Multi proxy chemical properties of freshwater sapropel

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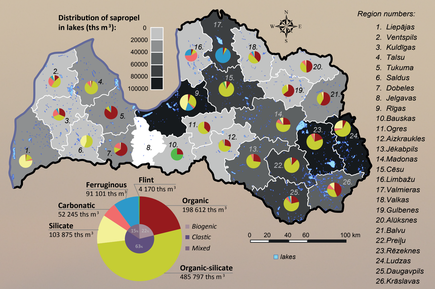

Fig.1. Distribution of fresh-water lake sapropel and allocation of its types in Latvia

Introduction

Freshwater sapropel is organic rich lake sediment firstly named "gyttja" by Hampus van Post in 1862. It is composed of organic remains such as shell detritus, plankton, chitin of insects, spores of higher plants and mineral part formed in eutrophic lake environments. The most appropriate environments for the formation of sapropel are in shallow, overgrown post-glacial lakes and valleys of big rivers in boreal zone, while thick deposits of this kind of organic sediments rarely can be found in lakes on permafrost, mountainous regions or areas with increased aridity. Organic lake sediments are divided in 3 classes according the content of organic matter and mineral part: biogenic, clastic and mixed. The value of sapropel as natural resource increases with the content of organic matter and main applications of sapropel are in agriculture, medicine, cosmetic and chemical industry. The research of sapropel in Latvia has shown that the total amount of this natural resource is close to 2 billion m^3 (Fug.1.). Sapropel has fine, dispersed structure and is plastic, but colour from light pink to dark brown, in high natural content of phosphorus usually is dark blue, later after drying it becomes light blue.

Site Location

Various sapropel types from lakes (Fig.2.) Pilcenes, Pilvelis, Veveru and Padelis (Fig.3.) were chosen for this study. Lakes are located in Rezeknes Region, Latvia. The area is uninhabited and surrounding territory mostly is covered with forests and mires. The water surface area of each lake does not exceed 10 hectares, and the sediment fills the lakes trench for more than 80%. Table 1 presents information about sites location, main parameters for different sapropel types and labels are given.

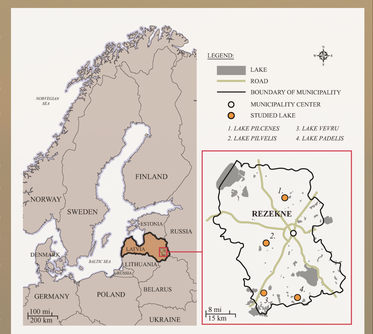

Fig.2. Map of the sampling site

Lake	Sapropel class	Sapropel type	Label	Moisture, %	Organic matter, %	Carbonates, %
Pilvelis	Biogenic	cyanobacteria	CB	94.22	84.51	1.26
Veveru	Biogenic	green algae	GA	95.81	86.25	1.18
Pilvelis	Biogenic	peaty	PTP	94.10	90.21	0.39
Padelis	Biogenic	peaty	PWP	94.18	93.07	1.31
Pilcenes	Clastic	organic - sandy	OS	90.20	58.61	2.38
Padelis	Mixed	carbonatic	CA	77.01	15.27	35.57

Tab.1. Characteristics of the samples

Results and Discussion

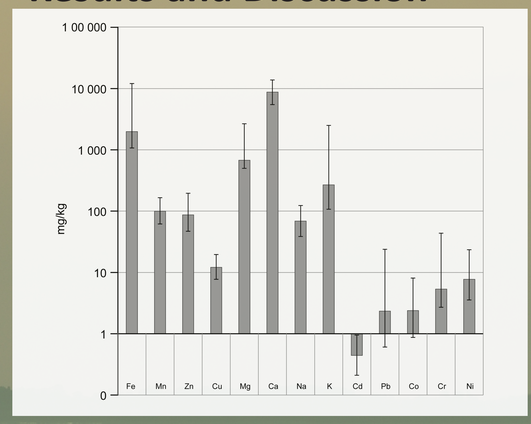

Fig.4. Average metal content in sapropel samples

Considering the large amount of accumulated organic materials in sapropel, studies of metals could have high importance to understand metal accumulation processes in limnic systems

Metal concentration in sapropel vary over wide range, indicating that sediments formation took place at different environmental conditions in the water bodies and those catchment basins at different time. In the sapropel the highest metal concentrations have natural origin: magnesium, calcium and iron (Fig.4.)

