Supplementary data for the article:

Supplementary information for the article: Sakan, S.; Mihajlidi-Zelić, A.; Škrivanj, S.; Frančišković-Bilinski, S.; Đorđević, D. An Integrated Approach in the Assessment of the Vlasina River System Pollution by Toxic Elements. Frontiers in Environmental Science 2022, 10. https://doi.org/10.3389/fenvs.2022.909858.

Supplementary Material

Table S1. Obtained and certified contents of extractable Cd, Cr, Cu, Ni, Pb and Zn in certified reference material BCR – 701

[mg/kg]	Cd	Cr	Cu	Ni	Pb	Zn
Step 1:						
Obtained	8.1	2.24	45.49	14.3	3.10	178
Certified	7.3	2.26	49.3	15.4	3.18	205
Recovery	111.0 %	98.94 %	92.3 %	92.9 %	97.5 %	86.8 %
Step 2:						
Obtained	3.39	43.7	113	25.4	128	108
Certified	3.77	45.7	124	26.6	126	114
Recovery	89.9 %	95.6 %	91.1 %	95.5 %	101.6 %	94.7 %
Step 3:						
Obtained	0.28	121	58	12.6	10.7	37.1
Certified	0.27	143	55	15.3	9.3	46
Recovery	103.7 %	84.6 %	105.4 %	82.4 %	115.0 %	80.6 %

Table S2. Concentrations of elements (μg/L) in the investigated river water samples and detection limits (DL)

	VBAT	GRBCV	VBMT	TRSP	TRD	VBTUW	LjS	LjMF	LjMP	LjMLjV	VBLj	PR	VUPR	BR	RR	VBWI	VUV	ZR	DL
Zn	0.12	1.39	<DL	6.40	<DL	<DL	0.29	<DL	<DL	<DL	<DL	0.69	<DL	<DL	<DL	5.04	<DL	0.12	0.09
Ni	0.128	0.478	0.132	0.458	0.285	0.217	0.028	0.202	0.208	0.197	0.486	0.268	0.135	0.222	0.324	0.426	0.470	0.400	0.025
Cu	0.852	1.05	0.332	0.651	0.256	0.218	<DL	0.085	<DL	0.072	0.770	0.719	0.131	0.272	0.531	0.603	0.882	0.140	0.055
Cr	0.082	0.048	0.102	0.121	0.039	0.116	0.021	0.108	0.05	0.042	0.149	0.047	0.041	0.057	0.194	0.144	0.187	0.087	0.006
Cd	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.029
Pb	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.056
Al	11.92	1.14	<DL	8.06	<DL	1.92	<DL	<DL	<DL	<DL	1.45	<DL	3.67	1.89	<DL	3.92	4.28	<DL	0.89
B	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.62
Ba	7.10	6.00	7.65	19.02	12.31	11.51	4.13	6.53	5.32	9.12	14.57	11.09	8.20	5.30	8.55	12.16	13.21	11.41	0.20
Be	0.10	<DL	<DL	0.10	0.10	0.10	<DL	<DL	0.14	0.15	0.13	0.11	<DL	0.10	<DL	0.14	<DL	0.12	0.09
Ca	11970	11870	13970	45970	35110	25270	46650	42060	40310	42300	36950	38940	23500	8452	11930	28850	29680	3918	2
Co	<DL	0.012	<DL	0.02	<DL	0.013	<DL	0.013	0.018	0.031	0.017	0.035	0.015	0.016	0.011	0.023	0.036	<DL	0.009
Fe	2.19	1.79	1.72	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	2.33	5.40	10.22	10.91	2.00	0.62
K	<DL	6.4	51.6	912	378	300	<DL	909	818	627	689	865	12.3	53.2	108	686	801	<DL	0.9
Mg	2375	3892	3942	7634	5690	5210	5687	6900	6253	5557	5607	5968	3958	2106	3651	4985	5014	865	4
Mn	0.047	0.083	0.099	0.202	0.259	0.122	<DL	0.113	0.053	0.044	0.075	0.107	<DL	0.052	0.132	0.477	0.574	0.102	0.032
Na	1907	2726	2808	3671	2662	3103	3017	5477	5097	4283	3899	4202	2395	2130	2899	3551	3759	1831	22
Sr	32.3	38.6	41.4	121	98	68.2	173	188	190	185	117	133	78.7	32.9	56.6	89.4	90.4	37.5	0.04
Ti	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.431
V	0.330	0.226	0.262	0.516	0.453	0.382	0.334	0.568	0.533	0.540	0.426	0.477	0.378	0.390	0.283	0.330	0.505	0.106	0.005
As	0.285	0.259	0.271	1.08	1.12	0.624	7.13	2.97	3.05	2.40	1.03	0.494	0.821	0.399	0.236	0.449	0.616	0.338	0.021

