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Post-orogenic evolution of mountain ranges and associated foreland basins: Initial investigation of the central Pyrenees

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Mountain topography, including surrounding foreland basins, results from the long-term competition between tectonic and surface processes linked to climate. Numerous studies on young active mountain ranges such as the Southern Alps, New Zealand and Taiwan, have investigated the interaction between tectonics, climate and erosion on the topographic landscape. However most of the mountain ranges in the world are in various stages of post-orogenic decay, such as the European Alps, Urals, Caledonides, Appalachians and Pyrenees. The landscape evolution of these decaying mountains, which involve relatively inactive tectonics, should appear simple with progressive and relatively uniform erosion resulting in a general lowering of both elevation and topographic relief. However, in a number of examples, post-orogenic systems suggest a complex dynamism and interactions with their associated foreland basins in term of spatio-temporal variations in erosion and sedimentary flux. The complexity and transition to post-orogenesis is a function of multiple processes. Underpinning the transition to a post-orogenic state is the competition between erosion and crustal thickening; the balance of these processes determines the timing and magnitude of isostatic rebound and hence subsidence versus uplift of the foreland basin. It is expected that any change in the parameters controlling the balance of erosion versus crustal thickening will impact the topographic evolution and sediment flux from the mountain range and foreland basin to the surrounding continental margin.

This study will focus on the causes and origins of the processes that define post-orogenesis. This will involve analyses of low-temperature thermochronological and topographic data, geodynamical modelling and sedimentological analyses (grainsize distribution). The Pyrenees and its associated northern retro-foreland basin, the Aquitaine basin, will form the natural laboratory for the project as it is one of the best documented mountain range/foreland basin systems in the world. Initial results of a review of the low-temperature thermochronological data using inverse modelling, illustrates the asymmetric exhumation of the mountain range, and the diachronous timing of decelerated exhumation linked to the transition to post-orogenesis. This study is part of the Orogen project, an academic-industrial collaboration (CNRS-BRGM-TOTAL).