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Multidimensional Mn(II) and Fe(II) Flux Estimations across the Water-Sediment Interface: Marine and Lacustrine Applications

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Total fluxes of both dissolved manganese and iron across the water-sediment interface in aquatic environments are control by several processes like molecular diffusion, advection, precipitation, bioturbation and bioirrigation. The weighting coefficient for the contribution of each process depends on the physical characteristics of sedimentary deposit, and the type and number of organisms living in it. However, evaluating the effects of bioturbation and bioirrigation on fluxes of these metals across the water-sediment interface is difficult due to significant heterogeneity and complex three dimensional reaction patterns in surface sediments caused by the activities of various bottom dwelling fauna.
Pore water concentration gradients are commonly used to estimate chemical fluxes across the water-sediment interface during in situ measurements and laboratory incubation microcosms experiments. However, the traditional approaches for solute sampling and measurement such as regular electrodes, dialysis arrays (peepers), diffusive gradients in thin gel film, coring, sediment extruding, and pore water separation, could smear the spatial resolution, blur benthic organism effects, affect solute speciation (i.e. oxidation states) and even alter the water-sediment interface during transport process and/or tool deployment.
In this study we discuss preliminary data of both two-dimensional and three- dimensional determinations of Mn(II) and Fe(II) distributional patterns in marine sediments obtained during incubation experiments by using novel planar optodes, remarking advantages and limitations of these techniques, in comparison with traditional methods, for its use in both ex situ and in situ flux studies in aquatic systems. Planar optodes provide detailed information about analyte's production, consumption, and multidimensional transport patterns in aquatic sedimentary environments; therefore, I propose its use in combination with traditional method of flux estimations for two specific marine and lacustrine study sites in South America.