Table S3. Contents of elements in the investigated sediments (mg/kg)

	Zn	Ni	Cu	Cr	Pb	Cd	Al	B	Ba	Be	Ca	Co	Fe	K	Li	Mg	Mn	Na	Si
VBAT	66.4	9.20	17.9	10.95	7.67	0.37	8392	0.33	25.67	0.50	15543	10.71	33375	901	7.77	8159	588	27.95	861
GRBCV	80.6	20.47	19.5	12.51	5.14	0.36	5267	0.37	25.18	0.55	9410	11.82	41098	329	15.97	4038	838	36.16	545
VBMT	60.9	14.32	19.6	15.79	7.13	0.40	7280	0.21	24.24	0.49	15404	12.76	33991	636	10.89	6851	738	29.61	736
TRSP	70.5	37.38	28.4	25.52	16.15	0.60	11552	0.52	57.56	0.76	179722	19.66	43302	602	26.06	14468	812	100.99	1517
TRD	73.7	36.72	25.7	26.44	13.94	0.60	11193	0.50	49.10	0.73	197845	18.17	42787	606	24.69	15576	707	98.70	1129
VBTUW	68.0	25.93	21.8	19.95	12.37	0.51	9368	0.42	42.27	0.60	104164	15.43	37085	673	17.48	11215	707	75.07	983
LjMF	24.1	14.43	13.0	9.41	7.28	0.35	5071	2.48	22.64	0.47	684660	5.02	14382	646	12.55	3004	155	74.46	1090
LjMP	26.2	13.85	13.2	8.19	8.12	0.35	4334	1.39	24.69	0.44	685128	4.83	14636	506	12.49	3006	179	95.51	822
LjMLjV	37.4	16.27	15.4	9.96	10.28	0.37	5246	1.43	33.12	0.53	853656	6.48	15807	675	12.83	3007	292	56.52	955
VBLj	61.6	20.73	19.2	17.46	8.35	0.48	7624	0.38	28.55	0.55	113971	11.59	33106	555	16.07	8280	576	56.66	892
PR	31.9	13.77	12.9	12.09	6.92	0.32	5616	1.29	31.20	0.53	655219	6.70	19525	630	7.45	3280	239	35.31	762
VUPR	65.1	21.30	20.7	16.99	10.99	0.43	8541	0.37	36.04	0.60	148349	12.78	34683	663	15.88	9372	615	59.18	861
BR	60.6	8.33	17.3	10.57	8.64	0.44	8289	0.22	34.74	0.54	19084	12.73	33238	746	8.05	6995	678	38.39	955
RR	59.1	16.82	17.9	17.61	11.75	0.39	7902	0.73	30.18	0.48	27101	8.75	28193	568	11.62	6550	379	31.92	739
VBWI	64.3	20.50	22.1	17.39	13.21	0.48	8939	0.36	46.18	0.60	106984	13.40	34541	712	14.79	8938	707	52.72	999
VUV	66.7	18.58	23.2	17.37	13.03	0.44	9098	0.47	40.79	0.62	123395	11.29	33949	743	14.01	8366	542	47.35	1121
ZR	60.0	3.93	9.1	1.44	18.36	0.52	4646	1.24	40.79	0.31	8192	3.89	16460	573	4.96	2592	337	31.79	449

Table S3. (continuation of the Table S3)

Uzorci	Sr	Ti	V	As
VBAT	3.70	706	37.12	7.83
GRBCV	5.81	117	18.38	10.13
VBMT	5.33	522	30.92	8.79
TRSP	20.86	626	34.45	24.25
TRD	20.49	703	34.40	23.62
VBTUW	12.65	533	30.94	15.68
LjMF	10.56	83	13.56	9.79
LjMP	15.67	59	12.33	10.24
LjMLjV	29.10	61	13.93	10.37
VBLj	9.73	463	26.74	13.78
PR	7.31	131	17.74	8.30
VUPR	11.41	455	28.83	13.40
BR	4.55	809	37.35	7.49
RR	7.46	228	18.94	7.95
VBWI	10.81	472	30.57	12.15
VUV	9.06	417	31.38	12.57
ZR	2.74	146	11.77	9.10

