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Geoecological Problems of Urban Land Pollution in Contact Zones with Iron Ore Production.

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ABSTRACT

The article is concerned with the issues of study heavy metal migration in the soils in close proximity to iron ore mining and processing facilities in the territory of Starooskol-Gubkin industrial area. Tecnogenic accumulation of Pb and Cd has been registered in the upper soil horizons of home grounds. Despite the absence of facts that heavy metals exceed the established of the threshold limit value, we should state the presence of disadvantageous areas with the tendency of heavy metal content background levels excess and risk of agricultural products contamination.

Keywords: urban lands, heavy metals, iron ore facilities, ecological problems.

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INTRODUCTION

In the territory of Belgorod Region, the most unfavorable environmental situation including land use, is forming in the territory of Starooskol-Gubkin industrial area. Open Iron ore mining in the Kursk Magnetic Anomaly, in the territory of Belgorod and Kursk Regions led to anthropogenic transformation of the landscapes over considerable areas [1, 2]. Previously, the comprehensive analysis of the environmental change in the area of the Kursk Magnetic Anomaly has been completed concerning the water resources [3-4] and soil mantle [5-8], methods of control of resource reproduction processes [9-11] and ways of land use economic regulation [12] under heavy technogenic pressure.

METHODS

Private land use areas, 65 home grounds, have been examined in the cities (Gubkin and Stary Oskol) and Starooskolsky District, and the assessment of soil pollution with heavy metals (HM), Pb and Cd, has been performed. Map control of the sampling points was conducted using a GPS receiver or (in the urban area) compiling a detailed address of the sampling point.

In order to determine radial differentition factors, the soil samples (n=80) have been taken at a depth of 0-20 cm and 100-120 cm. The content of Pb and Cd total forms has been determined at the FSBI "Agrochemical Service Center "Belgorodsky" using atomic absorption method according to the procedure established in agrochemistry and agroecology. The analysis results have been processed using statistical methods: the distribution analysis and cluster analysis have been performed.

RESULTS

The Pb and Cd concentration value distribution in the soils of home grounds in Gubkin are shown in Fig. 1.

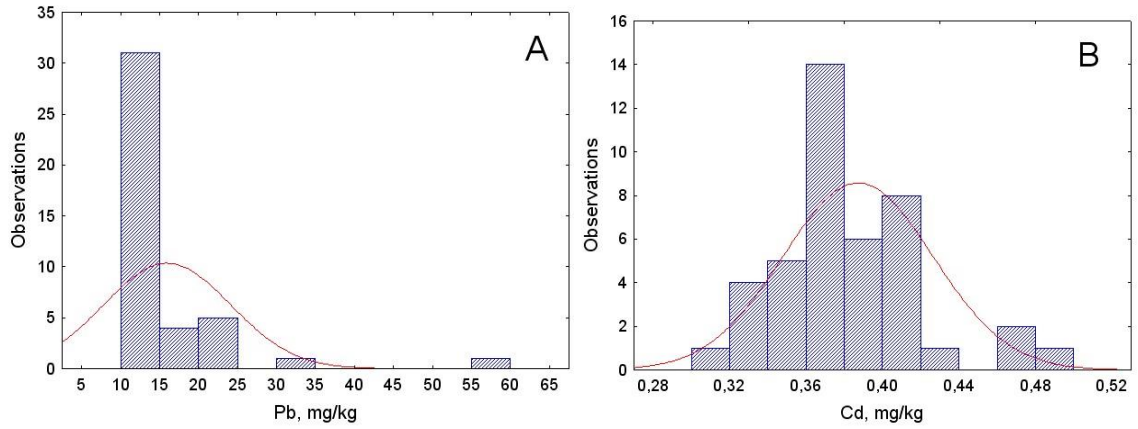

Figure 1: Distribution of Pb (A) and Cd (B) content in the soils of Gubkin (mg/kg)

The Pb distribution analysis demonstrates that the content values close to the baseline one. Besides, there are the areas with locally increased content of Pb. The distribution differs from the normal one and corresponds to the extreme distribution to a greater extent. Such distribution character is possible in case of presence of local but not widespread pollution sources with the determined aggregate background pollution. The Cd distribution is close to the normal one. This fact evidences the predomination of the background pollution that is caused by the sources with the wide range of their effects.

Sampling points for the samples with the increased level of HM content are characteristic for the high rise urban areas. Private housing areas are primarily characterized by the background pollution.

Concerning Pb pollution, we can state that the areas with the increased content of this element are located in the central and northern parts of Gubkin (Fig. 2).

