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Flexural-slip mechanism in plunging folds. Example from N-S folds in the South Pyrenean thrust front, Central Pyrenees (Spain)

Ruth Soto (1), Antonio M. Casas-Sainz (2), Cristina García-Lasanta (2), and Esther Izquierdo-Llavall (2)

(1) Instituto Geológico y Minero de España, Unidad de Zaragoza, Zaragoza, Spain, (2) Dpto Ciencias de la Tierra, Zaragoza University, Zaragoza, Spain

This work deals with the analysis of slickenfibres as kinematic indicators in plunging folds located in the External Sierras, Central Pyrenees (Spain) to unravel the history of oblique superimposed folding. The External Sierras constitute part of the emergent frontal thrust of the South Pyrenean thrust and fold belt. The studied folds are oriented N-S, perpendicular to oblique to the main WNW-ESE direction of the frontal Pyrenean thrust in this area and they are located at the hanging wall of this frontal thrust. The axial traces of these folds can be followed for 2 km and they present angular to rounded hinges and rectilinear to curved limbs. Their axes plunge between 10 and 40º towards the North, which has been interpreted to be the result of the folds position over a N-dipping footwall ramp with an average dip of 30º.

Thirteen sites were studied in six of these N-S folds, where slickenfibres on bedding surfaces were measured. All sites but one are located in fold limbs and only one site is located at the hinge of an anticline. Most slickenfibres measured on bedding surfaces at the flanks are orthogonal with respect to the fold axis and show a reverse and sinistral movement, indicating a flexural-slip mechanism during folding. However, some sites at the flanks show slickenfibres oriented parallel (2 sites) and oblique (4 sites) with respect to the fold axis. In order to explain these oblique slickenfibres, two geometrical models have been proposed related to the possible kinematics of folding: (1) two sequential stages of folding, first N-S and then WNW-ESE, and (2) simultaneous WNW-ESE (Pyrenean) and N-S folding. A clear relationship between the obtained data and one of the proposed models does not exist, although they rather support the first hypothesis, what is consistent with the clockwise rotation of the sedimentary cover of the External Sierras during the Eocene. Several factors preclude the univocal correspondence between the data and the proposed models: (i) ocurrence of bedding parallel stylolites in limestones, which difficult the flexural-slip movement of beds, (ii) different folding mechanisms in different folds and/or (iii) elimination of previous slickenfibres during subsequent folding stages by newly formed fibres.