

THE PEDOGENETICAL FACTORS OF SOIL IN THE HILLY AREA OF THE MIDDLE PRUT FROM THE REPUBLIC OF MOLDOVA

Olesea COJOCARU

State Agrarian University of Moldova, 44 Mircesti Street, Chisinau, Republic of Moldova

Corresponding author email: olesea.cojocaru@bk.ru

Abstract

This article shows that pedogenesis factors of soils in the village Negrea, Hancesti district are typical for our area from point of view of relief, climate, solification rocks, peculiarities of soil cover and its use in agriculture. The main factor that ensured diversity of soil units in the area of Middle Prut is soil erosion. The object of study occupied the northeast and the middle of the agricultural land of the village New Negrea. Approximate distance from the village New Negrea to the main cities is as follows: Hancesti - 23 km, Chisinau - 60 km. One peculiarity of rocks solification is the texture with a high content of fine sand (15-30%). As content of this fraction is not characteristic for loess deposits actual (Cerbari et al., 2010; Cojocaru, 2015). The soils on the slopes are affected by denudation and evolve through pedogenesis compensation - denudation, in the sense that relatively long period going slow denudation; there is also a certain development of soil in the depth, pedogenesis thus compensating, at least partial denudation.

Key words: *pedogenesis factors, erosion, soil, solification, Middle Prut, Republic of Moldova.*

INTRODUCTION

Motto: „Most precious natural resource is undoubtedly - the soil” Jean Dorst. Soil is a natural formation that was born and evolves under the influence of the natural conditions of vegetation and environmental factors. The promoter of this concept, Dokuceaev showed that the soil is the result of the cumulative action of five natural factors, called *factors of solification* and of *pedogenetic factors*, these being: climate, rock, relief, living organisms (particularly vegetation) and during of evolution. In the conception of Dokuceaev the soil is a dynamic and complex system in which there is a permanent change in the composition, properties and energy. These changes represent the essence of soil formation processes. Factors of soil formation are natural components of the environment, by the action which is formed of soil cover the surface of our planet. Soil formation is the result of complex interaction what is happening between the upper part of lithosphere, biosphere, atmosphere and hydrosphere; and human activity (Cojocaru, 2015; Dimo, 1958).

All these factors are interrelated and have inspired pedogenesis processes that have led to the formation of the soil cover. Soil cannot be

created and cannot evolve if one of these factors cannot act on the pedogenesis. During time, through atmospheric agents, hydrosphere and subsequently of the biosphere produces a series of phenomena of disintegration (crumbling) and alteration (changing the chemical composition).

Therefore the massive rock, hard, compact becomes loose, creating minimum conditions for plant growth and development, which means beginning the process of the soil formation.

Accordingly are formed a succession of horizontal layers, between themselves distinguished by color, thickness, structure, etc., forming the so-called soil profile. Developing soil profile is depending on the stage of evolution, the intensity of the action of the soil formation factors etc. (Cojocaru et al., 2013).

MATERIALS AND METHODS

The perimeter of investigated soils is bordered in the middle of the accumulation basin of the rivulet Lăpușnița and it is typical for the whole totality of reception basins, formed as a result of fragmentation of erosion processes of the

high terraces of the Prut River and its tributaries on the left.

The pedogenesis factors of catchment basins in the hilly region of the Middle Prut were studied within the reception basin "Negrea".

RESULTS AND DISCUSSIONS

Of hydrographic network development is conditional decisively on relief that in the case of the reception basin "Negrea" presents a complex character with different structural forms. Relief of soils of the village Negrea, Hancesti district is varied. In the nature of the modeling the landscape is determined by the joint action of internal factors (endogenous) with the external factors (exogenous), on the terrestrial crust with permanent trend of balance between the forces and the intensity with which the two categories of factors acting (Guide to Climate of the USSR, 1965, 1968).

