10.1071/SR24118

Soil Research

Supplementary Material

Understanding extractable metal species relationships with phosphorus sorption and organic carbon in soils

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Supplementary information

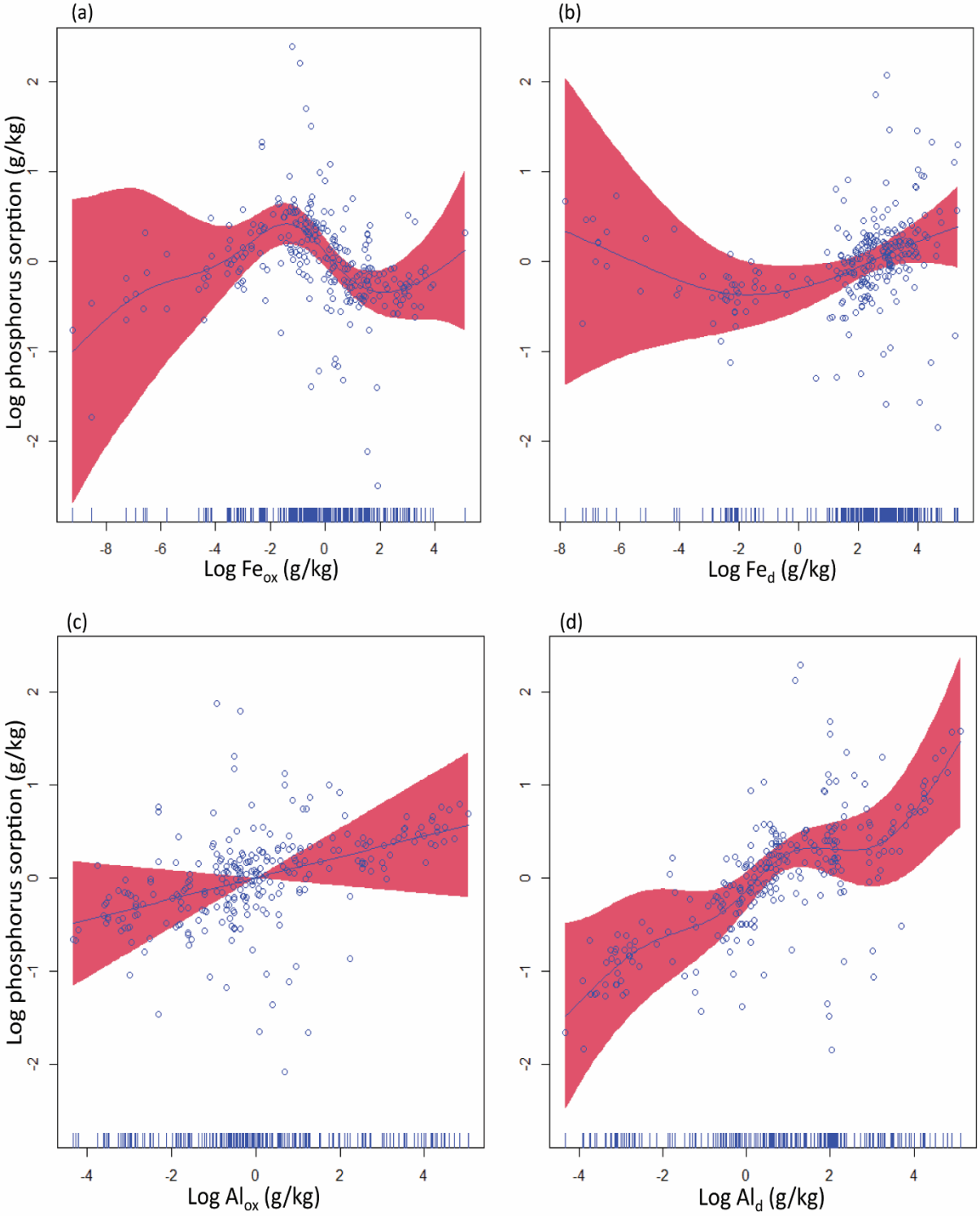
Table 2. Selected publications/papers used for this study.

