



Using apatite fission track thermochronology to document the deformation sequence in an exhumed foreland basin: an example from the southern Pyrenees.

F. Meresse (1), P. Labaume (1), M. Jolivet (1), and A. Teixell (2)

(1) University Montpellier 2, INSU-CNRS, Geosciences Montpellier, France, (2) Universitat Autònoma de Barcelona, Dept. de Geologia, Spain

Université Montpellier 2, INSU-CNRS, Laboratoire Géosciences Montpellier, cc060, 34095 Montpellier Cedex 5, France

florian.meresse@gm.univ-montp2.fr

The study of foreland basins provides important constraints on the evolution of orogenic wedges. In particular, the study of tectonics-sedimentation relationships is essential to date the tectonic activity. However, processes linked to wedge growth are not always completely recorded by the tecto-sedimentary markers, and thermochronological study of the basin-fill can provide further insights.

In this work, we have combined apatite fission track analysis (apatite FTA) with structural analysis to precise the timing of the deformation sequence and to characterise the coupling between thrust activity, burial and denudation in the south-Pyrenean foreland basin, a proximal foredeep of the Pyrenees that has been incorporated in the Pyrenean thrust wedge. We have focused the study on a NNE-SSW cross-section of the south-vergent thrust system from the southern flank of the Axial Zone to the South-Pyrenean Frontal Thrust (SPFT), in the west-central part of the belt. This section provides a complete transverse of the South-Pyrenean Zone, here corresponding to the Ainsa and Jaca basins.

Apatite FTA provides important new constraints on the south-Pyrenean foreland basin evolution:

(i) Data show the southward decrease of the fission track reset level, from a total reset (indicating heating at $T_{max} > 110^{\circ}\text{C}$) in the Paleozoic of the Axial Zone, to a partial reset ($110^{\circ}\text{C} > T_{max} > 60^{\circ}\text{C}$) in the lower-middle Eocene Hecho Group turbidites in the northern part of the Jaca basin, and to the absence of reset ($T_{max} < 60^{\circ}\text{C}$) in the middle Eocene-Oligocene continental sediments of the southern part of the Jaca basin. This indicates a decreasing amount of denudation going southwards, from more than 4.5 km in the north to less than 2.5 km in the south if we assume an average geothermal gradient around $25^{\circ}/\text{km}$. The structural setting of the Jaca basin attests that the burial of sediments was mainly due to sedimentary accumulation.

(ii) Results in the Hecho Group turbidites bring evidence of exhumation around 18 Ma on the Oturia thrust in the middle of the Jaca basin, an age that is younger than the Middle Eocene to Aquitanian deformation registered by tecto-sedimentary relationships in the southernmost part of the basin (Guarga syncline and SPFT). These tectonic movements may be related to the exhumation, at the same time, of the southern flank of the Axial Zone by out-of-sequence thrusting on the Bielsa basement thrust (Jolivet et al., 2007*).

Therefore, low-temperature thermochronology reveals an out-of-sequence episode of deformation in the interior of the south-Pyrenean thrust wedge that had remained unknown due to the lack of related sedimentary record. This late tectonic activity is younger than the generally admitted Aquitanian age for the end of the Pyrenean compression, and would be linked to an ultimate internal thickening stage in the orogenic wedge (Meresse et al., this volume).

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