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# Characterization of arid soil quality: Physical and chemical parameters

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## Abstract

Land degradation especially as a result of the rapid increase in demand and pressure in the population, have emerged as one of the most important problems. Degradation leads to the loss of biological and economic productivity due to the fact that the soil loses its functional properties, which are one of the most important elements of the terrestrial ecosystem. Combined with excessive biophysical and socio-economic damage in arid areas, land degradation causes irreversible consequences leading to desertification. Thus, land degradation is an environmental threat not only on a local or regional scale, but also on a continental or even global scale. The change in the state of soils as a result of anthropogenic impact and climatic changes determines the relevance of conducting a study of the soils of the Republic of Kalmykia. Endosalic Calcisols of sandy loam and sandy granulometric composition predominate in the structure of the soil cover of the southern part of the Caspian lowland, significant areas are occupied by sands. More than 70% of agricultural land is subject to wind erosion. Salt marshes are widely distributed.

**Keywords:** Caspian lowland, arid soil, organic carbon, soil acidity, heavy metals.



## Introduction

The problem of soil degradation is one of the main manifestations of negative processes, which can be attributed to a global problem throughout the world. The area of eroded lands is increasing every year. The problem of desertification is the result of anthropogenic impact on natural resources and is a socio-ecological and economic problem, as it poses the biggest challenge to all mankind for its sustainable development (Dordzhiev et al., 2018).

Degraded territories occupy more than 41% of the area on the globe. The eroded lands in the Russian Federation is about 100 million hectares of agricultural land. The greatest distribution of degradation processes is observed on the territory of the Caspian lowland at the South of the European part of Russia, in such areas as the Republic of Kalmykia, Rostov, Astrakhan, Volgograd regions and the Republic of Dagestan. Degradation processes are manifested to a greater extent in arid regions, where there is significant climate change, such as drought, as well as technogenic pressure on nature due to man vigorous activity, irrational use of natural resources (Glazovskaya and Gorbunova, 2002; Novikova et al., 2022).

The active desertification processes are noted on the territory of the Caspian lowland due to the prolonged droughts, wind erosion, as well as inefficient use of water for irrigation, soil salinization, overgrazing, unjustified use of chemicals that cause soil and water pollution. All these processes lead to a decrease and deterioration of the soil layer, blowing out of the soil layer of dehumification and the formation of mobile sands (Dordzhiev et al., 2018).

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The Republic of Kalmykia is currently a zone of ecological disaster. The main reason for the appearance of anthropogenic phenomena on the territory is the irrational use of land, internal and external impacts on the soil layer, etc. In addition to the main natural factors in the formation of degradation processes, the territory of the region is affected by the facts of human economic activity, one of which is overgrazing, which leads to the irrational use of soil and plant resources, in combination with water and wind erosion, the destruction processes have an accelerated rate of development (Bakinova et al., 2019). The problem of desertification and land degradation in the Kalmykia is one of the most urgent, as it is associated with ongoing irreversible changes in the natural potential of territories and environmental degradation of living space (Bakinova et al., 2019). Desertification and land degradation in the Kalmykia have not only environmental, but also negative socio-economic consequences (Glazovskaya and Gorbunova, 2002).

The purpose of this study was to characterize the quality of arid soil of the Caspian lowland: the physical and chemical parameters, in order to assess changes in the soil cover.

## Material and Methods

The territory of the Republic of Kalmykia is located in the southeast of the European part of Russia at the Caspian lowland. It occupies 76.1 thousand square meters (0.4% of the area of the Russian Federation). The climate of Kalmykia can be characterized as warm, dry, sharply continental with long hot summers and rather severe but unstable winters. The amount of precipitation varies from 180 to 495 mm per year (Tashninova, 2015).

The studied territories are the settlements of the Yashkul district, which located on the territory of the Republic of Kalmykia at the Caspian lowland, distinguished by very harsh natural and climatic conditions (Tashninova, 2015). The Yashkul district of the Republic of Kalmykia occupies 11,769 sq. km. The study area is completely located in the redistributions of the Caspian lowland. The south-west of the district is partly located on the eastern slopes of the Ergeninsky Upland.