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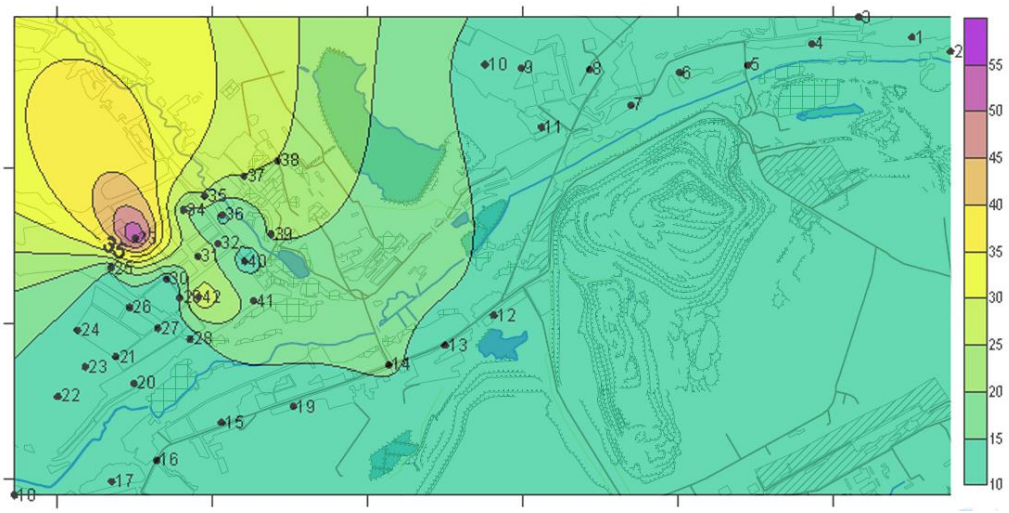

Figure 2: Cartogram of Pb content (mg/kg) in the soil on the territory of Gubkin with the designation of the sampling points

In these areas the background level is 1.5-2 times exceeded. Individual samples have Pb content comparable to the threshold limit value (TLV) (sample G 33, G 42). The sampling points are located near the highways with heavy traffic. The city outskirts have the pollution level corresponding to the background level (not exceeding 15 mg/kg of the soil). Therefore, Pb comes into the soils of Gubkin mostly from the internal source (sources) with a narrow radius of element diffusion.

Low range of Cd content variability in the samples taken in Gubkin (0.30-0.50 mg/kg) does not make it possible to detect the areas accurately different by the level of this index. Totally, the content of this element corresponds to the background level with the tendency of its excess in the central part of the city and its southeast outskirts. Thus, an external source of Cd ingress located to the southwest of the city, influences on the content of this element in the soils of Gubkin.

In Stary Oskol areas with TLV exceeded in terms of Pb and Cd have not been registered. Unfavorable environment is being formed in private land use areas in Vatutina Str. and Sloboda Yamskaya, where the background level has been registered as 1.7-2.7 times exceeding in terms of Pb, 1.3-1.5 exceeding in terms of Cd (the local background has been used, which is the HM content in the parent material).

In Starooskolsky District, grouping of the researched areas according to the heavy metal content with the use of cluster analysis can be performed in the following way (Fig. 3).

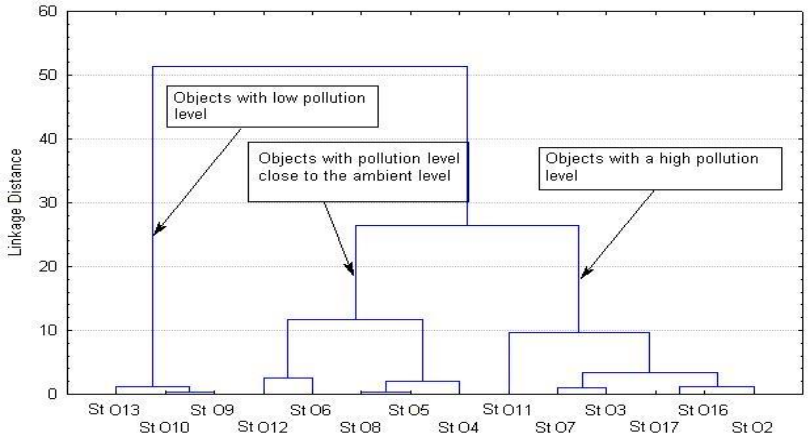

Figure 3: The dendrogram of the cluster analysis of Pb and Cd pollution of Starooskolsky District soils (sample survey)

Areas StO 9, StO 10 (Gorodische), StO 13 (Novikovo) are characterized by low HM content, it is connected with the light granulometric composition of the soils and their low absorbing capacity. At the same time, as we get closer to the electrometallurgical plat, the HM content level increases: in Babayevka (StO 12) and Obuhovka (StO 11) it exceeds the local background 2-2.2 times in terms of Pb and 1.2 times in terms of Cd. High concentration of Pb and Cd is observed in the soils of home grounds in Peschanka (StO 2 and StO 3) with the background values exceeded 1.5-1.8 times in terms of Pb and 1.2 times in terms of Cd. Besides, high HM concentration has been found in the soil of Verhnechufichevo (StO 7) it exceeds the background values 1.5-1.8 times in terms of Pb and 1.2 times in terms of Cd. In Katenevka (StO 6) the background level has been exceeded 1.3 times in terms of Cd, the Pb pollution is not observed. In Sokovoye (StO 16 and StO 17) high HM concentration is also observed, it exceeds the background one 1.2-1.9 times in terms of Pb and 1.2-1.4 times in terms of Cd.

CONCLUSION

Therefore, the technogenic accumulation of Pb and Cd in the soils has been registered in Stary Oskol and Starooskolsky District, in this respect the former element has higher concentration factors. Despite the absence of the facts that the HM exceed the established TLV we should state the presence of disadvantageous areas with the tendency of HM content background levels excess and risk of agricultural products contamination. In the conducted research we have emphasized the prospects of correlation for HM content in the upper soil horizon with their content in the parent material (local background content). This has enabled us to assess the level of the accumulation and radial differentiation of the elements in the soil.

The obtained results will make a real basis for ecological territorial zoning in the situation of the most acute conflicts between the agricultural and industrial natural resource users.

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