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Sin-folding extensional deformation in the Anaran Anticline (Zagros, Iran).

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Reservoir-scale anticlines in thrust and fold belts are frequently characterized by the presence of extensional structures, like joints, veins and normal faults, striking roughly parallel to the fold axial trend (e.g. Stearns, 1968; Srivastava and Engelder, 1990; Price and Cosgrove, 1990; Lemisky et al., 1994; Grhaam et al., 2003; Tavani et al., 2008). These longitudinal extensional structures commonly develop during the growth of the hosting anticline and indicate that, during folding, [U+F073][U+F033] orients parallel to the shortening direction. Outer-arc extension is commonly indicated as the deforming mechanism able to explain the local inversion between [U+F073][U+F031] and [U+F073][U+F033] (e.g. Price, 1966; Fischer and Wilkerson, 2000). However, the role of the outer-arc extension in the development of sin-folding extensional structures is especially complex to evaluate in anticlines having a rather constant axial trend, where maximum curvature, topographic slope, and regional remote stress field are roughly coaxial. On the contrary, thrust-related anticlines characterized by strongly variable axial trends allow discriminating the role of each component in the development of longitudinal extensional structure.
In this work we present the case of the Anaran anticline (Zagros fold-and-thrust belt, Iran). This south verging anticline is characterized by a roughly E-W axial trend, which in detail ranges from ENE-WSW to NW-SE. Map scale extensional faults affect the crest and the forelimb, being clustered in two sets striking parallel (set 1) and at about 45º (set 2) from the local fold axis, respectively. These two different sets are located in different fold segments, oriented perpendicular (set 1) and oblique (set 2) to the shortening direction, respectively. Their location, orientation and angular relationships with the fold axial trend indicate a clearly syn-folding origin. However, these structures do not show relationships with curvature. A possible explanation, alternative to outer arc extension, invokes a drastic decreasing of the sub-horizontal stress components during folding. In such a scenario, "weak" stress components, active in the upper structural levels of the anticline, can reorient the sub-horizontal components of stress field and, accordingly, can determine the orientation of the normal faults. In the case of the Anaran anticline, the development of set 2 is interpreted as related with a right lateral strike slip contribution along the oblique sector of the anticline. In the central sector, where the fold axial trend is almost perpendicular to the regional shortening direction, set 1 development is interpreted as mainly induced by the topography relief.

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