

Mosses as Bioindicators of Air Pollution with Potentially Toxic Elements in Karaganda Region, Kazakhstan

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Air pollution is one of the main problems which society faces during last several decades. Among compounds released into the atmosphere as a result of anthropogenic activity special attention is given to potentially toxic elements (PTEs), including heavy metals. The control of atmospheric air quality requires, primarily, a multi-element analysis of the aerosol particles and determination of the concentrations of elements considered as toxic for living organisms.

For the first time, moss biomonitoring was carried in Karaganda region, Kazakhstan. In October 2019, 38 moss samples were collected on the territory of the Karaganda region. Sampling was carried out within the framework of the United Nations Air Program in Europe (UNECE ICP Vegetation) in accordance with the manual. Most of the samples were collected on the territory of the Karkaraly National Park, which is one of the specially protected natural areas of Kazakhstan. The high conservation value of the park is attributable to the exceptional diversity of landscapes for Central Kazakhstan. Moss samples were also collected in the village of Akzharyk (Aktogay district) located in the close vicinity to the Karagaily mining and processing plant, the Kentobe deposit and town Karkaralinsk. The studied area covered two territories with different level of anthropogenic load: the Karkaraly National Park and the Akzharyk settlement.

A total of 39 elements were determined in mosses collected at 38 sites using neutron activation analysis and atomic absorption spectrometry. The values of potentially toxic elements were higher for samples collected near Akzharyk settlement. To reveal any associations of elements and to match them with possible emission sources factor analysis was applied. Four factors were determined, of which two of mixed geogenic–anthropogenic origin and two of anthropogenic origin. To assess the level of studied area pollution and the impact of elements on human health, the contamination factor, pollution load index and environmental risk were calculated. According to the calculated values, studied region can be characterized as unpolluted to slightly polluted, with low potential ecological risk. Maps of the spatial distribution of elements were compiled using ArcGIS. The obtained data were compared with the results of the 2015/2016 moss survey reported for neighboring countries. The content of Pb in analyzed samples was the highest relative to neighboring countries, while the content of other elements was lower or comparable. Mining, ore processing, metallurgy and transport can be considered as main source of air pollution in Karaganda region.