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ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халык»

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В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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CHEMICAL CHARACTERISTIC OF THE BLACK AND WHITE MUD OF THE SHOSHKALY LAKE

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Abstract. The article presents the results of a study of the physicochemical properties, mineral and elemental composition of the natural black and white mud of Lake Shoshkaly and assesses the possibility of using this natural raw material in general. An analysis of studies in recent years shows the lack of data on the composition and structure of Shoshkala peloids, which are popular with the population for their healing properties. A comparative analysis of the obtained data with previous studies of peloids from other regions of Kazakhstan was carried out and a physicochemical assessment of its therapeutic effect was given. Conclusions are drawn on the surface morphology, granulometry, and elemental composition of the studied peloid. The results of the study showed that the black and white mud of Lake Shoshkaly is an alkaline sulfide silt saturated with salt, has a low content of humus carbon, and is of the sodium-ammonia-chloride-sulfate type in terms of chemical composition. They slightly differ in mineralogical and granulometric composition. Elemental analysis showed increased

concentrations of chalcophile elements in comparison with Clarks in the Earth's crust. The total content of elements in the sample indicates the need for systematic monitoring studies since natural mud can be a sensitive indicator of changes in the geochemical background due to anthropogenic influences.

Keywords: Natural mud, peloid, mineralogy, composition, silt, Shoshkaly, black mud, white mud

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ШОШҚАЛЫ КӨЛІНІҢ ҚАРА ЖӘНЕ АҚ БАЛШЫҚТАРЫНЫҢ ХИМИЯЛЫҚ СИПАТТАМАСЫ

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Аннотация. Мақалада Шошқалы көлінің табиғи қара және ақ балшықтарының физика-химиялық қасиеттерін, минералдық және элементтік құрамын зерттеу нәтижелері берілген және жалпы осы табиғи шикізатты пайдалану мүмкіндіктері бағаланған. Соңғы жылдардағы зерттеулерді талдау емдік қасиеттерімен халық арасында танымал Шошқала пелоидтарының құрамы мен құрылымы туралы деректердің жоқтығын көрсетеді. Алынған мәліметтерге Қазақстанның басқа аймақтарынан алынған пелоидтарға бұрынғы зерттеулермен салыстырмалы талдау жүргізіліп, оның емдік әсеріне физика-химиялық баға берілді. Зерттелетін пелоидтың беткі морфологиясы, гранулометриясы және элементтік құрамы бойынша қорытындылар жасалады. Зерттеу нәтижелері Шошқалы көлінің қара және ақ балшықтары тұзға қаныққан сілтілі сульфидті тұнба болып табылатынын, құрамында гумусты көміртегі аз және химиялық құрамы жағынан натрий-аммоний-хлоридті-сульфатты түріне жататынын көрсетті. Олар минералогиялық

және гранулометриялық құрамы бойынша аздап ерекшеленеді. Элементтік анализ жер қыртысындағы кларктармен салыстырғанда халькофильді элементтер концентрациясының жоғары екендігін көрсетті. Сынамадағы элементтердің жалпы құрамы жүйелі мониторингтік зерттеулердің қажеттілігін көрсетеді, өйткені табиғи балшық антропогендік әсерге байланысты геохимиялық фон өзгерістерінің сезімтал көрсеткіші бола алады.

Түйін сөздер: Табиғи балшық, пелоид, минералогия, құрамы, лай, Шошқалы, қара балшық, ақ балшық

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ХИМИЧЕСКАЯ ХАРАКТЕРИСТИКА ЧЕРНОЙ И БЕЛОЙ ГРЯЗИ ОЗЕРА ШОШКАЛЫ

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Аннотация. В статье представлены результаты исследования физико-химических свойств, минерального и элементного состава природных черной и белой грязей озера Шошкалы и дана оценка возможности использования этого природного сырья в целом. Анализ исследований последних лет показывает отсутствие данных по составу и структуры пелоидов Шошкалы, пользующихся популярностью у населения своими целебными свойствами. Проведен сравнительный анализ полученных данных с предыдущими исследованиями пелоидов других регионов Казахстана и дана физико-химическая оценка её терапевтического эффекта. Сделаны выводы по поверхностной морфологии, гранулометрии, а также элементного состава исследуемого пелоида. Результаты

