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HEAVY METALS IN SOME PEAT SOILS OF MIDDLE POMERANIA

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Abstract

The content of heavy metals in peat soils of north part of Słupsk Region was low. Enrichment factors for Cd, Zn and Mn indicates on their anthropogenic origin in studied peat soils, and for Cr and Ni - natural origin. However copper may be of anthropogenic or natural origin depending on location. The farther from sea peat soils are situated the higher concentration of those metals is.

Key words: heavy metals, peat soils, Middle Pomerania

INTRODUCTION

Atmosphere and flowing waters are the main ways of pollution dislocation in environment including heavy metals. There are two sources of heavy metals: anthropogenic - connected with human activity and natural - connected with their natural circulation in nature. Pollution environment index is not only the presence of heavy metals but exceeding of their natural concentrations so called geochemical background. The most often used pollution index is so called enrichment factor (Forstner and Wittmann 1985, Pempkowiak and Ciszewski 1990).

The content of trace elements and their distribution in different types and subtypes of soils give a good view of occurred soil formation processes. Character and mechanism of trace elements sorption by soil are fundamental problems in natural environment protection. The toxicity degree of those elements depends on types of compounds in which those metals exist, their chemical forms, absorption ways and metabolic activity of a given individual. Lead, mercury and cadmium belong to the group of elements, which do not play any role in metabolic processes. However by higher concentration of those metals in environment they undergo bioaccumulation in internal organs. Zinc and copper are elements with considerably decreased toxicity.

The compounds of chromium and nickel are parts of environment poisoning. On the one hand they are components essential to live and play important function in metabolism of living organisms and on the other hand after exceeding of some determined concentrations they become agents destructive for ecosystem, pathogenic for organisms, mutagenic or carcinogenic for animals and men.

The purpose of presented work is determination of pollution degree by trace elements in peat soils observed at coastal the Baltic Sea shore. Numerical values of enrichment factors are the basis for evaluation of pollution degree.

MATERIAL AND METHODS

Investigations were carried out on peat soils from surface layers from Krakulice, Czerwieniec, Kluki and Karwieńskie Błoto.

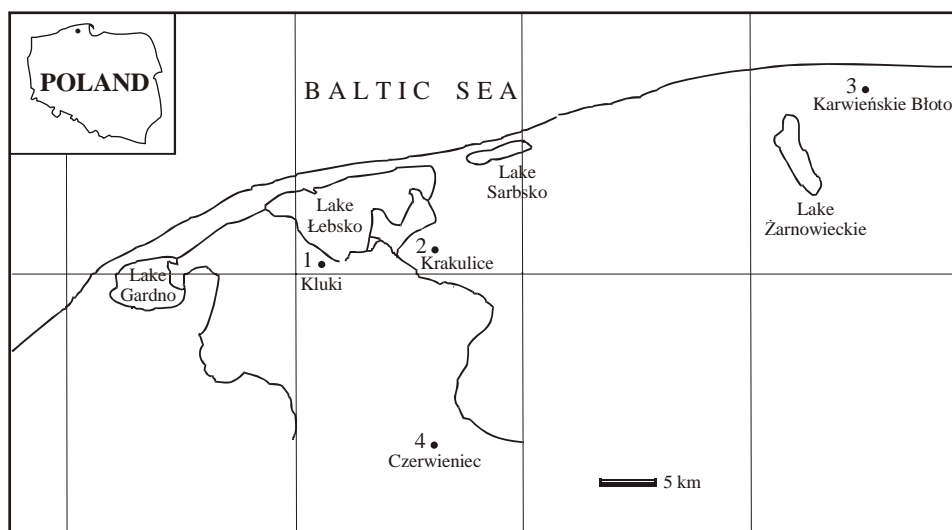


Fig. 1. Localization of sampling stations

Stations location is presented in Fig. 1, where Station 1 is situated in Kluki village and Station 2 - in Krakulice Village. The both stations are situated in Gardneńsko - Łebska Lowland. The Station 3 is located in east direction from that Lowland, in Karwieńskie Błoto village, much near the sea shore than previous stations. The Station 4 was in south direction, near Łębork, in Czerwieniec village and the farthest from sea.

