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Final « pop-up » structural reactivation of the internal part of an orogenic wedge: west-central Pyrenees

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Tectonics-sedimentation relationships are often used to describe the tectonic evolution of orogenic wedges. However, does the sedimentary record associated to the build-up of the wedge recall the entire tectonic history?

Numerous studies based on tectono-stratigraphic and thermochronological data, as well as numerical modeling, have demonstrated that on the large scale the growth of the Pyrenees is characterized by a southward propagation of the deformation (e.g., Muñoz, 1992; Morris et al., 1998; Fitzgerald et al., 1999; Beaumont et al., 2000). However, in the west-central Pyrenees, recent thermochronological data have suggested that the in-sequence propagation of the basement thrust system was followed by out-of-sequence (re)activation of hinterland structures after the South-Pyrenean Frontal Thrust had been sealed (Jolivet et al., 2007).

To better describe the structural evolution of the Pyrenean prism, we focused our work on a NNE-SSW transect from the northern piedmont (Bagnères-de-Bigorre), through the Axial Zone and down to the Jaca basin where tectonics-sedimentation relationships have been extensively described (e.g., Teixell, 1996). A crustal scale cross-section combined with detailed apatite fission track analysis are used as a case study to unravel in detail the deformation history.

Apatite fission track data from the Bagnères-de-Bigorre Paleozoic massif (central ages: 41-42 Ma) and the Lesponne Hercynian granite (central age: 31 Ma) located in the North-Pyrenean Zone and in the north of the Axial Zone, respectively, reveal Middle Eocene-Early Oligocene denudation ages of the northern part of the wedge. Immediately to the south, central ages around 24-20 Ma attest to a Latest Oligocene-Early Miocene denudation ages of the Chiroulet granite. According to the structural context, these results suggest a late exhumation stage associated with the tectonic (re)activation of north-vergent thrusts in the northern part of the Axial Zone.
Similarly, results from the southern flank of the Axial Zone and the northern part of the Jaca basin suggest a denudation age around 18 Ma (Meresse et al., this volume), which may be linked to out-of-sequence tectonic movements on a south-vergent basement thrust (Bielsa thrust, Jolivet et al., 2007).

In conclusion, thermochronological data reveal an Early Miocene “pop-up” exhumation of the internal parts of the Pyrenean wedge, which also shows that the Pyrenean compressional deformation ended later than the generally accepted Aquitanian age deduced from tectonics-sedimentation relationships. This late exhumation was achieved through out-of-sequence (re)activation of hinterland structures linked to a final internal thickening stage in the orogenic prism.