PEDOGENETICAL PROCESSES CHARACTERISTIC TO THE PERESCHIV CATCHMENT - TUTOVA ROLLING HILLS

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Abstract. The soil cover patterns from the studied area emerged from the action of the climatic conditions, local distribution of the vegetation cover but also a slight elevation ratio induced by the relief. According to the soil map of the Pereschiv catchment, they identified 13 soil types, which belong to 7 classes. At first glance it is observed the prevalence of cernisols which occupy 40.62% of the territory (9450 ha), luvisols (25.07%, 5830 ha) and protisols with slightly more than 5275 ha (22.67%). The soils formed under the anthropic influence (anthrosols) occupy 2196 ha (9.44%). On small areas the hydrisols (203 ha, 0.88%), salsodisols (129 ha, 0.55%) and pelisols (76 ha, 0.33%) may occur.

The main pedogenetical processes resulting in the pedogenetical horizons formation are the bioaccumulation, argillisation, illuviation, carbonatation and decarbonatation, gleysation, surface-water gleysation, salinisation, alkalization and the vertic processes etc.

The improper human activity, mainly the up and down hill farming and inadequate road network resulted in a significant soil and land degradation especially through the development of soil erosion, gulling and to a lesser extend of landslides all with a negative effect on soil cover by destroying the soil horizons, humus removal, soil fertility loss .

Keywords: *pedogenetical process, pedogenetical horizon, soil cover, rolling hills area*

1. Introduction

Spindle–shape in form the Pereschiv catchment is located in the Tutova Rolling Hills, Southern Moldavian Plateau, Eastern Romania and covers 23,267 ha.

Sandy - clayey Miocene-Pliocene layers with a gentle dipping of 7-8 m/km NW-SE have outcropped from the sedimentary substratum because of the erosion (Jeanrenaud, 1971).

Over the last two centuries, the native vegetative cover has been dramatically changed. Thus, the proportion occupied by forestland decreased from over 60% to only 12.2%. Conversely, the agricultural land has extended up to 80.3% and arable land up to 54.3% of the total basin area. At the same time, it is obviously the predominance of the row spacing crops such as corn, sunflower against close growing crops as winter wheat and rye (Niacsu, 2009b).

The improper human activity, mainly the up and down hill farming and inadequate road network resulted in a significant land degradation especially through the development of soil erosion (Ionita et.al., 2006, Popa, 1999), gulling (Radoane et al., 1995; Ionita, 2000) and to a lesser extend of landslides (Pujina, 1997).

The whole Tutova Rolling Hills area is a typical rural area, poorly developed, where over 90% of the active population is working in the primary sector. Actually, this region deals with subsistence agriculture, described by very low yields. It is based on crop production resulting in a high pressure on the soil cover. In these conditions, the soil becomes the most important local resource. Thus, the need to evaluate its capacity to support basic human activities in the area appears.

Two main objectives have been emphasized:

- The identification of areas affected by the main pedological processes characteristic to the study area and their degree of effectiveness intensity;
- The achievement of a GIS data base by mapping each pedological process.

2. The study area and the work method

Based on existing data represented by a series of soil studies conducted by OJSPA Vaslui, Bacau, Vrancea and Galati, has attempted a unified database for the entire Pereschiv river basin at scale 1:10.000, using TNTmips Software (MicroImages, Inc., 2008). After scanning, georeferencing and digitizing soil maps it started the verification and validation of each soil unit (U.S.). While they made a series of field trips that were aimed at the development of representative soil profiles, some of these won the benefits of complete analysis performed in specialized laboratories. The initial vector comprising around 2500 polygons has been simplified to 965 polygons grouped in 327 U.S. sites, taking into account the information field and the DEM, DEM-derived maps and the aerial photomaps. It was further moved to centralize data in a uniform basis of analytical soil data (physical, chemical indicators of soil erosion, etc.). Attached to each polygon, the database contains about 80 parameters directly obtained by analysis or indirectly by calculation. Subsequently, based on this information, they realized a series of thematic maps in digital form that presents synthetic the most important pedological features through the eyes both of the appearance and intensity of the pedogenetical processes which are characteristic for the studied area (Niacsu, 2009a).

3. Results and discussions

The main pedogenetical processes resulting in the formation of pedogenetical horizons are the bioaccumulation, argillisation, illuviation, carbonatation and decarbonatation, gleysation, surface-water gleysation, salinisation, alkalization and the vertic processes (Fig 1).

