Ancient soil in non-glaciated mountain areas on peridotite: the Lanzo Ultramafic Massif example (TO, NW Italy)

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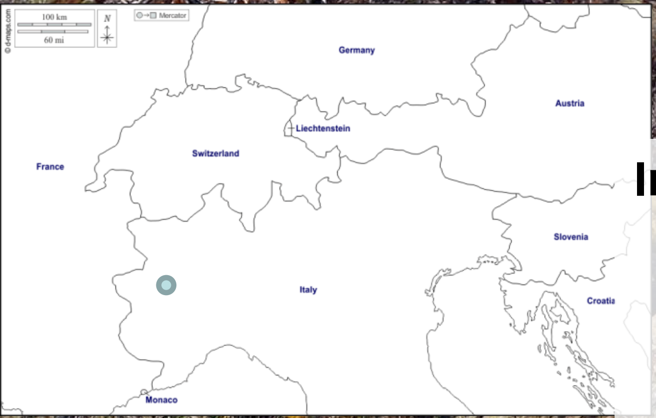
Introduction

Ancient soils (pre-Holocenic Paleosols and Vetusols) can provide many paleoenvironmental information, imprinted by pedogenetic processes on morphology, chemistry, clay minerals, organic matter content and decomposition degree, etc.. Long-term pedogenesis can also have deeply modified the original chemical properties derived from the parent materials.

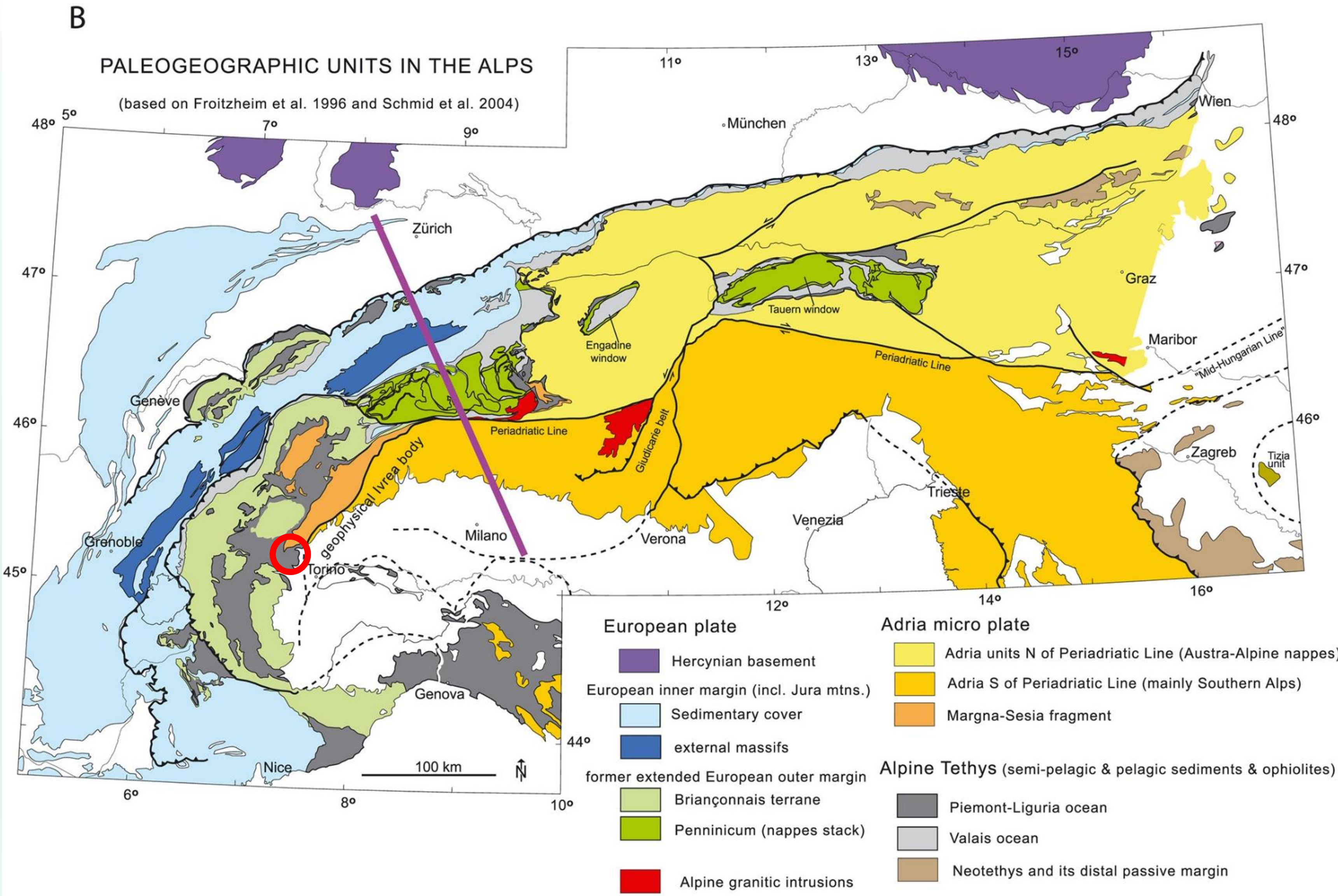
Ancient soils are uncommon on the Alps, because of the extensive Pleistocenic glaciations which erased most of the previously existing soils, the slope steepness and climatic conditions favoring soil erosion

