Neotectonics in the Vienna Basin: Insigths from 3D-seismic, microtectonics, morphology and earthquake data

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Analyses of recent earthquake data, thicknesses of Quaternary conglomerates, and geomorphologic features seen in digital elevation models indicate continued deformation along the sinistral Vienna Basin fault system and localized tectonic subsidence in the center of the part of the basin. Although the area has been noted as a site of active tectonics for several decades, integration of new data with 3D-seismic alows to tightly constrain fault geometries and kinematics.

We show that neotectonics use the prae-existing Miocene faults which are characterized by extensional strike-slip duplexes of outcrop to map scale. Miocene master faults trend NE–SW and display sinistral to normal-sinistral movement. Off-branching splays delimiting rhomb-shaped duplexes show strike-slip and normal separation as indicated by lineations on fault surfaces. Surface fault architecture perfectly matches fault polygons mapped on Sarmatian and Pannonian horizons in the 3D-seismic cube Moosbrunn (Souther Vienna Basin).

N–S oriented splays with oblique-normal offset bend into a NE–SW striking, several hundred meters broad principle displacement zone (PDZ) which is defined by anastomosing faults. Interaction of strike-slip and normal faults caused downwarping of blocks along the PDZ. In cross sections, the N–S striking faults define a negative flower structure and merge into the PDZ around 2000 ms TWT.

Seismic fault patterns and surface data prove large Miocene sinistral-normal displacement along the PDZ. The PDZ imaged in 3D-seismic parallels a linear morphologic scarp of some 40 m height mapped in digital elevation data. The NE-trending scarp is traced over 15 km separating the elevated western block with Pannonian sediments at the surface from the eastern, downthrown block with up to 140 m thick Quaternary deposits. Short, pronounced valleys incise the fault scarp perpendicular to strike suggesting high syntectonic erosion which compensates the vertical component of displacement. Wetlands and moors overlying thick Quaternary gravels are interpreted as sag ponds along the fault zone. The distribution of Quaternary depocenters along the fault coincides with the relief of Pannonian and Sarmatian horizons mapped in 3D-seismic. Quaternary displacement therefore occurred on faults which were already active in the Late Miocene. Ongoing sinistral movement on the reactivated faults causing local Quaternary subsidence is compatible with the regional stress field and the recent seismicity in the area. The fault mapped in the Moosbrunn area is part of a seismically active fault zone which extends over 80 km from the Semmering into the Vienna Basin. Earthquake hypocentres and focal plane solutions prove sinistral strike-slip movement along a subvertical NE-striking fault system.