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How can organo-mineral interactions contribute to minimize eutrophication?

JUAN ANTELO, SARAH FIOL, IÑAKI BECEIRO-CILLERO AND PEDRO VÁZQUEZ

University of Santiago de Compostela

Presenting Author: juan.antelo@usc.es

Phosphorus and nitrogen are essential nutrients for biomass growth, although an excessive application of P and N to agricultural soils may lead to leaching and increasing concentrations of these elements in aqueous systems. This may cause the degradation of water (fresh and saline) quality through eutrophication processes. Iron oxides have been widely used to control the mobility and availability of ions such as phosphate, nitrate, arsenate, etc. The presence of natural organic matter and its interaction with iron oxides affect the mobility of ions through competitive or synergistic interactions. Thus, the organo-mineral interactions might alter the surface charge and sites availability on the mineral surface.

In the present work we have studied the interaction of ferrihydrite-organic matter composites with N and P at variable environmental conditions: pH, ionic strength, type of organic matter, or presence of competing ions. Surface complexation models have been applied to simulate the ion behavior in the presence of these organo-mineral composites. The results revealed that changes in the pH, carbon content in the organo-mineral or the presence of other anionic species are important factors capable of changing the mobility of P and N.

The information obtained, allowed to design remediation solutions that could be applied to minimize the risk of eutrophication in water bodies. Considering the mechanisms of the organo-mineral interactions for the removal of P and N, we studied the potential combination of these composites with common adsorbent materials such as ZVI (zero valent iron), biochar, or Technosols. The biogeochemical processes involved in the immobilization of P and N can be enhanced under the appropriate environmental conditions.