In the settlements of the Yashkul district, monitoring sites have been laid in the center of the settlement or on the territory of a school, on the border and at a distance of 500 m from the borders of the settlement. In total, 18 medium soil samples were taken for the study, in the territory of 8 settlements (Figure 1). Soil sampling was carried out in 7 settlements of the Yashkul district: the village of Chilgir, the village of Ulan-Erge, the village of Elvg, the village of Ermeli, the village of Hogn, the village of Gashunsky, the village of Yashkul. Samples were taken from the surface layer of 0-20 cm. The physical and chemical state of the soils was studied.

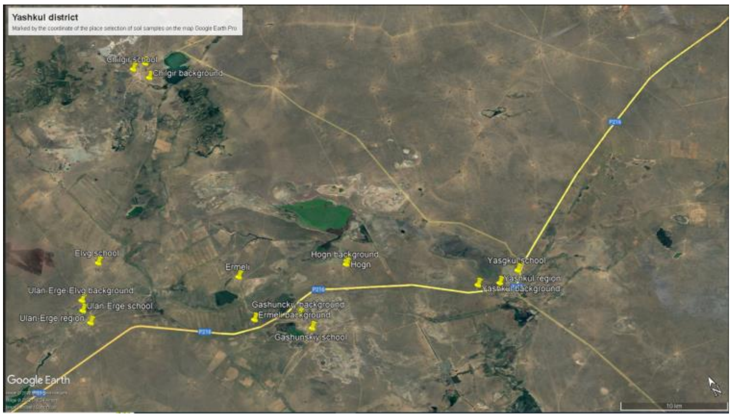



Figure 1. Location of soil monitoring sites on the territory of the Republic of Kalmykia at the Caspian lowland.

The soils of the region are represented by Endosalic Calcisolspre dominantly deflated soils. They differ from Haplic Kastanozems Chromic is a much smaller amount of humus. Depending on the nature of parent rocks, the mechanical composition of soils varies from light loamy to sandy. Significant areas are occupied by sands. More than 70% of agricultural land is subject to wind erosion. Solonetzes and solonchaks are widespread (Tashninova, 2015; Bakinova et al., 2019; Sangadzhieva et al., 2019; Lazareva et al., 2020).

The landscape of the Yashkul region is formed by sandy and sandy sea and delta-sea late Khvalyn plain: in the eastern part with traces of the ancient delta relief such as lagoons, ramparts, estuaries, bay-bars, in the south - dunes, blowout basins, occasionally with Burr hillocks. Relative height fluctuations from 0-5 to the north to (-20) m in the south. In addition, the plain is complicated by eolian processes. Covering deposits are slurry, sands, loams. Zonal vegetation cover was formed by *Artemisia absinthium*. There are camphor-sagebrush-free semi-shrub deserts in combination with psammophyte sagebrush free Siberian hummock and sagebrush-fescue-tyrsichkovy steppes, with sandy *Artemisia tridentata*, *Calligonum* communities on the sands and petrosimonium associations (Sangadzhieva et al., 2019).

### Methods

The soil particle size distribution was performed according to ISO 13317–2:2001. The pH in 1:5 soil/water suspension was measured using a glass electrode according to ISO 10390:2005. The carbonates content was determined by volumetric method on a Scheibler apparatus according to ISO 10693:1995. Total organic carbon (Corg) content was determined by sulfochromic oxidation (ISO 14235:1998). The exchangeable cations $Ca^{2+}$ and $Mg^{2+}$ were determined using a hexamine cobalt trichloride solution (ISO 23470:2018). The chemical composition of soils was studied by X-ray fluorescence spectroscopy using ‘‘Spectroscan MAKC-GV’’ (Spectron, Russia).

### Statistical analysis

To carry out statistical processing of the data of the research results, it was determined indicators, such as the concentration coefficient - $K_k$, the coefficient of the relative accumulation of trace elements in the soil - $K_{cr}$, and the background concentration coefficient - $K_f$. Elements with high Kk values are typomorphic and determine the geochemical setting. The calculation of indicators was carried out using the methodology of Glazovskaya (1999).

Statistical data processing was carried out using the Microsoft Excel software package.