The content of available forms of trace elements was determined respectively: Cu - in extract of diluted HNO_3 solution, Zn - in extract of 0.1 mol HCl solution, Mn - after extraction using MgSO_4 solution adding Na_2SO_4 with $\text{pH} = 8.00$. The determination of total forms of trace elements Cu, Zn, Pb, Cr, Ni, Fe, Cd and Mn was carried out by atomic absorption spectrometry (AAS). The chemical reaction was determined by potentiometric method in 1mol KCl solution. The loss on ignition was determined after burning of dried samples of peat in muffle furnace at 550°C tem-

perature and organic carbon - Tiurin method. For ash determination gravimetric method was used and it was done after having roasted the peat soil sample and then dissolving the remaining in hydrochloric acid solution.

Enrichment factors (EF) of those metals were calculated on the basis of measurements of trace elements concentrations in those peat soils. They were used in order to determine their origin in ecosystem (Szefer 1989). The details presenting origin and sources of chromium and nickel in peat soils were discussed with details for cadmium, which is typical anthropogenic metal. The enrichment factor is defined as a quotient of concentration of a given metal (C_{me}) in studied environment ($(C_{me})_S$) and in earth's crust ($(C_{me})_{EC}$) (Szefer 1989):

$$EF = \frac{(C_{me}/C_{Fe})_S}{(C_{me}/C_{Fe})_{EC}}$$

C_{Fe} - means iron concentration

RESULTS AND DISCUSSION

Our studied peat soils were characteristically featured by low content of heavy metals. That indicates on the absence of large sources of pollution in forms of wastes or dusts. The largest concentration was observed for manganese (average from 173 to 227 mg kg⁻¹), (Fig. 2) and zinc (from 69 to 141 mg kg⁻¹), (Fig. 3).

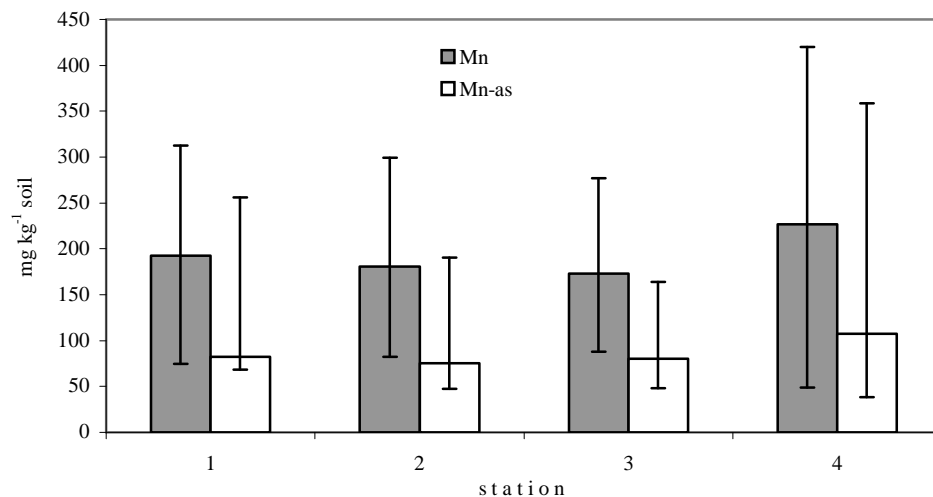


Fig. 2. The content of total manganese (Mn) and available manganese (Mn-as) in peat soils of Middle Pomerania

