



Baseline

Organic pollutants in the central and coastal Beibu Gulf, South China Sea

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ABSTRACT

Surface sediments from the central and coastal Beibu Gulf, southern China, were analyzed for persistent organic pollutants. The absence of polychlorinated biphenyls (PCB; generally below detection limit), low concentrations of polycyclic aromatic hydrocarbons (PAH; 24–647 ng g⁻¹), and locally high contamination with organo-chloro pesticides (DDT; 0.03–92 ng g⁻¹) reflect the early stages of development in southwest China, with human activities dominated by agriculture and low impact of industry. Concentrations of PCB and PAH indicate no ecological risk, while DDT accumulation poses a probable toxic risk in coastal but not in shelf sediments. Diagnostic ratios suggest PAH originating mainly from combustion of biomass and diesel fuels, and recent DDT use in agriculture and antifouling paint. Distribution patterns along the coastal-shelf gradient indicate mainly airborne transport of PAH and waterborne transport of DDT. In the central Gulf, also water column samples reveal low concentrations of PAH (1.7–7.8 ng L⁻¹) and DDT (0.006–0.053 ng L⁻¹).

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Compound classes like polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organo-chlorine pesticides (e.g. DDT) pollute air, soil, water, and sediments (Wong et al., 2007), and are of global concern due to their toxic effects on living organisms (Cruz-Martinez et al., 2015; Gao et al., 2008; Smalling et al., 2015; van den Berg, 2009). While PAH creation results dominantly from petrogenic sources such as oils and coal, and from pyrogenic sources like the combustion of fossil fuels, natural sources of PAH include wild forest and grass fires and natural oil seepage, as well as degradation of biomass (Turner et al., 2014; Yunker et al., 2002). PCBs have been used as e.g. capacitors and flame retardants in old appliances. Contemporary sources include the recycling (Labunska et al., 2015) and combustion (Colombo et al., 2014) of electronic waste. DDT has been internationally banned from direct application as agricultural pesticide (van den Berg, 2009). However, DDT is still used in disease vector control and illegally in agriculture (van den Berg, 2009).

In China, organic pollutants contaminate 29,720 km² of coastal marine areas and wetlands (Zhang et al., 2014). While PCB

contamination is relatively low in China (Xing et al., 2005), large quantities of PAHs are produced in coal power plants and automobile use (see Li et al., 2015a,b). DDT has been used throughout China as a pesticide in agriculture in the 1950s–1980s (Chen et al., 2006), but has been banned for this purpose in 1983 (Gao et al., 2008) and not been used in disease control since 2003 (van den Berg, 2009). Most studies of Chinese sediment POPs have concentrated on estuaries and nearshore waters of developed north to south-east China (compare Tables 4 and 6). There is scarce knowledge on contamination in mangroves (Zhang et al., 2014) and the impact of the growing coastal aquaculture industry (Kong et al., 2005). No POP data is available from the central Beibu Gulf, a semi-enclosed, shallow marginal sea of the subtropical north-western South China Sea (Fig. 1). Against this background, this study investigates (1) which POP groups contribute to POP contamination in the Beibu Gulf and its coastal zone, (2) how they distribute over the study area, and (3) which sources they derive from.

A total of 44 surface sediment samples were collected from the northern coast of the Beibu Gulf (Fig. 1) in March and October 2010 using a rust-free metal spoon and were stored in cleaned aluminum trays or combusted glass vials. Samples from stations C01–C03 were obtained as surfaces of intact sediment cores in acryl liners; sample material was not in contact with the liner. Estuarine (n = 18), mangrove (n = 19) and aquaculture (n = 7) samples were collected from intertidal river banks and mangrove plateaus or inside shrimp ponds, respectively. Samples were dried at 40 °C over 24 h and stored sealed with silica gel until grinding in a Retsch PM100 planetary mill.

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