

Geochemistry of Metals and Organic Matter in Water and Sediments of the Karst River Cetina, Croatia

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Supplement materials

Table S1 Sampling points of sediment and water in the Cetina River (2016 to 2021)

Mark	Sampling points	Type of sample (W – water, S – sediment), description of sampling point	X and Y coordinates
CS - 1	Glavaš vrelo	W + S; spring, HR-R 12*	43°58'36.25" ; 16°25'48.13"
CS - 2	Batića vrelo	W + S; spring, HR-R 12*	43°58'14.20" ; 16°25'15.24"
CS - 3	Vuković vrelo	W (M) + S; spring, HR-R 12*	43°57'56.17" ; 16°24'46.27"
CR - 4	Cetina Barišići	W (M); watercourse, HR-R 12*	43°58'10.30" ; 16°25'41.26"
CT - 5	Pritok uzvodno od Vinalića	W (M); tributary, HR-R_16A*	43°57'28.96" ; 16°24'27.96"
CT - 6	Zduški potok	W (M); tributary, HR-R_16A*	43°56'11.96" ; 16°25'45.25"
CR - 7	Cetina Vinalić	W (M) + S; watercourse, HR-R_12*	43°56'9.98" ; 16°26'33.01"
CAL - 8	HE Peruča 1	S; storage lake, n.a.	43°50'42.24" ; 16°31'16.87"
CAL - 9	HE Peruča 2	S; storage lake, n.a.	43°49'48.05" ; 16°32'11.10"
CAL - 10	HE Peruca 3	S; storage lake, n.a.	43°49'29.67" ; 16°32'25.17"
CAL - 11	HE Peruca 4	W (M); storage lake, HR-AD_13*	43°49'11.76" ; 16°32'42.90"
CAL - 12	HE Peruca 5	S; storage lake, n.a.	43°49'5.11" ; 16°32'42.53"
CAL - 13	HE Peruca 6	S; storage lake, n.a.	43°48'42.48" ; 16°32'53.38"
CAL - 14	HE Peruca 7	S; storage lake, n.a.	43°48'32.28" ; 16°33'2.20"
CAL - 15	HE Peruca 8	S; storage lake, n.a.	43°48'23.87" ; 16°33'20.28"
CAL - 16	HE Peruca 9	S; storage lake, n.a.	43°48'12.70" ; 16°33'54.87"
CR - 17	Cetina Panj	W (M); watercourse, HR-R_12*	43°46'32.81" ; 16°37'54.89"
CT - 18	Potok Rumin	W (M); tributary, HR-R_11*	43°46'34.23" ; 16°38'53.29"
CT - 19	Vojskova	W (M); tributary, HR-R_16A*	43°45'25.57" ; 16°37'54.74"
CT - 20	Mala Ruda izvorište	W (M); tributary, HR-R_16A*	43°40'27.98" ; 16°47'1.97"
CT - 21	Odvodni kanal HE Orlovac	W (M); tributary, HR-R_12*	43°40'20.12" ; 16°46'56.09"
CT - 22	Gornji kanal-pritok Cetine kod Trilja	W (M); tributary, HR-R_16A*	43°38'23.91" ; 16°42'57.72"
CT - 23	Donji kanal-pritok Cetine kod Trilja	W (M); tributary, HR-R_16A*	43°38'27.66" ; 16°43'2.29"
CR - 24	Cetina Trilj	W (M); watercourse, HR-R 12*	43°37'19.29" ; 16°43'52.98"
CAL - 25	HE Đale 1	S; storage lake, n.a.	43°34'54.26" ; 16°43'18.75"
CAL - 26	HE Đale 2	S; storage lake, n.a.	43°34'40.82" ; 16°42'56.55"
CAL - 27	HE Đale 3	S; storage lake, n.a.	43°34'31.04" ; 16°42'48.91"
CAL - 28	HE Đale 4	S; storage lake, n.a.	43°34'27.56" ; 16°42'43.08"
CAL - 29	HE Đale 5	W (M); storage lake, HR-AD 9*	43°34'12.60" ; 16°42'22.95"
CAL - 30	Cetina Prančevići	W (M); storage lake, HR-AD 8*	43°32'35.40" ; 16°44'19.01"
CR - 31	Cetina Čikotine lađe	W (M) + S; watercourse, HR-R 12*	43°31'54.66" ; 16°44'50.44"
CR - 32	Cetina Nejašmić	W (M); watercourse, HR-R 12*	43°26'44.82" ; 16°53'13.66"
CAL - 33	HE Kraljevac	S; storage basin, n.a.	43°25'54.17" ; 16°53'11.87"
CT - 34	Zvizda gornji tok	W (M); tributary, HR-R 16A*	43°25'18.32" ; 16°53'27.53"
CT - 35	Zvizda prije ušća	W (M); tributary, HR-R 16A*	43°25'53.21" ; 16°52'52.01"

*Type of surface water according to Croatian Regulation on water quality standard (OG 96/2019)

Table S2 Descriptive statistics of measured parameters in surface water samples at sites CS-1, CS-2, CS-3, CR-4, CR-7, CAL-11, CR-17, CR-24, CAL-29, CAL-30, CR-31, CR-32 in the Cetina River and CT-5, CT-6, CT-18, CT-19, CT-20, CT-21, CT-22, CT-23, CT-34, CT-35 in tributaries in the period 2016-2021.

