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PHYSICAL AND CHEMICAL STUDY OF SAPROPEL OF KUSHKANATAU FIELD OF KARAKALPAKSTAN

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Abstract

This paper examines the chemical composition and properties of the sapropel of the Kushkanatau field located in the territory of Karakalpakstan. Sapropel is a widespread deposit with a large number of micro and macro elements. The article shows the possible uses of the mineral sapropel and their role in the agricultural sector. The results of the existing experience in the use of sapropel in agriculture show that sapropel has the property of restoring soil fertility due to the content of various trace elements that increase soil fertility. Along with this, the water-retaining property of sapropel will allow more rational use of water.

Keywords: *Karakalpakstan, Kushkanatau, sapropel, fertilizers, trace elements, agriculture, crop production*

Introduction

Sapropel – bottom sediments of various freshwater reservoirs. The name came from the Greek words sapros – "rotten" and pelos – "dirt." Natural coloration varies from pink to dark brown. In the air, the natural color disappears. Sapropel forms the remains of animals and plants, as well as mineral and organic impurities brought by wind and water (Wildflush I. R., Kukresh S. P., Ionas V. A., 2001). It contains at least 15% organic matter, including ligninohumus complex, carbohydrates, bitumens, and other substances in a colloidal state. Sapropel

can range in color from pink to dark brown, and hardens when dried. Sapropel mud is used in medicine to treat various diseases, including atherosclerosis, chronic hepatitis, peptic ulcer disease and others (Kama sapropel http://sapropel.su).

Sapropel is a valuable organic fertilizer that improves soil structure, provides plants with nutrients and increases yields. It can be used as a pre-sowing fertilizer, when planting trees and shrubs, as well as in greenhouses (Kireicheva L. V., Khokhlova O. B., 2004).

In agriculture, sapropel is used as a fertilizer (after freezing, water is separated, the structure is a loose state). Especially effective is the use on acidic and light sandy and sandy loamy soils, as well as to increase the humus content in soils (dose for crops 30–40 t/ha; for vegetable, potato and fodder root crops 60–70 t/ha), for compost preparation (Sapropel. 1991).

The use of sapropel as a fertilizer improves the mechanical structure of soils, moisture-absorbing and water-retaining ability and aeration, gives an increase in humus soil, activates soil processes. Sapropel fertilizer helps to mobilize the soil composition, leads to self-purification from pathogenic plants, fungi and harmful microorganisms. Studies of scientists have found that the mineral part of sapropels contains a large number of vitamins macro and trace elements, such as: Co, Mn, Cu, B, Br, Mo, V, Cr, Be, Ni, Ag, Sn, Ba, Sr, Ti (Dubinina L. F., 1974; Mishin G. M., 1966).

Sapropel is used for direct application to the soil as well as for land reclamation, sanitation and restoration (Wildflush I. R., Kukresh S. P., Ionas V. A., 2001; Kama sapropel http://sapropel.su; Kireicheva L. V., Khokhlova O. B., 2004; Sapropel // 1991).

The organic matter of sapropel is a combination of plant and animal residues, as well as their decay products. It includes products of hydrolysis of biopolymers, polymer compounds formed in the process of biotic and abiotic destruction, products of synthesis of organic substances, as well as products of microorganisms. The organic matter of sapropel is characterized by a low carbon content (4,7–6,0%) and a fairly high oxygen content (23–39%) (Lishtvan I. I., Lopotko M. Z., 1976; Plaksin G. V., Likholobov V. A., Krivonos O. I., 2008).

According to L. R. Mukina, studies show that sapropel-based fertilizers support a positive balance of nitrogen and phosphorus. After the test experiments, the content of mobile phosphorus increased compared to the control (version without fertilizers). A particularly significant accumulation of the element was observed during the application of fresh and activated sapropel, vermicompost and granulated peat zeolite fertilizers. The maximum increase in the yield of barley green mass on floodplain soil was obtained by saturating the additives with mineral fertilizers in the version using a vermicompost and fresh sapropel mined from a depth of 2–2,5 m (Mukina L. R., 2008).

The chemical composition and properties of sapropels of various deposits differ significantly and are determined by the conditions of formation, as well as the diversity of the flora and fauna of the lakes. Also classification of sapropel type is Carbonate, silica, organic, ferrous

Biologically active components include nitrogenous and hormone-like compounds, enzymes, vitamins, carotenes and pigments. The mineral part consists of compounds of iron, magnesium, potassium and other elements.

Research objects and methods

The object of the study in this study is the sapropel of the Kushkanatau field of Karakalpakstan, located 130 km from Nukus in the Bozatau region. It is a calcareous raw material often found in lakes and under peat beds. When choosing sapropel for fertilizers, acidity indicators, nitrogen, calcium and other trace elements are important. These characteristics may vary depending on the location of production. Fresh sapropel from a great depth contains more nutrients, but has low ash content.

