DISTRIBUTION OF SELECTED METALS IN HOLOCENE SEDIMENTS OF THE MIDDLE LABE FLOOD PLAIN

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The basic chemism of Holocene fluvial sediments in the middle Labe flood plain is determined by progressive decrease of mafic components towards the depth and by an increase of free SiO_2 portion at the same time. This tendency is accompanied by a gradual increase of the median grain size, even when there exist local deviations in the frame of lithological profiles. The series of boreholes situated perpendicularly to the Labe River course did not confirm systematic changes in the abundance of heavy metals and some other elements with the increasing distance from the Labe River bed. Sediments „preserved" under the medieval dam represent phon concentrations of studied elements in the given area. The distribution of majority of elements correlates with a general trend of iron distribution. Maximum amounts are bound in surface layers, made up by a fluvial humic loam. Sediments in these sections are moderately contaminated as a result of different antropogenic influences (regional atmospheric deposition, periodical floods and fertilization of cultivated area). In deeper layers (4–7 m) heavy metals are in a deficit and their content corresponds with typical concentrations in sandy marlstones forming the bedrock. The portion of mobile forms, which represent a hazardous factor for the basic components of the environment is the highest for Cu and Zn. A great part of Cr and Fe is bound on the contrary in siliceous reziduum. The Holocene sediments as a whole are no significant source of inorganic pollutants in the territory of interest.

fluvial Holocene sediments; middle Labe flood plain; distribution of elements; heavy metals

Some comprehensive review papers have been written on the subject of the Holocene Flood Plain of the Labe river (Růžičková et al., 1993; Růžičková, Zeman, 1994). These studies were focused on the geomorphological and sedimentological conditions, mineralogy of sediments and stratigraphy of quaternary filling of the flood plain. Chemical data for these unconsolidated sediments were already partly published (M i n a ř í k et al., 1992).

The purpose of this study was threefold:

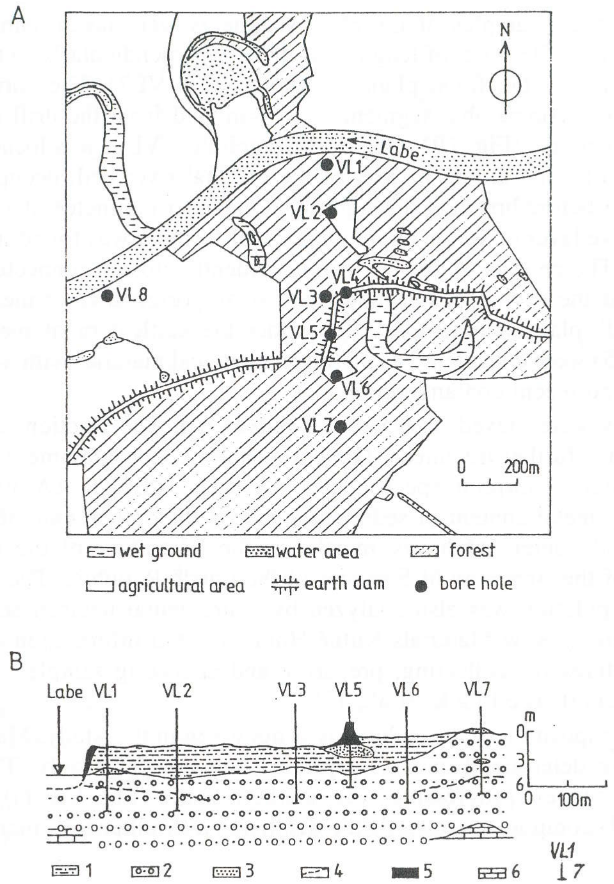
1) to provide basic data on the abundance of selected elements in samples of sediments collected in the vicinity of the middle Labe River flow
2) to determine the mobile forms of metals which may represent potential enviromental hazards in the area of interest
3) the evaluation of human activity influence and the geochemical aspect of spreading the possible inorganic contaminants in the porous medium of Holocene fluvial sediments.

MATERIAL AND METHODS

A model area of roughly 10 km^2 in the valley tract was chosen in the boundary line of the locality Sedlčánky near Čelákovice and Lysá nad Labem (Fig. 1A). The selected territory is a typical quaternary accumulation zone with a majority of psamite fluvial sediments. One half of the experimental territory has been cultivated and intensively exploited for agricultural production. The second half of the territory is a meadow forest. The major part of this area has got a status of the State Nature Reserve and is situated apart from the more significant exploitation interests. A significant landforming phenomenon appears to be an earth dam of medieval pond, preserved in a length of more then 4 km (Fig. 1). The foundation of the pond is dated between the thirteenth and fifteenth century.

The investigated sediments consist of redeposited fluvial material, products of weathering of rocks occurring in the Labe River basin and, to a certain extent, of matter of antropogenous origin. As for the grain size, sediments consist of quartz sands and sands with an admixture of medium-grained gravel. The layer of fluvial sands and gravels is 10–12 m thick. Lithological basement are the rocks of the Middle and Early Turonian. Turonian sediments are mainly represented by sandy marlstones.

The surface of the recent flood plain is covered with fluvial loam („flood loam“) overlying the fluvial sands and gravels. Thickness of fluvial loams is on an average 2 m. As for the grain size, silty fractions prevail, variable proportions of clay and sandy fractions are non-dominant. Both fine sandy and silty fraction are represented mostly by quartz (70–90 %), followed by feldspars, lithoclasts and variable amount of micas. Anthropogenous artifacts (slag, glass, bricks etc.) are accesory (R ů ž i č k o v á , Z e m a n , 1994). Clay matter of the studied sediments in the fraction <4 μm is characterized by mineral association: kaolinite, illite, interstratifications of 1.0 and 1.4 nm sheet phyllosilicates. Besides the clay minerals, also quartz, K-feldspar, Na-rich



1A. The situation of studied locality (adapted from the basic map 1 : 10 000)
1B. Geological section through the flood plain of the Labe River near the town Čelákovice; 1 – fluvial sandy – loam (flood loam), 2 – fluvial sand with admixture of gravel (the Early and the Middle Holocene), 3 – silty sand, 4 – unstabilized level of underground water, 5 – the dump, the earth dam of the Middle Age pond, 6 – Upper Cretaceous marlstone, 7 – borehole

plagioclase, limonite and lepidocrocite have been identified. X-ray data suggest that mineral association does not depend on the stratigraphical position but depends on the source of material (Š ť a s t n ý , 1994). Information concerning the grain-size composition of samples is given in the work by R ů ž i č k o v á and Z e m a n (1994).

