



*Supplement of*

## **Aluminous clay and pedogenic Fe oxides modulate aggregation and related carbon contents in soils of the humid tropics**

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11 **Table S1:** Multiple linear models with degrees of freedom (Df), F-value, coefficient of determination ( $r^2$ ),  
 12 and p value. Models reveal the effect of aluminous clay (clay), dithionite-citrate-bicarbonate-extractable  
 13 Fe ( $Fe_d$ ), and respective  $Fe_d$  to aluminous clay ratios ( $Fe_d/clay$ ) on mean weight diameter (MWD), masses  
 14 of aggregates > 4 mm and 2–4 mm, and loss of organic carbon (OC-Loss) due to land-use change from  
 15 forest to cropland. Aluminous clay represents the weight sum of kaolinite and gibbsite present in the < 2-  
 16  $\mu$ m fraction.

Dependent Variable	Clay	$Fe_d$	$Fe_d/clay$	Inter- cept	Df	F- value	$r^2$	P value
MWD <sub>0-10 cm</sub>	0.003			3.27	52	4.81	0.07	0.03
MWD <sub>Forest 0-5 cm</sub>	0.001			3.95	16	0.08	< 0.01	0.79
MWD <sub>Forest 5-10 cm</sub>	0.002			3.78	16	1.15	< 0.01	0.30
MWD <sub>Cropland 0-5 cm</sub>	0.001			2.90	7	0.40	< 0.01	0.55
MWD <sub>Cropland 5-10 cm</sub>	0.009			1.23	7	23.56	0.74	< 0.01
MWD <sub>Forest+Cropland 0-5 cm</sub>	-0.000			3.84	25	0.00	< 0.01	0.95
MWD <sub>Forest+Cropland 5-10 cm</sub>	0.005			2.86	25	9.48	0.25	0.01
MWD <sub>0-10 cm</sub>		0.003		3.79	52	0.47	< 0.01	0.50
MWD <sub>Forest 0-5 cm</sub>		0.023		2.79	16	12.03	0.4	< 0.01
MWD <sub>Forest 5-10 cm</sub>		0.015		3.32	16	4.05	0.15	0.06
MWD <sub>Cropland 0-5 cm</sub>		-0.012		3.98	7	8.17	0.47	0.02
MWD <sub>Cropland 5-10 cm</sub>		-0.014		4.86	7	1.08	< 0.01	0.33
MWD <sub>Forest+Cropland 0-5 cm</sub>		0.005		3.54	25	0.51	< 0.01	0.48
MWD <sub>Forest+Cropland 5-10 cm</sub>		0.000		4.15	25	0.00	< 0.01	0.95
MWD <sub>0-10 cm</sub>	0.003	0.002		3.14	51	2.50	0.05	0.09
MWD <sub>Forest 0-5 cm</sub>	0.000	0.023		2.90	15	5.69	0.36	0.02
MWD <sub>Forest 5-10 cm</sub>	0.001	0.014		3.07	15	2.26	0.13	0.14
MWD <sub>Cropland 0-5 cm</sub>	0.001	-0.012		3.79	6	3.76	0.41	0.09
MWD <sub>Cropland 5-10 cm</sub>	0.009	-0.015		2.17	6	30.11	0.88	< 0.01
MWD <sub>Forest+Cropland 0-5 cm</sub>	0.000	0.005		3.58	24	0.25	< 0.01	0.78
MWD <sub>Forest+Cropland 5-10 cm</sub>	0.005	-0.002		2.96	24	4.61	0.22	0.02
MWD <sub>0-10 cm</sub>			-0.15	4.04	52	0.03	< 0.01	0.86
MWD <sub>Forest 0-5 cm</sub>			3.58	3.21	16	10.79	0.37	0.01
MWD <sub>Forest 5-10 cm</sub>			0.99	4.05	16	0.59	< 0.01	0.45
MWD <sub>Cropland 0-5 cm</sub>			-1.96	3.72	7	8.00	0.47	0.03
MWD <sub>Cropland 5-10 cm</sub>			-5.32	5.27	7	8.18	0.47	0.02
MWD <sub>Forest+Cropland 0-5 cm</sub>			1.01	3.55	25	0.92	< 0.01	0.35
MWD <sub>Forest+Cropland 5-10 cm</sub>			-1.54	4.58	25	1.62	0.02	0.22