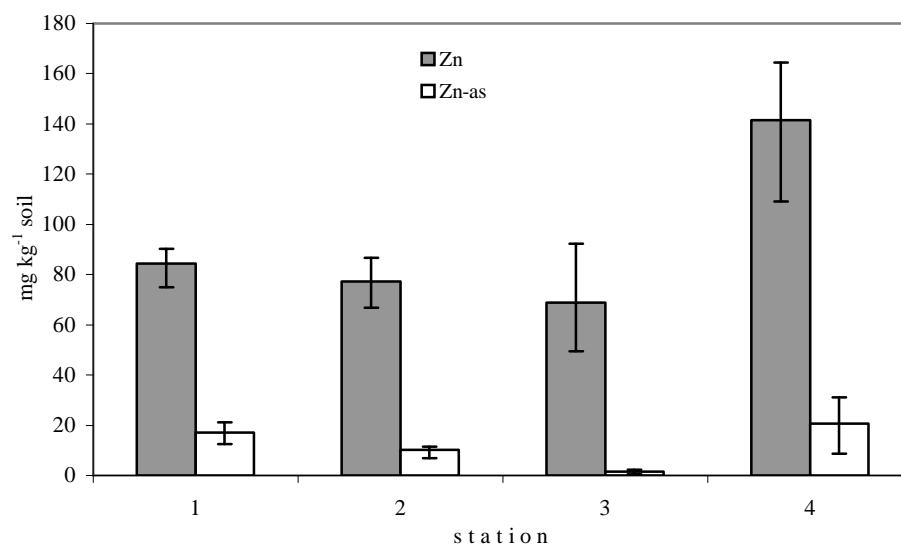


Fig. 3. The content of total (Zn) and available (Zn-as) zinc in peat soils of Middle Pomerania

Contents of chromium, nickel and cadmium amounted up to several mg kg^{-1} (Fig. 4) and did not exceed values (Cr) 8.1, (Ni) 2.6 and (Cd) 5.9 mg kg^{-1} .

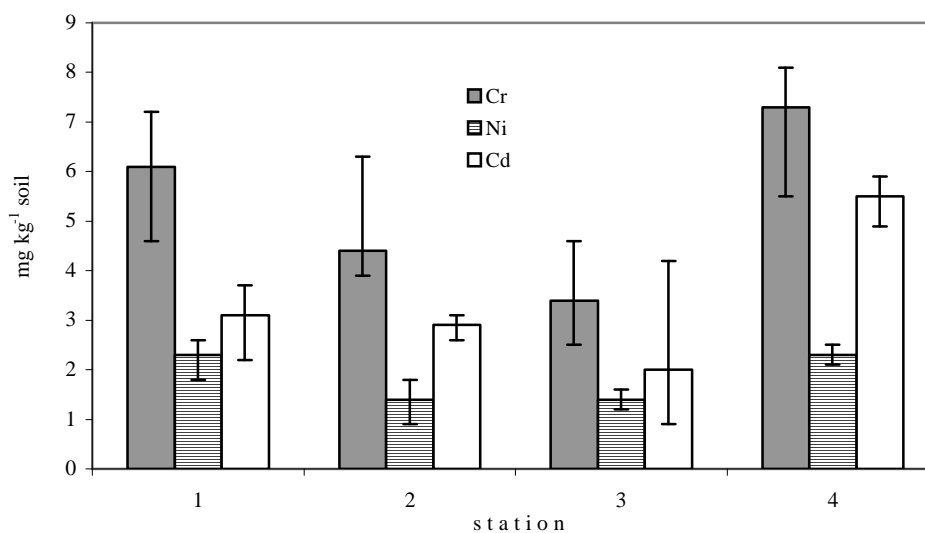


Fig. 4. The content of chromium, nickel and cadmium in peat soils of Middle Pomerania

Some differences in those metals concentration resulted from of studied peat soils localization. The considerably highest level of them was observed in peat soils from Czerwieniec village and the lowest - from Karwieńskie Błoto village. The distinct dependence on the distance from the sea is here significant. The farther from sea peat soils are situated the more exposed to pollutions particularly atmospheric once are and contain more quantities of metals. The pollution of air increased towards inland (Korzeniewski and Falkowska 1992) because road traffic and industry increase.