## Results

In all soil samples, the contents of organic carbon were determined (Table1). The content of organic carbon in the studied soils of the Yashkul region varied from 0.31% to 1.89%. The maximum values (1.89%) were recorded in the village of Ermeli, the minimum on the territory (0.31%) was in the village of Chilgir. According to the content of organic carbon in soils, it can be concluded that the soils are mostly low-humus.

Table 1. Content of organic carbon and pH in Endosalic Calcisols Sodic

| Place of sampling | pH | Corg, % |
|---|---|---|
| Chilgir background | 7.2 ±0.11 | 1.08 ±0.34 |
| Chilgir | 7.4 ±0.11 | 1.46 ±0.34 |
| Chilgir school | 7.6 ±0.11 | 0.31 ±0.35 |
| Ulan-Erge | 7.6 ±0.15 | 0.66 ±0.133 |
| Ulan-Erge school | 7.9 ±0.15 | 0.46 ±0.133 |
| Elvg | 7.9 ±0.1 | 0.92 ±0.174 |
| Elvg school | 7.9 ±0.1 | 1.35 ±0.215 |
| Ermeli | 7.6 ±0.1 | 0.79 ±0.55 |
| Ermeli background | 7.6 ±0.1 | 1.89 ±0.55 |
| Hogn | 8.0 ±0.5 | 1.14 ±0.23 |
| Hogn background | 7.0 ±0.5 | 0.69 ±0.23 |
| Gashunsky school | 8.0 ±03 | 1.35 ±0.03 |
| Gashunsky background | 7.4 ±0.3 | 1.29 ±0.03 |
| Yashkul background | 7.7 ±0.13 | 1.68 ±0.05 |
| Yashkul | 7.3 ±0.13 | 1.52 ±0.05 |
| Yashkul school | 7.7 ±0.13 | 1.52 ±0.05 |

The selected samples in the settlement of the village of Chilgir have content of organic carbon value of 0.31-1.46 gm/kg, the highest value was noted at the point taken at the edge, the lowest on the territory of the school, the data show that the school territory is less humus, it can be assumed that this is due from business activities. The results on the territory of Ulan-Erge have approximately equal values, and do not change significantly with distance. In the village of Elvg, the highest value is observed at the sampling point on the territory of the school 1.35 mg/kg, which is most likely due to the fact that on the territory of the school manure was applied, and humus was formed due to the large amount of greenery and trees.

The difference in the values of the humus content was most likely due to the fact that in the territory of the background value, the soils are covered with vegetation, and the center of the settlement, under the influence of the anthropogenic factor from the side of people, cars, has a minimum vegetation cover, respectively, the formation of plant residues was not formed.

On the territory of the village of Hogn, the highest value of humus was observed in the center of the settlement - 1.14 mg/kg, the background value was 0.69 mg/kg. The values of humus content in the territory of Gashunsky settlement were 13.5 mg/kg in the territory of the school, and 1.29 mg/kg in the territory of 500 m from the settlement. High rates of soil humus are due to a large amount of vegetation throughout the village, as well as the formation of organic fertilizer as a result of livestock breeding.

The content of humus in Yashkul settlement had the highest value at the sampling point of the background value was 1.69 mg/kg, and the content of humus at the points "edge" and "school" was equal to 1.52 mg/kg. The values were approximately equal, most likely, because the village of Yashkul is a populated settlement where the landscaping takes place.

In the semi-desert zone of Endosalic Calcisols Sodic, the accumulation of Mo, V, Ti, Sn was found in the upper horizons; with a non-contrasting distribution, cationogenic elements – Co, Ba, Ni, Mn, Cu were accumulated (Table 2). The accumulation of elements associated with soil salinization was noted, these were Co, Mo, and Mn, which accumulate in the salt crust and in the upper saline horizon (Sangadzhieva et al., 2019).

