

Table S1. General physicochemical and surface properties of the studied soils.

Soil N°	Horizon	Depth cm	Sand	Silt g.kg ⁻¹	Clay	OM g.kg ⁻¹	pH	K	Ca	Mg	Al Mmol.kg ⁻¹	H	SB	CEC	V %	SSA m ² g ⁻¹
1	Ap	0-8	415	460	125	37	4.7	2.1	21.3	7.4	6	36	30.8	72.8	42.4	3.04
	C1	8-20	422	439	139	28	4.6	1.4	17.7	4.8	20	52	23.9	95.9	24.9	6.49
	C2	20-32	466	392	142	25	4.5	1.0	14.0	4.1	16	37	19.1	72.1	26.5	15.09
2	Ap1	0-13	516	392	92	34	4.7	1.9	10.0	5.0	4	38	16.9	58.9	27.3	2.86
	Ap2	13-25	577	345	78	18	4.4	0.6	6.3	1.2	10	32	8.1	50.1	16.8	5.03
	AB	25-37	574	350	76	19	4.2	0.4	5.0	2.0	11	36	7.4	54.4	13.6	4.99
	Bt	37-54	534	372	94	16	4.4	0.5	9.3	1.1	8	26	10.9	44.9	24.5	7.19
	Bt/Cr1	54-78	478	392	130	16	4.7	0.5	14.9	3.1	5	23	18.5	46.5	39.8	11.11
3	Ap1	0-15	621	309	70	21	4.1	0.5	7.0	1.0	12	35	8.5	55.5	15.3	3.54
	Ap2	15-30	608	302	90	19	4.3	0.2	7.8	0.9	6	32	8.9	46.9	18.6	4.37
	A2/ E	30-42	615	328	57	18	4.7	0.1	12.6	0.9	4	27	13.6	44.6	29.8	4.59
	E	42-62	612	316	72	16	4.9	0.1	11.7	0.9	2	20	12.7	34.7	36.6	4.14
	Bt	62-92	515	311	174	16	4.8	0.2	14.9	4.0	3	22	19.1	44.1	43.1	11.39
	Bt/Cr	+ 92	433	342	225	16	4.6	0.3	10.4	5.3	7	27	16	50	32.0	15.08
4	Ap1	0-20	482	133	385	30	4.2	0.2	2.2	1.1	20	101	3.5	124.5	2.8	26.21
	Ap2	20-40	450	124	426	25	4.2	0.1	1.8	0.9	21	77	2.8	100.8	2.2	30.56
	A21	40-70	449	130	421	22	4.1	0.1	1.7	0.9	18	80	2.7	100.7	2.2	31.33
	A22	70-100	446	131	423	23	4.2	0.1	6.1	0.9	15	73	7.1	95.1	7.3	31.98
	A23	100-130	417	146	437	22	4.3	0.1	7.9	0.8	17	63	8.8	88.8	9.7	31.82
	A24	130-150	446	136	418	21	4.4	0.1	8.1	1.0	16	72	9.2	97.2	9.5	31.84
	A25	150-180	450	126	424	21	4.4	0.2	7.0	1.0	14	84	8.2	106.2	7.7	31.65
	Bw1	250-300	435	117	448	16	4.5	0.2	5.0	0.9	3	43	6.1	52.1	11.7	29.77
5	Ap	0-10	199	227.5	573.5	24	4.8	2.4	10.0	6.0	4	48	18.4	70.4	26.1	40.34
	B1	10-35	256	219.5	524.5	21	4.6	1.1	8.1	4.2	6	46	13.4	65.4	20.6	37.81
	B21	35-60	276	219	505	21	4.7	0.8	8.8	3.9	1	37	13.5	51.5	26.0	37.01
	B22	60-76	220	211	569	19	5.1	0.8	10.7	4.1	0	31	15.6	46.6	33.5	40.79
	B23	76-104	173	219.5	607.5	16	5.6	0.8	10.4	3.3	0	25	14.5	39.5	37.0	42.62
6	Ap	0-18	216	211	573	31	5.1	2.8	25.0	7.0	0	42	34.8	76.8	45.4	43.23

