Reduced trace metals in the Sediments of the Changjiang (Yangtze) Estuary：Evidence of Impacts from Three Gorges Dam Construction

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Abstract:

the heavy metals ((and metalloids, i.e. As) which are listed in the EPA's Priority Pollutants list) aggregation in the sediments of the Changjiang Estuary inputs from industrial and municipal sewage discharges and their significant ecological risk to the local environment have been paid a lot of attentions. For the last few decades, with the continuous decrease of water and suspended sediments discharge of Changjiang River, few studies have been performed on the changes of the trace elements (not limited of heavy metals ((and metalloids, i.e. As) which are listed in the EPA's Priority Pollutants list) inputs from land sources and corresponding elemental geochemical characteristics and behavior. Furthermore, little attention has been paid to the unlisted trace elements and their distribution and potential ecological risk, despite their likely presence in local and regional discharges. Their storage, accumulation and enrichment of more particle-reactive phases in the sediments of the Changjiang Estruary are seldom reported.

In this study, we examine the concentration of 26 trace elements (Sc, V, Cr, Co, Ni, Cu, Zn, Ga, As, Rb, Sr, Zr, Nb, Mo, Cd, Sn, Sb, Cs, Ba, Hf, Ta, W, Tl, Pb, Th, U) and 15 Rare Earth Elements (REY: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y), and 11 major elements (Na, Mg, Al, Si, P, S, K, Ca, Ti, Mn, Fe) in archive (2006) surface sediments from 35 sites across the Changjiang Estuary and near shore zone, and in two sediments cores (to examine depositional history with 137Cs and 210Pb dating, collected in 2016). Geo-accumulation index (Igeo) values are used to assess element enrichment and possible variation along the modern sedimentary history in the Changjiang Estuary, the potential ecological risk caused by the elements with elevated content are concerned. Enrichment Coefficient, interelemental correlations and Principle Component Analysis (PCA) are utilized to examine the factors impacting the distribution of the elements in surface sediments in the study area in the last decades. Standard extraction procedures are performed on the two cores to observe the change of the occurrence of trace elemetnts in different fractions. Special attentions were paid on the top 50cm to evaluate the possible impacts from the construction of Three Gorges Dam.

The study suggested that: 1) Tm and Er, Tl and Sb show high accumulation factors in surface sediments with average Igeo values between 0 and 1 ranked in order of Tm>Tl>Er>Sb. There are at least two accumulation areas for trace elements in the area studied, one located in the south branch of the Changjiang Estuary and another located at the mouth of Hangzhou Bay. 2) The consistent variation of elements in the two sediment cores may reflect at least 30 years of anthropogenic input history locally. It is notable that most major and trace elements exhibit an obvious reduction in the upper 30cm of the core B8, which may due to a decrease of sediment discharge by Changjiang River runoff following the construction of the Three Gorge Dam, coupled with the effective implementation of pollutant emission controls. Contrary to B8, C3 displays increase of some trace elements in its upper 20cm, demonstrating a distinct local anthropogenic input in recent years, which indicate the B8 and C3 representing two different deposit area respectively. 3) No obvious abnormal fractionations of elevated trace elements are observed in different occurrence fraction, which may suggest that the natural terrigenous source is still the dominant input of the trace elements in this sea area, even though the anthropogenic input of certain trace elements should not be neglected.

The study suggested that besides the anthropogenic input, the change of natural material sources is another main factor controlling the distribution pattern of trace elements in the study area. The reduced CDW discharge and improvement of pollution controlling in the Chanjiang Basin results in reduced trace elements input, however, abnormal high values some trace elements due to the input from the local industry need to pay attention. The abnormally elevated concentrations of some trace elements not only leads to potential ecological risk, but also may lead to misleading conclusions when adopting traditional geochemical tracers and indices to study land-sea interaction effects.

Key words: Changjiang Estuary; trace elements; elevated content; material sources; impact factors

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