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Changes in Cyclic Chemical Elements in Saline Landscape

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Annotation

In Central Fergana, over 50 years, in non-irrigated primary solonchaks, the degree of salinity practically did not increase; it remained within 2.5-3% of the dry residue, and the concentration of salts in groundwater did not increase, which was facilitated by wind erosion, the construction of collector-drainage networks in the adjacent territory. The level of content of macro- and microelements of the group of cyclic elements in soils of relatively autonomous landscapes with a developed solonchak profile on the surface in a layer with a thickness of 0-3 cm is quite high, in addition, water-soluble salts are contained in an amount of more than 3%. As for Clarke, the concentrations of Na-3.9, K-0.81, Ca-2.60, Fe-0.69, Ba-1.28, and the content of trace elements vary within 0.71-5.69.

Key words: Clarke concentration, microelements, accumulation, secondary solonchaks, carolina, reed.

Introduction. Soil and vegetation cover, including salt marshes, saline soils, secondary salt marshes and their natural, anthropogenic vegetation are the most important components of the geochemical elementary landscape, including complex and dynamic components of the landscapes of Central Fergana. Vegetation cover affects the distribution and redistribution of cyclic chemical elements in soils, especially when natural and anthropogenic cover changes. The changes occurring in soils influenced by vegetation are quite good ofscientists in steppe landscapes [1,2,3].

The metabolism of the chemical elements of the group cyclic elements, like others in the vegetation cover, is currently being studied in many countries of the world [4].

The chemical elemental composition of the soil practically determines the composition of the plants growing on them. However, this relationship is variable and depends on a number of soil and plant factors, the composition and properties of chemical elements and are not always correlated. The main sourceof macro- and microelements for plants are soils. Different salt marshe plants on soils of different salinity absorb chemical elements in different quantities, as a result of which the accumulation of elements occurs in different ways. Some elements accumulate others do not. This provision determines the relevance of the topic. The relevance of the problem of the content of macro- and microelements in plants is also the fact that they are one of the leading factors determining the productivity and quality of crop products.

A large amount of material has been collected on biogeochemistry and agrochemistry of a large number of chemical elements in plants, soils, soil-forming rocks of Siberia and other regions of Russia. The participation of macro- and microelements in complex functional physiological, biochemical, biogeochemical processes has been proven [5,6,7].

The geochemical properties of macro- and micronutrients are determined by their behavior in the soil-plant system, which are quite well studied in a number of plants [8,9].

According to the classification of chemical elements, elements such as K, Mn, Co, Zn and others are considered necessary elements of plant nutrition. Potassium as a macroelement, Mn, Co, Zn and other trace elements in soils and plants take part in a number of biogeochemical and physiological-biochemical processes. It is well known that both excess and non-abundance of macro- and microelements in soils, and in other nutrient media, leads to abnormal growth, development of plants and animals. This position requires strict monitoring in geochemical elementary landscapes.

The aim of the study is to study the quality and quantity of cyclic chemical elements their migration in natural and secondary salt marshes and their vegetation.

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The material and methods of research are based on the ideas of V.I. Vernadsky [10] about the migration of chemical elements and the laws of distribution, which was developed in the works of A.I. Perelman and N.S. Kasymov [9].

Sampling of soils and plants for analysis was carried out by the morphological method of V.V. Dokuchaev, in the autumn of 2020. The assessment of the accumulation and distribution of cyclic elements was carried out according to a comprehensive program based on the principles and methods of landscape geochemistry, biogeochemistry [9,10] and methods of agrochemical studies of soils.

With the aim of assessing the biogenic accumulation of chemical elements of the group, cyclic elements in the elementary geochemical landscapes of Central Fergana determined the chemical elemental composition of salt marshes, as well as in natural and anthropogenic vegetation, by the neutron activation method. The regularities of the processes of migration and accumulation of cyclic elements in elementary superaquatic landscapes have been studied. The object of research is the desert geochemical elementary landscapes of Central Fergana: secondary salt marshes of the Yazyavan region, as well as a desert salt marsh - on the territory of the nature reserve, where the main components of the landscape are natural and secondary salt marshes, saline meadow saz soils and their natural, anthropogenic vegetation.

