Trace element (Co, Cr, Fe and Mn) distributions in Louisiana Shelf waters

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Dissolved trace elements (TEs) were studied in Louisiana Shelf waters including the Mississippi (MR) and Atchafalaya (AR) River plumes during May and November 2008, and June/July 2009, representing high, low and mid-range river discharges, respectively. The dissolved (< 0.02 μm) form was dominant for Co and Mn, whereas considerable colloidal (0.02-0.45 μm) Fe and Cr were found at low salinity.

Surface distributions of these TEs showed either low-mid salinity removal (Cr, Fe, Mn) or addition at mid-high salinity (Co, Fe, Mn) which varied seasonally. Based on mixing experiments, nutrient and chlorophyll distributions, and surface-bottom concentration contrasts, the non-conservative behavior of these TEs was variously related to colloidal flocculation (Fe, Cr), biological activity (Fe, Mn), desorption (Co, Mn), photochemistry (Cr) and vertical mixing (Co, Cr, Fe, Mn). Different distributions of TEs were observed in the low-salinity mixing zones of the MR and AR plumes. Additional inputs from the Red River and wetland waters in the AR Basin derives different river concentrations of TEs, and the different biogeochemical characteristics may have led to different TEs distributions between the two river plumes.

Bottom water concentrations of Co, Fe and Mn were 2 to 10-fold higher during hypoxia season than other times, and these elements were negatively correlated with dissolved oxygen (DO), suggestive of particulate or sedimentary dissolution and/or diffusion under reducing conditions. At the same time, bottom water Cr showed removal at low DO, probably due to diffusive or adsorptive removal as a result of Cr reduction. Particularly during bottom water hypoxia, we observed an increase of Co, Fe and Mn in some surface waters, probably due to episodic vertical mixing associated with upwelling favorable summer winds in shallow shelf areas.

Our findings suggest that vertical mixing could be an important mechanism for supplying the TEs to surface waters even when water column stratification is strong. Additionally, the AR influence on shelf trace element distributions needs to be be accounted for in studies of Louisiana Shelf biogeochemistry.