исследования показали, что черная и белая грязь озера Шошкалы представляет собой насыщенный солью щелочной сульфидный ил, имеют низкое содержание углерода гумуса и по химическому составу относятся к натриево-аммиачно-хлоридно-сульфатному типу. Они незначительно различаются по минералогическому и гранулометрическому составу. Элементный анализ показал повышенные концентрации халькофильных элементов по сравнению с Кларками в Земной коре. Валовое содержание элементов в образце указывает на необходимость систематических мониторинговых исследований, поскольку природные грязи могут являться чувствительным индикатором к изменению геохимического фона в виду антропогенных влияний.

Ключевые слова: Природная грязь, пелоид, минералогия, состав, ил, Шошкалы, черная грязь, белая грязь

Introduction

Natural mud is a complex product obtained in the course of long-term complex processes of geochemical and biological origin. The chemical composition of natural muds, their physical properties, as well as the therapeutic effect are studied by researchers in different countries. A comprehensive physical and chemical study of mud was described, including the determination of pH, granulometry, chemical, and mineralogical composition, organic matter in Romania (Baricz et al., 2021), in Montenegro (Potpara et al., 2017), in Turkey (Odabasi et al., 2007), in Cuba (Martínez-Villegas et al., 2020). The factors influencing the formation of the chemical composition and genesis of silt mud include the salt composition of the brine of the reservoir, soil, and organic matter of plant and animal origin. At the same time, the degree of accumulation of mud is greatly influenced by the morphological features of water salinity, the geological structure of the shores, and the landscape features associated with it. Depending on the geographical location and climatic conditions, fluctuations in the composition and content of mineral and organic substances of peloids will vary within fairly wide limits that indicate their specificity in each individual case. In Kazakhstan, the most studied physicochemical properties of peloids of salt lakes are in Western Kazakhstan (Akhmedenov, Khalelova, 2021), as well as the Kossor deposit, located three kilometers from the southern coast of Alakol Lake (Dzhetimov, 2014), Zhalanashkol Lake (Tokpanov, 2016), and Ray Lake (Tokpanov et al., 2021) in South Kazakhstan.

Salt Lake Shoshkaly is located in the eastern region of Kazakhstan and contains large volumes of native black and white mud. They have been popular among the local population since ancient times. actively used as a folk remedy. Especially during the COVID-19 pandemic, interest in this affordable healing source has increased. In open sources, there are no data on systematic studies of the mud of this lake in recent years. The purpose of this study is to determine the mineral and particle size distribution, as well as the elemental composition to identify and expand potentially significant areas of application, as well as processing, rational use of this raw material in industry. The conditions and time of maturation can change some characteristics of peloids, such as their plasticity, ability to absorb, and biochemical composition (Carretero, 2002). This

article presents the results of a study of the physicochemical properties and mineralogical composition of the black and white mud of Lake Shoshkaly, their analysis is carried out and a characteristic is given in terms of the existing classification, and an attempt is made to scientifically interpret the possible industrial applications of these peloids.

Materials and method of experiment

Samples were taken from the area where the mud is mined using the method of point samples with a depth of up to 20 cm in one layer for black mud and up to 30 cm for white mud every 5 m in the radius of the source and were subjected to further quartering according to GOST 17.1.5.01–80. Figure 1 shows the coordinates of the sampling site of Lake Shoshkaly (51.2776037; 78.7108238) and the appearance of the peloid, respectively. The GPS location at the time of sampling was determined using the GoogleMaps mobile phone application. Sampling was carried out in the autumn period (September 2022). The averaged samples were stored in clean polyethylene containers with tightly closed lids at 40°C in a dark place.

