



## Short Communication

## Distribution of perfluoroalkyl compounds in Osaka Bay and coastal waters of Western Japan



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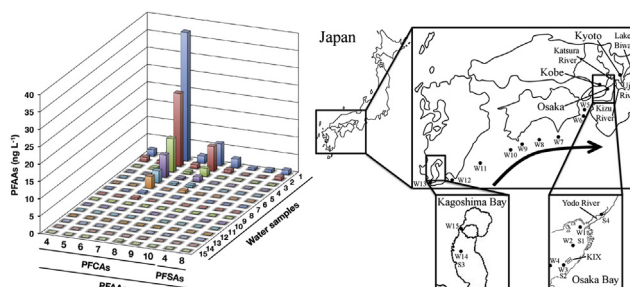
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## HIGHLIGHTS

- PFAAs were analyzed in sediment and seawater samples from coastal waters of Western Japan.
- The highest concentration of  $\Sigma$ PFAA was determined in Ajifu Water way in Osaka.
- The  $\Sigma$ PFAA in seawater samples ranged between the LOQ and 53.4 ng L<sup>-1</sup>.
- PFHxA was the most prevalent with the highest concentration of 37 ng L<sup>-1</sup>.
- PFAAs in surface waters are influenced mainly by sources from the Yodo River basin.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Perfluoroalkyl acids (PFAAs) including perfluoroalkyl sulfonates (PFSAs) and perfluoroalkyl carboxylates (PFCAs) were analyzed in sediment samples taken from Ajifu Waterway in Osaka city, from Osaka Bay, and from Kagoshima Bay, as well as in fifteen seawater samples collected from Osaka Bay and coastal waters of Western Japan. In all sediment samples, only PFCAs were detected, and the highest concentration was determined in Ajifu Waterway, where  $\Sigma$ PFAA was 58990 ng kg<sup>-1</sup> dry weight. The total concentrations of PFAAs in sea water samples ranged between the limit of quantification and 53.4 ng L<sup>-1</sup>, and perfluorohexanoic acid was the most prevalent and had the highest concentration of 37 ng L<sup>-1</sup>. The changes in the patterns and concentrations of PFAAs in Osaka Bay and coastal waters of Western Japan indicate that the PFAAs in surface waters are influenced by sources from Keihanshin Metropolitan Area,

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## 1. Introduction

The two most studied perfluoroalkyl acids (PFAAs) are perfluorooctanoic acid (PFOA,  $C_7F_{15}COOH$ ) and perfluorooctane sulfonic acid (PFOS,  $C_8F_{17}SO_3H$ ) (Domingo, 2012). PFOS, including its form as salts and its precursor, perfluorooctane sulfonyl fluoride, is classified as a persistent organic pollutant (POP, Stockholm Convention, 2012). A number of studies have reported their bio-accumulative and toxic properties, and the ubiquitous distribution of PFAAs in the environment, wildlife and humans because of their physico-chemical properties and their persistence (Haug et al., 2011; Domingo, 2012).

After Tokyo, the second largest urban region in Japan with nearly 19 million inhabitants is Keihanshin Metropolitan Area. This area encompasses metropolitan areas of the cities of Osaka in Osaka Prefecture, Kobe in Hyogo Prefecture and Kyoto in Kyoto Prefecture. Keihanshin surrounds Osaka Bay, the semi-enclosed bay located in Western Japan (Fig. 1). The major river in this area is the Yodo River, which receives water from Lake Biwa, the largest lake in Japan, through the Uji River and water from two other upstream rivers, the Katsura River and the Kizu River. The Yodo River has 19 intakes for drinking water for various cities, along with 12 discharge sites from wastewater treatment plants, before finally, flowing into Osaka Bay. As a result of predominantly human activities, much nutrient is loaded out to Osaka Bay,

organic matter is accumulated at the bottom, and nutrients are released from the bottom sediment. Because of the polar nature of PFAAs, the aquatic environment is a primary phase in the environment to harbor these chemicals (Ahrens et al., 2010). Many studies have confirmed that concentrations of PFAAs in the rivers of Keihanshin Metropolitan Area were higher than in other districts of Japan (Saito et al., 2004; Lein et al., 2008; Takagi et al., 2008). Although high PFOA concentrations have been detected in the river, information on levels of PFAAs in Osaka Bay is scarce (Takemine et al., 2014).

