



Characterization of natural riverine colloids and their fate at increased salinity

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The Objective of this study was to characterize the colloidal size distributions in boreal river waters and how they are affected by increasing salinity.

Main findings

- Three colloidal size distributions occurred in river water samples
- Positively charged Fe(oxy)hydroxide nanoparticles were removed at increasing salinity
- Larger size distributions were less affected by salinity

The combination of X-ray absorbance spectroscopy (XAS) and dynamic light scattering (DLS) analysis demonstrated the existence of three size distributions:

- Fe(oxy)hydroxide as nanoparticles (10-40 nm) with a positive surface charge
- An intermediate (100-200 nm) and negatively charged distribution, inferred to contain organically complexed Fe (Fe-OM).
- Fe(oxy)hydroxide as larger aggregates with organic matter interactions (300-900 nm)

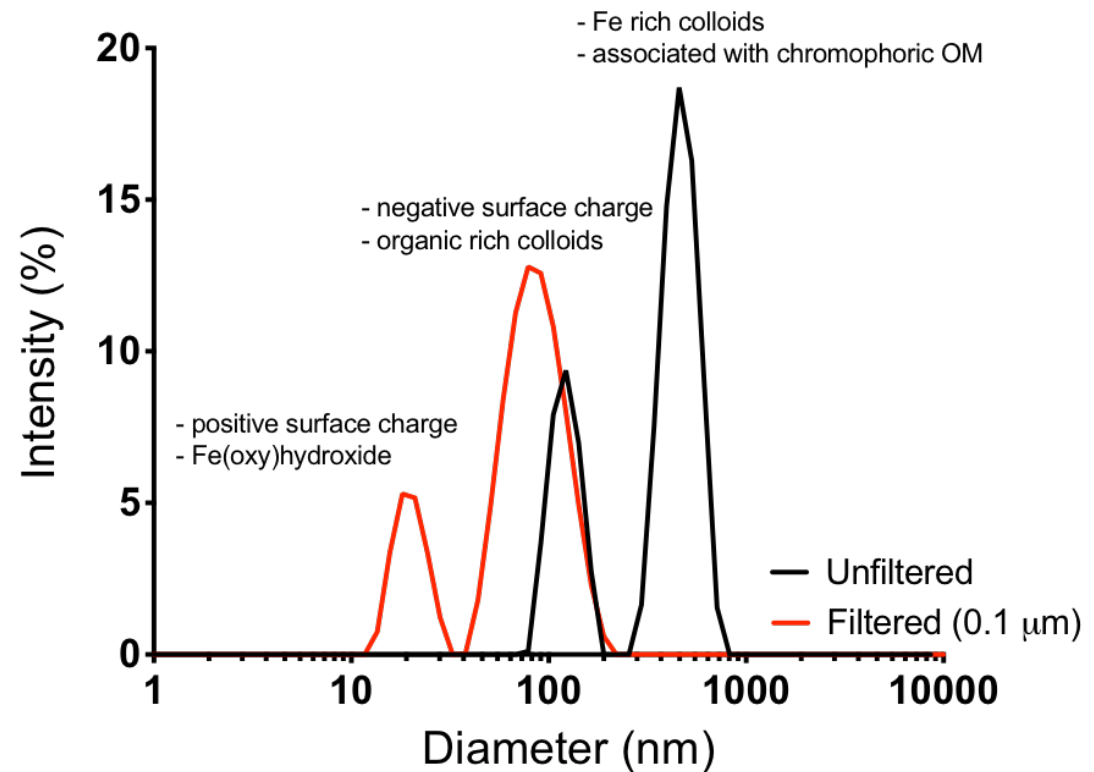


Figure 1. Colloidal size distribution of unfiltered and filtered (0.1 µm) river water sample. The size distribution and the surface charge were measured with a Zetasizer. Absorbance measurements and DOC analyses provided information on the organic matter concentration and composition. The Fe fractions were determined by XAS.

After increasing salinity and subsequent centrifugation, the smallest positively charged Fe(oxy)hydroxide nanoparticles are no longer detected. Interestingly, both the larger size distributions are still detected at high salinity.