Authors, year	Title of publications/papers
Bromfield 1965	Studies of the relative importance of iron and aluminum in the sorption of phosphate by some Australian soils
Lopez-Hernandez and Burnham 1974	The covariance of phosphate sorption with other soil properties in some British and tropical soils
Leger et al. 1979	The effects of organic matter, iron oxides and moisture on the color of two agricultural soils of Quebec
Loganathan and Fernando 1980	Phosphorus sorption by some coconut-growing acid soils of Sri Lanka and its relationship to selected soil properties
Jeanroy and Guillet 1981	The occurrence of suspended ferruginous particles in pyrophosphate extracts of some soil horizons
Peña, and Torrent 1984	Relationships between phosphate sorption and iron oxides in alfisols from a river terrace sequence of mediterranean Spain
Borggaard, et al. 1990	Influence of organic matter on phosphate adsorption by aluminium and iron oxides in sandy soils
Goldberg 1990	Effect of aluminum and iron oxides and organic matter on flocculation and dispersion of arid zone soils
Peña, and Torrent 1990	Predicting phosphate sorption in soils of mediterranean regions
Singh, 1991	Mineralogical and chemical characteristics of soils from South-Western Australia
Colombo et al. 1991	The contrasting effect of goethite and hematite on phosphate sorption and desorption by Terre Rosse
Soon 1991	Solubility and retention of phosphate in soils of the northwestern Canadian prairie
Walbridge et al. 1991	Vertical distribution of biological and geochemical phosphorus subcycles in two southern Appalachian Forest soil
Espejo and Cox 1992	Factors affecting phosphorus sorption in palexerults of western Spain
Torrent et al. 1992	Fast and Slow Phosphate Sorption by Goethite-Rich Natural Material
Jorgensen and Borggaard 1992	A Preliminary investigation of sorption and mobility of phosphate in a Danish spodosol
Osodeke et al. 1993	Phosphorus sorption characteristics of some soils of the rubber belt of Nigeria
Afif et al. 1993	Availability of phosphate applied to calcareous soils of West Asia and North-Africa
Arduino et al 1993	Phosphorus status of certain agricultural soils of Lesotho, Southern Africa
Demesquita and Torrent 1993	Phosphate sorption as related to mineralogy of a hydrosequence of soils from the Cerrado region (Brazil)
Mubiru and Karathanasis 1994	Phosphorus-sorption characteristics of intensely weathered soils in South-Central Kentucky
Yuan and Lavkulich 1994	Phosphate sorption in relation to extractable iron and aluminum in Spodosols
Wang and Tzou 1995	Phosphate sorption by calcite, and iron-rich calcareous soils
Indiati et al. 1995	Soil phosphorus sorption and availability as a function of high phosphorus fertilizer additions