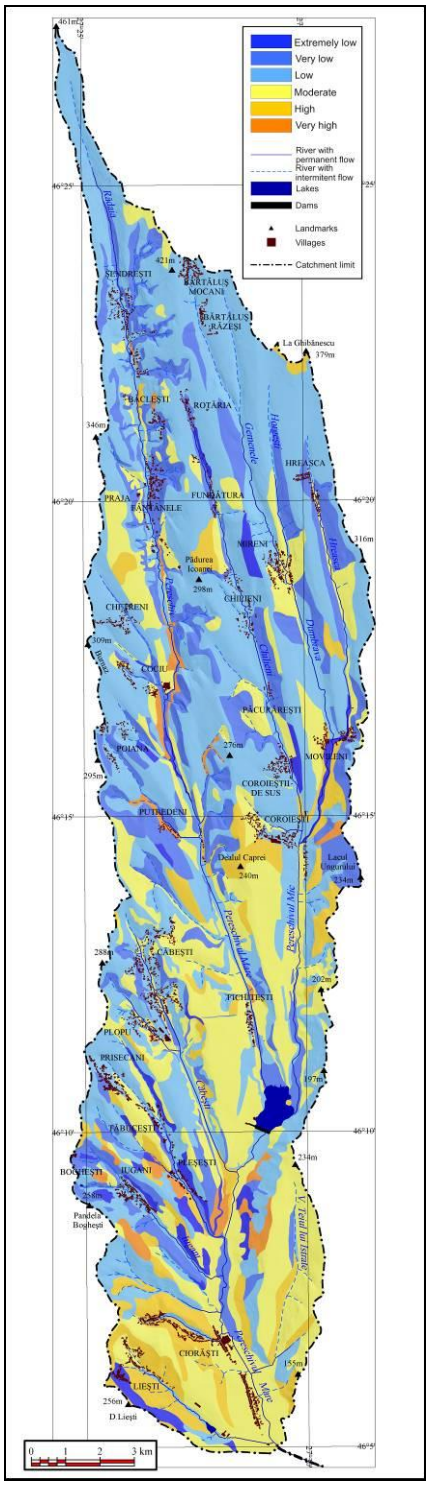

Figure 2 The humus reserve map

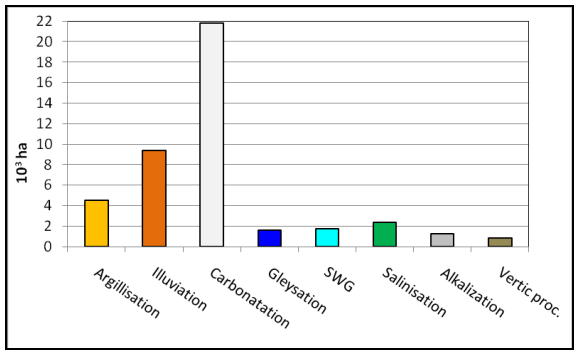

Figure 1 The occurrence histogram of the appearance of the main pedogenetical processes

3.1. The bioaccumulation

In the specific terms of the southern Moldova Plateau, the organic matter that accumulates at the A horizon level, succeeds to consistently humificate making that the humus reserve to be a true indicator of the intensity of bioaccumulation. In the southern basin, the dry climate and the forest steppe vegetation are optimal conditions for the formation of a calcium type of Mull humus (Fig 2). All of the chernozems and faeozems and the mollic subtype of entic luvosols is characterized by an intense accumulation framing class (high and very high) with a humus reserve value witch starts from 120 to 250 t / ha (Fig 3).

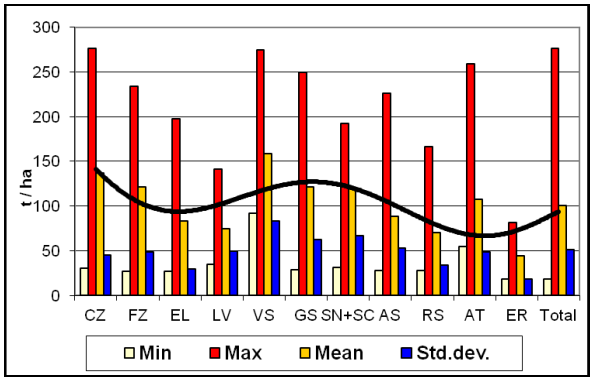

Figure 3 The average humus reserve for soils type

In the higher area from the center and north of the study area, where the higher rainfall values contributes to a relatively intense leaching of the minerals and humic substances, the forest vegetation produces organic matter harder to mineralize, resulting a forest type of the Mull humus. The lower value of the humus reserve (30-120 t/ha) is powerful influenced by the high development intensity of some geomorphological processes such as surface erosion. These values characterize the luvosols, entic luvosols, regosols and eroded anthrosols totaling about 60% of entire surface.

3.2. The argillisation is the transformation process that consists of clay enrichment of a pedogenetical horizon by "in situ" alteration of primary silicates, resulting secondary clay minerals. This process occurs both in the forest steppe and in the forest on well-drained parental materials where the decarbonatation is installed.

In all the studied area, this process takes place on rather large areas being associated with the bioaccumulation. The most important areas affected by the argillisation are present on the hilltops between the lower courses of Pereschivul Mic, Pereschiv and Tutova River (Fig 6).

