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Spatial organization of a soil cover in ppreserve "Arkaim" (Chelyabinsk region, Russia)
L'organisation de la couverture pédologique dans la région de "Arkaim" (région de Tchélabinsk, Russie)

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Soil cover, as the set of elementary soil areals (ESA) and units of soil cover structures of the higher order, has a complex structure. The questions of study of a soil cover detailed per the last years were considered by many scientists (Fridland, 1972, 1984; Godel'man, 1981; Stepanov, 1983; Korsunov, Kraseha, 1990; Kozlovsky, Gorjachkin, 1993 and other).
The authors studied spatial organization of a soil cover on an example of preserve Arkaim territory (Chelyabinsk region, Russia).

METHODS of RESEARCH
Four complex (botanic-soil-geologic-geomorphological) profile, consisting of 120 soil sections and crossing preserve, were laid and investigated. On the average one soil section is on 12 hectares.
The soil cover map of preserve in scale of 1:25000 was made. For its drawing up topographical map in scale of 1:10000, aerial photographs in scale of 1:12500, landscape and geomorphological maps of preserves made by the authors, soil maps in scale of 1:25000 and sketches of inspection of territory by Uralgiprozem Expedition, soil map of preserve by O.Z. Eremchenko in scale of 1:10000; extensive share materials, map of South-Ural Complex Geological Expedition; map of vegetation of preserve in scale of 1:50000 made by D.G. Moiseev, were used.
The relief plastic map of preserve in scale of 1:10000, made by V.N. Haritonova (ISSP RAS) on a Stepanov's technique has become the important material for drawing up of soil cover map. On it all hollow-valley network and its original figure were reflected. On this map the orders of valleys by R. Horton (1948) and by V.P. Filosofov (1975), the areas of valley pools of the different orders were determined, also valuations of volumes of a water drain were given. The study of a modern soil cover of preserve was conducted by group of the scientists from Institute of Soil Science and Photosynthesis RAS under a management by Dr. I.V. Ivanov and scientists from Perm State University under a management by Dr. O.Z. Eremchenko.
The researched area is located in a moderate climatic zone, in continental western-siberian area, in a steppe zone with elements of forest-steppe landscapes, in a cernozemic soil zone, in soil-climatic facies of moderate-freeze soils. The temperatures make: annual - from +1 to +3 centigrade degree, January - from -16 to -18 centigrade degree, July – from +19 to +20 centigrade degree, annual precipitation - 300-360 mm, total evaporation - 450-650 mm, depth of freezing - up to 2 m.

The preserve is located within the limits of a Zaurals plateau. The plateau (peneplain), after its formation in a Trias, has undergone to differential tectonic movements, the ancient (mesozoic) kaolin weathering crusts were generated. On about river sites the peneplain was dismembered, about river little-nipples with the washed off and redeposited weathering crusts was formed. The modern river valleys of the rivers Bol'shaja Karaganka and Utjaganka are located on ancient valleys and lake deposits of a noegene surface with a cover of deluvial, lake and alluvial adjourment.

The dense ingeous rocks of paleozoic age and their eluvium-deluvium, ancient clay weathering crusts of kaolinite composition, stony and not stony noegene loams of alluvial, lake and deluvial origin (capacity up to 20m) with prevalence among clay minerals of a montmorillonite and hydromicas serve soilforming rocks.

RESULTS And DISCUSSION

Six genetic groups of a soil cover, depending on structure of parent rocks, relief genesis and forms, ratios of soil forming processes, denudation and accumulation, age both maturity of soil profiles and set of soils were allocated.

Soil cover of denudative surfaces of little-nipples (Pg-N) with immature chernozems and forest soils of significant age (30-50 thousands years). It is submitted by two groups.

Soil cover of sites of little-nipples with steppe vegetation. The background distribution of stony immature chernozems and outputs of mountain rocks dated for tops of nipples is characteristic of a soil cover of noses and separate nipples. A figure of a soil cover is roundish-spotty. On slopes of little-nipples with micro- and meso-hollows the soil cover has other character. The hollows of 1-st order have mainly radial arrangement from tops of nipples. The immature chernozems or ordinary shallow chernozems are dated. A figure is radial-hollow striped.

Soil cover of sites of little-nipples with forest vegetation. The soil formation under forest vegetation more intensive, than under steppe, that is stipulated by a richer vegetative litter, accumulation of snow, best drainage conditions. On eluviums of dense rocks the immature grey forest soils, on hollows and on equal platforms with greater capacity of a earthly material steppe and boggy solods are formed. These soils will form combinations and variations. A figure of soil cover of forest territories is far-hollow branchy.

