SOILS OF THE FLOOD PLAIN OF THE MUREŞ (MAROS) RIVER

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Introduction

Along its 768-km route the Mureş River - the most important tributary of the Tisza River - crosses several relief features with varying lithological structures, which leave their marks on the soil cover of the flood plain, including the active flood plain.

Having its source in Hăsmaşu Mare (Nagy Hagymás) Mountain, the Mureş River steps in the Intracarpathian fluviolacustrine Depression of Giurgeu, a large, poorly drained Quaternary subsidence zone, surrounded by a mountainous area built of silicatic metamorphic rocks, on the one hand, and volcanic andesitic rocks, on the other. All alluvia arriving in the bottom of the depression consists of deposits from gravel to fine sand, originating from these surrounding montains.

Leaving this depression area, the Mureş crosses its longest gorge - Topliţa - Deda - (60 km) through volcanic mountains. The alluvia consists of coarse gravel with few fine particles, mostly andesitic.

At its emergence from the narrows through the volcanic mountains (Deda), the river flows at first in a Quaternary paleodelta, developed exclusively in the subsidence zone, at the contact point of the mountain. This hinterland fandelta is situated between the foot of the mountain and the mouth of the Gurghiu River, a tributary of the Mureş, near Reghin. On this extent the alluvial deposits consist of a mixture of coarse andesitic gravel, sand and fine particles, the two latter originating from the nearby piemontane region.

The further path of the river cuts the large Transylvanian Plateau, a relief developed on friable Sarmatian and Pliocen deposits, consisting mostly of pellitic-psephitic, and subordinately of psamitic sediments (marly clay, sandy clay, loam and bench of sand). Consequently, the recent alluvia of the river are, in most cases, band water conductors, finely granulated, rich in lime.

Breaking through the diapir zone of Ocna Mureş - Teiuş, the alluvia of Mureş frequently becomes salty.

Due to the nearness of the South Carpathians (Sebeş Mountains) and Apuseni Mountains along the Alba Iulia - Orăştie trough-like depression, and mainly in the Deva - Zam gorge, the alluvial deposits are coarser and contain less lime, than that in the section of the Transylvanian Plateau.

At the issue from the mountain at Lipova the Mureş flows on a succession of self-built deltas, situated between the foot of the mountain and the mouth of the river, belonging to the low-level Holocene area of the southeastern Hungarian Plain.

Prior to river regulation in this deep alluvial area, the running waters wandered freely, virtually without beds, due to the very low gradients in the region.

Nowadays, several sections of the Mureş River are regulated, and flood-control levees have been erected.

Materials and Method

In this paper we present the soil cover of the flood plain of the Mureş River, on a scale of 1:300 000. Within the limits of the flood plain, the active flood plain represents frequently a relative narrow stripe, extremely difficult to delineate at the scale we used.

We present the soil map of the flood plain on fourteen sheets, with a profile of the signifcant soils found in the presented area sketched on each.

The materials used consist of soil maps published by the Romanian Research Institute of Pedology and Agrochemistry [10,11,12,13,14], soil maps of Mureş County [6] and Hunedoara County [15] and several other published or unpublished soil surveys and studies.

In compiling Table 1 we have used data from the offices of Pedology and Agrochemistry of counties intersected by the Mureş River, as well as proper ones. In all chemical procedures air-dry samples were crushed, care being taken to avoid fragmenting nonsoil material, to pass a 2-mm roundhole sieve. Material retained by the sieve was reported as greater than 2 mm. All determinations were performed on the less than 2 mm fraction, and results were reported on this basis.

The heavy metal analyses were performed by means of atomic absorbtion spectrofotometric analysis (PYE-UNICON, Model SP-2900), in order to determine if any heavy metal pollution exists.

The soils of the flood plain, in particular those of the active flood plain, are of great importance for aquatic biocoenoses, generally for the state of running water, for many reasons. First of all, the soil cover is an important natural filter, which retains in large quantities the waste products. Its efficiency depends considerably on certain soil characteristics affecting permeability, cation mobility, such as clay, humus, pH, and their integration as cation-exhange capacity. Secondly, as a component of riverside biotopes, the soils of the flood plain determine to a great extent the nature, the structure of biocoenoses.

Short description of soils

Characteristics of the soils described in this paper are presented in Table 1. Four groups of soil have been found in the flood plain of the Mureş River, as follows: alluvial protosoils, alluvial soils, gley soils and peaty soils.

Alluvial protosoil

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

Generally, the alluvial protosoils are stratified, having in most cases a loose consistency and coarse texture (gravels, sands, loamy sands), but here and there, they also

Table 1 Physical and chemical characteristics of several soil samples

Soil	Clay %	pH-H_2O	Org mat %	$CaCO_3$ %	P ppm	K ppm	HCO_3 (mg/100g)	Cl (mg/100g)	SO_4 (mg/100g)	T (mg/100g)	Na % from T
AP1 Morareni											
Ao 0-20 cm	15,4	7,8	1,78	0,41	41	69					
C 20-40 cm	15,4	7,8	1,22	0,41	23	45					
AP2- Sintana de Mures											
Ao 0-30 cm	28,8	8,2	1,87	0,50	39	78					
C1 30-75 cm	16,5	8,2	0,85	0,40	27	78					
C2 75-(120) cm	13,4	8,2	-	0,50	-	-					
AP3- Chelmac											
Ao 0-30 cm	36,9	8,0	2,30	0,69	31	79					
AC 30-45 cm	36,8	7,8	1,60	0,20	8	51					
C 45-(120) cm	30,2	8,2	0,60	0,30	-	-					
AP4- Deva											
Ao 0-30 cm	8,7	8,0	1,09	1,73	67	110					
C1 30-60 cm	18,8	8,0	0,91	2,32	25	85					
CGo 60-(120) cm	27,5	8,0	1,29	3,12	-	-					
AP5- Zam											
Ao 0-20 cm	24,2	7,9	1,2	2,40	72	170					
AC 20-50 cm	36,0	7,8	0,7	1,70	44	150					
CGo 50-(120) cm	34,2	8,0	0,6	2,60	-	-					
AS1- Ogra											
Ao 0-70 cm	30,7	7,8	2,45	2,3	156	170					
AC 70-80 cm	28,5	7,8	2,23	2,0	48	100					
C 80-(150) cm	28,4	7,9	0,65	1,6	-	-					
AS2- Deda											
Ao 0-40 cm	27,0	6,5	3,42	0,0	34	14					
R 40-(80) cm	4,2	6,2	0,14	0,0	-	-					
AS3- Pecica											
Ao 0-50 cm	43,4	8,0	2,77	8,8	20	155					
C1 50-70 cm	30,9	8,4	2,35	5,3	15	105					
C 70-(120) cm	18,7	8,6	0,37	5,1	-	-					
AS4- Deda											
Ao 0-30 cm	27,7	7,2	3,84	0	36	150					
30-60 cm	27,8	7,1	1,17	0	11	80					
CGor 60-(120) cm	33,0	7,0	0,82	0	-	-					
AS5- Ocna Mures											
Ao sc 0-40 cm	39,0	8,7	2,98	4,4	17,0	120	61,0	12,4	144		
AC sc 40-60 cm	38,0	8,8	1,80	4,7	15,0	107	42,7	14,2	120		
CGo sc 60-(120) cm	36,0	8,7	1,07	14,6	10,0	98	24,4	17,8	105		
AS6- Cenad											
Am 0-30 cm	43,1	7,5	4,0	9,2						29,5	2,13
Cna 30-85 cm	38,3	9,2	0,8	9,2						29,1	17,10
CGona 85-(120) cm	40,3	9,4	0,5	7,9						-	-
LG1-Deva											
AGo 0-50 cm	11,5	8,1	1,05	13,23	16	70					
Gr 50-(120) cm	18,0	7,8	-	4,90	-	-					
LG2- Singeorgiu de Mures											
Ao 0-25 cm	50,5	7,6	3,88	1,5				14,7	12,5		
A/Go 25-40 cm	49,5	7,8	2,98	2,1				51,8	2,5		
Gor 40-(120) cm	61,5	8,0	1,39	1,1				21,7	2,0		
Hg1- Joseni											
Am 0-20 cm	33,0	5,4	6,0	0	6	80					
Gr 20-70 cm	13,2	5,6	2,7	0	21	50					
HG2- Toplita											
Am 0-25 cm	57,0	5,1	5,91	0	78	130					
AGr 25-40 cm	58,2	5,0	5,08	0	-	-					
Gr 40-100 cm	60,4	5,0	-	-	-	-					
HG3- Teisus											
Am sc 0-50 cm	31,0	8,2	3,20	2,7	28	70	61,0	12,4	144		
AGo sc 50-70 cm	38,9	8,5	1,10	0,6	-	-	42,7	14,2	120		
Gr 70-(120) cm	52,0	8,7	-	7,3	-	-	24,4	17,8	105		
DG- Orăstie											
Am 0-45 cm	47,0	7,6	3,10	-	22	178					
Cna 45-64 cm	51,0	8,3	2,30	4,3	11	164					
CGona 64-(120) cm	42,0	8,6	0,72	4,6	10	125					
TB- Voslobeni											
T1 0-25 cm	0	7,5	32,00	16	39						
T2 25-70 cm	0	7,0	26,60	136	27						
Gr 70-(120) cm	0	7,4	2,32	-	-						

