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Kinematic evolution of an intracontinental convergent orogen from the analysis of syntectonic sediments in piggy-back basins. Application to the South-Central Pyrenees

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The Pyrenees are an asymmetric, doubly vergent orogen formed by the collision between the European and Iberian plates from late Cretaceous to Miocene times. The high subsidence rates in the South-Central Pyrenees intramontane basins and the fact that the South Pyrenean foreland basin became endorheic from Late Eocene until Middle Miocene times favoured an unusual and excellent preservation of thick packages of synorogenic sediments on its southern flank.

Analysis of synorogenic sediments preserved in sedimentary basins adjacent to an orogen contributes significantly towards a better understanding of the coupled evolution of the mountain belt and the basin. Geometric relationships between tectonic structures and synorogenic materials provide a relative chronology of events, however the precise timing and rate of deposition and deformation can only be attained with absolute ages. Magnetostratigraphy provides near-continuous absolute ages of sedimentary successions, allowing timing and quantification of the tectonic processes to be determined when applied to syntectonic sediments. Additionally, ages provided by detrital thermochronology, especially if combined with in-situ thermochronology of the source region, yield constraints on the exhumation (timing, magnitudes and rates) and tectonic history of the orogen as well as changes in sediment provenance and landscape evolution.

In this work we present the Cenozoic kinematic evolution of the South-Central Pyrenees, integrating structural, sedimentological, magnetostratigraphic, magnetotectonic and thermochronological analyses of synorogenic strata. The magnetostratigraphic and thermochronological ages obtained permit the link between the sedimentation rates in the surrounding basins and the exhumation rates in the hinterland. This reveals that accommodation space was the main control on sedimentation rates within the piggy-back basins. Our results highlight a strong relationship between the structural evolution of the South Pyrenean thrust system, thrusting and exhumation in the Axial Zone and the stratigraphic record of the synorogenic materials preserved in intramontane basins. Tectonic forces controlled not only the observed patterns of exhumation but also the evolution of the synorogenic topography of the piggy-back and foreland basins, and hence depositional features of the synorogenic sediments.