

# Spatial Variability of Topsoil Contamination by Trace Elements on the Territories of Kindergartens in Vilnius, Lithuania

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## Abstract

The most vulnerable part of our population is children who play in points of exposure, such as kindergarten playgrounds. They can have direct contact with contaminated topsoil via ingestion, inhalation and dermal contact. An investigation of the spatial and temporal variability of topsoil contamination level was performed in playgrounds of the city kindergartens in Vilnius. Topsoil samples were collected from 50 playgrounds and analysed for 22 chemical elements. Correlations of element concentrations with traffic, industrial and other specific sources of pollution were found.

## Introduction

Soil in urban territories is continuously polluted by heavy metals, petroleum products and other potentially harmful chemical elements, which tend to accumulate in topsoil (Kadunas et al., 1999). People who live and work in the urban territories can be exposed to the contaminated topsoil, which can also become a secondary source of atmosphere pollution and be hazardous to the health. The most vulnerable part of the population is children who play in points of exposure, such as playgrounds, and can have direct contact with contaminated topsoil via ingestion, inhalation and dermal contact. It is therefore important to investigate the spatial and temporal variability and identify reasons of a topsoil contamination to assess risks for children health.

The aim of the study was to identify the main inorganic pollutants, their spatial and temporal variability in playgrounds of the city kindergartens in Vilnius, Lithuania.

## Methods

Topsoil samples were collected in 2007 from the playgrounds of 50 kindergartens of Vilnius city (Fig. 1). The kindergartens had various geomorphologic conditions. Composite samples, consisting of 20-25 sub-samples, were taken from the upper 10 cm soil layer. All composite samples were homogenized, air-dried at room temperature and sieved through 1 mm nylon sieves. The <1 mm fraction was ashed at 450°C, ground and analysed by atomic emission spectrophotometry. Total contents of the following 22 elements were determined: Ag, B, Ba, Co, Cr, Cu, Ga, Li, Mn, Mo, Nb, Ni, Pb, Sc, Sn, Sr, Ti, V, Y, Yb, Zn and Zr. To correlate the element concentrations with traffic, industrial and other specific sources of pollution, PCA with Varimax rotation statistical method was used, while ANOVA was applied to identify spatial and temporal differences. Total contamination index  $Z_s$  was calculated as follows:

$$Z_s = C_{ci} - (n-1), \quad (1)$$

where  $n$  is the number of elements and  $C_c$  is the concentration coefficient of an element. The concentration coefficients were calculated:

$$C_c = C_i / C_f, \quad (2)$$

where,  $C_i$  – the concentration of  $i$  element in a sample and  $C_f$  – the background value of  $i$  element

## Topsoil samples collected in the kindergartens in 2007 Vilnius, Lithuania

-  Sampling points and their numbers where heavy metals and petroleum products have been analyzed
-  Sampling points where heavy metals have been analyzed
-  Highly hazardous contamination level  $Z_{s13}$  (32-128)

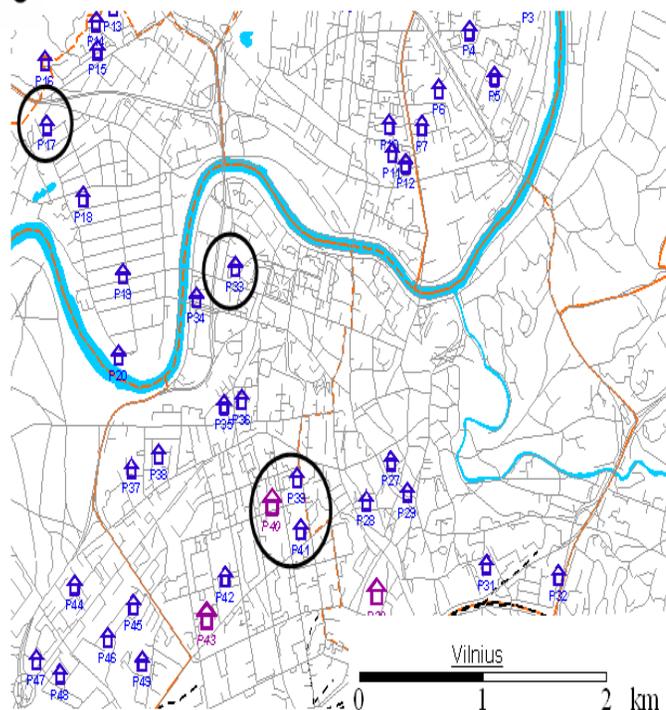


Figure 1. Points of topsoil sampling.

## **Results**

The total contamination index, Zs13, was calculated for 13 trace elements: Ag, B, Ba, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sn, V and Zn. According to the Zs13 values and Lithuanian hygienic norm (HN 60-2004, 2004), concentration of trace elements in soil from 29 kindergartens was within the allowable limits,

i.e. Zs=6-16, while in 16 playgrounds, the Zs13 values exceeded the allowable contamination level and 5 playgrounds were located in the highly contaminated zone, where total contamination index Zs13 varied between 32 and 95.

## **Discussion**

The results of the investigation show that in some kindergartens children are exposed to a hazardous level of contamination. These kindergartens are located in the former industrial part of the Naujamiestis city district. In the past there were very intensive industrial activities, e.g. machine-tool plant, furniture and knitwear factory, manufacturing of electronics, etc., which caused accumulation of high concentrations of trace elements in topsoil (Taraskevicius, 2000). A railway and motor transport emissions are additional sources of soil contamination in the Naujamiestis district.

## **References**

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