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Thema
Kommission II: Bodenchemie

Waldernährungsstrategien und deren Wechselwirkung mit bodenchemischen und bodenbiologischen Eigenschaften

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Titel
The bioaccessibility and bioavailability of subsoil phosphorus from P-33-labeled hydroxyapatite

Abstract
Phosphorus (P) is an essential but often limiting macronutrient in ecosystems. In soil, free phosphorus is rapidly immobilized by sorption onto hydrous oxides or minerals containing Fe, Mn and Al. Therefore plants have the need to increase the availability of P from other sources e.g. solubilizing P from mineral apatite. Apatite can be found in mineral and biological forms, such as residues from bones and dentin, in soil. This Ca-phosphate mineral occurs in trace amounts in practically all metamorphic and igneous rocks and is often found as small mineral inclusions associated to weathering-resistant silicate minerals. Yet, there is not much information on the bioavailability of P from mineral apatite. Numerous papers have been published on hydroxyapatite synthesis, mostly focusing on its use as a bioceramic for biomedical applications that often differ in their physic-chemical properties from mineral apatite. In framework of the DFG-SPP 1685 on ecosystem nutrients the aim of this work was to implement a chemical synthesis for P-33-labeled hydroxyapatite (Ca/P ratio = 1.67) in order to get more information on the bioaccessibility and bioavailability of subsoil P from minerals. A wet-chemical synthesis based on Wang et al. (2010), has been modified and extended, to create a procedure that allows the fast preparation (ca. 30 h) of hydroxyl-apatite labeled with P-33. The products were analyzed with IR-RAMAN and XRD. The reactions were performed under different reaction temperatures which resulted in four forms of hydroxyapatite with different degrees of crystallinity (amorphous high crystalline). Solubility tests were performed with all forms to investigate their pH-dependency, stating that the amorphous and high crystalline forms behave similar but differ from the intermediate forms. Rhizotrone experiments (60 days) will be performed using summer wheat as model organisms and the amorphous apatite form as point sources in soil. Two different subsoils (P-deficient/non-deficient) with two different water scenarios will be used to investigate the differences in root growth and the effects on the bioaccessibility and –availability of P from apatite. Radioactive imaging will be used to get information on the time that the roots need to grow to the apatite source, the amount that is taken up into the plant and to locate the areas of P-storage. High resolution pictures will be taken to investigate the growth of the root system for modeling purposes.