SUPPLEMENTARY INFORMATION

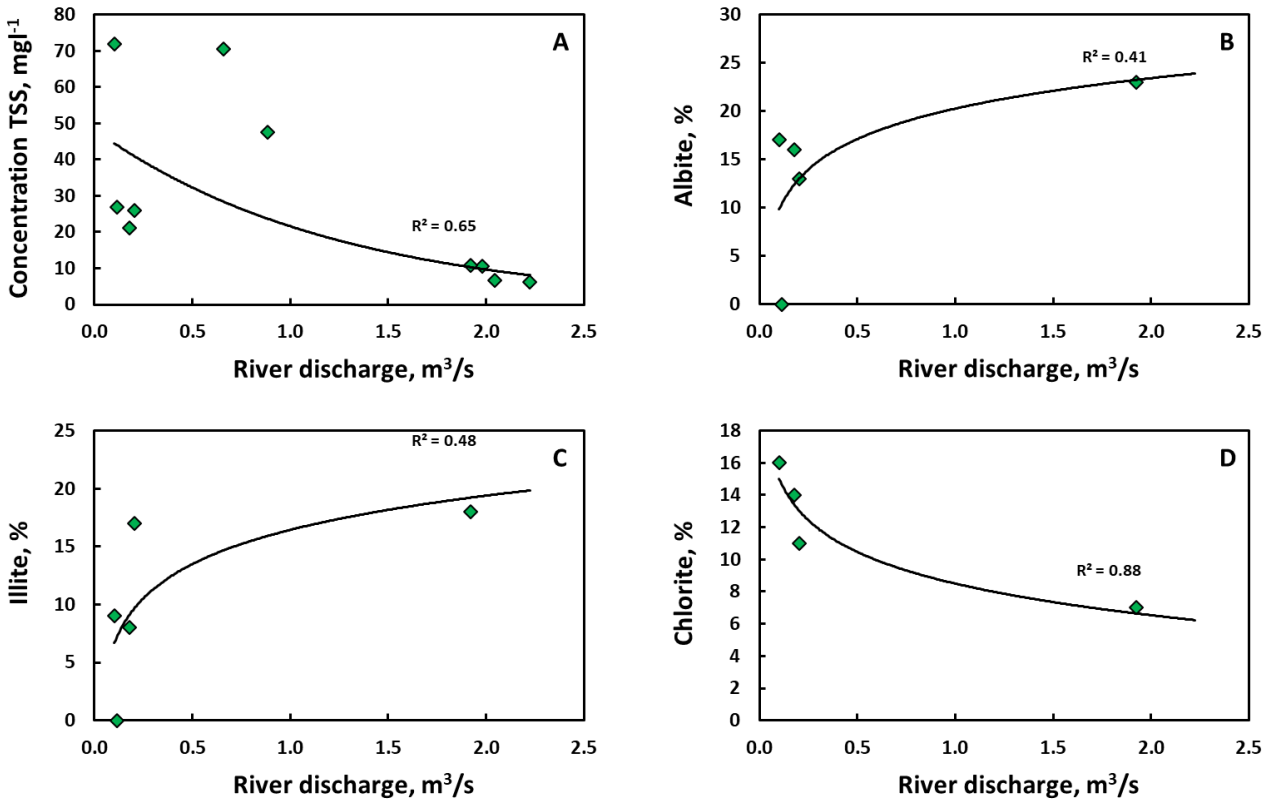

Figure S1. Mass percentage of different minerals in the RSM of two small tributaries of the Ob River as a function of river discharge. A, Total suspended solid; B, albite; C, illite; and D, chlorite. Significant ($p < 0.05$) trends are visualized via empirical logarithmic or power regression.

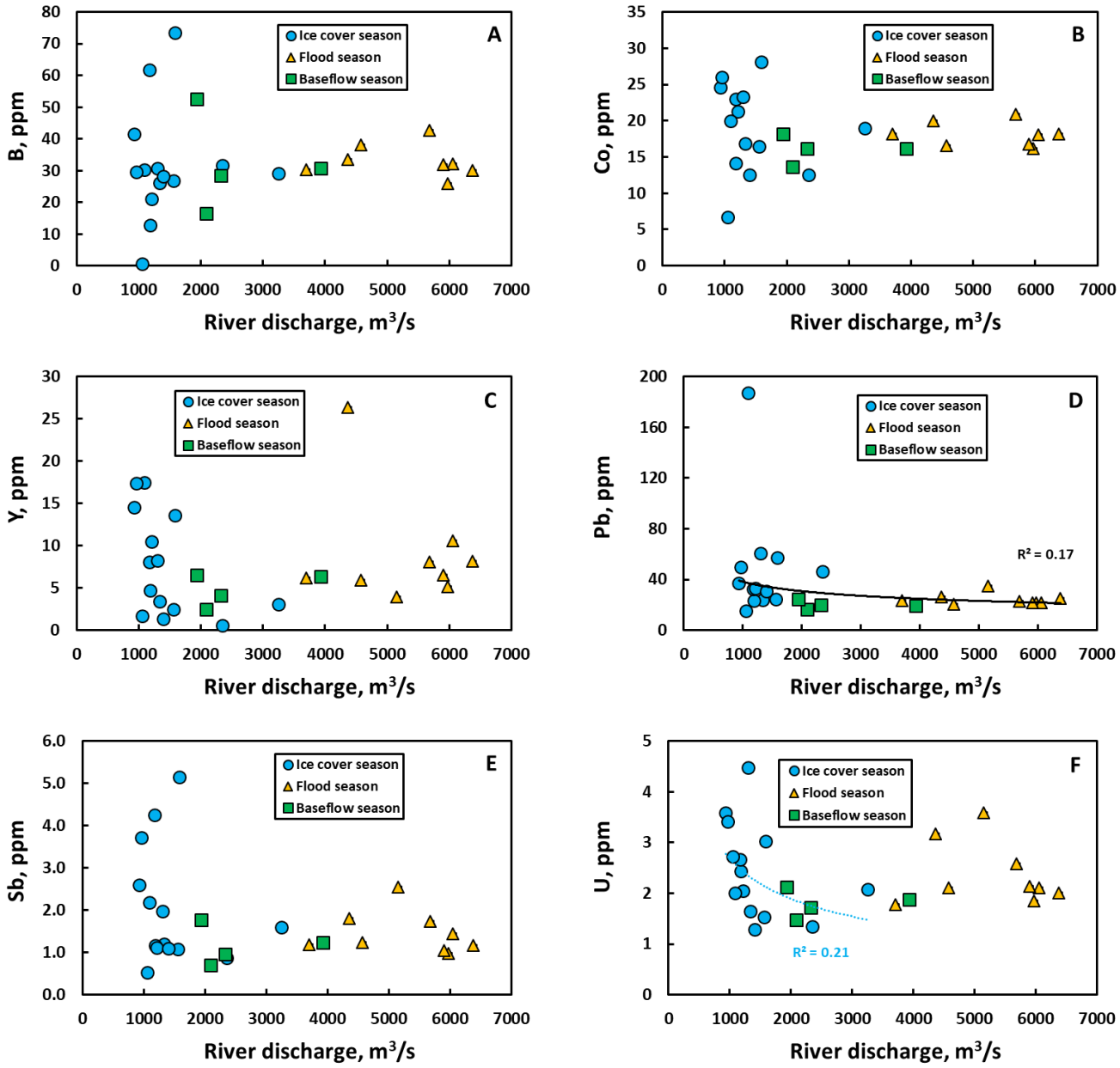

Figure S2. Elements, showing lack of discharge - concentration dependence in the RSM of the Ob River during winter (blue circles), spring flood (yellow triangles), and summer baseflow (green squares). Significant ($p < 0.05$) trends are visualized via empirical logarithmic or power regression.

