

Paleoseismicity of the Alpine foreland: the Upper Rhine Graben

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The Upper Rhine Graben faults in Central Europe are known for significant seismic activity within the Earth's crust, even though they are located within a tectonic plate, in an intraplate setting. This region has experienced destructive earthquakes throughout history, such as the 1356 Basel earthquake amongst others, which had a magnitude below 7 on the Richter scale. In recent decades, several research initiatives have assessed the seismic hazard associated with the Rhine Graben. These efforts primarily concentrated on investigating the western edges of the graben, where Late Pleistocene to Early Holocene faults that ruptured the surface during earthquakes were identified.

However, the use of "period and characteristic" fault models in earthquake geology has led to incomplete estimates of the faulting history and the seismic potential of these faults. Our research is designed to comprehensively characterize the seismogenic faults within the Rhine Graben by examining their recent geological activity and creating a chronological record of seismic events along each fault or fault segment. Our approach involves several methods, including geomorphological mapping of fault features, studying the deposits from the Quaternary period, trenching to investigate paleoseismic evidence, and employing various morphometric parameters to delineate the segmentation of these faults while considering long-term deformation.

The data we have collected provide compelling evidence regarding the dynamic behavior of these faults, allowing us to define specific areas with varying levels of tectonic activity formerly not known. We conducted trenching activities at several key sites for paleoseismological investigations, including comprehensive geophysical surveys conducted in the Upper Rhine Graben. Notably, our findings include the discovery of surface rupturing earthquakes near Karlsruhe (Ettlingen) and Freiburg (Tunsel), offering the initial evidence of tectonic activity during the Late Pleistocene and Holocene periods, with magnitudes exceeding M 6 on the Richter scale. Consequently, our research significantly, hence we contribute significantly to the completeness of the earthquake history in this region North of the Alps.