ACCUMULATION COEFFICIENT OF PB IN SOILS FROM ZLATNA AREA

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Abstract
Activity of Zlatna floating and smelting factory causes the soil loading with heavy metals, especially with Pb and Cu. In the area of Zlatna smelting influence, the assessment of soil loading degree with Pb was made using accumulation coefficient. The content of total Pb was studied on 30 soil profiles. The most of the sites are located on the direction of prevailing winds. The soil samples were taken from each soil horizons. The total Pb content was measured with atomic absorption spectrometer and was extracted by a mixture of strong acids (hydrochloric, sulphuric and perchloric acid - 5:10:1 ratio). This coefficient ranges from 1.25 to 49.4. Average values of this coefficient in studied area were 9.7. Median concentration was 7.1 and percentiles of 75% and 90% were 11.9 and respectively 19.8. General trend of Pb accumulation coefficient decreased with distance from processing plant. Pb accumulation was strong influenced by type of land uses and type of soils.

Keywords: Pb, anthropogenic impact, accumulation coefficient, topsoil, subsoil.

1. INTRODUCTION

Soil contamination has been one of the recognized degradation threats occurring in European soils [10] Anthropogenic activities like smelting are important point sources of trace elements in the environment. Mining and milling operation together with grinding, concentrating ores and disposal of tailings provide obvious sources of contamination [8]. The Ampellum S.A. copper smelter produced potentially toxic gaseous (mainly SO2) and particulate emission, the latter containing high levels of Pb and other substances which may impact on human and environmental health [7]. Because lead is immobilized by the organic matter of soil, lead deposited from the air is generally in the upper 2-5 cm of undisturbed soil [11].

The concentration of lead in the top layer of soils varies considerably because of the deposition and accumulation of atmospheric particulate from anthropogenic sources [11].

It was proposed that this enrichment in surface could be taken as an indicator of the atmospheric deposition [2].

To assess anthropogenic contribution, Galiulin at al. [5] proposed a coefficient of accumulation –the ratio of heavy metals in the top horizon to that in parent rock not affected by anthropogenic impact, and Kabala & Singh [6] proposed the concentration ration (total heavy metal in surface layers versus heavy metals in parent material.

Others [3] [1] used the term ''relative topsoil enhance cement (RTE)'' that is defined as ratio of trace elements accumulated in topsoil to trace elements accumulated in subsoils

The object of this paper was to evaluate the loading degree with Pb of soil from Zlatna area by accumulation coefficient.

2. MATERIALS AND METHODS

The content of total Pb was studied on 31 soil profiles. The studied soils have been classified according to their main characteristics in agreement with SRTSS and WRB. The main soil classes in this area are: Protisols, Cernisols, Cambisols, Luvisols, Hidrisols, Hidrisols, and Anthrisols. Most of the soils belongs to Dystricambisols and Eutricambisols witch have skeleton in soil profile and the soil profiles are not deep (60-80 cm), except made Luvisols. The most of the sites are located on the

direction of prevailing winds. The soil samples were taken from each soil horizons.
The total Pb content was measured with flame atomic absorption spectrometer and was extracted by a mixture of strong acids (hydrochloric, sulphuric and perchloric acid - 5:10:1 ratio).
Accumulation coefficient of Pb was calculated surface layers versus heavy metals in lowest soil profile horizon.
The field studies were made on area of the influence of Ampellum Zlatna S.A, on 14 km upstream and 22 km downstream of contaminating source.

3. RESULTED AND DISCUSSION

Pb is a less mobile element and the highest concentrations of anthropogenic Pb are found in surface horizon. Mountainous relief covers 85.2% of he total studied area and the slopes occur over 55%. The land around the pollution sources is devoid of vegetation and under these conditions occurred erosion which cause significant losses of soil and heavy metals including Pb. Thus the total contents of Pb partly reflect the fallout Pb.
Total Pb in top soil had values in the range 901-21 mg/kg. The smallest value in top soil was recorded in profile control (profile 1). In some soil profiles, in BC or C horizons were found values 5mg/kg respectively 7 mg/kg of total Pb. After Smejkal [9], specific value of total Pb in uncontaminated soil from this area is 16 mg/kg.
The accumulation coefficient of Pb in studied profile is presented in figure 1. This coefficient ranges from 1.25 to 49.4. Average value of this coefficient in studied area was 9.7.

