EUROSOIL – 2008 EXCURSION 1CRO-SLO-pre congress

"MAIN SOIL TYPES THROUGH CROATIA AND SLOVENIA"

(CROATIAN PART)

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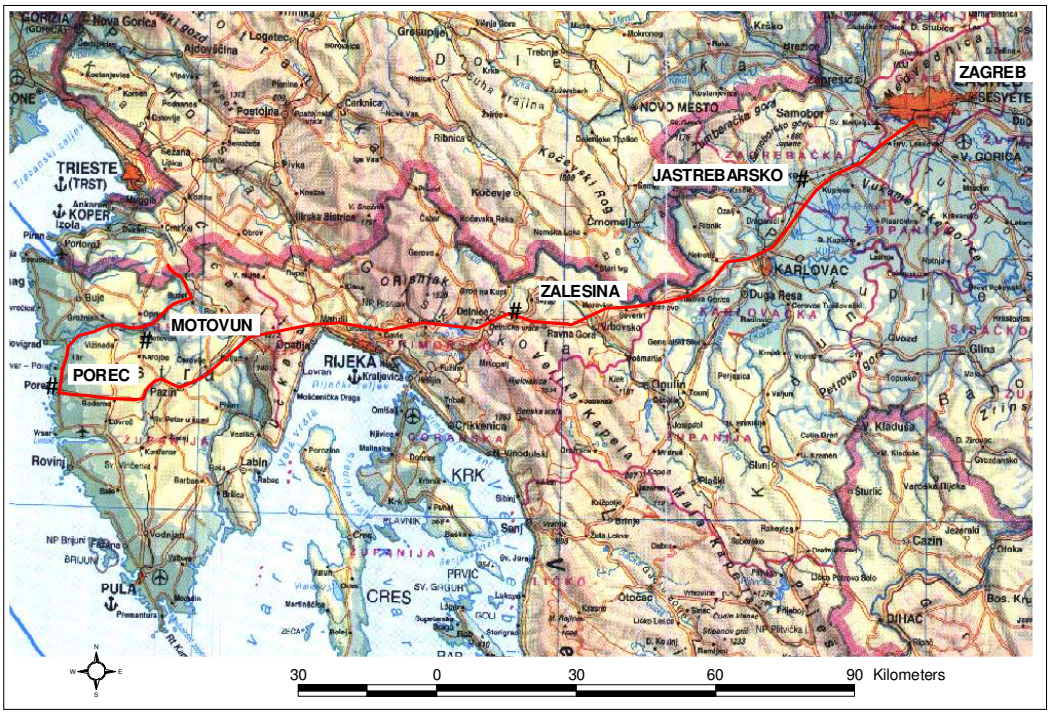
1. GENERAL INTRODUCTION

The main goal of this part of the Croatia-Slovenia field excursion is to show the characteristic soil types of Croatia, on different geomorphological regions and parent materials, in different climate areas of Croatia. Excursion will start in Zagreb and continue to Motovun with four stops; Jastrebarsko, Zalesina, Porec and Motovun near Buzet.



Rout with stops through Croatia

General description

In Croatia, the excursion will start from the plain part of central Croatia, then it will pass through mountain region, and it will end in the Istria peninsula, located in the northen Croatian coastal area. The mentioned route is very heterogeneus in the topographic, climatic, geological, pedological and phytocenological sense. The Pokupsko basin near Jastrebarsko is some 115 meters above sea level. After leaving Jastrebarsko we climb towards Gorski Kotar, at 800 meters above sea level. Finally we descend to the adriatic coast, and then through the Ucka tunnel we enter to Istrian peninsula, which is the most western point of Croatia.

In the lithologic sense, the excursion area is characterized by quaternary silty clay sediments between Jastrebarsko and Karlovac, and by classic karst complex with Cretaceous and Jurassic limestones between Karlovac and the most western border of Croatia. Big enclaves of Triassic dolomites and clastic rocks with inclusions of paleozoic clastics, metamorphic and magmatics rocks egsist in this complex. The southeast part of Istria is covered in classic karst complex with limestones and dolomites also, while at the northern part of the peninsula we can find a wide flysch belt spreading to northwest, towards the city of Trieste, Italy.
We meet several bioclimates on the excursion route. In the area between Jastrebarsko and Karlovac, the forests of pedunculate oak on Gleyosols and Cambisols are the main characteristics, while southwest of Karlovac we find oak forests on Stagnosols, Luvisols and Cambisols. Aproaching Gorski Kotar we pass through the bioclimate of beech and beech-fir forests on Leptosols, Cambisols, Luvisols, Podzols and Regosols. While descending from Gorski Kotar to the west we pass through the belt of littoral beech forests on Leptosols and Cambisols and enter the submediterranian area, characterized by communities of pubescent oak with hop hornbeam and pubescent oak with oriental hornbeam on Cambisols, Leptosols and Phaeozems. At the western end of Croatia we enter the eumediterranian bioclimate area, characterized by forests of holm oak on chromic Cambisols.
According the way the land is being used, the excursion area can be devided in three parts. The first one is the plain and hilly area around Jastrebarsko and Karlovac, with agricultural and forest soils almost equally present. The second part is Gorski Kotar area, which spreads until the exit of the Ucka tunnel to the Istrian peninsula and is dominated by forest land. The third part is Istria, largely represented by agricultural lands.

2. METHODS

2.1. Soil physical analyses

HRN ISO 11277/04: Soil quality - determination of particle size distribution in mineral soil material - method by sieving and sedimentation; soil textural analysis according Soil Survey Staff (1999)
HRN ISO 11272/04: Soil quality - Determination of dry bulk density

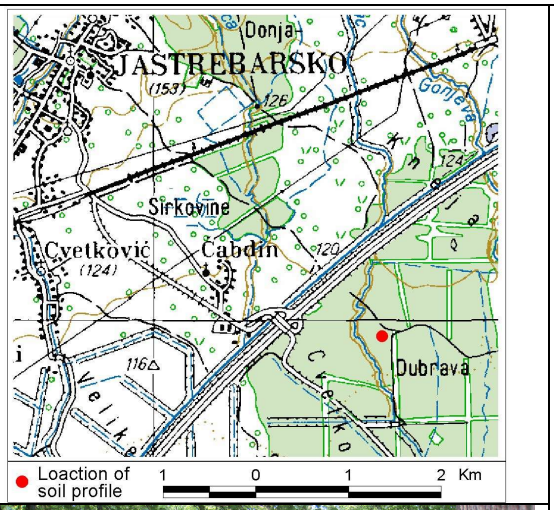
HRN ISO 11508/04: Soil quality - Determination of particle density
Determination of soil capacity for water and air (Resulovic and Burlica, JDPZ 1971)
Determination of total porosity calculation from particle and bulk densities (Danielson and Sutherland, 1986)
Determination of hydraulic conductivity of saturated soils - laboratory methods (Klute and Dirksen, 1986).
HRN ISO 11274/04: Soil quality - Determination of the water-retention characteristic-laboratory methods
The aggregate stability was determined according to "Murer E.J., Baumgarten A., Eder E., Gerzabek M.H., Kandeler E., Rampazzo N.: An improved sieving machine for estimation of soil aggregate stability (SAS). Geoderma, 56, 539-547, 1993."
Pore size distribution was calculated using the method: Estimation of Soil Water Retention Using Two Models Based on Regression Analysis and an Artificial Neural Network: Proceedings of the International Workshop on Characterization and Measurement of the Hydraulik Properties of Unsaturated Porous Media, 22-24. October 1997.
Riverside, California. 1261-1267.

