

Supplementary Materials

Trace Element Compositions and Defect Structures of High-Purity Quartz from the Southern Ural Region, Russia

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Table S1. Trace-element concentrations of investigated quartz samples analyzed by solution inductively coupled plasma mass spectrometry (ICP-MS), results in ppm.

Elements	Berkutinskaya	Ky-175	Argazinskoe	Vjazovka	Itkulskoe	Bolotnaya	Ku-414	Ku-2136	Yurma	MT-09
Al	28.8	24.1	16.3	44.4	22.1	108	26.0	89.2	42.7	1570
As	0.029	0.034	0.051	0.084	0.081	0.29	-	0.073	0.033	0.40
Ba	0.23	0.25	0.28	0.64	0.38	0.43	0.45	2.38	1.05	1.89
Be	0.001	0.015	0.001	-	0.001	-	-	-	0.001	0.004
Bi	0.003	0.002	0.011	0.003	0.024	0.021	0.011	0.011	0.006	0.033
Ca	16.0	19.1	13.2	12.7	19.3	25.6	21.7	23.4	19.5	18.7
Cd	-	-	-	-	0.002	-	-	0.004	0.008	0.005
Co	0.006	-	0.005	0.043	0.007	0.041	0.010	0.012	0.022	0.050
Cr	0.034	0.035	0.14	0.24	0.12	0.28	0.12	0.20	0.18	5.91
Cs	-	-	-	-	0.002	0.007	-	0.005	0.006	0.051
Cu	0.032	0.13	0.017	0.17	0.33	0.75	0.42	0.74	0.17	0.48
Fe	3.66	9.52	14.3	12.1	9.39	90.7	6.32	135	8.48	250
Ge	0.90	0.66	1.48	1.41	1.55	0.49	0.93	1.18	1.09	0.75
Ga	0.008	0.52	0.007	0.012	0.007	0.022	0.008	0.024	0.013	0.54
Hf	-	-	-	0.005	0.007	-	-	-	-	0.22
K	4.95	14.4	3.24	15.5	9.65	14.0	7.46	68.0	9.21	726
Li	1.32	0.52	1.15	0.78	1.25	1.10	1.08	0.44	0.50	0.33
Mg	0.89	1.56	3.99	3.81	1.35	24.2	0.40	7.82	4.72	41.8
Mn	0.16	0.37	0.28	2.34	0.30	1.63	0.070	1.10	0.71	33.7

Mo	-	-	0.029	0.010	0.008	0.006	0.022	0.023	0.055	0.033
Na	7.12	6.48	8.02	16.1	7.92	18.4	2.67	30.6	12.8	64.6
Ni	-	-	0.36	0.12	-	0.71	0.29	0.37	0.081	0.17
Pb	-	0.13	2.47	0.083	2.59	0.30	0.12	0.29	0.069	0.32
Rb	0.027	0.19	0.015	0.053	0.028	0.080	0.032	0.15	0.071	1.30
Sc	-	-	-	-	-	0.033	-	-	-	0.34
Sr	0.17	0.17	0.13	0.14	0.12	0.16	0.18	0.43	0.22	0.62
Ta	-	0.25	-	-	-	-	-	-	0.002	0.016
Th	-	0.033	0.003	0.021	0.011	0.009	-	0.003	0.011	1.20
Ti	5.9	2.74	0.92	3.81	2.63	6.75	4.52	10.7	3.05	102
Tl	-	-	-	0.003	-	-	-	-	0.003	0.009
U	0.005	0.17	0.005	0.005	0.010	0.004	0.003	0.004	0.012	0.17
Zn	0.14	0.21	0.47	0.89	6.94	0.67	2.50	3.44	5.64	0.40
Zr	0.035	0.079	0.075	0.21	0.22	0.083	0.059	0.12	0.071	7.54

(-) = below limit of detection

Table S2. Rare earth element (REE) concentrations (results in ppm) and chondrite-normalized interelemental ratios of investigated quartz samples analyzed by solution (ICP-MS).

