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Distribution and speciation of metals, phosphorus, sulfate and organic material in brackish estuary water affected by acid sulfate soils

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Abstract

Dissolved (<1 kDa) and colloidal (1 kDa-0.45 µm) size fractions of sulfate, organic carbon (OC), phosphate and 17 metals/metalloids were investigated in the acidic Vörå River and its estuary in Western Finland. In addition, geochemical modelling was used to predict the formation of free ions and complexes in these waters. The sampling was carried out during high-water flow in autumn and in spring when the abundantly occurring acid sulfate (AS) soils in the catchment area are extensively flushed. Based on the high concentrations of sulfate, acidity and several metals, it is clear that the Vörå River and its estuary is strongly affected by AS soils. The high dissolved form of metals limits also the existence of fish and other organisms in this estuary, and certainly also in other similar shallow brackish estuaries elsewhere in the Gulf of Bothnia. However, generally already <20% saline sea water reduces the concentration for OC and several elements (Al, Cu, Cr, Fe, Pb, PO₄ and U) by half and c. 20-30% saline sea water is needed to halve concentrations of Cd, Co, Mn, Ni and Zn. Consequently, these elements as well as organic matters were rapidly precipitated in the estuary, even after mixing with fairly small amounts of the alkaline brackish sea water.

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