2.2. Soil chemical analyses

HRN ISO 10390/05: Soil quality - determination of pH
HRN ISO 10693/04: Soil quality - Determination of carbonate content - volumetric method
HRN ISO 10694/04 : Soil quality - Determination of organic and total carbon after dry combustion (elementary analysis)
HRN ISO 13878/04: Soil quality - Determination of total nitrogen content by dry combustion (elementary analysis)
HRN ISO 11260/04: Soil quality - Determination of effective cation exchange capacity and base saturation level using barium chloride solution
HRN ISO 11466/04: Soil quality - extraction of trace elements soluble in aqua regia (Determination of P, Ca, Mg, Mn, Na, K, Al, Fe in aqua regia extracts of soil using ICP technics)
Determination of available phosphorus and potassium (Al-method, Vajnberger JDPZ 1966)

3. EXCURSION POINTS

3.1. Excursion points 1: Soil profile at Jastrebarski Lug, Panonic lowland near Jastrebarsko



Site characterisation

Location : Jastrebarsko
Altitude: 114 m
GPS coordinates: X 5554372, Y 5055858

Climate – acording to Köppen classification it is warm-moderate rainy climate, type Cfwbx, acording to Lang humide climate

Temperature (°C) – weather station Jastrebarsko, period - 1971-2000

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
Temperature	0,4	1,9	6,2	10,1	15,2	18,1	20,2	19,8	15,2	10,1	4,6	0,8	10,2

Precipitation (mm) – weather station Jastrebarsko, period - 1971-2000

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.

Precipitation	46,9	47,9	59,6	69,6	71,8	104,3	81,6	90,5	93,9	85,7	93,1	66,5	911,4

Relief: position °, slope - °

Landuse/vegetation – Peduncled Oak and Common Hornbeam *(Carpino betuli-Quercetum roboris,* Anić 1956 ex. Rauš 1969)

Parent material **-** Pleistocene loams

Soil profile description

O (0-5 cm) thick organic layer; clear irregular boundary

A (0-2,5 cm) silty loam, 7,5YR3/0 (dry), 7,5YR2/0 (moist), many very fine and many very few fine to coarse roots, earthworms observed while digging the profile, abrupt irregular, pH very acid, sharply overlying

Eg (2,5-20 cm) silty loam, 10YR6/1 (dry), 10YR5/1 (moist), angular blocky structure, redish brown nodules, very fine and medium roots and few coarse roots, pH very acid, gradually turning into

Btg (20 – 52 cm) silty clay loam, 10YR6/4 (dry), 10YR5/6 (moist), sporadically present reduction along pores and more oxides in peds, angular blocky structure, very few coatings in macropores, very fine, medium and few coarse roots, pH very acid, expressly turning into

BCg (52-71 cm) silty clay loam, 10YR7/1 (dry), 10YR6/3 (moist), reduction along pores and more oxides in peds, angular blocky structure, very few coating in macropores, pH very acid, sharply overlying

Cg (71-139 cm) silty clay, 10YR6/1 (dry), 10YR5/1 (moist), matrix composing of geological strata, seems strong reduction, colour gleyic, massive structure, pH acid, sharply overlying

Cg (139-190 cm) silty clay, 10YR7/3 (dry), 10YR6/3 (moist), massive structure, pH acid, gradually turning into

Cg (190-240 cm) silty clay, 10YR6/3 (dry), 10YR5/3 (moist), massive structure, calcareous, pH alkaline, concretions of $CaCO_3$, gradually turning into

Cg (240-260 cm) clay, 10YR 7/4 (dry), 10 YR 5/4 (moist), massive structure, calcareous, pH alkaline, gradually turning into

Cg (260-280 cm) silty clay, 10YR 7/6 (dry), 10YR (6/6), massive structure, calcareous, pH alkaline

Soil physical parameters

Particle size distribution

Depth cm	*Genetic layer*	*Diameter (mm) and percent of particles content*					*Texture*
		2-0,2	0,2-0,063	0,063-0,02	0,02-0,002	<0,002	
0,0-2,5	A	6,7	7,3	32,9	39,4	13,7	Silty loam
2,5-20	E	6,3	4,7	31,2	42,8	15,0	Silty loam
20-52	Btg	3,0	0,6	27,8	35,5	33,1	Silty clay loam
52-71	BCg	1,5	1,4	29,9	36,9	30,3	Silty clay loam
71-139	Cg	0,1	0,5	22,2	32,0	45,2	Silty clay

139-190	Cg	0,1	0,5	19,4	28,1	51,9	Silty clay
190-240	Cg	0,6	1,3	17,2	25,0	55,9	Silty clay
240-260	Cg	0,2	1,1	15,1	23,1	60,5	Clay
260-280	Cg	0,6	2,8	23,3	25,6	47,7	Silty clay

Some other physical properties of soil

Depth *cm*	*Soil capacity for*		*Porosity* vol%	*Density of soil*		*Soil water permeability m/day*	*Water holding capacity* (% mass)	
	water vol%	*air* vol%		*bulk* Mg/m^3	*specific* Mg/m^3		0,03 MPa	1,5 MPa
0,0-2,5	-	-	-	-	-	-	52,0	23,8
2,5-20	54,5	5,0	59,5	1,01	2,48	0,41	43,4	12,5
20-52	44,5	6,4	50,9	1,26	2,56	0,30	38,3	16,0
52-71	42,2	5,2	47,5	1,35	2,57	0,59	38,3	14,1
71-139	40,7	3,5	44,3	1,45	2,60	0,04	36,0	16,5
139-190							38,6	18,4
190-240							43,1	19,6
240-260							43,4	21,0
260-280							36,9	18,2

Chemical properties of soil

Some chemical properties of soil

Depth *cm*	pH		$CaCO_3$ %	C_{tot} %	N_{tot} %	C/N	C_{org} %	Content (mg/100 g soil)	
	H_20	$CaCl_2$						P_2O_5	K_2O
0,0-2,5	4,59	3,79	-	3,840	0,110	35	3,800	4,2	23,5
2,5-20	4,55	3,86	-	2,028	0,438	5	2,017	3,2	7,4
20-52	4,67	3,93	-	0,717	0,060	12	0,711	1,5	5,4
52-71	5,05	4,18	-	0,386	0,056	7	0,383	0,6	7,6
71-139	5,93	4,91	-	0,710	0,088	8	0,299	0,4	10,0
139-190	7,03	6,29	-					2,8	11,0
190-240	7,99	7,49	3,9					3,3	11,8
240-260	7,95	7,35	2,3					3,9	11,4
260-280	7,95	7,39	3,1					2,9	10,2

Cations exchange capacity (CEC) and base saturation (B)

Depth *cm*	*Exchangeable base cations*				*Total amount of base cations (A)*	CEC	B (%) (A/CEC) *100
	Ca^{2+}	Mg^{2+}	K^+	Na^+			
	cmol/kg						
0,0-2,5	1,05	0,82	0,51	0,19	2,57	11,9	21,6
2,5-20	0,22	0,26	0,18	0,04	0,70	8,06	8,7
20-52	1,15	1,07	0,17	0,05	2,44	12,15	20,1
52-71	4,29	2,72	0,20	0,09	7,30	14,15	51,6
71-139	10,71	6,21	0,31	0,57	17,80	20,76	85,7
139-190							
190-240							