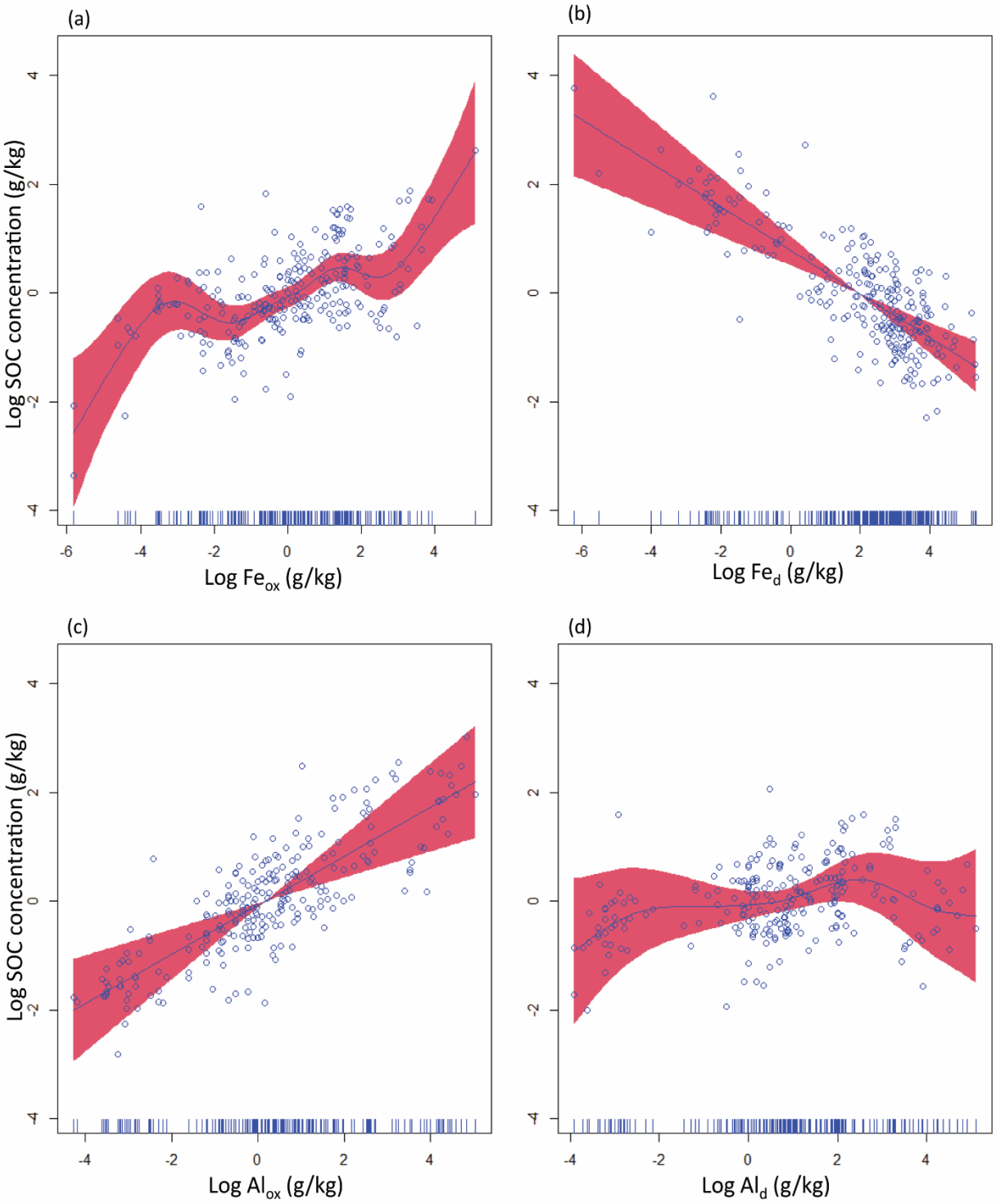
Jugsujinda et al. 1995	Influence of extractable iron, aluminum, and manganese on p-sorption in flooded acid sulfate soils
Anghinoni et al. 1996	Phosphorus sorption isotherm characteristics and availability parameters of Appalachian acidic soils
Tsadilas et al. 1996	Phosphate sorption by red mediterranean soil from Greece
OwusuBennoah et al. 1996	Phosphate sorption in relation to aluminum and iron oxides of oxisols from Ghana
Zhou et al. 1997	Phosphorus sorption characteristics of Bh and Bt horizons horn sandy coastal plain soils
De Mello et al. 1998	Phosphorus and iron mobilization in flooded soils from Brazil
Van Ranst et al. 1998	Charge characteristics in relation to free iron and organic matter of soils from Bambouto mountains, Western Cameroon
Hansen et al. 1999	Phosphate sorption to matrix and fracture wall materials in a Glossaqualf
Osei and Singh 1999	Electrophoretic mobility of some tropical soil clays: effect of iron oxides and organic matter
Uusitalo and Tuhkanen 2000	Phosphorus saturation of Finnish soils: evaluating an easy oxalate extraction method
Borling et al. 2001	Phosphorus sorption in relation to soil properties in some cultivated Swedish soils
Dubus and Becquer 2001	Phosphorus sorption and desorption in oxide-rich ferralsols of New Caledonia
Villapando and Graetz 2001	Phosphorus sorption and desorption properties of the spodic horizon from selected Florida spodosols
Agbenin 2003	Extractable iron and aluminum effects on phosphate sorption in a savanna alfisol
Duiker et al. 2003	Iron (hydr)oxide crystallinity effects on soil aggregation
Eusterhues et al. 2003	Stabilization of soil organic matter by interactions with minerals as revealed by mineral dissolution and oxidative degradation
Pizarro et al. 2003	Influence of organic matter on iron oxides mineralogy of volcanic soils
Hartono et al. 2005	Phosphorus sorption-desorption characteristic of selected acid upland soils in Indonesia
Li et al. 2007	Phosphorus sorption-desorption by purple soils of China in relation to their properties
Ranno et al. 2007	Phosphorus adsorption capacity in lowland soils of Rio Grande do Sul State
Tsaousidou et al. 2008	Iron oxides in four Red Mediterranean soils on metarhyolite and metadolerite in Kilkis, Greece
Spielvogel et al. 2008	Soil organic matter stabilization in acidic forest soils is preferential and soil type-specific
Lair et al. 2009	Phosphorus sorption-desorption in alluvial soils of a young weathering sequence at the Danube River
Igwe et al. 2010	Fe and Al oxides distribution in some ultisols and inceptisols of southeastern Nigeria in relation to soil total phosphorus
Heiberg et al. 2010	A comparative study of phosphate sorption in lowland soils under oxic and anoxic conditions
Janardhanan and Daroub 2010	Phosphorus sorption in organic soils in South Florida

