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Diachronism as process-inherent part of Pleistocene river terrace formation: First results based on luminescence dating for testing a well-established theoretical concept and possible implications for practical field work

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There are two main statements of a long-accepted paradigm of fluvial morphodynamics formalized inter alia by S.A. Schumm: (i) changes in fluvial systems strongly depend on exceeding external and / or internal thresholds and (ii) they are always characterized by a nonlinear and asynchronous character. While the first aspect of this paradigm is part of numerous studies on fluvial morphology and river dynamics, the second aspect has so far tended to be sidelined in practical geomorphology.

With particular respect to the field of paleo-environmental research, this is evident from studies that aim at determining ages of Pleistocene river terraces in order to provide a time frame for the reconstruction of paleo-environmental conditions. Typically, numerical dating approaches are only applied to a single location that is supposed to be exemplary for the respective terrace level. Numerical ages determined for this specific location are then extrapolated and interpreted in a generalizing way to derive "THE age" of the river terrace as a whole.

With respect to the concept of asynchronism of fluvial reactions to environmental changes, such an approach seems problematic. In fact, asynchronism implies different sections of a river showing different and specific reactions to environmental changes at a given point in time. For fluvial terraces, this means that the processes controlling their formation may already have started in some sections of a valley, while in other sections they do not yet have any impact on landscape evolution.

In this contribution, we present luminescence ages of fluvial deposits originating from an Upper Pleistocene river terrace in a small valley located in the headwater of the Main River, Germany. Here, several samples from various locations throughout the river longitudinal course have been analysed. The luminescence ages determined for the lowermost part of the valley are significantly older than those from the middle section, which in turn are older than those from the valley's upper reaches.

Our results suggest a diachronic alignment of sedimentation ages for fluvial deposits, starting with

old ages close the mouth of a river and getting progressively younger for locations approaching the upper reaches. If these findings are confirmed in other fluvial systems and are not only the result of specific local conditions, they will be of great relevance for geomorphological research in fluvial landscapes. As a result, the widespread approach of deriving age estimates for fluvial terraces from numerical results merely determined for a single location appears to be inadequate and should be subjected to a critical review.