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Autoren

J. Mihajlovic[1], H. J. Stärk[2], J. Rinklebe[1]

[1]Bergische Universität Wuppertal, Wuppertal; [2]UFZ - Helmholtz Centre for Environmental Research, Leipzig

Titel

Seltene Erden und ihre Mobilisierung unter dynamischen Redoxbedingungen in einem zeitweise überfluteten Boden

Abstract

Rare earth elements (REE) are an emerging field of environmental research. Although they occur naturally in minerals; however, they are used in many key technologies such as mobile phones, solid state lasers, catalysers in cars, in storage media for data handling, lodestones, photovoltaic cells etc. currently. In consequence, REE attain to the Environment. However, considerable knowledge gaps exist about the fate of REE in flooded soils up to date. To our best knowledge, the impact of systematic and pre-definite redox conditions on the release dynamics of REEs in floodplain soils has not been mechanistically studied up to date. Thus, we quantified the impact of pre-definite E_H-conditions on the release dynamics of dissolved REEs, and to elucidate underlying redox-driven processes including the the determining factors pH, iron (Fe), manganese (Mn), aluminum (Al), dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), and sulfate (SO_4^{2-}) in a floodplain soil. For this purpose, we were able to use an advanced, highly sophisticated automatic biogeochemical microcosm system allowing controlled adjustment of redox conditions. The novelty of our study is very high: this is the first time, where this particular topic is addressed.

The redox potential (E_H) ranged between +82 and +498 mV during the experiment. The systematic increase of E_H caused a decreasing pH from 4.6 to 6.6 which resulted in an enhanced mobilization and release of REEs along with Fe, Al, and Mn under oxic and acidic conditions. Also, a gradual oxidation of REE-bearing sulfides seems to contribute to the mobilization of REE from reducing to oxidizing conditions. A factor analysis identified that the REEs form one group with E_H, Fe, Al, and Mn what indicates that they have a similar geochemical behavior which substantially differs from those of pH, DOC, and DIC which are together in another cluster. The geochemical distribution of the REEs revealed that the majority of the REEs was in the residual fraction, followed by the reducible, the oxidisable and the water soluble / exchangeable / carbonate bound fraction. Future studies should further elucidate the specific release kinetics of REEs, their determining factors and the underlying mobilization processes in highly dynamic wetland soils around the globe.