Geochemical samples of the plain sediments were taken using a EP 10 light rig. A profile 1 km of length was drilled, perpendicularly to the today's river bed across the flood plain (boreholes VL1–VL7). The corresponding lithologically comparable segments were sampled from the drill core in the whole 7 m course (Fig. 1B). One of the boreholes (VL8) was located outside the studied profile along the axis of the original river bed, occupied by the Labe River before breaking the significant meander in nineteenth century. An inexpressive layer of soil in an initial stage of forming was found in the depth of 2.3 m. The genesis of this horizon is evidently closely connected with the moment of the drying of the major part of the original river meander. The „preserved“ plain sediments, drilled under the earth dam of medieval age (VL4, VL5) were considered as a lithogeochemical material with a high probability of no recent contamination.

Samples were sieved, crushed and pulverized. The fraction <0.063 mm was used for further treatment. The basic analytical programme was realized on the atomic absorption spectrometer VARIAN SPECTR AA-300 (extractable heavy metal content of sediments) and on the optical emission spectrograph (total content of heavy metals) in the laboratory of the Geological Institute of the Academy of Sciences of the Czech Republic. The part of the sample population was also analyzed by instrumental neutron activation in the Institute of Raw Materials Kutná Hora. A detail information concerning the procedures for collecting, preparing and analyzing samples is given in research report (L e l l á k et al., 1991).

Bulk composition of the sediments is not given in this study. Major constituents were determined in six samples of borehole VL8 only. The vertical variations suggest progressive decrease both mafic (Mg, Ca, Ti) and felsic (Na, K, Al) components towards the depth and a simultaneous increase of Si.

RESULTS AND DISCUSSION

A total of 51 samples of sediments were analysed for 11 elements (Fe, Cu, Pb, Zn, Cr, Mn, Ni, V, As, Cd, and Be). Results are given in Tab. I.

Iron

The total content of Fe varies in the range of 0.75–5.00 % with median value 1.80%. Vertical variations indicate considerable Fe enrichment in sections near the surface. The extractable content (evaluated by leaching of samples using the mixture of HCl and HNO_3 1 : 3) is significantly lower (0.82% Fe on the average). The distribution of Fe is presented in Fig. 2 .

Copper

A comparison of the Cu concentration in lower layers of the sediments with those in the upper part of boreholes generally shows significant differences. The average Cu content in the surface layer is twofold higher than the median value for all samples (20 ppm). The extractable Cu content shows the highest range of values of all studied elements (Fig. 3).

Lead

The median concentration of Pb in Holocene sediments is 39 ppm (range 12.5–110 ppm). The values in Table I indicate that lead is progressively enriched in the surface layer. The extractable Pb content is relatively low (Fig. 4).

Zinc

Zinc, like copper, shows a high range of extractable content. These values prove that Zn is a very mobile element in the Holocene sediments. The total Zn content varies in the range of 30 - 150 ppm with median value 67 ppm (Fig. 5).

Chromium

The total Cr content varies in the range of 17–90 ppm. The average value 35 ppm is lower than in the corresponding unconsolidated sediments (T u r e k i a n , 1977). The diference between Cr concentration in surface layers and that in deeper parts of boreholes is inexpressive. The extractable Cr content is generally very low. Most of this element is bound in the silicate residuum (Fig. 6).

Vanadium

Vanadium was determined only as a total V in this study. The total content varies in the range of 17–90 ppm, arithmetical mean 44 ppm. Surface layers are generally moderately enriched with vanadium.

Manganese

Mn shows the widest range of values of any of the elements studied (80–1 500 ppm). The median value for manganese in surface samples is much higher than that of Mn in the whole population. The extractable Mn content is about 50% of the total content Mn in sediments studied (Fig. 7).

I. Distribution of selected elements in Holocene sediments of middle Labe flood plain (total content and mobile form [*], data in ppm)

Borehole – VL 1						
Depth [m]	0.45	0.65	2.2	3	4.05	5.4
Fe*	11 500	12 400	9 500	5 600	4 300	4 700
Fe	35 000	35 000	25 000	12 500	10 000	9 800
Cu*	17	23	23	32	10	12
Cu	25	35	40	32	10	12
Pb*	16.5	21	14	7.5	5.5	6.4
Pb	75	65	35	22	20	22.5
Zn*	54	68	51	51	17	23
Zn	85	100	65	55	45	40
Cr*	14	17.8	16	8	6	7.7
Cr	42.5	52.5	40	30	20	22.5
Mn*	336	423	311	145	93	111
Mn	500	750	500	300	250	250
Ni*	15	16.9	13.8	8	7	8.8
Ni	32.5	32.5	28	22.5	17.5	17.5
V	52.5	60	42.5	30	25	25
As*	7	9.4	6.9	6	4.5	6
Cd*	0.5	1	1	0.5	0.2	0.2
Be*	0.95	0.94	0.69	0.55	0.5	0.29

Borehole – VL 2							
Depth [m]	0.125	0.425	2.3	3.5	4.725	6.05	6.75
Fe*	15 400	10 800	15 900	23 300	3 800	7 100	3 200
Fe	35 000	25 000	35 000	50 000	11 000	15 000	9 000
Cu*	23.7	30	21.5	19.2	10	17.4	8.5
Cu	37.5	30	30	37.5	10	17.5	8.5
Pb*	31.5	21	24.5	28	7.9	13.4	7.5
Pb	72.5	62.5	62.5	65	17.5	25	17.5
Zn*	85	75	70	71.9	18	32	57
Zn	100	100	110	135	45	65	57
Cr*	22.3	13	13.5	19.2	5	9	4
Cr	57.5	50	55	75	20	32.5	20
Mn*	557	350	384	395	45	115	38
Mn	1 000	500	750	750	90	250	80
Ni*	23.2	16	21	57.5	7.9	14.9	8
Ni	37.5	30	37.5	57.5	15	32.5	12.5
V	75	52.5	60	110	30	45	32.5
As*	8.2	7	7	8.2	5	6.5	4.5
Cd*	1	0.5	1	1	0.2	0.2	0.2
Be*	0.68	0.5	0.65	0.9	0.7	0.4	0.7