<u>**However...**</u>



In the Western Italian Alps, some areas were not glaciated during the Pleistocene, and some surfaces retain Vetusols (i.e., soils which underwent very long periods of the same pedogenetic processes) or relict and buried Palesols. Some of these are developed on peridotite

Alpine ophiolites (gray areas): ancient ocean (Tethys) between paleo-African plate (Adria plate – yellow, orange and green areas) and paleo-European plate (blue areas)

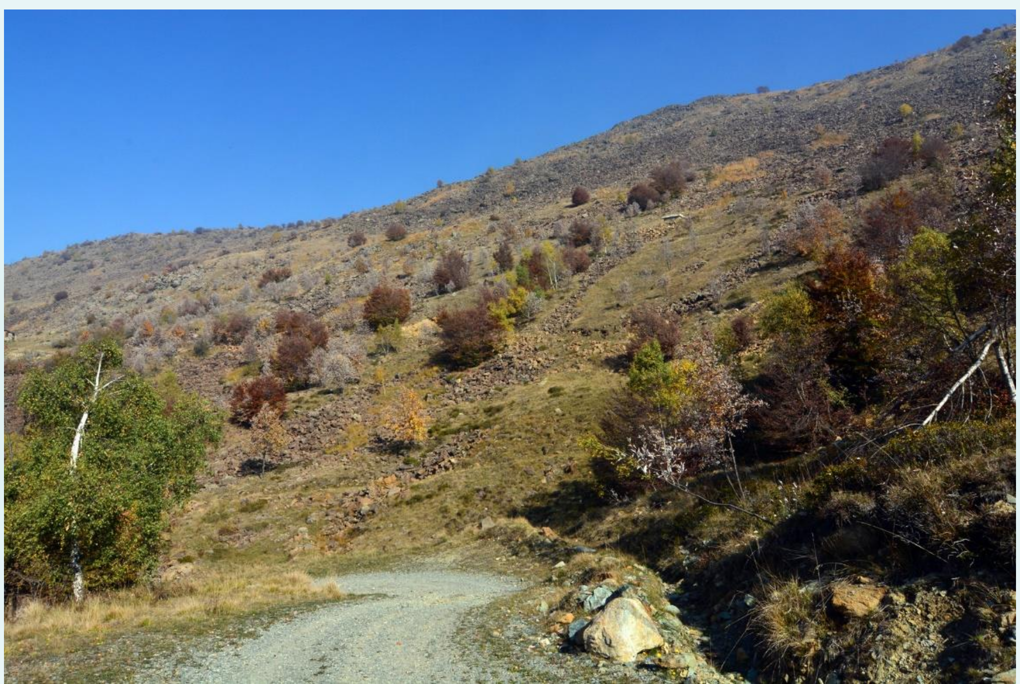


