



Geochemistry of trace elements in boreal seasonally stratified lake: control of colloidal iron and organic matter

Oleg Pokrovsky (1), Liudmila Shirokova (2), Svetlana Zabelina (2), Taissia Vorobieva (2), Olga Moreva (2), Sergey Klimov (2), Artem Chupakov (2), Stephane Audry (1), and Jerome Viers (1)

(1) CNRS, LMTG, Toulouse, France (oleg@lmtg.obs-mip.fr), (2) Institute of Ecological Problems of the North, 163061, Nab. Severnoi Dviny, 23, Arkhangelsk, 163000, Russia

We have studied colloidal distribution and size fractionation of major and trace elements in boreal strongly stratified lake of Arkhangelsk region (Maselgskoe lake of the Kenozersky natl. park 20 m depth) during 4 years in winter (glacial) periods, summer period and spring and autumn overturn. In-situ dialysis (1 kDa, 50 kDa) and frontal filtration and ultrafiltration were used to assess organic carbon and trace element concentrations at different depths. There are three groups of elements according to their concentration depth profile and affinity to colloidal fraction: those exhibiting little variation of concentration with depth (most monovalent and divalent elements and anions), those demonstrating strong increase in the bottom horizons with weak (Si, Mn, Ba...) or significant (Fe, REEs) proportion of colloidal forms.

In all samples, large colloidal forms (10 kDa – 0.22 μm) of iron, organic carbon, trivalent and tetravalent elements are clearly dominating. Change in speciation of trace elements with depth occurs due to stratification processes, redox condition change and the biodegradation of plankton biomass releasing dissolved organic matter in the bottom horizons. Concentrations of most trace elements (Li, B, Al, Ti, V, Cr, Ni, Co, Zn, As, Rb, Sr, Y, Zr, Mo, Sb, Ba, REEs, Th, U) are not subjected to variations along the water column, despite the presence of strong redox stratification starting from 7-10 m down to the bottom during summer and winter stratifications. Apparently, these elements are not significantly controlled by production/mineralization processes and by redox phenomena in the water column, or the influence of these processes is not pronounced under the control by the allochthonous river water input. It is possible that organo-ferric colloids controlling petrogenic elements speciation in soil and river waters are being replaced by autochthonous organic colloids in the lake system. The same observation is true for some heavy metals such as nickel, copper and zinc, whereas cobalt, as limiting component, is being strongly removed from the photic zone or it is coprecipitating with manganese hydroxide. Colloidal status of most insoluble elements also remains during spring and autumn periods; however, relative proportion of large-size subcolloids originated from soil allochthonous organic matter increases during spring time. Results of the present work allow quantitative evaluation of the role of redox processes in the bottom horizons and organic detritus degradation in the creation of chemical stratification of organic-rich small boreal lakes.