240-260							
260-280							

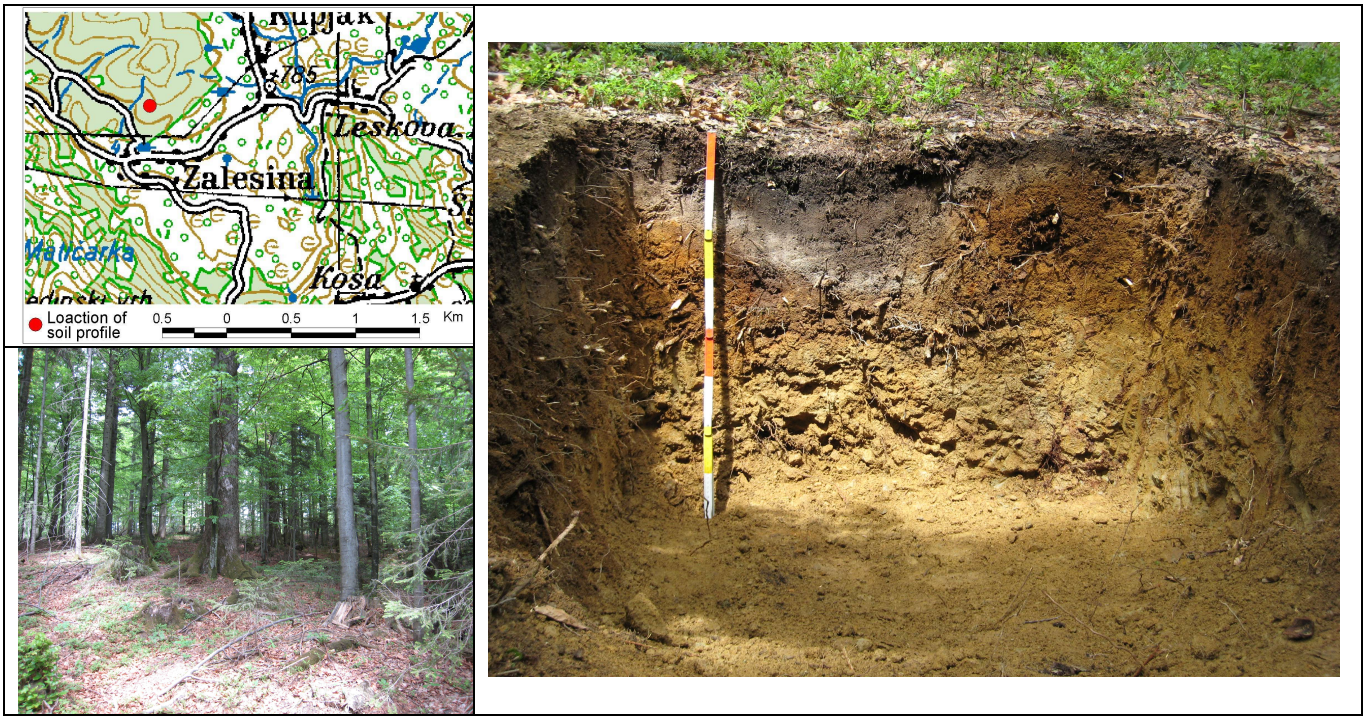
Content of elements

Depth cm	P	Ca	Mg	Mn	Na	K	Al	Fe
	mg/kg					g/kg		
0,0-2,5	771,7	1660,6	4768,7	757,6	638,6	5,39	46,2	21,99
2,5-20	520,5	1860,2	5570,5	381,4	809,3	6,22	55,5	24,24
20-52	515,1	1692,2	6355,2	180,8	765,7	6,45	65,1	36,36
52-71	396,3	2062,6	6886,7	174,8	746,8	6,34	65,3	36,24
71-139	167,1	3079,2	5533,8	119,1	741,6	5,89	72,3	21,53
139-190	170,5	3042,9	5817,2	80,2	948,9	6,78	74,8	26,32
190-240	231,9	5344,7	6877,4	123,8	919,6	6,28	73,7	40,72
240-260	289,3	4306,7	7297,8	122,4	1110,9	6,60	78,9	38,13
260-280	264,2	4121,3	5911,9	178,3	880,6	6,01	65,5	47,38

Classification:

WRB(2006):
Endogleyic Luvic STAGNOSOL (Albic, Epidystric, Endoeutric, Episiltic, Endoclayic, Ruptic)

3.2. Excursion points 2: Soil profile at Zalesina, mountain region of Gorski Kotar



Site characterisation

Location : Zalesina
Altitude: 804 m
GPS coordinates: X 5028740, Y 5490567

Climate - acording to Köppen classification it is warm-moderate rainy climate, type Cfsbx“
- acording to Lang perhumide climate

Temperature (°C) – weather station Zalesina

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
1948-1960	-2	-1,8	1,3	6,3	11,2	14,9	16,6	16,1	12,4	7,9	3,3	0,7	7,2
2001-2005	-3,5	-4,5	0,6	5,3	11,6	15,6	16,4	17,0	10,8	6,8	4,0	-1,3	6,6

Precipitation (mm) – weather station Zalesina

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.
1948-1960	168	156	121	153	160	145	127	123	193	207	205	221	1.979
2001-2005	123	116	78	170	124	97	60	115	140	266	104	129	1.522

Relief: position 185°, slope 10 °

Landuse/vegetation – Fir forest with hard fern (*Blechno-Abietetum*)

Parent material **-** Permian quartz-sandstones

Soil profile description:

O (2-4 cm) 2-4 cm thick organic layer on the soil surface with 1,5-2 cm full decomposed matter (dark powder). Oa/Oe subhorizons are rich with fine roots of *Vaccinium myrtillus*.

A (0-4(22)): sandy loam, without coarse fraction, 10 YR 3/1 (dry), 10 YR 2/1 (moist), pH very acyd, very fine weak grain structure. There are some medium tree roots and few fine tree and bush roots. This horizon has very variable depth.

E (4(22)-10(28)): sandy loam, without coarse fraction, 10 YR 7/1 (dry), 10 YR 6/2 (moist), pH very acyd, very fine weak grain structure – grey sandy loamy material. This horizon is discontinuous. It is less streaked with roots then A horizon.

Bhs (10(28)-23(36)) is sporadically present chocolate color horizon, sandy loamy texure, with some coarse fraction, 10 YR 4/4 (dry), 10 YR 3/3 (moist), pH very acid, very fine granular structure. There are present medium and coarse roots and less fine roots.

Bs (23(36)-35(40)) is light brown sandy loam horizon with 30-50% present coarse fraction. Color is 10 YR 6/4 (dry), 10 YR 5/4 (moist), pH very acid, fine granular structure. There are persent medium and coarse roots and less fine roots. This horizon has very variable depth.

C >35(40) is detritus of quartz sandstone. It is sandy loamy texture with 50-70% coarse fraction (to 50 mm in diameter). Color is 10 YR 7/3 (dry), 10 YR 6/4 (moist), pH very acyd. There are present some fine roots.