Table S4. Pearson correlation matrix for the studied elements in the river water

	Ba	Ca	K	Mg	Na	Sr	V	Cr	Mn	Ni	Cu	As
Ba	1											
Ca	0.255	1										
K	0.500*	0.730**	1									
Mg	0.325	0.921**	0.774**	1								
Na	0.078	0.753**	0.861**	0.798**	1							
Sr	-0.038	0.907**	0.667	0.783**	0.841**	1						
V	0.195	0.784**	0.795**	0.779**	0.765**	0.734**	1					
Cr	0.487*	-0.151	0.272	0.021	0.117	-0.234	-0.027	1				
Mn	0.511*	0.089	0.425	0.175	0.131	-0.083	0.151	0.587*	1			
Ni	0.666**	-0.081	0.365	0.054	0.072	-0.213	-0.071	0.549*	0.559*	1		
Cu	0.362	-0.218	0.101	-0.062	-0.139	-0.424	-0.130	0.422	0.390	0.634**	1	
As	-0.389	0.631**	0.080	0.431	0.362	0.730**	0.278	-0.402	-0.273	-0.496*	-0.531*	1

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

Table S5. Pearson correlation matrix for the studied elements in the river sediments

	Zn	Ni	Cu	Cr	Pb	Cd	Al	B	Ba	Be	Ca	Co	Fe	K	Li	Mg	Mn	Na	Si	Sr	Ti	V	As
Zn	1																						
Ni	0.414	1																					
Cu	0.685**	0.845**	1																				
Cr	0.518*	0.907**	0.925**	1																			
Pb	0.326	0.311	0.275	0.245	1																		
Cd	0.574*	0.629**	0.604**	0.583*	0.790**	1																	
Al	0.653**	0.713**	0.899**	0.872**	0.441	0.712**	1																
B	-0.848**	-0.280	-0.650**	-0.507	-0.090	-0.382	-0.639	1															
Ba	0.460	0.642**	0.627**	0.583*	0.835**	0.858**	0.718**	-0.304	1														
Be	0.459	0.889**	0.914**	0.897**	0.207	0.536*	0.830**	-0.438	0.659**	1													
Ca	-0.871**	-0.059	-0.414	-0.272	-0.259	-0.432	-0.493*	0.794**	-0.233	-0.108	1												
Co	0.742**	0.790**	0.941**	0.877**	0.257	0.678**	0.908**	-0.724**	0.637**	0.868**	-0.514*	1											
Fe	0.890**	0.653**	0.887**	0.776**	0.139	0.547*	0.815**	-0.842**	0.473*	0.743**	-0.705**	0.934**	1										
K	-0.021	-0.206	0.097	0.025	0.121	0.022	0.375	-0.138	0.143	0.109	-0.060	0.106	0.014	1									
Li	0.407	0.979**	0.832**	0.852**	0.298	0.632**	0.667**	-0.251	0.601**	0.855**	-0.055	0.764**	0.633**	-0.247	1								
Mg	0.650**	0.809**	0.902**	0.897**	0.440	0.780**	0.967**	-0.601**	0.717**	0.843**	-0.446	0.929**	0.820**	0.235	0.777**	1							
Mn	0.895**	0.514*	0.788**	0.614**	0.124	0.523*	0.692**	-0.862**	0.433	0.612**	-0.736**	0.880**	0.949**	-0.001	0.515*	0.698**	1						
Na	-0.132	0.711**	0.409	0.480*	0.286	0.481*	0.338	0.216	0.459	0.545*	0.373	0.358	0.114	-0.170	0.766**	0.484*	0.009	1					
Si	0.048	0.675**	0.674**	0.661**	0.285	0.467*	0.686**	-0.029	0.586*	0.785**	0.169	0.585*	0.348	0.354	0.689**	0.663**	0.230	0.681**	1				
Sr	-0.197	0.601**	0.331	0.385	0.242	0.271	0.203	0.230	0.402	0.505*	0.580*	0.217	-0.033	-0.062	0.626**	0.289	-0.082	0.716**	0.582*	1			
Ti	0.623**	0.335	0.656**	0.560*	0.194	0.561*	0.833**	-0.732**	0.441	0.559*	-0.609**	0.788**	0.741**	0.538*	0.317	0.790**	0.716**	0.083	0.454	-0.097	1		
V	0.655**	0.393	0.753**	0.633**	0.127	0.479*	0.864**	-0.780**	0.435	0.653**	-0.595*	0.832**	0.808**	0.548*	0.364	0.801**	0.769**	0.053	0.500*	-0.083	0.968**	1	
As	0.404	0.928**	0.763**	0.793**	0.524*	0.812**	0.718**	-0.225	0.772**	0.814**	-0.080	0.747**	0.573*	-0.109	0.928**	0.833**	0.459	0.780**	0.703**	0.594*	0.408	0.407	1