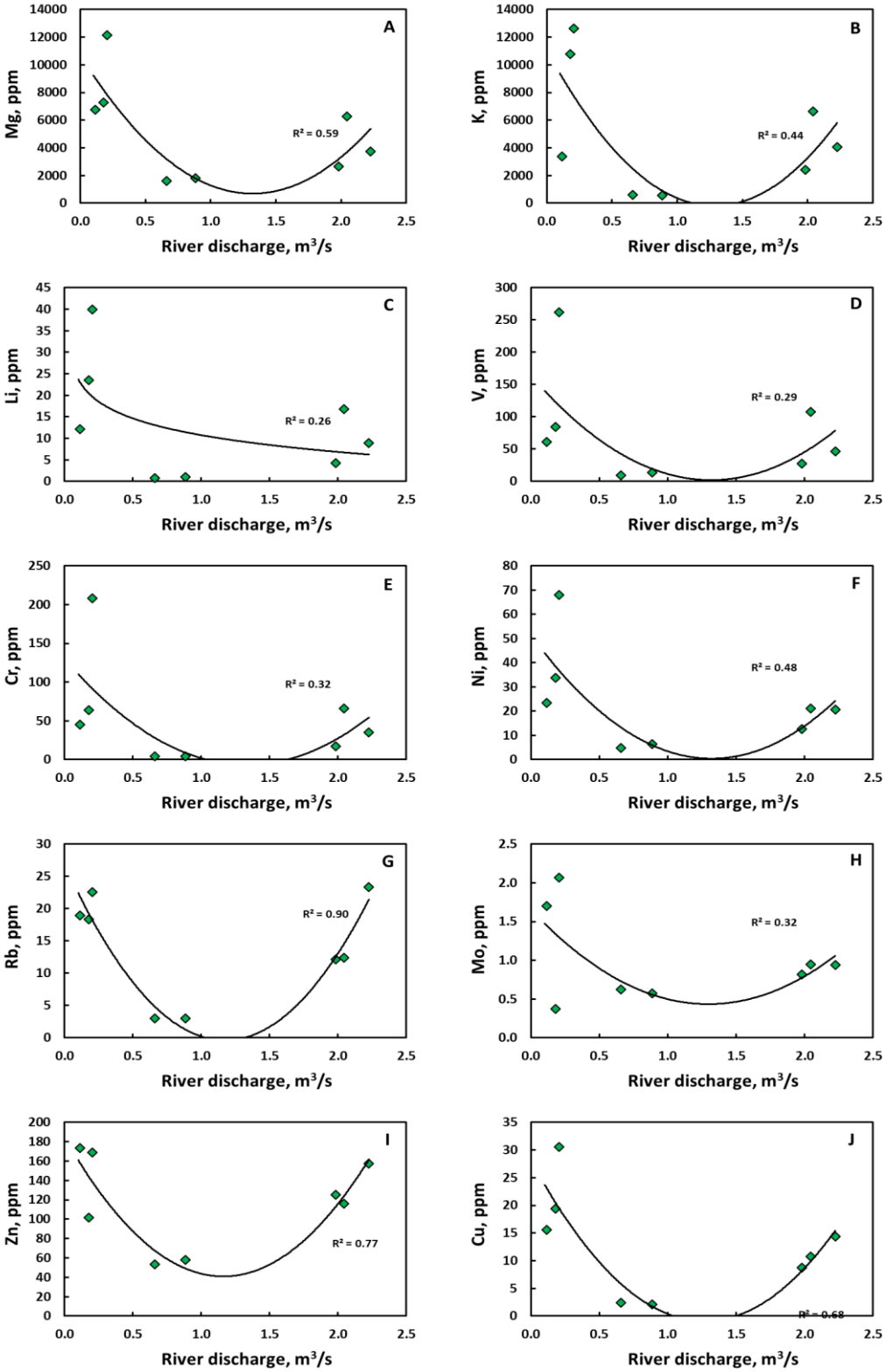

Figure S3. Major and trace element concentration in the RSM of the small tributaries of the Ob River as a function of river discharge. Significant ($p < 0.05$) trends are visualized via empirical logarithmic or power regression.

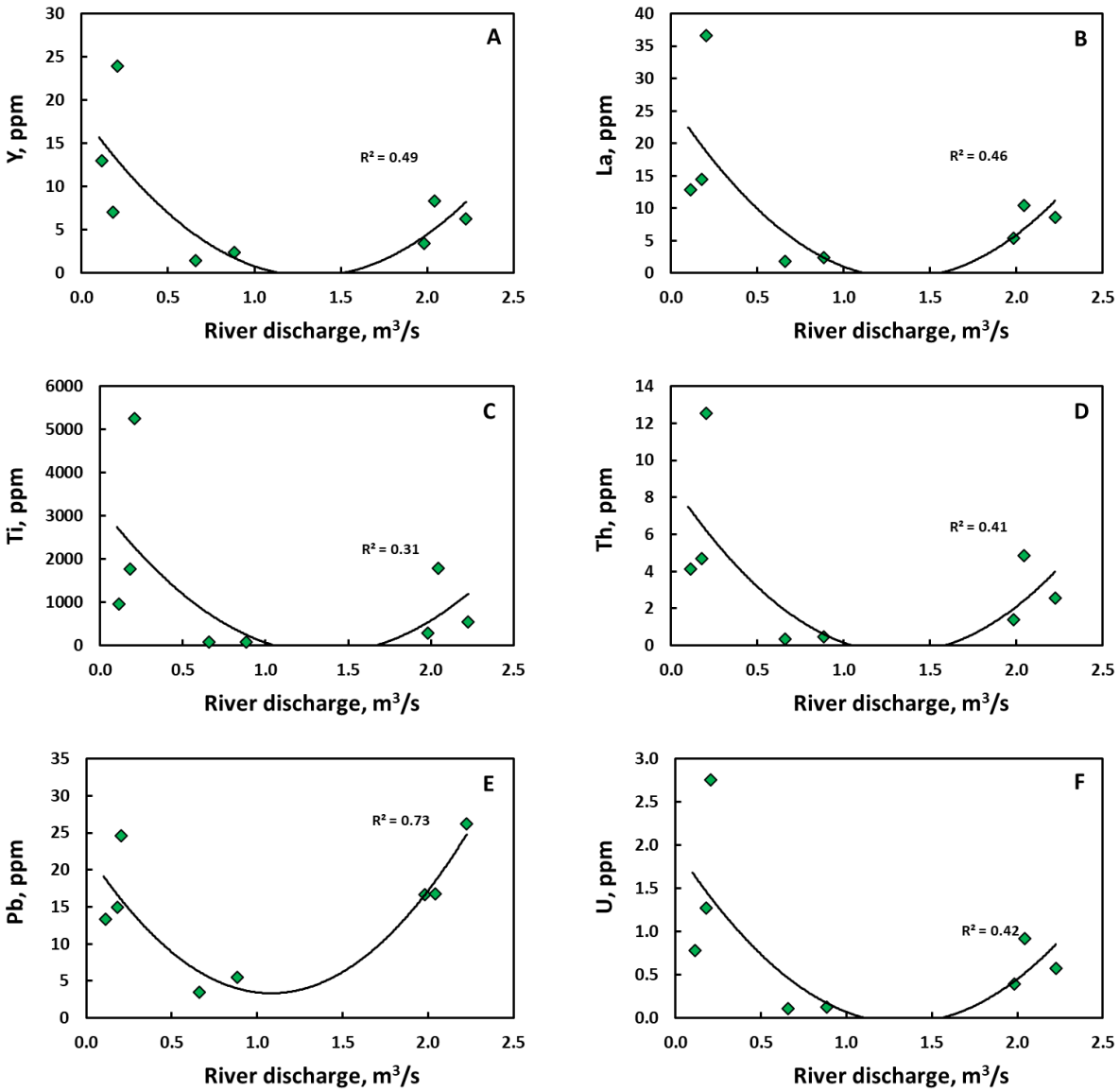

Figure S4. Major and trace element concentration in the RSM of the small tributaries of the Ob River as a function of river discharge. Significant ($p < 0.05$) trends are visualized via empirical logarithmic or power regression.

