

Supplement of Biogeosciences, 14, 1153–1164, 2017  
<http://www.biogeosciences.net/14/1153/2017/>  
doi:10.5194/bg-14-1153-2017-supplement  
© Author(s) 2017. CC Attribution 3.0 License.



Biogeosciences  Open Access

*Supplement of*

## **Colloid-bound and dissolved phosphorus species in topsoil water extracts along a grassland transect from Cambisol to Stagnosol**

**Xiaoqian Jiang et al.**

*Correspondence to:* Barbara J. Cade-Menun ([barbara.cade-menum@agr.gc.ca](mailto:barbara.cade-menum@agr.gc.ca)) and Erwin Klumpp ([e.klumpp@fz-juelich.de](mailto:e.klumpp@fz-juelich.de))

The copyright of individual parts of the supplement might differ from the CC-BY 3.0 licence.

17

18 Table S1 The concentration ( $\text{mg kg}^{-1}$  soil) of organic carbon (OC), Al, P, Fe, and Si in asymmetric flow field-flow fractionation (AF4) fractograms of soil  
 19 particles ( $d < 450$  nm) from Cambisol (S1), Stagnic Cambisol (S2), and Stagnosol (S3). Data of S1 and S3 are the mean values of three replicate fields with  
 20 standard deviations. The lowercase indicate significant differences among soil sites (significant difference of soil sites 1 and 3 was tested by t-test, One Way RM  
 21 ANOVA for AF4 fractions with Fisher LSD,  $P < 0.05$ ).

22

	First peak ( $\text{mg kg}^{-1}$ , $d=0-20$ nm)					Second peak ( $\text{mg kg}^{-1}$ , $d=20-450$ nm)				
	OC	Al	P	Fe	Si	OC	Al	P	Fe	Si
S1	2.94±0.89a	0.05±0.03a	0.01±0.01a	0.04±0.01a	0.07±0.02	52.32±10.82	7.65±1.74	0.47±0.17a	7.60±2.11	8.86±1.63
S2	3.15	0.04	0.004	0.05	0.10	60.95	10.6	0.76	13.22	12.51
S3	19.05±3.46b	0.20±0.04b	0.05±0.01b	0.18±0.02b	0.16±0.09	84.00±19.67	8.36±1.99	1.26±0.21b	7.34±0.53	10.32±1.95

23 All the data of S1 and S3 showed significant difference between AF4 first and second peaks (OC of S1 was log transformed before One Way RM ANOVA  
 24 analyses because of unequal variances).

25

26 Table S2 Detailed phosphorus species<sup>a</sup> determined by <sup>31</sup>P-NMR for the studied S1 (Cambisol), S2 (Stagnic Cambisol), and S3 (Stagnosol) samples (% of total  
 27 extracted P)

Sample	AEP	Mono1	Mono2	Mono3	myoIHP	4.7 ppm	$\alpha$ -glyc	$\beta$ -glyc	Nucl	Pchol	scyllo-IHP
S1 bulk	0.2	3.5	7	2.1	17.4	-	1.4	2.8	4.2	1.4	6.3
S2 bulk	0.7	1.4	7.6	2.1	16.6	-	0.7	2.1	2.1	0.7	7.6
S3 bulk	0.7	2.1	1.4	2.1	12.5	-	-	1.4	2.8	-	4.8
S1 300 kDa-450 nm	-	5	18.9	1.7	13.4	-	1.1	2.8	3.3	1.1	1.7
S2 300 kDa-450 nm	-	3	8.4	1.2	7.2	-	-	0.6	2.4	-	4.8
S3 300 kDa-450 nm	-	1.2	4.4	0.6	7.5	-	0.6	1.2	2.5	0.6	2.5
S1 < 3 kDa	-	-	26.9	-	-	-	-	-	-	-	-
S2 < 3 kDa	-	-	7.3	3.8	2.3	2.5	1	1.5	3.5	-	0.5
S3 < 3 kDa	-	6.8	10.5	1.7	1.7	0.9	-	0.3	1.7	-	0.6
	3.4 ppm	4.2 ppm	5.0 ppm	5.3 ppm	5.9 ppm	neo-IHP	chiro1	chiro2	DNA	OthDi1	OthDi2
S1 bulk	-	-	2.8	-	-	-	4.2	-	1.1	0.8	0.3
S2 bulk	-	-	3.5	-	-	-	4.2	-	0.8	0.4	0.2
S3 bulk	-	-	2.1	-	-	-	2.1	-	0.6	0.7	0.2
S1 300 kDa-450 nm	-	-	-	1.7	-	-	3.3	-	2.8	7.4	0.9
S2 300 kDa-450 nm	-	-	-	0.6	-	-	1.8	-	1.2	2.3	1.7
S3 300 kDa-450 nm	-	-	-	0.6	-	0.6	1.9	-	0.8	1.6	0.4
S1 < 3 kDa	-	-	-	-	-	-	-	-	-	1.9	-
S2 < 3 kDa	-	1	-	-	1	-	-	0.8	4.4	24.2	-
S3 < 3 kDa	0.6	-	-	-	0.6	0.3	1.7	0.9	1.5	6.7	-

