10.1071/WF23096
International Journal of Wildland Fire

Supplementary Material

Phosphorus chemistry in plant charcoal: interplay between biomass composition and thermal condition

Yudi Wu[A], *Lois M. Pae*[A] and *Rixiang Huang*[A,*]

[A]Department of Environmental and Sustainable Engineering, University at Albany, 1400 Washington Avenue, Albany, NY 12222, USA

*Correspondence to: Email: rhuang6@albany.edu

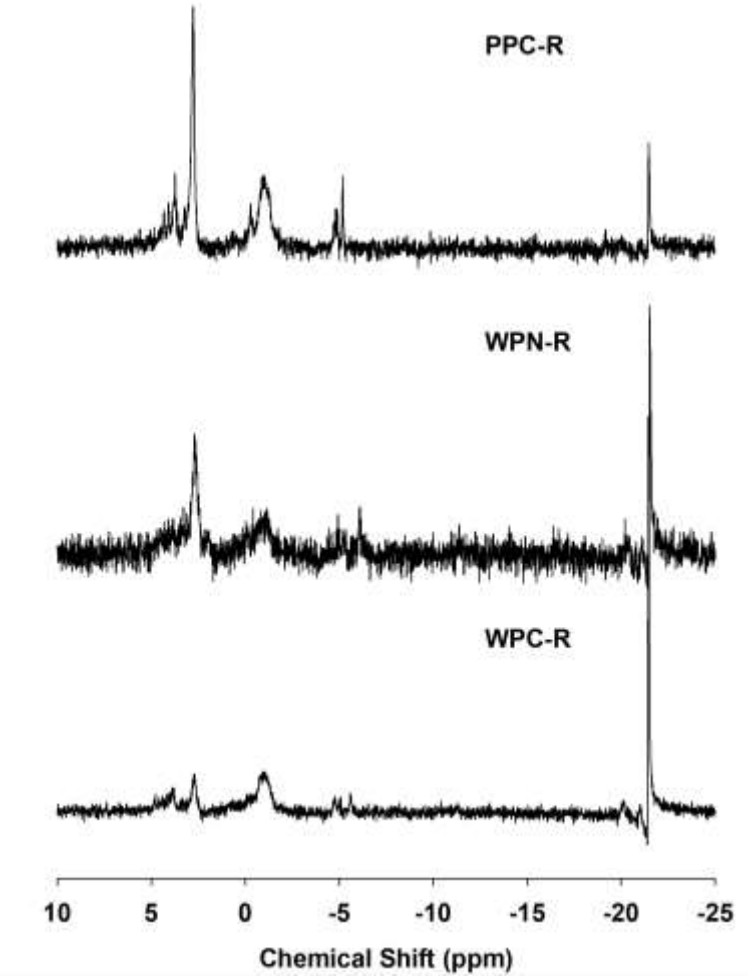

Figure S1. ^{31}P liquid NMR spectra of the NaOH/EDTA extracts from pitch pine cone (PPC-R), white pine needle (WPN-R), and white pine cone biomass (WPC-R).

Table S1. LCF analysis results for P XANES spectra of ash samples.

Sample	R-factor	P Speciation (%)						
		K-phosphate	Dimagnesium phosphate trihydrate	Struvite	Trimagnesium phosphate octahydrate	Amorphous Ca phosphate	Hydroxyapatite	Phytic Acid
SC-Raw	0.0540	0	0	0	35.9	10.8	0	53.3
SC300	0.0033	0	32.5	0	2.4	17.7	0	47.4
SC450	0.0099	0	0	0	29.0	20.0	28.0	23.0
SC600	0.0035	0	0	0	20.1	29.5	21.2	29.3
SC600-EDTA	0.0245	0	0	0	33.2	10.4	25.8	30.6
SC600-HCl	0.0198	0	0	0	62.5	0	21.8	21.3
SN600	0.0097	0	0	0	31.4	20.7	31.7	6.8
ROW600	0.0173	6.5	0	0	16.8	57.6	19.1	0
ROL600	0.0131	0	0	0	32.3	17.9	49.8	0
ROB600	0.0318	0	0	0	30.2	10.5	59.3	0
PPN600	0.0066	0	0	0	30.2	0	47.0	22.8
PPC600	0.0128	0	0	0	27.4	0	60.6	12.0

Table S2. Major elemental contents in biomasses used in this study.

	Tree Parts	Ash content (%)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Na (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
Pitch Pine	Cone	2.0	186.0	196.5	1148.5	220.6	28.29	269.5	17.0
	Needle	2.1	392.5	624.1	4783.8	610.1	72.00	153.8	40.3
	Twig	1.0	267.0	210.1	2055.6	251.2	49.83	179.0	32.8
	Bark	1.0	135.0	209.8	1575.1	86.6	42.36	88.4	7.4
White Pine	Cone	1.6	296.4	1786.6	2134.0	684.8	63.55	203.4	28.9
	Needle	2.9	340.1	491.7	4795.9	735.0	24.39	85.7	37.0
Spruce	Cone	1.4	514.2	3736.3	1187.1	625.7	83.17	140.8	24.9
	Needle	6.0	1001.7	4794.3	9444.1	678.1	719.10	164.9	53.0
Beech	Leaf	7.7	373.4	622.2	10073.1	476.8	1467.27	311.6	46.8
White Oak	Leaf	6.4	364.7	685.3	13309.6	749.8	300.95	237.7	17.6
Red Oak	Leaf	5.3	684.8	1368.2	11213.9	1479.4	382.47	196.9	33.4
	Wood	0.8	230.1	1473.7	8731.5	306.4	14.23	35.4	1.9
	Bark	9.3	180.6	1224.4	37085.4	327.3	16.72	24.7	1.5
Maple	Leaf	9.7	510.0	1029.4	14612.6	1208.9	111.77	319.6	26.3
	Wood	2.3	163.3	1112.4	1870.3	245.0	13.33	187.8	9.1
	Bark	9.7	309.9	1686.8	13571.5	426.1	26.18	104.2	52.1

Table S3. Determination coefficients (R^2) and standard errors of estimates (S.E.) for kinetic equations used to describe P release pattern.

Charcoal samples	pseudo-first-order kinetic model $\ln(q_e-q_t) = \ln q_e - k_1 t$				pseudo-second-order kinetic model $t/q_t = t/q_e + 1/(k_2 q_e^2)$				simple Elovich equation $q_t = 1/\beta \ln(\alpha\beta) + (1/\beta) \ln t$			
	R^2	S.E.	q_e	k_1	R^2	S.E.	q_e	k_2	R^2	S.E.	α	β
SC300	0.51	1.91	6.20	3.48	0.12	0.05	6.04	5.56	0.80	1.22	1.70E+02	1.17
SC450	0.92	1.21	13.16	4.50E+04	0.05	0.01	13.26	25.13	0.94	1.11	6.31E+18	3.48
SC600	0.85	2.61	20.03	3.44	0.23	0.01	20.28	7.95	0.92	1.95	9.20E+06	0.91
WPC600	0.75	1.24	6.85	805.88	0.01	0.02	6.61	-39.79	0.80	1.13	1.02E+09	3.38
WPN600	0.69	0.95	4.47	101.12	0.09	0.07	4.50	6.83	0.83	0.71	2.23E+04	2.77
PPC600	0.60	0.56	2.17	123.34	0.02	0.21	2.07	10.03	0.64	0.53	2.61E+07	9.19
PPN600	0.79	0.790	6.93	6.53	0.12	0.03	6.96	9.04	0.88	0.93	1.88E+03	1.39