Mass.Aggregates <sub>0-10 cm</sub> > 4 mm	0.54		259.93	52	8.36	0.12	< 0.01
Mass.Aggregates <sub>Forest 0-5 cm</sub> > 4 mm	0.36		345.60	16	0.75	< 0.01	0.40
Mass.Aggregates <sub>Forest 5-10 cm</sub> > 4 mm	0.61		284.33	16	5.96	0.23	0.03
Mass.Aggregates <sub>Cropland 0-5 cm</sub> > 4 mm	0.15		237.64	7	0.35	< 0.01	0.57
Mass.Aggregates <sub>Cropland 5-10 cm</sub> > 4 mm	1.37		-9.07	7	20.23	0.71	< 0.01
Mass.Aggregates <sub>Forest+Cropland 0-5 cm</sub> > 4 mm	0.09		358.91	25	0.09	< 0.01	0.76
Mass.Aggregates <sub>Forest+Cropland 5-10 cm</sub> > 4 mm	0.89		181.82	25	17.26	0.39	< 0.01
Mass.Aggregates <sub>0-10 cm</sub> > 4 mm	-0.45		435.27	52	0.33	< 0.01	0.57
Mass.Aggregates <sub>Forest 0-5 cm</sub> > 4 mm	1.71		335.54	16	1.45	0.03	0.25
Mass.Aggregates <sub>Forest 5-10 cm</sub> > 4 mm	0.84		399.96	16	0.39	< 0.01	0.54
Mass.Aggregates <sub>Cropland 0-5 cm</sub> > 4 mm	-1.98		409.04	7	11.33	0.56	0.01
Mass.Aggregates <sub>Cropland 5-10 cm</sub> > 4 mm	-2.39		540.41	7	1.40	0.05	0.28
Mass.Aggregates <sub>Forest+Cropland 0-5 cm</sub> > 4 mm	-0.36		404.23	25	0.11	< 0.01	0.75
Mass.Aggregates <sub>Forest+Cropland 5-10 cm</sub> > 4 mm	-0.78		481.82	25	0.46	< 0.01	0.50
Mass.Aggregates <sub>0-10 cm</sub> > 4 mm	0.56	-0.66	296.52	51	4.56	0.12	0.02
Mass.Aggregates <sub>Forest 0-5 cm</sub> > 4 mm	0.28	1.56	275.61	15	0.95	< 0.01	0.41
Mass.Aggregates <sub>Forest 5-10 cm</sub> > 4 mm	0.60	0.28	270.56	15	2.83	0.18	0.09
Mass.Aggregates <sub>Cropland 0-5 cm</sub> > 4 mm	0.08	-1.97	383.65	6	5.12	0.51	0.05
Mass.Aggregates <sub>Cropland 5-10 cm</sub> > 4 mm	1.37	-2.46	146.84	6	31.88	0.89	0.00
Mass.Aggregates <sub>Forest+Cropland 0-5 cm</sub> > 4 mm	0.10	-0.36	378.99	24	0.10	< 0.01	0.91
Mass.Aggregates <sub>Forest+Cropland 5-10 cm</sub> > 4 mm	0.93	-1.24	250.10	24	9.93	0.41	0.00
Mass.Aggregates <sub>0-10 cm</sub> > 2 mm	-0.18		217.16	52	15.86	0.22	0.00
Mass.Aggregates <sub>Forest 0-5 cm</sub> > 2 mm	-0.17		208.12	16	2.75	0.09	0.12
Mass.Aggregates <sub>Forest 5-10 cm</sub> > 2 mm	-0.17		222.00	16	6.97	0.26	0.02
Mass.Aggregates <sub>Cropland 0-5 cm</sub> > 2 mm	-0.11		204.21	7	1.33	0.04	0.29
Mass.Aggregates <sub>Cropland 5-10 cm</sub> > 2 mm	-0.29		245.92	7	5.57	0.36	0.05
Mass.Aggregates <sub>Forest+Cropland 0-5 cm</sub> > 2 mm	-0.13		202.26	25	3.60	0.09	0.07
Mass.Aggregates <sub>Forest+Cropland 5-10 cm</sub> > 2 mm	-0.22		232.27	25	13.88	0.33	< 0.01
Mass.Aggregates <sub>0-10 cm</sub> > 2 mm	0.78		120.82	52	21.98	0.28	< 0.01
Mass.Aggregates <sub>Forest 0-5 cm</sub> > 2 mm	0.96		111.43	16	10.47	0.36	0.01
Mass.Aggregates <sub>Forest 5-10 cm</sub> > 2 mm	0.09		168.02	16	0.06	< 0.01	0.81
Mass.Aggregates <sub>Cropland 0-5 cm</sub> > 2 mm	0.91		114.03	7	29.12	0.78	0.00
Mass.Aggregates <sub>Cropland 5-10 cm</sub> > 2 mm	1.14		88.14	7	6.76	0.42	0.04
Mass.Aggregates <sub>Forest+Cropland 0-5 cm</sub> > 2 mm	0.94		112.77	25	25.81	0.49	0.00