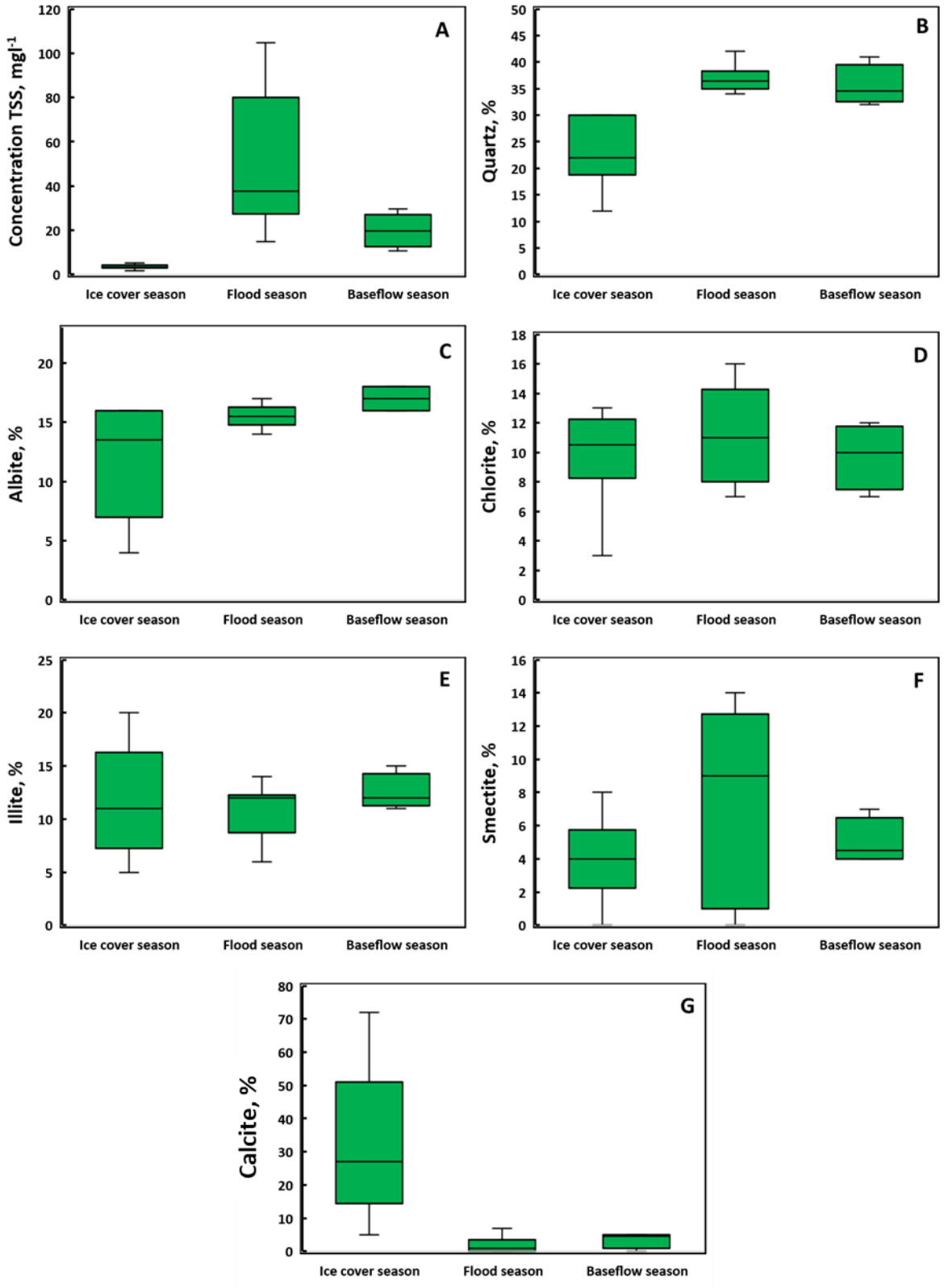

Figure S5. Seasonal pattern of total suspended solid (A) and mass percentage of different minerals (quartz, B; albite, C; chlorite, D; illite, E; smectite, F; calcite, G) in the RSM of the Ob River.

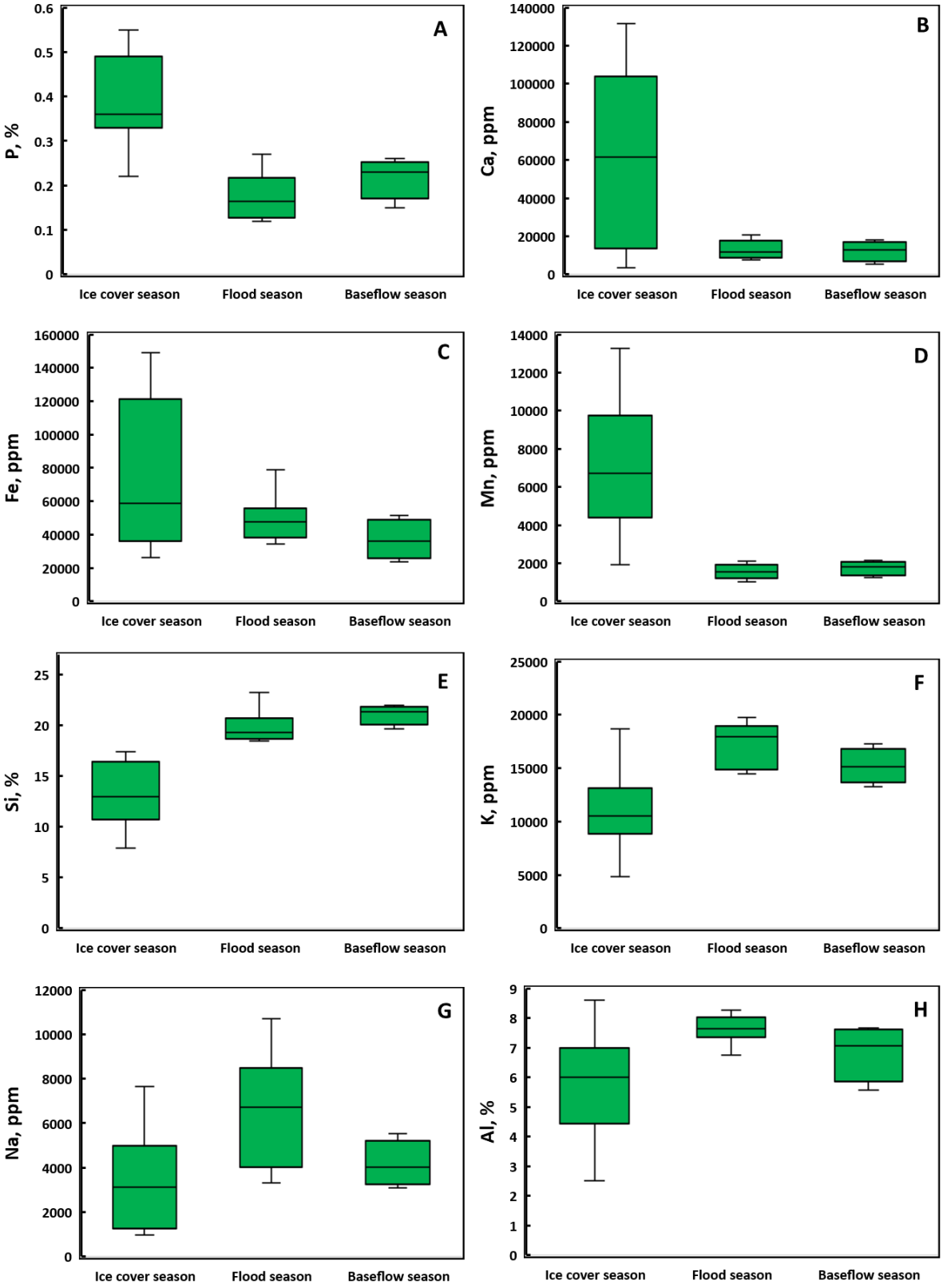

Figure S6. Seasonal pattern of element concentration in the RSM of the Ob River.

Table S1. Mineralogical composition of sediments and RSM concentration in the Ob River and tributaries.

Mineral composition of the Ob River

Date	Discharge $m^3 s^{-1}$	TSS $mg L^{-1}$	Quartz	Albite	Potassium feldspars	Amphi-bole	Pyro-xene	Musco-vite	Calcite	Smectite	Illite	Kaoli-nite	Chlorite	Vermiculite
04.11.2016	1560	3.30	30	16	8		4		5	4	20	3	10	
04.12.2016	1340	3.33	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
05.01.2017	1180	4.60	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
05.02.2017	1170	1.88	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
10.03.2017	1210	4.21	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
16.03.2017	1300	2.79	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
05.04.2017	3250	18.3	30	16	8	5	5			5	15	5	11	
01.03.2018	1050	3.02	12	4	1				72	trace	5	2	3	
01.04.2018	2350	2.83	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
29.11.2018	1590	3.40	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
28.12.2018	1400	3.50	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
17.01.2019	1090	3.60	22	8	5	3	2		27	8	8	2	13	
08.02.2019	930	5.10	22	14	5	trace	3		30	4	9	3	10	
03.03.2019	960	3.44	21	13	7	2	3		24	3	13	2	12	
05.05.2017	5970	29.3	38	16	6	4		3	1	8	12	3	8	

