HISTOSOLS AND SOME OTHER REFERENCE SOILS FROM THE SEMENIC MOUNTAINS – ROMÂNIA

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Abstract: *The Semenic is situated in the county of Caraş-Severin. Its highest elevation is 1445 m, the crystalline schists are represented of mica-schists, gneiss with granite intrusion. The Semenic has a climate moderately continental, with an annual average temperature, at 1400 m altitude, of 3,5-4,0°C, an annual average precipitation of 1400 mm. the slopes of the Semenic are covered by forests consisting mainly of beech. The high plain consists of pasture with single old beech trees. Because of the numerous springs there are large surfaces with water-logging where the topmost layer contains more or less living Sphagnum patches. The Sphagnum peat below consists of the same moss species and with additional species like Cyperaceae. In those areas were effectuated soil profiles, and the type of soil are Histosols, upon 34 ha, with a total volume of 320000m^3. Histosols are Dystric, with o pH of 3,0-4,6, and are composed mainly of organic soil material. During development, the organic matter production exceeds the rate of decomposition. The decomposition is retarded mainly by low temperatures and anaerobic conditions which result in high accumulations of partially decomposed organic matter. Lateral linkages exist with a variety of other Reference Soil Group, including Podzols (Entic, Histi-Entic, Lepti-entic, Haplic, Umbric), Stagnosols, Cambisols and Regosols. A 1,6m Histosols profile was investigated by pollen and plant macrofossil analysis and dates by radiocarbon dating. The bottom date (140-150 cm), 6781±57BP, corresponds to the Mixed Oak Forest – Corylus zone – Middle Atlantic. Around the Histosols. Large areas are occupied by Podzols, soils characterized by the presence of a spodic horizon, in which the pH is 4,77 and BSP is 7,57. In this horizon amorphous compounds have accumulated consisting of organic matter and aluminium, with or without iron or other cations.*

Management requirements and use possibilities of Histosols are largely conditioned by characteristics such as the low bulk density and high compressibility and the high rate of decay upon drainage (subsidence), liming, fertilization. Podzols are used more often for forestry, extensive grazing or left fallow.

***Key words**: peat, Histosols, Podzols, subsidence, pollen*

INTRODUCTION

Histosols (from Gr. "histos", tissue) includes a wide variety of peat and muck soils ranging from moss peat of the boreal tundra reeds/sedge peat and forest peat of the temperate zone and the swamp forest peat of the humid tropics.

The definition for Histosols, in accordance with W.R.B. (1, 4) includes soils having a histic or a folic horizon with a depth of at least 10 cm overlying rock, or of 40 cm or more on mineral soil material, and lacking an andic horizon. Histosols cover approximately 275 million hectares in the northern parts of America, Europe and Asia. Histosols are normally associated with Podzols, Gleysols and Fluvisols. The map of Atlas of Europe shows that Histosols cover 5% of Europe. USDA Soil Taxonomy (2) consider that Histosol is a soil order saturated with water for ≥30 cumulative days during normal years, or are artificially drained, have an upper boundary within 40 cm from the soil surface and have a total thickness of either: ≥ 60 cm if ≥3/4 of the volume consists of moss fibres, or if the bulk density moist, is < 0.10gcm^{-3} or ≥40cm if they consist of either sapric or hemic materials, or of fibric material with 3/4 moss fibres, and have a bulk density, moist, of ≤0.10gcm^{-3}.

In SRTS, Histisol is a soil class including soils that have in the upper part of the soil profile a folic or histic horizon >50cm thick, or >20cm (Foliosol) thick if it rests on hard rock. Histosols are commonly called peatlands. Highly acid soils are referred to as bogs. Less acid Histosols are called fens if they lack trees and are dominated by grasses or swamps if they are at least partially forested. Marsh refers to wet mineral soils that are dominated by grasses and/or sedges. The dominant pedogenic process is the alteration of recognizable organic forms of leaves, stems, and roots, to unrecognizable organic materials. Histosols form on parts of landscapes where there is concentration of run-on, retention of precipitation, or discharge of groundwater. Accumulation of organic materials is favored by cold and wet climates because they inhibit decomposition of the materials. The anaerobic environment preserves pollen, therefore they contain a record of past climates and flora (Mokma, 7). In temperate zones the median rate of Histosols formation is about 0.6mm year^{-1} and the carbon contribution is about 21.4gm^{-2} year^{-1}. Most Histosols have formed since the end of the last ice age. In accordance with Mokma (6), in low-latitude region the average rate of accumulation was about 1.4mm year^{-1}. In Michigan, more northern latitude, the average rate was 0.55 mm year^{-1}. In Iceland it was 0.39mm year^{-1}. About 3.6 m of organic materials accumulated between 4400 B.P. and 1914 near Belle Glade, USA. The global biomass of higher plants amounts to approximately 500-700 GtC (1 Gt=10^{9}t) and contributes approximately 100 GtC in litter annually in the soil, either on the surface or deposited belowground as rhizodeposition. About the same amount of C is annually released from soil as CO_2.

