Wilhelmsburg – one of the largest river islands in Europe
Does it still hold the memory of an industrial history in the sediments?

Susanne Heise, Judith Angelstorf, Maximilia Kottwitz & Peich Hsu, Hamburg University of Applied Sciences, Hamburg, Germany

Abstract

On the river island Wilhelmsburg, industry has been in close proximity to urban settlement and agricultural activity for a long time. Here, metal contamination of suspended matter in drainage channels was examined to estimate the recent impact of historic contamination on the ecological quality of Wilhelmsburg waters.
Sedimentation bottles were used to collect suspended matter monthly for half a year in different channels around the island. Chemical analysis of anorganics showed a distinctive pattern of suspended sediment contamination which reflects current pollution deriving from highway/road run-off and probably from atmospheric deposition around the largest European copper plant. It also reflects historic contamination probably from former deposition around the copper plant and from industrial legacies. Fish samples from the channels exceeded the Biota-EQS for mercury up to ten-fold. Ecotoxicity, however, was not enlarged due to the relatively low concentration of SPM in the channels. Finkenriek was an exception with partly high toxicities, which do not reflect heavy metal concentrations but may be due to pesticides from agricultural areas.

Fig. 1: Elbe Estuary

Introduction to the river island Wilhelmsburg

- With 35.3 km² one of Europe's largest river islands
- 48000 inhabitants
- biggest district of Hamburg
- In close vicinity: Industrial legacies, active industrial facilities, agricultural land, nature protection areas, urban sites, small trades and allotments
- Europe's largest producer of copper
- disposal site "Georgswerder", famous for its hazardous waste, now contained

Throughout the island, channels ("Wettern") drain the area and transport water and suspended matter towards the Elbe. As a consequence of former and current industrial use, contaminants may be transported with this water and distributed throughout the island.

Fig. 2: Wilhelmsburg with sampling stations

Methods

Sedimentation bottles were deployed in 5 different channels, which drain areas of different use and history (see Fig. 2). SPM was collected monthly for 6 months, lyophilized and heavy metals determined by AAS. Ecotoxicity was measured with bacterial contact test and luminescence bacteria test in the wet samples, enriched in SPM by a factor of 20.
Fishes were caught close to Finkenriek and metals determined in muscle tissue.

Results and Discussion

Overview: Metals

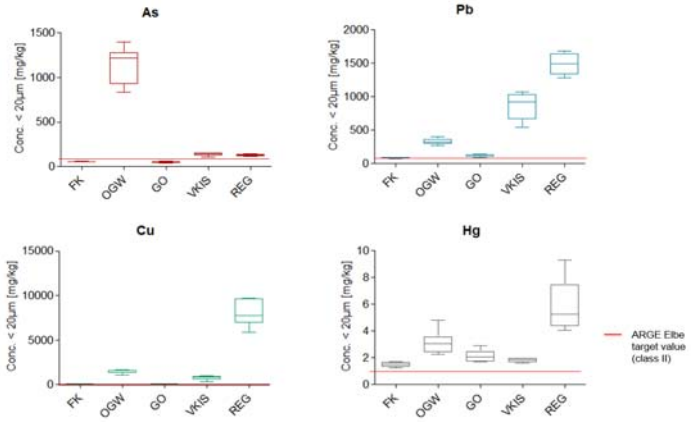


Fig. 3: Contamination of selected metals in SPM collected from the sites shown in fig. 2. Red line: Environmental target values acc. to ARGE-Elbe 2000 Klassification

Some metals are extremely enriched in SPM when compared to the target values for protection of the aquatic community (ARGE-Elbe 2000).

Per Station

(O)GW Georgswerder

Contamination: **As** Pb Cr **Cu** Ni **Cd** Hg

Site adjacent to Europes biggest copper plant
- Still high deposition of As in the vicinity of up to 230 µg/(m² d) (BSU- Monitoring)
- Additional legacies / soil contamination assumed

REG Rainwater drain

Contamination: As **Pb** Cr **Cu** Ni **Cd** **Hg**

REG receives run-off from several highways and roads
- According to McKenzie et al. (2009) likely source of Pb and Cu (and Cd) in highway run-offs is tires (and Cd-plated break rotors. Hg source unknown.

VKIS Vering Channel

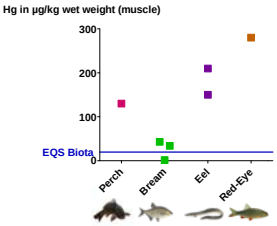
Contamination: As **Pb** Cr **Cu** Ni **Cd** Hg

Site in the former industrial centre, receiving water from larger surrounding and surface run-off also from lorry parking space
- High Pb concentration still signal from leaded fuel?
- Heavy metal contaminated sediment in the catchment of the channel known, historic source not clear.

FK Finkenriek

Much lower metal-contaminated than other sites (Fig. 3). Highest toxicity (Fig. 4). Finkenriek receives waters from agricultural areas (as does Götjendorf GO). Imidacloprid and isoproturon have been found (not shown), indicating impact of pesticide application.

Hg in fish tissue



Ecotoxicity of SPM

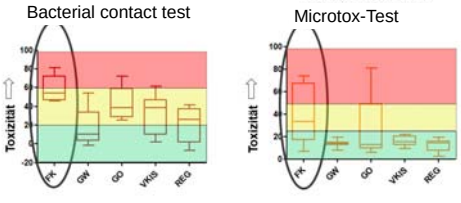


Fig. 4: Ecotoxicological Effects: Bioaccumulation of Hg in muscle tissue of fish from channels (left); Toxicity of monthly sampled sediment suspension (20 fold concentrated) on bacteria (right).

In most fish tissue, EQS for Hg was exceeded up to 10 fold.
Ecotoxicity was highest in Finkenriek in both bacteria test systems.

Conclusion

- Partly extremely high metal-contamination in SPM
- Metals are transported and distributed in W'burg waters
- Extent and pattern of contamination varies among channels
- Clear signals from ongoing (copper smelter, road run-off) and historic emissions (Vering channel)
- Ecotoxicity low due to low SPM concentration in channels

Contact: susanne.heise@haw-hamburg.de