can be moderately coarse-textured (sandy loam) and medium-textured (loam and silt). This group of soils has a low organic matter and clay content, consequently a weak cation-exchange capacity and low retaining power, mostly the coarse-textured ones. The lime content and in connection with this the pH-value vary along the river, but they do not limit plant growth.

Due to their particle-size distribution and the lack of an impermeable layer, even in the deeper levels, most of the alluvial protosoils are excessively permeable, therefore they cannot retain a great part of the substances which pollute the running water. In this respect the storage of various wastes on the active flood plain can be harmful for the river, however the heavy metal analysis of some soil samples originating from the active flood plain did not show any sign of pollution (Table 2).

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, forestation with poplar species is desirable.

Table 2. Heavy metal concentration of some soil samples of the active flood plain in mg/kg dry matter

Characteristic Soil	1	2	3	4	5	6
pH-H2O	6,6	6,6	5,3	5,9	8,0	7.9
Clay, %	0	13,2	36,0	13,0	25,6	19,6
Org. Matter, %	22,7	2,0	3,9	9,0	4,4	4,0
Cd, mg/kg	0	0	0	0	0,2	0,1
Cr, mg/kg	0	0	0	0	21,0	17,0
Cu, mg/kg	0	0	0	0	0	0
Fe, mg/kg	0	382	478	400	23,0	123
Mn,mg/kg	0	118	100	118	104	87
Ni, mg/kg	0	0	0	0	0	0
Pb, mg/kg	0	0	0	0	0	0
Zn, mg/kg	0	0	5	19	0	7

Provenance of soil samples: 1. Vosloben; 2. Senetea; 3. Remetea; 4. Lunca Bradului; 5. Lernut - Cipau; 6. Teius.

Alluvial soils

The alluvial soils occupy most of the parts 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%, reaching even 4% in some cases.

With the exception of those of the Topliţa-Deda gorge, showing neutral or slightly acid reaction, all alluvial soils showed an alkaline reaction.

The clay content was also higher, as compared with alluvial protosoils, and varied from 27% to 43%. As a result of this higher clay content, the water penetrated through their profile is well filtered.

Generally having high fertility, the alluvial soils of the Mureş River are used almost totally as plough-land, in some cases employing irrigation.

The groundwater level fluctuates seasonally between 0.50 and 2.50 meters, in close connection with the water level of the river.

Though large quantities of fertilizers have been employed in the last decades, no chemical pollution of the soil cover could be proved. Nevertheless groundwater pollution with nitrates is not out of question.

Nearby the greater cities - Tîrgu Mureş, Alba Iulia, Deva, Arad - large amounts of waste are deposited on the flood plain, extensive surfaces of fertile alluvial soils being withdrawn from agricultural use, harming in the same time not only more or less broad neighbouring soil strips, but also the groundwater and running water, too.

An important source of soil - and groundwater pollution can be the waste-water purification plants, when because of frequently filling up of their drying beds, large amounts of sewage sludges are deposited directly on the soils, not far from the river.

Gley soils

Two groups of gley soils have been distinguished: low humic gley soils and humic gley soils. Both are hydrogenic soils with high groundwater levels during a long period of the year.

Most of this soil type have a high clay content, and thus are bad water conductors. The most extensive occurrence of the gley soils is in the Intracarpathian fluviolacustrine Depression of Giurgeu. After emerging from the volcanic mountains, the gley soils are spread mainly in the deep-lying marginal areas of the flood plain. The important river-regulation and floodwater-prevention works performed, especially downstream from Arad, led to many changes in the position of the riverbed. As a result, the present flood plain is full of cut-off branches and oxbows, filled with poor water-conducting silty and clayey materials, favorable for hydrogenic soil-forming processes.

On these soils grows generally a luxuriant herbaceous vegetation, representing not only an important fodder source for cattle, but at the same time a favourite transitional place for some migratory birds. Transformation of these soils into farmland is not indicated.

Peaty soils

In the upper course of the Mureş River, a considerable part of the active flood plain is covered by a thick organic matter layer, partly transformed into peat or peaty soil. Their existence is due to a permanent water supply from lateral thick alluvial fans, that maintain a high groundwater levels. As a result the organic matter layer is saturated permanently. Near Voslobeni, in these waterlogged soils grow some relic plants of the last glacial period. Protection of these relicts by law is necessary.

Conclusions

On the flood plain of the Mureş River, four groups of soils were distinguished: alluvial protosoils on the active flood plain with a low retaining and filtering power, alluvial soils on the greatest part of the floodwater-free higher level of the river plain, gley soils on the marginal deep lying areas of the flood plain, and peaty soils in the upper course of the river.

No harmful chemical pollution of the soil cover could be proved along the entire course of the river. Some exceptions exist, however, mainly around the waste-water purification plants of the greater cities.

In order to enhance the retaining and filtering power of the alluvial protosoils on the active flood plain, forestation with popular species is recommended.

