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The Chainons Béarnais (Northern Pyrenees): an exposed example of a submarine gravity-driven contractional salt-tectonic system?

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New mapping and cross-section construction emphasizes the role of salt tectonics in the folding of the Chaînons Béarnais belt (CBB) of the northern Pyrenees during the Cretaceous extension and subsequent Pyrenean shortening. The CBB comprises a sequence of Jurassic to Lower Cretaceous carbonates and Albian flysch, strongly folded above a Keuper décollement level and overlain to the north by Upper Cretaceous flysch sequences. Stratigraphic thickness variations and erosional truncations point to early diapiric rising during the Jurassic to mid Aptian, probably above normal faults in the underlying basement. The late Aptian to late Santonian period corresponds to a rift to post-rift stage in the Pyrenean realm, with formation of ductilely hyperextended margins characterized by smooth basement tops tilted toward the basin axis and absence of large faulted basement blocks. This topography promoted down-margin gliding of the detached cover which locally lay on mantle rocks exhumed at margin bottom, while the upper margins were denuded. Cover gliding was accompanied by rising of salt walls enclosing rapidly subsiding salt-withdrawal minibasins, beginning with deposition of upper Aptian carbonate platforms with reef to slope facies changes, followed by thick flysch sequences during the Albian-early Cenomanian. Depocenter migration toward the basin center and foundering of previous high diapiric zones controlled further flysch deposition during the Cenomanian to late Santonian. From the latest Santonian, onset of Pyrenean compression resulted in inversion of the rift basin, diapir squeezing and sliding back of the detached cover up onto the margins in a pop-up structure. To the north, the North-Pyrenean Frontal Thrust (NPFT) reactivated and squeezed a mid-Cretaceous diapiric ridge initially located along a basement structural high at the northern boundary of the hyperextended domain (the Grand-Rieu ridge). In the NPFT footwall, a fan of growth strata attests to long-lived folding during deposition of a thick Campanian-Maastrichtian flysch sequence followed by Paleocene-Eocene slope to coastal sediments, corresponding to much of the Pyrenean compressional history. The CBB diapiric ridges comprise welded and thrust salt anticlines and salt walls, salt extrusions and footwall pouch-like synclinal minibasins with thick growth strata and overturned flaps, typical of contractional salt-tectonic systems. Based on the timing of the growth folding, we suggest that these structures are not solely related to the Pyrenean inversion, but that contraction affected the diapiric structures during syn- to post-rift down-margin gliding. This would make the CBB a unique surface outcrop example of contractional salt-tectonics by gravity in a distal continental margin.