The results of the study and their discussion. The processes of salt accumulation and accumulation of a number of macro- and microelements in soils and groundwater are clearly distinguished on water-accumulative plains such as Central Fergana. This situation is associated with ancient lowlands, where in the deserts there is an increase in salinization of soils and groundwater. The study of desert salt marshes in Uzbekistan, in particular, Central Fergana, has shown that for 50 years in non-irrigated primary salt marshes the degree of salinity of soils and soils practically did not increase in the range of 2.5-3% in dry residue, and the concentration of salts in groundwater did not increase, which contributed to wind erosion, the construction of collector-drainage networks in the territory adjacent to the objects. In the late 20s, according to S.I. Prisonov's research on the plains of Central Azerbaijan, soil salinity did not exceed 2%, and the mineralization of groundwater was not higher than 75 g / l. In 1948, according to the research of other authors, salinity reached up to 3-4%, the mineralization of groundwater was 45-70 g / l,[11]. Human economic activity around the salt marshes practically did not strengthen the processes of salt accumulation in deserts such as Central Fergana, where precipitation falls 80-150 mm per year, and evaporation exceeds 10-15 times.

With the salt accumulation in these natural accumulative deserts with landscape and geochemical conditions for the formation of salt marshes and saline soils in Central Fergana, which are distinguished primarily by an alkaline and slightly alkaline environment, as well as high contents of carbonates, gypsum and water-soluble salts, special vegetation, migration and accumulation of cyclic chemical elements is associated.

Such a background causes different mobility of a number of macro- and microelements of the group of cyclic elements, as well as a special soil-geochemical province. Accumulation, distribution and redistribution of a number of cyclic chemical elements ($^{11}Na_{23}$, $^{19}K_{39}$, $^{20}Ca_{40}$, $^{26}Fe_{56}$, $^{56}Ba_{137}$, $^{24}Cr_{52}$, $^{25}Mn_{55}$, $^{27}Co_{59}$, $^{28}Ni_{53}$, $^{30}Zn_{65}$, $^{33}As_{75}$, $^{38}Sr_{88}$, $^{42}Mo_{96}$, $^{51}Sb_{122}$) depending on their atomic weight and serial number in salt marshes occurs differently (Table).

In addition,the equal content of macro- and microelements of the group cyclic elements in salt marshes with a developed saline profile on the territory of the reserve (section 3) as a whole in the distribution of chemical elements retains Fersman's law, which states with the complication of the atomic nucleus of chemical elements, weighting, the clarks of the elements decrease. These tables show that at the same valences with the weighting of the atomic nucleus of the clark, the concentration of elements from Na to K and from Ca to Ba decreases.

A similar pattern is observed in the QC content of other metals studied. Secondary salt marshes (section 1,2) in this regard do not differ significantly both among themselves and with the section 3.

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Table 1
Clark concentrations of cyclic macronutrient elements

No.	Place taken	Depth, cm	^{11}out of$_{23}$	$^{19}K_{39}$	$^{20}Ca_{40}$	$^{26}Fe_{56}$	$^{56}Ba_{137}$
3	Salt marshes of Central Fergana, reserve	0-3 3-46 46-74 74-107 107-160	3,9 4,1 3,8 4,0 3,9	0,81 1,23 0,74 1,03 1,60	2,60 3,61 3,58 4,31 3,90	0,69 0,76 0,57 0,78 1,08	1,28 1,41 1,85 1,90 2,69
1	Secondary salt marshes, Farm "Abdullah"	0-33 33-44 44-66 66-96 96-115	2,76 4,11 5,52 3,92 3,96	0,86 0,82 0,81 1,04 1,55	1,64 1,66 1,59 2,58 2,72	0,70 0,75 0,69 0,75 0,81	1,46 1,32 1,27 1,28 1,34
2	Secondary salt marshes, Farm "Mardan"	0-23 23-40 40-50 50-100 100-150	4,84 3,64 3,84 3,64 3,24	0,81 0,56 0,84 1,04 1,53	1,61 1,01 1,11 1,12 1,13	0,68 0,60 0,58 0,56 0,79	1,18 1,20 1,00 1,12 1,13
Clark Soil			6000	15000	15000	40000	500

As for Clark, the concentrations of macronutrients in these salt marshes vary between 0.56-5.52. Clark concentrations of trace elements then they vary from 0.71-5.69 (Fig. 1.2).. Inthe lower profile of natural and secondarysalt marshes in the distribution of macronutrients, a similar pattern is observed, but with slight deviations. Clark concentrations of Na in all studied salt marshes in the profile change smoothly, which is associated with the long virgin state of the salt marshes of the reserve and the irrigation regime of crops on secondary salt marshes. In addition, the highest rates of QC macroelements are characteristic of these salt marshes, which is due to sodium sulfate salts, calcium in the soils and in groundwater of shallow occurrence, as well as the desert climate of the region. Of the otherindicators, the calcium content is of particular interest, which is much less contained in secondary salt marshes than in natural salt marshes. In Clark, the concentration of other elements is not observed significantly. Geochemical spectra (Fig. 1.) trace elements in natural salt marshes show that alluvial deposits, that is, parent rocks are relatively enriched with Mo, Zn, Cr, Mn, Sr in relation to the upper 0-3 cm horizon, clark concentration (CC) of Ni, Sb, As and Co is less, in parent rocks. Changes in Clark concentrationsof each of their elements in the genetic horizons of these soils repeat the above indicators with slight deviations.