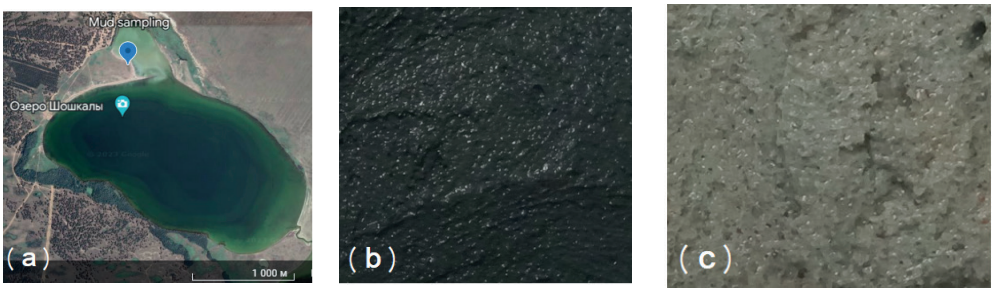


Fig. 1. Sampling (a) and general view of mud samples:
(b) – Shoshkaly Black Peloid; (c) – Shoshkaly White Peloid

Determination of the pH value of the peloid and the dense residue of the aqueous extract was determined according to GOST 26423–85 using a two-channel meter S47 Seven Multidual meter pH/conductivity (Russia). The content of mobile forms of nitrogen in the nitrate form was also determined according to GOST 26951–86 by the potentiometric method; phosphorus and potassium according to the Machigin method according to GOST 26205–91; sulfur by the photometric method according to GOST 26490-85. Sodium, potassium, ammonium, calcium, magnesium cations were determined by capillary electrophoresis according to the PNDF method 16.1:2:2.2:2.3.74-2012 (KZ.07.00.03091-2015), chloride ions, sulfate ions in the inlet extract according to PNDF 16.1:2:2.3:2.2.69–10 (KZ.07.00.03091–2015). For these studies, the system of capillary electrophoresis "KAPEL-104T" with the software "Elforan" was used. Gross concentrations of metals were determined by laser ablation in combination with mass spectrometry ICP-MS Agilent 7500cx manufactured by Agilent Technologies (USA). To obtain reliable results, a threefold analysis of the samples was carried out. Data are presented as mean ±SD. The granulometric composition of the mud was determined according to GOST 12536-2014 by the pipette method. Volumetric mineralogy was determined by X-ray diffraction (XRD) using an X'Pert High Score modular X-ray

diffractometer manufactured by PANalitical (Netherlands). The analyzes were carried out in the range of diffraction angles 2θ from -12º to +140º with a minimum scanning step of 0.001º. The diffraction pattern data were interpreted using the Crystallography Open Database (COD), Inorganic Crystal Structure Database (ICSD) file cabinet. To study the surface microrelief and particle size distribution (PSD), scanning electron microscopy (SEM) was used using a JSM6390LV low-vacuum analytical scanning electron microscope manufactured by JEOL Ltd. (Japan) with an energy-dispersive microanalysis system INCA EnergyPenta FET X3 from OXFORD Instruments Analytical Limited (Great Britain) microscope. Particle size distribution was calculated using ImageJ software and plotted in OriginPro 2018.

Results and discussion

A sample of black silt (sample 1) and white silt (sample 2) from Lake Shoshkaly is an oily homogeneous mass of dense consistency with a persistent smell of hydrogen sulfide. Sample 1 is dark gray (Figure 1b), and sample 2 is light gray (Figure 1c). Sample 1 contains a slightly larger amount of carbon from humic and fulvic acids compared to sample 2 (Table 1). Humic acids have antiviral and anti-inflammatory, antimutant effects. They play an active role in wound healing (Gomes de Melo et al., 2016). The total carbon content of humus in both samples is below the accepted norm for the total content of organic matter for sulfide silts (Adilov et al., 2000).