28.04.2018	4570	105	42	15	7	3	3		trace		12	5	10	3
05.05.2018	5150	89.0	37	17	6	3	3			4	10	3	16	
12.05.2018	5680	62.4	37	15	7	3	3	3	trace	trace	6	2	14	9
23.05.2018	6050	77.0	35	16	5	3	3		2	12	8	2	14	
10.06.2018	6380	32.2	36	15	7		2	3	1	13	12	2	9	
25.06.2018	5900	14.9	39	16	6	4	3			10	14	1	7	
27.04.2019	3700	27.5	36	19	8	5			7	trace	13	4	8	
17.05.2019	4360	27.2	34	14	5	3	2	4	trace	14	9	3	12	
01.06.2019	4480	43.0	35	14	8	4		2	4		12		15	6
26.07.2018	3930	29.5	32	18	6	3	1	3	5	7	11	2	11	
06.09.2018	2330	20.1	35	18	8		4	4	5	4	12	3	7	
28.09.2018	2090	19.0	41	16	8	3	2		trace	4	12	2	12	
19.10.2018	1940	10.7	34	16	7	4	3		4	5	15	3	9	

Mineral composition of tributaries

	Date	Discharge $m^3 s^{-1}$	TSS $mg L^{-1}$	Quartz	Albite	Potassium feldspars	Amphibole	Pyroxene	Muscovite	Calcite	Smectite	Illit	Kaolinite	Chlorite	Vermiculite
Rybnaya	**10.05.2018**	1.98	10.6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Rybnaya	**05.07.2018**	0.659	70.4	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Rybnaya	**20.09.2018**	0.115	26.8	90	trace	trace	trace				trace	trace	trace		
Rybnaya	**21.10.2018**	0.101	71.8	36	17	8	6	3				9	5	16	trace
Andreva	**10.05.2018**	2.22	6.29	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Andreva	**05.07.2018**	0.885	47.6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Andreva	**20.09.2018**	0.206	26.0	35	13	11	6				trace	17	6	11	
Andreva	**21.10.2018**	0.180	21.2	34	16	7	5	3				8	4	14	9
Andreva	**17.05.2019**	2.04	6.67	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Andreva	**01.06.2019**	1.92	10.8	41	23	9		trace			trace	18	trace	7	

Table S2. Chemical composition of sediments and RSM concentration in the Ob River and tributaries.

Elemental composition Ob' river

Date	04.11.2016	04.12.2016	05.01.2017	05.02.2017	10.03.2017	16.03.2017	05.04.2017	01.03.2018	01.04.2018	29.11.2018	28.12.2018	17.01.2019	08.02.2019	03.03.2019	05.05.2017	28.04.2018	05.05.2018	12.05.2018	23.05.2018	10.06.2018	25.06.2018	27.04.2019	17.05.2019	26.07.2018	06.09.2018	28.09.2018	19.10.2018
Si,%	17.4	n.d.	10.7	n.d.	n.d.	n.d.	15.4	n.d.	n.d.	n.d.	n.d.	12.4	16.4	13.0	20.2	18.8	23.3	22.2	19.4	18.9	18.5	20.2	19.2	22.0	21.3	19.7	21.5
Al,%	6.98	n.d.	4.43	n.d.	n.d.	n.d.	8.60	2.52	n.d.	n.d.	n.d.	5.18	6.12	6.00	7.94	7.49	8.26	8.01	7.52	8.10	7.42	7.13	7.74	7.67	7.45	5.58	6.66
P,%	0.330	n.d.	0.550	n.d.	n.d.	n.d.	0.220	0.340	n.d.	n.d.	n.d.	0.360	0.450	0.490	0.160	0.270	0.130	0.120	0.120	0.170	0.150	0.270	0.170	0.150	0.230	0.260	0.230
Li, ppm	16.1	17.8	15.8	34.5	20.0	25.7	20.3	5.90	11.1	51.0	13.2	31.8	40.6	37.6	23.5	27.5	36.4	28.4	33.2	35.6	20.1	23.2	37.9	23.5	18.6	11.4	20.4
Be, ppm	1.36	1.52	1.14	2.31	1.47	1.92	1.75	0.435	1.13	3.65	0.342	2.01	2.53	2.35	1.75	2.01	3.90	2.57	2.38	1.98	1.89	1.83	2.47	1.99	1.78	1.43	2.30
B, ppm	26.7	26.0	12.8	61.7	21.0	30.7	29.2	0.624	31.6	73.5	28.1	30.4	41.5	29.5	25.8	38.1	64.0	42.6	32.0	30.1	31.9	30.2	33.5	30.8	28.4	16.5	52.6
Na, ppm	1140	1180	3460	1780	2770	4620	1310	2160	969	4070	4060	7670	7310	6060	5390	8460	3640	7040	10700	6710	4410	3310	8490	5530	3740	3080	4290
Mg, ppm	2380	3110	6510	6580	7000	10610	2450	3260	910	10600	2860	13700	12800	15100	6140	8280	4270	6330	11200	11400	4890	4960	13000	4090	2650	1280	3990
K, ppm	9060	10400	8230	11500	10600	11700	10400	4850	9190	18700	7400	13000	18000	13400	14700	16900	19500	18000	18300	18300	14500	15000	19700	15400	14900	13300	17300
Ca, ppm	8690	15300	87900	30500	47400	114000	3570	132000	4400	39000	75900	111000	81050	101000	8880	12800	7700	10100	17800	11900	8560	17600	20600	14100	11300	5320	18100
Ti, ppm	1060	1230	903	3920	976	1660	1370	449.0	980	4300	814	2260	3170	2730	1780	2600	4720	3510	3010	2180	1890	2020	3120	2520	1870	1320	3210
V, ppm	120	113	99.2	422	116	175	92.4	41.5	62.2	388	59.6	184	271	256	106	130	277	179	153	125	112	129	183	133	110	79.9	185
Cr, ppm	59.2	75.3	64.8	260	81.1	130	64.5	25.9	40.0	465	42.1	146	207	207	82.3	110	208	127	134	104	89.3	92.8	151	104	80.2	53.1	134
Mn, ppm	9850	5690	7060	9710	13300	9660	1990	2140	1940	9390	6350	5150	5380	13000	1490	1030	1660	1210	1230	1750	1560	3390	2100	1270	1680	1910	2150
Fe, ppm	43500	37100	53800	149000	64100	105000	32500	26200	27800	126000	43100	84300	120000	127000	34400	45400	78700	52800	50600	41400	35500	47500	58400	40100	32200	23600	51700
Co, ppm	16.5	16.8	14.2	23.0	21.3	23.3	19.0	6.72	12.5	28.1	12.6	20.0	24.6	26.0	16.2	16.6	29.9	20.9	18.1	18.2	16.7	18.1	20.0	16.2	16.1	13.7	18.1
Ni, ppm	47.1	50.6	36.8	63.1	48.7	56.0	58.2	18.3	39.7	138	32.9	64.3	85.5	78.3	50.4	49.8	102	67.2	56.3	55.7	52.7	54.4	58.7	54.7	50.8	41.1	61.8
Cu, ppm	34.5	38.4	49.2	84.0	57.6	76.2	57.8	20.2	33.5	76.4	27.5	53.5	62.9	75.4	31.8	29.0	58.6	37.1	32.3	35.9	33.5	38.5	39.7	32.8	35.3	33.0	43.3
Zn, ppm	152	122	122	160	186	214	204	156	120	278	466	241	406	306	74.7	69.7	105	78.1	88.4	88.8	73.4	105	114	60.1	66.4	69.2	81.2
Ga, ppm	11.3	12.4	9.48	24.7	11.6	15.3	14.9	4.21	8.37	31.8	7.24	19.1	24.9	23.5	14.7	17.1	33.6	20.0	19.3	17.3	15.4	15.7	22.5	16.3	14.2	11.1	18.2
Ge, ppm	0.957	1.03	0.886	3.25	0.873	1.29	1.03	0.295	0.700	1.56	0.702	1.73	1.49	1.90	1.12	0.907	1.90	1.15	1.28	0.895	0.923	0.866	1.70	1.16	0.779	0.874	1.01
As, ppm	64.1	39.7	60.8	210	79.2	141	10.3	33.6	20.1	135	56.2	99.1	144	151	12.2	20.2	26.5	18.6	24.5	17.9	13.1	25.9	27.7	13.9	13.2	12.5	31.7
Rb, ppm	7.38	5.41	47.5	4.50	43.5	54.1	13.5	25.8	1.6	21.9	24.9	47.1	32.5	37.7	7.60	6.88	5.42	26.3	22.7	14.0	18.2	13.8	n.d.	8.70	6.33	7.88	7.40
Sr, ppm	56.1	97.7	569	190	373	786	39.4	729	45.3	282	467	666	536	632	80.1	112	76.7	104	150	110	74.5	107	191	91.6	72.1	53.8	116
Y, ppm	2.46	3.38	4.75	8.11	10.5	8.27	3.08	1.68	0.62	13.6	1.37	17.4	14.6	17.4	5.11	5.92	3.91	8.09	10.6	8.17	6.54	6.17	26.4	6.36	4.11	2.49	6.52
Zr, ppm	49.7	57.1	24.7	133	36.4	49.2	66.6	4.96	38.3	180	7.33	76.6	109	77.8	70.6	91.7	159	115	102	84.5	75.3	76.0	123	93.0	71.9	53.2	112
Nb, ppm	5.85	6.77	4.98	22.4	5.45	9.19	6.87	2.36	5.08	22.7	3.25	12.0	16.5	14.8	9.20	13.8	25.1	18.2	15.3	11.6	9.77	10.6	17.1	12.7	9.56	5.78	17.5

