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Continental Break-up and the dynamics of rifting in backarc basins : the Gulf of Lions margin

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Deep seismic profiles and subsidence history of the Gulf of Lions margin reveal a non-classical evolution with intense stretching of the distal margin and delayed subsidence, despite a rather weak extension of the onshore and shallow offshore portion of the margin. The interpretation of an unpublished MCS profile (TGS-NOPEC) and published geophysical data leads us to revisit this evolution. The 70 km-long domain of extremely thinned continental crust, the GoL MCC, has been extracted from below the margin by the south-eastward flow of hot asthenosphere in the backarc region during rollback of the Apennines slab. The combination of Eocene crustal thickening related to formation of the Pyrenees and the nearby volcanic arc and associated hot asthenosphere makes the upper mantle and the lower crust weak enough to flow south-eastward entrained by the underlying asthenospheric flow due to slab retreat. The upper crust, more resistant, has been left behind and was only moderately thinned. The overall hot geodynamic environment also explains the subaerial conditions during most of the rifting stage and the delayed subsidence after the breakup. The efficiency of such a basal drag is not ascertained and it should certainly be further tested but, in the Mediterranean backarc regions, the coupling between asthenospheric and lower crustal deformation seems quite strong as suggested by the comparison of stretching directions in MCCs and seismic anisotropy of SKS waves which suggests that shear stresses due to asthenospheric flow toward retreating subduction zones can be transmitted up to the lower crust. This model cannot be simply used for Atlantic-type passive margins because they usually do not show exhumed lower crust within the continent-ocean transition but the role that an astheospheric flow could play during rifting should be looked at.