The Dead Sea Transform (DST) fault system is a part of the Syrian-African rift system dividing African and Arabian plates that accommodated more than 100 km of left-lateral transform displacement. Despite the area of the DST is tectonically active during at least last 17 Myr (Krienitz et al., 2009), heat flow lower than $50 \text{mW/m}^2$ is reported for the area. The value of $50 \text{mW/m}^2$ is consistent with the thickness of the lithosphere of more than 120 km while observed thickness of the lithosphere at the DST area is 70-80 km, according to seismic data (Mohsen et al., 2005). This discrepancy means that lithosphere around DST was thinned in the past and related high heat flow had not enough time to reach the surface. However, it remains unclear which thickness had the lithosphere before the thinning and when the thinning has occurred. To find the appropriate values for the parameters, we use a gradual complication approach. At the initial stage we solve a number of 1D thermal transient problems. Resulting transient geotherms in combination with additional constraints allow us to constrain magnitude and time of lithospheric reduction to 50-70 km and 15-22 Ma, respectively (fig.1).

At the second stage we use 2.5D thermomechanical modeling technique (Sobolev et al., 2005) to model thermal evolution and deformation at the 1000 km transsection of the lithosphere from Mediterranean to Arabian platform, crossing the DST near the Dead Sea (fig.2). As an initial setup we use simplified geometry of the lithosphere-asthenosphere boundary and lithospheric structure according to available geophysical data. The lithospheric thickness is reduced within the 200 km -wide domain beneath the DST. The ranges for the time and for the magnitude of the lithosphere thinning are given by the 1D model (fig.1). The 2.5D model allows using additional constraints for the model such as evolution of a surface topography and rheological patterns beneath the DST fault.

Figure 1. Stacked results for 1D thermal models set. Shaded polygons reveal the areas where the results of the modeling fit the constraints for 15Myr, 20Myr and 25Myr modeling time. Red and blue stars show set of parameters for “hot” and “cold” models respectively (see also fig.3).
Figure 2. Temperature distribution after 25Myr modeling time. The dashed and solid lines indicate the initial and final positions of the lithosphere-asthenosphere boundary (LAB). The white dashed line bounds the region of initial invasion of the hot plume material. Model name (e.g. 160_80) correspond to the model where lithosphere is thinned from 160 km to 80 km.

In addition we use the brittle brick stretching (BBS) approach (Petrunin and Sobolev, 2006, 2008) and estimate the present-day thickness of the brittle layer near the DST as 20-22 km. As a result of the 2.5 D modeling, we significantly narrow down the ranges of model parameters. At the final stage we check the obtained parameters using the 3D model of the Dead Sea basin similar to (Petrunin and Sobolev, 2006) that gives good correlation with the sedimentary subsidence rate and present-day geometry and crustal structure of the basin, i.e. more than 10 km thick sediments without significant displacement of Moho and intracrustal seismic boundary (Mechie et al., 2009).

“Hot” models:

“Cold” models:

Figure 3. Cross-section of the lithosphere through the Dead Sea Basin after 100 km of strike-slip displacement along the DST. “Hot” models (upper row) fit well all the constraints. “Cold” models, (excepting the 160_90 model) reveal deflection at the Conrad boundary. Model name (e.g. 160_80) corresponds to the model where lithosphere is thinned from 160 km to 80 km. Heat flow numbers mean present day surface heat flow at the flanks of the basin achieved in the model after 105 km of strike-slip displacement.
Parameter search using geophysical constraints in 1D thermal model as well as 2.5D and 3D thermo-
mechanical models suggest an initial thickness of lithosphere between 160-180 km and more likely around
160 km. Thermal transient state of the lithosphere after thermal erosion at about 20Myr allows to reconcile
apparent inconsistencies: (i) Minimum present-day surface heat flow around 50-53 mW/m², (ii) Current
thickness of lithosphere between 70-90 km, (iii) Today’s absence of earthquake in the upper mantle.

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