RADIOISOTOPES AS INDICATORS OF HEAVY METALS TRANSLOCATION IN THE ENVIRONMENT

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Introduction

Since the early 60. of the 20th century in environmental biomonitoring plant organisms were used. Due to their prevalence, mosses become the most commonly used bioindicators. Their morphological and physiological properties as well as the ability of contaminants accumulation [Gerdol al. 2014] allowed the wide use of them to study the degree of environmental pollution with heavy metals and polycyclic aromatic hydrocarbons [Ciesielczuk et al. 2012]. At the same time increased attention is given to the use of radioisotopes in environmental monitoring.

The aim of the study was to describe the relationships between the concentrations of selected gamma radioisotopes and heavy metals contained in epigeic mosses (*Pleurozium schreberi*), lichens (*Hypogymnia physodes*) and base soil.

The study was performed within the framework of the project: Ecosystem stress from the combined effects of winter climate change and air pollution - how do the impacts differ between biomes? (WICLAP) Polish Norwegian Research Programme (NCRD) POL-NOR / 198571/83/2013.

Methods

The soil, moss and lichen samples were collected in forest sites in Karkonosze mountains area, which in the 70. of the 20th century was under strong influence of emissions from power plants. After manual removal of impurities and drying in 323 K, the collected material was stored in closed polyethylene bags and containers. The 0.4 g of subsamples taken from homogenized material were mineralized in mixture of nitric acid and hydrogen dioxide (1:3) in microwave mineraliser Speedwave Four (Berghof, Germany). Concentrations of Mn, Ni, Cu, Zn, Cd and Pb were determined with FAAS method, using iCE 3000 (Thermo Electron Corporation, USA). The determinations of activity concentrations of gamma radioisotopes (among others:Cs-137, Pb-210, K-40, Pb-214, Bi-214) were carried out by means of a gamma-spectrometer with a germanium detector HPGe (Canberra) of high resolution. Geometry of samples was Marinelli beaker, 450

cm^3. Measuring process and analysis of spectra were computer controlled with use of the software GENIE 2000.

Results

The results obtained from Karkonosze region indicate that the activity concentrations of radioisotopes of potentially antropogenic origin was significantly higher in mosses than in soil on which they occur. At the same time cluster analysis in test samples shows that the content of radionuclides in mosses slightly depends of their re-deposition from surface soil layers (Fig. 1), thus emphasizing the role of selective accumulation and atmospheric precipitation of these contaminants.

The contents of heavy metals in mosses and lichens samples were different, depending on sampling site and plant type. Analysis showed divergence between concentrations of heavy metals in samples from the same sampling site (Fig. 2) which indicates different mechanisms and ways of accumulation of heavy metals.

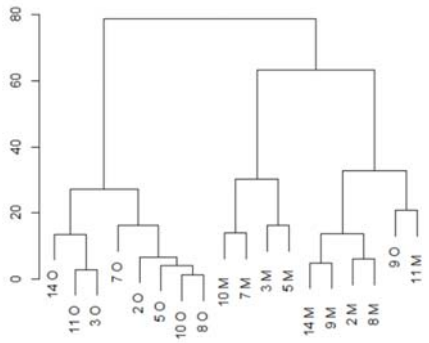

Figure 1. Dendrogram showing a tendency to cluster in which the coordinates of points are determined by concentrations of radioisotopes in the soil (O), and mosses (M).

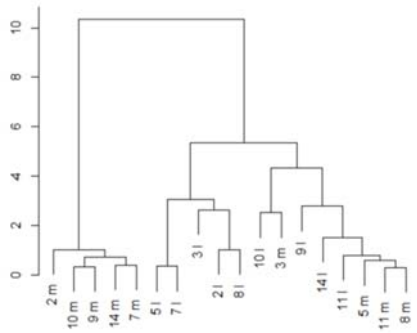

Figure 2. Dendrogram showing a tendency to cluster in which the coordinates of points are determined by concentration of heavy metals in mosses (m), and lichens (l).

While comparing the concentrations of radionuclides with concentrations of heavy metals no trends for clustering were observed. However, the introduction of the excessive lead term (Pb_{ex}) into the analysis showed high association with previously mentioned heavy metals in mosses.

Conclusion

The contents of heavy metals in samples of mosses and lichens were different depending on sampling site and plant type. The content of radionuclides in mosses slightly depends on their re-deposition from surface soil layers. The excessive lead concentration (Pb_{ex}) in mosses showed high association with heavy metals content in them.

References

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