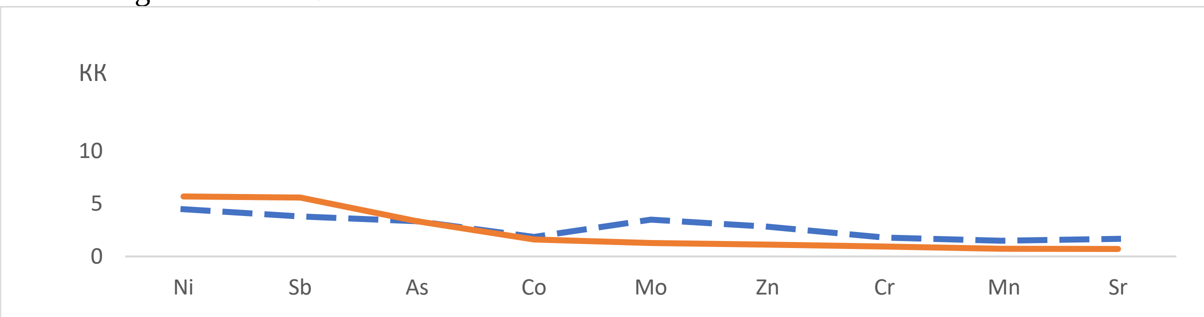

Fig.1. Geochemical spectra

--- alluvial-proluvial parent breeds
—— top 0-3 cm

As for thegeochemical spectra of the studied trace elements in the secondary salt marshes, which were formed among the irrigated lands and are annually subjected to washing irrigationam, they are shown in Fig. 2.

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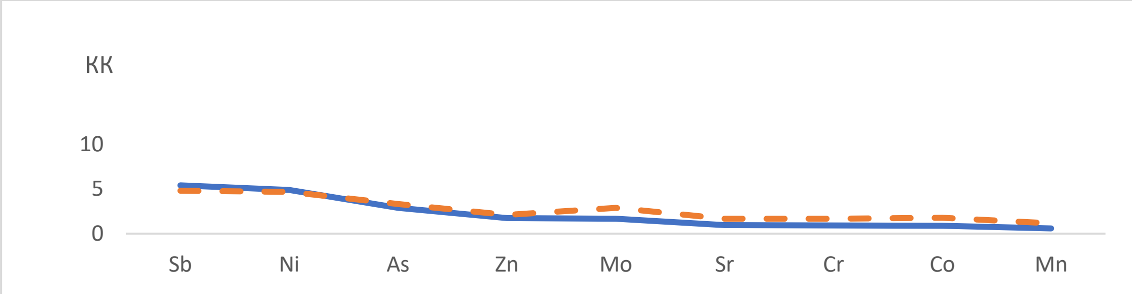

Fig.2. Geochemical spectra

--- alluvial-proluvial parent breeds

—— top 0-33 cm

Almost the previous pattern that was characteristic of salt marshes (Fig. 1.) is repeated with slight deviations. The content of As, Zn, Mo, Sr, Cr, Co, Mp according to QC is higher in parent rocks, and Sb, Ni is higher, in arable 0-33 cm layers of secondary salt marshes (Fig. 2.). Clark concentrations of Ni and Sb are respectively 4.89-5.40, Zn and As 1.72-2.88, etc.

In the salt marshesof Central Fergana grow annual, perennial sublime plants, such as Carolina caspian (karolinia caspia), common reed (phiragmites austalis cav), Paulsen's solyanka (salsola paulseni) and others.