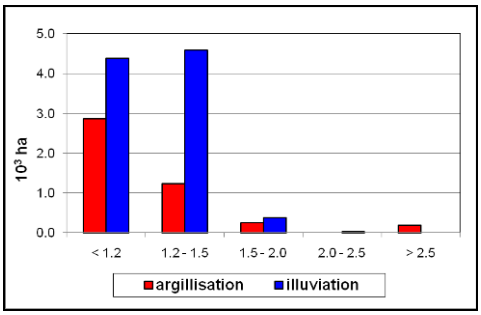

Figure 4 The area occupied by the argillisation and illuviation by classes of textural differentiation index (TDI)

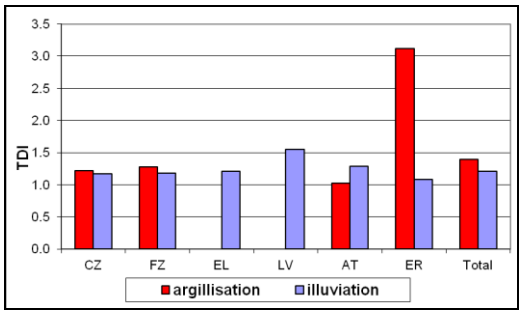

Figure 5 The textural differentiation index (TDI) by soils type

The argillisation occurs on about 4500 ha (19.8% of total) in the southern and central-southern of the catchment and is accompanied by an intense process of bioaccumulation (Fig 4). The characteristic soil types are represented especially by the chernozems and less faeozems. On relatively large areas, the soil erosion is installed in the profile of anthrosols and regosols.

3.3. The illuviation is a process by which the mechanical clay enrichment of the soil horizons is realized. The higher hilltops from central and northern catchment, developed on well aerated materials and under forest vegetation, present the best conditions for this process (Fig 6). Thus, the illuviation occupies over 9300 ha (40.34%) and usually is more intense northward, to a higher altitude. Due to the pedogenetical patterns, intensity of the process is generally weak. Thus, the textural differentiation index (TDI) is kept under 1.5 on 95.6% of the studied area that corresponds to undifferentiated and poorly differentiated textural classes (Fig 4).

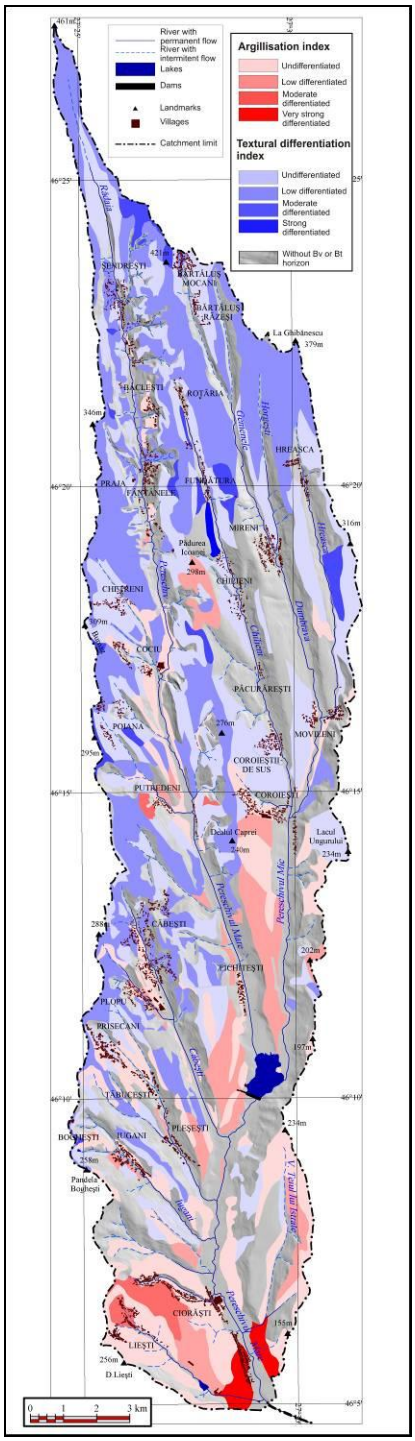

Figure 6 The illuviation and argillisation intensity map

Only 0.37% of the area presents a strong textural differentiation. The presence of the illuviation process and Bt horizon is specific for the luvisols (the entic and typic luvosols) on approximately 25.07% of the catchment, but also for some faeozems subtypes on 18% of the area (Fig 5). Although the Pereschiv catchment does not present a large altitude development, there is however a direct correlation between the average altitude of the soils units and the value of the differential soil texture (Fig 7). Opposite, the report values between the percentage of clay in the horizon Bv and parental horizon (argillisation index) decreases with altitude. Thus, the argillisation is replaced by illuviation.

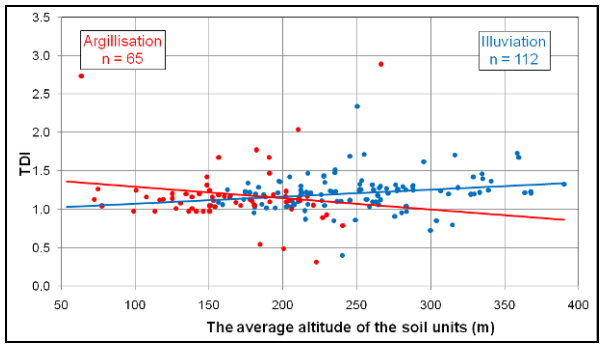

Figure 7 The correlation chart between the average altitude of the soil units and the average TDI

3.4. The carbonatation is one of the most widespread pedogenetical processes characteristic of the studied area (Fig 8). Overall, the process appears on 21,770 ha (93.6%) and over 41% of the affected area develops carbonated soils (Fig 9).