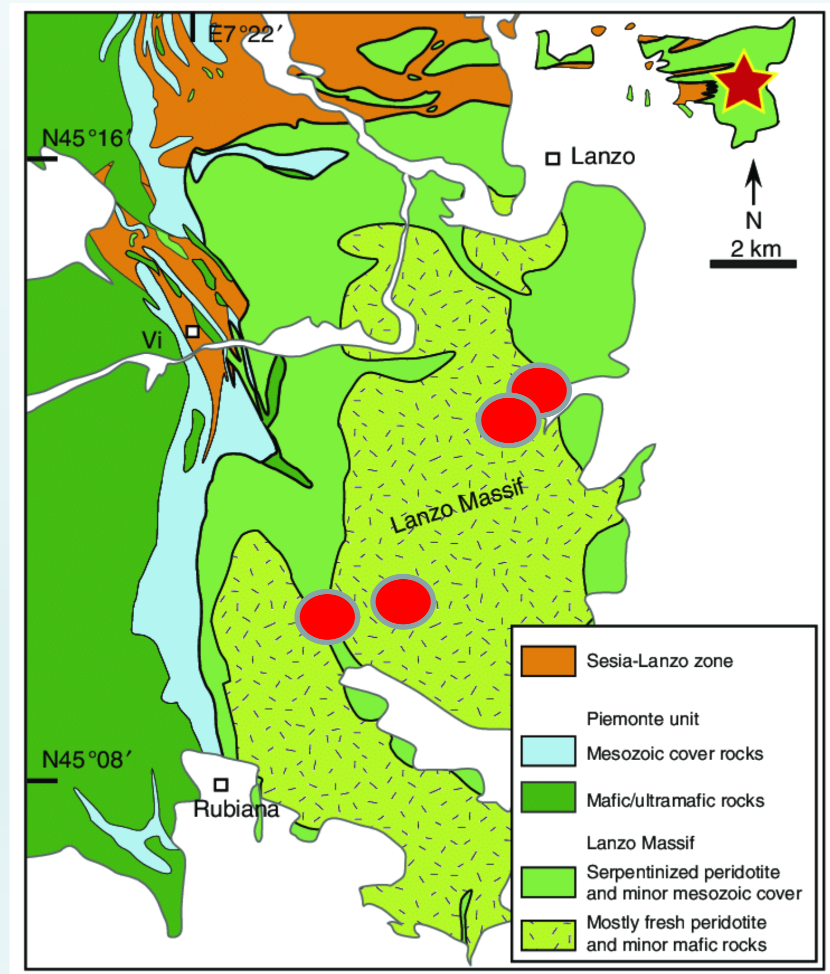
We sampled 4 different soil profiles located under different vegetation covers and on different landforms, in the Lanzo Ultramafic Massif (LUM).

The sampling sites were characterized by low steepness and elevation between 600 and 1450 m, under present day lower montane/montane forest or grassland, on peridotite and on serpentinized peridotite

Climate: MAP 970-1300 mm/y

MAT: 12° - 7° C





Peridotite soils, 1450 m a.s.l.

