Inversion of the Rhenohercynian rift shoulder (Middle European Variscides): Implications for the strain and the metamorphism from numerical modelling

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The Rhenohercynian zone of Belgium and Germany represents the northern fold-and-thrust belt of the central European Variscides. The rocks which underwent the shortening at the end of Carboniferous consist of mainly (meta-) sediments of the Lower Palaeozoic and the Devono-Carboniferous. In the northern part of the fold-and-thrust belt (Ardenne Anticlinorium), the Lower Paleozoic rocks are exposed as a series of inliers such as the Rocroi and the Stavelot–Venn Massifs. These are surrounded by Lower Devonian detrital sediments which show a considerably thickening toward the south. This variation is due to steep-dipping normal synsedimentary faults during a rifting event (Oncken et al. 1999). During the Variscan Orogeny (Carboniferous), this zone induced a preferential strain localisation and a strong exhumation above a major ramp. In the eastern Stavelot–Venn Massif, the synsedimentary fault was inverted into a transpressive shear zone (Fielitz 1992), the so-called the Monshau shear zone. It is located between a series of south-dipping thrusts (Venn, Soiron, Aachen thrusts) in the North and the north-dipping Troisvierges–Malsbenden backthrust in the South. The southern limb of the Ardenne Anticlinorium shows mainly green-schist facies metamorphic aureoles in Lower Palaeozoic and Lower Devonian metasediments. The paragenesis and the fluid inclusions indicate that maximal P and T values of 400 MPa and 500 °C, while the paleo-geothermal gradient ranged between 30 °C/km and 60 °C/km.

We used the 2D thermomechanical finite element "DLR" software (Batt and Braun 1997) to study the strain partitioning, the exhumation and the PTt paths during the inversion of a steep-dipping normal synsedimentary fault. Different models have been applied to compare the influence of the competence contrast between the footwall and the hangingwall. The results show that without the presence of a low cohesion level along the fault and whatever the competence contrast is, the footwall is cut by a shear band which decreases the synsedimentary fault dip. The models applying a weak level show (1) in the ductile field, the strain growths along the synsedimentary fault and (2) the footwall is only cut at the brittle-ductile transition. The results of the numerical models are consistant with structures of eastern Stavelot–Venn Massif and the available PT data of the Ardenne Anticlinorium.

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Dynamical evolution of orogenic wedges and continental plateaux: Insights from thermal-mechanical modelling of convergent orogens

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Orogenic belts are zones of thickened continental crust that form as a result of convergence between lithospheric plates. Deformation of the crustal layer typically comprises a phase of