Soils of the flood plain of the River Someş/Szamos[1]

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Introduction

Along its way the River Someş crosses several relief units of various lithological structure, which leave their marks on the soil cover of the flood plain, including the active flood plain. Its catchment area of 15.217 km^2 covers the south and west sides of the northern group of the East Carpathians, built up of metamorphic, igneous and heterogeneous sedimentary rocks; the northern slopes of the Bihor and Gilău Mountains, constructed of metamorphic rocks, granite, and partly of limestone; and the north-west half of the Transylvanian Tableland, consisting mostly of pellitic-psephitic and, subordinately, of psammitic deposits (marly clay, sandy clay, loam, sand and sandstone). Finally, the hydrographic basin of the river Someş includes the north-eastern corner of the Great Pannonian or Hungarian Plain.

Upstream the town Dej/Dés, the river has two branches, namely the Someşul Mare and the Someşul Mic. The origin of the whole Someş system is considered to be the source of the Someşul Mare, in the Rodna Mountains.

In its upper reaches the valley of the Someşul Mare has not flood plain. Between the source and Sanţ/Újradna it follows a fault line, running in a tight bed full of block boulders accompanied by bluffs and steep rocky slopes covered with a shallow soil.

From Sanţ to its emergence from the mountainous region a few kilometres below Năsăud/Naszód, the Someşul Mare cuts first into crystalline formations and andesites, then hard sedimentary rocks composed of sandstone and conglomerate. The valley broadens a little, forming a narrow flood plain stripe covered with a shallow alluvial protosoil on gravely crystalline and andesitic substratum that originated from the surrounding mountains. The soil covering the latters, although shallow, is generally well protected by forest and mountain pastures.

After its emergence from the mountainous area, the river crosses a relatively high hilly country built up of looser sedimentary rocks (marly clay, sandy clay, loam, benches of sand and volcanic tuffs). Below Beclean - Bethlen - the valley widens continually, the flood plain reaching a breadth of 3-4 km and covered by an alluvial skeletal protosoil near the river bed, and skeletal alluvial soils farther from the river. On this section the alluvial deposits consist of a mixture of coarse crystalline and andesitic gravels, sand and fine particles, the latters originating from the nearby piemontane region. The dominance of bare plough-land in this area accelerates soil erosion on the sloping areas, frequently causing turbidity in the river.

[1] The first name is Romanian, and the second Hungarian

The River Someşul Mic is formed by two branches beyond Gilău/Gyalu: the Someşul Cald river and the Someşul Rece river. Both flow entirely through a mountainous area, cutting their way through crystalline schists, granites, and the Someşul Cald, at its riverhead, through limestones. They have no real flood plain, running in more or less narrow valleys. The valleys occasionally broaden, however, the slopes become gentle and the gradient of the river bed decreases to some extent. In these broadenings peat soils and even high moor have been developed, as near Blajoaia, Runcu Ars and Smida is. In the headwaters of the Someşul Rece, as a consequence of extensive deforestation in 1968 and inadequate silviculture in the last decades, a wide-ranging poses of swamp formation has arised. In certain cases storage lakes have been established, such as Fantanele-Belis, Tarniţa on the Someşul Cald, Someşul Rece on the and Gilăuat the junction of the river branches beyond Gilău .

On leaving the mountainous area near Gilău, the Someşul Mic enters into the hilly country of Someş Tableland, being a highly deforested agricultural region, strongly exposed to soil erosion.

Between Gilăuand Cluj the flood plain is narrow (1-1,5 km). The soil consists mostly of skeletal alluvial protosoil on calcareous gravely substratum. Below Cluj the valley broadens out and the soil cover deepens, consisting of loamy alluvial soils and sandy loam and silty stratified substratum. The risk of soil erosion on the surrounding hilly area, predominately on arable and strongly eroded pastures is considerable.

After the confluence of the Great and Someşul Mic near the town of Dej, the river Someş, penetrates at first into Oligocene sandstones and conglomerates of Someş Tableland, then into Eocene formations composed of limestones, sandstones, marls and striped clays. The flood plain narrows in this sector between Câţcău/Kackó and Jibou/Zsibó, the alluvial deposits are coarser, containing less fine fractions, than in the sector between Cluj and Câţcău.

After its emergence from the Surduc-Jibou narrows the Someş flows in a small trough-like depression between Jibou and Benesat/Benedekfalva, covered with reddish loamy alluvia, originating from the surrounding Paleocene continental red clays.

On breaking through the short (about 3 km) narrows of Ţicău/Szamoscikó the river steps into the wide Depression of Baia Mare/Nagybánya, and then flows over a large selfbuilt succession of paleodeltas, situated between the foot of the Gutâi Mountains and the confluence with the river Tisza, belonging to a large area of subsidence of the north-east Great Hungarian Plain. All this area of subsidence is filled by a thick porous sedimentary sequence that originated from the neighbouring mountains.

