EUROSOIL 2008 - EXCURSION 4A pre-post-congress

"CROSS SECTION OF NORTHERN LANDSCAPES IN LOWER AUSTRIA FROM LOESS TO PALEOZOIC"

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1 INTRODUCTION

1.2 General description and geology of the excursion route

This excursion exemplarily shows the different soil formations within a short spatial distance depending on parent material, climate and vegetation cover. The altitude above sea level increases during the excursion from about 150 m asl (Danube niveau) til about 590 m asl (Göpfritz an der Wild) respectively 530 m asl (Eugenia) in the Waldviertel. The climate changes as well in a relatively short distance from Pannonian of the Vienna region through the hilly country climate of the Weinviertel til the rough climate of the eroded landscapes of the crystalline Waldviertel.

The excursion starts from Heldenplatz, in the historical centre of Vienna. We first cross at the Nordbrücke („north bridge") the river Danube, then the Donauinsel („ Danube island") and then we come to the motor-way A22 towards Stockerau (see fig.1).

The Vienna area, as well as the eastern located Marchfeld, geologically belongs to the Vienna Basin, which was formed during the Jung Tertiary through the break-in of a massif which connected the Alps with the Carpathians. In this basin the Tertiary Sea entered from south-east. Deep layers of marine sediments were deposited above the basin ground, which later sinked deeper due to further depressions and breaks. The siltation of the sea in the Vienna Basin took place during the Pannonian Age, the jungest Tertiary period.

During the following ice ages the landcape was strongly re-formed. Parts of the Alps were covered by glaciers during the four ice ages (Günz, Mindel, Riß und Würm), but not the Vienna Basin. With the rhythm of the ice and warm ages enormous amounts of debris and gravel were eroded from moraine areas and periglacial regions, transported by the Danube into the Vienna Basin and deposited above the tertiary sediments. These quaternary deposits were then periodically cleared out and trenched by new deposites. This way the recent terrace geomorphology of Vienna developed, see fig. 2. Later on, different layers of eolian, fluvial and colluvial sediments were deposited above the gravel, and represents today the parent material for soil formation.

Along the A22 we drive in the area of the Danube floodplain, previous flooding zones. Shortly before Klosterneuburg we cross the so-called „Wiener Pforte“, („Vienna Gate“), this is the breach of the Danube from west to south-east through the Alps-Carpathians-chain, see fig. 1. Typical uprisings of the Wiener Pforte are the Leopoldsberg („Leopold-hill“) and the Kahlenberg („Kahlen-hill“) (western of the Danube) and the Bisamberg (“Bisam-hill”) (eastern of the Danube). Both belongs to the Flysch-zone, an alternating sequence of sandstones and marl, marine sediments which are extended west until Switzerland. During the Helvetian (Tertiary) a drawdown occured north to the Danube. This is called the Korneuburger Becken (Korneuburg Basin). This basin was flooded by the Tertiary Sea as well and filled up with tertiary sediments. Above them Danube gravel first and loess later were deposited.

Near Stockerau we leave the A22 and take the B4- road in direction Horn, see fig.1. We cross the Krems-Stockerauer-Feld (“Krems-Stockerau-field“) (which corresponds to the Würm-ice-aged Prater-terrace in the Vienna surrounding) and enter the Tertiär-Hügelland (“Tertiary Hillyland”). Here the climatic transition from east European climate region, characterized through cold winters and warm, dry summers, to west European climate zone, with gentle winters and humid, relatively cold summers begins.

We soon reach the **excursions stop 4A-1 (Ziersdorf, Lower Austria),** see fig. 1. This area is drained by numerous small channels, which mainly flow into the river Schmida. The crystalline ground rock material occurs in this part of the western Weinviertels (“Wine Region”) below the marine sediments (sands, “schlier”, “tegel”, clay-marl) of the Tertiary Sea (Molasse-Sea). During the pliocene the ur-Danube brought in large parts of this area a mighty gravel deposit (“Hollabrunner Schotterkegel”). In general, the crystalline rocks of the Böhmische Masse („Bohemian Mass“), the sediments of the Tertiary Sea and the gravel deposit are differently covered by loess, depending on erosion intensity.

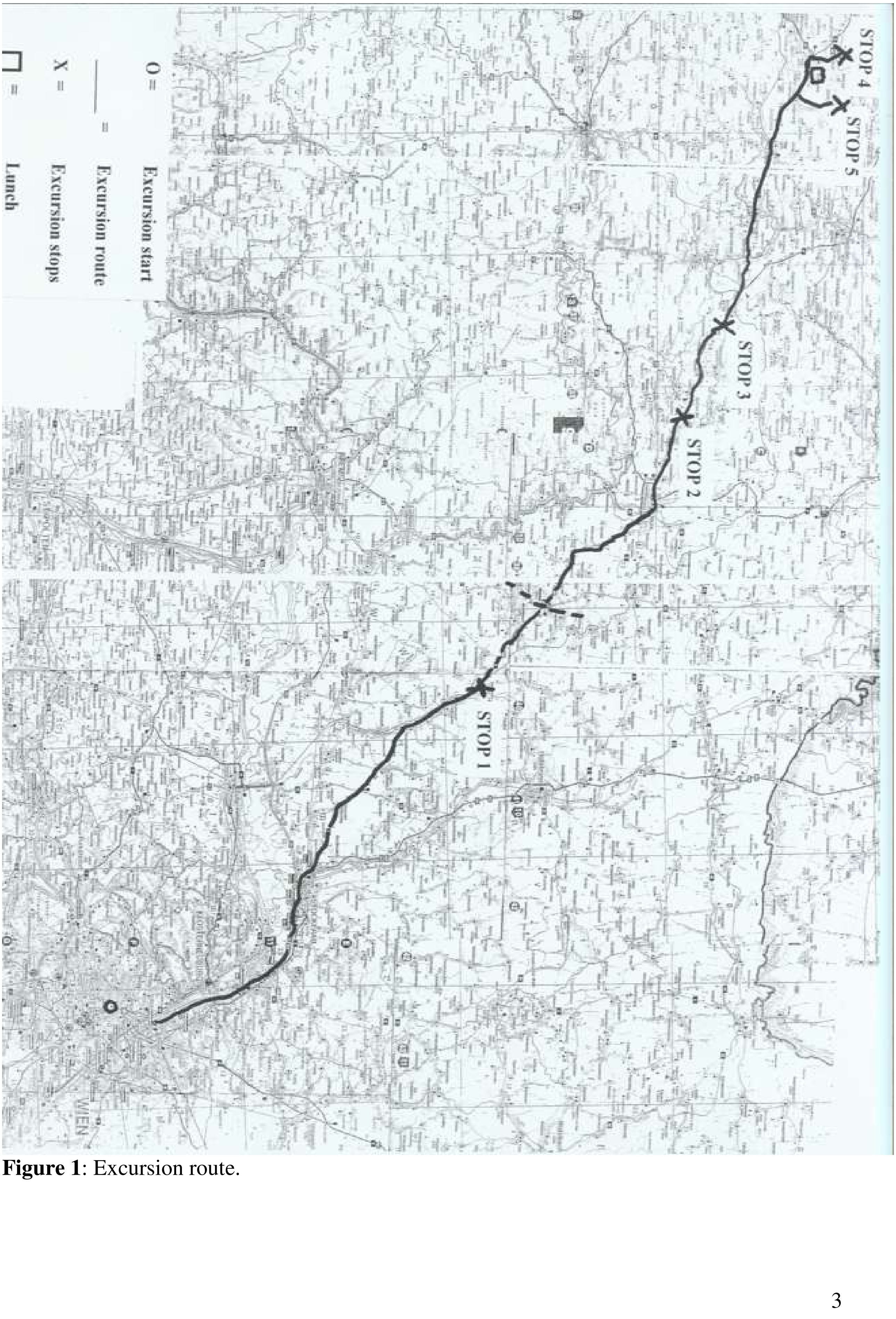

Figure 1: Excursion route.