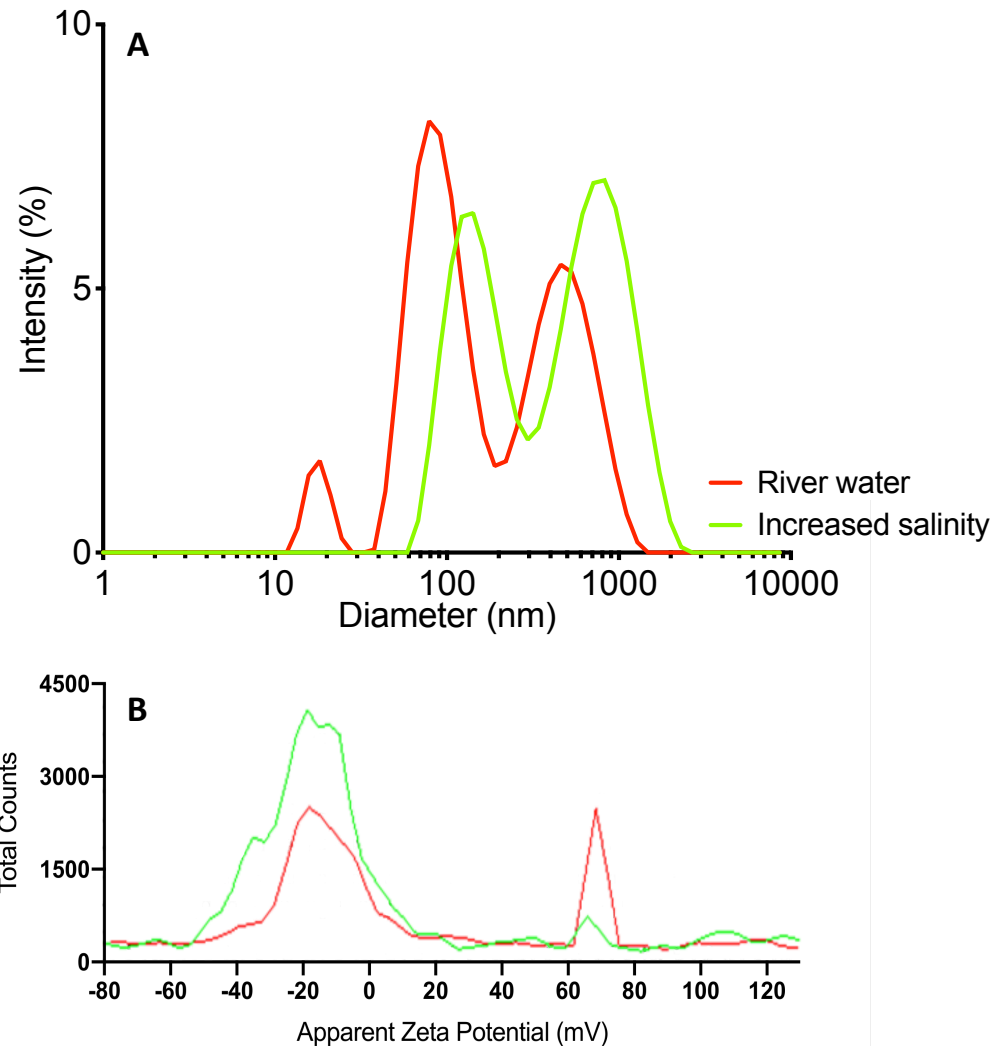


Figure 2. (A) Colloidal size distribution of unfiltered river water (red) and at increased salinity (green; Salinity of 25) in the supernatant after centrifugation. (B) Zeta potential after filtration with 0.1 μm of river water (green) and at increased salinity (red; Salinity 1).

Conclusion

- Fe (oxy)hydroxides and Fe-OM complexes are both found across the wide size range studied, and that colloidal size does not necessarily reflect neither Fe speciation nor stability towards salinity induced aggregation.
- From this it follows that the fate of riverine nutrients, trace elements and pollutants depend largely on the carrier phase to which they are associated and not solely on the size.
- Further, our understanding of how Fe and organic matter respond to increasing salinity may have been biased by the focus on small size fractions, and omitted larger size fractions that may be surprisingly stable.

