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Unravelling early orogenic processes: constraints from the inverted hyper-extended rift preserved in the Basco-Cantabrian belt

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A major key issue when addressing orogenic processes is to understand how the former rift systems interact with shortening during early stages of convergence. This problem is well exposed along the North Pyrenean Zone of the Pyrenees, where former hyper-extended rifts systems are inverted and juxtaposed to the Axial Zone. There, documenting the early stages of orogeny as well as its former rift architecture remains challenging because its geological record is strongly overprinted by later collisional deformations

At the western termination of the Pyrenees, the Basco-Cantabrian fold-and-thrust belt escaped from most of the mature pervasive collisional deformations. There, the Nappe des Marbres Unit (NMU) preserves the pre- and syn-rift sedimentary cover of a former hyper-extended rift system that shared the same first order rift record as the rest of the Pyrenees. Hyper-extension is recorded by the formation of minibasins going along gentle folding and salt diapirs. The NMU is lying above a major salt decollement and a hyper-thinned crust. A top-basement detachment fault below the basin is suggested to accommodate such an extreme crustal thinning. Along the northern limit of the unit, a late rift pervasive HT-LP metamorphism (>550°C following Raman spectrometry measurements) is affecting former folds above a zone of exhumed mantle. Metamorphic isograds are oblique to the main fold trends.

The subsequent early orogeny consists in the development of a regional schistosity in a colder environment. It results from a moderate tightening of the former rift structures above the major top-basement decollement. Therefore, we interpret this structural style as the result of the inversion of the former detachment system as an "underthrust" of hyper-extended crustal domains. The end of shortening is marked by the onset of limited thick-skin thrusting that could correspond to a failed mature collisional phase.