The objective of our study was to investigate the occurrence, spatial distribution, and pattern of PFAAs in the aquatic environment i.e. in seawater samples (W1-W15) from Osaka Bay, Kii Channel, and coastal waters of Western Japan from Osaka to Kagoshima Bay as well as in sediment samples (S1-S4) from Osaka Bay and Kagoshima Bay. Although there are several recent studies on PFAA pollution in the rivers which discharge their waters to Osaka bay (Takemine et al., 2014; Niisoe et al., 2015), we wanted to confirm our hypothesis that Osaka bay is a source of pollution for the western part of the Pacific Ocean near Japan. Our study will contribute to further understanding of the distribution of PFAAs in these waters in Japan and in the Pacific Ocean, which is important for the protection of environment and human health as well as for future remediation measures for polluted sediment.

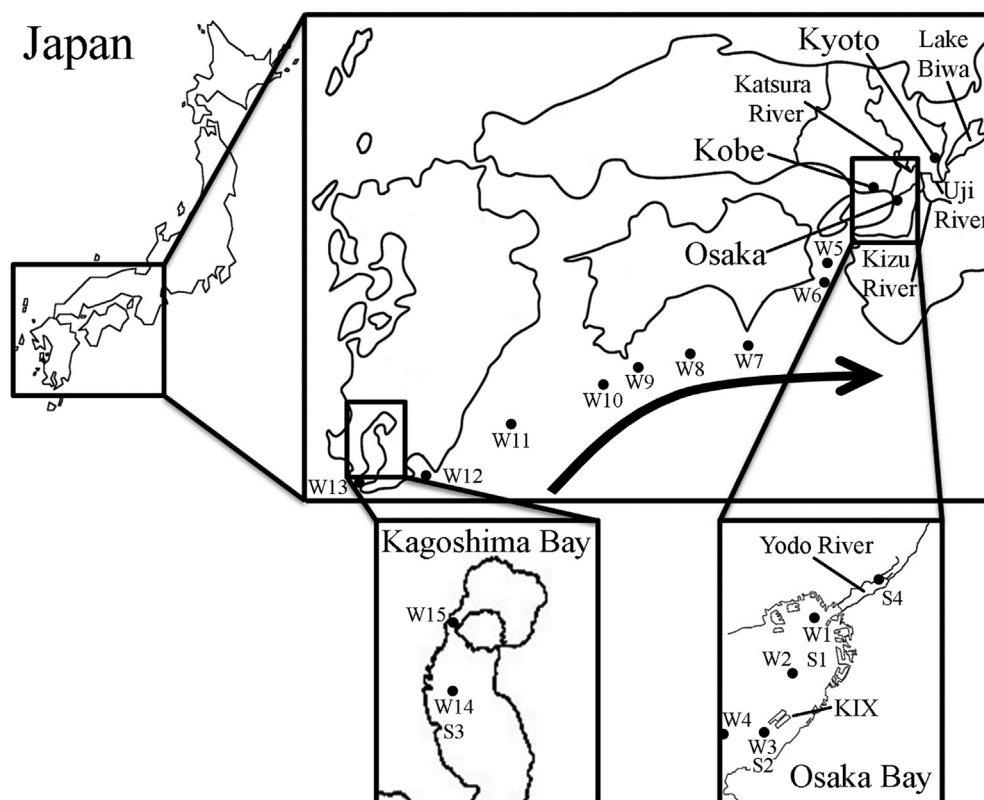


Fig. 1. Sampling locations in the Osaka bay, Kagoshima bay, and coastal waters of Western Japan. The arrow represents ocean currents in the Pacific Ocean.

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