Mass.Aggregates <sub>Forest+Cropland 5-10 cm &gt; 2 mm</sub>		0.61	130.25	25	4.42	0.12	0.04
Mass.Aggregates <sub>0-10 cm &gt; 2 mm</sub>	-0.20	0.85	169.81	51	35.95	0.57	< 0.01
Mass.Aggregates <sub>Forest 0-5 cm &gt; 2 mm</sub>	-0.22	1.09	159.48	15	13.14	0.59	< 0.01
Mass.Aggregates <sub>Forest 5-10 cm &gt; 2 mm</sub>	-0.19	0.28	208.18	15	3.83	0.25	0.05
Mass.Aggregates <sub>Cropland 0-5 cm &gt; 2 mm</sub>	-0.08	0.88	139.04	6	22.94	0.85	< 0.01
Mass.Aggregates <sub>Cropland 5-10 cm &gt; 2 mm</sub>	-0.29	1.16	172.46	6	47.69	0.92	< 0.01
Mass.Aggregates <sub>Forest+Cropland 0-5 cm &gt; 2 mm</sub>	-0.14	0.97	149.09	24	23.33	0.63	< 0.01
Mass.Aggregates <sub>Forest+Cropland 5-10 cm &gt; 2 mm</sub>	-0.24	0.74	191.73	24	16.19	0.54	< 0.01
Mass.Aggregates <sub>0-10 cm &lt; 0.25 mm</sub>	-0.03		67.56	52	0.34	< 0.01	0.56
Mass.Aggregates <sub>Forest 0-5 cm &lt; 0.25 mm</sub>	0.08		33.92	16	1.33	0.02	0.27
Mass.Aggregates <sub>Forest 5-10 cm &lt; 0.25 mm</sub>	0.02		36.73	16	0.17	< 0.01	0.69
Mass.Aggregates <sub>Cropland 0-5 cm &lt; 0.25 mm</sub>	-0.1		118.01	7	2.09	0.12	0.19
Mass.Aggregates <sub>Cropland 5-10 cm &lt; 0.25 mm</sub>	-0.22		143.23	7	6.82	0.42	0.03
Mass.Aggregates <sub>Forest+Cropland 0-5 cm &lt; 0.25 mm</sub>	0.03		57.73	25	0.29	< 0.01	0.60
Mass.Aggregates <sub>Forest+Cropland 5-10 cm &lt; 0.25 mm</sub>	-0.06		72.89	25	1.14	< 0.01	0.30
Mass.Aggregates <sub>0-10 cm &lt; 0.25 mm</sub>		0.28	43.47	52	2.76	0.03	0.10
Mass.Aggregates <sub>Forest 0-5 cm &lt; 0.25 mm</sub>		-0.21	66.61	16	0.61	< 0.01	0.45
