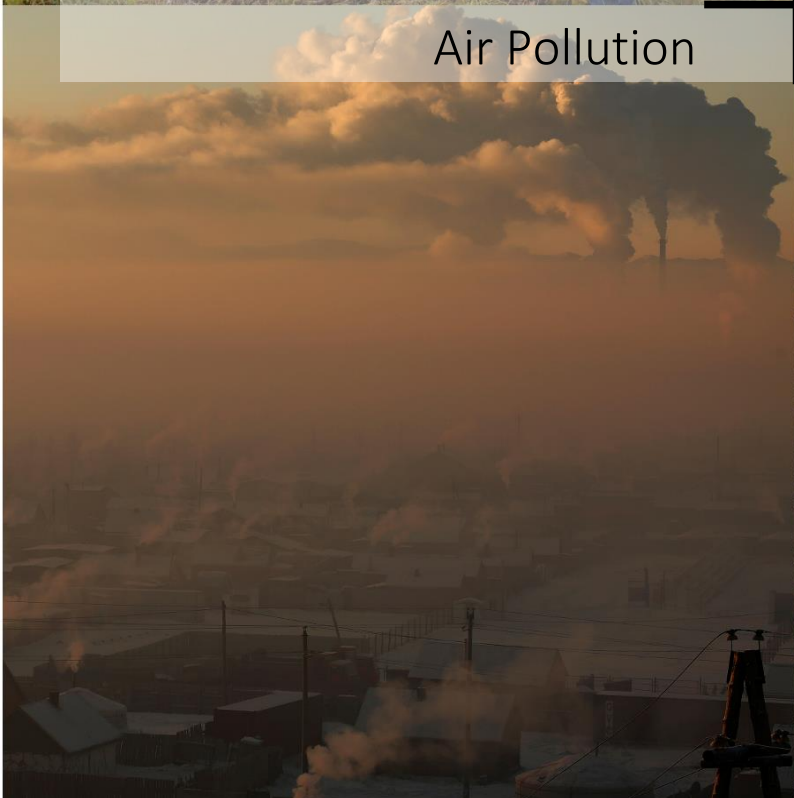




Sustainable Forestry
Air Pollution



Water Management
Mining and Environment



Book of Abstracts

GMIT Symposium on Environmental Science and Engineering

GMIT Nalaikh ▪ 31 August – 2 September 2018

Imprint

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Timofeev et al.: Potential toxic elements in topsoils of the industrial and transport center of Darkhan (Northern Mongolia)

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Abstract

The aim of the current work was to determine the levels of potential toxic elements (PTEs) in topsoils of Darkhan. Darkhan is the third largest city in Mongolia, the administrative center of the Darkhan-Uul aimak, in which more than 85 thousand people live. It stretches from north to south for 12 km along the Haraa river valley. The climate is a sharply continental with a predominance of the southern winds (Figure 1). The main sources of pollution are motor transport and industries, represented by the iron-and-steel metallurgy, fuel and energy complex, consumer industry, production of food and construction materials, etc.

The soil-geochemical survey of Darkhan territory was performed in summer of 2011-2014. 123 mixed urban and 3 background samples were taken from the topsoils (0-10-cm) on a grid with step of 500–700 m, which ensured the spatial resolution necessary for compiling large-scale geochemical maps. The bulk contents of PTEs were analyzed by mass spectrometry and inductively coupled mass spectrometry. Thirteen priority pollutants As, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Sn, V, W, Zn were selected for the detailed analysis. Data analysis was carried out by calculating: global enrichment EF_g and dispersion DF_g factors (Timofeev and Kosheleva, 2017), index of geoaccumulation I_{geo} , and degree of contamination CD (Loska et al., 2004). Visualization of geochemical data was performed by local interpolation or kriging method in MapInfo 11.5 and Surfer 11 packages.

The background soils of the study area had a weakly pronounced W specialization ($EF_g = 3$), the highest dispersion was inherent in Cu, Cr, Cd, Ni, As, Co, V ($DF_g = 1.5-2.9$). Concentrations of other elements were close to world average PTE contents. Soils in industrial zone were the most contaminated with Pb, Mo, Sb, Zn, W, Cr, As, Cd, Cu ($I_{geo} = 0.15-0.98$). Antimony, Zn, Pb were accumulated in the central and northern parts of the city in residential zone with multi-story and single-story houses. There was also a slight increase in Sn ($I_{geo} = 0.013$) and Cd (0.011) content. Weak to moderately strong contamination was specific of areas along roads and large cross-roads where local I_{geo} values reached 2.61 for Sn, 1.96 for Sb, 1.87 for Cd, 0.48 for Pb, and 0.3 for Zn. Recreation park zone and undeveloped areas were characterized by $I_{geo} < 0$ values, which indicated the absence of contamination.

