Supplement

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

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

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

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

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

Aggregates < 0.25 mm OC-Loss$_{0\text{-}10\ cm}$		-257.5	102.2	4	16.52	0.76	0.02

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

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

Table S3: Organic carbon (OC) content of aggregate size fractions, sum of OC contents in aggregate fractions, and deviation of the sum compared with total soil OC (OC_{soil}). Aluminous clay represents the weight sum of kaolinite and gibbsite present in the < 2-µm fraction after removal of OM and pedogenic Fe oxides. Lower case letters indicate significant differences within a certain land use as separated by depth. 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 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	OC	OC	OC	OC	OC	OC_{sum}	OC_{sum}/OC_{soil}
			> 4 mm	2 mm–4 mm	1 mm–2 mm	0.25 mm–1 mm	< 0.25 mm		
		(cm)	($g\ kg_{soil}^{-1}$)						(%)
Forest	**Low** aluminous clay–	0–5	**18.3**$^{b, A}$ (5.9)	**11.8**$^{ab, A}$ (2.3)	**12.5**$^{ab, A}$ (1.5)	**19.8**$^{a, A}$ (7.8)	**9.3**$^{a, A}$ (4.9)	**71.6** (22.1)	**94**
	Low pedogenic Fe oxides	5–10	**13.2**$^{a, A}$ (1.4)	**6.9**$^{ab, A}$ (2.3)	**5.0**$^{a, A}$ (2.1)	**7.3**$^{a, A}$ (2.4)	**2.4**$^{a, A}$ (1.3)	**34.9** (7.0)	**103**
Forest	**Low** aluminous clay–	0–5	**33.0**$^{ab, A}$ (9.7)	**13.5**$^{ab, A}$ (3.6)	**6.9**$^{b, A}$ (3.2)	**7.5**$^{b, A}$ (4.7)	**2.4**$^{b, B}$ (2.5)	**63.4** (21.5)	**111**
	High pedogenic Fe oxides	5–10	**18.0**$^{a, A}$ (3.6)	**7.6**$^{a, B}$ (1.9)	**4.0**$^{ab, B}$ (0.9)	**5.1**$^{ab, B}$ (2.0)	**1.7**$^{a, B}$ (1.6)	**36.4** (9.0)	**98**
Forest	**High** aluminous clay–	0–5	**23.0**^{ab} (4.4)	**8.3**^{b} (3.1)	**7.3**^{b} (2.8)	**7.2**^{b} (1.5)	**2.7**^{b} (0.7)	**48.5** (10.5)	**112**
	Low pedogenic Fe oxides	5–10	**14.3**^{a} (8.0)	**4.5**^{b} (1.1)	**2.6**^{b} (0.5)	**3.3**^{b} (1.1)	**1.3**^{a} (0.6)	**26.0** (11.0)	**113**
Forest	**High** aluminous clay–	0–5	**34.5**$^{a, A}$ (12.7)	**13.6**$^{a, A}$ (3.5)	**15.6**$^{a, A}$ (6.6)	**18.8**$^{a, A}$ (7.8)	**9.9**$^{a, A}$ (3.8)	**92.3** (30.6)	**97**
	High pedogenic Fe oxides	5–10	**16.7**$^{a, A}$ (7.1)	**5.0**$^{b, A}$ (0.9)	**4.3**$^{ab, A}$ (1.2)	**5.8**$^{ab, A}$ (2.4)	**2.6**$^{a, A}$ (1.3)	**34.5** (6.0)	**99**
Cropland	**Low** aluminous clay–	0–5	**6.8**$^{a, B}$ (0.3)	**3.1**$^{c, B}$ (0.3)	**2.0**$^{c, B}$ (0.1)	**3.7**$^{c, B}$ (1.3)	**1.8**$^{c, A}$ (0.4)	**17.3** (1.1)	**93**
	Low pedogenic Fe oxides	5–10	**7.3**$^{b, B}$ (0.9)	**3.2**$^{b, B}$ (0.7)	**1.9**$^{b, A}$ (0.1)	**3.3**$^{b, B}$ (0.5)	**1.8**$^{b, A}$ (0.3)	**17.5** (2.2)	**93**
Cropland	**Low** aluminous clay–	0–5	**9.4**$^{a, B}$ (1.5)	**10.4**$^{a, A}$ (0.4)	**7.2**$^{a, A}$ (1.2)	**13.6**$^{a, A}$ (1.1)	**7.4**$^{a, A}$ (0.1)	**47.9** (1.8)	**102**
	High pedogenic Fe oxides	5–10	**9.2**$^{b, B}$ (2.3)	**10.8**$^{a, A}$ (0.6)	**7.4**$^{a, A}$ (1.0)	**13.0**$^{a, A}$ (0.8)	**7.0**$^{a, A}$ (2.6)	**47.3** (6.2)	**98**

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

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