28 <sup>a</sup>2-Aminoethyl phosphonic acid (AEP), orthophosphate monoesters, regions 1, 2, and 3 (Mono1, Mono2, and Mono3, respectively), hexakisphosphate (myoIHP),  
 29  $\alpha$  glycerophosphate ( $\alpha$ -glyc),  $\beta$  glycerophosphate ( $\beta$ -glyc), mononucleotides (nucl), choline phosphate (Pchol), scyllo-inositol hexakisphosphate (scyllo-IHP),  
 30 neo-inositol hexakisphosphate (neo-IHP), chiro-inositol hexakisphosphate 4e/2a (chiro1), chiro-inositol hexakisphosphate 2e/4a (chiro 2), deoxyribonucleic acid  
 31 (DNA), and orthophosphate diesters, regions 1 and 2 (OthDi1 and OthDi2, respectively). No these phosphorus forms were detected in 3-300 kDa of S1, S2, and  
 32 S3.

33

34 Table S3 Chemical shift of peaks detected in <sup>31</sup>P-NMR spectra of NaOH-Na<sub>2</sub>EDTA samples.

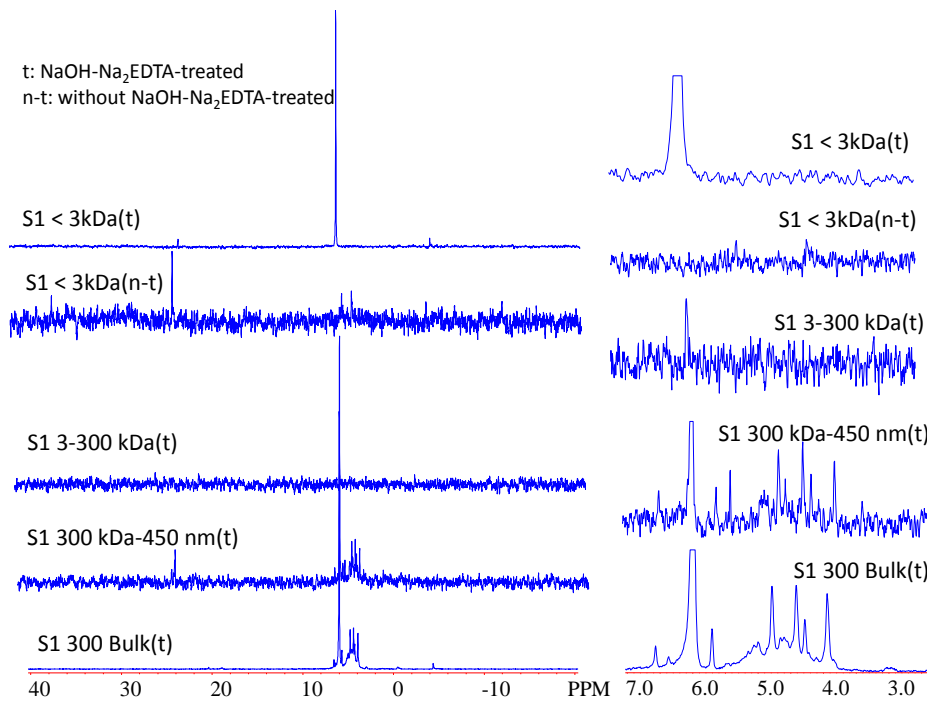
Category <sup>a</sup>	P Form or Compound Class	Chemical Shift (ppm)
Inorganic P		
	Orthophosphate	6.00 ± 0.0
	Pyrophosphate	-4.31 ± 0.26
Organic P		
	Phosphonates	45.81 ± 0.44, 37.73 ± 0.91, 23.95 ± 0.16, 20.40 ± 0.01, 18.96 ± 0.03
Orthophosphate Monoesters		
	myo-IHP	5.61 ± 0.10, 4.69 ± 0.09, 4.30 ± 0.12, 4.17 ± 0.12
	scyllo-IHP	3.85 ± 0.09
	neo-IHP	6.62 ± 0.09, 4.47 ± 0.08
	chiro1	6.47 ± 0.11, 5.01 ± 0.13, 4.52 ± 0.09
	chiro 2	6.76 ± 0.07, 5.46 ± 0.05, 4.15 ± 0.14
	Unknown	5.01 ± 0.01, 5.34 ± 0.07, 5.83 ± 0.12
	α-glyc	5.00 ± 0.13
	β-glyc	4.60 ± 0.07
	nucl	4.47 ± 0.15
	Pchol	3.98 ± 0.16
	F6P	4.74 ± 0.03
	Orthophosphate diesters-- DNA	-0.60 ± 0.19

