

Integral Parameter for Balance Estimation of Radionuclides Biogeochemical Current in the Soil-Plant System

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Parameters of radionuclides accumulation in biomass are usually presented as a ratio of their content in air-dry vegetation to specific soil contamination. In this case the difference of weight dissipation when drying plant and soil isn't taken into account. By this reason value of accumulation coefficient (C_a) is often exceeds 1 and even 10. It means that an acceptor (plant) accumulates more contaminant than a donor (soil) contains. These parameters are satisfactory useful for species accumulation studying in biological researches. For balance estimation of contaminants currents in geochemical media, the author have introduced Coefficient of Geochemical Transfer (CGT) that presents the ratio of radionuclide content in plants gathered from 1 square meter to the density of soil contamination at this area. Values of CGT are up to 100 times smaller than those for C_a .

15-years dynamics of radionuclides reception by meadow grass within the Chernobyl Exclusion Zone area have been studied and approximated by the equation:

where k_p corresponds to constant of radioactive decay of appropriate radionuclide; t – time after radionuclide release into ecosystem, years; k_p – integral constant of biogeochemical current rate in the soil-plant system, year⁻¹.

As distinct of C_a , CGA of ¹³⁷Cs and ⁹⁰Sr have strongly pronounced landscape discrimination (Figure 1).

Figure 1. k_p for typical soils of contaminated areas, year⁻¹

Cs				
0,000213	0,00088	0,00105	0,00425	0,00704
Soddy-weakly-podzolic sandy and loamy	Soddy-weakly- and medio-podzolic gleyish	Peaty-gley	Soddy-gley	Peaty-meadow
0,00263	0,0214	0,00097	0,00066	0,00026
90Sr				

As comparing with the rates of radionuclides transformation in soils, biogeochemical transformation in the soil-plant system is the slowest stage of migration. k_p is up to 100 times smaller than constants of radionuclides diffusion rate in the fallout solid phase, and 3-5 orders of magnitude smaller than rates of radionuclides mobilization, fixation, and ionic exchange in soils.

Obtained data testifies that soil water regime is playing a substantial part in radionuclides biogeochemical current formation. But for all that the ecosystem biomass productivity has the sidetrack significance.

Secondary mineral formation in coal ash disposal facilities: Implications for metals sequestration

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Coal ash cores were collected from three closed combustion disposal facilities (CDFs) in the Southeast United States to evaluate the relationship between ash diagenesis and pore water trace metal concentrations. The three CDFs have been in existence for 30-45 years and represent a range of pore water compositions and hydrologic settings. Core pore waters and solid phases were analysed to determine secondary mineral formation reactions occurring in the ash during and after burial.

X-ray diffraction analysis and scanning electron microscopy (SEM) with energy dispersive x-ray spectroscopy were used to identify core sample mineralogy. The bulk of core materials consist of aluminosilicate glasses having small but variable amounts of K, Ca, Na, Mg, Ti and As. Crystalline to amorphous mineral phases identified in the core materials include mullite, quartz, hematite, maghemite, allophane, graphite, calcium phosphate, gypsum, calcite and HFO. Iron coatings on glass particles were found to be common at each facility, although finite iron concentrations varied widely from site to site.

Microwave digestions of ash samples were performed for each core at several depth intervals. Trace metal concentrations of As, Ba, Co, Cr, Cu, Ni, Pb, Sr and Zn were positively correlated with aluminium and generally decreased with increasing depth, while B and Mn concentrations were more strongly correlated with iron and generally increased with increasing depth.

Pore water samples showed variable trace metal concentrations. Aqueous Cd, Pb and As concentrations were positively correlated with dissolved iron levels, while V concentrations were more strongly correlated with aqueous aluminium. Pore water chemistry showed no apparent trends with depth or solid phase chemistry. CDF hydrology was observed to be an important control on ash diagenesis and pore water chemistry.

Although the ash and CDF pore water samples generally showed elevated levels of many trace elements, metal mobility appears to be limited through the formation of secondary mineral phases that sequester metals through adsorption or co-precipitation. Chemical equilibrium modelling and sequential extraction experiments were performed in order to better identify trace metal/secondary mineral phase associations and to assess the long-term mobility and fate of trace metals derived from CDF sites.