Table 1. Physico-chemical parameters of mud samples

Parameter	Sample 1	Sample 2
pH	9.666±0.119	9.685±0.018
Maximum hygroscopic moisture, %	26.54	23.38
Mud solution mineralization, g/dm^3	154.67±3.11	216.00±2.34
Group composition of humus, %		
C total	0.1716	0.1332
C (humic acids)	0.0744	0.0648
C (fulvic acids)	0.0972	0.0684
Water aqueous forms of composition, mg kg^{-1}		
Cl^-	17,967±639	9,571±341
SO_4^{2-}	116,899±5,616	49,651±2,381
Ca^{2+}	100±2	100±2
Mg^{2+}	120±1	120±1
Na^+	21,378.5±491.7	13,628.0±313.5
K^+	374.4±14.6	203.2±8.0
NH_4^+	69,561±4,149	53,107±3,399
Mobile forms of composition, mg kg^{-1}		
P – P_2O_5	55.98±0.45	20.75±0.31
K – K_2O	903.45±7.46	466.54±5.60
S – SO_4^{2-}	138.29±5.68	124.33±4.88
N-NO_3^-	52.50±1.37	27.50±0.93

According to the obtained physicochemical parameters, both samples can be salt-saturated (mineralization>150 g/L) alkaline (pH>9) sodium-ammonium-chloride-sulfate type and can be described by the Kurlov formula:

for sample 1 $M155\frac{SO_4 121.77 Cl 50.61}{NH_4 386.45 Na 92.95}, \%mmol; pH 9.67$

for sample 2 $M216\frac{SO_4 51.72 Cl 26.96}{NH_4 296.04 Na 59.25}, \%mmol; pH 9.69$

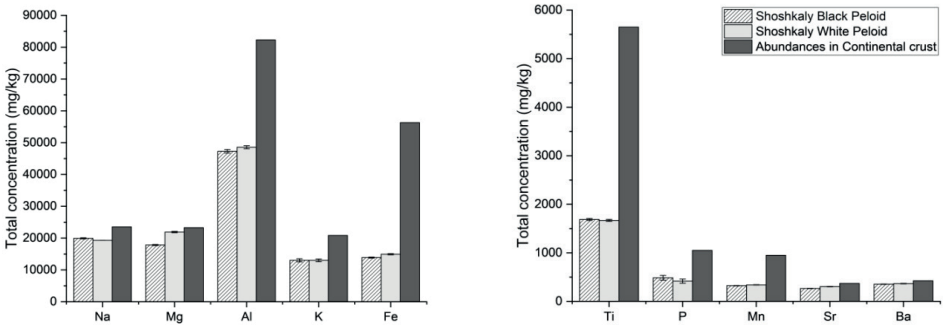
An alkaline environment activates the protease, which helps to remove damaged components in skin lesions, however, an excessive amount of protease eventually destroys the newly built tissue and can irritate it (Greener et al. 2005). The studied samples have approximately the same moisture values. Taking into account the humidity standards adopted for the use of mud in balneology, sample 1 may be suitable for these purposes. According to the data in Table 1, sodium, ammonium, and sulfate anions are mostly found in the aqueous extract of Shoshkala peloids. In comparison with the available data on the composition of peloids from other regions, the samples of Shoshkaly Lake are distinguished by a lower content of calcium and magnesium ions in the aqueous extract of mud solutions and increased content of sulfate compared to the muds of Inder, Alzhansor Lakes of Western Kazakhstan (Khalelova, Kalyuzhnaya, 2022; Myazina, 2019), Zhalanashkol Lake of South Kazakhstan (Tokpanov, 2016). In both samples, the highest content of sulfate ions in the aqueous extract was revealed in comparison with the salt extract. Sulfate ions, together with chloride ions and sodium ions, have an antioxidant and anti-inflammatory effect in the treatment of atopic dermatitis and psoriasis (Tsoureli-Nikita et al., 2002). It is known that sodium ions increase skin permeability, promote moisture retention, activate the ion transport system through the cell membrane, and participate in the elimination of toxins and cell stimulation (Potpara, 2017). Ammonium salts have a keratolytic effect of an anti-allergic and anti-inflammatory nature, reducing flaking and facilitating the course of skin diseases such as psoriasis, dermatitis (eczema), etc. A comparison of the quantitative values of the total content of phosphorus and potassium (Figure 2) and their exchange forms (Table 1) shows that most of the phosphorus and potassium are in both peloids in a fixed form. The mineralization of the white mud is higher than in the black mud sample. This may be due to the deeper level of occurrence of sample 2 and the features of the processes of deposition of elements with a high density in the lower layers (Rzetala et al., 2019). In addition, the accumulation and distribution of microelements are greatly influenced by the particle size distribution, the content of carbonates, water-soluble salts and amorphous oxides, and organic carbon (Karnaukhova, 2016). The elemental composition of the studied samples was analyzed based on a comparison with the abundances in Continental Crust (CC) according to Vinogradov, 1962 since there are no calculated clarke values for bottom sediments and mud (Vinogradov, 1962). Analysis of the data shows that among the elements, the content of which does not exceed 100,000 mg/kg (Figure 2a) and 2000 mg/kg (Figure 2b), in samples 1 and 2 of the Shoshkala Lake mud, all the elements presented are in smaller quantities compared to CC.

