



## **Speciation and migration of trace elements in surficial, organic and Fe-rich fluids of boreal zone**

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Boreal zones of Russian Arctic are likely to play a crucial role in the regulation of trace elements (TE) input in the ocean at the high latitudes. In view of the importance of these circumpolar zones for our understanding of ecosystems response to the global warming, detailed regional studies of trace elements geochemistry in the boreal landscapes are very timing. In contrast to relatively good knowledge of Western European arctic environments, located in relatively warm climate on the Baltic sea coast, within the area subjected to some anthropogenic influence, our understanding of geochemistry of small watersheds located at the coast of Arctic ocean and the White Sea, remains extremely poor. The nature of dissolved organic matter, iron and aluminium colloids and the estuarine profiles of TE in this region may be very different from that of the “model” Kalix river while these relatively easy accessible watersheds of the White Sea should be representative for the large zones of the Russian Arctic.

High concentration of Dissolved Organic Matter (DOM) and thus, colloidal status of most of TE is the most important characteristic feature of the geochemistry of TE in European Russian Arctic zone. To get the first-order understanding of colloidal transport and speciation of TE in this region, size fractionation of about 40 major and trace elements (TE) in boreal small rivers and their estuaries has been investigated in the Karelian region of the North-West of Russia around the mountain chain “Windy Belt” and Pannayarvi National Park (Karelia). Samples were filtered in the field through a progressively decreasing pore size (5  $\mu\text{m}$ , 2.5  $\mu\text{m}$ , 0.22  $\mu\text{m}$ , 100 kD, 10 kD and 1 kD) using the frontal filtration and ultrafiltration technique and *in-situ* dialysis through 10 kD and 1 kD membranes with subsequent analysis by ICP-MS. Most rivers ex-

hibit high concentration of dissolved iron (0.0025 – 8.5 mg/L), aluminium (0.002 – 2 mg/L), manganese (0.005 – 4.3 mg/L), organic carbon (20 – 150 mg/L) and significant amounts of trace elements usually considered as immobile in weathering processes (Ti, Zr, Th, Al, Ga, Y, REE, V, Pb).

In (ultra)filtrates and dialysates, Fe and OC are poorly correlated: iron concentration gradually decreases upon filtration from 5  $\mu\text{m}$  to 1 kD whereas the major part of OC is concentrated in the < 1–10 kD fraction. This reveals the presence of two pools of colloids composed of organic-rich and Fe-rich particles. All major anions and silica are present in “dissolved” forms passed through 1 kD membrane. According to their behaviour during filtration and association with these two types of colloids, three groups of elements can be distinguished: (i) species that are not affected by ultrafiltration and are present in the form of true dissolved inorganic species (Ca, Mg, Li, Na, K, Cs, Si, B, Sc, Sb, Mo) or weak organic complexes (Ca, Mg, Rb, Sn); (ii) elements present in the fraction smaller than 1–10 kD prone to form inorganic or organic complexes (Ni, Zn, Cu, Cd, Ge, As, Ba, W and, for some rivers, Cr, U), and (iii) elements strongly associated with colloidal iron in all ultrafiltrates and dialysates with 30-50% being concentrated in large (>10 kD) colloids (Mn, Al, Ga, REE, Pb, V, Cr, Ti, Zr, Th, U, Co, Sr, Y, Nb, Hf, Ta, Bi).

Estuarine behaviour of several trace elements was studied for two small iron- and organic-rich watersheds: Ladreka and Yukova creek. While Si, Sr, Ba, Rb, and Cs show a clear conservative behaviour during mixing of freshwaters with the White sea, Al, Pb and REE are scavenged with iron during coagulation of Fe hydroxide colloids. Size fractionation of colloidal material during estuarine mixing reflects a number of inorganic and biological processes whose relative contribution to element speciation varies depending on the hydrological stage and the period of the year.