Indicator	MAC*	MAC**	Biokovo Mt. Springs ¹	Gacka River springs ²	Cetina River						Tributaries of the Cetina River					
					N	MAX	MIN	MEAN	MEDIAN	SD	N	MAX	MIN	MEAN	MEDIAN	SD
pH	7.0-9.0	6.5-9.5	7.57	7.50	468	8.46	6.92	7.94	7.95	0.271	412	8.3	7.1	7.7	7.7	0.242
Conductivity (μScm^{-1})	n.a.	2500	283	457	468	706	253	379	363	61.3	413	1499	225	584	531	230
TDS (mgL^{-1})	n.a.	n.a.	201	306	468	473	169	254	243	41.0	413	1004	151	391	356	154
Alkalinity ($\text{mgCaCO}_3\text{L}^{-1}$)	n.a.	n.a.	n.a.	257	468	413	102	168	167	24.2	413	756	67.0	223	217	70.0
Suspend solids (mgL^{-1})	n.a.	10	n.a.	n.a.	468	32.1	< 2,0	< 2.0	< 2.0	2.26	404	56.3	< 2.0	2.1	< 2.0	4.05
Total Hardness ($\text{mgCaCO}_3\text{L}^{-1}$)	n.a.	n.a.	n.a.	236	468	285	110	185	185	20.4	413	1327	79.5	299	259	163
HCO_3^- (mgL^{-1})	n.a.	n.a.	n.a.	n.a.	468	504	124	205	204	29.5	413	922	82.0	272	265	85.4
Turbidity (NTU)	n.a.	4	n.a.	1.49	251	12.1	< 0.6	1.13	0.870	1.41	69	11.5	< 0.6	2.56	1.90	2.22
Ammonium (mgNL^{-1})	0.05	0.50	0.029	0.012	468	0.978	< 0.012	0.024	< 0.012	0.054	412	28.3	< 0.012	0.479	0.020	2.25
Nitrates (mgNL^{-1})	0.700	50	0.579	0.197	468	3.96	< 0.230	0.260	0.250	0.206	412	5.10	< 0.230	0.547	0.388	0.587
Nitrites (mgNL^{-1})	n.a.	0.500	0.005	< 0.001	467	0.110	< 0.030	< 0.030	< 0.030	0.005	412	2.60	< 0.030	0.042	< 0.030	0.184
T ($^{\circ}\text{C}$)	n.a.	25	13.2	n.a.	465	25.7	5.3	13.0	12.1	4.47	413	25.1	1.6	13.2	12.5	4.11
Orthophosphates (mgPL^{-1})	0.030	0.300	< 0.005	0.005	468	0.169	< 0.006	0.005	< 0.030	0.012	413	3.0	< 0.006	0.060	< 0.006	0.293
Fluorides (mgL^{-1})	1.5	1.5	0.065	0.031	122	0.080	0.012	0.036	0.035	0.012	143	0.2	0.011	0.052	0.042	0.029
Chlorides (mgL^{-1})	n.a.	250	11.7	3.23	363	104	< 1.5	16.6	9.40	16.8	268	105	2.00	15.4	6.93	21.1
Sulphates (mgL^{-1})	n.a.	250	8.80	5.39	200	49.0	< 2.4	16.1	16.4	5.42	210	759	3.82	66.3	19.3	129
DOC (mgL^{-1})	n.a.	n.a.	n.a.	0.489	120	1.50	< 0.3	0.780	0.795	0.250	17	3.0	1.05	1.63	1.,59	0.514
TOC (mgL^{-1})	n.a.	n.a.	n.a.	n.a.	467	6.90	< 0.3	1.12	1.02	0.679	412	15.0	< 0.3	1.72	1.10	2.10
O_2 (mgL^{-1})	n.a.	n.a.	n.a.	n.a.	465	20.8	1.0	11.1	11.1	1.32	411	14.0	1.20	10.1	10.4	2.13
COD (mgL^{-1})	4	5	n.a.	0.556	464	7.28	< 0.5	1.44	1.20	0.990	412	17.1	< 0.5	2.21	1.50	2.30
BOD (mgL^{-1})	3.4	n.a.	n.a.	n.a.	460	8.80	< 0.6	0.830	< 0.030	0.971	394	10.3	< 0.6	1.29	0.730	1.40
Calcium (mgL^{-1})	n.a.	n.a.	64.0	81.9	346	100	26.1	62.7	62.0	7.81	263	502	26.3	98.8	86.0	60.8
Potassium (mgL^{-1})	n.a.	12	0.628	0.349	122	3.45	< 0.280	0.731	0.702	0.389	205	25.4	< 0.280	2.03	1.16	3.25

