Soils of Urban Industrial Traffic Mining and Military areas

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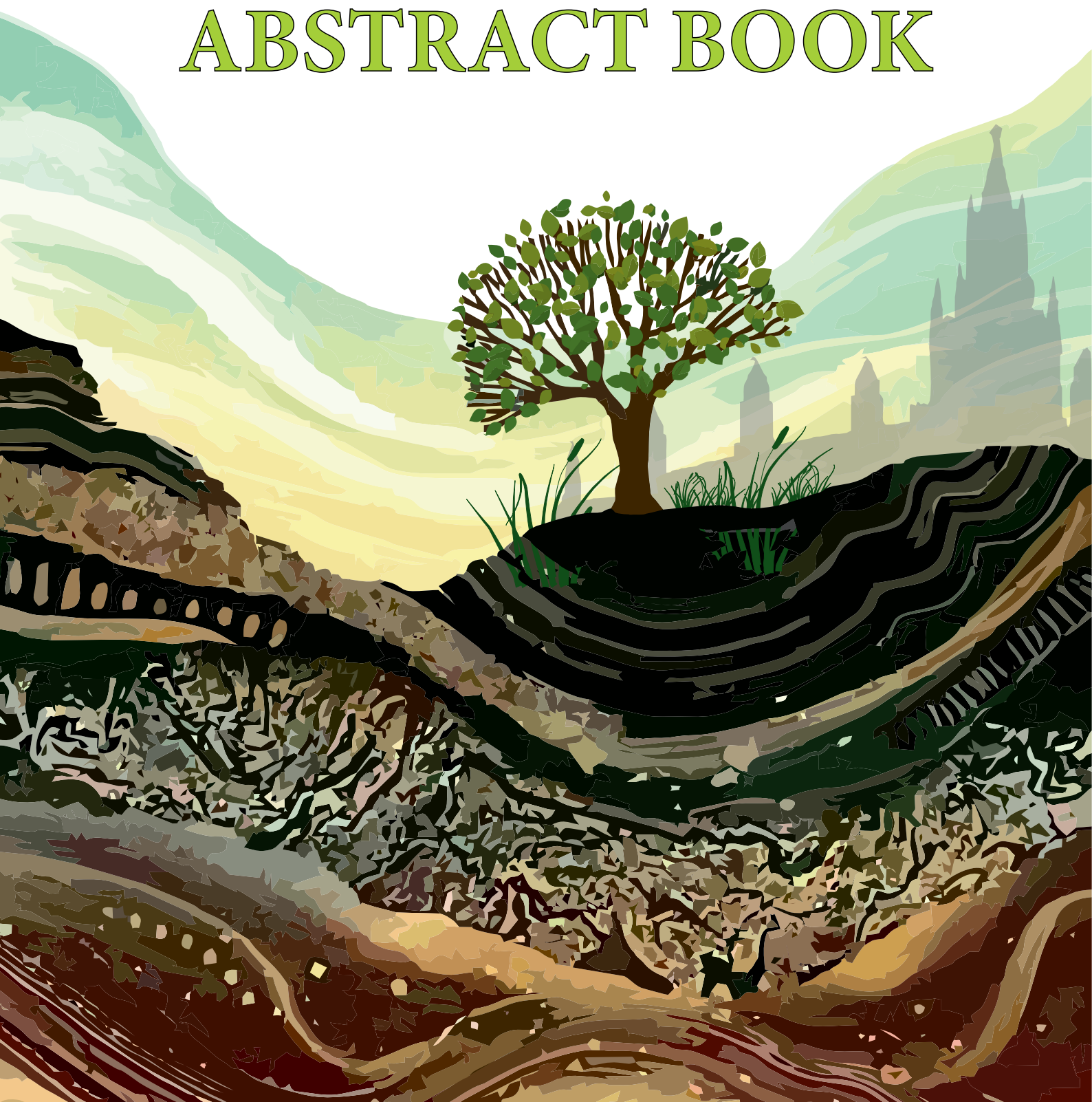
ABSTRACT BOOK



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Heavy metals and fluorine in soils of Minusinsk basin

J.Yu.Vasil'chuk, E.A.Ivanova, P.P.Krechetov, E.V.Terskaya
Lomonosov Moscow State University, Moscow, Russia
jessica.vasilchuk@gmail.com