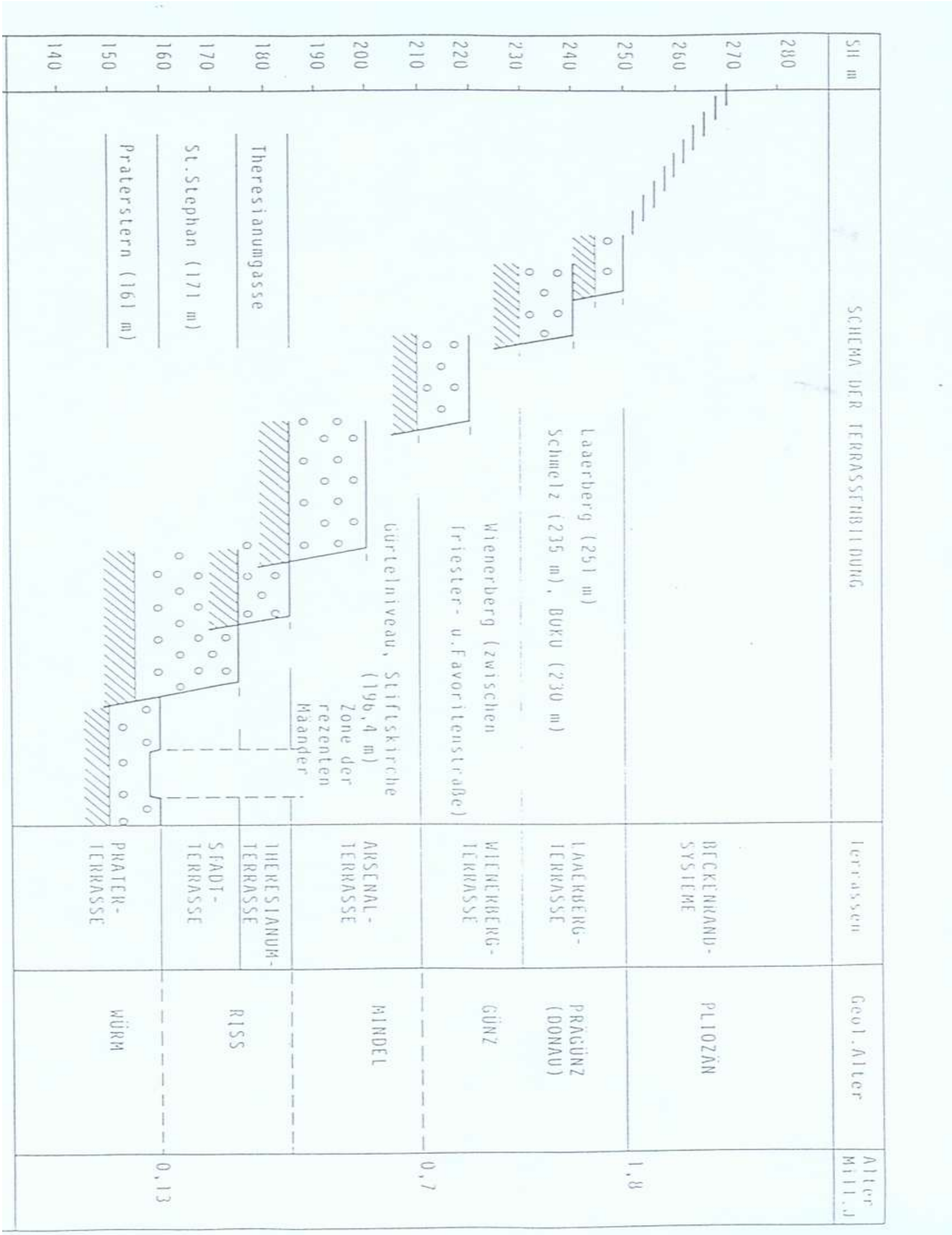

Figure 2: Terraces of the Vienna region.

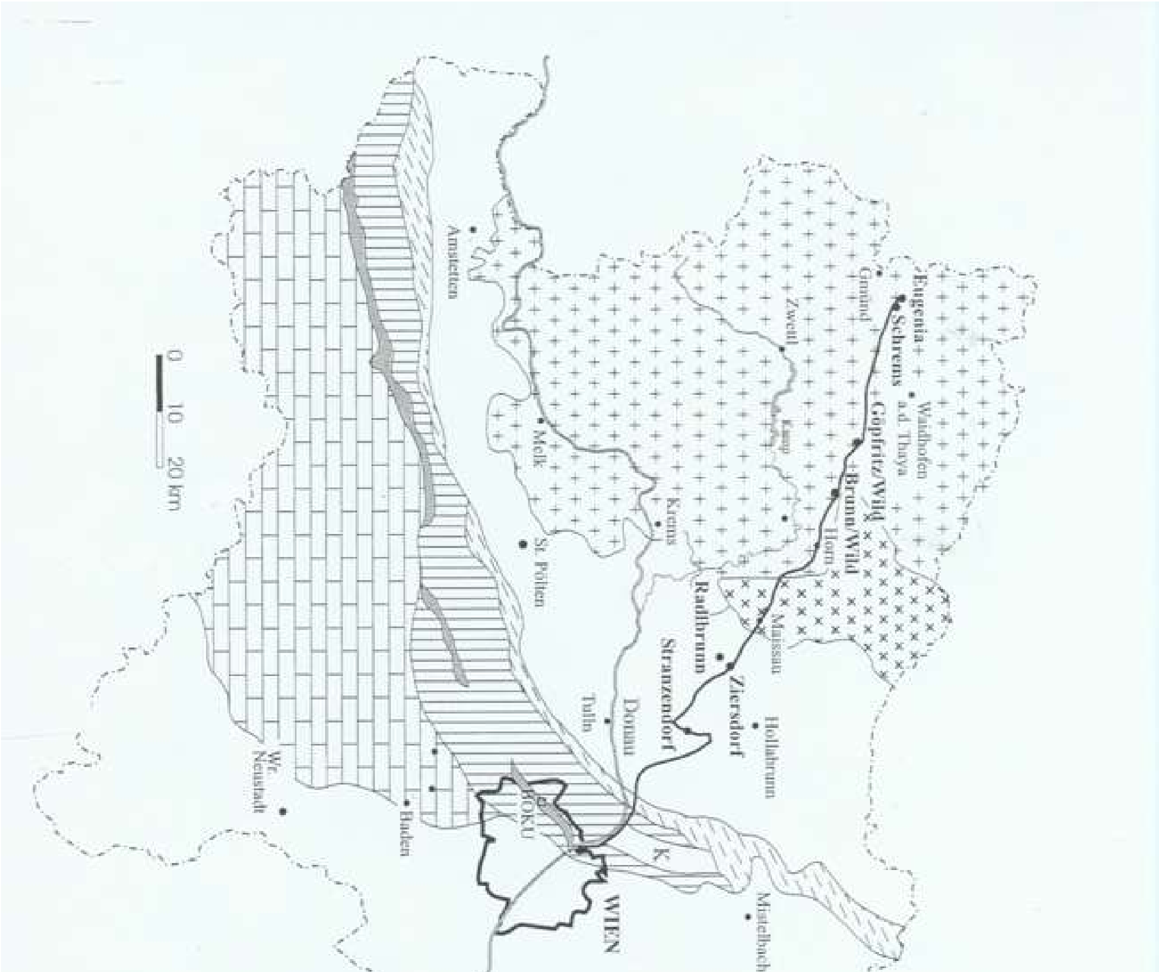

Figure 3: Locations and geology of the excursion route.