The distribution of macronutrients was as follows:

for black mud sample: Al>Na>Mg>Fe>K>Ti>P>Ba>Mn>Sr;

for white mud sample: Al>Mg>Na>Fe>K>Ti>P>Ba>Mn>Sr.

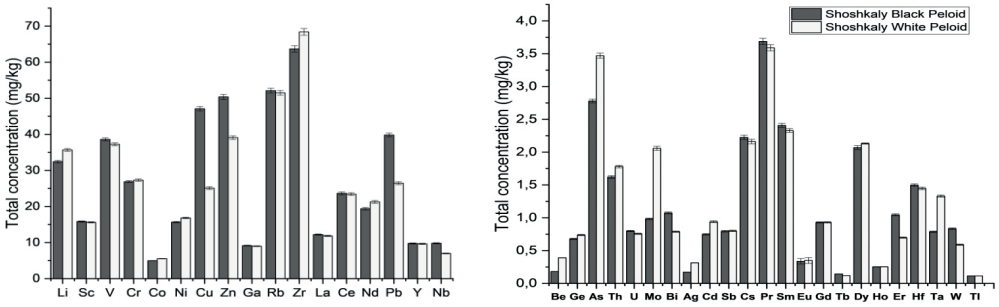
Compared to black mud, the white mud sample has high magnesium content relative to sodium. With the exception of iron and manganese, the distribution corresponds to the geochemical specificity of the analyzed elements in both samples.



a) b)

Fig.2. Total concentration of elements in interval < 100,000 mg/kg (a) and < 2000 mg/kg (b) in the black and white mud samples of Shoshkaly lake in comparison with the Abundances in Continental crust, mg/kg

The total concentration of elements, the content of which does not exceed 100 mg/kg (Figure 3a) and 5 mg/kg (Figure 3b), is approximately the same in both samples, with the exception of copper, molybdenum, silver, and tantalum. The content of copper in black mud exceeds the content in white mud by 1.9 times. The reduced copper content may indicate a more clayey nature of sample 2 (Suarez, 2015).



a) b)

Fig. 3. Total concentration of elements in interval < 100 mg/kg (a) and < 5 mg/kg (b) in the black and white mud samples of Shoshkaly lake, mg/kg

The molybdenum, silver, and tantalum content in white mud are 2.1, 1.9, and 1.7 times higher, respectively. According to the prevalence of these elements, the following distribution is observed:

