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GEOCHEMICAL BARRIERS AND THEIR EFFECTS ON PLANTS

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Abstract;The article describes the description of geochemical barriers in soils and the migration and accumulation of chemical elements and substances in these barriers based on geochemical spectrum formulas. Also, the influence of the barriers formed in the irrigated marshy soils of the Central Fergana on the development and productivity of the cowpea crop is covered.

Key words: chemical element, geochemical barrier, pedolite, alluvial mud, arzic-shoch, gypsum, carbonate, rock, yield.

Introduction Today, despite the fact that most of the land used for agriculture in the world is affected by salinity in various degrees and composition, the area of such land is increasing year by year. From this point of view, researching the processes of migration and accumulation of chemical elements and substances in irrigated soils, as well as the geochemical barriers formed in their genetic layers, is one of the most important issues of today.

The concept of geochemical barriers was introduced to science by A.I. Perelman [1], and barriers in soils, that is, new cracks in soil layers, salt accumulation, etc., are included in microbarriers. They are formed due to a decrease in the rate of migration of elements and substances in the soil layers. According to the classification of A.I. Perelman, there are oxygen, sulfide or hydrogen sulfide, gley, alkaline, sour, acid-alkaline, double, evaporative, sorption and thermodynamic barriers in nature.

According to M.A. Pankov [7], the accumulation of salt in the soils of Central Fergana occurred mainly due to Na_2SO_4 and gypsum. The author explains that the formation of gypsum is one-sided, i.e., it appeared only due to the exchange reaction between calcium bicarbonate and sodium sulfate. In fact, the genesis of gypsum in the soils of this region is multifaceted.

From this point of view, the soils in Central Fergana with poor water permeability at different depths were studied and in our field observation studies, it was found that such soils still exist in the research area.

Research object and methods. The object of the researches is the newly expanded, newly and old irrigated marsh soils and goza plant, which have arzygous-horny, horny-arzygous layers formed at different depths on the alluvial and alluvial-proluvial beds of the Central Fergana.

A.I. Perelman [1], B.B. Polinov [3], V.A. Kovda [4], V.V. Dobrovolskyi [5] principles were used in the research of geochemical barriers on a comprehensive basis. Systematic pedogeochemical methods of M.A. Glazovskaya [6] and A.I. Perelman [1] were used in the studies. Soil-chemical analyzes were carried out on the basis of " Methods of agrochemical, agrophysical and microbiological research in irrigated areas " (SoyuzNIHI Vol. 1963, 1977) and " Guide to soil chemical analysis " (1971) by E.V. Arinushkina. Elemental analysis of soils was carried out by the method of neutron activation analysis at the Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan.

Research results. Evaporative, oxygen, gley, sorbing and double carbonate-gypsum, gypsum-carbonate and other barriers are characteristic for the saline soils of Central Fergana.

Bidirectional barriers are among lateral barriers, and barriers with one side, i.e., the entrance side of the barrier is acidic, and the exit side is alkaline, and the barriers with the opposite environment are called bilateral.

A group of such layers formed in the irrigated soils of Central Fergana is 93- 111 см. (section 7A), 32- 55 см. (section 6A), 18- 33 см. (Section 8A) was determined in the depths, and the amount of carbonates and sulfates in them is the following values (Table 1).

Table 1.

Carbonate, sulfate salts of calcium and magnesium, %

Cross section t/r	Depth, cm	CO2 _	CaCO3 _	MgCO3 _	CaSO 4 ·2HOH	MgSO 4 ·7HOH
7A	Formerly irrigated deep rich-horned, saline meadow saz soils					
	0-28	7.50	7.30	6.30	5.80	5.30
	28-36	5.80	6.10	5.30	10,20	8.20
	36-93	6.80	6.10	9.40	10,20	10,10
	93-11 1	**10.80**	**12,20**	**12,10**	**11,20**	**10.30**
	11 1 -1 4 0	7.60	6,10	5,10	13,10	12,20
	1 4 0-180	6.30	7.20	6.20	11.0	12,20
6A	Shallow rich-sandy, saline meadow loamy soils irrigated from the Yangi					