Usually, the younger soils formed under stable pedogenetical patterns contain large quantities of carbonates. While the pedogenesis evolves the soil profile becomes more structured and the carbonate leaching is more evident. This happens in altitude and to the north area. In the extreme southern, eastern and south-eastern of the region, on a loess deposits, with a slightly excessive climate and under a steppe vegetation,

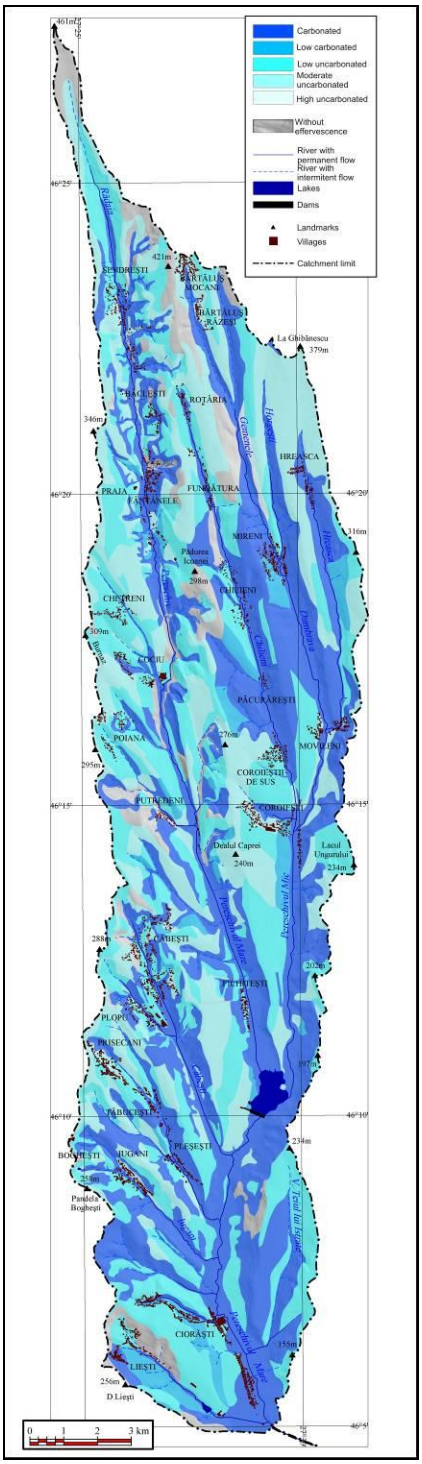

Figure 8 The depth of carbonates occurrence map

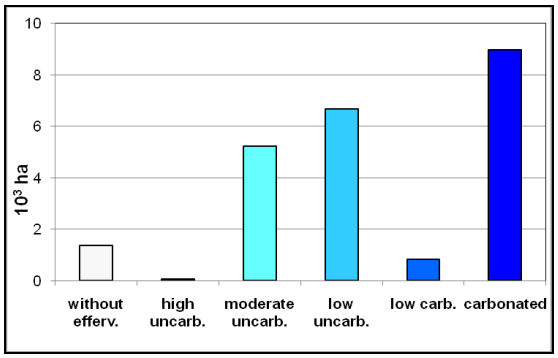

Figure 9 The areas histogram of carbonates occurrence classes

the carbonates accumulations can occur even from the ground surface.

As regards the average occurrence depth, on zonal soil types, the value increase with altitude, from 55 cm for chernozems (CZ), to 77 cm for faeozems (FZ), 98 cm to entic luvosols (EL) to 112 cm for luvosols (LV) (Fig 10). For others soils, the very close appearance to the surface and the high intensity of the process is related to the groundwater depth (gleysols, fluvisols, solonceaks), the intensity of soil erosion under natural conditions (regosols) or to the anthropogenic influence (eroded and typic anthrosols).

