LANDSLIDES AND THEIR CONTROL AT MARGINA VILLAGE, TIMIȘ COUNTY, ROMANIA

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Abstract *Land displacement processes on the slope can be differentiated after the types of movements in creep, landslide or mass movement, earth flow, rock fall, rock topple. By combination of two or more types results a complex displacement. Factors that determine degradation by displacement are the relief, vegetation, climate, rock and parent material, and plus the influences of erosion, earthquakes. The studied land is situated in the Făget Hills and near the river Bega, in the northeastern part of Timi; county. For the cadastral territory Margina has been made a pedological report at large scale of 1:10.000 for 5029,46 ha. There are 77 soil mapping units. In the southern territories of river Bega (Coşeviţa) there are Pleistocene and accumulation of alluvia, wherein prevail argillaceous marl. The soil mapping units established for the whole territory are: Luvisols; Cambisols; Gleysols; Stagnosols; Leptosols; Regosols; Fluvisols; Anthrosols. The total area affected of landslide is 194.28 ha, which represents 3.86 % from the total villige's territory. The soil profiles situated in the territory with landslides are 10, 11, 12 and 38, namely: Stagnic Luvisols, Anthrosols, eroded, Luvic Stagnosols, stagnic Luvisols. A general characteristic for all soil profiles situated on the landslide field is the interference between the horizons. The bedding rocks are predominantly clayey (argillaceous marl) in which the expandable minerals are ~ 80%, with strong shrinkage – swelling phenomena. Corresponding to the recommended measures established by the studies can be constructed concrete plates, supportwalls, elements of ferroconcrete or soil conservation by afforestation. The land improvement must be realized within a single project for the whole torrential watershed.*

Keywords*: active, furrow, stairs, waves landslides, stagnosols, control, stability*

INTRODUCTION

Landslides phenomena belong to a wide category of land displacement processes. Dynamic force of land displacement is the gravitation, amplified by water infiltration and influenced by slope, erosion, overload with constructions, and deforestation. Landslides are wide-spread in the hilly regions in Romania, of about 700,000 hectares.

For the whole region of Banat, with an area of 1,198,264 ha land resources, the area with landslides represent 5.53%, that means 66,335 ha, from which active landslides are 8,886 ha (Rogobete, 2013)

Landslides represent a danger for human society because they cause damages and each year landslides kill nearly 600 people around the world and cause over $12 billion (US) damage. The worst landslide disaster in historical times occurred on December 16,1020 in Kansou, China when 180,000 people were killed.

An important contribution for knowledge the landslides bring Blasio De (2011). A short list of the subjects treated in this book includes: problems of slope stability, rheological flows, mass flows, mud flows, lahars and debris, granular flows, rock falls.

Ugai K. (2012) presents an ample book (989 pages) with 107 scientific papers, which examine types of earthquake landslides, case study, mechanism, hazard mapping and monitoring.

The mineralogical composition of the clayey soil fraction from the soil profile of Coșteiu de Sus (Margina) indicates the preponderance of expandable minerals (Rogobete, 1979).

For example in the Ao horizon they represent 62% and in Bt horizon 80% (illite 30% and 17% kaolinite only 8% and 3%).

The presence of expandable minerals can be explained by the nature of parent material which is rich in tufaceous elements originated from andezitic volcanic eruptions. The expandable minerals induced landslides near the route of highway situated in the northern part of Margina's territory.

Munteanu A. (1991) appreciate for the hilly regions that the most important measurements for the degraded land are reafforestation and hydrotechnical works.

For the agricultural degraded land, Baloi V. (1986) presents a lot of reclamation schemes, like land grading – leveling works, open canals and drains, stone walls.

Traci C. (1985) proposes for landslides a series of receipts to afforestation with forest species, as: Pinus s., Pinus n., Robinia ps., Salix h., Hippophae r., etc.

