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A numerical model of the evolution of the Dead Sea transform during the Neogene

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We investigate, by numerical models, the tectonic evolution of the eastern Mediterranean margin during the Neogene, and constrain the parameters leading to the development of the Dead Sea transform. This area underwent a complex tectonic history during the Neogene with stress rotations between Early and Late Miocene which are well pronounced in the central and northern part of the eastern Mediterranean coast. Using a plane-stress finite element modeling, we discuss the relations between this evolution and the opening of the Gulf of Aden and Red Sea in the south, the closure of the Tethyan Ocean in the north and the rheological heterogeneities of the crust. Our results reveal that, in the Neogene, the forces along the northern collision zone between Africa-Arabia and Eurasia vary from west to east. Collision forces dominate along the northern Mediterranean border whereas slab-pull forces control the north-eastern Arabian plate border. The ridge-push forces,existing up to the northern Red Sea, led to the initiation of the Dead Sea transform in Late Miocene times. Its propagation across the western part of the Arabian plate was controlled by the crustal thickness contrast between this thick continental crust and the thinned crust in the Levant basin. An evolution model of the Dead Sea transform is then proposed. The transform boundary initiated simultaneously in the south at the northern end of the Red Sea and in the north along the collision belt between the Arabian plate and the Anatolian sub-plate. Following local complex strain distribution in the triple point Suez-Aqaba-Red Sea area, the southern segment of the transform propagated faster than the northern one and accumulated more displacement. In this model, the bending of the transform along its central segment is a primary feature and resulted from the fault-related weakening of the Palmyrides basin in relation with its earlier inversion.