Mineralogical composition of solonetzic complex with unexpressed micro-relief in the northern part of the caspian lowland.

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Introduction

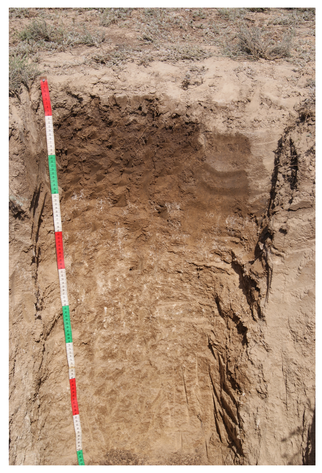
Mineralogical composition of the meadow-chestnut soils as a component of the solonetzic complex of the dry-steppe zone are described in a large number of works. In such works were studied the soils of the solonetz complex with expressed microrelief, where the solonetzes are situated on the elevations of the microrelief, and the meadow-chestnut soils are in microdepressions. There are no studies of the mineralogical composition of meadow-chestnut soils which have been compared to solonetzes in the territory with an unexpressed microrelief in the presence of a high-contrast soil cover.

The aim of the study is to identify similarities and differences in the mineralogical composition of the silt fraction (<1 µm) between the meadow-chestnut soil and the solonetz in the territory with an unexpressed microrelief.

Objects

The objects are situated in the oldest part of the Caspian lowland at absolute heights about 40–45 m above sea level, near the early-khvalynsky sea terrace and limited to a height of about 50 m above sea level (5 km to east from the village of Borsi of the Republic of Kazakhstan; 50.108 ° N, 47.496 ° E). According to geomorphological zoning, this territory belongs to the Urdinsk-Torgun elevated flat plain, located in the northern part of the Caspian lowland.

For the chestnut soil we can see the following vegetation: forbs-fescue-feather association with spirea, sometimes with a thin moss cover.



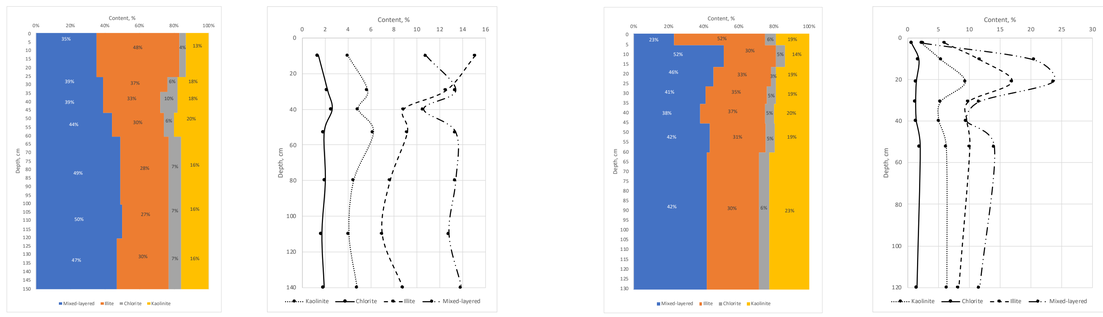
Above the solonetz dominates *Kochia prostrata* and *Artemisia pauciflora* with *Myosúrus sp.* and rare *Poa sp.* curtains.

Methods

We studied the composition of clay minerals in the fraction <1 µm. To separate soil fraction <1 micron, samples were rubbed into a thick paste and sedimented. Carbonates, highly soluble salts and amorphous substances were removed before fractionation. Oriented preparations of the fraction saturated with magnesium was examined by XRD method in 3 states of sample: air-dry, solvated with ethylene glycol and after calcination for 2 hours at a temperature of 550 ° C. The content of the main mineral phases in the fraction less than 1µm is determined by the method of Biscaye.

