Mobility of Contaminant Metals in Shallow Coastal Sediments

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The sediments of many urban, coastal regions contain elevated levels of potentially toxic metals. This study examines the geochemical and physical processes that account for silver, lead and copper release from sediments to the overlying water column. Two contrasting sites in north-eastern USA were investigated, a heavily contaminated site in Boston Harbor and a less impacted, offshore site in Massachusetts Bay. High-resolution porewater and solid phase samples were collected in each season to determine the diagenetic cycles and chemistry controlling the fate of these metals. Within the sediments, trace metals are scavenged by iron oxyhydroxides and released to the porewaters when these oxides are reduced. At the strongly reducing site in Boston Harbor, there is seasonal transfer of trace metals from oxide phases in winter, to sulfides phase in summer. At the Massachusetts Bay site, due to the lack of sulfide, the metals are focused into the surface oxide layer, giving a solid phase enrichment. There is a diffusive flux of copper to the water column throughout the year, while silver is released only in winter. Lead is strongly scavenged and is rarely released to overlying waters.

The role of sediment resuspension in mobilizing metals from these sediments was also investigated using a laboratory-based erosion chamber. Sediment resuspension leads to enhanced release of dissolved metals and is especially important in redistributing contaminants as the first particles to be eroded are highly enriched in trace metals. Eroded particles that were maintained in suspension released 5-7% of the particulate copper and silver and less than 1% of lead and iron to the dissolved phase after 90 hours. The total release of dissolved metals from the sediments by diffusion and sediment resuspension is estimated to be 60% and 10% of the riverine flux for copper and lead respectively. With continued pollution control reducing the discharge of metals from other sources, the benthic release of metals will increase in relative importance as a source of contaminant metals to Boston Harbor.