Elements	Berkutinskaya	Ky-175	Argazinskoe	Vjazovka	Itkulskoe	Bolotnaya	Ku-414	Ku-2136	Yurma	MT-09
Y	0.010	0.395	0.102	0.076	0.084	0.024	0.009	0.032	0.091	0.852
La	0.063	0.059	0.088	0.039	0.082	0.023	0.012	0.074	0.093	6.31
Ce	0.015	0.089	0.179	0.051	0.166	0.087	0.014	0.052	0.089	12.9
Pr	0.003	0.012	0.023	0.009	0.021	0.005	-	0.010	0.010	1.65
Nd	0.008	0.052	0.095	0.034	0.084	0.021	0.004	0.029	0.028	6.58
Sm	0.014	0.015	0.026	0.010	0.025	0.023	0.006	0.038	0.007	1.28
Eu	-	0.005	0.010	0.004	0.006	-	-	-	0.002	0.233
Gd	0.011	0.047	0.021	0.011	0.024	0.008	0.011	0.020	0.010	0.723
Tb	-	0.010	0.003	0.002	0.003	-	-	-	0.002	0.074
Dy	-	0.076	0.018	0.009	0.015	0.004	0.005	0.004	0.013	0.264
Ho	-	0.017	0.003	0.002	0.003	-	0.001	-	0.003	0.038
Er	-	0.057	0.008	0.005	0.007	-	-	-	0.010	0.095
Tm	-	0.010	-	-	-	-	-	-	0.002	0.010
Yb	-	0.074	0.005	0.004	0.004	0.003	-	0.002	0.013	0.061
Lu	-	0.012	-	-	-	-	-	-	0.002	0.009
La _n /Yb _n	-	0.6	12.6	7.1	12.5	5.5	-	11.1	5.1	72.2
La _n /Sm _n	2.8	2.5	2.1	2.4	2.0	0.9	1.4	1.8	8.3	3.1
Gd _n /Yb _n	-	0.5	3.6	2.4	4.4	2.2	-	9.9	0.6	9.9
Eu/Eu*	-	0.6	3.9	1.2	0.7	-	-	-	0.7	0.7
Ce/Ce*	0.1	0.8	1.0	0.7	1.0	1.9	-	0.5	0.7	1.0

(-) = below limit of detection

Eu/Eu* = Eu_n/(Sm_n · Gd_n)^{0.5}; Ce/Ce* = Ce_n/(La_n · Pr_n)^{0.5}; the normalization is based on data given by Anders and Grevesse [22]

Table S3. Results of spatially resolved trace-element analyses by laser ablation inductively coupled plasma mass spectrometry LA-ICP-MS (in ppm).