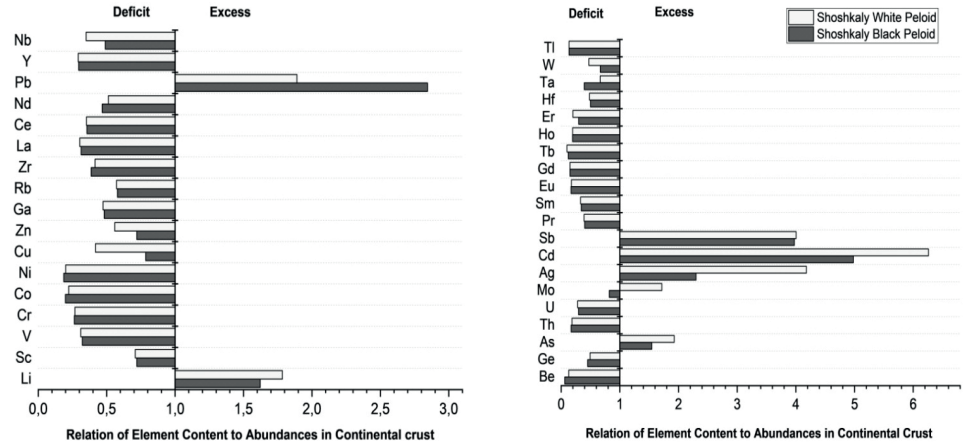
for black mud sample

Zr>Rb>Zn>Cu>Pb>V>Li>Cr>Ce>Nd>Sc>Ni>La>Nb>Y>Ga>Co>Pr>As>Sm>Cs >Dy>Th>Hf>Bi>Er>Mo>Gd>W>U>Sb>Ta>Cd>Ge>Eu>Ho>Be>Ag>Tb>Tl;

for white mud sample

Zr>Rb>Zn>V>Li>Cr>Pb>Cu>Ce>Nd>Ni>Sc>La>Y>Ga>Nb>Co>Pr>As>Sm>Cs >Dy>Mo>Th>Hf> Ta>Cd>Gd>Sb>Bi>U>Ge>Er>W>Be>Eu>Ag>Ho>Tb>Tl.

The distribution rows of elements are significantly different for black and white mud, especially for copper, molybdenum, bismuth, tungsten, and erbium. The resulting distributions in both cases do not quite match the geochemical specification. This may indicate a stronger influence of mud formation and sedimentation processes on the accumulation of microelements.



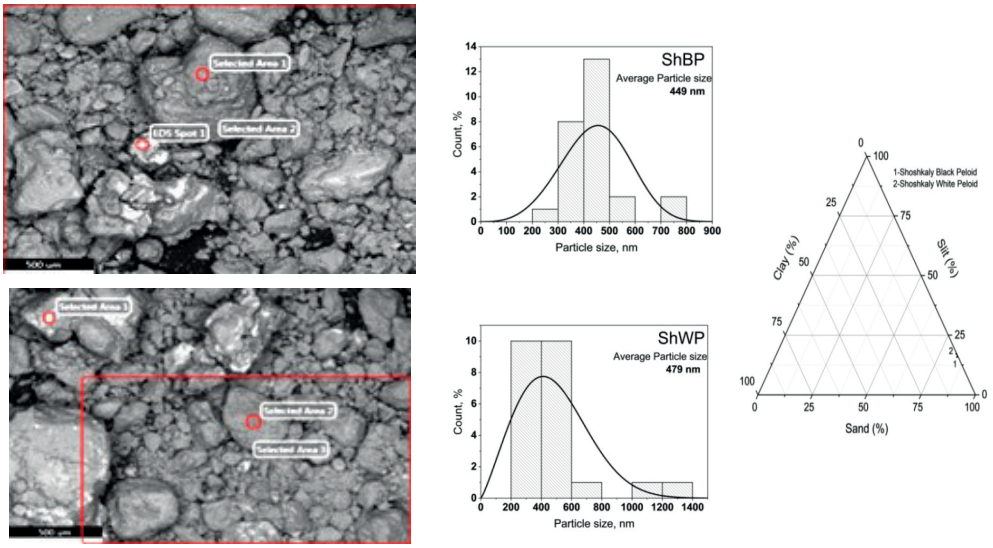
a) b)

