Introduction

- Biosolids (sewage sludge, SS) and manure application on soils results frequently in undesirable buildup of high soil P. Does the behaviour of these P are the similar to the P from the fertilizer?
- The aim of this study was to determine the P release patterns in a high-pH, low fixed-P capacity sandy soil amended with sewage sludge (FSS) or water-soluble fertilizer (Fertilizer), and to understand who and how control soil P release, based on the change of soil P Gibbs free energy.

Materials and Methods

- A high P sandy loam soil amended with Water soluble P fertilizer (KH2PO4) or Anaerobically digested sewage sludge.
- Prolonged (1000-h) batch extraction with water and a 210 pore-volume column leaching experiment were employed to follow kinetic of P release and determine which phases control P chemistry in the amended soil.

Soil P system was constituted as Ca-P, Fe-P and Al-P three sub-systems, and the Gibbs free energy of each P minerals in soils was calculated as the equation:

\[ AG = RT \ln ([AlP] / [AP] \times [P]) \]

where \([AlP] = \text{Ksp} \times [Al^3+] \times [H_2PO_4^-] \times [OH^-] \]

and \([AP] = \text{Ksp} \times [Al^3+] \times [H_2PO_4^-] \times [OH^-] \]

The AG of Hydroxyapatite (Ca-P), Wavellite (Al-P), and Strengite (Fe-P) in batch experiments and each measured fraction of P column leaching experiments were calculated by VMinTEQ software.

We also were assuming that the increase of AG between two adjoining fractions is more than 5% as the energy increase in the process of P leaching in column experiments.

Materials and Methods

- Summary
- Double-function plots of P potential versus Ca, Al, or Fe potentials indicated that time of equilibration strongly affected the solution status in respect to various P minerals.
- The simultaneous changes in the Gibbs free energies of Ca-P, Al-P and Fe-P systems well described the dynamics of the P-leaching process: there were often reversals in the increase of the Gibbs free energy of the Ca-P during P release, and each temporal decrease was accompanied by an increase in the Gibbs free energy of Al-P and/or Fe-P, regardless of the source of the soil-P amendment.
- No single phosphate mineral controlled the entire process of P leaching: both Al-P and Fe-P played a significant role, even Ca-P was still the dominate factor in the high-pH calcareous soil.