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Organohalogenated contaminants in sediments and bivalves from the Northern Arabian Gulf

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ABSTRACT

Several classes of Organohalogenated contaminants (OHCs) were determined in sediments and bivalves collected from Kuwait coast. The levels and profile of polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and polybrominated diphenyl ethers (PBDEs) were compared in both sediments and bivalves. PCB-153 and -138 were the major contributors towards total OHCs followed by DDT and its metabolites (DDTs). The higher contribution of DDTs (~40%) and BDE-47 (~15%) in bivalves as compared to that in associated sediments indicated high biota-sediment accumulation factors (BSAF). Higher BSAF (values for heavier PCBs, DDTs and PBDEs) also indicated their high accumulation potential from sediment into associated biota at most of the studied locations. Overall, OHCs in sediments and bivalves measured in current study were lower than those reported in the literature worldwide. Most of the sediment concentrations of OHCs (ng/g, dry weight) were in the range of permissible guideline values proposed by Canadian Sediment Quality Guidelines (CSQGs), with few exceptions for DDTs (5 ng/g) and PCBs (22.7 ng/g). Similarly, 10% of bivalve samples contained high levels (ng/g, lipid weight) of PCBs (300) and DDTs (150) and were above the set safety benchmarks. This study establishes baseline for future monitoring programs.

1. Introduction

Organohalogenated contaminants (OHCs), such as polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and polybrominated diphenyl ethers (PBDEs), are a group of toxic chemicals and have attracted attention throughout the world in last few decades due to their long half lives, persistence and toxicity (Eqani et al., 2013, Ali et al., 2013). Occurrence of these toxic chemicals has also been widely reported into various environmental compartments (e.g., air, soil, water, biota etc.) and ultimately resulted into variety of health threats to human and wildlife (Eqani et al., 2012a; 2013). According to UNEP (2012), many of OHCs are classified as persistent organic pollutants (POPs) under Stockholm Convention (2009), and their usage is restricted and/or banned throughout the world including Kuwait (Ali et al., 2014, Gevao et al., 2012). Although banned but given consideration to their high lipophilicity, it can be expected that these toxic chemicals may get accumulate into the different fatty tissues of exposed organisms and consequently affect the biota at higher trophic levels through the process of biomagnifications (Eqani et al., 2013). Despite of other aforementioned noxious properties of OHCs; long range atmospheric transport of these chemicals is of particular environmental concern in the context of global POPs emission and their spatial distribution patterns (Zhang et al., 2008). However, several studies have reported the existence of distinct OHCs profiles into the local, regional, and global environment (Ali et al., 2014). Likewise, few studies have also provided the evidence of POPs contamination into coastal environment of Kuwait but with narrow scope (Gevao et al., 2006, 2012, 2014).

In coastal and aquatic environments, sediments are the principal receptor of different environmental pollutants and well

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documented to act as reservoir for a wide range of toxic chemicals (Covaci et al., 2005; Eqani et al., 2011). Sediments are also very important fingerprinting tool, which provided clear cut chemical profiles along with the estimation of historical deposition of OHCs into the water bodies through local and regional sources (Pan et al., 2010; Eqani et al., 2011). Nevertheless, sediment OHCs levels are directly linked to predict the biological exposure of these toxic chemicals, and thus reported to become an important step for mapping possible exposure pathways into aquatic and/or coastal food web (Li et al., 2010; Byun et al., 2013). In literature, bivalves have been extensively used as bioindicators of POPs exposure, due to their bioaccumulation potential, wider benthic distribution and sessile behavior (Ramu et al., 2007; Ramu et al., 2010; Byun et al., 2013). Biomonitoring of bivalves also offer several advantages e.g., ease in collection, especially to measure the biota-sediment accumulation potential and benthic OHCs-levels (Zhou et al., 2001; Byun et al., 2013). Bivalves acts as filter feeders into the coastal environments and their prolonged OHCs exposure may also result into several health abnormalities including reproductive, neurological impairments and their monitoring may also reflect the ecological health of marine biota (Byun et al., 2013; Commendatore et al., 2015). In order to assess the dietary suitability of different marine biological species, bivalves reflected the quantitative amounts of biological fraction of different toxic chemicals and their possible health concerns (Guzzella et al., 2005; Moon et al., 2007).