Water directly affects decomposition through its controls on activity and transport of soil microorganisms, solubilization of organic constituents, oxygen supply and soil pH. Temperature controls the biochemical activity of intra-and extracellular enzyme activities, as well as metabolic activity of most soil organisms. For every 10^0 C rise in temperature, decomposition generally increases one-to two-fold. When oxygen becomes limiting in soil decomposition proceeds at a much slower rate. Alternative electron acceptors, including NO_3^-, Fe^{3+}, Mn^{4+}, SO_4^{2-} and CO_2 can be utilized by anaerobic bacteria such as denitrifiers, sulfate reducers, and methanogens. As soil pH decreases less than 4, microbial activity is severely retarded and accumulation of organic matter can occur. The process including accumulation in wetland conditions of plant remains and their transformation into peat is considered as peat forming. Peat is a soil organic material consisting of plant remains in various stages of decomposition. According to these stages, fibric, hemic and sapric peats are distinguished. *Fibric* material (Dictionary of Soil Science, 2) is an organic soil material whose fibre content is ≥ 3/4 of the total volume, and that has a low bulk density and a high water-holding capacity. *Hemic* material is intermediate in degree of decomposition between fibric and sapric materials. Bulk density is 0.10-0.20 gcm^{-3}, fibre content is normally 1/3 – 2/3 of the volume and the maximum water content, ranges from about 450 to ≥850%. *Sapric* material is highly decomposed, its fibre content is < 1/6 of the whole volume of the material, excluding coarse fragments. Their bulk density is commonly ≥ 0.2gcm^{-3} and the maximum water content is < 450 %.

MATERIAL AND METHODS

The study is based on a few special research works executed in the last decade, a co-operation with some German colleagues (Rösch, 10). As part of the pedological mapping the soil profile was sampled using the ICPA-București methods. For pollen and radiocarbon dating were taken subsamples every 2 cm and when the first pollen results enabled the construction of a stratigrafic overview subsamples were taken and submitted to the Radiocarbon Laboratory of Heidelberg.

RESULTS AND DISCUSSIONS

As part of detailed soil surveys were identified acid soils, like Podzols (predominantly Entic Podzols) and Dystric Cambisols, on the high table-land with numerous springs and water-logging there are Histosols. The slopes of the Semenic are covered by forests, consisting mainly of beech, birch and oak. These forests are partly managed in a traditional way with forest burning, grazing and pollard. The high plain consists of pasture with *Nardus stricta Deschampsia caespitosa*, *Festuca rubra*, *Agrostis tenuis*, *Vaccinium myrtillus*, *Carex rostrata*, *Carex flava*, *Sphagnum acutifolium*, *Sphagnum magellanicum*, *Sphagnum fallax*. The parent material are represented of mica-schists, gneiss and granite intrusion. The analytical datas for the main types of soil are presented in the tables.

Table 1

Analytical data – Dystric Histosols

Depth, cm	pH_{H2O}	Hydrol. acidity me	Exch base	CECs	BSP %	C %	Ntot %	P_2O_5 %	C/N
0-32	3.60	60.2	13.8	73.8	18.43	50.42	0.71	0.03	71.01
32-53	3.71	58.8	13.8	72.6	19.01	50.76	1.02	0.02	49.76
53-64	3.76	58.3	14.7	73.0	20.14	51.18	1.12	0.05	45.70
64-74	3.75	58.3	14.6	72.9	20.03	53.20	0.74	0.05	71.89
74-130	3.95	56.6	15.1	71.7	21.06	54.36	0.59	0.08	92.13
130-153	4.10	55.4	15.4	70.8	21.75	57.22	0.77	0.06	74.31
153-160	4.20	55.2	16.1	71.3	22.58	55.07	0.50	0.04	110.14

Table 2

Analytical data – Entic Podzols

Depth, cm	Clay %	Silt %	pH_{H2O}	Humus	P_{mobile} ppm	K_{mobile} ppm	Exch. base me	Hexch. me	CECs me	BSP %
5-22	9.7	14.2	4.77	15.0	9.2	140	2.17	26.49	28.66	7.57
22-47	10.9	19.7	4.73	7.25	7.8	130	1.08	18.16	19.24	5.61
47-76	9.6	13.3	5.43	2.10	16.8	127	0.43	9.42	9.88	4.35

Table 3

Analytical data – Haplic Podzols

Depth, cm	Clay %	pH_{H2O}	Humus %	Ntot %	Ptot %	BSP %
Ao 0-18	19.2	3.9	13.7	0.388	0.065	3.5
Ea 18-21	10.8	3.8	5.0	0.203	0.049	3.3
Bs 21-56	12.7	4.3	3.2	0.116	0.040	2.4

