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Numerical modeling of salt-based mountain belts with pre-existing basement faults: application to the Zagros fold and thrust belt, southwest Iran

Faramarz Nilfouroushan (1,2), Russell Pysklywec (2), Alexander Cruden (2,3), and Hemin Koyi (1)

(1) Uppsala University, Earth Sciences, Uppsala, Sweden (faramarz.nilfouroushan@geo.uu.se, 0046 184712591), (2) Department of Earth Sciences, University of Toronto, 22 Russell St, Toronto, ON M5S 3B1, Canada, (3) School of Geosciences, Monash University, Melbourne, VIC 3800, Australia

Two-dimensional thermal-mechanical models of thick-skinned, salt-based fold- and thrust belts, such as the Zagros, SW Iran, are used to address: 1) the degree of deformation and decoupling between cover and basement rocks due to the presence of a weak salt detachment; 2) the reactivation potential of pre-existing basement normal faults due to brittle or ductile behavior of the lower crust (as related to cold or hot geothermal gradients); and 3) variations in deformation style and strain distribution. The geometry and kinematics of the orogenic wedge and the activity of pre-existing basement faults are strongly influenced by the geothermal gradient (defined by the Moho temperature, MT) and basement rheology. We infer that the MT plays a major role in how the lower and upper crust transfer deformation towards the foreland. In relatively hot geotherm models (MT = 600°C at 36 km depth), the lowermost basement deforms in a ductile fashion while the uppermost basement underlying the sedimentary cover deforms by folding, thrusting, and displacements along pre-existing basement faults. In these models cover units above the salt detachment are less deformed in the hinterland. In relatively cold geotherm models (MT = 400°C at 36 km depth), deformation is mainly restricted to the hinterland of the models where basement imbricates form. Detachment folding, thrusting and gravity gliding occur within cover sediments above uplifted basement blocks. Gravity gliding contributes to a larger amount of shortening in the cover compared to the basement.