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A coupled thermokinematic-depositional model of the Pyrenean mountain building

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This study presents a coupled thermokinematic-depositional model of the Pyrenees. The model has been designed for making use of constraints on the depositional history of foreland basin sequences, thrusting history and exhumation within the thrust wedge, and on climate evolution through erosion laws. Depositional facies in the foreland basin are reproduced by taking into account basin subsidence caused by the downgoing plate flexure, base level changes (eustasy) and the model influx of sediments from the growing orogen using undercapacity transport laws. Together with erosion/transport and tectonic modeling, the temperature-time paths of rock particles within the orogenic wedge are computed by solving 2D heat equations for diffusion and advection.

The development of the Pyrenean orogenic wedge is characterized by a marked change in exhumation and sedimentation at $\sim$36 Ma. At this time, the southern foreland became endoreic while the northern foreland basin was still connected to the Atlantic. Moreover, the Axial Zone recorded a drastic acceleration of the denudation. Tectonics, through the underplating of basement units in the Axial Zone, has been claimed to be at the origin of the fast exhumation. Conversely, climate change at the Eocene-Oligocene boundary has been considered as one of the main driving mechanisms for this increasing denudation. We aim here to examine in this model, which of the tectonics, the eustasy or the climate was the main driving mechanism of the relative base level rise observed in the Ebro basin and what was the role of baselevel changes in the northern Aquitanian foreland basin ? To constrain our model of the Pyrenees, we gather data on foreland basin subsidence from well data and field logging in the Ebro/Aquitain basin. The history of the Pyrenean collision wedge is constrained by available in-situ and detrital thermochronometric data including our recent findings in the northern Pyrenees, concerning tectono-sedimentary relationships in the frontal wedge-top basins. Finally, the Paleogene climatic evolution has been constrained by using a compilation of published data and our own dataset.