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An experimental approach to active tectonics of the Alborz Mountains, northern Iran

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This paper uses results of scaled sand-box models to simulate the influence of changing in direction of the South Caspian basin motion since 12 Ma on the active tectonics and structural styles of the Alborz Mountains. It has been reported that movement of the South Caspian basin caused dextral displacement on the NW-striking faults in the Talesh and the western Alborz and sinistral movement on the NE-striking faults in the eastern Alborz between middle Miocene to Pliocene ($\sim$ 12-5 Ma). Onset of westward movement of South Caspian basin relative to both Eurasia and the Alborz since Pliocene ($\sim$ 5 Ma) was recorded synchronous with the kinematic reversal on the NW-striking dextral strike slip faults.

Focusing on geometry and kinematics of active faulting in upper continental crust, the models presented in this study are scaled geometrically and kinematically to the Alborz. Several models with the same stratigraphy were shortened by a rigid indenter in two phases. A first phase of north-south orthogonal shortening is followed by a second phase of oblique NE-SW shortening (30 degrees to the orthogonal shortening). During the orthogonal shortening a progressive series of oblique thrusts developed in front of the indenter. Unlike what has been reported, a component of sinistral and dextral movements was recorded along the WNW- and ENE- striking frontal oblique thrusts, respectively. The amount of strike-slip displacement increases away from the central

part of the indenter towards the sides (i.e. east- and westward). With progressive deformation, overlapping oblique back-thrusts developed in the immediate vicinity of the indenter. During the second phase, the oblique shortening was associated with the onset of sinistral oblique slip movement along the active deformational front, which showed an increase in amount of sinistral motion from the east to the west. Some of the former dextral oblique thrusts showed reverse kinematics during this progressive oblique shortening. This reversal in the sense of movement was promoted by the fact that these pre-existing dextral oblique faults were trending in the preferred orientation relative to direction of the oblique shortening (N30E). In general, during this phase of deformation, sinistral motion is prevailing on the active southern deformational front and NE-striking strike-slip faults.

Model results show that kinematics reversal of the dextral oblique thrusts could be due to a change in the regional stress field between the Alborz and South Caspian basin since ca. 5 Ma. In addition, increasing slip-rate along the active frontal oblique thrusts from east to west, shown by the models and are consistent with the preliminary geomorphological and paleoseismological studies, have implications in determination of earthquake recurrence time and seismic risk assessment in the heavily populated urban areas along the southern foothills of Alborz.