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On distribution of Cs-137 in cultivated elementary landscape toposequence contaminated after the Chernobyl accident

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One of important problems of modern biogeochemistry is the study of spatial structure of geochemical fields. The aim of our research since 2005 is a detailed study of spatial distribution of technogenic radioisotope ^{137}Cs in conjugated elementary landscape-geochemical systems (ELGS).

The object of the research is a 180 m $\times$15 m test plot characterizing the agricultural landscape which was in use after the accident but then was abandoned; and nowadays the field is covered by ruderal herb and grass association. Last three years we tested a hypothesis of similarity in character of lateral distribution of ^{137}Cs in soil cover of the elementary landscape toposequence (elementary landscape geochemical system, ELGS) in this test plot with the established earlier in undisturbed systems in the forest test site “Vyshkov-2”.[1, 2]

Measurement of ^{137}Cs activity was performed along 3 parallel cross-sections from the top point to local depression in increment of 1 m using a field gamma-spectrometer Violinist III (USA), with collimated scintillation detector (NaI[Tl]) 2.5 inches in diameter. Relative elevation of all the measurement points was determined during topo survey with 1 cm accuracy. To reveal vertical ^{137}Cs distribution the undisturbed soil cores were taken by a hand drill at the selected 39 points down to a depth of 40 cm. Laboratory gamma-spectrometry was carried out with a spectrometer Canberra (USA). Spatial distribution of radionuclides in ELGS was interpolated using Surfer 11.6 software using ordinary kriging procedure.

Obtained results showed that lateral distribution of radiocesium in ELGS of the abandoned arable land has cyclic character with 15-25 m spacing. Parallel cross-sections showed practically similar variation of lateral ^{137}Cs distribution ($r_{0.95}$=0.744, n=155). The same character of lateral ^{137}Cs distribution was also found earlier in undistributed soils of forest ELGS. Thus a common character of cyclic pattern in lateral Cs-137 distribution in both the undisturbed natural and arable ELGS was proved.

Activity measurements in soil cores also proved the cyclic pattern of radiocesium lateral distribution and the absence of straightforward downslope redistribution. Activity of ^{137}Cs varied from 225.0 to 779.1 kBq/m^2. Vertical radiocesium distribution correlated with humus horizon thickness ($r_{0.95}$=0.415, n=33) and plowing shoe depth (detected by photo and debris presence in the cores). Soil moisture measurements allowed suggestion of an influence of moisture retention on radiocesium redistribution.

The research gives insight into the specificity of chemical elements migration in ELGS, that is of theoretical and methodological importance in mineral plat nutrition and pollutant distribution.

References

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