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How far the convergence in Alpine-type orogens is controlled by rift inheritance?

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The Alpine orogen in Western Europe preserves one of the best-documented ancient rifted margins. This unique situation gives the opportunity to investigate the reactivation of rift-related structures within collisional orogens. Therefore the major questions addressed in this study are first how the complex crustal architecture, thermal regime and heterogeneous rheology of rifted margins may control the onset of subduction, and subsequent continental collision? In a second part, we will discuss how far we can extrapolate the mechanisms of Alpine reactivation to other orogenic systems.

From a rifted margins perspective many studies conducted in present-day systems revealed a more complex and diverse crustal architecture than previously thought. New seismic data from rifted margin highlights the occurrence of (1) an extreme oceanward crustal thinning, along the so-called necking zones, from 30 km in proximal margins to 10 km in the distal domains, (2) hyper-extended V-shaped basins with crustal thicknesses less than 10 km thick, (3) Ocean-Continent Transitions (OCT) generally characterized by exhumed and highly serpentinized subcontinental mantle. These new observations have not yet been integrated in the understanding of the formation and evolution of collisonal orogens.

From an orogen perspective, we can show that main Alpine structures result from the reactivation of major inherited rheological boundaries from the former rifted margins. We propose that the initiation of the subduction takes place within the OCT, enhanced by partial serpentinization related to rifting processes.
The two necking zones of the former conjugate rifted margins represent major Alpine tectonic boundaries separating the weakly deformed external domains originating from the former proximal margins from a highly metamorphosed and deformed internal domain made of relics of oceanic crust, OCT and hyper-extended crust. Thus the necking zones are interpreted as buttresses marking the transition from continental subduction to continental collision. Hyper-extended continental crust, inherited from the rifting, will either be subducted or/and incorporated into the orogenic prism. Continental collision will only occur when the two necking zones of the conjugate margins, associated with the “thick” proximal margins will collide precluding the subduction of continental materials.

The Alpine-type orogen represents a collisional orogen end-member without developed arc and/or back-arc systems. In the latest part, we will address the questions of how the Alpine-type reactivation can be generalized to other orogenic systems such as the Himalaya. This question should be seen in the light of recent discoveries in present-day margins asking if the Alpine Tethys is really related to a true Atlantic-type Ocean.