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Organic matters contents and distribution in Chernozem-related soils of Poland and Slovakia (preliminary studies)

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SOILS WITH A MOLLIC HORIZONS

Soils containing relatively deep, black, humic horizons [A] of the *mollic* type in the top part of the profile, are situated among the most fertile and the most productive arable soils of the world. There are some types of such soils occurring on the territory of Poland and Slovakia in various geomorphological, lithological and hydrological conditions. Black color of these horizons is often marked in their names, according to local soil systematics, for example: černozem, čiernica, czarnoziem, czarna ziemia, smolnica.

SOILS WITH A MOLLIC HORIZONS



MOLLIC HORIZON (WRB 2006)

Mollic horizon (from *Latin* mollis, soft)

General description:

- well-structured, dark-coloured surface horizon with a high base saturation and moderate to high content of organic matter

Diagnostic criteria

A mollic horizon, after mixing either the upper 20 cm of the mineral soil or, if *continuous rock, a cryic, petrocalcic, petroduric, petrogypsic or petroplinthic* horizon is present within 20 cm of the mineral soil surface, the entire mineral soil above, has:

1. a soil structure sufficiently strong that the horizon is not both massive and hard or very hard when dry in both the mixed part and underlying unmixed part if the minimum thickness is larger than 20cm; **and**
2. Munsell colours with a chroma of 3 or less when moist, a value of 3 or less when moist and 5 or less when dry on broken samples in both the mixed part and underlying unmixed part if the minimum thickness is greater than 20 cm. The colour value is one unit or more darker than of the parent material; **and**
3. An organic carbon content of 0.6% or more in both the mixed part and the underlying unmixed part if the minimum thickness is larger than 20 cm; **and**

MOLLIC HORIZON (WRB 2006)

Mollic horizon (from *Latin* mollis, soft)

