



Magnetostratigraphy of Eocene syntectonic sediments in the Balpez anticline (southern Pyrenees): laying the foundations for 3D & 4D reconstructions.

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The Balpez anticline is the eastern and southernmost structure of the External Sierras front in the Southern Pyrenees. Together, with the Boltaña anticline represent a set of remarkable oblique structures between the Jaca and Ainsa basins being a key area of deformation transference. Previous paleomagnetic studies in the area have demonstrated the occurrence of important clockwise rotations (up to 80°) denoting an important gradient of shortening (diminishing to the west). Both structures grew up mostly during lower and middle Eocene times, a key period in the configuration of the South Pyrenean marine basins. Except for some sections including the Iberian stratotype (upper Tertiary and lower Ypresian), this important time gap has received very little attention from the magnetostratigraphic point of view in the entire South Pyrenean Basin. Therefore an accurate and continuous dating in the Balpez anticline will allow attaining an accurate age for: 1) the lower middle Eocene sedimentary sequence, 2) the deformation (folding and thrusting), 3) the South Pyrenean sole thrust rotational movement, 4) moreover, the paleomagnetic study can give very valuable and precise rotation values.

Two long magnetostratigraphic sections were sampled in the Balpez anticline. The SIV section (500 m) is located in the southeastern limb of the anticline, comprising Cuisian and lower Lutetian (Boltaña and Guara Formations). The BZ section (450 m) is located in the northernmost outcrops of the structure, where a progressive uncon-

formity affects the Lutetian limestones in the western limb (Guara Formation). More than 400 standard cores were sampled with a water-refrigerated drilling machine giving an averaged out of a sample every 2 - 3 meters of section. Paleomagnetic analyses comprised detailed progressive thermal demagnetization (steps every 25-50°C) to unravel the NRM components as well as some magnetic mineralogy experiments (IRM and Thermal demagnetization of IRM three components). These measurements were conducted in the University of Burgos laboratory by means of a 2G – 655 cryogenic magnetometer, an ASC TD-SC oven and a M2T-1 pulse magnetizer. Susceptibility was monitored with a KLY-4 during the thermal treatment to control possible mineralogical changes. Some pilot AF demagnetizations were not able to satisfactorily remove the NRM. Besides recent overprints, at low temperatures, only one paleomagnetic component can be distinguished and unblocks from 200° - 250° up to 450°C - 575°. This component presents two polarities, passes the fold test and seems to be a reliable record of the Eocene magnetic field. Comparison between the local sequence and the global polarity time scale (GPTS) shows a good correlation; chrons C23 to C20 were unambiguously identified in the SIV section. C21r to C18r chrons are expected to be found in the ongoing BZ section as regards of pilot studies carried out in other locations of the Guara Fm (Isuela valley). A remarkable result in SIV section is the lack of coincidence between the base of the Guara Fm. and the base of the Lutetian as it was previously assumed. This study demonstrates that the onset of the Guara platform sedimentation started within the normal polarity of chron 22 during Cuisian (Ypresian) times.

Considering the difference between the local mean direction (DEC=015, INC=32; $\alpha_{95}=4.8^\circ$, $k=5.4$, $n=109$) and the Eocene reference of Iberia (DEC=003, INC=52, $\alpha_{95}=2^\circ$, $k=11$), a statistically significant but small clockwise rotation ($\approx 10^\circ$) was deduced in the southern part of Balzez Anticline (SIV section). The northern section (BZ), currently in progress, is expected to display much larger values of rotation in agreement with previous paleomagnetic data from the northern Boltaña anticline. However this small angle of CW fits perfectly within the regional trend if the fold axis curvature is considered; the northern sector (BZ) of the anticline trends N010E (as Boltaña) since the southern (SIV) displays a N105E orientation, closer to the Pyrenean frontal structures.

This chronological frame attained from magnetostratigraphic analysis will allow for the foundations of a truly 3D reconstruction and restoration to be established. The potentially large structural dataset, due to the excellent outcropping conditions, and the vast seismic information derived from oil exploration together with the isochrones obtained from the magneto-chron boundaries will permit a detailed-scale and accurate 3D reconstruction of the structure. Besides, the precise chronology of deformation

will constrain the fold kinematics, variable key during the cross- section restoring. Magnetostratigraphic profiles and other paleomagnetic sites around the structure will also give referenced vectors that will allow the use of real 3D reference elements during the restoration.