

Zircon (U-Th)/He evidence for pre-Eocene orogenic exhumation of eastern North Pyrenean massifs, France

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Orogens and their associated foreland basins are considered as part of a single dynamic system evolving from an early, non equilibrated, growth stage to a late, mature, steady-state stage. Most of our understanding in foreland basins, in particular early convergence-stage deposition, comes from the subducting plate, so that the classic paradigm for foreland basins is the pro-wedge. Models that clearly depict the relationship between erosion of the orogenic wedge and sedimentation into its associated foreland basin only focus on the late post-orogenic phase. Relatively little is known and understood about the very long phase of initiation of orogenesis. In the doubly wedged Pyrenean orogen, where we know and understand relatively little about how the early retro-wedge developed, the record of the onset of orogenic denudation from massifs is quite limited, not only in time but also in space.

As part of the OROGEN project funded by TOTAL and the BRGM, this study presents first single-grain zircon (U-Th)/He data from two Palaeozoic massifs of the external Northern Pyrenean Zone, the Agly and Salvezines massifs. It aims at constraining the exhumation history of eastern Pyrenean massifs and understanding what is their significance for early orogenic wedge growth.

The Pyrenean orogeny was generated from end Santonian (84 Ma) to Oligocene-Miocene due to convergence of the Iberian and European plates. Aquitaine foreland basin history (Ariège region) indicates that convergence took place in two phases, Campanian to Maastrichtian and Eocene, separated by a quiet Paleocene phase. Yet, only Eocene cooling events are recorded by low-temperature thermochronometers in the central Pyrenean massifs (Arize and Trois-Seigneurs).

Nine bedrock samples were collected along a WNW-ESE traverse (Salvezines and Saint-Arnac granites, Belesta-Caramany gneisses) and analysed for ZHe dating. Zircon (U-Th)/He data for the Agly and Salvezines massifs, together with forward modelling of data for two end-members, Late Cretaceous (Campanian, 75 Ma) and Eocene (50 Ma), show that the easternmost external basement massifs record a first phase of cooling from $\sim 200^{\circ}\text{C}$, between ca. 75 Ma and ca. 60 Ma, which we correlate with the early Pyrenean orogenic phase. Our data provide important new constraints on the timing of early Pyrenean exhumation and temperatures associated with pre-orogenic HT-LP metamorphism but have limited resolution in quantifying the amount of exhumation and shortening at the onset of the convergence in this region. These results are integrated into a tectonic reconstruction of the eastern Pyrenees from an early Cretaceous extensional template to present day