LITHOGENESIS AND HYDROGENESIS IN PĂDUREA CRAIULUI MOUNTAINS

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Abstract

One of the most important pedogenetic processes, as lithogenesis and hydrogenesis, lead the evolution of soils from many mountain areas. The researchers were performed on a slope located in the northern part of Pădurea Craiului Mountains of the Romanian Western Carpathians. The soil sequence includes Cambisols located in the upper part of the slope (P1) and Stagnosols located down slope (P2). The studied soils were characterized by the aim of micromorphological, physical and chemical analysis. The data showed that lithogenesis lead the evolution of the soils located in the higher part of the slope, throughout Districambosol Litic (SRTS-2012), very acid (pH 4.75 – 4.95), but with a low content of Al (1.17 – 2.03 me/100 g soil) due to the location on the landscape. The weathering of the rock fragments present in all the profile horizons was influenced not only by the microorganisms and roots exudates, but also by the mezofauna (activity and coprolites). The hydrogenesis lead the genesis of the soils located on the lower part of the slope throughout Stagnosols Albic Clinogleic (SRTS-2012), generating many types of redoximorphic features. Hydrogenesis, together with the acidity of the parent material leaded the soil pedogenesis through an acid and hydromorphic soil with a low and specific biodiversity.

Key words: lithogenesis, hydrogenesis, micromorphology, biodiversity, Pădurea Craiului Mountains

INTRODUCTION

The lithogenesis is a process that influence (by weathering of rock and accumulation of weathered material) the soils and further the landscape.

Lithogenesis strongly influence especially shallow soils with a high quantity of skeleton (rock fragments).

The hydrogenesis is the pedogenetic process characterize by periodically wet favoring the concretion and the bleaching of soil matrix showing degradation and leaching of soil components.

Vlad L. et al. (1988) studying the chemical characteristics of different stages of the evolution of some soils, named the most degraded stage (due to stagnogleization) „podzol of hydrogenesis".

The paper emphasized the main important pedogenetic processes, as lithogenesis and hydrogenesis, which lead the evolution of some soils from a slope of Pădurea Craiului Mountains.

MATERIAL AND METHOD

The researchers were performed in the northern part of Pădurea Craiului Mountains of the Romanian Western Carpathians. The absolute altitude is ranging from 537 m (in the higher point of the slope) to 420 m (in the lower point of the slope); while the mean annual temperature is 6 - 8^{o}C and the mean annual precipitation is 680 mm. The land use is meadow.

The soil sequence includes: Cambisols (Districambosol Litic - SRTS-2012; Dystric Cambisol - WRB-SR) represented by P1 located in the upper part of the slope; Stagnosols (Stagnosol Albic Clinogleic – SRTS-2012), Stagnosol Albic - WRB-SR) represented by P2 located down slope.

The studied soils were characterized by the aim of micromorphological, physical and chemical analysis.

For the micromorphological research, undisturbed soil samples were air drayed and impregnated with epoxidic resins and prepared thin sections (25 - 30 μm), which were studied with the Documator (20 X) and the optical microscope (50 - 500 X) in PPL and XPL. The terminology used was from according to Bullock et al. (1985).

The chemical and physical characteristics of the soils were analyzed according to the ICPA Methodology (1987).

RESULTS AND DISSCUSIONS

Pădurea Craiului Mountains are sculptured in limestone. The studied site is an island composed of acid rocks (sandstones, etc.) located in a massive of limestone, with karst topography (Răducu D. et al., 2012). One of the most important pedogenetic processes, as lithogenesis and hydrogenesis, lead the evolution of soils from the researched site in Pădurea Craiului Mountains.

Lithogenesis

The depth and the lithology of the parent material had a considerable

influence on soil forming process, leading the pedogenesis through the formation of a specific soil type Districambosol Litic, very different of the surrounding soils formed on limestones.

The Districambosol was characterized by the aim of P1 data (Districambosol Litic - SRTS-2012; Dystric Cambisol - WRB-SR) located in the upper part of the relief.

The character and chemical composition of the parent material plays an important role in determining soil properties, especially during the early stages of the soil pedogenesis. The rock fragments are very frequent in soil horizons. According to their mineralogy, the rock fragments strongly weathered and favor the secondary clay minerals formation (Fig. 1). Due to the peculiarity of the soil profile environment, mainly to the acidity, the secondary clay minerals are not stabile.

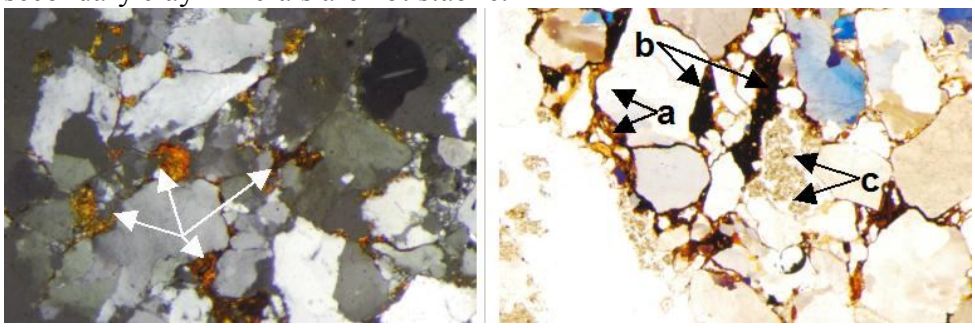

Fig. 1. A skeleton grain strongly weathered: 1) secondary products compose of clay±Fe (➔), N +; 2) weathered (a) fungi in the fissures (b) and mezofauna coprolites in the cracks (c), N II.