Table 2. Average content of heavy metals in the Endosalic Calcisols Sodic of the Caspian Lowland.

| Place of sampling | V | Cr | co | Ni | Cu | Zn | As | Sr | Pb |
|---|---|---|---|---|---|---|---|---|---|
| Chilgir | 72.56±3.0 | 133.0±9.8 | 11.97±0.9 | 52.71±4.3 | 33.85±1.84 | 79.01±11.36 | 7.24±1.14 | 168.35±3.78 | 25.78±2.73 |
| Ulan-Erge | 80.4±4.7 | 155.9±30.4 | 15.3±1.17 | 41.9±8.06 | 27.6±4.8 | 67.11±5.5 | 7.4±1.04 | 193.0±11.26 | 20.9±4.55 |
| Elvg | 96.25±2.0 | 116.1±5.85 | 14.0±2.0 | 62.5±3.18 | 41.7±0.39 | 108.3±1.4 | 5.4±0.93 | 166.8±3.75 | 36.04±1.48 |
| Ermeli _ | 90.81±5.8 | 116.7±116.7 | 14.27±1.05 | 53.8±3.24 | 39.8±1.6 | 62.8±2.65 | 6.3±1.29 | 221.3±43.54 | 24.5±3.37 |
| Hogn | 85.4±10.8 | 108.4±3.37 | 13.8±0.28 | 59.2±0.62 | 39.5±1.37 | 76.1±1.98 | 5.5±0.6 | 172.9±6.02 | 27.25±3.2 |
| Gashunsky | 86.9±0.07 | 134.5±23.0 | 14.2±1.37 | 57.2±2.9 | 42.34±3.06 | 78.2±9.73 | 6.7±1.75 | 178.4±17.3 | 26.6±3.28 |
| Yashkul | 82.84±0.09 | 116.7±9.4 | 11.8±1.24 | 55.1±1.08 | 39.09±1.37 | 84.09±8.5 | 5.9±0.5 | 215.4±26.1 | 25.7±1.08 |
| MPC | 150.0 | 100.0 | 5.0 | 85.0 | 55.0 | 100.0 | 2.0 | 600 | 30.0 |
| Hazard Class | I | I | I | I | I | II | II | III | II |
| Clark according to Vinogradov | 100.0 | 200.0 | 8.0 | 58.0 | 14.7 | 83.0 | 1.7 | - | 16.0 |
| In Endosalic Calcisols Sodic of the Caspian lowland | - | 40.0 | 8.0 | 20.0 | 1.8 | 16.0 | - | - | 16.0 |
| Background content in soils of the world | - | 200.0 | 10.0 | 40.0 | 20.0 | 50.0 | - | - | 10.0 |

The obtained values of the heavy metals content in the soils showed that the content of V was in the range from 66.70 to 98.33 mg/kg (Table 2). The Cr content in the soils of the studied area showed that the content varies within 98-202 mg/kg. High values were found on the territory of the school in the village of Ulan-Erge - 201.49 mg/kg. This concentration significantly exceeds the background concentrations of Cr in the Endosalic Calcisols Sodic of the Caspian lowland, but did not exceed the background content in the soils of the world, as well as the Clarke values according to Vinogradov of this element.

The obtained values of the Co content showed that its maximum concentration was 16.12 mg/kg, taken on the territory of the school in the village of Elvg. The obtained values of the average concentration of Co in the territory of the studied sites significantly exceeded the given background regional values by 1.5-2 times (Table 2). The content of Ni in the analyzed soil samples was in the range of 44.34-65.73 mg/kg. In comparison with the background content the excess concentration was significant. The maximum value of the Ni was found in the soil sample taken between the village of Ulan-Erge and the village of Elvg exceeded background regional values by 2.5 times. The content of Cu in soil samples was in the range of 27.38-42.61 mg/kg. The highest value was found in a soil sample taken at the edge of the village of Yashkul. The background content was 1.8-2.5 mg/kg and the excess was 15-17 times. The content of Zn in the soils of the Yashkul region varies between 56-110 mg/kg (Table 2). The background content in relation to the indicators of the regional content of Zn in the soils of the Caspian lowland was 3-6 times higher. Compared to the Clark value according to Vinogradov, the excess was 1.2 times. And the background content of the world was exceeded by 2 times. The concentration of As in the analyzed soil samples was in the range of 49-27 mg/kg. The content of Sr in soils showed that the values of the concentration of the element varies from 161.16-266.41 mg/kg (Table 2). The highest value was found in a soil sample taken at the edge of the village of Yashkul. The average content of this element did not exceed MPC values. Determination of the Pb concentration in the soils showed that its content varies within 20.54-37.52 mg/kg. High values were found near the school in the village of Elvg. These values of the Pb content significantly exceeded the background values. The average value of the majority of the analyzed elements in the soil samples of the Yashkul district did not exceed or slightly exceeded the maximum permissible concentration (MPC), and the Clarke values according to Vinogradov. But the content of the analyzed elements significantly exceeded the regional Clarke.