Soil between blockstreams, very little trees because of «peridotitic infertility»

Haplic Luvisol (Loamic, Ochric)

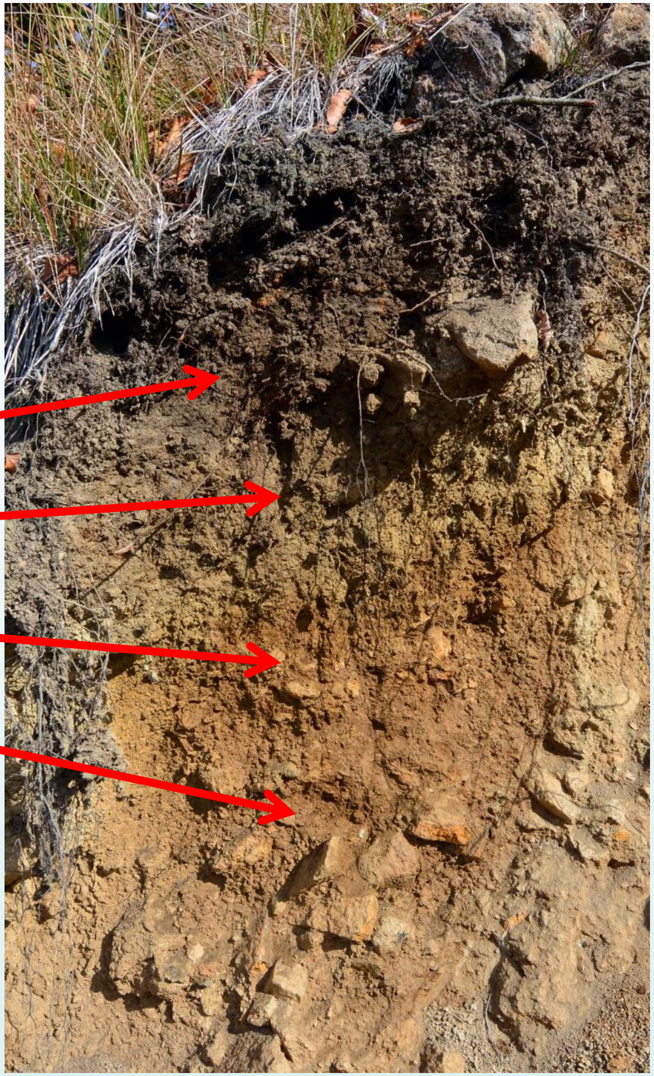
Humus: Amphi

Peridotite soils, 1450 m a.s.l.

High Ni and Cr contents implies little external inputs
Cr not redistributed
Ni, Fe redistributed

	pH	TOC %	Silt	Clay	Nit ppm	Crt
A	5.8	3.31	33.2	4.3	1674	1091
E	6.4	0.72	32.6	6.9	1085	1065
Bs	6.7	0.38	23.1	6.2	1828	1001
Btg	6.8	0.21	23.5	10.5	1831	967

	Fe tot %	Fe dcb %	Fe ox %
A	6.91	2.21	0.42
E	6.53	2.27	0.22
Bs	7.47	4.56	0.25
Btg	6.30	3.90	0.24



Haplic Luvisol (Loamic, Ochric)

Antigoritic serpentinite soil, 1450 m a.s.l.

Soil developed under Pleistocene periglacial blockslope/blockstreams (geomorphologically it is the basal layer of the blockslope);

imbrications in the stony cover (strong ancient cryoturbation, probable permafrost during LGM);

Rhododendron ferrugineum (strongly «podzolizing» plant species in the Alps)

Akroskeletic Umbric Hyperalbic Podzol (Siltic, Placic)

