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Post-orogenic evolution of the Pyrenees and the rifting of the Liguro-Provençal Basin

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The Late Eocene and Oligocene saw a first order change in subduction dynamics in the Mediterranean realm. The western and eastern Mediterranean subduction zones started to retreat and back-arc basins started to form at the expense of mountain belts build before. In the western Mediterranean, the slab subducting below Provence and Sardinia-Corsica started a fast southeastward retreat and the Liguro-Provençal Basin formed. Rifting started some 32 Myrs ago and oceanic accretion around 24 Ma, coeval with the fast rotation of the Corsica-Sardinia block. This syn-rift period in the Gulf of Lion margin is exactly contemporaneous with a fast exhumation of the eastern part of the Pyrenees Axial Zone, as documented by LT-thermochronology, with continuing thrusting toward the south over the southern foreland basin. Exhumation then migrated westward along strike until the early Miocene. At the same period, the Alps show a transition from flysch to molasses, long documented, and the westward thrusting of the External Crystalline Massifs and their cover. While this first order event in the Alps has been previously related with the initiation of the Apennine slab retreat through a return toroidal flow below the Po Plain, the contemporary Pyrenean Axial Zone exhumation has not yet found an explanation. We discuss this question here and propose that the mantle flow related with the Apennine slab retreat has (1) exhumed and thinned the continental mantle below the Gulf of Lion and the eastern Pyrenees, leading to the observed fast exhumation and then (2) exhumed the lower crust, leading to crustal thinning and subsidence and formation of the Gulf of Lion passive margin. This simple model is in line with the evolution of the Gulf of Lion margin seen on seismic profiles and it explains the apparent paradox of crustal thinning without major normal faults in the upper crust. The direction of SKS-waves seismic anisotropy below the Pyrenees as well as the observed migration of exhumation toward the west also fits this simple model. Both uplift and removal of upper mantle, inducing an increase of potential energy of the chain, may explain why thrusting continued in the Pyrenees while rifting was still active nearby along strike.