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NOTIONS REGARDING THE RELATION BETWEEN LANDFORMS AND SOIL IN THE EASTERN AND NORTH-EASTERN REGION OF THE ROMANIAN PLAIN

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Abstract: The present study aims at rendering the way the geomorphologic features of the eastern and northeastern regions of the Romanian Plain, influenced by the subsidence movements, is reflected in the soil cover. For its achievement, there was used Romania Soil Map, 1:200 000 scale and field mapping, inventorying the soil cover at the level of class, type and, partially, subtype.
In the mentioned area located between the Argeş and the Siret, besides the soils (chernozems, phaeozems, reddish preluvosols) the genesis of which is triggered by the bioclimatic conditions characteristic to steppe, forest steppe and nemoral zone, there also develop soils with azonal and intrazonal character.
Thus, the presence of large floodplains imposed the noticeable extension of the soils developed on recent fluviatile deposits (alluviosols). At the same time, the altitude and reduced relief intensity impose an increased phreatic level, which is mineralized in many areas and, consequently, certain soils are affected by hydromorphism (Gleysols and gleyic subtypes) and salinization (solonchaks and salinic subtypes, solonetz and alkalic subtypes). Another characteristic of the studied region is linked to the presence of certain soils buried under alluvial and proluvial deposits.
The calculation of the topographical-pedogenetic index (Florea, 1997), as a rapport between non-zonal and zonal soils, emphasizes the pregnant influence of the local conditions from the Buzău and the Lower Siret subsidence plains compared to a series of higher plains (Râmnic, Galaţi).
Key words: zonal soils, non-zonal soils, phreatic aquifer, salinization, buried soils, subsidence plains.

Rezumat: Noţiuni privind legatura dintre relief şi sol în regiunea estică şi nord-estică a Câmpiei Române. Studiul de faţă are ca scop interpretarea modului în care caracteristicile geomorfologice ale regiunilor estice şi nord-estice ale Câmpiei Române, influenţată de mişcările de subsidenţă, este reflectat în învelişul de sol. Pentru realizarea acesteia, s-a folosit Harta Solurilor României, scara1: 200.000 şi cartarea de teren, inventariind învelişul de sol la nivelul clasei, tipului şi parţial subtipului.
În zona menţionată, situată între Argeş şi Siret, în afară de soluri (cernoziomuri, faeoziomuri si preluvosoluri roscate), geneza lor este declanşată de condiţiile bioclimatice caracteristice stepei, silvo-stepei şi zonei nemorale; se dezvoltă de asemenea soluri cu caracter zonal şi azonal.
Astfel, prezenţa unor câmpii de umplere a impus expansiunea notabilă a solurilor dezvoltate pe depozite fluviatile recente (aluvisoluri). În acelaşi timp, altitudinea şi intensitatea redusă a reliefului a impus un nivel freatic ridicat, care este mineralizat în multe zone şi, în consecinţă, anumte soluri sunt afectate de hidromorfism (gleisolurile şi subtipurile gleice) şi salinizare (solonceacuri şi subtipuri salinice; soloneţuri şi subtipuri alcalice). Altă caracteristică a regiunii studiate este legată de prezenţa anumitor soluri îngropate sub depozitele aluviale şi proluviale.
Calcularea indexului topografic- pedogenetic (Florea, 1997), ca raport între solurile azonale şi zonale, accentuează influenţa pregnantă a condiţiilor locale de la subsidenţa câmpiilor Buzăului şi Siretului Inferior faţă de serii de câmpii mai înalte (Râmnic, Galaţi).
Cuvinte cheie: soluri zonale, soluri azonale, acvifer freatic, salinizare, soluri îngropate, câmpii de subsidenţă.

1. Methodological principles, location

For the plain region located between the Argeş and the Siret rivers, neotectonics emphasized by an active subsidence, may be reflected in pedogenesis through the extension of recent fluviatile deposits, as well as through the development of small areas with shallow and frequently salted phreatic aquifers.

In terms of general bioclimatic conditions, zonal soils (unconditioned by local pedological factors) from the Romanian Plain located east of the Argeş River are represented by chernozems, phaeozems, reddish preluvosols, characteristic to stepped, forest steppe, and nemoral zone (plain forest). Within this bioclimatic framework, relief (through the development of subsident sectors) generates characters of intrazonality and azonality reflected by soil cover.

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This phenomenon is conditioned by the presence of certain large floodplains and of sectors with shallow phreatic aquifers.