Rezapour et al. 2010	Distribution of iron oxides forms on a transect of calcareous soils, North-West of Iran
Chakraborty et al. 2012	Compositional differences between alaquods and paleudults affecting phosphorus sorption-desorption behavior
Ketrot et al. 2013	Interactive effects of iron oxides and organic matter on charge properties of red soils in Thailand
Wang et al. 2013	Phosphorus adsorption by soils from four land use patterns
Wissing et al. 2013	Management-induced organic carbon accumulation in paddy soils: The role of organo-mineral associations
Pinto et al. 2013	P-sorption and desorption in savanna Brazilian soils as a support for phosphorus fertilizer management
Cloy et al. 2014	Stabilization of organic carbon via chemical interactions with Fe and Al oxides in gley soils
Fink et al. 2014	Mineralogy and phosphorus adsorption in soils of south and central-west Brazil under conventional and no-tillage systems
Bortoluzzi et al. 2015	Occurrence of iron and aluminum sesquioxides and their implications for the P sorption in subtropical soils
Guareschi et al. 2015	Adsorption of P and forms of iron in no-tillage areas in the 'Cerrado' biome
Guedes et al. 2015	Maximum phosphorus adsorption capacity adjusted to isotherm models in representative soils of Eastern Amazon
Jonczak et al. 2015	Characteristics of iron and aluminium forms and quantification of soil forming processes in chernozems in western Slovakia
Rezapour et al. 2015	Changes in forms and distribution pattern of soil iron oxides due to long-term cropping in the Northwest of Iran
Hanke et al. 2015	Influence of organic matter on mean size of clay minerals in basalt soils in Southern Brazil
De Campos et al. 2016	Phosphorus sorption index in humid tropical soils
Estevez et al. 2016	Poorly crystalline components in aggregates from soils under different land use and parent material
Souza et al. 2017	Al/Fe (hydr)oxides organic carbon associations in Oxisols - From ecosystems to submicron scales
Zhao et al. 2017	Aggregate stability and size distribution of red soils under different land uses integrally regulated by soil organic matter, and iron and aluminum oxides
Jafarzadeh-Haghighi et al. 2017	Preservation of organic matter in soils of a climo-biosequence in the main range of Peninsular Malaysia
Gonzalez-Rodriguez and Fernandez-Marcos 2018	Phosphate sorption and desorption by two contrasting volcanic soils of equatorial Africa
Durn et al. 2019	Impact of iron oxides and soil organic matter on the surface physicochemical properties and aggregation of Terra Rossa and calcocambisol subsoil horizons from Istria (Croatia)
Fang et al. 2019	Paddy cultivation significantly alters phosphorus sorption characteristics and loss risk in a calcareous paddy soil chronosequence
Xue et al. 2019	Roles of soil organic carbon and iron oxides on aggregate formation and stability in two paddy soils
Ye et al. 2019	Controls on mineral-associated organic matter formation in a degraded oxisol

