The role of rift inheritance in building collisional orogens

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A long-standing problem in geodynamics and in modelling is to evaluate the role of initial conditions, also referred to as the "inheritance". Inheritance can be defined as the difference between an ideal "layer-cake" lithosphere and a real lithosphere containing heterogeneities of structural, compositional or thermal origins. The reactivation of rifted margins during continental collision and the reactivation of orogenic structures during rifting reflect the interplay between inheritance (innate/"genetic code") and physical processes at play (acquired/external factors). While physical processes can be modelled with some confidence using numerical codes, assessing the role of inheritance requires to define the initial conditions, which depend on the history of a geological system that is often little constrained.

The aim of the presentation is to provide a conceptual framework about how to integrate rift inheritance in the description of orogenic systems and how to explore its control on the initiation of subduction and subsequent collision. The presentation will focus on one of the best studied and imaged tectonic system worldwide, which is the Biscay-Pyrenean system. This system results from a complex multistage and polyphase rift evolution that shows a differential intensity of reactivation along-strike. This example enables also to compare, from west to east, the reactivation from a mature rifted margin to an immature hyperextended rift system, and to describe the role of exhumed mantle, necking zones and salt from early subduction stages to the onset of collision and to the final formation of a fold and thrust belt.

The presentation will focus on two main points: 1) the definition and description of different rift templates at onset of convergence, and 2) the characterization of the bulk rheology and distribution of the main potential decoupling levels that can be reactivated during convergence. The present-day architecture of the Biscay-Pyrenean system suggests a complex mode, timing and distribution of the deformation during reactivation with a complex partitioning between thick- and thin-skinned deformation, the former controlled by the presence of exhumed mantle and necked crust, the latter by the presence of salt . Thus, the "genetic code" of a geological system (e.g. inheritance) may evolve during reactivation and may be scale-dependent. Once strain becomes localized, the orogenic evolution may be mostly controlled by the physical processes and parameters ruling the Coulomb-wedge theory. This may explain why most numerical models create similar final architectures and why inheritance may have been overlooked in the study of mature orogens, best exposed in fold-and-thrust belts. The results from the OROGEN project suggest that the role of inheritance may be more important during the initial, yet little understood stages of subduction and collision. Future research using other orogenic systems such as those exposed in the Alps, Columbia, Taiwan, Zagros or Timor will be necessary to test these new concepts that may provide a more realistic understanding of how rift systems and rifted margins are reactivated and evolve into orogens.

Mots-Clés : rift-system, reactivation, inheritance, orogenic systems, Biscay-Pyrenees

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