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Molecular components of dissolved organic matter distinguished by optical properties and HPLC in the sediments of Lake Tõugjärv, Southern Estonia

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Sedimentary organic matter (OM) plays an important role in many geochemical and biochemical processes in aquatic environments. Sedimentary OM is an extremely complex and heterogenous mixture of humic substances (HS), proteins, lipids, carbohydrates, and other biomolecules. OM is formed during the degradation process of higher plant detritus and the composition of microbial cellular material. It is distributed in both particulate and dissolved phases. The investigation of aquatic OM gives an overview of the processes going on in the studied media (polymerization, degradation, etc). The types and amounts of OM in lake sediments present a paleolimnological record of past conditions in the lake and its catchment area. Thus, there is a genuine interest in investigation and characterization of sedimentary OM from lakes as it allows to predict and evaluate temporal changes in the studied ecosystem.

Since OM is a very complex mixture, it is impossible to identify its exact chemical composition. As a result, only detailed chemical characterization using various analytical methods could be provided.

A fraction of dissolved organic matter (DOM) is optically active and, thus, methods based on UV absorption properties could be used for the characterization of DOM types. Another means of DOM analysis is the measurement of molecular weight distribution. Humic substances compose the main part of DOM. HS are formed by the association of components of the humification process. The source of aquatic HS is thought to be the formation from phytoplankton in the water or they might be washed into waters from terrestrial and soil deposits.

Lake Rõuge Tõugjärv (Estonia) is a startified hard-water eutrophic lake. It is a small (4.2 ha) and 17 m deep lake with annually laminated lake sediments (8.3 m) situated in a dense prehistoric setting. Annually laminated (varved) lake sediments possess continuous and independent records with calendar year chronology and will deliver changes in lake ecosystem and climate at seasonal to decadal resolution.A varved sediment studied, consisted of two visible layers, a clastic inorganic spring/summer layer and a darker organic humic layer consisting predominantly of autochthonous organic matter. Sediment core was taken in April 2005 at a sampling site 57o44‘30“N and 26o54‘20“E. A frozen sediment core (45-cm long) was sliced into 1-cm thick sub-samples. The samples were dated using 210Pb method and varvochronology. The analysed period covered last 150 years (from 1852 to 2005).

In the present study HPLC based high-performance size exclusion chromatography (HPSEC) as a separation method with diode-array detection (DAD) was used to analyse dissolved organic matter from Lake Rõuge Tõugjärv sediment pore water. Analysis method is characterized as being non-destructive, requiring small amounts of sample and minimal sample pretreatment.
HPSEC analysis enabled to separate 3 molecular fractions of DOM and devide them into high-, humic-like and low-molecular matter. The temporal changes in the separated fractions were evaluated and presented with detailed spectroscopic analysis. We will focus on revealing down-core trends of separated fractions and connect them to the changes in the lake ecosystem. The similarity and/or difference of optical properties of separated fractions will be useful for revealing the aromatic or protein-like character of studied DOM.