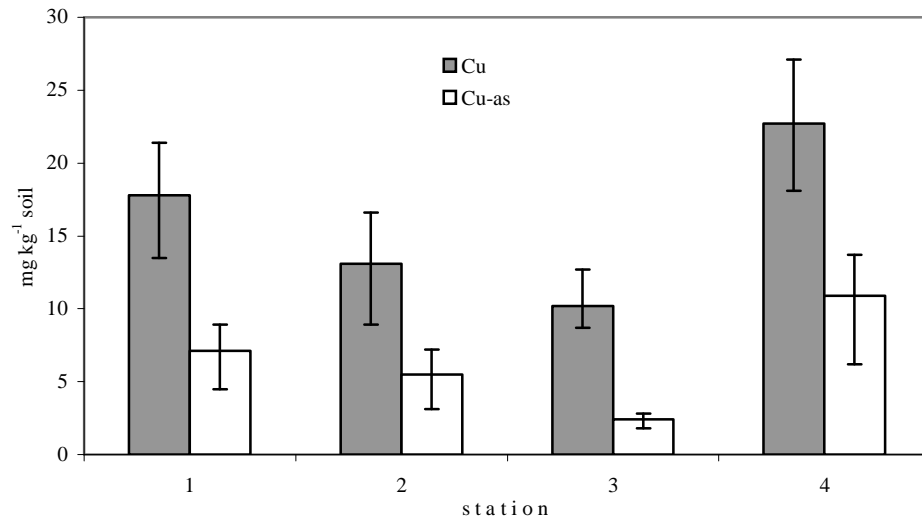


Fig. 5. The content of total (Cu) and available (Cu-as) copper in peat soils of Middle Pomerania

The content of copper in peat soils from Krakulice village (Fig. 5) was similar to its content in peat soils in that region (Cu - 11.3 mg kg⁻¹) (Tobolski *et al.* 1997). Whereas the concentration of manganese was higher by 24% and zinc by 44% lower in comparison to concentration to those soils. Peat soils from Kluki village show considerable higher content of those metals than nearby semihydrogenic soils (Cu - 9, Zn - 38 and Mn - 105 mg kg⁻¹).

The origin of metals in different environment components may be determined on the basis of enrichment factor (Szefer 1989). The calculated enrichment factors for discussed metals, normalized to iron were presented in Table 1. It was assumed that enrichment factor higher than 10 indicate on anthropogenic origin of metals. Enrichment factors lower than 3 indicate on natural origin of those metals (Pempko-wiak 1991). Zinc, cadmium and manganese belong to the first group and chromium and nickel E - to the second one. EF values of copper are in the range from 2.8 to 6.3. That suggests that copper concentration change in environment by local sources of pollution by that element in this region.

Table 1

Enrichment factors (EF) normalized to iron for peat soils in some village of Middle Pomerania

Village	Cu	Zn	Cr	Ni	Cd	Mn
Kluki (St. 1)	4.9	23.3	1.1	1.3	34.4	11.9
Krakulice (St. 2)	3.6	21.4	0.8	0.8	32.2	11.1
Karwieńskie Błota (St. 3)	2.8	19.1	0.7	0.8	22.3	10.7
Czerwieniec (St. 4)	6.3	39.3	1.3	1.3	61.1	14.0

CONCLUSIONS

1. The content of heavy metals in peat soils of north part of Słupsk Region indicates that the farther from sea peat soils are situated the higher concentration of those metals is the environment pollution increase in that direction.
2. EF factor for cadmium, zinc and manganese indicates on their anthropogenic origin in studied peat soils. Although the copper concentrations are relatively low they do not exclude copper pollution. Enrichment factors for chromium and nickel, normalized to iron, are in the range from 0.7 to 1.3. That suggests their natural origin, whereas EF for copper (2.8 - 6.3) may be of anthropogenic or natural origin depending on the region.

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METALE CIĘŻKIE W GLEBACH TORFOWYCH POMORZA ŚRODKOWEGO

Streszczenie

W pracy analizowano zawartość niektórych metali ciężkich (Cu, Zn, Cd, Mn, Cr, Ni) w glebach torfowych Ziemi Słupskiej (Środkowe Pomorze). Koncentracja tych metali w badanych glebach jest niewielka, niemniej jednak wyznaczone współczynniki wzbogacenia wskazują, że Cd, Zn i Mn są pochodzenia antropogenicznego, natomiast Cr i Ni - pochodzenia naturalnego. Pochodzenie miedzi było zależne od lokalizacji gleb torfowych. Im dalej od morza były usytuowane badane gleby, tym więcej zawierały analizowanych metali.