CONTAMINATION AND DISTRIBUTION OF PERSISTENT ORGANOCHLORINE AND ORGANOTIN COMPOUNDS IN DEEP-SEA FISH FROM EAST CHINA SEA: DIFFERENT RESIDUE LEVELS IN SHALLOW AND DEEP WATER ECOSYSTEMS

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Introduction

During the last few decades, pollution by persistent man-made chemicals such as organochlorine compounds (OCs) has spread all over the world as evidenced by their detection in various environmental components and biota including those from remote areas. In this regard, it has been emphasized that deep-sea sediments play a role as a sink and final reservoir for persistent contaminants[1]. During 1970s and '80s, several monitoring studies have reported the accumulation of OCs in deep-sea organisms collected from the Atlantic Ocean and around US coasts[2-5]. However, only few studies have reported contamination by OCs in deep-sea environment so far[6-8]. In particular, very little data are available from the marginal seas around western North Pacific.

Based on this background, we have investigated the contamination by man-made chemicals, such as OCs including polychlorinated biphenyls (PCBs) and organochlorine pesticides and organotin compounds (OTs) including an antifouling agent, tributyltin (TBT), in deep-sea organisms collected around Japanese coastal and offshore waters[9-13]. Here we report our recent data in East China Sea and compare it with our previous studies, to elucidate the present status of contamination in deep-sea ecosystem and the horizontal and vertical distribution of these pollutants.

Materials and Methods

Various shallow-water and deep-sea fish (belonging to 33 species) were collected from East China Sea at a depth of 89 - 500 m during October to November 2001 and November 2002. Sampling locations are shown in Fig 1. OCs including PCBs and organochlorine pesticides such as DDT and its metabolites (DDTs), chlordane compounds (CHLs), hexachlorocyclohexane isomers (HCHs) and hexachlorobenzene (HCB) were determined by gas chromatography with an electron capture detector (GC-ECD) following the method described elsewhere[10]. OTs such as butyltin compounds (BTs) including TBT and its breakdown compounds, mono- (MBT) and dibutyltins (DBT) and phenyl- and octyltin compounds were determined by gas chromatography with a flame photometric detector (GC-FPD)[9].

Results and Discussion

OCs were detected in all the deep-sea and shallow water fish from East China Sea. Among the OCs analyzed, concentrations of DDTs (up to 7900 ng/g lipid wt) were the highest and other OCs were approximately in the order of PCBs > CHLs > HCHs = HCB. Among the fish species analyzed, blackbelly lantern sharks and conger eels showed relatively high concentrations of OCs, which may be due to their carnivorous feeding habit. Concentrations of OCs such as PCBs and DDTs in deep-sea fish from East China Sea were lower than those from the Atlantic Ocean and around the US coasts reported earlier during 1970~80s[2-5], but comparable to those from offshore waters of the North Pacific and Atlantic Ocean reported during the last decade[6-8]. Particularly, deep-sea fish from East China Sea had the highest concentration of DDTs among the data so far reported in our related studies[9-13] in the western North Pacific region. This indicates a large scale input of DDTs from the countries around East China Sea by its use for public health (malaria control) and/or other purposes (suspected illegal use in agriculture etc.) in China and other Asian developing countries.

In East China Sea, apparently higher concentrations of all the OCs analyzed in this study were observed in fish from deep waters (depth of >200m), than those from shallow regions (depth of <200m) (Fig. 2). Similar trend of higher concentrations of PCBs, DDTs and CHLs in fish from deeper waters were noticed in the western North Pacific, off-Tohoku, Japan[12,13]. These observations may indicate the vertical transport of hydrophobic OCs (e.g., DDTs, PCBs and CHLs) in some areas of the western North Pacific, where high primary productivity and export of materials to deep waters have been observed. On the other hand, evaporation of volatile OCs (e.g., HCHs and HCB) from surface waters can also be suggested in the low latitude regions. Lower concentrations of HCHs and HCB were found in fishes from shallow waters than deep-sea fish from Suruga[10] and Tosa Bays[11] which are influenced by warm Kuroshio current. Vertical distribution of OCs observed in the East China Sea ecosystem may be the result of the vertical downward transport of hydrophobic OCs to deep waters and the removal of volatile OCs from the surface waters in the low latitude region.

