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The Rhine Delta – a record of sediment trapping over time scales from millennia to decades

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At the land-ocean interface, large river deltas are major sinks of sediments and associated matter. Over the past decennia, many studies have been conducted on the palaeogeographic, historic and sub-recent overbank deposition on the Rhine floodplains. In this study these research results are synthesises with special focus on the amounts and changes of overbank fines trapped in the Rhine delta at different time scales in the past, present, and future. This contribution forms an update of the results presented at the EGU 2009 in session HS11.3 (Sediment response to catchment disturbances).

Sediment trapping in the Rhine delta throughout the Holocene was quantified using a detailed database of the Holocene delta architecture. Additional historic data allowed the reconstruction of the development of the river floodplains during the period of direct human interference on the river. Using heavy metals as tracers, overbank deposition rates over the past century were determined. Measurements of overbank deposition and channel bed sediment transport in recent years, together with modelling studies of sediment transport and deposition have provided detailed insight in the present-day sediment deposition on the floodplains, as well as their controls.

Estimated annual suspended sediment delivery rates were about 1.4 Mton (million tons) yr-1 between 6000-3000 yr BP and increased to about 2.1 Mton yr-1 between 3000-1000 yr BP. After embankment between 1100 and 1350 AD the amount of sediment trapped in the floodplains reduced to about 0.92 Mton yr-1. However, when accounting for sediment reworking, the actual sediment trapping of the embanked floodplains was about 1.6 Mton yr-1. Downstream of the lower Waal branch an inland delta developed that trapped another 0.4 Mton yr-1 of overbank fines. Since channel normalisation around 1850, the average deposition amounts on the embanked floodplains have been 1.15 Mton yr-1. Scenario studies show that the future sediment trapping in the lower Rhine floodplains might double.

The variations in sediment deposited in the Rhine delta during the Holocene are largely attributed to changes in land use in the upstream basin. At present, the sediment trapping is low and heavily influenced by river regulation and engineering works. Upstream changes in climate and land use, and particularly direct measures for flood reduction in the lower floodplains may again change the amounts of sediments trapped by the lower floodplains in the forthcoming decennia.