Fig. 4. The ratio of the concentration of elements in interval < 100 mg/kg (a) and < 5 mg/kg (b) in samples of black and white mud of Shoshkaly Lake to their Abundances in Continental Crust according to Vinogradov, 1962

Among the elements, the content of which does not exceed 100 mg/kg (Figure 4a) and 5 mg/kg (Figure 4b), in most cases they are in smaller quantities compared to their content in the CC. However, in both samples, an increased content of lead is observed in comparison with CC by 2.8 times (sample 1) and 1.9 times (sample 2), lithium by 1.6 and 1.8 times, arsenic by 1.5 times and 1.9 times, silver by 2.3 and 4.2 times, antimony 4.0 times, cadmium 5.0 and 6.2 times, respectively.

The content of molybdenum is increased by 1.7 times in comparison with the CC in the white mud sample. A significant excess of the total content of bismuth is observed in sample 1–126 times and in sample 2–93 times. Molybdenum has an affinity for iron, is oxyphilic, and concentrates under reducing conditions. The high content of bismuth can be explained by the fact that in sulfide minerals the content of bismuth varies by several orders of magnitude and tends to be concentrated to a greater extent together with galena. Elements that are in increased concentrations in the studied samples compared to the values in the CC are included in the group of chalcophile

metals according to Goldschmidt and have a specific affinity for sulfur. Most forms of their minerals are inactive in alkaline mineral-rich environments, representing natural geochemical barriers. However, other factors, such as temperature, the ratio of cations to anions, the ionic strength of the medium, and microbial metabolites, can significantly change the mobility of elements (Sherene, 2010). An analysis of the granulometric and complex composition of the peloid shows its close connection with the physicochemical properties and state of aggregation. Figure 5a presents the results of the analysis of variance. Elemental analysis of the surface shows that in both samples, the largest fraction by mass is accounted for by oxygen, silicon, sodium, and chlorine. In sample 1, in comparison with sample 2, in some areas, there is a higher content of iron, and aluminum, but a lower content of calcium, magnesium, and carbon. Thus, in the selected areas of both peloids, we can assume the presence of sodium chloride, silicon oxide, and sodium to a greater extent. In the case of the black mud of Shoshkaly Lake, silicates, aluminum, and iron oxides are present to the greatest extent, and oxides, silicates, calcium, and magnesium carbonates are present in the white mud sample.



a) b) c)

Fig. 5. Morphology of samples of black (upper sample) and white (lower sample) mud of Shoshkaly Lake: SEM images at a scale of 500 μm (a); particle size distribution (b-c)

According to the literature, particle size distribution plays an important role in the mobility of metal ions. The results of the surface morphology study show that the samples have close average particle sizes (Figure 5b). At the same time, in the black mud sample, the largest number of particles are in the size range of 400-500 nm, while in the white mud sample – 200–600 nm, which is slightly shifted towards smaller sizes. This confirms the quantitative data on the granulometric and mineralogical composition of the samples. In white mud, the content of silt (<0.001mm) is slightly higher, while the fraction of sand (<0.01mm) is lower (Figure 5c). A higher content of halite (Table

2), in the case of the white peloid of Shoshkala, can cause an increase in the content of the clay fraction and affect the textural features of the peloid (Cara, 2000). Both samples are distinguished by the highest content of the sand fraction and they can be attributed to the "sand" type (Shepard, 1954). Samples contain significant amounts of coarse sand fraction (1–0.25 mm) in their composition, which exceeds the accepted norm for use in peloid therapy (Adilov et al. 2000). This indicates the need to screen out this fraction with the potential use of these muds in pelotherapy. The low percentage of the clayey fraction of both peloids may indicate a coastal nature of continental origin. The studied samples have a similar mineralogical composition. Sample 1 is enriched to a greater extent with fine-grained quartz and sample 2 with albite mineral. The mineral composition of the white mud of Shoshkala is also characterized by a high content of calcite and halite. The presence of calcite may be responsible for the therapeutic effect since carbonates stimulate subcutaneous circulation and epidermal renewal (Karakaya et al., 2010).

