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Neue Ansätze zur Quantifizierung und Charakterisierung pedogener Minerale und Mineraltransformation

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Titel

Changes in iron mineral composition in Alisols and Andosols under paddy management

Abstract

Paddy soils are periodically submerged and therefore undergo redox fluctuations, which may manifest different biogeochemical dynamics as a function of soil type. We considered paddy soil evolution in two contrasting soil types (Alisol and Andosol) and focused on Fe mineral composition as Fe is strongly influenced by redox dynamics. Using Mössbauer spectroscopy, which is sensitive to Fe mineral speciation, we found that paddy management led to loss of Fe oxides due to reductive dissolution and leaching in both soils, however, with contrasting effects on Fe oxide crystallinity. Iron mineral crystallinity decreased in the Alisol, while it increased in the Andosol. We suggest that different soil types approach a certain level of Fe oxide crystallinity until the original crystallinity pattern has been overridden by the redox dynamics under paddy management.

To further investigate the Fe mineral transformation processes during paddy soil development we incubated the Alisol and Andosol non-paddy topsoils for 1 year with 8 anoxic-oxic cycles. Solutions were regularly analyzed for redox potential (Eh), pH, dissolved organic C (DOC), as well as dissolved Fe, Si, and Al. At the end of the experiment, soils were analyzed with Mössbauer spectroscopy. Alternation of Eh was successful in both soils and pH as well as dissolved Fe^{II} varied simultaneously with larger values during anoxic than oxic conditions. Iron reduction rates were larger in the Andosol. Measured changes in Fe oxide crystallinity in the incubated soils were consistent with the field paddy soils but were too small to be significant. Our data additionally suggest that Fe mineral transformations, like the re-crystallization of Fe oxyhydroxides induced by Fe^{II} as well as the long-term formation of Fe substituted phyllosilicates are not impossible in the Andosol under paddy management.