	0-18 _	8,50	7,90	5,30	5,50	4,30
	18 - 32	7,60	6,20	6,30	13,20	10,20
	32-55	**18,80**	**16,20**	**16,10**	**29,20**	**24,30**
	55-80	7,80	7,10	6,10	14,20	11,10
	80-140	7,60	6,10	5,10	15,10	14,20
	140-200	6,10	8,10	6,20	13,00	13.80
8A	Newly developed surface thorny , salted meadow saz soils					
	0-18	8.6 0	8.4 0	6,90	6,30	5,40
	18-33 _	**10,10**	**9.30**	**8,10**	**44,10**	**27,20**
	33-83 _	6.1 0	6,20	7,10	12,20	11,10
	83-121	7.8 0	7,10	6,10	12,10	11,80
	121-157	7.6 0	6,10	6,20	11,10	12,10
	157-202	7.1 0	7,10	5,90	10,10	13,20

These mentioned layers are dense, cemented, the degree of density, cementation is determined during the observation of morphological signs, it is clearly noticeable that it decreases in the direction of the inner layers, in addition, iron, carbonate, gypsum wounds with a dense separate layer formed in the process of soil formation, I.P. Gerasimov pedolite named . In this context, we consider it correct to use this base phrase.

It can be seen from the obtained data that the irrigated meadow saz soils are carbonate and gypsum. They contain CO_2 6.1-18.8%, $CaCO_3$ 4.5-16.2%, $MgCO_3$ 4.3-16.10%, gypsum 3.5-44.1%, epsomite salt 2, It fluctuates between 2-27.2%.

At this point, it is necessary to pay special attention to the fact that high amounts of carbonate and sulfate salts correspond to rich-horned, horn-rich layers. From this point of view and based on the dictionary data on soil science and the classifications related to gypsum and carbonates, 93- 111 см. Taking into account that the stratum corresponds to the deep group and the amount of carbonates is more than gypsum and epsomite, it is called deep arzic-horned, saline meadow saz, whose soil is irrigated from the olden days.

If we evaluate the soils of section 6A in this way, the amount of carbonates is significantly less than gypsum and epsomite, and the impermeable layer is 32- 55 см. taking into account its location, it can be said that the shallow, fertile, saline meadow soils irrigated from Yangi are fertile.

8A section soils are also evaluated in the same way. Newly cultivated surface is called saline meadow sedge soils, as it is said that the reason for this name is dense layer with poor water permeability 18- 33 см. located, the amount of sulfates in this layer is significantly higher than that of carbonates.

93 in section 7A- 111 см. It is located in the pit and is characterized by a dense chert composition, that is, in this layer, carbonates differ in abundance compared to gypsum. The thickness of this layer at this depth is not great. But he can play the role of barer. We named this barer S - Ca , that is, gypsum-carbonate barer.

In this barrier, macroelements accumulate in the following quantities and form the formula of the geochemical spectrum.

S - Ca , 93- 111 см., with gypsum-carbonate, KK: $\frac{Sr}{43,5} > \frac{Ba}{2,72} > \frac{Rb}{1,13} > \frac{Ca}{0,98} > \frac{Mg}{0,87} > \frac{Na}{0,69} > \frac{K}{0,67} > \frac{Fe}{0,58}$

The description of the geochemical spectrum of microelements in this barrier is as follows. S-Ca, 93- 111 см., gypsum-carbonate, KK: $\frac{Sb}{6,4} > \frac{As}{3,35} > \frac{Cd}{3,15} > \frac{Cs}{2,8} > \frac{Br}{1,67} > \frac{Hg}{1,25} > \frac{Au}{1,05} > \frac{Hf}{0,80} > \frac{Ni}{0,71} > \frac{W}{0,67} > \frac{Ta}{0,35} > \frac{Co}{0,30} > \frac{Sc}{0,27} > \frac{Cr}{0,21}$;

The distribution spectrum of lanthanoids and radionuclides in this barrier is as follows, i.e. KK: $\frac{Yb}{2,33} > \frac{U}{1,4} > \frac{Eu}{0,69} > \frac{La}{0,67} > \frac{Ce}{0,49} > \frac{Th}{0,28} > \frac{Nd}{0,19} > \frac{Sm}{0,15} > \frac{Lu}{0,09} > \frac{Tb}{0,06}$.