Mass.Aggregates <sub>Forest 5-10 cm &lt; 0.25 mm</sub>		0.16	32.55	16	0.44	< 0.01	0.52
Mass.Aggregates <sub>Cropland 0-5 cm &lt; 0.25 mm</sub>		0.63	48.88	7	16.98	0.67	< 0.01
Mass.Aggregates <sub>Cropland 5-10 cm &lt; 0.25 mm</sub>		0.54	44.57	7	1.85	0.1	0.22
Mass.Aggregates <sub>Forest+Cropland 0-5 cm &lt; 0.25 mm</sub>		0.26	50.83	25	1.39	0.02	0.25
Mass.Aggregates <sub>Forest+Cropland 5-10 cm &lt; 0.25 mm</sub>		0.35	32.27	25	1.96	0.04	0.17
Mass.Aggregates <sub>0-10 cm &lt; 0.25 mm</sub>	-0.03	0.29	51.53	51	1.65	0.02	0.20
Mass.Aggregates <sub>Forest 0-5 cm &lt; 0.25 mm</sub>	0.1	-0.26	45.9	15	1.16	0.02	0.34
Mass.Aggregates <sub>Forest 5-10 cm &lt; 0.25 mm</sub>	0.02	0.14	29.4	15	0.25	< 0.01	0.79
Mass.Aggregates <sub>Cropland 0-5 cm &lt; 0.25 mm</sub>	-0.08	0.6	73.27	6	16.15	0.8	0.004
Mass.Aggregates <sub>Cropland 5-10 cm &lt; 0.25 mm</sub>	-0.22	0.54	108.5	6	7.24	0.61	0.03
Mass.Aggregates <sub>Forest+Cropland 0-5 cm &lt; 0.25 mm</sub>	0.03	0.26	43.3	24	0.79	< 0.01	0.47
Mass.Aggregates <sub>Forest+Cropland 5-10 cm &lt; 0.25 mm</sub>	-0.08	0.39	51.01	24	1.82	0.06	0.18
OC <sub>soil</sub> -Loss <sub>0-10cm</sub>		-206.8	87.9	4	7.73	0.57	0.05
Aggregates > 4 mm OC-Loss <sub>0-10 cm</sub>		-178.5	87.6	4	6.80	0.54	0.06
Aggregates > 2 mm OC-Loss <sub>0-10 cm</sub>		-207.0	88.6	4	6.11	0.51	0.07
Aggregates > 1 mm OC-Loss <sub>0-10 cm</sub>		-199.8	85.7	4	3.87	0.36	0.12
Aggregates > 0.25 mm OC-Loss <sub>0-10 cm</sub>		-269.1	100.7	4	9.29	0.62	0.04

