



CONTAMINATION OF THE SOIL ALONG THE RIVER ZLETOVSKA BY METALS AS BY PRODUCTS OF ECONOMIC PRODUCTION OF Pb-Zn

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Abstract: *This paper shows the results constraining the degree of contamination of soil along the course of the River Zletovska by some metals. These are by-products of economic production of lead-zinc ores which are common in this area. Contamination of soils by some metals, first of all by Pb, Zn, Cu, Cd, As, Fe, Al, Mn, Na, K is an important issue for the quality of the environment in which we live from several aspects: accumulation of waters under river alluvions; agricultural products grown in these areas; human and animal food. All this is of great importance of the problem for contamination of soils by individual metals.*

KEY WORDS: contamination, metals, sediments, recovery

1. INTRODUCTION

The geochemistry of minor elements has great influence on environment. In developed countries there is enormous increase of the concentration of certain elements in soils/sediments, disturbances in their natural relation and local accumulation to the stage of contamination of soil.

In many countries concentration of heavy metals in surface parts of sediments has been noticed in districts which are far from industrial centres. Thus, large amount of lead (60 mg/kg) accumulated in forests in Poland because of atmospheric pollution, as well as cadmium (1.6 mg/kg) (SAPECK, 1976). In some rural areas in Canada local anomalous zones of increased arsenic (126 mg/kg), cadmium (8.1 mg/kg), copper (664

mg/kg), lead (888 mg/kg), mercury (1.14 mg/kg) a.a. concentrations have been discovered (FRANCK et al., 1976).

Metals in the contaminated soils enter agricultural products and cause various physiological changes in them lowering their biomass. By consuming such agricultural products they enter human bodies causing various chronic diseases.

Metals contaminating the soil can also have a negative effect on the characteristics of the soil itself. For example some of them impede reaction features of humus acids preventing the occurrence of movable organic compounds which results in mineralization and accumulation processes in the soil.

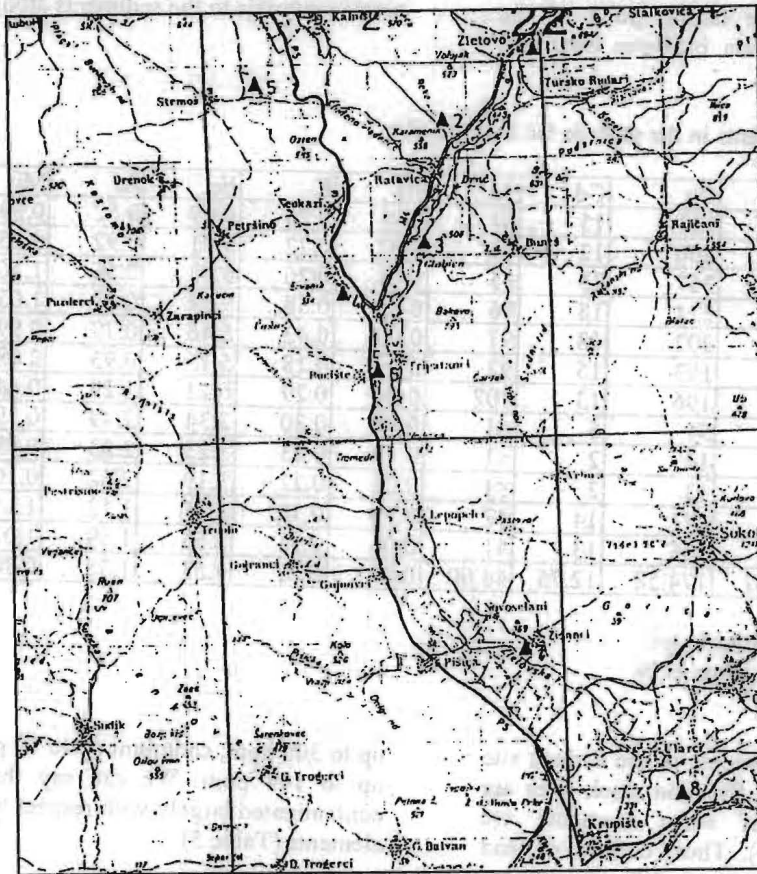
The River Zletovska is the largest water artery in the Kratovo-Zletovo volcanic area. The river and its tributaries collect all waste waters coming of the recovery of lead-zinc ores which are abundant in this area.

During the Oligo-Miocene intensive hydro-thermal activity took place in the volcanic area resulting in formation of large number of lead, zinc and copper deposits.

Recovery of these deposits is the basic economy in the town of Probitip. The mineral resources encouraged the construction of the Zletovo lead and zinc mine which processes 300000 tonnes of lead-zinc ore and produces 25000 tonnes of those concentrates. The technological process of ores discards large quantities of waste waters which flow into tailing ponds. Rivers and tributaries flowing in the vicinity of these dumps, tailing ponds and mine pits entrain large amounts of dissolved material and stockpile it into sediments along its course.

of lead is up to 985 ppm, cadmium up to 11 ppm, whereas arsenic is up to 80 ppm. These values show the increased contamination by individual

elements in soil as a consequence of the presence of large supplies of waste mine waters in the analysed site.



