

## BIOACCUMULATION OF RARE-EARTH ELEMENTS IN MOSSES

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The results of neutron activation analysis of more than 70 moss samples sampled in different areas of the Tula region showed that the medium content of rare-earth elements in moss ranges from 0.065 to 3.60 mg/kg in dry matter. Such rare earth elements as Ce > Nd > La are dominant in moss of Tula Region. Their minimum concentrations range from 0.25 to 0.4 mg/kg; maximum concentrations range from 10.9 to 27.5 mg/kg in samples from contaminated areas of the region. Average concentrations are characteristic for such elements as Sm > Gd > Yb > Eu. Their minimum concentrations range from 0.01 to 0.05 mg/kg; maximum concentrations range from 0.56 to 2.13 mg/kg. Minimum concentrations are characteristic of such elements as Tb and Tm: from 0.005 to 0.355 mg/kg.

Accumulative ability of different species of mosses in relation to rare-earth elements differs by more than 10 times. The maximum accumulation ability characterizes such species of mosses as *Eurhynchium angustirete*, *Oxyrrhynchium hians*, *Plagiomnium ellipticum* (11.7–2.5 mg/kg Ce; 5.6–12.5 mg/kg La; 5–10.9 mg/g Nd; 0.8–2.1 mg/kg Sm; 0.25–0.56 mg/kg Gd; 0.15–0.31 mg/kg Tb; 0.07–0.17 mg/kg Tm; 0.61–1.08 mg/kg Yb). The minimum accumulation ability characterizes such species of mosses as *Climacium dendroides*, *Rhytidiadelphus triquetrus*, *Sphagnum angustifolium* (0.42–1.51 mg/kg Ce; 0.11–0.27 mg/kg La; 0.67–1.71 mg/kg Nd; 0.02–0.16 mg/kg Sm; 0.02–0.04 mg/kg Gd; 0.01–0.02 mg/kg Tb; 0.01–0.08 mg/kg Tm; 0.07–0.09 mg/kg Yb).

The concentration of rare-earth elements Ce and Sm in the atmospheric depositions of Tula region, studied using the moss-biomonitor method was higher than in other regions of Russia in 1.7–4.7 times for Ce and in 1.4–8.3 times for Sm.

Correlation analysis of the results revealed the interrelationship between the bioaccumulation of element-pollutants of the industrial origin deposited from atmosphere and absorbed from the soil: La, Ce, Nd, Sm with Sc, Ti, Cr, Mn, Fe, Ni, Co, As, S, Ba, Cs and high degree of correlation with the other rare-earth elements which may indicate the formation of conglomerates of these elements. Factor analysis clearly identified 4 factors that can be attributed to technogenic soil pollution. Factor 1: Na, Mg, Al, Sc, Ti, Cr, Ni, Co, As, Rb, Zr, Ba, Cs, La, Ce, Nd, Sm, Eu, Tb, Yb, Hf, Ta, Th, U associates with soils, industrial pollution of soil and weathering processes.

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