Relief conditions in our country, the climate and soil, to which are added anthropogenic influences, have triggered a strong process of erosion, with serious consequences on production potential.

Erosion is manifested intensively in various forms, as a destabilizing factor of the ecosystem where acts causing environmental pollution respectively (Cerbari et al., 2013; Cojocaru, 2015; Dimo, 1958; Guide to Climate of the USSR, 1966).

Climate acting on the solification through precipitations and temperature, but also its other elements: wind, atmospheric humidity, sunburn etc. The climate influences the formation of soil organic part. It creates conditions for the development of vegetation, which is the source of soil organic matter. Humification occurs under the influence of conditions determined by climate. Order to illustrate the influence of different climates on the solification, we can give as an example the formation of clay minerals. The period solar in research area (sunny days) is 290-310 days, during insolation varies between 2050-2150 hours. The average annual temperature is 9.5⁰ on the surfaces of the ridge and 9.0⁰ in the bottom of the ridge slopes.

The amount of active temperatures above 10⁰ the territory of Republic of Moldova varies from 3000⁰ on the crests up to 3100⁰ at the foot

of the slopes (Guide to Climate of the USSR, 1965, 1966, 1968).

According to research conducted reception basin "Negrea" is located in the temperate zone and is characterized by a moderate continental climate, warm, semi-humid. The difference in altitude and latitude causes a slight variation of the majority of climatic parameters from the witnesses the erosion in the upper of basin and leading to valley of the river Lăpușna (Cojocaru, 2015; Condorachi, 2005).

One of the most powerful factors having a role in pedogenesis is represented by *microorganisms*, represented by plants and microorganisms. Microorganisms are responsible nature of mineralization in the greater part of the organic material that it transforms CO₂. The organic material remained and that is not easy mineralized is incorporated into humus (this principle can be used successfully for bioremediation). Considering the mentioned transformations, many processes can be developed based on the action of microorganisms involved in the natural process recycling of carbon (Chaudhry et al., 1988; Cookson et al., 2007; Kirchner et al., 1993).

Humus is decomposed organic matter in the soil, which we find to a depth of 20-30 cm. It insures the food to plants and he is a protective factor against disease due to the presence of medicines called fitoalexine, substances that for plants have a role similar antibodies. Not all soils contain the same amount of humus are soils very poor, which they recognize after their yellow-gray color, containing more than 2%, and rich soils, with black color, by more than 4.2% of humus (Davidescu et al., 1988; Dýúrak et al., 1995).

Vegetation determines not only the retention and accumulation of nutrients in the soil, but it participates in all processes leading to defining the main soil properties. During the vegetation period on the investigated soils in the village Negrea constitutes 180-185 days and during the period with the without frosts days corresponding 180-185 days. The thermal resource ensures the increase of a broad spectrum of agricultural crops (Cojocaru et al., 2013; Cojocaru 2015; Guide to Climate of the USSR, 1965).

In the process of pedogenesis a certain influence have and representatives of the fauna

in the soil. Microorganisms in the soil fulfilling a number of important functions in the transformation of substances and of energy in the soil formation process such as: the transformation of organic substances, formation of various simple salts from in the mineral and organic combination in the soil.

The negative aspect of climate is drought; its frequency is 2-3 times in ten years and torrential character of precipitates. During the summer the rarely fall rainfall longstanding with low intensity, which well moistened the soil and do not cause appreciable erosion.

The *solification rock* or parent rock is represented by rock parenting and parental material which on account is formed of the soil. It influences soil formation through its specific characteristics such as: gas raising status or of compaction, granulometric composition, mineralogy and chemical industries.

