

## **Mechanisms involved in phosphorus mobility at sediment/water interface under redox oscillations in dam-reservoir context**

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The construction of dams, in response to the growing human demand of water and electricity, leads to the perturbation of several natural biogeochemical cycles, including phosphorus (P). Given its high affinity for solid phases, P tends to accumulate with the sediments in dam-reservoirs. Since the sedimentary P may contribute to water eutrophication, attention should be paid to better understand the parameters, conditions and mechanisms controlling the release of P at the sediment/water interface in such a system. The mobility of P at sediment/water interface closely depends on bio-physico-chemical conditions (redox potential, pH, temperature).

Champsanglard dam-reservoir (19.5 m height; 55 ha; Creuse, France) was constructed in 1982 and is annually subject to bathing bans caused by the development of cyanobacteria, although the surface water is classified by the EU Water Framework Directive as being of medium quality regarding total dissolved P. The sediments accumulated in this reservoir are relatively rich in P ( $1.81 \pm 0.22$  mgP/gDW), in the silt-sand fraction and characterized by high organic matter content ( $21 \pm 0.1$  %). The development of temporary anoxia during summer in hypolimnion and P distribution in the sediments (66% of P associated with amorphous Mn/Fe-oxy-hydroxydes) highlight the importance of the redox potential variation on P mobility.

In this context, incubation experiments were conducted to evaluate the role of alternation between aerobic and anaerobic conditions on P sediment mobility. Surface sediments ( $\Phi < 2$  mm) were incubated with a synthetic solution simulating the chemistry of Champsanglard reservoir water and submitted to two successive aerated and non-aerated phases. Physico-chemical composition (pH, Eh, P-PO<sub>4</sub><sup>3-</sup>, FeII, Mn, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup> and dissolved organic carbon (DOC)) and organic matter aromaticity (SUVA<sub>254</sub>) of the supernatant were monitored all along the incubation.

The results showed that the development of anaerobic conditions (decrease of redox potential, NO<sub>3</sub><sup>-</sup> and SO<sub>4</sub><sup>2-</sup> and increase of FeII and Mn concentrations) during the two non-aerated phases induces the release of P to the solution. However, during the second anaerobic phase, a higher release of 57 % P- PO<sub>4</sub><sup>3-</sup> was observed ( $8.7 \pm 0.5$  mgP/L for the second phase to  $6.4 \pm 0.5$  mgP/L for the first one). During the first anaerobic phase, P-PO<sub>4</sub><sup>3-</sup> dynamic was correlated with the release of FeII and Mn suggesting that the reductive dissolution of Mn/Fe-oxy-hydroxydes was the main mechanism controlling the P mobility. However, in the second anaerobic phase, Mn and FeII concentrations were much lower (respectively of 24 % and 56 %) than in the first anaerobic phase. SUVA<sub>254</sub> index showed that organic compounds released in the first cycle were less aromatic than in the second cycle and exhibited the geochemical characteristics of microbial metabolites (in opposition to humic substances in the second cycle). According to Pan et al. (2016), aromatic organic matter could limit reductive dissolution of Fe-oxyhydroxydes and involve competition for P sorption sites.

This experiment highlighted that organic matter quality plays together with Mn/Fe-oxy-hydroxydes an important role in P mobility at sediment/water interface in dam-reservoirs.

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