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MATERIAL AND METHODS

The study area is located at ~200 – 250 m in the Făget Hills and on the alluvial plain of the river Bega in the northeastern part of Timiș county. The climate is moderately continental with sub-Mediterranian influence. Mean annual temperatures are 10,4^{o}C with the following values for seasons: in spring = 11,4^{o}C, summer = 20,5^{o}C, autumn = 11,5^{o}C, winter =0,5^{o}C.

The annual precipitations are 734 mm, with the following monthly distribution (mm/month):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
43,9	39,8	51,3	59,6	83,9	98,1	68,9	64,3	51,9	62,2	57,4	53,1

The maximum quantity for a rain is 63,6 mm.

For the cadastral territory Margina has been made a pedological report at large scale of 1:10.000 for 5029,46 ha. There are 77 soil mapping units.

RESULTS AND DISCUSSIONS

The village Margina is formed of settlements: Margina, Coșevița, Coșteiu de Sus, Breazova, Bulza, Groși, Nemești, Sintești, Zorani.

A North – South geological profile indicates a great diversity of rocks. In the northern territories of river Bega, for example Coșteiu de Sus are deposits of Thortonian and Pannonian represented of breccia, conglomerate, reddish clay and psephite complexes, near the volcanic agglomerate and tuff. In the southern territories of river Bega (Coșevița) there are Pleistocene and accumulation of alluvia, wherein prevail argillaceous marl (Rogobete, 1979).

The soil mapping units established for the whole territory are:

- SM.U 1 – 37 = Luvisols;
- SM.U 38 – 47 = Cambisols;
- SM.U 48 – 53 = Gleysols;
- SM.U 54 – 57 = Stagnosols;
- SM.U 58 – 59 = Leptosols;
- SM.U 60 – 61 = Regosols;
- SM.U 62 – 74 = Fluvisols;
- SM.U 66 – 68 = Anthrosols;
- SM.U 75 = puddles;
- SM.U 76 = holes;
- SM.U 77 = gullies.

The great angle of slope, correlated with small content of humus in the upper horizon and clayey B horizon, and a seasonal saturation of soil pores with water, have had induces intense phenomena of soil erosion and landslide.

The total area affected of landslide is 194.28 ha, which represents 3.86 % from the total villige's territory (5029.46). It has been included here all types of landslides, active or stabilized.

Figure 1 Map of soils

The soil profiles situated in the territory with landslides are 10, 11, 12 and 38, namely: Stagnic Luvisols, Anthrosols, eroded, Luvic Stagnosols, stagnic Luvisols.

Soil profile 10

SRTS – ***Luvosol stagnic***; WRB – ***Stagnic Luvisols***

Degraded land with active landslide in furrow (101.04 ha)

Profile description

0 – 7 cm, Aț (wasteland), ochric horizon, light brown, medium loam, dry, granular structure, strong structure;

7 – 15 cm, EB, transitional horizon, brown, dry, subangular blocky structure, strong structure;

15 – 23 cm, Bt, argic horizon, brown, medium loam, slightly moist, subangular blocky structure, strong structure;

23 – 45 cm, Btw_2, stagnogley argic horizon, brown mottled strong prismatic structure;

45 – 48 cm, BCw_2, transitional stagnic horizon, brown with rust – colored spots, moderate prismatic structure;

58 – 66 cm, CBw_2, transitional stagnic horizon, yellowish brown, prismatic structure;

66 – 90 cm, C, medium loam, slightly moist, dark yellow, massive structure.

Table 1.

Analytical data

Properties	7-15 cm	15-23 cm	23-45 cm	45-58 cm	58-66 cm	66-90 cm
pH	6.05	5.90	5.90	5.90	6.20	6.00
Clay	24.8	26.0	27.7	31.1	28.4	29.5
Silt	25.5	26.5	20.1	25.9	28.5	27.1
OC	1.05	0.86	0.55	0.19	-	-
CECc	23.19	24.71	27.15	36.31	35.91	35.81
BSP	75.37	75.03	76.75	80.74	82.20	82.99