More than half of the city had a considerable level of multi-elemental contamination (Fig. 1) with an average $CD = 18.3$. The first and the most pronounced anomaly ($CD = 39.5-45$) was found in the southern industrial cluster. The greatest contribution to CD was made by Mo (14.4%), Cr (14), W (13.5), Ni (11.5), As (8.2), Cu (8), Co-Zn-Sb-Pb-Cd-V (4.2-5). The second anomaly ($CD = 44.2$) with priority pollutants Pb (26.7%), Sb (17.1), Cd (13.9), Zn (6.5), Cu-W-Mo-As (4.2-5.9) was formed near leather factory “Darkhan Nekhiy”. The third anomaly was located around Darkhan Metallurgical Plant ($CD = 33$). Zinc (24.9%), Cd (22.7%), Pb (8.6), Cr (7.1), Cu (6.6), Sb (5.2), Mo-V-Ni (4.1-4.7) exerted the greatest impact. The fourth anomaly extended from north to east by 750-800 m. It was located near mill plant and railroad station in the north of the city. CD values were up to 39.4-42.2 in the anomaly center. It indicated very high multi-elemental contamination with Pb (34.7%), Sb

(15.6), Zn (10.4), Mo (7), W (6.5), As (5.2) priority pollutants. Totally all anomaly areas did not exceed 4% of urban territory (Fig. 1).

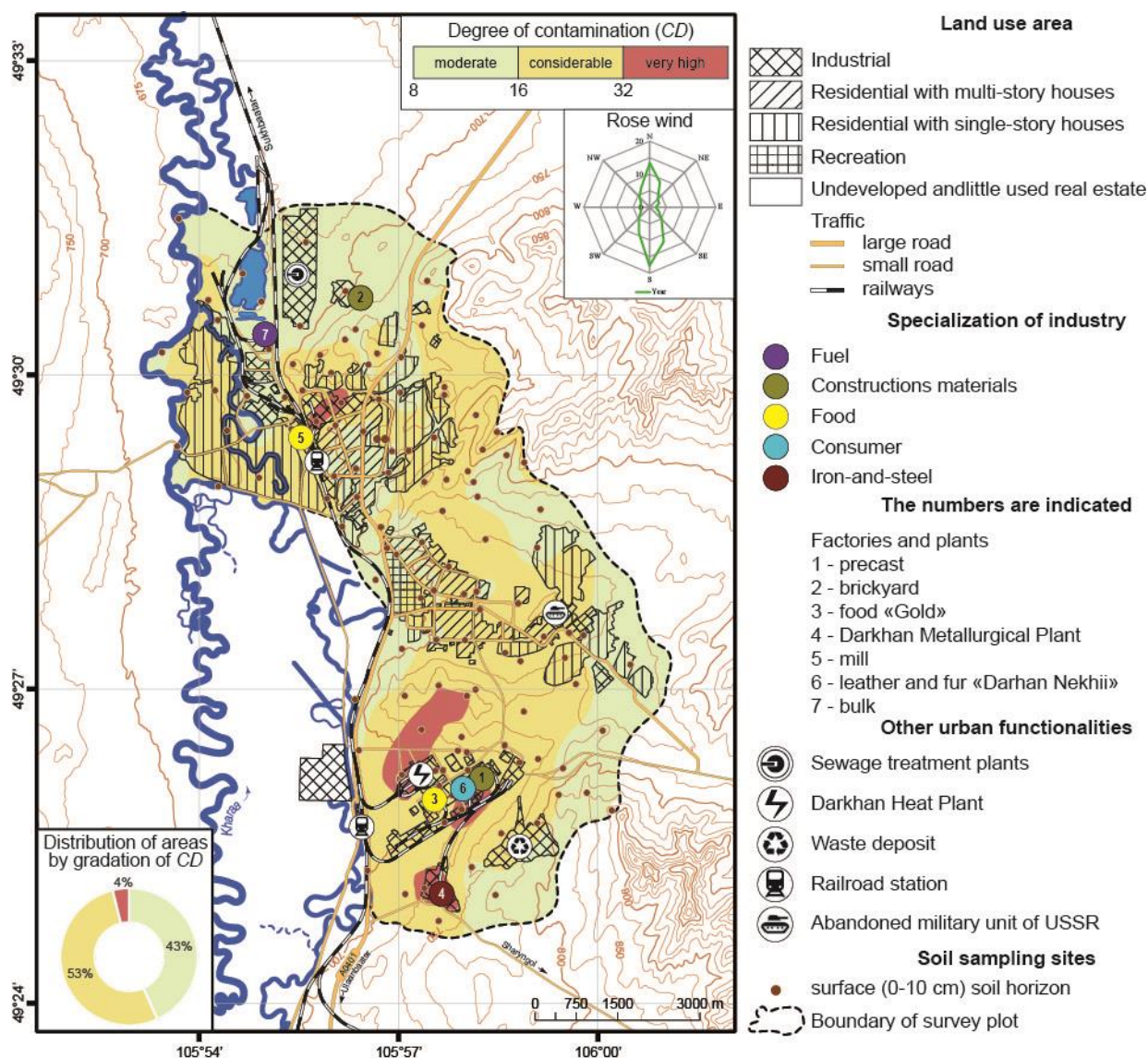


Fig. 1. Contamination degree of topsoils in Darkhan

This study was performed within the framework of the project supported by the Russian Foundation for Basic Research (project nos. 18-35-00079\18).

Keywords

Environmental geochemistry • technogenic anomalies • priority pollutants

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Timofeev, I.V. & Kosheleva, N.E. (2017): Geochemical disturbance of soil cover in the nonferrous mining centers of the Selenga River basin. *Environmental Geochemistry and Health* 39: 803–819. <https://doi.org/10.1007/s10653-016-9850-0>

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