REEs and ε_{Nd} in the Ganga (Hooghly) and other East Indian Estuaries: Massive desorption of particulate REEs to the Ocean

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Rare Earth Element (REE) concentrations and Neodymium isotopic composition (ε_{Nd}) serve as tracers for ocean water masses, their present, paleooceanographic circulations and biogeochemical processes. The sources and internal cycling of REEs and ε_{Nd} to the modern oceans, however, are still debated.

For this study we sampled waters and particulate matters during Monsoon-2013 with salinity gradiant from four East Indian Estuaries namely the Ganga (Hooghly), Mahanadi, Godavari and Krishna which are connected to the Bay of Bengal (BoB) to determine REEs and ε_{Nd} in dissolved (<0.2μM) and particulate phases in oder to understand their geochemical behaviour. The dissolved ε_{Nd} values of the Ganga, Mahanadi, Godavari and Krishna River end-members are -13.9, -22.7, -18.3 and -15.4 respectively and the particulate ε_{Nd} of the Hooghly and the Godavari are -17.7 and -17.4 respectively. For both (dissolved and particulate) the ε_{Nd} of river end-members shows significant differences reflecting the lithologies they drain. Except Godavari, remaining three estuaries show a significant removal of dissolved REE in the low salinity zone which could be due to coagulation of colloidal matter. At mid-salinity regions, in all these estuaries all the dissolved REEs enhances to very high levels. This increase of REEs at mid sailinities is possibly governed by their desorption from particulate matters, mainly from Fe-Mn hydroxide. High dossolved Mn associated with decrease in dissolved oxygen and particulate ε_{Nd} in these salinity ranges of the Ganga estuary supports this proposition. Isotope mass balance calculation suggests ~ 1% release of particulate Nd at mid salinities. Such particle desorption process in the four eastern Indian estuaries could supply ~900×10^6 g of dissolved Nd to the Bay of Bengal, considerable in terms of missing Nd ($11000\text{-}5500 \times 10^6$ g) in its global budget.