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Marine chemistry in the coastal environment: principles, perspective and prospectus

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Marine chemistry of the coastal environment starts with the principles of congruent and incongruent weathering using primarily atmospheric carbonic acid to mobilize rock elements, only some representing the major ions in sea salt. The reason is reverse weathering, a process extensively represented in coastal waters. Here most elements are reconstituted into newly formed colloids or minerals in the short term, while eventually recycling carbon dioxide back to the atmosphere. Notwithstanding is the benthic extent of ocean sediment diagenesis, including hydrothermal weathering of basalts, subsequent mixing plumes and attendant low-temperature alteration.

Reverse weathering in the estuarine and shelf regimes include both conservative and non-conservative processes. These can be distinguished and modeled to determine elemental proportions transmitted to the open ocean or consumed by coastal sedimentation. Conceptually the steady state process that leads to the composition of sea water can be viewed as heterogeneous equilibria between dissolved constituents and solid mineral products taking hundreds of millennia. However, initial processes of reverse weathering in the estuarine and coastal environment are comprised of short term mixing and scavenging resulting in inorganic and organic colloidal products. These recycle and sediment both carbon and many trace elements on time scales commensurate with estuarine flushing and shelf exchange with the ocean.

The natural uranium and thorium decay series provide powerful tools for quantifying the rates of estuarine mixing and sedimentation processes, including those within ground waters and the attendant subterranean estuary. High resolution mass spectrometric techniques help to identify the molecular nature and isotopic composition of newly formed estuarine colloids for both inorganic and organic constituents. The coastal environment apparently responds to climate change of warming and sea level rise with the forces of growing storm impacts. How might these impact chemistry of the coastal environment as net sources or sinks of material and carbon with the open ocean?