Recently, various preparations, tinctures, extracts have been prepared from these plants, these drugs can be part of many complex products, in addition, they contain a wide range of chemical elements that have not been sufficiently studied. Some of them can be potentially dangerous to animal and human health, and their concentration, which abnormally affect the properties of life, is insufficiently or not regulated at all. In the literature there is information about the elemental composition of H. Perforatum, for a group of steppe vegetation [12]. The content of trace elements in the plants of the world has been studied [8]. Of particular note are the studiesof Korobova E. M., Romanova S. L. [5] on the methodology for studying biogeochemical provinces and zoning. The agricultural value of Co, Zn, Mo of other heavy elements in different soils of different regions is estimated differently, which is associated with the properties of soils and plants. Anumber of works [5,7] on the accumulation of biogenic and toxic elements in chernozems are aimed at studying these properties of trace elements in the soil-plant system. Heavy metals in the soil-plant system are especially well studied [8]. Based on the above, it can be noted that the studied elements both in content and in otherand biogeochemical For example, the ground frequency of H.Perforatum of the South of Western Siberia contains less Be, Co, Mn, Ni, Y, Zr and more rare earth elements [12].

For example, the comb contains macroelements: Na-14100, K-6100, Ca-7300 mg / kg, in addition, contains trace elements Cr, Co, As, Mo, Sb in the amount of 0.14-1.9 mg / kg. Most of all contain chemical elements of the group of cyclic caroline Caspian, cane ordinary, geochemical spectra of biological absorption coefficients (KBP), which are shown in Figure 3. As can be seen from the figure, selective absorption

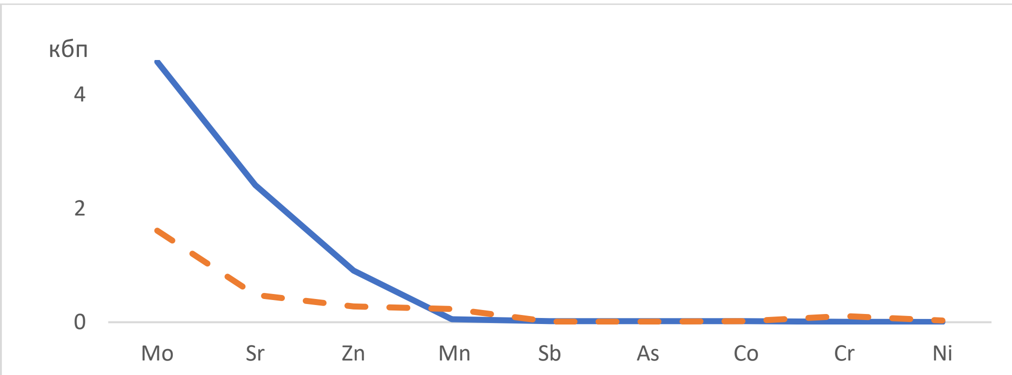

Fig.3. Geochemical spectra

- - - Common reed

—— Carolina Caspian

Common reed and Carolina Caspian within Mo-Mn according to KBP differ sharply in the creep of Carolina Caspian. Starting from manganese to nickel, the KBP of these plants are practically at the same level in the range of 0.01-0.05. It should be noted that for Mo, Sr, Zn, Mn, which perform a number of important

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physiological and biochemical functions in plants, the characteristic essential acropetal without barrier absorption. KBP for Mo, Sr, Zn Carolina Caspian is more than one and according to these indicators Sr, Mo are quite sharply different from others, which is obviously due to the high content (up to 3-4%) of water-soluble salts in the salt marshes of the region.

According to A.I. Perelman and N.S. Kasimov [9] KBP >1 element or elements are absorbed by plants, KBP <1 are captured. Following these statements, plants on salt marshes of the Caspian caroline type absorb Mn, Sr, Zn, and ordinary reed absorbs only Mo, the rest of the elements are captured by these plants. Consequently, in these plants for Mp, Sr in some cases and for Zn there are biological barriers where they accumulate.

Conclusion. The level of trace elements in natural as well as secondary salt marshes that were formed during one growing season in Central Fergana, where desert soil-forming processes with highly mineralized groundwater of chloride-sulfate type are developed, the distribution of Cr, Mn, Co, Ni, Zn, As, Sr, Mo, Sb are close to each other, they are arranged in the following sequence: natural salt marshes, 0-3 cm: Ni> Sb> As> Co> Cr> Mo> Zn> Mn> Sr; secondary salt marshes, 0-33 cm, arable horizons: Sb> Ni> As> Zn> Mo> Sr> Cr> Co> Mn. For the terrestrial part of the Caspian Carolina in Central Fergana is characterized by rather high contents of Na, K, Ca (2800-10000 mg / kg), and reed (17000-26000 mg / kg) and low coefficients of biological absorption of trace elements Co, Ni, As, Sb, which is associated with the content of these elements in salt marshes and physiological and biochemical features of these plants.

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