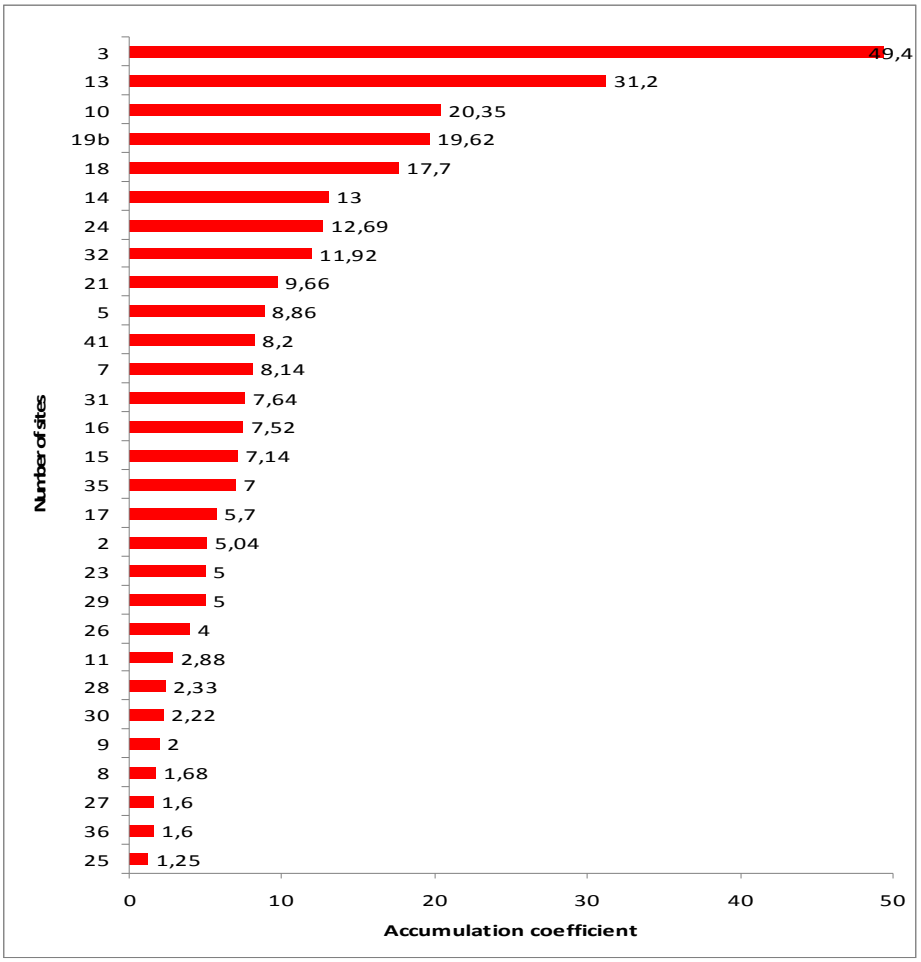

Figure 1 Accumulation coefficient of Pb from soils of Zlatna area

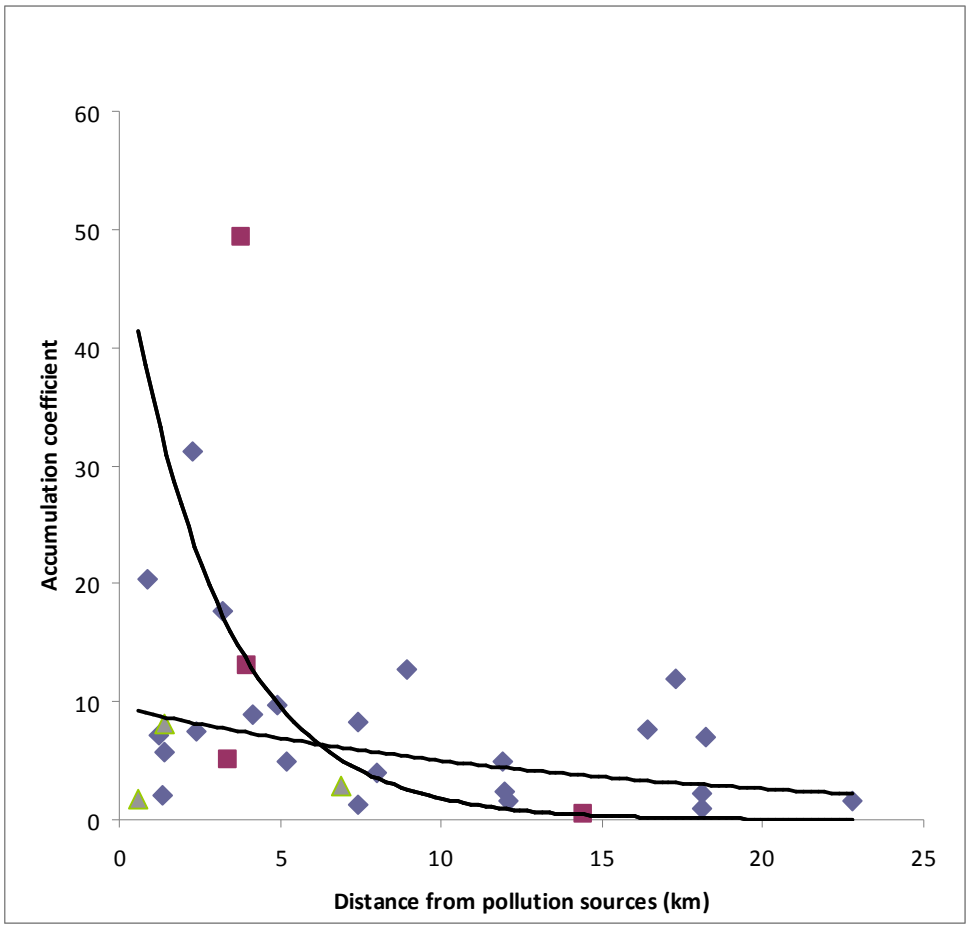

Figure 2 Variation of Pb accumulation coefficient as a function of the distance from the pollution source

Median concentration was 7.1 and percentiles of 75% and 90% were 11.9 and respectively 19.8.

The highest value belongs to site no. 3 located at 3.8 km away of pollution sources.

The smallest value was at 14 km upstream on pollution sources in a profile control. Also there is some profile under arable use, like profile 19 and 33 that had lower values in surface horizons than the subjacent horizon. Due to severe erosion, lack of vegetation or high concentrations of Pb in the soil profile, accumulation coefficient had not always the highest values around the smelter.

General trend of Pb accumulation coefficient decreased with distance from processing plant. And this decrease is statistically significant (r=0,462*) (fig. 2). The values of this coefficient was also strong influenced by direction of prevailing wind, the degree of soil erosion, type of land uses, type of soils, vegetation coverage.

Similar results were obtained by Donisa et al. that studied heavy metals contamination of natural soil located north of Baia Mare due to atmospheric transport found concentration of Pb in the surface layers, in some cases, 10-30 times higher than in the lower part of B horizon (about 50 cm depth).

Also, Kabala and Singh found corresponding ratios for Pb between 2 and 30 in the four soils located near a copper smelter and this depending on distance to the smelter, direction of prevailing wind and soil texture.

4. CONCLUSION

Accumulation coefficient range between 1.25 and 49.4 and decreased with distance, indicating that the Pb originated from atmospheric deposition.
In the Zlatna area the wind was the main transport vector of particles loaded with heavy metals, including Pb.
Also, the Pb accumulation was strong influenced by type of land uses and type of soils.

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