The Vienna Basin: tectonics, subsidence and thermal evolution of a thin-skinned pull-apart

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The sediments of the Vienna pull-apart basin unconformably overly Alpine-Carpathian thrust sheets and sediments of an Early Miocene piggy-back basin which were thrust over the European (Bohemian) basement between the Eocene the early Miocene (c. 55 to 17 Ma). The formation of the pull-apart between the Karpatian (17 Ma) and the Pannonian stage (c. 8 Ma) coincides with the transition from post-collisional thrust shortening to the eastward lateral extrusion of the Alpine units. During extrusion, a sinistral transform system evolved which continued from the central Eastern Alps through the Vienna Basin into the Outer Carpathian Flysch nappes. The tectonics which led to Middle Miocene subsidence of the Vienna Basin between left-stepping segments of this transform fault can be described as divergent strike-slip duplexes. Rhomb-shaped duplexes from several hundred meters length up to the size of the entire basin are delimited by NE-striking sinistral faults and by connecting NNE-striking oblique-normal faults. Such duplexes were mapped along the basin margins and by 3D-seismic surveys of the OMV in the basin (Häusler et al., this vol.). Extension and strike-slip faulting was restricted to the Neogene sediments and the Alpine-Carpathian nappes overlying the European basement, i.e., to the uppermost 10-12 km of the crust.

Paleogegraphic maps show that the pull-apart basin acquired its outline in less than 1 Ma (within the Karpatian stage) and that the basin shape did not change during the Middle Miocene. High total basement subsidence, high subsidence rates (up to 5.8 km in 9 Ma), and comparably low finite extension (20-30%) characterise the duplex-shaped basin.

The basement subsidence of a divergent strike-slip duplex mainly is a function of the geometries and the kinematics of the basin boundary faults. Strain rate, duplex size, and depths to detachment determine amount and velocity of subsidence. Basement subsidence curves computed for a duplex of constant volume show that subsidence rates decrease with time, resembling subsidence curves of the McKenzie rifting/thermal cooling model. However, unlike in the McKenzie-model, this decrease is not due to thermal processes during cooling of the basin. Concave-up subsidence curves result from the strain geometry and from isostatic rebound effects.

The thermal evolution of a thin-skinned extensional basin which formed by extension of the uppermost crust has been modelled by finite difference algorithm. The model was set up for a 100 km thick lithosphere (30 km crustal thickness) with an initial steady-state geotherm and constant heat flux at the base of the crust as lower boundary condition. Crustal temperatures were computed for a 50 m grid which gives extremely good spatial resolution. Thin-skinned extension was modelled by a pure-shear velocity field applied to the uppermost 12 km of the crust. The resulting „basin" was continuously filled with sediments and a velocity field was constructed which accounted for synsedimentary deformation. Models were computed for 9 Ma subsidence, constant strain rate, 60% vertical thinning, and different sediment conductivities. The results show that thin-skinned extension hardly changes the initial thermal conditions and that only a very minor downbending of isotherms occurs. Advective downward transport of cool crust in the strained area overlaps and is nearly extinct by heat convection from the base of the lithosphere to the surface.

In sum it can be shown that subsidence of thin-skinned extensional basins is a function of strain geometries, deformation mechanisms, and isostatic rebound effects which result from the substitution of basement rocks by the unconsolidated basin-fill sediments. Thermal processes are not important for the subsidence of such basins. For the description of the Vienna pull-apart basin, the model of a divergent strike-slip duplex with a basal detachment which coincides with the floor thrust of the Alpine-Carpathian nappes seems to be most appropriate.

New geothermal measurements in Transylvanian Depression. Preliminary report on a joint cooperation between the Institute of Geodynamics - Bucharest, Romania, and the Geophysical Laboratory - Aarhus, Denmark

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From the heat flow point of view the Transylvanian Depression is well known as a remarkable low, in contrast to other Neogene basins in the Carpatho-Pannonian-Dinaride