The components of solification rock influence over the composition granulometric, chemistry and mineralogy of the soils, of the physical, physico-mechanical properties, the system of air, heat and food. Depending on their origin, parental rocks can be: igneous rocks, metamorphic or sedimentary rocks. The terraces in the investigated area were formed during the Pleistocene, and represent a unique complex of relief in point of view of the genesis and lithology surface rocks, characteristic Plain Middle Prut. Solification and rock composition characteristics influence the process of pedogenesis, granulometry and level of fertility. Rocks of the soil formation on the investigated area are formed from the mixture loess deposits in the Pleistocene-Holocene ones of derivatives of the Pliocene-Pleistocene as a result of joining subterranean aeral global process of accumulation of loess deposits at local wind for land application of ancient alluvial deposits Pliocene he dusty sandy from the primary surface of denudation (Cojocaru, 2015; Bilinkis, 2004).

A peculiarity of texture of investigated rocks is the high content of fine sand (15-30%). As content of this fraction is not characteristic for loess deposits actual (Cerbari et al., 2010; Cojocaru et al., 2013). In the central part of the researched slope of the exhibition northwest on the sola located above the warehouse in the center of dale, rocks of solification sometimes

are are weak skeletal contain fragments of sandstone, showing the location of a shallow depths of the compact rocks.

In the dale in the center of the reception basin "Negrea" solification rocks consist of deposits of proluvial pedolit and on the glacises at the foot of the slopes - in the delluvial deposits of pedolit, washed down of the slopes (Figure 1).



Figure 1. Research on soil factors influence of solification on the soil in the hilly area of the Middle Prut

The *relief* is support that is produced of the soil formation. It acts in the formation, evolution and diversification of soil cover, particularly through the influence it exerts on other solification conditions, distributing the earth's surface precipitations, the heat and light. Reception basin "Negrea" is consists of the following relief items (Cojocaru, 2015):

- denudation primary surface (right atop the periphery of the Codri plateau) on the age Pliocene, raised in Pleistocene and situated parallel to the river course of Lăpușna;
- two elongated ridges that stemming from the witnesses of erosion, denudation situated on the primary surface (ridge ramification of the Codri plateau of Pliocene age) and end in the valley of Lăpușna;
- of the exhibition hillsides southeast and northwest of the basin;
- segment northwestern versant in the lower part of the reception basin, is fragmented by landslides;
- dry glen in the center reception basin (Figure 2).

Primary surface of denudation of Pliocene age, recently located at the highest altitudes (226-227 m) parallel the tributaries courses and Prut river, it was formed on the basis of Pliocene

alluvial plain, which occupies the entire territory of Republic of Moldova.



Figure 2. The presence of modification of the relief on the slopes in the village Negrea

At the end of the Pleistocene is distinguished gradually lifting of territory and unique river dividing into two big courses. This forms "Codri" Plateau and arises contemporary hydrographical network (Cojocaru et al., 2013; Cojocaru, 2015; Bilinkis, 2004).

The inclination relicts of primary surfaces of denudation are about 1°. Primary denudation surface are situated witnesses of erosion - two local heights linked together by a saddle from which it is starting glen of the hills.

Elongated ridges have the beginning of the witnesses of erosion, lying on the primary surface of denudation (peripheral summit of the Plateau of "Codri" in the Pleistocene age) and end - in the Lăpușna valley.



Figure 3. The beginning inclination of flat surface ridge varies within 1-2°

These represent the initial surfaces of high terraces of the river Lăpușna (of the Prut tributary), fragmented by erosion processes. The terraces are present along of the Prut and its tributary valleys. Terraces number varies from 5 to 8, which reached heights of 140 ... 190 m. The recent inclination of flat surface ridge varies within 1-2° (Figure 3).

Slopes of the northwest exhibition and southeast of peaks the upper reception basin is

characterized predominantly incline in 2-5° limits, which determine a manifestation of slightly soil erosion (Figure 4).



Figure 4. Variation of slightly soil erosion in the investigated territory

Inclination of the slopes in the middle and lower part of reception basin varies between 3-8° (Figure 5), which caused intensification of the big processes of soil erosion on these lands.



