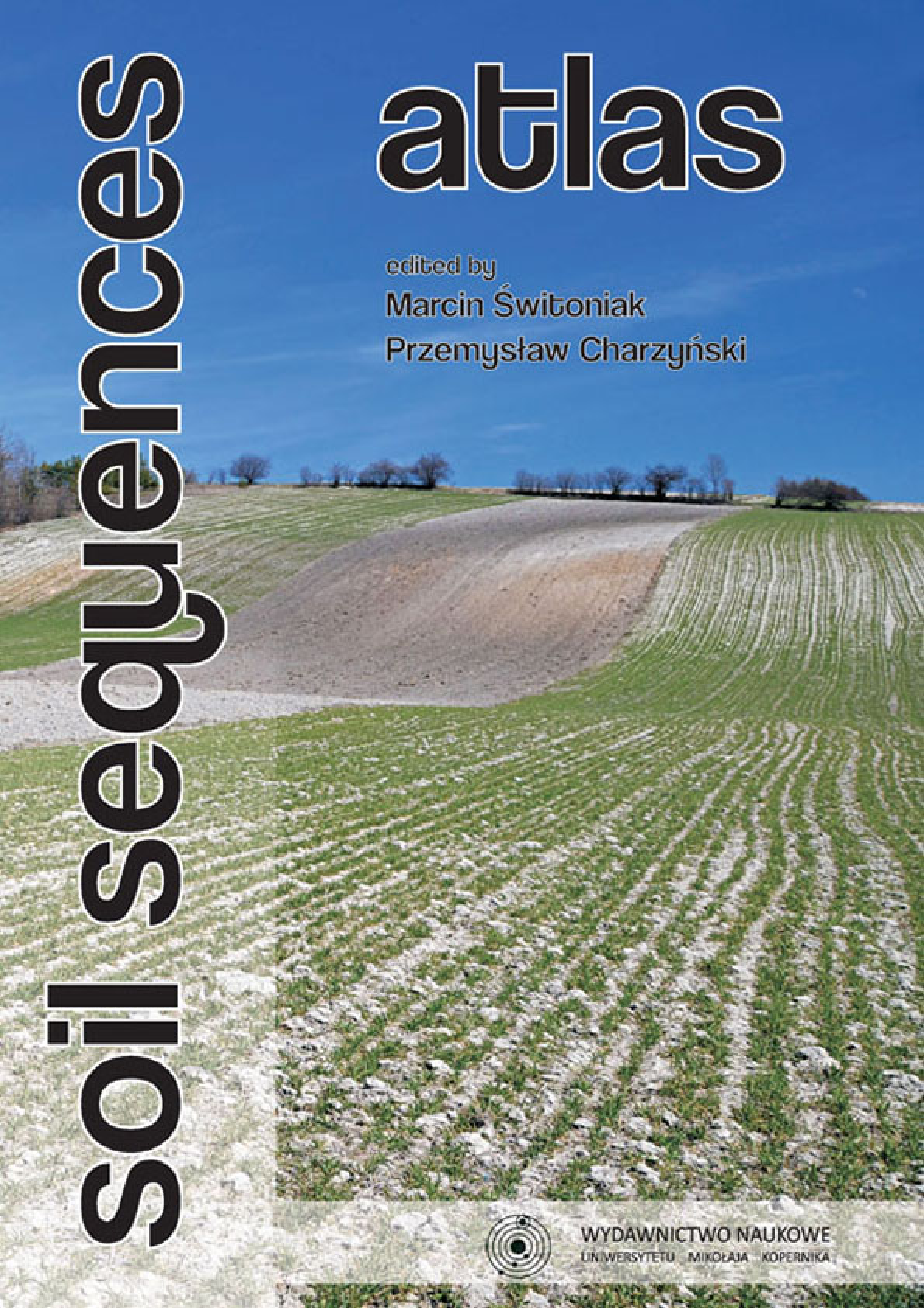
soil sequences atlas

edited by

Marcin Świtoniak
Przemysław Charzyński



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UNIWERSYTETU MIKOŁAJA KOPERNIKA

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Soil Sequences Atlas
M. Świtoniak, P. Charzyński (Editors)
First Edition

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Foreword

To understand the soil-landscape relation it is necessary to study the spatial diversity of soil cover. This variability is partly predictable due to the substantial repeatability of soil units. Depending on dominant soil-forming factor affecting the repeated soil patterns, different types of soil sequences can be distinguished. The influence of relief on the repeated variability of soil cover was first noticed by Milne in 1935 in East Africa. He proposed the term "catena" to describe a transect of soils that are related to the topography. Sommer and Schlichting in 1997 distinguished several archetypes of catenas depending on the mobilization processes and hydrological regimes. The impact of climate on the variability of soil cover is described as climosequences. The diversity of soils due to the different time of development - chronosequences are a suitable tool for investigating rates and directions of soil and landscape evolution.