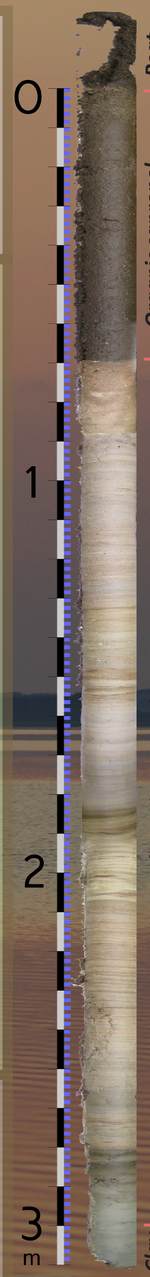

Fig.3. Sapropel profile from Lake Padelis

Antiradical activity characterizes the ability of compounds to react with free radicals. The peaty sapropel samples have highest antiradical activity - PTP 13.20% and PWP 9.16%. Antiradical activity of other sapropel types does not reach 3% (Fig.5.).

High concentration of polyphenol is found in many terrestrial plants, aquatic vascular plants and brown algae; those play different roles in plant biology and affect some soil processes such as decomposition and nutrient cycling. The supreme polyphenol content is found in peaty sapropel samples and in cyanobacterial sapropel. The low content of polyphenols is in organic-silicate and carbonatic sapropel due to lack of organic matter (Fig.6.).

Humic acid is a principal component of humic substances, which are formed by the microbial and chemical degradation of dead plant matter. The main resource of humic substances is thematic plants, hence algae and water vascular plants remains produce less humic substances. The PTP sample formed mainly from thematic plants have highest humic acid content 81.20 mg/g (Fig.7.).

Carbohydrates are the most abundant among the major classes of biomolecules. Carbohydrates are produced in green plants by photosynthesis and serve as a major source of energy in animal diets. The peaty sapropel contains highest quantity of carbohydrates - 108 mg/g dry matter (Fig.8.).

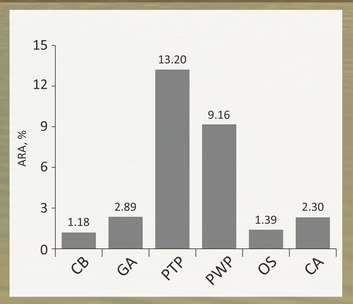

Fig.5. Antiradical activity

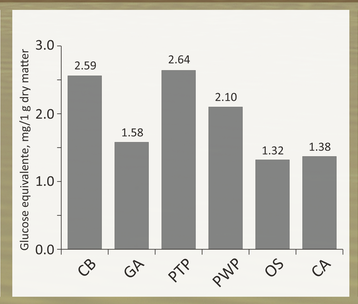

Fig.6. Polyphenol content

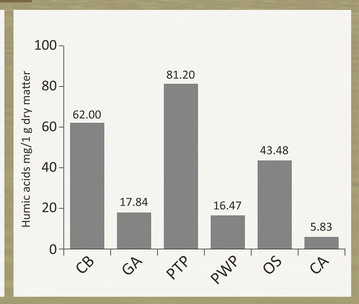

Fig.7. Humic acid content

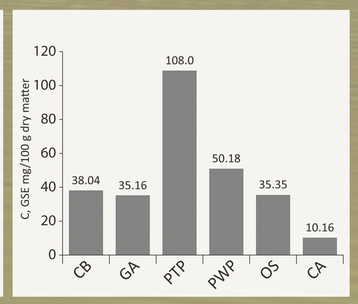

Fig.8. Carbohydrate content

Conclusion

Chemical properties of different sapropel types have big variability. Those depend not only on composition of sediments, but also on formation conditions, specific characteristics of lake and catchment basin. Peaty sapropel is richest with biological active matter, but poorest of metal element content.