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Kinematics of a curved structure: paleomagnetic constraints on the Balzes anticline (Southern Pyrenees)

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Paleomagnetic data are very useful to accurately estimate values of VAR at the structure scale. At the same time, this tool can contribute significantly to unravel story of kinematics and emplacement of fold and thrust belts along the time but unfortunately, detailed studies at small scales are very limited until today. Special requirements as syntectonics and synrotational series as well as obliquity are necessary to provide the correct information and these needs probably have limited the studies on the topic. Nevertheless, the unravelling of the detailed evolution of oblique structures would significantly improve the understanding of complex fold and thrust belts in 4D. Although the obliquity may have different origins, paleomagnetism is the only tool to prove if they are primary or secondary (and related with vertical axis rotations). Additionally, the study of velocities of rotation an acceleration rates are very important to understand how a thrust belt is able to accommodate the room problems related to VARs and how the stress and strain fields vary in relation to the origin of these oblique structures.

The External Sierras represent the outcrop of the Southern Pyrenean sole thrust, characterized by many oblique structures (WNW-ESE). Here we present the case-study of Balzes anticline, the easternmost oblique structure of the External Sierras. It is a 17Km long, continuous, arched structure in which we have performed a dense paleomagnetic study (75 sites) to unravel the origin of its curvature (50° of arc in map-view). The availability of syn-folding and syn-rotational materials enables us to decipher the complete kinematics history of the fold. Reliable paleomagnetic directions (>500 specimens from more than thousand demagnetizations) from Ypresian to Priabonian rocks, were defined with 6 steps in average. The ChRM was mostly unblocking up to 420°C and 575°C (85%) some at 675°C (15%). This single component direction displays two polarities and passes the fold test.

Individual paleomagnetic sites display clockwise rotations related with curvature with ranging values from cero to > 80°. A good-quality regression can be calculated (VAR= - 46° + 0,511 * TREND [R = 0.9724]), and it reveals the addition of primary and secondary curvatures and the original (primary) curvature can be reconstructed. Synfolding materials attest for a Middle-Late Lutetian major folding event recorded in a progressive unconformity (Santa Marina). The rotational velocity has been also recorded (5.2°/M.a.) as well as the rotation period (Lutetian-Bartonian). They can be determined taking into account additional magnetostratigraphic data and these rate and ages are in agreement with previously published from the South Pyrenean front.