AB	18-36	215	206	579	31	5.1	2.5	29.0	8.1	0	47	39.6	86.6	45.8	41.24
Bw1	36-73	212	227	561	26	5	1.6	23.0	6.0	0	34	30.6	64.6	47.4	44.88
Bw2	73-117	196	144	660	22	5.1	1.1	19.2	6.3	0	38	26.6	64.6	41.2	47.26
Bw3	117-158	186	189	625	21	5	0.5	16.2	5.1	2	36	21.8	59.8	36.5	46.88

Abbreviations: OM = organic matter content, SB = sum of bases of the exchange complex (Ca, Mg, K, Na), CEC = cation exchange capacity, V = percent base saturation,

5 SSA = specific surface area, $V_{0.95}$ = cumulative volume of N_2 adsorbed at $p/p_0 = 0.95$.

Table S2. Mean values of multifractal parameters from NAIs and NDIs for all the 32 horizons studied, and results of one way ANOVA analysis.

5

	D_{-5}	D_1	D_2	D_5	$(D_{-5} - D_5)$	α_0
Adsorption	2.317	0.571	0.428	0.306	2.011	1.477
Desorption	1.242	0.683	0.554	0.419	0.823	1.206
F value	179.39	124.20	49.42	36.82	211.12	142.42
p *	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

10

Table S3. Pearson product-moment correlation coefficients between chemical and physical soil properties and multifractal parameters from adsorption and desorption isotherms with the scores of the first, second and third axis in principal component analysis (PCA).

	Adsorption			Desorption		
	PC1	PC2	PC3	PC1	PC2	PC3
Sand	-0.781***	-0.484***	-0.170	-0.557***	-0.669***	0.337
Silt	0.054	-0.879***	-0.052	0.384**	-0.694***	0.538***
Clay	0.514***	0.769***	0.143	0.196	0.805***	-0.499***
OM	0.341	0.249	-0.060	0.178	0.447**	0.704***
pH	0.885***	-0.066	-0.045	0.828***	0.287	-0.175
SB	0.901***	-0.185	0.092	0.882***	0.268	0.231
Al	-0.760***	0.298	0.058	-0.795***	-0.064	0.206
H+Al	-0.535***	0.701***	0.063	-0.746***	0.361**	0.074
CEC	-0.237	0.711***	0.108	-0.481***	0.512***	0.176
V (%)	0.862***	-0.432**	0.042	0.944***	0.012	0.048
SSA	0.496	0.773***	0.171	0.188	0.780***	-0.538***
D₅	0.257	0.771***	-0.453**	0.102	-0.208	0.904***
D₁	-0.039	0.073	0.970***	0.399**	-0.758***	-0.124
D₂	-0.032	0.330	0.906***	0.399**	-0.784***	-0.095
D₅	-0.058	0.461**	0.834***	0.418**	-0.771***	-0.213
(D₅-D₅)	0.263	0.717***	-0.547***	-0.174	0.306	0.884***
α₀	0.188	0.732***	-0.603***	-0.258	0.694***	0.508***

10 (** and ***, correspond to $P < 0.05$ and $P < 0.01$ respectively)

Abbreviations: OM = organic matter content, SB = sum of bases of the exchange complex, CEC = cation exchange capacity, V = percent base saturation, SSA = specific surface area; D₅, D₁, D₂, D₅= generalized dimension for $q = -5, 1, 2$ and 5 , respectively; α_0 = Hölder exponent of order zero.

15

Figure S1. Images extracted from Google earth showing landscape of the studied area and positions of five (P1, P2, P3, P4 and P5) out of six profiles studied.

5



10

5

Figure S2.- Results of principal component analysis of soil physicochemical properties (sand, silt, clay, OM, pH, Al, H+Al, CEC, V, SSA) and multifractal parameters (D_s , D_1 , D_2 , D_3 , D_{s^*} , D_5 , D_{s^*} , D_5 , α_0) extracted from desorption isotherms.

5