This book provides an extensive database of soil sequences of various types from the following countries: Hungary, Latvia, Lithuania and Poland. The main objective of this study was to present a great diversity of soil-landscape/climate/hydrology relations and its effect on patterns in soil cover. Most recent edition of the World Reference Base classification system was used to classify presented soils (2014). Fourteen Reference Soil Groups are represented in this publication.

The collected data will be a useful tool in soil-science teaching, helping to understand reasons of variability of soil cover and influence of various soil-forming factors on directions and degree of development of 'Earth skin'. Presented data can also be used for comparison purposes.

Marcin Świtoniak

Przemysław Charzyński

Soils of *Quercus robur* L. stands on parent material with different genesis in the boreo-nemoral zone

Raimonds Kasparinskis, Vita Amatniece, Oļģerts Nikodemus

The distribution range of *Q. robur* L. covers all of Europe and extends to the Ural Mountains in Russia, reaching its northern distribution range in Scotland, Sweden and Estonia (Hytteborn et al., 2005). In the context of climate change, it is important to understand the limiting factors for the distribution of each tree species. Not only climate but also soil is one of the main limiting factors in the distribution of many tree species. Our research was conducted in Latvia, located in the boreo-nemoral transition region between the boreal and nemoral zones (Sjörs, 1963), near the northernmost distribution limit of oaks (*Quercus robur* L.). In Latvia, about 9734,38 hectares are covered by oak stands, i.e. 0.34% of the total area of forests (State Forest Service, 2011).

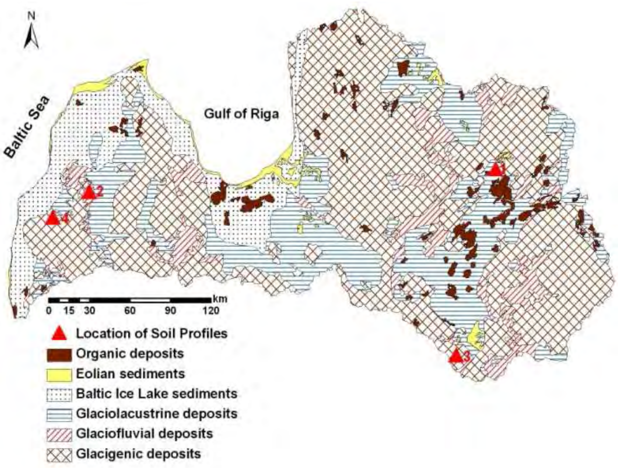


Fig. 1. Location of Soil profiles and Quaternary surface deposits in Latvia (after Geological map of Latvia, 1981)

In the boreo-nemoral transition region, *Q. robur* forms mixed stands on rich soils with nemoral tree species: linden (*Tilia cordata* Mill.), maple (*Acer platanoides* L.), elm (*Ulmus glabra* Huds.), white elm (*Ulmus laevis* Pall.) and common ash (*Fraxinus excelsior* L.), and boreal conifers − pine (*Pinus sylvestris* L.) and spruce (*Picea abies* (L.) H.) (Hytteborn et al., 2005).