Soil physical parameters

Particle size distribution

Depth cm	*Genetic layer*	*Diameter (mm) and percent of particles content (%)*					*Texture*
		2-0,2	0,2-0,063	0,063-0,02	0,02-0,002	<0,002	
0-4(22)	A	29,4	28,2	18,7	16,6	7,1	Sandy loam
4(22)-10(28)	E	35,3	29,2	14,2	14,3	7,0	Sandy loam
10(28)-23(36)	Bhs	32,5	24,1	13,1	13,5	16,8	Sandy loam
23(36)-35(40)	Bs	28,2	25,2	14,1	14,2	18,3	Sandy loam
>35(40)	C	53,3	21,4	6,6	10,1	8,6	Sandy loam

Some other physical properties of soil

Depth cm	*Soil capacity for*		*Porosity* (vol.%)	*Density of soil*		*Water holding capacity* (% mass)	
	water vol.%	*air* vol.%		*bulk* Mg/m^3	*specific* Mg/m^3	0,03 MPa	1,5 MPa
0-4(22)	35,3	27,5	62,8	0,91	2,43	34,1	13,3
4(22)-10(28)	43,8	21,8	65,6	0,85	2,46	20,4	6,8

10(28)-23(36)	54,1	9,5	63,6	0,90	2,48	30,5	13,4
23(36)-35(40)						30,1	10,9
>35(40)						15,6	4,8

Chemical properties of soil

Some chemical properties of soil

Depth	pH		C_{tot}	N_{tot}	C/N	C_{org}	*Content* (mg 100^{-1} g)	
cm	H_20	$CaCl_2$	%	%		%	P_2O_5	K_2O
0-4(22)	3,82	3,10	6,5	0,19	34	6,3	2,4	8,9
4(22)-10(28)	4,01	3,35	1,7	0,58	3	1,6	0,1	4,0
10(28)-23(36)	4,21	3,62	1,4	0,10	14	5,2	0,1	6,8
23(36)-35(40)	4,68	3,89	1,5	0,10	15	4,1	0,1	5,4
>35(40)	4,87	4,29	0,8	0,10	8	0,7	0,9	5,0

Cations exchange capacity (CEC) and base saturation (B)

Depth	*Exchangeable base cations*				*Total amount of base cations (A)*	CEC	B (%) (A/CEC) *100
cm	Ca^{2+}	Mg^{2+}	K^+	Na^+			
	cmol kg^{-1}						
0-4(22)	0,28	0,26	0,24	0,16	0,94	20,09	4,7
4(22)-10(28)	0,15	0,09	0,15	0,03	0,42	15,47	2,7
10(28)-23(36)	0,20	0,12	0,22	0,05	0,59	14,16	4,2
23(36)-35(40)	0,15	0,09	0,17	0,04	0,45	6,94	6,5
>35(40)	0,07	0,04	0,13	0,04	0,28	2,69	10,4

Content of elements

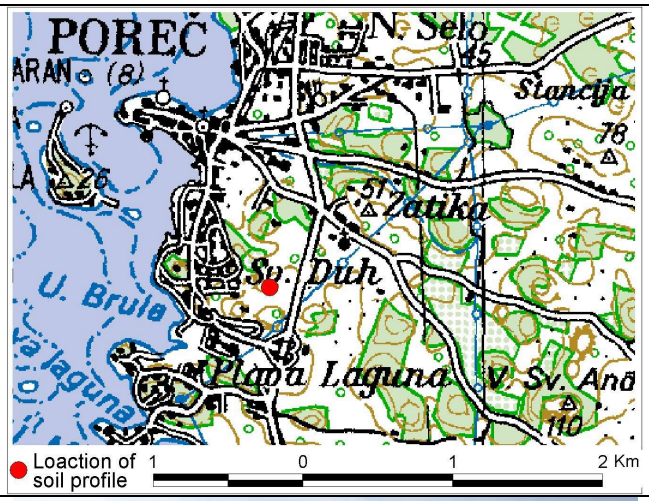
Depth	P	Ca	Mg	Mn	Na	K	Al	Fe
cm	mg kg^{-1}					g kg^{-1}		
0-4(22)	275,4	165,1	1770,2	32,4	407,6	3,11	35,5	9,49
4(22)-10(28)	129,5	34,0	1420,8	15,5	417,4	3,84	31,4	4,95
10(28)-23(36)	264,3	92,7	2638,5	34,5	428,5	5,49	51,5	31,56
23(36)-35(40)	227,7	87,9	2616,7	38,9	435,1	5,83	56,4	29,79
>35(40)	124,7	55,7	4284,4	131,7	369,7	10,02	55,8	23,15

Classification:

WRB(2006):

Albic Entic PODZOL (Endoskeletic)

3.3. Excursion points 3: Soil profile at Porec, karst area of Istra



Site characterisation

Location : Istra, about two km south from old part of town Porec
Altitude: 28,6 m
GPS coordinates: x 5390780; y 5009537

Climate - acording to Köppen classification it is warm-moderate humid climate with hot summer, type Cfsax“
- acording to Lang semiarid climate

Temperature (°C) – weather station Porec, period 1964-2004

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
Temperature	4,9	5,2	7,9	11,6	16,4	20,3	22,5	22,4	18,5	14,1	9,7	6,3	13,3

Precipitation (mm) – weather station Porec, period 1964-2004

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.
Precipitation	50,8	42,5	43,6	54,8	53,2	53,4	37,4	75,2	78,8	79,8	87,7	59,4	716,6

Relief **:** Plateau, slope 3-5%

Landuse/vegetation **–** meadows and vineyards

Parent material **-** relict terra rossa

Soil profile description:

P (0-55 cm) clay, <3% coarse fraction (skeleton), 10 R 4/6 (dry), 10 R 4/3 (moist), pH neutral, without carbonate, polyhedral structure, poorly humic, slightly rooted, with a lot concretions of manganese moltles, human influenced straight horizon boundary, sharply overlying

C (55-120 cm) clay, 2,5 YR 4/6 (dry), 2,5 YR 4/4 (moist), pH neutral, without carbonate, polyhedral structure, very poorly humic, without root development, rare signs of reducing conditions, with lot concretions of manganese moltles, gradually turning into

Cg (120-220 cm) clay, 2,5 YR 4/6 (dry), 2,5 YR 4/4 (moist), pH acid, without carbonate, polyhedral structure, very poorly humic, without root development, with a lot concretions of manganese moltles and signs of reducing conditions

Soil physical parameters

Particle size distribution

Depth cm	*Genetic layer*	*Diameter (mm) and percent of particles content*					*Texture*
		2-0,2	0,2-0,063	0,063-0,02	0,02-0,002	<0,002	
0-55	P	0,1	3,3	14,8	23,8	58,0	Clay
55-120	C	0,1	2,6	14,9	18,2	64,2	Clay
120-220	C	0,3	2,3	12,2	16,8	68,4	Clay

Some other physical properties of soil

Depth cm	*Soil capacity for*		*Porosity* vol%	*Density of soil*		*Water holding capacity* (% mass)		*Average aggregate stability, weight %*
	water vol%	*air* vol%		*Bulk* Mg/m^3	*Specific* Mg/m^3	0,03 MPa	1,5 MPa	
0-55	40,0	4,9	44,9	1,46	2,65	35,5	22,0	19,4
55-120	41,8	4,0	45,8	1,43	2,65	37,7	23,6	10,1
120-220	39,7	3,7	43,4	1,50	2,65	39,7	22,3	11,3

Pore Size Distribution and Available Field Capacity (aFC)

Depth cm	Pore Size Distribution (Vol. %)*				aFC mmWC
	wCP	nCP	MP	FP	
0-55 cm	8.0	4.0	4.0	30.0	44.0
55-120 cm	7.0	5.0	3.0	31.0	52.0
120-220 cm	2.5	5.0	2.0	32.0	70.0

*wCP = wide corse pores (>50µm) ; nCP = narrow corse pores (50-10 µm); MP = medium pores (10-0,2 µm); FP = fine pores (<0,2 µm)

Chemical properties of soil

Some chemical properties of soil

Depth cm	pH		C_{tot} %	N_{tot} %	C/N	C_{org} %	Content (mg/100 g soil)	
	H_20	$CaCl_2$					P_2O_5	K_2O
0-55	7,24	6,54	0,791	0,133	6	0,760	1,4	13,0
55-120	7,28	6,62	0,354	0,072	5	0,338	0,0	9,8
120-220	6,45	5,97	0,276	0,077	4	0,271	0,0	10,0

Cations exchange capacity (CEC) and base saturation (B)

