Biogeosciences

Discussions

Open Access

EGU

BGD

Interactive
comment

Interactive comment on "Anoxic conditions maintained high phosphorus sorption in humid tropical forest soils" *by* Yang Lin et al.

Eric Roy (Referee)

eroy4@uvm.edu

Received and published: 25 March 2019

General comments: This manuscript by Lin et al. examines the influence of anoxic conditions on phosphorus sorption in highly weathered, acidic soils in humid tropical forests. It is well known that phosphorus solubility and bioavailability in soils and sediments can be impacted by fluctuations in redox conditions that lead to iron reduction and pH changes. However, to my knowledge (and based on the literature reviewed by Lin et al.), this topic has not been well studied in tropical forest soils (or tropical soils used for agriculture) that are rich in Fe- and Al-minerals and characterized by large P sorption capacity. Therefore, this is a welcome study and the authors have done a nice job generating results that increase understanding of this topic. They perform their experiments using humid tropical forest soils (0-15 cm depth) from two sites in Puerto

Rico featuring different parent materials and soil characteristics. Tests include P sorption isotherms, P sorption time curves, soil Fe and Al analyses and P fractions, and a P solubility experiment. The methods used are appropriate for the study questions. I support the publication of this manuscript in Biogeosciences once my comments below have been taken into account.

Specific comments:

1) Re: the choice of P concentrations for the sorption isotherm experiments: a. Can the authors provide more justification for their decision to omit the lower concentrations (i.e., 10 and 100 mg P kg-1 soil)? Typically, sorption isotherm experiments have included a 0 mg P kg-1 soil treatment, as well as lower concentrations where most P is sorbed (e.g., Graetz and Nair 2000). Would including these results influence the Langmuir models in this study? b. The range of concentrations used (500 – 10,000 mg P kg-1 soil) is very high. It should be noted that estimates for Smax can be dependent on the concentrations used in the P sorption isotherm experiment, particularly when testing a material with high P sorption capacity. For example, Drizo et al. (2002) found that the Smax for a steel slag material tested for use in constructed wetlands varied from 0.31 to 3.93 g P kg-1 material depending on the range of P concentrations used. Here, the authors report maximum P sorption capacities ranging from 2526 $\pm$ 667 mg P kg-1 to 8256 $\pm$ 2517 mg P kg-1 soil. These are high compared to other studies of P-fixing soils that used lower, more conventional ranges in P concentrations (e.g., Brazilian forest soils tested in Roy et al. 2017 using the range of 0 - 1,500 mg P kg-1 soil exhibited Smax up to 1167 mg P kg-1 soil). I think the authors should provide some discussion of whether their Smax results are method-dependent, and how their results compare to other studies, including those that used more conventional, lower ranges of P concentrations. This discussion can add nuance to their conclusion that Smax was "at least one of magnitude above total soil P concentrations."

2) The authors state that "sorption isotherms of all soils followed Langmuir functions", however, no model fit diagnostics appear in the manuscript. Can the authors please

provide quantitative evidence to justify this statement? The standard errors for Smax presented seem somewhat high to me and it would be helpful to know how well the Langmuir model fit the data. Model efficiency is one option (Bolster and Hornberger 2007).

3) Page 6, Line 20 – Can the authors please explain here how they determined that vivianite precipitation was occurring? There is some discussion on subsequent pages that I suggest be moved to the first mention of vivianite precipitation. Furthermore, the calculations made using Visual MINTEQ should be described somewhere in the Methods.

4) Page 8, Line 10 – The evidence that soils experienced reducing conditions mentioned here should probably come earlier in the paper given its importance for all results presented.

References

Bolster, C. H., & Hornberger, G. M. (2007). On the use of linearized Langmuir equations. Soil Science Society of America Journal, 71(6), 1796-1806.

Drizo, A., Comeau, Y., Forget, C., & Chapuis, R. P. (2002). Phosphorus saturation potential: a parameter for estimating the longevity of constructed wetland systems. Environmental science & technology, 36(21), 4642-4648.

Graetz, D. A., & Nair, V. D. (2000). Phosphorus sorption isotherm determination. In Methods of phosphorus analysis for soils, sediments, residuals, and waters (Vol. 369, pp. 35-38). North Carolina State University Raleigh.

Roy, E. D., Willig, E., Richards, P. D., Martinelli, L. A., Vazquez, F. F., Pegorini, L., ... & Porder, S. (2017). Soil phosphorus sorption capacity after three decades of intensive fertilization in Mato Grosso, Brazil. Agriculture, ecosystems & environment, 249, 206-214.