Mo, ppm	0.661	0.774	0.942	4.12	0.987	3.82	0.561	0.516	0.889	4.96	0.622	1.45	1.66	3.15	0.471	0.964	1.33	1.01	0.976	0.698	0.575	0.628	1.34	0.520	0.461	0.418	0.948
Cd, ppm	0.687	0.691	1.44	0.982	0.795	1.05	0.696	0.252	0.513	0.995	0.494	0.437	0.877	0.976	0.466	0.425	0.601	0.376	0.354	0.392	0.448	0.492	0.444	0.397	0.430	0.405	0.544
Sn, ppm	1.99	3.53	4.35	26.8	5.81	10.6	2.10	1.79	2.67	21.8	2.94	9.40	8.69	15.4	2.52	3.83	5.81	4.05	4.35	3.55	2.85	2.96	5.43	3.34	2.87	2.15	5.37
Sb, ppm	1.07	1.21	1.16	4.25	1.11	1.99	1.60	0.535	0.879	5.14	1.10	2.18	2.60	3.72	0.976	1.24	2.54	1.73	1.45	1.17	1.05	1.19	1.80	1.24	0.956	0.699	1.77
Cs, ppm	0.506	0.334	3.47	0.355	3.02	3.25	0.973	1.72	0.040	1.31	0.438	2.09	1.64	1.66	0.223	0.148	0.147	1.57	1.16	0.682	1.08	0.782	4.83	0.331	0.216	0.386	0.251
Ba, ppm	218	269	490	562	659	772	156	296	135	697	307	696	818	733	263	323	309	304	410	365	228	321	470	285	257	175	333
La, ppm	2.86	5.41	13.0	7.31	16.0	21.3	3.63	3.25	1.45	26.3	2.21	26.0	31.8	29.1	9.65	7.95	4.53	9.25	14.5	13.1	9.46	9.47	41.0	13.5	9.71	4.13	11.9
Ce, ppm	9.75	21.8	25.7	17.3	31.1	40.8	7.95	5.26	5.45	73.8	3.97	50.1	64.1	53.9	29.7	24.3	15.6	24.7	39.8	40.1	24.5	29.4	96.7	39.2	30.6	12.7	37.4
Pr, ppm	0.880	1.84	3.01	2.49	3.75	5.11	0.954	0.705	0.695	7.12	0.545	6.09	7.71	6.84	3.65	3.49	2.10	3.11	5.25	4.98	3.05	3.22	11.0	4.53	3.47	1.53	4.41
Nd, ppm	3.74	7.62	11.8	11.0	14.7	20.1	3.77	2.96	3.08	28.8	2.23	23.8	30.3	27.1	15.4	15.5	9.48	13.1	22.7	21.3	12.7	13.5	43.5	18.7	14.2	6.41	18.5
Sm, ppm	0.844	1.66	2.22	2.70	2.71	3.80	0.830	0.503	0.678	5.96	0.440	4.61	5.64	5.34	3.29	3.76	2.36	2.94	5.03	4.57	2.72	2.86	8.82	3.93	2.90	1.39	4.04
Eu, ppm	0.203	0.383	0.481	0.673	0.640	0.872	0.195	0.134	0.153	1.38	0.135	1.05	1.30	1.21	0.739	0.846	0.545	0.677	1.17	1.01	0.616	0.640	1.84	0.853	0.631	0.327	0.878
Gd, ppm	0.842	1.57	2.06	2.66	2.72	3.61	0.786	0.503	0.547	5.65	0.449	4.60	5.30	5.16	2.84	3.22	2.04	2.70	4.50	4.03	2.44	2.60	8.19	3.49	2.56	1.18	3.46
Tb, ppm	0.124	0.203	0.274	0.410	0.361	0.471	0.133	0.0686	0.0792	0.812	0.0666	0.615	0.715	0.690	0.375	0.460	0.322	0.396	0.630	0.556	0.336	0.350	1.10	0.463	0.331	0.172	0.473
Dy, ppm	0.693	1.16	1.56	2.46	2.12	2.70	0.688	0.386	0.416	4.61	0.413	3.46	4.01	3.87	2.12	2.60	1.80	2.24	3.61	3.12	1.88	2.00	6.15	2.54	1.86	1.00	2.71
Ho, ppm	0.132	0.213	0.285	0.482	0.399	0.498	0.140	0.0757	0.0732	0.846	0.0839	0.668	0.747	0.742	0.379	0.464	0.335	0.477	0.638	0.538	0.343	0.355	1.11	0.441	0.310	0.184	0.481
Er, ppm	0.374	0.570	0.782	1.41	1.14	1.37	0.387	0.220	0.209	2.43	0.241	1.91	2.08	2.13	1.01	1.25	0.920	1.19	1.82	1.50	0.971	1.02	3.10	1.25	0.897	0.518	1.36
Tm, ppm	0.0513	0.0800	0.111	0.204	0.165	0.178	0.0578	0.0318	0.0263	0.338	0.0356	0.266	0.277	0.283	0.134	0.167	0.126	0.168	0.242	0.199	0.133	0.144	0.425	0.167	0.123	0.0628	0.172
Yb, ppm	0.316	0.516	0.644	1.30	1.02	1.10	0.374	0.187	0.173	2.12	0.208	1.75	1.82	1.79	0.870	1.03	0.809	1.06	1.52	1.26	0.859	0.903	2.69	1.02	0.762	0.448	1.15
Lu, ppm	0.0471	0.0653	0.0879	0.188	0.154	0.156	0.0581	0.0276	0.0206	0.302	0.0345	0.251	0.268	0.263	0.118	0.144	0.109	0.151	0.211	0.174	0.114	0.134	0.389	0.138	0.100	0.0592	0.153
Hf, ppm	1.82	2.18	0.826	5.12	1.28	1.72	2.43	0.184	1.39	6.73	0.321	2.76	4.03	2.72	2.74	3.46	5.97	4.26	3.87	3.14	2.75	2.83	4.65	3.46	2.74	1.93	4.23
Ta, ppm	0.376	0.483	0.348	1.59	0.382	0.608	0.473	0.153	0.312	1.64	0.272	0.919	1.27	1.12	0.665	1.10	1.71	1.28	1.21	0.857	0.692	0.760	1.27	0.871	0.677	0.377	1.27
W, ppm	1.45	1.72	4.28	7.55	1.60	2.58	0.958	0.633	0.902	6.25	1.07	3.71	5.48	5.37	2.22	3.12	3.09	2.46	3.21	2.84	1.46	1.78	3.38	1.84	1.50	0.811	2.68
Tl, ppm	0.322	0.355	0.253	0.633	0.318	0.392	0.253	0.114	0.224	0.726	0.261	0.504	0.681	0.644	0.441	0.491	0.789	0.531	0.535	0.511	0.477	0.490	0.580	0.465	0.455	0.359	0.584
Pb, ppm	24.2	24.1	23.6	32.8	33.1	60.7	n.d.	15.2	46.1	57.4	30.9	187	37.3	49.6	21.8	20.6	34.8	22.7	21.9	25.0	21.5	23.3	26.3	19.4	19.9	16.7	24.3
Th, ppm	1.21	1.81	3.22	3.39	3.62	2.50	1.23	0.509	0.355	6.81	0.225	5.12	7.25	6.20	3.95	4.88	2.57	3.69	7.00	6.47	3.73	3.36	13.9	4.33	2.83	1.21	3.78
U, ppm	1.53	1.64	2.43	2.66	2.04	4.48	2.08	2.73	1.34	3.03	1.29	2.01	3.58	3.41	1.85	2.11	3.58	2.59	2.11	2.00	2.14	1.78	3.17	1.87	1.72	1.48	2.13

Elemental composition of tributaries. All concentrations are in ppm unless indicated.