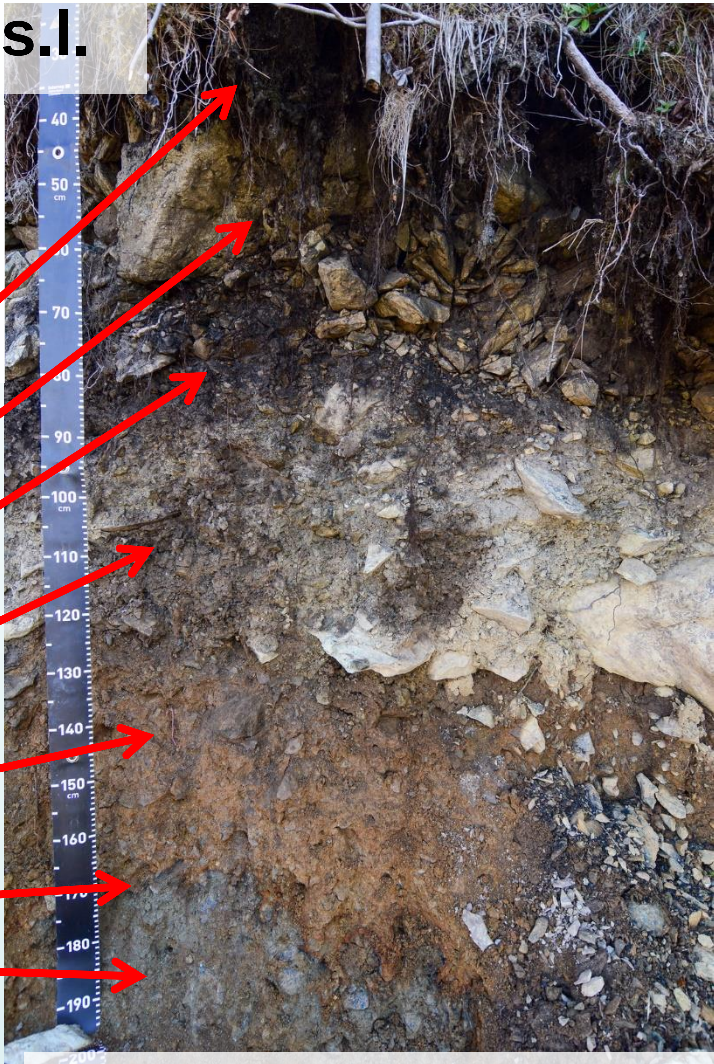
Humus: Dysmoder

Antigoritic serpentinite soil, 1450 m a.s.l.

Higher pH than normal in Podzols;
Pedogenic Fe has Podzolic trends;
Total Fe??????
Strong Ni redistribution;
No Cr redistribution

	pH	TOC %	Silt	Clay	Nit ppm	Crt
A	5.2	12.66	38.0	12.1	531	1138
C						
2A	5.9	4.68	62.6	11.0	1401	1122
2E	6.1	0.97	43.8	14.1	811	1166
2Bs	6.3	0.44	29.6	14.2	1712	1003
2Bsm	6.4	0.33			1236	1108
2Cg	6.5	0.13	27.6	9.4	764	1170

	Fe tot %	Fe dcb %	Fe ox %	Spd-index
A	3.32	1.40	0.45	0.37
2A	3.59	1.12	0.38	0.31
2E	6.68	1.01	0.22	0.22
2Bs	6.26	2.49	0.54	0.37
2Bsm	4.86	2.66	0.86	0.54
2Cg	6.41	0.94	0.18	0.14



Akroskeletic Hyperalbic Podzol (Siltic)

Soil in peridotitic alluvial fan, 750 m a.s.l.

Soil developed in Pleistocene alluvial fans

Birch forest, with Molinia and Calluna vulgaris in the understory, evidence soils poor in nutrients.

Very thick and polyciclic soils, developed in alluvial fans deposited in different periods mainly during the Pleistocene

Endogleyic Luvisol (Loamic, Cutanic, Epidystric, Magnesic)

Humus: Dysmull

Soil in peridotitic alluvial fan, 750 m a.s.l.