Research results and their analysis:

These raw materials were subjected to X-ray phase analysis. From Fig. 1. it can be seen that the following diffraction band peaks are observed in the sapropel composition; calcium strontium aluminosilicate 28%, Code Reference 01-075-9267, chemical formula $Na_{0.84}Ca_{0.16}Al_{1.16}Si_{2.84}O_8$;

Figure 1. *Diffractogram of sapropella in Kushkanatau field*

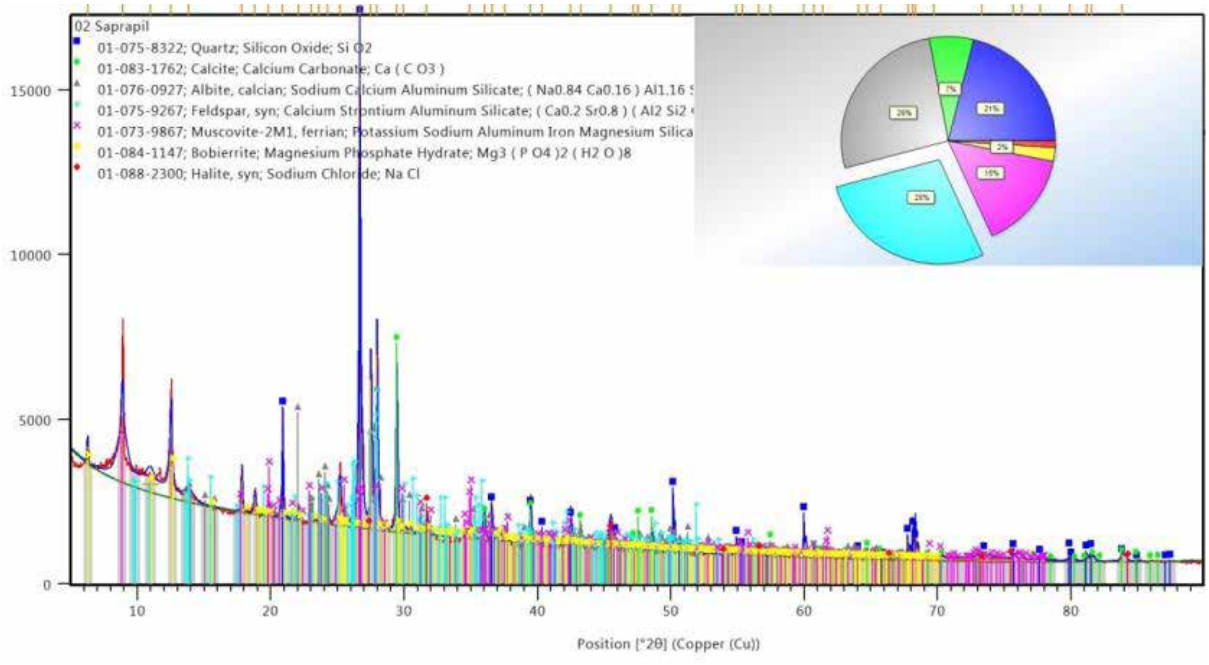
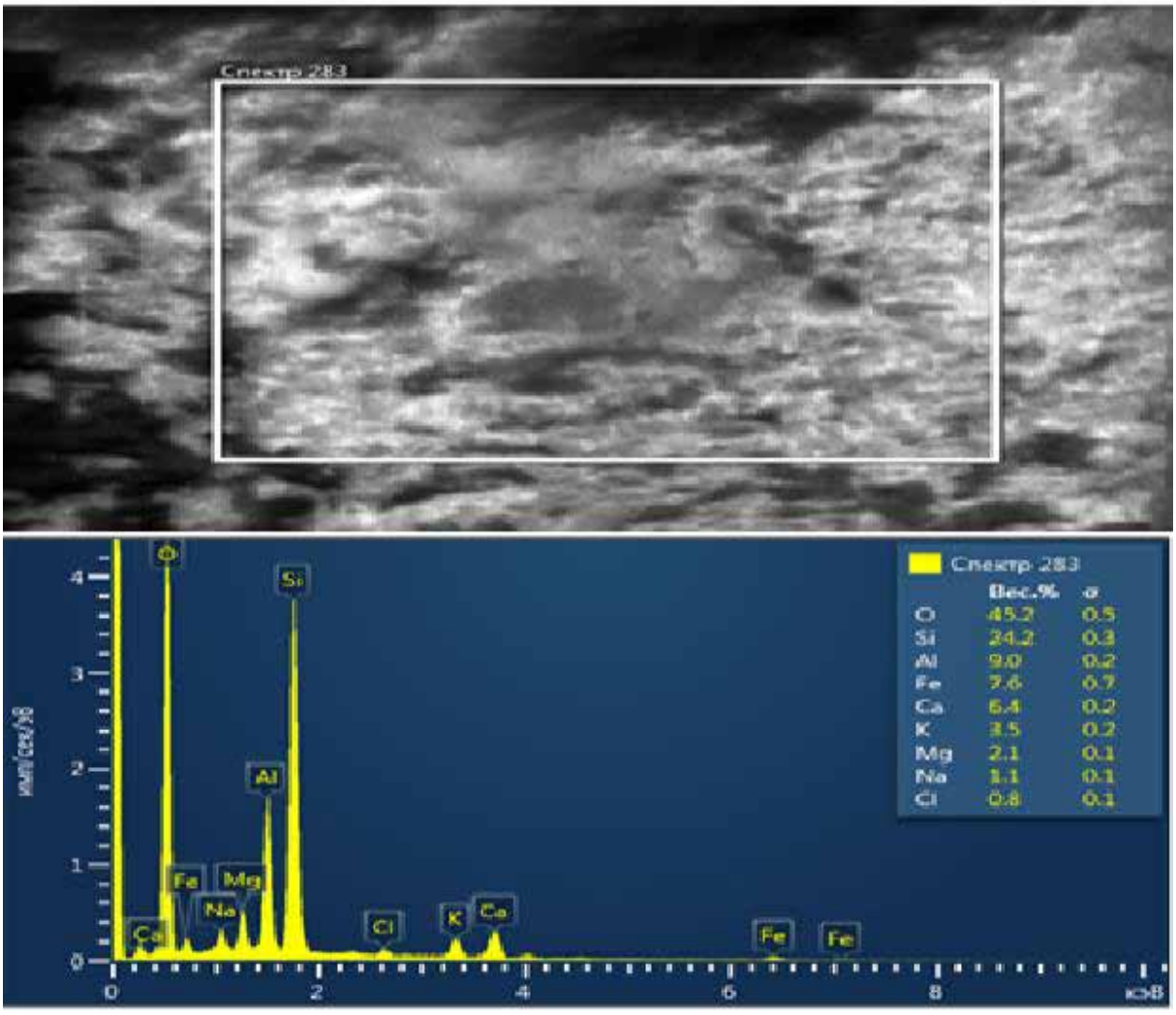


