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Mechanisms of continental break-up : tectonic, stratigraphic and structural constraints from a preserved distal rifted margin (Agly massif, eastern Pyrenees)

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The Agly massif and its neighboring Mesozoic basins altogether form part of the Pyrenean Cretaceous rift preserved in the retro-wedge of the Pyrenean mountain belt. The relationships between the tectonic evolution of these syn-rift basins and the crustal-scale tectonic processes allows us to investigate the strain partitioning, the rheology and the sequence of deformation associated with the thinning of the deep crust leading to continental break-up.

Based on structural, microstructural and thermochronological studies of the deep crust of the Agly massif and the revised stratigraphy and depositional environments of the pre- and syn-rift sedimentary rocks, we propose a tectonic reconstruction of the eastern segment of the Pyrenean rift at the time of continental break-up. Two parallel cross sections allow us to discuss about the mechanical behavior of the deep crust and the control by lateral rheological heterogeneities on the spatial and temporal evolution of rifting. We emphasize the role of low-angle (decollement) and high-angle (detachment) extensional structures in the deep crust that collectively accommodate thinning and exhumation, respectively. Structural relationships between the Variscan basement and the Mesozoic basins are highlighted, such as a major extensional detachment fault system exhuming the mantle at the contact between the Agly massif and the Boucheville basin in the south. We further discuss the origin of tectono-sedimentary breccias in the context of crustal-scale thinning/exhumation processes and basins evolution.

Our different results are finally integrated in a 3D tectonic model of the distal margin, illustrating a crustal scale space-time vision of the mechanisms leading to continental break-up.