The crystalline rocks of the Böhmische Masse (especially granite, gneiss, granulite and mica schist) slowly emerge from the Molasse zone at Manhartsberg (537 m asl, „Manhart-Mountain“, see fig.3). In Maissau we leave the Weinviertel and drive into the western part of Waldviertel („Wood-Region“), the Horner Becken (“Hon-Basin”). This basin thermally belongs already to the Waldviertel, but the precipitation niveau is that of the dry Weinviertel.

We reach soon the **excursion stop 4A-2 (Brunn an der Wild, Löwer Austria, see fig. 1)**. The underground of the Waldviertel consists of a mighty crystalline rock mass (Böhmische Masse, especially granite, gneiss, granulite, quartzite, amphibolites, serpentinite and older crystalline schist rocks, see fig.3), which were unfolded during the Palaeozoic to a high mountain and then ablated again.

Enhancements and depressions with consequent strong erosion formed this rock basement to a highland with weak relief, which was later strongly corrugated by little rivers. During the Tertiary Age the recent area of the Horn Basin sinked. Later on the Tertiary-Sea (Parathethys) intruded from the south through the Kamptalfurche (“Kamp-Valley depression”) and filled the basin with clays, sands and pebble above the crystalline underground. Later again the Sea transformed into a lake and silted finally.

Still in the Tertiary Age weathering processes started under extremely high temperature: the fine see sediments as well as the silica rocks above the see level were strongly transformed through weathering. These relictic processes are shown through high amounts of kaolinite, compaction and red weathering colours of soils and parent materials.

During the ice ages the eroded landscape of the Böhmische Masse remained free of ice. Due to extreme temperature changes through frost and solar radiation, rocks were differently transformed and often re-turbated. During the Ice Ages storms brought carbonate-free (loam) and carbonate-rich (loess) fine material and deposited with different depth, which was further transformed through loss/accumulation erosion processes.

After some kilometres we reach the **excursion stop 4A-3 (Göpfritz an der Wild, Lower Austria, see fig. 1)**. This site is located in the Wild, the ascension to the Oberen-Thaya-Hochland („Upper-Thaya-Highland“). Here soil formation is stronger influenced by climate (colder, more humid) and vegetation (coniferous forest). Short vor Langschwarza we can see at the right side of the road the European Watershed between North-Sea (river Elbe) and Black Sea (river Danube) and reach soon the “granites“ city of Schrems, where we can enjoy the lunch in a typical Waldviertel restaurant.

After lunch the excursion continues to Eugenia, northern of Schrems, where we reach the **excursion stop 4A-4 (Eugenia, Lower Austria, see fig. 1)**. This site is located in the Upper-Thaya-Hochland under coniferous forest. Here the climate is already significantly colder and humid as compared to similar altitudes of the region Lower Austria. The wind velocity is relatively high (3-4 m/sec). Here the underground consists of crystalline rocks, mostly granites or gneiss, where granite formations are sharp clefted, whereas gneiss formations are characterized through gently, round domes. The landscape consists either of old, weathered eroded areas or depresions filled up with clayey-loamy weathered tertiary material. The most important rock for soil formation of the excursion stop 4A-4 is the Eisgarn-granitr, a coarse grained 2-mica-granite.

The excursion ends in the protected area of Schrems with the **excursion stop 4A-5 (Gebharts, Lower Austria, see fig. 1**).
Moor landscapes are wide diffused in Austria. In this part of the Waldviertel, a transition zone between the west European-Atlantic influenced climate and the Pannonian climate, high moors are strongly continentally influenced and they therefore differ, even in their vegetation, from the more western located ones. This climatic effect was furthermore anthropogenically enhanced, since people used to extract peat for the glass industry for more than 3 centuries.

What we can see here today are simply old peats site, still under influence of ground water, which start to regenerate, or moor rests at the edge of artificial sees, which were created since Middle Ages. This could be confirmed through pollen analysis. The most important and dominant tree arts today are *Pinus, Betula, Populus, Corylus, Ulmus and Frangula alnus*. Moreover we can find *Molinia*, *Calluna vulgaris*, carnivorous Plants *Doseracea*, *Pinguicula*,, *Sphagnum* moss. This site is climatic similar to the stop 4A-4. The impermeable underground of this moor region consists of old, weathered material above crystalline rock of the Böhmische Masse.

2 METHODS

2.1 Soil physical analyses

- Particle size distribution, (wet sieving-pipette-method), after BLUM et al.(1996);
- Bulk density (dry), total porosityafter BLUM et al., 1996;
- Vol% water contents, pore size distribution and available Field Capacity after HARTGE and HORN, 1992;
- Soil aggregate stability, after MURER et al. (1993);

2.2 Soil chemical analyses

- pH-value ($CaCl_2$), after BLUM et al.(1996);
- $CaCO_3$-content, SCHEIBLER-method, after BLUM et al.(1996);
- Electrical conductivity, after BLUM et al., 1996
- Ct, Nt, Corg, gas chromatographically, after BLUM et al. (1996);
- Effective Cation Exchange Capacity (CECeff), $BaCl_2$-extract, after BLUM et al.(1996);
- P und K in CAL-extract, after BLUM et al., 1996;
- Elements in aqua-regiaextact, after BLUM et al., 1996;
- Pedogenical Fe-oxides, after SCHWERTMANN, 1959, 1964;

2.3 Soil mineralogical analyses

- Total mineral distribution (semiquantitative) after SCHULTZ (1964).
- Clay mineral analysis after BRINDLEY & BROWN (1980), DIXON & WEED (1989), MOORE & REYNOLDS (1997);

3 EXCURSION STOPS

EXCURSION STOP 4A-1: Ziersdorf, soil profile vermi-calcic Chernozem (WRB) from loess.

Site description : N 48° 31' 40,1'' - EO 15° 54' 53,9''

Soil survey district: KB 150, Ravelsbach (Lower Austria).

Location: Western Weinviertel („vine-region"), 257 m asl.

Climate: Pannonian dry region.

Temperature in °C (long term average 1951-1980).

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	aver.
-2.0	0.3	4.3	10.0	13.9	17.5	19.2	18.8	15.3	9.5	4.3	0.1	9.3

Precipitation in mm WC (1921-1980):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
26	29	26	41	65	80	87	73	43	40	38	28	576

60% of the yearly precipitations (346 mm) fall in the vegetation period April-Aaugust (220 – 230 days).

Relief: Tertiary Weinviertel-Hügelland („ vine-region-hillyland").

Land use: arable land.

Soil profile description (see fig. 4):

Ap (0-20 cm): loamy silt, <1% skeleton, Munsell 10YR/5/3, fine crumby structure, single tillage fragments on the surface, high porosity, humous, pH neutral-weakly alkaline, medium carbonate content, strongly rooted, earthworm channels, gradual boundary to:

Ah (20-30 cm): loamy silt, < 1% skeleton, Munsell 10YR/5/3, crumby-subpolyhedrical structure, compacted through ploughing, medium porosity, humous, pH neutral-weakly alkaline, medium carbonate content, strongly rooted, earthworm channels, gradual boundary to:

Aca (30-45 cm): loamy silt, < 1% skeleton, Munsell 10YR/5/2, crumby-subpolyhedrical structure, medium porosity, humous, pH neutral-weakly alkaline, medium carbonate content with pseudomycelium features, strongly rooted, earthworm channels, gradual boundary to:

ACca (40-65 cm): loamy silt/silty loam, <1% skeleton, Munsell 10YR/5/2,subpolyhedrical structure, medium porosity, weakly humous, pHneutral- weakly alkaline, medium carbonate content with pseudo-mycelium features,weakly rooted, some earthworm channels, gradual boundary to:

Cv (65+ cm): loamy silt, no skeleton, Munsell 10YR/7/4, coherent massive structure, medium porosity, single humus spots (10YR/3/3), pH neutral-weakly alkaline, high carbonate content with needle-shaped $CaCO_3$-crystals, single earthworm channels and krotowines.

