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Some aspects of the role of rift inheritance on Alpine-type orogens

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Processes commonly recognized as fundamental for the formation of collisional orogens include oceanic subduction, arc-continent and continent-continent collision. As collisional belts result from the closure of oceanic basins and subsequent inversion of former rifted margins, their formation and evolution may also in theory be closely interlinked with the initial architecture of the former rifted margins. This assumption is indeed more likely to be applicable in the case of Alpine-type orogens, mainly controlled by mechanical processes and mostly devoid of arc-related magmatism. More and more studies from present-day magma-poor rifted margins illustrate the complex evolution of hyperextended domains (i.e. severely thinned continental crust (<10 km) and/or exhumed serpentinized mantle with relatively minor magmatic additions) between unequivocal continental and oceanic domains.
In this contribution, we compare the deep structure of the Pyrenean and Alpine belts to discuss some aspects of the relative role of rift-inherited hyperextension and collisional processes in building Alpine-type orogens. The Pyrenees and Western to Central Alps respectively result from the inversion of a Late Jurassic to Mid Cretaceous and an Early to Middle Jurassic rift system eventually floored by hyperextended crust, exhumed mantle and/or proto-oceanic crust. In spite of uncertainties on the initial width of the hyperextended and proto-oceanic domains, the rift-related pre-collisional architecture of the Alps shows many similarities with that proposed for the Pyrenees. Remnants of these domains occur in the internal parts of both orogens, but they are largely affected by orogeny-related deformation and show a HP-LT to HT-MP metamorphic overprint in the Alps as a result of a polyphase deformation history. Yet, recent high-resolution tomographic images across the Pyrenees (PYROPE) and the Alps (CIFALPS) reveal a surprisingly comparable present-day overall crustal and lithospheric structure.
Based on the comparison between the two orogens we discuss: (1) the nature and depth of decoupling levels inherited from hyperextension; (2) the implications for restorations and interpretations of orogenic roots (former hyperextended domains vs. lower crust only); and (3) the nature and major role of buttresses in controlling the final stage of collisional processes. Eventually, we discuss the variability of the role of rift-inheritance in building Alpine-type orogens. The Pyrenees seem to represent one extreme, where rift-inheritance is important at different stages of collisional processes. In contrast, in the Alps the role of rift-inheritance is subtler, likely because of its more complex and polyphase compressional deformation history.