Continuation of Tab. I

Borehole – VL 3						
Depth [m]	0.15	2.35	3.35	3.55	4.9	5.5
Fe*	27 300	25 200	8 000	1 900	3 900	4 000
Fe	45 000	35 000	15 000	7 500	9 000	10 000
Cu*	55	53.5	14.2	11.2	9	10.5
Cu	55	53.5	37.5	27.5	9	10.5
Pb*	41.8	33.8	14.7	5.9	8.4	8.5
Pb	90	75	62.5	45	17.5	21.5
Zn*	117.9	99.4	34.2	11.7	60	43.5
Zn	135	135	110	90	60	52
Cr*	21.1	23.9	10.7	3.4	6.4	6.5
Cr	82.5	77.5	65	42.5	20	30
Mn*	1 496	791.5	139.7	17.6	49.4	62.5
Mn	1 500	1 200	750	500	80	80
Ni*	7.9	7	12.2	5.4	8.4	8.2
Ni	57.5	57.5	47.5	28	10	15
V	140	115	105	52.5	20	32.5
As*	8.8	8.5	5.9	1.9	3.5	4
Cd*	1.5	1	0.5	0.2	0.2	0.2
Be*	0.98	0.89	0.44	0.29	0.35	0.3

Borehole – VL 4						
Depth [m]	0.25	1.5	3.45	4.3	5.65	6.65
Fe*	3 300	4 200	7 000	3 400	3 300	2 600
Fe	12 500	17 500	22 500	10 000	10 000	8 000
Cu*	10	10	11.5	8.3	9.5	10
Cu	10	10	17.5	8.5	10	10
Pb*	5.4	6.5	11	4.9	5	4.5
Pb	22.5	22.5	27.5	17.5	17.5	12.5
Zn*	14.6	16.4	24.5	13.7	15.2	14
Zn	60	45	45	40	40	40
Cr*	2.9	4	6.5	4.9	4.5	3.5
Cr	15	20	22.5	22.5	30	20
Mn*	106	125	178	68	71	45
Mn	500	500	500	250	250	250
Ni*	6.3	6.5	9.5	5.9	6.3	6
Ni	10	12.5	17.5	12.5	10	10
V	22.5	25	45	27.5	22.5	22.5
As*	4.9	8	11	5.4	7.3	7
Cd*	0.2	0.2	0.5	0.2	0.2	0.2
Be*	0.24	0.3	0.65	0.54	0.8	1.55

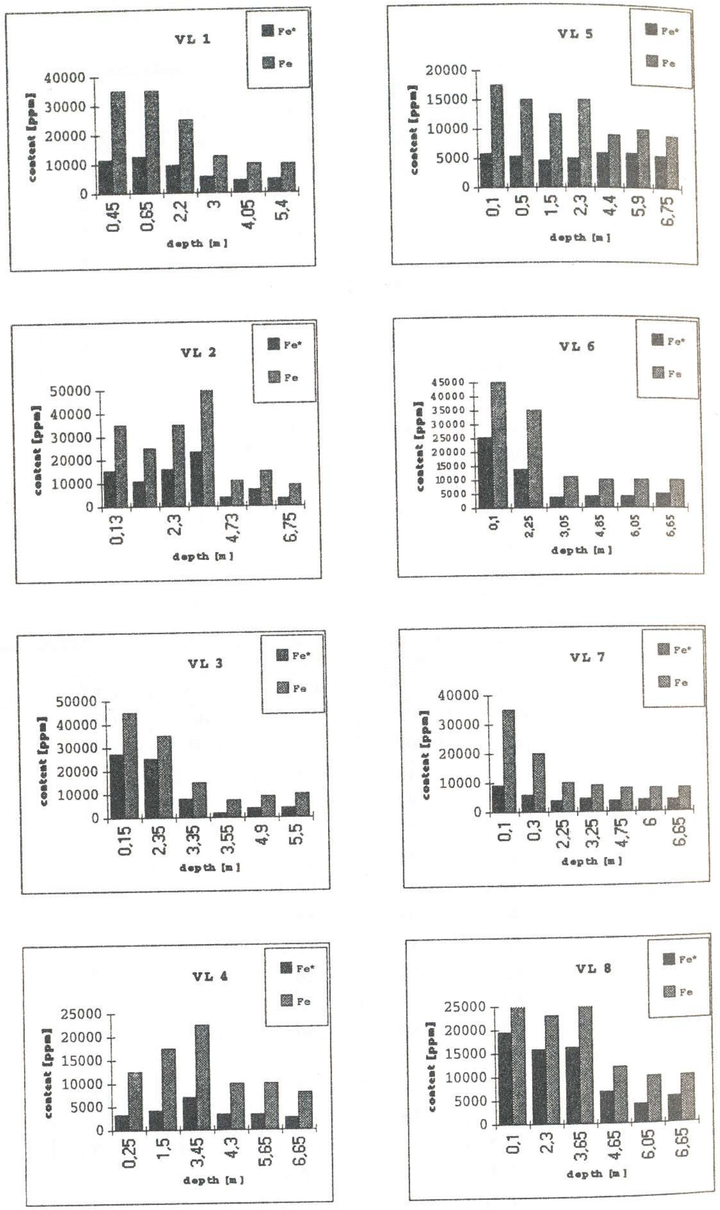
Continuation of Tab. I

Borehole – VL 5							
Depth [m]	0.1	0.5	1.5	2.3	4.4	5.9	6.75
Fe*	5 800	5 300	4 600	5 000	5 900	5 900	5 500
Fe	17 500	15 000	12 500	15 000	9 000	10 000	9 000
Cu*	11	10	10	9	4	3.9	3.5
Cu	15	10	10	9	7.5	8	7.5
Pb*	12	11	7.5	8.8	7.5	9.5	9
Pb	27.5	22.5	22.5	22.5	17.5	20	17.5
Zn*	32	32.9	22.4	25.9	11.5	16.5	13.5
Zn	65	55	55	55	38	40	37
Cr*	5.5	5	4	5	12.5	8.5	7
Cr	30	30	32.5	37.5	20	20	17.5
Mn*	321	314	238	272	118	186	136
Mn	500	500	500	500	250	250	250
Ni*	9	8.5	7	7.5	6	6.5	6
Ni	25	20	20	20	17.5	20	15
V	35	30	27.5	32.5	25	30	25
As*	11.5	11.9	9	8.7	11.4	8.5	7
Cd*	0.5	0.5	0.2	0.35	0.2	0.2	0.2
Be*	0.35	0.5	0.45	0.65	0.7	1.7	1.7