Soil type: vermi-calcic Chernozem (WRB).

Parent material: loess.

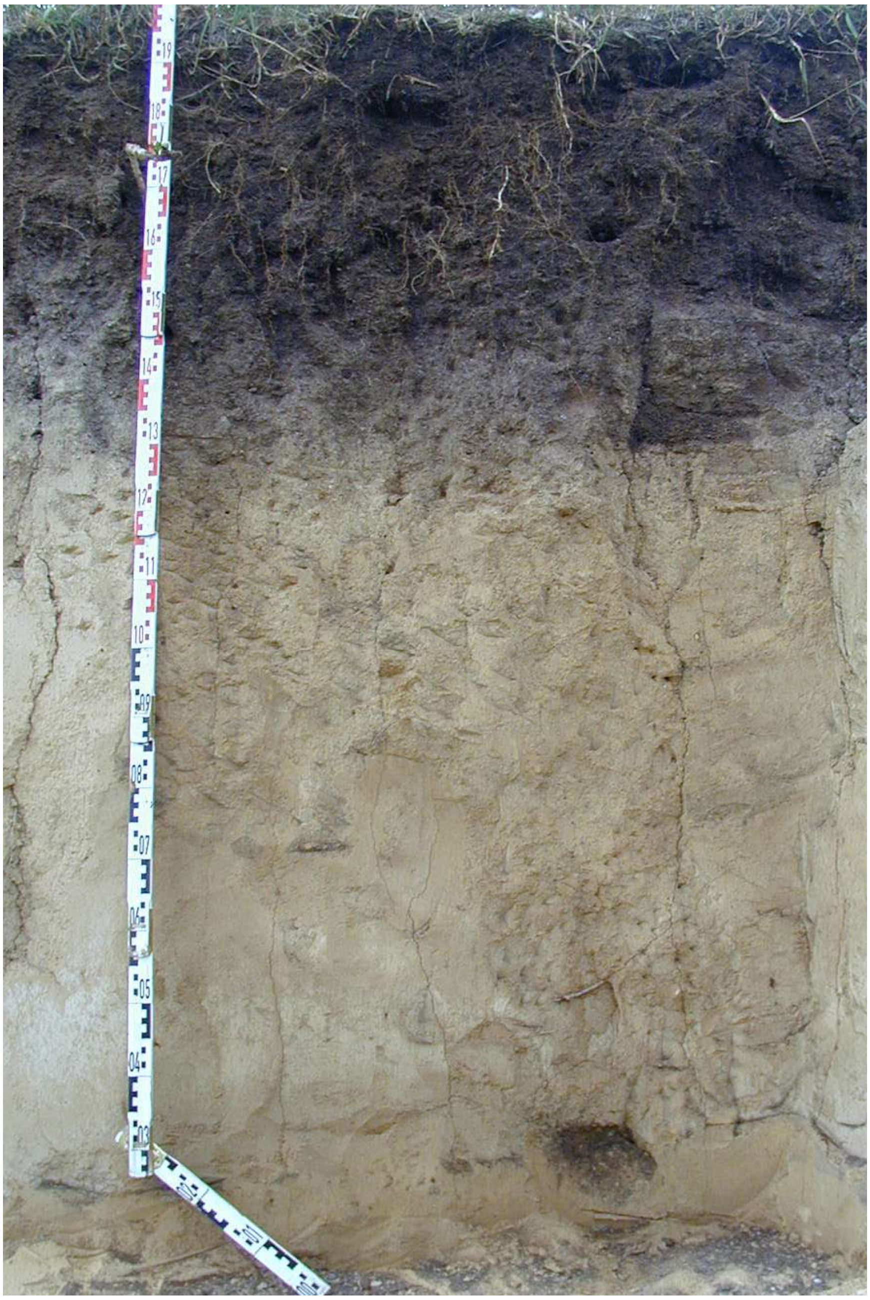

Figure 4: Excursion profile 4A-1: vermi-calcic Chernozem from loess, Ziersdorf, Lower Austria.

Table 4A-1.1: Particle size distribution and texture type.

horizon (cm)	weight % of humus free fine earth (< 2mm)									
	coarse sand	med. sand	fine sand	coarse silt	med. silt	fine silt	∑sand	∑silt	clay	texture type
Ap (0-20)	0.5	1.6	7.8	39.8	18.3	11.8	6.1	69.9	20.2	loamy silt
Ah (20-30)	0.1	0.7	4.6	38.0	18.1	10.3	4.6	66.4	28.1	loamy silt
Aca (30-45)	0.1	1.2	8.8	29.0	21.0	10.5	10.1	60.5	22.5	loamy silt
ACca (45-65)	0.1	0.3	5.4	34.5	29.5	2.0	5.8	66.0	25.0	loamy silt
Cv (65+)	0.2	1.9	8.0	46.9	15.1	8.0	13.3	70.0	19.9	loamy silt

Table 4A-1.2: Bulk density, total porosity, water contents and soil aggregate stability.

horizon (cm)	bulk density Mg/m^3	total porosity vol%	vol% water at pF 1,8	2,0	2,5	4,2	aggregate stability weight %
Ap (0-20)	1.16	56	37	34	31	18	52
Ah (20-30)	1.25	53	35	34	32	19	37
Aca (30-45)	1.22	54	37	36	31	17	18
AC ca (30-60)	1.19	55	37	36	31	19	17
Cv (60+)	1.36	49	34	30	29	13	5

Table 4A-1.3: Pore size distribution and available field capacity (aFC).

horizon (cm)	pore size distribution in vol.%				aFC
	wide CP (> 50 µm)	narrow CP (50-10 µm)	MP (10-0.2 µm)	FP (< 0.2 µm)	mmWC
Ap (0-20)	19	6	13	18	38
Ah (20-30)	18	3	13	19	19
Aca (30-45)	17	6	14	17	30
ACca (45-65)	18	6	12	19	36
Cv (65+)	15	5	16	17	-

Table 4A-1.4: General chemical parameters.

horizon (cm)	pH ($CaCl_2$)	$CaCO_3$ %	Corg %	Ct %	Nt %	C/N	el. conductivity µS/cm
Ap (0-20)	7.1	11.9	2.7	4.1	0.29	14.1	190
Ah (20-30)	7.3	15.1	1.8	3.6	0.16	18.7	160
Aca (30-45)	7.4	16.7	1.7	3.6	0.16	22.5	200
ACca (45-65)	7.4	20.8	1.7	4.2	0.16	26.2	211
Cv (65+)	7.4	36.8	0.1	4.5	0.04	112.5	356

Table 4A-1.5: Effective cation exchange capacity (CECeff), base saturation (BS) and saturation of exchangeable cations.

horizon	CECeff	BS	cation saturation in % of CECeff						
(cm)	mmolIÄ/kg	%	Ca	Mg	K	Na	Fe	Al	Mn
Ap (0-20)	294.0	100	89.5	8.5	2.0	<0.1	0	0	0
Ah (20-30)	278.0	100	89.2	10.4	0.4	<0.1	0	0	0
Aca (30-45)	229.8	100	89.7	9.3	0.8	0.5	0	0	0
ACca (45-65)	202.5	100	90.4	8.9	0.7	0.7	0	0	0
Cv (65+)	162.0	100	83.4	14.8	0.6	1.2	0	0	0

Table 4A-1.6: Plant available P and K (the letters besides the values show the content level according to the prescriptive class of the Federal Ministry of Forest and Agriculture).

