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Speciation and distribution of P associated with Fe and Al oxides in aggregate-sized fraction of an arable soil

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Table S1 Soil physicochemical characteristics.

Soil	pH[a]	CEC[b] (meq/100g)	TOC[c] (g kg^{-1})	TN[c] (g kg^{-1})	Clay (%)	Silt (%)	Sand (%)
Cropped soil	7.64	24	11.8±0.2	1.48±0.03	19	65.6	15.7

a Soil : water=1:2.5.
b CEC: cation exchange capacity.
c Total organic carbon and total nitrogen values are average of triplicate experiments with standard deviation.

Table S2 The proportions (%) of NaOH-Na_2EDTA extractable P of the bulk soil and aggregate-sized fractions without and with oxalate and dithionite (DCB) pre-treatments. Data are the mean values of three replicates with standard deviations.

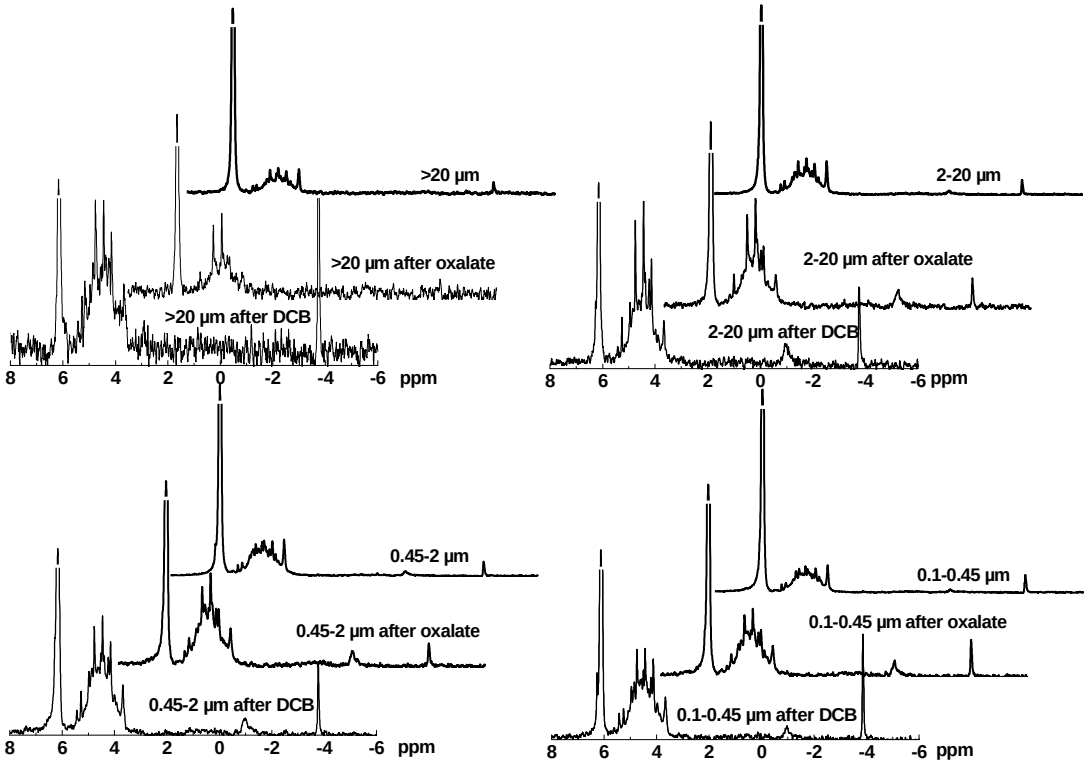
Aggregate-sized fractions	P_N [a] (%)	$P_{N\text{-}I}$ [b] (%)	$P_{N\text{-}II}$ [c] (%)
Bulk soil	61.6±1.9	17.0±1.0	10.0±2.1
Sand-sized >20 µm	57.9±4.3	15.5±1.1	8.6±1.5
Silt-sized 2-20 µm	61.7±1.2	15.8±0.6	11.3±1.2
Clay 0.45-2 µm	61.7±2.7	16.5±0.5	11.3±1.5
Clay <0.45 µm	64.5±0.5	16.9±0.4	12.7±1.5

a NaOH-Na_2EDTA extractable P in bulk soil and aggregate-sized fractions.
b NaOH-Na_2EDTA extractable P in bulk soil and aggregate-sized fractions with oxalate pre-treatment.
c NaOH-Na_2EDTA extractable P in bulk soil and aggregate-sized fractions with DCB pre-treatment.

Table S3 The amounts of Al, Fe and Ca in NaOH-Na_2EDTA extracts and oxalate and DCB extractable Ca in bulk soil and aggregate-sized fractions (g kg^{-1}). Fraction in bracket (%) with respect to total Fe, Al and Ca values of bulk soil and each aggregate-sized fraction shown in Table S3 are given in parentheses. Data are the mean values of three replicates with standard deviations.

Aggregate-sized fractions	Al_N*	Fe_N*	Ca_N*	Ca_{ox} ‡	Ca_{DCB}§	c-Ca∓
Bulk soil	1.28±0.10 (3)	0.17±0.08 (1)	2.22±0.18 (55)	0.17±0.05 (4)	2.49±0.19 (62)	2.31 (57)
Sand-sized >20 µm	0.88±0.10 (2)	0.12±0.07 (1)	1.55±0.10 (43)	0.16±0.04 (4)	1.75±0.11 (48)	1.59 (44)
Silt-sized 2-20 µm	1.92±0.11 (3)	0.16±0.07 (0)	4.35±0.14 (77)	0.19±0.03 (3)	4.51±0.04 (80)	4.31 (77)
Clay 0.45-2 µm	2.65±0.07 (2)	0.19±0.09 (0)	6.79±0.18 (96)	0.19±0.03 (3)	7.15±0.32 (100)	6.96 (98)
Clay <0.45 µm	3.27±0.15 (3)	0.28±0.02 (0)	8.10±0.14 (98)	0.19±0.05 (2)	8.42±0.40 (102)	8.22 (100)

***** NaOH-Na_2EDTA extractable Al, Fe and Ca.
‡ Oxalate extractable Ca.
§ DCB extractable Ca.
∓ The c-Ca means the difference between Ca_{DCB} and Ca_{ox}.



	Orthophosphate (%)	P-monoesters (%)	Pyrophosphate* (%)
>20 µm soil fraction	80.1	18.3	1.6
>20 µm after oxalate	64.2	31.7	4.1
>20 µm after DCB	43.2	48.0	8.8
2-20 µm soil fraction	77.7	21.5	0.9
2-20 µm after oxalate	57.2	41.1	1.7
2-20 µm after DCB	50.4	45.2	4.4
0.45-2 µm soil fraction	76.5	22.9	0.6
0.45-2 µm after oxalate	59.3	39.5	1.3
0.45-2 µm after DCB	52.0	44.7	3.3
0.1-0.45 µm soil fraction	80.5	18.5	1.0
0.1-0.45 µm after oxalate	65.2	33.4	1.4
0.1-0.45 µm after DCB	52.1	43.1	4.8

*All other P forms are not included.

Fig. S1 Solution phosphorus-31 nuclear magnetic resonance spectras of NaOH-Na_2EDTA extracts of different soil aggregate-sized fractions without and with oxalate and dithionite (DCB) pre-treatments (all subfigures have been reduced by the same factors). The associated table only shows the relative mass distribution (%) of orthophosphate, P-monoesters and pyrophosphate in NaOH-Na_2EDTA extracts of different aggregate-sized fractions without and with oxalate and DCB pre-treatments.