

## **Phosphate release upon sulfide-induced transformation of phosphate-containing iron oxides: kinetics and mechanism**

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The fate of phosphate(P) in aquatic environments is often linked to the redox cycling of iron. In aquatic system, P can enter sediments being bound to Fe(III) (hydr)oxides. Upon burial in sediments, P-containing Fe(III) (hydr)oxides might be exposed to dissolved sulfide. As a consequence of sulfidation, they can be transformed into FeS, which can be coupled to a release of previously bound P. By this, the released P can increase the benthic flux of P from sediments towards the overlying water and thus exacerbate eutrophication in oceans and lakes. Although it is generally believed that Fe(III)-bound P is released in the sulfidation process of Fe(III) (hydr)oxides, it is not clear whether a part of released P can be re-adsorbed onto the products of sulfidation reactions, or provoke the formation of vivianite ( $\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$ ). Consequently, the mobilization of P during sulfidation might proceed incongruently with the progress of sulfidation. This implies that it is still unknown how the rates of P release from Fe(III) (hydr)oxides are related to the kinetics of sulfidation.

To study the kinetics and mechanism of P release during sulfidation, experiments were performed with P-bearing lepidocrocite( $\gamma\text{-FeOOH}$ ) in flow-through reactors. Hydrogen sulfide was added to the inflow solution and P, sulfide and Fe(II) concentrations were monitored in the outflow. Sulfide concentrations in the outflow of reactors with lepidocrocite without pre-adsorbed P, had the tendency of being lower than those in the outflow of reactors with P-bearing lepidocrocite. This implies that the consumption rate of sulfide was lower when P was present at the lepidocrocite's surface. That is, the rate of sulfidation was reduced by adsorbed P. During the experiment, only a small fraction of P was released compared to the P that had been added to the reactor. Hence, a part of the P has been retained in the reactors despite a considerable progress of sulfidation. The mechanism of P retention and the connection between the P release and the reaction of Fe(III) hydroxides with sulfide will be discussed.