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Fold-and-thrust belt curvature in the Fars region, eastern Zagros, achieved by variable thrust slip vectors and fault block rotations

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Many fold-and-thrust belts are curved in plan view, but the origins of this curvature are debated. Understanding which mechanism(s) is appropriate is important to constrain the behaviour of the lithosphere during compressional deformation. Here we analyse the active deformation of the Fars Arc region in the eastern part of the Zagros, Iran, including slip vectors of 92 earthquakes, published GPS and palaeomagnetism data, and the distributions of young and/or active folds. The fold-and-thrust belt in the Fars Arc shows pronounced curvature, convex southwards. Folds trends vary from NW-SE in the west to ENE-WSW in the east. The GPS-derived velocity field shows NNE to SSW convergence, towards the foreland on the Arabian Plate, without dispersion. Earthquake slip vectors are highly variable, spanning a range of azimuths from SW to SSE in an Arabian Plate reference frame. The full variation of azimuths occurs within small (10s of km) sub-regions, but this variation is superimposed on a radial pattern, whereby slip vectors tend to be parallel to the regional topographic gradient. Given the lack of variation in the GPS vectors, we conclude that the Fars Arc is not curved as a result of gravitational spreading over the adjacent foreland, but as a result of deformation being restricted at tectonic boundaries at the eastern and western margins of the Arc. Fault blocks and folds within the Fars Arc, each ∼20-40 km long, rotate about vertical axes to achieve the overall curvature, predominantly clockwise in the west and counter-clockwise in the east. Active folds of different orientations may intersect and produce dome-and-basin interference patterns, without the need for a series of separate deformation phases of different stress orientations. The Fars Arc clearly contrasts with the Himalayas, where both GPS and earthquake slip vectors display radial patterns towards the foreland, and gravitational spreading is a viable mechanism for producing fold-and-thrust belt curvature.