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Ecological Dangers of Chemical Contamination of Urban Areas Soils: Casestudy of Tomsk

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Abstract

The elemental composition of soils in Western Siberia industrial center – Tomsk city is studied. The content of 28 elements in soils of the four administrative districts is determined by the instrumental neutron activation analysis method. The value of calculated total pollution index indicates a high degree of soil contamination, and dangerous levels of human health risk. The main contributors to the total pollution index value are elements: Tb, Br, Sb and Ta. The districts were ranked by the accumulation level of some elements, and it is shown that increased concentration values are confined to industrial enterprises and fuel cycle. The specificity of city districts soil cover is the increased values of relative to the city average values of several elements contents: Kirovsky district- Na and Ba, Oktyabrsky - Hf, Sc, Tb, Sm, La, Ce, Yb, Lu, and Br, Leninsky - Ca, Rb, Sr. The main sources of chromium and barium in the Tomsk city environment are analyzed.

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Keywords:

1. Introduction

Storage medium such as soil, snow cover and etc. is assessed for complex characteristics of aerogenic impact pollution. On the one hand, the soil is a major factor in the formation of natural and artificial biogeochemical provinces, playing a leading role in the occurrence and prevention of endemic diseases, and, on the other hand, soil is the environment which provides the circulation of exogenous chemicals in the "external environment - people". The migration and exchange of all chemical elements take place in the soils[1].

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Accumulation of various chemical contaminants in soils of Tomsk and its suburbs was studied previously[2]. The observed spatial heterogeneity of pollutants, especially heavy metals and radioactive fissile elements indicate that the chemical composition of the soil material of Tomsk region reflects the specific character of production activities associated with the operation of heat and power facilities, petrochemical complexes, and with nuclear fuel cycle enterprise located nearby[2].

The aim of this work is to establish the levels of chemical elements in soils of Tomsk districts.

2. Experimental technique

215 soil samples were selected and studied within the research program of soils at Tomsk administrative districts and the areas of industrial enterprises. Among them 204 soil samples were selected by the net in the Tomsk city with 103 samples taken in the areas of currently and previously functioning industrial enterprises[3].

The elements were quantitatively determined by atomic emission method with inductively coupled plasma (ICP, Laboratory of Kara-Balt mining plant, Kyrgyz Republic), multielement instrumental neutron activation analysis (INAA) in nuclear and geochemical laboratory of the Department of Geoecology and Geochemistry of TPU.

3. Results and discussion

According to the studies of the Tomsk soils, the levels of rare, rare earth, and other radioactive elements accumulation are measured (Table 1)

Table 1. Average content of elements in soils of Tomsk city districts, mg / kg

Elements	District				Tomsk city	Background[2]
	Kirovsky (57 samples)	Sovietsky (48 samples)	Oktyabrsky (61 samples)	Leninsky (38 samples)	(204 samples)	
Na. %	**1.3±0.04**	1.1±0.05	1.1±0.03	1.1±0.04	1.1±0.02	0.46
Ca. %	1.3±0.03	1.5±0.06	1.5±0.1	**1.7±0.1**	1.4±0.04	0.43
Fe. %	2.9±0.1	3.2±0.1	3.2±0.1	3.2±0.1	3.2±0.04	1.3
Br	8.9±1.1	8.5±0.7	**9.5±0.7**	8±1.5	8.8±0.5	1.24
Ba	**608.7±31.1**	576±19.8	542.6±16.3	560±29.4	550±12.3	124
Co	14.5±1.1	13.1±0.4	14.7±0.3	13.8±0.5	14.3±0.3	6.5
Cr	109±6.3	113.2±4.9	102.4±14.7	109±5.4	103.6±5	43.2
Sb	1.7±0.4	1.8±0.2	1.6±0.2	1.6±1.7	1.6±0.3	0.3
As	< d.l.	< d.l.	0.5±0.36	1.2±0.6	0.4±0.2	< d.l.
			Rare elements			
Rb	72.8±2.9	71±3.6	79.4±3.2	**85.7±3.4**	76.7±1.7	17.2
Cs	3.5±0.1	3.8±0.2	3.7±0.1	3.5±0.1	3.6±0.1	1.25
Sr	30.1±13.3	44.7±22	44.4±18	**188.4±41.6**	67.3±12	164
Hf	6.5±0.2	6.6±0.2	**7.1±0.2**	6.1±0.2	6.6±0.1	3.8
Ta	0.92±0.05	0.83±0.05	0.91±0.04	0.86±0.06	0.85±0.02	0.16
Sc	10.9±0.3	10.8±0.3	**12.1±0.3**	11.2±0.4	11.3±0.2	8.3