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journal or publication title	Coastal marine science
volume	30
number	1
page range	88-90
year	2006-04-28
URL	http://doi.org/10.15083/00040755

The elemental composition of particulate matters in Bang Pakong River estuary, Thailand

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Received: 30 September 2005; Accepted: 10 November 2005

Abstract—Biological and chemical conditions were investigated at Bang Pakong River estuary, Thailand, where red tides were often occurred. Chlorophyll *a* (Chl *a*) concentration, nutrients, particulate organic carbon (POC), particulate organic nitrogen (PON) and particulate phosphorus (PP) were determined on November 2002, as the preliminary survey, and November 2004. Moreover, the latter observation was conducted including with upper stream (salinity varied from 0–27 psu). The average stoichiometric ratios of particulate matter (POC:PON:PP) which derived from the slope of linear regression between each C, N and P concentrations and Chl *a* concentration was discussed. Our results indicated that the major composition of particulate matter in Bang Pakong River originated from planktonic particulate materials. In Bang Pakong River system, nutrients originated in upper stream and ran toward to estuarine zone. In the cast of particulate organic matter, it was not produced by allochthonous detritus but derived from autochthonous planktonic materials.

Key words: estuary, red tide, Bang Pakong River, Biophilic element, Redfield ratio, phosphorous

Introduction

In Thailand, four large rivers flow into the Gulf of Thailand, namely Mae Klong, Tha Chin, Chao Phraya, and Bang Pakong River. These rivers contribute substantial pollution from land-based sources such as agricultural, domestic, and industrial wastes, including high load of wastes from pig farms, and aquaculture to the inner Gulf of Thailand (Pollution Control Department 2000). In the four main rivers, Bang Pakong River provides the most important watershed for the estuary and coastal environment in the eastern part of Thailand. The watershed covers 18,500 km², and the river runs from the conjunction of two smaller rivers, the Ha-nu-man and Pra-prong, at 220 km upstream from the river mouth. The river drains into the eastern part of the Gulf of Thailand and, during the dry season, saline intrusion can travel 150 km upstream. Buranapratheprat et al. (2002) reported seasonal variation of nutrients in the river estuary and discussed the nutrient budgets of the river estuary. Suspended particle is one of the main form in which various materials are transferred from land to marine environments. It is very important for understanding the material cycle in estuary to study the behavior of biophilic elements (CNP). In this study, we investigate the chemical characteristic of the suspended particles to elucidate the material cycle at large river estuary where red tides often occur.

Materials and Methods

Area and observation items

We conducted the observation in November 2002 and November 2004 at Bangpakong River Estuary (Fig. 1). Chlorophyll *a* (Chl *a*) concentration, particulate organic carbon (POC), particulate organic nitrogen (PON) and particulate phosphorus (PP) were determined. Moreover, in the observation conducted in 2004, PP was measured with dividing it into particulate organic phosphorous (POP) and particulate inorganic phosphorous (PIP)

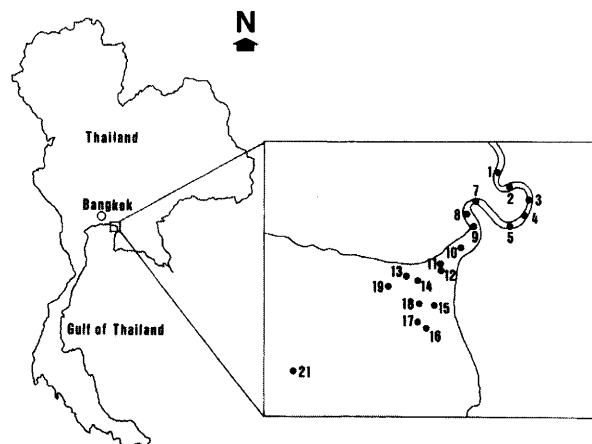


Fig. 1. Location of sampling stations in the Bang Pakong River estuary.

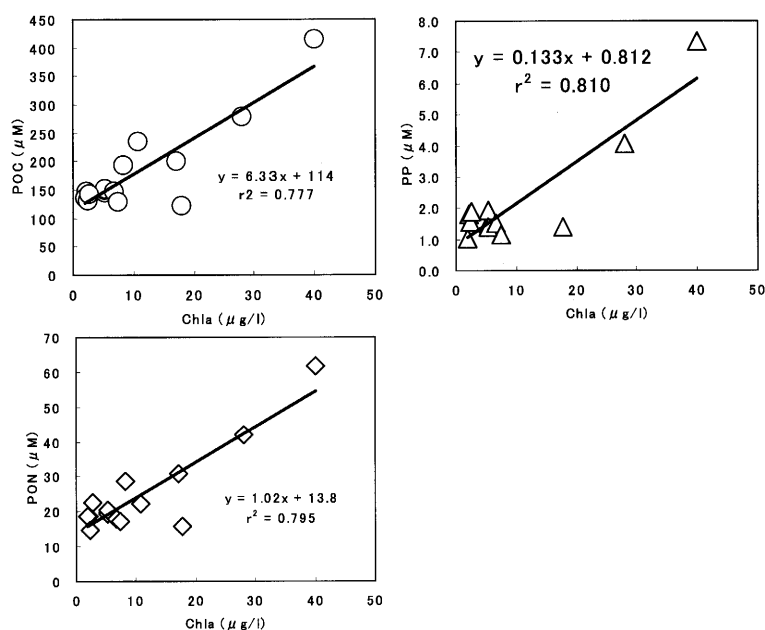


Fig. 2. The correlations between Chl *a* and POC, PON and PP from the results of observation conducted in 2002.

