Recent incident putting an international river basin under pressure - Historically high PCB-concentrations on the move

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Introduction

What happens when polluted sediments are on the move? When they don´t stay within boundaries and don't correspond to quality criteria changes from country to country?

Sediments play a major role in numerous bio-geochemical processes. Fine sediments can function as a dominant long-term sink for contaminants, but can also act as a relevant secondary source. The latter may jeopardize the integrity of the environment, in an extreme case even of an entire river basin. In the following it is shown, how an upstream pollution incident is affecting 700 km river reach and putting dredged material management in the estuary under pressure.

Event-triggered release of high PCB concentrations

Since spring of 2015 historically high PCB concentrations (up to 6.000 µg/kg sum 6 PCB-congeners) have been detected in the Elbe. This is the highest ever measured value at an Elbe-measuring station. In large areas and over long periods of time critical exceedances of the environmental quality standard for PCB occur. Recent studies of PCB in bream underlined the relevance of the incident for the food chain.

According to the Czech Environmental Inspectorate, PCB release was largely caused by maintenance dredging works in the waterway. In contrast, the state water management of the Elbe (Povodí Labe), attributes the cause of the extremely elevated concentrations to a construction site, where the removal of PCB-containing paint of a railway bridge crossing the Elbe in the city of Ústí nad Labem has been conducted improperly (see **Fig. 1**).

Fig. 1: Railway bridge crossing the Elbe in the city of Ústí nad Labem

Spatial and temporal development

As persistent organic pollutants PCBs have been detected for almost four decades in the international river basin Elbe, to some extent in significant concentrations. While during the early 1980s the detection of PCBs production residues was focused on, beginning with the 1990s characteristic PCB congeners (so-called Ballschmiter PCB-congeners No. 28, 52, 101, 138, 152, 180) have been recorded and evaluated along the main stream of German and Czech Elbe as well as in the relevant tributaries [1].

Both, then and now, the largest contribution of high chlorinated PCBs in the Elbe catchment area originates from the Czech Republic. In this context, historic industrial PCB point sources have been identified as particularly relevant [2, 3]. In contrast to the high chlorinated PCBs, most of the low chlorinated PCBs result from stoping regions, where PCBs have been used in hydraulic oils for the underground extraction of ore, and are - via remaining drainage galleries - still emitting today. The Middle Elbe itself is now regarded to as a relevant buffer and secondary source for persistent contaminants such as PCBs. Here, temporary or permanently connected still water areas change their predominant function from acting as a sink at low to medium headwater discharge to presenting a source in the event of a flood [4].

Due to the distinct low water levels in the middle and upper Elbe in 2015 and 2016, PCB-loaded suspended solids have deposited preferentially in the adjacent still water areas.

Implications for dredged material management

With a greater headwater discharge in December 2015 increased levels of PCB have entered the Elbe estuary for the first time. Particularly striking here is the disproportionate increase of high chlorinated PCB congeners 180, 153 and 138.

It is currently still unclear how the PCB event will affect the sediment quality in the Port of Hamburg in mid to long-term. Here, every year millions of cubic meters of sediments have to be dredged and subsequently disposed of on land or have to be relocated in the river system to secure shipping and navigation.

This presentation gives an insight how an international river basin deals with this situation.

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