It is well know that the weathering of the rock fragments is influence by the microorganisms and roots exudates. The contact of the fungi with the weathering zones of the rock fragments strongly influence the weathering process (Fig. 1).

The micromorphological study of the thin sections of P1 clearly showed many rock creaks filled with small, reddish organo-mineral coprolites produced by mezofauna (Fig. 1). This pointing out that not only microorganisms and plant roots influenced the weathering by the exudates produced, but also the soil mezofauna (activity and coprolites).

The mezofauna coprolites in the cracks favor microorganism development which further initiate or accelerate the weathering process.

The weathering intensity depends also, on the climate and on the weatherability of the rock fragments (more specific the weatherability of the minerals present in the rock fragments).

Although lithic and with a high quantity of skeleton in all the pedogenetic horizons, the small quantity of the cations released by weathering are not able to buffering the soil reaction which is strongly acid

in all horizons of the soil profile, the pH ranging from 4.75 to 4.95. The position of soil profile in the upper part of the relief, the climate conditions and the soil texture favor the leaching of the small quantity of bases resulted from weathering, downward in the lower horizons or in the lower position of the relief.

In time, the leaching process increased the soil acidity, thus, the values of the sum of exchangeable bases (SB) are extremely low, being under the lower limit of the inferior class „very low" (4 - 8 me/100 g soil - Metodologia ICPA, 1987) and raging from 2.46 to 4.11 me/100 g soil.

The rapid leaching of the products resulting from weathering is also showed by the small quantity of Al (too low for the soil acidity), with the values ranging from 1.17 - 2.03 me/100 g soil. The biggest value (2.03 me/100 g soil) of the Al is in the Bv horizon, were the weathering is high.

The base saturation degree (V %) showed values lower than 53% (representing diagnostic character for Districambosols). In this respect, the V% is 32.85% in the upper horizon and decrease at 30.94% in the deeper one. The lower value (24.37%) of V% is in the cambic horizon. According to the degree of the base saturation, the soil is oligomesobasic-oligobasic.

Part of the soil acidity is buffering not only by soil, but also by soil organisms: by roots which recycles nutrients from the lower to the upper layers and also by soil fauna which transported soil material from deeper horizons (rich in leached products) to the upper one.

The lithogenesis lead the genesis of the soils (on the higher part of the slope) throughout a Districambosol Lithic, with a high acidity and influence either the vegetation or the soil life.

Hydrogenesis

The soils formed in the lower part of the slope was characterized by the aim of P2 data (Stagnosol Albic Clinogleic - SRCS-2012); Stagnosol Albic - WRB-SR).

The ground water, which came, by pressure, from the limestone area, influenced the soil genesis and evolution. Due to its permanent lateral movement into the soil profile, strongly affected soil by „clinogleyisation" and mobilization of the plasmic material, generating many types of depleted pedofeatures and redoximorphic zones at the surface of the peds, as well as the segregation of sesquioxides, generating many types of amorphous pedofeatures inside of the peds (Fig. 2).

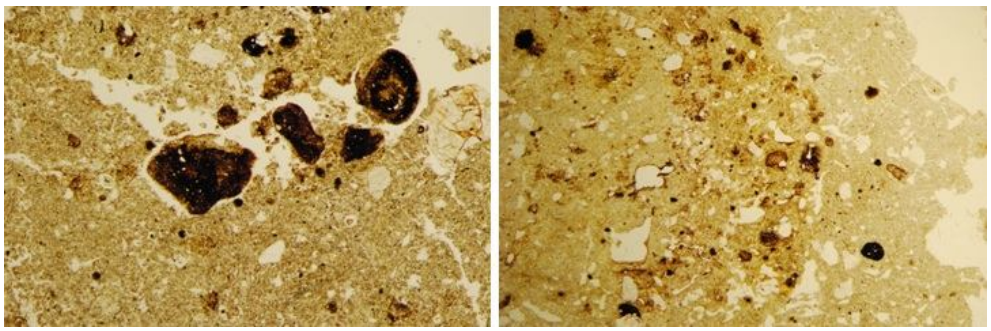

Fig. 2. Redoximorphic features: 1) nodules; 2) oxihydroxides concentrations inside the peds (a) and redoximorphic zone at the surface of the peds (b). N II.

Even if the water table arising from the limestone, do not have a high influence on the profile reaction that still remains moderate acid, with the pH values ranging from 5.13 - 5.76. The exchangeable Al was detected in a very low quantity (1.01 - 1.79 me/100 g soil) only in the upper part of the soil profile (with lower pH values).

The exchangeable bases (SB) are very low, raging from 6.17 to 6.38 me/100 g soil, while the base saturation degree (V %) is 44.69% in the upper horizon and increased to 56.46% in the deeper one.

The hydrogenesis lead the pedogenesis of the soils located on the lower part of the slope throughout the formation of Stagnosols Albic Clinogleic.

On the general background of a moderate acid soil, with low content of organic matter (2.80%) and saturated with water for a long period of time during the year, the biodiversity is low and composed manly by the specialized species (either vegetation, microorganisms or soil fauna).

CONCLUSIONS

The researchers proceed on the lithogenesis and hydrogenesis of some soils from Padurea Craiului Mountains, lead to few important conclusions:

The lithogenesis lead the genesis of the soils (located on the higher part of the slope) throughout the formation of a Districambosols Lithic, shallow, with a high quantity of skeleton and high acidity, which affect either vegetation or the soil life.

The weathering is influence not only by the microorganisms and roots exudates, but also by the mezofauna (activity and coprolites).

The hydrogenesis lead the genesis of the soils (on the lower part of the slope) throughout Stagnosol Albic Clinogleic, generating oxihydroxides pedofeatures and strongly influencing biodiversity.

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