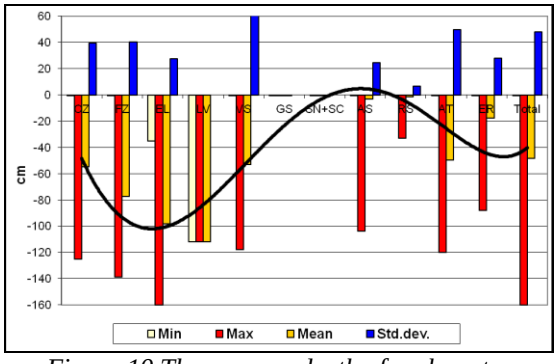

Figure 10 The average depth of carbonates occurrence by soils type

3.5. The gleysation comes from the excessive presence of ground water near the soil surface (Fig 11). The surface-water

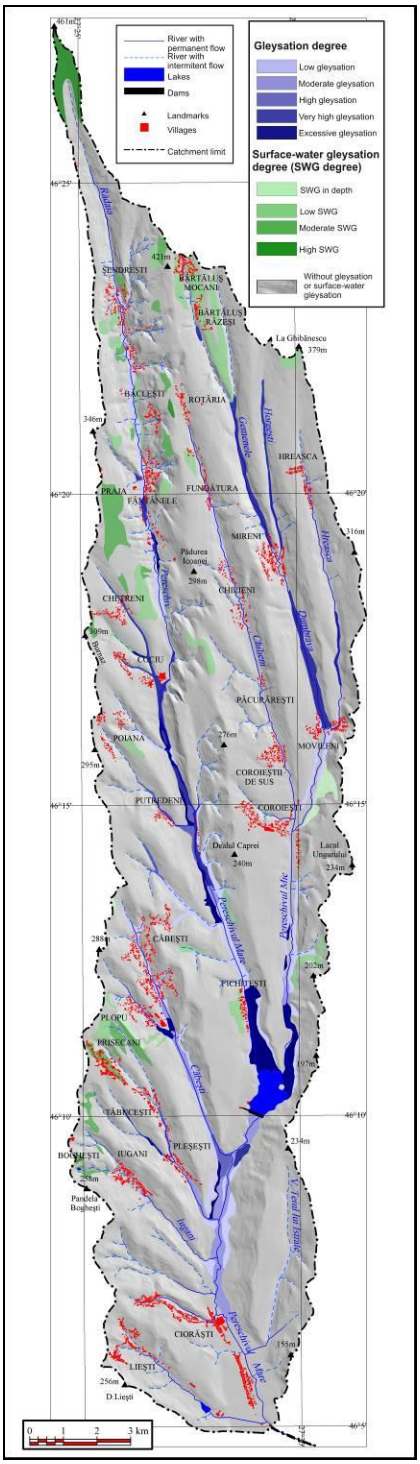

Figure 11 The gleysation and surface-water gleysation intensity map

gleysation is due to the excess rainfall water.

The process occur an area of over 1620 ha (6.97% of total) in the alluvial plains with a low and moderate intensity on 62% of the catchment (Fig 12).

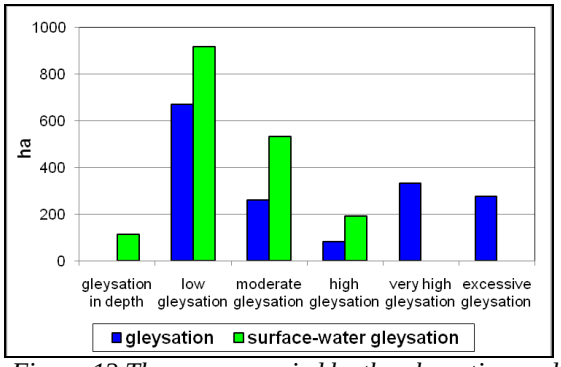

Figure 12 The area occupied by the gleysation and surface-water gleysation by the process intensity degree

The areas affected by a very powerful and excessive gleysation defines the gleysols, which appear near the Fichitesti reservoir where the groundwater occurs very nears the surface (Fig 13).

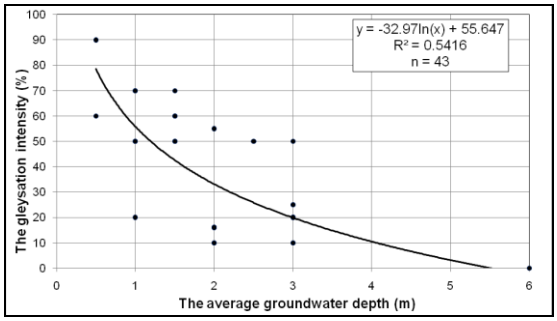

Figure 13 The correlation chart between the average groundwater depth and the gleysation intensity

Usually the process affects the soil cover at the subtype level associated to the fluvisols, solonetzs, chernozems and faeozems (Fig 14).

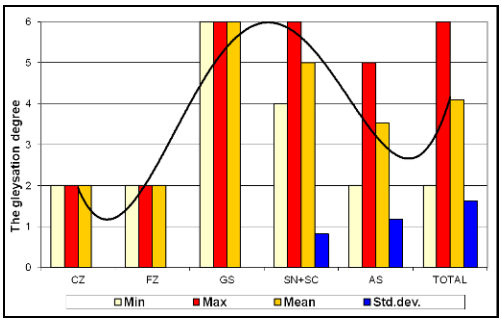

Figure 14 The average gleysation degree by soil types

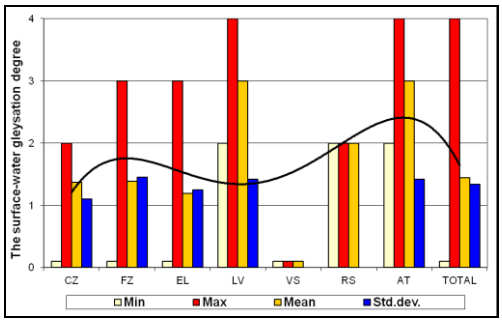

Figure 15 The average surface-water gleysation degree by soil types

The surface-water gleysation appears on about 1759 ha (7.56% of the basin), both on hilltop plateaus from the northern basin but also and on the hill slopes. The process is frequently associated to the illuviation and more rarely to the argillisation. The intensity of the process is generally weak and moderate (68%) and rarely strong and very strong. The most affected soil types are the entic luvosols and typic luvosols and sometimes the anthrosols and faeozems (Fig 15).

3.6. The salinisation appears throw the soil enrichment in easily soluble salts while **the alkalization** consists in the accumulation of soluble Na^+ on soil profile.