Prior to river regulation and the erection of flood-control levees, in this deep alluvial area the running waters wandered freely, virtually without beds, as the countless backwaters prove.

Keywords: flood plain soil, River Someş

Materials and methods

In this paper we present shortly the soil cover of the flood plain of the river Someş, at a scale of 1:200.000. Within the limits of the flood plain, the active flood plain represents frequently a relatively narrow strip, difficult to delineate at the scale we used.

For a convertible manipulation we present the soil map of the flood plain on eight sheets. On each of them we sketched the profile of the significant soils to be found in the presented area.

The materials used consist of soils maps and geological maps published by the Romanian Research Institute of Pedology and Agrochemistry, and by the Institute of Geology, as well as several other published and unpublished soil surveys and studies and our own survey and soil analyses. In all chemical procedures air-dry samples were crushed, than the nonsoil material fragments were carefully avoided by a 2-mm roundhole sieve. The material retained by sieve is reported as greater than 2 mm fraction, and the results are reported on this basis.

The soils of the flood plain, in particular those of the active flood plain, are of great importance for aquatic plant communities. The soil cover is an important natural filter, which retains waste products in large quantities. Its efficiency depends considerably on certain soil characteristics that affect permeability, cation mobility (such as clay, humus, pH) and their integration as cation exchange capacity. Secondly, as a component of riverine biotopes, the food plain soils determine to a great extent the nature, the structure of communities.

The soil cover is, at the same time, a mediator between climatic factors, runoff and underground water supply of rivers, considering that it represents the upper layer of medium in which the runoff is formed. So, in the case of high permeable soils the abundant rainfalls do not cause the appearance of high runoff values in every case because of rapid infiltration. In the deeper levels the rapidly infiltrated water is protected against evaporation, consequently higher fluctuations of ground water arise and hereby that of underground supply. An opposite effect occurs with the soils of a high water-holding capacity (loamy and clayey soils with high humus content).

In regions of previous soils the values of runoff are higher, and those of evapotranspiration are reduced, as compared to regions of clayey soils.

The soils of mountainous regions are less permeable during the whole year, as compared to those of pericarpathian areas. The excessive moisture of the mountain soils assure, at the same time, almost a continuous infiltration of the ground water toward the rivers, and consequently a rich underground supply, which maintains the clearness of water in mountain rivers.

Short description of soils

The characteristics of soils described in this paper are shown in Table 1. Three groups of soils have been found in the flood plain of the river Someş, as follows : alluvial protosoils, alluvial soils and gley soils.

Alluvial Protosoils

The recent formations of the flood plain are represented by alluvia or alluvial protosoils. In most of the cases the soil-forming processes are incipient or absent, due to more or less frequent flooding that hinders pedogenesis. The spreading of alluvial protosoils is limited to the active flood plain, or flood control stripe.

Generally the alluvial protosoils are stratified, having in most cases a loose consistency and coarse texture (gravels, sands, loamy sands), but occasionally, they also can be moderately coarse textured (sandy loam) and medium-textured (loam and silt). This group of soils has a low content of organic matter and clay, consequently a weak cation-exchange capacity and low retaining power (mostly in the coarse-textured soils). The lime content, and in connection with this the pH-value vary along of the river. But they never become a limiting factor for plant growth.

Due to their particle-size distribution and lack of an impervious layer, even in the deeper levels, most of the alluvial protosoils are excessively permeable to water, therefore they cannot retain a great part of the substances which pollute the running water. In this respect the storage of various wastes on active flood plains, near the riverbed, can be harmful for the river. In countless cases waste matter of different origin and mostly sawdust are deposited close by the riverbed, polluting the water.

When the alluvial protosoils are covered with vegetation, their retaining and filtering power becomes more efficient. Consequently, in order to enhance the retaining and filtering power of these soils, their deforestation with poplar is desirable.

Alluvial soils

Alluvial soils occupy most of the floodwater free, or rarely flooded, higher level of the river plain, being in various stages of development and fertility. Contrary to alluvial protosoils, their upper - Ao or Am - horizon is deep, with a humus content exceeding 2-2,5 %. The clay content is also higher, compared with alluvial protosoils, and vary from 22 to 33 %. As a result of this higher clay content the water that penetrated through their profile is well filtered.

Excepting those of the mountainous region, showing acid reaction, in most cases all alluvial protosoils and alluvial soils of the flood plain show slightly and moderately alkaline reaction, and only seldom neutral or slightly acid.

