Available online at www.sciencedirect.com
ScienceDirect
Marine Pollution Bulletin 52 (2006) 1625–1633
MARINE POLLUTION BULLETIN
www.elsevier.com/locate/marpolbul

Organic carbon and nitrogen stable isotopes in the intertidal sediments from the Yangtze Estuary, China

M. Liu [a,*], L.J. Hou [b], S.Y. Xu [a], D.N. Ou [a], Y. Yang [c], J. Yu [a], Q. Wang [a]

[a] Department of Geography, Key Laboratory of Geographical Information Science of the Ministry of Education, East China Normal University, No. 3663 Zhongshan North Road, Shanghai 200062, PR China
[b] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200062, PR China
[c] Institute of Geoscience, Johannes Gutenberg-University Mainz, Becherweg 55099, Germany

Abstract

The natural isotopic compositions and C/N elemental ratios of sedimentary organic matter were determined in the intertidal flat of the Yangtze Estuary. The results showed that the ratios of carbon and nitrogen stable isotopes were respectively −29.8‰ to − 26.0‰ and 1.6‰–5.5‰ in the flood season (July), while they were −27.3‰ to − 25.6‰ and 1.7‰–7.8‰ in the dry season (February), respectively. The $\delta^{13}C$ signatures were remarkably higher in July than in February, and gradually increased from the freshwater areas to the brackish areas. In contrast, there were relatively complex seasonal and spatial changes in stable nitrogen isotopes. It was also reflected that $\delta^{15}N$ and C/N compositions had been obviously modified by organic matter diagenesis and biological processing, and could not be used to trace the sources of organic matter at the study area. In addition, it was considered that the mixing inputs of terrigenous and marine materials generally dominated sedimentary organic matter in the intertidal flat. The contribution of terrigenous inputs to sedimentary organic matter was roughly estimated according to the mixing balance model of stable carbon isotopes.
© 2006 Elsevier Ltd. All rights reserved.

Keywords: Sedimentary organic matter; Stable carbon and nitrogen isotopes; C/N elemental ratio; Intertidal flat; The Yangtze Estuary; China

1. Introduction

Estuaries and coastal zones are the main channels between the lands and the oceans, which can trap significant quantities of natural and anthropogenic organic matter under the interactions of a series of physical, chemical and biological processes (Kennedy, 1984; Thornton and McManus, 1994). Thus estuaries and their adjacent areas have already become a significant sink of organic matter within the ecosystems on the earth's surface. A large magnitude of accumulated organic matter has the important ecological significance to sustain higher productivity and biomass in the estuarine and coastal ecosystems (John et al., 1988). More and more biogeochemists and ecologists have already realized the ecological significance of the organic matter pool in the recent decades (Peterson et al., 1985; Zhang et al., 1997; Peterson, 1999; Cloern et al., 2002; Savoye et al., 2003). Although the dynamics of organic matter in estuaries have been intensively studied, questions still remain regarding the sources, fate and role of organic matter in the ecology of estuaries and the coastal oceans (e.g., Mantoura and Woodward, 1983; Cifuentes et al., 1988; Peterson et al., 1994; Yunker et al., 1995; Cai et al., 1998; Cifuentes and Eldridge, 1998; Canuel, 2001; Harvey and Mannino, 2001 and references therein). The reasons for these uncertainties include the complex interactions among the various physical, geological and biochemical factors that define each estuarine ecosystem and control organic matter in these environments (e.g., Howarth et al., 1991; Fogel et al., 1992; Hobbie, 2000).

Considerable attention in biogeochemical and organic geochemical studies has been focused on the utilization of carbon and nitrogen stable isotopes and their elemental

* Corresponding author. Tel.: +86 21 62232117; fax: +86 21 62232416.
E-mail address: mliu@geo.ecnu.edu.cn (M. Liu).

0025-326X/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.marpolbul.2006.06.008

ratios (C/N) as natural tracers to identify the provenance, fate and seasonal processes of organic matter in estuarine and coastal marine environments (e.g., Thornton and McManus, 1994; Zhang et al., 1997; Andrews et al., 1998; Goñi and Thomas, 2000; Graham et al., 2001; De Brabandere et al., 2002; Goñi et al., 2003; Lepoint et al., 2004). The use of these tracers relies on the existence of gross differences among natural abundances of stable carbon isotopes, stable nitrogen isotopes and C/N elemental ratios in organic matter from terrigenous and anthropogenic inputs and that from marine and in situ inputs. This approach is often based on the fundamental assumption (a) that sedimentary organic matter isotopic and C/N ratios are conservative and (b) that their distributions in natural systems reflect only physical admixing of material from compositionally distinct end-member sources (Cifuentes et al., 1988; Thornton and McManus, 1994). Provenance identification can be significantly improved by the simultaneous utilization of two or more organic tracers, but problems may exist when tracers are employed in isolation due to poorer resolution of sources which contribute material with similar or intermediate ranges of compositions (Thornton and McManus, 1994; Goñi and Thomas, 2000; Goñi et al., 2003). Sources recognition is also compounded by potential modification of end-member signatures by biogeochemical processes which are known to alter the isotopic and elemental composition of organic matter pools in estuaries.