Starting from this premise, we have inventoried the soil cover at a taxonomic level (S.R.T.S., 2003) of class, type, and subtype (partially) on the basis of Romania soil map, scale 1:200 000, and of field surveys in 15 sites.

Within subsidence plains, the influence of relief in pedogenesis is manifested in several ways:

-low relative altitude and reduced fragmentation keeps phreatic level increased (0-5 meters); phreatic water becomes the main pedogenetic factor determining the development of gleyzation processes combined with the salinization and alkalinization ones in the areas where the water table is mineralized;

- subsident areas represent local base levels, which polarize the drainage system and determine alluvia discharge on large surfaces;

- the extension of floodplains or of alluvial fans characterized by the presence of soils in their incipient evolution phase (alluviosols) located above the buried zonal soils.

In order to render the transformations imposed to pedogenesis by the relief factor, we comparatively analysed, together with the subsidence plains (Titu-Sărata, Buzăului, Siretului Inferior), the other genetic types of plains located between the Argeş and north of the Siret, at the contact with the sub-Carpathian hills (hilly plains – glacis and piedmont plains) and at the limit of the subsidence area (terminal-piedmont, tabular, terrace plains etc.).

These plains are: Târgovişte-Ploieşti, Istrița, Vlăsia, Brăila, Central, Southern Bărăgan, Mostiştea, Râmnic, Lower Siret, Buzău, Galați. The subsident area extends from the Argeş River to the Siret River, its width varying between 5 (in the central and eastern sector of the Titu-Sărata Plain) and more than 50 kilometers (in the Lower Siret Plain).

2. Results and discussions

The issue of the soils influenced by the phreatic level. The shallow phreatic level determines the development of certain hydromorphic soils; the ones displaying a strong hydromorphism (phreatic level below 1.5 meters) are included to hydrisols – Gleysols (typical, cernic, salinized), while those with a less intense hydromorphism (phreatic level between 2 and 5 meters) are gleyic subtypes of other soils (alluviosols, chernozems and phaeozems, solonchaks); in their proximity, within drier areas, chernozems and phaeozems display a humid phreatic character.

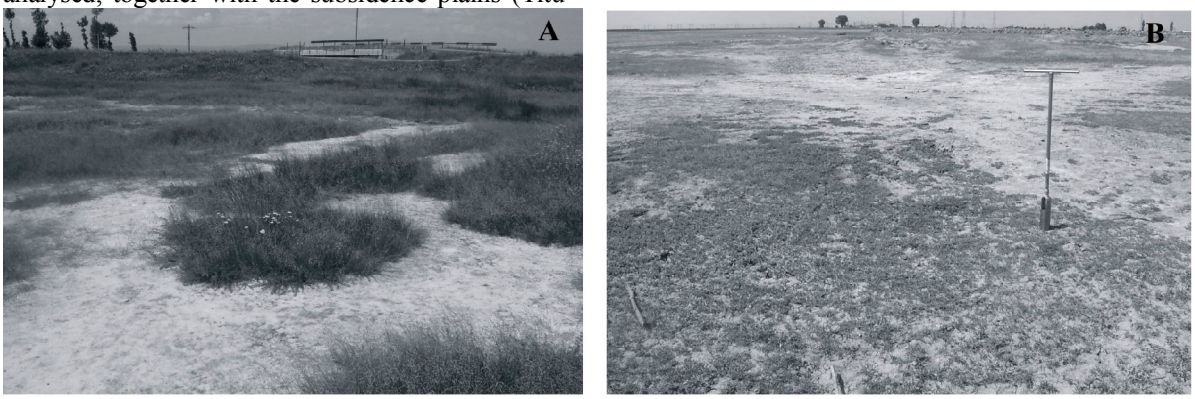

Photo 1 – Powders of easily soluble salts at the surface of certain solonchaks from the northeast of the Titu-Sărata Plain, Săhăteni settlement (A) and from the Buzău Plain, northeast of Surdila-Greci settlement (B)

Photo 2 – Salinized entic alluviosol within the Buzău Floodplain (the Buzău Plain)

Intense mineralization of the phreatic water in certain sectors and the exudative moisture regime determine the development of some soils affected by salinization, either at the type level (solonchaks and solonetz belonging to Salsodisols class) or subtype level (salic or alkalic subtypes of alluviosols, chernozems, Gleysols). Salsodisols cover the areas where mineralized phreatic water is located above the critical soil salinization depth (2 – 3.5 meters).