Chemical analysis methods

Water samples for Chl *a* was filtered by Whatman GF/F filters and water samples for POC, PON, PP analyses were filtered by precombusted Whatman GF/F filters (450°C for 4 h). Chl *a* was measured following Lorenzen (1967) spectrophotometric method described in Parsons et al. (1984). The filters for POC and PON analyses were freeze-dried. After the filter papers were treated with HCl fumes to remove inorganic carbon, POC and PON was measured using CHN analyzer (Yanagimoto MT-5; Yanaco, Japan). The filters for PP was determined by Murphy and Riley (1962) method after persulfate oxidation (Menzel and Cowin 1965). Also, in 2004 observations, PP and PIP was measured by the method described in Suzumura et al. (2004) and POP value was calculated from the difference between PP and PIP.

Results and Discussion

In our observation in 2002, we encountered the red tides of *Ceratium furca* at the Estuary and the color of surface water was brown to red. Chl *a* concentrations varied from 1.91 to 167 µg/l. POC, PON and PP concentrations varied from 131 to 415 µM, 15 to 62 µM and 1.01 to 7.33 µM, respectively. At the observation points where red tides observed, the Chl *a*, POC, PON and PP concentrations of surface seawater showed high concentration. Moreover, good correlations can be observed between Chl *a* and POC, PON and PP in surface seawater (Fig. 2). Generally, if the good correlations can be observed between Chl *a* and POC, PON and PP, we can assume the slope of the regression line shows

C, N and P amounts in phytoplankton. Calculated phytoplankton C:N:P molar ratio using the slope of regression line was 106:17:2. It was quite similar with Redfield ratio, phytoplankton C:N:P ratio is 106:16:1 (Redfield et al. 1963), but phosphorous ratio was higher by two times. There are two explanations about that. One is that inorganically-bound P in the suspended matter in the surface water can not be ignored. Another is that phytoplankton accumulates P in their cells. We conducted another observation in 2004 at many observation points including those of 2002. As same in 2002 observation, from river to sea, salinity increased gradually. Chl *a* concentration was high in offshore. This time, we measured PP dividing to PIP and POP. Good correlations can be observed between Chl *a* concentration and POC, PON, PP and POP in surface seawater (Fig. 3). Calculated phytoplankton C:N:P (POP) molar ratio was 106:17:0.9. It was quite similar with the Redfield ratio. However, if we used PP value, the ratio was 106:17:1.5. It was high by about one point five times. These results confirmed that inorganically bound P in suspended particles in surface water can not be ignored as we found in 2002. The relative abundance of PIP as percentage of PP varied from 30% to 75% in the river water and 11% to 50% in estuary water. The PIP contribution for PP in this study area coincided with the previous reported value of Suzumura et al. (2004). They reported PIP contribution for PP of surface water varied from 12 to 86% at Arakawa River estuary, Tokyo Bay Japan. These results also indicate that the particulate organic matter in surface water was originated from phytoplankton not from the terrestrial substances.

Acknowledgements

We would like to thank to all members of Dr. Mek-

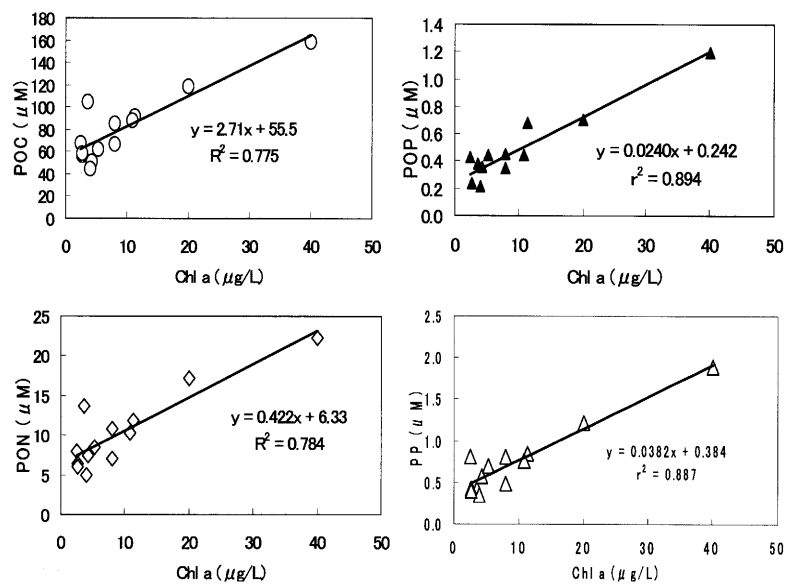


Fig. 3. The correlations between Chl a and POC, PON, POP and PP from the results of observation conducted in 2004.

sumpan's Laboratory for their assistance during the Bang Pakong River Estuary observations. We also thank Dr. Sarawut Srithongouthai and Ms. Sayaka Wada for their assistance and support during this study. The authors thank Japan Society for Promotion of Science for giving us the opportunity to do this study.

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