To assess the distribution and accumulation of toxicants in soils the analysis of variance were carried (Table 3). In order to determine the nature of technogenic pollution, it was necessary to calculate the values of the concentration coefficients Kc (the ratio of the element content in the soil to the content in the lithosphere), the coefficient of the relative accumulation of trace elements in the soil Kcr (the ratio of the trace element content in the soil to the background level), the background concentration coefficient Kf (the ratio of the content of trace elements to the background) (Figure 2).

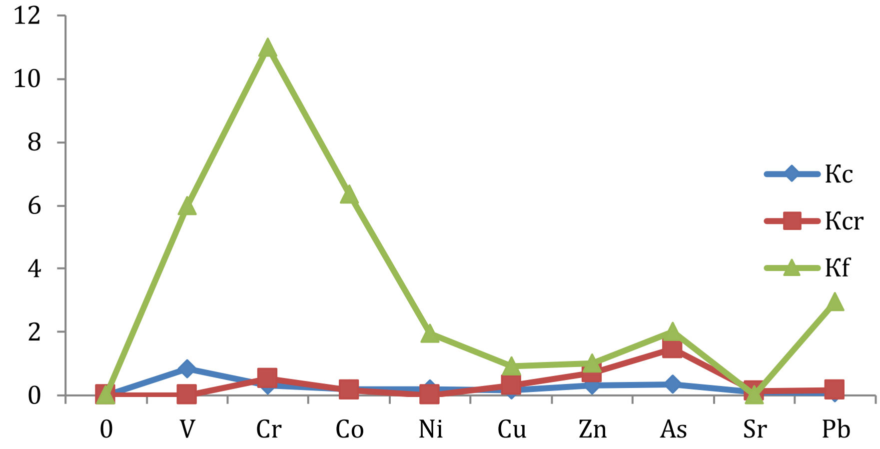



Figure. 2. Geochemical spectra of metals in the Endosalic Calcisols Sodic: Kc - to the regional clarke, Kcr - to the lithosphere clarke, Kf - to the background Clarke

Table 3. Analysis of variance of the results of the determination of metals.

| Element | Kk | Kkr | Kkf | Shares of MPC |
|---|---|---|---|---|
| V | 0.19 | - | 1.94 | 0.48 |
| Cr | 0.84 | 0.64 | 11.0 | 1.33 |
| Co | 0.42 | 0.40 | 0.95 | 2.30 |
| Ni | 0.30 | 0.65 | one | 0.62 |
| Cu | 0.36 | 1.0 | 2.94 | 0.62 |
| Zn | 0.37 | 0 | 1.25 | 0.79 |
| As | 0.07 | 0.04 | one | 4.26 |
| Sr | 0 | 0 | 2.48 | - |
| Pb | 0.18 | 0.19 | 6.36 | 1.61 |

