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Salt structures and vertical axis rotations; a case study in the Barbastro-Balaguer anticline, Southern Pyrenees.

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Vertical axis rotations are common in all deformation settings. At larger scales, for example in fold and thrust belts, they are usually related to differential shortening along strike and this may be caused by a number of reasons (interplay of plate boundaries, sedimentary wedges, detachment level distribution, etc.). At smaller scales, local stress fields, interference of non-coaxial deformation phases, development of non-cylindrical structures, etc. may play an important role to accommodate significant magnitudes of rotation. Apart from their implication in the truly 4D understanding of geological structures, the occurrence of vertical axis rotation usually precludes the application of most 3D restoration techniques and thus, increases the uncertainty in any 3D reconstruction. Salt structures may form in different geological settings, but focusing on compressive regimes, very little is known about the relation between their geometry and kinematics and their ability to accommodate vertical axis rotations (i.e. local or regional lateral gradients of shortening).

The Barbastro-Balaguer anticline (BBA) is the southernmost structure of the Central Pyrenees. It is a large detachment fold spreading more than 150 km along the front. In contrast to most frontal Pyrenean structures, the BBA is detached in Priabonian evaporites and was folded during Oligocene times as witnessed by well exposed growth strata. Along strike changes in the fold axis trend may reach 50°, an overall the anticline displays a convex shape towards the foreland (south). A residual Bouguer anomaly map based on a densely sampled gravimetric surveying (10.000 stations) has helped delineating a heterogeneous distribution of the Eocene detachment level in the subsurface.

In this contribution we explore the interplay between vertical axis rotations, detachment level distribution and the fold geometry (structural trend and style based on hundreds of data). Seventy paleomagnetic sites evenly and densely distributed along the structure have been analyzed for this purpose. About 600 standard specimens have been thermally demagnetized in the Paleomagnetic Laboratory of the Burgos University (ASC TD48DC thermal demagnetizer and 2G superconducting magnetometer). Data processing has been carried out with the VPD program, applying standard PCA and virtual direction analyses. The ChRM directions passes the fold test and display two polarities, pointing to the primary character of the magnetization (key factor for the 3D restoration). This large dataset allows us to draw a robust network of rotation magnitudes along strike the western sector of the BBA that are key to understand its kinematics together to the aforementioned factors. We also pretend to use this network of vertical axis rotations to restore in 3D this salt structure.