Figure 5. Intensification of the big processes of soil erosion in the Middle Prut

At the foot the slopes often a highlight glacises consisting of deposits of pedolit, washed down slopes. Linear erosion on these slopes is manifested by the formation of gullies. Parallel with roads, located on the slopes of the hill in the valley, were formed several wheel track cutting. On agricultural land on the slopes of ravines were not formed.

The segment of northwestern slope of at the bottom of investigated soils is fragmented by landslides as a result of the layered structure of surface rocks, the great inclination (up to 15°) of the surfaces in this part of the slope and medium energy of manifestation of the denudation processes.

The dried glen in the center of hilly area of the Middle Prut has the in the upper part width of the 20-30 meters and 50-60 m in the middle. In this part of the basin the surface inclination of glen varies within 1-2°.

In the bottom of the reception basin, where on the slopes are widespread of landslides, the glen evolved into a ravine with abrupt walls strongly fragmented (Cojocaru, 2015; Dimo, 1958). The

absolute altitudes by erosion witnesses are 226-227 m and the glen at the exit it's the river meadow Lăpușna - 62 m.

The depth of relief fragmentation is about 165 m. Relief energy of manifestation of denudation processes within the limit of reception basin is moderate.

Humans can change the the natural evolution of soil by agroproductive activity. Under the direct influence of the man, from the cultivation of the soil, the upper layers are homogenized, originally type of humus undergo significant changes. Reducing of herbaceous carpet by plowing are causes a decrease in structural stability; a reduction in humus content in nutrients; and degradation of basic elements through evapotranspiration. In case of replacements vegetation herbaceous with woody vegetation in lowland areas, are found a development of humus horizons, a return to the original shape of the structure, the elongation the upper horizons and the leaching of soluble salts is not desired and basically lead to deteriorating quality of soil.

Incorrect use of fertilizers leads to a decrease of harvest, how the important perturbations on soil properties:

- the fertilizers with nitrogen causing a accentuated acidification;
- the fertilizers with potassium applied without amendment determines a decrease in pH;
- of organic fertilizers applied irrationally can create nutrition imbalances, dejections from a zoo technical complex can create serious ailments of pollutant in the soil.

Time is the other aspect of how the objective existences of the soil cover which express the order they are irreversible happening processes occurring in the soil. Being a dynamic system that continually evolves to time, the linkages of researching time-sol were virtually identified with the study soil formation and evolution, including the rate of solification. Duration solification of soils called absolute age of the soil. For determine the absolute age of the soil is necessary to specify the time zero, ie of the moment of initiation of the pedogenetic process. The relative age intervenes when they do occur different stages of evolution of some soils, than the rest of the surrounding soils. Solification process is performed in a certain space (relief) and is developed a long period of

time, which varies depending on the mineral and chemical composition of the rocks, their porosity and pedogenesis intensity factors.

CONCLUSIONS

The primary surface of denudation of Pliocene age recently located at the highest altitudes (226-227 m) parallel affluents courses and of the river Prut, has been formed on the basis from Pliocene alluvial plain, which occupies the entire territory of Republic of Moldova.

The negative aspect of climate is drought; its frequency is 2-3 times in ten years and torrential character of precipitates. During the summer the rarely fall rainfall longstanding with low intensity, which well moistened the soil and do not cause appreciable erosion.

The relief influences the hydrological regime of the land and the amount of heat received by the sol is made conditional besides the latitude and season and slope and its exhibition.

A peculiarity of texture of investigated rocks is the high content of fine sand (15-30%). As content of this fraction is not characteristic for loess deposits actual.

Elongated ridges have the beginning of the witnesses of erosion, lying on the primary surface of denudation (peripheral summit of the Plateau of "Codri" in the Pleistocene age) and end - in the Lăpușna valley.

In conclusion, we can accept that the formation and evolution of soils, most important have climatic factors characterized by conditions of temperature and moisture, they are linked to water and the thermal regime of soils and biological processes.

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