In the studied area, the salinisation occurs in southeast and south of the region where the climate is more arid and the mineralized groundwater is located close to the surface (Fig 18). The process occurs on about 2400 ha (10.3% of total area) and is due to the shallow groundwater (<3 m) that appears in dry climatic conditions on the flood plains of the main valleys. On hill slopes, the appearance of the process depends both on the depth occurrence of salty parental material and the erosion intensity.

Generally, the process presents a weak or moderate intensity (99.1%) and only 0.9% of the area has a very high intensity (Fig 16). Actually, we speak about a single soil unit with solonceak type with an area of about 15 ha. As regards the salinisation type, the sulphate salinisation prevails on about 72% while the chloride salinisation has a weaker intensity.

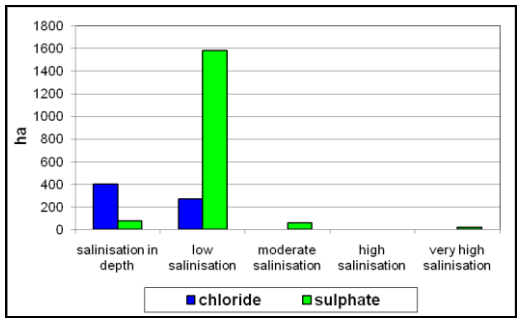

Figure 16 The area occupied by the salinisation type by process intensity degree

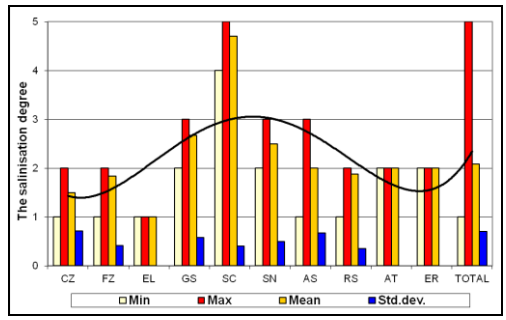

Figure 17 The average salinisation degree by soil types

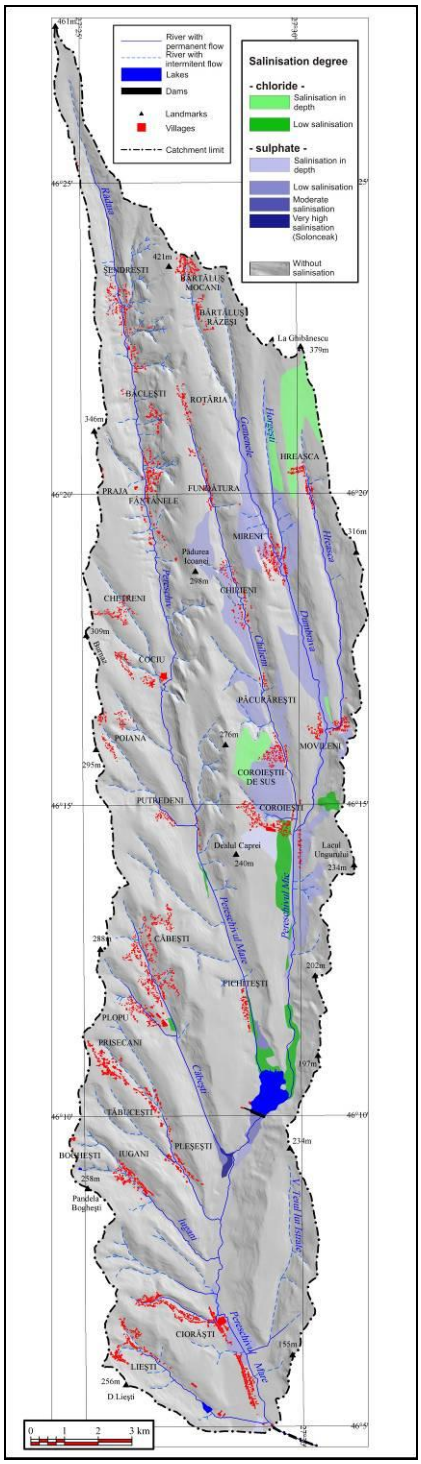

Figure 18 The salinisation intensity map

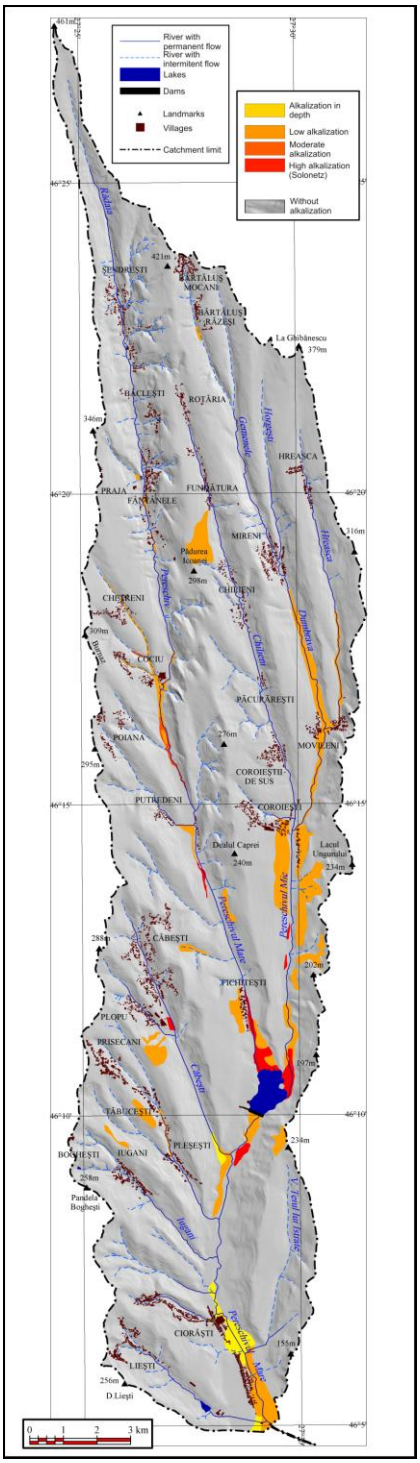

Figure 19 The alkalization intensity map