Δ Locations where probes were taken

Fig. 1 Map of analyses taken for ecological investigation along the River Zletovska

Table 3: Content of elements in the soils in the Globica site

	Pb	Zn	Cu	Cd	As	Na	K	Fe	Al	Mn	S
1	322	269	25	5	21	0.08	0.28	3.47	2.16	0.19	0.08
2	174	245	61	8	<1	0.06	0.43	5.13	3.01	0.20	0.21
3	529	693	44	9	18	0.08	0.21	3.53	1.11	0.61	0.11
4	193	347	72	9	9	0.06	0.37	5.18	2.84	0.21	0.22
5	944	706	55	9	18	0.06	0.34	3.58	1.70	0.28	0.11
6	177	532	31	4	9	0.06	0.21	2.74	1.10	0.13	0.13
7	429	306	38	5	6	0.09	0.41	3.44	2.19	0.19	0.07
8	502	402	34	7	5	0.07	0.40	3.61	1.79	0.21	0.11
9	164	201	24	4	16	0.1	0.34	2.90	2.05	0.12	0.08
10	244	353	44	6	10	0.08	0.29	3.43	1.41	0.17	0.09
11	445	398	34	7	11	0.07	0.35	3.78	1.31	0.22	0.16
12	1007	770	90	9	4	0.08	0.47	3.62	2.49	0.17	0.26
avera	427.50	435.17	46.00	6.83	10.60	0.07	0.34	3.70	1.93	0.23	0.14

Pb, Zn, Cu, Cd and As are given in g/t
Na, K, Fe, Al, Mn and S are given in %

Content of individual elements in the Globica site is still large, although there is no direct flow of

waste materials from lead and zinc production. Arsenic amounts with about 10 ppm is lower than

Table 6: Contents of elements in the soils of the Buciste site

	Pb	Zn	Cu	Cd	As	Na	K	Fe	Al	Mn	S
1	778	858	106	10	25	0.07	0.32	4.06	1.97	0.50	0.28
2	368	557	44	7	15	0.07	0.24	3.21	1.23	0.33	0.30
3	2529	2232	200	21	153	0.05	0.46	5.69	0.92	2.38	3.00
4	398	565	89	10	3	0.07	0.43	5.03	3.14	0.32	0.27
5	380	609	84	9	9	0.06	0.41	4.73	2.65	0.30	0.22
6	381	821	84	10	8	0.06	0.40	4.80	2.70	0.31	0.25
7	314	462	50	5	7	0.08	0.34	3.00	1.59	0.26	0.11
8	157	181	31	5	<1	0.07	0.38	4.03	2.99	0.17	0.09
9	475	560	35	6	7	0.07	0.31	3.13	1.29	0.28	0.10
10	666	641	50	8	20	0.08	0.34	3.85	1.78	0.35	0.10
11	482	585	37	6	14	0.08	0.33	3.28	1.38	0.28	0.10
12	582	547	47	7	11	0.08	0.39	3.51	1.70	0.34	0.16
avera	625.83	718.17	71.42	8.67	13.00	0.07	0.36	4.03	1.94	0.49	0.42

Pb, Zn, Cu, Cd and As are given in g/t
Na, K, Fe, Al, Mn and S are given in %

Tables 7 and 8 show concentration of individual elements in the Ziganci and Ularci sites located downstream the River Zletovska and are the most

distant places from Strmos, Kiselica and Koritnica sites with a maximum of lead, zinc, cadmium, copper and arsenic.

Table 7: Content of elements in the soils in the Ziganci site

	Pb	Zn	Cu	Cd	As	Na	K	Fe	Al	Mn
1	407	605	59	7	6	0.09	0.29	3.42	1.46	0.45
2	935	1175	63	14	21	0.07	0.22	4.30	1.13	0.88
3	2095	1824	147	18	118	0.06	0.31	5.04	1.49	0.96
4	805	1058	64	12	21	0.06	0.23	3.84	1.33	0.77
5	384	265	22	5	<10	0.06	0.31	3.30	3.21	0.09
6	383	493	22	4	<1	0.06	0.31	3.31	3.15	0.08
7	379	568	39	7	13	0.09	0.27	3.87	1.19	0.35
8	809	1111	61	11	25	0.1	0.28	3.75	1.45	0.67
9	813	1179	63	13	21	0.13	0.34	4.65	1.58	0.89
10	577	1057	87	10	9	0.08	0.43	4.03	2.58	0.57
11	761	1049	58	11	25	0.09	0.25	3.90	1.27	0.65
12	930	994	63	12	24	0.15	0.32	3.96	1.52	0.73
avera	773.17	948.17	62.33	10.33	19.5	0.09	0.3	3.95	1.78	0.59

Pb, Zn, Cu, Cd and As are given in g/t
Na, K, Fe, Al, Mn are given in %

Table 8: Content of elements in the soils in the Ularci site

	Pb	Zn	Cu	Cd	As	Na	K	Fe	Al	Mn
1	2023	2178	153	18	64	0.05	0.48	3.24	1.52	0.58
2	481	510	40	6	2	0.08	0.24	2.84	1.40	0.37
3	813	1226	56	14	21	0.08	0.26	4.15	1.21	0.80
4	677	822	61	10	23	0.07	0.31	3.54	1.55	0.57
5	985	1456	63	16	31	0.08	0.19	4.68	1.14	0.94
6										
7	474	756	54	7	11	0.08	0.26	3.09	1.11	0.45
8	720	1091	54	11	21	0.1	0.34	3.80	1.50	0.61
9	490	736	44	8	9	0.11	0.32	3.44	1.46	0.54
10										
11	419	632	32	7	12	0.08	0.29	3.22	1.06	0.39
12	531	602	42	6	12	0.1	0.27	2.71	1.35	0.44
averag	475	617	37	6.5	12	0.09	0.28	2.97	1.21	0.42

Pb, Zn, Cu, Cd and As are given in g/t
Na, K, Fe, Al and Mn are given in %