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Human impact on the Middle and Late Holocene floodplain sediment characteristics along the River Rhine

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The Rhine catchment has an extensive history of human land use. Deforestation to create arable land started as early as 6300 cal BP, at the onset of the Late Neolithic. This caused increased erosion and sediment production on the hillslopes in the upstream part of the fluvial system. Recent studies show that this human-induced erosion also increased the suspended load sedimentation rates in the Rhine trunk valley and delta from approximately 3000 years ago. Besides such changes in the quantity of fine sediment, it is hypothesised that human land use may also change the source of the sediment supplied to the fluvial system. Sediment released by erosion during agricultural practises may be different than the sediments that erode under conditions of forest cover. If this is true, the Late Holocene floodplain sediments have different characteristics in terms of grain size and texture than older floodplain deposits (Middle Holocene). To test this, we collected 15 cores from three large stretches along the trunk Rhine River: the Upper Rhine Graben, the Lower Rhine Valley, and the Rhine Delta. Using detailed palaeogeographic reconstructions of the area, the cores were carefully selected in order to (i) to obtain the longest possible record (preferably up to 5000 years), and (ii) to have a continuous sedimentation record as much as possible. Cores are taken from residual channels, and distal flood basin and plains, although very distal sites were avoided to minimise the amount of peat or soil formation. Individual age-depth models are derived from radiocarbon dates taken in the cores, correlation of the regional deposits with a known age, and by using groundwater models (in the delta). Grain size characteristics of the siliciclastic sediment fraction were analysed every 2-5 cm, which yielded a record of grain size variations of the floodplains depositions in time. Using the end-member modelling algorithm EMMA it was possible to distinguish different groups of sediment mixtures in the floodplain reflecting the transport process (suspended and bed load sediments), and sediment source. The results show that in the last 2000-3000 years significantly more silt and fine sand are present in floodplain deposits. Because this signal is found throughout the entire catchment, it shows that (pre-historic) human impact was already capable of changing the sedimentation on the scale of the Rhine catchment before the modern era.