Potential remobilization of phosphorus from acid mining lake sediments

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Introduction and methods

Natural maturation or artificial neutralization measures will lead to an accumulation of organic carbon (C_{org}) and phosphorus (P) in acid mining lakes. Concurrently, a reduction of Fe-imports into these lakes is foreseeable (Kleeberg and Grüneberg 2005).

Consequently, due to low redox potential and the neutral pH conditions in the sediment, reductive dissolution of Fe-hydroxides and the formation of sulfides might lead to P-remobilization and higher trophy.

This hypothesis was tested by studying the response of undisturbed sediment cores from the mining lake 117 (pelagic pH 3, age 35 a, z_{max} 14.4 m, Plessa mining area, Lusatia, Germany) to C_{org}- and P-additions. Glucose and dried *Chlorella* algae where added at rates between 0.2 and 3.5 g C m^{-2} d^{-1}.

Results

Only the columns with high sulfur (S) and relatively low Fe content (Fe:S ratio molar 1.4 – 2.0) showed P release with a flux between 0.15 and 0.46 mg m^{-2} d^{-1}, which is in a range comparable to oligotrophic lakes. The resulting concentration of soluble reactive P (SRP) in the pore water was approximately calculated in adsorption equilibrium with the fraction of Fe which is not immobilized as FeS using PHREEQC (Parkhurst and Appelo 1999). Vivianite formation is probably inhibited as high SRP-concentrations in the pore water up to 0,63 mg l^{-1} can not be explained in equilibrium with Vivianite.

Column experiments proved that P-sorption capacity becomes very low (< 1 mg P m^{-2} d^{-1}) under the influence of FeS_x-formation in the sediment and without constant supply of $Fe(OH)_3$, and that a mobilization of sediment P is possible despite high Fe content. The future P-sorption capacity might be approximated from the ratio of Fe- and S-input into the lake, provided that the supply of C_{org} is adequate for intensive sulfate reduction.

References

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Parkhurst D. L. and Appelo C. A. J. (1999), *Water-resources investigations report* 99-4259, Denver, Colorado. 312 pp.

Estimation of ferromanganese concretions growth rates using ^{210}Pb

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The present investigations are devoted to dating of ferromanganese concretions from Gulf of Finland using ^{210}Pb. About 90% of ^{210}Pb detected in the concretions are generated directly inside concretions as a result of ^{222}Rn decay formed from ^{226}Ra. The content of ^{226}Ra in the concretions are 10-50 times higher than in all types of bottom sediments irrespective of the morphology of the concretions (Grigoriev *et al*., 2004).

For the study of ^{210}Pb concentrations one spheroidal concretion (20 mm in diameter) sampled in the eastern Gulf of Finland was selected. Four probes for ^{210}Pb determination were sampled: 1 – from the centre of the concretion (distance from the centre 0-2.5 mm); 2 – 2.5-5 mm; 3 – 5-8 mm; 4 – 8-9 mm. Analysis of ^{210}Pb concentrations was fulfilled in the Center of Isotopic Research of VSEGEI. The radioactive decay spectra of ^{210}Pb and its daughter elements were detected with liquid-scintillation spectrometer Quantulus 1220.

The first model does not take into account ^{222}Rn emanation. Composing equations set and solving it we got the minimal value of concretion age 670±50 yr. Accordingly the rate of concretions radial growth is within the range 0.013 – 0.042 mm/yr.

For the second model we tried to take into account ^{222}Rn emanation. For this purpose we applied parameter φ, which defines emanation process. After solution of the equations set we obtained the age of studied spheroidal concretion is within the range 260 – 490 yr or its radial growth rate is within the range 0.018-0.034 mm/yr.

Reference

Grigoriev A.G., Zhamoida V.A. and Glasby G.P. (2004), *Baltica* **17**(2), 63-70.