

Abstract

[Research Title]

Development of a New Method for Determining Phosphorus Flux from Lake Sediments Using a Passive Sampler

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[Abstract]

The occurrence of harmful algal blooms caused by eutrophication has been reported in lakes around the world. One reason is the increase in phosphorus concentration in lake water, which is caused by the release of orthophosphate ($\text{PO}_4\text{-P}$) from the lake sediments. Therefore, an assessment of $\text{PO}_4\text{-P}$ release from lake sediments is needed. We developed a new receiving phase for $\text{PO}_4\text{-P}$ passive sampler that can provide representative concentrations of $\text{PO}_4\text{-P}$ as time-weighted average concentrations (C_{TWA}). In addition, two types of new samplers were developed using the $\text{PO}_4\text{-P}$ passive sampler to assess the $\text{PO}_4\text{-P}$ release from lake sediments. The developed receiving phase shows good sorption capacity and selectivity for $\text{PO}_4\text{-P}$. The quantification limit of the passive sampling method was between 0.2-0.5 $\mu\text{g-P/L}$ as C_{TWA} of $\text{PO}_4\text{-P}$, when the sampler deployment time is 7 days. The passive samplers were deployed above lake sediments of Lake Barato. The release of $\text{PO}_4\text{-P}$ from lake sediments resulted in an increase in $\text{PO}_4\text{-P}$ concentrations. The C_{TWA} of $\text{PO}_4\text{-P}$ was higher in bottom water than in surface water. Another type of $\text{PO}_4\text{-P}$ passive sampler was developed and deployed at the sediment-water interface in Lake Barato and Lake Kasumigaura. The vertical-horizontal distribution of $\text{PO}_4\text{-P}$ concentration at the sediment-water interface was obtained. Furthermore, the rate of $\text{PO}_4\text{-P}$ release from lake sediments was calculated using the obtained vertical distribution of $\text{PO}_4\text{-P}$ concentration at the sediment-water interface. The $\text{PO}_4\text{-P}$ release rate obtained was comparable to that obtained with the existing sediment core sampling method. We also developed a model to estimate the rate of $\text{PO}_4\text{-P}$ release from lake sediments and a model of dissolved oxygen dynamics which is related to $\text{PO}_4\text{-P}$ release. The $\text{PO}_4\text{-P}$ passive samplers developed in this study can be used for $\text{PO}_4\text{-P}$ monitoring in lakes and rivers. By using two types of samplers, it is possible to evaluate when, where, and how much $\text{PO}_4\text{-P}$ is released from lake sediments. This can contribute to the planning and implementation of countermeasures to protect the lake environment.

[References]

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