The most affected soil types are the azonal ones such as the fluvisols, gleysols, solonetzs and regosols but also the anthropic ones such as the typic and eroded anthrosols (Fig 19). Usually, the intensity of the process decreases with the altitude in the case of the zonal soil types (Fig 20).

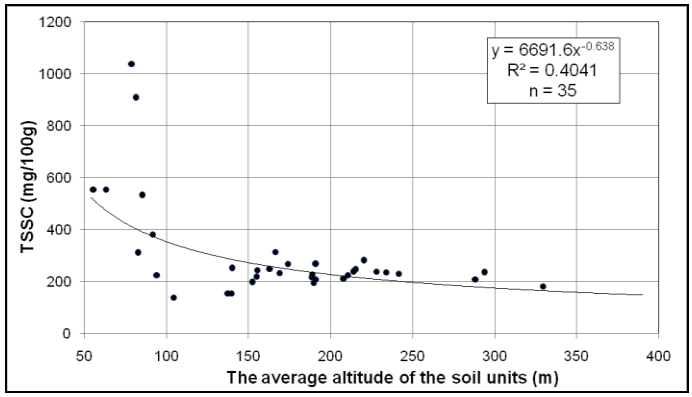

Figure 20 The correlation chart between the average altitude of the soil units and the total soluble salts content (TSSC)

Associated to the salinisation process, **the alkalization** affects over 1234 ha (5.3% of the catchment) grouped in low areas with the groundwater close to the surface (Fig 19). Less often, the process appears on some degraded hill slopes with a clayey texture on specific parental materials and climatic patterns which creates favorable conditions for Na^+ retention (Fig 21).

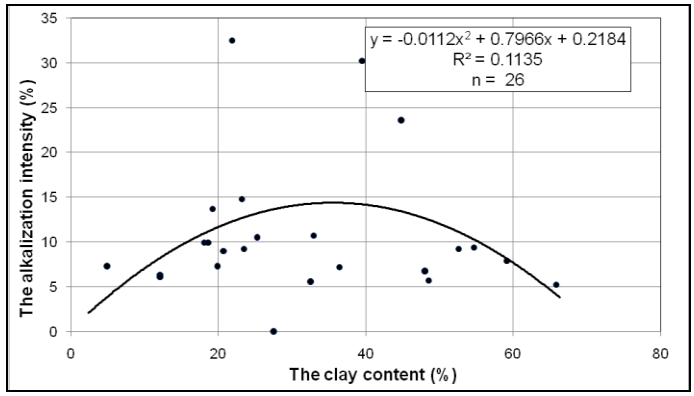

Figure 21 The correlation chart between the clay content and the alkalization intensity

The process affects in depth almost 10% of the appearance area. 81.5%,. The subtypes that belongs to the fluvisols (220 ha), regosols (233 ha), gleysols (108 ha), solonceaks (15 ha) and even cernisols (chernozems and faeozems – 266 ha) are affected by a low and moderate alkalization intensity (Fig 22). The high and very high alkalization intensity affects 113 ha (9.2% of total) that represents those areas where the solonetzs appears (Fig 23).