References

1. Andó, M. (1978) Physical-geographical characterization of the running waters of the southeastern Hungarian Plain.- Acta Univ. Szeged. Acta Geographica XVIII.
2. Cotet, P., Stăncescu-Grumăzescu, C. (1969) Harta geografică a Cîmpiei Tisei (Geographical map of the flood plain of Tisza).- St. si cerc.de geol., geof.geogr. seria geogr. XIV.
3. Haan, S. de, Rethfeld, H., Driel,W. van (1985) Acceptable levels of heavy metals (Cd,Cr,Cu,Ni,Pb,Zn) in soils, depending on their clay and humus content and cation-exchange capacity.- Rapport 9-85 Inst.voor Bodemvruchtbaarheid.
4. Iacob, Gh. (1967) Aspecte geografice privind lucrările hidroameliorative şi utilizarea actuală a terenului în Cîmpia Mureşului (Geographical aspects of the use of agricultural land in the Mureş valley).- St. si cerc. de geol.geof.geogr.seria geogr.XIV.
5. Jakab, S. (1977) Resursele funciare ale judeţului Mureş şi principalele probleme pedoameliorative (Reserve-fund of agricultural land and principal melioration problems of Mureş County).-Lucr.II-lea Simp. de geogr.aplicata,Cluj.
6. Jakab, S., Incze, A., Sipos, Z., Peter, B. (1979) Harta solurilor judeţului Mureş(Soil map of Mureş County).- I.G.E.F.C.O.T Bucureşti.
7. Mezôsi, G. (1983) Szeged geomorfológiai vázlata (Geomorphological scheme of Szeged).- Alföldi tanulmányok, Békéscsaba.
8. Popp, N. (1972) The Problem of quaternary paleodeltas in Romania.- Rev.roum. geol.geoph.serie geogr. 16.
9. Preda, M., Crişan, I., Roman, I., Taropa, T. (1962) Solurile din bazinul Mureş de la confluenţa cu Nirajul la confluenţa cu Arieşul (Soils of the Mureş valley between Niraj and Arieş streams).- Edit.Acad.R.P R.,Fil.Cluj.
10. Harta solurilor României (Soil map of Romania)sc. 1:200 000,foaia Arad,1991. Inst.cerc. ped.si agroch. Bucureşti.
11. Harta solurilor României (Soil map of Romania)sc.1:200 000,foaia Deva,1990. Inst.cerc. ped.si agroch. Bucureşti.
12. Harta solurilor României (Soil map of Romania)sc.1:200 000,foaia Orastie,1979. Inst.cerc.ped.si agroch. Bucureşti.
13. Harta solurilor României (Soil map of Romania)sc.1:200 000,foaia Sînicolau Mare,1989. Inst.cerc.ped.si agroch. Bucureşti.
14. Harta solurilor României (Soil map of Romania)sc.1:200 000,foaia Turda,1988. Inst.cerc.ped.si agroch. Bucureşti.
15. Harta solurilor judeţului Hunedoara (Soil map of Hunedoara County)sc.1:100 000.1989. Ofic jud.stud.ped.si agroch. Deva.

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Figs. 1-14. The soil cover types of the flood plain of the Mure□ River.

LEGEND OF SOILS

I. ALLUVIAL PROTOSOILS

AP1	Loamy sandy stratified alluvial protosoil on gravelly andesitic substratum.
AP2	Loamy sandy and sandy stratifed alluvial protosoil on sandy substratum.
AP3	Sandy loam alluvial protosoil on loamy substratum.
AP4	Deep gley loamy alluvial protosoil on sandy loam or loam.
AP5	Moderately gleyied silty alluvial protosoil on silty substratum.

II. ALLUVIAL SOILS

AS1	Loamy alluvial soil on sandy loam.
AS2	Loamy sandy skeletal alluvial soil on gravelly andesitic substratum.
AS3	Loamy and clayey loam alluvial soil on sandy loam and silt.
AS4	Deep gley sandy loam alluvial soil on sandy loam and silt.
AS5	Salt-affected poorly drained alluvial soil on salt clay.
AS6	Alkali alluvial soil on clayey substratum with cut-off branches and remnants of oxbow lakes

III.GLEY SOILS

[illegible]	Low humic gley soil on sandy substratum.
[illegible]	Low humic gley soil on silty and clayey substratum.
[illegible]	Humic gley soil on gravelly andesitic and silicatic substratum.
[illegible]	Humic gley soil on silty and clayey substratum.
[illegible]	Salt-affected humic gley soil on silty and clayey substratum.
DG	Drained humic gley soil on silty substratum.

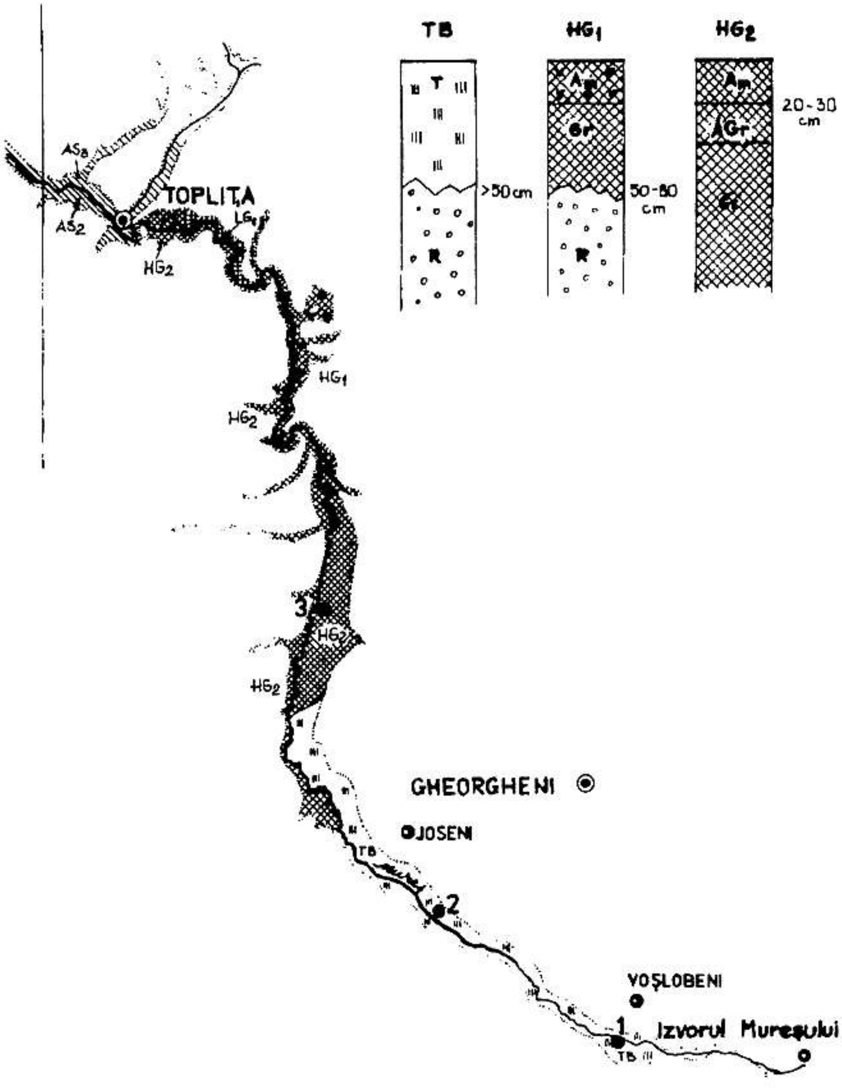
IV. PEATY SOILS

TB	Peaty soil on gravelly andesitic and silicatic substratum.

