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THE STUDY OF THE MINERAL CHEMICAL COMPOSITION OF THE YAKUT SAPONITE MINERAL AND THE PHYSICO-CHEMICAL BASES OF COMPLEX TRACE ELEMENTS

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A B S T R A C T

The conducted chemical studies show that in the selected saponites of the upper layer the content of chemical elements is CAO - 22.57%; MdO - 20.99; SiO_2 - 26.30; K_2O - 1.23% and Fe_2O_3 - 7.92% and in the lower layer the content of chemical elements is CaO_2 1.48%; MgO - 19.75; SiO_2 - 27.41; K_2O - 1.31% and Fe_2O_3 - 8.23%. . The mass loss when the saponite sample is heated to 1000 °C is 9.87%. The endoeffects in the range of 90-160 °C correspond to the removal of adsorbed water on the inner surface of the intercrystal minerals that make up saponite. Endoeffects in the range 160-330°C correspond to the beginning of the removal of constitutional water minerals A further increase in temperature is also accompanied by dehydration of mineral impurities.

K E Y W O R D S

saponite, analcime, smectite mineral composition, exchange capacity of cations.dolomite, , chemical composition, mineralogical composition, physico-chemical properties, X-ray spectrometric analysis, X-ray phase analysis, X-ray fluorescence analysis, mining and metallurgical, chemical, agricultural and other branches of the national economy.

Saponite, the so-called "soapstone," is a highly magnesian clay mineral trioctohedral smectite.

The Kyzylkum region of the Republic of Uzbekistan is a rich region in minerals containing a large number of chemical elements of the periodic table. Of these, Kyzylkum phosphorites, Yakut dolomites, betonites, marbles, gypsum and much more have been mastered at the industrial level[1]. To date, exploration of new mines and their complex development continues. There is a certain demand and shortage of magnesium-containing minerals in the Republic of Uzbekistan. An urgent issue is the exploration of mines of magnesium-containing minerals and their processing at the industrial level[2]. 100,000 tons of magnesium-containing raw materials for the production of magnesium chlorate are imported to the Republic annually from abroad. To obtain magnesium oxide and magnesium chloride from a dolomite mineral, research is being conducted in the leading research institutes of the republic, such as the Institute of General and Inorganic Chemistry (IONH) of the Academy of Sciences of the Republic of Uzbekistan and Tashkhti[3]. These studies can serve as a basis for the development of processing technology and to a certain extent cover the demand for magnesium-containing raw materials[4]. In this article, attempts are made to study the mineralogical composition, chemical composition and physico-chemical characteristics of saponites of the Vaush mine in the Navoi region[5]. The mineral saponite was first discovered and studied in the Khmelnitsky region of Ukraine, which is the largest and richest mine in the world [6]. This mineral has a pale pink light, odorless and tasteless. The chemical formula has the form (Ca,Na)0.3 $(Mg,Fe^{2+})_3(Si,Al)_4O_{10}(OH)_{24}H_2O$, and the short formula has the form $Mg_3(OH)_2$ $[Si_4O_{10}].nH_2O$. In many cases, Fe and Cr change places [7]. Despite the fact that saponite is used in various sectors of the national economy: for the treatment of industrial effluents, for the reclamation of radiation-contaminated sites, for the manufacture of sorbents absorbing radioactive radiation, for the manufacture of adsorbents, catalysts and filters, in animal husbandry and for feeding livestock, in the form of mineral fertilizers and in the production of ceramics, the studied local saponite and its complex properties are poorly studied [8].

Technique and methodology of the experiment. The chemical composition of saponite was studied by the method of semi-quantitative spectral analysis on the EDX-7000 device, mineralogical analysis was carried out on the Model 410 device, IR spectrometric analysis was carried out on the IRTRACER100 SHIMADZU device and differential thermal analysis was carried out on the Q-1500 derivatograph of the company MOM (Hungary)[10].