Depth cm	*Exchangeable base cations*				*Total amount of base cations (A)*	CEC	B (%) (A/CEC) *100
	Ca^{2+}	Mg^{2+}	K^+	Na^+			
	cmol/kg						
0-55	21,62	1,51	0,43	0,09	23,65	26,58	89,0
55-120	19,54	1,92	0,29	0,16	21,91	24,66	88,8
120-220	15,80	2,47	0,32	0,25	18,84	19,48	96,7

Content of elements

Depth cm	P	Ca	Mg	Mn	Na	K	Al	Fe
	mg/kg					g/kg		
0-55	400,53	4155,2	3482,5	1089,9	568,7	6,95	95,0	49,7
55-120	286,79	3376,9	3561,9	1057,5	621,0	7,21	101,9	54,4
12-220	275,73	2598,1	3504,1	904,7	528,9	6,48	103,1	56,5

Classification:

WRB(2006):

Endostagnic ANTHROSOL (Eutric, Clayic,)

3.4. Excursion points 4: Series of soils formed on flysch

Area characterisation

Location : Central part of Istra
Altitude: 20-750 m

Climate - acording to Köppen classification it is warm-moderate humid climate with warm summer, type Cfsbx“
- acording to Lang semiarid climate

Temperature (°C) – weather station Pazin, period 1964-2004

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
Temperature	3,0	3,5	6,4	9,9	14,8	18,3	20,8	20,2	16	11,7	6,9	3,9	11,3

Precipitation (mm) – weather station Pazin, period 1964-2004

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.
Temperature	74,7	66,9	78,8	91,7	79,1	92,7	65	94,9	102,8	123,5	123,7	92,6	1.086,4

Relief (position, slope) – Hilly to mountainous

Landuse/vegetation – Agriculture and forestry

Parent material - Flysch

Series of soils formed on flysch in the area of Istria

The central undulating part of Istria is cold «gray» Istria, because of the predominantly eroded shallow soils of the same color on flysch. Flysch sediments consist of marl, sandstone and embedded soft limestone. Flysch belongs to Eocene marine sedimentary rocks. In contrast to pure and hard limestones, flysch contains much less calcium carbonate and much more of the

silicate component. It weathers more rapidly, thus forming more detritus to be inherited by the soil cover. Particular flysch components are differently represented, and a notable feature is the alternation of marl and sandstone layers of different thickness. With regard to the relief, this area is lower than the hilly-mountainous one, but lies higher above sea level than the southwestern Istrian table. Though, according to the described characteristics of the lithological substratum, a deeper and continuous pedosphere cover and more developed soils might be expected in the flysch zone, this is not the case everywhere. Namely, the relief, impermeable sediments, as well as considerable precipitation all together enhance removal and leaching of the formed detritus and soil. Besides, the anthropogenic influence, notably clearing of natural forest vegetation and soil development, have until recently precipitated removal of loose soil. Man's survival in this region has always been associated with fighting erosion and protection from torrential waters. A number of terraces as well as different hydrotechnical structures built to control soil erosion show that this region used to be one of the most highly populated in the Croatian littoral.

As soil formation on flysch is permanently "hindered" by removal of particles, initial or young, predominantly shallow, dry and erosion prone soils are found in this area. Of undeveloped soils or soils not essentially different from the parent rock detritus, but still prossessing some fertility, Haplic Regosol and Colluvium have been determined. Rendzic Leptosols and Phaeozems , which represent a further development step from undeveloped soils and may be considered a young soil, have also been determined. Eutric Cambisol and Stagnosol are found on mild landforms, allowing parent material deepening and carbonate leaching. As soil was conserved and deepened by formation of moisture retaining terraces, Anthrosol has been formed.

4. LITERATURE –

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HRN ISO 11277/04: Soil quality - determination of particle size distribution in mineral soil material - method by sieving and sedimentation; soil textural analysis according Soil Survey Staff (1999)

HRN ISO 11272/04: Soil quality - Determination of dry bulk density

HRN ISO 11508/04: Soil quality - Determination of particle density

HRN ISO 11274/04: Soil quality - Determination of the water-retention characteristic-laboratory methods

HRN ISO 10390/05: Soil quality - determination of pH

HRN ISO 10693/04: Soil quality - Determination of carbonate content - volumetric method

HRN ISO 10694/04 : Soil quality - Determination of organic and total carbon after dry combustion (elementary analysis)

HRN ISO 13878/04: Soil quality - Determination of total nitrogen content by dry combustion (elementary analysis)

HRN ISO 11260/04: Soil quality - Determination of effective cation exchange capacity and base saturation level using barium chloride solution

HRN ISO 11466/04: Soil quality - extraction of trace elements soluble in aqua regia (Determination of P, Ca, Mg, Mn, Na, K, Al, Fe in aqua regia extracts of soil using ICP technics)

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Soil Survey Staff, 1999, Soil taxonomy, a basic system of soil classification for making and interpreting soil surveys, 2nd ed.: U.S. Department of Agriculture, Natural Resources Conservation Service, Agriculture Handbook Number 436, 870 p.

Vajnberger A., 1966: Priručnik za ispitivanje zemljišta, Knjiga I, Kemijske metode ispitivanja zemljišta, Određivanje lakopristupačnog fosfora i kalija u zemljištu, Jugoslovensko društvo za proučavanje tla, Beograd, str. 184-188

"MAIN SOIL TYPES THROUGH CROATIA AND SLOVENIA"

(SLOVENIAN PART)

Marko ZUPAN[a], Jani RUPREHT[a], Marjan ŠPORAR[a], Tomaž PRUS[a], Mihej URBANČIČ[b], Primož SIMONČIČ[b], Milan KOBAL[b], Andreja HODNIK[a], Tomaž KRALJ[a]

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Programe 23-24 August 2008

Saturday 23. august 2008
8:30 Entrance to Slovenia
http://www.slovenia.info
9:30-10:30 Plot 1: Baredi – Izola
11:00-13:00 Šmarje: snack and wine testing in wine cellar
http://www.monteko.si
14:00-15:30 Plot 2: Dobravlje
16:00-18:00 Škocjan Caves
http://www.park-skocjanske-jame.si
19:30 Dinner in Ljubljana
21:00 Accommodation
http://www.slovenia.info

Sunday 24. august 2008
9:00 Departure from Ljubljana
11:00-13:00 Plot 3: Pokljuka
13:30-15:30 Lunch on Bled
15:30-18:00 Visit Bled - Castle, Info centre of Triglav National Park
http://www.bled.si, http://www.tnp.si

