Dynamic characteristics of dissolved reactive iron, sulfur, and phosphorus in sediments of the Changjiang Estuary based on diffusive gradients in thin films technique (DGT)

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Simultaneous analysis of dissolved reactive iron (Fe), sulfur (S) and phosphorus (DRP) dynamics across sediment-water interface is essential for better understanding the biogeochemical processes of these elements and their connections in large-river delta-front estuaries (LDEs). In this study, high-resolution Diffusive Gradients in Thin films techniques (DGT) were used, for the first time, to investigate the release characteristics of dissolved Fe^{2+}, sulfide and DRP from sediments in the Changjiang LDE, respectively. Spatial distributions and vertical profiles of the fluxes of Fe^{2+}, sulfide, and DRP in these sediments were highly heterogeneous. In sites adjacent to the estuary, where muddy sediments deposited, all three elements varied widely across the profiles and generally increased with depth, indicating active accumulation of reduced iron, sulfide and labile P, whereas in offshore sandy sediments, the fluxes remained relatively stable, probably as a result of weak early diagenesis. In particular, vertical profiles of Fe^{2+}, sulfide, and DRP in three muddy sediment cores showed different patterns depending on their locations. The fluxes of Fe^{2+} in these cores were very low in the top 10 mm of sediment but increased gradually after that. Unlike Fe^{2+}, dissolved sulfide decreased first rather steadily until a depth of around 20 mm, then increased with depth. For both Fe^{2+} and sulfide, maximum values were found in the nearest site to the estuary. From the upperlying water to pore-water, DRP increased gradually and reached a maximum value at different depths for these three cores, and then decreased, possibly because of the limited availability and reactivity of organic P and/or the formation of authigenic P (e.g., apatite). Due to the various vertical profiles, the relationships between DRP and Fe^{2+} and sulfide were very complicated. Besides the interactions among them, each element has its own variation processes and mechanisms that may not connect with others. In general, the release dynamics of Fe^{2+}, sulfide, and DRP in the Changjiang LDE sediments were not only controlled by sediment dynamic processes, but also related to the reactivity of organic matter.