

PCB-anomalies around the urban karst area in Zadar (Croatia) as consequence of war action and /or industrial contamination

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A great part of the former Yugoslavia has recently been encompassed by warfare. Research on the environmental impact of warfare has shown that many sorts of highly stable organic contaminants have entered the environment. Karstic regions and in many cases urban karst regions of former Yugoslavia warrants particular attention because of its exceptional ecological vulnerability. Objective of the EU-Project APOPSBAL (Assessment of the selected POPs (PCBs, PCDDs/Fs, OCPs) in the atmosphere and water ecosystems from the waste materials generated by warfare in former Yugoslavia, ICA2 – CT – 2002 – 10007) was to investigate the levels of POPs (with the special attention to PCBs) in various environmental matrices, their atmospheric and hydrogeological fate. Identification of hot spots, laboratory and field PCB biotransformation studies, and suggestions for remediation of contaminated soils were among the general goals.

The harbour area of the *Marina (u. Vrulje) and the Jazine* (Zadar) is an large area of about 0.18 km² with a so far unknown PCB-anomaly of 0.2–3 mg/kg (sum 7 cong.) in the fine fractions (<0.063 mm). Analysing the size distribution of these sediments showed this fraction is the dominating one, however, the coarser fractions (200–2000 µm) contain similar quantities of PCBs. Studies in other areas showed that these organic rich very fine grained sediments in a mixture zone of meteoric and sea water are particular prone to scavenge nearly all contaminants to the sediments including PCBs.

Even the depth controlled sampling down to about 0.3 m indicate a decrease of PCB contamination towards the top, a mean minimum sediment-depth of 0.3 m show that at least 54 000 m³ or 75 000 t (1.4 t/m³) of PCB contaminated sediment are deposited in the harbour area. At a mean PCB concentration of about 0.8 mg/kg about 60 kg (sum 7) PCBs were trapped in this harbour basin. As the action level of PCB-contamination of most European countries are in the concentration range of 0.1–2 mg (sum 6 or 7 PCBs) per kg dry sediment (OSPAR 2004) further investigations of these sediments are strongly recommended.

The source of this contamination is not clear. Complete different congener patterns exclude the electrical transformer station (ETS) Zadar as common source. Likely sources

of PCBs are PCBs in ship paintings used as antifouling agent in former times or contamination in the industrial recharge area of the harbour.

The marine sediments south of the Zadar centre and west of this industrial area are not affected by any significant PCB-contamination. This is more or less supported by the analysis of fish (Picer et al. 2005) around the Zadar area.

The missing correlation of TOC-content and PCB-concentration in the harbour basin sediments indicates that the mechanism of PCB fixation is different in the finer (<0.2 mm) than in the coarser fractions. The negative correlation with TOC and therefore a positive one with carbonate suggests a fixation in the carbonate pore space. The different distribution of the single congeners support a fixation of the lighter congeners to organic compounds whereas the heavier ones rather stick to the carbonates. Future measurements on the coarse carbonate fractions should test this hypothesis.

Haslinger, E.; Kralik, M.; Picer, M.; Picer, N.; Ottner, F. & Cencic Kodba, Z. (2005): PCB-contamination in "Terra Rossa" soil samples of an electro transformer station in Zadar as consequence of oil spills during war action (Croatia). Abstr. Soil indicators – Annual Meeting Austrian Soil Sci. Soc., May 12 & 13th, Ljubljana, p. 34-35, Inst. f. Bodenforsch., Univ. f. Bodenkultur, Wien,

Ospar (2004): Overview of Contracting Parties National Action Levels for Dredged Material. Publ. No. 211, 22 p. (www.ospar.org 4/11/2005)

Picer, M.; Picer, N.; Kovac, T.; Hodak Kobasic, V.; Calic, V.; Miosic, N. Cencic Kodba & Rugova, A. (2005): PCBs hazards to karst water system, as consequences of war in Croatia, Bosnia and Herzegovina, and Kosovo and Metohija. In: Stevanovic Z. & Milanovic P. (eds.): Water resources & environmental problems in karst. (187-192), Proc. Intern. Conf., 888 p., 13-19 Sept. 2005, Belgrade & Kotor.