

P binding and sorbent dynamics

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In conflict with common knowledge on liming and phosphorus (P) availability, experiments on agricultural soil occasionally suggest a minimum in P solubility at slightly acidic pH [1, 2]. Although liming in the field enhanced overall P solubility, our results show that batch titration may indeed yield such a minimum, possibly due to dissolution of sorbent along with occluded P on large acid additions (Fig. 1). Rather than just modifying pH, we hypothesized that liming prevents occlusion of P in less reactive forms.

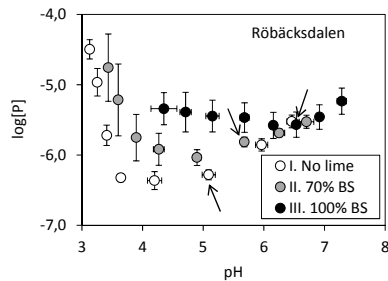


Figure 1: Dissolved P (\log_{10} of molar concentration) in batch titration of soil limed to various base saturation ('BS') since 1962. At arrows, no acid or base was added.

Acetate–lactate–extractable P ('P-AL'), is a proxy for reactive P on mineral surfaces, and was empirically modelled ($R^2 = 0.84$) based on the 1962 value ($P-AL_0$) and an expression that was proportional to the field P balance, and inversely proportional to the net proton load:

$$P-AL = P-AL_0 \frac{1 + \frac{\text{Field P balance}}{P_0}}{k(\text{Net proton load}) + m}$$

Besides reducing the net proton load, liming resulted in enhanced accumulation of oxalate-extractable silica in the soil, demonstrating the need to include sorbent dynamics in a theory for long-term ion binding in soil.

[1] Murrmann & Peech (1969) *Soil Sci Soc Am Proc* **33**, 205–210. [2] Gustafsson *et al.* (2012) *Geoderma* **189**, 304–311.