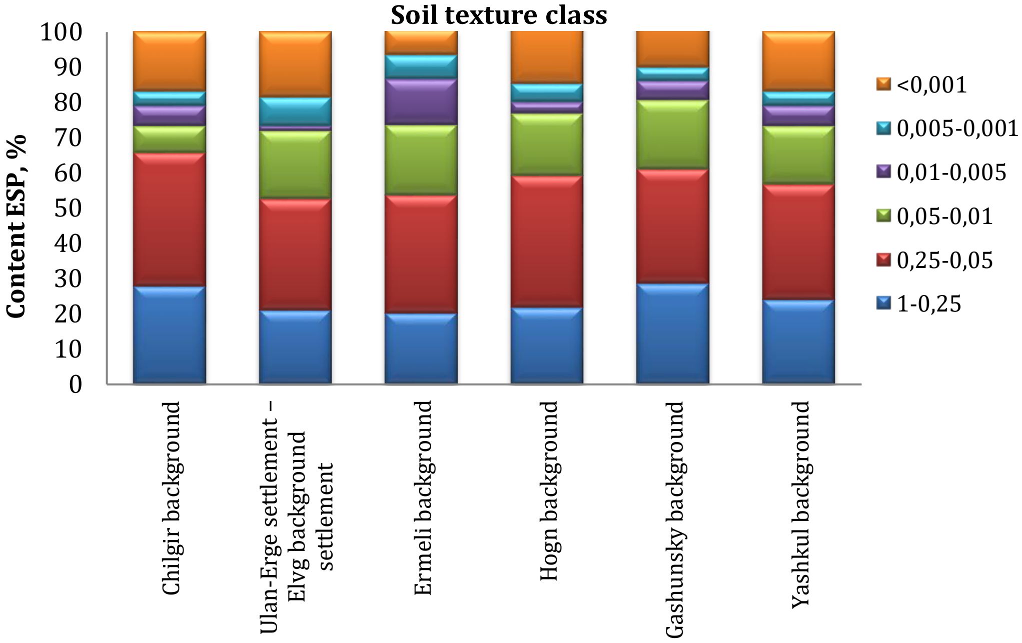
The data obtained for the determination of cations in the samples under study are presented in Table 4. The chemical composition of the soil is the main reflection of the elemental composition of all geospheres that take part in the formation of the soil (Lhissou et al., 2014). Allows you to determine the absorption capacity of the soil. With its help, the values of the provision of soil with nutrients were determined. The chemical composition of the soil showed that the soil need for fertilizer. The composition of the soil includes 15 main elements of the periodic system of Mendeleev, a greater number of elements had a low content or were quite rare. The Endosalic Calcisols Sodicare enriched in Si and Mg. It was very poor in Ca, P and K.

Table 4. Chemical composition of soils of the Caspian Lowland

| Place of sampling | $Na_2O$ (%) | MgO (%) | $Al_2O_3$ (%) | $SiO_2$ (%) | $P_2O_5$ (% ) | $K_2O$ (% ) | CaO (%) | $TiO_2$ (%) | $Fe_2O_3$ (%) | MnO (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Chilgir background | 1.22±0.12 | 1.74±0.13 | 11.86±0.31 | 67.67±1.54 | 0.15±0.02 | 2.41±0.03 | 1.53±0.53 | 0.66±0.02 | 3.54±0.31 | 752.76±38.5 |
| Chilgir | 0.80±0.12 | 1.85±0.13 | 12.29±0.31 | 62.35±1.54 | 0.22±0.02 | 2.49±0.03 | 3.04±0.53 | 0.64±0.02 | 4.07±0.31 | 797.28±38.5 |
| Chilgir school | 0.95±0.12 | 2.17±0.13 | 12.94±0.31 | 64.97±1.54 | 0.14±0.02 | 2.40±0.03 | 1.37±0.53 | 0.72±0.02 | 4.60±0.31 | 883.76±38.5 |
| Ulan-Erge | 1.15±0.15 | 1.69±0.10 | 11.04±0.71 | 64.50±1.21 | 0.14±0.02 | 2.10±0.29 | 4.31±121 | 0.69±0.02 | 3.27±0.64 | 574.07±164.6 |
| Ulan-Erge school | 1.18±0.15 | 2.04±0.10 | 11.67±0.71 | 60.45±1.21 | 0.17±0.02 | 2.15±0.29 | 5.19±1.21 | 0.65±0.02 | 3.60±0.64 | 579.68±164.6 |
| Elvg background | 0.71±0.18 | 1.84±0.07 | 13.41±0.57 | 63.41±0.99 | 0.21±0.013 | 2.99±0.225 | 1.19±0.65 | 0.72±0.28 | 5.32±0.51 | 1070.76±41.6 |
| Elvg school | 1.14±0.22 | 1.76±0.04 | 12.54±0.435 | 64.97±0.78 | 0.22±0.005 | 2.67±0.16 | 1.34±0.07 | 0.79±0.04 | 4.56±0.38 | 1107.97±18.6 |
| Ermeli | 1.17±0.02 | 1.58±0.42 | 11.64±0.29 | 70.27±6.32 | 0.09±0.02 | 2.33±0.07 | 1.11±2.83 | 0.79±0.04 | 3.76±0.27 | 864.79±84.6 |
| Ermeli background | 1.14±0.02 | 2.41±0.415 | 12.22±0.29 | 57.62±6.32 | 0.14±0.02 | 2.19±0.07 | 6.76±2.83 | 0.72±0.04 | 4.30±0.27 | 695.46±84.6 |
| Hogn | 0.87±0.06 | 2.21±0.17 | 13.13±0.07 | 61.49±1.49 | 0.19±0.02 | 2.64±0.03 | 2.05±0.37 | 0.68±0.72 | 4.63±0.01 | 760.79±69.6 |
| Hogn background | 0.99±0.06 | 1.87±0.17 | 13.27±0.07 | 64.47±1.49 | 0.16±0.02 | 2.70±0.03 | 1.30±0.37 | 0.75±0.72 | 4.65±0.01 | 900.11±69.6 |
| Gashunsky school | 1.14±0.12 | 1.99±0.015 | 12.48±0.11 | 63.17±1.0 | 0.20±0.035 | 2.62±0.23 | 2.86±0.62 | 0.78±0.01 | 4.67±0.17 | 930.65±70.2 |
| Gashunsky background | 0.90±0.12 | 2.02±0.015 | 12.70±0.11 | 61.17±1.0 | 0.13±0.035 | 2.17±0.23 | 1.63±0.62 | 0.80±0.01 | 4.33±0.17 | 790.34±70.2 |
| Yashkul background | 1.24±0.07 | 2.29±0.295 | 12.13±0.21 | 61.96±1.83 | 0.17±0.06 | 2.49±0.11 | 3.22±1.69 | 0.69±0.01 | 4.18±0.13 | 740.89±78.8 |
| Yashkul | 0.86±0.07 | 2.51±0.295 | 12.21±0.21 | 57.69±1.83 | 0.14±0.06 | 2.28±0.11 | 6.61±1.69 | 0.70±0.01 | 4.34±0.13 | 720.64±78.8 |
| Yashkul school | 1.01±0.07 | 1.92±0.3 | 11.80±0.21 | 61.34±1.83 | 0.25±0.06 | 2.50±0.11 | 3.23±1.69 | 0.68±0.01 | 4.08±0.13 | 878.15±78.8 |

