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Intraplate crustal deformation within the northern Sinai Microplate: Evidence from paleomagnetic directions and mechanical modeling

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We present a new examination of the intraplate crustal deformation of the northern Sinai Microplate based on paleomagnetic and geodetic observations as well as elastic and elasto-plastic modeling. Previous studies have suggested that distributed deformation found in Lebanon and southwest Syria, near the northern part of the Dead Sea Fault system, is accommodated by regional uniform counterclockwise rigid block rotations. However, remanent magnetization directions observed near the Lebanese restraining bend are not entirely homogeneously-distributed suggesting that an unexplained and complex internal deformation pattern exists. In order to better understand the nature of these variations we construct a set of crustal mechanical models that aims to fit the geodetic as well as the paleomagnetic constraints. The models simulate both the localized deformation induced by motion along these faults and the broad scale regional deformation caused due to the obliqueness of the plate boundary with respect to the plate motion slip vector. The mechanical modeling predicts heterogeneous distribution of localized rotations around the faults and varying degree of regional counterclockwise rotations across the entire region. They also reveal different mechanical properties of Sinai and Arabia Plates. The combined rotation field generally matches the observed magnetization directions. The new modeling results unravel important insights to the mechanical properties of Sinai and Arabia Plates and to the fashion in which crustal deformation is distributed within the northern part of the Sinai Microplate.