The Yangtze River is one of the largest rivers in the world, which ranks the fifth in average water discharge at its mouth and the fourth in suspended sediment discharge. A large quantity of organic matter from terrigenous and marine end-members is deposited in the Estuary and its adjacent areas (Milliman et al., 1984). Therefore, it has been already paid more attention to the source, fate and ecological significance of organic matter in the Yangtze Estuary. Previous reports have been published on carbon and nitrogen stable isotopes in suspended particulate organic matter from the Yangtze Estuary in recent years (Tan et al., 1991; Cauwet and Mackenzie, 1993; Shi, 1993; Wu et al., 2000, 2002, 2003). However, the geochemical characteristics of carbon and nitrogen stable isotopes in the intertidal sediment of the Yangtze Estuary have not been presently reported. Thus, the main objectives of this study are to explore the spatial and temporal variations of carbon and nitrogen stable isotopes in sedimentary organic matter in the intertidal flat, and to further elucidate the sources of organic matter accumulated in the intertidal sediments at the study area. The present study also is part of the project of the biogeochemical cycling of multi-materials in the Yangtze estuarine and coastal complex ecosystem.

2. Study area

The study area is situated on the Yangtze Estuary and adjacent coastal tidal flat areas (Fig. 1). The Yangtze Estuary is of particular interest to the biogeochemical and organic geochemical studies because of its worldwide importance. The Yangtze River traverses Central China in an approximately westerly direction for nearly 6000 km before discharging through the Yangtze Estuary into the East China Sea near Shanghai. The Yangtze River is a primary source of sediments for the widely developed continental shelf of the East China Sea. The river annually transports a runoff discharge of 9.0×10^{11} m^3 that carries approximately 5.0×10^8 tons of sediments and 1.2×10^7 tons of particulate organic matter to the Estuary and its adjacent coastal areas (Milliman et al., 1984; Chen and Zhong, 1998). More than 80% of the suspended matter is transported during high runoff periods of the river. About 25% of suspended sediment is deposited in the near shore area off the river mouth; in addition, 25% is transported southwards where it settles and remains in the coastal zone. Very little suspended sediment escapes to the north of the Estuary, and most of the remaining sediment is transported and deposited directly offshore (Milliman et al., 1985).

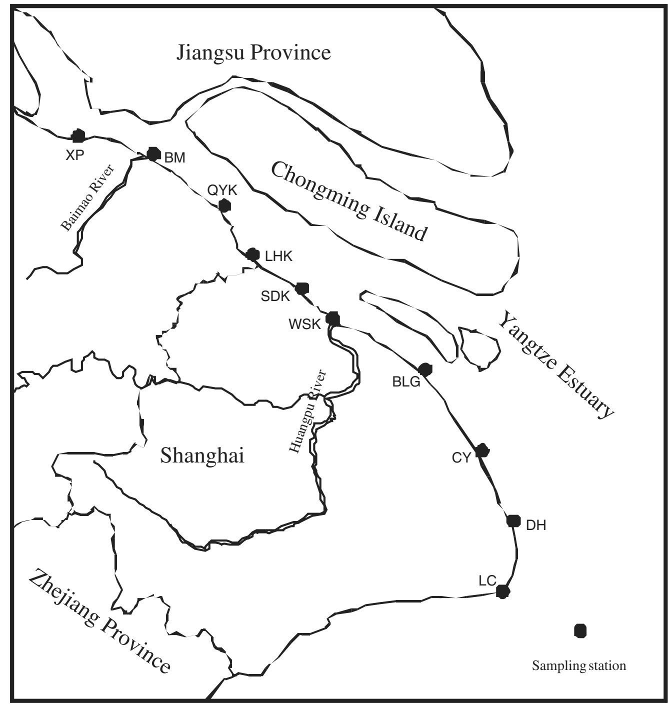

Fig. 1. Study area. The figure shows the location of Yangtze Estuary and the sampling stations during field investigations.

With an area of approximately 904 km^2, the tidal flats developed along the Yangtze estuarine and coastal zone mainly distribute the South bank of the Yangtze Estuary, the North bank of the Hangzhou Bay, Chongming Island, Changxing Island, Hengsha Island and Jiuduansha Island, which can be divided into high, medium and low tidal flats from land to sea. However, there are no high tidal flats in some sections of the South bank of the Yangtze Estuary and the North bank of the Hangzhou Bay due to human activities such as the reclamation. The tidal flat areas between Xupu (XP) to Bailonggang (BLG) are the freshwater areas mainly controlled by the Yangtze River runoff, while the areas from Chaoyang Farm (CY) to Luchao (LC)

Download English Version:

https://daneshyari.com/en/article/4477920

Download Persian Version:

https://daneshyari.com/article/4477920

Daneshyari.com