Table 4

Analytical data – Dystric Cambisols

Depth, cm	pH_{H2O}	Exch. base me	$Exch.H^+$ me	CECs me	BSP %
0-12	5.85	12.0	19.9	31.9	37.6
12-20	5.03	7.2	14.7	21.9	32.8
20-42	4.88	4.8	12.3	17.1	28.0
42-65	4.92	3.7	8.6	12.3	30.1
65-87	5.01	3.6	4.0	7.6	47.4
87-107	4.86	4.6	2.8	7.4	63.0

Most Podzols have a coarse texture ranging from sandy loam to sandy less than 10-15 percent clay. The capacity for water retention is low. Podzols and Dystric Cambisols are very acid soils, with a pH ranging from 3.8 to 4.8 in the surface horizons. The pH may increase to 5.4 in the lower horizons. Organic matter has high C/N ratios, especially in the surface horizons (≥25), indicative of low, biological activity and slow degradation of the organic materials. Histosols covered 34 ha with an estimated volume of 320000m^{-3}. The main areas are named Zănoaga Roşie (peat of 8-9 ha, depth185 cm, pH 3,7-4,6), Gozna (4 ha, depth 2,4m), Goznuța (0,5 ha, depth 0,9m), Şaua Goznei (1 ha, depth 1,5 m, pH 3,75-4,30), Râtul Mare (15 ha, depth 2,5 m, pH 3,7-4,2), Baia Vulturilor (2,5 ha, depth 1,5 m), Ogaşul Băilor (2 ha, depth 0,75m), Poiana Preluca (4000m^{-2}, depth 1,4 m).

Oligotrophy and prolonged wetness are primarily accountable for the low decay rate of organic debris. Specific density and volume density of the material are of particular importance among the mechanical, physical and chemical properties of Histosols. They determine the total pore volume and influence greatly the bearing capacity of the soil, its trafficability and the rate of subsidence of the soil surface if drainage is installed. Peat lands may be used for various forms of extensive forestry and/or grazing or are unused. Deep peat formations are best left in their natural state. The water samples collected at the downstream of the Histosols from the Baia Vulturilor area are very pure, with a pH ranging between 7.20-7.28, CO_3 0.0 mg·dm^{-3}, HCO_3 9.6-24 mg·dm^{-3}, Cl^- 30.2-39.5 mg·dm^{-3}, Ca^{2+} 4.0-12 mg·dm^{-3}, Mg^{2+} 2.43 mg·dm^{-3}, PO_4^{3-} 0.0, NH_4^+ 0.0, Na^+ 1.0-1.5 mg·l^{-1}, EC 41-42 µS·cm^{-3}.

Table 5

Radiocarbon datings (Rösch and Fischer, 13)

Depth, cm	Material	Pollen zone	Age BP	Standard deviation
90-84	peat	Fagus –Picea-Carpinus-MOF	1261	±19
115-105	peat	Fagus –Picea-Carpinus-MOF	2586	±39
135-125	peat	Carpinus	3895	±47
150-140	peat	Corylus-MOF	6781	±57

MOF Mixed Oak Forest (Quercus+Ulmus+Tilia+Fraxinus+Acer).

The bottom date (150-140 cm, 6781 ± 57BP) corresponds to the Mixed Oak Forest – Corylus zone from the Middle Atlantic. The next date is three Millenia younger (135-125 cm, 3985 ± 47BP) and marks the Carpinus peak and the beginning of the Fagus expansion at the beginning of the Middle Subboreal. The uppermost date (90-84 cm, 1261 ± 19 BP) marks the final decline of Tilia and Ulmus towards the end of the Middle Subatlantic. The rate of peat growth increases from 0.05 mm per year at the bottom to 0.7 mm per year in the upper part.

CONCLUSIONS

The Semenic mountains has a high plain at 1400m altitude, with an annual average temperature of 3.5-4.0^{0}C, and 1400 mm precipitations, covered with pasture which consists of Nardus stricta, Festuca rubra, Deschampsia flexuosa, Carex flava, with single old beech trees. There are large surfaces with water – logging where the topmost layer contains Sphagnum patches. The parent materials consists of mica-schists, gneiss and granite intrusion. The dominant types of soil, on the high plain are the Podzols (Entic and Histi-Entic). The slopes of the Semenic covered by forests consisting mainly of beech are with Dystric Cambisols. Histosols covered 34 ha, with a total volume of 320000m^{-3}, composed mainly of Sphagnum peat, with a pH of 3.0-4.6. Peat lands may be used for various forms of extensive forestry but are best left in their natural state. The water who spring from peat –bog is a pure water, with a pH 7.20-7.28, and a less quantity of Ca^{2+}, Mg^{2+}, Na^+.

The bottom radiocarbon date (150-140 cm, 6781 ± 57 BP) corresponds from the Middle Atlantic, and the rate of peat growth increases from 0.05 mm per year at the bottom to 0.7 mm per year in the upper part.

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