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The role of rift inheritance during Cenozoic mountain building of the central Pyrenees and geodynamic implications

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Providing accurate estimates of shortening, as well as the duration and vertical amplitudes of tectonic events in collisional orogens is critical to better understanding the retroactions between the distribution of crustal deformation and surface processes during mountain building. However, structural and bedrock geochronological constraints are usually lacking accuracy for the early stages of convergence that are generally overprinted by complex deformation patterns and synorogenic burial.

In this aim, we present new detrital low-temperature thermochronometry (detrital AFT dating, zircon (U-Th)/He ages) and geochronology (zircon U/Pb ages) on both flanks of the Pyrenean orogen. Combined with available in-situ thermochronometric constraints we examine the role of rift inheritance on the early stages of orogenesis. Together with foreland tectono-stratigraphic constraints and re-appraisal of the distribution of crustal deformation in the central Pyrenees, these new data offer the unique opportunity to precisely determine the kinematics on both sides of the Pyrenean mountain belt from Late Cretaceous to Miocene. Intermediate restorations are then produced for well-suited and key time intervals (Early Oligocene, Middle Eocene, Cretaceous-Paleogene transition, Late Campanian and Late Santonian) in order to examine the mass balance within the orogenic wedge.

This study shows that during the initial stage of contraction (83-68 Ma) exhumation rates were accommodated by a limited amount of underthrusting. Acceleration of plate convergence in the Late Cretaceous, as inferred from plate reconstructions, is supported an exhumational event at $\sim$65 Ma. At this time, the North Pyrenean flysch basins were inverted on top of an inherited S-dipping crustal detachment that previously exposed lithospheric mantle (Pyrenean Lherzolites) to the surface during the mid-Cretaceous extension phase . The amount of accreted material from the Iberian crust increased significantly after the Paleocene continuing until the late Oligocene to form an antiformal stack of basement units in the backbone of the chain. Mass balance estimates show a long-term unsteady pattern of orogenic evolution characterized by a remarkable increase of erosional fluxes during the Late Eocene-Oligocene with no commensurate incoming flux of crustal material. This result appears consistent with a major renewal of rapid exhumation in the hinterland for which both internal and external drivers are discussed.