Magnesium (mgL ⁻¹)	n.a.	n.a.	4.0	7.49	347	20.0	< 0.600	6.71	6.45	2.30	263	81.0	2.14	8.70	7.95	5.93
TN (mgNL ⁻¹)	1.0	n.a.	0.794	0.573	452	2.30	< 0.250	0.472	0.410	0.214	412	47.4	< 0.250	2.13	0.650	5.66
TP (mgPL ⁻¹)	0.06	n.a.	0.011	0.013	458	0.410	< 0.009	0.013	< 0.009	0.031	413	4.19	< 0.009	0.094	< 0.009	0.407
Sodium (mgL ⁻¹)	n.a.	200	6.97	1.57	122	69.9	1.20	16.1	10.7	13.4	194	68.8	1.17	13.5	6.52	16.3
Silicates (mgSiO ₂ L ⁻¹)	n.a.	50	n.a.	n.a.	241	2.85	< 0.110	1.31	1.25	0.624	17	12.0	1.40	4.20	2.30	3.18

*Regulation on water quality standards (OG 96/2019) (MAC for good water condition)

**Ordinance on compliance parameters, methods of analysis, monitoring and water safety plans for human consumption and the method of keeping a register of legal entities performing the activity of public water supply (OG 125/2017)

According to authors ¹ [46]; ² [49]

Table S3a Descriptive statistics of elements in surface water samples at sites CS-3, CR-7, CR-17, CR-31 in the Cetina River in the period 2016-2021

		Al µg ⁻¹	As µg ⁻¹	B µg ⁻¹	Ba µg ⁻¹	Be µg ⁻¹	Cd µg ⁻¹	Co µg ⁻¹	Cr µg ⁻¹	Cs µg ⁻¹	Cu µg ⁻¹	Fe µg ⁻¹	Hg µg ⁻¹	Li µg ⁻¹	Mn µg ⁻¹
MAC*		n.a.	n.a.	n.a.	n.a.	n.a.	≤ 0.08	n.a.	n.a.	n.a.	40	n.a.	0.07	n.a.	n.a.
MAC**		200	10	1000	700	n.a.	5	n.a.	50	n.a.	40	200	1	n.a.	50
Mean values of conc. in surface water	Zrmanja river ¹	1.28	0.203	n.a.	14.5	n.a.	n.a.	0.011	0.217	0.010	0.063	8.23	n.a.	5.65	0.168
	Biokovo Mt. Springs ²	1.03	0.110	n.a.	12.0	n.a.	< LOQ	0.083	0.648	n.a.	0.230	2.80	n.a.	n.a.	0.150
	World rivers ³ (median)	32.0	0.630	10.2	23.0	0.0089	0.080	0.148	0.700	0.011	1.48	66.0	n.a.	1.84	34.0
CS-3	N	21	21	19	19	21	21	21	21	21	21	21	18	21	21
	MAX	27.1	0.170	4.42	6.98	<0.005	0.078	0.231	0.810	< 0.015	1.08	58.1	0.017	0.649	7.77
	MIN	1.76	0.074	0.379	3.98	<0.005	<0.010	<0.010	0.145	< 0.015	0.390	2.91	<0.010	<0.030	<0.050
	MEAN	5.43	0.109	2.07	5.36	<0.005	0.018	0.032	0.307	< 0.015	0.687	12.0	<0.010	0.359	0.715
	MEDIAN	3.45	0.106	2.34	5.31	<0.005	0.011	0.012	0.264	< 0.015	0.609	7.71	<0.010	0.383	0.134
	SD	5.34	0.022	1.27	0.741	0	0.018	0.057	0.165	0	0.239	12.1	0.004	0.175	1.69
CR-7	N	35	35	30	34	35	35	35	30	35	15	35	n.a.	35	35
	MAX	35.5	0.163	4.35	6.92	0.005	0.042	0.257	0.0657	0.031	2.25	53.1	n.a.	0.824	5.36
	MIN	1.27	0.085	0.329	4.24	<0.005	<0.010	<0.010	0.083	< 0.015	0.380	4.23	n.a.	<0.030	0.393
	MEAN	8.40	0.119	1.87	5.60	<0.005	0.011	0.030	0.304	< 0.015	0.960	20.7	n.a.	0.383	2.52
	MEDIAN	5.27	0.117	1.60	5.69	<0.005	<0.010	0.023	0.276	< 0.015	0.856	16.9	n.a.	0.429	2.33
	SD	8.38	0.019	1.13	0.752	0.0004	0.008	0.041	0.146	0.004	0.468	12.9	n.a.	0.197	1.11
CR-17	N	5	6	5	5	5	5	5	6	5	6	5	n.a.	5	5
	MAX	13.3	0.155	0.718	6.22	<0.005	<0.010	0.021	0.182	0.019	0.962	28.4	n.a.	0.447	0.774
	MIN	1.31	0.120	0.417	5.72	<0.005	<0.010	0.011	0.114	< 0.015	0.243	3.28	n.a.	0.390	<0.050
	MEAN	5.01	0.132	0.536	5.99	<0.005	<0.010	0.014	0.144	< 0.015	0.664	9.49	n.a.	0.425	0.268
	MEDIAN	3.14	0.129	0.546	6.06	<0.005	<0.010	0.013	0.139	< 0.015	0.692	5.08	n.a.	0.435	0.056
	SD	4.26	0.012	0.105	0.207	0	0	0.003	0.022	0.005	0.217	9.49	n.a.	0.022	0.302
CR-31	N	59	58	52	51	57	59	59	52	57	59	57	28	57	57
	MAX	31.1	0.492	6.90	11.2	<0.005	0.056	0.338	0.628	0.048	1.96	32.6	0.021	1.34	3.21
	MIN	1.15	0.127	0.456	6.16	<0.005	<0.010	<0.010	0.060	< 0.015	0.375	3.82	<0.010	0.052	0.485
	MEAN	5.35	0.224	2.88	7.97	<0.005	0.016	0.082	0.287	< 0.015	0.859	11.6	<0.010	0.586	1.60
	MEDIAN	3.74	0.204	3.06	7.70	<0.005	0.013	0.030	0.289	< 0.015	0.816	10.4	<0.010	0.549	1.49
	SD	5.13	0.080	1.65	0.964	0	0.013	0.086	0.132	0.009	0.305	6.38	0.005	0.300	0.602