horizon (cm)	$P_{(CAL)}$ mg/kg	$K_{(CAL)}$ mg/kg
Ap (0-20)	41B	220D
Ah (20-30)	29B	39A
Aca (30-45)	22A	36A
ACca (45-65)	10A	27A
Cv (65+)	3A	21A

Table 4A-1.7: Elements in the aqua-regia-extract in g/kg.

horizon (cm)	Ca	Mg	K	Na	P	Fe	Al	Mn
Ap (0-20)	38.3	13.0	4.9	0.14	840	25.0	24.0	<1.0
Ah (20-30)	50.4	13.0	4.6	0.17	808	26.0	26.0	<1.0
Aca (30-45)	66.8	13.5	3.1	0.12	782	22.7	21.6	<1.0
ACca (45-65)	88.0	15.2	2.6	0.09	674	20.8	19.3	<1.0
Cv (65+)	116.7	22.0	2.1	0.22	498	18.7	15.0	<1.0

Table 4A-1.8: Dithionite (Fe_d)-, oxalate (Fe_o)-, pyrophosphate (Fe_p)- and total (Fe_t)-soluble Fe-contents in mg/kg.

horizont (cm)	Fe_d	Fe_o	Fe_p	Fe_o/Fe_d	Fe_t	Fe_d/Fe_t
Ap (0-20)	9805	1695	176	0.17	25000	0.39
Ah (20-30)	6767	950	46	0.14	26000	0.26
Aca (30-45)	6063	838	47	0.14	22700	0.28
ACca (45-65)	4202	858	38	0.20	20800	0.20
Cv (65+)	1670	743	20	0.44	18700	0.09

Table 4A-1.9: Semiquantitative total mineral composition in weight %.

horizon (cm)	quartz	layer silicates	felspars	calcite	chlorite	dolomite
Ap (0-20)	30	48	7	8	-	7
Ah (20-30)	30	49	7	8	-	6
Aca (30-45)	34	46	2	15	-	3
ACca (45-65)	32	42	4	18	-	4
Cv (65+)	23	23	4	34	-	16

Table 4A-1.10: Semiquantitative clay mineral distribution in weight %.

horizon (cm)	illite	chlorite	vermiculite	smectite	kaolinite
Ap (0-20)	66	21	-	-	13
Ah (20-30)	66	20	-	-	13
Aca (30-45)	51	31	-	-	18
ACca (45-65)	33	26	-	20	21
Cv (65+)	20	19	-	31	30

EXKURSION STOP 4A-2: Brunn an der Wild, soil profile hypereutric-mollic Cambisol (WRB) from weathered loess.

<u>**Site description :**</u> N 48° 40’ 51,3’’ - EO 15° 33’ 07,7’’

<u>Soil survey district:</u> B 132, Horn (Lower Austria).

<u>Location:</u> Waldviertel („Forest region“), weastern edge of the Horner Bucht („Horn Basin), 433 m asl.

<u>Climate:</u> Transition Pannonian dry region – Atlantic humid region.

Temperature in °C (long term average 1951-1980):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	aver.
-2.3	-0.6	3.0	8.5	13.3	16.8	18.5	17.6	13.9	8.3	3.4	0.5	8.4

Precipitation in mm WC (1921-1980):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
25	27	25	37	62	80	81	72	41	38	37	29	554

60% of yearly precipitations (332 mm) fall in the vegetation period April-August (210 days).

<u>Relief:</u> Gentle ascent of the western edge of the Horner Bucht to the Allentsteiger and Upper Thaya-Highland.

<u>Landuse</u>: arable land.

<u>Soil profile description (see fig. 5)</u>:

Ap (0-12 cm): silty loam, 5% skeleton, Munsell 10YR/5/4, fine crumby structure, highporosity, humous, pH-neutral-weakly acid, weak carbonate content, strongly rooted, medium earthworm activity, gradual boundary to:

AhBv (20-35): loam, 2%skeleton, Munsell 10YR/4/3, prismatic-polyhedrical structure, weak porosity, humous, pH-neutral-weakly acid, no carbonate, weakly rooted, weak earthworm activity, gradual boundary to:

Bv (35-45 cm): loam, 2% skeleton, Munsell 10YR/5/6, prismatic structure, weak porosity, weakly humous, pH-neutral-weakly acid, no carbonate, not rooted, weak earthworm activity, gradual boundary to:

BvC (45-55): silty loam, 2% skeleton, MUNSELL 10YR/6/6, prismatic structure, weak porosity, weakly humous, pH-neutral-weakly acid, weak carbonate content, not rooted, weak earthworm activity, gradual boundary to:

Cv (55+ cm): loamy silt, <1% skeleton, Munsell 10YR/6/6, coherent massive structure, weak porosity, no humus, pH-neutral-weakly alkaline, high carbonate content with needle-shaped $CaCO_3$-cristals, not rooted, weak earthworm activity.

Soil type: hypereutric-mollic Cambisol (WRB) from weathered loess**.**

Parent material: weathered loess.

Figure 5: Excursion profile 4A-2: hypereutric-mollic Cambisol from weathered loess, Brunn an der Wild, Lower Austria.

Table 4A-2.1: Particle size distribution and texture type.

horizon (cm)	weight % of humus free fine earth (< 2mm) coarse sand	med. sand	fine sand	coarse silt	med. silt	fine silt	∑sand	∑silt	clay	texture type
Ap (0-12)	2.3	6.9	9.7	33.5	13.2	8.3	18.9	55.0	26.1	silty loam
AhBv (12-35)	4.1	7.6	10.8	28.5	15.5	8.5	22.5	52.5	28.0	loam
Bv (35-45)	3.6	5.9	9.5	28.5	17.0	7.5	19.0	53.0	30.0	loam
BvCv (45-55)	3.6	5.7	8.6	31.0	16.0	12.0	17.9	59.0	27.0	silty loam
Cv (55+)	1.9	5.8	13.6	28.4	20.3	13.0	21.3	61.7	17.0	silty loam

Table 4A-2.2: Bulk density, total porosity, water contents and soil aggregate stability.

horizon (cm)	bulk density Mg/m^3	total porosity vol%	vol% water at pF 1,8	2,0	2,5	4,2	aggregate stability weight %
Ap (0-12)	1.17	56	35	33	31	18	41
AhBv (12-35)	1.25	53	36	36	31	17	45
Bv (35-45)	1.40	47	37	36	31	18	37
BvCv (45-55)	1.47	45	36	34	30	16	20
Cv (55+)	1.41	47	35	32	27	12	5

Table 4A-2.3: Pore size distribution and available field capacity (aFC).

horizon (cm)	pore size distribution in vol.% wide CP (> 50 µm)	narrow CP (50-10 µm)	MP (10-0.2 µm)	FP (< 0.2 µm)	aFC mmWC
Ap (0-12)	21	4	13	18	34
AhBv (12-35)	17	5	14	17	38
Bv (35-45)	10	6	13	18	19
BvCv (45-55)	9	6	14	16	20
Cv (55+)	12	8	15	12	-

Table 4A-2.4: General chemical parameters.

horizon (cm)	pH ($CaCl_2$)	$CaCO_3$ %	Corg %	Ct %	Nt %	C/N	el. conductivity µS/cm
Ap (0-12)	6.9	2.0	2.2	2.4	0.27	8.8	190
AhBv (12-35)	6.7	0.1	1.3	1.3	0.14	9.3	190
Bv (35-45)	6.3	0.0	0.7	0.7	0.08	8.7	178
BvCv (45-55)	7.0	8.0	0.6	1.6	0.05	12.0	210
Cv (55+)	7.2	35.2	0.2	4.4	0.02	220.0	350

Table 4A-2.5: Effective cation exchange capacity (CECeff), base saturation (BS) and saturation of exchangeable cations.