Due to their high fertility, the alluvial soils of the river Someş are used almost totally as plough-land, in same cases employing irrigation.

The groundwater level fluctuates seasonally between 1-5 m, in close connection with the water level of the river.

No chemical pollution of the alluvial soils could be proved as a consequence of fertilisers, but near the towns and cities large amounts of waste are deposited on the flood plain. A lot of fertile alluvial soils being withdrawn from agricultural use, harming at the same time not only the neighbouring soil stripe, but also the groundwater and running water.

The wastewater purification plants can be important sources of soil- and groundwater pollution. Because their dry beds are frequently filled, large amount of sewage sludges are deposited directly on the soils, not far from the river.

Gley soils

Three types of gley soils have been distinguished : low humic gley soil, humic gley soil and gley solonchak. Each is hydrogenic soil with high groundwater levels during a long period of the year. Most of these soils have high clay contents, and are thus bad water conductors. They appear mostly at the contact of the flood plain with the slope foot, or in deep-lying areas of the flood plain. The important river regulation- and floodwater prevention works performed, especially in the lower reaches of the river Someş, led to many changes in position of the riverbed. As a result , the present flood plain is full of cut-off branches and oxbows, filled with poor water conductor silt and clayey materials, favourable for hydrogenic soil-forming processes. Where the substratum contains soluble salts, or salty underground springs occur, salt-affected soils and solonchaks are developed, as in the case below the city of Cluj.

On the gley soils generally a luxuriant herbaceous vegetation grows which represents not only an important fodder source for cattle but a favourite transitional place for many migratory birds. Transformation of these soils into agricultural land is not advisable.

Conclusion

On the flood plain of the river Someş (Szamos), three groups of soils were distinguished: alluvial protosoils, alluvial soils and gley soils. The alluvial protosoils appear on the active flood plain having a low retaining and filtering power. The alluvial soils are spread on the greatest part of the floodwater-free higher level of the river plain, while the gley soils occur mostly on the marginal deep lying areas of the flood plain.

No harmful chemical pollution of the soil cover could be proved along the entire course of the river. However some exceptions exist, mainly around of wastewater purification plants of the towns and cities, as well as in the places where different waste materials are deposited, mostly in the neighbourhood of settlements. In order to enhance the retaining and filtering power of the alluvial protosoils on the active flood plain, their deforestation with poplar is desirable.

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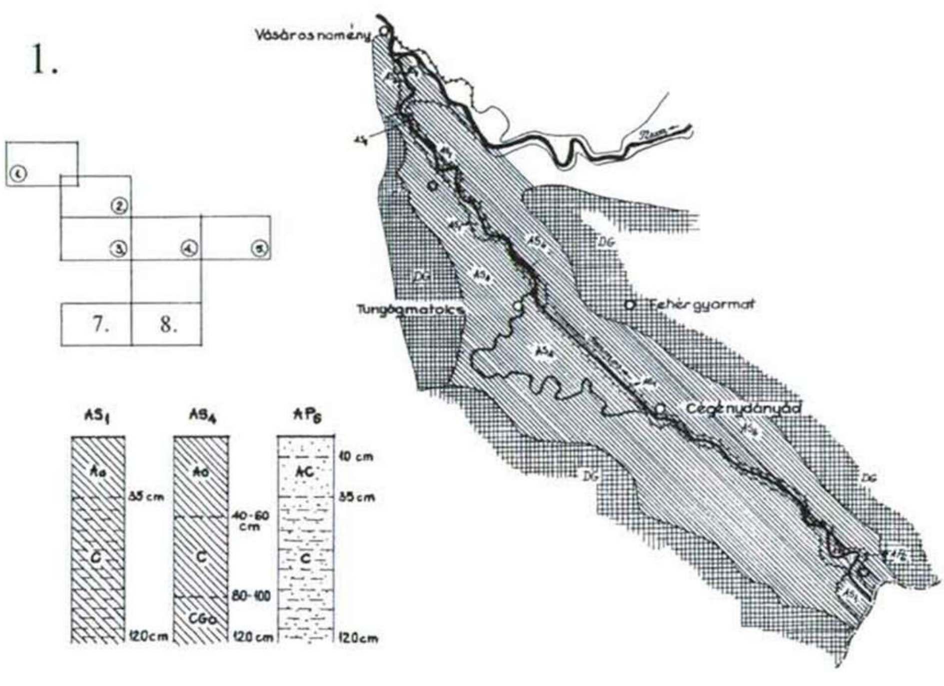
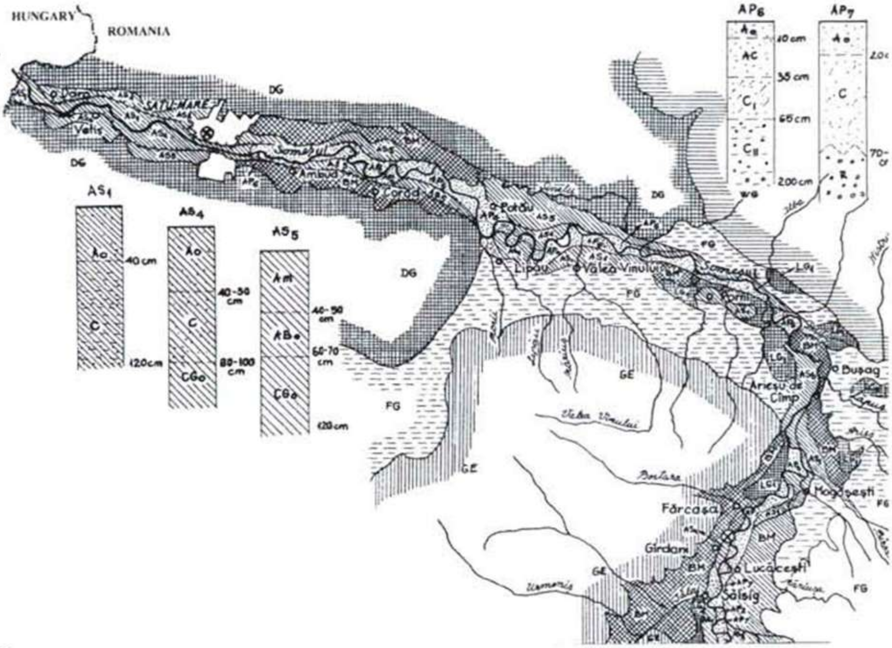
1.



