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Key role of iron oxides in the mobility of sedimentary P in dam-reservoir context.

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Dams impact sediment transport continuity and lead to an important accumulation of phosphorus (P) in dam-reservoir sediments. A better knowledge of P sediment mobility is necessary considering P major role on eutrophication process. Its biogeochemistry is closely related to Fe, as P might be adsorbed or incorporated to Fe oxy-hydroxides phases (Fe-ox).

A complex composed of three consecutive hydroelectric dams located on Creuse River (France) is subjected to seasonal cyanobacterial blooms. Accumulated sediments are fine and rich in P, Fe and organic matter. The development of temporary anoxia in hypolimnion during summer questions the importance of the redox potential (Eh) on P mobility.

The aims of this study are to: (i) investigate the influence of cascade dams on sedimentary P distribution;(ii) highlight the mechanisms involved in P mobility at sediment/water interface under redox oscillations. Seventeen surface sediment samples were collected in the three dams and free-flow river sections, their physico-chemical characterisation and P fractionation were performed. In addition, an incubation experiment (S/L: 1/10) was realized using reservoir sediments and synthetic water, to simulate two successive aerobic and anaerobic stages.

In close relationship with grain size, an increase in total P content from the head of the reservoir to the dam was observed within each reservoir. Sedimentary P fractionation revealed that 58 % of P was supported by amorphous Fe-ox. P content associated to this fraction increased from upstream to downstream, explaining the longitudinal variations of total P content in reservoirs sediments. The incubation experiment results highlighted an important release of $P\text{-}PO_4^{3-}$ to the solution under anaerobic conditions. During the first anaerobic phase, the reductive dissolution of Fe-ox was the main mechanism controlling the P mobility. However, during the second anaerobic phase, the release of $P\text{-}PO_4^{3-}$ was 1.4 higher, while Fe^{II} concentrations were lower and organic compounds released more aromatic. Aromatic organic matter could limit reductive dissolution of Fe oxy-hydroxides sites (Pan et al. 2016) and involve competition for P sorption on iron Fe-ox (Kalbitz et al. 2005), explaining observed results.