Numerical simulation of structural growth in the Lebanese restraining bends, Dead Sea fault system

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Strike-slip structures are rarely validated because commonly used 2D restoration techniques are not applicable. Here we present the results of 3D numerical simulation of the restraining bends in Lebanon using boundary element methods of fault deformation implemented in MOVE™. The Lebanon restraining bend is the largest transpressional feature along the Dead Sea Transform (DST), and consists of two mountain ranges: Mount Lebanon on the west, dominated by the active Yammouneh fault, and the Anti-Lebanon Range to the east, influenced by the Serghaya and other faults. We built a new 3D geometrical model of the fault surfaces based on previous mapping of faults onshore and offshore Lebanon, complemented by interpretation of satellite images and DEM, and analogy with experimental models of restraining bend or transpressional structures. The model was simulated in response to the regional stress produced by the left-lateral displacement of the Arabian plate. The simulation accurately predicted the shape and magnitude of positive and negative topographic changes and faults slip directions throughout Lebanon. Furthermore, this simulation supports the hypothesis that the formation of the Anti-Lebanon Range was influenced by the intersection of the DST with the older Palmyrides belt, resulting in failed restraining bend. In contrast, the structure of Mt. Lebanon is similar to laboratory experiments of a restraining bend without inheritance. In addition, our simulation presents an approach of how strike-slip structural models may be validated in areas where subsurface data are limited.