Table 2. Mineralogical composition of peloid samples from Shoshkaly Lake, %

	Sample 1	Sample 2
Quartz low (SiO_2)	57.2	25.8
Plagioclase-Albite ($Na[AlSi_3O_8]$)	36.1	59.1
Zeolite X ($Na_{88}Al_{88}Si_{104}O_{384}.220H_2O$, Mn,Rb-exchanged, dehydrated)	-	3.4
Calcite ($CaCO_3$)	2.6	6.3
Halite (NaCl)	2.3	5.4
Magnetite ($FeO \cdot Fe_2O_3$)	1.8	-

It is also distinguished by the presence of a small amount of zeolite X. Zeolites can enhance the sorption activity of this peloid in terms of active radicals, solar radiation, ecotoxicants, and pathogenic microbes (Pesando, 2022). Since sample 2 is distinguished by a large value of total mineralization, concentrations of molybdenum, silver, and arsenic, this may show the potential relationship and affinity of this mineral to these elements. The black peloid contains the mineral magnetite which has magnetic properties and opens up prospects for the complex use of Shoshkala black mud in magnetotherapy.

Conducting a detailed study of the physical and chemical composition of black and white sapropels of the Shoshkaly salt lake was carried out for the first time, its rich mineral composition makes it possible to scientifically substantiate the conditions for its integrated use in balneology and also promotes new developments to expand the range of its use and obtain products based on it.

Conclusion

Physicochemical and mineralogical analysis of the black and white natural mud of the Shoshkala lakes showed that these peloids belong to alkaline, salt-saturated sulfide muds with a low content of humus carbon. They have a homogeneous finely dispersed colloidal mass of dark gray color for black mud and light gray color for white mud. Shoshkala muds are of the "sand" type and have a similar mineralogical composition. The black peloid of Shoshkala is distinguished by a high content of fine-grained quartz

and also contains albite, halite, calcite, and magnetite, which opens up prospects for its use in magnetotherapy. Analysis of surface morphology confirmed the higher content of silicates and aluminum and iron oxides in black mud, and calcium and magnesium carbonates in white mud. A sample of white mud contains a slightly larger amount of silt and a smaller amount of sand fraction, it contains large amounts of albite, calcite, halite, and zeolite X, which can enhance its sorption properties. This may cause greater mineralization of the composition of white mud and the manifestation of a greater physiological effect on the human skin biome. Analysis of the total content of elements in both muds showed a significant content of lead, silver, antimony, cadmium, and bismuth in comparison with their abundances in Continental Crust. Most of these metals belong to chalcophiles and have a natural barrier in a weakly alkaline adsorption medium. The distribution of elements with a concentration of more than 2000 mg/kg in both types of mud corresponds to the geochemical specification, with the exception of lower values for iron and manganese, and elements with a concentration of less than 100 mg/kg are largely absent. A study of the mobile forms of the main cations and anions of natural mud shows that both peloids can be associated with sodium-ammonium chloride-sulfate disease, which has a complex anti-inflammatory and antioxidant effect in the fight against skin diseases. The analysis of the physicochemical composition of the black and white mud of the salt lake Shoshkaly was carried out for the first time. The rich mineral composition, on the one hand, makes it possible to scientifically substantiate the complex conditions for the use of these peloids in the research field, with other research monitoring requirements to determine various sources and characteristics of the conditions for the content of active ingredient research and extensive research. The results of the study show that the development of the virus may be associated with the distribution and production of concentrate products based on them.

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