In addition to OCs, all the BTs (MBT, DBT, TBT) and triphenyltin (TPT) and mono- and dioctyltins were detected in the fish from East China Sea. The concentrations of BTs (up to 41 ng/g wet wt) in the fish from East China Sea were comparable to those from the offshore waters of western North Pacific[11-13]. The fact that BTs were detected in almost all the deep-sea organisms from East China Sea as well as other western North Pacific regions investigated in our previous studies[9-13] indicates a widespread contamination in deep-sea ecosystems by these compounds. While detection of TPT in deep-sea organisms had been scarcely reported[14], TPT concentrations in some fish collected from East China Sea in the present study were even higher than those of TBT. This may imply the persistent nature and/or recent use of TPT around East China Sea. Detection of octyltin compounds, which are mainly used as plastic stabilizers and catalysts, implies the input of OTs in to the marine environment, not only by their use as antifouling agents but also by their application in the industrial processes in terrestrial areas.

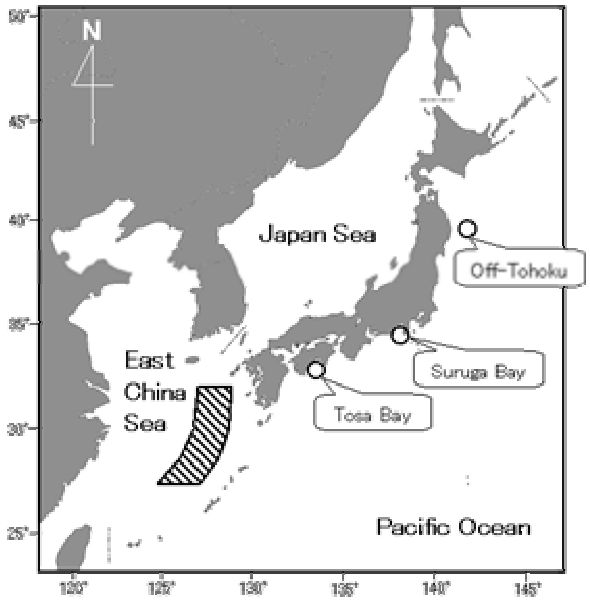

Fig. 1. Map showing the sampling area (shaded portion) in East China Sea. Circles indicate the sampling areas in our previous studies (off-Tohoku[12,13], Suruga[9,10] and Tosa Bay[11])

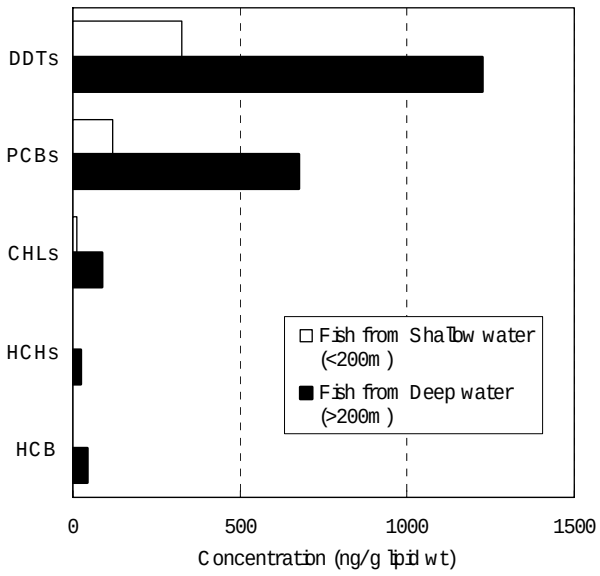

Fig. 2. Average concentrations of DDTs, PCBs, CHLs, HCHs and HCB in the fish from shallow (<200m water depth) and deep waters (>200m water depth) of East China Sea

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