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Trends in Holocene floodplain sedimentation in the Rhine catchment

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During the Holocene, climate and human impact have profoundly altered the functioning of rivers. Fluvial systems responded to these impacts by adjusting erosion, fluvial transport and alluvial deposition in their catchments. Varying sedimentation rates in the floodplain of the River Rhine during the Holocene are assumed to be the direct result of variations in sediment flux to the River Rhine that seem to be related to climate-induced and human-induced vegetation changes in the upstream drainage basin. Hence, calculating sedimentation rates allow to determine the response of the Rhine system, expressed in floodplain sedimentation, to changes in its drainage basin on an interglacial time span. This may be of major importance to better understand the response and behaviour of fluvial systems to predicted global climate and land use changes in the future.

We will present evidence of changing Holocene floodplain sedimentation in the River Rhine catchment based on a database with 219 alluvial ^{14}C-samples and quantification of floodplain sediment volumes. The ^{14}C-data were analysed in terms of: i) sedimentation rates and ii) fluvial activity and stability. Based on ages indicating activity and stability, cumulative frequency distributions were calculated. Floodplain sediment volumes were quantified for successive Holocene timeslices based on valley wide cross sections in major sedimentary sinks along the River Rhine (i.e. the Upper and Lower Rhine Graben and the Rhine delta)

The results of the probability frequency analysis suggest a tendency towards stable fluvial and colluvial systems during the early and middle Holocene and increased activities during the Late Pleistocene and the last 4000 years in the River Rhine catch-

ment. Single peaks of increased activity during the last 9 ka are present at 9.0 ka, 8.2 ka, 7.5 ka, 5.6 ka, 4.2 ka, 3.3 ka, 2.8 ka, 2.3 ka and 1.1 ka. In general, phases of increased activity coincide with phases of decreased stability (and vice versa) suggesting a homogenous response of the studied system to external forcing.

The analysis of the ^{14}C-ages in terms of sedimentation rates show three phases during the last 14 000 years. The first phase (from 14 000 - 8 000 years BP) is characterised by slightly increased sedimentation rates between 0.1 and 1.0 mm year^{-1} in response to the Late Glacial-Holocene transition. The second phase with decreased sedimentation rates coincidences with the more stable environment during the Holocene climatic optimum. The third phase from 4000 years BP onwards, show strongly increasing sedimentation rates as a result of increasing human impact.

First results of the floodplain sediment volumes quantification show an increase in sedimentation between 4 ka and 2 ka BP, and a strong increase after 2 ka BP. This trend is visible in all three large sediment sinks in the non-alpine River Rhine, and it exceeds amplitudes expected from Holocene climatic forcing. Therefore, we interpret this as a drainage basin-wide response to human impact in the Rhine catchment.

In general, the results show a coherent shift from a natural controlled to a human dominated fluvial system. Due to the long history of human impact in the Rhine catchment, the shift already started at 4 ka BP and increased after 2 ka BP.