

Phosphorus availability in agricultural soils of Wallonia (Belgium) – A modeling approach

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A better understanding of Phosphorus (P) behaviour in soil is needed to adapt the ordinary practices of P fertilization to the requirement of reducing agricultural impact on the environment (eutrophication of surface water) without impairing crop yields.

The aim of this study was to identify the chemical parameters that actually govern the modelling of available P in agricultural soils of Wallonia with the PHREEQC geochemical model [1]. In a first step, the chemical parameters necessary in input data to have an optimal modeling of P available in Wallonia soils were defined. During this input data calibration, our results show that it is necessary to use soil pH_{water} rather than soil pH_{KCl} and $[\text{Al}]_{\text{ox}}$ (oxalate-extractable Al) rather than $[\text{Al}]_{\text{total}}$. For other parameters, this study shows that using total content is suitable enough. In a second step, sensitivity tests were performed to quantitatively evaluate the impact of input data variations on mean P available modelled. Results of these sensitivity tests show that only pH_{water} and $[\text{Mg}]_{\text{total}}$ variations significantly influence the modelling results (i.e. mean P available in agricultural soils of Wallonia). Indeed, mean P available modelled increases by a factor 3 when the soil pH_{water} is raised from 7.3 to 8.0. The modelled values decrease of 9% and 16%, respectively, when $[\text{Mg}]_{\text{total}}$ increases of 20 and 40%, at soil $\text{pH}_{\text{water}} = 8.2$. However, results show that mean available P is not sensitive neither to soil pH_{water} nor to $[\text{Mg}]_{\text{total}}$ variations, when soil $\text{pH} \leq 7.3$.

This study has shown the high potential of PHREEQC modelling to predict available P and to estimate chemical parameters that govern P availability in Wallonia soils. As these input data parameters and PHREEQC model are calibrated, we will further try to predict the impact of various agricultural systems on the fate of P in soils.

[1] Parkhurst, D.L., Appelo, C.A.J., 1999. User's guide to PHREEQC (Version 2)

The structure of Mg-stabilised amorphous calcium carbonate

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Amorphous calcium carbonate (ACC) is thought to play a key role in biomineralisation processes in sea organisms. Very few structural studies have been performed on ACC, mainly due to its instability and tendency to crystallise into calcite. Magnesium-stabilised ACC has been prepared [1,2] with Mg:Ca ratio of 0.05:1, and has enabled neutron and x-ray diffraction measurements. The Empirical Potential Structure Refinement (EPSR) method has been used to make a model of Magnesium-stabilised ACC having good agreement with the experimental diffraction data. The model has well-defined CO_3 and H_2O molecules with an average calcium coordination of 7. The distribution of calcium in the model is homogeneous with a uniformly distributed Ca-rich network and no evidence of Ca-poor channels [3].

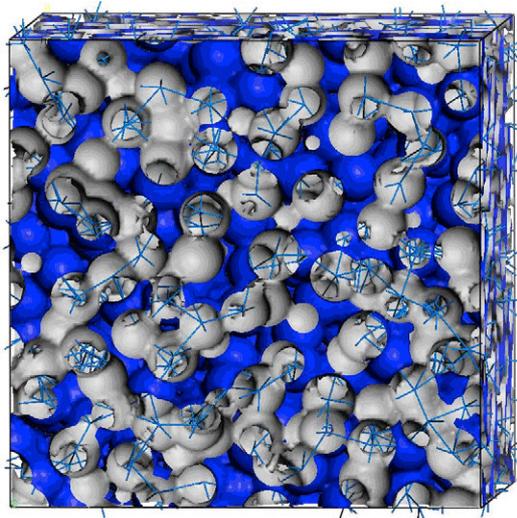


Figure 1: EPSR model of Mg-stabilised ACC with sticks showing the Ca-rich network (i.e. Ca–O–Ca)

[1] Jiang *et al.* (2010) *Nanoscale* **2**, 2358-2361. [2] Rodriguez-Blanco, Shaw & Benning (2008) *Mineral. Magazine* **72**, 283.

[3] Goodwin *et al.* (2010) *Chem. Mater.* **22**, 3197-3205.