The temporal evolution of seismicity and variability of Gutenberg-Richter b-values along the Vienna Basin Transfer Fault System

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The Vienna Basin Transfer Fault System (VBTFS) is the most active fault in the region between the Eastern Alps, the western Carpathians and the Pannonian Basin. The spatial and temporal distribution of earthquakes along the fault shows a heterogeneous pattern including a long-time decay of seismicity at the northern part of the VBTFS, which was interpreted to result from a long aftershock sequence subsequent to the 1906 Dobrá Voda earthquake (M = 5.7). In this paper we investigate if other strands of the VBTFS display similar long-term declines of seismicity that might indicate long aftershock sequences following strong, yet unrecorded, earthquakes in historical times. In order to analyse the distribution of seismicity, the VBTFS is divided into arbitrary segments of about 50 km length each. The segments are chosen to overlap each other to avoid missing information from neighbouring segments due to arbitrarily selected segment boundaries. For each segment we analyse the temporal evolution of seismicity and calculate the parameters of the corresponding Gutenberg-Richter (GR) relation. The temporal seismicity patterns revealed from the segments covering the Dobrá Voda area confirm the protracted aftershock sequence following the 1906 earthquake. All but one of the other segments do not show temporal changes of seismicity comparable to the long-term Dobrá Voda aftershock sequence. Seismicity patterns, however, include short-term Omori-type aftershocks following moderate earthquakes such as the 2000 Ebreichsdorf earthquake (M = 4.8). The segment covering the SW tip of the VBTFS revealed a 200 years long gradual decrease of the largest observed magnitudes starting with the 1794 Leoben (M = 4.7) earthquake. The 1794 event is the oldest earthquake listed in the catalogue for the region under consideration. It therefore remains open if the recorded decay of seismicity results from the 1797 event, or a stronger earthquake before that time. The latter is corroborated by the low magnitude of the 1794 earthquake which would typically not be considered to cause long aftershock sequences. GR a- and b-values, calculated for the individual segments, vary significantly along the VBTFS. Values range from 0.47 to 0.72 (b-values) and 0.81 to 2.08 (a-values), respectively. Data show a significant coincidence of the lowest b-values with fault segments with large seismic slip deficits and very low seismicity in the last about 300 years. These parts of the VBTFS were previously interpreted as “locked” fault segments which have a significant potential to release future strong earthquakes, in spite of the fact that historical and instrumentally recorded seismicity is very low. We find this interpretation corroborated by the low b-values that suggest high differential stresses for these fault segments.