The results obtained and their discussion. Several saponite samples from the Vaush mine in the Navoi region were selected for the study[11]. These samples were crushed on a mobile analytical device of the Retsch RM 200 brand. Crushed saponite ores were sieved through a 0.01-4.0 mm sieve on an AS 200 laboratory unit[12]. The conducted chemical studies show that in the selected saponites of the upper layer the content of chemical elements is CAO - 22.57%; MdO - 20.99; SiO2 - 26.30; K2O - 1.23% and Fe2O3 - 7.92% and in the lower layer the content of chemical elements is CaO21.48%; MdO - 19.75; SiO2 - 27.41; K2O - 1.31% and Fe2O3 - 8.23%[13].

SCIENTIFIC AND LABORATORY RESEARCH

НАУЧНО-ЛАБОРАТОРНЫЕ ИЗЫСКАНИЯ

Таблица 1

Результаты полуколичественного рентгенофлюоресцентного метода анализа отобранных проб

№ и наименований проб	Элементный состав сапонитовых руд, %									
	Ca	Si	Fe	Mn	Sr	Cu	Ti	V	K	Орг. смес.
№1 – верхний слой	76,0	12,1	8,8	0,14	0,11	0,05	0,7	0,02	1,40	0,68
№2 – нежный слой	75,3	13,2	8,9	0,13	0,11	0,05	0,7	0,02	1,46	0,56