Soil cover of accumulative-denudative surfaces (Pg-N) with rejuvenated low- and middle-generate by chernozems, complete-profile chernozems of different degree of salinity and alkalinity and solonchakous solonetzes of average age (10-20 thousands years). The accumulative-denudative surface is characterized by content of denudative and accumulative sites.

Denudative sites. The ordinary shallow chernozems (or immature chernozems) with meadow-chernozemic soils on hollows are characteristic of a soil cover of denudative sites. A figure of a soil cover is branchy-hollow. On a surface frequently is characteristic of a soil cover of sites with weathering crusts availability of outputs of crusts, why figure becomes spotty branchy-hollow.

Accumulative sites. The salinity and alkalinity of soils of accumulative sites of a accumulative-denudative surface is caused by the saline soil forming rocks, slakening of a drainage because of heavy granulometric composition and low orders of valleys, and also rule of soils in a relief and concentration of salts owing to a water mode named by V.A. Kovda (1973) evaporating. On subnormal sites of slopes the soil cover is submitted by combinations-mosaics of ordinary calciferous solonetzic chernozems to solonchakous solonetzes. The surface of these sites of slopes is low cut up by hollows on which the meadow-chernozemic soils are advanced. A figure of a soil cover is branchy-hollow.

Soil cover of inter-nipple downturn are characterized by prevalence chloride-solonchakous solonetzes. The meadow-cernozemic soils of a different degree of an alkalinity are dated for far hollows. A figure is far-hollow branchy.

Soil cover of denudative-accumulative surfaces (NII-Q) with complete-profile mature chernozems and solonetzes (10-30 thousands years).

The soil cover of a denudative-accumulative surface is generated in main complete-profile ordinary and southern chernozems. The conditions of a soil formation at these soils are most favorable. Depending on time of formation of elements of a mesoreliefe (watersheds, top, middle and bottom parts of slopes with deluvial loops) the soils of specific sites have unequal age of a soil formation from zero-moment till our days. In main it is estimated by units of tens thousands years.

The properties of hydromica-montmorillonite clays and loams are most favorable for a soil formation. The rather large speeds of a soil formation at chernozems - 1sm for 100 years (Targul'jan, 1982) are known. Thus, for formation of humus horizon the capacity 40-50sm requires 3-4 thousands years. Therefore character of chernozems on different elements of a mesorelief in main features is rather similar, as the speed of a soil formation in most cases exceeds speeds of geological processes of denudation and accumulation.

The soil cover of a lake-deluvial surface is submitted by ordinary and southern chernozems of different degree of a calcareousness and alkalinity, chernozemic-meadow and, sometimes, meadow-chernozemic soils. A figure of a soil cover is branchy-hollow striped or parallel-hollow striped.

The top clay-accumulative parts of a denudative-accumulative surface, in places of affinity with an accumulative-denudative surface, for want of superficial presence of residual-salt noegene clays, are characterized by combinations-mosaics of chernozemic solonchakous solonetzes with ordinary calciferous chernozems and meadow-cernozemic soils on hollows.

The valley like downturn are characterized by combinations and variations of ordinary chernozems of different degree of calcareousness and alkalinity with meadow-chernozemic soils. A figure is hollow-nose.

Soil cover of erosive-water-accumulative surfaces (QIII) with complete-profile mature chernozems and solonetzes (6-12 thousands years).

Soil cover of erosive-water-accumulative surfaces in valleys of the rivers Bol'shaja Karaganka and Utjaganka submitted by complete-profile chernozems and solonetzes, more young, than on denudative-accumulative surfaces. It has age 6-12 thousand years, that is connected in due course drainages of lakes in these valleys, differs from a soil cover of a denudative-accumulative surface by large participation in it is solonetzic also by large variety of soils with additional humidifying. Besides the bigger variety of soil forming rocks on granulometric composition determines differentiation of a soil cover to this attribute. The soil cover is submitted by parallel hollow-nose combinations-mosaics of chernozemic solonchakous solonetzes with ordinary calciferous and deep-calciferous chernozems, meadow-chernozemic, chernozemic-meadow and meadow soils. Besides the places form boggy-meadow soils dated for downturn, probably, karst origin.