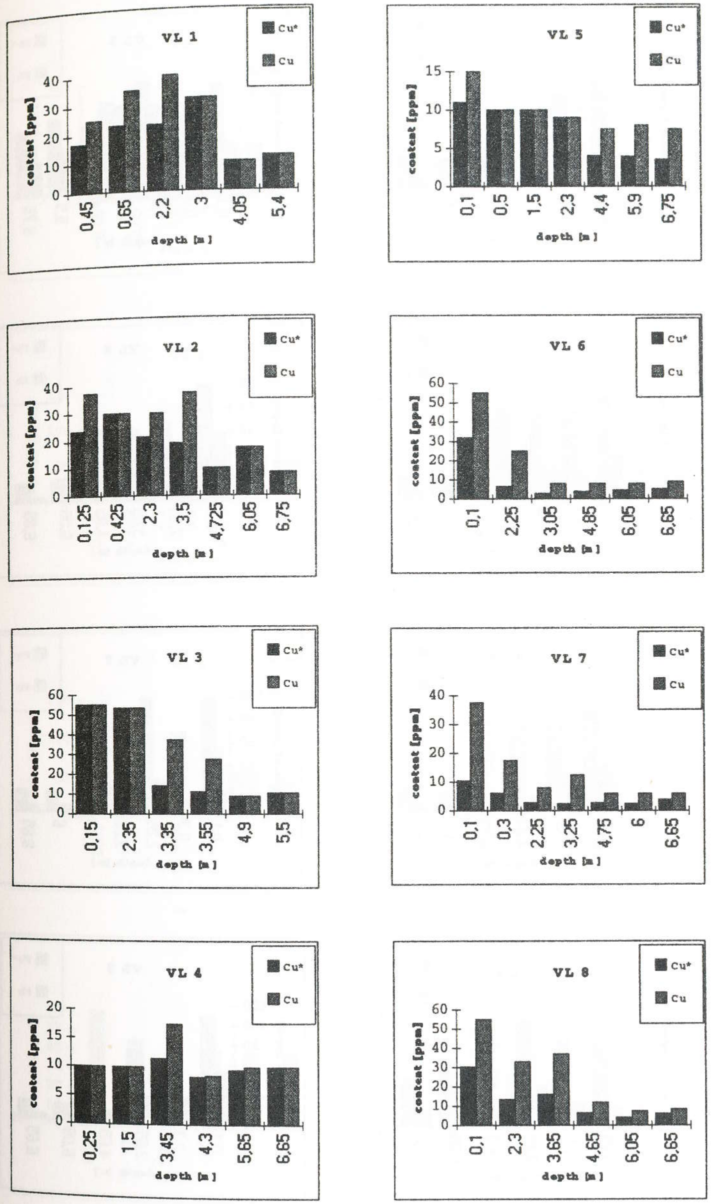
Borehole – VL 6							
Depth [m]	0.1	2.25	3.05	4.85	6.05	6.65	
Fe*	25 300	13 700	3 700	4 000	4 000	5 000	
Fe	45 000	35 000	11 000	10 000	10 000	10 000	
Cu*	32	6.5	2.8	3.9	4.5	5.1	
Cu	55	25	8	8	8	9	
Pb*	57.6	10	4.3	6.4	5.9	4.2	
Pb	100	47.5	27.5	17.5	20	17.5	
Zn*	110.3	31.8	10.9	12.3	12.9	9.8	
Zn	115	75	42.5	40	42.5	38	
Cr*	27.3	12.4	4.3	4.4	5	13.1	
Cr	90	35	20	20	17.5	20	
Mn*	865	343	57	64	70	60	
Mn	950	600	100	100	100	100	
Ni*	28.8	15.9	6.2	5.4	9.4	7.5	
Ni	60	35	12.5	15	15	10	
V	105	52.5	27.5	27.5	27.5	20	
As*	11.7	9.9	4	5.2	6.4	4.7	
Cd*	1	0.2	0.2	0.2	0.2	0.2	
Be*	1.07	0.95	0.43	0.49	0.45	0.38	

Borehole – VL 7							
Depth [m]	0.1	0.3	2.25	3.25	4.75	6	6.65
Fe*	9 100	5 800	3 800	4 500	3 700	4 000	4 000
Fe	35 000	20 000	10 000	9 000	8 000	8 000	8 000
Cu*	10.5	6.1	2.8	2.5	2.8	2.5	3.9
Cu	37.5	17.5	8	12.5	6	6	6
Pb*	20.1	10.9	28.5	5	6.1	6.9	6.4
Pb	100	27.5	100	22.5	17.5	17.5	20
Zn*	52.7	23.6	9.3	10	8.5	9.1	11.3
Zn	100	90	55	45	45	40	30
Cr*	9	6.6	3.7	7	5.2	5	5.4
Cr	50	35	20	20	17.5	17.5	17.5
Mn*	164.2	68	56.9	61.2	41.5	40.5	49.5
Mn	450	200	100	90	90	90	90
Ni*	12.6	9	7	7	5.2	5.2	5.4
Ni	30	22.5	12.5	12.5	10	12.5	10
V	52.5	42.5	27.5	22.5	20	20	20
As*	11.5	9	9.3	9	6.6	7.4	7.3
Cd*	0.5	0.5	0.2	0.2	0.2	0.2	0.2
Be*	0.85	0.71	0.47	0.5	1.42	0.33	0.24

