Geophysical Research Abstracts
Vol. 19, EGU2017-906-1, 2017
EGU General Assembly 2017

Heterotrophic bacterium Pseudomonas saponiphila and sunlight as impact factors on organo-mineral colloids transformations in boreal humic waters

Olga Oleinikova (1,2,3), Olga Drozdova (1), Liudmila Shirokova (2,3,4), Sergey Lapitskiy (1), Andrew Bychkov (1), Oleg Pokrovsky (3,4,5)

(1) Geological Faculty, Moscow State University, Moscow, Russian Federation (olga-oleyn@yandex.ru), (2) Paul Sabatier University, Toulouse, France, (3) Geosciences and Environment Toulouse, Toulouse, France, (4) Institute of Ecological Problem of the North, Arkhangelsk, Russian Federation, (5) BIO-GEO-CLIM Laboratory, Tomsk State University, Tomsk, Russian Federation

Two of the main factors of carbon balance in high latitudes, known to govern the CO_2 flux from the lakes and rivers to the atmosphere, are bacterial mineralization (respiration) of allochthonous dissolved organic matter (DOM) and photochemical degradation of DOM. Yet, in contrast to large numbers of experimental and field studies on these factors impact on the utilization of DOM of different origin, the fate of metals bound to colloids during bacterial processing of DOM and behavior of trace element (TE) during photodegradation of DOM remains poorly constrained. This is especially important in view of essentially organic and organo-mineral colloidal status of TE in most boreal waters.

To answer this questions, a monoculture of Pseudomonas saponiphila from a boreal creek in NW Karelia (Russia) was separated and allowed to interact with boreal peat leachate in nutrient-free media. We quantified colloidal transformation of the peat leachate during 5-days activity of live bacteria using 3 kDa, 50 kDa Amicon® centrifugal filtration and 0.45 μm syringe filtration. The total net decrease of the concentration of Dissolved Organic Carbon (DOC) over 93 h of exposure was within 5% of the initial value for all fractions except low molecular weight one (< 3 kDa), which yielded a 16%-decrease due to long-term bio-uptake or coagulation. Elements most affected by bacterial presence were Al, Mn, (Ni), Cu, Ga, REEs, Y, U which exhibited essentially the adsorption at the cell surface over first hrs of reaction, and Fe, Ti, (Zr), and Nb showing short-term adsorption and long-term assimilation.

Towards a better understanding of concentration, size fractionation and speciation change of TE in boreal waters subjected to solar radiation, we conducted on-site photo-degradation experiments in stream and bog water from pristine zone of Northern Karelia (Russian subarctic). After 5 days of exposure, the DOM in stream photodegraded in a much smaller degree than that in the bog water with 25 and 60% removal of initial DOC, respectively. Specific UV absorption (SUVA254) decreased by a factor of 1.75 and 5 over 200 h of exposure in stream and bog water, respectively. The removal of Fe and Al occurred only in the bog water (90 % and 50% respectively, over 5 days of reaction), whereas no detectable decrease of Al and Fe concentration (< 0.22 μm) was observed in the boreal stream.

The majority of colloidal constituents including DOC, Fe, Al, metal micronutrients are weakly affected by heterotrophic bacterial activity and as such the stability of peat soil colloids in boreal waters is expected to be high. In contrast to this, in bog waters, alkali, alkaline-earth metals and divalent metal micornutrients, present in the form of organic complexes (50-80%), may be completely degraded over a week of sunlight exposure.

We acknowledge support from a RFBR research projects №№ 16-55-150002 _a, 15-05-05000_a, 14-05-00430_a, 16-05-00542_a. Experimental study was supported by RSF № 14-50-00029.