It is clear from the geochemical spectrum formulas that in these pedolitic layers, that is, in deep gypsum-carbonate barriers, macroelements Sr, Ba, Rb are simply concentrated, the amount of other elements is not accumulated according to the genesis of this layer and soil, and their KK<1, i.e. 0.58- It is located in the range of 0.98. This situation is typical for carbonate soils.

Of the microelements, Sb, As, Cd, Cs, Br, Hg are collected in this layer. These elements form a separate association. Of the remaining elements, Au is almost not accumulated, that is, KK≥1. But Hf, Ni, W, Ta, Co, Sc, Cr are not accumulated in this layer, that is, their KK is less than one.

One of the reasons for the accumulation of Sb, Hg, As in this layer, in the soils of this region, is the influence of the arsenic-antimony-mercury subregion on the formation process of these soils. Indicators of other elements are typical for this soil genesis.

Yb from lanthanoids and U from radionuclides are present in this layer in anomalous amounts, i.e. 1.4-2.3 KK. The very nature of other elements is evidence of their non-accumulation, since they belong to the group of dispersed elements.

It is not difficult to see some differences if we pay attention to the migration of elements in this situation, i.e. in pedolite-rich, horn-rich, i.e. carbonate-gypsum, gypsum-carbonate barriers, compared to the barriers described above as shallow and surface. These layers are also called deep, shallow, and surface barriers according to the depth of their location. For example, 32-55 см., 18- 33 см. in sections 6A and 8A. migration and accumulation of elements do not take place simultaneously in the correspondingly hornblende, hornblende, i.e. gypsum-carbonate, carbonate-gypsum barriers located in the depths.

Such barer, i.e. arzic-hornblende pedolite, i.e. gypsum-carbonate barer 32- 55 см. located deep, but deep 93- 111 см. It is denser, cemented, therefore it also acts as a mechanical barrier, but it is analyzed as a physico-chemical barrier.

Macroelements in these Ca-S barriers have the following geochemical spectrum. KK: $\frac{Sr}{42,3} > \frac{Ca}{1,54} > \frac{Ba, Mg}{1,05 - 1,06} > \frac{K}{0,71} > \frac{Rb}{0,67} > \frac{Na}{0,52} > \frac{Fe}{0,50}$;

Microelements

KK: $\frac{Au}{23} > \frac{Sb}{14} > \frac{As}{8,53} > \frac{Cs, W}{6,7 - 6,8} > \frac{Cd}{3,15} > \frac{Ni}{3,1} > \frac{Br}{2,76} > \frac{Hf}{1,43} > \frac{Hg}{1,25} > \frac{Sc}{0,70} > \frac{Cr}{0,52} > \frac{Ta}{0,49} > \frac{Co}{0,44}$;

Lanthanoids and radionuclides,

KK: $\frac{Yb}{5,75} > \frac{U}{1,76} > \frac{La}{0,99} > \frac{Th}{0,84} > \frac{Nd,\ Eu}{0,67} > \frac{Ce}{0,49} > \frac{Sm}{0,47} > \frac{Lu}{0,36} > \frac{Tb}{0,11}$.

These cases are now referred to in Section 18 of Section 8A 33 см. Let's look at the example of a pedolite, i.e., a cemented hornblende layer, a gypsum carbonate barrier located in the depth.