Representative areas with salt-flats, predominantly solonchaks, are located in the northeast of the Titu-Sărata Plain (Photo 1 A) and in the Buzău Plain, especially in its southern part, but also in the north (Photo 1 B). Together with

solonchaks, within the Buzău Plain, there frequently develop salic subtypes of alluviosols, even of those emerging on recent levees (photo 2).

The soils the genesis of which is influenced by the accumulation of easily soluble salts are used for low productivity meadows; there grow small graminaceous plants e and bushes of *Artemisa sp.* In the areas where salts precipitate at the surface, vegetation misses, whitish spots emerging (popularly called *chelituri*). These areas are delimited by clusters of *Salicornia herbacea* that have a reduced coverage degree.

Salinic entic alluviosol from the Buzău Floodplain (located at about 300 meters north of the relatively flat contact pointed through a dislevelment of 4-5 meters between the Brăila and Buzău Plains) displays finely stratified alluvial material in the first 20 centimeters, with sequences of less than one centimeter (especially in the first 10 centimeters).

At the surface, the material that is finer (clayish sand to sandy clay) than the rest (sandy-clayish texture) forms polygonal squames (limited by cracks) that display salt powders. Along the rest of the profile to the depth of 60 centimeters, alluvium has a more compact character and presents oxidation spots, as well as reduction spots (weakly green colours) at the base, induced by the oscillation of the phreatic level, located at more than one meter depth.

In the western part of the Lower Siret Plain (in the area of Corbu Nou-Gulianca settlements), on a higher sector overlapped on the ending parts of the piedmont fans of the Râmnic River, there appears an area (more than 5,000 hectares) with typical solonetz (in the central and western part of the area), as well as northwards and eastwards, where the soils are influenced by the phreatic aquifer (moist phreatic, gleyic, salinic).

They are used for low productivity meadows dominated by *Salicornia herbacea.* The presence and spatial distribution of these solonetz supposes a desalinization of the solonchaks and, consequently, a lowering of the phreatic level (linked to the active subsidence characterizing the confluence between the Buzău and the Siret rivers).

Northwards, in the area of Latinu-Voineşti settlements, at the confluence of the Buzău with the Siret, phreatic level is higher being located at less than 0.5 meters depth and, seasonally, water stagnates at the soil surface. Here, alluviosols display a swampy character and they are used for rice crops, but under irrigation (Photo 5 A, B).

The issue of unevolved soils within floodplains. Within subsident areas, there occurs important alluvia discharge (sand, clay, silt) on large surfaces (Photo 3). Rivers form large meanders and they exceed their bed during floods. In the floodplains, there develop alluviosols, inclusively entic ones (incipiently solified alluvia), which sometimes have gleyic, salinic or sodic character.

Photo 3 – Alluvia accumulations at the confluence between the Buzău and the Siret

The most representative sector from this point of view is the Lower Siret Plain, which corresponds to the floodplain and floodplain terrace at the surface, while in the fundament, to the area of maximum subsidence. Here, the alluvial plain (that includes the floodplain terrace and the floodplain) is more than 20 kilometers wide and alluviosols cover large surfaces (61%).

Photo 4 – The contact between the Brăila Plain and the Lower Siret Plain within the perimeter of Muchea settlement

Immediately after Muchea settlement located in the north of the Brăila Plain (Northern Bărăgan), at the foot of the Danube's terrace scarp, at the contact with the Siret divagation plain, phreatic level is at about one meter depth. Here, on the floodplain terrace of the Siret, alluviosols (Photo 4) display gleyzation marks at the base of the profile (gleyic alluviosols). As mentioned before, at the confluence of the Buzău with the Siret, the water seasonally stagnates at the soil surface. There developed alluvic Gleysols (on recent fluviatile deposits) used for rice crop under irrigation (Photo 5 A, B).

The issue of buried soils. The passage between the hilly plain (glacis and piedmont plain) and the subsidence plain is marked by a slow modification of slope and the appearance of a line of phreatic discharge from the alluvial fans.

This phenomenon brought to the burying of the zonal soils (frequently chernozems) developed at the contact between the two genetic types of plains by alluvial-proluviale deposits. Presently, these soils are buried and fossilized by a new generation of alluviosols.