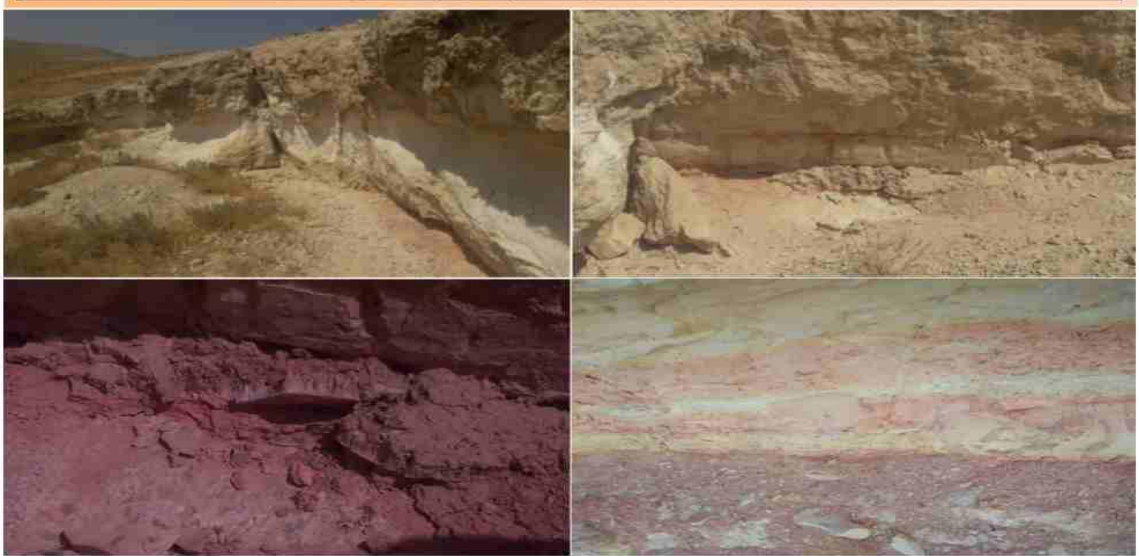
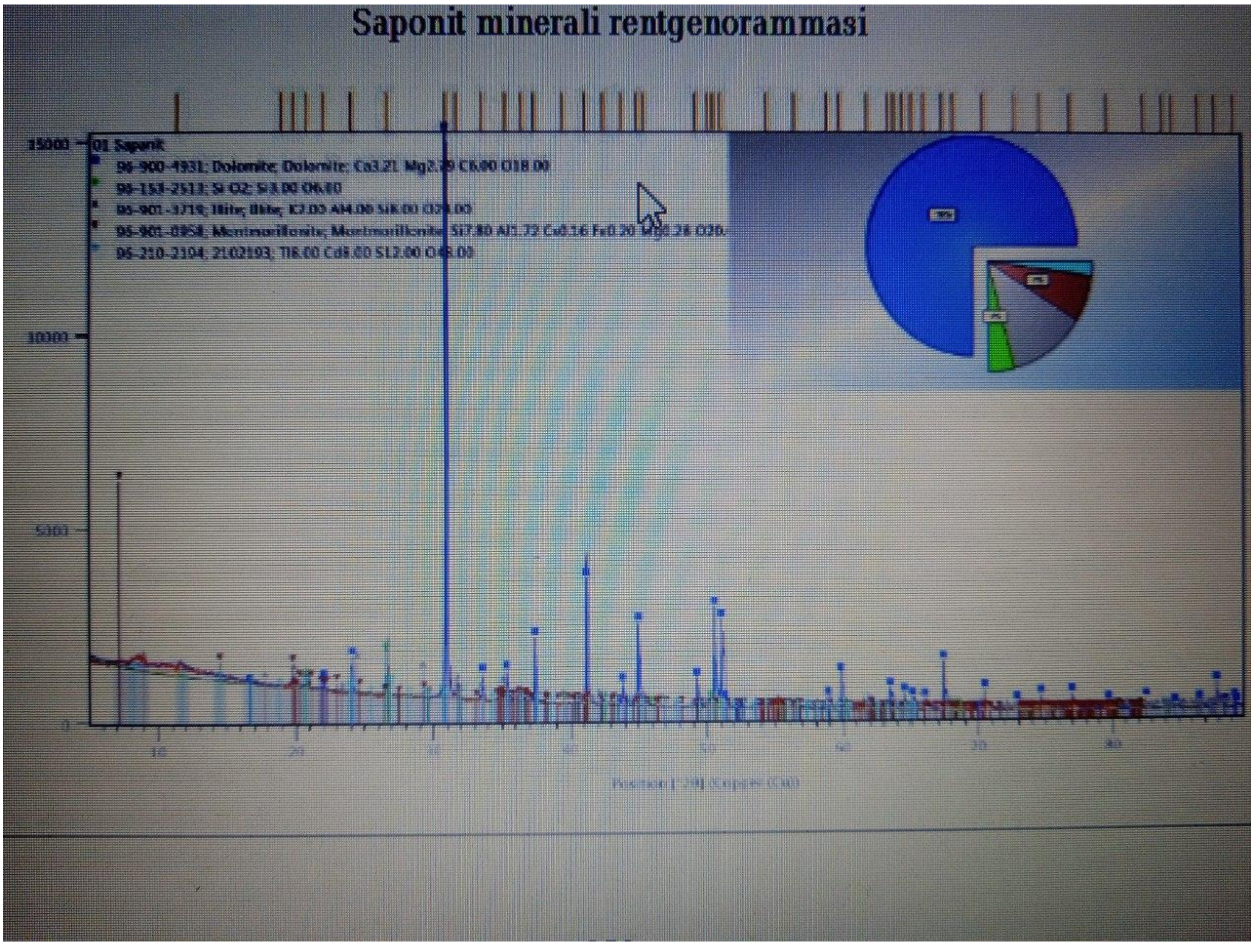


Рис. 1. Общий вид минералов сапонита в руднике Вауш Навоийской области



usulda tarkibi aniqlandi (jad.) va mineralning tarkibi tuzilishi aniqlash uchun rentgenorammasi olindi (rasm). Ushbu ko'rsatkichlar saponit mineraliga xosligini ko'rsatadi.

