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BIOGEOCHEMISTRY OF MICROELEMENTS IN HYDROMORPHIC SOILS

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ABSTRACT

The work, based on its own and literary sources, presents materials on the content of iron, aluminum, silicon and other cyclic chemical elements in irrigated meadow saz soils with arzyk-shokho metamorphic horizons of Central Fergana. It has been established that Fe, Al, Si and other cyclic elements accumulate at these horizons.

KEYWORDS: *cyclic elements, irrigated, grassland, lithosphere, silica, minerals, bulk, silicate minerals*

Introduction

The distribution of chemical elements along the profile of hydromorphic soils in the desert zone is complex, since in addition to biogenic and hydrogenic accumulation and removal, a process of redistribution develops under the influence of both irrigation and groundwater.

As a result of soil formation, geochemical barriers are formed in soils, each of which represents a special physical and chemical system. In the hydromorphic conditions of the desert zone, oxidizing conditions prevail in the upper horizons, and in the contact zones of groundwater, especially without oxygenated waters, with soil-forming rocks, reducing conditions, weakly alkaline and alkaline environments prevail. Many features of the chemical elemental composition of geochemical barriers, groundwater and irrigation waters determine the accumulation and redistribution of a number of macro- and microelements. In this case, the chemical composition of the accumulating elements depends, along with others, on the properties of the chemical elements themselves.

For example, in many landscape waters, calcium, magnesium, sodium, chlorine, and sulfates predominate over other elements.

Silica has relatively low solubility. Therefore, its content, like the content of aluminum and iron in waters, is small [1]

The composition of soil and groundwater depends on many factors. Thus, in the landscapes of humid zones, fresh, hydrocarbonate-calcium waters predominate, and these waters are enriched with organic substances [2]

In landscapes of arid zones with a desert climate, chlorides and sulfates predominate in waters; among cations, the role of sodium and calcium, and magnesium increases [13]

Thus, it can be noted that a certain role belongs to Fe, Al, Si, etc. in the biogeochemical and physicochemical processes of the formation of meadow soils with arzyk-shokho metamorphosed horizons on the territory of the lacustrine-alluvial plains of Central Fergana. In this case, the redox conditions of the environment, especially soil and groundwater, play a huge role in the migration of Fe, Al, Si and their complexes [4].

It is well known that the most important oxidizing agent in landscapes is free oxygen in the air. Other elements can also act as oxidizing agents, especially those whose valency changes. In the conditions we studied, that is, in hydromorphic soils with metamorphic horizons, the oxidizing agent is ferric iron; hexavalent sulfur, etc., are capable of accepting electrons. Ferrous iron is a reducing agent that is capable of donating electrons. Of course, the most important reducing agent in soils is humus and ferrous iron under these soil-geochemical conditions. The same element, that is, iron, is considered an oxidizing agent and a reducing agent. This position determines the mobility and migration of iron in these soil-geochemical conditions.

When studying redox processes, it is important to take into account the value of the electrokinetic potential Eh, which is characteristic of a given natural system with its specific values of concentration, pH and temperature, as well as the E0-standard potential of this reaction [5,6,7].

The main object of our research was the territory of the farm "Mukkaramkhon opa", where irrigated meadow saline soils are widespread, which have water-air-tight arzyk-shokho metamorphic horizons at different depths. But basically these horizons are located at a depth of 20-30 cm from the soil surface. The total area is 9.2 hectares, where in recent years the Polovchanka variety of wheat has been cultivated.

With the help of the farmer, we created three production options, on the basis of which field and laboratory studies were carried out.

I. Variant-control, Arzyk-Shokho metamorphic horizons are not disturbed. Cut-1i.

II. Option - Arzyk-Shokho metamorphic horizons are mechanically destroyed using a special ripper. Cut-2i.

III. Option-Arzyk-Shokho metamorphic horizons are destroyed and carried outside the experimental area. Cut-3i

In general, the research used Dokuchaev's morphogenetic and stationary field methods.

Laboratory analyzes were performed: humus according to I.V. Tyurin, gross nitrogen, phosphorus, potassium according to Maltseva, Gritsenko, absorbed bases according to Pfeffer, water-soluble salts using the water extract method.

Geochemical and biogeochemical studies based on landscape-geochemical approaches A.I. Perelman [8,9], MA. Glazovskaya [10] Macroelements are determined by the method of atomic emission spectroscopy with inductively coupled plasma (ICP AES), techniques described in regulatory groups with the plasma observation mode of the spectrometer, hybrid scanning system Avio 200 Perkin Emler [11], which provides a completely new level productivity. The calibration of the Avio 200 Perkin Emler model with induction plasma with an atomic emission spectrometer was used.

Some elements, in this case iron, change their valency depending on environmental conditions [13]. In conditions of oxygen deficiency in hydromorphic saline soils, especially during the supply of a large amount of water in a volume of 2-4 thousand m^3/ha during the leaching period, in winter and spring on the surface of a waterproof metamorphic Arzyk-Shokho horizon lying shallow from the soil surface at a depth of 20; 30 cm with a thickness of 26-30 cm temporarily i.e. until the end of the leaching period, an oxidizing environment arises, while ferric iron partially transforms into a divalent state, i.e., it takes an active part in redox soil processes, as a result of which partial precipitation of some elements occurs after water is absorbed into the depths and partially discharged through the surfaces where precipitation is observed Fe_2O_3.

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During this process of washing soils from water-soluble salts, Fe_2O_3 partially transforms into the reducing form FeO and after the washing period, iron in the form of Fe_2O_3 is deposited on the surface of the Arzyk-Shokh metamorphic horizon and begins to accumulate.

