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

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The Holocene Rhine-Meuse delta forms a unique palaeo-environment to study both palaeogeography, and evolution of river avulsions and sediment trapping on a millennia timescale. It contains a relatively complete geological record, as a result of rapid aggradation during the Holocene, governed by relative sea level rise and land subsidence. Over the past decennia, the palaeogeographic development of the delta has been extensively studied and an extremely detailed database of the Holocene delta architecture has been established. Additionally, historic data has allowed reconstructing the development of the river floodplains during the period of direct human interference on the river. Using contaminants and radionuclides as a tracer, 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 morphodynamics of the lower Rhine-Meuse channels and their floodplains, as well as their controls.

Over the past millennia different periods of sediment trapping in the Rhine delta could be identified, associated with high sediment delivery from the upstream basin. Estimated annual suspended sediment delivery rates were about 2.5 Mton/yr between 9000-6500 yr BP, about 1.3 Mton/yr between 6500-3000 yr BP and increased to about 2.3 Mton/yr between 3000-1000 yr BP. These variations are largely attributed to changes in land use in the upstream basin. Accounting for clay extracted from the floodplain for brick production, the average deposition of clay along the Waal branch (the main Rhine distributary, carrying 2/3 of the suspended sediment load) from 1850 onwards was approximately 0.9 Mton/yr. At present, about 3.1 Mton suspended sediment reaches each year the lower Rhine delta, of which about 0.2 Mton (26%) is trapped along the Waal. These values have been strongly determined by river regulation and engineering works. Upstream changes in climate and land use, and direct measures for flood reduction in the lower floodplains may again change the amounts of sediments and associated contaminants trapped by the lower floodplains over the forthcoming decennia. Scenario studies show that net sediment trapping efficiency of the Waal might increase to over 35%.