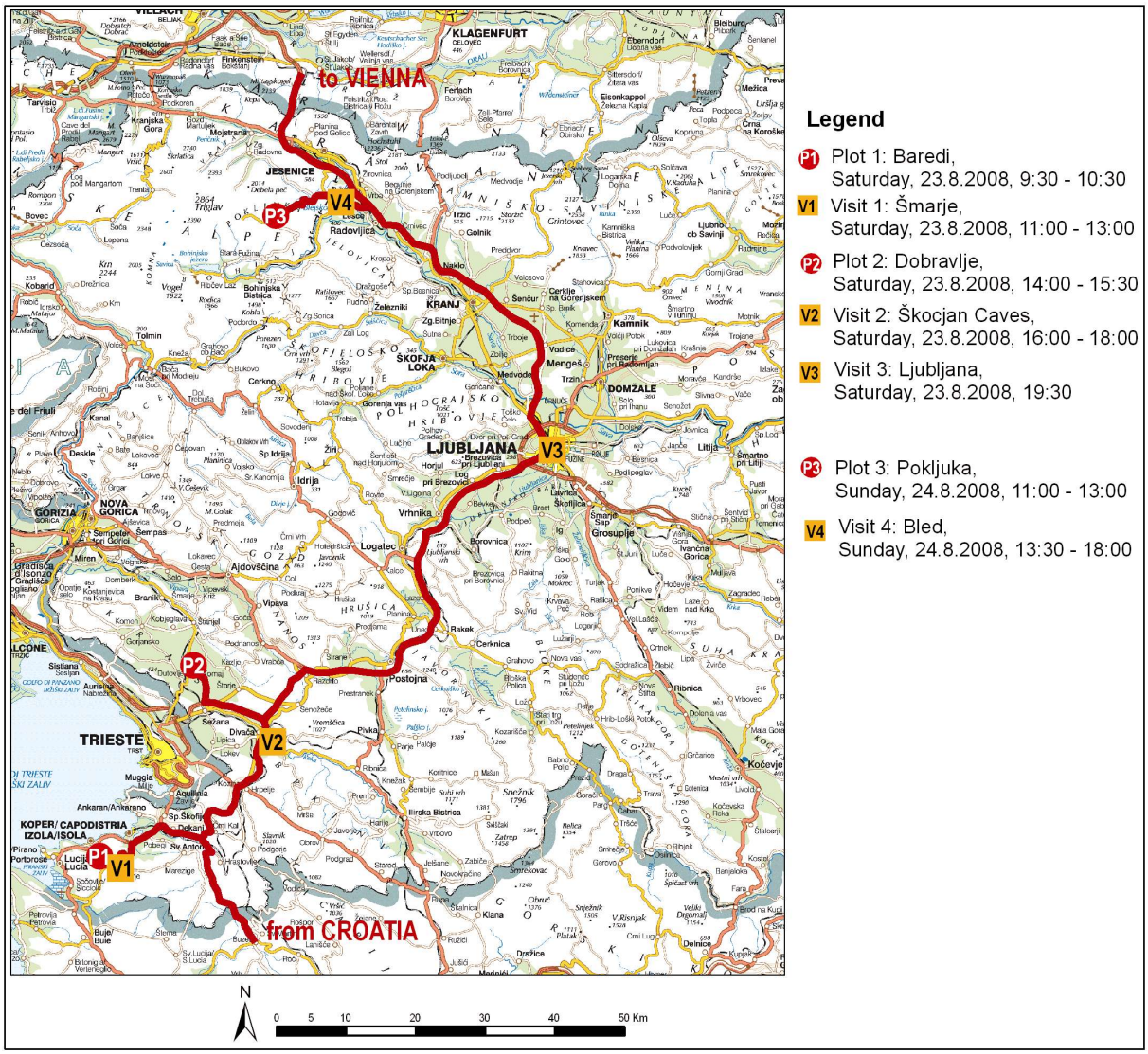

Figure 1: Rout with stops through Slovenia.

1 GENERAL OVERVIEW

Slovenia can be divided in three larger regions according to ecological/climatical and geomorphological criteria. Panonian region dominates on northeastern part of Slovenia. The altitudes are hilly, between 150 to 600 m. The climate is characterised by smallest rainfall (for Slovenian circumstances) between 1000 to 800 mm. But the growing period is significantly long as 230 to 260 days. Geologically the area is very variegated but clastic deposits prevail, as calcareous and non-calcareous as well. Agricultural land use especially arable land is a general characteristic for lowlands but in hilly parts vineyards and orchards on south oriented slopes prevail. A detail description for this area we have to leave for some other occasion since it is in many ways similar to Burgenland belonging to our Eurosoil 2008 host county Austria.

The excursion trail enters Slovenia in the sub-mediterranean region, which is frequently divided to coastal, with almost some mediterranean characteristics, and hinterland part. The altitudes are rising from sea level and some ten meters above up to 300 m in coastal part and generally around 400 m in hinterland. A part of the hinterland is also Vipava valley with a hardly 100 m above see level. The first part of the excursion begins in costal part with following climatic characteristics. The mean monthly temperature is above 5° C for all months in the year, summer temperatures of more than 20° C start from mid June till mid September and the rainfall is about 1000 mm per year. Geologically the area belongs to Eocene flysch with a strong calcareous characteristic. Traditionally agricultural land use is almost abandoned but investment in commercial agricultural production (vineyards) means some re-establishing of the area together with tourism and summer housing. On the other hand within the area we have increased thread of soil sealing due to housing, summer housing and increasing of harbour facilities in Koper.

The focal point of the second part of the excursion is classical karst. Our voyage shall bring us to Kras, the area from which the German name Karst became a professional term for describing land on limestone with specific karstic phenomena. Beside a soil profile of a very acid "terra rossa" we shall visit a remarkable cave, which belongs to UNESCO world heritage as well. The red soil from Kras represents a specific substrate for wine growing in climatic conditions with the mean annual temperature above 10° C, about 1500 mm annual rainfall and 240-300 days growing period. Burja –bora is a specific wind used in traditional agriculture for drying ham. But specific protection measures against aeolian soil erosion can be noticed in the area as well.

From that point limestones will be the geological substrate almost until Ljubljana where we shall descend to Ljubljana moor. Before that we shall cross the Dinaric ridge which is situated parallel with Adriatic sea depression. Its northwestern end is includes the highest pick Snežnik (Snow mountain) close to Postojna.
The mentioned ridge divides the sub- mediterranean part from the inland. Alpine region covers the most northern and partially western part of the state. It is characterised by mostly mountainous altitudes above 1500 -1700 m. Vegetation period is limited to mostly from June to September that means about 120 days growing period. Geologically limestone and dolomite prevail, but toward Austrian border igneous rocks are present as well. Alpine grassland and coniferous forests are the basic vegetation forms. Varieties in ecological conditions on southern part of the area can be described also as sub- alpine or alpine –dinaric according to some milder climatic characteristics. On the second day we want to present an Alpine plateau Pokljuka. Thou the limestone prevail we shall present a Podzol soil on mixed siliceous moraine. Subalpine Norway spruce forest is the surrounding where a forest permanent research plot is situated on mentioned soil.

2 MATERIAL AND METHODS

- SIST ISO 10390: 2005; Soil quality – Determination of pH.
- SIST ISO 14235:1999 modify after WALKLEY-BLACK. Soil quality – Determination of organic carbon by sulfochromic oxidation.
- SIST ISO 11261: 1996; Soil quality – Determination of total nitrogen – Modified KJELDAHL- method.
- ISO 13878: 1998; Soil quality – Determination of total nitrogen content after dry combustion (incineration at 900° C in the CN analyser and defining with the TCD detector).
- SIST ISO 10693:1996; Soil quality – Determination of carbonate content-Volumetric method.
- ÖNORM L 1087: 1993; Change: ammonium- lactate extraction VAJNBERGER, 1966, HOFFMAN, 1991. Chemical analysis of soils – Determination of plant-available phosphate and potassium by calcium-acetate-lactate.
- Exchangeable cations Ca, Mg, K, Na. Soil survey laboratory methods manual, 1993. Determination of exchangeable cations Ca, Mg, K, Na, after ammonium-acetate (pH=7,0) extraction.
- Extractable acidity. Soil survey laboratory methods manual, 1993. Determination of the extractable acidity using $BaCl_2$ –Triethanolamine.
- Cation Exchange Capacity (CEC). Soil survey laboratory methods manual, 1993. Cation Exchange Capacity (CEC) is sum of the basic cations Ca, Mg, K, Na, and exchangeable acidity.
- ISO 11277: 1998 Modify after JANYTZKI, 1986. Soil quality-Determination of particle size distribution in mineral soil material – Method by sieving and sedimentation following removal of soluble salts, organic matter and carbonates – Modify after JANYTZKI, 1986.
- Bulk Density (BD). Core method with (KOPECKY´s) steel cylinders of volume 100 cm3 (ISO 11272, 1993).
- Coarse Fragments (Skeleton). Coarse Fragments (Skeleton) were separated from the fine earth fraction during the preparation of soil samples. The content of coarse fragments was determined by weighing the residue left on a 2 mm sieve after washing and drying in the lab (ISO 11464, 1994; ISO 11277, 1998).
- Soil color. Colors of soil layers were determined by Munsell soil color charts.