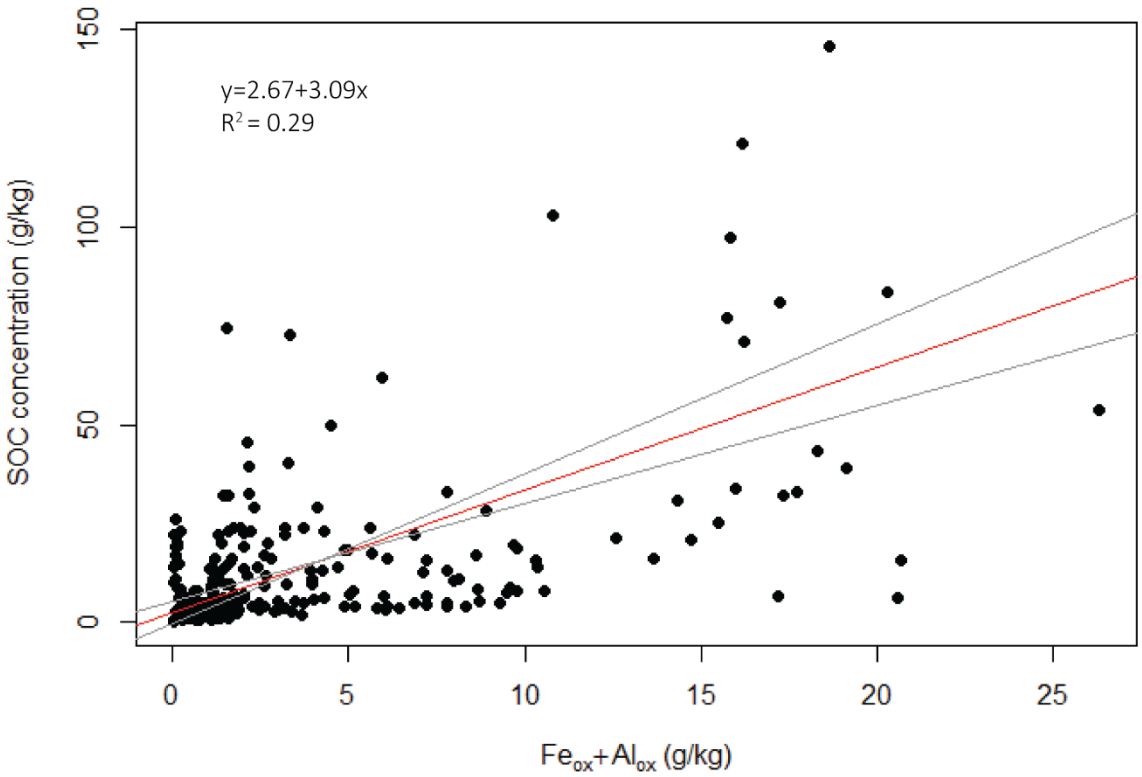
Yu et al. 2019	Soil organic carbon stabilization in the three subtropical forests: importance of clay and metal oxides
Biswas et al. 2020	Organic carbon content and Fe-organo association in soils under rice dominant cropping system in Bangladesh
Chen et al. 2022	Increased interactions between iron oxides and organic carbon under acid deposition drive large increases in soil organic carbon in a tropical forest in southern China


(a)
(b)
(c)
(d)
Log phosphorus sorption (g/kg)
Log Fe$_{ox}$ (g/kg)
Log Fe$_{d}$ (g/kg)
Log Al$_{ox}$ (g/kg)
Log Al$_{d}$ (g/kg)

Supplementary Figure S1. Marginal relationships between phosphorus sorption and ammonium oxalate extractable iron (Fe_{ox}) (a), dithionite-citrate-bicarbonate extractable iron (Fe_d) (b), ammonium oxalate extractable aluminium (Al_{ox}) (c), and dithionite-citrate-bicarbonate extractable aluminium (Al_d) in the single optimal generalized additive mixed model (GAMM) (R^2 = 0.93). All predictors were significant at P<0.001. Shaded regions indicate two SEs from the mean predicted value.


(a)
(b)
(c)
(d)
Log SOC concentration (g/kg)
Log Fe_{ox} (g/kg)
Log Fe_d (g/kg)
Log Al_{ox} (g/kg)
Log Al_d (g/kg)

Supplementary Figure S2. Marginal relationships between soil organic carbon (SOC) concentration and ammonium oxalate extractable iron (Fe_{ox}) (a), dithionite-citrate-bicarbonate extractable iron (Fe_d) (b), ammonium oxalate extractable aluminium (Al_{ox}) (c), dithionite-citrate-bicarbonate extractable aluminium (Al_d) in the single optimal generalized additive mixed model (GAMM) (R^2 = 0.69). All predictors were significant at P<0.001. Shaded regions indicate two SEs from the mean predicted value.


y=2.67+3.09x
R² = 0.29
SOC concentration (g/kg)
0
50
100
150
0
5
10
15
20
25
Fe_ox+Al_ox (g/kg)

Supplementary Figure S3. Relationship between soil organic carbon (SOC) concentration and ammonium oxalate extractable iron (Fe_{ox}) + ammonium oxalate extractable aluminium (Al_{ox}). Lines in red indicate reduced major axis (RMA) regression, and lines (in grey) indicate confidence intervals for the RMA regression line, R^2 values and RMA regression equation are given in each plot. Regression slope was statistically significant at $p<0.01$.