Jadval

Saponit minerali mass-spektroskopik usuldaub kimyoviy tarkibi

Li	Be	B	Na*	Mg*	Al*	P	K*	Ca*	Sc	Ti*	V	Cr	Mn	Fe*	Co
26,0	0,870	24,0	15000	10000 0	2900 0	480	10000	1500 00	4,10	810	54,0	44,0	250	11000	1,70
Ni	Cu	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd	In	Sn
9,10	20,0	27,0	3,90	18,0	5,80	41,0	150	5,00	26,0	3,40	9,50	0,250	0,210	0,085	0,670
Sb	Te	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
1,60	0,360	4,50	41,0	6,40	13,0	1,50	5,80	1,10	0,24	0,98	0,16	0,820	0,180	0,560	0,060
Yb	Lu	Hf	Ta	W*	Re	Pt*	Au*	Tl	Pb	Bi	Th	U			
0,490	0,077	0,670	0,310	0,690	0,01	<0,5	<0,50	0,12	5,00	0,15	2,80	4,30			

Rasm

CHTUT D....html

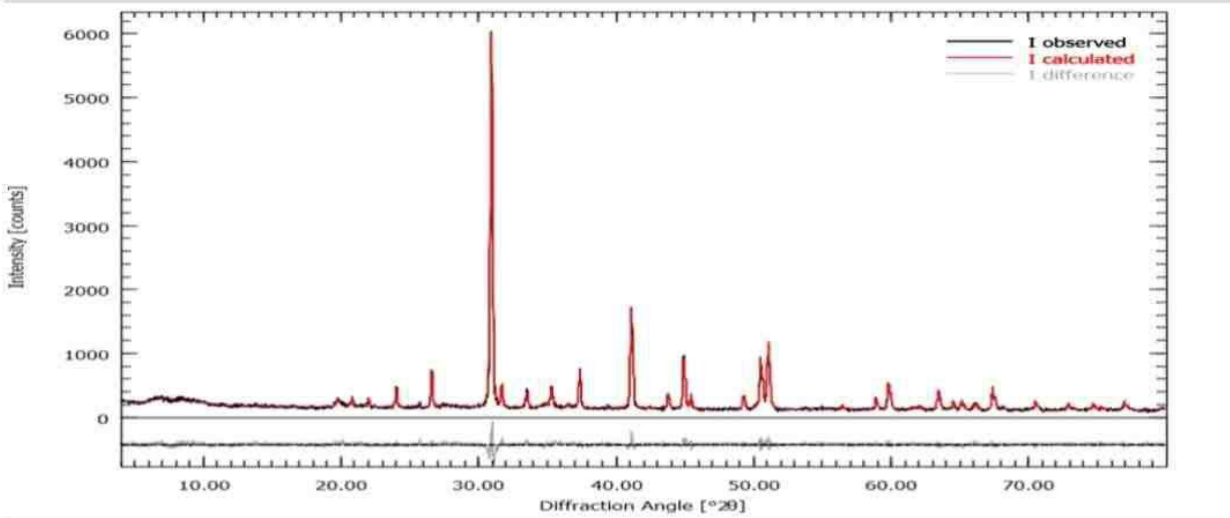


Рис.2. Спектр рентгенофазного анализа минерала сапонита

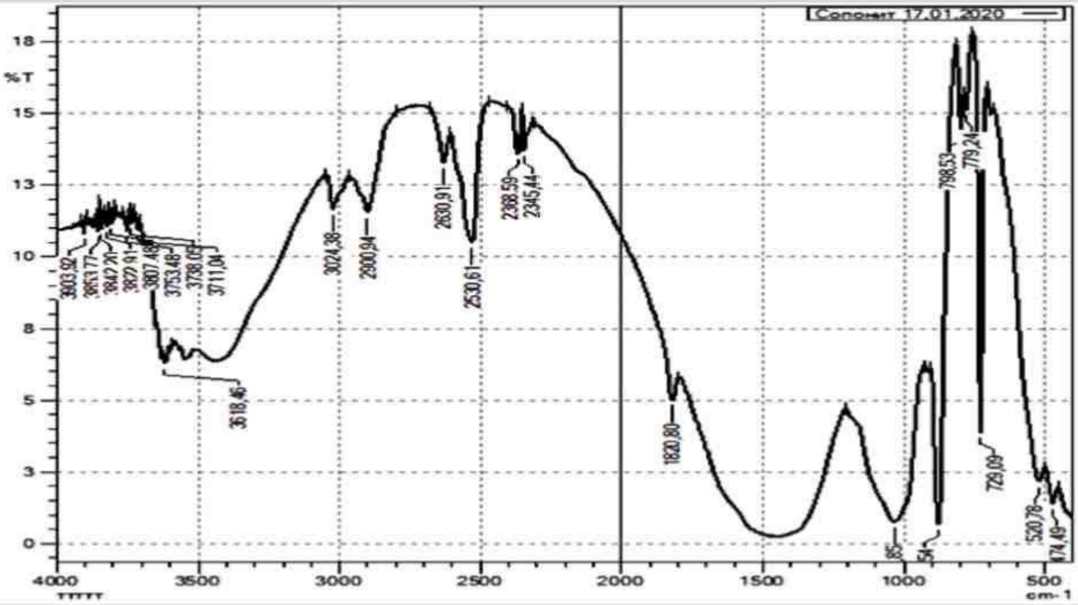


Рис.3 Спектр ИК-спектрометрического анализа сапонита на приборе IRTRACER-100 SHIMADZU

To determine the chemical composition of saponite by semi-quantitative spectral analysis on the EDX-7000 device, 10 grams of crushed ores were taken and packed into a cuvette[14]. The obtained results of the semi-quantitative analysis are given in Table 1[15]. From the results given in Table 1, it can be seen that they are very close to the results obtained by chemical methods. A general view of the saponite mineral in the Vash mine of the Navoi region is shown in Figure 1. Figure 2-4 shows the results obtained using X-ray phase analysis, X-spectral analysis and derivatographic analysis[16]. X-ray phase analysis shows that the saponite and dolomite minerals in the selected samples occur