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COMPARATIVE STUDY OF LOW MOOR AND SAPROPEL PROPERTIES

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SUMMARY

Sapropel layers often are an element of bogs, especially mires, but at the same time sapropel itself is a valuable resource with multiple areas of application. Within this study sapropel properties form lakes in Latvia were studied and the metal accumulation patterns in sapropel and mires were compared as well as the functions of sapropel layers at the development of bogs has been discussed. The technical parameters of studied sapropel samples (ash, carbonates and moisture content), elemental composition, dominant bacterial species in the upper layers of sapropel as well as fluorescence, UV spectra of the sapropel and peat extracts were determined in three lakes in Latvia. A comparison of studied parameters characterizing sapropel properties with low moor peat properties were done, focusing on the transition layers from sapropel to peat and vice versa.

KEYWORDS: sapropel, organic – reach sediments, low moor peat, Latvia, heavy metals

INTRODUCTION

The sapropel is the bottom deposits of fresh water bodies containing the organic matter more than 15%, which is formed from water's animals and vegetation's remains after mixing with mineral components (Kurzo *et al.*, 2004). Sapropel formation is an important stage at the bog development and after accumulation of sapropel deposits often follows low moor stage and development of bog. However it can be supposed that sapropel layers might significantly influence bog development process and peat composition. In Latvia there are 11,2 billion m^3 of peat resources and 2 billion m^3 of sapropel, from which 800-900 million m^3 of sapropel are in the bottom of lakes and 1,1 billion m^3 (Peat Fund of Latvia, 1980) - in the bogs under layer of peat. Sapropel is a valuable resource and can be used in the various fields of economy. In some countries, for instance in Russia, Byelorussia and Ukraine, during long time the sapropel is used in balneology, livestock farming, agriculture, cosmetology and other fields. However, nowadays in the world the products made on the basis of peat are more popular, but the number of studies on lake organic sediments is small.

As far as sapropel resources are sufficiently large, lakes with abundant sapropel layers in Northern hemisphere are quite common and sapropel as a resource is cheap and accessible it is important to study it properties, especially in comparison with peat properties. On the other hand the removal of bottom sediments (sapropel dredging) can help to improve quality of fresh water, lakes, protecting from overgrowth (Bakšienė & Janušienė, 2005), but the sapropel layers under peat after peat extraction can be used as a valuable material.

The aim of our study is to comparatively analyse sapropel and mire peat properties and the metal accumulation patterns in sapropel and peat to understand the functions of sapropel layers at the development of bogs.

MATERIALS AND METHODS

Study site

Three lakes - Padelis, Pilcines, Pilvelu – and mire Taurene were chosen for study. Full peat and sediment profiles were taken and each of them was cut into 10 cm slices and until analysis they were stored - 20°C.

METHODS

Sapropel and peat properties were determined using the following methods:
To estimate moisture, organic matter and carbonate matter content of sediments was used loss on ignition (LOI) method (Dean, 1974; Heiri *et al*., 2001). At first, moisture of sediments is determined after drying at 105°C. After this, organic matter amount is estimated at 500-550°C, but mineral substances were determined after heating at 900-1000°C. Elemental analysis (C, H, N, S and O) was carried out in triplicate using an Elemental Analyzer Model EA-1108, and the found values were normalized with respect to ash content. Fourier transform infrared spectra were collected using Nicolet AVATAR 330 spectrophotometer in KBr pellets. UV/Vis spectra were recorded on a Thermospectronic Helios γ UV spectrophotometer in a 1-cm quartz cuvette. Fluorescence spectra were recorded using a Perkin Elmer LS 55 fluorescence spectrometer, on aqueous solutions of each sample. Metal concentrations were measured by flame atomic absorption (Perkin Elmer 503). The reliability and accuracy of analytical results were checked using blank and reference (ISE 1998.3-921 (Wageningen Evaluating Programmes for Analytical Laboratories), SLRSS-2 river water, BCSS- coastal marine sediments; Analytical Chemistry Standards NRC, Canada) samples.

RESULTS

Selected study sites represents commonly found lakes with abundant sediment layers consisting of sapropel and typical low-moor mire. In the studied sapropel and peat samples following parameters were determined: ash, carbonates and moisture content, elemental composition, dominant bacterial species in the upper layers of sapropel as well as fluorescence, UV spectra of the sapropel and peat extracts. One of the main sapropel and peat quality parameter is organic matter content. High ash content makes sapropel less valuable.

