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Tracing source and mobility of major, trace and rare-earth elements in a tropical estuary: A multivariate approach

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Abstract

In this work, a multivariate approach was applied to determine the multi-element signatures of surface water, suspended particulate matter (SPM) and sediments in the tropical Cai River estuary under multiple stresses.

The bulk element content, enrichment factor (EF) and partition coefficients between filtered, particulate and sedimentary phases were determined and linked to the major environmental factors by the application of Principal Component Analysis (PCA) and Redundancy Analysis (RDA) to the data obtained. Most of the major, trace and rare-earth elements studied are introduced in the Cai River and its estuary by basement rock weathering under enhanced monsoonal precipitation. These elements show low chemical mobility and mainly settle within the downstream sedimentary phase due to the association with terrigenous aluminosilicate clay host minerals. Co, Ni, Cu, As and Mo were mainly accumulated within both the upstream and downstream particulate phases, showing high chemical mobility due to their association with the most labile fraction of the fluvial particulate load (mainly organic colloids and carbonates). Overall, Bi showed both severe enrichment and a nonweathering distribution pattern in the solid phases with respect to other elements considered.

The major factor controlling element distribution between filtered and particulate phases is the salinity gradient and associated total suspended sediment (TSS) removal from the water column accompanied by a release of particulate elements into the solution. The major factor controlling element distribution between particulate and sedimentary phases is the salinity gradient and associated nonorganic colloid dynamics.

Further studies should focus on the colloid pool composition and dynamics.

Keywords

Nha Trang Bay, tropical estuary, salinity gradient, element partitioning