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Results from the first paleoseismological trenches in the Vienna Basin, Austria

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The Vienna Pull-Apart Basin between the Alps and the Carpathians is characterized by moderate seismicity focused along the NNE-SSW striking left-lateral strike-slip Vienna Basin Transfer Fault (VBTF) that delimits the basin towards the east. Displacement rates determined from GPS geodesy and geological markers range between 1.5 - 2.0 mm/a. However, seismic slip rates calculated from cumulative scalar seismic moments for different segments along the fault are quite hetereogeneous, varying from 0.5-1.1 mm/a at the southern and northern tips to an apparently seismically totally locked segment in the central part of the basin, the so-called Lassee segment, close to the city of Vienna.

Within the southern Vienna Basin, accurate maps derived from seismic, GPR, gravity and morphologic data sets reveal that the VBTF is split up into six fault splays crossing the whole basin. They mostly branch from releasing bends of the main strike-slip fault compensating fault-normal extension in a transtensional strain environment. Even though those splay faults do not show any historical or instrumental seismicity, geological and morphological data proof that they moved at very slow velocities of < 0.1 mm/a during the Quaternary. Whether those very slowly moving faults must be included into seismic hazard assessment for the Vienna Basin or if they are negligible is one of the key questions for seismic hazard assessment.

Here, we present new data from the first paleoseismological investigation within the Vienna Basin. We excavated two trenches crossing one of those splay faults, the Markgrafneusiedl Fault. In both trenches, we found evidence for several surface-breaking events that cut through gravels of a Pleistocene Danube terrace ($\sim$ 270 ka). The top of those gravels in the hanging wall is not visible in both trenches. However, borehole data reveal that the base of those gravels show a total displacement of up to 40 m.

In one of the trenches, the hanging-wall strata is very well defined. The oldest layer excavated in the hanging wall is about 85 ka, while the youngest faulted sediments directly below the present-day soil horizon are around 13 ka. Hence, we can trace the fault history for approximately 70 ka. The youngest event recorded in the trench displaces layers that can be traced from the foot wall into the hanging wall. The total displacement for this event is about 15 cm. For this trench, it is the only event for which we can determine a total displacement. Evidence for at least two more events is only given indirectly, i.e. by colluvial wedges.

In total, we are able to proof that the Markgrafneusiedl Fault has generated several earthquakes in the past 86 ka. This implies that very slowly moving faults, even with displacement rates < 0.1 mm/a, should be taken into account for seismic hazard assessments. In addition, the data presented here suggests that also the other splay faults close to Vienna may attribute to the seismic hazard in the Vienna Basin.