Loss-on ignition analysis shows that content of organic matter in lake sediments vary from 3 – 94 %, in peat 14 – 98%. More mineral sediments are observed in depth silt layers which are of more ancient origin. In upper sediments in lakes organic matter content is 44 – 94 %. Moisture of samples can be correlated with organic matter content. In sediments with ash content more 85% moisture is 32-75%, but in organic-rich sediments it can reach even till 95%. Carbonates in studied sapropel samples vary from 0.2 – 3 %, in Padelis Lake sediments it amount till 38% (Fig. 1, 2).

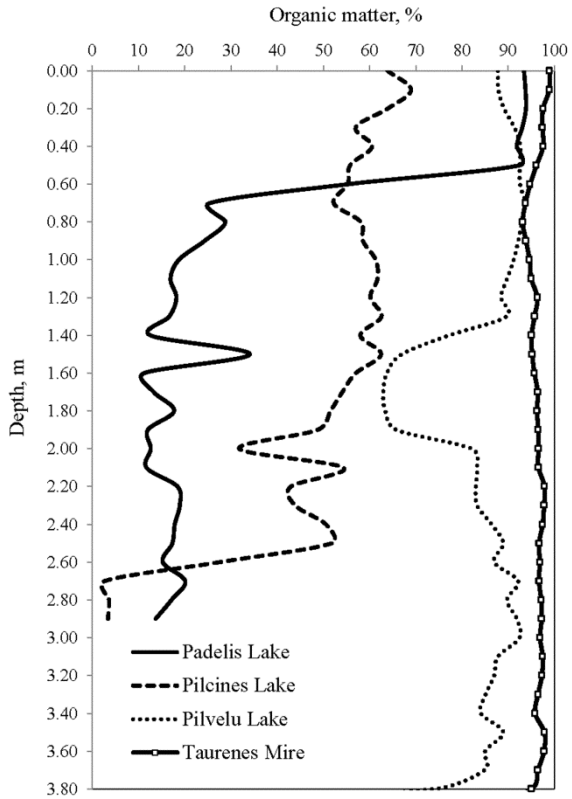

Fig.1. Organic matter content in sapropel and peat

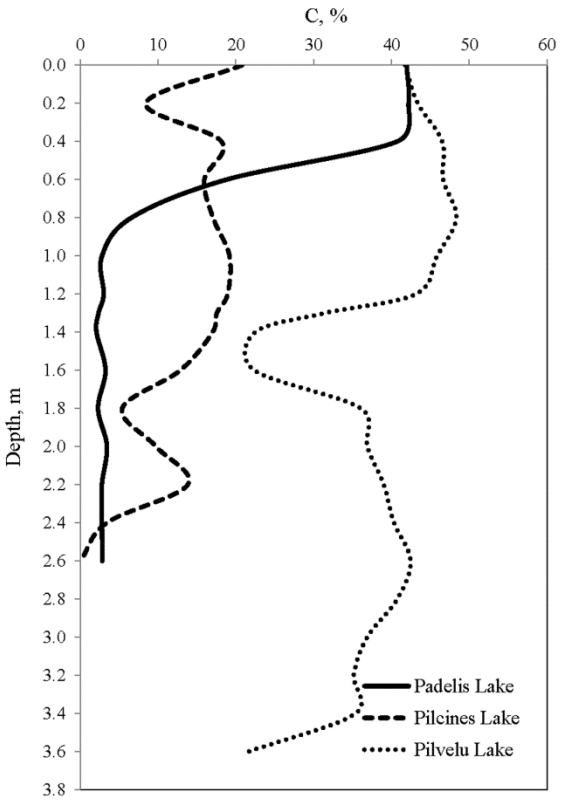

Fig.2. Carbon content in sapropel

The concentrations of metals in sapropel of the studied lakes and Taurenes Mire peat are not directly influenced by pollution from industrial sources as far as the found concentrations of trace elements are much lower than in sediments and peat cores in Western European bogs and lakes (Zerbe *et al.*, 1999). Concentrations of heavy metals are rather dependent on content of organic matter in sediments and geochemical peculiarities of catchment area. At the same time evident is the increase of metal concentrations of evidently anthropogenic origin, for example, lead (Fig. 3), but also other elements, such as Cd, Cu, Ni, Cr, As indicating overall pollution level.

Much differing accumulation pattern do have metals of evidently natural origin, for example, Mg (Fig. 4), but also Na, K, Ca, Mn, Fe. In this case natural accumulation processes dominate and for example, in Lake Padelis impacts of loading from basin rich in carbonatic minerals (and also dolomites) is of importance.