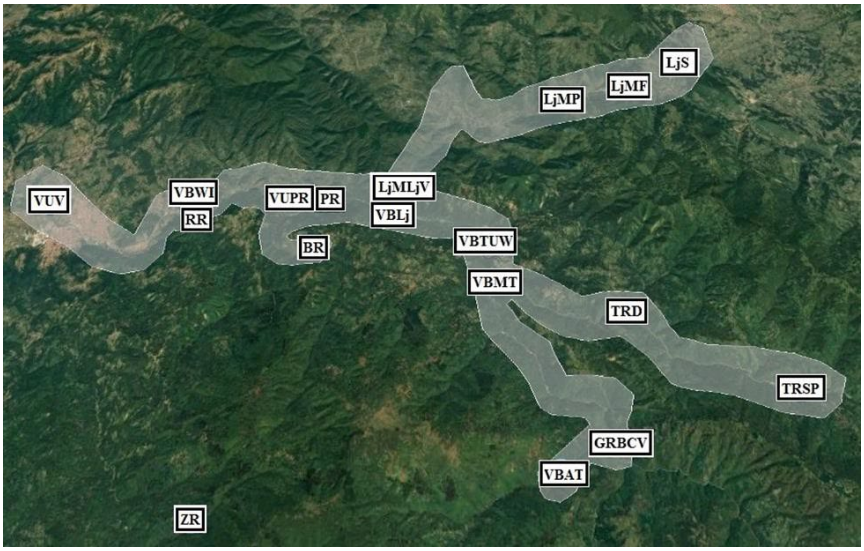

Figure S1. Study area (related to Figures S2-S4).

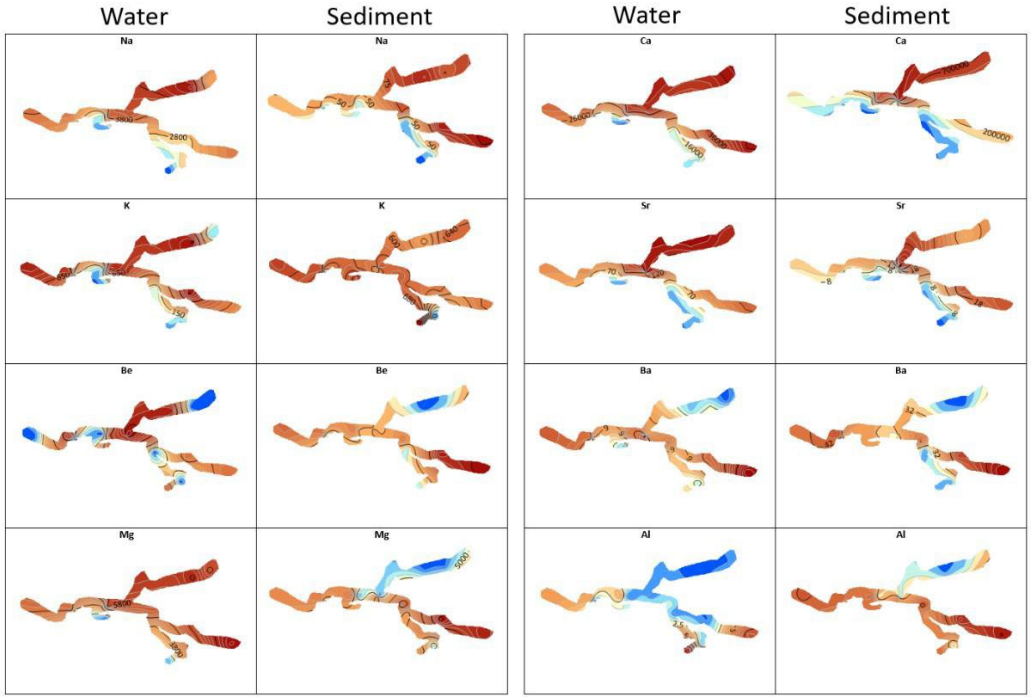

Figure S2. Spatial distribution of Na, K, Ca, K, Sr, Be, Ba, Mg, and Al (W + S).

