



The timing of river terrace formation – possibilities and challenges of luminescence dating methods: a case study from Northern Bavaria, Germany

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Fluvial terraces are widespread geomorphic features of Quaternary landscapes. Besides tectonics, their formation is predominantly controlled by climatic conditions. Changes in either conditions cause changes in fluvial discharge and sediment load. Therefore, fluvial terraces can be used as important non-continuous sedimentary archives for paleotectonic and paleoenvironmental reconstruction.

The information gained from fluvial archives and their significance for paleoenvironmental research, however, strongly depend on a precise dating of the terrace formation. In the past, numerical dating of fluvial sediments has often been proved to be difficult. Radiocarbon dating has been applied on fluvial sediments frequently, but it depends on the presence of organic remains and its dating range is limited to the last ca. 40-50 ka. In contrast, luminescence dating enables the dating of fluvial sediments far beyond the last glacial-interglacial cycle and due to the general abundances of quartz and feldspar, there is almost no limitation of dateable material. Thus, luminescence dating has become a commonly applied method for yielding sedimentation ages of fluvial deposits. Applying luminescence dating techniques to fluvial archives is, however, still far from being a standard method. Several problems, such as incomplete bleaching of the dated material, dosimetric inaccuracies due to the heterogeneity of terrace gravels and difficulties in estimating accurate water contents, have to be considered. Thus, the calculation of OSL ages for fluvial deposits often proves to be challenging and their implications for paleoenvironmental reconstructions always demand a careful interpretation.

This contribution illustrates the informative value of fluvial archives for paleoenvironmental research and reveals some of the difficulties that may occur when luminescence dating techniques are applied to river terraces. The presented results are based on a case study, located in an oversized valley north of the city of Bayreuth, Bavaria, Germany. Here, within the headwaters of the River Main, five Pleistocene terraces are distinguished. The terraces are interpreted as the result of a complex landscape evolution, which is characterized by an at least twofold river deflection. To shed light on the question of Pleistocene environmental conditions for terrace formation, we investigate the timing of the river terrace accumulation by establishing a terrace chronostratigraphy based on optically stimulated luminescence dating.

Despite the described methodological problems, the obtained OSL dating results clearly show the potential to provide a reliable time frame for the terrace formation. They improve the knowledge about the Quaternary landscape evolution within the research area. Indicating significantly older sedimentation ages, these results clearly are in conflict with established explanations of terrace formation based on traditional concepts. They show that the response of fluvial systems to environmental changes is complex and strongly depends on local conditions.