Macroelements KK: $\frac{Sr}{46,17} > \frac{Ba}{1,85} > \frac{Ca}{1,56} > \frac{Mg}{1,16} > \frac{Na}{0,78} > \frac{K, Fe}{0,70 - 0,71} > \frac{Rb}{0,67}$;

Microelements

KK: $\frac{Sb}{34,5} > \frac{As}{11,12} > \frac{Cs}{9,4} > \frac{W}{8,07} > \frac{Cd}{6,61} > \frac{Ni}{4,82} > \frac{Hf}{3,26} > \frac{Au}{3,25} > \frac{Hg}{1,25} > \frac{Co}{1,0} > \frac{Sc}{0,98} > \frac{Cr, Ta}{0,95} > \frac{Br}{0,48}$
;

Lanthanoids and radionuclides

KK: $\frac{Yb}{7,57} > \frac{U}{2,76} > \frac{Th}{2,22} > \frac{La}{2,0} > \frac{Eu}{1,31} > \frac{Nd}{1,05} > \frac{Ce}{0,97} > \frac{Sm}{0,85} > \frac{Lu}{0,49} > \frac{Tb}{0,17}$.

If we compare both, i.e., branched S-Ca and branched Ca-S barriers according to these indicators, we can see a number of similarities and differences.

After determining the properties and characteristics of geochemical barriers during the research, we continued practical observations in the field conditions in Koshtepa, Yozyovon, Ulug'nor, Mingbulok districts and monitored the cotton yield in 2017, 2018, 2019 in the lands with gypsum-carbonate barriers formed at different depths.

In the irrigated soils of the Central Fergana region, it was found that the yield changed as follows in the conditions of the field production experiment, when mineral fertilizers were given in the same proportions, that is, N_{200}, P_{150}, K_{90} per hectare, while maintaining agrotechnical processes in the farm, with the surface and shallow and deep pedolitic layers (2 -table).

Table 2

Effect of geochemical barriers on cotton yield, ts/ha

Options	Pedolite layer depth	Annual average			Average	Excess yield compared to option 1
		2017	2018	2019		
1	-	27.5	28.6	29.1	28.4	-
2	18-33 cm	31.2 *	32.8	33.5	32.5	4.1
3	32-55 cm	29.6	29.7	30.4	29.9	1.5
4	93-111 cm	27.7	28.5	29.3	28.5	0.1

*) determination of productivity was carried out in 3 repetitions by calculating on the basis of 25 cotton harvests in small areas.

According to the data, compared to option 1 (control), the yield increased by 4.1 t/ha in option 2, 1.5 t/ha in option 3, and 0.1 t/ha in option 4.

In this case, the pedolite layers located at the depths of 18-33 cm and 32-55 cm acted as a unique geochemical barrier and prevented the migration of trace elements and water along with mineral nutrients to the lower layers. Therefore, nutrients were stored mainly in layers of 20-30 cm, i.e., where the main mass of the cotton root is distributed, as a result, the supply of nutrients to cotton during the phases of growth and development was improved compared to the option with a deep, i.e., 93-111 cm pedolite layer.

Also, the amount of irrigation water is limited, i.e., 93-111 cm deep pedolite stratified version is given water in the usual amount of 1200 m^{3}/ha, 32-55 cm deep pedolite stratified version is given 1000 m^{3}/ha, 18-33 cm deep pedolite is given 1000 m 3 /ha 800 m^{3}/ha of irrigation water was used for the layered version.

Conclusions and recommendations. Arzic-shoh, horn-arzic layers are genetic layers of irrigated marshy soils, called pedolites, which are formed during the formation of these soils, lose their agricultural characteristics as a result of long-term agricultural use, that is, as a result of the effects of anthropogenic factors.

When planning the planting of agricultural crops, taking into account the root depth of the type of plant to be planted, the use of surface, shallow, deep pedolitic soils with the level of provision of biomicroelements for the tillage layer will lead to good results. When carrying out salt washing works, it is recommended to calculate the amount of water consumed taking into account the depth of the impermeable layer. In this case, 20-30% of irrigation water will be saved, water consumption will be reduced during salt washing activities, and economic efficiency will be achieved.

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