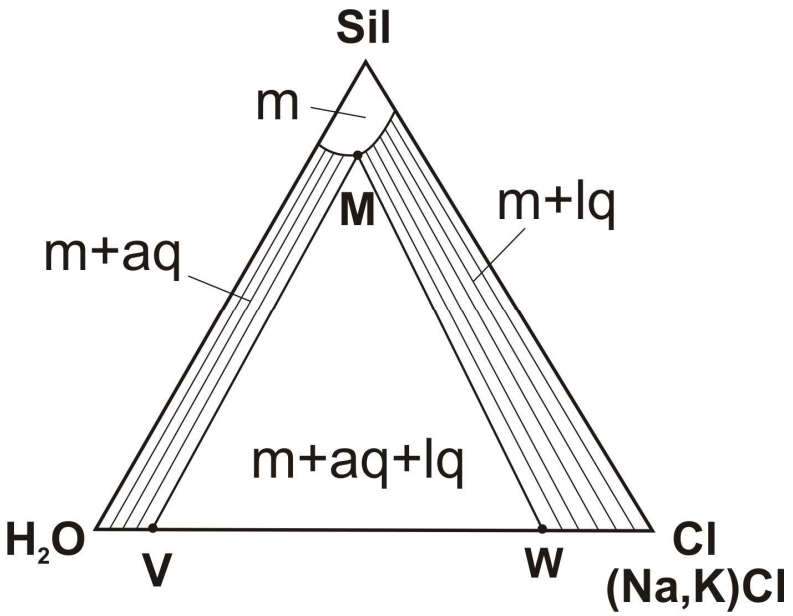

Fig. 1S. Simplified isobaric – isothermal sections of the pseudoternary system rhyolite–H_2O–Na(K)Cl at low pressure (~0.4 < P < 0.852 kbar) below the critical point. The section shows possible crystallization paths for melts saturated with aqueous Cl-bearing fluids. The diagram shows schematically the fields of phase equilibria with rhyolite melt (m), H_2O-rich aqueous phase with chloride (aq), and Cl-rich aqueous liquid – brine (lq). M is melt in equilibrium with aq of composition V and lq of composition W at given P–T conditions. The thin solid lines are tie-lines linking the equilibrium compositions of phases in the fields m + aq and m + lq. According [Lukanin, 2016].