horizon	CECeff	BS	cation saturation in % of CECeff						
(cm)	mmolIÄ/kg	%	Ca	Mg	K	Na	Fe	Al	Mn
Ap (0-12)	263.0	100	84.0	15.6	<0.1	<0.1	0	0	0
AhBv (12-35)	163.1	100	83.1	15.0	0.9	0.6	0	0.4	0
Bv (35-45)	170.8	100	81.8	16.4	0.7	0.7	0	0.4	0
BvCv (45-55)	170.0	100	87.9	13.8	0.7	0.7	0	0.1	0
Cv (55+)	156.0	100	87.6	6.9	<0.1	<0.1	0	0	0

Table 4A-1.6: Plant available P and K (the letters besides the values show the content level according to the prescriptive class of the Federal Ministry of Forest and Agriculture).

horizon (cm)	$P_{(CAL)}$ mg/kg	$K_{(CAL)}$ mg/kg
Ap (0-12)	24A	138C
AhBv (12-35)	16A	69B
Bv (35-45)	6A	52A
BvCv (45-55)	8A	41A
Cv (55+)	8A	39A

Table 4A-2.7: Elements in the aqua-regia-extract in g/kg.

horizon (cm)	Ca	Mg	K	P	Na	Fe	Al	Mn
Ap (0-12)	11.2	8.0	4.2	639	0.13	29.4	26.0	<1.0
AhBv (12-35)	6.8	5.7	3.1	634	0.08	28.0	23.2	<1.0
Bv (35-45)	7.1	6.3	3.0	502	0.09	29.7	24.0	<1.0
BvCv (45-55)	34.6	11.3	2.9	461	0.09	27.6	17.5	<1.0
Cv (55+)	76.3	35.0	2.3	441	0.15	17.7	15.0	<1.0

Table 4A-2.8: Dithionite (Fe_d)-, oxalate (Fe_o)-, pyrophosphate (Fe_p)- and total (Fe_t)-soluble Fe-contents in mg/kg.

horizont (cm)	Fe_d	Fe_o	Fe_p	Fe_o/Fe_d	Fe_t	Fe_d/Fe_t
Ap (0-12)	2816	1848	166	0.66	29400	0.10
AhBv (12-35)	1671	956	70	0.57	28000	0.06
Bv (35-45)	10919	1596	102	0.15	29700	0.37
BvCv (45-55)	7190	1169	34	0.16	27600	0.26
Cv (55+)	2800	1768	147	0.63	17700	0.16

Table 4A-2.9: Semiquantitative total mineral composition in weight %.

horizon (cm)	quartz	layer silicates	felspars	calcite	chlorite	dolomite
Ap (0-12)	34	50	16	0	0	0
AhBv (12-35)	36	49	15	0	0	0
Bv (35-45)	30	58	12	0	0	0
BvCv (45-55)	27	52	8	10	0	3
Cv (55+)	25	45	5	19	0	6

Table 4A-2.10: Semiquantitative clay mineral distribution in weight %.

horizon (cm)	illite	chlorite	vermiculite	smectite	kaolinite
Ap (0-12)	29	23	0	18	30
AhBv (12-35)	29	22	0	22	27
Bv (35-45)	24	19	0	27	30
BvCv (45-55)	18	22	0	30	30
Cv (55+)	11	24	0	33	32

EXKURSION STOP 4A-3: Göpfritz an der Wild, soil profile eutri-stagnic Cambisol (WRB) from granulite mixed with weathered loess.

Site description: N 48° 42' 52,9'' - EO 15° 25' 31,2''

Soil survey district: KB 83, Allentsteig (Lower Austria).

Location: Highland Waldviertel, 598 m asl.

Climate: Upper Balticum.

Temperature in °C (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	aver.
-5.8	-3.8	-0.3	4.6	9.5	12.2	14.1	13.6	10.3	5.2	0.0	-3.9	4.6

Precipitations in mm WC (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
32	33	32	49	78	90	106	89	65	44	32	35	685

58% of the yearly precipitations (397 mm) fall in the vegetation period april-august (160-200 days).

Relief: Highland of the Waldviertels.

Landuse: Coniferous forest partly mixed with deciduous forest.

Soil profile description (see fig. 6):

L (5-3 cm): undecomposed litter layer (picea needles and haulm plants), gradual boundary to:

F (3-0 cm): fermented, not humified litter layer, gradual boundary to:

Ae (0-12 cm): loamy silt, 1% skeleton, Munsell 2.5YR/3/2 til 2.5 YR/4/2, weak crumby structure, porous, highly humous, pH acid, strongly rooted, no carbonate, no earthworms, gradual boundary to:

P1 (12-22 cm): loamy silt, 1% skeleton, Munsell 10YR/7/3 with punctiform Mn-concretions (Munsell 7.5YR/5/6), coherent massive structure (during the wet period) respectively prismatic cracky structure (during the dry period), weakly humous, pH weakly acid, not rooted, no carbonate, no earthworms, gradual boundary to:

P2 (22-34 cm): loamy silt, 1% skeleton, Munsell 10YR/7/3 with punctiform Mn-concretions (Munsell 7.5YR/5/6), coherent massive structure (during the wet period) respectively prismatic cracky structure (during the dry period), weakly humous, pH weakly acid, not rooted, no carbonate, no earthworms, gradual boundary to:

S (34+ cm): silty loam, 1% skeleton, with typical mottling with pale grey zones (Munsell 2.5Y/6/4 til 2.5Y/5/4) and rusty brown Fe-concretions (Munsell), coherent massive structure (during the wet period) respectively prismatic cracky structure (during the dry period), unpermeable during the wet period, no humus, pH weakly acid, not rooted, no carbonate, no earthworms.

Soil type: Eutri-stagnic Cambisol (WRB).

Parent material: Weathered granulite mixed with weathered loess.

Figure 6: Excursion profile 4A-3: eutri-stagnic Cambisol from weathered granulite mixed with weathered loess, Göpfritz an der Wild, Lower Austria.

Table 4A-3.1: Particle size distribution and texture type.

horizon (cm)	weight % of humus free fine earth (< 2mm) coarse sand	med. sand	fine sand	coarse silt	med. silt	fine silt	∑sand	∑silt	clay	texture type
L (5-3)	-	-	-	-	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-	-	-	-	-
Ae (0-12)	1.4	4.2	7.5	25.7	28.0	15.4	14.0	69.1	17.7	loamy silt
P1 (12-22)	6.3	4.8	7.8	26.5	25.5	14.0	18.9	66.0	19.0	loamy silt
P2 (22-34)	5.4	4.4	7.4	27.0	27.0	11.0	17.2	65.0	20.5	loamy silt
S (34+)	2.8	4.2	8.6	27.3	19.3	9.8	17.2	56.4	27.9	silty loam

Table 4A-3.2: Bulk density, total porosity, water contents and soil aggregate stability.

horizon (cm)	bulk density Mg/m^3	total porosity vol%	vol% water at pF 1,8	2,0	2,5	4,2	aggregate stability weight %
L (5-3)	-	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-	-
Ae (0-12)	1.12	58	35	33	31	18	38
P1 (12-22)	1.43	46	36	33	28	12	18
P2 (22-34)	1.43	46	37	34	28	13	8
S (34+)	1.58	40	33	32	31	19	10

Table 4A-3.3: Pore size distribution and available field capacity (aFC).

horizon (cm)	pore size distribution in vol.% wide CP (> 50 µm)	narrow CP (50-10 µm)	MP (10-0.2 µm)	FP (< 0.2 µm)	aFC mmWC
L (5-3)	-	-	-	-	-
F (3-0)	-	-	-	-	-
Ae (0-12)	23	4	13	18	17
P1 (12-22)	10	8	16	12	24
P2 (22-34)	9	9	15	13	24
S (34+)	7	2	12	19	-