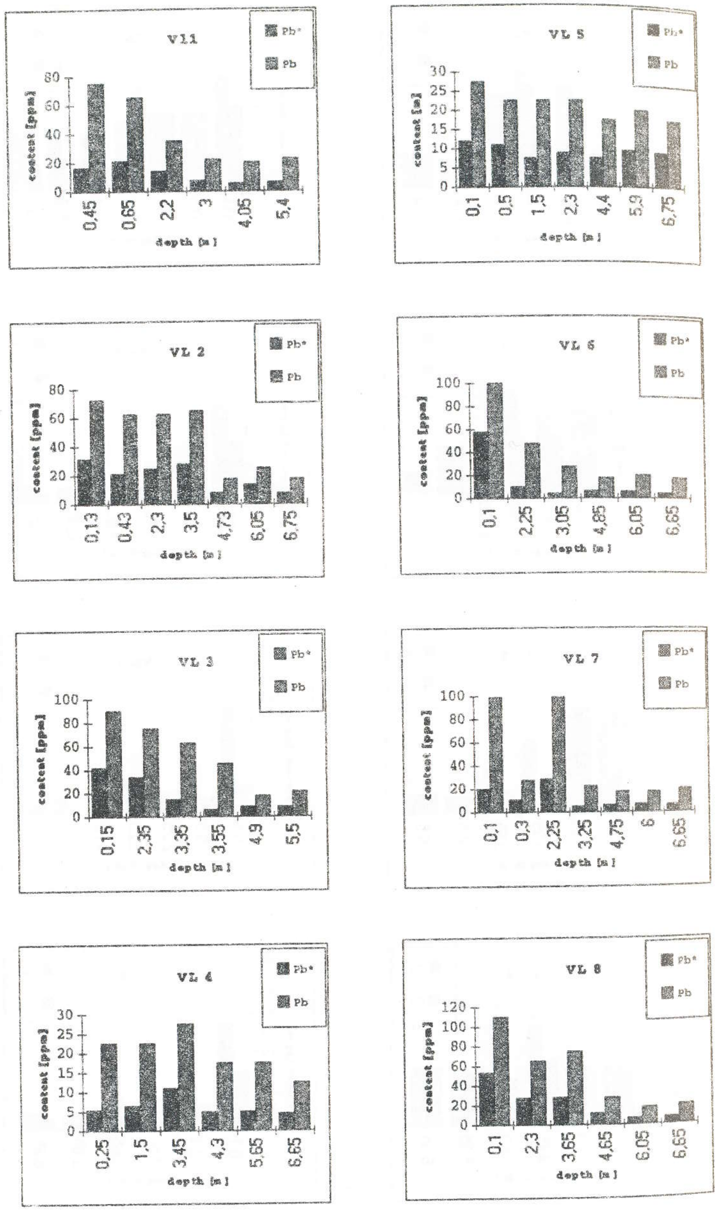
Borehole – VL 8							
Depth [m]	0.1	2.3	3.65	4.65	6.05	6.65	
Fe*	19 500	15 800	16 200	6 800	4 100	5 600	
Fe	25 000	23 000	25 000	12 000	10 000	10 000	
Cu*	30.3	13.5	16.1	6.6	4.2	6.2	
Cu	55	33	37	12	7.5	8.5	
Pb*	53.5	27.4	27.9	11.8	6.5	7.2	
Pb	110	65	75	27.5	17.5	20	
Zn*	136	79.4	66.6	37.9	14.8	14.9	
Zn	150	100	100	55	30	30	
Cr*	32.2	16.7	16.1	7.6	6.5	9.6	
Cr	90	53	57	28	28	17	
Mn*	822	362	317	150	58	72	
Mn	1 000	750	550	150	100	100	
Ni*	26.1	16.2	20.3	8.5	6	7.2	
Ni	48	37	37	28	13	13	
V	95	58	58	32	20	20	
As*	11.8	9.7	7.5	9.5	6.9	7.2	
Cd*	1	0.5	1	0.5	0.3	0.3	
Be*	0.76	0.56	0.61	0.62	0.46	0.43	
Be	2.5	1.5	1.5	1.5	1	1	



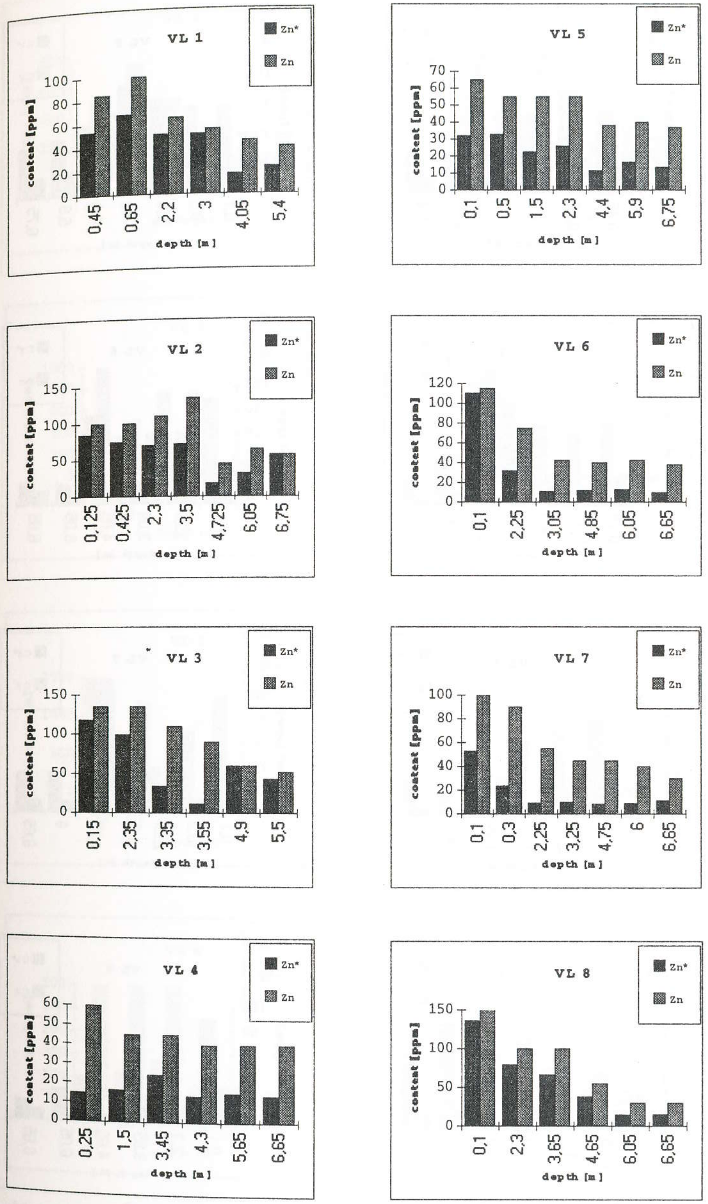
2. The content of iron in the boreholes (Fe = total content, Fe* = extractable form of metal)



