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Structural modeling of active faults in the Vienna Basin: constraints on Maximum Credible Earthquakes (MCE) ?

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The Vienna Basin Transfer Fault is a slow active fault passing through the most populated and most productive region of Austria with 2.4 million inhabitants who produce c. 45% of the Austrian GDP. The fault and the Vienna pull-apart basin belong to the Miocene system of crustal escape blocks between the Eastern Alps and the Pannonian-Carpathian System. Recent tectonic activity is indicated by moderate seismicity (Imax c. 8), Quaternary geology (tilted fluvial terraces and deep Quaternary sedimentary basins) and geomorphological indicators (linear scarps with hanging valleys). Novel tectonic data such as maps of active faults and computed seismic slip deficits indicate that stronger earthquakes than those recorded in the historical earthquake catalogue probably cannot be excluded for the region (Hinsch and Decker, 2003; Decker et al., 2005; Hinsch et al., 2005a). In this presentation we use an additional approach to appraise the seismic potential of the area. We focus on the integrated structural modeling from 3-D seismic interpretation, subcrop maps and earthquake data to get indications on kinematics and to assess fault surface areas. Kinematic interpretation indicates several important differences between Miocene and active tectonics, although both deformations occurred under grossly similar boundary conditions. Miocene deformation is characterized by the formation of a thin-skinned pull-apart basin with normal faults rooting in a common detachment horizon. The active Vienna Basin Transfer Fault seems to be a straight system rather than having a pull-apart step over like in Miocene times (Hinsch et al., 2005b). The main activity of the fault system occurs along the eastern basin border, as indicated by seismicity and thick Quaternary basins, which subsided on top of negative flower structures. However, Miocene normal faults throughout the basin still seem to be active as indicated by tilted Quaternary fluviatil terraces. Some of these faults pass through the urban center of Vienna, but have not been the loci of recorded earthquakes. Subsurface fault plane areas at depth between 4 and 14 km have been calculated for the strike-slip faults and the detachment system of the normal faults. Using the empirical relations of magnitude-rupture area and magnitude-length (Wells and Coppersmith, 1994) we find that measured subsurface faults might produce earthquakes with magnitudes well above the historically observed ones. Our findings call for rigorous further investigations on the seismic potential and on recurrence interval for this area to update seismic hazard estimates.

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