Results	Li	B	Mn	Ge	Rb	Sr	Al	P	K	Ti
LoD	0.20	0.40	0.08	0.20	0.02	0.01	4.1	1.0	0.36	0.9
Berkutinkaya-a	0.38	0.71	0.21	0.98	< 0.02	0.04	7.5	7.6	0.75	5.1
Berkutinskaya-b	0.29	0.44	0.08	0.92	< 0.02	< 0.01	5.3	5.0	0.39	6.8
Berkutinskaya-c	0.62	0.67	0.15	0.99	< 0.02	0.04	5.4	4.4	0.46	8.8
Ky175-b	0.69	0.92	0.25	0.94	< 0.02	0.08	4.6	3.2	1.67	1.8
Ky175-c	0.79	1.9	0.16	0.95	0.02	0.04	< 4.1	1.0	< 0.36	3.3
Ky175-d	0.47	0.88	0.32	1.18	0.04	0.09	6.5	2.6	0.84	3.1
Ky175-e	0.61	0.70	0.20	0.86	< 0.02	< 0.01	4.1	3.8	0.74	4.4
Ky175-f	0.45	0.71	0.26	0.92	< 0.02	0.04	4.1	1.5	< 0.36	3.6
Ky175-g	0.48	0.64	0.24	0.84	0.04	0.04	4.7	1.2	< 0.36	3.2
Argazinskoe-a	< 0.20	5.3	0.67	1.40	< 0.02	0.02	14.2	< 1.0	< 18*	< 0.9
Argazinskoe-b	0.70	2.6	0.12	1.62	< 0.02	0.02	12.3	2.8	< 18*	< 0.9
Argazinskoe-c	1.20	3.1	0.25	1.24	< 0.02	0.03	14.5	< 1.0	< 18*	< 0.9
Vjazovka-a	1.20	1.9	0.27	1.17	< 0.02	0.03	20.9	< 1.0	< 18*	4.7
Vjazovka-b	2.30	1.9	0.24	1.31	< 0.02	0.03	32.3	< 1.0	< 18*	4.3
Vjazovka-c	1.10	1.6	0.14	1.27	< 0.02	0.04	20.9	< 1.0	< 18*	3.5
Itkulskoe-a	0.41	1.7	0.20	0.59	< 0.02	0.04	10.9	< 1.0	< 18*	2.3
Itkulskoe-b	0.60	1.9	0.20	0.51	< 0.02	0.02	< 4.1	< 1.0	< 18*	3.2
Itkulskoe-c	0.32	1.9	0.14	0.57	< 0.02	0.03	6.3	< 1.0	< 18*	2.8
Bolotnaya-a	1.20	1.8	0.34	0.48	< 0.02	0.02	9.3	< 1.0	< 18*	4.6
Bolotnaya-b	1.01	1.6	0.22	0.48	< 0.02	0.05	12.6	< 1.0	< 18*	6.2
Bolotnaya-c	0.70	1.2	0.14	0.49	< 0.02	0.03	8.5	< 1.0	< 18*	6.9
Ku414-a	0.63	0.41	0.11	0.91	0.04	0.02	6.3	3.3	1.81	3.9
Ku414-b	0.33	0.47	0.26	0.81	0.02	0.04	5.2	2.5	1.68	4.6
Ku414-c	0.42	0.59	0.13	0.97	< 0.02	0.04	7.8	2.0	1.71	3.7
Ku2136-a	0.38	1.16	0.15	1.29	< 0.02	0.06	8.5	2.9	0.56	6.6

Ku2136-b	0.34	0.74	0.13	1.31	< 0.02	0.11	6.2	< 1.0	< 0.36	6.6
Ku2136-c	0.30	0.84	0.22	1.39	0.02	0.13	9.3	< 1.0	3.01	5.4
Ku2136-d	0.66	0.52	0.21	1.38	0.03	0.22	6.3	< 1.0	1.56	7.4
Yurma-a	0.20	1.5	0.12	0.95	< 0.02	0.03	11.5	< 1.0	< 18*	2.8
Yurma-b	< 0.20	2.0	0.36	1.03	< 0.02	0.11	11.6	< 1.0	< 18*	3.4
Yurma-c	< 0.20	2.0	0.28	0.89	< 0.02	0.02	13.3	< 1.0	< 18*	1.8
MT-09-a	1.20	2.1	0.17	0.77	0.06	0.03	10.6	< 1.0	< 18*	8.2
MT-09-b	< 0.20	3.4	0.16	0.72	< 0.02	0.03	16.9	6.3	< 18*	10.7
MT-09-c	< 0.20	1.7	0.27	0.76	< 0.02	0.04	10.4	< 1.0	< 18*	36.9

In all samples: Be < 0.03 ppm, Ga < 0.1 ppm, Ca < 7.2 ppm, Na < 10.9 ppm, Sb < 0.1 ppm, U < 0.1 ppm

Fe < 0.6 ppm (except Bolotnaya-b 1.6 ppm, MT-09-b 2.9 ppm)

K < 18* (limit of detection was 18 ppm)