* Regulation on water quality standards (OG 96/219) (MAC for good water condition)

** Ordinance on compliance parameters, methods of analysis, monitoring and water safety plans for human consumption and method of keeping a register of legal entities performing the activity of public water supply (OG 125/2017)
According to authors ¹[50]; ²[46]; ³[4]

Table S3b Descriptive statistics of elements in surface water at sites CS-3, CR-7, CR-17, CR-31 in the Cetina River between in the period 2016-2021.

		Mo µg ⁻¹	Ni µg ⁻¹	Pb µg ⁻¹	Rb µg ⁻¹	Sb µg ⁻¹	Se µg ⁻¹	Sn µg ⁻¹	Sr µg ⁻¹	Ti µg ⁻¹	Tl µg ⁻¹	U µg ⁻¹	V µg ⁻¹	Zn µg ⁻¹	Zr µg ⁻¹
MAC*		n.a.	4	1.2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	300	n.a.
MAC**		n.a.	20	10	n.a.	5	10	n.a.	n.a.	n.a.	n.a.	n.a.	5	3000	n.a.
Mean values of conc. in surface water	Zrmanja River ¹	0.528	0.054	< LOQ	4.02	n.a.	n.a.	n.a.	320	n.a.	n.a.	0.442	0.616	< LOQ	n.a.
	Biokovo Mt. Springs ²	0.104	0.249	0.014	n.a.	< LOQ	0.316	n.a.	59.4	n.a.	n.a.	n.a.	0.096	0.599	n.a.
	World rivers ³ (median)	0.420	0.810	0.079	1.63	0.070	n.a.	n.a.	60.0	0.489	n.a.	0.600	0.710	0.620	0.039
CS-3	N	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	MAX	0.938	1.87	0.226	0.409	0.135	0.280	0.274	244	0.820	0.021	0.748	0.894	7.65	0.145
	MIN	0.144	0.035	0.033	0.102	< 0.015	< 0.090	< 0.020	42.4	0.042	< 0.003	0.307	0.317	0.440	< 0.030
	MEAN	0.481	0.443	0.114	0.253	0.040	0.158	0.035	131	0.195	0.007	0.517	0.567	1.93	0.041
	MEDIAN	0.481	0.288	0.104	0.255	0.027	0.170	0.023	128	0.140	0.006	0.521	0.542	0.907	< 0.030
	SD	0.197	0.460	0.061	0.065	0.036	0.073	0.056	46.9	0.205	0.005	0.105	0.134	2.14	0.040
CR-7	N	30	34	34	30	35	35	35	35	30	35	30	35	35	34
	MAX	0.806	1.23	0.514	0.397	0.212	0.344	0.442	247	1.10	0.021	0.711	0.626	10.7	0.102
	MIN	0.199	< 0.015	0.029	0.207	< 0.015	< 0.090	< 0.020	26.4	< 0.030	< 0.003	0.416	0.295	< 0.040	< 0.030
	MEAN	0.456	0.251	0.128	0.270	0.059	0.170	0.066	142	0.242	0.007	0.532	0.478	2.10	0.031
	MEDIAN	0.447	0.190	0.108	0.269	0.039	0.185	< 0.020	144	0.141	0.005	0.520	0.484	1.53	< 0.030
	SD	0.179	0.268	0.100	0.045	0.051	0.075	0.095	53.0	0.264	0.005	0.078	0.071	1.90	0.024
CR-17	N	5	5	5	5	5	5	5	5	5	5	5	5	6	5
	MAX	0.373	0.329	0.247	0.367	0.028	0.252	0.043	145	0.378	0.011	0.492	0.460	0.783	0.077
	MIN	0.279	0.097	0.030	0.290	0.015	0.217	< 0.020	97.3	0.092	0.005	0.455	0.377	0.313	< 0.030
	MEAN	0.321	0.170	0.082	0.332	0.022	0.232	0.021	118	0.190	0.007	0.472	0.408	0.587	0.050
	MEDIAN	0.315	0.130	0.039	0.339	0.022	0.232	0.020	105	0.138	0.005	0.470	0.389	0.579	0.051
	SD	0.033	0.085	0.083	0.031	0.004	0.013	0.012	19.7	0.101	0.002	0.012	0.031	0.160	0.021
CR-31	N	52	57	59	52	57	57	59	57	51	57	52	57	59	56
	MAX	0.696	1.23	0.503	0.646	0.165	0.388	0.494	247	0.831	0.028	0.789	0.969	3.14	0.228
	MIN	0.256	< 0.015	< 0.010	0.285	< 0.015	< 0.090	< 0.020	87.3	0.038	< 0.003	0.411	0.353	< 0.040	< 0.030
	MEAN	0.435	0.287	0.150	0.420	0.061	0.194	0.086	158	0.224	0.007	0.547	0.568	1.19	0.054
	MEDIAN	0.414	0.225	0.128	0.396	0.052	0.206	0.047	158	0.146	0.005	0.539	0.551	1.01	0.038
	SD	0.112	0.218	0.099	0.093	0.033	0.088	0.107	38.7	0.187	0.006	0.078	0.104	0.721	0.051

