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Structural style of lithosphere scale inversion in the Central Pyrenees, controls of inherited structure

Suzon Jammes and Ritske S. Huismans
Department of Earth Sciences, University of Bergen, Norway (suzon.jammes@geo.uib.no)

Factors controlling the structural style of tectonic inversion of rift zones and passive margins are still not well understood. Both local inherited weaknesses and regional inherited crust and mantle lithosphere structure are believed to contribute to the structural style of inversion but it still unclear to which extent structural inheritance plays a role during inversion tectonics. Here we focus in the context of the Topo-Europe project PYRTEC on the Pyrenean-Cantabrian mountain belt which is very well studied. The moderate inversion, the good preservation of both pre and syn-orogenic strata and the excellent geological and geophysical data set make this chain one of the best candidates to investigate these questions. Previous work focused on the role of crustal heterogeneities. Here we follow up on this work with lithosphere scale models. A first order question is if the heterogeneities introduced at crustal level in previous models to reproduce the tectonic style of the central Pyrenees are necessary if inversion at the lithospheric scale is considered.

We use 2D thermo-mechanical models to model experiments to investigate the role of inheritance during lithosphere scale inversion and incipient mountain building. We focus on two aspects of the inversion and collision process: 1) the role of structural inheritance and strength of the lower crust on the style of inversion, and 2) the role of pre-orogenic rift structure on inversion style. The model involves a crustal layer of 35 km thick and a lithosphere of 125 km. All materials follow frictional-plastic strain softening, or thermally activated viscous flow laws. A first set of models evaluates the role of inherited structure and tests the level of complexity of inherited weakness zones necessary to reproduce structural style of deformation in the Central Pyrenees. A second set of models studies control of pre-orogenic rift structure by explicitly modeling rift basin formation. The rift basin or passive margin geometry is then used as initial condition for a phase of lithosphere scale inversion and collision, a procedure which we coined Accordion Tectonics. Using a prior rift or passive margin formation phase allows examining the role of pre-existing heterogeneity on the style of inversion and continental collision.

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