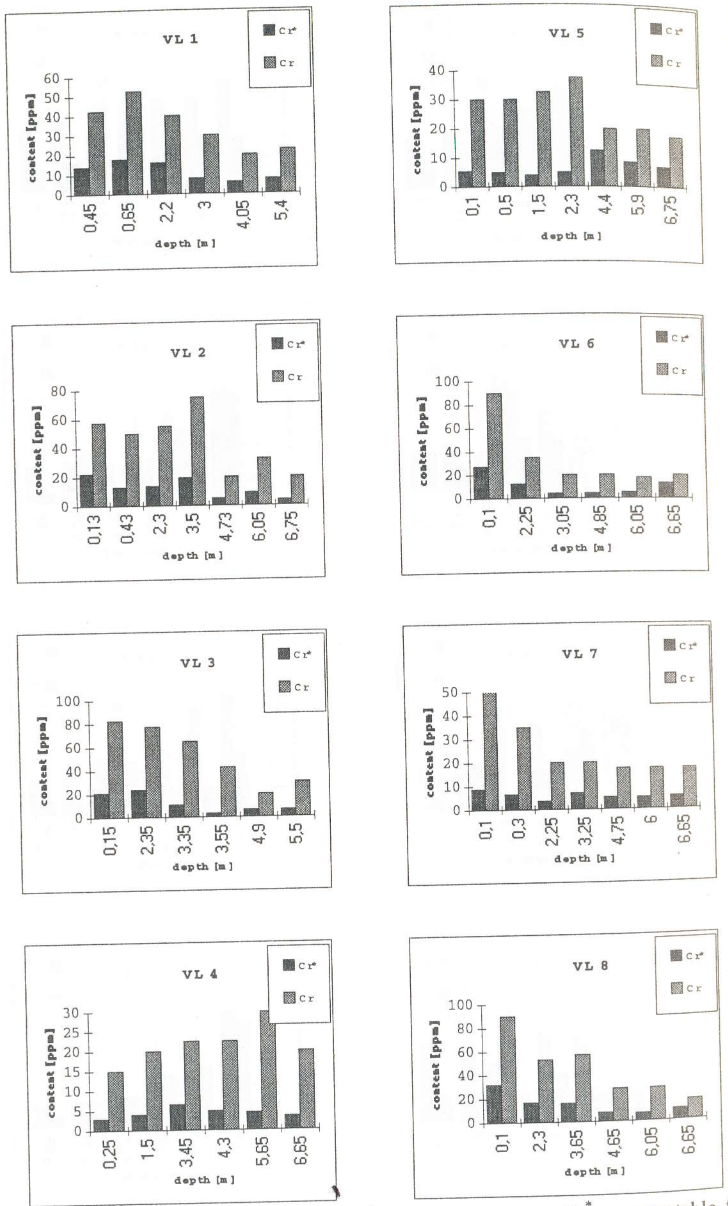
3. The content of copper in the boreholes (Cu = total content, Cu* = extractable form of metal)



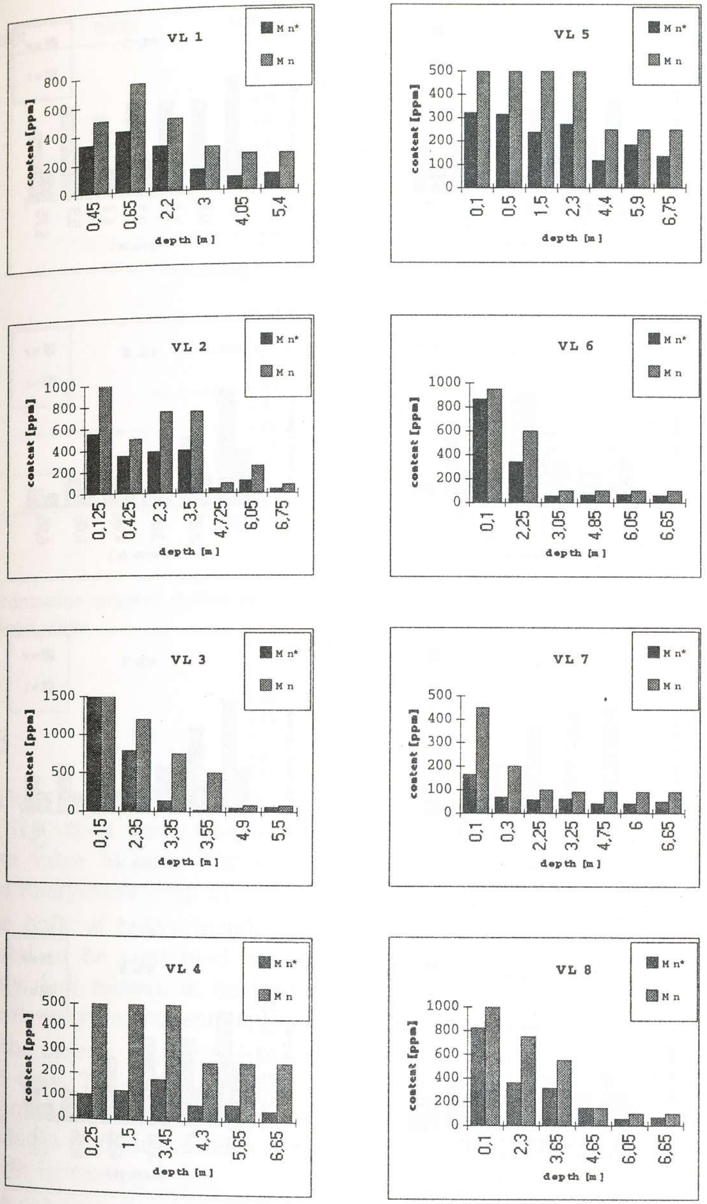
4. The content of lead in the boreholes (Pb = total content, Pb^* = extractable form of metal)



