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The role of continental collision in the separation of Arabia from Africa and the formation of the Dead Sea Fault

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The separation of Arabia from Africa has been proposed to result from the collision-induced stress field in the NE corner of the former African plate (see Bellahsen et al., ESPL, 2003). Using this proposed mechanism as a starting point we numerically model the lithospheric stress field resulting from the collision induced changes in boundary forces, with emphasis on temporal and spatial variations. The collisional segment of the Africa/Arabia–Eurasia plate boundary gradually increases in length in E-SE direction. The stress field results show overall SW-NE tension in Arabia just prior to collision, followed by a drastic reduction in tensional stress upon collision. In the vicinity of the Owen Fracture Zone, however, tensional stresses remain high. At the same time the stress level in the Red Sea region is very moderate, thus not indicating simultaneous rifting. Since the initiation of rifting postdates the collision, we consider the high tensional stresses (after collision) at the eastern boundary to have started rift formation (in the present-day Gulf of Aden) towards the Afar region.
Upon incorporation of a propagating rift the model results show two important changes: (1) near the tip of the propagating rift, stress concentration leads to high tensional stresses, and the rifting process appears to becomes self-sustaining; (2) the orientation of the tensional stress axis rotates clockwise with the changing boundary conditions along the plate contact during ongoing collision and rift propagation. When the rift arrives in the northern part of the Red Sea area, the direction of the tensional stress axis has rotated towards NW-SE, promoting rifting in the Gulf of Aqaba, rather than in the Gulf of Suez region.
We further explore the role of the (evolution of the) subduction/collision process in, specifically, the formation of the Dead Sea Fault. In particular, we address the following three questions: (a) Was collision induced rifting able to create the present-day Dead Sea Fault as a new plate boundary, over its entire length ? (b) Did the stress field evolution originally favor a northward continuation of the southern part of the Dead Sea Fault into an off-shore direction to the northwest? And: (c) What is the relation between the Cyprus Arc and the Dead Sea Fault? As a result, we present a model for the formation of the Dead Sea Fault, with specific causes for the formation of the southern, the central and the northern segments.