OTHER SIGNS

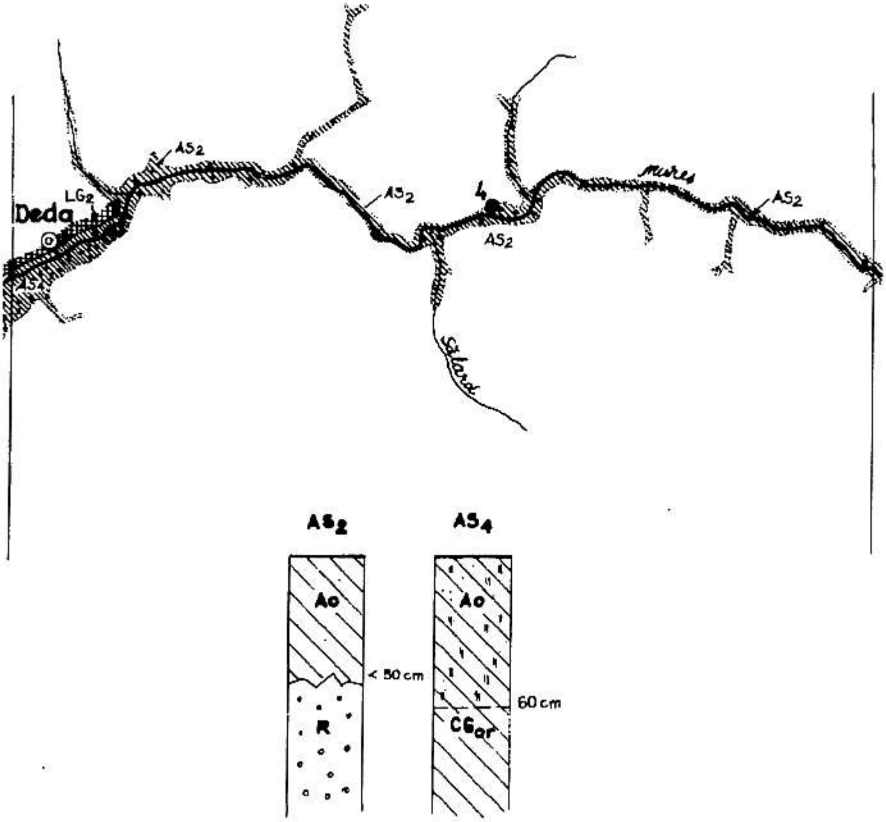
	Water covered area
⊗	Place of soil samples
	Regulated river section
	Floodcontrol level

Fig. 1



TB
HG1
HG2
20-30 cm
>50 cm
50-80 cm
TOPLIȚA
HG2
HG1
HG2
3
HG2
HG2
GHEORGHENI
JOSENI
TB
2
VOȘLOBENI
1
Izvorul Mureșului
TB

Fig.2.



Deda
LG2
AS2
AS2
4
AS2
Mures
AS2
Szlard
AS2
AS4
Ao
< 50 cm
R
Ao
60 cm
CGor

Fig. 3.

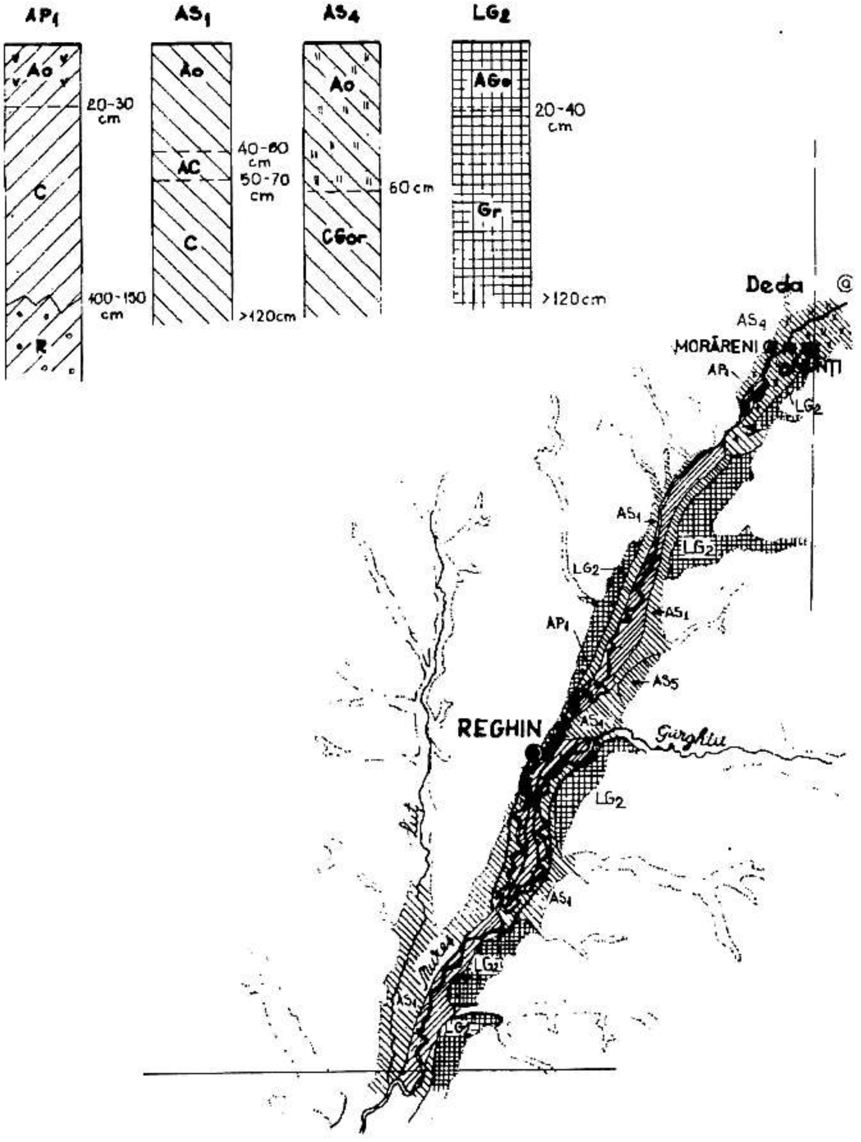

AP1
AS1
AS4
LG2
Ao
20-30 cm
C
100-150 cm
R
AC
40-60 cm
50-70 cm
>120cm
CGor
60 cm
AGo
20-40 cm
Gr
>120cm
Deda
AS4
MORĂRENI
AP1
LG2
AS1
LG2
LG2
AS1
AP1
AS5
REGHIN
AS4
Gurghiu
LG2
AS1
Mureş
LG2
AS1
LG2

Fig. 4.