	Rybnaya	Rybnaya	Rybnaya	Andreva	Andreva	Andreva	Andreva	Andreva
Date	**10.05.2018**	**05.07.2018**	**20.09.2018**	**10.05.2018**	**05.07.2018**	**20.09.2018**	**21.10.2018**	**17.05.2019**
Si,%	n.d.	n.d.	5.26	n.d.	n.d.	13.7	16.9	n.d.
Al,%	n.d.	n.d.	0.990	n.d.	n.d.	4.84	5.22	n.d.
P,%	n.d.	n.d.	1.14	n.d.	n.d.	0.590	0.520	n.d.
Li	4.27	0.722	12.2	8.91	1.03	39.9	23.5	16.9
Be	0.333	0.126	0.924	0.632	0.175	2.70	1.29	0.944
B	3.75	n.d.	27.9	13.5	1.49	49.8	16.9	15.9
Na	1030	390	2810	1450	350	8330	7220	4150
Mg	2650	1620	6770	3730	1790	12200	7280	6280
K	2410	600	3380	4060	561	12600	10780	6650
Ca	15700	24500	67400	12500	23800	45100	17900	16300
Ti	285	82.3	965	539	74.0	5247	1773	1781
V	27.7	9.77	61.3	46.6	13.6	262	84.6	107
Cr	16.8	4.06	45.3	35.0	4.53	208	64.1	65.8
Mn	22900	49200	88100	19400	55400	30400	3650	8680
Fe	149000	171000	681000	122000	159000	351000	111000	149000
Co	43.9	79.3	70.0	36.9	126	30.3	14.7	21.4
Ni	12.6	4.85	23.3	20.6	6.36	67.9	33.8	21.2
Cu	8.73	2.41	15.6	14.4	2.14	30.6	19.4	10.8
Zn	125	53.4	173	158	58.0	169	101	116
Ga	4.99	4.24	11.6	6.67	4.24	29.9	11.5	8.56
Ge	0.240	0.144	0.969	0.223	0.152	2.70	1.07	0.911
As	152	348	834	53.4	102	167	46.0	83.1
Rb	12.2	2.98	18.9	23.4	3.04	22.6	18.4	12.4
Sr	102	198	591	100	199	365	179	133
Y	3.46	1.43	13.0	6.22	2.36	23.9	7.06	8.34
Zr	11.3	3.24	40.7	21.9	3.55	187	60.8	55.2
Nb	1.54	0.443	4.71	2.88	0.369	25.5	9.00	9.41
Mo	0.818	0.627	1.70	0.939	0.576	2.07	0.375	0.948

Cd	0.837	0.207	0.486	0.771	0.264	0.480	0.270	0.556
Sn	1.09	0.208	2.05	2.24	0.317	6.28	2.03	2.84
Sb	1.38	0.210	0.904	2.27	0.330	2.43	0.685	0.854
Cs	0.820	0.180	1.45	1.59	0.182	0.897	0.777	0.712
Ba	399	741	2484	493	936	1374	585	528
La	5.37	1.84	12.8	8.58	2.35	36.6	14.5	10.4
Ce	13.0	4.14	28.0	22.9	6.70	88.4	35.0	25.7
Pr	1.16	0.406	3.21	2.04	0.588	10.6	4.39	3.31
Nd	4.59	1.63	13.1	7.95	2.33	42.2	17.3	13.6
Sm	0.945	0.329	2.83	1.60	0.510	8.75	3.56	3.03
Eu	0.223	0.132	0.865	0.381	0.191	2.09	0.834	0.741
Gd	0.936	0.355	2.89	1.59	0.545	8.42	3.16	2.89
Tb	0.126	0.0474	0.414	0.217	0.0740	1.18	0.417	0.409
Dy	0.690	0.255	2.45	1.26	0.441	6.82	2.37	2.39
Ho	0.135	0.0529	0.472	0.229	0.0794	1.24	0.419	0.441
Er	0.370	0.140	1.36	0.704	0.239	3.62	1.18	1.26
Tm	0.0509	0.0225	0.207	0.0984	0.0304	0.523	0.155	0.173
Yb	0.343	0.127	1.30	0.658	0.207	3.40	1.01	1.15
Lu	0.0485	0.0196	0.190	0.0949	0.0280	0.484	0.138	0.166
Hf	0.417	0.113	1.53	0.836	0.231	7.20	2.38	2.24
Ta	0.0950	0.0324	0.330	0.202	0.0225	1.83	0.852	0.678
W	0.646	0.200	2.58	0.975	0.204	3.92	1.42	1.89
Tl	0.141	0.0939	0.122	0.161	0.0535	0.569	0.304	0.196
Pb	16.7	3.54	13.3	26.2	5.51	24.6	15.0	16.8
Th	1.41	0.343	4.13	2.55	0.454	12.6	4.69	4.84
U	0.390	0.108	0.784	0.572	0.128	2.76	1.27	0.921

Table S3. Mann-Whitney (U-test) for the difference in mineralogical and chemical composition of the RSM from the Ob River main stem (n = 28) and two small tributaries (n = 10).

Ob River vs. tributaries	U	Z	p-value
RSM Concentration	99	-1.34	0.18
Si,%	21	2.02	0.04
Al,%	12	2.60	0.01
P,%	5	-3.06	0.002
Quartz	30	-1.32	0.19
Albite	29	-1.43	0.15
Potassium feldspars	12	-2.58	0.01
Amphibole	5	-2.55	0.01
Pyroxene	14	-1.06	0.29
Smectite	5	-2.21	0.03
Illite	34	-1.05	0.29
Kaolinite	4	-3.09	0.002
Chlorite	31	-0.70	0.49
Li	48	2.34	0.02
Be	35	2.85	0.004
B	39	2.34	0.02
Na	72	1.39	0.16
Mg	88	0.77	0.44
Al	80	1.08	0.28
P	26	-3.20	0.001
K	19	3.48	0.001
Ca	92	-0.61	0.54
Ti	52	2.18	0.03
V	37	2.77	0.01
Cr	41	2.61	0.01
Mn	17	-3.56	0.000
Fe	9	-3.87	0.000
Co	28	-3.12	0.002
Ni	28	3.12	0.002
Cu	3	4.11	0.000
Zn	95	0.49	0.62
Ga	44	2.49	0.01
Ge	63	1.75	0.08
As	33	-2.93	0.003
Rb	87	0.67	0.50
Sr	87	-0.81	0.42
Y	107	-0.02	0.98

Zr	53	2.14	0.03
Nb	50	2.26	0.02
Mo	101	0.26	0.80
Cd	83	0.96	0.34
Sn	35	2.85	0.004
Sb	65	1.67	0.10
Cs	97	0.41	0.68
Ba	32	-2.97	0.003
La	97	0.41	0.68
Ce	88	0.77	0.44
Pr	81	1.04	0.30
Nd	81	1.04	0.30
Sm	82	1.00	0.32
Eu	91	0.65	0.52
Gd	89	0.73	0.47
Tb	87	0.81	0.42
Dy	86	0.84	0.40
Ho	85	0.88	0.38
Er	88	0.77	0.44
Tm	90	0.69	0.49
Yb	93	0.57	0.57
Lu	94	0.53	0.60
Hf	56	2.02	0.04
Ta	57	1.98	0.05
W	59	1.91	0.06
Tl	29	3.08	0.002
Pb	32	2.90	0.004
Th	99	0.33	0.74
U	21	3.40	0.001

Table S4. Pairwise Pearson linear correlation between element concentration in the RSM of he Ob River and percentage of constituting minerals. Red numbers denote significant ($p < 0.05$) correlations.