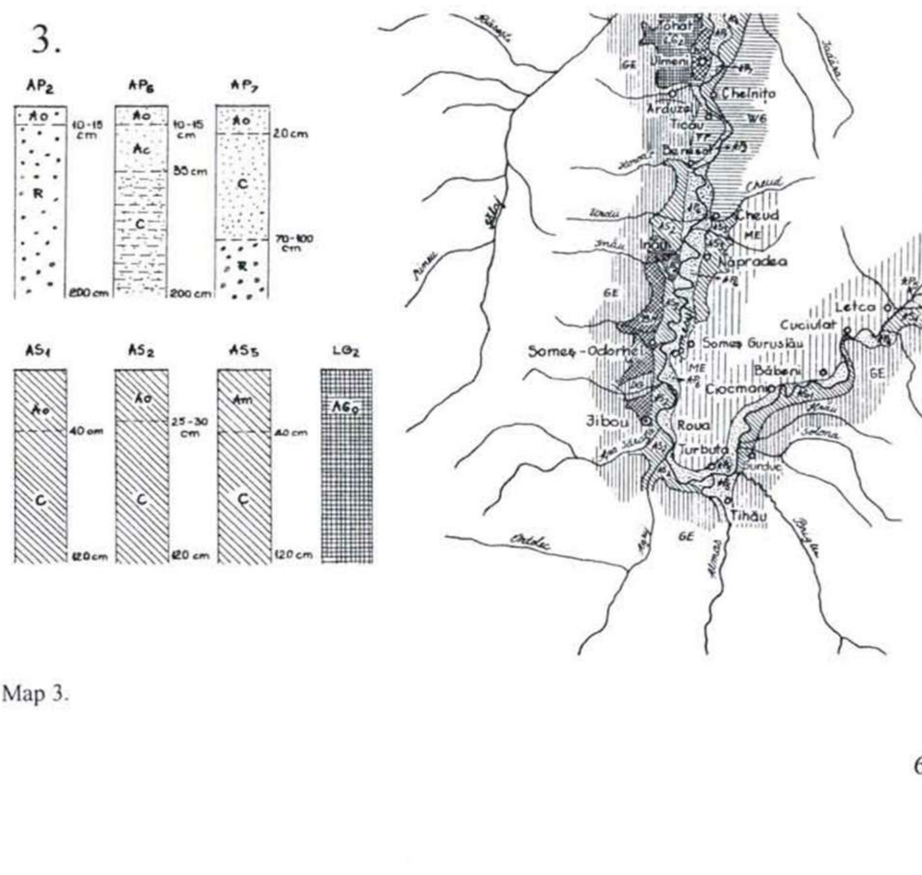
Map 1.

2.

