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Quantification of Holocene sediment delivery to the floodplains in the Rhine valley and delta: a record of changing allogenic controls?

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During the Holocene, the vegetation cover in the Rhine catchment and surrounding NW Europe developed initially in response to postglacial climatic warming and later under increasing human influence. This most likely influenced erosion and subsequently sediment delivery to the fluvial system. These spatio-temporal developments make the history of sediment delivery to the Rhine and its floodplains a complex one. From several smaller Rhine tributaries, it is known that floodplain sedimentation amounts varied significantly over time. This is explained to be the result of changes in sediment delivery from the nearby hill slopes. It is expected that sediment delivery to the floodplains in the Rhine trunk valley and delta downstream varied as well. But, up till now the magnitude and variation of Holocene suspended sediment delivery in these large sinks were unknown. Likewise it was unknown whether there was a time lag between the response in upstream (upper valley and smaller tributaries) and downstream (Rhine-Meuse delta) reaches. We have quantified the amounts of floodplain sedimentation per millennium over the timescale of the Holocene. We distinguish three main sinks of Holocene floodplain sediments along the Rhine trunk river: the Upper Rhine Graben, the Lower Rhine Embayment and the Rhine-Meuse delta. New collected field data and borehole data from extensive databases allow to calculate the thicknesses and ages of floodplain sediments. This information is used to calculate floodplain sediment storage and to estimate sediment delivery on a catchment-scale. The results are coherent for different parts of the drainage basin. They show an initial high sediment delivery in the early Holocene (9000 – 6000 cal BP), a very stable middle Holocene

(6000 – 3000 cal BP), characterised by low sediment delivery values, and an increase in all study areas after 3000 cal BP. This is interpreted to be the delayed response of the system to the postglacial climatic warming in the early Holocene and a shift from a natural controlled to a human modified fluvial system in the late Holocene. The latter implies that early human land-use already modified sedimentation patterns in large catchments such as the Rhine system. Quantification of sediment delivery in downstream sediment sinks could also provide in an evaluation of the buffer capacity of the entire drainage area to external forcing. Hence, the calculated floodplain sedimentation rates allow to determine the response of the Rhine system to changes (climate, human impact) in its drainage basin on an interglacial time scale. This may be of major importance to better understand the spatial scale and magnitude of fluvial system response to predicted global climate and land use changes in the future.