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Paleoseismological investigations within the Vienna Basin (Austria) excavate the largest earthquake north of the Alps

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The bimodality between short-term and long-term deformation of regions with low Quaternary displacement rates is typically represented by the Vienna Pull-Apart Basin (Austria) between the Alps and the Carpathians: Moderate historical and instrumental seismicity (Mmax = 5.2/ Imax = 8) is focused along the NNE-SSW trending strike-slip Vienna Basin Transfer Fault that delimits the basin towards the east. In contrast, secondary splay faults showing normal displacement seem to have been seismically inactive during historic times. However, geomorphologic and subsurface geophysical data reveal that those faults indeed show Quaternary displacement of several tens of meters. Whether those very slowly moving faults must be included into seismic hazard assessment or if they are negligible is one of the key questions for the Vienna Basin.

Here, we present a paleoseismological dataset of three trenches crossing one of those splay faults, the Markgrafneusiedl Fault. In those trenches, we excavated the Markgrafneusiedl Fault that offsets gravels from a Pleistocene Danube terrace ($\sim$ 250 ka) by about 40 m. The hanging wall of all three trenches comprises flood plain sediments, loess and colluvial wedge deposits. While the oldest layers within the hanging wall are of varying ages, the youngest deposits are dated consistently to ages between 13 and 15 ka. Comparing the observations of the different trenches, we found evidence for five major surface-breaking earthquakes during the last 104 ka. Especially, offset of the youngest layers for about 15-20 cm in all three trenches can be associated with one single event at around $\sim$ 14 ka. The second youngest event is characterized by a triangular-shaped colluvial wedge of 70-95 cm height with similar appearance in both southern trenches. Further correlations between the events found in each trench depend on more age constraints that are expected for March 2011.

Probabilistic evaluation of the inferred single-event displacements lead to magnitude estimates ranging between Mw = 6.3 and Mw = 7.0. The latter is the largest magnitude that has been documented in a paleoseismological investigation within Central Europe north of the Alps. In addition, preliminary dating results allow estimating the recurrence interval of severe earthquakes with magnitudes > 6 at the Markgrafneusiedl Fault to 20 - 25 ka.

These results together with the fact that five additional splay faults occur close to the Austrian capital, Vienna, indicate that the mentioned very slowly moving faults cannot be excluded from seismic hazard assessment, even for the relatively short recurrence periods used for national building codes or the Eurocode 8 (475 yrs).