Figure 2. *SEM Micrographs and EDR analysis of Sapropel of the Kushkanatau Field*



Sodium calcium aluminosilicate 26%, reference 01–076–0927 chemical formula $Ca_{0.2}Sr_{0.8}Al_2Si_2O_8$; silicon oxide 21%, reference 01–075–8322, chemical formula SiO_2, Potassium, Sodium, Aluminum, Iron, Magnesium, Silicate, Hydroxide 15%, reference 01–073–9867, chemical formula $K_{0.93}Na_{0.07}Al_{1.66}Fe_{0.18}Mg_{0.16}Al_{0.82}Si_{3.18}O_{10}(OH)_2$; Calcium carbonate 7%, 01–083–1762 formula $CaCO_3$, Magnesium phosphate hydrate 2%, 01–084–1147 formula $Mg_3(PO_4)_28H_2O$, sodium chloride 1%, 01–088–2300 formula NaCl; The sample consists mainly of calcium carbonate, aluminum, iron, sodium, magnesium, potassium, silicon (Allaniyazov D. O., 2019; Allaniyazov D. O., Erkaev A. U., 2019; Allaniyazov D. O., Tazhibaev T. A., Ochilov S. U., 2024; Allaniyazov D. O., Erkaev A. U., 2022).

Further, sapropel powders of the Kushkanatau deposit were analyzed using SEM, and elemental compositions of this sample were simultaneously determined using an energy dispersion analyzer. Electron microscopic images are shown in Fig.2.

The following chemical elements were recorded in the energy dispersion spectrum with the following percentage correspondences; oxygen 45.2; silicon 24.2; aluminum 9,0; iron 7,6; calcium 6,4; potassium 3,5; magnesium 2,1; sodium 1,1 and chlorine 0,8. Sapropel processing has the potential to increase agricultural yields. However, it is necessary to develop technologies to create competitive fertilizers.

Conclusions

Physical and mechanical characteristics and chemical composition of sapropel of Kushkanatau deposits are presented. Methods are described for determining the chemical composition, as well as conducting physicochemical studies of sapropel. For this, radiographic, electron microscopic studies were carried out on modern devices. According to our study, the sample consists mainly of calcium carbonate, aluminum, iron, sodium, magnesium, potassium, silicon.

Summing up, it should be noted that sapropel is widespread in most lakes in the regions of Karakalpakstan. This opens up great opportunities for using it to increase agricultural yields due to its unique properties. However, for this it is necessary to develop a comprehensive technology for the production of complex fertilizers, which is competitive with foreign counterparts.

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