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Tectonic heritage and intra-crustal decoupling: consequences for inversion of a passive margin

Evgueni Burov (1), Laetitia Le Pourhiet (1), Leila Mezri (1), Thibault Duretz (2), and Nicolas Bellahsen (1)

(1) University of Pierre & Marie Curie, University of Pierre & Marie Curie, ISTEP, Paris, France (evgenii.burov@upmc.fr),
(2) University of Lausanne, Switzerland

We investigate the consequences of tectonic heritage and rheological structure on the style and evolution of collision process resulting from inversion of rifted margins. Recent studies of structure and evolution of passive margins have led to significant reconsideration of conceptual models of margin evolution, specifically regarding the concepts of proximal inversion during the post-rift collision. For example, for a number of margins, it has been shown that the crust very locally thins in the vicinity of the continent-ocean transition, from about 30 km to a few km in thickness, along a very short distance. This observation has been interpreted as the result of large crustal detachments that result in thinning of the medium and lower crusts, or as the result of a particular sequence of activity of steep faults. This localization of deformation occurs after a period of distributed rifting during which forms the proximal margin, and follows a phase of exhumation of the mantle to the surface. It seems clear that the burial (during the collision) of such complex margins must necessarily differ from that of margins which structure would be more continuous. We implement a parametric thermo-mechanical numerical study of the role of geometry and of the inherited structure of the inverted margins in the subduction-collision transition. In the experiments, we first form a margin by applying passive extension to continental lithosphere of different structure. After the margin is formed, we apply compression allowing for different periods of relaxation. The experiments demonstrate strong dependence of the developing collision style on the initial thermo-rheological structure and geometry of the margin and on the delay between the extension and compression phase. The resulting collision modes vary from subduction of the continental margin to pure shear thickening and, in some cases, to obduction of the oceanized lithosphere. Our experiments also treated as a particular case the evolution of the Mont Blanc system in the Western Alpes, including the external and internal zones of this orogeny.