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A refined regional model of the thickness of Quaternary growth strata for the identification of active faults in the Vienna Basin (Austria)

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Active slip along the Vienna Basin strike-slip fault system, the formation of pull-apart basins and sag ponds along the fault, and normal faulting at splays of the strike-slip system that compensate transtension at releasing fault bends is associated with very low vertical displacement rates of about 0.01 to 0.1 mm/year. Although small, these displacements provide an opportunity to map the location of active faults and assess their displacement rates from the elevation of the basis and the thickness of Quaternary fluvial sediments that were deposited by the Danube and its tributaries.

Actual research targets the modeling of the 3D geometry of the base of the Quaternary strata (horizon Base Quaternary) from a compilation of shallow drillings and the construction of a regional isopach map showing the thickness of Quaternary (growth-) strata. Work benefits from the existence of literally thousands of shallow drillings that are available from the city of Vienna and the densely populated area the surrounding. Data were shared by several institutions (City of Vienna, Land Niederösterreich, Geological Survey), which collected data in different databases.

Most of the used drillings were done for construction or hydrogeological purposes to identify the base of Quaternary fluvial gravels, which form the most important shallow aquifer in the region. Gravels overlay mostly fine-grained Miocene sediments of the Vienna pull-apart basin or hard rock at the basin margins, both forming a basal aquiclude or aquitard. Because of the different purpose of drillings the Base Quaternary is not identified with the same accuracy in every case. This is particularly the case in areas where Quaternary gravels overlay coarse-grained Miocene strata, or where fine-grained Quaternary sediments are present. The reconstruction of the horizon Base Quaternary therefore needs careful evaluation of the collected drilling profiles and comparison with seismic data, shallow geophysics and LiDAR. Data processing and horizon modeling is done in a GIS environment using suitable gridding algorithms.

Results depict several syntectonic Quaternary basins within the Miocene Pull Apart Vienna Basin. Quaternary pull-apart basins along the strike-slip system and basins adjacent to normal splay faults are filled with up to about 140 m and 40 m of Quaternary growth strata, respectively. The large areal coverage of the dataset that extends over some 2200 km^2 and the high density of boreholes in some regions allows for a rather accurate reconstruction of the active fault pattern on the regional scale.

Actual work on the refinement of former models of the Base Quaternary focuses on the urban area of Vienna and the Marchfeld northeast of the city. In this region Vienna plans a deep borehole to use geothermal resources. In preparation of this geothermal project a research cooperation (Geotief Explore 3D, funded by Wien Energie and FFG) has been constituted to identify, map, and assess, Quaternary faults as zones which are not suitable for the reinjection of thermal water because of the hazard of triggered earthquakes.