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Accurate dating of fluvial deposits in the Lateglacial Niers Valley system (Germany) using a multiple dating strategy

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The River Rhine occupied the Niers Valley (Germany) from the Saalian Glaciation (MIS 6) until the Early Holocene (Kasse et al., Journal of Quaternary Science 2005). The fluvial landscape of the time of abandonment has been exceptionally well preserved, leaving a series of cut-off meanders and residual channels. This unique preservation provides the possibility to investigate Late Weichselian fluvial dynamics of the River Rhine. We combined several dating techniques to accurately determine the age of the deposits. We developed a sampling strategy based on detailed field survey and cross sectioning. 1) The geomorphological relationships of the cut-off meanders gave a relative age for the successive stages of meandering. 2) The occurrence of Laacher See Pumice in the point bar deposits gave a maximum age for these deposits. 3) Optically Stimulated Luminescence (OSL)-dating on sandy point bar and channel-fill deposits yielded absolute ages for active meandering and channel abandonment. 4) AMS-14C dates on terrestrial macrofossils from the basal fills of the residual channels yielded minimum ages for abandonment. 5) Biostratigraphy of the organic channel fills using palynology gave a relative chronology, which could be linked to the well-dated regional biostratigraphy of the nearby Netherlands and is cross-checked by additional AMS-14C dates.

By combining these dating techniques we obtained a firm chronological framework that allows linkage to climate records and above the cross-validation of the different dating techniques. All techniques gave consistent ages that confirm the Lateglacial age and Early Holocene abandonment of the Niers Valley by the River Rhine. Palynology and 14C-dating on the channels fills supported the relative chronology indicated by the cross-cut relationships. The presence of the Laacher See Pumice in the point bar deposits, which has an unambiguous age of 12.9 ka cal. BP concurs with the organic channel fill ages. Because OSL signals in some grains of the fluvial deposits were not completely reset at the time of deposition, advanced statistical methods were used to determine the burial dose from the equivalent dose distribution.

We conclude that by combining several dating techniques we increase insight in the dynamics of the fluvial system during its last stages of activity and during abandonment.