Heavy metals are priority industrial pollutants that significantly affect the environment and human health. The soils and carbonate neoformations are the storage medium for heavy metals. The purpose of this study is to identify the factors, which determine the content of heavy metals in soils soil solutions and carbonate pendants in soils of the Minusinsk Basin. Three study sites were investigated: Sayanogorsk aluminum smelter area, and the lake Khankul and Khakass National Museum Kazanovka, selected as the background. The study area is characterized by grasslands with Castanozems soils. The climate is sharply continental. The total content of major and ininor elements in soils, soil solutions and carbonate neoformations was measured with ICP-MS, the content of mobile forms of some heavy metals in soils was measured with atomic absorption spectrometry, for extraction from soils ammonium acetate buffer was used. Most of studies of anthropogenic pollution in the aluminum industry zone of influence are related to F and Al content, as well as Na, Ca Mg [2, 5, 10]. Since Sayanogorsk aluminum smelter is not the only source of anthropogenic influence in the Minusinsk Basin, the contents of heavy metals (HM) in soils is also an important indicator for the ecological assessment. The lithology of Minusinsk Basin is heterogeneous, and we consider that not only human-made anomalies are important but also the sources of HM, which are parent rocks and especially locally exposed Devonian rocks [4]. The pollution is estimated by hygienic standards adopted in the form of maximum permissible concentration (MPC) of compounds [3, 4]. In soil minor elements absolute values Ba, Sr, V, Cr, Zn, Zr, Rb, Ce, Ni, Nd, La, Y prevail, Sayanogorsk content of Ba, V, Cr is greater relatively to the two other sites, Sr and Zr content is the highest in soils of Lake. Khankul ares. The highest clarkes of concentration [6] of elements in comparison with natural abundance of elements in igneous rocks by A.P. Vinogradov [8] are marked for Bi (14-26), Se (14-20), As (2,2-7,9) , Hf (1,75-5,01), Yb (4,4-7,4), Cd (in the lower soil horizons in Kazanovka CC=2), Sb (1,4-2,4 except lake Khankul). Minory exceeded MPC for soil are noted for V, in Sayanogorsk the content in soils is 161 ppm as MPC is 150 ppm. In general, in soil solutions Sr, Ba, Zn, Al, V prevail, and the content of Sr, Ba, V, Al is the highest in Sayanogorsk soils. In soil solution from Sayanogorsk the Al content is 129 ppb 14.8 ppb and in Kazanovka the content of V is 19,6 and 4.6 ppb, respectively.

In the area of influence of the Sayanogorsk aluminum smelter a number of heavy metals - specific pollutants for the area is identified. They are elements such as zinc, lead, cobalt and nickel.

Background Zn content in soils is 100 ppm. The maximum total concentration of Zn in the soil reaches 270 ppm, the maximum value of the content of mobile forms of Zn 33.9 Zn ppm observed in the impact zone of the Sayanogorsk aluminum smelter. MPC for total Zn in soil is 100 ppm, for mobile forms of Zn it is 23 ppm. Spatial distribution of lead in the soils of the study area sufficiently can be differentiated according to the remoteness from the industrial complex. The highest concentration of total forms of Pb observed in the vicinity of the smelter and is up to 80 ppm. Background concentration of Pb in soils is 35 ppm. The maximum Pb content of mobile forms in soils is 1.5 ppm. MPC for total Pb in soils is 32 ppm, for mobile forms of Pb it is 6 ppm. In the area of influence of the Sayanogorsk aluminum smelter maximum nickel concentrations in soils are up to 140 ppm. Background values of total Ni concentrations is 60 ppm. The maximum content of mobile forms of Ni is 1 ppm. MPC for total Ni in soils is 85 ppm, for mobile forms of Ni it is 4 ppm. The maximum concentrations of total forms of cobalt in soils is up to 50 ppm. Local background cobalt content in soils is 18 ppm. The maximum value of the content of mobile forms of cobalt reaches 2.4 ppm. MPC for mobile forms of Co is 5 ppm.

The fluorine content in the soils in the area of the Sayanogorsk smelter impact reaches maximum concentrations of 10-12 ppm at a distance of 1.5 km from the plant in the direction of the prevailing western and south-western winds. The background content of water-soluble forms of fluorine for the study area was 1.5 ppm. MPC for water-soluble fluorine in soils is 10 ppm for the water it is 1.2 ppm. In soil solutions fluorine content is from 0.1 to 0.3 ppm in the Chernozems soils of Sayanogorsk study area. The water-sol-

uble fluorine content in Kazanovka in Castanozem soils is low: 1.2-2.0 ppm while in the soil solutions fluorine content ranges from 0.1 to 0.75 ppm. The high fluorine content in soil solutions in Kazanovka compared to Sayanogorsk is probably due to the higher content of fluorine in groundwater and parent rocks.

In carbonate pendants strontium and barium prevail. The content of these two elements is maximum in the saline landscapes of lake Khankul, exceeding the content of the Sayanogorsk and Kazanovka 2-10 times. Zr, Ce, Zn predominate in absolute values in Kazanovka and Khankul, while in Sayanogorsk - Ni, Zn, Cr, V prevail. Also Sayanogorsk area compared to other areas is characterized by higher Cu content, as well as Sc and Y content. Highest CC of elements in carbonate neoformations compared with natural abundance of elements in carbonate rocks [1] in the three key sites are observed for Pb (60-302,5), Ba (17-262), Tl (30-350), Co (32-261), Hf (11- 48), Nb (5,3 - 10,4), the content of Sr is also high (273-810 ppm) in absolute values and it is close to the natural abundance of this element in carbonate rocks. The conclusions are the following: 1) The high content of V, Cr, Ba in soils and carbonate pendants compared to clarkes and the MPC in Sayanogorsk, is probably due to the anthropogenic factor, 2) excess of Al and V relative to the background content in soil solutions also shows the human impact 3) high content of Hf and Nb compared with clarkes in carbonate pendants and in soils may be associated with Devonian rocks, some of which are enriched by these trace elements [9] high Sr content but not exceeding clarke is also associated with lithogenic factor. 4) The fluorine content in the soils in the area of the Sayanogorsk smelter impact reaches maximum concentrations of 10-12 ppm at a distance of 1.5 km from the plant and also zinc, lead, cobalt and nickel are identified as major pollutants in the vicinity of the plant 5) The fluorine content in soil solutions is higher in the background area due to the lithogenic factor.

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