Aggregates < 0.25 mm OC-Loss<sub>0-10 cm</sub>

-257.5    102.2    4    16.52    0.76    0.02

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19 **Table S2:** Multiple linear models with degrees of freedom (Df), F-value, coefficient of determination  
 20 ( $r^2$ ), and p value. Models reveal the effect of aluminous clay (clay), dithionite-citrate-bicarbonate-  
 21 extractable Fe ( $Fe_d$ ), and respective  $Fe_d$  to aluminous clay ratios ( $Fe_d/clay$ ) on mean weight diameter  
 22 (MWD) of water stable 2–4 mm and > 4 mm aggregates. Aluminous clay represents the weight sum  
 23 of kaolinite and gibbsite present in the < 2- $\mu$ m fraction.

Dependent Variable	Clay	$Fe_d$	$Fe_d/clay$	Inter- cept	Df	F- value	$r^2$	P value
MWD <sub>0-10 cm</sub> Aggregate stability 4 mm	-0.0003	0.008		4.77	51	3.66	0.09	0.03
MWD <sub>Forest+Cropland 0-5 cm</sub> Aggregate stability 4 mm	-0.0003	0.01		4.66	24	5.21	0.25	0.01
MWD <sub>Forest+Cropland 5-10 cm</sub> Aggregate stability 4 mm	-0.0004	0.006		4.80	24	0.73	< 0.01	0.49
MWD <sub>0-10 cm</sub> Aggregate stability 4 mm			1.09	4.86	52	5.72	0.08	0.02
MWD <sub>Forest+Cropland 0-5 cm</sub> Aggregate stability 4 mm			1.28	4.89	25	6.42	0.17	0.02
MWD <sub>Forest+Cropland 5-10 cm</sub> Aggregate stability 4 mm			0.89	4.84	25	1.27	0.01	0.27
MWD <sub>0-10 cm</sub> Aggregate stability 2 mm	-0.0003	0.004		2.45	51	12.95	0.31	< 0.01
MWD <sub>Forest+Cropland 0-5 cm</sub> Aggregate stability 2 mm	-0.0003	0.003		2.59	24	12.32	0.47	< 0.01
MWD <sub>Forest+Cropland 5-10 cm</sub> Aggregate stability 2 mm	-0.0002	0.006		2.23	24	10.16	0.41	< 0.01
MWD <sub>0-10 cm</sub> Aggregate stability 2 mm			0.69	2.45	52	22.74	0.29	< 0.01
MWD <sub>Forest+Cropland 0-5 cm</sub> Aggregate stability 2 mm			0.51	2.56	25	25.77	0.49	< 0.01
MWD <sub>Forest+Cropland 5-10 cm</sub> Aggregate stability 2 mm			0.91	2.33	25	13.02	0.32	< 0.01

25 **Table S3:** Organic carbon (OC) content of aggregate size fractions, sum of OC contents in aggregate fractions, and deviation of the sum  
 26 compared with total soil OC (OC<sub>soil</sub>). Aluminous clay represents the weight sum of kaolinite and gibbsite present in the < 2- $\mu$ m fraction after  
 27 removal of OM and pedogenic Fe oxides. Lower case letters indicate significant differences within a certain land use as separated by depth.  
 28 Sample numbers for the combinations are as follows: 'low clay–low Fe' under forest ( $n = 4$ ), 'low clay–high Fe' under forest ( $n = 4$ ), 'high  
 29 clay–low Fe' under forest ( $n = 3$ ), 'high clay–high Fe' under forest ( $n = 7$ ); all cropland combinations ( $n = 3$ ).