Soil cover in high-water bed of rivers with young (up to 2-3 thousands years) alluvial soils, hidromorphic solonetzes and solonchaks. The soils of a high-water bed, alongside with soils of a hollow network, are youngest on territory of preserve. Large their part was generated for period less than 2-3 thousands years as a result of processes of active formation of river alluvium. The soils of high-water beds repeatedly salinizated and desalinizated in connection with fluctuations of erosion basis and ground water level because of breaks lakes, fluctuation of height of high waters for want of changes of a climate. Relief formation and soil formation represent uniform process of a lithomorphohalopedogenesis (Berg, 1951; Egorov, 1959; Hakimov, 1995).

The soil cover of this surface is submitted by roundish-spotty mound-hollow complexes of alluvial-soddy, alluvial-meadow soils, hidromorphic solonetzes and solonchaks. Besides in a high-water bed meet spotty complexes of hidromorphic solonetzes and solonchaks, connected with an over grazing. In places of merge of hollows with the rivers develop striped-hollow complexes of hidromorphic solonetzes, alluvial-soddy and alluvial-meadow soils. Concentric about cutoff meander complexes of hidromorphic solonetzes, alluvial-soddy, alluvial-meadow and alluvial-boggy soils also are distributed in a high-water bed. This or that degree of a salinization is characteristic of all soils of high-water beds of the rivers Bol'shaja Karaganka and Utjaganka.

Soil cover of hollow-valley network with young (up to 2 thousands years) meadow-chernozemic, chernozemic-meadow and meadow soils.

Hollows of the 1-st order is youngest on territory of preserve, repeatedly changed the site. Their depth reaches 30sm, width - 1-2m, length - 10-100m, area of catchment - up to 0,6 hectares. Volume taking place through them for a year of a superficial drain - 90 Í3. The hollows of the 2-nd order have the following parameters: depth 0,7-2m, width 10-20m, length 300-500m, area of catchment up to 6 hectares, annual superficial drain up to 9 thousand Í3. The hollows 1-st and 2-nd of the orders are distributed on all types of surfaces and reflect dynamics of a modern and ancient soil formation. The soils formed in hollows of the 1-st and 2-nd orders differ from background soils unsignificantly, in main, plenty of earthly material and heavier granulometric composition.

For hollows of the 3-rd order the depth reaches 2-5m, width - 20-50m, length - 300-700m, area of catchment till 25-30 of hectares, annual superficial drain up to 45 thousand Í3. Their arrangement is stable, and age greater, than at hollows of the 1-st and 2-nd orders. For hollows of the 3-rd order are dated in main meadow-chernozemic soils.

The formation of hollows of the 4-th and 5-th orders is connected to development of an erosive network and relief of territory of preserve. The hollows of the 4-th order are characterized by depth 2-5m, width 20-50m, length 2-4km, area of catchment of 100-200 hectares; an annual superficial drain up to 300 thousand Í3. The chernozemic-meadow soils formed in conditions of additional humidifying (ground waters level - 3-4m) are dated for hollows of the 4-th order.

The hollows of the 5-th order are characterized by depth 5-7m, width 70-100m, length 0,5-1km, area of catchment up to 1000 hectares; an annual superficial drain up to 1,5 millions Í3. In outfalls of hollows of the 5-th order the meadow soils (ground waters level - 3-4m, plentyful additional humidifying) are formed.

In the closed and karst downturn on noegene clays and neogene-quaternary loams (ground waters level - 3-6m) the meadow-boggy soils are formed.

CONCLUSION

The differentiation of a soil cover of chernozemic steppes of a Zaurals plateau is determined in main lithologic-geomorphological conditions. The following mechanisms of differentiation of a soil cover are characteristic of preserve territory: differentiation of mineralogical composition and humidifying (for a high-water bed), striped (for erosive-water-accumulative and denudative-accumulative surfaces) and lithogenic (for little-nipples and accumulative-denudative surface).

Now it is accepted to count, that the study of soil cover structure (SCS) includes study of "sets of all monotonous heterogeneities of soil cover", study "of the certain system-organizational relation" and "histories of development created SCS of processes" (Fridland, 1984). At the same time, from experience of the system analysis (Geological bodies, 1986) it is known, that the system structure is special case of its organization. In common case a organization of system is understood: an internal order of system, set of processes and actions leading to a coordination of interactions of its parts. With reference to a soil cover, as it is possible to

speak to system, about its spatial organization (common SSC), functional organization (interaction of system parts) and temporary organization (history of development).

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