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Active transform fault zone at the fringe of Large pull apart basin: an example from north Dead Sea Basin

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The Dead Sea Basin is located along a step between two large segments of the sinistral Dead Sea transform fault and it is one of the deepest and longest continental grabens. We present a comprehensive study of the kinematics and the evolution of deformation along the Jericho Fault, the fault segment that borders the basin from the north. Our study incorporates geophysical data, geological observations, geodetic measurements and mechanical modeling.
Analysis of 17 deep and shallow seismic lines along the northern edge of the basin indicates recent subsidence, folding and oblique faulting along the Jericho Fault. The sub-vertical fault surface crosses the entire sedimentary sequence and typically widens to a few hundred meters width in the shallow subsurface. The subsurface three-dimensional structure of the basin in this area is interpreted as an asymmetric depression bordered on the east and on the west by long monoclinic folds. The thickness of the sedimentary fill varies from about 1.4 km near the present lake shores to a few hundreds of meters, about 10 km northward. The subsidence is partitioned between a vertical component of slip along the Jericho Fault, and the simultaneously active monoclines bordering the basin. The instrumental seismologic catalog shows that the area south to the northern border of the Dead Sea lake is one of the most active parts in the basin, but at the same time the Jericho Valley (e.g., the ∼15 km zone north of the lake) is seismically silent. Outcrops and trenches across the Jericho fault display faulted Late-Pleistocene and Holocene sediments which generate up to 200 m width near-surface deformation belt. In places, it consists of faults with indications to horizontal and vertical displacement components, tilted blocks and folds. GPS measurements indicate that the fault is locked for strike slip motion while orthogonal extension by creep occurs at shallow depths, between 0.3-3 km.
3-D mechanical modelling of the regional evolution reconstructs the present basin architecture in the uppermost part of the crust and demonstrates the generation of flexures along the basin margins. Numerical modelling shows that the basin asymmetry and the association of folds and fault are long-term response of the upper crust to the coupled regional subsidence and strike slip motion.