What are the effects of sediment resuspension events on nutrient and trace metal mobilisation along an estuarine continuum?

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Estuaries play a crucial role in the freshwater to ocean continuum in regulating the fate, recycling and transport of nutrients and metals. Sediment mobilisation during regular tidal cycles and less frequent (seasonal-annual) storm events leads to the release of porewater and particles from different sediment redox zonations to the water column. During sediment resuspension, a combination of desorption and adsorption processes, ion-exchange and redox reactions, and precipitation of new minerals take place in the estuarine environment. Sediment has been collected from two different depths, the frequently mobilised oxic surface layer (0-1 cm) and the rarely disrupted anoxic subsurface layer (5-10 cm), at four sites along the salinity gradient of the Humber Estuary (UK). A series of batch experiments were carried out to investigate which geochemical processes drive major element (N, Fe, S and Mn) cycling and trace metals behaviour during simulated sediment resuspension events in oxic conditions. Nutrients and major metals behaviour showed significant differences when surface and subsurface sediments were reoxidised; whereas the behaviour of the selected trace metals did not differ between sediment depths. Humber sediments showed an important scavenging capacity for dissolved Mn, Cd, Cu and Zn, therefore they may act as an ultimate sink for these elements. Additionally, in terms of magnitude, nutrient and metal release was significantly greater during the resuspension of sulphidic (outer estuary) rather than from non sulphidic (inner estuary) sediments. Hence, nutrient cycling may be altered if anoxic, especially FeS-rich, subsurface sediments are disturbed. This may become increasingly important since, in a climate change scenario, the frequency of extreme storms mobilising deeper (subsurface) and larger amounts of sediments in the UK is expected to increase, which will have implications for the cycling and transport of nutrient and heavy metals to the coastal environment, enhancing the likelihood of eutrophication.