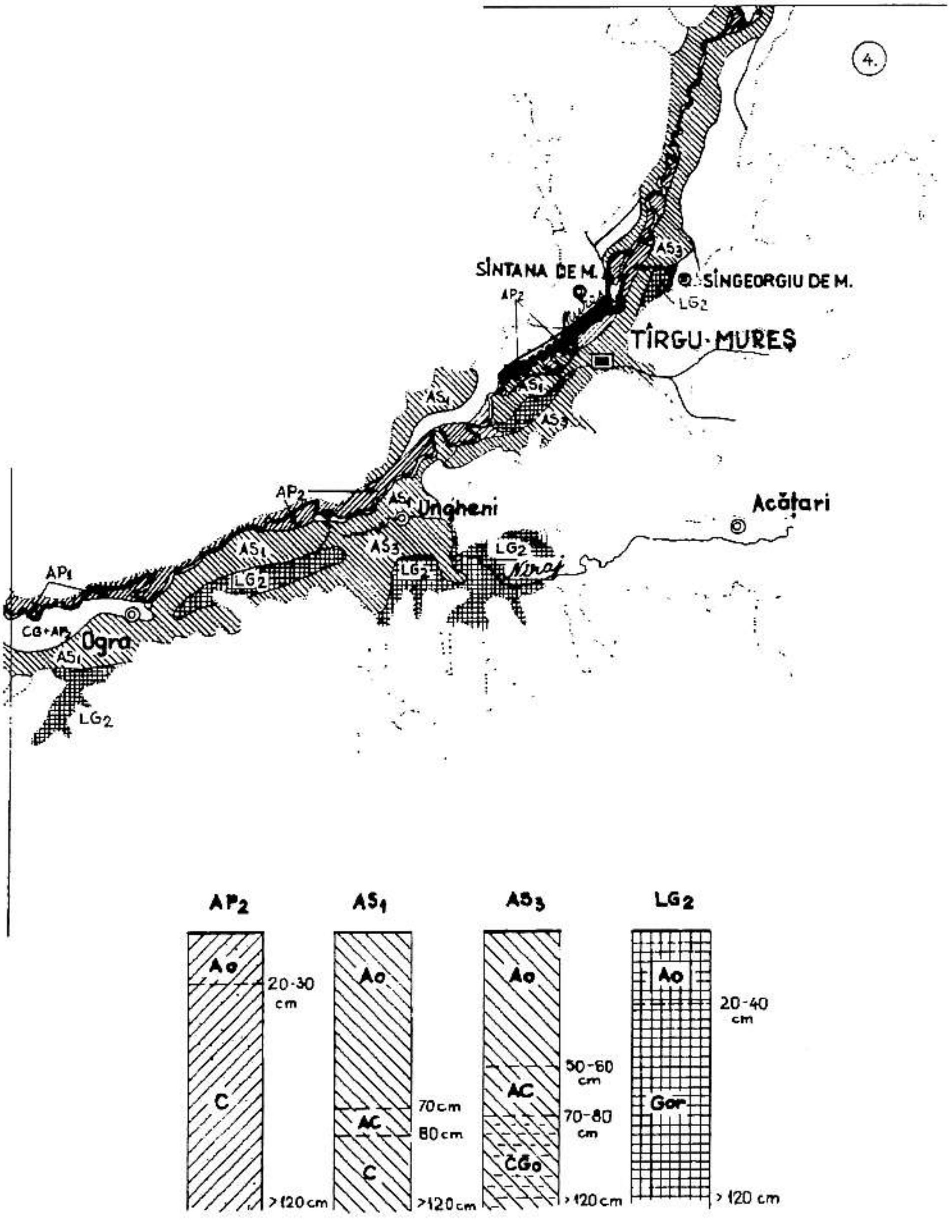
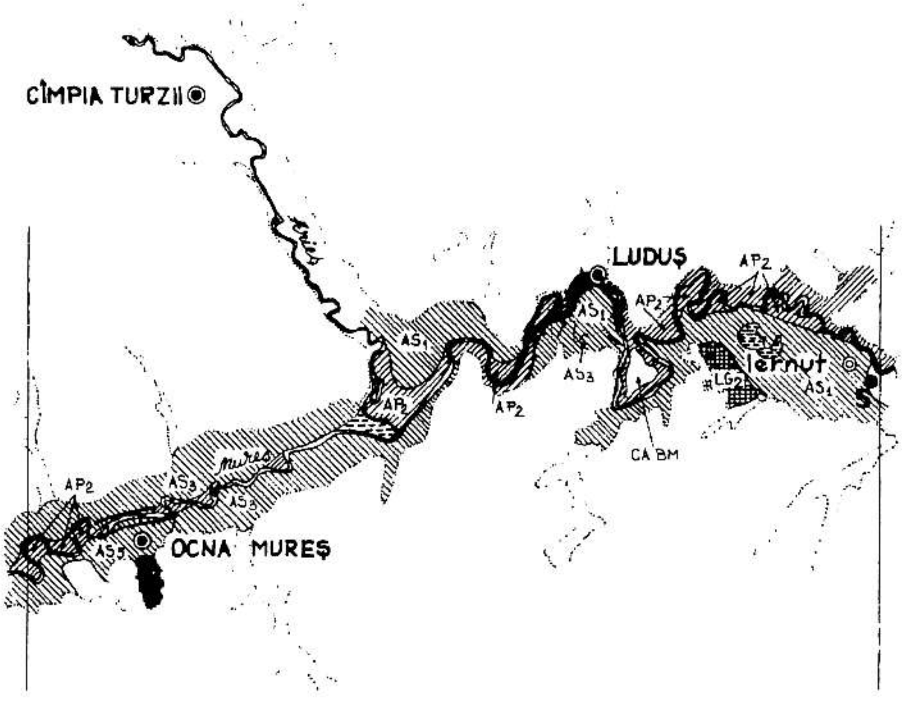

4.
SINTANA DE M.
SINGEORGIU DE M.
TIRGU-MUREŞ
AS3
LG2
AP2
AS1
Ungheni
Acăţari
Niraj
AP1
CG+AP2
Ogra
AP2
AS1
AS3
LG2
Ao
20-30 cm
C
>120 cm
Ao
70 cm
AC
80 cm
C
>120 cm
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm
Ao
20-40 cm
Gor
>120 cm

Fig. 5.


