Impacts of flocculation and redox shuttling on iron and manganese in non-tidal estuarine sediments

TOM JILBERT[1], ROSA TIIHONEN[2], JUKKA-PEKKA MYLLYKANGAS[1], EERO ASMALA[3], SUSANNA HIETANEN[1]

[1] Department of Environmental Sciences, University of Helsinki, Finland (tom.jilbert@helsinki.fi)
[2] Department of Geosciences and Geography, University of Helsinki, Finland
[3] Department of Bioscience, Aarhus University, Roskilde, Denmark

Iron (Fe) and manganese (Mn) play important roles in sedimentary carbon cycling in freshwater and brackish marine systems. Estuaries are transitional environments characterized by gradients of salinity and redox conditions which impact on the mobility of Fe and Mn. However, few studies have attempted to describe the distribution of Fe and Mn in estuarine sediments in the context of processes occurring in the overlying water column. In particular, salinity-driven flocculation and redox shuttling are two key processes whose relative impacts on sedimentary Fe and Mn have not been clearly demonstrated.

In this study we investigate the coupled water column and sedimentary cycling of Fe and Mn along a 60km non-tidal estuarine transect in the Gulf of Finland, Baltic Sea. We show that Fe entering the estuary as colloidal oxides associated with riverine dissolved organic matter (DOM) is quickly flocculated and sedimented within 5km of the river mouth. Sediments within this range are enriched in Fe (up to twice the regional average), principally in the form of crystalline Fe oxides. In contrast, sedimentary Mn concentrations are dominated by redox shuttling in the estuary, with Mn being focused into a silled basin more than 10km downstream. Porewater data suggest that the heterogeneity of Fe and Mn availability in estuarine sediments influences the relative importance of the two metals in carbon cycling, including the anaerobic oxidation of methane.