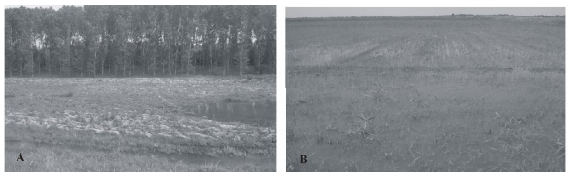

Photo 5 A, B - Swampy alluviosols at the confluence of the Buzău and the Siret rivers, in the area of Latinu-Voineşti settlements. Phreatic water stagnates at the soil surface.

Buried soils were identified in the following locations: Fântânele (photo 6 a), at the contact with the glacis plain of Istrița and the subsidence plain of Sărata, within the Bălana stream floodplain; Nicoleşti (photo 6 b), between the piedmont plain of the Râmnic and the Lower Siret subsidence plain. At Fântânele, the buried A mollic horizon displays its upper limit at 60 centimeters (low-depth buried soil), at about 250 meters away from the right bank of the Bălana stream.

At about 50 meters north-eastward (towards the sub-Carpathians hills) of the profile area (about 300 meters of the right bank of the Bălana stream), the A Mollic horizon has the upper limit at 30 centimeters (depth determined by means of pedological sampler) and, at about 400 meters of the right bank of the Bălana stream, the A Mollic horizon appears at the surface as chernozems characteristic to this region.

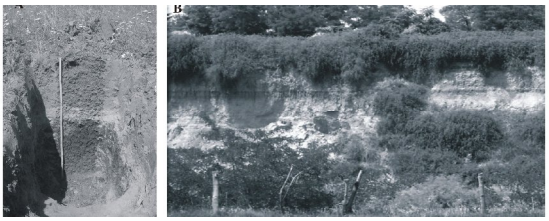

Photo 6 – Buried soils in the area of Fântânele settlement (A). It may be noticed a dark horizon on the soil profile resulted from an A mollic horizon of chernozems covered by alluvia. Buried soils in the perimeter of Nicoleşti settlement (B)

3. Conclusions

The comparison of the share of the soils located within floodplains (alluviosols with different subtypes belonging to Protisols class) and influenced by phreatic water (solonchaks and solonetz belonging to Salsodisols class and Gleysols from the hydrisols class) from the Lower Siret Plain and the Buzău Plain (within these two plains there are to be found most of the subsident sectors) with a series of plains located out of the subsidence area reflects the above mentioned issues very well.

Fig. 1 – After the interpretation of *Romania Soil Map, scale 1:200 000,* the Romanian Geology Institute, Bucharest (computerized cartography Săvulescu I., Faculty of Geography, the University of Bucharest).

In the second category, there were included the hilly plain of Râmnic and the Galați Plain (Table no. 1), with large plateau-like interfluves and terraces, which display the same climatic conditions as the steppe and forest steppe regions (characterized by the extension of Cernisols class).

Table 1.
Share (%) of non-zonal soils within floodplains and sectors with shallow phreatic aquifers. Comparison between the Siret-Buzău subsidence plain and a series of higher external plains (Râmnic and Galați)

SOIL CLASS	Buzău Plain	Lower Siret Plain	Râmnic Piedmont Plain	Galați Plain
CERNISOLS	31	17	89	88
PROTISOLS	34	61	9	10
SALSODISOLS	32	11	1	1
HYDRISOLS	3	11	1	1

At the same time, analyzing at the level of taxonomic type and subtype the distribution of soils within the East and Northeast Romanian Plain (east of the Argeş), one may notice the extension, within the subsidence plains (Titu-Sărata, Buzău, Lower Siret), of the soils the genesis of which is

influenced by other pedogenetic factors not by the bioclimatic conditions specific to the region. Such soils are considered non-zonal (fig. 1). Their genesis and evolution, as previously emphasized, is imposed by the depositing of alluvial materials within floodplains and by the high phreatic level (either mineralized or not).

Table 2.

Topographic-pedogeographical index (It). Comparison between the Siret-Buzău subsidence plains and a series of higher external plains (Râmnic and Galaţi)

It	Buzău Plain	Lower Siret Plain	Râmnic Piedmont Plain	Galaţi Plain
value	2.23	4.88	0.12	0.14

In order to better emphasize this situation, one may calculate a synthetic index, called the topographic-pedogeographical index (**It**), as a rapport between non-zonal soils (intrazonal and azonal) and the zonal ones (influenced by the bioclimatic conditions). This index (Florea, 1997) was calculated for the soils within the Buzău, the Lower Siret, the Râmnic, the Galaţi plains.

The lowest the value of this index is the lowest the share of non-zonal soils is (Table no. 2). The highest value was registered for the Lower Siret Plain (4.88).

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