Geophysical Research Abstracts, Vol. 7, 09689, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09689

Towards the coupled 3D thermo-mechanical modelling of the Dead Sea basin

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The continental transform boundary between the Arabian and African plates marked by the Dead Sea Transform (DST) accommodated ca 105 km of relative strike-slip displacement during the last 15-20 Myr. The transform deformation resulted in several pull-apart basins along the DST. The most important from them is the Dead Sea basin, which accumulated up to 10 km thick sediments during the last 15 Myr.

We employ a fully coupled thermo-mechanical modelling numerical technique to study 3D deformation at the DST with focus on the investigation of the possible effects of inherited heterogeneity of the lithospheric structure on the origin of the Dead Sea basin. Our finite-element, explicit, parallel computing code handles realistic temperature-, strain- and stress-dependant visco-elasto-plastic rheology of the lithosphere and is able to model spontaneous self generation of the faults in the upper crust and zones of the strain localization in the lower crust and upper mantle.

First we demonstrate that our modelling technique replicates strike-slip sandbox experiments (Shreuers and Colletta, 2002). Then in a series of models we study deformation of the heterogeneous lithosphere subjected to the plate scale strike-slip motion. General features of the lithospheric structure and distribution of temperature in the models are set up according to the data in the Dead Sea region. We investigate effects of different inherited 3D heterogeneities in the lithosphere, including (i) predefined fault in the upper crust, (ii) zone of mechanical weakness (low viscosity) in the crust and mantle lithosphere not parallel to the strike-slip direction, and (iii) variations of the lithospheric temperature and crustal thickness. The modelling shows that strike-slip deformation of such heterogeneous plate does generate pull-apart basins. We will discuss the question, which kind of the inherited heterogeneity could be responsible for the formation of the Dead Sea and will show the model predictions for its crustal and lithospheric structure.