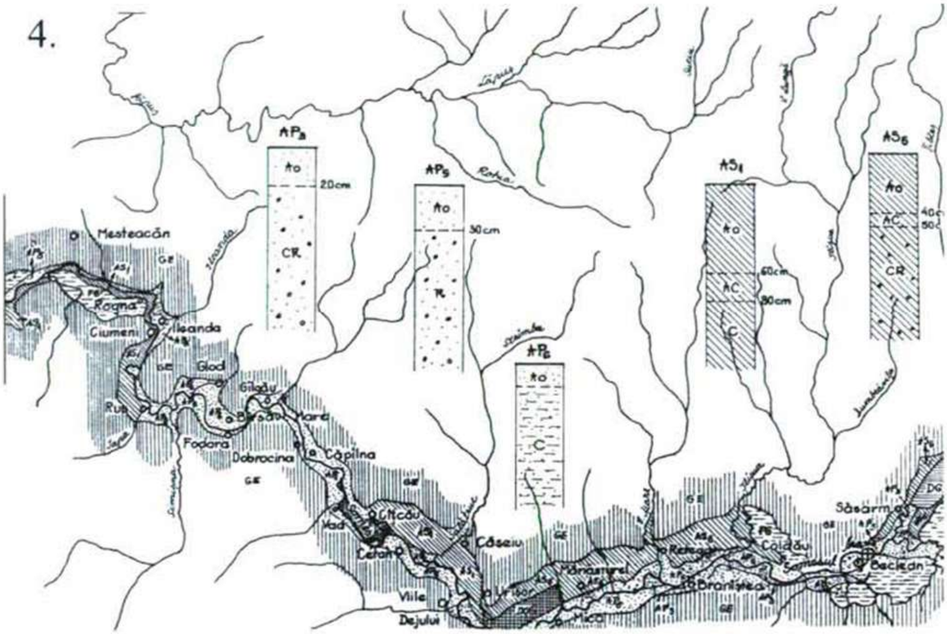

HUNGARY
ROMANIA
SATU-MARE
Vetiș
DG
AS1
Ao
40 cm
C
120cm
AS4
40-50 cm
80-100 cm
CGo
AS5
Am
ABo
CGo
120cm
AP6
AC
35 cm
65cm
200cm
AP7
Potău
Lipău
Valea Vinului
Someșul
FG
GE
Ariesu de Cimp
Bușag
Fărcasa
Girdani
Lucăcești
Sălsig
Mogoșești
Valea Vinului
BM

Map 2.

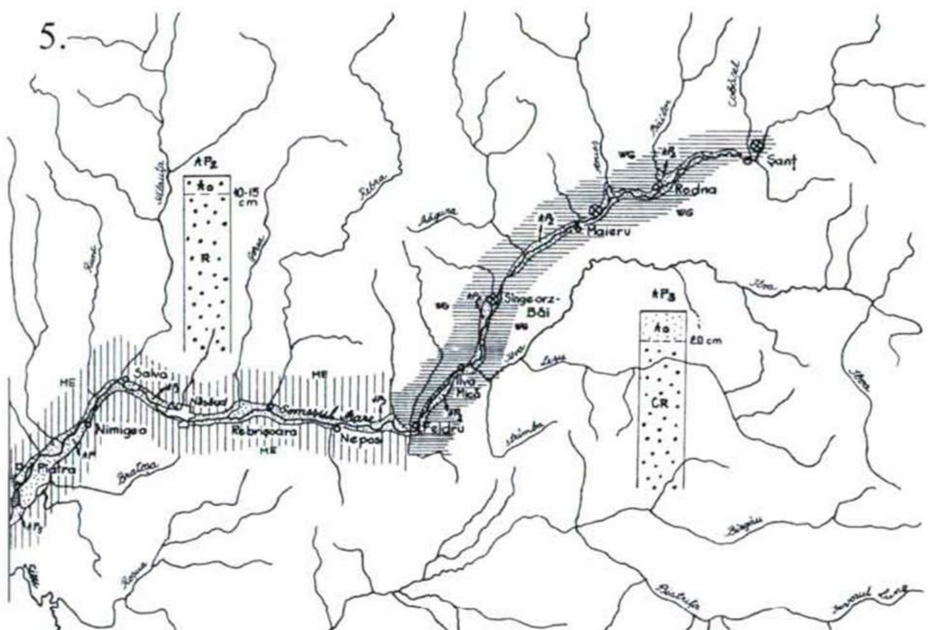
3.


AP2
Ao
10-15 cm
R
200 cm
AP6
Ac
35 cm
C
AP7
20 cm
70-100 cm
AS1
40 cm
120 cm
AS2
25-30 cm
AS5
Am
LG2
AGo
Tohat
Ulmeni
Chelnita
Arduzel
Ticău
Bersoci
Cheud
Ineu
Năpradea
Letca
Cuciulat
Someș-Odorhei
Someș Guruslău
Băbeni
Ciocmania
Jibou
Roua
Turbuța
Surduc
Tihău
GE
ME
WG

Map 3.