Horizon	Depth, cm	Fraction <1 µm, %	Minerals in fraction, %.				Minerals in soil, %.			
			ML	I	C	K	ML	I	C	K
Meadow-chestnut soil										
AJ	0-25	31.3	35	48	4	13	10.8	15.1	1.4	4.0
AJB	25-34	33.9	39	37	6	17	13.4	12.6	2.2	5.7
BMK	34-46	27.0	39	33	10	18	10.6	8.9	2.6	4.9
Bca	46-60	30.7	44	30	6	20	13.4	9.2	1.9	6.2
Bca2	60-100	27.6	49	28	7	16	13.4	7.7	2.0	4.5
BC	100-120	25.6	50	27	7	16	12.8	7.0	1.7	4.1
BC	120-150	29.5	47	30	7	16	13.9	8.8	1.9	4.8
Solonetz										
SEL	0-5	11.7	23	52	6	20	2.6	6.1	0.7	2.3
BSN1	5-16	39.7	52	30	5	14	20.6	11.8	1.8	5.5
BSN2	16-26	51.6	46	33	3	18	23.7	17.0	1.4	9.4
BSN3s	26-35	28.3	41	35	5	19	11.7	9.9	1.3	5.4
BCA s.cs	35-45	25.7	37	37	6	20	9.6	9.6	1.4	5.1
BCAnc	45-60	27.9	42	31	5	19	14.1	10.1	2.0	6.3
Cca.s	110-130	32.5	42	30	6	23	11.7	8.3	1.5	6.4

Table 1. The ratio of the main mineral phases in the clay fraction (<1 µm). ML – mixed-layered; I - illite; C- chlorite; K - kaolinite.



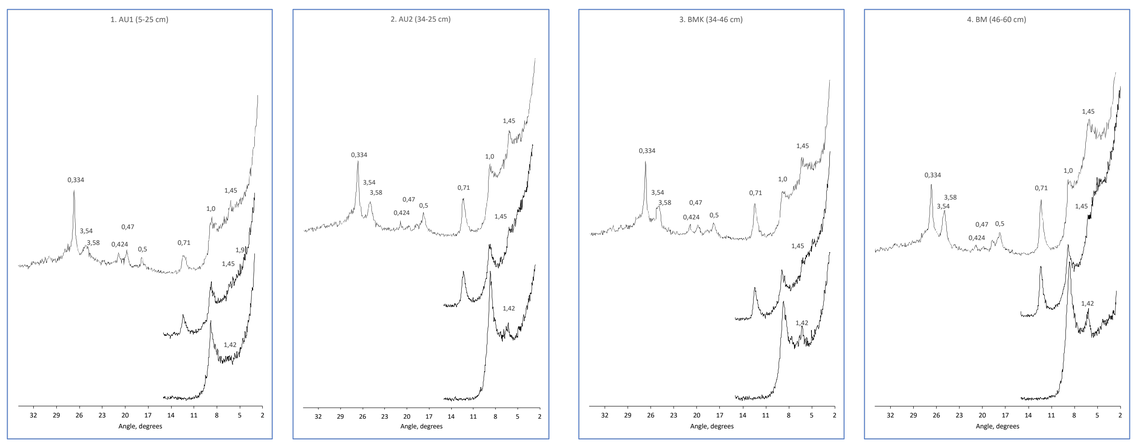
a b

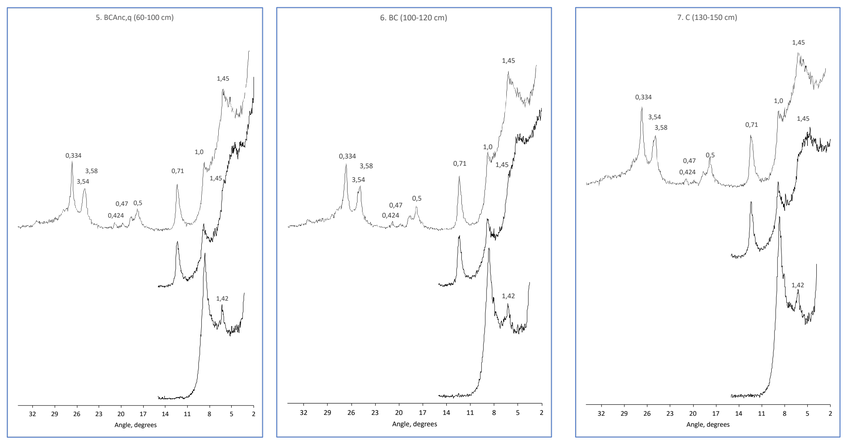
The mineral content in fraction (a) and in the soil (b) in chestnut soil.

a b

The mineral content in fraction (a) and in the soil (b) in the solonetz.