Soil profile 11

SRTS – ***Antrosol erodic***; WRB – ***Anthrosols, supplementary stagnic, eroded phases***

Degraded land with active stairs landslide (63.54 ha)

Profile description

7 – 24 cm, Bt_1, medium clay loam, yellowish brown angular blocky structure, slightly;

24 – 65 cm, b Bt_{1+2+2}, loamy – clayey, dark blue, strong prismatic, dry;

65 – 76 cm, BC, loamy – clayey, yellowish brown, strong prismatic, dry;

76 – 87 cm, CB, clayey, dark brown leaden, prismatic;

87 – 110 cm, C, loamy – clayey, dark brown, strong, prismatic;

110 – 160 cm, 2C, medium clay loam, yellowish with dark brown and gray spots, dry.

Table 2.

Analytical data

Properties	7-24 cm	24-35 cm	35-53 cm	53-65 cm	65-76 cm	76-87 cm	87-110 cm	110-130 cm
pH	5.60	5.80	5.90	6.00	6.05	6.80	6.15	6.30
Clay	37.9	47.7	44.7	46.3	42.4	46.6	48.0	38.1
Silt	24.0	20.5	22.2	20.1	26.1	20.7	19.6	21.0
OC	1.47	1.40	1.22	-	-	-	-	-
CECc	31.49	34.67	35.48	35.36	32.04	34.53	34.54	34.40
BSP	70.05	73.51	74.57	84.78	79.71	82.59	84.30	85.20

Soil profile 12

SRTS – ***Stagnosol tipic***; WRB – ***Luvic Stagnosols***

Degraded land with stabilized waves landslide (7 ha)

Profile description

0 – 28 cm, Aow_2, medium clay loam, brown strong prismatic structure, slightly moist;

28 – 40 cm, ElW, silt loam, whitish, yellowish brown, strong angular blocky structure, slightly moist, small iron – manganese concretions;

40 – 54 cm, EBtW, medium clay loam, yellowish brown, strong angular blocky structure, slightly moist, small iron-manganese concretions;

54 – 84 cm, Bt_1w_3, medium clay loam, dark brown, strong prismatic structure, slightly moist;

85 – 125 cm, Bt_2w_2, loamy clay, dark blue swarthy, slightly moist;

125 – 135 cm, BC, medium clay loam, dark blue, yellowish, slightly moist;

135 – 145 cm, C, medium clay loam, yellowish, dark blue, slightly moist.

Table 3.

Analytical data

Properties	8-28 cm	28-40 cm	40-54 cm	54-84 cm	84-125 cm	125-135 cm	135-145 cm
pH	5.60	5.50	5.35	5.60	5.60	5.80	5.70
Clay	33.4	38.5	34.1	37.6	46.8	42.7	40.1
Silt	27.3	35.1	32.9	31.8	25.4	30.2	30.9
OC	0.96	0.64	0.55				
CECc	24.40	21.64	22.5	25.65	29.35	27.29	26.59
BSP	67.45	55.17	53.06	59.08	66.57	64.05	64.15

Soil profile 38

SRTS – ***Preluvosol stagnic***; WRB –***Stagnic Luvisols***

Degraded land with stabilized stairs landslide (22.70 ha)

Profile description

0 – 21 cm, Ao, medium clay loam, dark brown, strong granular structure, slightly moist;

21 – 30 cm, ABw_2, medium clay loam, light brown, strong angular blocky structure, slightly moist, iron – manganese concretions;

30 – 52 cm, Btw_3, medium clay loam, dark blue, spots and iron-manganese concretions, strong angular blocky structure, slightly moist;

52 – 69 cm, BCw_2, medium clay loam, yellowish dark brown, mottled, medium prismatic structure, slightly moist;

69 – 125 cm, Cw_2, medium loam, dark brown, yellowish colour, mottled, slightly moist.

Table 4.