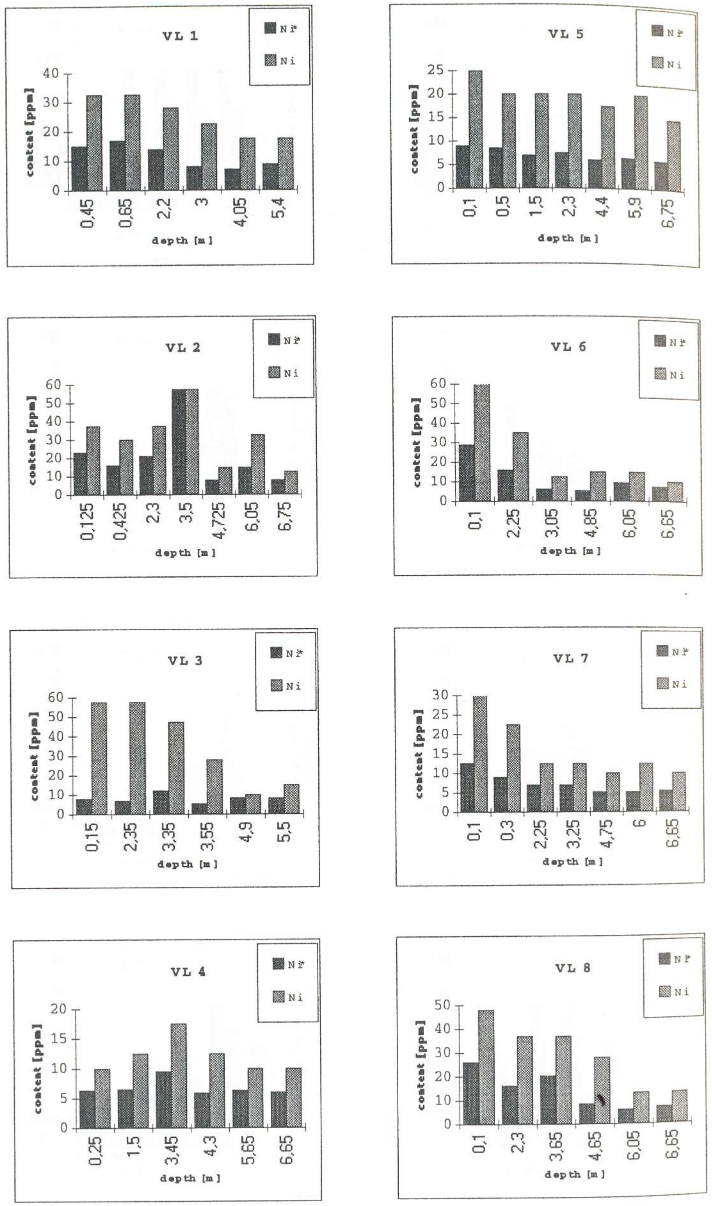
5. The content of zinc in the boreholes (Zn = total content, Zn^* = extractable form of metal)



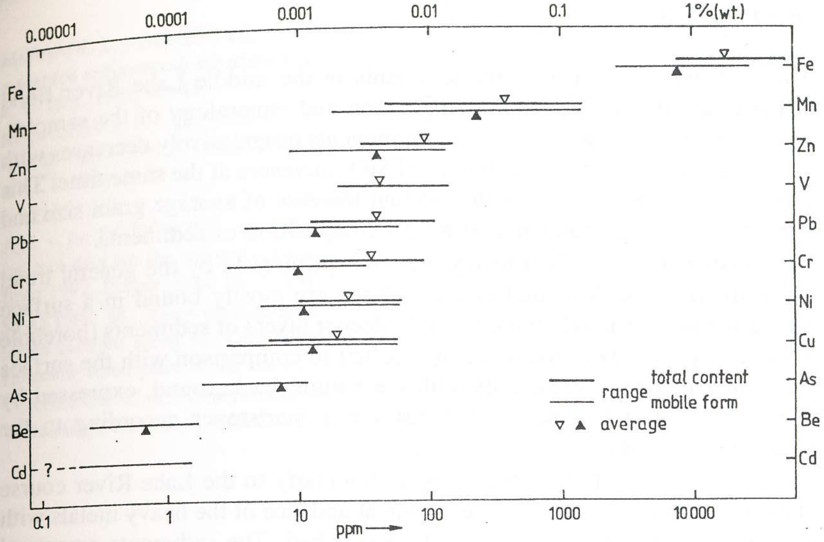
6. The content of chromium in the boreholes (Cr = total content, Cr^* = extractable form of metal)



7. The content of manganese in the boreholes (Mn = total content, Mn^* = extractable form of metal)



8. The content of nickel in the boreholes (Ni = total content, Ni* = extractable form of metal)



9. Concentration range of studied elements in 51 samples of Holocene sediments in the middle Labe flood plain

Nickel

Nickel, like Co, V and Mn, shows a high positive corelation with Fe. The total Ni content varies in the relatively narrow range of 10–60 ppm with median value 24 ppm. The average extractable nickel content is similar to that of manganese (Fig. 8).

The bulk of heavy metals of the iron group in Holocene sediments is believed to be contained in ferromagnesian minerals of the rock clasts (mainly dark micas), in limonite and lepidocrocite. Minor amount of these elements may be concentrated in interstratified clays, too.

In the case of As, Be and Cd, the extractable form of elements was determined only. The range of values for As is 1.9–11.9 ppm, the average being 7.5 ppm; for Be 0.24–1.7 ppm, the average 0.66 ppm; for Cd < 0.2–1.5 ppm. Abundance of these elements is highest near the top of boreholes and decreases with increasing depth.

The concentration range of all elements tested in 51 samples of Holocene sediments in the middle Labe River flood plain is given in Fig. 9.