CÎMPIA TURZII
LUDUȘ
AP2
AS1
AP2
AS3
Iernut
LG2
AS1
AP2
CA BM
mureș
AP2
AS3
AS3
AS5
OCNA MUREȘ

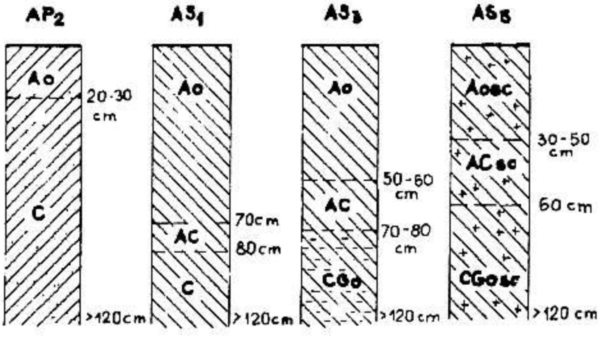
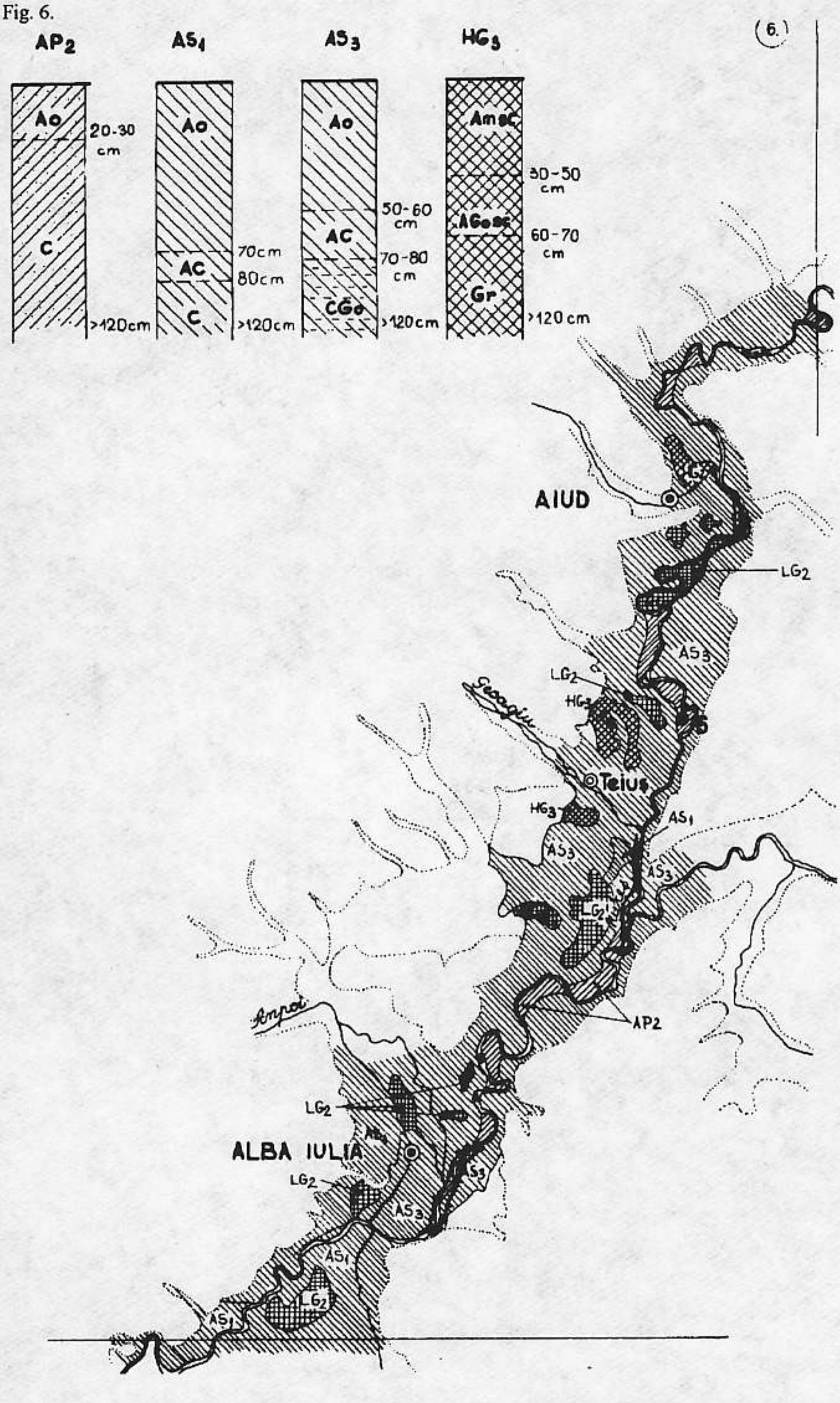
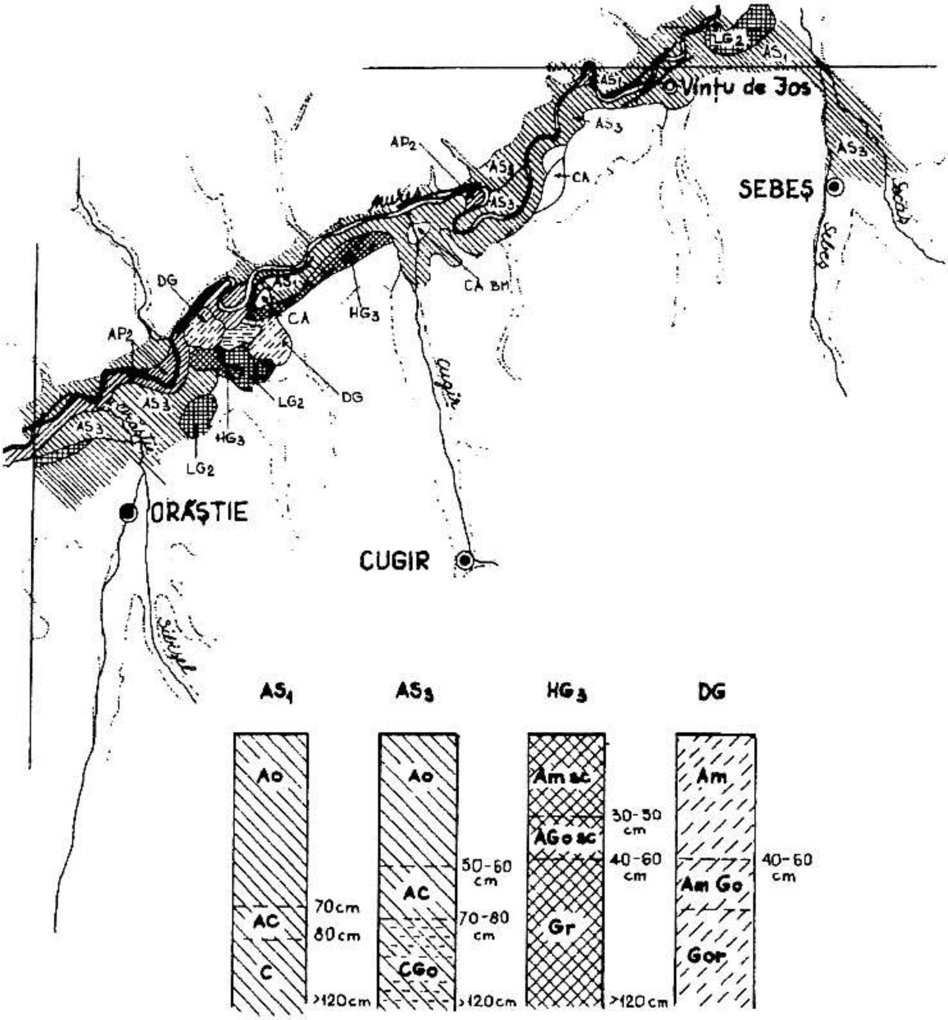

AP2
Ao
20-30 cm
C
>120cm
AS1
Ao
70cm
AC
80cm
C
>120cm
AS3
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm
AS5
Aosc
30-50 cm
ACsc
60 cm
CGosr
>120 cm

Fig. 6.



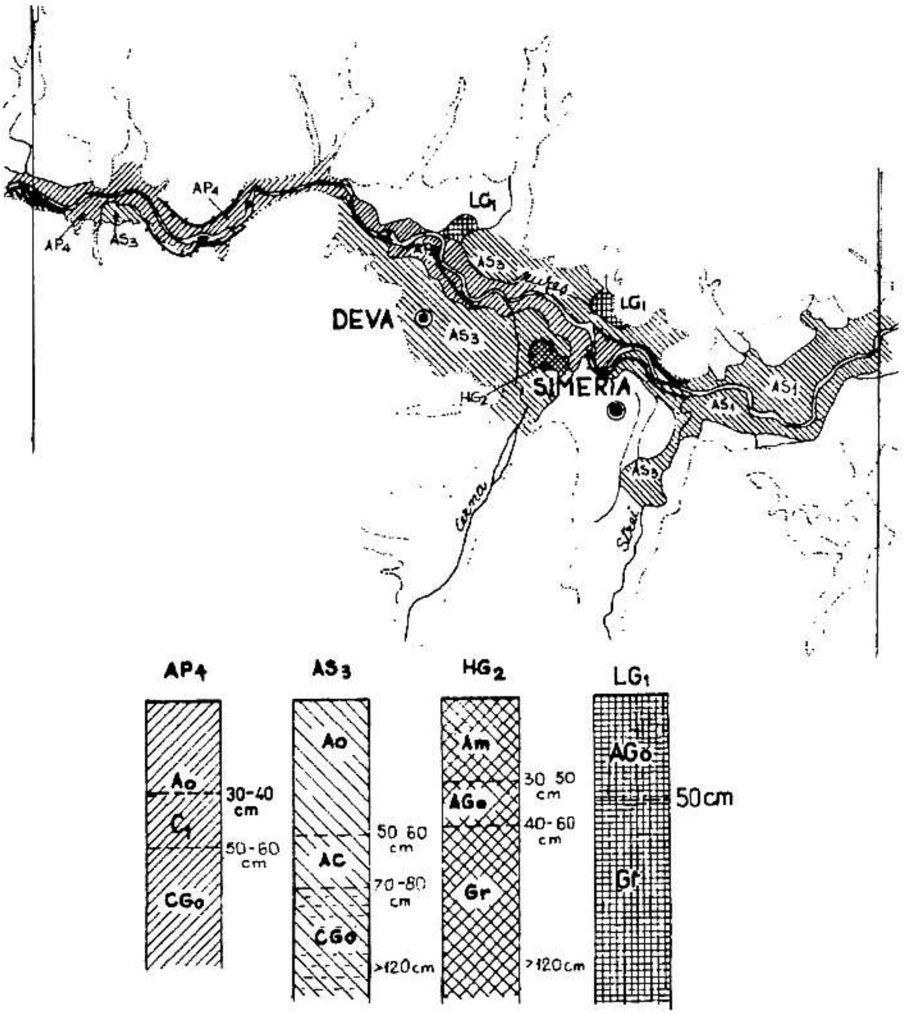
AP2
Ao
20-30 cm
C
>120cm
AS1
Ao
70cm
AC
80cm
C
>120cm
AS3
Ao
50-60 cm
AC
70-80 cm
CGo
>120cm
HG3
AmsC
30-50 cm
AGoss
60-70 cm
Gr
>120 cm
6.
AIUD
LG2
AS3
Teiuş
HG3
AS1
LG2
AP2
Ampoi
ALBA IULIA
AS1

Fig.7.



