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ScienceDirect
Chemosphere 67 (2007) 1794–1801
CHEMOSPHERE
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Pollution sources and occurrences of selected persistent organic pollutants (POPs) in sediments of the Mekong River delta, South Vietnam

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Accepted 26 May 2006
Available online 16 January 2007

Abstract

The Mekong River delta is one of the largest agricultural land in the Southeast Asia. It plays a very important role for agriculture and fisheries in South Vietnam. However, comprehensive studies on the environmental pollution of persistent organic pollutants (POPs) in Mekong River delta have not been carried out in recent years. In this study, we collected sediment samples from the Mekong River to evaluate the contamination and ecological risks caused by several POPs. The contamination pattern of POPs was DDT > PCBs > CHLs > HCHs > HCB. DDTs are the most abundant pollutants, their concentration ranging from 0.01 to 110 ng/g dry wt, followed by PCBs (0.039–9.2 ng/g dry wt). DDTs and PCBs concentrations were higher in sediment from adjacent to urban areas than those from rural and agricultural sites, suggesting urban areas as important point sources of DDTs and PCBs to the river. Ratio of *p*,*p*′-DDT/*p*,*p*′-DDE was lower compared to those previously reported. However, some samples still had the ratio higher than 0.5, indicating recent input of DDT into the aquatic environments. This result shows that although the magnitude of contamination decreased over time, recent inputs of DDTs to the river still occur. Some sediment samples had concentrations of DDT compounds higher than the standards from the Canadian Environmental Quality Guideline, suggesting continuous monitoring for POPs contamination in the Mekong River is necessary.

Keywords: Vietnam; Mekong River; POPs; Sediment; Pollution source

1. Introduction

The Mekong River is the longest river in southeastern Asia, which flows a distance of almost 4800 km from China through Myanmar, Thailand, Laos, Cambodia and Vietnam. The Mekong River basin with an area of nearly 800 thousand square kilometers is an important habitat for approximately 60 million people. The Mekong River delta (MRD) in South Vietnam, which is inhabited by about 20 million people, is one of the most highly productive agriculture areas in the world (MRC, 2002). Rice production is a major agronomic activity in MRD contributing half of the rice production in Vietnam. On the other hand, economic development in MRD also raised concerns over the environment and biodiversity. For example, intensive use of persistent organic pollutants (POPs) including organochlorine pesticides (OCPs) and polychlorinated biphenyls

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doi:10.1016/j.chemosphere.2006.05.144

(PCBs) may have led to their considerable residues in soil, water and sediment. Moreover, relative persistence of such chemicals together with natural processes like evaporation and runoffs might enhance their ubiquitous distribution in the environment and food chains. Several of these chemicals are believed to alter normal function of the endocrine and the reproductive systems in humans and wildlife (Colborn et al., 1993; Kelce, 1995; Cheek et al., 1999; Vos et al., 2000).

In Vietnam, despite an official ban on the use of OCPs since 1995 (Sinh et al., 1999), there has been continuous evidence on their use throughout the country, particularly for dichlorodiphenyltrichloroethane (DDT). Moreover, recent studies carried out in Hanoi and Hochiminh city showed high levels of DDTs in birds, mussels and human breast milk (Minh et al., 2002; Monirith et al., 2003; Minh et al., 2004), suggesting relevant contamination by DDTs in the local environment. High contamination by POPs in MRD may be expected due to high population density and the intensive agronomic activities in this region. Despite this fact, no comprehensive study to evaluate the contamination status caused by POPs in this region has been carried out recently.

Generally, POPs are hydrophobic and therefore, readily bind to the particle fraction in lake and river waters. Subsequently, via sedimentation processes, these chemicals are deposited to the bottom. They remain very long in sediment due to their long half-life times (Rawn et al., 2001). From sediment, they can be taken up and retained in benthic organisms and consequently biomagnified through aquatic food chains to higher trophic levels. Humans, through ingestion of contaminated fish and shellfish, may be exposed to elevated levels of POPs (Ross and Birnbaum, 2003). Examination of POPs levels in sediment may give basic information on the contamination status, sources and ecological risks of POPs in the aquatic environments. In this study, we collected sediments from different locations along the Mekong River and determined the concentrations of several POPs such as PCBs, DDTs, HCHs (hexachlorocyclohexane isomers), CHLs (chlordane compounds) and HCB (hexachlorobenzene) in order to elucidate their recent contamination status, their usage pattern as well as to decide possible potential pollution sources of these chemicals to the river.

2. Materials and methods

2.1. Sample collection

Sediment samples were collected in September 2003 and May 2004 from the Hau River – the biggest branch of the Mekong River, which crosses South Vietnam and empties into the East Sea. Sampling points were selected along the Hau River from Chau Doc town to Can Tho city and Tranh De estuary (Fig. 1). Sediments named as *CC* and *NKSE* were collected near Can Tho city and those named as *Hau* were collected at other points along Hau River (Table 1). At each site, a grab of 5 cm surface sediment was collected by using Ekman dredge. The sediment was well mixed in an aluminum tray and a portion about 200–300 g was put in a clean polyethylene bag and transported to our laboratory in boxes packed with gel ice. In the laboratory, sediments were dried in room temperature, ground and sieved for a particle fraction of less than 2 mm size, which was used for the chemical analysis.

2.2. Analytical methods

POPs in sediment were analyzed following the method described by Iwata et al. (1994) with some slight

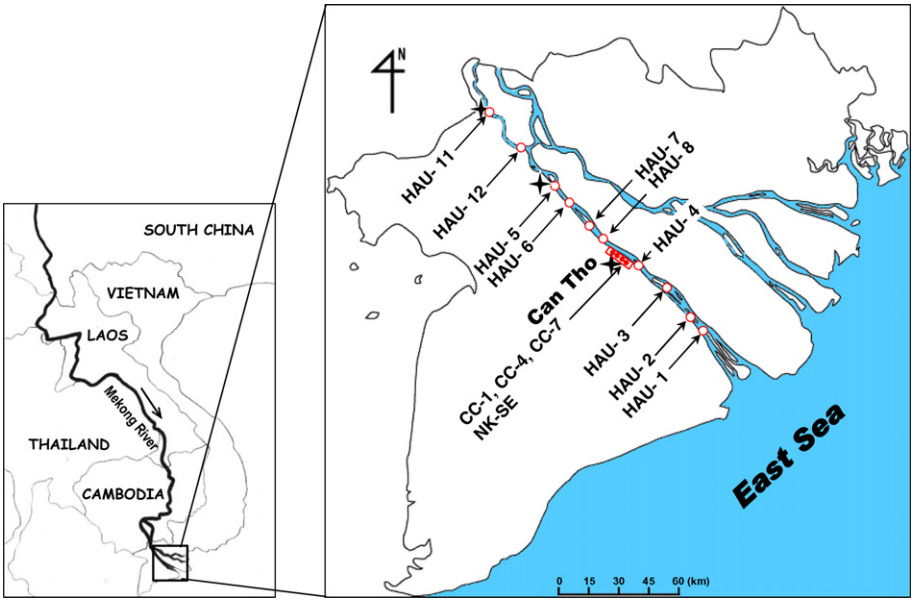

Fig. 1. Sampling locations in Mekong River, South Vietnam (2003–2004).