Iron and manganese in coastal sediments of the Gulf of Finland: relevance for methane dynamics

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Recent studies have suggested that iron (Fe) and manganese (Mn) oxides may play a role in the anaerobic oxidation of methane in Baltic Sea sediments (Egger et al., 2015). However, it remains to be established which forms of Fe and Mn oxides are involved in this process, and whether the process is also widespread in the coastal zone of the Baltic Sea, where gradients of salinity and oxygen conditions influence the mobility of these elements.

In this study, we investigated sedimentary Fe and Mn dynamics along a transect of sites in Pohjanpitäjänlahti, a silled estuary in Uusimaa, Finland. The estuary is fed by the Karjaanjoki river system and discharges into the Gulf of Finland through a narrow salinity-stratified channel. Fe and Mn contents and mineralogy of sediments were determined by sequential extraction, including a separate extraction scheme for sulfur-bound phases. The results show that sedimentary Fe contents decrease steadily offshore, implying capture of riverine dissolved Fe by flocculation, and/or direct sedimentation of riverine suspended Fe. In contrast, Mn contents are highest in the deep inner basin of Pohjanpitäjänlahti, some 12km from the river mouth, implying internal shuttling of Mn related to redox conditions in the estuary. The Fe and Mn mineralogy of inshore sites is dominated by more reactive phases such as poorly-crystalline and crystalline oxides, while at offshore sites, less reactive phases such as sheet silicates are quantitatively more important. These results have strong implications for the distribution of anaerobic oxidation of methane by Fe and Mn oxides in Baltic Sea sediments.

References:

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