* Regulation on water quality standards (OG 96/219) (MAC for good water condition)

** Ordinance on compliance parameters, methods of analysis, monitoring and water safety plans for human consumption and method of keeping a register of legal entities performing the activity of public water supply (OG 125/2017)

According to authors ¹[50]; ²[46]; ³[4]

Table S4 Measured concentrations of observed elements in bulk fraction of the surface sediments

	Min. toxic effects (mg kg ⁻¹)*	Max. toxic effects (mg kg ⁻¹)*	Concentration in surface water sediment			CS-1	CS-2	CS-3	CR-7	CAL-8	CAL-9	CAL-10	CAL-12	CAL-13	CAL-14	CAL-15	CAL-16	CAL-25	CAL-26	CAL-27	CAL-28	CR-31	CAL-33
			Zrmanja River (bulk fraction mean) ¹	Biokovo Mt. springs (bulk fraction mean) ²	World river sediment (median) ³																		
Al %	n.a.	n.a.	2.1	1.65	5.45	0.318	0.932	0.305	1.12	4.74	4.01	4.06	3.71	3.11	2.88	3.63	2.15	1.48	1.48	1.87	1.70	0.491	0.380
As mgkg ⁻¹	3	33	5.66	n.a.	6.0	3.33	7.45	8.10	4.76	18.1	22.3	17.3	19.0	17.8	16.1	19.3	31.2	4.37	6.52	6.80	5.55	1.79	1.51
B mgkg ⁻¹	n.a.	n.a.	n.a.	n.a.	n.a.	0.497	0.982	0.426	2.88	7.52	5.78	4.97	4.15	3.02	2.72	2.83	1.58	2.13	3.42	1.78	5.40	0.767	1.11
Ba mgkg ⁻¹	< 20	500	98.7	64.0	386	10.2	40.5	15.0	55.0	158	151	139	145	134	133	132	124	78.2	174	122	115	44.3	34.4
Be mgkg ⁻¹	n.a.	n.a.	0.693	0.364	1.44	0.182	0.671	0.281	0.908	1.70	1.47	1.58	1.56	1.42	1.35	1.69	1.15	0.990	0.798	0.894	1.18	0.333	0.216
Ca %	n.a.	n.a.	17.7	n.a.	1.66	32.9	12.9	14.7	9.8	14.9	14.2	13.5	13.4	11.9	11.4	10.7	9.5	22.4	23.0	20.1	21.5	23.3	25.4
Cd mgkg ⁻¹	0.2	10	0.392	0.314	0.280	0.301	0.472	0.274	0.595	1.31	1.34	1.64	1.97	1.70	1.62	1.71	2.42	0.674	1.53	1.56	1.77	0.453	0.275
Co mgkg ⁻¹	n.a.	50	4.55	7.68	8.0	1.16	7.07	2.61	4.37	10.5	10.5	9.97	10.6	10.7	9.26	11.5	10.8	6.69	7.85	8.32	8.27	2.60	1.62
Cr mgkg ⁻¹	26	110	34.4	73.9	63.0	7.36	21.1	15.7	20.7	67.2	60.4	62.9	71.9	66.5	65.1	77.0	68.7	33.8	44.5	49.0	56.0	12.6	9.68
Cs mgkg ⁻¹	n.a.	n.a.	2.84	n.a.	< 4.0	0.581	2.17	0.934	2.81	9.65	10.1	11.1	11.3	11.3	11.1	11.2	10.8	4.34	9.15	7.11	6.53	1.58	1.14
Cu mgkg ⁻¹	16	110	6.11	13.1	17.0	7.41	14.3	7.98	17.3	29.6	28.2	32.2	46.6	32.9	34.7	46.5	23.1	22.9	26.7	28.5	27.9	13.4	8.79