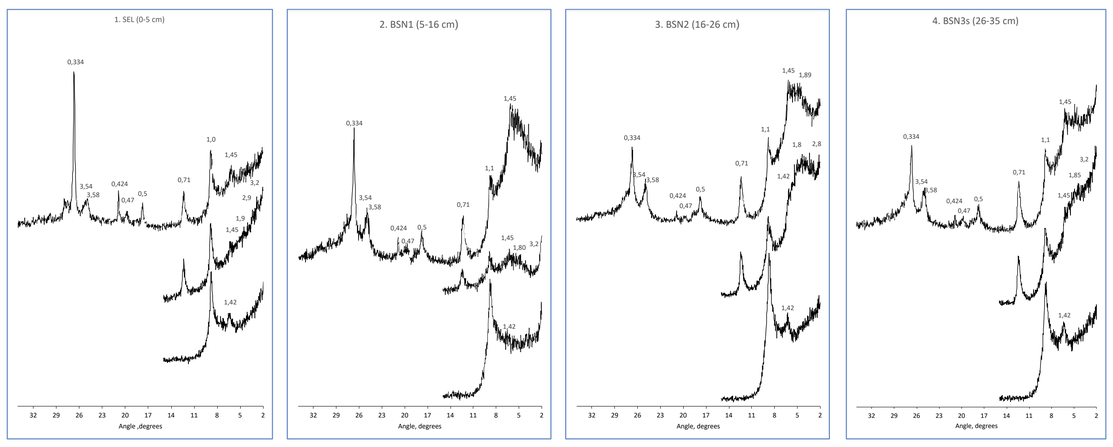
X-ray diffraction patterns of meadow-chestnut soil

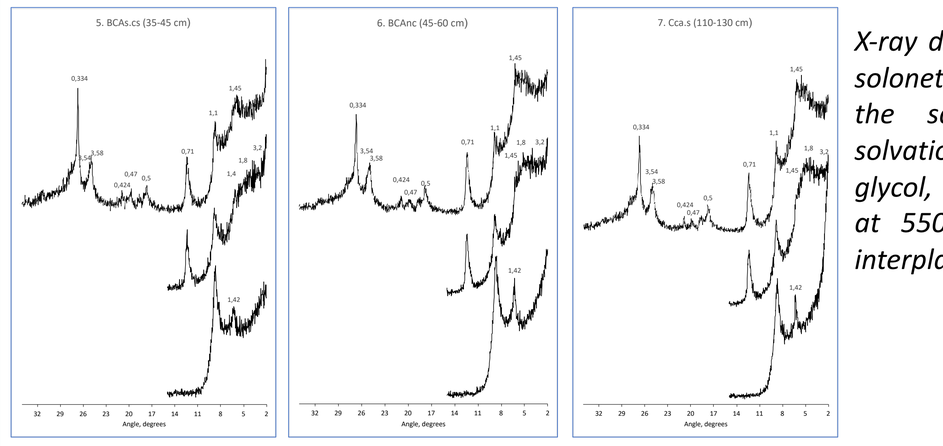




X-ray diffraction patterns of meadow-chestnut soil: a - air-dry state of the sample, b - after solvation with ethylene glycol, c - after calcination at 550 ° C for 2 hours, interplanar distances in nm.

X-ray diffraction patterns of solonetz





X-ray diffraction patterns of solonetz: a - air-dry state of the sample, b - after solvation with ethylene glycol, c - after calcination at 550 ° C for 2 hours, interplanar distances in nm.

Conclusion

The results of the analysis of the mineralogical composition of the clay fraction of the compared soils of the solonetzic complex show close values both in the content of mineral phases and their distribution in the profiles. In the solonetz and in the meadow-chestnut soil in all genetic horizons (except the surface) and in parent rocks, clay is dominated by mixed-layer minerals and illite, kaolinite is intermediate in content, and chlorite is minimal. An exception is only the most superficial horizons of the compared soils, in which illite prevails over mixed-layer minerals.

We have revealed common properties in the crystal-chemical state: 1) the imperfection of the kaolinite structure is noted in the upper 40 cm, 2) mixed-layer minerals of the BC and C horizons of both soils differs from overlying soil horizons by the appearance of individual smectite and chlorite packets, which were not present in the upper part of profile, 3) both profiles are characterized by the superdispersed state of the mixed-layer phase in the upper horizons (SEL in the solonetz and AU1 in the meadow-chestnut soil).

In the compared soils, the more intense eluvial-illuvial redistribution of silt in the solonetz associated with both the process of leaching and alkaline hydrolysis (confirmed by many researchers). Therefore, we noted the minimum content of labile minerals in the upper horizons. If we assume that these processes are responsible for the features of the profile distribution of labile minerals of the mineral phases in the solonetz, then in the meadow chestnut, these processes probably proceeded. This is also indicated by the increased superdispersed state of the mixed-layer phase in the upper horizons (SEL in the solonetz and AU1 in the meadow-chestnut soil).

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