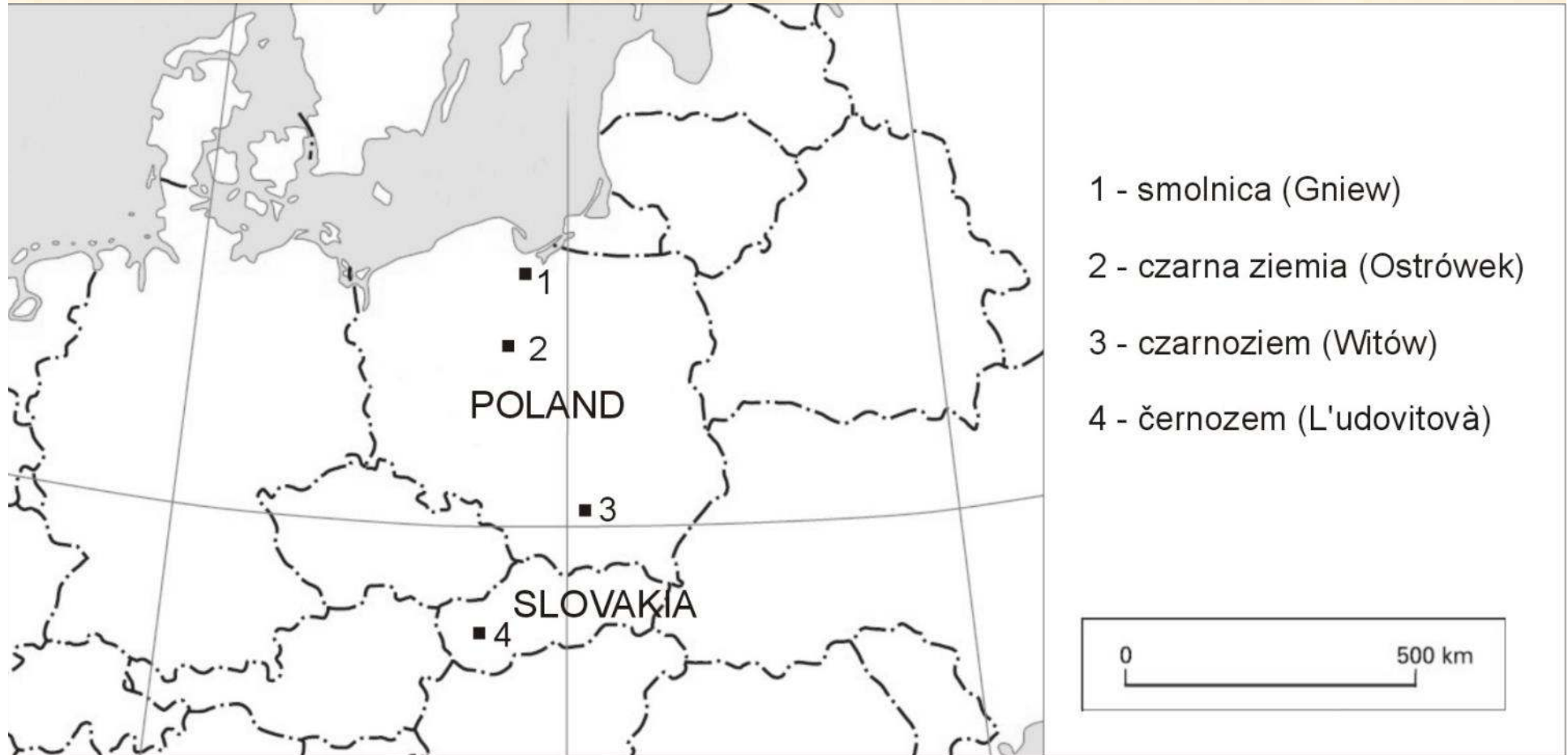
Diagnostic criteria

4. A base saturation (by 1M NH₄OAc) of 50% or more on weighted average throughout the depth of the horizon, **and**
5. A thickness of one of the following:
 - a) 10 cm or more if directly overlying continuous rock, or a cryic, petrocalcic, petroduric, petrogypsic or petroplinthic horizon; **or**
 - b) 20 cm or more and one-third or more of the thickness between the soil surface and the upper boundary of continuous rock, or a calcic, cryic, gypsic, petrocalcic, petroduric, petrogypsic, petroplinthic or salic horizon or calcaric, fluvic or gypсарic material within 75 cm; **or**
 - c) 20 cm or more and one-third or more of the thickness between the soil surface and the lower boundary of the lowest diagnostic horizon within 75 cm and, if present, above any diagnostic horizons listed under b) **or**
 - d) 25 cm or more.

THE AIM OF THE STUDY

The aim of this study is to present
and to compare basic properties
of humic horizons of four exemplary profiles
representing different soil types

Location of the study soil profiles



METHODS

- Soil texture using sieve method and the aerometric method of Bouyoucose, in modification of Casagrande and Prószyński;
- soil colour with Munsell colour chart;
- pH, using a pH-meter;
- TOC, Nt , using CN analyser;
- humus fractional composition using the Scitzer method;
- CaCO₃, using Scheibler method;

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MATERIALS

Profile 1. Smolnica (Vertisol), Gniew, Poland
Starogard Lakeland, terminoglacial lake deposits



Ap

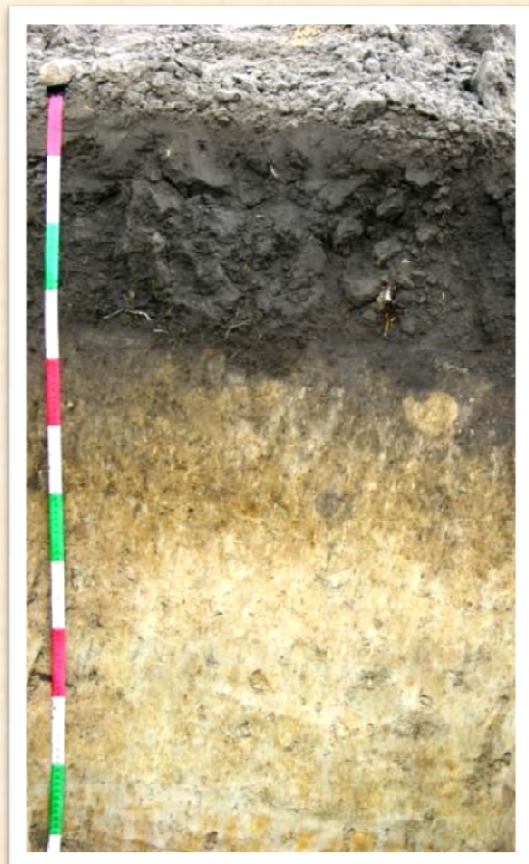
Ah

A/C

Cikg



Profile 2. Czarna ziemia (black earth), Ostrówki, Poland
Gniezno Lakeland, glacial till