LG2
AS1
Vințu de Jos
AS3
AP2
AS3
CA
SEBEȘ
Mureș
CA BH
DG
AS1
CA
HG3
AP2
AS3
LG2
DG
AS3
HG3
LG2
ORĂȘTIE
CUGIR
Cugir
Sebeș
AS1
AS3
HG3
DG
Ao
AC
C
70cm
80cm
>120cm
Ao
AC
CGo
50-60 cm
70-80 cm
>120cm
Am sc
AGo sc
Gr
30-50 cm
40-60 cm
>120cm
Am
Am Go
Gor
40-60 cm

Fig. 8.



AP4
AS3
LG1
DEVA
HG2
SIMERIA
AS1
AP4
Ao
30-40 cm
C1
50-60 cm
CGo
AS3
Ao
50 60 cm
AC
70-80 cm
CGo
>120cm
HG2
Am
30 50 cm
AGo
40-60 cm
Gr
>120cm
LG1
AGo
50cm
Gr

Fig. 9.

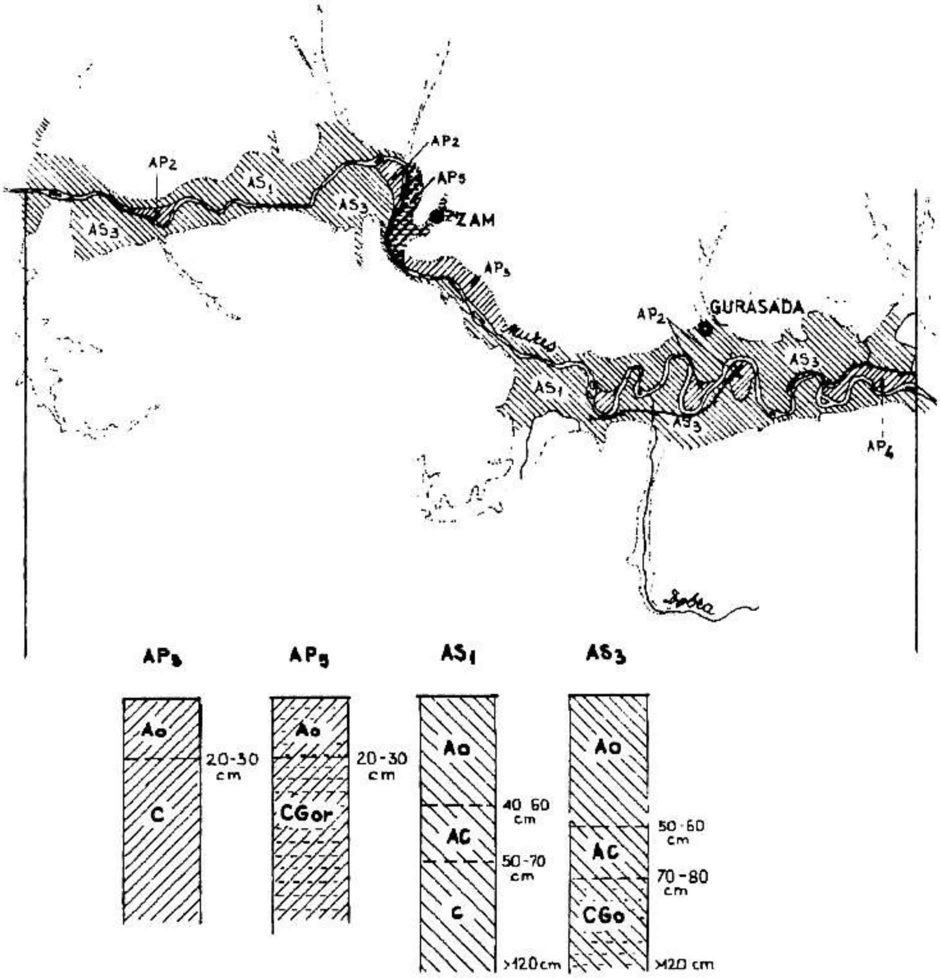

AP2
AP2
AP5
ZAM
AS1
AS3
AS3
AP5
GURASADA
AP2
AS3
AS1
AS3
AP4
AP5
AP5
AS1
AS3
Ao
20-30 cm
C
Ao
20-30 cm
CGor
Ao
40-60 cm
AC
50-70 cm
C
>120 cm
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm

Fig. 10.

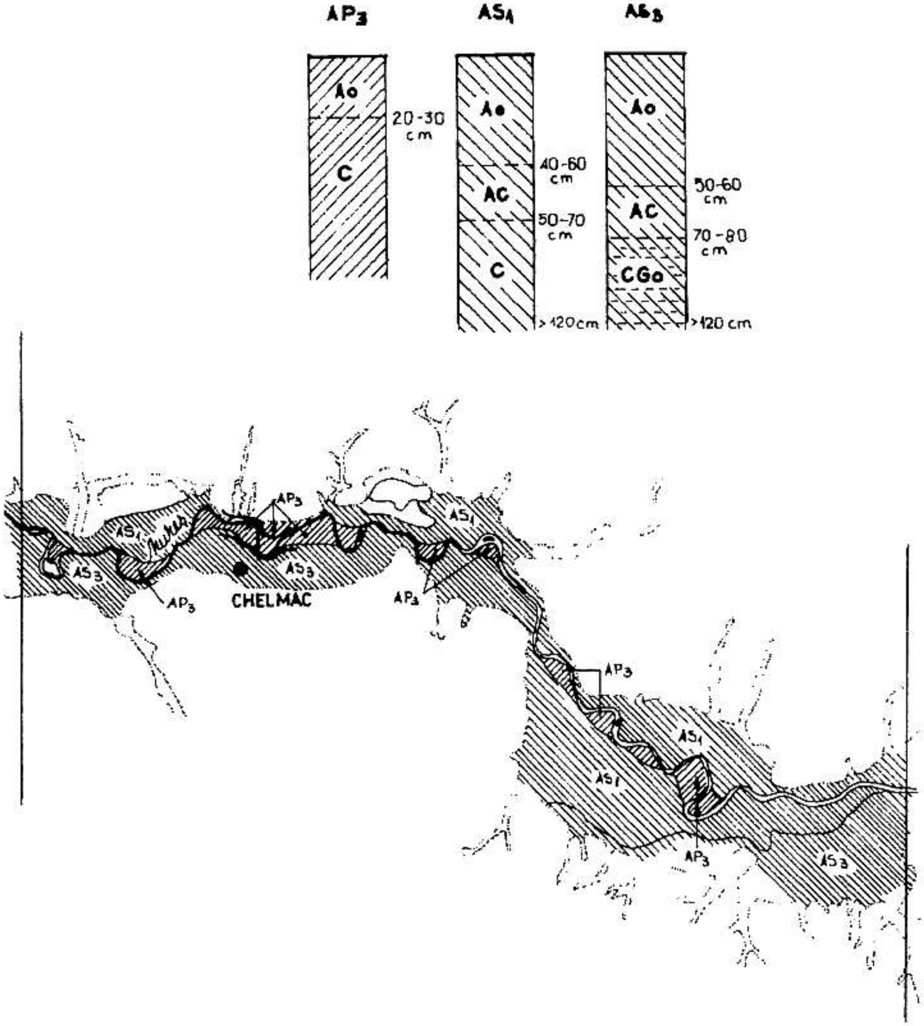
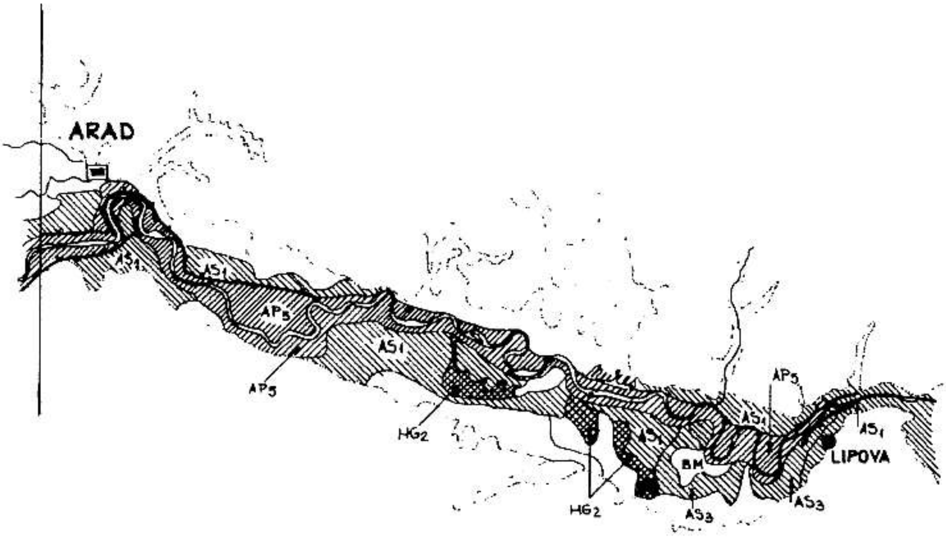