Land Use	Mineralogical Combination	Depth (cm)	OC (g kg <sup>-1</sup> soil <sup>-1</sup> )							OC <sub>sum</sub> (%)	OC <sub>sum</sub> /OC <sub>soil</sub> (%)
			> 4 mm	2 mm–4 mm	1 mm–2 mm	0.25 mm–1 mm	< 0.25 mm	OC	OC		
Forest	Low aluminous clay– Low pedogenic Fe oxides	0–5	18.3 <sup>b,A</sup> (5.9)	11.8 <sup>ab,A</sup> (2.3)	12.5 <sup>ab,A</sup> (1.5)	19.8 <sup>a,A</sup> (7.8)	9.3 <sup>a,A</sup> (4.9)	71.6 (22.1)	94		
		5–10	13.2 <sup>a,A</sup> (1.4)	6.9 <sup>ab,A</sup> (2.3)	5.0 <sup>a,A</sup> (2.1)	7.3 <sup>a,A</sup> (2.4)	2.4 <sup>a,A</sup> (1.3)	34.9 (7.0)	103		
Forest	Low aluminous clay– High pedogenic Fe oxides	0–5	33.0 <sup>ab,A</sup> (9.7)	13.5 <sup>ab,A</sup> (3.6)	6.9 <sup>ab,A</sup> (3.2)	7.5 <sup>b,A</sup> (4.7)	2.4 <sup>b,B</sup> (2.5)	63.4 (21.5)	111		
		5–10	18.0 <sup>a,A</sup> (3.6)	7.6 <sup>a,B</sup> (1.9)	4.0 <sup>ab,B</sup> (0.9)	5.1 <sup>ab,B</sup> (2.0)	1.7 <sup>a,B</sup> (1.6)	36.4 (9.0)	98		
Forest	High aluminous clay– Low pedogenic Fe oxides	0–5	23.0 <sup>ab</sup> (4.4)	8.3 <sup>b</sup> (3.1)	7.3 <sup>b</sup> (2.8)	7.2 <sup>b</sup> (1.5)	2.7 <sup>b</sup> (0.7)	48.5 (10.5)	112		
		5–10	14.3 <sup>a</sup> (8.0)	4.5 <sup>b</sup> (1.1)	2.6 <sup>b</sup> (0.5)	3.3 <sup>b</sup> (1.1)	1.3 <sup>a</sup> (0.6)	26.0 (11.0)	113		
Forest	High aluminous clay– High pedogenic Fe oxides	0–5	34.5 <sup>a,A</sup> (12.7)	13.6 <sup>ab,A</sup> (3.5)	15.6 <sup>a,A</sup> (6.6)	18.8 <sup>a,A</sup> (7.8)	9.9 <sup>a,A</sup> (3.8)	92.3 (30.6)	97		
		5–10	16.7 <sup>a,A</sup> (7.1)	5.0 <sup>b,A</sup> (0.9)	4.3 <sup>ab,A</sup> (1.2)	5.8 <sup>ab,A</sup> (2.4)	2.6 <sup>a,A</sup> (1.3)	34.5 (6.0)	99		
Cropland	Low aluminous clay– Low pedogenic Fe oxides	0–5	6.8 <sup>a,B</sup> (0.3)	3.1 <sup>a,B</sup> (0.3)	2.0 <sup>a,B</sup> (0.1)	3.7 <sup>a,B</sup> (1.3)	1.8 <sup>a,A</sup> (0.4)	17.3 (1.1)	93		
		5–10	7.3 <sup>b,B</sup> (0.9)	3.2 <sup>b,B</sup> (0.7)	1.9 <sup>ab,A</sup> (0.1)	3.3 <sup>b,B</sup> (0.5)	1.8 <sup>ab,A</sup> (0.3)	17.5 (2.2)	93		
Cropland	Low aluminous clay– High pedogenic Fe oxides	0–5	9.4 <sup>a,B</sup> (1.5)	10.4 <sup>ab,A</sup> (0.4)	7.2 <sup>a,A</sup> (1.2)	13.6 <sup>a,A</sup> (1.1)	7.4 <sup>a,A</sup> (0.1)	47.9 (1.8)	102		
		5–10	9.2 <sup>b,B</sup> (2.3)	10.8 <sup>ab,A</sup> (0.6)	7.4 <sup>a,A</sup> (1.0)	13.0 <sup>ab,A</sup> (0.8)	7.0 <sup>a,A</sup> (2.6)	47.3 (6.2)	98		

<b>Cropland</b>	<b>High</b> aluminous clay-	0-5	<b>7.6<sup>a,B</sup></b> (1.7)	<b>4.6<sup>b,B</sup></b> (1.0)	<b>5.3<sup>b,B</sup></b> (0.7)	<b>9.7<sup>b,A</sup></b> (0.4)	<b>3.1<sup>b,B</sup></b> (0.4)	<b>30.4</b> (1.7)	<b>90</b>
	<b>High</b> pedogenic Fe oxides	5-10	<b>14.9<sup>b,A</sup></b> (3.6)	<b>3.1<sup>b,B</sup></b> (0.5)	<b>2.7<sup>b,A</sup></b> (1.0)	<b>4.4<sup>b,A</sup></b> (1.5)	<b>1.8<sup>b,A</sup></b> (0.6)	<b>26.9</b> (0.1)	<b>93</b>