High stability of riverine iron along salinity gradients – the role of iron speciation

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Iron (Fe) concentrations are increasing strongly in Swedish and Finnish rivers since the last decades, and this results in higher Fe export to the Baltic Sea. While the general perception is that most Fe is lost by salinity-induced aggregation in estuaries, we find that the stability of Fe from these boreal rivers is remarkably high. Aqueous Fe solubility is strongly dependent on interactions with organic matter, and that association can be roughly divided in two dominating phases: organically complexed mononuclear Fe, and colloidal Fe(oxy)hydroxides which exhibit surface interactions with organic matter.

We hypothesized that Fe(oxy)hydroxides are selectively removed by aggregation at increasing salinity, while organically complexed Fe remains stable. From this it follows that the stability of riverine Fe would depend on the relative contribution of organically complexed Fe and Fe(oxy)hydroxides. These hypotheses were tested by mixing experiments with waters from Swedish river mouths and artificial sea water. Rivers with differing catchment characteristics were included and sampling was done during different seasons. Fe speciation of river waters and salinity induced aggregates was determined by synchrotron based extended X-ray absorption fine structure (EXAFS) spectroscopy.

Understanding the fate of Fe along the estuarine salinity gradient, and how that depends on Fe speciation and the nature of the interaction with organic matter, is highly relevant, since high Fe concentrations may be a factor contributing to the success of nitrogen fixing cyanobacteria in the Baltic Sea.