CONCLUSIONS

Bulk chemistry of quaternary sediments in the middle Labe River flood plain is controlled by the grain composition and mineralogy of the samples. The content of both mafic and felsic components progressively decreases with increasing depth and the total content of SiO_2 increases at the same time. This tendency is expressed even by the gradual increase of average grain size and by increasing quarz abundance in modal composition of sediments.

The distribution of minor heavy metals is influenced by the general trend of iron distribution. Maximal concentrations are mostly bound in a surface layer, made up by fluvial humic loam. In deeper layers of sediments (borehole 4–7 m in depth) heavy metals are in a deficit in comparison with the surface parts. Their content corresponds with the natural background, expressed by the mean values for upper Cretaceous sandy marlstones according to the literary date (Č a d k o v á et al., 1985).

The series of boreholes situated perpendicularly to the Labe River course did not confirm systematic changes in the abundance of the heavy metals with the increasing distance from the Labe River bed. The sediments preserved under the medieval earth dam correspond with the sterile parts of the whole area of interest with a monotonous composition and minimal contents of all metals studied.

The comparison of total content of metals with their extractable amount leads to a remarkable conclusion: siliceous reziduum (i.e. the portion which can be considered as immobile) represents a significant part of total metal content in the studied sediments. Some irregularities were found in extractable portion of many metals, caused mainly by the changes in mineral composition of samples. Average concentrations of all tested elements in surface layer have been compared with the median values for uncontaminated soils in Czech Republic (B e n e š , P a b i a n o v á , 1987). The chemical data demonstrate moderate enrichment of Cu, Pb, Zn and As in the fluvial humic loam.

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Distribuce vybraných kovů v holocénních sedimentech v nivě středního Polabí.

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Byly sledovány geochemické aspekty šíření možných anorganických kontaminantů ve fluviálních sedimentech holocénního stáří, které tvoří typickou kvartérní akumulační zónu v nivě středního Polabí (obr. 1A). Variace obsahů vybraných prvků v rámci litologického profilu byly studovány na osmi dílčích lokalitách vymezených stanovišti mělkých vrtů (obr. 1B). Z vrtných jader bylo získáno celkem 51 litogeochemických vzorků, jejichž analýzy jsou sumarizovány v tab. I. Mocnosti jednotlivých odebíraných horizontů byly dány charakterem zeminy tak, aby každý vzorek představoval stejnorodý materiál.

Studie je zaměřena především na silně toxické prvky jako Pb, As, Cd a Be a dále na některé tranzitní kovy (V, Cr, Mn, Fe, Ni, Cu a Zn), které mohou výrazně identifikovat antropogenní znečištění základních složek životního prostředí. Údaje v tab. I reprezentují jednak absolutní obsah kovů, jednak podíl, který je uvolnitelný do prostředí loužením (nesilikátová forma prvků - loužení Lefortovou lučavkou). Tento mobilní podíl může pronikat smyvem do povrchových toků nebo průsakem porézními sedimenty do podzemní vody, která je v předmětném území často využívána jako zdroj pitné vody.

Základní chemismus nivních sedimentů modelového území (plocha 10 km^2 v blízkosti Čelákovic) je určován progresivním ubýváním mafických složek (Mg, Fe) s hloubkou a současným zvětšováním podílu SiO_2. Tento trend je doprovázen postup-

ným zvětšováním průměrné velikosti zrn (resp. zvyšováním podílu štěrku), třebaže v tomto směru lze pozorovat v rámci jednotlivých profilů lokální odchylky.

Hloubkové variace většiny těžkých kovů v hlavních rysech sledují distribuci Fe. Maximální koncentrace jsou vázány převážně v povrchové vrstvě tvořené fluviálními humózními naplaveninami. V těchto partiích jsou sedimenty mírně kontaminovány v důsledku různých antropogenních vlivů (regionální atmosférická depozice, hnojení) a recentních přírodních dějů (periodické záplavy). V hlubších vrstvách sedimentů (4 až 7 m pod povrchem) jsou těžké kovy vůči povrchovým partiím vesměs deficitní. Jejich obsah se blíží přirozenému pozadí, což je vyjádřeno středními hodnotami pro písčité slínovce, které tvoří pevné podloží v blízkosti vrtů (Č a d k o v á et al., 1985). Typický trend postupného klesání obsahu kovů s hloubkou je nejlépe dokumentován vrtem VL8 situovaným v těsné blízkosti hlavního toku Labe v oblasti Hrada.

Série vrtů v prostoru chráněného lužního lesa „Babinec", realizovaných kolmo na labské řečiště (vrty VL1 až VL7), neprokázala systematické změny v zastoupení žádného ze sledovaných kontaminantů s rostoucí vzdáleností od koryta Labe. Ve střední části metodického profilu byla navrtána pozdně středověká sypaná písčitá hráz (vrty VL4 a VL5, celkem 13 vzorků). Tato ukázka prokazatelně antropogenního sedimentu odpovídá látkově sterilním partiím celého sledovaného profilu s monotónním koncentračním zastoupením a minimálními (řádově nižšími) obsahy všech sledovaných kovů. Sedimenty „konzervované" pod hrází jsou archivovány jako standardní srovnávací materiál s fónovými koncentracemi prvků pro dané území.

Podíl mobilních forem těžkých kovů, které mohou představovat rizikový faktor pro základní složky životního prostředí ve vymezeném regionu, extrémně kolísá v závislosti na mineralogii a granulometrii vzorků. Z frekvenčních rozdělení koncentrací lze přibližně odhadnout, že mobilní formy v průměru činí 30 % pro Cr, 40 % pro Pb a Fe, 50 % pro Ni a Mn, 65 % pro Zn a více než 80 % pro Cu z jejich celkového obsahu.

Provedený výzkum ukázal, že holocénní sedimenty v nivě středního Polabí nejsou kolektorem anorganických kontaminantů, které by mohly negativně ovlivňovat současný stav životního prostředí. K jisté akumulaci některých těžkých kovů dochází pouze v povrchové vrstvě sedimentární výplně sledované oblasti.

fluviální holocénní sedimenty; niva středního Polabí; rozdělení prvků; těžké kovy

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