Kuwait coast is one of the important parts of Arabian Gulf, which harbor different activities including shipment of exports and imports items, oil drilling and transportation, ship breakage activities etc. The northern part of the coast is composed of soft mud and gypsiferous silty sediments by Euphrates and Tigris rivers. Moreover, few important islands i.e., Failaka, Kubar, Qaruh etc., are surrounded by reefs and serve as breeding ground for important migratory birds and supported the nesting activities of turtles and other marine biota. Despite the significance of this coast, the area has never been investigated in detail for the OHCs contaminants, which may enter into the marine ecosystem from surrounding areas including Iran, Iraq, Syria, Kuwait mainland etc., through atmospheric deposition and surface runoff. The objective of this study was to assess the environmental levels of selected

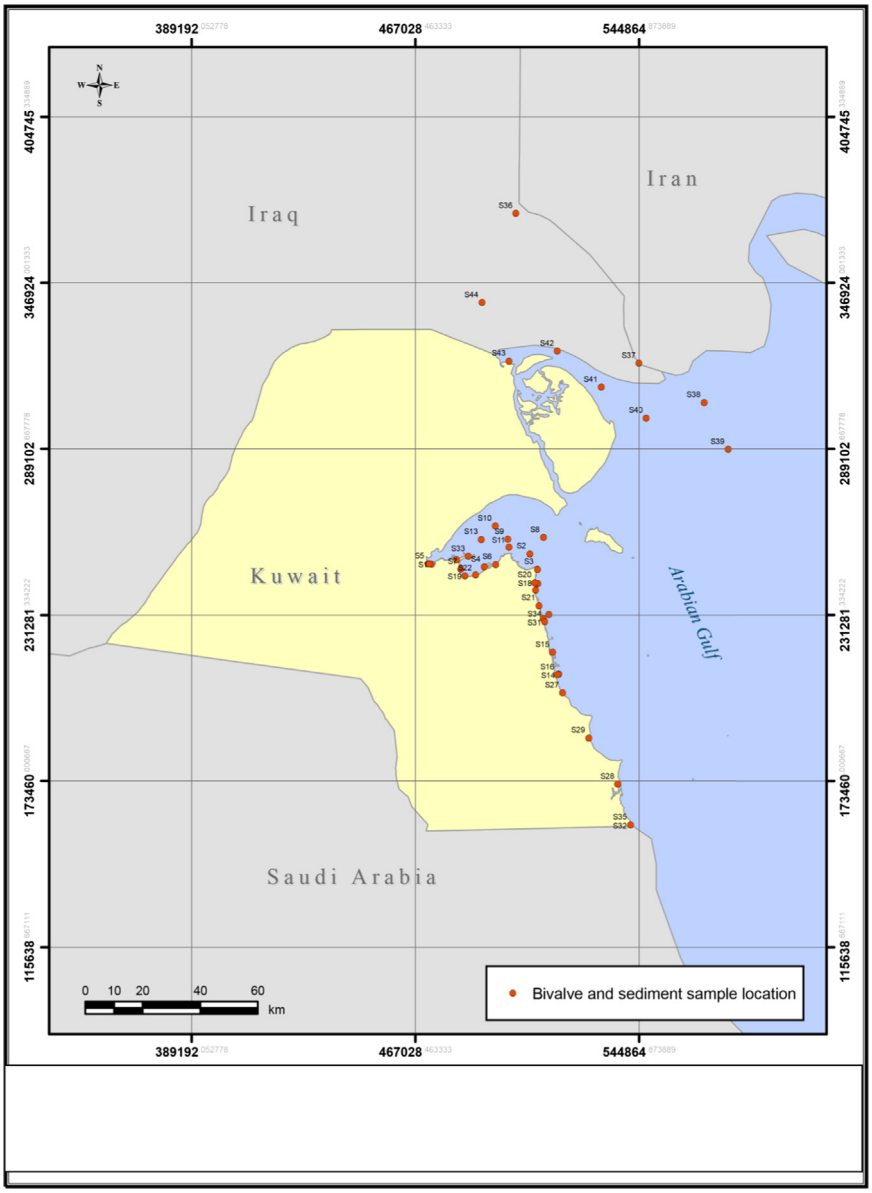

Fig. 1. Showing the study area and sampling points from Kuwait coast.