You can give data from sections 3, 2, 1 (tab.), where the content of Si fluctuates in the Arzik-Shokho horizons in the range of 26.7-38.1, and aluminum 4.36-8.77% iron contains 1.87-3.95%.

Along with other reasons, there is a partial decrease in gross iron in the upper horizons and accumulation of hydromorphic soils in the Arzyk-Shokho metamorphic horizons under the influence of large volumes of leaching water.

Changes in the macroelement composition of soils

Size number	Depth, cm	Macroelements, %						
		Fe	Al	Si	Na	Mg	K	Ca
Irrigated meadow saz soils with Arzyk-Shokho metamorphic horizons (the horizon is destroyed and moved beyond the experimental limits)								
3	0-33	2,83	5,31	26,7	0,70	0,67	1,28	1,13
	33-59	2,94	7,77	29,6	0,83	0,71	1,21	1,18
	59-71	3,05	7,93	32,9	0,91	0,91	1,40	1,40
	71-112	2,40	8,76	30,6	1,01	1,01	1,21	1,40
	112-120	1,95	4,36	28,9	0,78	0,71	1,18	1,81
Irrigated meadow saz soils with Arzyk-Shokho metamorphic horizons (the horizon is mechanically destroyed)								
2	0-20	2,84	5,33	27,4	0,71	0,77	1,27	1,31
	20-45	3,45	8,27	35,2	1,03	1,21	1,38	3,72
	45-71	3,25	7,98	35,4	1,38	1,38	1,49	2,92
	71-112	2,45	8,70	29,8	1,10	1,03	1,48	1,80
	112-120	1,87	4,46	28,8	0,82	0,78	1,21	1,82
Irrigated meadow saz soils with Arzyk-Shokho metamorphic horizons - control (horizon not destroyed)								
1	0-20	2,93	5,40	27,8	0,90	0,93	1,31	1,29
	20-47	3,95	8,77	38,1	1,96	1,96	1,77	4,82
	47-71	3,40	8,01	36,9	1,90	1,90	1,57	3,48
	71-112	2,40	9,55	27,8	0,81	0,81	1,40	1,81
	112-120	1,91	4,46	27,6	0,90	0,81	1,23	1,84

As for the differences in iron content between soil horizons that are located below the Arzyk-Shokho horizon and the parent rock horizon, this situation can be explained by the mobility of FeO in anoxic groundwater and its rise to the level of the capillary fringe or Arzyk-Shokho metamorphic horizon, which formed under the influence of iron compounds, silicates, aluminosilicates and carbonates, as well as calcium and magnesium sulfate salts in the process of soil formation. These soils are moderately and highly saline of the sulfate type. In the upper horizons of desert soils, including meadow saz soils, iron is mainly in the form of Fe^{+3}, where the oxidative regime and the evaporative geochemical barrier prevail. There is a lack of oxygen in the deep horizons, as evidenced by the smell of hydrogen sulfide; iron is in the form of Fe^{++} [14,15]

Changes in the state of iron Fe^{+3}, Fe^{+2} lead to changes in the color of genetic horizons and layers. The trivalent form of iron has a red, brown color, and the ferrous form of iron has a greenish and bluish color. Under the influence of redox conditions, various geochemical barriers are formed.

The gross chemical composition of the studied soil horizons, including metamorphic horizons, shows that the cyclic elements Fe, Al, Si, Na, K, Ca, Mg, etc. are inherited and concentrated in the metamorphic subarable soil horizons of the meadow saz soils of the lacustrine-alluvial plains of Central Fergana , where the content of gypsum and partially magnesium sulfate reaches 50 percent or more [4]

Over a short period of observation, during the natural, anthropogenic process of soil formation, a significant change is observed in the gross contents of Fe, Al, Si in the studied dirty gray metamorphic soil horizons with brownish tints. The content of microelements of the cyclic group in these metamorphic horizons is usually slightly increased relative to other genetic horizons of soils and parent rocks.

In principle, in the studied Arzyk-Shokho horizons, taking into account its color, the content of iron, aluminum, silicon and other elements, it was possible to give a different name to this horizon. For example, ferrous-aluminosilicate-gypsum metamorphic horizons, but the name is cumbersome. Can be referred to as ferruginous-calcium metamorphic horizons. Abbreviated as Fe-calcium metamorphic, other sentences may be used. Of course, the issue is controversial, but so far there is only one name: Arzyk-Shokhovye. In general, we recommend, taking into account the color, that this horizon be called ferruginous-arzyk-shokhovo. This name is not prevented by the content of iron and carbonates, calcium sulfates, as well as the yellowish-gray color, which in the dry state clearly stands out in the soil morphologies; you can also see a clear difference in hardness.

They are well cemented, this is facilitated by a fairly high content of silica and aluminum, iron, obviously silicates and sulphates, carbon dioxide compounds of alkaline earth and alkaline elements. This situation requires a thorough study of the mineralogical and elemental composition of similar horizons in desert conditions on the lacustrine-alluvial plains of Central Fergana and other regions.

Conclusions

In the desert conditions of Central Fergana, in hydromorphic soils with metamorphic horizons at a depth of 20-30 cm with a thickness of up to 30 cm on lacustrine-alluvial plains, an increase in the amount of macroelements is observed compared to other genetic horizons, which is to a certain extent facilitated by leaching irrigation and periodic raising of the ground level waters that rise during autumn-winter flushing irrigations.

As a result, a reducing environment is formed, both on the surface and in the lower part of the metamorphic horizon, as a result of which the migration of the studied elements slows down, some are completely sedimented and cemented.

Under these conditions, when the oxidation regime changes to the reduction regime, sparingly soluble compounds of cyclic elements can be partially or completely formed.

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