Fe %	2.12	4.38	1.06	n.a.	2.47	0.429	1.46	1.11	1.33	3.45	3.81	3.39	3.46	3.42	3.14	3.58	3.60	1.36	2.53	1.91	2.31	0.59	0.433
Hg mgkg ⁻¹	0.2	2	n.a.	n.a.	0.038	0.209	0.091	0.062	0.079	1.59	0.128	0.183	0.143	0.261	0.124	0.471	0.174	0.211	0.322	0.177	0.103	0.166	0.053
K mgkg ⁻¹	n.a.	n.a.	7800	n.a.	16700	362	1363	516	1559	6379	5072	5000	5139	4442	4391	4931	2528	2230	3309	3079	3290	693	890
Li mgkg ⁻¹	n.a.	n.a.	26.8	n.a.	20.8	3.27	16.3	6.66	20.8	58.7	47.9	46.7	44.7	41.3	37.0	46.3	30.0	21.1	16.6	21.8	26.8	9.63	7.15
Mg %	n.a.	n.a.	5.66	n.a.	0.723	1.42	2.72	2.59	1.26	0.606	0.512	0.577	0.553	0.531	0.424	0.537	0.234	0.410	0.441	0.438	0.584	0.146	0.124
Mn mgkg ⁻¹	460	1100	170	244	620	95.2	487	82.0	153	753	1101	508	551	371	303	433	392	366	363	469	412	280	186
Mo mgkg ⁻¹	n.a.	4	0.640	n.a.	0.630	1.11	2.15	2.45	5.28	3.61	3.65	3.41	4.79	3.78	3.41	3.71	14.3	0.696	1.22	0.887	1.33	0.620	0.486
N mgkg ⁻¹	550	4800	n.a.	n.a.	n.a.	228	355	722	1760	730	845	1147	1566	944	816	1392	1214	1298	2365	2768	2624	2166	836
Na mgkg ⁻¹	n.a.	n.a.	7700	n.a.	6670	151	137	26.6	229	387	374	501	323	241	177	680	104	214	275	499	383	187	159
Ni mgkg ⁻¹	35	75	12.2	71.8	21.0	6.47	19.1	9.99	16.0	58.1	53.2	55.7	57.8	56.8	55.1	66.1	49.3	30.0	35.2	39.5	33.7	12.7	7.95
P mgkg ⁻¹	600	2000	n.a.	n.a.	61.0	103	388	466	806	677	656	506	546	461	625	623	516	576	867	1230	713	687	748
Pb mgkg ⁻¹	31	250	18.0	87.9	20.5	4.56	14.2	9.41	13.6	39.8	42.3	44.4	94.2	50.5	46.1	48.8	56.5	17.9	38.7	28.5	27.1	24.0	7.78
Rb mgkg ⁻¹	n.a.	n.a.	39.7	n.a.	70.0	3.96	18.6	5.88	20.3	59.4	52.2	56.7	59.3	55.7	55.2	59.5	42.0	32.1	61.0	48.2	42.3	10.8	8.75
Sb mgkg ⁻¹	200	500	0.401	2.35	0.620	0.646	0.594	0.573	0.487	1.63	1.44	1.81	4.14	1.73	1.69	1.83	2.12	0.504	0.714	0.750	0.490	1.69	0.507
Si mgkg ⁻¹	n.a.	n.a.	n.a.	n.a.	28600	2758	6914	3424	9271	788	683	1118	2138	1156	6329	1414	664	6620	7188	7317	7786	6678	5611
Se mgkg ⁻¹	n.a.	n.a.	n.a.	n.a.	n.a.	0.333	0.584	0.508	1.73	0.953	0.947	1.00	1.14	1.18	0.974	1.26	1.06	0.904	1.54	1.60	1.71	1.51	1.11
Sn mgkg ⁻¹	n.a.	n.a.	1.56	n.a.	2.25	1.37	1.70	1.75	3.10	4.24	3.17	4.17	6.86	4.42	14.3	7.15	4.06	2.66	5.43	3.15	3.53	1.76	1.19
Sr mgkg ⁻¹	n.a.	n.a.	136	n.a.	126	234	79.9	95.3	91.6	133	140	169	187	159	150	170	102	201	280	265	227	205	183

