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Combined Stable Carbon Isotope and C/N Ratios as Indicators of Source and Fate of Organic Matter in the Bangpakong River Estuary, Thailand

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Abstract

Stable carbon isotopes and C/N ratios of particulate organic matter (POM) in suspended solids and surficial sediment were used to define the spatial and temporal variability in an anthropogenic tropical river estuary, the Bangpakong River Estuary. Samples were taken along salinity gradients during the four different river discharges in the beginning, high river discharge and at the end of the wet season, and low river discharge during the dry season. The values of $[C/N]_a$ ratio and $\delta^{13}C$ in the river estuary revealed significant differences from those of the offshore station. Conservative behaviors of $[C/N]_a$ and $\delta^{13}C$ in the estuary during the wet season indicated major contribution of terrigenous C_3 plants derived OM. By contrast, during the dry season, marine input mainly dominated OM contribution with an evidence of anthropogenic input to the estuary. These compositions of the bulk sedimentary OM were dominated by paddy rice soils and marine derived OM during the wet and dry seasons, respectively. These results show that the combined stable carbon isotopes and C/N ratios can be used to identify the source and fate of OM even in a river estuary. This tool will be useful to achieve sustainable management in coastal zone.

Keywords: particulate organic matter; stable carbon isotope; the Bangpakong River or Estuary

1. Introduction

An estuary is the region where a terrestrial drainage system meets the sea. With highly variable environments in both space and time, estuaries are the most dynamic and productive ecosystems on earth (Allanson and Baird, 1999). In these systems, heterotrophy generally dominates autotrophy (Gattuso *et al*., 1998) and the biologically reactive fraction of the riverine organic matter may be partly or entirely mineralized (Abril *et al*., 2002). One of the key components of the biogeochemical processes in these systems is organic matter (OM), providing substrate for the detritus-based food webs that characterize many estuaries (Wissel and Fry, 2005).

Estuarine OM can be derived from natural and anthropogenic sources; the former including autochthonous and allochthonous inputs and marine-derived material from adjacent coastal water (Graham *et al*., 2001). Defining the sources and composition of OM in estuaries is crucial for a quantitative understanding of the contribution of terrestrial materials to the energy and nutrient supply of coastal systems (Wu *et al*., 2004). Transport of terrestrial materials into tropical estuaries is controlled by processing operating in the drainage basins and near the river mouths. Many of the operative processes differ significantly from those temperate rivers (Nittrouer *et al*., 1995).

In this work, the sources and distribution of OM in a tropical estuary, the Bangpakong River Estuary in the Gulf of Thailand were investigated. This estuary is subject to large seasonal changes in discharge and receives anthropogenic inputs from agricultural, industrial and urban activities. Our approach was to use a combination of elemental and stable carbon isotope analyses to characterize the composition and sources of two reservoirs of OM within the river estuary. Samples were collected along the river estuary channel at four seasonal river discharge regimes. This is the first comprehensive study of OM sources in this regionally important tropical river estuary.

Description of the study area

The Bangpakong River Estuary is located in the northeast corner of the Gulf of Thailand (Fig. 1). This river system is the most important watershed in the eastern part of Thailand in terms of water for irrigation, industry, intensive aquaculture and animal farming,