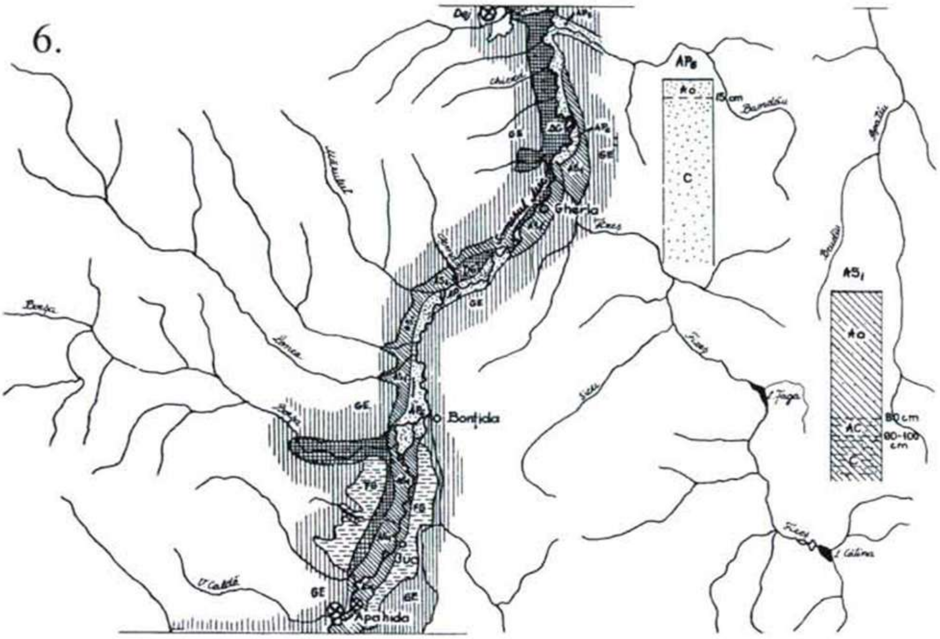

4.
Mesteacăn
Rogna
Ciumeni
Ileanda
Glod
Gîlgău
Bîrsău Mare
Rus
Fodora
Dobrocina
Căpîlna
Vad
Cetan
Cîţcău
Căşeiu
Viile
Dejului
Mănăstirel
Reteag
Braniştea
Mica
Coldău
Săsărm
Beclean
AP3
Ao
20cm
CR
AP5
Ao
30cm
R
AP6
Ao
C
AS1
Ao
AC
C
60cm
80cm
AS5
Ao
AC
CR

Map 4.


5.
Salva
Nimigea
Piatra
Rebrişoara
Nepos
Feldru
Ilva
Mică
Sîngeorz-
Băi
Maieru
Rodna
Şanţ
AP2
Ao
10-15
cm
R
AP3
Ao
20 cm
CR

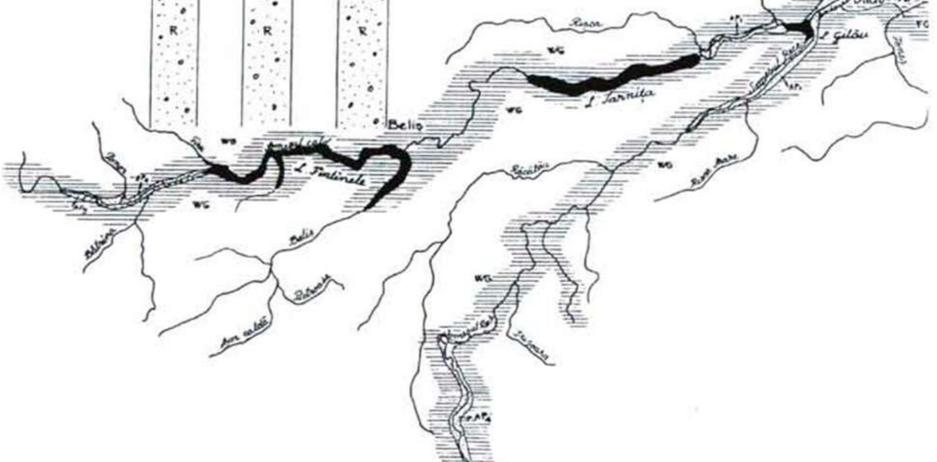
Map 5.

6.