35 <sup>a</sup>myo-inositol hexakisphosphate (myo-IHP), scyllo-inositol hexakisphosphate (scyllo-IHP), neo-  
36 inositol hexakisphosphate (neo-IHP), *D-chiro*-inositol hexakisphosphate 4e/2a (chiro1), *D-chiro*-  
37 inositol hexakisphosphate 2e/4a (chiro 2), α-glycerophosphate (α-glyc), β-glycerophosphate (β-glyc),  
38 mononucleotides (nucl), choline phosphate (Pchol), D-Fructose 6-phosphate (F6P), and  
39 deoxyribonucleic acid (DNA).

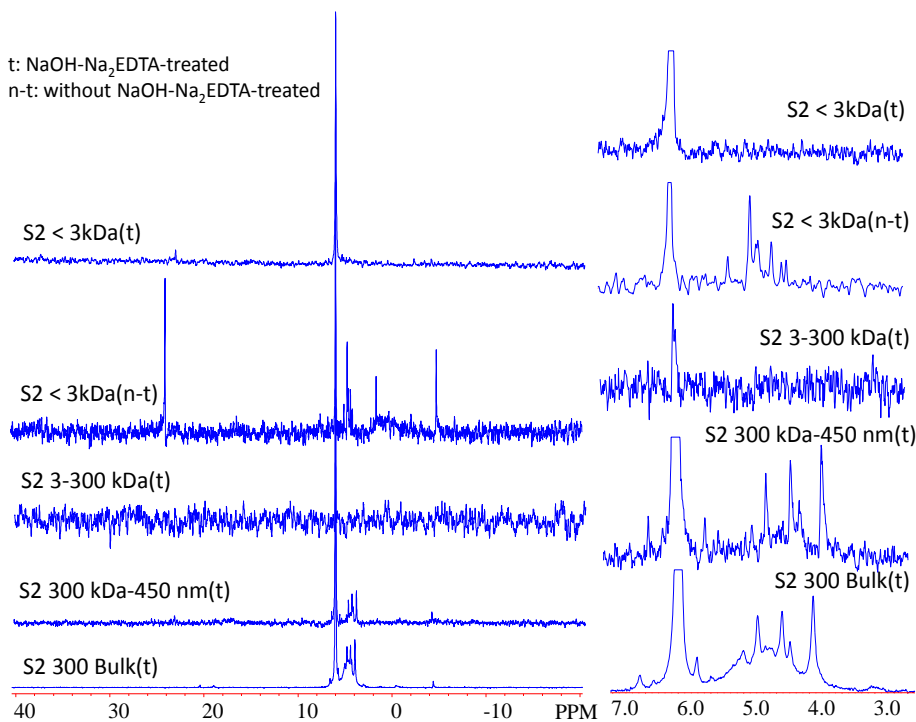
40

41

42



43



44

45 Fig. S1 Solution phosphorus-31 nuclear magnetic resonance spectra of NaOH-Na<sub>2</sub>EDTA extracts of  
 46 bulk, 300 kDa-450 nm, 3-300 kDa, and < 3 kDa fractions in soil water extracts < 450 nm of S1  
 47 (Cambisol) and S2 (Stagnic Cambisol).