	Dis-charge	Water level	Quartz	Albite	K feldsar	Illite	Kaolinite	Chlorite	Amphibol	Pyroxene	Muscovite	Calcite	Smectite
n	*n=27*	*n=25*	*n=19*	*n=19*	*n=19*	*n=19*	*n=19*	*n=19*	*n=14*		*n=6*	*n=12*	*n=15*
Si,%	0.56	0.46	0.78	0.84	0.45	0.18	0.11	0.24	0.04	-0.16	0.61	-0.80	0.08
Al,%	0.71	0.56	0.72	0.81	0.59	0.34	0.33	0.39	0.33	0.28	0.41	-0.96	0.34
P,%	-0.83	-0.65	-0.70	-0.45	-0.12	0.09	0.08	-0.22	-0.26	0.13	0.20	0.60	-0.55
TSS	0.73		0.58	0.31	0.10	-0.25	0.29	0.47	-0.20	-0.03	-0.53	-0.52	0.28
Li	0.20	0.38	0.02	0.12	0.00	-0.23	0.00	0.60	-0.55	-0.26	0.03	-0.29	0.33
Be	0.31	0.47	0.31	0.40	0.18	-0.13	0.05	0.75	-0.36	-0.11	0.07	-0.56	0.00
B	0.13	0.28	0.39	0.47	0.30	0.09	0.21	0.59	-0.07	0.07	-0.12	-0.62	-0.14
Na	0.47	0.52	0.13	-0.07	-0.24	-0.51	-0.17	0.41	-0.59	-0.47	-0.02	-0.20	0.64
Mg	0.03	0.16	-0.29	-0.30	-0.26	-0.35	-0.18	0.32	-0.57	-0.33	0.11	0.08	0.42
K	0.59	0.63	0.57	0.51	0.22	-0.17	0.02	0.54	-0.34	-0.42	0.17	-0.68	0.47
Ca	-0.61	-0.43	-0.90	-0.86	-0.67	-0.46	-0.28	-0.22	-0.46	-0.19	0.58	0.89	-0.18
Ti	0.30	0.44	0.26	0.30	0.05	-0.27	0.00	0.70	-0.45	-0.23	0.00	-0.43	0.06
V	-0.14	0.02	-0.12	0.10	0.02	-0.14	-0.04	0.62	-0.55	-0.11	0.16	-0.10	-0.22
Cr	-0.09	0.12	-0.10	0.07	-0.05	-0.22	-0.07	0.61	-0.61	-0.20	0.21	-0.09	-0.07
Mn	-0.67	-0.54	-0.51	-0.19	0.14	0.37	-0.09	0.09	-0.40	0.17	0.72	0.15	-0.44
Fe	-0.38	-0.20	-0.43	-0.17	-0.10	-0.15	-0.08	0.42	-0.58	-0.08	0.15	0.19	-0.26
Co	0.02	0.16	0.08	0.30	0.26	0.03	0.09	0.71	-0.35	0.09	0.05	-0.35	-0.24
Ni	0.05	0.25	0.07	0.30	0.21	-0.03	0.06	0.69	-0.32	0.04	-0.19	-0.32	-0.28
Cu	-0.42	-0.32	-0.32	0.02	0.19	0.10	0.12	0.48	-0.20	0.22	0.55	0.03	-0.47
Zn	-0.57	-0.46	-0.72	-0.40	-0.21	-0.08	0.05	0.08	-0.21	0.18	0.40	0.49	-0.35
Ga	0.21	0.37	0.15	0.27	0.10	-0.15	0.05	0.72	-0.44	-0.13	0.21	-0.35	-0.03
Ge	-0.09	0.01	-0.08	0.05	0.02	-0.12	-0.07	0.76	-0.60	-0.22	0.26	-0.18	-0.02
As	-0.61	-0.44	-0.65	-0.37	-0.16	-0.04	-0.14	0.15	-0.52	0.00	0.43	0.37	-0.36
Rb	-0.19	-0.11	-0.38	-0.45	-0.42	-0.43	-0.19	0.20	-0.34	-0.29	0.53	0.57	0.47
Sr	-0.59	-0.40	-0.89	-0.84	-0.66	-0.48	-0.28	-0.16	-0.51	-0.20	0.42	0.86	-0.13
Y	0.00	0.05	-0.23	-0.22	-0.22	-0.31	-0.16	0.35	-0.46	-0.38	0.52	0.06	0.44
Zr	0.33	0.47	0.41	0.45	0.17	-0.14	0.10	0.70	-0.29	-0.21	0.16	-0.63	0.17
Nb	0.27	0.41	0.24	0.27	0.04	-0.25	0.01	0.67	-0.43	-0.22	0.06	-0.42	0.07

Mo	-0.36	-0.22	-0.41	-0.23	-0.08	-0.13	-0.11	0.42	-0.63	-0.06	0.33	0.20	-0.19
Cd	-0.54	-0.43	-0.30	0.15	0.30	0.43	0.23	0.23	-0.09	0.41	0.44	-0.03	-0.61
Sn	-0.37	-0.23	-0.44	-0.25	-0.08	-0.15	-0.18	0.38	-0.62	-0.16	0.39	0.18	-0.21
Sb	-0.26	-0.10	-0.33	-0.07	0.03	-0.08	-0.01	0.55	-0.50	0.02	0.14	0.07	-0.29
Cs	-0.19	-0.14	-0.36	-0.44	-0.44	-0.42	-0.16	0.13	-0.24	-0.22	0.52	0.72	0.51
Ba	-0.43	-0.25	-0.54	-0.38	-0.31	-0.34	-0.17	0.24	-0.58	-0.25	0.38	0.31	-0.01
La	-0.12	-0.07	-0.31	-0.20	-0.24	-0.28	-0.16	0.24	-0.46	-0.38	0.58	0.10	0.33
Ce	0.03	0.07	-0.12	-0.04	-0.17	-0.25	-0.13	0.23	-0.39	-0.46	0.58	-0.18	0.47
Pr	0.08	0.11	-0.12	-0.06	-0.19	-0.28	-0.14	0.26	-0.45	-0.46	0.55	-0.15	0.47
Nd	0.12	0.15	-0.08	-0.03	-0.18	-0.28	-0.14	0.27	-0.46	-0.48	0.53	-0.20	0.50
Sm	0.20	0.24	0.01	0.02	-0.15	-0.28	-0.11	0.31	-0.47	-0.49	0.50	-0.30	0.55
Eu	0.19	0.24	-0.01	0.01	-0.16	-0.29	-0.13	0.32	-0.50	-0.49	0.47	-0.27	0.54
Gd	0.15	0.19	-0.05	-0.03	-0.17	-0.29	-0.13	0.31	-0.48	-0.48	0.51	-0.23	0.53
Tb	0.16	0.23	-0.03	-0.02	-0.16	-0.30	-0.11	0.35	-0.50	-0.47	0.48	-0.24	0.54
Dy	0.16	0.22	-0.02	-0.02	-0.16	-0.30	-0.12	0.35	-0.50	-0.47	0.48	-0.25	0.54
Yb	0.09	0.17	-0.09	-0.08	-0.18	-0.32	-0.14	0.38	-0.50	-0.45	0.49	-0.15	0.49
Hf	0.34	0.48	0.43	0.46	0.16	-0.15	0.11	0.68	-0.26	-0.21	0.19	-0.65	0.19
W	-0.19	-0.01	-0.24	-0.10	-0.11	-0.22	-0.05	0.43	-0.67	-0.21	0.08	0.00	0.02
Tl	0.25	0.37	0.24	0.35	0.16	-0.10	-0.07	0.59	-0.52	-0.30	0.30	-0.47	0.02
Pb	-0.04	-0.15	-0.16	-0.03	0.20	0.20	0.48	0.12	0.47	0.53	0.17	0.18	-0.15
Th	0.29	0.31	0.04	0.00	-0.19	-0.28	-0.08	0.28	-0.39	-0.43	0.47	-0.30	0.66
U	-0.11	0.03	-0.40	-0.29	-0.43	-0.43	-0.06	0.28	-0.48	-0.03	0.34	0.58	-0.07

Table S5. Pairwise Pearson linear correlation between element concentration in the RSM of the Ob River and small tributaries. Red numbers denote significant ($p < 0.05$) correlations.