AP3
AS1
AS3
Ao
C
20-30 cm
AC
40-60 cm
50-70 cm
>120cm
50-60 cm
70-80 cm
CGo
>120 cm
CHELMAC

Fig. 11.


ARAD
AS1
AS1
AP5
AP5
AS1
HG2
HG2
AS1
BM
AS3
AP5
AS1
AS1
AS3
LIPOVA

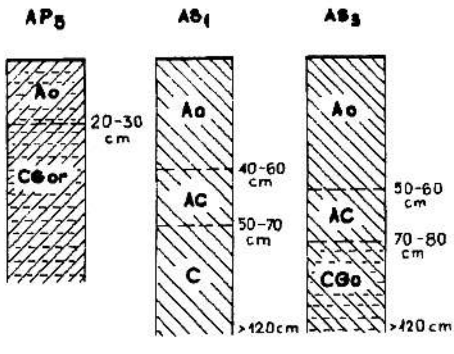

AP5
Ao
20-30 cm
CGor
AS1
Ao
40-60 cm
AC
50-70 cm
C
>120cm
AS3
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm

Fig. 12.

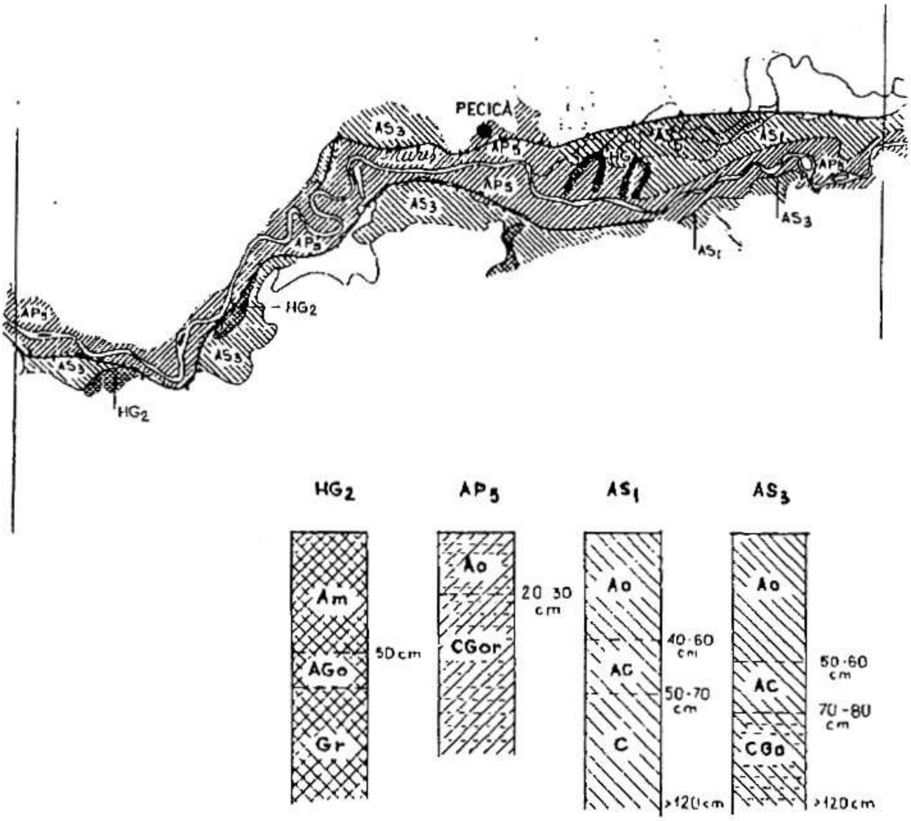

PECICA
AS3
AP5
AS1
HG2
HG2
AP5
AS3
HG2
AP5
AS1
AS3
Ao
Am
20 30 cm
AGo
50 cm
CGor
Ao
AC
C
40-60 cm
50-70 cm
>120 cm
Ao
AC
CGo
50-60 cm
70-80 cm
>120 cm

Fig 13.

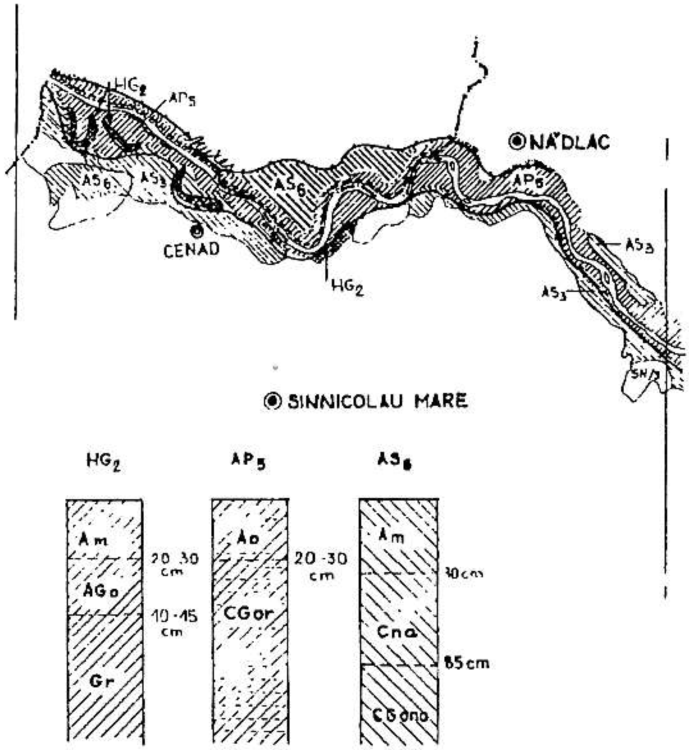

HG2
AP5
AS6
AS3
CENAD
NĂDLAC
AP6
AS3
HG2
SINNICOLAU MARE
HG2
AP5
AS6
Am
20-30 cm
AGo
10-15 cm
Gr
Ao
20-30 cm
CGor
Am
30 cm
Cna
85 cm
CGono

Fig. 14.