3 EXCURSION POINTS

Plot 1: Baredi - Izola

Table 1.1: General site information.

Plot 1	Baredi – Izola, Slovenia
Date of description	12/4/2007
Authors	Jani Rupreht, Tomaž Kralj
Location	West part of Slovenia, near coast
Elevation	252 m
GPS coordinates	45°31'40.61" 13°41'8.67"
Climatic data	1000 mm rainfall
Topography	Hilly, top of the hill
Land use	Agriculture
Human influence	Cultivated land
Parent material	Eocene flysch (marlstone and sandstone)

Figure 2: Profile location on flysch on the top of the hill (foto: T. Kralj).

Table 1.2: Soil description.

No.		Horizon description
H1	A	0-7 cm, 10YR 5/3 (moist); abrupt, wavy boundary; very few fine gravel, weathered, flat and angular; few mycelia; few faunal droppings; common very fine and fine roots; disperse powdery lime; friable consistence; strong, granular structure
H2	Bk1	7-20 cm; 10YR 5/4 (moist); abrupt, wavy boundary; few fine gravel, weathered, flat and angular; moderate to strong granular structure, 15-20 mm; friable consistence; few mycelia; few faunal droppings; common very fine and fine roots, few medium and coarse roots; disperse powdery lime, strongly calcareous
H3	Ab	20-25 cm; abrupt, wavy boundary; few fine gravel, weathered, flat and angular; moderate to strong granular structure
H4	Bk2	25-64 cm; 10YR 5/4 (moist); gradual, wavy boundary; few fine gravel, weathered, flat and angular; moderate granular structure, 10-25 mm; friable consistence; few earthworm channels; very few very fine and fine roots, few medium and coarse roots; disperse powdery lime, strongly calcareous
H5	Bk3	64-101 cm; 10YR 5/4 (moist); clear wavy boundary; few fine gravel, weathered, flat and angular; moderate blocky subangular structure, 15-30 mm, friable consistence; few earthworm channels; very few very fine and fine roots, few medium and coarse roots; disperse powdery lime, strongly calcareous
H6	BC	101+ cm, abundant rock fragments

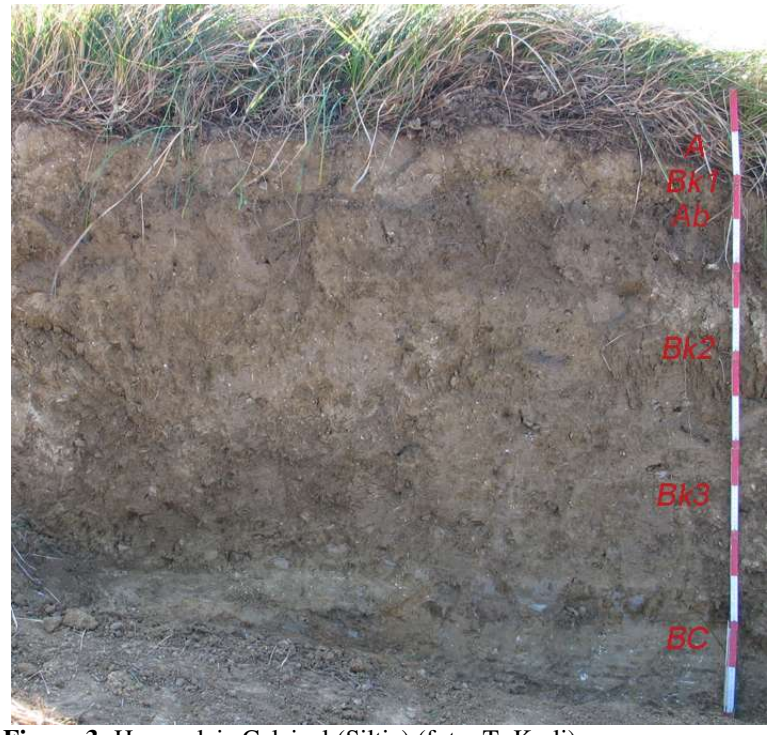

Figure 3: Hypocalcic Calcisol (Siltic) (foto: T. Kralj).

Table 1.3: Analitical data.

Nr.	Sym.	Depth cm	pH $CaCl_2$	P_2O_5	K_2O	OS %	C %	C/N	N sum. %	Sand %	Silt %	Clay %	Text. class.
				mg/100g soil									
H1	A	0-7	7,1	1,7	24,2	6,7	3,9	13,4		25,5	49,9	24,6	SL
H2	Bk1	7-20	7,3	0,4	14,7	3,6	2,1	14,0		17,5	55,0	27,5	SL-SCL
H3	Ab	20-25	/	/	/	/	/	/	/	/	/	/	/
H4	Bk2	25-64	7,3	0,7	12,2	3,1	1,8	11,3		21,4	54,8	23,8	SL
H5	Bk3	64-101	7,5	0,8	12,0	1,3	0,8	8,9		22,1	50,1	27,8	CL
H6	BC	101+	7,6	0,4	7,2	0,7	0,4	8,0		15,7	58,5	25,5	SL
Nr.	Sym.	Depth cm	Ca	Mg	K	Na	H	S	T	V %	CaCO3 %		
			mmolc/100 g soil										
H1	A	0-7	31,71	1,05	0,58	0,14	2,50	33,5	36,0	93,1	24,4		
H2	Bk1	7-20	32,29	0,59	0,35	0,14	1,60	33,4	35,0	95,4	24,6		
H3	Ab	20-25	/	/	/	/	/	/	/	/	/	/	/
H4	Bk2	25-64	32,50	0,50	0,27	0,13	1,40	33,4	34,8	96,0	25		
H5	Bk3	64-101	31,73	0,48	0,34	0,15	1,25	32,7	34,0	96,2	24,6		
H6	BC	101+	30,33	0,33	0,17	0,15	0,60	31,0	31,6	98,1	37,0		

Classification name (WRB 2006): Hypocalcic Calcisol (Siltic)

Plot 2: Dobravlje

Table 2.1: General site information.

Plot 1	Dobravlje, Slovenia
Date of description	12/4/2007
Authors	Jani Rupreht, Marjan Šporar
Location	West part of Slovenia
Elevation	340 m
GPS coordinates	45°45'22.24" 13°52'50.7"
Climatic data	1000 mm
Topography	Hilly karst relief
Land use	Forest
Human influence	Strong human influence, excavation of soil
Parent material	limestone

Table 2.2: Soil description.

No.		Horizon description
H1	A1	0-10 cm, 5YR 5/8 (moist), granular structure, friable consistence; common very fine and fine roots, few medium roots;
H2	B	10-50 cm; 2,5YR 3/6 (moist); blocky subangular structure; very firm consistence
H3	Bt1	50-100 cm; 2,5YR 3/4 (moist); blocky subangular structure; very firm consistence; Mn concretions
H4	Bt2	100-130 cm; 2,5 YR 3/3 (moist); very firm; blocky subangular structure;

Figure 4: Haplic Cambisol (Humic, Hyperdystric, Siltic, Rhodic) - Terra rossa (foto: T. Kralj).

Table 1.3: Analytical data.