	Si	Al	P	K	Ca	Fe
Si	1.0	0.3	-0.5	0.8	-0.9	-0.2
Li	0.2	0.9	0.4	0.8	0.0	0.7
Be	0.6	0.7	0.2	0.8	-0.3	0.5
B	0.7	0.5	0.1	0.8	-0.4	0.4
Na	0.2	0.8	0.2	0.7	0.0	0.4
Mg	-0.2	0.8	0.6	0.4	0.4	0.7
Al	0.3	1.0	0.2	0.8	-0.1	0.5
P	-0.5	0.2	1.0	0.0	0.7	0.9
K	0.8	0.8	0.0	1.0	-0.5	0.3
Ca	-0.9	-0.1	0.7	-0.5	1.0	0.5
Ti	0.6	0.7	0.2	0.9	-0.2	0.5
V	0.2	0.6	0.6	0.6	0.1	0.9
Cr	0.2	0.7	0.6	0.7	0.1	0.9
Mn	-0.5	-0.1	0.7	-0.4	0.5	0.6
Fe	-0.2	0.5	0.9	0.3	0.5	1.0
Co	0.3	0.6	0.4	0.6	-0.1	0.8
Ni	0.4	0.6	0.4	0.7	-0.1	0.7
Cu	-0.2	0.2	0.8	0.1	0.3	0.8
Zn	-0.5	0.1	0.8	-0.1	0.6	0.8
Ga	0.5	0.7	0.3	0.8	-0.2	0.7
Ge	0.2	0.7	0.5	0.5	0.1	0.8
As	-0.5	0.2	1.0	-0.1	0.7	0.9
Rb	-0.4	0.5	0.4	0.0	0.5	0.4
Sr	-0.8	0.0	0.7	-0.4	1.0	0.6
Y	-0.1	0.8	0.5	0.4	0.3	0.6
Zr	0.7	0.7	0.0	0.9	-0.4	0.4
Nb	0.6	0.7	0.2	0.8	-0.2	0.5
Mo	-0.3	0.5	0.8	0.2	0.5	0.9
Cd	-0.4	-0.2	0.6	-0.3	0.3	0.5
Sn	-0.3	0.5	0.9	0.2	0.5	0.9
Sb	-0.1	0.5	0.8	0.4	0.3	0.9
Cs	-0.5	0.3	0.3	-0.1	0.5	0.3
Ba	-0.4	0.5	0.9	0.2	0.7	0.9
La	-0.2	0.8	0.7	0.4	0.4	0.7
Ce	0.1	0.8	0.5	0.5	0.2	0.5
Pr	0.1	0.9	0.5	0.6	0.2	0.6
Nd	0.1	0.9	0.5	0.6	0.2	0.6
Sm	0.2	0.9	0.4	0.7	0.1	0.5
Eu	0.2	0.9	0.4	0.7	0.1	0.6
Gd	0.1	0.9	0.4	0.6	0.1	0.6
Tb	0.1	0.9	0.4	0.7	0.1	0.6
Dy	0.1	0.9	0.4	0.7	0.1	0.6
Ho	0.1	0.9	0.5	0.7	0.1	0.6

Er	0.1	0.9	0.5	0.6	0.2	0.6
Tm	0.1	0.9	0.5	0.6	0.2	0.6
Yb	0.1	0.9	0.5	0.6	0.2	0.6
Lu	0.1	0.9	0.5	0.6	0.2	0.6
Hf	0.7	0.7	0.0	0.9	-0.5	0.4
Ta	0.5	0.8	0.2	0.9	-0.2	0.6
W	-0.2	0.6	0.8	0.4	0.4	0.9
Tl	0.6	0.8	0.4	0.9	-0.2	0.7
Pb	-0.2	-0.2	-0.1	-0.3	-0.1	-0.1
Th	0.1	0.9	0.3	0.6	0.0	0.4
U	-0.2	0.4	0.6	0.3	0.4	0.7

Table S6. Mann-Whitney (U-test) for the difference in mineralogical and chemical composition of the RSM from the Ob River main stem by seasons. Significant ($p < 0.05$) differences are shown by red color. TSS is total suspended solid

	U	Z	p-value	U	Z	p-value	U	Z	p-value
	Ice cover season/ Flood season			***Flood season/ Baseflow season***			***Ice cover season/ Baseflow season***		
TSS	1	-4.01	0.00006	6	1.91	0.0562	1	-2.81	0.00489
Si	3	-3.07	0.00211	10	-1.34	0.179	0	-2.55	0.0107
A	11	-2.29	0.0218	8	1.63	0.104	8	-1.04	0.299
P	2	3.17	0.00152	13	-0.990	0.322	3	1.98	0.0472
Quartz	0	-3.20	0.00138	12	1.13	0.258	0	-2.45	0.0142
Albite	14	-1.68	0.093	9	-1.48	0.138	2	-2.03	0.0428
Potassium feldspars	27	-0.325	0.745	12	-1.06	0.289	8	-0.853	0.394
Pyroxene	11	0.974	0.330	13	0.189	0.850	6	0.857	0.391
Calcite	1	2.30	0.0216	4	-1.04	0.297	1	1.79	0.0736
Smectite	4	-2.01	0.0446	3	1.81	0.0700	9	-0.245	0.806
Illite	28	0.217	0.828	14	-0.778	0.437	11	-0.213	0.831
Kaolinite	27	-0.059	0.953	16	0.231	0.817	11	0.107	0.915
Chlorite	26	-0.434	0.664	15	0.707	0.480	10	0.320	0.749
Li	41	-1.35	0.176	4	2.08	0.0372	24	0.372	0.710
Be	34	-1.80	0.073	10	1.16	0.247	24	-0.372	0.710
B	38	-1.54	0.123	12	0.849	0.396	26	-0.159	0.873
Na	24	-2.43	0.0153	8	1.47	0.143	20	-0.796	0.426
Mg	53	-0.598	0.550	0	2.70	0.00693	16	1.22	0.222
K	12	-3.18	0.00147	9	1.31	0.190	9	-1.96	0.0495
Ca	28	2.17	0.0298	18	-0.077	0.939	12	1.65	0.100
Ti	32	-1.92	0.055	12	0.849	0.396	18	-1.01	0.313
V	54	-0.535	0.592	14	0.540	0.589	26	0.159	0.873
Cr	47	-0.976	0.329	10	1.16	0.247	27	0.0531	0.958
Mn	5	3.62	0.00029	12	-0.849	0.396	3	2.60	0.00927
Fe	49	0.850	0.395	8	1.47	0.143	12	1.65	0.100
Co	61	0.094	0.925	4	2.08	0.0372	17	1.12	0.265
Ni	52	-0.661	0.508	13	0.694	0.487	27	0.0531	0.958
Cu	35	1.73	0.083	18	-0.077	0.939	13	1.54	0.124
Zn	0	3.94	0.00008	4	2.08	0.0372	0	2.92	0.00350
Ga	39	-1.48	0.139	8	1.47	0.143	27	-0.0531	0.958
Ge	60	-0.157	0.875	11	1.00	0.316	21	0.690	0.490
As	14	3.06	0.00225	14	0.540	0.589	5	2.39	0.0169
Rb	39	1.13	0.260	9	1.10	0.270	15	1.33	0.184
Sr	34	1.80	0.0726	10	1.16	0.247	12	1.65	0.100
Y	53	-0.598	0.550	9	1.31	0.190	24	0.372	0.710
Zr	29	-2.11	0.0348	12	0.849	0.396	17	-1.12	0.265
Nb	31	-1.98	0.0472	12	0.849	0.396	20	-0.796	0.426
Mo	47	0.976	0.329	5	1.93	0.0538	8	2.07	0.0384
Cd	16	2.93	0.00340	18	-0.077	0.939	7	2.18	0.0295

Sn	51	0.724	0.469	12	0.849	0.396	19	0.903	0.367
Sb	56	0.409	0.682	12	0.849	0.396	18	1.01	0.313
Cs	46	1.04	0.299	11	1.00	0.316	6	2.28	0.0224
Ba	47	0.976	0.329	9	1.31	0.190	15	1.33	0.184
La	56	-0.409	0.682	17	-0.077	0.939	27	0.0531	0.958
Ce	52	-0.661	0.508	18	0.077	0.939	25	-0.265	0.791
Pr	47	-0.976	0.329	16	0.231	0.817	25	-0.265	0.791
Nd	44	-1.17	0.244	16	0.231	0.817	25	-0.265	0.791
Sm	39	-1.48	0.139	15	0.386	0.700	22	-0.584	0.559
Eu	43	-1.23	0.219	14	0.540	0.589	25	-0.265	0.791
Gd	46	-1.04	0.299	14	0.540	0.589	26	-0.159	0.873
Tb	45	-1.10	0.270	13	0.694	0.487	25	-0.265	0.791
Dy	46	-1.04	0.299	12	0.849	0.396	25	-0.265	0.791
Ho	48	-0.913	0.361	10	1.16	0.247	28	0.0531	0.958
Er	48	-0.913	0.361	11	1.00	0.316	28	0.0531	0.958
Tm	49	-0.850	0.395	11	1.00	0.316	28	0.0531	0.958
Yb	49	-0.850	0.395	10	1.16	0.247	27	-0.0531	0.958
Lu	51	-0.724	0.469	10	1.16	0.247	26	0.159	0.873
Hf	25	-2.36	0.0182	12	0.849	0.396	16	-1.22	0.222
W	60	-0.157	0.875	7	1.62	0.105	21	0.690	0.490
Tl	36	-1.67	0.0951	10	1.16	0.247	20	-0.796	0.426
Pb	21	2.47	0.0135	6	1.77	0.0760	7	2.09	0.0362
Th	32	-1.92	0.0547	10	1.16	0.247	25	-0.265	0.791
U	62	-0.031	0.975	7	1.62	0.105	17	1.12	0.265