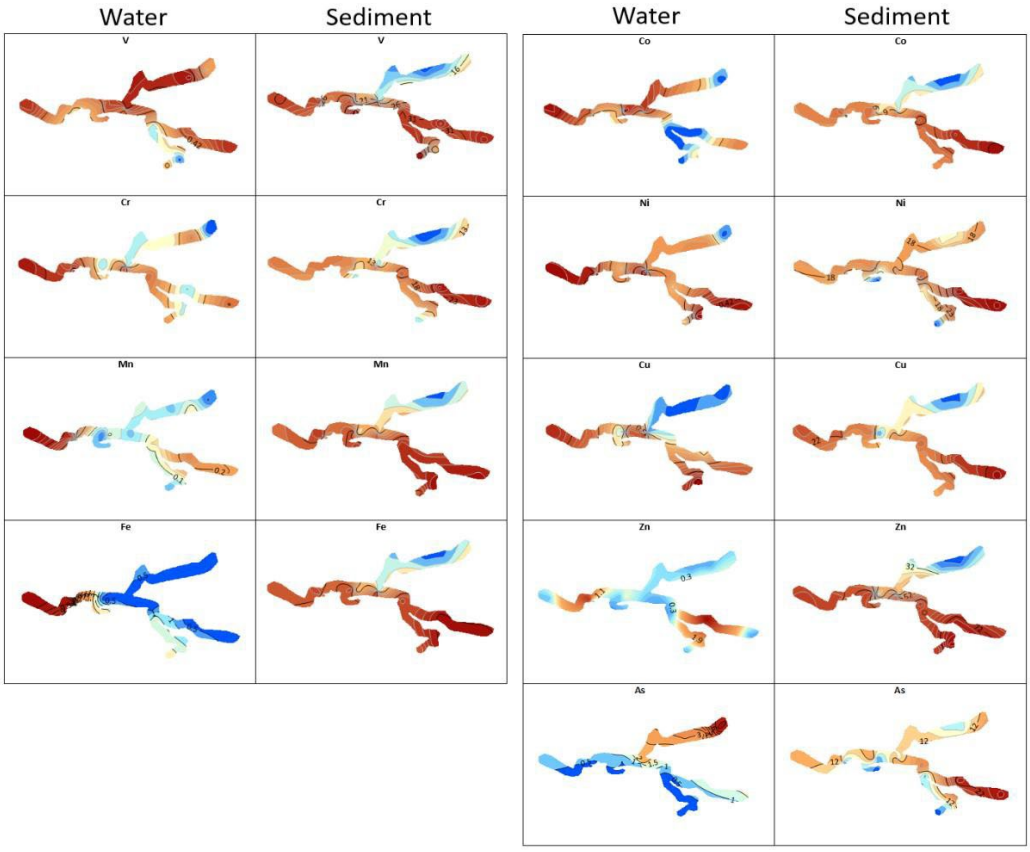

Figure S3. Spatial distribution of V, Co, Cr, Ni, Mn, Cu, Fe, Zn, and As (W + S).

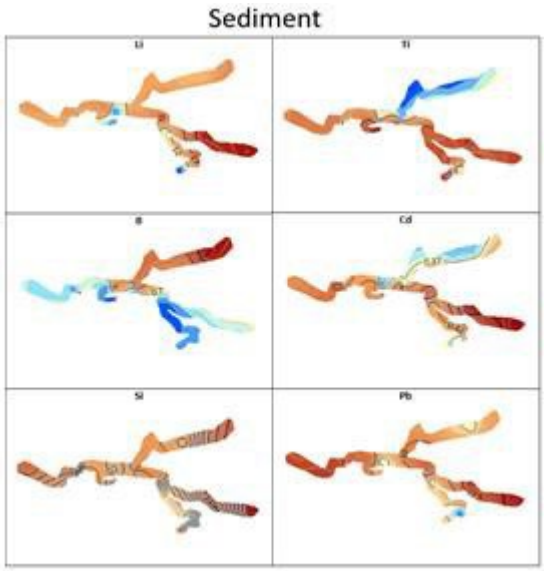

Figure S4. Spatial distribution of Li, Ti, B, Cd, Si, and Pb (S).