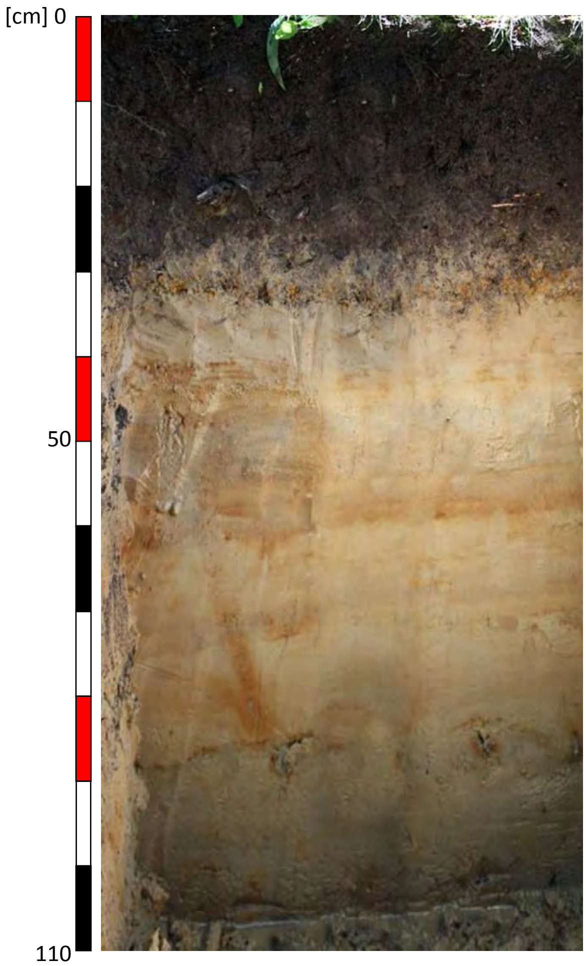
Lithology and topography

In Latvia, forests occur on soils of relativity high diversity, formed on different, mainly unconsolidated Quaternary deposits, in some places also on weakly consolidated pre-Quaternary terrigenous or hard carbonate sedimentary rocks (Kasparinskis, Nikodemus, 2012). The presented soils occur on a glaciolacustrine plain (Profile 1), glaciofluvial deposits (Profile 2), a glacigenic till hummock (Profile 3) and a glacigenic till plain (Profile 4) (Fig. 1).

Climate

Latvia is located in the transition zone of the nemoral and boreal zones (Ozenda, 1994), or the boreo-nemoral zone (Sjörs, 1963). The climate is between transitional maritime and continental with a mean temperature of -5.3°C in January and 14.8°C in July. Annual precipitation is 700–800 mm, of which about 500 mm falls in the warm period (data from the Central Statistical Bureau of Latvia, 2013). The climate is more continental towards the east. The forest area is about 55% and the dominant species are pine (*Pinus sylvestris L.*), birch (*Betula pendula L.*) and spruce (*Picea abies (L.) H.*), which represent 43%, 28% and 15% of the total growing stock volume, respectively (State Forest Service, 2008). Only about 1.1% of the forest area is dominated by nemoral tree species, such as oaks (*Quercus robur L*). An increase in the climate continentality from west to east is one of the main factors determining a decrease in the oak abundance with the increasing distance from the Baltic Sea (Krampis, 2010).

Profile 1 – Stagnic **Phaeozem** (Arenic, Ruptic)
Localization: East-Latvia lowland, glaciolacustrine plain, flat terrain 0–0.2%, oak forest, 111 m a.s.l.
N 60°09'10'', **E** 20°47'26''



Morphology:

Oi – 2–0 cm, slightly decomposed organic material;

Ah – 0–18 cm, *mollic* horizon, sandy loam, very dark gray (10YR 3/1), moist, moderate granular and subangular blocky fine, medium and coarse structure, diffuse and smooth boundary;

AEh – 18–28 cm, *mollic* horizon, sandy loam, very dark grayish brown (10YR 3/2), moist, strong granular and subangular blocky fine, medium and coarse structure, diffuse and wavy boundary;

EBsg – 28–44 cm, sand, pale brown (10YR 6/3), moist, weak subangular and angular blocky medium and coarse structure, *stagnic* properties, reducing conditions, common prominent sesquioxides coatings, diffuse and wavy boundary;

Bsg – 44–62 cm, sand, pale brown (10YR 6/3), wet, weak subangular and angular blocky medium and coarse structure, abundant prominent sesquioxides coatings, *stagnic* properties, reducing conditions, common reductimorphic mottles, diffuse and wavy boundary;

BCsg – 62–92 cm, sand, pale brown (2,5Y 7/3), wet, weak subangular and angular blocky medium and coarse structure, *stagnic* properties, reducing conditions, common prominent sesquioxides coatings, common reductimorphic mottles, clear and smooth boundary;

2Crk – 92–(109) cm, parent material, *lithic discontinuity*, loamy sand, greenish gray (GLEY2 5/5), very wet, weak subangular and angular blocky medium and coarse structure, reducing conditions, very few prominent reductimorphic mottles, moderately calcareous.

Table 1. Texture

Horizon	Depth [cm]	Percentage share of fraction [mm]			Textural class
		2.0–0.05	0.05–0.002	< 0.002	
Ah	0–18	55	44	1	SL
AEh	18–28	64	35	1	SL
EBsg	28–44	87	11	2	S
Bsg	44–62	92	3	5	S
BCsg	62–92	88	10	2	S
2Crk	92–(109)	72	25	3	LS

Table 2. Chemical and physicochemical properties

Horizon	Depth [cm]	OC [g·kg^{-1}]	Nt [g·kg^{-1}]	C/N	pH KCl	$CaCO_3$ [g·kg^{-1}]	Al^{3+}	Fe^{2+}	Mn^{2+}
							[mg·kg^{-1}]		
Oi	2–0	760	112	7	5.9	-	4.5	1.69	32.0
Ah	0–18	22.0	4.80	5	5.5	-	50.7	4.77	2.93
AEh	18–28	10.0	0.90	11	5.3	-	16.9	2.29	0.74
EBsg	28–44	-	-	-	4.8	-	2.9	0.97	0.22
Bsg	44–62	-	-	-	4.9	-	1.2	0.12	1.07
BCsg	62–92	-	-	-	6.0	-	1.4	0.37	0.23
2Crk	92–(109)	-	-	-	7.3	+	0.6	0.23	6.10