The texture of soils is the main physical parameter of soils, which shows the level of fertility. The granulometric composition shows the development of physical properties of the soil, such as porosity, moisture capacity, water permeability, etc., shows the ratio of the content of macro- and microelements in soils and reflects the absorption capacity (Shein, 2009).

The soils are represented mainly by zonal Haplic Kastanozems Chromic and Endosalic Calcisols Sodic, their complexes with solonetzes and solonetzes. According to the results of the granulometric composition, it follows that the soils of the study area were characterized as medium loamy with a predominance of the sandy fraction (Figure 3).




Desertification processes are most intensive on soils of light granulometric composition. The content of soil particles < 0.001 mm in the 0-20 cm layer was 5.4-18.4, the lowest values were observed in the territory of the village of Yashkul, the village of Ermel, the village of Chilgir. The content of soil particles < 0.01 mm ranges from 20.6-29.8, the lowest values were noted in the village of Chilgir, the village of Yashkul, on the territories of schools (Figure 4).

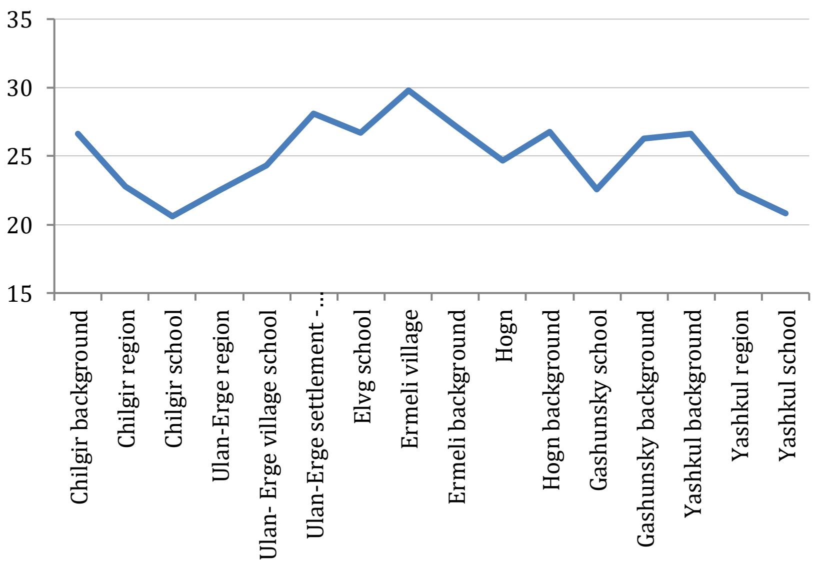



Figure 4. Distribution of soil particles >0.01 mm in Endosalic Calcisols Sodic.