Ti mgkg ⁻¹	n.a.	n.a.	1540	n.a.	3740	73.2	447	293	476	918	616	697	738	708	793	938	795	519	626	673	721	147	125
Tl mgkg ⁻¹	n.a.	n.a.	0.357	0.140	0.390	0.198	0.661	0.241	0.609	1.35	1.18	1.36	1.52	1.38	1.39	1.70	1.67	0.662	1.03	0.906	0.859	0.355	0.271
U mgkg ⁻¹	n.a.	n.a.	1.57	n.a.	2.0	3.42	1.47	1.47	1.26	1.87	1.48	1.88	1.65	1.97	1.78	1.77	1.77	0.869	1.69	1.25	1.33	0.963	0.563
V mgkg ⁻¹	n.a.	n.a.	37.1	122	62.0	16.6	44.2	35.7	40.5	94.4	86.0	90.0	93.8	94.1	92.4	107	92.3	49.3	55.2	59.6	62.5	19.8	13.5
Zn mgkg ⁻¹	< 90	> 200	76.6	13.2	71.0	14.6	34.2	22.6	38.8	99.8	88.9	98.1	118	97.9	91.8	113	74.3	61.5	78.8	86.4	79.4	31.9	32.9
Zr mgkg ⁻¹	n.a.	n.a.	n.a.	n.a.	391	3.91	13.2	6.32	16.9	33.1	26.4	31.4	35.0	33.5	37.0	42.3	33.4	16.3	27.7	24.6	25.5	7.0	4.30
TOC %	n.a.	n.a.	n.a.	n.a.	1.71	4.36	2.84	2.32	7.37	2.02	1.33	2.05	1.02	1.78	2.28	1.57	2.0	4.34	3.14	4.04	4.6	3.38	5.37

*According to available legislative for sediments of: USA federal criteria, Great Lakes; St. Lawrence River (Canada); Ontario (Canada) and British Columbia (Canada)
According to authors¹[50]; ²[46]; ³[54]

Table S5 Correlation coefficients of log-transformed data for 35 elements and TOC in bulk fraction of sediment*