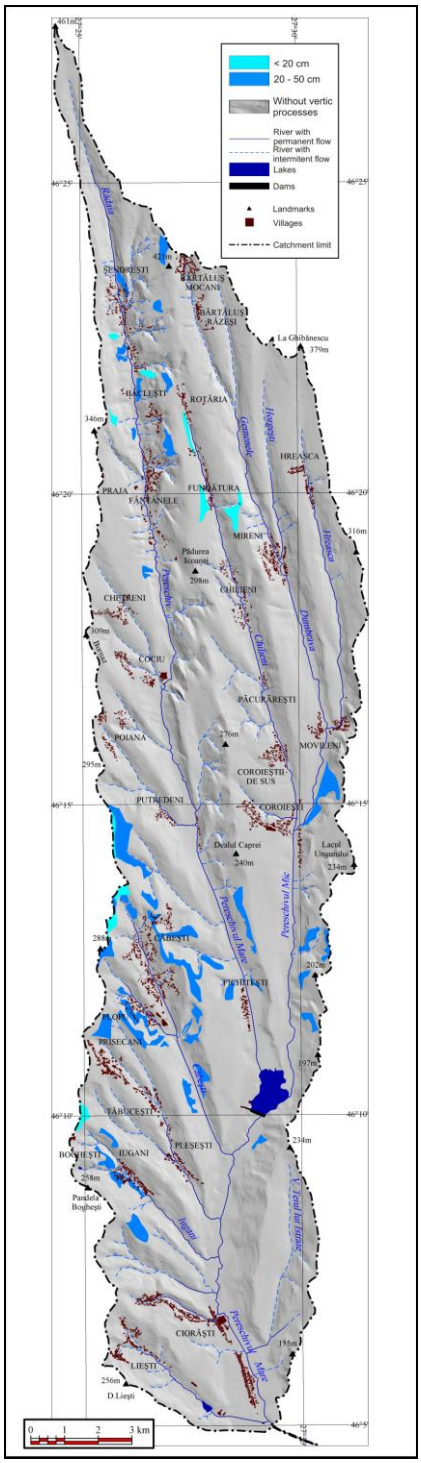

Figure 24 The occurrence depth of the vertic processes map

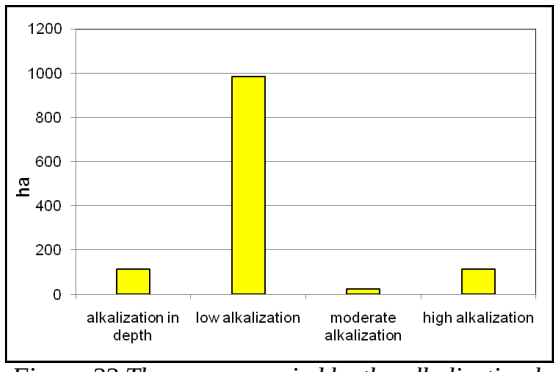

Figure 22 The area occupied by the alkalization by process intensity degree

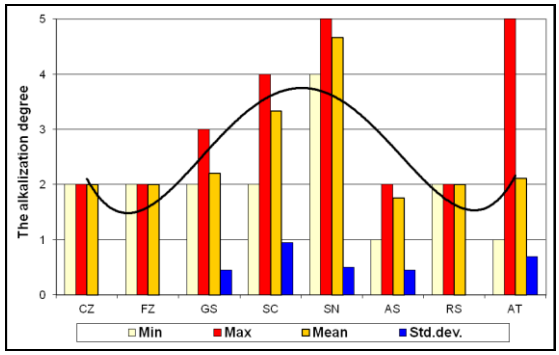

Figure 23 The average alkalization degree by soil types

3.7. The vertic processes are specific to the horizons that have over 30% inflated clay and contribute to the formation of a vertic horizon.

The process is located in the Podu Turcului, Coroiesti and Bogheşti county where the parental materials of the soil are represented by some Pliocene clay intercalations (Fig 24). The occupied area is about 807 ha (3.4% of the total) of which only 119 ha in the first 20 cm is installed (Fig 25).

The process is characteristic for the typic and calcic vertosols (76 ha, average occurrence depth - 15 cm) but also for the vertic subtypes of the entic luvosols (357 ha, 26 cm), faeozems (241 ha, 33 cm) and chernozems (131 ha, 35 cm) (Fig 26).

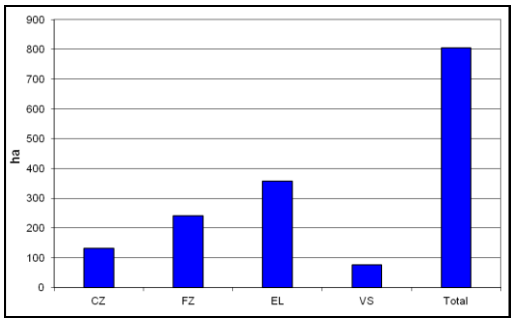

Figure 25 The area occupied by the vertic processes by soil types

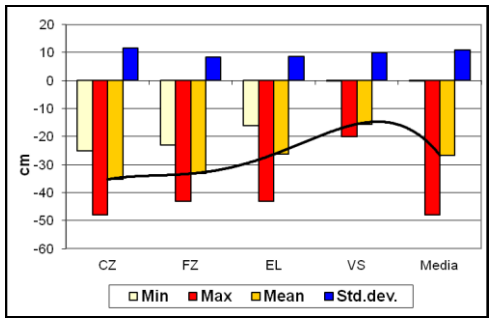

Figure 26 The average occurrence depth of the process by soil types

Conclusions

The natural geographical patterns of the Tutova hilly area have led to large scale emergence of some specific pedogenetical processes such as bioaccumulation, argillisation, illuviation and carbonatation. This explains, according to the soils map of the entire catchment, the prevalence of cernisols (40.62%) and luvisols (25.07%).

Locally, conditioned by the specific physical geographical patterns, the gleysation, surface-water gleysation, salinisation, alkalization and vertic processes appear. Thus, the soils formed belong to the hydrosols (0.88%), salsodisols (0.55%) and pelisols (0.33%).

On large areas, the action of the pedogenetic processes becomes secondary to the detriment of some geomorphological processes (soil erosion, sedimentation) and / or anthropogenic ones (erosion, cleaning, fertilization, etc.). Thus, the protisols cover 22.67% of the entire catchment and the anthrosols formed under anthropogenic influence occur 9.44% of the total area.

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