Contaminant transport from soil to sediments though suspended matter in the catchment of a drinking water reservoir (Southern Poland)

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Introduction: Suspended matter can be can be recognized as a key factor in circulation of contaminants between catchment and sediments in dam reservoir catchments. Especially, in areas where surface run-off is a major concern during snow melt and rain periods due to the catchment slope. The Dobczyce Reservoir is situated on the Raba River (Wieliczka Foothills, Southern Poland) and supplies over 50% of the drinking water to the urbanization of Cracow (around 1 million inhabitants). Due to this reservoir function. there are several limitations concerning the discharge of wastewater from the catchment, and land use. However, this water body is still subjected to effects of a considerable contaminant load delivered from its catchment (including eutrophication [1]). Since fine-grained (<62.5 mm) sediment-associated transport dominates the land-water flux of many natural and anthropogenically derived substances [2], qualitative analysis of suspended matter and identification of its sources is necessary for the proper construction of catchment management programs.

Methods: Initial soil/suspended matter/sediment sampling was performed in summer 2016, and sampling effort has continued since then. Soil/sediment samples are collected by hand every season, while suspended matter retained by a "time integrated collector" (developed accordingly [3]) is retrieved on the same sampling day as soil/sediment samples. Two reservoir tributaries and their catchments have been selected for this study with a contrasting land use characteristic (the Raba River with around 55% of the catchment covered by forest, and the rest evenly split into crops, pastures and buildings, and the Wolnica Stream with nearly 85% covered by arable land and crops). Soil sampling sites represent different types of the land use, while sediments and suspended matter are collected from the outlet cross-sections. All samples have been analyzed for grain size, organic matter, and trace metals (Cd, Cu, Pb, Ni, Zn, Mn, and Fe) as a part of the sediment fingerprinting local study [4].

Results: About 95% of the material retained in the time integrated samplers are characterized by a fine (<62.5mm) suspended sediment particle size distribution. Among the investigated metals, Ni and Zn are of the greatest concern since their concentrations frequently exceed sediment quality guidelines for the Lowest Effect Level (LEL, [5]), however, concentrations do not exceed the Severe Effect Level (SEL). In samples from the Wolnica Stream, Mn and Zn concentrations were markedly higher than in the samples from the Raba River.

Discussion: Metal concentration levels recorded through the current research were not different from previous studies [6-8], which allows the assumption that the contamination sources in the area remain steady over time. However, noticeably higher concentrations were detected during snow melt and rain periods, especially for Fe and Pb. Substantial differences were also observed depending on the prevailing land use in the catchment. In the catchment where agriculture was the dominant activity (Wolnica Stream), concentrations of Mn and Zn were much higher, while all the remaining metals were detected at higher levels in the catchment with more diversified land use (Raba River). The metal concentrations in suspended matter well reflected the level of metal contamination of the soil fine fraction (<62.5mm) collected from the catchments.

Acknowledgements: The sediment fingerprinting study was supported by the Cracow University of Technology through the PhD statutory funds of Gabriela Zemelka (S-3/365/2016/DS-M).

References: [1] Mazurkiewicz-Boroń (2000) ZBW PAN, Kraków; 35–38; [2] Walling (1989) *Int. J Sediment Res.* **4**:27-39; [3] Phillips et al. (2000) *Hydrol. Process.* **14**:2589-2602; [4] Zemełka & Szalinska (2016) SGEM2016 Conference Proceedings, **3**: 697-702; [5] Persaud et al. (1992) Guidelines, Ontario Ministry of Environment, Canada; [6] Reczynski et al. (2010) *Int. J Sediment Res.* **25**:28-38; [7] Szarek-Gwiazda et al. (2011) *Clean-Soil, Air, Water* **39**:368-375; [8] Szarek-Gwiazda (2013) Studia Naturae **60**.