

Particle-reactive trace elements in estuaries: Simulating estuarine mixing of seawater with organic and inorganic nanoparticle-rich river waters

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As rivers are one of the major sources of trace elements to the ocean, it is vital to understand the estuarine processes that control trace element input from rivers into the ocean. While some elements, such as Sr, generally mix conservatively in estuaries, the behavior of particle-reactive elements may vary between different estuaries. While salt induced coagulation of colloids removes a high percentage of dissolved particle-reactive elements in most estuaries, exceptions have been observed for organic-rich rivers draining into the Arctic ocean. Here we present results of mixing experiments with river water rich in organic and inorganic nanoparticles, respectively, with seawater. The Rio Negro was chosen as a riverine endmember rich in *organic* particles, colloids and nanoparticles, whereas the Rio Solimões was chosen as a riverine endmember rich in *inorganic* particles, colloids and nanoparticles. Both endmembers were 200 nm-filtered prior to mixing, in order to ensure that the experiment would only reflect the trace element removal by the salt induced coagulation of colloids and nanoparticles. During the mixing experiment of Rio Solimões water with seawater, rapid removal of particle-reactive elements in the low-salinity zone occurred (e.g., Nd concentrations decreased by >50% between salinity 0 and 6.5), which can be attributed to the salt-induced coagulation and subsequent removal of colloidal particles carrying a major fraction of these elements. In marked contrast, mixing experiments using Rio Negro river water, which is rich in organic nanoparticles and colloids, revealed almost conservative mixing of particle-reactive elements. This behavior agrees with that of DOC during the mixing experiment, indicating that organic riverine colloids and nanoparticles do not readily coagulate and aggregate to form larger particles upon mixing with seawater. The flux of particle-reactive trace elements via organic colloids/nano-particles-rich rivers into the ocean may, therefore, be significantly more important than previously thought.