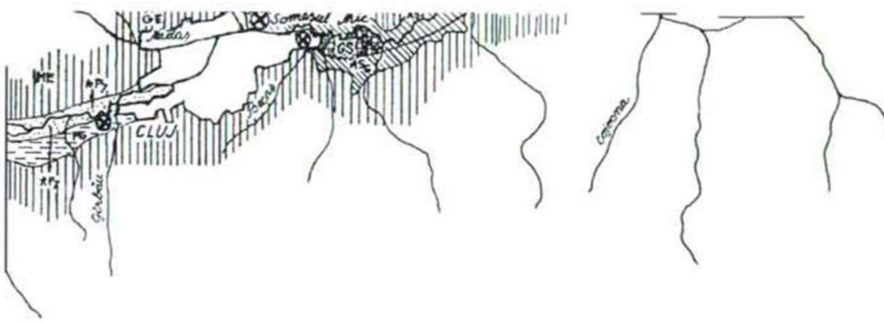

Dej
Gherla
Bonțida
Apahida
AP6
Ao
C
AS1
Ao
80 cm
AC
80-100 cm
L. Țaga
GE

Map 6.

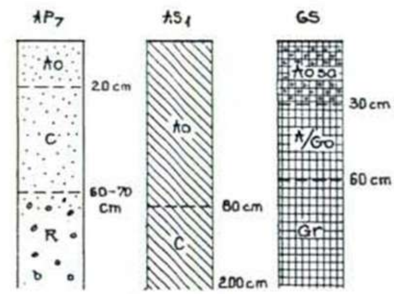
7.


AP1
Ao
5-10 cm
R
AP4
Ao
10-15 cm
R
AP5
Ao
10-15 cm
R
Beliș
L. Fîntînele
L. Tarnița
Gilău
L. Gilău
ME

Map 7.


Somesul Mic
CLUJ

8.


AP7
AS1
GS
Ao
20 cm
C
60-70
cm
R
Ao
80 cm
C
200 cm
Aosa
30 cm
A/Go
60 cm
Gr

Map 8.

LEGEND OF SOILS

1. ALLUVIAL PROTOSOILS

AP_1	Skeletal alluvial protosoils on metamorphic rocky substratum
AP_2	Skeletal alluvial protosoils on gravelly crystallin substratum
AP_3	Loamy sandy skeletal alluvial protosoil on gravelly andesitic and crystallin substratum
AP_4	Gley loamy sandy alluvial protosoils and peaty soil on gravelly granitic substratum
AP_5	Skeletal alluvial protosoils on gravelly calcarous substratum
AP_6	Sandy loam and loamy stratified alluvial protosoils on sandy substratum
AP_7	Sandy loam and loamy alluvial protosoils on gravelly substratum

2. ALLUVIAL SOILS

AS_1	Loamy alluvial soil on stratified loamy sandy and silty substratum
AS_2	Red loamy alluvial soil on red loam
AS_3	Clayey loam alluvial soil on silt
AS_4	Deep gley sandy loam alluvial soil on sandy loam and silt
AS_5	Deep gley loamy alluvial soil and brown earth on silt
AS_6	Skeletal alluvial soil on gravelly substratum

3. GLEY SOILS

LG_1	Low humic gley soil on silt and clayey substratum
LG_2	Low humic amphygley soil clayey substratum
GS	Gley solonchak on salty clayey substratum
DG	Drained humic gley soil on silty and clayey substratum

OTHER SIGNS

BM — Brown earth on loamy substratum outlying of flood plain

Water covered area

Floodcontrol levee

WG — Wooded and grazing land with well protected soil cover of the mountainous regions; no pollutants

ME — Steep slopes covered mostly with pasture and partly with plough-land,moderatly submited to soil erosion

GE — Gently to moderate slopes used mostly as plough-land,submited to a great extent to soil erosion