together, and the amount of dolomite is always found to be greater[17]. The results (Fig.2.) showed the presence of the following minerals in saponite: Saponite + montmorillonite - 75.66%, quartz - 4.93, illite - 7.11%, dolomite - 5.2%, calcite - 1.9%, sodium chloride - 1.5, hematite - 1.7%, rutile - 1.0%, anatase - 1.0% IR spectroscopic analysis was performed on an Irtracer -100 spectrometer (Shimadzu, Japan) in the frequency range of 400-4000 cm-1[18]. The samples were prepared by pressing with Kvl. In the IR spectra of Fig.3. saponite shows obvious absorption bands in the region of Si-O valence oscillations with maxima (798.53, 930.54, 1000.85)cm[19].

The symmetry of the silicon-oxygen tetrahedra depends on the size of the cations composing the crystal lattice of saponite, with increasing magnesia, an increase in the frequency of Si-O oscillations is noted[20]. The most sensitive to ferromagnesium substitutions in the saponite structure is the frequency response of the line in the region (930-1000) cm-1 Also in the IR spectra of saponite Fig. 3, numerous absorption bands are traced in the region (3630-3903) cm-1 due to fluctuations of OH groups[21]. In the saponite spectra, the oscillation frequencies of 779.49 cm-1 refer to calcite. The change in the intensity of the band (474-520) cm-1 is characteristic of symmetric deformation vibrations of SiO4 tetrahedra. Weak and medium intensity frequencies (1650-2000) and (3600-3800) cm-1 belong to the fluctuations of crystallization, as well as physically adsorbed water on the surface of mineral[22].
grains..