	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cs	Cu	Fe	Hg	K	Li	Mg	Mn	Mo
Al	1																	
As	0.81	1																
B	0.88	0.54	1															
Ba	0.91	0.62	0.87	1														
Be	0.97	0.79	0.87	0.90	1													
Ca	-0.56	-0.75	-0.34	-0.42	-0.64	1												
Cd	0.89	0.76	0.77	0.92	0.88	-0.47	1											
Co	0.93	0.81	0.78	0.91	0.96	-0.63	0.90	1										
Cr	0.95	0.84	0.80	0.92	0.95	-0.58	0.95	0.97	1									
Cs	0.96	0.78	0.84	0.97	0.95	-0.54	0.96	0.95	0.98	1								
Cu	0.94	0.70	0.83	0.93	0.94	-0.49	0.92	0.92	0.94	0.96	1							
Fe	0.93	0.91	0.78	0.86	0.94	-0.68	0.90	0.96	0.97	0.94	0.89	1						
Hg	0.54	0.39	0.45	0.46	0.45	-0.04	0.44	0.42	0.46	0.47	0.48	0.43	1					
K	0.98	0.73	0.92	0.96	0.95	-0.50	0.90	0.93	0.95	0.97	0.95	0.91	0.49	1				
Li	0.97	0.78	0.87	0.91	0.98	-0.66	0.85	0.94	0.94	0.94	0.92	0.92	0.45	0.96	1			
Mg	-0.15	0.16	-0.19	-0.39	-0.06	-0.21	-0.26	-0.06	-0.14	-0.26	-0.22	0.02	-0.11	-0.21	-0.15	1		
Mn	0.83	0.56	0.76	0.83	0.78	-0.28	0.71	0.81	0.75	0.79	0.76	0.72	0.45	0.83	0.82	-0.27	1	
Mo	0.57	0.85	0.37	0.38	0.60	-0.88	0.55	0.58	0.59	0.53	0.45	0.70	0.17	0.47	0.60	0.25	0.26	1
TN	0.29	-0.03	0.41	0.57	0.37	-0.04	0.49	0.38	0.40	0.45	0.49	0.29	0.03	0.39	0.34	-0.48	0.27	-0.08
Na	0.69	0.23	0.74	0.69	0.63	-0.03	0.61	0.54	0.55	0.63	0.72	0.46	0.50	0.70	0.62	-0.30	0.68	0.00
Ni	0.97	0.83	0.81	0.93	0.96	-0.57	0.94	0.97	0.99	0.98	0.96	0.96	0.52	0.96	0.95	-0.18	0.81	0.56
TP	0.36	0.04	0.46	0.62	0.41	-0.21	0.38	0.45	0.42	0.47	0.45	0.34	0.00	0.49	0.46	-0.44	0.42	-0.05
Pb	0.88	0.75	0.72	0.91	0.86	-0.55	0.91	0.89	0.91	0.93	0.92	0.88	0.42	0.87	0.88	-0.33	0.75	0.55
Rb	0.95	0.70	0.87	0.98	0.95	-0.48	0.93	0.95	0.96	0.99	0.96	0.91	0.48	0.98	0.93	-0.24	0.82	0.44
Sb	0.63	0.67	0.37	0.53	0.54	-0.48	0.61	0.53	0.59	0.61	0.62	0.59	0.41	0.55	0.61	-0.31	0.50	0.57
Si	-0.53	-0.74	-0.34	-0.32	-0.42	0.42	-0.42	-0.40	-0.47	-0.44	-0.33	-0.54	-0.47	-0.42	-0.49	0.07	-0.42	-0.63
Se	0.41	0.00	0.55	0.67	0.46	-0.17	0.53	0.44	0.44	0.53	0.55	0.34	0.08	0.51	0.47	-0.56	0.39	0.00
Sn	0.79	0.70	0.66	0.77	0.80	-0.55	0.82	0.77	0.84	0.85	0.87	0.81	0.38	0.80	0.76	-0.13	0.46	0.54
Sr	0.02	-0.32	0.14	0.18	-0.08	0.71	0.19	-0.09	0.03	0.10	0.19	-0.13	0.25	0.09	-0.12	-0.47	0.08	-0.61
Ti	0.88	0.79	0.76	0.86	0.94	-0.67	0.86	0.97	0.95	0.91	0.88	0.95	0.38	0.90	0.91	0.02	0.69	0.60
Tl	0.96	0.83	0.80	0.93	0.96	-0.64	0.94	0.96	0.97	0.98	0.94	0.95	0.48	0.95	0.95	-0.19	0.78	0.63
U	0.28	0.55	0.10	0.04	0.23	-0.21	0.32	0.21	0.27	0.21	0.20	0.37	0.44	0.16	0.15	0.49	0.01	0.52
V	0.93	0.92	0.74	0.83	0.95	-0.69	0.89	0.96	0.97	0.93	0.89	0.99	0.45	0.90	0.92	0.05	0.69	0.70
Zn	0.94	0.70	0.86	0.97	0.92	-0.46	0.92	0.92	0.96	0.98	0.97	0.89	0.46	0.98	0.93	-0.32	0.80	0.42
Zr	0.95	0.81	0.81	0.92	0.97	-0.63	0.95	0.97	0.98	0.98	0.96	0.96	0.47	0.95	0.94	-0.10	0.73	0.61
TOC	-0.62	-0.81	-0.34	-0.46	-0.54	0.49	-0.54	-0.59	-0.63	-0.58	-0.56	-0.69	-0.34	-0.55	-0.59	-0.01	-0.54	-0.58
	N	Na	Ni	P	Pb	Rb	Sb	Si	Se	Sn	Sr	Ti	Tl	U	V	Zn	Zr	TOC
N	1																	
Na	0.42	1																
Ni	0.36	0.61	1															
P	0.80	0.35	0.40	1														
Pb	0.48	0.52	0.93	0.44	1													

Rb	0.49	0.68	0.97	0.54	0.90	1												
Sb	0.09	0.31	0.65	0.02	0.80	0.52	1											
Si	0.27	-0.16	-0.50	0.22	-0.46	-0.33	-0.66	1										
Se	0.91	0.55	0.43	0.84	0.52	0.58	0.14	0.20	1									
Sn	0.35	0.44	0.83	0.32	0.82	0.82	0.60	-0.23	0.40	1								
Sr	0.40	0.48	0.05	0.09	0.08	0.14	-0.01	0.23	0.28	0.09	1							
Ti	0.42	0.46	0.92	0.52	0.82	0.92	0.41	-0.32	0.46	0.79	-0.15	1						
Tl	0.36	0.60	0.98	0.40	0.93	0.96	0.65	-0.48	0.47	0.84	-0.03	0.92	1					
U	-0.40	0.07	0.27	-0.60	0.20	0.14	0.36	-0.47	-0.42	0.35	-0.03	0.17	0.27	1				
V	0.26	0.45	0.96	0.30	0.87	0.90	0.60	-0.53	0.29	0.82	-0.14	0.95	0.94	0.39	1			
Zn	0.51	0.68	0.97	0.55	0.92	0.98	0.59	-0.39	0.58	0.81	0.18	0.89	0.94	0.09	0.88	1		
Zr	0.42	0.59	0.97	0.43	0.90	0.97	0.57	-0.39	0.50	0.87	-0.01	0.96	0.98	0.29	0.96	0.94	1	
TOC	0.11	-0.15	-0.66	0.05	-0.72	-0.50	-0.84	0.74	0.12	-0.52	0.15	-0.49	-0.61	-0.42	-0.68	-0.56	-0.55	1

*|r| 0.00 to 0.20: no or slightly correlated; 0.20 to 0.40 weak correlation; 0.40 to 0.70 real significant correlation; 0.70 to 1.00 high or very high correlation [59]