FG — Flat or gently undulating surfaces;no soil erosion risk

⊗ Source of pollutants

Soil and Location	pH H_2O	Org. mat %	$CaCO_3$ %	N total %	P ppm	K ppm	Coar -se Sand %	Fine Sand %	Silt %	Clay %
AP_1 - Şanţ										
Ao 0 - 10 cm	7,15	4,33	-	0,212	39	142	24,8	29,6	32,5	13,2
R 10 - 30 cm							83,7	2,2	10,1	4,0
AP_2 - Sângeorz-										
Băi	7,42	1,97		0,100	126	266	68,7	22,3	5,0	4,0
Ao 0 - 6 cm	7,47									
R 10 - 30 cm										
AP_3 - Salva										
Ap 0 - 20 cm	7,75	2,41	3,2	0,118	33	176	45,3	42,7	8,0	4,0
C 20 - 40 cm	8,12		4,5				17,6	66,3	8,0	8,1
AP_4 - Blăjoaia										
AoGr 0 - 15 cm	3,70	12,2	-	0,668	9	166	25,6	48,8	11,2	18,8
C 15 - 35 cm	5,55	0	-	0,110			76,0	12,0	8,0	6,0
Gr 65 - 85 cm	5,60	1,93	-				12,5	21,4	33,6	31,5
AP_5 - Floreşti										
Ao 0 - 10 cm	7,90	1,93	4,9	0,096	43	109	52,2	28,6	15,0	4,2
C 10 - 20 cm	8,05	0,40	5,2				57,0	30,4	8,2	4,4
AP_6 - Păuleşti										
Ao 0 - 8 cm	8,00	2,00	1,5	0,110	29	183	1,9	65,2	14,5	18,4
AC 10 - 30 cm	7,95	1,53	2,3				1,5	64,0	17,0	17,5
C_I 40 - 60 cm	8,15	0,20	3,0				0,5	57,3	21,0	21,2
C_{II} 80 - 120 cm	8,15	0,63	1,1				1,7	76,0	10,3	12,0
AP_7 - Gârdani										
Ao 0 - 20 cm	7,70	1,85	2,1	0,111	23	133	8,4	59,6	16,6	15,5
C 40 - 60 cm	8,10	0.92	2,3				0,7	30,7	38,0	30,6
R 100 - 120 cm	8,0									
AS_1 -										
Vásárosnamény										
Ao 0 - 20 cm	7,85	2,12	0,8	0,115	63	274	2,7	45,8	29,9	21,6
CI 40 - 60 cm	8,14	1,13	0,6				2,3	67,8	15,3	14,6
CII 80 - 120 cm	8,15	1,38	1,3				0,5	64,0	26,6	9,0

Table 1.

Table 1. continue

Soil and Location	pH H_2O	Org. mat %	$CaCO_3$ %	N total %	P ppm	K ppm	Coarse Sand %	Fine Sand %	Silt %	Clay %
AS_2 - Someş-Odorhei										
Ao 0 - 20 cm	8,08	2,09	1,5	0,111	95	199	2,9	63,0	10,6	23,5
C 20 - 40 cm	8,21		1,7				2,6	72,5	6,6	18,3
AS_3 - Vetiş										
Ap 0 - 20 cm	7,55	2,61		0,133	83	175	0,8	38,2	27,8	33,2
Ao 20 - 40 cm	7,80	2,69		0,127			0,9	48,0	25,6	25,5
C 50 -120 cm	7,80	0,70					0,4	67,0	10,2	22,4
AS_4 - Satu Mare										
Ap 0 - 20 cm	6,30	2,03	-	0,109	78	211	11,2	45,4	17,4	26,0
Am 20 - 37 cm	6,30	1,91	-	0,117	59	232	12,5	43,8	16,2	27,5
CGor 70 - 120 cm	6,30	0,59	-	0,060	37		7,4	42,7	15,9	34,0
AS_5 - Culciu Mare										
Ap 0 - 20 cm	6,50	2,44	-	0,138	84	232	22,0	26,7	19,2	32,1
Am 20 - 45 cm	6,62	1,97	-	0,097	96	245	28,7	23,1	17,2	31,0
CGo 80 - 120 cm	7,00	1,20	-	0,070	29	193	23,6	25,3	17,6	33,5
AS_6 - Reteag										
Ap 0 - 20 cm	7,90	1,72	1,3	0,090	96	266	21,7	44,9	8,1	25,3
Ao 20 - 36 cm	7,92	1,53	1,5	0,073	99	258	22,3	47,0	7,4	23,3
C 50 - 120 cm	7,90	0,70	0,7	0,037	63	199	29,5	54,9	2,0	13,6
LG_1 - Valea Vinului										
Ao 0 - 20 cm	7,1	4,48	-	0,233	46	234	2,3	18,7	29,5	49,5
A/Go 20 - 40 cm	7,2	1,70	-	0,112	43	210	1,9	19,9	29,7	48,5
Gr 60 -120 cm	7,5	0,90	-	0,056	36	189	0,7	16,8	22,4	60,1
LG_2 - Sălsig										
Aow 0 - 20 cm	7,95	3,01	2,2	0,172	89	180	5,1	20,9	34,0	40,0
A/Go 30 - 45 cm	8,32	1,30	3,2	0,090	76	166	3,2	18,6	32,0	56,2
Gr 50 - 120 cm	8,30	0,70	4,1	0,042	49	156	2,0	25,5	9,0	63,5
				SO_4 %	Cl %	Total res%				
GS - Dezmir										
Aosa 0 - 20 cm	7,6	4,30	8,83	0,12	1,76	6,40	0,9	20,5	36,3	42,3
A/Gosa 40 - 60 cm	7,8	1,65	10,42	0,07	1,19	4,28	0,8	24,3	35,2	39,7
Grsa 65 -120 cm	7,8	0,87	6,92	0,05	1,30	4,59	1,0	18,1	28,0	52,9