Table 4A-3.4: General chemical parameters.

horizon (cm)	pH ($CaCl_2$)	$CaCO_3$ %	Corg %	Ct %	Nt %	C/N	el. conductivity µS/cm
L (5-3)	-	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-	-
Ae (0-12)	5.1	0	3.7	3.7	0.26	14.2	123
P1 (12-22)	4.5	0	0.8	0.8	0.08	10.0	178
P2 (22-34)	4.3	0	0.5	0.5	0.03	16.7	187
S (34+)	6.4	0	0.3	0.3	0.02	15.0	218

Table 4A-3.5: Effective cation exchange capacity (CECeff), base saturation (BS) and saturation of exchangeable cations.

horizon	CECeff	BS	cation saturation in % of CECeff						
(cm)	mmolIÄ/kg	%	Ca	Mg	K	Na	Fe	Al	Mn
L (5-3)	-	-	-	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-	-	-	-
Ae (0-12)	140.0	97	68.6	26.8	0.7	1.1	0.7	0.7	1.4
P1 (12-22)	57.1	88	52.9	30.8	1.4	3.2	0.1	10.5	1.3
P2 (22-34)	58.3	88	49.1	34.6	1.4	2.6	0	11.3	0.9
S (34+)	68.0	100	69.6	29.2	0.6	0.6	0	0	0

Table 4A-3.6: Elements in the aqua-regia-extract in g/kg.

horizon (cm)	Ca	Mg	K	Na	Fe	Al	Mn
L (5-3)	-	-	-	-	-	-	-
F 3-0)	-	-	-	-	-	-	-
A 0-12)	3.3	4.0	1.5	0.13	19.2	20.0	<1.0
P1 (12-22)	1.3	3.3	1.0	0.08	22.7	16.0	<1.0
P2 (22-34)	1.2	3.7	1.2	0.09	23.7	17.5	<1.0
S (34+)	8.3	8.0	3.2	0.13	31.2	29.0	<1.0

Table 4A-3.7: Dithionite (Fe_d)-, oxalate (Fe_o)-, pyrophosphate (Fe_p)- and total (Fe_t)-soluble Fe-contents in mg/kg.

horizont (cm)	Fe_d	Fe_o	Fe_p	Fe_o/Fe_d	Fe_t	Fe_d/Fe_t
L (5-3)	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-
Ae(0-12)	5497	4665	1825	0.85	19200	0.29
P1 (12-22)	4947	3352	783	0.68	22700	0.22
P2 (22-34)	10277	3918	431	0.38	23700	0.43
S (34+)	10258	3875	223	0.38	31200	0.33

Table 4A-3.8: Semiquantitative total mineral composition in weight %.

horizon (cm)	quartz	layer silicates	felspars	calcite	chlorite	dolomite
L (5-3)	-	-	-	-	-	-
F (3-0)	-	-	-	-	-	-
Ae(0-12)	43	41	16	0	0	0
P1 (12-22)	43	42	15	0	0	0
P2 (22-34)	44	41	15	0	0	0
S (34+)	44	40	16	0	0	0

Table 4A-3.9: Semiquantitative clay mineral distribution in weight %.

horizon (cm)	illite	chlorite	vermiculite	smectite	kaolinite
L (5-3)	-	-	-	-	-
F (3-0)	-	-	-	-	-
Ae(0-12)	20	12	3	10	55
P1 (12-22)	15	14	3	10	58
P2 (22-34)	13	12	4	11	60
S (34+)	12	10	3	12	63

EXKURSION STOP 4A-4: Eugenia, soil profile haplic Podzol (WRB) from Eisgarn-granite.

Site description : N 48° 48’ 47,6’’ - EO 15° 03’ 26,6’’

Soil survey district: KB 18, Schrems (Lower Austria),

Location: Highland of the Waldviertels, 560 m asl.

Climate: Upper Balticum.

Temperature in °C (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	aver.
-3.3	-1.9	1.6	6.5	11.9	15.0	16.8	15.9	12.1	6.8	1.8	-1.6	6.8

Precipitations in mm WC (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
43	36	39	58	78	82	101	76	59	49	38	45	704

55% of the yearly precipitations (387 mm) fall in the vegetation period April-August (200 days).

Relief: Upper Thaya-Highland of the Waldviertel.

Landuse: Coniferous forest.

Soil profile description (see fig. 7):

L (10-8 cm): Undecomposed litter layer (picea needles), sharp boundary to:
F1 (8-5 cm) Fermented litter layer, gradual boundary to:
F2 (5-3 cm): Fermented-humified litter layer, gradual boundary to:
H (3-0 cm): Humified litter layer, gradual boundary to:
A(E) (0-2 cm): loamy sand, 1% skeleton, Munsell 10YR/3/1, weak crumby structure – single grain structure, high coarse porosity, highly humous, pH very acid, strongly rooted, no carbonate, gradual boundary to:
E (2-12 cm): Sand, 1% skeleton, Munsell 10YR/4/1, single grain structure, highly coarse porosity, no humus, pH very acid, weakly rooted, no carbonate, gradual boundary to:
Bh (12-14 cm): Sand, 1% skeleton, Munsell 10R/4/4, sinle grain structure, highly

	coarse porosity, humous, pH very acid, weakly rooted, no carbonate gradual boundary to:
Bs1 (14-35 cm):	Sand, 1% skeleton, Munsell 10YR/6/8, sinle grain structure, highly coarse porosity, no humus but with single humus nests, pH acid, very weakly rooted, no carbonate, gradual boundary to:
Bs2 (35-62 cm):	Sand, 5% skeleton, Munsell 10YR/7/6, sinle grain structure, highly coarse porosity, no humus, pH acid, very weakly rooted, no carbonate, gradual boundary to:
Cv (62+ cm):	Sand, 5% skeleton, Munsell 10YR/7/4, sinle grain structure, highly coarse porosity, no humus, pH acid, no carbonate, no roots.

<u>Soil type</u>: Haplic Podzol (WRB).

<u>Parent material:</u> Eisgarn-granite.

Figure 7: Excursion profile 4A-4: haplic Podzol from Eisgarn-granite.

Table 4A-4.1: Particle size distribution and texture type.

horizon (cm)	weight % of humus free fine earth (< 2mm)									
	coarse sand	med. sand	fine sand	coarse silt	med. silt	fine silt	∑sand	∑silt	clay	texture type
L (10-8)	-	-	-	-	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-	-	-	-	-
A(E) (0-2)	13.0	45.7	9.0	4.9	10.6	4.7	68.9	20.2	12.1	loamy sand
E (2-12)	20.0	54.9	8.6	4.5	5.5	1.5	83.5	11.5	6.0	sand
Bh (12-14)	19.9	54.8	6.8	3.5	3.5	1.0	81.5	8.0	10.0	sand
Bs1 (14-35)	19.2	56.6	6.4	2.0	3.5	0.5	82.2	6.0	8.0	sand
Bs2 (35-62)	16.1	60.9	8.6	4.5	2.5	0.5	85.6	7.5	6.5	sand
Cv (62+)	36.0	30.7	12.2	6.0	7.5	3.0	78.9	16.5	4.0	sand

Table 4A-4.2: Bulk density, total porosity, water contents and soil aggregate stability.

horizon (cm)	bulk density Mg/m^3	total porosity vol%	vol% water at pF				aggregate stability weight %
			1,8	2,0	2,5	4,2	
L (10-8)	-	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-	-
A(E) (0-2)	1.15	57	31	31	30	11	59
E (2-12)	1.37	48	28	25	19	6	59
Bh (12-14)	1.35	49	31	30	27	12	71
Bs1 (14-35)	1.43	46	35	28	17	6	31
Bs2 (35-62)	1.47	45	32	25	15	5	43
Cv (62+)	1.50	43	29	25	14	4	-

