

Revisiting the Wilson cycle(s) across the Africa-Iberia-Europe diffuse plate boundary: How much an orogenic lifecycle is predestined?

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The OROGEN project (CNRS-BRGM-TOTAL partnership) aimed at better understanding orogenic processes along the Africa-Europe plate boundary across Iberia. One advantage of the project's playground is that different orogenic maturity stages are today exposed ranging from the incipient subduction of the Bay of Biscay to the Gulf of Lion back-arc. A significant outcome of the project is to reveal the control of the pre-orogenic divergent setting on later orogenesis as: 1) the maturity of divergence and 2) the spatial and temporal partitioning/scattering of rifting. First starting diffuse and far-field, convergence is progressively focusing along mature hyper-extended rift domains that gets inverted during the “early orogenesis” (Basque Cantabrian belt/Bay of Biscay OCT and Pyrenees). West of Pyrenees, it can be shown that underneath a basal salt decollement, exhumed mantle and hyper-thinned crustal domains get “consumed” by a forced “proto-subduction” (mega-thrust). In the Pyrenees, this “consumable material” was presumably too narrow to promote a mature subduction before being interrupted by continental collision. An exception to this pattern results from the 3D segmentation of rifts. As shortening linkup different rift axes spatially, convergence shortcuts relay zones. As today imaged by the Maupasacq passive seismic images, it leads to sample the « consumable material » in the orogenic supra-structure. Once the “consumable material” is consumed, a progressive regional stress increase and a diffuse deformation is recorded while necking zones are shortened. It forces convergence to reorganize spatially and implies the inversion of neighbouring less mature rifts before new crustal-scale structures forms beyond the necking zones in the prowedge side thick continental crust. Then, the orogenic system tends to reach a new equilibrium between tectonic/body forces, accommodated strain and surface processes. Two end-member post-orogenic dynamics are then discussed. A post-orogenic back-arc dynamic starts if there is a remaining “consumable material” for an active and mature subduction (e.g. Gulf of Lion) while a mature collision happens laterally (Alps). The second “collapse” lifepath follows a mature collision (Pyrenees) and is caused by the decrease of tectonic forces that breaks the depth-surface equilibrium. From our results, we propose a new “orogenetic” classification linking orogenic diversity/lifecycles as a function of varying divergence and convergence maturities within different Wilson Cycles.

Mots-Clés : Orogen project, Orogen, Pyrenees, Rifted margin, inversion, collision, far-field , kinematics,