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Heavy Metals Contamination in Sediments along the Eastern Coast of the Gulf of Thailand

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Abstract

Levels of Hg, Cd, Pb, Zn, Cu, Ni, Fe and Mn in surface sediments were investigated in 52 stations along the Eastern Coast of the Gulf of Thailand. The sediment samples were collected in March 2004. Concentrations of the heavy metals ranged from 0.005 - 0.121 μg g^{-1} for Hg, <0.006 - 0.19 μg g^{-1} for Cd, 1.69 - 66.3 μg g^{-1} for Pb, 7.48 - 131 μg g^{-1} for Zn, 14.4 - 103 μg g^{-1} for Cu, <0.64 - 79.9 μg g^{-1} for Ni, 1.17 - 92.8 mg g^{-1} for Fe and 0.03 - 1.71 mg g^{-1} for Mn. Only Pb and Cu in the sediments exceeded the effects range low of the proposed marine and coastal sediment quality guidelines for Thailand. The calculated geoaccumulation index (I_{geo}) showed that the sediments were moderately polluted with Pb in some locations, particularly at Map Ta Phut Industrial Estate, and were slightly polluted with Cu, Zn and Mn at some sampling stations. All metals (except Cu) were associated with each other in the sediments. Organic matter, clay and silt were the major sediment components responsible for most metals sorbed in the study area.

Keywords: heavy metal; sediment; pollution; geoaccumulation index; the Gulf of Thailand

1. Introduction

Heavy metal contamination is an environmental problem in both developing and developed countries throughout the world. Human activities increase the release of heavy metals to natural environment because most metals are widely used in a variety of industrial and agricultural applications. High concentrations of heavy metals could have toxic effects on living organisms, accumulate in marine food chain and affect human health through consumption of contaminated seafood. After being discharged into aquatic environments, heavy metals are subsequently deposited into bottom sediments. However, under some conditions, they can be released back to the water column as a result of physical, chemical or biological processes (Bakan and Balkas, 1999). Thus, sediments serve as a potential risk source as well as ultimate sink of heavy metals in aquatic environments and are considered to be a good environmental indicator of metal pollution (Soares *et al.*, 1999).

The Eastern Coast of the Gulf of Thailand has a total coastline of approximately 500 kilometers, covering 5 Provinces: Chachoengsao, Chon Buri, Rayong, Chanthaburi and Trat. This regional coast has various kinds of anthropogenic activities including agriculture, fisheries, tourism, industrial and urban communities. There are two industrial estates located on the coast as a result of the Eastern Seaboard (ESB) Development Programme which was first introduced during the 5th National Economic and Social Development Plan (1981-1984). Map Ta Phut Industrial Estate, Rayong Province, for example, has been developed as the heavy industry zone with a gas separation plant, petroleum refining plants, petrochemical industries, chemical fertilizer, iron & steel, and power plants. Laem Chabang Industrial Estate was established in Chon Buri Province for light industries and an international deep sea port. Since the east coast has been developing with a high expansion rate of industrialization and urbanization, these activities will substantially increase the potential risk of heavy metal pollution along the coast which will subsequently degrade natural resources and aquatic environments. Lately, this area has faced the problem of mercury discharged by industries especially around Map Ta Phut Industrial Estate (Chongprasith and Wilairatanadilok, 1999).

Therefore, the present study was undertaken 1) to investigate current metal concentrations in sediments of the Eastern Coast of the Gulf of Thailand and the relationship between these contaminants and some sediment characteristics, and 2) to evaluate the potential for heavy metal pollution in the sediments from anthropogenic inputs.

2. Materials and Methods

2.1. Sediment Sampling

Surface sediments were collected from 52