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Non-cylindricity of mountain belts: a case for rheological and rift inheritance

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Many mountain belts exhibit significant along strike variation in structural style with changes in the width of the orogen, the thickness of thick-skinned thrust sheets, the geometry and kinematics of the crustal-scale thrust system, and the degree of partitioning between pro- and retro-wedge deformation. While the main factors controlling structural style are understood to first order the cause of these lateral variations remains to be resolved. Here we focus on the Pyrenean example that is characterized by significant lateral variation in structural style with an antiformal stack in the eastern section and thick-skinned deformation in its western part. The Mesozoic rifting event preceding Pyrenean mountain building was similarly characterized by significant lateral variation in structure, with wide distributed extension in the eastern segment and very narrow rifting in its western part leading to mantle exhumation. We integrate the available geological and geophysical data with forward numerical models of both the rifting event and lithosphere scale inversion leading to mountain building. We show that a lateral variation in crustal strength related to inherited Variscan crustal composition explains both the variation in structural style during Mesozoic rifting as well as those observed during Pyrenean mountain building.