Manganese, Iron and Phosphorus cycling in the Loire Estuary: outcomes from the RS2E-OSUNA project

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During their path across riverine estuaries, particles undergo tremendous chemical transformations before reaching the ocean. Redox sensitive elements such as Mn, Fe and P are particularly affected by chemical transformations controled by redox oscillations in the maximum turbidity zone or during deposition/resuspension cycles. Between 2012 and 2016 several field campaigns allowed to collect surface water samples and sedimentary cores in the Loire estuary to cover contrasted hydrodynamic and climatic situations through the regional project RS2E-OSUNA (Pays de la Loire). Several salinity transects showed that most of reactive iron was depleted from suspended particles entering the estuary while reaching the Atlantic ocean. A clear fractionation between iron and manganese is at work. While iron recycling dominates early diagenesis processes within the estuary, it seems that in surrounding littoral mudflats manganese cycling takes over.

Another outcome of this project was that benthic recycling (sediment efflux) through bioirrigation could reach 80 % for iron and phophorus. Such results were possible coupling 2D imagery of porewater chemistry and modeling. Our results suggest very limited burial of reactive iron and do not explain its loss in the suspended particles reaching the ocean. Despite the under representation of our dataset we can hypothtyze that most of iron burial takes place in the mudbelt of the continental shelf.

Finally, the hydrological cycle forces diagenetic processes and ultimately phosphorus dynamics by the occurrence of floods with fast deposition of particles rich in metal oxydes preventing phosphorus to escape. Progressive erosion and reductive dissolution of oxydes allow phosphorus release fueling primary production until the end of summer.