Sources and cycling of metals in the Ganga (Hooghly) River estuary, India: Role of sediment resuspension and solute-particle interactions

SAUMIK SAMANTA[1] AND TARUN K DALAI[1]

[1]Indian Institute of Science Education and Research Kolkata, Mohanpur-741246, India (saumik.papan@gmail.com)

The Ganga (Hooghly) River estuary is a part of the Ganga-Brahmaputra (G-B) river system and is located in the eastern margin of the G-B delta. A detailed study has been carried out to investigate the sources and cycling of a suite of trace metals (Co, Ni and Cu) based on analysis of water, suspended and bed sediment samples of the Ganga (Hooghly) River estuary collected seasonally during the years 2012 and 2013. The ranges of dissolved metal concentrations: 0.8-24 nM for Co, 3.5-172 nM for Ni and 8-178 nM for Cu; are considerably higher than those reported for many other estuaries. Dissolved concentrations vs. salinity plots show that majority of the samples are placed above the conservative mixing lines, suggestive of intra-estuarine source(s) of metals. The "excess metal" concentrations, defined as the difference between the observed and theoretical concentrations due to conservative mixing, show increasing values at higher salinity.

Particulate metal concentrations show strong positive correlations with Al, K, Fe and Mn. This feature, together with the observations of significant positive correlations between metal concentrations and (Fe+Mn)/(Al+K), suggests that Fe-Mn oxyhydroxide phases are the dominant carriers of metals. Particulate K/Al ratios exhibit significant to strong negative correlations with metal concentrations and metal/Fe ratios, suggestive of desorption of particulate metals via ion-exchange with dissolved K. Using the K_d values at various salinity calculated from the riverine suspended particulate matter (SPM) concentrations, resuspended SPM concentrations that are required to generate the "excess metal" concentrations were estimated. Results show that the estimated total SPM concentrations roughly agree with the reported data in the Hooghly estuary, and increase downstream suggestive of supply of metals via resuspension in the lower estuary. Preliminary calculations indicate that the riverine dissolved metal fluxes are enhanced by ca. 5–25 fold due to estuarine production of metals.

This study brings out the importance of sediment resuspension and solute-particle interactions in modifying dissolved metal fluxes from tropical monsoon estuaries.