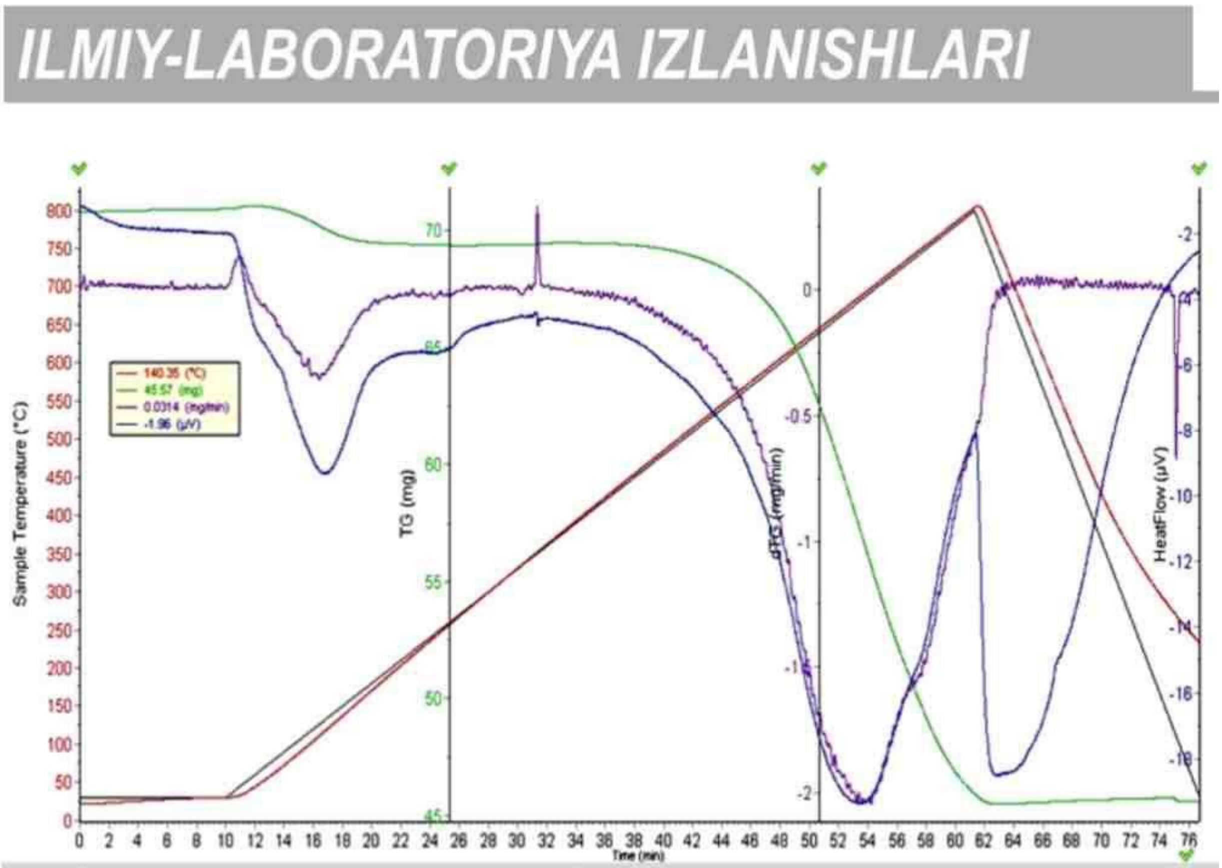


Рис.4. Дериватограмма в диапазоне температур 10-800⁰С минерала сапонита

Differential thermal analysis (Fig. 4) was carried out on a derivatograph Q-1500 of the company MOM (Hungary) in the temperature range of 20-1000°C[24]. The heating speed of the furnace is 10°C/min. Synthetic sapphire was used as a reference. The mass loss when the saponite sample is heated to 1000 °C is 9.87%. The endoeffects in the range of 90-160 °C correspond to the removal of adsorbed water on the inner surface of the intercrystal minerals that make up saponite. Endoeffects in the range 160-330°C correspond to the beginning of the removal of constitutional water minerals A further increase in temperature is also accompanied by dehydration of mineral impurities. The wide shallow endothermic effect at 330-775 ° C is due to the superimposition of the effects of polymorphic transformation of quartz, the beginning of decarbonization of calcium minerals. The rate of mass loss increases significantly in the area of decomposition of carbonate minerals at 775-935 ° C, while the accompanying mass loss of 8.67% samples corresponds mainly to the intensive decomposition of calcite.

Based on the conducted studies, it can be concluded that within the framework of this article, the chemical composition and properties of saponites have been studied on the basis of X-ray phase analysis, IR spectral analysis and derivatographic analysis. It was found that the samples taken from the upper layer and the lower layer of the mine are very similar and the content of chemical elements in them is close to each other. X-ray phase analysis shows that the saponite and dolomite minerals in the selected samples occur together and the amount of dolomite is always found to be greater.

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