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Speciation, size fractionation and migration of trace elements in small rivers from contrasting climatic environments of boreal zone

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This work is aimed at studying the evolution of molecular mass distribution of trace elements (TE) and their association with organic matter (OM) or Fe colloids in the system soil water-bog-river-lake in contrasting climatic regions of the boreal zone. Characterization of TE speciation within colloids during their migration from the site of origin (bog and soil solutions) towards the transit zone (river) and finally to the deposition, accumulation or transformation zone (lake) was the main fundamental objective of this study.
The sites selected in this study include a small watershed Vostochniy, the river Palojoki (North Karelia, Russia), the river Senga and the lake Ignatkovo surrounded by bogs (Vladimir region, Central Russia). The water samplings in Karelia were performed in summer 2007 – 2010 and included soil solution, feeding bog, the middle part of the brook originated from the swamp, the mouth of the brook and the lake Tsipringa. The water samplings in Central Russia were performed in October 2008 – 2009 and in March 2009. We sampled large volumes (50 - 100 liters), and we applied, directly in the in-field-installed "clean laboratory" the sequential frontal filtration and ultrafiltration of samples through the filters of progressively decreasing poresize 100, 20, 10, 5, 0.8, 0.4, 0.2 and 0.1 μm; 100 kDa (0.0065 μm), 10 kDa (0.003 μm) and 1 kDa (0.0014 μm). This allowed separation of organic matter, coarse and fine particulate matter and colloids. In-situ dialysis with 1 kDa membrane was also used. All filtrates and selected retentates were analyzed for a wide range of macro-and micronutrients using ICP-MS. Dissolved organic carbon (DOC) was determined in the laboratory using TOC-autoanalyser and in-situ using portative field-photometer.
The waters of the Central Russia exhibited high concentrations of heavy metals (Cd, Zn, Pb, Sr, Ba) likely originated from anthropogenic pollution.
In filtrates of the river water, a significant decrease of iron concentration occurred in the range of 5 μm to 0.22 μm, which indicates the presence of iron inorganic colloids.
The changing of REEs concentrations occurred in the fraction smaller than 100 kDa for river water and in the fraction larger than 100 kDa of the soil solution. The light REEs predominate in Northern rivers because of intensive illuviation from rocks and soils. The REE's normalized patterns of Central region waters are flat probably due to illuviation from quarternary soils, strongly depleted in light REEs.
Concerning the evolution of element concentration in the system "soil solution – feeding bog - river - lake", the concentration of Ca and Mg increases, and the concentration of Cu, Ni, Cr, Ti, Al decreases.
Results of the present study allow straightforward evaluation of the transformation of TE colloidal status between the site of their origin, migration and consumption (deposition).
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