Table 4A-4.3: Pore size distribution and available field capacity (aFC).

horizon (cm)	pore size distribution in vol.% wide CP (> 50 µm)	narrow CP (50-10 µm)	MP (10-0.2 µm)	FP (< 0.2 µm)	aFC mmWC
L (10-8)	-	-	-	-	-
F1 (8-5)	-	-	-	-	-
F2 (5-3)	-	-	-	-	-
H (3-0)	-	-	-	-	-
A(E) (0-2)	26	1	19	11	4
E (2-12)	20	9	13	6	22
Bh (12-14)	18	4	15	12	4
Bs1 (14-35)	11	18	11	6	54
Bs2 (35-62)	13	17	10	5	81
Cv (62+)	14	15	10	4	-

Table 4A-4.4: General chemical parameters.

horizon (cm)	pH ($CaCl_2$)	$CaCO_3$ %	Corg %	Ct %	Nt %	C/N	el. conductivity µS/cm
L (10-8)	-	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-	-
A(E) (0-2)	2.8	0	14.5	14.5	0.51	28.4	88
E (2-12)	2.8	0	3.6	3.6	0.19	18.9	48
Bh (12-14)	3.0	0	6.6	6.6	0.11	60.0	148
Bs1 (14-35)	3.9	0	0.5	0.5	0.01	50.0	150
Bs2 (35-62)	4.0	0	0.5	0.5	0.01	50.0	152
Cv (62+)	4.3	0	0.3	0.3	0.01	30.0	164

Table 4A-4.5: Effective cation exchange capacity (CECeff), base saturation (BS) and saturation of exchangeable cations.

horizon (cm)	CECeff mmolIÄ/kg	BS %	cation saturation in % of CECeff Ca	Mg	K	Na	Fe	Al	Mn
L (10-8)	-	-	-	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-	-	-	-
A(E) (0-2)	66.3	59	47.5	8.1	2.7	0.7	0.9	40.0	0.1
E (2-12)	29.2	20	13.0	3.9	2.9	0.5	0.7	79.1	0.0
Bh (12-14)	44.8	7	3.1	1.3	1.8	0.5	3.6	89.7	0.0
Bs1 (14-35)	6.1	2	0.0	0.2	1.3	0.0	0.3	97.5	0.0
Bs2 35-62)	4.8	3	0.0	1.0	2.5	0.0	0.4	95.6	0.0
Cv (62+)	2.0	3	0.0	1.8	1.3	0.0	0.3	96.5	0.0

Table 4A-4.6: Elements in the aqua-regia-extract in g/kg.

horizon (cm)	Ca	Mg	K	Na	Fe	Al	Mn
L (10-8)	-	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-	-
A(E) (0-2)	0.90	0.2	0.2	0.02	1.5	2.0	<0.1
E (2-12)	0.10	0.1	0.2	0.02	1.6	1.9	<0.1
Bh (12-14)	0.01	0.2	0.2	0.01	4.6	3.1	<1.0
Bs1 (14-35)	0.00	0.3	0.3	0.09	5.0	8.6	<1.0
Bs2 (35-62)	0.01	0.4	0.3	0.02	4.7	7.5	<1.0
Cv (62+)	0.23	2.0	1.4	0.05	12.9	15.0	<1.0

Table 4A-4.7: Dithionite (Fe_d)-, oxalate (Fe_o)-, pyrophosphate (Fe_p)- and total (Fe_t)-soluble Fe-contents in mg/kg.

horizont (cm)	Fe_d	Fe_o	Fe_p	Fe_o/Fe_d	Fe_t	Fe_d/Fe_t
L (10-8)	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-
A(E) (0-2)	1066	702	515	0.66	1500	0.71
E (2-12)	905	463	281	0.51	1600	0.57
Bh (12-14)	3660	3236	1862	0.88	4600	0.80
Bs1 (14-35)	2657	2411	556	0.91	5700	0.47
Bs2 (35-62)	2281	1583	219	0.69	4700	0.48
Cv (62+)	1933	558	130	0.29	12900	0.15

Table 4A-4.8: Semiquantitative total mineral composition in weight %.

horizon (cm)	quartz	layer silicates	felspars	calcite	chlorite	dolomite
L (10-8)	-	-	-	-	-	-
F1 (8-5)	-	-	-	-	-	-
F2 (5-3)	-	-	-	-	-	-
H (3-0)	-	-	-	-	-	-
A(E) (0-2)	65	0	35	0	0	0
E (2-12)	80	0	20	0	0	0
Bh (12-14)	63	0	37	0	0	0
Bs1 (14-35)	64	10	16	0	0	0
Bs2 (35-62)	65	10	25	0	0	0
Cv (62+)	66	12	22	0	0	0

Table 4A-4.9: Semiquantitative clay mineral distribution in weight %.

horizon (cm)	illite	chlorite	vermiculite	smectite	kaolinite
L (10-8)	-	-	-	-	-
F1 (8-5)	-	-	-	-	-
F2 (5-3)	-	-	-	-	-
H (3-0)	-	-	-	-	-
A(E) (0-2)	40	0	0	0	60
E (2-12)	42	0	0	0	58
Bh (12-14)	52	0	0	0	48
Bs1 (14-35)	55	0	0	0	45
Bs2 (35-62)	62	0	0	0	38
Cv (62+)	73	0	0	0	27

EXKURSION STOP 4A-5: Nature park Schrems, Brunn an der Wild, soil profile ombri-fibric Histosol (WRB).

Site description : N 48° 47’ 54,6’’ - EO 15° 06’ 09,0’’

Soil survey region: KB 18, Schrems (Lower Austria).

Location: Highland of the Waldviertel, 562 m asl.

Climate: Upper Balticum.

Temperature in °C (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	aver.
-3.3	-1.9	1.6	6.5	11.9	15.0	16.8	15.9	12.1	6.8	1.8	-1.6	6.8

Precipitations in mm WC (long term average):

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
43	36	39	58	78	82	101	76	59	49	38	45	704

55% of the yearly precipitations (387 mm) fall in the vegetation period April-August (200 days).

Relief: Upper Thaya-Highland of the Waldviertel.

Land use: Protected area, Moor.

Soil profile description (see fig. 8):

Tearth (0-15 cm): Munsell 10YR/2/1, earthy, strongly decomposed, weakly crumby structure, strongly rooted, gradual boundary in:
T1 (15-20 cm) Munsell 10YR/2/1, decomposed, fibrous-platy, weakly rooted, gradual boundary to:
T2 (20-30 cm): Munsell 10YR/2/1, decomposed, faserig-platy, gradual boundary to:
T3 (30-80 cm): Munsell 10YR/2/1, weakly decomposed, gradual boundary to:
T4 (80-100 cm): Munsell 10YR/2/1, weakly decomposed, coarse fibrous, gradual boundary to:
T5 (100+ cm): Munsell 10YR/2/1, very weakly decomposed.

Soil type: Ombri-fibric Histosol (WRB)

Parent material : Organic material.

Figure 8: Excursion profile 4A-5: ombri-fibric Histosol.

Table 4A-5.1: General physico-chemical parameters.

horizon (cm)	bulk density Mg/m^3	pH ($CaCl_2$)	Corg %	Ct %	Nt %	C/N %
Tearth (0-15)	0.28	2.7	26.7	26.7	1.06	25.2
T1 (15-20)	-	2.6	34.3	34.3	1.63	21.0
T2 (20-30)	0.15	2.6	28.7	28.7	1.17	24.5
T3 (30-80)	-	2.6	25.3	25.3	0.94	26.9
T4 (80-100)	0.13	2.9	16.6	16.6	0.59	28.1
T5 (100+)	-	3.5	18.4	18.4	0.76	24.2

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