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Method article

A new method for assessment of sediment-associated contamination risks using multivariate statistical approach

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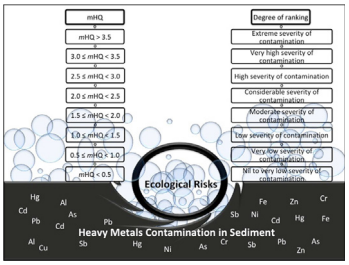
GRAPHICAL ABSTRACT



ABSTRACT

This paper presents the assimilation of heavy metal concentration data from sequential extraction method (SEM) with metal toxicity factors to develop and propose two new sediment quality indices modified hazard quotient (*m*HQ) and ecological contamination index (ECI), to predict the potential ecological risks associated with sediment contamination. Chemical speciation data of five heavy metals: cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), and lead (Pb) from five coastal aquatic ecosystems of the Equatorial Atlantic Ocean were used in the assessment of the degree of heavy metal contamination. Evaluation based on ECI indicated that sediments of most aquatic ecosystems were considerably to highly contaminated. The results showed that the proposed indices are reliable, precise, and in good agreement with similar existing indices used for evaluating the severity

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of sediment-associated contamination by heavy metals. The principal component analysis (PCA) and factor analysis indicated that heavy metals in the benthic sediments were mostly from anthropogenic sources.
- New indices – modified hazard quotient (*m*HQ) and ecological contamination index (ECI) - were developed for predicting sediment-associated risk adverse effects.
- Newly proposed indices agree closely with the existing pollution indices.
- Pollution indices reveal significant anthropogenic contamination by Cd and Pb.

ARTICLE INFO
Method name: New ecological risk indices
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Specifications Table

Subject area	*Environmental Science*
More specific subject area	*Analytical Chemistry*
Method name	*New ecological risk indices*

Method details

Background

Sediments are integrated components of aquatic ecosystems, and have been recognized as sinks of heavy metals [1–7]. Heavy metal concentration data are commonly applied in monitoring and assessing the degree of contamination of aquatic environments using sediment quality indices [2,8–14]. Reports indicate that heavy metals in sediments could pose considerable adverse effects on aquatic animals, plants and the environment due to their bioaccumulation potential, non-biodegradability, and toxicity [4,15–21]. Several empirical and statistical indices have also been developed as contamination assessment tools for monitoring sediments in aquatic ecosystems. Sediment quality indices have been developed and widely applied in assessment of heavy metal contamination in aquatic ecosystems including risk assessment code [22], ecological risk index [23], pollution load index [24], modified degree of contamination [25], modified risk assessment code [26], and contamination severity index [7]. Although these approaches have existed since the early 80′s and are widely accepted and employed in sediments associated studies, each of these indices and reference values has their peculiar reliability advantages and limitations.

In this study, two new composite indices, namely, modified hazard quotient (*m*HQ) and ecological contamination index (ECI) have been developed, proposed, and applied as new sediment quality assessment tools, based on the assimilation of heavy metal concentration data from sequential extraction method with metal toxicity factors to assess potential degree of metal contamination in sediments from multiple tropical estuaries and freshwater ecosystems off the Equatorial Atlantic Ocean. The report provides a better understanding of the metal pollution status in the aquatic ecosystems.

Materials and method

Study Area and sampling

Details of the sampling area, sampling technique and extraction procedure, heavy metals instrumental and data analysis have been previously reported [2,10]. Five mesotidal and intertidal coastal water systems were considered. The aquatic ecosystems include Douglas Creek (DOU), Okorotip Creek (OKT), Stubbs Creek (STB), Qua Iboe Estuary (QUE) and Qua Iboe River (QUR).