## Discussion

Morphological features of Endosalic Calcisols were described as soils characterized by low power of the humus layer and weak differentiation of the profile. The destruction of the organic component under the influence of aerobic processes is characteristic of soils of this type (Tashninova, 2015).

The thickness of the humus layer in Endosalic Calcisols Sodic was 30-40 cm, the humus content at a depth of 0.3-1.12% was insignificant, the reaction of the soil solution was neutral at the top (pH 6,7-8,2), an increase in alkalinity occured at the bottom (Bakinova et al., 2019).

On the territory of Kalmykia, under the conditions of insufficiency of humid processes, arid climate, high content of salts in soils, and low content of humus, the migratory ability of microelements significantly increases in soils with a light granulometric composition, which have an increased leaching capacity. In the steppe zone in the desert steppe subzone, to which the study area belongs, the mobility of microelements decreases due to the alkalinity of soils (Buluktaev, 2018; Sangadzhieva et al., 2019; Tumanyan et al., 2019).

According to the data obtained, it can be observed that when compared with Clark according to Vinogradov, all elements $_{Kc}$ < 1. Soils did not pose a threat for all detected metals. The series formed in soils:

Co >Ni >As >Zn >V >Sr >Cu >Pb >Cr.

For comparison with the obtained values of the accumulation of concentrations of heavy metals in the territory of the Yashkul district, it is possible to build series of metals accumulation for each settlement.

| | |
|---|---|
| Chilgir: | As>Co>Pb>Cu>Ni>V>Zn>Cr>Sr |
| Ulan - Erge: | As>Co>Pb>Cu>Ni>Zn>V>Cr>Sr |
| Elvg: | As>Co >Pb>Cu>Ni>V>Zn>Cr>Sr |
| Ermeli: | As>Co >Pb>C u>Ni>Zn>V>Cr>Sr |
| Hogn: | As>Co >Pb>Cu>Ni>Zn>V>Cr>Sr |
| Gashunsky: | As>Co >Pb>Cu>Ni>Zn>V>Cr>Sr |
| Yashkul: | As>Co >Pb>Cu>Ni>Zn>V>Cr>Sr |

To identify the features of the distribution of heavy metals in the studied soils of the territories, the method of geochemical spectra was applied, the spectra were built according to the clarks of the concentration or dispersion of elements. The coefficient of regional concentration - Kcr is the ratio of the average content of the element in the soil to its background in the territory of the Caspian lowland (Figure 2).

Based on the analyzes of the metals accumulation, samples of the studied soils, their ecological and geochemical specialization was revealed. In comparison with the values of metals content in Endosalic Calcisols Sodic of the Caspian lowland, the soils of the study area showed the accumulation of all analyzed elements. As a result of studies of the chemical composition of the soils at the studied territories, it was found that the soils of the region have insignificant accumulations of the studied elements.

## Conclusion

According to the results based on the determination of the chemical composition of the soils on the territory of the Yashkul district, several conclusions can be made:

1. Studies on the metals content in the soils of the studied area showed that the average values of most of the analyzed elements did not exceed or slightly exceed the maximum permissible concentrations. But the content of the analyzed elements significantly exceeded the regional clarke.
2. The content of organic carbon in soil samples varieв from 0.31% to 1.89%. The maximum values (1.89%) were recorded in the village of Ermeli, the minimum was on the territory (0.31%) of the village of Chilgir. The soils were mostly low-humus.
3. The reaction of the soil solution is neutral or slightly alkaline.
4. According to the results of the analysis of the soil texture, the studied soils are characterized as medium loamy with a predominance of the sandy fraction.

According to the data obtained, it can be concluded that the territory of the Yashkul district was subject to changes in the soil cover under the influence of anthropogenic factors, as well as natural and climatic factors, which leads to degradation of territories and the movement of sands.

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