Strong Ni and Fe leaching
Low Cr values in most horizons?
Ca/Mg remains low, verifying the peridotitic material and scarcity of allochtonous material: Why low Cr?

	pH	TOC %	Silt	Clay	Nit ppm	Crt
A	4.9	2.38	49	7	517	531
EA	5.4	0.97	51	11	428	450
EB	5.7	0.62	48	14	530	507
Bt1	6.2	0.35	48	18	723	503
Bt2	6.5	0.34	40	14	831	645
2Bt3	6.8	0.33	41	16	1063	841
3Bt3	6.5	0.36	33	13	1400	1118

	Fe tot %	Fe dcb %	Ca tot%	Mg tot%
A	3.75	2.09	0.17	2.11
EA	3.31	1.89	0.34	1.63
EB	3.82	2.18	0.34	1.80
Bt1	5.20	3.22	0.23	1.99
Bt2	5.12	3.34	0.33	2.51
2Bt3	5.42	3.67	0.36	2.95
3Bt3	6.83	4.94	0.46	3.88

Endogleyic Luvisol (Loamic, Cutanic, Epidystric, Magnesic)

Soil in peridotitic alluvial fan, 630 m a.s.l.

Soil developed in Pliocene alluvial fans

Strongly cemented, red subsoil, harder than weathered stones.

Endogleyic Luvisol (Loamic, Cutanic, Epidystric, Magnesic)

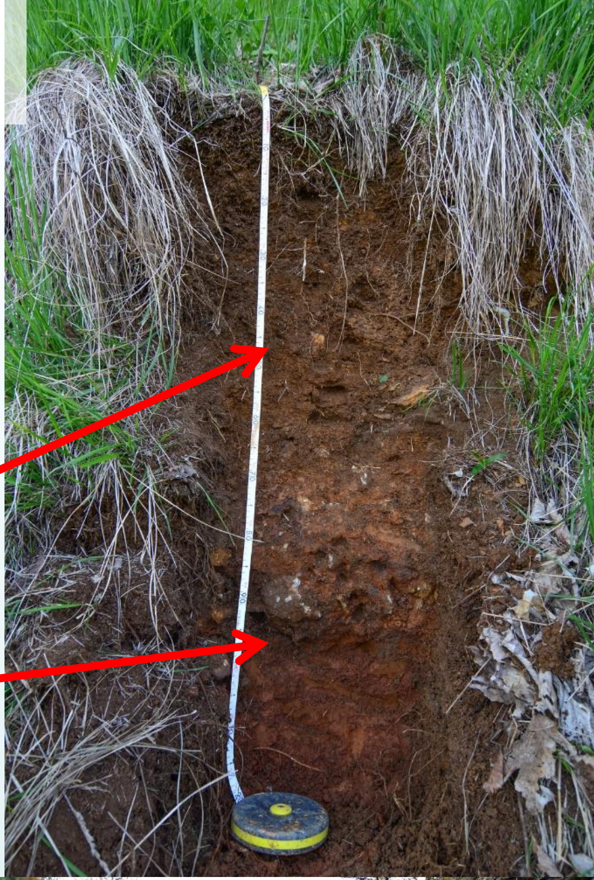
Humus: Eu/Oligomull

Soil in peridotitic alluvial fan, 650 m a.s.l.

High biological activity in the top layer
Very high pedogenic Fe, probably it is the main cementing agent;
Very high Ni (redistributed), less for Cr (constant)
High pH, but carbonates are in traces

	pH	TOC %	Silt	Clay	Nit ppm	Crt
BA	6.3	1.53	32	7	1396	1112
Bv1	8.0	0.16	4	4	1993	1170
Bv2-1	7.8	0.30	9	4	1926	924
Bv2-2	8.2	0.13	5	3	2308	963

	Fe tot %	Fe dcb %	Ca tot%	Mg tot%
BA	6.16	3.74	0.32	3.97
Bm1	6.49	4.18	0.28	7.81
Bm2-1	5.64	4.48	0.55	10.12
Bm2-2	6.16	5.50	0.30	10.62



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Conclusions

But:

Each layer represents one interglacial?

Gibbsite and kaolinite in Podzols?

Dating of the different soils/layers is necessary.