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Contributions of U-Pb dating of carbonates to deformation-fluid circulation relationships during the formation of the Pyrenees (France-Spain)

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We present recent advances in understanding the relationships between deformation and fluid circulation during the Pyrenean orogeny, which took place in the Cenozoic, and the preceding rifting in the Cretaceous. Through several case studies in France and Spain, we highlight the contributions of recent analytical techniques such as U-Pb dating of veins, faults, and carbonate cements, coupled with other recently developed proxies (Δ47) as well as more classical but essential approaches (mesostructural measurements, petrography, fluid inclusions, elemental compositions, etc.). We demonstrate the significance of the pre-orogenic history, particularly mantle exhumation and salt tectonics, in shaping the orogen and determining the types of fluids involved during compression, especially on the northern flank of the Pyrenees, with implications for energy resources. We also detail the progressive evolution of fluid nature towards an increasing meteoric influence during the construction of the orogenic prism, particularly evident on the southern flank. Finally, on a broader scale, we discuss the influence of this orogeny on intra-plate deformation, which may have been recorded as far as Ireland, despite the relatively modest size of the mountain range.