Ap
Ah
A/C
Ckr



Profile 3. Czarnoziem, Witów, Poland
Proszowice Plateau, loess



Ap

Ah

A/C

Ck





Profile 4. černozem, L'udovitová, Slovakia
Nitra river valley, silt deposits



Ap

Ah

A/C

Ck



RESULTS

Table 1. Selected physical properties

Horizon	Depth [cm]	Color by Munsell		Texture [%]			Class (FAO)	Class (PTG)
		moist	dry	sand (0.05-2,0)	silt (0.002-0,05)	clay (<0,002)		
Profile 1. Smolnica - Gniew								
Ap	0-30	10YR 3/1	10YR 4/1	36	35	29	L	gc
Ah	30-60	10YR 2/1	10YR 4/1	29	49	22	L	gcp
A/C	60-80	2.5Y 3/1	2.5Y 5/1	32	46	22	L	gsp
Ck	80-110	2.5Y 3/2	2.5Y 5/2	31	48	21	L	gsp
Profile 2. Czarna ziemia								
Ap	0-30	10YR 1.7/1	10YR 3.5/1	65	20	15	SL	glsp
Ah	30-40	10YR 2/2	10YR 4/2	67	26	7	SL	gls
A/C	40-68	10YR 3/3	2.5Y 5/3	69	23	8	SL	gls
Ckr	68-120	2.5Y 5/3	2.5Y 7/3	68	25	7	SL	gls
Profile 3. Czarnoziem - Witów								
Ap	0-20	10YR 1.7/1	10YR 3/1	24	67	9	SiL	ptz
Ah	20-50	10YR 2/2	10YR 4/2	17	73	10	SiL	pti
A/C	50-90	10YR 3/3	10YR 5/3	20	64	16	SiL	pti
Ck	90-120	10YR 4/4	10YR 6/4	20	69	11	SiL	ptz
Profile 4. Černozem - L'udovitová								
Ap	0-25	10YR 2/3	10YR 4/2	42	51	7	SiL	gsp
Ah	25-70	10YR 2/3	10YR 4/2	37	54	9	SiL	gsp
A/C	70-110	10YR 4/3	10YR 6/2	48	44	8	L	glsp
Ck	110-150	10YR 4/3	10YR 6/3	48	44	8	L	glsp

L – loam, SL – sandy loam, SiL – silty loam

Table 2. Selected chemical properties

Horizon	Depth [cm]	pH		Lol	Corg [%]	Nt	C:N	CaCO ₃ [%]
		H ₂ O	KCl					
Profile 1. Smolnica - Gniew								
Ap	0-30	7.6	6.8	6.4	2.21	0.245	9	n.d.
Ah	30-60	8.4	7.6	4.9	1.46	0.185	5	n.d.
A/C	60-80	8.5	7.8	3,9	1.02	0.115	9	n.d.
Cikg	80-110	8.5	7.9	2.9	n.d.	n.d.	-	24.2
Profile 2. Czarna ziemia - Ostrówek								
Ap	0-30	8.0	7.4	3.1	1.43	0.142	10	n.d.
Ah	30-40	8.3	7.5	2.1	0.93	0.082	11	n.d.
A/C	40-68	8.4	7.6	1.9	0.40	0.023	17	n.d.
Ckr	68-120	8.7	8.0	1.0	n.d.	n.d.	-	16.4
Profile 3. Czarnoziem – Witów								
Ap	0-20	5.2	4.6	4.5	2.06	0.201	10	n.d.
Ah	20-50	6.7	5.8	3.9	1.56	0.114	14	n.d.
A/C	50-90	7.7	7.4	2.2	0.52	0.042	12	n.d.
Ck	90-120	8.1	7.2	1.3	n.d.	n.d.	-	0.93
Profile 4. Černozem - L'udovitová								
Ap	0-25	7.9	7.1	4.0	1.50	0.166	9	n.d.
Ah	25-70	8.3	7.4	3.3	1.00	0.097	10	n.d.
A/C	70-110	8.5	7.6	2.5	0.53	0.093	16	n.d.
Ck	110-150	8.7	7.6	1.9	n.d.	n.d.	-	11.4

RESULTS

Table 3. Characteristic of soil organic matter (Schnitzer method)

Horizon	Depth [cm]	pH (H ₂ O)	C_{HA} C_{FA} C_H			$C_{HA} \cdot C_{FA}$
			%Corg			
Profile 1. Gniezno - Gniw						
			4.9	10		
Profile 2. Czarna ziemia - Witów						
Ap	0 - 5					0.65
Profile 3. Czarnoziem - Witów						
A	0 - 25	7.9	4.0	8.0	88.0	
Profile 3. Czarnoziem - Witów						
Ap	0 - 20	5.2	20.0	13.8	66.2	1.45

SUMMARY

1. Analyzed chernozem-related soils have been formed from loam material and feature high thickness of humus layer (up to 70 cm), increased content of organic matter, even to considerable depths, and narrow C:N ratio;
2. Highusability of those soils to large extent results from local conditions (i.a. lithology, depth of ground waters occurrence);
3. Application of humus fractional composition by Schnitzer method yields satisfactory results only in case of acidic soils, with no carbonates.

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