Analytical data

Properties	6-21 cm	21-30 cm	30-52 cm	52-69 cm	69-125 cm
pH	6.40	6.40	5.90	5.75	6.50
Clay	27.6	42.6	45.9	37.9	29.4
Silt	23.3	20.7	17.6	17.6	15.6
OC	1.09	0.59	0.19	-	-
CECc	21.49	25.39	28.48	22.66	19.02
BSP	80.22	82.07	79.84	76.08	81.80

A general characteristic for all soil profiles situated on the landslide field is the interference between the horizons, in fact there is a homogenization process.

We propose some variants for landslide appropriate for the studied territory.

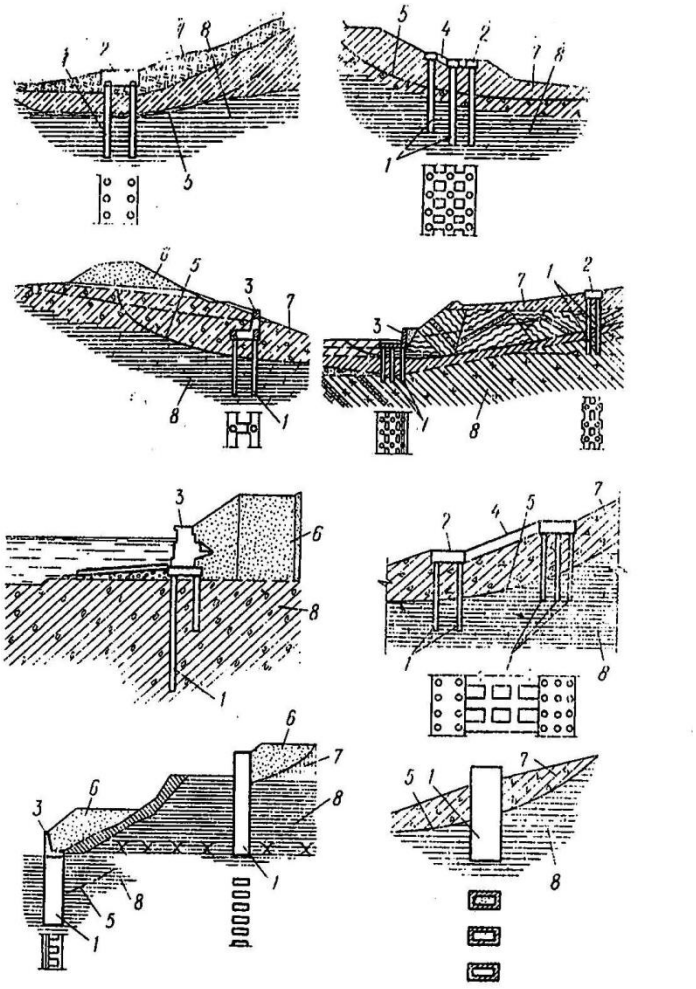

Figure 2 Structural variants for landslide stabilization

1. retention elements; 2. concrete plate; 3. support walls; 4. elements of ferroconcrete; 5. slide surfaces for computations; 6. filler; 7. the thickness of slide layer; 8.settled soil under slide layer

CONCLUSIONS

In the studied territory Margina, the soil cover are composed of Luvisols, Cambisols, Stagnosols, Anthrosols, and with small areas Gleysols, Regosols, Fluvisols, Leptosols. They are evaluated from different types of deposits with different ages: Pleistocene, Pliocene and Thortoniene, all of them with a great content of clay.

Because the territory with landslides are non-productive we propose reafforestation with forest species, like Hippophae r., Robinia ps., Pinus s., Populus a.

The areas occupied with landslides in the village Margina are 194.28 ha (3.86 % from the total area).

The bedding rocks are predominantly clayey (argillaceous marl) in which the expandable minerals are ~ 80%, with strong shrinkage – swelling phenomena (Coșteiu de Sus), (Rogobete, 1979)

Decreasing the slope angle and removing water from the slope through drains will decrease the driving forces. Corresponding to the recommended measures established by the studies can be constructed concrete plates, supportwalls, elements of ferroconcrete or soil conservation by afforestation.

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