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Modelling the role of basement block rotation and strike-slip faulting on structural pattern in the cover units of fold-and-thrust belts

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A series of scaled analogue models are run to study the degree of coupling between basement block kinematics and cover deformation. In these models, rigid basal blocks were rotated about vertical axis in a "bookshelf" fashion, which caused strike-slip faulting along the blocks and, to some degrees, in the overlying cover units of loose sand. Three different combinations of cover basement deformations are modeled; cover shortening prior to basement fault movement; basement fault movement prior to shortening of cover units; and simultaneous cover shortening with basement fault movement.

Model results show that the effect of basement strike-slip faults depends on the timing of their reactivation during the orogenic process. Pre- and syn-orogen basement strike-slip faults have a significant impact on the structural pattern of the cover units, whereas post-orogenic basement strike-slip faults have less influence on the thickened hinterland of the overlying fold-and-thrust belt. The interaction of basement faulting and cover shortening results in formation of rhomb features. In models with pre- and syn-orogen basement strike-slip faults, rhomb-shaped cover blocks develop as a result of shortening of the overlying cover during basement strike-slip faulting. These rhombic blocks, which have resemblance to flower structures, differ in kinematics, genesis and structural extent. They are bounded by strike-slip faults on two opposite sides and thrusts on the other two sides. In the models, rhomb-shaped cover blocks develop as a result of shortening of the overlying cover during basement strke-slip faulting. Such rhomb features are recognized in the Alborz and Zagros fold-and-thrust belts where cover units are shortened simultaneously with strike-slip faulting in the basement.

Model results are also compared with geodetic results obtained from combination of all available GPS velocities in the Zagros and Alborz FTBs. Geodetic results indicate domains of clockwise and anticlockwise rotation in these two FTBs. The typical pattern of structures and their spatial distributions are used to suggest clockwise block rotation of basement blocks about vertical axes and their associated strike-slip faulting in both west-central Alborz and the southeastern part of the Zagros fold-and-thrust belt.