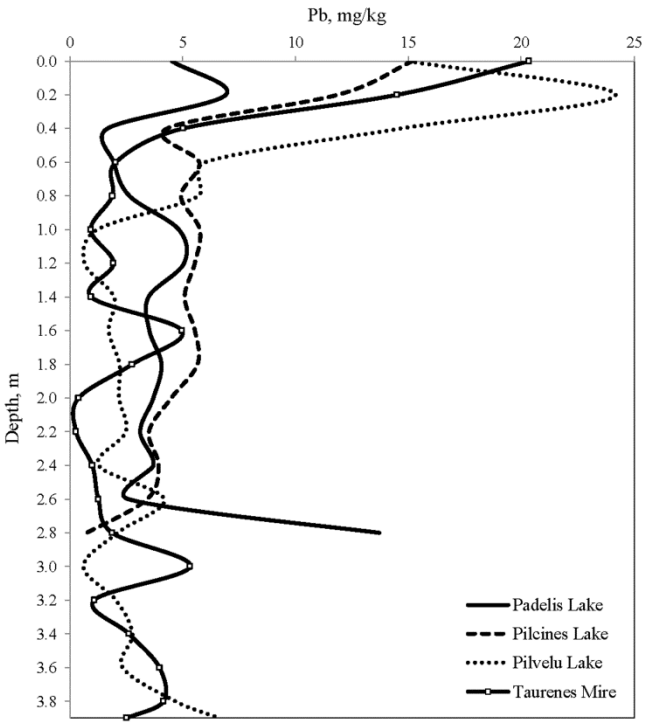

Fig.3. Pb content in sapropel and peat

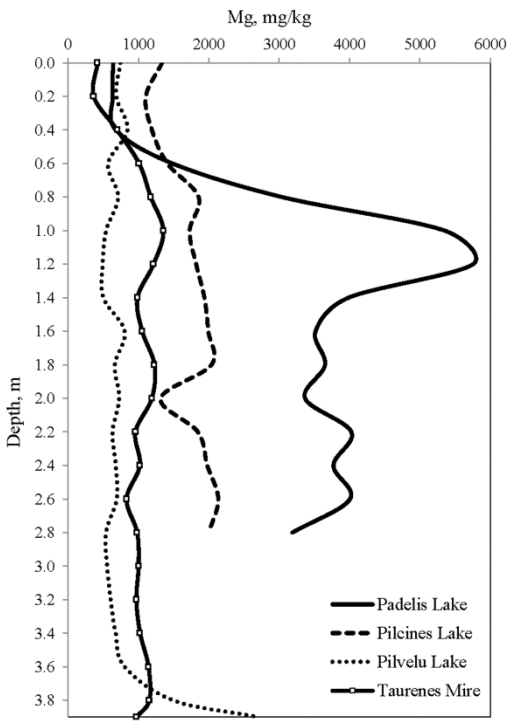

Fig.4. Mn content in sapropel and peat

For the studied sapropel and peat samples also their FTIR spectra were obtained, indicating structural changes of the precursor organic matter during humification process and diagenesis of the sapropel/peat mass. A distinctive feature in this case is the changes in relatively alkaline environment (pH > 6, but reaching even pH 7.5), especially in respect to pH in raised bog peat. Alkaline extraction (0.1 N NaOH) yielded sapropel and peat extracts which were characterized using total organic carbon (TOC) analysis and UV and fluorescence spectra. Spectral properties of peat and sapropel extracts were used to character of estimate humification process.

CONCLUSION / DISCUSSION

Multiparameter analysis of sapropel from 3 lakes and low moor peat helped to gain detailed insight in the properties of each material studied and do exhaustive comparison between the studied samples, sapropel, low-moor peat, raised bog peat (known from our previous studies) and support development of knowledge on organic matter diagenesis in sedimentary phases and bogs. At first as remarkable may be considered possibilities to use sapropel (lake sediments) and low moor peat as archive of human impacts especially considering that for this aim mostly raised bog peat has been commonly used. As we have found also sapropel and low-moor peat demonstrate ability to accumulate trace elements indicating human pollution in the upper layers of peat and sapropel profiles.

As a major distinctive feature between studied objects might be considered impacts of alkaline environment determined by presence of carbonates/hydrogencarbonates and correspondingly calcium/magnesium ions. At first significant differences between the studied objects is evident and all further characteristics of the sapropel and peat might be related to influence of the alkalinity controlled processes. Diagenesis of sapropel properties under such

conditions can be characterized using humification indexes, fluorescence spectra and spectral ratios in UV spectra. Use of such approach helps to identify the dominant pathways of sapropel forming residue decay, especially if compared with the same parameters in peat A comparison of studied parameters characterizing sapropel properties with low moor peat properties were done, focusing on the transition layers from sapropel to peat and vice versa.

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