

Changes of floodplain morphology by water mills: Legacy sediments stored behind mill dams as archive and source for pollution – Examples from the Wurm River, Lower Rhine Embayment, Germany

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The Wurm River (Lower Rhine Embayment, Germany) is a small stream in a low mountain area near the Dutch-German border that has seen a lot of anthropogenic changes of its morphology since medieval times. Among other influencing factors, water mills, in particular, had an early impact on the sediment dynamics and created sediment traps. Several knickpoints in the long profile may represent the legacy of mill damming - or founded mill building at these spots. The knickpoints may also represent the aftermath of the colliery history.

A study site in the upper reaches of the Wurm River features erosion terraces, incised following the demise of a mill dam in the early 20th century. The mill pond most likely collected sediment and additives e.g. used in agricultural and industrial processes. These legacy sediments from behind former mill dams provide information about anthropogenic pollution, particularly for the era of industrialization in the vicinity of the old industrial area of the city of Aachen. Along with the demise of the mill dam and the increased incision tendency, the sediments are also a secondary source for pollution in case of remobilization of contaminated sediments.

Two major research questions are addressed. A) Which individual hydrological and geomorphological processes, both upstream and downstream, triggered the incision and the construction of the erosion terraces, which are preserved in the mill pond sediments? Is either the demised mill dam, or subsidence effects, or a combination of both the determining factor? B) Which contaminants are retained in the sediments? Is there a detectable point source for the pollutants or is it a mixture of diffuse anthropogenic (industry, agriculture, traffic, wastewater) and natural origin?

To tackle these questions, sedimentological data are combined with geomorphological mapping and evaluation of historical data. A soil profile provides insight into the architecture of the floodplain, which is built of riverbed sediments overlain by stratified fine clastic and organic-rich material, representing the sediment being trapped when the mill dam existed. X-ray fluorescence and grain size analysis are used to determine the depositional process, provenance and chemostratigraphy.

Knowledge about the distribution and fate of pollutants in sediments is valuable for river management purposes. Measures within the scope of the EU Water Framework Directive have been implemented at several breaches at the Wurm River, and further ones are planned. Potential risks due to remobilization of polluted alluvial sediments must thereby be taken into account. Furthermore, e.g. dismantling of transverse structures to improve passage for fish might trigger similar erosion processes and affects the sediment continuity.