Nr.	Sym.	Depth cm	pH $CaCl_2$	P_2O_5	K_2O	OS %	C %	C/N	N sum. %	Sand %	Silt %	Clay %	Text. class.
				mg/100g soil									
H1	A1	0-10	4,5	5,3	11,0	4,9	2,8	11,8	0,24	26,8	50,4	22,8	SL
H2	B	10-50	4,5	/	/	2,6	1,5	11,6	0,13	20,1	54,2	25,7	SL-CL
H3	Bt1	50-100	4,7	/	/	1,2	0,7	8,0	0,09	15,6	44,2	40,2	SCL-SC
H4	Bt2	100-130	4,8	/	/	1,0	0,6	7,1	0,08	6,7	48,6	44,7	SC
Nr.	Sym.	Depth cm	Ca	Mg	K	Na	H	S	T	V %			
			mmolc/100 g soil										
H1	A1	0-10	2,63	0,52	0,19	0,10	15,49	3,44	18,93	18,2			
H2	B	10-50	3,98	0,29	0,13	0,11	12,38	4,51	16,89	26,7			
H3	Bt1	50-100	8,35	1,08	0,16	0,14	11,80	9,73	21,53	45,2			
H4	Bt2	100-130	8,28	1,24	0,14	0,12	10,65	9,78	20,43	47,9			

Classification name (WRB 2006): Haplic Cambisol (Humic, Hyperdystric, Siltic, Rhodic)

Plot 3: Pokljuka

Table 3.1: General site information.

Plot 1	Pokljuka, Slovenia
Date of description	12/4/2007
Author	Mihej Urbančič
Location	Julian Alps, NW part of Slovenia
Elevation	1200 m a.s.l.
GPS coordinates	46°20'3.28" 13°59'25.08"
Climatic data	cold (ann.T ≈ 3°), humid (ann. P ≈ 2000 mm) climate
Topography	plateau
Land use	managed Norway spruce forest
Human influence	middle - tourism, grazing cattle
Parent material	mixed moraine (silicate & carbonate material)

Figure 5: Norway spruce mature stand of research plot on Pokljuka plateau (Foto: T. Kralj).

Table 3.2: Soil description.

No.		Horizon description
H1	L	3 – 1/2 cm, litter, mostly spruce remnants (needles, branches, cones)
H2	F, H	1/2 – 0 cm, soft layer of fermented to well decomposed SOM, strong abundance of fine roots, few mycelia
H3	H A	0 – 3/5 cm, 10 YR 3/2 (moist), very few gravel, loose consistence, thin crumbly structure, many very fine and fine roots, few medium roots;
H4	E	3/5 – 7/15 cm, 10 YR 5/2 (moist), common abundance of coarse gravel, friable, medium granular, few roots;
H5	Bh	7/15 - 18/20 cm, 10 YR 3/4 (moist), common coarse gravel, very friable, medium granular, common roots,
H6	Bf,h	18/20 – 25/30 cm, 5 YR 3/4 (moist), common coarse gravel, very friable, medium granular, common roots,
H7	Bw	25/30 - 40 cm, 7.5 YR 4/2 (moist), common coarse gravel, very friable, angular blocky, few roots
H8	E	40 - 60 cm, 10 YR 4/3-4 (moist), common coarse gravel, friable, angular blocky, very few roots
H9	Bt	60 - 80 cm, 10 YR 4/4 (fresh), common coarse gravel, friable, thick granular, very few roots
H10	B/C	80 - 120 cm, 10 YR 4/4 (moist), many stones, slighty plastic, thick granular,
H11	CB	120 + 160 cm, 10 YR 5/4 (wet), abundant stones, very plastic, massive

Figure 6: Albic Folic Podzol (Ruptic) on morraine overlaying lake chalk (foto: T. Kralj).

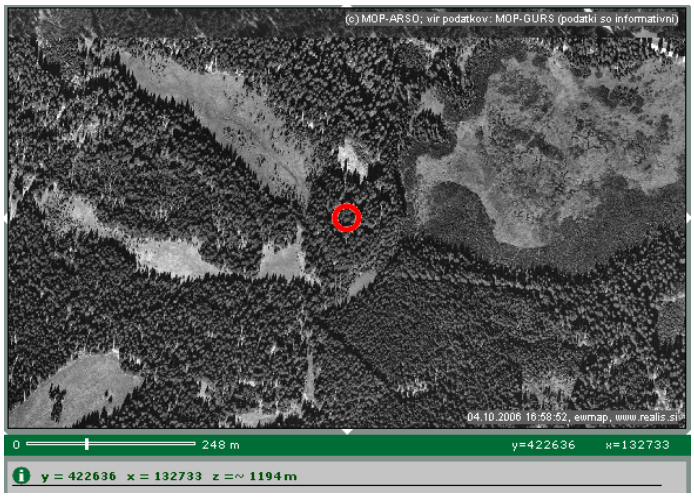

Figure 7: Location of the profile (source: http://kremen.arso.gov.si/Nvatlas).

Table 3.2: Analytical data.

Nr.	Sym.	Depth cm	pH $CaCl_2$	P_2O_5	K_2O	OS g/kg	C g/kg	C/N	N g/kg	Sand %	Silt %	Clay %	Text. class.
				mg/100g soil									
H1	L	3 – 1/2	3,89			715,5	415	55,3	7,5				
H2	F/ H	1/2 – 0	3,28	/	/	534,4	310	24,8	12,5				
H3	H A	0 – 3/5	3,20	/	/	328,4	191	25,4	7,5				
H4	E	3/5 – 7/15	3,38	/	/	25,0	15	11,2	1,3	43,2	36,9	19,9	L
H5	Bh	7/15 - 19	3,49	/	/	81,0	47	23,5	2,0	36,5	36,5	27,0	L
H6	Bf,h	19 – 25/30	3,77	/	/	56,0	33	23,2	1,4	41,7	35,0	23,3	L
H7	Bw	25/30 - 40	4,04	/	/	38,8	23	16,1	1,4	43,6	22,8	33,6	CL
H8	E	40 - 60	4,37	/	/	25,9	15	13,6	1,1	36,9	33,2	29,9	CL
H9	Bt	60 - 80	4,05	/	/	6,9	4	6,7	0,6	25,0	35,8	39,2	CL
H10	B/C	80 - 120	7,22	/	/	0,3	6	0,4	0,5	9,0	51,8	39,2	SiCL
H11	CB	120 + 160	7,24	/	/	3,8	4	3,7	0,6	51,9	24,9	23,2	SaCL
Nr.	Sym.	Depth cm	Ca	Mg	K	Al	H	S	T	V %	CaCO3 %		
			mmolc/100 g soil										
H3	H A	0 – 3/5	9,11	1,66	0,76	3,44	16,95	11,5	33,74	34,17			
H4	E	3/5 – 7/15	0,20	0,05	0,06	4,35	3,94	0,31	9,83	3,15			
H5	Bh	7/15 - 19	1,68	0,24	0,12	11,85	5,94	2,04	23,01	8,87			
H6	Bf,h	19 – 25/30	1,03	0,17	0,14	10,12	1,92	1,34	14,92	8,98			
H7	Bw	25/30 - 40	0,37	0,09	0,15	7,77	1,09	0,61	10,21	5,97			
H8	E	40 - 60	0,60	0,14	0,09	2,62	0,51	0,83	4,12	20,15			
H9	Bt	60 - 80	0,54	0,13	0,20	5,32	0,87	0,87	7,23	12,03			
H10	B/C	80 - 120	15,58	0,17	0,27	0,00	0,00	16,0	16,06	99,75	48,3		
H11	CB	120 + 160	10,81	0,12	0,21	0,00	0,00	11,1	11,14	100	15,0		

Classification name (WRB 2006): Albic Podzol