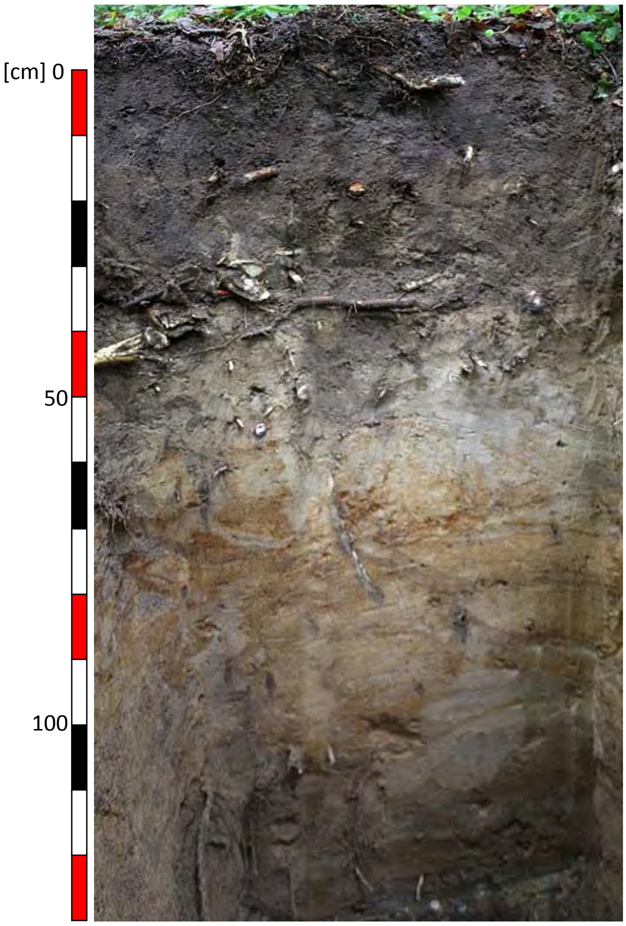
- $CaCO_3$ absent; + $CaCO_3$ present

Table 3. Sorption properties

Horizon	Depth [cm]	Ca^{2+}	Mg^{2+}	K^+	Na^+	TEB	TA	CEC	CEC_{clay}	BS [%]
		[cmol(+)·kg^{-1}]								
Oi	2–0	35.6	4.56	0.350	0.083	40.6	0.050	40.6	-	100
Ah	0–18	9.38	1.07	0.102	0.053	10.6	0.563	11.2	350	95
AEh	18–28	5.73	0.74	0.018	0.032	6.52	0.188	6.71	321	97
EBsg	28–44	2.25	0.49	0.109	0.138	2.99	0.033	3.02	151	99
Bsg	44–62	4.30	0.75	0.077	0.154	5.28	0.013	5.29	106	100
BCsg	62–92	2.07	0.62	0.142	0.151	2.98	0.015	3.00	150	99
2Crk	92–(109)	4.22	1.00	0.076	0.039	5.33	0.007	5.34	178	100

Profile 2 – Haplic **Phaeozem** (Loamic)

Localization: West-Kursa upland, glaciofluvial terrace, gently sloping 2–5°, oak forest, 67 m a.s.l.
N 57°29'5'', **E** 20°52'10''



Morphology:

Oe – 6–0 cm, moderately decomposed organic material;

A – 0–10 cm, *mollic* horizon, loamy sand, dark brown (7.5YR 3/2), moderate granular coarse and very coarse structure, abrupt and wavy boundary;

AE – 10–33 cm, *mollic* horizon, loamy sand, very dark grayish brown (10YR 3/2), moderate subangular blocky medium and coarse structure, gradual and irregular boundary;

AEB – 33–53 cm, sandy loam, yellow light yellowish brown (2.5Y 6/3), strong subangular blocky very coarse structure, gradual and irregular boundary;

Bs – 53–94 cm, silt loam, yellowish brown (10YR 5/6), strong subangular blocky coarse and very coarse structure, common distinct sesquioxides coatings, gradual and irregular boundary;

BCg – 94–124 cm, sand, light yellowish brown (10YR 6/4), strong prismatic very coarse structure, *stagnic* properties, abrupt and smooth boundary;

2Cgk – 124–(134) cm, parent material, *lithic discontinuity*, sandy clay, grayish brown (10YR 5/2), weak subangular blocky coarse structure, *reducing* conditions, strongly calcareous.